European Parliament

EU climate action policy

Responding to the global emergency

STUDY

EPRS | European Parliamentary Research Service

Lead author: Gregor Erbach

PE 689.378 – March 2021

EN

EU climate action policy

Responding to the global emergency

The European Green Deal aims to make the European Union climate-neutral by 2050, a target supported by all EU institutions. With this objective, the EU takes a leading role in addressing the global climate emergency. Achieving the climate-neutrality goal requires massive investment and an unprecedented transformation of all sectors of the economy.

This study explains the physical basis of climate change and highlights its expected impacts on the EU. To give an overview of EU and international climate policies, it outlines international climate agreements, EU climate action and the climate policies of major economies. It assesses the coherence of EU climate policy with other policy areas and presents the financing of EU climate action through the EU budget and other instruments.

To assess the implications of the climate neutrality objective, the study analysis the challenges and opportunities for the EU economy and its impacts on issues such as international relations, migration, trade, consumers and health.

The final chapter addresses the issues facing European decision-makers and the outlook for European and global climate action in the context of the coronavirus pandemic.

EPRS | European Parliamentary Research Service

AUTHORS

Aleksandra Heflich, Niombo Lomba and Klaus Müller, European Added Value Unit; Stefano Vettorazzi, Ex-Ante Impact Assessment Unit; Ekaterina Karamfilova, Ex-Post Evaluation Unit; Alessandro D'Alfonso, Gregor Erbach, Vivienne Halleux, Liselotte Jensen, James McEldowney, Marketa Pape, Henrique Simões, Frederik Scholaert, Jana Titievskaia and Ionel Zamfir, Members' Research Service. Drafting coordinated by Gregor Erbach.

Illustrations and graphics by Samy Chahri, Lucille Killmayer and Eulalia Claros, EPRS.

This paper is the result of a cooperative project involving staff from across the Directorate-General for Parliamentary Research Services (EPRS) of the Secretariat of the European Parliament.

To contact the authors, please email: eprs@ep.europa.eu.

LINGUISTIC VERSIONS

Original: EN

Manuscript completed in March 2021.

PE 689.378
ISBN: 978-92-846-7911-9
DOI:10.2861/009509
CAT: QA-02-21-321-EN-N

eprs@ep.europa.eu
http://www.eprs.ep.parl.union.eu (intranet)
http://www.europarl.europa.eu/thinktank (internet)
http://epthinktank.eu (blog)

Executive summary

The European Green Deal aims at making the European Union (EU) climate-neutral by 2050, a target supported by all EU institutions. With this objective, the EU takes a leading role in addressing the global climate emergency. Achieving the climate-neutrality goal requires massive investment and an unprecedented transformation of all sectors of the economy.

This study explains the physical basis of climate change and highlights its expected impacts on the European Union; outlines international climate agreements, EU climate action and the climate policies of major economies; assesses the coherence of EU climate policy with other policy areas and presents the financing of EU climate action through the EU budget and other instruments. To assess the implications of the climate neutrality objective, the study analyses the challenges and opportunities for various sectors of the EU economy and its impacts on issues such as international relations and trade. Some of the main challenges and opportunities are summarised below.

Citizens support ambitious climate action and are ready to change towards more climate-friendly behaviours. Climate-friendly consumption choices can be supported by appropriate policies and information about the climate impact of consumer products. Policies to address climate change often also have co-benefits for human **health**.

Innovation policies and research and development (R&D) funding help to facilitate and accelerate the diffusion of innovative low-carbon technologies from the research laboratory to large-scale deployment in the market. This rapid innovation needs to be accompanied by measures to ensure a **just transition** for regions that are currently dependent on energy and emissions-intensive industries. Local action in **cities** plays an important role in reducing their vulnerability to climate change, through adaptation measures and in contributing to emissions reductions at the local level. Due to the large existing building stock, the **buildings** sector faces a challenge to accelerate energy-efficient renovation, which offers opportunities for job creation and addressing energy poverty. The **finance** sector faces the challenge of aligning financial flows with the transition towards climate neutrality and managing the risks associated with stranded assets.

Europe's **industry** will need to become climate neutral and less energy intensive. Key enabling factors are markets for green products, infrastructure, and support for industrial innovation. The **energy system** faces the challenge of replacing fossil fuels with reliable emission-free energy sources. The **transport** sector will need to introduce clean alternatives to fossil fuels rapidly, to prevent European automotive and aerospace industries from falling behind in the transition towards low-carbon mobility.

Nature-based solutions offer great potential for climate mitigation and adaptation, but natural systems are also vulnerable to a changing climate. The same is true for **agriculture**, which is highly vulnerable to climate change, but also has a large potential to contribute to emission reductions and carbon sequestration. **Oceans** face various climate-related pressures, which also affect **fisheries**, while ocean energy and offshore wind offer large untapped potential for clean energy.

Since the EU is responsible for only a fraction of global emissions, global leadership and engagement with **international** partners through trade and diplomacy are vital. Development cooperation can also support adaptation to climate change in third countries and thereby address one of the drivers of **migration**.

The final chapter addresses the issues facing European policy-makers and the outlook for European and global climate action in the context of the coronavirus pandemic.

List of main abbreviations and acronyms

BECCS	bioenergy with carbon capture and storage
CAP	common agricultural policy
CCS	carbon capture and storage
CCU	carbon capture and utilisation
CCUS	carbon capture utilisation and storage
CDR	carbon dioxide removal
CFC	chlorofluorocarbon
CFP	common fisheries policy
CH_4	methane, a short-lived greenhouse gas
CO_2	carbon dioxide, a long-lived greenhouse gas
CO_2e	CO_2 equivalent
COP	Conference of the Parties
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
DAC	direct air capture
EAP	environmental action programme
EEA	European Environment Agency
EEA	European Economic Area
EIB	European Investment Bank
EIR	environmental implementation review
EIT	European Institute of Technology
EMAS	eco-management and audit scheme
EPA	Environmental Protection Agency (USA)
EPRS	European Parliamentary Research Service
ETS	Emissions Trading System
EU	European Union
EUA	EU allowance
FAO	Food and Agriculture Organization (UN)
G20	Group of Twenty
G7	Group of Seven (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States)
GDP	gross domestic product
GHG	greenhouse gas
GWP	global warming potential
HCFC	hydrochlorofluorocarbon
HFC	hydrofluorocarbon
ICAO	International Civil Aviation Organization
ICT	information and communication technologies
IEA	International Energy Agency
IED	Industrial Emissions Directive
IMO	International Maritime Organization

IMP	integrated maritime policy
INDC	intended nationally determined contribution
IPCC	Intergovernmental Panel on Climate Change
IPCEI	important project of common European interest
IRENA	International Renewable Energy Agency
JRC	Joint Research Centre (European Commission)
JTF	Just Transition Fund
JU	Joint Undertaking
LCA	lifecycle assessment
LULUCF	land use, land use change and forestry
MFF	Multiannual Financial Framework
MPA	marine protected area
MRV	monitoring, reporting and verification
MSFD	Marine Strategy Framework Directive
MSP	maritime spatial planning
N_2O	nitrous oxide
NDC	nationally determined contribution
NECP	national energy and climate plan
NGFS	Network for Greening the Financial System
NGO	non-governmental organisation
NO_2	nitrogen dioxide
NUTS	nomenclature of territorial units for statistics
PESETA	projection of economic impacts of climate change in sectors of the European Union based on bottom-up analysis
RDP	rural development programme
RES	renewable energy source
RGGI	Regional Greenhouse Gas Initiative (USA)
SDG	Sustainable Development Goal
SOER	State of European Environment
SRM	solar radiation management
TFEU	Treaty on the Functioning of the European Union
UK	United Kingdom
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WMO	World Meteorological Organization
WTO	World Trade Organization

Table of contents

Table of figures

Table of tables

1. Climate change – Causes, risks and impacts

1.1. Climate system – Changes and relevant causes

1.1.1. Observed changes in the climate system

Scientific evidence shows that, since the 1950s, the climate system has been changing rapidly. According to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) published in 2014,[1] many of the observed changes, such as warming atmosphere and oceans, melting glaciers, rising sea level and extreme weather events, are 'unprecedented in magnitude and rate over decades to millennia'.

The 2014 IPCC report found that each of the last three decades has been successively warmer for planet Earth than any preceding decade since 1850. More recently – between 2015 and 2019 – the world has experienced the highest atmospheric temperature since 1850, when records of global average temperature began.[2] Very recently, 2019 was the second warmest year on average after 2016, which holds the record.[3] Since 1850-1900, the average temperature of the Earth's surface has risen by around 1°Celsius, according to scientific estimates.[4]

The IPCC 2019 Special Report on the Ocean and Cryosphere in a Changing Climate shows[5] that since 1970, oceans have progressively warmed and have absorbed more than 90 % of the excess heat in the climate system. Rising temperature has led to widespread shrinking of the cryosphere (i.e. the frozen water part of the Earth system), with mass lost from ice sheets and glaciers, reductions in snow cover and Arctic sea ice extent and thickness and increased permafrost temperature. Scientists have observed a more than 20 metres loss in ice thickness[6] compared to 1960 levels.

The IPCC oceans and cryosphere report also shows that melting ice sheets and glaciers lead to sea level rise, which has accelerated in recent decades. In particular, since 1900, the global mean sea level increased by around 20 centimetres (cm), 8 cm of which have been accumulated since 1993.[7]

---

1 Synthesis Report *on Climate Change 2014, Fifth Assessment Report*, Intergovernmental Panel on Climate Change, 2014 (IPCC, 2014). The IPCC report is one of the main and most authoritative sources on climate change, its causes, potential impacts and response options.

2 Climate change impacts and adaptation in Europe, PESETA IV final Report, Joint Research Centre, 2020 (JRC, 2020a).

3 The European State of Climate in 2019, Copernicus Climate Change Service, 2020 (C3S, 2020).

4 JRC, 2020a.

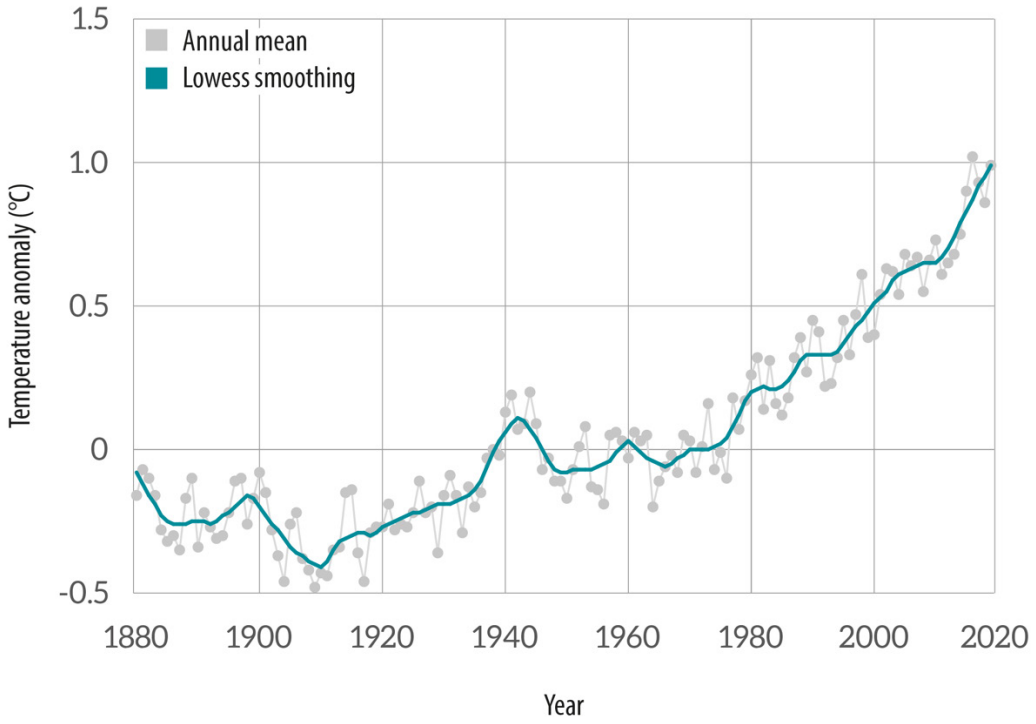
5 Special Report on the Ocean and Cryosphere in a Changing Climate, Intergovernmental Panel on Climate Change, 2019 (IPCC, 2019a).

6 Ice thickness is measured as water equivalent. Because ice is less dense than water, 1 metre water equivalent corresponds to about 1.1 metre of ice.

7 The European State of Climate in 2018, Copernicus Climate Change Service, 2019 (C3S, 2019).

Around 30 % of global sea level rise can be attributed to ocean thermal expansion and 70 % to land ice melt.[8]

Figure 1 – Global land-ocean temperature index



Data source: NASA.

The observed changes in the climate system provoke more frequent extremes, such as heatwaves (including marine), droughts, storms, heavy precipitation, floods and extreme waves.[9]

1.1.2. Causes for observed and projected changes in the climate system

The climatic system is changing constantly, and it is clear for scientists that this change is the result of both natural causes (such as volcanic eruptions and changes in solar activity) and human influence.[10] However, scientists also claim, with a very high level of certainty, that it is mainly human influence that has caused the observed unprecedented warming since the mid-20th century.[11]

To understand the link between human influence and the warming trend described above, one should consider the 'greenhouse' effect and its interaction with human activity.

The Sun radiates energy towards planet Earth. A certain part of the solar energy that reaches the top of the Earth's atmosphere is reflected back into space. The rest is absorbed mainly by the Earth's surface (i.e. land and oceans), and warms the Earth. To balance the incoming energy absorbed, the Earth must, on average, radiate the same amount of thermal energy. The heat from the Earth's

8 ibid.

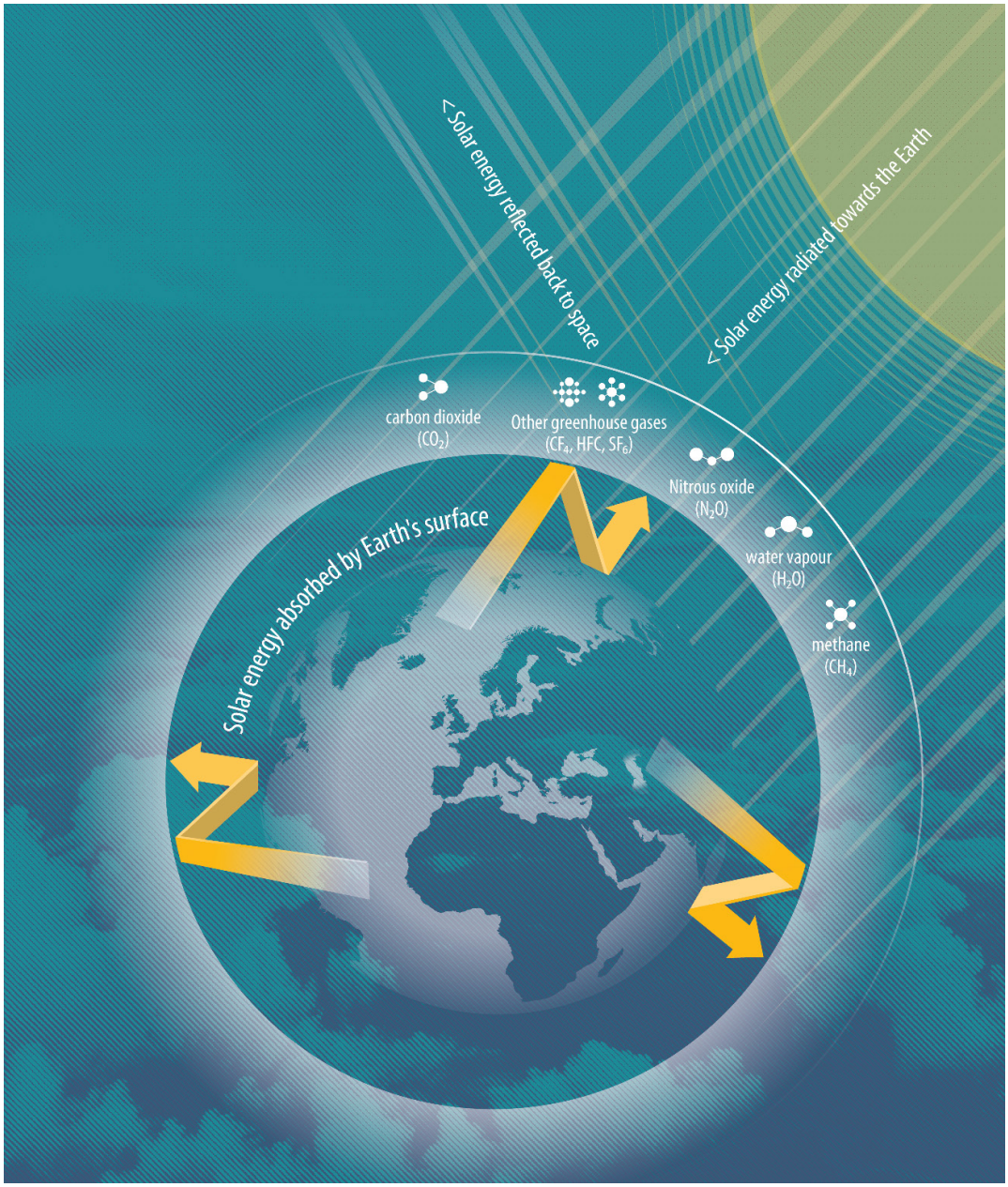
9 IPCC, 2014.

10 ibid.

11 The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Intergovernmental Panel on Climate Change, 2013 (IPCC, 2013).

surface is therefore radiated back into space. However, some of this radiated heat is trapped by greenhouse gases (including evaporated water (H_2O), carbon dioxide (CO_2), etc.), contained in the atmosphere and then reradiated in all directions, thus warming the surface of the Earth and the lower atmosphere (Figure 2) This process is known as 'the greenhouse effect' and the heat-trapping gases are called 'greenhouse gases' (GHGs). In fact, without the atmospheric warming provoked by the greenhouse gases, the average Earth surface temperature would be below water's freezing point and would thus be hostile to life.[12]

Figure 2 – The greenhouse effect



Source: EPRS

12 ibid.

This natural phenomenon and its capacity to keep our planet warm enough to sustain life as we know it, was discovered as early as in the 19th century. In that same century, scientists also found that human activities, such as burning fossil fuel, increase the concentration of GHGs in the atmosphere and could thus enhance the warming created by the greenhouse effect. Further knowledge on the interaction between human activity, GHGs, global warming and its impacts on the climatic system was accumulated throughout the 20th century, and eventually accepted as a necessary concern in politics and policy-making towards the end of the past century.[13]

Broadly, humans intensify the greenhouse effect in two main ways. On the one hand, human activities enhance the greenhouse effect by emitting GHGs into the atmosphere. On the other hand, humans reduce the natural capacities of the planet to absorb the excess of GHGs. These interlinks are explained below.

While water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4) are gases that occur naturally in the atmosphere, concentrations rise as a result of human activity. For example, the burning of fossil fuels such as coal, oil and gas for energy production and transport raises the atmospheric concentrations of CO_2 and N_2O.[14] More N_2O is added to the atmosphere by the use of nitrogen-based fertilisers in agriculture. Human activities also produce gases such as chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs)[15] that do not occur naturally in the atmosphere but have a much stronger heat trapping potential and remain in the atmosphere for longer than CO_2, N_2O and CH_4.[16] In fact, while water vapours are short-lived and removed from the atmosphere in a matter of days, CO_2 and some F-gases can remain in the atmosphere and heat it for thousands (CO_2), if not tens of thousands of years (fluorinated gases).[17]

The production of GHGs and its effect on warming is further enhanced by human-induced reduction of Earth's natural capacity to absorb the excess concentrations of GHGs, which is key to regulating the greenhouse effect and hence the climatic system. For example, cutting down forests – the Earth's lungs, absorbing CO_2 and releasing oxygen (O_2) back into the atmosphere means this beneficial absorption effect is lost. Furthermore, the carbon stored in trees cut or burned in fires is released back into the atmosphere, thus adding to the greenhouse effect and hence to global warming.[19]

'Anthropogenic greenhouse gas emissions have increased since the pre-industrial era, driven largely by economic and population growth, and are now higher than ever. This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800 000 years. Their effects, together with those of other anthropogenic drivers, have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century'[18] (IPCC, 2014, p. 4).

[13] M. S. Seidenkrantz, '80 years since the first calculations showed that the Earth was warming due to rising greenhouse gas emissions', Phys.org, 2018.

[14] IPCC, 2013.

[15] HFCs are a type of fluorinated GHGs (known as 'F-gases') used as substitutes to the ozone-depleting CFCs and HCFCs.

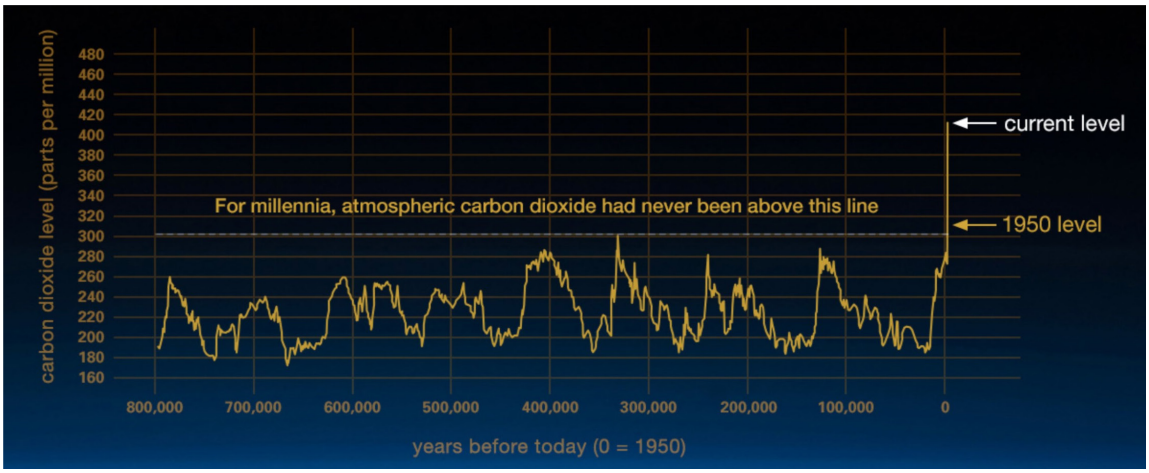
[16] Greenhouse gas emissions - Understanding global warming potential, United States Environment Protection Agency, 2017.

[17] ibid.

[18] IPCC, 2014, p. 4.

[19] IPCC, 2014.

Figure 3 – Atmospheric CO_2 concentrations (parts per million)



Source: NASA, based on based on the comparison of atmospheric samples contained in ice cores and more recent direct measurements.

To forecast changes in the climate system resulting from different concentration levels of GHGs in the atmosphere, scientists have created and tested various emission scenarios. The test results suggest that continued emission of GHGs will cause further warming that 'will persist for centuries to millennia'[20]. In particular, 'Global warming is likely to reach 1.5°C between 2030 and 2052, if it continues to increase at the current rate'.[21] Furthermore, it is very likely that heatwaves will occur more often and last longer, and that extreme precipitation events will become more intense and frequent in many regions.[22] The ocean will continue to warm and global mean sea levels will rise.[23]

The precise magnitude and rate of those climatic changes will depend on the levels of future anthropogenic GHGs and their warming potential.[24] It should be noted, however, that many aspects of climate change, including temperature rise, will continue over the 21st century even if man-made emissions are reduced or even stopped in the future.[25]

1.2. Risks of climate related impacts

The changes in climate observed over the last few decades have caused tangible impacts on all continents and across oceans. Existing authoritative evidence – such as the series of reports by the IPCC and the European Environment Agency (EEA) frequently referred to in this study – considers those impacts in the context of natural and human systems. All sources are unanimous that the higher the magnitude and rate of future warming and related changes in the climate system, the higher the risks for natural and human systems to be negatively (and less so positively) impacted by climate change. Other factors increasing or decreasing climate-sensitive risks relate to the

[20] Special Report on *Global Warming of 1.5°C, Intergovernmental Panel on Climate Change*, 2018, p. 5 (IPCC, 2018).

[21] ibid., p. 4.

[22] IPCC, 2014.

[23] IPCC, 2019a.

[24] IPCC, 2014.

[25] ibid.

geographical location, exposure, vulnerability and capacity of natural and human systems to adapt to climate-related impacts.[26] The level of risk posed by climate change also depends on how population, consumption, production, technological development, and land management patterns evolve.[27]

The following example illustrates the systemic link between the changes in the climate system and the risks of negative impacts for both natural and human systems. As a result of climate change, and in particular of the increase in atmospheric concentrations of CO_2, the ocean surface pH has declined from 8.2 to below 8.1 from pre-industrial times. The oceans have thus become more acidic.[28] In fact, in recent decades, ocean acidification has been occurring 100 times faster than during past natural events over the last 55 million years. Ocean acidification, combined with other climate-related pressures such as rising ocean temperatures, is affecting marine organisms (for example, fish stock distribution), and could alter marine ecosystems and their potential to continue providing services to humans such as food and income.[29]

Against this background, scientists state that continued man-made emissions of GHGs **'will increase the risk of severe, pervasive and in some cases irreversible detrimental impacts'** on both natural and human systems.[30] Therefore, they warn that limiting climate change and mitigating its adverse impacts requires substantial and sustained reductions of anthropogenic GHG emissions within what is called the 'carbon budget', i.e. within the amount of greenhouse gases that human activities can emit without exceeding a given level of warming.[31] Furthermore, climate mitigation requires the strengthening of GHGs absorption capacities.[32] In particular, a temperature rise of 2°C (compared to preindustrial times) is considered a threshold beyond which there is a much higher risk that dangerous and possibly destructive impacts for natural and human systems could occur.[33] The latest evidence suggests that ideally the warming should be kept at 1.5°C (compared to preindustrial times) to minimise the negative impacts of climate change globally.[34]

However, as already noted, reducing or even stopping manmade GHGs in the future does not necessarily mean that warming and related climate changes will stop. There is therefore a need for adaptation efforts to minimise the negative impacts of inevitable climate change, as well as to benefit from any opportunities that may arise from climate change.[35]

Both climate change mitigation and adaptation are already subject to specific policy action at all levels of governance, (see Chapter 2). However, before looking at climate action policies in more detail, it is important to examine what climate change means for Europe's natural and human systems, thereby depicting the context for EU policy-making.

---

26 IPCC, 2014.

27 Special Report on Climate Change and Land, Intergovernmental Panel on Climate Change, 2019 (IPCC, 2019b).

28 IPCC, 2019a.

29 SOER – The European environment – State and outlook 2020 Report, European Environment Agency, 2019 (EEA, SOER-2020).

30 IPCC, 2014, p. 64.

31 EEA, SOER-2020.

32 ibid.

33 IPCC, 2014.

34 IPCC, 2018.

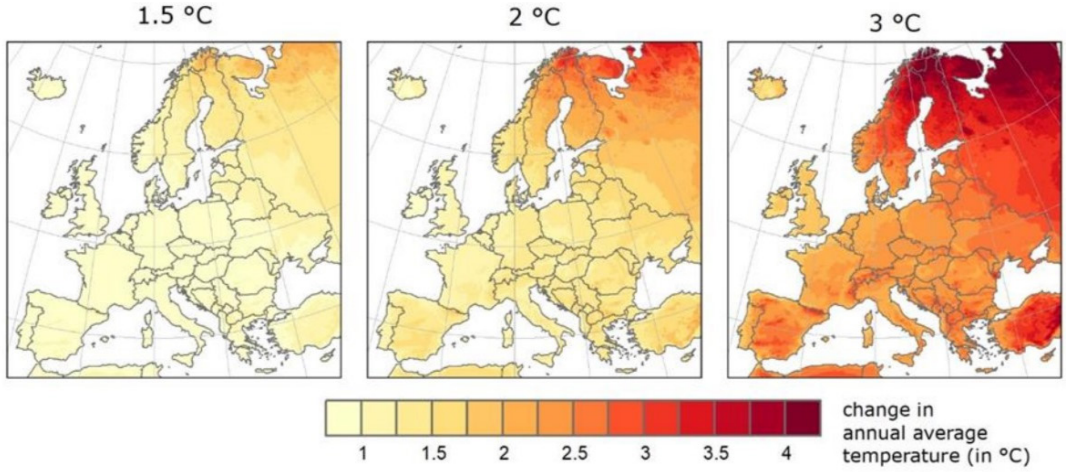
35 EEA, SOER-2020.

1.3. What does climate change mean for Europe?

1.3.1. Observed and projected changes in the climate

Satellite observations made by Copernicus (the European Union's Earth Observation Programme) show[36] that, while globally the average temperature at the Earth's surface has risen by around 1°C since the pre-industrial period, in Europe the temperature increased by almost 2°C for the same period with significant regional and seasonal differences. Furthermore, the average temperature throughout Europe increased steadily during most of the industrial era, but then rose sharply from the 1980s, to reach its absolute highest in 2019, which was the warmest year Europe has seen since temperature recording began.[37]

Figure 4 – Changes from reference (1981-2010) in annual average temperature for three global warming scenarios (1.5°C, 2°C and 3°C warmer than pre-industrial times).



Source: Climate change impacts and adaptation in Europe, PESETA IV Final Report, Joint Research Centre, 2020.

Copernicus data also suggest that Europe's seas have all warmed considerably since 1870.[38] This warming, which has been particularly rapid since the late 1970s, continues. Similar to the global trend, Europe's glaciers are facing a loss of ice mass. The observed loss in ice thickness since the 1960s ranges between 2 metres in south-western Scandinavia and 34 metres in the Alps. Furthermore, since 1997, scientists have observed that the monitored glaciers in Europe have lost 8 to 25 metres. This trend in ice mass loss is projected to continue, contributing to rising sea levels.

Evidence suggests that all coastal regions in Europe have seen an increase in absolute sea level, although with significant regional variations.[39] Projections of the Joint Research Centre (JRC)[40] show that extreme sea levels in Europe, due to global warming, could rise by as much as one metre or

[36] C3S, 2019.

[37] C3S, 2020.

[38] C3S, 2019.

[39] ibid.

[40] JRC, 2020a.

more by the end of this century. This rising trend will continue for many centuries, even if the surface temperature is stabilised.[41]

According to scientific evidence, a given increase in the global average temperature is associated with a much larger increase in heat extremes in Europe. Indeed, according to the recent 'European environment – State and outlook 2020' (the 'SOER' report),[42] published every five years by the EEA, the number of heat extremes and waves in Europe has risen considerably since the 1950s, and in particular after 2000. Two intense heatwaves in June and July 2019 resulted in record-breaking temperatures in some European countries.[43] Human-induced climate change has made such heat events in Europe much more likely than they would have been in a climate system not been impacted by human influence.[44] In Europe, such heat events are projected to become even more frequent and to last longer. Under a high-emissions scenario – i.e. unmitigated climate change – very extreme heatwaves[45] are projected to occur every two years in the second half of this century.[46] Moreover, very extreme heatwaves will be more frequent in southern and south-eastern Europe.[47]

According to the EEA SOER-2020 report, the intensity of heavy precipitation events, which can cause floods, has increased in summer and winter in most parts of northern Europe and is projected to increase further.[48] According to same source, the number of very severe flooding events in Europe has increased in recent decades, but there is large regional variability. Furthermore, river flooding is projected to become more frequent in north-western and central-western parts of Europe and pluvial floods and flash floods, which are the result of intense local precipitation events, are likely to become more frequent across Europe.

The EEA SOER-2020 report also indicates that, generally, droughts have increased in southern Europe and decreased in northern Europe, however with seasonal variations.[49] The increased droughts in southern Europe result from less frequent precipitation, as well as from rising temperatures, which increases evapotranspiration. According to the EEA, this pattern is projected to continue in the future. In this century, drought frequency is projected to increase everywhere in Europe during spring and summer, in particular in southern Europe, as well as in autumn, however less intensely. The projections for winter suggest a decrease in drought frequency in northern Europe.

As already mentioned, the higher the magnitude and rate of future warming and related changes in the climate system, the higher the risks for natural and human systems to be negatively (and less so positively) impacted. Based on available knowledge, which has continued to grow in recent years, the following section sheds light on the most pertinent risks and relevant impacts specific for the natural and human systems of the European continent, outlining the context for EU policy-making.

---

41 Climate change, impacts and vulnerability in Europe 2016, An indicator-based report, European Environment Agency, 2017 (EEA, 2017).

42 EEA, SOER-2020.

43 C3S, 2020.

44 EEA, SOER-2020.

45 Compared to the heatwaves that affected southern and central Europe in 2003 and Eastern Europe in 2010.

46 EEA, SOER-2020.

47 ibid.

48 ibid.

49 ibid.

1.3.2. Risks of climate-related impacts in Europe

Natural systems

Scientists consider climate change a key risk factor in declining **biodiversity** globally and in Europe.[50] Global natural climate change (i.e. at magnitude and rates lower that the currently observed human-induced climate change) has already caused significant ecosystem shifts and species extinctions during the past millions of years. Scientists therefore predict that more human-induced climate change will pose even higher risks for species and (all) ecosystems in the future.[51]

According to the EEA,[52] 14 % of **habitats** and 13 % of **species of interest** in Europe are assessed as already under pressure because of changes in the climate system. The European continent has experienced widespread changes in the distribution of plant and animal species. While generally this migration has been northwards for most species, land-based species have migrated to higher altitudes. It should be noted that the migration of many land-based species is lagging behind the changes in the climatic system, which may result in a progressive decline in European biodiversity.

Climate change is also leading to changes in the seasonality of biological events, such as for example the flowering of plants.[53] However, these changes are not uniform across species. Some animals therefore struggle to find sufficient food where and when they need it, which puts their survival at risk. According to scientific projections, in the near future, the number of habitats threatened by climate change will more than double.[54] Many species in the EU's Natura 2000 network – the world's largest coordinated network of protected areas – are expected to lose suitable climate niches that meet their needs. According to the findings of the JRC PESETA III project studying some of the consequences of climate change in Europe,[55] the Mediterranean climate zone, which is home to almost half of the plant and animal species and more than half of the habitats in Europe, is facing the highest risks,[56] because it is shrinking under the pressure of climate change. Furthermore, the problem of invasive species could be exacerbated under the pressure of climate change, thereby causing damage to human health, the environment and economy.[57]

Forests cover around 33 % of the total European land area.[58] As a result of climate change, forest tree species follow the general trend of species migration and are thus moving towards higher altitudes and latitudes.[59] Furthermore, in recent years, large forest fires have repeatedly affected Europe, in particular Mediterranean countries (e.g. Portugal in 2017 and Spain and Greece in 2018), while the north of the continent is also affected (e.g. in Sweden in 2014, 2018, and 2019). According to JRC estimations,[60] the danger of forest fires will increase under the high warming scenario of unmitigated climate change, especially in the Mediterranean area). The risks of fires in the Mediterranean are higher because of, among other factors, expected lower levels of moisture

50 ibid.

51 IPCC, 2014.

52 EEA, 2017.

53 EEA, SOER-2020.

54 EEA, 2017.

55 PESETA III Science for policy summary, Policy card on climate change and Mediterranean habitat loss, Joint Research Centre, 2018 (JRC, 2018a).

56 Especially under the high warming scenario of unmitigated climate change.

57 EEA, 2017.

58 PESETA III Science for policy summary, Policy card on climate change and forest fires, Joint Research Centre, 2018 (JRC, 2018b).

59 EEA, SOER-2020.

60 JRC, 2018b.

content of the soil and trees. The EEA highlights[61] that severe wildfires may remove soil organic matter and thus provoke erosion and loss of nutrients and biodiversity. This process may turn forest soils into carbon sources. Climate change is also affecting the regional and spatial occurrence of forest pests and diseases that are projected to increase in most regions of Europe.[62] These combined impacts considerably affect, and will continue to affect, the structure and functioning of forest ecosystems and the services they provide to humans.

Climate change is a key factor affecting **marine ecosystems**. Following the EEA,[63] Europe's marine ecosystems (together with the ecosystems of the Alps) are considered to be the most sensitive to changes in the climate. They are affected mainly through acidification and rises in temperature and sea level. For example, changes in ocean temperature, which is one of the strongest marine life regulators, cause significant shifts in the distribution of marine species, both horizontally, towards the poles, and vertically, with changes in depth distribution. This can have impacts on local fishing communities. The impacts of a warming climate combined with other human stressors (e.g. fisheries and ocean pollution from various economic activities), will continue to endanger the capacities of seas and their marine ecosystems to provide services and benefits to humans, including transport, energy, food and income, as well as vital life-supporting functions, such as the oxygen in the air we breathe.[64]

Climate change also puts Europe's **water system** at risk, as an essential source of human health, nature, agriculture, energy production, industry and transport. According to the EEA SOER-2020 report,[65] water scarcity is becoming increasingly frequent and widespread in Europe, and is likely to get worse as the seasonality and intensity of precipitation may change and temperatures may increase as a result of a rapidly changing climate. Drought is one of the major factors endangering water availability. These climate-related events also decrease soil moisture, which affects terrestrial ecosystems negatively, as well as agriculture, especially in the Mediterranean.[66] According to JRC estimations,[67] over the 21st century, drought conditions are expected to increase in frequency, duration and severity for most of Europe. The largest increase is projected for southern Europe and the western part of the Mediterranean, where competition between water users including agriculture, industry, tourism and households, will increase.[68] The fourth edition of the JRC PESETA project suggests[69] that, in a scenario of climate change without mitigation and adaptation, losses from drought in Europe would grow from €9 billion/year today to €45 billion/year in 2100.

In addition, the EEA SOER report warns[70] that climate change is also expected to intensify human-induced pressures on water, such as over-abstraction and pollution from nutrients and hazardous substances, which may impact groundwater, rivers, lakes, transitional and coastal waters, as well as wetlands. As a result, this will decrease the quality of the services provided by those ecosystems.

---

61 EEA, SOER-2020.

62 ibid.

63 EEA, 2017.

64 EEA, SOER-2020.

65 ibid.

66 EEA, 2017.

67 PESETA III Science for policy summary, Policy card on drought and climate change, Joint Research Centre, 2018 (JRC, 2018c).

68 Climate change impacts in Europe, European Environment Agency, 2020 (EEA, 2020).

69 JRC, 2020a.

70 EEA, SOER-2020.

Human systems

Climate change has negative impacts on **human health**, 'contributing to the burden of disease and premature deaths in Europe',[71] thus creating substantial economic costs. Population groups are affected differently, depending on their general health, age and socio-economic status. Some groups, such as elderly people, those suffering from ill-health, children, migrants and marginalised populations, are considered to be more vulnerable to negative climate change impacts.[72]

Increasingly frequent heatwaves are the deadliest climatic hazard in Europe. According to the EEA, since 2000, heatwaves have caused tens of thousands of premature deaths in Europe.[73] People living in cities are more severely affected compared to those living in rural areas, because of the 'heat island' effect.[74] Heatwaves are projected to increase in frequency, length and intensity. Without suitable adaptation measures, over the next decades, many more lives, especially the most vulnerable, could be lost due to heatwaves.[75] The JRC suggests that without climate mitigation and adaptation efforts, by the end of the 21st century, 300 million citizens per year in the EU and United Kingdom would be exposed to deadly heatwaves, resulting in a 30-fold rise in deaths from extreme heat.[76]

Flooding events, which are also increasingly frequent as a result of the increased number of extreme precipitation events, affect humans in various negative ways. On the one hand, flooding may lead to drowning, heart attack, injury, infection, exposure to chemical hazards and mental health consequences, but, on the other hand, could also cause disruption to services such as healthcare, safe water supply, sanitation and transportation.[77] Climate-related flooding events are projected to increase, thus increasing risks for human health and the economy.[78]

In the context of climate extremes such as heatwaves and floods, climate change is expected to affect the ability of health systems to function effectively.[79]

In addition to heatwaves and floods, factors such as changes in the distribution of climate-sensitive – communicable (vector-, water- and food-borne) and non-communicable (including mental) – diseases and changes in environmental and social conditions could also contribute to the adverse effects of climate change on human health.[80] A report by the United Nations Environmental Programme (UNEP), published in 2016, claims that climate change is a major factor for disease emergence. More specifically, the link between observed recent climate change trends and disease emergence is explained as follows: '[climate change] influences the environmental conditions that can enable or disable the survival, reproduction, abundance, and distribution of pathogens, vectors, and hosts, as well as the means of disease transmission and the outbreak frequency'.[81] Furthermore, the UNEP report suggests that outbreaks or epidemic diseases may become more frequent with a

---

71 EEA, 2017, p. 199.

72 The imperative of climate action to protect human health in Europe, European Academies' Science Advisory Council, 2019 (EASAC, 2019).

73 EEA, 2017.

74 EASAC, 2019.

75 EEA, 2017.

76 JRC, 2020a.

77 EEA, 2017.

78 ibid.

79 ibid.

80 ibid.

81 Frontiers 2016 Report – Emerging Issues of Environmental Concern, United Nations Environment Programme, 2016, p. 22 (UNEP, 2016).

changing climate. These findings set the context for the outbreak of the coronavirus disease (Covid-19) pandemic – believed to have stemmed from a wildlife source – which has severely affected human health and put strong pressure on healthcare systems in Europe and globally.

Agriculture is a vitally important human system delivering food for Europeans, as well as being the economic sector that is most dependent on climate and therefore very vulnerable to climate change.[82] The EEA suggests[83] that crop yields and livestock productivity in Europe are already impacted by changes in temperature and precipitation patterns as well as weather and climate extremes. More specifically, recent heatwaves, droughts, and floods have greatly reduced some crop yields, especially in southern Europe. Furthermore, the number of extreme events negatively affecting agriculture in Europe is generally expected to increase, although northern regions may benefit from longer growing seasons in the future.

As already mentioned, climate and weather conditions affect the availability of water needed for agricultural activities. Such activities include irrigation, livestock watering practices, processing agricultural products, as well as transport and storage conditions.[84] The demand for irrigation is expected to increase, especially in southern Europe where there is already considerable competition between different users.[85] Increasing water scarcity, the rise in temperatures and more frequent droughts will also increase soil desertification, which will not only negatively affect agriculture but will, in return, amplify climate change because degraded soil emits greenhouse gases into the atmosphere.[86]

European agriculture is also vulnerable to climate change impacts occurring outside Europe, with potential implications for Europe's food and nutrition security.[87] In particular, such impacts may affect the price, quantity and quality of traded products, and consequently trade patterns, which in turn may affect agricultural income in Europe.[88] Although fodder and food scarcity in Europe, and in the European Union in particular, is not that probable, the expected increase in food demand could exert pressure on food prices in the coming decades.[89]

In terms of income, recent EEA estimations suggest[90] that the overall impacts of climate change on European agriculture could cause a significant loss for the sector, of up to a 16 % loss in EU agriculture income by 2050, with large regional variations. However, the EEA warns that the impacts of climate change on agriculture have not yet been fully researched, especially when those impacts are multiplied or combined with other socio-economic consequences of climate change.

Climate change has affected **energy** demand in Europe, and in particular the demand for heating and cooling. In particular, as a result of the warming trend, the energy demand for heating has decreased, particularly in northern and north-western Europe, while the energy demand for cooling

82 Climate change adaptation in the agriculture sector in Europe, European Environment Agency, 2019 (EEA, 2019a).

83 ibid.

84 ibid.

85 EEA, 2020.

86 Combating desertification in the EU – steps so far lack coherence, European Court of Auditors, 2018 (ECA, 2018).

87 EEA, SOER-2020.

88 EEA, 2020.

89 EEA, SOER-2020.

90 EEA, 2019a.

has increased, in particular in southern and central Europe.[91] The JRC estimates[92] that the reduction in heating demand will compensate for increases in cooling demand and which, under a high warming scenario of unmitigated climate change, will lead to a reduction of 26 % of the overall energy demand across the EU by the end of the 21st century. These estimates suggest that this reduction could rise to 40 %, if policies are applied (see Chapter 2) that aim at reducing the energy demand further through improved energy efficiency.

Although the above example shows that climate change could have certain beneficial effects, Europe's energy system does experience negative effects on its energy system from water availability. For example, cooling water for thermal power generation is scarce, especially in summer when the abundance of water is at its lowest.[93] Furthermore, hydropower production depends on water availability. The EEA suggests that additional climate-related pressures, such as extreme weather events and rising sea levels, increase the risks for energy infrastructure.[94] In particular, geological instability due to increased precipitation puts mountainous regions' infrastructure at risk.[95]

The EEA suggests[96] that northern Europe will experience both beneficial and adverse impacts on its energy system, whereas southern European regions will face overwhelmingly adverse impacts. Furthermore, according to the EEA, direct damage to the European energy system from extreme weather events could amount to billions of euros per year by the end of the century, with much larger indirect costs, unless appropriate adaptation measures are applied.

As regards the **transport** sector, the main climatic stressors are extreme weather events such as heatwaves in southern and Eastern Europe, cold spells and snow in northern Europe, as well as heavy precipitation and floods in most of Europe.[97] Such events are expected to occur increasingly frequently, and therefore, under a high warming scenario of unmitigated climate change, the risks for the transport sector are expected to increase. This is especially true for airports and seaports across Europe that, according to JRC estimations,[98] could face a risk of flooding due to rising sea and river levels, as well as extreme weather events. Furthermore, inland navigation is sensitive to drought. More specifically, such conditions can badly affect inland navigation services by decreasing water levels to the point where navigation is impossible, or to a point where water vessels have to carry a reduced load. Rail transport is projected to face particularly high risks from extreme weather events, mostly due to the projected increase in heavy precipitation events and limited route alternatives.[99]

Tourism is another economic sector where performance depends on climate and weather conditions. According to the EEA,[100] climatic suitability for general tourism activities was considered

---

91 EEA, 2017.

92 PESETA III Science for policy summary, Policy card on climate change and residential energy demand, Joint Research Centre, 2018 (JRC, 2018d).

93 EEA, 2017.

94 Adaptation challenges and opportunities for the European energy system – Building a climate-resistant low-carbon energy system, European Environment Agency, 2019 (EEA, 2019b).

95 EEA, 2017.

96 EEA, 2019b.

97 EEA, 2017.

98 PESETA III Science for policy summary, Policy card on climate change impacts on airports, seaports, and inland waterways, Joint Research Centre, 2018 (JRC, 2018e).

99 EEA, 2017.

100 ibid.

best in southern Europe in 2016. As a result of climate change, the most favourable regions for general tourism are projected to shift northwards. Therefore, the attractiveness of tourism in northern and central Europe is expected to increase in most seasons, while tourism in southern Europe will decline markedly during the key summer months, but will improve in other seasons. Winter sports tourism is very vulnerable to climate change. The widespread reductions in snow cover projected over the 21st century will negatively affect these sports and related industry in many regions. In particular, the regions close to the low elevation limit for winter sports tourism will be the most sensitive to the expected warming.

The projected shift in major tourist flows in Europe can have substantial consequences for regions where tourism is an important economic activity. The magnitude of the climate-related impacts will be strongly determined by non-climatic factors, such as for example, the ability of tourists to adjust the timing of their holidays.[101]

Climate change causes **internal displacements** in Europe, i.e., people have migrated from affected areas to safer zones but remain within their national borders. Data from the Internal Displacement Monitoring Centre for 2017 suggests[102] that events arising in the context of climate change and natural disasters – such as floods, wildfires and landslides – have displaced 22 000 people in France, 6 800 in Portugal, 6 200 in the UK, 3 500 in Albania, 2 100 in Italy and 2 100 in Spain. The most intensive natural hazard recorded was a wildfire in September 2017 that forced around 10 000 people living on the island of Corsica (France) to leave their homes.

Internal displacement is a particular risk for populations living close to the coast (coastal communities). As already mentioned, climate change results in rising sea levels, which is expected to continue for many centuries, even if the surface temperature is stabilised. The JRC estimations suggest[103] that without adaptation measures, flood damage could increase 20 to 50-fold per year due to climate change alone, depending on the emissions scenario. This means that coastal communities in Europe will experience negative impacts, including ecological damage, economic loss and other societal problems such as population displacements. This is an issue of concern given that approximately one third of Europeans lives within 50 kilometres from the coast.

Climate change has, and will continue to have, negative impacts on the **economy**, and in particular substantial economic losses for Europe. According to EEA data,[104] the total reported economic losses caused by climate-related extremes (in the EEA member countries)[105] between 1980 and 2013 were estimated at €400 billion,[106] and more than 70 % of the losses were caused by only 3 % of all registered events. In the future, the economic costs of climate change will potentially be high, even for modest levels of climate change, while under scenarios of greater warming these costs would rise significantly.

---

101 ibid.

102 Global report on internal displacement in 2018 – Europe and Central Asia regional overview, Internal Displacement Monitoring Centre, 2018.

103 PESETA III Science for policy summary, Policy card on climate change and coastal floods, Joint Research Centre, 2018 (JRC, 2018f).

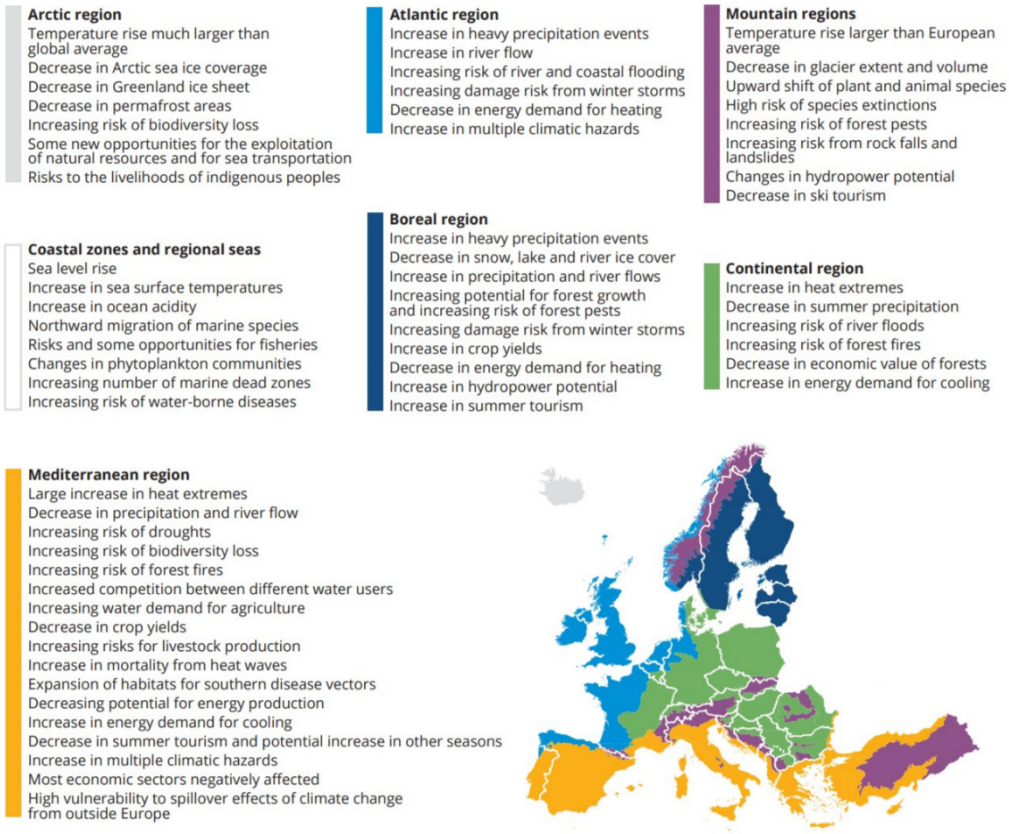
104 EEA, 2017.

105 As per the date of publication, EEA member countries are the 27 EU Member States as well as Norway, Iceland, Switzerland, Liechtenstein and Turkey.

106 In 2013 prices.

JRC PESETA III estimations show[107] that, by the end of the 21st century, [annual] welfare losses for the EU vary between €240 billion (1.9 % of GDP, gained in today's EU economy) in a high warming scenario and €79 billion (0.65 % of GDP) in a 2°C warming scenario. The projected damage costs are largely heterogeneous across regions. Southern European areas are projected to undergo relatively larger losses than the rest of Europe.[108] In particular, southern regions will see the largest regional welfare loss under both scenarios, of around 4.2 % of annual GDP under high warming by the end of the century and 1.7 % under 2°C warming. Without suitable adaptation measures, these economic costs will be amplified by the projected loss of daily outdoor labour productivity under the high warming scenario, especially in southern Europe. The fourth edition of the JRC PESETA project suggests[109] that limiting warming to 2°C would reduce welfare losses by 70 % compared to a 3°C scenario, while achieving the Paris Agreement goal of 1.5°C would lower the welfare losses by 90 %.

Figure 5 – Observed and projected climate change impacts for the main regions in Europe



Source: Climate change, impacts and vulnerability in Europe 2016, European Environment Agency, 2017.

[107] PESETA III Science for policy summary, Policy card on the economic effect of climate change, Joint Research Centre, 2018 (JRC, 2018g).

[108] ibid.

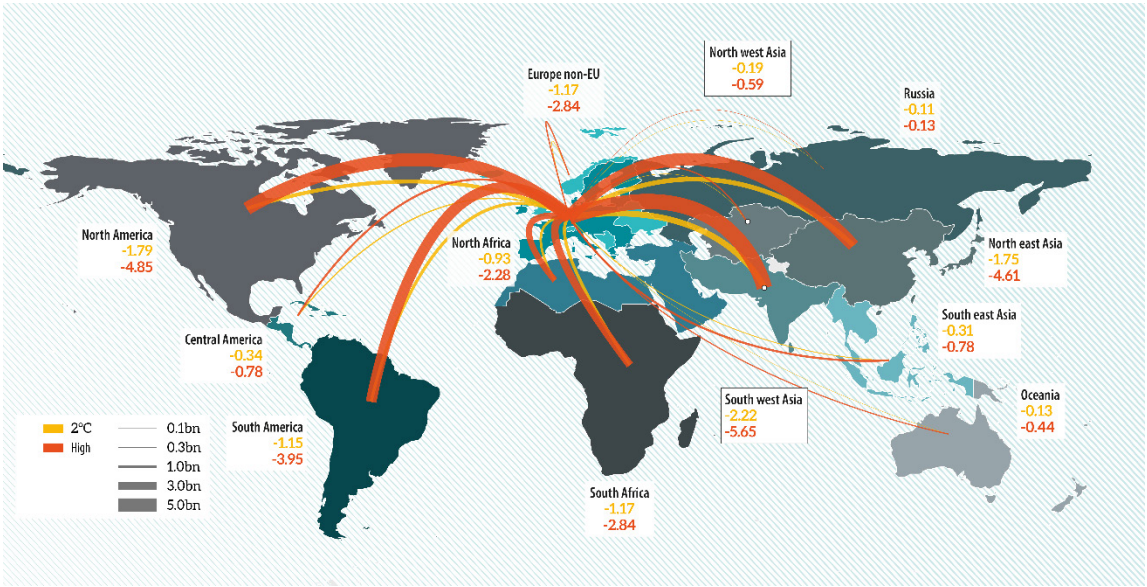
[109] PESETA IV Welfare losses from climate change impacts, Joint Research Centre, 2020 (JRC, 2020b).

The regional variety of observed and projected climate change trends, as well as their potential impacts on Europe's natural and human systems are shown in Figure 5.

Europe's vulnerability to worldwide climate change-related impacts

Europe is also vulnerable to climate change-related impacts occurring outside the continent, as it is part of a highly interconnected world, and therefore subject to spill-over effects.[110] Climate impacts elsewhere may affect the economic performance of the EU in terms of imports, exports, sectoral production, employment and prices. International spill-over effects may thus affect overall European economic activity and could increase the internal EU welfare loss by approximately 20 %.[111] Spill-over effects occur through six major pathways: trade in agricultural commodities, trade in non-agricultural commodities, infrastructure and transport, geopolitics and security risks, finance, and human migration resulting from cross-border displacements, especially as regards population migrating from Northern Africa and the Middle East to Europe.[112] The magnitude of these effects depends on two aspects: the severity of climate impacts in the rest of the world and the intensity of trade between other world regions and the EU.[113] Most of the transboundary effects on Europe are due to climate damage that occurs in two regions: the Americas and Asia, and about half of the transboundary effects experienced by the EU are due to climate change impacts on crops and related price volatility, which mainly affect central and southern European regions.[114]

Figure 6 – Impacts on annual EU GDP (€ billions) due to climate impacts in the rest of the world regions, via international trade (imports and exports).



Data source: The economic impact of climate change, JRC PESETA III.

As described in this chapter, Europe is already negatively (and less so positively) affected by ongoing climate change. This trend is projected to continue, or even be exacerbated, unless climate action is

110 EEA, 2017.

111 JRC, 2020a.

112 EEA, 2017.

113 JRC, 2018g.

114 ibid.

taken. Both the mitigation of and adaptation to climate change have been addressed by policies designed and implemented at all levels of governance. The next chapter of this study looks in particular at EU policy-making in the field of climate action and its international context.

2. Policy responses to climate change

There are two complementary approaches to avoid or limit the multiple impacts of climate change described above, namely mitigation and adaptation. Mitigation comprises the reduction of GHG emissions and the removal of GHGs from the atmosphere. Adaptation consists of measures to prevent or soften the impacts of climate change, for example by building defences against rising sea levels. Mitigation and adaptation are complementary approaches because effective mitigation reduces the need for and costs of adaptation.

Adaptation is mostly done on a local scale, and those who take effective adaptation measures can expect to reap the benefits. On the other hand, mitigation is a collective action problem, since emission reductions in one part of the world will benefit everybody else. Therefore, there is no strong incentive for any party to incur the cost of emission reductions when other parties are not doing the same. Another aspect of climate change is the large time lag between GHG emissions and climate impacts: the impacts of today's emissions will only be fully experienced in decades, and emission reductions will only have benefits over the medium to long-term. Moreover, what counts is not the annual amount of GHG emissions, but the cumulative total concentration of GHGs in the atmosphere.[115] This means that any delay in emission reductions will necessitate much steeper emission cuts later on. To maintain GHG concentrations within acceptable limits, net CO_2 emissions will have to fall to zero in the coming decades,[116] which implies a complete transformation of the economy and an unprecedented decoupling of economic output (GDP) and emissions, which will be further explored in Chapter 3.

Moreover, there is disagreement about who should take the responsibility for reducing emissions. Many developing countries take the position that the developed countries have a particular responsibility for reducing emissions and providing assistance to developing countries because they have contributed a large part of atmospheric GHGs, enjoying higher prosperity as a result, and have greater financial and technological means. However, China and other developing countries have industrialised and increased emissions to such an extent that effective mitigation is not possible without their contribution. Economic development and eradication of poverty often goes hand in hand with emission-intensive activities such as cement and steel production, use of fossil fuels and land use change.

All of these features make it very challenging to design and implement effective policies to address climate change. This is evidenced by the fact that global GHG emissions and their atmospheric concentrations keep growing, even though the need to act on climate change has been

[115] CO_2 stays in the atmosphere for a very long time, up to thousands of years. Short-lived climate pollutants like methane have a shorter lifetime, but cause more warming over the short-term.

[116] The IPCC special report on global warming of 1.5°C estimates the carbon budget for a 66 % chance of staying below 1.5°C to be 420 Gt CO_2 from the beginning of 2018 – around 10 years of current emissions.

acknowledged for a long time and the issue has received more attention over the last decades than any other environmental problem.

Carbon budgets

The concept of 'carbon budget' is used in two different senses:

1. **Global carbon budget:** The amount of GHGs that can be emitted worldwide without exceeding a given level of global warming with a certain probability.[117] The IPCC defines the carbon budget as emissions of CO_2, the principal long-lived GHG, while taking account of other anthropogenic GHG emissions. The IPCC special report on global warming of 1.5°C estimates the remaining carbon budget for a 66 % chance of staying below 1.5°C to be 420 gigatonnes (Gt) CO_2 from the beginning of 2018.[118] With current global CO_2 emissions estimated at 42 Gt per year, the remaining budget for achieving the 1.5°C target would be used up in 8 years (counting from 2020), if emissions are not reduced. For a 50 % chance of staying below 1.5°C, the carbon budget would be 580 Gt CO_2 – around 12 years of current emissions.

2. **National/regional carbon budget:** GHG emission limits established in climate policy and legislation, at national or regional level. For example, the United Kingdom sets five-year carbon budgets. Although the EU does not have a formal carbon budget, the following emission limits in EU climate legislation have a similar effect: emissions cap in the EU emission trading system (ETS), annual emission allocations in the effort sharing regulation and the 'no-debit rule' of the Land Use, Land-Use Change and Forestry (LULUCF) Regulation. The European Parliament has called for the introduction of a process for setting an EU carbon budget in the proposed European Climate Law.

To achieve the Paris Agreement targets, national or regional carbon budgets should represent a fair and equitable share of the global carbon budget.

2.1. Climate action policies at international level

The world's governments have a long history of cooperation on addressing the challenge of climate change, starting with the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988.[119] The IPCC reviews and assesses the scientific evidence on climate change, based on the voluntary participation of thousands of scientists, and publishes regular assessment reports, which summarise the current scientific knowledge about climate change and its impacts. The fifth assessment report[120] was published in 2014, and the sixth is due in 2021-2022. Besides the regular assessment reports, the IPCC has prepared special reports, such as that on global warming of 1.5°C, published in 2018.[121]

The international organisations and agreements listed in Table 1 aim to curb GHG emissions across the globe and in specific sectors.

---

117 K. Tokarska and D. Matthews, How the global 'carbon budget' is calculated, and predictions improved, *Energy Post*, February 2021.

118 Gt = 1 billion metric tonnes. There are significant uncertainties due to the climate response to CO_2 and non-CO_2 emissions (±400 Gt CO_2), the level of historic warming (±250 Gt CO_2), potential additional carbon release from future permafrost thawing and methane release from wetlands (-100 Gt CO_2 over the course of this century and more thereafter) and the level of non-CO_2 mitigation in the future (±250 Gt CO_2).

119 The establishment of the IPCC by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) was endorsed by the UN General Assembly in 1988.

120 IPCC, 2014.

121 IPCC, 2018.

Table 1 – International climate agreements

Agreement	Scope and objectives	Time period	Signatories
United Nations Framework Convention on Climate Change (UNFCCC)	Stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system	1992-present	198 Parties
UNFCCC: Kyoto Protocol and Doha Amendment	Quantified emission reductions by developed (Annex I) countries	Commitment periods: 2005-2012, 2013-2020	192 Parties
UNFCCC: Paris Agreement	Hold the increase in the global average temperature to well below 2°C above pre-industrial levels and pursue efforts to limit the temperature increase to1.5°C above pre-industrial levels	2016-present	190 Parties
Kigali Amendment to the Montreal Protocol	Reduce consumption of hydrofluorocarbons (HFC) by 80-85 % over the next 30 years	2019-present	93 Parties
ICAO: Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)	Compensate CO_2 emissions above 2020 levels from international aviation	Voluntary phase: 2021-2026; mandatory from 2027 to 2035	83 countries

2.1.1. United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the 1992 Earth Summit in Rio, and entered into force in 1994. Its objective is the 'stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. The UNFCCC acknowledged that countries have common but differentiated responsibilities. Developed countries,[122] responsible for most of the greenhouse gases in the atmosphere and with more capacity to act, were therefore expected to take the lead in the fight against climate change by reducing their own greenhouse gas emissions, as well as providing support (including financial) to developing countries.

The third Conference of the Parties under the UNFCCC (COP3, 1997) adopted the Kyoto Protocol, which entered into force in 2005. It commits developed countries to quantified reduction of their collective carbon emissions – 5.2 % by 2012 compared to the base year (1990). It established an international emissions-trading system and a clean development mechanism allowing developed countries to meet their commitments with emissions-reduction projects in developing countries. However, the United States of America (USA) – at the time the world's number one emitter – did not ratify the protocol, seriously limiting its effectiveness. The second commitment period (2013-2020)[123] of the Kyoto Protocol affects only 14 % of global emissions, because only EU Member States,

[122] The developed countries (Annex I to the UNFCCC) are most European countries (including all EU Member States and the European Economic Community itself), Russia, Turkey, Japan, the USA, Canada, Australia, and New Zealand.

[123] The Doha Amendment to the Kyoto Protocol, which establishes the second commitment period, will enter into force on 31 December 2020, after ratification by 145 countries.

other European countries and Australia assumed commitments, while the USA, Russia, Canada and Japan did not.

In the period since the adoption of the UNFCCC and the Kyoto Protocol, a number of developing countries experienced considerable economic growth, developed their industries and became major emitters of GHGs.[124] As it became clear that action by developed countries alone is not sufficient, the parties to the UNFCCC negotiated an agreement for the post-Kyoto era that involves all countries in climate action. The Paris Agreement, adopted in 2015 by COP21, aims to maintain the increase in global temperatures well below 2°C above pre-industrial levels, whilst pursuing efforts to limit the increase to 1.5°C. The agreement aims to ensure global greenhouse gas emissions peak as soon as possible, and to balance emissions and removals of greenhouse gases in the second half of this century. Furthermore, the agreement addresses adaptation to climate change, financial support for developing countries, technology transfer and capacity-building, as well as loss and damage.

In contrast to the Kyoto Protocol, which commits only developed countries to specific reduction targets, the Paris Agreement requires all countries to prepare nationally determined contributions (NDCs), take measures to achieve their objectives, and report on progress. To raise the level of ambition over time, Parties must submit updated NDCs every five years, and each Party's new NDC must be more ambitious than its previous NDC. This architecture, which is based on voluntary national commitments, made it politically possible for major emitters like the USA and China to support the agreement.

Equity in the UNFCCC

The UNFCCC and the Paris Agreement require equity to be taken into account in the distribution of climate action efforts and climate finance, but do not set out how this relates to national climate plans. Parties to the Paris Agreement submit their NDCs, which may explain how they take equity into account. Neither the IPCC nor the UN emissions gap report recommend specific equity principles or suggest national carbon budgets.

The IPCC 5th Assessment Report provides an overview of different approaches to taking equity into account when setting emission reduction targets:

- responsibility (e.g. historic emissions);
- capacity (ability to pay);
- right to development;
- equality (e.g. equal per capita carbon budget for all countries).

Projects like Climate Action Tracker assess national climate plans against a range of equity principles.

[124] In 2018, China (a developing country under the UNFCCC) emitted more CO_2 (27 % of the global total) than the United States (13 %) and the EU-28 (8.5 %) combined. Ten developing countries account for 45.5 % of global CO_2 emissions.

However, there is a still a large gap between the carbon budget for achieving the temperature target of the Paris Agreement and national commitments. The UN emissions gap report[125] estimates that full implementation of all unconditional NDCs would lead to 3.2°C warming.

The COP25 climate change conference in December 2019 in Madrid addressed outstanding issues relating to the rulebook for implementation of the Paris Agreement. Despite some progress on loss and damage and gender issues, the conference failed to reach agreement on cooperative approaches and carbon-market mechanisms.[126] This issue will be on the agenda on COP26 in Glasgow, which has been postponed to 2021, due to the Covid-19 crisis. COP26 will also focus on raising ambition, based on the updated NDCs and national long-term strategies, which had to be submitted in 2020.

Climate change is also one of the 17 UN Sustainable Development Goals, adopted by all UN Member States in 2015 as part of the 2030 Agenda for Sustainable Development,[127] a 15-year plan to achieve the goals.

Carbon removal technologies and solar radiation management

To stabilise global temperatures, emissions must eventually reach net-zero, and possibly go below zero for some time to remove CO_2 from the atmosphere if carbon budgets are exceeded. Because some activities such as agriculture are hard to decarbonise completely, net-zero emissions will also require negative emissions (CO_2 removal) to compensate for unavoidable GHG emissions.[128]

Approaches to achieve negative emissions comprise natural solutions such as forests, grassland and wetlands. The creation of forests has high potential for removing CO_2, but is ultimately limited by the availability of land and the diminishing ability of older forests to remove CO_2. In addition, various technologies for carbon dioxide removal have been proposed: enhanced weathering (dissolution of certain natural or artificially created minerals), ocean fertilisation, direct air capture with carbon storage, bioenergy with carbon capture and storage (BECCS). However, all of these have limited capacities, high costs and in some cases high energy use as well as unknown and potentially dangerous side effects, so that their eventual contribution is uncertain.

An alternative exists in solar radiation management – reducing the amount of solar radiation that reaches the earth. The most promising approach is to disperse sulphur dioxide in the atmosphere.[129] However, the IPCC 5th Assessment Report concludes that although solar radiation management might help to avoid crossing dangerous climate thresholds or tipping points, there is insufficient knowledge about the feasibility, effectiveness, cost, and risks. Issues of ethics and global governance for solar radiation management would need to be addressed, to prevent international conflicts.[130]

To help finance global climate action, the COP15 climate conference (2009) agreed a goal to provide climate finance, from 'a wide variety of sources', worth US$100 billion per year, to developing countries by 2020 (Copenhagen Accord). In 2017, climate finance provided and mobilised by

125 Emissions Gap Report 2020, UN Environment Programme, December 2020.

126 G. Erbach, COP25 climate change conference: Outcomes, EPRS, European Parliament, March 2020.

127 Transforming our world: the 2030 Agenda for Sustainable Development, Resolution adopted by the United Nations General Assembly, 25 September 2015.

128 G. Erbach with G. Andreo Victoria, Carbon dioxide removal: Nature-based and technological solutions, EPRS, European Parliament, February 2021

129 Air pollution has a similar effect. It has been estimated that global temperatures could be 0.5 to 1.1°C higher if all air pollution would suddenly disappear.

130 L. Van Woensel with M. Fernández Álvarez, What if we could engineer the planet to help fight climate change?, EPRS, European Parliament, February 2021.

developed countries[131] reached US$71.2 billion, up from US$58.6 billion in 2016. The Green Climate Fund, established in 2010 by the UNFCCC, supports climate mitigation and adaptation programmes in developing countries. As of November 2020, the fund approved US$7.2 billion of funding for 159 projects with a total value of US$23.2 billion.[132] The level of climate finance is important to climate action, as many developing countries have conditional NDCs, the achievement of which depends on financial support.

2.1.2. International Civil Aviation Organization

Aviation accounts for approximately 2.1 % of global CO_2 emissions – roughly equivalent to Germany's total emissions. International flights account for around 1.3 % of emissions. With the growth in air traffic anticipated before the pandemic, emissions in 2050 were expected to be seven to ten times higher than 1990 levels.[133]

In 2016, the International Civil Aviation Organization (ICAO) decided to establish a global market-based measure in the form of the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).[134] To compensate international civil aviation CO_2 emissions above 2020 levels[135] and achieve carbon-neutral growth over time, emitters (i.e. airlines) would buy emissions units (representing 1 tonne of CO_2) from green projects. After a voluntary pilot phase (2021 to 2023) and first phase (2024 to 2026), participation will become mandatory for all signatory states in phase II (as of 2027), although exemptions apply to certain developing countries. Eighty-eight states, including all EU Member States, will participate in CORSIA from its outset.[136]

The European Parliament called for measures to strengthen CORSIA, and urged the ICAO to adopt a long-term emission reduction goal,[137] while defending the EU's autonomy to apply the ETS to international aviation – which was called into question in a 2019 ICAO resolution to make CORSIA the only global market-based measure applying to CO_2 emissions from international aviation.[138]

2.1.3. International Maritime Organization

In 2012, shipping accounted for about 2.5 % of global GHG emissions. Exempt both from international (UNFCCC) and EU climate targets, these emissions are projected to increase by up to 50 % between 2018 and 2050, if left unchecked.[139] The task of controlling them has been assigned to the International Maritime Organization (IMO).

In 2011, the IMO adopted global and legally binding energy-efficiency standards for new ships, in order to limit their CO_2 emissions. Since 2019, ships of 5 000 gross tonnes and above must collect and report data on fuel consumption to their flag state, who submit aggregated data to the IMO. In 2018, the IMO adopted an initial strategy on the reduction of greenhouse gas emissions from

---

131 Climate Finance Provided and Mobilised by Developed Countries in 2013-17, OECD, September 2019.

132 GCF at a glance project portfolio, Green Climate Fund, November 2020.

133 G. Erbach, CO_2 emissions from aviation, EU Legislation in progress, EPRS, European Parliament, January 2018.

134 A. Debyser, ICAO Agreement on CO_2 emissions from aviation, EPRS, European Parliament, October 2016.

135 The baseline is determined on the basis of emissions in the years 2019-2020. However, since 2020 saw a deep reduction in air traffic during the Covid-19 pandemic, the Council of ICAO decided in June 2020 that the year 2020 will not be taken into account.

136 CORSIA States for Chapter 3 State Pairs, International Civil Aviation Organization, July 2020.

137 Resolution of 15 January 2020 on the European Green Deal, 2019/2956(RSP), European Parliament.

138 Resolution A40-19, International Civil Aviation Organization, 2010.

139 Fourth IMO GHG Study, International Maritime Organization, July 2020 (accessible after registration).

ships,[140] which should peak as soon as possible and fall by at least 50 % by 2050 compared to 2008, while pursuing efforts towards phasing them out entirely. In the negotiations, the EU had pushed for a higher level of ambition.[141] Although this initial strategy includes candidate further short-, mid- and long-term measures with possible timelines and their impacts and identifies barriers and supportive measures, up to now there is no agreement in the IMO on the concrete measures to be implemented to achieve this long-term emission reduction target.[142] According to the IMO roadmap approved in 2016, the initial strategy is due to be revised by 2023.

2.1.4. Montreal Protocol and Kigali Amendment

The Montreal Protocol on substances that deplete the ozone layer,[143] adopted in 1987, phased out ozone-destroying substances[144] that also happen to be potent GHGs. Apart from protecting the ozone layer, their phasing-out made a substantial contribution (estimated at 1-2 billion tonnes CO_2 equivalent per year) to fighting climate change. However, in certain applications (for example refrigeration), the substances banned by the Montreal Protocol have been replaced by hydrofluorocarbons (HFC) – very potent greenhouse gases (GHG) with a capacity to cause global warming up to 15 000 times greater than that of CO_2. With growing demand for refrigeration and air-conditioning exacerbated by global warming, HFCs could account for 8 % of global GHG emissions by 2050 (up from 1.3 % in 2004).

The Kigali Amendment to the Montreal Protocol,[145] adopted in 2016, commits developed countries, including the EU,[146] to start reducing their use of HFCs by 2019. A number of developing countries, such as China, Brazil and most of Africa, will freeze HFC consumption levels in 2024, while India, Iran, Pakistan, Kuwait and Saudi Arabia will follow in 2028. All Parties agreed to reduce HFC consumption by 80-85 % below their respective baselines over the next 30 years. They further agreed to provide financing for HFCs reduction and substitution.

2.2. Climate action policies at EU level

2.2.1. Introduction

The EU is committed to taking action to achieve climate neutrality by 2050, in line with the objectives of the Paris Agreement. Article 191 of the Treaty on the Functioning of the European Union (TFEU) establishes climate action as one of the objectives of EU environment policy. Article 11 TFEU requires the integration of environmental protection requirements into the definition and implementation of the Union's policies and activities (see section 3.1 on policy coherence in the context of climate action policy).

---

140 M. Pape, The first climate change strategy for shipping, EPRS, European Parliament, May 2018.

141 Commissioners Bulc and Arias Cañete welcome the IMO agreement on CO_2 reductions in the maritime sector, STATEMENT/18/3341, European Commission, 13 April 2018.

142 Greenhouse emissions from shipping: waiting for concrete progress at IMO level, Policy Department for Economic, Scientific and Quality of Life Policies, DG IPOL, European Parliament, September 2020.

143 G. Erbach, Using the Montreal Protocol for climate action, EPRS, European Parliament, November 2016.

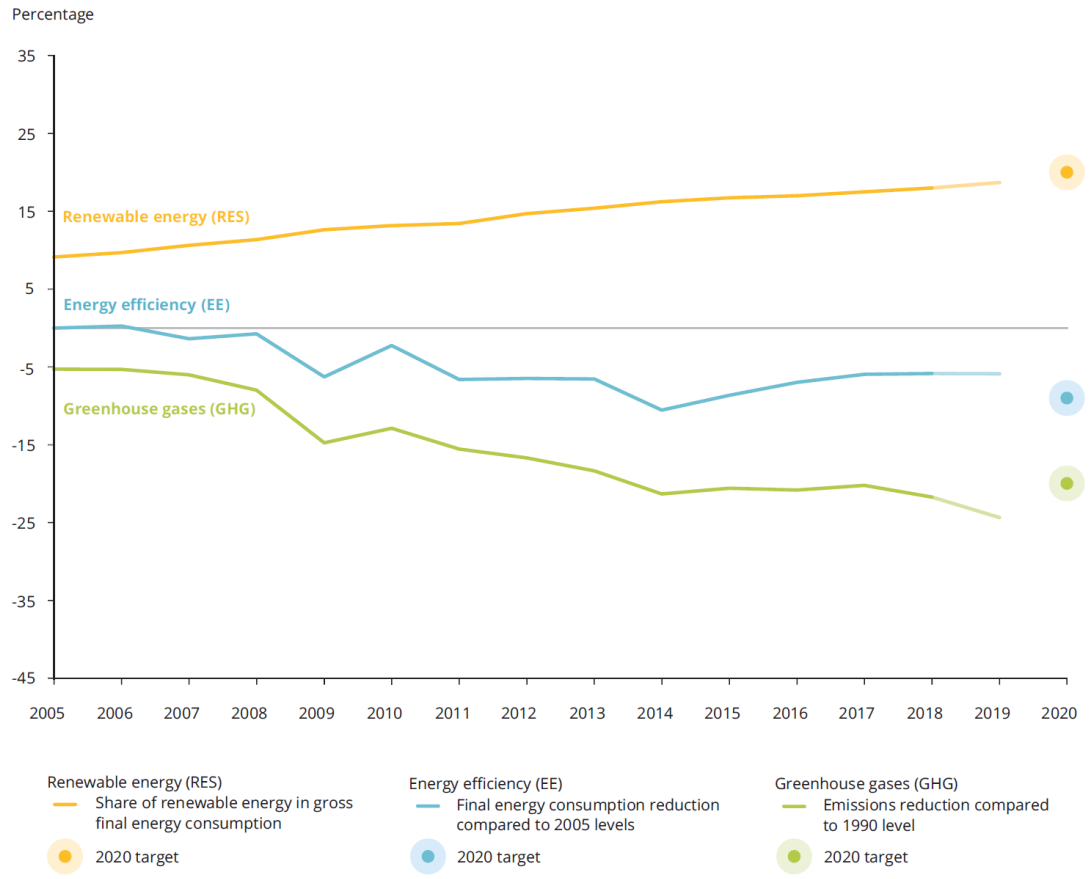
144 Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs).

145 Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, United Nations, Kigali, October 2016.

146 At EU level, the phase-out of HFCs is implemented by the f-gas Regulation, see page 28.

The EU has a target to reduce its GHG emissions by 20 % by 2020,[147] compared to 1990 levels, and is on track to exceed that target. In 2019, GHG emissions in the EU-27 were 24 % below 1990 levels. With an 18.9 % share of renewable energy in 2018, the EU is on track to meet its 20 % renewables target for 2020. However, EU final energy consumption grew for four years in a row up to 2018, and the EU was thus not on track to meeting its energy efficiency target of reducing energy consumption to 20 % below baseline projections by 2020. However, because measures taken in 2020 in reaction to the Covid-19 pandemic have reduced GHG emissions and energy use, the EU may well achieve and exceed its energy efficiency target for that particular target year,[148] although energy use and emissions may rebound afterwards.

Figure 7 – Progress towards 2020 targets for EU GHG emissions, renewable energy share, and energy consumption



Source: Trends and projections in Europe 2020, European Environment Agency, November 2020.

As energy use is the principal cause of GHG emissions, energy policy naturally plays a key role in climate action. The Juncker Commission (2014-2019) addressed this linkage through the overarching Energy Union strategy and by assigning the climate and energy portfolios to a single Commissioner, Miguel Arias Cañete. The 2030 EU climate and energy framework, adopted in the

147 This is also the EU's target under the Kyoto Protocol's second commitment period.

148 2019 assessment of the progress made by Member States towards the national energy efficiency targets for 2020 and towards the implementation of the Energy Efficiency Directive, COM(2020) 326 final, European Commission, July 2020.

European Parliament's eighth legislative term (2014-2019), sets an EU target of 40 % for GHG emission reductions by 2030. In 2020, the European Council endorsed the Commission's proposal to raise the 2030 target to a 55 % reduction of the EU's net emissions,[149] and updated the EU's NDC accordingly.[150] Other headline targets of the 2030 framework are a 32 % share of renewable energy sources (RES) in final energy consumption and a 32.5 % improvement in energy efficiency.

In 2009, the European Council endorsed a long-term target to reduce EU GHG emissions by 80 to 95 % by 2050,[151] compared to 1990 levels. In November 2018, the Commission analysed scenarios for long-term decarbonisation and adopted the 'clean planet for all' strategy, aiming for a prosperous, modern, competitive and climate-neutral economy by 2050. This climate neutrality target is at the core of the European Green Deal (see section 2.2.7 below). All EU institutions support the objective of achieving a climate-neutral EU by 2050, and this objective was also submitted to the UNFCCC as the EU's long-term strategy.[152]

2.2.2. EU 2030 climate and energy framework

The EU regulatory framework for achieving the targets up to 2030[153] was set during the eighth parliamentary term. Council and Parliament have revised existing energy and climate legislation, adopted new rules and set 2030 emission targets for specific sectors, strengthening and extending previous targets.[154] Many elements of the framework are scheduled for revision as part of the European Green Deal.[155]

Energy and industry: the EU emissions trading system (ETS)[156] sets a fixed amount (cap) of allowable GHG emissions for EU electricity generation and industry. It covers around 45 % of the EU's greenhouse gas emissions.[157] Economic operators are required to acquire an EU emission allowance (EUA) for each tonne of CO_2e that they emit. Allowances can be acquired at auction[158] and traded between operators. This would lead to cost-effective emissions reductions, as operators would reduce emissions where this has lower costs than the market price of allowances.[159] Emissions covered under the ETS must be reduced by 43 % by 2030, compared with the levels in 2005, the year

149 European Council meeting – Conclusions, European Council, December 2020.

150 Submission to the UNFCCC on behalf of the European Union and its Member States on the update of the nationally determined contribution of the European Union and its Member States, Council, December 2020.

151 Brussels European Council 29/30 October 2009 Presidency conclusions, Council of the European Union, December 2009.

152 Long-term low greenhouse gas emission development strategy of the European Union and its Member States, Council of the European Union, March 2020.

153 2030 climate & energy framework, European Commission website.

154 G. Amanatidis, European policies on climate and energy towards 2020, 2030 and 2050, Policy Department for Economic, Scientific and Quality of Life Policies, DG IPOL, European Parliament, January 2019.

155 See section 2.2.7.

156 G. Erbach, Post-2020 reform of the EU Emissions Trading System, EU Legislation in progress, EPRS, European Parliament, May 2018.

157 The EU ETS applies to the EU Member States, Liechtenstein, Iceland and Norway. The emissions trading system of Switzerland is linked to the EU ETS since 1 January 2020.

158 Operators deemed at risk of carbon leakage (industries that are both emission-intensive and trade-intensive) can obtain free allocations of allowances, in order to safeguard their competitive position against foreign competitors that do not pay a comparable price for emissions.

159 The financial crisis resulted in a large surplus of allowances and a price that was too low incentivise most emission reductions. In reaction, a market stability reserve was introduced in order to balance the supply and demand of allowances. This will also affect the supply of allowances after the COVID-19 crisis.

when the EU ETS was set up. The Carbon Capture and Storage (CCS) Directive sets the legal framework for carbon capture and storage in the EU.[160]

Figure 8 – Price of EU allowances in the EU ETS (€)

Date source: EMBER carbon price viewer.

Transport, buildings and agriculture: the Effort Sharing Regulation[161] requires emissions not covered under the EU ETS to be cut by 30 % by 2030 compared with 2005 levels. Specifically on transport, revised CO_2 standards for cars and vans[162] and the first-ever CO_2 standards for trucks and buses[163] require that the CO_2 emissions of new vehicles are 30 % below today's levels by 2030. The Clean Vehicles Directive promotes the public procurement of vehicles with low emissions of GHGs and air pollutants.[164] CO_2 emissions from aviation also fall under the EU ETS, but its application to international flights outside the European Economic Area has been suspended, to allow for the development of an international market-based mechanism (see section 2.1.2).

Land use and forestry: the regulation on the land-use sector requires greenhouse gas emissions from land use and forestry to be offset by the removal from the atmosphere of at least an equivalent volume of CO_2 in the period from 2021 to 2030.[165]

Energy efficiency: the revised Energy Efficiency Directive adopted in December 2018 sets a binding energy efficiency target of 32.5 % for 2030.[166] The EU regulation on energy labelling helps to drive the demand for energy efficient products by informing consumers about the energy use of products,[167] while ecodesign rules ensure the supply of such products by setting minimum energy efficiency standards for certain product groups.[168] The Energy Performance of Buildings Directive

160 Directive 2009/31/EC of 23 April 2009 on the geological storage of carbon dioxide.

161 G. Erbach, Effort sharing regulation, 2021-2030: Limiting Member States' carbon emissions, EU Legislation in progress, EPRS, European Parliament, July 2018.

162 G. Erbach, CO_2 standards for new cars and vans, EU Legislation in progress, EPRS, European Parliament, May 2019.

163 G. Erbach, CO_2 emission standards for heavy-duty vehicles, EU Legislation in progress, EPRS, European Parliament, August 2019.

164 G. Erbach, Review of the Clean Vehicles Directive, EU Legislation in progress, EPRS, European Parliament, August 2019.

165 G. Erbach, Land use in the EU 2030 climate and energy framework, EU Legislation in progress, EPRS, European Parliament, July 2018.

166 N. Šajn and A. Wilson, Revised Energy Efficiency Directive, EU Legislation in progress, EPRS, European Parliament, January 2019.

167 A. Wilson, Framework for energy efficiency labelling, EU Legislation in progress, EPRS, European Parliament, July 2017.

168 A. Zygierewicz, The Ecodesign Directive (2009/125/EC), European Implementation Assessment, EPRS, European Parliament, November 2017.

requires new buildings in the EU to be 'near-zero energy buildings' and promotes measures to encourage the energy-efficient renovation of existing buildings[169] (see section 3.4.3 on buildings).

Renewable energy: the revised Renewable Energy Directive adopted in December 2018 sets a binding EU target for a 32 % share of renewable energy sources (RES) in EU final consumption by 2030 and a 14 % RES target for the transport sector, subject to sustainability criteria for biomass energy.[170]

Fluorinated greenhouse gases (F-gases) including hydrofluorocarbons (HFCs), are used in refrigeration equipment and other industrial applications. Their emissions are addressed in the F-gas Regulation,[171] which progressively limits the total amount of the most important F-gases, bans the use of F-gases where less harmful alternatives are readily available and aims to prevent emissions of F-gases by requiring checks, servicing of existing equipment and recovery of the gases from end-of-life equipment. The Mobile Air Conditioning (MAC) Directive[172] prohibits the use of F-gases with a global warming potential of more than 150 times greater than CO_2 in new cars and vans.

To simplify and strengthen the process of monitoring progress and to address weaknesses in implementing the Energy Union goals, the EU adopted a regulation establishing a governance framework for the Energy Union in December 2018.[173] The regulation mentions explicitly the 'Union-wide binding target of at least 40 % domestic reduction in economy-wide greenhouse gas emissions as compared to 1990 to be achieved by 2030'. The Governance Regulation requires Member States to prepare National Energy and Climate Plans (NECP).[174]

The Governance Regulation includes and repeals the EU Monitoring Mechanism Regulation, which requires monitoring and reporting of GHG emissions by Member States according to the IPCC guidelines.[175] Emissions from maritime transport are currently monitored and reported under two overlapping systems, an EU system and an IMO system (see section 2.1.3). A legislative proposal for harmonising the two systems is being considered by the co-legislators.[176]

The Commission's November 2020 progress report on climate action[177] estimates that the implementation of the measures in the Member States' NECPs would result in a 41 % emission reduction by 2030.

---

169 A. Wilson, Improving energy performance of buildings, EU Legislation in progress, EPRS, European Parliament, July 2018.

170 A. Wilson, Promoting renewable energy sources in the EU after 2020, EU Legislation in progress, EPRS, European Parliament, January 2019.

171 Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006.

172 Directive 2006/40/EC of 17 May 2006 relating to emissions from air-conditioning systems in motor vehicles and amending Council Directive 70/156/EEC.

173 A. Wilson, Governance of the energy union, EU Legislation in progress, EPRS, European Parliament, January 2019.

174 See section 2.2.8.

175 Regulation (EU) No 525/2013 of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC.

176 G. Erbach, Monitoring, reporting and verification of CO_2 emissions from maritime transport, EU Legislation in progress, EPRS, European Parliament, September 2020.

177 Kick-starting the journey towards a climate-neutral Europe by 2050 – EU Climate Action Progress Report 2020, COM(2020) 777 final, European Commission, November 2020.

Table 2 – EU energy and climate targets and related legislation

		GHG emission reduction	Energy efficiency	Renewable energy
EU climate and energy targets		Emission reduction compared to 1990 level	Reduction of energy consumption relative to projections	Share of renewables in final energy consumption
	Targets for 2020	**-20 %**	**-20 %**	**20 %**
	Targets for 2030	**-40 % / at least -55 %**	**-32.5 % / to be revised**	**32 % / to be revised**
	Targets for 2050	**Net-zero**		
EU climate and legislation	European climate law (proposal)	Binding targets for 2030 and 2050	Energy efficiency contributes to emission cuts	Emission-free energy supply
	ETS Directive	Cap on GHG emissions in specific sectors	ETS price drives efficiency improvements	ETS price raises cost of fossil energy sources
	Effort Sharing Regulation	Annual emission allocations	Efficiency contributes to emission cuts	Emission-free energy supply
	LULUCF Regulation	No-debit rule		
	Energy Efficiency Directive	Efficiency contributes to emission cuts	EU-wide binding target	
	Renewable Energy Directive	Emission-free energy supply enables emission cuts		EU-wide binding target
	F-gas Regulation			
	Energy Performance of Buildings Directive			
	Energy efficiency labelling			
	Ecodesign Regulation			
	CO_2 standards for new cars and vans			
	CO_2 standards for heavy-duty vehicles			
	Energy Union and Climate Action Governance Regulation	Over-arching framework		

Source: EPRS (green: direct contribution to targets; yellow: indirect contribution).

2.2.3. EU initiatives

The EU has initiated and supports a number of initiatives and activities to promote climate-friendly technologies and practices. The Covenant of Mayors for Climate and Energy, launched by the European Commission in 2008, is a bottom-up initiative of more than 10 000 democratically constituted local authorities from 60 countries. The signatories are voluntarily committed to implementing EU climate and energy objectives. Built around three pillars: mitigation, adaptation, and secure, affordable and sustainable energy, the Covenant merged in 2016 with the Compact of Mayors, another city initiative, to form the Global Covenant of Mayors.

Research and innovation on climate change and climate action is supported through the EU's Horizon 2020 and Horizon Europe research framework programmes. Over 35 % of the programmes' budget are to be spent on climate-related activities.[178] The European Institute of Innovation and Technology initiated knowledge and innovation communities on climate (Climate-KIC) and energy innovation (KIC InnoEnergy), which bring together businesses, research centres and universities.

The Copernicus Climate Change Service provides climate data and information on impacts in Europe and worldwide.[179] It is part of Copernicus, the EU's earth observation programme, which offers information services based on satellite earth observation and in situ (non-space) data.

The EU supports some key enabling technologies through specific actions in its research and innovation programmes and by building alliances between policy, industry and research communities. The purpose of these initiatives is to advance technological development while supporting European industrial competitiveness in the specific field.

Examples include the European Battery Alliance and the European Technology and Innovation Platform on Batteries. In July 2020, the Commission further launched the European Clean Hydrogen Alliance, inspired by the success of the alliance on batteries. Member States can support specific innovation projects as important projects of common European interest (IPCEI).[180] An IPCEI on batteries has also been launched[181] and one on hydrogen is in preparation.

2.2.4. EU adaptation strategy

The first EU adaptation strategy,[182] adopted in 2013, focused on adaptation strategies and measures in Member States, better information for decision-making, and climate-proofing EU-level action by promoting adaptation in key vulnerable sectors such as agriculture, fisheries and cohesion policy. The Climate-ADAPT platform was established as a partnership between the European Commission and the EEA to build a consistent knowledge base on adaptation in Europe.

The new EU strategy on climate change adaptation,[183] adopted by the Commission in February 2021, aims at enhancing the EU and global capacity to adapt to and minimise the impacts

---

178 Horizon 2020: Environment & Climate Action, European Commission website.

179 Copernicus Climate Change Service, website.

180 Communication on criteria for the analysis of the compatibility with the internal market of State aid to promote the execution of important projects of common European interest, 2014/C 188/02, European Commission, June 2014.

181 State aid: Commission approves €3.2 billion public support by seven Member States for a pan-European research and innovation project in all segments of the battery value chain, press release, IP/19/6705, European Commission, 9 December 2019.

182 Communication on an EU strategy on adaptation to climate change, COM(2013) 216 final, European Commission, April 2013.

183 Communication on Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change, COM(2021) 82 final, European Commission, February 2021.

of climate change and at the same time further develop and accelerate actions across the economy and society. To deepen the international scope of the strategy, the Commission plans to intensify and broaden support to partner countries and local authorities.

The strategy addresses the need to improve the existing knowledge and the management of the uncertainties associated with climate change. In addition, it envisages the development of policy at all levels and sectors. The strategy mostly focuses on the interaction with other strategies,[184] to increase EU preparedness for the impacts of climate change. Moreover, adaptation will be addressed in forthcoming legislative proposals.[185] As with the previous strategy, Member States will remain the central implementation partners. To assist local and regional authorities, the Commission expresses interest in further developing the EU and Global Covenant of Mayors, to assist in the process of moving from the planning phase to concrete action.

Key elements of the strategy are the development of nature-based solutions, action to close knowledge gaps and financing of climate adaptation. The Commission highlights the importance of the insurance sector both in the gathering of knowledge – through the possible further development of the European Insurance and Occupational Pensions Authority – and through the expansion of insurance coverage to alleviate the costs of climate impacts.

2.2.5. Funding of EU climate action

EU finances, in their broader sense, contribute to climate-related objectives through three main categories of initiatives, variously interlinked:

1. relevant projects and activities across a broad range of funding instruments in the EU budget
2. programmes for the demonstration of innovative technologies, funded by the EU's Emissions Trading System (ETS)
3. climate finance from the European Investment Bank (EIB).

EU budget (2014-2020)

The EU budget represents only 2 % of public spending in the Union, but some features make it particularly relevant to climate action, such as its focus on investments, its capacity to leverage additional funding and its medium-term predictability. In the 2014-2020 Multiannual Financial Framework (MFF), the EU increased its budget's contribution to the fight against climate change, introducing a political objective of devoting 20 % of its total resources to climate expenditure. Known as climate mainstreaming, this approach means that, alongside a specific instrument for climate under the LIFE programme, the EU budget incorporates climate considerations and objectives in all its spending instruments relevant to climate, including cohesion, research and development, agriculture, and large infrastructure projects. The EU budget was projected to invest around €210 billion in climate action over the 2014-2020 period. Assessments of the tracking methodology and of its impact have identified both achievements and shortcomings. Stressing its full support for the principle of climate mainstreaming in the EU budget, the European Parliament

[184] Circular economy action plan, biodiversity strategy, Renovation Wave, Farm-to-Fork strategy.

[185] INSPIRE Directive, Urban Waste Water Treatment Directive, Energy Performance of Buildings Directive, Construction Products Regulation, Directive on the marketing of forest reproductive material, Directives on the marketing of seed and other propagating material.

has called for improvements in the tracking methodology, including a reform of its performance indicators and the prevention of financial support for harmful measures.[186]

Programmes funded by the EU ETS

Outside the MFF, the Innovation Fund (and its predecessor NER 300) and the Modernisation Fund have been set up to finance climate-related projects, using part of the revenue stemming from auctioning carbon allowances under the ETS. The former focuses on projects demonstrating promising low-carbon technologies, while the latter finances modernisation of energy systems, improvements in energy efficiency and just transition in ten lower-income Member States in central and eastern Europe.

European Investment Bank (EIB)

The EIB supports the objectives of the EU, offering a wide range of financial products to the public and private sectors, as well as advisory services. The EIB, which is already the world leader in climate finance among multilateral banks, has committed to increasing the share of its support to climate action and environmental sustainability from 25 % to 50 % of its total lending by 2025, expecting the new target to correspond to an annual amount of €30 billion. Considering that its lending activities ensure additional funding from other sources to the supported projects, the Bank estimates that its target would translate into €1 trillion of climate finance over the next decade.[187] In addition, the EIB has decided to phase out financing of unabated[188] fossil fuel energy projects and to align all its financial activities to the goals of the Paris Agreement.

European Green Deal Investment Plan and Next Generation EU

Up to 2030, it is expected that EU financing of climate action will be further stepped up in the context of initiatives still being negotiated or already agreed, such as the new EIB target. In January 2020, the European Commission put forward the European Green Deal Investment Plan that should trigger total investment for climate action and environmental sustainability worth €1 trillion over the next decade. This new funding instrument would focus on facilitating the transition for the regions, sectors and communities most exposed to its costs.

Since the European Green Deal Investment Plan and the EIB activities only partially overlap, it can be inferred that, taken together, they should ensure some €1.75 billion for climate action by 2030.[189] However, these estimates pre-date the coronavirus pandemic. In May 2020, the Commission announced Next Generation EU, an instrument for recovery from the Covid-19 crisis. This would channel an additional €750 billion through EU budgetary instruments during the first half of the 2021-2027 MFF, with a view to ensuring not only an economic rebound but also that stimulus measures incorporate green and digital objectives (see section 3.1).[190]

The agreement reached by Parliament and Council on the next MFF includes an increase in the climate mainstreaming objective from 20 % in the current period to 30 % in the years 2021-2027. This strengthened objective will apply both to the new MFF and Next Generation EU, which could

---

186 A. D'Alfonso, Mainstreaming of climate action in the EU budget: Impact of a political objective, EPRS, European Parliament, October 2019.

187 >€1 TRILLION FOR <1.5°C: Climate and environmental ambitions of the European Investment Bank Group, European Investment Bank Group, January 2020.

188 Without carbon capture and storage.

189 A. D'Alfonso, European Green Deal Investment Plan: Main elements and possible impact of the coronavirus pandemic, EPRS, European Parliament, April 2020.

190 A. D'Alfonso, Next Generation EU: A European instrument to counter the impact of the coronavirus pandemic, EPRS, European Parliament, July 2020.

result in a €550 billion EU budget contribution to the broader Green Deal Investment Plan by 2027. In addition, the agreement includes provisions to strengthen the mainstreaming methodology and to introduce corrective measures in case of insufficient progress towards the 30 % objective.[191]

Sustainable Finance Package

To facilitate sustainable and climate-friendly investments, the EU adopted a package of measures on the financing of sustainable growth. The package includes three regulations aimed at establishing an EU taxonomy on sustainable economic activities,[192] improving disclosure requirements[193] and creating a new category of financial benchmarks to help investors measure the carbon footprint of their investments.[194]

2.2.6. EU Climate diplomacy and climate finance

Climate is one of the priorities of EU external policy. The EU plays an active role in international negotiations in the framework of the UNFCCC, ICAO, IMO, Montreal Protocol, G7, G20, and other international fora. The EU played a leading role in concluding the Paris Agreement, as part of the 'high-ambition coalition' that pushed for the inclusion of a 1.5°C target.

EU climate diplomacy and cooperation initiatives also include sharing of expertise, financing to support developing countries in their mitigation and adaptation efforts, development cooperation on issues such as adaptation, mitigation, disaster risk reduction and desertification, technology transfer and research collaboration and the integration of sustainable development into EU trade policy.

The EU, its Member States and the European Investment Bank are together the biggest contributor of public climate finance to developing countries, providing €23.2 billion in 2019, a 6.9 % increase compared to 2018.[195]

The EU has a number of bilateral initiatives on climate action. For example, the EU and China cooperate on climate action since 2005 in the framework of the EU-China Partnership on Climate Change. At the 2018 EU-China Summit, both sides affirmed their commitment to the implementation of the Paris Agreement and to strengthen their cooperation on climate action, emissions trading and clean energy.[196] After the 2020 US elections, the EU High Representative for Foreign Affairs and Security Policy outlined a new EU-US agenda for global change, which includes coordinated positions for ambitious global agreements on biodiversity and climate, a joint commitment to climate neutrality by 2050, a transatlantic green trade agenda and green tech alliance, and a global sustainable finance framework.[197]

---

191 A. D'Alfonso, Parliament's consent to the 2021-2027 MFF, EPRS, European Parliament, December 2020.

192 S. Spinaci, Sustainable finance – EU taxonomy: A framework to facilitate sustainable investment, EU Legislation in progress, EPRS, European Parliament, July 2020.

193 S. Spinaci, Sustainable finance and disclosures: Bringing clarity to investors, EU Legislation in progress, EPRS, European Parliament, January 2020.

194 S. Spinaci, Sustainable finance and benchmarks: Low-carbon benchmarks and positive-carbon-impact benchmarks, EU Legislation in progress, EPRS, European Parliament, January 2020.

195 Climate finance: EU and member states' contributions continued to increase in 2019, press release, Council of the EU, 29 October 2020.

196 International action on climate change – cooperation with non-EU countries & regions: China, European Commission website.

197 Joint Communication on a new EU-US agenda for global change, JOIN(2020) 22 final, High Representative for Foreign Affairs and Security Policy, December 2020.

2.2.7. European Green Deal

The European Green Deal is a strategic EU priority, first outlined in the political guidelines of the Commission President, Ursula von der Leyen. On 11 December 2019, the Commission presented a communication on the European Green Deal[198] that sets out a detailed vision to make Europe the first climate-neutral continent by 2050, safeguard biodiversity, establish a circular economy and eliminate pollution, while boosting the competitiveness of European industry and ensuring a just transition for the regions and workers affected. Pricing of carbon emissions is mentioned as a key element in ensuring that every person and every sector contributes. The Emissions Trading System (ETS) would be extended to the maritime sector, and the free allowances allocated to airlines would be reduced over time. The Commission plans to investigate the possibility of further extending the ETS to road transport and buildings. GHG emissions from transport should be reduced by 90 % by 2050. Tax policies would be reformed in line with climate ambitions, which includes work on a carbon border tax and a review of the Energy Taxation Directive. European Commission Executive Vice-President Frans Timmermans is in charge of leading and coordinating the work on the European Green Deal.

A new European Climate Pact, launched in December 2020, aims at bringing regional and local authorities, civil society, industry and schools together to agree on commitments to change behaviour.[199]

The von der Leyen Commission also aims for more ambitious 2030 emissions reduction targets, both in the EU and internationally. The Commission President wants the EU to lead international negotiations to raise the ambition of other major emitters by 2021.

A legislative proposal for a new European climate law[200] sets the objective for the EU to become climate-neutral by 2050 and establishes a framework for achieving that objective. The proposed climate law would also require EU institutions and Member States to strengthen adaptation to climate change. The Commission would have to carry out five-yearly assessments – aligned with the review cycle of the Paris Agreement – of the progress towards the objectives and of the consistency of national and EU measures with the objectives. It would be required to take corrective action and could issue recommendations to Member States whose measures are inconsistent with the emissions trajectory. Moreover, the Commission would have to ensure broad public participation. To mainstream climate action across all policy areas, the proposed European climate law would require the Commission to assess any draft measure or legislative proposal in light of the climate-neutrality objective.

In September 2020, the Commission presented an impact assessed climate target plan with a target of 55 % reduction of the EU's net GHG emissions by 2030, and amended the climate law proposal accordingly.[201] The European Council endorsed the 55 % target in December 2020, whereas the Parliament favours a 60 % reduction in its October 2020 position on the climate law proposal.[202] Other amendments made by the Parliament include the establishment of a European Climate Change Council and an obligation for each Member State to achieve climate neutrality by 2050 and negative emissions thereafter.

---

198 Communication on the European Green Deal, COM(2019) 640, European Commission, December 2019.

199 Communication on European Climate Pact, C(2020)788, European Commission, December 2020.

200 G. Erbach, European Climate Law, EU Legislation in progress, EPRS, European Parliament, December 2020.

201 L. Jensen, EU climate target plan: Raising the level of ambition for 2030, EPRS, European Parliament, December 2020.

202 Amendments adopted by the European Parliament on 8 October 2020, on the proposal for a regulation establishing the framework for achieving climate neutrality (European Climate Law), 2020/0036(COD).

According to the guidelines, record amounts of public funds would be invested in advanced research and innovation, complemented by a strategy for green financing. Parts of the European Investment Bank (EIB) should become Europe's climate bank. In January 2020, the Commission adopted a communication on the Sustainable Europe Investment Plan,[203]often referred to as the European Green Deal Investment Plan (see section 3.1). It aims to increase funding for the transition by mobilising €1 trillion for sustainable investment over the next decade through the EU budget and associated instruments like InvestEU; create an enabling framework for sustainable investment; and support the identification, structuring and execution of sustainable projects. At the same time, the Commission adopted a legislative proposal for a new Just Transition Fund to support the people and regions most affected by the low-carbon transition[204] (see section 3.2.3). The budget for the Just Transition Fund will be €17.5 billion, of which €10 billion will come from Next Generation EU. The new fund is part of a Just Transition Mechanism that cuts across different funds and financing instruments and should mobilise at least €100 billion in public and private investment.

A new industrial strategy, adopted in March 2020, aims at making the EU a world leader in the circular economy and clean technologies, and to decarbonise energy-intensive industries.[205] The sustainable and smart mobility strategy, adopted in December 2020, applies to all modes of transport and aims to reduce dependence on fossil fuels, increase use of less polluting transport modes, and internalise the external costs.[206]

Furthermore, policy coherence is the focus of the Commission strategies for energy system integration[207] and for hydrogen,[208] aimed at better linking the various energy sectors (electricity, gas, buildings, mobility, industry), thus allowing for optimisation of the energy system as a whole by harnessing synergies across sectors.

2.2.8. National Energy and Climate Plans

To ensure the effectiveness and coherence of national climate action, the Regulation on the Governance of the Energy Union and Climate Action[209] requires Member States to draw up National Energy and Climate Plans (NECP) and long-term strategies.

The NECPs define Member States' approaches towards achieving, among other things, the targets for emission reductions, energy efficiency, and renewables. The NECPs are thus considered a key policy instrument ensuring coherence between climate and energy policies in the next decade.[210] However, the Commission's assessment of those first drafts, published in June 2019, showed that there were certain gaps in the national contributions to the Union targets for GHG reduction, renewables and energy efficiency, meaning that the collective ambitions and the measures envisaged by Member States are not enough to achieve the EU targets for 2030, which could cause

---

203 Communication on sustainable Europe Investment Plan European Green Deal Investment Plan, COM(2020) 21 final, European Commission, January 2020.

204 A. Widuto and P. Jourde, Just Transition Fund, EU Legislation in progress, EPRS, European Parliament, October 2020.

205 Communication on a new Industrial Strategy for Europe, COM(2020) 102 final, European Commission, March 2020.

206 Communication on sustainable and Smart Mobility Strategy – putting European transport on track for the future, COM(2020) 789 final, European Commission, December 2020.

207 Communication on powering a climate-neutral economy: An EU Strategy for Energy System Integration, COM(2020) 299 final, European Commission, July 2020.

208 Communication on a hydrogen strategy for a climate-neutral Europe, COM(2020) 301 final, European Commission, July 2020.

209 A. Wilson, Governance of the energy union, EU Legislation in progress, EPRS, European Parliament, January 2019.

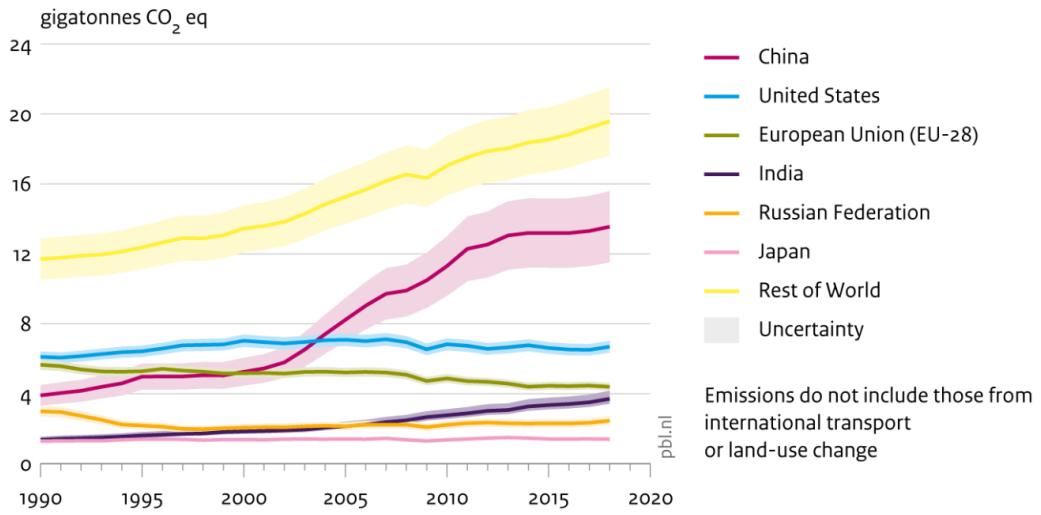
210 Communication on a Europe that protects its citizens and enhances their quality of life, COM(2019) 149 final, European Commission, April 2019.

incoherence in energy and climate policies.[211] Consequently, all Member States had to revise the first drafts of their NECPs to reflect the Commission's country-specific recommendations. All final plans for 2021-2030 were submitted by mid-2020 and assessed by the Commission. While the assessment shows that full implementation of the plans would allow the EU to over-achieve on its current 2030 emissions reduction, the NECPs will probably need to be revised again to ensure coherence with the updated 2030 target to be decided by the co-legislators.[212]

2.3. Climate action outside the EU

Under the rules of the Paris Agreement, each party is free to define its own plans and targets in its NDC. However, the current national commitments taken together are not sufficient to achieve the temperature targets of the Paris Agreement. The UN emissions gap report[213] estimates that full implementation of the NDCs submitted before 2020 would lead to 3.2°C of warming. The NDCs were to be updated in 2020,[214] and the COP26 climate conference, postponed to November 2021, will provide an opportunity to assess the aggregated effect of the updated NDCs. In addition to national climate policies, many sub-national jurisdictions have their own climate policies. This section presents the NDCs and climate policies of the world's major GHG emitters and of the United Kingdom, which left the EU in February 2020.

Figure 9 – Greenhouse gas emissions, per country and region



Source: Trends in global CO2 and total greenhouse gas emissions, PBL Netherlands Environmental Assessment Agency, 2020, page 27.

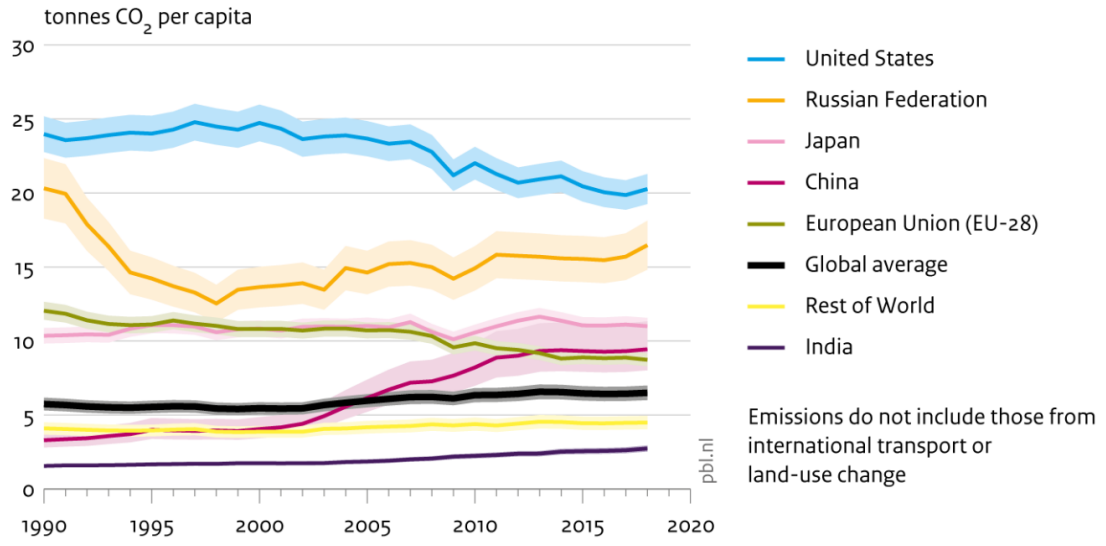
211 Communication on a united in delivering the Energy Union and Climate Action – Setting the foundations for a successful clean energy transition, COM(2019) 285 final, European Commission, June 2019.

212 Communication on EU-wide assessment of National Energy and Climate Plans driving forward the green transition and promoting economic recovery through integrated energy and climate planning, COM(2020) 564 final, European Commission, September 2020.

213 Emissions Gap Report 2020, UN Environment Programme, December 2020.

214 Many NDC updates were delayed amid the coronavirus crisis. As of 31 December 2020, only 75 of 198 Parties, including the EU and its Member States, had submitted an updated NDC. These Parties account for 30 % of total GHG emissions. According to a synthesis report prepared by the UNFCCC, implementation of these updated NDCs would lead to total emissions which are 2.8 % lower for 2030 than the levels according to the Parties' previous NDCs.

Figure 10 – Greenhouse gas emissions per capita, per country and region



Source: Trends in global CO_2 and total greenhouse gas emissions, PBL Netherlands Environmental Assessment Agency, 2020, page 28.

2.3.1. China

China's NDC[215] aims for GHG emissions to peak by 2030 at the latest, a higher share of renewable energy, lower carbon intensity in the economy and a larger forest stock. In June 2020, the Chinese environment ministry declared that China would not raise the ambition of its NDC,[216] but Chinese President Xi Jingping announced in September 2020 that China would achieve a peak in carbon dioxide emissions before 2030 and carbon neutrality before 2060.[217] China is the country with the highest total GHG emissions (27 % of worldwide emissions in 2018), while its per capita GHG emissions are above the global average. It is by far the largest coal producer and coal consumer in the world.[218] China continues to build new coal fired power plants, and is also financing coal projects in the rest of the world. However, the country is also a world leader on renewable energy, batteries and electric vehicles. China has established an emissions trading system that started to operate in 2020, and has plans for a mandatory renewable energy certificate scheme that sets renewable energy targets for each province.[219] A quota system requires car manufacturers to sell a growing number of electric vehicles.[220]

2.3.2. United States of America

The United States has the second-largest total GHG emissions (13 % of global emission in 2018), with per capita emissions at 20.5 tonnes CO_2e in 2018, more than twice the level of the EU or China. The

215 Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions, September 2016.

216 China says sticking to climate pledges despite coronavirus outbreak, Reuters, 2 June 2020.

217 China pledges to achieve CO_2 emissions peak before 2030, carbon neutrality before 2060, Reuters, 22 September 2020.

218 Statistical Review of World Energy: Coal, BP, 2020.

219 China country summary, Climate Action Tracker website.

220 China to increase NEV quota moderately from 2021, *Electrive*, 11 July 2019.

US is a party to the UNFCCC and the Paris Agreement.[221] The United States' NDC,[222] submitted by the Obama administration in 2015, states an intention to reduce GHG emissions by 26-28 %, compared to 2005 levels. Under the Trump administration, in June 2019, the US Environmental Protection Agency (EPA) repealed the Clean Power Plan,[223] a key regulation to implement the Paris Agreement. In March 2020, it weakened emission standards for new cars.[224]

President Biden's climate action plan[225] calls for an emission-neutral society by 2050, with considerable infrastructure investments and a comprehensive transition from fossil fuels. President Biden aims to quickly reverse many of Donald Trump's environmental policies.[226]

Moreover, the federal states play a large role in US climate action. The state of California, for example, is a pioneer on climate action, with a target to reduce 2030 GHG emissions by 40 % relative to 1990 levels, and policies in support of clean energy and low-carbon mobility.[227] California's emissions trading (cap and trade) system is linked with that of Québec. On the east coast, the Regional Greenhouse Gas Initiative (RGGI) is an emissions trading system for the power sector of ten federal states.[228]

2.3.3. India

India was responsible for 7.2 % of global GHG emissions in 2018. With 2.7 tonnes CO_2e, the country's per capita emissions are less than half the global average, which is related to the fact that a large proportion of the population lives in poverty and does not have adequate access to energy services. India's NDC[229] sets a target of reducing its GHG emissions relative to GDP[230] by 33 to 35 % by 2030, compared to 2005 levels and to achieve 40 % of its electricity generation capacity from clean (non-fossil-fuel based) energy sources by 2030. India's NDC is contingent upon financial support, technology transfer and capacity building. Mitigation activities are expected to cost US$834 billion, and adaptation actions US$206 billion.

India has an ambitious programme for developing renewable energy sources. By 2028, the country plans to have 500 gigawatt (GW) of renewable electricity capacity installed, of which 350 GW will be driven by solar power. At the same time, coal production and use in India are still increasing, driven by steel production and electricity generation.[231]

---

221 Under the Trump administration, the US quit the Paris Agreement. The instrument to re-join the Paris Agreement was signed by President Biden on his first day of office, and took effect on 19 February 2021. The US refused to ratify the Kyoto Protocol.

222 Intended nationally determined contribution, United States of America, 2015.

223 Affordable Clean Energy Rule, US Environmental Protection Agency website.

224 EPA and NHTSA Finalize Rollback of Vehicle Fuel Economy and GHG Standards, National Law Review, 13 April 2020.

225 Biden-Sanders unity task force recommendations: combating the climate crisis and pursuing environmental justice.

226 M. Gerrard and E. McTiernan, Biden Administration Will Reverse Many Trump Environmental Policies, *New York Law Journal*, November 2020.

227 California Climate Policy Dashboard, Berkeley Center for Law, Energy & the Environment website.

228 Program overview and design: Elements of RGGI, Regional Greenhouse Gas Initiative website.

229 India's intended nationally determined contribution: working towards climate justice, 2015.

230 Under the Paris Agreement, developed (Annex I) countries set economy-wide absolute emission targets, whereas developing countries may set targets relative to GDP or to projected future emissions.

231 E. D'Ambrogio, India: environmental issues, EPRS, European Parliament, April 2019.

2.3.4. Russian Federation

The Russian Federation was responsible for almost 5 % of global GHG emissions in 2018. The country's per capita emissions were 16.5 tonnes (t) CO_2e, 2.5 times the global average and far above those of the EU and China. Russia ratified the Paris Agreement only in October 2019, one of the latest countries to do so. The country's NDC[232] aims at reducing emissions by 25 to 30 % by 2030, compared to 1990 levels. This would represent an increase of emissions from the present level, which is far below 1990 levels (before the collapse of the Soviet Union and its heavy industry). Russia's NDC relies to a big part on CO_2 removals from the country's extensive forests. Analysts consider the NDC as very weak.[233] Russia's economy depends largely on fossil fuels, which also make up for the majority of its exports. The country has a low share of renewable energy sources and poor energy efficiency. Russia plans to adopt a law on greenhouse gas emissions by the end of 2020.[234]

2.3.5. United Kingdom

The United Kingdom (UK) reduced its GHG emissions by 45 % from 1990 to 2018, and is responsible for less than 1 % of global emissions in 2018.[235] Per capita emissions are below the EU average, but above the global average.

The 2008 UK Climate Change Act[236] originally set a long-term target of reducing the United Kingdom's GHG emissions by 80 % by 2050, but was amended in 2019 to raise that target to 100 %, thus requiring net-zero emissions.[237] The law establishes an independent advisory body, the Committee on Climate Change, to provide evidence-based advice on emissions targets and adaptation. The Climate Change Act requires the government to set legally-binding 'carbon budgets' that limit the amount of GHGs emitted in the United Kingdom over five-year periods. The carbon budgets are based on the advice of the Committee on Climate Change and must be set at least 12 years in advance to give policy-makers, businesses and individuals time to prepare.

On 4 December 2020, the UK – host of the COP26 climate change conference in Glasgow – announced its target to cut GHG emissions by at least 68 % by 2030, compared to 1990 levels, together with a plan for a green industrial revolution, aiming to create up to 250 000 jobs and deliver over GB£40 billion (around €44 billion) of private investment by 2030.[238]

The UK left the European Union on 1 February 2020, but applied EU climate legislation and took part in the EU ETS during a transition period that ended on 31 December 2020.

---

232 Intended Nationally Determined Contribution of the Russian Federation, April 2015.

233 Russian Federation, Climate Action Tracker, September 2020.

234 Russia to adopt law on greenhouse gas emissions by end of 2020 — presidential envoy, TASS, 24 September 2019.

235 2019 UK greenhouse gas emissions, provisional figures, UK Department for Business, Energy and Industrial Strategy, March 2020.

236 Climate Change Act 2008, UK Public General Acts.

237 The Climate Change Act 2008 (2050 Target Amendment) Order 2019, UK Statutory Instruments.

238 UK sets ambitious new climate target ahead of UN Summit, press release, Department for Business, Energy & Industrial Strategy, 3 December 2020.

3. Challenges and opportunities ahead

3.1. Coherence and coordination across the EU policies

The success of climate action does not depend solely on the full implementation of climate action policies. It is also crucial that climate concerns are sufficiently mainstreamed in policies primarily designed to serve the interests of GHG-emitting industrial sectors such as agriculture, transport and energy, rather than to address climate change.

The importance of policy integration, or **policy coherence**, to the success of climate (and also broadly environmental) policies is acknowledged by the Treaty (Article 11 TFEU) and by the consecutive environmental action programmes of the European Union (Article 192(3) TFEU). Policy coherence was addressed by the seventh environment action programme (7th EAP), which served as a long-term strategic framework for EU and national policy-making in the field of environment and climate for 2014-2020 and beyond (by 2050).[239] In the programme's architecture, policy coherence was considered – together with implementation, funding and knowledge – as a key enabler for the achievement of the programme's policy objectives, which among other things require the EU to become a low-carbon economy. In particular, the 7th EAP required that sectoral policies at Union and Member State level were developed and implemented in a way that would support relevant environment and climate-related targets and objectives.

Furthermore, policy coherence is a priority under the Interinstitutional Agreement on Better Law-Making signed by the European Parliament, European Commission and Council of the EU.

The European Parliament addresses policy coherence in its legislative and non-legislative work, and most pertinently in its various scrutiny activities towards the Commission and Member States.

The Commission is assessing policy coherence in the context of its Better Regulation agenda, and more specifically when making ex-ante impact assessments of new policy initiatives and ex-post evaluations of policies under implementation. As regards ex-ante impact assessment, the Commission assesses three major impacts: economic, social and environmental. EPRS analysis of the quality of the Commission's ex-ante impact assessments completed between 2015 and 2018 shows that the environmental impacts of the various policy options explored by the Commission are less frequently assessed than economic or social impacts. Furthermore, the analysis found that the Commission has declared environmental impacts to be irrelevant in several cases, when their assessment would have been necessary. The practice observed creates the risk of omitting the need to mainstream environmental (including climate) concerns where needed, which would weaken policy coherence.

[239] Decision No 1386/2013/EU of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well within the limits of our planet'.

On 14 October 2020, the European Commission submitted a proposal for a next (8th) environment action programme.[240] While the proposal translates the priorities of the European Green Deal into six thematic priority objectives on environment and climate action to be achieved by 2030, it reiterates the overall goal of its predecessor (the 7th EAP), which is: 'living well within the limits of our planet'. Following the example of the 7th EAP, the proposal for the 8th EAP also considers policy coherence to be a condition enabling the achievement of the thematic priority objectives. At the time of writing, parliamentary committees have started their legislative work on the proposal.

Several assessments recognize the role of the 7th EAP as a tool, which helped to increase policy coherence, while at the same time indicate that more needs to be done. In particular, according to the European Environment Agency (EEA), overall, environment and climate related concerns are not sufficiently integrated into sectoral policies.[241] Furthermore, in the second (2019) edition of the Environmental Implementation Review (EIR), which (in contrast to the first edition) also covers climate action, the Commission has acknowledged that 'insufficient policy and institutional coherence is one of the main causes of implementation gaps with regard to achieving the objectives of EU environmental policy and law'.[242]

Climate mitigation – Policy coherence

As regards climate change mitigation, aimed primarily at reducing GHG emissions, it appears that more focus is needed on the mainstreaming of environmental and climate objectives into policy areas such as agriculture, transport and energy, which contribute most to climate change (and, more broadly, to environmental degradation).[243] This assessment of the EEA is largely shared by stakeholder views on the implementation of the 7th EAP.[244]

In agriculture, climate (and more broadly environmental) concerns at EU level have been mainstreamed mainly through the common agricultural policy (CAP). More specifically, in 2014-2020, the CAP implemented measures such as cross-compliance, greening as well as various voluntary measures. Even though it is difficult to assess how successfully those mainstreaming measures have contributed to climate action, and the reduction of GHGs in particular, certain conclusions may be made. On a more positive note, the market reform of the CAP has been assessed as contributing to a reduction in GHG emission from methane (CH_4) and nitrous oxide (N_2O).[245] However, more negatively, it appears that overall the CAP mainstreaming measures, especially as regards 'greening', and their practical implementation did not fully live up to climate expectations given that in recent years the agricultural GHGs from both livestock and soils have increased.[246] This problem has been acknowledged by the Commission, which consequently included climate action as a separate objective in the set of nine policy objectives in the 2021-2027 CAP. Furthermore, the Commission has suggested specific contributions that agriculture could make to reduce its climate footprint. These contributions include the use of mitigation technologies, creating carbon sink

240 Proposal for a decision of the European Parliament and the Council on a General Environment Action Programme to 2030, COM(2020) 652 final, European Commission, October 2020.

241 EEA, SOER-2020. p. 290.

242 COM(2019)149 final

243 Environmental Indicator Report 2018 – in support of the monitoring of the Seventh Environment Action Programme – EEA Report No 19/2018, European Environment Agency, 2018 (EEA, 2018).

244 E. Karamfilova, Mid-term review of the Seventh Environment Action Program, European Implementation Assessment, EPRS, November 2017 (EPRS, 2017); Evaluation of the 7th Environment Action Programme to 2020 'Living well within the limits of our planet', (SWD2019) 181 final, Part 2/2, European Commission, May 2019.

245 EEA, SOER-2020.

246 Greening: a more complex income support scheme, not yet environmentally effective – Special Report No 21/2017, European Court of Auditors, 2017.

through better soil management, biomass production, reduction in fossil fuel intensity of farm production, and reduction in agricultural production losses and waste.[247] However, the individual positions of Council and Parliament on the future CAP are criticised by environmental organisations for compromising the Green Deal objectives.[248]

For many years, the EU had no dedicated transport strategy setting out specific transport policy measures to achieve the 40 % reduction in GHG emissions by 2030. Instead, several policy documents mainstreamed the GHG reduction objective in EU transport policy. For example, the 2011 White Paper on transport,[249] set out the ambition to reduce GHG emissions from transport by at least 60 % by 2050 compared with 1990 levels, and the 2016 EU strategy for low-emission mobility identified priority areas for action to achieve this target. In addition, the European Green Deal envisages a target of reducing GHG from transport by 90 % by 2050. However, the current trend shows that the share of transport in the EU's total GHG emissions, rather than decreasing as required, is increasing greatly – from 15 % to 24 % between 1990 and 2016.[250] In terms of renewable fuels used in transport, the Renewable Energy Directive[251] requires that, by 2020, at least 10 % of transport fuels come from renewable sources. However, with 7.6 % for 2017, the EU trend in the share of renewables in transport remains well below the target.[252]

As of December 2020, the EU has a dedicated strategy on sustainable and smart mobility.[253] Among other things, it aims at transforming the EU transport sector in line with the priorities of the European Green Deal. The successful completion of the strategy and of the initiatives included in the relevant action plan should be instrumental in achieving better coherence between the EU's climate and transport policies.

In contrast to fuels used for road transport, the fuels used in the aviation and maritime sectors have been exempt from taxation for years under the Energy Taxation Directive,[254] and thus the climate (and more broadly the environmental and health) impacts of these GHG-intensive and polluting sectors are still not sanctioned by excise duties. The Commission acknowledged the issue in its communication on the Green Deal of December 2019, and scheduled the directive for revision, with the aim of addressing, among other things, the 'non-taxing aviation and maritime fuels' loophole.

In the energy sector, which is one of the major contributors to human-induced GHGs, emissions seem to be decreasing.[255] In this context, a series of recent initiatives are noteworthy, such as the launch of the strategy on the energy union and the adoption of the related 2030 energy and climate framework and upward revision of targets[256] aimed at integrating climate concerns into EU energy policy. This integration process is ongoing. In particular, Member States developed[257] national

247 CAP specific objectives … explained. Agriculture and climate mitigation, Brief No 4, European Commission, 2018.

248 E. Sánchez-Nicolás, EU farming deal attacked by Green groups, EU Observer, 22 October 2020.

249 Roadmap to a single European transport area – towards a competitive and resource efficient transport system, European Commission, March 2011.

250 EEA, SOER-2020.

251 Directive 2009/28/EC of 23 April 2009 on the promotion of the use of energy from renewable sources.

252 EEA, SOER-2020.

253 COM(2020) 789

254 Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.

255 Trends and drivers of EU greenhouse gas emissions – Special Report 3/2020, European Environment Agency, 2020 (EEA, 2020).

256 See more details on these policy initiatives in Chapter 2 of this paper.

257 Under Regulation (EU) 2018/199 of the European Parliament and of the Council of 11 December 2018, on the Governance of the Energy Union and Climate Action.

energy and climate plans (NECPs) for 2030, with the aim of ensuring that implementation at national level is coherent with the EU targets on GHG reduction, increased energy efficiency and share of renewables in the energy mix. However, the Commission found[258] that the NECPs prepared by Member States would need to be strengthened to achieve a 55 % reduction in emissions by 2030 (as well as corresponding increases in energy efficiency and renewables).[259]

Industry is another major source of GHG emissions, although the tendency is to decrease.[260] The new industrial strategy for Europe aims specifically at aligning industrial production with climate and environmental objectives under the Commission's European Green Deal.[261] However, a key policy instrument aimed at reducing industrial pollution, the Industrial Emissions Directive (IED),[262] does not include GHGs from industry in its scope, and thus points to an incoherence between climate, environmental and industrial policies.[263] While industrial GHG emissions are mainly covered by the EU Emissions Trading System, permits issued under the IED could also support GHG cutting measures for large industrial installations, making the EU measures to address air, water and soil pollution from such installations, and the IED in particular, 'fully consistent with climate, energy and circular economy policies'.[264]

Climate change adaptation – Policy coherence

As regards **climate change adaptation**, the 2018 Commission evaluation of the EU 2013 climate adaptation strategy, found[265] that, broadly, there was coherence between EU adaptation objectives and actions and other EU and national policies. The CAP (2014-2020), however, is an exception. Even though the Commission concluded that without the strategy, an equivalent amount of progress would not have been made in climate-proofing key EU policies such as agriculture, an EEA topical report considers[266] that the CAP still contains provisions that are incoherent with adaptation efforts, especially as regards the national rural development programmes (RDPs). According to the EEA,

---

258 Communication on an EU-wide assessment of National Energy and Climate Plans – Driving forward the green transition and promoting economic recovery through integrated energy and climate planning, COM(2020) 564 final, European Commission, September 2020.

259 National Energy and Climate Plans: Member State contributions to the EU's 2030 climate ambition, European Commission, 2020.

260 EEA, 2020.

261 COM(2020)102 final

262 The Industrial Emissions Directive 2010/75/EU is the EU's main instrument aimed at controlling and mitigating the environmental and human health impacts from industrial emissions to air, water and soil. More specifically, the IED is there to prevent, reduce and eliminate, as far as possible, emissions into air, water. The IED regulates around 52 000 of the largest industrial installations in the EU in a number of agro-industrial sectors.

263 The assessment referred to above is that of the European Environment Agency, expressed in its SOER-2020 report. The Commission ex-post evaluation of the directive, published in September 2020, states that 'the IED has not contributed greatly to decarbonisation'. In particular, a number of agro-industrial installations falling within the scope of the IED release CO_2 emissions that are not regulated by the ETS, and there are emissions of GHGs other than CO_2 from IED installations, most of which are not regulated by the ETS. It is estimated therefore that around 10 % of GHG emissions of IED plants are not covered by the ETS, which accounts for around 4 % of total EU GHG emissions. The Commission evaluation adds that views diverge about whether the directive is indeed relevant to the process of decarbonisation (SWD(2020)182 final). Furthermore, following the Commission's view to date, there has been little investigation into the potential of the IED to support industry decarbonisation and this merits further reflection (SWD(2020)181 final).

264 Inception impact assessment – Roadmap for a revision of the Industrial Emissions Directive (2010/75/EU), Ares(2020)1738021, European Commission, March 2020, p. 1.

265 Report on the implementation of the EU strategy on climate change adaptation, COM(2018)738 final, European Commission, November 2018.

266 Climate change adaptation in the agriculture sector in Europe – Report No 4/2019, European Environment Agency, 2019.

several evaluations of the CAP have shown that Member States' efforts to include adaptation in their RDPs have been limited. Even though most of the national RDPs under the second CAP pillar include adaptation measures, they aim mainly at modernisation, rather than at wider environmental benefits. In the context of the European Green Deal, the Commission adopted a new EU climate adaptation strategy[267] in February 2021, building among other things, on the lessons learned from the implementation of the previous strategy.

Funding – Policy coherence

Coherence requires that climate concerns are also integrated into funding policies.

On the one hand, funding policies could enhance climate action by investing in climate mitigation and adaptation projects. In the previous funding period (2014-2020), the EU committed to spend at least 20 % of its funding resources under the Multiannual Financial Framework (MFF) on projects aimed at tackling climate change and its impacts. Programmes funding EU policies in agriculture, regional development, the Connecting Europe Facility, research and innovation account for more than 90 % of EU climate-related spending in 2014-2020.[268] Following Commission estimations, the EU was broadly on track to achieve the 20 % objective, although more efforts are needed.[269] According to the European Court of Auditors,[270] the approach of earmarking a certain percentage of the EU budget for spending related to climate action has triggered progress, although this is uneven across policy areas, but the tracking methodology has a number of weaknesses. In particular, the auditors recommend strengthening the performance framework, establishing climate-related results indicators and netting off the possible negative impact of other EU-funded measures on climate. This development would make it possible to assess the net effect of the EU budget on climate (e.g. in terms of GHG reductions). Likewise, the European Parliament, which fully supports the principle of climate mainstreaming in the EU budget, has repeatedly called for improvements to the tracking methodology. In particular, the share of EU budget to be spent on climate action projects was increased to at least 25 % in the Commission MFF proposal,[271] whereas the European Parliament advocated a more ambitious approach. The agreement between Parliament and Council on the 2021-2027 MFF includes an objective of devoting 30 % of the overall resources from the MFF and the Next Generation EU recovery instrument to measures contributing to the fight against climate change (see sections 2.2.5 and 3.8).

On the other hand, policy coherence would require that focused investment in climate mitigation and adaption projects be complemented by phasing out – at all levels of governance – subsidies for GHG-generating activities (such as burning fossil fuels). However, the EEA notes[272] that even though the EU has set up ambitious climate change and clean energy objectives, 'large subsidies for fossil fuel-based energy persist'. This assessment was shared by stakeholders responding to the EPRS survey carried out in 2017 in the context of the mid-term review of the implementation of the 7th EAP,[273] especially as regards funding from the regional development funds. Examples of funding

---

267 See section 2.2.4

268 Supporting climate action through the EU budget, European Commission webpage.

269 ibid.

270 Spending at least one euro in every five from the EU budget on climate action: ambitious work underway, but at serious risk of falling short – Special report No 31/2016, European Court of Auditors, 2016; and Tracking climate spending in the EU budget – Review No 1/2020, European Court of Auditors, 2020. The ECA findings were echoed in a 2020 study of the Institute for European Environmental Policy (IEEP) for the European Parliament's Committee on Budgets on documenting climate mainstreaming in the EU budget.

271 This target was retained in the revised MFF proposal submitted by the Commission on 27 May 2020.

272 EEA, SOER-2020.

273 EPRS, 2017.

such projects at EU level include the approval of the lists of 'projects of common interest' (PCI) under the Connecting Europe Facility. Endorsement of PCI projects investing in the gas sector has been particularly criticised.[274] The recently agreed EU sustainable finance methodology (taxonomy) should help authorities at both EU and national level in setting up their investment priorities in the context of sustainable development and climate action in particular.

Climate and environmental policies – Trade-offs

Another important aspect to consider is the coherence between EU climate and environmental policies. While, generally, these policy areas are mutually beneficial,[275] in certain cases climate action policies could offset the broader environmental objectives.[276] More specifically, while, the reduction of GHGs brings co-benefits for policies aimed at reducing air pollution, some climate action measures could increase certain air pollutants.[277] This is, for example, the case of promoting the uptake of diesel vehicles because of their lower CO_2 emissions, which, however, leads to higher real-world emissions of NO_2, thereby worsening the air quality situation, especially in cities, with negative impact on health and the environment.[278] Another example is the promotion of biomass as a carbon-neutral fuel for domestic heating, which, however, contributes to a local increase in the concentrations of air pollutants such as fine particulate matter ($PM_{2.5}$), benzo[a]pyrene and black carbon.[279] Furthermore, the EEA also reports that climate mitigation (biofuel production, hydropower) and adaptation efforts (land-use changes or coastal defences) could directly and negatively impact biodiversity.[280] Such policy trade-offs show that, even if climate action has been declared a top policy priority, the achievement of climate-related goals may come at the expense of broader environmental policy, of which climate is an indispensable part.

Finally, yet importantly, policy coherence is an explicit priority of the European Green Deal presented by the von der Leyen Commission at the end of 2019. In particular, the Commission has planned to align all its new initiatives (as from 2020 onwards) in all policy sectors with the objectives of the Green Deal, including on climate action. However, whether the EU would choose to speed up or slow down the European Green Deal in its efforts to recover the EU economy in the aftermath of the Covid-19 pandemic, would be a political choice. If there is to be a green recovery, as advocated by the European Parliament,[281] the European Council[282] and the Council of the EU,[283] climate (and more broadly environmental) concerns would need to be mainstreamed in the relevant recovery initiatives. The agreed MFF (2021-2027) and the recovery instrument show progress in this direction. Furthermore, the agreed EU sustainable finance methodology (taxonomy), the EU Green Bonds Standard, and the Paris-aligned and climate transition benchmarks – key policy instruments enabling coherence in the field of environment and climate – could serve as a basis for such an

274 D. Boffey, EU accused of climate crisis hypocrisy after backing 32 gas projects, *The Guardian*, 12 February 2020.

275 COM(2019)149 final

276 EEA, SOER-2020.

277 Air pollution – Our health still insufficiently protected – Special Report 23/2018, European Court of Auditors, 2018.

278 N. Hooftman, et al., A review of the European passenger car regulations – Real driving emissions vs local air quality, *Renewable and sustainable energy reviews*, volume 86, April 2018; EEA, SOER-2020.

279 EEA, SOER-2020.

280 Climate change, impacts and vulnerability in Europe 2016, Report No 1/2017, European Environment Agency, 2017.

281 Resolution of 15 May 2020 on the new multiannual financial framework, own resources and the recovery plan, European Parliament and Resolution of 23 July 2020 on the conclusions of the extraordinary European Council meeting of 17-21 July 2020, European Parliament.

282 Conclusions from the European Council special meeting held between 17 and 21 July 2020.

283 Joint Call for a green recovery by the EU Environment Ministers, Council of the EU, 14 July 2020.

assessment and guide public and private sector plans for recovery, as suggested by the Technical Expert Group on Sustainable Finance.[284]

3.2. Financing and supporting the transition towards climate neutrality

3.2.1. Financing, budget and taxation

Financing the fight against climate change is a crosscutting challenge, since the transition to a climate-friendly economy requires huge investments not only in energy production and use but also across a vast range of sectors, from heavy industry to real estate and agriculture. There is growing awareness that appropriate funding is crucial for decarbonisation strategies.

According to the European Commission, additional investment worth €260 billion will be needed each year[285] to meet the EU's current target of reducing GHG emissions by 40 % by 2030 (as compared to 1990 levels). Increased ambitions for 2030 and the objective of climate neutrality by 2050 imply the mobilisation of even larger financial resources with a view to ensuring a smooth and just transition.[286] At global level, the World Bank warns that necessary funding must be counted in the trillions, rather than billions.[287] According to the UNFCCC's 2018 Biennial Assessment of Climate Finance Flows, the level of climate finance is still significantly lower than the identified investment needs and opportunities.[288]

The magnitude of the needs makes it clear that both the public and private sectors have to contribute to financing the transition for it to be successful and timely. On the one hand, public finances alone may lack the sufficient firepower. On the other, the private sector is not yet investing at a sufficient pace to bridge the financing gap, due to a number of factors such as market failures, information gaps and undervaluation of natural capital. Complementary and joined efforts from the two sources are mutually beneficial to the achievement of climate and sustainable development objectives.[289]

In this domain, the role of public authorities is multifaceted. Public budgets such as those at EU, national and local levels can support climate-friendly projects, while promoting the inclusion of environmental considerations and objectives ('climate mainstreaming', see section 3.1) in all their spending areas and programmes that have an impact on climate. At the same time, these budgets can leverage funding from the private sector, for example by supporting financial instruments based on equity, debt or guarantees that seek to close market gaps and increase the attractiveness of climate-related projects. Multilateral financial institutions and national promotional banks usually manage such instruments.[290]

---

284 Statement 'Sustainable recovery from the Covid-19 pandemic requires the right tools', Technical Expert Group on Sustainable Finance, April 2020.

285 COM(2019)285 final

286 A. D'Alfonso, European Green Deal Investment Plan: Main elements and possible impact of the coronavirus pandemic, EPRS, European Parliament, April 2020.

287 Climate finance overview, World Bank Group website.

288 2018 Biennial Assessment and Overview of Climate Finance Flows, UNFCCC, 2018 (UNFCCC, 2018).

289 R. Clark, J. Reed and T. Sunderland, Bridging funding gaps for climate and sustainable development: Pitfalls, progress and potential of private finance, *Land Use Policy*, Volume 71, February 2018, pp.335-346.

290 A. D'Alfonso, Mainstreaming of climate action in the EU budget: Impact of a political objective, EPRS, European Parliament, October 2019.

In addition to expenditure, public finances can powerfully fight climate change through their revenue side, triggering behavioural change and generating resources to invest by means of energy and environmental taxation, such as carbon pricing. However, these tools can negatively affect economically vulnerable citizens, communities and sectors. For this reason, public authorities need to strike a delicate balance with the implementation of accompanying measures, for example through social policy and welfare systems. The use of relevant taxation revenues to facilitate the transition for those most exposed to its costs is a possible way of addressing this challenge.[291]

A similar balancing need can be observed at the broader level of international relations on climate-related issues. Carbon pricing on imported goods with a heavy carbon footprint is deemed a possible tool to avoid carbon leakage,[292] and could at the same time push major polluting countries to increase their efforts to address climate change. At the same time, the UNFCCC stressed in its 2018 assessment of climate finance that developing and vulnerable countries still suffer from limited access to climate finance, capacities and technologies. Against this background, international cooperation should increase support to address the specific needs of developing and vulnerable countries in these areas.[293]

As regards the private sector, the financial system does not yet sufficiently include the assessment and management of climate-related risks in its allocation of resources.[294] Initiatives from regulators, supervisors and the sector itself could improve the functioning of capital markets in this respect. For example, the further development of green finance could significantly increase the competitiveness of renewables and batteries, making polluting technologies altogether less attractive for investors, which could in turn ease difficult international negotiations on the commitments necessary for the transition.[295]

3.2.2. Investment instruments

The coronavirus pandemic has the potential to have an impact on the financing of decarbonisation efforts for many years to come. Its profound socioeconomic consequences across the world prompted policy-makers to announce stimulus packages worth €9 trillion by May 2020. Such a vast amount of financial resources represents both a challenge and an opportunity, depending on how much climate and environmental considerations are taken into account in their use.[296]

Possible tensions may arise between the objectives of kick-starting the economy swiftly and making it climate-friendly and future-proof. If the focus is only on the former, support to a rapid return to a business-as-usual situation could lock in harmful emissions for a longer timeframe. This was largely the case in the wake of the 2007-2008 financial crisis.[297]

However, numerous analysts, stakeholders and policy-makers have stressed that sustainability should be at the heart of stimulus packages and guide investment decisions. With infrastructure suffering from chronic underinvestment since before the financial crisis, for example, the Organisation for Economic Co-operation and Development (OECD) has repeatedly underlined the

---

291 Communication on a more efficient and democratic decision making in EU energy and climate policy, COM(2019)177, European Commission, April 2019.

292 COM(2019)640

293 UNFCCC, 2018.

294 T. Johnson, Treat climate change as a systemic risk to global finance, *Financial Times*, 9 March 2020.

295 A. Tooze, Davos prioritises environment as activists invest hope in greener finance, *Financial Times*, 22 January 2020.

296 How a post-pandemic stimulus can both create jobs and help the climate, McKinsey & Company, 27 May 2020.

297 A. Bailey et al., The world must seize this opportunity to meet the climate challenge, *The Guardian*, 5 June 2020.

key role of investment in modern, smart and clean infrastructure for sustainable and inclusive growth.[298]

A number of central bankers have recently noted the two-fold potential of investment in renewable energy infrastructure that can promote an orderly transition while creating much-needed jobs to support the recovery from the impact of the pandemic.[299] Given the high level of public investment that recovery plans can trigger, the development or reinforcement of frameworks for green public procurement can also help orient expenditure towards climate-friendly solutions.

The European Commission has stressed the focus on future-proof investment already in the name chosen for the European recovery instrument, Next Generation EU, which is linked and should contribute to the European Green Deal. Disbursements will be dependent on green conditions and channel resources for a vast array of measures, including retrofitting of buildings and infrastructure, renewable energy projects, clean transport, and just transition. In addition, with a view to financing the repayment of borrowed funds as of 2028, the Commission plans to propose new EU own resources that could include a carbon border adjustment mechanism and the proceeds stemming from a revision of the ETS, including its possible extension to other sectors such as maritime.[300]

With regard to the EU budget, the European Parliament,[301] the European Court of Auditors and various stakeholders such environmental NGOs have demanded the strengthening of the methodology to track climate-related expenditure and assess its impact, which could increase the overall effectiveness of climate mainstreaming.[302] In addition, the EU budget's contribution to the fight against climate change could increase if the 'do no harm' principle that prevents its programmes from supporting fossil fuels is extended and fully applied.[303] The agreement on the 2021-2027 MFF and the Next Generation EU recovery instrument includes a more ambitious climate mainstreaming objective (30 % of the total resources), as well as provisions to strengthen the tracking methodology and to introduce corrective measures in case of insufficient progress towards the objective.[304]

In the Commission's view, energy taxation should support the clean energy transition and contribute to sustainable and socially fair growth. However, its potential in this respect is weakened by Treaty provisions that require unanimity in the Council, leading to deadlocks in decision-making and an outdated EU framework. The possible move to qualified majority voting through a *passerelle* clause in the Treaty could improve the contribution of the EU framework for energy taxation to climate-related objectives.[305]

The overall financial system is another area that could increase its contribution to the green transition. The Network for Greening the Financial System (NGFS) – a coalition of 66 central banks and supervisors – has been working to ensure that the financial system takes account of the financial

---

298 Investing in Climate, Investing in Growth, OECD, 2017.

299 Bailey et al., 2020

300 Communication on the EU budget powering the recovery plan for Europe, COM(2020) 442, European Commission 27 May 2020.

301 Resolution of10 October 2019 on the 2021-2027 multiannual financial framework and own resources: time to meet citizens' expectations, P9_TA(2019)0032, European Parliament.

302 A. D'Alfonso, Mainstreaming of climate action in the EU budget: Impact of a political objective, EPRS, European Parliament, October 2019.

303 The EU's Recovery Plan: next steps to deliver on the European Green Deal, Climate Action Network (CAN) Europe, 19 June 2020.

304 A. D'Alfonso, Parliament's consent to the 2021-2027 MFF, EPRS, European Parliament, December 2020.

305 COM(2019)177

risks that climate change triggers.[306] At EU level, initiatives to promote the uptake of the EU taxonomy, a unified classification system that helps determine which activities can be considered sustainable, will play a major role in the measures designed to put sustainable finance at the heart of the financial system. The idea of creating an EU Green Bond Standard also goes in this direction.

3.2.3. Just transition

On 12 December 2019, the Commission adopted the communication on the European Green Deal based on ambitious climate and environmental objectives 'bringing citizens, cities, and regions together' in a participatory process. The European Green Deal includes a Just Transition Mechanism (JTM), supported by the Just Transition Fund (JTF).[307] The related legislative proposal was published on 14 January 2020.

Regions and citizens will be affected from the transition in different ways and not all regions and sectors start from the same point and have the same capacity to act. The Commission points out that 'the most vulnerable are the most exposed to the harmful effects of climate change and environmental degradation'. There is a high risk and understandable concern that EU-citizens in these regions are left behind.

In light of the coronavirus crisis, the need to provide support to the most vulnerable regions has become more pressing. The European Commission proposed to reinforce the JTM as part of its crisis response mechanism and in its new proposal for the next long-term EU budget on 28 May 2020.[308] The overall budget of the Just Transition Fund should be increased to €40 billion and the just transition scheme under InvestEU reinforced. In total, the Just Transition Mechanism is expected to mobilise at least €150 billion of public and private investment.

All Member States will be eligible for support under the JTF, following Commission approval of their territorial just transition plans. Funds are pre-allocated on a national level. The eligible regions (NUTS3 level) facing serious transition challenges resulting from high employment in the fossil fuels sector and high industrial emissions have to be identified by Member States in dialogue with the Commission.

The focus of the JTF will be on the economic diversification of the regions most affected to avoid regional divergence growing. It can be seen as a form of solidarity with these regions and will be established within the framework of cohesion policy under shared management.

Member States have to take account of the 2020 European Semester recommendations and provide an outline of the transition process to 2030.[309] The plans need to be consistent with the NECPs and the transition to a climate-neutral economy. The territorial just transition plans will identify the most affected territories that should be supported in each Member State and the priority policy areas for each region. The investments, including the public sector loan facility, have to be based on these transition plans.

The Commission has proposed that affected communities, local authorities, social partners and non-governmental organisations are also involved, supported by a governance framework and with technical support.

---

306 Bailey et al., 2020

307 A. Widuto and P. Jourde, Just Transition Fund, EU Legislation in progress, EPRS, European Parliament, July 2020.

308 EU budget for recovery: Questions and answers on the Just Transition Mechanism, European Commission website.

309 ibid.

European Parliament

The Commission proposal for a regulation establishing the Just Transition Fund (COM(2020) 0022) was announced in plenary on 29 January 2020 and referred to the Committee on Regional Development (REGI). The Committees on Budgets (BUDG), Economic and Monetary Affairs (ECON), Environment, Public Health & Food Safety (ENVI), Industry, Research and Energy (ITRE) and Employment and Social Affairs (EMPL) is associated under Rule 57, with shared competence over the entire proposal. The European Parliament adopted its position on the Commission proposal on 16 September 2020, and insisted on a substantial increase in JTF resources from the EU budget for 2021-2027 (€25 billion in 2018 prices compared to the €11 billion proposed by the Commission and the decrease to €7.5 billion agreed by the European Council). This amount should be supplemented by €32 billion, as proposed under the EU Recovery Instrument.

The European Parliament confirmed key provisions outlined in the draft recommendations[310] by the Regional Development Committee:

- Possibility to transfer resources from other cohesion funds on a voluntary basis.
- Creation of a 'green rewarding mechanism', allowing 18 % of the total JTF resources to be allocated to Member States that reduce their GHG emissions more quickly than others.
- Broadening the scope to include micro-enterprises, including sustainable tourism, social infrastructure, universities low-emission district heating, smart and sustainable, projects fighting energy poverty, as well as culture, education and community building.
- A derogation for investments in activities related to natural gas, for regions heavily reliant on the extraction and combustion of coal, lignite, oil shale or peat, In addition, only 50 % of the national allocation will be available for countries which have not yet committed to a 2050 national target for climate neutrality, until such a target is adopted.

Political agreement between the European Parliament and the Council

The main points of the December 2020 final compromise between the European Parliament and the Council included:

- An overall budget of €17.5 billion for the Just Transition Fund, of which €7.5 billion from the MFF and €10 billion from Next Generation EU, starting with a budgetary commitment in 2021.
- Positioning of the JTF as a building block of the European Green Deal and the first pillar of the JTM. It aims to alleviate the social and economic costs resulting from the transition, through a wide range of activities directed mainly at diversifying economic activity and helping people adapt to a changing labour market.
- Voluntary transfers from the European Regional Development Fund (ERDF) and the European Social Fund+ (ESF+) to complement the JTF allocation.
- A 'green rewarding mechanism' linked to the reduction of GHG emissions achieved in regions benefiting from JTF support. Additional resources will be distributed among Member States that succeed in reducing GHG emissions from their industrial facilities.
- A wider scope to better address the social aspects of the transition, in particular the creation and safeguarding of jobs, plus investments in smart and sustainable mobility and district heating networks, whenever necessary to support the transformation of local economies.
- Fossil fuel financing is excluded.

[310] Report on the proposal for a regulation of the European Parliament and of the Council establishing the Just Transition Fund, Committee on Regional Development, European Parliament, 15 July 2020.

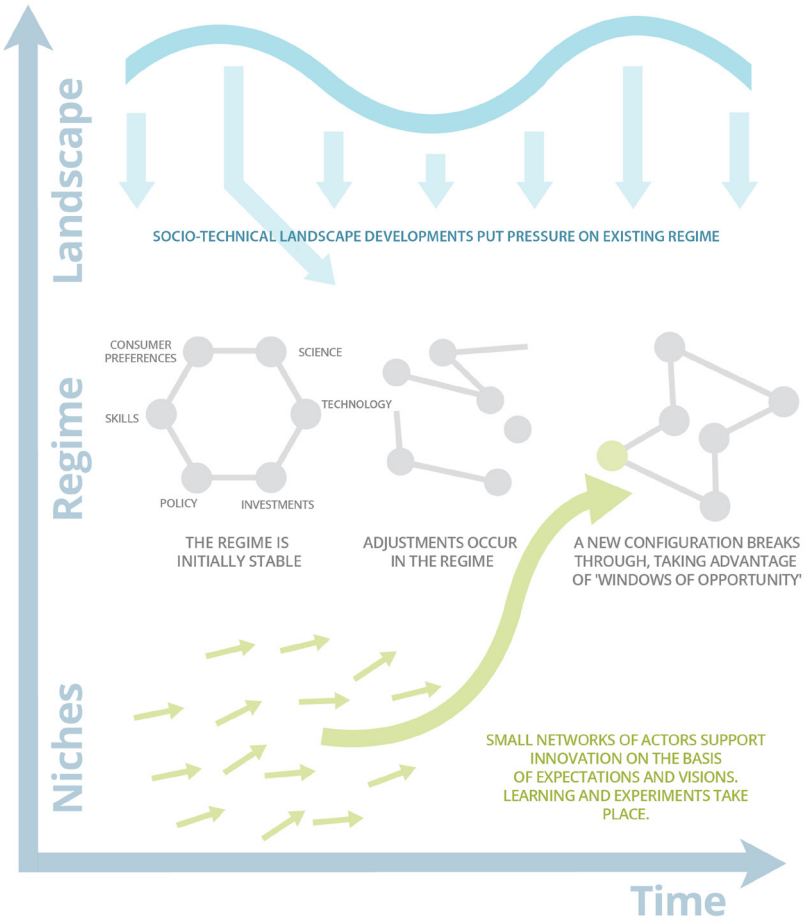
- Support of investments in large enterprises whenever needed to bridge job losses.

3.2.4. Technology, innovation and research

Impacts of climate change on technology and innovation

The EU commitment to the Paris Agreement means pursuing efforts to limit global warming to 1.5°C. The IPCC 2018 special report states that 'Realizing 1.5°C-consistent pathways would require rapid and systemic changes on unprecedented scales'.[311] Although technology will play the main role for energy systems, adaptation to a changing climate will affect urban planning, food production systems will be increasingly dictated by the changing climatic conditions and ultimately mitigation and adaptation efforts will affect individual lifestyle. The systemic change required makes it difficult to predict the pace and end results.

Figure 11 – Fostering innovations in sociotechnical systems – a systems perspective



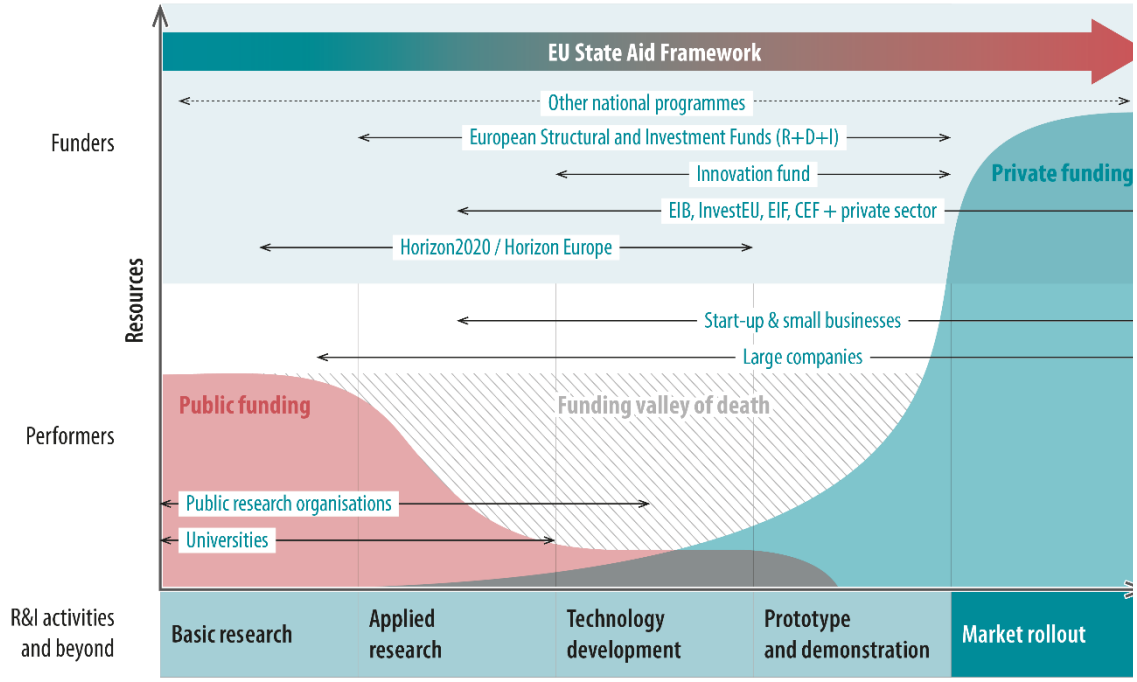
Source: adapted from Sustainability transitions: Now for the long term, EEA, December 2016.

311 H. de Coninck et al., Strengthening and Implementing the Global Response, In: Special report on global warming of 1.5 °C, IPCC, 2018 p. 322.

Potential for reducing emissions and mitigating effects

Significant reductions in emissions are possible with existing technologies, especially through efficiency gains. This is the case for buildings especially (see chapter 3.6), as well as through optimisation via digitalisation across sectors, where climate modelling suggest an abatement of 668 megatonnes (Mt) CO_2e, equivalent to 1.3 % of global emissions in 2030.[312] Digital technology enabling teleworking also has a potential to reduce emissions related to mobility.[313]

Figure 12 – General overview of funding (2014-2020) according to R&I activities



Source: EPRS, graphic based on JRC Technical Report Drawing funding and financing scenarios for effective implementation of Smart specialisation strategies.

For energy systems, the International Energy Agency (IEA) evaluated close to 400 mitigation related technologies. More than half are not commercially available today and 35 % are in early adoption phases needing further innovation. The more mature technologies are generally linked to buildings and power generation, while industry, transport and fuel transformation technologies lag behind. In IEA projections, significant leaps are required to bring forward net-zero emissions in the energy systems from 2070[314] to 2050. For the 2050 case, technologies at laboratory or small prototype stage are expected to be commercialised in 10 years, a pace only achieved once before, in the case of light-emitting diode (LED) technology.[315] For the efforts to reach 1.5°C, the IPCC notes the importance of

312 Digital with Purpose: Delivering a SMARTer2030, Global e-Sustainability Initiative (GeSI), 2019.

313 A. Hook et al., A systematic review of the energy and climate impacts of teleworking, *Environmental Research Letters*, Volume 15, Number 9, August 2020.

314 IEA Sustainable Development Scenario has established 2070 as possible net-zero emissions year for energy systems with existing technologies, including technologies not commercially available today but in final stages of research, while excluding early research and prototype stage technologies.

315 Energy Technology Perspectives, International Energy Agency, 2020.

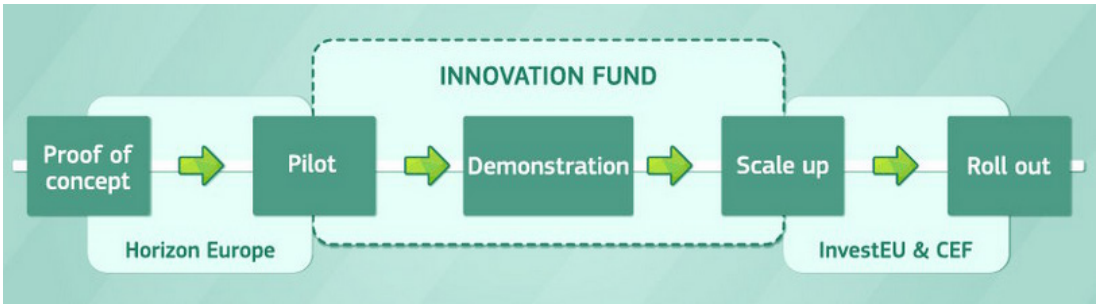
reaching environmental and social acceptance, including the affordability of carbon dioxide removal (CDR) technology, without which it states the 1.5°C pathway will be 'difficult to realise'.[316]

Impact of EU policies on research and innovation

The European research and innovation agenda outlined the need for an increased EU level focus on supporting innovation by attracting venture capital and aligning regulation. It further outlined arguments for key innovation concepts and focus areas in the Commission proposals for Horizon Europe and the MFF.[317] Further to this, the Green Deal Investment Plan outlined how key funds would support specifically the Green Deal[318] initiatives. The EU programmes support implementation and ensure progress in strategic agendas bridging the 'valley of death' between research and market uptake.

Through various industry and research partnerships, the EU seek to execute strategic innovation agendas and ensure additional co-funding. This was the case for Horizon 2020, with industry in ten contractual partnerships (cPPP) and further seven joint undertakings (JU).[319] EU emissions trading policy further supports innovation as revenue resulting from auctions in the Emissions Trading System (ETS) is also transferred back into support for low-carbon technologies through the Innovation Fund, providing an estimated €10 billion (depending on the price of EU allowances) from 2020-2030.

Figure 13 – Innovation Fund and its relation to other EU programmes supporting climate action



Source: Innovation Fund, European Commission website.

316 H. de Coninck et al., 2018, p. 319.

317 Communication on a renewed European Agenda for Research and Innovation, COM(2018) 306, European Commission, May 2018.

318 COM(2020) 21

319 Industry partnerships develop strategic research and innovation agendas, to inform funding priorities. Possible partnerships in Horizon Europe. Partnerships relate to Article 187 TFEU.

3.3. Citizen involvement and local action

3.3.1. Citizen engagement and consumer behaviour

Impacts of climate change on citizens and consumer wellbeing

According to a recent Eurobarometer,[320] 94 % of EU citizens EU strongly believe in the importance of protecting the environment, and 91 % say climate change is a serious problem; 78 % see environmental issues as having a direct effect on them; 65 % say they are worried, but only some say they know how to act. A stark majority of citizens are willing to change, but often do not actually do so, or only to a minor extent. A report[321] shows that consumption patterns are most problematic in three sectors, tourism, buildings (without construction)[322] and food, causing about 53 % of energy related CO_2 emissions worldwide.

Tourism and behaviour change in aviation

According to 2018 World Bank statistics, tourism is one of the fastest growing economic sectors. International tourist arrivals have grown from 25 million in 1950 to 1.451 billion in 2018, representing a 5 % growth in 2018 alone.[323] Transport-related CO_2 emissions from tourism accounted for 5 % of global CO_2 emissions in 2016. Aviation is a central part of tourism. In early 2019, a public debate emerged in Europe and beyond regarding the environmental implication of flying. Known as 'flight shame', discussed in Sweden for a decade, the debate has led to behaviour change. According to WWF Sweden (2019),[324] to reduce their carbon footprint, 23 % of Swedes opted not to fly over the past year, with 18 % of respondents choosing to travel by train instead. In the same year, domestic travel decreased by 3 %. Individual responsibility is now being debated in numerous EU Member States. According to UNEP, public perception is changing towards frequent flying as a personal benefit which infringes wider societal goals.[325]

Potential for citizen wellbeing and change of consumer behaviour

The EU has already introduced a range of mechanisms and policies to tackle climate change and the lack of resources, such as sustainable consumption and production (SCP) action plan, the roadmap to a resource-efficient Europe, eco-labelling and energy labelling, eco-design, eco-management and audit (EMAS), green public procurement (GPP), and the eco-innovation action plan (EcoAP).[326]

The EU is using its powers to support the protection of consumers by banning products that are damaging or dangerous for the environment; informing consumers about the characteristics and performance of other products; and banning companies from misleading consumers by using unfair commercial practices. Climate change litigation[327] and collective redress respectively have gained

---

320 Attitudes of European citizens towards the Environment. Special Eurobarometer 501, European Commission, March 2020.

321 Consumer Information Tools and Climate Change, Facilitating low-carbon choices in Tourism, Buildings and Food Systems, United Nations Environment Programme (UNEP), 2019.

322 Buildings excluding emissions related to the construction refers to everything concerning the use of buildings and maintenance such as heating, hot water, cooling, cooking, lighting, refrigerators, clothes and dishwashers, computers, air conditioning and so forth.

323 2017 International Tourism Results: the highest in seven years, Press release, World Tourism Organization (UNWTO), 15 January 2018; and International tourism highlights – 2019 Edition, World Tourism Organization (UNWTO), 2019.

324 WWFs Klimatbarometer: Allt fler väljer bort flyg och kött – och kvinnorna går före, Press release, WWF Sweden, 21 March 2019.

325 UNEP, 2019

326 The legal base for EU policies for consumer protection and environment are article 114 (internal market), 169 (health and safety) and Articles 191 to 193 (environment) TFEU.

327 For more on climate change legislation see UNEP, The status of climate change: a global review, 2017.

much more publicity due to lawsuits, such as that against the Netherlands[328] (*Urgenda Foundation*) and discussions on Volkswagen's business practices ('Dieselgate').[329] The New Deal for Consumers[330] seeks to strengthen consumer power. On collective redress, the European Parliament and Council reached agreement in June 2020 and approved the Representative Action Directive in November 2020. Furthermore, the European Commission included in the European Green Deal the idea of empowering consumers to contribute towards greater sustainability, and published the new circular economy action plan in March 2020. In November 2020, the European Parliament adopted a report on a sustainable single market for business and consumers.[331]

According to 69 % of Europeans, governments should focus on subsidising renewable energy, followed by re-training programmes for employees of fossil-fuel industries (40 %), as well as a carbon tax.[332] Technological changes are needed but will not be sufficient to achieve the EU carbon emissions reduction goals. New products need to be fabricated and new consumption patterns need to be learned and adopted. Credible labels for socially and environmentally sustainable products, competences to understand and interpret product labels and information on trustworthiness of labels are also needed.

Consumer behaviour and repair of products

Repairing products can contribute significantly to climate change mitigation, e.g. in many cases, new products emit more over their whole lifetime, than when products are repaired and in use for longer. The idea of a life cycle approach and of repairing products, are part of circular economy approaches.[333] A 2018 European Commission study on consumer engagement in the circular economy[334] indicated that 64 % of consumers always repaired broken products. About 36 % claimed not to repair products (from 25 % in Romania to 56 % in the Netherlands). Consumers' most relevant reasoning for deciding to repair was first the price and then convenience. Obstacles to repairing are the need for additional effort, favouring new trends and technology, and lacking trust in repair services. According to the study, consumers would be willing to pay more for better reparability and value durability. In the behavioural experiment conducted within the scope of the study, consumers were willing to pay around €29-54 more for vacuum cleaners, €83-105 for dishwashers, €77-171 for TVs, €48-98 for smartphones and €10-30 for coats.

Improving the information on and awareness of consumer rights will be of key importance.[335]

---

328 J. Setzer and R. Byrnes, Global trends in climate change litigation: 2020 snapshot, Policy report, Grantham Research Institute on Climate Change and the Environment and Centre for Climate Change Economics and Policy, London School of Economics and Political Science, 2020.

329 Five years Dieselgate: A bitter anniversary – 2015-2020: A long and bumpy road towards compensation for European consumers, Bureau Européen des Unions de Consommateurs, 2020.

330 N. Šajn, Modernisation of EU consumer protection rules. A new deal for consumers, EU Legislation in progress, EPRS, European Parliament, January 2020; and Šajn N., Representative actions to protect the collective interests of consumers – A new deal for consumers, EPRS, European Parliament, January 2021.

331 N. Šajn, Empowering the consumers for the green transition, ((2020/2021(INI)), Legislative train schedule, European Parliament.

332 T. Garton Ash and A. Zimmermann, In Crisis, Europeans Support Radical Positions. Climate Change and Social Welfare issues most salient, eupinions brief, 6 May 2020.

333 For more on the topics see: Life cycle approaches, Life cycle initiative and Completing the Picture: How the Circular Economy Tackles Climate Change, Ellen MacArthur Foundation, 2019.

334 A. Cerulli-Harms et al., Behavioural study on consumers' engagement in the circular economy, European Commission, October 2018.

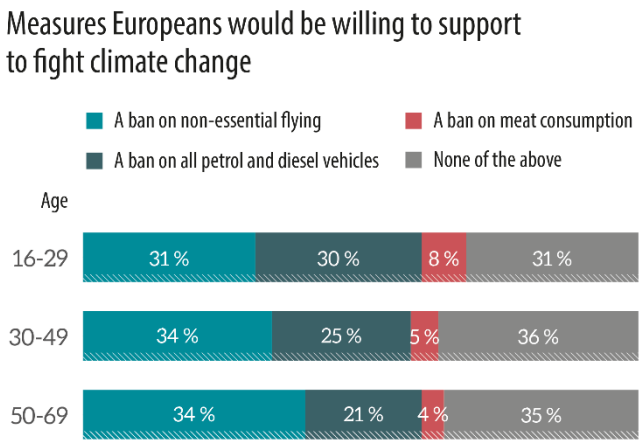
335 UNEP, 2019.

336 Cerulli-Harmset.

Impact of EU policies in favour of sustainable behaviour and consumer wellbeing

A recent Eurobarometer[337] shows that 83 % of EU citizens support more EU legislation. They also support policy measures that reduce plastic waste and littering, want longer lasting clothing and the introduction of recycled materials in the design of products and goods. EU citizens are in favour of greater industry and retailer responsibility for environmental and working conditions, as well as more engagement in sustainable activities, more information and education, more and better collection facilities, investment in research and development, and finally tighter legislative controls. A study[338] backs these results, showing that about 58 % of EU citizens want the EU countries to reduce GHG emissions to achieve carbon neutrality by 2030.

Figure 14 – Europeans' attitudes to measures to tackle climate change



Source: Garton Ash, T., Zimmermann, A., In Crisis, Europeans Support Radical Positions. Climate Change and Social Welfare issues most salient, eupinions brief, 6 May 2020.

In general, measures could concentrate on soft policy instruments as well as follow classical EU consumer law logic, focusing on safety, contract law, commercial practices and access to justice. Soft policies could help to understand the impact and costs of climate change and inform about the implications. Studies[339] show that such tools have an impact and that carbon literacy is as important as consumer information. However, to meet the required reductions in emissions, production methods would also need to change, as well as sales and marketing, e.g. obsolescence and inefficiency of products and goods.

A study[340] analysed the potential of consumer-oriented policies and their effect on the reduction of European and foreign carbon emissions. They indicated that consumer options to reduce carbon footprints could achieve about 30 % reduction in territorial emissions[341] in the EU and 25 % of CO_2 footprint reduction (75 % within Europe and 25 % by reduced imported carbon footprint).[342] Another study[343] looked into possible recommendations and identified five areas for action at EU

337 European Commission, Attitudes of European citizens towards the Environment, Special Barometer 501, 2020.

338 Garton Ash and Zimmermann

339 D. Moran et al., Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions, *Climate Policy*, Volume 20, 2018; and M. Pantzar et al., Sustainable consumption – policy approaches for systems change, Institute for European Environmental Policy, 2018.

340 Moran et al.

341 UNFCCC and the Kyoto Protocol accounting follows a territorial concept – 'territorial-based emission inventories'. This includes emissions within one territory. Not attributed to a territory, but counted as a memo, are emissions stemming from international territory, international aviation and shipping.

342 Imported carbon footprint stems from goods and services produced outside the EU but consumed within. This footprint could be reduced through a shift in the setup of imports within the EU (Moran et al).

343 Pantzar et al.

level: a green fiscal reform, a centralised system for environmental product information, funding to advance a sustainable consumption agenda, best practice and scalability of integrating behavioural insight and circular and green procurement guidelines (including mandatory requirements).

Another approach, based on the quantification of emission impacts,[344] is looking at behavioural solutions. The study[345] identified 30 behavioural solutions that could mitigate 20-37 % of global emissions from 2020 to 2050 worldwide. This could lead to a global reduction potential of 393 to 729 Gt CO_2e. The suggestions cover four areas: food, agriculture and land management, transportation, and energy and materials.

3.3.2. Health

Impacts of climate change on human health

As outlined in Chapter 1, climatic changes pose risks to human health in a multitude of ways. Extreme weather events such as floods, drought, storms and heatwaves are closely linked to potential health impacts. As well as changing the spread of disease vectors, climatic conditions can cause significant changes to global food production and increase migration flows. A 2021 joint EEA and Lancet Countdown publication states that 'climate change threatens to undermine the past 50 years of gains in global public health'.[346]

Challenges and opportunities of climate change on health

Health risks related to climate change are exacerbated with socio-economic trends such as urbanisation and globalisation. By 2050, it is estimated that almost 85 % of European citizens will reside in urban areas.[347] The urban heat island effect increases daytime temperature and air pollution, while night-time temperatures will decrease less within cities than outside. This is a particularly serious health threat for vulnerable groups such as the elderly, people suffering from cardiovascular and respiratory diseases and those with lower socioeconomic status. Premature mortality rates are expected to increase significantly with the projected increase in frequency and intensity of heatwaves.[348]

Particulate air pollution[349] is one of the primary negative health factors in urban areas due to transport and heating. Heatwaves further increase air pollution levels, while wildfires during extreme drought can lead to pollution increases in both urban and rural areas.

Urban flooding events can disrupt sanitation services, limiting access to safe water and increase the risk of infections. Furthermore, they can affect provision services and transportation.[350]

Ecological changes driven by climate change are changing the spread of known disease vectors as well as new pathogens from animals. Urbanisation, globalisation and dietary habits further increase the risk of pathogen spread, which can lead to infectious diseases in humans, with outbreaks and

---

344 P. Hawken (ed)., Drawdown: the most comprehensive plan ever proposed to reverse global warming, Penguin, 2017.

345 K. Williamson et al., Climate Change Needs Behavior Change: Making the Case For Behavioral Solutions to Reduce Global Warming, Rare, 2018.

346 Responding to the health risks of climate change in Europe, Lancet Countdown and EEA, March 2021

347 Urbanisation in Europe, European Commission website.

348 EASAC, 2019

349 The presence of particulate matter (PM) in cities comes mainly from e.g. smoke, fumes, and exhaust from combustion.

350 Protecting health in Europe from climate change: 2017 update, World Health Organization Regional office for Europe, 2017.

epidemics at risk of becoming more frequent with increases in climate change.[351] As recently indicated, the 'globalised transport links – in the absence of an adequate global disaster response – are among the factors contributing to the rapid spread of infectious diseases, as seen in the case of the Covid-19 pandemic.'[352]

However, a number of opportunities for positive health co-benefits exist – tied to climate action. This includes the potential for healthier lifestyles with increased physical activity in e.g. car-free zones and nudged future decreases in red meat consumption.[353] With better air quality through renewable and clean fuels and increased green spaces in urban areas, improvements in respiratory and cardiovascular conditions can be expected.[354] An increase in green public spaces in cities is also linked to mental health benefits.[355]

EU policies in the framework of climate change and health

The EU and its Member States are signatories to the 2017 Ostrava Declaration.[356] Developed in the framework of the WHO European Environment and Health process, it calls for action on adaptive capacity and resilience to health risks related to climate change in national plans, while driving mitigation efforts and harvesting health synergies with the Paris Agreement. The Paris Agreement calls directly for an increased adaptive capacity and resilience to safeguard communities from the adverse effects of climate change, and among the 17 Sustainable Development Goals (SDGs), adopted in 2015, climate action, health, sanitation and cities have direct goals.[357]

While the EU shares competence with Member States in relation to climate action, public health systems primarily remain a national competence, whereby the EU mainly complements national policy and has a coordinating and supporting role, although with a designated competence in, among other things, serious cross-border health threats.[358]

In the 2013 climate adaptation strategy, the European Commission addressed the climate-health interlinkages arguing the need for the EU to take on the coordinating role to enhance cooperation and knowledge sharing between Member States when it comes to adaptation measures for resilient health systems. The new EU strategy for adaptation to climate change,[359] adopted in February 2021, stresses the need to better understand the relation of climate change risks and their impacts on health. Therefore, based on a 'One Health' approach,[360] the Commission aims to gather data, make use of tools and expertise to better communicate, monitor and prevent the effects of climate change on human health. The strategy mentions the strengthening of the Climate-ADAPT platform as an information hub on climate impacts and adaptation, including the creation of the 'European climate and health observatory', recently launched in pilot version.[361] Furthermore, based on a planned EU-

---

351 Frontiers 2016 Report: Emerging Issues of Environmental Concern, United Nations Environment Programme, Nairobi, 2016.

352 Independent Expert Report, Adaptation to health effects of climate change in Europe, Scientific Opinion No 9, European Commission, June 2020.

353 EASAC, 2019; WHO, 2017.

354 Watts et al., 2015.

355 EASAC, 2019.

356 Ostrava Declaration, European Environment and Health Process, World Health Organization Regional office for Europe, 2017.

357 Specifically Sustainable Development Goals 13, 3, 6 and 11 respectively.

358 Decision No 1082/2013/EU of 22 October 2013 on serious cross-border threats to health.

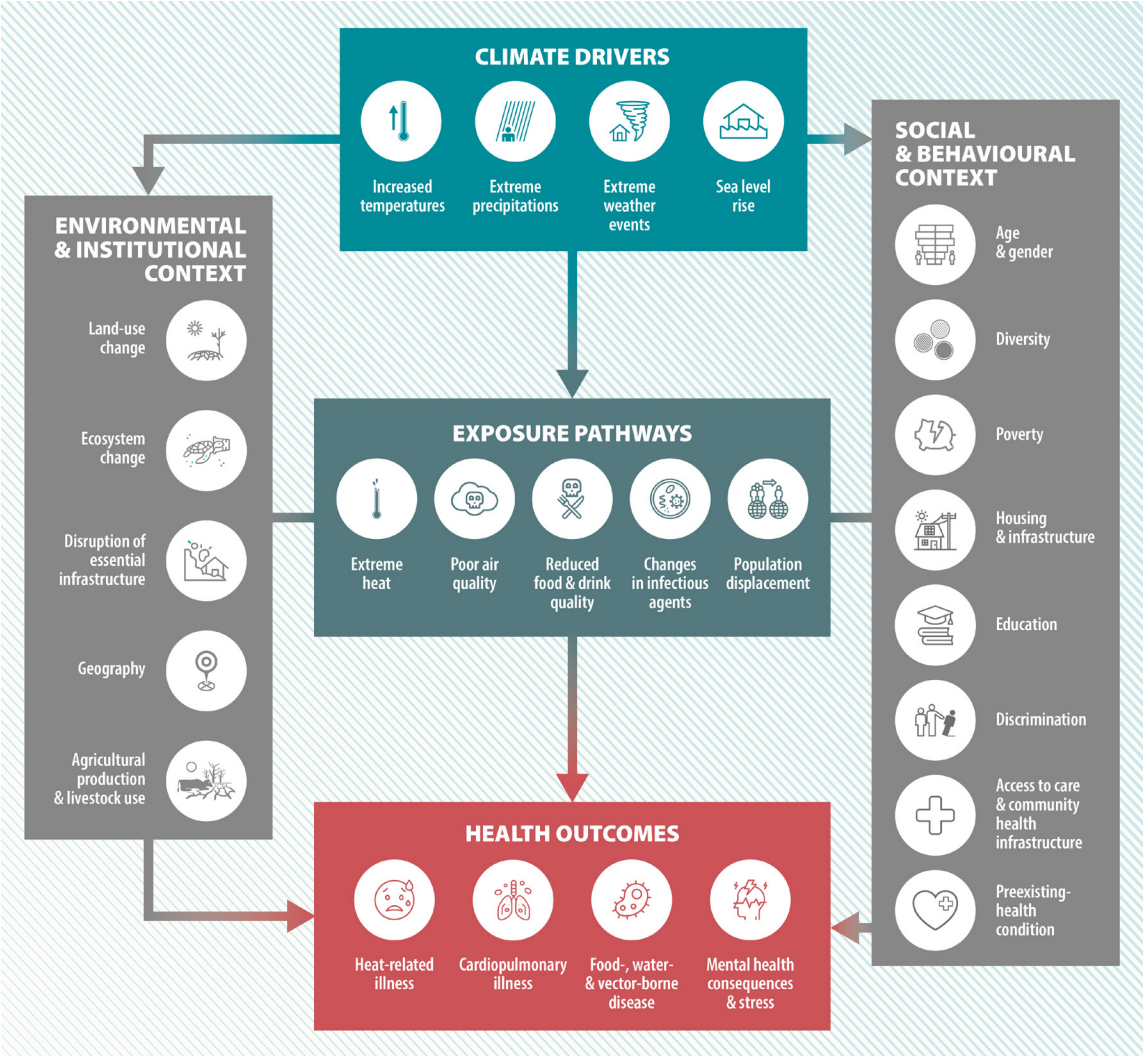
359 COM(2021) 82 final.

360 One Health, World Health Organization website.

361 European climate and health observatory, Climate-ADAPT website.

wide climate risk assessment, the Commission will strengthen attention to climate considerations, leveraging synergies and ensuring preparedness in EU disaster risk prevention and management initiatives including the EU framework on health threats and the proposed Health Emergency Preparedness and Response Authority.[362]

Figure 15 – Climate drivers, exposure pathways and health outcomes



Source: EPRS, graphic based on The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment, U.S. Global Change Research Program, 2016.

When analysing the primary policy framework for EU Member States' efforts on integrating climate action in health policy, a recent survey suggests that most relate to the UNFCCC's required process of reporting through national communications (NC), although awareness exists on the inclusion of health in the EU climate adaptation strategy.[363] The survey report further states that in the seventh NC updates, several EU Member States stated direct effects and concern regarding climate change

362 Communication on Building a European Health Union: Reinforcing the EU's resilience for cross-border health threats, COM(2020)724 final, European Commission, November 2020.

363 Public health and climate change adaptation policies in the European Union, World Health Organization Regional Office for Europe, 2018.

impacts on health, although only 13 Member States had chosen to dedicate a chapter to the topic. In a June 2019 report, the European Academies Science Advisory Council (EASAC) pointed to the 'policy disconnect', whereby health policy remains national while significant collaboration exists at EU level on climate change policy.[364] The report called for a 'health in all policies' approach, making health a major focus in the revision of EU climate adaptation strategy and ensuring health impact assessments in climate action initiatives on e.g. urban design and transport. It further recommended looking into EU policy coherence related to food security-diet-environment interactions. Most of the EASAC recommendations are echoed in the 2020 report from the Commission's Scientific Advisory Mechanism calling for the EU to use policy interventions to intensify the integration of health into climate adaptation and to target structural funding for adaptation.[365]

3.3.3. EU cities

Impacts of climate change on cities

The impacts that European cities will experience depend on their location and their physical characteristics and design. Main climate threats relevant specifically to cities include heat, flooding, water scarcity and drought, but other climate hazards, such as wildfires, can also be important for some. Sealed surfaces and concentrations of people, assets and economic activity in cities increase risks from weather extremes compared to other areas.[366] Since artificial surfaces absorb more solar heat than green areas, a high degree of soil sealing exacerbates cities' heat island effect, increasing their vulnerability against heatwave impacts. It also hampers water infiltration, increasing flood risks.[367]

Climate change will have profound impacts on a wide range of city functions, infrastructure systems (water and energy supply, sanitation and drainage, transport and telecommunication) and services (including health care and emergency services), on the built environment as well as quality of life.[368] Those impacts can trigger knock-on effects on other areas, sectors and people inside and outside the city.[369] For instance, extreme events (heatwaves, flooding) can damage the transport network, hampering the movement of goods and commuters, with a spill-over effect on e.g. industry. At the same time, because they depend heavily on their hinterlands and wider areas for food, water, energy and other essential supplies, cities are vulnerable to climate-related impacts outside their boundaries.

Potential for reducing emissions and climate proofing

Around three quarters of the EU's population live in urban areas (a share projected to reach almost 85 % by 2050),[370] meaning that much of European society's production-consumption dynamic is also to be found there. Cities account for the bulk of the EU's energy use and related GHG emissions. While the concentration of people and activities in cities causes heavy environmental pressures, it also offers opportunities for economies of scale and resource conservation. Urban density and

364 EASAC, 2019.

365 Adaptation to health effects of climate change in Europe, Group of Chief Scientific Advisors, European Commission, June 2020.

366 Climate change impacts on European cities, Urban adaptation support tool, Covenant of Mayors, Climate-ADAPT website.

367 Urban soil sealing in Europe, European Environment Agency, 2011 (last modified December 2019).

368 A. Revi et al., 'Urban areas', In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, IPCC, 2014.

369 Urban adaptation to climate change in Europe 2016, Report No 12/2016, European Environment Agency, 2016.

370 Developments and Forecasts on Continuing Urbanisation, European Commission website.

compactness enable more energy-efficient forms of transport, housing and service provision. Cities further provide good settings for innovation and experimentation.[371] Local authorities can trial solutions on a relatively small scale before rolling them out more broadly, or test different options in various districts.[372]

Cities hold key competencies for climate action.[373] Core areas for **mitigation** at municipal level include buildings and infrastructure lighting; transport and mobility; land-use planning; local renewable energy generation; and waste and water management.[374] Urban mitigation options currently displaying high multidimensional feasibility with a view to limiting global warming to 1.5°C include solar photovoltaics and wind associated with battery storage; bioenergy; energy efficiency; efficient appliances; electric vehicles, better public transport and local shared mobility; non-motorised transport; low-energy buildings; reduced food wastage; ecosystem restoration; and more sustainable urban planning.[375] To promote energy efficiency in urban sectors, support the transition to sustainable transport and promote the use of renewable energy sources, urban authorities can use various levers.[376] These include local regulations and urban planning principles; city purchasing and property management (green public procurement for purchasing energy efficient appliances and clean vehicles; investments in municipality-owned assets, e.g. energy retrofits of buildings); and provision of services and financial resources (e.g. direct transport and energy infrastructure investments; incentives and grants).[377] They can also facilitate cooperation among stakeholders, and engage in public education and awareness campaigns (e.g. to encourage changes in people's energy consumption behaviour).

Adaptation depends on the specific regional and local circumstances, including the climate hazards faced. Such action can be clustered around three main types:

- green, ecosystem-based adaptation measures (such as using or expanding green infrastructure for water runoff management or microclimate moderation);
- grey (technical) adaptation measures (e.g. refurbishing buildings; building dykes);
- 'soft' adaptation measures (e.g. early warning systems and insurance against damage from natural disasters).[378]

Combining those various kinds of measures often produces the best results.[379] Adaptation can follow different approaches: coping with the consequences of disasters and change (responding to the damage arising from a disaster and recovery afterwards); incrementally improving existing conventional measures, such as enhancing sewage capacity or increasing flood defences; and/or transforming ways to address climate impacts by applying different solutions (e.g. changing city design, building design, behaviours). While coping and incremental adaptation can offer effective

---

371 I. Vandecasteele et al., The Future of Cities, Joint Research Centre, 2019.

372 'Responding to sustainability challenges', In: EEA, SOER-2020.

373 Cities and Climate Change, OECD, 2010.

374 Guidebook 'How to develop a Sustainable Energy and Climate Action Plan (SECAP)': PART 3 – Policies, key actions, good practices for mitigation and adaptation to climate change and Financing SECAP(s), Joint Research Centre, 2018.

375 What the IPCC Special Report on Global Warming of 1.5°C Means for Cities: Summary for Urban Policy Makers, Intergovernmental Panel on Climate Change, December 2018.

376 Vandecasteele et al.

377 K. Kern and G. Alber, Governing Climate Change in Cities: Modes of Urban Climate Governance in Multi-Level Systems. In: International conference on Competitive Cities and Climate Change, October 2008.

378 Identifying adaptation options, Urban adaptation support tool, Covenant of Mayors, European Climate Adaptation Platform website.

379 EEA, 2016.

short and medium-term solutions, they may not be sufficient in the long-term, and would gain from being combined with transformative action.

Impacts of policies supporting urban action

Several conditions need to be in place for cities to steer local climate action effectively. Main enabling factors include a supportive political and legal context; autonomy/decision-making power; access to funding for climate action; coordination (both vertical, i.e. between local, regional and national governments, and horizontal, i.e. across different departments, agencies and organisations within a city); participation in capacity-building and learning networks; and stakeholder involvement.[380] EU support for cities, focused on providing guidance, facilitating city-to-city learning, fostering cooperation, and funding mitigation and adaptation action, addresses several of these aspects.[381]

3.4. Sectoral challenges and opportunities

3.4.1. Energy

Impacts of climate change on energy use and energy production

Due to rising temperatures, climate change is expected to lead to reduced **energy demand** for heating and to increased demand for cooling, with large regional differences across the EU. As regards **energy supply**, changes in rainfall are expected to lead to more frequent shortages of cooling water for fossil and nuclear power plants. Hydropower production may be affected by lower availability of water due to drought and reduced snowfall. The availability of energy biomass may be enhanced by CO_2 fertilisation and longer growing seasons in northern Europe, but reduced by lower agricultural productivity in other regions and by wildfires. Energy infrastructure is also vulnerable to extreme weather events, such as storms, floods and heatwaves.

Potential for reducing emissions and enhancing removals

As energy use is responsible for around 80 % of GHG emissions in the EU,[382] reducing emissions in the energy sector is critical to achieving a climate neutral economy. The reduction of energy demand through improved **energy efficiency** is regarded as an efficient and cost-effective measure. However, challenges related to energy efficiency include rebound effects, split incentives[383] and the difficulties of turning energy efficiency measures into bankable investments. Buildings offer huge opportunities for energy efficiency improvements, for example through more efficient heating and cooling systems and better thermal insulation.[384] **Digital networks and equipment** have experienced rapid increases in energy efficiency, relative to performance, but due to fast-growing demand for digital services and equipment, the overall energy savings are limited. Moreover, the use of digital technologies in the energy system, including smart grids and smart appliances, has a great potential for improving energy efficiency and smart energy use.[385] The IEA

---

380 J. van der Heijden, Studying urban climate governance: Where to begin, what to look for, and how to make a meaningful contribution to scholarship and practice, *Earth System Governance*, Volume 1, January 2019.

381 V. Halleux, Cities: Front line of climate action, EPRS, European Parliament, February 2018.

382 Greenhouse gas emission statistics - emission inventories, Eurostat, June 2020 (Combustion and fugitive emissions accounted for 54 % of EU GHG emissions in 2017, and transport energy for 25 %).

383 Rebound effects occur when lower energy costs resulting from efficiency improvements lead to increased energy use. Split incentives refer to a situation where the party that pays for efficiency improvements is different from the one that benefits from them, e.g. landlord and tenant.

384 See section 3.4.3 on buildings.

385 See section 3.5 on research, technology and innovation.

highlights the need to maintain or increase funding for research and development in clean energy technologies, to accelerate innovation cycles and achieve a resilient zero-emission energy sector.[386]

The **electricity sector** offers plenty of opportunities for reducing emissions, by switching from fossil energy sources to **renewable energy sources** (RES) and possibly nuclear power. Challenges arise from the fact that the production of many RES, such as wind and solar, is variable as it depends on the time of day, the seasons and the weather. This variability can be addressed by flexible demand and energy storage. The most common form of energy storage today is pumped hydro,[387] but batteries on the electricity grid and in electric vehicles are expected to play a growing role in balancing the supply and demand of electricity. Energy storage faces challenges through a shortage of suitable sites for pumped hydro and the high cost of batteries. There is an economic opportunity for battery production in Europe, provided that the sustainable supply of raw materials such as lithium and cobalt can be ensured. **Nuclear energy** faces challenges in terms of cost, safety, waste disposal and public acceptance in Member States. There is a potential for the electricity sector to achieve negative emissions through **bioenergy with carbon capture and storage**, where biomass plants (trees and grasses) remove CO_2 from the atmosphere during their growth, while the CO_2 produced by the combustion of biomass in power plants is captured and placed in long-term storage. However, the production of biomass for energy often has negative environmental and questionable climate impacts,[388] and CO_2 storage faces challenges in the availability of suitable geological sites and transport infrastructure, as well as a potential lack of public acceptance.

With the growing availability of emission-free electricity, there is an opportunity to **electrify** applications that currently use fossil fuels. Examples include the use of electric heat pumps for heating and cooling of buildings, or the use of electricity for transport (trains, trams and electric road vehicles). Reducing emissions is more challenging where fossil energy sources are used because of their low weight-to-energy ratio (aviation, heavy goods transport), for high temperature heat (metal industry) or associated chemical reactions (iron production).[389]

Emission-free electricity can also be used to produce hydrogen by means of electrolysis. Such **renewable hydrogen** can be used in hard to electrify applications such as heavy goods transport and high-temperature heat for industrial processes, and can also be converted to electricity by combustion in a power plant or by fuel cells, especially for mobile uses such as heavy goods transport. Renewable hydrogen can also be used to produce methane[390] or synthetic liquid fuels.[391] Hydrogen or renewable gases can be stored over long periods and by making use of already existing gas storage infrastructure, thus reducing the overall system cost, compared with full electrification of economic activities. **Energy system integration**[392] – i.e. the use of electricity to produce renewable gases or electrify end uses directly – provides opportunities for emission-free energy in a wide range of sectors and for mitigating the variability of RES.[393] The Commission strategies for energy system integration and for hydrogen set out a roadmap and action plan for decarbonisation

386 Clean Energy Innovation, International Energy Agency, July 2020.

387 Pumped hydro means using electricity to pump water from a river or lake to a reservoir at a higher elevation, where it is stored and used later to drive a turbine and generate electricity.

388 Forest bioenergy, carbon capture and storage, and carbon dioxide removal: an update, European Academies' Science Advisory Council, February 2019.

389 See section 3.4.2 on industry.

390 M. Olczak and A. Piebalgs, What is renewable gas?, Florence School of Regulation, March 2018.

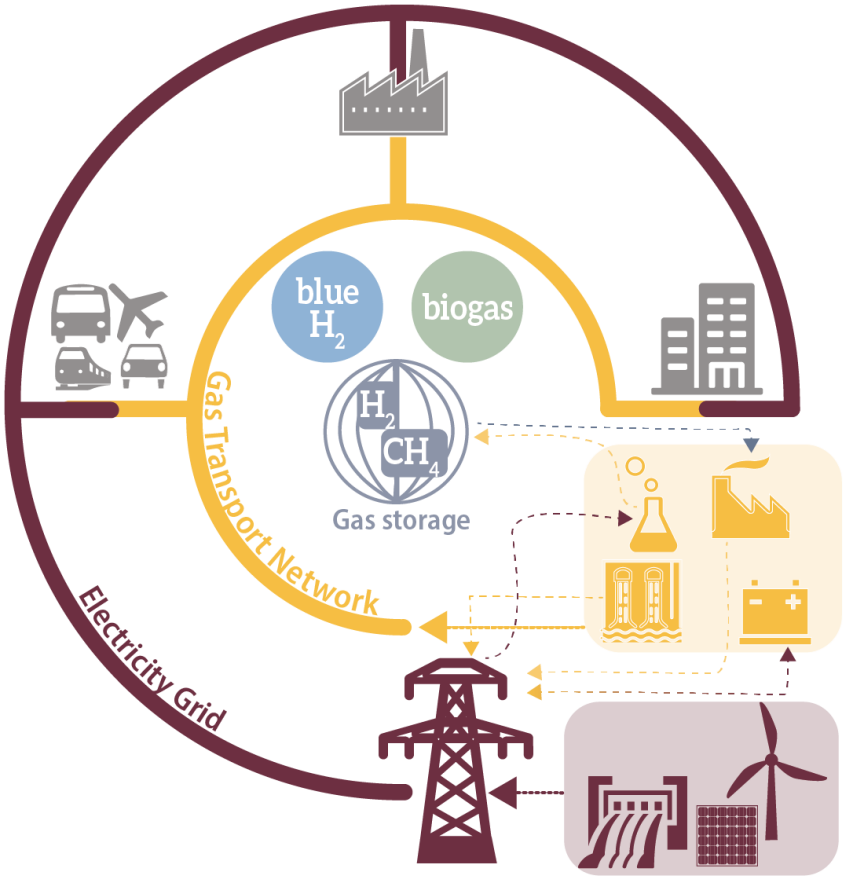
391 Hydrogen and synthetic fuels, European Academies' Science Advisory Council C, September 2020.

392 Also known as 'sector coupling' or 'sectoral integration'.

393 G. Erbach, Energy storage and sector coupling: Towards an integrated, decarbonised energy system, EPRS, European Parliament, June 2019.

of the EU energy system. The Commission's methane strategy,[394] adopted in October 2020, addresses energy-related methane emissions.[395]

Figure 16 – Energy system integration for a climate-neutral energy system



Energy system integration involves:

- the electrification of transport, industry and households through the electricity grid,
- production of gases such as hydrogen (H_2) and methane (CH_4) from renewable electricity,
- storage of energy in pumped hydro, batteries and as gases (H_2 and CH_4),
- supply of end-use sectors with renewable gases, and
- electricity production from hydrogen through fuel cells and from gas with thermal power plants.

Source: EPRS.

Impacts of EU policies in favour of emission-free energy

Trillions of Euros will need to be invested to achieve a climate-neutral economy, by increasing renewable energy capacities, electricity transmission, energy and CO_2 storage, electrification of end uses and sectoral integration. The European Commission estimated that additional annual investment in the energy system and related infrastructure of around €350 billion is needed in

394 Communication on EU strategy to reduce methane emission, COM(2020) 663 final, European Commission, October 2020.

395 H. Simões, Reducing methane emissions: A new EU strategy to address global warming, EPRS, European Parliament, December 2020.

2021-2030.[396] The challenge is to design markets and regulation in such a way as to facilitate this investment. At the same time, energy needs to remain affordable to prevent energy poverty among households and safeguard the competitiveness of European industry. EU support[397] for key industries such as battery manufacturing and hydrogen technologies helps to strengthen industrial value chains, enhance European competitiveness and reduce the dependence on imports of high-value components and technologies.

The phasing-out of fossil fuels will impact workers in this field, notably in coal-producing regions.[398] Conversely, the transformation towards an emission-free energy system provides opportunities for the creation of skilled jobs, but may also suffer from shortage of skilled labour. While the EU's dependency on fuel imports would be reduced, new challenges with regard to the supply of raw materials and industrial components may arise, notably with respect to the production of batteries used in electrified applications (e.g. in electric cars). The examples of CO_2 storage and wind farms have shown that social acceptance can be another challenge.[399]

3.4.2. Industry

Industrial activity and industrial products are major contributors to GHG emissions, and therefore targeted by policies to reduce emissions and combat climate change. In fact, the energy-intensive industry sectors (e.g. iron and steel, cement and lime, chemicals and refineries) in the EU already decreased their greenhouse gas emissions by almost 40 % between 1990 and 2017.[400] At the same time, industry is the source of materials and products that enable economy-wide decarbonisation, for example insulation materials, heat pumps or wind turbines. Industry is also affected by climate change impacts, although not as much as agriculture or tourism.

Impacts of climate change on industry

Industry is at risk from impacts of climate change. Damages and disruptions may arise from weather-related events such as storms, hurricanes, flooding and wildfires. Such events may also affect critical infrastructure on which industry depends, such as energy, telecommunications and transport networks. Insurance costs may rise as extreme weather events become more likely.

Climate-induced water shortages can pose a risk to certain industries. Climate change may also have an impact on the supply chain, especially for agriculture-based inputs, but also for textiles and electronic equipment.[401] Heat may affect the safety and productivity of workers, and lead to increased costs for cooling.[402]

Regarding the consumer products industry (e.g. vehicles, household appliances), impacts may arise from climate-induced changes in purchasing power, shifting consumer demand, for example for seasonal and weather-related products, and consumer preference for climate-friendly products.

---

396 Communication on stepping up Europe's 2030 climate ambition: Investing in a climate-neutral future for the benefit of our people, COM(2018) 773 final, European Commission, September 2020.

397 The main EU initiatives in this area are the European Battery Alliance and the Fuel Cells and Hydrogen Joint Undertaking.

398 For EU measures to support affected workers and regions, see section 3.2.3

399 Understanding public responses to low carbon technologies, EPRS, European Parliament, January 2019.

400 Energy-intensive industries, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, July 2020.

401 Climate change risks to business and industry, UK 2017 Climate Change Risk Assessment, Committee on Climate Change, 2017.

402 S. Huntington, Is climate change having an impact on manufacturing?, *Altenergymag*, 22 January 2020.

Potential for reducing emissions and enhancing removals

Industry (without energy industries) is responsible for about 20 % of GHG emissions in the EU.[403] Industrial emissions result from energy use and from industrial processes (process-related emissions). The literature identifies five principal ways to achieve emission reductions in industry:

1. Switching to low or zero carbon energy (renewable or nuclear electricity, sustainable biomass, clean or low-carbon hydrogen),[404] reduction of energy use (energy efficiency), and use of waste energy;[405]
2. Reduction of process-related emissions through new or modified production processes and alternative raw materials (for example in the steel, cement and chemical industries, as explained below);
3. Carbon capture for unavoidable emissions, with storage or use of the captured carbon (CCUS);
4. Reduction of demand for industrial materials and products, for example by improved material efficiency, substitution by low-emission products, smarter use of products and longer product lifetime;
5. Reduction of lifecycle emissions related to raw material input through increased recycling of industrial by-products and end-of-life products; use of bio-based materials.

Scenarios for the decarbonisation of industry generally build on electrification of industrial processes with low-carbon electricity, and on the use of clean or low-carbon hydrogen as an energy carrier and feedstock.[406] Extensive electrification would require a massive expansion of electricity generation capacity and of the electric grid, while the clean hydrogen option would require an increased supply of renewable electricity as well as investment in hydrogen transport and storage infrastructure.

Digital technologies and services can support the decarbonisation of industry by helping to optimise production processes and design products to be more resource and energy-efficient. Moreover, they enable a more efficient use of industrial products in the 'sharing economy'. However, the rapid growth in digital services and technologies can also result in an increase in GHG emissions from energy use for servers and digital devices and for the production of electronic equipment.

---

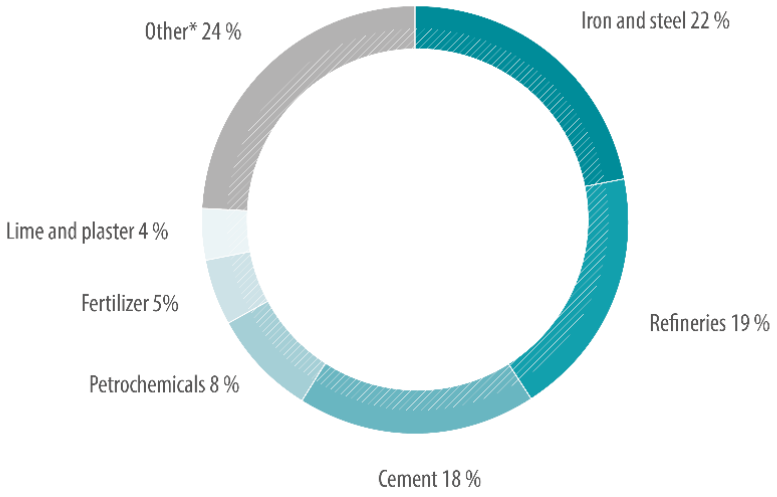
403 EEA greenhouse gas - data viewer (emissions from 'Manufacturing Industries and Construction' and from 'Industrial Processes and Product Use').

404 The EU hydrogen strategy defines clean hydrogen as hydrogen produced from renewable energy. Low-carbon hydrogen is fossil-based with CCS or electricity-based with significantly reduced lifecycle GHG emissions.

405 According to the International Renewable Energy Agency (IRENA), renewables, together with demand reduction and energy efficiency, could account for over 80 % of the required CO_2 emission reductions (Reaching Zero with Renewables: Eliminating CO_2 emissions from industry and transport in line with the 1.5°C climate goal, International Renewable Energy Agency, September 2020).

406 G. Erbach and L. Jensen, EU hydrogen policy: Hydrogen as an energy carrier for a climate-neutral economy, EPRS, European Parliament, February 2021

Figure 17 – Share of industrial activities in the total industrial CO_2 emissions in the EU ETS (2018)



Source: Energy-intensive industries, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, July 2020.

Apart from reducing its own emissions, industry has a key role in the low-carbon transition by providing materials and products to enable the low-carbon transition, for example electric vehicles and their components or materials for the insulation of buildings. The move towards a circular economy implies a transformation of industrial processes, for example by using carbon captured from steel and cement production as a feedstock for the chemical industry.

Climate policies for industry

Climate policies have a direct impact on industry by raising the costs of emissions, either directly through a carbon price or indirectly through rising energy prices. In addition, regulation, such as the phasing out of F-gases or CO_2 limits for new vehicles, has a direct impact on specific industries. Rising carbon prices, higher energy prices and compliance costs may put European industries at a disadvantage relative to competitors that do not face such costs. On the other hand, well-designed climate policies can also be a driver of efficiency improvements and industrial innovation,[407] leading to competitive advantage. Moreover, decarbonisation policies may help create demand for industrial materials and products that help to achieve emission reductions, with a potential to create new market opportunities for European manufacturing industries.[408]

[407] S. Ambec et al., The Porter Hypothesis at 20: Can Environmental Regulation Enhance Innovation and Competitiveness?, *Review of Environmental Economics and Policy*, Volume 7:1, pp. 2-22, 2013.

[408] M. Lorenz et al., Grüne Technologien für grünes Geschäft, Boston Consulting Group and Verband Deutscher Maschinen- und Anlagenbau, July 2020.

Decarbonisation of industry is addressed in a number of EU policy measures, notably the EU ETS, but also by specific instruments such as vehicle emission standards or ecodesign.[409] Various EU funding instruments are available to support the decarbonisation of energy-intensive industries.[410] The Commission's new industrial strategy, adopted in March 2020, aims specifically at aligning industrial production with climate and environmental objectives under the Commission's European Green Deal.[411] In November 2020, the European Parliament called on the Commission to revise the industrial strategy in the context of the coronavirus crisis, to create conditions for achieving mid-century climate neutrality, durable economic growth, prosperity and competitiveness.[412]

The Commission strategies for energy system integration[413] and for hydrogen[414] set out a roadmap and action plan for the decarbonisation of the EU energy system and energy-intensive industries. Moreover, the circular economy action plan, adopted in March 2020, considers circularity a prerequisite for climate neutrality and focuses on specific industrial value chains: electronics and information and communications technologies (ICT), batteries and vehicles, packaging, plastics, textiles, construction and buildings, and food.[415]

The design of policies to support the decarbonisation of industries has been addressed by a number of organisations, including the OECD,[416] IEA,[417] International Renewable Energy Agency (IRENA),[418] the High-Level Group on Energy-Intensive Industries,[419] and the Directorate-General for Internal Policies of the European Parliament.[420] A higher carbon price, rules on carbon accounting and optimal valorisation of biomass, markets for green products and product policies are considered essential elements of industrial policy in supporting the transition towards climate neutrality. A number of obstacles were further identified that need to be addressed by industrial strategies and policies because carbon pricing and market forces alone are considered to be insufficient for driving the necessary emission reductions;

- cost: capital expenditure for low-carbon technologies, and increased operating costs resulting from the price of clean energy and low-carbon feedstock;
- markets for 'green' products are not well developed;[421]

---

409 See section 2.2 on EU climate policy.

410 EU funding and investment instruments to support energy-intensive industries include the European Fund for Strategic Investments (EFSI) and EFSI 2.0, the Programme for Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME), the European Structural and Investment Funds (ESIF), the Horizon 2020 research framework programme, the Just Transition Fund, and the Innovation Fund.

411 COM(2020) 102 final

412 Resolution of 25 November 2020 on a New Industrial Strategy for Europe, (2020/2076(INI)), European Parliament.

413 COM(2020)299 final

414 COM(2020)301 final

415 Communication on a new circular economy action plan for a cleaner and more competitive Europe, COM(2020) 98 final, European Commission, March 2020.

416 C. Bataille and S. Fraser, Low and zero emissions in the steel and cement industries: Barriers, technologies and policies, OECD, 2019.

417 Tracking Industry 2020, International Energy Agency, June 2020.

418 Reaching Zero with Renewables: Eliminating CO_2 emissions from industry and transport in line with the 1.5 °C climate goal, International Renewable Energy Agency, September 2020.

419 Masterplan for a Competitive Transformation of EU Energy-intensive Industries: Enabling a Climate-neutral, Circular Economy by 2050, High-Level Group on Energy-Intensive Industries, Publications Office of the European Union, 2019.

420 Energy-intensive industries, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, July 2020.

421 Steel and cement production are both highly competitive with low profit margins, and would therefore have difficulties in passing increased costs on to consumers.

- lack of infrastructure, such as storage and transport networks for hydrogen and CO_2;
- an uncertain policy context, which increases the risks of investments;
- inertia resulting from the difficulty of changing integrated industrial operations and established practices; long lifetime of investments, and higher risks for first movers who invest in leading-edge innovative technology.

Creating market demand for low carbon products is considered critical to the decarbonisation of industrial production. Market demand can be generated by product standards and regulation, public procurement of low-carbon products and information and education of consumers.

The competitiveness of European industries depends on affordable clean energy and non-energy inputs. To avoid a dislocation of industrial activity to regions with lower carbon costs (carbon leakage), measures such as free allocation of carbon allowances, and compensation of indirect carbon costs are currently used, and a carbon border adjustment is under discussion in the context of the European Green Deal.

Firms in energy-intensive industries face uncertainty regarding future global and national policies, and therefore delay investment decisions.[422] Carbon-intensive investments, which are not compatible with the targets of the Paris Agreement, face the risk of more stringent climate policies, while many climate-friendly choices lack a clear business case in an uncertain policy regime.[423] However, due to long investment cycles and the long lifetimes of industrial installations, the switch to low-carbon technology needs to start in the next few years. Risky first-mover investments in innovative low-carbon technologies would depend on public support (additional tax breaks, subsidies, and financing). Although a number of mature low-carbon technologies already exist, support for research and innovation is critical for the transition towards a circular and climate neutral industrial system.[424]

Public investment support is considered necessary to enable the infrastructure required for reducing industrial emissions to be set up or upgraded:

- expansion of the electricity grid to support the supply of clean electricity for the electrification of industrial processes;
- transport networks and storage facilities for hydrogen and CO_2.

Several studies highlight the need for roadmaps and strategic planning for the transition.[425] The pace of innovation is considered as critical, because the competitiveness of European industries is at risk if the transition is too fast or too slow.

Decarbonisaton of key industrial sectors

The challenges and opportunities for the industrial sectors with the largest GHG emissions include metals production (20.8 % of EU industry emissions), chemicals (15.4 %) and cement (10.9 %). In all

[422] Energy-intensive industries have very long investment cycles, so that investment decisions made today determine the emissions trajectory for decades to come.

[423] It is against this background that more than 150 European companies urged EU leaders to support an EU GHG emissions reduction target of at least 55 % by 2030, backed up by ambitious implementation of the EU recovery package to achieve a green and digital transition. (Over 150 business and investor CEOs urge the EU to raise EU 2030 GHG emissions targets to at least 55 per cent, Corporate Leaders Groups, September 2020).

[424] See section 3.5.3 on technology and innovation.

[425] The European Parliament study, referred to above, suggests a technology roadmap for industry, an investment roadmap for both the public and private sectors, and a roadmap towards competitive carbon costs. IRENA recommends inter-linked sector-level strategies at the local, national and international levels, built on the five technology pillars of demand reduction and energy efficiency, renewable electricity, renewable heat and biofuels, green hydrogen and e-fuels, and carbon-removal technologies.

three sectors, GHG emissions result not only from energy use, but also from industrial processes (process-related emissions).

Metals production

The production of non-ferrous metals,[426] such as copper and aluminium, is already highly electrified, so that GHG emissions can be reduced through an increased supply of low-carbon electricity. Energy accounts for a major part of the production cost of these globally traded commodities, so energy prices have a significant impact on competitiveness. Moreover, copper and aluminium already have high recycling rates, which results in reduced energy use, compared to the production of primary metals from copper ore and bauxite.

Markets for 'low-carbon metals are starting to emerge. The London Metal Exchange plans to launch a platform in 2021 to trade 'low-carbon' aluminium mostly produced with renewable energy.[427] A market for low-carbon steel does not yet exist.

The production of ferrous metals (iron and steel) is much harder to decarbonise because most of the GHG emissions in iron and steel production result from the use of coke[428] as a fuel and reactant in the blast furnace. Newer coal-based technologies[429] are more energy-efficient and can reduce CO_2 emissions by more than 50 %. The use of hydrogen as a fuel and reactant is currently at the demonstration stage,[430] with commercial application expected for the mid-2020s.[431] With the use of clean hydrogen, this can enable the production of fossil-free steel. Electrowinning, an electrochemical process, is another promising technology for producing steel from iron ore.[432]

Electricity (electric arc or induction furnaces) is already widely used for the recycling of steel (more than a quarter of current production is secondary steel), and can be decarbonised by using clean electricity.[433] Emissions can be reduced by increased recycling of steel, although recycled steel will not be available in sufficient quantities to meet expected future global demand, while contamination with copper and other metals may affect quality.

A further reduction of GHG emissions will depend on technological alternatives, notably clean hydrogen (produced from renewable electricity) and carbon capture and storage (CCS). To switch European steel production to carbon-neutral technology would require a capital expenditure of up to €100 billion, according to the Roland Berger consultancy.[434]

Cement production

Cement production causes CO_2 emissions from energy use and from the production process. The most GHG intense part of cement production is limestone calcination to produce clinker, which is

---

426 T. Wyns and G. Khandekaru, Metals for a Climate Neutral Europe: A 2050 Blueprint, VUB Institute for European Studies, October 2019.

427 London Metal Exchange plans 'low-carbon' aluminium trading, *Financial Times*, 5 June 2020.

428 Coke is a solid fuel with high carbon content produced by heating coal in the absence of air.

429 e.g. the Hisarna direct reduced iron process.

430 World first in Duisburg as NRW economics minister Pinkwart launches tests at thyssenkrupp into blast furnace use of hydrogen, thyssenkrupp, 11 November 2019.

431 J. Lilja, Fossil-free steel production, SSAB, June 2020.

432 Development of new methodologies for industrial CO_2-free steel production by electrowinning, SIDERWIN project website.

433 Iron and Steel Technology Roadmap, International Energy Agency, October 2020.

434 The future of steelmaking – How the European steel industry can achieve carbon neutrality, Roland Berger, 2020.

responsible for around 60 % of total emissions.[435] Strategies for lowering the GHG emissions of the cement industry have been developed by OECD,[436] IEA,[437] and the Energy Transitions Commission.[438]

Carbon capture and storage/utilisation will likely be required to abate process-related emissions from cement production. Captured CO_2 from cement production and other industrial processes can be added to concrete to make it stronger while providing long-term carbon storage.[439] Reduction of cement demand and recycling are further potential avenues for reducing emissions. Potential alternative chemical pathways to produce cement with much lower and potentially even negative emissions are still at a low technology readiness level.

It is difficult to develop markets for low-carbon cement, due to concerns about the safety of newer, less-proven materials for the construction of essential infrastructure such as buildings and bridges.[440] Construction codes established by regulatory agencies are generally based on the traditional Portland cement chemistry.[441] In the absence of clear regulation and markets for low-carbon cement, investment in low-carbon innovation in the cement industry is not economically feasible.

Chemical industry

Worldwide, the chemical industry is the largest industrial consumer of both oil and gas[442] (15 % of primary oil demand and 9 % of gas demand).[443] The European chemical industry accounts for a large proportion of industrial GHG emissions in the EU, but has reduced its GHG emissions by 49.6 % from 1991 to 2018, in parallel with a 55.7 % reduction in energy intensity.[444]

The chemical industry can reduce its GHG emissions further by improving energy and resource efficiency,[445] making use of hydrogen, CO_2 and renewable biomass as alternatives to fossil feedstocks and introducing electricity-based processes that can benefit from a progressive decarbonisation of electricity production[446]. The Joint Research Centre considers CCS and combined heat and power to be promising technologies for improving energy efficiency and reducing GHG emissions in the chemical industry.[447] However, complete decarbonisation of the chemical industry would depend on the availability of huge amounts of low-carbon energy (electricity and hydrogen)

---

435 It is already common to partially replace clinker with alternative inputs (blast furnace slag, coal fly ash, bauxite, and natural pozzolanic materials), although the use of these products may be constrained by available volume. While not yet widely applied, clinker can be substituted (up to 40-50 % by mass) with a mixture of limestone and heat treated clays, which are common materials.

436 Bataille and Fraser, 2019.

437 Cement - Tracking report, International Energy Agency, June 2020.

438 Mission Possible: Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century: Sectoral Focus: Cement, Energy Transitions Commission, 2019.

439 D. Roberts, These uses of CO_2 could cut emissions — and make trillions of dollars, *Vox*, November 2019.

440 C. Harvey, Cement producers are developing a plan to reduce CO_2 emissions, *Scientific American*, July 2018.

441 Portland cement was patented in 1824 and is still the most widely used type of cement.

442 Around half of the chemical industry's energy input is used as feedstock (fuel used as raw material input and not as a source of energy).

443 Chemicals - Tracking report, International Energy Agency, June 2020.

444 The European chemical industry: a vital part of Europe's future - facts & figures2021, Cefic.

445 Process intensification in the chemical industry involves the design and installation of customised equipment for specific chemical production processes, to avoid the inefficiencies associated with using a combination of more standardised processes.

446 Technology Study: Low carbon energy and feedstock for the European chemical industry, DECHEMA, June 2017.

447 A. Boulamanti and J.A. Moya Rivera, Energy efficiency and GHG emissions: Prospective scenarios for the Chemical and Petrochemical Industry, Joint Research Centre, 2017.

and alternative feedstock (hydrogen, CO_2). It would require a large increase in investment and risks, making production costs uncompetitive[448] in the absence of supporting measures.

The chemical industry can support the decarbonisation of other sectors, notably through the production of synthetic fuels for the transport sector. Circular economy principles can be applied for material flow between different industries, for example by using captured CO_2 from steel or cement production as a chemical feedstock. Chemical recycling can enable the valorisation of waste plastics that would otherwise be incinerated.

Bio-based chemicals

Bio-based chemicals are an emerging field, based on specific molecules extracted or produced from biomass. Bio-based chemicals offer large CO_2 reductions, compared to fossil feedstocks if the molecular structure of the biomass is fully valorised and only limited processing is required. The costs of bio-based chemicals are still higher than for fossil-based products, but are expected to drop with further research and development.

However, the climate and environmental benefits depend on the sustainability of the biomass used. Moreover, the land used for biomass production is also needed for other uses, including nature preservation and the production of wood, food, feed, fibre and energy biomass.

The EU chemicals strategy for sustainability addresses EU innovation support for low-carbon chemical production processes, and the inclusion of the environmental and carbon footprint into the information requirements of the EU chemicals legislation (REACH).[449] The European Parliament resolution on the strategy notes the role of the chemical industry as a provider of low-carbon solutions, which can help to deliver the EU climate ambitions for 2030 and 2050.[450]

3.4.3. Buildings

The buildings sector is the single biggest energy consumer in the EU.[451] Due to fossil fuels used as the dominant energy source to heat and cool buildings, the sector is responsible for 36 % of total EU GHG emissions.[452] Apart from contributing to climate change, buildings are also vulnerable and expected to bear some climate change impacts. Rising temperatures have already increased cooling needs and, in some regions, decreased demand for heating. Buildings infrastructure might be damaged by extreme weather conditions, which will also impact the availability and cost of insurance against climate change related damage. Climate change can also further aggravate the situation of vulnerable citizens living in energy poverty in over 50 million EU households.[453]

The success of decarbonising EU economy and reaching zero-net emissions by mid-century largely depends on whether the EU buildings stock will be decarbonised by 2050. Almost the whole (95 %) cost-effective saving potential lies in existing buildings, as they will constitute at least 75 % of the 2050 building stock.[454] Decarbonisation could be mainly achieved by greater energy efficiency, as

448 DECHEMA, 2017.

449 Communication on chemicals Strategy for Sustainability: Towards a Toxic-Free Environment, COM(2020) 667 final, European Commission, October 2020.

450 Resolution of 10 July 2020 on the chemicals strategy for sustainability, (2020/2531(RSP)), European Parliament.

451 In focus: Energy efficiency in buildings, European Commission, 17 February 2020.

452 Energy efficient buildings, European Commission website.

453 What is energy poverty?, EU Energy Poverty Observatory, European Commission.

454 Comprehensive study of building energy renovation activities and the uptake of nearly zero-energy buildings in the EU, European Commission, 2019. (EC, 2019)

well as through better use of materials in the whole lifecycle of buildings. However, the current energy renovation rate of buildings is very low and estimated at about 1 % per year.[455] For this reason, the EU has adopted several legal measures, guidelines and recommendations, earmarked funds, and stimulated investment in energy efficiency in buildings in the last decade. In addition, the increased circularity in the sector has been acknowledged as having important potential to reduce the amount of new materials used (especially concrete, cement and steel) and the GHG emissions associated with their production.[456] Renovating the EU's existing building stock requires a substantial amount – around €275 billion – of additional investment per year.[457]

Despite the existing legal framework that still requires improved use of finance schemes and enforcement, there is an urgent need for a further increase in energy efficiency of buildings and a more rapid switch to sustainable energy sources. Today, neither the renovations rate nor their depth are sufficient to substantially reduce buildings' energy consumption and GHG emissions.[458] Until the coronavirus outbreak led to lower overall energy consumption, further efforts in the buildings sector were required to avoid missing the EU 2020 energy efficiency target,[459] where it had been estimated that annual energy renovations rate would need to more than double to achieve the 2020 energy efficiency goal.[460] One of the main barriers to renovate, especially in residential buildings, is the issue of upfront costs that need to be borne before long-term benefits can be reaped. This situation is a disincentive to renovation in rented real estate, where the investment cost would be borne by the owner, but the tenant would benefit. On a positive note, the price of technologies needed to achieve nearly zero emission buildings is expected to decline further, becoming cost-optimal, which could speed up the renovation rate.[461] Thermal insulation is key to energy savings, as is the continuous uptake of more energy efficient appliances and products (e.g. condensing boilers and heat pumps for heating).[462] However, positive market developments are not enough to face the challenge of energy efficiency in buildings and according to analyses, full public policy support is needed.[463]

Some challenges the buildings sector faces are the same as in the energy sector, e.g. electrification and better integration of renewable energy (produced on-site) to the electricity grid. Moreover, switching to low carbon energy sources for heating and cooling as well as connecting more consumers to district heating and cooling systems (powered by sustainable sources) could bring further energy savings and lower GHG emissions. Other technology-based opportunities in buildings lie in smart and connected buildings that could further optimise the use of energy in buildings, help manage on-site produced renewable energy sources, empower consumers in their choices and actions as well as contribute to decarbonisation of transport (by smart charging possibilities).

---

455 Idem.

456 European Environmental Agency, Cutting greenhouse gas emissions through circular economy actions in the buildings sector - Briefing, published 9 July 2020.

457 Communication - A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives, COM(2020)662 final, European Commission, 2020

458 EC, 2019

459 It seems unlikely that the current decrease in energy demand, mainly due to lowered industrial output, will continue in the long-term when full economic activity resumes.

460 In-depth analysis in support of the Commission communication COM(2018) 773 'A Clean Planet for all A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy', European Commission, November 2018.

461 Mapping of Existing Technologies to Enhance Energy Efficiency in Buildings in the UNECE Region, United Nations Economic Commission for Europe - UNECE, Joint Task Force on Energy Efficiency Standards in Buildings, Geneva, 2019.

462 N. Šajn, Energy efficiency of buildings: A nearly zero-energy future?, EPRS, European Parliament, 2016.

463 See. e.g. UNECE, 2019.

Increasing energy efficiency in buildings brings many socio-economic benefits. Estimates of achieving 33 % energy savings by 2030 (the EU target agreed is 32.5 %), show a GDP increase of at least 1.3 % and an increase in employment by creating 680 000 jobs.[464] If the renovation rate triples, between 2 and 4 million additional full time employees will be needed in the construction sector alone.[465] Moreover, many other benefits are expected in health and wellbeing (e.g. due to better indoor and outdoor air quality, more comfort), in social affairs (e.g. a decrease in energy poverty), in industrial competitiveness (e.g. insulation materials industry),[466] and in increasing the value of buildings assets that otherwise would be stranded.[467]

To overcome these challenges, as well as several structural and market failures in this sector and to be able to benefit from the underlying potential, ambitious EU level public policy is needed. In 2016, the Commission established an EU Building Stock Observatory to close a long-standing lack of a centralised database on the energy performance of the EU building stock. In 2018, the Commission launched the Smart Finance for Smart Buildings financial instrument that aims to increase the attractiveness of investing in energy efficiency in residential buildings to private actors. The initiative also aims to better target subsidies towards vulnerable consumers or specific market failures.[468] The European Commission recently adopted a renovation wave strategy[469] that aims at doubling the renovation rate by 2030 in order to cut emissions, boost recovery and reduce energy poverty. It lays out new solutions and tools to, among other things, strengthen regulations, standards and information on the energy performance of buildings and achieve better-targeted renovation funding from the recovery funds. The latest EU circular economy action plan envisages support for circularity throughout the lifecycle of buildings.[470] The promised facilitation of innovative financing and promotion of energy efficiency investment in buildings remains an utmost priority for EU energy and climate policies.[471] The Commission has already announced that the increase in renovation rate and making it affordable for all households, including those with a limited ability to cover upfront costs, will be addressed in upcoming reviews of relevant EU legislation.[472] Finally, in the ongoing and timely debate on how to overcome the current economic downturn and with the EU-level declarations on a need for a green recovery, boosting building renovations is indicated as one of the solutions that would be good for citizens, the economy and for the climate.

3.4.4. Transport and Tourism

Impacts of climate change on transport and tourism

The specific impact of climate change on transport and tourism will depend on the degree of change, regional conditions and local transport systems. For instance, **inland waterways** in the northern hemisphere could profit from longer operational seasons due to reduced winter freezing, while low summer water levels can cut transport capacity. Warmer winters are opening up **new**

---

464 European Commission, The macro-level and sectoral impacts of energy efficiency policies, June 2017.

465 EC, 2019

466 C. C. Pavel and D. T. Blagoeva, Competitive landscape of the EU's insulation materials industry for energy-efficient buildings, Joint Research Centre, 2018.

467 European Commission, Impact assessment accompanying the document Proposal for a Directive of the European Parliament and of the Council amending Directive 2010/31/EU on the energy performance of buildings, 2016.

468 Financing energy efficiency, European Commission website.

469 COM(2020)662 final

470 COM(2020) 98 final

471 COM(2019)640

472 The Commission plans to propose reviews of the Energy Efficiency Directive, the Energy Performance of Buildings Directive and the Renewable Energy Sources Directive in 2021.

shipping routes through the Arctic, raising questions as to their economic viability and risks of polluting the sensitive ecosystems.

Transport infrastructure malfunctions when the weather conditions are outside its design range, which is expected to happen more often. While all assets are exposed to damage from storms and freeze-thaw cycles, bridges are particularly vulnerable to floods, road surfaces to high temperatures and road bases to the stability loss due to strong precipitations or melting permafrost. Many airports and seaports are at risk of inundation by rising sea or river levels.[473]

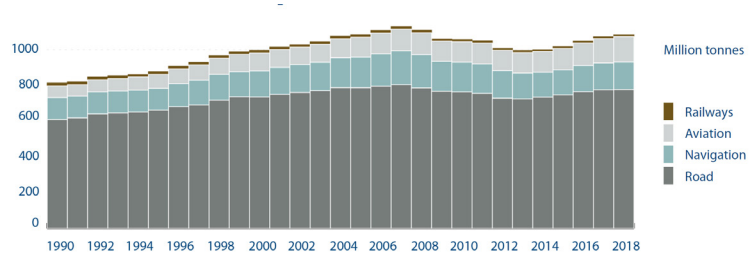
New patterns in agriculture and distribution of human activities including tourism could transform **transport demand**. Climate change will make some **tourist destinations** undesirable or unavailable, affecting mostly beach-, winter- and nature-based resorts. Tourist flows may shift towards higher altitudes and latitudes, with possible benefits for destinations that become more attractive. However, impacts will vary geographically and seasonally.

Potential for reducing emissions and climate proofing

Transport is an important climate change driver and tourism further amplifies this trend. Transport accounts for about a third of the final energy consumption in the EU, mostly sourced from fossil fuels (95 % in 2015).[474] It is the only sector where GHG emissions have not been decoupled from economic growth and have kept increasing due to increasing demand, in particular those caused by aviation and shipping. While cutting these emissions is essential for a climate-neutral economy and the potential for reduction is large, the outcome will depend on travel behaviour choices; as well as on how fast new technologies and applications can be developed, manufactured and sold to buyers; whether cleaner solutions can be retrofitted to existing fleets or will concern only new fleet additions.

Transport-related CO_2 emissions from tourism, at about 5 % worldwide in 2016, were predicted to grow by 25 % by 2030 (2019 scenario).[475] Aligning tourism with climate action requires adopting a low carbon pathway based on awareness and optimisation, measurement and disclosure of the emissions generated by tourism activities and setting of evidence-based targets. Changes can be achieved through the transport means used, for instance by giving preference to rail over air travel for shorter distances. The choice of travel destinations and distances involved can also reduce emissions, as witnessed during the Covid-19 pandemic, with an increase in domestic holidays.

Figure 18 – Evolution of EU transport CO_2 emissions, 1990-2018



Data source: Eurostat [env_air_gge].

[473] PESETA III, Climate impacts in Europe, Final report, Joint Research Centre, 2018.

[474] K Keramidas et al., Global Energy and Climate Outlook 2019: Electrification for the low-carbon transition, Joint Research Centre, 2020.

[475] Transport-related CO_2 Emissions of the Tourism Sector, World Tourism Organization (UNWTO) and International Transport Forum (ITF), 2019.

Mitigation measures seek to reduce transport GHG emissions by lowering energy intensity and diversifying the fuel mix. Solutions include increasing vehicle efficiency, introducing **alternative fuels**, both liquids and gases, in vehicles with internal combustion engines, as well as alternative **powertrains**. Electrification can help decarbonise road vehicles, in particular cars, vans and city buses, if sufficient charging infrastructure becomes available and the electricity is sourced sustainably. For airplanes and ships, options are more challenging and require scaling up fuels that are costly and available in limited supply.

Adaptation strategies take account of potential impacts from climate change that can cause operational failures and lead to damage or temporary unavailability of some infrastructure and service perturbations. Plans for **transport infrastructure**, including location decisions, should incorporate extreme weather considerations in their **design and upgrade**. For instance, assets at risk of flooding can be protected with dykes and levees, elevated or relocated. However, while climate proofing is costly, the occurrence of extreme weather events will remain uncertain. Decisions on how to use limited infrastructure budgets can be facilitated by including **risk assessments**, both at the level of asset and network, into existing cost-benefit analyses. Infrastructure vulnerability can be reduced by **targeted maintenance** using sensors and digital technologies. These can also improve forecasting of wind and water levels, allowing for operational adaptations. Resilience-based approaches target the whole system, not just robust infrastructure. Rather than avoiding failure completely, service continuity plans allow for a 'safe failure' of assets and focus on **minimising system downtime** through traffic re-routing and use of other transport modes.[476]

EU policies in favour of low-emission transport

Policy interventions focus on improving vehicle efficiency and promoting low and zero emission vehicles through **emission limits** for new fleets and public procurement of low-emission vehicles. The EU has set rules for fuel quality and supports large-scale deployment of **refuelling and recharging infrastructure**. While developing an EU-wide transport infrastructure network,[477] the EU places strong focus on reducing transport's environmental impact and improving the **efficiency** of the whole transport system, for instance through digital technologies.

Bringing new technologies and fuels to the market or making alternative fuels widely available requires legal support, assorted pricing incentives and significant **investment**. To decarbonise aviation and shipping, for instance, the European Commission envisages taxing fuel in both areas, including maritime emissions in the EU ETS and reducing free emission allowances for airlines, in combination with support for the roll-out of low-emission fuels. It also intends to end subsidies for fossil fuels and establish effective road pricing. The EU 2021-2027 budget underpins this approach, as at least 60 % of the budget earmarked for transport, energy and digital infrastructures will support climate objectives.[478]

The Commission sustainable and smart mobility strategy outlines the steps it is about to take to reduce GHG transport emissions by 90 % by 2050.[479]

---

476 Adapting transport to climate change and extreme weather: implications for infrastructure owners and managers, International Transport Forum, OECD, December 2016.

477 Trans-European Transport Network (TEN-T), European Commission website.

478 COM(2020) 21 final

479 COM(2020) 789 final

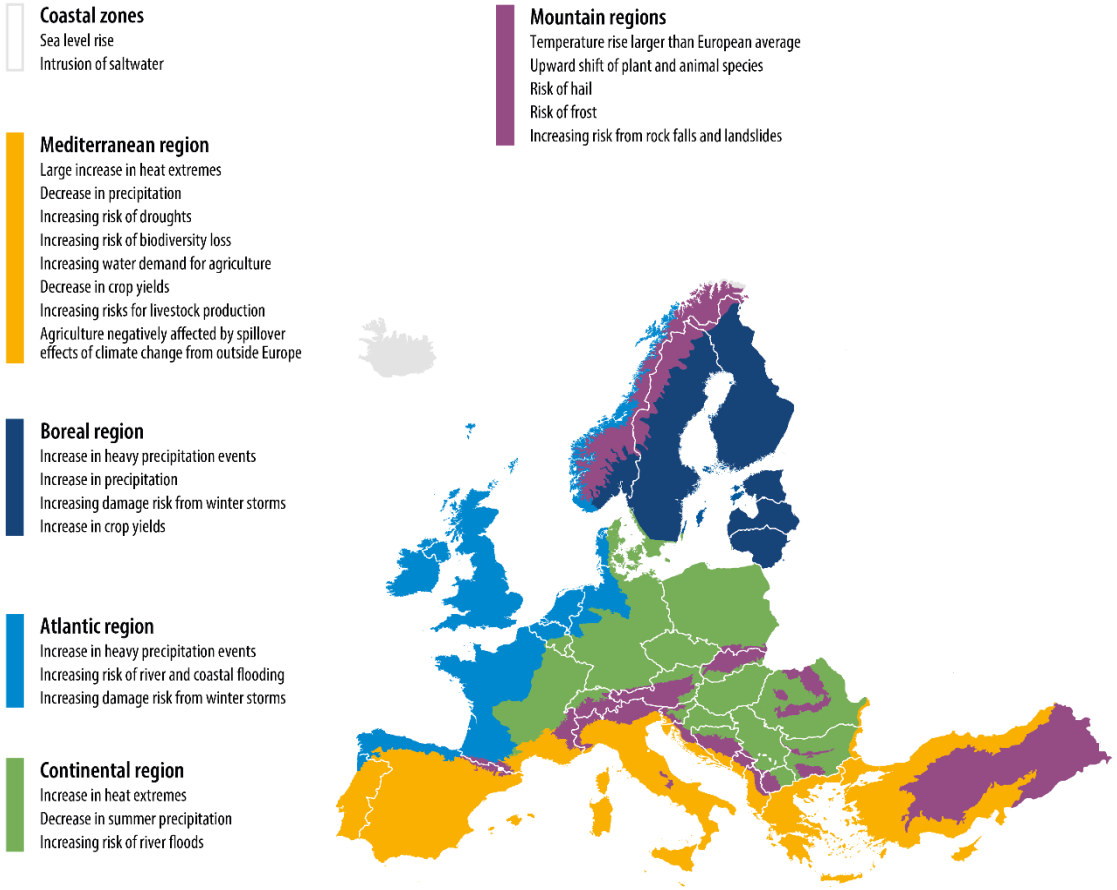
3.5. Natural systems and agriculture

3.5.1. Agriculture, food production and forests

Impacts of climate change on agriculture

Reports from the IPCC, as well as the JRC and EEA all indicate the extensive range of expected climate change impact on the EU's agriculture sector. Although there may be instances where climate change could be positive for certain places, such as in northern Europe, most impacts are expected to be negative. These include impacts on crop yields, crop development, a shortening of the active growing season across large parts of southern and central Europe, coupled with reduced precipitation affecting water and soil availability for plants, especially in the Mediterranean. Climate change will also impact on livestock production systems including effects on milk production, as well as reproductive health and disease susceptibility in dairy cattle. The increased risk of wildfires and increased temperatures will result in the severe drying of soil and vegetation. A key point to note is how projected impacts of climate change on agriculture will vary across regions, crops and different farming systems, as illustrated in Figure 19.

Figure 19 – Main climate change impacts on the agriculture sector in Europe



Source: Climate change adaptation in the agriculture sector in Europe, EEA Report No 4/2019.

Potential for reducing emissions and enhancing removals

The agriculture sector is not only affected by climate change, it is also a driver of climate change through the release of GHGs such as methane (arising from livestock digestion processes and stored animal manure) and nitrous oxide derived from the use of fertilisers. The agriculture sector was responsible for about 10 % of the EU's total GHG emissions in 2015.

Two sets of policy interventions are available to the agriculture sector to address the challenges presented by climate change. They include **mitigation measures** designed to reduce the sources of GHGs (such as converting arable land to grassland to sequester carbon in the soil and the afforestation of cropland for example) as well as **adaptation measures** to address the impacts of climate change. The latter include a range of measures such as choosing crops and varieties better suited to the changing climate, using water more efficiently, breeding more heat-tolerant livestock varieties, improving soil management or introducing a higher diversity of crops.

Within the agricultural sector, there is large scientific interest in developing and using farm models to assess the impacts of policies on agriculture and the environment in the EU.[480] One such modelling exercise[481] suggests that the mitigation options with the highest potential by 2050 are: the application of precision farming to nutrient management (which optimises the application of nutrients to plants as well as adapting fertiliser application more precisely), breeding for productive, healthy and fertile livestock, as well as nitrification inhibitors to reduce the release of nitrous oxide.

Such measures face barriers; actions such as introducing anaerobic digestion for methane recovery or investing in different forms of precision agriculture for example would require significant investment on the part of the enterprise concerned. Other changes in farming practice could involve reducing the intensity and types of production with all the implications this may have for existing farming models. There is also the challenge of overcoming knowledge gaps among farmers concerning climate change, coupled with the need to address levels of IT literacy in a context where just over 30 % of EU farmers are over 65 years of age.

Impacts of CAP measures on climate adaptation and mitigation

The common agricultural policy (CAP) is one of the EU's longest prevailing policies, and has considerable significance for its 10 million farmers. Climate change represents a significant challenge to the CAP, not least because most current CAP measures have objectives other than climate issues, such as supporting farmers' incomes, with few measures having an explicit intervention logic for the achievement of adaptation objectives. A larger number of measures have an intervention logic involving the mitigation of emissions. Livestock and cropland emission make up a large proportion of agricultural GHG emissions. Despite this, the current CAP measures relevant to emissions from livestock are all optional (with the exception of requirements under cross-compliance).[482] In relation to climate mitigation efforts, land management practices such as greening, adherence to Good Agricultural and Environmental Conditions (GAECs), payments for afforestation and the establishment of agro-forestry schemes, are seen as offering high mitigation potential alongside investments in manure management, support for renewable energies and energy efficiency improvements.

---

480 P. Reidsma et al., On the development and use of farm models for policy impact assessment in the European Union - A review, *Agricultural Systems 159*, 2018, pp. 111-125.

481 This is quoted in the European Commission's in-depth analysis in support of its communication, A Clean Planet for all (COM(2018) 773).

482 Evaluation study of the impact of the CAP on climate change and greenhouse gas emissions, Final Report, Alliance Environment, October 2018.

Looking to the future, proposals for the EU's post-2020 agricultural and rural development policies are the subject of on-going discussions between the European Parliament and the Council, which commenced for all three CAP legislative files on 10 November 2020. The European Commission's communication in January 2020 on the European Green Deal Investment Plan indicated that the EU budget 2021-2027 would allocate 40 % of the CAP to climate action with all direct payments conditional on enhanced environmental and climate requirements.[483] This figure was included in the conclusions adopted at the European Council meeting in July 2020. On 20 May 2020, the Commission adopted its communication on 'A Farm to Fork Strategy for a fair and healthy and environmentally friendly food system' accompanied by a draft action plan containing regulatory and non-regulatory measures.[484] This strategy includes a range of approaches or practices relevant to climate change such as precision farming, agro-ecology (including organic farming), carbon farming[485] and agro-forestry. These would be mainstreamed in the EU farm and rural development policy. In November 2020, a study[486] undertaken for Parliament's Committee on Agriculture and Rural Development concluded that, on the basis of current trends, delivering on Green Deal objectives for European agriculture would not be easy. It highlighted the need for significant changes in farming practices if reductions in agricultural GHG emissions are to be achieved, including a reduction in the use of nitrogen fertilisers and in the number of animals farmed. It also recommended changes in human dietary patterns for health, climate and environmental reasons.

Under the Commission's legislative proposals, the CAP will be implemented through national CAP strategic plans. Member States will be free to select and design specific measures they consider most effective, such as eco-schemes. Set in this context, the design and implementation of the new CAP strategic plans will have an 'instrumental role' in delivering on the EU's climate neutrality objective by 2050,[487] offering an opportunity to direct more resources to reducing emissions in the agriculture sector. In relation to the work being undertaken by Member States in the preparation of their CAP strategic plans, the Commission published its recommendations[488] to Member States on their specific needs in mid-December 2020, as part of a structured dialogue.

3.5.2. Environment and biodiversity

This section illustrates the interactions between climate action and environmental policies, aimed specifically at protecting, conserving and enhancing the Union's natural capital. Furthermore, it highlights the potential of 'nature-based solutions' for climate mitigation and adaptation.[489]

---

483 COM(2020)21 final

484 Communication 'A Farm to Fork Strategy for a fair, healthy and environmentally - friendly food system', COM(2020) 381, European Commission May 2020; Draft action plan of the Farm to Fork Strategy (Annex of the Commission Communication COM(2020) 381).

485 The European Commission's Communication 'Stepping up Europe's 2030 climate ambitions' COM (2020) 562 final, published on 17 September 2020, explains that individual farmers or forest managers need to be directly incentivised to store carbon on their land and their forests. Reference is made to an EU carbon farming initiative under the Climate Pact.

486 The Green Deal and the CAP: policy implications to adapt farming practices and to preserve the EU's natural resources, Policy Department for Structural and Cohesion Policies, European Parliament, November 2020.

487 The Farm to Fork Strategy implications for agriculture and the CAP, Policy Department for Structural and Cohesion Policies, European Parliament, May 2020.

488 Communication on recommendations to the Member States as regards their strategic plan for the Common Agricultural Policy, COM(2020) 846 final, European Commission, December 2020

489 For the impacts of climate change on the natural environment and biodiversity in Europe, see section 1.3.

Interactions between environmental protection policies and climate change

The relationship between environmental protection and climate change is complex.[490] In many cases, environmental policies have co-benefits for climate mitigation and adaptation, and vice versa. However, there are also cases where climate action can contribute to degradation of the environment and a loss of biodiversity.

EU policy in the area of **waste management**, which is a major building block of EU environmental policies, aims at the reduction, reuse and recycling of waste. In cases where this is not possible, landfilling of waste should be minimised as it contributes to methane emissions. GHG emissions from waste management in the EU have fallen by 42 % from 1995 to 2017.[491]

The phasing-out of **ozone-depleting chemicals** under the Montreal Protocol had unintended side effects: it supported climate mitigation because the banned substances are also GHGs. However, they were substituted by F-gases, which do not harm the ozone layer but are also powerful GHGs. As outlined in chapter 2, the Kigali amendment to the Montreal Protocol and the EU F-gas regulation aim to limit and phase their use.

In general, a reduction in the use of fossil fuels will have co-benefits for **air quality**, which is at the heart of environmental protection policies. These co-benefits are stronger in regions that have less strict regulation than the EU on preventing air pollution from power plants and vehicles. However, the use of solid biomass (e.g. wood) as a renewable energy source for residential heating leads to substantial emissions of particulate matter and other pollutants.[492] Paradoxically, measures to improve air quality can reinforce climate change because air pollution has helped to reduce global warming by reducing the amount of solar radiation that reaches the earth.[493]

Renewable energy is the key technology for reducing GHG emissions, but the production and installation of all renewable energy technologies have environmental impacts, within the EU and abroad. For example, the growing of crops for bioenergy[494] implies land use and possibly indirect land use change, and requires inputs of energy and fertilisers, all of which are associated with GHG emissions. The use of slow-growing biomass such as trees for heating or electricity generation leads to 'carbon debt' because it takes tens to hundreds of years for new trees to capture the CO_2 released by combustion, creating a risk of GHG overshoot during this period.[495] Furthermore, replacing natural old-growth forests with commercial tree plantations has negative impacts on resilience, biodiversity and carbon storage capacity.[496] Another example is hydroelectricity, which may cause disruptions to river ecology by changing water flow and making it difficult for fish to migrate. The

490 See section 3.5.1 on agriculture and section 3.5.3on oceans.

491 Greenhouse gas emissions from waste, Eurostat, January 2020.

492 See section 3.1 on coherence and coordination across EU policies, which explains other trade-offs between climate action and environmental policies.

493 B. H. Samset, Climate Impacts From a Removal of Anthropogenic Aerosol Emissions, *Geophysical Research Letters*, January 2018.

494 The combustion of biomass for energy releases CO_2, previously captured by photosynthesis while the bioenergy plants were growing. It is therefore considered as carbon-neutral in the energy sector. Emissions associated with the growing and processing of energy biomass are accounted for separately.

495 M. Norton et al., Serious mismatches continue between science and policy in forest bioenergy, *Global Change Biology - Bioenergy*, 2019.

496 S.L. Lewis, Restoring natural forests is the best way to remove atmospheric carbon, *Nature*, April 2019.

damming and flooding of river valleys to create a water reservoir for hydroelectricity has impacts on biodiversity, and reservoirs are a source of methane emissions.[497]

Forests, grasslands, mangroves[498] and wetlands can store large amounts of carbon. **Protected areas**, such as the EU Natura 2000 network, can help to preserve and enhance natural carbon sinks. Healthy biodiverse ecosystems are more resilient to the impacts of climate change.[499] However, natural ecosystems are impacted by climate change both positively and negatively. On the one hand, rising CO_2 concentrations can help enhance plant growth and rising temperatures can help extend vegetation zones towards the poles. On the other hand, climate events such as droughts and heatwaves can lead to the release of forest carbon through lack of water, pest infestation and wildfires, and to methane releases through thawing of permafrost. Wildfires are also a source of methane and air pollutants.

Challenges and opportunities

There is a growing recognition that **nature-based solutions** have an important role in climate change adaptation and mitigation.[500] **Forests** play a key role in removing carbon from the atmosphere. The amount of carbon stored is highest in old-growth (primary) forests, while younger (secondary) forests have a greater potential for removing CO_2.[501] Forest management, afforestation and reforestation can enhance the forest carbon sink. However, deforestation is still a major contributor to climate change in many regions, including outside Europe.[502] Instruments like REDD+[503] reward the preservation and restoration of forests in developing countries, but face the challenges of monitoring the state of the forests in the recipient countries and of ensuring that the area remains forested over the long-term, even after a change of government. Besides forests, the preservation and restoration of grasslands, wetlands and mangroves can also make an important contribution to carbon storage. Moreover, climate-friendly agriculture can help to enhance the carbon content in soils.

Finding the optimal use of land and biomass is another challenge. Land can support carbon-rich biodiverse ecosystems, however there is also demand for land to produce food, wood and fibre, biomass for renewable energy, and bio-based feedstocks to substitute fossil inputs in chemical industry sectors.[504]

Besides carbon storage, nature-based solutions bring benefits in terms of microclimate, water retention, natural spaces for leisure and recreation, and planetary health.[505] The restoration of

---

497 B. R. Deemer et al., Greenhouse Gas Emissions from Reservoir Water Surfaces: A New Global Synthesis, *BioScience 66:11*, November 2016, pp. 949-964.

498 Duarte C.M. et al., The role of coastal plant communities for climate change mitigation and adaptation, *Nature Climate Change*, 2013.

499 Y. Malhi et al., Climate change and ecosystems: threats, opportunities and solutions, *Philosophical Transactions B*, Royal Society Publishing, December 2019.

500 N. Seddon, Understanding the value and limits of nature-based solutions to climate change and other global challenges, *Philosophical Transactions B*, Royal Society, January 2020.

501 Multi-functionality and Sustainability in the European Union's Forests, European Academies' Science Advisory Council, May 2017.

502 The EU contributes indirectly to forest loss by importing products linked to deforestation in third countries. See the textbox on imported deforestation in section 3.6.1

503 *Reducing emissions from deforestation and forest degradation* (REDD+) is a mechanism developed through the UNFCCC to create a financial value for the carbon stored in forests by offering incentives for developing countries to reduce forest-related emissions, enhance forest carbon stock and manage forests sustainably.

504 See section 3.4.2 on industry.

505 The disturbance of ecosystems can lead to the spread of diseases from wild animals to humans (zoonotic diseases).

degraded ecosystems can play a key role in enhancing carbon storage capacity and boosting resilience.[506] Climate adaptation can also benefit from **green infrastructure**. Urban parks and city trees can improve the micro-climate and provide shade[507] and noise shelter. Natural areas can retain water and mitigate the effects of extreme precipitation events.

Launched in the context of the European Green Deal, the new EU biodiversity strategy considers nature-based solutions as essential for emission reduction and climate adaptation.[508] It stresses that investment in natural capital has high economic multipliers and positive climate impact. Therefore 25 % of the EU budget dedicated to climate action should be invested in nature-based solutions and biodiversity, complemented by a natural-capital and circular-economy initiative under InvestEU.

3.5.3. Oceans and fisheries

Impacts of climate change on oceans and the seafood sector

Oceans are not only a primary source of food, they also produce most of the oxygen we breathe and play a fundamental role in **mitigating** climate change. Covering over 70 % of the earth's surface and holding about 97 % of the earth's water, they have a large capacity in storing heat and hold 50 times more carbon dioxide than our atmosphere.[509] However, literally taking the heat from climate change comes with severe consequences. To date, more than 90 % of the excess heat has been taken up by the oceans, and by absorbing human-induced carbon emissions (some 20 % to 30 % of these emissions to date), oceans are also becoming increasingly more acid.[510] Water heatwaves are harming vulnerable ecosystems, especially warm water coral reefs, leading to a loss of biodiversity and threatening **small-scale fisheries** in the lower latitude zones (affecting mostly developing countries). The combination of ocean warming and acidification worsens the impact. The velocity of climate change impacts leaves little space for adaptation and causes both a decline in abundance, as well as geographical shifts in fish populations. These shifts are already taking place, for example a broad range of North Sea fish species shifted by distances ranging from 48 to 403 km over three decades.[511] Forecasting these changes is very complex, as it involves many factors such as the temperature limits of the different life stages of a species, the interaction between species, the level of carbon dioxide and oxygen deficiency. However, available projections show losses in primary productivity, animal biomass and **maximum fisheries catch potential** across the globe with increases only in the Poles (particularly the Artic) and some other locations. Up to **almost a quarter** of fisheries catch potential could be lost by the end of the 21st century due to the effects of climate change in a 'business as usual' scenario. Tropical oceans are particularly projected to experience large impacts in such a scenario: three times or more decrease in catch potential compared to the global average, particularly the western central Pacific Ocean, eastern central Atlantic Ocean and the western Indian Ocean.[512] **Aquaculture** is also impacted. Two-thirds of the food for farmed fish originates from wild catches, while ocean acidification and increasing temperatures also threaten marine aquaculture directly (including an increased risk of disease). Livelihoods that depend highly

---

506 U. Irfan, Why restoring nature is so important to limiting climate change, *Vox*, November 2019.

507 See section 3.3.3 on cities.

508 Communication on EU Biodiversity strategy for 2030 - Bringing nature back into our lives, COM(2020) 380, European Commission, May 2020.

509 The ocean, a carbon sink, Ocean & Climate Platform website.

510 IPCC, 2019a.

511 Food and Agriculture Organization, 2018.

512 N. L. Bindoff et al., Changing Ocean, Marine Ecosystems, and Dependent Communities, In: Special Report on the Ocean and Cryosphere in a Changing Climate, IPCC, 2019.

on seafood and fishing are at risk of food insecurity and loss of income. As these communities live in coastal areas, they are also most immediately affected by **sea level rise**.

Potential for reducing emissions and mitigating the effects

Keeping global warming below 2°C and pursuing efforts to limit global warming even further to 1.5 C, would make an enormous difference for marine life as compared to an unabated emissions scenario. The total loss of **fisheries catch potential** is much lower in a strong mitigation scenario (3.4-6.4 % loss by the end of the 21st century under the +1.5°C scenario) compared to the 'business as usual' scenario (20.5-24.1 % under the +4°C scenario). The area of large catch loss is also projected to be halved by mitigation. Equally, **sea level rise** would be limited to 0.43 metres and below 1 metre by 2100 and 2300 respectively with an increase of 1.5°C, while it would amount to 0.83 metre and several metres respectively with an increase of about 4°C.

Fisheries and aquaculture are not only victim to climate change, they also contribute to it through their GHG emissions, although, due to the limited size of the sector, in relatively small proportion. Fishing vessels contributed to 0.5 % of total global CO_2 emissions in 2012; emissions from aquaculture amount to around 7 % of those from agriculture. There is a lot of room for more energy-efficiency in fishing vessels (e.g. by modernising engines), however any subsidies in this area can be considered as capacity enhancing, sustaining otherwise unprofitable fisheries and possibly contributing to overfishing. Harmful fishery subsidies are subject of long-standing negotiations at WTO level.[513] Alternatively, good fisheries management might improve stock abundance by reducing fishing pressure, resulting finally in higher profits, more fishing efficiency and a reduction in emissions.

Reducing fishing pressure and other human-induced pressures on marine life (such as pollution), thereby maintaining as healthy as possible ecosystems, can compensate for the environmental impacts of climate change. For some fish stocks however, this will also depend on whether the area concerned is still a suitable habitat at all following the impacts of climate change. **Marine protected areas** (MPAs) are an important tool in enhancing resilience against climate change for many reasons. They enhance the production of fish stocks (with spill-over effects to surrounding areas), improve the ability of marine organisms to adapt (as areas of reduced stress) and allow increased carbon take up (e.g. through the restoration of degraded coastal habitats). Well-integrated networks of MPAs can also increase species survival by allowing them to migrate from one area to another.[514]

As regards sea level rise, an ecosystem-based adaptation is the most beneficial because it maintains or restores the coastal ecosystem, benefiting biodiversity and coastal carbon storage. It is clear, however, that resource-rich coastal cities have more means to adapt, while without strong reduction in emissions, tropical deltas, Artic communities and small island states risk facing adaptation limits and a need to relocate.

Oceans also offer enormous potential for decarbonising electricity generation. Offshore wind energy represented 0.3 % of the global electricity supply in 2018, but this might increase up to a share of 5 % globally by 2040 in a sustainable development scenario.[515] Ocean energy, in a much earlier stage of development, represents another promising emerging energy sector. Tidal and wave power even have the greatest potential capacity of all renewable energy sources, however they also tend to have the highest production costs.[516] In Europe, the Commission estimates between 240 and

---

513 Negotiations on fisheries subsidies, World Trade Organization website.

514 Marine protected areas and climate change, International Union for Conservation of Nature, November 2017.

515 Offshore Wind Outlook 2019, International Energy Agency, November 2019.

516 A Green Economy in a Blue World, United Nations Development Programme, 2015.

450 GW of offshore wind power would need to be deployed by 2050 to keep global warming below 1.5°C.[517] Electricity would represent at least 50 % of the total energy production with 30 % of the future electricity demand supplied by offshore wind.[518] Ocean energy is still mainly in a development stage, but would have the potential to meet 10 % of EU's power demand by 2050.[519]

Impacts of EU policies

The **Marine Strategy Framework Directive** (MSFD), adopted in 2008, provides the legal framework in the field of marine environmental policy. Its holistic approach towards human-induced environmental pressures affecting marine ecosystems (such as eutrophication, sea-floor damage, marine litter, introduction of non-indigenous species and underwater noise), aims at enhancing and maintaining the resilience of marine ecosystems. Although assessing the effects of climate change is not a specific objective, the MSFD helps to distinguish wider climate-change impacts such as hydrological alterations (e.g. changes in salinity, water temperature, sea level), changes in water chemistry (in particular increased acidification), and biological changes (e.g. in species distribution). It also helps to explore solutions for climate change mitigation and to apply an ecosystem-based approach in climate change adaptation. The 2020 Commission implementation report[520] stated that considerable efforts were made in integrating existing policies and developing completely new measures, but not all the pressures on the marine environment were covered properly. The objective to reach good environmental status by 2020, as required by the directive, has therefore not been reached and increased action will be needed post-2020. The accompanying report from the EEA points to the poor condition of European seas due to the overexploitation of marine resources, pollution and climate change, but also draws lessons from observed successes in marine recovery and proposes further solutions based on an ecosystem-based management.[521] The MSFD will be reviewed by mid-2023 and, if necessary, amended.

Regarding **marine protected areas**, the EU surpassed the international commitment it made under the Convention on Biological Diversity to establish MPAs in 10 % of its marine waters.[522] Shortcomings include an uneven geographical distribution across sea basins, a concentration in coastal areas while a significant number of offshore habitats are not represented, and a lack of proper MPA management.[523] As part of the Green Deal, the Commission presented its biodiversity strategy for 2030 in May 2020, which proposes a new binding target of 30 % MPAs in EU waters by 2030,[524] an ambition that was previously expressed in the European Parliament resolution of 15 January 2020 on the European Green Deal.

The conservation of marine biological resources is an exclusive competence of the EU and forms the core of the **common fisheries policy** (CFP). The latest 2013 reform of this policy represented a major milestone, requiring an exploitation of all stocks at sustainable levels by 2020, and provided several tools to support this target. Important progress has been made in the north-east Atlantic and

517 Onshore and offshore wind, European Commission website.

518 Our energy, our future How offshore wind will help Europe go carbon-neutral, Wind Europe, November 2019.

519 Ocean energy strategic roadmap: building ocean energy for Europe, Ocean Energy Forum, 2016.

520 Commission implementation report of the Marine Strategy Framework Directive COM(2020) 259 final, European Commission, June 2020.

521 EEA, 2020.

522 Marine protected areas, European Environment Agency website.

523 Protecting Our Ocean: Europe's challenges to meet the 2020 deadlines, WWF, September 2019.

524 COM(2020) 380

adjacent seas.[525] Scientific advice is the basis for setting fishing opportunities, and if necessary a fishery is closed to allow stock recovery (for example, this is currently the case for eastern Baltic cod, which is suffering from various pressures, including low oxygen and high water temperatures).[526] More specifically, in relation to climate change, an own-initiative report from the European Parliament looks specifically into the consequences for fish stocks and fisheries related to rising seawater temperatures.[527] The draft report, considered in the Committee on Fisheries on 3 December 2020, highlights the Mediterranean as one of the most prominent and vulnerable climate change hotspots, where climate change contributes to a decline in native pelagic species (such as anchovy and sardine), the arrival of non-indigenous species and a higher risk in disease outbreaks in aquaculture. Besides the need for increased climate action and strengthened scientific programmes, the rapporteur calls for an institutional response (including impact assessments, regionalisation, cross-border cooperation and adaptation measures). In December 2020, the co-legislators also reached provisional agreement on the European Maritime and Fisheries Fund for 2021-2027. The compromise allows for fleet investments under strict conditions, so that they do not contribute to overcapacity and overfishing. These fleet measures include support for engine modernisation and other energy-efficient investments in vessels. In line with the Green Deal, at least 30 % of the financing must be used for climate action.

Through international commitments and established policies, the EU is also an active player in shaping **ocean governance**.[528] Global action to protect and restore marine biodiversity helps to build climate resilience. A 2019 report outlines the progress made since the adoption of an ocean governance agenda as part of EU's response to the United Nations 2030 Agenda and the SDGs, in particular SDG 14 on 'life below water'.[529] Other examples of EU action on the international stage are the 22 commitments, worth €540 million, made by the EU during the 2019 Our Ocean Conference.[530] Through its marine environment monitoring service, Copernicus is an important EU observation tool providing information on the state and dynamics of the oceans, including weather forecasting and climate change monitoring.[531]

The EU is a world leader in both offshore wind energy and ocean energy. Offshore wind in Europe is an established blue economy sector, while ocean energy is supported through EU funded research. In its communication on the Green Deal, the Commission mentions that increasing offshore wind production will be an essential part of the clean energy transition. In November 2020, the Commission published an EU strategy on offshore renewable energy production.[532] The strategy aims to dramatically increase the EU's production of electricity from offshore renewable energy sources from 12 GW at the present time, to over 60 GW by 2030 and 300 GW by 2050, which will require the commercial development of floating technologies. The strategy also covers renewable

---

525 Communication on the State of Play of the Common Fisheries Policy and Consultation on the Fishing Opportunities for 2020, COM(2019)274 final. European Commission, June 2019.

526 F. Scholaert, Support for fishermen affected by the eastern Baltic cod closure, EPRS, European Parliament, January 2020.

527 Consequences for fish stocks and fisheries related to rising seawater temperatures (2019/2163(INI)), European Parliament.

528 F. Scholaert, Ocean governance and blue growth, EPRS, European Parliament, November 2019.

529 Improving International Ocean Governance – Two years of progress, JOIN/2019/4 final, European Commission and High Representative of the Union for Foreign Affairs and Security Policy, March 2019.

530 EU makes 22 new commitments for clean, healthy and safe oceans and launches The Ocean Tracker, press release, European Commission, 22 October 2019.

531 Copernicus Marine Service, website.

532 An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future (COM(2020)741 final), European Commission, November 2020.

technologies such as tidal and wave power, floating solar energy, and algae for biofuels. **Maritime spatial planning** (MSP), as part of EU integrated maritime policy (IMP), is used to manage the increased competition for maritime space between blue economy sectors.[533]

3.6. International aspects

3.6.1. Climate action and international relations

EU and international climate action

Climate change has a stronger international dimension than most other environmental issues. This is due to the fact that GHGs mix in the atmosphere so that emissions or removals of GHGs in one region have worldwide climate impacts. This situation makes international cooperation both necessary and difficult (see section 2.1).

The EU has ambitious plans to achieve net-zero GHG emissions by 2050, but is responsible for only 8.5 % of global GHG emissions (2018). To address climate change effectively and meet the goals of the Paris Agreement, the EU's efforts would need to be matched by other global economies. However, international climate action is stalling. Global carbon emissions continue to grow; and countries' climate plans (Nationally Determined Contributions) are insufficient to collectively reach the Paris Agreement temperature targets. International climate finance is struggling to reach the agreed target of US$100 billion by 2020, let alone the amounts needed by developing countries to implement their plans. Two successive climate conferences (COP24 and COP25) failed to finalise the rulebook for the Paris Agreement, and COP26 was postponed to November 2021 due to the Covid-19 pandemic. At the beginning of 2020, the EU was the only major economy with a climate neutrality target; it has now been joined by other industrial economies, together representing around 75 % of global GDP.[534]

Challenges and opportunities for EU action

The EU faces the challenge of motivating other countries to raise their ambition in line with the Paris Agreement ahead of COP26. The EU can influence the climate policy of other countries through climate diplomacy, trade policy (see section 3.6.1), regulation, carbon pricing, setting of standards, technological cooperation and development aid.

However, as the example of international aviation has shown, EU action can lead to international conflict. When the EU included international aviation to and from EEA airports in the EU ETS, several international partners refused to comply with the rules and threatened to take counter-measures.[535] In consequence, the EU suspended the application of the ETS to extra-EEA flights and decided to work towards a market-based mechanism in the ICAO framework (see section 21.2). Similar situations may arise in connection with the introduction of carbon border adjustments or the inclusion of shipping in the EU ETS.

The EU faces the challenge of achieving its own transition towards climate neutrality without damaging the international competitiveness of its industries.[536] Indeed, the European Green Deal is

---

533 F. Scholaert, The blue economy: overview and EU policy framework, EPRS, European Parliament, January 2020.

534 5 years after the Paris Agreement, the largest global economies are engaging in the race towards climate neutrality, infographic, Jacques Delors Institute, December 2020.

535 The United States passed a law that prohibits US airlines to participate in the EU ETS. China reportedly threatened to cancel orders of Airbus planes in retaliation.

536 When climate policy in one region raises the cost for industry, production may shift to other regions with less strict standards, known as carbon leakage.

presented as a growth strategy the economic benefits of which exceed the costs. If Europe can achieve low-carbon growth and prosperity while strengthening social cohesion, this can serve as a model for other regions to follow.

If other world regions take decisive climate action, the EU faces the challenge and opportunity to move towards more sustainable models of consumption, as it will become more difficult to import products that are carbon-intensive or linked to land use change and deforestation.

The low-carbon transition and the expansion of local renewable energy sources presents an opportunity for Europe to reduce its dependency on the imports of fossil fuels. However, there is a risk of creating a new dependency on raw materials (e.g. rare earth minerals, lithium and cobalt) and components (solar photovoltaic panels and batteries), which are essential for renewable energy and e-mobility.

Climate change is considered a threat multiplier,[537] as it can lead to humanitarian emergencies, migration (see section 3.6.3), trade disruption and conflicts over land and water. This presents both a challenge and an opportunity for the EU to engage internationally to mitigate risks and ensure security.

3.6.2. Trade policy

Impacts of climate change on international trade

Climate change may directly and indirectly disrupt and decrease international trade, but also create sector-specific opportunities as geographical competitive advantages shift. Primary direct impacts of climate change on trade concern the supply, production, transport and distribution of trade in goods. Extreme weather events and natural disasters may damage infrastructure, e.g. shutting down ports or damaging bridges.[538] Changes in atmospheric conditions such as humidity, rainfall, sea level and ice mass influence trade routes e.g. by eroding road surfaces, affecting air operations, or slowing down the speed of shipping. Trade in services such as shipping, transport, tourism and insurance may be particularly vulnerable to climate change. At the same time, as mentioned above, retreating ice masses may open up new trade routes in the Arctic, subject to the development of appropriate logistics and infrastructure.

Generally, by 2060, the OECD has estimated that overall global exports would decrease by only 1.8 % relative to the baseline without the adverse effects of climate change. At the regional level, estimated trade decreases become more pronounced, with African and Asian states most affected. For low-income countries, higher temperatures have already been found to decrease exports: according to past data, +1°C translated to a between 2-5.7 % decrease in exports by value, in particular for agricultural goods, but also for light manufacturing products such as electric equipment, footwear, and wood manufacturing.[539] Meanwhile, specific crops and regions may flourish with small temperature increases. Other studies have found highly uneven impacts of climate change on trade in agricultural goods, due to the different and partially unpredictable developments in production capacities and regional economies.[540]

---

537 Quadrennial Defense Review, United States Department of Defense, 2014.

538 R. Dellink et al., International trade consequences of climate change, OECD Trade and Environment Working Papers 2017/01, OECD, 2017.

539 M. Dell, B. Jones and B. Olken, Temperature Shocks and Economic Growth: Evidence from the Last Half Century, *American Economic Journal: Macroeconomics 2012*, 4(3): 66-95.

540 L. Porfirio, D. Newth, J. Finnigan, and Y. Cai. Economic shifts in agricultural production and trade due to climate change, *Palgrave Communications*, 2008.

In terms of indirect effects of climate change on trade, there are income effects (falling GDP as a result of a decrease in trade due to climate change), compositional effects in agriculture and food (e.g. Brazil exporting a comparatively higher share of food to the EU), and spill-over effects (such as damage in one region influencing trade patterns in another).[541]

EU driven deforestation

The EU is an important contributor to greenhouse gas emissions (GHG) originating from deforestation and land conversion. Due to imports and consumption of 7-10 % of 'forest risk commodities',[542] the EU contributes to climate change even though the environmental degradation and resulting CO_2 emissions occur in exporting countries. Globally, expansion for agricultural land is the main driver of deforestation.[543] It has been estimated that global deforestation accounts for 15 % of GHG emissions.

Despite many private and public initiatives, pledges and unmet targets in ending deforestation, the practice has continued and is projected to persist. Challenges in addressing this complex and multifaceted problem lie both in supply and demand countries, as well as in global financing systems. The EU has so far addressed global deforestation in legislation on illegal timber[544] and on biofuels.[545] Nevertheless, if EU import and consumption patterns remain unchanged, they will continue to drive global deforestation.

Lately, a clear consensus has emerged at EU level that there is an urgent need to act to halt EU-driven global deforestation. The European Parliament, following its previous calls for action adopted on 22 October 2020 an own-initiative legislative proposal[546] called on the European Commission to put forward rules to end EU-driven global deforestation through mandatory due diligence for companies placing products on the EU market. Members have underlined that such a framework should also be extended to include high-carbon stock and biodiversity-rich ecosystems other than forests, such as marine and coastal ecosystems, wetlands, peatlands or savannahs, to avoid pressure being shifted onto these landscapes. The European Commission is planning to publish a proposal in 2021 and the Council has also supported actions in the field. Moreover, the private sector also seems to favour EU level action in this field. The EU action in fighting imports of illegal timber has been replicated elsewhere in the world and it is believed that the same positive effect could be obtained when addressing embedded deforestation from imported agricultural commodities.

Impacts of trade and climate policies

Climate action policies in themselves affect international trade, and vice versa. Carbon pricing initiatives, such as the EU ETS, influence companies' comparative advantage and production costs. As a result, the Commission has proposed an objective of developing a carbon border adjustment mechanism to avoid carbon leakage and nudge partner countries to adopt carbon pricing mechanisms. The essential idea behind the carbon border adjustment measure is to apply a cost (e.g. tax, or tariff with export rebate) at the border, based on the carbon footprint of the product. Climate objectives are in turn integrated into the newer EU trade agreements,[547] for instance by

---

541 Dellink, R. et al., 2017.

542 Such as e.g. palm oil, soy, beef, rubber, maize, cocoa and coffee.

543 Expansion for agricultural land is estimated to be responsible for 80 % of deforestation, followed by infrastructure construction at 20 %.

544 Regulation (EU) No 995/2010 of the European Parliament and of the Council laying down the obligations of operators who place timber and timber products on the market.

545 Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources. Directive 2018/2001 progressively eliminates from the market feed and food-based biofuels that bare a high indirect land use change risk.

546 European Parliament resolution of 22 October 2020 with recommendations to the Commission on an EU legal framework to halt and reverse EU-driven global deforestation, 2020/2006(INL).

547 EU trade policy and sustainable development, European Commission, website

lowering tariffs on environmental goods,[548] or by allowing for the reinstatement of tariffs in cases of non-respect of the sustainability provisions. Benefitting from EU unilateral preferences – given to developing and least developed countries – could be made conditional on the implementation of the Paris Agreement. A multilateral or plurilateral effort to discipline fossil fuel subsidies could be made in the context of the World Trade Organization (WTO).

3.6.3. Migration

Migration induced by global climate change

Throughout the entire human history, natural disasters and environmental changes have driven human migration. The International Organization for Migration (IOM) defines environmental migrants as 'people who due to sudden or gradual changes in the environment, which have a negative effect on their living conditions, are forced to abandon their homes, temporarily or permanently, and move to other parts of their own country or outside it'. In the last decade, in Europe (including Russia), 700 000 people have been displaced by natural disasters[549] (such as fires, floods, storms and avalanches).

There is increasing recognition of the link between global climate change on the one hand, and sudden natural disasters as well as gradual environmental changes that force people to move, on the other.[550] Climate change exacerbates sudden-onset disasters, such as floods, storms and droughts. Global climate change also compounds slow environmental degradation, including that which is caused partly or wholly by intensive human activity, such as degradation of agricultural land, disruption of ecosystems, water scarcity, desertification or coastal erosion. For example, according to FAO, between 1990 and 2015, 3.2 % of the world forests were lost.[551] Local deforestation exacerbates droughts and floods, phenomena which are also supposedly made worse by global climate change, and which force people to move. Global climate change will impact coastal areas at risk, through storms or increased sea levels. Population levels in low-elevation coastal zones are expected to increase in the future, due to a combination of natural population growth and rural-urban migration, making them even more vulnerable to climate change.[552] Environmental change can also exacerbate potential conflict drivers, contributing to flows of refugees, as is already the case in the Sahel.

Experts agree that migration is likely to increase in the future due to climate change. The IPCC has warned that climate change will influence migration patterns. According to a 2018 study by the World Bank, by 2050 'without concrete climate and development action, almost 3% of the population of these three regions [Sub-Saharan Africa, South Asia, and Latin America] - could be forced to move within their own countries to escape the slow-onset impacts of climate change'.[553] Without strong adaptation efforts, more than 700 million people living in low-lying coastal areas and small islands states risk facing more intense storms, flooding and finally land loss and relocation.

The international protection gap

While most of the people affected flee environmental disasters in their own country, others cross borders. Identifying migration induced by global climate change against other types of

548 S. Vaughan and B. Lee, Trade can be a driver of climate action, IISD, 2019.

549 Extreme weather exiles: how climate change is turning Europeans into migrants, Euronews, 17 June 2020.

550 E. Wilkinson et al., Climate-induced migration and displacement: closing the policy gap, Overseas Development Institute, October 2016.

551 The state of the world's forests, UN Food and Agriculture Organization (FAO), 2018.

552 Migration, environment and climate change: Literature review, German Environment Agency, March 2020.

553 K. K. Rigaud et al., Groundswell: Preparing for Internal Climate Migration, World Bank, 2018.

environmental migration and economic migration would be instrumental to addressing the issue, in line with calls for international climate solidarity and justice. The term of 'climate refugee' has been in use for several decades, but it is not officially recognised under any existing international law.[554] 'Climate refugees' do not qualify for international protection under the Geneva Refugee Convention (1951), which only covers people who have a well-founded fear of being persecuted on grounds related to race, religion, nationality or membership of a particular social group or political opinion, and are unable or unwilling, owing to fear of persecution, to seek protection from their home countries. To establish a similar international protection framework for people fleeing climate change, either by expanding the scope of the Geneva Convention or by adopting a separate international treaty, the status of climate refugee would require legal clarity and certainty, similar to that of 'refugee' under the Geneva Convention. As climate change sets in gradually, slowly degrading the environment and related socio-economic conditions often alongside other factors such as population pressures, it is difficult to prove that someone was forced to flee mainly due to global climate change.[555] Moreover, to claim the protection of another state, it would be necessary to prove that one cannot claim the protection of one's own state, as a recent ruling by the UN Human Rights Committee has made clear.[556] Except for very low-lying island states threatened by rising sea levels, all other countries have the possibility to adapt and mitigate the effects of climate change. Alternative avenues[557] to a legally binding instrument for protecting climate migrants have been proposed. The Platform on Disaster Displacement is a state-led initiative that encourages states to adopt effective norms and practices for protecting people displaced across borders in the context of disasters and climate change. In the framework of the Paris Agreement on climate change (2015), a taskforce was established to make recommendations for dealing with displacement related to the adverse impacts of climate change. The Global Compact for Migration, adopted in 2018, focuses on a preventive approach, seeking to minimise 'the adverse drivers and structural factors that compel people to leave their country of origin', among these 'natural disasters, the adverse effects of climate change, environmental degradation'. When resilience measures are impossible, the proposal is to 'enhance availability and flexibility of pathways for regular migration'. Those on the move should benefit from humanitarian assistance and protection.

Opportunities provided by climate action to tackle migration

Measures to prevent and respond to environmental devastation induced by climate change can provide opportunities for potential labour migrants to remain at home. They could be involved in mitigation or adaptation projects (e.g. by building dams to stop rising seas from encroaching on land, or relocating settlements to higher ground). The tsunami in the Indian Ocean in 2004, 'acted as a pull factor rather than a push factor'[558] for migration; people moved to the area to support their families or to work in aid and reconstruction projects. Evidence shows that people affected by climate change would rather stay where they are and adapt to new conditions than migrate to another country. New Zealand has opened an immigration channel to citizens of Kiribati, a country of low islands threatened by rising sea levels. The immigration quotas it has provided, even if low, have not been fully used by applicants.[559]

---

554 J. Apap, The concept of 'climate refugee' - Towards a possible definition, EPRS, European Parliament, February 2019.

555 B. Benjamin Glahn, 'Climate refugees'? Addressing the international legal gaps, International Bar Association, 2009.

556 Historic UN Human Rights case opens door to climate change asylum claims, UN Human Rights Committee, January 2020.

557 S. Atapattu, 'Climate Refugees' and the Role of International Law, Oxford Research Group blog, September 2018.

558 S. Klepp, Climate Change and Migration, Oxford Research Encyclopedias, April 2017.

559 B. Alexis-Martin et al., Climate crisis: migration cannot be the only option for people living on 'drowning' islands, *The Conversation*, July 2019.

EU response

The EU has recognised that a 'comprehensive migration policy should consider environmentally triggered migration'.[560] Exploring possibilities for providing international protection in the EU to 'climate refugees' is still at an early stage.[561] The issues have been addressed in several internal Commission documents. In a 2017 resolution,[562] the European Parliament expressed the view that persons displaced by the effects of climate change should be given a special international protection status that takes account of their specific situation.

In line with the overall EU approach to migration, which emphasises tackling the root causes of irregular migration, the EU helps the most affected countries to put in place measures to adapt and mitigate the causes of climate change. The new EU Pact on Migration and Asylum[563] calls for climate change to be addressed in connection with other policies as part of multidimensional tailor-made partnerships with third countries. The EU provides funding and support for climate change adaptation in developing countries within the UNFCCC. The EU also uses its development aid, e.g. through its Global Climate Change Alliance (GCCA) initiative. The European Fund for Sustainable Development seeks to contribute to the implementation of the Paris Agreement on Climate Change, requiring 28 % of its financing to be invested in measures related to climate action, renewable energy and resource efficiency. The European Emergency Trust Fund for stability and addressing the root causes of irregular migration and displaced persons in Africa supports, through various projects, communities affected by environmental changes in the Sahel and eastern Africa.

560 Climate change, environmental degradation and migration, SWD/2013/0138, staff working document, European Commission, 2013.

561 Apap, 2019.

562 European Parliament resolution of 5 April 2017 on addressing refugee and migrant movements: the role of EU External Action.

563 Communication on a New Pact on Migration and Asylum, COM/2020/381 final, European Commission, September 2020.

4. Outlook

In the current legislative term, EU co-legislators will be called upon to take far-reaching decisions that will shape climate policy, the EU economy and international relations for decades to come. As the preceding chapters have shown, the changes required to achieve climate neutrality in line with the Paris Agreement targets will need to take place at unprecedented speed, breadth and depth, and are thoroughly interlinked.

While climate policy in the past mainly focused on the energy sector, efforts in all sectors are now needed to achieve deep emission cuts and mid-century climate neutrality. There is a growing recognition that the limits of incremental improvement have been reached, and transformative systemic change is now needed.[564]

Such profound transformations will not happen without social impacts. Although the European Green Deal is expected to result in economic growth and job creation, the benefits will not be distributed equally, so that measures are needed to ensure a just transition. The European Climate Pact will provide a forum for establishing a broad societal consensus, while the European Committee of the Regions[565] and the European Economic and Social Committee[566] can catalyse the contributions of local and regional authorities and civil society, respectively.

Climate action will need to be defined in the context of the coronavirus crisis. The lockdown measures taken to contain the pandemic have led to a drop in GHG emissions, but this is likely to be a temporary effect.[567] The crisis has resulted in a record fall in economic activity and investment, for example in energy efficiency.[568] Governments around the world have initiated economic rescue programmes worth trillions of euros, which can provide an opportunity to drive the transition towards climate neutrality, but may also perpetuate outdated fossil-fuel based business models.[569]

Public and private finance will be critical to the success of the success of the transition towards climate neutrality. All future investment must be green investment, aiming at accelerating the transition and avoiding the risk of stranded assets and destabilisation of the financial system.

The next legislative task will be setting the EU's 2030 emission reduction target in the European Climate Law. The Commission and the European Council favour a target of 55 % reduction of net GHG emissions, while the Parliament calls for a 60 % reduction. Other issues in the negotiations on

564 Towards a sustainable future: transformative change and post-COVID-19 priorities, European Academies Science Advisory Council, December 2020.

565 Green Deal Going Local, European Committee of the Regions website.

566 European Climate Law, Opinion NAT/784, European Economic and Social Committee, July 2020.

567 C. Le Quéré et al., Fossil CO2 emissions in the post-COVID-19 era, *Nature Climate Change*, March 2021.

568 Energy Efficiency 2020, International Energy Agency, December 2020.

569 C. Hepburn, B. O'Callaghan, N. Stern, J. Stiglitz and D. Zenghelis, Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?, *Oxford Review of Economic Policy*, May 2020.

the Climate Law include the establishment of a *European Climate Change Council* and the emission reduction obligations of individual Member States.

Once an agreement on the 2030 target has been reached, the 2030 climate and energy framework will need to be revised in line with the agreed ambition. This will be a challenging task as it implies modification of a legislative framework, which is already being applied. The expected legislative proposals under the Commission's 'Fit for 55' package are listed in Table 3.

Table 3 – Initiatives under the Fit for 55 package

Initiatives under the Fit for 55 package and their timeline			
Revision of the EU ETS, including a proposal for ETS as own resource	Q2, 2021	Carbon Border Adjustment Mechanism (CBAM) and a proposal for own resource	Q2, 2021
Effort Sharing Regulation (ESR)	Q2, 2021	Revision of the Energy Tax Directive	Q2, 2021
Amendment of the Renewable Energy Directive	Q2, 2021	Amendment of the Energy Efficiency Directive	Q2, 2021
Reducing methane emissions in the energy sector	Q2, 2021	Revision of the LULUCF Regulation	Q2, 2021
Revision of CO_2 emission performance standards for new passenger cars and vans	Q2, 2021	Revision of the Directive on deployment of alternative fuels infrastructure	Q2, 2021
Revision of the Third Energy Package for gas and competitive decarbonised gas markets	Q4, 2021	Revision of the energy performance of Buildings Directive	Q4, 2021

Data source: Communication on 2021 Commission work programme – annexes, COM(2020) 690 final, European Commission, October 2020.

The year 2021 will be of critical importance for international climate action. The parties to the Paris Agreement must submit their long-term strategies and updated NDCs ahead of the COP26 climate conference in November.[570] A number of major economies have already committed to long-term climate-neutrality. The new and updated commitments will be on the agenda of COP26 in Glasgow, which will also finalise the rulebook for the Paris Agreement.

Moreover, the election of Joe Biden as President of the United States changes the international dynamics, as the country with the world's second-largest GHG emissions re-joined the Paris Agreement and plans to raise its climate ambition.

Finally, the EU plans to introduce a carbon border adjustment mechanism, which aims at safeguarding the international competitiveness of European industries, while also offering an opportunity to inject climate considerations in international trade relations.

[570] Long-term strategies and updated NDCs were due in 2020, but their delivery has, in many cases, been delayed in connection with the coronavirus crisis and the postponement of COP26. By 31 December 2020, 48 updated NDCs and 27 long-term strategies were submitted to the UNFCCC.

5. REFERENCES

2018 Biennial Assessment and Overview of Climate Finance Flows, UNFCCC, 2018.

A Just Transition Fund - How the EU budget can best assist in the necessary transition from fossil fuels to sustainable energy, Policy Department for Budgetary Affairs, European Parliament, April 2020.

Adaptation challenges and opportunities for the European energy system – Building a climate-resistant low-carbon energy system - Report No 1/2019, European Environment Agency, 2019 (EEA, 2019b).

Adaptation Gap Report 2020, United Nations Environment Programme, January 2021.

Air pollution - Our health still insufficiently protected, Special Report 23/2018, European Court of Auditors, 2018.

Amanatidis G., European policies on climate and energy towards 2020, 2030 and 2050, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, January 2019.

Amelung B. and Moreno A., Costing the impact of climate change on tourism in Europe: results of the PESETA project, *Climatic Change,* 2012.

Amended proposal for a Council Regulation laying down the multiannual financial framework for the years 2021 to 2027, COM(2020) 443 final, European Commission, May 2020.

Apap J., The concept of 'climate refugee': Towards a possible definition, EPRS, European Parliament, January 2019.

Appraising the quality of the European Commission's impact assessments - trends and developments from 2015 to 2018, EPRS, European Parliament, December 2019.

Assessment of the Just Transition Fund proposal, Policy Department for Structural and Cohesion Policies, European Parliament, February 2020.

Attitudes of European citizens towards the Environment. Special Eurobarometer 501, European Commission, 2020.

Bassot E., The von der Leyen Commission's six priorities: State of play in autumn 2020, EPRS, European Parliament, September 2020.

Bataille C. and Fraser. S., Low and zero emissions in the steel and cement industries: Barriers, technologies and policies, OECD, 2019.

Boucher P., Understanding public responses to low carbon technologies, EPRS, European Parliament, January 2019.

Boulamanti A. and Moya Rivera J.A., Energy efficiency and GHG emissions: Prospective scenarios for the Chemical and Petrochemical Industry, Joint Research Centre, 2017.

Cameron Hepburn C. et al., Will COVID-19 fiscal recovery packages accelerate or retard progress on climate change?, *Oxford Review of Economic Policy,* 2020.

CAP specific objectives … explained. Agriculture and climate mitigation, Brief No 4, European Commission, 2018.

Cerulli-Harms A. et. al., Behavioural study on consumers' engagement in the circular economy, European Commission, October 2018.

Claros Gimeno E. and Pape M., Transport CO_2 emissions in focus, EPRS, European Parliament, October 2020.

Clean Energy Innovation, International Energy Agency, July 2020.

Climate Change 2014: Synthesis Report, Intergovernmental Panel on Climate Change, (IPCC, 2014).

Climate change adaptation in the agriculture sector in Europe - Report No 4/2019, European Environment Agency, 2019 (EEA, 2019a).

Climate Change and Migration, Policy Department for Citizens' Rights and Constitutional Affairs, European Parliament, July 2020.

Climate change impacts in Europe, European Environment Agency, 2020 (EEA, 2020).

Climate change, impacts and vulnerability in Europe 2016: an indicator-based report, Report No 1/2017, European Environment Agency, 2017 (EEA, 2017).

Climate change: How do we know?, National Aeronautics and Space Administration, 2020 (NASA, 2020).

Collova C. and Vikolainen V., European climate pact - Pre-legislative synthesis of national, regional and local positions on the European Commission's initiative, EPRS, European Parliament, October 2020.

Consumer Information Tools and Climate Change, Facilitating low-carbon choices in Tourism, Buildings and Food Systems, United Nations Environment Programme, 2019.

Dafnomilis I. et al., Exploring the impact of the COVID-19 pandemic on global emission projections: Assessment of green versus non-green recovery, PBL Netherlands Environmental Assessment Agency, 2020.

D'Alfonso A., European Green Deal Investment Plan: Main elements and possible impact of the coronavirus pandemic, EPRS, European Parliament, April 2020.

D'Alfonso A., Mainstreaming of climate action in the EU budget: Impact of a political objective, EPRS, European Parliament, October 2019.

D'Ambrogio E., EU-India: Cooperation on climate, EPRS, European Parliament, November 2020.

D'Aprile P. et al., Net-Zero Europe: Decarbonization pathways and socioeconomic implications, Mc Kinsey, November 2020.

Davis S.J.et al. Net-zero emissions energy systems, *Science,* June 2018.

Debyser A., ICAO Agreement on CO2 emissions from aviation, EPRS, European Parliament, September 2019.

Decarbonisation of industrial heat: The iron and steel sector, Joint Research Centre, European Commission, 2020.

Documenting climate mainstreaming in the EU budget, Policy Department for Budgetary Affairs, DG IPOL, European Parliament, July 2020.

Eichhorn J., Molthof L., and Nicke S., From Climate Change Awareness to Climate Crisis Action: Public Perceptions in Europe and the United States, Open Society European Policy Institute, November 2020.

Emissions Gap Report 2020, UN Environment Programme, December 2020.

Energy-intensive industries: Challenges and opportunities in energy transition, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, July 2020.

Environment, Studies on EU action to combat deforestation and palm oil, European Commission, website.

Environmental Indicator Report 2018 – in support of the monitoring of the Seventh Environment Action Programme - EEA Report No 19/2018, European Environment Agency, 2018.

Erbach G. and Jensen L., EU hydrogen policy: Hydrogen as an energy carrier for a climate-neutral economy, EPRS, European Parliament, February 2021.

Erbach G. with Andreo Victoria G., Carbon dioxide removal: Nature-based and technological solutions, EPRS, European Parliament, February 2021.

Erbach G., CO2 emission standards for heavy-duty vehicles, EU Legislation in progress, EPRS, European Parliament, August 2019.

Erbach G., CO2 emissions from aviation, EU Legislation in progress, EPRS, European Parliament, January 2018.

Erbach G., CO2 standards for new cars and vans, EU Legislation in progress, EPRS, European Parliament, May 2019.

Erbach G., Effort sharing regulation, 2021-2030: Limiting Member States' carbon emissions, EU Legislation in progress, EPRS, European Parliament, July 2018.

Erbach G., Energy storage and sector coupling: Towards an integrated, decarbonised energy system, EPRS, European Parliament, June 2019.

Erbach G., European climate law, EU Legislation in progress, EPRS, European Parliament, December 2020.

Erbach G., Impact of the coronavirus crisis on climate action and the European Green Deal, EPRS, European Parliament, April 2020.

Erbach G., Land use in the EU 2030 climate and energy framework, EU Legislation in progress, EPRS, European Parliament, July 2018.

Erbach G., Monitoring, reporting and verification of CO2 emissions from maritime transport, EU Legislation in progress, EPRS, European Parliament, October 2020.

Erbach G., Post-2020 reform of the EU Emissions Trading System, EU Legislation in progress, EPRS, European Parliament, May 2018.

Erbach G., Review of the Clean Vehicles Directive, EU Legislation in progress, EPRS, European Parliament, August 2019.

Erbach G., Using the Montreal Protocol for climate action, EPRS, European Parliament, November 2016.

EU Environment and Climate Change Policies State of play, current and future challenges, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, September 2019.

Evaluation of the 7th Environment Action Programme to 2020 'Living well within the limits of our planet', (SWD2019) 181 final, Part 2/2, European Commission, May 2019.

Evaluation of the Industrial Emissions Directive, SWD(2020)181 final and SWD(2020)182 final, European Commission, 2020.

Evas T., Heflich A. and Navarra C., An EU legal framework to halt and reverse EU-driven global deforestation: European added value assessment, EPRS, European Parliament, September 2020.

Climate change and its impact on food and nutrition security, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, November 2020.

Feasibility study on options to step up EU actions against deforestation, COWI A/S, European Commission, 2018.

Garten Ash T., Zimmermann A., In Crisis, Europeans Support Radical Positions. Climate Change and Social Welfare issues most salient, *eupinions,* May, 2020.

Global Environment Outlook 6, UN Environment, 2019.

Global report on internal displacement in 2018 – Europe and Central Asia regional overview, Internal Displacement Monitoring Centre, 2018.

Greenhouse gas emissions - Understanding global warming potential, United States Environment Protection Agency, 2017 (US EPA, 2017).

Greening: a more complex income support scheme, not yet environmentally effective - Special Report No 21/2017, European Court of Auditors, 2017.

Grieger G., Amazon deforestation and EU-Mercosur deal, EPRS, European Parliament, October 2020.

Halleux V., An EU legal framework to halt and reverse EU driven global deforestation, EPRS, European Parliament, October 2020.

Halleux V., Cities: Front line of climate action, EPRS, European Parliament, February 2018.

Halleux V., Forest fires: Environmental stakes, EPRS, European Parliament, November 2020.

Hausfather Z., State of climate: First quarter of 2020 is second warmest on record, *Carbon Brief,* 2020.

Hawken P. (ed)., Drawdown: the most comprehensive plan ever proposed to reverse global warming. Penguin, 2017.

Greenhouse emissions from shipping: waiting for concrete progress at IMO level, Policy Department for Economic, Scientific and Quality of Life Policies, DG IPOL, European Parliament, September 2020.

Henrique Simões, Reducing methane emissions: A new EU strategy to address global warming, EPRS, European Parliament, December 2020.

Hooftman N. et al., A review of the European passenger car regulations – Real driving emissions vs local air quality, *Renewable and sustainable energy reviews,* April 2018.

Impacts of climate change on fisheries and aquaculture, United Nations Food and Agriculture Organization, 2018.

Inception Impact Assessment - Minimising the risk of deforestation and forest degradation associated with products placed on the EU market, European Commission, February 2020.

Inception Impact assessment - Roadmap for a revision of the Industrial Emissions Directive (2010/75/EU), European Commission, March 2020.

Interinstitutional agreement on Better Law Making, 2016.

Investing in Climate, Investing in Growth, OECD, 2017.

Ionescu S., Sabbati G. and Scholaert F., A Just Transition Fund for climate-neutral EU regions, EPRS, European Parliament, October 2020.

Jensen L., EU climate target plan: Raising the level of ambition for 2030, EPRS, European Parliament, December 2020.

Karamfilova E., Mid-term review of the Seventh Environment Action Program, European Implementation Assessment, EPRS, November 2017.

Keramidas K et al., Global Energy and Climate Outlook 2019: Electrification for the low-carbon transition, Joint Research Centre, 2020.

Kick-starting the journey towards a climate-neutral Europe by 2050 - EU Climate Action Progress Report 2020, COM(2020) 777 final, European Commission, November 2020.

Knowledge for a sustainable Europe, A snapshot from the European Environment Agency, European Environment Agency, 2019 (EEA, 2019c).

Kurrer C., The potential of hydrogen for decarbonising steel production, EPRS, European Parliament, December 2020.

Le Quéré C. et al., Fossil CO2 emissions in the post-COVID-19 era, *Nature Climate Change,* March 2021.

Making Mission Possible – Delivering a Net-Zero Economy, Energy Transitions Commission, September 2020.

Marcu A. et al., 2020 State of the EU ETS Report, ERCST, Wegener Center, BloombergNEF and Ecoact, April 2020.

Marine Messages II, European Environment Agency, June 2020 (EEA 2020).

Masterplan for a Competitive Transformation of EU Energy-intensive Industries: Enabling a Climate-neutral, Circular Economy by 2050, High-Level Group on Energy-Intensive Industries, Publications Office of the European Union, 2019.

McEldowney J., EU agricultural policy and climate change, EPRS, European Parliament, May 2020.

Mission Possible: Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century. Sectoral Focus: Steel, Energy Transitions Commission, 2019.

Mission Possible: Reaching net-zero carbon emissions from harder-to-abate sectors by mid-century: Sectoral Focus: Cement, Energy Transitions Commission, 2019.

Moran D. et al., Quantifying the potential for consumer-oriented policy to reduce European and foreign carbon emissions, *Climate Policy,* 2018.

Multi-functionality and Sustainability in the European Union's Forests, European Academies' Science Advisory Council, 2017.

Nies S. and Schmidt von Sydow H., The European Energy Transition: Actors, Factors, Sectors, Claeys & Casteels, 2019.

Climate change and its impact on mental health, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, December 2020.

Pantzar M. et al., Sustainable consumption – policy approaches for systems change, Institute for European Environmental Policy, November 2018.

Pape M., Decarbonising maritime transport: The EU perspective, EPRS, European Parliament, October 2020.

Pape M., The first climate change strategy for shipping, EPRS, European Parliament, May 2018.

Paris Agreement turning point, Climate Action Tracker, December 2020.

PESETA III, Science for policy summary, Policy card on climate change and Mediterranean habitat loss, Joint Research Centre, 2018 (JRC, 2018a).

PESETA III, Science for policy summary, Policy card on climate change and forest fires, Joint Research Centre, 2018 (JRC, 2018b).

PESETA III, Science for policy summary, Policy card on climate change and residential energy demand, Joint Research Centre, 2018 (JRC, 2018d).

PESETA III, Science for policy summary, Policy card on climate change impacts on airports, seaports, and inland waterways, Joint Research Centre, 2018: (JRC, 2018e).

PESETA III, Science for policy summary, Policy card on climate change and coastal floods, Joint Research Centre, 2018 (JRC, 2018f).

PESETA III, Science for policy summary, Policy card on drought and climate change, Joint Research Centre, 2018 (JRC, 2018c).

PESETA III, Science for policy summary, Policy card on the economic effect of climate change, Joint Research Centre, 2018 (JRC, 2018g).

PESETA IV, Climate change impacts and adaptation in Europe, Final Report, Joint Research Centre, 2020 (JRC, 2020a).

PESETA IV, Welfare losses from climate change impacts, Joint Research Centre, 2020 (JRC, 2020b).

Petri F., Revisiting EU climate and energy diplomacy: A starting point for Green Deal diplomacy?, Egmont, November 2020.

Raza W. et al., How can international trade contribute to sustainable forestry and the preservation of the world's forests through the Green Deal?, Policy Department for External Relations, European Parliament, October 2020.

Reaching zero with renewables: Eliminating CO2 emissions from industry and transport in line with the 1.5°C climate goal, International Renewable Energy Agency, 2020.

Remáč M., Parliamentary scrutiny of the European Commission - Implementation of Treaty provisions, European Implementation Assessment (update), EPRS, European Parliament, July 2019.

Remeur C., Carbon emissions pricing: Some points of reference, EPRS, European Parliament, March 2020.

Roadmap to a single European transport area — Towards a competitive and resource efficient transport system, European Commission, March 2011.

Rossi R., Desertification and agriculture, EPRS, European Parliament, February 2020.

Rossi R., Irrigation in EU agriculture, EPRS, European Parliament, December 2019.

Impacts of climate change and air pollution on the health of the EU population, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, November 2020.

Šajn N. and Wilson A., Revised Energy Efficiency Directive, EPRS, European Parliament, January 2019.

Šajn N., Consumers and repair products, EPRS, European Parliament, September 2019.

Šajn N., Energy efficiency of buildings: A nearly zero-energy future?, EPRS, European Parliament, May 2016.

Šajn N., Modernisation of EU consumer protection rules. A new deal for consumers, EPRS, European Parliament, January 2020.

Šajn N., Representative actions to protect the collective interests of consumers. A new deal for consumers, EPRS, European Parliament, January 2020.

Šajn N., Sustainable consumption: Helping consumers make eco-friendly choices, EPRS, European Parliament, October 2020.

Scholaert F., Ocean governance and blue growth: Challenges, opportunities and policy responses, EPRS, European Parliament, November 2019.

Scholaert F., The blue economy: Overview and EU policy framework, EPRS, European Parliament, January 2020.

Seddon N., Understanding the value and limits of nature-based solutions to climate change and other global challenges, *Philosophical Transactions B*, Royal Society, January 2020.

Simões H., Reducing methane emissions: A new EU strategy to address global warming, EPRS, European Parliament, December 2020.

SOER - The European environment — State and outlook 2020, European Environment Agency, 2019 (EEA, SOER-2020).

Soone J., Sustainable aviation fuels, EPRS, European Parliament, November 2020.

Special Report on the Ocean and Cryosphere in a Changing Climate, Intergovernmental Panel on Climate Change, November 2019.

Spinaci S., Sustainable finance – EU taxonomy: A framework to facilitate sustainable investment, EPRS, European Parliament, July 2020.

Spinaci S., Sustainable finance and benchmarks: Low-carbon benchmarks and positive-carbon-impact benchmarks, EPRS, European Parliament, January 2020.

Spinaci S., Sustainable finance and disclosures: Bringing clarity to investors, EPRS, European Parliament, January 2020.

Opportunities of post Covid-19 European recovery funds in transitioning towards circular and climate neutral economy, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, November 2020.

Statement 'Sustainable recovery from the Covid-19 pandemic requires the right tools', Technical Expert Group on Sustainable Finance, April 2020.

Summary for Policymakers, In: *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*, Intergovernmental Panel on Climate Change, 2019 (IPCC, 2019b).

Summary for Policymakers, In: *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*, Intergovernmental Panel on Climate Change, 2018 *(IPCC, 2018)*.

Summary for Policymakers. In: *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report*, Intergovernmental Panel on Climate Change, 2013(IPCC, 2013).

Summary for Policymakers. In: *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate,* Intergovernmental Panel on Climate Change, 2019 (IPCC, 2019a).

Summary for urban policy-makers, What the IPCC special report on global warming of 1.5°C means for cities, Intergovernmental Panel on Climate Change, December 2018.

Summary of the Public Consultation Stepping up EU Action against Deforestation and Forest Degradation, European Commission, 2019.

Supporting climate action trough the EU budget, European Commission webpage.

Tagliapietra S. and Veugelers R., A green industrial policy for Europe, Bruegel, December 2020.

Technology Study: Low carbon energy and feedstock for the European chemical industry, DECHEMA, June 2017.

The European State of Climate in 2018, Copernicus Climate Change Service, 2019 (C3S, 2019).

The European State of Climate in 2019 - Summary, Copernicus Climate Change Service, 2020 (C3S, 2020).

The future of cities, Joint Research Centre, 2019.

The global climate in 2015-2019, World Meteorological Organisation, 2019.

The imperative of climate action to protect human health in Europe - Report No: 4/2019, European Academies Science Advisory Council, 2019 (EASAC, 2019).

The Production Gap Report: 2020 Special Report, SEI, IISD, ODI, E3G, and UNEP, 2020.

The role of fiscal rules in relation with the green economy, Economic Governance Support Unit and Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, September 2020.

The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2019, World Meteorological Organization, November 2020.

The State of the World's Forests, UN Food and Agriculture Organization, 2018.

Titievskaia J., Using trade policy to tackle climate change, EPRS, European Parliament, October 2019.

Towards a sustainable future: transformative change and post-COVID-19 priorities, European Academies' Science Advisory Council, October 2020.

Tracking climate spending in the EU budget - Review No 1/2020, European Court of Auditors, 2020.

Transport-related CO2 emissions from the tourism sector, United Nations World Tourism Organization, 2019.

Trends and drivers of EU greenhouse gas emissions - Special Report 3/2020, European Environment Agency, 2020 (EEA, 2020).

Trends and projections in Europe 2020, European Environment Agency, November 2020.

Trends in global CO2 and total greenhouse gas emissions: 2019 report, PBL Netherlands Environmental Assessment Agency, February 2020.

Updated analysis of the non-CO_2 climate impacts of aviation and potential policy measures pursuant to EU Emissions Trading System Directive Article 30(4), COM(2020)747 final, European Commission, November 2020.

Urban adaptation to climate change in Europe 2016, European Environment Agency, 2016.

Urban areas, in *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects,* Intergovernmental Panel on Climate Change, 2014.

Van Woensel L. with Fernández Álvarez M., What if we could engineer the planet to help fight climate change?, EPRS, European Parliament, February 2021.

Vikolainen V., Setting the 2030 GHG emissions reduction target, EPRS, European Parliament, December 2020.

Volckaert K., Roadmap for Reallocation: A critical assessment of the Green Deal's growth, financial and regulatory challenges, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, April 2020.

Widuto A. and Jourde P., Just Transition Fund, EPRS, European Parliament, October 2020.

Williamson, K. et al., Climate Change Needs Behavior Change: Making the Case For Behavioral Solutions to Reduce Global Warming, Rare, 2018.

Wilson A., Framework for energy efficiency labelling, EPRS, European Parliament, July 2017.

Wilson A., Governance of the energy union, EPRS, European Parliament, January 2019.

Wilson A., Improving energy performance of buildings, EPRS, European Parliament, July 2018.

Wilson A., Offshore wind energy in Europe, EPRS, European Parliament, October 2020.

Wilson A., Promoting renewable energy sources in the EU after 2020, EPRS, European Parliament, January 2019.

WMO Provisional Report on the State of the Global Climate 2020, World Meteorological Organization, December 2020.

Wyns T. and Khandekaru G., Metals for a Climate Neutral Europe: A 2050 Blueprint, VUB Institute for European Studies, October 2019.

Wyns T., Khandekaru G. and Robson I., Industrial Value Chain: A Bridge towards a Carbon Neutral Europe, VUB Institute for European Studies, 2018.

Zoonoses: Blurred Lines of Emergent Disease and Ecosystem Health, In: Frontiers 2016 Report - Emerging Issues of Environmental Concern, United Nations Environment Programme, 2016 (UNEP, 2016).

Zygierewicz A., The Ecodesign Directive (2009/125/EC), EPRS, European Parliament, November 2017.

QA-02-21-321-EN-N

The European Green Deal aims to make the European Union climate-neutral by 2050, a target supported by all EU institutions. With this objective, the EU takes a leading role in addressing the global climate emergency. Achieving the climate-neutrality goal requires massive investment and an unprecedented transformation of all sectors of the economy.

This study explains the physical basis of climate change and highlights its expected impacts on the EU. To give an overview of EU and international climate policies, it outlines international climate agreements, EU climate action and the climate policies of major economies. It assesses the coherence of EU climate policy with other policy areas, and presents the financing of EU climate action through the EU budget and other instruments.

To assess the implications of the climate neutrality objective, the study analysis the challenges and opportunities for the EU economy and its impacts on issues such as international relations, migration, trade, consumers and health .

The final chapter addresses the issues facing European decision-makers and the outlook for European and global climate action in the context of the coronavirus pandemic.

This is a publication of EPRS | European Parliamentary Research Service

PE 689.378
ISBN 978-92-846-7911-9
doi:10.2861/009509
QA-02-21-321-EN-N