X ENVIRONMENT, ENERGY AND CLIMATE CHANGE

2022 and the first months of 2023 were marked by the direct and indirect impact of the war in Ukraine and its synergies with developments in the energy sector as well as with climate change. One visible outcome has been the worsening of economic inequality within countries, but also between developed and developing countries (with severe famine, mainly in African regions). Another was a halt (to some extent) to the progress in tackling climate change, whenever it was considered that ensuring energy sufficiency was in conflict with the decarbonisation policy. However, at the 27th Conference of the Parties to the UN Convention on Climate Change (COP 27, November 2022) and at the 15th Conference of the Parties on Biodiversity (COP 15, December 2022) some important steps were taken, albeit less than required by the current situation and projections. Some positive developments in policy measures have taken place in the EU, the United States, Brazil, as well as in Greece.

In the period under review, central banks and supervising authorities continued within their mandate to act towards further integrating climate issues into their functions, thus contributing to addressing climate risks and meeting governments' sustainability objectives.

In the scientific field, a major breakthrough in nuclear fusion reaction research was achieved at a California laboratory in December 2022, but it will take further efforts and several decades before fusion is commercialised for electricity generation. Important studies and reports were also published on the economic policies required to tackle climate change and its health implications. The latest report from the UN Intergovernmental Panel is a desperate call for coordinated, massive and rapid action by all countries to limit global warming to 1.5°C. Failure to do so would have catastrophic and irreversible consequences.

Finally, during the period under review, extreme weather events were particularly frequent worldwide: floods in Asia, Australia and Europe; droughts and falling river levels in Europe and the United States; heatwaves in Europe; melting of ice in Antarctica, the Arctic and Greenland; as well as severe bad weather and storms in the United States.

1 GLOBAL REAL DEVELOPMENTS AND POLICIES ON CLIMATE CHANGE AND ENERGY, MAJOR SCIENTIFIC FINDINGS AND REPORTS[1]

Following Russia's invasion of Ukraine on 24 February 2022, ensuring energy has become crucial, especially for European countries. In some cases, however, this was seen as conflicting with rapid decarbonisation (see Box X.1). It is worth noting that at the 27th UN Climate Change Conference of the Parties (COP 27, held in Sharm El-Sheikh, 6-20 November 2022) no agreement was reached on accelerating the reduction of greenhouse gas emissions or phasing out all fossil fuels, despite reliable UN reports[2] having predicted earlier that the commitments of the signatories to the Paris Agreement would result in a devastating increase in global average

1 The cut-off date for information and data used in this chapter is 22 March 2023.

2 See UNFCCC, *Nationally determined contributions under the Paris Agreement – Synthesis report by the secretariat*, 26.10.2022, and UN Environment Programme, *Too Late, Too Slow – Climate adaptation puts the world at risk*, 27.10.2022. Also: IPCC, *Climate Change 2022*: *Mitigation of Climate Change – Summary for Policymakers*, Working Group III contribution to the Sixth Assessment Report, 4.4.2022. See also the IPCC report that followed on 20 March 2023 entitled *Synthesis Report of the IPCC Sixth Assessment Report (AR6) – Summary for Policymakers*, the key message of which is summarised in the introduction to this chapter.

temperature by 2.5°C by the end of the century, versus a target of 1.5°C.[3] It is also indicative that Germany, despite having planned to shut down its last three nuclear power plants at the end of 2022, announced on 5 September that two of them would remain operational as a backup option. Furthermore, Sweden has been implementing a policy for gradually phasing out nuclear power plants since the 1990s. However, the newly elected government in September 2022 is now offering incentives to promote the construction and operation of new nuclear reactors. (It should be recalled that in February 2022 the European Commission had proposed including nuclear energy and natural gas in the investments eligible for funding on a transitional basis and under strict conditions. The European Parliament adopted this proposal on 6 July 2022, against strong objections. However, Austria and Luxembourg have taken legal action against it, while several large non-governmental environmental organisations have announced their intention to appeal against this decision before the European Court of Justice.)

The COP 27 decision[4] had a positive outcome, as it laid the groundwork for rich polluters to finance a new loss-and-damage fund to compensate poor countries for damages caused by climate change. Further details will be determined at the next Conference of the Parties.

At the EU level, the REPowerEU plan was presented, while many governments implemented measures to tackle the severe energy crisis resulting from the war in Ukraine (see Box X.1 in more detail). In December 2022, a provisional and conditional political agreement was reached between the Council of the EU and the European Parliament regarding the Carbon Border Adjustment Mechanism (CBAM), laying the foundation for carbon market reform. This agreement provides for the introduction of a carbon tax on imports of products from countries with less stringent standards. The agreement will be implemented gradually, starting from 1 October 2023 and ending on 31 December 2025, subject to reporting on imported products.

The US government passed the Inflation Reduction Act in August 2022, allocating a budget of USD 370 billion for subsidies to invest in energy and tackling climate change, with the aim to reduce emissions by 40% by 2030 (compared to 2005).[5] Although this law is undoubtedly a positive step towards addressing climate change, it has been strongly criticised by the EU for protectionism, as it grants preferential treatment to US-based businesses and could potentially drive investment from EU countries to the United States. In response, the European Commission proposed two legislative measures in March 2023: one seeks to "strengthen Europe's net-zero technology manufacturing products ecosystem" and the other to ensure the supply of critical raw materials.[6] Additionally, in the same month, after a meeting between the President of the European Commission and the President of the United States, discussions have started, which are expected to be long, but will hopefully lead to a trade deal regarding critical raw materials and to a possibility of European enterprises benefiting from the US Inflation Reduction Act.

Turning to other countries, Brazil serves as a prime example, as the election of a new president in October 2022 resulted in a commitment to climate change policies and a radical shift towards preserving the Amazon rainforest, which is considered as the Earth's lungs. Latin America is generally seen as a region that can make a significant contribution to the global transition to-

3 See also the forecasts included in the report: David I. Armstrong McKay et al., "Exceeding 1.5° C global warming could trigger multiple climate tipping points", *Science*, Vol. 377, No. 6611, 9.9.2022.

4 See: Decision -/CMA.4 Sharm el-Sheikh Implementation Plan and Funding arrangements for responding to loss and damage associated with the adverse effects of climate change, including a focus on addressing loss and damage.

5 See also the relevant report from Brookings Institution: Sud, R., S. Patnaik and R.L. Glicksman, "How to reform federal permitting to accelerate clean energy infrastructure – A non-partisan way forward", *Brookings Policy Brief*, February 2023. Also: Jacob Funk Kirkegaard, "The US-EU race for green subsidies can help fight climate change", *Realtime Economics*, Peterson Institute for International Economics (PIIE), 14.2.2023.

6 See (i) Proposal for a Regulation on Establishing a framework of measures for strengthening Europe's net-zero technology manufacturing products ecosystem (Net zero Industry Act), 16.3.2023, and (ii) Proposal for a Regulation on Establishing a framework for ensuring a secure and sustainable supply of critical raw materials, 16.3.2023.

wards renewable energy sources (RES). Brazil, Mexico and Chile are rich in RES and are among the 15 countries participating in the UN's RELAC initiative (Renewable Energy for Latin America and the Caribbean),[7] launched in 2019. The aim of this initiative is to achieve a minimum of 70% renewable energy participation in the region's electricity matrix by 2030.[8]

Recently, Greece passed a climate law (Law 4936/2022; see also Box X.2) in May 2022. Like in other countries, a panoply of measures has been deployed to assist households and businesses in response to the surge in energy costs (see Annex to Chapter V and Box II.3).[9] Due to unforeseen circumstances, some countries have resorted to providing subsidies for fossil fuels, the use of which reached record highs in 2022, in direct contrast to the decisions taken at COP 26 in Glasgow in 2021.[10]

The 15th UN biodiversity conference was held in 2022 (COP 15, Montreal, 7-9.12.2022), after a two-year break due to the pandemic. Despite some pessimistic forecasts, the international press described the outcome of the Conference as historic. Its decision foresees (despite some ambiguities) a target of preserving 30% of land and seas by 2030, protecting indigenous rights and doubling the resources for nature conservation over the next eight years. In many respects, protecting biodiversity and tackling climate change are seen as interdependent or "twin" goals.[11]

As regards climate actions of the ECB, there has been significant progress since the ECB's commitments in July 2021.[12] These actions relate to three pillars: managing climate risks; supporting the transition to a green economy; and promoting further action (see also Box X.3).[13] In its effort to enhance climate-related information communication, the Eurosystem started publishing this information as of the first quarter of 2023, as well as the first statistics on sustainable finance debt securities.[14] Box X.4 reports central bank disclosures in response to the recommendations of the Financial Stability Board (FSB), while the last part of this section outlines the activities, research papers and other publications related to the integration of climate change issues into the institutional and supervisory framework of credit institutions.

The growing need to address both the climate and energy crises has resulted in the production of valuable documents outlining the necessary economic policies,[15] while particular consideration has been given to the impact on inequality within countries and between the North and the

7 See IRENA, "Renewable energy in Latin America and the Caribbean – Towards a regional energy transition", 16.6.2022.
8 Chile had already reached 31% in November 2022.
9 It should also be noted that (i) the most recent OECD report on Greece contains a chapter on the green transition in the country: "Transitioning to a green economy", *OECD Surveys – Greece*, 10.1.2023; and (ii) the Foundation for Economic and Industrial Research (IOBE), with the support of the Bank of Greece, published *Adaptation to climate change – challenges and opportunities for the Greek economy*, February 2023 (see also Section 3 below).
10 See (i) "The global energy crisis pushed fossil fuel consumption subsidies to an all-time high in 2022", commentary, International Energy Agency (IEA), 16.2.2023, and (ii) *Fossil Fuels Consumption Subsidies 2022*, IEA Policy Report, February 2023.
11 See Institute for European Environmental Policy (IEEP), "Synergising climate and biodiversity agendas is an important challenge for the century", *blog*, 18.1.2023. See also the report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services, *Sustainable Use Assessment*, 8.7.2022.
12 Climate change and the ECB, and press release "ECB presents action plan to include climate change considerations in its monetary policy strategy", 8.7.2021.
13 ECB climate agenda 2022, 4.7.2022.
14 "ECB publishes new climate-related statistical indicators to narrow climate data gap", ECB press release, 24.1.2023.
15 See (i) Airaudo, F.S., E. Pappa and H.D. Seoane, "The green metamorphosis of a small open economy", 31 January 2023 (presented at a Bank of Greece seminar on 23.2.2023); (ii) Bofinger, P. (2022), "Public debt in the 'new normal' – A Schumpeterian perspective on fiscal policy", Hans-Bockler-Stiftung Working Paper No. 215; (iii) "L'action climatique: un enjeu macroéconomique", *France Strategie*, Nov. 2022 (submitted to the prime minister of France); (iv) Blanchard, O., C. Gollier and J. Tirole (2022), "The portfolio of economic policies needed to fight climate change", PIIE Working Paper; (v) *Geneva reports on the world economy*, *Climate and Debt*, No. 25, 14.10.2022; and (vi) Agliardi, E. and A. Xepapadeas, "Temperature targets, deep uncertainty and extreme events in the design of optimal climate policy", *Journal of Economic Dynamics and Control*, Vol. 139, June 2022, 104425. At least three of the papers examine the use of fiscal policy (and especially in terms of public debt) to tackle climate change.

South.[16] (See also Boxes IV.2 and V.1 herein). Several significant reports have been released regarding the impact of climate change on health – especially of children.[17]

Research on new technologies, which is particularly relevant for promoting clean energy production and supply, thus reducing emissions in the future, was marked by the breakthrough achieved at the Lawrence Livermore National Laboratory of California regarding nuclear fusion reactors, which was announced (jointly with the US Department of Energy) on 13 December 2022.[18] Certainly, as stressed by experts, it will take a lot of effort and several decades before nuclear fusion is commercialised for electricity generation.

The following is a list of important activities, studies and other publications on mainstreaming climate change issues into institutional and supervisory frameworks:

– Network of Central Banks and Supervisors for Greening the Financial System (NGFS): (a) a new work programme extending to 2024, which builds on previous initiatives as well as new ones;[19] (b) research papers focusing on progress made by central banks and supervisory authorities in climate scenario analysis exercises,[20] analysing risks to the financial system due to biodiversity loss,[21] analysis of climate change data challenges,[22] as well as increasing market transparency in green and transition finance;[23] and (c) updated tools, such as new scenario narratives for climate stress testing[24] and a dashboard for scaling up green finance.[25]

– Basel Committee on Banking Supervision (BCBS): principles for effective management and supervision of climate-related financial risks[26] and FAQs on how to incorporate climate-related financial risks into the existing Basel framework.[27]

– European Banking Authority (EBA): release of an updated roadmap on sustainable finance;[28] a discussion paper on the role of ESG risks in the prudential framework for credit institutions and investment firms and how these risks are to be incorporated in the Pillar 1 prudential framework.[29] EBA also published (jointly with ESMA and EIOPA) a final draft of regulatory technical standards regarding the Regulation on sustainability-related disclosures in the financial services sector, fossil gas and nuclear energy investments,[30] and a call for evidence from stakeholders on greenwashing.[31] Finally, EBA issued an opinion on the revision of the macroprudential framework and suggestions for incorporating environmental risks into the relevant capital buffers.[32]

– Single Supervisory Mechanism (SSM): a report regarding the results of the European supervisory climate change stress testing;[33] a report on credit institutions' practices and progress in

16 *Climate Inequality Report 2023 – Fair Taxes for a Sustainable Future in the Global South*, World Inequality Lab, 30.1.2023.
17 (i) *The coldest year of the rest of their lives: Protecting children from the escalating impacts of heatwaves*, UNICEF, 25.10.2022; and (ii) *The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels*, 25.10.2022.
18 "National Ignition Facility achieves fusion ignition", Lawrence Livermore National Laboratory, press release, 14.12.2022.
19 NGFS, press release, 30.5.2022.
20 NGFS, Climate Scenario Analysis by Jurisdictions: Initial findings and lessons, 15.11.2022.
21 NGFS, Statement on Nature-related Financial Risks, 24.3.2022.
22 NGFS, Final report on bridging data gaps, 6.7.2022.
23 NGFS, "Enhancing market transparency in green and transition finance", Technical document, April 2022.
24 NGFS, NGFS Climate Scenarios for central banks and supervisors, 6.9.2022.
25 NGFS, Dashboard on scaling up green finance, October 2022.
26 BIS, Principles for the effective management and supervision of climate-related financial risks, 15.6.2022.
27 BIS, press release, 8.12.2022.
28 The EBA roadmap on sustainable finance, December 2022.
29 EBA launches discussion on the role of environmental risks in the prudential framework, 2.5.2022.
30 ESAs propose disclosures for fossil gas and nuclear energy investments, 30.9.2022.
31 ESAs launch joint Call for Evidence on greenwashing, 15.11.2022.
32 EBA proposes to simplify and improve the macroprudential framework, 29.4.2022.
33 ECB Banking Supervision, *2022 climate risk stress test,* 8.7.2022.

incorporating climate change risks into their operations and in meeting the relevant supervisory expectations;[34] a report on good practices for climate change stress testing[35] and integrating climate change risks into credit institutions' operations.[36]

– European Insurance and Occupational Pensions Authority (EIOPA): a guidance on integrating climate change scenarios into the Own Risk and Solvency Assessment Report[37] (ORSA) and customer sustainability preferences under the Insurance Distribution Directive (IDD);[38] the results of the stress test regarding the impact of environmental risks on institutions for the occupational pension funds in the European Union;[39] re-evaluation of the exposure of the insurance sector to physical risks related to climate change;[40] and, finally, a consultation on the issue of the prudential treatment of insurers' sustainable assets and activities[41] and analysis of the insurance of private projects on adaptation to climate change.[42]

– European Securities and Markets Authority (ESMA): guidance on the supervision of the documentation and marketing material of sustainability-related funds and guiding principles on the use of sustainability-related terms in funds' names, and guidance on convergent supervision of the integration of sustainability risks by AIFMs and UCITS managers.[43]

– European Commission: technical standards to be used by financial market participants when disclosing sustainability-related information under the Sustainable Finance Disclosures Regulation (SFDR) and amendments to the Regulation on disclosures of gas and nuclear-related activities.[44]

34 ECB Banking Supervision, *Walking the talk – Banks gearing up to manage risks from climate change and environmental degradation,* 2.11.2022.
35 *ECB report on good practices for climate stress testing,* 19.12.2022.
36 ECB Banking Supervision, *Good practices for climate-related and environmental risk management,* 2.11.2022.
37 EIOPA publishes application guidance on how to reflect climate change in ORSA, 2.8.2022.
38 EIOPA, *Guidance on the integration of the customer's sustainability preferences in the suitability assessment under IDD,* 20.7.2022.
39 EIOPA, Climate stress test for the occupational pensions sector 2022, 16.12.2022.
40 EIOPA, Discussion paper on physical climate change risks, 20.5.2022.
41 EIOPA, Discussion paper on the Prudential Treatment of Sustainability Risks, 5.12.2022.
42 Impact underwriting: EIOPA reports on insurers' use of climate-related adaptation measures in non-life underwriting practices, 6.2.2023.
43 ESMA provides supervisors with guidance on the integration of sustainability risks and disclosures in the area of asset management, 31.5.2022.
44 Regulation on sustainability-related disclosure in the financial services sector.

Box X.1

THE IMPACT OF THE CURRENT ENERGY CRISIS ON CLIMATE CHANGE AND THE ENVIRONMENT

The health and energy crises have affected climate and the environment, both directly and indirectly. Energy and environment issues are interrelated, as it is almost impossible to generate, transport or consume energy without significant environmental impact. Environment issues related to energy production and consumption include air pollution, climate change, water pollution, thermal pollution and solid waste disposal.[1] Moreover, the energy sector is the largest source of greenhouse gas emissions, in particular carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O),[2] accounting for almost 3/4 of global greenhouse gas emissions,[3] with multiple negative

1 See https://www.eea.europa.eu/help/glossary/eea-glossary/environmental-impact-of-energy.
2 International Energy Agency (2021), *Net Zero by 2050: A Roadmap for the Global Energy Sector*.
3 World Meteorological Organization (2022), *2022 State of Climate Services: Energy*.

effects, including climate change and environmental destruction. The present box examines the impact of the current energy crisis on climate change and the environment.

Impact

Just as the COVID-19 pandemic was getting under control in mid-2021, the energy crisis broke out, primarily due to the reopening of the global economy. The energy crisis worsened and was prolonged after the Russian invasion of Ukraine in 2022.

Initially, the reopening of industries worldwide after the pandemic led to higher demand for energy. In 2021, global carbon dioxide (CO_2) emissions from the energy sector and industrial processes recorded their highest rise so far (6% y-o-y), pushing greenhouse gas emissions to 36.4 gigatons (Gt).[4,5] This resulted in a slowdown of the effort to reduce greenhouse gas emissions, while the share of renewable energy sources (RES) remained virtually unchanged.[6] Burning fossil fuels (oil, natural gas and coal) is the main cause of global warming, as greenhouse gases released into the atmosphere trap the sun's ultraviolet rays, thereby increasing average global temperature, fuelling extreme weather, causing biodiversity losses and generally having a negative impact on ecosystems and living conditions.[7] As a result, the years 2015-21 have been the seven warmest consecutive years on record, while 2018-22 is the fourth warmest five-year period on record. The global warming outlook in the coming years is nothing but bleak. There is a 48% chance that the annual mean global temperature will temporarily be 1.5°C above pre-industrial levels (1850-1900) for at least one of the next five years (2022-26) and a 93% chance that at least one year out of these five years will see a higher temperature increase than in 2016 (which has been the hottest on record).[8] At the beginning of 2023, the European Copernicus Climate Change Service announced that 2022 has been the second warmest year in Europe and the fifth worldwide.[9]

Subsequently, the war in Ukraine caused problems and generated uncertainty regarding the supply of energy in Europe, leading to increases in energy prices. Energy insecurity directly affects the European Union (EU) energy and climate policy and targets.[10] For the EU, the implementation of the UN 2030 Agenda for Sustainable Development and in particular the fulfilment of Goal 7 "Ensuring access to affordable, reliable, sustainable and modern energy for all" is a top priority. Some European countries (Iceland, Sweden, Finland, Denmark, Estonia,[11] but also Germany, France and Italy[12]), in response to the energy crisis, are accelerating the transition to and are investing in renewable energy. In addition, Austria, Germany, the Netherlands, the United Kingdom and Greece[13,14] are planning – in order to mitigate uncertainty and secure the required volume of energy – to restore or prolong the operation of lignite plants in the short term, thereby changing their energy transition plans.[15]

As Europe tries to prevent a widespread energy crisis, higher energy prices, among other things, made many European households turn to wood as a complementary or primary source of heating. However, this has negative

4 International Energy Agency (2022), *Global Energy Review: CO2 Emissions in 2021*.
5 See https://www.icos-cp.eu/science-and-impact/global-carbon-budget/2021 and carbon dioxide emissions chart from 1990 to 2021 (https://www.icos-cp.eu/sites/default/files/inline-images/essd2021_FossilFuel_and_Cement_emissions_1959.png).
6 European Environment Agency (2022), *Trends and Projections in Europe 2022*, EEA Report 10/2022.
7 Sengupta, S. and M. Edy, "War and warming up end global energy supplies and amplify suffering", *The New York Times*, 20.7.2022.
8 WMO, UNEP, GCP, UK Met Office, IPCC and UNDRR (2022), *United in Science 2022*.
9 Copernicus Climate Change Service (2022), *Global Climate Highlights 2022*.
10 See footnote 6.
11 European Environment Agency (2022), *Share of energy consumption from renewable sources in Europe*.
12 See https://www.statista.com/statistics/267233/renewable-energy-capacity-worldwide-by-country/.
13 International Institute for Strategic Studies – IISS (2022), *Europe's energy crisis and the pace of transition*.
14 Business News, "Ministry of Environment and Energy: Three-year extension to PPC's lignite-fired plants, due to the energy crisis" (in Greek), 16.12.2022.
15 UN Department of Economic and Social Affairs (DESA) – Sustainable Development Goal 7.

consequences on the environment, air quality and human health.[16] Last autumn, the National Observatory conducted a simulation for the city of Athens, where it isolated the particulate matter pollution from domestic heating and found a 10-20 mg higher concentration per cubic metre during evening hours, aggravating the already existing air pollution load.[17] This forecast is also in line with the strong demand for firewood observed this autumn in the Greek and the European market. Furthermore, burning wood for home heating creates additional problems of illegal and arbitrary logging, which in turn causes pressure and losses on European forests. Many European governments (Poland, Romania, Lithuania and Hungary) are relaxing their forest protection rules, in an effort to provide households with alternative and cheaper forms of heating.[18] Illegal logging contributes to deforestation, loss of biodiversity and, in particular, to reduced capacity of forests to bind and store carbon and thus contribute to climate change mitigation. Moreover, existing forests currently reduce greenhouse gas emissions generated by human activities by around one-third.[19] But in 2021, burning wood released more carbon dioxide than would have been released if fossil fuels had been used.[20]

Conclusions

A critical challenge of the current energy crisis is to avoid a direct confrontation between the two targets: ensuring low-priced supply of energy on the one hand and transition to renewable energy on the other. Environmental awareness and willingness to mitigate climate change were a prerequisite for the most basic needs: living and security. If these were called into question, then the social consensus currently in favour of energy transition would be undermined.[21] In response to the difficulties and disruptions in the global energy market and seeking to support its climate target as part of the "Fit for 55" package, the EU proposed, by means of the REPowerEU Action Plan, a number of measures. The measures include an increase of the target for RES participation in the energy mix to 45% (from 40%) by 2030.[22]

In recent years, alongside climate change, one global crisis has been followed by another. The health crisis that broke out at the end of 2019 and the energy crisis of 2021 have put their own mark on climate and the environment. Undoubtedly, the manifestations of the current energy crisis are particularly noticeable. The increase in global greenhouse gas emissions resulting in higher temperatures and climate change, both detrimental to natural ecosystems and the anthropogenic environment, has adverse effects *inter alia* on human health and causes forest losses that negatively affect biodiversity.

Climate change is a real threat linked to various environmental issues and tipping points. It triggers and exacerbates economic and social problems, disproportionately burdening less developed countries. Global action is urgently needed, as today's actions will determine not only the future of the global climate system, but also the lives and livelihoods of all humanity for the decades to come.[23] After all, climate change is perhaps the longest-lasting crisis and the question of whether it will be overcome, or at least mitigated, cannot be answered with certainty.

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16 Öztürk, Y., "Escalating concern about air pollution with energy crisis in Europe", *Synergy*, 3.10.2022.
17 Athanasopoulou, E. and E. Gerasopoulos "What will we inhale this year in Athens atmosphere if we massively turn to burning wood for our heating?" (in Greek), *Kosmos*, 30.11.2022.
18 Olden, M. and M. Pigeon (2022), "Europe's Dark Winter: How will people and forests survive the energy crisis?", Fern, *Briefing Notes*.
19 Ceurstemont, S. (2022), "Protecting forests on the front line of the climate-change battle", European Commission, *Horizon*, The EU Research & Innovation Magazine.
20 Hurtes, S. and W. Cai, "Europe is sacrificing its ancient forests for energy", *The New York Times*, 7.9.2022.
21 Makantasi, F. and I. Valentis, "The energy crisis in Greece: what is happening exactly with energy costs, what are their origins, how should they be addressed and what lessons are to be learned?" (in Greek), *diaNEOsis*, November 2022.
22 See footnote 6.
23 OECD (2022), *The Climate Action Monitor 2022: Helping Countries Advance Towards Net Zero*, Paris (https://doi.org/10.1787/43730392-en).

Box X.2

NATIONAL CLIMATE LAW

In May 2022, the first climate law[1] was passed in Greece, establishing, among other things, the framework for the adaptation to climate change and the gradual mitigation of anthropogenic greenhouse gas emissions. In order to achieve the long-term objective of carbon neutrality[2] by 2050, intermediate emission reduction targets are set for the years 2030 and 2040 (a reduction of 55% and 80%, respectively) relative to 1990 levels.

Successfully implementing the measures and achieving the objectives of the new law is crucial for limiting the temperature increase to 1.5°C above pre-industrial levels, pursuant to the Paris Agreement, which was ratified by Law 4426/2016 (Government Gazette A 187), and in accordance with the climate-neutrality objective of the European Union (EU).

The climate law strengthens considerably the pre-existing institutional framework for tackling climate change, also in line with the provisions in force at the European level, setting national climate targets, a system of governance and implementation measures. In particular, the new law includes:

Measures and policies to enhance mitigation and adaptation

– A National Adaptation Strategy to Climate Change (NASCC), prepared by the Ministry for Climate Crisis and Civil Protection, which spans ten years and is subject to review and/or revision every five years at least. The NASCC is further specified by the Regional Adaptation Action Plans (RAAPs), which define and prioritise the necessary adaptation measures and actions at the regional level.

– Adoption of five-year sectoral carbon budgets for specific sectors[3] of the economy. The drafting of the first sectoral budgets is planned for 2024 (for the period 1.1.2026-31.12.2030), and it will thereafter be repeated every five years.

– Regular assessment of the progress towards climate neutrality on the basis of the latest available scientific data and annual progress reports, with the possibility to review and/or set new intermediate climate targets.

General and specific measures and policies to reduce emissions

– Implementation of general measures aimed at: (a) saving the greatest possible amount of energy and increasing energy efficiency; (b) attaining the greatest possible penetration of renewable energy sources (RES); (c) phasing out all fossil fuels and substituting them for RES, with a view to securing energy supply and in line with technological advances; (d) gradually substituting natural gas for renewable gases, such as biomethane and green hydrogen, particularly in transport and industry; (e) promoting electromobility; (f) promoting sustainable urban mobility and the use of means of public transport; (g) improving the carbon footprint of buildings and infrastructures; (h) reducing greenhouse gas emissions; (i) increasing the greenhouse gas removal; and (j) fostering synergy between policies that are jointly related to the mitigation of the impacts of climate change and to the improvement of air quality.

– Permanent withdrawal of lignite-fired plants and a ban on electricity generation from solid fossil fuels. The implementation of the measure will start as of 31 December 2028, with a specific clause for the review of delignitisation in 2025, should the above date be brought forward.

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1 Law 4936/2022 "National Climate Law – Transition to climate neutrality and adaptation to climate change, emergency provisions to address the energy crisis and protect the environment" (in Greek).

2 Climate neutrality or net-zero greenhouse gas emissions: the balance between anthropogenic greenhouse gas emissions from sources and their removal by sinks. Sinks include any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere.

3 (a) Electric power and heat generation; (b) transport; (c) industry; (d) buildings; (e) farming and livestock breeding; (f) waste and (g) land use activities and land use change, and forestry.

– Faster penetration of electromobility to reduce air pollution, by implementing measures to promote the use of very low- or zero-emission vehicles, with a focus on specific sectors. As of 2026, new passenger cars for public use (taxis) and one-third of new vehicles for rental/leasing purposes will be zero-emission vehicles. In addition, as of 2024, at least a quarter of new private company cars will be purely electric or hybrid electric vehicles.

– Ban on the sale and installation of heating oil burners as of 2025. Sale, exclusively, of heating oil blended with renewable liquid fuels at a percentage of 30% by volume as of 2030. Applications for the issue of building permits for specific types of buildings (with coverage >500 m^2) with an obligation to install electric power generation systems from photovoltaic or thermal solar systems corresponding to at least 30% of the coverage as of 2023.

– A quantitative emission reduction target of at least 30% by 2030 relative to 2019 is set for specific types of activities[4] and an annual reporting requirement is introduced from 2026 onwards in order to monitor compliance with the defined target.

– An annual reporting requirement is introduced for specific types of undertakings[5] regarding their carbon footprint (as of 2023, with 2022 as the reference year). The report will include voluntary emission reduction or offsetting targets and actions, verified by a certified body and updated annually.

– Speeding up the interconnection with the mainland electricity grid of the non-interconnected islands, as well as the substitution of liquid fossil fuel power plants by plants using RES and storage systems. An 80% reduction in the emissions of non-interconnected islands by 2030 compared with 2019. As of 2030, the use of fuel oils (mazut) for electricity generation on non-interconnected islands will be prohibited.

System of governance and participation of the public for engaging in climate action

Governance and public participation system for climate action

– Establishment of a National Observatory for Climate Change Adaptation, under the Ministry for Climate Crisis and Civil Protection, with a view to supporting the national adaptation policy.

– Creation of an online climate discussion forum by the Natural Environment and Climate Change Agency (NECCA[6]) for consultation on the main results of the proposal submitted by the Minister of the Environment and Energy to the Governmental Committee for Climate Neutrality[7] as regards the sectoral carbon budgets, the assessment of progress towards the achievement of goals and the annual progress report.

– Preparation of an annual progress report on climate change mitigation and adaptation issues by the Ministry of the Environment and Energy, the Ministry for Climate Crisis and Civil Protection, and the NECCA, comprising, among other things, national data on emissions and greenhouse gas removal by sector of economic activity, as well as a description of climate change actions and progress by sector of economic activity.

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4 Type of activity: (a) environmental infrastructure systems; (b) tourist facilities and urban development projects; building projects, sports and recreation projects; (c) poultry-livestock establishments; (d) aquaculture; and (e) industrial activities and relevant facilities.

5 These include (a) listed companies; (b) credit institutions; (c) insurance undertakings; (d) investment firms; (e) fixed and mobile telephony companies; (f) water supply and sewerage companies; (g) couriers; (h) electricity and natural gas supply companies; (i) retail chains; (j) logistics companies; and (k) civil transport companies.

6 The NECCA was founded in 2021 as the sole successor of the National Centre for Environment and Sustainable Development (NCESD). It is a legal person governed by private law, which aims at implementing the policy formulated by the Ministry of the Environment and Energy for the management of protected areas in Greece, biodiversity conservation and the promotion and implementation of sustainable development actions and climate change mitigation.

7 Governmental committee established pursuant to Article 8 of Law 4622/2019 to act as a coordinator on issues related to emissions reduction and adaptation to climate change.

– Establishment of a National Climate Change Adaptation Council under the Ministry for Climate Crisis and Civil Protection to act as the main advisory body of the State for the coordination, monitoring, adoption and evaluation of climate change adaptation policy actions.

– Establishment of a Scientific Climate Change Committee (SCCC) under the Ministry of the Environment and Energy, which will be responsible, among others, for proposing and developing science-based climate change policies, issuing opinions to the Governmental Committee for Climate Neutrality on the five-year carbon budgets for all sectors of the economy, assessing whether it is needed to update the long-term and intermediate climate targets, or the actions and methods to achieve these targets, and for any issue related to tackling climate change.

Box X.3

FURTHER STEPS BY THE ECB TO INCORPORATE CLIMATE CHANGE INTO ITS MONETARY POLICY OPERATIONS

In July 2022, the Governing Council of the European Central Bank (ECB) decided to take further measures to include climate change considerations in the Eurosystem's monetary policy framework.[1] These measures follow up on the actions announced in 2021 as part of the ECB's strategy review[2] and are designed in full accordance with the Eurosystem's objective of maintaining price stability.[3] They aim to reduce climate-related financial risk in the Eurosystem balance sheet, encourage transparency and support the green transition of the economy in line with the European Union's (EU) climate neutrality objectives.

Briefly, the ECB decided to: (i) take into account the climate performance of corporate bond holdings in the Eurosystem's monetary policy portfolios; (ii) adjust its collateral framework; (iii) introduce climate-related disclosure requirements; and (iv) enhance its risk management practices. In more detail:

(a) Corporate bonds: The Eurosystem aims to gradually decarbonise its corporate bond holdings, along a path aligned with the goals of the Paris Agreement. Starting from October 2022, the Eurosystem has been tilting reinvestments of principal payments from maturing corporate securities purchased under its asset purchase programmes[4] towards better climate-performing issuers. In September 2022, the ECB announced further details on the implementation of this measure.[5] Effectively, the assessment of the performance of corporate bond issuers in relation to climate change considerations will be based on a score calculated as the sum of three individual scores, involving: (i) the historical greenhouse gas emissions of each issuer; (ii) the issuer's greenhouse gas emission reduction targets; and (iii) the quality of the issuer's greenhouse gas emission disclosures. In any event, the level of corporate bond purchases will continue to be driven by monetary policy considerations and the achievement of the price stability objective. The ECB started in the first quarter of 2023 to publish, on a regular basis, climate-related information on its corporate bond holdings.

(b) Collateral framework: The Eurosystem will limit the share of assets issued by entities with a high carbon footprint that can be pledged as collateral by counterparties when borrowing from the Eurosystem. In addition, the Eurosystem will consider climate change risks when reviewing haircuts applied to corporate bonds used as collateral. In any case, all measures will ensure that ample eligible collateral remains available, allowing monetary policy to continue to be implemented effectively.

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1 "ECB takes further steps to incorporate climate change into its monetary policy operations", press release, 4.7.2022.
2 "ECB presents action plan to include climate change considerations in its monetary policy strategy", press release, 8.7.2021.
3 For more information on initial initiatives to integrate the impact of climate change into the Eurosystem's operational framework, see Bank of Greece (2021), *Monetary Policy 2020-2021*, Box III.1.
4 In particular, under the Corporate Sector Purchase Programme (CSPP) and the Pandemic Emergency Purchase Programme (PEPP).
5 "ECB provides details on how it is intended to decarbonise its corporate bond holdings", press release, 19.9.2022.

(c) Climate-related disclosure requirements for collateral: The Eurosystem will only accept marketable assets and credit claims from companies and debtors that comply with the Corporate Sustainability Reporting Directive (CSRD) as collateral in Eurosystem credit operations, once the directive is fully implemented.

(d) Risk assessment and management: The Eurosystem will further enhance its risk assessment tools and capabilities to better include climate-related risks. It will encourage credit rating agencies to more transparently disclose how they integrate climate-related risks into their ratings and to take more ambitious steps with regard to climate risk disclosure requirements. In addition, the Eurosystem agreed on a set of common minimum standards for integrating climate risks into the ratings provided by the national central banks' internal credit assessment systems (ICASs).

These decisions are part of the climate action plan announced in July 2021. The ECB's work is progressing as outlined in the climate roadmap[6] and may have to be aligned if and when the timetable in EU legislation changes. In addition, the ECB will regularly review the above methodologies and criteria, which are likely to be adjusted as available data, analytical tools, legislation and risk assessment capabilities are enhanced and enriched over time.

6 "Detailed roadmap of climate change-related actions", July 2021.

2 GREENHOUSE GAS EMISSIONS IN THE EU AND GREECE

Greenhouse gas emissions in 2020 for the EU-28 as a whole and Iceland stood at 3,707.6 million tonnes of CO_2 equivalent (MtCO2e), the lowest level since 1990 (down by 34.3%), despite GDP growth of 54% over the same period (see Table X.1). After a dramatic decline in emissions in 2020, in part due to the COVID-19 impact on economic activity, 2021 saw increased emissions. However, despite this increase, emissions levels are still lower than those recorded in 2019. More specifically, in 2021, total EU-27 emissions (excluding the UK) rose by 4.8% compared to 2020 and stood around 28.7% below the 1990 level. Compared to 1990, emissions were lower for most EU Member States, with the exception of Cyprus and Ireland, which recorded higher emissions. There were several factors behind changes in 2021, including a notable increase in total energy consumption.[45] Specifically, there was a 6% rise in primary energy consumption and a 5% increase in final energy consumption compared to 2020.[46]

Greenhouse gas (GHG) emissions decreased in most sectors between 1990 and 2020, with the notable exception of transport, cooling and air conditioning. Emissions reductions have been larger for manufacturing and construction, households, electricity and heat production, as well as iron and steel production. In addition to the 2020 economic downturn, lower emissions in industrial sectors are also attributed to a combination of factors, such as improved energy efficiency and structural changes in the economy, implying a higher share of services and a lower share of more energy-intensive industries in total GDP. Emissions from electricity and heat production decreased sharply compared to 1990. In addition to improved energy efficiency, this development is also due to an observed shift towards less carbon-intensive fuels: between 1990 and 2020, the use of solid and liquid fossil fuels in thermal power plants decreased significantly, gas consumption more than doubled, coal use decreased by three times, while RES use has increased significantly in the EU since 1990. Improved energy efficiency and a less carbon-intensive fuel mix have led to reduced CO_2 emissions per unit of energy produced by fossil fuels. Emissions in the household sector also recorded one of the largest decreases. Improvements in energy efficiency owing to optimised insulation standards in buildings, but also the broadly milder winters in Europe over the past three decades, can partly explain lower demand for heating in the EU over the past 30 years. The agricultural and environmental policies

45 European Environment Agency, *Approximated EU greenhouse gas inventory – Proxy GHG emission estimates for 2021*, ETC CM Report 2022/4.

46 European Environment Agency, *Trends and projections in Europe 2022*, EEA Report No. 10/2022.

Table X.1 Greenhouse gas emissions[1]

(in million tonnes of CO_2 equivalent)

	1990	2020	Change 2019-2020	Change 2020-2021*	Change 1990-2020	Change 1990-2021*
Country	(MtCO2e)			(percentage changes)		
Austria	78.4	73.6	-7.7	4.8	-6.2	-1.7
Belgium	145.7	106.4	-8.6	4.2	-26.9	-23.9
Bulgaria	98.4	49.2	-17.3	10.6	-50.0	-44.7
Croatia	31.4	23.8	-3.5	-2.1	-24.4	-26.0
Cyprus	5.6	8.9	-0.3	0.5	59.0	59.8
Czech Republic	198.8	113.3	-8.3	5.6	-43.0	-39.8
Denmark	71.1	41.7	-6.2	-1.6	-41.3	-42.2
Estonia	40.2	11.6	-21.0	12.4	-71.2	-67.7
Finland	71.2	47.8	-9.5	-0.1	-32.9	-33.0
France	544.1	393.0	-9.6	6.4	-27.8	-23.1
Germany	1241.9	728.7	-8.9	4.5	-41.3	-38.7
Greece	103.5	74.8	-12.6	1.9	-27.7	-26.3
Hungary	94.8	62.8	-2.7	1.4	-33.8	-32.8
Iceland	290.1	274.7	-12.5	5.1	-5.3	-0.5
Ireland	54.4	57.7	-3.6	4.8	6.1	11.2
Italy	519.9	381.2	-8.9	6.2	-26.7	-22.1
Latvia	25.9	10.5	-5.9	2.4	-59.6	-58.7
Lithuania	47.9	20.2	-0.9	2.1	-57.8	-57.0
Luxembourg	12.7	9.1	-15.5	3.5	-28.8	-26.3
Malta	2.6	2.1	-0.5	-1.9	-18.4	-19.9
Netherlands	220.5	164.3	-8.8	1.5	-25.5	-24.4
Poland	475.9	376.0	-3.7	6.7	-21.0	-15.7
Portugal	58.5	57.6	-9.5	-1.3	-1.5	-2.8
Romania	249.7	109.9	-3.5	4.4	-56.0	-54.1
Slovakia	73.5	37.0	-7.0	10.3	-49.6	-44.4
Slovenia	18.6	15.9	-7.2	-1.5	-14.8	-16.1
Spain	3.7	4.5	-4.3	3.0	22.7	26.5
Sweden	71.4	46.3	-8.9	3.7	-35.2	-32.8
United Kingdom	796.2	404.8	-9.5	-	-49.2	-
EU plus Iceland[2]	**5646,5**	**3707,6**	**-8.5**	**4.8**	**-34.3**	**-28.7**

Sources: European Environment Agency, *Annual European Union greenhouse gas inventory 1990-2020 and inventory report 2022*, May 2022. For 2021: European Environment Agency, *Approximated EU greenhouse gas inventory — Proxy GHG emission estimates for 2021*, April 2022.
* Figures in these columns refer to the EU without the UK (EU-27).
1 Total GHG emissions, excluding land use, land-use changes and forestry.
2 The EU and Iceland jointly report their national GHG emissions during the second commitment period of the Kyoto Protocol, reflected in the Doha Amendment.

of the 1990s and energy and climate policies since 2005 have also contributed to lower total emissions, both at the European and national levels.[47]

In 2020, the largest emitters in the EU were Germany (20%), the UK (11%) and France (11%), followed by Italy (10%), Poland (10%) and Spain (7%). However, Germany and the UK

47 European Environment Agency, *Annual European Union greenhouse gas inventory 1990-2020 and inventory report 2022*, 27.5.2022.

accounted for 47% of the total emissions reduction between 1990 and 2020 (see Table X.1). France, Romania, Italy, Poland and the Czech Republic together have contributed to almost one-third of total EU GHG emission reductions since 1990. The main reasons for the significant emissions reduction in Germany were the increased efficiency of power and heating plants and the economic restructuring, particularly in the iron and steel sector. Other important reasons include the decrease in the carbon intensity of fossil fuels with the switch from coal to natural gas, a strong increase in RES, and waste management measures that reduced the landfilling of organic waste. Lower GHG emissions in the UK were primarily attributed to the liberalisation of energy markets and the fuel switch from oil and coal to gas in electricity production, as well as to decreasing iron and steel production and the implementation of methane recovery systems at landfill sites.[48]

As regards the percentage distribution of the six greenhouse gases in the EU in 2020, carbon dioxide (CO_2) accounts for the largest share (79.9%, compared with 79.3% in 1990) and is responsible for the largest reduction in emissions since 1990. It is followed by methane (CH_4) and nitrogen oxide (N_2O) at 11.3% and 6.1% respectively, down from 12.6% and 6.8% in 1990. Lower methane and nitrogen oxide emissions reflect a decline of mining activities, decreasing livestock breeding, reduced production of adipic and nitric acid (i.e. from fertiliser use in agriculture) and lower emissions attributed to improved waste management.

In 2020, the biggest contributor to greenhouse gas emissions was energy-related activities, accounting for 75.5% or 2.801 MtCO2e in the EU (as shown in Table X.2). Agriculture followed with 11.4% or 424 MtCO2e, while industrial processes and waste had shares of 9.5% (351 MtCO2e) and 3.5% (130 MtCO2e) respectively.[49]

Greenhouse gas emissions in Greece totalled 74.8 MtCO2e, reflecting a considerable decrease of 27.7% compared to 1990, largely driven by mitigation measures such as increased RES use and improved energy efficiency.[50] The decrease in emissions primarily resulted from energy-related activities. Emissions from this industry in 2020 accounted for 69.0% of total emissions (1990: 74.5%), down by 33.0% compared to 1990. Industrial processes are the second most important source of greenhouse gases, with a share of 14.0%. Agriculture (including livestock) follows with a share of 10.5%. Emissions have decreased significantly (-23.6%) compared to 1990, mainly owing to a reduction of nitrogen oxide (N_2O) emissions from agricultural soils, due to reduced use of synthetic nitrogen fertilisers and a decline in the livestock population. Reduced use of synthetic nitrogen fertilisers is attributable to an increase in organic farming, high fertiliser prices and improved practices in fertiliser use. Turning to waste, its share in GHG emissions reached 6.5% in 2020, with emissions marginally increasing by 0.3% compared to 1990. As regards the percentage distribution of individual GHGs, in 2020 carbon dioxide accounted for 74.3% of total emissions, down by 33.4% compared to 1990, mainly reflecting the introduction of natural gas and renewables into the electricity generation system, the actions to improve energy efficiency and the gradual reduction of lignite combustion. It is worth noting that the high availability of hydroelectric power has made a significant contribution to the downward trend in emissions. This is followed by methane emissions with a share of 12.9%, reduced by 13.2% compared to 1990.[51]

48 European Environment Agency, *op. cit*.

49 The annual changes relative to 1990 were: -35.2% for energy-related activities, -20.3% for agriculture, -35.9% for industrial processes and -45.4% for waste.

50 Specifically in Greece, the upward trend in emissions over the period 1990-2007, which was due to improved living standards and the significant expansion of the services sector, was followed by a declining trend in 2008-19. This development is mainly due to the economic recession, but also to an increase in RES and improved energy efficiency, as well as to a reduction of emissions from public transport. Moreover, the major decrease in 2020 compared to 2019 can be mainly attributed to the decreased operation of lignite-fired plants, which were replaced with a higher percentage of natural gas and RES than in past years, as well as to COVID-19 restrictions in the transport sector (Ministry of Environment and Energy, *National Inventory Report of Greece for greenhouse and other gases for the years 1990-2020*, April 2022).

51 *Greece – National Inventory Report 2022*, Ministry of Environment and Energy, April 2022.

Table X.2 Greenhouse gas emissions by source category in the EU[1] and Greece

(in million tonnes of CO_2 equivalent)

	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
					EU						
Energy	4,323	4,062	3,995	4,108	3,795	3,364	3,348	3,351	3,270	3,113	2,801
Industrial processes	548	523	480	487	407	393	391	400	392	382	351
Agriculture	532	466	457	434	419	428	430	433	429	425	424
Waste	238	244	227	199	166	141	137	136	135	133	130
Other	0	0	0	0	0	0	0	0	0	0	0
Indirect CO_2 emissions	4.00	4.00	3.00	3.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00
Total*	5,647	5,299	5,162	5,231	4,789	4,329	4,308	4,322	4,228	4,054	3,708
					Greece						
Energy	77	81	97	107	93	71	67	70	67	61	52
Industrial processes	11	14	15	15	12	12	12	13	12	12	10
Agriculture	10	10	9	9	9	8	8	8	8	8	8
Waste	5	5	5	5	5	4	5	5	5	5	5
Total*	103.5	109.4	126.5	136.4	118.5	95.4	91.8	95.6	92.3	85.6	74.8

Sources: European Environment Agency, *Annual European Union greenhouse gas inventory 1990-2020 and inventory report 2022*, May 2022. For Greece: Ministry of Environment and Energy, *Climate Change Emissions Inventory*, April 2022.
* Total GHG emissions, excluding land use, land-use changes and forestry.
1 The EU and Iceland jointly report their national GHG emissions during the second commitment period of the Kyoto Protocol, reflected in the Doha Amendment. The EU aggregate therefore includes Iceland.

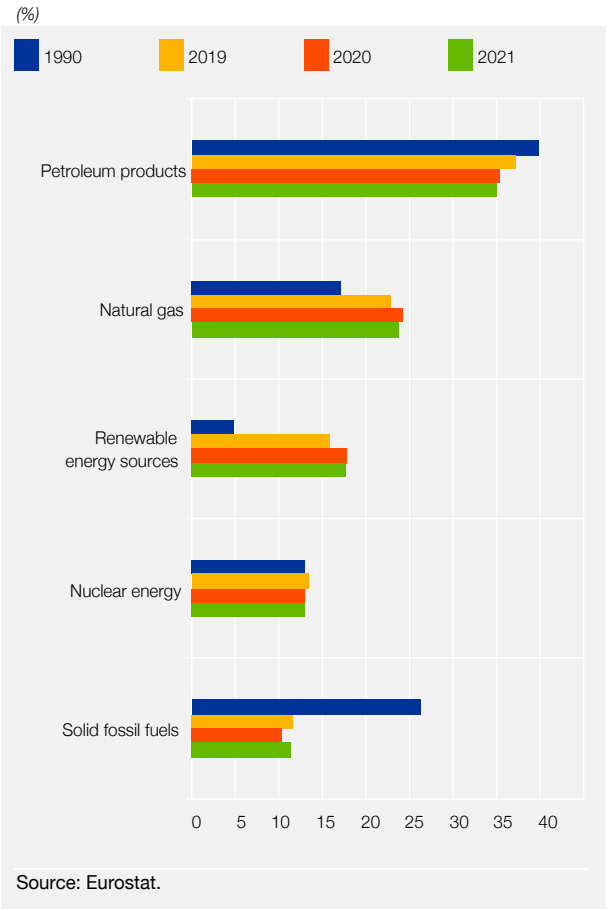
Today, Europe is facing an energy crisis that has halted its GHG emissions reduction path. Emissions increased in 2021, after the pandemic, especially in transport, industry and energy supply. With the energy crisis and in particular the high price of natural gas, the energy supply sector has partly turned to more carbon-intensive energy fuels, while the strong growth of renewables observed in previous years slowed down in 2021. The short-term measures deemed necessary to boost energy supply in the winter of 2022 should not trap Europe into reliance on fossil fuels for many years to come. Energy savings and support for renewables are crucial not only to tackling the current energy crisis and ensuring energy sufficiency, but also to achieving climate neutrality. Educating people, which is inextricably linked to environmental protection and contributes to reducing dependence on conventional energy products, can play an important role in this regard, since the development of human capital, including raising environmental awareness, leads to a reduction in energy consumption and CO_2 emissions.[52]

According to European climate legislation, the GHG emission reduction target has been raised to 55% compared to 1990 levels by 2030. To reach this target, emissions need to decrease by an average of 134 MtCO2e per year from the estimated 2021 levels. This is more than double the average annual reduction between 1990 and 2020. Additionally, to meet the initial target of 32% of total energy consumption from RES (now revised to 40%[53]) by 2030, their share should increase by 1.1 percentage points per year on average from 2021 levels. In order to achieve this, it is important to focus on improving energy efficiency and increasing the use of renewables in electricity generation.

It should be noted that the evolution of the EU's energy mix between 1990 and 2021 highlights the progress already achieved in RES penetration. According to Eurostat data, the energy mix

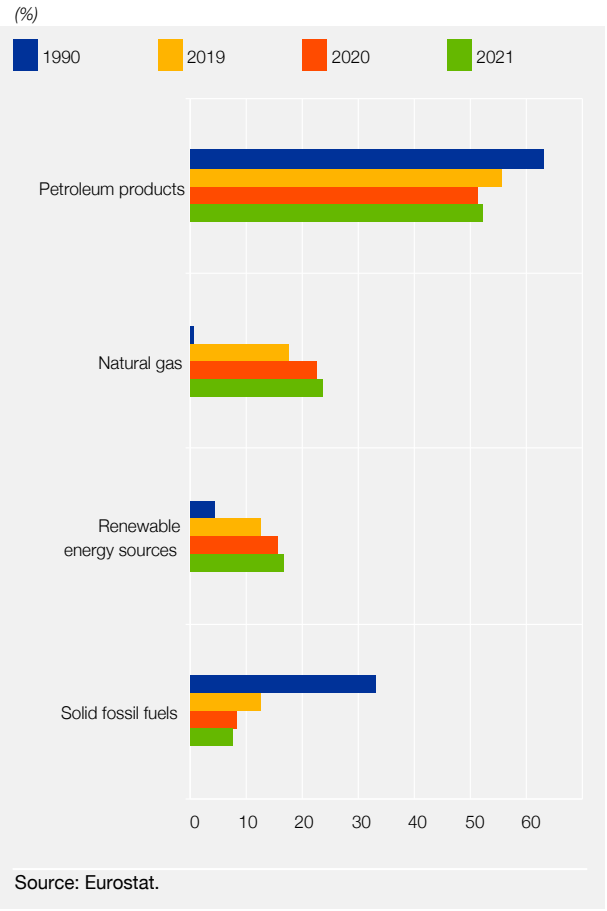
52 Hondroyiannis, G., E. Papapetrou and P. Tsalaporta (2022), "New insights on the contribution of human capital to environmentaldegradation: Evidence from holiday and cross-correlated countries", *Energy Economics*, 116, Article 106416.
53 Decision of the EU Council; see press release, 27.6.2022.

Chart X.1 Shares of energy products in total available energy in the EU



Source: Eurostat.

Chart X.2 Shares of energy products in total available energy in Greece



Source: Eurostat.

in the EU for 2021 (see Chart X.1) consisted mainly of five sources: petroleum products including crude oil (34% of total available energy, against 39% in 1990), natural gas (23%, against 17% in 1990), RES (17%, against 5% in 1990), nuclear energy (13%, the same as in 1990) and solid fossil fuels (11%, against 26% in 1990). For Greece (see Chart X.2) the corresponding shares were 51% for petroleum products (1990: 62%), 23% for natural gas (1990: 0.6%), 16% for RES (1990: 4%) and 7% for solid fossil fuels (1990: 33%).

At the international level, both the targets and the evolution of greenhouse gas emissions fall significantly short of what is needed to achieve the Paris Agreement's goal of keeping the global average temperature rise below 1.5°C. According to a UN report,[54] current commitments by countries could reduce in part the global average temperature rise to 2.4-2.6°C by the end of the century; therefore, a systemic and far-reaching transformation is urgently needed to secure the path towards the Paris Agreement.

3 THE BANK OF GREECE'S SUSTAINABILITY AND CLIMATE ACTIONS IN 2022

Over the past year, the Bank of Greece further promoted its climate change and sustainability agenda, as outlined in its Annual Financial Report 2022. The key actions are presented below.

54 United Nations, *Emissions Gap Report 2022*.

In the context of the Bank's contribution to the project "LIFE-IP AdaptInGreece: Boosting the implementation of adaptation policy across Greece (2019-2026)", the update of the studies on the economic, environmental and social impacts of climate change in Greece is ongoing. In addition, the Climate Change and Sustainability Centre of the Bank of Greece co-organised with the Ministry of Environment and Energy and the Green Fund an online event entitled "Adaptation Finance in Greece: Current challenges and the role of the financial sector".[55]

In cooperation with INSPIRE (International Network for Sustainable Financial Policy Insights, Research and Exchange), Bank of Greece staff participated in the preparation of a handbook on central bank disclosures regarding climate change issues (see Box X.4).

The two issues of the Bank of Greece's *Economic Bulletin* released in 2022 (No. 55 and No. 56 in July and December respectively) include studies by the Bank's staff on green finance ("Green finance in Europe: actors and challenges")[56] and energy consumption ("Energy consumption by energy type and exports of goods in Greece: a comparative analysis in relation to the euro area").[57]

Members of the Bank's staff also participated in the Ministry of Finance Working Group on Sustainable Finance and Green Economic Transition.

In addition, the Bank supported the preparation of a specific study by the Foundation for Economic and Industrial Research (IOBE) on the state of play of climate change adaptation actions, entitled *Adaptation to climate change – challenges and opportunities for the Greek economy*.[58]

Moreover, in February 2023 the Bank published its first monthly statistics on sustainable debt securities issuance,[59] while in March climate change data on the Bank's euro-denominated portfolios, other than those held for monetary policy purposes, are expected to be published for the first time (see Box X.4).

55 See Bank of Greece, press release (in Greek), 24.5.2022, and an introductory speech by the Governor.
56 Bank of Greece, *Economic Bulletin*, No. 55, July 2022.
57 Bank of Greece, *Economic Bulletin*, No. 56, December 2022.
58 See Bank of Greece, press release (in Greek), 14.2.2023.
59 See Bank of Greece, press release, 21.2.2023.

Box X.4

CENTRAL BANK DISCLOSURES ON ISSUES RELATED TO CLIMATE CHANGE IN APPLICATION OF THE TCFD RECOMMENDATIONS

Central banks are constantly stepping up their efforts to find ways to integrate the impact of climate change in the development and implementation of monetary policy, in supervisory practices as well as in the processes for safeguarding financial stability.

Measuring and reporting information on climate change-related risks and opportunities is an important step in this direction. The Recommendations of the Task Force on Climate-related Financial Disclosures (hereinafter the "TCFD recommendations")[1], which was created by the Financial Stability Board, form a basic framework for

1 Recommendations of the Task Force of the Financial Stability Board on the disclosure of climate-related financial information: Recommendations on Climate-Related Financial Disclosures.

the disclosure of climate change-related information and are already being implemented by governments, central banks, public organisations and corporations.[2]

Summary of the TCFD recommendations

The TCFD recommendations are based on a set of principles that, among other things, allow for flexibility in their implementation. The recommended disclosures can be applied to central bank portfolios (both monetary policy portfolios and other portfolios), to the provision of credit facilities as well as to issues of financial stability and central bank operations.[3] The TCFD recommendations are implemented on a voluntary basis (except in the event of their transposition into national legislation) and in any case they do not prevail over any disclosures set out in the legislation in force. Finally, the recommended disclosures are structured around four interrelated thematic pillars that represent the core elements of how organisations operate: a) Governance, b) Strategy, c) Risk Management and d) Metrics and Targets.

As early as 2019, the European Commission published guidelines on the disclosure of climate-related information by firms, incorporating the TCFD recommendations.[4] The NGFS (Network of Central Banks and Supervisors for Greening the Financial System) emphasises the importance of a robust and internationally consistent climate and environment-related disclosure framework and its members have collectively pledged their support for the TCFD recommendations.[5] At the same time, since December 2021, the NGFS has incorporated the TCFD recommendations into a guide for central banks on how to make climate-related disclosures.[6]

Implementation of the TCFD recommendations by the Eurosystem and the Bank of Greece

In February 2021, the Eurosystem committed to start making climate change-related disclosures, aligned with the TCFD recommendations for its non-monetary policy portfolios, comprising bonds[7] and equities. This was followed by the ECB's commitment in July 2022 for similar disclosures for corporate bonds held under the CSPP and the PEPP. The disclosures will be annual and will start at the end of the first quarter of 2023 at the latest.[8] According to the Eurosystem's common stance, which was finalised in November 2022, Eurosystem NCBs are required, as a minimum, to proceed to the disclosures mentioned in the thematic area "Metrics and Targets". At this early stage, in particular, they are required to disclose the climate footprint of euro-denominated non-monetary policy portfolios and to commit to the alignment of their investment policy with the goals of the Paris Agreement and the EU objectives for carbon neutrality by 2050. Disclosures relating to portfolios invested in foreign currency or to the other thematic pillars of the TCFD recommendations (Governance, Strategy and Risk Management) are currently optional.

The Bank of Greece, in line with the Eurosystem's common stance, is expected to disclose for the first time at end-March 2023 the climate footprint of its euro-denominated non-monetary policy portfolios for the financial year 2022, incorporating the TCFD recommendations outlined in the "Metrics and Targets" pillar.[9]

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2 As evidenced by the list of supporters of disclosures in accordance with the TCFD recommendations and the alignment of their formal reports with the requirements, this applies to a wide geographical and sectoral scale worldwide. The list comprises central banks, including the Bank of Greece.

3 In addition, a relevant guide was published by INSPIRE (International Network for Sustainable Financial Policy Insights, Research and Exchange), tailored to central banks' specificities, containing practical advice and guidance on the implementation of the TCFD framework. The Bank of Greece contributed to the writing of the guide, in cooperation with distinguished scientists from INSPIRE.

4 Communication from the Commission – Guidelines on non-financial reporting: Supplement on reporting climate-related information (2019/C 209/01), June 2019.

5 NGFS, *A call for action: Climate change as a source of financial risk*, April 2019.

6 NGFS, *Guide on climate-related disclosure for central banks*, December 2021.

7 These include: sovereign bonds, corporate bonds, covered bonds, and supranational and agency bonds.

8 Members of the Eurosystem that face legal and operational constraints in disclosing information prior to their relevant annual report for 2022 have the option of making the disclosures during the second quarter of 2023.

9 The key metrics of portfolios' climate footprint, as recommended by the TCFD, are the following: (1) Weighted Average Carbon Intensity, (2) Total Carbon Emissions, (3) Carbon Footprint and (4) Carbon Intensity. In accordance with the common minimum disclosure framework approved at the Eurosystem level, disclosure of the first three metrics is mandatory, while the fourth is optional.

Disclosures under the TCFD recommendations mark an important step towards understanding climate-related risks to which central bank investment portfolios are exposed and providing information about their environmental footprint.

By continuously pursuing enhanced transparency about their investment activities, central banks can help improve the quality and availability of climate-related data and provide knowledge leading to a better understanding of the risks and opportunities that may arise due to climate change. In addition, all relevant actions are aimed at reducing the environmental footprint and more broadly at raising awareness of climate action.