The Annual Climate Action Monitor

HELPING COUNTRIES ADVANCE TOWARDS NET ZERO

OECD

LAUNCH VERSION

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BETTER POLICIES FOR BETTER LIVES

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The Annual Climate Action Monitor

The Climate Action Monitor is part of the diagnostic component of the International Programme for Action on Climate (IPAC). Its goal is to provide a digest of country progress towards climate objectives and alignment with Paris Agreement goals to support countries in making better informed decisions and allow stakeholders to measure improvements more accurately. Alongside the IPAC dashboard, it contributes to international efforts in evidence based monitoring of progress to net zero by: 1) reviewing key trends and developments and highlighting areas for further analysis and policy action; 2) promoting greater harmonisation of key indicators; 3) showcasing examples of good climate mitigation and adaptation practices and results; 4) strengthening transparency over climate policies.

Preface

The Intergovernmental Panel on Climate Change (IPCC) reinforced the urgency of climate action in August 2021 demonstrating the unequivocal link between human-induced greenhouse gas emissions and the occurrence of climate-related extreme events. The Paris Agreement and the increasingly visible and damaging impacts of climate change created momentum for more effective climate action. While recent advances on climate ambition have been encouraging, countries still require the tools to track, co-ordinate, and achieve their announced climate ambitions.

With the urgent need to turn climate ambitions into practical action and concrete outcomes, the OECD is building on its long-standing experience in climate-related policies to ramp up its contribution on reaching global climate objectives. The OECD's contribution to climate action centers on five core pillars: 1) supporting policy pathways to net zero 2) enhancing adaptation and building resilience to climate impacts 3) mobilising finance, investment and business action 4) monitoring and measuring progress towards climate ambitions and 5) multilateral and multi-disciplinary approaches to build co-operation. These pillars build on the OECD's key strength in providing a whole-of-government approach to supporting evidence-based policy design, and facilitating collaboration and peer learning to drive effective and inclusive policy action.

The International Programme for Action on Climate (IPAC) draws on the OECD's multi-disciplinary competence to provide concrete tools for monitoring climate performance on national commitments and global net-zero trajectories. It creates a space for the exchange of good practices across countries to encourage dialogue and pragmatic actions countries can take to innovate towards climate objectives. The Climate Action Monitor provides a policy framework for assessing country progress towards net zero. This first iteration of the Monitor highlights ongoing methodological work to develop indicators towards this goal as well as a selection of preliminary results, with more to be made available for COP27.

Given the understandably differing approaches to climate action across countries, IPAC offers an integrated framework to measure, improve, and exchange on the coherence, transparency, and effectiveness of global, national and local climate action. It forms part of the OECD Project on Building Climate and Economic Resilience in the Transition to a Low-carbon Economy and is complementary with OECD efforts to support the UN climate process and the OECD-IEA Climate Change Expert Group (CCXG). The OECD is fully committed to helping secure globally co-ordinated, sustainable, ambitious, and measurable action to achieve net zero. IPAC provides us with tools to build solid, collaborative pathways to help advance towards our global climate ambitions.

Mathias Cormann

Secretary-General, OECD

Foreword

The International Programme for Action on Climate (IPAC) was established in May 2021 to assess and support progress towards net-zero greenhouse gas (GHG) emissions and a more resilient economy by mid-century. To support these global objectives, IPAC provides governments with information and tools to monitor, evaluate and support the effectiveness of climate measures.

IPAC draws on the wealth of international climate-related data, indicators and research developed in partnership with the International Energy Agency (IEA), Nuclear Energy Agency (NEA) and the International Transport Forum (ITF), covering environmental, economic, financial and social dimensions of climate change.

IPAC encompasses four inter-related components:

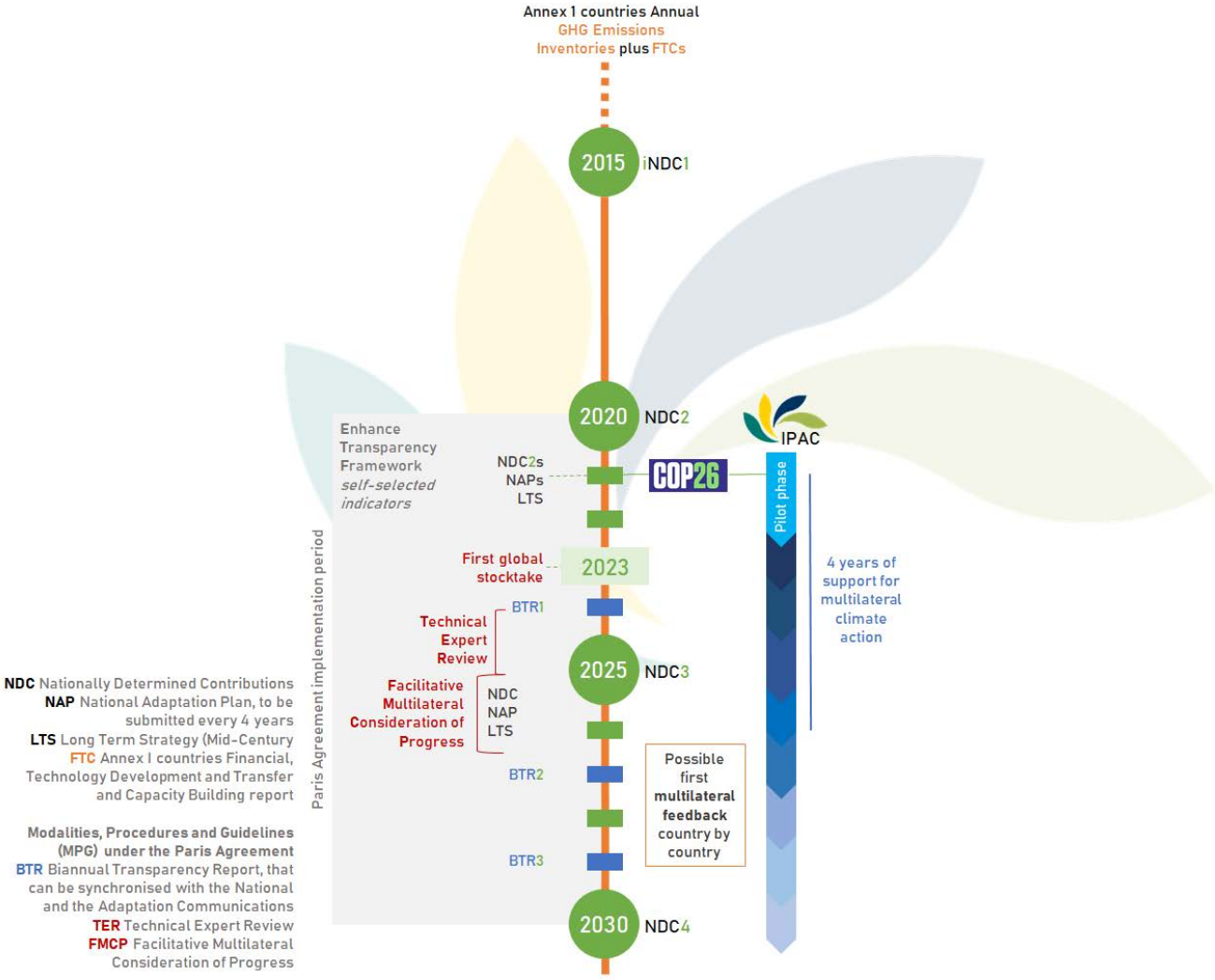
- The IPAC Dashboard features key indicators that provide an at-a-glance view of country actions and progress towards climate objectives and net-zero trajectories. It takes the form of an interactive web page, with data visualisation tools. A preliminary version of the Dashboard was launched during the Meeting of the OECD Council at Ministeral Level (MCM) in October 2021.
- The annual Climate Action Monitor, based on the Dashboard, provides a digest of country progress towards their own climate objectives and their alignment with Paris Agreement goals. It also highlights examples of good practices and results.
- IPAC country notes with targeted policy advice will assist in the design of coherent and phased mitigation and adaptation actions that are economically viable and sound, as well as socially acceptable.
- An IPAC Interactive Platform for dialogue and mutual learning across countries, a first part of which showcases a selection of good policy practices, was launched during the Meeting of the OECD Council at Ministerial Level (MCM) in October 2021.

IPAC aims to provide targeted policy advice and internationally harmonised indicators that are complementary to the UNFCCC framework for tracking progress of Paris Agreement goals. At this juncture, a common, agreed and methodologically coherent framework to assess country progress towards the Nationally Determined Contributions (NDCs) targets is not available.

IPAC focuses on internationally comparable and sound policy indicators that go beyond the information to be provided in country transparency reports, and would thus provide a means for understanding effort across countries, taking into account national circumstances. This scope differs from the reporting envisaged under the MRV (monitoring, reporting and verification) requirements under the UNFCCC and the Enhanced Transparency Framework (ETF) under the Paris Agreement, which are currently in a transition phase towards a new consolidated reporting system.

IPAC and ETF will have different timelines and contributions. IPAC's work will be annual, starting in 2021, across all participating countries, as opposed to the biennial nature of the reporting under the ETF that will start in 2024 (Figure 1).

Figure 1. IPAC's timeline and contribution are complementary to the UNFCCC Enhanced Transparency Framework



IPAC covers all OECD countries, and is open to Partner economies: (Brazil, People's Republic of China (hereafter "China"), India, Indonesia, South Africa), six prospective members (Argentina, Brazil, Bulgaria, Croatia, Peru, Romania), and the other G20 countries (Russian Federation, Saudi Arabia). The IPAC Dashboard is based on data published by official sources or otherwise validated by countries concerned.

IPAC is an integral part of the OECD's strategic approach to incorporating climate action into all of its work, thereby harnessing the multi-disciplinary and whole-of-economy nature of OECD activity. This strategic approach comprises five-pillars of action, with IPAC contributing to supporting pathways to the net-zero transition (pillar 1) and providing a monitoring and measurement framework with a wide range of OECD data and indicators (pillar 4). IPAC also contributes to extensive OECD work on adaptation and resilience to climate change (pillar 2), public and private finance, climate-centered investment and business action (pillar 3), and multilateral and multi-disciplinary approaches to build co-operation and drive progress (pillar 5). All five pillars allow for innovative advancements for better measurement, monitoring, policy design, implementation and evaluation for enhanced climate action.

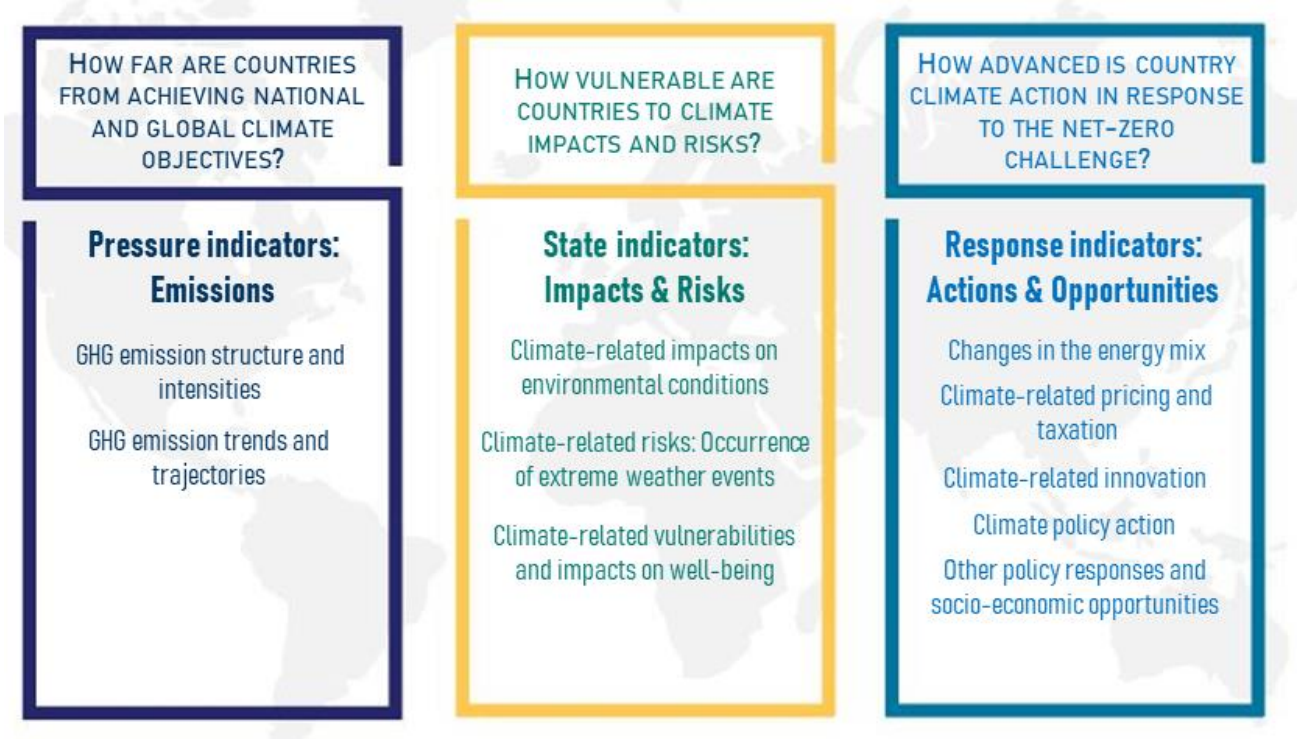
Scope and indicators

This Monitor provides key insights on climate action building on the IPAC Dashboard of climate-related indicators. The IPAC indicator framework uses an adapted "pressure-state-response" model. This model integrates the topics covered in the assessments of the IPCC and used in the United Nations Statistical Division (UNSD) and United Nations Economic Commission for Europe (UNECE) indicator frameworks. A number of criteria are used for validating the choice of the indicators: they are required to be policy relevant and of value for users, as well as analytically sound and measurable. The Monitor, alongside the IPAC Dashboard, complements and supports the UNFCCC and Paris Agreement monitoring frameworks by:

- providing a snapshot of key trends and developments, and highlighting areas requiring further analysis or policy action;
- promoting greater harmonisation of key indicators allowing for a better understanding of country effort towards reaching international commitments;
- promoting climate action by highlighting or showcasing good practices;
- strengthening transparency and accountability over climate policies, thereby supporting countries in making better-informed decisions, and allowing stakeholders to measure improvements more accurately.

The Monitor is structured around three monitoring areas: (1) emissions, (2) impacts and risks and (3) actions and opportunities, supported by the corresponding indicators.

Figure 2. The Climate Action Monitor addresses key issues in line with IPAC indicators



“Emissions” monitoring area: Monitoring GHG emission trends is at the core of country climate action and key to measuring progress towards national targets. Emissions-related indicators reflect both direct pressure on climate and the results of policy action. Given the heterogeneity of national targets, visualising the emission trajectories towards the Paris Agreement goal of climate neutrality by 2050 is also essential to guide policy action and close the gap between long-term commitments and concrete short-term actions.

“Impacts and risks” monitoring area: Assessing climate-related impacts, risks and vulnerability is key to identifying adaptation needs and guiding adaptation measures. Particular attention is given to weather-related impacts, such as temperature anomalies and extreme weather events.

“Actions and opportunities” monitoring area: Climate policies are necessary to provide effective incentives to businesses and households to modify behaviour in ways that are less emission intensive. This monitoring area zooms-in on key aspects of action, including climate innovation, climate-related pricing and taxation, and climate budgets and expenditure. Monitoring policy responses to the net-zero challenge feeds into the IPAC’s diagnostic component that will provide targeted policy advice for each country’s pathway to climate neutrality.

Key findings

How far are countries from achieving national and global climate objectives?

An increasing number of countries have announced their commitments to net zero but the pledges and results to date do not match the level of ambition of the Paris Agreement. Current pledges, even if successfully fulfilled, would still leave around 22 billion tonnes of CO_2 emissions worldwide in 2050 (IEA, 2021[1]) (Jeudy-Hugo, Lo Re and Falduto, 2021[2]). Only an additional 7.5% of GHG reductions are expected this decade when 55% are needed to align global mitigation efforts to the 1.5°C target. The continuation of that trend would be consistent with a temperature rise of around 2.1°C in 2100. Emission intensities per unit of GDP and per capita decreased since 2005 in most OECD countries, revealing a strong overall decoupling from economic growth. However, further gains in energy intensity efficiency will be insufficient to put emissions on a path to reach net-zero targets – transformative changes in energy and production systems are needed to address key drivers behind emissions. IPAC contributes to international efforts in monitoring country progress by developing a common methodology to measure distance to national targets and track net-zero emission trajectories.

How vulnerable are countries to climate impacts and risks?

The climate emergency is associated with major socio-economic risks, with potentially profound negative impacts on well-being. The latest IPCC report warns that "at 2°C of global warming, heat extremes would more often reach critical tolerance thresholds for agriculture and health" (IPCC, 2021[3]) alongside other impacts. Estimates suggest a global impact on gross domestic product of 11% relative to a prior trend baseline in case of a 2°C temperature increase and up to 18% if no mitigating actions are taken (World Economic Forum, 2021[4]). A disaster related to either a weather, climate or water hazard occurred every day on average over the 50 years – killing 115 people and causing USD 202 million in losses daily (Jeudy-Hugo, Lo Re and Falduto, 2021[2]). IPAC's forthcoming indicators on climate-related natural hazards and socio-economic inequality will help to measure and assess key impacts of climate change. Monitoring country risk and vulnerability levels are crucial for guiding adaptation policies to protect populations highly exposed to climate-related threats.

How advanced is country climate action in response to the net-zero challenge?

The global pathway to net zero relies on a mix of policy actions that support profound structural reforms and turn challenges associated with the transition into opportunities. Climate action needs re-inforcement in all five cross-cutting areas monitored:

- **From fragmented (and often misaligned) climate policies to an integrated multi-level governance for climate.** Most governments have yet to operationalise their NDCs. In the last few years, 31 countries have developed implementation strategies and domestic roadmaps to support their long-term targets (Jeudy-Hugo, Lo Re and Falduto, 2021[2]). These plans need to support sub-national climate action, taking into account regional specificities: metropolitan areas account for 70% of energy-related CO_2 emissions, while emissions per capita are highest in remote regions.
- **Insufficient support for climate-related innovation.** Countries need to provide a major boost for innovation if net-zero transition is to be achieved. Efforts should build on the encouraging increase in climate-related patents, trademarks, and green start-ups recorded in the OECD region: the share of high-value climate change mitigation inventions in all technologies has increased from 4% in the early 1990s to over 9% in latest years; the proportion of trademarks for climate-related goods and services has nearly quadrupled in Europe; and global venture capital investment in climate-related start-ups grew from USD 5 billion in 2010 to USD 30 billion in 2020. Research, Design and Development (RD&D) spending however, while on the rise in most countries covered, remains unsatisfactory, considering that almost 50% of CO_2 emissions reductions in the IEA's net-zero scenario comes from technologies currently at demonstration or prototype stage.

- **Largely unused potential of climate-related pricing and taxation.** Half of all CO_2 emissions from energy use in G20 economies are priced in 2021, up from 37% in 2018. Despite this welcome progress, the coverage continues to vary across sectors and there has been little change in carbon prices in countries, where rates were relatively low in 2018. At the same time, the share of climate-related taxes continues to decline in the OECD. The effectiveness of these market-based measures is hampered by continued support to fossil fuels: USD 183 billion worth of support for fossil fuels was provided by OECD countries and partner economies in 2020.
- **Urgent need for scaling up climate-related public expenditure and finance**. Despite notable good practices in coupling COVID-19 recovery with climate action, the overall progress in powering net-zero transition is deficient: to date only 21.5% of recovery financing has supported the climate agenda. Misalignment between recovery measures and climate goals can lead to longer-term economic costs – both in terms of stranded assets, and increased costs associated with climate or other environmental impacts.
- **Unlocking socio-economic opportunities at home and abroad**. Governments strive to turn the challenge of climate change into an opportunity, recognising that climate action contributes to resilient and inclusive growth. One such opportunity is represented by global trade in environmental goods, which increased by 53% between 2007 and 2019 – representing an average annual growth of 4%. While on the rise, only 27% of Official Development Assistance targets climate action to some degree, which is insufficient to support the Paris Agreement goal. More targeted funding is needed for particularly vulnerable countries and regions, such as extractive-based countries.

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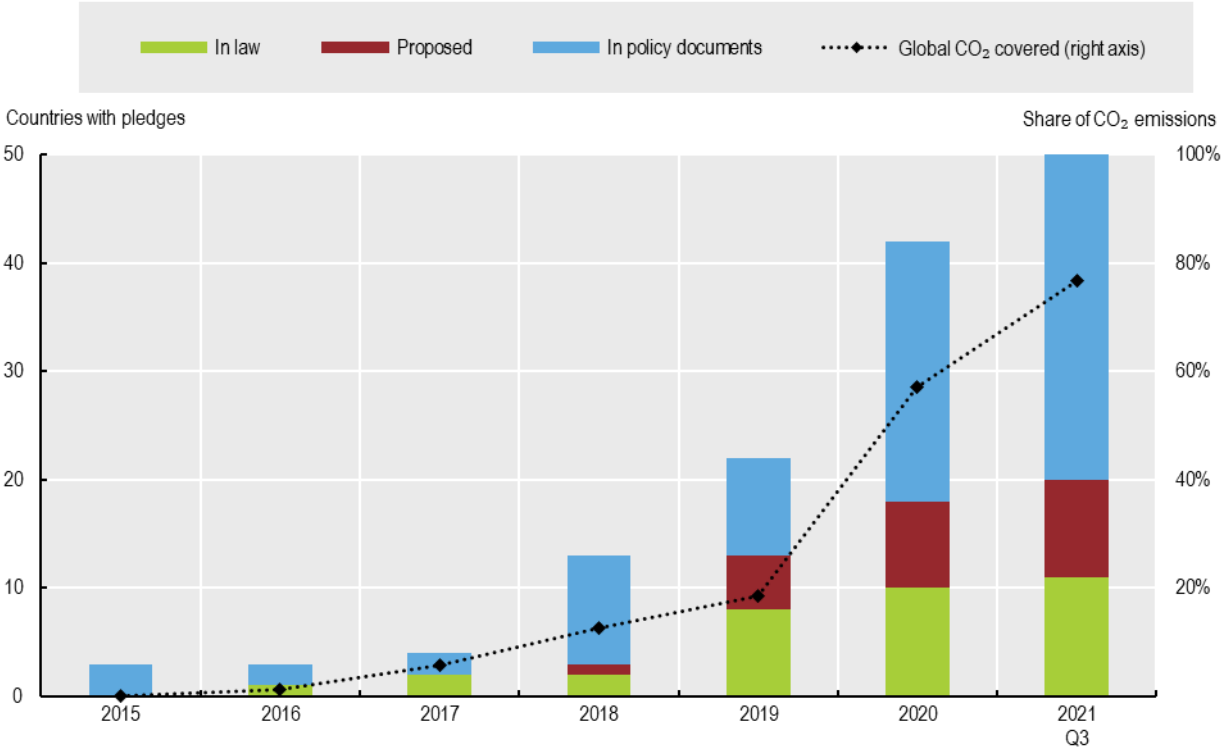
How far are countries from achieving national and global climate objectives?

Target-setting and operationalisation are at the core of effective climate action. Although climate goals need to be delivered globally, the long-term and intermediary targets and measures to achieve them are set by governments at the national level. Under the Paris Agreement, 191 countries covering more than 90% of global energy-related and industrial process CO_2 emissions, submitted their Nationally Determined Contributions (NDCs) to the UNFCCC with different targets and levels of ambition.

The number of countries, sub-national governments and companies making pledges to reduce GHG emissions to net zero is on the rise. As of 1 October 2021, net-zero targets have been adopted by 51 countries and the European Union (EU) in law, proposed in legislation or included in national policy documents (Figure 3) (Jeudy-Hugo, 2021[5]). These targets cover around 65% of global CO_2 emissions. Many more countries are considering similar targets and over 4 500 non-state actors have joined the "Race to Zero" campaign. In the Paris Agreement, countries agreed to "achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second-half of the century". These targets cover around 65% of global CO_2 emissions. Moreover, over 4 500 non-state actors have joined the "Race to Zero" campaign.

Figure 3. The number of national net-zero pledges is on the rise

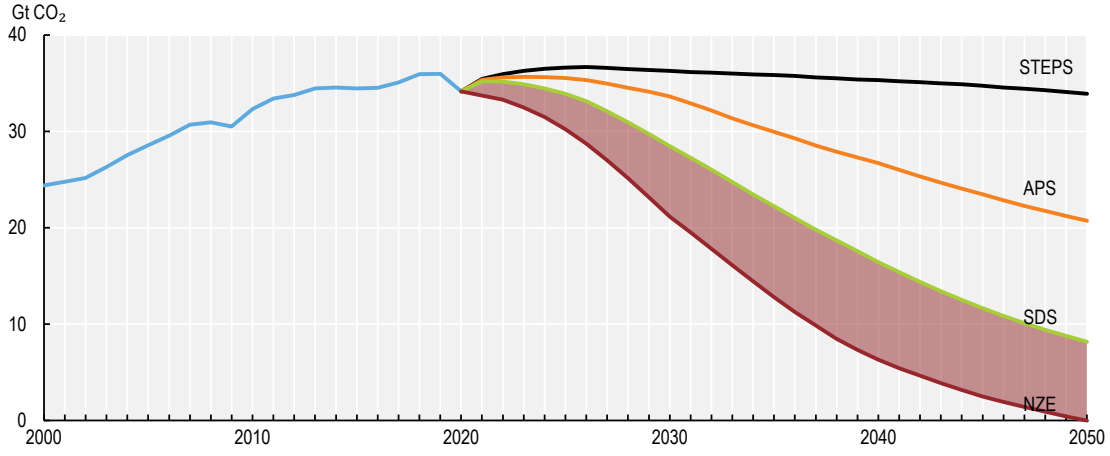


Note: In law = a net-zero pledge has been approved by parliament and is legally binding. Proposed = a net-zero pledge has been proposed to parliament to be voted into law. In policy document = a net-zero pledge has been proposed but does not have legally binding status.
Source: IEA (2021), World Energy Outlook 2021.

Despite an increasing number of pledges, the current commitments set out in Nationally Determined Contributions are not sufficient to reach the Paris Agreement long-term net-zero goal. According to the IEA World Energy Outlook 2021, current policy settings and announced pledges (including NDCs), even if implemented, would fall short of the needed reduction in energy-related CO_2 emissions. Realising the pledges in full would fill less than 20% of the total gap between the Stated Policies Scenario (STEPS), which reflects current policy settings, and the Net-Zero Emissions by 2050 Scenario (NZE). This leaves a 12 gigatonne "ambition gap" between the Announced Pledges Scenario (APS) and the NZE in 2030 that requires countries to go beyond existing pledges to be on track to achieve net-zero emissions by 2050 (Figure 4).

Figure 4. The world's carbon emissions are not in line with net zero by 2050

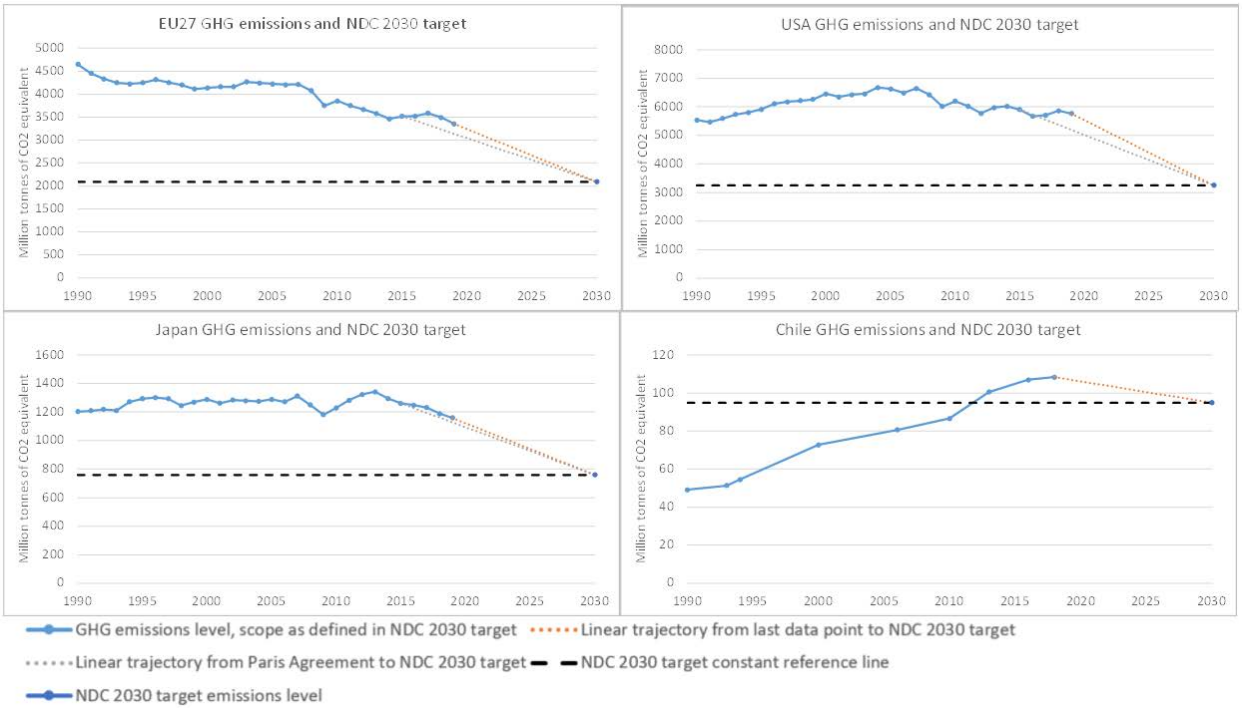
Energy-related and industrial process CO_2 emissions in the IEA World Energy Outlook 2021 scenarios



Note: The Net-Zero Emissions by 2050 Scenario (NZE) sets out a narrow but achievable pathway for the global energy sector to achieve net-zero CO_2 emissions by 2050. The Announced Pledges Scenario (APS) assumes that all climate commitments made by governments around the world, including Nationally Determined Contributions (NDCs) and longer term net-zero targets, will be met in full and on time. The Stated Policies Scenario (STEPS) reflects current policy settings based on a sector-by-sector assessment of the specific policies that are in place, as well as those that have been announced by governments around the world. STEPS is based on prevailing policy settings and so provides a useful barometer of the strength and impact of these policies over time. The Sustainable Development Scenario (SDS), like the NZE, achieves key energy-related United Nations Sustainable Development Goals related to universal energy access and major improvements in air quality, and reaches global net-zero emissions by 2070 (with many countries and regions reaching net zero much earlier).
Source: IEA (2021), World Energy Outlook 2021.

Significant efforts will need to be made at the national level to achieve intermediary targets by 2030 (Figure 5)**.** Some large emitters such as Japan, the United States and the EU are still far from their 2030 objectives, but they are gradually progressing towards them, albeit at different paces. In contrast, in many emerging economies such as Brazil, China, Russia, and Mexico, emissions are still rising and have not yet reached their expected peak. Overall, countries will have to reduce emissions or limit their increase to a much larger extent in the next 10 years than they have done over the past 30 years to achieve intermediate targets (Jeudy-Hugo, Lo Re and Falduto, 2021[2]).

Figure 5. Countries need to improve climate performance to meet their targets in 2030



Note: Preliminary calculations. Information on the scope of Nationally Determined Contributions (NDCs) and the targets for GHG emissions were compiled by the OECD Secretariat from official documents on NDCs as submitted to the UNFCCC. Linear trajectories to NDC targets, shown as dotted lines, are presented for illustrative purposes and do not represent actual emission trends. Offsets from international credits may be included in country targets. Japan and Chile intend to include offsets from international credits to achieve the target. The USA does not intend to use offsets to achieve the target, but retains the right to do so. The EU's target is to be achieved without offsets.
Source: UNFCCC (2021), National Inventory Submissions 2021; NDCs are from the UNFCCC NDC Registry.

Forthcoming work

The heterogeneity of national targets presents challenges in tracking, measuring and comparing country efforts.

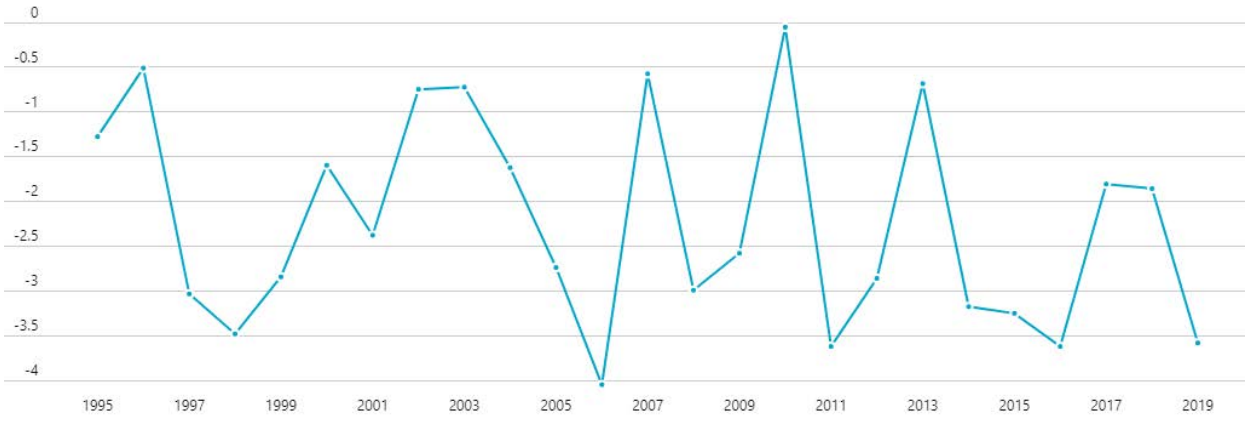
To address these challenges, IPAC is developing a common methodology to measure distance to targets that takes into account country-specific formulations of domestic targets and the country's national circumstances. This includes the development of sub-indicators that provide complementary information on the trend of emissions, including the annual gap to the target, and the distance to the target implied by the country conditions. Sub-indicators will follow the level of detail of official national targets, including dissagregations by gas and sector.

IPAC is reviewing net-zero commitments and long-term emission trajectories. Following a similar approach, sub-indicators on distance to GHG neutrality will be developed for countries who are pursuing the net-zero objective. Visualising the emission trajectory towards GHG neutrality is essential to guide policy action and close the gap between long-term commitments and concrete short-term actions.

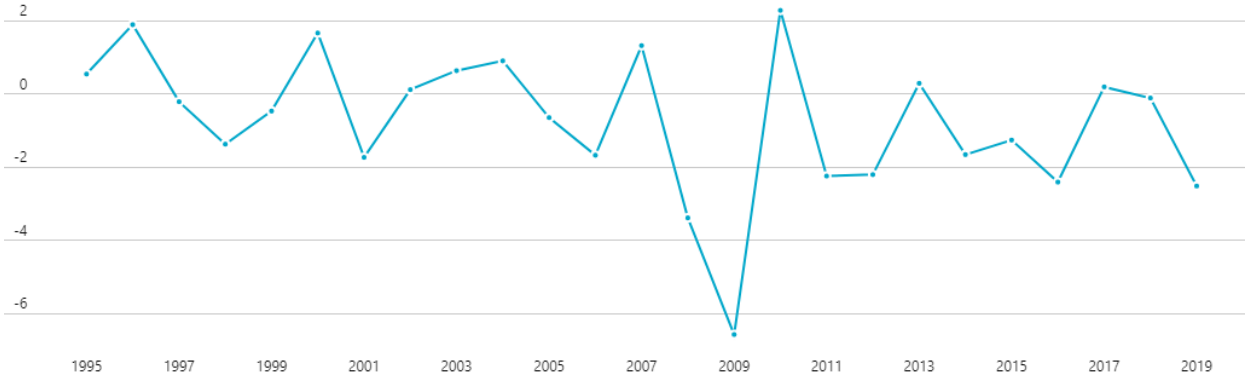
Global GHG emissions have increased by 1.5-fold since 1990, driven by economic growth and increasing fossil energy use in developing countries (OECD 2021). Emissions of OECD countries peaked in 2007 and have been gradually falling over the past 12 years (-12%), partly due to a slowdown in economic activity following the 2008 economic crisis, but also thanks to strengthened climate policies and changing patterns of energy consumption. Emission intensities per unit of GDP and per capita decreased since 2005 in most OECD countries, revealing a strong overall decoupling from economic growth (Figure 6). However, further gains in energy intensity efficiency will be insufficient to put emissions on a path to reach net-zero targets – transformative changes in energy and production systems are needed to address key drivers behind emissions.

Figure 6. OECD countries have made progress in decoupling emissions from economic activity and population growth

GHG emission intensities per unit of GDP, Annual percentage change; Including LULUCF, 1995 - 2019



GHG emission intensities per capita, Annual percentage change; Including LULUCF, 1995 - 2019

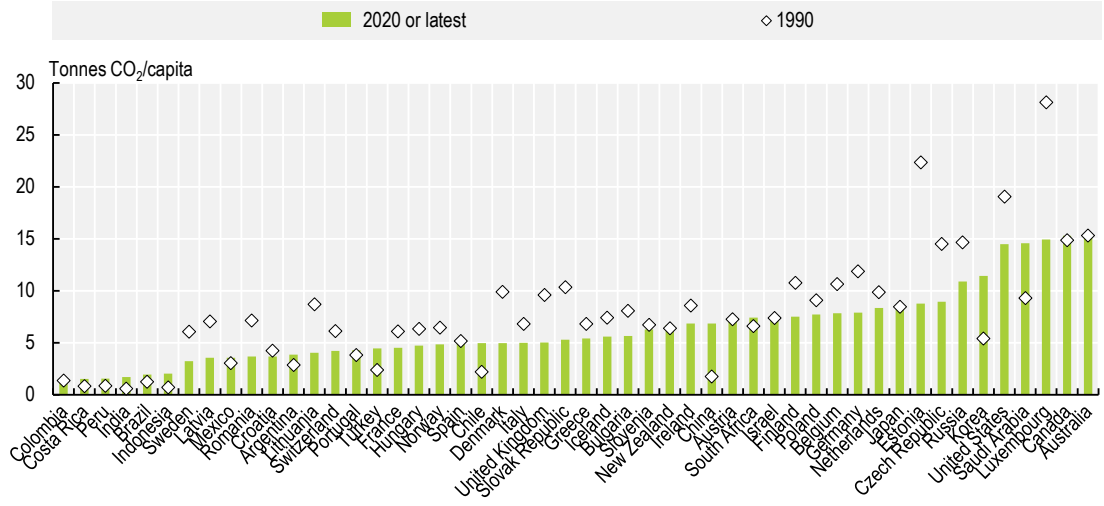


Source: OECD, "Air and climate: Greenhouse gas emissions by source", OECD Environment Statistics (database) - https://doi.org/10.1787/data-00594-en

Emissions of carbon dioxide from the combustion of fossil fuels and biomass are the main driver of the overall GHG emissions trend. This source of emissions accounts for about 90% of total CO_2 emissions and two third of total GHG emissions[1]. Global energy-related CO_2 emissions reached a record high of 33.5 billion tonnes in 2018, then remained relatively flat at 34.2 $GtCO_2eq$ in 2019. Data for 2020 show an unprecedented 5.8% decline in emissions as the COVID-19 pandemic slashed energy demand. In 2021 global energy-related CO_2 emissions are projected to rebound and grow by 4.8% as demand for coal, oil and gas rebounds with the economy[2].

Since 1990, energy-related CO_2 emissions have grown more slowly in OECD countries as a group than they have worldwide. Today, OECD countries emit about 35% of global CO_2 emissions from energy use, compared to more than 50% in 1990. On a per-capita basis, OECD countries still emit far more CO_2 than most other world regions, with 8.3 tonnes of CO_2 emitted per capita on average in OECD countries in 2019, compared to 4.4 tonnes in the rest of the world[3].

Figure 7. Energy-related CO_2 emissions per capita have declined overall but vary between countries



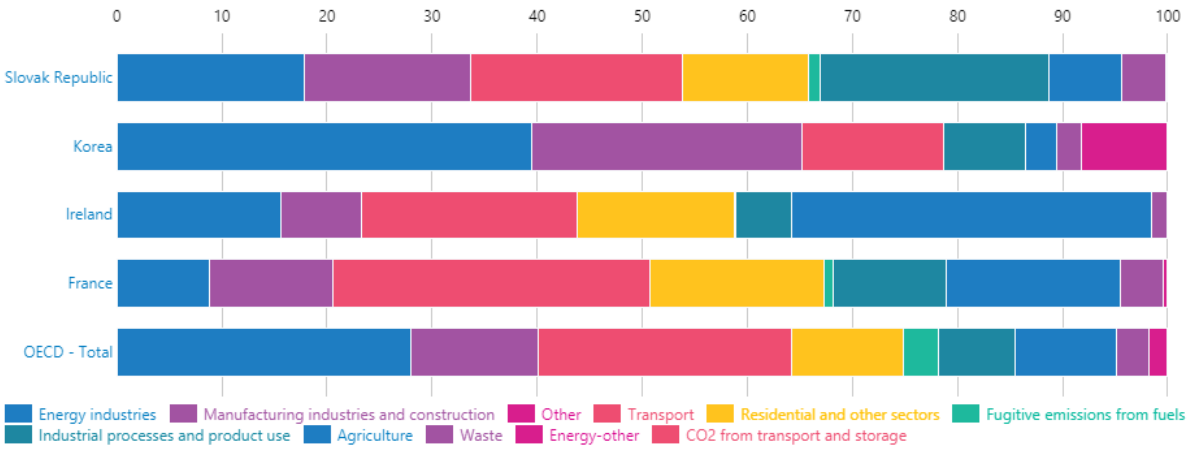
Source: OECD (2021), IPAC (database).

A more nuanced picture emerges when emissions are considered from the perspective of final demand. The carbon footprint of OECD countries that accounts for all carbon emitted anywhere in the world to satisfy domestic final demand is generally higher than emissions from domestic production. This is because OECD countries have increasingly outsourced the production of consumer goods to other countries. Such outsourcing may increase pressures on the global environment if less energy efficient techniques and less stringent environmental standards are involved.

A country's sectoral structure is one of the major determinants of where and how emissions are generated (Figure 8**).** While in all countries combusting fossil fuels and biomass is by far the largest source of GHG emissions, the share of emissions by source sectors vary. For example, the share of emissions due to electricity production is considerably larger in countries such as Japan, Korea and Poland than in France, Switzerland or Ireland on account of their high reliance on fossil fuels in electricity production[4]. Other main sources of emissions include manufacturing industries, transport, and the residential sector. Agriculture and animal farming are an important source of non-energy emissions, especially in countries like Ireland and New Zealand. Emissions from manufacturing processes, generated for example in the production of cement, steel, and plastic, are a major concern in those countries specialising in these sectors[5].

Figure 8. The composition of emissions by source sector varies considerably between countries

Shares of total GHG emissions (%), 2019 or latest year available



Note: GHG emissions excluding the Land Use, Land Use Change and Forestry (LULUCF).
Source: OECD, "Air and climate: Greenhouse gas emissions by source", OECD Environment Statistics (database) - https://doi.org/10.1787/data-00594-en

While carbon dioxide is the dominant greenhouse gas overall, the impact of methane and nitrous oxide emissions is significant. Methane emissions are the second-largest cause of global warming today. The recent IPCC Sixth Assessment Report highlighted that rapid and sustained reductions in these emissions are key to limit near-term warming (IPCC, 2021[3]). Alongside livestock and waste, the energy sector is one of the largest sources of methane emissions: total emissions in 2020 represented almost 10% of all energy sector GHG emissions[6]. Agriculture, combustions processes and industry are the main sources of emissions of nitrous oxide.

Box 1. Agriculture Forestry and other Land Use (AFOLU) Sector is expected to play an increasing role in pathways to net-zero emissions

AFOLU sector's share of global GHG emissions, which is estimated to be close to 23% by IPCC, is expected to grow due an increase in emissions from agriculture, and due to other sectors finding solutions to mitigate emissions. The AFOLU sector is also called to play a key role in sequestering carbon, thus contributing to moving to net zero.

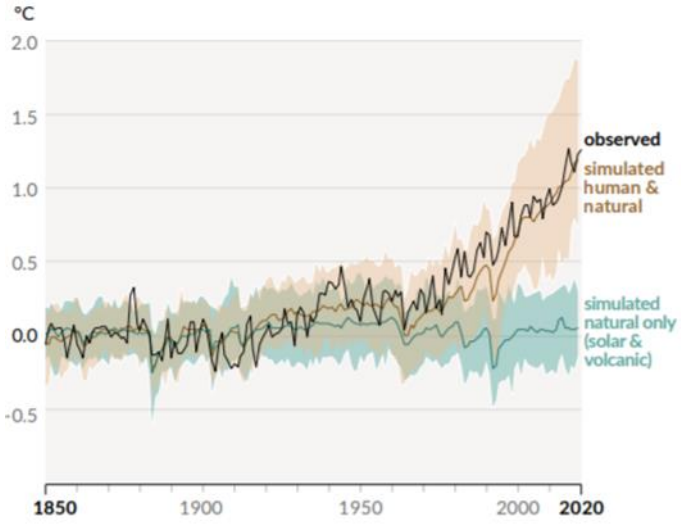
At present policy efforts are relatively limited on non-CO_2 emissions, and mostly involve payments for farmers to adopt practices rather than more effective market-based instruments. Interesting initiatives include New Zealand's plan to price emissions in agriculture by 2025, depending on a feasibility study, at farm level for livestock and industry for fertilisers, the emission reduction fund in Australia, carbon offset schemes in North America, afforestation programmes in Ireland or China, a preferential credit programme in Brazil, and research and development initiatives in many countries.

Governments will need to strengthen their efforts to fulfil their increasingly ambitious targets and ensure that the AFOLU sector effectively contributes to GHG emission mitigation without impeding on food security and other policy objectives.

How vulnerable are countries to climate impacts and risks?

The climate system is being altered due to human influence through anthropogenic GHG emissions. According to the IPCC report, "it is unequivocal that human influence has warmed the atmosphere, ocean and land". In 2019, atmospheric CO_2 concentrations were higher than at any time in at least 2 million years (high confidence), and concentrations of CH_4 and N_2O were higher than at any time in at least 800 000 years (very high confidence)[7]. Global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years (high confidence).

Figure 9. The world keeps getting warmer

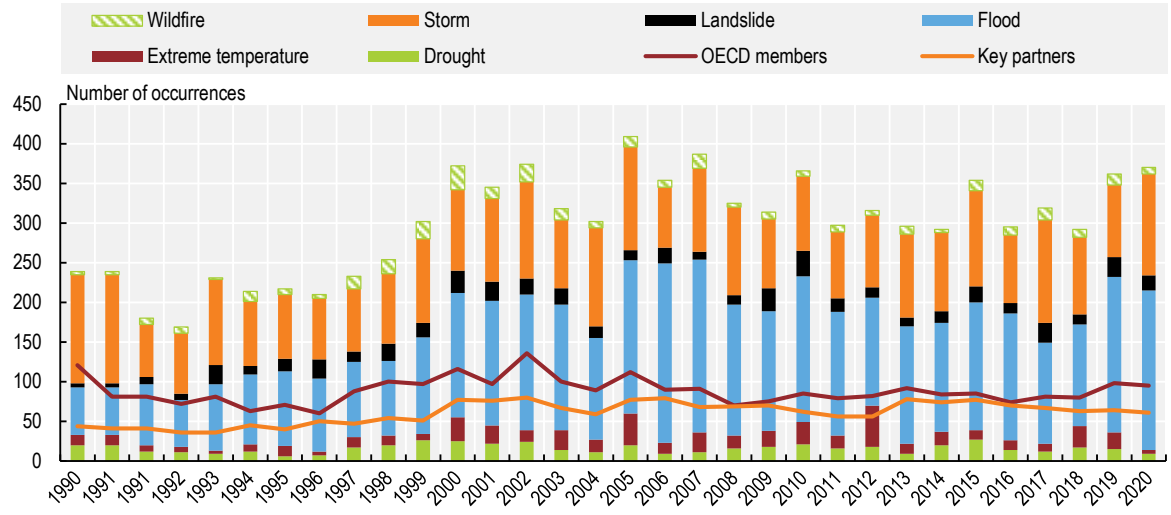


Notes: History of global temperature change and causes of recent warming.
Changes in global surface temperature over the past 170 years (black line) relative to 1850–1900 and annually averaged, compared to CMIP6 climate model simulations of the temperature response to both human and natural drivers (brown), and to only natural drivers (solar and volcanic activity, green). Solid coloured lines show the multi-model average, and coloured shades show the very likely range of simulations.
Source: IPCC (2021), AR6 WG1 SPM.

Beyond their impacts on ecosystems, these temperature trends also have wide-ranging physiological impacts on humans. For instance, they result in premature death and disability, especially in urban areas where the population is disproportionately affected because of the urban heat island effect.[8] According to a WHO report, "the number of people exposed to heat waves increased by around 125 million between 2000 and 2016" and a single heatwave event can result in significant excess mortality.[9] The WHO reported that "an estimated 70 000 people died in Europe during a June to August event in 2003, while an estimated 56 000 people died during a 44-day heatwave in Russia in 2010". In addition, the global excess death ratio changed by -0.51 percentage points for cold temperatures and increased by 0.21 percentage points for hot temperatures, indicating that anthropogenic changes to the climate system are shifting the balance from excessive cold-related mortality to excessive heat-related mortality.[10]

Countries will face increasingly frequent and intense climate hazards, which will be more severe the greater the level of warming. Rising temperatures provoke other environmental changes, such as changes to wetness and dryness, winds, snow and ice cover, occurring at oceans, coastal areas or inland– each with associated risks. These include increases in the frequency of concurrent heatwaves and droughts on the global scale (high confidence); fire weather in some regions of all inhabited continents (medium confidence); and compound flooding in some locations (medium confidence)[11].

Figure 10. Extreme weather events occur more and more frequently



Note: Worldwide, the occurrence of floods has increased significantly over the past thirty years. Extreme temperatures saw an increase towards the early 2000s, droughts and wildfires followed a cyclical rise-and-fall pattern, and storms and landslides remained constant on the global scale over this time period. Altogether, the total number of occurrences of such events has remained approximately constant in OECD countries; however, there has been a rapid increase elsewhere in the world.
Source: OECD (2021), calculations based on data extracted from EM-DAT, CRED / UCLouvain, Brussels, Belgium.

These compound effects could have a substantial negative effect on the global economic outlook and could contribute to socio-economic inequality. The World Economic Forum cites estimates of global loss of GDP as high as 18% if no mitigating actions are taken (3.2°C increase) and 11% if the increase is limited to 2°C[12]. All populations will be affected but they will not be affected equally. Climate risks will depend upon the extent of climate change, the location of people and assets, and the extent to which societies and ecosystems are able to adapt to a changing climate. The scale of the adaptation challenge is largest for developing countries, where resources and capacity to respond to climate risks are most clearly constrained.

Forthcoming work

IPAC is developing the following **new indicators** on climate-related natural hazards, exposure and socio-economic inequality:

- climate-related hazards (extreme temperature, extreme precipitation, drought, wildfire, wind);
- climate-related disasters (occurrence, human casualties, direct and indirect economic losses);
- exposure of people, produced assets and natural assets to these hazards;
- socio-economic inequality in the exposure to climate-related hazards on vulnerable groups, characterised by their age, gender, education, occupation, employment, immigrant status and home ownership.

The OECD Geography of Environmental Well-being project seeks to better understand the distribution of different population groups and their local environmental quality. A preliminary analysis for seven countries (Argentina, Australia, France, New Zealand, South Africa, the United Kingdom and the United States) showed differences across some characteristics of the population (See page 10 in https://www.oecd.org/environment/brochure-gender-and-environmental-statistics.pdf).

Box 2. Measuring progress in implementing national adaptation policies

To strengthen resilience to the impacts of climate change, countries have made adaptation a national priority through the wide adoption of national adaptation strategies (NAS) and plans (NAPs). Nearly all OECD countries have either NAS or NAPs, or both, in place. Several OECD countries such as the United Kingdom and France have already published their second NAP. At the subnational level, some cities are adopting their own strategies and plans. For instance, Milan (Italy) is using the exit from the crisis to question fundamental characteristics and expectations of the city and its scale in its Adaptation Plan 2020, and the need for increased well-being.

However countries are facing difficulties in measuring progress in the implementation of their national adaptation policies. Only a few countries have developed an elaborated set of national adaptation indicators (e.g. United Kingdom, Germany). Where in place, their use is limited because of data availability and challenges related to aggregation across sectors and levels of reporting. In the United Kingdom for example, the Climate Change Committee developed an indicator framework to assess trends in adaptation action and impacts, with a set of over 130 indicators classified according to the main chapters of the UK National Adaptation Programme. The majority of these indicators are on a "wish list" because data is either not currently available or with time series considered too short to be meaningful.

There is increasing recognition that synergies between adaptation and mitigation actions could be better exploited. Their identification can support the development of policy measures and financing mechanisms that are mutually reinforcing. Opportunities exist to implement climate actions that bring both adaptation and mitigation benefits across different sectors, notably in forestry, agriculture and land management, water management and urban planning. For example, forest or mangrove restorations can increase carbon storage capacity, while simultaneously reducing exposure and vulnerability to weather-related risks, such as coastal storm surges or landslides.

At the same time, there are trade-offs involved not just between mitigation and adaptation objectives, but also with other environmental goals. Trade-offs emerge from the complexity and diversity of these linkages across geographical scales. They need to be well understood and managed. For example, while hydropower dams contribute to mitigating climate change by providing a clean energy source, they can exacerbate the consequences of climate variability for communities downstream of the dams.

How advanced is country climate action in response to the net-zero challenge?

No single policy instrument is sufficient for effective climate action, which calls for a comprehensive package of measures encompassing different policy instruments, designed and implemented in a co-ordinated manner, to allow for exploiting synergies and managing trade-offs inherent to climate action.

Countries differ in the way they organise their mitigation efforts. These differences reflect the complex interactions between country climate ambitions, pre-existing conditions, political constraints and social preferences. However, they have all been focusing their efforts on five main cross-cutting climate action areas:

- Enabling climate action through integrated and multi-level governance
- Boosting innovation for a clean technology push
- Setting effective carbon pricing and taxation
- Powering climate action through green budgets and expenditure
- Turning risks into opportunities for the benefit of all.

Climate Action Index

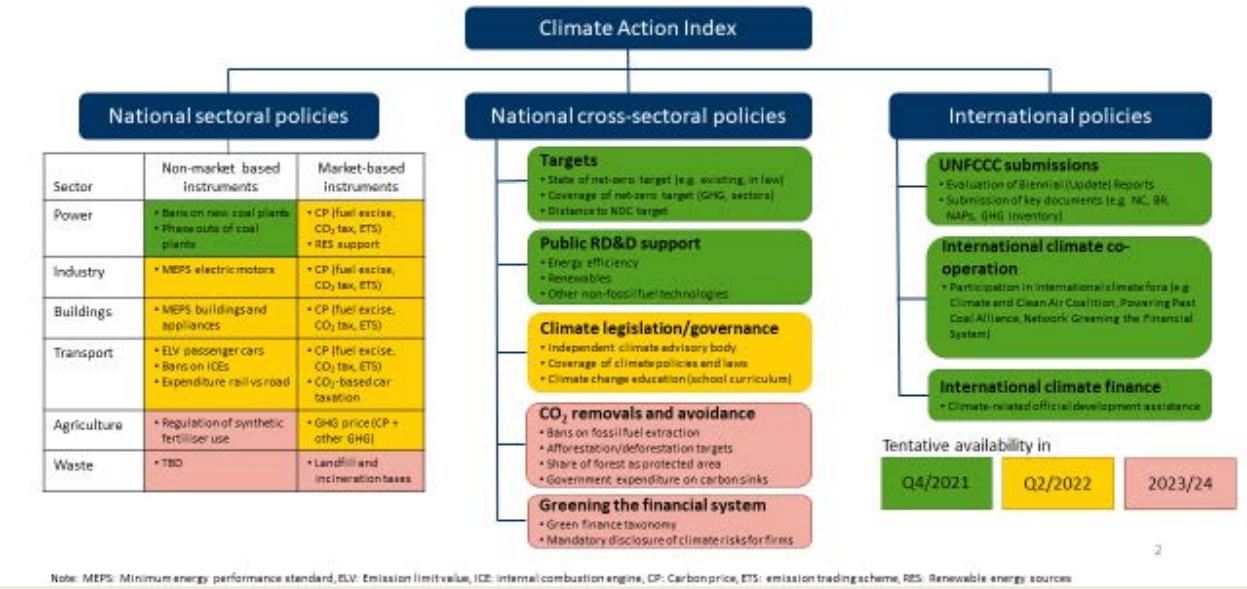
The Climate Action Index (CAI) is one of the innovative indicators of the IPAC Dashboard. It aims to assess countries' climate action as comprehensively as possible to support countries' efforts to achieve the objectives of the Paris Agreement. It enables countries to track progress of their climate policies and to compare policy action across and within countries. The CAI is also designed to be suitable for statistical and econometric analyses, allowing for robust evaluation of the effectiveness of climate policies.

Following the approach of the OECD Environmental Policy Stringency Index, the CAI focusses on factual policy action of countries (objective, quantifiable). The CAI does not consider policy-related outcomes nor subjective perceptions of policies or actions. For example, the index would include country public Research, Design, and Development (RD&D) spending on 'green' technologies, but not the number of patents filed by countries' inventors, which is a result of the policy.

The CAI is a composite indicator that assesses a wide range of climate policy areas (Figure 11). It covers the three building blocks national sectoral policies, national cross-sectoral policies and international policies. It covers policies in the major emitting sectors and distinguishes between market-based and non-market based policies. Within each building block, the CAI covers a number of different modules with different indicators therein. Data comes from the OECD and its sister agencies (IEA, ITF, NEA) as well as from recognised and validated external data sources.

The CAI is work in-progress and will be further developed as new data become available. The first results of the CAI are expected to be ready in Q1/2022. A working paper version with a first set of indicators and a detailed methodology will be published before COP27.

Figure 11. Conceptual framework for the Climate Action Index



Source: IPAC (2021), Technical Expert Group document.

Enabling climate action through integrated multi-level governance

Governments have a key role to play in the net-zero transition. They set the ambition and provide credible plans to reach climate goals, building confidence among investors, industry and civil society. Climate objectives need to be mainstreamed in all areas and all levels of government. A concerted whole-of-government effort is needed to establish a diagnosis, mapping and evaluation of climate policy instruments and underlying policy frameworks to support the transition. Governments are also responsible for the very foundation of climate action: the operationalisation of long-term goals. Several countries have developed roadmaps and implementation strategies to support their long-term targets. Some have further complemented these with specific national sectoral plans, such as National Energy and Climate Plans. The United Kingdom's experience shows that an independent expert body can provide the evidence base to inform the target setting, revision processes and policy decisions to implement the Climate Change Act (Box 3).

Box 3. The United Kingdom's pioneering Climate Change Act

The UK Climate Change Act (2008) set a comprehensive framework for climate change mitigation and adaptation across the country. Its approval benefitted from broad cross-party consensus and strong civil society engagement. The Act was the first of this kind in the world.

The Act sets a long-term emission goal and requires the identification of interim targets, expressed in five-year legally binding carbon budgets. The Act also requires the government to publish a climate change risk assessment every five years and to develop a National Adaptation Programme.

In 2019, the headline target of the Act was amended to reflect the government's net-zero ambition. Originally, the Act committed the United Kingdom to reduce its greenhouse gas emissions by 80% by 2050, compared to 1990 levels. In 2021, the government adopted the sixth carbon budget (2033–37) to cut emissions (including international aviation and shipping emissions) by 78% by 2035. This is the first carbon budget setting the United Kingdom on the path to net zero.

Carbon budgets should be established on the basis of advice from an independent expert body – the Climate Change Committee (CCC). The Committee reports on progress to Parliament. Its mandate extends beyond parliamentary elections.

The Act balances the primacy of the government and parliament in making decisions with the use of independent advisers in interpreting science and evidence.

Source: Adapted from Jeudy-Hugo, S., L. Lo Re and C. Falduto (2021), "Understanding countries' net-zero emissions targets", *OECD/IEA Climate Change Expert Group Papers*, No. 2021/03, OECD Publishing, Paris, https://doi.org/10.1787/8d25a20c-en.

The transition needs to be a shared responsibility across levels of government. While climate challenge is a global phenomenon, its impacts are territorially different. Within-country regional variation in emissions is larger than between countries and there is much variation in agriculture, power generation and industry-related emissions (see section 1)[13]. The capacity of subnational governments to respond is equally different. Regions and cities are already at the forefront of implementing ambitious measures to mitigate and adapt to climate change (Box 4). They are responsible for 55% of public spending and 64% of public investment for climate mitigation and adaptation. Many cities and regions have adopted climate neutrality targets and actions that are more ambitious than those of their national governments. However, acting alone, their full potential remains untapped. Local governments are estimated to have direct power to cut up to one-third of GHG emissions in their cities, with the remaining two-thirds dependent on national and state governments or co-ordination across levels of government[14].

Box 4. A new urban paradigm of inclusive, green and smart cities

The COVID-19 crisis accelerated the shift towards a new urban paradigm of inclusive, green and smart cities. At the city-level, an increasing number of green recovery initiatives and investments have emerged, with particular emphasis on sustainable urban mobility.

During lockdowns, most cities experienced a significant drop in traffic and a reduction of air pollution and CO_2 emissions. Global levels of nitrogen dioxide, a pollutant linked to cars, hit a record low. Despite a sharp bounce-back as lockdowns were lifted, the experience motivated city leaders to pursue more sustainable urban mobility. Cities have been promoting cycling as one of the favoured options for the post-confinement period as part of the tactical urbanism movement. Moving into more long term strategies, cities are now investing in active mobility infrastructure, improved public transport safety and accessibility, and low emission options, such as electric vehicles and scooters.

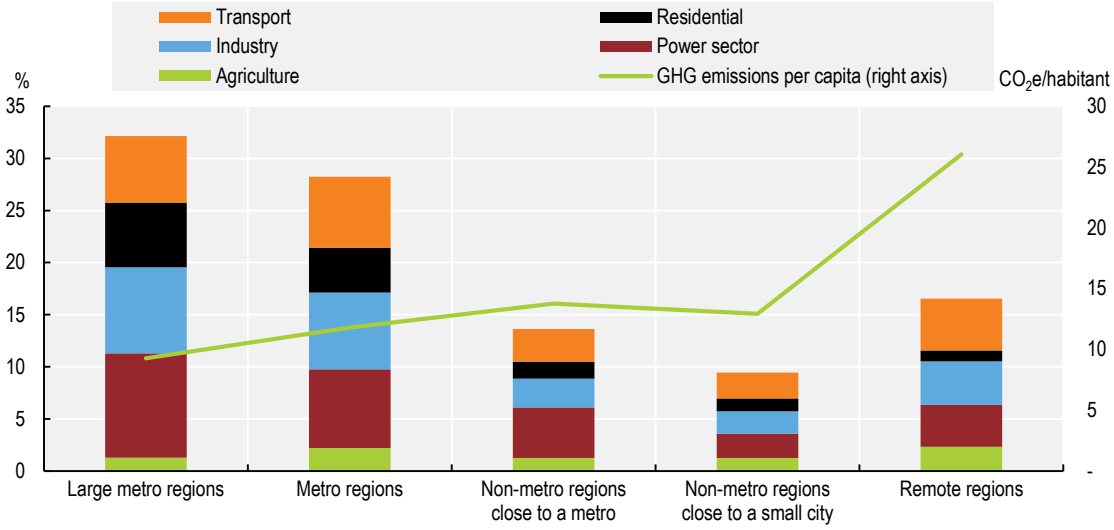
For example, the mayor of **Paris (France)** announced that 50 kilometres (30 miles) of lanes normally used by cars would be reserved for bicycles. **Medellín (Colombia)** plans to expand bike lanes by almost 50% within three years and more than double the number of interconnected public transport lines by 2030. The city is working to provide 50 000 electric bicycles that residents can rent at a low cost, and it plans to electrify all public transport by the end of the decade. **Seoul (Korea)** will continue to pioneer smart green mobility options by implementing driverless vehicles, delivery of goods via robots and smart parking lots.

Source: Adapted from OECD (2020), Cities policy responses, https://www.oecd.org/coronavirus/policy-responses/cities-policy-responses-fd1053ff/#endnotea0z88

Metropolitan and rural regions will face specific challenges, which will require targeted urban and rural policies. Globally, cities account for more than 50% of the global population, two thirds of energy demand, and more than 70% of energy-related CO_2 emissions. These shares are expected to increase significantly over coming decades without decisive action[15]. While metropolitan regions emit the most, production-based emissions per capita are highest in remote regions (Figure 12). Rural regions also cover around 80% of the territory in OECD countries[16] and contain biodiversity and ecosystems needed to sustain our lives and that are increasingly under threat. Greening subnational government policies and budgets, both on the expenditure and revenue side, is a critical course of action, also given that wellbeing co-benefits often arise locally and can exceed the costs of climate action.

Figure 12. Metropolitan regions emit the most, but production-based emissions per capita are highest in remote regions

Contribution to GHG emissions (bars) and GHG emissions per capita (line) by type of region, 2018



Note: OECD countries, Romania and Bulgaria. Excluding emissions from land use and land use change.
Source: OECD (2021), OECD Regional Outlook 2021: Addressing COVID-19 and Moving to Net-Zero Greenhouse Gas Emissions, OECD Publishing, Paris, https://doi.org/10.1787/17017efe-en.

Boosting innovation for a clean technology push

Innovation helps to broaden the range of low-carbon technology options available to governments and the private sector over time. In the power sector, these options include the next generation of renewable electricity generation technologies, nuclear power and carbon capture and storage (CCS), as well as energy storage technologies and smart grid technologies. In the transport sector, new low-carbon vehicles are being developed including vehicles that run on electricity, hydrogen fuel cells, compressed or liquified gas, and biofuels. In the buildings sector, advanced building materials and energy-efficient home appliances are being developed and existing technologies improved. The industrial sector needs to switch to lower-carbon and alternative fuels for production; make more efficient materials, and deploy best available technologies, including CCS[17].

Without a major acceleration in clean energy innovation, reaching net-zero emissions by 2050 will not be achievable. If properly deployed, technologies that are available on the market today are sufficient to provide nearly all of the emissions reductions required to 2030, according to the IEA. However, reaching net-zero emissions will require the widespread use after 2030 of technologies that are still under development. In 2050, almost 50% of CO_2 emissions reductions in the IEA's net-zero scenario come from technologies currently at demonstration or prototype stage. This share is even higher in sectors such as heavy industry and long-distance transport. Major innovation efforts are vital in this decade so that the technologies necessary for net-zero emissions reach markets as soon as possible[18].

Box 5. Meeting climate targets: the role of nuclear energy and innovation

Nuclear energy is the largest source of non-emitting electricity generation in OECD countries and the second largest source worldwide after hydropower. Existing nuclear capacity displaces 1.6 gigatonnes of carbon dioxide emissions annually and has displaced 66 gigatonnes of carbon dioxide since 1971 – the equivalent of two years of global emissions (NEA, 2020). Long-term operation of the existing fleet can continue making a contribution for decades to come.

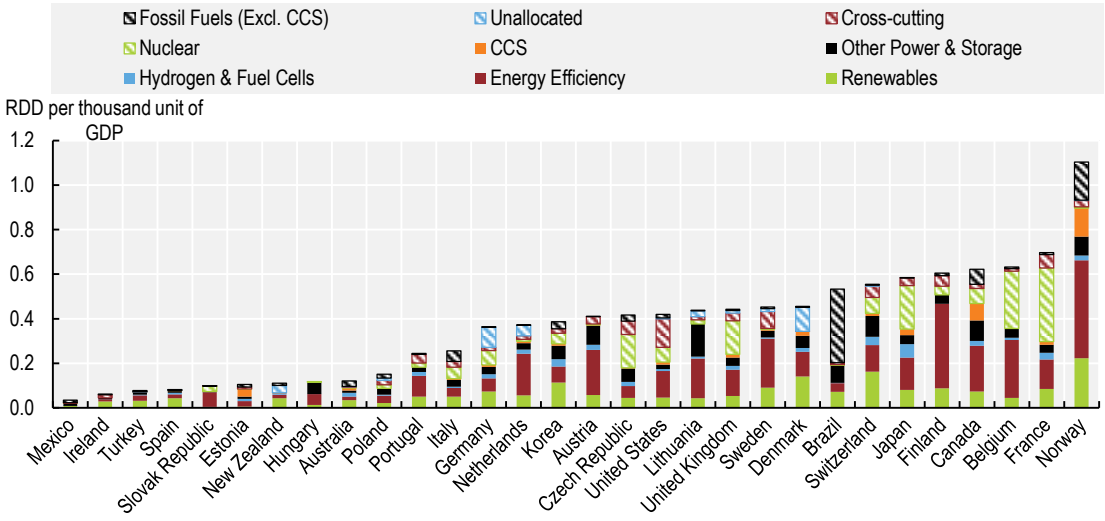
A wave of near-term and medium-term nuclear innovations have the potential to open up new opportunities with advanced and small modular reactors, as well as nuclear hybrid energy systems, reaching into new markets and applications. These innovations include sector coupling, combined heat and power for heavy industry and resource extraction, hydrogen and synthetic fuel production, desalination, and off-grid applications.

NEA analysis (*forthcoming*) identifies the potential contribution of nuclear energy to clean energy capacity and emissions reductions towards net zero by 2050. Taken together, the installed nuclear capacity of long-term operation, large-scale new builds using existing nuclear technologies, small modular reactors, nuclear hybrid energy and hydrogen systems could reach 1160 gigawatts electric by 2050, consistent with the 1.5°C decarbonisation pathways studied by the IPCC. By 2050, nuclear energy could displace 5 gigatonnes of carbon dioxide emissions every year – more than the annual emissions from the entire United States economy today.

Total public low-carbon energy RD&D spending has been increasing in most of the countries in the last five years. The United States is the leading spender in technologies such as renewables, energy efficiency and CCS and Japan spends the most in hydrogen and fuels cells technologies. Several other countries have notably increased their spending in low-carbon technologies: for example, the Czech Republic and Belgium have more than doubled their budgets in energy efficiency over the last five years.

Norway spends most per unit of GDP and, like Finland, its highest category of spending is energy efficiency technologies. This is followed by renewables, an area that only Switzerland, Denmark and Korea count as their largest category, among the top spenders in relative terms. Several countries, such as the Czech Republic, the United Kingdom and the Netherlands, have significantly increased their spending per unit of GDP over the past five years (Figure 13).

Figure 13. Public RD&D spending across countries varies considerably

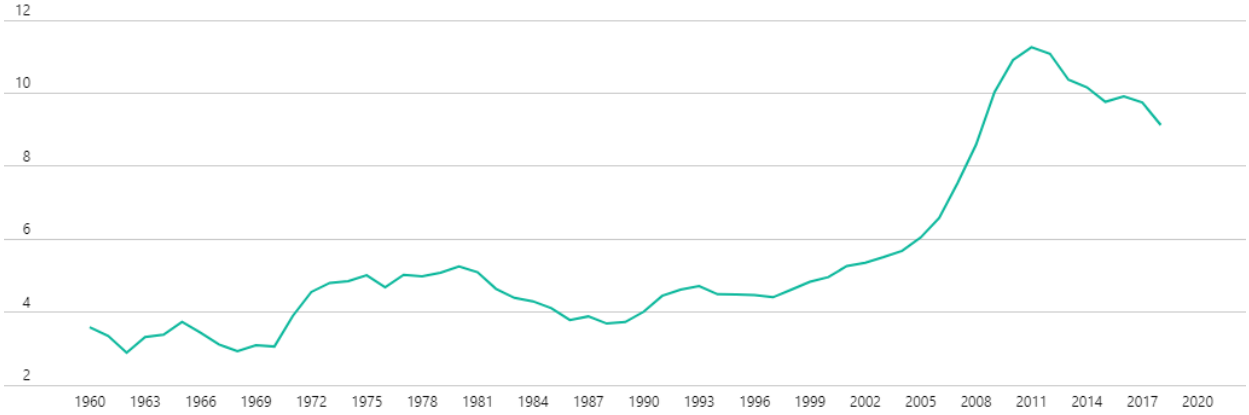


Note: CCS= carbon capture and storage.
Source: IEA (2021), "Energy technology RD&D budgets" (database); https://www.iea.org/data-and-statistics/data-product/energy-technology-rd-and-d-budget-database-2.

OECD countries represent the vast majority of worldwide patents on climate change mitigation technologies. The share of "high-value" climate change mitigation inventions in all technologies has increased from around 4% in the early 1990s to over 9% in latest years[19]. Among selected technologies, the increase in filed inventions since 1990 has been more marked for road transport and energy storage. Renewable energy generation technologies increased the fastest up to 2011[20] (Figure 14). While patent data are informative about the production of new innovation, they do not indicate whether the technology protected by the patent is actually being used by the owner. Data on trademark filings can usefully complement patent data by focusing on the commercialisation phase of innovations.

Figure 14. Climate mitigation technologies increased quickly up to 2011

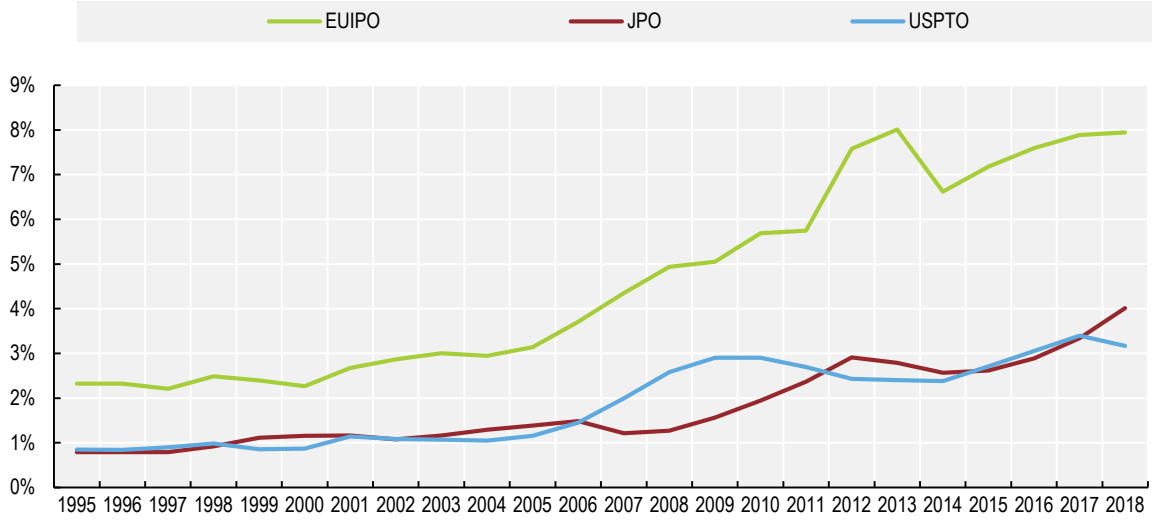
Patent applications in climate mitigation technologies as % of total technologies, by inventor's residence



Source: OECD, "Patents in environment-related technologies: Technology development by inventor country", OECD Environment Statistics (database) - https://doi.org/10.1787/data-00760-en.

The proportion of trademarks for climate-related goods and services has grown markedly over the last two decades. The proportion has tripled in the United States and in Japan (from 1% to 3%) and has nearly quadrupled in Europe (from 2% to 8%). Interestingly, the observed decrease in climate-related patenting since 2012 lasts for a much shorter period compared to trademarks, and has picked up again in the most recent available years. This suggests that firms have partly switched activities away from R&D and toward diffusion and commercialisation. Accelerating diffusion of available technologies is critical to reach medium-term carbon emissions reductions, but in the long run, developing new breakthrough technologies that are not on the market yet is also important. An important question for policy is therefore how to accelerate the diffusion of existing low-carbon technologies further, while reigniting low-carbon innovation in breakthrough technologies.

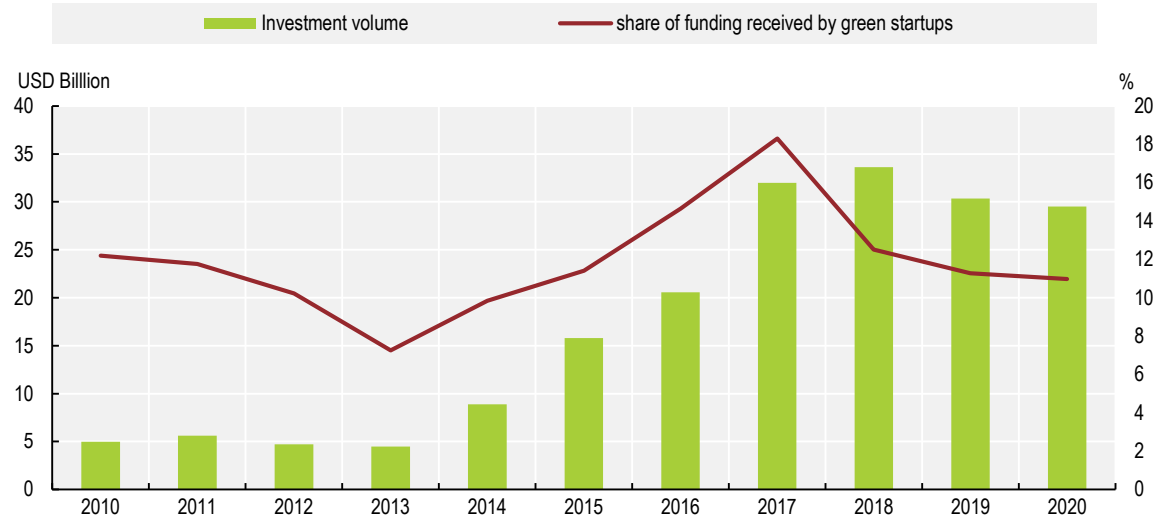
Figure 15. The proportion of trademarks for climate-related goods and services has grown markedly over the last two decades



Note: Data on trademark applications relate to trademarks registered at the European Union Intellectual Property Office (EUIPO), the Japan Patent Office (JPO) and the United States Patent and Trademark Office (USPTO). While patent data are informative about the production of new innovation, they do not indicate whether the technology protected by the patent is actually being used by the owner. Data on trademark filings can usefully complement patent data by focusing on the commercialisation phase of innovations.
Source: OECD (2021), forthcoming.

Monitoring progress in the development of "green" start-ups allows to track private investment targeting new companies engaged in climate-related sectors and activities. There has been a large increase in global venture capital (VC) investment in climate-related start-ups in the last decade, from USD 5 billion in 2010 to USD 30 billion in 2020. However, after a peak in 2018, global VC investment in green start-ups has decreased in the last two years. Between 2010 and 2020, the share of total VC funding going to climate-related start-ups has not changed much (12% in 2010, 11% in 2020), but has fluctuated significantly, with a peak at 18% in 2017 (Figure 16).

Figure 16. Investment in green start-ups has increased in the last decade



Source: OECD (2021) forthcoming.

Box 6. The Netherlands has an ambitious policy to support innovation in the industry sector

The Netherlands illustrates the strength of an approach that combines a strong commitment to raising carbon prices with ambitious technology support. These two pillars can be mutually reinforcing, as a clear trajectory of increasing carbon prices helps make the business case for investment in low-carbon technologies. At the same time, the Dutch case demonstrates the pervasiveness of competitiveness provisions and the trade-off between short-term emissions cuts and longer-term technology shifts.

Alongside carbon pricing, the Netherlands' decarbonisation strategy aims to support the uptake of low carbon technologies, focusing on the cost-effective deployment of both mature (e.g. renewable electricity) and radically new technologies (e.g. hydrogen) through subsidy programmes and corporate tax incentives. The main instrument is the Sustainable Energy Transition Incentive Scheme (SDE++), which subsidises the additional costs associated with adopting a low-carbon technology. The instrument is allocated to applicants in increasing order of subsidy requirement per tonne of CO_2 reduction.While this allocation design is economically efficient and ensures least-cost decarbonisation in the short run, it favours technologies that are close to the market at the expense of more radical alternatives that are still at an earlier stage of development, such as green hydrogen.

The analysis of the Dutch technology support policy package calls for a balanced approach that supports both emerging and mature technologies. The Netherlands supports R&D mostly through broad tax credits and the Innovation Box, which are technology neutral but, by construction, benefit mostly technologies that are closest to the market. Options to support emerging technologies include holding separate tenders across technology readiness level for deployment instruments, and combining horizontal R&D support with targeted support for emerging technologies.

Source: (OECD, 2021[6])

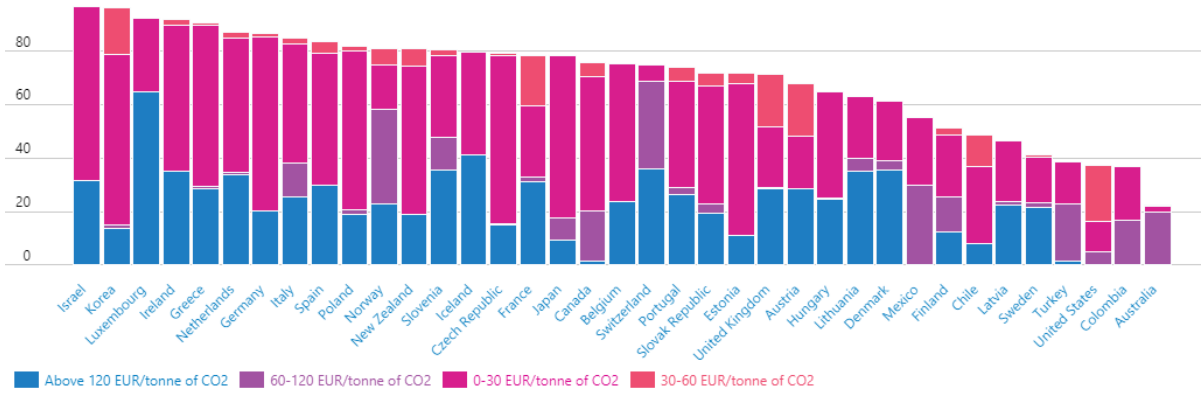
Setting effective carbon pricing and taxation

Carbon pricing is an essential element of climate change mitigation policy. Pricing CO_2 and energy remains the most economically efficient tool to bend the trajectory of carbon emissions globally, and create favourable conditions to mobilise the private finance and investment required to achieve global mitigation objectives. Climate-related taxation can improve environmental quality by using price signals to shift investment and behaviour patterns. Taxes on tax bases such as logging, forestry products and land-use change can, in turn, help safeguard planetary carbon sinks and encourage carbon sequestration[21]. Whereas carbon taxes fix the price but not the quantity of emission reductions, emissions trading systems fix the targeted quantity but not the price of emissions allowances. Cap-and-trade provides more certainty regarding environmental outcomes[22].

There has been a noticeable, albeit uneven, progress in carbon pricing since 2018: half of all CO_2 emissions from energy use in G20 economies are priced in 2021, up from 37% in 2018. The coverage increase is largest for emissions trading systems, with the new Chinese national emissions trading system for the power sector as the main driver. At the same time, coverage continues to vary widely across sectors. Across G20 countries the average effective carbon rate has increased to EUR 19, up by approximately EUR 2 since 2018. However, there has been little change in countries where rates were relatively low in 2018.

Figure 17. Carbon pricing is not yet used to its full potential

Share of emissions priced above EUR Y per tonne of CO_2, 2018



Source:OECD, "Environmental policy: Effective carbon rates", OECD Environment Statistics (database)- https://doi.org/10.1787/108c55c1-en.

In most countries effective carbon rates (ECR) in the road transport sector are higher than in other sectors. About 53% of emissions from road transport are already priced above EUR 60/tCO_2 and around 24% are priced at above EUR 120/tCO_2. ECRs are particularly low in the electricity and the industry sectors. In the residential and commercial sector, there is significant heterogeneity: a handful of countries price a significant share of carbon emissions above EUR 60/tCO_2, but with very low carbon prices in other countries[23].

Box 7. The Pan-Canadian framework for carbon pricing

Until 2016, climate change policy was driven mainly by provincial initiatives. The 2016 Pan-Canadian Framework on Clean Growth and Climate Change (PCF) represents the first time since 2002 that concrete steps to develop a nationwide strategy have succeeded. The PCF aims to reduce emissions by 30% from 2005 levels by 2030, in line with the target Canada set in its nationally determined contribution under the Paris Agreement.

Carbon pricing is a foundation of the PCF. The other pillars include complementary mitigation action across sectors; adaptation and climate resilience; and clean technology, innovation and jobs.

A form of carbon pricing applies across the country using a benchmark approach. Since 2018, provinces and territories have had to implement their own carbon pricing scheme. Such a scheme can take the form of either a carbon tax, a cap-and-trade system, credit trading programmes for large emitters or a hybrid approach. The carbon pricing systems must be deemed as equivalent to the benchmark by the federal authorities. For cap-and-trade systems, for example, the benchmark requires: firstly, a 2030 emissions reduction target equal to or greater than Canada's 30% reduction target; and secondly, progressively more stringent annual emission caps at least until 2022.

For any jurisdiction that lacks a system aligned with the benchmark, a federal carbon pricing backstop applies in the form of a fuel charge. The direct revenue remains in, or is returned to, the jurisdiction in which it originates. The minimum price under the federal benchmark was set at CAD 10 per tonne of carbon dioxide (CO_2) in 2018, rising by CAD 10 per year to reach CAD 50 per tonne in 2022.

The 2020 climate plan "A Healthy Environment and a Healthy Economy" proposes further annual increases of the national backstop carbon price of CAD 15 per tonne of CO_2 from 2023 until 2030, bringing the price per tonne to CAD 170 in 2030. This is roughly the mid-point of the range of prices (CAD 81 to CAD 239) the Parliamentary Budget Office estimated to be required to meet Canada's Paris commitments.

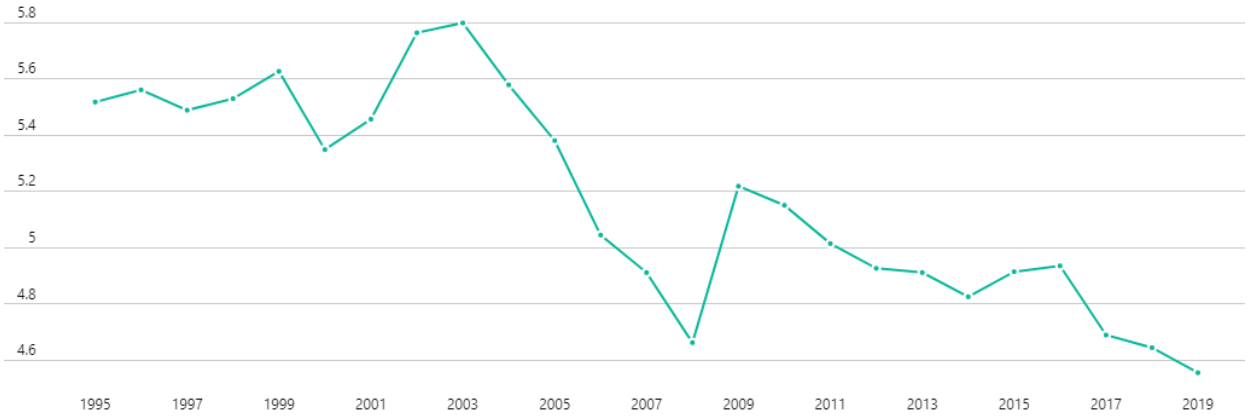
As a result of the PCF, several carbon pricing systems coexist in Canada. As of end of 2020, a carbon tax was in place in British Columbia and Northwest Territories, and a cap-and-trade system applied in Nova Scotia and Quebec. The national backstop carbon pricing system applied, in whole or in part, in the other jurisdictions.

Source: OECD (2017), OECD Environmental Performance Reviews: Canada 2017, OECD Environmental Performance Reviews, OECD Publishing, Paris, *https://doi.org/10.1787/9789264279612-en*; OECD (2021), OECD Economic Surveys: Canada 2021, OECD Publishing, Paris, https://doi.org/10.1787/16e4abc0-en.

Reliance on climate-related taxes varies across countries. In the OECD area, climate change-related taxes raised USD 793 billion in 2019, representing the majority of environmentally related tax revenue (90%). This share has remained relatively unchanged since 2000. The bulk of revenue coming from taxes directed at climate change is raised from taxing energy (77%), in particular motor fuels, and transport (22%), while pollution and resource tax bases play a minor role in generating revenue.

Figure 18. The share of climate-related taxes continues to decline in the OECD

Climate related tax revenue as % of total tax revenue



Source: OECD, "Environmental policy: Environmentally related tax revenue", OECD Environment Statistics (database) - https://doi.org/10.1787/df563d69-en.

Overall, the share of environmentally related tax revenue (ERTR) continues to decline in OECD countries, amounting to 5.2% of total tax revenue in 2019, down from 6.1% in early 2000s. Compared to GDP, ERTR is also decreasing and reached 1.5% of GDP in 2019. The decreasing trend is a combination of factors, namely, that tax rates are typically defined in physical units (e.g. per litre) and hence are set in nominal terms. Without inflation adjustment, these rates decrease in real terms over time. While countries such as Denmark, the Netherlands and Sweden have implemented such adjustments, most OECD countries do not yet apply inflation adjustments to environmentally related taxes. Another factor contributing to this trend is the increase in crude oil prices up until mid-2014, which triggered substitution away from motor fuel use, also making adjustments in nominal tax rates on motor fuels politically difficult. Yet some countries, such as Slovenia, Costa Rica, Turkey and Estonia strengthened the role of environmentally related taxes and have tripled their share of tax revenue since 2000.[24].

Governments are pushing ahead with emissions-trading systems. The largest carbon market in operation is the EU Emissions Trading System, covering about 2 billion tonnes of CO_2 equivalent (tCO_2-eq) emissions. Several smaller systems have been implemented, with at least one initiative to link two systems (Quebec and California). The systems vary in scope – e.g. few include forestry or agriculture activities, while almost all include power generation.

The environmental effectiveness of taxes and tradable permits on carbon may be hampered by direct and indirect government support to fossil fuels. OECD countries and partner economies provided around USD 183 billion worth of total support for fossil fuels in 2020, which represents a year-on-year decline of around 10%. Such decrease was mostly driven by a drop in fuel consumption following widespread COVID-19 mobility restrictions and by record-low oil prices that reduced government spending on end-user consumption of fossil energy. By contrast, support for production of fossil fuels experienced a 5% rise as governments drew up rescue programmes for state oil and electricity companies[25].

Box 8. Ireland's carbon tax trajectory

The Irish carbon tax applies to all fuels used in sectors not covered by the Emissions Trading System of the European Union. It was introduced in 2010 in the context of a deep economic recession. The tax initially applied to liquid and gaseous fuels at the rate of EUR 15 per tonne of carbon dioxide (CO_2). It was extended to solid fuels in 2013 (although initially at a lower rate). There were phased increases of the tax to reach EUR 26 per tonne in 2020.

The 2021 government budget further raised the tax to EUR 33.5 per tonne of CO_2 on automotive fuels in October 2020 and on all fuels as of May 2021. The 2021 budget implemented the government commitment to raise the carbon tax by EUR 7.50 per tonne of CO_2 per year over the decade. This would allow the tax rate to reach EUR 100 per tonne of CO_2 by 2030.

The increase of the nominal carbon tax rate between 2018 and 2020 resulted in a nearly 5% rise in the effective carbon tax rate in the transport sector and a 35% increase in the non-transport sector. Ireland is among the ten OECD countries that priced (via carbon and energy tax and emission trading) at least half of their energy-related CO_2 emissions at EUR 60 per tonne. This is the mid-point estimate of carbon costs in 2020 and a low-end estimate for 2030.

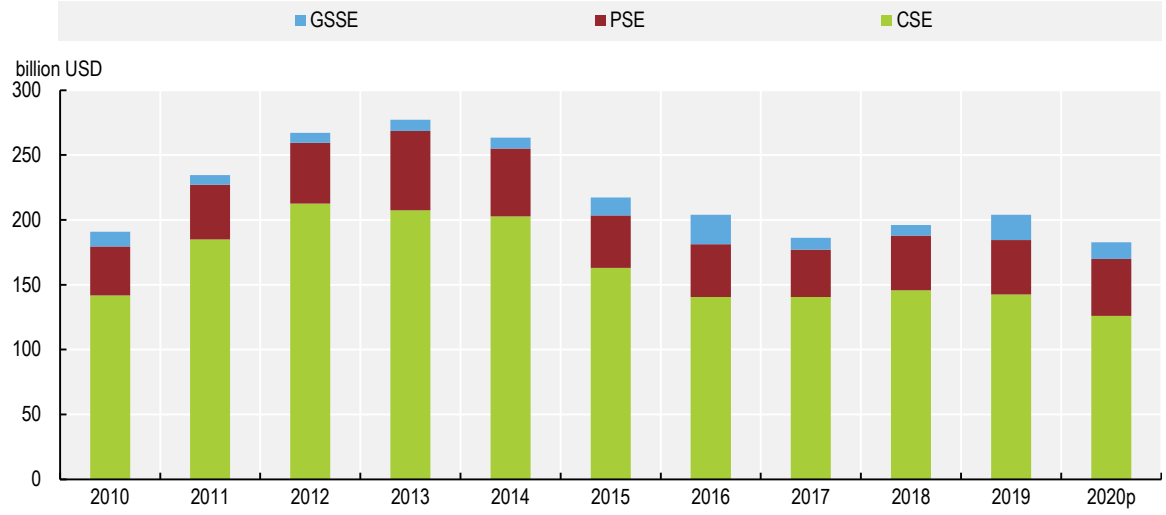
The government committed to use the revenue from the carbon tax increase until 2030 (EUR 9.5 billion over ten years) to prevent fuel poverty, ensure a just transition for displaced workers and finance climate-related investment. In line with this commitment, the government allocated part of the carbon tax revenue to enhance some social welfare schemes in 2021, such as benefits for children and people living alone. This increase is expected to mitigate the impact of the carbon tax on vulnerable households. It may even contribute to reducing poverty, as average weekly disposable income of households would increase as a result of the budget package. In addition, EUR 6 million of carbon tax revenue was allocated in both 2020 and 2021 to finance the newly established national Just Transition Fund for the Midlands. The Fund provides financial support for retraining workers and for business projects that can generate sustainable jobs in a region that is being affected by the phase out of peat extraction and use.

Source: OECD (2021), *OECD Environmental Performance Reviews: Ireland 2021*, OECD Environmental Performance Reviews, OECD Publishing, Paris, https://doi.org/10.1787/9ef10b4f-en.

And government support for fossil fuels is expected to increase once again. With several hefty government COVID-19 recovery bailouts coming up for disbursement in fiscal year 2021 as well the gradual re-opening of the global economy driving energy prices up, it is expected that overall fossil fuel support will rise again. Backsliding on support for fossil fuels demonstrates a concerning disconnect with the increasingly pressing climate emergency. It also underscores the need for ongoing efforts to enhance transparency on the many ways that governments continue to encourage fossil-fuel production and use. Supporting economies and societies through the COVID-19 crisis must be a priority, necessitating the phase out of support for polluting technologies.

Figure 19. Support for fossil fuel production and use has decreased in 2020 but further reduction is required to support the net-zero transition

Billion USD, 50 OECD, G20, and Eastern Partnership economies



Note: General Support Services Estimates (GSSE) represents the value of transfers arising from policy measures that create enabling conditions for the fossil fuel sector through the development of private or public services, institutions and infrastructure regardless of their objectives and impact on fossil fuel production and or consumption. It includes policies where fossil fuels are the main beneficiaries, but does not include any payments to individual producers. GSSE transfers do not directly alter producer receipts or costs, or consumption expenditures, although they may affect production or consumption of fossil fuels in the long term. The Producer Support Estimate (PSE) indicator measures the annual value of transfers from consumers and taxpayers to producers of fossil fuels. Consumer Support Estimate (CSE) reflects the value of transfers to consumers of fossil fuels regardless of their nature, objectives or impacts on consumption.
Source: OECD (2021), Inventory of Support Measures for Fossil Fuels.

Forthcoming work

The environmental effectiveness of taxes and tradable permits on carbon may be hampered by direct and indirect government support to fossil fuels. To address this issue work has been initiated to calculate net effective carbon rates and develop related indicators that would account for both opposing incentives and use international benchmark carbon prices. Thus, all subsidies on fossil fuels relevant to energy use will be covered, beyond tax expenditure data.

Powering climate action through green budgets and expenditure

The radical transformation of the global energy system alone, required to achieve net-zero emissions in 2050, hinges on a big expansion in investment and a big shift in capital expenditure. Getting the world on track for net-zero emissions by 2050 requires clean energy transition-related investment to accelerate from current levels to around USD 4 trillion annually by 2030. Lack of investment on low-carbon infrastructure could lock economies into the emission-intensive systems and technologies, and make them increasingly vulnerable to climate impacts[26].

An expansion of public sources of finance is required. While the IEA estimates that around 70% of clean energy investment will need to be carried out by private developers, consumers and financiers responding to market signals and policies set by governments, public sources of finance are also required. They will in fact need to double relative to current pledges for the net-zero pathway to be achieved. Public actors, including state-owned enterprises (SOEs), often have a key part to play in funding network infrastructure and clean energy transitions in emissions-intensive sectors.

The boost in public spending undertaken by governments as a response to the COVID-19 pandemic presents a unique opportunity for climate action. In 2020, the world's fifty largest economies announced USD 14.6 trillion in fiscal measures to address the crisis[27]. Such measures are to provide immediate support to the most vulnerable categories of population, workers and firms and, as conditions allow, to drive near-term economic recovery. These measures also have implications for the achievement of broader national and international goals, including countries' NDCs and the Paris Agreement goal.

However, while green spending grew since the beginning of the pandemic, it remains low as a proportion of total recovery spending (21.5%)[28]. South Korea, Spain and Germany lead in total green spending. Under the lens of green spending as a proportion of GDP, Spain, South Korea and the United Kingdom take the lead. Despite the efforts of these countries, recovery measures in other countries lacked a green focus in 2020.

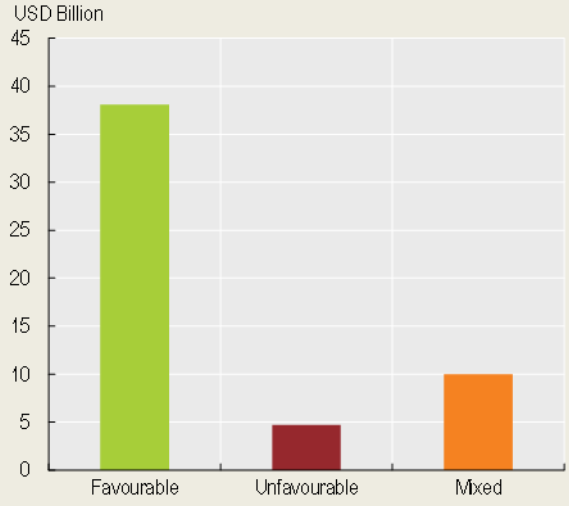
For the fiscal policy to be effective in supporting climate action, governments need to mainstream green budgeting. Green budgeting means using the tools of budgetary policy-making to help achieve climate and environmental goals. It entails a systematic approach to assess the overall coherence of the budget relative to a country's climate and environmental agenda, and to mainstream an environmentally aware approach across all policy areas and within the budget process[29]. Most frequent tools are ex-ante and ex-post environmental impact assessment, green budget tagging, environmental cost-benefit analysis and carbon assessments.

Less than half of 39 countries studied by the OECD were identified as having green budgeting practices in place, while nine were planning to introduce some of these practices. Finland and Sweden highlight within the budget documents the measures that have a clear impact on specific environmental objectives. France, Ireland and Italy tag the budget to identify items with a potential environmental impact. For each item, its green content is identified, i.e., the proportion relevant to green objectives. In doing so, Ireland implements a binary weighted approach, where the entire cost of a measure is tagged as green or not. France and Italy implement a scaled approach to determine the green content of a measure. Sweden focuses on climate change mitigation measures, while Finland, France and Italy cover a broad set of environmental aspects. As for the budgetary items covered, these countries focus on favourable expenditure, with the exception of France that covers also revenue and tax expenditure, both favourable and unfavourable[30].

Box 9. Green budget tagging and performance in France

France conducted its first green budgeting exercise in 2019 (Inspection générale des finances - conseil général de l'environnement et du développement durable, 2019[7]). In 2020, it has established a budget tagging system using positive, negative, and neutral classifications according to six environmental objectives (Figure 22).

Figure 20. Green Budget Tagging of the French Central Budget in 2021



The second edition of the "Green Budget" concludes that, out of a total of EUR 586.6 billion for 2022 in budgetary spending and tax expenditures, EUR 53.4 billion have an impact on the environment, which is an increase of +0.6 billion euros compare to the 2021 finance law.

The evolution of tagging practices in France will enable the Ministry of Finance to publish a consistent time series for a three-year period to help inform budget decisions. The procedure is evolving as France will continue to publish a green budget as an annex to its finance act every year. The 2022 edition incorporates methodological clarifications and new elements of analysis. A more in-depth analysis of the rating of expenditures, a clarified differentiation between expenditure effectively considered as neutral, expenditure not rated due to methodological difficulties, the integration of a performance section and the presentation of expenditure executed in the year 2020 complete and enrich the 2022 edition.

Source: Authors and (Ministry of Economy and Finance of France, 2020[8]) and (Ministry of Economy and Finance of France, 2021[9])

Forthcoming work

Building on the OECD Paris Collaborative on Green Budgeting, the OECD Green Budgeting Framework and the OECD Subnational Government Finance for Environment and Climate project, IPAC has initiated work to further develop and improve data and indicators on climate-related public budget and government expenditure. The work focusses on tracking the budgetary measures relevant for climate change and developing a methodology for the construction of internationally comparable indicators. This work will also contribute to improving data on climate-related expenditure by establishing bridges between climate-related green budgeting and climate-related environmental expenditure accounts.

Turning risks into opportunities for the benefit of all

Public acceptance of climate action is crucial and depends on un-locking the full potential of the green economy. Perceptions of distributional fairness can play a significant role for public acceptability, which is why integrating environmental and inclusiveness aspects into recovery packages and measures for the net-zero transition is a mutually beneficial strategy. Beyond protecting vulnerable groups from socio-economic impacts associated with the net-zero transition, countries need to unleash new opportunities - for the energy sector alone, there is an annual market opportunity that rises well above USD 1 trillion by 2050 for manufacturers of wind turbines, solar panels, lithium-ion batteries, electrolysers and fuel cells[31].

To maximise benefits of the transition, countries are increasingly coupling climate action with wider wellbeing objectives, recognising that climate action could contribute to a broader reform agenda for greener, more resilient and inclusive growth, including better designed tax codes, pro-growth long-term infrastructure investment, and energy and transport systems that support cleaner air, better health and a more diversified energy supply. The co-benefits mentioned in some first NDCs include food security (e.g. South Sudan), rural and regional development (e.g. Indonesia), resilience to natural disasters (e.g Bangladesh) and employment (e.g. Niger). Chile's recently-revised NDC requires each goal in the NDC to also contribute to fulfilling one or more sustainable development goal. Jamaica is drawing on integrated approaches across energy and land-use sectors, yielding co-benefits such as health and strengthening of ecosystems. Rwanda is mainstreaming gender equality and nature-based solutions in actionable items within the agriculture sector.

Box 10. Global Commission on People-Centred Clean Energy Transitions

The Global Commission on People-Centred Clean Energy Transitions was convened in early 2021 by the Executive Director of the International Energy Agency (IEA) to make actionable recommendations on how to ensure clean energy policies are fully inclusive and people-centred. The Commission believes that all clean energy transitions should be truly people-centred and inclusive, and that this is essential to the success of energy system transformation at the pace and scale required to deliver global ambition for climate change mitigation.

Clean energy transitions will create jobs, enhance the quality of life and ensure a cleaner, healthier environment. A people-centred approach ensures the benefits and costs involved in the transformation of our energy system are distributed fairly and in a way that protects the most vulnerable in society. People-centred clean energy transitions require a focus on skills, decent jobs and worker protection; social and economic development; equality, social inclusion and fairness; and engaging people as active participants.

The transition to a green economy creates opportunities for firms and workers, but could also lead to short and medium-term economic and social costs. The estimated employment impacts of decarbonisation, while modest overall, will be much higher in some regions. On average across OECD regions, only 2.3% of employment is in sectors at potential risk from climate policies consistent with the Paris Agreement. But in some large regions, this may exceed 6%. For example, in the Polish region of Silesia, more than half of employment in sectors at risk is in the mining of coal and lignite, and a quarter is in the manufacturing of rubber and plastics products[32]. Employment opportunities may not materialise where losses occur, which is why vulnerable regions and communities will need targeted support.

Green skills are essential, as a shift to green jobs is gradually underway: the ILO estimates that **labour market and skills policies play a key role to enable countries to better manage and profit from the green transition.** 24 million jobs worldwide could be created by the green economy by 2030[33]. In almost half of OECD countries, local and regional governments are wholly or partially responsible for implementing active labour market policies and are therefore key for a response that takes territorial differences into account. New “green” skills can help local economies secure employment for workers losing out from the transition. “Greening” of skills is likely to require upskilling, as low-carbon sectors are estimated to require more skills than carbon-intensive industries. In addition, on-the-job training should be given priority over external retraining programmes, to ensure a connection to job prospects. Skills mapping can also help identify skill needs in future investment priority areas. This is especially important in regions in industrial transition, where it is often uncertain how workers’ skills in “brown” industries are transferable to emerging jobs in low-carbon sectors[34].

Policy action on the green transition will also require adequate social protection and co-ordination of migration and housing policies. Climate change and mitigation policies can have a profound impact on individuals and communities by shaping family circumstances and livelihoods. Social protection will be a crucial building block of governments’ strategies to promote a just green transition by preventing and cushioning individuals and communities from potentially damaging disruptions to their livelihoods, thus easing voter resistance to carbon pricing and other mitigation efforts. Migration policies will also play an important role, as climate change is expected to push greater numbers of people to seek to emigrate from the most affected areas. Migration could also play a role in reducing any short to medium-term skill gaps that may appear in OECD countries, including as part of the transition to a low-carbon economy.

In all countries, there is scope to design policies to ensure the benefits of the transition are shared by all, including low-income households. Such measures include decreasing labour taxes at the lower end of the wage distribution, and improving access to education and training, healthcare, low-cost quality housing and public transport. Priorities will differ depending on individual countries. Assuming, crucially, that governments invest in quality projects and that the fundamental framework conditions are in place to get the most out of these investments, the transition has the potential to bring sizeable gains in employment to most countries[35]. Social entrepreneurship and the social economy can also be sources of quality job creation, while addressing environmental issues and often integrating disadvantaged people into the labour market. In some regions, percentage growth in employment in the social economy has outpaced that of the private sector in recent years[36]. Policy makers at the local level can complement national framework conditions with supports such as social entrepreneurship hubs and social and environmental clauses in local public procurement processes.

Forthcoming work

Measuring the transformation of the labour market is essential for tracking all aspects of climate action. Work to develop internationally comparable indicators to monitor the growth in climate-related jobs and the skills required to perform these jobs; and to estimate the future impact of climate policy indicators on jobs and skills is planned.

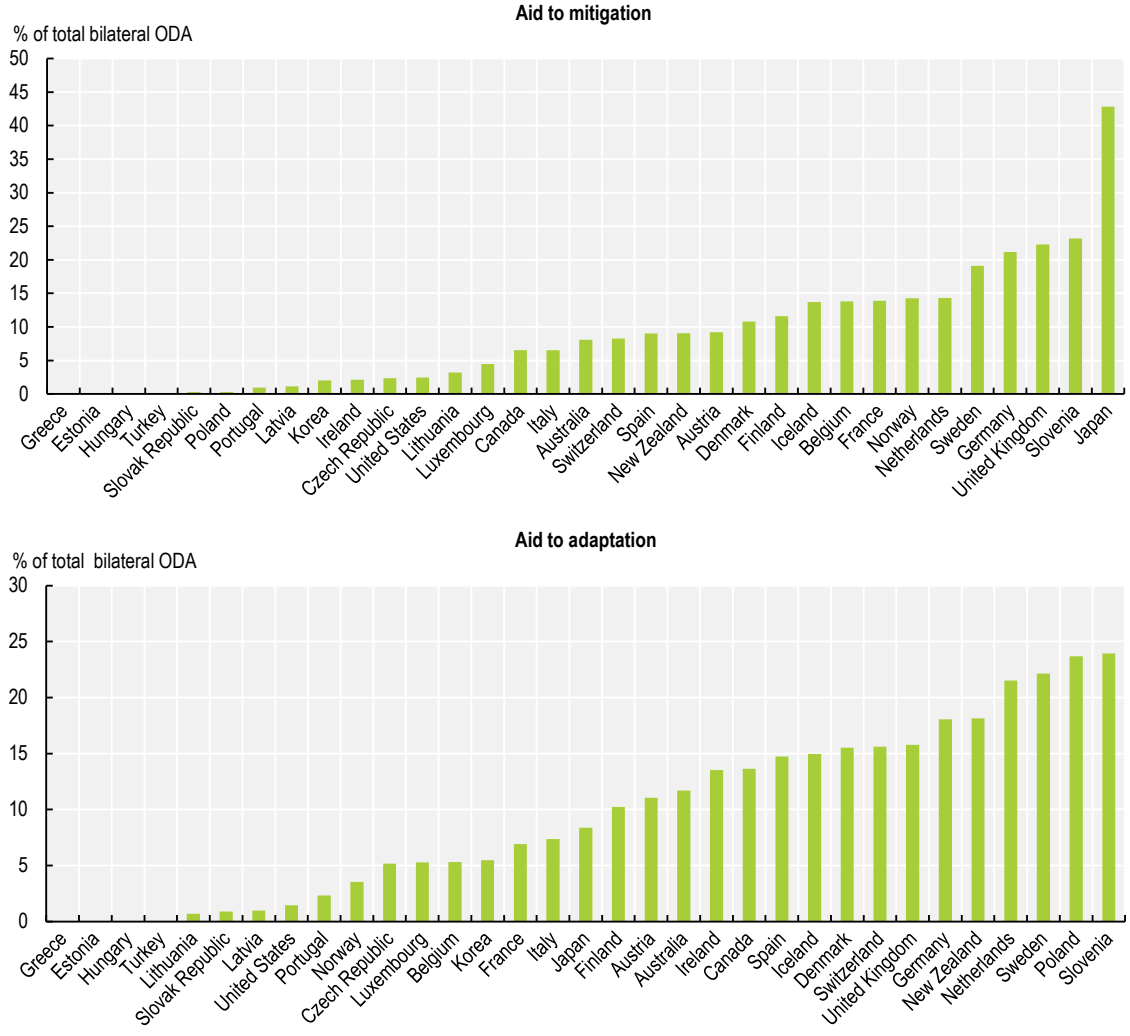
Climate action is also about ensuring that no country is left behind in the transition to net zero. Fulfilling the commitment by advanced economies to mobilise USD 100 billion per year in climate finance is necessary, but not sufficient. Mobilising additional private capital on the back of these commitments will rely in particular on the enhanced deployment of blended finance to catalyse project development. This will need to include the packaging of a range of instruments and approaches ranging from guarantees to concessional loans to first-loss equity. Such packages are critical to improving the risk profiles of some market-ready investments (e.g. renewables-based power in many sub-Saharan Africa countries) and to support development of small-scale projects that lack a track record with banks (e.g. building retrofits or EV charging infrastructure). It will also be important to deploy risk capital in sectors at early stages of readiness to support, for example, industrial decarbonisation, and to help in cases where risks are hard to mitigate, such as energy access projects for vulnerable communities or in remote areas[37].

About 27% of Official Development Assistance (ODA) targets climate action to some degree. In 2019, members of the OECD Development Assistance Committee (DAC) committed USD 34.3 billion in bilateral allocable ODA that principally or significantly targeted climate action (screened against the Rio markers). This represents an increase in volume of 45% since 2014. 43% went to climate change mitigation activities, 33% to climate change adaptation, and 24% to projects that addressed both climate change mitigation and adaptation.

A particular attention of the international community will need to be given to extractive-based countries. The carbon footprint of oil and gas projects will affect prospects for continous market access and has global equity implications, considering the weighted value of income in countries with a diversified industrial base, compared to fossil-fuel dependent developing economies, where diversification is challengeing. Support will be thus needed for these countries to manage uncertainties and increased vulnerability, build their resilience to external shocks and embrace the challenge of undergoing unprecedented economic and social structural transformation[38].

International trade, coupled with appropriate policies for the environment and society, can be a principal driver of the transition to an inclusive green economy. To achieve ambitious environmental outcomes, countries are expected to raise the level of stringency of their environmental policies, citizens are expected to demand more goods and services that are 'environmentally friendly' and businesses to be seeking cleaner investment opportunities. This in turn can generate higher demand for products deemed "environmental" – which "measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems"[39] – as firms and households seek to alleviate the compliance costs of new environmental regulations and to access environmental goods and services.

Figure 21. While growing overall, the flows of climate-related ODA are insufficient to support the Paris Agreement objectives

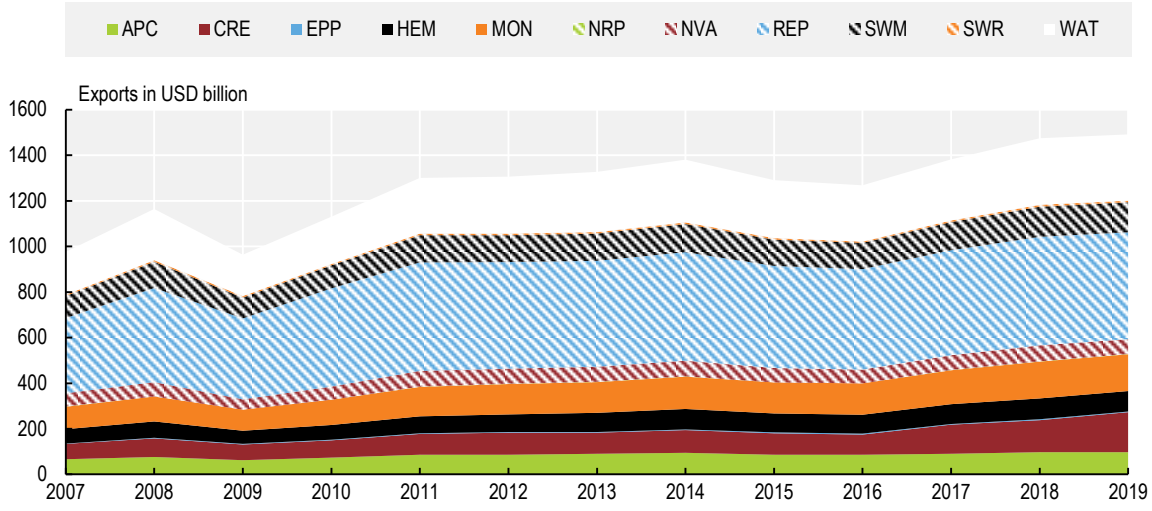


Note: Climate change mitigation-related aid is defined as activities that strengthen the resilience of countries to climate change and that contribute to stabilisation of GHG concentrations by promoting reduction of emissions or enhancement of GHG sequestration. The climate change mitigation marker was introduced in 1998. Climate change adaptation-related aid, approved by OECD-DAC members in December 2009, is defined as aid in support of climate change adaptation and complements the climate change mitigation marker, thus allowing presentation of a more complete picture of aid in support of developing countries' efforts to address climate change. The climate change adaptation marker was introduced in 2010. Total ODA comprises both screened and non-screened ODA bilateral commitments. ODA data are obtained from the Aid Activities Targeting Global Environmental Objectives dataset of the.
Sources: OECD (2021), "Creditor Reporting System", OECD International Development Statistics (database).

Global trade in environmental goods (EGs) increased significantly in the last decades, by 52.8% between 2007 and 2019 – from USD 976 billion to USD 1.492 billion – representing an average annual growth of 4%. In relative terms, the share of trade in environmental goods grew from 7.5% to 8.2% of global trade (Figure 22). The largest category of exported EGs is renewable energy plants (REP), which accounts for 31.4% of global trade in EGs. This is consistent with recent trends of countries shifting towards greater renewable energy use, particularly in electricity generation[40]. The other three largest traded categories of EGs are wastewater management and potable water treatment [WAT] (19.5%); cleaner or more resource efficient technologies and products [CRE] (11.8%); and environmental monitoring, analysis, and assessment equipment [MON] (10.9%). Together, REP, WAT, CRE, and MON account for 73.6% of global trade in EGs.

As firms in different countries have specialized in different environmental technologies, international trade in environmental goods is likely to increase further. Removing barriers to trade in EGs will contribute to achieving a sound environmental agenda by facilitating the diffusion of equipment and technologies necessary to abate or avoid environmental damage.

Figure 22. Global environmental goods' (EGs) exports by environmental medium, 2007-2019



Note: Environmental media of environmental goods: APC = Air pollution control; CRE = Cleaner or more resource efficient technologies and products; EPP = Environmentally preferable products based on end use or disposal characteristics; HEM = Heat and energy management; MON = Environmental monitoring, analysis and assessment equipment; NRP = Natural resources protection; NVA = Noise and vibration abatement; REP = Renewable energy plant; SWM = Management of solid and hazardous waste and recycling systems; SWR = Clean up or remediation of soil and water; WAT = Waste water management and potable water treatment.
Sources: OECD (2021); Combined List of Environmental Goods; BACI (2021), International Trade database.

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The Annual Climate Action Monitor

HELPING COUNTRIES ADVANCE TOWARDS NET ZERO

The Climate Action Monitor is part of the diagnostic component of the International Programme for Action on Climate (IPAC). Its goal is to provide a digest of country progress towards climate objectives and alignment with Paris Agreement goals to support countries in making better informed decisions and allow stakeholders to measure improvements more accurately. Alongside the IPAC dashboard, it contributes to international efforts in evidence based monitoring of progress to net zero by: 1) reviewing key trends and developments and highlighting areas for further analysis and policy action; 2) promoting greater harmonisation of key indicators; 3) showcasing examples of good climate mitigation and adaptation practices and results; 4) strengthening transparency over climate policies.

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