Transformations for the Joint Implementation of Agenda 2030 for Sustainable Development and the European Green Deal

A Green and Digital, Job-Based and Inclusive Recovery from the COVID-19 Pandemic

SUSTAINABLE DEVELOPMENT SOLUTIONS NETWORK
A GLOBAL INITIATIVE FOR THE UNITED NATIONS

Published by the United Nations Sustainable Development Solutions Network (SDSN) 2021.

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Recommended citation: SDSN 2021.Transformations for the Joint Implementation of Agenda 2030 for Sustainable Development and the European Green Deal. Sustainable Development Solutions Network (SDSN)

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SDSN mobilizes global scientific and technological expertise to promote practical solutions for sustainable development, including the implementation of the Sustainable Development Goals (SGDs) and the Paris Climate Agreement. In Europe, over 300 members and 13 national and regional networks of SDSN are part of SDSN Europe, a common initiative that aims to align the European recovery with the Agenda 2030. Leveraging on the research within the networks as well as on the SDSN's work on the Six Transformations and other publications, SDSN Europe will play an active role in the shaping of a sustainable and resilient Europe.

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Executive Summary

By the end of 2020, the COVID-19 pandemic had claimed more than 1.5 million lives worldwide, led to the greatest peacetime economic disruption in living memory, and caused temporarily a serious setback for sustainable development. The world is currently facing three simultaneous crises: the health crisis caused by the pandemic, the unprecedented (during peacetime) economic recession caused by social distancing measures, and the most far-reaching crisis of all, the climate crisis. The pandemic has proven that it is paramount to understand and integrate the connection between environmental and public health agendas in policymaking. Cleaning unsustainable supply chains and production processes that lead to deforestation and biodiversity threats can help reduce the risk of future zoonotic diseases and pandemics.

It becomes increasingly evident that the world lives beyond the boundaries of our planet, and that the climate and biodiversity emergencies need to be integrated in the pandemic recovery plans. **It is essential for governments to learn the lessons from the pandemic and build more resilient and inclusive societies.** For this purpose, the United Nations' Agenda 2030 with its Sustainable Development Goals (SDGs) and the Paris Agreement of 2015 provide the long-term vision and remain what the UN General Assembly called "The Future we Want." The European Green Deal is the detailed vision of "The Future Europe Wants," which is consistent with the SDGs and the Paris Agreement.

Recognizing the global sustainability challenges, European Union leaders have adopted the European Green Deal with wide-ranging goals for a climate-neutral, resource-efficient, technologically advanced, and socially equitable continent. They have also decided to integrate the SDGs in the European Semester, which is the major process for the coordination of national economic and employment policies in the EU, thereby deciding to **"put people and the planet at the centre of EU economic policy".** In addition to these decisions made in 2019 and early 2020, EU leaders responded to the immense health, environmental, and economic challenges posed by the pandemic with a strong "Next Generation EU" package of policies and funds to boost economic recovery while pursuing Europe's green transition.

This report attempts to connect the dots between these four major policy initiatives – **the SDGs, the European Green Deal, the European Semester, and the EU recovery plan** – to support policymakers with actionable strategies that can guide EU-wide and national economic recovery in line with the continent's overarching sustainability agenda.

We developed a 3D-mapping method to explore whether the European Commission's Country Specific Recommendations (CSRs – an outcome of the European Semester process) are aligned with the SDGs and the European Green Deal's main policy areas. Section 2 describes this framework and EU-wide results. The analysis shows that **the EU has largely achieved mainstreaming SDGs in its strategic priorities, but there are still some remaining discrepancies:** a number of issues that have been identified as major or significant challenges in the SDSN's Sustainable Development Report 2020 are not captured by CSRs. Country-specific results of this mapping, which are provided in online Annex I of this report, can assist the European Commission and national governments to improve the alignment of policy priorities of EU Member States with the broader sustainability goals.

On the road to sustainable societies by the mid-21st century, **governments need to make consistent decisions about investment flows and to enable a green financial sector** for investing in technologies that can help achieve the objectives of the European Green Deal. In Section 3 of the report, drawing on the experience of leading research teams around Europe, we outline technological and investment pathways to attain climate-neutral and circular economies. In particular, we identify six pillars towards EU climate neutrality, encompassing energy, resource efficiency, and land use; describe the necessary governance for preparing National Climate Neutrality Roadmaps to 2050; and provide elements for an enabling policy framework that can contribute to the decarbonisation goal.

We also review the investment plans announced by the EU in support of both the European Green Deal and the post-pandemic economic recovery, outline sustainable finance initiatives, and describe a successful example from the introduction of green bonds and their potential to contribute to specific SDGs. In this regard, it is essential to **adopt a systems approach to take advantage of complementarities between different aspects of the green transition and identify trade-offs between diverse sustainability objectives.** In the report we provide numerous examples of EU-funded projects that enable the co-development of regional approaches and business solutions between multiple stakeholders and explore synergies among social actors to reinforce climate resilience, nature protection, land restoration, and pollution prevention.

Greening the financial sector will not come alone; it requires proactive action by governments towards transformational spending and investments. In Section 4 of the report, we look at the role that 'patient' finance can play for the green transition and provides examples of novel financial and fiscal policies that have been applied at national and regional level. Sustainable innovation requires long-term, strategic finance, which the private sector will not provide unless there is a stable and consistent direction for investment so that regulation and innovation converge along a green trajectory. To provide this 'patient' finance, there is a significant entrepreneurial role for the state as also demonstrated during the 2020 pandemic. For this purpose, an ecosystem of public finance is needed to direct the European economy towards a sustainable direction; this requires alignment of priorities of multiple financial institutions at various levels – from monetary and macroprudential policy down to firm-level economic policies. At this point, the SDGs should be drawn on to provide the framework for creating conditions on the finances available, so that only SDG-compatible investments are supported. Today, such **green conditionalities are a unique opportunity to direct economic growth towards a systemic transition to sustainability.**

To make this transition inclusive and just, especially since the pandemic has eliminated or endangered millions of jobs around Europe, the impacts on **employment prospects and the need for new skills in the population are essential elements of any economic recovery plan.** In Section 5 of the report, we provide an overview of recent EU-wide and international work on the topic and we conclude with a set of recommendations for European policymakers. **There is ample evidence that a 'return-to-normal' economic stimulus is not only environmentally unsustainable but also economically inferior to a green recovery strategy in which immediate interventions can focus on energy efficiency retrofits and sustainable urban mobility.** Later in this decade, investments for capital-intensive projects in manufacturing and infrastructure can serve as accelerators of the green transition. **Growth-and employment enhancing measures in Europe are not only those related to green energy but also those promoting circular economy, organic agriculture, and nature-based solutions.** Still, policymakers need to be aware of trade-offs – for example, recovery programs with short-term employment benefits may have weaker effects for long-run growth, as the green transition requires commitments to public spending and pricing reforms over a longer period. Moreover, as green recovery measures seem to be most effective in places where workers already possess the necessary green skills, appropriate training should be provided through the European Just Transition Fund for other vulnerable parts of the workforce.

Apart from jobs and skills, another essential element of a just transition is ameliorating income inequalities. As some decarbonisation policies may have adverse impacts on social equity, this aspect must receive special attention. In Section 6 we report on the well-documented evidence that some decarbonisation policies in Europe may result in lower-income households benefiting more than other income groups (progressive effect), while other measures can result in lower-income households being disproportionately burdened by costs (regressive effect). **Undesirable impacts on income distribution can be avoided if policies are designed carefully,** revenues generated by measures like energy and carbon pricing are recycled to vulnerable parts of the population, energy efficiency measures are targeted to low-income households, and green innovation is funded by general taxation rather than by green surcharges.

Finally, Section 7 builds on the cross-mapping method developed in Section 2 of this report, as well as on insights from the technological, financial, employment and equity considerations presented in the report, to provide a framework for the design and assessment of actionable sector-specific recovery policies. A comprehensive list of sustainability and resilience criteria, explicitly linked with the SDGs, is presented. Each sector-specific policy and measure can be evaluated across this array of criteria, differentiating clearly between short- and long-term impacts. The assessment should be based on a combination of quantitative modelling with proper tools and data, and qualitative input from stakeholders. **The policy formulation process should be transparent and open to broad stakeholder participation in order to ensure public support and effective implementation of the green recovery.**

2021 is a milestone year in which all major sustainability challenges will be addressed in international summits. Since the post-pandemic economic stimulus is larger than anything similar in living memory, and incremental improvements are not sufficient to meet the planetary emergency, **Europe has a once-in-a-generation opportunity to accelerate the transformation to sustainable societies, whereby governments intervene proactively and co-design a systemic green transition with stakeholders.** Such an approach can ensure democratic oversight, increase the ownership of investments and reforms in society, and direct public funds towards the most socially desirable uses.

Introduction

The United Nations (UN) 2030 Agenda for Sustainable Development[1], including its 17 Sustainable Development Goals (SDGs) and 169 targets, was adopted on 25 September 2015 by the international community at the UN Sustainable Development summit in New York. It provided a shared blueprint for peace and prosperity for people and the planet, aimed to eradicate poverty in all its forms and to achieve sustainable development in its three dimensions - economic, social, and environmental - by 2030 world-wide, in a balanced and integrated manner, ensuring that no one is left behind.

A few weeks later, on 12 December 2015, the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) joined at the 21st Conference of Parties (COP21) in Paris, to deliver a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The resulting Paris Agreement[2] aimed to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

After the adoption of the Paris Agreement, the Intergovernmental Panel on Climate Change (IPCC) produced in 2018 a Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways[3]. The Special Report of Global Warming of 1.5°C was a scientifically sound alarm bell highlighting the potential ecological and economic costs of unabated warming. The results of the study provided the scientific premise from which urgent action must be taken to limit emissions to address the threat of climate change and promote sustainable development and resilient communities globally.

Both the Sustainable Development Goals (SDGs) and the Paris Agreement called for deep transformations in every country and required complementary actions by governments, civil society, scientists, and businesses. While significant progress has been made on some goals, no country is currently on track towards achieving all SDGs. As Professor Sachs says, *"the SDGs have become the world's shared framework for sustainable development, but countries need more clarity on how to operationalise and track progress towards the 17 goals. Similarly, businesses, science, and civil society must support SDG achievement."*

In response, the UN Sustainable Development Solutions Network (SDSN) introduced in 26 August 2019 the Six Transformations to achieve the SDGs (6T)[4]. Each Transformation identified priority investments and regulatory challenges and called for actions by well-defined parts of government working with business and civil society. Transformations could, therefore, be operationalised within the structures of government while respecting the strong interdependencies across the 17 SDGs. The 6Ts also outlined an action agenda for designing, implementing, and monitoring the SDG Transformations.

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[1] https://sustainabledevelopment.un.org/post2015/transformingourworld

[2] https://sustainabledevelopment.un.org/frameworks/parisagreement

[3] IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press

[4] Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six transformations to achieve the sustainable development goals. *Nature Sustainability*, 2(9), 805-814.

The **6Ts** are listed below:

- Education, Gender and Inequality
- Health, Wellbeing, and Demography
- Energy Decarbonisation and Sustainable Industry
- Sustainable Food, Land, Water, and Oceans
- Sustainable Cities and Communities
- Digital Revolution for Sustainable Development

Building on the Paris Agreement and the SDGs as frameworks for action, the EU introduced the European Green Deal[5] (EGD) on 1 December 2019 to reach the goal of climate neutrality by 2050. Recognising the challenges associated with decarbonisation of the European economy as illustrated in Figure 1, the European Green Deal is the compass that will guide the actions of governments, organisations, and businesses in the European Union and offers a comprehensive framework for decarbonising the EU economy, reducing pollution and waste, and placing sustainable development and the SDGs at the centre of the European policy agenda. This makes SDSN's Six Transformations a useful integrated policy framework from which European countries and businesses can work together to help Europe become the first carbon-neutral continent in the world by 2050.

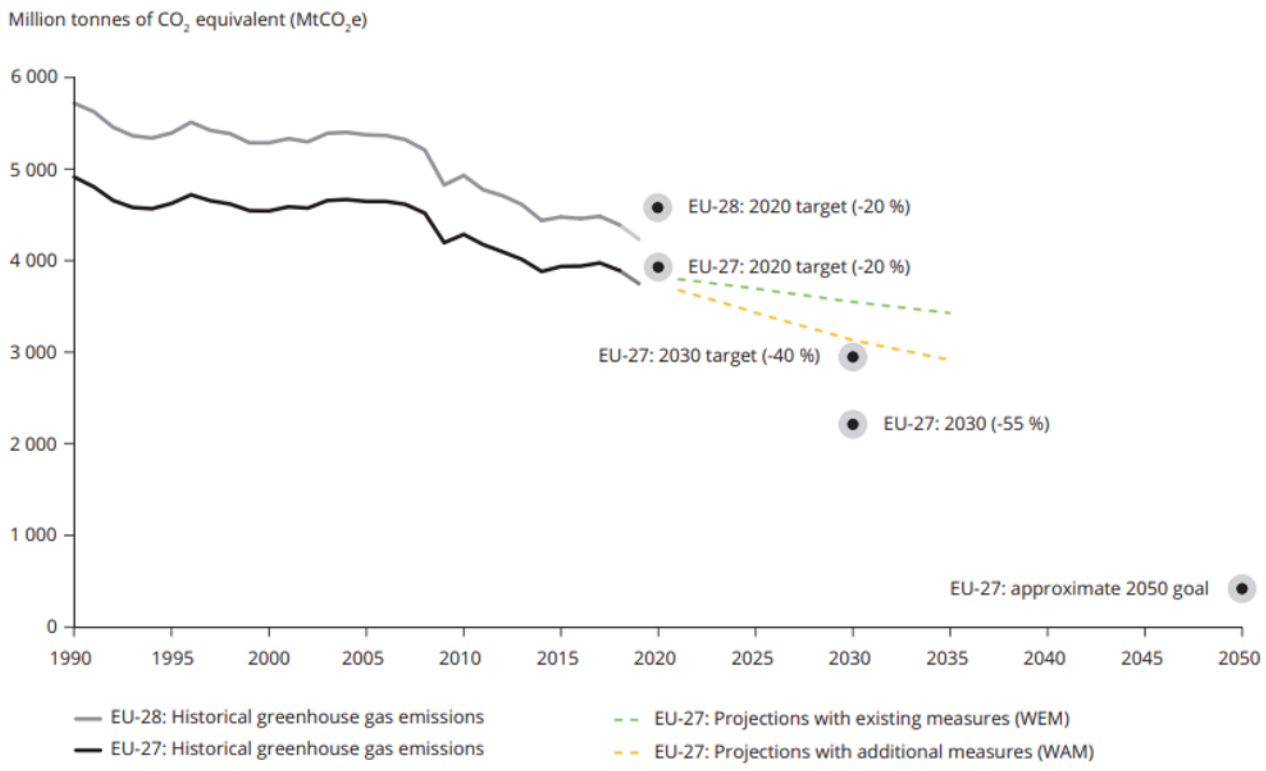

Figure 1. Greenhouse gas emission targets, trends, and Member States MMR projections in the EU, 1990-2050. Source: EEA Report No 13/2020[6]

[5] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[6] Trends and projections in Europe 2020 - Tracking progress towards Europe's climate and energy targets, 2020

[7] https://ourworldindata.org/grapher/total-deaths-covid-19

[8] https://www.unsdsn.org/never-waste-a-good-crisis-for-a-sustainable-recovery-from-covid-19

While these initiatives were in development, the COVID-19 pandemic hit in February 2020. The coronavirus COVID-19 pandemic is the defining global health crisis of our time, costing life to 1.45 million people globally as of 29 November 2020[7]. But COVID-19 is much more than a health crisis - it has tremendous socioeconomic impact around the world, the scale of which is still hard to assess. The measures that can help solve the health crisis aimed to "flatten the curve of the pandemic," but, inevitably, they steepened the macroeconomic recession curve and put in danger all supply chains[8]. In response to the pandemic, the European Council agreed on 21 July 2020 to spend a total €1.8 trillion[9], including the enhanced 2021-2027 long-term EU budget and the Next Generation EU recovery facility, to help Europe recover from the coronavirus pandemic.

To support the implementation of the European Green Deal (EGD) and to facilitate the participation of national stakeholders and local experts through SDSN's European networks to advise the European Commission, SDSN introduced the EU Green Deal Senior Working Group for the Energy Transition in April 2020. This report presents the work of the Group members and aspires to become a blueprint for the implementation of different policies and their synergies, as well as to propose criteria for possible investment pathways at the European level.

The objectives of this report are the following:

- Identify and promote, for each EU Member State, and the EU as a whole, technological and policy pathways for climate change mitigation (decarbonisation) and adaptation within and across the EU Member States, for the implementation of the EGD and the SDGs, supported by financial portfolios derived from (a) the European Green Deal, (b) the EU Multiannual Financial Framework, (c) the EU Recovery Plan.
- Provide strategic recommendations and mobilise experts for the ongoing implementation of the European Green Deal through SDSN networks. Mobilise experts to "rethink policies for clean energy supply and climate adaptation projects, across the economy, industry, production and consumption, large-scale infrastructure, transport, food and agriculture, construction, taxation, and social benefits."
- Support politicians and policymakers to identify sustainable and resilient investment projects for the absorption of the EU Next Generation funds at national level, as well as create cross-country alliances for a regional sustainable recovery. Also support businesses that are willing to make partnerships with the public sector to facilitate and mobilise private resources for the implementation of the EGDl.
- Mobilise stakeholders in partnership with the SDSN European networks to guarantee local engagement and support for these policies.

[9] https://www.consilium.europa.eu/en/meetings/european-council/2020/07/17-21/

Section 1. The Policy Framework

The key policy frameworks that will be used for the purposes of this report are the UN Sustainable Development Goals (SDGs), the European Green Deal (EGD), and the European Semester (ES), in particular the Country Specific Recommendations (CSRs).

1.1. Sustainable Development Goals (SDGs)

The 2030 Agenda for Sustainable Development, which was adopted by all United Nations Member States in 2015, includes 17 Sustainable Development Goals and 169 targets. The Agenda is a commitment to eliminate poverty and achieve sustainable development by 2030 world-wide, incorporating the three dimensions of sustainable development - economic, social and environmental. The SDGs are global and universally applicable, taking into account national realities, capacities, and levels of development, and specific challenges. Thus, all countries have a shared responsibility to achieve the SDGs, and all have a significant role to play locally, nationally, and globally, following the UN principle "leave no one behind".

The 17 SDGs represent a system of interconnected goals with 169 targets, each measured by a number of indicators (see Sustainable Development Reports, published since 1995)[10]:

Goal	The ambition of the Goals
Goal 1 - No Poverty	End poverty in all its forms everywhere
Goal 2 - Zero Hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture
Goal 3 - Good Health & Well Being	Ensure healthy lives and promote well-being for all at all ages
Goal 4 - Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Goal 5 - Gender Equality	Achieve gender equality and empower all women and girls
Goal 6 - Clean Water & Sanitation	Ensure availability and sustainable management of water and sanitation for all
Goal 7 - Affordable & Clean Energy	Ensure access to affordable, reliable, sustainable, and modern energy for all
Goal 8 - Decent Work & Economic Growth	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all
Goal 9 - Industry, Innovation & Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
Goal 10 - Reduced Inequalities	Reduce inequality within and among countries
Goal 11 - Sustainable Cities & Communities	Make cities and human settlements inclusive, safe, resilient, and sustainable
Goal 12 - Response Consumption & Production	Ensure sustainable consumption and production patterns
Goal 13 - Climate Action	Take urgent action to combat climate change and its impacts

[10] The latest report is Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G., Woelm, F. 2020. The Sustainable Development Goals and COVID-19. Sustainable Development Report 2020. Cambridge: Cambridge University Press.

Goal 14 - Life Below Water	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
Goal 15 - Life On Land	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16 - Peace Justice & Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels
Goal 17 - Partnerships for the Goals	Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

Table 1. Ambitions of the 17 SDGs

1.2. The European Green Deal

The European Green Deal (EGD) is a new growth strategy adopted by the European Commission in December 2019 that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy; zero net emissions of greenhouse gases in 2050; and where economic growth is decoupled from resource use. The four horizontal priorities announced at the EGD launch were to:

- Make Europe a climate-neutral continent
- Protect human life, animals and plants by cutting pollution
- Help European companies become world leaders in clean technologies
- Ensure that the green transition is just and inclusive.

These four overarching goals are planned to be achieved by implementing policies in the following nine areas:

- **Biodiversity:** The new EU Biodiversity Strategy for 2030[11] aims to put Europe's biodiversity on a path to recovery by 2030 with benefits for people, the climate, and the planet. The Strategy includes a comprehensive, long-term plan for protecting nature and reversing the degradation of ecosystems.
- **From Farm to Fork:** The Farm to Fork Strategy[12] aims to make food systems fair, healthy, and environmentally-friendly. A sustainable food system will help to mitigate climate change and adapt to its impacts; will ensure food security, nutrition, and public health; and will reinforce the EU's competitiveness.
- **Sustainable Agriculture:** The common agricultural policy (CAP)[13] combines social, economic, and environmental approaches on the path towards achieving a sustainable system of agriculture in the EU.
- **Clean Energy:** The smart integration of renewables, energy efficiency, and other sustainable solutions across sectors will help to achieve decarbonisation at the lowest possible cost. The EU Hydrogen Strategy[14] will also give a boost to clean hydrogen production in Europe.

[11] COM(2020) 380 final of 20 May 2020.

[12] COM(2020) 381 final of 20 May 2020.

[13] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/future-cap_en

[14] COM(2020) 301 final of 8 July 2020.

- **Sustainable Industry:** The EU Industrial Strategy[15] aims to transform the industrial sector and make it more competitive, greener, and more digital. The development of new markets for climate-neutral and circular products is essential.
- **Building and Renovating:** Improving the energy performance of public and private buildings will reduce energy poverty.
- **Sustainable Mobility:** The focus of the upcoming strategy for sustainable and smart mobility will be the production and deployment of sustainable alternative transport fuels for road, maritime, and air transport, as well as the roll-out of public recharging and refuelling points for long-distance travel and in less densely populated areas.
- **Eliminating Pollution:** The Commission will adopt in 2021 a zero-pollution action plan for air, water, and soil to create a toxic-free environment.
- **Climate Action:** The EU aims to become climate neutral by 2050 and already proposed a plan to further cut emissions by at least 55% by 2030[16].

In line with the EGD, the Commission proposed the first European Climate Law[17] in March 2020, intending to set out the conditions for an effective and fair transition, to provide predictability for investors, and to ensure that the transition is irreversible. In September 2020, the Commission proposed a greater climate ambition[18] and put forward a plan to further cut emissions by at least 55% (compared to 1990 levels) by 2030, to ensure a transition to a climate-neutral economy that is fair and cost-effective for all, aiming to become the world's first climate-neutral continent by 2050. The main elements of this plan are shown in Figure 2. Responding to this proposal, the European Parliament voted on 6 October 2020 to propose a GHG emissions cut by 60% in 2030 compared to 1990 levels[19], setting thus an even more ambitious climate goal than that proposed by the Commission.

EU leaders, at the meeting of the European Council held on 10th and 11th December 2020, agreed on a binding new EU emissions reduction target by 55% compared to 1990 levels until 2030, and "call the co-legislators to reflect this new target in the European Climate Law proposal"[20]. Achieving 55% GHG emissions reductions by 2030 will also support the COVID-19 recovery and the longer-term competitiveness and resilience of the European economy. For an increased GHG emissions reduction target of 55%, an increase in investment of €350 billion per year is needed compared to the previous decade.

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[15] COM(2020) 102 final of 10 March 2020.

[16] https://www.europarl.europa.eu/doceo/document/TA-9-2020-0253_EN.pdf

[17] COM(2020) 80 final of 4 March 2020.

[18] COM(2020) 562 final of 17 September 2020.

[19] https://www.europarl.europa.eu/doceo/document/TA-9-2020-0253_EN.pdf

[20] https://www.consilium.europa.eu/media/47296/1011-12-20-euco-conclusions-en.pdf

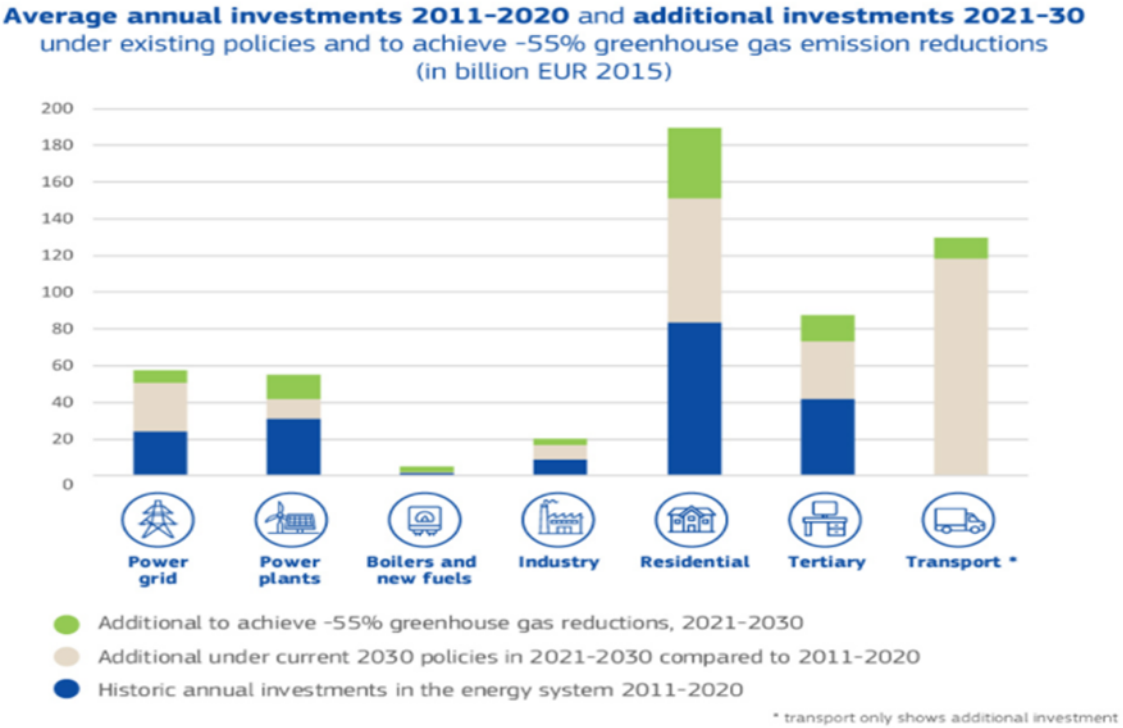

Figure 2. EU 2030 Climate Target Plan. Source: European Commission

Experts around Europe have praised the ambitions of the proposed European Climate Law but have also provided comments to broaden its scope and improve its implementation. As an example, the box below describes feedback provided by Greek experts on the Law's provisions.

Another major European initiative is the European Climate Pact, which was launched on 16 December 2020, aiming to give all European citizens a voice and space to design new climate actions, share information, launch grassroots activities, and showcase solutions that others can follow.

Review of European Climate Law by the Climate Change Committee of the Greek Ministry of Energy and Environment

The European Climate Law will make Europe the first continent in the world to adopt the goal of climate neutrality by 2050. It will be a long-term energy strategy for 2050 outlining 2 scenarios for emissions reduction by 95% compared to 1990. Also, it serves as an international initiative to protect monuments of natural and cultural heritage from human-made climate change and it must be properly modified to be strengthened and eventually adopted by all European Institutions.

The need for a Climate Law becomes even more urgent in the current period as the coronavirus pandemic causes a new economic crisis with enormous dimensions. The route for the economic recovery of Europe from the coronavirus consequences passes through an ambitious and strengthened European Green Deal, which will ensure Europe's transition to a climate-neutral and socially just economy. The necessary economic recovery packages from the coronavirus crisis that are currently being designed must be fully aligned with and in support of the goal of climate neutrality.

However, the Climate Law should be a comprehensive framework that will recognise the relationship between water, energy, food security, and ecosystem (WEFE Nexus) and the need to maintain biodiversity, which is closely linked with ecosystem services. Also, it needs to emphasise the implications of climate change in public health and food systems, and the linkage of air quality improvement policies as well environmental/climate migration. Moreover, it needs to be complemented with a description of the financial mechanisms that will be required to achieve the climate neutrality goal and to create equal conditions for competition between EU companies and non-EU companies, mitigating the risk of "carbon leakage".

More specifically, the Committee has made comments explicitly for each Article of the Climate Law, as follows:

Article 1: Subject matter and scope

- The reduction of greenhouse gas emissions will be "irreversible"
- Link of the goal for climate neutrality with "achieving the long-term temperature target as set out in Article 2 of Paris Agreement" (par. 2, Art. 1)
- Should be clarified that the goal is regarding the 1.5 C target

Article 2: Climate-neutrality objective

- The goal of reducing greenhouse gas emissions by 65% in 2030 should be compared to the reduction targets of 50% and 55% in the European Commission's ongoing study
- Adoption of the new target and climate law before the 26th World Conference on Climate in Glasgow (COP26)
- Statement of legislative consequences from the change in the target of greenhouse gas emission reduction by 2030
- Inclusion of international aviation and shipping in the EU's goal of climate neutrality with a clear reference to the need for financial support
- Clarification in the law that the transfer of emission rights between Member States is permitted

Article 3: Trajectory for achieving climate neutrality and Article 9: Exercise of the delegation

- Establishment of a Scientific Committee:
    - Drawing up the pathway to achieving the goals and issuing the relevant delegated acts
    - Assess progress and propose corrective actions in case of deviations
    - European Union's commitment to political decision making on climate change based on scientific conclusions and not based on current political circumstances and correlations
- Science as the basis of all the parameters that determine the EU's pathway to climate neutrality
- Clear timeline link between the evaluation of achieving the goals and the implementation of the relevant decisions

Article 4: Adaptation to climate change

- Evaluation of adaptation to climate change
    - Along with assessing the progress towards climate neutrality:
        - Damages already happened to the Member States from the climate
        - Potential natural hazards for the future of societies and the economy
        - Measures for all sectors of the economy
        - Assessment of the level of financial resources required to strengthen the more vulnerable areas
- Provision of technical and organisational support to regions affected by climate change

Article 5: Assessment of Union progress and measures

- Alignment with the goals also for 2030 and not only that of 2050
- The corrective actions proposed by the European Commission must also take into consideration the course of achieving the objectives (Article 3) and not only its purpose for climate neutrality until 2050
- The co-responsibility and the role of the European Parliament about the evaluation report and the corrective measures to be taken next is positive but unclear
- Unclear how the mechanism by which the assessment in the course of achieving the goals at the European level made by the European Commission will be translated into measures and proposals for legislative changes

Article 6: Assessment of national measures

- Climate law should include a reference to sanctions - to be specified in the relevant legislation
- Evaluation of the course of the Member States to be based on their National Energy and Climate Plans (NECPs)
- Assessment of the progress of Member States after 2030 must be based on the Long-Term Strategy for 2050
- More details required on the methodology to be used for the assessment of the progress of each Member State:
    - e.g., only the emission sources and absorption sinkholes?

Article 8: Public participation and Article 10 (par.5): Multilateral climate and energy dialogue

- Integration of Article No.8 and par. 5 of Article No.10
- A clear reference to the Commission's initiative to create a European Climate Pact is suggested
- Include provision for the cooperation of the EU and third countries at the level of climate (cross-border) consultations are the "minimum standards" based on which the process of public participation is carried out by the European Commission is sufficient to conduct climate consultation

Even though the EU has been the first to implement a comprehensive Green Deal and commit to be carbon-neutral by 2050, it is not the only one. Within 2020, many countries have committed to carbon neutrality and many more are expected to do so in the coming months. For example, South Korea announced a Green New Deal on 14 July 2020 committing approximately $132.6 billion into New Deal projects in just five years. Canada has also proposed the Pact for a Green New Deal in May 2019 with over 150 partner organisations to build a vision for a Green New Deal in Canada, calling for a rapid, inclusive, and far-reaching "just transition." Also, President Xi Jinping announced on 22 September a plan to make China a carbon-neutral state by 2060 and to reach an emissions peak by 2030, and the Israeli Government presented in June 2020 a Green Recovery Plan, which aims to exit the COVID-19 crisis by improving the country's environmental and economic resilience. The incoming US administration declared already in December 2020 its intention to re-join the Paris agreement immediately and to organise a climate summit of the world's major economies early in 2021. By the end of 2020, it was estimated that countries and regions corresponding to between two-thirds and four-fifths of global GDP had committed to 'net zero carbon emissions pledges[21].

1.3. The European Semester

The European Semester was introduced in 2010 to help Member States coordinate their economic and social policies throughout the year and deal with possible challenges that the EU may face. Under the framework of the European Semester, the Commission prepares every year a detailed analysis of each Member States' budgetary plan, its macroeconomic challenges, as well as needs for structural reforms. Accordingly, the Commission provides Member States with country-specific recommendations for the next 12-18 months.

Over the past decade, the European Semester has established itself as the key tool for the coordination of national economic and employment policies. Integrating the objectives of the UN Sustainable Development Goals (SDGs) in the European Semester will put people and the planet at the centre of EU economic policy. As such, it can help drive these policies towards the achievement of the SDGs by monitoring progress and ensuring closer coordination of national efforts in economic and employment policies.

In this context, the 2020 Semester cycle started with the adoption by the Commission Von der Leyen of the Autumn Package under the title "Creating an economy that works for people and the planet." Instead of an Annual Growth Strategy, the Annual Sustainable Growth Strategy (ASGS) 2020 was published, that sets out the economic and employment policy strategy for the EU, placing sustainability and social inclusion at the heart of the EU's economic policymaking in line with the priorities enshrined in the European Green Deal, the Commission's new growth strategy.

The publication of the ASGS 2021 launches 2021's European Semester cycle, in full continuity with 2020. In its 2021 ASGS, the Commission has set out strategic guidance for the implementation of the Recovery and Resilience Facility that will provide €672.5 billion of loans and grants in front-loaded financial support for the crucial first years of the recovery. The four dimensions of environmental sustainability, productivity, fairness and macroeconomic stability identified in ASGS 2020 remain the guiding principles underpinning Member States' recovery and resilience plans, and their national reforms and investments.

In order to benefit from the Recovery and Resilience Facility, Member States should submit their draft recovery and resilience plans outlining national investment and reform agendas in line with the aforementioned EU policy criteria. Member States' recovery and resilience plans should address the economic policy challenges set out in the country-specific recommendations of recent years and in particular in the 2019 and 2020 cycles. The plans should also enable Member States to enhance their economic growth potential, job creation and economic and social resilience, and to meet the green and digital transitions.

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[21] Net zero: from 'tell us' to 'show us', 15 December 2020.

Based on their relevance across Member States, the very large investments required, and their potential to create jobs and growth and reap the benefits from the green and digital transitions, the Commission strongly encouraged Member States to include investments and reforms in their plans in the following flagship areas:

- **Power Up:** The frontloading of future-proof clean technologies and acceleration of the development and use of renewables. ASGS 2021 launches 40% of Renewable Power to be generated by 2030 (for building and industrial integration) should be supported by green hydrogen entrance. For this reason, a total capacity of 6 GW of Electrolysers should transform renewable power to Green Hydrogen production by 2025.
- **Renovate:** The improvement of energy efficiency of public and private buildings. Energy efficiency and raw material efficiency and recirculation has to be doubled in terms of utilisations for private (residential) and public (administration) building by 2025 in Europe.
- **Recharge and Refuel:** The promotion of future-proof clean technologies to accelerate the use of sustainable, accessible and smart transport, charging and refuelling stations, and the extension of public transport. 3 million EV charging points have to be developed by 20302. By 2025 this number has to be raised to 1 million points, and 1 million tonnes of renewable hydrogen has to be facilitated across Europe by 2025. By the same time, 500 hydrogen fuelled stations must be constructed.
- **Connect:** The fast rollout of rapid broadband services to all regions and households, including fibre and 5G networks. Since the current residential connectivity in the EU is about 2/5 of households, EU countries have to develop the network of 5G, fibre optic, and quantum encryption (VPN capability and peer to per transaction), covering all areas not sufficiently served by the current market.
- **Modernise:** The digitalisation of public administration and services, including judicial and healthcare systems. European Digital Identity, digital signs and other encrypted user – friendly services should be provided by 2025.
- **Scale-up:** The increase in European industrial data cloud capacities and the development of the most powerful, cutting edge, and sustainable processors. Semi-conductors should be doubled by 2025 and micro-processors should be multiplied by ten times by the same time. This is necessary for the rapid promotion and development of digital connections between cars and installation (promotional for demand response services in EV charging, for instance) and to double the connection of enterprises to cloud services and big data from 1/6 up-scaled to 1/3 of the European companies.
- **Reskill and Upskill:** The adaptation of education systems to support digital skills and educational and vocational training for all ages. Three main targets are in the front line of the EU, to be reached by 2025. First, digital skills to reach 70% of the EU citizens aged from 16 to 74 years old. Second, the percentage of 14-year-old students that are underperforming in computer and IT skills should be reduced under 15%. Third, regarding professional training and advanced skills, 80% of labour potential educated in VET (Vocational Education & Training) support should be employed and 60% of the workers should benefit from on- job training.

Section 2. Methodology for Country-Specific 3D Mapping of SDGs, EGD Policies and the European Semester Process Recommendations (CSR's)

This section outlines the methodological approach for integrating the SDG framework both in the European Semester's Country-Specific Recommendations (CSRs), as foreseen in the EU's Annual Sustainable Growth Strategy (ASGS), and in the policies envisaged by the European Green Deal (EGD). This 3D mapping approach aims at assisting EU and national policymakers to identify actionable policies that are aligned with all three overarching frameworks while avoiding trade-offs between specific policies and measures that will compromise the pursuit of some goals. A similar approach has been applied by the European Commission's Joint Research Centre, exploring the connections between EU policy documents on economic recovery and the SDGs[22]. The approach described in this report is partly different as it focuses on linking the overarching EU-wide strategy document (the European Green Deal) with country-specific assessments - the country scores on SDG progress and the country recommendations of the European Semester process. In this way:

- EU policymakers may identify areas in which the current European growth strategy and economic policy coordination effort is consistent with the SDG framework, both EU-wide and on a country-by-country basis.
- National policymakers may obtain insights on the extent to which major sustainability challenges of their country are linked with national priorities promoted by the EU sustainable growth strategy, in order to improve the alignment of sustainability objectives with national policies and measures that are consistent with the broader EU policy framework.

Figure 3 provides an overview of the methodology. Steps 1-7 involve the 3D mapping, which identifies horizontal priorities across the entire economy. Step 8 onwards, focuses on sectoral domains to identify investment gaps and needed reforms, to be assessed and ranked by all relevant stakeholders. The engagement of all stakeholders, (politicians, policy makers, businesses, the civil society, the NGOs, technology developers, research and innovation) is crucial for an inclusive, fair and effective co-design of the transition to sustainability, that will enable the timely joint achievement of EGD and the SDGs and provide a least-cost pathway to a sustainable EU.

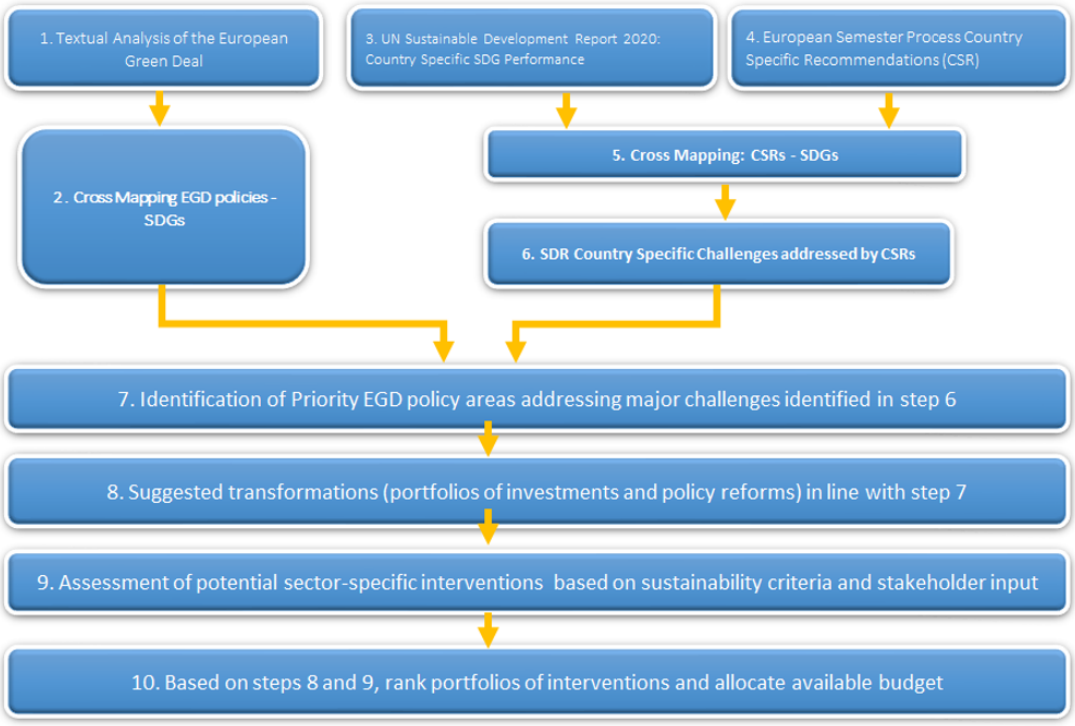

Figure 3. Flowchart of the 3-D Mapping methodology

[22] A sustainable recovery for the EU - A text mining approach to map the EU Recovery Plan to the Sustainable Development Goals. European Commission, Joint Research Centre, Report EUR 30452 EN, 2020. doi:10.2760/030575

2.1. Methodological steps for 3-D Mapping

Step 1. Textual Analysis of the European Green Deal Policies
As already mentioned, the European Green Deal is a policy document that delivers the vision for a sustainable, just, inclusive, and environmentally neutral European continent, based on 9 main axes: Biodiversity Protection, "From Farm to Fork" Production, Sustainable Agriculture, Clean Energy, Sustainable Industry, Building and Renovation, Sustainable Mobility, and Elimination of Pollution. As shown in Figure 4, a scrutiny of the EGD text has identified concepts such as "Climate,, "Energy," "Green,, "Sustainable,, and "Environmental" as dominant among the most frequently used words in the document. This analysis helped move to the linkage of EGD priorities with the SDGs as explained in Step 2.

Figure 4. Word cloud of the European Green Deal

Step 2. Linkage of EGD policy areas to SDGs
The ambition of each one of the 17 SDGs as set by the UN 2030 Agenda, can be found in Table 1 of the previous section.

Evidently, both the EGD and the 17-SDG framework have common objectives, so that the implementation of EGD policies will support actions that will contribute to achieving many of the SDGs. To make this linkage, we performed a mining exercise over the text of the EGD and we matched specific parts of the EGD document to certain SDGs that are explicitly relevant (Table 2). Some extracts may appear more than one time as they can be associated to more than one SDGs.

SDG	Excerpts from the European Green Deal document
Goal 1	• Fairness and Justice are pervasive in the EU Green Deal as a whole and a Just Transition Mechanism for most vulnerable regions is proposed. Moreover, EGD explicitly calls: "The risk of energy poverty must be addressed for households that cannot afford key energy services to ensure a basic standard of living"
Goal 2	• The Farm to Fork Strategy will strive to stimulate sustainable food consumption and promote affordable healthy food for all
Goal 3	• Protect the health and well-being of citizens from environment-related risks and impacts • The focus should also be put on renovating schools and hospitals, as the money saved through building efficiency will be money available to support education and public health • Plans should lead to the use of sustainable practices, such as precision agriculture, organic farming, agroecology, agroforestry, and stricter animal welfare standards • The price of transport must reflect the impact it has on the environment and health • Achieving sustainable transport means putting users first and providing them with more affordable, accessible, healthier, and cleaner alternatives to their current mobility habits
Goal 4	• Particular attention will be paid to the renovation of social housing, to help households who struggle to pay their energy bills. The focus should also be put on renovating schools and hospitals, as the money saved through building efficiency will be money available to support education and public health
Goal 5	• No EU Green Deal Policy explicitly deals with Gender Equality Affairs
Goal 6	• About half of total greenhouse gas emissions and more than 90% of biodiversity loss and water stress come from resource extraction and processing of materials, fuels, and food • Digitalization also presents new opportunities for distance monitoring of air and water pollution • By shifting the focus from compliance to performance, measures such as eco-schemes should reward farmers for improved environmental and climate performance, including managing and storing carbon in the soil, and improved nutrient management to improve water quality and reduce emissions • To protect Europe's citizens and ecosystems, the EU needs to better monitor, report, prevent and remedy pollution from the air, water, soil, and consumer products
Goal 7	• About half of total greenhouse gas emissions and more than 90% of biodiversity loss and water stress come from resource extraction and processing of materials, fuels, and food • Digitalization also presents new opportunities for distance monitoring of air and water pollution • By shifting the focus from compliance to performance, measures such as eco-schemes should reward farmers for improved environmental and climate performance, including managing and storing carbon in the soil, and improved nutrient management to improve water quality and reduce emissions • To protect Europe's citizens and ecosystems, the EU needs to better monitor, report, prevent and remedy pollution from the air, water, soil, and consumer products
Goal 8	• EGD is a growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy • The transition is an opportunity to expand sustainable and job-intensive economic activity • The European Green Deal will support and accelerate the EU's industry transition to a sustainable model of inclusive growth

Goal 9	• EU industrial strategy to address the twin challenges of the green and the digital transformation • Rethink policies for clean energy supply across the economy, industry, production, and consumption, large-scale infrastructure, transport, food and agriculture, construction, taxation, and social benefits • The transition to climate neutrality also requires smart infrastructure • Achieving a climate-neutral and circular economy requires the full mobilization of industry • Energy-intensive industries, such as steel, chemicals, and cement, are indispensable to Europe's economy, as they supply several key value chains • EU industry needs 'climate and resource frontrunners' to develop the first commercial applications of breakthrough technologies in key industrial sectors by 2030. Priority areas include clean hydrogen, fuel cells, and other alternative fuels, energy storage, and carbon capture, storage, and utilization • Digital technologies are a critical enabler for attaining the sustainability goals of the Green deal in many different sectors. The Commission will explore measures to ensure that digital technologies such as artificial intelligence, 5G, cloud and edge computing, and the internet of things can accelerate and maximise the impact of policies to deal with climate change and protect the environment
Goal 10	• The growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy • The common agricultural and common fisheries policies will remain key tools to support these efforts while ensuring a decent living for farmers, fishermen, and their families • Particular attention will be paid to the renovation of social housing, to help households who struggle to pay their energy bills
Goal 11	• The EU has the collective ability to transform its economy and society to put it on a more sustainable path • The construction, use, and renovation of buildings require significant amounts of energy and mineral resources • The Commission will rigorously enforce the legislation related to the energy performance of buildings • To achieve climate neutrality, a 90% reduction in transport emissions is needed by 2050. Road, rail, aviation, and waterborne transport will all have to contribute to the reduction. Achieving sustainable transport means putting users first and providing them with more affordable, accessible, healthier, and cleaner alternatives to their current mobility habits • The price of transport must reflect the impact it has on the environment and health • The EU should in parallel ramp-up the production and deployment of sustainable alternative transport fuels. By 2025, about 1 million public recharging and refuelling stations will be needed for the 13 million zero- and low-emission vehicles expected on European roads • Transport should become drastically less polluting, especially in cities. A combination of measures should address emissions, urban congestion, and improved public transport

Goal 12	• the growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient, and competitive economy • Encourage changes in consumer and business behaviour, and facilitate an increase in sustainable public and private investment • The circular economy action plan will include a 'sustainable products' policy to support the circular design of all products based on a common methodology and principles • Action will focus in particular on resource-intensive sectors such as textiles, construction, electronics, and plastics • The circular economy action plan will also include measures to encourage businesses to offer, and to allow consumers to choose, reusable, durable, and repairable products • Reliable, comparable, and verifiable information also plays an important part in enabling buyers to make more sustainable decisions and reduces the risk of 'greenwashing • A sustainable product policy also has the potential to reduce waste significantly • Access to resources is also a strategic security question for Europe's ambition to deliver the Green Deal
Goal 13	• the Commission will propose a carbon border adjustment mechanism, for selected sectors, to reduce the risk of carbon leakage • European 'Climate Law' for Climate Neutrality by 2050 • The Commission will adopt a new, more ambitious EU strategy on adaptation to climate change • the Commission will propose a carbon border adjustment mechanism, for selected sectors, to reduce the risk of carbon leakage • To ensure a toxic-free environment, the Commission will present a chemicals strategy for sustainability
Goal 14	• Protect, conserve and enhance the EU's natural capital • Increase the value given to protecting and restoring natural ecosystems • European farmers and fishermen are key to managing the transition. The Farm to Fork Strategy will strengthen their efforts to tackle climate change, protect the environment, and preserve biodiversity • European food is famous for being safe, nutritious, and of high quality. It should now also become the global standard for sustainability • The Commission will work with the Member States to develop the potential of sustainable seafood as a source of low-carbon food • The strategic plans will need to reflect an increased level of ambition to significantly reduce the use and risk of chemical pesticides, as well as the use of fertilisers and antibiotics • The Commission will present a Biodiversity Strategy by March 2020, to be followed up by specific action in 2021 • Work will continue under the common fisheries policy to reduce the adverse impacts that fishing can have on ecosystems, especially in sensitive areas • The role of oceans in mitigating and adapting to climate change is increasingly recognised • The Commission will also take a zero-tolerance approach to illegal, unreported, and unregulated fishing • The natural functions of ground and surface water must be restored. This is essential to preserve and restore biodiversity in lakes, rivers, wetlands, and estuaries, and to prevent and limit damage from floods

Goal 15	• EU Biodiversity Strategy 2030 • The strategic plans will need to reflect an increased level of ambition to significantly reduce the use and risk of chemical pesticides, as well as the use of fertilisers and antibiotics
Goal 16	• The Commission will consider revising the Aarhus Regulation to improve access to administrative and judicial review at the EU level for citizens and NGOs who have concerns about the legality of decisions with effects on the environment. The Commission will also take action to improve their access to justice before national courts in all Member States. The Commission will also promote action by the EU, its Member States and the international community to step up efforts against environmental crime
Goal 17	• Increased cross-border and regional cooperation will help achieve the benefits of the clean energy transition at affordable prices • Promoting new forms of collaboration with industry and investments in strategic value chains is essential • The Commission proposes to work with stakeholders on a new initiative on renovation in 2020. This will include an open platform bringing together the buildings and construction sector, architects and engineers, and local authorities to address the barriers to renovation

Table 2. Matching of the European Green Deal to the 17 SDGs

Table 3 presents the linkage between each SDG to specific EGD policies. Cells coloured dark green denote a direct linkage between EGD Policies and SDGs, based strictly on the extracts of the EGD document that are explicitly similar to the ambition of each SDG from a conceptual point of view. Light green coloured cells depict the implicitly derived association between EGD Policies and the SDGs, whereas white coloured cells indicate a weak or no apparent connection.

Goal	P1	P2	P3	P4	P5	P6	P7	P8	P9
	Biodiversity	From Farm to Fork	Sustainable agriculture	Clean energy	Sustainable industry	Building and renovating	Sustainable mobility	Eliminating pollution	Climate action
Goal 1 - No Poverty									
Goal 2 - Zero Hunger									
Goal 3 - Good Health & Well Being									
Goal 4 - Quality Education									
Goal 5 - Gender Equality									
Goal 6 - Clean Water & Sanitation									
Goal 7 - Affordable & Clean Energy									
Goal 8 - Decent Work & Economic Growth									
Goal 9 - Industry, Innovation & Infrastructure									
Goal 10 - Reduced Inequalities									
Goal 11 - Sustainable Cities & Communities									
Goal 12 - Responsible Consumption & Production									
Goal 13 - Climate Action									
Goal 14 - Life Below Water									
Goal 15 - Life On Land									
Goal 16 - Peace Justice & Strong Institutions									
Goal 17 - Partnerships for the Goals									

Table 3. Mapping of the European Green Deal Policies to the 17 SDGs

Step 3. Collection of country-specific assessments of SDSN's Sustainable Development Report
The assessment of how well a country performs towards the achievement of a specific SDG is conducted by the UN through a set of performance indicators that are provided for each country annually. According to the "Global indicator framework for the Sustainable Development Goals and targets of the 2030 Agenda for Sustainable Development"[23], 231 unique performance indicators have been established in total, but a subset of 115 out of them is used for the relevant assessment of European countries.

We obtained the following information from the Sustainable Development Report (SDR) of year 2020[24] and for each one of the EU-27 countries:

- The country's SDG Index, which tracks each country's performance on the SDGs with equal weight to all 17 goals
- The score of the region on each SDG, for comparability reasons
- An assessment on SDG achievement or the level of remaining challenges
- The individual scores for each indicator under SDG's with Major Challenges to determine the root causes of underperformance

Step 4. Collection of European Commission's Country-Specific Recommendations
As part of the Semester Process, the integrated framework for coordinating economic policies across the EU, the European Commission annually assesses the performance of every Member State against specific targets and publishes a report with its findings along with specific recommendations for improvement, the so-called Country Specific Recommendations (CSRs)[25]. For 2020, the short-term suggestions fall under four main categories:

- Pandemic Recovery / Healthcare System effectiveness
- Employment and Address the Social Impact of the Crisis
- Energy/ Environment/ Digital Transition
- Further Improvement of Structural Characteristics

[23] https://unstats.un.org/sdgs/indicators/indicators-list/

[24] https://s3.amazonaws.com/sustainabledevelopment.report/2020/2020_sustainable_development_report.pdf

[25] https://ec.europa.eu/info/publications/2020-european-semester-country-specific-recommendations-commission-recommendations_en

Thus, for each of the 27 EU Member States, we collected the Commission's CSRs concerning each of these four categories and prepared a summary like the one shown in Table 4, found in Annex I.

CSR Category 1	CSR Category 2	CSR Category 3	CSR Category 4
Address Pandemic / Health System	Employment / Decent Work / Reskill	Energy / Environment / Digital Transition	Further Improvement of Structural Characteristics
Effectively address the COVID-19 pandemic, sustain the economy. Strengthen the resilience of the health system and ensure adequate and equal access to healthcare.	1) Mitigate the employment and social impacts of the COVID-19 crisis, including by implementing measures such as short-time work schemes and ensuring effective activation support. 2) Swiftly deploy measures to provide liquidity and the continued flow of credit and another financing to the economy, focusing in particular on SMEs most affected by the crisis. 3) Front-load mature public investment projects and promote private investment to foster the economic recovery.	Focus investment on the green and digital transition, in particular on safe and sustainable transport and logistics, clean and efficient production and use of energy, environmental infrastructure, and very-high-capacity digital infrastructure and skills. Improve the effectiveness and digitalization of the public administration and promote the digital transformation of businesses.	Completing reforms in line with the post-program commitments.

Table 4. An example of a Country-Specific Recommendations summary for Greece

Step 5. Linkage of CSRs with SDGs
Each CSR can be directly or indirectly associated with some of the SDG indicators used in the UN Sustainable Development Report (SDR). Therefore, we identified the relevance of each one of the 115 SDR performance indicators mentioned in step 3 with the CSRs that were grouped in categories in Step 4. An example is shown in Table 5.

Goal	CSR_1 Address Pandemic - Health System	CSR_2 Employment-Decent Work-Reskill	CSR_3 Energy-Environment-Digital Transition	CSR_4 Improvement Structural Characteristics	Total
Goal 1-No Poverty					0
Goal 2-Zero Hunger					0
Goal 3-Good Health & Well Being	2	2			4
Goal 4-Quality Education			5		5
Goal 5-Gender Equality					0
Goal 6-Clean Water & Sanitation					0
Goal 7-Affordable & Clean Energy	3				3
Goal 8-Decent Work & Economic Growth			1		1
Goal 9-Industry, Innovation & Infrastructure			1		1
Goal 10-Reduced Inequalities					0
Goal 11-Sustainable Cities & Communities	2				2
Goal 12-Responsible Consumption & Production	2				2
Goal 13-Climate Action	2				2
Goal 14-Life Below Water					0
Goal 15-Life On Land					0
Goal 16-Peace Justice & Strong Institutions					0
Goal 17-Partnerships for the Goals	1	1		3	5
Total Number of relevant SDG indicators	**12**	**3**	**7**	**3**	**25**

Table 5. An example of the association of CSRs with some of the SDG Indicators for Austria

Step 6. Identification of national 'major challenges' in SDR that are addressed by CSRs
After completing the linkage of Step 5, we focused on those policy domains, which the SDR has identified as presenting 'Major' or 'Significant' remaining challenges by country and examined whether these are addressed by the European Commission's CSRs - see Table 6. If there is at least one performance indicator of the SDR that is associated with a specific CSR, we consider that CSRs urge for a country's attention to this issue. Our results indicated that several of the 115 SDR performance indicators cannot be found in any CSR. This is a notable result as one would expect that many of the SDGs with Major or Significant challenges have been identified and are addressed by CSRs, however this is not the case. This suggests that the CSR process is not efficiently capturing all sustainability challenges within EU countries.

Goal	CSR_1 Address Pandemic/ Health System	CSR_2 Employment / Decent Work / Reskill	CSR_3 Energy - Environment / Digital Transition	CSR_4 Improvement to Structural Characteristics	Total	SDSN Dashboard Assessment	Addressed By CSRs
Goal 1 - No Poverty					0	Achieved	NO
Goal 2 - Zero Hunger					0	Significant Challenges	NO
Goal 3 - Good Health & Well Being	2	2			4	Challenges Remain	YES
Goal 4 - Quality Education			5		5	Challenges Remain	YES
Goal 5 - Gender Equality					0	Significant Challenges	NO
Goal 6 - Clean Water & Sanitation					0	Challenges Remain	NO
Goal 7 - Affordable & Clean Energy	3				3	Challenges Remain	YES
Goal 8 - Decent Work & Economic Growth			1		1	Challenges Remain	YES
Goal 9 - Industry, Innovation & Infrastructure			1		1	Significant Challenges	YES
Goal 10 - Reduced Inequalities					0	Challenges Remain	NO
Goal 11 - Sustainable Cities & Communities	2				2	Challenges Remain	YES
Goal 12 - Responsible Consumption & Production	2				2	Major Challenges	YES
Goal 13 - Climate Action	2				2	Major Challenges	YES
Goal 14 - Life Below Water					0		NO
Goal 15 - Life On Land					0	Significant Challenges	NO
Goal 16 - Peace Justice & Strong Institutions					0	Achieved	NO
Goal 17 - Partnerships for the Goals	1	1		3	5	Major Challenges	YES
Total Number of relevant SDG indicators	**12**	**3**	**7**	**3**	**25**		

Table 6. An example of examination whether Major and Significant Challenges are addressed by the European Commission's CSRs

Step 7. Identification of priorities by country, related to EGD policy areas and addressing major challenges identified by SDGs & CSRs
This step combines the mapping of SDGs to EGD Policies described in Step 2 with the mapping between CSRs and Major/Significant Challenges for each country that was performed in Step 6. In this way we propose a country-specific prioritization for the implementation of the EGD policies. As a rule, policies associated with Major-Challenge-SDGs are prioritised first and followed by policies in domains associated with SDGs under the label of 'Significant Challenges'.

Step 8. Identification of country-specific interventions
Having identified the main national priorities through this horizontal 3D mapping of Steps 1-7, the next stage for policymakers is to design a package of interventions by sector for the country. Sectoral granularity may be left to each country's policymakers, e.g., the sectoral breakdown could be conventional as organised in official statistics (e.g., power generation, industry, transport, tertiary sector, agriculture) or span across broader production and consumption systems (e.g., energy, mobility, urban development, food).

It is important to identify synergies and trade-offs between sectors, so that a high-priority action in one domain does not jeopardise sustainability in another one. Table 7, compiled by the European Environment Agency (EEA), maps such relationships between different SDGs which have to be seriously considered by decision makers. For example, increased income (SDG 1), better access to energy (SDG 7), more economic growth (SDG 8), and industrial and infrastructure investments (SDG 9) tend to increase overall consumption and natural resource extraction and may run against SDGs 12-15, which are crucial for environmental protection and climate action. Acknowledging these tensions more explicitly reinforces the call for alternative sustainability pathways.

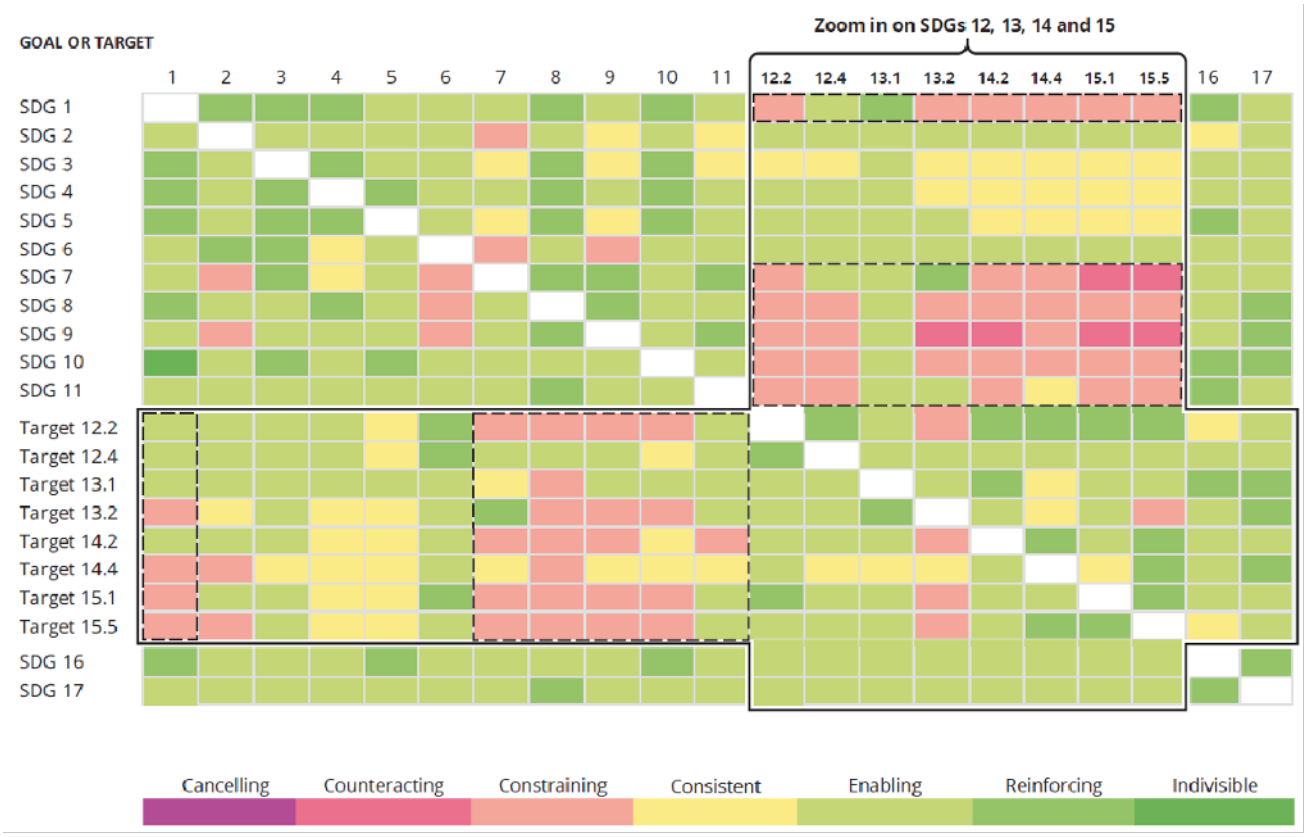

Table 7. Interactions between SDGs. Source: European Environment Agency[26]

[26] EEA (European Environment Agency), 2020. The European Environment – State and outlook 2020, Copenhagen. doi: 10.2800/96749

Step 9. Assessment of potential national interventions by sector based on sustainability criteria and stakeholder input
After narrowing down the horizontal approach of Steps 1-7 to sectoral policy interventions identified in Step 8, policymakers can assess these alternative sectoral options in order to arrive at those which are the most promising for enhancing the country's sustainable development prospects. This can be implemented through the evaluation of alternative measures with a wide range of sustainability indicators, encompassing both short- and long-term impacts on economy, jobs, the environment, climate change adaptation, social equity, infrastructure enhancement, energy security, political acceptance, and others. Section 7 provides a non-exhaustive list of such indicators that can be adapted to the needs of each European country.

Assessment of these indicators has to proceed with the widest possible participation from societal stakeholders. Decision makers from national and local governments, representatives of business associations, small and medium sized enterprises and trade unions, scientific experts, and diverse civil society organisations need to provide input in this process as outlined in Section 7.

Step 10. Ranking of interventions based on the assessment of step 9 and allocation of budget
Following the evaluation of possible sectoral measures based on the judgement of experts and societal stakeholders described above, it is possible to rank interventions through a composite score that weighs the views of stakeholders and the relative importance of each criterion. Policymakers can use this ranking to proceed with a list of priorities for policies, investments and reforms in each economic sector and – to the extent that they involve public funding – allocate the available public budget to individual interventions.

2.2. Results

The first stage of the 3D mapping methodology outlined in Section 2.1, i.e., Steps 1-7, has been applied to each EU Member state (Annex I).[27] This section offers some aggregate EU-wide results from this analysis.

Table 8 below shows that, according to the UN Sustainable Development Report, Major Challenges for most of the EU-27 Countries can be found in the policy domains of SDGs 12, 13, and 14, whereas most of the Significant Challenges (i.e., challenges of slightly lower priority) are addressed by SDGs 2, 5, and 9. It is also worth noting that 16 out of the 27 EU countries have achieved SDG 1 of No Poverty.

Goal	Major Challenges	Significant Challenges	Challenges Remain	Achieved	Unavailable Info	Total
Goal 1-No Poverty	0	2	9	16		27
Goal 2-Zero Hunger	10	17	0	0		27
Goal 3-Good Health & Well Being	0	8	17	2		27
Goal 4-Quality Education	1	10	12	4		27
Goal 5-Gender Equality	0	16	10	1		27
Goal 6-Clean Water & Sanitation	0	6	18	3		27
Goal 7-Affordable & Clean Energy	2	8	12	5		27
Goal 8-Decent Work & Economic Growth	0	7	19	1		27
Goal 9-Industry, Innovation & Infrastructure	6	17	4	0		27
Goal 10-Reduced Inequalities	4	8	13	2		27
Goal 11-Sustainable Cities & Communities	0	9	18	0		27
Goal 12-Responsible Consumption & Production	17	10	0	0		27
Goal 13-Climate Action	24	2	1	0		27
Goal 14-Life Below Water	11	9	2	0	5	27
Goal 15-Life On Land	0	8	13	6		27
Goal 16-Peace Justice & Strong Institutions	0	10	13	4		27
Goal 17-Partnerships for the Goals	9	12	5	1		27
Total	**84**	**159**	**166**	**45**	**5**	**459**

Table 8. SDG assessment categories for the EU-27 Countries

[27] Please refer Annex I for more details on the implementation of the Methodology to each of the 27 Member States and the respective results.

The main conclusion from Step 6 of the analysis, which links SDGs with CSRs, is that CSRs as part of the European Semester Process are quite efficient in addressing the challenges identified in the UN Sustainable Development Report – but there is room for further improvement so that the European Semester can lead to CSRs that are better aligned with Sustainable Development Goals. As shown in Table 9, 321 out of 459 (17 SDGs x 27 countries) assessments regarding the level of achievement of the 17 SDGs, have been addressed by CSR as well. This leads to an efficiency ratio estimate of 70%, meaning that currently the European Semester Process can capture approximately 7 out of 10 weaknesses identified by the Sustainable Development Report.

SDG's Assessment Category	Addressed by CSR	NOT addressed by CSR	Total
Achieved	21	24	45
Challenges Remain	120	46	166
Significant Challenges	115	44	159
Major Challenges	64	20	84
Grey (not available info)	1	4	5
Grand Total	**321**	**138**	**459**
Ratio	**70%**	**30%**	

Table 9. Overall CSR efficiency ratio

Table 10 summarises the CSR-SDG Correspondence Index, for each of the EU-27 countries, focusing only on SDGs for which the SDR identifies either Major or Significant Challenges.

Country	Total Significant and Major Challenges	Not addressed by CSR	Addressed by CSR	Overall Efficiency ratio
Austria	7	3	4	57%
Belgium	10	4	6	60%
Bulgaria	12	2	10	83%
Croatia	8	2	6	75%
Cyprus	7	1	6	86%
Czech Republic	9	2	7	78%
Denmark	5	3	2	40%
Estonia	8	2	6	75%
Finland	6	2	4	67%
France	9	1	8	89%
Germany	8	3	5	63%
Greece	15	3	12	80%
Hungary	10		10	100%
Ireland	8	2	6	75%
Italy	12	2	10	83%
Latvia	11	4	7	64%
Lithuania	14	3	11	79%
Luxembourg	12	5	7	58%
Malta	8	2	6	75%
Netherlands	8	3	5	63%
Poland	10	2	8	80%
Portugal	8	4	4	50%
Romania	9	3	6	67%
Slovak Republic	10	1	9	90%
Slovenia	6		6	100%
Spain	9	3	6	67%
Sweden	4	2	2	50%
Grand Total	**243**	**64**	**179**	**74%**

Table 10. CSR efficiency ratio in Major-Significant Challenges for EU-27 Countries

The prioritization for implementation of each of the European Green Deal policy areas, as derived from our country-specific analysis and explained in Step 6 in section 2.1, is shown in Table 11. The key message is that policies expected to demonstrate the highest impact on most countries – and will therefore have to be given a higher priority – are Policies P2, P5, P8, and P9 of the European Green Deal, i.e., those associated with an environmentally-friendly food system ("From farm to fork"), sustainable industry, the elimination of pollution, and climate action, respectively.

Prioritization of EGD Policies for each Country. A - High Priority B - Next Priority Blank - Not relevant	P1 Biodiversity	P2 From Farm to Fork	P3 Sustainable agriculture	P4 Clean energy	P5 Sustainable industry	P6 Building and renovating	P7 Sustainable mobility	P8 Eliminating pollution	P9 Climate action
Austria	B	B	B	A	A	A		A	A
Belgium	A	A	B	B	A	B		A	A
Bulgaria	B	A	B	B	B	A	B		B
Croatia		A		B	B	A	B	B	B
Cyprus	B	B		A	A	A	B	A	A
Czech Republic	B	B	B	A	A	A		A	A
Denmark	A	A			A	B	B	A	A
Estonia		A	B	B	A	B		A	A
Finland	B	B		B	A	B		A	A
France	B	B		B	A	B		A	A
Germany		B			A			A	A
Greece	B	B	B	B	B	B	B	A	A
Hungary		A	B	A	A	B		A	A
Ireland	B	B		A	A	A		A	A
Italy	A	A	B	A	A	B	B	A	A
Latvia	A	A	B	A	A	A	B	A	A
Lithuania	B	A	B	A	A	A	B	A	A
Luxembourg	B		B	A	A	A	B	A	A
Malta	A	A	B	A	A	A		A	A
Netherlands	A	A	B	A	A	A		A	A
Poland	A	A		A	A	A		A	A
Portugal	A	A		B	B	B		A	A
Romania	A	A	B	B	B	A	B	B	A
Slovak Republic		A		A	A	B		A	A
Slovenia	A	A		B	A	B		A	A
Spain		A						B	B
Sweden		B			A			A	A
High Priority for # of Countries:	10	17	0	13	21	13	0	23	24
Next Prority for # of Countries:	10	9	14	10	5	11	10	3	3

Table 11. Prioritization of EGD Policies for the EU-27 Countries (**A:** High Priority, **B:** Next Priority, **Blank:** Neutral)

Section 3. Technological and Investment Pathways

On the road to sustainable societies by the mid-21st century, governments need to make consistent decisions about investment flows and enable a green financial sector for investing in technologies that can help achieve the objectives of the European Green Deal. This section draws on the experience of leading research teams around Europe and outlines technological and investment pathways to attain climate-neutral and circular economies. We identify pillars towards EU climate neutrality, describe the necessary governance for preparing National Climate Neutrality Roadmaps to 2050, and provide elements for an enabling policy framework that can contribute to the decarbonisation goal. We also review the investment plans announced by the EU in support of both the European Green Deal and the post-pandemic economic recovery and outline sustainable finance initiatives. This section contains numerous examples of projects that enable the co-development of regional approaches and business solutions between multiple stakeholders and explore synergies among social actors to reinforce climate resilience, nature protection, land restoration, and pollution prevention. These examples highlight the necessity to adopt a systems approach to take advantage of complementarities between different aspects of the green transition and identify trade-offs between diverse sustainability objectives.

3.1 Technological pathways: Roadmap to 2050, A Manual for Nations to Decarbonise by 2050

As mentioned in the Introduction, the European Parliament voted in October 2020 in favour of an even more ambitious 60% reduction target by 2030, while the European Council finalised the process by sealing the 55% target in December 2020. From a climate action standpoint, all of this represents good news. The 55% target will send a clear signal to market players about the irreversibility of the EU's climate trajectory and is important for shaping expectations and influencing companies' and investors' decisions and consumers' choices. The 55% target will likely also have positive global implications, considering that in 2021, Paris Agreement signatories must present their updated nationally determined contributions (NDCs) for 2030 at the Glasgow climate conference (COP26).

To this end, in 2021, the EU is expected to unleash a torrent of new climate and energy legislation to align its tools with the new 55% target. The emissions trading system (ETS), the effort sharing regulation (ESR) for non-ETS emissions, and the energy taxation directive will have to be reformed. EU legislation on renewable energy and energy efficiency will also need a substantial upgrade. Other important areas of EU legislation, including transport and agriculture, will have to be upgraded to push the decarbonisation of these sectors. The EU must find ways for its countries to deliver on higher targets in the absence of nationally binding commitments, and for private investment to be unleashed.

In response to the above and the COVID-19 pandemic, the National Recovery and Resilience Plans are built around the 4 key principles to effectively address the policy challenges set out in the country-specific recommendations adopted by the Council: green transition, digital transition and productivity, fairness, and macroeconomic stability. At the same time, they present an opportunity to create European flagships with tangible benefits for the economy and citizens across the EU. These flagships, as presented in the Annual Sustainable Growth Strategy for 2021[28] (power up, renovate, recharge and refuel, connect, modernise, scale-up, reskill and upskill), should address issues that are common to all Member States. They will need significant investments, but they will create jobs and economic growth and are needed for a sustainable transition.

[28] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0575&from=en

While scaling-up legislation to meet its new 2030 climate target, the EU will also have to promote a deeper reflection on how to implement its climate neutrality trajectory not only up to 2030, but also between 2030 and 2050. Also in view of supporting this reflection, the Fondazione Eni Enrico Mattei (FEEM) and the UN Sustainable Development Solutions Network (SDSN) published the report "Roadmap to 2050: A Manual for Nations to Decarbonise by 2050".[29] Launched at the COP25 in Madrid in 2019, the report provides an overview of the latest decarbonisation technologies available for governments to populate their low emission development strategies. This chapter summarises the key findings of the report, in view of providing EU policy makers a set of technological and policy insights to consider while designing the EU's long-term strategy to climate neutrality by 2050.

3.1.1 Six pillars to get the EU on track to reach climate neutrality by 2050

The European Green Deal should be conceived on a systems approach, aspiring to simultaneously address multiple objectives and promote policy instruments and technological solutions that can be used across the various sectors of the economy. The multiple objectives span decarbonisation and environmental sustainability, economic prosperity (including poverty reduction), and social inclusion that leaves no one behind. Policy instruments include public investments, phase out subsidies to fossil fuels, market mechanisms, regulatory frameworks, and regulations on land use, while technological solutions address a wide range of current and emerging solutions, from smart power grids to synthetic fuels.

A systems perspective recognises the interconnectivity of actions towards any one or more of these objectives, using any one or more of the mentioned policy instruments or technological solutions. An action in one can be detrimental to another, while some combined efforts could amplify their cumulative effects and achieve multiple objectives. For example, the power grid itself represents a complex system that must continue to operate reliably and efficiently even as it undertakes the deepest transformation in its history. No single policy or technology can achieve decarbonisation by itself or be implemented without due consideration to its spillover effects or to the delicate state of the current, broader system. To use the proverbial expression, we must rebuild the airplane while it is in flight.

In taking a systems approach, many complementarities should be considered for managing the complexity of the energy system:

- **Complementarities of variable renewable energy (VRE) sources.** Wind, solar, and to some extent hydropower, vary by the minute, day, season, and year. This variability must be addressed in a systematic manner, through storage, backup reserves, interconnections across uncorrelated or anti-correlated primary energy sources, demand side management, etc. The usefulness of any potential source of VRE depends on the other VRE sources in the grid, and that in turn depends on the extent of the transmission and distribution systems, the nature of the electricity market, and other design features of the power grid. A big role can be played in this challenge by digitalisation systems with metering and remote control.
- **Complementarities of zero-carbon technologies.** As one obvious example, zero-emission vehicles depend on complementary infrastructure for fuel supply. Battery electric vehicles (BEVs) will require charging sites; hydrogen vehicles will depend on a network of refuelling stations and pipelines or trucks to transport the hydrogen. Based on **Flagship No 3 (Recharge & refuel)** of ASGS 2021, it is necessary to accelerate the development of retail infrastructure regarding stations for refuelling of (green fuelled) cars and recharging points of Electric Vehicles and Hybrid cars. Geological carbon capture and storage technologies will depend on a network of CO_2 pipelines and sequestration sites. A biorefinery that ferments sugars into ethanol provides one of the cheapest forms of CO_2 capture given the clean and concentrated stream of CO_2. That CO_2 can then be coupled with hydrogen produced with green electricity to produce power fuels. Nuclear plants hinge on the critical problem of

[29] https://www.feem.it/en/news/feem-and-sdsn-present-the-report-roadmap-to-2050-a-manual-for-nations-to-decarbonize-by-2050-at-the-cop25-in-madrid/

nuclear waste, proliferation, and safety concerns that influence public opinion and compromise long-term sustainability of this option in the future energy mix, although there are some 4th generation technologies working to address these concerns. All solutions therefore depend on patterns of land-use, transport, transmission networks, etc. that must be remade depending on the types of zero-carbon energy sources. Life cycle and supply chain perspectives are both useful and mandatory to design long-term effective solutions for decarbonisation with little or no drawbacks on other productive sectors of a national economy.

- **Complementarities of public and private investments.** In virtually every economy, parts of the energy system are in private, for-profit hands, and parts are publicly owned. In each case, significant efforts must be made to harmonise these public and private investments. **Flagship No 5 (Modernise)** of ASGS 2021 denotes digitalization in services and, as a result, a dramatic change throughout an integrated network of public administration, private services, the justice system, and healthcare systems, all properly digitised to promote on-line services and to elevate the level of transaction and exchanges between society and the main power institutions. European Digital Identity, digital signs and other encrypted user-friendly services should be provided by 2025. In addition, there are a few cases in which public sector (or a not-for-profit entity) owns most of the transmission grid, while private operators usually own the power generators. Rules of access to the transmission grid are needed to ensure the transmission and distribution of power. There are significant debates and unsolved problems on how to share the costs of an integrated public-private system. Who pays, for example, for energy storage, grid reliability services (e.g. frequency management), transmission lines, etc.? Moreover, special attention needs to be given to areas where private investments are not competitive but there is a strong need for transportation services for the mobility of goods and services to guarantee access and local development.[30]
- **Complementarities of natural and engineered systems.** The world must reduce net anthropogenic GHG emissions to zero by around 2050 and then reach net negative emissions in the second half of the century. One obvious path to net negative emissions is biological absorption of CO_2 in vegetation and soils via preservation of existing forests and/or restoration of degraded habitats.[31] As such, land-use and energy-system strategies must be intimately interconnected. Energy strategies that amplify land-use degradation (e.g., through the overuse of those biofuels that contribute to land clearing and deforestation) must be ruled out. Moreover, we must recognise that ecosystem functions will be degraded by human-induced climate change, thereby threatening positive feedback effects. Recent studies have found that global warming is likely to contribute to the natural release of methane from tropical wetlands and permafrost.[32] For that reason, emissions reductions from fossil fuels should be accelerated to avoid dangerous natural GHG feedback.
- **Complementarities of mitigation and adaptation.** Climate policies should combine mitigation and adaptation strategies for two reasons. Most obviously, even the most ambitious mitigation strategies will result in several decades of further warming and an intensification of the adverse impacts of anthropogenic climate change: heat waves, droughts, floods, extreme storms, rising sea levels, etc. Damages and risks will continue to rise, so investments in adaptation will be vital in many circumstances. The second reason for linking adaptation and mitigation is that adaptation measures can contribute to mitigation strategies. Forest

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[30] E3 in consultation with Southern California Edison and California PUC has been attempting to quantify a "VRE cost adder". Available at: California Public Utilities Commission. "Integration Cost Adder Status Report." *California Public Utilities Commission.* Accessed August 20, 2019. http://www.cpuc.ca.gov/WorkArea/DownloadAsset.aspx?id=10755 and Jaquelin, Cochran, Paul Denholm, Bethany Speer and Mackay Miller. "Grid Integration and the Carrying Capacity of the U.S. Grid to Incorporate Variable Renewable Energy." *U.S. Department of Energy Office of Scientific and Technical Information.* Accessed August 20, 2019. https://www.osti.gov/biblio/1215010-grid-integration-carrying-capacity-grid-incorporate-variable-renewable-energ

[31] European Academies Science Advisory Council. " Negative Emission Technologies: What role in meeting Paris Agreement targets?" *European Academies Science Advisory Council.* Published 2018. Accessed August 20, 2019. https://easac.eu/fileadmin/PDF_s/reports_statements/Negative_Carbon/EASAC_Report_on_Negative_Emission_Technologies.pdf

[32] Yale Environment 360. "Scientists Zero in on Trees as a Surprisingly Large Source of Methane." *Yale Environment 360.* Accessed June, 2019. https://e360.yale.edu/features/scientists-probe-the-surprising-role-of-trees-in-methane-emissions

restoration and protection of coastal wetlands, for example, can protect landscapes, prevent floods, storm surges and rising sea levels, and promote resilient food production in the face of global warming, while also securing larger biological stocks of carbon, thereby servicing both adaptation and mitigation. Because of these complementarities, an "all-of-government" approach to climate change is more than a slogan or symbol of commitment. It is a logical response to a set of interconnected challenges. The head of government should convene a cross-cabinet committee to oversee national planning and implementation, especially in the context of national commitments under the Paris Agreement, discussed in more detail below.

A recent study[33] has indicated that the economic benefits of adaptation programmes such as early warning systems, making infrastructure resilient, improving dryland agriculture, or managing water resources, exceed costs by five to ten times. The same study suggests that adaptation could generate a triple dividend that consists of avoided losses due to climate change, economic benefits from the investment programmes, and social and environmental benefits. As argued in Opinion NAT/778 of the European Economic and Social Committee on Financing the Transition to a Low-Carbon Economy and the Challenges in Financing Climate Change Adaptation,[34] Phoebe Koundouri provided an expert perspective arguing the urgent need for a new EU adaptation strategy in order to translate "equal emphasis" of financing mitigation and adaptation into optimal distribution of available and future funds between those two priorities. While mitigation targets are clear, adaptation targets are tricky to set. However, they are necessary in order to achieve an efficient adaptation process. For this purpose, it is important to establish vulnerability indexes (VIs) which will guide adaptation strategies and set adaptation targets. VIs should be developed in three dimensions: geographical or regional vulnerability, sectoral or economic vulnerability, and social vulnerability.

- **Complementarities of centralised and decentralised solutions.** Renewable energy resources are by nature different from one place to another. For cities and rural areas with a sufficient density of population, distributed generation systems are suitable to be installed and connected to local distribution networks. For areas with available space and high-quality renewable energy resources, renewable electricity could be generated locally and transmitted over a long-distance high voltage grid to where it is needed, which is more viable economically. With that being said, both a large and robust transmission grid that may extend beyond national boundaries, and a smart and flexible distribution grid that could facilitate the integration of distributed generators in a more efficient way are needed.
- **Complementarities of actions and strategies.** Climate policies should combine a different set of actions and mitigation and adaptation strategies for two reasons. The global challenge of decarbonisation can be split according to geographical criteria, taking into account economic and cultural differences that are mirrored, at large scale, by different geography. There are some common features that can pool together different geographical areas: a big city in North America may be very similar to a metropolitan area in Europe, but this similarity might not be true of a big city in North America and in sub-Saharan Africa. Urban areas are also different from rural areas, where efforts to bring access to energy and other services to all remain a challenge. One solution does not fit all, and trying to impose the same pathway to different contexts can lead to failure with the risk of returning to business-as-usual practises.
- **Complementarities of R&D activities promoted by research institutions and academia and funded by private or public sector.** R&D activities should aim at promoting breakthrough innovations to continuously feed the process of decarbonisation and keep under control any risk of lock-in to solutions that may fail to contribute to total decarbonisation in the long run. **Flagship No 6 (Scale Up)** of ASGS 2021 indicates development of materials and equipment (such as semiconductors and microprocessors), which can enhance the rapid connection of enterprises to cloud service and big data.

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[33] Global Commission on Adaptation, *ADAPT NOW: A Global Call for Leadership on Climate Resilience*, World Resources Institute, September 2019

[34] European Economic and Social Committee, NAT/778 Opinion on Financing the Transition to a Low-Carbon Economy and the Challenges in Financing Climate Change Adaptation, May 2020

Flagship 7 (Reskill and Upskill) of ASGS 2021 promotes policies suitable for facing the employment inequalities and potential for equal growth opportunities for different geographical regions across Europe. Digital skills and vocational training should be reinforced by focused investments and reforms connecting education with labour market.

In order to make sense of this very complex and integrated system of energy and power, **six pillars** can be applied as identified in the Roadmap to 2050 paper to get the EU on track for climate neutrality by 2050. Each pillar summarises the currently available decarbonisation technologies; however, each country and locality will decide their technology mix depending on their local context.

- **Zero-carbon electricity.** This is the most important single step toward decarbonisation, as "green" (zero-carbon) electricity can be used directly (e.g., battery electric vehicles) or indirectly to create zero-carbon fuels (e.g., hydrogen). The EU Commission suggests to Member States **Flagship Area No 1 (Power Up)**, as presented in page 12 of Section 1.3, to be included on the purpose of Zero-carbon Electricity Implementation. Zero-carbon electricity therefore involves a shift towards zero-carbon primary energy sources and a very significant overall expansion of electricity production for end uses. Zero-carbon electricity can engage multiple possible types of power generation. These include renewables, broadly defined to include wind, solar, hydropower, geothermal, ocean, and tidal; nuclear; bioenergy; and carbon-capture utilization or storage (CCUS) of fossil-fuel generated electricity. Recent studies have emphasised the special role of renewables in zero-carbon electricity.[35] This is because the costs of renewable energy have plummeted (especially solar photovoltaics), while energy alternatives – nuclear, biofuels, and CCUS – each pose major technical and social obstacles leading to significant public opposition. Zero-carbon electricity should also be complemented with the most advanced energy efficiency measures available.
- **Electrification of end uses.** There are many sectors currently using fossil-fuel energy that can be converted to direct use of (green) electricity, thanks to existing technologies. These include battery electric vehicles (BEVs), heat pumps for residential and commercial buildings, electric cooking (e.g., induction and microwave stoves), and direct reduction of ores in metallurgy. For example, major automakers are now making significant commitments to BEVs, with dates set for the phase out of conventional internal combustion engine (ICE) vehicles. A key aspect to this pillar will include the expansion and upgrade of an interconnected smart power grid to support the electrification of various sectors.
- **Green synthetic fuels.** These are applicable for harder to abate sectors that are not easily electrified. For example, in aviation, there is a continuing debate about the feasibility of electrification. Overall, there is a wide range of potential synthetic fuels, including hydrogen (for direct combustion, industry, or use in fuel cells), synthetic methane, synthetic methanol, and synthetic liquid hydrocarbons. **Flagship No 3 (Recharge and Refuel)** of ASGS 2021 encourages promotion of future clean technologies for refuelling stations. These synthetic fuels can be manufactured using green electricity and can facilitate the circular economy by processing materials from municipal and agricultural waste into energy. We should also note the synergies between biorefining and direct air capture technologies, which can provide the CO_2 for green synthetic fuel development. This third pillar relies on full accomplishment of the two previous pillars.
- **Smart power grids.** Built with contributions from big data, artificial intelligence, and the Internet of Things, smart grids are self-regulating systems that can shift among multiple sources of power generation and multiple uses to provide reliable and low-cost systems operations despite the variability of renewable energy (VRE). There are many aspects of a smart grid. On the supply side, a smart grid will integrate VRE from many sources in order to smooth the variability of power generation; various storage options, including batteries, pumped hydro, compressed air, and conversion of renewable energy into synthetic fuels, will help to stabilise supply. The demand side will also show flexibility by enabling smart meters to turn on and off the electricity consumption of users depending on temporal needs,

[35] Ram, Manish et al. "Global Energy System based on 100% Renewable Energy."

urgency, and shifts in market prices that reflect supply-demand conditions. **Flagship No 4 (Connect)** of ASGS 2021 promotes connectivity, networks, updates, and maturity for the integration of modern smart grids.

- **Materials efficiency.** Designed to economise the use of plastics, metals, cement, and other industrial materials that emit CO_2 in their production processes, improved materials and material flows such as reuse and recycling can significantly improve materials efficiency, reduce the process emissions of CO_2 (such as in the manufacture of clinker for cement), and slash energy inputs in industrial processes. Further aspects of the circular economy are outlined in Section 3.1.8 below.
- **Sustainable land-use** (mainly involving the agricultural sector). Agriculture contributes up to a quarter of all greenhouse gas emissions, including: CO_2 from direct fossil-fuel use in agriculture; CO_2 emitted in the industrial production of chemical fertilisers and other agricultural inputs; CO_2 emitted from deforestation and the degradation of farm lands; the methane released by ruminant animals (especially cattle) and from flooded rice paddies; and nitrous oxide emissions from the use of nitrogen-based fertilisers. Agricultural practices also harm biodiversity and ecosystem functions in many ways beyond GHG emissions, including: overuse of freshwater resources; destruction of habitat (e.g., through deforestation); overharvesting of plant and animal life, both marine and terrestrial; chemical pollutants to the air, water, and soils in addition to GHGs, including pesticides, hormones, antibiotics in animal feeds, etc.; destruction and degradation of top soils; aerosol pollution from peat burning and slash-and-burn agricultural generally; eutrophication of coastal environments due to phosphorus and nitrogen flows; and more. All of the environmental challenges of food production are exacerbated by the extensive wastes and losses of food along the entire value chain, from post-harvest losses to food waste among consumers, notably in high-income countries. One-third of all food is lost due to waste along the supply chain.

The challenge of sustainable land-use also critically includes the delineation and management of protected areas, which not only act as major carbon sinks through their soils and vegetation, but as safe harbours for threatened and endangered species. Such protected areas should be considered across both marine and terrestrial ecosystems. The challenges of sustainable land-use in regard to agriculture are enormously complex and will be the object of a specific analysis which will be carried out next year; the following paragraphs provide an outline of the importance of broader nature-based solutions.

On the 5th anniversary of the Paris Agreement, Nature Based Solutions are emerging as essential climate mitigation and adaptation strategies. It is now widely accepted that protecting ecosystems could provide at least a third of the climate mitigation needed by 2030 under the Paris Agreement. The 2019 IPBES Global Assessment[36] (Global Assessment Report on Biodiversity and Ecosystem Services) found that the biggest driver behind the global decline in nature is change in land and sea use, proving that conservation of areas rich in biodiversity must be expanded to curb biodiversity loss and reduce species extinction. This conservation also increases resilience to climate change as the forests, mangroves, coral reefs, soils, and oceans that contain the most biodiversity are also carbon sinks.

[36] IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany.

EIT Climate-KIC Landscapes as Carbon Sinks Deep Demonstration Project

EIT Climate-KIC's response to the climate emergency has been to focus our efforts on systems innovation to generate options and pathways for radical transformations in whole countries, cities, regions, industries and value chains. Deep Demonstrations are the large-scale projects through which EIT Climate-KIC offers a 'systems innovation as a service' model to Europe's most ambitious 'challenge owners' – i.e., the mayors, government ministries, industries and community leaders, and funders who have the means and mandate to tackle Europe's biggest climate change challenges.

EIT Climate-KIC's Deep Demonstration projects act as: (a) a testbed environment for the 1.5C-consistent systems transitions called for by the IPCC and European policymakers; (b) sources of innovation and learning that can accelerate change elsewhere and provide policy inputs. These demonstrations were launched in 2019 and build on our ten-year track record of climate innovation in cities, industry, land-use and finance, which we bring into the portfolio phase of our demonstration projects. You can explore our larger portfolio of work in these areas here: https://www.climate-kic.org/programmes/deep-demonstrations/

The **Carbon Sinks Deep Demonstration Project** focuses on economic activities that mine soils and landscapes and are causing land to become sources of emissions, rather than sinks. Lack of land management is also raising the risk of wildfires that can create spikes of emissions, while opportunities for carbon sequestration are missed. This EIT Climate-KIC Deep Demonstration Project includes demo projects to turn landscapes from carbon sources to sinks and to tackle lack of investment, forge new social contracts with soil and forests, and line up value-chain incentives. Current partners of the Carbon Sinks Deep Demonstration Project include Chalons-en-Champagne, a French landscape ecosystem, and the Government of Scotland. Case studies include:

- The Landscape Finance Lab, an online platform created to attract large amounts of green capital for sustainable land initiatives and systematically refine products for broader applications. It helps stakeholders to package together separate land initiatives into larger products, structuring and launching projects with wider impacts.
- WINnERS (Weather Index-based Risk Services),a multi-funder innovation project that offers risk management services to build resilient supply chains from the smallholder to the global retailer.
- The Feed-X programme, which aims to source, test, finance and scale sustainable vegetal protein alternatives for animal and aqua-farming feeds. Feed-X aims to revolutionise alternative feed solutions for aquaculture, initially focusing on salmon and shrimp. The project is part of a wider initiative known as Project X, which will accelerate development across other global industries over the next decade in a bid to reverse biodiversity decline and climate change. It aims to shift 10 percent of the global feed industry towards more sustainable production, drawing on novel alternative solutions by independent entrepreneurs.
- Friendly Fruit, which aims to implement the appropriate structure to promote environment-friendly agricultural practices in various regions in the fruit industry. Friendly Fruit has changed agricultural practices in various regions to allow environmentally-friendly strawberry and apple production, which account for 11 per cent of the global fruit market. The project focuses on the supply chain in close link with farmers. It will bring systemic change towards a sustainable fruit value chain through new guidelines and then assess the impacts of these practices.
- The WEBio Platform, which has been designed for entrepreneurs and innovators at the local level to be able to assess and measure the regional biomass available to them, and to develop innovative projects with low carbon emissions. All the information is homogeneous and dynamic and is georeferenced, which means that one can follow in real time the availability of wood waste in a given forest.

- GeoFootprint, which will take the form of a user-friendly online world map to measure the environmental footprint of agricultural practices and supply chains of major crops with an unprecedented level of detail. Companies and other relevant stakeholders will have access to key environmental information to help them make sustainable decisions and support better crop management practices.

Find more at: https://www.climate-kic.org/in-detail/eit-climate-kics-case-studies-on-innovative-land-use/

While technologies for energy and emissions mitigation have advanced considerably in recent years, the powerful role of natural solutions cannot be overemphasised and a more concerted effort to explore and finance nature-based solutions is needed. In the wake of COVID-19, there is a growing understanding of the interdependence of biodiversity, climate and human health. It has started to become clear that the natural world should be a focus point in climate solutions, and that global leaders should address all three crises in an integrated manner. Furthermore, when these areas are disturbed by humans, they could become a future source of animal to human zoonotic disease spread. Currently, only 15% of the land and 7% of the oceans are protected. Expanded protection of these ecosystems is a critical foundation for climate resilience, biodiversity preservation, and pandemic prevention.

The science-based proposal to protect at least 30% of the planet's lands and seas by 2030 is now the United Nations' draft target for area-based conservation in the Convention on Biodiversity's post-2020 global framework. This "30×30" proposal is one of the leading nature-based solutions with strong backing globally. Nearly 40 countries from around the world have joined forces to form an interregional group called the High Ambition Coalition for Nature and People (HAC), which seeks a global agreement to protect at least 30% of the planet's land and oceans by 2030. France, the President of COP21, and the UK, the President of COP26, are Co-chairs of the HAC with Costa Rica, working alongside dozens of other countries. Nature-based solutions currently receive less than 3% of climate finance. France has committed 30% of their climate finance to nature, and the UK has recently stated that they will increase the share of their climate finance directed towards nature.

In summary, to get to climate neutrality by 2050, the EU will have to transform its power, industry, transport, and buildings sectors in view of completely abating their GHG emissions (Figure 5), while land-use and broader nature-based solutions as outlined above will also have to contribute to this goal. The next paragraphs provide insights on which technologies and policies the EU can use to deliver this major challenge.

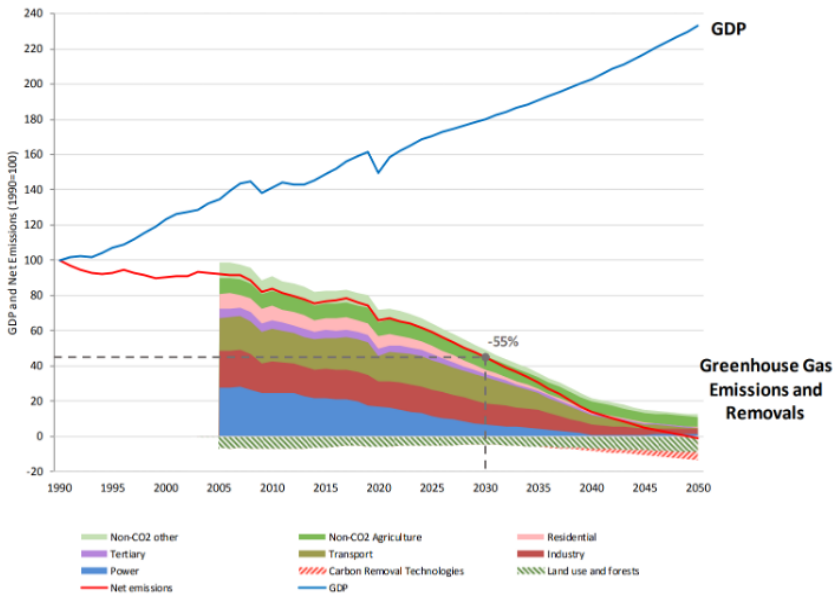

Figure 5. The EU's pathway to sustained economic prosperity and climate neutrality, 1990-2050, Source: European Commission, 2020

AMAre ACTIONS FOR MARINE PROTECTED AREAS

One solution to address the issue of sustainable marine systems and waterways has been designed in the Mediterranean to identify important takeaways for other such program designs. The main objectives of AMAre project are:

To develop shared methodologies and geospatial tools for multiple stressors assessment, coordinated environmental monitoring, multi-criteria analyses, and stakeholder engagement;

To develop concrete pilot actions and coordinated strategies in selected Marine Protected Areas (MPAs) to solve hot spots of conflicts affecting marine biodiversity and the services it provides.

This effort encouraged transnational cooperation and regulation, development of coordinated best practices, data access and information sharing, and concrete stakeholder and users' involvement. The final aim is to scale up strategies and recommendations at the transnational level to adopt an ecosystems-based approach that considers the goals of the Marine Strategy Framework Directive (MSFD) across MPAs.

Main outputs:

AMAre Geoportal for Mediterranean MPAs

AMAre Geoportal was developed in the context of the Interreg-MED AMAre project aimed at the identification of possible strategies and solutions to improve the effectiveness of marine environment management in the Mediterranean. The geoportal was implemented following the INSPIRE Directive conceptual model, the main goal of which is to enhance environmental spatial information sharing.

Find out more at: https://amare.interreg-med.eu/

RECONNECT - REGIONAL COOPERATION FOR THE TRANSNATIONAL ECOSYSTEM SUSTAINABLE DEVELOPMENT

RECONNECT aims to develop strategies for sustainable management of Marine Protected Areas (MPAs) and Natura 2000 sites. The study areas are characterised by similar habitats in different countries, which are threatened by common pressures. Creating a transnational cooperative network to confront the environmental threats of ecosystems with a high natural and cultural interest under a common approach is the overall goal of this project. The establishment of common practices and a joint regional strategy are the main challenges of RECONNECT. The overall objective of the project is to promote efficient management of natural systems, which will enhance the competence of local management authorities through the development of a multi-disciplinary Decision Support System (DSS). The new transnational holistic approach which will be developed will change the current protection strategies in the Balkan-Mediterranean area to promote more efficient and accurate management practices. The main outputs of the RECONNECT project will provide information concerning habitat attributes, as well as the essential biodiversity and socio-economic and cultural variables that will be freely available as tools through a web-based platform.

Main outputs:

- Designation of new tools such as a Decision Support System (https://reconnect.hcmr.gr/decision-support-system/) and a Handbook of management practices (https://reconnect.hcmr.gr/handbook-of-management-practices/) that are going to be released by the end of December 2020, developed through the combination of multidisciplinary methodologies targeting to evaluate ecosystem quality and to promote the sustainable conservation of these vulnerable and fragile ecosystems
- Wiki pages offering information related to species mapped in the study areas https://reconnect.hcmr.gr/wp-content/uploads/2020/07/D5.X.4%20wiki%20pages-final-June%202020%20(1).pdf

Find out more at: https://reconnect.hcmr.gr/

3.1.2 Decarbonising the power sector

The EU power sector is already undergoing a decarbonisation process. The traditional centralised organisation of the power system is now facing a paradigm shift to distributed and renewable generation. This new model is closely related to the implementation of smart grids, where end users act as prosumers by supplying the network with the excess of power generation produced by their distributed photovoltaic (PV) systems. Digital technologies will be at the centre of this revolution, unlocking the potential of different business models like virtual aggregators and peer-to-peer energy trading.

The current technologies supporting this transition in the EU can be classified into four main groups:

- Low-carbon energy sources (e.g., on and offshore wind, solar PV and concentrated solar power, hydropower, biomass, and geothermal);
- Short-term and long-term energy storage solutions;
- Other flexible options such as network interconnections, sector coupling, supply response (e.g., hydro reservoirs, bioenergy) and demand response (to reduce fluctuations in energy demand);
- Carbon capture, utilization, and storage (CCUS), and variants including bio-energy CCUS and direct air capture.

While many of these technologies are already cost-competitive and may offer even lower costs in the future, others require future technological developments and/or increased economies of scale to support their effective deployment at the levels needed to reach a full decarbonisation of the power sector.

The EU climate neutrality target will require a combination of multiple technologies. Depending on local conditions, the mix of available power options will vary from one country to another, and thus there will be no one-size-fits-all solution. The implementation of transition technologies may also be required. Coal should be phased out earliest given its high carbon content and its contributions to air pollution. While natural gas may play a crucial role during the transition period, it will also need to be either decarbonised or progressively phased out. In all cases, EU countries should prepare detailed plans exploring all options for decarbonisation and their associated costs. To allow for unanticipated technological breakthroughs and cost reductions, energy policies need to be flexible, regularly assessed, and adaptive to ongoing technology advances to allow each potential low-carbon solution to be supported and deployed.

While many EU policies are heavily oriented towards the electrification of energy systems, electrification must proceed alongside decarbonisation in order to fight climate change. The energy efficiency potential along the whole electricity chain should not be underestimated. Moreover, a strongly integrated approach across sectors and energy pathways is essential for addressing climate change issues. Finally, secondary effects and a holistic perspective on the entire lifecycle of technological solutions should be considered to avoid potential rebound effects from specific technology choices.

3.1.3 Decarbonising the industry sector

Heavy industry emits a large share of EU GHG emissions because industrial processes employ high temperatures and depend on high energy densities to enable the chemical processes involved. Within the industrial sector, the chemicals industry is one of the largest energy users. Three energy intensive sectors are considered here: cement, iron and steel, and petrochemicals (plastics, solvents, industrial chemicals). Each of these sectors contributes to emissions of different kinds: i) direct, thermal, ii) direct, chemical, and iii) indirect.

Emissions from these types of industries are significant and require solutions that go beyond electrification of energy inputs to actually adjust the chemical and physical processes associated with typical huge industrial plants operations. To reduce emissions, these industry sectors will need to displace fossil fuel-based energy inputs with low- to zero-emission electricity and improve heat integration and energy efficiency, all by taking advantage of new processes. Fully decarbonizing such complicated and integrated industrial environments requires a multidimensional approach.

Three action areas in this sector include:

- Reducing demand for carbon-intensive products and services;
- Improving energy efficiency in current production processes;
- Deploying decarbonisation technologies across all industries, which in turn can be split between four supply-side decarbonisation routes:
    - Electrification
    - Use of biomass
    - Use of hydrogen and synthetic fuels
    - Use of carbon capture technology.

There are currently no purely technological limitations blocking major decarbonisation routes across any industrial sector. The barriers are economic and not technological; we have the technologies today, but they are expensive. Moreover, the complexity of very integrated production plants introduces an additional obstacle: secondary products are used as feedstock for other plant sections. As a major consequence, changes in one process need to be introduced to ensure compatibility with the other processes.

Some material efficiency options for the three industrials sectors analysed include:

- Cement: building design optimization, concrete reuse, materials substitution
- Iron and Steel: optimization of scrap recycling, product design for efficiency, more intensive use of products
- Petrochemicals: chemical and mechanical recycling, plastic demand behaviour change, use of renewable feedstocks, and product eco-design to better enable recycling

For these industries, improvements in energy efficiency should run in parallel with material efficiency and demand reduction. Appropriate technologies for energy efficiency exist today and can be applied in any country. Some of the key solutions for energy efficiency improvement include:

- Cement: switch to dry kilns and multi-stage cyclone heaters
- Iron and Steel: re-use of high-pressure gas for power, coke dry quenching
- Petrochemicals: energy efficiency in monomer production, and naphtha catalytic cracking

These solutions may result in a meaningful reduction in emissions, but policymakers must also promote change through economic and policy incentives.

Geographical contexts will impact technology decision making. Countries investing in new plants should choose zero-carbon technology rather than invest in energy efficiency improvements in plants at the end of their lives. In contrast, countries where legacy plants and facilities will continue to operate for years to come should invest in energy conservation and energy efficiency improvements for existing processes. Additionally, the possibility of combining more of these solutions in a given country or facility will vary depending on the geographical distribution of resources and social acceptability of specific technologies.

The pace at which technological breakthroughs are adopted will determine deployment opportunities over the next decades. Specific geographic and political scenarios play a critical role in the pace of technology development, adoption, and deployment, notably:

- The existence of appropriate policy incentives as well as other policy instruments;
- Reduction in the cost of alternative zero-carbon fuels, in particular zero-carbon electricity;
- Trade-exposed industries facing international competition from jurisdictions that have chosen to reduce their emissions at a slower pace.

A relevant Deep Demonstration Project has been implemented in the port of Piraeus, Greece, and a description showing the case of systems innovation is given in the box below.

Deep Demonstrations for Zero-Net Emissions in the port of Piraeus, Greece

Ports are places where multiple systems collide (shipping, energy, waste, tourism, and other transport). Ports can either be emissions hotspots or hubs that are able to drive enormous change. In a phased process, EIT Climate-KIC will work with a small cohort of high-ambition port authorities in Valencia, Spain and Piraeus, Greece and with the Cyprus Ministry of Shipping to demonstrate how ambitious maritime hubs can be catalysts for reversing the fast-growing emissions from international shipping and trade.

The port of Piraeus is a particular hotspot of waste and shipping industry emissions. As the second maritime cluster globally, it is necessary to demonstrate that it can become a catalyst of rapid change and a resilient maritime hub. At present, 51% of the port belongs to the Chinese company COSCO and the port is involved in 14 European projects, which show its commitments to becoming a green port and becoming financially independent using alternative financing models.

EIT Climate-KIC Hub Greece, directed by Prof. Phoebe Koundouri (Athens University of Economics and Business) at the ATHENA Research Centre, already has a deep understanding of the intended systems of Piraeus and many of the structural changes needed. This group is comprised of top academic and research institutions in Greece, namely ATHENA, Foundation for Economic and Industrial Research (IOBE), UN SDSN, Athens University of Economics and Business (AUEB), National Kapodistrian University of Athens (NKUA), PRAXI Network, Hellenic Resource Asset Development Fund (TAIPED), and the Municipality of Piraeus. These stakeholders are working together to combine systems innovation approach with multi-annual expertise on blue growth and maritime research and entrepreneurship to co-design port innovations that will bring system changes. ATHENA is committed in rivers, ocean, water management, sustainable maritime, and the green shipping sector, as well as the promotion of Blue Growth.

Deep Demonstrations start with a demand-led approach, working with organisations willing to take on the responsibility of acting as ‘problem owners’ – such as the Greece Piraeus Port Authority – committed to zero-net emissions and resilient futures. Deep Demonstrations progress in tightly designed, iterative phases - steps of rolling out systems innovation-as-a-service, aiming at the identification of the key actors to be involved, current status, vision, innovation needs, sustainable financial planning and ultimately at the alignment of all actors able to drive systems transition to a low-carbon emissions future. Deep Demonstration is a circular approach in innovation implementation with the final goal of the holistic change of the port to sustainability.

This project is part of a much bigger UN SDSN Initiative called the 4 Seas Initiative on Sustainable Blue Growth Transformation in the Mediterranean, Black Sea, Caspian Sea and Aral Seas, led by SDSN Greece and SDSN Black Sea, which will work together with SDSN Mediterranean, and the national SDSN networks of Italy, Spain, France, Turkey and Russia under the auspices of the Global SDSN.

Challenge owners: Piraeus Port Authority, Valencia Port, Ministry of Shipping, Cyprus

Implementation period: 2019-2022

Find more at: https://www.athenarc.gr/el/institoyto-pliroforiakon-systimaton/projects/deep-demonstrations-zero-net-emissions-maritime-hubs

3.1.4 Decarbonising the transport sector

The transport sector is the backbone of any productive system. Enabling the mobility of people and goods means connecting people and nations, and consequently fostering economic and cultural exchanges and social development. The complexity of the sector requires deploying a diverse mix of decarbonisation solutions to meet the challenges within each of its four main segments: roadways, railways, aviation, and navigation. This is particularly true considering that over the last two decades the EU has failed to substantially decarbonise the sector.

The difficulty of decarbonisation for each segment will vary. Moreover, transport interacts strongly with other productive sectors and in order to avoid rebound effects, the power sector must be fully decarbonised and the cradle-to-grave energy supply chain must become increasingly efficient. Effective decarbonisation pathways in transport rely mostly on technological solutions, new sustainable fuel development, and fuel shifts, and are complemented by demand reduction and modal shift strategies.

Finally, different energy vectors will play a role in transport decarbonisation. The most important energy vector is electricity (either through batteries or electrified railways and electric road systems), which together with hydrogen, synthetic fuels, and sustainable biofuels (properly allocated to hard-to-decarbonised modes) will contribute to decarbonise the transport sector. As far as the use of biomass, scarcity of the resource and complexity in overall supply chain may suggest that biofuels could be prioritised in particular modes of transport (e.g., harder-to-abate segments like long-haul aviation) or geographical areas (e.g., those not likely to proceed toward total decarbonisation in the power sector in the near term).

The following are action areas in this sector.

- A diverse mix of decarbonisation solutions and energy vectors needs to be sought by each transport segment: roadways, railways, aviation, and navigation.
- Effective decarbonisation pathways rely mostly on technological solutions, new sustainable fuel developments, and fuel shifts, complemented by demand reduction and modal shift strategies.
- In the road segment, CO_2 emissions are easier to abate due to **electric vehicles** and **fuel-cell electric vehicles** for short-to-medium length hauls (freight, passenger, light-duty, or heavy-duty categories).
- The pathways for railway decarbonisation are mostly based on **fuel shifts** from **diesel to electricity or hydrogen**.
- Concerning aviation, advanced jet fuels (such as synthetic fuels) are the main way to decarbonise the current fleet and the most relevant one in the near future. Modal shift from air to land could be enhanced with innovative alternatives, such as ultra-high-speed trains, with the right policies in place.

- For similar reasons, long-haul navigation is hard to abate, while short-haul navigation[37] can be supplied by **electricity or hydrogen technologies.** Ammonia and hydrogen are currently being investigated in long-haul navigation.
- Use of biofuels and the sustainability of biomass for biofuels need to be carefully assessed so as to avoid competition with food production; deforestation or loss of biodiversity in natural regions; and competition with industries that currently use biomass for higher value products or uses. As sustainable biofuels will only be available in limited volumes, their use should be prioritised in hard-to-abate modes like aviation.
- Regulatory frameworks need to be technology agnostic to create a fertile environment for innovation, unleashing the potential of the research while fostering virtuous behaviours of citizens in all transport modes.
- Research and innovation need to investigate life-cycle analysis (LCA) and indirect land-use change (ILUC) impacts of technologies to confirm sustainability, avoiding solution lock-in and stranded assets.

3.1.5 Decarbonising the buildings sector

Buildings are responsible for approximately 40% of energy consumption and 36% of CO_2 emissions in the EU. Currently, about 35% of the EU's buildings are over 50 years old and almost 75% of the building stock is energy inefficient, while only 0.4-1.2% (depending on the country) of the building stock is renovated each year. Therefore, the European Commission estimates that more renovation of existing buildings has the potential to lead to significant energy savings, potentially reducing the EU's total energy consumption by 5-6% and lowering CO_2 emissions by about 5%. The goal of total decarbonisation in the buildings sector includes the construction of new buildings and districts with zero or almost-zero energy consumption from fossil fuels and the total renovation of existing buildings with the same net-zero carbon standards.

As mentioned in **Flagship No 2 (Renovate)** of ASGS 2021, energy efficiency and raw material efficiency and recirculation has to be doubled in terms of utilizations for private (residential) and public (administration) buildings by 2025 in Europe.[2] This is the main Target, set as a nodal "KPI" for a modern and renovating wave for European Building Sector, ensuring a large number of jobs throughout the Union, covering a massively inclusive category of low-to-medium labour skills across European societies.

It should be noted that CO_2 emissions from material use in buildings represents almost one-third of building-related emissions. The construction industry must radically change its manufacturing structure in order to abate this increasing embodied energy.

In general, using a combination of readily available technologies and approaches and performance-based design metrics, net zero-carbon buildings and districts can be achieved today, according to the following strategy:

- Maximise the building's energy efficiency first, mainly through passive and low embodied-carbon solutions;
- Adopt high-efficiency technical systems and advanced control/management strategies; phase out inefficient solutions, encourage low-carbon systems such as heat pumps and district heating and the adoption of advanced control/management strategies;
- Maximise on-site or nearby renewable energy production and self-consumption while electrifying the buildings sector, to completely cover or exceed the total energy demand of each building with the minimum exchange of energy with the grid, thus stimulating energy management, storage and exchange at district level.

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[37] Short-haul encompasses in-land waterways, coastal and intra-regional shipping; long haul navigation covers intercontinental or deep sea shipping

This will result in different combinations of solutions that are appropriate for each specific context, creating buildings that are resilient to climate change effects. Moreover, in order to achieve the overall decarbonisation of the buildings sector, energy consumption related to cooking must also be addressed.

The action areas in this sector include:

- Developing further advanced building energy codes with mandatory performance standards and setting minimum energy performance levels for existing buildings. Policies and subsidies to favour the retrofit of existing buildings rather than new constructions are absolutely necessary.
- Achieving high efficiency building, mandating energy performance standards for envelope components, and working with industry to deliver non-invasive and whole-building retrofit packages. Policymakers should develop strategic frameworks to create the adequate market conditions for low-carbon technologies, guiding building owners and designers in making the correct choices.
- Tightening minimum energy performance standards for stand-alone heating equipment, preventing expansion of fossil fuel heating, and pursuing strategy to shift demand to high efficiency and integrated energy solutions with net-zero emissions. In particular, the electrification of final uses (e.g. heat pumps for space and water heating) play a key role in decarbonising the building sector.
- Pursuing low-cost solar cooling technologies such as high efficiency and renewable district cooling where appropriate; mandating use of waste heat from large-scale cooling for heating and hot water use on-site or via district systems. Local governments are uniquely positioned to advance district energy systems in their various capacities.
- Lifting regulations and measures obstructing energy self-consumption such as specific additional taxes or levies; and administrative procedures to allow self-consumption should be user-friendly.
- Achieving affordable thermal storage and low-cost solar thermal systems (for low-income countries only).
- Adequately promoting training and capacity building activities for the construction sector, while also pushing the development of specific DSS (decision support system) or design-aid tools to strongly increase the application of climate-responsive and integrated building design.

3.1.6 Getting the governance right: the need for National Climate Neutrality Roadmaps

EU climate and energy governance is currently based on the national energy and climate plans (NECPs of the 27 Members States are presented in more detail in Annex II) that member states have to develop for the timeframe 2021-2030 to outline their intentions to promote energy efficiency, renewables, greenhouse gas emissions reductions, interconnections, and research and innovation. This process, introduced in 2019, promotes coordination across all government departments and between member states and the EU with the aim of providing a level of planning that will ease public and private investment.

This system is necessary to deliver on the EU 2030 climate targets, but in view of getting to climate neutrality by 2050, EU countries should also be asked to develop national climate neutrality roadmaps.

Countries will face three main challenges in developing such roadmaps. The first is designing a framework that is specific enough to be technologically credible and useful to investors, but remains flexible enough to incorporate future learning and advances in technologies. The second is designing a framework that is fair and politically credible; for example, providing compensation for hard-hit regions and vulnerable populations. The third is designing a system of mutual responsibility and accountability for both public and private stakeholders.

The complexity, comprehensiveness, and urgency of the transformation compound these challenges, as do the uncertain trajectories and development of leading technologies that are continually advancing. These challenges call for broad policy frameworks with clear goals (most importantly, zero emissions by 2050); technology roadmaps (e.g., the shift to zero-emission vehicles); regulatory assignments to stakeholders (e.g., utility companies, energy users, power generators, public agencies); and strong systems of deliberation, public awareness, reporting on outcomes, and feedback loops based on outcomes and learning.

Finally, a comparable effort should be made on the demand side, particularly with regards to energy efficiency and energy savings. The expected increase in energy demand worldwide should be limited as much as possible without compromising economic development and energy access. Optimal energy management is the basis for the potential success of decarbonisation policies throughout the main sectors. Moreover, both for supply and demand, the focus should be clearly given on the desired targets rather than pushing specific technologies or solutions.

3.1.7 Policy frameworks to support the national climate neutrality roadmaps

The global climate regime, governed by the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, leaves most actions to national governments. Each national government offers Nationally Determined Contributions (NDCs) that are supposed to be consistent with meeting the objectives of the Paris Agreement. The first round of NDCs were offered upon ratification of the Paris Agreement during 2015-16 and generally covered the period to 2025-30. The next round of NDCs will come in 2021 and will presumably cover the period of 2030-35. In addition to the NDCs, countries are requested in Article 4.19 of the Paris Agreement to submit low-emission development strategies, presumably on a time horizon to mid-century or beyond.

Three points must be emphasised:

- National plans should cover the time period to at least 2050. NDCs that have a time horizon of just 10 to 15 years are far too short to plan for energy systems and land-use transformations. Incremental planning based on short intervals does not produce the desired long-term effects, since decisions made today determine outcomes far beyond a 10- to 15-year planning horizon. Power plants built today will still be operational beyond 2050. New or retrofitted buildings will be standing well beyond 2050. Land-use choices made today can result in irreversible effects after 2030 in the form of species extinction or permanently degraded ecosystems.
- According to the UN Environment Programme's (UNEP) Emissions Gap Report 2018, the sum of the NDCs to date would put the planet on a path of reaching around 3° C by the end of the century, continuing to rise thereafter, rather than the limit of "well below 2° C and aiming for 1.5° C" set in the Paris Agreement.[38] This means that current NDCs fall far short of the ambition needed to achieve the Paris Agreement objectives. Since the NDCs process is "bottom-up," with each country submitting its contribution on a voluntary basis, the ensemble of the NDCs do not add up to the requested global effort.
- While countries are responsible for their own resources and energy choices, cross-border solutions are required to achieve common goals of reducing GHG emissions. Climate change is a global issue that transcends national boundaries; therefore, we need to keep cross-border solutions in mind, complementary to national approaches.

To lead by example, the EU should be guided by a basic standard in the 2021 submissions to the UNFCCC under the Paris Agreement: national plans should cover the period to at least 2050 and should aim to equitably reach net-zero emissions by 2050 and net negative emissions in the second half of the century.

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[38] UN Environment. "Emission Gap Report 2018." UN Environment. Published 2018. https://www.unenvironment.org/resources/emissions-gap-report-2018

Moreover, each national plan should be based on national efforts backed by global enablers. The national efforts are the actions under the control of each individual country. The global enablers are the changes in the global systems needed for each country to be consistent with the goal of zero net emissions by 2050.

Table 12 summarises national efforts and global enablers and illustrates the complementarity between them. Each national or local authority is responsible for its own power grid, building codes, transport infrastructure, and land-use policies. Yet each nation also depends on global-scale technological systems–for battery electric vehicles, zero-carbon aviation and ocean shipping, clean industrial processes, and zero-carbon heavy industry–in order to achieve net zero emissions at the national level. Nations should plan their national policies based on the expectation of global supply chains for the needed zero-emission technologies, while also taking into consideration diversity of socioeconomic status and access to affordable technology and innovation.

There are important signs that new global supply chains are coming into existence to enable the transition. For example, some automobile manufacturers are declaring their intention to move away from internal combustion engine (ICE) light-duty vehicles and shift towards zero-emission vehicles (ZEV).

Six Pillars to Zero Net Emissions by 2050	National Actions	Global Enablers
Zero-carbon Electricity	Zero-carbon electricity grid, mainly based on renewable energy	Reduced costs of renewable energy, mass scale-up of solar photovoltaics and wind turbines, improved energy storage technologies, and expanded R&D of new energy sources
Electrification	Infrastructure for battery electric vehicles, retrofitting of buildings for electric heating and cooking	Global phaseout of ICE vehicles, global mass production of battery electric vehicles (BEVs)
Synthetic Fuels	Infrastructure for trade and distribution of synthetic fuels and biorefining	Global R&D and scale-up of synthetic fuels for heavy-duty vehicles, ocean shipping, aviation, heavy industry
Smart Power Grid	Introduction of a digital power grid and the Internet of Things (IoT)	R&D of artificial intelligence (AI)-backed smart grid systems
Materials Efficiency	Introduction of the circular economy and national waste management systems	R&D of alternatives to cement, plastics, and other pollutants (persistent pesticides)
Sustainable Land-Use	Sustainable land-use regulations (reforestation, restoration of degraded lands), precision agriculture, reduced food wastage, shift towards plant-based protein diets	Sustainable global supply chain management for major crops, global real-time monitoring systems for land management

Table 12. National efforts and global enablers to reach zero net emissions by 2050

At the national level, each EU member state will need to take responsibility for the following major actions: 100% zero-carbon electricity; infrastructure for electrification of buildings, vehicles, and industry; infrastructure for synthetic fuels; smart grid management, including implementation of technology like the Internet of Things (IoT); waste management (reduce, reuse, recycle); and sustainable land management, including land conservation, sustainable farm practices, reduced food wastage, and a shift towards healthier diets through public health initiatives and food industry regulations. Further, stronger international cooperation supported by innovative blended finance and investment allocations will be needed to fund the transition. Such mechanisms would further strengthen international partnerships and ensure cooperation in the decarbonisation of heavily-traded global commodities.

At the core of national efforts should be an expanded zero-carbon electricity grid to be achieved by mid-century at the latest, and ideally by 2040 or even earlier. Many national governments are already committed to reaching zero-carbon electricity by 2040, with the phase out of coal power plants having a prominent role as shown in Figure 6.

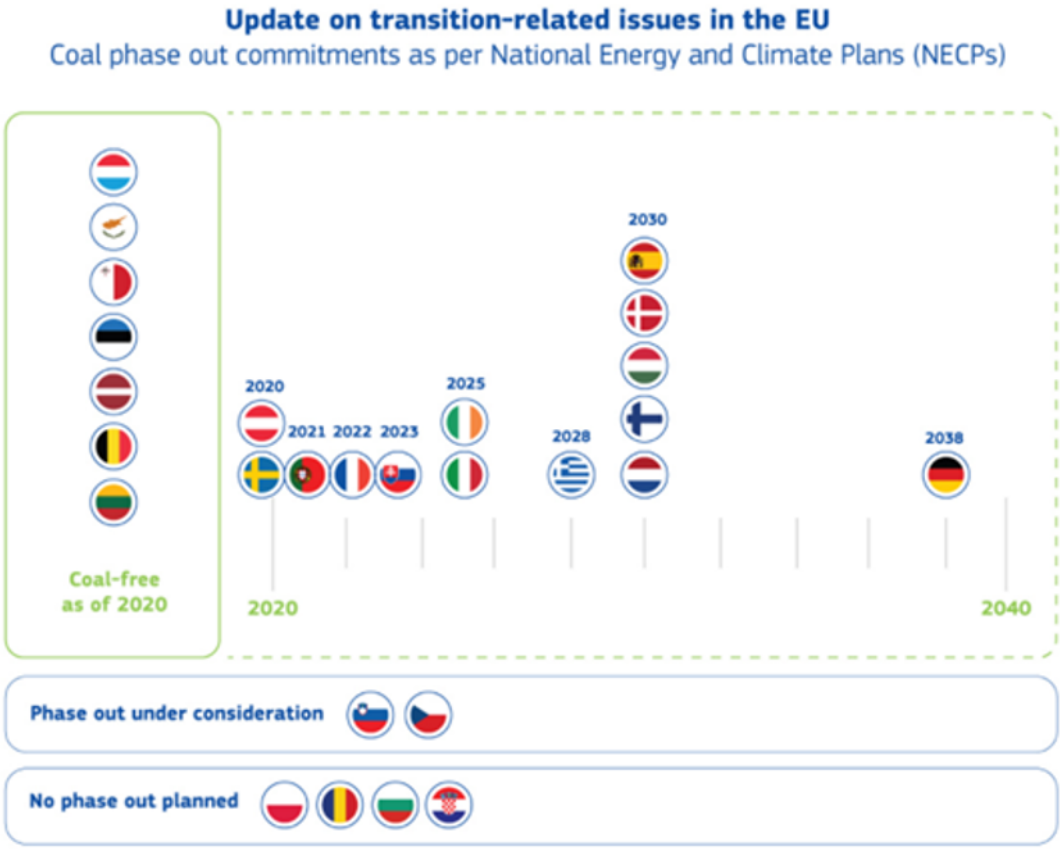


Figure 6. Coal phase out commitments by EU Member states. Source: European Commission document COM(2020) 564 final

The options for doing so are favourable. Several scenarios suggest that rapid progress towards zero-carbon electricity is possible based on renewable energy resources at low cost, and even below the costs of current energy systems. While such reports utilise different assumptions and somewhat differing timings, they all indicate movement in the same direction, suggesting the feasibility of global decarbonisation in the coming decades. Special attention would need to be given in the light of Agenda 2030 to low-income countries where the transition will have to occur without increasing the poverty gap or exacerbating global inequality. The fourth target,[39] SDG 7, is indeed created for this purpose: where national capacity or resources are not enough to proceed with the needed speed towards the energy transition, the international community should create the right support via international cooperation and fund allocations.

[39] "By 2030, 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."

The precise design of national and regional electricity markets to accommodate 100% renewable energy remains in debate. In a traditional, centralised fossil fuel-based power system, system-level reliability and flexibility is achieved largely through characteristics of fossil fuel-based technologies. Base load fossil fuel plants, for example, provide the inertia needed for frequency control, as turbine power provides reliable, low-cost dispatchable power.

For systems with high penetration of VRE, by contrast, systems reliability and flexibility must be built into the system alongside power generation capacity. VRE sources such as wind and solar power are intermittent and non-dispatchable. Therefore, the challenges of frequency control and dispatchability must be achieved through technologies that are complementary to power generation. Intermittency of renewable energy must be accommodated through larger interconnected transmission grids, storage technologies (e.g., pumped hydro, grid-scale batteries), demand-side flexibility, by-products of biorefineries, and other means. How these complementary services are incentivised and managed will depend on many specific characteristics of the electricity market, such as the ownership structure of power generation, transmission, and distribution, the availability and ownership of pumped and fully dispatchable hydro storage, and the regulatory and financing authority of the systems operators.

Among all other key figures to be involved at a national level, finance ministers have a distinctive and central role to play in the design and implementation of national zero-emission plans, a role that has recently been recognised in the formation of the Coalition of Finance Ministers for Climate Action. This role centres on the financing and regulation of zero-emission plans with the policy tools summarised in Table 13. Fiscal and financial policies range from financing of public infrastructure, to regulation of private financial institutions, to collection of carbon taxes, to compensatory transfer payments to individuals and regions that will incur unusually heavy costs during the transition from fossil fuels to renewable energy.

Action Area	Major Fiscal and Financial Policies
Zero-Carbon Electricity	Regulatory framework for power grid operators; public investments in renewable energy transmission and distribution; income support for fossil fuel-producing regions and sectors experiencing social costs of transition; redesign of electricity markets; financial market regulations to avoid stranded assets in the financial system; carbon pricing and taxation; green bonds
Electrification	Public investments in infrastructure (e.g., charging facilities for BEVs); building codes for zero-emission buildings; regulations for phasing out ICE vehicles (coupled with incentive schemes to address equity issues); public procurement of BEVs; retrofitting and design of public buildings
Synthetic Fuels	R&D outlays for synthetic fuels; public infrastructure for synthetic fuels (e.g., adaptation and upgrading of existing pipelines for hydrogen, e-fuels, etc.), regulation to ensure ethical sourcing of biomass. These fuels should be generated by RES and may require 5 to 6 times more RES electricity units to generate one unit of synthetic fuel
Smart Power Grid	Public investments in digital technologies for the power grid; regulations on AI and big data; design of IoT
Materials Efficiency	National and local regulations on waste management and recycling; policies for waste valorisation
Sustainable Land-Use	Land-use regulations; public investments in national land-use monitoring systems and enforcement mechanisms; public payments for ecosystem services (e.g., payments for protected areas); green bonds
International Cooperation and Investment Allocation	Result based Investment for all public aid at bilateral and multilateral level, national support to de-risk private investment for the energy transition

Table 13. Major Fiscal and Financial Policies for Zero-Emission Policies

3.1.8 Circular Economy

The pillar on Materials Efficiency in Table 12 above makes explicit reference to the Circular Economy (CE). Departing from conventional 'take-make-use-dispose' practices, CE is a new and promising approach to waste and resource management that has attracted strong business, policy, research, and investor attention. As shown in Figure 7, CE focuses on how different types of value can be created through implementing a variety of circular strategies. At the same time, CE aims to reduce, avoid, or negate pollution, emissions, and other externalities through increased resource efficiency and productivity, aiming to decouple resource consumption and emission production from economic growth. As such, CE pursues a win-win situation for both business and the environment wherever possible. In particular, CE is an economic model designed to minimise resource input as well as waste and emission production. It aims to reach the maximum efficiency in the use of finite resources, the gradual transition to renewable resources, and recovery of the materials and products at the end of their useful life. Moreover, CE aims to rebuild all available types of capital, including financial, human, social, and natural. Essentially, a circular economy describes a regenerative economic system.

The box below provides an example of implementing CE principles in cities. Furthermore, two projects regarding the elimination and reuse of plastic in the seas can be found in the Box: "Tackling single-use-plastic item uses in the Eastern Mediterranean Sea."

The concept of CE is relevant for all sectors of the economy and all business sizes, both in the public and private sector. It is based on three main principles. First, the minimization of waste and pollution, by reducing damages from economic activities. Second, the extension of the useful life of products and materials by creating the loops of the materials and products circulating in the economy; this goal is achieved through the active reuse, repair, and remanufacturing of the products and materials utilised in the economy. Third, it is necessary to create the conditions for the regeneration of natural systems.

The transition to CE is estimated to have the potential to produce 600 billion euro annual savings for EU businesses, which correspond to 8% of their annual turnover, and 580,000 jobs in innovative design and business models, research, recycling, remanufacturing, and product development (EU Commission, Circular Economy Factsheet). It is also estimated to reduce EU carbon emissions by 450 million tonnes, or equivalently more than 14%[40] by 2030, and reduce the EU's environmental footprint by optimizing waste management through boosting recycling and reducing landfill. To build the economic case for CE, a holistic framework of integrating the monetary value of cost savings, job creation, and carbon and environmental footprint reduction is needed. Non-market valuation methods should be used for the monetary valuation of the related social and environmental benefits. Given the private and social benefits deriving from CE, the public-private partnership finance model seems better equipped for financing the transition to CE. Importantly, CE is relevant for small- to medium-sized enterprises, which are the back-bone of the EU economy, as well as large companies.

[40] Calculated as: Total carbon emissions in 1990 according to EEA were approximately 5,700. That means a targeted reduction until 2030 by 5,700*55% = 3,135 ($MtCO_2e$). Out of these 450m or 450/3,135 = 14.3% is attributed to CE

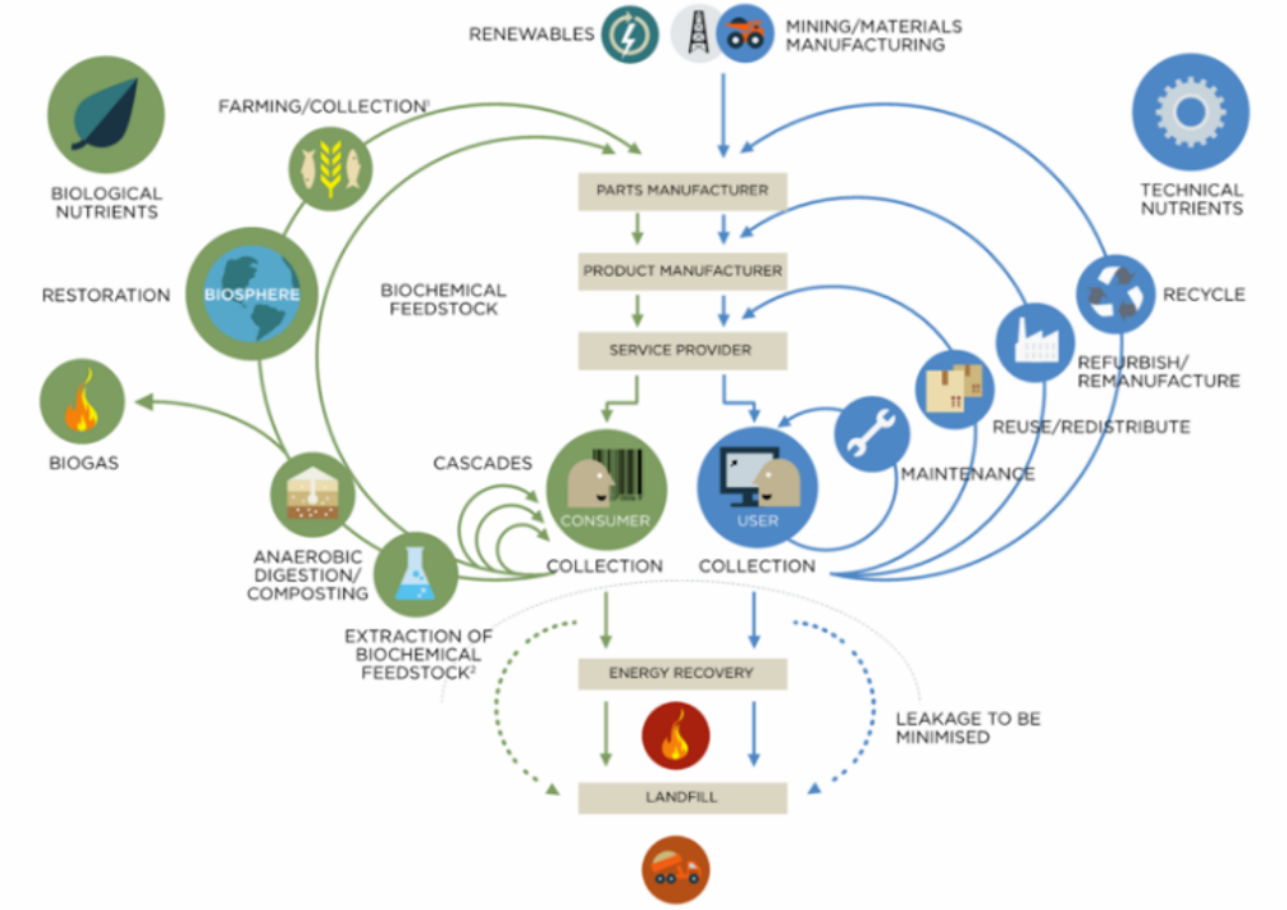


Figure 7. Circular economy systems diagram (February 2019), available at www.ellenmacarthurfoundation.org

Circular Economy Transition in Smart Specialisation Strategy (CE in S3)

The EU has set an ambitious plan for the adoption and implementation of the circular economy (CE). The plan estimates that by 2030 the integration of CE will result in savings of over 600 bil. euros for EU businesses, create 580,000 new jobs, and contribute to the reduction of 450 mil. tons of GHGs. Member States are key players in Europe's transition to CE. Adopting CE in each country should be aligned with its strategic documents and identified sectoral strengths and needs, set in the individual country's Smart Specialization Strategies.

In the past, CE projects could not benefit fully from the S3s due to the different requirements of the funding instruments and, in some cases, lack of CE priorities incorporated in the strategies themselves. In order for all CE aspects (resource efficiency, design, bio-economy, digitalization, new business models, CE education, etc.) to be stimulated inclusively, the CE needs to be incorporated in S3 horizontally. 2019 is a truly strategic moment to align this adoption and uptake of the EU CE action plan, as currently the S3s are undergoing evaluation and are in the process of being revised based on past experiences.

Cleantech Bulgaria (Bulgaria project coordinator: Hamanova Mariyana) and ATHENA (Greece project coordinator: Prof. Phoebe Koundouri, School of Economics and ReSEES Laboratory, AUEB, Director EIT Climate-KIC Hub Greece) with the support of EIT Climate-KIC (1) will pilot the adoption of CE in their respective S3s, working together with the responsible authorities.

Each country will identify challenges, priorities, and potential for synergies and support instruments for CE. Participatory workshops with experts from EIT Climate-KIC will be run. Specific approaches to implementation and supporting funding instruments will be discussed and shared with participants. The end goal of the project is to stimulate the timely and systemic adoption of the CE in S3s for the 2020-2027 programming period in EU Member States.

Together with the support of the Ministries of Economy of Bulgaria and the Hellenic Ministry of Energy and Environment of Greece, a 1-day workshop was held in each country, applying the developed methodology and identifying the needs, barriers, and strengths in each of the participating countries. The workshop in Greece took place on 19 September 2019 in Athens. The focus of this workshop was the presentation of the mapping of the key aspects of the National Strategy on C) in relation with the Research and Innovation Strategies for Smart Specialisation (RIS3) and the discussion on the implementation of these strategies identifying the needs, barriers, and strengths in Greece. Mutual learning between Greece and Bulgaria was guaranteed by providing exchange visits between members of CTBG and ATHENA during the workshops.

Building upon the outputs provided, a final event in Brussels with the participation of external EU experts and other RIS countries was held during the European Week of Regions and Cities. On Wednesday, 9 October 2019, an executive meeting for the CE in S3 project took place at EIT House, Brussels. The aim of these meetings was to present the work of both Greece and Bulgaria and upgrade the project to a national-based Deep Demonstration of CE project, which will be led by ATHENA RC and the Ministry of Environment and Economy. Potential synergies with existing projects of EIT Climate-KIC Greece with focused areas the ports and the plastic are discussed, while the Ministry of Environment and Energy stimulated the discussions by being represented at the meetings in Brussels with Greek delegates from the Ministry of Environment and Energy.

- Project website: https://www.athenarc.gr/el/circular-economy-transition-ce-smartspecialization-strategy-s3
- Countries: Bulgaria, Greece
- Implementation period: 2019

(1): EIT Climate-KIC is a European knowledge and innovation community, working towards a prosperous, inclusive, climate-resilient society founded on a circular, zero-carbon economy. The EIT Climate-KIC is part of the European Institute of Innovation and Technology (EIT) and the EIT Community. The EIT is a body of the European Union and a global innovation leader, delivering world class solutions to societal problems. In particular, we aim to catalyse the rapid innovation needed across sectors by convening the brightest minds to tackle challenges, empowering leaders through capacity building, and seed funding the most promising climate-positive businesses.

Tackling single-use-plastic item uses in the Eastern Mediterranean Sea

The EIT Climate-KIC hub Greece marine projects address the challenge of marine plastic littering southern European waters by building capacity for innovation to address the issue at the very beginning of its life cycle, on the prevention side, by avoiding production of plastic materials (and plastic waste), thus avoiding carbon emissions in the first place. During 2019, the EIT BL.EU project focused around ports (commerce, fishing, tourism) and worked closely with local problem owners: in Croatia (island Cres and island Zlarin), in the port of Piraeus in Greece, and the port of Lisbon in Portugal. The project developed an engagement strategy around the pillars of the local challenge, identifying gaps in knowledge and mitigation related to marine plastic pollution, and produced a change roadmap for plastic free southern European waters in the next 10 years involving research, education, businesses, start-ups and public bodies through participatory processes.

Building on the BL.EU project, the MEDfreeSUP project's objectives are to enable, foster and support the broader adoption of alternatives to Single-Use-Plastic items among citizens with the commitment of food & beverage business operators at municipal level. The project is developing a Single-Use-Plastic-Free protocol to reduce, eliminate, reuse, and educate using a co-creation process to identify and implement the best mix of policy instruments in coastal municipalities and islands, combined with an online awareness platform to favour behavioural change. The project follows a systemic approach, involving local stakeholders to harness local knowledge and ensure the commitment of local communities, create partnerships, and co-identify solutions.

MEDfreeSUP project

- Countries: Italy, Croatia, and Greece
- Project Coordinator: UNIBO, University of Bologna ART-ER, Italy
- Project coordinator Greek activities: ATHENA RC – Phoebe Koundouri
- Implementation period: 2020-2021
- Find more: http://www.unsdsn.gr/medfreesupeit-climatekic

BL.EU project

- Countries: Portugal, Croatia, and Greece
- Project Coordinator: Universidade NOVA de Lisboa, Faculty of Science and Technology
- Project coordinator Greek activities: ATHENA RC – Phoebe Koundouri
- Implementation period: 2019
- Find more: https://www.athenarc.gr/el/climate-innovation-southern-european-waters-bleu-climate

3.2 The importance of adopting a systems approach to deliver the national climate neutrality roadmaps

Our proposed approach for the technological breakthroughs that will lead to major transformation in national and regional economies through the reorganisation of industries (as described in Section 3.1) is Systems Innovations. This approach integrates scientific and technological knowledge into national plans for recovery and resilience. It requires coherent contributions from diverse policy areas, including innovation and research, industry, education, welfare, trade, and employment. The Paris Agreement aims to strengthen the global response to climate change in the context of sustainable development and efforts to eradicate poverty. A systems approach is thus needed to ensure that **multiple objectives** are simultaneously addressed. These multiple objectives include the three main pillars of sustainable development: economic prosperity (including poverty reduction), social inclusion (leaving no one behind), and environmental sustainability. More specifically, the strategy to address climate change must simultaneously aim to achieve the 17 Sustainable Development Goals (SDGs).

A systems perspective is vital because actions in one area can trigger outcomes in other areas that are detrimental to sustainable development. Therefore, the overall package of measures in national roadmaps must simultaneously address and satisfy the globally-agreed objectives of sustainable development. An overreliance on biofuels, for example, could reduce the carbon content of energy, thereby slowing contributions to climate change from anthropogenic emissions, but at the expense of biodiversity, and therefore, at the expense of SDG 14 (sustainable marine ecosystems) and SDG 15 (sustainable terrestrial ecosystems). This is not to say it is not a critical part of the solution. Similarly, a reliance on geoengineering via solar radiation management to cool the climate (e.g., through the injection of aerosols into the stratosphere) might reduce anthropogenic warming but exacerbate other sustainable development challenges (such as crop productivity). The aim of the national climate neutrality roadmaps is to meet the needs of both society and the planet by relying on the integrated use of different resources, technologies, and processes, while avoiding short-sighted **competition** among them.

A systems approach recognises that we have multiple instruments (public investments, income redistribution, elimination of subsidies to fossil fuels, carbon taxation, R&D promotion, regulations on land-use, etc.) that should be combined in order to achieve multiple goals (economic prosperity, the eradication of extreme poverty, climate adaptation, and of course, the limits on anthropogenic warming adopted in the Paris Agreement). No single policy – such as carbon taxation – can by itself address the multiple dimensions of the socio-economic-physical systems needed to combine climate actions with other sustainable development policies. Therefore, a systemic approach is needed to penetrate the national and global policy dialogue.

Moreover, even within the narrower purview of climate mitigation, a systems approach is needed to plan and implement a strategy to limit and stop anthropogenic contributions to climate change. The transition to zero-carbon energy involves many interconnected components that need careful coordination. The power grid itself is a complex system, including power generation, transmission, and distribution, and the system must be coordinated continuously to maintain high performance and prevent blackouts, forced shutdowns, and other instabilities. Grid systems managers coordinate across a plethora of public and private institutions and technological and socioeconomic domains. This complex system must continue to operate reliably, efficiently, and economically, even as it undertakes the deepest transformation in its history.

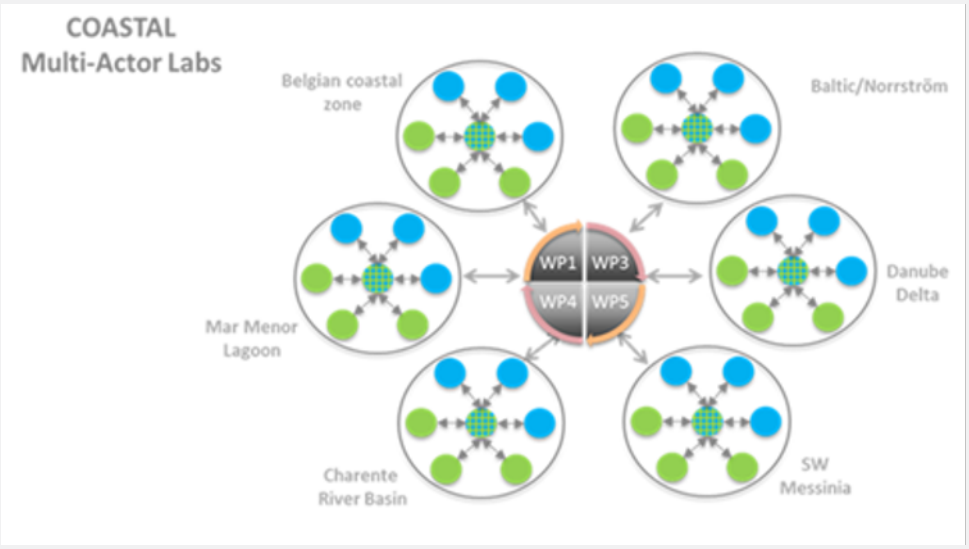
To conclude, it is necessary to highlight that technologies and related services are inextricably linked to geography. Technologies require resources and, in the majority of the cases, they have specific geographical distribution. Moreover, the same services and the quality of those services are judged differently in different geographical areas according to local behaviours and perceptions of priorities. The risk of neglecting this point is that deep EU decarbonisation strategies may further exacerbate inequalities, thus affecting development of some geographical regions. The European Green Deal should properly consider this point and avoid this risk in order to be politically and socially sustainable in the long-run.

Two examples, highlighting the potentials of land-sea synergies and the application of climate resilience, can be found in the Boxes below.

Systemic policy frameworks can enable sustainability transitions by guiding and aligning actions across policy areas and scales. System Innovations can be structured in a way that facilitates the co-integration of various factors of change, such as new business models, policies, materials, knowledge and skills. At the same time, they need to involve reorienting public budgets, private investments and financial markets towards promoting the green transition.

The H2020 COASTAL Project

The H2020 COASTAL project is a unique research and innovation project based on multi-actor collaborations of coastal and rural stakeholders to formulate and evaluate business solutions and policy recommendations aimed at improving land-sea synergies and coastal-rural collaborations in strategic business and policy decision-making. Stakeholder driven, it combines quantitative and qualitative approaches, local knowledge, and scientific expertise using participative methods and system modelling to better understand land-sea interactions and foster cross-sectoral collaborations in 6 Multi-Actor Labs (Belgium, Greece, Sweden, France, Romania, Spain) across Europe. COASTAL will contribute to the long-term improvement of sea water quality by creating synergies in the agriculture, tourism, fishing/aquaculture, port, and energy sectors for the sustainable management of the water resource from source-to-sea.



COASTAL MALs- H2020 COASTAL project

Main outputs:

- Evidence-based business road maps and policy guidelines with measurable results and performance indicators;
- An online platform for land-sea knowledge exchange between knowledge institutes, practitioners and stakeholders;
- Intuitive and innovative tools demonstrating the added value of improved land-sea collaboration and the proposed solutions

Coordinator: VITO, Belgium
Implementation period: 2018-2022
More information at https://h2020-coastal.eu

BRIGAID

BRIGAID is a 4-year project (2016-2020) under EU Horizon2020 that aims to effectively bridge the gap between innovators and end-users in resilience to floods, droughts and extreme weather. It offers state-of-the-art knowledge of climate risk; science-based methods and funding opportunities to improve innovations by performing tests, evaluating results and making improvements; incorporates the needs of clients in the design and business model; and puts innovations in the spotlight. BRIGAID's ambition is to provide structural, ongoing support for innovations in climate adaptation by developing an innovative mix of methods and tools that should become a standard for climate adaptation innovations.

Main outputs:

- A framework that evaluates the effectiveness of innovations and the organisational and governance requirements.
- A business development and financing model for climate adaptation innovations.
- An online interactive platform (https://climateinnovationwindow.eu/) that presents innovations and connects innovators, end users, qualified investors, and grants and fiscal incentives advisors throughout Europe.

Coordinator: TU DELFT, NL
Implementation period: 2016-2020
More information at https://brigaid.eu/

At the same time, Systems Innovations cannot happen without active participation of society. The 2019 Eurobarometer finds that 93% of EU citizens see climate change as a serious problem; 79% see it as a very serious problem. The vast majority of respondents think it is important their national government set ambitious targets to increase renewable energy (92%) and improve energy efficiency (89%). The European Climate Pact that was launched in December 2020 provides an opportunity for institutions to work closely together for an enabling framework for civil society and citizens' involvement, building on and going beyond the existing consultation processes. The Climate Pact needs to leverage the power of Europeans to achieve the EGD's vision of a prosperous, inclusive, climate resilient society with a circular, net-zero emissions economy by 2050. The IPCC report explicitly refers to the need for rapid, far-reaching, and unprecedented changes in all aspects of society. Incremental changes will not be enough. A narrow focus on CO_2 reduction is counter-productive at the grassroots level, limiting the engagement, the thinking and the changes that are imagined and implemented. What is needed now is a fundamental transformation of economic, social, and financial systems that will trigger exponential change in decarbonisation rates and strengthen climate resilience. For this to happen, inspiring, broad, and diverse narratives are needed, communicating why the world has to change.

SYSMA (System Mapping as a Service for post-COVID Regional Transition)

Investments to revive our economies must go beyond a recovery of what existed before COVID-19. To enable regions & cities to act upon this challenge and provide the needed long-term economic sustainability, a clear map of system functions and existing interconnections is needed. This project is designed to support the scaling-up stage for system mapping services as part of resilience planning in local community governance, to be applied for the most vulnerable and value-added sectors that need to be kept as priorities in COVID-19 (i.e., tourism, food supply, mobility) and address fast recovery objectives. This pan-European project activates communities spread across 10 of the most vulnerable countries in Southern Europe in the recovery phase to set system mapping as a strategic knowledge intensive service, aimed to provide new indicators and understanding of system and, thereby, supporting local authorities in the needed post-COVID-19 transition and related strategic planning challenges. Through an orchestrated co-creation process, a diverse cohort of partners and non-traditional partners from private bodies and civil society will work with stakeholders and decision makers to generate practice-based knowledge and strategies. The output is a knowledge management service tool to boost alternatives for challenge-owners in prioritizing economic activities and inform investment in Southern Europe to speed the transition process, aimed at making resilient, healthy communities, and recognizing innovations for market and positive transformation. The service provides opportunity for utilization of current and novel unstructured data, not relying solely on historic trends, but allowing for path-emergence and systemic decision-making to be applied as a rapid response.

PROJECT IMPLEMENTATION PERIOD: June 2020 - December 2020
SPECIFIC FUNDING PROGRAMME: European Institute of Technology

Main outputs:
Provision of a marketable tool supporting decision-makers in building resilience against future pandemics and other global threats with aligned expectations, as well as expertise of all service-delivery partners. Methodology utilised and workshops delivered have followed the same pattern in all participating countries towards the development of a one stop shop system mapping service for decision-makers.

In view of the positive experiences with the European Circular Economy Stakeholder Platform, the European Economic and Social Committee proposed to set up a similar European Climate Pact Stakeholder Platform (see Box below). The guiding principles should be inclusiveness, transparency, and genuine participation and ownership by local climate actors. The European Climate Pact Stakeholder Platform should monitor the implementation of EU climate policy at the national and regional level and gather data in support of policy-making at all levels. An essential element of the Platform would be a capacity-building and finance hub, providing guidance, information, and education on climate policies and strategies, as well as to facilitate access to finance for small-scale projects. The EU hub and national hubs could be set up in cooperation with local and regional authorities. The European Climate Pact Stakeholder Platform's online forum would serve to create spaces for sharing information and knowledge, facilitating networking, and building commitments. The European Climate Pact Stakeholder Platform would require setting up a coordination group composed of representatives of various actors. Selection of coordination group members will require transparent and clear criteria in order to ensure inclusiveness and representation while maintaining efficient governance of the structure. The following stakeholders should be represented: EU institutions, civil society (including business, trade unions, local and regional authorities), science community, finance community, and youth. Stakeholders from institutions and sectors with fewer resources should be provided with sufficient resources to participate and have a decision-making role.

Opinion regarding the European Climate Pact (NAT/785)[41]

According to the European Economic and Social Committee (EESC), mobilization of the energy and climate transition towards carbon neutrality is based fundamentally on the action of all participants from social and economic activities. Energy communities, researchers, labour forces, smart entrepreneurs, and multinational companies should all be included in the next steps.

EESC encourages the EU to achieve targets for 2030 GHG emissions reductions and carbon neutrality by 2050. UN Environment Programme (UNEP) suggests annual emissions reductions by 7.6%, globally, to meet the planet-warming limit of +1.5 °C. That is translated to a minimum global GHG reduction of 68% by 2030. Adoption of a participatory model at all levels and implementation of the Climate Pact requires the EU Commission to build an innovative approach, to reflect, encourage, and provoke active participants from the economy and society.

The SDGs are necessary to manipulate digital transformation to protect societies and labour rights against transition risks. A just transition frame focusing on the high quality of employment for all people should be based on the European Pillar for Social Rights and the EGD. Major challenges ahead include the limited access to finance and the absence of specialist knowledge, recognition, and a dominant narrative inspired by EU Leadership and the Member States.

Significant finance resources are necessary for the achievement of climate targets across the EU and globally. Sustainable Recovery and Climate Action should be at the core of the EGD Budget, of the Recovery Fund, and the allocation of funds within the frame of the EU Semester Process.

Additionally, design of the post-COVID era should be progressive and not support unsustainable pathways and scenarios. This design should align with the SDGs and the Paris Agreement, defining conditional funding mechanisms to ensure success. All stakeholders should receive technical support and capacity building to implement the transition. Access to finance should be accelerated by the help and encouragement of an EU Climate Finance Forum.

[41] European Economic and Social Committee, NAT/785 European Climate Pact Opinion, July 2020.

The EESC suggests the inception of a European Climate Pact Stakeholder Platform which should follow the principles of transparent active involvement of all environment and climate stakeholders. The opportunity of society to participate at any level in research, practice, and implementation should be a key element of the Climate Pact.

By June 2021, the Commission will prepare the key legislative proposals on how to achieve the increased 2030 climate and energy ambition, including revising and expanding the EU Emissions Trading System; adapting the Effort Sharing Regulation and the framework for land-use emissions; reinforcing energy efficiency and renewable energy policies; and strengthening CO_2 standards for road vehicles.

Existing practices on civil society and citizen engagement

- In 2019, 150 randomly selected French citizens started deliberating on the question, "How can we reduce GHG emissions by at least 40% by 2030, in a spirit of social justice?" Sessions of this Citizens' Convention are held at the French Economic and Social Council. The Government plans to publicly address the proposals and publish a provisional timetable for their implementation.
- The Irish Citizens' Assembly established in 2016 consisted of 100 citizens, randomly selected to be representative of the Irish electorate. They were tasked with deliberating on topics ranging from the constitutional ban on abortion to making Ireland a leader in tackling climate change. The parliamentary committee established to take forward the Assembly's recommendations on climate change shaped to a significant degree Ireland's landmark Climate Action Plan published in June 2019.
- In Spain's two major cities, citizens' dialogues and local forums have been established to promote broader participation of citizens and civil society organisations (CSOs) in deciding parts of the local budget and brainstorming about the future of the city.
- The Youth Climate Council at the Ministry of Energy, Supply and Climate in Denmark aims to bring new thinking into climate policy and provide input to the minister on future climate solutions.
- The city of Gdańsk in Poland has organised three citizens' assemblies on adapting to extreme weather events, reducing air pollution, and improving civic engagement.
- In Finland, the first Citizens' Panel on sustainable development brought together about 500 Finns to assess the state of sustainable development. The results will be used to promote the work on sustainable development by the Finnish Government and Parliament.
- In Italy, after COP 25, a legislative proposal was made by civil society representatives to set up a Citizens' Assembly on the model of the French one. A similar process was launched in the UK, with "Climate Assembly UK: the path to net zero."
- In Bologna, Italy, the municipality created a "Civic Imagination Office" as part of its wider work to re-engage citizens. It created six "laboratories" that run regular visioning events, using Open Space and other tools. When strong ideas for projects emerge, the municipality creates "pacts" with the community to ensure they become a reality. Over 500 pacts have been agreed in the last five years, ranging from new benches on streets to far larger and more ambitious projects. It has also become the channel through which participatory budgeting is organised.

Social Innovation in Marginalised Rural Areas (SIMRA)

One such project that attempted to quantify just transition metrics is the Social Innovation in Marginalised Rural Areas (SIMRA) project, a four-year project (2016-20) funded by the European Union's Horizon 2020 programme. It aims to advance understanding of social innovation and innovative governance in agriculture, forestry, and rural development, and how to boost them in marginalised rural areas across Europe and around the Mediterranean, including non-EU countries. SIMRA has characterised marginalised rural areas across Europe and the Mediterranean region according to physical constraints, limited access to infrastructure (road networks, electricity), and social marginalisation (people with low incomes, at risk of social exclusion, with high levels of infant mortality, and high proportion of early leavers from education and training).

Source: Slee, B., Mosdale, L. (2020). How policy can help bring about social innovation in rural areas.

Main outputs:

- Theoretical and operational frameworks
- Methods for evaluation of SI and impacts in rural areas
- Synthesis and dissemination to policy makers/end-users
- Collaborative learning, networking and innovation actions

Coordinator: James Hutton Institute, UK
Implementation period: 2016-2020
Find out more at: http://www.simra-h2020.eu/

3.3 The Sustainable Europe Investment Plan – European Green Deal Investment Plan and the Just Transition Mechanism[42]

3.3.1 The Sustainable Europe Investment Plan and the EU Budget

The European Green Deal (EGD) is the Commission's new growth strategy, according to which the EU is committed to becoming the largest climate-neutral consortium in the world by 2050. This requires significant investment from both the EU and the national public sector, as well as the private sector. The **EGD's Investment Plan, i.e. the Sustainable Europe Investment Plan**, is the investment pillar of the EGD, and contributes to the implementation of the Sustainable Development Goals, putting them at the heart of the EU's policy making and action. A sustainable Europe requires significant investment effort across all sectors of the economy; reaching the 2030 climate and energy targets is estimated to require additional investments of €260 billion every year by 2030.

This figure mainly includes energy-related investments in buildings and part of the transport sector (vehicles). Significant investments will be also necessary in other sectors, notably in agriculture, to tackle broader environmental challenges including biodiversity loss and pollution, the protection of natural capital, and the support to the circular and blue economy, as well as for human capital and social investments related to the transition. Notably, a key enabler for the EGD is Digitalisation: substantial investment in European strategic digital capacities, as well as in the development and wide deployment of cutting-edge digital technologies will deliver smart, innovative, and tailored solutions to tackle climate-related concerns.

At the same time, investor appetite for sustainable opportunities with measurable impact is on the rise. The annual global issuance of green bonds has more than tripled since 2016, reaching $362 billion in June 2020 according to the recent estimates.[43] Therefore, a framework is needed to bridge the gap between policy objectives and the significant private financial resources available.

The Sustainable Europe Investment Plan will enable the transition to a climate-neutral green economy across the following three dimensions:

- Mobilise at least €1 trillion of sustainable investments over the next decade through the EU budget.
- Create an enabling framework for private investors and the public sector.
- Provide tailored support to public administrations and project promoters in identifying, structuring and executing sustainable projects.

In addition to the EU spending related to climate action and environmental policy, the Sustainable Europe Investment Plan also covers the funds used under the Just Transition Mechanism (JTM), which will help the most affected regions going through the transition, a key tool to ensure that the transition towards a climate-neutral economy happens in a fair way, leaving no one behind.

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[42] https://ec.europa.eu/info/publications/communication-european-green-deal_en

[43] https://www.climatebonds.net/2020/08/green-bonds-h1-2020-update-916bn-green-bonds-loans1000-green-issuers-milestone-reached

As demonstrated in Figure 8, mobilising at least €1 trillion over the next decade requires a combination of funds provided by the EU budget as proposed by the Commission and further public and private investments triggered by it[44]:

- Climate and environmental spending under the EU budget will provide about €547 billion for the years 2021-2027 in line with the increased 30% climate mainstreaming target proposed for the 2021-2027 multiannual financial framework (MFF) and including spending on the environment across all programmes. If extrapolated for 10 years, this amount could reach €700 billion (additional €150 billion for 2028-2030 without Next Generation EU). This will trigger additional national co-financing of €114 billion over this timeframe on climate and environment.
- The InvestEU Fund will leverage around €108 billion from 2021 until 2027, i.e., close to €15 billion per year and €150 billion over a decade (2021-2030) of private and public climate and environmentally-related investments, assuming that at least 30% of its overall financial envelope is used for climate investment, by providing an EU budget guarantee to reduce the risk in financing and investment operations.
- To leave no one behind, the JTM, based on its €17.5 billion budget, would range from €70 to 115 billion to ensure a just transition for 2021-2027, reaching €100-165 billion if extrapolated for 10 years. This amount doesn't include the other two Pillars of JTM, because they haven't yet been confirmed after the July 2020 EU decision; these would be the InvestEU Just Transition Scheme that would mobilise up to €45 billion investments with a guarantee of €1.8 billion and the Public Sector Loan facility with EIB that would mobilise €25-30 billion investments based on a contribution of €1.5 billion from the EU budget.
- The Innovation and Modernisation funds, which are not part of the EU budget but are financed through a part of the revenues from the auctioning of carbon allowances under the Emissions Trading Scheme, will provide at least some €25 billion for EU transition to climate neutrality.

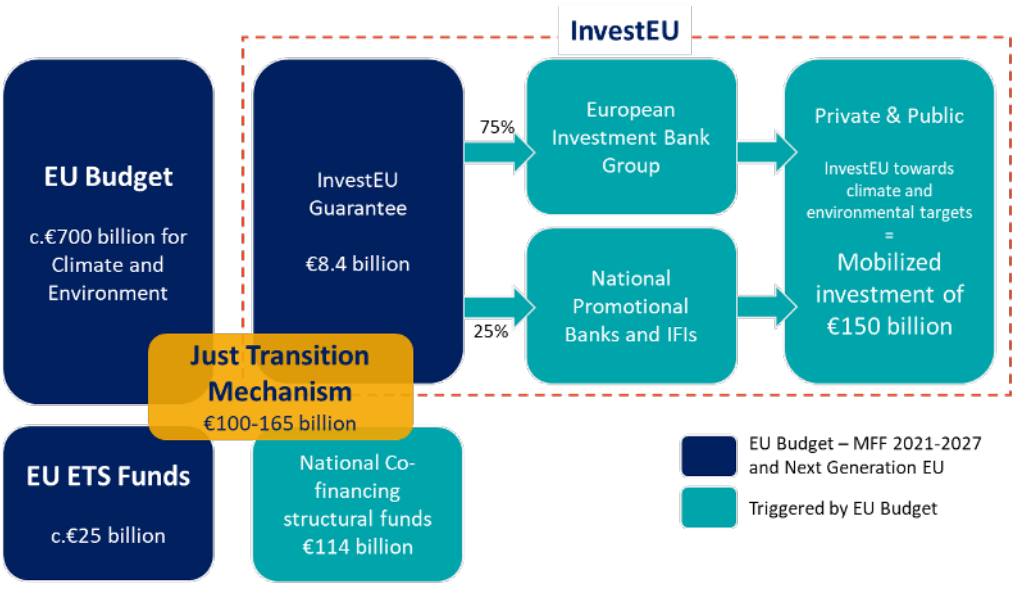

Figure 8. How the European Green Deal Investment Plan will be financed

[44] EU Budget, InvestEU and Just Transition Mechanism funds are EGD Senior Working Group estimations; to be confirmed upon official release from EU

The figures estimated are a simple extrapolation over 10 years of the Commission proposal for the 2021-2027 MFF, without prejudice to the future MFF post-2027, while assuming that the climate ambition will be at least maintained.

The budget provision for InvestEU, as shown in Figure 9, is EUR 8.4 billion and it will be the key EU instrument to crowd in private capital to support investments in policy areas essential for achieving the EGD objectives: renewable energy, energy efficiency, decarbonised energy infrastructure, or research and innovation in green technologies.

By providing an EU budget guarantee to partially cover the risk of financing and investment operations, the InvestEU programme, the successor of the European Fund for Strategic Investments and 13 other EU financial instruments, is expected to mobilise about €360 billion over 7 years. InvestEU must be used to its full potential to support the objectives of the EGD. Achieving an ambitious climate target for InvestEU in the context of the ongoing inter-institutional negotiations is therefore essential. The Commission has proposed to use at least 30% of its overall financial envelope to contribute directly to achieving the climate objectives, which would trigger approximately €108 billion of climate investment from 2021 until 2027, i.e., close to €15 billion per year and €150 billion over a decade.

Figure 9. Invest EU Programme

InvestEU will support sustainable investments in all sectors of the economy. It will also diffuse sustainable practices among private and public investors. The Commission will put forward a climate tracking methodology for measuring the contribution of specific financing and investment operations to the climate and environmental objectives of the programme. In addition, it will put in place a method for 'sustainability proofing' on the basis of which promoters of projects above a certain size will be required to assess the environmental, climate, and social impact of those projects. As these methods will be applied by all InvestEU Implementing Partners (the European Investment Bank Group, National Promotional Banks and Institutions, International Financial Institutions) and will also be the reference point for private investors and financial intermediaries participating in the programme, they are expected to spill-over beyond the InvestEU Programme. These methods will make appropriate use of the EU-wide classification system for environmentally sustainable economic activities ('EU taxonomy').

The JTM, as shown in Figure 10, will consist of three pillars:

- A Just Transition Fund;
- A dedicated just transition scheme under InvestEU;
- A new public sector loan facility for additional investments to be leveraged by the European Investment. Bank.

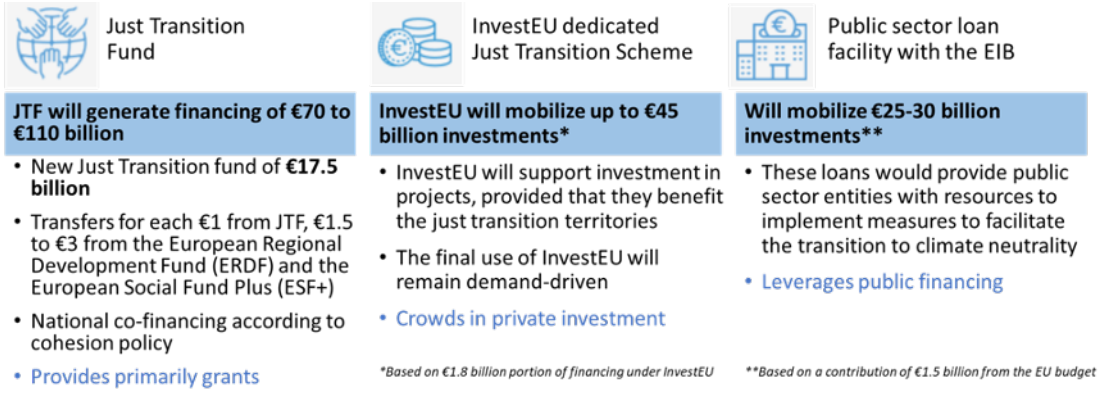

Figure 10. Just Transition Mechanism updated

Each pillar will assist with different grant and financing instruments in order to offer a full range of support options in line with the needs to mobilise investments benefiting the most impacted regions. **To ensure coherence between the three pillars, the Just Transition Fund will be used to provide primarily grants; the dedicated transition scheme under InvestEU will crowd in private investments, and the new just transition public sector loan facility will leverage public financing. These measures will be accompanied by dedicated advisory and technical assistance for the regions and projects concerned.** The JTM will include a strong governance framework centred on territorial just transition plans.

Taken together, the components of the JTM could help mobilise investment in the regions most exposed to transition challenges in the order of at least €100 billion over the period 2021-2027. All investments financed will be coherent with the EGD objectives.

3.3.2 Putting sustainable finance at the heart of the financial system

In order to address the significant number of investments needed to reach the EU's climate and broader sustainability objectives, in March 2018 the Commission proposed the Action Plan on financing sustainable growth. Based on this Action Plan, which contributes to building a Capital Market Union, important foundations for conducive frameworks to mobilise finance for sustainable investments have been put in place. This is the case notably of the EU taxonomy of disclosures on sustainability by the financial sector, as well as of climate benchmarks. Through international cooperation, e.g., via the International Platform on Sustainable Finance, the EU is promoting coherent approaches and an enhanced impact of sustainable finance globally.

The Commission welcomes in particular the recent political agreement by co-legislators on the Regulation establishing a framework to facilitate sustainable investment (EU taxonomy), to be further specified through delegated acts adopted by the Commission. The EU Taxonomy will determine whether an economic activity is environmentally sustainable based on performance criteria for its contribution to at least one of the six environmental objectives. It will also ensure that it will not produce any significant harm to the other five, while minimal social safeguards are guaranteed.

The Commission will also explore how the EU taxonomy can be used in the context of the EGD by the public sector, beyond InvestEU. While initially designed for private investors, the taxonomy – once sufficiently developed – could also be used by public sector entities. It is important that there is convergence of standards between the private sector and the public banks/entities, for example, the European Investment Bank.

Companies will need to increase their disclosure of climate and environmental data so that investors are fully informed about sustainable investment opportunities and can better direct their investment in support of the EGD. To this end, the Commission will review the Non-Financial Reporting Directive. Furthermore, the renewed strategy will further increase investment opportunities by facilitating the identification of sustainable investments through clear labels for a variety of sustainable investment products and by developing and implementing an EU green bond standard.

An interesting perspective could also derive from future developments in the valuation of the financial impacts of social and environmental sustainability. Today, corporate leaders, analysts, and investors must deal with two separate and entirely disconnected reporting systems: one for financial results and the other for environmental and social impact, or ESG (Environmental, Social and Governance) performance. The result is two separate narratives: one telling how profitable a company is, the other highlighting whether it is good for people and the planet. There is no clear way to discern which company is most profitably doing the best. Although a standard method to integrate ESG performance data into earnings projections or valuation analysis does not exist, there are some relevant developments regarding the evaluation of climate risks. The Task Force on Climate-related Financial Disclosures was created by the Financial Stability Board to develop consistent climate-related financial risk disclosures that can be used on a voluntary basis to inform stakeholders. Very recently (November 2020), the International Accounting Standards Board (IASB) also released a document that highlighted the requirements within the International Financial Reporting Standards that are relevant for entities' financial statements on climate-related matters.

A study recently conducted by Enel Foundation and FSG, in cooperation with Harvard Business School and Shared Value Initiative (SVI), shows how hybrid metrics – composed of both financial and ESG indicators – could represent a possibility in the direction of giving a joint indication of performance.[45] Researching the possibility of a causal relation between financial results and social and environmental performance, the study is an early effort to demonstrate the potential of sector-specific hybrid metrics to measure this relation. It also provides a framework to lay down the practices and enable conditions to develop such metrics and keep track of their trends. For example, for the energy sector, the value of decarbonisation strategies could be evaluated by analysing the causal relation between EBITDA (Earnings before interest, taxes, depreciation, and amortisation) and carbon intensity. Once developed and vetted, these metrics could help companies, public institutions, and investors better orient their investment choices towards solutions bringing the maximum benefits to both the social and environmental dimension and the economic one, at the same time.

In addition to shedding light on important ESG measures and sustainability rating organisations, trustees need to effectively navigate the plethora of ESG data by focusing on the most critical for evaluation, including environmental impacts, labour standards, diversity and inclusion, and just transition. Capital stewards must avoid pitfalls of investing in the wrong alternatives by posing tough questions about fees and increased ESG risks to any and all external managers.

The conceptualization and development of such hybrid metrics is a significant initial step towards clear-cut quantitative assessment of the economic impact of sustainability. The possibility to introduce a standardised set of metrics capable of correlating financial and economic indicators with ESG qualifiers has great potential to support a transition towards a sustainable economy.

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[45] https://www.enelfoundation.org/news/a/2020/09/connecting-shared-value-to-shareholder-value-with-hybrid-metrics; https://www.enelfoundation.org/content/dam/enel-found/connecting-shared-value-to-shareholder-value/Hybrid-Metrics-Connecting-Shared-Value-to-Shareholder-Value_September-4-2020.pdf

Such a system, when devised and deployed extensively, has the potential of reorienting business and investment decisions by matching optimal economic and sustainability choices, as it would directly illustrate the difficult trade-off between short- and long-term returns on both economic and socio-environmental dimensions.

3.3.3 How sustainable finance can support the European Green Deal

Sustainable finance generally implies the inclusion of environmental, social and governance (ESG) considerations in the financial sector. Speaking about debt instruments, specifically when it comes to bonds, sustainable finance includes, inter alia, green, social, sustainable and sustainability-linked transactions, as defined by the International Capital Markets Association (ICMA) with dedicated Principles and Guidelines.[46]

A green bond is a fixed-income instrument designed specifically to support specific climate-related or environmental projects. The World Bank issued the first official green bond in 2009, and around $157 billion worth of green bonds were issued in 2019.

Green Bonds, or Climate Awareness Bonds or Transition Bonds, were launched for the first time by the European Investment Bank (EIB) in 2007. By 2020, EIB has raised a total of €6.8 billion using such bonds.[47] Meanwhile, many countries have also opted for this financial instrument to fund environmentally friendly projects. According to Climate Bonds Initiative's (CBI) report, "Green Bonds: Global State of the Market 2019", three European countries–France, Germany, and the Netherlands–are among the top 5 countries based on the amount issued, whereas in terms of the number of issuers, Sweden and France are listed within the top 5 countries worldwide.[48]

Of course, Green Bonds are not issued only at the country level but at the Corporate as well. For example, **Enel** has successfully issued green bonds as described in the box below. A second example is **Iberdrola**,[49] which during the last 6 years has raised €11.4 billion from Green Bonds to fund its investment plan. One issuance, amounting to €750 million and a maturity horizon of 5 years, took place in 2020 as the COVID-19 pandemic evolved, and it is targeted to finance renewables in Mexico and the UK. **TenneT**,[50] an electricity company that operates in the Netherlands and Germany, issued two bonds during 2020. The first amounts to €600 million and matures in twelve years and the second to €750 million and matures in twenty years. Both have been issued to finance projects focusing on the interconnection of large-scale offshore wind turbines with the continental electricity system and upgrading the total network capacity to accommodate more Renewable Energy Sources. In Greece, the **National Bank of Greece (NBG)**[51] became the first Banking Institution in the country to issue a Green Bond. During Q4-2020, it issued a six-year Green Bond and raised €500 million to fund green economy projects such as hydropower, wind parks, and photovoltaic parks.

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[46] https://www.icmagroup.org/sustainable-finance/

[47] https://www.eib.org/en/investor_relations/cab/index.htm

[48] https://www.climatebonds.net/system/tdf/reports/cbi_sotm_2019_vol1_04d.pdf?file=1&type=node&id=47577&force=0

[49] https://www.iberdrola.com/sustainability/investments-green-bonds

[50] https://www.tennet.eu/company/investor-relations/emtn-programme/

[51] https://www.nbg.gr/en/the-group/press-office/press-releases/nbg-landmark-issue-of-a-%E2%82%AC500m-green-senior-bond-

SDG-linked Bond Issuance by Enel Group

Green bonds were one of the main sustainable financial instruments adopted by Enel, and they were issued in order to finance sustainable development projects. The Enel's Green Bond Committee was set up in 2017, with the aim of overseeing the implementation of the Green Bond Framework and the process of allocating the proceeds of green bond issues.[52]

The Enel Group placed three green bonds on the European market with a total value of 3.5 billion euro. In November 2018, Enel prepared and published its last Green Bond Framework to facilitate transparency and the commitments made by the Group with regard to green bonds. The green bonds were issued for institutional investors and are guaranteed by Enel SpA. The net issuance proceeds – carried out under the medium-term bond issue program of Enel and Enel Finance International (Euro Medium-Term Notes Program - EMTN) – were used to finance eligible projects according to the "Green Bond Principles" categories, published by the International Capital Market Association.

In particular, the proceeds were used to finance:

- New projects for the development, construction and repowering of generation plants from renewable sources (green bond emission in 2017 and 2019);
- New projects for the development, construction, repowering and refinancing of generation plants from renewable sources as well as projects for transmission, distribution and smart grids (green bond emission in 2018).

However, since simply directing a portion of debt towards green projects does not change a company's overall environmental footprint, nor does it provide visibility to investors around the strategic targets pursued by a company in terms of sustainability, in 2019, Enel realised that financial innovation was needed.

Consequently, in September 2019, the Enel Group launched the world's first "general purpose SDG linked bond", successfully placing a 1.5 billion U.S. dollar bond on the dollar market in September 2019. The interest rate of the issue was linked to Sustainable Development Goal (SDG) 7 and to the Group's ability to achieve, by December 31st, 2021, a percentage of installed renewable generation capacity (on a consolidated basis) equal to or greater than 55% of total consolidated installed capacity. It was oversubscribed by almost three times, with total orders of approximately 4 billion US dollars and the significant participation of Socially Responsible Investors, allowing the Enel Group to continue to diversify its investor base.[53]

Alongside the issue of September 2019, Enel has structured the world's first "SDG Linked Cross Currency Swap". Peculiar characteristics of this derivative instrument through which the Group is hedged against the dollar-euro exchange rate and interest rate risk, is the commitment of the bank with which it was signed to support the development of "Positive Impact Finance" and obtaining a discount in transaction costs due to the sustainability factor, in line with the structure of the bond.

Moving one step further, on October 2019, Enel has signed with UniCredit S.p.A. its first revolving credit line linked to the achievement of the SDGs, an "SDG-Linked" loan agreement in the amount of 1 billion euro with a 5-year term, with the intention to expand and diversify Enel's sources of sustainable financing.[54]

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[52] For a complete overview of the Green Bond initiatives of the Enel Group please refer to the following Investor Relation section: https://www.enel.com/investors/investing/sustainable-finance/green-bonds

[53] https://www.enel.com/media/explore/search-press-releases/press/2019/09/enel-launches-the-worlds-first-general-purpose-sdg-linked-bond-succesfully-placing-a-15-billion-us-dollar-bond-on-the-us-market-

[54] https://www.enel.com/media/explore/search-press-releases/press/2019/10/enel-signs-first-credit-line-linked-to-united-nations-sustainable-development-goals

In October 2019, Enel launched a multi-tranche SDG-linked bond for institutional investors on the European market for a total amount of almost 2.5 billion euros. The bond is linked to the achievement of the SDGs 7 and 13 and represents the Group's first "General Purpose SDG Linked Bond" issued on the European market. The bond was almost four times oversubscribed, with total orders of about 10 billion euros and significant participation by Socially Responsible Investors, enabling the Enel Group to continue to diversify its investor base.

The market reaction was enthusiastic and 3 main milestones certified the success of Enel's sustainability-linked strategy:

- First, in June 2020 the International Capital Markets Association (ICMA) recognised the value of these instruments, releasing the new Sustainability-Linked Bond Principles. The guidelines were drafted by a group of market participants in the context of the ICMA's Executive Committee and Advisory Council, with a leading role played by Enel: released in June 2020, they are aligned with Enel's transactions.
- Second, the new instrument has been replicated by other issuers: starting in September, several Sustainability-Linked transactions have been issued by global corporate players across different industries, thus demonstrating how this kind of tool can serve the financing needs of all the players that intend to invest in sustainable strategies.
- Third, the rise of a global Sustainability-Linked fixed-income market has been certified by the European Central Bank (ECB): bonds with coupons linked to sustainability performance targets will become eligible as central bank collateral and in the context of ECB's purchase programmes, starting from January 2021.

In October this year, Enel launched the first sterling-denominated Sustainability-Linked Bond for an amount of 500 million pounds, linked to the Group's ability to achieve 60% of renewable installed capacity by 2022, under a new, holistic, and first-of-its-kind Sustainability-Linked Financing Framework with targets and principles to guide the Group's use of sustainable finance instruments in a comprehensive way, across commercial papers, loans, and bonds.

To Enel, investing in sustainability means generating economic and financial value for our Group and for all the stakeholders, through the improvement of financial performance and thanks to greater cash generation with predictable results and lower risks. Developing sustainable finance within the Group means, therefore, pursuing a lower cost of debt, thanks to a comprehensive approach that links the Group's strategy to the debt's financial terms. As an example, the Sustainability-Linked bond issues have a lower cost of about 15% compared to conventional transactions: it is for this reason that Enel's ambition is to increase the share of sustainable sources of financing to 48% by 2023 and more than 70% by 2030.

The above-mentioned Sustainability-Linked strategy put in place by the Enel Group, represents the direct result of pursuing a new sustainable strategy: sustainable finance is at the heart of Enel Group Strategy with the aim of long-term value creation and ESG performance enhancement, thus preserving the group stability over time. Enel played a leading role in this field by giving the right example to be followed by private and public institutions, thus reinforcing sustainable finance and the deployment of sustainable investments.

When it comes to public finance, in fact, the post-pandemic response marks a new era of economic policy. We are experiencing an unprecedented boost of public finance and a supersized level of state intervention both at the national and supranational level.

The EU will make available above 1.8 trillion euros to support long-term economic growth: 40% of the grants will be made available to countries where Enel is present, supporting an acceleration of investments in Europe. In particular, Italy and Spain will benefit from around 150 billion euros of grants, out of which more than 30% have to be allocated on climate initiatives.

More than 60% of the EU Recovery Plan is aligned with Enel's business model, and the Group has already identified a wide range of eligible projects in the European countries in which it is present. Out of the total increase of investments of the plan, more than 75% is allocated to Europe: this sharp acceleration of capex is connected with the grants and policy programme made available by the European Union.

To this end, Enel will push towards the decarbonisation of its power mix to become a renewable super major, developing power grids of the future that excel in quality, reliability, flexibility, and efficiency, thus delivering green power and energy solutions to customers.

Enel's investors and ESG ratings

Socially responsible investors continue to grow in Enel, presently holding 13.4% of total shares (10.8% in 2018), equivalent to 17.5% of floating capital (14.1% in 2019). Moreover, more than 47% of Enel investors have signed the UN Principles for Responsible Investment. ESG analysts and international ESG rating agencies monitor Enel's sustainability performance constantly. Through the application of different methodologies, analysts assess Group performance in relation to ESG topics that may be of significance for the financial community. ESG ratings are therefore deemed to be a strategic tool to support investors and identify risks and opportunities linked to the sustainability in their investment portfolio, aiding the development of active and passive sustainable investment strategies.[55]

Over the past year, Enel has maintained or improved its score and positioning in the majority of ESG ratings and sustainability indices, with several important results achieved, including:

- Achievement, for the first time, of "AAA" rating ("AA" in 2018), by MSCI ESG Research, the main provider of data and research studies, which measures the performance of companies on the basis of ESG factors. In particular, Enel is among the top ten utility companies present. Furthermore, Enel was selected for the MSCI ESG Leaders index in June 2020 for the first time, the most prestigious among MSCI's index series measuring companies' sustainability performance.
- Insertion in the CDP Climate "A-List" in December 2020 for the second consecutive year, confirming Enel's leadership in the management of risks and opportunities linked to climate change, supported by a reduction of greenhouse gas emissions;
- Leader of the electric utility sector in the 2020 edition of the DJSI World and DJSI Europe, and second position within the sector in the overall SAM CSA rating developed by S&P;
- World sustainable leader among all industries in the 2020 edition of V.E. (Vigeo Eiris) Rating, among the nearly 5,000 companies assessed on their sustainability performance for the first time, with a score that doubles the average;
- Leader of the electric utility sector of the FTSE Russell's ESG Ratings, reaching the maximum score in all ESG dimensions evaluated and confirming its membership in the FTSE4Good Indices;
- Presence, for the first year, in the Bloomberg Gender Equality Index, confirming the commitment and performance in the realm of promotion and integration of gender diversity throughout the Company's entire value chain. Furthermore, Enel was recognised Enel recognised by 2020 Refinitiv D&I Index as world diversity and inclusion leader in "Electric Utilities and Independent Power Producers" industry group;
- Presence, for the first time, in the Global 100 Ranking of Corporate Knights, achieving the eighth position in the general classification and the second position in the energy sector.

[55] For a complete review on Enel Group "ESG Ratings and Indices" please refer to the following investor relation section: https://www.enel.com/investors/sustainability/esg-rating-indices

Section 4. The role of patient finance and fiscal policy in the European COVID recovery

The global economy has been significantly disrupted by COVID-19. The crisis has exposed systemic shortcomings, both in terms of the capacity of member states to address the enormous public health emergency and the resilience of international industry to immediate and sustained disruption.

But, more than this, the pandemic shines a light on the need for a proactive state. Since the 1980s, governments have been steered to take a back seat on the economy, intervening only for the purpose of fixing market failures, and always cautious of government failures, which might be even worse. This view of the public sector assumes that only business can create value, with the public sector at best de-risking some of the process. Buying into this has sliced out one of the vital organs of productive and innovation capacity: the entrepreneurial state.[56]

Against this backdrop, governments are now being asked to make significant and long-term investments to support rapid recovery from the coronavirus shock. This has mobilised sizable public finance for the first time in a generation. Billions are being invested, including an initial 484 billion USD relief package in the US (planned to grow to 2 trillion USD), 350 billion pounds in the UK, 1 trillion USD in Japan, and 26 billion USD in South Africa, just to name a few.

With corporations left indebted by the pandemic and millions of workers left unemployed, fiscal stimulus is necessary to bolster demand and ensure the green transition is at the centre of the pandemic recovery. This must be done with a specific focus on a new, post-COVID social compact with Europe's citizens. Citizens need to be the first consideration in a public health crisis and in the climate crisis too.

This chapter looks in particular at the role of patient finance and novel fiscal policies related to the green transition and explores interactions between the European Green Deal (EGD) and the Sustainable Development Goals (SDGs) to drive a greener, more inclusive recovery from COVID-19 at the systems level. The chapter concludes with three brief case studies that bring attention to new practices.

4.1 European Recovery and Resilience

In Europe, as already mentioned in Section 3 of this report, the stimulus has taken the form of the NextGeneration (NGEU) Recovery Package. This package supports the reorientation of activity towards innovation for resilience and places conditions on the finance available. It requires member states to prioritise green, digital, and healthcare investment, and to demonstrate alignment with European values. The Recovery and Resilience Facility, which makes up 90% of the NGEU budget, requires Member State Recovery and Resilience Plans to be submitted by April 2021. Under these plans, 37% of the expenditure has to be related to climate and 20% to digital transitions. The NGEU is also permitted to borrow on capital markets, giving the package significant financial firepower.

The €750bn package had been agreed by the European Parliament and European Council on 10 November 2020 but was initially blocked by Hungary and Poland due to the new spending to 'rule of law norms' conditionalities linked to the 'values' element. At the time of writing, these objections have been lifted, and will hopefully not delay the total 1.8 trillion Euro package.

The long-term path for EU recovery remains unpredictable. However, its direction looks far more certain than in summer 2020, when early-stage responses to the pandemic indicated that the EGD, only recently launched in December 2019, was set to be delayed or diluted. The bloc's Industrial Strategy, launched in March 2020, may not have the scale of ambition to be a significant support mechanism in the post-COVID recovery.

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[56] Mazzucato, M., McPherson, M. 'Why the COVID-19 recovery needs a proactive public sector'. New Statesman. 06/07/20, accessible at https://www.newstatesman.com/spotlight/coronavirus/2020/07/why-covid-19-recovery-needs-proactive-public-sector

Even before the COVID-19 crisis hit, Europe's economy was fragile, not having recovered to its pre-2008 crisis GDP level until 2014. By the end of 2019 it was still performing worse than most other major economic areas. Furthermore, within the eurozone, countries continue to have very different levels of competitiveness, often due to different levels of investment in key drivers of growth, such as education, R&D, and skills. Unless Europe kick-starts a new action plan that looks at both the rate of growth and its direction, there is a risk of a decade of stagnation for the continent. This was true before COVID-19 hit the continent and is even more true now.[57]

4.2 The need for long-term, patient finance for the world's grand challenges

Finance is not neutral. The characteristics of financial actors, vehicles, and methods affects investments made, activities undertaken, and outcomes observed.[58] The private financial sector often tends towards a short termism and risk-averse approach that frequently results in latter-stage investment, taking on a narrower portfolio of low-risk items only once future returns are secure. In the past, this has led to calls for state finance to ameliorate risk-return ratios; this is particularly visible in the energy and infrastructure space. The rationale is that this will open the 'floodgates' of private finance and resolve the problem. However, private finance galvanised through these methods does not always improve the quality of funding for sustainable innovation.[59]

Sustainable innovation requires patient, long-term, strategic finance. But the private sector will not fund the market for sustainable business, so the long-term business models and capex needed to align activity with sustainability alone. There is not yet a ready-made route that will make multi-directional, experimental, green innovation profitable.[60] Only when there is a stable and consistent direction for investment will regulation and innovation converge along a green trajectory. Business does not invest unless it sees an opportunity for growth, so turning mitigation into opportunities for investment and innovation is key.[61]

This has been proven in long-lifespan assets such as renewables, for which the characteristics of short-term funding are poorly suited. Indeed, the US post-2008 Recovery Act provides an example of public finance actively de-risking and tilting the playing field in a green direction, as the stimulus provided high risk, early-stage investment into renewables. It not only offered much-needed capital but shifted the asset classification of renewables from 'unconventional' or high-risk 'energy' assets, towards more reliable 'infrastructure' assets, crowding in long-term institutional investors such as pension funds and insurers.[62]

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[57] Mazzucato, M. , McPherson, M., Dibb, G. 2020. 'The path to COVID recovery: the urgent need for the EU Green Deal and a new approach to Industrial Strategy'. UCL IIPP Medium. Accessible at https://medium.com/iipp-blog/the-path-to-covid-recovery-the-urgent-need-for-the-eu-green-deal-and-a-new-approach-to-industrial-e91a4ad5ae7

[58] Mazzucato, M. and Semieniuk, G. 2018. Financing green growth. UCL Institute for Innovation and Public Purpose Working Paper Series (IIPP WP 2018-04)

[59] Mazzucato, M and McPherson, M. 2019The green entrepreneurial state: What the Green New Deal can learn from the IT revolution. UCL Institute for Innovation and Public Purpose, Policy Brief series (IIPP PB 08).

[60] Mazzucato, M., Perez, C. 2014. Innovation as Growth Policy: The Challenge for Europe'. SPRU Working Paper Series.

[61] Mazzucato, M., McPherson, M., (2019). The Green New Deal: A bold mission-oriented approach. UCL Institute for Innovation and Public Purpose, Policy Brief series (IIPP PB 04).

[62] Varro, L. et al. 2020. Green stimulus after the 2008 crisis. International Energy Agency. Accessible at https://www.iea.org/articles/green-stimulus-after-the-2008-crisis

Considering patient finance in the EU, seven years, as provided for in the EU's expected budget, may be a significant time horizon compared to other short-term funding mechanisms. However, this is not long-term by the standards of truly 'patient' finance, which is needed for transformative change. The innovation that the EU needs – technological, organisational, institutional, and social – as we move into a green and sustainable transition period requires substantial changes to the global economy. It is also characterised by uncertainty. We do not yet know which innovation pathways will take off and succeed, and which will not. We need to ensure that a portfolio, multi-pathway approach is taken to investment, and that each route is supported across the innovation chain. This would allow for opportunities from basic research through to full deployment, and from general purpose technologies through to highly-specialised design to flourish. This requires finance that is risk-welcoming and dependable, and that is able to absorb the possibility of failure.

There is a significant entrepreneurial role for the state to provide this patience. The 2020 crisis has underscored this potential. This is something that is being written about extensively by researchers at the UCL Institute for Innovation and Public Purpose (IIPP), as well as being explored 'on the ground', working with national, international, and local governments to widen their role towards 'market-shaping' and 'market co-creating' with the private and third sectors[63], rather than the narrow arena of simply 'fixing market failures' that has been seen as the purview of government. This has included projects on market-shaping and taking a mission-oriented innovation[64] approach[65] to do so, in areas as diverse as London, Mexico, Manchester, Italy, and Colombia, and at the intra-national level of the European Commission itself.

4.3 The finance ecosystem that is needed: Macro, Meso and Micro level

An ecosystem of public finance and public policy is needed to direct the European economy towards a sustainable direction and to actively 'tilt the playing field' in favour of sustainable activity. This requires alignment and active discussion between multiple financial institutions at macro- (monetary and macroprudential policy), meso- (long-term finance from public financial institutions), and micro- (firm) economic policy level. A project at IIPP, Priming Public Sector Financial Institutions for the Green Transition (PUFFIN) with EIT Climate-KIC, aims to understand the implications and interlinks between these three layers and how they can be better aligned, via deep dive case studies and interviews with institutions across Europe.[66]

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[63] The 'third sector' is an umbrella term that covers a range of different organisations with different structures and purposes, belonging neither to the public sector (i.e., the state) nor to the private sector (profit-making private enterprise), such as the voluntary sector, non-governmental organisations, non-profit organisations

[64] UCL IIPP. Mission Oriented Innovation web page. Accessible at https://www.ucl.ac.uk/bartlett/public-purpose/research/mission-oriented-innovation

[65] Mission oriented approach: Focus on societal challenges drawn from the Sustainable Development Goals, or the Paris climate change agreement, or from related national priorities. These give a very clear agenda for innovation and research, and provide a very clear focus on tangible, concrete actions that will be meaningful for transitioning society to where we need to be, in order to achieve goals for sustainable development. Another key aspect of missions is taking a systemic approach, deliberately moving across existing structures and organisational boundaries, finding the gaps and gluing them together, and working in a far more people and place-based way as a result.

[66] PUFFIN team. 2019. The PUFFIN Project: Briefing Pack for participants. Accessible at https://www.ucl.ac.uk/bartlett/public-purpose/sites/public-purpose/files/briefing_pack_puffin_project_final_web.pdf

First, setting a conducive macroeconomic framework for investment is key. While central banks have played an increasingly interventionist role in our economies since the financial crisis, this has not coincided with any significant adjustment of their policies in support of financing a zero-carbon transition.[67] However, there has recently been an explosion of research and policy analysis by central banks in this field. From a sustainability perspective, there has been particular emphasis on the way in which climate-related financial risks and nature-related financial risks may impact central banks' established financial stability mandates.[68]

The European Central Bank is increasingly publicly questioning the concept of 'market neutrality' - the idea that central banks act as a mirror to the market in terms of their bond purchasing and other programmes - in a changing and transforming environment such as that which exists in the climate crisis.[69] Re-conceptualising financial stability, and therefore the mandate or 'mission' of central banks, to include both climate risk and the far-less quantified risks attributable to natural and environmental degradation will be a vital step in Europe's long-term recovery and resilience. This is a shift which seems to be taking place in the world of central banking, and the European Central Bank should take a forward-thinking stance.

Secondly, at the 'meso' level, the role of national public investment organisations, including investment funds, infrastructure banks, national promotional banks, and so on, provide positive sources of long-term patient finance, which have been proven to support sustainable investing. While the traditional functions of state investment banks have been to provide infrastructure investment and counter-cyclical lending, some have taken on a new role as key global actors steering the path of innovation towards addressing contemporary challenges such as climate change. The German development bank KfW, through its systems-led 'One Health' approach, has set pace for other development and investment banks.[70]

In Europe, looking forward to post-pandemic recovery, a vital lever will be the European Investment Group (EIG), made up of the European Investment Bank (EIB), along with the European Investment Fund. The EIG has the expertise and scale to set direction in deploying equity-type financial instruments that are complementary to loans and guarantees. This is important for companies that are increasingly indebted in the crisis. Financing the plans set by the commission will require a mixture of financial instruments to cater to various types of risk. The EIB will need to be more risk-welcoming while investing in analytical expertise and market intelligence to assess challenge-oriented investments based on future scenarios. It will also act as a co-manager of the InvestEU programme together with state investment banks and national promotional banks. The EIB has pledged to become the world's 'climate bank', aiming to provide 1 trillion euros of investment in climate action and environmental sustainability from 2021 to 2030.[71]

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[67] Ryan-Collins, J. 2020. 'Central Banks must change course if they are to lead us out of the coronavirus crisis'. https://www.theguardian.com/commentisfree/2020/may/26/banks-uk-recover-coronavirus

[68] Kedward, K., Ryan-Collins, J. and Chenet, H. (2020). Managing nature-related financial risks: a precautionary policy approach for central banks and financial supervisors. UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2020-09)

[69] Schnabel, I. 2020. 'Monetary policy in changing conditions'. Bank for International Settlements. Accessible at https://www.bis.org/review/r201104e.htm

[70] Huong Le, L. et al. 2020. Materials on Development Finance. KfW Development Bank. Accessible at https://www.kfw-entwicklungsbank.de/PDF/Download-Center/Materialien/2020_Nr.11_One-Health_EN.pdf

[71] Mazzucato, M. and Mikheeva, O. (2020). The EIB and the new EU missions framework, UCL Institute for Innovation and Public Purpose, IIPP Policy Report (IIPP WP 2020-17)

This macro-meso-micro interaction can be supported by cross-governmental policy-making that aims squarely at mobilising cross-sectoral business activity. Industrial strategies, increasingly developed by governments around the world, are an example of the kind of cross-sectoral policy with the potential to direct economies towards sustainable development through innovation and investment. Indeed, the UK, although it is now leaving the European Union, can be an exemplar in this regard: In 2017, the UK authored a challenge-led National Industrial Strategy, supported by regional Local Industrial Strategies, in which four 'grand challenges' – large, societal challenges – were identified as key cross-sectoral arenas for setting missions. This approach should be actively explored by the European Industrial Strategy as it is developed and increasingly aligned with recovery tools throughout 2021.[72]

4.4 Conditionalities: A once-in-a-generation opportunity to direct economic growth

The shortage is not of money; the innovation gap is in direction-setting for the money that is being placed at the disposal of NGEU and the RFF. The SDGs can and should be drawn on to provide a useful framework for creating conditions on the finances available.

Condition-less bailouts in 2008 allowed policy-makers to flood the world with liquidity without directing it toward good, or even specific, investment opportunities. Outcomes from this approach often led to money going back into the financial sector, away from the real economy which could have fuelled investment-led growth and recovery. With so much at stake in the climate crisis, and a need to embed resilience against uncertain future risk in the European recovery, we cannot afford to make this mistake again.

COVID-19 relief conditionalities can align with sustainable outcomes, if well designed, and there are differences between 'emergency' liquidity lending, the rapidity of which can make it difficult to attach conditions, and longer term lending geared towards recovery.[73] Conditions can be attached to the latter, to make sure that bailouts are structured in ways that transform the sectors they're saving so that they become part of a new economy, one that is focused on 'Green New Deal' principles of lowering carbon emissions while also investing in workers and making sure they can adapt to new technologies. Whether emissions targets, green R&D investment, or carbon-intensive materials use, conditions around worker treatment, including minimum wage, and payroll retention, could be attached to high-carbon sectors.

Such approaches have been undertaken in some countries. In France, the bailouts for both Renault and Air France were conditional on carbon reduction commitments (as well as stopping flying domestic routes where there are rail competitors). In both France and Denmark, state aid is denied to any company domiciled in an EU-designated tax haven and large companies receiving aid are being barred from paying dividends or buying back their own shares until 2021. The US CARES Act conditions include limits on compensation for the highest paid airline employees, and maintenance of employee pay.[74]

The narrative must also be developed in a manner which allows European citizens and the business community to understand their benefits, rather than see them as a tool which is 'picking on' high carbon activity at a time when demand is already dampened - for example with flights and car purchase decreases. Conditionalities should not be seen as increasing access barriers to doing business – instead they align corporate behaviour with long-term societal needs. If we are serious about heading towards a greener economy, the companies that switch organisations in that direction soonest will be the most competitive, most innovative and most successful over time.

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[72] Gov.UK. 2019. The UK's Industrial Strategy. Accessible at https://www.gov.uk/government/topical-events/the-uks-industrial-strategy

[73] McDonald, D.A., Marois, T., and Barrowclough, D.V. (Eds.). 2020. Public Banks and Covid-19: Combatting the Pandemic With Public Finance.Municipal Services Project (Kingston), UNCTAD (Geneva), and Eurodad (Brussels)

[74] Mazzucato, M., Andreoni, A. 2020. 'No More Free-Lunch Bailouts. Project Syndicate. Accessible at https://www.project-syndicate.org/commentary/conditional-bailouts-of-private-companies-2020-crisis-by-mariana-mazzucato-and-antonio-andreoni-2020-06

4.5 What questions should Europe be asking?

The question faced by the European Union is: what does it mean to govern resilience and recovery policy in a way that drives sustainable development and creates public value?

A key place to start from is existing policy. Milton Friedman said, "Only a crisis - actual or perceived - produces real change. When that crisis occurs, the actions that are taken depend on the ideas that are lying around". In this instance, Europe must ensure that the ideas lying around are not its answer to the 2008 financial crisis, such as austerity-led nation-state bailout conditionalities and fractured inter-European relationships, which did nothing to increase resilience to forthcoming shocks.[75]

Instead, investment must be based on the carefully and thoughtfully laid policies already laid out in Europe, including the Industrial Strategy; the European Green Deal (EGD), with its pledge to 'leave no one behind'; the Just Transition Mechanism (JTM); the work ongoing on Circular Economy, Biodiversity and the 'Farm to Fork' sustainable food strategy; and the mission-oriented approach underpinning Horizon Europe that is also being embraced by member states and at the sub-national level. These are critically interlinked policies that come with the potential for new ways of participating in capitalism, for new routes to economic growth, and a new prioritisation of citizens in the post-COVID society.

The enhancing of the EGD in 2020, with a commitment to reduce emissions by at least 55% on 1990 levels by 2030, indicates a show of trust in the EGD, along with the European Commission President Ursula von der Leyen's public statement that the EGD will be the "compass" and "motor for the recovery".[76] The JTM is a crucial element in ensuring that the rights of workers, who have suffered in the COVID-19 crisis so far, are prioritised in the 'build back better' approach to a carbon-neutral continent. This mechanism and fund, if used correctly, can ensure that new structures are built between workers, employers, and organisations towards a fairer 'stakeholder capitalism'. While transitioning away from energy-intensive and polluting industries is important, so are the people currently relying on these industries for their livelihoods. With the unemployment rate in the Eurozone currently at 8.4%, there are many unemployed people who could be put to work on many of the promises of the EGD. This is an opportunity to increase economic growth and job security.[77]

4.6 Integrating the SDGs into the European Recovery

Whilst these key 'jigsaw piece' policies are in place, there is work to do – as outlined in the preceding sections – in ensuring that they share and reflect the holistic nature of the SDGs. Each of the policies outlined above has high ambitions and is backed by impactful stakeholders, but the language of each does not make as much explicit use of SDG wording as might be possible.

Linking the missions approach that is at the heart of the Horizon Europe Research, Science and Innovation programme through to wider policies such as the EU Industrial Strategy, and the EGD, could support the integration of the SDGs into the European Recovery. Mission-oriented innovation is one mechanism through which governments at national and local level can approach the 'market-shaping' rather than 'market-fixing' role outlined above, orienting economic activity and prosperity in the direction of big societal challenges. The SDGs can provide the grand challenges from which missions are built; missions then provide concrete actions and roadmaps and build out long-term, ambitious goals that galvanise multiple bottom-up innovation approaches from cross-sectoral consortia.

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[75] Mazzucato, M. 2020. 'The success of the EU recovery fund will depend on bold missions'. Accessible at https://www.ft.com/content/b26f6785-e08a-450b-8c62-bdafbeb5ff2c

[76] Mazzucato, M. , McPherson, M., Dibb, G., 'The path to COVID recovery: the urgent need for the EU Green Deal and a new approach to Industrial Strategy'. UCL IIPP Medium. Accessible at https://medium.com/iipp-blog/the-path-to-covid-recovery-the-urgent-need-for-the-eu-green-deal-and-a-new-approach-to-industrial-e91a4ad5ae7

[77] Current Eurostat statistics for October 2020 as of 11/12/20

For the pandemic in particular, missions can be used for stimulating innovation in areas as different as vaccines (SDG 3), to online education for the digital divide experienced by students while studying from locked down homes (SDG 4), to ensuring access to water and sanitation for all (SDG 6). COVID-19 is the moment which makes mission-oriented, innovation-led economic renewal in the direction of the SDGs unavoidably urgent. At member state level, the EU could explore the opportunity of NGEU lending to support the reconnaissance of local government capacity and capabilities to work on the SDGs, making public service an attractive career opportunity for people across the continent. The recently launched 'New European Bauhaus' movement, with its ambition to draw ideas for the European Recovery from interdisciplinary innovation between academics and practitioners in social sciences, arts, architecture, economics, could be an exciting and galvanising narrative.[78]

Below, we include two short case studies, based on IIPP work, which aim to demonstrate how the SDGs, missions, and finance can constructively co-ordinate towards a green and sustainable economy at national and regional level.

4.7 Case studies: Financial mechanisms to tilt the playing field in the direction of the Sustainable Development Goals

Case study 1: New patient public sector financial institutions: a new National Investment bank for Scotland that is linked to the SDGs

Over the past three years, Scotland has been designing and planning for a pivotal institutional innovation in long-term, patient finance. The Scottish government has been looking to a long-term, public, patient finance vehicle to support specific goals, including the green transition, and 'place-making' i.e., supporting investment outside of traditional urban and financial centres.

IIPP worked with Scottish First Minister Nicola Sturgeon to write the blueprint for a new Scottish National Investment Bank, to be mission-oriented towards a zero-carbon economy.[79] The bank's zero-carbon mission was announced in the September 2019 Programme for Government and formally launched on the 23rd November 2020[80].

An IIPP paper, "A mission-oriented framework for the Scottish National Investment Bank," presents a framework for guiding the bank's investments towards tackling key societal challenges and promoting transformational change across Scotland's economy. This 'mission-oriented' approach to policy-making is not about top-down planning by an overbearing state; it is about providing a direction for growth, increasing business expectations about future growth areas, and catalysing activity – self-discovery by firms – that otherwise would not happen.[81]

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[78] Europa. 2020. A New European Bauhaus: op-ed article by Ursula von der Leyen, President of the European Commission. Accessible at https://ec.europa.eu/commission/presscorner/detail/en/AC_20_1916

[79] UCL IIPP. 2019. 'New IIPP report sets out a mission-oriented vision for the Scottish National Investment Bank'. Accessible

[80] Gov.Scot. 2019. Protecting Scotland's Future: the Government's Programme for Scotland 2019-2020. Accessible at https://www.gov.scot/publications/protecting-scotlands-future-governments-programme-scotland-2019-20/

[81] Mazzucato, M., Kattel, R. & Ryan-Collins, J. Challenge-Driven Innovation Policy: Towards a New Policy Toolkit. J Ind Compet Trade 20, 421–437 (2020).

Figure 11. Scotland's SDG-led National Performance Framework

The bank's national missions are underpinned by international challenge-led thinking and agreements on the SDGs. In 2018, the Scottish Government updated its world-leading National Performance Framework (NPF), which sets out a vision for national wellbeing in Scotland across a range of economic, social and environmental factors. As illustrated in Figure 11, the NPF consists of 11 'national outcomes' that reflect the values and aspirations of the people of Scotland and are aligned with the UN SDGs.

Case study 2: Using fiscal policy as a lever: Biscay's regional SDG oriented tax policy

The tax powers of the Biscay Government in Spain enable it to do something revolutionary: become the first regional authority to implement fiscal policies that are aligned with the UN SDGs. In 2020, IIPP embarked on a partnership with the Biscay Regional governor and the region's tax team to rethink tax policy and consider how the SDGs can be used to set a direction for the region's development.

While different models for aligning taxation and the SDGs were considered, the proposed changes focus on rewarding firms that are making contributions towards Biscay's priority SDGs. The programme has identified a series of contribution areas against which companies report their actions. These actions are tallied in a manner that allows for participating companies to be compared and receive, where eligible, a different tax treatment. This is currently moving through the legislative process.

Globally, this is the first initiative of this type, and marks a significant advance in the proposed use of tax instruments to benefit the SDGs. The SDGs help to clarify what type of economy, society, and environment the region wants in the future, and, through the use of tax instruments, the government is able to incentivise action towards these goals. More fundamentally, this work contributes to a reappraisal of the potential for governments worldwide to take a more proactive role in driving sustainable development.

Section 5. Effects of Sustainability Transition on Jobs and Skills

It has become increasingly evident that the world is living beyond the limits of our planet, exceeding global biocapacity in many aspects, and the European continent is responsible for a substantial share of this degradation[82]. Coping with this planetary emergency entails numerous challenges. One issue that has been addressed in recent years is the impact of environmental protection on employment, as policy makers recognise the need for policies and investments to induce green growth. Two years ago, the International Labour Organisation (ILO) conducted a review of studies on green jobs. The ILO concluded that the evidence surrounding green policy's impact on employment was limited, mostly based on simulations rather than empirical evidence, focused on energy and paid less attention to economic sectors, and largely ignored developing countries, gender aspects, and questions about the quality of the jobs created.[83]. Since that review, the analytical base has improved, and the COVID-19 pandemic – with the associated 400+ million job losses in the second quarter of 2020[84] – has highlighted the need to focus on policies that restore employment while avoiding the exacerbation of global climate change and resource depletion. It has been repeatedly stated that the right investments at this stage will need to be labour-intensive in the short run and have high multipliers and environmental co-benefits[85].

The European Green Deal Investment Plan (EGDIP) aims at mobilising at least €1 trillion in sustainable investments over the next decade, part of long-term efforts to reach net-zero greenhouse gas (GHG) emissions by 2050 for the European Union, as well as contribute to short-term efforts to stimulate economic recovery in the face of the Covid-19 pandemic and financial crisis. These investments, a mix of public and private expenditure, can profoundly reshape the energy sector across Europe, including economy-wide employment patterns.

In this context, efforts to assess the effect of investments and reforms on the job market have been stronger than ever before. Meta-studies have reviewed the findings from the available international literature in order to propose a way forward. This section focuses on a few studies that can directly inform European policymakers and offers a set of criteria that can aid decision-making in the current uncertain economic environment; a detailed review of a large number of studies with European relevance is provided in Annex III of this report.

5.1 Employment impact of clean energy projects

The International Energy Agency (IEA) offers a helpful framework of findings and recommendations related to the green transition and its effect on jobs.[86]. In response to calls from governments around the world, the IEA produced a *Sustainable Recovery Plan* for actions that can be taken over the next three years. The Covid-19 pandemic has created a historic crisis for economies and energy markets; the greatest peacetime economic disruption in living memory is having a severe impact on employment and investment across all sectors, including energy. This disruption has sent shock waves through energy markets, with global energy investment expected to shrink by an unparalleled 20% in 2020.

Based on rigorous analysis conducted in co-operation with the International Monetary Fund (IMF), the IEA's Sustainable Recovery Plan has three main goals: boosting economic growth, creating jobs, and building more resilient and cleaner energy systems. The Sustainable Recovery Plan shows it is possible to simultaneously spur economic growth, create millions of jobs and put emissions into structural decline. The IEA considered the circumstances of individual countries as well as existing pipelines of energy projects and current market conditions and provided assessments

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[82] Is Europe living within the limits of our planet? European Environment Agency, Copenhagen, April 2020.

[83] Green growth, just transition, and green jobs: there's a lot we don't know. Employment Research Brief, International Labor Organization, Geneva, May 2018.

[84] ILO Monitor: COVID-19 and the world of work. Fifth edition. International Labor Organization, Geneva, 30 June 2020.

[85] Stern N., Bhattacharya A. and Rydge J. (2020) Better Recovery, Better World: Resetting climate action in the aftermath of the COVID-19 pandemic. The Coalition of Finance Ministers for Climate Action, July 2020.

[86] IEA (International Energy Agency), *Sustainable Recovery*. Paris, France, July 2020.

of more than 30 specific energy policy measures that can be carried out over the next three years. According to the Agency, implementation of this plan would require global investment of about USD 1 trillion annually over the next three years, or 0.7% of global GDP, and can add 1.1 percentage points to global economic growth each year, saving or creating about 9 million jobs a year over the next three years.

IEA's energy employment database shows that in 2019, the energy industry directly employed around 40 million people globally. It is estimated that 3 million of those jobs have been lost or are at risk due to the impacts of the Covid-19 crisis, with another 3 million jobs lost or under threat in related areas such as vehicles, buildings and industry. The Sustainable Recovery Plan can create and maintain jobs, especially in retrofitting buildings and improving their energy efficiency, and in the electricity sector, particularly in grids and renewables. Other major areas where jobs are created or saved include energy efficiency in industries such as manufacturing, food and textiles; low-carbon transport infrastructure; and more efficient vehicles.

To standardise the comparison of employment creation, the IEA developed employment multipliers for the various measures based on the gross number of jobs that would be produced for every million dollars spent in each measure. These numbers represent global weighted averages for the gross direct and indirect jobs created. Direct jobs denote the jobs created by a renewable energy or energy efficiency project itself, while indirect jobs relate to jobs associated with the manufacturing of the equipment of a renewable plant or an energy efficiency retrofit/replacement. A third category of employment effects (jobs that may be induced or lost by the subsequent spending or saving of new workers) are not included in IEA's assessment. Tables 14 and 15 present these multipliers for specific energy-related capital investments and spending respectively[87]. The related measures proposed for consideration by policy makers are the following:

- **Electricity:** Support the expansion and modernization of electricity grids; accelerate new wind and solar installations and repower existing ones; maintain the role of hydro and nuclear power, mainly by preserving existing facilities; and manage gas- and coal-fired generation. Each option has the potential to create 1-14 jobs per million dollars invested and would have very different impacts on energy resilience and sustainability.
- **Transport:** Car sales are expected to drop by around 15% globally in 2020. Government support through schemes such as "cash-for-clunkers" could reduce job losses, boost the efficiency of the vehicle fleet and promote the use of electric cars. Investment in high-speed rail and urban transport – walking and cycling infrastructure, electric vehicle recharging and mass transport – has significant job creation potential while at the same time reducing local air pollution.
- **Buildings:** Measures to improve the efficiency of buildings and appliances could be implemented quickly, in some cases have very short payback periods and would create 10-15 jobs per million dollars invested. In low-income countries, over 2.5 billion people still lack access to clean cooking. Low LPG prices make providing access attractive, with payback periods of just one year, plus substantial job creation potential.
- **Industry:** One-in-four of all jobs are in industry, and the Covid-19 pandemic has disproportionately hit small and medium industrial enterprises. Investing in energy efficiency, notably motors and agricultural pumps, and recycling would create around 10 and 18 million jobs per million dollars invested respectively.
- **Fuels:** Investment to reduce methane emissions could mitigate some job losses in the oil and gas sector while cost effectively reducing GHG emissions. The current period of low oil and gas prices provides fertile ground for renewed efforts to phase out fossil fuel subsidies. The biofuels sector is being hit hard by Covid-19: supporting growth in sustainable biofuels could create around 15-30 jobs per million dollars invested.
- **Innovation:** Technology innovation plays a crucial role in improving future energy systems, and innovation in hydrogen, batteries, small modular nuclear reactors, and carbon capture, utilization and storage could bring enormous long-term sustainability and resilience benefits while creating 3-8 new jobs per million dollars invested.

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[87] IEA's multipliers for 'advanced economies' are shown, as they are the most relevant for European nations.

Type of investment	Construction	Manufacturing	Total
Electricity:			
New Grids	4.4	1.1	5.5
Existing Grids	5.3	1.9	7.2
New hydro	1.3	0.3	1.6
New nuclear	0.8	0.7	1.5
Wind power	0.9	0.8	1.7
Solar PV	6.8	5.4	12.2
Unabated coal-fired power	4.0	1.5	5.5
Unabated gas-fired power	1.4	3.0	4.4
Hydrogen production	-	-	5.9
CCUS	-	-	2.5
Reduced methane emissions	-	-	3.8
Transport:			
Urban transport infrastructure	-	-	11.4
High-speed rail	-	-	6.6
Buildings:			
Buildings efficiency retrofit	-	-	14.8
Efficient new buildings	-	-	15.2
Industrial efficiency	-	-	9.9

Table 14. Employment multipliers expressed in jobs created per $m of capital investment. Source: IEA (2020)

Type of spending	
Transport - New vehicles	6.4
Appliances in buildings	9.1
Batteries	6.5
Biofuels	14.7
Recycling in industry	13.1

Table 15. Employment multipliers expressed in jobs created per $m of spending. Source: IEA (2020)

Employment in all clean energy sectors is set to grow during the 2020s but will need to grow much more rapidly in order to support the levels of investment necessary to achieve the IEA's Sustainable Development Scenario. This scenario describes the energy system changes and investments needed to meet Paris commitments and the energy-related Sustainable Development Goals (SDGs).

Europe is one of the leading geographies to commit substantial funds to a sustainable recovery as a part of the European Green Deal Investment Plan (EGDIP). The scale of investment outlined for the next 10 years creates a need for a rapid scaling up of clean energy employment in the region. This is in line with the European Commission's intention to boost the economic potential of the European energy sector as a cornerstone of the new EU industrial and growth strategy[88]. While the final levels of investment will depend on a series of factors, the portfolio touches on all of the major measures associated with the IEA's sustainable recovery plan. Accordingly, the IEA has estimated a range for how many additional employees must be added per 1 million USD of incremental investment in Europe (Figure 12).

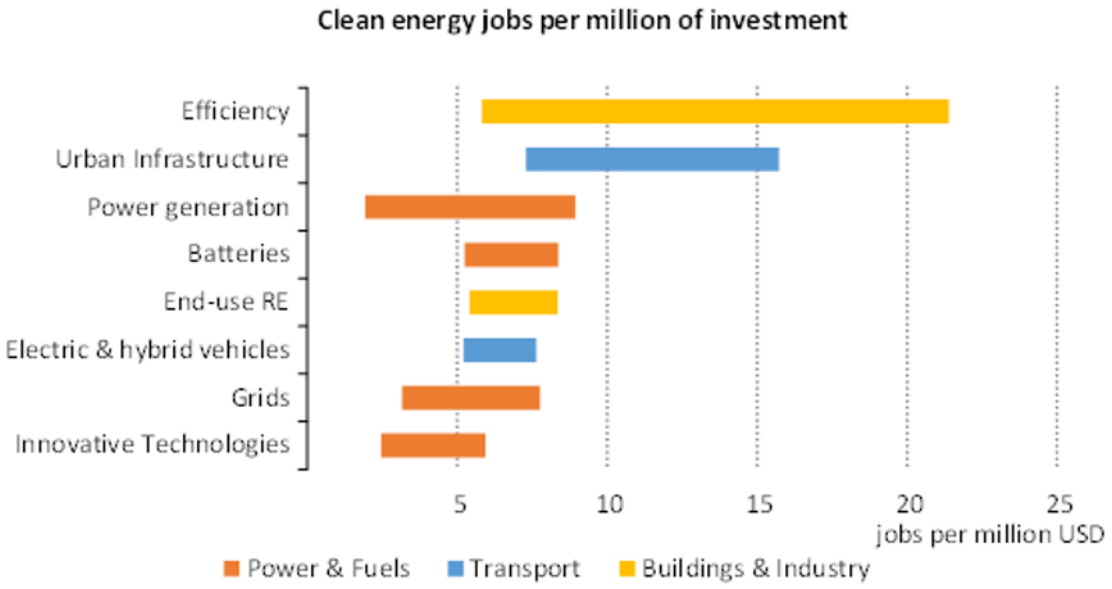

Figure 12. Number of additional European jobs needed to support an additional per one million USD of incremental investment annually. Source: IEA analysis

This rapid scale up of employment can necessitate a doubling of the current workforce in nascent industries like EV production. But even in established segments like electricity networks and power generation, a 30% increase in the workforce would be required in Europe, on top of massive shifts and retraining of the current workforce to work on new segments of business. This poses challenges for the companies expanding their workforce and for policymakers striving to maintain a stable labour market amidst a rapid shift toward a new energy economy. This includes recruiting and cultivating the necessary talent pool, creating effective industrial policy to quickly mobilise investment, managing dislocations and local impacts to the economy, and optimizing against other policy goals such as equity and inclusion.

Globally, clean energy jobs are highly skilled, with around 40% of jobs requiring highly skilled individuals, while less than 5% can be filled by untrained manual labour. In Europe, the share of highly skilled positions may be even higher, given the types of energy investments required in Europe and the nature of the current global supply chain for clean energy. This underscores the importance of workforce training and retraining, which must target universities, trade schooling, and vocational retraining programs, which can be a key focus for EGDIP's Just Transition Mechanism.

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[88] European Commission, Report from the Commission to the European Parliament and the Council on progress of clean energy competitiveness. Document COM(2020) 953 final, Brussels, October 2020.

Most roles created would require at least moderate retraining, which can focus on transitioning workers within the same industry from one segment to another or between industries but within the same occupation (e.g., a construction worker being retrained to conduct high quality building energy envelope investments). It is important to note the quality of retraining programs has material impacts on the effectiveness of delivering cost-effective emissions reductions. For example, studies[89] indicate that in building retrofits, bringing the least skilled labourers up to the best in-class skill base improves the amount of emissions delivered per project substantially.

These trainings could also target those entering the workforce for the first time, as well as addressing asymmetry in the participation of women and other underrepresented communities in the energy industry. Globally, males hold around 93% of construction jobs and more than 60% of manufacturing jobs, which are the two labour segments which will transform the most within a clean energy transition. Unless gender occupational segregation is addressed, the jobs created by sustainable recovery plans are likely to be taken mainly by men. A multi-track approach is needed to close gender gaps and achieve equality in employment and remuneration (ILO, 2019). Rights at work should ensure that women and men have equal opportunities, are protected from discrimination and have access to maternity and parental leave allowances. Child-care policies, support for lifelong learning, an enabling environment for female entrepreneurs and social dialogue would also contribute to empowering women in the labour market.

Clean energy measures would stimulate demand for imports of goods and services, especially in the short-term. Suppliers for high-tech goods and services (for example relating to power networks and high-speed rail) are often located in advanced economies, while basic fabrication materials and appliances are often manufactured outside of advanced economies. Clean energy transition policies intersect with broader questions of industrial policy and national energy security objectives. Directing investments into one segment of the energy economy versus another could be used to maintain or develop a higher proportion of jobs by promoting local industries and developing domestic supply chains, although this would need to be balanced against the need to ensure competitiveness. While, for example, increased demand for electric vehicles or solar panels in the near-term may drive up manufacturing in other parts of the world, EGDIP's investments could help shift current production lines to efficient, low-carbon alternatives or could help seed new manufacturing in Europe. Europe must consider not just the scale up of the European market, but also how the simultaneous scale up of clean energy demand and production impacts prices, availability of critical labour and material inputs, and relative competitive advantages globally. This is especially prescient in light of recent announcements by other national governments of net-zero emissions commitments. International cooperation and trade agreements could help reduce potential areas of conflict and mutually reinforce and accelerate collective action and economic activity in this space.

More details on the impacts of EGDIP's investments on the European labour force will be detailed in a forthcoming analysis by IEA, in collaboration with the European Investment Bank, and included in EIB's Investment Report 2020/21[90].

The International Renewable Energy Agency (IRENA) reinforces IEA's findings. In its most recent "Global Renewables Outlook"[91], it includes an "ambitious but achievable" Transforming Energy Scenario, in which jobs in the overall energy sector – comprising transition-related technologies (renewable energy, energy efficiency, and power grids and energy flexibility), fossil fuels and nuclear power – could reach 100 million by 2050 or 15% more than under a scenario that reflects current national energy policies, and 72% more than total energy employment at present. New jobs in transition-related technologies are expected to outweigh job losses in fossil fuels and nuclear energy.

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[89] See e.g. Pollin et al. (2014), Green Growth: A U.S. Program for Controlling Climate Change and Expanding Job Opportunities. 2014. https://www.peri.umass.edu/publication/item/585-green-growth-a-u-s-program-for-controlling-climate-change-and-expanding-job-opportunities

[90] IEA, Ramping up clean energy jobs in Europe, insights from IEA Sustainable Recovery Plan. Unpublished Note, November 2020.

[91] IRENA, Global Renewables Outlook: Energy Transformation 2050. International Renewable Energy Agency, Abu Dhabi, 2020.

In 2050, energy efficiency and power grids could employ 21% and 14% more workers than business as usual. By contrast, there would be 27% fewer jobs in fossil fuels in 2050, at just 22 million. Investments projected under the Transforming Energy Scenario would stimulate considerable job growth, most of it directly in renewables, where employment would rise to 64% higher levels than under business as usual and close to four times the number of jobs in the sector today. Solar photovoltaic (PV) would account for almost half of these jobs, followed by bioenergy and wind. Among segments of the renewable energy value chain, construction and installation jobs would dominate. In terms of occupational profile, construction and factory workers, together with technicians, would hold a 77% share of total employment. Nonetheless, this transition comes with challenges: the expanded renewable energy workforce will require specific knowledge and skill sets. The labour market must be able to meet those needs, which would entail education, (re-) training and social policies, among other measures.

The Transforming Energy Scenario would also achieve a small net increase (6.5 million) in the total number of jobs created economy-wide by 2050, 0.15% more than under business-as-usual conditions. This includes not only investments, but also indirect and induced employment effects across many sectors of the global economy, as well as changes in trade patterns. As IRENA points out, maximizing the job creation potential of the energy transition requires a solid understanding of future skill requirements, including targeted education and capacity-building policies.

Responding to the challenges of the pandemic, IRENA prepared a proposal for a sustainable economic recovery in summer 2020[92]. With its own estimates of employment multipliers that are higher than those of the IEA (Tables 20 and 21), the organisation states that each million dollars invested in renewables or energy flexibility would create at least 25 jobs, while each million invested in efficiency would create about 10 jobs. With the added investment stimulus already simulated in IRENA's Transforming Energy Scenario mentioned above, energy transition-related technologies would add 5.5 million more jobs by 2023 than would be possible under business-as-usual conditions, far more than the 1.07 million jobs projected to be lost due to reduced investments in the fossil fuel and nuclear sectors. Importantly, the Agency's analysis finds that this transition would yield net job gains in all regions of the world, including those where fossil fuel jobs are now concentrated. It therefore provides a list of energy transition measures for the short and medium term that would enable reaping these benefits.

5.2 The broader effect of green investments

Other national or international studies, which are reviewed in Annex III, provide support to the recommendations of IEA and IRENA mentioned above. In summary, they demonstrate that:

- Investment in clean energy and energy efficiency creates up to three jobs for each job lost in the fossil fuel sector, and for each $1 million shift in expenditures from fossil fuels to clean energy, an average of five additional jobs may be created[93]. Renewable energy investments are expected to yield the strongest employment benefits in some European countries, while energy renovations may create more jobs in others[94].
- Climate action brings about net job creation. According to the ILO, investing for a sustainable energy sector can create around 18 million more jobs globally by 2030. This is the result of around 24 million jobs created and around 6 million jobs lost. Out of 163 economic sectors analysed, only two (petroleum refinery and extraction of crude petroleum) are projected to exhibit significant job losses in the coming decade[95].

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[92] IRENA, The post-COVID recovery: An agenda for resilience, development and equality. International Renewable Energy Agency, Abu Dhabi, 2020.

[93] Garrett-Peltier, H., Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling* Vol. 61 (2017), 439-447.

[94] See e.g. the review of studies of Arvanitopoulos and Agnolucci (2020), Kamidelivand et al. (2018), Makraki et al. (2013) and Ram et al. (2019) in Annex III.

[95] ILO, *Greening with Jobs – World Employment Social Outlook 2018*. International Labor Organization, Geneva, 2018.

- Beyond clean energy, the transition to a circular economy can also be a significant employment generator in Europe; growth in services and waste management offset job losses in mining and manufacturing. Furthermore, the adoption of organic agriculture in developed countries will attract more labour to the sector, leading to a growth in employment in agriculture in Europe[96]. Experience from recovery measures deployed in the US after the 2008 crisis showed also that nature-based interventions like habitat restoration and other conservation measures had a higher job creation potential than traditional industries; this is due to the high labour intensity and low capital intensity of such investments[97].
- According to McKinsey, a low-carbon recovery can both initiate the significant emissions reductions needed to halt climate change and also create more jobs and economic growth than a high-carbon recovery. Analysing a list of feasible green stimulus options for a European country suggests that mobilizing €75 billion to €150 billion of capital could yield up to three times more in economic output and generate up to three million new jobs[98].

5.3 Comparisons with recovery measures in other economic sectors

Green investments and reforms are not the only growth-enhancing measures that policymakers may consider. Given the occurrence of the pandemic, many public investments will be directed to health and social care infrastructures as well as information and communication technology. Besides their economic returns, such expenditures may be more aligned with the priorities of an aging population in the industrialised world[99]. It is therefore essential to explore the job creation potential of green interventions in comparison with those in other economic sectors.

International evidence that addresses this question is relatively limited. In its latest World Economic Outlook of October 2020, the IMF explored the growth and distributional impacts of climate change mitigation in the context of the global pandemic[100]. Two main findings emerge from this analysis:

Although it is recognised that renewable energy is more job intensive than fossil-fuelled power generation, econometric analysis of past data indicates that the net economy-wide effect of decarbonisation policies on jobs is typically small and unclear, depending on the extent of substitution between high-emitting and low-emitting activities as well as the impact of such substitution on the broader economy.

A comprehensive climate change mitigation package is proposed, which consists of green fiscal stimulus in the short term, gradually increasing carbon prices, and supporting households through cash transfers financed by carbon revenues. Its economy-wide impacts are simulated with a general equilibrium model. Employment grows globally over the first years of the simulations (up to 2027) and then essentially remains at the same levels projected by the baseline scenario without decarbonisation policies. However, this comes with a reallocation of 2% of total jobs from high- to low-carbon sectors of the economy, which underlines the need to carefully manage this transition through supporting and reskilling the affected workers. In contrast to the US and China, this transition is possible with lower adjustment costs in Europe because it already has a high share of initial capital stocks in low-carbon sectors.

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[96] ibid.

[97] Edwards, P.E.T., Sutton-Grierac, A.E., and Coyle, G.E., Investing in nature: Restoring coastal habitat blue infrastructure and green job creation. *Marine Policy* Vol. 38, March 2013, pp 65-71.

[98] McKinsey, "How a post-pandemic stimulus can both create jobs and help the climate", May 2020.

[99] Helm, D., The environmental impacts of the coronavirus. *Environmental and Resource Economics* 76 (2020):21–38.

[100] IMF, *World Economic Outlook – A Long and Difficult Ascent*. International Monetary Fund, Washington, DC, October 2020.

Apart from IMF's work, studies carried out with the macro econometric model E3ME demonstrate that green recovery policies are superior for economic output and employment. Recently the model was used to simulate two economic stimulus scenarios[101]: a 'Return to Normal' Plan, which assumes a reduction in VAT rates to boost consumer spending, and a Green Recovery Plan, which involves investments in renewable energy, energy efficiency and electricity grid modernization; car scrappage schemes to accelerate introduction of electric vehicles; and a tree planting program. Simulations show that both recovery plans provide immediate boosts to output and employment, but the impact is consistently larger in the Green Recovery Plan, which also provides long-term economic benefits. Green Recovery leads to about half a million more jobs EU-wide in comparison to the 'Return-to-Normal' stimulus plan. Out of the individual green interventions simulated, car scrappage shows higher benefits for job creation, both at EU level and in the individual European countries that were simulated – Germany, Poland, Spain and the United Kingdom. The same model was also used in IRENA's studies and led to the result mentioned above, that green recovery is projected to create at global level 0.15% more jobs economy-wide by 2030.

The above findings are in line with those of the European Commission's Impact Assessment on stepping up Europe's 2030 climate ambition that was published in September 2020[102]. That Assessment made use of three macroeconomic models of different structures (JRC-GEM-E3, E3ME and E-QUEST) to simulate the effect of increasing the EU's climate ambition by the year 2030. A general finding is that stronger climate policies do not have a very significant impact on aggregate economic output and employment by 2030, but sectoral changes in the European labour market can have considerable effects, particularly hurting the carbon-intensive sectors. This highlights the challenges associated with the just transition – to provide support and reskilling options to vulnerable workers in order to match labour supply and demand in alignment with the structural changes to be caused by the low-carbon transition.

In summary, the available evidence indicates that a green economic recovery program, as decided by EU leaders in the second half of 2020 and in line with the European Green Deal, is likely to perform better in boosting short- and long-term employment around Europe; in any case there seems to be no evidence that alternative stimulus plans could be superior in enhancing economic growth and job creation prospects.

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[101] Pollitt, H., 2020. Assessment of Green Recovery Plans After COVID-19. Cambridge Econometrics, Cambridge, October.

[102] European Commission, Impact Assessment Accompanying the Communication on Stepping up Europe's 2030 climate ambition – Investing in a climate-neutral future for the benefit of our people. Document SWD (2020) 176 final, Brussels, September 2020.

Critical aspects to be considered by policymakers

The brief overview that was presented in this section on the effects of a sustainability transition on the labour market leads to a number of conclusions that are relevant for European policymakers:

- There is sufficient evidence that green economic recovery programs are not only important for keeping Europe on track to the climate neutrality objective as envisaged in the European Green Deal but can also positively affect employment prospects in the continent. A 'return-to-normal' economic stimulus is not only environmentally unsustainable but also economically inferior to a green stimulus.
- Immediate interventions can focus on programs that can mobilise money quickly, such as energy efficiency retrofits, small-scale renewables deployment and improvements to infrastructure for sustainable urban mobility, which can fast support the job creation potential in downstream segments of the value chain. In the coming years it will be possible to mobilise higher levels of investment for more capital-intensive projects that will accelerate the green energy transition.
- The advantage of clean energy projects over fossil fuel related investments regarding job creation has been well documented. However, other elements of the sustainability transition such as the circular economy, green agriculture and nature-based solutions like restoration of ecosystems and tree planting, which have been less well researched up to now, are also important ingredients of a green recovery plan, as they are expected to yield favourable employment impacts.
- At the same time, it is important to keep in mind that there are trade-offs between short-term and long-term impacts on employment. Programs with large short-term employment effects may have weaker effects for long-run growth, while those yielding a larger job impact may be more beneficial for lower-skilled workers, thus jeopardizing long-term economic growth prospects[103]. Moreover, transitioning away from fossil fuels to sustainable low-carbon economies requires commitments to public spending and pricing reforms over a period of at least 5-10 years which may not have a strong effect in the short term. Therefore, immediate measures with attractive short-term impact may have short-lived benefits and turn out to be inferior in both economic and environmental terms by 2030[104]. It has also been argued that green stimulus investments may be more effective for reshaping than for restarting an economy because they may not be sufficient for short-term growth and job creation[105]. Scaling up the fiscal support for immediate green interventions can help overcome such barriers.
- Green recovery measures may be particularly effective in communities whose workers already have the appropriate green skills[106]. European policymakers will hence need to adopt interventions that can match labour supply and demand, both by identifying regional 'hot spots' around Europe with workers who already possess such skills, and by providing appropriate educational and vocational training to the work force of vulnerable sectors and regions that have been affected by the pandemic or will be affected by the green transition.

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[103] Strand J. and Toman M., Green stimulus, economic recovery, and long-term sustainable development. Policy Research Working Paper No. 5163. World Bank, Washington, DC, 2010.

[104] Barbier E.B., Greening the Post-pandemic Recovery in the G20. *Environmental and Resource Economics* (2020) 76:685–703.

[105] Popp, D., Vona, F., Marin, G., Chen, Z., 2020. The Employment Impact of Green Fiscal Push: Evidence from the American Recovery Act. Working Paper 27321, National Bureau of Economic Research, Cambridge, MA, June.

[106] Chen, Z., Marin, G., Popp, D. and Vona, F., Green Stimulus in a Post-pandemic Recovery: the Role of Skills for a Resilient Recovery. *Environmental and Resource Economics* (2020) 76:901–911.

- For this purpose, there is a need for unprecedented investment in reskilling and upskilling. The Fourth Industrial Revolution with the unprecedented pace of technological advancement, calls for governments to invest in life-long learning and focusing education systems on "deep learning", or learning how to learn.
- Solid empirical analysis of previous economic stimulus programs can provide valuable evidence and inform policy making; this section has relied on findings from several studies of this kind. Such aspects cannot be easily captured by simpler country-specific analyses, and time is limited – policy makers cannot wait until comprehensive national studies are conducted and reported. As the size of the post-pandemic fiscal stimulus is larger than anything similar in the past, and as policy makers seek out fast guidance to steer between health protection, economic relief and climate resilience, it may not be sufficient to rely on sophisticated analyses based on data from a few large industrialised countries. This reinforces the importance to adapt the design of economic recovery policies to the national context of each country.

Questions for policymakers when designing an employment-enhancing recovery strategy

What follows is a non-exhaustive list of issues to be considered by national and local decision makers when they consider the job impact of economic recovery plans.

- How much do new investments in a sector of the economy affect demand for intermediate goods/services in other sectors?
    - This would determine the economic multiplier of the stimulated economic activity.
- What part of intermediate inputs of an economic sector takes place in the country, and what part depends on imports?
    - This is an indication of the local value added of the stimulated economic activity.
- Which production activities are displaced by the new investments induced by the green stimulus? How are they spread in different economic sectors?
    - This identifies the economic sectors that stand to lose from the green stimulus.
- How labour-intensive are the sectors affected by new investments, and how labour-intensive are the displaced activities in other sectors?
    - This indicates the balance between jobs created and jobs lost.
- Are employees to be adversely affected by the green transition concentrated in specific regions of the country?
    - This would inform policies for regional interventions and for targeted green investments in particularly vulnerable regions.
- What is the age profile of vulnerable workers?
    - Companies or regions with a high share of older employees retiring may need to receive stronger government support for their early retirement, while those with a higher share of younger workers will need to receive assistance for their further education or vocational training.

- Is the available national workforce sufficient to satisfy additional economic activity in a given sector? If not, is there time for reskilling workers or importing a skilled workforce?
    - Projects to be stimulated by a green recovery plan may take longer to be implemented – and be less beneficial – if the necessary skills are not sufficiently available in the workforce. This may delay the mobilization of investments at the desired level. For example, a building renovation wave around Europe may have to deal with the lack of skilled technicians in the construction sector.
- What is the share of high-skill jobs induced by the green stimulus?
    - There is evidence that high-skilled jobs are more beneficial for long-term economic growth.

Section 6. Equity Considerations

The European Union is required to implement ambitious and stringent decarbonisation policies to achieve the goal of carbon neutrality by 2050. The costs associated with these policies will need to be minimised and distributed across different sectors to ensure that low-income population and vulnerable communities do not carry an inequitable share of the financial burden. A recent study carried out by Eurelectric with the scientific contribution of Enel Foundation and in collaboration with Guidehouse and Cambridge Econometrics (2020)[107] shows that appropriate countermeasures should be put in place to avoid the increase of inequality and to ensure a broader support for the energy transition.

The research combined detailed macroeconomic modelling based on the standard E3ME model baseline[108] with an assessment of the existing policy best practices to explore the patterns of inequality in Europe (EU27 and the UK) and its macro-regions. In particular, the study analysed the distributional effects of six selected EU key climate policies until 2050– carbon pricing, taxation of energy vectors, emission performance standards, subsidies for low-carbon technologies, phase out of the subsidies for fossil fuels and energy efficiency measures – identifying measures that could be implemented to mitigate potential regressive effects. It also provided an estimate of the effect of decarbonisation policies on GDP and employment. The analysis included an assessment of the short-term effects of the macroeconomic shock linked to COVID-19 on the combined policy options.

The study found that decarbonisation policies needed for Europe to achieve its climate goals will have a mix of progressive and regressive effects on European citizens. Some policies will result in lower-income households financially benefiting more than other income groups (progressive effect), while others will result in lower-income households being disproportionately burdened by costs (regressive effect). The study starts by analysing the net distributional effects over the period 2020-2050 of each selected decarbonisation policy, if implemented on its own. Figure 13 presents the variation of the Gini Index for the six selected EU key climate policies. The Gini index, or Gini coefficient, is an indicator of inequality in terms of financial and social wealth. It measures the distribution of income within a nation or any other group of people and its value ranges between 0 and 1, interpreted as complete equality and perfect inequality, respectively. Thus, an increase in the Gini index expresses a rise in inequality and vice versa.

[107] Enel Foundation, Eurelectric, Cambridge Econometrics and Guidehouse "E-quality - Shaping an inclusive energy transition", June 2020 (https://www.enelfoundation.org/news/a/2020/06/discussing-e-quality-in-the-context-of-energy-transition); https://www.eurelectric.org/e-quality/

[108] The model baseline is largely consistent with the 2016 EU Reference Scenario (DG Energy, European Commission 2016) and includes projections for demographic indicators, employment, labour supply and GDP growth, sectoral production and trade, energy system developments and CO_2 emissions. For more details: https://www.e3me.com/wp-content/uploads/2019/09/E3ME-Technical-Manual-v6.1-onlineSML.pdf

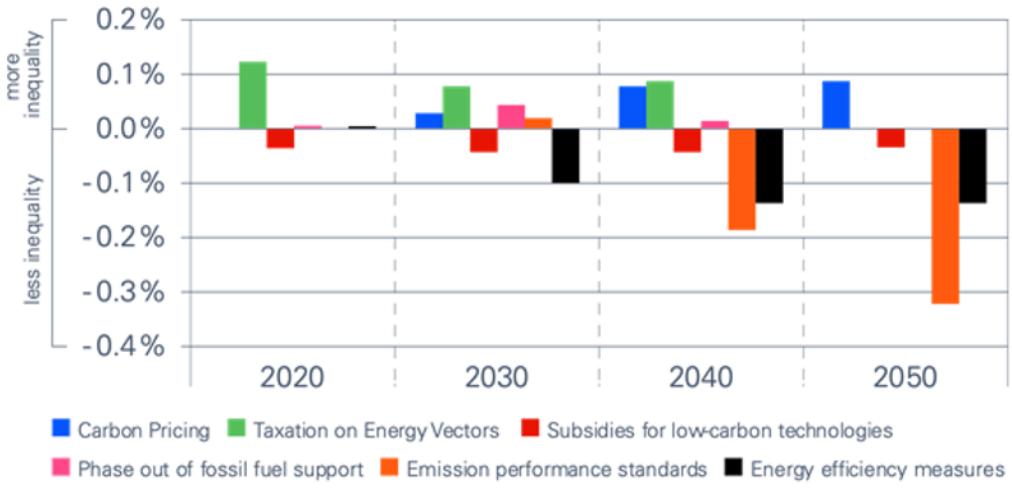

Figure 13. Gini Index variation for individual policy scenario without revenue balancing (EU27 + UK)

Policies which directly increase costs such as energy taxes or carbon pricing have the most regressive effects (if implemented in isolation) as these increased costs will affect lower-income households more strongly than higher-income ones. On the contrary, decarbonisation policies that reduce costs or energy consumption, such as energy efficiency measures or incentives for low-carbon technologies, are more progressive.

Nevertheless, it would be incorrect to make the oversimplified interpretation that decarbonisation policies with regressive impacts are bad or less effective than those with progressive impacts. Rather, the key point is that all six types of decarbonisation policies are needed in order for Europe to achieve its climate goals, but a policy that makes sense from a climate point of view can create regressive distributional effects, i.e. have a disproportionate negative impact on low-income households. Therefore, it is important that these regressive effects are acknowledged, and proper counter measures are introduced to mitigate them, making citizens feel like they are part of the energy transition instead of victims of it.

As a second step, the study analysed several case studies and a number of jurisdictions around the world that have successfully enacted measures to counter the regressive elements of key climate policies. A menu of policy options that can effectively reverse the regressive effects of the decarbonisation policies was then added into the modelling. The study suggests the following four mitigation policies, which can be introduced jointly with the six decarbonisation policies to both help achieve needed climate goals while addressing inequality issues:

- Public revenues raised from revenue-generating decarbonisation policies such as carbon pricing can be recycled so as to reduce taxes such as the value added tax (VAT) or electricity taxes; as an alternative, the revenues can be used for lump-sum direct rebates.
- Energy efficiency measures targeted at low-income groups (e.g., upfront subsidies to help overcome initial investment costs, which are often barriers for the most vulnerable households) can reduce inequality and ensure future energy savings.
- Introducing programs to reskill and upskill workers, in particular job retraining programs focused on industrial sectors most affected by decarbonisation, can help prevent people from falling into poverty.
- Low-carbon innovative technologies can benefit from subsidies funded via general taxation (e.g., increasing income tax rates for high incomes) or using carbon revenues; on the contrary, if subsidies are funded by a surcharge on electricity users, the policy would not have progressive effects.

These policies are not mutually exclusive, and their mix should clearly be adapted to the specific contexts they mean to influence. In any case, the study clearly shows that if policy-makers pay attention to policy design, potential socially counterproductive effects can be effectively addressed. In addition, such policy options could increase the longevity of climate policies by achieving greater public acceptance. it is also worth noting that many policies identified by the study do not face significant legislative barriers in their implementation, as they are administratively straightforward to implement, and the infrastructure and institutional capacity required are often already in place.

As can be seen in Figure 14, implementing the combined policy options – key decarbonisation policies plus mitigation measures – can greatly improve social equity. The positive effect will grow over time and the difference in Gini coefficient compared to the standard revenue balancing case will be very substantial, especially in the period 2030-2050. Furthermore, although the COVID-19 pandemic and the measures that were taken to limit its spread are currently having devastating effects on the economy and on society, the sensitivity analysis carried out shows that COVID-19 shock does not have a substantial impact on the distributional effects of climate policies and on the effectiveness of the identified mitigation policies. There is a small reduction in the progressive impact throughout the 2020-2030 period as the scale of the change in real income under the COVID-19 shock is slightly reduced.

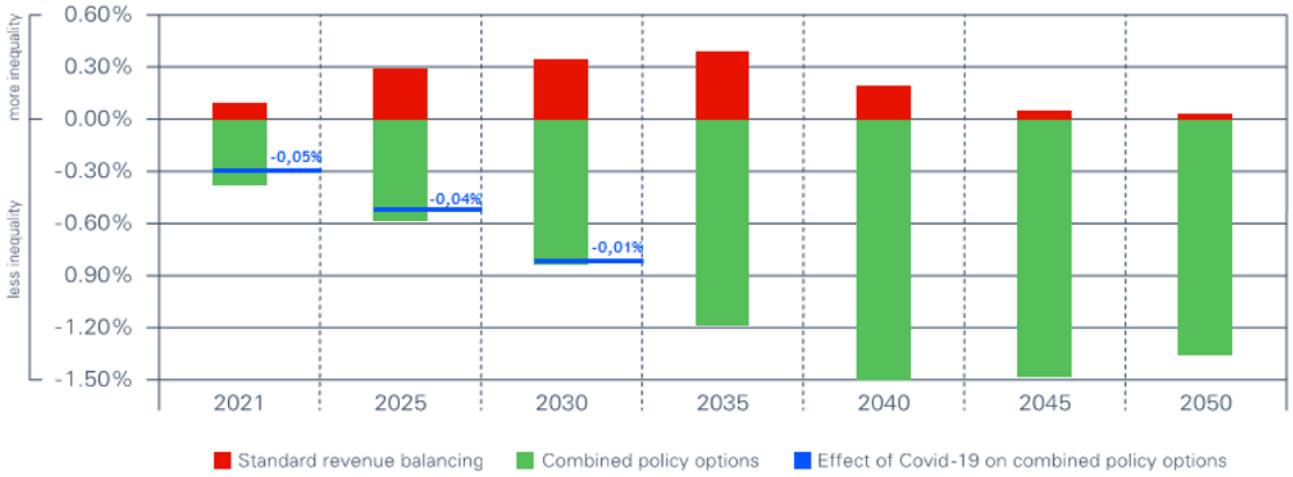

Figure 14. Gini Index variation for combined policy options in EU27 + UK

Figure 15 shows instead that combined policy options with mitigation measures increase both GDP and employment. In particular, throughout the 2020-2050 period, there is a positive economic impact. In the short term, GDP impact is mostly driven by investments in energy efficiency measures. In the longer term, the positive change in GDP increases as emissions performance standards come into effect, reducing consumer prices through energy savings in industry, and reducing fossil fuel imports as road transport is progressively electrified over time. A comparison with the combined policy options without recycling climate policy revenues highlights the importance for the government to redistribute any revenue generated from climate policies back into the economy – especially in the short term where the upfront costs of climate policies are outweighed by economic benefits.

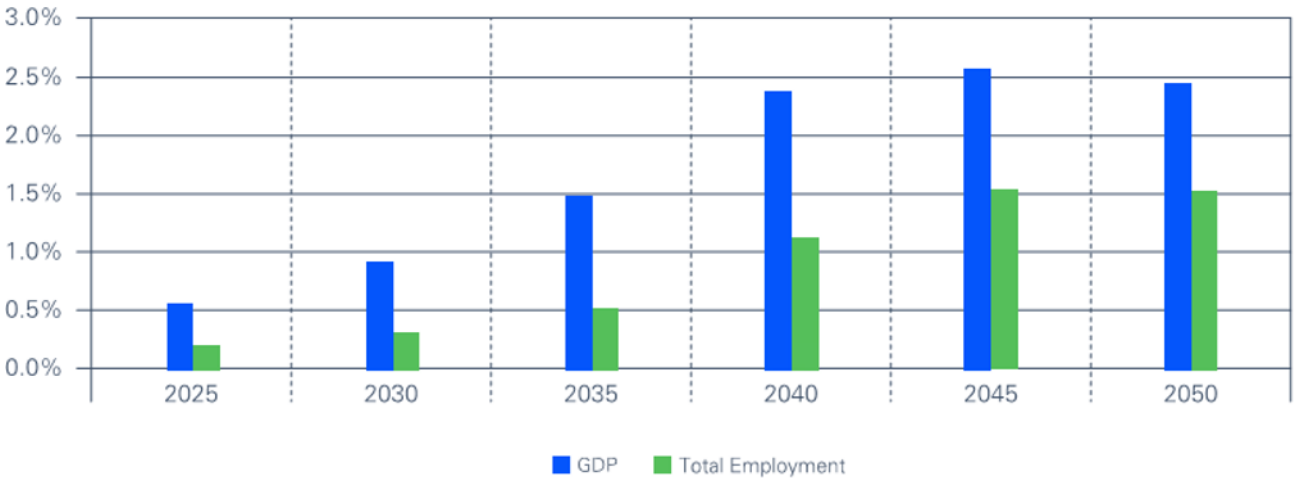

Figure 15. EU27 + UK macroeconomic impacts of combined policy options

Employment growth until 2035 is dominated by an increase in construction and manufacturing jobs to meet the energy efficiency investment. Over the longer term, the growth in employment is concentrated in service sectors and the electricity generation and supply sector. The positive employment effect in the service sectors is driven by an increase in consumer demand due to higher real incomes, whereas in the electricity generation and supply sector the positive impact is driven by the need to meet the additional electricity demand due to electrification. Nevertheless, jobs associated with fossil fuel production and distribution fall over time due to decarbonisation. This highlights that even beyond the distributional impact in terms of average incomes or net employment effects, the path to decarbonisation is a transition that will not be smooth for everyone. Where job losses are concentrated, effective social, labour market and retraining policies (i.e., reskilling, upskilling) will be required to mitigate the impact for those negatively affected. These results are in line with the findings of the broader review on the employment effects of the green transition that was presented in Section 4.

The modelling also suggests that all European macro-regions (Figure 16) will benefit from the combined policy options. Southern Europe and Central and Eastern Europe are expected to experience most benefits in terms of GDP growth and declining inequality, while Western Europe is expected to have a large share of the employment benefits in terms of increased jobs. On the contrary, Northern Europe shows the smallest economic impact from the various climate policies, largely because a higher level of decarbonisation will already be achieved at the baseline compared to the rest of the EU. The general trend of positive distributional effects is broadly consistent across all EU macro-regions.

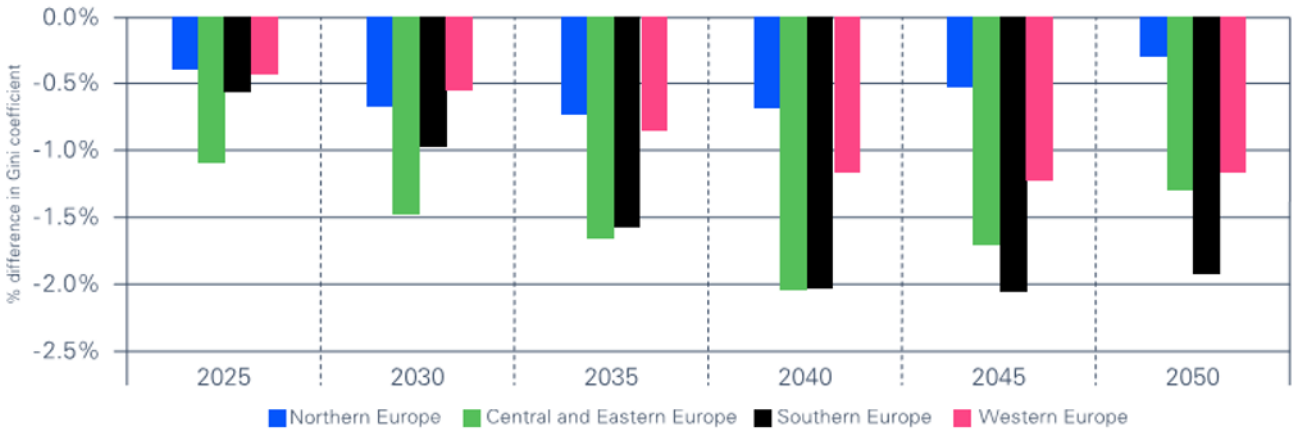

Figure 16. Distributional effects across EU macro-regions with combined policy options

In conclusion, what is needed now is the political will and ambition to act and make the changes needed to address the distributional impacts of the critical decarbonisation policies that the EU needs to combat climate change. The European Green Deal and the recovery measures that EU leaders are preparing should be oriented so that inequalities are not made worse, but rather mitigated. Not addressing the unintended consequences that policy design may have on citizens will reduce public support, which is critical to ensure the implementation and overall sustainability of climate policies. The energy transition can and should be a just one for all citizens of Europe.

Main implications for EU policy-makers

- Stringent decarbonisation policies must be implemented to achieve the goal of carbon neutrality by 2050. The costs associated with these policies will need to be minimised and equally distributed across society in order to ensure that low-income populations and vulnerable communities do not carry a non-equitable share of the financial burden.
- Mitigating the negative social impacts of climate policies is essential to ensure broader support for the energy transition. Regressive effects can be fully offset with targeted policies, which can be introduced jointly with the main decarbonisation policies to both help achieve needed climate goals while addressing inequality issues.
- Implementing the following combined policy options can ensure more equality and have a progressive effect in all EU macro-regions; it can also have a positive impact on GDP and employment:
    - Revenues raised from revenue-generating decarbonisation policies such as carbon pricing can be used to offset reductions in indirect taxes such as VAT or electricity taxes; alternatively, the revenues can be used for lump-sum direct rebates.
    - Energy efficiency measures targeted at low-income groups can reduce inequality, ensuring future energy savings.
    - Other important preventive options include programs to reskill and upskill workers, in particular job retraining programs focused on industrial sectors most affected by decarbonisation.
    - Low-carbon innovative technologies can benefit from subsidies funded via general taxation (e.g., increasing income tax rates for high incomes) or can be financed by carbon revenues.
- The energy transition must be inclusive and should be just for all citizens of Europe: the EU Green New Deal and the recovery measures that EU leaders are implementing should be oriented to reduce income inequalities.

Section 7. From strategic priorities to sector-specific policies: Designing and Implementing Country-Specific Recovery and Resilience Plans

In line with the methodology outlined in Section 2, after having identified appropriate investment pathways, the interventions required, and the appropriate sources of financing for the Transformations, the big challenge is implementation of the plans in practice. This is not a straightforward task; it is a complex problem, because apart from the financial restrictions and the large scale of the projects, it must also take into account the preferences of many different stakeholders with conflicting interests and variating powers, such as local communities and businesses, as well as the adoption of new technologies to a specific national context.

Effective implementation requires a systemic approach because what is currently needed is a step change, not just an incremental improvement in some environmental or economic issues. As the European Environment Agency highlights, Europe faces persistent environmental challenges of unprecedented scale and urgency. Despite substantial progress in many environmental fronts, the improvements are insufficient to meet the long-term sustainability objectives to 2050. Such persistent challenges are resistant to traditional policy responses and have to be addressed as broader systemic issues that cross environmental, social, economic, and governance dimensions, both at European and global levels[109].

Europe, like the rest of the world, needs "transformative spending" not just "stimulus spending". A "return-to-normal" plan for investments and reforms after the pandemic is not only environmentally unsustainable but also economically inferior to a green stimulus[110],[111]. Therefore, Europe needs integrated and coordinated interventions in economic, financial, political, and social systems, and along whole value chains, in order to identify an innovative new structure that will be resilient and sustainable. The EGD, the SDGs, and the Paris Agreement are the blueprints to achieve this system innovation. Embracing the SDGs as an overarching framework for policymaking and action and linking them with the regular macroeconomic monitoring foreseen in the European Semester, can support the design and implementation of plans that enable the sustainability transition in Europe. The methodology to facilitate this linkage as proposed in Section 2 of this report can serve as a useful toolkit for policymakers.

To translate these priorities to specific measures, a holistic framework is necessary. After identifying cross-cutting policy areas as a result of the application of the SDG-EGD-CSR mapping methodology described in Section 2, implementation has to proceed at the sectoral level. In this context, the potential of sector-specific economic policies and reforms to advance the sustainability agenda could be assessed through a comprehensive list of sustainability and resilience criteria which are explicitly linked with the SDGs. These criteria can provide clear guidance on the different priorities against which an intervention has to be evaluated and can help design a green recovery plan that is adapted to each country's resources, conditions and needs.

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[109] EEA (European Environment Agency), 2020. The European Environment – State and outlook 2020, Copenhagen. doi: 10.2800/96749

[110] IMF, *World Economic Outlook – A Long and Difficult Ascent*. International Monetary Fund, Washington, DC, October 2020.

[111] Pollitt, H., 2020. Assessment of Green Recovery Plans After COVID-19. Cambridge Econometrics, Cambridge, October.

Tables 16 and 17 illustrate a list of such criteria and their linkage with specific SDGs; they span across all sustainability aspects – from environmental and nature protection, climate change mitigation and adaptation, to providing prospects for economic growth and jobs, especially in vulnerable parts of the population. Assessment of these criteria is possible only with a combination of quantitative evidence informed by expert modelling and qualitative input from stakeholders. To ensure inclusiveness and social acceptance of the green transition, measures need to be co-designed and assessed with the broadest possible participation from society (public policy makers, private sector, local authorities, and NGOs). Such a participatory, multi-criteria decision approach contributes to the democratization of the policy formulation process[112] by enabling ownership of the measures by national stakeholders, which in turn ensures that investments and reforms indeed reach the implementation stage and affect production and consumption patterns in society. This can help avoid relying solely on the knowledge silos of academic experts or governmental policymakers and falls in line with the objective of the European Climate Pact to mobilise society for the transition to sustainability.

Inclusive governance of the green transition is considered paramount by social actors. According to the European Economic and Social Committee (EESC), the green transition should be based fundamentally on the action of all participants from social and economic activities. Energy communities, researchers, labour forces, smart entrepreneurs, multinational companies, should be included in this process[113]. Projects supported by public funds should recognise local community ownership and include appropriate participation in the benefits or ownership of the projects by local communities. Genuine stakeholder participation can ensure democratic oversight, as well as direct public funds towards the most socially desirable uses[114].

[112] Jordan, A.J. and Turnpenny, J.R., 2015. *The Tools of Policy Formulation*. Edward Elgar. doi: 10.4337/9781783477043

[113] European Economic and Social Committee, NAT/785 European Climate Pact Opinion, July 2020.

[114] European Economic and Social Committee, NAT/778 Opinion on Financing the Transition to a Low-Carbon Economy and the Challenges in Financing Climate Change Adaptation, May 2020.

a. Performance criteria for the short term (for the next 2 years):

	Short name	Explanation	Related SDGs
Environmental impact	Energy	Energy savings (ktoe) per million Euros invested	7
	CO_2	CO_2 emission savings (tn) per million Euros invested	13
	Nature	Will the intervention improve agriculture and land productivity? Will it protect biodiversity and ecosystem services?	11, 14, 15
	Other Environmental Impact	Other short-term environmental impact (on air quality, water resources etc)	3, 6, 11, 15
Economic / social impact	Economic multiplier	Economic output generation (million €) per million Euros invested	8
	Jobs	Net employment generation (persons) per million Euros invested	8
	Jobs for vulnerable	Are the employment opportunities of the intervention inclusive, gender-balanced, and available to vulnerable populations?	5, 8, 10
	Demand in affected sectors	Does the initiative generate demand in the most affected sectors? Or does this initiative target new or different sectors? If in a different sector, can the workforce easily shift to this new sector? Does the initiative include measures to facilitate the transition of workers and the required investments?	4, 8
	Skills	Are new skills required in new jobs? If yes, are they available in the population?	4, 8
	Time to Implement	How long will it take to fully implement this initiative and to create jobs and activity (including project design, consultation processes, budget mobilization, procurement, etc.)?	8
	Infrastructure & Productivity	Does the measure improve existing infrastructure? Does this affect productivity in the short term?	9, 12
	Technical feasibility	Is the intervention technically feasible with the country's capacity and know-how?	9
	Affordability	Is there a risk that vulnerable households or firms will incur high costs due to the measure?	1, 10
	Social acceptance	Could low social acceptance jeopardise the implementation of the measure?	1, 10

Table 16. Short-term criteria used for the evaluation of green economic recovery measures and their relation to UN Sustainable Development Goals (SDGs) (Zachariadis et al., 2020[115]; list of criteria adapted from Hammer and Hallegatte, 2020[116])

[115] Zachariadis T., Giannakis E., Taliotis C., Karmellos M., Fylaktos N., Howells M. Blyth W., and Hallegatte S., "Building Back Better" in Practice: A Science-Policy Framework for a Green Economic Recovery After COVID-19. Economic Policy Paper, Economics Research Centre, University of Cyprus. Also forthcoming in the World Bank Policy Research Papers series.

[116] Hammer S. and Hallegatte S., Planning for the economic recovery from COVID-19: A sustainability checklist for policymakers, World Bank blog on Development and a Changing Climate, 14 April 2020.

b. Performance criteria for the longer term (mostly for 2030):

	Short name	Explanation	Related SDGs
Environmental impact	Energy	Energy savings (ktoe) per million Euros invested	7
	CO_2	CO_2 emission savings (tn) per million Euros invested	13
	Low-carbon technologies / strategies	Does the intervention provide the technical means to better integrate or employ low-carbon technologies or strategies (for instance, through improvements to transmission and distribution infrastructure, public transit infrastructure, sidewalks or bike lanes, or by promoting denser urban development) that may yield benefits beyond the year 2030? Does it contribute to a deep decarbonisation objective by 2050?	13, 15
	Nature	Will the intervention improve agriculture and land productivity? Will it protect biodiversity and ecosystem services?	11, 14, 15
	Other Environmental Impact	Other long-term environmental impact (on air quality, water resources etc)	3, 6, 11, 15
Economic / social impact	Economic multiplier	Economic output generation (million €) per million Euros invested	8
	Jobs	Net employment generation (persons) per million Euros invested	8
	Jobs for vulnerable	Are the employment opportunities of the intervention inclusive, gender-balanced, and available to vulnerable populations?	5, 8, 10
	Skills	Are new skills required in new jobs? If yes, are they available in the population?	4, 8
	Energy security	Does the intervention increase local/national energy security?	7
	Infrastructure & Productivity	Will the intervention improve local economic productivity through access to better, more reliable infrastructure services?	9, 12
	R&D and innovation	Can the intervention spur R&D or innovation in the specific technologies?	9
	Market Failures	Will the intervention address market failures, such as market distorting subsidies, pricing that fails to account for externalities, etc.?	8
	Economic Resilience	Does the intervention improve socio-economic resilience, that is, the ability of the population to cope with and recover from shocks?	1, 8, 10, 11
	Climate Resilience	Does the intervention improve the population's adaptive capacity, that is their ability to reduce negative impacts (such as adapting buildings to improve resilience to extreme temperature) or capture opportunities (such as higher agriculture productivity in some place and for some crops)? Will the intervention boost resilience to natural disasters, for instance through hardened infrastructure or use of nature-based solutions?	11, 13, 15
	Decarbonisation / Effect on NDC	Does the measure contribute substantially to decarbonisation of the economy by 2030? Does it significantly affect the country's NDC to be submitted to UNFCCC?	12, 13

Table 17. Long-term criteria used for the evaluation of green economic recovery measures and their relation to UN Sustainable Development Goals (SDGs)

The boxes on the next pages present two case studies of post-pandemic recovery impacts. The first one reports on an immediate analysis of the effects of the pandemic on the Italian energy system. The second case study is an implementation of the approach presented in this section for a post-pandemic recovery plan in Cyprus, which will be utilised by the Finance Ministry of the country to prepare the National Recovery and Resilience Plan in line with the priorities of the European Green Deal and the SDGs.

Case study: the medium-term impact of COVID-19 on the Italian energy system

By Fondazione Eni Enrico Mattei (FEEM)

The aim of this research has been to estimate the potential impacts of different COVID-19 scenarios on the Italian energy sector through 2030. The analysis was based on a multi-disciplinary approach that included a group of researchers from Fondazione Eni Enrico Mattei, Linz Energie Institut and IRES Piemonte.

1. Methodology

The approach used in this project included the assessment of economic conditions using macroeconomic and input-output models, modelling the evolution of the energy system using an energy and transport model, and forecasting the reaction of travel demand and modal choice using econometric models and expert interviews. A summary of the interaction between the different modelling frameworks is represented in Figure 17.

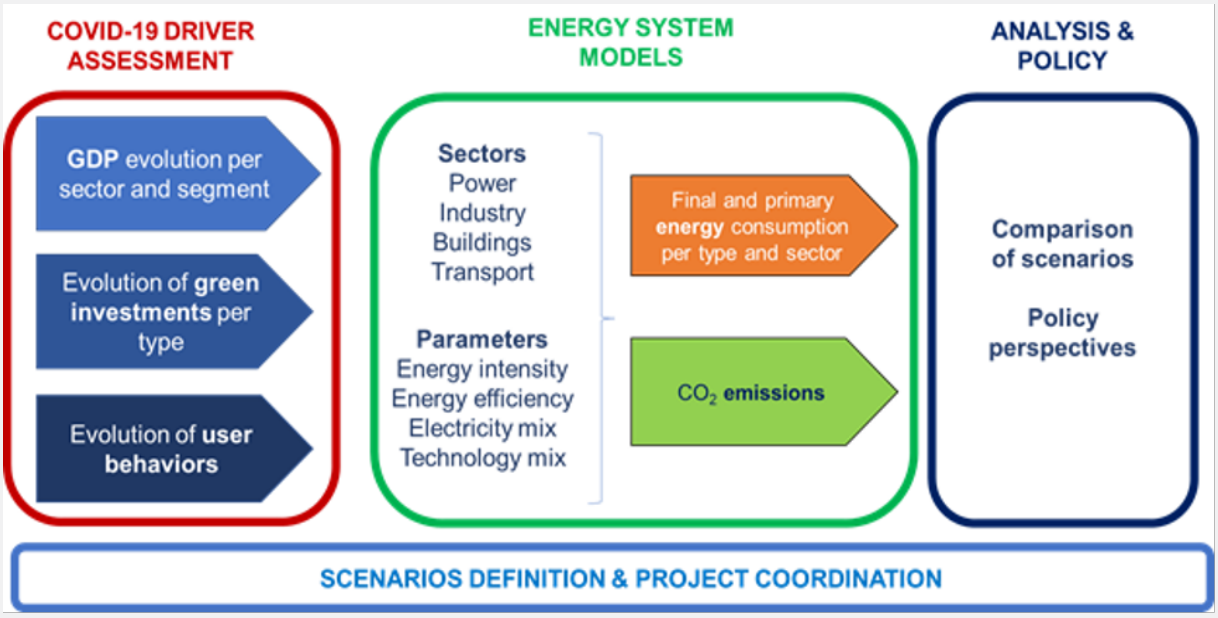


Figure 17. Modelling activities' organisation

The main drivers that have been considered include the evolution of GDP in the different sectors, green investments and user behaviour, with a special focus on the transport sector. Those trends have been used in an energy system model to estimate the impact on energy consumption and energy-related greenhouse gas emissions.

The model has been applied to three different scenarios, a best-case, a medium-case and a worst-case. Each scenario is defined by a different duration of the "active" phase of the pandemic, i.e., we define an end-point of the pandemic when a treatment or a vaccine reduces the stress for the Italian health care system to pre-COVID-19 levels.

For all scenarios we assume that before this end-point is met, COVID-19 remains one of the most critical issues for the healthcare system and significant resources are required to keep the quality of treatment at an acceptable level. After the end-point, the situation in the health care system returns to its pre-COVID-19 situation. All these scenarios have been compared against a pre-pandemic trend that estimated the future energy consumption and emissions if COVID-19 had never happened.

The three end-points that have been considered are January 2021, January 2022 and January 2025. From these end-points onwards, there is no apparent medical reason for avoiding crowded spots, such as airports, public transport (metros/busses), trains or cultural events. The first scenario seems rather optimistic, but the results have been calculated to compare the potential effect of a relatively short shock on the economy.

1.1. Users' behaviours in transport

The goal of this analysis is to contribute updated passenger kilometres (PKM) travelled annually by specific modes of transport. The analysis has three distinct parts:

- Econometric assessment linking COVID-19 severity, measured by number of patients in the ICU, with the mobility behaviours of Italian citizens as measured through Google Mobility Data.
- An expert survey as a foresight exercise to predict the long-term impacts of the pandemic on transport demand.
- The merging of steps 1 and 2 to produce predictions of PKM values for public road transport, cars, motorcycles and rail.

These figures are used as inputs to the energy-transport system model and will enable an impact assessment of how changes to transportation demand due to COVID-19 will affect the future energy and transport system.

1.2. Economic conditions

This activity had the objective of defining the expected evolution of GDP in the different sectors (industry, tertiary) and the different segments (industry types and commercial activities). The output will be reported as an annual evolution and will be used in the energy model to estimate the impact on the energy consumption by using different indicators of energy intensity (e.g., kWh/GDP units). The expected evolution of green investments was also assessed, in accordance with the EU targets that have been set to decarbonise the energy system. Those investments included electricity generation from renewable energy sources (RES), electrification of final uses (especially in transport) and energy efficiency measures (e.g., in industries and buildings).

1.3. Energy model

Energy consumption and greenhouse gas (GHG) emissions have been calculated by considering the evolution of the industry and the transport sectors, together with the evolution of the power generation sector. No significant variations across the scenarios have been considered for the buildings sector.

The energy consumption of the industrial sector has been modelled by considering the historical trend of the energy intensity, measured as energy consumed per unit of GDP. This trend has been calculated for the main energy carriers used in the industrial sector: natural gas, electricity, heat, coke and other fuels.

The passenger transport has been modelled by calculating the energy consumption of the sector starting from an exogenous transport demand for each scenario. This model estimates the energy consumption of each mode by considering the evolution of the technologies used in each transport mode, together with an efficiency trend calculated from historical data. Thus, the model is able to calculate the final energy consumption for each mode and each energy carrier, together with the related CO_2 emissions. The parameters used in the model have been defined by considering the targets reported in the National Energy and Climate Plan, with reference to the emissions reductions, the expected penetration of electric vehicles, as well as the share of renewable electricity generation.

The freight transport has been built on the very same model used for passenger transport, considering as input data the evolution of freight demand (expressed in tons-km, tkm) scaled by the real industry GDP in the different scenarios.

2. Results

The long-term effects of the COVID-19 appear to be limited: in comparison with the baseline (i.e., no COVID pandemic), by 2030 the "Best" scenario shows a 1% reduction, and the "Worst" scenario a 7% reduction (see Figure 18). Considering the sectoral energy consumption, the negative effect on industry, driven by the evolution of GDP, appears stronger, with a 19% reduction of the final energy consumption by 2030 in the "Worst" scenario in comparison to the baseline. Conversely, the influence on the transport energy consumption in the "Worst" case is limited to 9%.

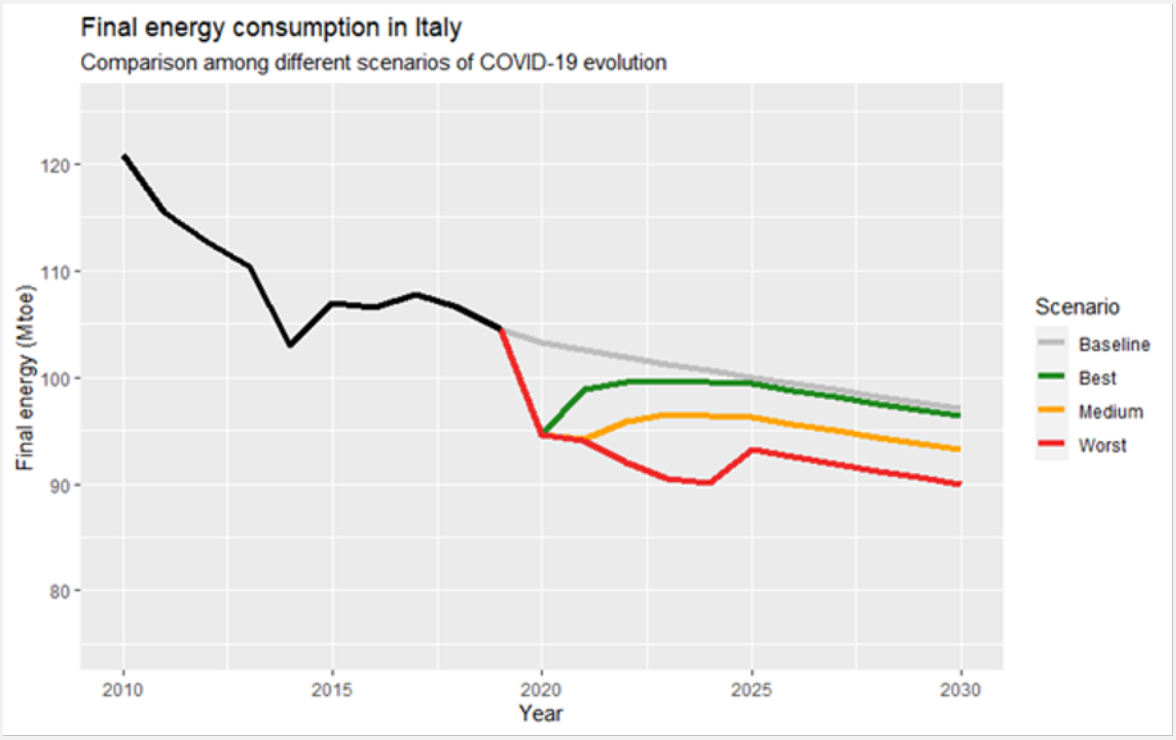


Figure 18. Final energy consumption in Italy in different COVID-19 scenarios.

Considering the share of energy consumption by energy carriers, natural gas and electricity remain the most relevant across scenarios, while diesel shows a continuous decrease in the future, mostly related to the gradual shift to alternative technologies in the transport sector.

The evolution of energy-related CO2 emissions follows the trends of final energy consumption presented above for the different scenarios. An additional aspect is the strong decrease of the electricity-related emissions, thanks to a rise of the renewable share in the power generation mix, in accordance with recent trends and future national targets for the next decade.

3. Conclusions

The preliminary results of this study depict a decrease of both energy consumption and carbon emissions in comparison with the baseline (i.e., without considering COVID-19), regardless of the scenario (although with differences among them). Still, this small benefit comes at a cost: the GDP in the industrial sector is never fully recovering from the strong shock of 2020.

Considering the transport sector, COVID-19 scenarios show a decrease of emissions, mainly driven by a decrease in mobility demand, especially for freight transport, but also for passenger transport. Still, in all scenarios the modal share of cars by 2030 rises, at the expense of public transport use. While those effects are compensated by an increased efficiency of new vehicles, dedicated policies will be needed to avoid an excessive use of cars, leading to multiple consequences in terms of global and local emissions, as well as congestion and safety issues.

These preliminary results will be the basis for further sensitivity analyses, to assess the potential effect of different policies in exploiting the current situation to foster innovative and sustainable solutions. Policies will be analysed in the framework of the EU Green Deal and the new targets that are being considered to further push towards a quick and effective decarbonisation for the EU energy system.

An example of Designing and Assessing Green Recovery Measures in a Science-Policy Framework in Cyprus

A recently completed study in Cyprus provided an integrated framework for designing an economic recovery strategy aligned with sustainability objectives through a multi-criterion, multi-stakeholder lens, in line with the principles set out in this report. The study was conducted by researchers at the Cyprus Institute and was co-developed with expertise from the World Bank and UK analysts who are members of the COP26 strategy team. The aim was to enable decisions by policymakers on economic stimulus with the aid of transparent methods that include both expert evidence based on quantitative open-source modelling, and qualitative input by diverse social actors in a participatory approach. The study employed an energy systems model and an economic input-output model to provide quantitative evidence, and a multi-criteria decision process, in which stakeholders from government, enterprises, and civil society were widely engaged for much needed qualitative input. Thirteen green recovery measures were selected, some of which came from existing national economic and climate plans, while some others constitute necessary investments or reforms that can drive the green transition in the medium and long term. The appropriateness of these interventions was assessed with numerous criteria related to environmental sustainability, socio-economic and job impact, and climate resilience. The results highlighted trade-offs between immediate and long-run effects, between economic and environmental objectives and between expert evidence and societal priorities. An important finding, also illustrated in Figures 19 and 20, was that a ‘return-to-normal’ economic stimulus produces mediocre growth and job impacts; hence it is not only environmentally unsustainable, but also economically inferior to most green recovery schemes. Economic officials of the government of Cyprus are applying this framework, along with other policy assessment methods to evaluate their package of investments and reforms that will be included in the National Recovery and Resilience Plan to be submitted to the European Commission by April 2021.

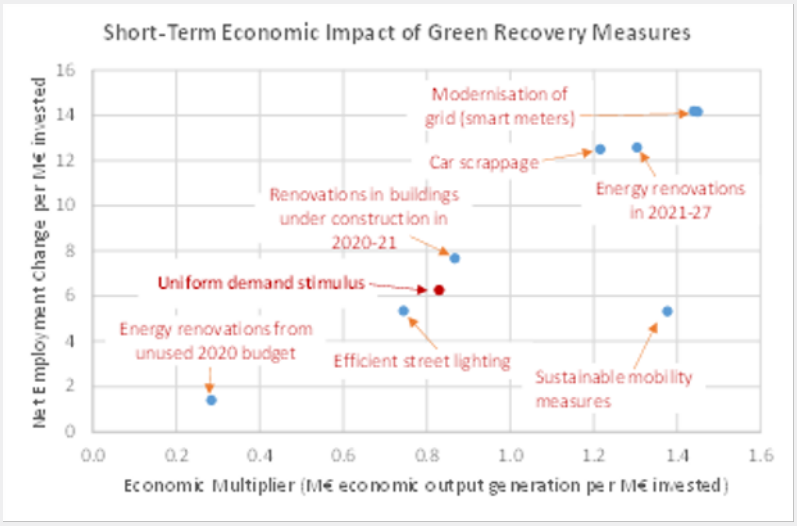
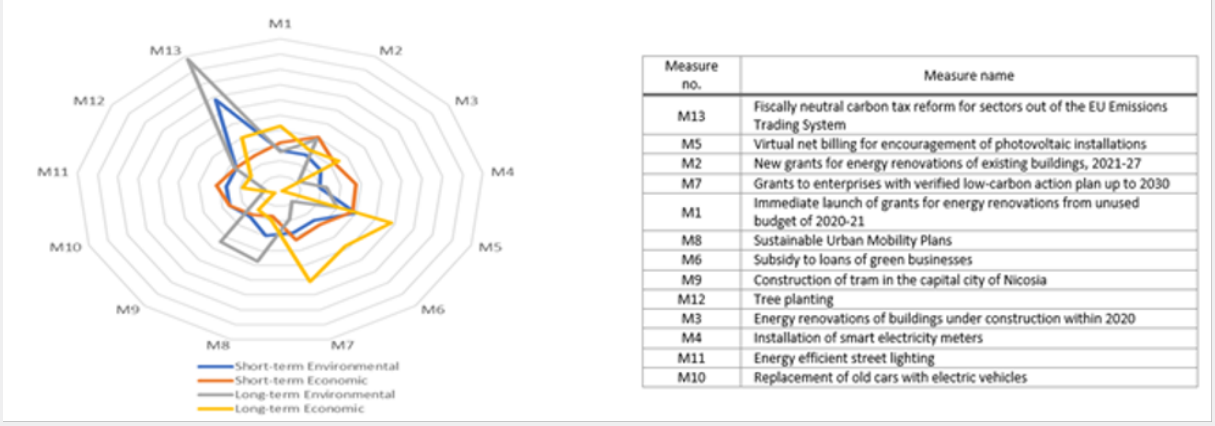


Figure 19. Relationship between short-term impact of recovery measures on economic output and employment in Cyprus.



Measure no.	Measure name
M13	Fiscally neutral carbon tax reform for sectors out of the EU Emissions Trading System
M5	Virtual net billing for encouragement of photovoltaic installations
M2	New grants for energy renovations of existing buildings, 2021-27
M7	Grants to enterprises with verified low-carbon action plan up to 2030
M1	Immediate launch of grants for energy renovations from unused budget of 2020-21
M8	Sustainable Urban Mobility Plans
M6	Subsidy to loans of green businesses
M9	Construction of tram in the capital city of Nicosia
M12	Tree planting
M3	Energy renovations of buildings under construction within 2020
M4	Installation of smart electricity meters
M11	Energy efficient street lighting
M10	Replacement of old cars with electric vehicles

Figure 20. Evaluation of green recovery measures (M1-M13) (left) and ranking (right) based on scoring and weighting provided by societal stakeholders in a multi-criteria decision assessment framework.

Source: Zachariadis T., Giannakis E., Taliotis C., Karmellos M., Fylaktos N., Howells M. Blyth W., and Hallegatte S., "Building Back Better" in Practice: A Science-Policy Framework for a Green Economic Recovery After COVID-19. Economic Policy Paper, Economics Research Centre, University of Cyprus. Also forthcoming in the World Bank Policy Research Papers series. See also summary on the World Bank's website

Section 8. Concluding Remarks

COVID 19 -related recovery packages are financed by national debt, which means they are loans from future generations. This creates a moral responsibility for the current generation, to "Building back Better" by investing in the transformation of the current economic, financial, social and political system, which will trigger the exponential change needed to face the climate crisis, the economic crisis and the health crisis in a sustainable, resilient and socially inclusive future. Beyond a fiscal stimulus that is expected to boost aggregate demand, this crisis calls for transformative public investments that will shape a sustainable, fair, and digital transition, and leverage private sector investment. The United Nations Secretary-General António Guterres, in his recent special address on "The State of the Planet" (12 December 2020), underlined that the main drivers for a trans-formative recovery are (1) Global climate neutrality by 2050 (including technological advances, circular economy and nature-based solutions) (2) Sustainable Finance and (3) Climate Adaptation and Resilience. The **2030 Agenda** and the **Paris Agreement** provide the long-term vision and blueprints for developing these transformation pathways.

The good news is, in addition to a moral obligation, there is an economic case for "Building Back Better". Although all countries are facing a central trade-off, whether they should provide "stimulus spending" in order to provide immediate support to maintaining business as usual, or provide "transformative spending" focused on accelerating the transition to a job-based green and digital economy and inclusive society, recent simulations of the effect of green recovery plans worldwide confirm that a green economic stimulus is more growth-enhancing than a 'return-to-normal' stimulus that would merely boost current, unsustainable consumption and production patterns. Moreover, cleaning unsustainable supply chains and production processes that lead to deforestation and biodiversity threats can help reduce the risk of future zoonotic diseases and pandemics. investing in climate resilience also reduces the risk of extreme weather events and poverty for hundreds of millions of people.

So far, global financial resources devoted to and commitments made for a green recovery are largely insufficient. As mentioned in the Lancet COVID-19 Commission Statement on the occasion of the 75th session of the UN General Assembly[117], one exception is the European Union, where the **European Green Deal provides the right level of ambition and direction, and where efforts have been made to align the investment framework with a green and digital recovery.** Our report analyses the transformations Europe must make to implement the Sustainable Development Goals and the European Green Deal, and enable a green and digital, job-based and fair recovery from COVID-19 Pandemic, which will be co-designed by all relevant stakeholders: politicians, policy-makers, researchers, innovators, technology developers, businesses, NGOs and the civil society. In this respect, ensuring a successful biodiversity COP in Kunming, a climate COP in Glasgow and the World Food Summit in Copenhagen is essential for coordinated actions on climate and biodiversity. Combined with other annual meetings (UNGA, G20, HLPF etc.), these can make **2021 the "super year for nature and climate"** and can set the foundation for long-term, international cooperation on transformative change that integrates the environment.

Never waste a good crisis!

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Annexes

(available online)

Annex I: Detailed results on the methodology for Country-Specific 3-D Mapping of SDGs, EGD Policies and the European Semester Process Recommendations (CSRs) by EU Member State

Annex II: Overview of National Energy and Climate Plans (NECPs) of EU Member States

Annex III: Detailed review of studies on the effect of green policies on jobs and skills