60 years
PAISII HILENDARSKI
UNIVERSITY OF PLOVDIV

Faculty of Economics and Social Sciences

ECONOMIC, REGIONAL AND SOCIAL CHALLENGES IN THE TRANSITION TOWARDS A GREEN ECONOMY

CONFERENCE PROCEEDINGS

30th of September 2021
Plovdiv, Bulgaria

PLOVDIV UNIVERSITY PRESS
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GREEN ECONOMY
PLOVDIV 30.09.2021

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Edited by Prof. Daniela Bobeva, PhD
Assoc. Prof. Stefan Raychev, PhD

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Assoc. Prof. Stefan Raychev, PhD

The conference was attended by

Ms. Rosalinde Van Der Vlies, Director, DG Research and Innovation, European Commission

Mr. Radan Kanev, Member of the European Parliament from the Group of the European People`s Party

Ms. Tsvetelina Penkova, Member of the European Parliament from the Group of the Socialists and Democrats

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PLENARY SESSION

Welcome and keynote speeches:

H.E. Mr. Petar Stoyanov, President of the Republic of Bulgaria 1997 – 2002

Mr. Zdravko Dimitrov, Mayor of Plovdiv

Speech by H.E. Mr. Petar Stoyanov, President of the Republic of Bulgaria 1997 – 2002

Plovdiv Conference, September 30, 2021

Economic, regional and social challenges in the transition to a green economy

Ladies and gentlemen,

First of all, I would like to thank the organizers of this conference and especially Prof. Bobeva as chairman of the organizing committee for the extremely timely idea for its holding. I am glad that it is being held in Plovdiv, with the active support of the Plovdiv academic and business communities, as well as the local government. Plovdiv is going to be a pioneer in the implementation of the green transition – both the civic spirit and the business atmosphere, and I am sure the local authorities will contribute to this.

The transition to a green economy is not just another routine initiative of politicians and scientists, but one of the most important missions facing humanity. In addition to that, the green transition is a mission whose importance is not recognized by most people on our planet and this makes it a real challenge for scientists, intellectuals, politicians and representatives of NGOs and the media who all must work together.

It must be clear! The green transition has become mandatory by way of our connection to the environment. This connection has always been vital to human existence, but it has never been as alarming as it is now. Our lives depend on nature, but today we put so much and unreasonable pressure on it that we abuse its capability to provide us with what we need in the future. Today, the planet is inhabited by so many people who treat it unreasonably, so much so, that current levels of production and consumption are already unsustainable, and in just 30 years we expect the world's population to grow to 9 billion people.

There is no alternative! The economy must become much more resource efficient. In the future we will have to produce more from less. We will have to reduce the amount of resources we extract and use. We will have to reduce waste generated during extraction, production and consumption. This requires active action, patience and commitment over many years.

But we must be aware of something. We need not just a transition, but a fair green transition, in which the reduced use of resources and the closure of certain production facilities must not be at the expense of job losses and must not be unbalanced to the detriment of the companies concerned and the economy as a whole. And this is the huge challenge for politicians today.

We must be also aware of something else! Europe must be a pioneer in this regard, not only because it is technologically and scientifically among the most developed parts of the world. Europe must be at the forefront of this green transition for historical and civilizational reasons. Europe is the cradle of the industrial revolution, of colonial expansion, and today it has an obligation to be the first to face the challenges posed by it.

The first steps seem to be optimistic. Various EU strategies and legislation, such as Europe 2020, the Resource Efficient Europe initiative and the Waste Framework Directive or the Seventh Environment Action Program, are important steps in the right direction. The green transition together with the digital transition are the two main highlights of the European Commission's work program for 2021, because according to the commission they are interconnected. Moreover, the post-coronavirus mechanism "Next Generation EU" relies on these two goals. The presentation of national plans under the mechanism requires 37% of the funds to be directed to green projects and 20% to digital ones. The European Green Pact, also known as the Green Deal, has been launched.

In brief, now is the time for serious work and I am sure that for small countries like Bulgaria, getting involved in this process may offer a significant opportunity. Moreover, in Eastern Europe we know the meaning of the word "transition". The transition to liberal democracy and a free market economy has made us part of the civilized European area, and the transition to a green economy can make Bulgaria an economically highly developed and prosperous country.

And since you will be part of this effort, I wish you success!

Speech by Mr. Zdravko Dimitrov, Mayor of Plovdiv

Dear Mr. President,
Honourable members of the European Parliament,
Dear Mrs. Van Der Vlies,
Dear Prof Mladenov,
Ladies and Gentlemen,

It is a pleasure for me to be here and welcome you to the territory of this remarkable archaeological monument – the Bishop's Basilica of Philippopolis. What could be more symbolic than that – to discuss the future standing at the foundations of the past?

I would like to thank the Plovdiv University for focusing today's conference on a topic that directly affects the development of Bulgaria and all the EU member states over the next 30 years. I hope that today's forum will offer more answers to the question: *How will the green economy help us unfold our potential and become competitive in the rapidly changing economic world*?

Plovdiv has become the most developed industrial zone in Bulgaria and Southeast Europe. More and more young people come to the city to study and live, because in addition to job possibilities, Plovdiv offers a good quality of life. Almost 50% of the gross domestic product of the region comes from production, and dozens of new plants are to be opened. Yesterday we officially cut the ribbon of a factory for the production of edible coffee cups, which is an example of a circular economy. It is important for us as a Municipality that we have increasing number of investments in high-tech and environmentally friendly industries with high added value, good working conditions and pay. We are proud that the industry in Plovdiv is looking to the future. Here, at the Trakia Economic Zone a strategic project for the construction of the **first carbon-neutral industrial park in Bulgaria** is to be implemented. We support the efforts of the business in this respect, because they will result in reduction of the carbon emissions, which is one of the main climate goals of the European Union.

The rapid economic growth also leads to serious challenges – congestion of the infrastructure, deteriorating quality of air, overbuilding and the need of new health, social and educational services. One of the leading policies of the Municipality of Plovdiv is to improve the quality of the atmospheric air by easing the traffic – introduction of low-emission zones, closing of the inner ring, construction of two-level intersections, completion of the Ring Road to lead the transit traffic from the centre.

A priority project for the Municipality of Plovdiv during this programming period will be together with the National Railway Infrastructure Company to develop the City Railway. More than ever, Plovdiv needs it, because through this environmental-friendly transport we will connect all districts of the city with the nearby communities and industrial zones. In this way we will significantly contribute to reducing the heavy traffic.

Plovdiv is one of the cities with the best developed bicycle lane network with a length of nearly 60 km with good connectivity. That is why the number of people who use bicycles and electric scooters as their main means of transportation is increasing, and we are continuing to build them.

We are expanding the green system of the city focusing on the Maritsa River. Its bed is to be cleaned and secured and with minimal intervention will be turned into the newest area for recreation and sports. In the plan for integrated urban development we envisage the creation of new green areas, including two new parks in the southern and eastern part of the city.

The Municipality of Plovdiv together with the World Bank has developed a project for the establishment of a municipal company for ecological transport. Our ambition is to have two lines in the city within two years, which will be served entirely by electric buses, and by 2027 this will be the predominant public transport.

We rely on the support of the Plovdiv academic community for the upcoming transformation. To this end, the Municipality and the Plovdiv universities have signed a memorandum of cooperation in the field of educational, scientific, cultural and sports exchanges. Science and business need to join hands to develop the economy of the future together.

I wish all effective work!

CHAPTER I
GLOBAL AGENDA FOR A GREEN ECONOMY

The EU as a Global Leader in the Green Agenda and the Role of Research and Innovation

Rosalinde Van Der Vlies[1]

The European Green Deal is the most ambitious commitment towards green transition not only in Europe but also in the world.

We will focus on **transitions** across **all key sectors** of the economy and society – climate, energy, industry, buildings, mobility, food systems, biodiversity, and pollution.

We need to "**build back better**" and this is a reason why the **green and digital transition** will be also in the **center of the recovery** from COVID-19.

As European Commission, we support the Green Deal transitions through **forward-looking**, **mission-oriented, and impact-focused research.**

With the EU missions, the European Commission **introduces a new way of working** across policy areas, fields of expertise and science, directly engaging with companies, local communities and the innovation community**.**

Missions are rooted in research and innovation, but have much **wider scope and aim to address societal challenges.**

The missions will directly support priorities such as the **European Green Deal, Europe's Beating Cancer Plan and the New European Bauhaus.**

- Five mission areas have been identified:
  - **Climate-neutral and smart cities;**
  - **Healthy oceans, seas, coastal and inland waters;**
  - **Soil health and food;**
  - **Cancer;**
  - **Adaptation to climate change, including societal transformation.**

[1] Director, Directorate C – Clean Planet, DG Research and Innovation, European Commission

These missions will develop and implement a portfolio of actions with the aim of **achieving measurable goals, support the transitions,** and acting as **excellent platforms for citizens to actively participate in the Green Deal.**

EU missions set out bold, concrete, and measurable targets in a well-defined timeframe to deliver tangible outcomes for all Europeans.

The objectives for the Mission on Climate-Neutral and Smart Cities are ambitious – and necessary: (1) to deliver at least **100 climate-neutral and smart European cities by 2030** and (2) to ensure that these cities act as **experimentation and innovation hubs** to enable all European cities to follow suit.

It is only with **cities** in the vanguard of efforts that we will be able to **reduce climate emissions by 55% by 2030** and to **become the first climate-neutral continent by 2050**.

The Cities Mission **wants to bring cities of different sizes** and from all corners of Europe within its scope, but most of all, **to bring on board cities with very different starting points in terms of climate neutrality.**

Our starting point in the Cities Mission will be **the cities needs.** A **Call for Expression of Interest**, inviting cities to participate in the Mission, will be published before the end of this year.

A **Mission Platform** will provide **technical, regulatory, and financial assistance** to the cities that will be selected.

These Cities will then **prepare and implement Climate City Contracts**, which will be **co-created with citizens and local stakeholders.**

With the Mission, we also want to reach beyond Europe. We will set up a **Global Knowledge Exchange Centre** between European cities and their counterparts in third countries to facilitate the **exchange of experience on climate neutrality, monitor** and **promote best practices** that can be **replicated** and **scaled-up**.

The **Mission does not stop at Europe's borders.** We want our cities to be able to share their experience with the world – and we want them to learn from first movers across the globe.

This is why we are working with Mission Innovation to set up a global mission on **Innovation-Driven Urban Transitions**. Pilot cities in the EU and worldwide will show how urban areas can be powered by 100% sustainable energy by 2030.

We will **cooperate** with **industry, academia, and civil society to boost investments in research and innovation** and to overcome major climate and sustainability challenges.

Horizon Europe will invest around EUR 360 million in R&I actions to support the implementation of the cities mission in the period **2021 – 2023**. But this will of course **not be enough.** We are also working with other EU programmes as well as with the European Investment Bank, and we will involve other public and private investors to leverage the investments that cities will require for reaching climate neutrality.

As you can see we have a very ambitious plan. The plan, which we will be able to achieve not only by strong commitments and financial support. To accomplish it we **need to work with all of you** – innovators, researchers, representatives of business, government and international public institutions in an open, cross-cutting, and inclusive way.

I hope that with your ideas, concepts, and tested products**, you will join our Climate Neutral and Smart Cities mission.**

Comparison of the Green Deal Policy in the European Union and South Korea

Evgeni Evgeniev[1]

Abstract: The European Commission announced the Green Deal package in December 2019 as the new growth strategy for the European Union (EU) based on the twin transition – digital and environmental; whereas South Korea included a Green Deal pillar in the Korean New Deal, which is the new national great transformation strategy, launched in July 2020. The present study provides a focus on the international public discourse on sustainability, green transition and it offers recent theoretical findings. Then, it gives details of the green deal packages and compares the cases of the EU and South Korea. It also demonstrates examples from selected EU Member States on how they plan to address climate and digital objectives in the mid-term through the Recovery and Resilience Facility, which targets immediate response to the Covid-19 crisis. Finally, the paper concludes.

Keywords: green new deal, green transition, sustainability, climate change, digital transition, sustainable development

JEL classification: F63, F64, F68, O38

1. Introduction

The Covid-19 pandemic crisis has entered the world in early 2020 with great speed, infecting 245,4 million people so far (as of October 31st, 2021), according to the World Health Organization, and bringing down the economic activity in a majority of the countries around the world, which imposed tight lockdown measures to stop the virus. The economic damage is enormous and it represents the largest external shock the world has seen in decades.

As per World Economic Outlook (IMF, October 2021), the global growth for 2021 is estimated at 5,9 percent, whereas for 2022 it is estimated at 4,9 percent. This is a reversed trend compared to 2020 when the global economy contracted by 3,1 percent. In IMF's World Economic Outlook Update from July 2021, it was reported that a substantial adverse impacts were seen from the following group of people: women, youth, the poor, the informally employed, and those who work in contact-intensive sectors. (https://www.imf.org/en/Publications/WEO/Issues/2021/01/26/2021-

[1] *PhD, Permanent Representation of Republic of Bulgaria to the EU*

world-economic-outlook-update) Last year, the EU has been hit hardest, as it contracted by –7,2%, which was somehow worse than the United States (–3,4%) and Japan (–5,1%). Other reports say that South Korea's economy shrank by just 1% as strong exports limited the impact of the coronavirus damage. South Korean economy contracted for the first time in about two decades as the coronavirus pandemic destroyed service industry jobs and worsened consumer spending (https://www.business-standard.com/article/international/south-korea-economy-shrank-in-2020-for-first-time-in-over-two-decades-121030400143_1.html).

Many governments around the world have proposed urgent actions to cushion the consequences of the pandemic crisis on the health and economic systems, as well as protect vulnerable populations. Governments have also addressed the challenges by implementing reforms to support strong and sustainable growth once the health crisis subsides.

The European Green Deal is a substantial part of the EU's strategy to implement the United Nation's 2030 Agenda and the sustainable development goals (https://sustainabledevelopment.un.org/post2015/transformingourworld), and the other priorities announced in European Commission President von der Leyen's political guidelines (See, Political Guidelines of President-elect Ursula von der Leyen at https://ec.europa.eu/info/sites/default/files/political-guidelines-next-commission_en_0.pdf). It proposes a comprehensive climate action framework, encompassing a wide range of policy areas and emphasizing inclusivity among Union members. Furthermore, to support reforms and investments in the mid-term horizon, the EU introduced a Recovery and Resilience Facility (RRF), which offers EUR 723.8 bln. (in current prices) in loans (EUR 385.8 bln.) and grants (EUR 338 bln.). The purpose of RRF is to fight the economic and social consequences of the coronavirus pandemic and make the EU economies sustainable and resilient, building on the twin transition agenda – green and digital transitions (The RRF is a mid-term strategy, which entered into force on 19 February 2021 and it will finance reforms and investments until 31 December 2026). To date, all EU Member States, save Netherlands, have submitted their national plans (Information about the national recovery and resilience plans of EU Member States is available here: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en#national-recovery-and-resilience-plans).

The South Korean government, on the other hand, introduced a Green new deal as a policy, part of the Korean's government new package called the Korea New Deal. It is a rolled-out package of economic, environmental, and social reforms, which emerged in July 2020 (National

Strategy for a Great Transformation, Korean New Deal. July 2020, pp. 3 – 17). The main initiative aims to expedite recovery from the COVID-19 pandemic and fundamentally reshape the economy of South Korea through a massive government investment of public funds.

The ***objective*** of this paper is to focus on the Green Deal packages, developed in the EU and South Korea to foster recovery and resilience in the context of the Covid-19 crisis. It will look specifically at the RRF's support of environmental and digital reforms in selected number of EU Member States. The main ***research question*** is directed towards finding similarities and differences between the EU' and South Korea's immediate response to the Covid-19 crisis via the green deal package and the RRF in the case of the EU.

The next *section II* looks at the implications of the international public discourse on sustainability, green transition and refers to recent theoretical findings. Then, the author discusses the specific components of the EU package in *section III*, whereas the South Korea package is unveiled in *section IV*, while a comparative analysis is provided in *section V,* which replies to the research question. The focus on environment and digital objectives in the recovery and resilience national plans of selected EU Member States are presented in *Section VI*. Finally, the paper concludes.

2. International public discourse on sustainability, green transition and recent theoretical findings

UN Environment report (Oberle, B., et al, 2019) says that since the 1970s the global population has doubled, while the global GDP has grown fourfold. These trends required the use of large amounts of natural resources to boost economic development. These benefits have brought a huge cost to our natural environment and created substantial inequalities between countries. Between 1970 and 2017, the report continues, the annual global extraction of materials tripled and it continues to grow, posing a major global risk. "About half of total greenhouse gas (GHG) emissions and more than 90% of biodiversity loss and water stress come from resource extraction and processing of materials, fuels, and food." (2019, p. 27). The concept of green growth was promoted as a possible way of introducing a new, low-emission model of sustainable development for fast-developing Asian countries.

The international public discourse on the environmental threat has started, however, a long time ago. One of the earliest books on environmental issues comes with the rise of coal. *The Coal Question* is a book, written in 1865 by the economist William Stanley Jevons. It brings the issue of implications of Britain's reliance on coal. Given the fact that coal was known to be non-renewable energy, Jevons questions the sustainability, taxation of energy resources, and even renewable energy – subjects commonly discussed even today.

Willian Vogt's book *Road to Survival* documented in 1948 the negative effects of an expanding global population on the environment. The author gathered reports of deforestation, gullying, overgrazing, soil erosion, and lots of varieties of destruction of fundamental resources. Another big title from that year was the book *Our Planet* by Fairfield Osborn. With attention on soil, the book conveys a critique of humankind's poor stewardship of Earth. Those two books are often cited as a significant inspiration for the modern environmentalist movement.

In 1972 the Club of Rome (The Club of Rome is composed of "scientists, economists, businessmen, international high civil servants, heads of state and former heads of state from all five continents who are convinced that the future of humankind is not determined once and for all and that each human being can contribute to the improvement of our societies."), published *The Limits to Growth*. The book had three main ideas: first, gain insights into the bounds of our world system and also the constraints it puts on human numbers and activity; second, identify and study the dominant elements, and their interactions, that influence the long-term behavior of world-systems; and warn of the likely outcome of up to date economic and industrial policies, to influence changes to a sustainable lifestyle. The report has received also heavy criticism from academics, economists, and businesspeople. The methodology, computer simulation, conclusions, and rhetoric were criticized. Nobel Prize laureate Robert Solow from MIT argued that prediction in the *Limits to Growth* was based on a weak foundation of data.

More recently, in 2018, the globe witnessed the *Greta effect*. This is when Greta Thunberg, a Swedish environmental activist challenged the world leaders to take immediate action for climate change mitigation. She was 15 when she started a movement in Sweden, called "Fridays for Future" by holding a sign "School strike for climate" and spending her schools days outside the Swedish Parliament. The movement spread throughout the world, especially after she addressed the 2018 UN Climate Change Conference. In 2019, millions of students were involved in the movement. Greta received numerous awards and she had three consecutive nominations for the Nobel Peace Prize (2019 – 2021).

In a recently published paper, Hémous, D. and Olsen, M. (2021) discussed that "a balanced growth path in an economy allows avoiding slow development of green technologies in environmental economics and rising inequality in labor economics". The authors claim that "*a climate policy should be designed with innovation at the forefront and that directed technical change models should be further integrated with climate change and labor economics for better design of the policy"*.

The question of climate policy is a pertinent one in a green growth economy, but it is also relevant to look at the impact on consumers and how the behavior of consumers influence business models. In Aghion, et al. (2021), the authors investigate the effects of consumers' environmental concerns and market competition on firms' decisions to innovate in clean technologies. Panel data on around 250,000 patents by 8,562 automobile sector firms in 41 countries during 1998 – 2002 and 2008 – 2012 were analyzed. The authors find "*a significant positive effect of pro-environment attitudes on the probability for a firm to patent relatively more in the clean direction, and this effect is stronger, the higher competition is"*.

Besley, T. and Persson T. (2020) in "Escaping the Climate Trap? Values, Technologies, and Politics" look at how changing environmental values, changing technologies, and the politics of environmental policy, can lead to creating sustainable societal change. Among the major findings of the authors, one finds that changing social values can support structural change towards predominantly green technologies. Furthermore, Stern, N. and Valero, A. (2021) look at ideas and evidence on how policies and institutions can enable and foster private sector investment in sustainable and productive assets at the scale and pace required to tackle climate change and simultaneously achieve a strong economic recovery and growth into the future. The paper justifies an action at scale and across the economy, via a coordinated set of policies and institutions. Then, the authors argue that policies for a strong and sustainable recovery must include environmental and growth levers.

Overall, the green economy, green growth, and green new deal concepts have succeeded in reinvigorating the global debate on how to redefine our economic model (On the distinction between green economy and green new deals, see Lee, Jae-Hyup & Jisuk Woo (2020). The Covid-19 pandemic, which led to a global crisis, urged many governments to create "Green New Deals" to recover from the economic downturn while mitigating the climate crisis (The term "Green New Deal" was first used by Pulitzer Prize-winner Thomas Friedman in January 2007. America had just experienced its hottest year on record (there have been five hotter since). Since then, the "Green New Deal" has been used to describe various sets of policies that aim to make systemic change. The United Nations announced a Global Green New Deal in 2008. Former President Barack Obama added one to his platform when he ran for election in 2008, and Green party candidates, such as Jill Stein and Howie Hawkins, did the same), including also digital components. Theoretical findings from recently published papers found that the green agenda is growing from consumer, business, government and societal perspective. What matters though is a package of policies and investment that require proper implementation and regular communication.

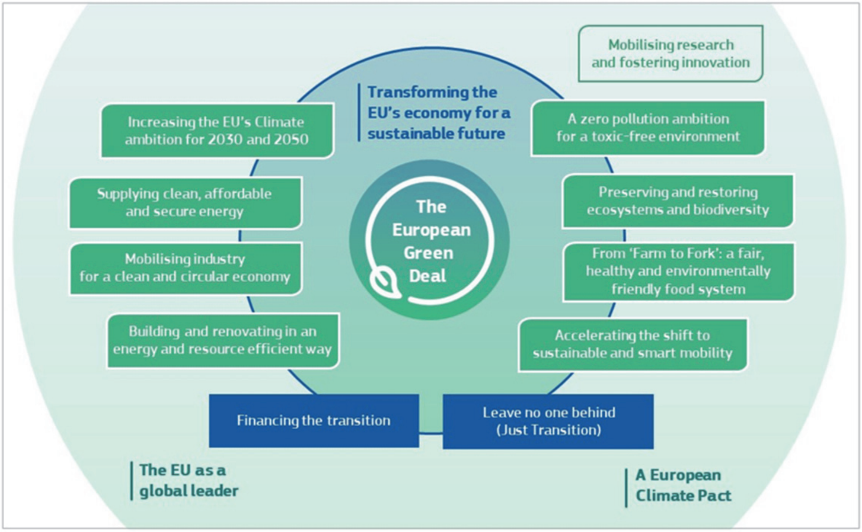
3. European Green Deal

In 2007 – 2008, during the global financial crisis, the idea of a Green New Deal came out simultaneously within the US and the UK. In fact, Thomas Friedman wrote an article in January 2007 that suggested the approach. Little over a decade later, the European Commission presented the European Green Deal as a community-wide policy in December 2019. It was the European Council meeting in Brussels on 20 June 2019, which preceded this decision as it agreed on an agenda for the EU for 2019 – 2024.

The strategic agenda focuses on four main priorities and one of them is on "building a climate-neutral, green, fair and social Europe" (More on the new EU Strategic Agenda for the future 2019 – 2024, https://www.consilium.europa.eu/en/eu-strategic-agenda-2019-2024/). It was proposed as the EU's comprehensive climate action plan and growth strategy, with the overarching objective of making Europe the world's first climate-neutral continent by 2050. The European Green Deal encompasses the implementation of the EU's GHG emissions reduction target for 2030, which is set at a minimum of 50% and ambition of 55% compared with 1990 levels.

The European Green Deal is a substantial part of the Commission's strategy to implement the United Nation's 2030 Agenda and the sustainable development goals (https://sustainabledevelopment.un.org/post2015/transformingourworld), and the other priorities announced in President von der Leyen's political guidelines (See, Political Guidelines of President-elect Ursula von der Leyen at https://ec.europa.eu/info/sites/default/files/political-guidelines-next-commission_en_0.pdf). It proposes a comprehensive climate action framework, including a wide range of policy areas and emphasizing inclusivity among Union members. The major parts include (i) net climate neutrality by 2050; (ii) decoupling economic growth from resource use; and (iii) Just Transition (articulated as "leaving no one behind"). Under the Green Deal, existing environmental policies will be integrated, to establish a 'circular economy' and preserve ecosystem biodiversity. The policy scope of the European Green Deal includes streamlining and/or replacing existing policies (e.g., phasing out fossil fuel subsidies, the EU Emissions Trading System) as well as extending to a diverse range of sectors (e.g., farm to fork, sustainable mobility, biodiversity).

Figure 1: *Key Pillars of the European Green Deal*



Source: *COM (2019), 640 Final*

The European Green Deal has an Action Plan to boost the efficient use of resources by moving to a clean, circular economy, and restore biodiversity, and cutting pollution. The plan focuses also on how to ensure a just and inclusive transition. By 2050, the EU aims to be climate neutral. To achieve this target will require action by all sectors of the economy, including investing in environmentally-friendly technologies; incentivizing industry to innovate; introducing less costly and healthier forms of private and public transport; decarbonizing the energy sector; ensuring residential buildings are more energy-efficient and working with international partners to improve global environmental standards.

The European Commission introduced a European Climate Law. It is a legally binding instrument to achieve net-zero GHG emissions for EU countries by 2050. It adopted some tools, mainly cutting emissions, investing in green technologies, and protecting the natural environment; most importantly, it requires that these tools be deployed in a socially fair and cost-effective manner. The legislation not only functions as a system for providing predictability but also includes a monitoring mechanism every five years. The EU institutions and the Member States are bound to take the necessary measures at the EU and national levels to meet the target, taking into account the importance of promoting fairness and solidarity in the Union.

On 21 April 2021, the Council and the European Parliament reached a provisional agreement for the European Climate Law, while on 26 April 2021, the provisional agreement was reached on the public sector loan facility to support Just Climate Transition, while EU ambassadors approved a compromise text on the EU climate law on May 5th, 2021. On 14 July 2021, the European Commission published its "Fit for 55" package to enable the EU to meet the European Green Deal targets. Interconnected proposals cover areas of climate, land use, energy, transport and taxation to bring them into line with the targets agreed in the European Climate Law. The package is comprised of thirteen proposals; eight of them are revisions to existing laws and five are new proposals (The package is comprised of thirteen proposals; feight of them are revisions to existing laws and five are new proposals. Revisions are envisaged for the EU Emissions Trading Scheme, Effort Sharing Regulation, Regulation on Land Use, Land Use Change and Forestry, Renewable Energy Directive, Energy Efficiency Directive, Regulation, setting CO2 emission standards for cars and vans, Alternative Fuels Infrastructure Directive, Energy Taxation Directive. New initiatives are as follows: EU Forest Strategy, Carbon Border Adjustment Mechanism, Social Climate Fund, ReFuelEU Aviation Initiative, FuelEU Maritime Initiative. More proposals and amendments are expected towards the end of 2021, like amendments in the Energy Performance of Buildings Directive and the new Climate, Energy and Environmental State Aid Guidelines). It is expected that the Commission will issue recommendations to the Member States whose actions are inconsistent with the climate-neutrality objective. Then, Member States will be obliged to take due account of the recommendations or explain their reasoning if they fail to do so. Member States will also be required to develop and implement adaptation strategies to strengthen resilience and reduce vulnerability to the effects of climate change (More on EU climate law and next steps, see https://ec.europa.eu/clima/policies/eu-climate-action/law_en).

Because of the impact of Covid-19, the EU's long-term budget, coupled with *NextGenerationEU*, the temporary instrument designed to boost the recovery, is the largest stimulus package ever financed in Europe (Specific funding is available at: https://ec.europa.eu/info/strategy/recovery-plan-europe_en). A total of €1.8 trillion will help rebuild a post-

COVID-19 Europe. It will be a greener, more digital, and more resilient Europe. The last step of the adoption of the next long-term EU budget was reached on 17 December 2020. More than 50% of the package will support modernization through the following targets: a) research and innovation, via "Horizon Europe", which is the framework program for research and innovation, covering the period 2021 – 2027; fair climate and digital transitions (via Just Transition Fund and the Digital Europe Programme); preparedness, recovery, and resilience, via the Recovery and Resilience Facility, rescue and a new health program, EU4Health. Particular attention will be paid to modernizing traditional policies such as cohesion and the common agricultural policy, to maximize their contribution to the Union's priorities; fighting climate change, with 30% of the EU funds, the highest share ever of the European budget; and biodiversity protection and gender equality (To finance NextGenerationEU, the European Commission – on behalf of the European Union – will borrow on the markets at more favorable rates than the many Member States and redistribute the amounts. The European Commission already issues bonds to finance loans to EU and third countries under four programs, including up to €100 billion for the SURE program to support jobs and keep people in work. To raise to around €800 billion in current prices until 2026 for NextGenerationEU under the best financial terms – 5% of EU GDP – the Commission will use a diversified funding strategy. By June 2021, the Commission will propose digital, a carbon border adjustment mechanism, the EU Emissions Trading System, whereas by June 2024, it will propose a new common corporate tax base; a financial contribution linked to the corporate sector; and a financial transaction tax).

4. Korean Green New Deal

The Korean Green new deal is a policy, part of the Korean's government new package called the Korea New Deal (The author would like to thank Denis Pavlov (student at Dong-A University in Busan, South Korea) for the background research work and relevant findings related to this section). It is a package of economic, environmental, and social reforms, which emerged in July 2020 (National Strategy for a Great Transformation, Korean New Deal. July 2020, pp. 3 – 17). The main initiative aims to expedite recovery from the COVID-19 pandemic and fundamentally reshape the economy of South Korea through a massive government investment of public funds.

President Moon called the program "*a huge shift for Korea to leap to becoming a leading nation.*" (https://www.kocis.go.kr/eng/webzine/202008/sub08.html#:~:text=The%20New%20Deal%27s%20two%20pillar s,(AI)%20and%20big%20data) Under the New Deal, the government plans to invest EUR 90 bln. by 2025, and with the addition of private and local government funds, the amount will eventually reach EUR 127 bln. The project's main goal is to create new jobs – 890,000 by 2022 and 1.9 million by 2025 – and foster economic growth in weathering the impact of the pandemic.

The New Deal's two pillars are the Digital New Deal and the *Green New Deal*. The Digital New Deal targets the digitalization of the economy by leveraging the nation's robust tech infrastructure such as 5G, artificial intelligence, and big data. The Green New Deal will help make the economy less dependent on fossil fuels as there will be a transition towards eco-friendly energy use. Under the plan, the government will invest around EUR 58 bln. in areas such as responses to climate change, green infrastructure, and renewable energy. Schools, cultural facilities, and daycare centers will be turned into energy-efficient, eco-friendly buildings, while some 25 smart green cities, numerous city forests, and national parks will be built. In order to limit the use of carbon, 1,13 million electric vehicles and 200,000 hydrogen fuel cell cars will be added by 2025, while the supply and use of clean and renewable energies like wind, solar and hydroelectric power will be expanded.

The main goal of the Green New Deal is to prepare South Korea from the growing damage of the environmental crisis and at the same time combat the ongoing COVID-19 pandemic by moving the economy and society to a carbon-zero country. This plan is a precedent for Korea to put its first "blueprint" for its goal to reach its goal of Net Zero Carbon country by 2050. It is claimed, however, "*the Green New Deal was inserted into the Korean New Deal at the last minute, which reflected the broader global trends in green new deal policy"* (See Jae-Hyup Lee and Jisuk Woo (2020, pp.8-9). Korea Herald (August 9, 2020) alleged that the Green pillar is the odd one, which started to make headlines only in May 2020 because of growing concerns on climate change, epidemic breakouts, and other natural disasters (http://www.koreaherald.com/view.php?ud=%2020200809000207).

The Korean Green New Deal identifies three main areas and eight specific implementation targets. Investment funds to support Green New Deal projects are expected from public authorities, private companies, and local authorities.

Table 1: *Main Pillars and Specific Targets of the Korean Green New Deal*

Pillars	Specific Targets
Green Transition of Infrastructures – creating a green-friendly environment towards a future where humans and nature coexist	➢ **Turning public facilities into zero-energy buildings** Renewable energy equipment and high-performance insulation will be used to make public buildings green and energy-efficient (Targets: 225,000 public rental housings, 440 public daycare centers, and 1,148 cultural facilities). ➢ **Restoring the terrestrial, marine, and urban ecosystems** By conducting a comprehensive diagnosis on the climate and environmental challenges of a city, customized solutions based on environmental technology and ICT will be introduced in 25 regions by 2022. ➢ **Building a management system for clean and safe water** The entire water supply system will be made smart through the use of ICT and AI (Targets: 48 inter-regional and 161 local water supply systems).
Low-carbon and Decentralized Energy Supply – preparing for a paradigm shift towards future energy by actively investing in R&D facilities that promote the use of sustainable and renewable energy throughout the country	➢ **Building a smart grid for more efficient energy management** Advanced metering infrastructure, which is an integrated system of smart meters that enables two-way communication between suppliers and consumers, will be provided to 5 million apartments to help disperse energy needs and save energy. ➢ **Promoting Renewable Energy Use and Supporting a Fair Transition** Support will be provided to measure the wind conditions and conduct feasibility studies on up to 13 regions to find sites for large-scale offshore wind farms of either the floating or fixed-bottom types. Demonstration complexes will be established in phases. ➢ **Expanding the supply of electric and hydrogen vehicles** The provision of 1,13 million EVs including passenger cars, buses, and freight vehicles, will be supported along with the installation of 15,000 rapid chargers and 30,000 slow chargers. The provision of 200,000 hydrogen vehicles including passenger cars, buses, and freight vehicles will be supported along with the installation of 450 charging facilities. Fuel cell plants and other infrastructure for the distribution of hydrogen will also be established.

Innovation in the Green Industry – finding areas of the green industry that strategically address climate change and environmental risks and building infrastructure in support of this to create an innovative environment	➢ **Promoting prospective businesses to lead the green industry, and establishing low carbon and green industrial complexes** For 123 SMEs in the environmental and energy sectors, the entire process of developing a business item (from R&D, testing, and commercialization) will be supported. A 'green startup town,' a concentrated complex of startups that help improve environmental, transportation, and residential infrastructures, will be set up by 2021. ➢ **Laying the foundation for green innovation via the R&D and financial sectors** The foundation will be set to test and support the commercialization of large-scale carbon capture utilization and storage by 2023, and the technology to produce chemical stock and other useful materials from CO2 will be developed. A loan of EUR 1,34 bln. will be introduced for the green sector including investment to prevent the environmental pollution of businesses, and a joint fund made up by the public and the private sectors will be set up for EUR 154 mln. to foster green businesses.

Source: *National Strategy for a Great Transformation: Korean New Deal, July 2020, pp. 26 – 31*

5. Comparative Analysis

The EU and South Korea both share the same goal. They aim at tackling the climate change crisis and build a sustainable society in a context of global pandemic. They both search for mobilization of the private sector to achieve a net-zero emissions. They both look at hydrogen and renewables as sources of energy to reduce the carbon emissions, although they both stay below the targets of the Paris Agreements (See, more on Paris Agreement, https://www.consilium.europa.eu/en/policies/climate-change/paris-agreement/).

The approach of EU is towards creating a stable legislative framework with specific targets in the mid-term and long-term to make sure countries and regions stick to the Green New Deal, whereas the South Korean government, although it offers an ambitious agenda, it does not foresee any legal framework to facilitate the effort towards achieving net-zero emissions, neither it provides any near-term deadlines. In addition, the Korean Green Deal does not offer an inclusive environment agenda, similar to the EU case. Although the renewable energy is present in both plans, the Korean agenda does not focus on the food or agricultural sector, whereas the EU has a specific focus on that. Finally, the fossil fuel subsidies is another critical element, which distinguishes both agendas. While the European Green Deal will ensure that regions and sectors in Europe which rely upon fossil fuels, will use a Just Transition Fund to transform their mode of operation, while Korea does not mention anything specific, related to a fund for a just transition.

Critics argue that the main purpose of the Korean Green New Deal is to provide opportunities for enterprises during climate and Covid-19 crisis. Lee Yujin, a Researcher from the Green Transition Institute, claims that South Korea has put forth a "Green New Deal" that aims to ease the economic impact of Covid-19 while addressing climate change. However, its ambiguous targets for reducing GHG emissions and failure to propose a just transition to clean energy make the program unworthy of its name. The term New Deal raised high expectations in Korea, but it disappointed the agriculture, biodiversity, waste, and pollution management sectors by excluding them, as the author claims (https://hk.boell.org/en/2020/09/14/south-koreas-reforms-should-not-be-called-green-new-deal.)

Seong Poong-Hyun from Korea Advanced Institute of Science and Technology argues that "the Green New Deal seems to be a hollow plan" (https://www.koreatimes.co.kr/www/tech/2021/02/515_293556.html.) "Renewable energy sources have their limits in intermittency; thus they should be coupled with other resources — namely nuclear power which has no carbon emissions. Since the Moon government is sticking to renewable energy only, the costs are growing far faster, before the output of renewable energy sources reaches a feasible level." "A large-scale transition of industrial trends is bound to create sunset industries, but the Green New Deal does not have any plan on how to help them make a soft landing as renewable energy is introduced," he said.

Finally, environmental groups are urging the Korean government to come up with policies to phase out combustion engine vehicles to encourage carmakers to make more electric vehicles and get consumers to choose them. Experts said the individual plans in the Green New Deal are not related to each other and thus are anticipated to fail in creating synergy.

Critics of the European green deal (for example, Greenpeace) argue that the mechanism, which is set to run until 2027, will provide funds to countries, which are not committed to phasing fossil fuels. The EU budget currently allows investments in fossil fuels and nuclear energy. For instance, a substantial part of the new Connecting Europe Facility for 2021 – 2027 will see an invested EUR 43,3 bln. go towards gas projects. Poland for instance is keen to access funds from the Just Transition mechanism, despite its refusal to commit to EU climate action agreements and set a date for the phasing out of coal. To recall, as per the Paris Climate Agreement, the EU must phase out coal by 2030 and fossil fuels altogether by 2040. The EU however states that it is on track to meet its nationally determined contributions goal of reducing emissions by “at least 40 percent” if it implements its targets.

The continuation of the Covid-19 pandemic does not bring any favors to the European Green Deal either as prime ministers and heads of state of the EU-27 argue that governments need to fight the loss of jobs and declining industries at the same time while large investments for green economies are prepared.

6. Recovery and Resilience National Plans of Selected EU Member States

The Recovey and Resilience Facility (RRF) is at the core of the *NextGenerationEU*, a financial instrument that allows the European Commission to raise funds to help repair the immediate economic and social damage, created by the coronavirus pandemic. RRF is closely aligned with the Commission’s twin transition – green and digital transformation of the economies. In practice, the Commission does an assessment of the national plans of EU Member States and afterwards it will provide funds to cover for reforms where a minimum of 37% of the expenditure should be addressing climate objectives, while 20% of the expenditure will have to foster digital transition. Two cases for each category of innovation performers under the European Innovation Scoreboard 2021 (Information about the European Innovation Scoreboard 2021 is available here: https://euraxess.ec.europa.eu/worldwide/asean/european-innovation-scoreboard-2021-published) are presented below to understand the key reforms in the national recovery and resilience plans of EU Member States by 2026 (More details on the national recovery and resilience plans of the EU Member States are available here: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en#the-facility-and-nextgenerationeu).

***Table 2**: RRF Envrionmental and Digital Focus in Selected EU Member States*

Innovation Leaders	**Finland** will spend 50% of the expenditures to meet climate objectives, while 27% of the expenditure will cover the reforms in the digital transformation out of a total budget of EUR 2,1 bln. in grants. The country will invest in energy transmission and distribution and in new energy technologies. Moreover, investments are planned along the hydrogen value chain as well as in carbon capture, storage and recovery. Green transportation will be prioritized as well. In the digital sphere, minor investments are planned in high-speed broadband infrastructure across Finland and in the Digirail project to introduce the European Rail Traffic Management System on the entire national network by 2040, along with the 4G and 5G-based Future Railway Mobile Communication System.	**Belgium** will invest 50% to meet the climate objectives and 27% to address the digital transformation out of EUR 5.9 bln. in grants. Investment of EUR 540 mln. will be chanelled to novel low-carbon energy technologies, like financing of innovative hydrogen projects and the construction of a multi-functional energy platform in the North Sea to connect 2,1 GW of offshore wind electricity to Belgium. Investments are planned in sustainable transport by financing 356 green buses for public transport, deployment of electric charging stations, improving railway infrastructure, ports and cycling pathways for about EUR 920 mln. In the digital area, Belgium will reinforce cyber resilience and security with EUR 80 mln. and it will finance a more inclusive and future-proof education system across the country with digital and STEM skills of pupils and students and access to digital tools and technologies for about EUR 480 mln.
Strong Innovators	The **German**'s Recovery and Resilience Plan will be financed by EUR 25.6 bln. 42% of the expenditures will be directed towards achieving climate objectives, while 52% will be channeled for investments in digital reforms. Among the most prominent investments is the one in green hydrogen at all stages of the value chain (EUR 1.5 bln.). EUR 2.5 bln. will be directed towards support for electric cars and another EUR 2.5 bln. will be used to improve energy efficiency in residential buildings. In the digital field, Germany will invest in microelectronics and communication technologies. It will target deployment of the next generation of low-power processors (EUR 1.5 billion). EUR 3 bln. will be directed towards digitalization of public services.	In **Austria,** 59% of the expenditure will support the climate objectives, while 53% of the expenditure will support the digital transition out of EUR 3.5 bln. in grants. Among the most prominent reforms, the country will refocus its tax system to benefit climate objectives. For instance, it will introduce tax reforms to boost green technologies, it will apply preferential tax rates for low or zero emission products; it will support zero-emission busses; support environmental mobility, like expanding the electrified rail network between regions. In the sphere of digital transition, it will target improvement of digital connectivity and access to digital education.

Moderate Innovators	**Italy's** Recovery and Resilience Plan is enormous. It includes a budget of EUR 191.5 billion, consisting of EUR 68.9 bln. in grants and EUR 122.6 billion in loans. 37% of the expenditures will address climate objectives, while 25% will target reforms in the digital transformation field. Most of the resources (EUR 32,1 bln.) will cover reforms in the sustainable mobility area. More regions will be integrated into the high-speed rail network and complete the rail freight corridors; boost sustainable local transport through the extension of cycle lanes, metros, tramways and zero-emission buses, including the construction of electric charging stations across the country and hydrogen refuelling points for road and rail transport. Similar to Germany, it will invest in energy efficiency in residential buildings for EUR 12,1 bln., whereas EUR 11,2 bln. will be invested in renewable energy and circular economy, incentivising the use of renewable energies including green hydrogen as well as increasing recycling, reducing landfill waste and improving water management. In the field of digital transition, Italy will develop ultra-fast and 5 G networks (EUR 6.7 bln.); it will provide a tax credit scheme to support digital transformation of companies (EUR 13.4 bln.) and support also the digitalization of the public administration (EUR 6 bln.).	**Portugal's** EUR 16.6 bln. recovery and resilience plan, consists of EUR 13.9 bln. in grants and EUR 2.7 bln. in loans. 38% will cover climate objectives while 22% will address digital objectives. The energy efficiency in residential buildings component will take up to EUR 300 mln., whereas EUR 185 mln. will be invested in hydrogen and renewable gases. Unlike other Member States, Portugal will invest in protecting vulnerable forest areas. Close to half a billion of euros will be spend on upgrade of technological laboratories and technical equipment in secondary schools and professional training centres, while EUR 300 mln. will be spend on digital health transition, modernizing the computer systems of the National Health Service. A total of EUR 650 mln. will be spend on digital transition of businesses, supporting SMEs and their workers with tailored digital skill trainings and coaching to help them make the best use of digital technologies.

Emerging Innovators	**Romania's** recovery and resilience plan will be financed by EUR 14,2 bln. in grants and EUR 14.9 bln. in loans. 41% will target the achievement of climate objectives, while 21% will address the digital objectives. The country will finance with EUR 3.9 bln. the railway modernization, and it will finance the urban mobility with EUR 1.8 bln., whereas clean energy production will attract EUR 855 mln. in phasing-out of coal and lignite power production and deployment of renewables, related production processes, and hydrogen. Energy efficiency of buildings will absorb another EUR 2.7 bln., while biodiversity and environmental protection will need another EUR 1,1 bln. In the digital space, most of the funding will go to digitalization of public administration (EUR 1.5 bln.), while EUR 470 mln. will be needed for developing an integrated e-Health system. Another EUR 881 mln. will be used for digitalization of education, namely for improving digital pedagogical skills, educational content and equipment and resources, including in universities.	**Croatia's** recovery and resilience plan will be financed by EUR 6,3 bln. in grants. 40% of the expenditure will meet the climate objectives, while 20% will meet the digital targets. About EUR 800 mln. will target investment in energy efficiency and post-earthquake reconstruction of buildings, whereas EUR 728 mln. will be invested in sustainable mobility to upgrade railway lines, introducing zero-emission vehicles and vessels, among other. Croatia will support also low-carbon energy transition through investments for the production of advanced biofuels and renewable hydrogen, financing innovative carbon capture and storage projects (EUR 658 mln.) Finally, it will support green transition and energy efficiency of businesses through sustainable tourism, investing in green technologies (EUR 542 mln.). On the digital side, the country will support the digitalization of the public administration (EUR 287 mln.) and it will increase digital connectivity of rural areas (EUR 126 mln.), but also digitalize higher education by investing EUR 84 mln. in e-learning and digital teaching tools.

Source: *Excerpts from factsheets of the Recovery and Resilience National Action Plans, October 2021. Available at:* https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en#national-recovery-and-resilience-plans

As seen from the table above, the EU Member States aim to meet the climate objectives by investing in decarbonization of the energy sector (Finland) and hydrogen projects (Belgium, Portugal, Romania). In particular, there is specific focus on green hydrogen (Germany, Italy), but also on tax reforms to boost green technologies (Austria, Croatia), sustainable mobility (Finland, Belgium, Germany, Italy, Romania, Croatia), and energy efficiency in residential buildings (Italy, Germany, Portugal).

In the digital area, EU member states will invest in railway mobile communication system (Finland), reinforce cyber resilience and security (Finland) and finance a more inclusive and future-proof education system across the country with digital skills (Belgium, Austria, Romania, Croatia), invest in microelectronics and communication technologies and deployment of the next generation of low-power processors (Germany), as well as digitalize the public service administration (Germany, Italy, Portugal, Romania, Croatia), but also provide support for the digital transformation of companies (Italy, Portugal).

The European Commission evaluates the plan according to specific set of criteria. Important part is related to horizontal principles, namely, the measures should be complementary to the European Union Programmes 2021 – 2027 and the plan should respect the principle of additionality – should cover other costs, different from Union funds and programmes.

7. Conclusions

Policymakers have bee trying to achieve sustainable development for many years as the international public discourse has been running for decades. The past three decades in particular have witnessed enormous dynamics through forums, declarations, protests.

In the last few years, the New Green Deal policy has become an international inspiration for many governments. The present study has identified specific similarities between the European and the Korean Green deal – they share the same goal and they aim to take urgent climate action, achieve net-zero emissions, and mobilize the industry and the private sector, although neither of them plans to go beyond the Paris Agreements pledges. The author captured also important differences, namely the legislative framework and the inclusive environmental agenda that is visible in the European Green Deal vis-à-vis the Korean Green New Deal.

The paper presented also characteristics of immediate environmental and digital reforms, which are part of the national recovery and resilience plans of selected EU member states. The financial support for EU member states varies and the investments and reforms target to generate efficiency gains in zero-emissions and digital transformation as per country specifics. These plans are oriented towards reforms in the mid-term and they manifest a better policy choice for response to the Covid-19 crisis than the comparator. In fact, the Covid-19 crisis has put a high pressure on consumers, businesses and governments and, thus a quick policy response was necessary. What policymakers need to consider is that, on the one hand, climate and digital policies have to be designed with research and innovation at the forefront, and on the other hand, a package of policies, investments and reforms would require proper implementation and regular communication to specific audiences and the public.

An important aspect, not considered in the paper, is the fact that the Green Deal is also a foreign policy because climate change is a global problem. A transition away from carbon that would only focus on Europe or South Korea would not do much to mitigate global warming, as these two global actors account for less than 10 percent of GHG emissions. The European Commission has already recognized that it will either need to export its standards or create a mechanism to work closely with large actors, like the US and China to maintain European competitiveness in the global economy(On the geopolitics of the European Green Deal, see, https://ecfr.eu/publication/the-geopolitics-of-the-european-green-deal/).

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Sustainable Development and ESG Approaches as the Basis of a Global Centralized Economy

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Abstract: The idea of creating a model of production and consumption that does not harm the environment in which the next generations of people will live already includes such areas of business responsibility as the environment, social obligations and corporate governance (environmental, social and corporate governance – ESG). The main discussions are taking place around the climate agenda, reducing greenhouse gas emissions and the resulting issues of the need to verify the reliability of data provided by companies on their social, economic and environmental activities. The purpose of the article is to study current trends and develop proposals for the formation of methodological tools for managing possible corporate risks faced by companies in the process of becoming a global socially oriented development model. The results of the study allowed us to conclude that the conceptual model of the market economy is gradually being transformed. The economic goals of the subjects are modified towards the rational use of rare resources, including a person, his intellect, emotions and creative abilities. At the same time, an environmentally friendly and socially oriented global development agenda creates additional risks and constraints for almost all companies. The novelty of the work lies in the proposed risk analysis related to the ESG agenda, which will allow the business to adapt to the changes taking place, adjust existing models and tools. The established dependencies expand the understanding of contradictions and prospects for the development of the green economy in the context of the transition of the world economy to a new model of energy supply.

Keywords: sustainable development, corporate governance, risks, ESG – factors, green economy

1. Introduction

The development of ethical values and the implementation of the sustainable development Concept, which was first declared in 1987 in the UN report "Our Common Future", brought the interaction of companies with stakeholders to a qualitatively new level.

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The development of ethical values and the implementation of the Concept of Sustainable Development, first stated in 1987 in the UN report "Our Common Future", brought the interaction of companies with stakeholders to a qualitatively new level (Wallis & Klein, 2015). The requirements for openness, transparency, compliance with the principles of corporate governance and corporate social responsibility are increasing. Disclosure of information about their environmental impact and the social responsibility of doing business in the form of preparing reports on sustainable development has become a prerequisite for public joint stock companies, and stakeholders have the opportunity to punish corporations for unfair social initiatives (Belayeva & Danilova, 2021). The topics of transition to new energy sources are widely discussed: hydrogen technologies, alternative sources of electricity: solar energy, wind energy, biomass energy, wave energy and others (Mikheeva & Suvorov, 2019). The driver of the new agenda, of course, is digitalization, since it opens up opportunities for managing those processes and systems that were previously not available to business.

Accordingly, stakeholders who evaluate or have certain expectations regarding the results and activities of a particular company react in one way or another to the changing agenda and begin to be interested in how companies manage risks in the field of ecology, social aspects, and corporate governance. In the article, we will turn to the content and practice of introducing ESG factors into the activities of Russian companies, and also consider the possible risks of "green" investment in the context of the problem of manipulating the opinion of responsible investors (Pearce, 1992). The purpose of the study was to identify the complex and contradictory impact of the global restructuring of the world economy on the prospects for the formation of ecosystems in Russian companies (a set of own or partner services united around one company).

2. "Green Agenda" as a driver of development of the Russian responsible investment market

Materials and methods

To achieve this goal, the following key research methods were used. Content analysis of scientific articles of scientists published in Russian and foreign libraries, quantitative and descriptive data are taken from open sources, observation, comparison, quantitative analysis, systematization and evaluation of statistical data were used as the main empirical research methods, the final analysis of the choice of methods for assessing and managing ESG risks was carried out on the basis of special methods of strategic analysis and risk management.

The information basis of this study was the data characterizing the processes of adaptation of national economies to the sustainable development agenda, presented in official reviews and databases for the period from 2005 to 2020 of the Federal State Statistics Service of the Russian Federation, the World Economic Forum, the OECD, etc.

Based on the use of a theoretical and methodological approach, the conceptual provisions of socially responsible investment were determined. Socially responsible investments are understood by us as a fundamentally new form of investment that ensures the placement of funds in assets that meet special environmental, social and corporate selection criteria and provide an acceptable level of profitability to the investor.

In the process of global restructuring of existing economic ties and interdependencies, business, starting to deny (due to their insufficient effectiveness) the primary, spontaneous forms of social responsibility, retains their positive features in a transformed form and forms new tools (Danilova & Shandra, 2009) and mechanisms of responsibility to society.

The main trend of the last decade has been the transition to a "green economy" and the development of responsible investment based on ESG factors that allow companies to clearly systematize investment choices based on achieving sustainable development criteria. ESG is an exceptionally new direction for many Russian companies, especially for companies that operate in the domestic market, large corporations are constantly experiencing enormous pressure from their stakeholders (Demidova, 2019; Ivanitsky &Petrenko, 2020). Due to the emergence of significant environmental restrictions, companies are forced to step up their actions from the position of social and environmental responsibility: starting with the rejection of the use of harmful and toxic materials for the production of products to large-scale restructuring of production and the introduction of "green" technologies (Grabchak, 2021). The position of investors in relation to corporations is becoming increasingly tougher. In December 2020, investors managing $9 trillion in assets announced that no later than 2050 they would exclude companies from investment portfolios whose activities would not be neutral in terms of greenhouse gas emissions.

Starting in 2020, additional ESG requirements have appeared, which directly affect the cost of products and companies' access to specific markets. Slowly, but the outflow of investments from raw materials companies has begun, some financial organizations have already declared their refusal to invest in new projects related to coal mining, from investments in projects related to new coal generation. In December 2020 The third largest pension fund in the United States has announced that it will exclude from its portfolio securities of oil and gas companies that will not fulfill the environmental requirements put forward by it over the next four years. In this portfolio there are securities of Novatek, Rosneft, Surgutneftegaz and Tatneft. At the beginning of 2021, it became known that the world's largest bond fund, RIMSO, refused to purchase social bonds of JSC "Russian Railways", since carbon-containing cargoes account for more than 50% of the company's cargo transportation structure (Belikov, 2021).

ESG ratings are a practical tool with a potential material effect that allows evaluating the processes of making key business decisions focused on sustainable development in three categories – Environmental, Social, Governance. Each of the reputable rating agencies – RobecoSAM (S&P Global), Sustainalytics, MSCI, CDP, ISS, Vigeo Eiris (Moody's), FTSE Russell and FTSE4Good – receives information based on questionnaires, publications and annual reports of companies from open sources. Rating agencies apply individual approaches and form their own methodology for scoring points and assigning ESG ratings. As a result, ESG ratings assigned to the same company, but calculated by different agencies, may differ significantly.

In many OECD countries, it is normal practice for ESG companies to have a strategy and policy for managing relevant risks and have an appropriate regulatory framework. In the EU countries, private and public investments are focused on "green" projects and the transition to a low-carb economy. In 2020, Ernst&Young (EY) conducted a survey among institutional investors on how much they take into account ESG ratings of companies when making their investment decisions. As a result, it turned out that 98% of the surveyed insurance and investment companies, pension and charitable foundations clearly monitor ESG ratings. The predominance of institutional investors enhances the socialization of investment, turning responsible investment into an instrument of influence, and even ensuring competitive advantage.

ESG ratings allow assessing the effectiveness of corporate governance and predicting the likelihood of risks in the environmental and social spheres. The structure of ESG risks is shown in Figure 1.

Figure 1: *The structure of ESG risk*

Strategic/financial risks	**Compliance risks**
Withdrawal of investments from commodity companies; Risks of termination due to global climate change; The impact of the ESG rating on the stock price	Lack of compliance with and monitoring of international directives and regulations; Violations related to occupational safety and industrial safety; Violations related to working conditions, human rights or sustainable procurement
Public opposition to the conduct/expansion of activities; Incorrect reporting in the field of sustainable development or failure to fulfill promises; Ineffective supplier verification; Increasing demand for transparency	Accidental environmental pollution; Accidents related to the destruction of equipment, loss of materials and products; Management of hazardous substances
Reputational risks	**Operational risks**

Physical and transformational risks deserve the most attention, while financial risks deserve less attention. It is easier to work with financial risks: clear rules, more transparent reports that are verified according to clear methodological foundations.

The objectives of ESG risk management are:

– minimization of potential investment risks;
– minimization of claims from regulatory organizations; minimization of regulatory risks;
– increasing interest from investors and clients focused on working with those companies whose activities comply with the principles of sustainable development;
– minimizing the risks of the company "falling out" from the supply chains.

Over time, ESG risks can become a source of financial risks. Corporations operating in accordance with ESG principles attract capital and become able to provide investors with a more sustainable income.

The evolution of the most significant global risks and the probability of their occurrence, according to experts of the World Economic Forum, is presented in Figure 2 and Figure 3.

Figure 2: *The most significant global risks by probability of occurrence*

	1 st	2 nd	3 rd	4 th	5 th
2021	Exstreme weather	Climate action failure	Human enviromental damage	Infectious diseases	Biodivercity loss
2020	Exstreme weather	Climate action failure	Natural disasters	Biodivercity loss	Human enviromental damage
2019	Exstreme weather	Climate action failure	Natural disasters	Data fraud or theft	Cyberattacks
2018	Exstreme weather	Natural disasters	Cyberattacks	Data fraud or theft	Climate action failure
2017	Exstreme weather	Invo-lantary migration	Natural disasters	Terrorist attacks	Data fraud or theft
2016	Invo-lantary migration	Exstreme weather	Climate action failure	Interstaty conflict	Natural catastrofes
2015	Interstaty conflict	Exstreme weather	Fallure of national governance	State collapce or crisis	Unemployment
2014	Income disparity	Exstreme weather	Unemployment	Climate action failure	Cyberattacks
2013	Income disparity	Fiscal imbalances	Greenhouse gas emission	Water crisis	Population ageing
2012	Income disparity	Fiscal imbalances	Greenhouse gas emission	Cyberattacks	Water crisis

Economic risks	Environmental risks	Geopolitical risks	Social risks	Technological risks

Source: *The Global Risks Report 2020* https://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf

Figure 3: *The most significant global exposure risks*

	1 st	2 nd	3 rd	4 th	5 th
2021	Infectious diseases	Climate action failure	Wepons of mass destraction	Biodivercity loss	Natural resourses crisis
2020	Climate action failure		Biodivercity loss	Exstreme weather	Water crisis
2019	Wepons of mass destraction	Climate action failure	Exstreme weather	Water crisis	Natural disasters
2018	Wepons of mass destraction	Exstreme weather	Natural disasters	Climate action failure	Water crisis
2017	Wepons of mass destraction	Exstreme weather	Water crisis	Natural disasters	Climate action failure
2016	Climate action failure	Wepons of mass destraction	Water crisis	Involantary migration	Energy price shock
2015	Water crisis	Infectious diseases	Wepons of mass destraction	Interstaty conflict	Climate action failure
2014	Fiscal crisis	Climate action failure	Water crisis	Unemployment	Infrastructure breakdown
2013	Financial failure	Water crisis	Fiscal imbalances	Wepons of mass destraction	Climate action failure
2012	Financial failure	Water crisis	Food crises	Fiscal imbalances	Energy price volatility

Economic risks	Environmental risks	Geopolitical risks	Social risks	Technological risks

Source: *The Global Risks Report 2020* https://www3.weforum.org/docs/WEF_Global_Risk_Report_2020.pdf

In 2012, financial, fiscal risks, cyberattack risks, water shortage risks and financial inequality risks were included among the most important in terms of importance and impact of global risks. According to the estimates of 625 experts, in 2021 financial risks were classified as minor risks. Extreme weather conditions are in the first place, climate problems, the disappearance of a comfortable environment for humans, infectious diseases and biodiversity are in the second place. In terms of the impact of risks, their assessment does not differ from the assessment of their probability of occurrence. The only change is that the risk of using weapons of mass destruction is added. Thus, the structure of global risks has changed from the position of increasing their importance for humanity.

Results and Discussion

The changed view on the structure of global risks was the main driver of the introduction of the ESG agenda into business practice.

Investors are not guided by abstract declarations and disparate facts. It is important for them to know how much companies are ready to work in the "green economy" of the future. Investors put corporate governance risks in the first place. 63% of investors said that if there are problems in the company with corporate governance, investments in the company are impossible. Supply chain risks associated with ESG factors are in second place. In third place are the risks of supply chain disruption associated with ESG factors. Half of the investors will not decide to invest in a company if the company has such problems. In fourth place are problems in the field of human rights violations. In fifth place are the problems associated with climate disruption. For half of investors, this is a key issue when making an investment decision. In fifth place are the problems of providing the population with clean water and environmental performance.

Insufficient assurance of companies' data and statements of commitment to the principles in ESG and the lack of communication between ESG initiatives and the company's strategy are in last place.

ESGs are becoming a tool for active investment strategies (Belikov, 2021). The nature of investors' demands is changing, especially the global trend – an increase in the number of institutional investors, an increase in their share in equity. Accordingly, their influence on corporations becomes very significant and reflects the need of society to socialize the activities of economic institutions – corporations (Zakharova, 2015).

The fundamental basis of the modern model of global development is the principles of safe interaction of society, nature and man, obtaining economic benefits from social activities. It is impossible to reverse the trend towards globalization. To be competitive in the global market, you need to integrate into the value chain. It should be agreed with the authors that the problems associated with the Fourth Industrial Revolution (4IR) are accompanied by the rapid emergence of environmental restrictions, the emergence of an increasingly multipolar international order and the growth of inequality (Vostrikova, 2020). The transition to a green economy – to waste-free production, reducing CO2 to zero – requires significant material, financial and intellectual costs for both private and state-owned Russian companies.

A company that attracts investors may position itself as socially and environmentally responsible, but in practice it is not. There is a problem of "green washing". Similar situations may arise in the social sphere, corporate governance, achievement of economic goals and objectives of sustainable development. In the absence of unified regulatory requirements, such manipulation of investors' opinions may occur regularly. Practice has developed several solutions to such problems. Firstly, investors can be guided by their own methods of in-depth analysis of investment projects for their compliance with ESG criteria. Secondly, it is possible to focus on publicly available ESG ratings compiled by reputable rating agencies.

It should be agreed with the authors that the determining factor should be the quality of investment assets, and not how investors position their activities (Lvova, 2019). In this sense, in our opinion, rankings are a tool for improving the social reputation of the company, and not a method of objective assessment. In this regard, not only specialized assessment models and ratings should be in demand, but also classifiers of acceptable types of business, which include (EU taxonomy for sustainable activities (The European Commission, 2020). The Russian analogue is the taxonomy of green projects – "Main directions of implementation of green projects" (VEB. Russia, 2020).

3. Conclusion

Based on the presented results, it can be concluded that the global restructuring of the world economy is aimed in favor of an environmentally friendly and socially oriented development model. The global "green transition" cannot be ignored. It is necessary to find non-standard solutions to emerging problems. Corporations operating in accordance with ESG principles attract capital and become able to provide investors with a more sustainable income. There is mutual influence, on the one hand, corporate responsibility is growing, on the other hand – despite the requirements of socialization of investments, capital owners are changing the conditions for raising capital, having different opportunities and degrees of development, the application of ESG principles will have an ambiguous impact on business. The transition period of ESG transformation has just begun. The state and business need to clearly set priorities and identify key areas of socio-economic policy that ensure the sustainable effectiveness of “green” projects.

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China's Policy for Economy Decarbonization

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Abstract: In 2020 China committed to the achievement of a peak carbon emissions before 2030 and carbon neutrality by 2060. This commitment will be supported by a set of policies, starting with green finance year of 2021 and new goals for the 14th Five Year that runs from 2021 to 2025. The report highlights China's key policies for green finance for a green economic recovery, for emission reduction in key sectors such as energy, manufacturing, transportation, and for the development of the national emissions trading system. A focus is put on the sources of financing to achieve clean energy deployment one of which is the assets owned by commercial banks and the establishment of "carbon emission reduction support tool".

Keywords: green economy, green finance, China, decarbonization, green bonds

1. Introduction

China is the world's largest CO^2 emitter, with 12.4mn kilotons of emissions in 2018, accounting for 26,9% of the world's total (World Bank, 2018). In the end of 2020 China committed to reach peak in emissions by 2030 and carbon neutrality by 2060, an ambitious goal, that requires a comprehensive policy framework for each polluting sector and the establishment of robust finance system to secure capital for the investment (Green Central Banking, 2021).

There are several factors determining the large share of China's emissions in the globe's total. Besides being the world's largest energy consumer, and soon the largest economy, China is also the largest coal consumer with 63% of its power mix being coal fired power plants. The country has high energy consumption per unit of GDP, maintaining the largest capacities in the world of energy-intensive sectors as iron, steel and cement production. It is estimated, that by 2030, coal consumption in Asia will make up 81% of the world's total, rising from 77% in 2020. The demand will come mainly from China. The country's economy is expected to grow by 4 – 5% per year – a significant increase in power consumption, and therefore emissions.

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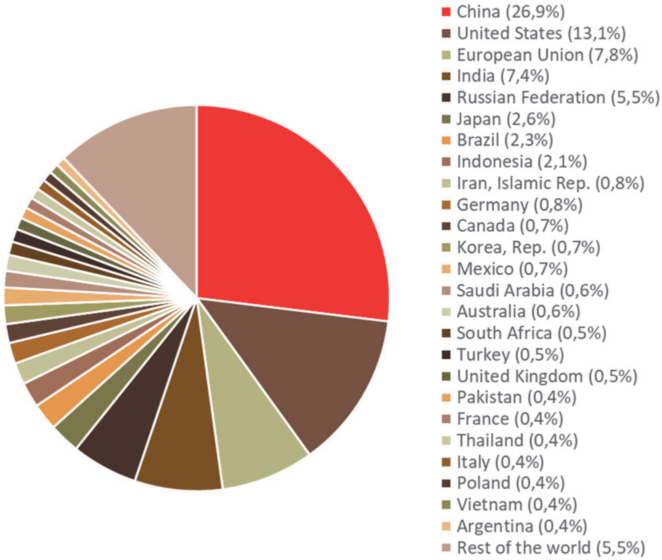
Figure 1: *Share of CO2 emissions by country*



Source: *World Bank (2018)*

China will need 140 trillion RMB (21,33 trillion USD) of debt financing over the next 40 years to meet its net-zero emissions target. The country will need 22 trillion RMB by 2030 and the remaining 118 trillion for the years from 2031 to 2060 (CICC, 2021). China's power sector will need the largest investment to be decarbonized (67,4 trillion RMB), followed by transport (37,4), buildings (22,3), chemical (4,1), agriculture (3,6), iron and steel (3,1) and cement (0,9) (CICC, 2021).

This is a bit more than the total outstanding loan balance of Chinese commercial banks of 120 trillion RMB, as of the end of 2019. To reach the so-called "30 – 60" target, China will have to establish a sound green financial system, and harmonize its existing green finance standards, set up a comprehensive mechanism for green information disclosure, strengthen the education of the green investment concept and improve the policy framework.

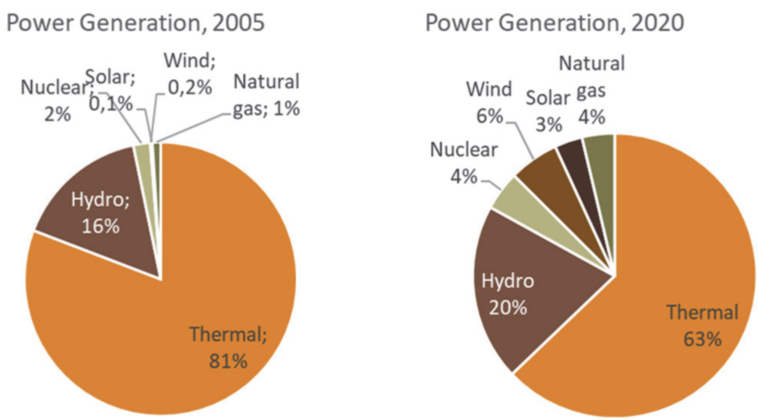
The purpose of this article is 1) to present the existing policy framework for increase green investment in the main polluting sectors, including power generation, industrial sector and transport; and 2) to present and analyze China's existing green financial system, its challenges and perspectives for future development.

2. Policies for Economy Decarbonization

2.1. Power Sector Decarbonization

China's large share of coal-fired plants in the generation mix is the key challenge for decarbonization. To decrease the share of coal plants from 81% in the generation mix in 2005 to 63% in 2020. China had to close hundreds of coal mines and old coal-fired plants (NDRC, China Electricity Council, 2016), and invest in renewable energy, having now the world's largest renewable energy installed capacity, at 905,1 GW in 2020 accounting for 41,1% of the country's power capacity and 27% of the electricity generation (China Electricity Council, 2021). However, in periods of economy recovery (such as in Q3 of 2021), the country had to re-open closed coal mines and raise coal and gas imports so as to respond to the surging demand (Reuters, 2021).

Figure 2: *China's Power Generation Mix*



Source: *China National Bureau of Statistics, China Electricity Council*

Insufficient capacity of clean energy is not the only challenge for decarbonizing the power sector. Among other challenges are the still regulated market, government subsidies, high electricity price, insufficient diversification for gas supply, underdeveloped grid and infrastructure in some regions. Reshaping the sector is also an issue for diverting employment of 5mn people in coal mining and 2,5mn in power generation. Huge investment in the sector will be needed for power grid construction, energy storages, clean generation capacity and special equipment, and for developing hydrogen technologies. Renewable capacity is planned to reach 1,200 GW of wind and solar by 2025, up from 535 GW in 2020, and additional 150 GW by 2035.

To stimulate investment in renewables, the government had applied feed-in-tariffs, preferential land leases, priority grid connections, long-term contracts with grid companies and preferential income tax policies in target regions investing within the scope of encouraged categories. In 2020 the government also required a certain volume of renewable energy purchases by the state, provincial and private grid operators, introducing a "*Mandatory Renewable Energy Consumption Mechanism*". However, since mid – 2019 the country started gradually dropping out the subsidies for utility-scale solar and onshore wind projects, decreasing incentives in an 18-month transition period to parity renewable energy, and prioritizing subsidies-free projects. It leaves just smaller amounts of subsidies in residential PV and a feed-in-tariff for RMB 0.03 per watt for some 16GW of residential PV in 2021. These parameters differ slightly across provinces and cities, depending on the progress towards local targets for renewable capacity. New investment will rely on green finance and will require even more reforms in the market mechanisms, in a market with dominating state-owned companies.

Power market liberalization had been long postponed, despite intentions dating back in 2002, serious plans for market unbundling in 2012. In fact, so far just the power generation segment for small scale hydropower and other renewables was liberalized, allowing private capital to enter in the last 15 years. Electricity wholesale market was set up on a pilot basis, in specific regions and for specific industries and users, or in a hybrid format with a mixture of deals at fixed regulated prices and at market prices, and did not operate on a national scale until 2021.

The first national emissions-trading scheme was launched in July 2021, after pilot testing in seven pilot cities including Beijing, Shanghai and Shenzhen In October since 2013. The scheme is based on a cap-and-trade model, emitters are allocated a certain number of emissions allowances up to a set limit. Emitters were initially just coal- and gas-fired energy plants, and plans were to include construction, steel and aluminum production sectors, oil and chemicals in coming years. However, after facing power shortages and rising electricity prices in October 2021, the government decided to finally charge industrial and commercial users at 100% market prices (Reuters, 2021, A) and leave just residential, agricultural users and public welfare initiatives at regulated prices. In mid – 2021 a total of 2,225 power firms are included in the project.

In December 2017, the National Development and Reform Commission (NDRC) issued Program for the Establishment of a National Carbon Emissions Trading Market. In September 2021 a green power exchange market was launched to use blockchain for a new electricity system based primarily on new energy, a market having a potential of several trillions RMB in size.

Among other efforts of the country to decarbonize the power sector are the construction of a modern energy system with six key areas of energy development: eight large-scale clean energy “bases”, coastal nuclear power, electricity transmission routes, power system flexibility, oil-and-gas transportation and storage capacity. By 2025 the country has to cut 18% of the CO2 emissions per unit of GDP, 13,5% of the energy consumption per unit of GDP and increase the share of non-fossil energy in total energy consumption to around 20%. All this will require nearly 50% of the total investment needed for the country to reach the 30 – 60 target.

2.2. Industry Decarbonization

The main polluting industries in China are iron and steel manufacturing, cement and chemical industries. Investment for industry decarbonization is needed for carbon-capture technologies, high technology furnaces and new casting technologies in the iron and casting factories, and so on. The main challenge for decarbonization in the power and industry sectors are in fact the undeveloped technologies, and therefore high cost for research and development.

The steel sector makes up 15% of total carbon emissions in China and 60% of global steel sector carbon emissions. In recent years, the government constantly eliminated steel overcapacity and imposed strict restrictions on permits of new capacity and closures of steel mills that use outdated technologies. New technologies are adopted, including cleaner-burning electric arc furnaces to apply carbon-neutral new technologies fueled by renewable hydrogen or electrolysis.

In March 2019, the Green Industry Guidance Catalogue was jointly issued by NDRC and other six ministries and commissions (Ministry of Industry and Information Technologies, Ministry of Natural Resources, Ministry of Ecology and Environment, Ministry of Housing and Urban-Rural Development, People’s Bank of China (PBOC), and National Energy Administration) to channel better the green finance in the sector.

2.3. Transport Decarbonization

The transport sector will need 37,4 trillion RMB to decarbonize by 2060, accounting for over one quarter of the total investment needed (CICC, 2021). China has started work in this sector ten years ago and now is a leader in the global production and sales of the so-called New Energy Vehicles (NEV).

In 2012 the State Council released "*Energy Conservation and New Energy Vehicle Industry Development Plan (2012 – 2020)"*. In November 2020, the State Council published its updated plan for the period 2021 – 2035, outlining critical goals for the NEV subsector. By 2025, 20% of the vehicles sold in China is expected to be electrified. In addition, fuel cell vehicles should also be commercialized by end – 2035. It is expected that by 2035, electric vehicles will account for approximately 50% of all new car sales in China.

At the start 2021, compulsory emission quotas for internal combustion engines and electric vehicles have been tightened. Development of core technologies include batteries, drive motors, power systems, Internet of Vehicles along with 5G and Internet of Things technologies, development of both hardware and software, chassis-by-wire and smart terminals. Electrification, smartification, and connectivity are the key principles set in the guiding policy documents.

NEV Industry Development Plan (2021 – 2035) was released in November 2020, setting air pollution control key areas where 80% of the newly purchased vehicles must be NEV starting in 2021. Public vehicles are those of the government, postal, sanitation, rental, port and airport, delivery vehicles, urban buses and taxis. NEV manufacturers have to carry out battery recycling and provide convenient battery exchange services.

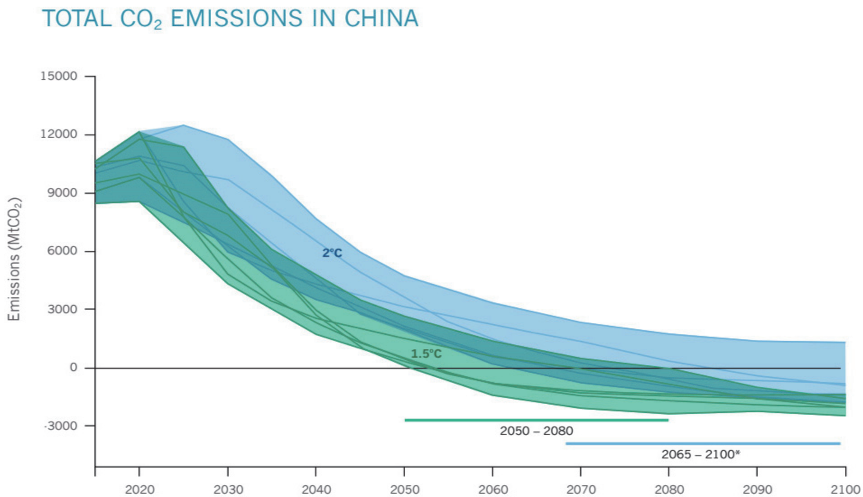
Strategy for Innovation and Development of Intelligent Vehicles was released in February 2020, including goals for commercialization of self-driving vehicles. In 2020 China lifted the foreign shareholder cap for all NEV joint ventures.

2.4. Projections and Financial Needs

Besides the fact that just 60% of the technologies needed for decarbonization are in their conceptual stage, another challenge that China needs to resolve is the fact that just 10% of the total investment can be done by the government, and the remaining 90% need to be covered by private capital. Additional challenge is that 80% of the funding will use the assets of commercial banks. All this shows the strong need for setting up a sound financial management and risk management system.

Projections for the investment feasibility in China's economy decarbonization are quite optimistic. A review on selected models of CO_2 emission reduction trajectories for 1,5ºC and 2ºC temperature rise globally shows that most scenarios project that China may see a peak in CO_2 emission before 2030, even before 2025 (Carbon Brief, 2021).

Figure 3: *Projections for Total CO_2 Emissions in China*



Source: *Energy Foundation China, 2020*

3. China's Green Finance System

3.1. Basic Foundation with Green Taxonomy and Green Loans

Before setting the new "30 – 60" target, in fact China already has set up the foundation of its green finance system. Initiatives started in 2007 with the new Environmental Protection Law, and the joint introduction of the "*Guidelines for Green Credits*" by the PBOC and the Banking Regulatory Commission (CBRC). The next year CBRC implemented statistical system and further introduced Green Credit Key Performance Indicators for the purpose of monitoring and evaluation of green banking. These policies enabled commercial banks to effectively identify, manage and control environmental and social risks. In the years after 2012, commercial banks had already established teams and processes, and banks' performance was ranked by market capitalization on sustainability criteria in regular reports of the Ministry of Environmental Protection.

Green credit taxonomy started from 2013, requiring 21 major commercial banks to report their green credit data every six months. The statistical indicators mainly include green credit balance, change in balance, 5-categories loan classification (Normal, concerned, subprime, doubtful, loss), energy savings, and emissions reductions. The PBOC green credit taxonomy required major deposit-taking financial institutions to report their green credit data on a seasonal basis. The statistical indicators focus on green loans include quantitative (80% weight) and qualitative.

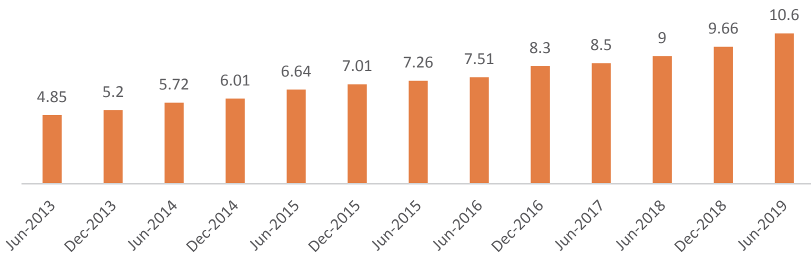
The CBIRC and PBOC confirmed unified green credit standards in 2013 and updated them in 2018, to ensure that green credits would support the manufacturing loans for three strategic emerging industries (energy saving and environmental protection, new energy, and new energy automobile), for 12 types of energy saving and environmental protection projects (*1)* Green Agriculture; *2)* Green Forestry; *3)*Industrial energy saving, water conservation & environmental protection; *4)* Nature protection ecological restoration and disaster prevention; *5)* Resource Recycling; *6)* Waste disposal pollution prevention & treatment; *7)* Renewable energy & clean energy; *8)* Rural and urban water projects; *9)* Building energy efficiency & green building*; 9)* Green transportation; *10)* Energy Conservation & environmental protection services; *11)* Overseas projects applying international best practices & standards; *12)* Strategic emerging industries) and 60 services.

Statistics from CBRC showed that by end of June 2017, projects and services supported green loans for the reduction of 491mn tons of carbon emissions. Non-Performing Loans (NPL) ratio of these green loans stood at 0,37%, much lower than the average level of 1,69% (Climate Policy Initiative, 2020).

By the end of 2019, the outstanding volume from 21 major banks exceeded RMB 10 trillion, over 10% of total loans on their balance sheet. Their outstanding balance of green credits more than doubled from RMB 4.85 trillion in June 2013 to more than 10.6 trillion in 2019, up by an average annual growth rate of 14%, faster than the average loans growth in the same period.

Incentives for banks to develop green credits were: 1) including the performance of green finance into macro-prudential assessment system, which provides more points for banks with higher ratio of green credits. 2) subsidies of some local governments on part of the loan interest for specific green projects; 3) internal bank policies and strategies to increase green credits by creating an independent green finance department and allocate more resource to it (Tsinghua University National Institute of Financial Research, 2021).

Figure 4: *Green credit balance of 21 largest commercial banks in China, RMB trillion*



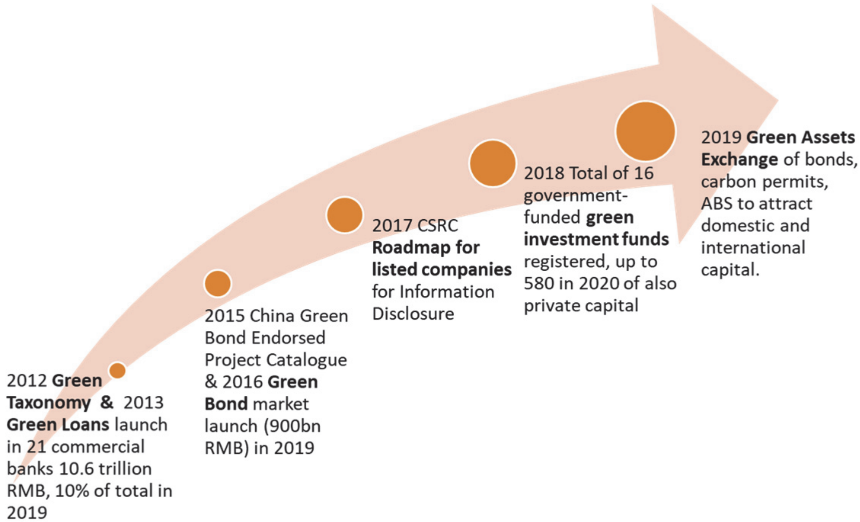
Source: *China Banking and Insurance Regulatory Commission*

3.2. Setting a Comprehensive Green Financial System with Diverse Instruments

Having found the framework for green loans was not enough to cover the country's finance needs for economy decarbonization. The government started developing more financial instruments and synchronizing standards for all available financial products into one single financial system. In 2015, the Green Finance Committee under the China Society for Financing and Banking was established. The committee was mandated to lead the research on the role of financial markets and the possibility of establishing a comprehensive green financial market. In 2016 the PBOC issued "Guidelines for Establishing the Green Financial System", just a year after the World Bank published its toolkit for policymakers to green the financial system (World Bank, 2015).

Implementation of the Guidelines of PBOC followed consistently in the following years, setting up the entire financial coordination mechanism at all levels, all institutions and for all type of products. The system is built in harmony with the World Bank's indicative stakeholder map, starting from strategy and coordination, building skills and capacity, financial regulation and central bank activities, increasing transparency, greening financial institutions and developing green financial tools and instruments. All these elements were gradually introduced and simultaneously developed over the years to 2021. In fact, the green finance strategy was announced by the PBOC in February 2021, after the country officially committed to the "30 0 60" decarbonization target, and was in line with the financing needed to reach the target. The next figure shows just part of the milestones of building the financial system, which apparently is much more complex.

Figure 5: *Milestones of China's Green Financial System*



Source: *Author's*

Building the system's infrastructure and institutional capacity was gradual and cautious, first by building green finance pilot zones, and then connecting them into a single system. Financial institutions participating had to build green financial information management system with data analytics, environmental benefit measurement, off-site supervision, peer review and information sharing. At the same time, all pilot zones introduced strong incentive policies of all types, including monetary, fiscal and regulatory.

Monetary policies were introduced at a national level, the central government operated stimulated policies in four main aspects: re-lending facility, re-discounting facility, macro-prudential assessment and eligible collaterals range expansion.

Fiscal policies were introduced at local level. Local governments provided fiscal incentives for corporations and financial institutions, such as interest subsidies for banks for green credits, tax refund for senior management members and grants to green financial businesses and green financial institutions based on their performance in green credits, green bonds, green insurance, green funds and other green financial products. Local governments also built green funds to support local projects.

Regulatory policies relate to all guidelines for environmental information disclosure and capacity building.

After the joint issuance of *Guiding Catalogue of Green Industries (2019)* by seven ministries and institutions including the NDRC, the PBOC and CBIRC, adjusted the green credit classification standards and issued consultation paper on revisions to their respective green credit statistical system to establish more scientific and dynamic credit classification standard.

In December 2015, the Green Finance Committee released the *China Green Bond Endorsed Project Catalogue* (2015). The catalogue was further updated in 2019, to remove industries that do not comply with international standards, such as clean utilization of coal and clean fuel, excluded completely, and partially railway transportation and hydropower generation.

There had been two taxonomies for green bonds, including PBOC's *China Green Bond Endorsed Project Catalogue* since 2015 and NDRC's *Instructions for Issuing Green Bonds* from December 2015. There are six eligible categories of green bonds: Energy Saving, Pollution Prevention and Control, Resource Conservation and Recycling, Clean Transportation, Clean Energy, and Ecological Protection and Climate Change Adaption.

Table 1: *Green Bond Endorsed Project Catalogue (2019 Edition)*

Level 1 Category	**Level 2 Category**
1.Energy Saving Industry	1.1. Energy Efficiency Enhancement
	1.2. Sustainable Building
	1.3. Pollution Prevention
	1.4. Water Saving and Unconventional Water Use
	1.5. Integrated Use of Resource
	1.6. Green Transportation
2. Clean Production Industry	2.1. Pollution Prevention
	2.2. Green Agriculture
	2.3. Integrated Use of Resource
	2.4. Water Saving and Unconventional Water Use
3. Clean Energy Industry	3.1. Energy Efficiency Enhancement
	3.2. Clean Energy
4. Ecology and Environmental Industry	4.1. Green Agriculture
	4.2. Ecology and Environmental Industry

5. Green Infrastructure Enhancement	5.1. Energy Efficiency Enhancement
	5.2. Sustainable Building
	5.3. Pollution Prevention
	5.4. Water Saving and Unconventional Water Use
	5.5. Green Transportation
	5.6. Ecology and Infrastructure
6. Green Service	6.1. Consultation Service
	6.2. Business Management Service
	6.3. Project Audit, Assurance and Evaluation Service
	6.4. Inspection and Monitoring Service
	6.5. Assurance and Promotion for Technical Products

Source: *CECEP, 2020*

All this resulted in fast development of innovative financial products and services. In 2016, China-based institutions issued 58 labeled green bonds in both domestic (53) and overseas (5) markets, with a total value of RMB 240bn, making up 40% of the global issuance. The country remains the largest player in the world green bond market, and expands its positions constantly, including Europe. As of the end of 2019, the total value of green bonds issued by Chinese institutions, since 2016, reached RMB 1,1 trillion.

Figure 5: *China's Green Bond Issuance in Q1, USD mn*

Source: *Thomson Reuters*

In China, government-supported investment fund is playing a leading role in the country's capital market development. By the end of 2018, there were 16 government-funded green industrial investment funds registered in the Credit Information Registration System of National Government-Funded Industrial Investment Funds. These funds have a target of raising RMB 29,64 bn and an actual capital contribution of RMB 9,16 bn. The funds are mainly distributed in Beijing, Shanghai, Shanxi, Inner Mongolia, Hebei, Anhui, and Yunnan, and invest mainly in ecological governance, energy conservation and environmental protection, clean energy, culture-oriented tourism, green industries, etc. The number of green investment funds exceeded 580 in 2020.

4. Conclusion

China's experience shows the strong role of the government in setting the entire green finance system and ensure the feasibility of realizing economy decarbonization by 2060. The top-down approach of the government led to the successful set up of the key parameters of a green financial system before announcing the "30 – 60" target. The country has already set solid foundation of green taxonomies and definition of green activities, environmental information disclosure by corporation and financial institutions, rules and standards for green finance products and an incentive system for corporation and financial institutions.

The country overcame main challenges in synchronizing green standards for all green financial products and services, for setting up information management and disclosure systems, building capacities at the institutions and more important – coordinating all stakeholders in the system from various agencies and ministries. This process was conducted in a financial system that still has its specifics of mixed ownership, large stake of state assets in the largest commercial banks, and bigger difficulty to activate the private capital, private institutions and have them also participate and contribute in the market with new rules and new evaluation systems.

There are still risks that hinder the development of the green finance market and the country's economy decarbonization. 1) The high concentration of investment in just specific sectors will put pressure on the finance supply for other sectors; 2) The concentration of green projects in the transportation industry leads to a mismatch between the actual demand for finance and the intended destination of the finance supply. 3) The high share of green credits in the current green financial structure, at 90% of total, with green bonds and green stocks accounting for just 7% and 3% of total, which raises concerns that the capital market may not be able to fully adapt to the expected 40% of bonds and stocks share in total, set among goals for reaching the 30 – 60 target; 4) Decarbonizing the coal-fired generation segment already resulted in huge power shortages in October 2021, shutting down factories, switching off electricity in entire cities, and seriously impacting the normal life and slowing down economy growth. Such disbalances in the system are not new, but they certainly raise concerns about the country's ability to reach its targets; 5) The country is not prepared for Europe's carbon border adjustment mechanism. If the carbon border adjustment mechanism is implemented in the international trade system, estimations are that this will impact one fifth of China's exports (CICC, 2021). This will result in a certain increase the cost of products manufactured in China, and will require reshaping the industrial structure and production methods, urging the decarbonization process. Yet there are huge risks for entire industries such as iron and steel casting, which may suffer huge losses in China. 6) The green finance standards in the country and in the international market are still not synchronized, which will lead to further changes in the market development.

China apparently looks for flexible solutions of its structural and systematic problems and continues its active international cooperation, taking an active part in all major international organizations and events. One of these solutions could be being part of a large and efficient international green finance system. Chinese green project definitions and standards are not fully consistent with the international ones, so China needs to harmonize definitions and standards and synchronize the Chinese information disclosure system with more systems in other countries. The country needs to work with its international partners on developing risk assessment and evaluation criteria and management system. The institutional capacity to analyze environmental and climate risks should be shaped in a forward-looking manner.

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CHAPTER II

MACROECONOMIC AND FINANCIAL CHALLENGES OF THE GREEN TRANSITION

Real Convergence and Green Transition

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Abstract: Real convergence performance was strong before the global financial crisis but the period following the crisis saw distinctly weakened catching-up processes. One of the major long-term factors for the convergence process in the EU is the Green Transition since it is expected to transform the entire economy. While some EU member states advanced in catching-up to the green targets before the adoption of the Green Pact, some others' weaker starting point would lead to deeper restructuring of their economies. The aim of this study is to evaluate the dynamics of real convergence and green convergence before the start of the Green pact and on that ground to assess their relationship. If the tendencies from the past decade persist in the period till 2030 we could expect slow real convergence as well as green convergence. The growth and convergence of GDP per capita in the past were associated with slow convergence of the use of renewable energy sources and greenhouse emissions while the relation with energy efficiency was weak. We argue that while green transition envisages radical measures for reaching common green targets (full convergence), there is no target neither measures for real convergence. This could lead to further weak real convergence or divergence.

Keywords: real convergence, Green Transition, green convergence

1. Introduction

All EU countries share some common economic dynamic but the level of development of them all is far from homogenous. This implies that the trajectory to higher incomes is hardly linear. In the last two decades both convergence and environment improvement made a progress but still far from the policy targets and the expectations. Large disparities in income and GDP per capita persist between the countries and regions cou-

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pled with divergence tendencies. The set goal of greater convergence is further compounded as the ongoing Green Deal initiative challenges the economies on the path to cleaner environment.

Linking the growth with conversion and environment is not a new challenge for the theory. The neoclassical growth theory of Solow and the theory of Simon Kuznets (Environmental Kuznets Curve) try to explain the linkages. Those theories rely on the combination of economic and technological factors to foster the convergence and improve the environment. The spontaneous process though turned out delivering marginal results. The power of regulatory factors exceeds the role of economic factors in shaping up the green growth.

The aim of this study is to evaluate the dynamics of real convergence and green convergence before the start of the Green pact and on that ground to assess their relationship. The expectation is that if the past tendencies persist in the future we could expect slow real convergence as well as green convergence. This paper deals with the striking questions that emerge out of the ambitious targets of green transition. The first part of the article is focusing on the recent development in convergence theory as well as green growth theory. The second part of the study aims at assessing the current status and past dynamics of real convergence. Using σ- convergence the countries are grouped as per the progress in convergence. Also, the driving forces and impediments of convergence are identified. In the third part, green convergence is assessed using again σ- convergence in terms of three main "green indicators", GHG, energy efficiency and the share of renewable energy sources. Then, the linkage between the real convergence and green convergence is tested. In the last part applying exponential smoothing the real convergence is forecasted for the period until 2030.

The methodology used for extrapolation of green indicators is based on tracking the dynamics of the indicators from 2010, on the basis of which the estimated future values on a linear trend until 2030 are calculated.

Convergence Theory in the Context of Green Transition

Convergence has been a topical area for both macroeconomic theory and economic policy. The concepts evolved to a variety of forms of convergence: nominal, real, structural, institutional, etc (Rangelova, R, Bobeva, D, etc. 2021). In this study we examine the real convergence measured by the GDP per capita.

The common ground for studying convergence is the the neoclassical growth theory developed by Solow (1956). The principle of transition dynamics states that the low-income countries exhibit a higher economic growth the further they are from their steady state (Solow, 1956; Swan, 1956). The convergent mechanism is essentially triggered by the diminishing marginal productivity of capital, so the differences in the cross-country paths are due to the unequal initial stocks of physical capital per worker. When the catching-up process of the economies with identical structural parameters is assumed to end at the same long-run steady state level of income the convergence is unconditional or absolute. Many studies on the EU convergence process challenge the ability of this theory to explain the developments of convergence after the global financial and economic crisis.

The growing literature proving the damages the economic growth makes on the climate encourage the research on the relation between the convergence and the environment. Some authors (Rios, V. and Gianmoena, L, 2016) extended the neoclassical Solow Model to take into account technological externalities in the analysis of CO2 emissions per capita growth rates. Brock and Taylor (2010), also propose a green modification of the Solow model to incorporate technological progress in abatement. They argue that the Environmental Kuznets Curve and the Solow model are related. According to them the EKC is a necessary by product of convergence to a sustainable growth path.

As complementary indicators beta and σ-convergence could be used for the assessment of the real convergence that has taken place in the EU. Specifically, Sala-i-Martin (1996) argues that β-convergence, although necessary, is not a sufficient condition for σ-convergence. Sigma-convergence involves a decline over time in the cross-sectional dispersion of per capita income (Barro & Sala-i-Martin, 1991). It is frequently measured by the coefficient of variation.

The neoclassical growth theory inspired the expectations that the economic integration will deliver convergence. Convergence is a political target for the EU. As stipulated in the Treaty of the European Union one of the aims of the EU is “to achieve the strengthening and the convergence of their economies and to establish an economic and monetary union”. The theory failed to explain the divergence in the EU although the integration deepens. The EU cohesion policies proved weak to compensate the divergence tendencies of some countries and regions.

The new political target of the EU the Green Transition is expected to have fundamental impact on the entire EU economy. The restructuring will have a strong impact on the energy, industry, transport, agriculture and other sectors. The question is whether this transformation will eliminate the shortcomings of the past convergence and whether it will create new challenges that may lead to divergence. Preservation of climate as a target for the economic development gives a rise to the concept of a *green growth*. There is a broad consensus built around the concept of green growth as the growth consistent with low GHG. OECD (2011) defines green growth as fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our wellbeing relies. According to World Bank (2012) the green growth is growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters. The green growth is a vital tool for achieving sustainable development. The green growth is at the core of the EU Green deal initiative.

Achieving the green growth cannot happen without convergence of the policies that would lead to reduction of GHG and eliminating the damages on the environment. Most of the studies dedicated to linkage between economic growth and environment use mainly CO_2 emissions as measure since it is a pollutant with global effects. For the purpose of this study we extend the analysis to two more indicators. We develop the concept of the *green convergence* as the narrowing of difference between the countries as regards the three main "green indicators" (net greenhouse gas emissions per capita, Energy efficiency per capita, measured by primary energy consumption and share of energy from renewable sources) targeted by the Green Pact. The methodology of this study is in line with the EU's climate goals and in particular with the goals set in the Green Deal.

Real convergence in the EU

Some studies on convergence (Alcidi, 2019; Rama, 2019) came to the conclusion that integration does not necessarily lead to income convergence. The free movement of capital, people, goods and services in the EU can result in the uneven distribution of activities and income. Baumol and Wolff (1988) developed the concept of "club convergence". The last decade dynamics proved fast convergence in the group of new EU member states and divergence in Southern Member States.

Our study along with other recent studies challenge the expectation of σ-convergence derived from the neoclassical theory and which is often used politically to defend the position that the economic integration is associated with convergence.

The σ-convergence is measured by the cross-sectional coefficient of variation (CV):

$$CV = \frac{s}{\bar{x}} \qquad (2)$$

where s is the standard deviation of the GDP per capita over all EU countries in a given year, while $\bar{x}$ is the mean of the GDP per capita over all EU countries in a given year. The σ-convergence is estimated for the whole EU, the EU19 and the EU11 as to check whether its dynamic is uniform at different EU levels.

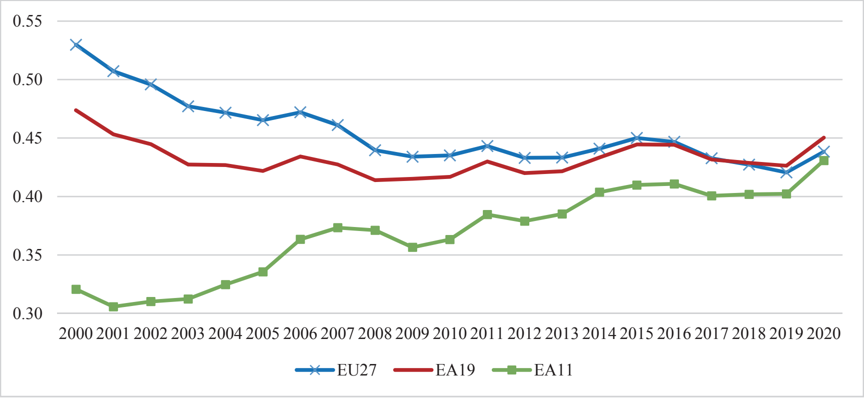
The convergence to higher incomes in the post-crisis period is traced by the convergent gap:

$$convergent\ gap = \frac{\left(\frac{Y}{P}\right)_i - \left(\frac{Y}{P}\right)_{EU}}{\left(\frac{Y}{P}\right)_{EU}} \qquad (3)$$

where $\left(\frac{Y}{P}\right)_i$ is the GDP per capita of country i, while $\left(\frac{Y}{P}\right)_{EU}$ is the GDP per capita of the EU. This indicator is also flexible enough to examine the dynamic of the carbon emissions in the given period.

The outlined dynamic of convergence could be evaluated by the σ – convergence.

Figure 1: *Sigma-convergence of EU27, EA19 and EU11 over 2000 – 2020*



Source: *WB data, own estimations*

The dynamic of the σ- convergence in fig. 1 is not straightforward as it deviates substantially throughout the period. Furthermore, the dynamic of the catching-up process depends on the level of disaggregation.

In the run-up to the EA a convergent process took place. Shortly after 2001 divergent dynamic came in. Although, it was moderate till 2005, it accelerated sizably thereafter. It is noteworthy that up to 2008 the initial euro adopters exhibited σ- divergence. The reason for this development is the poorer performance of some EU11 member states – Portugal, Ireland, Italy and Spain. The outset of the Great recession widened the cross-country differences within the EA11**.** During the European debt crisis, the underperforming countries prior to 2008 together with Greece were denoted as PIIGS manly due to their financial instability issues. This disturbing trend of rising divergence within the core of the European union induced various repercussions casting a doubt on the EU's capability to deal with the income non-convergence trap.

After 2003 the σ-convergence of EA19 largely levelled off because the observed rising divergence of EA11 was offset by the higher convergence exhibited by the late euro adopters. The decline in the dispersion of the EU27 countries' GDP per capita came to a halt due to the outbreak of the Great recession in 2008. The convergence stalled till the end of 2015. The high unemployment and the insufficient fiscal space of some EU governments to stimulate their economies contributed to this standstill. The σ-convergence returned more clearly as late as 2016. This convergent process, however, continued only for three years. It was the outset of the pandemic that put an end to this timid comeback of σ-convergence. At present the renewal of convergence is only possible after the overcoming of the challenges posed by Covid 19.

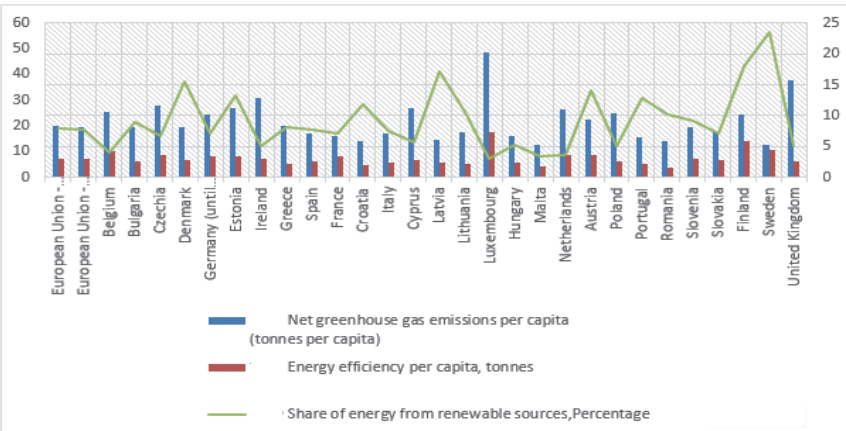
The heterogenous convergent experience of all EU countries implies that the convergence is not necessarily the final outcome of the economic dynamics. At the starting point of the implementation of the sizeable reforms that the Green Pact envisages the real convergence is weak and volatile. In this context the reform agenda has to take into consideration the risk for widening the convergence gap.

EU Green Convergence

The EU as well as international organisations and think tanks use different set of indicators to assess the dynamics of environment development. Most of the studies come to the conclusion that small progress is achieved and the world needs to act in order to preserve the worst case scenarios. In spite of the achieved economic growth in the EU and the imposed environment targets the convergence between the EU countries as per the green targets has been slow. The new Green Deal introduces regulations and sets ambitious target values for three green indicators, respectively 50% reduction in GHGs (compared to 1990 levels); 32% energy from renewable energy sources; 32,5% improvement in energy efficiency. The goal set for 2050 is to achieve net-zero emissions.

Taking into consideration the starting point of convergence between the member states as regards the achieving the above targets it could be assumed that some countries will face more challenges than some others. The data confirm different scope of reaching the three targets at the starting point of the Green Pact (see Fig. 2).

Figure 2: *Green indicators, in EU28, 2019*



Source: *Eurostat, own graphics*

The net greenhouse gas emissions per capita range from 1 ton to 20,3 tons of CO2 equivalent in the EU member states. Sweden and Malta are with the lowest net greenhouse gas emissions per capita – respectively 5,2 t. and 5,3 t. CO2 equivalents. Luxembourg has the highest amount of net greenhouse gas emissions per capita, namely 20,3 tons of CO2 equivalents followed by Ireland and Netherlands. Obviously, some highly developed countries have more severe problems with the greenhouse emissions than some poorer countries in the EU. As regards the other green indicator, namely the share of energy produced by renewable sources in gross final energy consumption varies considerably from one member state to another, from 7,04% in Luxembourg to 56,4% in Sweden. The best performers are some Nordic countries Sweden, Denmark and the worst ones Luxemburg, Netherlands.

The energy efficiency indicator shows also large discrepancies between the EU member states. Luxembourg has the lowest energy efficiency – 7,25 tons. oil equivalent and this is one of the factors for the country to rank first in the amount of greenhouse gas emissions per capita. Belgium and Sweden follow according to this indicator. The best performers in energy efficiency are Malta, Romania and Portugal.

The results of the data analysis show that countries with a level of GDP per capita corresponding to the EU average (100% of the EU-28 average for Malta and 112% for Sweden, respectively) also perform well in terms of green indicators. It is noteworthy that for 2019 Malta has the best energy efficiency through consumption of primary energy per capita – respectively 1,76 tons oil equivalent, as well as with the lowest amount of net greenhouse gas emissions per capita – respectively 5,3 tons.

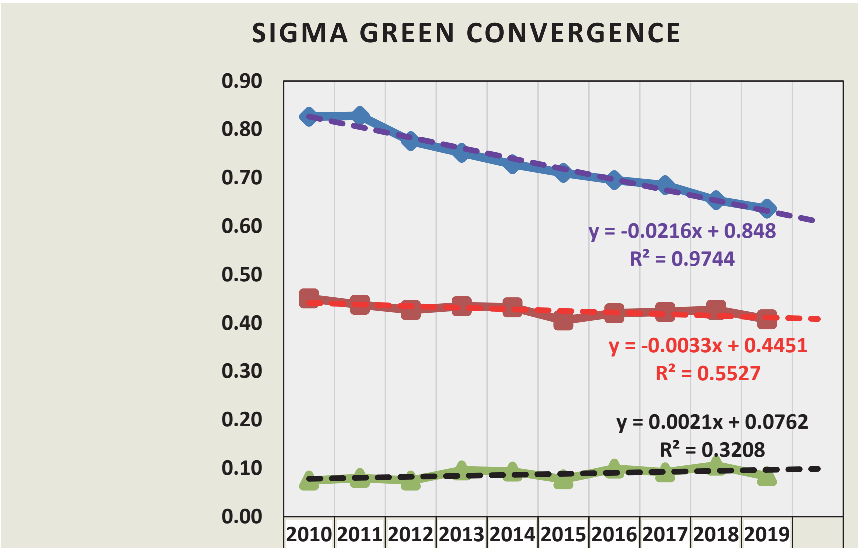
The above static analysis confirms the hypothesis of large divergence between the EU member states as regards reaching the Green Pact targets (as of 2019). Further on, a dynamic approach is applied in order to define the tendency of green convergence. The question is whether the differences between the countries as regard the green targets narrow or enlarge. This assessment is made using an (sigma) – green convergence, which measures the change of the three green indicators in the EU countries in a dynamic order (for the period from 2010 to 2019) (see Fig. 3).

The results of the analysis of σ-green convergence outline a tendency of narrowing the differences between the countries in renewable energy sources and greenhouse emissions per capita. The σ- coefficient decreased from 0,83 in 2010 to 0,64 in 2019 for renewable energy sources. In the case of greenhouse gas emissions it also decreases from 0,45 to 0,41. Trends until 2019 show a continuing convergence in the EU on these two indicators. In the case of energy efficiency the data suggest almost constant level of convergence, σ-indicator was between 0,07 to the highest level of 0,11 in 2018 and back to 0,08 in 2019. Why the energy efficiency convergence has not happened in the last ten years in the EU needs additional analysis.

The σ – green convergence suggests a significant progress as regards the renewable energy sources used. This is a sector where the strong EU policies, including targeting and financing helped achieving more tangible narrowing of the differences while their contribution in the energy mix increased in the last decade. This case indicates that the spontaneous improvement of environment may not achieve tangible green convergence.

The strong policy interventions may speed up the process and lead to reaching the targets while diminishing the differences between the countries. The analysis that follows investigates whether green and real convergence is expected to happen till 2030 if the tendencies in the last decade continue.

Figure 3: *Sigma green convergence*



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Renewable energy sources	0.83	0.83	0.78	0.75	0.73	0.71	0.70	0.68	0.65	0.64	
Greenhouse gas emissions per capita	0.45	0.44	0.43	0.43	0.43	0.41	0.42	0.42	0.43	0.41	
Primary energy consumption	0.07	0.08	0.07	0.10	0.09	0.08	0.10	0.09	0.11	0.08	

Source: *Eurostat data, own estimations*

The relation between real conversion and green conversion

The relation between the environment and economic growth has been studied by Simon Kuznetc (1955). The Environmental Kuznet's Curve (EKC) suggests that the process of economic growth is expected to limit the environmental damages created in the early stages of development. The EKC concept provoked an academic discussion and many studies in the early 1990s. Although there was no convergence of their views as regards whether the environmental problems will be eliminated by the economic growth they all stressed the importance of environment for the economic development.

Several recent studies (Chakrabarti, G, 2016) tried to test whether "green" convergence follow as a consequence of economic convergence. They suggest that the past GDP growth is related with a growth of carbon emissions. The energy demand pushes up the consumption of coal while the growth of transportation is also related with emissions. But in the same time the outcomes confirm that, if homogenous group of countries is used, growth has accompanied the demand for environmental quality.

The studies of Romualdas Juknys and Genovaitė Liobikienė (2016) led to the conclusion that the economic growth and convergence lead to both positive and negative environmental outcomes. The first signs of absolute decoupling have been noticed over the last decade in some developed countries, but only a relative decoupling of environmental impact from economic growth is characteristic of developing regions and countries. The authors argue that the different development stages require different approaches and policies for both economic development and environmental sustainability.

The research of Markus Haller (2011) suggests that economic catch-up has been accompanied by above-average growth of the use of most primary energy carriers and more CO2 emissions. For industrialized countries, the study find that economic growth is partially decoupled from energy consumption and that above average rates of economic growth were accompanied by larger improvements in energy efficiency.

The literature review shows different results as regards the relation between the economic growth and convergence of environment indicators.

The relation between the real convergence and the narrowing of distance between the countries as regards the improvement of environment has not yet attracted the attention of the academia. In order to test the thesis that there is a significant relationship between real convergence and green convergence we examine their relationship using GDP per capita and the three green indicators. For this purpose, a correlation-regression analysis was applied through descriptive analysis in real values by key indicators for 2019 (see Table 1).

***Table 1:** Correlation between GDP per capita and the main indicators of green convergence*

Correlations

		Renewable energy sources	Primary energy consumption	GDP per capita in PPS	Greenhouse gas emissions per capita	Primary energy consumption per capita
Renewable energy sources	Pearson Correlation	1	-,102	-,201	-,430*	,078
	Sig. (2-tailed)		,599	,296	,020	,689
	N	29	29	29	29	29
Primary energy consumption	Pearson Correlation	-,102	1	,003	-,033	-,026
	Sig. (2-tailed)	,599		,987	,864	,893
	N	29	29	29	29	29
GDP per capita in PPS	Pearson Correlation	-,201	,003	1	,696**	,714**
	Sig. (2-tailed)	,296	,987		,000	,000
	N	29	29	29	29	29
Greenhouse gas emissions per capita	Pearson Correlation	-,430*	-,033	,696**	1	,629**
	Sig. (2-tailed)	,020	,864	,000		,000
	N	29	29	29	29	29
Primary energy consumption per capita	Pearson Correlation	,078	-,026	,714**	,629**	1
	Sig. (2-tailed)	,689	,893	,000	,000	
	N	29	29	29	29	29

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

***Source:** Eurostat data, own estimations*

Tab. 1. shows a correlation between GDP per capita and the main indicators of green convergence – net greenhouse gas emissions per capita; energy efficiency (primary energy consumption) per capita; share of energy from renewable sources (as a percentage of gross final energy consumption).

The purpose of the analysis is also to test the possible internal correlations between the indicators in order to enrich the analysis of the impact of GDP per capita as a key measure of real convergence on the individual indicators describing the green convergence. This will prove whether the relationship between the real convergence and green convergence is significant.

The regression equation for the influence of GDP per capita on energy consumption per capita shows 0,51 (51%) coefficient of determination. Therefore, 51% of the variation in the per capita energy consumption indicator is due to the variation in GDP per capita. The regression equation for the impact of GDP per capita on greenhouse gas emissions per capita shows that 48% of the variation in per capita greenhouse gas emissions is due to variation in GDP per capita.

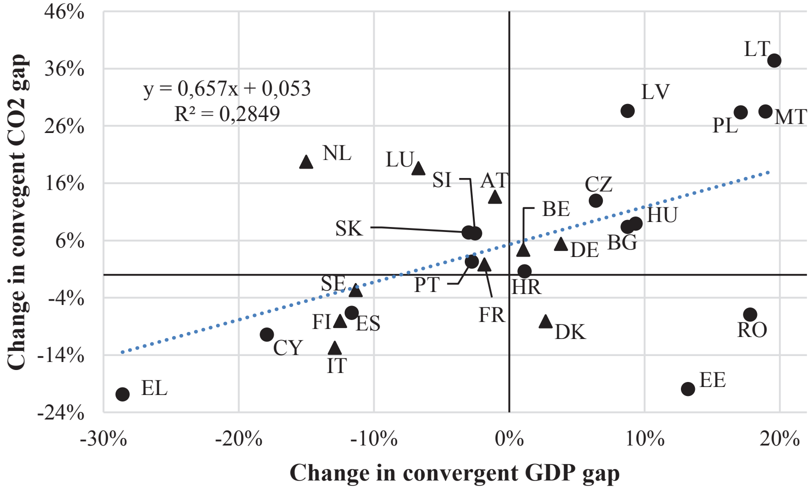
The GDP per capita in 2019 in all Member States, as well as at EU level exhibits a positive, significant correlation and a positive effect on per capita greenhouse gas emissions and per capita energy consumption (the relationship is marked in dark blue). The changes in these two green indicators are strongly related to each other, as well as to the GDP per capita.

According to Pearson's coefficient values, GDP per capita has a statistically insignificant and negative relationship with the share of renewable energy resources. Pearson's ratio (0,629) shows that greenhouse gas emissions have a positive, significant correlation with energy consumption per capita. This maybe explained by the fact that the deterioration of energy efficiency is related with the increase in greenhouse gases. On the other hand, greenhouse gases are associated with renewable energy sources. Correlation coefficients show that there is a negative, moderate relationship between the two indicators. This means that improvements in one area are related to improvements in another or that as the share of renewable energy sources increases, there is a tendency to reduce greenhouse gas emissions.

The same results are received if another methodology is applied. Fig. 4 relates the change in convergent GDP per capita gap of each country against the change in convergent CO_2 gap over 2008 – 2019. The outlier Ireland is omitted as it exhibits much stronger than usual positive convergent gaps. Fig. 4 further differentiates the countries regarding their GDP per capita in PPP relative to the average EU level over the observed period. The countries with higher-than-average real GDP are denoted by a triangular marker while the rest of the EU members are denoted by a circle marker.

The outlined positive relation between the change in convergent GDP gap and the change in the convergent CO_2 gap means that over 2008 – 2019 the stronger CO_2 polluting behaviour corresponded to higher GDP per capita covergence. This inference is rather straightforward because the unadjusted carbon intensive structure of some economies rendered the convergence easily attainable but at the cost of higher carbon emissions given the prevailing technological level. Bearing in mind this then the attempts to restructure the economy in a short term in order to encourage the green growth would not be without adverse consequences. This is the reason why the governments have to implement green policies with great consideration so as to lower the economic and social costs.

Figure 4: *Change in convergent GDP gap and change in convergent CO2 gap over 2008 – 2019*



Source: *WB, Eurostat, own estimations*

The countries affected by the green challenge are of no equal economic development. 7 out of 9 countries with higher-than-average GDP have increased their carbon emissions above the EU average level in Fig. 5. Therefore, the polluting activity is not intrinsic to less developed countries only.

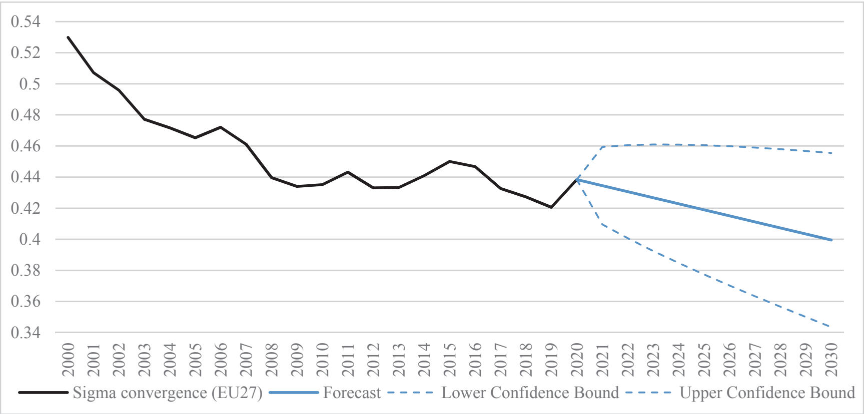
Although the positive relation between catching-up and pollution was prevalent over 2008 – 2019, some of the highest real convergence performers such as Romania and Estonia managed to align their strong convergent experience with abatement in pollution. Such development is supportive of the Stern's view (2006) whereby the economic growth doesn't preclude climate change aversion. Therefore, the trade-off between cleaner environment and growth has so far been largely accounted for by the countries with environment-unfriendly economies.

Prospect of real convergence and green convergence

In this part we try to map the future development of both real convergence and green convergence continuing the past tendencies without taking into consideration the envisaged green policies that are expected to change the trajectory of green conversion to reaching the green targets by all member states.

As regards the real convergence the forecast suggests improvement of convergence between the EU member states in 2021 – 2030 period.

***Figure 5:** Forecast of σ- convergence for EU27 over 2020 – 2030 using exponential smoothing*



***Source:** WB data, own estimations*

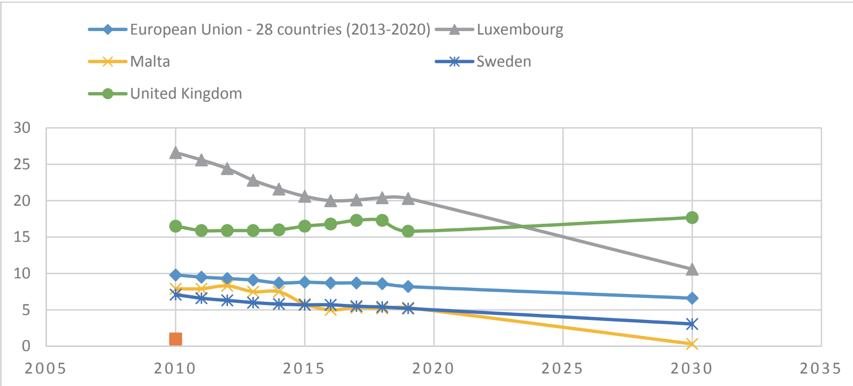
The σ-convergence will restore its downward trend soon after the Covid 19 crisis, though it will reach the pre-crisis levels no earlier than 2025. The differences between the EU member states in their GDP per capita will remain significant till the end of 2030 if no concrete and efficient policies are undertaken. The problem is that the free movement of goods, capital and labour leads to a significant concentration of production resources and growing divergence between the regions. Extensive migration also fuels the income divergence that further impedes the real convergence.

The forecast for net greenhouse gas emissions per capita and for the share of renewables by 2030 shows a similar trend of slow convergence between EU Member States and large differences between Member States. The development of the two green indicators in 2030 is forecasted using the data for the two best and worst performers.

Figure 6 shows the countries with the best (Malta and Sweden) and the worst values (Luxembourg and the United Kingdom) in terms of greenhouse gas emissions per capita, as well as the values for the EU28. The trend in this indicator is to decrease by 2030. in all of the countries considered, except in the United Kingdom, where its values are expected to rise to 17,6 tonnes CO2 compared to 15,8 tonnes CO2 equivalent for 2019

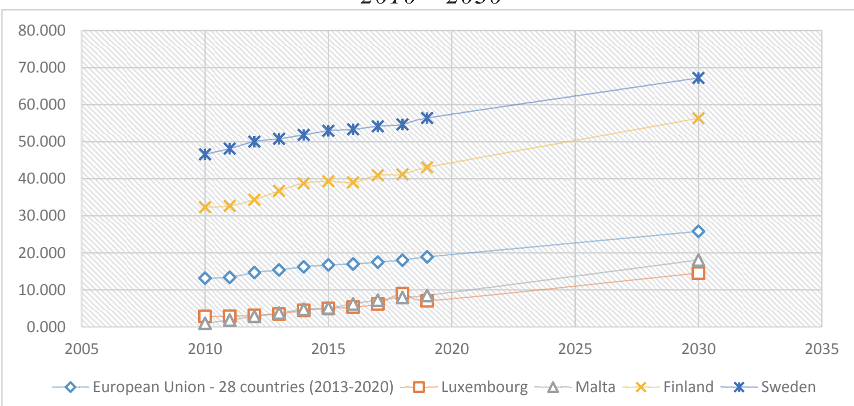
The most serious decline is expected in Malta, where in 2030. GHG emissions per capita will be 0,32 tonnes. CO2 equivalent.

Figure 6: *Forecast of the net greenhouse gas emissions per capita, 2010 – 2030 (tonnes)*



Source: *Eurostat, own estimations*

Figure7: *Forecast of the share of renewable energy, percentage, 2010 – 2030*



Source: *Eurostat, own estimations*

The data in figure 7 show the trend in the EU Member States with the best values (Sweden and Finland) and with the worst values (Luxembourg and Malta) in terms of the share of energy from renewable sources. The forecast suggests that all countries would increase the share of energy from renewable sources. Sweden and Finland would remain the leaders, with 67,2% and 56,3%, respectively.

3. Conclusion

The study of real and green convergence revealed that at the starting point before the implementation of the Green pact there are large differences between the EU member states. In the last decade the slow and hesitant real convergence was accompanied with modest convergence between the EU member states as regards the greenhouse emissions and the use of renewable energy sources while the energy efficiency differences remain. The linkage between the real and green convergence is positive but weak. If the past tendencies continue without the Green deal policies the green convergence will improve but slowly and hardly only few countries would achieve the 2020 green targets.

The Green Deal sets up policies that directly target the achievement of the green targets. Those policies include new taxes, charges, financing, restrictions, etc. Neither the Green Deal nor the EU economic policies set up clear targets and most importantly concrete tools and instruments to achieve greater real convergence. This asynchrony movement ahead may create a risk for further real divergence between the EU member states. There a lot of challenges to be faced by the EU countries during the period ahead. Hitting the Green pact targets warrants the transformation of entire economies. The economic adjustment on the path to greener economy might be painful especially for these economies which are inflexible, unrestructured and dependent on carbon industries. As pointed out by Zhironkin S, Sobic L (2021) the transition from environmental divergence to convergence should be carried out in a system of convergent oriented structural policy. After the recent financial and economic crisis the slow growth of the European economy reviled its structural problems. They led to an increasing divergence between ‘core’ and ‘periphery’ of the euro area and to a weak environmental sustainability and green convergence. With the start of the Green Pact the future of convergence is expected to be different from the past. We could expect that green transition will lead to convergence if it changes the trajectory of the economic development, namely if green transition helps deconcentrating the production resources, diminishing income gap between the countries and regions and encourages return migration from more developed countries and regions to less developed once. The research and practices suggest no case of success of such return of migration pattern. In this respect, the future may not be different from the past, if mobility increases and flows from peripheral countries toward the core continue. As regards the relocation of resources the decarbonisation will be associated with the closure of coal mining and energy production from fossil which is located in most of the cases in less developed regions. So, the risk of further concentration is real.

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The Circular Economy and the Opportunities for Green Recovery in Bulgaria

Vania Ivanova[1]

Abstract: At the end of 2019, the European Commission presented its new long-term vision for the development of the EU. Built on the Sustainable Development Goals (SDGs), this transformation goes through a complete change in the production and territorial infrastructure. It covers a whole set of activities, new practices and business models, interconnected and hierarchically ordered, according to their contribution to optimizing the use of raw materials and energy. In order to successfully meet the EU's resource efficiency targets by 2030, the transition to a circular economy model should become a state priority. This implies that the concept should be expanded not only to waste reduction and recycling, but also to the disruption of the dependence between economic growth and waste production. **The purpose** of this paper is to systematize the benefits of the circular economy and analyse Bulgaria's progress in the transition to a circular model. The leading hypothesis is that accelerating environmental transformation can not only boost the recovery of the economy, but also lead to new competitive opportunities. Work is based on a descriptive analysis of secondary data on the performance of the selected indicators of circular economy and comparative analysis within the EU member states. The analysis shows the presence of a certain delay compared to the EU average indicators as well as unused opportunities not only related to more efficient use of resources, but also to a radical change in the business model. This calls for accelerating the reform of eco-fiscal and innovative government policies. The added value of the article is not only the analytical consideration of the problems, but mostly in drawing up recommendations for future measures.

Keywords: circular economy; resource productivity; waste management, recycling, green recovery

1. Introduction

At the end of 2019, the European Commission presented its new long-term vision for the development of the EU. A strategy for growth, a fair environmental transition, a resource-efficient and low-carbon economy

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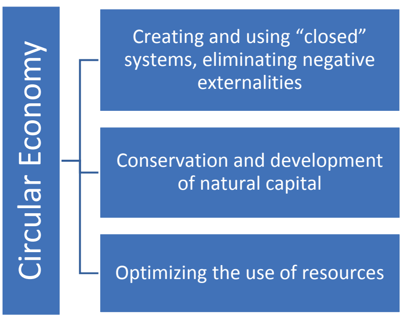
are the key highlights of this ambitious strategy for the next decade. Built on the Sustainable Development Goals (SDGs), this transformation goes through a complete change in the production and territorial infrastructure. It covers a whole set of activities, new practices and business models, interconnected and hierarchically ordered, according to their contribution to optimizing the use of raw materials and energy. In order to successfully meet the EU's resource efficiency targets by 2030, the transition to a circular economy model should become a state priority.

Circular economy is an economic system of exchange and production, in which the aim at every stage of the life cycle of the product (good or service) is to increase the efficiency in the use of resources and reduce the harmful effects on the environment, thus ensuring the well-being of individuals (1.ADEME(2014)http://www.ademe.fr/sites/default/files/assets/documents/fiche-technique-economie-circulaire-oct-2014.pdf). This definition is also adopted for the purposes of this study.

To rise up to the current challenges facing the economy in the context of the scarce and finite, as well as increasingly costly resources, on the one hand, and the environmental needs, on the other, circular economy steps on three fundamental principles, a summary of which is shown in Figure 1.

Figure 1: *Principles of Circular Economy*



Source: *Author's sistematization*

The observance of each of these principles leads to a sparing, responsible and efficient use of resources. This is made possible through controlling the use of finite and balancing the flows of renewable resources. The effect is threefold: economic, environmental, and social. Therefore this model is an integral part of the concept of sustainable development.

This is a practice-oriented concept. An essential element of this model is the production of durables. Products should be created in such a way so as to allow repair, while also guaranteeing maintenance of spare parts production. Products should be suited for reuse or shared use, and have a maximum life span. And last but not least, circular economy requires the creation of products that are made to decompose and their components or subsystems are reusable as components in making new products. Recycling (as far as possible) of the parts that cannot be reused or repaired is crucial. The circular economy refers to the ability of an economy to grow while the use of resources decreases (Andersen, 2007). The transition to a circular model aims to achieve "dematerialization" – an absolute or relative reduction in the number of materials used as well as the amount of waste with the aim to provide a better alternative to the dominant economic development model, so called "take, make and dispose" (Ness, 2008). However, the concept of a circular economy goes a step further. In it, the products not only are not discarded, but they are made in a manner that they can be easily repaired, turned into other products, or combined.

Such an approach should include a global, systemic and integrated vision (Geissdoerfer, M.et al., 2017), changing the model with a new one and adopting the principle of systematicity and connectivity of individual systems (Figure 2).

Figure 2: *Scope of the circular economy model*

Product / service oriented approach	Waste management approach	Territory-oriented approach
• Ecodesign, functional economy	• Recycling, reuse of secondary raw materials, zero waste	• Industrial ecology, balanced territorial development

Source: *Author's sistematization*

Going green to achieve greater competitiveness and sustainability of production has become an unavoidable necessity for firms. (Bansal, P. and Roth, K., 2000). The primary focus here is on resource efficiency leading to reduced production costs and productivity growth. To this effect, the actions related to waste recovery and reuse, and its actual reduction carry considerable potential (Frecker, A., 2003).

The transition towards a circular economy requires fundamental changes to production and consumption systems, going well beyond resource efficiency and recycling waste. Circular economy is a closed cycle covering each of the three areas: the supply and responsible choice of the producers, the demand and the consumer behavior and the waste management. CE promotes a more appropriate and environmentally sound use of resources aimed at the implementation of a greener economy(Stahel, 2010). It is a model aiming at preserving and increasing the value of resources used in production and consumption, while reducing their impact on the environment, during the whole life cycle of the products. Circular economy is seen as a new business model expected to lead to a more sustainable development(Mathews and Tan, 2011). Circular economy has as its immediate objective an optimal management of all resources (material resources, energy sources, water and land use being the main issues). The objectives are to be pursued: create new opportunities for growth and economic performance while reducing resource use, boost the competitiveness and limit the environmental impacts of resource use. This change was recognized in Europe, with the European Commission's Communication "Roadmap to a Resource Efficient Europe", published in January 2011(COM(2011) 571). In the following years, many European Union and national public policies and programmes were designed and introduced in order to keep abreast of the profound changes the model of circular economy and society brings into our world. There are clear links between the Circular economy Action Plan(2015) and the New Circular Economy Action Plan for a cleaner and more competitive Europe(2020). Targets and ambitions formulated in the EU Circular Economy Package which offers great opportunities to make better and more efficient use of resource and to reduce overall resource consumption.

In order to successfully meet the EU's resource efficiency targets by 2030, the transition to a circular economy model should become a state priority.

Applying the new model of circular economy should bring about a radical change in the production and consumer behavior models and, at the same time, be incorporated into the new concepts of territorial and regional development. This would allow to:

- reduce energy consumption;
- create sustainable cities;
- drastically reduce waste generation and further enhance the potential for their recycling and reuse;
- create new ‘green’ jobs in the green industries.

CE not only require innovative concepts but also innovative actors. The implementationof this concept needs to be supported by innovation designers and intermediaries who provide services and designs towards appropriate radical changes in both practices, policies and decision making tools (Golinska et al., 2015).

1.1. Methodology

The purpose of this paper is to systematize the benefits of the circular economy and analyse Bulgaria's progress in the transition to a circular model, while making a comparison with the EU (according to selected indicators).

The leading hypothesis is that accelerating environmental transformation can not only boost the recovery of the economy, but also lead to new competitive opportunities and that public authorities need take more active and adequate measures to promote such a change.

The research is based on a descriptive analysis of secondary data on the performance of circular economy indicators and their comparison with those for the EU (Ivanova, V., N. Sterev, 2019). There is currently no "universally recognized method for measuring the efficiency of a country or company in the transition to circular economy, nor holistic tools for monitoring and supporting this process" (European Environment Agency, 2016).

Based on a set of indicators and in the absence of a single composite indicator, the trends in the dynamics of each of the selected indicators for Bulgaria, Belgium, Nederland and the EU average are derived. The choice of the countries for comparison is based on the clusters formed on the basis of the same indicators for 2018 (Ivanova, Chipeva, 2019, Based on the outcomes for year under study (2016), three clusters are drawn with different number of countries within each one, corresponding to three models of transition to circular economy. Cluster 1 includes Bulgaria and Estonia, Cluster 2 includes 12 countries which, with few exceptions (Belgium, Finland, Sweden, Portugal), are the majority of the new Member States, and Cluster 3, comprising 14 countries, covers mainly old Member States and three new Member States (Czech, Slovenia,Cyprus) that joined EU after 2004.). One country is selected from each cluster, and the selection criterion is relative comparability of the countries by size and population.

The time period covers 2010 – 2018 as it draws on the available statistics allowing comparative analysis.

In order to achieve the objectives of this study, it is important to fully capture many aspects of the circular economy. For this reason, a total of 4 indicators were selected to analyse the state and progress of the transformation:

Resource productivity +DMC

Generation of waste excluding major mineral wastes per GDP unit (in euro)

Circular material use rate (%)

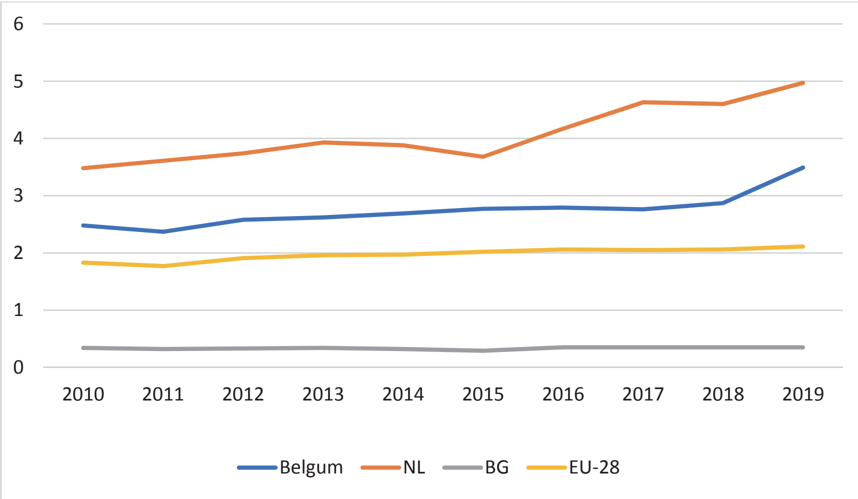
Recycling rate of all waste(%)

Resource productivity +DMC, which is part of the SDG 12 (Sustainable Production and Consumption) of the Sustainable Development Goals that are being monitored, has also been added to the EC indicators as it gives an idea of resource efficiency – one of the immediate tasks in a circular economy.

2. Results and discussion

Over the past 10 years, resource productivity in the EU has increased by 28,1% to reach 2,32 euro/kg. (2019). At the same time, domestic material consumption (DMC) has decreased by 7,8%. Of course, this positive trend should be interpreted carefully and on a broad basis (complexly), since this change is hardly due solely to the successful eco-policies of the countries. It is very likely that the decline in DMC is due to the effects of the economic crisis (2008) and the slow recovery from it in a number of countries (also in Bulgaria). With declining economic activity, it makes sense to have a faster reduction in the production consumption of raw materials. Unlike the EU-28 average indicator, which has shown a gradual, sustained upward trend in the period considered, there is virtually no serious growth in Bulgaria (12,9%). The absolute values of this indicator (measured as euro GDP per kilogram of domestic resource consumption) also point to an adverse trend and a serious delay in the change of the business model from resource-intensive to resource-saving (Fig. 3). Unlike the indicator of Belgium and the Netherlands, which in the period under review shows a steady upward trend, with increasing rates after 2017, in Bulgaria there is no progress. This can be attributed to ineffectiveness of the measures applied in our country and poor performance of innovative transformation in resource productivity.

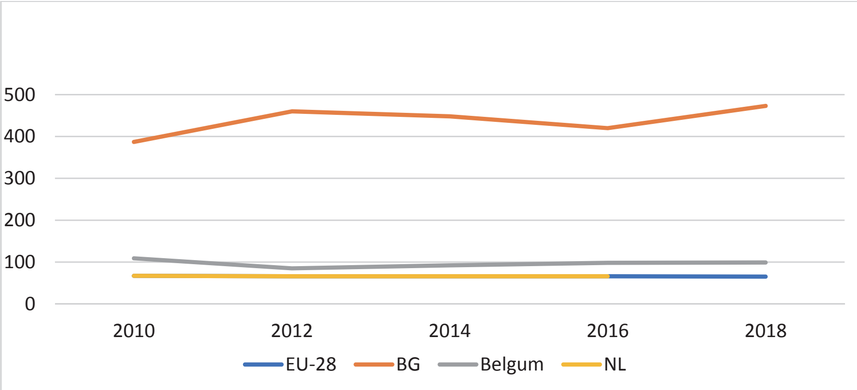
***Figure 3:** Resource productivity +DMC*



***Source:** Eurostat and author's calculations*

Therefore, the focus of the transformation of business models into circular models is the serious reduction of the share of waste. Despite the EU's efforts in this direction and the numerous measures, especially after 2018, and the adoption of the plastics strategy, the total level of waste generated to produce a unit of GDP in Bulgaria remains unreasonably high (Fig. 4). In Belgium and the Netherlands, resource productivity growth has been accompanied by maintaining a constant level in waste and even a slight decline in Belgium. Compared to the European average, ours is 7,2 times larger, and without any distinct downward trend. Even after 2016, it rose by 13,1%, which is probably a consequence of the sustained recovery in economic growth after the global recession of 2008. This link of growth with increase in waste generation unequivocally suggests a lack of progress in the transition from line to circular model and poor performance of the technological and innovative transformation of the production processes in the country as a whole. This risks not only worsening the competitiveness of Bulgarian production, but also leaving the country behind in terms of ecological transition.

Figure 4: *Generation of waste per GDP unit (kg/thou. euro)*

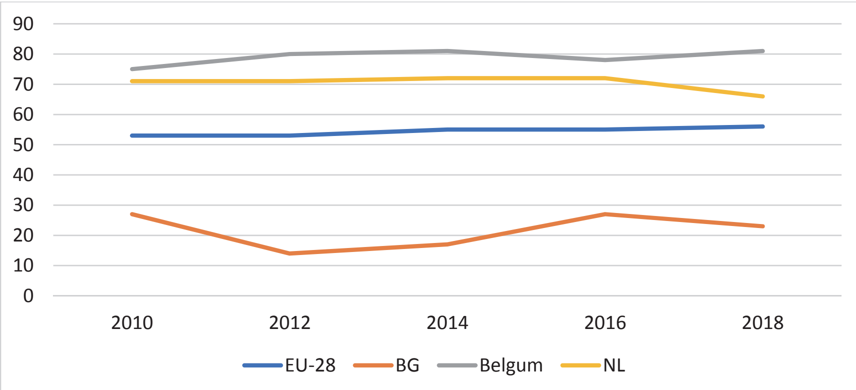


Source: *Eurostat and author's calculations*

Recycling is the final phase in the circular economy, allowing waste (industrial or household) to be used again in the production as raw material. In a circular economy, recyclable materials are returned to the economy as new raw materials, thereby increasing security of supply. These 'secondary raw materials' can be marketed and transported just like primary raw materials derived from traditional resources. An important factor in creating a dynamic market for secondary raw materials is sufficient demand, which depends on the use of recycled materials in products and infrastructure. Secondary raw materials are still only a small proportion of the production materials used in the EU. Their use in the economy faces significant obstacles, for example due to uncertainty about their composition. Standards need to be put in place to build trust.

In Bulgaria, for the analysis period, the dynamics of the recycling rate are too volatile (Fig. 5). After adopting the European methodology of calculation and correction in the NSI data (2012), a very serious progress of 92,8% and a peak in 2016 emerged. This coincided with the start of operations of the waste plant in Sofia. A slight decrease followed and in 2018 the recycling rate in Bulgaria was 23% compared to 56% on average in the EU. Compared to the other two countries, representing models of circular economy from the second and third cluster, Bulgaria lags behind in recycling is almost three and four times larger, respectively. By this indicator, the country is last. Given the progress in this area, we cannot fail to note the more than twice lower recycling rates in Bulgaria. The reason should be sought in the absence of a serious market for secondary raw materials and the still very low waste disposal fees. Another major hurdle is the underdeveloped infrastructure related to the recycling process.

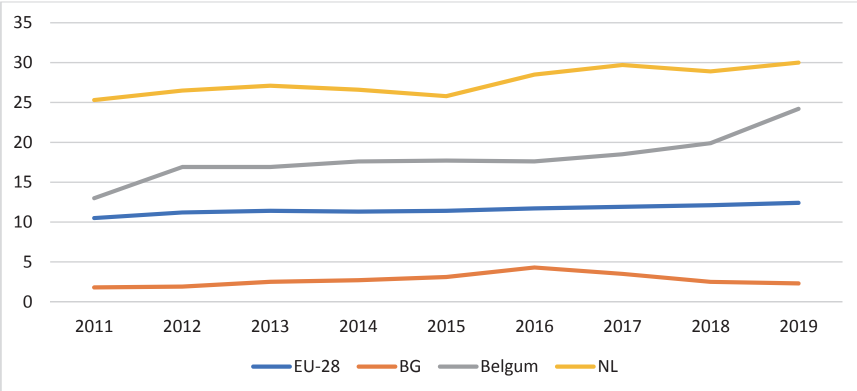
Figure 5: *Recycling rate of all waste*



Source: *Eurostat and author's calculations*

One of the most important indicators for measuring the degree of circularity of the economy is circular material use rate (CMR). It shows how much of the materials used come from secondary consumption. The EU average is 12,4% for 2019, which in itself suggests that the circular economy model is not prevailing yet. For Bulgaria, CMR is only 2,3% (Fig. 6), which indicator, together with those for Romania and Ireland, are the lowest in the EU. Compared to Belgium (24%) and the Netherlands – 30%, for which there is an upward trend, this indicator proves the lag of Bulgaria. This clearly demonstrates our economy's attachment to the linear model, the lack of progress in breaking away from this dependency and the very serious backlog in terms of green transformation. The reasons are complex and correlated with the low recycling rate, the small market share of secondary raw materials, the lack of traditions and knowledge in waste recovery on the part of the companies, the lack of capability and price incentive in repairing and reuse of products. In the absence of a well-developed network of services in the field of repair, purchase and decomposition for the reuse of individual components, the majority of products in Bulgaria end their life cycle as waste. Which leads to unreasonably high consumption of primary raw materials and slows down the process of environmental transformation of the economy.

Figure 6: *Circular material use rate*



Source: *Eurostat and author's calculations*

3. Conclusion and recommendations

The transition to a circular economy model has been proceeding sluggishly. The transformation is just beginning and this process has been slow and cumbersome. The analysis reveals that the country is significantly falling behind EU average indicators and shows there is an untapped potential related not only to a more efficient use of resources, but also to a wide scope for a radical change in the business model. The transition towards a circular economy requires fundamental changes to production and consumption systems, going well beyond resource efficiency and recycling waste. In the concept of the circular economy, preserving the value of products for as long as possible plays a central role, and puts products centre-stage in the transition process. Current actions to stimulate and monitor the transition, however, primarily focus on materials, which is not surprising, as the circular economy vision has evolved as a solution to the waste problem, and current policy and business tools focus on waste or materials. The shift from product-based to service-based business models is another promising development. Well-tailored governance and finance mechanisms, including innovation incentives, will be required to turn these niche activities into mainstream economic models. The initial hypothesis of the study confirms and highlights the need for rapid measures to accelerate green transformation.

In order for such a model to be built and become effective, several successive steps are required:

- Develop a strategy and long-term goals. It should be more complex and comprehensive, and should transcend the currenttly drafted National Waste Management Plan (2014 – 2020);
- Promote and launch the eco-design concept. To this effect, raising the awareness of best practices would mobilise businesses and bring about a more radical change in production models.
- Investments in key resources and natural capital, such as: water, renewable energy, marine resources, biodiversity and ecosystem services, sustainable agriculture, forests, waste and recycling. They could become areas of future economic growth and world markets.
- Advance projects (also through economic incentives) involving technological innovation of processes, new products and materials resulting in 'greening' industrial productions and lengthened life cycle of products. It is necessary to create more incentives for projects that favor the use of few resources and allow a longer product life cycle and easier repair and recycling and sustainable development of innovative start-up system and innovation clusters. Upgrading development of the innovation activity of the enterprises. Grant support needs to focus on the risky part of the investment in this area with a focus on creating new products and services, technology transfer and commercialization, strengthening collaboration with knowledge-generating units and businesses, and ensuring full participation in the development of the scientific and innovation ecosystem;
- Create favourable environment for increased involvement in separate collection of waste by both consumers and producers. This would facilitate the supply of quality material to recyclers and considerably enhance the efficiency of the process;
- Combining market and regulatory instruments: environmental taxes, elimination of environmentally harmful subsidies, mobilization of public and private financial resources, investment in skills and green jobs.

A new, more global and integrated vision is needed, in which the state's role is to foster a change in the economic entities' behavior and risk management, and launch new rules and regulations. Only this can help create conditions for a genuinely successful model of eco-friendly economy. Growing aware of that is a new challenge both in terms of implementing the circular economy model and the need for pursuing a different type of macroeconomic policy and regulation.

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Fiscal Measures for Diffusion of Environmental Technologies

Iana Paliova[1]

Abstract: Climate changes are threatening the life on our planet and carbon dioxide (CO2) emissions are a key of this alarming trend. Fiscal policy has an important role to play and policy makers implement various strategies to mitigate global warming and thus to reduce its damaging effects. Environmental taxes and investment subsidies have proven significant in promoting both innovation and diffusion of environmental technologies in the economy. The empirical studies provide useful insights about the ways in which the impacts occur and the factors that may be important in promoting innovation. In particular, they suggest the need for a tax rate that is sufficiently high to provide a meaningful incentive and signaling effect, and that is fixed for a sufficiently long period of time to reduce uncertainty about the future benefits of investment. This paper suggests that environmental regulation in general, and price-based policy instruments such as environmental taxes, carbon pricing and public spending on environmental protection and innovation in particular, have a positive impact on reduction of greenhouse gases emissions and diffusion of environmental technologies. However, the supporting empirical and case study evidence is not universal and the effectiveness of these instruments would appear to vary across different countries and sectors.

Keywords: Environmental Taxes and Subsidies, Economic Impact of Globalization Environment, Government Policy Innovation

JEL classification: H23, F64, O38

1. Introduction

In international, regional and national political circles, the concept of a green economy is gaining popularity following the work of David Pearce's "Green Economy Plan" (Pearce et al., 1989, Pearce, D., Markandya A. and Barbier.E. (1989), Blueprint for a Green Economy, DOI:10.4324/9780203097298), prepared for the British Ministry of the Environment. The Stern Review on The Economics of Climate Change (2006, Stern, N. (2007). The economics of climate change: The Stern Review.

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Cambridge University Press, Cambridge., https://www.lse.ac.uk/ granthaminstitute/publication/the-economics-of-climate-change-the-stern-review/) released for the UK government stated that climate change is the greatest and widest-ranging market failure ever seen and public policies to support the development of a range of low-carbon and high-efficiency technologies are required urgently. To mitigate the climate change it prescribes the governments to introduce environmental taxes and to establish a carbon price, through trading or regulation.

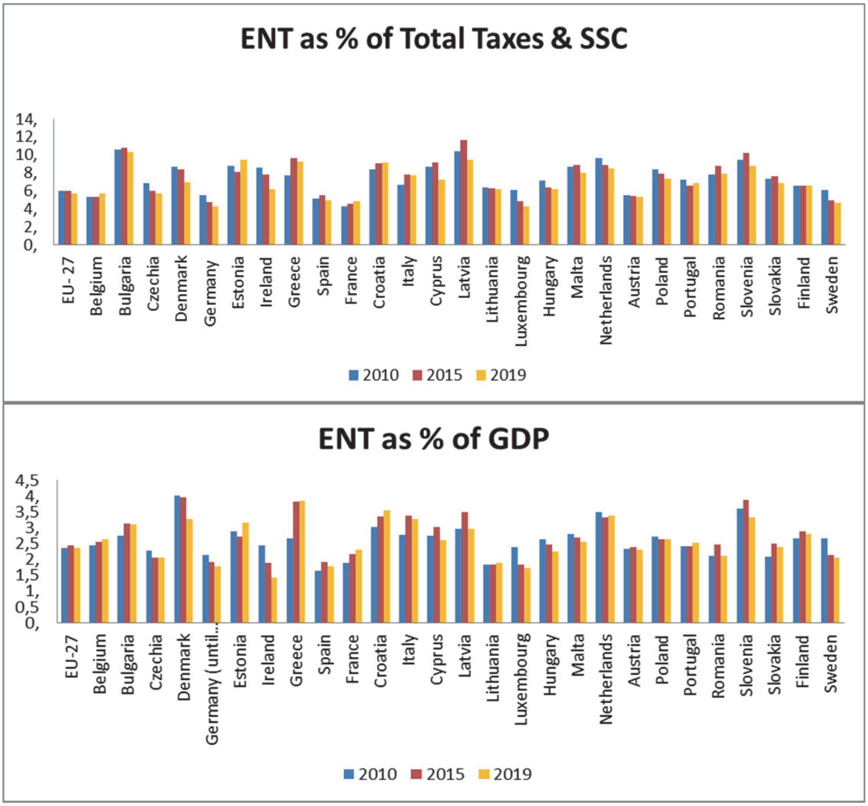
This paper contributes to the analysis on economic impacts of fiscal policy with environmental taxes and public expenditures for encouraging environmental technologies. The study summarizes empirical studies on the relationship between environmental taxes reforms in advanced countries introduced in early 90s of XX as fiscal instruments for reduction of carbon emissions and examines the impact of environmental taxes and public spending on greenhouse emissions as a measurement of pollution and diffusion of environmental technologies for Bulgaria and EU-27.

2. Environmental taxes under the EU Green Transition Plan

The introduction of environment tax in the EU can be traced back to 1990 with the idea to charge polluters a certain fee per unit of the damage they cause to third parties. The EU introduced four types' environmental taxes: taxes on energy, transport, pollution and resource tax (Sterner T, Köhlin G. Pricing carbon: Towards a Workable and Effective Climate Regime. CEPR Press and Ferdi. 2019: 251 – 266). In 2018 the EU adopted a long-term strategy to reduce global greenhouse gas emissions (GHE) by 80 – 95% of the 1990 levels reaching climate neutrality by 2050 (Official site of the European Commission, https://ec.europa.eu/clima/policies/strategies/2050_en).

The EU is the third largest emitter of GHGs, after China and USA, with a current share of about 9% (Oliver and Peters, 2017, **Olivier and Peters, 2017, Trends in global CO2 and total greenhouse gas emissions: 2017 report, PBL Netherlands Environmental Assessment Agency**). On the other hand, the trend of GHG emissions in the EU is reducing gradually by about 25%, while global emissions in 2015 have increased by about 55% since 1990 (UNFCCC, 2019, UN Climate Change Conference COP 25 (2 – 13 December, 2019), https://unfccc.int/cop25). In April 2021, EU-27 reached an agreement on a framework for climate action through European Climate Law (https://ec.europa.eu/clima/policies/eu-climate-action/law_en). Consequently, the Green Deal and the EU financial instruments for mitigating and adaptation to climate change, and pollution control and natural resource management have become among the highest priorities of the EU member states during the EU program cycle 2021 – 2027. The EU Flagship Initiative for a Resource-Efficient Europe (European Environment Agency, https://www.eea.europa.eu/policy-documents/a-resource-efficient-europe-flagship) targets environmental taxes to account for 10% of total tax and social contribution revenues by 2020 which is a substantial increase from the achieved level in 2019 for EU-27 average (Figure 1). In 2019, environmental taxes accounted for only 5,8% of total tax revenues for EU-27, while labour taxes have been slightly increased from 19,4% (2007) to 20,7%.

Figure 1: *Environmental taxes as share of total taxes and GDP*



Source: *Eurostat (2021)*

Across Member States, the share of environmental taxes in total tax revenues and social security contributions ranged from 4,9% (France) to 10,9% (Bulgaria), while as a share of GDP fluctuated from 1,4% (Ireland) to 3,9% (Greece). Compared with 2010, the share of environmental taxes has declined in Ireland, Luxembourg and Germany.

Figure 2: *Taxes on labour as% of total taxation – difference between 2009 – 2019 pp*

Source: *Eurostat (2021)*

The Europe 2020 strategy (Official site of the European Commission, Europe 2020 strategy, https://ec.europa.eu/regional_policy/en/policy/what/glossary/e/europe-2020-strategy), call for a shift in taxation from labor to environmental taxes, which mean that revenues from environmental taxes must increase relative to labor taxes. During the period 2009 – 2019, this ratio increased in some countries, including Bulgaria due to the increase in social security contributions, while in others decreased by up to 6,4% (Croatia) (Figure 2).

The European Commission recognizes fiscal instruments as an important part of the policy mix to support the transition to an inclusive green economy. Several country-specific recommendations on environmental taxes and subsidy reform under the European Semester have been given to the EU member states during policy discussions. Experience with the use of fiscal instruments in the process of GHG reduction, in particular environmental taxes and public spending on environmental protection and innovation, has grown over the past two decades.

3. Literature review

The literature suggests that environmental taxes can discourage behavior that is potentially harmful to the environment and can provide incentives to reduce the burden on the environment. The tradition towards cleaner energy and reduced energy consumption requires overcoming externalities, which occur when firms and individuals affect others through their actions but do not pay the price for doing so. Martinez-Alier (1987) consider that a bulk of consumers are automatically excluded from having an impact upon the prices of commodities, as these consumers are future generations who have not been born yet.

The International Monetary Fund (IMF, October 2019) suggests that carbon taxes levied on the extraction of fossil fuels in proportion to CO2 content of their extraction are the most powerful and effective, as they allow businesses and households to find the most effective ways to reduce energy consumption and move to cleaner alternatives. Lin and Li (2015) examine the real mitigation effects of carbon tax in five north European countries, which introduced it among first countries in Europe. The results indicate that carbon tax in Finland imposed a significant negative impact on the growth of its per capita CO2 emissions. The effect of carbon tax in Denmark, Sweden and Netherlands was negative but not significant.

Many economic studies look for the link between increasing environmental taxes to stimulate environmental technologies and minimizing the impact of GHE on environment, given the limitation of global and regional resources and their access to the economy. Higher revenues from environmental taxes show higher reductions in carbon dioxide (CO2) emissions, PM10 emissions, and energy consumption and production from fossil sources in the study for 50 countries (Miller and Vela, 2013).

Several studies suggest that environmental regulation in general, and price-based policy instruments such as environmental regulations in particular, have a positive impact on both innovation and diffusion of environmental technologies. Haščič et al.(2009) noted that the relative importance of environmental regulations has been proven in automotive emission-control technologies, distinguishing between post-combustion devices and engine redesign technologies. While the analysis does not explicitly consider the impact of fuel taxes, it suggests that an increase in automotive fuel taxes would have a major impact on innovation in relation to engine design. Based on new vehicle registration data from 2005 to 2010, a study for Germany found that CO2 taxes reduce registrations (Klier et al., 2015).

A study for Sweden show that, after the introduction of the environmental taxes in the early 1990's, CO2 emissions from the Swedish transport sector are reduced by around 6 p.p. in an average per year from the carbon tax (Anderssen, 2017). In Norway, which has also implemented an ambitious climate policy since 1991, the effect from lower energy intensity and energy mix changes was 14%, while the carbon taxes contributed to only 2% reduction in CO2 emissions (Bruvoll and Larsen, 2015). Their comparative analysis of the impacts of climate change policies on the petroleum sectors in Norway and the Netherlands during the 1990s showed different approaches. The Norwegian petroleum sector was a subject to a CO2 tax since 1991 as part of a portfolio of measures and the Netherlands relied on a series of voluntary agreements on energy efficiency. Both approaches appear to be effective as CO2 emissions per unit production fell by around 22% between 1990 and 2001 in Norway, while over the same period energy efficiency improved by around 35% in the Netherlands.

Other studies noted that total value of emissions taxes paid by the plant may have a positive impact on its decision to invest in environmental equipment, but it depends on industries (Millock and Nauges, 2006). In their study of several industries they found that public policy plays an important role in inducing innovation in the iron and steel sectors. The impacts of the individual instruments vary across the different technologies (Skjaerseth and Christiansen, 2005, Johnstone et al., 2008).

To a certain extent, the studies explain the differences in efficiency of policy instruments by the structure of the markets. In particular, the impact of environmental taxes relative to other instruments is predicted to depend on the ability the regulated firms to operate and innovator firms to appropriate the benefits accumulating to other firms during diffusion. The findings of a comprehensive analysis of the impacts of the environment tax reform in Germany showed that the payback period for energy-efficient products was reduced; the energy taxes reduced uncertainties about the benefits of energy-efficiency investments; the reduction in employers' social contribution payments tended to reduce the costs of labour intensive innovation processes; the reform had a signaling effect, strengthening awareness of the need for more efficient and rational energy use (Knigge and Görlach, 2005). The other study suggests that an environmental tax may actually reduce the level of uncertainty over future returns provided that it is of sufficient magnitude and longevity (Jaffe et al., 2002).

Mickwitz et al. (2007) examined the relationship between policy instruments and innovation, based on experiences in two industrial sectors in Finland: pulp and paper, and the manufacture of diesel engines for ships show different results. The authors conclude that energy taxation had a negligible impact on innovation in the pulp and paper industry. The study found that the differentiation of Swedish fairway and port fees on the basis of SO2 and NOX emissions was a significant factor driving the installation of in-engine NOX reduction equipment in ferries operating between Finland and Sweden. They also found that R&D subsidies accelerated the development of ship engine emissions-reduction technologies.

Other studies emphasise that it is also important that innovation be socially optimal in the sense that it minimises the cost of attaining a particular environmental goal in the long term (Johnstone, 2005).

Based on the above studies it can be summarized that environmental taxes and investment subsidies have proven significant in overcoming externalities and promoting both innovation and diffusion. The transition toward cleaner energy sources and reduced energy consumption requires overcoming externalities both at home and internationally.

4. Modelling and data

4.1. Data description

The information base of this study is the database of Eurostat, the European Commission, the World Bank and the IMF. The logarithmic values of the indicators for Bulgaria and for EU-27 were used. The stationarity of the time series with logarithmic data for Bulgaria and EU-27 in the econometric model is supported by the test results of Dickey-Fuller for unit root.

***Table 1:** Logarithmic values of the annual data for the period 2010 – 2020*

Variable	**Definition**	**Source**
Log GHE	Logarithm of greenhouse gas emissions	Eurostat
Log GHEC	Logarithm of greenhouse gas emissions per capita	Eurostat
LogENT	Logarithm of energy tax revenues	Eurostat
LogTRT	Logarithm of vehicle tax revenues	Eurostat
LogGDP	Logarithm of GDP at current prices	Eurostat
LogENC	Logarithm of final energy consumption	Eurostat
LogPDN	Logarithm of the production index 2015 = 100	Eurostat
LogGE	Logarithm of public expenditure% of GDP	Eurostat
LogEco-IS	Logarithm of the index for eco-innovation (Eco-IS) *In 2009, the EC introduced the Eco-IS Index to assess the degree of innovation of Member States' economies, and Eurostat maintained reporting with 2010 data, https://ec.europa.eu/environment/ecoap/indicators/index_en*	Eurostat

4.2. Modelling

We study the impact of fiscal parameters for Bulgaria and EU-27 average on GHE for the transition to a decarbonised economy through environmental technologies, examining the relationship between the level of environmental taxes on energy and transport (Pollution taxes are still insignificant is a macroeconomic plan), public expenditure, which include R&D and environmental expenditure, on the one hand, and the reduction of GHE for 10-year period, on the other hand.

The estimation model is a combination of regression equations, examining the positive or negative relationship between indicators of pollution and environmental taxes and public spending similar to the study of Streikiene et al. (2018) and Ganda and Garidzirai (2020). The following OLS regression equations were applied:

$$LogGHE\ it = a_1 + a_2 LogENTit + a_3 LogTRTit + a_4 LogGDPit + a_5 LogPDNit + a_6 LogENCit + a_7 LogGEit \quad (1)$$

$$LogGHEit = a_1 + a_2 LogENTit + a_3 LogTRTit + a_4 LogGDPit + a_5 LogGE + a_6 LogENC \quad (2a)$$

$$LogGHEit = a_1 + a_2 LogENTit + a_3 LogTRTit + a_4 LogGDPit + a_5 LogEco\text{-}ISit + a_6 LogGE + a_7 LogENC \quad (2b)$$

Where:

LogGHE greenhouses gas emissions
LogENT energy taxes
LogTRT taxes on transport
LogGDP GDP at current prices
LogPDN production index, 2015 = 100
LogENC final energy consumption
LogGE public spending, including environmental and R&D expenditures
LogEco-IS index for eco-innovation (Eco-IS)

We assume that the overall level of LogGHE is the main indicator for measuring reduction of pollution through diffusion of environmental technologies. For the purposes of this study, independent (explanatory) variables environmental taxes on energy and transport, and public expenditures are included as factors for the change of the dependent variable.

Environmental taxes include taxes on energy LogENT and transport LogTRT, which are expected to be an incentive for achieving environmental sustainability depending on demand price elasticity of energy and transport costs.

Public expenditure, including environmental protection and R&D, are part of the budgetary parameters, are another instrument of fiscal policy for green transition. The study is expected to find a reverse relationship between public spending and reduction of GHE. Public policies should decrease the level of greenhouse gases as they stimulate mitigation and adaptation to climate change and transition to environmental technologies in the public and private sector, including under the EU financed projects.

Control explanatory variables are added, including GDP at current prices LogGDP, production index at 2015=100 LogPDN, final energy consumption LogENC, eco-innovation index (Eco-IS). Final energy consumption is the energy used in industry and households measured in tonnes of oil equivalent. The study is expected to find a reverse relationship between final energy consumption and GHE. The reverse effects of GDP would suggest that it stimulates introduction of environmental technologies for reduction in GHE. Eco-IS measures the performance of EU member states on environmental innovations. The study expects the higher average score of Eco-IS for EU-27, which shows better innovation performance, to have positive effect on reduction of GHE.

4.3. Analysis of the results

Applying the model with data for Bulgaria and EU-27, we obtained empirical assessments that clearly show that fiscal policy plays a fundamental role in reducing pollution and diffusion of environmental technologies through fiscal measures with environmental taxes and public spending on environmental protection and innovation.

We tested the regression coefficient for autoregression by Durban-Watson test and Heteroskedasticity by Breusch-Pagan (χ^2) test. The values of the Durban-Watson test are between 2 and 2.4, and the values of the P-value of the Breusch-Pagan (χ^2) test were not less than 0.05, so we were not able not reject the null hypothesis, which means that we had no evidence to say that heteroskedasticity was present in the regression model.

The regression coefficients for Bulgaria showed statistical significance and direct relationship between environmental taxes on transport, but not for environmental taxes on energy and public spending and GHE. The presumption that the taxes on transport raise the awareness of transport consumers to use new environmental technologies was confirmed. The regression coefficients of equation (1) showed that the increase of 1% of environmental taxes on transport would lead to a forecast reduction of greenhouse gases by 0,40%. The explanation about energy taxes would be that in Bulgaria energy taxes reached the maximum level as a share in total taxes and social security contributions (9,1% for 2019).

Regarding public expenditures the result displays that public spending has no direct effect on reduction in GHE and diffusion of environmental technologies in Bulgaria. Another study on the impact of fiscal policy in the transition to a low-carbon economy Bulgaria also finds no statistical significance of the impact of government spending on GDP components in the short term (Zlatinov, 2020). Bulgaria is following strict fiscal discipline, maintained after the introduction of a currency board in Bulgaria and its transition towards green technologies should be supported by the 40% limit for public spending in terms of GDP.

The regression coefficients show that an increase in production index by 1% will increase GHE by 1,9%, while the increase in GDP is projected to decrease the level of GHE by 1%.

$$LogGHE\ it = -0{,}965 + 0{,}111LogENTit - 0{,}401LogTRTit - 1{,}01LogGDPit + 1{,}905LogPDNit + 1{,}566LogENCit + 0{,}057LogGEit \quad (1)$$

Table 2: ***Bulgaria: Regression Results for GHE (equation 1)***

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	–0,96568686	1,287323179	–0,75015107	0,507635833
Log Energy taxes% of GDP	0,111148997	0,16280576	0,682709239	0,543783991
Log Transport taxes% of GDP	–0,401491353	0,084158776	–4,77064153	0,017497684
Log GDP market prices	–1,01385228	0,166204763	–6,100019394	0,008850716
Log Production Index, 2015=100	1,905824077	0,586741645	3,24814864	0,047556187
Log Final Energy Consumption	1,566554571	0,434034589	3,609285093	0,03652205
Log Government Expenditures% of GDP	0,057617504	0,116196395	0,495863091	0,65404246

Durban Watson test 2,445623263
Breusch-Pagan Test ($\chi^{2)}$ 0,440493285
R Square 0,97

The model with the equation (2) for Bulgaria estimates coefficients, which are not statistically significant. Bulgaria is last in the EU27 in terms of eco-innovation performance and is a modest performer with a score of 34 for 2021 (Official site of the European Commission, https://ec.europa.eu/environment/ecoap/indicators/index_en). Bulgaria has the potential to move from a modest to a moderate eco-innovator only if it manages to work on science and innovation; support to SMEs and the energy system.

Applying the equation (2) for to the EU-27 countries, the impact of public spending at European level is statistically significant for reduction of GHE. It has a reverse effect on GHE, i.e. an increase in public spending of 1% leads to a decrease of 1.72% in GHE. The estimated impact by Ganda and Garidzirai (2020) for EU countries on reduction of GHE was also positive (0.81%). The impact of final energy consumption and GDP is statistically significant and its reduction leads to the same reduction in GHE. Environmental taxes have no impact at EU-27 level according to the results obtained.

LogGHE it =10,629 – 0,185LogENTit – 0,506Log TRTit -1,048 LogGDPit + 1,023LogENCit – 1,721 LogGEit (2a)

Table 3: *EU-27: Regression Results for GHE (equation 2a)*

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	10,62961499	2,127141007	4,997137	0,007505625
Log Energy taxes% of GDP	–0,185983627	0,359096786	–0,51792	0,631841003
Log Transport taxes% of GDP	–0,506349508	0,676498204	–0,74849	0,495777086
Log GDP market prices	–1,048128304	0,236581094	–4,43031	0,011419241
Log Final Energy Consumption	1,023694105	0,367796424	2,783317	0,049649842
Log Government Expenditures% of GDP	–1,721774054	0,467119061	–3,68594	0,021093652

Durban Watson test 2,1902877
Breusch-Pagan Test ($\chi^{2)}$ 0,451223792
R Square 0,98

Adding Eco-IS index in the EU-27 model (equation 2b), it changes the results for taxes on transport, public spending, GDP, but not for final energy consumption. An increase in taxes on transport by 1% leads to the similar reduction in GHE. Eco-IS Index is statistically significant with a coefficient of 0.019. However, Durban-Watson test gives results above the range of normal 1,5 – 2,5, so this configuration of the model may not be reliable.

Based on our analysis we can conclude that fiscal policy instruments are more powerful when prior to their introduction precise objectives are defined and carefully tailor for respective countries depending on their macroeconomic situation and market structure. Clear objectives linked to specific environmental goals can increase the acceptability of economic instruments trough environmental taxes and public spending and contribute to their success.

5. Conclusion

Fiscal measures for transition to environmental technologies should be established in coherence with other public policies. The success of the introduction of environmental taxes tools depends on the predictability to future change as this has a strong impact on the effectiveness of an economic instrument. To stimulate behaviour change the environmental taxes should be applied in a phased period.

When introducing fiscal measures how revenues from economic instruments are used has an important influence on the impact and effectiveness of the instrument, its political and public acceptability, and its potential to mitigate adverse impacts and overcome obstacles. Regular monitoring and evaluation of the impact of instruments, including unintended impacts, and subsequent revisions are critical to ensure their continued effectiveness. Clear communication by policy makers to affected stakeholders and civil society is critical to the success of an economic instrument and can help increase acceptance.

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Financial Stability Risks Related to Climate Change and Greening of Central Banks

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Abstract: The paper aims at exploring the risk for financial stability ensuing from the climate change and the role that the central banks have in containing those risks. Being aware of them the central banks take steps and we are witnessing a process of "greening" of central banks. For example, when presenting its monetary policy strategy review earlier this year, the European Central Bank introduced a climate change action plan, thus incorporating the climate related issues in its monetary policy framework.

Therefore, it would be useful to make an analysis and comparisons between the central banks approaches to climate related risks for financial stability. Furthermore, it is necessary to explore what active role could the central banks play in the greening of the economy. A comparison will be made in the approaches of certain major economies central banks (People's Bank of China, Bank of England, the European Central Bank, Bank of Japan and the Federal Reserve) but the emphasis will be put on the strategy of the European Central Bank.

The analysis of the Green Central Banking scorecard and of selected banks' policies suggest that the process of greening of central banks has just begun and there is still much work to be done. The commitments undertaken in Europe, namely by the Bank of England and the European Central Bank, if implemented accordingly, will improve their position in a green central bank ranking in the years ahead.

Keywords: climate change, financial stability, central banks

1. Introduction

The climate change represents one of the greatest challenges of our time and as such it poses risks for all economic and social systems, including the financial sector. It exposes the financial system to risks, stemming from the transition to a green economy and to physical risks. Key institutions in the financial system, that should manage and sustain those risks are central banks, which are primarily tasked to maintain price stability. While there is a consensus that the governments are responsible for tackling climate change, yet, a consensus is building that central banks should not stay

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away and should more actively engage with green policies. This is due to the fact that they either have a mandate for sustainability or their mandate to maintain price stability predisposes their engagement with climate-related risks. Another argument for their involvement is that it turns out that their policies and operations can contribute to the harm, caused to the environment. Last, but not least, the central banks and the financial system as a whole can play a significant role in the process of transition to a green economy, through mobilizing the financial recourses needed.

Further to this, the paper aims at looking and explaining the financial stability risk, related to climate change. After highlighting those risk, the paper examines the level of greening of central banks and financial regulators, based on the G20 Green Central Banking Scorecard, prepared by Positive Money. Further on selected central banks' cases and their green initiatives are considered. The green policies of People's Bank of China, Bank of England, European Central Bank, Bank of Japan and the Federal Reserve are discussed. The emphasis is put on the European Central Bank green policies.

2. Financial stability risks related to climate change

There are broadly two types of risks for the financial system, that are associated with climate change – transition risk and physical risk.

The transition risk is the risk that the financial system, namely the banks have exposures to firms with high carbon emissions throughout their value chain. The risk stems from the fact that those firms are facing rising carbon prices, as stricter political commitments to reduce the emissions are being undertaken. For example, in 2021 the European Commission increased its intermediate target for reduction of emissions from 40% to 55% by 2030 compared to 1990 levels. At the same time the carbon prices in the European Trading System has increased with 60% in the period November 2020 – May 2021. The ensuing change in preferences, consumer behavior and rising carbon prices will impact negatively the high-emitting enterprises and thus the quality of their assets, held by the financial system. The exposure of the financial firms can be measured by the value of loans provided by the financial system to high-emitting enterprises or by the share of securities, issued by such enterprises, held by banks or non-bank financial institutions. The estimates of the ECB (Alogoskufis, S. et al. (2021), Climate-related risks to financial stability, Special Feature in Financial Stability Review, May 2021, European Central Bank, Frankfurt, Germany) for 2020, based on reported emissions is for about 4 trillion EUR euro area banks' loans. About 5% is the loan exposure of Euroarea banks to the mining and energy sector which are among the non-financial sectors with high carbon emissions. A point of interest is that the loan exposure to the manufacturing sector is 20% and this sector emission falls within Scope 3. This could result in increased transition risks for banks in case a change in preferences in the consumption of manufactured goods materialize.

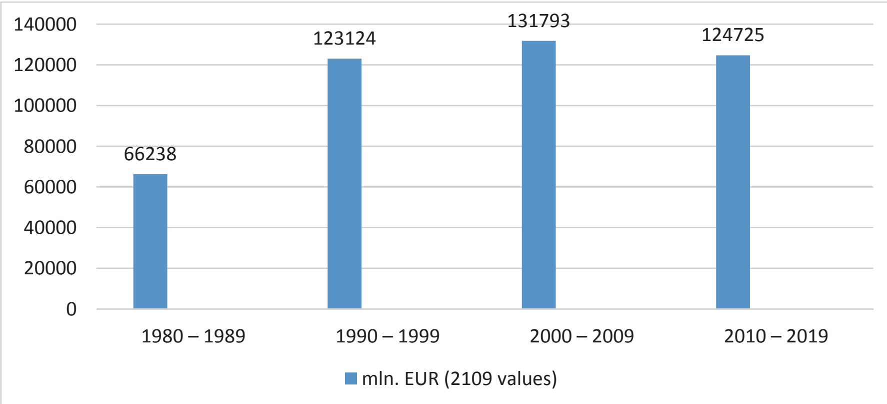
At the same time about 30% of euro area banks' holdings of securities consist of securities issued by high-emitting enterprises. The share of securities of high-polluting firms in the Euroarea investment funds' portfolios is also 30% and has remained at 30% for the period 2013 – 2019, but at the same time their value has doubled from 700 billion EUR to 1,3 trillion EUR. This trend reflects among other things the increase of the assets and the importance of the investment fund sector.

Physical risks for the financial sector arise where the financial firms have exposures to companies that are subject to climate-related physical risks, such as floods, wildfires, hurricanes, extreme heat and etc. In the case that the financial firms provide loans and hold as collateral physical or financial assets of such companies, the quality of such assets can be deteriorated in the event of extreme climate conditions.

The physical risks impose a significant toll on the economy. The global economic loss of extreme climate conditions has risen considerably in the past decades – from around 450 billion USD in the 80-ies of 20th century to about 1,7 trillion USD in the period 2010 – 2019 (Data in Climate-related risks, Financial Stability Board, https://www.fsb.org/work-of-the-fsb/financial-innovation-and-structural-change/climate-related-risks/, retrieved on 8 October 2021). The trends in Europe represent the same picture. The data on Figure 1 points out to the increase of economic losses in Europe in the four decades starting from the 80-ies of 20^{th} century. They have been most significant in the first decade of the new century, when they stood at 131,7 billion EUR.

In the euroarea alone, the economic loss of extreme climate conditions in 2019 is estimated at 1% of GDP. Not all regions and sectors are equally exposed to physical risks. The agricultural and the real estate sector are most vulnerable. The northern and central Europe is exposed to the threat of floods while southern Europe is exposed to the threat of heat-related hazards.

Figure 1: *Economic losses caused by extreme climate-related events in Europe (EEA 32)*



Source: *European Environment Agency*

The insurers can play a very important role in this case by providing protection against extreme climate events. It is considered that with physical risks becoming more and more pronounced the insurers can stop provide insurance for some risks and can increase premiums, which is about to lead to the so called "protection gap", which will impact negatively the exposed banks. This highlights the specific interplay between the different parts of the financial system, namely banks and insurers. In the euro area only one third of climate-related economic losses are insured. In the 32 member countries of the European Environment Agency plus United Kingdom, the average level of insurance protection is 28%, or below one third, as the picture in the different European economy is very mixed. In Belgium, Denmark, Luxemburg and Norway the insurance protection is above 50%, as UK stands out with 70% of economic losses being insured. At the same time countries like Romania, Lithuania, Hungary, Greece, Croatia and Cyprus have only 1% or 2% insurance cover, which exposes them to large economic losses.

There is a specific trade-off between the transition and physical risks. In case there is no action to limit the physical risks now, in the hope that the transition risks will be managed in a more protracted manner, this may imply the climate reaching soon a tipping point that will trigger an abrupt and chaotic transition. The research shows that the timing of the transition is key in the relation to financial stability. An early, smooth and orderly transition to a green economy will be associated with less losses than a late, abrupt and disorderly transition would imply. In this vein, *Barrett et al. (2020, Barrett. P. et al. (2020), Mitigating climate change – growth- and distribution-friendly strategies, Chapter 3, World Economic Outlook, October 2020, International Monetary Fund, Research Department, Washington.)* suggest that an initial green investment push with steadily rising carbon prices could deliver the necessary reduction of emissions, associated with reasonable loss of global output. The authors also recognize that not all population groups will be equally affected, therefor the governments should provide cash transfers, financed by carbon tax revenues, in order to minimize the cost of adjustment of those groups that are most affected.

The loan and portfolio exposures of banks and non-banks reveals the vulnerabilities to which the sector is exposed on one hand, but one the other hand describes the importance that the financial system has in battling climate change. An empirical study by *Reghezza et al. (2021)* finds out that after the Paris Agreement of 2015 the Euroarea banks have reallocated credit from more polluting to less polluting firms, suggesting that climate related initiatives make banks more willing to finance greener business. This is explained with the fact that those initiatives increase the awareness of the financial institutions of the risks they face and that the anticipated stringent policies can translate in deteriorating asset quality.

The financial system is not only exposed to climate-related risks. The financial sector is playing a significant role in financing the transition to a green economy. In the euroarea the assets under management of the ESG funds have increased three times since 2015 to reach about 1,5 billion EUR in 2020. The outstanding amount of green bonds have increased eightfold and the issuance of catastrophe bonds – twofold. The emission-related derivatives have also grown (Data is taken from Alogoskufis, S. et al (2021)).

3. The “greening” of central banks

Central banks are central institutions in the financial stability architecture. Therefore, it is important to highlight their role in the transition to a green economy. On one hand they should play a key role in sustaining the financial stability risks, ensuing from climate change. On the other hand, they can act to stimulate the role of the financial system in accumulating the recourses for the green transition.

In this respect we are witnessing an intensified political and academic debate on whether or not central banks should engage with climate related issues and if so, to what extent and how. The debate is focused around the question as to how the environmental concerns fall within the scope of the central banks’ mandates. There are two strong arguments which favor the greater involvement of central banks with climate change. Central banks are either explicitly or implicitly mandated with sustainability objectives. Additionally, the central banks bear responsibilities because with their monetary and financial policies they are not neutral to the environment.

As far as the mandate is concerned, many central banks have a mandate to support the government policies, which sometimes include sustainability goals, therefore the incorporation of climate related issues in their policies falls into the broader mandate of supporting the government policies. In a study of *Dikau and Volz (2019, Dikau, S. and U. Volz (2019), Central bank mandates, sustainability objectives and the promotion of green finance, Working Papers 222, Department of Economics, SOAS, University of London, UK,* 12% of 133 studied central banks have explicit mandates related to sustainability, but another 29% of them are mandated to support government policies, which, in most cases include sustainability goals. On the other hand, central banks are predominantly tasked with maintaining price stability and preserving financial stability. Due to the fact that climate-related risks, both transition and physical can have significant implications for the monetary and financial stability, the central banks should become increasingly involved in studying and managing those risks. So, even in the absence of an explicit or implicit mandate in this area, there are legal grounds for the central banks' involvement with climate and environmental issues.

As far as the other point is concerned, the policies of the central banks have their implications on the climate change and can exacerbate it. In the last decade the central banks around the world engaged in massive asset purchase programs to fight the effects of the Global financial crisis, and now the effects of the pandemic. As a result, the central banks' balance sheets increased enormously and they hold huge amounts of sovereign and corporate securities. In effecting the asset purchases the central banks apply the principle of market neutrality, which result in the central banks' asset portfolios being not climate neutral. According to the market neutrality principle, the central banks buy corporate bonds proportionally to their availability in the market. In a recent study *Papoutsi et al. (2021, Papoutsi, M., M. Piazzesi and M. Schneider (2021), How unconventional is green monetary policy?, JEEA-BBVA Lecture at ASSA (January 2021), Working Paper)*, using data for the ECB corporate bond purchases and carbon emissions finds out that the current formula for market neutrality that the bank uses leads to a brown rather than a green portfolio. This is explained with the fact that the companies from the energy and some manufacturing sectors, which record higher emissions are more prone to issue bonds, than for example companies from the service sector, due to higher capital investment needs. That is why the central bank's portfolio contains more bonds of high-emitting enterprises in proportion to low-emitting ones and thus negatively impacts climate change.

Both aspects necessitate reconsideration and adjustment of policies of central banks to respond to the needs of today.

A good starting point to consider the current level of engagement of central banks with the climate issues is "The Green Central Banking Scorecard" (Barmes, D. and Z. Livingstone (2021), Green Central Banking Scorecard: How green are G20 Central banks and financial supervisors? (2021), Positive Money). To assess the level of "greening" of central banks and financial supervisors around the world, the non-for-profit organization Positive Money has made the above mentioned scorecard, published in March 2021, where it ranks the G20 economies in terms of the involvement of their central banks and financial supervisors with environmental sustainability. This is the first analytical effort to describe how a green central bank should look like and to compare the central banks of the major developed and developing economies in that respect. The ranks are made based on four criteria: research and advocacy, monetary policy, financial policy and learning by example. The score on the firs criterion "research and advocacy" measures the extent to which the institutions are engaged with research on climate related issues and the spread of their research results and its outreach through the financial system, the economy and the society as a whole. As far as the "monetary policy" criterion is concerned, the score reflects the level at which climate change is incorporated into the monetary policy framework of the respective central bank – in its asset purchase programs, collateral requirements, funding and refinancing operations and reserve requirements. The third criterion "financial policy" relates to the work of central banks and financial supervisors in sustaining risks on a micro- and macro-level by prudential tools and by other instruments like disclosures and stress-testing. The capital instruments and the incorporation of climate risks into the risk weighting of assets relates to the amount of capital financial firms should hold and can have a significant impact, once adopted. The disclosure of climate-related information and stress-testing of financial firms can increase the understanding of the regulators about the climate risks to which the financial sector is exposed and also the extent to which they contribute to the climate change. Finally, the forth criterion "leading by example", as it name suggests, pertains to the engagement of central banks with green initiatives beyond their monetary and financial policies, namely in their day-to-day operations and most notably – disclosing their own environmental risk and greening their non-policy portfolios. Not all four criteria are equal in their impact and therefore the authors of the ranking attribute different weights to them, giving greater impact to monetary policy and financial policy (50 points each) and lower points to research and advocacy (10) and leading by example (20 points). Then the points on the four criteria are summed up to obtain he aggregate score that can range from 0 to 130.

The results are displayed in Table 1 below.

Table 1: *G20 countries ranked by green monetary and financial policies of their central banks and financial regulators*

Rank	Country	Research and advocacy (0 – 10)	Monetary Policy (0 – 50)	Financial Policy (0 – 50)	Leading by example (0 – 20)	Aggregate score (0 – 130)	Grade (A+ to F)
1	China	10	16	24	0	50	C
2	Brazil	10	16	18	1	45	C–
3	France	10	3	22	8	43	C–
4	United Kingdom	10	4	19	5	38	D+
5	European Union	10	2	15	6	33	D+
6	Italy	10	2	15	4	31	D+
7	Germany	10	1	15	3	29	D
8	Indonesia	10	1	8	2	21	D
9	Japan	10	5	4	0	19	D–
10	Australia	10	0	4	1	15	D–
11	Canada	10	0	2	1	13	D–
11	Mexico	10	1	1	1	13	D–
13	South Korea	10	0	1	0	11	D–
13	United States	10	0	1	0	11	D–
15	India	3	5	1	0	9	F
16	Russia	5	0	1	2	8	F
17	South Africa	7	0	0	0	7	F
18	Turkey	1	0	3	0	4	F
19	Argentina	0	0	0	0	0	F
19	Saudi Arabia	0	0	0	0	0	F

Source: *Green Central Banking Scorecard March 2021, Positive Money*

The central banks take individual steps to green their policies, but also they participate in several coordinated efforts. The ranking above reflects both the individual commitment and the engagement of the respective central bank in those collective efforts.

The most significant coordinated action of central banks is the participation in the Network for Greening the Financial System (NGFS). It is a group of central banks and supervisors aimed at supporting the management of climate-related risks in the financial system and at increasing the role of the financial system in the transition to a green economy. It was launched at the "One Planet Summit" in Paris in the end of 2017 by central banks and supervisors from eight jurisdictions, namely France, Mexico, United Kingdom, Germany, China, The Netherlands, Sweden and Singapore. As of June 2021, the network consists of 95 members and 15 observers. The members are either central banks or financial sector supervisory authorities, while observers are international or regional financial institutions and standard setting bodies. The NGFS achieves its objectives by devising and promoting best practices among its members and by doing research in the field of green finance. A membership in the NGFS or the leadership of some of its work streams is awarded a score in the above rating.

Another initiative that aims to stimulate the international coordination of efforts in this respect is the establishment of a G20 Sustainable Finance Working Group. It was initially launched in 2016 as Sustainable Finance Study Group but the Italian G20 presidency re-launched it in 2021 and decided to elevate it to a working group. It is co-chaired by China and USA and the United Nations Development Program serves as its secretariat. The G20 Sustainable Finance Working Group will be responsible to coordinate the international efforts for mobilizing sustainable finance. The first task of the group will be to devise a roadmap for a collective action.

Finally, it is worth noting the work of the Taskforce on Climate-related Financial Disclosures (TCFD). The taskforce was established in 2015 by the Financial Stability Board and began its work in the beginning of 2016. It is currently composed of 32 industry members, representing banks, insurers, big non-financial corporations and etc. In June 2017 the TCFD published its Recommendations on the information the firms should disclose, so that the market participants can accurately take investment decisions and properly assess climate-related risks. Those recommendations represent a kind of standard for disclosures.

As the ranking in the scoreboard reveals there is no central bank that is currently green enough. Even the leader in the ranking China has a score that is below the half of the aggregate score of 130 points. At the same time there are two G20 member countries (Argentina and Saudi Arabia) whose financial regulators haven't got a single point. This means that process of greening of central banks has just started and there is long way to go. The analysis of the results points to the fact that the work of the central banks is currently concentrated on research and analyses, organization of forums and supporting initiatives, which is reflected by the relatively high scores the institutions obtain on the "research and advocacy" criterion. Thirteen out of 20 countries get the maximum result. At the same time the results on the monetary policy and financial policy criteria are relatively low. The results are also low for the leading by example criterion. While these are the policies, which when implemented can have a sizable impact on the environment, we can once again conclude that the central banks greening has just commenced and the real work is not yet done. According to the authors of the scorecard, there is not a single policy implemented, even among the leaders, that has a high impact. This means that the policies implemented up to this moment stimulate green activities, but there is not a single measure aimed at restricting environmentally harmful activities and firms.

The text below reveals the green policies of selected central banks.

4. Selected central banks' cases

The paper presents the green policies of selected central banks, which are covered in the order that they take in the scorecard. The chosen banks are People's Bank of China, Bank of England, the European Central Bank, Bank of Japan and the Federal Reserve System. These central banks are chosen, because they define and conduct the monetary policy in the most significant world economies with significant financial markets.

4.1. People's Bank of China

China got the highest score in the scorecard, total 50 of 130 points. With 10 points for research and advocacy, 16 points for monetary policy and 24 for financial policy. The institutions whose policies were assessed are People's Bank of China (PBOC), conducting the monetary policy and China Banking and Insurance Regulation Committee (CBIRC), responsible for the prudential regulation of banks and insurers.

According to the authors of the Green Central Banking scorecard, a possible reason for the leading position of China in this ranking could be the fact that China (as well as Brazil, which is second in the ranking) is among the countries with most severe environmental issues. This can explain why the climate initiatives in the financial sector have started relatively earlier, compared to other countries and they have advanced since then. The first Chinese initiative dates back to 1995 when PBOC published a guidance to the banks on how to incorporate environmental concerns in their credit policies.

Nowadays, a Chinese representative chairs one of the work streams of the NGFS. The PBOC in coordination with other government authorities issued in 2016 Guidelines for Establishing the Green Financial System, which serves as a strategic document. In the monetary policy field, two measures of PBOC deserve attention. Since 2018 the monetary authority applies favorable interest rate on required reserves for banks, that are assessed to have good green policies. The PBOC also accepts green bonds as a collateral its medium term lending facility and green loans in the Standing Landing Facility. Through their financial policy measures the regulators in China require the banks to incorporate environmental risks in their risk management and to shift lending away from environmentally harmful to greener projects.

The authors of the scorecard have ascertained that the greening of the Chinese central bank, despite most advanced, has lost momentum in the last year. This is evidenced by the fact that there are no official commitments in the monetary and financial policy field.

4.2. Bank of England

The Bank of England is the central bank that has the second highest rank amongst the G20 central banks in Europe in terms of greening, preceded by Banque de France. Its total score is 38. On a global scale it takes the fourth place. It is one of the founding central banks of the NGFS and a UK representative leads one of the NGFS work streams. This rank reflects the fact that in March 2021 the mandate of Bank of England was updated to adhere to the commitments of the UK government for a net zero economy. The mandate update took place through letters of the Chancellor of the Exchequer to the Monetary Policy Committee and The Financial Policy Committee. On the same date as the remit letters were published, the Bank of England announced that in the coming months it will announce its strategy on how to adjust its Corporate Bond Purchase Scheme, so that it takes into consideration its climate effects. This should take place no later than the last quarter of 2021. In May 2021 Bank of England published a discussion paper, highlighting the options for greening the corporate bond purchases program, but to this end such strategy is not announced.

In June 2021 the Bank of England launched its Climate Biennial Exploratory Scenario (CBES), which is a stress test to check the resilience of the largest banks and insurers in UK to climate related risks. The results are expected in the beginning of 2022. At the same time the financial institutions are requested to integrate climate risks into their risk management practices. As per the Supervisory statement of the Prudential Regulation Authority "Firms should have fully embedded their approaches to managing climate-related financial risks by the end of 2021.

The asset issuers and the asset holders in UK will soon be subject to mandatory climate related disclosures. In 2019 the UK government adopted its Green Finance Strategy through which it endorsed the Financial Stability Board's Taskforce on Climate-Related Financial Disclosures recommendations. Further to that a UK Taskforce was established that produced a Roadmap towards mandatory disclosure in November 2020. As the Roadmap suggests all listed issuers and large asset owners will be obliged to make climate-related disclosures by 2022 and by 2025 the mandatory disclosure will spread across the entire UK economy. Doing this, UK will be the first G20 economy to put in place the TCFD recommendations, reflecting its status as a global financial center and its leading role in greening the international financial system. The Bank of England alone discloses the climate effects of its own physical and financial operations. In 2021 it published its second climate-related disclosure report.

Once Bank of England formal commitments regarding its monetary and financial policy become effective, we could expect that the position of the UK in the scorecard will move upwards.

4.3. European Central Bank

The European Union takes the fifth place in the ranking, which reflects the green policies of the European Central Bank and the European Banking Authority. Its total score is 33.

Both ECB and EBA are members of the NGFS and an ECB senior representative is a chair of the NGFS. At the time of making of the scorecard the ECB had only announced its intentions to adjust its monetary policy. The real commitments came a few months later, when it published the monetary policy strategy review. In 2020 the ECB undertook a review of its monetary policy strategy for a first time since 2003. The new strategy was published on July, 8, 2021. In order to incorporate climate-related considerations in its monetary policy framework, the Governing Council of the ECB decided on an action plan (Action Plan) and a detailed roadmap (Detailed roadmap of climate change-related actions. https://www.ecb.europa.eu/

press/pr/date/2021/html/ecb.pr210708_1_annex~f84ab35968.en.pdf. Retrieved on 10.08.2021) of needed actions. They were presented to the public on the same date as the new strategy, thus showing their commitment to address environmental challenges. The action plan sets several priority areas. The bank plans to *develop new macroeconomic models* and apply those models in order to analyze the implications of the climate change for the economy, financial system and the monetary policy transmission mechanism. It will conduct scenario analyses to test for the outcome of the different transition scenarios. The second priority area is *the development of new, experimental indicators* related to climate change (green financial instruments, climate risk exposure of financial institutions and the carbon footprint of portfolios of financial institutions) and collecting of statistical data. The third priority is the *introduction of disclosure requirements* for private sector assets as an eligibility criterion for collateral or asset purchases. The forth priority refers to the enhancement of the risk assessment within the ECB by starting to conduct *climate stress test of the Eurosystem balance sheet* in order to assess the exposure to climate-related risks.

Another measure, that will have a significant impact is that ECB plans to *revise its collateral policy*, so as to ensure that climate change risks are considered in the valuation and risk assessment of the assets, held as collateral. And finally, the last priority, which will as well give a high impact is the commitment of the ECB to *adjust its Corporate Sector Purchase Programme*, regarding the allocation of asset purchases and disclosure of information, in order to incorporate climate change criteria.

As the plan suggests the first stress test of the Eurosystem balance sheet will be held in 2022 and in 2023 the ECB will start disclosing climate-related information on its corporate bond purchases and on its non-policy portfolios in 2023.

The key elements and the steps, envisioned in in the ECB' action plan are summarized in the following table.

Table 2: *Action plan of ECB*

Milestones	**1. Paving the way with reliable data**	**2. Knowledge is the driving force**	**3. Action based on reliable data and best knowledge**
Action	Develop indicators and collect data, needed for climate change risk analyses	Check with stress tests the Eurosystem balance sheet exposure to climate related risks	Include climate risks into the collateral framework
Action	Adapt macroeconomic models and make them fit for climate change	Check firms' and banks' exposures to climate risks with climate stress tests	Adapt the Corporate Sector Purchase Programme to account for climate change
Action		Make the disclosure of climate risks a priority by introducing disclosure requirements	
Action		Review how credit ratings reflect climate risks	

Source: *ECB web page.* www.ecb.europa.eu

In addition to that the ECB established a climate change center in the beginning of 2021, to coordinate the work on climate change within the institution. The center will consist of about ten experts of the ECB working in different units across the bank and will report directly to the President of the ECB, who oversees the ECB's work on climate change.

All those facts lead to the conclusion that the ECB and EBA are leading in their efforts for greening and their work matches the ambition of the European Union to be a world leader in the transition to a green economy. The score in the current ranking does not reflect the serious formal commitments undertaken, because they were published several months upon the publication of the scorecard. Therefore, we can expect that the European Union will upgrade its position in a next edition of the scorecard, due to the commitments it has taken to adjust its monetary policy, prudential policy and its own operations to climate change.

4.4. Bank of Japan

The total score of Japan is 19 and the scorecard assesses the policies of Bank of Japan and the Financial Services Authority. Bank of Japan is a member of the NGFS since 2019. To manage and broaden its initiatives on climate change, the bank has set up an internal body – the Climate Coordination Hub. On July 16, 2021 Bank of Japan published its Strategy on Climate Change. In the strategy the bank commits its self to introducing a fund provisioning measure in 2021 as a part of its monetary policy measures. Bank of Japan is going to provide zero interest rate funds to financial institutions that disclose certain level of climate-related information, against their green investments or loans. As far as the stability of the financial system is concerned the bank, in collaboration with the Financial Services agency is working on the pilot Climate Stress Test for the most significant financial institutions. Furthermore, a TCFD Consortium was established in 2019 to promote the incorporation of the TCFD recommendations for disclosure in the Japanese practice.

4.5. The Federal Reserve

The Federal Reserve is a member of the Network for Greening the Financial System since December 2020. The involvement of the institution with climate change issues it still in its early stages and as the Chair of FED states climate considerations are not a main factor its policy decisions. The action of FED on climate change is currently limited to organization of events, public speeches and conducting and publication of research. Therefore, the institution’s score in the scorecard is 11. A notable step in FED’s “greening” was the establishment in the early 2021 of two committees – Supervision Climate Committee and Financial Stability Climate Committee. Both committees will advise the Board of Governors on its actions on climate change. The Supervision Climate Committee will focus on identifying risks with individual financial firms and putting together a program to address them. The Financial Stability Climate Committee will address macroprudential risks for how climate could pose systemic risks to the institutions the FED supervises. At the same time, there are no initiatives and no commitments, concerning monetary and financial policies, as well as the central bank own policies.

5. Conclusion

The paper presented the challenges and risks that the climate change represents for the financial system. The transition risks arise due to the financial system's exposure to high emitting enterprises, whose assets could face worsening of quality due to the stricter commitments to reduce emissions and the ensuing change in policies and preferences. On the other hand, the physical risks arise due to the realization of extreme climate events, which affect firms' assets and the financial system have exposure to those firms. The right management of those risk is of great importance for sustaining the stability of financial system.

While the governments bear the primary responsibility to deal with climate change, the central banks, being the main institutions responsible for price and financial stability should also be engaged in the process. It is because it falls within the scope of their mandates, as well as because the central banks' policies could also impact negatively climate change.

Further to that we are witnessing a process of greening of central banks. One way to assess the level of greening is to look at the Green Central Banking scorecard, which assesses the G20 countries central banks and financial supervisors on their green policies and compare them to the "ideal" green institution. The scorecard was first published in March 2021 and the picture it reveals is that the process of greening of central banks has just started and there is a lot of work to be done. Even the champion in the ranking, China is far from the ideal green central bank. The aspect in which most of the institutions have advanced is the research and the engagement with the climate change issue through organization of initiatives and participation in joint efforts. At the same time the scorecard suggests that there is a lot to be done in the field of monetary and prudential policies, because these are the policies, that once adjusted, could produce sizable impact on the environment. The same holds for the central banks' own operations and non-policy portfolios. The analysis of the selected banks' climate-related policies revealed the status quo, but also highlighted some commitments that took place after the scorecard was published. This is especially the case with the European Central Bank and Bank of England. Once their formal commitments become effective, we may expect that both institutions will take leading positions in the scorecard. The commitments of the ECB to adjust its monetary policy and its own operations to climate change considerations are ambitious and they match the intention of the European Union to be a leader in the transition to a green economy.

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The way to Sustainability in European Agriculture: the EU Green Deal and the Farm to Fork strategy

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Abstract: The EU is a region of productive but already relatively intensive agriculture with an array of unresolved environmental issues, and is currently a net exporter in terms of economic value in the agriculture and food sector. Given the challenges it appears that the European Union and its member states are uniquely suited to spearhead the challenge to push towards a more sustainable agriculture of the future – agriculture which maintains and enhances high productivity, which preserves and improves the production resource base, which moves towards more sustainable consumption patterns associated with reduced waste, and which at the same time radically improves the environmental performance of food production. Namely these are the main focus areas of the he EU Green Deal and the Farm to Food strategy of the Union. The study aims to analyse the future vision for sustainable agriculture in Europe that these strategic frameworks aim to, examining the EU Green Deal in the context of agricultural sustainability, and assessing the Farm to Fork strategy as means to achieving sustainable agriculture in Europe. The paper concludes with some remarks and considerations relating the EU Green Deal and the Farm to Fork strategy to the notion of sustainability in the context of agriculture.

Keywords: Sustainable agriculture, EU Green Deal, Farm to Fork

1. Introduction

Agriculture is the cornerstone of the past, present and future world. It is the key driver behind the population growth on the planet and an essential element that has enabled global economic growth. The most important aspect of agriculture is the supply of food for the human population and also the supply of various agricultural produce for major industries like pharmaceuticals, diesel fuel, plastic and more. In the last sixty years global agricultural productivity has increased throughout the world driven by growing food demand. The main elements that have contributed are the

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increased agricultural area, progress in seed development technologies, advancement in agricultural machinery, deeper understanding of agricultural processes and plant development, introduction of synthetic fertilizers and innovative crop protection products. Those technologies include but are not limited to modern agricultural machinery, innovative digital tools, new generation of crop protection products, seed varieties with higher yield potential. These changes allowed the expansion of the food value chain across the world.

The European Union has also experienced this positive increase of agricultural productivity even if the observed curve isn't so steep. The reasons driving this growth are similar to the global ones and shouldn't be accredited to the expansion of the union to include more countries from Central and Eastern Europe. To current date France, Germany, Italy and Spain remain the countries with the highest yield of the main agricultural produce.

However, this positive trend that has been observed in the last 60 years looks different if we focus on the short-term development. It becomes apparent that the agricultural productivity in the EU in most recent years is stagnating. This can be attributed to the recent climate changes that have faced agriculture with unprecedented weather conditions. Central and Eastern Europe have faced severe droughts in autumn and spring combined with softer winter leading to lack of humidity for arable crops. On the other hand, strong rainfalls in countries from Northern Europe have caused thousands of hectares to be impossible to farm as they remain under water for long periods of time. This raises certain concerns as data also shows that arable area in the EU is also not increasing and even has decreased by an average of 2% in the period between 2008 and 2018 (EC, 2019). This means that the increasing yield is left as the only element if increasing food demand is to be managed.

In the same time the topic of sustainable agriculture is a top priority in Europe and beyond. All the recent challenges that agriculture has faced raised concerns that moving forward, the higher productivity should not be the only driving force. Sustainable farming practices must be followed to ensure that agriculture is responsible towards the natural resources, biodiversity, climate and the society itself. Sustainable agriculture is not an entirely new topic but it is in the last several years that the need of a common European strategy that will generate the roadmap to achieve it became apparent. One important question for the future would be how to make agriculture more sustainable without having to sacrifice the much-needed productivity. Going in this line of thinking it is quite clear that new innovative technologies need to be implemented in the EU countries to facilitate this transition.

The EU commission however has taken a different direction and imposed quite a restrictive number of legislative acts that create hurdles in the development and implementation of new chemical products and seed technologies. This can be credited to the strong trend of changing consumer requirements and demand. In the past consumer demand was mainly driven by the need to find nutritious and affordable food. The main decision criteria were food quality and price. Now other leading criteria are food origin, food safety, taste, organically produced or not, ethics and beliefs (The European Green Deal, 2019).

Societal demands will remain a key driver in shaping agricultural markets over the next decade. Consumers and citizens show increasingly pressing and at times conflicting expectations towards food, extending beyond food affordability to issues such as health, origin, convenience, environment, climate change, animal welfare, etc. This creates a unique challenge in front of all stakeholders in the food value ecosystem in Europe – a need to increase agriculture productivity but also develop a new sustainable approach towards agriculture that adds value to farming, environment and society. This would require all parties in the value chain to reshape the way they do business to become more sustainable. In the same time, they must remain profitable and financially stable.

The answer of the European commission to the outlined questions above is the recently published Farm to Fork strategy, proposed by the Commission as part of the Green Deal, which wants to enable the EU to make a real contribution to the sustainability goals and address the important challenges faced by our food systems. The Farm to Fork strategy states: "In 2050, the world's population is projected to reach nearly 10 billion and important that people have sufficient access to safe, affordable and nutritious food. While the transition to more sustainable food systems has started, feeding a fast-growing world population remains a challenge with current production patterns. Food production results in air, water and soil pollution, contributes to the loss of biodiversity, climate change and resource depletion. Food waste is at an unacceptable level: currently, waste food is amounting to about 20% of all food produced in the EU. Obesity is also a growing concern with over half the EU's adult population is now overweight, contributing to a high prevalence of diet-related diseases and related health care costs."

To achieve the Farm to Fork strategy the EU needs to involve all stakeholders in the value chain and facilitate actions towards sustainable food supply. These actions are not just limited to farmers and agriculture but impact also society and environment. For this to be possible a mind-set shift is required. Sustainability is a long-term process which requires commitment and will. The EU commission's role is to push for all stakeholders to move in the same direction they are setting with the new strategy.

This study aims to analyse the future vision for sustainable agriculture in Europe that the Green Deal and Farm to Fork strategy aim to. The first section examines The EU Green Deal in the context of agricultural sustainability, while the second analyses the Farm to Fork strategy as means to achieving sustainable agriculture in Europe. The paper concludes with some remarks and considerations relating the EU Green Deal and the Farm to Fork strategy to the notion of sustainability in the context of agriculture.

2. The EU Green Deal – a roadmap to turn the challenges to opportunities

The Green Deal is EU's growth strategy that aims to address the current challenges that the climate, environment and economy are facing. It wants to achieve a zero net emissions of greenhouse gases by 2050. The Green Deal wants to protect, conserve and improve on the natural capital in the region. By doing so to ensure the health and well-being of all European citizens. When presenting it the president of the EU commission Ursula von der Leyen said "Our goal is to reconcile the economy with our planet and to make it work for our people."

The Green Deal is an ambitious roadmap that wants to make all economic sectors, which previously weren't, sustainable. The communication document clearly states that this transition to a more sustainable future must happen in a just way. It should take in account the needs of the people, the specifics of the different regions and members states and also the needs of the various business industries which would be impacted. Part of the introduction of the document describes EU's unique position to achieve this ambitious target:

"The EU has the collective ability to transform its economy and society to put it on a more sustainable path. It can build on its strengths as a global leader on climate and environmental measures, consumer protection, and workers' rights. Delivering additional reductions in emissions is a challenge. It will require massive public investment and increased efforts to direct private capital towards climate and environmental action, while avoiding lock-in into unsustainable practices. The EU must be at the forefront of coordinating international efforts towards building a coherent financial system that supports sustainable solutions. This upfront investment is also an opportunity to put Europe firmly on a new path of sustainable and inclusive growth. The European Green Deal will accelerate and underpin the transition needed in all sectors.

The environmental ambition of the Green Deal will not be achieved by Europe acting alone. The drivers of climate change and biodiversity loss are global and are not limited by national borders. The EU can use its influence, expertise and financial resources to mobilise its neighbours and partners to join it on a sustainable path. The EU will continue to lead international efforts and wants to build alliances with the like-minded. It also recognises the need to maintain its security of supply and competitiveness even when others are unwilling to act." (The European Green Deal, 2019).

This makes it clear that the ambitions of the Green Deal are not focused just on Europe as a continent but want to initiate in globally and lead to collaborative network between countries, united by the same vision.

The Green Deal is viewed as an integral part of the EU Commission's strategy to implement the UN sustainable development goals and other EU priorities. It consists of various elements which only by working in synergy can bring the desired result.

2.1. Increasing the EU's Climate ambition for 2030 and 2050

To clearly define the conditions for a fair transition to a climate neutral economy and offer transparency and predictability for investors the European Union will introduce the first European "Climate Law" which aims to set the legislative frame on how the EU's target for climate will be achieved. The introduction of these policies will ensure effective carbon management throughout the whole value chain in the economy. It aims to proactively address business and consumer behaviour and facilitate a change towards more responsible management of all activities to mitigate negative effects on climate. The EU will ensure that all parties will have sufficient access to information and will develop instruments to support risk management of activities connected to climate change.

2.2. Supplying clean, affordable and secure energy

Production and use of energy across the different economic sectors of the EU are contributing more than 75% of the total EU's greenhouse gasses. The EU aims to stimulate and develop infrastructure for alternative energy. All member states would need to revise their climate plans and take in account rapid transition from coal and decarbonizing gas to clean energy. This phasing however must not happen at the expense of the consumer. The EU Commission will present a plan that will ensure the energy supply needs and ensure its affordability for consumers and businesses while also pushing towards clean energy transition. Various financial programs would be put in place to stimulate renovation of households to improve energy efficiency.

2.3. Mobilizing industry for a clean and circular economy

It takes a whole generation to transform an entire industrial sector throughout the different value chains. To achieve the 2050 targets decisions, need to be made in the short-term. The transition to a greener EU is an opportunity to discover new business opportunities and find innovative ways to intensify economic activity. The EU business has already taken steps to become more sustainable but this is happening at a slow pace. To accelerate the transition The Commission aims to mobilize all industrial sectors to transition to a sustainable model of inclusive growth.

2.4. Building and renovating in an energy and resource efficient way

Construction and renovation of buildings account for more than 40% of energy consumed. The EU aims to increase the percentage of annual renovation rate of buildings which is on average 1% today. To address the challenges of energy efficiency and affordability the Green deal will set in motion actions to have Member states engage in a renovation wave of public and private buildings. This offers an opportunity to both optimize energy consumption and also stimulate SMEs in the construction sectors.

2.5. Accelerating the shift to sustainable and smart mobility

Transport accounts for almost a quarter of the GHG in the European Union. The Green deal aims to have a 90% reduction in transport GHG emissions by 2050. This target includes all rail, aviation, road and waterborne transport. The Commission aims to adopt a strategy for sustainable and smart mobility that will address this challenge and tackle all emission sources. This would lead to a substantial part of inland freight carried today by road to shift onto rail and inland waterborne transport. Automated and connected multimodal mobility will be a key role for the future. The EU aims to create an appropriate infrastructure to support new sustainable modes of transport that can reduce pollution and congestion, especially in densely populated areas.

2.6. Preserving and restoring ecosystems and biodiversity

The EU has not been able to meet some of its most important environmental goals for 2020 like the Aichi targets under the Convention on Biological Diversity. With the new Green deal the EU aims to halt biodiversity loss across its Member states by presenting a Biodiversity Strategy in 2020. It will outline EU's targets to protect biodiversity and also address the main causes of biodiversity loss. It will present a set of specific measures such as increasing the area of protected land and sea under Natura 2000 network. In fact, all future EU policies would be aimed at contributing and preserving the natural capital of Europe.

2.7. A zero-pollution ambition for a toxic-free environment

To protect Europe's citizens and ecosystem the EU aims to better monitor and remedy pollution from air, water, soil and various consumer products. To achieve this The Commission aims to provide a framework in which all Member states will need to systematically need to look at all policies and regulations. In addition, The Commission will adopt a zero-pollution action plan.

The Green Deal contains a number of strategies and plans, such as the Sustainable Europe Investment Plan, an action plan for circular economy, a new industrial strategy, the new EU Biodiversity Strategy to 2030 and a Farm to Fork sustainability strategy aimed at agriculture. In addition to that there is a concept of implementing a carbon border tax in order to prevent carbon leakage. The Green Deal also pushes the idea to transform the current European Investment bank into a European climate bank, focusing on financing predominantly green projects. It also envisions a financial mechanism to ensure a just transition to the vision of the future that the Green Deal aims for.

The Green Deal also led to the creation of the draft of a climate law which sets a goal for Europe to become climate neutral by 2050. This legislative document would allow the EU Commission to track and asses the progress of member states through reaching carbon neutrality. It plans to start this process as early as 2023 and perform assessments every five years. It goes even further by pushing for reduction of greenhouse gas emissions by 50% already in 2030. It sets this ambitious target to tackle the increasing risk of a catastrophic climate change.

3. The Farm to Fork Strategy – for a fair, healthy and environmentally-friendly food system

The Farm to Fork strategy is outlined as one of the major elements of the EU Green deal which provides a set of objectives for agriculture to achieve by 2030. It addresses the challenges of sustainable food systems and underlines the strong connection between healthy people, societies and a healthy planet. The strategy is also the answer to the United Nations' Sustainable Development goals. The EU commission believes that a sustainable food system which is responsible towards the environment, health and society would not just ensure the food security of Europe but also bring new economic gains. This is even stronger implied in the times of the Covid-19 pandemic.

European food by default is accepted as a high standard for safe, plentiful, nutritious and high quality. This is the result of steps which have been taken in the last years materializing in various policies. The Farm to Fork strategy now aims to turn European food into a global standard also for sustainability. It is important to note that the Farm to Fork strategy by itself is not a legislative document. However, it sets the direction for the EU Member states and would be taken in account in all future agriculture policymaking. For the purpose of this paper we would highlight the relevant to this research objectives that the Farm to fork strategy presents.

The Farm to Fork aims to reduce the environmental and climate footprint of the EU food system and strengthen its resilience to ensure food security in Europe in times with great challenges such as climate changes and biodiversity loss. In practice this would mean that all stakeholders in the food value chain – starting from production, through transportation, distribution, marketing and finishing with consumption have a positive or neutral environmental impact. This would require a responsible usage of all natural resources such as land, water, soil, air, plant and animal life. In addition to ensure food security it is required to have sufficient access to healthy and nutritious food for the entire population in the EU. There is also the element of preserving the affordability of food and in the same time to generate fairer income throughout the food supply chain, focusing mostly at farmers. To facilitate all of the above the Commission is expected to submit a framework for sustainable food system before the end of 2023. The framework will promote policy coherence at EU and local level and aim to mainstream the topic of sustainability and food security.

In fact, just a framework on sustainable food system would not suffice as currently there is no clear definition or criteria which define such kind of system. The EU would need to invest in providing it by tackling the topics of certification and labelling of food throughout the different levels in the food value chain.

The Farm to Fork strategy also addresses the topic of circular bio-based economy which the Commission defines as a largely untapped potential for farmers and their cooperatives. The strategy calls for farmers to grasp opportunities to reduce GHG emissions from their activities by developing circular models such as production of renewable energy from manure.

3.1. New approaches to plant protection and fertilization

One critical point that the strategy addresses is the usage of chemical pesticides. By using the already established Harmonized Risk Indicator to quantify the progress in reducing the risks linked to pesticides, the Commission sets an ambitious target to achieve by 2030. Additional action will be taken to reduce the overall use and risk of chemical pesticides by 50% and the use of more hazardous pesticides by 50%. To do so the Commission will revise the Sustainable Use of Pesticides Directive, enhance provisions on integrated pest management and promote use of safer alternatives for crop protection. However, this commitment has already met a lot of backlash from the crop protection industry and member states. These ambitious targets should not risk the food security and competitiveness of European farmers. It is important that a right approach is adopted to ensure more responsible usage of chemical pesticides by leveraging new technologies such as digital tools and new seed and trait development.

One of the key competitive advantages of European agriculture has always been the fact that food originating from the EU member states has to respond on various safety standards. This has given a certain competitive advantage to the EU compared to other leading agricultural regions in the world. However, this higher quality doesn't always materialize in a higher price on the market. Thus, European farmers are still strongly dependent on their yields. The proposal to severely reduce pesticide usage needs to be carefully evaluated and requires a thorough impact assessment. Already some member states have voiced concerns about the scientific reasoning behind such an ambitious target. In addition, he stressed the need to carefully approach the legislative framework that the Farm to Fork aims to generate.

Research done by the European Parliament Research Service shows that a ban of plant protection product use can lead to 80% yield losses (EU Scientific Foresight Unit, 2019). Data shows that major grown crops like wheat can have a yield gain of up to 19% thanks to the use of the crop protection products, while in potatoes it can lead to 42% compared to crops grown without any pesticide applications. An example of that are farms in Denmark, specialized in potatoes, sugar beet and grass seeds which lost 270 euro per ha after a certain group of active ingredients were banned for us. The study points that a pesticide reduction is possible in countries with high productivity and high intensity of arable crop cultivation. An example is study in France where low pesticide usage in selected farms did not lead to a reduction of yield or profitability (Lechenet et al, 2014). It is important to underline that a possible reduction of plant protection usage in agriculture is almost impossible to precise due to the complexity. Different crops and cultivation systems have different needs and requirements in achieving desired yield and ensuring needed profitability. So, as it may stand that some intensive crop growing like cereals can retain current yield levels even with a reduction of plant protection products, others like vegetables may not be able to do so. In the end a total removal of pesticide usage is not feasible today and me be possible only after a technological jump in cultivation and crop growing.

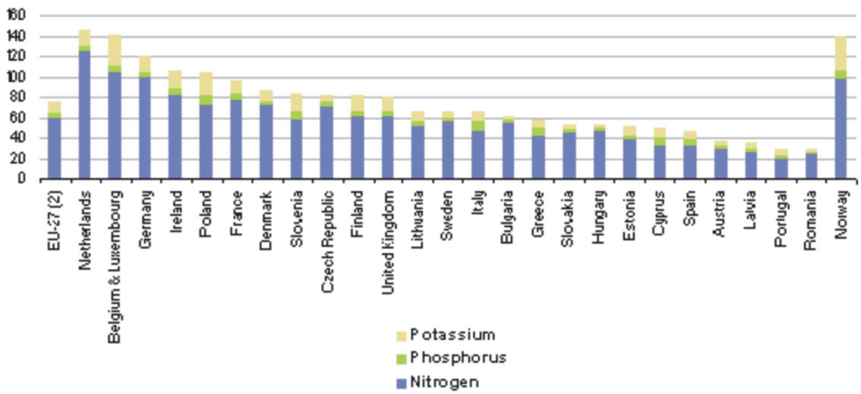
The topic of pesticide usage is one of the most discussed ones in recent years. Societal pressure has led a call for more sustainable practices which often is only correlated with a decrease in plant protection product usage. Mass media rarely changes existing attitudes but rather reinforces message and strengthens public perception through constant repetition. One of the key problems in the dialogue between stakeholders and media coverage is the lack of accuracy, objectivity and sourcing when it comes to statements and measures. The STOA research shows a 1999 study in 5 different countries found that more than half of consumers trusted NGO's messages on food safety, which was more than the people trusting scientists and even more of the authorities (EU Scientific Foresight Unit, 2019).

Farmers, who should be the ones which should be the focus of the dialogue, find plat protection products as a necessary input for their production. Due to the complexity of growing different crops and facing various external factors, precise forecasting of disease appearance and development is often not possible. Following the principles of integrated plant protection can ensure that pesticide treatments are used as a last resort but unfortunately with the currently available technologies this is not the case. Chemical treatments are viewed as an insurance for the farmer to reach the desired outcome.

Last but not least consumers, which are the ones heavily referenced in the Farm to Fork strategy, call for a reduction or avoidance of pesticide usage. Their expectations are often not substantiated with in-depth understanding, meaning they require a near-perfect product which is grown without any chemical usage. This however is almost not possible and delivering imperfect produce results in a lower price that the farmer receives for it. A reduction of plant protection product usage is only possible is society is well informed and sets the right expectation. However, this reduction again cannot result in total avoidance and needs to be adapted to the various production system requirements.

In addition to reducing pesticide usage the Farm to Fork sets out to reduce also fertilization usage by 20% by 2030 (Figure 1). To do so the Commission would propose an integrated nutrient management action plan which would ensure sustainable nutrient management throughout their lifecycle and ensure soil fertility.

Figure 1: *Estimated consumption of manufactured fertilizers*



Source: *EUROSTAT, Fertilizer consumption data in kg of nutrient per hectare*

The Commission will also work with Member States to extend the application of precise fertilization techniques and sustainable agricultural practices, notably in hotspot areas of intensive livestock farming and of recycling of organic waste into renewable fertilizers. This again poses the need of a careful assessment of the potential effect on yield. Nitrogen is the most used nutrient in agriculture. And is regarded as essential for a number of processes determining good crop growth and higher yields.

Furthermore, the EU Commission will act to reduce nutrient losses by at least 50%, while ensuring that there is no deterioration in soil fertility.

3.2. Supporting the move towards organic farming

The EU Commission will put forward an Action Plan on organic farming, as part of the Farm to Fork strategy. This will help Member States stimulate both supply and demand for organic products. It will ensure consumer trust and boost demand through promotion campaigns and green public procurement. This approach will help to reach the objective of at least 25% of the EU's agricultural land under organic farming by 2030.

Making 25% of EU's agriculture organic in the next 10 years will not, for example, reduce the climate footprint of the EU. The main reason behind this rationale is the yield gap between conventional and organic agriculture. Producing less within the EU will, broadly speaking, increase the need for importing certain products and hence occupying more land to produce these goods outside the EU. The yield gap between the two production systems has been widely covered in scientific literature (Smith et al., 2019; Wilbois & Schmidt, 2019).

Additionally, literature on land-use change, which would be the main driver of additional emissions, is ample. A recent study highlights the increase in overseas emissions due to a change in the farming system from conventional to organic: Smith et al. (2019) argue that food production would drop by 40 percent (expressed as metabolisable energy (ME)) under a 100 percent shift to organic food production in England and Wales. Direct emissions associated with organic crop and livestock production are smaller for organic farming compared with conventional: by 20% for crops, 4% for livestock and 6% overall. It is estimated that the land area needed to make up for shortfalls in domestic production is nearly five times the current overseas land area used for food for England and Wales. The GHG emissions occurring due to the increased need for land overseas depend on the kind of land use change (conversion of existing natural or semi-natural vegetation or pasture to crops). In the medium scenario, GHG emissions could increase by 21% compared to conventional agriculture.

It is important to think about consequences of increased agricultural imports. Importing food always means leaving a complex footprint of land and water use, GHG emissions and pressure on biodiversity in the producing country. These footprints differ greatly from country to country, depending on a multitude of factors, including growing and climate conditions, agricultural regulations, and productivity of the agricultural system. Now, this might differ from product to product, but EU agriculture has a comparative advantage on several agricultural products. For wheat, for instance, Europe has higher yields than the rest of the world. If one would now reduce agricultural area in Europe, more than this area would be needed elsewhere to produce the same amount.

Costs of eating organic-only are generally higher than a diet based on conventional food (Carlson, 2019). However, pricing of organic versus conventional products on the consumer level is very heterogeneous and strongly depends on the product category. One source analysing the German organic market finds an average increase of 5-70% for switching from conventional to organic food. 146 In contrast, price premiums on the producer level are usually easier to trace, as can be seen in the figures below for wheat and milk. As a reference, in 2017, households in the European Union spent 12,2% of their total consumption expenditure on 'food and non-alcoholic beverages'. This is the third most important category of household expenditure after 'housing, water, electricity, gas and other fuels' and 'transport' (Eurostat, 2020). Globally, household expenditures for food are relatively low in Europe. Nevertheless, the macro- and microeconomic theory behind yield declines and price increases on complex and closely connected international agricultural markets is highly complicated, hence, the impact of the shift to organic farming on food prices is difficult to predict. Furthermore, the price premium would probably disappear in case 'organic products' would become a commodity.

Having discussed possible methodologies for measuring and comparing the environmental impact of organic farming, it is important to highlight the yield difference between organic and conventional agriculture. This difference in yields, usually referred to as the yield gap is broadly documented and accepted in the scientific literature.

Several meta-analyses have been conducted in the past years, the three most widely recognised studies come to the following conclusions (average across all crops and regions):

- Seufert et al. (2012): – 5 to – 34% yield gap;
- de Ponti et al. (2012): – 20% yield gap;
- Ponisio et al. (2015): – 19% yield gap.

All three studies highlight, that the yield gap between the two production systems strongly depends on the crop type and region. Caldbeck and Sumption (2016) have provided a useful summary of the yield gap in different crop types. For the European Union, data for wheat and maize as well as milk indicates a rather strong variation between producing countries. Organic wheat yields in Germany are only roughly 40 percent of conventional yields, while in Italy, organic wheat yields are 85 percent of conventional yields. For maize the differences are not as substantial ranging from slightly above 60 percent in Poland and Austria to over 90 percent in France. For milk, organic yields range between 65 percent (Poland) and over 90 percent (Netherlands).

3.3. Output and productivity

A likely implication of the measure to European agriculture is a reduction of agricultural output and productivity. Reducing the use of PPP, increasing the area for organic farming, and setting aside land for protected areas will put pressure on agricultural land. A reduction of domestic production will, unless consumption levels in Europe will change significantly, be buffered by an increase of agricultural and food imports from third countries. As many of the trading partners of the EU have less strict environmental standards, a loss in competitiveness might be a consequence. Increasing imports is especially problematic when analysed from an environmental point of view. The EU is highly productive and yields of many agricultural products are amongst the highest on the planet. Outsourcing production to other countries will have negative effects on the environmental conditions of the trading partners, or as Fuchs et al. (2020) put it: "EU member states are outsourcing environmental damage to other countries, while taking the credit for green policies at home."

As a reference: In 2019, the European Union (EU-27) imported 153 million tons of agricultural products from outside the EU, worth a total of EUR 143 billion. Between 2002 and 2019, the volume of food imports annually increased by an average of 1.7%, while the value of imports annually increased by an average of 4.4% (Eurostat, 2020).

The targets of both the Biodiversity Strategy as well as the F2F Strategy are very likely to put considerable pressure on agricultural areas and consequentially on agricultural output. Increasing the agricultural area within the EU to maintain or increase current food production is unconvincing and not in line with the targets of both strategies. Essentially, this thought is part of the ongoing debate between 'land sharing' and 'land sparing', which Pearce (2018) summarizes as follows: "Should we be sharing our landscapes with nature by reviving small woodlands and adopting small-scale eco-friendly farming? Or should we instead be sparing large tracts of land for nature's exclusive use – by creating more national parks and industrializing agriculture on existing farmland?"

The two discussed strategies seem to combine both an increase of protected areas and a decrease of intensified agricultural production on agricultural areas, consequentially, combining both approaches. Agricultural land in the EU has, in fact, been declining in the past decades.

One of the main drivers for this is the expansion of artificial areas (urban areas, infrastructure, and industrial areas). At the same time, agricultural productivity in the EU has been increasing. For example, yields for wheat, maize and barley grew substantially since 1965 (these three main crops accounted for over 85 percent of total cereal production in the EU28 in 2018 (Eurostat, 2019).

On a global level, growing yields have contributed to the sparing of land for other uses. As Ritchie and Roser (2021) argue that, had yields stayed at the level of the early 1960s, the area needed to produce today's amount of cereals would be roughly 1,26 billion hectares bigger.

3.4. The expected results

By deriving from the Farm to Fork targets and following the basic assumptions (Table 1): organic farming results in 30% yield reduction in the EU, 50% in Germany; set-aside land for biodiversity does not yield anything (nothing harvested); when 25% organic farming and 10% set-aside land are achieved, 27% of reduction of crop protection products is already achieved; Remaining 23% results in at least 5% yield reduction – a rough estimate on the cumulative impact of the Farm to Fork measures suggested that productivity in EU would decrease by 20% and in the EU by 27%.

Table 1: *Expected results (3 different scenarios)*

		Aspect 1	Aspects 1+2	Aspects 1-3
EU	Current	F2F 25% Org	F2F + 10 n.p.	F2F - 50% PPP
Conventional farming				
Land (percent	92,5	75	67,5	67,5
Yield (percent)	100	100	100	92,87
Production units	9250	7500	6750	6268,725
Organic farming				
land (percent)	7,5	25	22,5	22,5
Yield (percent)	69	69	69	69
Production units	517,5	1725	1552,5	1552,5
Production units total	9767,5	9225	8302,5	7821,225
		-5,6%	-15,0%	-19,9%

Source: *own calculations*

The Farm to Fork strategy is high on the agenda of the agri-food community. Reactions range from emphasizing its positive aspects, at times despite negative expectations, to raising doubts or criticism. In general, ecologist NGOs welcomed the strategy as a timely potential game-changer to save the planet from destructive practices, and as a shift towards sustainable future policies, though commitments are still just aspirational. Others see it as a first real attempt at an EU food policy that favours biodiversity and health over agribusiness profits, aims at empowering consumers to make informed healthy food choices, and can offer opportunities to food and drink sector SMEs hit by the crisis. This entails changes in production and consumption patterns, including alternative proteins for food and feed.

Critics emphasize the lack of a scientific approach, such as in the case of the farming sector's claims that certain proposals lacking an impact assessment would endanger EU agriculture and mislead consumers.

Sector stakeholders question targets on pesticides as unrealistic and those on fertilizers as too ambitious, whereas targets on organic farming would be achievable by rewarding organic conversion. Others regret the absence of issues such as access to land, or consider new farm policy proposals are needed. In certain views, meat production and consumption are not adequately addressed by the strategy, despite being a main societal challenge.

On the other hand, the meat sector warns about simplistic measures putting off meat consumption and recalls meat's important place in the EU's rural economy and eating habits, and as a key component of circular food systems. Think-tanks generally welcome a strategy that identifies the conditions for reaching sustainable food systems, but warn that broad support for its realization is essential, in particular for overcoming its intrinsic limitations.

4. Conclusion

The recent challenges that Europe is facing have initiated a given way for an increasing focus and discussions on the topic of sustainable agriculture. Issues like loss of biodiversity and climate change have shown the importance of implementing practices to ensure a sustainable development for agriculture that takes in account the importance of economy, environment and society. These practices include selecting appropriate production systems fit for the specifics of the agricultural market in Europe, considering also the national and local agriculture needs. Sustainability and productivity should not be viewed as separate things and need to be achieved in parallel to ensure the future food security of the continent.

The right approach for European agriculture should consist of farmers adopting a more systematic approach on how they manage their farms. This means shifting the focus from managing inputs to maximize outputs to the overall interaction between the different elements like – water, biodiversity, soil, crops, cultural specifics, societal requirements, economic concerns. It is usually the case that investments in R&D are pointed in the direction of the largest types of production systems which are the ones bringing the highest profit. This may seem like a solid approach for many industries but for farming that is not the case. Farmers vary in what production systems they apply, how they realize their produce, what's their cultural and agronomical background. The high diversity of conditions both climatic, environmental and cultural throughout Europe present a complexity which might hide new opportunities moving forward.

European agriculture is faced with many challenges for the future. It has set out to become more sustainable without compromising the high levels of productivity it was able to reach in the last decades. This is crucial for assuring food security for European citizens. The EU commission has identified that to continue growth in the region it has to make sure this is done in a sustainable manner. To address the challenge of becoming more sustainable the EU has published the Green Deal – a set of legislative measures and policies which aims to make Europe the first climate neutral continent by 2050. Sustainable agriculture has been specifically addressed by the new Farm to Fork strategy, part of the Green Deal. Both documents show the priorities of the region and draw the vision for future Europe.

Sustainable agriculture is long-term process, a transformation, towards not just increasing efficiency in agriculture by producing more but by doing so in a sustainable manner that adds value to farmers, society and the environment. The European Union aims to be the front runner in this transformation and have set a bold vision for leading Europe towards a green economy. This is outlined in the EU Green Deal and Farm to Fork strategy, which focus on agriculture. The bold vision for farming in Europe needs to be reviewed systematically and a thorough impact assessment of the proposed measures needs to be done. A careful consideration of the opportunity that sustainability can provide for farmers and the risk to their ability to compete with producers in other parts of the world is needed.

Agriculture is uniquely positioned to address many of the challenges our planet faces today. Transforming agriculture towards more sustainable production models can lead to positive effect towards fighting climate change, preserving the environment and safeguarding biodiversity. However, this transformation would require development and adaptation of new technologies and strong collaboration between all stakeholders in the food value chain.

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Reshaping Finance
to Fighting Against Climate Change

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Abstract: Climate change and environmental degradation are challenges to economic development, natural systems and human life. The European Green Deal is a new strategy in response to these challenges. The strategy launched a transformation to resource-efficient and competitive economy without emissions of greenhouse gases to 2050. The EU Green Deal is an ambition plan that requires enormous investments, the main sources are the EU budget and debt instruments (climate and green bonds). The report addresses to two topics: the contribution of the EU public funding and debt instruments. The green bonds are innovative financial tools that can contribute to the achievement of the Paris Agreement objectives. Last decade a green bond market has emerged as a fast-growing segment of the financial markets. The analysis shows that investments in green finance is unequal allocated across the countries. The advantages of the green bonds are presented in the view of sustainable finance that can ensure the resilience of the economy to climate change.

Keywords: green bonds, sustainable finance, low-carbon economy, climate change

Introduction

Sustainable finance is a new concept of finance that integrates environmental, social and governance (ESG) measures into investments decisions. The sustainable finance is used to define new investment instruments that addressed to sustainable development such as sustainable funds, green and climate bonds, green credits and etc. The European Green Deal is a ground for shaping the financial approaches to make EU "green" and carbon neutral economy. The EU expects to mobilize at least €1 trillion of sustainable investments targeting to execute the Green Deal Investment Plan. The spending for climate and environmental actions will come from the EU budget, financial instruments from the European Investment Bank and capital markets. The paper provides an analysis of the financial products used by governments, public and corporate entities to support a transition to low-carbon economies. The first section of the paper is devoted to

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EU commitment to fighting climate change. The second section observes growth of green bond markets.

1. Review of the EU Cohesion contribution to fighting climate change

The Climate change mitigation and adaptation is a long term ambition strategy of the EU that will contribute to decrease the risk of natural disasters (floods, droughts, heatwaves, storms and others). Globally, damages and losses caused by weather and climate related extremes, such as floods, droughts, storms and heatwaves have increased over the past decades e and will likely further increase with the progression of climate change and socioeconomic development (IPCC, 2012(IPCC, (2012), Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]); IPCC, 2014 (IPCC, (2014), Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)].

Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA); UNISDR, 2015(UNISDR, (2015), Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland)). Most of the national, international and European investment globally dedicated to combat climate change. The international agreements such the 2030 Agenda for Sustainable Development, the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) and the Sendai Framework for Disaster Risk Reduction (DRR) have drawn the links between climate change adaptation, DRR and the goals to achieve sustainable development.

The European Commission has developed a comprehensive strategy with a clear regulatory framework (EU taxonomy) in order to achieve the goals to transition to a sustainable economy. The EU sets a Taxonomy aim at define objectives and criteria for investments in green projects that are coincided with Paris Agreement and decrease greenhouse-gas emissions.

According to the taxonomy, green investment should contribute to one of six objectives (climate mitigation and adaptation, sustainable water use, circular economy, pollution prevention and others).

The Taxonomy Regulation (Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives) defines national labels and standards for financial products that are available to finance sustainable projects. According to the taxonomy, green investment can contribute to one of six objectives (climate mitigation and adaptation, sustainable water use, circular economy, pollution prevention and the ecosystem). Article 8 of the Taxonomy requires financial and non-financial companies to provide information to investors about the environmental performance of their assets and economic activities

The Taxonomy regulation will be used for the financial instruments within the initiatives InvestEU. The regulation determines the EU green Bond Standards, green loans and the selection of the green projects should be done according to the EU Taxonomy (More information Taxonomy: Final report of the Technical Expert Group on Sustainable Finance ", Financing a Sustainable European Economy Technical report, EU expert group on sustainable finance, EU 2020).

The EU Climate law sets out objectives of climate neutrality in the Union by 2050 in pursuit of the goals at least 55% emission reduction by 2030 and to achieve climate neutrality by 2050 (Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law')). The EU will be a "climate-resilient society and will minimize vulnerability to climate impacts, in line with the Paris Agreement" (European Climate Law COM/2020/80).

In the current programming period (2021 – 2027), the cohesion policy is in accordance with the "Europe sustainability goal" (Sustainable development is a core principle of the Treaty on European Union and a priority objective for the Union's internal and external policies. The United Nations 2030 Agenda includes 17 Sustainable Development Goals (SDGs) intended to apply universally to all countries). The Cohesion Policy is focused on low-carbon targets through a new objective to promote "a greener carbon-free Europe: clean and fair energy transition".

The budget for the EU Cohesion policy (ERDF, CF, ESF+) for the period 2021 – 2027 is one third of the EU total budget (Current prices are calculated by applying annually a fixed deflator of 2% to the amounts in 2018 prices). The Multiannual Financial Framework (MFF) 2021 – 2027 integrates climate mitigation and adaptation under the main cohesion objective 2 .” A greener, low-carbon transitioning towards a net zero carbon economy and resilient Europe “. Overall, 25% of the ESFs will be focus on climate mitigation and adaptation in line with the Paris Agreement and the United Nations Sustainable Development Goals. At least 30% of the ERDFs will be directed to climate actions and 30% for green and circular economy (Proposal for a Regulation Of The European Parliament and of the Council on the European Regional Development Fund and on the Cohesion Fund, https://eur-lex.europa.eu/resource.html?uri=cellar:8d2f7140-6375-11e8-ab9c-01aa75ed71a1.0001.02/DOC_1&format=PDF).

The total amount of EU Multiannual Financial Framework (2021 – 2027) is € 2,018 trillion, consisting of the EU's long-term budget for 2021 to 2027 of € 1,221 trillion, supplemented by € 806.9 billion, through the Next Generation EU instrument (NGEU). Overall, around 30% of the ESFs will be focus on climate mitigation and adaptation in line with the Paris Agreement and the United Nations Sustainable Development Goals and at least 30% of the ERDFs will be directed to climate actions. Additionally, the JTF will support the adjustment to the transition to a climate-neutral economy by 2050, including the 55% GHG reduction by 2030, as established in the European Green Deal. The JTF will provide targeted assistance to regions and sectors that are most affected by the transition towards the green economy. At least 40% of the total EAGF expenditure and 35% of the EAFRD must be allocated to the environment and climate change.

Additional funds available for fostering climate adaptation and green economy will come from Horizon Europe, LIFE program. LIFE Program is the only EU financing source devoted exclusively to Environment and Climate Action (Regulation (EU) No 1293/2013 Of The European Parliament and of the Council of 11 December 2013 on the establishment of a Programme for the Environment and Climate Action (LIFE) and repealing Regulation (EC) No 614/2007).

The Green Deal (GD) and Climate change adaptation are long term ambition strategies the investment needs exceed the sum of available public funding, and grants delivered by the European structural funds.

The InvestEU Fund will mobilize around EUR 279 billion of private and public climate and environmentally-related investments over the period 2021 – 2030.

The traditional "Grant-Based" financial model cannot response to the investments needs of the private and public sectors to make transition to innovation and climate-neutral economy. Recently this grant model change shifting to blending mechanism (Types of blending – debt blending (- Interest rates lower than the market´s, longer repayment periods, reduced collateral requirements. Grant combined with an equity investment in a company; i.e., provision of capital in exchange for a stake of the company. The advantages are potential for higher returns, active role of the investor) allowing to combine EIB financing with additional investment from private sector. In particular, the use of blended financial products expected to increase because of leverage effect of the private funds. One of the model for blending finance is a combination of the EU budget (through structural funds) and the financial instruments (loans, guarantees and equity and venture funding) this model is directed to invest in green and climate change actions.

The European Investment Bank (EIB) uses its own resources and EU budgetary support to finance climate actions. In 2018, almost 30% of the EIB operations contributed to climate actions (climate change mitigation and adaptation, Communication From The Commission to the European Parliament, the Council, the European Economic And Social Committee and the Committee of the Regions Sustainable Europe Investment Plan European Green Deal Investment Plan, EU 2020, Commissisi-
on_Communication_on_the_European_Green_Deal_Investment_Plan_EN.pdf%20(4).pdf).

The previous program period (2014 – 2020) showed that financial instruments under shared management through the EIB and national structure have the ability to attract private capital which enables higher-risk climate and green infrastructure projects to be financed. Combining grants and financial instruments will continue to provide support for the environmental and green projects. The green and environmental projects don't generate the revenues but are beneficial for the economy and community, i.e. investments that do not generate sufficient returns but expected to be financially viable in the long run.(CPR article 54, Regulation (EU) 2021/1060 of the European Parliament and of the Council of 24 June 2021 laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, the Just Transition Fund and the European Maritime, Fisheries and Aquaculture Fund and financial rules for those and for the Asylum, Migration and Integration Fund, the Internal Security Fund and the Instrument for Financial Support for Border Management and Visa Policy). The combination grants and financial instruments is a model of blended finance, that is appropriate to apply in sectors or projects which needed financial support to be vital in long run, such as SMEs innovation, research development and innovation, energy efficiency, renewable energy, environment (including air, water and waste, biodiversity, forest protection), green infrastructure, and others.

2. The growing green bond market

2.1. Green Bonds characteristics

Alongside with EU funds there are other tools for financing such as debt instruments (green, sustainable bonds) which can help to mobilize climate and environmental finance. The Green finance have rapidly grown after Paris Agreement (2015) and UN Agenda and the Sustainable Development Goals 2030. The green bonds ensure investments in the field of clean energy production, transport, energy efficiency, water management, waste management and pollution control, conservation of natural resources, incl. land use, agriculture, forestry, information technology and communication, etc. The green bonds are appropriate instruments for investing in climate and green activities and provide stable investment profit.

The Green bond is a type of debt instruments where the proceeds will be applied to finance or re-finance eligiable green projects" (The Green Bond Principles 2017: Voluntary Process Guidelines for Issuing Green Bonds. Annual Report. Switzerland. https://www.icmagroup.org/assets/documents/Regulatory/Green- Bonds/GreenBondsBrochure-JUNE2017.pdf). Green bonds are "investments that deliver environmental benefits in the wider context of sustainable environmental development"(Ibid). Green bonds are debt instruments used to finance green projects that deliver environmental benefits. The main difference with traditional bond is the commitment of the issuers to use the proceeds to finance green and environmental projects.

Green bonds are issued by financial, non-financial, public entities and governments that are used to finance green, environmental – sustainable projects. The International Capital Market Association (ICMA) has developed a guideline for the Green Bond Principles (GBPs). The principles provide to issuers can be summarized as follows:(i) the use of proceeds for environmentally sustainable activities; (ii) transparency and visibility of the project proceeds, iii) determine the project eligible activities and costs; iv) annual reporting on the use of proceeds.

The issuer needs to declare that the proceeds will be towards environmental projects (renewable energy, energy efficiency, pollution prevention, carbon reduction technologies, green infrastructure, clean transport, recycling activities and etc. The EU taxonomy is a European framework that sets transparent principles and standards of the green bonds' issuance mainly in Europe. They are similar to principles of the International Capital Markets Association.

The issuers are obliged to declare that the proceeds will be used for environmental projects (renewable energy, energy efficiency, pollution prevention, carbon reduction technologies, green infrastructure, clean transport, recycling activities and etc).

Labelled green bonds are bonds that designate proceeds for climate or environmental projects and have been labelled as 'green' by the issuer (EU,2016, https://ec.europa.eu/environment/enveco/pdf/potential-green-bond.pdf).

The standards or labels used for assessing the greenness of the green bond investment. The issuers used these standards in order to qualify environmental use of proceeds. Standards, labels can differ in the degree to which they address the climate and low-carbon activities.

Green bond principles and standards are an important step towards the issuance of labelled green bonds and growing number of issuers from the private and public sectors.

The Green bonds are riskless assets and they offer investors diversification of their portfolio. A specific characteristic of the green bonds is a transparency of allocation of proceeds.

The OECD estimates that the needed investment for infrastructure is at least 6.9 trillion USD per year (Policy-highlights-financing-climate-futures.pdf (oecd.org)). The International Energy Agency points out that the total cumulative costs for renewable energy and energy efficiency technology should increase to 13.5 trillion to 2030 (IEA 2015a).

The EU estimates the investments to meet its target of reducing greenhouse gas emission by 55% is €350 billion by 2030 (https://www.spglobal.com/esg/insights/proposed-eu-standard-seeks-to-bring-clarity-to-ballooning-green-bond-market), and a further €130 billion for other environmental goals. It also aims to achieve net zero carbon emissions by 2050. The EU is counting on the private sector to fund those objectives, and for that, it needs European companies to increase green bond issues.

2.2. The Green Bond Market Development

Since 2007 the green bond market has grown rapidly the cumulative issuance has reached USD 1 trillion (https://www.climatebonds.net/market/explaining-green-bonds 17. IEA 2015a). At the end of 2015, the green debt capital market had reached a cumulative volume of USD104bn. The first green bond was issued from European Investment Bank (EIB) and World Bank in 2007. The green bond issuance went down in 2020 as a result of the COVID-19 pandemic however the issuance has recovered at the end 2020. European Investment Bank(EIB) remains the largest green bond issuer. The raised capital from debt market complements the EU budget for financing climate and green action.

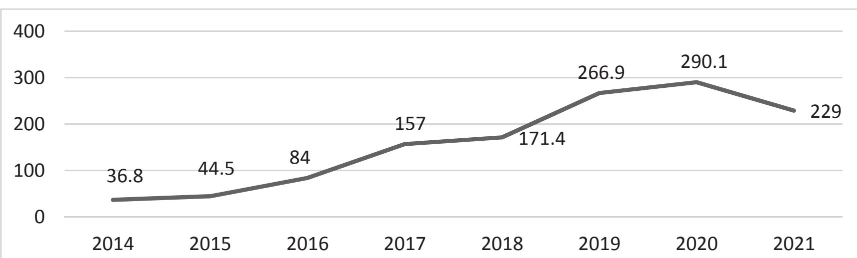
The volume of certified climate bonds increased by 14% in 2020. The certified amount reached $ 150 billion in October 2020, which becomes 15% of the green bond market.

The European Commission has issued green bonds approximately by €12 billion with focus to raise green and sustainable investments. The EU will mobilize funding for NextGenerationEU by green bond programme around up to €250 billion. The EU will become the world's largest green bond issuer in next years. The total market capitalization of EU government bonds is 9,1 trillion euro at the end of 2020. More than 62% of the volume of green bonds matures up to 10 years, almost 40% have a 5 – 10-year maturity in 2020.

In Europe the green bond market is not fully integrated, the amount of the bond issues is mainly on the domestic market (France, Germany, the Netherlands, Sweden and Norway). The green bond markets in USA, UK, China attract the interest of the international investment companies.

The Green bonds accounted around 89% of sustainable instruments in 2020, compared to 82% in 2019.

Figure 1: *Issued green bonds (in $ billion 2014 – 2021)*

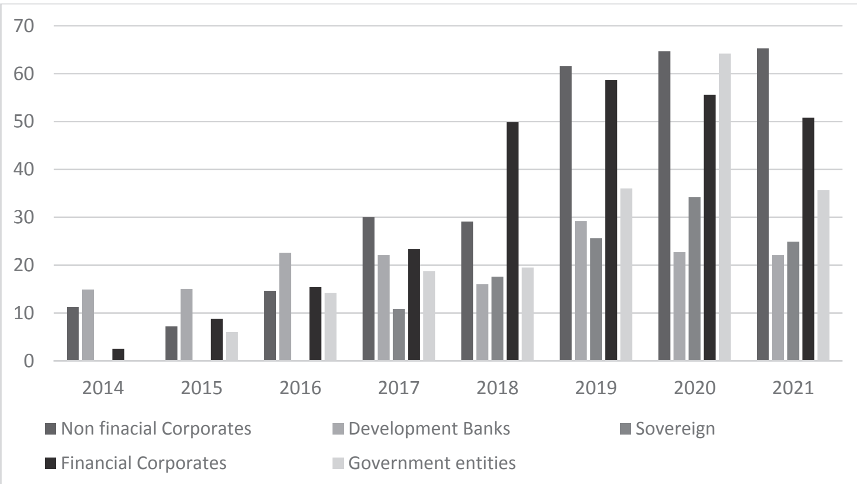


Source: *Climate bond initiatives* https://www.climatebonds.net/policy/projects/regional-projects

Sovereign green emissions reached € 82 billion at global level, the annual growth of green bond issues was 60% average compared to 2015. The sovereign issuers have contributed to 40% growth in 2020 compared to 2019. It is due to sovereign green issuance of the countries –Germany, Hungary, Denmark, Poland, Lithuania and Egypt.

The issuance of the Sovereign Green Bonds contributes to broaden capital market. The governmental decisions to issues sovereign bond to be support with large strategic governmental initiatives. The practice of some countries is to develop governmental programs for using the SGB proceeds for predefined green projects.

Figure 2: *Annual Green Bonds by Issuer Type ($ billion 2014 – 2021)*



Source: *Climate bond initiatives* https://www.climatebonds.net/policy/projects/regional-projects

The non-financial corporations remain the largest issuers of green bonds, but the growth was modest around of 6% in 2020. The slightly slump of the green securities' issuance is due to the growth of the social bonds' issuance towards recovery of the COVID 19 pandemic. The largest corporate issuance of green bonds was from the utility companies that have interest to finance renewable energy and climate projects. Corporate green bonds show a steady upward trend and they accounted around 40% of the total issuance. A number of the corporate issuers on the market are less than public and financial issuers.

Institutional investors such as pension funds, insurance companies, investment funds have contributed to the green bond market growth. The green bonds are preferable for institutional investors because they are low-risk investment and the returns are predictable.

Table 1: *Green bond issuance by countries 2020*

USA- $212 billon	Sweden $ 40,2 billion
China – $ 127 billion	Canada $ 25.9 billon
France- $115.6 billion	Japan $24.3 billion
Germany – $78.3 billion	Spain $34 billion
The Netherlands $52,1 billion	Italy $18 billion

Source: *Climate bond initiatives* https://www.climatebonds.net/policy/projects/regional-projects

The USA has a leading position, with green issuance $ 212 bbillion in 2020. China is the second country the green bond issuance accounted $ 127 billion.

The green bond issuances show a slight decrease, but this was due to lower issuance of Chinese banks last two years.

The green the market is strong in advanced countries, USA, France, the Netherlands, Germany, UK, and less advanced countries no practice of green bond issuance. France is the third largest green bond market after USA and China. In terms of bond market, the activity of new green issuances increased in Italy and Spain. The USA green bond market is dominated by local governments and public entities.

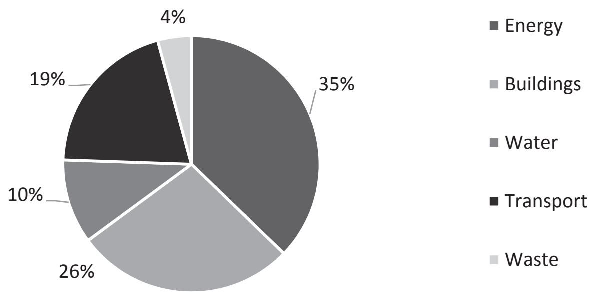
The EU is emerged as a global leader in the fight against climate change and committed to climate neutral economy by 2050 (The ECB supports the growth of the sovereign green securities by quantitative easing buying programme). Issuance from European governments will continue to grow in the next years, because of the needs to booster long term investments in Green deal and in decarburization of the EU economy.

The practice of some European countries is to develop programs for using the SGBs' proceeds and for defining the measurable criteria for the efficiency of the projects. Government can provide fiscal incentives (such as subsidies and taxes) aimed to encourage the issuers and investors in green bonds)

For example, France designed a green coefficient that expressed the relevance of the green expenditures that are adjusted to the six environmental priorities of the EU Taxonomy: climate change mitigation, climate change adaptation, water management, circular economy, pollution, and biodiversity (Caroline Harrison, Lea Muething, Sovereign Green, Social, and Sustainability Bond Survey The ultimate power to transform the market, Climate Bonds Initiative, January 2021). The sovereign bonds' proceeds to be target to national importance projects devoted to tackle climate issues.

Approximately 35% of green bond proceeds were allocated to renewable energy and energy efficiency, the second large sector is buildings with 26% of outstanding bonds. Other sectors such as water, waste and pollution control, accounted around 14% of the bonds (figure 3).

Figure 3: *Use of proceeds ($ billion 2020)*



Source: *Climate bond initiatives* https://www.climatebonds.net/policy/projects/regional-projects

Almost half of investments (46%) came from financial and non-financial corporates, including energy and utility companies.

For example, the French utility companies are among the main issuers of green bonds and the proceeds have been allocated to renewable energy projects (wind, solar, hydro-electric power and biomass (Annica Cochu, Carsten Glenting, Dominic Hogg Study on the potential of green bond finance for resource-efficient investments, ËU, 2016, https://ec.europa.eu/environment/enveco/pdf/potential-green-bond.pdf)).

Globally, green bonds have used to finance renewable energy, buildings, low carbon transport and energy efficiency.

Green bonds can offer some important benefits for green investment including:

- providing an additional source of green financing and green bonds are alternative for long term funding to green projects;

- the eligibility principles of the proceeds and activities allow the investors to planned cash flows of the expected proceeds of the environmental projects;
- green bonds provide investors (pension funds, insurance companies, institutional investors) to diversify their portfolio
- the EU Taxonomy provide principles and criteria for the EU green bonds that contribute to equal quality of the financial products and to achieve environmental effect. There is a restriction refers to funding only for the activities specified in the EU taxonomy;
- green bonds maturity is adjusted to climate and environmental project term and this precondition lead to reduction of the financial costs of debt;
- the green bonds price is more attractive compared to standard bonds. The increased interest from investors is due to the targeted spending of the investments;
- transparency of the use of the proceeds and low risk of the asymmetric information on the green bond markets;
- The green bonds represent a key financial tool that can contribute to the achievement of the Paris Agreement objectives.

Conclusions

The EU Taxonomy regulation defines technical criteria and green economic activities, the ICMA provides criteria and standards which require the investments to contribute to low-carbon investments and goals of the Paris Agreement. The investments in green projects are payable in a long term and a guideline for green bond standards to issuers and investors assure the ability the allocation of the investments and expected cash flows to be predictable.

Requirements for verificationand control of the green bond proceeds and to meet existing standards increase the transaction costs especially for small issuers. The governments, large non –financial corporations turn to green bonds to finance the carbon emission reduction and green infrastructure projects.

It is important to highlight that financial instruments and InvestEU will ensure to overcoming the shortage of Green Deal financing, and they are also suitable for risky climate and environmental projects with long-term returns and generating future revenues. The financial instruments will be essential to expand the projects with focus on renewable energy, green infrastructure, low-carbon production and to achieve the EU green measure package.

The vast majority of the green proceeds are used for low carbon transport, renewable energy, energy efficiency, large scale green infrastructure and other climate -friendly projects.

There are significant differences in the green bond market development within Europe. The differences are due to domestic bond market development, governmental strategies and solutions and applied incentives (tax or subsidies) to foster supply and demand of the green bonds.

Despite the favorable investment environment created by EU regulations, however less advanced EU countries where the bond market is not fully developed and open will meet obstacles for mobilizing private funding.

The EU plans are to mobilize around $300 billion in over the next years to finance green and sustainable investments and the EU will become a large green bond market.

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CHAPTER III

GREEN TRANSITION IN DIFFERENT INDUSTRIES

Green Economy: Next Generation Competitiveness – Reaching the Goal of Being Climate Neutral – is this Mission Possible for the Bulgarian Industry

Milena Angelova[1]

Abstract: The paper aims at identifying and analysing the effects of the transition to climate neutrality on the Bulgarian industry's competitiveness both in short and medium term, and on the basis of this to draw proposals for what can be done not only to safeguard, but most importantly to increase it, under the new reality, shaped by the pandemic, inflation and unprecedented increase of energy prices. It also aims at answering the question how to align market incentives and public funding with sectoral and global net-zero targets in order to stimulate the private sector to swiftly transform and grasps the opportunities of the green economy, navigating successfully through the transition process, while promoting resilience, sustainability and cohesion. Responses and actions taken by the industry and different governmental bodies were analysed and assessed, in order to arrive at better solutions and suggestions for future policy measures that will enable climate neutral competitiveness. This practical case is used to illustrate the evolvement of the economic theory, exploring how the policy of states and international unions becomes a factor with a growing importance that defines competitiveness.

Keywords: competitiveness, green transition, resilience, sustainability, market, pricing, policy measures

Economic theory foundations

The concept of competitiveness is subject to ongoing scientific interest and debate. Undoubtedly, the ecological factors and the energy prices are widely recognised to be important determinants of competitiveness (Kottler and Keller, 2006; Cho and Moon, 2005; Krugman, 1991). Together with marketing-related indirect effects – such as the increasing importance of the

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societal factors, corporate social responsibility and non-financial reporting (Regulation (EU) 2020/852), the ecological and energy factors also cause direct effects via the pricing mechanisms on the costs of the enterprises (Kleynhans and Swart, 2012; Porter, 1998; Holod and Reed, 2004) and in this way act as competitiveness determinants.

The current paper aims at identifying and analysing the effects of the transition to climate neutrality on the Bulgarian industry's competitiveness both in short and medium term, while at the same time drawing proposals for what can be done not only to safeguard, but also to increase it. There are at least two reasons that interline this aim as being topical and necessary: 1) as Bulgaria is the poorest EU member state, it needs to develop highly competitive industry that is able to generate added value to speed up and promote resilience, sustainability and cohesion; 2) the Bulgarian economy is characterised by high energy intensity and spends 1,5 times more energy resources for producing a unit of GDP, compared to the average European Union energy spending (Bulgarian Industrial Capital Association estimations, based on EUROSTAT data, finds the energy intensity in Bulgaria in 2018 to be 171,92 kg net energy per €1000 GDP (PPS) compared to 119,77 kg net energy per €1000 euro GDP (PPS) in average for EU-27), which makes it more susceptible to the possible effects of the green transition.

Political and legal framework

On 14 July 2021, the European Commission presented a package of proposals (COM(2021)550) for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels. This ambitious proposal is building on the goals announced in the Green deal package (COM(2019) 640) and envisages actions to promote decisively the climate neutrality and to embed it firmly in the areas of energy, land use, transport and taxation policies. The proposed legislative tools shall deliver on the climate neutrality targets and will fundamentally transform both economy and society, putting extra pressure on the energy prices, SMEs and micro-enterprises and all transport users in the short run.

A new Social Climate Fund (The Social Climate Fund would be financed by the EU budget, using an amount equivalent to 25% of the expected revenues of emissions trading for building and road transport fuels. It will provide €72,2 billion of funding to Member States, for the period 2025 – 2032, based on a targeted amendment to the multiannual financial framework. With a proposal to draw on matching Member State funding, the Fund would mobilize €144,4 billion for a socially fair transition) is proposed to provide dedicated funding to member states to help businesses and citizens finance investments in energy efficiency, new heating and cooling systems, and cleaner mobility. It strengthens further the Multiannual Financial Framework 2021 – 2027 (€2 trillion, https://ec.europa.eu/info/strategy/eu-budget/long-term-eu-budget/2021-2027_en) and the Next Generation EU (€723,8 billion, current prises, https://ec.europa.eu/info/strategy/recovery-plan-europe_en), where respectively 30% and 37% are ringfenced for actions promoting climate neutrality. Needless to point – an enabling condition for Bulgaria to access these funds is to comply with the applicable European Union legislation and to deliver on the underlined European political priorities.

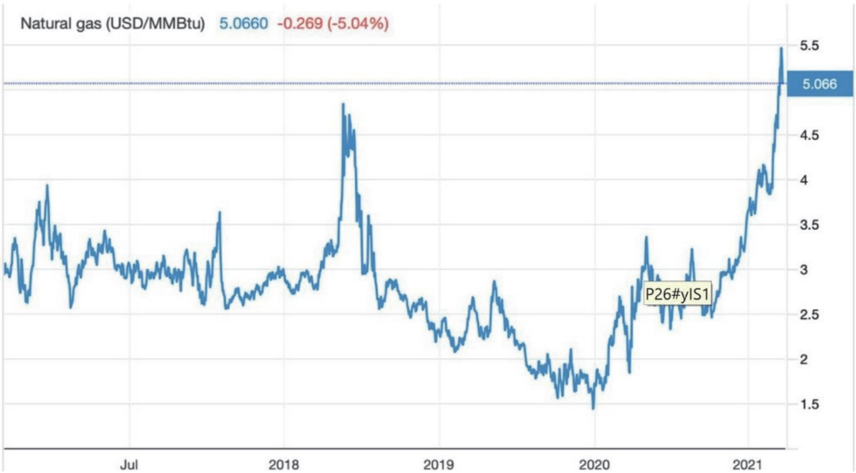
Avenues for safeguarding European competitiveness

As Bulgaria's legislation depends on the European legislative and normative environment, the Bulgarian industry and its competitiveness is affected by any legislative developments at EU level and shall anticipate such changes as early as possible in order to have sufficient time to prepare and adapt successfully. Therefore, it is worthy to take first the European perspective and contemplate the effects that climate neutrality and ecological factors produce on the competitiveness at that level.

There is no doubt that the above political developments will affect the costs of the energy, pushing the "brown energy" out, rising the prices of CO_2 emissions, promoting climate neutral technologies, in which the business shall have resources to invest, and making the access to finance only possible for those who obey the new requirements (Regulation (EU) 2019/2088). These medium-term effects have been further aggravated especially during the second half of 2021, by the rising inflation (In August 2021 the inflation rates are: EU – 4%, Bulgaria – 2,5%) and the steep rise of the natural gas prices, coupled with lack of wind that limits substantially the production of energy from wind (particularly in the North Sea). Recently, the global demand for energy has increased, following the re-opening of the economies around the world, with the gradual lifting of the pandemic-induced restriction measures. For this very reason, the natural gas price on the Asian markets has risen, motivating the producers to re-orientate their shipments to that direction. This affected the gas supplies to Europe, where the hot 2021 summer caused bigger energy consumption, and the following sudden cold wave rapidly emptied the gas tanks (In September the filling of the gas tanks in Europe was 71%, compared to 82% for the same period of 2020, according to the European Commission. Urgent unformal meeting of the European ministers of energy was held on 22 – 23 September as to discuss on measures and mechanisms for compensation both for citizens and businesses), pushing the gas prices to unprecedented high levels. Carbon, gas, electricity and energy prices are interrelated but also have their own dynamics (fig. 1). The ETS price has been gradually rising since 2017 to reflect climate policy fundamentals while energy (i.e., natural gas) markets face an economic shock (Elkerbout, 2021) – although the ETS price supports investments in the decarbonisation of the energy system, and ETS auction revenues provide member states with the funds to do so.

The European industry generates 8% of the global greenhouse emissions. Following the constant commitment to climate neutrality, during the last 15 years, it has already decreased it emissions by 35%. In order to maintain its competitiveness, while delivering on the EU goals, it is vital that a careful assessment is done at sectoral level of the impact of the increased greenhouse gas reduction target on the global competitiveness and ability to transition. This shall also map out the impact of increasing carbon prices on each sector's ability to compete globally, while being in a condition to invest in its transition. Rapidly rising carbon prices in EU ETS, coupled with the expected aggressive reduction of free allocation, would push higher carbon cost, leakage and loss of competitiveness for European production. Further, as level playing field is key for nourishing the competition potential, an effective and fair global carbon pricing is needed. Otherwise, the revised EU ETS should contain adequate provisions to prevent carbon leakage. In the light of this, the Carbon Border Adjustment Mechanism (CBAM) shall become one part of the mix of relevant instruments, under certain conditions that would fully safeguard against leakage: it could come into play after a pilot phase for some sectors, following an extensive analysis of sector specificities, including its impact on exports and assessment of potential trade risks. The best use of CBAMs will be made only if they are additional and complementary to free allowances and the compensation for indirect costs in the EU ETS. Equally important element is to secure the availability of sufficient clean energy at a competitive cost. Decarbonising industry involves a step-change in clean energy demand, coupled with the raise of the conventional energy sources. Energy security, resilience and cost efficiency for Europe's industry and consumers will become more critical, requiring an extra effort for forward-looking planning, implementation monitoring and swift elaboration and placement of support measures when such are necessary to safeguard the competitiveness.

Figure 1: *Natural gas prices (USD/MMBtu) and EUA prices (DEC21 ICE Future – not inflation-corrected, The source of data for the natural gas prices is* **https://tradingeconomics.com/** *and for EUA process –* **https://www.barchart.com/***)*



Source: *Trading Economics*

Source: Barchart.com

Current energy challenges the Bulgarian industry is confronted with

A clear Road Map for ending the "brown energy" use is an enabling condition for getting the National Recovery and Resilience Plan of Bulgaria approved and rolling. The European institutions, therefore, firmly insist Bulgaria to commit to particular timeline for decarbonising its economy. Unfortunately, the debate delayed too much and now will happen under severe time pressure, but still a national consensus shall be sought on such an important matter. To benchmark the winners, the example of Germany can be quoted, where the national debate took nearly two years and as a result, a comprehensive and detailed Report was published by the Commission on Growth, Structural Change and Employment (https://www.bmwi.de/Redaktion/EN/Publikationen/commission-on-growth-structural-change-and-employment.html), that gave the basis for adopting the necessary legislation and preforming the necessary reforms as to end up by 2038 production of electricity from coal, backed by sufficient financial resource – €40 bn.

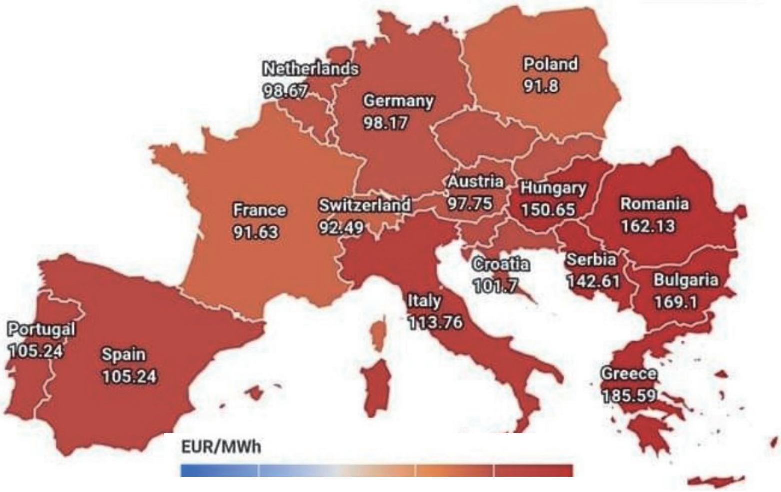
The need for green transformation of the Bulgarian energy supply can only be met successfully if it is based on a sound plan, elaborated on the basis of precise data and backed by consensus between all the stakeholders. But before arriving there, it is necessary first to guarantee the smooth functioning of the Bulgarian energy market and to prevent any market failures. Unfortunately, there is still much to be done in that direction, as the recent experience shows. Some examples shall be analysed – as they can help identifying the causes of such market failures and arriving at conclusions that shall help ensuring smooth functioning of the energy market.

In August 2021, the industrial energy price in Bulgaria marked absolute record (Fig. 2).

This price record seriously endangered the competitiveness of the Bulgarian industry and the whole economy, as it swept away the preciseness of any forecasts and price calculations of the companies, being 3 times higher than the official forecast of the State Agency of Energy Regulation and 50 – 70% above the energy prices on the main export markets for the Bulgarian industrial production – Germany, Italy, France and Austria. Under such circumstances, the companies found their annual plans being dramatically unprecise and it is quite unlikely that they can adjust them using only own resources. Hence, the competitiveness and resilience of the whole Bulgarian economy was at stake.

There are different reasons for the energy market failure – such as supply shortages, speculative and manipulative actions, export speculations, and lack of connectivity with the European electricity grid.

Figure 2: *Day ahead average energy price in Bulgaria, 4.08.2021*



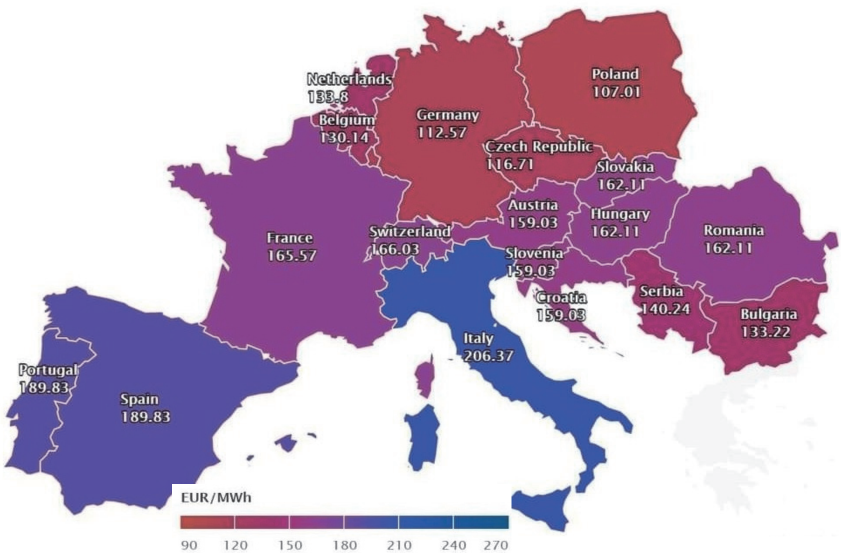
Source: *https://www.energylive.cloud/*

The supply side in principle, under such crisis situation, is expected to be secured by the state, which provides sufficient funding to support the production of electricity from coal, and guarantee the so cold “cold reserve” in the complex of power producing plants known as “Maritsa”. Let’s take the example of the state-owned power producing plant “TPP Maritsa East 2” EAD, which is being subsidised by the state with the view to maintain its capacity as it is of particular importance for the energy security. During the month of August, “TPP Maritsa East 2” EAD has been working at only 25% of its producing capacity (without any particular reason) and has not made any effort to offer electrical energy on the market, even when the price exceeded its break-even point (estimated at 171,59 BGN/MWh), creating in this way double trouble for the industrial users by missing the opportunity to: (1) increase the supply and push down the prices, and (2) cover its variable costs at least, contributing to its maintenance costs, instead of waiting the state to take care of them. The other two companies in the complex – “TPP AES Galabovo” and “TPP Contour Global” also contribute in general for the high price of the electricity, as they receive statutory allowances, which are not market based or defined based on the transparent European practice of bidding for capacity. Those allowances are paid by all customers, as the price of the electricity includes as component the so cold “societal liability”. All these elements further contribute to price increase.

The export of electricity from Bulgaria to Greece (both directly and indirectly through Republic of North Macedonia) has not been limited during the problematic month of August, and continued at full pace, aggravating the supply shortage. This domestic electricity supply shortage couldn't be compensated, as Bulgaria is not integrated in the pan-European energy market, due to lack of capacity for integration via Romania, Hungary, Czech Republic and Slovakia.

Motivated by the united call of all the Bulgarian industry representatives, the Bulgarian government took actions to address the electricity price crisis of August 2021, by: (1) securing that "TPP Maritsa East 2" EAD operates at its full capacity, (2) temporary limiting the electricity export (Greece, for example, also has introduced some electricity export limitations – e.g., towards Italy), (3) contemplating support measures to compensate the industrial users for the damages caused by this market failure, as it was obvious that the market instrument "day ahead" failed to provide balance between the supply and demand using the market forces, but was heavily affected by the actions of non-market alliances. The short-term result of these measures was positive – at least for the month of September, when the electricity price in Bulgaria has been the second cheapest in Europe (after Poland – fig. 3), but it is clear that more sustainable decisions are necessary in the future.

Figure 3: *Day ahead average energy price in Bulgaria, 30.09.2021.*



Source: https://www.energylive.cloud/

Bulgarian electricity price forecasts

Considering the trends on the European and on the global electricity markets as a starting point, some projections can be made about what will happen further with the price of the electricity for the industry in Bulgaria. Such analysis shall enable the policy makers to assess if the future developments of the prices will once again put at stake the competitiveness of the Bulgarian industry and economy as a whole and to arrive at potential measures that can help hedging such a risk.

The State Agency of Energy Regulation defines the annual market price during the period 1.07.2021 – 30.06.2022 of basic energy load amounting at 119,00 BGN/MWh. Taking stock of the current prices, of the future quotations on the Bulgarian market for the fourth quarter of 2021 – 164,65 €/MWh, as well as of those for the first two quarters of 2022 –166,60 €/MWh and 90,20 €/MWh respectively, an assertive forecast can be made for a price of 259,37 BGN/MWh of the basic energy load for the period in question. That means that the official price forecast of the State Agency of Energy Regulation will be exceeded in average for the period in question with 140,37 BGN/MWh – for each and every industrial user! Even under the assumption that a future stabilization will occur on the very stressed European electricity markets – resulting, for example, in a consolidation around more adequate prices of electricity after the winter passes, together with spreading part of the operational electricity costs for some following periods alongside the value-added chains, etc., such stabilization can eventually be viable not earlier than the second quarter of 2022.

Therefore, the only way to safeguard the competitiveness of the Bulgarian economy is to offer to the industrial users support so that they can cope with the unprecedented and unexpected raise of the electricity price. Such support is legally sound, thanks to the prolongation of the State Aid Temporary Framework (Amendments to the Temporary Framework to support the economy in the context of the coronavirus outbreak: 1st (OJ C 112I, 4.4.2020, p. 1 – 9), 2nd (OJ C 164, 13.5.2020, p. 3 – 15), 3rd (OJ C 218, 2.7.2020, p. 3 –8); 4th (OJ C 3401, 13.10.2020, p. 1 – 10), and a new proposal was made by the EC on 30.09.2021 to extent it by 6 more months till June 2022) and the Regulation (EU) No 360/2012 (Commission Regulation (EU) 2020/1474 of 13 October 2020 amending Regulation (EU) No 360/2012 as regards the prolongation of its period of application and a time-bound derogation for undertakings in difficulty to take into account the impact of the COVID-19 pandemic (Text with EEA relevance), OJ L 337, 14.10.2020, p. 1 – 2). Based on the calculations made above, an assumption can be made to compensate at least half of the excessive burden of 140,37

BGN/MWh – that means 70 BGN/MWh. During the period 1.10.2021 – 31.03.2022, the electrical energy consumption of all business users in Bulgaria can be forecasted at 12 TWh – so that will mean that a total amount of 840 m BGN is necessary to trigger such a compensation measure. Let's contemplate on how this amount can be provided?

The State Agency of Energy Regulation estimates the price for the electrical energy, produced by Kozloduy Nuclear Power Plant during the period 1.07.2021– 30.06.2022 to be 55,01 BGN/MWh, assuming net production of electrical energy of 15 601 067 MWh and forecasting total necessary income of 858,220 m BGN, where the net return is estimated to be 59,603 m BGN (6,94%). On the basis of the assumptions made earlier in the paper, and taking into account the forecasts for net energy production of Kozloduy Nuclear Power Plant for the fourth quarter of 2021 and for the first quarter of 2022 to be totalling to 8,3 TWh, from which 1,87 TWh for the regulated market, and 6,43 TWh for the free market, the additional net return (above the return that has already been calculated and above the huge profit accumulated so far) – only for the six month period in questions will exceed 1,31 bn BGN! Even "TPP Maritsa East 2" EAD is expected to generate profits during the second quarter of 2022 – what has never happened since many years. The National Electrical Company of Bulgaria – NEK EAD and the water power plants also are expected to realise huge profits, and only the gas power plants perhaps will operate without profits – depending on the fluctuations of the natural gas prices.

Taking stock of the above estimations, a conclusion can be made that the whole amount needed to compensate the business users for the unprecedented and unpredicted raise of the electricity prices for a period of six months (840 m BGN), comprises less than 64% from the expected excessive profit (above the forecasted levels and that has already been gained) of Kozloduy Nuclear Power Plant. At the same time, it is an established practice within the system of the energy production in Bulgaria (Bulgarian Energy Holding Company and Ministry of Energy of the Republic of Bulgaria) to distribute interim dividend – therefore, it shall not constitute a problem to utilize part of the excessive profit generated, distributed as dividend and taxed properly, to be transferred currently within the state budget system for compensating the business electricity users for the unprecedented price shocks. The payments can be executed monthly via the system of the National Revenue Agency, on the basis of submitted accounting reports, that prove the current electricity consumption of a given company. Such a compensation, if it is organized and channelled to the businesses promptly – e.g., before the years' end, will also have anti-inflation effect, as it will allow the companies to re-adjust their production plans, price calculations and offers.

Again, to benchmark the European practices, it shall be pointed that the electricity intensive industry all over Europe is being supported in order to preserve its competitiveness in the current uncertain situation generated by the sudden energy prices fluctuations and taking into consideration the inability of the companies to re-negotiate their already concluded contracts.

Necessary reforms to support the green transition of the Bulgarian industry

Taking a medium to long term perspective, if right measures are put in place immediately as to safeguard the current competitiveness of the Bulgarian industry, this will also make it possible to plan, gain consensus and execute the necessary forward-looking reforms, that will help the Bulgarian industry to accomplish successfully the green transition in a longer term. Of course, such reforms must aim at preserving and further promoting the competitiveness, as well to safeguard the social prosperity. Such complex challenges can only be successfully met if all the imperfections existing on the Bulgarian electricity market are corrected, so that the market is free, flawlessly operational and able to perform its core function – to set prices on the basis of equilibrium between the demand and supply within the country. The necessary measures were prescribed by the European Commission in its report on the Compliance Plan of Bulgaria 2021 regarding art. 20 p. 5 of the Regulation 2019/943 (European Commission Recommendations of 20.05.2021 regarding art. 20 p. 5 of the Regulation 2019/943 concerning the Compliance Plan of Bulgaria) and they require complex actions to exclude any possibility of market manipulations or competition distortions on the Bulgarian electricity market. Once those recommendations are implemented, the following actions should focus at elaborating a Road Map for Decommissioning the Coal Power Plants, stating a precise framework – e.g., closing the coal power plants till 31.12.2035 (In October 2021, the Bulgarian Government, in connection to its decision to submit the National Recovery and Resilience Plan for approval, announced that the date for closing production of electricity by coal shall be the end of 2038, and some further negotiations to extend this deadline till 2041 are considered), where it actions shall be envisaged for safeguarding both the electricity supply security and the well-being of the workers concerned. The decommissioned energy capacity can be partly replaced by renewables, and an open expert-level debate is needed regarding the future of the nuclear energy. As far as the affected workers are concerned – approximately 8 thousand miners and 12 thousand power engineers, at average age of 45, system of compensation and re-skilling shall be elaborated, tripartitely negotiated and put in place. To find sustainable employment shall be viable – having in mind that the Bulgarian labour maker loses 40 000 people every year – just because of the negative demographic trends. There are still some possibility resources to be ringfenced in the National Recovery and Resilience Plan and the Partnership Agreement 2021 – 2027 to support such measures, and also to support the economic transformation of the business by providing grants and other stimuli.

Special attention shall be devoted also to improve the business environment and cut the red tape – especially when it comes to planning and implementing new investments in renewables – where to obtain all the necessary permissions often can take a year.

Extra efforts are necessary to address one more malfunction of the Bulgarian electrical energy market– its unique characteristic of not only having the wholesale electricity price much higher than the retail price, but also the fact that the ratio between these two prices is as twisted as 5 to 1. The situation is exactly opposite in the whole EU and unless this is remedied, it implies uncertainties and risks for the competitive capacity of the Bulgarian economy.

Precise contemporary data are also necessary to be gathered as to provide a correct picture for the current state of the Bulgarian forest fund, in order to enable the best negotiating output under the new ETS framework.

Conclusion

The new economic realities change not only the business environment, affecting the rules of the game and competition, but they also challenge the classical economic theory. The growing importance and increased effects of the political commitments and political decisions over the competitiveness through the compliance costs and efforts certainly question the effective action that ‛the invisible hand’ of the market can take alone. The elements discussed in the paper here illustrate, on the basis of the recent case of the Bulgarian industry and how it is being affected by the rising energy prices, that competitiveness is no longer individual endeavour of the companies, but rather shall be seen in a wider context – at sectoral or even national level and being strongly influenced by and dependent on the applied policy measure – both at European and national level.

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The Green Context of Political, Economic and Social Development and the Tourism Industry

Mariya Stankova[1]

Abstract: Over the last two decades, development and progress, in their dual nature, are determined by one condition, defined as necessary, namely sustainability. There are numerous definitions of the category of ‛sustainability’, presented primarily in relation to development, but the discussion in this direction continues. In the “triangle” of ecological balance, economic security and social justice, sustainable development requires the achievement of important social and economic goals, in parallel with the ongoing efforts to protect the environment at various levels – from local to global. The question on the agenda, however, is, to what extent has modern society made progress in its development? His answer cannot be unambiguous. On the one hand, undoubtedly, development is observed with increasing intensity. On the other hand, the economy, as a means of development, uses physically limited resources, the source of which is nature. In line with Leibniz’s fundamental paradigm the ens line of limits and endless progress, the present study aims to examine the effects of the tourism industry and its relationship to the new realities of the UN 2030 Agenda and the European Green Deal. Exploring the topic, the advancement focuses on the challenges and opportunities for and against the tourism industry in the transition to the new realities of sustainability.

Key words: Sustainable Development, Green deal, Tourism, Climate action

1. Introduction

Development is among the main motives for human social and economic activity. Attempts to explain the nature of development are “as old as the world” (Soares & Quintella, 2008), with many published works and discussions on the subject. In a broad sense, development is associated with growth, maturation, achieving fullness in terms of potential. However, even after its long story, the debate remains controversial and instigating as the society and economy do not dispose of entirely unprejudiced measurements. As well the unified opinion regarding the characteristics of the development’s completeness status is not existing and probably, could not be achieved. The

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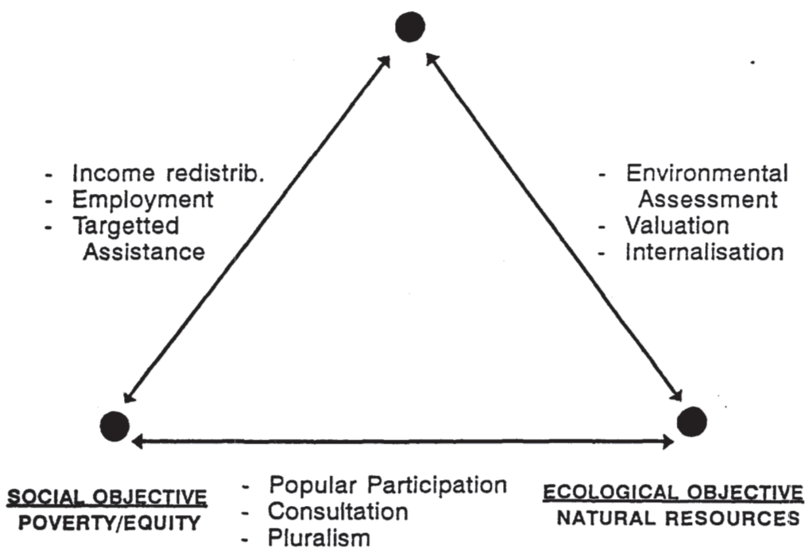
understanding of development for humanity is changing during the process itself, as it reflex the modifying subjective views. Therefore, it could be assumed that the concept of development largely reflects the value system and moral norms of society and individuals.

However, the question on the agenda is, to what extent has modern society made progress in its development? Definitely, his answer cannot be unambiguous. On the one hand, undoubtedly, development is observed, but it proceeds with increasing intensity. On the other hand, the economy, as a means of development, uses physically limited resources, the source of which is the nature. The fundamental paradigm of conscience of limit and Leibniz's infinite progress (1646 – 1716) dictates that resources be used in a way that provides a basis for development for a very long period of time (to infinity). A formulation that can be interpreted as ensuring the continuity of the development process as its intensity increases. Other scholars, philosophers, and thinkers such as Condorcet, Kant, Hegel and Marx, in turn, reflect on the nature of progress, as the interpretation they give differs, but not entirely, from the idea of the infinity of progress. For them, it is a non-linear process inherent in civilization and characterized by continuity, but also by inconsistency in the direction of "the constant search for wealth" (Rist, 2001, p.70). Traditionally, the prevailing philosopher understandings, related to the issues of development in the modern world order, presuppose the application of a conceptual approach. A mean through which the existing integrities and recurring connections, dependencies, relations, universals can be deduced and explained. Because, nowadays, development and progress, in their dual essence, are discussed by one condition, defined as necessary, namely sustainability.

1.1. On the question of the nature of sustainable development

The emphasis on the interconnected, deep and irreversible link between the economic development and the natural environment during the United Nations Conference on Environment and Development (UNCED), also known as the 'Earth Summit' (Rio de Janeiro, 3-14 June 1992), provoked a rethinking of the overall philosophy for the future of human civilization. Although back in 1987, the World Commission on Environment and Development has published a report entitled "Our Common Future", also known as the "Bruntland" report, which is the key tool used to promote the concept of sustainable development. The classical definition of sustainability in relation to development, given in it, defines "sustainable development ... as ... development that meets the needs of the present, without depriving future generations of the opportunity to meet their own needs." (Report of the World Commission on Environment and Development: Our Common Future, 1987). There are numerous definitions of the category "sustainable development" and the discussion in this direction continues today. Over the years, the understanding of sustainable development has expanded in the direction of the so-called "magic triangle of sustainable development" (Munasinghe, 1992), which covers both the ecological balance and the aspects of economic security and social justice (Fig. 1). Important social and economic goals have been formulated, in parallel with the ongoing efforts to protect the environment at various levels – from local to global.

Figure 1: *Trade-offs among the Three Main Objectives of Sustainable Development*



Source: *(Munasinghe, M. (1992). Environmental Economics and Sustainable Development, Paper presentedatthe UN Earth Summit, Rio de Janeiro, Environment Paper No.3, World Bank: Washington, p. 2)*

The three dimensions of sustainable development – economic, social and environmental – are interdependent. The interaction between them creates a synergy effect, especially the assessment is based on the main criteria for sustainable development – economic stability, social justice and environmental sustainability (Report of the World Commission on Environment and Development: Our Common Future, 1987). While the essential idea of sustainability is presented through two key characteristics: continuity and increasing intensity. That is why the development is sustainable, in which a process of real increase of well-being is established, in the presence of conditions for continuous continuation of the development and increase of its intensity.

1.2. Review on the Sustainable concept

As Ivanova (2018) notes, achieving sustainable development is global in nature and is part of world politics. Going back in time, the beginning of reflection on the essence of sustainability is set in connection with economic development and in particular – with the management of natural resources in a way that preserves their reproductive potential. The first steps in this direction were taken in Germany as early as the 17th century in terms of forest resources. The modern understanding of sustainability presupposes the preservation of the entire resource base of development. In addition to the natural environment, as a basis for all activities, the definition also includes social and human capital, cultural heritage. It builds on the conceptual constructions of the 1970s, emphasizing the link between the environment and the economy. The study of the literature on the problems of sustainable development outlines a set of definitions, but among them the following can be mentioned as more important:

- The World Commission on Environment and Development (Brundtland report) (1987) – Sustainable development is development that meets the needs of the present without depriving future generations of the opportunity to meet their own needs.
- To David Pierce (1993) – Any society that sets itself the task of sustainable development must develop economically and socially in a way that minimizes those activities whose costs are at the expense of future generations, and when these costs are inevitable – to provide compensation to future generations for these costs.
- The Organization for Economic Co-operation and Development (1998) – The supreme principle of sustainable development is to maximize human well-being and provide an appropriate economic, social and natural base for future generations.
- Donella Meadows (1998) – A good life for all people in harmony with nature.
- Hartmut Bossel (1999) – Sustainable development is the joint evolution of human and natural systems.

In the long-term process of affirming the concept of sustainable development, a number of key events stand out as a priority of humanity:

- 1972 – First World Conference on the Environment in Stockholm;
- 1983 – Report of the BRUTLAND Commission;
- 1987 – Report of the Brutland Commission “Our Common Future”;
- 1989 – Preparation of the conference in Rio;
- 1992 – First World Conference of the United Nations, in Rio de Janeiro;
- 1997 – RIO + 10;
- 2002 – Second World Conference on Environment and Development in Johannesburg
- 2002 – 2007 – meetings in Gothenburg, Lisbon, Leipzig;
- 2009 – Copenhagen Conference – COP 15.
- 2012 – The United Nations Conference on Sustainable Development (Rio + 20) in Rio de Janeiro, Brazil – endorses the document “The future we want”, upgrading the Millennium Development Goals with a set of sustainable development goals.
- 2015 – The UN General Assembly adopts 17 Sustainable Development Goals (Figure 2).

Figure 2: *Sustainable development goals*

Source: *(United Nation, 2015, https://sdgs.un.org/goals)*

- December 2015 – The Paris Agreement on Climate Change is adopted.

2021 is expected to be of particular importance. The 15th Meeting of the Conference of the Parties (COP 15) and the 26th United Nations Conference on Climate Change (COP26) (COP 26. 2021, July 16) is set for the period of 1 to 12 November 2021, Glasgow, United Kingdom. The COP26 summit is expected to bring together countries to accelerate action and to achieve the goals of the Paris Agreement and the UN Framework Convention on Climate Change. And one of the initiatives provoked young people aged 16 and under to show their vision for the future, as part of the #TogetherForOurPlanet #CreativeEarth competition (Creative Earth Competition, 2021).

2. Methodology

The research methodology is consistent with the outlined focus of the study. It uses a mixed approach, combining traditional scientific methods: historical, analysis and synthesis, literature review, case study. Official websites of Bulgarian and international institutions have been reviewed and studied, as well as titles and articles from publications in various media. The main results of this theoretical in nature research are systematized and the relevant conclusions are made. The choice of a similar approach is conditioned by the view that the study of the considered documents, processes and examples using a combined methodology allows making the right decisions to limit or stimulate the resulting effects. Especially in conditions of great obscurity and uncertainty, both of economic and environmental and political nature.

3. Results and discussion

3.1. The green deal and climate action as a framework for the tourism green engagement

Sustainable development, and in particular climate action, is at the heart of the EU green action (the EU climate action and the European Green Deal). The European Union is one of the parties most strongly involved in sustainable development and climate issues. By 2050, the goals are to make the continent the world's first climate-neutral. Along with reducing greenhouse gas emissions, the EU is committed to actions that will help adapt to the effects of climate change. Again, by 2050, Europe is expected to achieve a climate-resilient society. The essence of the European Green Deal is structured on an ambitious package of measures aimed at significantly reducing greenhouse gas emissions, investing in cutting-edge research and innovation, and protecting Europe's natural environment. In July 2021, the European Commission once again reviewed and proposed for consideration the various instruments for reducing greenhouse gas emissions. However, according to information published in the Financial Times (Khan, 2021b), a total of seven EU member states, including Bulgaria, are against the so-called "Package 55" reduction of greenhouse gas emissions by more than 55% over the next 10 years compared to the base year 1990 (Khan, 2021a), which is the latest proposal for the Green Deal. And the main reason for such a position is the expectations for an increase in direct and indirect taxes, which will be expected to be introduced for fuels and heating of households, and which may become "regressive" for the citizens of the union, unable to afford allow green alternatives.

Against this background, the tourism industry is undergoing significant changes. Placed in the conditions of extreme dependence on political decisions, in the conditions of the ongoing Kovid-19 pandemic, tourism is fighting for the new parameters of sustainability. In strategic terms, on the one hand, the principle of compliance should be mastered, related to the manifestation of the principle of additionality (Kuznetsov, 1975), where the basic statement requires a parallel assessment of the management processes applied to macro-, meso- and micro-level in the socio-economic systems (Uzunova, 2004). On the other hand, the categories of sustainability and variability of entities in tourism and related sectors should be analyzed, based on the principle of continuity (in terms of changes) in socio-economic systems. Through it, it is through continuity that the conformity or inconsistency in the behavior of the subjects in the transition from existing to new market conditions can be explained and "bound" (Uzunova, 2004). In the specialized literature, for the purposes of establishing dynamic changes, the use of the principle of transformation is also proposed (Yakovetz, 2011). Its application is aimed primarily at ensuring the need for constant determination of the boundaries, forms and content of changes in macro- and micro-subjects in a given social system from one qualitative state to another (Kurnysheva, 2002). Observing the set desired state in the conditions of stability.

At the same time, focusing the attention of planners, managers or organizers in tourism solely on its development has long proven to be insufficiently effective. A particularly important point is the capture and clear highlighting in the strategic framework of sustainable development, namely the effects of tourism, which in addition to positive, are often negative (Pearce, Moscardo & Ross, 1996). In the context of sustainability, the increased contacts between tourists and representatives of the local population lead to a change in the value system of the local community (Stankova, 2009); A serious effect, with a negative character, is the pollution, which can be related to the increase of the level of noise load, the emissions of the air transport, of the waste substances in the soils and waters. Among the damages caused by the tourism of the environment in the tourist destination can be listed as significant also the coastal erosion, provoked by the receding of the dunes and the leveling of the coastal surfaces (so relevant for Bulgaria); excessive use of natural areas (forests, mountain slopes, lakes); their destruction in order to create tourist sites; the impact on the culture of the locals, simultaneously with the increase of the population density in the places of rest; the aggravation of the socio-economic tension, etc. In their complex manifestation, the negative effects are further accompanied by increasingly difficult compromises between the local community, the tourism business and tourists, as well as increased efforts to restore the competitiveness of the tourism product and avoid decline. All these processes and interactions are well visible and easily explained through the Model of the tourist destination life cycle proposed by Butler (Butler, 1980). Over time, conceptually different theories have been developed to study the effects of tourism, such as the theory of social exchange, which researchers such as Jurowski, Uisal & Williams (1997) have discussed in their 1997 article. it is emphasized that tourism can bring both benefits and provoke additional costs. Whereas, although it provides economic growth, tourism actually provokes parallel negative social, cultural and environmental effects and instability. A play that brings research on the tourism industry closer to those in the field of economics by leading authors such as Repetto, Bartlett and team, Austin and team, as well as other scholars (Repetto, 2001). Therefore, many general economic developments could be adapted to the tourism industry. For example, the indicators developed by Repetto and a team, organized in a mathematical formula for deriving the assessment of the real state of the economy of the countries in the transition to a sustainable state (Repetto, 2001), are also applicable to the tourist destination. Clarifying that Butler also refers to the Disproportionate Productivity Increase Act, noting that there is a time in the development of the tourist destination when compromises are increasingly difficult to achieve. As a result, efforts to achieve sustainability are growing significantly (Butler, 1980) and require a political commitment that provides real opportunities for the economy and society to overcome inequalities and developmental disparities.

3.2. The case of Costa Rica

For countries that have made sense of these processes, such as Costa Rica, the results today are impressive. In 2016, the current government of Costa Rica signed the National Pact for Sustainable Development Goals together with representatives of civil society, religious organizations, business, promising to promote and respect the Sustainable Development Goals by monitoring and reporting to the public on their implementation (Costa Rica: Taking Action for Sustainable Development). Costa Rica also received the 2019 Earth Champion Award, the UN's highest environmental award, for its role in nature conservation and its commitment to ambitious policies to combat climate change (Costa Rica named ʽUN Champion of the Earth ʽfor pioneering role in fighting climate change, 2019). Tourism is among the leading and priority industries in Costa Rica. In 2019, before the COVID-19 pandemic, which in Costa Rica particularly affects tourism, the contribution of travel and tourism to GDP (% of GDP) was 13.5%. The real contribution of travel and tourism to GDP is 8,3 billion US dollars (Costa Rica – Contribution of travel and tourism to GDP as a share of GDP). The destination received 3.1 million foreign visitors (Costa Rica registers increase in tourist visits in 2019). The successes achieved for the country are significant, primarily due to the tourism policy developed by the Costa Rican Institute of Tourism, based on a set of general principles, including the adoption of sustainability as a basis for tourism and the creation of a national tourism product. , stands out as presupposing (OECD TOURISM TRENDS AND POLICIES, 2016). In fact, as early as 1995, Costa Rica worked with a national certification system in the field of sustainable tourism, approved in 2000 by the World Tourism Organization (WTO) (Penkova, 2013). Sustainable Tourism Certification aims to ensure the sustainability of business models in the tourism industry by categorizing tourism companies according to the degree to which they approach the sustainability model in the management of natural, cultural and social resources. That is why the WTO considers Costa Rica as an example of commitment to the environment. The country has 5% of the world's biodiversity and more than 25% of its area is classified as protected (BIOFIN, 2018). Costa Rica's National Decarbonization Plan has been in place in Costa Rica since 2019, with the aim of achieving net zero emissions by 2050, meaning the country will produce no more emissions than it can offset through actions such as maintaining and expanding its forests. In particular, in relation to tourism, there are plans for 70% of all buses and taxis are expected to be electric by 2030, with full electrification projected for 2050 (Costa Rica named 'UN Champion of the Earth' for pioneering role in fighting climate change, 2019). From the review of the Travel and Tourism Competitiveness Index, it is clear that the destination (at the state level) is developing successfully by positioning itself among the leaders in competitiveness among Latin American countries (Travel & Tourism Competitiveness Index, 2021). In 2019, Costa Rica received a Travel & Tourism Competitiveness Index (TTCI) score of 4,3 out of seven. It shows an increase in comparison to 2017, when the TTCI score of this country was 4,22 (López, 2021). The future of the country and its tourism industry can continue to be successful. Moreover, in the long run, Costa Rica's National Decarbonization Plan identifies and monitors eleven development centers in the country where production activities are concentrated and which promote economic growth on a regional and functional basis. And sustainability in tourism is guaranteed by the Ministry of Tourism and the Costa Rican Tourist Board, which support the implementation of a model of tourism development based on quality rather than volume growth or a low-cost product. In addition, a comprehensive destination-level management program has been set up to support local government by providing key decision-making information aimed at consolidating and increasing the competitiveness of the sector (OECD Tourism Trends and Policies 2020).

4. Conclusion

Definitely, the review and reflections made show that sustainable development can be successful for countries in general, but also for separate economic sectors, or for the society as a whole. In fact, sustainable development practically limits the contradictions in development, as the example of tourism demonstrates, orienting it towards minimizing the negative impacts on the environment and at the same time, supporting initiatives of the local population. Thus, tourism has the opportunity to show its positive effects to a much greater extent by adopting a rational approach to the use of resources. This is also the aspect in which the link between the tourism industry and the set of initiatives and framework documents for sustainable development should be sought. Among them is the EU's ambitious Green Deal project, through which the Union hopes to "climb" the "magic triangle of sustainable development". The plan at the moment is: political development to be backed by the consensus of the introduction of common legislation – the Green law – so as to ensure synchronicity in actions and achieve common goals for reducing carbon emissions; ecological balance and economic security are expected to be ensured through more efficient use of resources in the circular economy. The main aim is to limit climate change, reverse the trend of biodiversity loss and reduce pollution. However, some questions remain unanswered – Will social justice be achieved?; Has the contribution of the individual socio-economic sectors been considered? Is publicity enough? etc. At the moment it is still difficult to answer. First, because the Green Deal requires the commitment of all member states and secondly, because it implies a fair redistribution of funds between them, which, as it is obvious from the previous experience, very often does not work. Of course, there is also the expectation that, as usual, the financial burden will be borne by the citizens of the Union as entrepreneurs and consumers. September 2021 has already given the first indications of this. On the other hand, tourism is called to be a conduit of the parameters set in the European Green Deal (U.N.W.T.O., 2020). The WTO and the UN are of the opinion that the Green Deal is an integral part of the 2030 Development Plan and the implementation of the Sustainable Development Goals (General Assembly of the United Nations, 2015). Therefore, there are expectations that tourism could play a key role in promoting the sustainability paradigm, using its uniqueness in integrating people, businesses, and ideas in the fight against climate change, poverty, social inequality and achieving responsible growth.

Acknowledgment

Not applicable

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Green Deal in public transportation – transitions that actually make sense

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Abstract: Going green is a big challenge for public transportation systems. In this paper we suggest a generic framework and IT architecture that can facilitate this change in an environment-friendly and economically sound way. We analyse the rational motives driving transportation choices, such as: trip duration, delays and reliability, as well as factors like lifestyle, holistic motives, travel comfort. The impact of these indicators on passenger preferences and satisfaction level is comprehensively studied. We suggest analytical and self-learning systems that lead to optimized routes and transport schedules. This paper develops specific, measurable, achievable and time-bound solutions to create a sustainable and cost-effective transition path to green public transportation network.

Keywords: Passenger traceability, passenger behavior, public transport metrics, measuring impact, performance measurement

1. Introduction and methodology

Being environment-friendly is not limited to simply using the latest technology – it also means efficiency and flexibility of operation. For public transportation systems, this means that passenger profile should be used as a significant determinant in planning and delivering relevant services. This paper follows the model presented on Figure 1 and relies on data from INNOAIR project that aims to provide green and adaptive transportation options for two residential districts in Sofia – Manastirski Livadi and Buxton.

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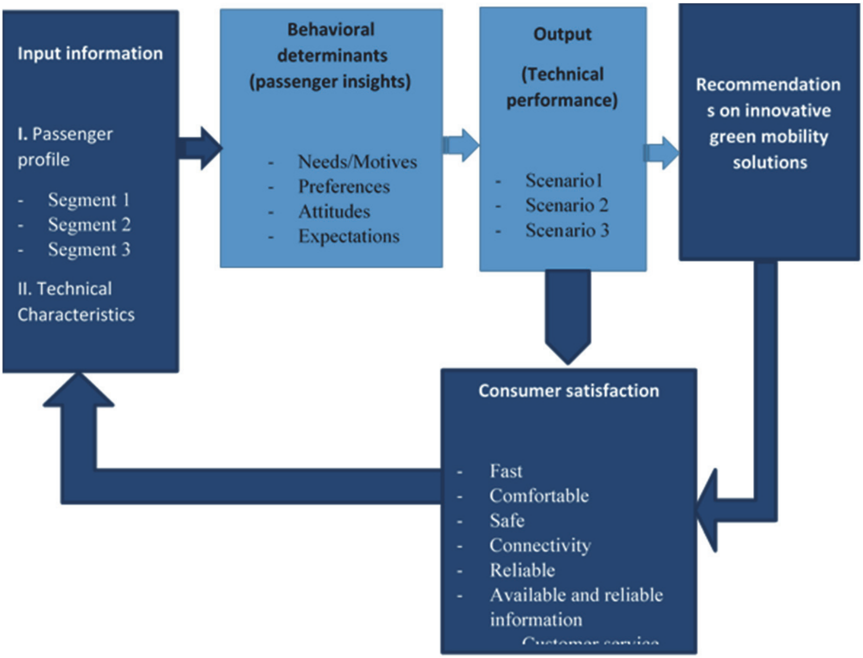
__Figure 1:__ Model on passenger behavior based on advanced analyses of real-time data



Source: *Author's research*

2. Consumer behaviour

2.1. Consumer characteristics

To design consumer profile, several key demographics are studied: age, gender, geographic area – the district, household size, occupation, income, education, vehicle availability. These indicators have been selected on the basis of previous research on public transport in different countries [1] [2] [3].

Age impacts the division of the various stages of life and indicates important types of activities. It is assumed that during childhood the purpose of traveling is to access school in the presence of an adult. For young people, the goal of socialization is added to travel for educational purposes and this trend continues during youth, for which work traveling should replace education purposes, and family care should be added. For the elderly, the tendency is to use public transport to meet family needs. There activities can also indicate the generation differences in habits – in particular regarding use of cars. Findings in reviewed reports differ with regard to the age of passengers using public transport. For example, in case of Novi Sad people relying on public transportation were primarily young adults, while in others contexts they belong to different age groups [4]. Thus, we have decided to also use age groups and analyze separately the inputs for economically active residents. By 2020 the population of Sofia (stolitsa) is 1 308 412 people, most of them are between 18 – 64 years old (826 131people), while the average age is 45 ([5]).

Gender is another main characteristic of passenger profile as there are many differences in transport needs between women and men, in many countries, the late-hour travelers tend to be mainly men, there are variances of trip length, and also the total sum of trips.

Geographic area – the district is significant in our case by means of the project`s test area and residents to be covered.

Household size is to be compared the general population and refer to the use of different modes of transport. Household size appears to show the number of working persons and the influence on the choice of public transport. There are two trends influencing the needs of passengers. The numbers of cars per household is increasing, while on the other hand, the household size is getting smaller. In Sofia, the average household size is 2.5 people ([6]).

Occupation lets us profile passengers into several groups – a pupil, student, full or part-time employed, unemployed, housewives, retired person. We believe these groups use different transports and have quite unique needs. As public transport facilitates trips to office locations, the occupation profile of the passengers is key in scheduling and route setting of the public transport. [5] Also, the availability of public transport to the workplace is also one of the important factors in accepting a job offer. There is also a difference between young and middle-aged workers' attitudes to commuting to work as younger generations prefer to spend less time traveling.

Income in important in structuring socio-demographic groups. Residential districts in focus tend to be inhabited with people with income levels that are slightly higher than the average in Sofia [6]. Adding household size income level is an important indicator showing the general attitude to establish the future growth of private car use or public transport need, willingness to pay more for better services.

Education level compared to the average habitant is an important factor to portray the passenger profile. Generally metropolitan riders have higher level of education than the bus riders. There are studies establishing that the commuters are mostly students or pupils [7]. Pupils mainly travel to their educational institutions, and typically travel shorter distances. In general, higher education levels are associated with bigger city centers. Recommendations aiming to change the attitudes have to be based on educational level. Complete bachelor or more degree, complete high school education, less than high school education, student and pupil outlines the groups.

2.2. Behavioural characteristics

We try to reveal typical patterns of passenger behavior and identify reasons for using public transport [1] [8]. In accordance with previous studies in the area the following important conclusions can be drawn ([9]):

1) The reasons for using public transport regards the passenger behavior motives, which can be divided into several categories: saving money, saving time, environmental concerns, convenience, avoiding traffic to pattern a need base or a preference base portray.
2) Frequency of using public transport demonstrates the importance of the transport for the passenger. There should be made distinction between routine work-home commute behaviors and on-occasion transport demand.
3) Access mode indicates if the riders walk, drive, bike or use another transit to their bus stop.
4) The duration and route of the passenger's trip display the travel routine.
5) Information sources are used as predictors of pre-travel planning behavior of travelers. Real Time Passenger Information is one of systems to increase the attractiveness of public transport, pre-travel information has also psychological effect on the passengers, as it reduces level of stress, and drops the wait time of the riders ([10]).
6) Vehicle availability is another important factor. The level of car ownership was tending to increase through the 70s, 80s, and 90s which triggered numerous issues with traffic, parking lots and infrastructure. National statistical surveys indicate that in Bulgaria, car ownership level is still rising ([2]). In US the millennial generation still prefers owning car ([13]) and in EU the youngest generations is believed to have more interest in gadgets and social networks rather than in vehicle ownership ([2]). Yet, habits will continue to play a very important role in choosing means of transportation ([11]).

These characteristics also highlight public transportation alternatives as taxi, subway, cycling and walking to name a few.

2.3. Social class and lifestyle

A stereotype dictates that the high-income individuals drive cars and the lower-income citizens use public transport. As a result, the "car pride" style has evolved, treating the vehicle value as a symbol of status and success. Recently the use of the subway and introduction of new lifestyle patterns have changed the picture significantly [12]. Consumers of high social class have definite requirements and tend to be more inclined to outstanding products and services. In spite of that, there are recent tendencies having a major impact with regard to healthier and sporty lifestyles, there is also increasing health and environmental awareness.

There is also a clear link between the quality of public transport and income distribution of users. Yet, this does not preclude the image campaigns, adequate guidance, and information systems from playing an important role [13]. Nevertheless, an increase of public transport quality would attract the higher income residents.

3. Inputs and data processing architecture

There are multiple data sources that can be used to analyze passenger behavior and use of public transportation system. But not all of them are equally important and useful. In order to find the balance between usability, accessibility and information value, we have separated different options with regard to:

- type of data inputs (numerical, categorical and nominal);

Giving preference to numerical inputs allows us to apply wide variety of analytical tools and provide more accurate and timely forecasts, conclusions and recommendations. While some sources are by virtue either categorical or nominal, we have tried in our report to focus on numeric sources and extract as much useful details as possible.

- frequency of new data that is made available;

Making strategic decisions takes time and preparations. Yet there are some daily changes that have to be made and that require to have information quickly, or its value will simply fade away before its even taken into consideration. In order to support both strategic and tactical decisions, our consumer behavior analysis approach relies on data inputs that arrive at different frequency – from real-time data of movements and fleet positions, to periodic surveys that take several weeks to complete and process.

- accessibility and control of municipal authorities on the quality of methodology of data collection.

Accessibility of data is a twofold issue – it depends on both legal and practical factors. For example, tracking movement of people is a very valuable input, but on the other hand it violates their privacy and intrinsic human rights. To eliminate issues with GDPR and access to sensitive information, in our study we rely on anonymized and pre-processed information that prevents identifying any individual based on the collected data.

With regard to practical concerns, we choose inputs that cannot be manipulated, have negligible margin for error (mostly due to the fact that they are automatically generated and do not require human intervention) and that can be reproduced and verified. The last two characteristics are of particular important in order to make sure that obtained results are valid and sustainable.

Table 1 contains a detailed list of inputs from the following categories:

- mobile network data;

Mobile network data is not freely available and requires close cooperation with mobile service providers. Use of anonymized or preprocessed information on the other hand makes it much easier to cope with legal restrictions and avoid violation of individual rights. To minimize the investment of time and resources on mobile providers' side, we plan to use information on density of users and summary of movements in specific areas, that are relevant to INNOAIR scope.

- ticketing system data;

Ticketing system data is already available and used to estimate revenues and cash flows. In our case it's more important to figure out relative weight of different products (ticket and prepaid travel cards), rather than the absolute amounts. With the introduction of electronic ticketing and check-in system, required inputs are readily available and can be provided with minimal efforts. To analyze the consumer behavior, it is required to have only timing and general information, thus avoiding potential conflicts with GPDR and use of personal data.

- mobile application statistics;

Mobile application inputs are focused on INNOAIR experimental services and green transportation. Therefore, its relevance is extremely high. Mobile application offers a direct channel of communication with passengers that rely on the service, can rate it and give suggestions on how to improve the quality of offered services. Our goal is to use this data with gradually putting more weight on it, as the number of application user's increases.

- traffic and transportation control data.

Traffic and transportation control data is crucial to mapping available resources to demanded services and improving customer satisfaction. This information serves analytical purposes and supports decision making process. In our model, traffic and transportation data is first used to assess current situation and compare it with user expectations. As gradually new services start to gain popularity, estimate that its role will be primarily as a support tool when changes have to be made to meet new requirements and consumer needs.

Table 1: *Data inputs and sources*

Data input	Description
Mobile network inputs	
Anonymized position	Used for heat maps and summarized tracking of movement in different hour zones.
Speed of movement	Used for rough estimates and classification of means of transportation
Time of appearance	Entry and exit time, calculated from available movement data as proxy of transportation use and load estimates.
Ticketing system inputs	
Transportation cards	Used to track down established route and sustainable interest in particular lines or areas of transportation. Inputs regarding sales of transportation cards are important not just for economic planning and financial forecasting, but also for separating long-term interest in particular routes.
Tickets sold/checked-in	Tickets sold and/or checked-in can be used to track down in real-time the load of transportation network. It can be used for adaptive scheduling and planning of resource allocation. This information is also very interesting with regard to traffic control and pollution monitoring.
Mobile application statistics	
Number of requests	In addition to number of requests (which is used to heat map the activity and user needs at given time), the distribution of these requests is very useful in resource optimization.
Frequency of use	Used as a proxy for customer satisfaction and segmentation of frequent/devoted users of the services offered.
Feedback and quality study	While this is a voluntary input (not obligatory to rate the service and application) and it provides an assessment of the complete service, quality feedback is a very strong (though irregular) input.
Traffic and transportation control center	
Schedules	Fixed schedules are used to compare demand for transportation services with supply. They are also the foundation of providing more flexible and efficient allocation of assets and forming dynamic schedules.
Delays	Delays are very important in reducing consumer satisfaction (as pointed out in D5.3.1) but also as indicator of problems and deficiencies in planning and implementation of transport network.
GPS live positioning	Live positioning information on vehicles (busses and other means of transportation) is vital for providing quality service and also map consumer behavior to availability of offered services.

Source: *Author's research*

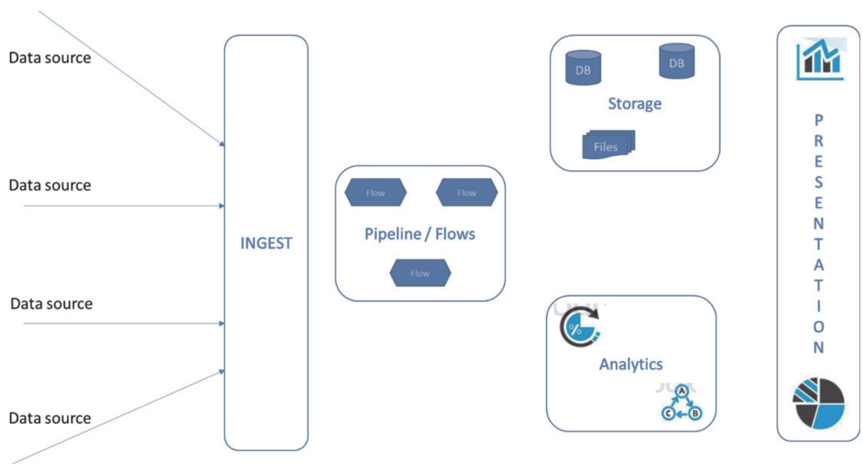
To handle data of different types in classification and clustering tasks, we suggest using Gower distance metric *d(i,j)*:

$$d(i,j) = \frac{\sum_q \theta_{ijk} d_{ijq}}{\sum_p \theta_{ijq}}, \tag{1}$$

Which depends both on individual differences d_{ijq} and weights θ_{ijq} assigned to each parameter. Due to the fact that Table 1, contains factors of different types (numeric, categorical), individual differences can be calculated as follows: (a) Numeric types: $d_{ijq} = \frac{|x_{iq} - x_{jq}|}{R_q}$, where R_p is the range of the q*th* factor; (b) Ordered types: $d_{ijq} = \frac{|t_{iq} - t_{jq}|}{R_q}$, with transformation of the rank r_{iq} of the input x_{iq} as $t_{ijq} = \frac{(r_{iq}-1)}{\max(r_{iq})-1}$; (c) Logical and factor types: $d_{ijq} = \begin{cases} 0, if\ x_{iq} = x_{jq} \\ 1, if\ x_{iq} \neq x_{jq} \end{cases}$.

Gower distance is successfully used in social studies ([16]) and that makes it possible to compare and explain results obtained with its application.

***Figure 2:** Data processing and analytics*



***Source:** Author's research*

Ingestion of data can be split into several steps, as shown on Figure 2, with integration of multiple sources, handled first. By abstracting this initial (pre)processing, we are able not only to support series with different frequencies, but also different communication protocols. Therefore, this step is crucial in putting together legacy systems and data producers managed by separate legal entities. Having a separate data ingest layer also helps in simulating some inputs that are not yet available or developed.

Pipeline and flows are key to our analysis and monitoring. Representing a sequence of tasks (pre-processing, analytical and data persistence ones), they are capable of wrapping up different algorithms and methods. By sticking to the idea of flow, that takes predefined inputs, processes them and stores and/or presents the results, we are able to create building blocks for consumer behavior modelling and link these blocks in very creative ways. This can provide the much-needed flexibility and improve sustainability of suggested solutions, as we are always able to modify or adapt some part of them, without rebuilding the complete system. In addition, the ability to immediately present the results is very important for maintaining real-time notifications and "live" view on consumer behavior.

The last part represents the graphical front-end of the system. It is responsible for providing consumer behavior analysis in a readable and convenient way. To highlight the dynamic nature of the built system we have implemented this component as user-controlled and user-configurable dashboard solution. This provides for interactive output and customization based on specific end-user needs.

4. Behavioural determinants

Here we put our focus on variables, that determine passenger behavior, such as: consumer needs, motives and preferences, attitudes and expectations. As the consumer behavior is not easy to study, we use the consumer insight approach, to reveal the personal drivers.

4.1. Needs and motives

In the last years the lifestyle patterns have substantially changed, generating diversified travel needs. Hence, the policy makers have to be more sensitive to the public concerns about the implications from transport congestion and pollution, and the demand for holistic behavioral approaches, gaining social, economic and ecological benefits.

In general, the needs can be evaluated based on two types of requisites:

- Utilitarian – the desire to achieve functional or practical benefit – to sustain innovative mobility solutions, to contribute to the city carbon reduction, to save money, to obtain a quick access to a definite place/point, to avoid traffic conjunction, etc.;

– Hedonic – the experiential need, involving emotional responses. It may address issues as: to enjoy the travel, to share the experience with other passengers, to be eco-friendly, to demonstrate a lifestyle or social class affiliation, etc.

Whatever the need is utilitarian or hedonic, a discrepancy exists between the passenger's present state and some ideal state. The gulf creates a state of tension, and its magnitude determines his drive. The travel need can be satisfied in different ways, as the personal choice depends on a specific set of experiences and personal characteristics (demographic, social or cultural, for example the cultural values he has been raised). Hence, the traveler will perform his choice, driven by his want to satisfy a certain need, to attain a concrete goal. Here comes the question – what is the exact reason for a concrete travel – it could be performed on a regular basis as traveling from home to work, or on a specific occasion – to visit friends, to sport, to go sight-seeing, to go for amusement, etc. The experienced occasion will influence the frequency of using public transport, the frequency of using alternative transport, the combination of the different options he made, etc.

In order to enhance the public transport use, we need to know the motives that drive passenger behavior, on one hand, and the barriers that prevent him.Table 2.

Table 2: *Motivations and barriers to public transport use*

Motivations	Barriers
Better service	Not having alternative to car
Be certain that the timetables are performed	Lack of direct transport
Direct transport from home to work	Lack of availability of buses
More information available and easy to understand	Long travel time or lack of reliability
Save money	Do not known what to expect
Not having a parking space	Need for multiple journeys
More comfort and air-conditioning on vehicles	Poor information
Contribute to a better environment	Bus not frequent enough or stop too far
	Buses are smelly and crowded
	Feeling of personal insecurity
	Having to use more than one transport
	Bad waiting conditions
	Negative feeling towards public transport
	Habit of driving

Source: *Gabriela Beirao, J.A. Sarsfield Cabral, 2007*

4.2. Preferences

The choice of transport is influenced by several factors, such as individual characteristics and lifestyle, the type of journey, the perceived service performance of each transport mode and situational variables ([21]).

Nowadays people perform a private car dependence, not only as a mode of travel, but also to express their social status and hedonic desires, such as feelings of sensation, power, freedom, status and superiority ([22]). In order to make a shift from private cars to other travel modes, they need alternatives, to be convinced in their benefits and corresponding to their personal values and lifestyle.

Regarding the type of mode, the passenger could make his choice among 4 options of public transport in Sofia: bus, trolleybus, tram and metro lines. Sofia is the only city in Bulgaria that operates the four modes of public transport. As additional option taxi, shuttle and electric scooters could be used.

Considering the different types of modes, passengers evaluate their characteristics, express their preferences and make their choices.

Among the most relevant determinants of the transport characteristics, that might influence passenger preferences and choice, and at the same time influence passenger satisfaction are identified as follows:

- Speed;
- Convenience;
- Safety;
- Connectivity;
- Reliable;
- Service quality.

As longer as there are many alternatives, bonded with appropriate source of information, a passenger would make more motivated choice. Thus, a targeted information campaign could assist this process, and promote a shift to more sustainable modes, such as eco-friendly and lower modes. Nowadays the information sources widely vary and they could satisfy each preference, but most of all they have to be easily accessible and attain credibility.

4.3. Attitudes

Beliefs and attitudes lay in the entire process of consumer decision making. They are determined by (1) the existing knowledge from the obtained information, and streamlined from the previous experience, and (2) the emotions evoked by the explored situation, and (3) the beliefs related to the concrete object. The combination of the three variables, as: cognition, affect and behavior, determine the consumer/passenger attitude, and we have to consider them as interlinked, in order to be able to predict the forthcoming reaction. Moreover, Michael Solomon (2004) explains the relative impact of the three components as hierarchy of effects, where each hierarchy specifies that a fixed sequence of steps occurs on the route to attitude, e.g an attitude based on cognitive information process, an attitude based on behavioral learning process. and an attitude based on hedonic consumption. In other words, passenger behavior could be determined very precisely when the attitudes are well-understood as a hierarchical process of the effects: (1) beliefs-affect-behavior or (2) beliefs-behavior-affect. In the first case called "standard hierarchy of learning a consumer is motivated to search for a lot of information carefully evaluate the alternatives, and come to a thoughtful decision. In the second case a passenger may not be particularly informed/knowledgeable about the different transport options and public modes, then he may have an emotional response. In the so called "low involvement hierarchy" a person does not initially have a strong preference for one over another alternative. Even more, when a passenger has "bonds" with a certain transport mode over time, he is not easily persuaded to experiment with other options, and through the communication channels the attitude could be changed. Additionally, we have to consider the passenger motives (rational and emotional), the existing knowledge and previous experience to model their attitudes towards the different travel options (public and private) and the different public travel modes. In order to make consumers more involved and conscious about their decision making, the marketing stimuli, affecting the whole process, have to be addressed properly and adequately. Taking in mind that attitudes are time-lasting, a special focus should be given on the communication set of tools, influencing cognitional learning rather than behavioral learning.

4.4. Expectations and satisfaction

Usually, passenger satisfaction is conceptualized as a function of the gap between expected and experienced service delivered. Travel satisfaction in transportation research has been predominantly measured as a function of objective or subjective attribute levels ([21]).

The discrepancy between expected and experienced waiting time, in-vehicle time, perceived service quality, attitude, mood, personality and socio-demographic characteristics have significant effects on trip stage satisfaction. Loyalty to public transport, price, seat availability, in-vehicle environment, enjoyment mood, happy mood and easy-going personality lead to higher ratings of trip stage satisfaction. Some studies of trip satisfaction found that gender has no significant effect on satisfaction with public transport services ([21]), others ([22]) in reverse state that satisfaction ratings of men are higher than satisfaction ratings of women.

5. Conclusion

Three major areas of interest have been identified with regard to consumer behavior, in the context of INNOAIR project goals:

- Consumer characteristics and profiling.

Consumer characteristics and segmentation goal follows well-defined and commonly used methods and inputs to analyze passenger choices and spending. In addition to traditional tools and features used to study customer decisions, we suggest applying state-of-the-art machine learning methods to improve segmentation results and handle special cases (e.g. outliers).

- Technical aspects.

Technical aspects of the output aim at finding the most relevant and precise sources of data. While it is often sufficient to conduct representative surveys of consumer preferences, such an approach is limited in terms of providing adequate real-time information. In addition to being rather expensive, we believe that for the sake of accuracy it is necessary to combine different sources of information and merge survey results with objective and real-time feeds like fleet management data, anonymized mobile network load and coverage information and ticket sales.

- Implementation details.

Implementation details refers to the use of appropriate technologies and employing open source packages in order to achieve sustainable and economically sound effect. This part follows from the previous two and despite playing supportive role, it is important to make sure that implementation can fulfill all required actions and process inputs in a timely and accurate manner. Apart from concerns regarding data analysis, it is of great importance to ensure that different sources can be used together and can be addressed in a uniform way. Due to the fact that inputs often come from separate organizations, with different level of technical readiness and degree of process automation, being able to integrate all existing solutions with ease is crucial.

INNOAIR foresee to pilot for the very first time in Europe the concept of “On-demand green public transport” which will entirely shift the way public transport works. Instead of driving on pre-defined routes the new e-buses will create route map based on citizen demand submitted via mobile application. The app will leverage machine learning and advanced data analytics to create the most efficient path for each ride, collecting as much passengers as possible. By doing so, we will introduce the biggest revolution of public transport in the city. The greatest “win-win” is that Sofia will have less traffic, better air quality and contribution to tackle climate change globally.

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The Green deal – a challenge and a factor for sustainable development of the construction company

Aneta Marichova[1]

Abstract: The construction market occupies an important place and plays a key role in achieving the goals set in the European Green Deal, in which special attention is paid to the process of renovation, decarbonisation of the construction industry, sustainability and introduction of digital information systems throughout the life cycle of buildings and construction facilities. This poses new challenges to every construction company, related to the need to develop new products, business models, innovative technologies, and securing the relevant investments. At the same time, this is the new driving force that allows implementation of a sustainable strategy aimed at creating, offering and realizing additional economic, social and environmental value for the client, stakeholders and society as a whole, which in practice means building competitive advantages in dynamic environment. The aim of the study is: 1) To develop a practically applicable model that can ensure sustainable development of the construction company and is focused on the relationship: Resources – Capabilities – Strategy, and 2) Empirical study of the model in companies operating in the construction market, which allows analysis of the necessary competencies, capabilities and strategies that must be created and developed by managers to overcome existing challenges and to achieve the goals of the company.

Keywords: Green Deal, Construction Market, Sustainable Development of the Company, Competitive Advantages

1. Introduction

The Green Deal proposed by the EC includes a package of actions aimed at tackling climate and environmental challenges that are closely linked to the concept of sustainable development and the circular economy (European Commission, 2019). The construction market occupies an important place and plays a key role in achieving these goals, with a special focus on renewal, decarbonisation of the construction industry, introduc-

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tion of digital information systems throughout the life cycle and sustainability of buildings and construction facilities.

The main reasons for this conclusion are primarily related to the environmental effect of the construction activity, which is characterized by high resource consumption. Construction companies consume a huge amount of resources – land, building materials, energy and water, and occupy a large share in environmental pollution. The construction sector accounts for 30-40% of world energy consumption, and over 70% of environmentally harmful emissions are due to electricity consumption during the operation of buildings. Due to the lack of energy efficiency alone, the annual loss in the EU is over 270 billion euros, and by implementing energy efficiency measures in buildings, an additional 500,000 jobs can be created. The volume of waste from construction and demolition of buildings is one of the largest among the various types of waste in Europe. Valuable materials are not always identified and collected. Many of them can be recycled or re-used, but the frequency of re-use and recycling varies considerably across the EU and is generally still insufficient.

On the other hand, construction is a structurally defining sector that affects economic development both directly (through the high relative share of GDP, value added and the large number of construction companies that provide employment) and indirectly through cross-sectoral links (high costs of purchasing raw materials, electricity and other components used throughout the design, construction, maintenance and operation process). The industry has an important role in maintaining production, employment, income, consumption levels and domestic demand, which is why it occupies a special place in any government policy.

The construction market is important not only with the economic effect, but also with the social effect on consumers. This effect is determined and depends on the ability of the final construction product (buildings and facilities) with its characteristics to provide the desired quality of life, comfort in all its aspects – visual, thermal, acoustic, healthy microclimate of the premises inhabited by people. The built facilities and infrastructure determine the degree of freedom and flexibility that society can enjoy. Through the construction activity the urban environment is built and developed. The introduction of new efficient technologies and intelligent investments ensure both the development of the building stock and the economy as a whole, and the integration of local communities.

Achieving climate neutrality has a strong impact on the construction industry (which covers the activities of producing construction materials and creating the final construction product through the design, construction, maintenance, operation and demolition of construction sites), because the production of construction products is still energy intensive, the possibilities for reducing harmful emissions are technologically limited, and at the same time the price of greenhouse gas emission allowances is increasing. On the other hand, sustainable construction is complex and includes sustainable use of natural resources, recycling and reuse of construction products, introduction of digital information systems throughout the life cycle of buildings and construction facilities, which is still in its infancy without the necessary financial resources and regulatory provision by the competent institutions.

The challenges of the construction market increase as a result of the specifics of the construction product (immobility, individuality, durability, high resource consumption, etc.), the construction process (complex relationships of different entities involved), the specifics of different market segments (civil engineering and building construction market – residential and non-residential), the influence of various subjective and objective factors that increase its instability. In addition, a common feature of the construction market is the presence of too many, mostly small companies, which means relatively limited technological, market, financial and innovation opportunities. They usually have no strategy and are willing to do anything to have a job or have more work. The distribution and use of scarce resources in practice is carried out by the market, by private individuals, managers, who in their behavior are guided mainly by self-interest and the main goal is to achieve higher profits for the company and shareholders. Usually, social and environmental goals are subordinated to this main goal, which limits the possibilities for effectively solving these problems. Most often, solving them is a function of legal requirements, pressure from customers, competing companies and society as a whole, which allows the company to maintain its reputation.

The dynamics of the external environment presents each company with new challenges, in which the familiar traditional models of corporate behavior have an increasingly limited role and chance of success. At the same time, it is the new driving force aimed at realizing a sustainable strategy that allows creating, offering and realizing additional economic, social and environmental value for the client, stakeholders and society as a whole, and building competitive advantages. From this point of view, a practically applicable model will be developed, focused on the relationship: Resources – Capabilities – Strategy (Teece, 2018). The author's goal is to analyze their nature, scope and relationships. This is the basis for an empirical study of the model in construction companies, which will assess and analyze the necessary competencies, capabilities and strategies, oriented towards sustainable development and building competitive advantages and performance in the three dimensions (environmental, economic and social).

The company's resource includes all assets, capabilities, organizational processes, company attributes, information, knowledge that are controlled by it and that allow it to implement strategies that are not implemented by current and potential competitors (Barney, 1991). The development of resources is a result of the social development of knowledge, technologies, they are exogenous for all companies and in this sense each company has access to the desired resource on the market and has similar resources. What makes a resource unique is the unique combination of this resource with other internal, company resources, the result of management and organizational decisions, which in turn creates distinctive competencies of the company and provides competitive advantages.

Distinctive competencies are related to the operational activity of the company and the way in which it combines and uses its tangible and intangible resources to achieve the desired end result. In practice, they provide the link between incoming company resources (information, knowledge, learning, management skills) and the material end result, and therefore this link is usually incomprehensible and difficult to imitate from competitors. Company resources and distinctive competencies are the main determinants of competitive advantages, provided that they meet the following four characteristics: they have value, rare, difficult to imitate competitors and can be used effectively, which means creating a strategic resource of the company (Barney, 2001).

In the conditions of constant dynamics in the external environment it is difficult to assume that a company can maintain these unique characteristics for a long time. However, successful development over time also reduces the demand for new alternatives for change, resource development and distinctive competencies, which is defined as the "ability trap", in other words – unique abilities limit the flexibility, adaptability of the company to new challenges (Qiang, 2017). This means that the company must constantly develop other competencies at a higher level, which are not only related to its direct activity and are defined as dynamic capabilities.

Dynamic capabilities are not a resource, they are not related to the assessment of the strategic resource in the company, but are related to:

- Constant changes in external factors, business environment (demand, technology, competition, legislation, stakeholder influence), which requires constant changes in resources, competencies of the company.

- The ability of the company to monitor, evaluate alternatives for development, and on this basis the acquisition, assimilation, transfer and use of new knowledge through learning and building a specific process of integration, coordination and reconfiguration of external and internal resources and competencies to adapt to changes in the business environment.

In other words, company resources and activities, distinctive competencies ensure operational efficiency, and dynamic capabilities influence and stimulate their change by expanding and reconfiguring the resource base in response to the dynamics of the external environment.

Building dynamic capabilities as capabilities at a higher level influences and changes the strategy, strategic behavior and strategic decisions of the company aimed at sustainable development, which requires the implicit inclusion of new practices in the overall set of business practices. There is no single set of sustainable practices, as each company has a unique business strategy, but there is a sufficient set of good practices that are applied taking into account the specifics of each company and the market in which it operates (Goldsmith & Samson, 2005).

Good practices include, in the first instance a set of principles aimed at analyzing the external environment, deepening relationships with stakeholders (customers, suppliers, owners, employees, financiers and regulators) and achieving higher level of approval, cooperation and satisfaction on their part. On the other hand, they are a factor for creating distinctive competencies, rare, valuable strategic resource that provides building a strategic competitive advantages of business in three dimensions (economic, environmental and social), which in turn is measured by a sufficiently wide range of results, and not just with the realized profit.

The most complicated problem for the company, related to extremely high risk, is the decision to change and the search for completely new opportunities for development and neutralization of threats. The source of information is the dynamics of the external environment. Each company must develop an effective system for monitoring, analyzing and assessing opportunities and threats to development, forecasting expected changes, defining development guidelines and the necessary transformation of resources and competencies. These activities are directly related to the dynamics of the environment and are a function of the senior management team. This determines the first research hypothesis:

Hypothesis 1. The dynamics of the external environment has a positive impact on the building of dynamic capabilities – a factor for the development of company resources, the realization of competitive advantages (economic, environmental and social) and performance.

Monitoring focuses on gathering new information about changes in the environment that needs to be analyzed, assimilated, and turned into new knowledge. The new knowledge is the result of learning of individuals and is therefore owned by private individuals. Each company must create a mechanism for the transfer and integration of individual knowledge into a collective system that provides new resource configurations and new company competencies. The activities related to the integration process require a new allocation of tasks, resources, people and coordination, synchronization of their activities.

Coordination is done through the exchange of information between individual employees, teams, different departments, which allows the company to evaluate a resource and find a way to use it in a new, more efficient way. The final reconfiguration and the development of new resources and competencies in response to the dynamics of the external environment are a function of the development of a learning system, capacity building for knowledge acquisition and transfer at all levels in the company and its partners involved in the vertical chain (Zahra & George, 2002), which defines the second hypothesis:

Hypothesis 2. Dynamic capabilities have a positive impact on the learning process and knowledge transfer as a factor in building competitive advantages (economic, environmental and social) and performance.

These general characteristics (good practices), combined with the specific process of monitoring, assessing opportunities, learning, integration, coordination, and on this basis reconfiguration of resources allow the development of a new vision and development strategy that takes into account the interests of customers, company and society and the realization of competitive advantages through the indirect impact of dynamic capabilities.

The company's strategy is related to the idea of building a competitive advantages by placing the company in a better position than its competitors (Henderson, 1989). A conceptual framework that connects the company's strategy with its specific decisions describes the relationship between internal resources and distinctive competencies, strategic thinking and actions to create, offer and realize additional value to its customers, build competitive advantages and performance is a business model (Richardson, 2005, Osterwalder & Pigneur, 2010, Teece, 2010).

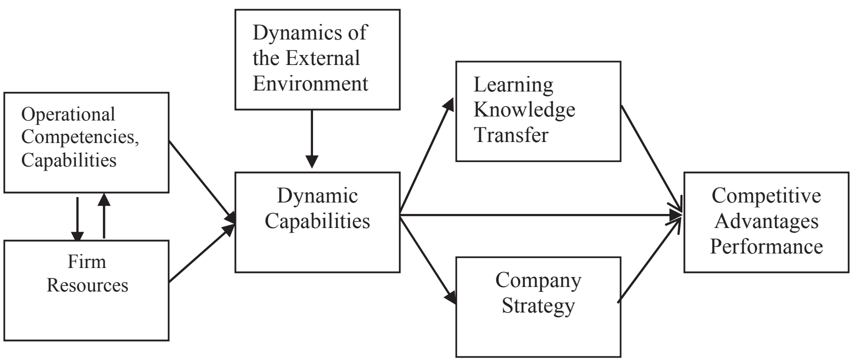
The company's strategy is one, although dynamic, but it can have different business models in order to achieve its goals. Each existing business model must be considered critically from a dynamic point of view, as internal and / or external changes in the environment require its development, improvement and implementation of innovations.

Hypothesis 3: Dynamic capabilities have a positive impact on building competitive advantages (economic, environmental and social) and performance through the development of a new strategy and a new business model.

The assessment of competitive advantages can be made on some key indicators included in the Global Reporting Initiative (GRI, 2002) and performance based on key financial indicators, such as there is not always and necessarily a direct connection between them. Building competitive advantages is a factor in achieving company goals, but the opposite is not always true.

The analyzed connections and dependencies in the conceptual model: "Resources – Capabilities – Strategy – factor for building competitive advantages (in three dimensions – economic, environmental and social) and performance" are summarized in Figure 1.

Figure 1: *Conceptual model: Resources – Capabilities – Strategy – factor for building competitive advantages (in three dimensions – economic, environmental, and social) and performance*



2. Method

2.1. Object of the research

The empirical research was conducted using a developed and applied methodology for evaluating the defined hypotheses. The study includes 12 companies selected at random, which operate for more than 5 years and have sufficient experience in a dynamic environment. The surveyed companies are included in the "top 20" of the construction market in Bulgaria and operate in different market segments (eight of them operate in the building construction market and four in the civil engineering market). They have different degrees of diversification or specialization in the respective market segment, different range of activities (considered as three streams – supply of raw materials, design and construction), different history, different territorial location, different business model, which allows to make generalizations with the necessary objectivity. The surveyed companies have different strategies, as they have different operational capabilities related to production, different dynamic capabilities related to the organization and management of the company, different market positioning and different opportunities for sustainable development.

2.2. Procedure and research tools

The information was collected through an online survey among senior managers of selected companies. Due to the specifics of the researched problem, the research includes one respondent – a manager from each company, who, however, is supposed to have complete information and knowledge about the company he manages.

Due to the expressed desire of most of them for confidentiality and anonymity (referring to company secret), the respondents are given the opportunity to submit the survey without stating the name or the name of their company. The survey includes a total of 15 questions, constructed as wording, to which respondents refer, noting their answers from 1 to 5 on the Likert scale (where 1 means "strongly disagree" and 5 means "strongly agree"). Since the aim is to determine the correlation and assess the impact of independent variables (dynamic capabilities, knowledge transfer, new strategy and business model) on the dependent – building competitive advantages in the three dimensions (economic, social and environmental) and performance, the questions are divided into three parts, which follow the formulated hypotheses. The questions are formulated in an understandable way, the necessary explanations for certain terms have been added, but they do not exclude the influence of the subjective factor in assessing the achieved results, a function of the applied specific practices.

In order to determine the influence of the dynamics of the external environment on the building of dynamic capabilities – a factor for the development of company resources, realization of competitive advantages (economic, environmental and social) and performance in the survey special attention is paid to the following issues:

(a) Market dynamics (changes in demand, tastes, preferences).

(b) Market structure dynamics, competitive actions and reactions.

(c) Active communication with direct and indirect stakeholders (end customers, shareholders, equipment suppliers, raw materials, employees, government, non-governmental institutions, media, citizens' associations for a clean environment, research institutes and universities).
(d) Assessment of the legal framework, sustainable norms, standards, requirements and regulations.
(e) Discovering new combinations of resources and developing programs and plans to change and reconfigure existing operational competencies.

The influence of dynamic capabilities on the process of learning and knowledge transfer as a factor for building competitive advantages (economic, environmental and social) and performance was studied by analyzing the following problems:

(a) Capacity building for knowledge acquisition and transfer.
(b) Establish a mechanism for integrating individual knowledge into a collective system that provides new configurations of resources and capabilities.
(c) Coordination and synchronization of business activities, building loyalty of all stakeholders, which allows the company through the exchange of information to find opportunities to use resources in a new, more efficient way.
(d) Establishment of an integrated vertical knowledge-based management system.
(e) Creating conditions for the implementation of strategic decisions and flexibility, adapting the company to the dynamics of the external environment.

The influence of the developed new strategy and new business model, function of the dynamic capabilities on the building of competitive advantages (economic, environmental and social) and performance includes the following successive steps, which are evaluated by the recipients:

(a) Effective market segmentation, selection of target market.
(b) Assessment of the possibilities for creating a sustainable (green) product.
(c) Digitization of the construction market and mandatory use of Building Information Modeling (BIM) in the development and implementation of all projects/objects.
(d) Develop an effective marketing policy aimed at extending the life of the product and its components through repair, modernization,

processing and resale, or developing models that increase the use of products through sharing, access to property.

(e) Creating a system of incentives and motivation, organizational and managerial changes.

2.3. Results and Discussion

When analyzing the results of the survey, the average values of the answers given by the conducted online survey were first calculated, which show the influence of the individual components of the independent variables on the development of company resources and the building of competitive advantages. On this basis, the Pearson coefficient (R) was calculated for the whole sample. To add more explanatory power to the empirical results, a coefficient of determination (%) – R^2 was also calculated and used, which gives a more accurate estimate and shows what percentage of changes in the independent variable lead to changes in the dependent (other percentages up to 100 determine the coefficient of uncertainty) (Table 1).

Table 1: *Correlation between dynamic capabilities, learning, knowledge transfer, new strategy and business model and building competitive advantages (economic, social and environmental) and performance*

		Competitive Advantages Performance
Dynamic capabilities	Pearson Correlation – R Coefficient of Determination (%) – R^2 N = 12	0,584 34,10
Learning, Knowledge transfer	Pearson Correlation – R Coefficient of Determination (%) – R^2 N = 12	0,742 55,05
Strategy and business model	Pearson Correlation – R Coefficient of Determination (%) – R^2 N = 12	0,863 74,47

Correlation is significant at the 0,01 level (1-tailed)

Source: *Own calculations*

Pearson's calculated correlation coefficient is statistically significant, which shows that there is a positive correlation between dynamic capabilities, learning, knowledge transfer, the creation of a new strategy and new business model with the development of company resources, building of competitive company advantages (economic, environmental and social) and performance. Since the correlation coefficient is significantly greater than zero, this by definition allows the rejection of the null hypothesis of independence between the studied variables.

The obtained results allow to draw the following conclusions from the research:

The surveyed managers understand the great importance of the process of monitoring, evaluation of alternatives and threats as a factor for building competitive advantages (H1 = 0,584). There is a need for constant active communication in the first place with direct stakeholders – investors, end customers, shareholders, equipment suppliers, raw materials. There is a growing need for communication with indirect stakeholders – government, non-governmental institutions, media, civic associations for a clean environment, control over the construction company, working conditions, reducing the negative effects of construction activities, which have often been underestimated. A key factor for stimulating the initiative, innovative and ecological thinking is the development and maintenance of close links with research institutes and universities, which facilitate access to highly qualified personnel, information about market innovations. The creation of a single standard, adequate legal norms, guidelines for design, construction and maintenance of sustainable construction sites will allow effective cooperation and motivation of all participants in the process – investor, owner, user, designer, builder, manager.

According to the opinion of construction managers, sustainable development requires a radical change in the strategic behavior of the company based on the transfer of knowledge and learning (H2 = 0,742). A particularly valuable source of knowledge today are the partners involved in the supply chain, who share their understandings of sustainable development, application of the principles of the circular economy, opportunities to create new capabilities, competencies, which is a factor in building collective rather than corporate competitive advantages. One of the main tasks for construction companies is to create an integrated vertical management chain based on competition, which covers the entire construction process.

The creation of a new business model in the construction company in the new dynamic conditions requires significant changes in its organization and management (H3 = 0,863). According to the managers, the organizational changes are aimed at creating a decentralized company structure and development of the specialization.

The main goal is to build a multidivisional structure with modern organization of simultaneous teamwork (rather than consistent development and implementation of innovations), decentralization of collection rights, analysis of information and decision-making, flexible distribution of responsibilities and tasks, an effective system of incentives to achieve the desired results.

In order to reduce the contradictions and opportunistic behavior of different entities, coordination is needed in the company by building internal integrated systems of motivation and incentives, coordination of different goals of different groups and the company as a whole and support the creation of corporate identity, culture and loyalty.

In a dynamic environment, management changes are aimed at improving relations between managers and all company units, active participation of all entities and units "bottom-up", which ensures the adaptation of internal resources and competencies to external changes, development of intangible assets, which in turn have a reverse effect and develop tangible assets. The efforts of managers are also aimed at creating high customer loyalty and maintaining the company's reputation by analyzing the constant flow of information from the market, consumers, competitors, suppliers, for changes in demand and on this basis rapid customer feedback, processing of the user evaluation data for the company. The role of the leader in making quality management decisions, motivation and creating incentives for employees in the company in order to achieve the goals is extremely important.

3. Conclusion

The surveyed managers are unanimous that the sustainable development of the company and the fulfillment of the requirements of the Green Deal can be the result of creating a construction product that meets the principles of sustainable construction, which aims to restore and maintain harmony between natural and built environment, and to create settlements that affirm human dignity and economic justice (Du Plessis, 2002). The successful realization of this task is a function of the development of company resources, the result of building dynamic capabilities, learning, knowledge transfer and creating a new strategy and business model, which will allow building competitive advantages – economic (high user rating), social (healthier life, better working atmosphere) and environmental (reducing the negative impact on the environment). But the study also shows some differences, specifics, of different market segments.

Large companies with large-scale and comprehensive activities operate on the civil engineering market. They create and offer a widely diversified product, for all market segments, for all customers in the construction market, with a full range of activities or a highly specialized, quality product, covering the entire construction process. With these characteristics, they have a well-developed system of dynamic capabilities, opportunities for flexible development and reconfiguration of resources in order to adapt to the dynamics of the external environment. The surveyed companies have experience in creating a sustainable construction product, effective vertical connections and digitalization of the construction process. A strategic company resource has been created as a result of effective organization and management, combined with history, experience, reputation and innovations in intangible assets (people, knowledge and systems), managerial competencies and skills for effective transformation of resources into the desired end result. These are factors that facilitate the realization of the concept of sustainable development and building competitive advantages.

In the market of building construction (residential and non-residential) there are smaller companies with limited resources, due to which the problems are significantly greater. The construction of the system of dynamic capabilities is unsystematic, there is a lack of readiness for the implementation of green and digital transition and application of the principles of sustainable construction in general. In initial stage is to create long-term relationships with partners, integrated vertical chain management, develop a clear sustainable strategy and sustainable business model. Despite the findings of experts that companies have the knowledge, skills, ability to meet all the requirements of sustainable construction, the necessary changes in this market are not available, sound desirable and are often the result of pressure from external stakeholders. It is still not possible to say that there are the necessary strategic changes – specialization and product differentiation and building competitive advantages based on sustainable construction. Companies need financial, legislative, organizational support and assistance with knowledge and learning. It is necessary to create new models of organization (sustainable supply chain management, strategic, industrial union as a factor for SME development, development and support of an innovative start-up company, construction cluster), which can facilitate double transformation of the construction market and in which the exchange, transfer of information, knowledge and continuous learning are a key factor for the success of the construction company.

Regardless of the conclusions made, it should be noted that the main limitation of the present study is the subjective nature of the responses. The developed model "Resources – Capabilities – Strategy", does not answer all questions as it includes general characteristics (or some good practices), which however, must be applied specifically in different companies, as they have different organizational characteristics, abilities, skills, history, experience, knowledge, routine, specialization, etc. In each company, managers must develop specific solutions and apply specific methods, approaches, analytical procedures and routine actions to build the system of dynamic capabilities and its integration into the overall organizational structure to ensure sustainability. Especially important for the success of the company is the application of a holistic, complex sustainable approach, which skillfully combines the development of internal and external factors/resources. The model developed in this article can make it easier for managers to solve problems and improve activities that ensure sustainable development and building competitive advantages of the company.

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Energy Transition Because of the Green Deal

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Abstract: The Green Deal is Europe's new growth strategy that aims to transform the EU into a fair and prosperous society and combines policies to tackle climate change, to protect and restore biodiversity, eliminate pollution, to move to a circular economy, and to ensure that no one is left behind in the green transition.

The most chalenging area of this strategy is the one of the energy transition that should achieve significant reshape by 2030. The concepts for reforming of the energy sector are not new – starting with deregulation in mid 80-s and introduction of free electricity and gas markets in early 2000-s, altogether with gradual penetration of the new renewable technologies.

Currently the green transition and promoting of the economic recovery shall be seen in the integrated energy and climate planning of the Member States. The article discusses the challenges to achieve sustainable transition at national level.

Keywords: energy strategy, Green Deal, electricity market, economic model, Taxonomy

Introduction

By the mid – 1980s, electricity was produced, sold and supplied primarily by local, state-controlled vertically integrated monopolies. Competition in the electricity market was almost absent and cross-border electricity exchanges were limited. Very similar situation was in place both in the Western and Eastern European countries. The supply system was sandglass like two-way hierarchy: multiple generation capacities provided electricity to one state company (adaptor) who ensures the electricity mix but also to one system operator (as a part of the "adaptor") who ensure the supplies to multiple end users. In this case the business model can be simply described as "sale of kWh".

Such centralized systems were criticised for price inefficiency and for the potential risks for security of supplies.

The development of concepts that modify the national energy market models was initiated in 1985 with introduction of the concept for Energy Union in Western Europe. By reforming of the sector and liberalization of

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the electricity market the Energy Union aims to give consumers secure, sustainable, competitive and affordable energy.

In 1992 with the adoption of the United Nations Framework Convention on Climate Change were established the long-term objective, general principles, common and differentiated commitments, and a basic governance structure, including an annual Conferences of the Parties (COP). The Kyoto Protocol from 1997 further called for limitation of the effects of the human activities on the environment. Later on the Paris agreement from 2015 established the basis for acceleration of the measures for global energy transformation.

The European Union's (EU) policy of introducing a functioning electricity market and a level playing field for market participants is evolving in parallel with efforts to combat climate change. Now the process for modification of electricity systems is advances by completion of the unbundling and the higher interconnection of the national grids, along with the established power exchanges. Following the requirements for sustainable development, the limitation of subsidies for fossil fuels based generation and the priorities for renewable energy sources (ES) generation are essential part of the economic models.

In June 2021, the Council of the European Union and the European Parliament adopted the European Climate Law, which sets out the binding objective of climate neutrality in the Union by 2050. The updated framework for sectoral development toward 2050 includes key aspects of energy legislation and provides incentives for certain types of production and activities (such as production from RES and energy efficiency) that put them in a privileged position by allowing public support for wide range of projects. They are also at the heart of a number of restrictive measures and requirements related to other types of electricity production (such as solid fuel production and emission limits) which face serious challenges and additional costs for implementing of the relevant environmental standards.

In this way the stage is cast for the energy sector ambitious transition which has already other aims apart from those announced in mid of 1980-s. Now the achievement of climate neutrality become priority goal and social policies take front place in the debates about socio-economic risks, including employment, social and distributional impacts affecting notably the most vulnerable as result of the concentrated negative employment effects in certain regions. Such debates show that aims for competitive and affordable energy may not be achieved while developing the new energy solutions and additional instruments for ensuring solidarity will be needed.

It should be added that the environment targets in the areas of transport, buildings and agriculture extend very much the scope of transition, which now is concerning the economy as whole. The general modification of work places, social aspects and reskilling are driving to conclusion that Europe has to be prepared for major social transition.

The planed structural reforms are based on transitional economic model, which encourage the higher level productivity, and is more ecological and socially sustainable. To achieve the long-term goals this economic model is introduced along with special instruments, such as:

- Caps on greenhouse emissions by introducing of Emissions Training System (ETS), application of best available techniques (LCP BREF), EU taxonomy;
- Focused aid instruments for development of infrastructure by Progects of Common Interest (PCI), stimulus for RES;
- State aid rules enabling and supporting the Union in fulfilling its Green Deal policy objectives.

The competition policy embraced the short-term markets, aiming at "energy only" trading, which clearly supports installations with low capital expenses.

Under such conditions actually the options for construction of new or even modernization of conventional power plants (PP) are very limited, as they are barred from financial support and cannot rely on the long-term contracts.

Now the supply system has less hierarchy but much more multiple choices ambient: multiple generation capacities provided electricity after contracting at multiple trading platforms and multiple ways to reach end users; still there is one national system operator but the distribution to end users is ensured via several sub-system operators. Now there are in place grate variety of business models for delivery of electricity but also services and the model to "sale of kWh" is not applicable.

Bulgarian electricity sector still rely on coal termal power plants (TPP), nuclear power plants (NPP), hydro plants and the emerging solar and wind plants, which are providing less than 10% of the internal electricity consumption [1]. The necessity of restructuring of the national energy mix has to acknowledge the new realities and limitations for State involvement:

- The use EU funds or State support is allowed for new renewable plants that become more and more competitive and subsequently the market conditions for operation of traditional power plants are less favourable;

– The increased price for CO_2 emissions limits the use of coal or even gas PPs and the use of traditional generation technologies is more and more limited for economic reasons;
– Electric transmission and distribution system need to accommodate with increased use of intermittent sources as to avoid risks;
– The high level of the investments in nuclear PPs requires guarantees for ensuring of the electricity take-off and presumes a high annual production load factor.

The long-term energy policy of Bulgaria is based on:

– Security of internal energy supplies with local generation and low dependency from external sources, which is based on well balanced electricity and heat generation capacities, based on the use of indigenous sources like coal and hydro, but also use of reliable nuclear power as base load.
– Application of proven technologies and development of supporting infrastructure, were the developed engineering and scientific capacity and general infrastructure are basis for successful maintain and upgrade of these technologies.
– Consideration of the social dimension by balanced approach for development of liberalized market but also securing of affordable supplies for end users was important policy focus.

Generally the "traditional" technologies are subject to gradual increase of requirements and public pressure to resolve wide range of ecological or even moral issues. The nuclear energy is one of possible options for development in Bulgaria but the requirements to ensure substantial funds for decommissioning, disposal of the spent nuclear fuel or for covering of the nuclear risks have to be clearly addressed. The high costs of the new nuclear plant under the strict market rules become the most challenging part for new nuclear projects in Europe. The future of the typical base load capacity, such as nuclear power depends on development of new technologies and options for brother regional and public-private partnerships.

The main goals at national level in the sector are defined by the special energy law include requirements for ensuring quality and security of supplies of electricity and heat. These supplies are considered as service of common interest ensuring important for society needs for access to the grid and special conditions for interruptions. Even more, the energy supplies must be provided at socially acceptable price.

The transformation of the electricity sector is ongoing and the national challenges shall consider the wider effects at EU level. For example the EU's air emissions limits applied for cutting pollution from coal-fired power plants were challenged by Member States, including Bulgaria. The case contested the validity of the emission limits for dangerous pollutants such as nitrogen oxides, mercury and hydrogen chloride. The procedure for introduction of new limits was annulled in the beginning of 2021 due to voting formalities. However, the Court clarified [3] that the current standards are still in force.

The ruling of the European Court of Justice provides that the already set new standards will remain valid until new standards are voted, as “the annulment of the contested decision with immediate effect would run counter to the objectives of ensuring a high level of environmental protection and the improvement of environmental quality’. It is expected that by the beginning of 2022 the European Commission will submit a new draft of the standards for operators to comply with the air pollution rules included in the Large Combustion Plants Best Available Techniques Reference Document (LCP BREF).

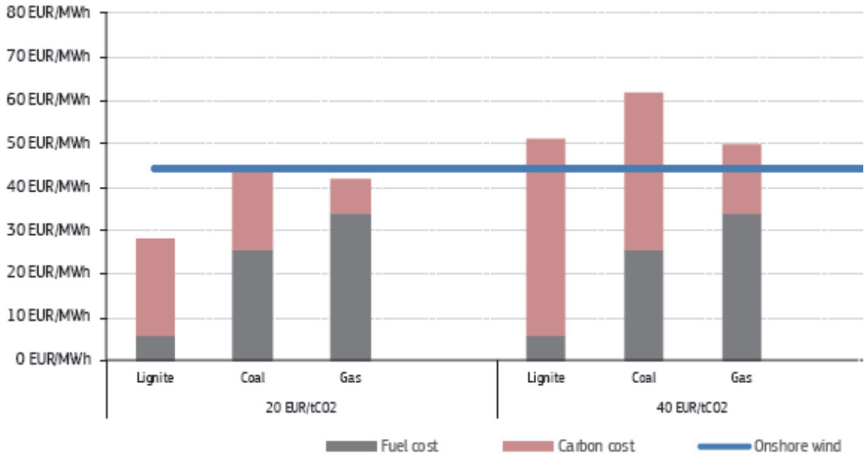
This case is representative for general tendency for ensuring the priority of environmental aspects in front of formal or national economic conditions.

The green transition will deeply modify the electricity system and trading models. The expectations [1] are that towards 2030, the prices will decouple from commodities due to the growing share of renewable energy in the system (mainly wind and solar). As such, higher penetrations of renewables (wind and solar generation) would reduce the exposure of electricity prices to the variations in prices of commodities like coal and CO_2 prices.

It is now considered that the rising CO_2 prices are the best support for renewables since they translate into higher electricity prices (i.e. higher revenues), while keeping operating costs unchanged. Figure 1 shows that at a carbon price of 40 €/tCO_2, it is already cheaper to build an onshore wind farm rather than keep running an existing gas/coal power plant in Germany.

This situation encourages investment in new unsubsidised renewable projects, as the gap between prices sought by private investors and market prices narrows. This is an example of how carbon prices can drive a reduction in emissions in the mid-term (since it takes some time for the price signal to be converted into a finished project).

Figure 1: *Generation cost of German lignite, coal, and gas plants, and onshore wind [2]*



Source: *BloombergNEF*

However, due to the replacement of lignite and coal, reliance on gas will tend to increase beyond 2030. Moreover, in the short-term perspective high carbon prices alone are not a guarantee of falling CO_2 emissions, since other factors such as low renewable generation, high gas prices or high demand due to cold winters/warm summers can overpower their effect. Thus, despite high carbon prices, the carbon emissions could still increase in 2021, driven by factors such as higher-than-average summer temperatures and the post-pandemic recovery in electricity demand.

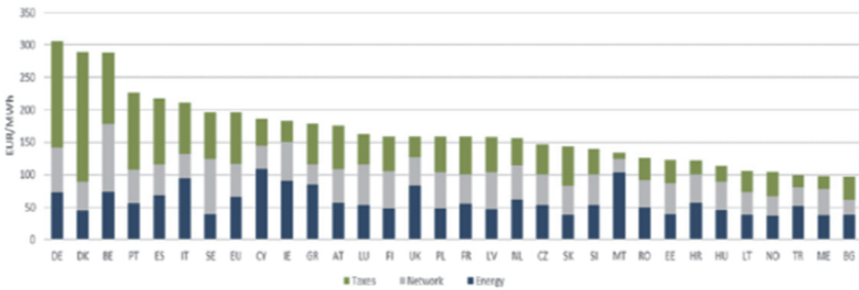
The risk for shortages of gas supplies on regional or European level are fact. The debate for implementation of new gas pipelines infrastructure for securing of diversification of supplies cannot overcome the vision for ceasing of the use of natural gas in 20 years – a period which is not long enough for attracting of bankable financing of such infrastructure.

The extrapolation of the current trends for penetrations of renewables leads to conclusion that by 2030, weather variability and not commodities, could become the main driver in power prices at some major markets in Europe. In order to avoid risks of shortage of supplies (low wind in Germany this summer) or increased demand (high temperatures at Balkans again this summer) is proposed to be mitigated by higher share of RES capacities.

Team of researchers performs assessment [4] of the penetration of RES into the energy systems of different countries and come up with methodology for measuring and forecasting the growth of new technologies. One of the conclusion is that three EU countries manage to maintain sustainable growth of RES during last decade (2% for wind and 1.5% for sun) – Portugal, Ireland, Germany. Here the point is that an increased share of renewables in the system shall make the uptake of variable generation in the power system much more important and the need of additional investments shall be considered.

The comparison of the current prices for electricity show that the countries with high growth of new renewable sources are among the countries with the highest level of the prices for electricity for households in Europe [6], as presented in Figure 2.

Figure 2: *Household electricity prices in 2017: composition of main elements*



Source: *DG ENER, Energy prices and costs in Europe, 2019*

Another system factor which needs consideration is the way to manage the reserve capacities. The general market drivers like demand and supply evaluate the needs of reserve capacities as economically unfeasible during the periods of lower price fluctuations. Thus the calls for decrease expenses for reserve capacities are frequent. But in case of occurrence of events with technical failures or climate extremes the lack of reserves becomes crustal circumstance.

Currently the proposed main action for compensation of lower reserve generation capacities is to increase the capacity of the trans-border connections. This justifies the need to further accelerate the implementation of interconnection projects and the effective use of interconnection capacity, which lead to increased competition and access to reserve capacities in neighbouring countries.

The plans are that with higher interconnection levels the greater price convergencewill be achieved and consequently the lower prices, especially in regions that are currently less well integrated. The evaluation of the efficiency of implementation of TEN-E Regulation shows that already commissioned electricity interconnections as PCIs have contributed to price convergence with a clear downward impact on price levels on EU average at wholesale level. In particular [1], regions that are currently less interconnected, such as the Iberian Peninsula will benefit from this effect. On the demand side, increasing the energy efficiency efforts will help to diminish energy consumption and its impact on prices. Lower and more flexible demand combined with the deployment of smart meters and smart grids will allow to soften the times of peak demand through smart demand response measures to real time prices. Overall, a well-functioning and well-integrated EU energy market, continued investment in renewable technology and improvements in energy efficiency are key to keep prices at check for all consumers. This is the core of the Fit for 55 climate and energy package.

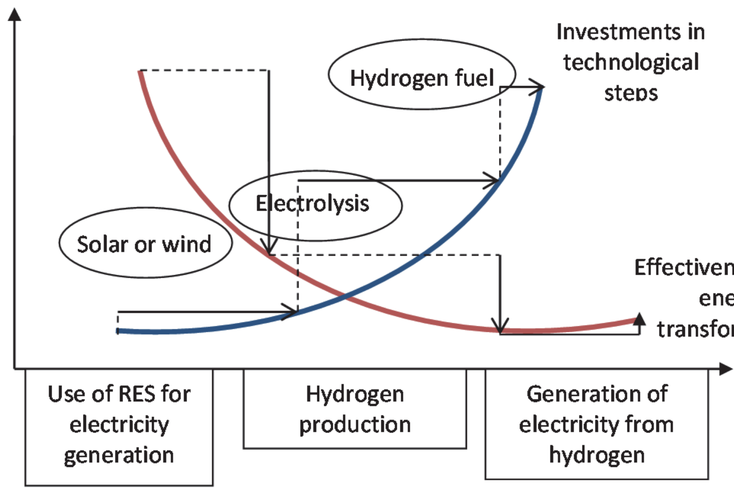
However, the support of projects that secure better cross border connections with support of PCI indirectly lead to decrease of national reserves capacities because more detailed justifications are required for new generation capacities. And in cases where the needs for reserve capacities are due to event with regional character, like hot or cold weather conditions, the cross-border support is not efficient.

It should be noted that still the reliability of the infrastructure and connectivity is not as high as needed in order to secure rebalancing at national level. This year we faced at least one event with major risk for the European electricity system stability due to failure to manage the transborder flows after technical problem in substation.

The discussion on the effects of the variable generation at system level and the needs for further improvements is not over. As specific solutions are considering either storage in batteries or use accumulation in hydro capacities. But solutions with combined RES and installations for production of hydrogen are also actively discussed. However such solutions still have low economic efficiency because they rely on several technological steps where the efficiency decrease and each of these steps require additional investment.

For example the case in which the excess energy from the RES is used for production of hydrogen which in turn is stored and used in case of periods with high demand for electricity, it is necessary to use three technological steps. The qualitative presentation of the energy and financial efficiency is presented at Figure 3, showing that in two technological steps solutions the economic value still could be positive but not in case with three steps.

Figure 3: Link between efficiency in use of sources and needed investments



Source: *own author's assessment*

The provided short review of the mode and effects when extending the security of supplies from national level to regional level aims to support the thesis that the more deep transformation of the electricity sector is applied the higher level of investments is required.

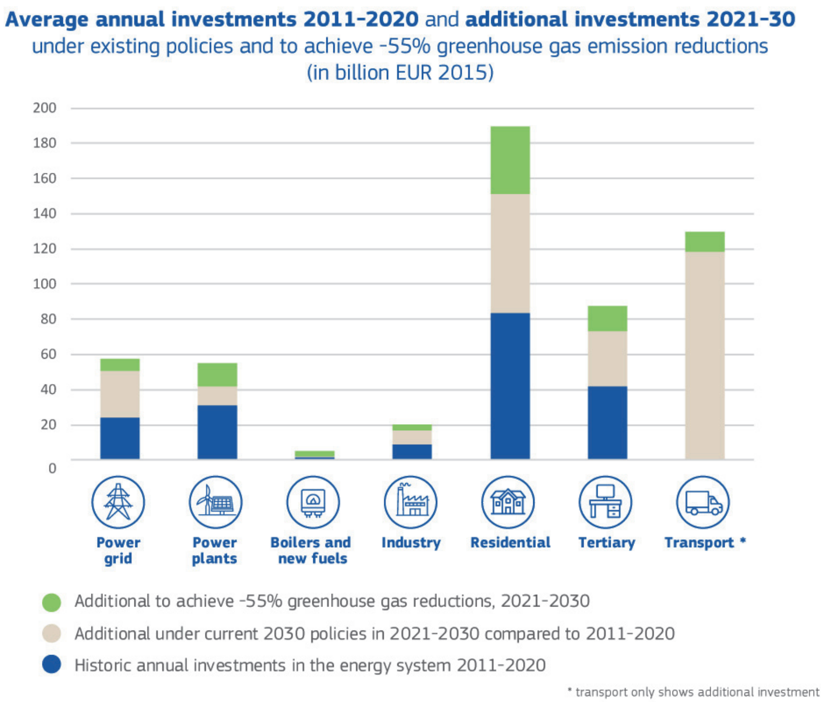
This conclusion is true not only for the electricity generation but shall be considered when proposing the Energy efficiency, Renovation and Mobility policies.

The energy sector has significant role in achieving of emissions targets until now but in the long-term future and for acceleration of the green transition for reaching of the new goal of a 55% reduction in greenhouse gases by 2030 and climate neutrality by 2050, requires much larger sectoral contributions.

The 'Fit for 55' legislative package includes very wide field of interventions, like preventing carbon leakage; aligning the taxation of energy products with EU energy and climate policies; strengthening emissions reduction targets for each Member State in certain sectors; raising the targets on renewable energy target and on energy efficiency at EU level; strengthening CO_2 emissions standards for cars and vans, and expanding alternative fuel infrastructures and charging capacities in line with zero-emission car sales. It also put forward proposals aimed at inter alia tightening the existing EU Emissions Trading System and the application of emissions trading to new sectors: buildings and transport.

The needs for investments in the buildings and transport are of significant magnitude, as shown at Figure 4. The Commission has estimated that achieving the newly increased climate, energy and transport targets for 2030 will require EUR 350 billion of additional annual investment compared to the levels in 2011 – 2020, with further EUR 130 billion a year for the other environmental objectives estimated earlier. The magnitude of this investment challenge requires mobilizing both the private sector and public funds in a cost-effective manner. This will affect all sectors and therefore the Union economy as a whole [5].

Figure 4: *Assessment of needed investments by sectors*



Source: *EC (COM (2020) – 564 final)*

To address this issue the European Green Deal was made a clear priority and core element of the Recovery Plan. The sustainable energy, transport and services of general interest for projects, technologies and market solutions that can bring direct benefits to citizens and local areas are considered as opportunities with high potential for financing by banking and private sources. It is also considered the impact of energy consumption and energy efficiency in the field of digitalisation, once it is clear that the deployment of the digital network.

Considering the real thread for social imbalances due to unequal access to financing, now it is proposed to establish a new Social Climate Fund, which will help mitigate the costs for those most exposed to price increases due to the introduction of emissions trading to new sectors (buildings and transport) during an initial phase of the transition. It will provide €72,2 billion in current prices for the period 2025 – 2032 in the EU budget, corresponding in principle to 25% of the additional revenues from emissions trading for buildings and transport. The Fund will enable Member States to support vulnerable groups (households, transport users, and micro-enterprises) through direct income support and green investments to increase energy efficiency and renovations of buildings, clean heating and cooling, renewable energy use, and access to zero- and low- emission mobility. The new Fund will promote fairness and solidarity between and within Member States while mitigating the risk of energy and mobility poverty.

Since significant public funds are involved in the green transition the question of what indicators for achievement of the green targets are relevant. These indicators are used for measuring of the advancement of countries in their plans for achieving the neutral economy by 2050. National targets and contributions have to support the assessment of 2030 ambition level on the following indicators with their specific values:

- Binding target for greenhouse gas emissions compared to 2005 under the Effort Sharing Regulation;
- National target/contribution for renewable energy Share of energy from renewable sources in gross final consumption of energy;
- National contribution for energy efficiency:
  - primary energy consumption,
  - final energy consumption;
- Level of electricity interconnectivity.

The listed indicators only partially concern the important expectations about energy policy which should ensure energy supplies that are *secure* (only as much as interconnectivity can provide), *competitive* (only in the future when RES would rich the major share in the mix) and *affordable* (only when the energy efficiency penetrate significantly among the end users). Currently these indicators are focused mainly on the environmentally sustainable energy issues.

The concept for market competition at the free electricity markets should be considered in connection with the influence of the policies on the pricing and prices for different generation types. Here is presented comparison between conventional and new technological solutions for generation of electricity by discussing of three aspects:

- <u>Operational expenses:</u>

  The new technologies usually have lower operational expenses except for biomass or waste related generation. The operational expenses of conventional power plants are usually significant, especially for those that use fossil fuels. On the top of the traditional costs, the expenses of these generators are completed by expenses for CO_2 emissions and for decreased efficiency due to additional measures for lowering of polluting emission.

- <u>Capital expenses:</u>

  Although the investments in new build RES (wind and solar) are decreasing, the attractiveness for private investments is not yet obvious in most cases. This is due to either low energy production potential in specific regions or due to need for additional investment in storage capacities. For this reason still most of investments are supported by different aid instruments. On contrary for new build conventional power plant there are restrictions for state aid and the access to banking capital is very limited.

- Trading with special products:

  For new build plants with long period for return of investments the way to reduce the financial risk in the past was managed through long term contracts. The current concept for competitive markets reduce the options for such contracts and rather are directed to financial products like energy futures or trading from virtual plants. These products are applicable together with penetration of digitalisation in the energy sector but also with enabling the cross border trade.

It is clear that routine economic indicators, such as LCOE, IRR and NPV are still applicable at project level but the dominant factor for success is the justification for application of instruments of green financing, which in turns provide opportunities for state support and favorable banking financing.

The vision of the future organisation of energy systems and infrastructures pays special attention on the active participation of all consumers – households, businesses and energy communities – in the frame of development of smart energy systems. It is considered the special roles of a future trans-European super grid and local energy islands. Such development requires significant investments in infrastructure but also involves considerable amount of public funding. The questions for the ownership and control of infrastructure at different levels are additional challenges that need further clarifications.

The development of transition infrastructure and large generation capacities depends heavily on the acceptance criteria for financing. This is the reason for high expectations and discussion about the scope of Taxonomy Regulation.

The Taxonomy Regulation shall provide the actual list of environmentally sustainable activities by defining technical screening criteria for each environmental objective through delegated acts. A first delegated act on sustainable activities for climate change adaptation and mitigation objectives was approved in principle in April 2021. A second delegated act for the remaining objectives will be published in 2022. The publication of the first delegated act was accompanied by the adoption of a Commission Communication on 'EU taxonomy, corporate sustainability reporting, sustainability preferences and fiduciary duties: Directing finance towards the European green deal' that aimed at delivering key messages on how the sustainable finance toolbox facilitates access to finance for the transition. The Taxonomy is the basics for the transition finance which act in favor of the sustainable development.

This delegated act specifies the content, methodology and presentation of information to be disclosed by financial and non-financial undertakings concerning the proportion of environmentally sustainable economic activities in their business, investments or lending activities.

The second delegated act should clarify the Commission position on the use of nuclear energy and natural gas as transition fuel. The launched by Commission in-depth assessment whether or not to include nuclear energy in the EU taxonomy of environmentally sustainable activities. The conclusion confirms 'do no significant harm' aspects of nuclear energy. This assessment has been reviewed by two sets of experts, the Group of Experts on radiation protection and waste management under Article 31 of the Euratom Treaty, as well as the Scientific Committee on Health, Environmental and Emerging Risks on environmental impacts.

Conclusions

In summary of the discussion can be concluded that the ability to attract investments for development of the electricity sector will define the national outlook for the next decades not only for this sector but for the economy in general.

To achieve the neutral economy by 2050 it is required to accept decisions in short terms which shall address the needs to:

– abandon working assets with high remaining value,
– build new energy capacity and infrastructure,
– further change the model for energy services provided to end users.

For Bulgaria the development of gas fired PP and nuclear PP are important options for achieving the strategic aims for securing of energy supplies.

The investing in gas PP (which is applicable for limited period) depends on availability of aid financing, considering that the use of transition fuel, but also the ability to attract interest for private financing to share risks for use of imported fuel.

The investing in nuclear PP is much more complicated because of the need to justify state support. In general terms the nuclear energy does not contradict to EU policies but decisions of application of specific technologies remains within the national jurisdiction.

Following the current concept for market competition it is allowed equal access to the training platforms for generators that enjoy public financial support and conventional generators without support but with additional duties, instead. This model is believed to includes temporary transition period with economic imbalances where public is paying more ether for services or for taxes. It should be noted that this transitional period includes higher risks for interruptions in supplies or failure of businesses.

The initial aims of the liberalization of the market from mid of ‘80-es now seems obsolete since the market is not designed to ensure to consumers competitive and affordable energy, and may pose at risk the security of supplies in case of premature closure of reliable conventional sources without proper replacement of generation capacities.

From high system level prospective the application of nuclear energy may provide the needed stability without compromising of the climate related targets. On the other site more and more consumers would chose to join micro-grids solutions that fit mostly to their needs but such process is slow and deepens on the consumers purchase power. Actually the micro-grids are very similar to the heavy centralized systems for ‘80-es but at local level – once setup the structure of the energy supplies is too intolerant for further modifications or improvements.

Now the EU policy is more socially oriented. Along with the priority of the environmental aims, the special attention to problems with energy and mobility poverty, solidarity between and within Member States, pose different priorities and justify the depart from the economic models with liberal values.

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Waste Products from Wine Production and Possible Paths to a Green Economy

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Abstract: The components of the environment (air, water, soil) are subject to the impact of the technological activity of wineries. The main pollutants (carbon dioxide, alcohol vapours, wastewater, solid waste from the used raw materials) that they emit during their production process are described. The material balance of the production of a newly designed wine enterprise with medium capacity is considered. The quantities of pollutants, released during its technological activity, are analysed. The obtained results are summarized on the basis of quantities of industrially produced wines in the country for the last five years and more precisely for the period 2016 – 2020. On this basis, an estimate is made of the total amounts of pollutants released into nature from industrial wine production in the country. In line with the transition to a green economy, new concepts have been proposed for the recovery of waste products from the activities of enterprises.

Keywords: Wine Production, Waste-free production, Waste Products, Green Economy

1. Introduction

Industry is an important part of any economy, but it is also one of the main causes of environmental pollution. The accumulation of pollutants creates an increasing danger of disturbing the natural balance and irreversible consequences. The EU is aware of the seriousness of the threat and is taking initiatives, adopting programs, norms, and directives, which seek to unite and direct the efforts of countries to increasingly reduce pollution and reduce its damage. To be successful, the measures taken must cover every human activity, every aspect of public life, every sector of industrial production.

The attention in the present study is focused on the waste products from the industrial wine production in the country. The aim of the development is not only to establish the approximate quantities of pollutants from production in this sector, but also what are the possible ways for their full or partial utilization.

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The significance of the problem attracts research interest. The analysis of its current state and ways to reduce pollution from wine production locally or globally are the subject of numerous studies. In this direction is, for example, the study of Gargallo and García-Casarejos (2018). In the context of climate change, they propose the application of specific mitigation measures in wine production in Spain, favouring the transition to a low-carbon economy. Benedetto (2013) assesses the pollution of the environment from white wine production in Sardinia. She pays special attention to CO_2 emissions. In their development, they track the environmental impacts of the entire production process. In this way, it manages to identify the production steps in which pollution can be reduced.

The content of the rest of the development is structured as follows: Section 2 describes the main pollutants that wineries emit during their production process. Section 3 examines the material balance of the production of a newly designed medium-sized wine enterprise and analyses the quantities of pollutants it emits during its production. Section 4 estimates the quantities of pollutants discharged into nature from wine production in the country in the period 2016 – 2020.

The obtained results are calculated on the basis of the quantities of industrially produced wines in the country during the indicated period. Section 5 proposes new concepts for the recovery of waste products from the activities of enterprises and identifies some of the financial aspects of their implementation. In conclusion, the obtained results are summarized, and conclusions are made.

2. Contaminants emitted from industrial wine production

The technological activity of wineries pollutes the environment. In the production of wine, carbon dioxide and alcohol vapours are released into the air, water is polluted with waste products, and solid waste from the used raw materials is dumped into the soil. The main pollutants from the production will be briefly presented here and, where possible, information on the quantities of waste product as a result of the technological process will be included.

2.1. Air pollutants

During the grape harvest campaign, alcoholic fermentation of must, grape pulp and young wine is carried out in the wine enterprises. These technological processes produce carbon dioxide and alcohol vapours, which are released into the atmosphere.

Carbon dioxide

Carbon dioxide is the second most abundant gas among greenhouse gases in the atmosphere. It is responsible for 9 – 26% of the greenhouse effect (Mozell and Thach, 2014). Limiting CO_2 emissions is the subject of a number of EU regulations and strategies related to pollution and climate change.

The amount of CO_2 that is released during alcoholic fermentation can be calculated from equation (1). It shows that one molecule of glucose or fructose produces two molecules of ethanol and two molecules of carbon dioxide. In theoretical terms, the final (main) products of alcoholic fermentation are formed in the following quantities and proportions:

$$C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2 \qquad (1)$$

1 *mol* → 2 *mol* + 2 *mol*[1][1]

100 *g* → 51,11 *g* + 48,9 *g*

180,15 *g* → 2 x 46,05 *g* + 2x44 *g*

The amount of carbon dioxide actually formed from 100 *g* of fermented sugar is about 45 – 46 *g*. The volume of 1 *g-mol* CO_2 at normal pressure is 22,4 dm^3. This means that *2 g-mol* CO_2 x 22,4 = 44,8 dm^3 are formed from 1 dm^3 of grape must with 18% sugar (180 g/dm^3). A small part of this amount is dissolved in the must, and the rest is separated in the fermentation rooms (Bambalov, 1981).

Ethyl alcohol (total evaporated wine from fermentation)

The export of the quantities of ethyl alcohol is carried out through the released carbon dioxide (the wine sticks to the surface of CO_2 and thus falls into the air). The main quantities of ethanol (evaporated wine) are released at the fermentation sites and the additional fermentation compartments.

2.2. Water pollutants

During their production activity, the wine enterprises emit wastewater into the environment. Without the inclusion of water for heating and domestic use, this wastewater is separated as follows:

Wastewater from disinfection and washing of the technological equipment with detergents

Wastewater from washing and disinfection of technological equipment is characterized by the following indicators:

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[1] The amount of substance in one mole (*mol*) contains exactly 6.02214076×1023 structural units. This number is the fixed numerical value of the Avogadro's constant NA, expressed in the unit *mol*-1, and is called the "Avogadro's number" (Haupmann et al., 1985).

– temperature: normal;
– mechanical impurities: up to 0,3 g/dm^3;
– actual acidity: pH 6,5 – 8,0;
– chemical oxygen demand (COD): COD ≤ 0,2254 g/dm^3;
– biological oxygen demand (BOD): BOD ≤ 0,1347 g/dm^3.

Wastewater from sanitation (without detergents) of premises, sites, and packaging

Typically, wastewater from sanitation has a degree of contamination close to that of rainwater.

2.3. Soil pollutants

Soil pollutants are wet clumps, sweet marc, fermented marc, solid sludge (must, yeast, wine, colloidal, from treatments and stabilizations – crystalline, dye), spent diatomaceous earth, spent cellulose charges, glass waste (broken).

Bunches: In the production of all types of wine, the grapes are initially crushed. This aims to separate the grapes from the bunches, for better quality of future wines. The content of the bunches varies widely both between varieties and within the same variety.

The bunches have approximately the following chemical composition: water about 70% (in the dry bunches about 25%), cellulose up to 10%, tannins 1 – 3%, tartrates 1%, minerals and others (Ivanov, 1972). The bunches do not contain fermentable sugars, but in the process of crunching grape must be rich in such sugars sticks to them. The mass of these sugars reaches 1 – 1,5% of the mass of the bunches.

Chips (sweet and fermented): The amount of chips and their mechanical and chemical composition depend mainly on the grape variety, maturity, climatic conditions, and processing technology. Fermented marc has the following mechanical composition: bunches 13%, skins 25%, seeds 12%, wine 50%. In chemical composition, fermented marc differs from sweet marc. They contain approximately 50 – 55% wine, tartrates 0,7 – 2,5% and a large amount of dyes (Marinov, 1990).

Kieselguhr: Kieselguhr or diatomaceous earth is a natural, soft, silicon sedimentary rock that disintegrates into a fine white powder. The typical chemical composition of dried diatomaceous earth is 80 – 90% silica with 2 – 4% aluminium trioxide and 0,5 – 2% iron oxide. The diatomaceous earth mass consists of fossilized remains of diatoms, a type of shell protist. It is used as a filtering agent.

Cellulose: Cellulose is a linear polysaccharide composed of β-D-glucopyranosyl residues (Pishtiiski and Ivanova, 1998). It is the most common organic compound on the planet and a major structural component of plant organisms. It contains more than 50% of organically bound carbon in the biosphere.

Batch: The charge is a filter barrier. Filtration of wines with cellulose charges is widely used in the wine industry and can be preliminary (rough), after stabilization, pre-sterile and sterile.

3. Production volume of a newly designed, medium-capacity wine enterprise and the quantities of pollutants released from its technological activity

The indicators of an average capacity enterprise will be used to estimate the amount of pollutants released in nature in wine production. Suitable for this purpose is the investment prepared and approved in 2012 project for a wine cellar in the town of Lyubimets. The project envisages the wine cellar to process its own grapes from white (772 500 *kg*) and red (1 882 000 *kg*) varieties, as the volume of the enterprise and the variety specifics are set in advance by the investor (Table 1). Based on the structure and content of the grape varieties presented in Tables 8 and 9 of Annex 1, the yield and the quantities of waste products were calculated separately for the white and red grape varieties.

Table 1: *Production volume and variety specification of the wine cellar*

	Grape variety	Mass, kg	Relative share, %
White	Chardonnay	360 000	46,6
	Sauvignon Blanc	157 500	20,4
	Traminer	135 000	17,5
	Resling	15 000	2,0
	Musket	105 000	13,5
	Total	772 500	100,0
Red add rose	Cabernet Sauvignon	792 000	42,1
	Merlot	496 000	26,4
	Syrah	198 000	10,5
	Mavrud	240 000	12,8
	Evmolpia	48 000	2,6
	Malbec	24 000	1,3
	Cabernet Franc	24 000	1,3
	Kraminer	28 000	1.5
	Rubin	32 000	1.7
	Total	1 882 000	100.0

3.1. Yield

1) Quality wine (The designations used are: White wine (W); Red and rose wine (R); Grape must (M) and Total (T)): (W) R = 57,44 *dm*^{3} wine/100 *kg* grapes; (R) R = 59,30 *dm*^{3} wine/100 *kg* grapes
2) Press wine: (W) R = 5,32 *dm*^{3} wine/100 *kg* grapes; (R) R = 4,96 *dm*^{3} wine/100 *kg* grapes
3) Total wine: (W) R = 62,76 *dm*^{3} wine/100 *kg* grapes; (R) R = 64,26 *dm*^{3} wine/100 *kg* grapes

3.2. Waste products

1) Wet plugs: (W) M = 25 389 *kg*; (R) M = 55 863 *kg*; (T) M = 81 252 *kg*
2) Sweet pressed chips: (W) M = 154 689 *kg*; (T) M = 154 689 *kg*
3) Fermented pressed marc: (R) M = 250 683 *kg*; (T) M = 250 683 *kg*
4) Solid sludges (at humidity 35%, liquid phase – wine): (W) V = 7850 *dm*^{3}; (R) V = 17 060 *dm*^{3}; (T) V = 24 910 *dm*^{3}
5) Technological waste

Carbon dioxide

– from violent fermentation:
(W) M = 49 183 *kg* (V = 26 730 *m*^{3});
(R) M = 122 406 *kg* (V = 66 525 *m*^{3});
(T) M = 171 589 *kg* (V = 93 255 *m*^{3}).
– from silent fermentation:
(W) M = 9 963 *kg* (V = 5 415 *m*^{3});
(R) M = 22 985 *kg* (V = 12 492 *m*^{3});
(T) M = 32 948 *kg* (V = 17 907 *m*^{3}).
– total of alcoholic fermentation:
(W) M = 59 146 *kg* (V = 32 145 *m*^{3});
(R) M = 145 391 *kg* (V = 79 017 *m*^{3});
(T) M = 204 537 *kg* (V = 111 162 *m*^{3}).

Ethyl alcohol

– wine evaporated by rapid fermentation:
(W) M = 491 *kg* (V = 495 *dm*^{3});
(R) M = 1 224 *kg* (V = 1 235 *dm*^{3});
(T) M = 1 715 *kg* (V = 1 730 *dm*^{3}).
– wine evaporated from silent fermentation:
(W) M = 50 *kg* (V = 51 *dm*^{3});
(R) M = 115 *kg* (V = 117 *dm*^{3});

(T) M = 165 *kg* (V = 168 dm^3).
– Total alcoholic fermented wine:
(W) M = 541 *kg* (V = 546 dm^3);
(R) M = 1 339 *kg* (V = 1 352 dm^3);
(T) M = 1 880 *kg* (V = 1 898 dm^3).

6) Spent diatomaceous earth (at humidity 35%, liquid phase – wine): (W) M = 5 015 kg; (R) M = 12 219 kg; (T) M = 17 234 kg.
7) Spent cellulose charges (at humidity 50%, liquid phase – wine): (W) M = 2 258 kg; (R) M = 5 495 kg; (T) M = 7 753 kg.
8) Glass waste (broken glass bottles) provided that approximately 60% of the wine produced is bottled in glass bottles: (W) 3 952 kg; (R) 9 628 kg; (T) 13 580 kg.
9) Other wastes (corks, capsules, labels, etc.) are incomparably less than the above-mentioned quantities. Their quantity is difficult to predict and will not be included in future calculations.
10) The waste waters from washing and disinfection of the technological equipment for a period of 1 year are: (W) 744 m^3, with the following composition:
   – Temperature: normal;
   – Mechanical impurities: ≤ 0.075 g/dm^3;
   – Actual acidity: pH = 6.5-8.0
   – Chemical oxygen demand: COD ≤ 0.0563 g/dm^3;
   – Biological oxygen demand (BOD): BOD ≤ 0.0337 g/dm^3

(R) 2 694 m^3, with the following composition:
   – Temperature: normal;
   – Mechanical impurities: ≤ 0,225 g/dm^3;
   – Actual acidity: pH = 6.5-8.0;
   – Chemical oxygen demand: COD ≤ 0,1691 g/dm^3;
   – Biological oxygen consumption: BOD ≤ 0,101 g/dm^3.

(T) 3 438 m^3, the composition of which is given below and in Table 2.
   – Temperature: normal;
   – Mechanical impurities: up to 0,3 g/dm^3;
   – Actual acidity: pH = 6.5-8.0.

11) The waste waters(Domestic wastewater is fed directly to the city sewer) from the sanitation of premises, sites, and packaging for a period of 1 year are in quantity:

(W) 698 m^3; (R) 1 700 m^3; (T) 2 398 m^3 as:

Table 2: *Wastewater from washing and disinfection of technological equipment*

№	Chemical	Concentration, g/dm^3	COD, g/dm^3	BOC, g/dm^3
1	Anthocyanins	0.001	0.0015	0.0003
2	Tartaric acid	0.010	0.0053	0.0027
3	Glycerin	0.020	0.0243	0.0127
4	Glucose	0.020	0.0213	0.0150
5	Ethyl alcohol	0.050	0,1044	0.0684
6	Lactic acid	0.005	0.0053	0.0029
7	Sodium hydroxide	0,150	—	—
8	Acetic acid	0.050	0.0533	0.0279
9	Polyphenols	0.005	0.0086	0.0038
10	Malic acid	0.002	0.0014	0.0010
	Total	0,313	0,2254	0,1347

(W) 298 m^3; (R) 725 m^3; (T) 1 003 m^3 will be released during the harvest campaign and the fermentation period (about 2 months), and the remaining amount:

(W) 400 m^3; (R) 975 m^3; (T) 1 375 m^3 will be released outside this period.

These waters are expected to have a degree of pollution close to that of rainwater wastewater.

4. Assessment of the pollution caused by the industrial wine production in the country for the period 2016 – 2020

The officially published data from the Agrostatistics Department of the Ministry of Agriculture (Website of Ministry of Agriculture, Food and Forestry, https://www.mzh.government.bg/bg/statistika-i-analizi/izsledvane-rastenievadstvo/danni/, accessed on 03.10.2021). Food and Forestry on the quantities of wine and must produced industrially during the last 5 years were used. Based on the average yields for the types of wines, the quantities of wines and must are determined separately (Table 3).

According to the ratio between the volume of production and the quantities of pollutants of the average statistical enterprise presented in Section 3 and taking into account the volume of wine production in the country. Table 3 estimates the total quantities of pollutants released in nature from industrial wine production. The results obtained for the five-year period are presented in Tables 4 – 7, separately for each waste group.

***Table 3:** Industrially produced wine and must in the period 2016 – 2020*

Vintage	White wine, dm^3	Red wine and rose, dm^3	Totally produced wine, dm^3	Totally produced grape must, dm^3
2016	54 930 016	65 848 384	120 778 400	3 720 700
2017	49 113 716	58 875 984	107 989 700	7 706 800
2018	47 328 671	56 736 129	104 064 800	4 338 500
2019	38 993 415	46 744 085	85 737 500	5 931 000
2020	34 393 113	41 229 387	75 622 500	6 666 800

***Source:** Website of Ministry of Agriculture and own calculations*

To summarize the results obtained. we will highlight a few more important facts. They are expressed in the following:

1) The total carbon dioxide emitted from industrial wine production for the period under review is 59 807 950 *kg* or an average of 11 961 590 *kg* per year. In comparison, this equates to the amount of carbon dioxide that 4197 cars would emit over the same period at 30 000 *km* per year and emissions of 95 *g/km* (according to EU limits after 2020, new cars should emit up to 95 *g/km* CO_2). The market price with VAT of carbon dioxide emitted as waste from wine production is equal to BGN 16 746 226 or BGN 3 349 245 per year. To utilize it, it is necessary to implement installations for capturing carbon dioxide.

***Table 4:** Quantities of waste from raw materials in the production in the period 2016 – 2020*

Vintage		Production volume, dm^3	Necessary grape mass, *kg*	Wet bunches mass, *kg*	Sweet and pressed chips mass, *kg*	Fermentated chips mass, *kg*	Solid sludge volume, dm^3
2016	(W)	54 930 016	87 523 927	2 876 911	17 522 290		892 744
	(R)	65 848 384	102 471 808	3 041 363		13 649 245	928 395
	(M)	3 720 700	5 498 301	180 729	1 100 980		55 863
	(T)	124 499 100	195 494 036	6 099 003	18 623 270	13 649 245	1 877 002
2017	(W)	49 113 716	78 256 398	2 572 288	15 666 931		798 215
	(R)	58 875 984	91 621 513	2 719 327		12 203 986	830 091
	(M)	7 706 800	11 388 799	374 350	2 280 493		115 710
	(T)	115 696 500	181 266 710	5 665 965	17 947 424	12 203 986	1 744 016
2018	(W)	47 328 671	75 412 159	2 478 798	15 097 514		769 204
	(R)	56 736 129	88 291 517	2 620 492		11 760 430	799 921
	(M)	4 338 500	6 411 261	210 738	1 283 791		65 138
	(T)	108 403 300	170 114 937	5 310 028	16 381 305	11 760 430	1 634 263

2019	(W)	38 993 415	62 130 999	2 042 246	12 438 626		633 736
	(R)	46 744 085	72 742 118	2 158 986		9 689 250	659 044
	(M)	5 931 000	8 764 593	288 092	1 755 022		89 048
	(T)	91 668 500	143 637 710	4 489 324	14 193 648	9 689 250	1 381 828
2020	(W)	34 393 113	54 801 009	1 801 309	10 971 162		558 970
	(R)	41 229 387	64 160 266	1 904 277		8 546 147	581 292
	(M)	6 666 800	9 851 928	323 833	1 972 750		100 096
	(T)	82 289 300	128 813 203	4 029 419	12 943 912	8 546 147	1 240 358

Table 5: *Quantities of technological waste in the production in the period 2016 – 2020*

Vintage		Carbon dioxide		Ethyl alcohol (totally evaporated fermentated wine)	
		Mass, *kg*	Volume, m^3	Mass, *kg*	Volume, dm^3
2016	(W)	6 700 832	3 641 871	61 293	61 861
	(R)	7 915 947	4 302 381	72 909	73 616
	(T)	14 616 779	7 944 252	134 202	135 477
2017	(W)	5 991 310	3 256 249	54 803	55 311
	(R)	7 077 762	3 846 821	65 189	65 821
	(T)	13 069 072	7 103 070	119 992	121 132
2018	(W)	5 773 555	3 137 900	52 811	53 301
	(R)	6 820 520	3 707 008	62 819	63 429
	(T)	12 594 075	6 844 908	115 630	116 730
2019	(W)	4 756 749	2 585 271	43 510	43 914
	(R)	5 619 329	3 054 151	51 756	52 258
	(T)	10 376 078	5 639 422	95 266	96 172
2020	(W)	4 195 565	2 280 270	38 377	38 733
	(R)	4 956 381	2 693 833	45 650	46 093
	(T)	9 151 946	4 974 103	84 027	84 826

2) The evaporated wine for the five-year period is 549 118 dm^3, which for the year is 109 823 dm^3. In comparison, this annual amount is enough to fill a medium-sized student pool. It should be clarified that if industrial plants use carbon capture installations, there will be virtually no evaporated wine.

3) The amount of average waste from raw materials in the production of grape must and wines are:

- Wet bunches for the whole period 25 593 739 *kg*, for the year 5 118 747 *kg*.
- Fermented marc for the whole period 55 849 058 *kg*, for the year 11 169 811 *kg*.

***Table 6:** Quantities of industrial waste in the production in the period 2016 – 2020*

Vintage		Worked out Kiezeiguhr, *kg*	Worked out cellulose batches, *kg*	Worked out glass (broken glass bottles)[1], *kg*
2016	(W)	568 118	256 445	447 772
	(R)	665 349	299 218	524 246
	(T)	1 233 467	555 663	972 018
2017	(W)	507 962	229 291	400 360
	(R)	594 898	267 535	468 736
	(T)	1 102 860	496 826	869 096
2018	(W)	489 500	220 958	385 809
	(R)	573 277	257 811	451 699
	(T)	1 062 777	478 769	837 508
2019	(W)	403 292	182 044	317 862
	(R)	472 315	212 407	372 149
	(T)	875 607	394 451	690 011
2020	(W)	355 713	160 567	280 362
	(R)	416 593	187 348	328 244
	(T)	772 306	347 915	608 606

***Table 7:** Quantities of wastewater in the production in the period 2016 – 2020*

Vintage		From washing and disinfection of technological equipment, m^3	From sanitation of premises. worksites and packaging, m^3	From production of grape must, m^3	Total, m^3
2016	(W)	84 294	79 087		163 381
	(R)	95 778	92 563		188 341
	(T)	180 072	171 650	2 529	354 251
2017	(W)	75 369	70 712		146 081
	(R)	85 637	82 762		168 399
	(T)	161 006	153 474	5 239	319 719
2018	(W)	72 629	68 142		140 772
	(R)	82 524	79 754		162 278
	(T)	155 153	147 896	2 949	305 998
2019	(W)	59 838	56 142		115 980
	(R)	67 991	65 708		133 699
	(T)	127 829	121 850	4 032	253 711
2020	(W)	52 779	49 518		102 297
	(R)	59 969	57 956		117 925
	(T)	112 748	107 474	4 532	224 754

[1] Provided that approximately 60% of the wine produced is bottled in glass bottles.

– Sweet chips for the whole period 80 089 559 *kg*, for the year 16 017 912 *kg*.

For comparison, the volume of bunches and chips per year is equal to the volume of an eight-storey block with four entrances (96 apartments). If the bunches and chips are not discarded, but processed into pellets or other alternative fuel, the expected revenues with VAT for the year are estimated at approximately BGN 6 784 358.

– Volume of solid sludge for the whole period 7 877 467 dm^3, for year 1 575 493 dm^3.

The volume of solid sludge discharged into nature each year is equal to the volume of an Olympic-sized pool.

5. Ways to solve the problem

5.1. Utilization of waste products

Specialized enterprises have been set up in some countries, such as France and Italy, for the processing of waste wine products. As a result of their activity, environmental pollution is significantly reduced and at the same time products (distillates, tartaric acid, enocyanin, tannins, etc.) are produced, which are again used in industry.

Nowadays, wine producers in Bulgaria are not interested in the processing of waste products. To improve the current state of the problem, we will focus on each of the main groups of waste separately and outline possible directions for work.

The main directions for processing the first group of waste products (technological waste and raw material waste) are related to the utilization of carbon dioxide, sugars, ethyl alcohol, tartaric acid, and dyes.

Fermentation CO_2 capture systems with 90% purity are already available on the market. The resulting carbon dioxide is then cleaned of impurities. compressed and reused or sold. For example. the Enomet systems from Italy and the Oresteo systems in Spain (Smart, 2019). Such systems are available even for microbreweries.

Another solution is offered by Château Smith Haut Lafitte from Bordeaux (Kevany and Haut, 2017), which uses a process developed by the French company Alcion Environnement to capture fermentation CO_2 and produce bicarbonate of soda from it.

The first group of waste products includes the bunches, which in the past were considered as raw material for the production of cellulose, tannins and concentrated sugar solutions (by pouring water over them and subsequent concentration). At present, the bunches are considered unnecessary and are discarded by the enterprises without processing. Difficulties that to some extent hinder the organization of the activities for their utilization are their irregularity as a raw material, their short duration and the relatively low quality of the obtained distillate products.

Before 1990, sweet marc was considered a valuable raw material used to produce: marc distillate, calcium tartrate, dried grape seeds, feed products. They are processed fresh (no later than 10-12 hours after receipt). In case of delay in processing, rapid spoilage occurs (fermentation and acidification under aerobic conditions). A number of technologies and schemes for processing of sweet marcs are known, such as: technological line for their complex processing; extraction with ED-4 extractor; auger extraction; preparation of calcium tartrate; obtaining grape seeds for technical purposes, etc. (Dimitrov et al., 1984).

In the past there were a number of areas. technologies and special equipment for utilization of fermented marc: distillation apparatus DD-50 (the last apparatus operating in the country in 2010 was decommissioned in Vinprom Haskovo); preparation of calcium tartrate; obtaining grape seeds for technical purposes; production of red dye concentrate (enocyanin) from dyed red marc.

Solid sludges can be used to produce yeast biomass, distillates and calcium tartrate. There is a new technology developed for their processing and production of biogas.

Despite the use in the past of the listed technologies and the emergence of new processing methods in other countries, at present the waste from the wine industry in Bulgaria is not recovered. The usual practice of enterprises is only to dispose of waste in a separate place and in very rare cases to use it for animal feed from small farms. The only processing, which is carried out by a limited number of Bulgarian winemakers, is the production of distillate products.

The first main factor on the way to the utilization of waste products are the technologies and technical means for carrying out this activity, and they are available and accessible to every winemaker. Bulgarian winemakers can take advantage of the developed technologies for the processing of bunches and marc in eco fuel – pellets and briquettes or their processing and production of methane. They can also be used for the production of eco-fertilizers from bunches and marc, despite the mandatory processing due to the high acid content.

Solid sludge, spent diatomaceous earth and cellulose charges can also be used by methane or fertilizer plants. In line with modern trends in organic production and the dynamically developing science and technology, these ideas are realistic, and their widespread application would help reduce industrial waste.

The second factor. but no less important. is the motivation (financial or otherwise) of winemakers. The financial aspects depend on the comparison between the costs of implementing a selected processing technology and the revenues from the sale of raw materials produced from waste products. Revenues from sales are directly dependent on the trade prices of raw materials, which to date with VAT are: 1 *t* CO_2 is BGN 280; 1 *t* of pellets is BGN 420; 1 *kg* of tartaric acid is BGN 14; 1 *kg* of enocyanin AC3W is BGN 12.

The last factor is the existence of purposeful centralized management by the state to guide and assist winemakers in this activity. The intervention of the state administration can be expressed in organizational work, in legal changes or in financing. One of the possible ways to progress in this direction is the establishment of specialized regional enterprises (according to the approved wine and wine map of the country) for the recovery of waste products.

The consolidation and general processing of waste products will reduce the costs of individual wine producers for the introduction of processing technologies, will ensure higher quality of raw materials produced, will increase the level of safety. Mandatory state control will become much more effective and will be carried out in one place (at the entrance of these enterprises) and not in each enterprise separately.

5.2. Establishment of landfills for collection and processing of waste products from the wine industry

According to EU requirements, only waste that has been processed can be disposed of. Directive (EU) 2018/850 of the European Parliament and of the Council of 30 May 2018 states that from 2030 onwards, restrictions will be imposed on the disposal of all waste that is suitable for the recycling or recovery of other materials or energy (Directive 1999/31/EU on the landfill of waste, https://eur-lex.europa.eu/legal-content/BG/TXT/HTML/?uri=LEGISSUM:l21208&from=CS, accessed on 03.10.2021). In winemaking, even after secondary recovery, waste is separated that is not subject to further processing. For example, used diatomaceous earth and cellulose charges are natural products from the surrounding environment, but they need to be deposited somewhere. As the demarcation of landfills for inert waste is regulated by European directives, winemakers should, where possible, use existing landfills or build new ones. The established system for separate waste collection in our country should be used for recycling of glass waste (broken glass bottles) and could be sought at the regional level to motivate and support local winemakers in this direction.

6. Conclusion

Wine production is a significant polluter of the environment. but unlike other industries. it has easy ways to limit and eliminate this pollution. In the present study the quantitative dimensions of the problem are established, the main factors on which its successful solution depends are identified, and finally concrete actions are proposed to achieve the desired result.

The recommendations echo the past, when the now forgotten stage of "Processing and utilization of by-products" of the production activity of the wine industry was mandatory. The results of the mass inclusion at this stage in the production process of wineries are personal and public and are expressed in:

- reduction of the prime cost of own production – use of own produced additives, access to cheap and ecologically clean source of energy (biogas, pellets), etc.;
- reduction of unregulated waste disposal;
- reduction of general environmental pollution and negative impacts on human health.

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Geospatial Approach to Analysis of Greenhouse Gas Emissions

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Abstract: The fact that Earth's biosphere is no longer able to neutralize carbon dioxide is a symptom of a disturbed natural balance. In this study, to understand the current situation and trends in greenhouse gas (GHG) emissions in the European Union (EU) and Bulgaria, we have applied a combination of statistical and machine learning methods. Spatial autocorrelation and cluster analysis have indicated that there exist a statistically significant dependency in geospatial spread of GHG emissions. GHG emissions by economic sectors in the EU and Bulgaria have shown that the energy production sector is the biggest carbon polluter. Correlation analysis has identified the factors that most strongly influence the GHG emissions from this sector in Bulgaria. In order for Bulgaria to be able to meet the stringent objectives for significant reduction of harmful GHG pollution, a set of measures has been proposed.

Keywords: climate change, greenhouse gas emissions, machine learning, spatial autocorrelation, cluster analysis

1. Introduction

Climate change has a major impact on ecosystems, human health and living standards. In recent decades, the frequency and intensity of extreme weather events, such as heat waves, fires, heavy rainfalls and strong storms have increased. Air and water temperatures, sea levels, and melting Arctic ice set new records (Quiggin et al., 2021). Climate crisis is associated with social consequences, such as the spread of certain communicable diseases (including coronavirus disease COVID-19). There are also many cases of sudden death due to excessive heat (Angelov, 2021). Climate change imposes significant costs on government budgets. Economic losses from climate-related extremes of European Union (EU) countries since 1980 have exceed 400 billion euros. The predicted damage due to natural disasters in the EU is highest in the Mediterranean region (EEA, 2016).

These issues have put the global warming in the focus of international organizations for decades. The key treaties on fighting climate change

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are the United Nations Framework Convention on Climate Change (UNFCCC, United Nations Framework Convention on Climate Change, 1992, https://treaties.un.org/doc/treaties/1994/03/19940321%2004-56%20am/ch_xxvii_07p.pdf, accessed on 17 October 2021) and its extension, the Kyoto Protocol (The Kyoto Protocol, 1997, https://unfccc.int/resource/docs/convkp/kpeng.pdf, accessed on 17 October 2021). The latest version of the protocol (Doha Amendment of The Kyoto Protocol, 2012, https://en.wikisource.org/wiki/Doha_Amendment_to_the_Kyoto_Protocol, accessed on 17 October 2021) requires reducing greenhouse gas (GHG) emissions causing global warming. GHGs are seven types of gaseous emissions – carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), three types of fluorinated industrial gases (hydrofluorocarbons (*HFCs*), perfluorocarbons (*PFCs*), sulfur hexafluoride (SF_6) and nitrogen trifluoride (NF_3, Applies from the beginning of the second commitment period (1 January 2020), (The Doha amendment, 2013). According to the Paris Agreement on climate change (Paris Agreement under the United Nations Framework Convention on Climate Change, 2016, https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement, accessed on 17 October, 2021), global warming should be limited to 2°C by 2050 and up to 1,5°C by the end of the 21st century compared to the pre-industrial period.
According to the Sixth Global Assessment Report (IPCC's Assessment Reports about knowledge on climate change, its causes, potential impacts and response options has been published since 1990. The latest, sixth Assessment Report appears this year, eight years after the previous one. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_Full_Report.pdf, accessed on 17 October, 2021) of the United Nations Intergovernmental Panel on Climate Change (IPCC), "it is clear that human influence has warmed the atmosphere, the ocean and the land". Without significant reduction in anthropogenic emissions in the coming years, the allowable warming threshold will be exceeded before the end of the 21st century. The measures included in the plan of the EU to tackle climate breakdown, have been named the Fit for 55 package because it puts the block to meet its 2030 goal of reducing emissions by 55% from 1990 levels. By 2019, the EU had cut its emissions by 28% from 1990 levels.

The increase in anthropogenic GHG emissions is a cause for great concern worldwide and is the subject of this study. The main goal of the study is to compare the GHGs emissions and trends in their change in the EU countries and Bulgaria.

The tasks of the study are as follows:

1) to determine the state and trends in the change of GHGs emissions;
2) to explore the existence of spatial autocorrelation in GHGs emissions;
3) to identify clusters of EU member states with similar greenhouse gas emissions;
4) to investigate the influence of certain industries (sectors) on the change of GHGs emissions in Bulgaria;
5) to make some recommendations for reducing the socio-economic consequences of climate change in Bulgaria.

Section 2 provides a short review of previous research on greenhouse gas emissions. The next section describes the datasets and the methods applied for their analysis. Section 4 reveals the main factors for the spread of GHG emissions in Bulgaria. The last section summarizes the obtained results and proposes recommendations for policy changes to cope with global warming by reducing greenhouse gases.

2. Related work

The problems of global warming have attracted the attention of many scholars recently. A significant part of them were focus on the factors influencing greenhouse gas emissions and their economic and social consequences. Angelov (2014) has examined the pollution caused by industrial production as a factor for spatial inequality in the economic development of the modern city.

Porter et al. (2018) have assessed the magnitude of fresh fruit and vegetables withdrawal and destruction, its spatial and temporal trends, and its associated GHG emissions between 1989 and 2015.

Camanzi et al. (2017) have carried out an integrated assessment of GHG emissions throughout the EU-25 food supply chain using the environmentally extended input-output (EE-IO) approach.

Sandström et al. (2018) have analyzed how trade and countries of origin impact GHG footprint calculation for EU food consumption. The share of animal products in the diet is the most important factor determining the footprint of food consumption.

Zyśk et al. (2020) have investigated how the fuel and technological transformations in the power, road transport, and household and tertiary sectors aimed at reducing CO_2 emissions in Poland would affect air quality, human health, and the associated external cost.

Several studies have been conducted on quantitative dependencies in greenhouse gas dynamics and prediction of GHG environmental degradation and the factors which cause the pollutions. Saleh et al. (2016) have proposed a Support Vector Machines (SVM) model for predict expenditure of CO_2 emission. In this study, the energy consumption such as electrical energy and burning coal was input variable and it has affected directly increasing of CO_2 emissions in the new model.

Sun and Liu (2016) have applied least squares SVM (LSSVM) to predict different types of carbon dioxide emissions. The described case studies have revealed that classification and prediction of CO_2 emissions can highly improve forecast accuracy. Zhao et al. (2017) have employed the same approach. Additionally, they have proposed the Whale Optimization Algorithm (WOA) to search the optimized values of parameters of LSSVM model. The driving forces of CO_2 emissions including Gross Domestic Product (GDP), energy consumption and population are chosen to be the import variables of the proposed WOA-LSSVM method.

Hamrani et al. (20120) have examined three categories of regression models, including classical regression, shallow learning and deep learning for predicting soil GHG emissions from an agricultural field.

As the volume of data collected on GHG emissions is growing rapidly, and recent quantitative research is not much, we will apply a set of classical and intelligent methods to find out trends and hidden patterns.

3. Materials and Methods

According to the UNFCCC, countries have an obligation to conduct annual inventories of GHG emissions by sources, according to an established methodology. The inventories cover the emissions of the seven main types of greenhouse gases. To compare different GHGs due to their different power to accelerate global warming, the IPCC has created an index called Global Warming Potential (GWP). The impact of heat energy on all GHGs is compared with the impact of CO_2 (GWP = 1) and is denoted as CO_2 equivalent (CO_2-*eq.*).

The data source for our study is the data viewer on GHG emissions and removals, sent by countries to UNFCCC and the EU GHG Monitoring Mechanism, available online at https://www.eea.europa.eu/data-and-maps/data/data-viewers/greenhouse-gases-viewer), accessed on 17 October 2021. The time series for EU countries span the period from 1990 to 2019.

In analysing quantitative data dependencies, we employ classical statistical methods – time series analysis and correlation analysis.

To test the hypothesis for spatial dependence, we apply Moran's statistic (Moran, 1950). Moran's I index measures the degree of autocorrelation in a given set of data, when a matrix of weights describes the dependencies between each pair of data. The null hypothesis H_0 for the test is that the data is randomly distributed in the space (no spatial dependence). The alternate hypothesis H_1 is that the dataset is spatially dependent.

Calculations for Moran's *I* are based on a weighted matrix with units *i* and *j*, where $i, j = \overline{1, n}$, where *n* is the number of sample's elements. Similarities between elements is calculated as the product of the differences between y_i and y_j with the overall mean:

$$Similarity = (y_i - \bar{y})(y_j - \bar{y}), \text{ where } \bar{y} = \frac{\sum_{i=1}^{n} y_i}{n}.$$

The Moran's statistic is calculated using the basic form, which is divided by the sample variance $s^2 = \frac{\sum_{i=1}^{n}(y_i - \bar{y})^2}{n}$ as follows:

$$I = \frac{1}{s^2} \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}(y_i - \bar{y})(y_j - \bar{y})}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}},$$

where the weights w_{ij} are taken from first-order adjacency matrix of sample's elements.

The null hypothesis is rejected at a significance level equal to $-\frac{1}{n-1}$.

To build clusters from EU member states, we utilize the two-step clustering method, which is an unsupervised machine learning algorithm.

In this work we employ a methodology that includes a variety of methods – from classical static methods to methods of artificial intelligence to detect patterns in data on GHGs emissions in the EU.

4. Geospatial, temporal and factor analysis of greenhouse gas emissions

The section presents the results of the analysis of GHGs emissions in the EU within the period from 1990 to 2019.

4.1. Status and trends in greenhouse gas emissions in the EU countries and Bulgaria

Table A.1 and Table A.2 (Appendix A – Available online at web.uni-plovdiv.bg/galili/Geospatial_Approach_2021/Appendix_A.pdf) visualize the emissions of GHGs, the total emissions and the share of the total emissions from the emissions in the base year (1990), accepted as 100%, for EU and Bulgaria, respectively. Data from the GHGs emission inventory in the EU for 2019 (Table A.1) show that total GHGs emissions in *CO_2-eq.* are 4059,2 *Mt*, which is the minimum value or 72% of the emissions in the base year. The decrease compared to the previous year is 3,92%. According to Table A.2, the total GHGs emissions in CO_2-*eq*. in Bulgaria in 2019 are 56,0 *Kt* or 56% of the emissions in the base year. The decrease compared to the previous year is 2,32%. The minimum value of GHGs emissions was reported in 2013 – 54,9 *Kt* (55% of the reference value).

The analysis of CH_4 (blue) and N_2O (yellow) emissions in the EU for the period 1990 – 2019 reveals a clear downward trend, while for CO_2 (column series, *y*-axis on the right-hand side) and *f*-gases (gray) in some previous years demonstrate a reverse trend (Figure 1).

The emissions of CO_2 (column series, y-axis on the right hand side) and CH_4 (blue) for Bulgaria in the period 1990 – 2019 decrease, while *f*-gases (gray) and N_2O (yellow) increase (Figure 2).

Figure 1: *Greenhouse gas emissions in EU-28 (t CO_2-eq., CO_2 values – y-axis on the right side)*

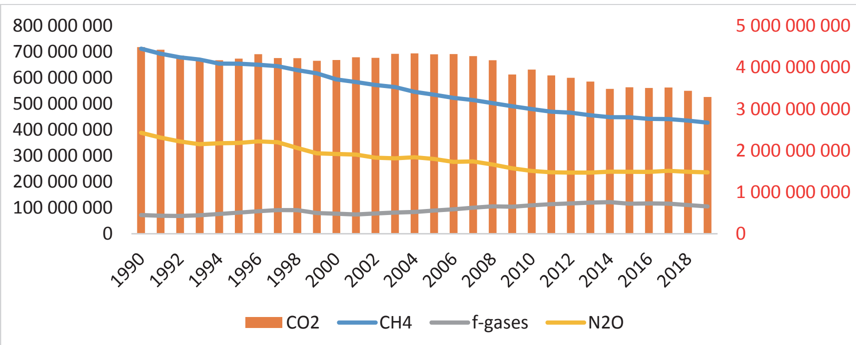
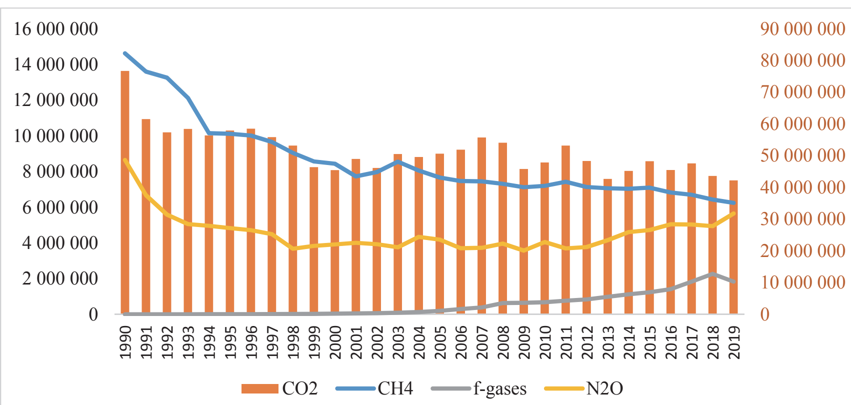


Figure 2: *Greenhouse gas emissions in Bulgaria (t CO_2-eq., CO_2 values – y-axis on the right side)*



The greenhouse gas emissions per capita in the EU are reduced by 11,9 t of CO_2-eq. in 1990 to 7,8 t of CO_2-eq. in 2019. The lowest levels were in 2000 – 7,1 t of CO_2-eq. According to this indicator, Bulgaria is approaching the average for the EU – 8,02 t of CO_2-eq. (Figure A.3) with a maximal value 9,5 t of CO_2-eq. (1990) and minimal value 7,1 t of CO_2-eq. (2000).

During the given period, the GHG emissions obtained from the creation of EUR 1 000 gross domestic product significantly decreased – from 2.6 t of CO_2-eq. for 1991 in 2019 they reach 1,1 t of CO_2-eq. Between 1990 and 2019, the emissions per unit of GDP in the EU fell by almost half – from 0,58 t to 0,27 t of CO_2-eq. (Figure A.4).

Figure A.5 (a) and (b) demonstrate the differences in the distribution by shares of four types of GHGs in 2019, for the EU and Bulgaria, respectively. The distribution by gases shows that the share of CO_2 in Bulgaria (76%) is smaller than in the EU (81%). The share of *f*-gases is the smallest – 3% for both Bulgaria and the EU.

The declining trend in the EU must continue in order to achieve the goal of Fit for 55 by 2030 ('Share' column in Table A.1 and Table A.2 for the EU and Bulgaria, respectively).

4.2. Measuring spatial autocorrelation of greenhouse gas emissions in EU

Given:

a) The column matrix $A = [a_i], i = \overline{1,28}$ with the total amounts of GHGs emissions in the EU countries in 2019;

b) The distance matrix $B = [b_{ij}], i, j = \overline{1,28}$ with the distances between the EU countries by land borders.

Find: The Moran's I index for spatial autocorrelation of GHGs emissions in the EU.

Solution: The Moran's I index is calculated by the following algorithm (Chen, 2013):

Step 1: Standardizing size measures

By using the data standardization procedure, Z matrix is determined. After the procedure, the sample mean of Z elements becomes 0 and the standard deviation is 1.

Step 2: Generating spatial weights matrix

The process of yielding a spatial weights matrix is as follows:

First, convert the spatial distance matrix b_{ij} into a spatial contiguity matrix. Select a spatial weight function such as:

$$v_{ij} = \begin{cases} {b_{ij}}^{-1}, i \neq j \\ 0, i = j \end{cases}. \tag{1}$$

Second, summate the spatial contiguity values using the following formula:

$$S = \sum_{i=1}^{28} \sum_{j=1}^{28} v_{ij}, \tag{2}$$

where *S* denotes an amount obtained by a double summation.

Third, calculate the normalized spatial contiguity matrix *W* dividing each *V* element by *S* value:

$$w_{ij} = \frac{v_{ij}}{S}. \tag{3}$$

The spatial contiguity matrix and normalized spatial weights matrix of 28 EU countries are obtained, *V* and *W*, respectively.

Step 3: Computing Moran's index *I*

The Moran's index is determined according to the formula:

$$I = Z^T W Z, \tag{4}$$

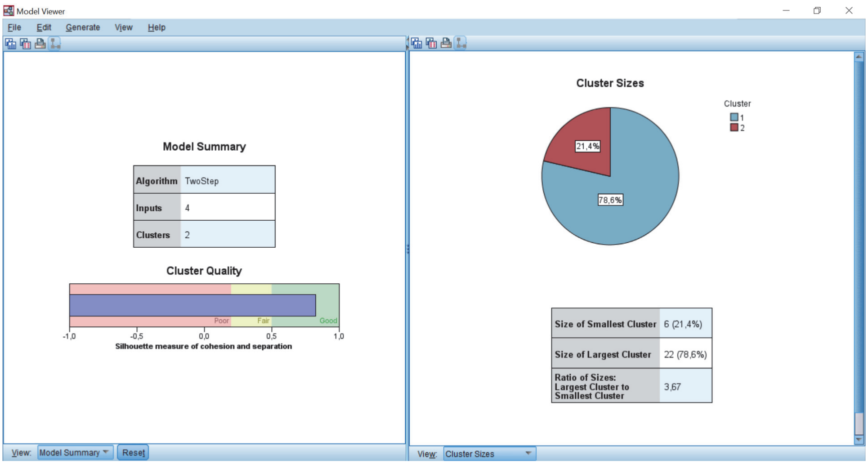
where *Z* is the normalized column matrix of GHGs emissions from 2019 for the EU countries (*Step 1*) and Z^T is its transposed row matrix.

The Moran's I statistics were calculated in two cases – for binary and real values of spatial distance matrix. In the first case, the spatial distance matrix consists of binary estimates, where '1' means that the countries have a common land border, '0' – no common land border between countries. In the latter case, the spatial distance matrix contains the length of borders between each pair of EU countries in kilometres. The obtained Moran's I values are 0,245 and 1,279 for binary and real estimates, respectively (Appendix B, Available at web.uni-plovdiv.bg/galili/Geospatial_Approach_2021/Appendix_B.xlsx). Since the significance level is equal to $-\frac{1}{n-1} = -\frac{1}{28-1} = -0{,}037$, and the index values are positive in both cases, the null hypothesis is rejected, i.e. there is a statistically significant dependency between the amounts of GHGs emissions and the geospatial location of the EU countries. Therefore, joint efforts and coordinated actions in all European countries are needed to achieve sustainable results in the fight to reduce harmful gas emissions.

4.3. Clustering of the EU countries by emissions of GHGs

In order to identify good practices and successful management decisions, we look for similarities between the EU countries. We employ cluster analysis for the 28 countries according to the amounts of GHGs they emit. Input data for the cluster analysis are the emissions of the four main GHGs in the EU countries in 2019 (Table A.3). We solve the problem of determining clusters from countries with similar emissions by the method of two-step clustering (IBM SPSPS Statistic software). The obtained solution is statistically significant (Figure 3, left), as the countries are divided into two clusters, consisting of 22 and 6 countries, respectively (Figure 3, right).

***Figure 3:** Quality assessment of clusters' model and basic description of obtained clusters*



The first cluster consists of twenty two countries – Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Germany, Greece, Hungary, Ireland, Italy, Latvia, Netherlands, Poland, Portugal, Romania, Slovakia, Sweden and United Kingdom (Figure 4). The second cluster consists of six countries: France, Lithuania, Luxembourg, Malta, Slovenia and Spain (Figure 5). The countries from the first cluster emit less amount of harmful gases into the atmosphere in 2019 and are more successful in reducing pollution (Table A.4).

Since the cluster analysis does not consider the area and population of the countries, we can take the largest in area and population countries from cluster #1 as a benchmark: Germany, Italy and United Kingdom. The other countries can study their experience in the field of decarbonisation and put it into practice.

Figure 4: Countries characteristics – cluster #1

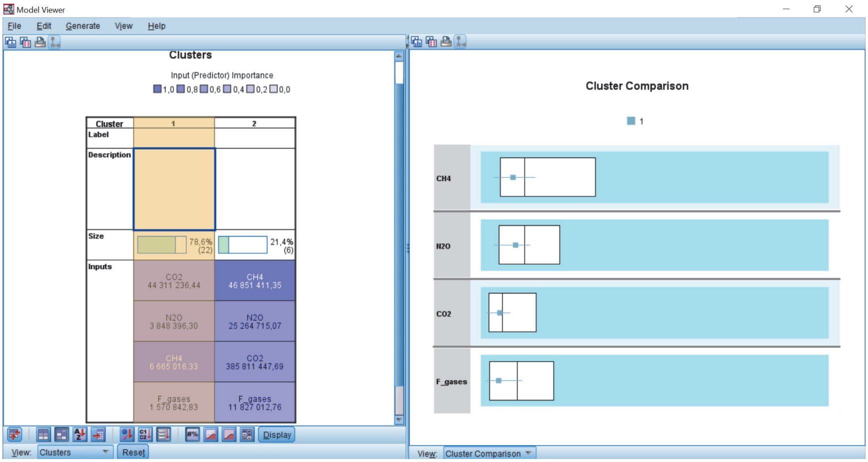
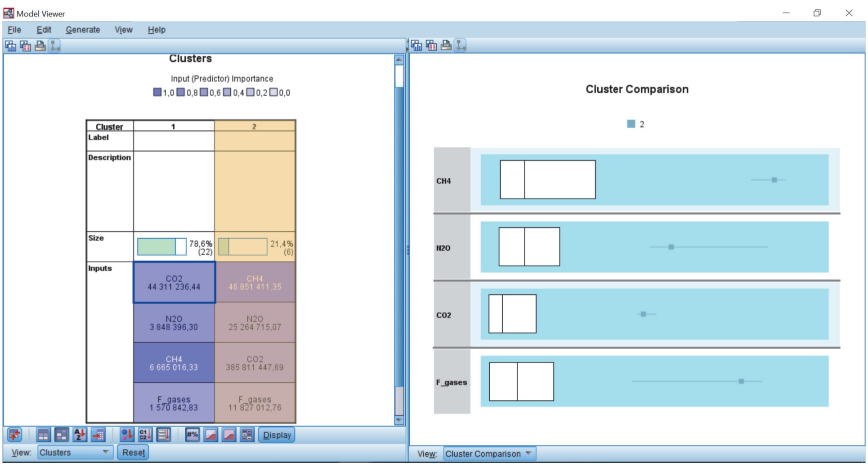


Figure 5: Countries characteristics – cluster #2



4.4. Industries as factors influencing greenhouse gas emissions in Bulgaria

The changes in GHG emissions in Bulgaria have a declining trend and the analysis by economic sectors illustrates that throughout the studied period, the largest source of pollution is from energy sector (Table A.5, Figure A.8).

The ratios between quantities of emitted gases by economic sectors in the EU and Bulgaria in 2019 are presented in Figure A.9. In both diagrams, the share of pollution from energy sector is the highest, as for Bulgaria (51,50%) it is significantly higher than for the EU (25.70%). This fact marks one of the directions that should be explored on to reduce GHG emissions in our country.

We studied the impact of some subsectors of energy sector and their impact on the total amount of GHG emissions in the sector. Table A.6 shows the total energy consumption in the country (P_1), the crude oil production (P_2), the refined oil products production (P_3), the consumption of natural gas (P_4), the coal domestic consumption (P_5) and the share of renewable energy sources (P_6). These indicators are considered as factors influencing the GHG quantities, emitted by the energy sector in Bulgaria.

The correlation coefficients R_i for each indicator P_i and their corresponding coefficients of determination R_i^2 and uncertainty K_i ($K_i = 1 - R_i^2$) were calculated (Table 1). According to the scale from Table A.7, the coal domestic consumption (P_5) has the strongest influence. The medium degree of influence on the amount of emitted gases in Bulgaria is exerted by the total energy consumption (P_1), the crude oil production (P_2) and the consumption of natural gas (P_4), as the negative sign of R^2 indicates that the dependence on crude oil production is inverse.

Table 1: *Correlation coefficients by energy subsectors in Bulgaria*

	Total Energy Consumption	Crude Oil Production	Refined Oil Products Production	Natural Gas Domestic Consumption	Coal and Lignite Domestic Consumption	Share of Renewables in Electricity Production (incl. hydro)
	(P_1) Kt	(P_2) Kt	(P_3) Kt	(P_4) billion m^3	(P_5) Kt	(P_6) %
R_i	0,456777	–0,351410	0,132307	0,357779	0,562020	–0,266658
dependence	medium	medium	low	medium	significant	low
	positive	inverse	positive	positive	positive	inverse
R_i^2	0,208645	0,123489	0,017505	0,128006	0,315866	0,071106
K_i	0,791355	0,876511	0,982495	0,871994	0,684134	0,928894

The analysis has shown that it is necessary: 1) to strengthen state control over the consumption of coal and gas and 2) to optimize their trade. The low renewable energy's share in Bulgaria determines the weak impact of this subsector in reduction of energy pollution. In order to increase this share, it is necessary to improve and facilitate the procedures for the approval of new renewable energy facilities. The increasingly expensive gas and electricity prices could make such government decisions attractive for new investors. In the last decade, the costs of solar and wind energy production continue to decline. This situation adds another advantage for renewable energy sources and can be used by government in its targeted actions for climate change mitigation.

5. Conclusion

The fossil fuel-based industrial economy has gradually changed the atmosphere, oceans, freshwater, soil and biodiversity. Climate change has raised the question about man's attitude towards toward nature in today's consumer society. Many studies have shown that the limit of nature's capacity to regenerate itself has already been exceeded.

In this study, classical and intelligent methods has applied for analysis of GHGs emissions of the EU member states in the period between 1990 and 2019. The obtained positive values for Moran's *I* index have indicated that the EU countries have neighbouring countries with similarly GHGs emissions and these countries could be part of a cluster. By using cluster theory, two clusters from the EU countries with similar GHGs emissions have been outlined and a comparative analysis has been made between clusters' countries. Changes of GHGs emissions by industrial sectors have been identified. Correlation analysis has clarified the influence of the main sources of anthropogenic GHGs emissions such as heat energy and electricity production, road transport, production processes and domestic combustion.

The EU has redundant regulatory frameworks that create business challenges and generate inflation. For example, electricity and fuel prices in the EU are significantly higher than in the US, but air purity is not better. Bulgaria supports the transition to a net-zero carbon economy by 2050, but Bulgarian position is that nuclear and blue fuel energy should become part of the EU's green mix. It is also necessary to find innovative substitutes for our traditional energy facilities (thermal power stations). At the same time, measures should be envisaged to reduce the socio-economic impact for the regions and workers affected. The proposed environmental products and market solutions must become part of an entirely new paradigm that is sensitive to restoring balance in nature.

Acknowledgement

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The Green Transition and Bulgarian Consumers' Attitudes Towards Ecolabels and Sustainable Products

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Abstract: European environmental policy emphasizes the need to provide consumers with the opportunity to make an informed choice of environmentally friendly goods and services through the use of ecolabels. Ecolabelling has therefore become a popular tool in encouraging sustainable production and consumption practices, as well as in promoting sustainable behaviour patterns. However, despite various regulations and clearly defined requirements put in place, in addition to the continuous development of criteria for different product groups, these measures rarely result in an increase of demand or recognition of ecolabelled products and services in Bulgaria.

The purpose of this paper is to review and summarize relevant literature in the field and to analyze Bulgarian consumers' perception of ecolabels and their impact on purchase decisions. Based on the analysis of Eurobarometer public opinion surveys examining the knowledge and attitudes towards different labelling schemes in the EU, we identified that the majority of consumers in Bulgaria do not recognize or knowingly seek ecolabels, except for the Energy label. The presence of information asymmetry additionally hinders the development of sustainable products market in the country. Therefore, we draw the conclusion that Bulgarian consumers need additional information and/or clarifications about ecolabels, standards, certification schemes and the control measures.

Keywords: Bulgarian consumers, attitudes, sustainable products, ecolabels

Introduction

Delivering the European Green Deal poses serious challenges to the European Union economy (EC, 2019). On the one hand, they are related to business and government institutions' activity, but on the other hand, consumers represent another key factor in the successful implementation of these policies.

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One of the topics in the Circular Economy Action Plan (EC, 2020) is sustainable products and the improvement of design and production processes, directly interlinked with the demand of these products. Due to the difficult distinguishing of products which have a lower impact on the environment, ecolabelling is the most reliable means for consumers to recognize them on the market.

Ecolabels are a widely recognized communication tool, and their main purpose is to provide additional information to market actors about the environmental impact of the production and consumption of products and services (McAllister, 2009). The effective and long-term use of this tool is expected to result in impacting consumer habits and promoting sustainable (responsible) consumption patterns, as well as encouraging producers and other stakeholders to improve environmental standards of products and services (Galarraga Gallastegui, 2002). Businesses now recognize that environmental concern could be transformed into a market advantage for certain products or services, which would explain the variety of environmental labels and declarations on the market and the continuous development of new types of programs.

According to the Global Ecolabelling Network, the three main objectives of ecolabelling are protecting the environment, encouraging environmentally sound innovation and leadership, and building consumer awareness about environmental issues (Global Ecolabelling Network, 2004).

Ecolabelling seeks to inform consumers and potential customers about the environmental performance of a product or service within a product category. It is based on life cycle considerations, which include an assessment of environmental impact within all phases – from production and consumption to waste management and disposal. Consequently, ecolabelling assists consumers in distinguishing and recognizing eco-friendly products on the market (Global Ecolabelling Network, 2004).

The main purpose of ecolabels in addition to providing information is related to increasing consumer awareness about the environmental impact of the products, as well as promoting certain behaviour models. Ecolabels' ability to create a certain consumption model defines their successful implementation and their added value for consumers, impacting their choice and purchase decision. The role of ecolabels depends on consumers' recognition and understanding of the information, as well as on their accessibility and the quality of the information provided.

The challenges posed by the European Green Deal regarding the development of sustainable products market are directly related to consumer awareness and purchase. Therefore, the *purpose of this paper is to review and* *summarize previous research in the field and to analyze Bulgarian consumers' perception of ecolabels and their impact on purchase decisions.*

Since the introduction of the first eco-label in 1978, more than 450 ecolabelling schemes have been developed and implemented according to Ecolabel index. There are different classifications of ecolabels based on various criteria or characteristics, and one of the most popular defines them as *mandatory or voluntary* (Appleton, 1997; Rubik and Frankl, 2017).

Sustainability criteria for certain product groups in the EU are defined with specific initiatives or legal acts, such as the Ecodesign Directive (2009/125/EC) which establishes a framework for manufacturers related to energy effectiveness and other product characteristics. The regulation also impacts labelling and information requirements through the *mandatory EU Energy label*.

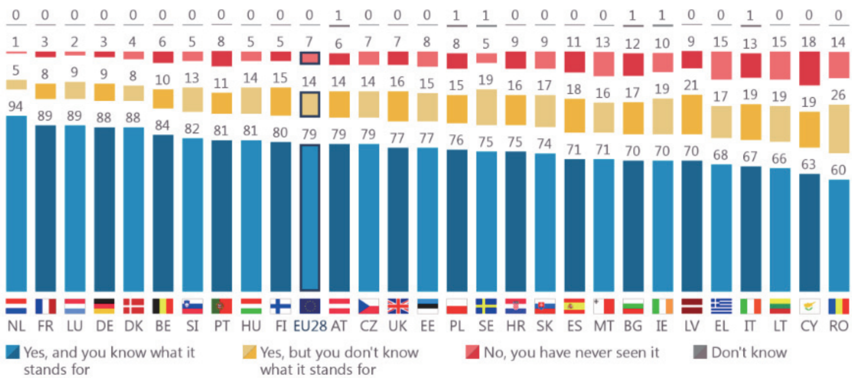
One of the widely used and most recognized *voluntary ecolabels is the EU Ecolabelling scheme*, introduced in 1992 with Regulation 880/92 and revised with Regulation 1980/2000 and Regulation 66/2010. The main objective of this ecolabel is to encourage organizations to develop more environmentally friendly products and, as an information tool, to assist consumers in identifying these products on the market.

A Special Eurobarometer public opinion survey on Europeans' attitudes on EU energy policy examines respondents' knowledge about energy labelling and provides information on the impact of EU *Energy label* (Eurobarometer, 2019). The survey was conducted in May 2019, as a face-to-face interview of 27438 respondents in their native language, of which 1032 respondents in Bulgaria. The results demonstrate that energy labelling is well-known to most of the respondents, and it has an impact on their purchase decisions.

Approximately 79% of the respondents confirm that they recognize the label and know what it stands for, while approximately 14% say they recognize it but do not know what it stands for, and approximately 7% state that they have never seen it. At a country level, the highest recognition is demonstrated by respondents in the Netherlands (94%), France (89%) and Luxembourg (89%). In contrast, the lowest recognition is in Romania (60%), Cyprus (63%) and Lithuania (66%).

Among respondents in Bulgaria, approximately 70% convey that they recognize the label and know what it stands for, which is below the EU average of 79%. In addition, 17% state that they recognize the label but do not know what it stands for, and 12% say they have never seen the label (Figure 1).

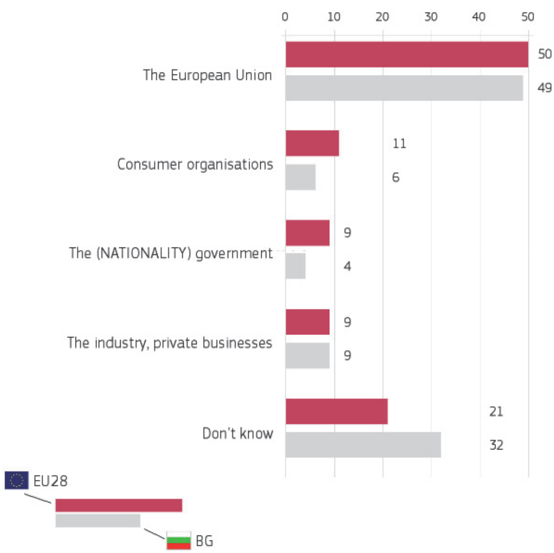
Figure 1: *Recognizing the EU Energy label within EU28 and on country-level (%)*



Source: *EC Eurobarometer, 2019*

With regards to the responsibility for energy labelling, approximately half of the respondents say that the European Union is responsible for the label, while approximately 21% state that do not know. According to 49% of the respondents in Bulgaria, the EU is responsible for the label, and approximately 32% say they do not know (Figure 2).

Figure 2: *Responsibility for the energy labelling – EU28 and Bulgaria (%)*

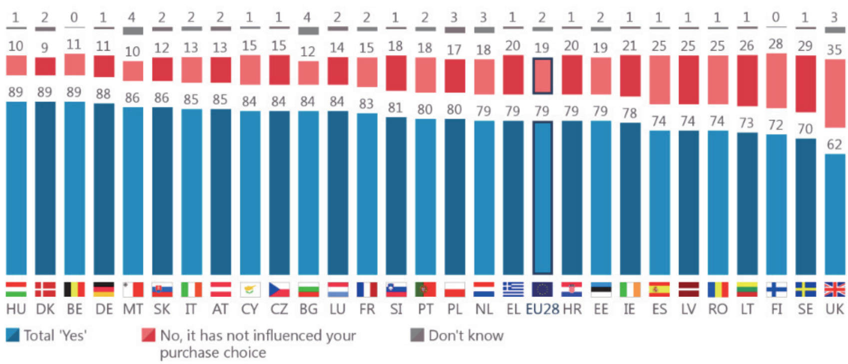


Source: *EC Eurobarometer, 2019*

As for the influence of the EU ecolabelling scheme, approximately 79% of respondents confirm that the EU Energy label has affected their consumer decision related to the purchase of electric appliances, while approximately 19% say that it did not have an influence on their choice. The results of the study show significant variations among different countries in the proportion of respondents who think they were affected by the label. Thus, the highest perceived influence of the label is registered in respondents in Denmark, Belgium and Hungary (all 89%), while the lowest is in respondents from the United Kingdom (62%), Sweden (70%) and Finland (72%).

Among respondents in Bulgaria, approximately 84% confirm that the EU Energy label has influenced their purchase choice, approximately 12% say it has not affected their decision, and 4% do not know (Figure 3).

***Figure 3:** Influence of the EU Energy label on the choice of purchase of electric appliances within EU28 and on country-level (%)*

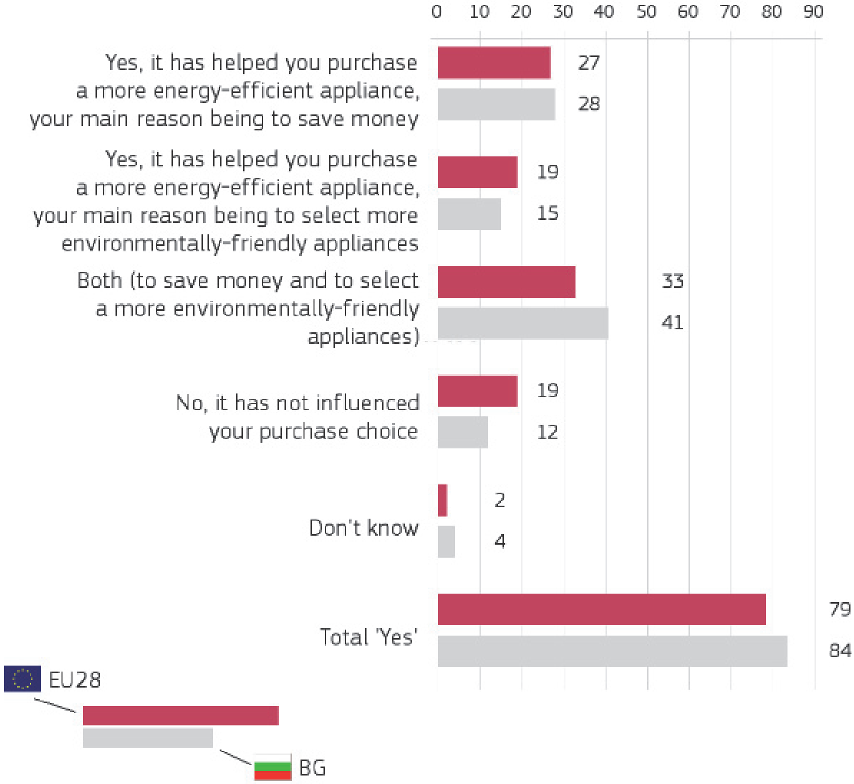


***Source:** EC Eurobarometer, 2019*

Out of the Europeans who confirm that the EU Energy label has affected their purchase choice of electric appliances (a total of 79%), approximately 27% advise that the main reason for them to buy a more energy-efficient appliance was in order to save money. Approximately 19% convey that the label influenced them to purchase a more energy-efficient appliance with the aim of selecting a more environmentally friendly product, while a third of the respondents (33%) state that the label affected them for both these reasons.

Among respondents in Bulgaria who say that their choice was influenced by the label (84%), approximately 28% state that it helped them purchase a more energy-efficient appliance with the main reason being the financial aspect. Approximately 15% advise that the main reason was to select a more environmentally friendly product, and 41% state both reasons. For approximately 12% of respondents in Bulgaria, their choice was not affected by the label (Figure 4).

Figure 4: *Influence of the EU Energy label on the choice of purchase of electric appliances – EU28 and Bulgaria (%)*



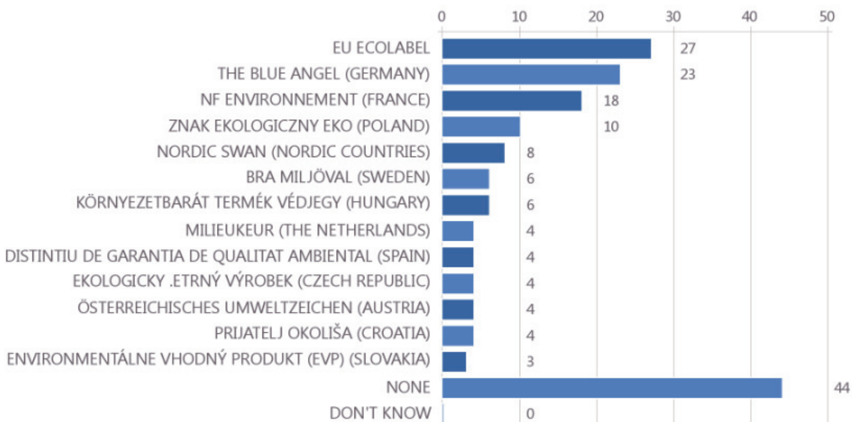
Source: *EC Eurobarometer, 2019*

Voluntary ecolabelling schemes are not so well recognized by consumers in comparison to the EU Energy label. This is demonstrated by a Special Eurobarometer public opinion survey on the attitudes of Europeans towards the environment, which also gathers information about consumers' attitudes towards environmental labeling schemes (Eurobarometer, 2017). The study was conducted in October 2017 as a face-to-face interview with 27881 Europeans aged 15 years and over, in their native language, and includes 1036 respondents in Bulgaria. Summarized results provide an overview on Europeans' attitudes towards the environment and the environmental labeling schemes and assists researchers in outlining some country-level differences related to ecolabels and their use in the EU market.

The study examines three topics related to ecolabels: (1) respondents' awareness of the various ecolabels on the EU market; (2) the role of ecolabels in purchasing habits and consumer decisions; (3) trust in the EU Ecolabel.

Overall, approximately 56% of the respondents confirm that they recognize at least one of the ecolabels they were shown, and more than a quarter of them (approximately 27%) say that they have seen or heard about the EU Ecolabel. Other country-specific labels that are relatively well recognized are the Blue Angel (approximately 23% of the respondents) and NF Environnement (approximately 18% of the respondents). All other labels demonstrated as part of the survey were recognized by 10% or less of the respondents. In addition, approximately 44% advise that they are not familiar with any of the ecolabels they were shown (Figure 5). Approximately 40% of all respondents say they are aware of one or two of the ecolabels they were shown, another 11% say they have seen or heard of three or four ecolabels, and 5% are aware of five or more of them.

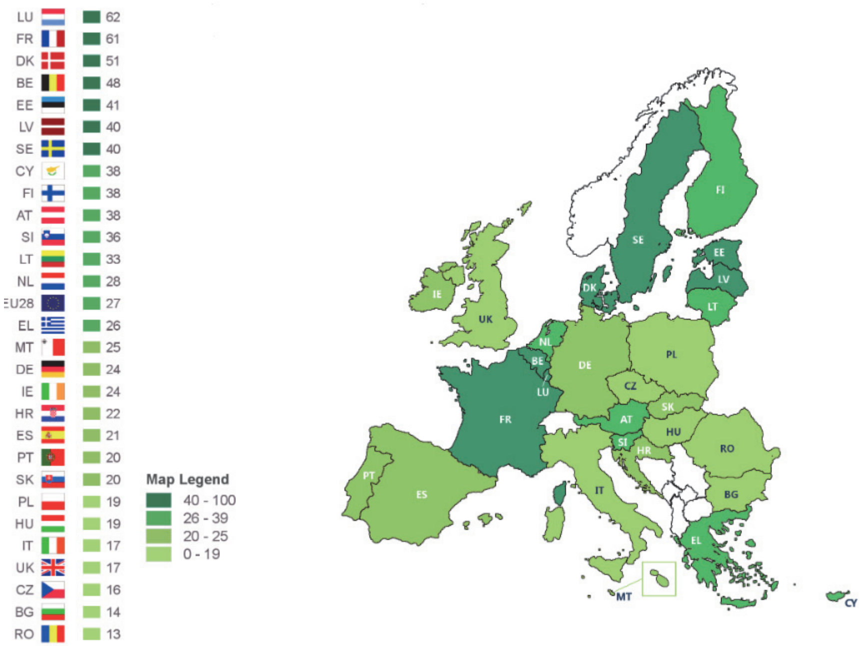
Figure 5: *Recall of EU Ecolabel and national ecolabels (%)*



Source: *EC Eurobarometer, 2017*

The results of the abovementioned Special Eurobarometer study show considerable variations between different countries in terms of awareness of the EU Ecolabel. In only three countries more than half of the respondents are familiar with this label – Luxembourg (62%), France (61%) and Denmark (51%). In contrast, awareness of the EU Ecolabel is the lowest in Romania (13%), Bulgaria (14%) and Czech Republic (16%) (Figure 6). Approximately 78% of the respondents in Bulgaria say they have not seen or heard of any of the ecolabels they were shown – this is also the country with the most answers 'None'.

Figure 6: *Awareness of the EU Ecolabel – EU28 and country-level (%)*

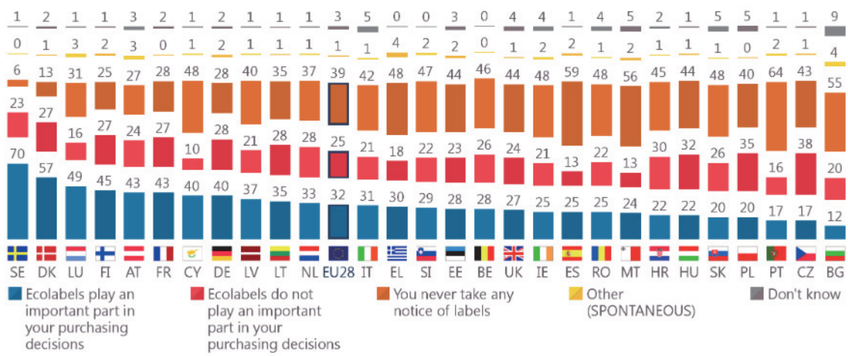


Source: *EC Eurobarometer, 2017*

In addition to examining respondents' awareness of ecolabels, the study also registers whether they have made a purchase of a product carrying an ecolabel, and the importance of these labels in the purchasing decisions. Out of the respondents who are aware of one or more ecolabel(s), approximately 30% confirm that they have bought a product carrying the EU Ecolabel, while 7% have not made a purchase of a product carrying this label, and 18% say they do not know. In terms of respondents in Bulgaria, out of the ones who state they are aware of at least one ecolabel, approximately 37% say they have made a purchase of a product carrying the EU Ecolabel, which is above the average for the EU 28 (30%).

Approximately a third of respondents (32%) claim that ecolabels have an important role in their purchasing decisions, while approximately 25% advise the opposite. A relatively large part of respondents (39%) declare that they never take any notice of labels, which demonstrates the need of implementing additional measures to increase the recognizing of ecolabels among consumers in the EU. In terms of variations per country, the majority of respondents in Sweden (70%) and Denmark (57%) say that ecolabels are important for their purchase decisions, while considerably less respondents in Bulgaria declare the same statement (12%). In addition, more than a half of the respondents in Portugal (64%), Spain (59%), Malta (56%) and Bulgaria (55%) claim that they never take any notice of labels. In contrast, only 6% of the respondents in Sweden and in 13% Denmark say this (Figure 7).

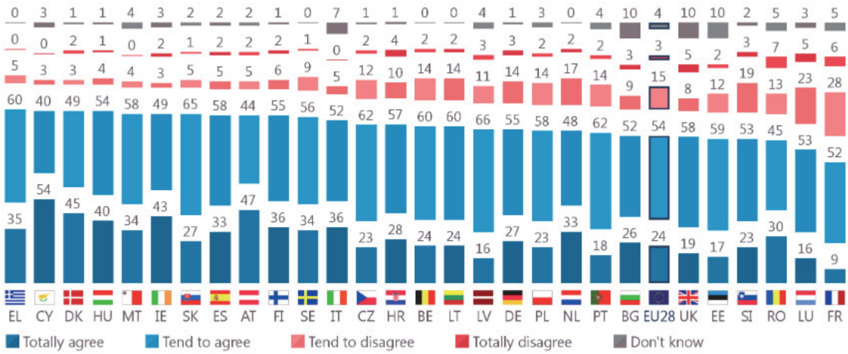
Figure 7: *Role of the ecolabels in purchasing decisions – EU28 and country-level (%)*



Source: *EC Eurobarometer, 2017*

In terms of trust in the EU Ecolabel, out of the respondents who stated that they are aware of this label, more than three quarters (78%) agree that products carrying it are environmentally friendly, while 18% of them disagree. Agreement with this statement is the highest in Greece (95%), Cyprus, Denmark and Hungary (all 94%) and is the lowest in France (61%) and Luxembourg (69%). Responses received from consumers in Bulgaria are similar to those for EU28: approximately 78% agree that the products carrying the EU Ecolabel are environmentally friendly, while 12% disagree and 10% say that they do not know (Figure 8). Overall, the study shows a relatively high degree of trust in the EU Ecolabel as a guarantee for consumers that the products carrying it are environmentally friendly.

Figure 8: *Trust that the products carrying the EU Ecolabel are environmentally friendly – EU28 and country-level (%)*



Source: *EC Eurobarometer, 2017*

The studies reviewed in this paper in relation to consumer awareness and attitudes towards ecolabels, demonstrate that *ecolabelling schemes are widely implemended in various business sectors and are carried by a variety of products, which determines their role as an important information tool for consumers.* In addition, they act as a measure for reducing information asymmetry for consumers regarding environmental aspects of these products.

The aforementioned Special Eurobarometer survey related to attitudes on EU energy policy indicates that the *EU Energy label is one of the successful tools implemented for ensuring the provision of information and for assisting consumers with their purchase decisions*. Ecolabelling criteria are subject to regular updates and improvements, in order to ensure that the most current information is presented to consumers and that products pertaining in the highest energy class have better environmental characteristics in comparison with other products on the market.

Despite the successful harmonization of Bulgarian legislation with the EU environmental legislation, and the improvement achieved in various environmental indicators, there are still significant efforts needed in the field of ecolabelling. Based on the analysis of Special Eurobarometer surveys, several emerging trends can be highlighted: *the majority of consumers in Bulgaria do not recognize and seek ecolabels, except for the EU*

Energy label. Consequently, we can draw the conclusion that Bulgarian consumers require additional information and/or clarifications about eco-labelling schemes, standards, certifications, and the control measures. Information asymmetry additionally hinders the development of the sustainable products market in the country.

Another issue which can be outlined based on the studies analyzed is that a *relatively small part of consumers acknowledges and relies on eco-labels when making a purchase decision. Despite the increased knowledge related to environmental issues, a significant part of consumers does not take them into consideration in their purchase decisions, as well as into their consumer behaviour.* As probable reasons for this gap we can outline the consumers' willingness to pertain to the established consumer behaviour models (adherence to the status quo, habit and previous experience) or the perception that buying more environmentally friendly products is related to higher initial costs.

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CHAPTER IV

THE SOCIAL PRICE OF THE GREEN TRANSFORMATION

Energy Poverty in Bulgaria – Dimensions and Challenges for Social Policy

Georgi Shopov[1]

Abstract: The report has two main focuses: (a) methodological aspects of measuring energy poverty and presenting its parameters in Bulgaria (2014 – 2017); (b) challenges and guidelines for the development of energy poverty policies.

The consideration of the methodological aspects includes outlining possible approaches for measuring energy poverty (objective, expenditure, subjective) with an emphasis on the expenditure approach, in which the share of energy expenditures of households in their incomes is estimated by various indicators. Based on NSI data, dimensions of energy poverty in Bulgaria for 2014 – 2017 are presented. Estimates of subjective poverty in the country are also presented based on Eurostat data. The methodological aspects of energy poverty are considered in the context of the understanding that before starting to prepare a national definition of this poverty (which Bulgaria has committed since 2009, but it has not yet been fulfilled) it is necessary to have a preliminary idea of the scale of this social phenomenon / problem, which will aggravate in the coming years given the liberalization of the energy market and the green transformation.

Concerning the challenges and possible directions for the development of social protection of the energy poor, a conceptual vision for the structuring of the policies towards the social problems related to energy poverty is presented and some concrete solutions for improving and developing the program for providing targeted social benefits for heating during the winter season.

Keywords: energy poverty; social policy

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Introduction

The objectives of this article are twofold:

- To present dimensions and estimates of energy poverty of Bulgarian households.
- To outline challenges and directions for social policy related to reducing energy poverty.

1. Dimensions and estimates of energy poverty of Bulgarian households

Methodological clarifications. In Bulgaria, there is still no official definition of "energy poverty" as expected from Article 3(7) and (8) of the "electricity" Directive 2009/72/EC. The adoption of a definition depends on "who and what" the responsible institutions want it to focus on, which in sequence requires a political decision. This, in turn, in order to be "informed" should be a priori oriented about the likely dimensions of the phenomenon in question, as well as taking into account the socio-economic specificities of the country and its experience in social protection of the poor. Therefore, the definition of concepts related to energy poverty should be done after outlining its main dimensions in Bulgaria and summarizing our national experience in providing targeted social benefits for heating. This is the approach followed in this article.

The main factors for energy poverty are generally considered to be three – high energy prices, low incomes and low energy efficiency of houses. To this some authors add the mechanism of household access to energy justice/consumer protection (Peneva, 2021). The present paper examines the impact of the first two factors.

There are several main indicators used to measure energy poverty (The essence of the indicators is presented mainly on the basis of the following publications: Thomson, H., C. Snell (2016), p.101-114; Flues, F. and K. van Dender (2017), p. 10-13. The publications of Buzarovski St. (2011), Pye, St., A. Dobbins (2015), Peneva T. (2015) are also taken into account), and they are constructed by different methods, based on which two groups can be formed. The indicators in the first group are determined by the so-called ʽexpenditure method' and they *reveal the affordability of energy prices for households*, which depends on their income. In other words, they measure the *vulnerability of energy consumers to price levels and price changes in the context of their income and expenditure*. Some European countries (England) include in their national definitions of energy poverty precisely an indicator from this group. With this clarification, for the purposes of this article the indicators considered are interpreted as measures of energy poverty in this aspect. The indicators in the second group, which uses the so-called "consensual method", take into account other aspects of energy poverty.

Results

A. Indicators based on the "cost method"

The "Ten Percent Rule" (TPR) – identifies as energy poor households whose energy costs exceed 10% of their disposable income. It (should) apply only to the lowest three income deciles of households to avoid distortion towards high income groups that do not impose restrictions on energy consumption in the home and therefore the share of their expenditures may exceed the perceived threshold. This is one of the most widely used indicators in a number of studies, including a World Bank report analysing the dimensions of energy poverty in Bulgaria (World Bank, 2017).

The "Relative Poverty Line" (RPL) – measures energy poverty, respectively – the affordability of energy prices for the people, on the basis of disposable income (i.e. after deducting energy costs), compared to the relative poverty line: energy poor is a household whose disposable income reduced by energy expenditures, is below relative poverty line. According to the Eurostat methodology, in the Survey on Income and Living Conditions Statistics (SILC) the relative poverty line is equal to 60% of the median equivalent disposable income after social transfers.

According to the indicator "**Low-Income, High-Cost" (LIHC)**, energy poor is a household that meets two conditions:

- its energy costs are above the median;
- after deducting the energy costs, its disposable income is below the relative poverty line (according to the RPL).

This is the energy poverty indicator that England officially adopted after 2013, replacing the TPR one.

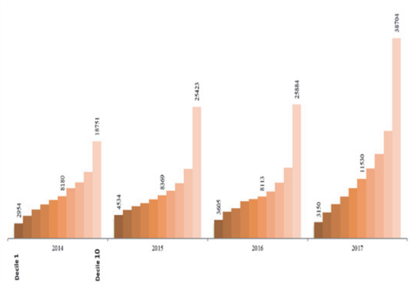
According to the indicator "**Low-Income, High-Cost-Share" (LIHCS),** energy poor is a household that meets the following two conditions:

- the share of its energy costs is over 10% of income (according to TPR);
- after deducting energy costs, its disposable income is below the relative poverty line (according to the RPL).

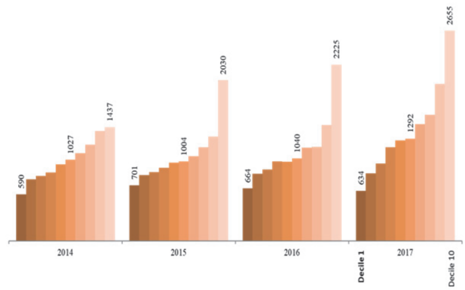
This indicator combines the requirements of the other two and (like the previous one) can be assessed as more selective, because in order to be classified as energy poor, households must not only spend a significant part of their income on energy at home, but also receive low incomes and therefore fall below the relative poverty line. Its weakness, which is common to all considered indicators based on the actual expenditure method, is that it does not take into account the fact that low-income households are self-reliant and consume considerably less energy (by some estimates about 1/3) than they need for normal home heating and other domestic needs. In Bulgaria, for example, in 2015 the weighted energy expenditure per person in the first decile was 3.6 times less than the same expenditure in the richest decile (see Fig. 1). In other words, the elasticity of their energy expenditure is (forcibly) relatively higher in order for them to meet their other acute living needs (e.g. food, medicines).

Figure 1: *Net total income and energy expenditures by decile groups, BGN/year*

Net total income



Energy expenditure



Source: *anonymized data from the Household Budget Survey of NSI for the respective years; own calculations completed with the assistance of Chef Assistant Professor, Teodora Peneva, PhD, ERI-BAS*

The obtained values for energy poverty in Bulgaria for 2014 – 2017 are presented in Table 1. The estimates of the individual indicators are different, but they logically reflect the nature and the described heuristic features of each of them.

Table 1: *Scope of energy poverty in Bulgaria – 2014 – 2017 (%)*

	2014				2017			
	(TPR) Households with share of energy exp. I net total income >10%	(RPL-HBS) Households with equalized net total income < RPL BGN 3225	(LIHCS - HBS) Households with equalized net total income after energy exp. < RPL BGN 3225	(LIHC – HBS) Households with energy exp. >885 лв. and equalized net total income after energy exp. < RPL BGN 3225	(TPR) Households with share of energy exp. I net total income >10%	(RPL-HBS) Households with equalized net total income < RPL BGN 5222	(LIHCS - HBS) Households with equalized net total income after energy exp. < RPL BGN 5222	(LIHC – HBS) Households with energy exp. >885 лв. and equalized net total income after energy exp. < RPL BGN 5222
Decile 1	85,0%	100,0%	85,0%	15,0%	84,7%	100,0%	84,7%	13,9%
Decile 2	80,6%	100,0%	80,6%	27,8%	76,6%	94,0%	74,4%	28,4%
Decile 3	72,9%	85,8%	71,6%	29,8%	67,0%	74,7%	56,2%	29,9%
Decile 4	65,9%	36,1%	49,0%	20,8%	67,7%	63,2%	51,0%	40,6%
Decile 5	60,7%	17,2%	29,1%	12,6%	57,1%	39,8%	30,1%	30,1%
Decile 6	63,0%	3,7%	17,9%	6,2%	48,9%	22,5%	16,0%	17,2%
Decile 7	56,4%	0,6%	7,8%	3,8%	45,3%	15,0%	10,7%	13,2%
Decile 8	49,4%	0,0%	2,2%	1,7%	34,4%	6,3%	5,4%	6,3%
Decile 9	48,4%	0,0%	0,0%	0,0%	29,5%	7,3%	5,9%	7,3%
Decile 10	32,4%	0,0%	0,0%	0,0%	20,5%	1,4%	1,4%	1,4%
All households (%)	**56,6%**	**22,6%**	**24,5%**	**8,9%**	**58,5%**	**52,4%**	**41,9%**	**19,9%**
Deciles 1-3 (%)	**14.5%**				**32.4%**			

Legend:
HBS- Households Budgets Survey in Bulgaria.
RPL – relative poverty line – 60% of the median equalized income.

Source: *anonymized data from the Household Budget Survey of NSI for the respective years; own calculations completed with the assistance of Chef Assistant Professor, Teodora Peneva, PhD, ERI-BAS.*

Over the analysed period, the extent of energy poverty increased according the prevailing part of indicators and for decile groups after the third one. The main factors are:

- Increase in income inequality, as indicated by the growth of (a) the Gini coefficient from 35,4% in 2014 to 40,2% in 2017; (b) the ratio between the income of the poorest and richest 20% of households from 7,1 in 2014 to 7,7 in 2017.
- Raising the relative poverty line from BGN 3,910 in 2014 to BGN 5,222 in 2017.
- Increase in energy prices – e.g. electricity prices for clients consuming below 2500 kWh/year by around 6% : from 0,176 kWh at the end of 2014 to 0,193 kWh three years later.
- Differences between decile groups in income growth are much larger than in energy cost growth. This indirectly indicates a deepening of energy poverty.
- The reduction in indicator values for the lowest three income deciles can be linked to the forced higher price elasticity of energy

costs, as the households concerned are likely to see themselves forced to further restraint these costs in order to meet their other needs.

The empirical results obtained, in addition that they outline the quantitative parameters of energy poverty *in the context of the affordability of energy prices for households*, can support the official institutional choice of one or another indicator to measure this poverty, which can be used as a benchmark and starting point for drawing up relevant definitions and possible national policy in this area.

B. Indicators based on the subjective/"consensual method"

Applying this method, an indicator, suggested by Healy (Heally, 2011, Cit. by Buzarovski St. (2011), p.2) is calculated. The indicator is based on self-assessments of the population, obtained through representative empirical sociological research within SILC on issues related to: their ability to pay their bills on time for energy used in the home; the quality of the home in which they live (presence of moisture, leaking roof); the heating of the dwelling during the winter period, etc.

Table 2: *Energy poverty level*

	2014	2015	2016	2017	2018	2019
EC-27 (percentage points – p.p.)	30,8	28,7	27,0	24,8	23,9	22,5
Bulgaria (p.p.)	70,3	67,7	67,2	64,2	60,5	54,5
Absolute difference (p.p.)	39,5	39,0	40,2	39,4	36,6	31,9
Ratio	2,28	2,36	2,49	2,59	2,53	2,42

Source: *own calculations on the basis of Healy's method and Eurostat data for the basic indicators*

The results of the assessment show (see Table 2) that Bulgaria, on the one hand, maintains a trend towards improvement of the composite indicator – the level of analysed poverty in 2019 decreased compared to 2014 by about 16 p.p. On the other hand, the gap with the European average remains significant – more than 2 times. This means that our country is also lagging behind other EU members in the area of reducing energy poverty.

2. Social policy challenges related to energy poverty

Currently, the main instrument in this area is the Targeted Winter Heating Assistance Programme for Heating Allowances during the winter period. Its parameters are set out in Ordinance No. RD-07-5 of 16 May 2008 on the conditions and procedure for granting targeted heating allowance (amended by State Gazette No. 51 of 28 June 2019). Its main strengths are the following:

- The design of the Programme is relatively sustainable in terms of the mechanism of operation – e.g. access conditions, the way allowance is determined, funding, etc. This facilitates its administration.
- It upgrades and complements the guaranteed minimum income (GMI) scheme providing monthly social assistance benefits and low-income beneficiaries receive more adequate social protection.
- A differentiated approach is applied to specific vulnerable groups in order to determine the income threshold for access to the heating allowance – this allows better targeting.
- For three vulnerable groups, lower/restrictive coefficients have been introduced compared to the basic income for heating, which forms a less favourable income threshold for access to benefits. Economic pressure for more socially responsible behaviour is applied to (a) parents raising children who do not attend school; (b) children who do not attend school; (c) children aged 16-18 who do not attend school, but are registered with Labour Bureau.
- Since June 2019 were increased:

  (1) The monthly norm for electricity consumption (from 380 kWh to 500 kWh). Its use ensures the automaticity of the mechanism for updating the amount of the heating allowance in case of changes in electricity prices for household consumers.

  (2) The income threshold for access to heating allowance (such as the so-called differentiated income for heating) – by introducing a basic income for heating equal to doubled rate of GMI (currently equal to BGN75) and by introducing a more favourable system of coefficients for vulnerable groups (replacing the system of lower percentages).

  This allows to increase the amount of benefits and to extend the scope of the Programme.
- Beneficiaries have the right to choose the type of heating they use.
- A solid administrative capacity has been built up for the implementation of the Programme, including the interaction of the Agency for Social Assistance and its territorial structures with the National Revenue Agency, with the GRAO, with the labour offices, with the energy suppliers, etc.

  Its weaknesses relate to the following:

- Unclear mechanism for setting the electricity consumption standard.
- Too detailed/wide system of coefficients for determining the differentiated income for heating as an income threshold.
- Equal amount of the heating allowance creating inequality.
- About 90% of the aid is used for solid fuel, which is a significant source of fine dust particles polluting the air.
- Orientation towards heating poverty.

The last weakness, which is structural rather than parametric, requires the introduction of a consolidated Targeted Social Assistance Program for the energy poor – the range of which is determined on the basis of an accepted definition. These benefits should: include ʽheating' and ʽother household needs' components; retain their targeted nature, with access to them being subject to verification of applicants' income, assets, family, health, employment and age status; be year-round, with the ʽheating' component only operating in the winter season.

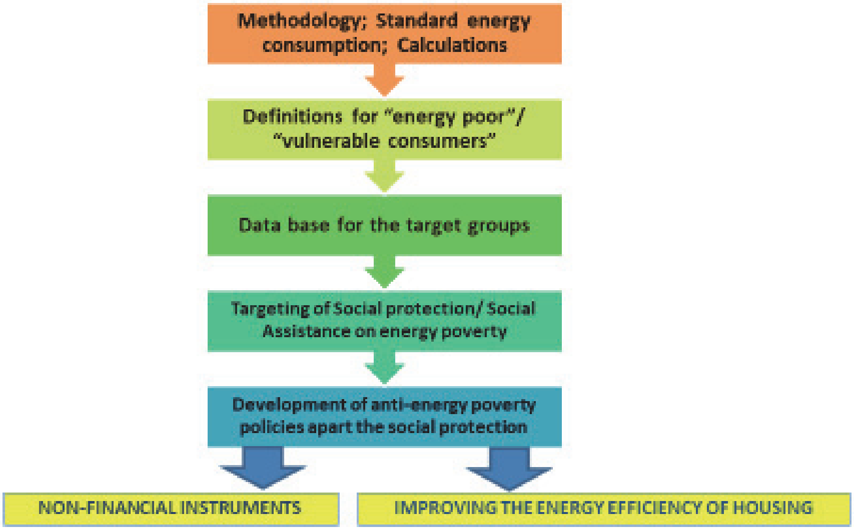
Conclusions

1. Regarding the quantification of the energy poverty coverage, it can be concluded that (obviously) different indicators give different results, which vary significantly. The design of social policy to alleviate and reduce this poverty depends on its scale. Therefore, the selection of an "appropriate" indicator is an important step for an informed approach to the development of mechanisms for the social protection of the energy poor.

2. The main prerequisites for the preparation of the proposed consolidated Targeted Social Assistance Program for the Energy Poor relate to the following:

- Clarify and reach expert agreement on methodological issues related to the various indicators for determining energy poverty, including norms/standards for per capita electricity consumption for various household needs (heating, cooling, lighting, hot water, communications, etc.), as well as an equivalent scale for this consumption depending on family composition.
- Calculate the extent of this poverty according to the relevant indicators and agree on the "most appropriate" for our country.
- On this basis, adopt a definition of "energy poverty", "energy poor (vulnerable) consumers".
- Easing and reducing energy poverty to become part of the strategic objectives of social protection.

The development of such a Programme can be seen as an element of the following **roadmap** for the modernisation of the social protection system in this part of it:



Finally, it should be stressed again that reaching a public consensus on the outlined range of methodological and policy issues is an important prerequisite for the development of an adequate social protection system for the energy poor.

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Impact of Decarbonization on Employment in the Energy Regions in Bulgaria

Yordan Atanasov Hristoskov[1]

Abstract: The purpose of this report is to assess the social consequences at different scenarios for the decarburization of the energy sector, in which one-time or gradual mass employment dismissals will be carried out at the closure of large energy facilities. Among the reasons for closure of electricity production capacities may be: impossibility to obtain special operating conditions (derogation) for Bulgarian coal-fired power plants; economic inefficiency of coal-fired power plants in the liberalization of the electricity market and the increase in emissions; expiration of the contracts for preferential purchase of electricity; transition to other energy sources (gas, hydrogen) and others. The scales and the consequences for the direct, indirect and induced employment in the regions of Maritsa-Iztok and Bobov Dol – Pernik are assessed at an extreme crisis and in a more socially tolerable scenario of power closures. The calculations are made on the basis of a *Modified model of inter-branch relations (Input – output tables)*. On this basis, public expenditures and business expenditures on social benefits and allowances for redundant staff of closed-down energy facilities and coal mining are envisaged. Active policies are proposed for a fairer social transition from fossil fuels to other types of energy sources.

Keywords: energy transition; direct, indirect and induced employment; social expenditure; active social policy.

1. Forecast assessment of the dynamics of the employed persons in the energy sector of Bulgaria

The prevision for the dynamics of the employed persons in the energy sector is prepared on the basis of the *Model for assessment and forecasting of the direct, indirect and induced employment, generated in the energy sector (The model was developed by Prof. Doctor Stefan Petranov, Sofia University Kliment Ohridski).* The Leontief tables of interbranch relations (input – output tables) lie at the theoretical basis of the model. Through a logical series of mathematical transformations of the basic formulas of the balance of the interbranch relations, a *Modified Model* is reached. Such a modified model allows for the use of the Tables Resource – or for their application using da-

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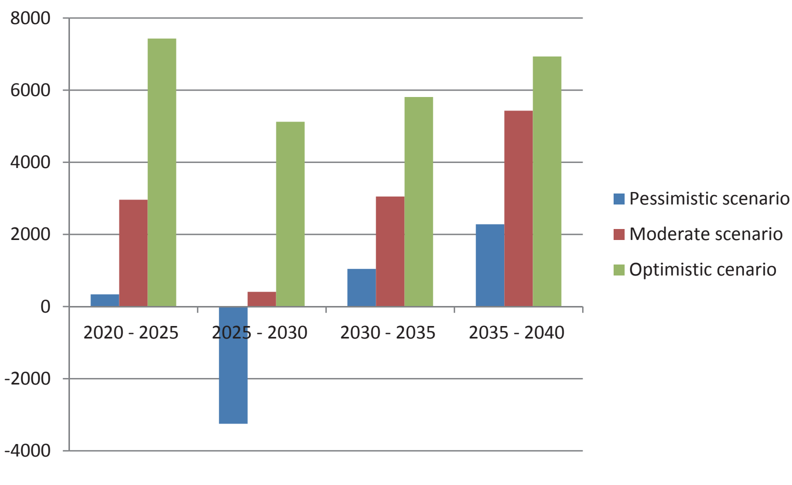
ta for Bulgaria, which are prepared according to the methodology of the EU Statistical Office – EUROSTAT.

The model makes it generally possible to estimate how many jobs could be created/ lost (directly, indirectly and induced) if electricity production were increased/ reduced. It can also be applied to estimate the increase/ decrease of direct, indirect and induced jobs in certain regions, if there are opened/ closed energy facilities with an annual volume of electricity produced for final consumption.

The increase/ decrease of employment over five-year periods until 2040 as a result of the increase/ decrease of the total final consumption of electricity in the pessimistic, moderate and optimistic scenario(The scenarios for total final electricity consumption are taken from the National Strategy in the field of energy (with a focus on electricity), report developed on the basis of an agreement between BAS and BEH. The forecasts for electricity consumption in the individual scenarios are as follows: pessimistic scenario: 2025 – 26,6 thousand GWh, 2030 – 25,8 GWh, 2035 – 26,1 GWh, 2040 – 29,0 thousand GWh; moderate scenario: 2025 – 27,3 thousand GWh, 2030 – 27,4 GWh, 2035 – 28,1 GWh, 2040 – 32,1 thousand GWh; optimistic scenario: 2025 – 28,6 thousand GWh, 2030 – 28,5 GWh, 2035 – 31,2 GWh, 2040 – 35,8 thousand GWh) are presented in Figure 1.

Figure 1: *Increase/ decrease in employment (direct, indirect and induced) as a result of increase/ decrease in final electricity consumption (number of jobs)*



Source: *The figure is based on NSI data and author's own calculations*

The total growth of jobs as a result of the increase/ decrease in the total final consumption of electricity in all three scenarios for each of the 5-year periods is formed by: 23,8% directly employed in the energy sector; 74,2% indirectly employed in branches related to electricity along the lines of inter-sectoral links (including 27,1% employed in extractive industries); 2% induced employment.

Equal methodological approaches for estimating the direct, indirect and induced employment are applied for the electricity production and coal mining in the regions Maritsa-Iztok and Bobov Dol – Pernik. The number of jobs directly and indirectly related to all thermal power stations (TPSs) and mines in the Maritsa-Iztok region by 2020 is 33 752, including 13 900 direct, 19 345 indirect and 507 induced jobs. In the Bobov Dol – Pernik region, 8129 workers and employees are engaged in the production of electricity and coal, including 3585 directly employed, 4411 indirectly employed and 133 people in induced jobs.

The conclusion from the calculations is that the production of electricity from the power plants in the region of Maritsa-Iztok and Bobov Dol engages directly, indirectly and along the lines of the induced effect about 40 000 employed. This total employment represents 1,43 percent of the total number of employees in Bulgaria (2778 thousand people in the same year). The total number of employees in the energy complex Maritsa-Iztok represents 23,1 percent of the employees in the Stara Zagora region. The employed in Bobov Dol – Pernik are 7,5 percent of the total employed in the districts of Kyustendil and Pernik(The data concern the number of employed persons and are taken from NSI – Workforce Monitoring). Therefore, the implementation of possible scenarios of closure of all or some electricity generation facilities in these areas would lead to significant social consequences.

2. Options for closure of energy capacities and coal production in the regions Maritsa-Iztok and Bobov Dol – Pernik and assessment of the employees made redundant

The modified model of inter-branch connections (Input – output tables) provides an opportunity to assess the loss of work places in the event of a reduction in production and employment in the electricity and mining industries, and namely:

1) The reduction of 1 job in the electricity industry leads, at other fixed conditions, indirectly to the loss of 1,14 jobs in the mining industry and almost twice as many – 1,98 jobs in other sectors of the economy. In

other words, 1 direct job in the energy industry is indirectly related to a total of 3,12 work positions in the economy. In addition, due to the induced effect, the same 1 job in power production is also associated with 0.06 induced jobs. Thus, the final effect (direct, indirect and induced) for the economy from the reduction of 1 job in the power production would lead to a reduction of jobs by a total of 4,18 (1 + 3,12 + 0,06). These coefficients are used in calculating the effects on employment in the event of capacity closures in electricity generation, which automatically leads to the closure of jobs in coal mining.

2) Similarly, the disappearance of 1 job in the extractive industry would indirectly, through inter-sectoral links, lead to the disappearance of 0.63 jobs in other sectors of the economy and another 0,03 jobs under the induced effect. Thus, the final effect (direct, indirect and induced) for the economy from the reduction of 1 job in the mining industry would be the reduction of jobs by a total of 1,66 (1 + 0,63 + 0,03). These coefficients can be applied in estimating employment while maintaining electricity production capacity in both regions, but when switching to another primary energy source (e.g. natural gas). The redundancies will then happen in coal mining and related indirect and induced jobs.

The assessment of the dismissed workers at the closure of capacities in the electrical power production is made on the basis of the following assumptions:

- The redundancies affect 85% of those directly employed in the respective year, as part of the staff remains engaged in liquidation, conservation of facilities, land re-cultivation and others.
- Indirect employment is expected to decrease by 30% in the year of closure of the respective electricity capacities due to the drop in demand for supplies and services from the closed companies and the time needed to find new customers or for the restructuring of the activities.
- In the year of closure of the respective electricity capacities, the induced employment is expected to decrease by 20% due to the reduction of family incomes and the number of the population in the areas where capacities are closed.

On the basis of the coefficients derived from the modified model for the result of the reduction of 1 job in the electricity generation and coal mining, the social consequences have been calculated, expressed in mass redundancies in several types (The mentioned options are exemplary and do not involve any institution in Bulgaria. They aim to suggest to the authorities what the cost will be at job losses (direct, indirect and induced) and the expenditures of social payments (distributed between the state and employers) in a single and gradual closure of coal-based energy facilities).

First, estimates are made at *an extreme crisis scenario, which is the closure of all companies for energy production and coal extraction in the regions of Maritsa-Iztok and Bobov Dol – Pernik in 2025*. This scenario is highly pessimistic and based on the hypothesis that all TPSs in these two areas will not be able to join the derogation regime. The implications for employment in that extreme crisis scenario are as follows:

- a total of 41 881 labor positions affected, including 17 485 direct, 23 756 indirect and 640 induced jobs;
- total number of redundant employees, based on the above assumptions – 22 117 people, incl. directly employed – 14 862 people, indirectly employed – 7127 people, and in induced employment – 128 people.

Secondly, from a social perspective, it is much better to extend the power plants closure process over a longer period of time, if this is necessary for environmental and economic reasons, with a pre-designed alternative employment program for the redundant workers and employees. This more socially acceptable option could develop in the following stages:

1) *In the period 2022 – 2023, due to environmental and economic reasons, the activity of TPS – Bobov Dol, Bobov Dol Coal Mining, Mini Otkrit Vagledobiv Mines, Brickel EAD and Maritsa 3 – Dimitrovgrad is terminated*. Partial redundancies are reported in Maritsa-Iztok Mines, in proportion to the reduced coal consumption (The percentage of redundancies in the Maritza Iztok mines was determined on the basis of the consumption of coal from the respective closed electricity generation capacities). The social consequences for employment are as follows:

- total number of affected workers and employees – 14 955 people, incl. directly employed – 5671 people, indirectly employed – 9048 people, and induced employment – 236 people;
- expected number of redundant employees – 7574 people, incl. directly employed in the production of electricity and coal mining – 4 820 people, indirectly employed 2714 people, and from induced employment – 40 people.

2) *Termination of the activity of Contour Global MI-3 and AES MI-1 Contour in 2028, due to the expiration of the contract for mandatory purchase of the produced electricity or switching to another primary energy source, which leads to a reduction of the activity of Maritsa Iztok Mines, due to reduced needs for coal. (However, an unlikely crisis option)*

The effects on employment are as follows:

- Total number of affected employees – 8165 people, incl. directly employed – 3522 people, indirectly employed – 4510 people, and induced employment – 133 people; These data also include the redundancies in Maritsa Iztok Mines as a result of the reduced demand for coal in the amount of 25 percent of the total production.
- Expected number of laid-off employees – 4374 people, incl. directly employed in the production of electricity and coal mining – 2994 people, indirectly employed 1353 people, and from induced employment – 27 people.

3) Termination of the activity of TPS Maritza Iztok 2 in 2036 and closure of the activity of Maritsa Iztok Mines due to lack of coal demand.

The consequences on employment are the following:

- total number of affected employees – 15 200 people, incl. directly employed – 5445 people, indirectly employed – 9518 people, and induced employment – 237 people;
- expected number of employees made redundant – 7 530 people, incl. directly employed in the production of electricity and coal mining – 4628 people, indirectly employed 2855 people and from induced employment – 47 people.

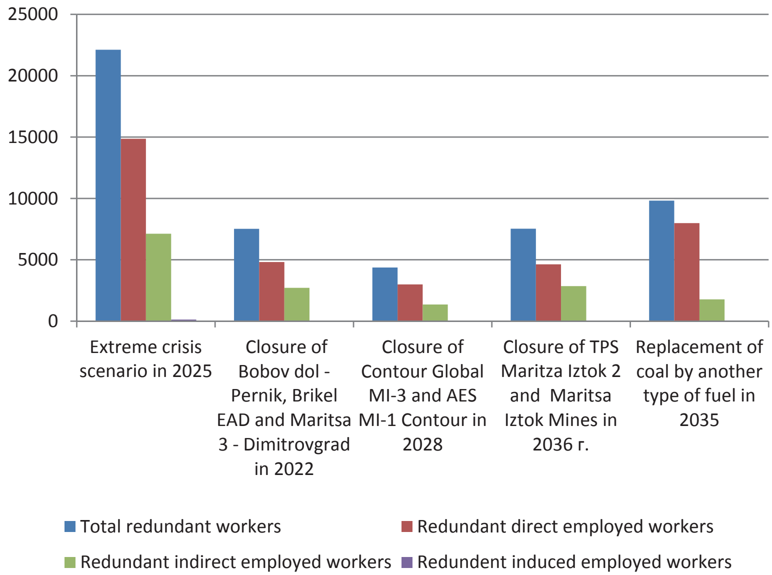
The number of redundancies in the individual scenarios is demonstrated in Figure 3.

Third, an even more compromising and socially tolerable option is possible – *the whole capacity in the Maritza Iztok region to be preserved, but coal to be replaced by another type of fuel*. Then the consequences on employment in coal mining will be the following:

- total number of affected workers and employees – 15 600, incl. 9400 directly employed, 5 920 indirectly employed and 280 induced jobs;
- expected number of redundant employees – 9822, incl. 7990 directly employed in coal production, 1776 people indirectly employed and 56 people in induced employment. The estimated number of lay off workers and employees under different scenarios are presented in figure 2.

In order to reduce the negative effect of redundancies in each of the scenarios at national and regional level, appropriate preventive policies must be designed. The necessary policies for the different scenarios of power closures in the areas of Maritza Iztok and Bobov Dol – Pernik, including in the event of an extreme crisis, are divided into two groups – **passive protection policies and active protection policies**, discussed in the next two paragraphs.

Figure 2: Estimated number of redundant workers and employees under different scenarios



Source: *Compiled by author's own calculations*

3. Passive protection policies for compensation of the incomes of the redundant workers and employees under the various options for closure of electric power capacities in the regions of Maritsa Iztok and Bobov Dol – Pernik

At the implementation of the negative scenarios – closure of all or individual companies for the production of electricity from coal, based on estimates of total (direct, indirect and induced) employment, specific calculations are made for the **costs of passive policies** for income protection of the dismissed workers. These calculations are based on the legal provisions in the Labor Code (LC), the Social Security Code (SSC) and the Social Assistance Act (SAA). Compensation costs provided for in the Branch Collective Labor Agreement registered with the Executive Agency General Labor Inspectorate are also taken into account.

The calculations for the amounts of the due benefits under the LC, unemployment benefits, pensions and monthly social benefits are made under the following **assumptions (**Some of the assumptions about the percentage of redundancies, registration as unemployed, retirement, etc. are based on similar reductions in previous years of individual sections and mines in coal mining):

- The income of the directly employed, which must be compensated in the form of lump benefits under the LC, unemployment benefits and pensions, is calculated on the basis of the average salary for all companies subject to closure in 2019, indexed by 5% for each coming year.
- Based on the educational and age structure and other factors, the following is assumed: 25% of the dismissed will retire immediately with state social security pensions; 60% of the dismissed individuals will receive unemployment benefits; 15% will be able to find a job within 2-3 months (the period of compensation under the LC) in related or other activities, incl. in independent businesses.
- The unemployment benefit is calculated at 60% of the average gross salary, calculated as indicated, and the duration of receiving the benefit is an average of 10 months.
- The amount of the granted pensions is determined on the basis of the pension formula and the expected average monthly insurance income for a 12-month period prior to retirement, as the data are according to the Actuarial Report of NSSI from 2019. The average individual coefficient of those due for retirement is 1,437, and the retirement pension rights converted to third category is 48 years (These parameters correspond to the data of the National Social Security Institute from the Pensions Statistical Yearbook, 2020). For the three TPSs and the mines in the Maritza Iztok region during the period 2025 – 2035 the individual coefficient of the retirees is expected to be 3.00. The coefficient equal to 1 year of retirement pension rights in the pension formula is 1,2 until 2021, 1,35 until 2030 and 1,5 after 2030. It is expected that all insured under the conditions of the first and second labor categories have transferred the funds from their individual account into the State Social Security such and receive an early pension from the National Social Security Institute.
- It is assumed that 20% of the families of the unemployed will receive monthly social benefits under the Social Assistance Act. The amount of these benefits is calculated for a family of 4 members under the current legislation. The monthly allowance in 2022 is BGN 480 per family, for 2025 – 2028 – BGN 520, and for

2035 – BGN 600, with an accelerated increase in the guaranteed minimum income.

- The income to compensate those who lost their jobs in indirect employment is the average salary in the country in 2019, indexed by 5% for each year. The average individual retirement ratio is 1,350, and the length of service converted to the third category of labor is 45 years. The cost estimate is for the same payments under LC and SSC as for direct employment.
- The income for compensation of those who lost their jobs in the induced employment is the average salary for the country in 2019, indexed by 5% for each year. It is assumed that persons who have acquired the right to a pension or working pensioners will be dismissed, and therefore no additional burden on the NSSI is envisaged.

The figures obtained at an extreme crisis scenario of closure of electricity capacities and coal production in the regions of Maritsa Iztok and Bobov Dol – Pernik in 2025 indicate that the costs of cash benefits, pensions and social benefits within 1 year will reach the total amount of almost 609 million BGN, including BGN 281 million at the expense of the employer and BGN 328 million at the expense of the National Social Security Institute and the MLSP. The continuing pension payments for the redundant directly employed in the two complexes in the next 5 years until 2030 are about BGN 400 million as additional public expenditure. Or, to sum up, for a period of 5 years after the closure of these sites nearly 1 billion BGN will be spent for benefits, pensions and social payments. In addition to these extremely high costs, the extreme crisis scenario leads to a lot of negative social consequences in non-monetary dimensions – the decline of the socio-cultural infrastructure due to the depopulation of these areas, if their de-industrialization becomes a fact.

Similar calculations are made for the three stages of the so-called moderate version of capacity closure, as well as for the option of replacing coal with another type of fuel (natural gas or hydrogen). The costs for compensatory social benefits (broken down as public expenses and employer costs) for redundant direct and indirect workers as well as those from induced employment are shown in Figure 3 for all options or stages.

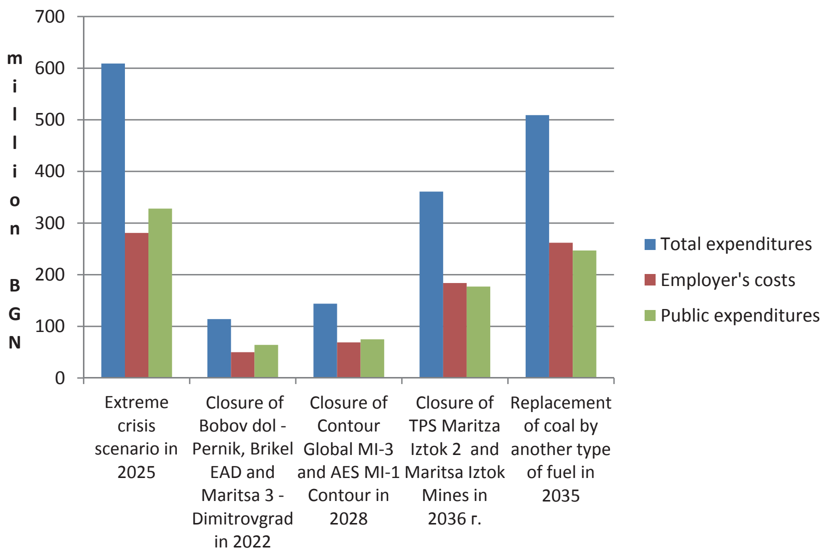
In summary, the assessment of the social consequences from the various options for closure of electricity generation capacities and the coal production providing it is developed as follows:

- The extreme (crisis) version of the closure of all capacities for electricity production and coal mining in the regions of Maritza

Iztok and Bobov Dol – Pernik in 2025 possesses the most negative and acute social consequences – about 21 000 workers and employees from direct, indirect and induced employment are simultaneously made redundant, which would require a total of BGN 710 million, including BGN 527 million within the first year and BGN 183 million continuing payments in the form of early pensions for a period of 5 years. At the same time, it is cheaper compared to the cumulative costs of BGN 890 million (including BGN 578 million in the first year and BGN 312 million subsequent payments) at the gradual closure of individual facilities due to the increase of the benefits paid by the employer, as well as the benefits for unemployment, pensions and allowances paid by the NSSI and the MLSP.

If the closure of all capacities for electricity production and coal mining in the regions of Maritza Iztok and Bobov Dol – Pernik is postponed until 2038 (this scenario is much probable), than the total expenditures for social payments will be 1045 million BGN because of the escalation of the wages.

Figure 3: *Expenditures for cash benefits, pensions and allowances at different electric power closure options*



Source: *Compiled by author's calculations*

- The option of successive gradual closure is relatively more acceptable from a social point of view for economic and environmental reasons or expiry of the contracts for mandatory purchase of electricity. The tension on the labor market, incl. at local level, is more tolerable. The total number of redundancies for the whole period is even slightly lower due to the natural reduction of workers as a result of technological innovations and a smoother reorientation or re-employment of the dismissed. Cumulatively, the costs for benefits at this scenario are higher due to the escalation of wages, but spread on a longer period of time and do not have a significant impact on the fiscal system. At this option, the pressure on the labor market as a result of mass layoffs is less and there is an opportunity to alleviate it through alternative employment programs.
- The scenario of gradual closure includes an unlikely crisis situation – the cessation of work of the American thermal power plants after the expiration of the contracts for preferential purchase of electricity, despite the fact that these plants will count with the material and moral resources even after 2040. If they continue to operate until the end of the forecast period 2040 (which is the most likely scenario), then the total costs in the option of successive closure of facilities will be a total of BGN 672 million, including BGN 451 million in the years of closure and BGN 221 million subsequent expenses from the National Social Security Institute and the MLSP.
- The option of replacing fossil fuel (coal) with alternative ecologically cleaner fuel in 2035 – 2036 is the most socially tolerable in terms of redundancies – a total of less than 10 thousand people directly, indirectly and induced. At the same time, it is quite expensive in terms of compensations and payments (BGN 508 million) due to the high salaries in coal mining and the escalation of salaries by an average of 5 percent per year from 2020 to 2035.

4. Active policies to counteract the negative social consequences of the de-carbonisation of electric power production in the context of the Green Deal

From a legal point of view, at every full or partial industrial closure the procedure of mass employees dismissal is applied, which is regulated **in our national legislation**. More specifically, the procedure is regulated by two laws. First, Art.130a of the Labor Code creates an obligation for the employer towards the employees and workers. Second, in Art.24 and 25 of the Employment Promotion Act and further developed in Art.18 – 19 of the Regulations for application of EPA, an obligation is created for the employer towards the departments of the Employment Agency.

The fundamental tools through which the Bulgarian legislation and our current practice can mitigate the social consequences of mass redundancies as a result of restructuring of entire industries are as follows:

- all programs and measures included in the Employment Promotion Act and implemented through the National Employment Action Plan;
- a large part of the measures included in the Operational Program for Human Resources Development, especially the qualification and retraining of the employees dismissed (a survey shows that 83 percent of those employed in the energy sector do not wish to work in another sector. (web_spravedliv_prehod_osnoven_doclad_prilojenia_low_res.pdf);
- local programs for alternative employment by directing investments, incl. public investment in infrastructure and other public activities;
- establishment of special employment companies (such employment companies were established by decisions of the Council of Ministers in the towns of Madan and Rudozem when closing large sections and coal mines) by the dismissed workers, carrying out activity on recultivation of coal mining sites, dismantling of equipment, modernization of the infrastructure and preparation of the vacated sites for new industries;
- creation of clusters in the field of industry, agriculture and other industries, which will create the necessary alternative jobs that can be financed with funds from the Recovery Program.

Good practices of active and passive labor market policy in closing down coal mines and restructuring of energy capacities are expressed in the following:

- Convincing the public (especially the mining communities) at the coming end of the coal age and involving local authorities in the development of various alternative economic development options for the regions affected by the conversion. Offering various sources of funding for the transition – grants, municipal bonds, revolving loans for entrepreneurs and others to avoid deindustrialization of the region.
- Approval of cleaner energy targets at national level. In the United States, Germany and France, energy policies focusing on renewa-

ble energy play a major role in triggering the transition to coal abandonment. In some cases, change is made possible by the leadership of local authorities (Canada, North Rhine-Westphalia in Germany), as they implement a change in the regulatory framework that leads to innovation and business development in the affected regions.

- Promoting the sectors related to environmental protection. China, the United States and Germany have chosen to support alternative sectors such as renewable energy production, energy saving, electric mobility and waste management.
- Optimization of the trainings and programs for integration of the workers in the coal mining, applying not general, but specific for this type economic activities, which are realized in the region.
- A package of social measures such as: lump compensation sums for the loss of a job; early retirement of affected workers; professional rehabilitation assistance; aid for the territorial mobility of families; compensation for differences in the remuneration at new jobs for a certain period; other social payments for families.

The preparation for the implementation of all employment measures and programs in the affected areas must precede the mass redundancies by at least one year. These measures and programs must be coordinated with and have the support of the social partners and local communities. With the effective implementation of these forms of impact on the labor market, especially through alternative employment, the expenditures of social payments will be significantly reduced and the restructuring of the energy sector will be more socially sustainable.

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Human Capital in the Context of National and Global Green Economy

Liliya Nedkova Nedeva[1]

Abstract: The green economy is a fundamental policy framework for sustainable development in developed and developing countries. Efficient use of human capital provides an opportunity to ensure more efficient use of resources, lower carbon emissions, less harmful to the environment and more socially inclusive societies. At the same time, changes in the employment of human capital are a consequence of the transition to a green economy and a determining factor for its success, as the labour force can stimulate the green economy. Conversely, skills shortages can be a solid barrier to environmental progress, slowing technological and economic transformation. This study aims to analyze the role of human capital in achieving a green economy and the ability of people individually and collectively to respond to challenges and policies and shape behaviour that responds to the need for transformation posed by the global environmental challenge. This includes fundamental changes in the structures of production and consumption, in the patterns of use of resources and investments, in technologies and their use, and behaviour and public policies from national to a global level, leading to the formation of a green society green economy.

Keywords: green economy, ecology, human capital, social capital, efficiency

1. Introduction

In recent years, the "green economy" has become a necessity for achieving sustainable development, both in developed and developing countries, through more efficient use of low-carbon resources, which are less harmful to the environment and allow socialization of societies. More and more national policies focus on achieving a "green economy" that will allow them to make more sustainable and efficient use of natural resources and environmental development. Support from various international funds and the use of different market instruments allows countries to stimulate

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the national market while reducing greenhouse gases and increasing the use of natural resources. National policies focus on using alternative sources for transport, recycling, development of ecological production, etc. The result of the organic output brings significant benefits to the health of the population, the restoration of the environment, the creation of new jobs, and the reduction of social inequality [Raworth & Wykes & Bass, 2014].

The term "green economy" was first used by D. Pierce in his book "Green Economy Plan" in 1989. The book formulates the principles and essential characteristics of sustainable development [D'Amato et all, 2017]. Following the global economic crisis of 2009, the United Nations, in its Environment Program (UNEP), saw the principles of the green economy as a necessary long-term strategy to help all national economies cope with the economic crisis. The green economy is considered a policy approach to help solve problems related to the slowdown in economic growth, job losses, the continuing negative impact on the environment and ecosystems [Global Green New Deal, 2009]. Concepts of a green economy are integrated into international and national policies, including supporting less developed countries to achieve economic transformation. The main goals of the green economy are focused on improving the efficiency of resource use; ensuring the sustainability of ecosystems and environmental protection; increasing social justice and improving the well-being of the population.

2. Theoretical background

The green economy leads to improved human well-being and the achievement of social justice and reduction of environmental risks, i.e. it is a socially inclusive economy that uses low-carbon resources [Shreekaracharya & Sequeira, 2012]. The concept of a green economy is linked to achieving "green growth" through the interaction of human capital with ecosystems, promoting investments that reduce carbon emissions and pollution, improve energy efficiency, and limit the loss of biodiversity. An essential aspect of the green economy is maintaining "natural capital", which includes the biosphere, ecosystems and biodiversity to achieve economic growth and better population welfare. The green economy helps eliminate social inequalities by positively affecting the most vulnerable groups in society and reducing poverty, which is why the United Nations encourages the transition to a green economy and the use of the benefit of "natural capital". In addition to the positive impact on poverty, the green economy ensures other goals presented in Table 1.

__Table 1:__ The positive impact of the green economy

Area of impact	Features
Agriculture and Fisheries	Increase productivity and create new jobs through the application of sustainable agricultural practices.
Buildings and Cities	Modernizing existing and building "smart" buildings and improving transport systems allows poverty control and supports the development of poorer areas of the country.
Energy	Using more renewable energy will limit expensive imports of other fuels and reduce final consumer prices, which will significantly impact the poorer population.
Water	Providing secure and permanent water sources will make it easier to deliver to people and encourage the development of agriculture.
Transport	The use of environmentally friendly public transport and making it more accessible to people will encourage the development of national and local economies and provide new jobs.
Waste	The more waste can be recycled, the more added value can be obtained by reducing poverty and the human capital hired to carry out the recycling.

Source: *Global green economy, 2011*

The UN Global Green New Deal has three main goals [Global Green New Deal, 2009]:

- economic recovery;
- poverty reduction;
- reducing carbon emissions and degrading ecosystems.

International organizations focus differently on achieving the three goals. The European Environment Agency defines a green economy as one whose policies allow society to use resources in such a way as to improve human well-being while preserving natural systems [European Environment Agency]. Green growth (the term is synonymous with a green economy) leads to the promotion of investment, which achieves sustainability and opens up new economic opportunities. Lack of green growth leads to inefficient use of natural resources, pollution, climate change and irreversible loss of biodiversity. Therefore, environmentally sustainable economic growth is considered green growth, and one of the most important policies of all governments is to achieve financial sustainability while protecting the environment. Achieving green growth requires innovation to use cleaner production and green technologies [Wiebe & Yamano, 2016]. The use of environmentally friendly technologies allows the conservation of natural resources and more efficient energy use, leading to low CO2 emissions. Because of this impact, green growth is used to control the harmful effects on the environment [Hao et all, 2020]. The constant demand for energy poses many challenges to countries. Reducing dependence on non-renewable energy sources such as gas, coal, crude oil, etc., and reducing CO2 emissions, also encourages the use of environmentally friendly production.

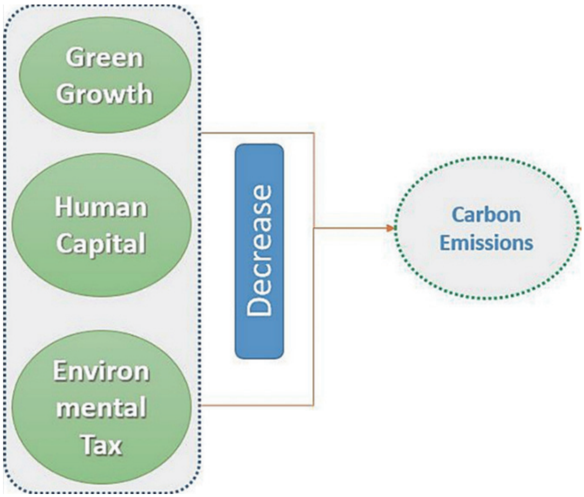
Many factors affect the sustainability of the environment. Some of them are:

- economic development;
- amount of investment in human capital;
- amount of foreign direct investment;
- development of internal and external markets;
- quantity of renewable fuels used in the manufacturing sector;
- availability of new technologies;
- interaction between departments of state institutions;
- sensitivity of the population to environmental protection [Brock & Taylor, 2010].

Another critical factor in promoting the green economy is the taxes and fees imposed by governments on various fossil fuels. Different amounts of taxes and fees encourage the use of one type of fuel at the expense of others. Investing in human capital development helps achieve green growth, as the additional impact of reduced taxes leads to a reduction in harmful emissions (figure 1).

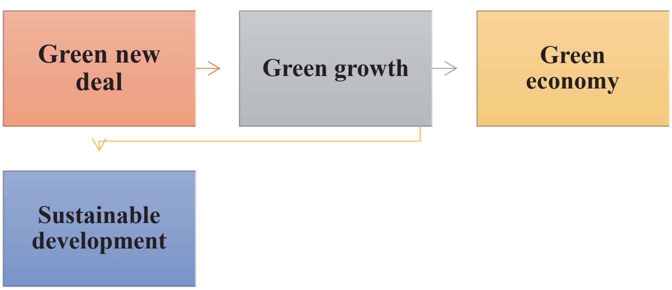
The literature review also shows a link between the state of the environment and physical and mental health. Environmental factors that are paramount to health are clean air, water quality, the availability of sufficient trees and virgin forests, and the use of renewable energy [Porreca, 2021]. To develop the economy, it needs human resources. Human resources are essential for improving resilience in changing climatic conditions. Zaid, along with other researchers, found that proper training and human resource development positively impacts sustainability, creating highly motivated and dedicated employees and adding value to the company. On the other hand, a small part of the company's management focuses on something different from the activity's economic dimension, leaving the social and environmental aspects in the background. However, environmental management and good management decisions directly increase sustainability [Zaid et all, 2018]. Achieving sustainability through a green economy requires companies to create a culture through which human capital can achieve sustainability in all processes and activities [Bag & Gupta, 2019]. Achieving sustainability requires the creation of green economies and their transformation into inclusive, with the active involvement of human capital to reduce poverty. The hierarchy of the green economy requires the implementation of sustainability in all its policies (Figure 2).

Figure 1: *Impact of human capital and green growth to reduce harmful emissions*



Source: *Hao et all, 2020*

Figure 2: *Dependence between Green economy and achieving sustainable development*



Source: *Georgeoson, et all, 2017*

As it is not visible from figure 2, green new deal is a catalyst for green growth, which contributes to the green economy. The green economy is a means of achieving sustainable development.

3. Research

3.1. Research model

The quality of the environment influences the development of human capital, which affects the economic development of countries. There is also the opposite dependence – economic development affects human capital, which through its actions affects the environment. The research model aims to identify how human capital helps to achieve a green economy and sustainability and what impact should be exerted to achieve efficiency.

3.2. Instruments

The tools used in the present study include an analysis of the content of various studies that examine the relationship between human capital and the green economy. The content analysis aims to reveal:

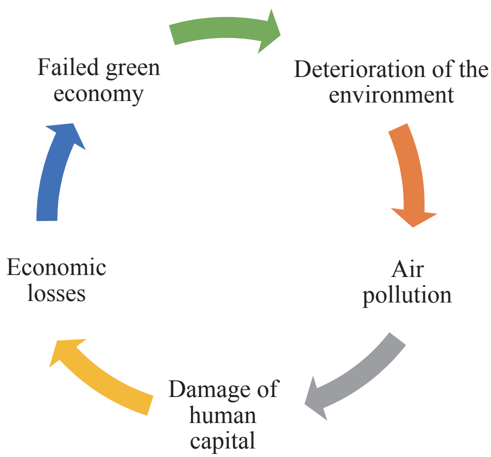
- what is the role of human capital in achieving a green economy;
- are targeted investments needed for human capital development to achieve green growth;
- what is the link between the environment, mental and physical health and achieving a green sustainable economy.

3.3. Findings, discussions, and implications

Jain and Nagpal establish a link between the quality of natural resources and access to them, which determine the quality of the environment with the development of human capital and overall economic growth [Jain & Nagpal, 2019]. The relationship is known as the Kuznets curve, which links economic growth to the depletion and damage of natural resources. According to the theory of the curve, the concentration of carbon emissions will increase in the early stages of economic development. Once the countries reach a stable financial base, efforts are directed to developing human capital in the direction of its actions to protect the environment. Thus, the protection of the environment and the achievement of green growth are linked to human capital activities.

Deterioration of the environment leads to economic losses inextricably linked to the depletion of human capital. The nation's financial well-being is declining every year due to the deteriorating health of human capital due to air pollution. This shows the massive losses that can occur as a result of the impact of negative environmental factors [Porreca, 2020]. An economy that has failed to develop in an environmentally sustainable way not only damages its environment, but all this also leads to damage to human capital, which is associated with significant financial losses. The factor that has the greatest negative impact on human capital is air pollution. Fine dust particles negatively impact health, which leads to reduced productivity and increases mortality, which affects the number and quality of human capital. All this is due to industrialization and a failed green economy. The relationship between economic development, environmental quality and human capital is shown in the following figure 3.

Figure 3: *The relationship between economic development, environmental quality and human capital*



Source: *Schmidt, 2019*

This relationship shows the dependence of human health and well-being on the environment. The factors that are of paramount importance are:

- the use of clean drinking water;
- fresh air;
- use of renewable energy;
- greenhouse gas emissions [Rodriguez-Rosa et all, 2017].

The study is also interested in establishing the link between national policies to achieve a green economy and their impact on the poor. The transition to a green economy stimulates the country’s economic growth and creates new jobs. This has both short-term and long-term consequences for the various social groups of the population. The following Table 2 presents the possible effects of the green economy policies on the poorer population.

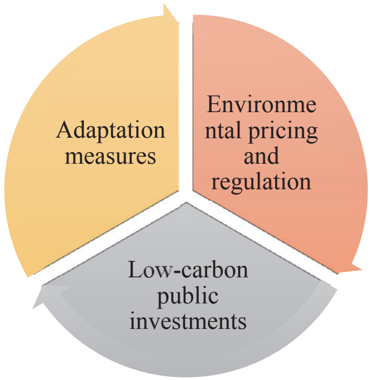
Table 2: *Effects of the green economy policies on the poorer population*

Effects	Features
Changing capabilities	• **Economic** – the change in income increases the opportunities for consumption and acquisition of assets. • **Environment** – access to ecological nature resources, health and education.
The impact of green economy policies on people living in poverty	• **Employment**. • **Access** to good and services. • Providing an opportunity to **express an opinion** on various policies adopted. • Acquisition of **quality assets** – physical, social, financial, intellectual.

Source: *Raworth & Wykes & Bass, 2014*

The green economy can change the opportunities of the population living in poverty. The change can be expressed as increasing the people's economic capacity, providing them with access to new services and assets and more active inclusion in society. In a World Bank document entitled "Is Green Growth Good for the Poor?" the notion that a green economy will automatically bring benefits to the poor is challenged. The reason for a different understanding is that although economic growth is associated with an increase in the well-being and income of the poorer population, this does not mean that it will lead to the recovery of the environmental assets on which the more impoverished people depend. The author of the World Bank report, Stefan Dercon, analyzes three main instruments needed to create a green economy, presented in the following Figure 4.

Figure 4: *Instruments needed to create a green economy*



Source: *Dercon, 2012*

Each of these three instruments, according to Dercon, has a negative impact on the poor people:

- **Environmental pricing and regulation** – the provision of environmental resources can raise water and fuel prices, increasing the costs to the poor. At the same time, the condition of ecological resources can lead to the creation of new jobs, which will increase the income of the poor. In other words, there is a negative impact on the poor, but depending on the applied policies of the green economy, they can be neutralized.
- **Low-carbon public investments** – usually low-carbon public investments are not directed to all regions of the country, and if they are directed – in some areas, they happen much faster than in others. This could harm the poorer population and keep them in areas without low-income investments for a long time, excluding them from the faster-growing regions.
- **Adaptation measures** – investments aimed at achieving a green economy are aimed at economically developed regions. This encourages the migration of the poor to them. The population that remains in rural and less economically developed areas is doomed to increasing poverty.

Based on the arguments presented, it can be concluded that if the green policy is not sustainable, it cannot quickly have a positive impact on the poorer population [Dercon, 2012]. This shows that opportunities for green growth come in different variants in different countries, according to their specific characteristics and policy challenges. These opportunities can range from more efficient management of natural resources to changing energy dependency. Therefore, each country must identify and use specific instruments in its green economy policy and combine them according to the national context. Green economy policies should focus on equity, and more specifically, on analyzing their possible effects on the entire population – small producers and the poorer population – to encourage job creation.

Green growth will only be achieved if an effective national policy is in place that is beneficial to all stakeholders. It requires the creation of a national plan for achieving a green economy, which includes the roles of each responsible institution, with three main objectives:

- achieving economic growth;
- creating favorable conditions for the inclusion of the poorer population;
- adequate protection of the environment.

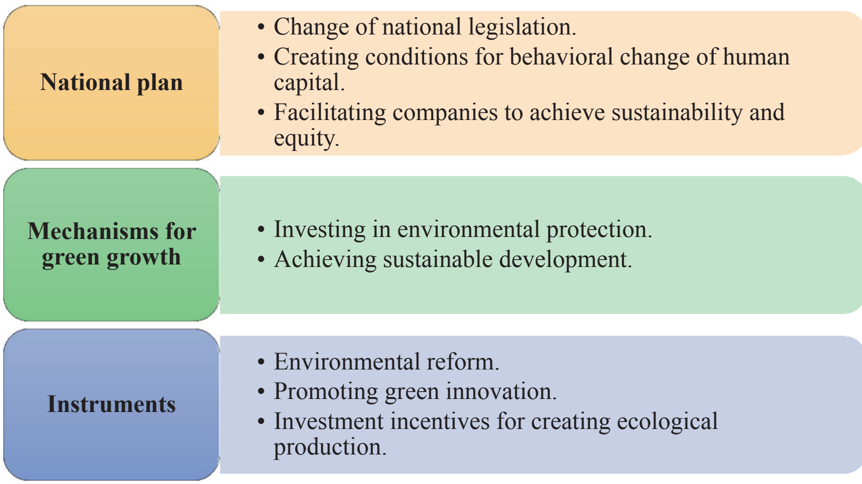
Achieving the goals depends on the continuous upgrading of existing policies, with the active participation of all national institutions, focusing on those that have proven to be successful for the specific country. This will ensure a green economy that is sustainable over time [Garrigos-Simon et all, 2012]. The green economy is related to each country's economic policy and its sustainable development, which includes:

- inclusive economic growth needed to reduce poverty and improve the well-being of the population;
- improved environmental management in a way to address natural resource scarcity and climate change.

The Organization for Economic Co-operation and Development recommends that each country adheres to the three main aspects presented in Figure 5 when developing and implementing a green economy policy.

Both developed and developing countries are essential in achieving global green growth. Developing countries are more vulnerable to climate change and more dependent on natural resources than developed countries. Many developing countries face serious challenges related to social and environmental threats from water and energy scarcity caused by climate change. Although developing countries currently still contribute small shares of global greenhouse gas emissions compared to developed countries, they can increase their impact through more intensive use of natural resources [OECD, 2012]. Achieving green growth is linked to the introduction of sustainable economic, environmental and social policies. Their effectiveness depends on how natural and human capital is used. Production and consumption that are economically resource efficient can lead to a sustainable green economy.

Figure 5: *Main aspects in the development and implementation of green economy*



Source: *OECD, 2012*

4. Conclusion

Based on the analysis, it can be summarized that the concept of green economy is not just the use of organic production in the economy, but it is a means to achieve sustainable development by:

- improving the well-being of people, ensuring better health, education and security of workplace;
- reducing social inequality by taking measures to reduce poverty and provide conditions for population inclusion;
- reducing the risk to the environment by introducing changes that allow more efficient use of natural resources and waste storage; ensuring access to water and natural resources, while protecting them.

Achieving a green economy in the context of sustainable development requires balanced investments in social, human and natural capital. The productive force should be used to allow access to quality natural resources for the poorest part of society to achieve fair and inclusive growth.

The article's findings point to the need to significantly reduce air pollution with fine dust particles. Clean air is the basis of human capital development, and its absence is a factor for the inefficient action of a green economy. Eliminating factors harmful to human health will reduce mortality and increase productivity. The expected effects can be easily measured. Therefore, the main conclusion that is formulated is that human capital and green growth are directly related. The more the harmful factors on human capital are limited, the more effective the green policy will be. When green policy is effective, there are many positive effects on human capital in terms of improving health, social well-being, reducing poverty, providing access to better services and much more.

5. Limitations and future research

The analysis presented in this article is based on an analysis of the content of selected literature sources – scientific articles. It does not include a country-by-country analysis in which the policies implemented to promote green growth may have different effects on human capital. This remains the subject of future research.

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The Evolution of Human Capital in the Transformation to a Green and Sustainable Economy

Tsveta Draganska-Georgieva[1]

Abstract: Transformation into a green and sustainable economy is impossible without the development of human knowledge, skills and competencies. The transition from an industrial to a green economy is an opportunity for new enterprises and new jobs to correspondent to the new challenges and regulatory requirements. The questions of what knowledge and skills will be needed in the future and how they would impact the affected sectors and human development are keys to achieving economic sustainability. The article presents the main competencies needed to achieve a green and sustainable economy, examines the new opportunities for the main sectors affected, the current "green" professions and the occupations of the future. In this article is derived the idea of the evolutionary development of human capital realized in the process of transformation into a green and sustainable economy.

Keywords: human capital; skills; competencies; green economy; sustainable development

1. Introduction

Bulgaria is one of the 27 countries in the European Union that have signed the European Green Pact. At the same time, the country does not fully introduce adequate policies for the implementation of the ecological transition. There is a lack of awareness among people and companies about the opportunities and untapped green potential, about social responsibility and the translation of the Bulgarian economy in accordance with European regulatory standards. There is a need to focus on the forthcoming transformation in a number of sectors such as the energy sector, emission-intensive industries, agriculture and forestry, transport and others. Scholars and academic researches (both theoretical and empirical) can develop interest in and encourage debate on green challenges, as well as help politicians take the necessary steps to achieve a greener and more sustainable economy.

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2. The process of transformation to a green and sustainable economy and the evolutionary development of human capital

2.1. The essence of human capital

Human capital is a set of knowledge, skills, abilities and talents that a person possesses and owing a person generates income. Human capital also includes health status, family status and the ability of the individual to migrate to live, work and socializes. In this way we look at human capital on an individual level.

At the corporate level, human capital represents the individual abilities of the people who support the production process. It is also at the basis for providing a competitive advantage to companies and each organization seeks to hire people who have human capital of a higher class – education, abilities, talent, professional experience, etc. [1]

Human capital at the social level is the summary of the human capital of all individuals in the community (state) and brings social benefits to the entire economy and society in which he lives and works.

According to the definition of the Organization for Economic Cooperation and Development (OECD), human capital is the knowledge, skills, competences and other qualities that an individual possesses in order to create personal, social and economic well-being. [2] The organization proclaims the idea of a knowledge-based economy and thus launched a number of programs and policies for the use of human knowledge and competencies as a factor for economic growth.

According to the Lisbon Strategy for Growth and Jobs adopted by the member states of the European Union in 2000, the Union must become the most dynamic and competitive knowledge-based economy in the world.

As a result the Europe 2020 Strategy for smart, sustainable and inclusive growth was adopted in order the face the global challenges after the Economic and Financial Crisis of 2009, which increasingly calls into question existing lifestyles, learning, work, communication and consumption. The Strategy is also based on knowledge and resource sharing. The Europe 2020 strategy enables the European Union to achieve growth that is:

- intelligent – through the development of knowledge and innovation;
- sustainable – based on a greener and more competitive economy with more efficient use of resources;
- inclusive – aimed at stimulating employment and social and territorial cohesion. [3,4]

2.2. The European Green Pact

The European Green Pact (European Green Deal) is an ambitious project to make Europe the world's first climate-neutral continent. Signed by all 27 countries of the European Union, it aims to reduce greenhouse gas emissions by 55% by 2030 compared to 1990, to achieve zero net greenhouse gas emissions by 2050 and to contribute to make the EU a modern, resource-efficient and competitive economy.

The main policy is to achieve economic growth independent of the use of natural resources, while no person or region should be ignored by the changes that are taking place.

The European Green Pact will create new opportunities for innovation, investment and jobs and will lead to:

- reduction of emissions;
- job creation and growth;
- overcoming energy dependence;
- improving human health and well-being.

The European Green Pact will contribute to improving the well-being and health of citizens and future generations by ensuring:

- Clean air, clean water, healthy soil and biodiversity;
- Renovated, energy efficient buildings;
- Healthy food at affordable prices;
- More public transport;
- Cleaner energy and cutting-edge innovation in clean technologies;
- More durable products that can be repaired, recycled and reused;
- Future-oriented jobs and up-skilling/re-skilling to acquire the skills needed for the transition;
- Sustainable and competitive industry worldwide. [5]

2.3. The difference between "green" and "sustainable"

Often when we talk about a green economy or a sustainable economy, there is a mixture of the two. But they are not equivalent and should not be used as synonyms.

The green economy can be defined as an economy concerned and supportive of the environment; an economy focused on activities that make a significant contribution to preserving or restoring the quality of the environment.

A sustainable economy is associated with environmental well-being, economic growth and social benefits.

A sustainable economy is based on the collection or use of resources which are not depleted or permanently damaged. It is defined as a future-oriented economy.

The green economy is a subset of a sustainable economy; it contributes to a sustainable economy, but is not in itself sufficient to achieve sustainability.

The main difference between green and sustainable is that “green” refers to only one aspect – environmental protection, while sustainability refers to the whole system, including economic, social and environmental benefits. [6]

For both “green economy” and “sustainable economy”, we can say that is a “clean” economy which reduces the harmful effects of man on nature and is based on:

- ensuring the sustainability of ecosystems and protecting the environment;
- efficient use of resources, including energy;
- limited use of traditional polluting production processes;
- introduction of new production technologies to reduce harmful emissions into the atmosphere;
- conversion of waste products into a production resource;
- use of renewable energy sources (sun, wind and water);
- energy efficiency;
- transport that uses clean energy, biofuels and electric cars;
- social justice and poverty reduction, improving people’s well-being and sharing justice in society.

2.4. Basic competencies for achieving a sustainable economy

The transition from an industrial to a green economy is an opportunity for new activities and new jobs to meet rising challenges and regulatory requirements. Transformation into a green and sustainable economy is impossible without the development of people’s knowledge, skills and competencies. The questions of what knowledge and skills will be needed in the future and how they would affect the sectors affected, mobility and human development, are key to achieving economic sustainability.

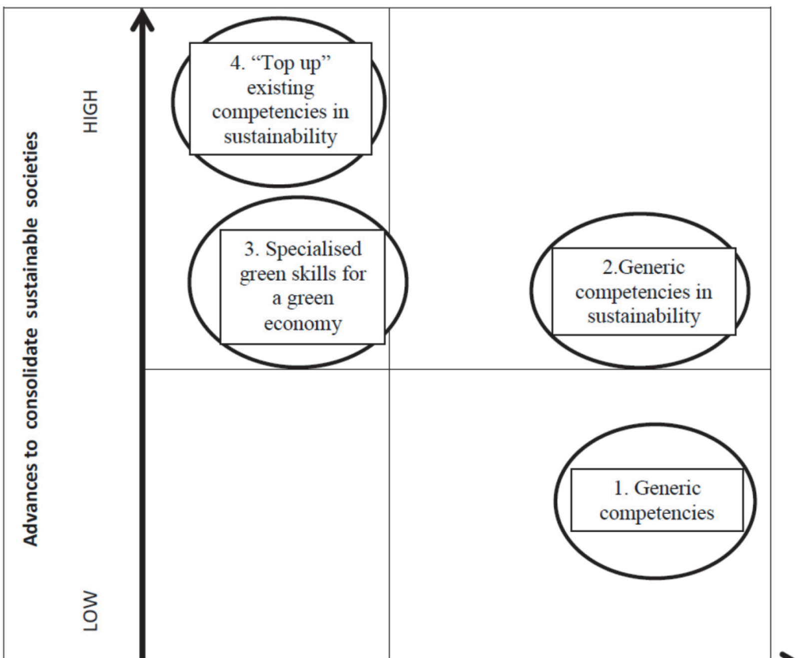
Universities are the main educational centers for a sustainable economy and their task is to develop and promote the necessary competencies, both for future graduates who will be employed in “green jobs” and for those graduates who will work in all other manufacturing sectors.

From the educational point of view, we consider four key competencies in the area of sustainability:

1. Traditional general competencies – of instrumental, interpersonal or systemic profiles that can be applied to everyday situations;
2. Competences for a sustainable economy – those competencies necessary for social behavior and styles that strengthen the sustainable economy; applying a transdisciplinary approach to education;
3. Specialized competencies of technical profile for the needs of "green jobs" – training in specialized technical skills – disciplines STEM (science, technology, engineering and mathematics);
4. Continuous up-skilling processes for updating specialists.

The four types of competencies are shown in Figure 1. [7] The vertical axis shows the progress from a traditional society to a society characterized by sustainability in its development, and the horizontal axis shows the degree of specialization of different types of competencies and the amount of presence they should have among students.

Figure 1: *Competencies and skills needs for a sustainable economy*



Source: *By Mª Ángeles Murga-Menoyo [7]*

Next in row to provide up-skilling/re-skilling and competencies are the vocational organizations. Such education is applied mainly at regional level with local enterprises, industries and entrepreneurs. The purpose of the up-skilling/re-skilling process is to enable employees to develop the proper know-how in specific subjects and areas of work, to update knowledge or to acquire new competencies.

Green Skills Checklist (United Kingdom)

In 2008, the UK government presented a Green Skills Checklist as part of a report on the impact of skills on the transition to a low-carbon and resource-efficient economy. The list includes ten broad skill groups, which are divided into general skill categories and more specific skills. The UK government periodically updates the list. The first entire *Green Skills Checklist* is published in an International Labor Organization (ILO) report *Skills for green job – A global view (2011)* [8]. The ten broad skill groups, the general skill categories and some of the specific skills are shown below:

1) Design skills – Eco-design (design for disassembly, design for recyclability, design for the environment, etc.), Green manufacturing, Materials specification, Life-cycle assessment/costing.
2) Waste skills – Waste quantification and monitoring (waste production calculations, mass balance, waste audit), Waste process studies (material/substance flow analysis, resource utilization mapping, life-cycle assessment), Waste management systems (objective setting, legislative and regulatory compliance, collection systems, segregation, waste cycle management, 3R implementation – reduce, reuse, recycle, etc.), Waste minimization (industrial symbiosis, integration of process waste), Waste technologies (recycling, waste-to-energy).
3) Energy skills – Energy minimization (energy reduction programmes, heat recovery and re-use, energy-efficient technologies, energy-efficient practices, etc.), Energy management systems, Energy quantification and monitoring, Energy costs and trading (energy markets and pricing, carbon trading schemes, climate change levy agreements, energy price trends, etc.), Renewable energy (RE) technologies (solar, wind, biomass, combined heat and power, photovoltaic, ground source heat pump, air source heat pump, hydro, hydrogen, fuel cell, integration into energy supply, etc.), Non-renewable technologies (nuclear, incineration with energy recovery, clean fossil fuel technologies, carbon sequestration, waste-to-energy).

4) Water skills – Water use minimization and water re-use (grey water, water harvesting, wastewater recovery, recycling, cascading, waste/water recovery, etc.), Water management systems, Water quantification and monitoring.
5) Buildings skills – Building energy management (insulation, regulatory compliance, passive heating, building regulations), Integration of renewable energy, Energy-efficient construction, Facilities management, Calculating building energy efficiency and carbon ratings.
6) Transport skills – Transport impact minimization technologies (hybrid vehicles, biodiesel, electric vehicles, fuel-efficient vehicles), Transport impact minimization processes (alternative transport strategies, communication/implementation campaigns, car-sharing schemes, public transport planning, public transport implementation, etc.), Transport management in business.
7) Materials skills – Sourcing (sources of low-energy materials, sources of low-mileage materials, recyclates (secondary materials), energy-efficient raw material extraction, industrial symbiosis, transport mileage), Procurement and selection (use and properties of low-energy materials and of recyclates, low-carbon and resource-efficient procurement, etc.), Material use and impact quantification (material usage calculations, life-cycle assessment and costing), Management systems, Impact and use minimization (life-cycle assessment and costing, energy-efficient process implementation, material flows analysis).
8) Financial skills – Investment models (energy technologies investment models, carbon derivatives investment models, calculation of payback/return on investment), New/alternative financial models (carbon trading, EU Emissions Trading Scheme, etc.), Quantification of climate change impacts (impact assessment of climate change on business finances, impact of climate change on materials availability and cost, carbon neutrality and associated cost/opportunities (costs of doing nothing), risk/opportunity assessment models for adaptation and mitigation, insurance risks/opportunities of a low-carbon economy), Principles of low-carbon and resource-efficient economies (polluter pays principle, externalities), Tools of low-carbon and resource-efficient economies (Climate Change Levy agreements, enhanced capital allowances, cost – benefit analysis, low-carbon and resource-efficient procurement).

9) Management skills – Impact assessment (energy use calculations, water use calculations, waste production calculations, carbon footprinting calculations, emissions measurement), Business planning (RE planning, low-carbon planning, climate change risks, etc.), Awareness raising (communication/implementation campaigns), Opportunities management (identification of low-carbon and resource efficiency opportunities, cost–benefit analysis), Risk management, Day to day management.
10) Policy and planning skills – Built environment master planning and implementation (low-carbon spatial planning, zero waste planning, resource-efficient planning, low-carbon and resource-efficient urban design, building regulations, public transport planning and implementation, cycle network planning and implementation), Strategy development (impact assessment and modelling, principles of low-carbon and resource efficiency), Strategy implementation (understanding of skills needs for HR managers, low-carbon and resource-efficient material sourcing and procurement, awareness raising/communications skills).

2.5. The transformation to a green and sustainable economy

To achieve the objectives of the European Green Pact (European Green Deal), the promotion of efficiency in the use of natural resources and fossil fuels, as well as the reduction of polluting emissions or waste, leads to a production-consumption model that has potential effects on all sectors of production activity.

Some sectors will be more affected or closed and this process will be followed by job cuts and the necessity to retrain employees and create new jobs. In other sectors, there will be a need for transformation to green standards, which also leads to the necessity for new knowledge and skills of employees. The transformation to a green and sustainable economy goes through the creation of new jobs, the closure of jobs that are no longer needed, the replacement of jobs or the transformation of jobs in the affected sectors.

Specialists currently occupying traditional jobs will need to update their knowledge and skills to acquire the new competencies needed in the context of sustainable development.

Increasing jobs in the green economy sector (waste collection and recycling, renewable energy or environmental management) requires specialists who have proper competencies to perform such tasks – these are mainly specialists in the fields of STEM (science, technology, engineering and mathematics).

At the same time, the entire population in EU, as potential recipients of green products and production processes, must also have sustainability competencies in order to be able to appreciate the benefits offered by the new economic model of production and consumption.

In order to fulfil the condition for the entire population to have competencies in the field of sustainability, it is necessary the knowledge for a green and sustainable society to be formed in educational programs. The basic principles of the UN Sustainable Development Goals are enshrined in European curricula, with green skills being taught in primary, secondary and professional-oriented schools in an interdisciplinary manner.

Let us look which sectors are most affected by green restructuring and how the transformation of their employees will be affected.

In the first place is the sector of agriculture, forestry, including food/wood processing and fisheries. The sector will change and develop in the production of organic food; biofuel production, sustainable forestry; new types of aquaculture. These changes are related to the needs for re-skilling of employees.

Second place is occupied by the extractive industries and the production of energy from fossil fuels. In order to achieve the objectives of the European deal, there is a need for new green technologies, clean coal and carbon-capture and storage, which will result in the reorientation of workers to renewable energy, again creating the need for re-skilling for employees.

In third place is the share of production with intensive emissions and in particular the automotive industry, shipbuilding, cement industry.

The automotive industry and related supply chains are targeting environmentally friendly vehicles (hybrid, electric, hydrogen). Due to the transformation in the sector there is a need for updating and new knowledge and skills for those employed in the automotive industry.

The next affected industries are shipbuilding and marine engineering – they are shifting to offshore renewable energy sources, including the construction, supply and maintenance of wind turbines and wave and tidal energy. For this purpose, employees retrain for the new activities.

The cement industry is taking steps to move to more energy efficient production methods. Its employees are less affected, but there is a need to update competencies.

The experience of Lindo, Denmark

The experience of the Danish shipbuilding company Lindo is indicative. Odense Steel Shipyard is a large shipbuilding company based in Odense on the Danish island of Fyn. Known for its container vessels in 2006, the company also produces the world's largest container vessels to date at its Lindo shipyard. However, the global recession of 2009 and strong competition from eastern companies herald the end of the Lindo shipyard, while another major Danish shipbuilding company, Royal Denship, declared bankruptcy. Faced with bankruptcy and the dismissal of 8,000 employees, the company's management made the important decision to restructure its activities and turned to the offshore sector of energy from renewable sources. [9]

It is important to point out the involvement of local authorities in the process of Lindo's transformation. The island of Fyn is the third largest island in Denmark, Odense is the third largest city in Denmark and the shipyard's activities are not only national but also of great local importance. The local authorities, through their employment service, identify the competencies of the yard's employees, as well as the needs for new knowledge and skills to carry out Lindo's new activities and productions. After the analysis, the workers go through re-skilling carried out by local educational organizations with the assistance of the local authorities and the offshore renewable center Lindo, established in 2009. Thus, together business and local government are accumulating efforts to keep jobs in the Odense administrative district. [10]

In January 2012, Lindo handed over the last ship produced and ceased shipbuilding. Preparations for the new activities began in parallel in 2010 and after the closure of the shipyard in 2012, Lindo Industrial Park was opened. In addition to producing energy from renewable sources, Lindo has managed to use the skills of its workers and turned the former shipyard's base into a base for the production, storage and unloading of large steel structures, including the production of wind turbine gondolas. Within a few years, Lindo quickly became one of the largest and most strategic offshore industrial parks in Europe. [11]

2.6. New opportunities

The transition to a greener economy has huge potential for long-term employment, the ability to create millions of jobs directly, indirectly and through induced effects.

In 2012 the International Renewable Energy Agency (IRENA) published for first time report concerning renewable energy and jobs analyses and estimates that the world's renewable energy sector employs 7,3 million people directly or indirectly. In 2016 the number of employees grows to 9.8 million. In 2019, the world's renewable energy sector employs 11,5 million people and in 2020 increase to 12 million employers. [12]

The solar photovoltaic industry is the largest employer of renewable energy in the world and employs about 4 million people, followed by the production of liquid biofuels and wind energy, which employs about 1,25 million people.

The renewable energy sector is employing over 1.5 million people in Europe in 2017 (direct and indirect employment) compared to 1 million in 2014. Another 1 million people are employed in energy efficiency activities in 2018. At the same time, direct employment in the fossil fuel extraction and processing sector amounted to 328,000 jobs in the EU-27 in the same year. [13]

According to IRENA, the number of people working in the renewable energy sector will reach 24 million by 2030. This will compensate for the loss of jobs in the fossil fuel sector and will become a major economic engine in the world. According to the latest IRENA report in 2050, the solar photovoltaic industry alone will employ about 20 million people.

A 2019 study estimates that the US green economy has 10 times more jobs than the entire fossil fuel industry in the country. [14]

According to the International Labour Organization (ILO), 75% of environmentally oriented companies in the EU need more skilled workers. According to a survey conducted in Spain, 99.7% of green jobs in the country are permanent, compared to only 72% in the entire Spanish economy. [ibid. 8]

Building the greener homes and offices of the future (and upgrading old ones to meet modern standards) is a huge undertaking that requires hundreds of specialized roles. The ILO estimates that by 2030 there will be 6.5 million jobs in sustainable construction, making it the second fastest growing sector after green energy. The "circular economy" processes, moving away from the old consumer model of "extraction, production, use and disposal" and a greater emphasis on "recycling, reuse and repair" will create about 6 million jobs worldwide. [15]

New opportunities for the development of agriculture and forestry are also being created. Among them stand out: construction of organic farms, construction of vertical farms (including urban farms); construction of forest farms and cultivation of fast-growing timber trees – an opportunity for sustainable development of poorer mountain areas; the production of technical crops (hemp, cotton, etc.) including as technical crops for land reclamation and other activities.

Along with the already known professions of renewable energy engineer, urban farmer, green/creative designer and eco-builder, among the professions of the future we also find: environmental technician; automotive or mechatronic engineer; engineer or energy management consultant; recycling specialist in the new "circular economy", sustainable development expert, environmental lawyer; natural scientist (biology, chemistry, physics, geology).

2.7. Why "evolution" of human capital and not just "development"?

Faced with new challenges for sustainability and at the same time the rapid development of technologies and processes, including the oncoming robotics (Industry 4.0), require rapid and efficient adaptation, acquisition and application of new competencies, development of new sectors or transformation of traditional ones to remain relevant and meet the new requirements. Man and his potential is the core of all these changes, and now more than ever they are undergoing evolutionary development, seen in the context of a green and sustainable economy in the following six areas:

1. The necessity to acquire new knowledge and skills – along with the basic traditional competencies in all areas there is a need for competencies for sustainability, application of a transdisciplinary approach in the re-skilling and promotion of "green" thinking and "green" knowledge in individuals;
2. The need of continuity of up-skilling process for actualization and developing abilities;
3. Improving the health of the individual and increasing life expectancy – along with advances in medicine and the application of technology in medicine, reducing carbon emissions and improving the environment will lead to better and healthier living conditions;
4. Creating healthy and safe working conditions and reducing occupational accidents;
5. The opportunities for mobility and work in the EU countries and other European countries, as well as the work from a distance imply unlimited opportunities for the realization of human capital in a large part of the economic spheres;
6. Social significance – new skills for sustainability generate not only a sustainable economy but also a sustainable society.

For the first time, along with economic sustainability and environmental sustainability, there is talk of social and cultural sustainability.

Social and cultural sustainability addresses issues about people's ability to realize their potential (human capital).

Depending on where in the world we live and what stage of our lives we are in our needs look different. These needs may concern freedom of religion or finding a balance in life in a developed society; they may relate to the opportunity to be educated, to take care of ourselves, or to live in peace.

Definition for social and cultural sustainability of University of Gavle is as follows: The social and economic life today and in the future fulfil basic human needs like for example self-provision, social justice, health, education, culture, religion, peace, human rights, balance in life and motivation, as a long-term processes, shaping social conditions for future generations. [16]

3. Conclusion

This article is the result of a study of European regulatory standards, reports from leading international organizations and publications about the transformation from an industrial to a green and sustainable economy.

Although Bulgaria reports on the implementation of the "Europe 2020" program until 2020, mainly through the built facilities for renewable energy, through low-energy new construction (mainly office buildings) and renovation of old buildings and production of biofuels, the country lags far behind policies and measures to restructure the economy to make it energy efficient, low-emission and competitive. There is a lack of vision and debate on key topics such as reducing the share of mining and emission-intensive industries, limiting the production of energy from fossil fuels, replacing high-energy and obsolete technological equipment with new, modern and low-energy ones, increasing the share of biological and biodynamic agriculture and others.

The transformation to a green and sustainable economy goes through the creation of new jobs, the closure of jobs that are no longer needed, the replacement of jobs or the transformation of jobs in the affected sectors. This global transformation can only take place if employers – bearers of human capital, develop or update their competencies – knowledge, skills, abilities, talent, experience.

The transformation to a green and sustainable economy is a step towards new sustainable models and the evolution of man and society. We have the unique opportunity here and now to develop and implement new competencies to ensure the sustainability of resources (material and human) for future generations.

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CHAPTER V

BULGARIA AND THE REGIONS IN THE GREEN TRANSITION

Perspectives and Challenges for the Regional Policy in Bulgaria in the Context of the Transition to a Green Economy

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Abstract: The actual research paper analyzes the opportunities and challenges facing regional development in Bulgaria in the context of a fair transition to a green economy and a lack of multilevel government. At European level, a link is identified between sustainable development (green economy), regional policy and decentralized governance. The economic statistics methods used provide a look at the dilemma of green development and social pressure. A solution is sought to the extent to which the green economy is a means or an obstacle to the socio-economic development of the regions in Bulgaria and the achievement of public welfare.

Keywords: sustainable regional development, green economy, welfare, green transition

1. Introduction

The green transformation of the world has undoubtedly come to the fore and become one of the most urgent activities along with controlling the Covid 19 pandemic. Recent decades have shown that, despite multiple ratified documents, efforts are still insufficient. The transformation of the energy systems needs to happen faster. The focus on climate, along with the development of new technologies, is attracting global attention to the decarbonisation of the energy systems. By 2018, 81% of the world's energy was

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still supplied by fossil fuels, global greenhouse gas emissions increased in 2019, and more than 770 million people worldwide still do not have access to electricity (WEF, 2021). In order to manage this trend, efforts are divided into two areas: an environment that includes efficient buildings, smart homes, a healthy community and mobility – compact urban structure and electrification. Several things need to be taken into account to ensure the sustainable transformation of the urban environment, which must be the result of the joint efforts of regional authorities, national governments, together with the business and civil society, and namely (WEF, 2021):

- Integrated policies to promote the circular economy. They coordinate the efforts of the parties envolved to adopt the best technologies and behaviors using public-private partnerships. In fact, such policies can directly stimulate consumer investment in decarbonisation solutions (IRENA, 2021).
- Data collection and tracking of results. The systems approach can best address the complexity of the urban carbon footprint by analyzing data to improve planning decisions in different city areas. This allows for transparency and consistency of decision-making, as well as measurement of results and progress, allowing participants to also identify links and reduce carbon and the related economic and health benefits.
- Public commitment to an inclusive transition. Civic participation is essential and can be achieved through a clear, transparent communication and education campaign: from stimulating consumer behavior driven by smart metering to television programs that seek to keep households away from highly polluting solid fuels such as wood and coal (Chef, 2021). The individual-centered approach is vital for the implementation of decarbonisation solutions (IEA, 2021).
- Regional projects for action promotion. Integrated planning at a district level provides an opportunity for pilot and large-scale approaches, constitution of targeted partnerships and trade models needed to carry out the urban transformation.

In connection with all this, one of the options is to integrate green infrastructure and territorial cohesion (EEA, 2011). This concept is oriented towards sustainability as a direction of development. Biodiversity or local renewable energy production require future regional policy to focus more on territorial potential and smart growth. Regional policy must be seen as a tool to support territorial cohesion and the environment. In this way, regional policy can contribute to the achievement of the EU's long-term plan for sustainable development goals after 2020. In order to achieve territorial cohesion, the importance of the ecological dimension of a territory, including ecosystem services, landscape, biodiversity and protection of resources must be fundamental. An integrated approach to planning, programming and implementation is fundamental to steer regional policy towards sustainable development priorities (EC, 2011).

1. Development analysis

With regards to the Paris Climate Agreement (Green Pact) and the European Union's (EU) carbon targets for 2030 and a climate-neutral economy by 2050, the EU and Bulgaria regions face the challenges of synchronically working for their economic recovery from the crisis caused by the Coronavirus, and also to cope with the expected social, economic and environmental impacts of the transition to decarbonisation. This concerns especially the regions whose economies are based on coal mining and electricity generation. The planned transition to a green economy will have unequal economic and social consequences in different regions of Europe. This is quite logical in view of their specific features and level of development. The dynamics of the green transition will depend on the implemented policies for sustainable regional development, as well as on the peculiarities of the regional economy, local resources, civic participation and the degree of decentralization of governance. The experience of EU regions and cities to date indicates that progress with green policies is clearly visible mainly at regional and local level, where certain cities/ municipalities implement ambitious sustainable development strategies. In regions with a higher level of decentralization and multilevel governance, there has been more significant successes related to green transformation. This requires a more decentralized and integrated approach to regional policy, based on local economic, social and environmental features.

EU regional (cohesion) policy is designed to focus on urban development. Cities are considered to be the engines of economic progress in the regions. Leading cities in Europe and around the world are pursuing a variety of green policies that put them at different stages of development on their path to decarbonisation. There are already a number of initiatives for energy and carbon-free urban transition.

The Green Cities Index indicates the progress of 30 European cities with environmental policies. On top of the ranking are three Scandinavian capitals – Copenhagen, Stockholm and Oslo, which pursue ambitious environmental goals, but also have great financial and administrative opportunities to provide local public goods. The first 10 cities in the index are located in countries with developed economies with multilevel and/ or federal government with decentralized powers at the regional and local levels. This provides greater autonomy and efficiency at lower levels of government (regions, municipalities), as well as opportunities for planning and implementing independent policies for development and green transformation. On average, local government spending as a percentage of GDP in the EU-28 is 10,6%. In Bulgaria they are 7,4%. In most countries of Western Europe and the Scandinavian countries a large part of public funds is realized through local budgets – in Denmark – 33,6%, Sweden – over 25,5%, Finland – 21,7%, Italy – 13,9% (Eurostat, 2018). The initiative of the European Commission (EC) – European Green Capitals, also shows that the winning cities possess strong local authorities with decentralized administrations – Stockholm, Hamburg, Vitoria-Gasteiz, Nantes, Copenhagen, Essen, Oslo and others. The EC Green Capital Award (EGCA) is given each year to a city that is at the forefront of urban policies for environmental protection and sustainable development.

According to the EC, urban areas are the source of many of today's environmental challenges. Local authorities can provide the commitment and innovation needed to address and solve a great number of these issues (EC, 2010). And this is not just an assessment of the EC. Currently, more than 2/3 of the European population live in cities. Many organizations and researchers also believe that cities are the key to green economic transformation. A report by the World Economic Forum proposes an integrated approach as a solution for decarbonising urban areas. The transformation of zero-carbon cities requires *systemic efficiency* based on clean electrification, smart digital technologies and efficient buildings and infrastructure, together with the circular economy's approach to water, waste and materials (WEF, 2021).

Our observations indicate that good examples of the ecological transformation of the cities in Europe are initiated decentrally through local green development policies and strategies and through local community initiatives. In addition to European green capitals, there are many examples of cities undergoing an ecological transition around the world (Transition Network). The Green Cities Agreement is gaining momentum in the EU.

Among the Organization for Economic Co-operation and Development (OECD) countries, the majority of the costs of adapting to climate change and environmental protection (approximately 55%) are at the subnational level. Compared to spending, investments related to climate change and the environment occur even more at the subnational level, with an average of about 64% of environmental investments being made by the subnational governments (OECD, 2019).

In Bulgaria, multilevel government is not applied – the real executive power is exercised at national and local level. There is a lack of an intermediate/ regional level of governance with competencies and policies to address broader territorial issues. The planning and implementation of regional policy, which strives for balanced development of the regions, is over-centralized. Simultaneously, the majority of the municipalities as representatives of local self-government are in a poor financial situation, mainly due to the lack of fiscal decentralization, which does not allow them to pursue independent policies and actively participate in regional initiatives. The regional governors and the Regional Development Councils (RDCs) do not currently have direct powers and do not perform real functions related to the planning of regional development and the programming of investments under the European Structural and Investment Funds (ESIF).

With the introduction of the integrated territorial approach for regional development and the implementation of integrated territorial strategies from 2021 in the planning regions from NUTS 2 level in Bulgaria, a timid step is being taken towards decentralization of public administration to an intermediate (third) level only with regard to the management of European funds intended for the regions. The regional policy is oriented to the specific features of the respective territory, to stimulation of the local economic activity and its specific potential. For the first time, through RSPs, which are dominated by municipalities, regions are given the opportunity to set their own ESIF priority interventions using the Integrated Territorial Investment Instrument (ITI). However, the regional planning and preparation of the integrated territorial strategies for the development of the regions of NUTS 2 level remains centralized, assigned by the responsible Ministry of Regional Development and Public Works. No concrete steps have yet been taken by the state to implement fiscal decentralization.

In the context of the transition to a green economy, it is of high importance that the regional development policy is linked to the objectives of the green deal and the measures under the recovery mechanism, part of which is the National Recovery and Sustainability Plan (NRSP). Bulgaria has taken steps in this direction by combining in one program the funds from ESIF for urban and regional development and the funds from the Fair Transition Fund (FTF), provided for the three coal regions – the administrative districts of Stara Zagora, Kyustendil and Pernik. However, the measures in the NRSP are still being specified between the sectoral institutions at national level, as the territorial bodies do not have an actual participation in the process of their preparation. The Regional Development Councils, in which the ITI concepts will be selected, are not involved in the management, coordination and monitoring of the projects set out in the recovery plan.

The future program *Development of the Regions* (RDP) 2021 – 2027, with a budget of almost BGN 7 billion, will finance the 50 urban municipalities in the country and the three regions whose economy is based on coal mining and its use. Funding for the program will be aimed at three directions. The ten big cities – centers of growth, will use the resource under Priority 1 of the program for integrated urban development and they will determine their priority interventions through the city committees for project selection. The big cities are united in 4 urban clusters – two in Northern and two in Southern Bulgaria, and for the first time they will compete with each other for the funds provided in the budgets of the respective clusters. The remaining 40 municipalities will be able to use the funds under Priority 2 of the RDP through the ITI instrument as for this purpose they will prepare concepts for ITI (integrated partnership projects), which will be selected and evaluated in advance by the six Regional Development Councils.

The FTF measures will be financed on the basis of territorial plans at NUTS 3 level (district) and will be approved by the Managing Authority of the RDP. However, the development of territorial plans for a fair transition of the three coal regions is lagging far behind. It is not even clear which institution is responsible for their preparation. It is not clear what interventions are envisaged and whether local stakeholders will have a say in setting priorities in the territorial plans. Here again it is obvious that centralized planning is cumbersome and does not render the necessary results, and this has been observed for two programming periods since Bulgaria became a member of the EU.

As for the preparation of the NRSP, our country has difficulties in identifying complex measures directly related to decarbonisation. Initially, only energy efficiency measures in residential, administrative and industrial buildings were envisaged. At the insistence of the EC for closer connection of the recovery plans with the measures for fair transition and the climate goals, in the third version of the plan dated July 2021 additional projects and funds are set for investments in facilities for energy storage, production of green hydrogen, construction of photovoltaic systems for own needs of households and businesses, etc.

2. Methodology, results and conclusions from the empirical research

The indicators applied are organised into four groups according to the dimension of sustainability and the public role at regional level: Indicators for sustainable economic growth and competitiveness: SDG8 – Decent Work and Economic Growth (index), SDG9 – Industry, Innovation and Infrastructure (index), Costs for R&D (%); Public sector indicators: SDG4 – Quality Education (index), SDG16 – Peace and Justice (index), Quality of Regional Governance (index); Indicators for social sustainability: SDG10 – Reduction of Inequalities (index), NEET index (15 – 24%), Population in Material Deprivation (%), Individuals at Risk of Poverty and Social Exclusion (%), Long-term Unemployment Rate (%); Indicators for sustainable development and green economy: SDG11 – Sustainable Cities and Communities (index), SDG12 – Responsible Consumption (index), Recycling Rate at Regional Level (%).

A comparative analysis of specific indicators is used, providing an objective image of the stage of economic development, social dimensions and the green economy at the level of large European cities, aiming to confirm the link between sustainable development and decentralized policies. Some of the data are supplemented by the European Cities Sustainability Index for 2019. The year was chosen to avoid distorting the conclusions based on the health crisis. The comparison between the selected 45 cities makes it possible, on the one hand, to examine the links and dependencies in the dimensions of sustainability on a regional scale. On the other hand, because of their economic and demographic weight, the conclusions can be correlated with some certainty for the regions in which these cities are located, and thus to objectify the regional analysis. An analysis is made of the relations between the sustainability of the regions in the EU, on a sample basis, by main cities in the relation competitiveness – social sustainability – green economy through the role of the public sector. Second, it is possible to justify the link between regional decentralization and the ability of the regions to better utilize the prospects for a green economy.

Figure 1 shows the correlation between sustainability indicators in their economic, social and green dimensions, as well as the role of the public sector at the local level.

Figure 1: Correlation between sustainability indicators

Correlations

		SDG4 : Quality education	SDG8 : Decent work and economic growth	SDG9 : Industry, innovation and infrastructure	SDG10 : Reduced inequalities	SDG11 : Sustainable cities and communities	SDG12 : Responsible Consumption and Production	SDG16 : Peace, justice and strong institutions	NEET rate (% 15-24)	Severe material deprivation rate in cities (%)	People at risk of poverty or social exclusion (%)	Long term unemployment Rate (%)	R&D expenditure (%)	Quality of local government	Municipal recycling rate (%)
SDG4 : Quality education	Pearson Correlation	1	,589	,725	,447	,567	,419	,422	-,610	-,650	-,627	-,440	,653	,770	,566
	Sig. (2-tailed)		,000	,000	,002	,000	,004	,004	,000	,000	,000	,002	,000	,000	,000
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
SDG8 : Decent work and economic growth	Pearson Correlation	,589	1	,537	,275	,312*	,326*	,422	-,626	-,655	-,571	-,635	,396	,499	,352*
	Sig. (2-tailed)	,000		,000	,067	,037	,029	,004	,000	,000	,000	,000	,009	,001	,018
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
SDG9 : Industry, innovation and infrastructure	Pearson Correlation	,725	,537	1	,294*	,611	,350*	,378*	-,426	-,560	-,493	-,368*	,827	,691	,717
	Sig. (2-tailed)	,000	,000		,050	,000	,018	,010	,004	,000	,001	,013	,000	,000	,000
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
SDG10 : Reduced inequalities	Pearson Correlation	,447	,275	,294*	1	,354*	,119	,466	-,477	-,442	-,514	-,417	,417	,330*	,248
	Sig. (2-tailed)	,002	,067	,050		,017	,436	,001	,001	,002	,001	,004	,006	,031	,101
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
SDG11 : Sustainable cities and communities	Pearson Correlation	,567	,312*	,611	,354*	1	,293	,184	-,341*	-,282	-,176	-,163	,481	,439	,560
	Sig. (2-tailed)	,000	,037	,000	,017		,051	,227	,022	,061	,265	,285	,001	,003	,000
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
SDG12 : Responsible Consumption and Production	Pearson Correlation	,419	,326*	,350*	,119	,293	1	,286	-,361*	-,306*	-,151	-,384	,321*	,233	,605
	Sig. (2-tailed)	,004	,029	,018	,436	,051		,057	,015	,041	,339	,009	,038	,133	,000
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
SDG16 : Peace, justice and strong institutions	Pearson Correlation	,422	,422	,378*	,466	,184	,286	1	-,447	-,675	-,502	-,515	,346*	,493	,217
	Sig. (2-tailed)	,004	,004	,010	,001	,227	,057		,002	,000	,001	,000	,025	,001	,153
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
NEET rate (% 15-24)	Pearson Correlation	-,610	-,626	-,426	-,477	-,341*	-,361*	-,447	1	,487	,506	,597	-,457	-,434	-,355*
	Sig. (2-tailed)	,000	,000	,004	,001	,022	,015	,002		,001	,001	,000	,002	,004	,017
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
Severe material deprivation rate in cities (%)	Pearson Correlation	-,650	-,655	-,560	-,442	-,282	-,306*	-,675	,487	1	,695	,499	-,440	-,781	-,369*
	Sig. (2-tailed)	,000	,000	,000	,002	,061	,041	,000	,001		,000	,000	,004	,000	,013
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
People at risk of poverty or social exclusion (%)	Pearson Correlation	-,627	-,571	-,493	-,514	-,176	-,151	-,502	,506	,695	1	,467	-,466	-,501	-,253
	Sig. (2-tailed)	,000	,000	,001	,001	,265	,339	,001	,001	,000		,002	,003	,001	,106
	N	42	42	42	42	42	42	42	42	42	42	42	39	40	42
Long term unemployment Rate (%)	Pearson Correlation	-,440	-,635	-,368*	-,417	-,163	-,384	-,515	,597	,499	,467	1	-,334*	-,257	-,289
	Sig. (2-tailed)	,002	,000	,013	,004	,285	,009	,000	,000	,000	,002		,030	,096	,055
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
R&D expenditure (%)	Pearson Correlation	,653	,396	,827	,417	,481	,321*	,346*	-,457	-,440	-,466	-,334*	1	,570	,675
	Sig. (2-tailed)	,000	,009	,000	,006	,001	,038	,025	,002	,004	,003	,030		,000	,000
	N	42	42	42	42	42	42	42	42	42	39	42	42	42	42
Gini Coefficient (1-100)	Pearson Correlation	-,447	-,275	-,293	-1,000	-,354*	-,119	-,465	,476	,442	,513	,416	-,416	-,330*	-,247
	Sig. (2-tailed)	,002	,068	,050	,000	,017	,437	,001	,001	,002	,001	,004	,006	,031	,101
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45
Quality of local government	Pearson Correlation	,770	,499	,691	,330*	,439	,233	,493	-,434	-,781	-,501	-,257	,570	1	,532
	Sig. (2-tailed)	,000	,001	,000	,031	,003	,133	,001	,004	,000	,001	,096	,000		,000
	N	43	43	43	43	43	43	43	43	43	40	43	42	43	43
Municipal recycling rate (%)	Pearson Correlation	,566	,352*	,717	,248	,560	,605	,217	-,355*	-,369*	-,253	-,289	,675	,532	1
	Sig. (2-tailed)	,000	,018	,000	,101	,000	,000	,153	,017	,013	,106	,055	,000	,000	
	N	45	45	45	45	45	45	45	45	45	42	45	42	43	45

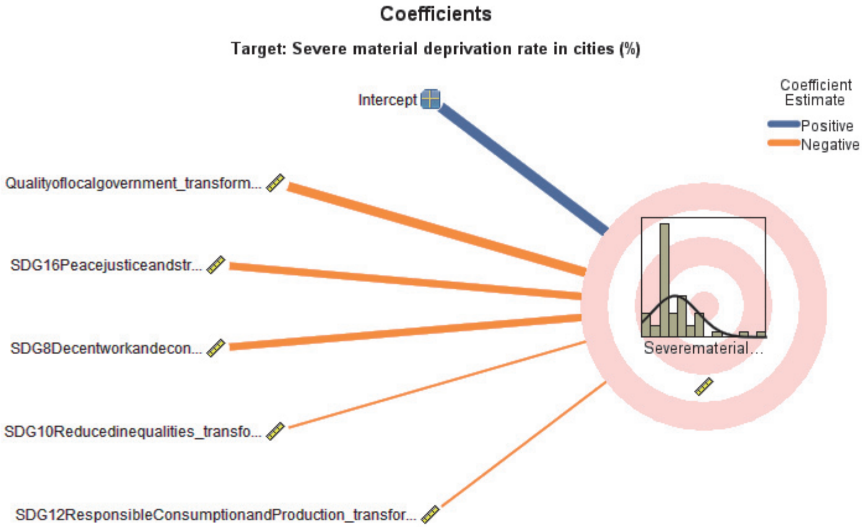
*. Correlation is significant at the 0.05 level (2-tailed).

Source: *own calculations*

The information from the figure reveals several basic dependencies. First: sustainable economic growth and the social dimension are negatively statistically significantly related. This is because increased investment costs, sustainable infrastructure and industry, as well as job availability and economic growth are key factors in increasing employment and labor incomes, which in turn lead to reduced indicators of poverty, exclusion and material deprivation. Second: the active role of local government in its qualitative aspect – reduction of corruption and bribery in all its forms, development of effective, responsible and transparent institutions, promotion of the rule of law, maintenance of quality education has a positive statistically significant relationship with economic and the social dimensions of sustainable development. The explanation should be found precisely in the fact that the active public sector promotes economic development and public relations, creating a fair framework for economic and social relations among market participants. Third: the indicators of green sustainability experience a statistically significant relationship with both sustainable development in its economic and social dimensions and the quality of local government. The logic should be found in the fact that the promotion of the green economy, the circular economy, environmental protection and sustainability is a product of state policy, which is objectified at the local level by quality governance and the local private sector. The result in reducing social evils provides an objective assessment of the possibilities of the green economy in this direction.

Figure 2 demonstrates the regression correlation between the indicators for sustainable growth and development in the context of local governance and green economy on the level of the population living in acute material deprivation. Due to the presence, on the one hand, of the direct and indirect relationship between the dependent and independent variables, and on the other hand the many factors that influence these relationships beyond both the regional level and other elements of the socio-economic system, the figure shows the direction rather than the strength of the connection. The orange color stands for the negative regression dependence of even the factors which are of no statistical significance in the equation. But the direction of impact clearly shows that the role of local government, the economic development of the region and the green economy have a positive impact on social evils in the role of this dependent variable.

Figure 2: Regression relationship between sustainable growth indicators



Source: *own calculations*

Inferences

Basic inferences which can be drawn up from the considered dependencies for the connection between the economic, social and green dimensions of the sustainable development in the context of local governance are:

At regional and urban level, as well as at national level, the main link between economic growth and social evils is evident. The achievement of sustainable economic growth and high employment alleviates social disparities;

The role of public governance at the local level is significant, creating the framework for sustainable development and growth;

The green economy creates not only opportunities for economic development, but also challenges for the local self-government to promote it;

Sofia as an index of sustainable development occupies one of the rear positions and ranks last as an index of quality of local government of the surveyed cities, which shows the difficulties and challenges at the regional level;

The green economy is an inevitable economic paradigm for new generations. Quality local self-government and regional decentralization are the basis for creating preconditions for using the opportunities of sustainable development and the green economy to alleviate social evils.

3. Conclusion

The results of this research, as well as many other empirical facts, as well as all normative and strategic documents at European level, indicate that territorial authorities and local stakeholders should have an increasing significance in the implementation of regional policies. It is logical and justified that they play a more substantial role in the green transformation. Municipalities, for example, have essential functions in waste management, water, green systems, transport, construction etc. – all elements on which the reduction of emissions to achieve climate neutrality directly depends. A lot of the challenges that accompany the transition to a green economy can be addressed at local and regional level through a bottom-up approach.

Without intensifying the decentralization process in Bulgaria, however, it will be very difficult to summon the full local potential for a fair transition. The goals for decarbonisation of the economy are unattainable without the involvement of every person and every enterprise in the country. In the current situation, municipalities (especially small ones) will not be able to fully participate in integrated territorial investments, as they do not dispose with sufficient capacity and resources to ensure their normal functioning, let alone a significant own contribution to the implementation of integrated partnership projects. In general, balanced territorial development is unattainable without the strengthening of a polycentric network of cities to ensure the necessary quality of life, growth and cohesion. However, decentralization should not be seen only from a financial point of view. Decentralization is primarily a matter of creating strong local and regional institutions and participants, which are provided with the necessary powers, resources and mechanisms to be able to actively and equally participate in the process of development of the country and the integration of the regions on the basis of local/ regional competitive advantages (Diaz H. K., UNDP, 2004).

In this regard, cohesion policy after 2020 is an important tool for the transition to a green economy, as it provides significant funding for the regions, incl. for creation of capacity and partnership with the relevant participants. It is targeted at the specific location, which allows the transition to take place on an appropriate scale and to be adapted to the specific area, while linking to other levels of government (EC, 2021). Regional policy tools and the new generation of funds facilitate the green transition as an alternative model for the socio-economic development of EU regions and will help to reduce the risks of negative social consequences for the most affected areas.

In accordance with the Charter for Multilevel Governance in Europe and the Territorial Agenda 2030 of the EU, the Bulgarian authorities should take action to strengthen local self-government and provide more opportunities for institutions and organizations closest to citizens to be leaders in the green transformation. The development of the regions in Bulgaria requires further boosting of the decentralization of public administration and strengthening of local authorities through fiscal decentralization, possible reform of the administrative-territorial structure and transfer of additional functions of the RDP to coordinate the implementation of ESIF co-financed programs, new recovery mechanisms and a fair transition.

Regions and cities should be at the forefront of green policies and public engagement with decarbonisation. However, they need support for the deployment of their strengths and for the successful implementation of the cohesion policy instruments, and in particular integrated territorial investment, which would lead to the goal of balanced territorial development. The implementation of a more decentralized regional policy will increase the effect of ITI and will contribute to the sustainable development of the regions in Bulgaria.

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Progress in Waste Management as a Factor for Regional Inequalities in the EU

Dellyan Angelov[1]

Abstract: For nearly two hundred years of industrial development and for about a hundred years of consumer society, the solid waste accumulated from production and consumption aroused exponentially. For a long period it was somewhere in the background behind air and water pollution, which made them invisible for some time. Solid waste depletes an important part of the space in cities and agricultural areas. From the shadow of environmental issues, today these solid wastes are considered by economists as important raw materials for a number of current industries. Many countries import industry-valuable waste, but there are also unwanted hazardous waste. It is that have become the target of large-scale organized crime over the last four decades, initially from some developed countries and has subsequently globalized. "Triangolo della morte" is a notorious region in Italy. It is a territory between the municipalities of Acera, Nola and Mariglana, all part of the administrative region of Campania. Serious problems with waste management from there are spilling over into eastern part of the EU, as in Poland, Bulgaria, etc. The amount of solid waste in Bulgaria has been growing rapidly in recent years. This report aims to trace the root causes and main consequences of this two-dimensional development of the waste management sector in EU countries.

Keywords: Green deal, waste management, hazardous waste, illegal waste dump, recycling

Introduction

The transition to circular economy and the "Green deal" are the most discussed economic topic in EU and worldwide nowadays and the focus is put on the energy sector and decarbonisation issues. Despite the great importance of energy supply, we should not forget about the industries like chemical, mechanical engineering, electronics and electrical engineering, food industry etc. Thus, unfortunately, decarbonization is only one side of the complex issue of green transition. After two hundred years of intensive industrialization and urbanization, and after about a century of mass consumerism,

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solid waste from production and consumption has outlined the second major direction on the road to the much-desired "circular economy".

The traditional way of managing solid waste, associated with landfilling in permanent storage (mechanized landfills) has already exhausted its capacity, not only in developed but also in developing countries. We are currently experiencing a crisis with the lack of landfills and innovative technologies are underway to minimize their volume. There are two main directions in this aspect in production: 1) the production of products suitable for reuse; 2) production of products suitable for recycling or rapid degradation. From the point of view of the already produced products, the innovations in the field of recycling of different types of materials are underway. Thus, a significant part of solid waste is already seen as a concentrated raw material that has a place in the international raw materials market. One part, however, remains unsuitable for recycling and this makes it inconvenient and expensive. While waiting for appropriate innovations for its utilization in the business, organized crime intervenes, which "covers" the inconvenient waste through illegal methods incompatible with ecology and sustainable development.

For almost five decades, the depletion of natural resources and environmental pollution have been leading topics in the field of ecology and in the activities of environmental movements. In the last twenty years, they have gradually begun to move into the real economy and transformed into a new and innovative industry (waste management), a new kind of inequality (regionally and globally), and a new niche for organized crime (national and international). Inadequate waste management leads to many environmental problems and the adoption of efficient and sustainable waste management has become a priority for the EU. In addition to demographic factors, the different socio-economic and geographical conditions of this complex area lead to large differences in municipal waste management between North and South, East and West. This article aims to make a spatio-temporal analysis of Eurostat indicators, using an ascending hierarchical cluster analysis that divides Member States into five typological classes. The maps obtained highlight the territorial differences between Member States in terms of municipal waste management, as well as the development of environmental policies between 2003 – 2009, related to the acquis. To a much greater extent than progress, the problem of pollution is a spatial, regional problem. It turns out that stopping waste generation is no longer enough. The modern economy needs a new sector – a sector for the processing of waste generated so far. This is a sector linked to innovation, research and development, a sector with a future. Recycling is becoming an increasingly important economic source for rare and valuable elements whose distribution in nature is limited or whose extraction is difficult. This is especially true for rare earths, which are often used in the electrical and electronics industries and which have fallen into the rubbish with discarded devices.

In 1971, the report "The limits of growth" (http://www.ask-force.org/web/Global-Warming/Meadows-Limits-to-Growth-Short-1972.pdf) on the exponential economic growth and population growth with limited resources, studied by computer simulation. Funded by the Volkswagen Foundation and commissioned by the Club of Rome, the results of the study were presented for the first time at international meetings in Moscow and Rio de Janeiro. In 1992, Mankiw, Roemer, and Vale (Mankiw et al., 1992) worked on a model that incorporated human capital and institutions as determinants of economic growth.

The superiority of North America and East Asia in the digital technology sector is clear. European economies have the opportunity to establish themselves as a global leader in another important area of innovation (waste management and recycling technologies) in the modern economy, thus compensating for this lag. Demographic factors, different socio-economic and geographical conditions lead to a discrepancy in the development of the waste treatment industry in the North-South and East-West directions in Europe. The EU's leading role in the field of waste management and recycling is due to consistent policies, laws and decisions over the last 25 years, including:

Council Directive 1999/31 / EC of 26 April 1999 on the landfill of waste, Directive 2008/98 / EC of the European Parliament and of the Council of 19 November 2008 on waste (https://eur-lex.europa.eu/legal-content/BG/TXT/?uri=celex%3A32008L0098), Waste Framework Directive, Landfill Directive , Directive on end-of-life vehicles, Directive on packaging, etc.

Among all of them, the Green Pact, constituted in 2019 (https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_bg), has a central role to play. It sets out a new industrial strategy that aims to achieve a "circular economy" with a declining share of natural raw materials and ensure that products are reused. and recyclable. The main mechanism for recycling is the integrated management of solid waste (separate collection, sorting and treatment of waste).

Methods

This report relies as basic methods on geographical and regional spatio-temporal analysis as well as on qualitative descriptive-chronological method and is supported by authorized EU and UN statistical sources.

The downside of progress is made up of two complementary problems – depletion of resources and pollution (which is essentially also depletion of the environment). This has led to new economic thinking and the use of a new type of resource – recycling. For this to happen, however, a new approach and new technologies are needed. Efforts have been focused on creating them for the last three decades. Part of this effort is the land pact concluded within the EU in 2019.

Main categories of solid waste by sectors (https://www.unescap.org/sites/default/files/CH08.PDF):

Solid household waste; Similar wastes (trade, tourism, offices); Solid waste it industrial production; Solid wastes from food and agriculture sector;

Refuse derived fuel (RDF) Waste fuel is produced from household and business waste, which includes biodegradable materials as well as plastics. Non-combustible materials such as glass and metals are removed and the remaining material is shredded. Waste fuel is used to generate energy in special incineration facilities or in thermal power plants.

Solid recovered fuel (SRF) Solid recovered fuel is a high-quality alternative to fossil fuels and is produced mainly from flammable commercial wastes, including paper, cardboard, wood, textiles and plastics.

Biodegradable waste: food and kitchen waste, green waste, paper (most can be recycled, although some difficult to compost plant materials can be excluded from this group.)

Recyclable waste: paper, cardboard, glass, bottles, jars, cans, aluminum cans, aluminum foil, metals, some plastics, textiles, clothing, tires, batteries, etc.

Inert waste: construction and destructive waste, dirt, rocks, debris

Electrical and electronic waste: electrical appliances, light bulbs, washing machines, TVs, computers, screens, mobile phones, alarm clocks, clocks, etc.

Composite waste: waste clothing, cardboard boxes for food and beverages Tetra Pack, waste plastics such as toys and plastic garden furniture

Hazardous and low-toxic waste: most paints, chemicals, tires, batteries, light bulbs, electrical appliances, fluorescent lamps, aerosol cans and fertilizers

Highly toxic wastes: including pesticides, herbicides and fungicides;

Biomedical waste: expired pharmaceuticals, etc. (https://www.unescap.org/sites/default/files/CH08.PDF).

Basic steps in the solid waste processing sector in the EU are: Collection (separately) and transport; Sorting and treatment in waste treatment plants; Landfilling in legal, treated landfills; Incineration for the production of electricity and heat (after shredding / shredding); Composting; Recycling (https://www.unescap.org/sites/default/files/CH08.PDF).

Recycling "means the industrial processing of waste materials for the same or other purposes, with the exception of energy recovery." (UNECE Decree № 133: Uniform provisions concerning the approval of motor vehicles with regard to their suitability for re-use, recycling and recovery). Recycling is any recovery operation in which waste, including organic waste, is processed into substances, materials or products for the purposes of its original function or for other purposes. Waste-to-energy operations, those related to the conversion of waste into fuel and landfill operations cannot be classified as recycling operations (French Environmental Code. https://www.academia.edu/37680496/Environmental_Law_of_France).

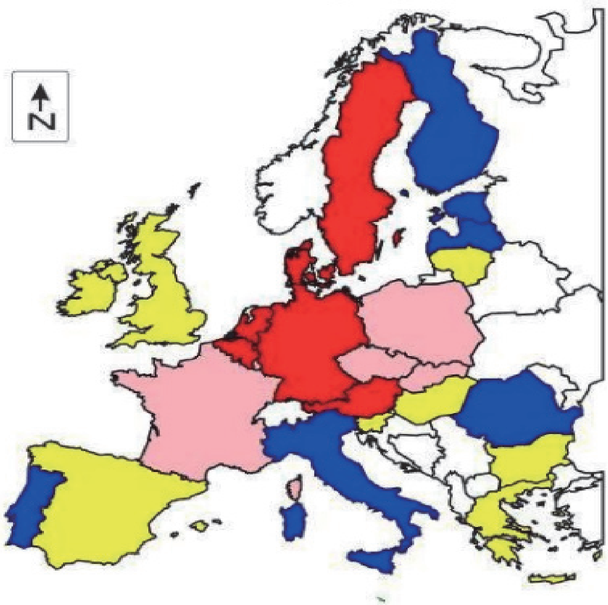
One leading fact about EU is that more developed economies generate more waste, but they also have more resources and access to new waste treatment technologies as well as more complex technological base. Less developed countries in the EU generate less waste, but the possibilities for solutions are more modest. Less developed countries in the EU are at risk of illegal exports to their territories of unwanted waste.

Some of the EU countries where waste directives are most fully implemented are those where landfilling has become a minor process, replaced almost entirely by incineration with energy recovery, recycling and composting. This has so far been achieved by Denmark, Sweden, the Netherlands, Belgium, Austria and Germany (Florin M., Liviu A., 2012).

Developed economies have begun to measure their economic success by the extent to which they recycle and reduce the share of depleted natural resources and pollution, and in the field of innovation today is among the leading industries. Europe has the opportunity to be a global leader in this ultra-innovative new field, thus compensating for its lag behind North America and East Asia in digital technology and electronics.

However, as a leader in waste management and recycling, Europe and the EU also face some inequalities. Here are some of them: more developed economies produce more waste, but they also have more resources to deal with. The opportunities for the economy and individual companies to use recycling technologies and materials are greater. In weaker economies, less waste is produced, but the need for recycling and the ways to do so are weaker.

Figure 1: *EU countries, according to the level of implementation of waste management directives*



Source:https://www.researchgate.net/publication/261296666_Disparities_in_municipal_waste_management_across_EU-27_A_geographical_approach

In Germany, landfills have decreased significantly in recent years due to improved recovery and recycling programs. The amount of landfilled waste from the population is constantly decreasing, which implies the effectiveness of the management of the systems implemented in each province.

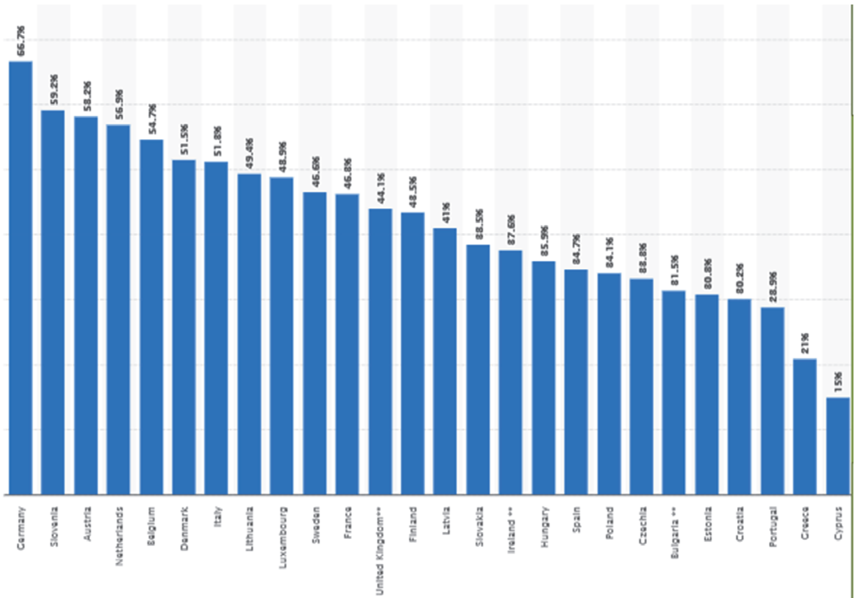
In southern Europe (Portugal, Spain, Italy and Greece), landfilling still plays a leading role in waste management methods, along with recycling and composting, which are not developing at the required pace.

The problem is bigger in Italy, which, as the largest economy in southern Europe, generates more waste, with disproportionate inequality between the North and the South.

In the Czech Republic, Slovakia and Poland, the disposal of solid waste is within the EU average (200 kg per capita respectively), but they have the largest share in the accumulation of waste for treatment. In Poland, the quantities of waste collected and disposed of are often deliberately manipulated as a result of illegal trade between the participating companies.

In the newer EU Member States, where most of the waste generated as a main method is still landfilled, Romania, Lithuania and Estonia. The process of separate collection and recycling has begun, but is still at an unsatisfactory level.

Figure 2: *Percentage of municipal waste recycled in the European Union (EU-28) in 2019 by country*



Source: https://www.statista.com/statistics/1219551/municipal-waste-recycling-eu-by-country/

Still solid waste disposal, well above the EU average, is observed in Malta and Cyprus. The main role in this situation is due to the highly developed tourism industry and the growing, almost year-round tourist flow in these two countries.

The main part of the generated solid waste is still disposed of directly in landfills with insufficient treatment in Bulgaria, Hungary, Slovenia, Lithuania and recycling is poorly developed. The scale of separate collection is unsatisfactory and the amount of waste generated and disposed of is expected to increase in the near future.

Table 1: *EU Countries ranked by level of implementation of EU solid waste management directives*

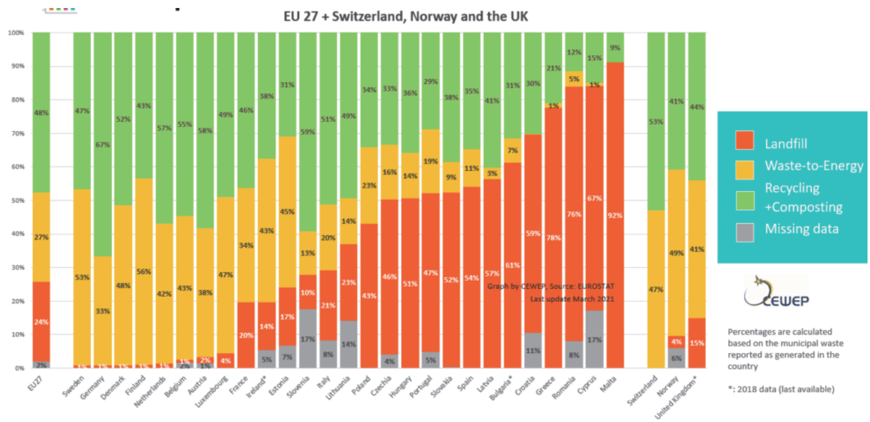
	EU member states	**EU macro regions**	**Leading methods**	**Implementation of the Solid Waste Management Directives**
1	Denmark, Sweden, the Netherlands, Belgium, Austria and Germany	Central and Northern Europe	Recycling, composting, energy incineration.	Highest level of implementation of EU directives
2	Portugal, Spain, Italy and Greece	Southern Europe	Landfill, energy incineration	Medium implementation
3	Czech Republic, Slovakia and Poland	Central and Eastern Europe	Landfill, energy, sorting	Small lag
4	Romania, Lithuania, Estonia, Malta and Cyprus	Eastern Europe, Southern Europe	Landfill, sorting	Moderate lag
5	Bulgaria, Hungary, Slovenia, Lithuania	Central and Eastern Europe	Landfill	Considerable lag

Results

The attached data show that there is an uneven development in the EU in reaching and implementing the directives on solid waste collection and treatment. This gives preconditions for the emergence of a gray sector and a network of illegal structures and practices in the waste management sector. The earliest illegal practice in European countries was the filling of decommissioned quarries for the extraction of minerals and aggregates. Accumulated disparities in the waste management sector in the EU spill over into the shadow economy, where it became the most profitable branch of the local and international mafia.

Over the last two decades, the illegal practice of international transport for the illegal incineration or disposal of solid and toxic waste has been actively developed.

Figure 2: *EU countries by leading method in municipal waste management, 2019*



Source: https://www.cewep.eu/municipal-waste-treatment-2019/

Unfortunately in some EU countries, the following illegal practices for dealing with different types of waste are still observed:

Illegal dumping in decommissioned quarries and underground galleries (Great Britain, Italy, Sweden, Poland, etc.); Disposal in the so-called illegal spontaneous dumps in natural spaces; Outdoor burning in illegal dumps; Illegal combustion in thermal power plants; Illegal combustion in domestic heating installations (in urban and suburban slams in Italy).

The industrial scale hazardous waste illegal disposal starts in the United Kingdom (Wales) From the very beginning of deindustrialisation process in the late 1960s, legal and illegal dumping of various wastes in abandoned quarries began in Wales (https://naturalresources.wales/guidance-and-advice/environmental-topics/waste-management/report-fly-tipping/?lang=en).

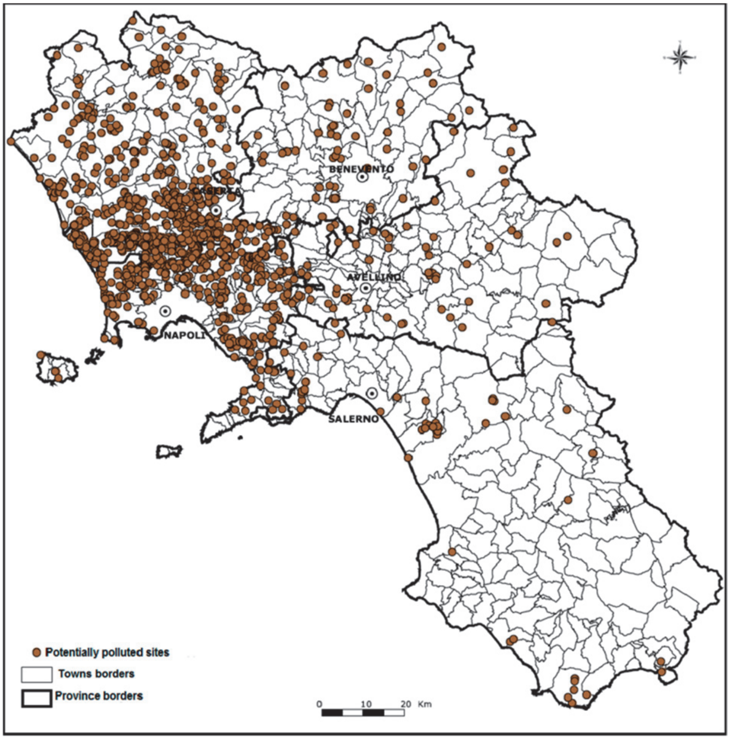
But eventually Italy became the central destination of waste cryme in Europe. Italy is one of the most developed economies in the EU, with the strongest regional inequality. Italy generates the largest amounts of plastic and toxic waste in the EU.

The "triangle of death" is a notorious region throughout Europe. This is a territory between the municipalities of Acera, Nola and Marigliano, all part of the Campania region. Known primarily for the Camorra, the waste problems and the sharp increase in the death rate of the local population from cancer, mainly due to the illegal dumping of toxic waste from organized crime and coming mainly from the industrialized regions of northern Italy. The environmental situation is very complex, in Italy, and in particular, in some areas (Naples and Caserta provinces) of the Campania region that have experienced numerous problems correlated with hazardous waste management. In particular, an area of Naples province has been referred to "Land of Fire" (or Terra dei fuochi) for the open burning of uncollected trash, including chemical and other potentially hazardous waste. (Caputo, 2020) Uncontrolled disposal generates complex and challenging situation that involves the entire population. In particular, the illegal dumping and burning of toxic waste in Campania (Italy) has caused immense environmental damage and an increase in cancer rate among the population (Marfe, Di Stefano 2020).

The Camorra is a powerful syndicate of Italian organized crime, dominating the Campania region with centers of activity in Naples and Salerno. There is a consensus among scolars who have carried out research on the Southern Italian msfia since the early 1960s that the origins of the mafia phenomenon can't be understand unless the state-building process in the South are taken into account (Antonopoulos, 2016). After the earthquake in Naples on November 23, 1980, the Camorra specialized in waste disposal, disposing of mostly construction waste and toxic materials directly into abandoned quarries, unused agricultural land and other areas (Spooner, 1984). Inhalation exposures to aerial emissions of landfill gas and its potencially harmfull constituents are crucial for local population's helth (Harrison, R, Hester, R. 2007).

(In the 1990s) the practice began to use the established quota from the municipal budget at lower than the thresholds for payment by fragmenting the orders specified in the European directives. […] The municipality artificially shreds the orders to keep them below two hundred thousand euros, after which it fails to check whether they are legal (Sabella, 2016).

__Figure 3:__ a map of the concentrations of illegal dumps in the territory of the Campania (NUTS 1) region



Source: *Illegal Dumping of Toxic Waste and Its Effect on Human Health in Campania, Italy* https://www.researchgate.net/publication/278790561_

Thus, the criminal organization diversifies its main source of illicit income (from drugs) with a new, somewhat legal source. After several decades of successful activity, other criminal unions have taken over the waste business in various regions of Italy. This is the main reason why Italy is lagging behind in the development of the waste recycling industry.

In early 2018, the Chinese government, as part of Operation National Sword, banned the import of 24 types of waste, including plastics. The ban has severely affected recycling industries worldwide, as China was the world's largest importer of waste plastics and problematic recyclable plastics; the ships carrying waste went to other ports – to Thailand, Indonesia, Taiwan, South Korea and India, but also to Turkey and Poland (Brooks A., Wang Sh., Jambeck J., The Chinese import ban and its impact on global plastic waste trade, Available at: https://www.science.org/doi/10.1126/sciadv.aat0131).

After China's withdrawal, Poland became the sixth largest importer of British waste in the world, and second in Europe after the Netherlands. Decommissioned landfills in the Upper and Lower Silesian regions of southern Poland, legally or illegally become target for waste dumping. A large number of coal-fired power plants suitable for solid waste incineration are concentrated in the highly developed industrial zone of southern Poland.

From 2010 to 2017, the import of waste in Bulgaria has increased almost five times (https://www.dw.com/bg/). Initially, the country is a traditional importer of scrap metal, batteries and old batteries, but after 2013 began deliveries from Italy and Britain to the so-called. solid waste fuel – RDF and SRF.

Over the years, this waste has incinerated (utilized) in several TPPs in Bulgaria, including the case of TPP "Bobov Dol". The question is what kind and quantity of waste has burned by Bulgarian facilities, if the sender was the Italian mafia. The investigating authorities in the Republic of Bulgaria have revealed manipulation in the codes of the imported waste from Italy: 19-12-12 (non-existent) and 19-12-11 (https://www.svobodnaevropa.bg/a/30386546.html) (mixed household waste after mechanical treatment. Unsuitable for recycling and intended for incineration or disposal, according to "European waste catalog", European waste catalogue, https://www.eea.europa.eu/help/glossary/eea-glossary/european-waste-catalogue-1).

Conclusion

The transition to green economy can only take place if the pollution allowed in the processes of industrial processing from the recent past is turned into a full-scale resource. This resource must be intelligently managed and allocated not to cause such tendencies towards gray economy. This can be done by developing an innovative waste management system that is equally available to EU members and all other european countries. Disparities between countries and regions that evoke illegal interest on hazardous waste must to be resolved soon by common efforts. The Green deal and the circular economy have no chance of success before equalizing waste management capabilities across the European Union.

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Possible Solutions in Support of Succession and Business Transfer in the Regions

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Abstract: After the creation and growth of a business, transfer is the third crucial phase in its life cycle. Business transfers/successions are standard in the business life cycle as well as in the entrepreneur's life cycle. Succession is a process that may extend from three to six years, or longer depending on entrepreneur's age and on the successor's age. This happens once in a lifetime and that is why it is extremely important to do it in an optimal way with minimal shocks and losses. Therefore, this process must be supported by optimal measures not only at the company but also at the regional level. The aim was to explore possible solutions for support from the regions of Europe. The methods for research from the office and exchange and collection of good practices of organizations supporting the business were used. As a result, we created a collection of good practices and possible solutions to be transferred to Bulgaria. An action plan has been set up to change strategic documents at national level. The changes were included in the documents for the next planning period. High-value results were achieved at the national level. In conclusion – the transfer and inheritance of business are a less risky alternative for starting a business and a prerequisite for a sustainable business ecosystem.

Keywords: business succession, family companies, management solutions

1. Introduction

After the creation and growth of a business, transfer is the third crucial phase in its life cycle. Business transfers/succession are standard in both life cycle of the business and life cycle of the entrepreneur. Inheritance/succession is a process that can last from three to six years or more, de-pending on the age of the entrepreneur and the age of the heir/successor.

1.1. Why is business transfer/succession important?

A successful business transfer has an immediate positive impact on the national and EU economies. This happens once in a lifetime and that is why it is extremely important to do it in an optimal way with minimal dis-

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ruption and losses, therefore this process must be supported by optimal measures not only to companies but also at the regional level. Our aim was to explore possible solutions to support business transfer and succession in the regions of Europe. The methods for research from the office and exchange and collection of good practices of business support organizations were used. As a result, we have created a collection of good practices and possible solutions to be transferred to Bulgaria.

1.2. What is the problem?

Planning of heritage as a topic is at the centre of attention of the private sector more than 20 years in countries with long-standing democracies, but in Bulgaria, as well as in some post-socialist countries, this process was interrupted and now the country is in a period in which the time has come to make the first transfer of business from the owners-creators of business in the beginning of democracy, and their direct successors/heirs. The main problem is the broken tradition and the lack of experience and legislative framework for this. On the other hand, we are in a great position to take advantage of other people's experience and good practices.

One of the main reasons why succession planning is so important is that be-cause key employees retire or leave for other reasons, they bring with them practical knowledge of how to do their job, as well as institutional knowledge of the company. the organization.

Succession planning is a critical factor in a company's long-term success. If a key CEO resigns or if an unforeseen event removes senior management from their role, we need to be confident that the business will continue. In general, transfers of family businesses are often challenging and, in some cases, do not occur as planned as only 30% of family businesses survive in the second generation and many fail soon after the transfer, 12% survive in the third, and only about 3% work in the fourth generation and beyond. With the aging of the population in many countries, the volume of business transfers is expected to in-crease sharply.

Whether changes are planned or not, if there is no effective strategy for succession/transfer, business continuity can be compromised.

1.3. What are the current solutions/research of the problem at the moment?

So far, the main attention is paid to the study of the process of transfer/succession of business at the company level, much less at above company/regional level, and at the level of policies and strategic documents – such research is almost absent.

1.4. What are the best solutions?

There are no universal solutions. Each one should be adapted to the specifics of the environment. It is generally accepted that family involvement in business makes the family business unique, but the literature continues to encounter difficulties in defining the family business. This also creates difficulties in creating appropriate policies and strategic documents addressing this group.

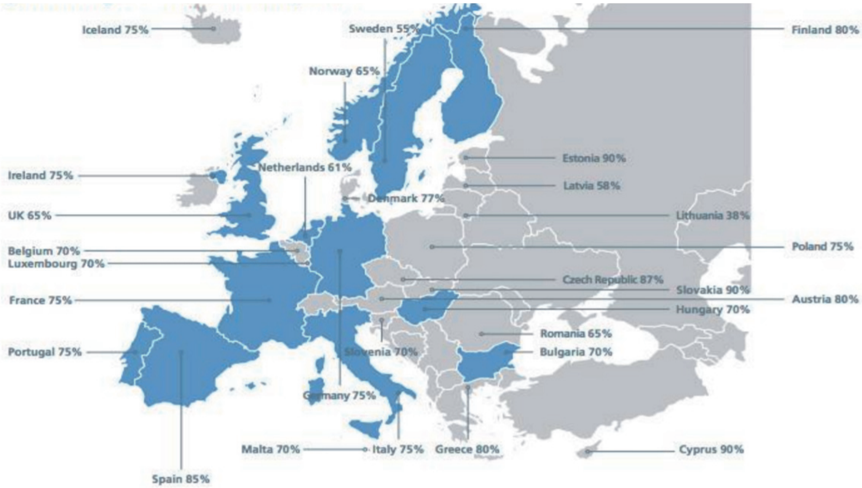
1.5. What have we achieved?

Based on the good practices from countries outside Bulgaria, we have selected and adapted three main tools to be implement-ed in our country. They were approved by the Ministry of Economy and will be tested in Bulgaria within a few years.

2. Possible solutions

Small and medium-sized enterprises are an extremely diverse category, which means that special efforts are needed to properly cover the various subgroups and especially small family and traditional enterprises. Many of the world's largest companies are also family-owned. The European Commission encourages the sup-port of small family and traditional businesses, as they are a key element in setting up new activities and generating income in areas with poor resources They bring added value to the regional development process, especially in less developed regions, as they have deep roots in the local economy, where they invest and contribute to maintaining of employment. The importance of watching in the long run is laid down from generation to generation and this is one of the many distinguishing features of the family business. It has also been proven to be a source of their endurance. Especially clearly this is seen in the pandemic COVID-19 the efforts of the old generation (historical memory) and the new generation (flexibility and progress) to meet the challenge. There is a prevailing trend that the COVID-19 pandemic is catalysing – the speed of the inheritance process has in-creased for many companies worldwide. This is due to a number of reasons, including the death of the founders and liquidity problems in the business.

__Figure 1:__ Family business in Europe (% of total companies)



Source: *(Instituto de la Empresa Familiar – IEF, 2020)*

In Europe, this unique category plays a vital role in the economy:

- Family business is an important part (on average 40-50% of all jobs) in European private employment.
- Family businesses reinvest profits responsibly, preferring equity instead of debt financing.
- Act as responsible owners because of their long-term strategy to the interests of stakeholders, including employees, customers, shareholders and local communities.
- Transmission of family values with a high sense of social responsibility.
- Special care for the local or region-al base.
- Natural incubators of entrepreneurial culture, they encourage the next generation of European entrepreneurs.
- Managers of social and economic capital from one generation to another.

The main advantages of family businesses are their long-term perspective, the specific values that form their unique organizational culture, and their commitment to the local community. Their unique culture is based on the values promoted by family stakeholders, such as a high degree of trust in the company and a high quality of services or products offered.

It is generally accepted that family involvement in business makes the family business unique, but the literature continues to encounter difficulties in defining the family business. This also creates difficulties in creating appropriate policies and strategic documents dealing with this group. The main focus is on family small and medium enterprises and less on large family businesses, for example. Adequate policies are needed to ensure that we give the next generation the best chance. To succeed, we need a strong legal and regulatory framework for these business transfers to happen.

Every year, about 450,000 family businesses, which employ about 2 million people, face this challenge. About 150,000 companies close down each year due to a failed succession settlement, leading to the loss of 600,000 jobs. What is needed:

- Greater emphasis and attention on business transfers by policy makers
- Tax and regulatory frameworks that do not put family businesses at a disadvantage when transferrin
- Accurate annual data on the transfer of the business situation in Europe
- Improved dissemination of best practices between Member States
- More public support for support, especially small and medium-sized, family businesses better prepare their transfers

For almost three years, we exchanged experiences and good practices with organizations from 8 regions (Germany, Denmark, Poland, Finland, Romania, Slovenia, Spain and Bulgaria) of the European Union, and how they deal with the challenges of business transfer. Each of them focused its efforts on the impact of various policy instruments – laws, strategies, regional plans and others, to optimize the environment in which the transfer and inheritance of business take place. We in Bulgaria focused on optimizing the National Strategy for Promotion of SMEs in Bulgaria 2014 – 2020.

What actions and tools did the organizations from the 8 regions choose to optimize their policy instruments?

2.1. Germany

The Action Plan (IHK-Projektgesellschaft mbH (2019) Action plan to support the transfer of business in the region of BRANDENBURG, [Online], Available: https://www.interregeurope.eu/stobregions/library/#) focuses on the Operational Program of the Land of Brandenburg for the European Social Fund (ESF) for the funding period 2014 – 2020. The

Brandenburg Action Plan consists of three actions (A). The Ministry of Economy, Labour and Energy of the Province of Brandenburg is responsible for the implementation and monitoring of all actions under this action plan. The Ministry of Economy and Energy is responsible for the implementation and monitoring of the third action.

A1: Development of a concept for a "Business Transfer Competence Center". It is designed as a one-stop shop for all aspects of business transfer.

A2: Regional succession clubs. With this approach, the successors are given the opportunity to exchange experiences with other future successors and to improve their knowledge and skills in a small closed group.

A3: Programme to increase the attention of SME owners to early consideration of the transfer and business succession. The programme is aimed at entrepreneurs aged 55 and over. The aim is to increase the sensitivity of business owners, to consider continuing their business earlier and to find an agreement on succession.

A4: Workshop for transfer, together with project iEER.

2.2. Denmark

The Action Plan (Business Development Center – South Denmark (2019) Action Plan for the Region of Southern Denmark, [Online], Available: https://www.interregeurope.eu/stobregions/library/#) focuses on the Decentralized Growth Strategy 2019, the program "Increased Competitiveness of SMEs", funded by the European Regional Fund and funds for the promotion of decentralized business.

A1: Awareness raising / program for owners-managers with potential for succession. Free one-stop-shop information, along with other traditional channels, to raise awareness.

A2: Succession screening and mentoring. The idea of the action is through screening to recruit SMEs with the greatest growth potential for individual succession. The concept is to create a strategy for successful transfer of the company through an individualized succession plan and to ensure the potential for growth to be realized after the succession. Mentoring by the in-dependent public business service to assist the owner-manager in his/her succession planning efforts. Private specialists and experts will be involved in solving specific problems and providing a professional succession plan.

A3: Voucher for consulting services. The idea is to help SME owner's amateur in the use of private specialists and experts in the field of succession. The concept is to offer 50% payment for private specialists and experts.

2.3. Poland

The Action Plan (Region of Malopolska (2019) Action plan to support the transfer of business in MAŁOPOLSKA region, [Online], Available: https://www.interregeurope.eu/stobregions/library/#) is directed towards the Regional Operational Programme of the Malopolska Region for the years 2014 – 2020.

A1: Direct introduction of procedures and processes related to strategic planning and implementation of continuity in the catalogue of consulting services provided under the sub-measure "Vouchers for consultations" of the Regional Operational Programme of the region of Lesser Poland 2014 – 2020

A2: Increasing access to knowledge and raising awareness about business transfer among entrepreneurs from the Małopolska region

A3: Network of the heirs of the Małopolska Region Increasing the level of readiness for continuity among the companies from the Małopolska region thanks to the organization of the pilot edition of the programme.

A4: Strengthen cooperation between institutions in the region in the field of promoting available inheritance instruments.

2.4. Finland

The Action Plan (Kainuun Etu Ltd. (2019) Action plan to support the transfer of business in region of KAINUU, FINLAND, [Online], Available: https://www.interregeurope.eu/stobregions/library/#) focuses on the Finnish Structural Funds Program: Sustainable Growth and Jobs 2014 – 2020. Only one action is planned earlier.

A1: Business transfer service platform.

2.5. Romania

The Action Plan (Ilfov City Council (2019) Action plan to support the transfer of business in region of Bucharest – Ilfov, [Online], Available:https://www.interregeurope.eu/stobregions/library/#) focuses on operational programs funded by the EU and the national budget.

A1: Promotion and raising awareness of the importance of business transfer in events organized and funded by Ilfov's council.

A2: Business transfer support, guidance and advice.

A3: Online platform for connecting contacts for business transfer.

2.6. Slovenia

The Action Plan (BSC Kranj (2019) Action plan to support the transfer of business in region of GORENJSKA, [Online], Available: https://www.interregeurope.eu/stobregions/library/#) focuses on the Operational Program for the Implementation of the EU Cohesion Policy 2014 – 2020 and the Regional Development Plan of the Gorenjska Region 2014 – 2020.

A1: Raising awareness

A1.1 Continuity map

A1.2 Emergency planning

A2: Connection

A2.1 Network of succession consultants

A3: Support services

A3.1 Seminars for preparation of succession plan

A4: Financing

A4.1 Financial product for business transfer.

2.7. Spain

The Action Plan (Chamber of Commerce Seville (2019) Action plan to support the transfer of business in region of ANDALUCIA, [Online], Available: https://www.interregeurope.eu/stobregions/library/#) targets Andalusia's ERDF Operational Programme 2014 – 2020.

A1: Creating an integrated framework for business succession and transfer in Andalusia. This action aims to ensure the coherence and long-term sustainability of the policy approach and measures to promote and facilitate business continuity and transfer in Andalusia.

A2: Development and dissemination of information, awareness-raising materials and technical support.

A3: Training of staff to provide consulting services in business transfer

A4: Special programme to support the transfer of business in rural areas.

2.8. Bulgaria

Taking into account all types of inheritance and business transfer – within the family (from father and/or mother to son and/or daughter), outside the family – to investors/employees, as well as mixed decisions – transfer only to management, but not to ownership, as well as by analysing the good practices and action plans of colleagues from 8 regions of the European Union, we have selected and adapted three main instruments to be implemented in our country. They were approved by the Ministry of Economy and will be tested in Bulgaria within a few years.

In the course of the research, we found the following problems:

- There is no specific definition and study of the family business, including a definition of “family business”
- There are no specific support tools for family business and business transfer
- There are no organizations to support business transfer

Regarding the National Strategy for Promotion of SMEs in Bulgaria 2014 – 2020, given that “small and medium-sized enterprises” are an extremely diverse cate-gory, we recommended to define a sub-group “Family Enterprises”. The terms “family business” and “family companies” are used interchangeably.

We have developed the following activities in our Action plan (RDA BSC SMEs – Plovdiv (2019) Action plan to support the transfer of business in region of Bulgaria, NUTS3 Plovdiv region, [Online], Available: https://www.interregeurope.eu/stobregions/library/#):

A1: Local network for managers-owners (successors): In Bulgaria more than one third of the current business owners will reach retirement age in the next ten years and very often there is no one within the family who can be transfer business, nor is there much practice of transferring business outside the family circle. The pilot local network is for family business owners who have reached the stage of transferring the company to the next generation or transferring the business to other companies; looking for opportunities to transfer business to new managers or stakeholders.

A2: Regional Business Transfer Platform (RBTP): This action focuses on business transfer and succession, a topic often overlooked and not recognized as a priority in industrial policies and entrepreneurship. On the one hand, the RBTP will provide access to useful documents as well as a training platform. On the other hand, it will provide succession and business transfer services to family businesses in which business management is “ripe” for the use of such services. The RBTP will also work as a tool for downloading and disseminating. The RBTP will lead to overall coordination of business transfer support, will help increase the lack of consulting and business transfer support services, including improving the quality of micro-enterprise transfer arrangements. The RBTP service is planned to serve all companies located in the region.

A3: Financial instruments/mentoring schemes/Certification. The purpose of the activity proposal is to provide financial support through a voucher scheme to SMEs and organizations based in Bulgaria who want to be prepared for the process of succession/transfer of business through consulting services as a financial instrument. Vouchers can be used to purchase specialized consulting services (including succession and transfer) that are not related to the company's normal operating expenses (eg routine tax consulting services, regular legal services or advertising). The councils should cover, inter alia, procedures and processes related to the strategic planning and implementation of the succession, with special emphasis on areas that are crucial for ensuring further activity and stability of the company's work.

3. Conclusion

How did the proposed actions plan to change/improve the strategy/policy?

A1: The local network of owner (successor) managers will contribute to creating and maintaining an environment in which entrepreneurs can thrive and entrepreneurship is rewarded: care for future entrepreneurs, in particular by promoting entrepreneurial interest and talent. The local network for owners-managers (recipients) will contribute to the transfer of business measures aimed at the smooth implementation of business transfer and achieving a more positive effect on the development of sustainable market competitiveness of Bulgarian SMEs.

A2: The Regional Business Transfer Platform will contribute to creating and maintaining an environment in which entrepreneurs can thrive and entrepreneurship is rewarded: care for future entrepreneurs, in particular by promoting entrepreneurial interest and talent. The regional platform for business transfer will contribute to the transfer of business measures aimed at the smooth implementation of business transfer and will achieve a positive effect on the development of sustainable market competitiveness of Bulgarian SMEs.

A3: Financial Instrument, Mentoring and Certification Schemes will contribute to creating and maintaining an environment in which entrepreneurs can thrive and entrepreneurship is rewarded: caring for future entrepreneurs, in particular by promoting entrepreneurial interest and talent. The financial instrument, mentoring and certification schemes will contribute to the transfer of business measures aimed at the smooth implementation of business transfer and achieving a positive effect on the development of sustainable market competitiveness of Bulgarian SMEs.

The situation in Bulgaria, as of March 13, 2020, is subject to measures to combat the COVID19 pandemic with a number of restrictions. In 2020 we were engaged in the development of plans and programmes for the next programming period 2021 – 2027, such as “National Plan for Reconstruction and Sustainability of the Republic of Bulgaria”, “National Strategy for SMEs 2021 – 2027”. We participated in workshops and discussions for the development of the National Strategy for SMEs 2021 – 2027.

As a result

The family business is included in the National Strategy for SMEs 2021-2027 based on our participation. The definition of family business is adopted in the national strategy 2021 – 2027. The draft technical report includes an in-depth analysis of SMEs in Bulgaria and the relevant measures.

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International Financial Institutions: an Opportunity to Prompt the Green Transition in Bulgaria

Elitsa Kantardzhieva[1]

Abstract: The European Union's ambitious goals by 2050 for Europe to become the world's first climate-neutral block is a great challenge, but also a great opportunity. It is crucial to coordinate action in the various sectors and institutions in the transition towards a Green economy. This report examines the Green Transition in Bulgaria by key indicators in several sectors, funded by international financial institutions(IFI). The possibility of the IFIs to accelerate the Green Transition in Bulgaria was assessed. The considered indicators and instruments examine the key areas of the Green Transition and the achievement of the set climate goals. The period under consideration is Bulgaria's membership in the European Union (EU). The comparison of indicators is based on EU averages. Bulgaria's participation in the periodic climate forums is active. The implementation of policies on the EU Budget, Member States and private actors will play an important role in funding the European Green Pact. The EU budget alone will not be enough to tackle climate change or meet the huge global investment needs. Member States and private actors will have to provide the necessary scale. Bulgaria's participation in international financial institutions is another tool that can be applied by the public and private sectors to make the transition smoother.

Keywords: Green transition, International financial institutions, climate policies, policy funding, correlations

Introduction

Climate challenges in Europe and Central Asia are ingrained. The region is home to 10 of the world's 20 most carbon-intensive economies. Meanwhile, natural resources – air, water and forests – are being depleted at unsustainable rates. 97% of europeans are exposed to 0_3 concentration above the World Health Organization recommendations (European Environment Agency, Eurobarometer).

There are five main pollution sources – fossil fuels; deforestation; increasing livestock farming; fertilisers containing nitrogen and fluorinated gases.

Heavy rain and other extreme weather events are becoming more frequent. This can lead to floods and decreasing water quality, but also de-

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creasing availability of water resources in some regions. Some of the consequences for Europe in Southern and Central Europe are seeing more frequent heat waves, forest fires and droughts. The Mediterranean area is becoming drier, making it even more vulnerable to drought and wildfires; Northern Europe is getting significantly wetter, and winter floods could become common. Urban areas, where 4 out of 5 europeans now live, are exposed to heat waves, flooding or rising sea levels, but are often ill-equipped for adapting to climate change (Climate change consequences, European Commission https://ec.europa.eu/clima/climate-change/climate-change-consequences_en).

Climate change is already having an impact on health. Risks for human health has been an increase in the number of heat-related deaths in some regions and a decrease in cold-related deaths in others. We are already seeing changes in the distribution of some water-borne illnesses and disease vectors. Globally, the last seven years have been the hottest on record and the concentration of heat-trapping carbon dioxide in the atmosphere spiked to a record high recently, 2020 have been the hottest year in Europe. Rising temperatures pose a fundamental threat to growth, stability, and poverty reduction, which is why climate change is not just an environmental problem, it is an economic one. All that effects cause costs for society and economy. Damage to property and infrastructure and to human health imposes heavy costs on society and the economy. In the last 40 years in the EU27 weather and climate-related events exceeded and caused direct economic losses of more than €419 billion. The overall cost is the highest for Germany, Italy and France. Sectors that rely strongly on certain temperatures and precipitation levels such as agriculture, forestry, energy and tourism are particularly affected (Climate change consequences, European Commission https://ec.europa.eu/clima/climate-change/climate-change-consequences_en).

The reality is stark and the action needed is urgent. Governments set the national climate strategies and have an important role to play as they hold the national purse strings and can wield a variety of fiscal policies and instruments to implement and accelerate the transition to low-carbon development while protecting the well-being of future generations. Carbon taxes, reductions in fossil fuel subsidies, investments in green energy and climate budgeting strategies are beneficial for growth, jobs, tax revenues, and protecting the planet. There isn't an easy way for any region or industry as the economies are connected globally. The biggest economies are often exporting carbon emissions as they are outsourcing their productions abroad in countries as China, Bangladesh, Indonesia, etc. There is no one-size-fits-all approach to the green transition, as all countries in the region must manage different economic and social contexts.

The first task of the study is to present the dynamics of the main indicators describing the Green Transition in Bulgaria through a descriptive analysis. Correlation analysis examines the relationships and dependencies of the used indicators. The second task is to indicate the IFI's policies and instruments for promoting the Green Transition on the main thematic indicators. The third goal is to present conclusions and to indicate possible correlations between the indicators and find solutions for a smoother convergence transition to a Green economy in Bulgaria.

International financial institutions (IFI)

The role of IFIs in the Green Transition is to assist countries in priority regions in the transition towards a Green Economy. Their policies 100% cover the priorities of the Paris Agreement. Indirectly support the Transition with policies and measures and in all the projects they are implementing in their portfolio.

Bulgaria is a member state in several IFIs. They all have different agenda but are united about the necessity of implementing rapid actions against the climate change. This report will look at all of them and their policies in climate change, also what projects are implementing in Bulgaria in the period after entering the EU – 2007 – 2021.

Table 1: *Compare of policies in Green transition of IFIs*

World Bank Group (WBG)	European bank for recovery and development (EBRD)
World Bank Group (WBG) have developed Climate Change Action Plan corresponding to the Paris Agreement and its 5-year action cycle. The WBG is committed to aligning its financing flows with the objectives of the Paris Agreement. They define alignment as providing support to clients that is consistent with pathways toward low-carbon and climate-resilient development. World bank plans to align all new operations by July 1, 2023, the start of fiscal year 2024. For IFC and MIGA, 85 percent of Board-approved real sector operations will be aligned starting July 1, 2023, and 100 percent two years later, starting July 1, 2025. To achieve this, both institutions will begin aligning 100 percent of their projects at the concept stage well ahead of July 1, 2023. Once a methodology for financial institutions and funds is finalized among multilateral development banks (MDBs), a similar approach will be taken for this business as well. The Paris Agreement recognizes that countries have different circumstances and gives countries latitude in the pathways they choose to achieve the overarching goal of low-carbon, resilient development. Their support to countries and private sector clients similarly respects individual country needs and circumstances in integrating climate and development outcomes and shaping green, resilient, and inclusive pathways. The WBG will produce a Paris alignment implementation plan with clear timelines and deliverables. There are two financial frameworks from the first period 2016 – 2020 and the second one from 2021 – 2025 called Climate Change Action Plan.	The EBRD is fully dedicated to supporting the economies in which it invests to meet their goals and commitments under the Paris Agreement . In July 2020, the EBRD set out its GET Approach 2021 – 2025 building on its work supporting a Green Economy Transition in the EBRD regions. As part of GET 2.1 the EBRD committed to "*aligning its activities with the principles of international climate agreements, including principally the Paris Agreement"*. The EBRD's approach to aligning its activities with the Paris Agreement ("Paris alignment") is an integral part of the Bank's activities to support the climate action of the economies in which it invests. This support is delivered through a combination of policy and investment activities. The EBRD has worked with other Multilateral Development Banks (MDBs) to develop an operational framework for Paris alignment. This joint MDB approach is based on six building blocks, seen as the core areas for alignment with the objectives of the Paris Agreement: • alignment with mitigation goals; • adaptation and climate-resilient operations; • accelerated contribution to the transition through climate finance; • strategy, engagement and policy development; • reporting; • and alignment of internal activities (for example, administration, procurement and treasury).

European investment bank (EIB)	Black Sea Trade and Development Bank (BSTB)
As the EU bank, EIB mandate consists in supporting EU policy objectives, which include promoting innovation and skills, access to finance for small and medium-sized businesses, strategic infrastructure and climate action. In 2015, the EIB's climate action lending target as announced at the UN climate conference in Paris was to increase the annual share and volume of its own financing in developing countries to 35% and $100 billion, respectively, by 2020. From 2015 to 2019, the Bank provided more than €96 billion to climate action projects, making the EIB one of the largest climate financiers globally. In 2018 and 2019, the share of climate action lending in developing countries was well above 35%. Therefore, the EIB is well on track to fulfil both commitments by the end of 2020. Moreover, since 2015 the EIB has consistently exceeded its global commitment to dedicate at least 25% of its overall portfolio to climate action annually. The Bank has therefore developed a number of innovative financial tools and mechanisms which aim at catalysing and mobilising private finance for low-carbon and adaptation projects. Some of these are blending instruments, combining grant and loan finance to improve financing conditions (optimised allocation of risk and/or reduced cost of capital). These products include equity funds, layered risk funds and funds of funds. In addition, the EIB has developed joint instruments with the European Commission and other donors, for example in the area of energy efficiency or for conservation of natural capital and adaptation measures. The EIB pioneered the Green Bond market in 2007 by issuing its first Climate Awareness Bond (CAB). CABs historically had their pro-	BSTDB, as a Multilateral Development Bank (MDB), has the mandate to promote economic cooperation and development in the Black Sea Region. It provides financing solutions to private and the public sector actors and creates value for its shareholders. Reasons for this include historic underinvestment, outdated practices, and aging infrastructure; as a result, they are less able to withstand the effects of the changing climate and therefore are increasingly vulnerable. Over the years BSTDB addressed this issue by supporting operations focused on reduction of emissions, promoting renewable energy generation, energy efficiency,cleaner production, modernization of existing, and building of new robust infrastructure, as well as more sustainable transport systems. Since 2011 the green financing, including operations with climate co-benefits, has comprised on average 20 percent of the Bank's annual new commitments. The goal of the BSTDB Climate Change Strategy is to notably increase the support to its shareholders in limiting climate change and coping more effectively with its impacts, as well as better aligning its financing to their climate priorities. In order to achieve this strategic goal, the Bank commits to meet in the next ten years the following three key objectives: • Gradually reduce the net emissions in the portfolio by setting periodic emission targets aiming at achieving zero net emissions by 2050; • Mobilize more capital for shifting economies to low-carbon and climate resilient models and increase gradually to at least 30 percent the share of its funding in the next ten years for climate mitigation and adaptation operations, and operations with climate co-benefits; and • Build capacity

ceeds earmarked for EIB lending projects in the fields of renewable energy and energy efficiency and this was widened to include low-carbon transport and innovative 10 EIB Climate Strategy low-carbon technologies.	to better serve the Member States public and private sector actors in mitigation and adaptation efforts, either internally or by targeted outsourcing.
Council of Europe Development Bank (CEDB)	**International Investment Bank (IIB)**
The Council of Europe Development Bank (CEB) has adopted five voluntary Principles for Mainstreaming Climate Action, a global initiative of leading financial institutions around the world. he Principles, agreed on the sidelines on the COP 21 climate talks in Paris, highlight practical, operational approaches to integrate climate into the core investments and advisory functions of a financial institution. The landmark initiative was undertaken by public and private financial institutions, from both developing and developed countries, with combined assets of more than $11 trillion.	International Investment Bank is a multilateral development institution that aims to facilitate connectivity and integration between the economies of the Bank's member states in order to ensure sustainable and inclusive growth and the competitiveness of national economies. IIB is governed in its activities by the principles of corporate social responsibility that enables the Bank to fulfill its objectives of an international development institution in an efficient manner. Financing socially-focused, energy and resource-efficient projects as a matter of priority, IIB contributes to the Goals of Sustainable Development that is in compliance with national interests of the member states and contributes to improving the life quality of their citizens. Activities of the Bank are intended to promote better environment and soften consequences of global climate changes. Goals, objectives and priority activities of IIB in the Sustainable Development area are defined by the Policy on Environmental and Social Sustainability of IIB approved by the Board of Directors.

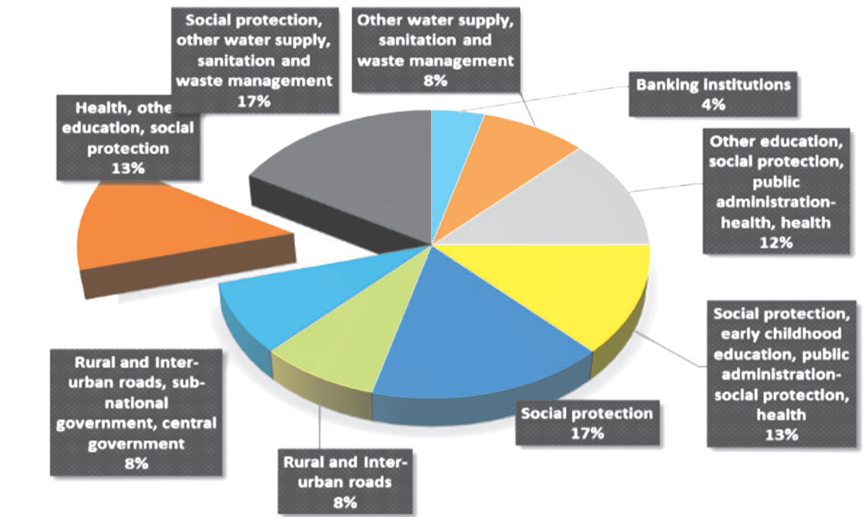
Sources: *The World Bank Environmental and Social Framework, Guidance note Methodology to determine the Paris Agreement alignment of directly financed EBRD investments, June 2021. EIB Climate Strategy, BSTDB Climate Change Strategy, March 2021; Policy on environmental and social sustainability of International Investment Bank.*

Implemented projects 2007 – 2021 by sectors in Bulgaria

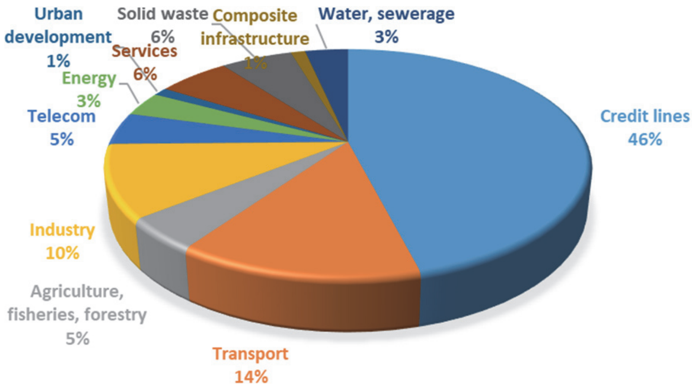
For the period 2007 - 2021, the total utilized and implemented projects financed by IFIs in Bulgaria are 182 and amount to a total of 7 251 million euros and 644 million US dollars. The main part of these investments in financial in the form of credit lines. This can be met with the crisis of 2008 and the capital needed to finance the private sector. In terms of public and privately funded projects, the private ones with 72% funded projects from all IFIs for the period 2007 - 2021 definitely lead. With the largest share of the funded projects in the field of environmental protection, water, electricity urban transport and energy efficiency are European Bank for Recovery and Development, the Council of Europe Development Bank and the European Investment Bank have financed the most projects from their portfolio, while the International Investment Bank have financed the least projects supporting the Green transition. Since the entry into force of the Paris Agreement, the only IFIs that have financed climate projects are EBRD, EIB and BSTDB.

Figure 1: *IFIs investment projects in Bulgaria by sectors*

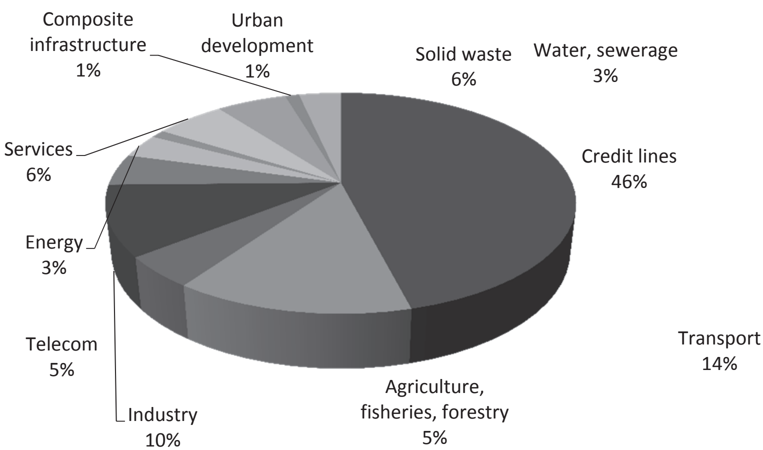
World Bank Group



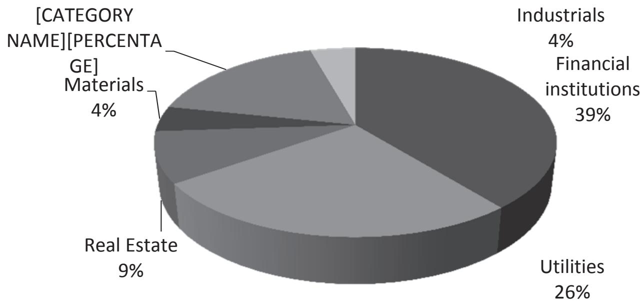
European bank for recovery and development



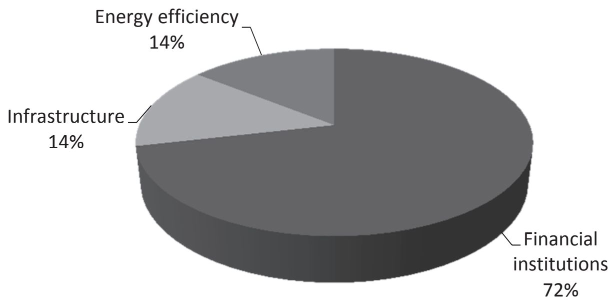
European investment bank



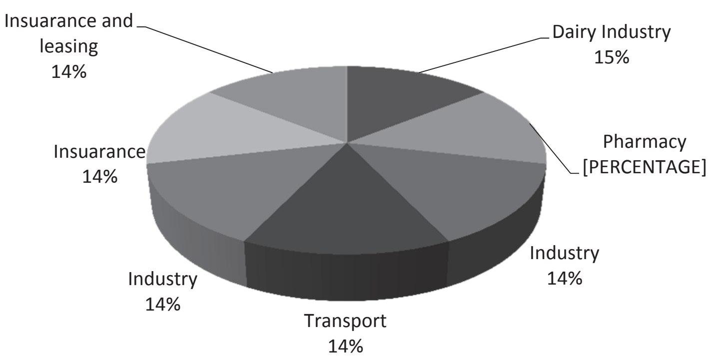
Black Sea Trade and Development Bank



Council of Europe Development Bank



International Investment Bank (IIB)

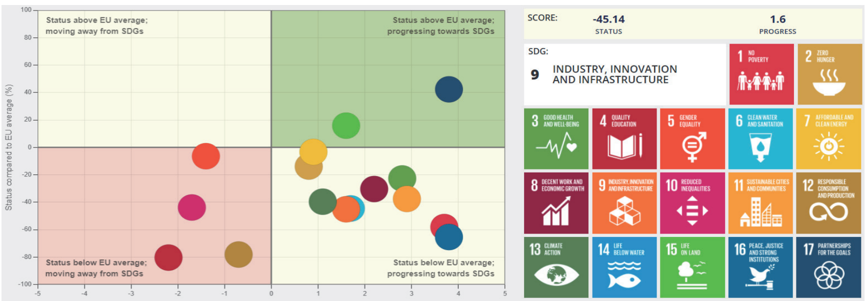


Source: *Own calculations*

EU28 and Bulgaria in their transition towards Green economy
Certain sustainable development goals score of Bulgaria

The 17 Sustainable Development Goals (SDGs) and their related 169 targets, which are at the heart of the UN's 2030 Agenda for Sustainable Development, provide a new policy framework worldwide towards ending all forms of poverty, fighting inequalities and tackling climate change, while ensuring that no one is left behind (United nations, Sustainable Development Goals https://sdgs.un.org/goals).

Figure 2: *SDGs Bulgaria scores*



Source: *Eurostat*

In 4/17 indicators of SDGs Bulgaria is moving away from the EU average in the last 5 years – Quality education, Responsible consumption and production, Reduced inequalities. In only 2/17 indicators Bulgaria's results are above the average for the EU – Partnerships for the goals and Life on land. In all other 11 indicators Bulgaria's status is bellow EU average, progressing towards SDGs.

The assessment method considers whether an indicator has moved towards or away from the sustainable development objective, as well as the speed of this movement. The method focuses on developments over time and not on the 'sustainability' of the status (EU SDG monitoring report 2021 methodology).

Methodology

The purpose of this report is to present the possibilities for building a more effective economic policy aimed at the Green transition through the role of IFIs. The current methodology adopts economic policy in its role of based on economic analysis weighing the alternatives of choice in a world of limitation. This includes not only the social, economic and public policies pursued within a country, but also the policies of supranational organizations, which emphasizes the international nature of economic analysis. It is the economic analysis underlying the present study that determines the optimal behavior of entities at the micro and macro level, measuring the economic and social costs, revenues and benefits of any alternative solution to increase the welfare of the individual, society or societies at the supranational level as a whole, sustainable development and the Green economy.

The thesis of this report is that the Green transition in Bulgaria is not implementing to its full potential. IFIs instruments will fully support the implementation of the Green transition policies in Bulgaria.

This report uses the tools and methods of economic statistics as a part of statistics, which examines the economic system through its indicators describing its state and dynamics. It uses various tools and methods of analysis such as time analysis, analysis of conclusions, descriptive analysis and correlation analysis. It is investigated by time series analysis, time analysis. Climate change in Bulgaria and the EU28 is studied. The Eurostat survey methodology is used. The time analysis is in the period 2007 – 2020.

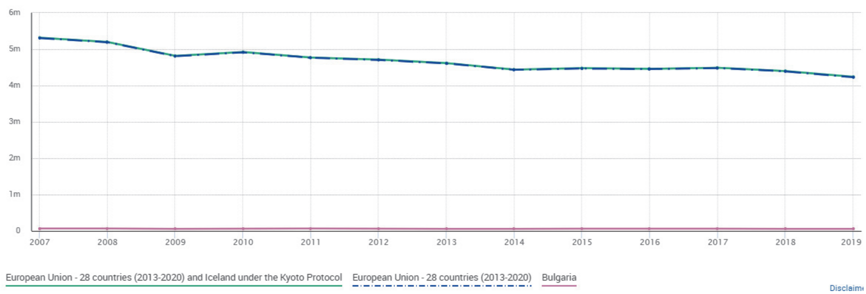
The 4 key indicators that will be reviewed on annual time frequency are:

- Greenhouse gas emissions by source sector – greenhouse gases (CO_2, N_2O in CO_2 equivalent, CH_4 in CO_2 equivalent, HFC in CO_2 equivalent, PFC in CO_2 equivalent, SF_6 in CO_2 equivalent, NF_3 in CO_2 equivalent. Source sectors for GGHEs are total (excluding LULUCF and memo items, including international aviation. Unit of measure is thousand tons (Eurostat methodology).
- Environmental protection investments of total economy – presents investments of total economy (general governments and corporations) to provide environmental protection services (e.g. waste and wastewater management, decontamination of soil). Investments undertaken by corporations to manage their own environmental pressures are included. Unit of measure is percentage of gross domestic product (Eurostat methodology).
- Resource productivity – this dataset provides ratios of gross domestic product (GDP) over domestic material consumption (DMC) in unit of measure euro per kilogram (Eurostat metadata https://ec.europa.eu/eurostat/cache/metadata/en/env_ac_mfa_sims.htm).
- Environmental tax revenue – the indicator is presented as a proportion of environmental tax revenues in total revenues from all taxes and social contributions in unit of measure percentage. This evidences the different taxation splits that Member States have

between environment and other factors such as labour and capital (Eurostat methodology).

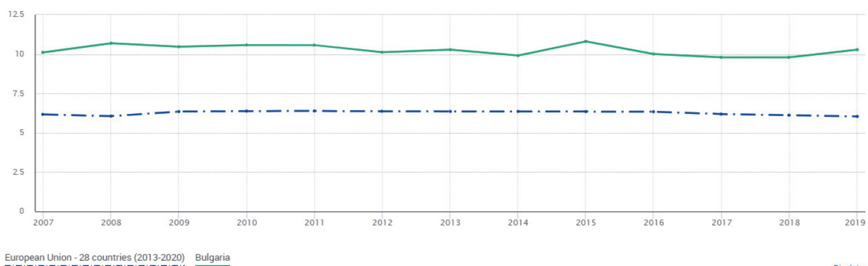
A comparison is made between the key indicators presented below for the average values for the EU28 and for Bulgaria, which is visible from the graphs. The drastically lower values of carbon emissions on average for the EU28 and Bulgaria can be easily explained, as those for the EU28 are calculated for the EU as a whole (Fig.4). Environmental tax revenues in Bulgaria are way above these in EU28 in average (fig.5). Environmental protection investments in Bulgaria are around the average for EU28, except these ones in the period 2012 – 2015 which are explained with national investments shown below in fig.8. The indicator Resource productivity average for the EU28 and Bulgaria shows that in Bulgaria is on very low levels from the average in EU28 (fig. 7).

Figure 3: *Greenhouse gas emissions by source sector for EU28 and Bulgaria (in red)*



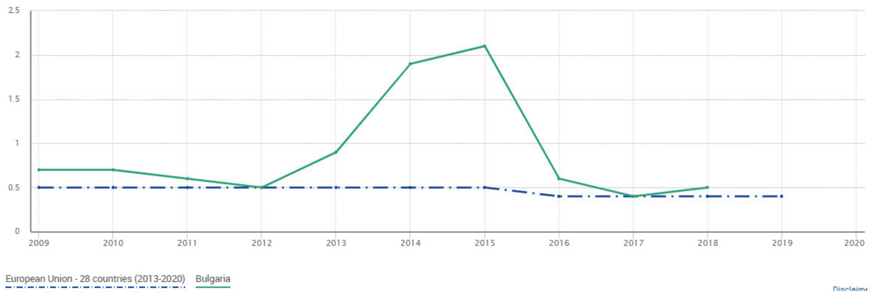
Source: *European Environment Agency EEA*

Figure 4: *Environmental tax revenues for EU28 and Bulgaria (in green)*



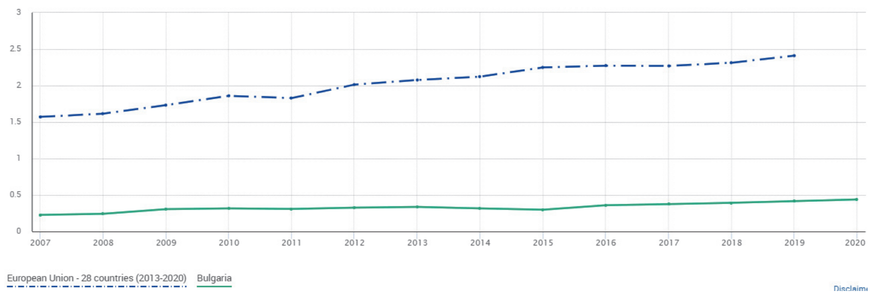
Source: *Eurostat*

Figure 5: Environmental protection investments EU28 and Bulgaria (in green)



Source: *Eurostat*

Figure 6: Resource productivity EU28 total economy EU28 and Bulgaria (in green)



Source: *Eurostat*

Analysis Results

Correlations

The studied relationship between the four indicators GHGE by source sector, Resource productivity, Environmental protection investments and Environmental tax revenues for EU28 average and Bulgaria (BG) for the period 2007 – 2021 shows the following correlations:

- There is a very strong negative statistically significant relationship (correlation coefficient –0,956, sigma = 0,0) between GHGE for EU28 and Resource productivity for EU28.
- There is a strong negative statistically significant relationship (correlation coefficient 0,632, sigma = 0,20) between GHGEs for BG and Resource productivity BG.

- There is strong negative statistically significant correlation (correlation coefficient –0,754, sigma = 0,07) between Resource productivity EU28 and Environmental protection investments for EU28, but there isn't any correlation with Environmental protection investments for BG.
- There is very strong positive statistically significant correlation (correlation coefficient 0,875, sigma = 0,00) between Resource productivity BG and with Resource productivity EU28.
- There is strong positive statistically significant correlation (correlation coefficient 0,688, sigma = 0,19) between Environmental protection investments for EU28 and GHGE for EU28 and very strong negative statistically significant correlation between Environmental protection investments for EU28 and Resource productivity for EU28 (correlation coefficient –0,754, sigma = 0,07) and BG (correlation coefficient –0,906, sigma = 0,00).
- There is very strong positive statistically significant correlation (correlation coefficient –0,809, sigma = 0,03) between Environmental protection investments for EU28 and Environmental tax revenues for EU28.
- There is strong positive statistically significant correlation (correlation coefficient 0,618, sigma = 0,43) between Environmental tax revenues for BG and Environmental protection investments for EU28.

It is worth paying more attention to the link between resource productivity and GHGE in the EU28 and BG, which makes perfect sense – the more inefficient a production or economy is, the more carbon it will emit.

Table 2: Correlations

Correlations

		Greenhouse gas emissions by source sector - European Union - 28 countries (2013-2020) and Iceland under the Kyoto Protocol	Greenhouse gas emissions by source sector - EU28	Greenhouse gas emissions by source sector - Bulgaria	Resource productivity - EU28	Resource productivity - Bulgaria	Environmental protection investments of total economy - EU28	Environmental protection investments of total economy - Bulgaria	Environmental tax revenues - EU28	Environmental tax revenues - Bulgaria
Greenhouse gas emissions by source sector - European Union - 28 countries (2013-2020) and Iceland under the Kyoto Protocol	Pearson Correlation	1	1,000**	,725**	-,955**	-,879**	,688*	-,334	-,041	,378
	Sig. (2-tailed)		,000	,005	,000	,000	,019	,346	,894	,203
	N	13	13	13	13	13	11	10	13	13
Greenhouse gas emissions by source sector - EU28	Pearson Correlation	1,000**	1	,724**	-,956**	-,880**	,688*	-,333	-,040	,379
	Sig. (2-tailed)	,000		,005	,000	,000	,019	,347	,897	,202
	N	13	13	13	13	13	11	10	13	13
Greenhouse gas emissions by source sector - Bulgaria	Pearson Correlation	,725**	,724**	1	-,632*	-,723**	,170	-,048	-,184	,282
	Sig. (2-tailed)	,005	,005		,020	,005	,617	,894	,548	,350
	N	13	13	13	13	13	11	10	13	13
Resource productivity - EU28	Pearson Correlation	-,955**	-,956**	-,632*	1	,875**	-,754**	,189	-,085	-,431
	Sig. (2-tailed)	,000	,000	,020		,000	,007	,602	,782	,142
	N	13	13	13	13	13	11	10	13	13
Resource productivity - Bulgaria	Pearson Correlation	-,879**	-,880**	-,723**	,875**	1	-,906**	-,536	-,142	-,483
	Sig. (2-tailed)	,000	,000	,005	,000		,000	,110	,644	,094
	N	13	13	13	13	13	11	10	13	13
Environmental protection investments of total economy - EU28	Pearson Correlation	,688*	,688*	,170	-,754**	-,906**	1	,447	,809**	,618*
	Sig. (2-tailed)	,019	,019	,617	,007	,000		,196	,003	,043
	N	11	11	11	11	11	11	10	11	11
Environmental protection investments of total economy - Bulgaria	Pearson Correlation	-,334	-,333	-,048	,189	-,536	,447	1	,319	,335
	Sig. (2-tailed)	,346	,347	,894	,602	,110	,196		,369	,345
	N	10	10	10	10	10	10	10	10	10
Environmental tax revenues - EU28	Pearson Correlation	-,041	-,040	-,184	-,085	-,142	,809**	,319	1	,184
	Sig. (2-tailed)	,894	,897	,548	,782	,644	,003	,369		,548
	N	13	13	13	13	13	11	10	13	13
Environmental tax revenues - Bulgaria	Pearson Correlation	,378	,379	,282	-,431	-,483	,618*	,335	,184	1
	Sig. (2-tailed)	,203	,202	,350	,142	,094	,043	,345	,548	
	N	13	13	13	13	13	11	10	13	13

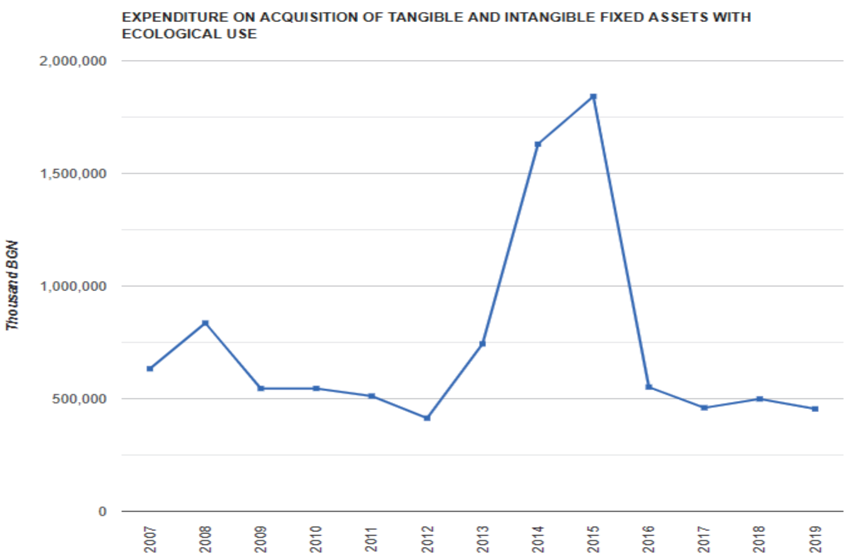
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: *Eurostat data, own calculations*

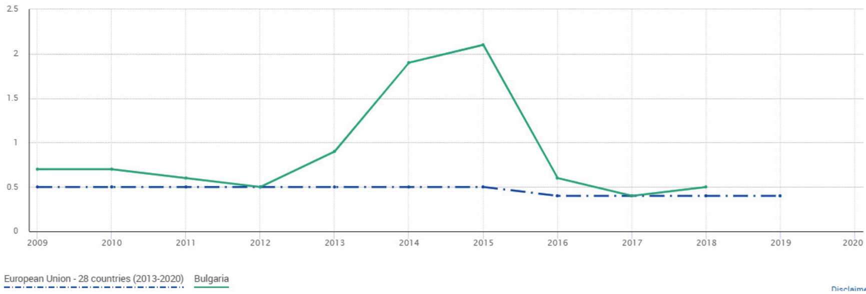
The correlation between Resource productivity of the EU28 and Environmental protection investments for the EU28 is interesting to be reviewed. The need for investments in environmental protection is lower the higher the productivity of resources in the EU28 – this can be a confirmation that when the use of the resources is optimal there are no prevention costs. But such a significant correlation between resource productivity and Environmental protection investments for BG does not exist. We can see a short-term trend with increased growth of Environmental protection investments for BG in the period 2012 – 2015 on the chart. This trend can be further studied and the reasons for it can be sought in the implementation of European and national projects in the field of environmental protection in two programming periods 2007 – 2013 and 2014 – 2020, which would be the subject of a deeper study. There is a significant increase of 22,45% in Expenditures for acquisition of fixed assets and Intangible assets with ecological purpose in Bulgaria according to National statistical institute (NSI) data from 2012 compared to 2015 and the sharp decline of 29,95% in 2016 compared to 2015, coincide exactly with the Environmental indicator protection investments of total economy in Bulgaria.

Figure 7: *Expenditure on acquisition of tangible investments and intangible fixed assets with ecological use*



Source: *NSI*

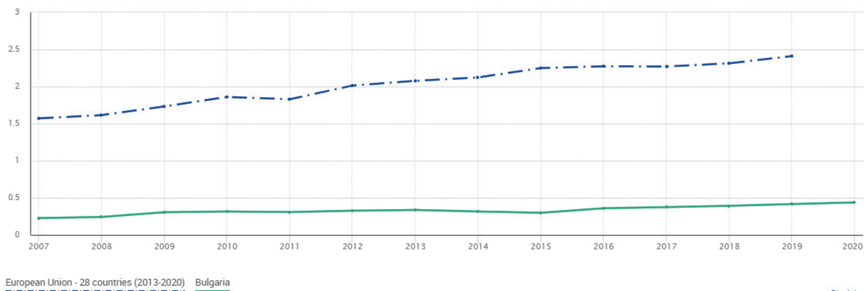
Figure 8: Environmental protection of total economy EU28 and Bulgaria



Source: *Eurostat (Bulgaria is in green)*

Statistically positive relationship between Resource productivity BG and with Resource productivity EU28 shows a positive trend of development and striving to go in the same direction with the EU in resource productivity, which is evident from the graph, but is far from the EU average and is only 17. Which can be seen from the table with descriptive statistics. While resource productivity in the EU fluctuates in the range of 0,84, in Bulgaria it fluctuates barely in the range of 0,19.

Figure 9: Resource productivity EU28 and Bulgaria

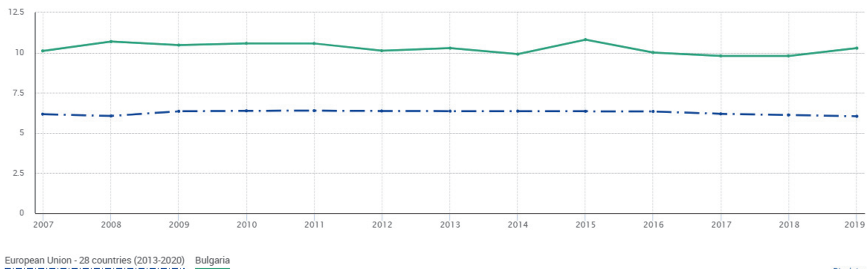


Source: *Eurostat (Bulgaria is in green)*

There is a strong positive statistically significant correlation between Environmental protection investments for EU28 and GHGE for EU28. As we know, every action taken also affects the environment and whether those to its protection and to what extent also contribute to the increase of GHGE is the subject of future research in the field.

There is very strong positive statistically significant correlation between Environmental protection investments for EU28 and Environmental tax revenues for EU28 which is very logical. Every single investment in environmental protection aim should meet its funding. The higher and more Environmental tax revenues are, the more investments could potentially can be made. In Bulgaria there is a gap between the draining investments in Environmental protection investments of total economy with the higher than EU28 average Environmental tax revenues. The more sources, the greener transition, but according to the SDGs indicators, we are far from the EU average for the 11/17 indicators Bulgaria's status is far below EU average, progressing towards SDGs (figure 2).

Figure 10: *Environmental tax revenues for EU28 and BG*



Source: *Eurostat (Bulgaria is in green)*

There is very strong positive statistically significant correlation between Environmental tax revenues for BG and Environmental protection investments for EU28 which can be considered in the variety of economic factors influencing both nationally and internationally leads to less definite results but nevertheless suggests possible dependencies and refers to future further research.

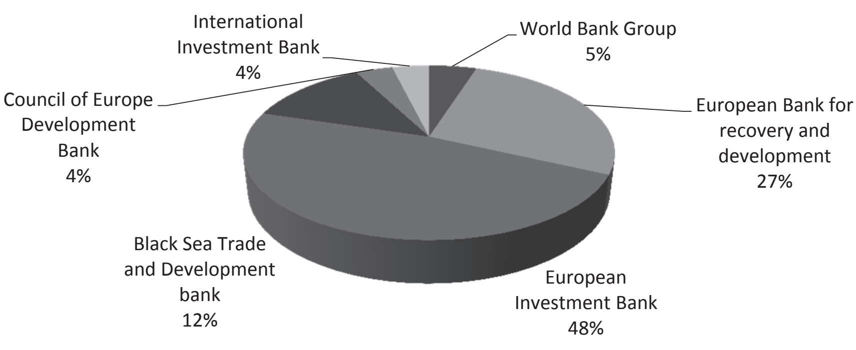
Summary

By 2021, Bulgaria meets a small part of the SDGs criteria for Green Transition in the EU, but in many of them we are significantly below the EU average with a convergence trend. The new EU funding program period is another opportunity to support the Green Transition.

International financial institutions have developed policies that fully cover those of the Paris Agreement on Climate Change and provide the necessary financial instruments to facilitate the transition to a Green economy. The share of loans in the private MFI sector in Bulgaria is 72%. The total disbursed and completed projects by IFIs in Bulgaria for the period 2007 – 2021 are 182. The largest number of loans was granted by the EIB, followed by the EBRD (figure 12). The main part of these loans are credit lines in the banking sector. Given the mandate of IFIs and support for sustainable development, direct financing of projects by them adds value through technical assistance in the implementation and development of the management capacity of public and private enterprises, contributing with good practices and ready solutions to a number of problems that arise during the Green Transition. IFIs instruments have the potential and the knowledge in implementing projects to greener economies. There is potential number of companies from the public and private sector in key sectors for the Green Transition to gain their value in a greener way. Until now, there are only few projects implementing in the green transition sectors. The generated knowledge, skills and policies of IFIs on the climate change can be capitalized by a much larger number of implemented projects in the sectors most affected by the green transition, such as energy, transport and waste management. The indirect effect of these investments in the Bulgarian economy and the added value for the partners of these companies and the society as a whole can be considered.

Diversifying funding sources from the national budget, EU funds and IFIs for the transition towards Green Economy and stimulating the Circular Economy in the sectors most in need will be a prerequisite for weaker shocks in economically sensitive sectors.

Figure 11: *IFI funding in Bulgaria 2007 – 2021*



Source: *Own calculations*

There are very strong statistically significant correlations between the 4 key indicators that are reviewed – Greenhouse gas emissions by source sector, Environmental protection investments of total economy, Resource productivity and Environmental tax for EU28 and Bulgaria, which are worth considering in more depth in further study.

Diversification of the financial instruments available to countries and the best combination of them can make the transition towards Green Economy easier and without shocks for the public and private sectors. The unstable political situation in Bulgaria is a potential threat in taking timely action to stimulate the public and private sectors to fulfill the EU regulations.

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The Transition of the Bulgarian Economy to Net Zero Emmisions – Opportunities and Challenges

Ivian Dechev Valev[1]

Abstract: The transition to a net-zero emissions economy creates both opportunities and challenges at a national level. External conditions for technological development and innovation appear and can be used by setting modern and appropriate goals. Accomplishment of these goals requires appropriately selected complex of real institutional changes aimed at promoting investment, technological penetration and innovation processes.

Keywords: investments, technologies, innovation, uncertainty, institutions

Introduction

Over the last 10 years, the rapid development of energy technologies and the reduction in the prices of their individual components have been combined with the desire to overcome the tragedy of the commons, leading to global warming caused by increased carbon emissions. The global goal is to achieve a carbon-neutral economy over the next 30 – 40 years. Bulgaria faces the difficult task of coping as well as possible with the challenges and seizing the opportunities offered by economic transition to a carbon-neutral economy. Properly set goals are the first step towards driving appropriate processes aimed at using emerging opportunities.

1. Data on investments and disproportions

According to data presented in a study by BNEF from 2021, investments in renewable energy, capture and storage of carbon, electrified transport, hydrogen, electrified heat and energy storage globally increased from $ 230 billion in 2012 to $ 501 billion in 2020. Data on investment in renewable energy technologies shows a slight decline in growth between 2018 and 2019, but in 2020, investment interest in a carbon-neutral economy is growing (BNEF, 2021, p. 6).

In 2020, when social distancing measures were imposed, the costs of green transition in high-income markets exceed by 50% the average annual expenditures for the previous five years (BNEF, 2021, p. 6). For the same year, emerging markets reported a 21% contraction in investment in the energy transition on an annual basis, with investment in high-income markets growing by 24% (BNEF, 2021, p. 6).

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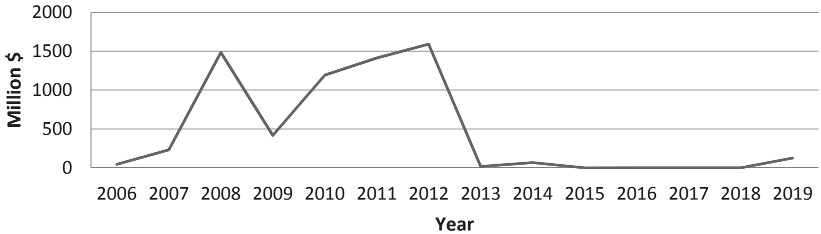
Foreign investments in Bulgaria in clean energy sources for 2006 – 2019 are shown in Figure 1 (Bloomberg NEF, 2021).

Figure 1: *Foreign investment in the clean energy sector*



Source: *Bloomberg NEF, 2021*

The data in Figure 1 shows an increase in foreign investment in Bulgaria in the clean energy sector for the period 2009 – 2012 and a sharp decline in investment interest in 2013. The reason for the decline is a retroactive change in the regulations in Bulgaria. Data for 2013 – 2019 suggests that despite the significant decline in the price of clean energy technologies, the presence of serious institutional problems in the Bulgarian energy market reduces the inflow of foreign investment in clean energy production to zero. In 2019, investment interest is mainly focused around efforts on the construction of the nuclear power plant in Belene.

By 2021, there are certain imbalances in the Bulgarian economy and in the Bulgarian energy sector, related to the intensity of energy use for the production of a unit of GDP, and to the predominant release of carbon emissions from thermal power plants. The imbalance, as data, is deduced from the recovery and sustainability plan and are reflected in Table 1.

Table 1: *Challenges in energy consumption and emission sources in Bulgaria*

1	"The economy consumes on average 3,5 times more energy resources per unit of GDP than the average energy consumption in the EU" (Council of Ministers, 2021, p. 98)
2	"The energy intensity of Bulgarian industry remains the highest in the EU, at almost three times higher than the EU average" (Council of Ministers, 2021, p. 98).
3	"The energy sector is the largest source of greenhouse gas emissions in the country with over 70% of total emissions in the country. Coal-fired thermal power plants account for almost half of the sector's emissions" (CM, 2021, p. 99).

Source: *MS, 21*

The data presented in Table 1 confirms the appropriateness of a conclusion for the presence of technological backwardness and serious disparities in our economy. Overcoming them requires analysis, setting appropriate goals, forming appropriate incentives and driving appropriate processes in three directions – attracting investment, technological penetration and innovative development.

2. Investment processes

The main deterrent to the development of investment processes in green energy production in Bulgaria at the moment is the uncertainty in energy policy and the institutional closure of its energy market. The main sectors in need of investment for the country's transition to a net zero-emission economy are energy, transport and construction. The inflow of investments is influenced by the general institutional conditions in the country and the specific factors in the given industry. Table 2 lists some of the general essential institutional conditions, and Table 3 shows specific factors in the energy sector that influence investment in it.

Table 2: *General institutional conditions influencing investment for the transition of the economy to "net zero"*

	General institutional conditions
1	Low level of corruption
2	Protection of property rights
3	Transparency and protection of contracts from default
4	Rule of law
5	Existence of strong institutions for conflict regulation resolution
6	Political will and power capacity
7	Appropriate public procurement regime

Source: *own analysis; BNEF, 2021; Knack and Keefer, 1995; Rodrik, 1998*

Table 3: *Specific factors in the energy sector influencing investment-for the transition to a zero-carbon economy*

1	Capacity and structure of the energy supply network
2	Existence of a clear regulatory framework for energy storage and rental use of storage
3	Content and standardization of purchase and sale agreements
4	Electricity tariffs reflecting costs
5	Existence of a competent authority able to implement a comprehensive strategy in the energy sector
6	Open investment entrance to the energy system

Source: *own analysis; BNEF, 21*

The combination of many factors influencing investments in the transition of our economy to carbon neutrality (Table 2 and Table 3) and the solutions to the challenges related to the differences in energy intensity of our economy (Table 1) require the application of an integrated institutional approach aimed at improving both the investment incentives in the individual industries and the general institutional investment incentives. The specific factors in the non-energy sectors (such as transport, construction of buildings, agriculture, etc.) influencing the investments in them need to be part of the complex institutional solution.

3. Technological renewal

Technological renewal requires clarity on possible directions for technological development relevant to the transition to a carbon-neutral economy. The interconnectedness of individual industries implies cross-sectoral technological penetration, and the uncertainty associated with the emergence of new cheaper and more efficient innovative solutions makes the list of areas for technological and innovative development incomplete and subject to adjustment over time. Table 4 lists some of the main areas in which there is potential for technological development and innovative development in the implementation of the transition of Bulgaria's economy to carbon neutrality.

Table 4: *Areas related to the transition to a carbon-neutral economy*

Building a reliable energy system	Electrification	Problematic sectors requiring technological development and innovation
Hydropower	Electrification of light and medium freight transport	Steel production
Bioenergy	Electrification of heating for residential and industrial buildings	Cement production
Nuclear energy	Electrification of industrial production	Production of chemicals
Geothermal energy	Use of pure hydrogen in industrial processes.	
Natural gas with carbon capture	Construction of energy efficient buildings	
Wind energy	Low carbon emissions in agriculture	
Solar energy		

Source: *own analysis*

In an analysis of the transition of the United States to a “net-zero” economy, scientists at Princeton University have modeled five different scenarios for the development of the transition to a carbon-neutral economy (Larson, 2020, p. 30). The main variables reflecting the uncertainty in the technological development and in the technological penetration are reduced to:

1. Degree of penetration of technologies related to the use of solar energy, wind energy and biomass;
2. Possibilities for carbon capture in the use of traditional fuels;
3. Degree of end use and electrification in transport and buildings.

The justified costs of achieving a net zero economy are a function of the time of change in the relative prices of different technologies leading to the target. The change in relative prices is a major factor that will determine the optimal relative share of energy sources used in energy systems and the optimal share of electrification in transport and buildings when reaching the target net zero. The conclusion is that in the long run (2050) the relative share of different energy sources in energy systems at the moment cannot be accurately predicted, i.e. the specifics of the transition at the moment should be planned in a shorter or medium-term time range. Currently, in order to reduce the risk, I propose an approach that excludes from targeted planning long-term capital investments that do not provide zero carbon emissions for the production of electricity.

4. Innovation

At a time when global incentives for investment in renewable technologies are growing, it is natural to expect an increase in the number of innovations in low-carbon industries. Table 5 lists some of the technological areas that are under development (National Academies of Science, Engineering and Medicine, 2021).

Each of the areas listed in Table 5 is a potential for the development of innovative design in Bulgaria. The implementation of R&D is an opportunity stimulated by the global transition and presupposes the course of specific and complex institutional processes at a national level. Unlocking innovation potential requires effective rules in R&D funding, to encourage private investment in R&D, in government support and in measures to accelerate R&D. The aim is to identify and create appropriate stimulus mechanisms for driving innovation processes and for the development and implementation of innovations in universities, government laboratories and companies fighting for markets in a competitive environment.

Table 5: *Technologies in development*

Technologies for the absorption of residual emissions or for direct decarbonization	Optimizing technologies	Penetrating technologies
Direct aerial capture and carbon storage (DACS)	Broadband and intelligent network technologies that enable demand management and network optimization.	Replacement of fossil furnaces and boilers
Bioenergy with carbon capture and absorption (BECCS)	Efficiency and productivity improvements that help to reduce the energy loads of the equipment	All electric new construction.
Ingestion in soils and forests	Cheaper carbon capture and utilization technologies	Transition to low carbon electrical capacity (for example through replacing or supplementing conventional units with electric boilers, heat pumps or non-contact heat sources such as infrared or microwave)
Hydrogen	Lower cost of direct air carbon capture.	Production of electricity without carbon (sun, wind, waves)
Low carbon fuels	Cheap low carbon fuels, including hydrogen from the electrolysis of gasification of water or biomass	Electric vehicle recharging network (EV),
Negative emission technologies	Zero options for aviation, shipping and production of steel, cement and bulk chemicals.	National CO 2 transport and storage
Innovations in housing models.		
New sources of solid fuel that meet the zero-zero target and ensure stability in the energy system, compensating for the instability in renewable supplies		

Source: *National Academies of Sciences, Engineering and Medicine, 2021*

The course of the innovation design sets a condition for the presence of modern knowledge and functioning feedback at each of the stages of the innovation process. The renewal of knowledge in the educational system is a prerequisite for a better innovation process. The creation of innovation systems – sectoral, regional and national is a condition for improving the results of innovation. Linking business with higher education is a necessary condition for building innovation systems and is appropriate to do so by building network interconnections.

5. Objectives

Setting timely and appropriate goals is the first step to a successful transition. Chile, which has set an ambitious goal in the green transition for 25 GW of hydrogen energy and 60% clean energy production by 2035, in the last three years has managed to attract investors' interest in hydrogen technology and attract large-scale investment, leading to increased share of solar energy in its energy mix from 4% to 14%. Morocco, whose economic priorities include the export of pure hydrogen, has signed a hydrogen partnership agreement with Germany in 2020 (BNEF, 2021, pp. 7-8). The specific conclusion we can draw is that the existence of clearly defined goals is of paramount importance for the subsequent effective actions.

A characteristic feature of the Bulgarian economy is the lack of sufficient own production of oil and natural gas. In the long run it is profitable for Bulgaria to increase the share of renewable energy sources in its own energy system (it is also associated with increasing energy storage capacity), as well as carry out technological transformation in transport and buildings in the direction of electrification., The innovative development of the Bulgarian economy in the sectors of renewable energy sources, energy storage and the use of energy from renewable sources in final consumption in buildings and transport, should be set as a short-term priority for innovative development. Achieving a multiplication effect requires accelerating the processes of innovative development in specific areas, attracting foreign high-tech investments with development centers in these areas, building different types of network innovative systems, binding knowledge, investment and two-way technological penetration. Creating the right conditions for investment, technological and innovative development presupposes both improvement of the institutional environment in order to create the appropriate market conditions and business climate, as well as specific institutional changes in the areas of energy, transport, construction, education, regional development, land use conditions, water resources exploitation, financial markets, etc.

Conclusion

In connection with the above, the following four goals of the Bulgarian transition to a net zero economy can be determined:

1. Access to internal, growing, cheap, stable and clean energy supply as a basis for a diversified, high-tech, innovative, growing and sustainable economy throughout the 21st century
2. Strengthening and stimulating the global competitiveness of Bulgarian companies.
3. Creating the appropriate institutional conditions for investments leading to technological and innovative development.
4. Creation of new, highly qualified and highly paid jobs.

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