# The Road to a Smart and Sustainable European Union

Edited by
Dr. Aleksander Aristovnik
Dr. Dejan Ravšelj
Dr. Nina Tomaževič

ZAVOD 14
zavod za sožitje in napredek

elf

THE ROAD TO A SMART AND SUSTAINABLE EUROPEAN UNION

Edited by Aleksander Aristovnik, Dejan Ravšelj and Nina Tomaževič

European Liberal Forum EUPF,
Rue d'Idalie 11-13, boite 6, 1050 Brussels, Belgium
info@liberalforum.eu
www.liberalforum.eu

Zavod 14,
Ljubljanska cesta 16, 3000 Celje, Slovenija
info@zavod14.si
www.zavod14.si

Graphic Design by Spotnet,
depositphotos.com

ISBN: 978-2-39067-044-5 9782390670445



Published by the European Liberal Forum EUPF with the support of the Friedrich Naumann Foundation and Zavod 14. Co-funded by the European Parliament. Neither the European Parliament nor the European Liberal Forum EUPF are responsible for the content of this publication, or for any use that may be made of it. The views expressed herein are those of the author(s) alone. These views do not necessarily reflect those of the European Parliament and / or the European Liberal Forum EUPF © 2022 European Liberal Forum (ELF)

ZAVOD 14
zavod za sožitje in napredek

elf

## EUROPEAN LIBERAL FORUM (ELF)

The European Liberal Forum (ELF) is the official political foundation of the European Liberal Party, the ALDE Party. Together with 51 member organisations, across Europe we work to bring new ideas into the political debate, provide a platform for discussion, and empower citizens to make their voices heard. The ELF was founded in 2007 to strengthen the liberal and democrat movement in Europe. Our work is guided by liberal ideals and a belief in the principle of freedom. We stand for a future-oriented Europe that offers opportunities for every citizen. The ELF is engaged on all political levels, from local to European. We bring together a diverse network of national foundations, think tanks and other experts. At the same time, we are close to, yet independent from, the ALDE Party and other Liberal actors in Europe. In this role, our forum serves as a space for the open and informed exchange of views among a wide range of actors.

## ZAVOD 14, ZAVOD ZA SOŽITJE IN NAPREDEK

Zavod 14, zavod za sožitje in napredek is a non-profit (ELF full member) organisation that has its headquarters in Celje (Slovenia). Zavod 14 promotes social liberal ideas (balancing between individual liberty and social justice) and protects liberal values (e.g., democracy, the rule of law, social development, good governance etc.) The mission of Zavod 14 is to support civil society, integrate and cooperate with the interested public, transmit the perspectives of interested stakeholders to state and other institutions, cooperation in the preparation and implementation of politics, and contribution in joining the civil society initiative into international integrations.

# CONTENTS

## INTRODUCTORY REMARKS

# CONTENTS

## INTRODUCTORY REMARKS

We live in times when globalisation and the rapid progression of smart technologies are bringing considerable changes to society. At the same time, humanity is faced with long-term structural global-scale challenges like global warming, rising inequalities, demographic trends, and growing economic disparity. The COVID-19 pandemic came as an additional challenge, emphasising the importance of leveraging digitalisation and sustainable, green solutions even more. Accordingly, the main goal of this ELF publication is to define the smart and green society in the European Union (EU) context and identify critical challenges and opportunities for the EU as regards the smart and green EU policy reforms with a focus on the COVID-19 pandemic and the EU's response to this unprecedented crisis, primarily through smart and sustainable development. Namely, the COVID-19 pandemic further highlights the interrelationship of between our natural and societal systems. As far as the environment is concerned, by 2050, Europe aims to become the world's first climate-neutral continent. The presented analysis of the situations in the smart and green society in the European Union will be the basis for detecting the policy implications and subsequent guidelines for governments and the EU/EC. These measures should provide concrete help content-wise for member states to rebuild economies following the pandemic-related disruptions. Thus, the proposed theme is vital, especially from the perspective of modern EU society during and after the COVID-19 pandemic, where democratic and liberal values and ideas are the basis needed for effective and efficient sustainable development.

The first chapter maps the road towards a green, sustainable and inclusive EU. It highlights that the goals of the European Green Deal are necessarily ambitious to mitigate the negative externalities of the widespread carbon emissions and subsequent environmental pollution and adverse climate change. The second chapter presents evidence from the EU in monitoring progress towards achieving sustainability. It emphasises the importance of developing of individual environmental and energy policy strategies, reveals that one-fits-all policies seem inadequate and suggests that individual policies related to circular material use and energy should be targeted more. The third chapter examines unmet expectations by analysing the adopting of country-specific recommendations in the fields of energy and infrastructure in Germany. The country is shown to have not met expectations with respect to the country-specific recommendations, particularly due to the lack of federal government involvement, too complicated legislative processes or no interest in implementing the recommendations. The fourth chapter presents the path towards sustainable recovery in the EU from the perspective of the Spanish recovery plan. It emphasises that the success of the transformation agenda in Spain will depend on the ambitious reforms and investments planned on the path to inclusive and sustainable growth in the coming years actually being implemented.

The fifth chapter concerns waste management and circular economy, revealing some lessons from the Greek experience. Recent developments in this area are shown, along with the ambitious provisions of the new Greek legislation on waste management, to create fertile ground for systemic changes and therefore substantial improvements to the waste management system in Greece. The sixth chapter presents digital transformation through artificial intelligence by considering the case of Slovenia. It reveals that Slovenia has many years of research experience in the field of artificial intelligence and a relatively large number of professionally educated personnel, namely, a key condition for understanding artificial intelligence models and technologies and the possibilities of their use in various products and services. The seventh chapter is about the energy transition in the EU from the perspective of Croatia. It shows that although Croatia is showing progress in terms of the consumption of renewable energy sources and energy efficiency, room for improvement remains and thus the country's energy sector must follow European and global decarbonisation trends. The eighth chapter refers to smart cities in Romania and the European Green Deal. Reaching the climate-neutral objective for local administration in Romania is revealed to be a challenging task and that additional investments in innovative and efficient technologies as well as changes in production and consumption are needed in order to ensure the sustainable use of resources, and reduce waste and carbon emissions.

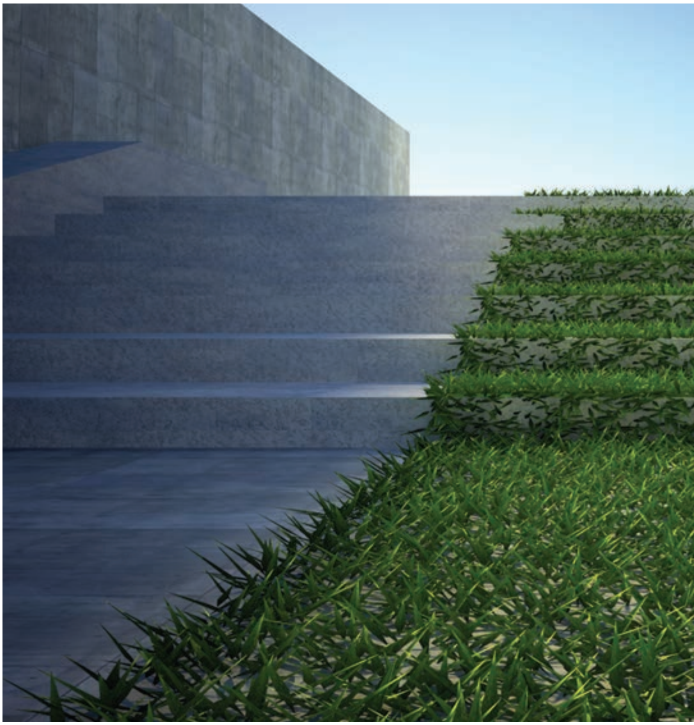
The Editors

## Chapter 1

# Mapping the road towards a green, sustainable and inclusive European Union: A science-based approach or ideological warfare?

**Rok Spruk**
University of Ljubljana, Slovenia

**Aleksandar Keševljević**
University of Ljubljana, Slovenia



# 1 Introduction

Without loss of generality, climate change and the damage caused by environmental degradation may easily be seen as one of the biggest threats and challenges confronting the European Union in its transition to sustainable and green energy. To address these challenges, the EU introduced the European Green Deal in 2020. The deal consists of a set of policy initiatives laid out by the European Commission. Its principal aim is to achieve carbon neutrality by 2050. In this respect, new legislative initiatives have been introduced with an emphasis on the circular economy, building renovation, biodiversity, farming and innovation. To pursue policies that hold the potential to move closer to zero net greenhouse gas emissions, the European Commission listed several priorities which ought to be implemented in national legislation and be enforced by the member states. These priorities principally include energy efficiency, development of the energy sector based predominantly on renewable resources, affordable energy supply, and a fully integrated and digitalised EU energy market.

Contrary to popular perception, the debate concerning the pursuit of climate neutrality does not revolve around the ardent claims of climate change denialism that have become a popular raison d'etre of progressive movements and policy circles around Europe. On the contrary, the debate revolves around the confrontation of climate change-related issues, such as: (a) problems that require science-based solutions; and (b) new ideological warfare being waged against any possibly sceptical views of public policies aimed at meeting the Deal's targets. The latter has become particularly omnipotent among the movement calling for the end of economic growth as a feasible solution to meet those targets. The initiative is informally part of what is known as the umbrella term of the 'degrowth' movement.

The obvious question to first ask is whether ideological warfare against the constructively sceptical views of climate change and its innate implications either puts sand in the wheel or facilitates the transition towards a green and climate-neutral European Union? In the legislative realm, the Commission's ambitious aims have been further bolstered by a series of subsequent initiatives. For instance, in the context of the Paris Agreement of 2015, using today's greenhouse gas emissions as the baseline, meeting the agreement's target of a 1.5°C temperature increase requires CO2 emissions to be reduced by 57% globally from 2019 levels before 2030. It immediately follows that the target is considerably higher than the 40% threshold promulgated by the European Green Deal. This is particularly important given that advanced economies are expected to contribute more than developing countries.

An important target area as part of moving towards the climate goals is the introduction of circular economic models in industrial policy. The key goals include the modernisation of industries to create a climate-neutral goods market principally reinforced by the decarbonisation and modernisation of energy-intensive industries like steel and cement. The Commission argues that a sustainable products policy can be enforced with a strong focus on the reduction of waste and use of materials to encourage and foster reuse and recycling processes and discourage the export of waste outside of the EU. Another important area is efficient and carbon-neutral building and renovation to reduce reliance on unsustainable methods. In this regard, the plan focuses on the promotion of the efficient methods, accelerated digitalisation and the enforcement of rules promoting clean energy in the performance of buildings.

Further, the European Green Deal brings a considerable focus to the issue of food sustainability, colloquially known as a "Farm to Fork" strategy to

pursue a climate-friendly approach to farming without loss of efficiency. The Commission specifically targets the use of chemical pesticides and aims to increase the availability of healthy good options, also by aiding consumers to better understand the health rating of products and opt for environmentally sustainable packaging. The farming-related focus area appears to be ambitious. In another example, by 2030, the Deal seeks to make around one-quarter of EU agriculture fully organic, halve pesticide use, decrease the use of fertilisers by one-fifth, at least halve the loss of nutrients, halve the use of antimicrobials in agricultures, create sustainable food labelling, and halve waste ,among several others.

In 2021, the Commission further accelerated the path towards the green energy transition by adopting the Zero Pollution Action Plan (Schiable 2020). In its broadest form, the plan intends to achieve zero pollution from all sources that either directly or indirectly produce greenhouse gas emissions to clean the air, water and soil by 2050. One of the plan's foundational pillars is strict environmental quality standards and their enforcement to render industrial activities free of toxic substances that cause environmental degradation. These include harmful resources such as micro-plastics and chemicals extensively used in the pharmaceutical industry. The plan's grandiose and ambitious aims have seen it being criticised in public discussions as chemophobic, anti-scientific and contradictory given that almost any life-related process inevitably results in pollution in one way or another. These critics emphasise that without any further scrutiny the Commission's approach is biased against industry since existing data and evidence show that the commuting and transport sector is the only one in which carbon emissions have been rising. Since the bulk of the emissions increase is driven by consumers and commuters in the transport sector, critics believe the plan should target commuters and consumers rather than the industrial sectors where emissions have been steadily declining since the 1990s in both absolute and relative terms.

> "Notably, the Commission aims for full environmental protection of 30% of EU land and 30% of the sea whilst safeguarding the growth of new and old forests."

Another pillar of the EU's ambitious policy package to achieve carbon neutrality consists of sustainable mobility. In particular, it aims to increase the adoption of sustainable and alternative fuels in road, maritime and air transport and strengthen the emissions standards for combustion-engine vehicles. The Commission seeks to make these solutions available to the private sector and the general public by promoting smart traffic management systems and applications as the principal solutions aside from the reduction of public congestion and installation of charging ports for electric vehicles to encourage the purchase of low-emission vehicles. In this respect, the Single European Sky plan lays out several policy initiatives targeting increased safety and flight efficiency in environmentally friendly conditions.

The last pillar of the Commission's Green Deal policy package hinges on biodiversity. In this target area, environmentally friendly management and environmental protection of forests and maritime including preservation of the ecosystem to further prevent the loss of species are discussed extensively. To restore ecosystems affected by environmental degradation, the Commission sets out to implement policy initiatives depending on the application of organic farming methods, restoration of free-flowing rivers, and reduction of pesticides endangering wildlife and reforestation. Notably, the Commission aims for full environmental protection of 30% of EU land and 30% of the sea whilst safeguarding the growth of new and old forests. The main aim is to restore the lost ecosystem and its innate biological diversity. By 2030, the biodiversity strategy of the Green Deal also intends to plant at least 3 billion trees, restore at least 25,000 km of free-flowing rivers, reduce pesticide use by half, boost organic farming and increase biodiversity in agriculture. Moreover, the strategy reinforces reversing the decline of pollinators and devotes EUR 20 billion per annum with the intention to make it a benchmark in business practice.

The EU's transformation to become a modern and resource-efficient economy that maintains both vibrancy and competitive rigor is an ambitious goal. The three foundational goals behind the Green Deal have received substantial attention in both scholarly and public debate. These goals include zero net emissions of greenhouses gases by 2050, with economic growth decoupled from resource use. The economic cost of achieving climate neutrality is too large to be neglected. For instance, one-third of the EUR 1.8 trillion investment from the NextGenerationEU Recovery Plan and the EU's 7-year budget are the key sources for financing the European Green Deal.

The Commission's general message suggests that all 27 EU member states are committed to transforming the EU into the first climate-neutral continent by 2050 by pledging to reduce emissions by at least 55% by 2030 relative to the 1990 baseline levels. The Commission argues that the European Green Deal will create a myriad of new opportunities to bolster innovation, investment and jobs. It states that the plan sets to reduce emissions, create jobs and growth, address energy poverty, reduce external energy dependency, and improve the health and well-being of EU citizens. Among the chief benefits of the Green Deal, the Commission cites the regeneration of forests, the availability of fresh air, clean water, healthy soil and biodiversity, retrofitted and energy-efficient buildings; available of organic fruits and vegetables; healthy and affordable food; more efficient public transport, cleaner energy along with cutting-edge clean technological innovation, longer lasting products that can be reused and recycled, future-proof jobs and skills training for the transition to a globally competitive and resilient industry.

## 2 External Threats to the European Green Deal

The COVID-19 pandemic's onset in the late winter of 2020 along with Russia's invasion of Ukraine are two major external threats to the determined goals of the European Green Deal. The advent of the pandemic brought a rigorous response by member states' governments to halt the absolute and relative excess mortality as well as the then estimated trajectory of infections. The reopening of EU economies along with China and other trading EU partners' reliance on a zero-COVID strategy after the first and second wave of the pandemic immediately led to the inevitably supply chain disruptions, which have largely resulted in the shortage of goods and talents as well as increased prices. By and large, post-pandemic disruptions in the supply chains have stalled and derailed the transition efforts towards sustainable energy primarily by adding to uncertainty regarding the ability to pursue the Deal's targets further reinforced by high unemployment rates and the mortality toll due to the pandemic.

> "The Russian invasion of Ukraine caused the largest refugee crisis since the Second World War."

On 24 February 2022, the Russian Federation invaded Ukraine, spearheading the most alarming military conflict since the end of the Second World War in a major escalation of the Russo-Ukrainian war that began in 2014. The invasion caused the largest refugee crisis since the Second World War with an estimated 7 million Ukrainians having fled the country and one-third of the population internally displaced. In response to the invasion, the EU has imposed several rounds of increasingly punitive sanctions in an attempt to cripple Russia's ability to finance its war in Ukraine, targeting Russia's political and economic elites. These sanctions refer to the freezing of assets and travel bans on 1,212 Russian officials, legislators and 108 entities, including several key banks, the expansion of sanctions on Russia's financial sector such as drastic debt and equity restrictions, restrictions on transactions with Russia's Central Bank and the blockage of access to reserve holdings, the disconnection of ten leading Russian financial institutions from SWIFT, prohibition of coal imports and a permanent reduction of reliance on Russian crude oil, natural gas, raw materials, export bans, the closure of EU airspace and seaports along with expanding the sanctions to cover Belarus as the key supporter of Russia in its invasion of Ukraine.

The invasion of Ukraine has seen global food prices rise dramatically. Ukraine has long been among the world's major agricultural producers and exporters of grain and wheat, informally known as the 'breadbasket of Europe'. For instance, in the 2021 international wheat marketing season Ukraine was ranked the sixth-largest wheat exporter, accounting for 9% of the world wheat trade. It is also recognised as a major global exporter of maize, barley and rapeseed. Before the invasion, it accounted for 12% of global maize and barley trade, and 14% of world rapeseed exports. In the sunflower oil sector, Ukraine was responsible about one-half of world exports in the year preceding Russia's invasion (Food and Agricultural Organization 2021).

Both the supply-chain disruptions in the post-pandemic recovery and Russia's invasion of Ukraine pose several major challenges that deal with the feasibility of the targets set out in the European Green Deal in a more critical manner. As an unintended consequence, both the invasion and supply-chain disruptions have revealed some underlying weakness in the approach taken by the European Commission. While the aims of the European Green Deal are clear, commendable and ambitious, the question remains of how to achieve the designated targets and which policies to select from among the vibrant public discourse given that evidence on the biggest impacts of these policies on economic and environmental performance is scarce and seldom enters public debate. Instead, a different spectrum is haunting the European public debate that is an even greater threat to the European Green Deal's aims than Russia's aggression against Ukraine and the disruptions in the post-pandemic recovery. This spectrum has reopened the old debate about the most feasible approach to accomplish the goals and meet the targets of the Deal.

## 3 A science-based approach vs ideological warfare

The most obvious question for any ambitious yet cautious policymaker is how to achieve the policy targets set out in the European Green Deal in a feasible way. If the challenges of climate change are seen as pressing problems that inadvertently require practical solutions supported by scientific consensus, the targets set out in the Deal can be reasonably operationalised and implemented based on the rationale of a nexus between structural and economic policies. This approach is not based on any specific ideological premise. However, in recent years it has come under the considerable scrutiny of a new generation of scholars and a policy entourage informally known as the "degrowth" movement. The general thrust of the degrowth movement is the need to bring about an abrupt end to the paradigm of economic growth.

The proponents and cheerleaders of the degrowth movement argue that economic growth causes social and ecological harm, proliferated by the relentless pursuit of growth and wealth. The movement instead emphasises the need to reduce consumption and production and advocates the paradigm of sustainability. In this paradigm, environmental well-being should replace GDP as the main indicator of prosperity. A more popular argument heard among the movement is that economic growth encourages the infinite expansion of the economy, which is fundamentally contradictory to the planet's finite resource limitations. The movement has grown sporadically in recent years and had an important influence on progressive political movements in the European Union, the United Kingdom, the United States, Canada, Australia and New Zealand among many other countries.

The fundamental flaw in the set of arguments used by the degrowth movement stems from the lack of understanding that, in the presence of zero economic growth, the feasible path towards becoming climate-neutral is simply impossible. The key fallacy arises from the inability to understand the cause-and-effect relationship between economic growth and the environment. Does higher economic growth entail greater environmental degradation? Conversely, as societies become richer and more affluent, are they simply better able to afford more innovation that, in turn, allows them to reduce pollution and carbon-intensity to approach the Green Deal's targets in the foreseeable future.

Instead of promulgating feasible science-supported solutions, the degrowth movement advocates ideas that have either been refuted many times in economics, political science or other disciplines (Demaria et al. 2013, Petridis et al. 2015). Some of these ideas have a clear ideological flavour with a clear disconnect from the scholarly consensus on climate change and sustainable development. Without loss of generality, the ideas calling for the end of economic growth have many explicit and implicit elements of ideological warfare against an open and inclusive market economy. In the end, if the 'zero-growth' ideas prevail in the policy discourse and are selected, the hopes of achieving carbon neutrality by 2050 are slim indeed sight. The basic question pundits of the degrowth movement fail to ask is how a world of zero economic growth would be able to survive the current challenges of climate change that call for multiple science-based and policy-relevant solutions. Economic history has taught us numerous times, from ancient Babylon to China's spectacular economic growth in the age of Deng Xiaoping, that a world of zero economic growth entails massive hunger, high rates of poverty, massive environmental moral hazard, soaring private and public indebtedness and deteriorating environmental quality leading to higher instead of lower levels of pollution. The general thrust of our argument is simple. As societies are becoming richer and more affluent, technology-driven solutions to the challenges of climate change are becoming more affordable, sanguine and feasible. On the contrary, the supporters of sustainability and planetary well-being highlight economic growth as the root cause of environmental degradation without providing any relevant empirical or experimental evidence beyond simplistic and ad hoc comparisons that never separate the causes from the effects of environmental degradation or provide any meaningful guidance to policymakers. The general policy advice emanating from the degrowth movement emphasises higher taxes on capital and labour, more widespread and distortionary regulation of the private sector and more generous government spending. Yet, such policy proposals from those cheering on sustainability and degrowth have rarely undergone any of the serious empirical scrutiny that is the backbone of modern-day policy evaluation techniques. Instead, most of the policy advice of those advocating zero economic growth is merely that more extensive regulation, higher taxation and a bigger GDP share of government spending along with public bashing of the private sector will provide a universal panacea for environmental degradation and high pollution levels that are to the detriment of current and future generations. Our argument is different and suggests that ideologically-motivated attacks on the owners of capital is at once flawed, misguided and counterproductive. The relevant question that an aspiring policymaker should ask is how to maximise growth through technology improvement and without negative externalities for the environment concerning the welfare and well-being of generations today and in the future, instead of promoting the illusion that zero economic growth will eventually reverse the path towards clean and efficient energy that the EU has been desperately striving for in the last two decades.

"The general policy advice emanating from the degrowth movement emphasises higher taxes on capital and labour, more widespread and distortionary regulation of the private sector and more generous government spending."


The cornerstone arguments that supposedly give credibility to the degrowth movement have often been debunked by modern economics scholars (Kallis et al. 2012). The degrowth movement arose from concerns about the consequences of the production and consumption of advanced industrial societies. These consequences have been designated as the ultimate, if not existential, threats to humanity, and have justified the formulation of distortionary economic and structural policies based on more extensive regulation, more burdensome taxation of labour and capital and higher government spending along with an increased level of social activism against private sector development. The consequences include the reduced availability of energy sources and declining quality of the environment, fauna and flora; the rise of unsustainable development, poorer health, and higher poverty, and the expanding use of resources by advanced industrial countries that are only consuming more food and energy, and produce greater waste at the expense of least developed and emerging economies. The key architects of degrowth proposals identified three major policy goals behind their movement: (i) a reduced environmental impact of human activity; (ii) redistribution of income and wealth within and across countries; and (iii) the transition from a materialistic to a convivial and participatory society (Cosme et al. 2017). These goals can only be achieved by adopting distortionary economic policies that do not enhance the welfare of citizens and exacerbate the dangerous slowdown of economic growth.

The obvious potency of the degrowth movement implies that it may not be possible to decouple economic growth from the use of natural resources and greenhouse gas emissions in either absolute or relative terms. These assertations have never been tested experimentally or empirically, whilst having been justified on dubious and weak claims and assumptions. A recent review of the literature shows an extensive array of empirical and theoretical contributions concerned with decoupling and concluded that "not only is there no empirical evidence supporting the existence of the decoupling of economic growth from environmental pressures on anywhere near the scale needed to deal with environmental breakdown, but also, and perhaps more important, such decoupling appears unlikely to happen in the future" (Parrique et al. 2019, p. 3).

Supporters of 'zero-growth' ideas also argue that decreasing the demand for natural resources is the only feasible way of preventing their near depletion, and tend to stress the existing limits of technology alongside the increasing carbon footprint in solving the agricultural and social challenges arising from growth. It has been repeatedly emphasised by these proponents that rich countries would have to reduce their standard of living through zero economic growth by way of a forced reduction of consumption as a means to improve the planet's well-being. The thinking and beliefs underlying the idea of zero economic growth are not only dangerous in terms of putting the European Green Deal and its goals at risk, but are also elusive and counterproductive to improved environmental quality. The opposition to economic growth stems from the belief that rising productivity is not the purpose of human organisation. In the last 20 years, these ideas have been included under the umbrella term "sustainability". Although the principles of sustainability are grounded in a similar conceptual framework to the analytical narratives of welfare economics, two distinctions should be made. First, diagnosing the sources of unsustainable consumption and production-based behaviour and the subsequent discussion of remedies, such as taxation, regulation, increased spending or a confluent policy mix, is commendable. Second, the practice of sustainability that sees ideological warfare being waged on the owners of physical and human capital and emphasises their moral responsibility for environmental damage and pollution is both dangerous and misleading. In the hazardous melange of such misguided scholarly activism and abrupt politically-motivated attacks on those with sceptical views on climate change and zero-growth initiatives, the cheerleaders of sustainability have simply forgotten that the economic growth slowdown would lead to increased unemployment, higher poverty and decreased per capita incomes. That said, degrowing would simply fail to deliver the principal supposed benefits of degrowth such as self-sufficiency and material responsibility.

The origins of the degrowth movement and its ideological avantgarde can be traced to 1967 when the Club of Rome commissioned a research report at the Massachusetts Institute of Technology to report on the limits of economic and population growth with a finite supply of natural resources. The report broadly concluded that uncontrolled demographic and economic growth would inevitably result in resource depletion along with a decline in both population and industrial capacity. The report became the flagging vehicle behind the more recent theories used to support sustainable development. In 2010, the degrowth movement organised the prominent Second International Conference in Barcelona focusing on the details of implementing the degrowth society. The conference led to concrete policy proposals developed for future political actions, including the elimination of fiat money, the transition to non-profit and small-scale companies, the support of participatory approaches in decision-making, a reduction of working hours, the facilitation of volunteer work, reuse of empty housing and introduction of a basic income, limitation on natural resource use, the preservation of biodiversity by regulation and taxes, the elimination of mega-infrastructures and of advertising from public spaces and the transition from car-based commuting to biking- and walking-based commuting. Although the Barcelona conference has had little influence on political and economic elites around the world, its ideas proved to be very popular among Latin American political leaders under the banner of socialism for the 21st century that has gained important momentum in Venezuela, Argentina, Nicaragua, Cuba, Ecuador, Bolivia and Brazil.

The most obvious question here is whether the Latin American countries in the name of socialism for the 21st century have witnessed a remarkable transformation towards more sustainable development by following the footsteps of the degrowth movement, or whether they merely fallen behind economically and their development is collapsing. Perhaps not a single economist or political scientist would disagree with the claim that the 21st century socialist experiment has failed miserably in many places. To date, the Latin American countries undergoing a socialist transformation have seen lower levels of per capita income, higher poverty rates, elevated political and social instability and considerably less sustainable economic and social development, which is a topic of vibrant and extensive scholarly discussion attracting near-universal academic consensus.

## 4 Debunking the ideological warfare using a smart, science-based approach to climate change

The goals set out in the European Green Deal are necessarily ambitious to mitigate the negative externalities that arise from widespread carbon emissions and subsequent environmental pollution and adverse climate change. Perhaps one of the most pressing and normatively relevant questions is how to safeguard and preserve a science-based approach and debunk the ideological warfare being waged against any sceptic of the policies proposed for delivering the Green Deal's goals. Unfortunately, an ideology-centric discussion, where policy formulation follows from the advice of influential figures in the degrowth and sustainability movements that rarely practise peer-reviewed analysis of policy impact evaluation to draw inferences, conclusions and implications about the policies needed to combat climate change, pursue climate neutrality goals, is particularly dangerous. The policy advice offered by such cheerleaders and politically-backed academics usually revolves around a modus operandi where the EU Commission 'must do something' superseded by a laundry list of wishes and desires that have never undergone any rigorous peer review of empirical outcomes. The basic thrust of such ill-suited advice seldom offers any relevant clues or a roadmap to European policymakers in terms of feasibility and specific plans for how to implement the policies. The avoidance of giving policy-relevant advice is typically justified by stating that it is not the goal of these discussion to provide the 'technicalities' or 'technical details' behind the policy formulation. Yet, it is precisely these details that matter the most to safeguard the pursuit of climate neutrality and other Green Deal goals. In a very similar context, some scholars have labelled such initiatives a policy cartel of good intentions (Easterly 2009).

To preserve the institutional integrity and assure policy credibility while pursing climate neutrality, the European Commission must get rid of the influence of policy hawks who are either explicitly or implicitly waging ideological warfare and seek to add to their credibility by publishing in journals that have either been blacklisted as predatory and are of dubious scientific quality and do not pursue the approach that led the revolution in credibility in empirical economics.

Maintaining the institutional integrity of the European Commission is not an impossible task. In safeguarding the science-based filtering of ideas as an input in policy selection, several steps are crucial. First, the notion that a broad range of ideas and a wide spectrum of interests should be represented in the public discussion often has countervailing effects. Easy access to the European Commission's influence will usually incentivise the ideological groups with the largest expected payoff to invest a bulk of resources and effort to secure their access to policymakers. This idea is well demonstrated by Mancur Olson in his famous and much cited Logic of Collective Action (Olson 1965). One possible and most often used political technologies is the non-institutionalised mode of influence through the signals of prestige, which may include scholars affiliated with renowned universities that, prima facie, invoke the false notion and impression of scholarly integrity and credibility that policymakers and participants in public discourse take for granted. Instead, the European Commission and other pivotal institutional bodies like the European Parliament and stakeholders from non-governmental organisations must realise that it is scholarship characterised by a good record of publications in journals of high quality accompanied by scholarly rigor and high-quality peer review that yields the required credibility in the formulation of policies. The innate reliance of the hawks who wage an ideological war either directly or indirectly through various activist movements or disproportionate involvement in social media seriously undermines the European Commission's institutional credibility and the European Union's institutional framework (Baykan 2007; Perkins 2019). This influence of policy pundits has recently been denounced as 'Kardashian scientists' where quasi-scientists with a dubious and suspicious publication record build their reputation by engaging with social media where the mode of influence of the propaganda-

type of communication pays almost zero attention to such aspects as scientific value or citation indices. If inputs of this nature prevail in the ad hoc formulation of policies and ideas, the EU's institutional credibility will be jeopardised as 'know-how' insights behind the pursuit of climate neutrality, reduction of carbon emissions and other goals laid out in the Green Deal come into serious jeopardy.

Second, the European Commission, Parliament and other institutional bodies in the EU framework should not hesitate to adopt a technocratic mode of governance where the best experts are recruited based on their peer-reviewed publication records that exclude predatory, dubious and suspicious journals. The expert entourage ought to be given a substantial degree of autonomy in the drafting of policy proposals where the goals should be elaborated with a specific and feasible definition of the 'know-how' needed to achieve them. Without this know-how component, policy proposals are not particularly meaningful and merely involve a list of desirable outcomes. Third, in the last two decades the European Commission has largely failed to monitor the progress in policy implementation and target outcomes across the member states. The EU's existing practice of facilitating mediocre follow-up reports and policy briefs where progress is not quantitatively evaluated through a rigorous review substantially undermines the policy credibility pursued by the European Commission and gives too few incentives for the member states to pursue the targets. The monitoring of policies and target outcomes ought to consist of the detailed tracking of legislative developments accompanied by a comparison of target outcomes per annum that is necessary to achieve climate neutrality by 2050 and the actual outcome in terms of pollution, environmental damage, carbom footprint, green-based investments, building renovation and other relevant outcome metrics. This approach necessitates the development of a comprehensive quantitative framework and presents the necessary condition for evaluating the credibility, feasibility and effectiveness of the Commission's policies pursued by member states' governments. The designated framework also offers a simple and easily understood approach to assess whether governments have been successful in pursuing climate neutrality goals over time provided that the data input is not in the domain of member states to overcome the standard issues behind the moral hazard and incentives to free-ride by manipulating the data input. Still, it should be the task of the European Commission and associated institutional bodies to prepare, undertake and supervise the data collection and perform a quantitative evaluation of progress made on the path towards climate neutrality. If it were the task of the member states, opportunistic incumbent politicians in member states would be incentivised to discover useful ways to tacitly manipulate data collection, which is the key input for the evaluation of governments' efforts to address the pressing issues of climate change and environmental hazards.

Fourth, the European Commission is expected to publicly denounce and debunk ideologically-motivated and flawed attacks pointing to dangerous culprits such as the state of zero economic growth, and impose a policy commitment that it will refrain and abstain from the influence of such ideas that seriously hamper and undermine its credibility both inside and outside the European Union. Instead, policy analysis undertaken by the European Commission should be grounded on the identification of the binding constraints on the pursuit of climate neutrality in a similar vein to identifying the major constraint in economic growth that is a standard practice in growth diagnostics (Rodrik 2005, 2006, 2010, 2011; Hausmann et al. 2008). In turn, a proper diagnosis of the key binding constraints on climate neutrality will facilitate the improvement of policies and also allow for more flexible policies that tackle the issues and better follow the targets of the Green Deal.

One of the first steps leading to such a framework is to disentangle the dynamics of economic growth across member states at various levels of aggregation such as cities or regions. Standard growth theories show that the growth of output can be driven either by inputs like physical capital and human capital or by the unexplained component, informally known as total factor productivity or the Solow residual. The unexplained component of growth captures the contribution of sources other than physical or human capital, especially improved technology, better know-how, the quality of firm- and industry-level management among others. The pursuit of climate neutrality confronts us with the inevitable task of minimising the contribution of inputs such as physical capital where the share of carbon-intensive components is high, whilst at the same time increasing the contribution made by technology improvements that, in turn, facilitate reduced reliance on carbon-rich components that allow for higher production without exhausting or depleting the environmental constraints and without causing negative externalities for society. The first and most obvious step here is the ability to properly measure, quantify and track the development of total factor productivity across countries, regions, cities and other relevant units. These measures will allow the European Commission and the scientific community to examine the contribution of policies on the member-state or EU level to total factor productivity and identify those sets of policies that maximise and those that minimise environmental damage. Although the renewed framework may be seen as a small step forward, it is a crucial one in improving the quality of policymaking, the subsequent implementation, and ex-post remedies.

Finally, the European Commission should reconsider its focal points in the promulgation of regulation that aims to tackle negative externalities such as environmental damage. In basic terms, the Commission and the stakeholder bodies must recognise and reconcile a simple empirical regularity, namely, that the level of carbon emissions in industrial sectors has been steadily declining since the 1980s, not primarily because of the extensive regulation imposed on the private sector but essentially due to the accelerated pace of technological improvements, and innovation (Azmahou et al. 2006; Elliott et al. 2010; Ajmi et al. 2015; Narayan et al. 2016; Antonakakis et al. 2018; Dong et al. 2020). By contrast, the level of carbon emissions caused by consumer behaviour in sectors such as retail, transport and tourism that are usually portrayed as cheerleaders of sustainable practices. In terms of assessment, the volume of legislation and extent of policy initiatives targeting the private sector disproportionately outweighs the legislation and initiatives targeting consumer behaviour, particularly commuting and tourism identified as sectors where carbon emissions have not declined in the last 20 years and, therefore, pose a threat to the containment and reduction of negative externalities such as environmental damage, which have become especially acute and cumbersome in light of both the post-pandemic recovery and the pressing need to reduce energy dependence on Russia after the invasion of Ukraine.

## REFERENCES


- Absher, S., Grier, K., & Grier, R. (2020). The economic consequences of durable left-populist regimes in Latin America. Journal of Economic Behavior & Organization, 177, 787-817.
- Ajmi, A. N., Hammoudeh, S., Nguyen, D. K., & Sato, J. R. (2015). On the relationships between CO2 emissions, energy consumption and income: the importance of time variation. Energy Economics, 49, 629-638.
- Angrist, J. D., & Pischke, J. S. (2010). The credibility revolution in empirical economics: How better research design is taking the con out of econometrics. Journal of Economic Perspectives, 24(2), 3-30.
- Antonakakis, N., Chatziantoniou, I., & Filis, G. (2017). Energy consumption, CO2 emissions, and economic growth: An ethical dilemma. Renewable and Sustainable Energy Reviews, 68, 808-824.
- Azomahou, T., Laisney, F., & Van, P. N. (2006). Economic development and CO2 emissions: A nonparametric panel approach. Journal of Public Economics, 90(6-7), 1347-1363.
- Baykan, B. G. (2007). From limits to growth to degrowth within French green politics. Environmental Politics, 16(3), 513-517.
- Cosme, I., Santos, R., & O'Neill, D. W. (2017). Assessing the degrowth discourse: A review and analysis of academic degrowth policy proposals. Journal of Cleaner Production, 149, 321-334.
- Demaria, F., Schneider, F., Sekulova, F., & Martinez-Alier, J. (2013). What is degrowth? From an activist slogan to a social movement. Environmental values, 22(2), 191-215.
- Dong, K., Hochman, G., & Timilsina, G. R. (2020). Do drivers of CO2 emission growth alter overtime and by the stage of economic development? Energy Policy, 140, 111420.
- Easterly, W. (2009). The cartel of good intentions. Foreign Policy, November 11.
- Elliott, J., Foster, I., Kortum, S., Munson, T., Perez Cervantes, F., & Weisbach, D. (2010). Trade and carbon taxes. American Economic Review, 100(2), 465-69.
- Food and Agricultural Organization (2021). Food Outlook – Biannual Report on Global Food Markets. New York, NY: Food and Agricultural Organization.
- Hall, N. (2014). The Kardashian index: a measure of discrepant social media profile for scientists. Genome Biology, 15(7), 1-3.
- Hausmann, R. (2017). Venezuela's Unprecedented Economic Collapse. Project Syndicate, July 31.

- Ioannidis, J., & Doucouliagos, C. (2013). What's to know about the credibility of empirical economics? Journal of Economic Surveys, 27(5), 997-1004.
- Kallis, G., Kerschner, C., & Martinez-Alier, J. (2012). The economics of degrowth. Ecological economics, 84, 172-180.
- Narayan, P. K., Saboori, B., & Soleymani, A. (2016). Economic growth and carbon emissions. Economic Modelling, 53, 388-397.
- Olson, M. (1965). Logic of collective action: Public goods and the theory of groups. Cambridge, MA: Harvard University Press.
- Parrique, T., Barth, J., Briens, F., Kerschner, C., Kraus-Polk, A., Kuokkanen, A., & Spangenberg, J. H. (2019). Decoupling debunked. Evidence and arguments against green growth as a sole strategy for sustainability. Brussels: European Environment Bureau EEB.
- Perkins, P. E. E. (2019). Climate justice, commons, and degrowth. Ecological Economics, 160, 183-190.
- Petridis, P., Muraca, B., & Kallis, G. (2015). Degrowth: between a scientific concept and a slogan for a social movement. In Handbook of ecological economics (pp. 176-200). Edward Elgar Publishing.
- Rankin, J. (2019). European Green Deal to press ahead despite Polish targets opt-out. The Guardian.
- Rodrik, D. (2005). Growth strategies. In: Aghion, P. & S. Durlauf (eds.), Handbook of economic growth, 1A (pp. 967-1014). Amsterdam, North Holland: Elsevier.
- Rodrik, D. (2006). Goodbye Washington consensus, hello Washington confusion? A review of the World Bank's economic growth in the 1990s: learning from a decade of reform. Journal of Economic Literature, 44(4), 973-987.
- Rodrik, D. (2010a). Diagnostics before prescription. Journal of Economic Perspectives, 24(3), 33-44.
- Rodrik, D. (2011). The myth of authoritarian growth. Nepal Times, January 28.
- Scartascini, C., & Tommasi, M. (2012). The making of policy: Institutionalized or not? American Journal of Political Science, 56(4), 787-801.
- Schaible, C. (2020). EU Industrial Strategy for Achieving the 'Zero Pollution'Ambition Set with the EU Green Deal. Brussels: European Environmental Bureau.

Chapter 2

# Is monitoring progress towards sustainability straightforward? Evidence from the EU-28


**Nikos Chatzistamoulou**
University of Ioannina, Greece

**Konstantinos Kounetas**
University of Patras, Greece


## 1 Introduction

The Sustainable Development Goals (SDGs) Initiative as well as a long line of policy directives by the European Commission framed in the recently launched European Green Deal (European Commission, COM/2019/640) set out priorities, guidelines and targets to be reached by 2030 to ensure a transition to a more sustainable future that leaves no one behind. Along with the policy directives, a monitoring mechanism is needed to record progress towards the set targets. In this sense, the Resource Efficiency Scoreboard, as part of the Resource Efficiency Flagship Initiative, is materialised via the Resource Efficiency Roadmap (European Commission, COM/2011/0571) in conjunction with the circular economy and energy-related indicators aim to document progress (or regression) made by the member states in achieving the transition to sustainability.

Nevertheless, recent evidence of sustainability trends based on the sustainable development goals index reveals sustainability disparities within the EU-28, even though all member states are subject to the same policy framework (Chatzistamoulou and Koundouri, 2021), while countries in Europe's north appear to outperform the rest in implementation of the SDGs (Hametner and Kostetckaia, 2020). These sustainability discrepancies have triggered the development of literature focusing on patterns of convergence/divergence and club formation, indicating that several clubs co-exist in the European Union (e.g., Kerner and Wendler, 2022; Karakaya et al., 2021). Moreover, several studies reveal significant divergent paths in EU countries with respect to several SDG measures (Karakaya et al., 2021; Kounetas, 2018; Parker and Liddle, 2017). Under the pressure of the ongoing energy crisis, monitoring the trends in sustainability targets, especially those related to energy as this is an input which affects production levels (Chatzistamoulou et al., 2019), is becoming of paramount importance. Thus, we focus on SDGs 7 "Affordable Energy for all" and 12 "Responsible Consumption and Production" using selected indicators such as energy productivity and resource productivity. We explore patterns of convergence in the EU-28 in the period 2000–2020 by extending the time window used in the literature thus far. Moreover, we employ a panel vector autoregressive (PVAR) model to explore the impact of resource productivity on energy productivity and the impact of circular material use and resource productivity on energy productivity and vice versa.

The findings show that for the investigated period there is a mixed pattern regarding the average performance of the EU-28 in the resource efficiency and circular economy indicators. In Greece however, the trends indicate that energy productivity is increasing, primary and final energy consumption is decreasing, while resource

"Under the pressure of the ongoing energy crisis, monitoring the trends in sustainability targets is becoming of paramount importance."

productivity and circular material use exhibit an upward tendency. Although much has yet to be achieved, recent national policy directives such as the National Plan for Energy and Climate as well as the National Circular Economy Plan, in conjunction with the guidelines and policy directives of the European Commission, modest progress has been made. Econometric results reject the overall convergence hypothesis for all indicators considered while, however, supporting club formation. We also provide evidence that indicators act independently even though some of them mirror aspects of the same SDG. Therefore, policy-wise, the results suggest that indicators capturing aspects of the SDGs should be more closely related to monitor the transition to sustainability. One-size-fits-all policies should be abandoned while the factors of enhanced circular material use, energy and resource productivity should be further investigated using additional econometric approaches.

## 2 Data and variables

We devise a balanced panel covering the EU-28 member states (Austria-AT, Belgium-BL, Bulgaria-BG, Croatia-HR, Cyprus-CY, Czech Rep.-CZ, Denmark-DK, Estonia-EE, Finland-FI, France-FR, Germany-DE, Greece-EL, Hungary-HU, Ireland-IE, Italy-IT, Latvia-LV, Lithuania-LT, Luxembourg-LU, Malta-MT, Netherlands-NL, Poland-PL, Portugal-PT, Romania-RO, Slovak Rep.-SK, Slovenia-SI, Spain-ES, Sweden-SE, United Kingdom-UK) for 21 years between 2000 and 2020. The sample consists of 588 observations. Data were collected from Eurostat (Eurostat, 2022).

To monitor the trends in sustainability and green growth, we focus on target indicators corresponding to two SDGs. Specifically, we explore the trends and patterns of energy efficiency and energy productivity corresponding to SDG 7 "Affordable and Clean Energy" and to those of resource productivity and circular material use or circularity rate corresponding to SDG 12 "Responsible Production and Consumption" in the EU-28 which are some of the priorities of the European Green Deal (European Commission, COM/2019/640).

Energy productivity measures the amount of economic output produced per unit of gross available energy required to cover the needs of a given country, and is measured in purchasing power standards per kilogram of oil equivalent to allow for cross-country comparisons (Eurostat, 2022). According to Eurostat (2022), "this indicator could be thought of as like the SDG indicator 7.3.1 'Energy intensity measured in terms of primary energy and GDP'".

Energy efficiency is evaluated using primary energy and final energy consumption in the EU where a higher volume of both indicates that energy efficiency is practically experiencing a decline. These measures are often benchmarked against the 2020 and/or the 2030 targets set by the EU. Specifically, primary energy measures the total energy needs of a country covering energy consumption by the main types of consumers such as industry, transport, households, services and agriculture. It also includes energy consumption of the energy sector itself for production and energy transformation (Eurostat, 2022). Final energy consumption only refers to the energy consumed by the same types as the primary energy consumption indicator, but does not include the energy consumption of the energy sector and related transformation losses. Both indicators are measured in tonnes of oil equivalent per capita to account for differences in the population across the member states. Energy efficiency holds a key role in climate change mitigation within the European Green Deal (European Commission, COM/2019/640).

Focusing on SDG 12, resource productivity falls within the Europe 2020 Strategy (European Commission, COM/2010/2020) and more precisely is part of the Resource Efficiency Flagship Initiative (European Commission, COM/2011/0571), which defines the EU Resource Efficiency Scoreboard, a 3-tier system based on a lead indicator, a dashboard of indicators focusing on resource management and environmental impact and a set of thematic indicators monitoring policy effectiveness. The lead indicator is resource productivity defined as the ratio of gross domestic product (GDP) to domestic material consumption (DMC) measuring the total amount of materials directly used by an economy (Eurostat, 2022). Thus, it captures the amount of GDP generated per unit of direct material consumed. It is measured in purchasing power standards per kilogram to permit cross-country comparisons. It should be mentioned that resource productivity is the European Union's sustainable development indicator for sustainable development goal 12 "Responsible Consumption and Production" (SDG 12) for policy evaluation providing insights into whether the decoupling of the use of natural resources and economic growth is occurring. The indicator is acknowledged by the literature as recent evidence shows that resource productivity can facilitate the sustainability transition of European Small and Medium-sized Enterprises (SMEs) across the EU-28 (Chatzistamoulou and Tyllianakis, 2022).

The circular material use rate or circularity rate is a ratio defined as the circular use of materials to overall material use. The latter is measured by summing up aggregate domestic material consumption (DMC) and the circular use of materials while the circular use of materials is approximated by the amount of waste recycled in domestic recovery plants minus imported waste destined for recovery plus exported waste destined for recovery abroad. A higher level of circularity indicates that more secondary materials substitute primary raw materials, thereby reducing the environmental impacts of extracting primary materials, and thus points to saving on the extraction of scarce environmental resources (Eurostat, 2022).

Table 1 below presents descriptive statistics (means and standard deviations in parentheses) by country for the whole period under study.

Table 1: **Basic descriptive statistics for the variables of interest, EU-28, 2000–2020**

| Country | SGD 7 | | | SDG 12 | |
|---|---|---|---|---|---|
| | Energy productivity | Energy Efficiency | | Resource productivity | Circular material use |
| | | Primary energy Consumption | Final energy consumption material use | | |
| Austria | 8.131 (1.275) | 3.723 (.167) | 3.216 (.123) | 1.631 (.285) | 9.736 (2.012) |
| Belgium | 5.160 (1.050) | 4.558 (.409) | 3.341 (.228) | 2.069 (.442) | 18.045 (3.212) |
| Bulgaria | 4.296 (1.256) | 2.445 (.131) | 1.280 (.097) | .614 (.127) | 2.673 (.758) |
| Croatia | 7.068 (1.602) | 1.994 (.116) | 1.600 (.099) | 1.388 (.371) | 4.182 (1.207) |
| Cyprus | 6.886 (1.249) | 3.119 (.363) | 2.254 (.243) | 1.125 (.341) | 2.436 (.448) |
| Czech Rep. | 5.128 (1.265) | 3.925 (.206) | 2.420 (.109) | 1.294 (.353) | 8.109 (2.625) |
| Denmark | 9.203 (2.430) | 3.352 (.357) | 2.660 (.181) | 1.317 (.268) | 7.791 (0.673) |
| Estonia | 4.150 (1.286) | 3.910 (.427) | 2.118 (.135) | .685 (.125) | 13.573 (3.006) |
| Finland | 4.429 (.756) | 6.240 (.455) | 4.704 (.221) | .846 (.138) | 8.718 (3.807) |
| France | 6.730 (1.242) | 3.818 (.266) | 2.362 (.175) | 2.210 (.460) | 18.645 (1.627) |
| Germany | 7.547 (1.614) | 3.741 (.208) | 2.646 (.078) | 1.970 (.391) | 11.882 (.792) |

| Country | SGD 7 | | | SDG 12 | |
|---|---|---|---|---|---|
| | Energy productivity | Energy Efficiency | | Resource productivity | Circular material use |
| | | Primary energy Consumption | Final energy consumption material use | | |
| Greece | 7.385 (.897) | 2.417 (.285) | 1.690 (.206) | 1.332 (.239) | 2.709 (1.175) |
| Hungary | 6.297 (1.366) | 2.435 (.096) | 1.755 (.092) | 1.320 (.361) | 6.418 (1.021) |
| Ireland | 11.910 (4.537) | 3.264 (.351) | 2.656 (.273) | 1.517 (.693) | 1.782 (.160) |
| Italy | 9.132 (1.478) | 2.735 (.287) | 2.101 (.190) | 2.526 (.793) | 16.582 (3.197) |
| Latvia | 6.360 (1.480) | 2.089 (.207) | 1.870 (.200) | 1.266 (.208) | 4.082 (1.689) |
| Lithuania | 6.201 (2.183) | 2.222 (.227) | 1.562 (.268) | 1.166 (.195) | 3.991 (.446) |
| Luxembourg | 8.079 (2.372) | 8.437 (1.130) | 8.040 (.985) | 2.795 (.659) | 13.845 (5.258) |
| Malta | 4.446 (.521) | 2.055 (.290) | 1.181 (.120) | 2.185 (.396) | 5.964 (1.569) |
| Netherlands | 6.064 (1.119) | 4.033 (.289) | 3.111 (.213) | 3.205 (.707) | 27.664 (2.031) |
| Poland | 6.019 (1.502) | 2.425 (.144) | 1.657 (.158) | .971 (.201) | 10.609 (1.015) |
| Portugal | 8.327 (1.316) | 2.173 (.126) | 1.674 (.116) | 1.131 (.246) | 2.118 (.240) |
| Romania | 7.380 (3.222) | 1.652 (.091) | 1.134 (.058) | .671 (.150) | 2.036 (.679) |
| Slovak Rep. | 5.416 (1.537) | 3.007 (.163) | 2.027 (.101) | 1.366 (.320) | 5.136 (.699) |
| Slovenia | 6.185 (1.224) | 3.340 (.217) | 2.404 (.132) | 1.393 (.428) | 9.218 (1.733) |
| Spain | 7.853 (1.410) | 2.741 (.247) | 1.933 (.192) | 2.008 (.837) | 9.173 (1.129) |
| Sweden | 5.858 (1.101) | 4.966 (.420) | 3.480 (.284) | 1.410 (.104) | 7.000 (.537) |
| United Kingdom | 8.361 (1.946) | 3.236 (.433) | 2.285 (.234) | 2.801 (.693) | 14.860 (1.010) |

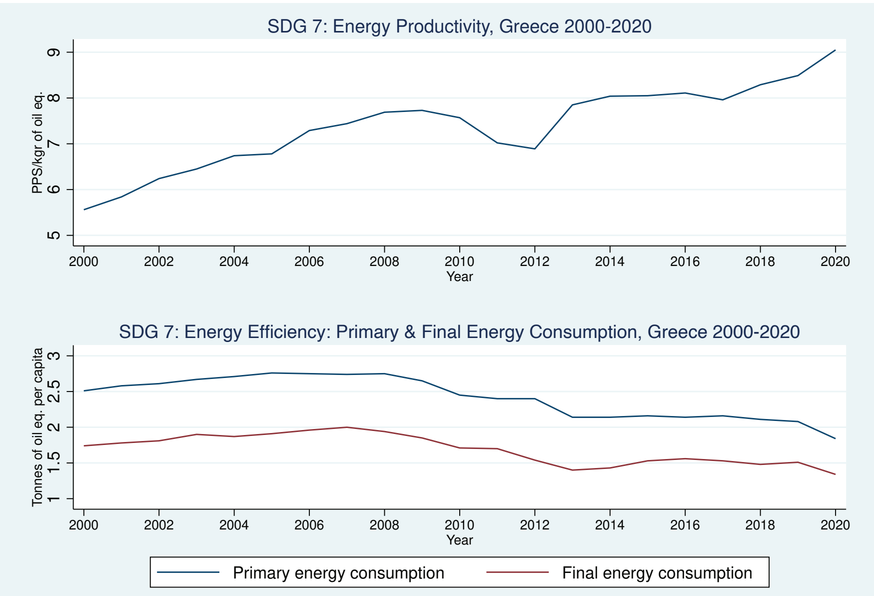
Source: The authors' construction.

## 3 Trends in sustainability indicators in Greece and in the EU-28

Figure 1 below presents the intertemporal trend for aspects of SDG 7 captured by energy productivity, primary and final energy consumption in Greece for the period 2000–2020. As regards energy productivity, it is noticeable that there is a steadily increasing trend, except for a decline in the 3 -year period between 2010 and 2012. After 2017, there is a constant rise in the volume of energy productivity while in 2020 it reaches the highest point in the period under consideration.

As far as the energy efficiency components are concerned, primary and final energy consumption in Greece for the period 2000–2020 follow a similar declining trend. In 2020, both measures reach their lowest point in the period, possibly indicating an increase in energy efficiency. Overall, based on the empirical evidence, Greece seems to be performing quite well in the selected indicators of SDG 7.

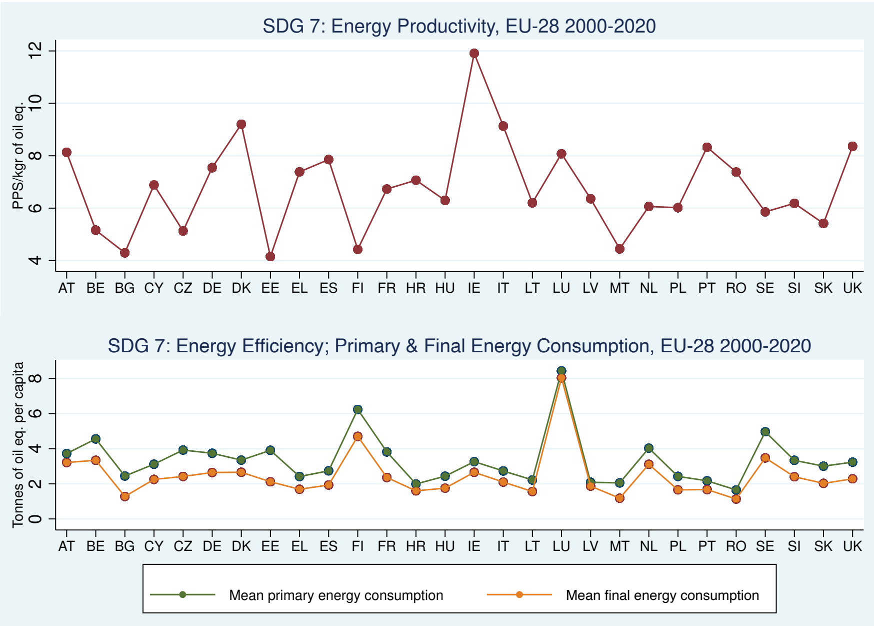
Figure 1: **Trends of energy productivity & energy efficiency (SDG 7), Greece, 2000–2020**




Source: The authors' construction.

Figure 2 below presents the patterns of energy productivity and energy efficiency for the EU-28 for the period 2000–2020. The dots refer to the average for the period of a given country. Regarding energy productivity, there is substantial heterogeneity in the indicator's performance across the EU-28. The highest volumes belong to Ireland, Denmark and Italy, while Bulgaria, Estonia, Finland and Malta hold the lowest levels for the period investigated. As regards primary and final energy consumption in the EU-28, a relatively smoother picture emerges as the countries exhibit similar consumption patterns on average.

Figure 2: **Patterns of energy productivity & energy efficiency (SDG 7), EU-28, 2000–2020**




Source: The authors' construction.

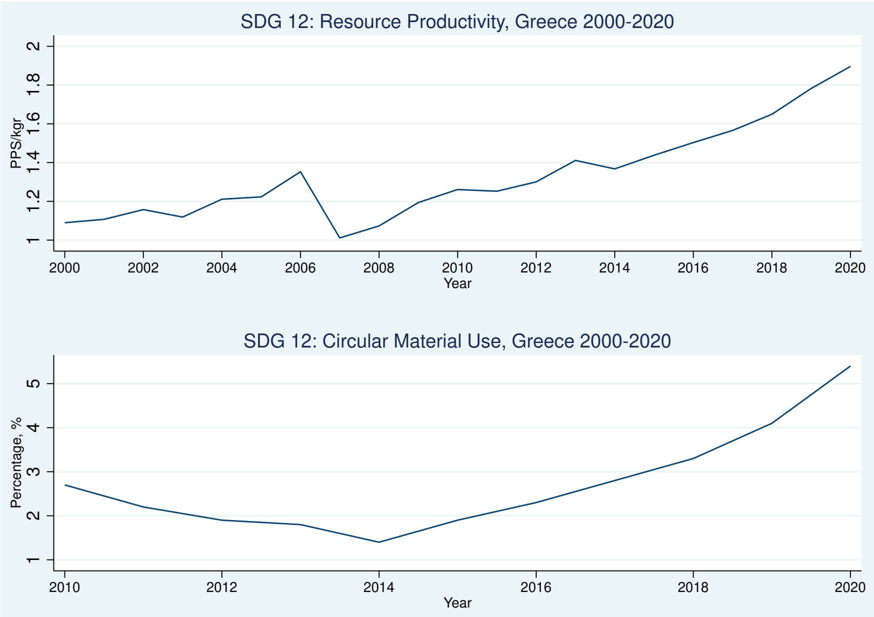
For the case of Greece, increases in energy productivity and restraining the energy consumption of all types of consumers are visible. This could be materialised using renewable energy, mostly solar and wind due to the country's geographical position as well as with improved technology to boost performance so that the same amount of energy could produce greater output. Since the European Green Deal was launched in 2019 (European Commission, COM/2019/640), member states have been required to compile national plans to promote the main pillars of the policy. Hence, in 2019 Greece launched the "National Plan for the Energy and Climate" built around the increased contribution made by renewable energy sources in economic activity that sets ambitious targets for emissions' mitigation and targets to increase energy efficiency by 38% so that energy consumption does not exceed 16.5 Mtoe by 2030.

The pressure of the current energy crisis brings a high risk of compromising the mentioned targets to guarantee energy security. However, final energy consumption in Europe is 16.3% away from the energy target of 2030 and 2.6% away from that of 2020 while primary energy consumption has experienced a small decline on the EU level, as Eurostat (2022) indicates. These conditions bring to the fore the impact of technology in resource conservation as the described challenges could be mitigated by technologically advanced machinery and equipment to boost energy efficiency. In addition, the replacement of energy-demanding machinery should be incentivised to cope with the rising energy costs.

Figures 3 and 4 below present the trends and patterns concerning SDG 12 for the cases of Greece and the EU-28, respectively. Figure 3 reveals a steadily increasing trend for resource productivity in Greece for the period 2000–2020, except for a short decline for 2006–2007. However, after 2008 until the end of the period examined, resource productivity is rising. Circular material use experiences a constant decline from 2010 until 2014, while from that point onwards it is characterised by an increasing trend to reach its highest volume in 2020. Greece appears to be performing well in terms of resource productivity, which is a sustainability indicator for Europe as its increase is translated into greater resource decoupling. The circularity rate seems to be following an increasing trend indicating that as time goes by the principles of circularity in terms of material use are gaining ground.

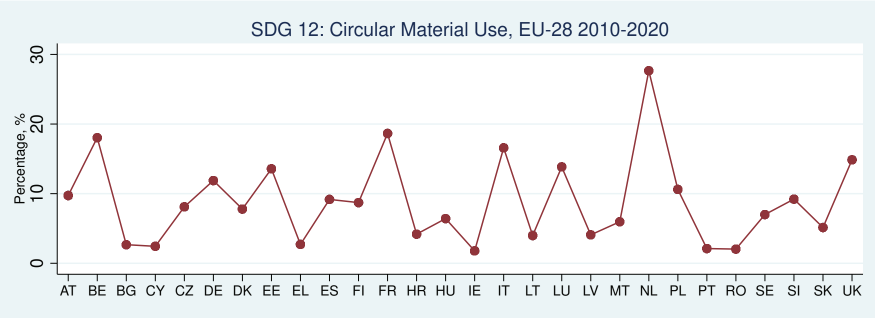
Figure 4 below presents the patterns of SDG 12 captured by resource productivity and the circularity rate for the EU-28. The evidence is aligned with the literature, indicating sustainability discrepancies exist within the EU-28 (Chatzistamoulou and Koundouri, 2021). Indeed, evidence shows that based on average performance distinct groups might co-exist for both indicators. The latter is explored in the next section.

Figure 3: **Trends of resource productivity & circular material use (SDG 12), Greece, 2000–2020**




Source: The authors' construction.

Figure 4: **Patterns of resource productivity & circular material use (SDG 7), EU-28, 2000–2020**




Source: The authors' construction.

## 4 Sustainability trends and club formation in the EU-28: Do distinct groups co-exist?

The evidence presented so far for the EU-28 has sketched out quite a heterogenous picture regarding the patterns of performance in the SDGs for the indicators considered. Accordingly, we are inclined to think that different groups, based on their performance in specific SDGs, co-exist in the EU. Should the latter be confirmed, that would hold significant implications for future policy directives which should take the formation of distinct clubs into consideration. The respective policy measures should account for the fact that countries belong to the same group and be adjusted by proposing tailor-made solutions instead of horizontal policies of the one-size-fits-all type to facilitate the transition to sustainability.

We apply the convergence algorithm of Phillips and Sul (2009; 2007) (hereafter PS) implemented by Du (2017) for the indicators of SDGs 7 and 12 as above. The PS algorithm covers a wide variety of possible transition paths towards convergence, including subgroup convergence and does not depend on stationarity assumptions. The heterogeneity of the member states can be captured by utilising the following equation:

$$X_{it} = \delta_{it}\mu_t \tag{1}$$

Component $\mu_t$ is common across countries while $\delta_{it}$ determines how a member state's performance relates over time to $\delta_{it}$. The idiosyncratic element $\mu_t$ provides information on the transition path and it is assumed to have nonstationary transitional behaviour and that each coefficient converges to a unit-specific constant:

$$\delta_{it}=\delta_i + \sigma_i + \xi_{it}L(t)^{-1}\, t^{-a} \tag{2}$$

where $\delta_i$ is time invariant, $\xi_{it}$ $^1$~$iid\ (0, 1)$ across $i$ but weakly dependent on $t$, and $L(t)$ is a slowly varying function, like $\log t$, for which $L(t)\rightarrow\infty$ as $t\rightarrow\infty$. To expunge the common component and test whether $\delta_{it}$ converges to a constant $\delta$, they suggested obtaining ratios to define a relative transition parameter, $h_{it}$:

$$h_{it}= \frac{X_{it} = \delta_{it}}{{}^1/_N\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}}{{}^1/_N\sum_{i=1}^{N} \delta_{it}} \tag{3}$$

which measures the loading coefficient $\delta_{it}$ in relation to the panel average at time $t$. The convergence hypothesis test is defined as:

$$H_0 : \delta_i = \delta \text{ and } \alpha \geq 0$$

$$H_1 : \delta_i \neq \delta \text{ for some } i \text{ and/or } \alpha < 0$$

The null hypothesis is tested using the following log t regression:

$$\log () - 2\log L(t) = \hat{b}\log t + u_t \tag{4}$$

where $L(t) = \log(t + 1)$ and $H_t=N^{-1}\sum_{i=1}^{N}(h_{it}-1)$. The coefficient of $\log t$ is $b=2\hat{a}$ where is $\hat{a}$ the estimate of $\alpha$ in $H_0$. When $b\geq0$, a full panel convergence occurs while higher values indicate faster rates of convergence. However, rejection of the null hypothesis of full panel convergence does not necessarily imply evidence against convergence on the level of subgroups within the panel.

The clustering algorithm of the PS methodology enables the number of clubs to be identified along with the member states that form each club. Tables 2 to 6 below present the results of the variables capturing SDGs 7 and 12.

Table 2 presents the results of applying the club clustering algorithm for energy productivity. The PS algorithm classifies the member states into

> "The growth in EU countries appears to be partly decoupled from energy consumption."

five subgroups denoting that distinct groups of convergence initially exist. Four of these subgroups form convergence clubs. While the point estimates of $\gamma$ are significantly positive for the four groups, they are also significantly less than 2.0. Thus, there is strong evidence of conditional convergence but weak evidence of level convergence within each club.

The first club includes Austria, Germany, Denmark, Italy, the UK, also the two countries of Latvia and Lithuania from the Baltic Sea, as well as Portugal and Romania. It also seems to be quite stable in terms of energy productivity convergence while it differs significantly from the other clubs. The second group consists of four countries – France, Spain, Poland (trade-intensive countries with a completely different energy mix) and Croatia with a moderate decline over the years. An analogous picture holds for the third club that includes most European countries. Finally, the fourth club consisting of Malta and Finland reveals a significant deterioration in the period investigated. Note that Ireland does not seem to belong to any convergence club.

A possible explanation could point to the different structures of the European economies. Therefore, countries that appear to be developed can broadly converge to similar patterns of energy productivity (Simionescu, 2022; Kounetas, 2018; Parker and Liddle, 2017). This explanation is consistent with the hypothesis that growth in EU countries appears to be partly decoupled from energy consumption. The two additional factors of efficient energy use (Camarero et al., 2013) and fuel mix (Stergiou and Kounetas, 2021) thus play a crucial role.

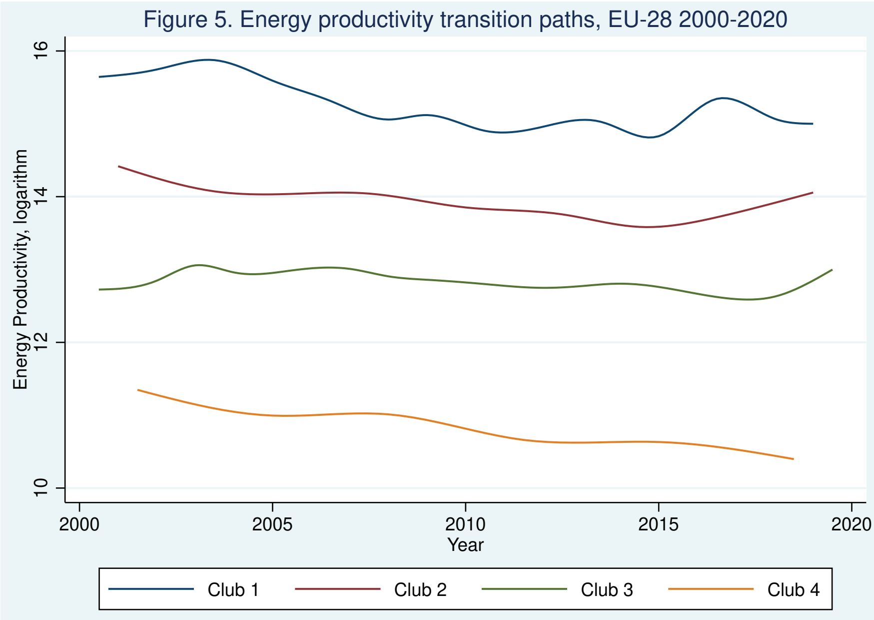
### Table 2: SDG 7; Energy productivity convergence testing, EU-28, 2000–2020

| $H_0$: Energy productivity convergence | | | | | |
|---|---|---|---|---|---|
| log(t) | Club1 | Club2 | Club3 | Club4 | Club5 |
| Coeff | .160 | .017 | .106 | .089 | Non convergent club |
| (Std Error) | (.249) | (.227) | (.092) | -1.152 | |
| t-stat | .642 | .073 | 1.145 | .078 | |
| Countries | AT, DE, DK, IT, LT, LU, PT, RO, UK | ES, FR, HR, PL | BL, BG, CY, CZ, EE, EL, HU, LV, NL, SE, SI, SK | ML, FI | IE |
| $H_0$: Club Merging | | | | | |
| log(t) | Club1+2 | Club2+3 | Club3+4 | | |
| Coeff | -.362 | -.148 | -.337 | | |
| (Std Error) | (.143) | (.075) | (.053) | | |
| t-stat | -2.523 | -1.970 | -6.391 | | |
| Final energy productivity clubs | | | | | |
| | Club 1 | Club 2 | Club 3 | | Club 4 |
| Final Clubs of Countries | AT, DE, DK, IT, LT, LU, PT, RO, UK | ES, FR, HR, PL | BL, BG, CY, CZ, EE, EL, HU, LV, NL, SE, SI, SK | | ML, FI |

Notes: (i) T-stat is compared to the critical value of -1.65 to decide whether to reject the null hypothesis at a 5% level of significance; (ii) asterisks indicate statistical significance or that the null is rejected; (iii) the first 4 periods are discarded before regression; (iv) IE is non-convergent.
Source: The authors' construction.

We now consider Figure 5. The four clubs start with different initial values. Club 1 follows a stable path that experiences a slight decline. The relative transition for Club 2 is relatively smooth up until 2015. That point onwards experiences improvement. Club 3, as the most populous one, follows quite a stable transition characterised by a slight deviation from its initial state. Finally, Club 4 (consisting of Malta and Finland) reveals a significant decline.

**Figure 5: Relative transition path for converging clubs with respect to energy productivity, EU-28, 2000–2020**




Source: The authors' construction.

Alataş et al. (2021) and Karakaya et al. (2021) use energy productivity data for the EU-28 for the period 2000–2017 and the EU-27 for the period 2000–2018, respectively. Both find that seven clubs exist, however with different composition compared to those ones demonstrated above. This is not surprising as we are dealing with a longer period when it is not impossible for changes to occur while energy directives such as the Renewable Energy Directives (2018/2001/EU; COM/2021/557) set updated energy targets for energy efficiency, intensity and productivity.

From a policy perspective and amid the current energy crisis, altering the energy mix by moving away from conventional fuels and transitioning to renewable energy in line with SDGs 7 and 12 could alter the production mode and foster the sustainability transition. In addition, evidence shows that energy productivity could be facilitated by trade flows (Wan et al., 2015) while other studies document evidence of a convergence between developed and developing countries with regard to energy productivity levels (Parker and Liddle, 2017). It should be noted that for countries showing a convergence pattern the shocks, attributed to policies for energy-demand management, have volatile effects. Accordingly, government interventions are not a recommended route. In the case of a divergence, the characteristics of a country play an important role and thus specific policies should be designed on the national level (Chatzistamoulou and Tyllianakis, 2022).

> "Altering the energy mix by moving away from conventional fuels and transitioning to renewable energy could alter the production mode and foster the sustainability transition."

We turn our attention to the primary and final energy consumption convergence clusters and paths. Tables 3 and 4 present the results while Figure 6 (a & b) displays the corresponding paths. For primary energy consumption, five convergence sub-clubs are first formed. Clubs 2, 4 and 5 have a fitted coefficient that is significantly negative, revealing evidence of divergence. However, like before, the t-statistic is not statistically different from zero, suggesting convergence among the members of those clubs. The final classification supports the existence of four clubs that converge. The latter indicates substantial diversity in the performance of EU countries and raises the possibility of between-club transitions.

## Table 3: SDG 7; Primary energy consumption convergence testing, EU-28, 2000–2020

| $H_0$: Primary Energy Consumption convergence | | | | | |
|---|---|---|---|---|---|
| log(t) | Club1 | Club2 | Club3 | Club4 | Club5 |
| Coeff | .093 | -.358 | .010 | -.146 | -.068 |
| (Std Error) | (.183) | (.226) | (.162) | (.148) | (.191) |
| t-stat | .507 | -1584 | .061 | -.988 | -.359 |
| Countries | EE, FI, LU | BL, CZ, SE | AT, DE, FR, NL, PL | BG, CY, DK, ES, HR, HU, IE, IT, LT, LV, PT, SI, SK, UK | EL, MT, RO |
| $H_0$: Club Merging | | | | | |
| log(t) | Club1+2 | Club2+3 | Club3+4 | | Club4+5 |
| Coeff | -.163 | -.221 | -.509 | | -.527 |
| (Std Error) | (.112) | (.092) | (.089) | | (.054) |
| t-stat | -1.458 | -2.408 | -5.733 | | -9.797 |
| Primary energy consumption clubs | | | | | |
| | Club 1 | Club 2 | Club 3 | | Club 4 |
| Log(t) coef | -0.163 | 0.01 | -0.146 | | -0.068 |
| T-stat | -1.458 | 0.061 | -0.988 | | -0.359 |
| Countries Final Club | BL, CZ, EE, FI, LU, SE | AT, DE, FR, NL, PL | BG, CY, DK, ES, HR, HU, IE, IT, LT, LV, PT, SI, SK, UK | | EL, MT, RO |

Notes: (i) T-stat is compared to the critical value of -1.65 to decide whether to reject the null hypothesis at a 5% level of significance; (ii) asterisks indicate statistical significance or that the null is rejected; (iii) the first 4 periods are discarded before regression.
Source: The authors' construction.

For the final energy consumption convergence case (Table 4), six convergence sub-clubs are formed initially. Clubs 1 and 2 have a fitted coefficient that is significantly negative, providing evidence of divergence. However, like before, the t-statistic is not statistically different from zero, suggesting convergence among members of this club. The final classification supports the existence of five clubs that converge, indicating substantial diversity in the performance of EU countries. Interestingly, the result for the specific variable reveals a completely different pattern regarding the country clubs in contrast to primary energy consumption.

Explanations for the specific behaviour with respect to primary and final energy consumption include the role of energy stacking (Masera, 2000), the quality of energy sources and different climatic characteristics, the role of past accumulated knowledge, and the presence of technical capabilities and technological "lock-in" (Stergiou and Kounetas, 2021). Recent evidence for the EU-15 concerning the period 1970–2019 reveals that economic growth is a factor pushing towards convergence in energy use (Simionescu, 2022). Combined with the findings of club convergence presented above as well as with those of (Kerner and Wendler, 2022), policies, both national and European, must enhance economic growth by moving beyond conventional means. Namely, by incorporating renewable sources into the production paradigm, strengthening institutions and incentivising investment in human capital to boost the country's absorptive capacity and thus its competitiveness. Along these lines, evidence suggests that energy efficiency is affected by the competitiveness club a country belongs to (Chatzistamoulou et al., 2019). This adds weight to the view that agencies and policymakers need to depart from opting for a 'one-size-fits-all' policy. A more case-specific treatment might be a more appropriate strategy.

"Recent evidence for the EU-15 concerning the period 1970–2019 reveals that economic growth is a factor pushing towards convergence in energy use."

## Table 4: SDG 7; Final energy consumption convergence testing, EU-28, 2000–2020

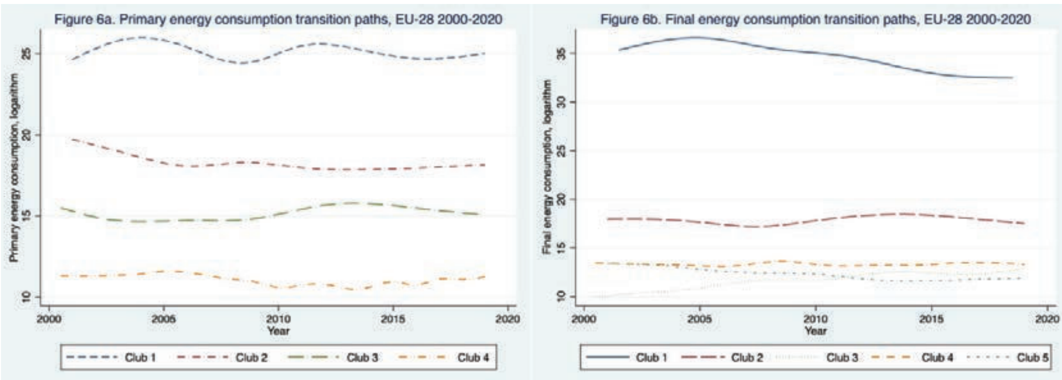
| $H_0$: Final Energy Consumption convergence | | | | | | |
|---|---|---|---|---|---|---|
| log(t) | Club1 | Club2 | Club3 | Club4 | Club5 | Club6 |
| Coeff (Std Error) | -.094 (.132) | -.016 (.086) | .147 (.136) | .118 (.195) | 079 (.431) | .118 (.156) |
| t-stat | -.713 | -.192 | 1.084 | .605 | .183 | .753 |
| Countries | FI, LU | AT, BL, LT, SE | DE, EE, LV, NL, PL | CZ, DK, HU, IE, SI | CY, FR, SK, UK | BG, EL, ES, HR, IT, MT, PL, RO |
| $H_0$: Club Merging | | | | | | |
| log(t) | Club1+2 | Club2+3 | Club3+4 | Club4+5 | Club5+6 | |
| Coeff (Std Error) | -.305 (.090) | -.041 (.097) | .136 (.121) | -.253 (.119) | -.245 (.119) | |
| t-stat | -3.407 | -.419 | 1.126 | -2.131 | -2.063 | |
| Final energy consumption clubs | | | | | | |
| | Club 1 | Club 2 | Club 3 | Club 4 | Club 5 | |
| Log(t) coef | -0.094 | -0.041 | 0.118 | 0.079 | 0.118 | |
| T-stat | -0.713 | -0.419 | 0.605 | 0.183 | 0.753 | |
| Countries Final Club | FI, LU | AT, BL, DE, EE, LT, LV NL, PL, SE | CZ, DK, HU, IE, SI | CY, FR, SK, UK | BG, EL, ES, HR, IT, MT, PL, RO | |

Notes: (i) T-stat is compared to the critical value of -1.65 to decide whether to reject the null hypothesis at a 5% level of significance; (ii) asterisks indicate statistical significance or that the null is rejected; (iii) the first 4 periods are discarded before regression.
Source: The authors' construction.

In Figure 6a below, Club 1 consists of six countries namely Belgium, Czech Republic, Estonia, Finland, Lithuania, and Sweden while Club 2 of five including Austria, Denmark, France, The Netherlands, and Poland. Both clubs show moderate improvement in primary energy consumption. The same picture holds for Club 3, the most populated one, and Club 4 including Greece, Malta and Romania. It is noteworthy that there are district differences between the four clubs departing from completely different initial values and exhibiting a stable behaviour.

In Figure 6b below, Club 1 consists of only two countries (Finland and Lithuania) that behave independently revealing a small pattern of deterioration over time. Moreover, Club 2, consisting of central European countries appears to be rather stable. In contrast, the path of Club 3 (Czech Republic, Denmark, Hungary, Ireland and Slovenia) exhibits the most diverse type, displaying a significant improvement over time. However, Club 4 remains rather stable whereas Club 5 performs in the opposite way, having a significant decline from its initial value. Note that Clubs 3,4 and 5 show quite similar values of final energy consumption.

Figure 6: **Relative transitory path for converging clubs regarding primary and final energy consumption, EU-28 2000–2020**




Source: The authors' construction.

In contrast with Alataş et al. (2021) who use data on resource productivity for the EU-28 with respect to the period 2000–2018 to determine that six clubs exist, we find that for the resource productivity case (Table 5), the PS algorithm classifies the data into four sub-clubs. However, three of these subgroups form convergence clubs. The fourth group has a fitted coefficient that is significantly negative, thereby rejecting convergence and providing evidence of divergence. The final empirical classification consists of three countries but also mixed clubs that converge.

Table 5: **SDG 12; Resource productivity convergence testing, EU-28, 2000–2020**

| $H_0$: Resource productivity convergence | | | | |
|---|---|---|---|---|
| log(t) | Club1 | Club2 | Club3 | Club4 |
| Coeff (Std Error) | -.115 (.140) | .245 (.485) | .965 (.455) | -.391 (.262) |
| t-stat | -.823 | .505 | 2.121 | -1.491 |
| Countries | BL, DE, ES, FR, IE, IT, LU, NL, SI, UK | AT, CY, CZ, DK, EL, HR, HU, LV, MT, SK | LT, PL, PT, SE | BG, EE, FI, RO |

| $H_0$: Club Merging | | | |
|---|---|---|---|
| log(t) | Club1+2 | Club2+3 | Club3+4 |
| Coeff (Std Error) | -.665 (.102) | -.072 (.409) | -.392 (.081) |
| t-stat | -6.539 | -.176 | -4.811 |

| Final resource productivity clubs | | | |
|---|---|---|---|
| | Club 1 | Club 2 | Club 3 |
| Log(t) coef | -0.115 | -0.072 | -0.391 |
| T-stat | -0.823 | -0.176 | -1.491 |
| Countries Final Club | BL, DE, ES, FR, IE, IT, LU, NL, SI, UK | AT, CY, CZ, DK, EL, HR, HU, LV, MT, SK, LT, PL, PT, SE | BG, EE, FI, RO |

Notes: (i) T-stat is compared to the critical value of -1.65 to decide whether to reject the null hypothesis at a 5% level of significance; (ii) asterisks indicate statistical significance or that the null is rejected; (iii) the first 4 periods are discarded before regression.
Source: The authors' construction.

The relative transition path for resource productivity reveals more mixed behaviour. Club 1 contains ten European countries: Belgium, France, Germany, Ireland, Italy, Lithuania, Slovenia, Spain, the Netherlands, and the UK. Compared to the other clubs, Club 1 starts from a different value, displaying an upward trend and a small improvement. Club 2 is the most populated one and shows quite a stable transition during the period examined, characterised by a slight diversion from its initial state. Finally, Club 3, consisting of Bulgaria, Estonia, Finland and Romania, shows a small decline.

The results are in line with recent literature, although from a global perspective, it suggests club formation and not overall convergence regarding resource productivity in over 100 countries for the period 1972–2012 (Kerner and Wendler, 2022). Countries classified in (three) convergence clubs resemble each other in terms of gross domestic product per capita and level of institutions. The latter is consistent with the sustainable development goals given that institutions are integral part of the sustainability transition. Moreover, other factors affecting transition and club participation have proven to be path- and state-dependent (Tsekouras et al., 2016, 2017), technology (Castellacci and Archibugi, 2008) and geography (Glaeser, et al., 2004; Acemoglu et al, 2001).

Figure 7: **Relative transition path for converging clubs of resource productivity, EU-28, 2000–2020**


Source: The authors' construction.

Finally, we examine convergence with regard to circular material use. As before, the initial creation of five clubs leads to the creation of four final clubs. It is noticeable that Clubs 1 and 2 only consist of 2 and 3 countries, respectively: Belgium and the Netherlands for the first one, and France, Italy and the UK for the second. The latter is quite interesting since it reveals the specific behaviour of the two clubs. The following two clubs are relatively heavily populated with countries of a mixed character.

### Table 6: SDG 12; Circular material use convergence testing, EU-28, 2010–2020

| $H_0$: Circular Material Use convergence | | | | | |
|---|---|---|---|---|---|
| log(t) | Club1 | Club2 | Club3 | Club4 | Club5 |
| Coeff (Std Error) | -.497 (.333) | .256 (.940) | -.159 (.107) | .317 (.186) | -2.823 (1.016) |
| t-stat | -1.493 | .273 | -1.487 | 1.703 | -2.780 |
| Countries | BL, NL | FR, IT, UK | AT, CZ, DE, EE, EL, ES, HU, LU, MT, PL, SI | CY, DK, FI, HR, LT, LV, SE, SK | BG, IE, PT |

| $H_0$: Club Merging | | | | |
|---|---|---|---|---|
| log(t) | Club1+2 | Club2+3 | Club3+4 | Club4+5 |
| Coeff (Std Error) | -.651 (.197) | -.805 (.130) | -.556 (.128) | -.234 (.198) |
| t-stat | -3.309 | -6.192 | -4.349 | -1.185 |

| Final energy productivity clubs | | | | |
|---|---|---|---|---|
| | Club 1 | Club 2 | Club 3 | Club 4 |
| Log(t) coef | -0.497 | 0.256 | -0.159 | -0.234 |
| T-stat | -1.492 | 0.272 | -1.487 | -1.185 |
| Countries Final Club | BL, NL | FR, IT, UK | AT, CZ, DE, EE, EL, ES, HU, LU, MT, PL, SI | CY, DK, FI, HR, LT, LV, SE, SK, BG, IE, PT |

Notes: (i) T-stat is compared to the critical value of -1.65 to decide whether to reject the null hypothesis at a 5% level of significance; (ii) asterisks indicate statistical significance or that the null is rejected; (iii) the first 2 periods are discarded before regression; (iv) RO is non-convergent
Source: The authors' construction.

## 5 Sustainability transition insights through the SDGs; a panel vector autoregressive approach

The presence of dynamic differences among European countries offers environmental and energy economists an opportunity to study how shocks are transmitted across regions and cross-sectional differences can emerge. Moreover, they can study the effect of specific variables on others. The latter help to understand the potential sources of these heterogeneities and provide policymakers with facts useful for building alternative scenarios and formulating policy decisions.

We use a panel vector autoregressions methodology (henceforth PVAR; Holtz-Eakin et al., 1988) that is particularly suited to address the research questions considered here. Further, this allows us to examine both static and dynamic interdependencies; like most VAR models for time series, to treat the relations across regions in an unrestricted way, account for cross-sectional dynamic heterogeneities (Arellano and Bover, 1995) and identify short-run dynamic relationships (Lütkepoh, 2005).

Below, we provide a brief outline of the panel VAR model, estimation and inference in a generalised method of moments (GMM) framework. We consider a k-variate panel VAR of order p with panel-specific fixed effects represented by the following system of linear equations that allows for unobserved individual heterogeneity (Love and Zicchino, 2006):

$$Z_{it}=\Phi_1 Z_{(it-1)}+\Phi_2 Z_{(it-2)}+\Phi_3 Z_{(it-3)}+\ldots+\Phi_p Z_{(it-p)}+BX_{it}+\mu_{it}+\varepsilon_{it} \qquad (5)$$

where $Z_{it}$ is a $(1xK)$ vector of dependent variables; $X_{it}$ is a $(1xL)$vector of exogenous covariates; $\mu_{it}$ and $\varepsilon_{it}$ are $(1xK)$ vectors of dependent variable-specific fixed effects and idiosyncratic errors. The $\Phi_1,\Phi_2,\Phi_3,\ldots,\Phi_p$ $(KxK)$ matrices and the $(1xK)$ matrix $B$ are parameters to be estimated. The model postulates that the innovations have the following characteristics:
$E(\varepsilon_{it}) = E(\varepsilon_{it+s},\varepsilon_{it}) = 0.$

The parameters of the above model can be estimated jointly with the fixed effects or, alternatively, using equation-by-equation ordinary least squares (OLS). However, estimators based on GMM have been proposed to calculate consistent estimates for the above model. One can its improve efficiency by including an extended set of lags as instruments. This, however, has the unpleasant side-effect of reducing the number of observations, especially with unbalanced panels. To remedy this, Holtz-Eakin et al. (1988) proposed creating instruments using “observed realisations”. They suggest substituting missing observations with zero based on the standard assumption that the instrument list is uncorrelated with the errors. Results for the examined relationships are presented in Table 8. Prior to estimating impulse-response functions (IRF), we first check the stability of the estimated panel VAR. Since all the eigenvalues lie inside the unit circle, the resulting figure 4 (panels a, b, c) confirms that the estimated PVARs are stable.

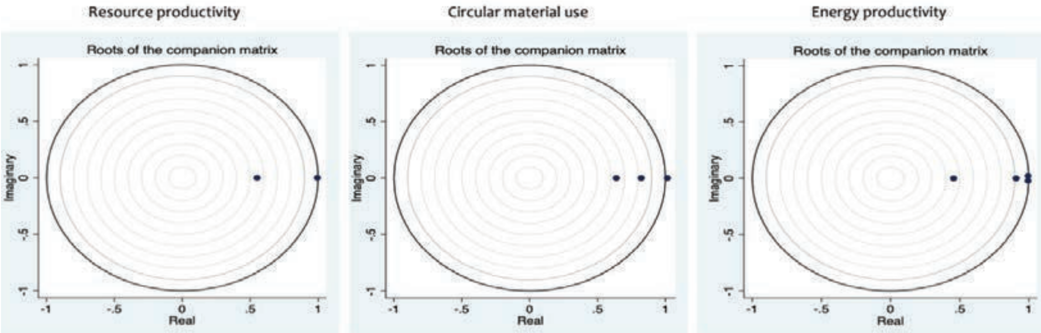
### Table 7: Panel vector autoregression (PVAR): model estimations

| Resource productivity (RESPROD) and energy productivity (ENPROD) | | | | |
|---|---|---|---|---|
| | Coeff. (Std. Error) | Dependent variable | | Coeff. (Std. Error) |
| | | ENPROD | | |
| RESPROD (-1) | 1.121 (11.52)* | | RESPRO (-1) | 1.15 (22.71)* |
| ENPROD (-1) | -0.027 (-2.84)* | | ENPROD (-1) | -0.342 (-1.74)** |

| Circular material use (CMU) Resource productivity (RESPROD) and energy productivity (ENPROD) | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Coeff. (Std. Error) | Dependen t variable | | Coeff. (Std. Error) | Dependen t variable | | Coeff. (Std. Error) |
| | | RESPROD | | | ENPROD | | |
| CMU (-1) | 0.826 (5.38)* | | CMU (-1) | -0.043 (-0.82) | | CMU (-1) | 0.026 (2.01)** |
| RESPROD (-1) | -0.715 (1.94)** | | RESPROD (-1) | -0.037 (-2.12)* | | RESPROD "(-1) | 0.011 (0.09) |
| ENPROD (-1) | 0.958 (1.91)** | | ENPROD (-1) | 0.697 (4.8)* | | ENPROD (-1) | 0.991 (11.04)* |

Note: Observations = 531; panels=28 for the first estimation and observations; panels for the second estimation. Standard errors are shown in parentheses. *,** and *** denote significance at the 10%, 5% and 1% levels, respectively. The PVAR models are estimated using system generalised method of moments (GMM). Reported numbers show the coefficients of regressing the dependent variables on lags of the dependent and independent variables.
Source: The authors’ construction.

Figure 8: **Panel vector autoregression (PVAR) stability conditions: a) resource productivity; b) circular material use c) and energy productivity**

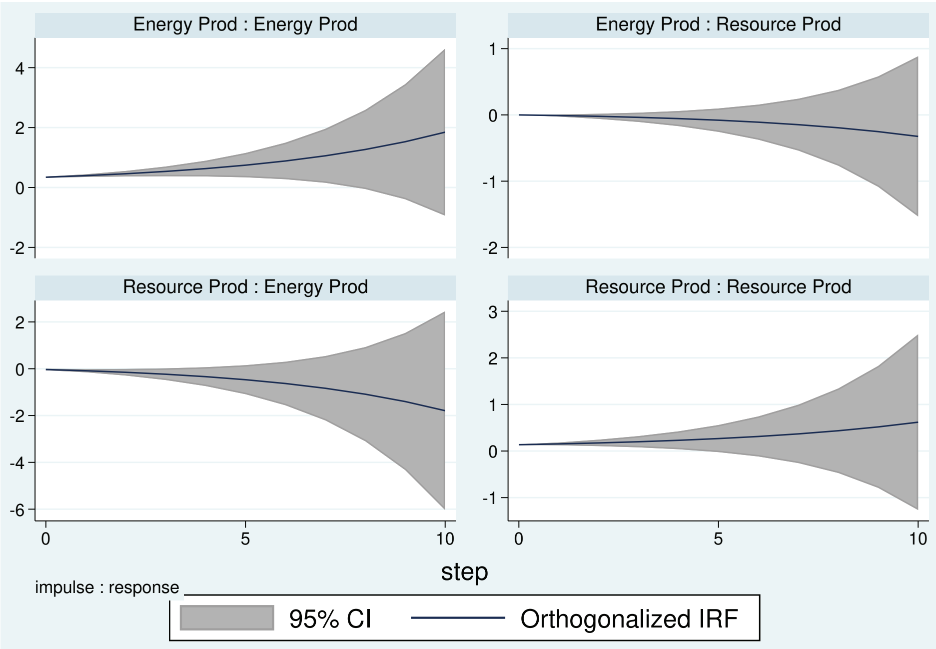



Source: The authors' construction.

We start the analysis by examining the relationship between resource and energy productivity. Figure 9 depicts the impulse response functions derived from the estimated PVAR and represents the impact on energy productivity (left column) and resource productivity (right column) for a period of 10 years after a positive shock to either energy (top row) or resource (bottom row) has occurred.

From the diagonal panels (top left and bottom right), it seems that the shocks to energy and resource productivity are temporary. In fact, the effect of a shock in energy productivity exerts a weak influence on resource productivity. However, a negative yet significant effect appears after 2005. The off-diagonal panels show the impact of a shock in resource productivity on energy productivity (bottom left) and the reverse impact on resource after a shock affecting energy productivity (top right), which is our main interest. The top-right impulse response provides slight evidence of a significant effect of energy on resource productivity. A positive shock to resource productivity, however, has a significant negative effect on energy productivity (bottom left), which persists for approximately 5 years after a period of approximately 4–5 years with no influence.

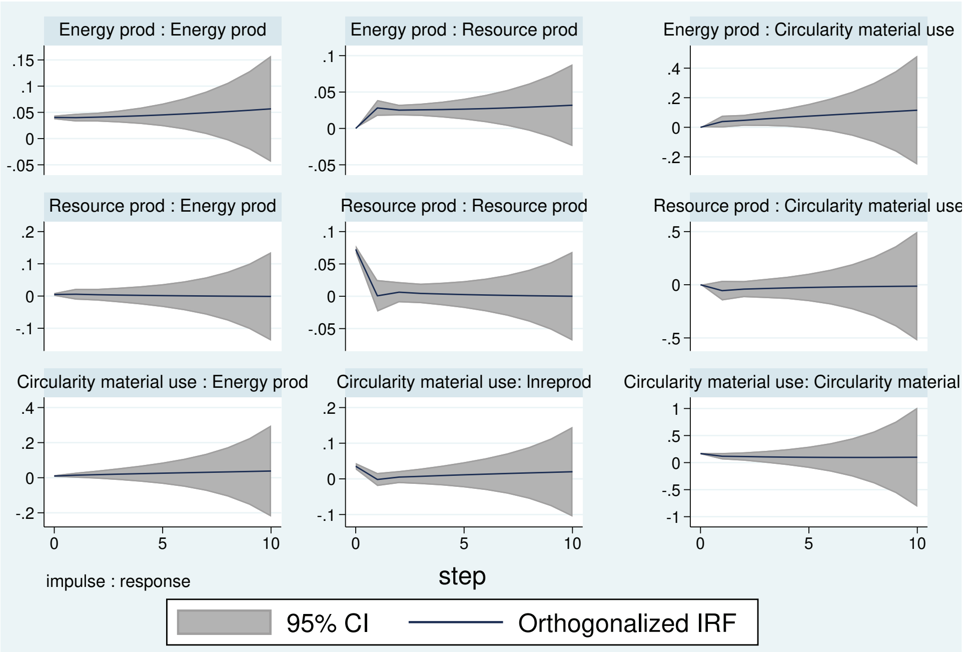
Figure 9: **Panel vector autoregression (PVAR) – IRF Energy and resource productivity**




Source: The authors' construction.

Figure 10 depicts the IRFs derived from the estimated PVAR model and shows the impact of energy and resource productivity on circular material use for a period of 10 years after a positive shock affecting either circular material use or energy or resource productivity. The main diagonal shows that the shocks in energy productivity and circular material use are mild. Resource productivity, however, is a different case. The off-diagonal panels display the impact on circular material use after a shock affecting resource and energy productivity, which is our main interest, and the reverse impact. The top-right impulse response shows a positive and significant effect of energy productivity on circular material use with a very small effect that remains stable after approximately 3 years. The bottom-left impulse response function describes the opposite relationship, revealing no effect. A positive shock to resource productivity does, however, have a significant negative effect on circular material use that persists for approximately 3 years, after which the effect slowly remains stable with a very modest impact.

Figure 10: **Panel vector autoregression (PVAR) – IRF Energy, resource productivity and circular material use**




Source: The authors' construction.

Some interesting results emerge from this analysis. The findings indicate that the variables used to capture the sub-targets of each SDG examined here appear to evolve in an autonomous manner because none is related to the changes in another sub-target used to monitor the same SDG. In other words, even though monitoring an SDG could be done through various sub-targets, the latter are not related to each another.

A potential policy implication is that sub-targets, of the same SDG mostly, must be linked to one another in a way that allows for improvements in one aspect to pass on to another. Moreover, investment in awareness mechanisms targeted to the stakeholders, e.g., governments, public sector, private sector, businesses etc., could foster the transition to sustainability. Recent evidence from a global perspective shows that productive performance affects environmental efficiency only for the economies of environmentally-aware countries, whereas a direct rebound effect is also documented that could trigger policy sequencing (Chatzistamoulou and Koundouri, 2022).

“Recent evidence from a global perspective shows that productive performance affects environmental efficiency only in environmentally aware countries.”

## 6 Conclusion

For the 28 European countries analysed, applying the log-t regression test no evidence of convergence within our sample emerges – suggesting that this method is indeed an improvement over simple traces of the coefficient of variation for the period 2000–2020. The clustering algorithm identified four convergence clubs for energy productivity, primary energy use and circular material use, three clubs for resource productivity, and five for final energy use, albeit club formation cannot be associated with explanations provided by one of the explanations is geography. Yet, while the transition curves are characterised by heterogeneity in performance, this does not apply to all indicators considered.

Two observations stand out. Transition paths for all indicators of both SDGs 7 and 12 that were examined reveal the autonomous behaviour of all clubs created, suggesting that policies should be designed for each specific club. Since a large variety of paths is observed, the monitoring of energy productivity and efficiency, resource productivity and circular material use is advised to ensure that the observed downward trends examined have a transitory rather than a permanent character.

The second is that different countries always make up the groups of champions and laggards revealing the absence of patterns for the EU-28. Overall, for the cases of both energy and resource productivity a few regularities are visible for the clubs obtained since geographical effects are not apparent. Moreover, no significant agglomeration effects are detected and in action and the classic North–South division does not appear to apply valid.

We employ a PVAR approach providing robust evidence concerning the impact of the role played by energy productivity on resource productivity. Our findings suggest that a higher level of energy productivity will have a small and negative effect after 5 years of declining resource productivity. At the same time, a reverse process was confirmed by the data. In addition, regarding circular material use our estimations show that European countries have not benefited from the presence of a positive shock affecting energy and resource productivity.

Our results hold several policy implications regarding the cohesion of environmental as well as energy policy today. Examining a phenomenologically homogeneous sample of countries (in terms of common agreements, Annex II countries, common regulations etc.), our findings point to the important need to develop individual environmental and energy policy strategies. One-fits-all policies seem to be inadequate since specific convergence groups appear with regard to particular variables under estimation. Thus, individual policies should focus on specific clusters with respect to the variables of circular material use and energy. Further, in terms of resource productivity and circular material use, policymakers must carefully design goals to accelerate European countries' convergence through energy and resource productivity. Finally, while the possible shocks of energy have mild effects on resource productivity, a positive shock affecting energy and resource productivity seems to not accelerate circular material use.

## REFERENCES


- Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: An empirical investigation. American economic review, 91(5), 1369-1401.
- Alatai, S., Karakaya, E., & Sarı, E. (2021). The potential of material productivity alongside energy productivity in climate mitigation: Evidence from convergence tests in the EU28. Resources, Conservation and Recycling, 167, 105322.
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. Journal of econometrics, 68(1), 29-51.
- Camarero, M., Picazo-Tadeo, A. J., & Tamarit, C. (2013). Are the determinants of CO2 emissions converging among OECD countries?. Economics Letters, 118(1), 159-162.
- Castellacci, F., & Archibugi, D. (2008). The technology clubs: The distribution of knowledge across nations. Research Policy, 37(10), 1659-1673.
- Chatzistamoulou, N., & Koundouri, P. (2022). Sustainability Transition Through Awareness to Promote Environmental Efficiency. In Advances in Econometrics, Operational Research, Data Science and Actuarial Studies (pp. 345-362). Springer, Cham.
- Chatzistamoulou, N., & Tyllianakis, E. (2022). Green growth & sustainability transition through information. Are the greener better informed? Evidence from European SMEs. Journal of Environmental Management, 306, 114457.
- Chatzistamoulou, N., Koundouri, P. (2021). SDGs Patterns Across the Globe: From Theory to Practice. In: Leal Filho, W., Azul, A.M., Brandli, L., Lange Salvia, A., Wall, T. (Eds.), Decent Work and Economic Growth. Encyclopedia of the UN Sustainable Development Goals. Springer, Cham. https://doi.org/10.1007/978-3-319 -95867-5_81.
- Chatzistamoulou, N., Kounetas, K., & Tsekouras, K. (2019). Energy efficiency, productive performance and heterogeneous competitiveness regimes. Does the dichotomy matter?. Energy Economics, 81, 687-697.
- Du, K. (2017). Econometric convergence test and club clustering using Stata. The Stata Journal, 17(4), 882-900.
- European Commission, 2018. Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the Promotion of the Use of Energy from Renewable Sources (Text with EEA relevance.) PE/48/2018/REV/. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2018.328.01.0082.01.ENG

- European Commission. (2011). COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Roadmap to a Resource Efficient Europe /* COM/2011/0571 final */. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52011DC0571
- European Commission. (2019) COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS The European Green Deal COM/2019/640 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1638528394129&uri=CELEX%3A52019DC0640
- European Commission. (2021). Proposal for a DIRECTIVE of the EUROPEAN PARLIAMENT and of the COUNCIL Amending Directive (EU) 2018/2001 of the European Parliament and of the Council. Regulation (EU) 2018/1999 of the European Parliament and of the Council and Directive 98/70/EC of the European Parliament and of the Council as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652. COM/2021/557 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0557
- European Commission.(2010). EUROPE 2020 A strategy for smart, sustainable and inclusive growth /* COM/2010/2020 final */. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:52010DC2020
- Glaeser, E. L., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). Do institutions cause growth?. Journal of economic Growth, 9(3), 271-303.
- Hametner, M., & Kostetckaia, M. (2020). Frontrunners and laggards: How fast are the EU member states progressing towards the sustainable development goals?. Ecological Economics, 177, 106775.
- Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. Econometrica: Journal of the econometric society, 1371-1395.
- Karakaya, E., Sari, E., & Alataş, S. (2021). What drives material use in the EU? Evidence from club convergence and decomposition analysis on domestic material consumption and material footprint. Resources Policy, 70, 101904.
- Kerner, P., & Wendler, T. (2022). Convergence in resource productivity. World Development, 158, 105979.
- Kounetas, K. E. (2018). Energy consumption and CO2 emissions convergence in European Union member countries. A tonneau des Danaides?. Energy Economics, 69, 111-127.

- Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. The Quarterly Review of Economics and Finance, 46(2), 190-210.
- Lütkepohl, H. (2005). New introduction to multiple time series analysis. Springer Science & Business Media.
- Masera, O. R., Saatkamp, B. D., & Kammen, D. M. (2000). From linear fuel switching to multiple cooking strategies: a critique and alternative to the energy ladder model. World development, 28(12), 2083-2103.
- Parker, S., & Liddle, B. (2017). Economy-wide and manufacturing energy productivity transition paths and club convergence for OECD and non-OECD countries. Energy Economics, 62, 338-346.
- Phillips, P. C., & Sul, D. (2007). Transition modeling and econometric convergence tests. Econometrica, 75(6), 1771-1855.
- Phillips, P. C., & Sul, D. (2009). Economic transition and growth. Journal of applied econometrics, 24(7), 1153-1185.
- Simionescu, M. (2022). Stochastic convergence in per capita energy use in the EU-15 countries. The role of economic growth. Applied Energy, 322, 119489.
- Stergiou, E., & Kounetas, K. (2021). European Industries' Energy Efficiency under Different Technological Regimes: The Role of CO2 Emissions, Climate, Path Dependence and Energy Mix. The Energy Journal, 42(1).
- Tsekouras, K., Chatzistamoulou, N., & Kounetas, K. (2017). Productive performance, technology heterogeneity and hierarchies: Who to compare with whom. International Journal of Production Economics, 193, 465-478.
- Tsekouras, K., Chatzistamoulou, N., Kounetas, K., & Broadstock, D. C. (2016). Spillovers, path dependence and the productive performance of European transportation sectors in the presence of technology heterogeneity. Technological Forecasting and Social Change, 102, 261-274.
- Wan, J., Baylis, K., & Mulder, P. (2015). Trade-facilitated technology spillovers in energy productivity convergence processes across EU countries. Energy Economics, 48, 253-264.

## Chapter 3

# Unmet expectations? Analysis of the adoption of country-specific recommendations in the fields of energy and infrastructure in Germany

**Julia Jänisch**
University of Münster, Germany & University of Victoria, Canada

## 1 Introduction

Germany is often seen as a leading country in terms of climate-friendly environmental and energy policies, both within Europe and around the world (Eckersley, 2016; Liefferink et al., 2009; Liefferink & Wurzel, 2017). The German energy policy is commonly known as Energiewende. Some of the more significant aspects of this policy include the decision to phase out nuclear power in 2011 after the reactor disaster in Fukushima, the expansion of renewable energies, and the decision to phase out coal by 2038 (Federal Ministry for Economic Affairs and Energy, 2020a). These are some of the more ambitious targets found within

**the European Union (EU) (Rechsteiner, 2021). This research paper addresses the question of whether Germany meets its own expectations regarding environmental and energy policies and its leading role in achieving a smart and sustainable Europe.**

This analysis is based on the EU's country-specific recommendations (CSRs) issued annually to the member states as part of the European Semester. The Semester was introduced after the 2009 financial crisis to better coordinate national policies across the EU so as to prevent such a crisis in the future (D'Erman & Verdun, 2022) . To investigate the research question in detail, the CSRs concerning Germany in the areas of environment and infrastructure/energy are considered. The analysis is based on the EUROSEM dataset (D'Erman et al., 2021), which includes all CSRs from 2012–2018. Using the dataset and Germany's responses to the CSRs in its annual National Reform Programmes (NRPs), this paper assesses Germany's adaptation to the CSRs issued by the EU.

Two country-specific recommendations frequently issued to Germany are the demand to expand the electricity and gas grids, as well as the need for stronger competition in the railway market. This paper examines these two sets of recommendations in greater detail as case studies. The focus is on which actors and political levels are involved in the implementation of these policy areas in the country.

In the next section, a literature review describes the European Semester and the CSRs and presents research already existing in this area along with an overview of previous research on implementation of EU environmental policy in Germany. This review is followed by the application of a theoretical model by Börzel (2000) to the implementation of CSRs in Germany. Subsequently, the empirical part of the paper analyses Germany's adaptation to CSRs in the areas of environment and infrastructure/energy using the EUROSEM dataset. The analysis shows that the adaptation could be strongly improved if the objective is to meet the stated goals of Energiewende. Detailed attention is paid to the demand to expand the electricity and gas grids and the demand for more competition in the railway market. The discussion section examines the extent to which these CSRs have been adopted in Germany and the difficulties emerging in the process. The conclusion summarises the results of the analysis and offers policy recommendations.

## 2 Literature review

The European Semester was introduced by the EU in 2011 as part of the Europe 2020 strategy (European Commission, 2010). The semester is the EU's response to the financial crisis of the late 2000s. It marks an expansion of EU governance in the context of influencing the national policies of the member states without handing over competences to the EU. Within the semester, the EU also makes country-specific recommendations to member states in various policy areas (Verdun & Zeitlin, 2018). During the last decade, several authors have dealt with the European Semester and CSRs in numerous research papers.

Many publications focus on the interactions of the two levels of governance – the EU and the member states – regarding the content of the CSRs; specifically, on their implementation and interpretation in the context of the Semester. There are case studies of specific countries (Bekker, 2016; Jansson et al., 2019), the comparison of performance regarding the recommendations for the southern and northern EU states (D'Erman et al., 2022), and on policy coordination within the Semester in the context of the COVID-19 crisis (D'Erman & Verdun, 2022). Also relevant here is literature that focuses on the role of member states in the Semester process (Haas et al., 2020; Maatsch, 2017; Woźniakowski et al., 2021). A growing body of literature engages with case studies of CSRs and specific EU member states (Azzopardi-Muscat, 2015; Bekker, 2021; Mariotto, 2022). Some generalisable findings from this body of work are that domestic interests and national governments are capable of both influencing the content of CSR language and framing the import of the European Semester in local contexts. Other authors engage with the utility of the European Semester for encouraging change, or at least improved coordination among member states. Efstathiou and Wolff (2018), and Darvas and Vihriälä (2013) both discuss whether the removed non-intrusive nature of the Semester is a suitable instrument for delivering policy advice at all. A central point here is that the long-term implementation of CSRs among the member states is weak, particularly in the euro area (Gros and Alcidi, 2015). For this reason, in 2020 the European Court of Auditors (2020) called for better implementation of the CSRs.

Green policy, which is another way of labelling environmental and energy policies, has become a flagship of the EU, particularly since the start of the von der Leyen Commission and introduction of the European Green Deal in 2019 (European Commission, 2019). EU environmental policy started several decades ago with the first Environmental Action Programme (EAP) in 1973 (Council of the European Communities, 1973) and has developed extensively since then. 'Green Europe' has become a new identity for the EU, almost like a brand attribute of the EU to the European public (Lenschow & Sprungk, 2010).

"Green policy has become a flagship of the EU,"

Because of this important feature, environmental policy integration and implementation through the EU member states has been widely studied (Drazkiewicz et al., 2015; Jordan and Lenschow, 2010; Knill & Lenschow, 2000; Lenschow, 1999; Pollex & Lenschow, 2020; Weale, 1999). Work in this area shows broad agreement among the member states to implement environmental policy. Nevertheless, important differences are found in the exact manner of implementation. In particular, cross-national convergence on this topic is low while the implementation gap is considerable. Knill and Lenschow (1998) conclude that the impact of German administrations on the implementation of EU environmental policy is negative due to the inflexibility in breaking up existing structures. However, industry can be made to implement environmental protection measures. Héritier and Eckert (2008) found that a legislative proposal by the government is sufficient for industry itself to start implementing environmental protection measures.

## 3 The pull-and-push model

In 2000, Börzel explains why Germany partly fails to implement EU environmental directives using a "push-and-pull" model. In this model, the implementation of EU environmental policy is difficult when member states incur high costs because these high costs reduce the incentive to implement the policy. However, policy adaptation can still occur if certain push and pull factors are present. Among the pull factors there are national actors that pull the implementation of the policy into the domestic politics of a member state. Push factors include actors like EU institutions, which can increase the pressure on member states by imposing sanctions in case of non-implementation. These sanctions can be financial or legal, but it is also important to note that some forms of pressure are reputational such as Lens chow when the EU makes public the transposition rates of different member states as concerns various directives (Börzel, 2000).

This paper applies a modified version of the pull-and-push model to the implementation of the country-specific recommendations in the environmental and energy/infrastructure sectors in Germany. The change in structures in these areas is very cost-intensive. Even if Germany is encouraged by the EU to spend more to implement the CSRs (Haas et al., 2020), it has little incentive to implement appropriate measures and change the status quo since the legal basis of the CSRs is weak. In principle, CSRs may be considered as soft law. According to the model, pushes and pulls can still lead to CSRs being implemented. Due to the legal situation in the country, the push factor is not very pronounced. The implementation of CSRs is not mandatory in contrast to EU directives whose implementation is essential. The possibilities to exert legal or financial pressure are therefore quasi non-existent for the EU institutions. The pressure that can be exerted from above is therefore more moral, in that an appeal can be made to Germany's responsible position as a leading country. Some political pressure can be exerted by linking the implementation of CSRs to other binding objectives but, apart from this linkage, the pressure from above is low overall for non-legally backed CSRs (Vanhercke & Verdun, 2022).

The focus here is therefore on the pull factors that may impact Germany's adaptation to the CSR prescriptions. Among actors involved in the 'pull' factors, Börzel (2000) counts political parties and environmental organisations, as well as the media and powerful interest groups such as trade unions and business associations. Specifically to the CSRs in the environmental realm, these actors also include interest groups outside the economy as well as newly emerging social movements, activist groups, and non-governmental organisations (NGOs), e.g., the German Federation for the Environment and Nature Conservation (BUND). A pull actor can also be the various political levels such as the Länder or the municipalities, provided they are not affected by having to bear the costs of implementing the CSRs. Namely, if they had to bear the cost they would have less interest in implementing them and would therefore this would not be a pull factor. Since implementing the CSRs in the areas of the environment and infrastructure/energy is expensive for Germany and push factors are quasi non-existent, successful implementation of CSRs therefore depends largely on the pull actors. The possible pull actors mentioned are very diverse and are not collectively organised. To be able to exert as much pressure as possible from below, the actors must therefore have sufficient economic power and influence or must be able to rally a broad mass of the population behind them. It should not be forgotten that there are, of course, also interest groups and other German actors who have no interest in implementing the CSRs or are simply unfamiliar with them. If these actors are strong and even more powerful than the pull actors that favour implementation, implementation is likely to be even more difficult. Further still, this might lead to implementation being prevented because there is an overriding interest in maintaining the status quo. From a theoretical perspective, it is nevertheless possible that the CSRs will be successfully adopted in Germany. However, as described, this adaptation depends to a large extent on the pull actors. This paper hypothesises that implementation is therefore less likely to occur on a satisfactory level. The next section examines existing data for two case studies.

## 4 Data analysis

The European Union pronounces country-specific recommendations for different policy areas, which have been grouped into overarching categories in previous research (Crespy & Vanheuverzwijn, 2019; D'Erman et al., 2019; Efstathiou & Wolff, 2018). In this paper, the categories of D'Erman et al. (2019) are used since this group of researchers also developed the EUROSEM dataset used hereafter. This paper examines two of the policy areas contained within the ten categorisations – environment, and infrastructure/energy. A relevant finding of D'Erman et al. (2019) is that the number of CSRs relating to the environment and infrastructure/energy are declining over time. This development should be viewed particularly critically because climate change and its consequences are having increasing impacts on the global economy and hence on growth and jobs – a key goal of the Semester's attention to macroeconomic coordination.

The CSR EUROSEM dataset is a new dataset that includes all CSRs for countries within the eurozone between the 2012 and 2018 (D'Erman et al., 2021). The authors of the dataset coded the CSRs formulated in texts according to an established scheme and thus made them comparable on an empirical level. Thus far, some research has been done using this dataset (Haas et al., 2020; Mariotto, 2022). For Germany, there is a total of 127 CSRs within the time span of the dataset, distributed across different policy areas. For our study, only the policy areas environmental and infrastructure/energy are relevant and therefore only 22.83% of the 127 CSRs are examined. Viewed in isolation, however, only 3.94 % of German CSRs relate to the area of the environment. Both the areas of the environment and infrastructure/energy are considered together in this study. The dataset also shows how the EU rates progress relative to individual CSRs. The EU assesses progress in its annual Country Reports. Information contained in these is also included in the dataset. The score ranges from 1 (no progress) to 5 (full implementation). On average, Germany scores 2.31 for progress, meaning that progress is limited (D'Erman et al., 2021). In other words, the implementation of CSRs in these policy areas in Germany could be greatly improved. This result is consistent with the literature that reveals CSRs are generally not implemented enough in the member states (Gros & Alcidi, 2015). This raises the question of whether Germany is meeting the expectations placed on it as a leading country in green policies within Europe and the world in general. It is also of interest to examine why progress is limited on average. It is assumed at this point that only pull actors can ensure that the CSRs are adopted. The fact that the progress of implementation is on average only limited suggests that the pressure of these actors is not strong enough, or that the pressure of competing interest groups against the implementation of these CSRs is stronger.

Germany responds to the CSRs in its annual national reform programmes. Here, Germany explains through which measures it would like to adopt the CSRs and also reports if it does not agree with the EU's proposals as it believes that many measures have already been taken in the area in question. Germany responds to the 2012 CSRs in its 2013 NRP, etc. Therefore, for this analysis, the NRPs from 2013–2019 are considered. It is noticeable that Germany addresses the CSRs less in its NRP over time. Instead, the focus in the NRPs is on the Europe 2020 strategy. Nevertheless, the NRPs are important for the analysis.

Within the seven observed years in the dataset, there are five primary country-specific recommendations, all of which repeat almost verbatim over the years. These include "minimise costs of energy transition" (occurs in the years: 2012, 2013, 2014), "expand electricity and gas grids" (occurs in the years: 2012, 2013, 2014), "remove barriers to competition in the rail market" (2012, 2013, 2014, 2015), "coordinate energy policy with neighbouring countries" (2014, 2015), and "more public investment in infrastructure" (2014, 2015, 2016, 2017, 2018) (author's analysis based on D'Erman et al. (2021)).

This paper concentrates on two of these CSRs: "expansion of the electricity and gas networks" and "eliminate barriers to competition in the railway market". These CSRs were selected for various reasons. Both CSRs selected are relatively concrete and measurable, while the other three CSRs are formulated in general terms and therefore cannot be considered so easily as case studies at this point. The chosen CSRs are also related to the topic of infrastructure. However, one focuses more on infrastructure in the area of energy, while the other focuses more on environmental protection through the expansion of public transport. Special attention is paid to the actors involved and the process of implementation in the two cases.

### 4.1 Case 1: Expansion of the electricity and gas networks

The first case study deals with the demand to expand the electricity and gas networks in Germany. The CSR "expansion of the electricity and gas networks" is addressed to Germany in almost the exact wording in the years 2012–2014. Progress in implementing this recommendation is initially rated at 3 for two years and at 2 in the final year, which means that in principle some progress is being made, but that it is declining. The expansion of the power grid is part of the German Energiewende to supply industry and households predominantly with renewable electricity in the future (Federal Ministry for Economic Affairs and Energy, 2020b). Especially in view of Germany's nuclear phase-out in 2022 and the perspective phase-out of coal energy, grid expansion is

becoming ever more important. Renewable energies in Germany are mainly generated by wind and solar energy. Most wind turbines are located on- and offshore in the coastal regions of the North Sea and Baltic Sea. These regions are relatively densely populated compared to the entire country. The energy generated must therefore be directed to the south and west of Germany, where it is needed. For this reason, grid expansion is a core element of a successful Energiewende in Germany.

Just like the EU, the German government sees the need to expand the grid for the same reasons mentioned above and seeks to optimise the existing grid by expanding it. This need was already prevalent in the last decade. Regarding expansion of the electricity grid, in its 2013 NRP Germany points to the existing legislation with the Federal Requirement Plan (BBP) and the Grid Expansion Acceleration Act (NABEG) as the central instruments and the Grid Development Plan (NEP) as the basis for the expansion.

After the recommendation to expand the networks was again brought to Germany's attention in 2013, the German government reaffirmed its will to do so in its 2014 NRP. The Federal Requirement Plan is again mentioned as the key steering instrument for the measure. In addition, reference is made to the Grid and Offshore Grid Development Plan and the Federal Network Agency (FNA) as the responsible institution (Federal Ministry for Economic Affairs and Energy, 2014).

The recommendation is repeated by the EU in 2014. In its response to this in the 2015 NRP, Germany again points to the existing legislation. Further, the Renewable Energy Sources Act passed in 2014 had made it easier to lay underground power cables. Moreover, in 2015 the German government stated that the formal procedure had been initiated for 3 of the 36 planned transmission grids. The NRP 2015 also mentions the goal of gaining access to the LNG terminals of the EU member states (Federal Ministry for Economic Affairs and Energy, 2015).

As seen from the analysis, Germany shares the EU's view that the networks need to be expanded. Legislation already exists in this regard. However, the statement in the 2015 NRP that the formal processes had already been initiated for 3 of the 36 planned transmission networks shows that the expansion efforts are progressing very slowly. The EU also rates the progress as too slow. As clear from the NRPs, the legislation and the actors involved are numerous. In addition to the federal government and the states, the Federal Network Agency is also mentioned. Applied to the push-and-pull model, these actors can be seen as push factors. It is not clear from the brief statements in the NRPs which law and which actor is responsible for action at different points in time. For this reason, the process of network expansion is examined in more detail below.

In Germany, there are four transmission system operators (TSO) among which the electricity grids in the country are divided. The TSO provide a graphical overview of the individual process phases and the players involved in grid expansion.

### Table 1: Process of grid expansion in Germany

| | | Scenario framework | Grid Development Plan (NEP) | Consultation | | | Federal Requirements Plan (BBP) | |
|---|---|---|---|---|---|---|---|---|
| | | Every year (from 2011 to 2015) | | | | | min. every 4 years | |
| **Process stages** | Development of the scenario framework | Consultation scenario framework | Preparation of the 1st draft | Consultation and revision of the 1st draft | Revision of the 2nd draft | Consultation of the 2nd draft, preparation of an environmental report, confirmation NEP | Draft BBP based on NDP and environmental report | Resolution of the BBP by the federal legislature |
| **Process responsibility** | TSO | FNA | TSO | | FNA | | | |
| **Consulted stakeholders** | | Public and TSO | | Public, TSO and FNA | TSO | Public and TSO | | |

Source: Author's translation and modification based on (Transmission System Operators, 2022).

This overview shows that grid expansion in Germany involves a wide variety of players (push and pull actions) occurring over several phases. In 2011, it was decided by law that the transmission system operators must revise the Grid Development Plan annually. Due to the considerable effort involved, this process only has to be carried out every 2 years after 2016 (Schmid et al., 2019). This is already a possible reason for the little progress made on expanding the grid in the observed 2012–2014 period. It is reasonable to conclude that the high bureaucratic effort caused by the revised Grid Development Plan has slowed down the expansion. In addition, the Federal Requirements Plan must be legally adopted at least every 4 years. Thus, there is the continuous and rotational revision of both plans. The overview shows eight process phases with two main responsible actors (the TSO and the FNA), that alternate in phases, with the public as the third stakeholder group. In most phases, the non-principal actors nevertheless have an advisory role. Moreover, the federal legislature is ultimately the only actor that can pass the Federal Requirements Plan.

The process shows close coordination between the network operators as the responsible companies and the Federal Network Agency as the regulatory institution, which is goal-oriented in terms of realistic implementation of the networks' expansion. However, the Federal Network Agency is only an executive administrative body with no powers of its own (Schmid et al., 2019). This circumstance is related to a problem that becomes apparent at the very beginning of the process. As a basis for expanding the grid, the scenario framework must be developed by the TSO within the framework of existing laws. However, the developed scenario framework often requires legislative changes to be made. This makes it difficult for the Federal Network Agency to develop a realistic Grid Development Plan since it must work with existing laws that it itself cannot change. Therefore, legislative institutions such as ministries and the Parliament have to be involved in the process (Schmid et al., 2019). Namely, the push factors need to be more strongly involved. From this analysis, two additional circumstances emerge that are able to influence the speed of the networks' expansion. First, legislation is usually a lengthy process. Accordingly, if legislative changes are first required before the network expansion can begin, this delays the process considerably. Second, legislative intuitions are not initially involved in the process at all. The Federal Network Agency, as a subordinate body of the Ministry of Economics, must therefore first communicate to the responsible political levels that an amendment to the law is necessary. This slows down the grid expansion process as well.

The NEP process is also conducted following the principle that additional grids should only be built as a last resort. Priority is given to the optimisation and reinforcement of existing networks (Schmid et al., 2019). Thus, expanding the networks is not Germany's first choice and thus the push factor is weak in this case. From economic, administrative and ecological points of view, it also makes greater sense to optimise the existing routes first. However, this was not considered by the EU in its CSRs, which points to a weakness of the CSRs' content. Therefore, Germany may be assessed as making hardly any progress in expanding the networks.

The inclusion of other stakeholders in different phases of the process as advisors shows that many interests are involved in the process. These interests must be coordinated and harmonised, which can sometimes entail a lengthy process. This coordination is another reason that could delay grid expansion. The largest and at the same time least defined interest group in this context is the public. These pull factors are residents and landowners as well as environmental protection organisations and other NGOs, among others. The stakeholder group public thus once again bundles many heterogeneous interests. Problems can arise, for example, with residents and landowners if networks are to be routed through their private properties or close to their homes. Reaching a solution appeasing both sides sometimes requires negotiations that can take a long time. This issue comes into play when the NEP process is complete because only then does the concrete spatial planning of new train paths begin. This subsequent process is called the regional planning procedure. A corridor of 1-km width will be defined. The determination considers nature, the environment, and the interests of citizens. Accordingly, many authorities, NGOs and private individuals are involved in this process (Schmid et al., 2019). Since this corridor must be defined for the entire length of the new route and the routes are often very long, this process can also take a long time as the total result requires several thousands of kilometres of network to be completed. Given that the decision to phase nuclear power out was taken in 2011, eight new routes have been planned in Germany, which are to be commissioned to be ready between 2027 and 2031. This shows that the planning process is a very lengthy; one that can take up to 20 years. Currently, all lawsuits filed by counties, municipalities and interest groups against the routes have been dismissed. However, there are still opportunities for legal action in the coming years (Assendorf & Lothringer, 2022).

Natural gas also plays an important role in successfully shaping the energy transition in Germany. The country has been and continues to be a major importer of natural gas. To ensure that this supply remains secure, and that the energy transition can continue to progress, a functioning and well-developed network system is important. Concerning the CSRs' requirement to expand Germany's gas network, the federal government has also addressed this objective. According to the Gas Grid Development Plan 2012, around 1,300 km of new pipelines for natural gas are to be built by 2022 (Federal Ministry of Economics and Technology [BMWi], 2013). In the period between 2012 and 2015 considered here with regard to the CSRs, the network was to be expanded by 200 km (Bundesnetzagentur, 2012). Within the framework of the gas network development plan, companies and associations have the opportunity to comment in the process. This was done by 63 stakeholders in relation to the 2012 plan (Bundesnetzagentur, 2012), revealing that many stakeholders are involved here as well.

The gas issue has become even more topical and urgent due to Russia's belligerent attack on Ukraine starting in February 2022. In order to avoid dependence on Russian gas, the German government has been changing its course since the war began. The newly constructed Nord Stream 2 pipeline through the Baltic Sea will not go into operation. Instead, Germany has started building LNG terminals on the North Sea coast. Germany is one of the last countries in the EU not to already have such terminals, which allow liquefied gas to be delivered by ship. According to a study, European countries (except Germany) primarily purchased LNG from the following countries, ranked by their share of imports: the USA, Qatar, Russia and Nigeria. With 17.5 %, Russia was the third-largest supplier, which must now be substituted (Franke et al., 2022). In 2020, Germany imported natural gas via pipelines chiefly from Russia, the Netherlands and Norway. The share of all imports accounted for by Russia was over 56% (Federal Ministry for Economic Affairs and Climate Protection, 2022). By April 2022, this import share was reduced to 35%. Instead, more gas was sourced from the Netherlands and Norway.

“Germany is one of the last countries in the EU not to already have LNG terminals.”

In developing LNG terminals, there is a dilemma between the need to import gas and, at the same time, gas as a climate-damaging energy source (Brauers et al., 2021). Gas is needed in Germany for households and industry, but also to be able to push the energy transition forward. In the future, gas will be replaced by green hydrogen. The German government is therefore planning to equip the LNG terminals technically to allow the switch to be made without any problems. Construction of the LNG terminals is expected to take at least several months. Brauers et al. (2021) identify three groups of actors in the context of these planned LNG terminals: the state, the private sector and civil society. These groups are further subdivided into more than ten subgroups and hence it is obvious also here that many interests must be taken into account in the expansion. The LNG sites are located in sparsely populated regions near the North Sea. Germany’s challenge is to then transport the energy to the places where it is needed. These are principally the Rhine-Main region and the south of

Germany. The problem here is similar to that with electricity – the energy has to be transported elsewhere. As a result, in the future, northern Germany is set to play an increasingly important role in ensuring that the entire country is supplied with electricity and gas.

### 4.2 Case 2: Elimination of barriers to competition in the railway market

The second case study deals with the EU's demand that Germany remove the barriers to competition in the rail market. In other words, access to the market is to be made easier for competitors. The CSR "eliminate barriers to competition in the railway market" appears almost word for word in the CSRs in 2012 through to 2015. Germany's progress here is on average rated at between 1 and 2, meaning that "no or limited progress" has been made in this area.

With regard to rail transport in Germany, there is already extensive literature on competition, liberalisation and regulation (Ait Ali & Eliasson, 2021; Beria et al., 2012; Laurino et al., 2015; Link, 2004, 2012, 2016; McKinsey & Company, 2019; Nash et al., 2013).

When it comes to competition in the German railway market, a distinction must be made between the rail freight, regional and long-distance passenger sectors. Germany refers to all three sectors in its national reform programmes from 2013 to 2016. Competition in the rail freight sector significantly increased in the period in question. While the share of competitors to Deutsche Bahn in this sector was still 26% in 2013, it was already over 33% in 2014 (Federal Ministry for Economic Affairs and Energy, 2014; BMWi, 2013). If one considers the share of 5% Deutsche Bahn held in 2002, the development becomes even more apparent, as stated by the German government in its 2015 NRP (Federal Ministry for Economic Affairs and Energy, 2015). Due to these developments, the rail freight sector will not be considered further in this analysis. The focus is instead on the two passenger transport sectors.

The reasons for reducing obstacles to competition in local passenger transport are to lower prices through more providers, thereby increasing the demand for rail travel and, as a result, increasing the frequency of train journeys as well as the expansion and new construction of train lines. In regional passenger transport, this could increasingly substitute the car as the dominant form of transport, especially in rural areas. On long-distance routes, domestic air connections could increasingly be substituted by rail connections. Both would lead to a reduction in Germany's dependence on fossil fuels and help lower CO2 emissions.

In its NRPs, Germany addresses the development of competition in regional and long-distance rail passenger transport. The share of competitors in regional rail passenger transport rose from 13% in 2012 to 29.3% in 2015. The German government continuously indicates the share of competitors in long-distance rail passenger transport as less than 1%. Overall, the share of competitors in the total rail market amounted to 19% in 2014 (Federal Ministry for Economic Affairs and Energy, 2014, 2015, 2016; BMWi, 2013). The German government emphasises its desire to further expand competition in the railway market. Various interest groups, such as the Pro-Rail Alliance (Allianz pro Schiene), support this project. Improving competition is hence desired by both push and pull actors. This is to be achieved with the help of the Railway Regulation Act under the supervision of the Federal Network Agency as the regulator

(Federal Ministry for Economic Affairs and Energy, 2014; BMWi, 2013). In the 2015 NRP, Germany states that it sees a mixed picture in competitive development, yet it emphasises the positive developments. As part of the railway reform, there is now "the right to the non-discriminatory use of the rail network and service facilities for all railway undertakings domiciled in Germany" (Federal Ministry for Economic Affairs and Energy, 2015). In order to strengthen competition in regional rail passenger transport, task ownership and fiscal responsibility has also been transferred to the Länder (ibid.). In the 2015 and 2016 NRPs, Germany also shows its effort to implement the EU Directive 2012/34/EU to establish a single European railway area: "On 13 January 2016, the Federal Cabinet adopted the draft of the Act to Strengthen Competition in the Rail Sector (Gesetz zur Stärkung des Wettbewerbs im Eisenbahnbereich) which contains the Rail Regulation Act (Eisenbahnregulierungsgesetz) as a centrepiece" (Federal Ministry for Economic Affairs and Energy, 2016).

Therefore, as shown in the NRPs, there is a significant difference between regional and long-distance passenger transport in Germany. While competition in regional passenger transport is steadily growing, the Deutsche Bahn holds a quasi-monopoly in long-distance passenger transport. After privatising in 1994, the long-distance railway market was opened for competitors. However, there is no system for awarding contracts for routes. It is hence more difficult for other long-distance providers to enter the market. There are discussions about whether routes should also be awarded in long-distance transport, as the EU additionally recommends in its CSRs. Also, in the current discourse, researchers make concrete proposals on how to improve long-distance passenger transport in Germany (Knorr & Eisenkopf, 2022). The situation is different in the German regional passenger transport sector. Local passenger transport is the responsibility of the Länder, of which there are 16 in Germany. In local passenger transport, the Länder are further subdivided into individual transport associations. These transport associations and municipal special-purpose associations put certain train links out to tender, which companies can then apply for. The company that makes the most attractive offer wins the contract (Link, 2016). Local passenger transport is also more heavily subsidised than long-distance transport. This means that smaller routes can also be served. The ultimate objective for these sets of recommendations is that as many citizens as possible can be connected to the rail network and thus a real alternative to the car can be created.

## 5 Discussion

This paper shows that on average Germany has not met expectations with respect to the country-specific recommendations. In both case studies on the CSR "expansion of the electricity and gas networks" and the recommendation "eliminate barriers to competition in the railway market", a very large number of actors was involved. The push factor – German federal government – was either insufficiently involved, caught up in legislative processes that were too complicated, or had no interest in implementing the recommendation. The pull actors consisted of many individual groups with mixed interests for and against implementation of the recommendations. Both delayed the process. Thus and as the empirical analysis shows, Germany's progress was limited. On one hand, this raises the question of Germany's pioneering role in environmental and climate protection, but also the question of the meaningfulness of CSRs. It is questionable whether a country's performance and progress can be fully captured in the CSRs. This finding concurs with the results of other authors, e.g. Efstathiou and Wolff (2018). The CSRs are formulated annually as part of the European Semester and thereby provide a good monitoring basis. However, their formulation is always quite general and does not offer a precise roadmap or tangible solutions. The EU also lacks the competence for direct interference. Accordingly, the country-specific recommendations are not binding on the member states. In terms of content, the CSRs are also often too vague. For example, the EU recommended that Germany expand its power grids. The German response was to first to optimise the existing network, which makes sense in an economic, administrative and ecological way.

"This paper shows that on average Germany has not met expectations with respect to the country-specific recommendations."

There are therefore suggestions on how the CSRs could be improved. Simon et al. (2022) recommend, for example, that the EU formulate CSRs with clearly limited timeframes. Although these time targets would still not be binding, they would make the CSRs more concrete. In this context, they also propose formulating the CSRs as measurable targets. In relation to the case studies, a clear expansion target for power lines or a percentage of competitors in long-distance passenger transport could thus be formulated. With respect to the case studies considered, we see that many actors are often involved in the expansion of networks. This slows down the process and brings high costs. In order to act more efficiently in this case, Germany is required to streamline the process. Successfully mastering the energy transition also means acting faster than in the past decade. Many of today's problems could have been avoided had more efficient action been taken in the early 2010s – part of the period under review. The same applies to passenger train services. The EU's recommendation to create stronger competition is part of the necessary measures. In long-distance traffic, we have seen that there is virtually no competition in Germany. Still, action is also needed on other levels if the train is to become a genuine alternative to the plane and the car. The long-distance network would have to be expanded in a way that makes domestic flights a less attractive option – this would also involve adjusting fares accordingly. Both of these factors also apply to rural connections. A well-running network as well as reasonable prices should create an incentive to shift traffic away from the car. The EU's CSRs concerning rail transport are thus going in the right direction towards broadly developed passenger rail transport, yet are far from sufficient. Following this analysis, the question arises as to how meaningful the CSRs in the areas of environment and energy/infrastructure are in the first place. In terms of the push-and-pull model applied, it appears that both factors are too weak to implement the CSRs. Top-down, push factors would have to be promoted. This could be done by setting incentives such as financial support. Penalties for non-implementation are not legally possible since the CSRs are not binding. Strengthening the pull factors is much more difficult because these are mostly NGOs or the public and, as a group, they are heterogeneous and disorganised. They also often lack economic power and hence influence on legislation, especially in the area of the environment.

## 6 Conclusion

This paper has dealt with the country-specific recommendations for Germany in the areas of the environment, energy and infrastructure between 2012 and 2015 to examine any adaptation of domestic policies following the CSR suggestions. The basis for the analysis was the push-and-pull model of Börzel (2000), which shows that primarily pull factors are responsible for the implementation of the CSRs in Germany given that the European Union cannot exert any pressure (or push) from above. Pull actors are political parties and environmental organisations, powerful economic interest groups, but also the media. Subsequently, the newly developed EUROSEM dataset (2021) was used to empirically investigate whether Germany is implementing the CSRs in the relevant years and policy areas. Based on two case studies on the expansion of electricity and gas grids and on competition in rail transport, it was shown that Germany's implementation of the CSRs in the realms of the environment, energy and infrastructure could be improved. Applied to the push-and-pull model, we found that in both cases the push factors are quasi non-existent because the CSRs are not binding. As described, grid expansion is a long and comprehensive process in which many players are involved. Pull factors in this case include the network operators, that naturally have an interest in expanding the networks, and local actors like residents and NGOs. Bringing these different interests together weakens the pull factor immensely. In the second case, pull factors exist, for instance the Pro-Rail Alliance and passenger associations. Still, they too have little room for improvement due to the legislation. The legislation still does not require that long-distance routes be put out to tender and hence 96% of the routes are currently operated by Deutsche Bahn. It is up to the federal government to act as a push factor and amend this.

### Acknowledgements

This article was supported in part by a Jean Monnet Network entitled "The Politics of the European Semester: EU Coordination and Domestic Political Institutions (EUROSEM)" Agreement no.: 600110-EPP-1-2018-1-CA-EPPJMO-NETWORK (Grant agreement no. 2018-1359), with the support of the Erasmus+ programme of the European Union.

## REFERENCES


- Ait Ali, A., & Eliasson, J. (2021). European railway deregulation: an overview of market organization and capacity allocation. Transportmetrica a: Transport Science, 1–25. https://doi.org/10.1080/23249935.2021.1885521
- Assendorf, D., & Lothringer, C. (2022). Neu verkabelt. Die ZEIT. https://www.zeit.de/wq/2022-17#infografik-elektrizitaet
- Bekker, S. (2016). Is there flexibility in the European Semester process? Exploring interactions between the EU and member states within post-crisis socio-economic governance. The European Internal Market - Challenges for Free Moment: 1/2016. Swedish Institute for European Policy Studies. http://www.sieps.se/sites/default/files/2016_1_rapp_eng.pdf
- Beria, P., Quinet, E., Rus, G. de, & Schulz, C. (2012). A comparison of rail liberalisation levels across four European countries. Research in Transportation Economics, 36(1), 110–120. https://doi.org/10.1016/j.retrec.2012.03.014
- Börzel, T. A. (2000). Why there is no 'southern problem'. On environmental leaders and laggards in the European Union. Journal of European Public Policy, 7(1), 141–162. https://doi.org/10.1080/135017600343313
- Brauers, H., Braunger, I., & Jewell, J. (2021). Liquefied natural gas expansion plans in Germany: The risk of gas lock-in under energy transitions. Energy Research & Social Science, 76, 102059. https://doi.org/10.1016/j.erss.2021.102059
- Bundesnetzagentur (2012). Konsultationsergebnisse zum Entwurf des Netzentwicklungsplans Gas 2012.
- Council of the European Communities (1973). Declaration of the Council of the European Communities and of the Representatives of the Governments of the Member States, meeting within the Council on 22 November 1973, on the programme of action of the European Communities on the environment. Official Journal of the European Communities, 16(C 112).
- Crespy, A., & Vanheuverzwijn, P. (2019). What "Brussels" means by structural reforms: empty signifier or constructive ambiguity? Comparative European Politics, 17(1), 92–111. https://doi.org/10.1057/s41295-017-0111-0
- Darvas, Z., & Vihriälä, E. (2013). Does the European Semester deliver the right policy advice? Bruegel Policy Contribution, 2013/12.
- D'Erman, V., Haas, J., Schulz, D. F., & Verdun, A. (2019). Measuring Economic Reform Recommendations under the European Semester: 'One Size Fits All' or Tailoring to Member States? Journal of Contemporary European Research, 15(2), 194–211. https://doi.org/10.30950/jcer.v15i2.999
- D'Erman, V., Haas, J., Schulz, D. F., & Verdun, A. (2021). EUROSEM CSR Dataset: Version 1.0. Scholars Portal Dataverse. Advance online publication. https://doi.org/10.5683/SP2/CYRZHE
- D'Erman, V., Schulz, D. F., Verdun, A., & Zagermann, D. (2022). The European Semester in the North and in the South: Domestic Politics and the Salience of EU-

Induced Wage Reform in Different Growth Models JCMS: Journal of Common Market Studies, 60(1), 21–39. https://doi.org/10.1111/jcms.13274

- D'Erman, V., & Verdun, A. (2022). An Introduction: "Macroeconomic Policy Coordination and Domestic Politics: Policy Coordination in the EU from the European Semester to the Covid-19 Crisis" JCMS: Journal of Common Market Studies, 60(1), 3–20. https://doi.org/10.1111/jcms.13276
- Eckersley, R. (2016). National identities, international roles, and the legitimation of climate leadership: Germany and Norway compared. Environmental Politics, 25(1), 180–201. https://doi.org/10.1080/09644016.2015.1076278
- Efstathiou, K., & Wolff, G. B. (2018). Is the European Semester effective and useful? Bruegel Policy Contribution, 2018/09.
- European Commission (2010). Europe 2020: A strategy for smart, sustainable and inclusive growth, COM(2010) 2020.
- European Commission (2019). Communication of the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal., COM(2019), 640 final, Brussels 11.12.2019.
- European Court of Auditors (2020). Special Report 16/2020: The European Semester - Country Specific Recommendations address important issues but need better implementation.
- Federal Ministry for Economic Affairs and Climate Protection (2022). Zweiter Forschrittbericht Energiesicherheit.
- Federal Ministry for Economic Affairs and Energy (2014). National Reform Programme 2014.
- Federal Ministry for Economic Affairs and Energy (2015). National Reform Programme 2015.
- Federal Ministry for Economic Affairs and Energy (2016). National Reform Programme 2016.
- Federal Ministry for Economic Affairs and Energy. (2020a). Final decision to launch the coal-phase out - a project for a generation [Press release]. https://www.bmwi.de/Redaktion/EN/Pressemitteilungen/2020/20200703-final-decision-to-launch-the-coal-phase-out.html
- Federal Ministry for Economic Affairs and Energy (2020b). Der Netzausbau schreitet voran. https://www.bmwi.de/Redaktion/DE/Downloads/M-O/netzausbau-schreitet-voran.pdf?__blob=publicationFile&v=8
- Federal Ministry of Economics and Technology (2013). National Reform Programme 2013.
- Franke, D., Ladage, S., Lutz, R., Pein, M., Pletsch, T., Rebscher, D., Schauer, M., Schmidt, S., & Goerne, G. von. (2022). BGR Energiestudie 2021 - Daten und Entwicklungen der deutschen und globalen Energieversorgung. Bundesanstalt für Geowissenschaften und Rohstoffe. https://doi.org/10.25928/ES-2021

- Gros, D., & Alcidi, C. (2015). Economic Policy Coordination in the Euro Area under the European Semester. CEPS Special Report(123).
- Haas, J. S., D'Erman, V. J., Schulz, D. F., & Verdun, A. (2020). Economic and fiscal policy coordination after the crisis: is the European Semester promoting more or less state intervention? Journal of European Integration, 42(3), 327–344. https://doi.org/10.1080/07036337.2020.1730356
- Héritier, A., & Eckert, S. (2008). New Modes of Governance in the Shadow of Hierarchy: Self-regulation by Industry in Europe. Journal of Public Policy, 28(1), 113–138. https://doi.org/10.1017/S0143814X08000809
- Jansson, O., Jansson, J., & Ottosson, J. (2019). Neither sticks nor carrots: Swedish trade union involvement in the European Semester. Case study Sweden. OSE Working Paper Series(42), 157–197. https://doi.org/10.4324/9780203408704-16
- Knill, C., & Lenschow, A. (1998). Coping with Europe: the impact of British and German administrations on the implementation of EU environmental policy. Journal of European Public Policy, 5(4), 595–614. https://doi.org/10.1080/13501769880000041
- Knill, C., & Lenschow, A. (Eds.). (2000). Implementing EU environmental policy. New directions and old problems. Manchester University Press.
- Knorr, A., & Eisenkopf, A. (2022). An alternative regulatory approach for long-distance passenger rail services: An explorative analysis with a focus on Germany. Transportation Research Interdisciplinary Perspectives, 14, 100593. https://doi.org/10.1016/j.trip.2022.100593
- Laurino, A., Ramella, F., & Beria, P. (2015). The economic regulation of railway networks: A worldwide survey. Transportation Research Part a: Policy and Practice, 77, 202–212. https://doi.org/10.1016/j.tra.2015.04.011
- Lenschow, A. (1999). Transformation in European Environmental Governance. In R. Eising & B. Kohler-Koch (Eds.), The Transformation of Governance in the European Union (pp. 37–57). Routledge.
- Lenschow, A., & Sprungk, C. (2010). The Myth of a Green Europe. JCMS: Journal of Common Market Studies, 48(1), 133–154. https://doi.org/10.1111/j.1468-5965.2009.02045.x
- Liefferink, D., Arts, B., Kamstra, J., & Ooijevaar, J. (2009). Leaders and laggards in environmental policy: a quantitative analysis of domestic policy outputs. Journal of European Public Policy, 16(5), 677–700. https://doi.org/10.1080/13501760902983283
- Liefferink, D., & Wurzel, R. K. (2017). Environmental leaders and pioneers: agents of change? Journal of European Public Policy, 24(7), 951–968. https://doi.org/10.1080/13501763.2016.1161657
- Link, H. (2004). Rail infrastructure charging and on-track competition in Germany. International Journal of Transport Management, 2(1), 17–27. https://doi.org/10.1016/j.ijtm.2004.05.002
- Link, H. (2012). Unbundling, public infrastructure financing and access charge

regulation in the German rail sector. Journal of Rail Transport Planning & Management, 2(3), 63–71. https://doi.org/10.1016/j.jrtpm.2013.02.002

- Link, H. (2016). Liberalisation of passenger rail services: Case Study - Germany. Centre on Regulation in Europe (CERRE).
- Maatsch, A. (2017). Effectiveness of the European Semester: Explaining Domestic Consent and Contestation. Parliamentary Affairs, 70(4), 691–709. https://doi.org/10.1093/pa/gsx021
- Mariotto, C. (2022). The Implementation of Economic Rules: From the Stability and Growth Pact to the European Semester. JCMS: Journal of Common Market Studies, 60(1), 40–57. https://doi.org/10.1111/jcms.13265
- McKinsey & Company (2019). The liberalization of the EU passenger rail market: Growth opportunities and new competition.
- Nash, C., Nilsson, J.-E., & Link, H. (2013). Comparing Three Models for Introduction of Competition into Railways. Journal of Transport Economics and Policy, 47(2), 191–206.
- Pollex, J., & Lenschow, A. (2020). Many faces of dismantling: hiding policy change in non-legislative acts in EU environmental policy. Journal of European Public Policy, 27(1), 20–40. https://doi.org/10.1080/13501763.2019.1574869
- Rechsteiner, R. (2021). German energy transition (Energiewende) and what politicians can learn for environmental and climate policy. Clean Technologies and Environmental Policy, 23(2), 305–342. https://doi.org/10.1007/s10098-020-01939-3
- Schmid, E., Zimmermann, H., & Wiesholzer, A. (2019). Stromnetz in Deutschland: Das System, die Netzbetreiber und die Netzentgelte: Eine umfassende Einführung(01).
- Simon, L., Herrmann, O., Juergens, I., Berendsen, S., & Kaspar, L. (2022). Time to reform the European Semester: How to make the EU’s economic surveillance & coordination machanism a key lever for the EU’s green transition.
- Transmission System Operators. (2022). Netzentwicklungsplan Strom. https://www.netzentwicklungsplan.de/de/netzentwicklung/prozessphasen
- Vanhercke, B., & Verdun, A. (2022). The European Semester as Goldilocks: Macroeconomic Policy Coordination and the Recovery and Resilience Facility. Journal of Common Market Studies, 60(1), 204–223.
- Verdun, A., & Zeitlin, J. (2018). Introduction: the European Semester as a new architecture of EU socioeconomic governance in theory and practice. Journal of European Public Policy, 25(2), 137–148. https://doi.org/10.1080/13501763.2017.1363807
- Weale, A. (1999). European Environmental Policy by Stealth: The Dysfunctionality of Functionalism? Government and Policy, 17, 37–51. https://doi.org/10.4324/9781849771221-32
- Woźniakowski, T. P., Maatsch, A., & Miklin, E. (2021). Rising to a Challenge? Ten Years of Parliamentary Accountability of the European Semester. Politics and Governance, 9(3), 96–99. https://doi.org/10.17645/pag.v9i3.4690

Chapter 4

# Towards sustainable recovery in the European Union: The experience of the Spanish recovery plan

**Beatriz Pérez de las Heras**
University of Deusto, Bilbao, Spain

## 1 Introduction

Despite the economic and geopolitical challenges posed by the ongoing COVID-19 pandemic and, more recently, Russia's aggression against Ukraine, the European Union (EU) continues to strive to implement transformative initiatives to ensure an inclusive and resilient recovery. The actions adopted and those being considered are aimed at achieving sustainability in line with the objective of sustainable development that guides the EU's internal and external policies (Arts. 3.3 and 21.2d of the Treaty on European Union). The initiatives undertaken also reflect the EU's commitment to the United Nations' 2030 Agenda for Sustainable Development, which remains the only comprehensive international agenda adopted by all UN members to address the three aspects of sustainable development: economic, social and environmental (UN, 2015). The 2030 Agenda includes 17 Sustainable Development Goals (SDGs) and 169 targets, to be achieved in all countries by 2030 and beyond.

Under its current president Ursula von der Leyen, the European Commission has made the SDGs a visible and inherent element of its political programme (von der Leyen, 2019). With this focus, an array of transformative strategies has been adopted since the beginning of her mandate. Of these, the flagship initiative is undoubtedly the European Green Deal (EGD), which seeks to make the EU the first climate-neutral region in the world by 2050 (European Commission, 2019). The ultimate ambition is to contribute to achieving the main goal of the Paris Agreement on climate change (UN, 2015a). The EGD is at the same time a new growth strategy that seeks to build a modern, resource-efficient, clean and competitive economy, and to ensure a fair and inclusive transition for all. As a comprehensive policy framework, implementation of the EGD is intended to contribute to achieving at least 12 of the 17 SDGs (European Commission, 2020). Complementing the EGD, the European Pillar of Social Rights and its accompanying Action Plan reflect the EU's strategy to ensure a fair and inclusive transition to a new more resilient and competitive economy (European Commission, 2021). Specifically, the Action Plan also seeks to meet SDGs in areas of equal opportunities, employment and working conditions, education and skills, fighting poverty and social inclusion.

"The flagship initiative is undoubtedly the European Green Deal (EGD), which seeks to make the EU the first climate-neutral region in the world by 2050"

Another relevant step included in the political guidelines of the current European Commission is the inclusion of the SDGs in the European Semester cycle, an essential framework for coordinating the economic and employment policies of the EU and the member states. Following presentation of the first Annual Sustainable Growth Strategy in December 2019 (European Commission, 2019a), the 2020 European Semester began to integrate the SDGs, with a specific annex reporting on member states' performance compared to the EU average, and their progress in each SDG area. The Pillar of Social Rights has also been integrated into the European Semester. Progress is assessed on the basis of the four dimensions of competitive sustainability identified by the Annual Sustainable Strategy 2020: environmental sustainability, productivity, fairness, and macroeconomic stability. The 2022 European Semester cycle follows the same path, providing an updated report on the SDG progress of each member state and paving the way for an inclusive, transformational recovery and a more resilient economic model for the future (European Commission, 2021a).

However, the COVID-19 crisis has set back the achievement of sustainable development on both the EU and global levels. The most negative impacts of the pandemic are obviously the high mortality rates and the health implications. The lockdown measures throughout Europe and travel restrictions also negatively impacted the EU's economy and its labour markets, further increasing the pressure on vulnerable groups (SDSN & IEEP, 2020). Further, while the European economy appeared to be beginning a slow recovery throughout 2021, in 2022 this process has been slowed by Russia's invasion of Ukraine, creating more uncertainty, as reflected in significant inflation due to rising energy prices and the disruptions to supply chains (Krammer, 2022).

Nevertheless, albeit at a slower pace (Eurostat, 2022), the EU is continuing to pursue the recovery it initiated in 2020, centring on the launch of the Next Generation EU (NGEU). This temporary financial instrument, worth more than EUR 750 billion (in 2018 prices), will address the economic and social effects of the COVID-19 pandemic, while fostering a greener, more digital and more resilient Europe. The cornerstone of the NGEU is the Recovery and Resilience Facility (RRF), which has a budget of EUR 672.5 billion (in 2018 prices). The NGEU and the current Multiannual Financial Framework (MFF) 2021–2027 form the largest stimulus package ever financed in the EU, with a combined budget of EUR 1.8 trillion (in 2018 prices) (European Commission, 2021b).

Beyond the figures, the most relevant aspect of this recovery package is that it aims not only to alleviate the consequences of the pandemic, but to consolidate and accelerate the transition to sustainability and resilience that started before the pandemic. The 17 SDGs are covered by the financial allocations provided for the 3 pillars of the NGEU: supporting member states' recovery, kick-starting the economy, and learning lessons from the crisis. The NGEU is littered with references to "sustainable", "sustainability", "SDGs" and "Agenda 2030" (Borchardt et al., 2020). From this perspective and in the current challenging circumstances, the EU and its member states have an opportunity to play a leading role in achieving the SDGs, both internally and internationally, while also implementing the recovery strategies.

To benefit from RRF funding, member states were required to submit their national recovery plans by April 2021 within the framework of the European Semester. Each national recovery plan had to include a minimum of 37% expenditure on climate-related activities and a minimum of 20% on digital objectives. The Spanish Recovery, Transformation and Resilience Plan (RTRP) is particularly ambitious, with more than EUR 140 billion in grants and credits from the RRF for the period 2021–2026 and 40% of resources allocated to the green transition (García Vaquero et al., 2021). As the main beneficiary of the NGEU (together with Italy), successful implementation of the recovery plan is important not only for Spain, but the EU as a whole. Provided it is duly aligned with the EU's recovery plan, the EGD and the SDG approach, and in combination with other national recovery plans, effective implementation of Spain's RTRP can become a key lever in enabling more sustainable recovery and shock-resilience in the EU.

Within the context of this process, this chapter analyses the current state of implementation of Spain's post-COVID recovery plan and assesses its contribution to a durable and sustainable recovery in the EU. It is structured as follows. After this introduction, which sets out the general context and broad outlines of the topic, section 2 describes the main initiatives undertaken by Spain in the last 5 years to promote sustainable development, as well as current trends in comparison to the EU and other member states. Section 3 analyses the Spanish recovery plan in detail and assesses it through the lens of the EU's sustainable recovery goals and requirements. Section 4 includes policy recommendations for sustainable recovery across the EU and in Spain. Finally, Section 5 summarises the main conclusions.

## 2 Understanding sustainable trends in Spain within the EU context

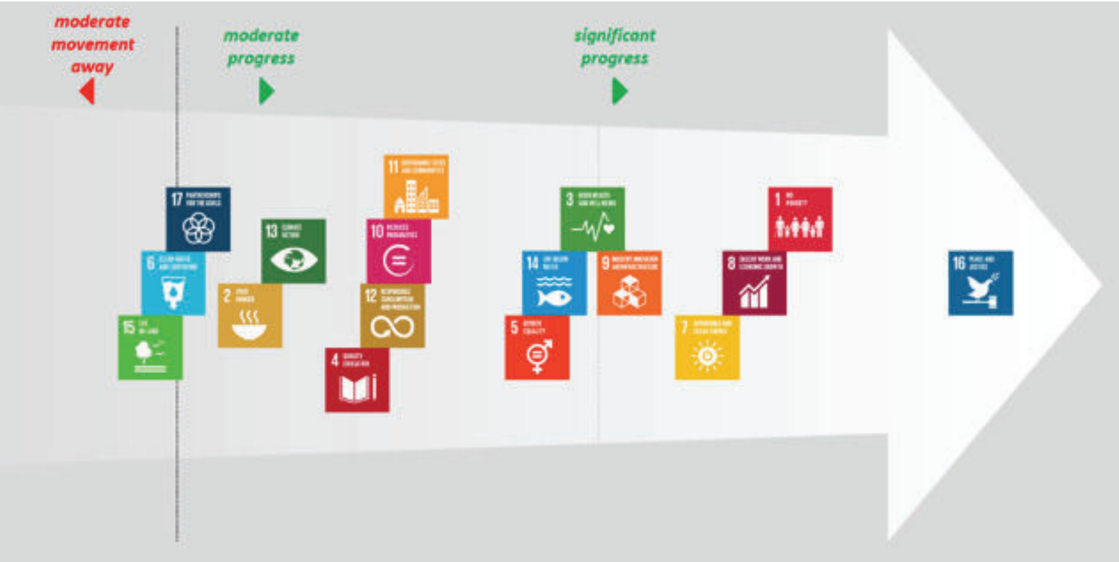
As a member of both the UN and EU, Spain is committed to contributing to achievement of the SDGs. The present socialist government, in particular, has shown its special and visible engagement since taking office in May 2018. The President of the Government Pedro Sánchez referred to the SDGs as "the government's roadmap" at a UN Summit held in September 2019 (Sánchez Pérez-Castejón, 2019). A year before, Spain had participated in a voluntary national review of the High-Level Political Forum on sustainable development. The report of this review identifies Agenda 2030 as a national blueprint, a new global social contract and a great opportunity for Spain to undertake essential reforms aimed at diversifying the economy and reducing poverty and inequality; to promote the ecological transition and to protect human rights and the social state (Boto-Álvarez & García-Fernández, 2020). The "Plan for Implementation of the 2030 Agenda", adopted a few days after the government took office, sets out the government's political commitment to the SDGs and describes its main policies in the area of sustainable development (Gobierno de España, 2018).

Prior to the pandemic, some of the first strategic frameworks adopted to realise Spain's sustainable development policies were the 2019–2023 National Strategy for Combatting Poverty and Social Exclusion (Gobierno de España, 2019), the Just Transition Strategy (Gobierno de España, 2019a) and the Integrated National Energy and Climate Plan 2021–2030 (Gobierno de España, 2020). As shown in the next section, many other reforms and initiatives are also currently being implemented in line with the SDGs as part of Spain's RTRP. This approach confirms that the EU's recovery plan is providing Spain with the guidance and drive to accelerate the transition towards a more sustainable economy and society.

As mentioned, since 2020 the COVID-19 pandemic has hampered efforts and progress towards achieving the goal of sustainability in Spain, the EU and globally. In the EU, in 2020 the average SDG Index failed to increase for the first time since 2015, even falling back slightly due to the negative impact of the pandemic on life expectancy, poverty and unemployment (SDSN & IEEP, 2021).

Overall, in the period 2015–2020 the EU made the greatest progress in the area of fostering peace, personal security within its territory and improved access to justice and trust in institutions (SDG 16). Significant improvements were also made in areas of economic growth and the labour market (SDG 8), innovation and infrastructure (SDG 9) and reducing poverty and social exclusion (SDG 1), although the latest available Eurostat data do not yet fully reflect the impact of the COVID-19 pandemic. Moderate progress was also made on other SDGs, such as reducing inequalities (SDG 10), sustainable cities (SDG 11) and climate action (SDG 13). However, the EU continues to face the biggest challenges in areas like partnerships to achieve the goals (SDG 17), clean water and sanitation (SDG 6) and biodiversity and ecosystems (SDG 15). In all, the EU still needs to speed up progress in many goals if they are to be fully met by 2030 and to achieve climate neutrality by 2050.

Figure 1: **Overview of EU progress on SDGs, 2015–2020**

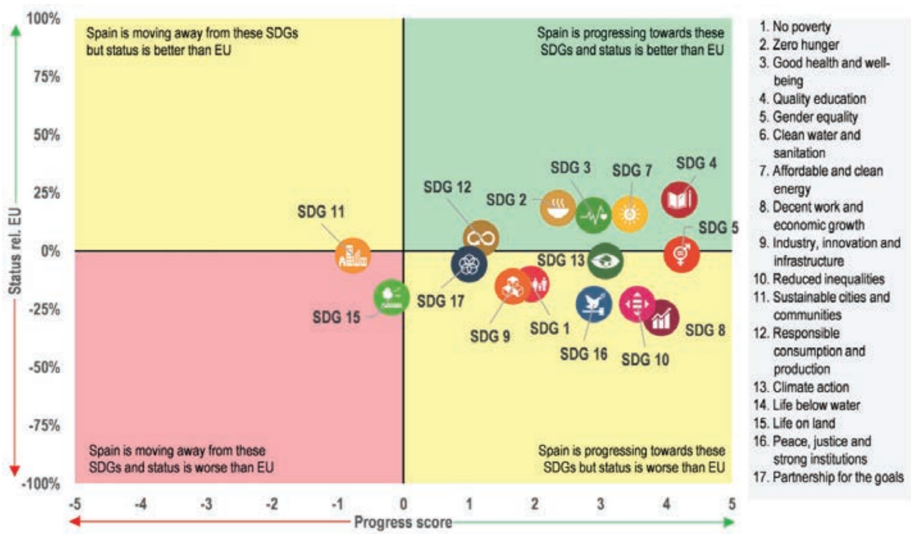



Source: Eurostat, Sustainable development indicators, Key findings, 2022a.

Finland was the EU member state least impacted by the COVID-19 pandemic and topped the 2021 SDG Index for European countries and worldwide. It continues to hold this position, followed by Denmark and Sweden. Indeed, the top ten countries in the SDG Index are all European and eight of them are EU members (Sachs et al. 2022; Eurostat, 2022b). Conversely, Spain and Italy were the countries most heavily impacted by the COVID-19 pandemic. The devastating economic effects of the strict lockdown measures adopted by the Spanish government were further exacerbated by certain structural aspects of the Spanish economy, such as poor diversification, major reliance on tourism and weaknesses in the labour market. In keeping with trends elsewhere in the EU and around the world, the pandemic has stalled progress and improvements made towards sustainability in Spain in recent years.

Nonetheless, some improvements have recently been made, particularly in the dimensions of environmental sustainability, energy efficiency and share of renewables. Within the dimension of fairness, indicators on poverty, health and education have also improved slightly. However, Spain is currently below the EU average in several SDG areas and underlying indicators. This is espcailly true of decent work and economic growth (SDG 8), industry, innovation and infrastructure (SDG 9), reduction of poverty and inequality (SDGs 1 & 10) and climate action (SDG 13) (European Commission, 2022).

Figure 2: **Spain's SDG progress status compared to the EU average**




Source: Eurostat, SDG Country Overview, 2022c.

At present, effective implementation of the multiple reforms and investments provided for in the RTRP for the coming years gives Spain an opportunity to address structural weaknesses and lay the foundations for a more resilient economic and social model.

# 3 The Spanish recovery plan: challenges and opportunities for a sustainable future

Spain remains one of the countries most heavily impacted by the COVID-19 pandemic, with serious health, economic and social consequences. The EU recovery funds and implementation of Spain's RTRP offer the possibility to diversify the economic system and establish a more resilient model, with investments and reforms in line with the EU's sustainability priorities. Yet, beyond the challenges addressed by the RTRP, Spain also faces additional challenges not sufficiently covered by the RTRP that have intensified in the current geopolitical context created by the war in Ukraine. Consequently, during the lifetime of the RTRP and beyond measures will have to be gradually adjusted to consolidate the path leading to a sustainable future.

## 3.1 Beyond recovery: investments and reforms paving the way to sustainability

As the EU member state most severely affected by the pandemic, Spain (together with Italy) is the main beneficiary of the NGEU. In the period 2021–2026, Spain will receive around EUR 141 billion from the RRF, of which EUR 69.5 billion will be in the form of grants and around EUR 71.6 in loans (European Commission, 2022a). An additional EUR 14.4 billion will be allocated to Spain between 2021 and 2022 from REACT-EU (Recovery Assistance for Cohesion and the Territories of Europe), included in the NGEU, as well as EUR 339 million from Just Transition, a fund intended to alleviate the socio-economic impact of the green transition in the most vulnerable regions. All of these figures represent an unprecedented level of funding that will come on top of the corresponding funds from the MFF 2021–2027, giving a combined total of around EUR 198.8 billion (Feás & Steinberg, 2021).

As discussed, the RTRP is Spain's strategic framework for channelling the NGEU funds (Gobierno de España, 2021). The RTRP seeks to address three complementary objectives in different timeframes: to boost economic recovery in the short term; to promote structural transformation of the system of production in the mid-term; and to ensure a more sustainable, inclusive and resilient growth model in the long term. Beyond the current crisis, the RTRP is therefore seen as an opportunity to undertake the reforms needed to address the weaknesses and unbalances in the Spanish economy. The approach to recovery hence differs from that observed in other crises since the efforts on this occasion have focused not only on providing a short-term boost to the economy to recover from the pandemic, but also on triggering a structural change through the green and digital transformations and a more diversified and sustainable economic model.

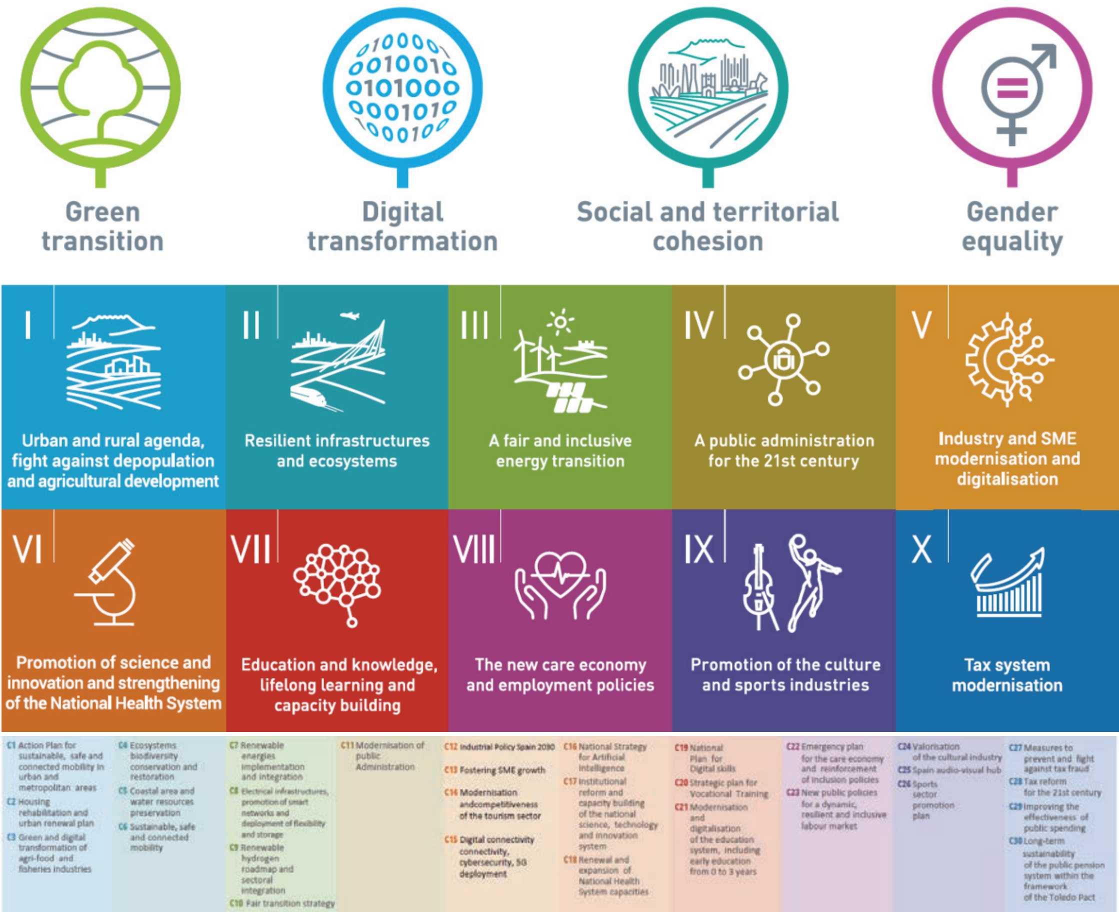
To achieve the hoped-for transformative impact, the RTRP includes 112 investments and 102 reforms, all of which will have to be implemented by the end of 2026. The investments are mainly targeted at accelerating the green transition and digital transformation towards a smart, climate-resilient economy and at ensuring social cohesion. The reforms, on the other hand, seek to address bottlenecks impeding lasting and sustainable growth. Specifically, the investments and reforms included in the RTRP will need to be developed during the first period, 2021–2023. The aim is to mobilise 80% of the EUR 69.5 billion in grants during this phase. In a second period, loans are expected to continue, consolidating the strategic programmes and projects undertaken during the first 3 years, together with more than EUR 36 billion from the MFF 2021–2027 (Gobierno de España, 2022).

The RTRP is built around four cross-cutting pillars: green transition, digital transition, social and territorial cohesion, and gender equality. Ten policy levers have been identified to address these cross-cutting pillars:

1. Urban and rural agenda, agricultural development and fight against depopulation.
2. Resilient infrastructures and ecosystems.
3. A fair and inclusive energy transition.
4. A public administration for the 21st century.
5. Modernisation and digitalisation of the business ecosystem.
6. The deal for science and innovation. Strengthening of the national health system.
7. Education and knowledge, lifelong learning and capacity building.
8. The new care economy and employment policies.
9. Promotion of the culture and sports industries.
10. Modernisation of the tax system for inclusive and sustainable growth.

These policies include 30 components that establish the specific investments and reforms required in each strategic area.

Figure 3: **Pillars, policy levers and components**




Source: Gobierno de España. Recovery, Transformation and Resilience Plan

The RTRP was submitted to the European Commission on 30 April 2021 and approved by the Council on 13 July 2021. According to the European Commission's evaluation, the RTRP meets the RRF's general objective of promoting the EU's economic, social and territorial cohesion and in a balanced way addresses the six policy pillars referred to in Article 3 of the RRF Regulation: green transition; digital transition; smart, inclusive and sustainable growth; social and territorial cohesion; health, economic, social and institutional resilience; policies for the next generation, children and youth, including education and skills (European Commission, 2021c).

In its assessment, the European Commission also considers that the RTRP answers a significant number of country-specific recommendations made to Spain by the Council in 2019 and 2020 within the European Semester. It also meets the requirement for a minimum of 37% of funds allocated to the green transition and 20% to the digital transition (specifically, 39.7% of the total allocation goes to measures to support climate targets and 28.2% to the digital target). In addition, the reforms and investment fulfil the 'Do no significant harm' principle, in line with Article 17 of Regulation (EU) 2020/852 on sustainable investment, for all six main environmental objectives: climate change mitigation and adaptation, circular economy, pollution prevention and control, protection and restoration of biodiversity and ecosystems and protection of water and marine resources. Spain's RTRP is also considered to be aligned with the European Pillar of Social Rights as it contains measures to improve digital skills and the education and vocational training system.

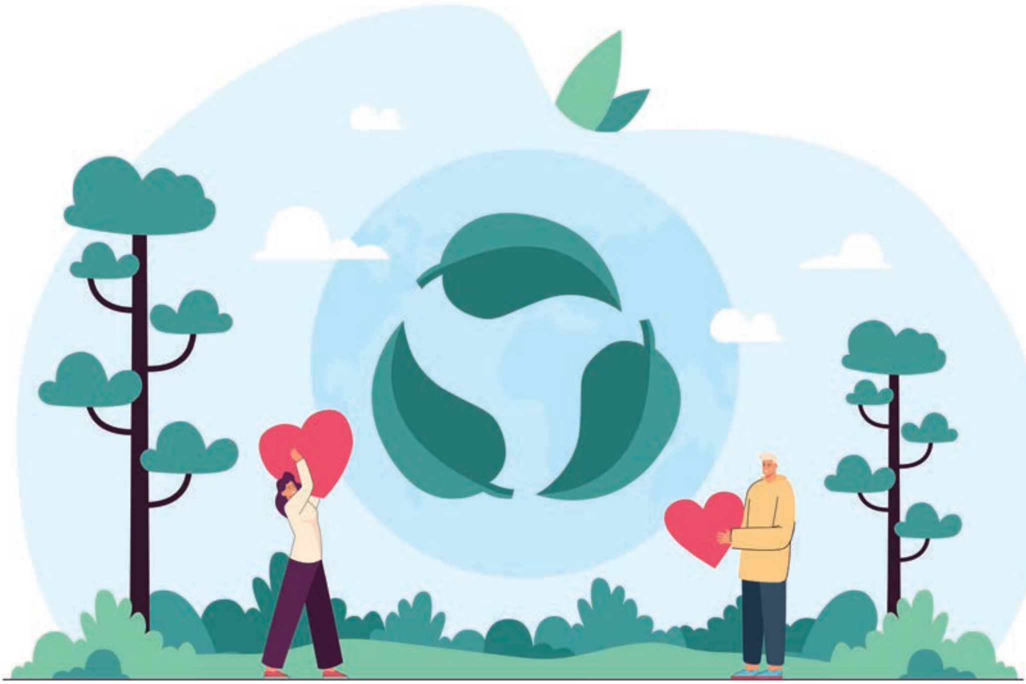


Table 1: **Spain's RTRP contribution to the six policy pillars provided by RRF**

| | Green transition | Digital transformation | Smart, sustainable & inclusive growth | Social and territorial cohesion | Health, and economic, social and institutional resilience | Policies for the next generation |
|---|---|---|---|---|---|---|
| 01. Sustainable urban mobility | ● | ○ | ○ | ○ | | |
| 02. Renovation | ● | | ● | ● | | ○ |
| 03. Agri-food and fisheries | ● | ○ | | ○ | | |
| 04. Ecosystems and biodiversity | ● | ○ | | ○ | ● | |
| 05. Coast and water resources | ● | ○ | | ○ | ● | |
| 06. Sustainable long-distance mobility | ● | ○ | ○ | ○ | | |
| 07. Renewable energy | ● | | ○ | ○ | | |
| 08. Electricity infrastructure | ● | ● | ○ | | | |
| 09. Hydrogen | ● | | ○ | | | |
| 10. Just transition | ● | | ○ | ● | | |
| 11. Public administration | ○ | ● | ● | ○ | ● | |
| 12. Industrial policy | ● | ● | ● | | ● | |
| 13. Support to SMEs | | ● | ● | ○ | ● | |
| 14. Tourism | ○ | ● | ● | ● | | |
| 15. Digital connectivity | | ● | ● | ● | | |
| 16. Artificial Intelligence | | ● | ● | | | |
| 17. Science, technology and innovation | ○ | | ● | | | ○ |
| 18. Reform of health system | | ○ | | | ● | ○ |
| 19. Digital skills | | ● | ○ | | | ● |
| 20. Vocational training | ○ | ○ | ○ | ○ | | ● |
| 21. Education | | ○ | | ○ | | ● |
| 22. Care economy, equality and inclusion | | ● | | ● | ● | ○ |
| 23. Labour market reform | ○ | ○ | | ● | | ○ |
| 24. Cultural industry | | ○ | ● | | | |
| 25. Audiovisual | | ○ | ● | | | |
| 26. Sports | ○ | ○ | | | ○ | |
| 27. Prevention of tax fraud | | | | | ● | |
| 28. Tax system reform | ● | | | | ● | |
| 29. Effective public spending | | | | | ● | |
| 30. Pension system reform | | | | ● | | |

Source: European Commission. 2021. Summary of the assessment of the Spanish Recovery and Resilience plan.

In harmony with the EU's sustainable recovery priorities, the RTRP also presents links to the SDGs, albeit to varying degrees. The strongest links are in areas where Spain's progress is currently below the EU average: industry, innovation and infrastructure (SDG 9); climate action (SDG 13); quality education (SDG 4); decent work and economic growth (SDG 8) and affordable and clean energy (SDG 7). However, SDG 5 on gender equality is among those least covered by the RTRP, despite it being one of the four cross-cutting objectives (SDSN & IEEP, 2021).

Figure 5: **Spain's RTRP links to the SDGs**


Source: SDSN & IEEP. (2021). Europe Sustainable Development Report 2021. Transforming the European Union to Achieve the Sustainable Development Goals

Implementation of the RTRP is expected to contribute to Spain increasing its GDP by between 1.8% and 2.5% by 2024. It is estimated that 0.4% of the GDP increase in 2024 will come from other member states' recovery plans, whose implementation will also benefit Spain (European Commission, 2021c).

To achieve the anticipated macroeconomic impact of the RTRP, investments and reforms are currently being implemented across Spain. The 110 investments scheduled in the RTRP are being channelled through 3 main instruments: the Strategic Projects for Recovery and Transformation (Spanish acronym, PERTEs); transfer of funds to the regional Autonomous Communities; and State-managed programmes. Specifically, the PERTEs aim to involve a significant number of companies, especially small and medium-sized enterprises (SMEs), including a governance system intended to consistently coordinate the activities of both the public and private sectors in line with the European strategic projects. The ambition is that Spain can lead transformation and technological development in the areas in which the PERTEs are implemented. The 11 PERTEs already approved by the Spanish government include Connected Electric Vehicles (Spanish acronym, VECs), Renewable Energy, Hydrogen and Storage (Spanish acronym, ERHA), Circular Economy, Digitalisation of the Water Cycle, and Aerospace (Gobierno de España, 2022a).

The 17 Autonomous Communities are also playing a key role in implementing the RTRP, receiving EUR 11.2 billion in grants from the RRF in 2021 and EUR 4.3 billion in the first half of 2022. They will receive a further EUR 10 billion from REACT EU for 2021 and 2022 to perform reforms aimed at strengthening the welfare state and public services and reactivating the economy (Gobierno de España, 2022b).

Along with the PERTEs and transfers to the Autonomous Communities, the investments are also being implemented through programmes directly managed by the State. To this end, more than 846 public calls had been published by June 2022, with a total amount of EUR 10.1 billion being allocated to private companies and local entities. The deployment of investments to date has enabled the launch of more than 11,500 projects (Gobierno de España, 2022b).

As regards the reforms, in exchange for larger amounts in grants and loans Spain is required to undertake more structural reforms (102) than other member states (Bisciari & Gelade, 2022). Some of these will reinforce the reforms already initiated by the Spanish government under the Agenda for Change from 2019 (Gobierno de España, 2019b). All the reforms are expected to address a considerable number of challenges identified in the country-specific recommendations. Some relevant reforms have already been accomplished, such as reforms of the education system and the labour market, a new climate change law and another new law on waste and contaminated soils for a circular economy, a law on 5G cybersecurity and reform of the pension system. Other noteworthy reforms will be undertaken throughout 2022 (Gobierno de España, 2022).

The investments and reforms both have the ultimate goal of shifting towards a fairer and more sustainable model that covers all citizens and territories. To date, the pace of implementation has been quite fast. Indeed, Spain was the first country to receive an initial allocation of EUR 9 billion in August 2021, with the first semi-annual payment of EUR 10 billion by the end of that year. In April 2022, the country requested a second payment of EUR 12 billion, which was assessed positively by the European Commission in June 2022 after it confirmed that Spain had complied with some of the milestones and objectives established by the Council's Implementing Decision. In the case of Spain, the country must comply with a total of 416 milestones and objectives to receive the successive payments (Council of the European Union, 2021).

Table 2: **Key elements of the Spanish RTRP**

| Total allocation | EUR 69.5 billion in grants (5.6% of 2019 GDP) |
|---|---|
| Investments and Reforms | 110 investments and 102 reforms |
| Total number of milestones & targets | 416 |
| Estimated macroeconomic impact | Raise GDP by 2.5% by 2024 |
| Pre-financing disbursed | EUR 9 billion (August 2021) |
| First instalment | EUR 10 billion (December 2021) |
| Second instalment | EUR 12 billion (assessed positively by the European Commission in June 2022) |

Source: European Commission. (2022). 2022 Country Report – Spain. Recovery and Resilience Scoreboard

Implementation of investments and reforms has continued apace in Spain in 2022 despite the complex and uncertain scenario generated by the war on the EU's eastern border. The current geopolitical context has made it all the more urgent to accelerate action to address major challenges, in particular the transition to a more resilient and energy-independent economic model, not only in Spain, but across the EU more widely. Other challenges not sufficiently covered by the RTRP will also require greater efforts by Spain, as highlighted in the 2022 Country Report (European Commission, 2022).

> "Spain is well below the EU average for the recycling of municipal waste and secondary use of materials."

### 3.2 Looking ahead: key challenges and further efforts

Despite Spain's low level of reliance on Russian energy supplies, the war in Ukraine has underscored the need to speed up the green transition. In particular, the conflict has led to a significant rise in energy prices, which comes on top of continuous increases since the summer of 2021. This vulnerability to international price variations is due to the high dependence of Spain's energy mix on oil and petroleum products. In this scenario, Spain needs to step up efforts to meet the current renewable energy targets established in its Integrated National Energy and Climate Plan 2021–2030 and in line with the new more ambitious energy targets proposed by the European Commission within the 'Fit for 55' legislative package and more recently in the REPowerEU Plan (European Commission, 2022b). This new plan includes specific measures and additional funding to reduce dependence on all Russian fuels and accelerate decarbonisation of the economy while implementing the EGD. Thus, building on the RTRP and the extra support provided by the

REPowerEU Plan, complementary efforts and investments can help speed up the economy's decarbonisation and reduce dependence on fossil fuels, as well as cut the high external debt (European Commission, 2022).

Meeting the EU's circular economy targets also represents an additional challenge for Spain. The country is well below the EU average for the recycling of municipal waste and secondary use of materials. Apart from the steps taken within the RTRP such as the new law on waste and contaminated soil, other measures and investments will be required to improve Spain's recycling capacity. The increase and improvement in recycling rates will also help reduce the import of goods and lower external dependence and imbalances (European Commission, 2022).

Actions to improve productivity are also required, in particular through further investment in R&D, since Spain is one of the member states with the lowest rate of investment in this area (1.4% of GDP in 2020 compared to 2.2% for the EU as a whole). Reskilling and upskilling of the workforce for the green and digital transitions will also call for bigger investments to tackle the challenge of improving productivity (European Commission, 2022).

Another major challenge for Spain is fiscal sustainability. In the medium and long term, the country is expected to face increasing shortfalls in this area due to the costs of healthcare and long-term care for its ageing population. Given this perspective, the pension and tax system reforms included in the RTRP will have to ensure a sustainable fiscal policy, notably one that can keep public expenditure to below the expected medium-term growth. Another challenge linked to fiscal sustainability involves the correction of macroeconomic imbalances. Following the lifting of the COVID-19 restrictions and the gradual economic expansion, the imbalances with their high levels of external, public and private debt are slowly improving, yet remain high. Measures recently adopted by the Spanish government are intended to accelerate the downward trajectory in public debt and facilitate preventive debt restructuring and debt relief for private individuals. Likewise, reforms of active labour market policies to be implemented by the end of 2022 are expected to reduce labour market fragmentation and youth unemployment (European Commission, 2022c).

The loans that Spain hopes to be allocated under the RRF, as well as the financial support it will receive from the 2021–2027 cohesion policy, are expected to help deal with these challenges and imbalances in the coming years. At the same time, addressing them will additionally contribute to progress in achieving many SDGs, such as SDGs 7 & 11 (affordable energy and housing), SDG 12 (circular use of materials and waste generation), SDGs 8 & 9 (productivity) and SDG 8 (macroeconomic stability) (SDSN & IEEP, 2021).

In the current unpredictable geopolitical scenario, flexibility is therefore required in policy responses and support. Measures will have to be gradually updated and adjusted throughout the lifetime of both the RRF and RTRP and beyond in order to consolidate the solid recovery leading towards a more sustainable and resilient economy and society in Spain and the EU more widely.

## 4 Policy recommendations

In 2021, the EU set out on the path towards a post-pandemic recovery with an ambitious approach in which the EGD objectives and the SDGs serve as a framework to guide recovery responses and financial support. Since February 2022, Russia's military aggression against Ukraine has generated a new environment, exacerbating pre-existing challenges and adding even more uncertainty to the expected recovery. In this scenario, it is clear and urgent that the EU should accelerate the green transition with strategic measures that have long been delayed. Specifically, this acceleration should include initiatives to reduce the EU's dependence on Russian gas and oil by boosting massive investment in renewable power systems, green logistic infrastructure (buildings and transport) and the circular economy. In this regard, the EU should speed up the adoption of the 'Fit for 55' legislative package and implementation of the new REPowerEU plan, including additional funding, to accelerate decarbonisation of the energy system and address the shortcomings in infrastructure.

At the same time, the current challenging context offers the EU an opportunity to demonstrate that the twin objectives of economic growth and sustainability are not mutually incompatible. Indeed, the EU remains committed to achieving the SDGs in the implementation of its recovery strategy. However, as noted above, the EU should deploy further efforts to achieve more significant progress on some SDGs, such as SDG 17 (partnership for the goals) and SDG 15 (biodiversity and ecosystems). Specifically, regarding the first of these points, partnership will require inequalities across member states to reduced. As stated by the SDSN and IEEP in their 2021 Report, strengthening education and innovation capacities for the green and digital transition could contribute to reducing divergence in living standards among member states in the coming years. Further, the EU should continue to pursue the recovery of biodiversity and acceleration of the green transition while also supporting social policies in line with the EGD' s 'leaving no one behind' objective (SDSN and IEEP, 2021).

By effectively coordinating and implementing the ambitious recovery plans with its member states, the EU also has a possibility to play a leading role in achieving the SDGs internally and externally. Still, in order to be credible as a global leader, the EU must drastically reduce its still-high external dependence on goods and materials, including fossil fuels. It is well known that European resource-intensive imports have had negative environmental impacts on exporting third countries, most of which are very vulnerable to climate change effects. In the present circumstances, addressing this challenge redoubles the need for the EU to accelerate the green transition and, in particular, policies on resource efficiency and the circular economy.

The EGD and the NGEU – in particular the RRF – are currently the framework for achieving the SDGs. However, the EGD contributes directly to 12 out of the 17 SDGs, while the social dimensions of the SDGs are covered by the European Pillar of Social Rights. As regards the RRF, its Regulation does not explicitly refer to the SDGs, although its six main pillars are closely related to them. The SDGs are also mainstreamed in the European Semester and accompanying documents and policies. As recommended by the SDSN and the IEEP in their 2021 Report, the EU should simplify this diverse array of instruments and frameworks and set out in a single comprehensive document how it intends to accomplish the SDGs. This integrated and more holistic document could be a European Commission Communication including targets, timelines and roadmaps that would be regularly updated. Such a clarification would help to enhance awareness and understanding among civil society regarding the SDGs in the process of implementing the EU's sustainable recovery policies. Finally, as many of its member states and UN members have done, it would be helpful for the EU to put in place a voluntary national review to share experiences, mobilise stakeholders and identify potentially stronger policies for addressing internal and external challenges (SDSN and IEEP, 2021).

> "Full recovery from the pandemic in Spain is expected to be delayed until mid 2023 due to the war in Ukraine."

Spain continues to lag behind the EU average in its progress on several SDGs. The COVID-19 pandemic has exacerbated regional disparities and worsened socio-economic indicators, such as unemployment, poverty and competitiveness. Like elsewhere in the EU, full recovery from the pandemic in Spain is expected to be delayed until mid 2023 due to the war in Ukraine. In this context and with this

"Spain should reduce its dependence on fossil fuels by accelerating the green transition."

prospect, Spain should maximise the potential of the RRF grants as well as the loan allocation under the RRF and the additional funding from the 2021–2027 cohesion policy funds. This will require additional coordination mechanisms between the central government and the 17 regional governments of its Autonomous Communities. In a highly decentralised country like Spain, consistent synergies among the different authorities are needed to ensure the effective use of European funding and support long-term recovery.

Despite Spain's recent significant investment and reform efforts, structural factors continue to hamper the path towards sustainable recovery and growth. The pending vulnerabilities, together with new emerging challenges, are identified in the European Commission's 2022 Country Report. As discussed, these especially refer to high external public and private debt, high unemployment, fiscal imbalances and increasing energy prices. Therefore, as well as the milestones and targets that Spain must address to implement the RTRP, the country needs to take additional measures to address these gaps and risks in the short and medium term. To this end, the 2022 country-specific recommendations should serve as a guide for Spain for consolidating its path to sustainability (Council of the European Union, 2022).

Specifically, like the EU as a whole, Spain should reduce its dependence on fossil fuels by accelerating the green transition. In this respect, the country should step up measures for the deployment of renewable sources and improve energy interconnections and integration in the single energy market by making use of the RRF, REPowerEU and other funds. Linked to this challenge, Spain should improve its recycling rates to meet the EU circular economy targets and levels by ensuring stronger coordination among the different levels of governments involved in this challenge. Another of the chief 2022 country-specific recommendations is to pursue a prudent fiscal policy. This will require Spain to rein in public expenditure to below the expected medium-term growth and adjust spending to the evolving circumstances. A contained fiscal policy would also help to gradually reduce the debt level. At the same time, Spain should prioritise greater investment in reskilling and upskilling the workforce and in promoting innovation to improve productivity and employment rates in Spain (Council of the European Union, 2022).

Finally, it is very important that all of these funding opportunities, additional efforts and continuous adjustments are properly communicated, not only to the public authorities involved in their implementation, but also to civil society, business and potential stakeholders to ensure that they can be understood, accepted and used to their full potential. The Spanish government, the regional Autonomous Communities and local authorities, together with civil society organisations, should therefore reinforce their communication efforts so that citizens are aware of and can seize the opportunities offered by the current recovery framework for a sustainable future.

## 5 Conclusions

The EGD, the EU's post-COVID-19 recovery package and the national plans have placed the EU and its member states on the road to long-term sustainable growth in line with the SDGs. The ongoing stimulus initiatives are intended to achieve sustainable development in the European context beyond simply coping with the crisis caused by the pandemic. With this approach, the stimulus policies offer great transformational potential since they are designed to have a long-lasting impact resulting in a new social and economic model which will be climate-neutral, inclusive and sustainable.

Nonetheless, much remains to be done. In the collective process of structural changes, the green transition is (as highlighted in this chapter) a crucial priority since climate change remains a major threat, exacerbating other challenges and emergencies. The main advantage of the green stimulus policies lies in their potential to create new green jobs and generate long-term multiplying effects to counteract climate risks. The present geopolitical and economic scenario caused by Russia's invasion of Ukraine is a clear reminder of this strategic priority. In the short term, it urgently requires decisive steps to accelerate the transition to clean and affordable energy, assure energy supply and reduce dependencies on fossil fuels coming from Russia as soon as possible.

This challenging context will also require member states to implement not only the investments and reforms included in their recovery plans, but the additional measures recently taken by the EU such as the REPowerEU plan. In this process of continuous adjustment, the 2022 country-specific recommendations play an important role as they provide helpful guidance on the actions required to tackle existing and emerging challenges. The European Semester will also continue to provide the essential framework for identifying new challenges that are not already being addressed by the recovery plans, and for putting forward country-specific recommendations in this regard.

As an EU member state, Spain is currently immersed in the same changing and uncertain scenario created by the ongoing pandemic and the war in Ukraine. In exchange for an unprecedented injection of EU funds, especially from the RRF, the country must undertake profound reforms to address its structural imbalances and shortcomings. Some significant reforms were already implemented in 2021, even before the first payment request was submitted. The reforms to be implemented throughout 2022 and in the coming years will also be crucial to help remedy the structural problems, some of which have been aggravated by the economic impact of Russia's war against Ukraine.

As highlighted in the 2022 country-specific recommendations, Spain must find ways to accelerate the deployment of renewable energy and its full integration into the single energy market; improve and increase its recycling rate and circular economy policies; reduce the structural budget deficit and fiscal imbalances; boost investment in productivity-enhancing policies, such as research and innovation; and reinforce coordination between different tiers of government in order to maximise the use of the available funds.

Like in other EU member states, the success of Spain's transformation agenda will depend on actual implementation of the ambitious reforms and investments planned on the path to inclusive and sustainable growth in the coming years. As Jean Monnet sagely predicted, "*Europe will be forged in crises, and will be the sum of the solutions adopted for those crises*". More than 70 years later, his prediction might still be true if the current context marked by economic, geopolitical and health crises is taken as a real opportunity to accelerate the planned green and digital transitions and benefit from sustainable recovery and growth in Europe.

## REFERENCES


- Bisciari, P. & Gelade, W. (2022). Recovery and resilience plans in Belgium, Germany, France, Italy and Spain, Belgian Financial Forum, pp. 1-24.
- Borchardt, S., Buscaglia, D., Barbero Vignola, G., Maroni, M., Marelli, L. (2020). A sustainable recovery for the EU. JRC Science for Policy Report. EU Publications Office.
- Boto-Álvarez, A. & García-Fernández, R. (2020). Implementation of the 2030 Agenda Sustainable Development Goals in Spain. Sustainability, 12 (6), 1-31.
- Council of the European Union. (2021). Council Implementing Decision on the approval of the assessment of the recovery and resilience plan for Spain, 10150/21, ECOFIN 637.
- Council of the European Union. (2022). Recommendation for a Council Recommendation on the 2022 National Reform Performance of Spain and delivering a Council opinion on the 2022 Stability Programme of Spain, 9752/22, ECOFIN 545.
- European Commission. (2019). The European Green Deal. COM (2019) 640 final.
- European Commission. (2019a). Annual Sustainable Growth Strategy. COM (2019) 650 final.
- European Commission. (2020). Delivering on the UN's Sustainable Development Goals - A comprehensive approach. SWD (2020) 400 final.
- European Commission. (2021). The European Pillar of Social Rights Action Plan: new ambitions for a strong Europe. Retrieved 20 July 2022 from: https://www.epr.eu/the-european-pillar-of-social-rights-action-plan-new-ambitions-for-a-strong-eu/
- European Commission. (2021a). Annual Sustainable Growth Survey 2022. COM (2021) 740 final.
- European Commission. (2021b). The EU's 2021-2027 long-term Budget and Next Generation EU. Facts and figures. Retrieved 20 July 2022 from: https://data.europa.eu/doi/10.2761/808559
- European Commission. (2021c). Summary of the assessment of the Spanish recovery and resilience plan. Retrieved 20 July 2022 from: https://ec.europa.eu/info/files/summary-assessment-spanish-recovery-and-resilience-plan_en
- European Commission. (2022). 2022 Country Report-Spain. SWD (2022) 610 final.
- European Commission. (2022a). Recovery and Resilience Facility. Retrieved 20 July 2022 from: https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en#the-recovery-and-resilience-facility

- European Commission. (2022b). REPowerEU Plan. COM (2022) 230 final.
- European Commission. (2022c). 2022 European Semester-Spring Package. COM (2022) 600 final.
- Eurostat. (2022). Eurostat commentary. European Statistical. Recovery Dashboard. Retrieved 20 July 2022 from: https://ec.europa.eu/eurostat/cache/recovery-dashboard/
- Eurostat. (2022a). Sustainable development indicators, key findings. Retrieved 20 July 2022 from: https://ec.europa.eu/eurostat/web/sdi/key-findings
- Eurostat. (2022b). Sustainable Development in the European Union. Overview of progress towards the SDGs in an EU context. 2022 edition. EU Publications Office.
- Eurostat. (2022c). SDG Country Overview. Retrieved 20 July 2022 from: https://ec.europa.eu/eurostat/cache/infographs/sdg-country-overview/
- Feás, E. & Steinberg, F. (2021). Las cifras para España del Plan de Recuperación Europeo. ARI, 25, 1-10.
- García Vaquero, M., Sánchez-Bayón, A. & Lominchar, J. (2021). European Green Deal and Recovery Plan: green jobs, skills and wellbeing economics in Spain. Energies, 14, 1-20.
- Gobierno de España. (2018). Plan de Acción para la implementación de la Agenda 2030. Hacia una estrategia española de desarrollo sostenible. Retrieved 20 July 2022 from: https://www.lamoncloa.gob.es/consejodeministros/Paginas/enlaces/290618-agenda2030.aspx
- Gobierno de España. (2019). Estrategia Nacional de prevención y lucha contra la pobreza y la exclusión social 2019-2023. Retrieved 20 July 2022 from: https://www.mdsocialesa2030.gob.es/derechos-sociales/inclusion/inclusion-social-espana.htm
- Gobierno de España. (2019a). Estrategia de transición justa. Retrieved 20 July 2022 from: https://www.miteco.gob.es/eu/transicion-justa/default.aspx
- Gobierno de España. (2019b). La Agenda del cambio. Hacia una economía inclusiva y sostenible. Retrieved 20 July 2022 from: https://www.lamoncloa.gob.es/consejodeministros/Paginas/enlaces/080219-enlaceagendacambio.aspx
- Gobierno de España. (2020). Plan Nacional Integrado de Energía y Clima (PNIEC) 2021-2030. Retrieved 20 July 2022 from: https://www.miteco.gob.es/es/prensa/pniec.aspx
- Gobierno de España. (2021). Recovery, Transformation and Resilience Plan, Retrieved 20 July 2022 from: https://portal.mineco.gob.es/es-es/ministerio/plan_recuperacion/Paginas/documentos-y-noticias.aspx

- Gobierno de España. (2022). Informe de Ejecución del Plan de Recuperación. Retrieved 20 July 2022 from: https://planderecuperacion.gob.es/ejecucion
- Gobierno de España. (2022a). Ejecución de los PERTE. Retrieved 20 July 2022 from: https://planderecuperacion.gob.es/ejecucion/ejecucion-de-los-perte
- Gobierno de España. (2022b). Datos periódicos de ejecución del Plan. Retrieved 20 July 2022 from: https://planderecuperacion.gob.es/ejecucion/datos-periodicos-de-ejecucion-del-plan
- Krammer, A. (2022). War in Ukraine is serious setback to Europe's economic recovery. IMFBlog. Retrieved 20 July 2022 from: https://blogs.imf.org/2022/04/22/war-in-ukraine-is-serious-setback-to-europes-economic-recovery/
- Sachs, J., Lafortune, G., Kroll. C., Fuller, G., Woelm, F. (2022). Sustainable Development Report 2022. From crisis to sustainable development: the SDGs as roadmap to 2030 and beyond. Retrieved 20 July 2022 from: https://dashboards.sdgindex.org/
- Sánchez Pérez-Castejón, P. (2019). Comparecencia del Presidente del Gobierno en funciones en la Cumbre sobre Objetivos de Desarrollo Sostenible. Retrieved 20 July 2022 from: https://www.lamoncloa.gob.es/presidente/intervenciones/Paginas/2019/prsp25092019bis.aspx
- SDSN & IEEP. (2020). The 2020 Europe Sustainable Development Report: meeting the Sustainable Development Goals in the face of the COVID-19 pandemic. Retrieved 20 July 2022 from: https://www.sdgindex.org/reports/europe-sustainable-development-report-2020/
- SDSN & IEEP. (2021). Europe Sustainable Development Report 2021. Transforming the European Union to achieve the Sustainable Development Goals. Retrieved 20 July 2022 from: https://www.sdgindex.org/reports/europe-sustainable-development-report-2021/
- UN. (2015). Transforming our world: the 2030 Agenda for Sustainable Development. Retrieved 20 July 2022 from: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E
- UN. (2015a). Paris Agreement. Retrieved 20 July 2022 from: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
- Von der Leyen, U. (2019). A union that strives for more. My agenda for Europe: Political guidelines for the next European Commission 209-2024. Retrieved 20 July 2022 from: https://data.europa.eu/doi/10.2775/018127

Chapter 5

# Waste management and circular economy: Lessons from the Greek experience

**Kleoniki Pouikli**
Utrecht University, Netherlands

**Ariti Tsoukala**
National and Kapodistrian University of Athens, Greece

## 1 Introduction

Waste generation constitutes the key by-product of the modern economic and social lifestyle and consumption patterns and is one of the main – constantly aggravating – problems for the environment and human health, despite all attempts to control it (Steenmans et al., 2017). More specifically, in 2014, 2,598 million tonnes of waste were generated by all economic activities and households in the 28 EU member states, equating to more than 5,118 kg per EU inhabitant (Eurostat, 2016). Apart from the environmental and health impacts, waste is directly related to economic loss as it is estimated that materials sent to landfill in the EU could have a commercial value of around EUR 5.25 billion per annum (European Commission, 2010). In addition, what should be considered/should not be disregarded is the cost of the infrastructure required for the collection, sorting and management of waste as well as the resource crisis due to the over-exploitation of natural resources

**caused by population growth, urbanisation and unsustainable economic activities and consumption patterns.**

Despite the efforts made since the mid-1970s to reduce the amount of waste produced on both the global and EU levels, this has not ceased to increase, going hand in hand with the growth of Gross National Product (GNP); not surprisingly, it has been observed that countries with a higher GNP produce proportionally bigger amounts of municipal waste as their citizens tend to renew their goods more often and faster (De Sadeleer, 2016). In this context, waste generation has been directly linked to resource depletion and the undermining of sustainable development (Dellis, 2018; Meadows et al., 1972). It is therefore imperative that an effective and holistic waste management policy be devised and implemented aimed at the transition to a circular economy and focused on controlling and reducing waste production, moving towards less harmful waste treatment methods as well as identifying ways to design sustainable products.

"Waste generation has been directly linked to resource depletion and the undermining of sustainable development."

In view of the above, the purpose of this paper is to briefly present some of the main aspects of the waste management policy and legislation in the EU and in Greece with the final aim to put a spotlight on certain issues that may arise in the near future with respect to the most recent legislative developments. In this context, a quick reference to the circular economy and the EU Green Deal is more than necessary in order to then focus on the Greek waste management reality and the most recent developments in relevant legislation. To this end, the first section focuses on an overview of the dense EU legal framework in the field of waste management and especially the Waste Management Directive and its interpretation through the case law of the CJEU, while it also intends to familiarise the reader with the provisions of the EU Green Deal and the Circular Economy Packages that are fundamental for the waste sector. In the second section, emphasis is given to waste law and policy in Greece: after a brief reference to the problematic approach to the issue of waste management that has existed for many years and often brought Greece before the CJEU, the key provisions of the new waste legislation are presented in the hope that the country is entering a new and better era. In the last section of the paper, a critical review of the latest developments in the waste sector in Greece is provided along with an effort to forecast future advances in the field.

## 2 The waste sector in the EU: policy and legislation

### 2.1 Brief overview of the dense EU legal framework in the field of waste management

The European waste management scheme is based on specific Directives and Regulations that the member states must comply with on the domestic level. The main piece of secondary EU legislation in the field of waste management is the Waste Framework Directive 2008/98/EC, (the WFD). The WFD aspires to control waste generation and regulate waste treatment in order to reduce its negative contribution to environmental problems such as global warming (through greenhouse gas emissions), pollution (soil, water, air) and nuisance (visual, olfactory, noise). In a nutshell, the Directive lays down the main rules applicable to waste management. It sets out the hierarchy between the various types of waste management operations, favouring prevention over recovery, and recovery over disposal. It the lays down the duties and responsibilities of the public authorities of member states, ensuring that waste management is carried out appropriately, that is, without endangering human health or the environment. This is achieved thanks to an integrated and adequate network of waste management installations, as well as by following waste management plans and prevention programmes. Further, the WFD provides for the responsibilities of the economic agents involved: primarily the holder of the waste and secondarily (also in a less systematic fashion) the producers of the products from which the waste comes. Last but not least, the WFD integrates the special legal regime applicable to hazardous waste which, obviously, requires special care.

The WFD, as its title suggests, provides the general regulatory framework and the fundamental principles of waste management while expressly giving

the possibility of laying down, by means of further/implementing directives, special rules for specific cases or supplementing its provisions concerning the management of particular categories of waste (Article 2(4) of the WFD). These further directives must of course always be interpreted in the light of the WFD's objectives and the waste hierarchy described in Article 2(4) thereof. In this vein, there is a dense legislative framework regulating waste management on the EU level. More specifically, parallel to the WFD, the Waste Shipment Regulation 1013/2006/EC should be mentioned on the 'framework legislation' level. On the 'waste treatment' level, the main pieces of legislation are the Landfill Directive 1999/31/EC and the Industrial Emissions Directive 2010/75/EU (covering incineration). On the 'waste streams' level, there is a series of technical directives focusing on different types of waste, such as Directive 94/62/EC on packaging and packaging waste, Directive 2000/53/EC on end-of-life vehicles, Directive 2012/19/EU on waste electrical and electronic equipment, and Directive 2006/66 on batteries and accumulators. The abovementioned directives establish the specific legal obligations of waste management in each concrete category of waste, depending on its technical characteristics and its typical impact on the environment and human health.

"Problematic or incomplete compliance with the EU's dense and highly technical regulatory waste framework constitutes one of the long-standing problems in EU environmental law generally."

### 2.2 Tackling ineffective enforcement of the EU's waste law

Problematic or incomplete compliance with the EU's dense and highly technical regulatory waste framework constitutes one of the long-standing problems in EU environmental law generally. In this sense, the rich case law of the Court of Justice of the European Union (CJEU) in the field of waste contributes to a better understanding and, consequently, to the better implementation of EU waste legislation on a national level. More specifically, the judges in Luxembourg have had numerous opportunities to interpret the key concepts of the WFD that are not explicitly defined in the Directive and could result in an uneven and inconsistent transposition into the national law and hence in impacts on the single market and environmental protection objectives (indicatively, see CJEU, Judgement of 10.05.2007, Thames Water Utilities, C-252/05, ECLI:EU:C:2007:276 and CJEU, Judgement of 24.6.2008, Commune de Mesquer, C-188/07, ECLI:EU:C:2008:359, where the CJEU was asked to interpret the meaning of the notion of 'waste'. Also, in CJEU, Judgement of 18.04.2002, Palin Granit and Vehmassalon kansaterveystyön kuntayhtymän hallitus, C-9/00, ECLI:EU:C:2002:232, and CJEU, Judgement of 12.12.2013, Shell Nederland and Belgian Shell, joined cases C-241/12 and C-242/12, ECLI:EU:C:2013:821, the Court interpreted the notion of 'by-products'. In CJEU, Judgement of 28.07.2016, Edilizia Mastrodonato, C-147/15, ECLI:EU:C:2016:606 the Court interpreted the notion of 'recovery of waste', as a waste management method of waste hierarchy stipulated in Art. 4 of the WFD.

In addition, many member states have been brought before the CJEU due to having infringed the obligations enshrined in different EU legal texts, such as their legally binding obligation to prepare and implement national waste management plans under Art. 28 of the WFD. Further, a considerable portion of the case law on waste consists of judgments against member states for illegal waste management such as unauthorised landfills or failure to establish adequate urban waste-water treatment networks, as stipulated by the relevant Directive 91/271/EC. Often enough, the CJEU also imposes fines on member states that fail to comply with the CJEU's previous judgments on waste-related cases (indicatively, see CJEU, Judgement of 02.12.2014, Commission v Greece, C-378/13, ECLI:EU:C:2014:2405, and CJEU, Judgement of 27.04.2017, Commission v Greece, C-202/16, ECLI:EU:C:2017:318, CJEU, Judgement of 04.07.2018, European Commission v Slovak Republic, C-626/16, ECLI:EU:C:2018:525).

Another category of the CJEU's case law concerning the waste sector reflects the tension between environmental and competition law in relation to the shipment of waste, which – having an economic value – can be the subject of commercial transactions. On one hand, according to the environmental law approach, waste is treated as the unwanted and potentially harmful by-product of economic activities, and its responsible management introduces barriers to its free movement in line with the principles of self-sufficiency, proximity and proximity (e.g., cf. CJEU of 10.11.1998, Case C-360/96, Gemeente Arnhem and Gemeente Rheden v. BFI Holding, ECLI:EU:C:1998:525, Judgment of 10.11.1998, ECJ, Case C-360/96, Gemeente Arnhem and Gemeente Rheden v. BFI Holding, ECLI:EU:C:1998:525, Judgment of 10.11.1998. CJEU of 23.05.2000, Case C-209/98, Sydhavnens Sten & Grus, ECLI:EU:C:2000:279, CJEU of 10.05.1995, Case C-422/92, Commission of the European Communities v Federal Republic of Germany, ECLI:EU:C:1995:125). On the other hand, through the lens of competition law waste is treated as a product whose movement should not, in principle, be hindered. In this context, the CJEU has clarified that exceptions to the principle of free movement of goods are justified on the ground that waste is deemed to be a special type of good because of the damage that its transboundary transport and management may cause to the environment (indicatively, see CJEU, Judgement of 09.07.1992, Commission v Belgium (Walloon Waste Judgement), C-2/90, ECLI:EU:C:1992:310, CJEU, Judgement of 12.12.2013, Ragn-Sells, C-292/12, ECLI:EU:C:2013:820, CJEU, Judgement of 10.11.1998, Gemeente Arnhem και Gemeente Rheden v BFI Holding, C-360/96, ECLI:EU:C:1998:525). Lastly, some judgments are related to the allocation of waste management cost, either in cases of charging fees to the users of waste management and disposal services or in cases of imposing penalties under the rules on environmental liability for waste pollution incidents, directly linked to the "polluter pays" principle (indicatively, see CJEU, Judgement of 07.09.2004, Van de Walle and Others, C-1/03, ECLI:EU:C:2004:490, CJEU, Judgement of 09.03.2010, ERG and others, C-378/08, ECLI:EU:C:2010:126).

### 2.3 Circular Economy Packages and EU Green Deal: a focus on the waste sector

In light of the aforementioned chronic and complex problems in the field of waste management, the most recent development in waste policy is the concept of the Circular Economy (CE). The transition to this economic model aspires to tackle the ever-increasing unsustainable use of natural resources since modern production and consumption patterns are inconsistent with nature's capacity for renewal and lead to irreversible damage to the climate, biodiversity, the atmosphere, soil and water (Pouikli, 2018). It should be noted that, in addition to waste, the Circular Economy also aims to manage water resources, eco-innovation, and green entrepreneurship (Kremlis, 2019).

The costs of waste management, the risks to the environment and the reduction in the use of raw materials and natural resources when the economy is not based on recycling products are factors that justify the central position of waste management on environmental, social, economic and political agendas (De Sadeleer, 2016). Moreover, waste generation plays a key role in the modern economic and social model as the impact on the environment and health, the commitment of space for waste disposal, as well as the creation and maintenance of structures for waste collection and recovery are directly linked to the spending of huge sums of money around the world (Pouikli, 2020) given that this 'market' involves a large number of stakeholders in society, including private stakeholders and local authorities (Verdure, 2011). Hence, in order to address these pressing challenges, the EU has decided to transform its linear economy (take-make-dispose) in a CE (Communication of the European Commission, 2015), aspiring to decouple economic growth and well-being from the ever-increasing waste generation, strengthen environmentally sound waste management, enhance eco-design, achieve higher recycling rates and a reduction of waste, stimulate competitiveness and resource-efficiency as well as to create new jobs and opportunities for businesses, innovations and investments by keeping the added value in products for as long as possible in the market; instead of creating waste, products, after use, should be subject to specific management in order to become the raw materials for new products (Kremlis, 2019). The aim is to design sustainable products ("eco-design") focusing, among others, on an improvement in their durability and reusability, an increase in their recycled content, the abatement of their carbon and environmental footprint, and the limiting of single-use or premature obsolescence products (Communication of the European Commission, 2020).

The establishment of circular production methods based on lifecycle thinking stresses the need to take into account the environmental impacts of the entire material lifecycle in an integrated way. In this context, the fact that the Circular Economy has adopted such a holistic perspective constitutes a clear sign of the interconnection of legally binding product standards, resource and waste law and policy, and the legislation on chemicals (Communication of the European Commission, 2020), given that decisions made in the stage when a product is being conceptualised and manufactured by the industry (design stage) are extremely important for all subsequent stages in its lifetime.

In the field of waste law and policy, the main concerns revolve around the obstacles and challenges related to "environmentally sound waste management", noting that only around 40% of the waste generated by EU households is currently recycled, while in 2013 the total waste generation in the EU amounted to approximately 2.5 billion tonnes, of which 1.6 billion tonnes was not used or recycled (Communication of the European Commission, 2015). Since 2015, the CE officially constitutes a pillar of the EU waste policy and is based on two action plans which, along with the EU Green Deal (Communication of the European Commission, 2019), frame the EU's goals concerning transformation of the economic model.

The first Circular Economy Package was adopted on 2 December 2015 and consisted of an Action Plan in the form of a Communication, an Annex with a list of over 50 measures that the Commission intended to adopt in the coming years, and four legislative proposals on waste. Making the circular economy a reality will however require the long-term involvement of the EU, local authorities of member states, and all stakeholders alike.

The Circular Economy Action Plan addresses the whole life cycle of products. In order to ensure harmonious movement in each stage of the cycle, the needs and limitations of the other steps must be taken into account because all stages are linked.

The objectives are to:

- Extract and use resources sustainably;
- Design and produce better products that use less resources, have a long life-span and can be re-usable, recyclable;
- Have a leaner production using less resources and creating less/no residual waste;
- Have smarter consumption by buying products that are recyclable and re-usable, use products for longer, repair them;
- Use waste as a resource rather than dispose of it. Improvements in terms of resource and energy efficiency can be made in all stages.

Concrete actions were proposed in this CE Action Plan in order to achieve the aforementioned objectives, such as the promotion of the eco-design of products to include reparability, durability and recyclability parameters, the strengthening of Green Public Procurement, the development of quality standards for secondary raw materials and the adoption of concrete strategies for plastics. In addition, specific legislative amendments were adopted focusing on inserting:

- A target to recycle 65% of municipal waste by 2030;
- A target to recycle 75% of packaging waste by 2030;
- The use of economic incentives for producers to produce greener products and support recovery and recycling schemes;
- Measures to promote re-use and stimulate industrial symbiosis;
- A binding target to reduce landfill to a maximum of 10% of municipal waste by 2030;
- A ban on the landfilling of separately collected waste;
- Economic instruments to discourage landfilling; and
- Simplified and improved definitions and harmonised methods to calculate recycling rates throughout the EU.

The 2nd Circular Economy Package forms part of the EU Green Deal, which recognises the transition towards a circular economy as a fundamental pillar of EU policy and stresses the need to strengthen and accelerate this process, which did not sufficiently progress under the 1st Circular Economy Package efforts. To this end, in March 2020 the Commission adopted, along with the European Strategy for the industrial sector (Communication of the European Commission, 2020), a new Action Plan for the Circular Economy. Emphasis is placed on energy-intensive industries such as steel, chemicals and cement, as well as sectors that are key to the implementation of the 'sustainable products' policy, such as plastics, construction, electronics and textiles. In addition, specific measures will include support for businesses to enable consumers to choose durable products that can be reused and/or repaired and to provide reliable, verifiable and comparable product information to combat the problem of misleading eco-claims through marketing products ('greenwashing').

The 2nd Action Plan aims to strengthen the EU's competitiveness while protecting natural resources and giving new rights to consumers, always by trying to keep the added value in products for as long as possible in the market. In summary, the new initiatives in the context of the 2nd CE package encompass measures destined to make sustainable products the norm in the EU, empower consumers and public purchasers, ensure less waste production and focus on the sectors that use the most resources and where the potential for circularity is high. Examples include electronics and ICT, batteries and vehicles, packaging, plastics, textiles, construction and buildings, and food (Pouikli & Tsoukala, 2021).

# 3 Waste law and policy: the case of Greece

Waste management has been recognised as one of the most pressing problems in Greece, a country suffering from a low level of organisation and relying predominantly on semi-controlled landfills since the end of the previous century (EEA, 2013). Nevertheless, during the last two decades solid waste management in Greece has been upgraded. While it is still generally considered a major problem, progress has been increasingly observed, and solid waste management in Greece is slowly becoming a well-structured, organised and environmentally responsible activity with specific goals, mostly in urban areas (Sakalis, 2022).

However, despite all the national efforts to improve the situation, there are still major structural problems with waste management in Greece. The landfill gate fee, which is currently low, along with the cheap/cost-free illegal landfills, do not encourage recycling over the disposing of waste. The available economic instruments are insufficient and the schemes currently in place are ineffective (European Commission, 2019). In addition, municipal waste generation has remained at the same level in recent years, slightly above the 2017 EU average (504 kg vs around 487 kg/y/inhabitant). Thus, Greece disposes most of its municipal waste in landfills (80% vs the EU average of 24%), with only 19% being recycled (the EU average being 46%). The landfill rate has modestly decreased while recycling rate has increased slightly (European Commission, 2019).

## 3.1 The arduous path to enforcing the EU's waste legislative framework on the national level

The historical structural problems of the Greek waste management system as well as the ineffective actions to bridge the implementation gap between the EU's legal requirements and the Greek reality have brought Greece before the CJEU for many different violations of the waste legislation. More specifically, the CJEU has concluded that Greece has violated its obligations to prepare and implement hazardous waste management plans that would ensure human health and environmental protection (CJEU, Judgement of 10.09.2009, Commission v Greece, C-286/08, ECLI:EU:C:2009:543). The Court noted that the competent Greek administrative authorities, by allowing the temporary storage of hazardous waste at designated sites or at sites that are mostly contaminated, do not ensure its proper disposal, but simply renew permits for the 'temporary' storage of such waste on the producers' premises and in some cases even impose fines, but without taking any measures to ensure the final safe disposal of the hazardous waste (CJEU, Judgement of 10.09.2009, Commission v Greece, C-286/08, ECLI:EU:C:2009:543, para. 64). In 2016, Greece was once again forced to pay a daily fine for not having taken all necessary measures to comply with the aforementioned judgment (CJEU, Judgement of 07.09.2016, Commission v Greece, C-584/14, ECLI:EU:C:2016:636). Unfortunately, the CJEU has repeatedly issued such decisions against Greece (similar to the above judgement, are: CJEU, Judgement of 02.12.2014, Commission v Greece, C-378/13, ECLI:EU:C:2014:2405, CJEU, Judgement of 15.10.2015, Commission v Greece, C-167/14, ECLI:EU:C:2015:684 and CJEU, Judgement of 22.02.2018, Commission v Greece, C-328/16, ECLI:EU:C:2018:98).

However, as referred to in the annual WWF review (WWF, 2018), the imposition of the above-mentioned financial penalties does not appear to have served as an incentive for complying with EU law in this area. According to the same review, at least 30 illegally operating landfills remain active and approximately 160,000 tonnes of urban solid waste end up in them, given that many Greek towns remain without the necessary waste management infrastructure. Indicatively, in 2017 illegal landfills were discovered on the caldera rock in Santorini and in the water stream of Doxatos in Drama (WWF, 2018).

### 3.2 The current state of play before the Greek Council of State

Greece's major and complex structural problems concerning waste management are also confirmed by the volume of national case law in the field, mainly that of the Greek Council of State. The waste phenomenon in Greek case law is mostly encountered in cases of selecting sites for waste treatment facilities or the mismanagement of waste. The prolific waste-related case law of the Greek Council of State vividly demonstrates that waste management in Greece falls dramatically short of the ideal model set by the EU law and the environmental protection standards.

Concerning the type of judgments related to the selection of sites for waste treatment installations, the Council of State has clarified that the siting of such an installation is conducted along with its environmental approval process in line with the relevant regional spatial plan, which establishes the management units and the relevant waste landfill installations (Greek Council of State Judgement No. 2405/2016, para. 18). Further, in order to highlight the significance of waste management plans the Court noted that, even after the

"The competent administrative authority needs to examine whether the ecosystem is about to suffer a severe deterioration/ degradation and whether its carrying capacity has already reached its limits."

issuance of the WFD and the law transposing it (Law 4042/2012), the pre-existing plans must remain in force until the new ones are adopted to ensure there is no gap in waste management planning (Greek Council of State Judgement No 989/2018, para. 8). Another issue refers to the concept of the "carrying capacity" of each ecosystem to accommodate a waste management facility, which should constitute the criterion for the public administration to grant the necessary permit. In short, the competent administrative authority shall examine whether the ecosystem is about to suffer a severe deterioration/degradation and whether its carrying capacity has already reached its limits and therefore the construction of such a facility would lead to infringement of Art. 24 of the Greek Constitution (Art. 24 refers to the obligation to protect the environment) (Greek Council of State Judgement No 101/2018, para. 10).

The Court has also clarified that even in the case of illegally operating landfill sites every industrial activity that is to be authorised should also be examined with respect to its environmental interaction with this illegal landfill (Greek Council of State Judgement No 4485/2011, para. 9). In another case (Greek Council of State Judgement No 4485/2011), the Court held that a landfill site reserved for a specific type of dangerous waste could not be converted into a landfill for other types and quantities of waste. This is considered to be a significant project amendment, which is illegal without prior environmental impact assessment. The Court has also deemed illegal the installation of a metal factory in a forest for the sole purpose of dumping industrial residues (Greek Council of State Judgement No 3883/2008). In the context of such cases, it should be recognised that the Council of State has occasionally demonstrated a willingness to examine even some more technical elements in order to conclude whether the required environmental impact assessment has been thorough and sufficient and whether all necessary factors concerning the site selection of waste landfills, their operation or environmental impact have been considered (indicatively, see Greek Council of State Judgements No 1394/2015, 1943/2012). In case No 1394/2015, the Court held that a landfill site, considered as needing a human health and environmental upgrade, does not run counter to the law and could legally be situated in a wildlife sanctuary. In the same vein, in Judgement No 1943/2012, the Court held that the quality of agricultural land as prime farmland does not exclude the possibility of siting a landfill there. However, in most of such cases these arguments related to the siting of a landfill, the operation mode or the impact of the waste disposal site have been rejected by the Court (Charokopou, 2019).

### 3.3 The new waste legislation in Greece and the transition to the Circular Economy

The new Law No 4819/2021 was adopted in order to transpose Directives 2018/851 and 2018/852, which in turn introduced amendments to the WFD and Directive 94/62 on packaging and packaging waste. The Law establishes the new integrated waste management framework imposed by the EU legislator in line with the objectives set out in the 2015 Action Plan for the Circular Economy, and aims to address some fundamental problems of the Greek waste management system, such as the pay-as-you-throw scheme, which had not yet been implemented, or the landfill fee which is imposed on municipalities in order to reduce the amount of waste in landfills.

### 3.4 Key provisions of the new Law No 4819/2021

In short, following Part A of the Law, which sets out its scope, Part B transposes – in most cases verbatim – the changes introduced by Directive 2018/851 to the WFD, with Chapter A containing the general provisions and Chapter B being more specific about the extended responsibility of the producer and the operation of the Alternative Management Systems. Chapter C refers to the forms of recovery and disposal of waste, while the following chapters (D to I) deal with more specific aspects of waste management, permits and registrations, management plans and programmes, inspections and records, and penalties. Part C of the law transposes into the national law the changes introduced by Directive 2018/852 to Directive 94/62/EC on packaging and packaging waste, while Part D introduces provisions relating to the organisation and operation of the Hellenic Recycling Organisation (EOAN) and Part E contains provisions for reducing the impacts of single-use plastic products.

More specifically, Art. 1 of new Law No 4819/2021 defines its object and scope, with an emphasis on prevention, preparation for reuse and recycling. It prioritises either the non-creation of waste in the first place by maintaining the identity of the product for a longer period in line with the CE requirements (which is inextricably linked to the design and manufacture of original products), or the option of a more environmentally friendly waste management method. The principle of waste hierarchy, which prescribes a hierarchical order of different waste treatment methods (i.e., waste prevention, preparation for re-use, recovery, disposal), is enshrined in Art. 4 of both the WFD and the new Greek waste law. Concerning prevention in particular, this pre-waste life stage of products includes ways of minimising the quantities of waste and products produced, as well as promoting environmentally friendly products and reducing the hazardous substances in them, while prevention also includes the stage of direct reuse of a product for the same purpose for which it was intended by the producer (consider, for example, the resale of used items such as second-hand clothes, cars etc. See Art. 3, para. 12, of the Framework Directive where prevention is defined as "measures taken before a substance, material or product has become waste, that reduce: (a) the quantity of waste, including through the re-use of products or the extension of the life span of products; (b) the adverse impacts of the generated waste on the environment and human health; or (c) the content of hazardous substances in materials and products"). The other three options in the 'pyramid' of the waste hierarchy apply from the point where products become waste and change their legal status, at the same time creating an obligation for the holder to effectively manage them.

More particularly, recovery is the method preferred by the EU legislator regarding waste treatment since, as already explained, it is the most environmentally acceptable. It is a broader concept that can be divided into three sub-concepts: preparation for re-use, recycling, and any other type of recovery, such as energy recovery. Preparation for re-use is a process that requires the least human intervention compared to the others in order to reintegrate the waste into the "world of products" (pursuant to Art. 3, para. 16, of the WFD, "'preparing for re-use' means checking, cleaning or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing"). Then, recycling, which requires greater intervention and treatment of the product and can lead to a change in its previous purpose, emphasising the useful function that recovered waste can acquire, and any other type of recovery, such as energy recovery (see Art. 3, para. 17, of the WFD, where recycling is defined as "any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations". In its Judgment of 27.02.2002, ASA, C-6/00, ECLI:EU:C:2002:121, para. 69, the CJEU underlined that " (...) the essential characteristic of a waste recovery operation is that its principal objective is that the waste serve a useful purpose in replacing other materials which would have had to be used for that purpose, thereby conserving natural resources". See also in this respect De Sadeleer, 2016, p. 194 and 197). Finally, disposal is defined in reserve as "any operation which is not recovery even where the operation has as a secondary consequence the reclamation of substances or energy" (see Art. 3, para. 19, of the WFD), while Annex I of the Framework Directive contains indicative actions that fall within the concept of disposal, such as landfilling, incineration, dumping at sea and permanent storage. This waste hierarchy is a binding framework for the management plans that Greece is required to adopt under Arts. 54–56 of the new Greek Law and Art. 28 para. 1 of the WFD.

In addition, the new Law puts emphasis on obligations establishing extended producer responsibility (EPR), which is a key tool in the CE. Recognising the role of the economic operators involved at the beginning of a product's life cycle, the different EPR schemes join the dots between the design and the end-of-life phases of products taking CE requirements into account. Producers are held largely responsible for the environmental impact of their products, not only downstream, through the processing and/or disposal of these products, but also upstream, through the activities inherent in the process of material selection and product design (OECD, 2001). To this end, extending a producer's obligations towards a product to the post-consumer stage of its life cycle seems to have an important role within the CE. Therefore, compared to other legal constructs, extended producer responsibility covers the stages both before and after the products are placed on the market (in this respect, producer responsibility is distinguished between simple economic responsibility and operational responsibility, as discussed in Pouikli, 2020), as it establishes specific obligations for producers to take back their products and carry out recycling processes to reduce the overall amount of waste produced and to facilitate its recovery, even in the case of outsourcing, where the cost disincentive remains.

Producers are therefore encouraged to develop and improve their products in terms of design, raw materials, packaging, durability, easier dismantling at the end of their life cycle, reduction or elimination of hazardous raw materials, etc. (De Sadeleer 2016). Extended producer responsibility implements the requirements of the "polluter pays" principle by incorporating the negative externalities of the manufacture of a product that are harmful to the environment and makes the producer also responsible for bearing the costs of this, while at the same time seeks to prevent environmental damage at source, in accordance with the requirement of Art. 191, para. 2, TFEU.

Finally, it should be noted that tax incentives are being introduced, encouraging the donation of defective products that could still be normally used, in order to reduce waste generation and promote prevention (Art. 21 of the new law). Another interesting regulation refers to the introduction of waste law into the planning law, through the provision of a suitable area for the collection and storage of waste, as a condition for granting a specific building permit (Art. 28) as well as the provision of Green Points for the collection of products to be recycled (Art. 29). The "pay as you throw" principle is stipulated in Art. 37, while in Art. 38 a special landfill fee is set to discourage disposal processes. In addition to the above, the new Law regulates the issuance of permits for waste treatment operations, always in accordance with the environmental law on permitting, by requiring a relevant environmental impact assessment (Arts. 52–53).

## 4 Critical assessment and the way ahead

In the wake of the brief analysis of the new Greek legislative framework, the links between the introduced regulations and the quantitative and qualitative targets set via the first package for the Circular Economy become evident. In this regard, it would be particularly interesting to shed light on some issues that may arise while implementing the new legislative framework and were already highlighted during the public consultation process prior to the final adoption of the Law by various stakeholders and individual citizens. Namely, some of the key concerns about the new legislation refer to the application of the "pay as you throw" instrument, which is indeed particularly important for the establishment of a form of justice in the field of waste law where the "polluter pays" principle will be effectively implemented. More specifically, the new Law makes the adoption and implementation of such systems compulsory for local authorities at different time frames (2023 or 2028), depending on their population. Such a regulation, however, as pointed out during the consultation (see, for example, the comment by Mr. Katsiamboulas, 2021), postpones the objective of restorative justice attempted by this principle to quite a distant time, while a uniform obligation imposed on all municipalities has not been examined. Further, concerns have been expressed regarding the deterrent effect of the landfill fee given its low rate, which may not stimulate municipalities to move towards methods of waste recovery (see, for example, the comment by Mr. Katsiamboulas, President of the Hellenic Waste Management Society and the Associations of the villages of Kallirroi, Constantinai and Vasilikos of Messinia, 2021). Maybe the setting of a minimum threshold for the disposal fee and the discretion of the Public Administration to adjust it reasonably in the future, possibly in the light of technological developments, would be a more adequate solution. In this regard, a similar observation regarding the possible need to increase the relevant amount can be made concerning the obligation to pay a financial contribution from the liable party to the Collective Alternative Waste Management Systems to allow the latter to properly perform their assigned mission (see the comment by WATT S.A., 2021).

Moreover, apart from the tax reliefs aimed at encouraging donations for the reuse of products, the new Law does not seem to provide for any other kind of tax incentive to encourage operators to select secondary materials in the manufacture of products, in line with the objectives of the first package for the Circular Economy. At the same time, it might be appropriate to provide an incentive for final consumers themselves to recycle their waste (as mentioned during the consultation, "reward as you recycle"; see the comment by the Standing Committee on the Environment of the Department of"Central Macedonia of "he Technical Chamber, 2021). Furthermore, as pointed out during the public consultation (see the commentary of the NGO WWF, 2021), the new Law fails to impose an obligation on producers to adopt specific labels on their products' packaging based on their recyclability according to the existing recycling system. This could raise consumer awareness and thus contribute to waste prevention. In the consultation process it was also highlighted that the new legislation has not been set any specific time frame for reaching the concrete quantitative target established by the new legislation related to the preparing for reuse and recycling of waste materials (paper, metal, plastic, glass etc.) (see the Green Party's comment, 2021). Although the time frame set out in Art. 11 of the Directive, i.e., 2020, is not feasible given the delayed transposition of the Directive into national law, the total lack of any reference to a clear deadline makes this target a 'toothless' and declaratory provision.

To sum up, the overall evaluation of the measures introduced by the new Law is undoubtedly positive as it incorporates – with a 1-year delay and following a request for compliance (Reasoned Opinion) sent by the European Commission in May 2021 – the two European Directives that were revised in view of the first package on the Circular Economy, while it also supports the ambitious objectives of the National Plan for Waste Management adopted in 2020. However, Greece, like some other member states that traditionally face major problems concerning their waste management sector, tends to adopt (very) ambitious regulatory frameworks without having the necessary toolbox to ensure their practical implementation. It is clear that the new Law sets more pragmatic objectives, aspiring to tackle the historical weakness of the system and pave the way towards a coherent and modern framework with the aim of establishing an integrated system for waste management and adapting to the requirements of the Circular Economy.

Still, the long-standing non-compliance with the existing rules regarding the objectives and methods of waste management, combined with the systematic deficiencies of the operation of the relevant facilities and the activity of businesses in this area, question the effectiveness of the new legislation. Moreover, the institutional rigidities of the administrative authorities involved as well as the lack of expertise in the field may raise additional obstacles.

Nonetheless, according to the Commission's report, Greece has made significant progress in increasing waste recycling and expanding its EPR schemes by reducing waste disposal in non-compliant landfills and establishing an operational plan for funding different EPR packaging schemes (European Commission, 2019). Besides, a large proportion of EU funds is destined for new, adequate waste management measures and infrastructure (European Commission, 2019). These developments together with the ambitious provisions of the new Greek legislation on waste management create fertile grounds for systemic changes and therefore substantial improvements to the waste management system in the country, in line with the requirements and standards set in the EU's waste law.

## REFERENCES


- Charokopou, A. (2019). The crucial waste issues in the case law of the Council of State, in Centre for International and European Economic Law, Waste management – Current legal issues (authors' translation – original title: Τα κρίσιμα ζητήματα των αποβλήτων στη νομολογία του Συμβουλίου της Επικρατείας in «Κέντρο Διεθνούς και Ευρωπαϊκού Οικονομικού Δικαίου, Διαχείριση αποβλήτων»), Nomiki Vivliothiki, p. 23.
- Comment of Mr.Katsiamboulas, (2021), President of the Hellenic Waste Management Society on the legislation under consultation, and the comment of the NGO WWF. Retrieved 28 July 2022 from: http://www.opengov.gr/minenv/?p=12045.
- Comment of the Associations of the villages of Kallirroi, Constantinai and Vasilikos of Messinia (2021), on the legislation under consultation. Retrieved 28 July 2022 from: http://www.opengov.gr/minenv/?p=12045.
- Comment of the Green Party (2021) on the legislation under consultation. Retrieved 28 July 2022 from: http://www.opengov.gr/minenv/?p=12045.
- Comment of the NGO WWF (2021) on the legislation under consultation. Retrieved 28 July 2022 from: http://www.opengov.gr/minenv/?p=12045.
- Comment of the Standing Committee on the Environment of the Department of Central Macedonia of the Technical Chamber (2021), on the legislation under consultation. Retrieved 28 July 2022 from: http://www.opengov.gr/minenv/?p=12045
- Comment of WATT S.A. on the legislation under consultation (2021). Retrieved 28 July 2022 from: http://www.opengov.gr/minenv/?p=12045).
- Communication from the Commission (2019). The European Green Deal, Brussels, 11.12.2019, COM(2019) 640 final. Retrieved 28 July 2022 from: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640&from=EN.
- Communication from the Commission (2020). A new industrial strategy for Europe, Brussels, 10.3.2020, COM(2020) 102 final. Retrieved 28 July 2022 from: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0102&from=EL
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (2015). Closing the loop – An EU action plan for the Circular Economy, Brussels, 2.12.2015, COM (2015) 614 final. Retrieved 28 July 2022 from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614.

- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (2020). A new Circular Economy Action Plan – For a cleaner and more competitive Europe, Brussels, 11.3.2020, COM(2020) 98 final. Retrieved 28 July 2022 from: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52020DC0098&from=EN.
- Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (2015). Closing the loop – An EU action plan for the Circular Economy, Brussels, 2.12.2015, COM (2015) 614 final. Retrieved 28 July 2022 from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614, p. 8-9.
- De Sadeleer, N. (2016). Droit des déchets de l'UE – De l'élimination à l'économie circulaire, Bruylant – Larcier, p. 19 and 230.
- Dellis G. (2018). Demos and Agora – Public law "in a different way", under the scope of economic analysis (authors' translation; original title: Δήμος και Αγορά – Το Δημόσιο δίκαιο «αλλιώς», υπό το βλέμμα της οικονομικής ανάλυσης), Evrasia, p. 99
- European Commission, (2019). Commission staff working document – The EU Environmental Implementation Review 2019 – Country Report-Greece, Brussels, 4.4.2019, SWD(2019) 138 final. Retrieved 28 July 2022 from https://ec.europa.eu/environment/eir/pdf/report_el_en.pdf.
- European Commission, (2019). Commission staff working document – The EU Environmental Implementation Review 2019 – Country Report-Greece, Brussels, 4.4.2019, SWD(2019) 138 final. Retrieved 28 July 2022 from https://ec.europa.eu/environment/eir/pdf/report_el_en.pdf, p. 7.
- European Commission. (2010). Being Wise with Waste: the EU's approach to waste management. Retrieved 28 July 2022 from: https://ec.europa.eu/environment/pdf/waste/WASTE%20BROCHURE.pdf
- European Environmental Agency (EEA), (2013). Municipal waste management in Greece, Retrieved 28 July 2022 from: https://www.eea.europa.eu/publications/managing-municipal-solid-waste/greece-municipal-waste-management/view, p. 5.
- Eurostat, Waste Statistics, December 2016.
- Kremlis, G. (2019). Waste management in circular economy (authors' translation: original title: Η διαχείριση αποβλήτων στο πλαίσιο της κυκλικής οικονομίας, in Centre of International and European Economy Law, Waste Management – Current legal issues (collective work), under the supervision of Chatzikonstantinou Ch., Sakkoulas, p. 4.

- Meadows, Don., Meadows, Den., Randers, J. & Behrens W. III. (1972). The limits to growth – A report for the Club of Rome's project on the Predicament of Mankind, Potomac Associates-Universe Books. Retrieved 28 July 2022 from: http://www.donellameadows.org/wp-content/userfiles/Limits-to-Growth-digital-scan-version.pdf, especially refer to p. 54-55
- OECD. (2001) Responsabilité élargie des producteurs – Manuel à l'intention des pouvoirs publics. Retrieved 28 July 2022 from: https://www.oecd-ilibrary.org/fr/environment/responsabilite-elargie-des-producteurs_9789264289864-fr, p. 9
- Pouikli K. (2020). Concretising the role of extended producer responsibility in European Union waste law and policy through the lens of the circular economy. Academy of European Law (ERA), 20:491-508, Springer. Retrieved 28 July 2022 from: https://link.springer.com/article/10.1007/s12027-020-00596-9, p. 492 and 499.
- Pouikli, K. & Tsoukala, A. (2021). The new Law 4819/2021 on waste management in the light of the requirements of EU waste law with emphasis on the Circular Economy, (authors' translation – original title: Ο νέος Ν 4819/2021 για τη διαχείριση αποβλήτων υπό το φως των επιταγών του ενωσιακού δικαίου αποβλήτων με έμφαση στην Κυκλική Οικονομία), Public Law Applications Journal, II-III, Nomiki Vivliothiki, p. 233-235.
- Pouikli, K. (2018). Circular Economy and EU Environmental Law: Legal foundations, content, perspectives (authors' translation; original title: Κυκλική Οικονομία και ενωσιακό δίκαιο περιβάλλοντος: Θεμέλια, περιεχόμενο, προοπτικές), Law and Environment Journal, No 4/2018, Nomiki Vivliothiki, p. 591.
- Sakalis, A. (2022). Waste Management in Greece: A Herculean Task. Waste Management World. Retrieved 28 July 2022 from https://waste-management-world.com/artikel/waste-management-in-greece-a-herculean-task/.
- Steenmans K., Malcolm R. & Marriott J. (2017). Commodification of waste: Legal and theoretical approaches to industrial symbiosis as part of a circular economy. University of Oslo, Faculty of Law, Research Paper No. 2017-26, p. 2. Retrieved 28 July 2022 from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2983631.
- Verdure C. (2011). The enforcement of competition law in the waste sector: review in light of the relevant market's definition, Maastricht University – Faculty of Law. Retrieved 28 July 2022 from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1941648, p. 5.
- WWF, (2018). Annual Environmental Law Review. Retrieved 28 July 2022 from https://www.contentarchive.wwf.gr/images/pdfs/WWF%20Annual%20environmental%20law%20review2018-ENG%20Summary.pdf, p. 16.

Chapter 6

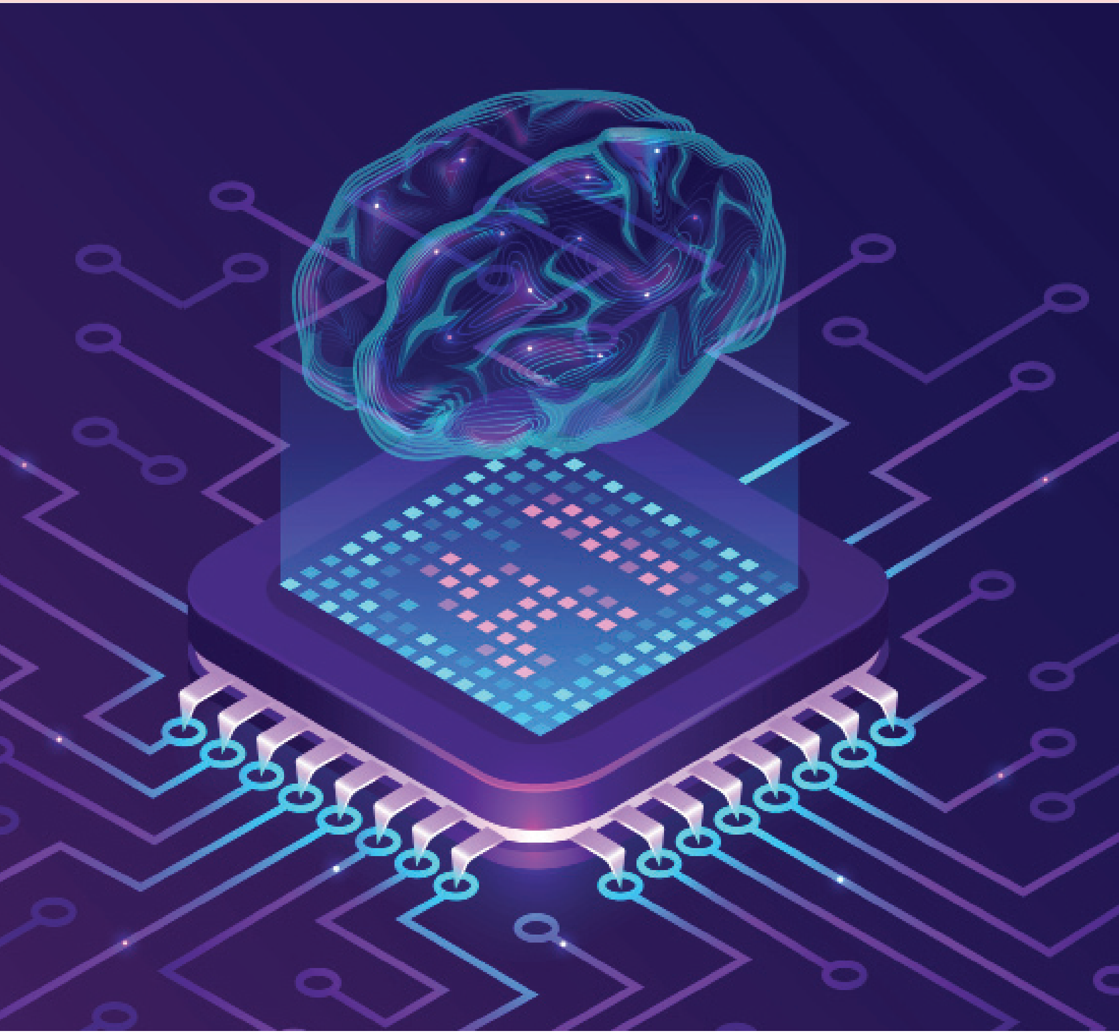
# Artificial Intelligence: Different perspectives and the case of Slovenia

**Eva Murko**
University of Ljubljana, Slovenia

## 1 Introduction

**Recent significant breakthroughs in the field of Artificial Intelligence (AI) have been made possible by the rapid advances in computing power, the increasing availability of big data, and the development of new algorithms. This 'new set of technologies' holds the potential to profoundly transform our societies and economic systems as it is becoming one of the most significant technological developments of the century for individuals, businesses and governments (Misuraca & Van Noordt, 2020).**

Self-adapting algorithms are being employed for the first time in human history in several situations, including industrial operations, data analytics, a wide range of daily activities (such as modern smartphones and self-driving cars), and many more. From a socioeconomic standpoint, AI is enhancing industrial and technological capacity, leading to more outstanding production, supporting the enhancement of public services, and improving



living conditions. It also holds great potential to support the achievement of sustainable development goals (United Nations, 2015). However, like with any disruptive technology, its development in the future and its effects on social and economic aspects need to be monitored and the related risks reduced (Righi et al., 2022).

The overall goal of the European Union is to become the world-leading region in developing and deploying cutting-edge, ethical and secure AI, promoting a human-centric approach on the global level (Misuraca

& Van Noordt, 2020). The vision for AI in Slovenia is to build on more than 40 years of research achievements in the field of AI and to become internationally recognised for the competence of knowledge transfer and top-quality, ethical and safe technologies in the field of AI in human-friendly and trustworthy services and products (NpUI, 2020).

Hence, this paper presents a short historical overview of AI and its definitions in the second section. The third section includes three different perspectives, namely AI investments in the EU, an overview of (potential) AI applications, and how this technology can align and assist with achieving sustainable development goals. The fourth section offers a brief overview of the situation of AI in Slovenia, and the last section brings everything together and provides concluding remarks.

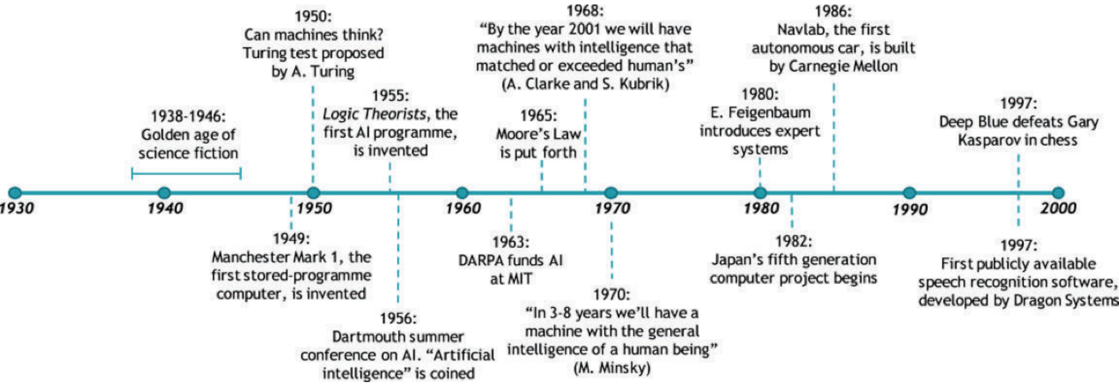
## 2 Artificial Intelligence – a short history and definition(s)

To understand why there is so much interest, research and funding dedicated to artificial intelligence globally, it is useful to (briefly) glance at its history. The field of AI is not new. The earliest ideas of "thinking machines" arose in the 1950s with British mathematician Alan Turing's paper (Turing & Haugeland, 1950) in which he considered the possibility of machines that think. The "Turing test", still used today, was created to establish a definition of thinking. To pass the test, a computer needed to have a conversation indistinguishable from a human's (Siebel, 2019). The term itself, "artificial intelligence", dates back to 1955. It was coined as a neutral term to describe this emerging field at the time by Dartmouth maths professor John McCarthy (Siebel, 2019). McCarthy proposed a summer workshop 1 year later (1956) together with Alan Newell, Arthur Samuel, Herbert Simon and Marvin Minsky. Their summer research project is considered to be the creation/birthplace of AI (OECD, 2019).

A majority of projects followed; however, those early AI efforts were unsuccessful due to the key obstacle of a lack of computing power. In addition, the mathematical concepts and techniques were not well developed. This led to the 'AI winter' in the mid 1970s as funding agencies started to lose interest in supporting AI research (OECD, 2019; Siebel, 2019).

In the 2000s, the field of AI was revitalised by three major forces: 1) Moore's law (Tardi, 2022) was confirmed with the rapid advances in computational power; 2) the growth of the Internet resulted in a massive amount of data (big data) and enabled additional computer resources with the emergence of cloud computing; and 3) significant advances in the mathematical foundations for AI (e.g., machine learning) were made in the 1990s (Siebel, 2019). Figure 1 depicts the timeline of AI's early development.

Figure 1: **Timeline of early AI developments, 1950s to 2000**




Source: OECD, 2019 (OECD adapted from Anyoha (2017).

Today, better and more affordable sensors are also becoming a reality as a result of ongoing technological advancement, providing AI systems with more trustworthy data. As these sensors become smaller and less expensive to deploy, the amount of data available to AI systems keeps expanding. As a result, several fundamental areas of AI research, such as natural language processing, computer vision, autonomous vehicles and robotics, have made tremendous advances (OECD, 2019). Using big data sets, AI systems can independently build models for planning, optimisation, prediction, decision-making and, ultimately, autonomous action without human intervention (Hilbert, 2020).

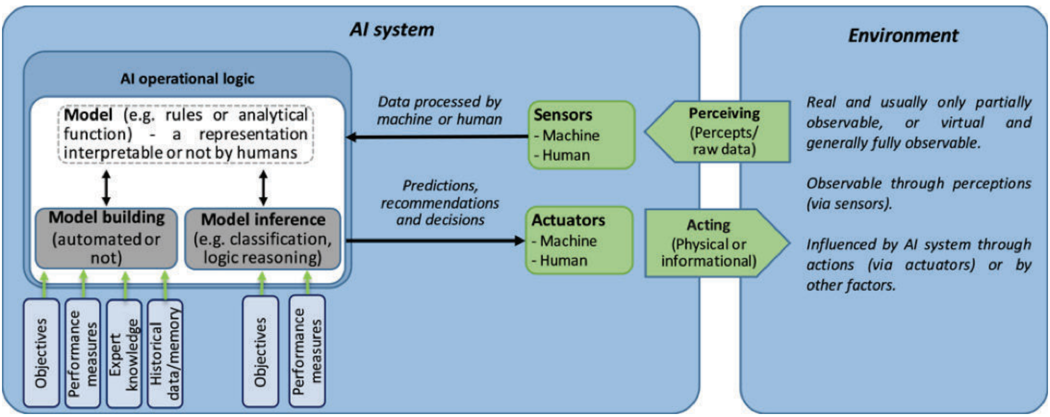
**What is AI?** There is no single, universally accepted definition of AI (yet), but several different ones. Some are formulated based on the disciplines for which AI systems are used and others on the life cycle phases (Berryhill et al., 2019). Wirtz et al. (2019) studied different definitions of AI and proposed an integrative definition for AI as the ability of a computer system to perform human-like intelligent behaviour and problem solving with the help of certain core competencies, including perception, understanding, action and learning. In line with this, the author's understanding of an AI application refers to integrating AI technology into a computer application field with human-computer interaction and data interaction (Wirtz et al., 2019).

The term is also used to describe a field of research that includes the creation and development of algorithms, techniques and intelligent systems and additionally the ethical and societal impact of such systems (Berryhill et al., 2019).

The AI Group of Experts at the OECD (AIGO) developed a description of an AI system that seeks to be understandable, technology-neutral, technically accurate, and relevant in short- and long-term time frames. The description is based on the conceptual view of AI from Artificial Intelligence: A Modern Approach (Russel and Norvig, 2009) and consistent with the widely used definition of AI as "the study of the computations that make it possible to perceive, reason, and act" (Winston, 1992) and with similar general definitions (Gringsjord and Govindarajulu, 2018; OECD, 2019).

According to the OECD (2019), a conceptual view of AI is presented as the structure of a generic AI system (also referred to as an "intelligent agent") (Figure 2), namely: »An AI system consists of three main elements: **sensors, operational logic and actuators.** Sensors collect raw data from the environment, while actuators act to change the state of the environment. The key power of an AI system resides in its operational logic. For a given set of objectives and based on input data from sensors, the operational logic provides output for the actuators. These take the form of recommendations, predictions or decisions that can influence the state of the environment«.

Figure 2: **Detailed conceptual view of an AI System**




Source: OECD, 2019 (As defined and approved by AIGO in February 2019).

# 3 Artificial Intelligence investments, (potential) applications and alignment with sustainable goals

AI is already changing our lives, almost exclusively by improving productivity, safety, human health etc. (Stone et al., 2016). It holds much potential to increase it even more through cheaper and more accurate predictions, decisions or recommendations. Hence, a majority of intriguing AI advancements are found outside of computer science in disciplines like biology, medicine, finance, and health. Its economic landscape is evolving as AI is becoming a general-purpose technology. The transition of AI is similar in many respects to the way computers spread from a few specialised enterprises to the broader economy and society in the 1990s (OECD, 2019).

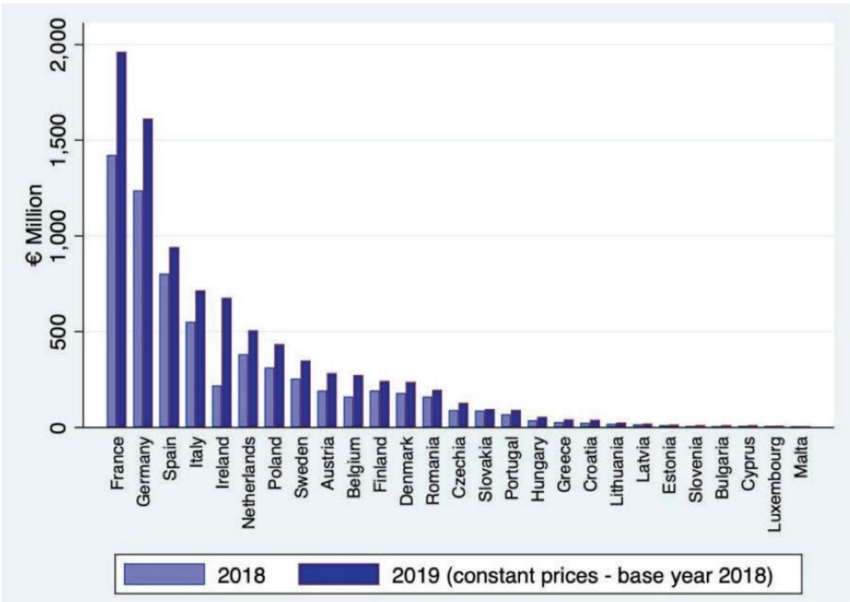
OECD (2019) points out that economies will need a new profile of employees, called "bilinguals", who are experts in a single field, such as economics, biology or law, and are also proficient in AI techniques like machine learning. However, leveraging AI requires complementary investments in such skills, also in data, and digitalised workflows, as well as bringing changes to organisational processes. Therefore, adoption varies across companies and industries (OECD, 2019). Major research universities devote departments to AI studies, and technological giants, companies such as Apple, Facebook, Google, IBM, and Microsoft invest heavily to explore AI applications which they regard as critical to their futures (Stone et al., 2016). This has evolved with the implementation of various policies encouraging AI development. Canada paved the way in 2017 by including a C$ 125 million budget for the development of its AI research capabilities. This was quickly followed by Germany, the USA, the UK, China and multilateral institutions, including the European Union (EU) (Buarque et al., 2020).

## 3.1 AI investments in the EU

According to the latest European Commission's JRC report, AI Watch Index 2021 (Righi et al., 2022), the EU invested between EUR 7.9 billion and EUR 9 billion in AI in 2019. This is an estimated increase of 39% compared with 2018. If the current trend continues, the EU will surpass its yearly AI investment target of EUR 22 billion by 2030. This suggests that the yearly investment objective in the 2018 Communication Artificial Intelligence for Europe (European Commission, 2018) of EUR 20 billion will be met earlier than expected. The estimated maximum investment scenario is shown in Figure 3. From 2018 to 2019, every EU member state boosted their level of AI investment. Ireland, Belgium and Austria had the most significant yearly increase among the members that made Investments, totalling more than EUR 50 million in 2019 (Righi et al., 2022).

Bulgaria, Slovenia and Croatia show the highest annual increase among members with lower investment levels (i.e., less than EUR 50 million), with rates of +96%, +75%, and +67%, respectively. In absolute terms, France and Germany are in the lead since they accounted for 22% and 18%, respectively, of all EU AI investments in 2019. If Spain is included, only these three countries made 50% of the EU's AI investments in 2019. However, the same three nations accounted for 53% of EU investments in AI in 2018. Thus, even if a single year is insufficient to detect a pattern, the fact that investments are becoming less concentrated may indicate that more nations are making an increasing amount of effort to invest. The public sector also boosted its AI investments from 2018 to 2019, accounting for 34% of the investments in 2019. yet, the private sector, which accounted for 66% of all investments, was largely responsible for the growth in AI investments in 2019 (Righi et al., 2022).

Figure 3: **Public and private AI investments, EU member states, 2018–2019**



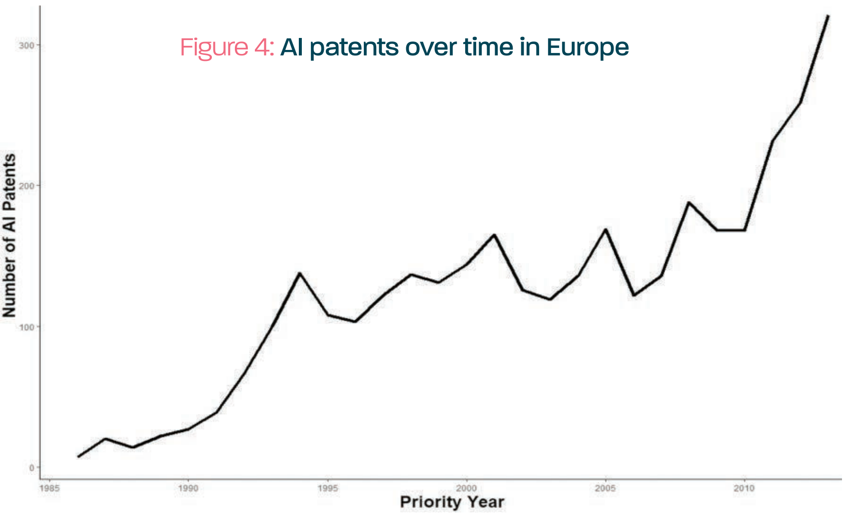

Source: AI Watch Index 2021 (Righi et al., 2022).

It is also very interesting to look at the development of AI technologies. Buarque et al. (2020) set a goal to build a data set of AI patents in Europe in order to study AI knowledge production and its distribution across the different regions and technological sectors of the European economy. They were able to identify 'AI superstar' regions that produce the most AI patents in Europe. They represent the top 10% of regions that create 39.3% of AI patents in Europe.

Their main finding is that "regions with the most AI patents also tend to be regions where AI is most connected to the overall knowledge space. If AI inventions were removed from these regions, there would be a significant shift in the inventive network structure. This finding suggests that AI is best developed when well connected to other research and development activities within the larger regional knowledge production ecosystem. Developing AI hand-in-hand with applications (such as image recognition for use in autonomous automobiles) may be more fruitful than developing AI as an isolated technology specialisation" (Buraque et al., 2020).

Figure 4 shows how the annual number of published patents varies from year to year. The earliest AI patent applications were released in 1987 (seven of them). The yearly number of patents increased in the early 1990s after a period of comparatively little activity. Another change occurred in about 2010, increasing both the total number of AI patents and their yearly growth rate (Buraque et al., 2020).

Figure 4: **AI patents over time in Europe**




Source: Buraque et al. (2020).

Table 1 lists the top 10% of AI-producing regions, along with the number of both AI and non-AI patents they produced during the sample (from 1987 to 2013). Regions on the list belong to France, Germany, Netherlands, the UK, Italy, Sweden and Finland. At the top are large regions with cities such as Munich and Paris, however, also smaller regions appear like East Anglia (UK) and Mittelfranken (DE). Irrespective of the sizes, these locations stand out due to their abnormally high percentages of skills in AI-related CPC codes (% AI CPCs) in their local knowledge spaces. CPC stands for Cooperative Patent Classification codes provided by the World Intellectual Property Organisation. A mean of 0.43% is obtained by dividing shares equally across the 230 NUTS 2 regions (The NUTS classification (Nomenclature of territorial units for statistics) is a hierarchical system for dividing up the economic territory of the EU and the UK (Eurostat, n.d.)). The CPC share of the top five most productive locations for AI is at least five times higher in comparison. This shows that areas that are leading the way in computing innovation also have an edge in producing AI patents (Buraque et al., 2020).

Table 1: **Top AI-producing regions in Europe, 1987–2013**

| NUTS 2 | Region | AI Patents | Non-AI Patents | % AI CPCs | AICI Change |
|---|---|---|---|---|---|
| **FR10** | Île de France | 293 | 173,250 | 6.93% | 2.359 |
| **DE21** | Oberbayern | 280 | 134,106 | 5.64% | 4.852 |
| **DE25** | Mittelfranken | 172 | 46,153 | 2.25% | 0.908 |
| **NL41** | Noord-Brabant | 137 | 84,923 | 5.45% | 1.481 |
| **DE11** | Stuttgart | 120 | 131,917 | 2.74% | 1.303 |
| **DE12** | Karlsruhe | 106 | 80,240 | 2.57% | 0.954 |
| **DE71** | Darmstadt | 77 | 108,034 | 1.81% | 2.420 |
| **UKH1** | East Anglia | 72 | 28,897 | 1.45% | 2.405 |
| **DEA2** | Köln | 72 | 87,022 | 1.72% | 1.186 |
| **ITC4** | Lombardia | 70 | 66,708 | 1.07% | 1.328 |
| **DE30** | Berlin | 68 | 40,251 | 1.48% | 0.804 |

| NUTS 2 | Region | AI Patents | Non-AI Patents | % AI CPCs | AICI Change |
|---|---|---|---|---|---|
| **FR71** | Rhône-Alpes | 66 | 78,988 | 1.93% | 1.388 |
| **DE14** | Tübingen | 66 | 44,424 | 1.02% | 1.000 |
| **DE13** | Freiburg | 65 | 51,076 | 1.72% | 1.060 |
| **SE11** | Stockholm | 64 | 40,235 | 2.95% | 0.911 |
| **UKJ2** | Surrey, East and West Sussex | 63 | 21,303 | 1.32% | 0.330 |
| **DE92** | Hannover | 60 | 28,012 | 1.06% | 1.274 |
| **FR82** | Provence-Alpes-Côte d'Azur | 54 | 25,405 | 1.82% | 0.689 |
| **SE22** | South Sweden | 52 | 22,225 | 1.41% | 1.018 |
| **UKJ1** | Berkshire, Buckingham-shire and Oxfordshire | 48 | 31,575 | 1.41% | 0.279 |
| **FI1B** | Helsinki-Uusimaa | 44 | 34,030 | 2.52% | 0.406 |
| **DE27** | Schwaben | 43 | 28,100 | 0.74% | 1.785 |

Source: Buraque et al. (2020).

### 3.2 AI (possible) applications

Numerous industries are adopting AI applications or starting to, in which it is possible for AI to find patterns in big data sets and model complex, interconnected systems in order to enhance decision-making and save costs (OECD, 2019). The most obvious ones are technological giants like Google, Baidu, LinkedIn, Amazon and Netflix that use AI on a large scale and is bringing them real business benefits. Some of the most established AI applications delivering business benefits are seen in advertising placement, online search and product or service recommendations (Siebel, 2019).

In addition to the technology sector, other industries are identifying great potential to use, are starting to use, or already are using AI technologies in a meaningful way, for example:

- **Financial services** use AI to detect and intercept credit card frauds, reduce customer churn by predicting when customers are likely to switch, streamline new customer acquisition, assess creditworthiness, automate trading, reduce customer service costs and support legal compliance (Siebel, 2019; OECD, 2019).
- The **healthcare industry** is starting to unlock value from AI. Significant opportunities exist for healthcare companies to use machine learning to improve patient outcomes, help predict diagnose and chronic diseases, prevent disease early, improve disease coding accuracy and discover treatments and drugs (Siebel, 2019; OECD, 2019). The significance of AI in healthcare, particularly in medical informatics, was emphasised by Khanna, Sattar & Hansen (2013). AI has the ability to provide better patient care and interpret medical images in fields like radiology (Dreyer & Allen, 2018; Dwivedi et al., 2021).
- In the **transport sector**, autonomous vehicles are an example of the deployment of AI on a large scale and will soon be the norm. It is a promise of safety, environmental benefits and quality of life with a virtual driver system, optimised traffic routes and high-definition maps (OECD, 2019). This might be most people's introduction to physically embodied AI systems and will significantly impact how people view AI. City inhabitants will own fewer automobiles, live farther from work, and spend time differently as cars become better drivers than people, creating a whole new urban structure. Physically embodied AI applications will probably include trucks, flying automobiles, and personal robots in addition to cars (Stone et al., 2016).
- **Industrial and manufacturing companies** have also started to unlock value from AI applications, including using AI for predictive maintenance and advanced optimisation across entire supply chains (Siebel, 2019). Organisations have posited the benefits of integrating AI technologies in developing intelligent manufacturing and the smart factory of the future (Li et al., 2017; Nikolic et al., 2017).
- **Energy companies** are transforming operations using AI. They use it to identify and reduce fraud, forecast electricity consumption and maintain their generation, transmission and distribution assets (Siebel, 2019).
- The United States' military uses AI applications to improve military readiness and streamline operations. Other use cases in **defence** include logistics and inventory optimisation and matching new recruits to jobs (Siebel, 2019). **Digital security** applications use AI systems to help automate the detection of and response to threats, increasingly in real-time (OECD, 2019).

The relatively dated concepts of AI machines taking the place of all human labour are generally being let go in the literature and general thinking. "Studies have recognised the realistic limits of the continuing drive to automation, highlighting a more realistic human-in-the-loop concept where the focus on AI is to enhance human capability, not replace it" (Katz, 2017; Kumar, 2017; Dwivedi et al., 2021), hence the literature is identifying more and more domains in which the AI technology can be applied, which is gradually being confirmed in practice.

### 3.3 UN sustainability goals and AI

The Sustainable Development Goals (SDGs) were developed by the United Nations (2015) in 2015 and presented as a roadmap and common agenda for world peace and prosperity for the planet. Seventeen SDGs have been created to emphasise many key issues related to eradicating poverty, improving health and education, decreasing inequality, focusing on climate change, and creating sustainable economic growth (United Nations, 2015).

The UN SDGs were discussed in a paper by Ismagilova et al. (2019) relative to smart cities and their residents and their potential future impact. The Hughes et al. (2019) study took the UN SDGs into consideration from the standpoint of blockchain technology and how this technology may be in line with the development of economic and social value (Hughes et al., 2019). Each of the UN SDGs is examined in research by Dwivedi et al. (2021) from the perspective of potential alignment with AI. Table 2 presents the SDGs and illustrates how AI technology may be able to support each one while also providing advantages and sustainability.

"The relatively dated concepts of AI machines taking the place of all human labour are generally being let go in the literature and general thinking."

The alignment of the UN SDGs and AI technology could benefit the widespread adoption of sustainability. This is likely to require significant investment from governments and industries together with collaboration at an international level to align governance, standards and security (Dwivedi et al., 2021).

## Table 2: UN sustainable development goals and AI technology-driven potential change

| UN sustainability goals | AI technology's potential in delivering UN goals |
|---|---|
| 1) No poverty<br>2) Zero hunger<br>3) Good health and well-being | AI technology is anticipated to lead to higher manufacturing automation levels, affecting both developing and developed economies. Studies have shown the inevitable loss of low-skilled labour and that there may be room for new, higher-value occupations that use human cognitive abilities. Numerous growing Asian economies that have historically relied on this kind of employment are expected to be disproportionately impacted by this. However, this realignment is expected to positively enhance people's quality of life and standard of living as new positions are developed to support the growing use of AI, requiring new skills and training. Medical professionals are in short supply in many emerging economies, especially rural regions. AI-based diagnosis systems might be used to assist physicians and possibly speed up the treatment process, improving public health. |
| 4) Quality education<br>5) Gender equality<br>6) Reduced inequalities | Schools and universities could utilise AI technology to help the learning process and assist educators in interacting with students. Greater faith in AI systems could reduce inequalities due to the inability of potential bribery, intimidation and transparency as long as algorithms are open and certified. |
| 7) Clean water and sanitation<br>8) Affordable and clean energy | AI technology has the potential to predict energy and utility demand and react to climate change using big data and intelligent energy supply systems. This would result in less waste, a more efficient supply network and lower-cost energy. |
| 9) Decent work and economic growth<br>10) Industry innovation and infrastructure<br>11) Sustainable cities and communities | Greater levels of automation and the advancement of machine learning technologies will improve working practices and productivity. This will, in turn, drive skill levels and growth within several sectors. The use of AI can generate innovation and greater levels of sustainability as governing authorities strive to incorporate AI technologies within communities and cities. |
| 12) Responsible consumption and production<br>13) Climate action<br>14) Life below water<br>15) Life on land | AI technology enhances the quality of understanding and responding to climate impacts and may play a crucial role in ensuring and fostering economic growth among the world's least developed nations. The potential improvements to forecasting and modelling via the use of machine learning elements of AI and big data, can directly contribute to the ongoing human impact on use of valuable resources, life below water and on land. This use of technology can potentially force human change in these areas as AI systems help to gain consensus on key global sustainable issues. |

| UN sustainability goals | AI technology's potential in delivering UN goals |
|---|---|
| **16)** Peace, justice and strong institutions | The combination of AI technology and human in the loop capability could potentially reinforce peoples trust in areas such as: medical diagnosis, interpretation of law and statute as well as government institutions that can be made more effective and efficient via AI technology. |
| **17)** Partnerships for the goals | The partnership between institutions and decision-makers is required at an international level to enable acceptance of AI and for the technology to deliver the required development outcomes. |

Source: Dwivedi et al. (2021).

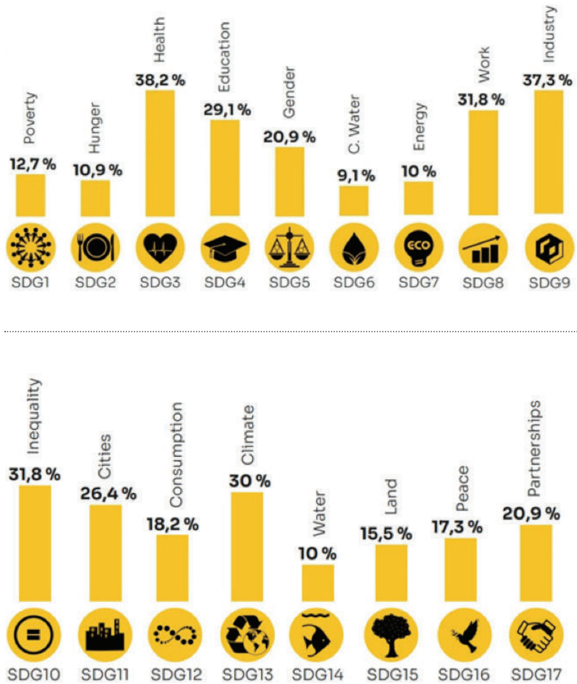
Further, the International Research Centre in Artificial Intelligence (IRCAI), under the auspices of UNESCO, is creating a list and index of the Top 100 projects that are solving problems related to the 17 UN SDGs with the application of AI technology from all 5 geographical regions: Africa, Europe and Americas, Asia and the Pacific, and the Middle East. The main aim is to scope and showcase solutions from around the world that contribute to the SDGs by creating the world's largest sustainable solutions platform and helping these solutions grow even more effective and impactful (IRCAI, 2021). The 2021 IRCAI Global Top 100 international call for applications mobilising current AI technologies to achieve the 17 UN SDGs was highly successful. They gathered projects which covered all 17 SDGs (see Figures 5 and 6), multiple sectors and every geographic region.

The call gave an insight into the state of the sustainable technology sector. While the majority of project applications (approximately 80%) came from Europe and North America, their context of application was frequently either global and transversal or targeted regions outside of the nation in which the projects were situated. The history and development of many of these initiatives required collaboration across many sectors, suggesting an encouraging degree of cross-pollination and cooperation in project creation, even though the majority of the call's entries (about 65%) were from the private sector.

SDGs 3, 9, 10, 8, 13 and 4 appeared to be the most preferred regarding SDG distribution across projects, whereas SDGs 6, 7, 14 and 2 were comparatively underrepresented. This finding might suggest that current AI technology is

more utilised in pursuing certain SDGs than others, particularly those which apply to sectors where AI currently thrives (e.g., healthcare and industry). There was also a lack of substantive awareness and concern for ethical criteria, such as privacy and transparency, or ethical risks and trade-offs, which is fundamental to many submitted projects. Hence, IRCAI suggested greater attention must be paid to how AI can ethically contribute to sustainability. The list of the top 100 AI projects for sustainable development from 2021 can be found in their report (IRCAI, 2021).

**Figures 5 and 6: Representation/mentions of SDGs across projects**

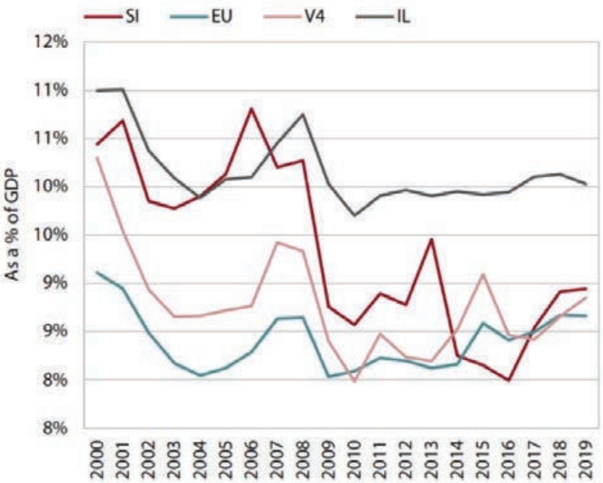



Source (both): IRCAI (2021).

## 4 Artificial Intelligence in Slovenia

The Slovenian economy saw a rapid recovery in 2021 and a stable income after the outbreak of the epidemic with the help of strong government measures that kept the material and financial situation of the population relatively steady (IMAD, 2022). However, the transition to innovation-driven economic growth with a highly productive economy has been slow since the global financial crisis. The gap with the EU average in GDP per capita in purchasing power standards, which is an indicator of economic development, only approached the 2008 level in 2021, and Slovenia is still far from the SDS 2030 target (IMAD, 2022). SDS stands for the Slovenian Development Strategy 2030, which is the state's new long-term national development strategy (SDS, 2017). The reason for the slow closing of the development gap in the last decade is the modest productivity growth, mostly attributable to low investment after the global financial crisis. Several years of declining investment in intangible capital after the previous (financial) crisis (on innovation and digitalisation) are impacting and slowing the transition to innovation-driven growth (IMAD, 2022).

Figure 7: **Investments in R&D, ICT and other machinery and equipment**

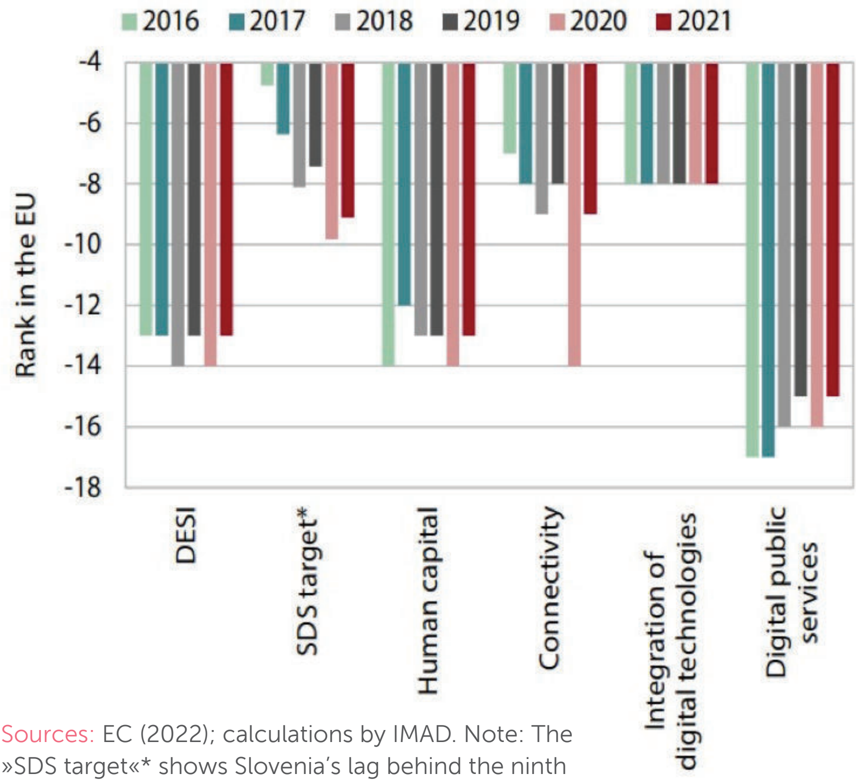



Sources: Eurostat (2022); calculations by IMAD (2022). The figure shows investment in R&D, ICT and other machinery and equipment combined, expressed as a % of GDP, for Slovenia (SI), the EU (computed as a weighted average of GDP, excluding data for Greece, Ireland, Cyprus and Croatia), the V4 (Visegrad Four) and the innovation leaders (IL): Sweden, Finland, Denmark and Belgium (since data for Denmark are unavailable, IMAD assumed that the value for 2019 is the same as for 2018).

"Slovenia is also increasingly moving away from its strategic SDS targets in the field of digitalisation of the economy and society. International rankings show Slovenia's present digitalisation performance is mediocre."

Slovenia is also increasingly moving away from its strategic SDS targets in the field of digitalisation of the economy and society. International rankings show Slovenia's present digitalisation performance is mediocre (European Commission, 2021; OECD, 2020; UN, 2020; IMD, 2021a; IMD, 2021b). Slovenia lags behind in terms of coverage with a fixed broadband network, which is unfavourable, especially for assuring quality digital accessibility for all, notably in rural areas. Slovenia did not increase its investments in ICT in 2020, which have remained stuck at around 2% of GDP for the last 10 years (IMAD, 2021). In the field of economy and society digitalisation (measured by the Digital Economy and Society Index (DESI)) in the EU, Slovenia's ranking has stagnated between 13th and 14th place in the last 6 years and is even losing its advantage over the EU average (IMAD, 2022) (see Figure 8). This also widens the gap with the SDS target, according to which the DESI value target is to rank at least among the top nine countries in the EU (SDS, 2017). By individual dimensions, it achieves above-average results in the areas of connectivity and integration of digital technologies, where it has been in around 8th place in the last 6 years, but with a noticeable reduction in advantages compared to the EU average (IMAD, 2022). In human capital, Slovenia ranks 13th and is slightly above the EU average but with similar dynamics as the EU. In the field of digital public services, the index score reached the EU average in 2021 thanks to progress in the use of e-government services (IMAD, 2022).

Figure 8: **Slovenia's rank in different targets (according to DESI Index, Slovenia is not changing its ranking within the EU but is moving further away from the SDS target in this area).**




Sources: EC (2022); calculations by IMAD. Note: The »SDS target«* shows Slovenia's lag behind the ninth ranked EU member state, which is the SDS target, expressed in index points in relation to the EU (100). Note: The place in the EU is expressed by a negative value so that improvement in the ranking is also reflected graphically (IMAD, 2022).

Being aware of the digital development situation, digital relevance is highlighted and stressed in several different Slovenian strategies (GOV, 2017; S4 strategy, 2020; GOV, 2020) and in the upcoming Digital Slovenia 2030 (GOV, 2021), which is expected to address the following priority areas: Digital inclusion, Digital public services, Gigabit connectivity, Smart Digital Transformation into Society 5.0, and Cyber security.

Further, as part of the digital transformation, the importance of Artificial Intelligence keeps increasing. In 2018, the European Commission adopted the Coordinated Plan on Artificial Intelligence (EC, 2018) that was developed together with the member states to maximise the impact of investments on the European Union (EU) and national levels and to encourage synergies and cooperation across the EU. One of the key actions towards meeting these aims was encouraging the member states to develop their national AI strategies (Van Roy et al., 2021). By 2020, more than 30 nations across the globe had started discussions about designing national AI strategies (Radu, 2021) and, by June 2021, 20 member states and Norway had adopted national AI strategies (Table 3), while 7 member states were in the final drafting phase and ready to publish their strategy in the coming months (Van Roy et al., 2021).

Table 3: **Overview of national AI strategies in the EU member states and Norway**

| Country | Status | Date | Country | Status | Date |
|---|---|---|---|---|---|
| Austria | In progress | | Italy | In progress | |
| Belgium | In progress | | Latvia | Published | Feb. 2020 |
| **Bulgaria** | Published | Dec. 2020 | Lithuania | Published | Mar. 2019 |
| Croatia | In progress | | Luxembourg | Published | May 2019 |
| **Cyprus** | Published<br>Last update | Jan. 2020<br>Jun. 2020 | Malta | Published | Oct. 2019 |
| Czech Republic | Published | May 2019 | Netherlands | Published | Oct. 2019 |
| Denmark | Published | Mar. 2019 | Norway [AC] | Published | Jan. 2020 |
| Estonia | Published | Jul. 2019 | **Poland** | Published | Dec. 2020 |
| **Finland** | Published<br>Last update | Oct. 2017<br>Nov. 2020 | Portugal | Published | Jun. 2019 |
| France | Published | Mar. 2018 | Romania | In progress | |
| **Germany** | Published<br>Last update | Nov. 2018<br>Dec. 2020 | Slovakia | Published | Jul. 2019 |
| Greece | In progress | | **Slovenia** | Published | May 2021 |
| Hungary | Published | Sept. 2020 | **Spain** | Published | Dec. 2020 |
| Ireland | In progress | | Sweden | Published | May 2018 |

Source: Van Roy et al., 2021. Note: Last update of the table on 1 June 2021. The information in the table is based on input from national contact points or public sources. It presents release dates of national AI strategies in their native language. Countries in bold have published or updated their national AI strategy since the release of the previous AI Watch report in February 2020. In addition to EU member states, this table includes Norway as Associated Country highlighted with the superscript AC. Switzerland does not intend to release a national AI strategy (Van Roy et al., 2021).

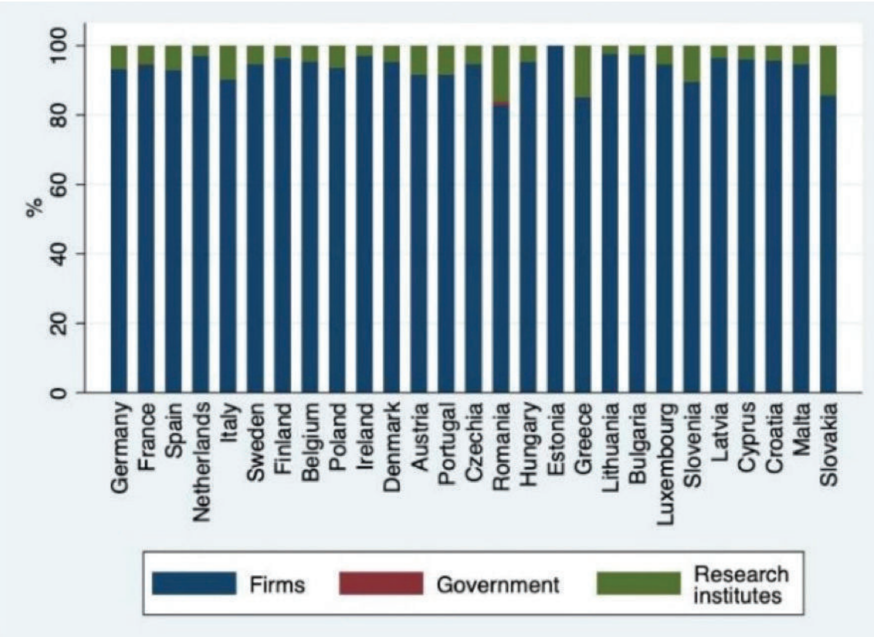
Slovenia published the strategic document "National programme for promoting the development and use of artificial intelligence in the Republic of Slovenia until 2025" (NpUI, 2020) in May 2021. Besides the vision of AI for Slovenia, strategic goals and measures for achieving the set development plan, it provides an overview of the development and state of the AI situation in Slovenia and its 40-year tradition of research activity in the field of AI and related advanced technologies.

### 4.1 How it started

A pioneer in the AI research sphere in Slovenia is Prof. Dr. Ivan Bratko, who started research and teaching work in the field of AI in the early 1980s. Research in the field of AI started in 1972 at the Jožef Stefan Institute (JSI) in Ljubljana and later also at the then Faculty of Electrical Engineering of the University of Ljubljana. In 1979, the AI Group was founded at the JSI, which was renamed the AI Laboratory in 1985. A laboratory with the same name was established in 1981 at the Faculty of Electrical Engineering of the University of Ljubljana. The two laboratories gradually grew into several research sections at the JSI and several research laboratories operating within the Department of AI at the Faculty of Computer Science and Informatics of the University of Ljubljana. Similar laboratories and centres have been developed at most Slovenian universities, at some research institutes and companies, especially those in the field of computer science and information and communication technologies. At the beginning of 2020, 98 research groups were operating in Slovenia within the framework of 65 registered research and development organisations under public and private law, whose work covered the fields of AI (AI, expert systems, intelligent systems, computer vision, systems and cybernetics and machine learning) (NpUI, 2020).

According to the AI Watch Index 2021 (Righi et al., 2022), Slovenia ranks fourth among EU member states regarding the presence of research institutes (10.34%) within the composition of AI players by type of organisation (Figure 9). On the EU level, companies are the predominant type of AI player in all member states. Governmental institutions account for only a small proportion, and the presence of research institutes is significantly high in Romania (16.05%), Greece (14.82%), Slovakia (14.29%), Slovenia (10.34%) and Italy (9.67%) (Righi et al., 2022).

Figure 9: **AI economic players by organisation type (%), EU member states, 2009–2020**




Source: AI Watch Index 2021 (Righi et al., 2022).

### 4.2 Funding of research activity

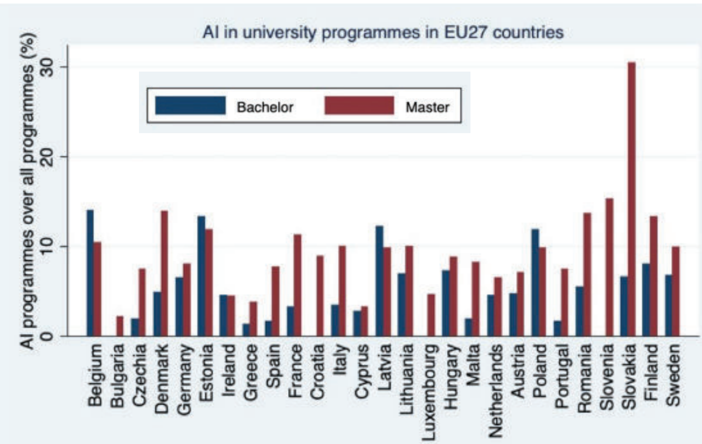
From the point of view of stable national funding of research activity, an important part of the funds for the Slovenian research community in the field of fundamental and applied research comes from the Public Agency for Research Activity of the Republic of Slovenia (hereinafter: ARRS) through its financing of research programmes. However, the total national funds for research activities decreased drastically in 2012 and only reached the level of 2011 in 2018. Further, the competitive funding of research projects in the field of AI by ARRS is also very limited since one project (100,000 EUR/year for 3 years) in a single tender is approved for the entire field of computer science (not only AI). In recent years, the research community has thus mainly relied on having success with obtaining funds from EU tenders, with an emphasis on projects based on applied research and development, but not to the same extent on fundamental research (NpUI, 2020).

### 4.3 Study of AI in Slovenia and digital (AI) skills

AI studies are included in several educational programmes at different higher education institutions in Slovenia. Today, AI is considered one of the main fields of study at the Faculty of Computer Science and Informatics of the University of Ljubljana. In a narrower sense, it is also included in several subjects of six educational programmes of the Faculty of Electrical Engineering and in the curriculum of the Faculty of Mathematics and Physics of the University of Ljubljana. The field of AI is also strongly represented at certain faculties (mathematics, electrical engineering, mechanical engineering, computer and information sciences) at the University of Maribor, the University of Primorska and the Jožef Stefan International Postgraduate School. From a legal, philosophical and security point of view, AI is also studied at other Slovenian faculties and in research organisations where AI is not included in educational programmes as a separate subject (NpUI, 2020).

According to the 2021 AI Watch Index (Righi et al., 2022), the presence of AI content in master's degree programmes is higher than for bachelor's degree programmes in most EU member states (Figure 10). The exceptions are the four countries with the biggest proportion of AI content in their bachelor's curricula: Belgium, Estonia, Latvia and Poland (Righi et al., 2022). There is no AI content in bachelor's degree programmes in Slovenia, but the AI intensity in the master's degree curricula is the second highest in the EU (15.3%).

Figure 10: **AI in university programmes by level of studies (%), EU member states, 2020–2021 academic year**



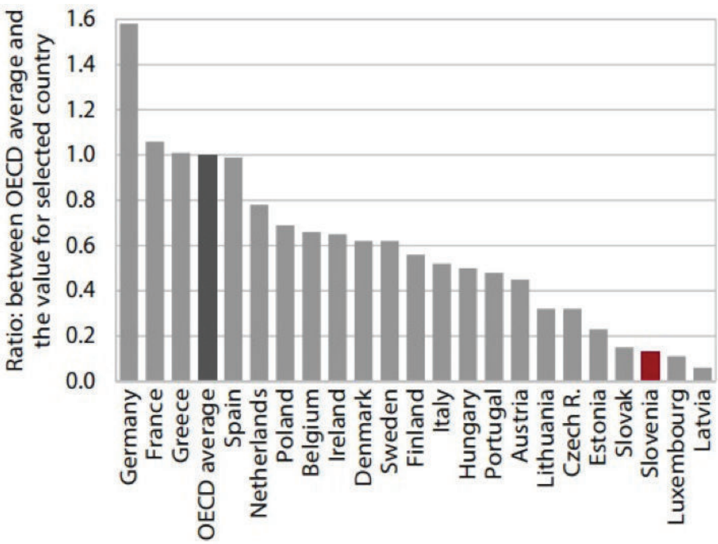

Source: AI Watch Index 2021 (Righi et al., 2022).

However, despite the relatively good and successful research and educational environment in the field of AI, Slovenia is increasingly faced with a brain drain of younger, highly educated citizens. There is a similar problem due to the current poor arrangement of rewarding and encouraging promising personnel working in the public research and higher education sphere, which is a consequence of the salary system in the public sector. There is a critical shortage of young researchers and post-doctoral fellows in the field of AI, recently also reflected in the outflow of young teaching staff in the industry, which is becoming increasingly difficult for higher education institutions to cope with. The growth of technologically advanced companies in Slovenia will only increase this gap. A change in the salary and reward systems based on (project) performance and not only education is therefore necessary for the research and higher education sphere to maintain or improve the personnel situation (NpUI, 2020).

Further, when considering the digital skills of the general population, they have been assessed as too low for the accelerated digital transformation of the economy, especially when it comes to advanced skills. The share of the population aged 16–74 with at least basic digital skills (basic and advanced together), which is a prerequisite for the successful digital transformation of the economy, was 55% in 2019 and close to the EU average (56%). In addition, in light of the digital transformation, there is a growing shortage of ICT professionals, and small businesses, in particular, have difficulty recruiting them (Eurostat, 2022).

At the same time, the latest development report for Slovenia (IMAD, 2022) points out that attention must be paid to the development of knowledge and skills in the field of artificial intelligence where Slovenia is one of the worst performers among the EU member states (OECD, 2021) (Figure 11), despite several educational programmes offering AI-related subjects; hence the brain drain could be an important factor in this situation. In order to meet the challenges of the digital economy, which is set to change in the coming years (IMAD, 2022), it is also essential to promote and enable the education and (re)training of employees, especially given the multi-year unfavourable trends in workers' participation in lifelong learning, which was further reduced due to the reduced implementation of educational programmes during the 2020 epidemic (IMAD, 2022).

Figure 11: **Artificial intelligence skills among employees, average for 2015–2020**




Source: OECD (2021) Notes: The figure shows the prevalence of artificial intelligence skills in employees, as reported by LinkedIn members in the period 2015–2020. Country-specific values are calculated on the basis of the OECD average of 1. For example, a value of 1.5 means that employees in a given country are 1.5 times more likely to report artificial intelligence skills than OECD average employees. The lowest value is 0, while the highest is not specified (IMAD, 2022).

### 4.4 AI in the private sector and international initiatives

AI is increasingly used in the ICT sector, which takes advantage of the knowledge gathered in the research sector. An increase in AI in start-up companies has been detected, yet there is still a significant lack of start-up entrepreneurial activities and also the development of entrepreneurial ventures in the field of AI. In 2020, an informal review of the state of the development ecosystem of companies in Slovenia dealing with AI showed that 156 companies were connected to AI in various ways. According to this review, it is estimated that there are between 300 and 500 data scientists working in the economy in Slovenia, and the designation for their profession is not as uniformly established as it is abroad and thus they often officially appear under other titles (analysts, business intelligence specialist, software developers, etc.), even though they actually perform the work of data scientists and have such competencies as well (NpUI, 2020).

When looking at the companies overall, regardless of the standard classification of activities, 905 companies with 10 or more employed and self-employed in 2021 in Slovenia reported using artificial intelligence technologies (Table 4). However, this represents only 12% of the 7,712 companies with 10 or more employees and the self-employed. Among AI users, most companies (585) use technologies for recognising objects or people based on an image, followed by 267 companies using natural language generation and 247 machine learning for data analysis. The most common purpose of AI use is for the protection and safe use of ICT (615 companies) and, lastly, most companies (683) purchased commercial AI software or a system as opposed to internal development of the system (243 companies) (SURS, 2021).

### Table 4: Use of artificial intelligence technologies in companies by technology and purpose

| | Companies with 10 or more employees and the self-employed |
|---|---|
| **Number of companies – TOTAL** | **7712** |
| **Use of artificial intelligence technologies** | **905** |
| Technologies that analyse written languages (text mining) | 59 |
| Technologies that convert spoken language into a machine-readable format (speech recognition) | 115 |
| Technologies that generate written or spoken language (natural language generation) | 267 |
| Technologies for recognising objects or people based on an image | 585 |
| Machine learning (e.g., deep learning) to analyse data | 247 |
| Technologies that automate various workflows or provide decision support (robotic process automation that uses artificial intelligence) | 163 |

| | Companies with 10 or more employees and the self-employed |
|---|---|
| Technologies that enable the physical movement of machines with autonomous decision-making based on observation of the surroundings (e.g., autonomous robots, self-driving vehicles, autonomous drones) | 45 |
| Purpose of use: for marketing or sales | 239 |
| Purpose of use: in the production process | 230 |
| Purpose of use: for the organisation of business administration | 124 |
| Purpose of use: for company management | 184 |
| Purpose of use: in logistics | 78 |
| Purpose of use: for the protection and safe use of ICT | 615 |
| Purpose of use: for HRM or in the recruitment process | 24 |
| It was developed by employees of the company (including employees of the parent or affiliated companies) | 243 |
| The commercial software or system was adapted to the company's needs by the company's employees (including employees of the parent or affiliated companies) | 314 |
| The open-source software or system has been adapted to the company's needs by the company's employees (including employees of the parent or affiliated companies) | 241 |
| They purchased commercial software or system (including that which was already built into the purchased product or system) | 683 |
| The software or AI system was developed or adapted to the company's needs by external contractors | 322 |

Source: SURS, 2021.

Slovenia is also active internationally. In March 2020, the Government of the Republic of Slovenia signed an agreement with UNESCO on establishing the first international research centre for artificial intelligence under the auspices of UNESCO, based in Ljubljana (IRCAI, 2021), which is mentioned in the previous section. The purpose of the centre is to provide an open and transparent environment dedicated to AI research, solving global challenges with the help of AI technologies, global education and discussions in the field of AI and providing substantive support to stakeholders around the world in the preparation of guidelines and action plans in the field of AI. As a founding member, Slovenia also joined the Global Partnership for AI (GPAI), which was created on the initiative of France and Canada, and brings together all countries committed to developing ethical and trustworthy AI in accordance with OECD principles (NpUI, 2020).

IRCAI was already introduced in the previous section for creating a list and index of the Top 100 projects that are solving problems related to the 17 UN SDGs with the application of AI technology. Among the top 100 is a project from Slovenia that covers three Sustainable development goals: SDG 4: Quality Education, SDG 5: Gender Equality and SDG 10: Reduced Inequality. The project is called **OpenProf** and falls in the education category (IRCAI, 2022).

According to the project's authors, the OpenProf solution is based on the idea that personalised learning will shape the future of education. The belief is supported by both market trends and scientific discovery (Bloom, 1984). By 2024, it is anticipated that the global private tutoring (personalised learning) industry's annual revenue will reach USD 260 billion. However, the tutoring sector has not managed to address its primary issue, which is that most parents cannot afford personalised learning. Without using the right technology, the issue cannot be resolved; this is where AI comes in. There have been numerous initiatives to aggregate instructional material from the internet and use AI to exploit them. However, the lack of a classification (at least a rudimentary one) for educational materials has made it difficult to arrange the contents in a way that would benefit the final users in any meaningful way (IRCAI, 2022).

"OpenProf has approached the problem thoroughly:

- In the first stage, OpenProf organises teachers' communities to crowdsource the needed content. As the technical design has been designed with the AI in mind, we are not only gathering (important!) standardised high-quality content, but we are also generating content which is by design highly enriched with additional metadata, a crucial part of an effective application of AI.

– In the second stage – and once the whole ecosystem is ready – the AI is applied. The goal of applying AI is to tailor the learning experience to every student's needs – and through that, to tackle the (big) problems described in the beginning" (IRCAI, 2022).

## 5 Concluding remarks

According to the SWOT analysis of AI in Slovenia created by the "National programme for promoting the development and use of artificial intelligence in the Republic of Slovenia until 2025" (NpUI, 2020), there are opportunities for Slovenia to develop its digital situation and progress towards an AI-supported society.

However, the previous section highlighted several critical areas related to the AI situation in Slovenia, despite the strong research community and AI-related educational programmes. The development report 2022 for Slovenia (IMAD, 2022) presents important recommendations for the general development policy, but they are also relevant for progress in AI development:

"Accelerating productivity growth by:

**(a)** strengthening education and (re)qualification for the skills of the future based on modernised and future-oriented education and training systems;

**(b)** significantly increasing investment in smart (especially digital) and sustainable transformation, both by the government (especially, but not exclusively, with EU funds) and by the business sector;

**(c)** fostering a dynamic business environment and strengthening the scientific research, innovation and digital ecosystem on the public side and accelerating the adoption of new business models, breakthrough and disruptive innovations and customised business processes and organisation, including domestic and international networking, on the business side; and

**(d)** accelerating change through social dialogue and active management of transformation".

Slovenia has many years of research experience in the field of AI and a relatively large number of professionally educated personnel, which is a key condition for understanding AI models and technologies and the possibilities of their use in various products and services. This applies to the development, integration and use of AI products and services. On the other hand, we have well-developed AI professional education on the tertiary level (university), which needs to be upgraded by introducing AI content into educational programmes (technical and non-technical) where AI methods can be successfully used to solve specific problems (electrical engineering, mechanical engineering, medicine, law, social sciences, etc.). At the same time, in order to ensure additional experts, mainly due to the brain drain, content relevant to AI (computer science, general ICT, STEM, etc.) should be introduced into the education system already in the primary and secondary curriculum programme and thus promote this area for potential future professionals (NpUI, 2020). Education is crucial, and leveraging AI requires investments in such skills, which are currently severely lacking. It was stated in the second section that the OECD (2019) indicates that industries will be in need of a new profile of employees, called "bilinguals", namely, experts in a single field such as economics or law who are also proficient in AI techniques. Slovenia is small enough that it can quickly and efficiently combine development and user knowledge in a wide variety of interdisciplinary fields, which enables it to develop specific pilot reference solutions that allow everyone to gain the necessary experience and knowledge and effectively transfer it between participating stakeholders. That is a great advantage since AI is best developed when well connected to other research and development activities within the larger regional knowledge production ecosystem, according to the findings of Buarque et al. (2020) (Section 2.2). Developing AI hand-in-hand with applications can be more fruitful than developing AI as an isolated technology specialisation. Due to Slovenia's involvement in the international environment, this can mean excellent opportunities for such solutions to penetrate international markets as well, which would increase the visibility of Slovenian stakeholders in the global environment and enable and accelerate further cooperation and development (NpUI, 2020).

The second section (2.2) presented several industries that are adopting AI applications or identifying the potential for its use and, additionally, how AI technology may be able to support the achievement of sustainable development goals. Climate change, crime, terrorism, disease, famine – AI promises to help alleviate all of these and other global ills (Siebel, 2019). Hence, Slovenia is set to build on the research achievements in the field of AI and to become internationally recognised for the competence of knowledge transfer and top-quality, ethical and safe technologies in the field of AI in human-friendly and trustworthy services and products.

To realise the vision of AI in Slovenia, the strategic programme (NpUI, 2020) for the period up to 2025 included the following strategic objectives:

- Establish a dynamic ecosystem of stakeholders for AI research, innovation and deployment;
- Educate and strengthen human resources;
- Support research and innovation in the field of AI;
- Introduce AI reference solutions in the economy, public sector, public and state administration and society;
- Establish technological infrastructure for research, development and use of AI;
- Enhance security using AI;
- Increase public trust in AI;
- Ensure an appropriate legal and ethical framework;
- Strengthen international cooperation;
- Establish a national observatory for AI in Slovenia.

Even though these objectives have been prepared for the development of AI initiatives in Slovenia, based on our current situation, they can be transferred to and helpful for other countries. They are nevertheless rooted in the same grounds for development as recommendations by other institutions or nations; for example, OECD (2019) recommends that policies should promote trustworthy AI systems, encouraging investment in responsible research and development and enabling small and medium-sized enterprises to thrive. A majority of enlightened businesses and government leaders are actively working to understand how to harness Al for the social, economic and environmental good. "We have hardly scratched the surface of what's possible in improving human life and the health of the planet with Al" (Siebel, 2019).

## REFERENCES


- Anyoha, R. (2017). The history of artificial intelligence. Retrieved 20 August 2022 from http://sitn.hms.harvard.edu/flash/2017/history-artificial-intelligence/
- Berryhill, J., Heang, K. K., Clogher, R., & McBride, K. (2019). Hello, World: Artificial intelligence and its use in the public sector. OECD library.
- Bloom, B. S. (1984). The 2 sigma problem: The search for methods of group instruction as effective as one-to-one tutoring. Educational researcher, 13(6), 4-16.
- Buarque, B. S., Davies, R. B., Hynes, R. M., & Kogler, D. F. (2020). OK Computer: the creation and integration of AI in Europe. Cambridge Journal of Regions, Economy and Society, 13(1), 175-192.
- Dreyer, K., & Allen, B. (2018). Artificial intelligence in health care: Brave new world or golden opportunity? Journal of the American College of Radiology, 15(4), 655–657.
- Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., ... & Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management, 57, 101994.
- EC. (2018). European Commission. Coordinated Plan on Artificial Intelligence (COM(2018) 795 final). Retrieved 9 November 2022 from https://digital-strategy.ec.europa.eu/en/library/coordinated-plan-artificial-intelligence
- EC. (2022). Digital Economy and Society Index. Brussels: European Commission. Retrieved 10 November 2022 from https://digital-agenda-data.eu/datasets/desi/
- European Commission. (2018). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Artificial Intelligence for Europe COM(2018) 237 final Brussels.
- European Commission. (2021). Digital Economy and Society Index 2021: overall progress in digital transition but need for new EU-wide efforst. Retrieved 11 November 2022 from https://ec.europa.eu/commission/presscorner/detail/en/ip_21_5481
- Eurostat. (2022). Eurostat [database]. Retrieved 10 November 2022 from https://ec.europa.eu/eurostat/data/database
- Eurostat. (n.d.). NUTS – nomenclature of territorial units for statistics. Retrieved 2 September 2022 from https://ec.europa.eu/eurostat/web/nuts/background

- GOV. (2017). Slovenian development strategy 2030. Retrieved 12 November 2022 from https://www.gov.si/assets/vladne-sluzbe/SVRK/Strategija-razvoja-Slovenije-2030/Slovenian-Development-Strategy-2030.pdf
- GOV. (2020). Osnutek Slovenske industrijske strategije 2021-2030 v javni razpravi. [Draft of Slovenian Industrial Strategy 2021-2030 in public debate]. Retrieved 12 November 2022 from https://www.gov.si/novice/2020-09-17-osnutek-slovenske-industrijske-strategije-2021-2030-v-javni-razpravi/
- GOV. (2021). Digitalisation of society. Retrieved 13 November 2022 from https://www.gov.si/en/topics/digitalisation-of-society/
- Gringsjord, S. & Govindarajulu, N. (2018). Artificial Intelligence. The Stanford Encyclopedia of Philosophy Archive. Retrieved 8 August 2022 from https://plato.stanford.edu/archives/fall2018/entries/artificial-intelligence/
- Hilbert, M. (2020). Digital technology and social change: the digital transformation of society from a historical perspective. Dialogues in Clinical Neuroscience, 22(2), 189-194.
- Hughes, L., Dwivedi, Y. K., Misra, S. K., Rana, N. P., Raghavan, V., & Akella, V. (2019). Blockchain research, practice and policy: Applications, benefits, limitations, emerging research themes and research agenda. International Journal of Information Management, 49, 114–129.
- IMAD. (2021). Development report 2021. Retrieved 09 November 2022 from https://www.umar.gov.si/en/publications/development-report/?no_cache=1
- IMAD. (2022). Development report 2022. Retrieved 09 November 2022 from https://www.umar.gov.si/en/publications/development-report/?no_cache=1
- IMD. (2021a). IMD World Digital Competitiveness Ranking 2021. Retrieved 13 November 2022 from https://www.imd.org/globalassets/wcc/docs/release-2021/digital_2021.pdf
- IMD. (2021b). Digital competitiveness ranking Slovenia. Retrieved 10 November 2022 from https://worldcompetitiveness.imd.org/countryprofile/SI/digital
- IRCAI. (2021). International research centre on Artificial Intelligence. Retrieved 18 September 2022 from https://ircai.org/
- IRCAI. (2022). OpenProf project. International research centre on Artificial Intelligence. Retrieved 15 November 2022 from https://ircai.org/top100/entry/openprof/
- Ismagilova, E., Hughes, L., Dwivedi, Y. K., & Raman, K. R. (2019). Smart cities: Advances in research—An information systems perspective. International Journal of Information Management, 47, 88–100.

- Katz, Y. (2017). Manufacturing an artificial intelligence revolution. Available at SSRN 3078224.
- Khanna, S., Sattar, A., & Hansen, D. (2013). Artificial intelligence in health – The three big challenges. Australasian Medical Journal, 6(5), 315–317.
- Kumar, S. L. (2017). State-of-the-art-intense review on artificial intelligence systems application in process planning and manufacturing. Engineering Applications of Artificial Intelligence, 65, 294–329.
- Li, B. H., Hou, B. C., Yu, W. T., Lu, X. B., & Yang, C. W. (2017). Applications of artificial intelligence in intelligent manufacturing: A review. Frontiers of Information Technology & Electronic Engineering, 18(1), 86–96.
- Misuraca, G., & Van Noordt, C. (2020). AI Watch-Artificial Intelligence in public services: Overview of the use and impact of AI in public services in the EU. JRC Working Papers, (JRC120399).
- Nikolic, B., Ignjatic, J., Suzic, N., Stevanov, B., & Rikalovic, A. (2017). Predictive manufacturing systems in industry 4.0: Trends, benefits and challenges. Annals of DAAAM & Proceedings, 28.
- NpUI. (2020). Nacionalni program spodbujanja razvoja in uporabe umetne inteligence v Republiki Sloveniji do leta 2025. [National program for promoting the development and use of artificial intelligence in the Republic of Slovenia until 2025]. Retrieved 18 September 2022 from https://www.gov.si/teme/digitalizacija-druzbe/
- OECD. (2019). Artificial Intelligence in Society. OECD Publishing, Paris.
- OECD. (2020). OECD Digital Government Index (DGI): 2019. Retrieved 14 November 2022 from https://www.oecd.org/gov/digital-government-index-4de9f5bb-en.htm
- OECD. (2021). Live data from OECD.AI partners. Paris: Organisation for Economic Co-operation and Development. Retrieved 14 November 2022 from https://oecd.ai/en/
- Radu, R. (2021). Steering the governance of artificial intelligence: national strategies in perspective. Policy and society, 40(2), 178-193.
- Righi, R., Pineda León, C., Cardona, M., Soler Garrido, J., Papazoglou, M., Samoili, S. & Vázquez-Prada Baillet, M. (2022). AI Watch Index 2021. López Cobo, M. and De Prato, G. editor(s), EUR 31039 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53602-4, doi:10.2760/921564, JRC128744.
- Russel, S. & Norvig, P. (2009). Artificial Intelligence: A Modern Approach. 3rd edition, Pearson, London.

- S4 strategy. (2020). Slovenska strategija pametne specializacije. [Slovenian smart specialization strategy]. Retrieved 12 November 2022 from https://www.eu-skladi.si/portal/sl/po-2020/priprava-programskih-dokumentov-1/slovenska-strategija-pametne-specializacije
- SDS. (2017). Slovenian development strategy 2030. Retrieved 8 November 2022 from https://www.gov.si/assets/vladne-sluzbe/SVRK/Strategija-razvoja-Slovenije-2030/Slovenian-Development-Strategy-2030.pdf
- Siebel, T. M. (2019). Digital transformation: survive and thrive in an era of mass extinction. RosettaBooks, New York.
- Stone, P., Brooks, R., Brynjolfsson, E., Calo, R., Etzioni, O., Hager, G., ... & Teller, A. (2016). Artificial intelligence and life in 2030: the one hundred year study on artificial intelligence. Stanford University.
- SURS. (2021). Podatkovna baza SiStat. [Database Sistat]. Retrieved 14 November 2022 from https://pxweb.stat.si/SiStat/sl/Podrocja/Index/88/razvoj-in-tehnologija
- Tardi, C. (2022). What Is Moore's Law and Is It Still True? Retrieved 24 August 2022 from https://www.investopedia.com/terms/m/mooreslaw.asp
- Turing, A. M., & Haugeland, J. (1950). Computing machinery and intelligence. The Turing Test: Verbal Behavior as the Hallmark of Intelligence, 29-56.
- UN. (2020). E-government development index 2020. Retrieved 15 November 2022 from https://publicadministration.un.org/egovkb/en-us/About/Overview/-E-Government-Development-Index
- United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. A/RES/70/1. Retrieved 5 August 2022 from https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf
- Van Roy, V., Rossetti, F., Perset, K. & Galindo-Romero, L. (2021) AI Watch - National strategies on Artificial Intelligence: A European perspective, 2021 edition. EUR 30745 EN. Publications Office of the European Union, Luxembourg.
- Winston, P. H. (1992). Artificial intelligence. Addison-Wesley Longman Publishing Co., Inc.
- Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2019). Artificial intelligence and the public sector—applications and challenges. International Journal of Public Administration, 42(7), 596-615.

Chapter 7

# Energy transition in the EU: The case of Croatia

**Dejan Ravšelj**
University of Ljubljana, Zavod 14, Slovenia

## 1 Introduction

The world population is seeing the growing impact of climate change every day (European Council, 2020). According to recent evidence, extreme weather and climate action failure are recognised as the top five short-term risks to the world, while the five most menacing long-term threats are all environmental. Although the concern about environmental degradation has been around for a long time, the growing concern with climate (in)action failure reveals the lack of faith in the world's ability to contain climate change, not least because of the societal fractures and economic risks that have deepened, especially following the COVID-19 pandemic and the Russia–Ukraine war (World Economic Forum, 2022a). Namely, the recent unexpected events have dramatically affected the global economy, including the energy sector. The COVID-19 pandemic triggered drastic fluctuations in energy demand, oil price shocks, disruptions to energy supply chains, and hampered energy investment, while the Russia–Ukraine war has led to energy price hikes and

**energy security challenges (Zakeri et al., 2022). The aforementioned deepens the existing global, supranational and national challenges.**

Namely, Russia accounts for about two-fifths of gas imports in the European Union (EU), more than one-fifth of its imported crude oil and almost half of its supplies of solid fuel (such as coal) that can be used to produce energy. In all, imports from Russia accounted for one-quarter of the EU's energy consumption in 2020, second only to the 42% produced from its own resources (World Economic Forum 2022b). On the other hand, the rapidly falling costs of renewable technologies and ongoing developments in energy efficiency in many countries offer a promising outlook for the security, inclusiveness, and sustainability inherent to a transformed energy sector (United Nations, 2021).

In this context, the energy transition is often viewed as a solution to address environmental, economic and societal challenges. The term energy transition refers to the change of the energy system from fossil fuel-based sources to renewable energy sources (Koons et al., 2022). Namely, the main goal of the European Green Deal, which is based on the Agenda 2030 for sustainable development, is to provide safe, environmentally friendly and affordable energy to ensure climate neutrality in the EU by 2050. On this basis, the goal of strategic documents on the national level of Croatia is to reduce greenhouse gas emissions, especially through greater use of renewable energy sources (Šimić et al., 2021). In this context, also energy efficiency represents significant potential for reducing greenhouse gas emissions (European Investment Bank, 2021). Despite Croatia maintaining affordable and clean energy, some of the challenges related to energy

"The energy transition is often viewed as a solution to address environmental, economic and societal challenges."

transition remain (Sachs et al., 2022). These primarily refer to the complex and time-consuming licensing and administrative procedures, consequently slowing, complicating and making the development of renewable energy sources more expensive. Moreover, despite Croatia having huge potential for renewable energy sources and energy efficiency, it is not sufficiently exploited. The abovementioned refers especially to the potential for developing offshore wind power plants, photovoltaic power plants, geothermal power plants and biomass power plants (Šimić et al., 2021).

In order to achieve the set goals related to climate neutrality and ensure the progress of the Croatian economy, the development of the Croatian energy sector must follow global and EU decarbonisation trends. This entails the greater use of renewable energy sources and increased energy efficiency (Office of the President of the Republic of Croatia, 2021). Accordingly, the main aim of this chapter is to present the challenges and opportunities for energy transition with a specific focus on a comparison of the EU and Croatia. The chapter is structured as follows. After the first section, the introduction, which describes the addressed topic in a broader way, the second section highlights the importance of the energy transition in the EU and Croatia. The third section presents energy trends in the EU and Croatia, including renewable energy and energy efficiency trends. The fourth section outlines selected good practices of energy transition in Croatia. The fifth section presents policy recommendations to accelerate the energy transition in Croatia. The final section provides a summary of the main concluding remarks.

## 2 Importance of the energy transition in the EU and Croatia

The international community recognises that the global energy system must change. If there were ever any doubt, the recent unexpected events have crystallised that resolve. Namely, the COVID-19 pandemic and the Russia–Ukraine war have revealed the weaknesses of the existing energy system and exposed the consequences of energy poverty experienced by the world population (United Nations, 2021).

The energy transition is strongly emphasised in the Agenda 2030 for sustainable development. More specifically, the transition of the energy system is operationalised within sustainable development goal 7, which aims to ensure access to affordable, reliable, sustainable and modern energy for all. It puts forward the following targets: 1) to ensure universal access to affordable, reliable and modern energy services; 2) to substantially increase the share of renewable energy in the global energy mix; 3) to double the global rate of improvement in energy efficiency; 4) to enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology; and 5) to expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing states, and land-locked developing countries, in accordance with their respective programmes of support (United Nations, 2015).

Global efforts for energy transition are also supported on the EU level as they represent an important part of the European Commission priorities for 2019–2024, especially within the European Green Deal in which all member states have committed themselves to turning the EU into the first climate-neutral continent. The production and consumption of energy account for more than 75% of greenhouse gas emissions in the EU. Therefore, decarbonising the energy system in the EU is vital to meeting the 2030 climate objectives and the long-term goal of reaching carbon neutrality by 2050. The European Green Deal is focused on three fundamental principles for the clean energy transition that will facilitate decarbonisation and enhance well-being: 1) ensuring a secure and affordable energy supply; 2) developing a fully integrated, interconnected and digitalised energy market; and 3) prioritising energy efficiency, improving the building energy performance and developing a power sector based largely on renewable sources (European Commission, 2019; European Council, 2020).

The energy transition efforts are also recognised by several strategic documents in Croatia, such as the Energy Development Strategy of the Republic of Croatia until 2030 with an outlook to 2050, National Development Strategy 2030, Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021–2030, Low-carbon development strategy of the Republic of Croatia until 2030 with a view to 2050, etc. The main strategic goals of energy development in Croatia are aligned with the global and EU guidelines for reducing greenhouse gas emissions and improving energy efficiency (Šimić et al., 2021).

In the context of the energy transition, renewable energy and energy efficiency are highlighted as two main channels through which the EU can achieve climate neutrality, with intermediate greenhouse gas emission reduction targets (a 20% cut by 2020 and a 55% cut by 2030, both compared to 1990 levels). Therefore, the EU has set ambitious renewable energy and energy efficiency targets for 2020 and 2030 (both relative to 1990 levels) to increase energy from renewable sources and reduce energy consumption on its path to becoming a climate-neutral continent by 2050. Accordingly, the EU countries are committed to increasing the share of renewable energy to at least 20% of consumption (including at least a 10% share of renewable energy in their transport sector) and achieving energy savings of 20% or more by 2020 on the EU level. The EU recently set new renewable energy and energy efficiency targets for the next decade. The current 2030 renewable energy and energy efficiency targets are to increase the share of renewable energy to at least 32% and to increase the energy efficiency to at least 32.5%, which translates into a final energy consumption of 956 million tonnes of oil equivalent (Mtoe) and/or primary energy consumption of 1,273 Mtoe (Castellazzi et al., 2020; European Commission, 2020, 2022a, 2022b).

In order to pursue the EU goals towards climate neutrality, Croatia has defined three scenarios. These scenarios refer to two periods: 1) the short term – until 2030, in which it is necessary to implement measures that will determine the path towards achieving these goals; and 2) the long term – until 2050, in which strategic goals are set by the sectors. These scenarios are (Šimić et al., 2021):

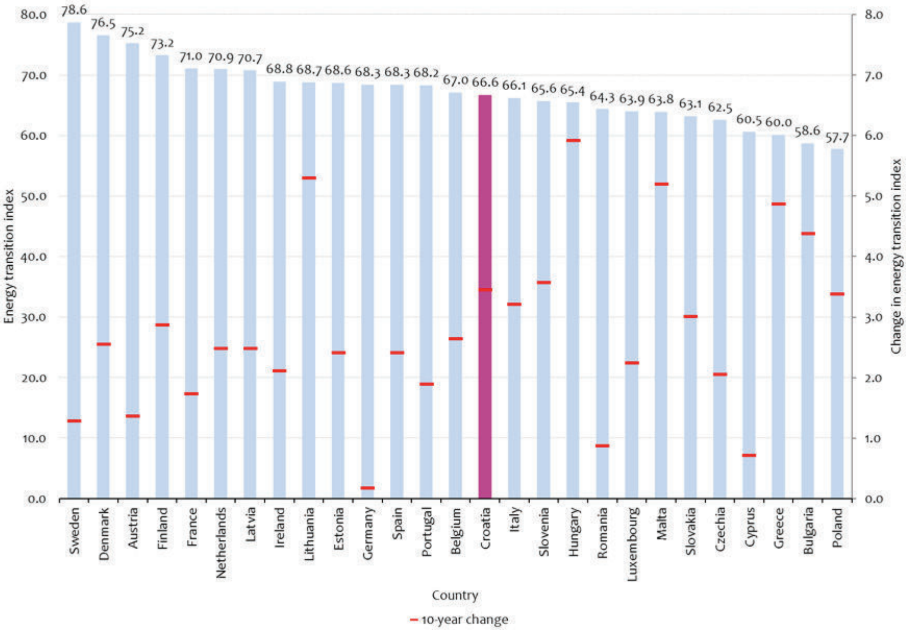
**1)** Scenario 0 (S0) or the Development Scenario. This scenario covers the application of existing measures, representing the continuity of the current policy of applying existing measures in the energy sector changes.

**2)** Scenario 1 (S1) or the Accelerated Energy Transition Scenario. In this scenario, greenhouse gas emissions are expected to decrease by 38% by 2030 and 74% by 2050 compared to 1990. In addition, according to the S1 scenario, it is expected that the share of renewable energy sources in gross direct energy consumption will reach 36.7% by 2030 or 65.6% by 2050.

**3)** Scenario 2 (S2) or the Scenario of Moderate Energy Transition. In this scenario, greenhouse gas emissions are expected to drop by around 35% by 2030, or 64% by 2050, compared to 1990. In addition, it is predicted that the share of renewable energy sources in gross direct energy consumption will reach 36.6% by 2030 or 53.2% by 2050.

The importance of energy transition is also recognised by the World Economic Forum, which constructed an 'energy transition index' to measure countries' energy transition progress (see Figure 12). This index provides a data-driven framework to foster an understanding of the performance and readiness of energy systems across countries for transition. An effective energy transition can be defined as a timely transition towards a more inclusive, sustainable, affordable and secure energy system that provides solutions to global energy-related challenges while creating value for business and society without compromising the balance of the energy triangle (security and access, environmental sustainability, and economic development and growth) (World Economic Forum, 2021).

Figure 12: **Energy transition index and its 10-year change in EU countries (2021)**




Source: World Economic Forum, 2021.

According to data for 2021, the highest energy transition index was observed in Sweden (78.6), followed by Denmark (76.5) and Austria (75.2). Among EU countries, Croatia (66.6) ranks in the middle. On the contrary, the lowest energy transition index was recorded in Poland (57.7), followed by Bulgaria (58.6) and Greece (60.0). Looking at the 10-year change (change in the energy transition index from 2012 to 2021), Hungary (5.9), Lithuania (5.3) and Malta (5.2) made the greatest progress in the energy transition, while Croatia (3.5) recorded moderate progress.

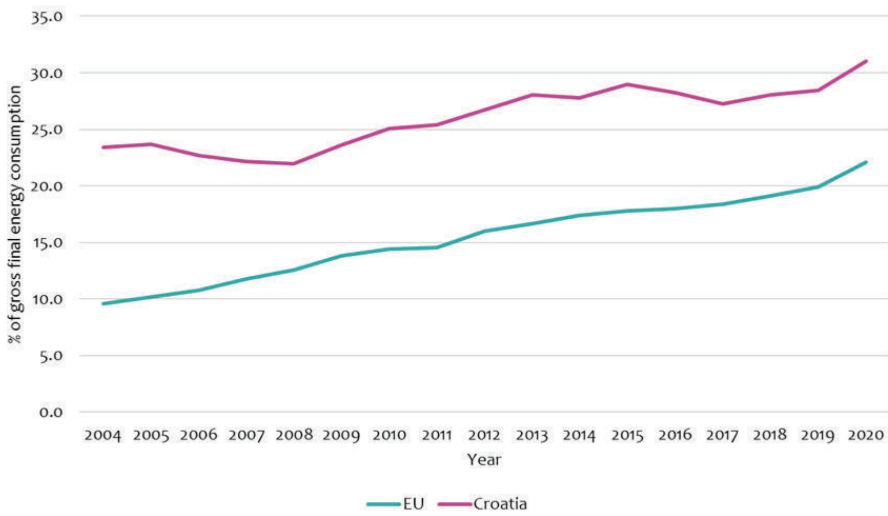
In contrast, Germany (0.2), Romania (0.7) and Cyprus (0.9) made the smallest progress in the energy transition.

## 3 Energy trends in the EU and Croatia

### 3.1 Renewable energy trends

In both the EU and Croatia, the share of energy from renewable sources increased in the observed period of 2004–2022, with Croatia consuming significantly higher shares of renewable energy than the EU (see Figure 1). Nevertheless, on the EU level the share of energy more than doubled between 2004 (9.6%) and 2020 (22.1%), while in Croatia, the consumption of renewable energy rose by 32.6% in this period (Eurostat, 2022a). Further comparison reveals that the gap between the EU and Croatia decreased over time, mainly due to some countries that have greatly increased their use of renewable energy (e.g., Malta, Luxembourg, Netherlands, Ireland, Belgium, Cyprus).

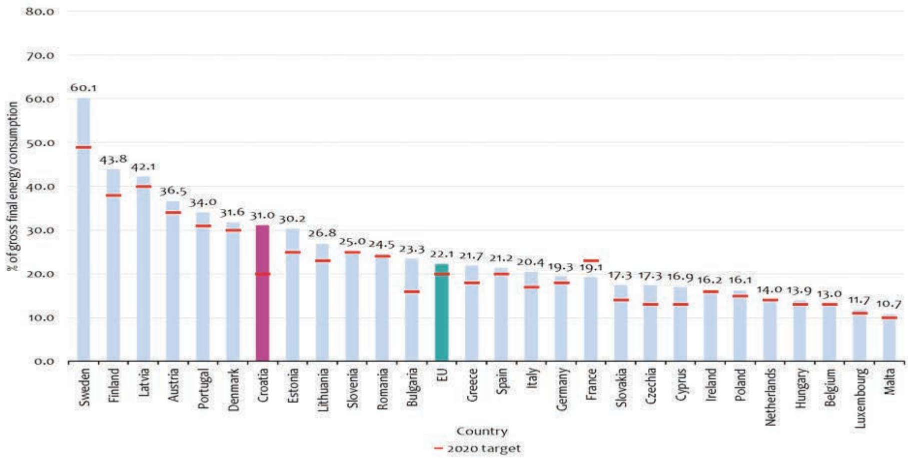
Figure 1: **Energy from renewable sources in the EU and Croatia, 2004–2020**




Source: Eurostat, 2022a.

In general, the EU reached a 22.1% share of gross final energy consumption from renewable sources in 2020, which is 2.1 percentage points above its target (20.0%). The positive development and achievement of the target have been prompted by the legally binding targets for increasing the share of energy from renewable sources. Presumably, the COVID-19 pandemic also played an important role in this context, especially from the perspective of its effect on decreasing fossil fuel consumption, e.g., in transport. However, this target is distributed across the EU countries with national action plans designed to plot a pathway for developing renewable energies in each country (see Figure 2) (Eurostat, 2022a).

Figure 2: **Energy from renewable sources in the EU countries, 2020**

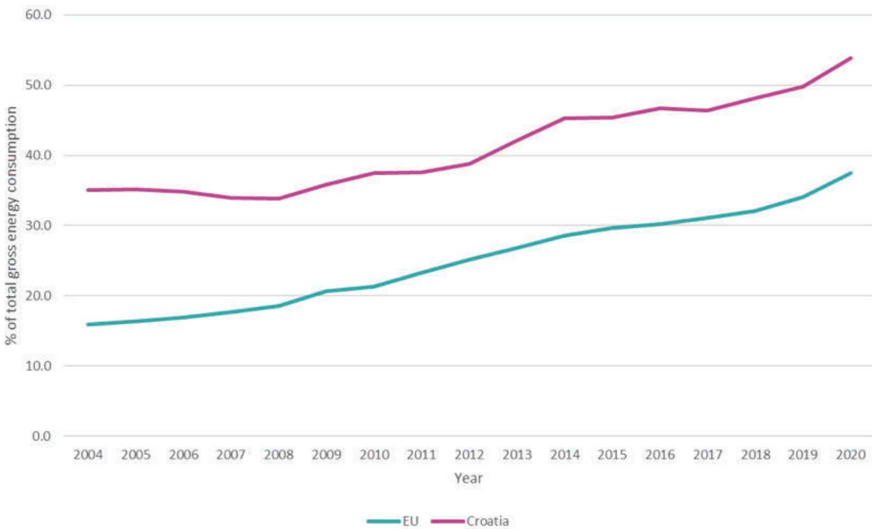



Source: Eurostat, 2022a.

According to the most recent data, Sweden, with more than half of its energy coming from renewable sources in its gross final consumption of energy (60.1%), had by far the biggest share among the EU countries in 2020, ahead of Finland (43.8%) and Latvia (42.1%). Croatia (31.0%) is still among the top 10 EU countries with the biggest shares of energy from renewable sources, and is above the EU share (22.1%). On the contrary, the smallest shares of energy from renewable sources were observed in Malta (10.7%), followed by Luxembourg (11.7%) and Belgium (13.0%). According to the national targets, 26 EU countries met or even exceeded their target levels for 2020. Countries that significantly exceeded their 2020 targets were Croatia and Sweden (both exceeding them by about 11 percentage points) and Bulgaria (exceeded by about 7 percentage points). On the other hand, France did not manage to meet its target as its share of energy from renewable sources was about 4 percentage points below the target. However, some EU countries met their targets through statistical transfers. Statistical transfers are agreements between EU countries to transfer a certain quantity of renewable energy from one country to another country. In 2020, six EU countries (Lithuania, Estonia, Denmark, Finland, Czechia, Sweden) deducted a specific amount from the share of renewable energy and transferred it to eight EU countries (Luxembourg, Belgium, Slovenia, Malta, Netherlands, Germany, Norway, Ireland) (Eurostat, 2022a).

The recent data also reveals the developments from 2004 to 2020 in the share of energy from renewable sources in three different areas: electricity, heating and cooling, and transport. The electricity generated from renewable energy sources increased during the observed 2004–2022 period (see Figure 3). During this period, the EU more than doubled the share of electricity generated from renewable energy sources, while Croatia saw a 53.6% increase.

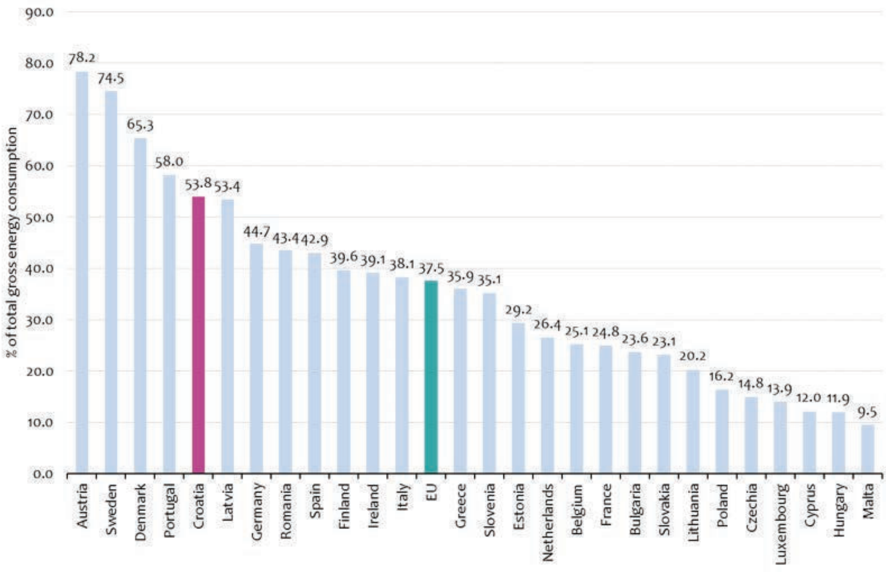
Figure 3: **Electricity from renewable energy sources in the EU and Croatia, 2004–2020**




Source: Eurostat, 2022a.

Among the EU countries, more than 70% of electricity consumed in 2020 was generated from renewable sources in Austria (78.2%) and Sweden (74.5%) (see Figure 4). The consumption of electricity from renewable sources was also high in Denmark (65.3%), Portugal (58.0%), Croatia (53.8%) and Latvia (53.4 %), accounting for more than half of the electricity consumed. Still, the share of electricity from renewable sources was 15 % or less in Malta (9.5 %), Hungary (11.9 %), Cyprus (12.0 %), Luxembourg (13.9%) and Czechia (14.8 %) (Eurostat, 2022a).

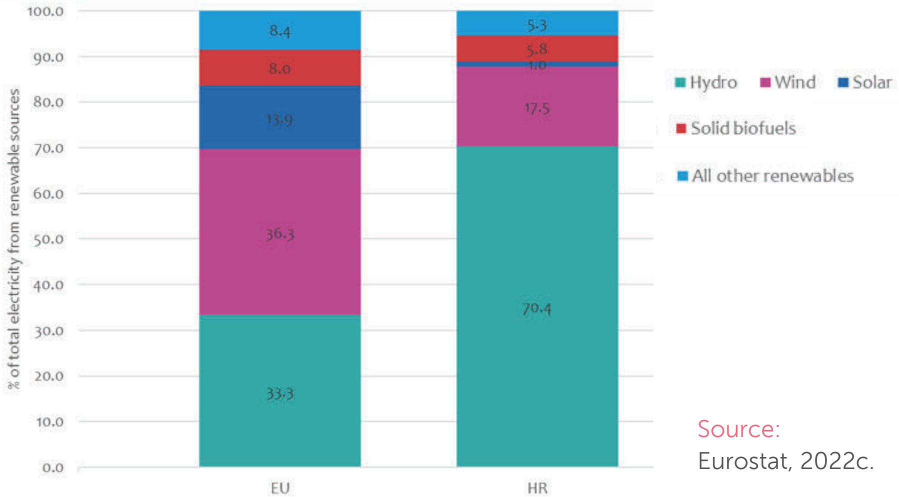
Figure 4: **Electricity from renewable energy sources in EU countries, 2020**




Source: Eurostat, 2022a.

In the EU, renewable energy sources made up 37.5% of gross electricity consumption in 2020. Wind and hydro power accounted for about one-third each of the total electricity generated from renewable sources (36.3% and 33.3%, respectively). The remaining one-third of electricity came from solar power (13.9%), solid biofuels (8.0%) and other renewable sources (8.4%). The fastest-growing renewable energy source is solar power: in 2004, it only accounted for 0.2% of the electricity consumed in the EU (Eurostat, 2022b). In Croatia, renewable energy sources made up 53.8% of gross electricity consumption in 2020. Hydropower accounted for more than two-thirds of electricity generated from renewable sources (70.4%). The remaining one-third of electricity came from wind power (17.5%), solid biofuels (5.8%), other renewable sources (5.3%) and solar power (1.0%) (see Figure 5). Although the EU has been generating electricity from various renewable sources since 2004, the renewable electricity in Croatia was based exclusively on hydropower (with just 0.1% of electricity generated from solid biofuels). Wind power began to be utilised in Croatia a year later, in 2005, when it accounted for 0.2% of the total electricity generated from renewable sources. Later, in 2012, Croatia began to also utilise solar power, which accounted for only 0.03% of the total electricity generated from renewable sources at that time. Nevertheless, wind power and solid biofuels were the two fastest-growing renewable energy sources in Croatia during the investigated 2004–2020 period.

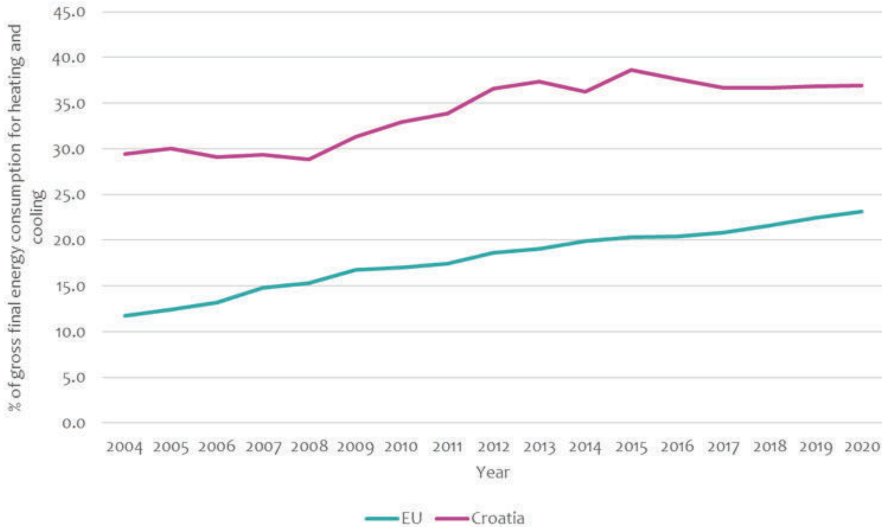
Figure 5: **Renewable sources generating electricity in the EU and Croatia, 2020**




Source: Eurostat, 2022c.

In 2020, renewable energy accounted for 23.1 % of total energy use for heating and cooling in the EU, increasing from 11.7% in 2004. Developments in the industrial sector, services and households contributed to this growth. In Croatia, the renewable energy used for heating and cooling was even higher. In 2020, it accounted for 36.9%, increasing from 29.4% in 2004 (see Figure 6) (Eurostat, 2022a).

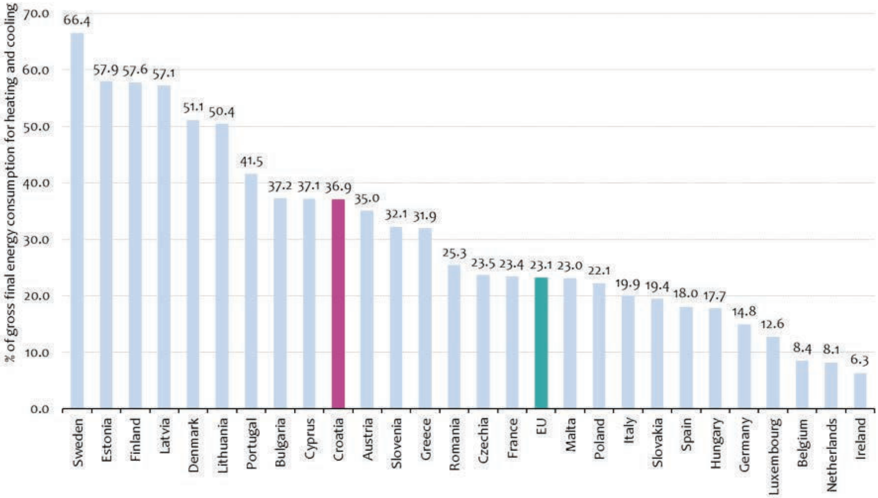
Figure 6: **Renewable energy used for heating and cooling in the EU and Croatia, 2004–2020**




Source: Eurostat, 2022a.

In the EU, more than half of the energy from renewable sources in heating and cooling was recorded in the Scandinavian and Baltic states in 2020. More specifically, the biggest shares of energy from renewable sources in heating in cooling were in Sweden (66.4 %), Estonia (57.9 %), Finland (57.6 %), Latvia (57.1 %), followed by Denmark (51.1%) and Lithuania (50.4%). In Croatia, more than one-third of the energy from renewable sources was used for heating and cooling (36.9%), which is above the EU level (23.1%). In contrast, EU countries with a share of energy from renewable sources in heating and cooling of less than 10% were Ireland (6.3%), the Netherlands (8.1%) and Belgium (8.4%) (see Figure 7) (Eurostat, 2022a).

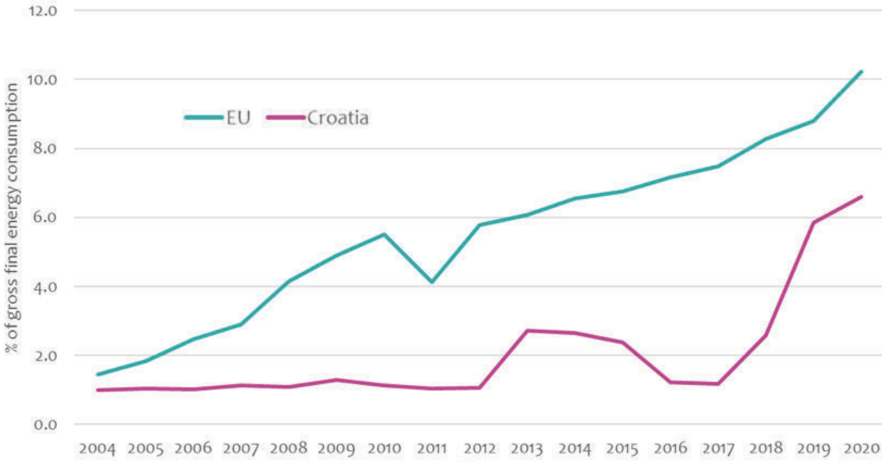
Figure 7: **Renewable energy used for heating and cooling in EU countries, 2020**




Source: Eurostat, 2022a.

In the EU and Croatia, the share of energy from renewable sources in transport grew in the observed 2004–2022 period, with the EU consuming significantly larger shares of renewable energy in transport than Croatia (see Figure 8). The share of energy from renewable sources in transport increased from 1.6% in 2004 to 10.2% in 2020 in the EU and from 1.0% in 2004 to 6.6% in 2020 in Croatia (Eurostat, 2022a).

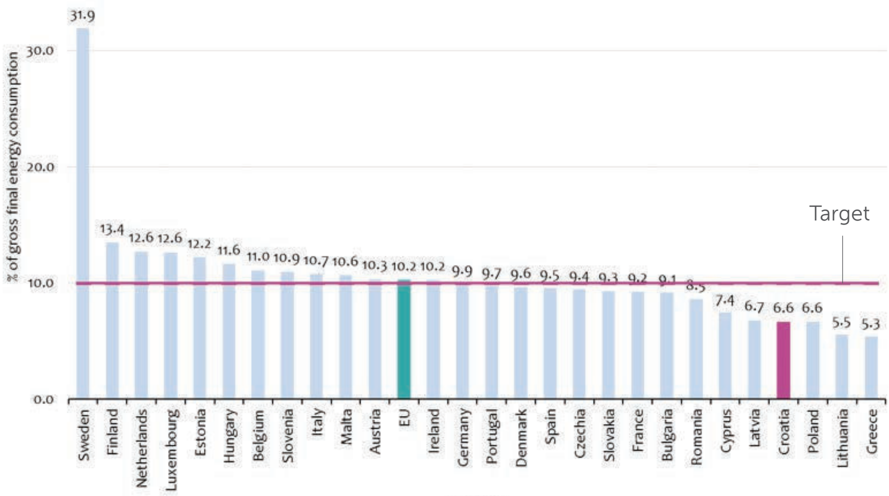
Figure 8: **Energy from renewable sources in transport in the EU and Croatia, 2004–2020**




Source: Eurostat, 2022.

In general, the EU reached a 10.2% share of energy from renewable sources in transport in 2020, therefore meeting its target of 10.0% (Eurostat, 2022a). Among EU countries, the share of renewable energy in transport fuel consumption was biggest in Sweden (31.9%), followed by Finland (13.4%) and the Netherlands and Luxembourg (both 12.6%). On the contrary, the smallest shares of renewable energy in transport fuel consumption were recorded in Greece (5.3%), Lithuania (5.5 %) and Poland and Croatia (both 6.6%) (see Figure 9). In terms of achieving the EU target, 13 EU countries managed to achieve the target and 8 EU countries were very close to the target (lagging behind the target by less than 1 percentage point), while the lag behind the target of 7 EU countries (including Croatia) was considerably larger.

Figure 9: **Energy from renewable sources in transport in the EU countries, 2020**



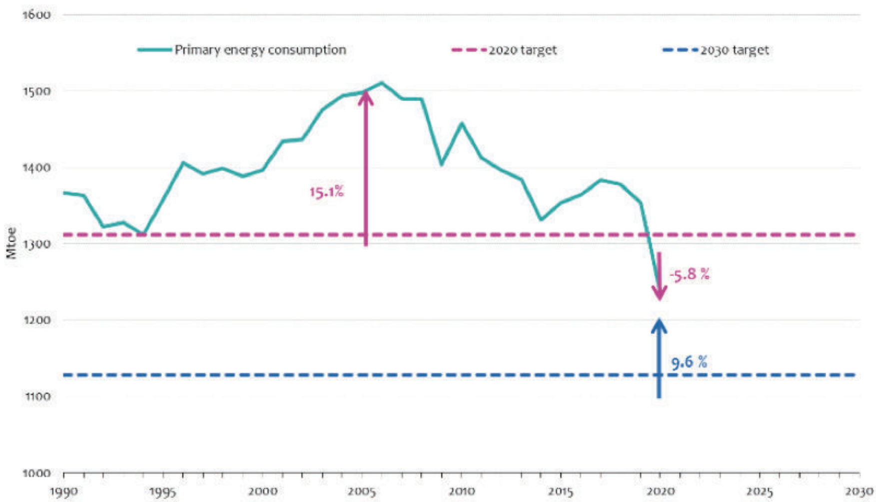

Source: Eurostat, 2022a.

During the observed period of 2004–2020, renewable energy consumption more than doubled in the EU, while in Croatia it rose by about one-third. However, Croatia significantly exceeded its national 2020 targets, placing Croatia among the top 10 EU countries, ranging above the general EU consumption of energy from renewable sources. The increasing trends for the EU and Croatia can also be observed for electricity from renewable energy sources. In 2020, more than one-third of electricity in the EU and more than one-half of electricity in Croatia were generated from renewable energy sources, especially hydro and wind power. Recent trends reveal that the fastest-growing renewable energy source is solar power in the EU and wind power in Croatia. Croatia also uses more renewable energy in heating and cooling than the EU, while renewable energy in transport is utilised less in Croatia than in the EU and below the desired 2020 target.

### 3.2 Energy efficiency trends

Primary energy consumption (total domestic energy demand) has fluctuated over the years as energy needs are influenced by economic development, structural changes in the industry, the implementation of energy efficiency measures and also the specific weather situation (e.g., cold vs warm winters). Since its peak in 2006, when the gap between the actual primary energy consumption and the target level in 2020 was 15.1%, the primary energy consumption decreased by 18.1% in 2020, thus reaching its lowest levels since 1990 (the first year for which data are available) (see Figure 10). One reason for such a significant drop was the outbreak of the COVID-19 pandemic in 2020 and the related restrictions (e.g., lockdowns, curfews and travel restrictions). In the EU, primary energy consumption reached 1,236 Mtoe, which is 5.8% better than the efficiency target for 2020 (20.0%), thus obviously outperforming it. However, this is still 9.6% away from the 2030 target, meaning that efforts to improve energy efficiency must be sustained in the coming years (Eurostat, 2021). Similar trends can also be observed for final energy consumption (actual consumption of end users).

Figure 10: **Primary energy consumption in the EU, 1990–2020**

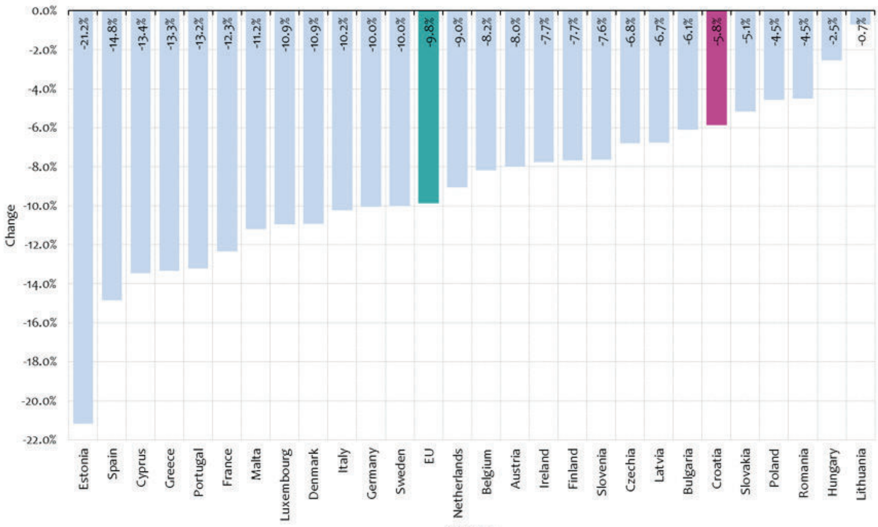



Source: Eurostat, 2021

Primary energy consumption in the EU plummeted due to the COVID-19-related restrictions (similar trends can also be observed for final energy consumption). The comparison between the pre-pandemic period (the 2017–2019 average) and the most recent observed period (2020) reveals that primary energy consumption decreased in all EU countries (see Figure 11). The biggest drops were recorded in Estonia (-21.2%), followed by Spain (-14.8%)

and Cyprus (-13.4%), while the smallest ones were registered in Lithuania (-0.7%), Hungary (-2.5%), Romania (-4.5%), Poland (-4.5%), Slovakia (-5.1%), and Croatia (-5.8%) (Eurostat, 2021).

Figure 11: **Comparison of primary energy consumption in EU countries, 2017–2019 average and 2020**




Source: Eurostat, 2021

In general, energy consumption decreased during the period 2004–2020, with a significant drop in 2020 due to the outbreak of the COVID-19 pandemic and the associated restrictions. Although some EU countries recorded significant drops in energy consumption, Croatia was among the countries with the smallest reductions in their energy consumption.

## 4 Selected good practices of the energy transition in Croatia

Energy transition has long become a reality all over the world, with the EU, including its member countries, being no exception. However, in Croatia, the increasing need to generate energy by utilising renewable rather than fuel-based sources, as well as the opportunity to use the energy in a more efficient way, is more discussed than acted upon (Spasić, 2020). Still, Croatia has recently started some energy transition projects, as briefly presented below.

**Križevci: Energy democratisation at work.** The Green Energy Cooperative is leading a crowdfunding project called Križevci sunny roofs in the city of Križevci, located some 60 kilometres east of the capital city of Zagreb. The project is implemented in cooperation with the city authorities and aims to provide citizens with an opportunity to invest in renewable energy, particularly solar power. Thus far, two campaigns have been successfully carried out. The first campaign was in May 2018, while the second was in March 2019, which together raised about EUR 50,000 for the installation of two solar power plants with a total capacity of 60 kW. These are the first two green power plants financed by citizens in Croatia. This model is widely implemented in the EU and represents the introduction of energy democracy. Another energy cooperative, called KLIK (Križevci Climate Innovation Laboratory), was established in 2020 to help Križevci become an energy-self-sufficient city but, more importantly, to engage citizens in the energy transition. According to KLIK, it is estimated that by 2050 one in two EU citizens will become a prosumer, a person who both produces and consumes energy (Spasić, 2020).

**Karlovac: Energy and climate planning is becoming part of urban planning.** In May 2020, the city of Karlovac, located about 50 kilometres southwest of Zagreb, adopted a Sustainable Energy and Climate Action Plan (SECAP), which was developed by the North-West Croatia Regional Energy Agency (REGEA). In order to create the conditions for carrying out the measures in the action plan, Karlovac has recently initiated changes to its master plan. REGEA will be responsible for developing guidelines, which will facilitate the action plan's integration into the master plan, thereby making Karlovac the first city in Croatia to do so. The guidelines will mark the beginning of the introduction of integrated energy and climate planning. This concept covers spatial and urban-energy analysis as well as a suggestion for the energy and climate strategy of the city. This generally implies that the master plan will define the entire Karlovac area in a way that will make it open to sustainable energy use and renewable energy sources, and enable the districts of the city to adapt to climate change (Spasić, 2020).

**Zadar: CO2 emissions cut by 19%.** The city of Zadar has announced that it reduced carbon dioxide (CO2) emissions by 19% from 2010 to 2017, nearly meeting the EU's target of 20% by 2020. Nevertheless, the city authorities expect even better results in the future. They also note that the biggest reduction was achieved in the transportation sector, followed by the construction sector. The foundation for this outstanding performance was laid in 2012 when Zadar signed the Covenant of Mayors for Climate and Energy, committing to work on green growth and CO2 emissions reduction. In the following years, the city adopted a Sustainable Energy Action Plan (SEAP), a programme to combat climate change, and a plan for introducing e-mobility, and is currently working on a Sustainable Urban Mobility Plan (SUMP). The city is co-financing the energy renovation of houses and buildings as well as investment in renewable energy sources, and has also implemented several projects such as introducing an IT system for energy management, replacing fuel oil with natural gas in heating boilers, installing LED lighting, etc. (Spasić, 2020).

**Krk: An island with zero CO2 emissions by 2040.** The island of Krk was recently recognised as one of the ten best examples of good practice in the energy transition by the Secretariat of the Clean Energy for European Islands Initiative. According to the Secretariat, in 2012 Krk published its decarbonisation strategy entitled "Krk 0% CO2 emissions", intending to become the first CO2-neutral and energy-self-sufficient island in the Mediterranean by 2040. Further, in 2012, Croatia's first energy cooperative was founded on the island. Energy cooperative "Otok Krk" provides assistance and support to residents interested in producing green energy, ranging from advice on choosing the optimal equipment to assistance with selecting contractors and obtaining permits to investing in larger projects and taking part in managing the cooperative itself. Krk has implemented LED technology in public lighting, cutting its electricity consumption from 1.02 million kWh in 2010 to 734,864 kWh in 2018. Given that 53% of CO2 emissions come from transportation, the island has deployed 12 charging stations for electric vehicles (EVs), which can service 24 EVs at a time, as well as 8 chargers for e-bicycles, which are part of a bicycle-sharing system. Recently, two firms were established to manage the energy transition: Ostrvo Krk Energy, which will coordinate the energy transition process, and Smart Island Krk, which will focus on smart processes and the digitalisation of activities on the island. Ostrvo Krk Energy has developed a solar power plant with an installed capacity of 5 MW and offered local residents and businesses to become co-owners. The solar panels were installed on about 10 public buildings. The zero-CO2 emissions strategy, which was amended in 2018, envisages the installation of rooftop photovoltaic (PV) panels with a total capacity of 36.8 MW in the next 20 years, along with 4 MW of ground-mounted solar power plants, 25.2 MW of wind farms, and 250 kW of biogas power plants. This should result in investments totalling EUR 89.6 million (Spasić, 2020).

**Koprivnica: The green Koprivnica initiative.** The city of Koprivnica, located about 50 kilometres east of Varaždin, continued to implement its green initiatives with the recent installation of 765 solar panels on the roof of the city swimming pool. These solar panels will be able to generate about 180,000 kWh of electricity per year. The investment totalled about EUR 99,500 and is expected to pay off in less than 5 years. Moreover, in cooperation with the Regional Energy Agency North (REA), the city has developed a map of Koprivnica's solar energy potential, allowing citizens to assess whether an investment in solar energy would pay off. The city also offers to prepare complete project documentation and select the best solution for each roof for residents who invest in solar energy. As part of the initiative, the city has thus far purchased electric and hybrid vehicles for the local administration, as well as smart benches, and built a recycling yard  Herešin, composting plant Herešin, and ecological gardens. Koprivnica also adopted a sustainable urban mobility plan in 2015. One of the initial benefits of the plan was an increased share of walking and cycling in the city (Spasić, 2020).

## 5 Policy recommendations to accelerate the energy transition in Croatia

The energy transition represents the backbone of the fight against climate change, providing an opportunity for strengthening and positioning the Croatian economy while protecting society as a whole from the adverse effects of dependence on fossil fuel sources. Dependence on fossil fuels, along with energy inefficiency, brings several negative consequences, including impaired physical and mental health, continuous increases in energy costs and energy sources, dependence on imports, and global pollution. Renewable energy sources, energy efficiency and changes in models of production and consumption together provide a solution for creating energy independence, strengthening the resilience of energy markets to an increase of fossil fuel costs in the global market, and enabling the use of locally available resources by creating new jobs (Office of the President of the Republic of Croatia, 2021). However, despite Croatia having huge potential for renewable energy sources and energy efficiency, it is not sufficiently exploited (Šimić et al., 2021). Accordingly, several policy recommendations are proposed for accelerating the energy transition in Croatia (Office of the President of the Republic of Croatia, 2021):

- Simplifying licensing, public procurement and administrative procedures by providing adequate support to investors and other stakeholders, which will consequently allow for meeting deadlines and implementing the national/EU-funded projects more efficiently.
- Integrating the energy transition measures of national and local strategies into spatial plans with the provision of funds from the national budget to help local governments implement integration in their area quickly and efficiently.
- Resolving property and legal issues on state-owned land which, according to national and local strategic guidelines, is favourable for the construction of renewable energy sources.
- Adopting the 'Zero Scenario' as a reference scenario for the energy transition with an obligation to conduct a public debate and structured consultations with the interested public and to update the relevant strategies in accordance with what the adopted.
- Ensuring and encouraging tenders for research and exploitation of renewable energy sources (wind, water, and solar power) at existing and new locations.
- Promoting the district heating and cooling systems and renewable energy sources and their wider use by educating citizens who are not sufficiently familiar with the opportunities already available to them.
- Drafting and adopting bylaws and implementing acts arising from both the legal and strategic frameworks of the energy transition.

## 6 Conclusion

The consequences imposed by macroeconomic turbulence and recent geopolitical developments on the energy system reveal the complexities and trade-offs inherent to the energy transition, calling for a balanced approach that meets the imperatives of sustainability, energy affordability, and energy security and access – in other words, driving a resilient energy transition (World Economic Forum, 2022c). The energy transition refers to changing the energy system from fossil fuel-based sources to renewable energy sources (Koons et al., 2022), and is often viewed as one of the solutions to address environmental, economic and societal challenges.

The overview of recent trends in the period 2004–2020 shows that renewable energy consumption more than doubled in the EU, while in Croatia it grew by about one-third. However, Croatia significantly exceeded its national 2020 targets, which placed Croatia among the top 10 EU countries, ranging above the general EU consumption of energy from renewable sources. The increasing trends for the EU and Croatia can also be observed for electricity from renewable energy sources. In 2020, more than one-third of electricity in the EU and more than one-half of electricity in Croatia were generated from renewable energy sources, especially hydro and wind power. Recent trends reveal that the fastest-growing renewable energy source is solar power in the EU and wind power in Croatia. Croatia also uses more renewable energy in heating and cooling than the EU, while renewable energy in transport is less utilised in Croatia compared to the EU and below the desired 2020 target. Moreover, energy consumption decreased during the observed 2004–2020 period, with a significant drop in 2020 due to the outbreak of the COVID-19 pandemic and the related restrictions. Although some EU countries recorded significant drops in energy consumption, Croatia was among the countries with the smallest reductions in energy consumption.

While Croatia is showing progress in terms of the consumption of renewable energy sources and energy efficiency, there is still room for improvement. In order to meet the set goals and ensure the progress of the Croatian economy, the development of the Croatian energy sector must follow European and global decarbonisation trends. This implies increasing the use of renewable energy sources and improving energy efficiency. The energy transition is primarily aimed at increasing competitiveness and encouraging innovation, reducing the negative impact on human health and the environment, but also assuring Croatia's energy independence. Consequently, the energy transition brings several direct and indirect benefits to the economy, health and the environment (Office of the President of the Republic of Croatia, 2021). Accordingly, urgent action in Croatia is needed since appropriate policy measures may facilitate the Croatian energy transition in the future.

## REFERENCES


- Castellazzi, L., Serrenho, T., Economidou, M., & Zangheri, P. (2020). Energy Consumption and Energy Efficiency trends in the EU-28, 2000-2018. Available at: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120681/energy_consumption_trends_2000-2018september_final_br.pdf
- European Commission. (2019). The European Green Deal. Available at: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
- European Commission. (2020). National Energy and Climate Plans: Member State contributions to the EU's 2030 climate ambition. Available at: https://ec.europa.eu/commission/presscorner/detail/en/fs_20_1611
- European Commission. (2022a). Renewable energy targets. Available at: https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-targets_en#the-2020-targets
- European Commission. (2022b). Energy efficiency targets. Available at: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficiency-targets-directive-and-rules/energy-efficiency-targets_en
- European Commission. (2022c). Starting the Energy Transition on the Zadar islands. Available at: https://clean-energy-islands.ec.europa.eu/news/starting-energy-transition-zadar-islands
- European Council. (2020). 5 facts about the EU's goal of climate neutrality. Available at: https://www.consilium.europa.eu/en/5-facts-eu-climate-neutrality/
- European Investment Bank. (2021). EU, EIB and Government of Croatia to support transition to renewable, green and carbon neutral energy sector. Available at: https://www.eib.org/en/press/news/eu-eib-and-government-of-croatia-to-support-transition-to-renewable-green-and-carbon-neutral-energy-sector
- Eurostat. (2021). Energy efficiency statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_efficiency_statistics#Country_specific_evolution
- Eurostat. (2022a). Renewable energy statistics. Available at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Renewable_energy_statistics#Share_of_renewable_energy_more_than_doubled_between_2004_and_2020
- Eurostat. (2022b). Renewable energy on the rise: 37% of EU's electricity. Available at: https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20220126-1
- Eurostat. (2022c). SHARES summary results 2020. Available at: https://ec.europa.eu/eurostat/web/energy/data/shares
- Koons, E. (2022). The Global Energy Transition: How the World Sees It. Available at: https://energytracker.asia/what-is-energy-transition-an-ultimate-guide/

- Office of the President of the Republic of Croatia. (2021). Energy Transition Council of the President of the Republic Presents Guidelines to Accelerate Energy Transition. Available at: https://www.predsjednik.hr/en/news/energy-transition-council-of-the-president-of-the-republic-presents-guidelines-to-accelerate-energy-transition/
- Sachs, J., Kroll, C., Lafortune, G., Fuller, G., & Woelm, F. (2022). Sustainable development report 2022. Cambridge University Press.
- Šimić, I., Dominković Cecelja, I., Turković, M., Ercegovac, V., Vrana, K., Dropulić Vejin, P., Domitrović, D., Leib, B., Trstenjak, J., & Komušanac, I. (2021). Vodič za razvoj i provedbu projekata obnovljivih izvora energije u Hrvatskoj. Available at: https://oie.hr/wp-content/uploads/2021/12/EBRD-Vodic.pdf
- Spasić, V. (2020). Energy transition in Croatia: five examples of good practice. Available at: https://balkangreenenergynews.com/energy-transition-in-croatia-five-examples-of-good-practice/
- United Nations. (2015). Transforming our world: The 2030 agenda for sustainable development. Available at: https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf
- United Nations. (2021). Theme Report on Energy Transition: Towards the Achievement of SDG 7 and Net-Zero Emissions. Available at: https://www.un.org/sites/un2.un.org/files/2021-twg_2-062321.pdf
- United Nations. (2021). Theme Report on Energy Transition: Towards the Achievement of SDG 7 and Net-Zero Emissions. Available at: https://www.un.org/sites/un2.un.org/files/2021-twg_2-062321.pdf
- World Economic Forum. (2021). Fostering EffectiveEnergy Transition. 2021 edition. Available at: https://www3.weforum.org/docs/WEF_Fostering_Effective_Energy_Transition_2021.pdf
- World Economic Forum. (2022a). The Global Risks Report 2022. Available at: https://www3.weforum.org/docs/WEF_The_Global_Risks_Report_2022.pdf
- World Economic Forum. (2022b). What is the EU doing to end its reliance on Russian energy? Available at: https://www.weforum.org/agenda/2022/04/europe-russia-energy-alternatives/
- World Economic Forum. (2022c). Fostering Effective Energy Transition: 2022 Edition. Available at: https://www3.weforum.org/docs/WEF_Energy_Transition_Index_2022.pdf
- Zakeri, B., Paulavets, K., Barreto-Gomez, L., Echeverri, L. G., Pachauri, S., Boza-Kiss, B., ... & Pouya, S. (2022). Pandemic, War, and Global Energy Transitions. Energies, 15(17), 6114.

## Chapter 8

# Smart cities in Romania and the European Green Deal

**Melania-Gabriela Ciot**
University Babes-Bolyai,
Romania

## 1 Introduction

**Today, cities are seen as both the source of our challenges and the solutions to it. European urban areas are home to more than two-thirds of the population, which account for 80% of energy use and provide 85% of European GDP. These urban areas are the 'engines' of the European economy and its development. An integrated approach will assure the success of urban development (European Commission, Regional Policy, 2022). Achievement of the objectives of European Green Deal (EGD) will bring answers to the challenges cities are facing.**

For the EGD's implementation, the European Commission recently launched the 100 smart cities initiative to reach the objective of climate neutrality. Smart cities are a global and European phenomenon because of their similar features and interdependencies. The European policies of the EGD will pressure the capacity building of local authorities and force the finding of innovative and smart solutions. The sustainability policies will offer the frame for implementing these solutions. The present paper aims to identify the challenges and opportunities of the EGD for smart cities from Romania, selected for the European Commission's 2022 initiative – 100 smart, climate-neutral cities, namely: Bucharest, Cluj-Napoca and Suceava. The analysis considers three factors: clean mobility, energy efficiency and urban ecological planning.

## 2 Objective of SDG 11 and its characteristics for Romania

The UN Agenda for Sustainable Development offers a global policy framework to better understand the economic, political and social actions of local authorities (European Union, 2022; Sachs et al., 2022). According to Eurostat, EU member states have made considerable progress toward meeting all 17 Sustainable Development Goals (Gronkiewicz-Waltz et al., 2020).

"EU member states have made considerable progress toward meeting all 17 Sustainable Development Goals."

It is estimated that in Europe cities will be 85% more populated by 2050. The cities are growing fast, producing 72% of greenhouse gas emissions, so the integrated and holistic approach to development will focus more on policies such as: energy, transport, environment, industry and agriculture (ibid.). In addition, capital access and know-how delivery could be used as models for tackling climate action. The new philosophy of governance (city governance) will first address the climate emergency and thus the citizens will be users, producers, consumers and owners (ibid.).
One SDG goal is dedicated to sustainable cities and communities (11th). For the EU, the indicators of this goal are quality of life (with significant progress toward the EU target), sustainable mobility (with insufficient progress toward the EU target) and environmental impact (with moderate progress toward the EU target):

Figure 1: **Progress in meeting the goal of SDG 11**


Note: More information available on https://ec.europa.eu/eurostat/web/sdi/key-findings
Source: Eurostat, 2022.

The situation of the SDG goals for Romania, especially SDG 11, is interesting. This situation is presented in the table below:

**Table 1: Data for SDG country overview chart 2022 for Romania (SDG 11 Sustainable cities and communities)**

| | | | Romania | | | | EU | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| SDG / Sub-theme | Indicator | Unit | Starting | | Latest | | Starting | | Latest | |
| | | | year | value | year | value | year | value | year | value |
| SDG 11 – Sustainable cities and communities | | | | | | | | | | |
| Quality of life in cities and communities | Severe housing deprivation rate | % of population | 2015 | 19.8 | 2020 | 14.3 | 2015 | 5.3 | 2020 | 4.2 |
| | Population living in households suffering from noise | % of population | 2015 | 22.2 | 2020 | 16.1 | 2015 | 18.3 | 2019 | 17.3 |
| | Years of life lost due to PM2.5 exposure | per 100 000 inhabitants | 2014 | 1371 | 2019 | 1261 | 2014 | 911 | 2019 | 762 |
| | Population reporting crime, violence or vandalism in their area | % of population | 2015 | 13.1 | 2020 | 8.8 | 2015 | 13.2 | 2020 | 10.9 |
| Sustainable mobility | Road traffic deaths | rate | 2015 | 9.6 | 2020 | 8.5 | 2015 | 5.5 | 2020 | 4.2 |
| | Share of buses and trains in total passenger transport | % of total inland passenger-km | 2014 | 21.5 | 2019 | 21.1 | 2014 | 17.8 | 2019 | 17.2 |
| Adverse environmental impacts | Settlement area per capita | m2 | 2015 | 364.8 | 2018 | 528.4 | 2015 | 680.6 | 2018 | 703.4 |
| | The recycling rate of municipal waste | % of total municipal waste generated | 2015 | 13.2 | 2020 | 13.7 | 2015 | 44.9 | 2020 | 47.8 |
| | Population connected to at least secondary wastewater treatment | % of population | 2014 | 38.2 | 2019 | 49.4 | 2014 | 77.8 | 2019 | 80.9 |

Note: More information available on https://ec.europa.eu/eurostat/web/sdi/key-findings.
Source: Eurostat, 2022.

The Eurostat data indicate that in comparison with the EU average Romania scores lower for all indicators. However, let us take a look at the data for Romania from 2015 and 2020. There is an evident improvement in all analysed indicators, with some significant developments. For example, the "population living in households suffering from noise" decreased from 22.2% in 2015 to 16.1%, meaning a drop of 6.1%, while the EU average decrease was 1%.

Romania is following the European trends for all indicators, but it is advisable to create more measures and more efficient national and local policies to compensate for the gaps.

The two pillars for building sustainable cities and communities on the European level are the EGD strategy (which will have to readapt its ambitious levels), the Multiannual Financial Framework, Next Generation EU (Gronkiewicz-Waltz et al., 2020) and the National Recovery and Resilience Plan.

Recent events in the EU's neighbourhood (Russia's invasion of Ukraine) have exposed some of the EU's fragilities. They show that building resilience is linked to a strong economy with strategic autonomy (ibid.). Technology is essential in this process and the EU has to catch up with other regions. The data collected by ICT or social media technologies could be used to transform cities and communities, supporting the creation of a European data space, especially for EGD, to develop a digital ecosystem of the environment (ibid.).

## 3 The 100 smart, climate-neutral cities initiative in Romania

The European Commission announced on 28 April the initiative 100 climate-neutral and smart cities by 2030 (European Commission, 2022b). The cities have to work on their Climate City Contracts, which include their plan for climate neutrality across all sectors. These contracts will be co-created with local stakeholders and citizens, supported by a Mission Platform, providing cities with technical, regulatory and financial assistance.

In Romania, three cities were selected: Bucharest, Cluj-Napoca and Suceava. These cities will be individually analysed based on the circular and green economy model from the perspectives of clean mobility, energy efficiency and urban planning capacities.

### 3.1 Bucharest

It is the capital of Romania, with the highest urbanisation degree (90%), concentrating almost 14% of the population of Romania (POR Regiunea București-Ilfov, 2021). The capital city is divided into six sectors, territorial administrative subunits, with their local authorities, local councils and mayors, budgets, and patrimony. Bucharest-Ilfov is the most developed city in Romania, with a GDP of 160% of the EU average, an occupancy rate of 89.4% and a 1.1% unemployment rate. Regarding regional competitiveness, it occupies 151st place among 268 EU regions. The capital city's occupancy rate is 97.7% (ibid.).

The sustainable strategy of the region for 2021–2027 indicates: consolidating the RDI capacities, an increase of the level of digitalisation of the economy and public administration and adopting the concept of a smart city, improving and diversifying smart specialisations competencies, increasing the energy efficiency for buildings, reducing the risk of earthquakes, increasing the surfaces and improving the quality of green areas and infrastructure, increasing mobility and attractivity for clean and unmotorised public transport, improving connectivity and accessibility to TEN-T, protecting and promoting cultural heritage (ibid.).

Regarding the smart city, the strategy mentions the low integration of digital technologies into citizens' activities, enterprises or public administration. The digitalisation and interoperability of public services are dysfunctional for the whole Bucharest-Ilfov region, and the percentage of the population interacting online with public authorities was 28%, below the European average of 58%. The leading digitalised service is local tax payments (around 70%). The management of documents is realised mainly on paper support.

The concept of a smart city is insufficiently promoted and applied, and the capital city does not have a strategy for it, occupying 104 places from 174 cities in 80 countries evaluated after the matrix of a smart city. It has five specific applications, and only one sector (S4) has smart city-type projects. On the regional level, there are not any clear initiatives in this sense.

This reality demonstrates that digitalisation was a secondary objective, focused on the acquisitions of assets and not on the applications for digitalisation. As a result, the pressure for digitalisation came mainly from the business community. However, the wrong perceptions of complexity and a period of implementation of projects on this topic contributed to the limited use of these financing sources.

The website of the City Hall indicated four smart city categories for applications:

Table 2: **Applications for the smart city – Bucharest**

| Name of application | Description |
|---|---|
| Mobile Application Social Alert Bucuresti | Facilitating and simplification of the reporting process for socially vulnerable persons |
| Mobile Application Traffic Alert Bucuresti | Reporting public circulation problems |
| Mobile Application Parking Bucuresti | Parking application |
| Info TB | Information about the public transport network |

Note: More information available on https://www.pmb.ro/programe/10
Source: Website of Bucharest City Hall.

Regarding clean mobility, on the website of City Hall one finds a Plan for Sustainable Mobility from 2016–2030, with no updates on the EGD strategy. The sustainable mobility plan was elaborated for the city and Ilfov county. The plan begins with a recommendation for updating it once every 5 years, but this is the only publicly available document. Three major projects are proposed: metro, railways and surface transport (PMUD 2016–2030, 2015).

Another document for this criterion of clean mobility is the Integrated Plan for Air Quality in the Municipality of Bucharest for 2018–2022 (PICA, 2018), which describes concrete measures for reducing greenhouse gas emissions from traffic, and residential heating systems etc., including a future scenario. Regarding clean mobility, the city is recognised for the problems of greenhouse gas emissions generated by public transport, air pollution, noise, agglomeration and accentuated insecurity. It is in the first place of agglomeration in the EU, caused by congestion (50%). The public transport infrastructure is used, unmodernised, unsafe, undigitised, and insufficiently developed for the daily commutes (approx. 1.3 million passengers transported). The rolling stock (488 trams, in 2021), auto park for public transport (265 trolleys and 1,530 buses) is used, old and unecological, with almost the entire fleet of trams being technically outdated, affecting the travel speed and the safety of the passengers during the transport (POR, 2021).

The applications and IT systems are uncorrelated and implemented in urban areas, generating a reduced efficiency of systems implementation and a low level of interoperability. Other dysfunctionalities are the underdeveloped infrastructure for bicyclists, its reduced accessibility, the city's limited network of bicycle tracks, and a small number of bicycle trips (ibid.). Regarding the connectivity with the TEN-T, due to the high volume of traffic, pollutants and insufficient, inadequate and insecure infrastructure, intra- and interregional connectivity are dysfunctional (ibid.). The regional infrastructure of transport is out of step with the daily challenges and opportunities of a more developed region, being little adapted to allow fast, safe and climate-neutral mobility (ibid.).

According to the regional development strategy, energy efficiency is reduced, and the residential and public buildings generate unsustainable energy consumption. For this city, the residential stock represents 12% of the national one, is old and characterised by low comfort and energy efficiency as concerns existing standards. Of 10,000 blocks of flats needing rehabilitation, almost 31% were rehabilitated in 2019, with an increased tendency (ibid.).
The Energy Strategy for the city available to the public is from 2007, presented on the website of the City Hall in four different files (Strategia energetica, 2007).

The higher prices of energy and the low incomes of different categories of inhabitants, who do not have the possibility for essential energy services, favour the existence of the vulnerable consumers category (almost 10% of the Romanian population find it impossible to heat their household to an adequate level). In the region, but especially in Bucharest, 33% of the total surfaces of the public buildings stock are owned or occupied by central authorities (POR, 2021).

Other vital problems generate incapacity for financial support of investments in fiscal schemes for thermic rehabilitation: the increase in prices of energy, the share of energy costs in household income, the inequality in the distribution of citizens' income, the energy-inefficient housing and public buildings, the lack of new public buildings with a demonstrative role, the limited banking credibility of homeowners' associations for obtaining credits for energy efficiency measures, and the high level of debt. Nevertheless, the European funds could support these investments through the cohesion and regional policy (ibid.).

For the urban planning, there is one document called Strategia Integrată de Dezvoltare Urbană a Municipiului București 2021 – 2030 (SIDU București, 2021), elaborated by the World Bank Group for the City Hall Bucharest. The strategy proposes a vision for 2050 for a global metropole, a European capital, a functional metropolitan area, a people's city and neighbourhoods with identity. The city has to be interconnected, innovative, sustainable, inclusive and compact. The vision for the city to be a competitive European capital with an international reputation, a regional, economic and financial hub, and the most attractive bridge city between West and East promotes diversity and dynamism in a clean city without greenhouse gas emissions (ibid.).

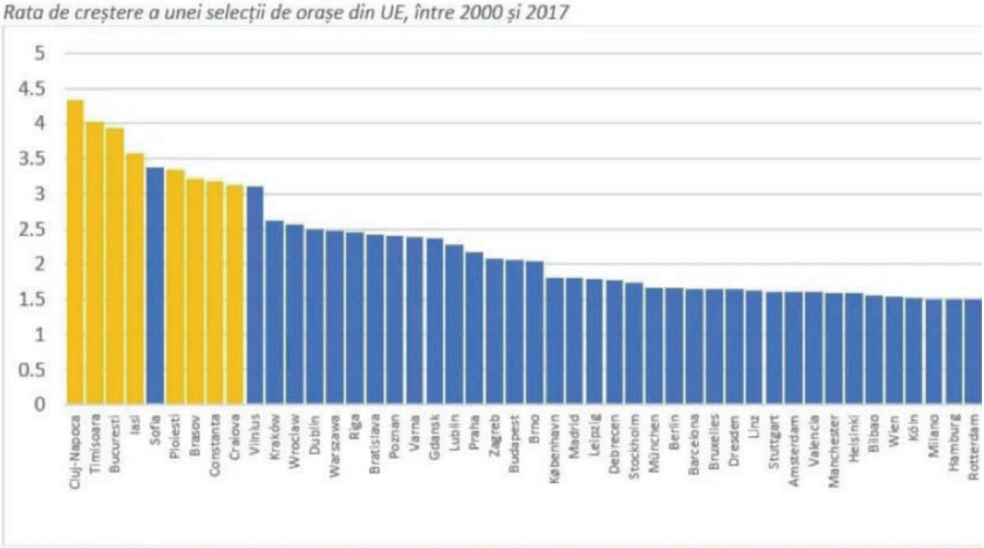
### 3.2 Cluj-Napoca

The socio-demographic characteristics indicate a positive evolution, with a yearly increase of 1.1% from 2008–2019 and a population of 442,000 (PMUD, 2022). The city is one of the foremost university cities in Romania, with approximately 100,000 students coming each academic year and important economic development which creates job opportunities and welfare for the citizens. It concentrates 73.8% of the residential population of the Metropolitan Area of Cluj. An addition of 4% from neighbourhood areas' population leads to a 54.5% increase in the city's and surrounding areas' population (from 2008 to 2019) (ibid.).

It is the only regional growth pole in Romania with an increased population. Although the city of Cluj-Napoca represents the primary vector of attractiveness for inhabitants, the localities in the functional areas take over the housing functions, leading to a broad phenomenon of urban development, commuting and interaction between the two plans, generating additional needs and challenges for mobility to and from the workplace, accessibility of services of general interest, pollution and traffic congestion, with implications for the quality of life of the citizens from the metropolitan area.

From an economic perspective, the city concentrates 70% of the county's economic activity and more than 25% of the North-West region of Romania. At the same time, 88.3% of the turnover of Cluj County is generated by companies active in the metropolitan area of Cluj-Napoca, which means that the activity in this area determines more than three-quarters of the production at the county level. This translates into a GDP / capita (PPS) at 89% of the EU-27 average for 2017, one of the highest good values in the country by capital (ibid.).

Figure 2: The City of Cluj-Napoca –fastest economic growth in the EU between 2000–2017




Source: Toward a climate-neutral Cluj (p. 4).

The above figure indicates in the first place the city Cluj-Napoca, with economic growth of almost 4.5% for 17 years. The city has been given the following awards: European Youth Capital, Best Major Festival – Untold, Best Medium Size Festival – Electric Castle, and Best Small Festival – Jazz in the Park, European Capital of Innovation (Toward a Climate-Neutral Cluj, 2022).
It is proposing to reach the following objectives of the climate-neutral targets (for 2030): 100 ha new green spaces, 100,000 trees, networks of sensors and stations for measuring air, water and soil quality, green-blue corridors of sustainable mobility on the banks of watercourses in the Cluj Metropolitan Area, sustainable mobility, energy efficiency, circular economy and sustainable urbanism (ibid.). To reach these objectives, four strategies were elaborated: Integrated Urban Development Strategy – Cluj 2030, Sustainable Urban Plan – SUMP, Digital Transformation Strategy, and Civic Engagement – participatory governance tools. The city is also one of the Signatory Members of the Green City Accord. Regarding the city's portfolio of projects, there are EUR 4 billion in investments till 2032 from Recovery and Resilient Facility and Next Generation EU, national budget and local budget and loans.

The Strategy for the digital transformation of the city of Cluj-Napoca was launched in 2021 and represented the city's vision for reaching climate neutrality through digital transformation. The positive effects of this strategy will generally represent the core element. It will contribute to the city's transition toward a digital society and economy and the interconnection of all relevant actors and stakeholders in a functional and innovative ecosystem. The new platform institutional model will have citizens at the centre of their vision, bring together different types of actors with common aims, and create the frame for open innovation for public products and services. The main objective is to increase the local community's quality of life and prosperity. It is part of a broad vision for the city's development based on the quality of life, innovation, university and participation. It is an instrument, not an aim, capable of concentrating the energies and projects in this field on a smart community platform based on continuing consultation and communication with society. Also, it will consider the development of institutional capacities and capabilities, of resilience, through an adaptative and transformational capacity, based on innovation and digital technologies (STG, 2021). The strategy considers the priorities of the European Commission for 2019–2024 regarding digitalisation, as well as the objectives from the NRRP. It signalises several missing aspects: a national strategy for e-governance, political consensus on the development direction in this field, national registers to consolidate public institutions' data, an interoperability system of public institutions, an electronic identity, and a central authority to coordinate the resources. Namely, the cities were forced by the new circumstances and private companies to develop their solutions. However, without a national interoperability system, common standards and clear interconnectivity rules, local administrations' private solutions have problems communicating with each other. The exchange of data is hard or impossible. Doubling the data is almost the norm, and integrating these e-governance solutions into a national system will be very difficult. Some initiatives from the central level, from the Authority for Digitalisation of Romania, regarding electronic signatures, the interconnectivity of databases or creating a unitary national system for developing online services are worth mentioning. Nevertheless, the cities will create and implement their solutions until the central administration finds the appropriate resources for a coherent reform plan to develop the infrastructure for a national e-governance system (ibid.).

Some of the proposed projects for the digital transformation of the city:

Table 3: **Proposed action for the digital transformation of the city of Cluj-Napoca**

| Name of the project | Description |
|---|---|
| Digiacademia | Standardisation of data sets used concerning other institutions |
| DigitalCity | Digitalisation and standardisation of GIS databases for urbanism documents |
| MoveIT! | Developing a digital platform for integrating the data, applications and stakeholders from the ecosystem of urban mobility |
| ClujOpendata | Creating a portal of geospatial data of the type GIS Urban/Metropolitan |
| ConnectCity | A platform for interconnecting the existent mobility applications or related to adminis-tration |
| Cluj Future of Work-Work 4.0 | (Partial) automation of jobs from front-office, administrator, software testing, etc. |
| culturaincluj.ro | The digitalisation of the cultural agenda of the city and region, of access to the cultural offer |
| Extension of GIS platform | For Single Opinion, waste management, residential parking, etc. |

Source: STD, 2021, p. 84.

Suppose the maturity matrix for a smart city is based on the Smart Cities Maturity Model and Self-Assessment Tool, Guidance Note for Completion of Self-Assessment Tool, October 2014, Regional Strategy for Urban Mobility, and Smart City for North West Region 2021. In that case, the pillars of a smart city are the economy (E), citizens (C), environment (E), housing (H), mobility (M) and governance (G). It may be seen in Table 4 below that Cluj-Napoca is approaching level 5 (among 6 levels) at half of the criteria – for example, for the criterion "The city is interacting directly with its citizens for public services – virtual civil servant".

### Table 4: Maturity level for the smart city – County seat municipalities

| Smart city pillars | Level 1 – Individual Systems designed to achieve a specific function or a function implemented without an information system | Level 2 – Dialog between different services providers in exchange for information and establishing connections between systems | Level 3 – Integration – the city has a strategic approach based on results, investments in technology, and shared responsibilities | Level 4 – System Management – The system analyses, makes predictions and responds in real-time to information from the city | Level 5 – Sustainable and open – A system of open systems which constantly adapts to changes |
|---|---|---|---|---|---|
| E | | | | | |
| C | | | | | |
| E | | | | | |
| H | | | | | |
| M | | | | | |
| G | | | | | |

Source: Strategia Regională de Mobilitate Urbană și Smart City pentru Regiunea Nord Vest 2021–2027, p. 31.

The coloured squares were presented in the Regional Strategy for Urban Mobility and Smart City for North Western Region 2021–2027 based on experts' studies. The green colour represents the maturity level (2020), the orange cell represents the projects in implementation, and the blue cells denote the city services and the quality of life. It may be seen as an excellent representation of the blue indicators, for city services and quality of life, especially on level 5, the only Romanian city reaching this level, expressing the potential for sustainability and flexibility for constant adaptation. The maturity level of the city is represented at levels 1, 2 and 3, having individual services, maintaining a continuous dialogue between services providers and, most importantly, having an integrated strategic approach based on results and investments in technology. A smart city represents a city that puts technology to the service of its community; this is the basic philosophy of the city's administration.

Regarding challenges and opportunities, for Cluj-Napoca: the European instruments accessible for 2021–2017 will create more opportunities for reducing the development gaps. Some co-financing projects could create difficulties or delays in implementation due to unforeseen factors (of contractors). However, the risk management strategies will help dimmish the negative consequences.

The increasing of the SMEs (98% from active companies), the flexibility of the business environment, a high entrepreneurial capacity, and the links between the city's authorities and the business community will create opportunities for developing the creative and cultural sectors. Also, the modernisation or completion of transport corridors (highway Cluj-Oradea, or electrification of the railway Cluj-Oradea) will increase the city's attractivity and accessibility.

On the other hand, the external migration of the working force could negatively affect the sustainability of smart development. The main employers come from economic sectors which use high technology, such as IT, but also manufacturing electric equipment, computers or electronic and optical products and transport vehicles. The main challenge is the COVID pandemic, which has affected SMEs' resilience (ibid.).

The city developed its support network for foreign investments: Tetarom I, TRC Park Transilvania, Parc Industrial Favorit, Cluj Innovation Park, Parc Industrial Nevia, CT Park Cluj II, Liberty Technology Park, and Tetapolis. These technological parks are located in the city or its metropolitan area, offering a location for foreign investors to develop their business and job opportunities for the local workforce (ibid.).

It is one of the biggest RDI centres in Romania, with good infrastructure and a workforce involved in specific activities – 15 public and private universities, six research institutes or branches, and more than 900 enterprises with RDI activity. One of the challenges is the weak cooperation level between different actors from the region of the innovation system, which does not sufficiently support the knowledge transfer between research centres of the city and companies from other cities in the North West region. Also, the most active clusters from the region are in the city in the field of smart specialisations: IT, advanced production technologies, new materials and food products. These clusters' networks must be extended to the regional and national levels. In addition, the business incubators support the IT and creative industries in the city (ibid.).

For the pillar Citizens, the city is confronted with a population decrease due to natural and migration tendencies. Regarding the workforce, the active population has decreased and natural growth is negative. However, the young generation was born in the digital age and thus their digital competencies are developed from childhood, allowing them to become smart citizens. Digital alphabetisation is challenging for elderly persons, but the tendency to reduce the barriers to accessing public services is increasing (ibid.).

Urban regeneration and green development planning, especially green infrastructure, remain a priority for the city. Therefore, the pillar of Mobility is reflected in the city's Sustainable Urban Mobility Plan for 2021-2027, launched in January 2022 (https://files.primariaclujnapoca.ro/2022/02/03/PMUD_Cluj-Napoca.pdf). The strategy describes some intelligent mobility solutions for each means of transport:

Table 5: **Smart mobility solutions**

| Name of the project | Description |
|---|---|
| Pedestrian | Wheeley Go (in tests) – system bonus to encourage users to move by bicycle or on foot while ensuring registration (km travelled, CO2 saved, calories, etc.) |
| Bicycling | |
| Public transport | Crazy – real-time information about local public transport and the Cluj Bike system for bike sharing |
| Parking | Ye Parking – the first park sharing in Romania |
| | Cluj Parking – locate and display the availability of parking places |
| | City Parking Cluj – locate and display the availability of parking places on the municipality's streets |
| | Parking Pay – card payments for parking places |
| | TPark – SMS payments for parking places |
| | 2 Park.io – allow management and monetisation of private parking sites |

Source: Planul de Mobilitate Urbană Durabilă Cluj-Napoca 2021–2030 (2022), p. 147.

The Smart Mobility Apps include red light enforcement, speed enforcement and video cameras with intelligent analytics (Toward a Climate Neutral Cluj, 2022).

Regarding charging stations for electric vehicles, the city has 40 stations in the municipality and metropolitan area, situated a fourth place in the country, after Bucharest (200 charging stations), Timișoara and Constanța (PMUD, 2022). Further, the city's local administration has made significant steps forward in smart mobility, offering from 2020 31 authorisations for electric taxies (HCL 737/2019).

For the public transport fleet, the city already has a fleet of electric buses and for 2028 is proposing the goal of a 100% electric fleet, with EUR 100 million invested in it. Further, the city developed a research project for autonomous public transport with the Technical University of Cluj-Napoca entitled Pilot Project Line 0. Also, for hydrogen buses, another pilot project with the same university.

The primary investment projects are Metropolitan Belt, with Metropolitan train and subway:

Figure 3: **Major Investments Projects for Cluj-Napoca**

**Metropolitan belt** **Metropolitan train** **Subway**


Source: Toward a Climate-Neutral Cluj (p. 99).

The above figure details the design of the future investment plan to increase the city's public transport.

The PMUD was elaborated based on the newest European strategies: the EGD, Paris Agreement, and Mobility and Climate Change Package. The policies of Greener Europe and More Connected Europe will assure the sustainability of local policies and solutions for mobility (SMUS, 2022).

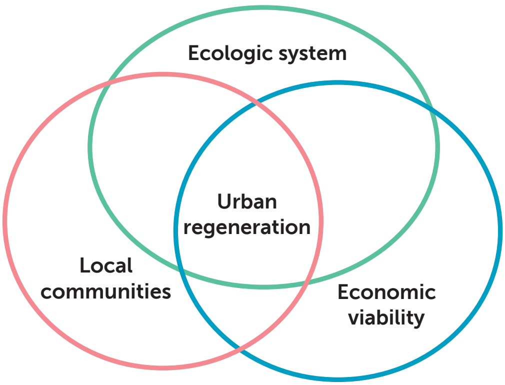
For the City Initiative developed by the European Commission, Cluj-Napoca is the Lead City for sustainable mobility, the only city in Romania (https://ec.europa.eu/jrc/communities/en/community/city-science-initiative).

Energy efficiency programmes will meet the EU's objectives through specific programmes for the Environment pillar. The first energy efficiency strategy of the city was elaborated in 2017, entailing collaboration between the City Hall and the Technical University of Cluj-Napoca (PIEE, 2019). The Plan was correlated with the Sustainable Development Mobility Plan by taking into account implementation of the smart city concept. The solutions elaborated for increasing the energy efficiency were: developing the professional competencies of human resources, including an energy manager for urban communities, procedures and instruments for better energy management on the level of the urban community, defining energy performance indicators with an environmental impact, as well as some direct actions on the level of the urban community, among which it is worth mentioning the promoting of local renewable energy solutions, promoting of contracts of energy efficiency for public requirements, collaboration with an energy provider so that the smart metering projects will respond to the needs and expectations of local beneficiaries (ibid.).

The city of Cluj-Napoca is improving its portfolio of A-class buildings for energy efficiency. Still, a database does not record the lack of information regarding consumption and the loss of distribution networks and drinking water supply. Network extension is not made by using smart technologies. Repairs and upgrades do not follow a smart strategy but respond to specific needs. Further, insufficient data on environmental factors and the lack of equipment to monitor their efficiency efficiently and accurately represent a challenge. Further, the lack of waste management and recycling data is a challenge for the city administration, which must elaborate a strategic vision without an aggregate database.

For urban planning, the green dimension of the city, the city strategy to become climate-neutral is based on the urban regeneration principle, configured as follows:

Figure 5: **Principles of urban regeneration**

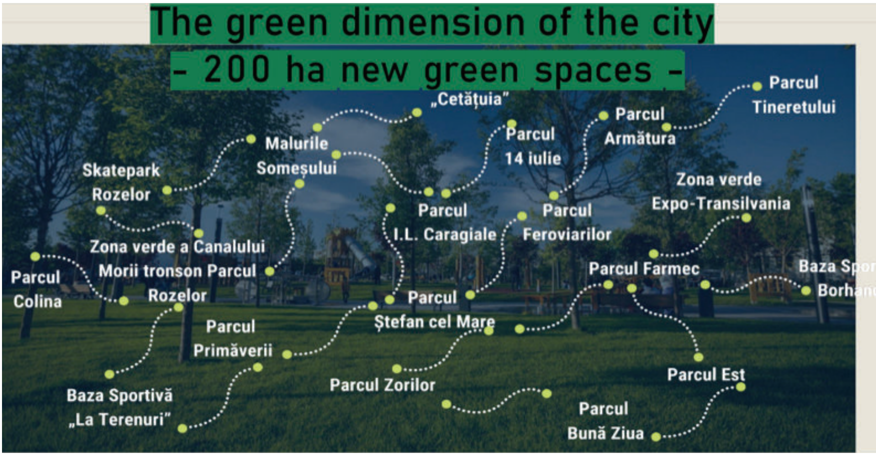



Source: Ghid de regenerare urbană (2020, p. 5).

The strategy for the urban development of Cluj-Napoca was elaborated from 2020 until 2030; it evaluates performances from 2014–2020, identifies the constraints for 2021–2027 and the prospects of an increase in the inhabitants' quality of life (SIDU, 2020).

The first significant proposal regards the increasing of green areas; concretely, more 200 ha of new green spaces, as the figure below shows:

Figure 6: **The Green City**




Source: Toward a Climate-Neutral Cluj (p. 11).

The Walkable City Programme is another EUR 100 million invested in pedestrian areas, supporting the city's green development and increasing the quality of life of its inhabitants (ibid.). Mentioned in this dimension is the first ECO neighbourhood in Romania (which includes a green corridor, green wildlife corridor, water bodies, a line of trees, a community park, highway wildlife overpass, East Park, and historical orchard).

Online participatory budgeting was the first initiative of this kind in Romania. Since 2017, 126 projects have been developed (www.bugetareparticipativa.ro).

Regarding the last pillar, Governance, from the smart city matrix, Cluj-Napoca was the first Romanian city to implement an e-governance solution.

### 3.3 Suceava

The city is situated in North East Romania, with 116,583 inhabitants (at the end of 2015) and a surface area of 53 km2 (PAEDC Suceava, 2021). For the period 2011–2018, the city had higher economic growth than other important cities in the region, 59%, in comparison with Iasi (53%) or Bacău (18%) (SIDU Suceava, 2021).

The city is part of the North East Region of Romania, characterised by the highest population density in Romania, an average age lower than the European rate, with an increased level of natality, compared with the other regions of Romania (PDR N-E, 2021–2027). The region's vulnerabilities indicate an increased level of external migration, a decrease in the urban population for 2021–2018, an unbalanced pyramid of population ages, ageing trends, and a significant population level in rural areas. The life expectancy is lower than the European average, with a higher fertility rate for female teenagers. The risk of social marginalisation is increasing, especially in urban areas. The majority of the population works in agriculture and services. There are also discrepancies regarding the population's education level, which is below the national rate (17% RNE vs 24.6% RO vs 40.7% EU-28 – 2018) (ibid.). Nevertheless, the most vulnerable characteristic of the region is the highest level of poverty in both Romania and the European Union: the poverty or social exclusion rate is 47.1%, being 8% higher than the national level of Romania and double the EU's level in 2019 (ibid.).

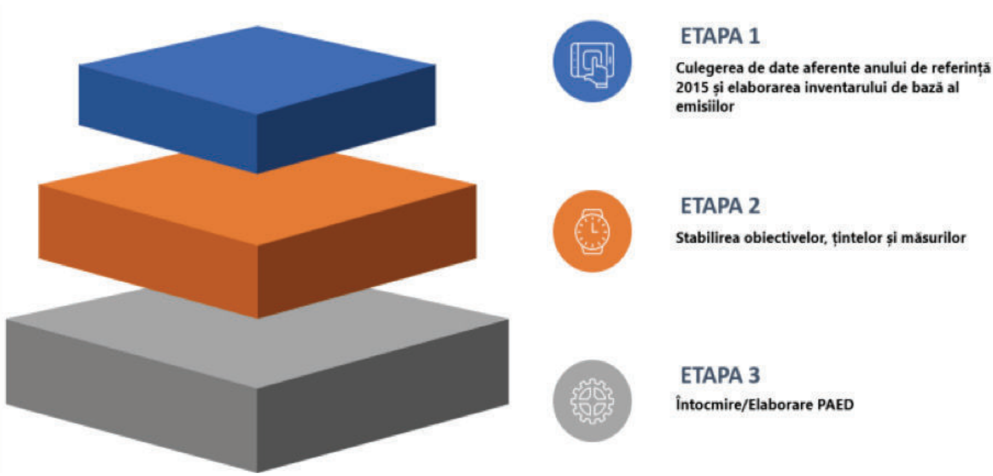
In terms of opportunities, on the regional level the integrated regional strategy indicates European funds being accessed through projects dedicated to the regional and cohesion policies A More Social Europe, the Next Generation EU initiative for the digital and resilience component, regional partnership for education, strategy for education modernisation, regional plans for medical services, the pilot project ITI from the National Decentralised Plan, developed by the Association for Sustainable Intercommunity Development for Upper Country (trans-free for Țara de Sus) (SIDU Suceava, 2021).

Regarding the first analysis criterion, clean mobility, the strategic document – the Plan for Sustainable Mobility of the Suceava Municipality – was elaborated in 2017 (PMUD Suceava, 2017), meaning that it is outdated from the perspective of the new European strategies, the Green Deal and other targets set by the European Commission for 2019–2024. Therefore, an analysis of this strategy would be obsolete.

Regarding the second criterion of the present analysis, energy efficiency, the city has elaborated a Plan for Actions for Sustainable Energy and Climate for 2021–2030 (PAEDC, 2021). The strategic document follows the 10 priorities and 17 objectives of Agenda 2030 for Sustainable Development of the UN. It aims for the political support of local administration to ensure success with implementing the projects and measures meant to improve energy efficiency to reach the EU's target of reducing greenhouse gas emissions by 55%. Also, the strategic document will assure the implementation of local policies in the short and medium term, specifying the directions, actions and measures in the energy and environment protection fields.

Three phases are configured for accomplishment of the aims of the strategy, as the figure below shows:

Figure 6: **Phases for realisation of PAEDC for the Suceava municipality for 2021–2030**




Source: PAEDC for the Suceava Municipality, 2021–2030, p. 30.

The first phase will focus on gathering data as the reference base for 2015 and elaborating the greenhouse gas emissions inventory. The second phase will establish the objectives and measures, while the third will implement these measures to meet the established objectives. The document focuses on the following interventions: buildings and utilities of buildings; centralised heat supply system; urban planning; production of local energy; transport; waste management; public procurement of products and services, and communication.

For each intervention, objectives and measures are provided under the European and national programmes in the field, especially in line with the European instruments that could be used. It is important to mention that the clean mobility criterion of analysis is present in this strategic document for increasing energy efficiency in transport, with nine measures to be implemented, targeting: local bus fleets, the acquisition of new buses (electric, hybrid, GPL, CNG type, etc.); implementing an e-ticketing system; modernisation of bus stations; bus garages; an intelligent traffic management system; an alternative mobility system for bicycles or a park and ride system. The measures are reasonable in terms of the smart city concept. Unfortunately, the document does not mention the concept, and the timing for applying the measures has expired. The proposals would have been suitable for the 2014–2020 period. Accordingly, it could be appreciated that delays in reaching the objective of being a climate-neutral city (the concept is not mentioned in the strategic document).

The urban planning criterion is presented as a subchapter of PAEDC, with a general objective of identifying the city's problems with available resources. Four objectives are mentioned for urban planning: urban rehabilitation and regeneration; development and rehabilitation of public utility services; rehabilitation and modernisation of environment infrastructure and public lightning. However, the measures elaborated for reaching these objectives are general ideas, without any concrete steps to be followed.

In the Integrated Strategy for Sustainable Development the concepts of smart city, digital transformation or climate-neutral are not mentioned. The strategies are aimed at the economic development of the region and of the city, ensuring sustainable development and social inclusion, improving quality of life and reducing the developmental gaps on the intra and inter-regional levels. None of the strategic documents provides a clear vision for development of the city of Suceava in order to meet the climate-neutral objective with tangible projects or solutions. E-governance is a faraway objective.

The website of City Hall Suceava has to be adapted for content and interactivity to prepare the digital transformation for reaching the very ambitious objective of a climate-neutral city.

## 4 Potential improvements in national policies for better implementation of the EGD in Romania

The analysed cities have different levels of understanding of the developmental policies and the EGD, while the original format of the EGD created some difficulties for the member states from the Central and Eastern Europe (CEE) region (Ciot, 2022). Eurostat data reveal that, from the point of view of the environment, economy and infrastructure, none of the member states could support the implementation of the EGD.

For Romania, the concept of the EGD was not approached by national authorities in an integrated manner, only on the sectoral level (the Ministry of Environment). The national authorities based the EGD's approach on the 'green' perspective of environmental policy. The digital transformation has not been approached in a national policy. The responsible authority on the national level for digitalisation is the Ministry of Research, Innovation and Digitalisation. A National Strategy for Digitalisation is needed to transpose the digital policies into different sectors of activity, especially for the policies involved in the EGD. So, the first policy recommendation is to develop a national digitalisation strategy, which will consider the actual international context and the specific characteristics of Romania. Then, a national GD strategy is a must, especially in the actual context of reorientation to it. On the national level, developing an intergovernmental committee dealing with the GD's national implementation, subordinated to the prime minister, will help increase its importance, motivated by strategic autonomy, which requires high-level decisions.

Second, expanding the international cooperation, especially with partners from Central and Eastern European member states which have similar regional characteristics, will be an excellent exercise to develop an adapted model for implementation.

Besides the strategic approach, there is a need for specialised qualified personnel for a better understanding of the integrated vision of the EGD. This aspect is the third recommendation. These courses should be provided from the level of the EC to sectoral ministries, for the personnel of the European Affairs department, in order to understand the transversal character of the EGD and to develop green and digital ways of elaborating future national policies.

## 5 Guidelines and instruments for local administration from Romania to achieve the climate-neutrality objective

For the local authorities from Romania, the most suitable policy recommendation for the analysed cities is the development of a twinning programme with a similar local authority, with a similar developmental policy approach from an EU member state. European and regional cooperation will support the finding of better solutions for local problems.

Smart cities represent a phase of cities' transformation toward climate neutrality. However, this requires a profound transformation of how citizens perceive their relationships with local authorities, participation, and responsibilities. A climate-neutral city means more responsibilities for the citizens. Accordingly, smart cities must base their vision on the European digital society model (Mărcuț, 2022).

The first recommendation for local authorities is to establish partnerships with universities, NGOs and the business community to increase the population's awareness level. The capacity-building process should start by training the local authorities' personnel to support the elaboration of better local policies, integrated into the EGD's implementation and adaptation to the newest trends from the sectoral fields.

The city administrations must understand the need for transparent decisions and communication regarding issues concerned with the EGD's implementation. Unfortunately, except for Cluj-Napoca city, the website of the two other cities' City Halls does not contain updated information on the EGD and their initiatives in this regard.

Public consultation with universities, NGOs and the business community will help structure a concrete implementation strategy for the EGD and create a proper framework for shared responsibility for its implementation.

The cities must take their roles as actors in the Internal Market, elaborate and implement, in dialogue and consultations with European institutions and other European bodies (for example, the Committee of Regions), specific solutions which could be financed from the National Recovery and Resilience Plan. The Association of Municipalities in Romania is a good actor. It might start the discussion with European and regional partners for concrete solutions and financial instruments that could support the reaching of the climate-neutral objectives.

On the national level, the three cities could create an alliance (called a Climate-Neutral Alliance) to raise awareness of the climate-neutral and strategic autonomy targets. A platform might offer a model of collaboration for implementing their concrete initiatives that might become models of good practice for other local European and national communities. These initiatives could be supported on the national level with national financial instruments.
Research and innovation projects developed with universities and research centres of business communities will support new, original and long-term solutions. Digitalisation will affect all dimensions of sustainable urban development, offering the opportunity for urban transformation because digital solutions will deliver innovative and high-quality services to the public and businesses. However, it has to be shaped in an environmentally sustainable, inclusive and fair manner (TNLC, 2022).

## 6 Conclusions

Reaching the climate-neutral objective for local administration in Romania is a challenging task. The three selected cities have different levels of development and understandings of the European policies and mechanisms involved.
Urban development challenges are expressed on the regional and neighbourhood level. The neighbourhood policies will encourage local commitment to community building and inclusiveness. These neighbourhoods should be seen as "tailor-made policy programmes" and potential laboratories for social innovations covering sustainable urban development. Local authorities are responsible at the national level for urban development, and local decision-makers establish strategic programmes and specific measures. They act as bridges between small neighbourhoods and wider functional areas, with a role in designing and stabilising surroundings and rural areas. Particular attention should be paid to the living conditions of citizens (ibid.).

The urban policies should be adapted to the citizens' lives. Hence, the cities must cooperate and coordinate their policies and instruments with suburban and rural areas on mobility, services, green infrastructure, housing, material flows, local and regional food systems, and energy supply. As a result, sustainable and resilient urban developments will take place on the regional level based on a complex network of functional interdependencies and partnerships (ibid.).

Of the analysed cities, only Cluj-Napoca has the capacities, understanding and strategising needed for the city's and its citizens' climate-neutral transformation. The digital transformation is perceived not only on the authority's level but also on the population's level, which uses the digital tool for interaction with their civil servants. Local administration solutions are proposed and promoted already, proving the responsibility for their implementation.

There is only a sustainable development strategy for the capital city, Bucharest, without mentioning the climate-neutral objective. However, the smart city concept and implementation plans are neither presented nor are there public debates or networks of support. The business community is an essential factor in the city, which might pressure the local authorities to find updated practical solutions for implementing the EGD strategy and creating developmental opportunities. The City Hall's website should also be improved and e-governance solutions should be developed quickly.

For the city of Suceava, the opportunity of becoming climate-neutral should generate the strategising of the objective, followed by plans and concrete measures. Unfortunately, at the moment there is no strategy, even one mentioning the word smart or digital concerning the city's transformation. It will be very hard, due to the lack of local administration's preoccupations with an integrated strategy, placed in the context of the latest international events and the newest European tendencies and policies in the field, to find the most suitable solutions and instruments for reaching the climate-neutral objectives and imagining the future of the city.

The EU's climate neutrality goals will challenge the member states differently. The transformative power of the cities will create equal opportunities and environmental justice for all. This transformation will require investments in innovative and efficient technologies and changes in production and consumption, creating the framework for the circular economy, which will ensure the sustainable use of resources, and reduce waste and carbon emissions (ibid.). The EGD's implementation will favour transformational changes and integrated, regional and local solutions. It is a recognised fact that some regions need special attention (CEE) because of the different levels of development, integration into the Internal Market, and political discourses. However, the new growth model that will be generated will be an example for the entire world.

## REFERENCES


- Bugetare participativă. Retrieved 5 July 2022 from https://primariaclujnapoca.ro/informatii-publice/comunicate/a-inceput-a-4-a-editie-a-procesului-bugetare-participativa-online/ .
- Ciot, M.-G. (2022). Implementation Perspectives for the European Green Deal in Central and Eastern Europe. Sustainability, 14, 3947. Retrieved 2 July from https://doi.org/10.3390/su14073947.
- City Science Initiative. Retrieved 5 July 2022 from https://ec.europa.eu/jrc/communities/en/community/city-science-initiative.
- European Commission (2019). European Green Deal. Retrieved 1 July 2022 from https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_ro.
- European Commission (2022a). Sustainable urban development. Retrieved 1 July 2022 from https://ec.europa.eu/regional_policy/en/policy/themes/urban-development/.
- European Commission (2022b). EU Missions – 100 climate neutral and smart cities. Retrieved 2 July 2022 from https://op.europa.eu/en/publication-detail/-/publication/822ee360-c9bf-11ec-b6f4-01aa75ed71a1/language-en/format-PDF/source-256649647.
- European Commission. (2021). The European Fiscal Board assesses the appropriate fiscal stance for the euro area in 2022. Retrieved 5 October 2021 from: https://ec.europa.eu/info/publications/european-fiscal-board-assesses-appropriate-fiscal-stance-euro-area-2022_en.
- European Union (2022). Sustainable development in the European Union Monitoring report on progress towards the SDGs in an EU context 2022 edition. Retrieved 2 July 2022 from https://ec.europa.eu/eurostat/documents/3217494/14665254/KS-09-22-019-EN-N.pdf/2edccd6a-c90d-e2ed-ccda-7e3419c7c271?t=1654253664613.
- Ghid de regenerare urbană. Retrieved 5 July 2022 from https://files.primariaclujnapoca.ro/2020/07/08/Ghid-Regenerare-Urbana-Cartiere-construite-in-perioada-socialista-Vlad-Rusu.pdf.
- Gronkiewicz-Waltz, H., Larsson, A., Boni, A.L., Andersen, K.K., Ferao, P., Forest, E., Jordan, R., Lenz, B., Lumbreras, J., Nicolaides, C., Reiter, J., Russ, M., Sulling, A., Termont, D., Vassilakou, M. (2020). Proposed Mission: 100 Climate-neutral cities by 2030 – by and for the citizens. Publications Office of the European Union.
- HCL 737/2019 – Local City Council Decision approval of the specialised study regarding establishing the maximum number of taxi authorisations for the period 2020-2025 in Cluj-Napoca, the maximum number for taxi licenses for 2020-

2025 and the Regulation on the organisation and execution of the taxi transport service in Cluj-Napoca. Retrieved 5 July from https://primariaclujnapoca.ro/consiliu-local/hotarare-de-consiliu/hotararea-737-din-2019/.

- Mărcuț, M. (2022). Redefining the Smart City within the European Digital Society. Romanian Journal of European Affairs, 22 (1), pp. 69-84. Retrieved 2 July 2022 from http://rjea.ier.gov.ro/wp-content/uploads/2022/05/Art.-5.pdf.
- Mc Kinsey Institute (2018). To tackle urban problems, city governments have to get smarter—Retrieved 2 July 2022 from https://www.mckinsey.com/mgi/overview/in-the-news/to-tackle-urban-problems-city-governments-have-to-get-smarter.
- Mc Kinsey Institute (2022a). Securing Europe's future beyond energy: Addressing its corporate and technology gap. Retrieved 2 July 2022. https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/securing-europes-future-beyond-energy-addressing-its-corporate-and-technology-gap.
- Mc Kinsey Institute (2022b). The net-zero transition: What it would cost, what it would bring. Retrieved 2 July 2022. https://www.mckinsey.com/business-functions/sustainability/our-insights/the-net-zero-transition-what-it-would-cost-what-it-could-bring.
- PAEDC Suceava (2021). Plan de Acțiune pentru Energie Durabilă și Climă 2021-2030. Retrieved 11 July 2022 from https://www.primariasv.ro/dm_suceava/site.nsf/atasament/3D75763913AF716EC22587D8003613C1/$FILE/PAEDC%20Suceava%202021-2030.pdf?Open .
- PDR NE – Plan de Dezvoltare Regională Nord-Est 2021-2027 (2020). Retrieved 11 July 2022 from https://adrnordest.ro/storage/2021/02/PDR-NE-2021-2027-dec.-2020.pdf .
- PICA - Plan Integrat de Calitate a Aerului în Municipiul București 2018-2022 (2018). Retrieved 5 July 2022 from https://doc.pmb.ro/institutii/primaria/directii/directia_mediu/planuri_de_calitate_aer/docs/plan_integrat_calitate_aer_buc/plan_integrat_calitate_aer_buc_2018_2022.pdf .
- Plan de imbunatatire a eficientei energetice a Municipiului Cluj-Naoca. Retrieved 5 July 2022 from https://files.primariaclujnapoca.ro/2019/02/05/Planul-de-%C3%AEmbun%C4%83t%C4%83%C8%9Bire-a-eficien%C8%9Bei-energetice-aferent-Municipiului-Cluj-Napoca.pdf .
- PMUD - Plan de Mobilitate Urbană Durabilă a municipiului Suceava (2017). Retrieved 11 July 2022 from http://ftp.primariasv.ro/pub/pub/pmud/PMUD%20Suceava%20-%20FINAL%20.pdf .
- PMUD - Planul de Mobilitate Urbană Durabilă Cluj-Napoca 2021-2030 (2022). Retrieved 1 July from https://files.primariaclujnapoca.ro/2022/02/03/PMUD_Cluj-Napoca.pdf .

- PMUD 2016-2030 – Plan de Mobilitate Urbană Durabilă Regiunea București-Ilfov 2016-2030. Retrieved 5 July 2022 from https://doc.pmb.ro/servicii/transporturi_drumuri/docs/planul_de_mobilitate_durabila_2016-2030.pdf .
- Program Operațional Regional – Regiunea București-Ilfov (2021). Retrieved 11 July 2022 from https://www.adrbi.ro/media/2755/programme_snapshot_2021ro16rfpr009_10_ro.pdf .
- Sachs, J., Lafortune, G., Kroll, C., Fuller, G., Woelm, F. (2022). SUSTAINABLE DEVELOPMENT REPORT 2022. Cambridge University Press. Retrieved 1 July 2022 from file:///D:/Backup_laptop%20Fuji/Gabriela%20Ciot/CARTI/2022/Volum%20colectiv%20ELF%20EP/materiale/2022-sustainable-development-report.pdf.
- SIDU (2020) – Strategia Integrată de Dezvoltare Urbană a municipiului Cluj-Napoca pentru perioada 2021-2017 (2030). Retrieved 5 July 2022 from https://files.primariaclujnapoca.ro/2020/10/15/Prezentare-CIIC-MC-15oct-ppt.pdf .
- SIDU București - Strategia Integrată de Dezvoltare Urbană a Municipiului București 2021 – 2030 (2021). Retrieved 10 July from https://estibucuresti.org/sidu.
- SIDU Suceava – Strategia Integrată de Dezvotare Urbană a Zonei Urbane Funcționale Suceava 2021-2030 (2021). Retreieved 11 July 2022 from https://mitocudragomirnei.ro/assets/documente/info_publice/anunturi/strategie/2.%20Sec%C8%9Biunea%202.%20Analiza%20situa%C8%9Biei%20actuale%20%C8%99i%20contextul%20urban_SIDU%20Suceava/2.2.%20Profil%20Economic_SIDU%20Suceava.pdf .
- SIDU ZMC (2020) - Regenerare urbană. Retrieved 5 July 2022 from https://files.primariaclujnapoca.ro/2020/07/08/SIDU-ZMC-Regenerare-urbana-ppt-Vlad-Rusu.pdf.
- SMUD (2020) - Strategia Regională de Mobilitate Urbană Durabilă și Orașe Inteligente a Regiunii Nord-Vest 2021-2027 (2021). Retrieved 1 July from https://www.nord-vest.ro/wp-content/uploads/2020/10/SRMUOIRNV-2021-2027-Strategia_Versiune-finala.pdf
- STG (2021). Strategia de transformare digital a municipiului Cluj-Napoca. Retrieved 5 July 2022 from https://digitalcluj.fspac.online/wp-content/uploads/2021/04/Strategia-de-transformare-digitala-web.pdf .
- Strategia energetică a municipiului București (2007). Retrieved 10 July 2022 from https://www.pmb.ro/programe/1/menu-page/strategia-energetica .
- The New Leipzig Charter (2020). Retrieved 2 July from https://ec.europa.eu/regional_policy/sources/docgener/brochure/new_leipzig_charter/new_leipzig_charter_en.pdf.

# A liberal future in a united Europe

/europeanliberalforum
@eurliberalforum
#ELFevent

liberalforum.eu



This publication was co-financed by the European Parliament. The European Parliament is not responsible for the content of this publication, or for any use that may be made of it.