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The Inequalities-Environment Nexus

TOWARDS A PEOPLE-CENTRED GREEN TRANSITION

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Executive Summary

As countries are confronting the COVID-19 global health emergency and its economic and social ramifications, they are also racing against the clock to avoid an environmental emergency. The pandemic has exposed systemic inequalities from the past, with its impacts hardest felt among disadvantaged groups. At the same time, environmental challenges such as climate change, biodiversity collapse and air pollution continue to pose great systemic risks to the wellbeing of current and future generations. The COVID-19 crisis has amplified the urgency of addressing societal challenges together with strong and concerted action on climate and other environmental crises. Recovery efforts to 'build back better' must be both green and people-centred, and consistent with the objectives of the Paris Agreement and the 2030 Agenda for Sustainable Development.

This paper examines the inequalities-environment nexus building on the multi-dimensional lens of the OECD Well-being Framework. It analyses the impacts of the environmental degradation and of environmental policies on different dimensions of people's well-being. The four key well-being dimensions considered are health, income and wealth, work and job quality, safety. The OECD Framework for Policy Action on Inclusive Growth and the Green Growth Policy Frameworks are used to identify policy responses that could sustain and share the benefits of green growth more equitably.

The analysis shows that the impacts of environmental degradation are concentrated among vulnerable groups and households. Lower baseline health, limited access to good quality healthcare, and lower ability to invest in defensive measures (e.g. air filtration and better housing quality) increase the vulnerability of lower socio-economic households to air pollution and climate change. Furthermore, the young and the old are often more affected. Evidence points to long-run effects of exposure to air pollution on child educational outcomes, especially for children from low-income households. Heatwaves, which are likely to become more frequent with climate change, represent a real risk for older people's well-being.

Similarly, the fallout from air pollution and climate change affects the livelihoods of low earners and workers in certain sectors. More frequent heat waves and extreme weather events are likely to affect outdoor workers more, who are often low earners. Moreover, several studies also highlight the negative impact of outdoor air pollution on low-skilled indoor workers. At the same, growing evidence on the negative impacts of air pollution on cognitive capabilities suggests that it represents a risk to the productivity of highly-skilled workers. The impact of climate change on the productivity of several sectors that are crucial to rural economies (e.g. agriculture, fisheries) may contribute to exacerbate the urban-rural divide.

The benefits and costs of environmental policies are also likely to be unevenly distributed across households. Overall, vulnerable groups may have a considerable stake in the success of green polices as direct beneficiaries since they bear a disproportionate share of the health costs of air pollution and climate change. While carbon pricing is a central component of green policies, affordability concerns need to be taken into account as higher energy costs may put greater burden on low-income households and compromise their well-being. Similarly, if segments of the elderly population are required to limit energy consumption for heating and cooling, their health and well-being may be put at risk. Moreover, higher taxes on road transport fuels may affect rural residents more than urban dwellers, since the former tend to rely more on private cars and have limited acces to viable public transport alternatives. At the same time, households that are owner-occupiers may benefit more from environmental policy measures that increase home and land values than home-renters, such as subsidies for improving the energy efficiency improvements or creation of green areas.

Even if small on aggregate terms, green policies can have important distributional implications for jobs at the sectoral or regional levels. On the one hand, if ambitious policies to curb climate change and air pollution were to be introduced, employment levels in carbon-intensive heavy industries and fossil fuels extractive activities are expected to fall. On the other, green industries are anticipated to be a source of job creation, such as in renewable energy generation. Job reallocation across sectors can also have gender and regional implications. Some of the most negatively affected industries (e.g. extractives and heavy industries) have a male-dominated workforce, which gives a rationale for considering gender-sensitive transition policies in certain regions. At the same time, the current low female participation in STEM-related fields of education and particular barriers to female entrepreneurship may constrain women's participation in the renewable energy sector, an area that is expected to expand considerably in the green transition. Furthermore, regional economies heavily reliant on carbon-intensive sectors or fossil fuel extraction may face severe challenges in their structural adjustment and diversification process.

This paper considers that an integrated policy approach could be structured in four pillars, including measures to:

1. **Mitigate the possible regressive impact of pricing environmental externalities for vulnerable households**. Well-designed revenue recycling schemes to accompany such price-based measures and transfer payment could be instrumental to this end.
2. **Achieve inclusive green growth with investment in human capital, through active labour market policies, well-targeted income support measures, and upgrading skills to facilitate labour reallocation**. Measures to support the geographic mobility of workers at risk of losing their jobs in shrinking industries would be important, as well as reforms to improve access to affordable housing.
3. **Address systemic inequalities with sectoral and place-based policies that facilitate social dialogue, social capital investments, social protection, skills and education investments to ease structural adjustment of local economies**. Geographically blind climate change and air pollution control measures can result in rising discontent among local communities if the benefits and costs of environmental policies are dispersed geographically. Importantly, policy packages for a just green transition should vary from one region to another, as no "one-size-fits-all" green pathway is possible.
4. **Ensure efficient and responsive governance to manage the inclusive green transition**. As policies in different domains (e.g. housing, transport) interact with each other across the economy, long-term strategies can help to strengthen coherency in favour of their alignment across different ministerial portfolios. Institutional mechanisms can support the mainstreaming of environmental and equity considerations in policy-making and budgeting across ministries and levels of government. Clear and regular entry points in the policy-making process for the civil society would also help to enhance public acceptance of ambitious green policies.

Monitoring consistently the outcomes of policies on economic, societal and environmental dimensions of a just transition is necessary to deliver on their objectives. To achieve this, the measurement framework needs to capture whether the people-centred green recovery is well-targeted, efficient and effective. To this end, data and indicators that capture the intersectionality of environmental and social challenges are needed such as more accurate and timely information on how different demographic groups, workers and territories are affected by the environmental degradation. Furthermore, there is a need for a better understanding of the types, incidence and extent of social impacts of the low-carbon transition. In addition, in light of existing climate risk disclosure standards for companies, more effort is also needed to align public approaches with private-sector approaches to measurement from a perspective of a "double-materiality" approach – a combined focus on both financial materiality and social

and environmental materiality. To move the measurement agenda forward, further OECD work is needed along these dimensions, particularly in the context of the 2030 Agenda for Sustainable Development.

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1. Introduction: The inequalities-environment nexus

1. As the world battles the coronavirus pandemic, it is also on a race against time to avoid environmental catastrophe. Climate change, worsening resource bottlenecks, the threat of biodiversity collapse, life-shortening air pollution, plastics and ocean acidification are all driving severe natural systems imbalances. These environmental emergencies could cause social and economic damages far greater than that caused by COVID-19. A growing body of scientific evidence underlines the immediate urgency of reversing current trends in environmental degradation.[1] For example, for climate change the window of opportunity for containing global temperature rise to 1.5 degrees Celsius is still open but closing fast. Though COVID-19 containment measures and curtailment of consumption by households and firms have led to temporary reductions in air pollution as well as greenhouse gas emissions, it is highly unlikely that these reductions will outlive the pandemic. This highlights the need and an opportunity for embracing the green transition. Most of the environmental challenges are global in terms of drivers, impacts and prevalence. They are also long-term and structural, and pose a serious risk of irreversible damage to the natural capital base on which future prosperity and well-being of all generations depend. Action is needed to catalyse a systemic and deep transformation in the ways we produce, consume and behave in order to "build back better," i.e. not only getting economies and livelihoods back on their feet, but also safeguarding prosperity for the longer term.

2. The green transition, and the deep transformation that this entails for our economic systems and societies, can also alleviate existing inequalities in well-being outcomes, given the interconnected nature of social and environmental challenges – as recognised by SDGs (Table 1.1). With 2030 on the horizon, countries need to quickly develop more holistic policies that concurrently address environmental and socioeconomic well-being, while at the same time putting in place COVID-19 recovery measures. The OECD is supporting countries in this endeavour, as set out in the OECD Action Plan on SDGs and through policy analyses and recommendations to tackle the COVID-19 crisis (OECD, 2020[1]; OECD, 2020[2]; OECD, 2019[3]; OECD, 2020[4]).

3. The pandemic is compounding social pressures in many countries. On the one hand, the impacts of COVID-19 have been the largest among the disadvantaged people and communities (OECD, 2020[5]). On the other hand, the crisis has seen the emergence of new disadvantaged (World Bank, 2020[6]). In order to face the dual challenge of overcoming social malaise and environmental problems, the recovery and the reconstruction need to be both green and fully inclusive. This also implies that the cost of the green transition, which the recovery and reconstruction may be able to catalyse, must also be spread fairly across population groups and sectors of the economy.[2]

[1] The window to contain temperature increase to 1.5°C is narrowing but it is not yet closed. Global GHG emission would need to decrease by about 40-50 percent below 2010 levels in 2030 (i.e. 7.6% a year) and be net-zero around 2050 (IPCC, 2018[241]) (UNEP, 2019[242]). The International Resource Panel (or IRP) concludes that resource efficiency policies could reduce resources use by about a quarter, thus strongly mitigating the associated negative environmental impacts, and deliver global economic growth of 3 to 5 per cent above the existing trend (IRP, 2017[243]).

[2] This paper treats the issue of justice under the specific angle of access to and distribution of material resources. The issue of justice is broader and covers both people's access to non-material resources which contribute to their capacity as individuals and communities (dignity, recognition, sense of belonging…) and the development of inclusive institutions (as recommended by SDG16 and the Framework for Policy Action on Inclusive Growth).The issues of recognitive justice and inclusive institutions are beyond the scope of this paper, but are the object of other OECD work.

Table 1.1. SDGs addressing environmental and social issues

Goal 1	**End poverty** in all forms everywhere
Goal 2	**End hunger**, achieve food security and improved nutrition and **promote sustainable agriculture;**
Goal 3	Ensure **healthy lives and promote well-being for all ages**
Goal 4	Ensure **inclusive and quality education for all** and promote **lifelong learning**
Goal 5	Achieve **gender equality and empower women** and girls
Goal 6	Ensure availability and **sustainable management of water and sanitation for all;**
Goal 7	Ensure **access to affordable, reliable, sustainable and modern energy for all;**
Goal 8	**Promote sustained, inclusive and sustainable economic growth**, full and productive employment and **decent work for all**;
Goal 9	Build resilient infrastructure, **promote inclusive and sustainable industrialization** and foster innovation
Goal 10	**Reduce inequality** within and among countries
Goal 11	**Make cities and human settlements inclusive**, safe, resilient **and sustainable;**
Goal 12	**Ensure sustainable consumption and production** patterns
Goal 13	Take urgent **action to combat climate change and its impacts**
Goal 14	**Conserve and sustainably use the oceans, seas and marine resources** for sustainable development.
Goal 15	**Protect, restore and promote sustainable use of terrestrial ecosystems**, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
Goal 16	**Promote peaceful and inclusive societies for sustainable development,** provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Goal 17	Revitalize the global **partnership for sustainable development**

4. In the lead-up to 2030, other important environmental milestones are also in view. The international community will agree on the post-2020 global biodiversity framework at the Convention on Biological Diversity (CBD) 15th Conference of the Parties (COP15), thus making this meeting the most important biodiversity meeting in a decade. Five years after the Paris Agreement, countries are to communicate or update their Nationally Determined Contributions for the Framework Convention on Climate Change 26th Conference of the Parties (COP26) in 2021.

5. The 2020 Ministerial Council (MCM) meeting was held under the overarching theme of a strong, resilient, green and inclusive recovery from the COVID-19 crisis. As this theme suggests, the recovery is a transformative moment that provides the opportunity to reflect on the need to better link the economic, social and environmental dimensions of growth and development into policy-making. The MCM discussion paved the way towards a new narrative on sustainable economic growth, economic analysis, and economic metrics, and thus economic policies that include social, environmental and technological factors that are essential today.

6. This background paper, which was prepared for the 2020 MCM, complements two existing bodies of OECD work, on green growth and inclusive growth. The first, the 2011 OECD Green Growth Strategy (OECD, 2011[7]), which was developed initially to "achieve concrete, measurable progress at the interface of the economy and the environment" by linking the environmental policies with the productivity growth and innovation policy agendas. The present document extends this work by explicitly addressing the social and inequality implications. The second, the OECD Framework for Policy Action on Inclusive Growth, which is supported by a dashboard of indicators, helps governments identify policy responses that sustain and better share the benefits of economic growth. The document also marks the occasions of the 10th anniversary of the OECD Green Growth Strategy and the 50th anniversary of the Environment Policy Committee (EPOC) in 2021.

7. This paper examines the **environment-inequality nexus** by shedding light on three different aspects of this relationship. First, it looks at "the physical costs and risks", which can be defined as those risks that arise from the interaction of environmental hazards with the vulnerability of human and natural systems, including their exposure and ability to adapt. This section focuses on population groups and geographical areas that are hit hardest by environmental degradation, specifically outdoor air pollution and climate change[3] (Section 2). Second, this document relates to "the transition costs and risks" that concern the distributional implications of policies for a green transition, including the inter-generational considerations (Section 3). Third, it outlines policy options to facilitate the transition to a more sustainable economy by redistributing the cost of action and alleviating the cost of inaction, in well-coordinated packages that take both environmental and social measures into account (Section 4).

8. Building on the OECD Well-being Framework, the inequalities-environment nexus is approached through a multi-dimensional lens, with inter-generational considerations. The impacts of the environmental degradation on people's well-being (Section 2) are analysed across four key well-being dimensions: health, income and wealth, work and job quality, safety. How such impacts are transmitted across generations is also considered. Likewise, the costs and benefits of policy action on the environment (Section 3) are assessed from the perspective of these well-being dimensions, taking into account differential effects across particular demographic groups.

9. Analyses and recommendations presented build on recent advances in the relevant work by the OECD and wider literature. In recent years, the OECD has made significant progress on researching and measuring multidimensional well-being, inclusive growth and environmental policy outcomes, and SDGs. Thanks to new sources of geo-referenced spatial data, considerable efforts have been made to develop granular data on people's exposure to environmental risks, access to green spaces, energy poverty and affordability by household groups, among others. These data advances allow to illustrate the distribution of environmental impacts (benefits and costs) associated with policy action (or lack of action) on the environment. Section 5 concludes by discussing how OECD measurement frameworks could be

[3] While there are other important aspects of inequalities-environment nexus such as inequalities in access (to natural capital and ecosystem services, water supply, public transport and sanitation) and health effects of industrial chemicals in products and the environment, they are outside the scope of this paper. Possible follow up work could address these aspects.

further updated to better measure progress towards the people-centred green transition. This measurement agenda is discussed in more detail in the 2020 MCM background document that looks at the intersection of production, well-being and sustainability measurement.[4]

[4] "Framing the Measurement of Production, Well-Being and Sustainability: a Source Paper for the MCM".

2. Who is affected by the environmental crisis?

10. While there are many dimensions of the environmental crisis, this section reviews available evidence of inequalities[5] in how outdoor air pollution[6] and climate change affect selected dimensions of wellbeing: health, income and wealth, work and job quality, safety. The section focuses on impacts of these environmental challenges on different types of households, individuals and workers as well as regions (urban, rural). The available literature[7] suggests that certain vulnerable groups' health and productivity are disproportionally impacted by air pollution and climate change. In addition, such 'environmental inequalities' faced by lower socioeconomic groups, ethnic minorities and certain demographic groups could be exacerbated by the COVID-19 pandemic in two ways. First, in terms of health, exposure to air pollution increases the risk of cardiovascular, respiratory and developmental diseases, as well as premature death, making individuals more vulnerable to COVID-19. Second, the efforts to curb the spread of COVID-19 have negative short- and long-term impacts on economy and society, often disproportionally affecting the lower socioeconomic groups which have already been more vulnerable to negative impacts of environmental pollution and climate change.

Exposure and vulnerability to environmental hazards

11. **The consequences of environmental degradation, such as air pollution and climate change, on well-being are mainly determined by two variables: exposure and vulnerability.** Exposure is defined as the presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected by environmental degradation (IPCC, 2014[8]). Vulnerability refers to the propensity or predisposition to suffer adverse effects and/or the lack capacity to cope or adapt, if exposure were to occur (IPCC, 2014[8]). In general, exposure is a necessary, but not a sufficient condition to be negatively affected by environmental degradation as it is possible to be exposed but not be vulnerable. For example, an individual's home might be located in a floodplain, yet they could have sufficient means to modify the structure of the building to mitigate against potential loss. Exposure and vulnerability are equally important when discussing the implications of environmental degradation since they differ among

[5] This document focuses on inequalities within OECD countries and does not address inequalities within or among countries outside the OECD, which could be addressed by further work.

[6] Main air pollutants with health impacts are: particulate matter (PM), a mix of solid and liquid droplets mainly caused by combustion and road traffic; nitrogen dioxide (NO2) from road traffic; sulphur dioxide (SO_2) from burning fossil fuels; and ozone at ground level (O_3) caused by the reaction of sunlight with pollutants from vehicle emissions. Air pollutant that affects people the most is PM: many empirical studies focus on fine particulate matter (PM_{10}), and fine particulate matter of diameter of 2.5 µm or less ($PM_{2.5}$) that penetrates deeper into the lungs and can cause respiratory and cardiovascular illnesses. While exposure to these air pollutants have direct impacts on human health and ecosystems locally, carbon dioxides (the most important greenhouse gas associated with human activities) is not toxic for human inhalation but causes climate change globally with negative impacts including on health from a number of mechanisms including more frequent extreme weather events and natural disasters. As fossil fuel combustion is the main driver of climate change and also a major contributor to air pollution, efforts to mitigate one can improve the other. There are inequalities in exposure to other types of environmental pollution but are not reviewed in the present document.

[7] As much of the available empirical evidence tends to be from the United States and the European Union, more studies on other individual OECD countries and regions would be useful as each country context is unique and may not fit around the trends observed in existing studies.

population groups. For example, in the context of climate change, exposure and vulnerability can interact to heighten the physical risk and impair people's ability to adapt.

12. **Location and occupation are among the main factors used when considering exposure to environmental degradation.** People's exposure varies throughout the day as they go about their day-to-day activities and over the life course as they move in and out of areas and take on different occupational duties, etc. Capturing full exposure is difficult and complex, but possible. Typically, geospatial and occupational data are used to determine exposure to environmental risks, and then matched with relevant socio-economic factors (e.g. average income and occupational types of households living in specific geographic regions or working in specific industries) (WHO, 2019[9]). Many studies rely on measurements of exposure at a particular point in time, rather than over the course of an individual's lifetime. Moreover, even within relatively small areas, the concentration of some pollutants can vary significantly.

Individuals and households

Lower socio-economic households

13. **Lower socio-economic households are often (but not always) more exposed to outdoor air pollution**. Although differences in observed exposure are small, such as a small change in exposure at the lower end of the dose response curve can lead to significant differences in risk. Drawing clear conclusions is possible only for some risks and countries, regions or cities due to limitations in data. For example, in the United States, disadvantaged groups are more exposed to higher concentrations of air pollutants; although there are exceptions in some cities where polluted neighbourhoods with good amenities attract higher socio-economic groups. Moreover, in the United States, some evidence indicates that disparities in exposure are greater by race than by income group (Paolella et al., 2018[10]; Clark, Millet and Marshall, 2017[11]), and relative to exposure caused by their consumption, on average, Blacks and Hispanics, bear a "pollution burden" of 56% and 63% excess exposure (Tessum et al., 2019[12]). In Europe, results are mixed and nuanced by pollutant type, location, city size and socio-economic metric used (Hajat, Hsia and O'Neill, 2015[13]). Preliminary analysis of the OECD Geography of Well-being Database suggests that on a national aggregate level, lower socio-economic households could be less exposed to fine particulate matter (PM). This is partly explained by a relatively high concentration of lower socio-economic households in rural areas[8]. Notwithstanding degrees of exposure, relative to higher socio-economic households, lower socio-economic groups have fewer opportunities available to limit exposure, such as installing home ventilation air conditioning systems, taking a vacation away from primary place of residence, or early retirement.

14. **Lower socio-economic households are often more vulnerable to air pollution.** Possible explanatory factors include lower baseline health, limited access to good quality healthcare, negative health behaviours, lifestyle factors and limited ability to invest in defensive measures such as air filtration and better housing quality (Mackie and Haščič, 2019[14]). Several UK-based studies indicate a higher disease mortality burden among lower socio-economic groups relative to exposure (Brunt et al., 2017[15]; Milojevic et al., 2017[16]). Some evidence suggests that race may modify the association between air pollution and vulnerability to a stronger degree than socio-economic status and ethnic/racial residential segregation For example, one US-based study highlighted a stronger adjusted association between air pollution and cardiovascular disease between Black and White people (Hicken et al., 2016[17]). Overall, higher vulnerability suggests that improvements to environmental quality that benefit everyone may

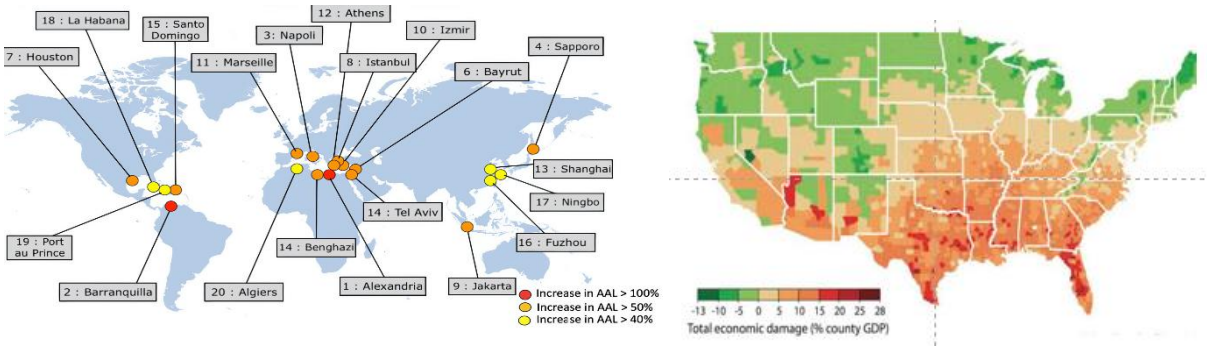
[8] In terms of socioeconomic and demographic data, socioeconomic position (SEP), sometimes used interchangeably with socioeconomic status (SES), refers to the social and economic factors that influence what positions individuals or groups hold within the structure of a society (Galobardes et al., 2006). Within the OECD's Geography of Well-being project, years of completed education, unemployment and type of employment are among the SES variables considered.

benefit lower socio-economic households more (Milojevic et al., 2017[18]). In the context of the coronavirus pandemic, people suffering from conditions linked to air pollution are more vulnerable to the effects of SARS-CoV-2. Good air quality not only has the merit of potentially reducing the vulnerability of individuals and communities to pandemics similar to COVID-19, but also of generating wider benefits for public health (OECD, 2020[19]).

15. **The variety of possible climate change impacts (e.g. droughts, sea level rise, floods) and the paucity of relevant data and studies makes it complex to identify a clear income gradient in people's overall exposure to climate change risks**. Research focusing on world regions indicates that developing countries may be the most exposed to climate change impacts, particularly low-income and poor populations within developing countries (IPCC, 2014[8]). Small island states are particularly affected by climate change, due both to their exposure to sea level rise and other extreme climate events. Similarly, poorer regions in OECD countries are more negatively affected than wealthier ones by climate change impacts. For example, in the United States, the potential impact of climate change is unequally distributed across the country. By the end of the century, in the poorest third counties, the average loss of county income could range between 2.0 to 19.6% while in the richest third of counties the average very likely loss range from −1.2 to 6.8% of county income (negative damages are benefits (Hsiang et al., 2017[20]).. By end of this century, the poorest third of US counties is estimated to experience damages between 2 and 20% of county income while positive impacts are estimated for the north-west regions under business-as-usual emissions scenario (Figure 2.1). At the European Union (hereafter 'EU') level, inaction on environmental degradation and climate change, under a 2 degree scenario and a high warming scenario, is estimated to cost 2% of GDP in the European Union and of 4% of GDP in Southern Europe. This would increase inequalities between regions (Szewczyk et al., 2018[21]).

Figure 2.1. Geographic distribution of climate impacts

Panel a. The 20 cities with highest increase in average annual losses. **Panel b**. Distribution on economic impact in USA



Note for left panel: The 20 cities where the increase in average annual losses between 2005 and 2050 is greatest in relative terms, considering subsidence and optimistic sea-level rise (SLR-1), with adaptation to maintain present flood probability. Source: Left panel: adapted from Hallegate et al. (2013[22]). Future flood losses in major coastal cities, https://doi.org/10.1038/NCLIMATE1979. Right panel: Hsiang, et al. (2017[20]) Estimating economic damage from climate change in the United States, https://doi.org/10.1126/science.aal4369

16. **Lower socio-economic households appear to be more vulnerable to climate change impacts.** Similar to air pollution, one of the primary reasons for greater vulnerability is lower ability to invest in adaptation technologies. For instance, a meta-analysis of studies on heat-related mortality waves established that home air-conditioning reduces the odds of death significantly (between 23 and 34%) (Bouchama et al., 2007[23]), yet lower socio-economic households are less likely to be able to afford such technology or pay the associated energy bills. Evidence at the EU-level indicates that a growing number

of households struggle to adequately cool their homes, which is a significant concern in light of more frequent and intense heatwaves. In the European Union, around 40 million people live in energy-poverty[9] (Thomson and Bouzarovski, 2019[24]) (EC, 2019[25]). Compared to owner-occupiers, energy poverty is more prevalent among renters, and is a problem for renters paying full market rent. On average, in the European Union, over one in five renters experience some form of energy poverty. Moreover, among home owners, who represent about 68% of households on average in 2018 across OECD countries (OECD, 2020[26]), lower socio-economic households are also more vulnerable to financial losses incurred in cases of extreme weather events caused by climate change as they have less a diversified asset portfolio, both geographically and financially, and have more limited access to insurance mechanisms. Lower socio-economic home owners may hold most of their wealth in their primary home, facing greater risk of losing their total wealth through a natural disaster. Richer households with more diversified or better insured portfolios, withstand better odds of preserving their wealth.

17. **The impact of climate change is particularly high for groups of the population that are particularly dependent on the environment and natural resources for their livelihoods** and survival, namely indigenous peoples. Indigenous peoples are among the first to face climate change and its consequences. These make the difficulties already facing these groups much greater, including poverty and inequality, loss of land and resources, and migration and forced displacement (ILO, 2017[27]). These intersections would benefit from deeper analysis in future OECD work.

18. **Natural disasters can have a greater impact on socially-disadvantaged groups and minorities.** A study on Hurricane Katrina disaster highlighted differences in responses between racial and socio-economic groups, ranging from evacuation timing to seeking emotional support and plans to return. For example, evacuation timing differed by income group and race; more affluent individuals were almost twice as likely than low-income individuals to evacuate before the hurricane, rising to three-times when remaining through the storm was considered. Outside of the city, Black people were 1.5 times more likely than similar White people to evacuate after the disaster, as opposed to before. Post-disaster, black people were much more likely to report loss of employment; Black workers were 3.8 times more likely to have lost their jobs, increasing to seven-times for low-income Black workers, as these workers were more likely to be employed in insecure jobs. Black people reported higher levels of extreme distress than white people, all else being equal. This supports previous findings that racial minorities are more likely than whites to report extreme distress in times of crisis due to the cumulative nature of stress. Overall, the study found that the worst of the fallout from the disaster was borne by Black low-income individuals (Elliott and Pais, 2006[28]). In all, these studies underline the acute need for support among disadvantaged groups to recover and rebuild their lives after large natural disasters. Studies on other OECD and non-OECD regions besides the United States would help to further confirm these findings. Globally, disadvantaged and vulnerable groups have been affected more by the COVID-19 pandemic. This could be the case also for other vector-borne diseases whose incidence may increase due to climate change.

Children and youth

19. **Air pollution is among the largest environmental causes of disease and pre-mature death, and affects the young and old disproportionately.** Premature deaths from pollution follow a U-shaped

[9] There are different indicators for energy poverty, and each country adopts their own definition. The EU Energy Poverty Observatory use the following: households unable to keep warm (37.4 million in 2018, or 7.3% of households), households with arrears on their utility bills (33.8 million in 2018, or 6.6% of households); households spending a large share of their income on energy (16.2% of households in 2015); and households reporting being uncomfortably hot (98 million in 2012). Since 2013, indicators on energy poverty in Europe have been improving and the share of energy poor households Europe was below pre-2008 crisis level in 2017 (EC, 2019[25]).Other countries are considering more multidimensional indicators of energy poverty, e.g. to reflect accessibility and quality.

curve that peaks among children under age five years, and then again at over 60 years of age. Disability-adjusted life years (DALYs)[10] resulting from pollution are highly concentrated among infants and young children, reflecting the higher years of life lost by each death among children and harm caused to children's development (Landrigan et al., 2018[29]). The stronger effect of endocrine disruptors (ECD) in children are among the numerous reasons behind such greater harm. Exposure to ECD during early development are likely lead to irreversible effects, whereas the effects of adult exposures seem to go away when the EDC is removed (WHO & UNEP, 2013[30]). ED can also produce epigenetic changes, which can be transgenerational. For example, exposure to EDC (i.e. vinclozolin) during embryonic gonadal sex determination can alter the male germ-line epigenetics transmitting transgenerational adult onset disease (Anway and Skinner, 2008[31]).

20. **Pre-natal exposure to air pollution adversely affects children's health and development.** Prenatal exposure is associated with a number of adverse birth outcomes, including pre-term birth, low birth weight, and small for gestational age (SGA) at birth (Currie et al., 2014[32]). Beyond adverse birth outcomes, exposure to air pollutants, such as nitrogen oxide and particulate matter, have been found to affect foetal brain development contributing to impaired cognition and neuro-developmental disorders. Possible mechanisms include endocrine disruptors, oxidative stress, neuro-inflammation and disruption of the hypothalamus-pituitary-adrenal axis (Ghassabian et al., 2019[33]). Air pollution is a significant factor in infant mortality with reductions in air pollution linked to declines in the infant mortality rate in a number of OECD countries: for example, the Czech Republic (Bobak and Leon, 1999[34]); Germany (Luechinger, 2014[35]); Turkey (Cesur, Tekin and Ulker, 2013[36]); and the United States (Chay and Greenstone, 2003[37]; Chay and Greenstone, 2011[38]). On the same note, higher air pollution is linked to differences in infant mortality within countries: for example, Japan (Shinkura, Fujiyama and Akiba, 1999[39]); Mexico (Loomis et al., 1999[40]; Arceo, Hanna and Oliva, 2016[41]); and the United States (Woodruff, Darrow and Parker, 2008[42]).

21. **Exposure during the pre-natal period and the first year of life has long-run effects on children's educational outcomes.** For instance, a reduction in prenatal exposure to total suspended particulate (TSP) by one standard deviation is associated with a two percent increase in tenth grade test scores (Sanders, 2012[43]). An increase in prenatal exposure to carbon monoxide by one standard deviation during the third trimester is associated with a 0.036 standard deviation decrease in fourth grade maths test scores and a 0.042 standard deviation decrease in language test scores, controlling for family characteristics, such as mother's age and level of education, and sibling effects. Significantly, the same study found greater effect of carbon monoxide exposure among children whose mothers have a low level of educational attainment on educational attainment (Bharadwaj et al., 2017[44]).

22. **Despite the understanding of the negative impacts on children's health and educational outcomes, few studies have linked early-life exposure to poorer well-being outcomes in adulthood.** A study by Isen, Rossin-Slater and Walker (2017[45]) found that higher exposure during gestation and in the first year of life negatively affects labour force participation and earnings at age 30. The study exploited improvements in air quality following the introduction of clean air legalisation in the United States in the early 1970s and found that a 10% reduction in exposure to total suspended particles (TSP) in year of birth generated a one percent increase in earnings at age 30, representing a cumulative gain in earnings over the lifetime of $4,300. In addition, further effects are found when considerations for adolescent exposure were included. These findings suggest that long-run economic costs of exposure to

[10] According to (WHO, 2014[247]), DALYS function as "a measurement of the gap between current health status and an ideal health situation". DALYS are calculated as the sum of the Years of Life Lost (YLL) due to premature mortality in the population and the Years Lost due to Disability (YLD) for people living with the health condition or its consequences.

environmental pollutants on children that could be as large as - or even greater - than the cost of infant mortality.

23. **Temporary reductions in air pollution have recorded considerable benefits for children's health.** Some studies demonstrate that seasonal variations in air pollution levels or an exogenous event such as the temporary closure of high polluting sources can generate short-run effects on children's health. For example, a study on the temporary closure of oil refineries in France in 2010 for around a 15-day-period generated sharp temporary reductions in SO_2 concentrations in local and neighbouring areas, which caused a significant reduction in hospitalisations for asthma and respiratory infections, particularly among children under five years of age. When such reductions or shocks occur during the prenatal period, they have the potential to improve birth outcomes; the oil refinery closures generated significant improvements in birth weight and gestational age of babies, particularly when exposure occurred during the third trimester of gestation. Findings from this study highlight that SO_2 concentration levels even when below permitted standards can still produce a harmful effect on children's respiratory outcomes. (Lavaine and Neidell, 2017[46]). Studies evaluating the impact of temporary restrictions on air pollution during the Beijing Olympics on child health found that reductions in $PM_{2.5}$ and black carbon resulted in decreases in acute respiratory inflammation in children (Perera, 2017[47]). Measuring the link between air pollution and short-term health outcomes of children warrants further attention to help better understand the true welfare costs and the policy implications.

24. **Children from low-income families appear to be particularly vulnerable to air pollution.** Possible reasons include the greater likelihood in some countries of living in areas of high pollution (Sieg et al., 2004[48]; Chay and Greenstone, 2005[49]) ; neighbourhood effects (Alexander and Currie, 2017[50]); having parents who are less able to make investments to compensate for pollution and/or to engage in avoidant behaviours (Sun, Kahn and Zheng, 2017[51]); and environmental pollutants acting as a potential mechanism through which socio-economic disadvantage affects health and educational outcomes (Gray, Edwards and Miranda, 2013[52]; Voorheis, 2017[53]). As such, low-income children can be said to benefit greatly from reductions in pollution. A US-based study by Persico, Figlio and Roth (2016[54]) associated differences in siblings' long-term cognitive and developmental outcomes to early life exposure to pollution, controlling for time invariant family characteristics. The study found that individual siblings born before the clean-up of a Superfund site[11] were 7.4 percentage points more likely to repeat a school grade, 6.6 percentage points more likely to experience behavioural problems at school, and 10 percentage points more likely to have a cognitive disability. These differences were stronger for low-income children but strongest for children whose families were consistently poor. Differential pre-school attendances between siblings did not have a significant effect. Such results highlight the particular benefits in reductions in pollution for children's development.

25. **Climate change contributes to adverse birth outcomes through foetal exposure to heat and extreme temperatures.** They include stillbirth, low birth weight, reduced gestational age, and increased neo-natal stress, based on studies on selected OECD countries. The exact pathways through which heat affects birth outcomes are not properly understood but may include increased maternal temperature, lower maternal tolerance to heat stress, and uterine constriction. To date, a critical window of maternal sensitivity to heat exposure has not been identified (Kuehn and McCormick, 2017[55]).

26. **Children are vulnerable to climate change-related illnesses, especially those from socially-disadvantaged backgrounds.** Children's developing bodies make them sensitive to heat waves and to the spread of infection, putting the risk of dehydration, heat stroke and heat exhaustion. For example,

[11] Superfund sites are designated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as locations with particularly high levels of environmental toxicants and are placed on the National Priorities List for clean-up.

increases in daily maximum temperatures are associated with increases in emergency department visits and hospital admissions for heat stroke and gastroenteritis in children under six. During natural disasters when water-borne diseases are common, children are less able to resist infection because of their immature immune systems, while small body sizes are very susceptible to quick dehydration from diarrheal diseases. Children also spend more time outdoors where temperatures are higher and disease vectors such as ticks and mosquitos are found. Furthermore, children living in disadvantaged neighbourhoods have limited access to open spaces with vegetation to cool down during heat waves (Bennett and Friel, 2014[56])

27. **Heat stress is associated with lower performance in high-stake school examinations.** A US study by (Park, 2017[57]) showed that a one standard deviation increase in average exam temperature across a student's time in high school reduces the likelihood of graduating by two percentage points, and substantially reduced the likelihood of meeting of key performance thresholds required for college admissions.

The elderly

28. **Greater exposure to air pollution in old age increases the risk of multiple non-communicable diseases, including pulmonary and cardiovascular disease, diabetes and dementia.** Emerging evidence suggests a causal association (Landrigan et al., 2018[29]). $PM_{2.5}$ and PM_{10} are associated with increased mortality from cardiovascular disease (Beelen et al., 2014[58]) and stroke (Stafoggia et al., 2014[59]). Pollutants linked to increased risk of cognitive decline and dementia include $PM_{2.5,}$ CO and NO_2/NO_x (Peters et al., 2019[60]). For example, a study by Bishop, Ketcham and Kuminoff (2019[61]) found that in older adults, a 1 μg/m3 increase in the average exposure to $PM_{2.5}$ over a decade increases the probability of receiving a dementia diagnosis by 1.68 percentage points. The authors suggest that the elevated risk posed by long-term exposure to $PM_{2.5}$[12] in the development of dementia is twice as large as that associated with hypertension and half of that associated with diabetes. Further research into the role played by exposure to air pollution in the development of dementia is warranted given the size of the public health challenges it creates for countries with an ageing population.

29. **Some studies indicate positive associations between air pollution exposure and poor mental health in the older population.** Such associations include fine particulate matter and $NO_{2,}$ on one side, and depression in elderly women with cognitive impairments (Altuğ et al., 2020[62]); between $PM_{2.5}$ and ozone and depression in middle-aged and elderly women (Kioumourtzoglou et al., 2017[63]); and between $PM_{2.5}$ and moderate-to-severe depressive and anxiety symptoms among all elderly people, with stronger susceptibility found among people in lower socio-economic backgrounds and those with certain co-morbidities (Pun, Manjourides and Suh, 2017[64]). Evidence is not consistent across regions and depression modalities, however. An analysis of data examining PM_{10} and NO_2 exposure and depressed mood from four European cohort studies showed heterogeneous results and no consistent evidence of effect (Zijlema et al., 2016[65]). A Korean study found that increases in short-term exposure to PM_{10}, NO_2, O_3 affected emotional symptoms of depression in older people, such as high life satisfaction and positive outlook but not somatic and affective symptoms (Lim et al., 2012[66]).

30. **Population ageing is one of the major drivers in the projected increase in numbers of air pollution-related premature death and disease.** OECD research projects a significant rise in the number of premature deaths due to outdoor air pollution from 3 million people globally in 2010 to between 6 and 9 million people by 2060. This large increase is not only due to higher concentrations of $PM_{2.5}$ and ground-level ozone (O_3), but also to a growing ageing population and greater urbanisation (OECD, 2012[67]; OECD, 2016[68]). As a result, as the population ages, the associated costs of air pollution will continue to

[12] Long-term exposure (i.e. over a decade) to $PM_{2.5}$ measured as 1 $\mu g/m3$ increase in average residential concentrations.

grow, making health-related benefits an important consideration for cost-benefit analyses for air regulations.

31. **Older people are more vulnerable to the impacts from climate changes, notably more frequent heatwaves.** Evidence from several OECD countries indicates higher heat-related mortality in the over-65s age group. For example, France (Institut de Veille Sanitaire, 2004[69]); Italy (Michelozzi, P.; de 'Donato et al., 2005[70]); Poland (Graczyk et al., 2019[71]); Slovenia (Kukec, 2018[72]); and the United States (Whitman et al., 1997[73]). Excess heat-related mortality increases with age, and is strongest among women in the over 75 age group, reflecting the greater proportion of women in this age-group. Risk factors that place older people at elevated risk include having cardiovascular and/or cerebrovascular disease (D'ippoliti et al., 2010[74]); physiological factors such as reduced ability to conserve sodium and water when dehydrated and impaired thermoregulation (Horton, Hanna and Kelly, 2010[75]); limited mobility (Kravchenko et al., 2013[76]), and lack of home thermal insulation (Vandentorren, 2006[77]). Moreover, higher heat-related mortality is recorded among low-income elderly people, for example in Italy. Possible factors driving this difference in mortality by income level are lower housing quality and the higher share among this group who remain in cities throughout the summer period (D'ippoliti et al., 2010[74]).

32. **In addition, smoke from wildfires contributes to higher rates of cardiovascular and respiratory deaths among over-75s.** A study based on wildfires in the city of Athens (Greece) over a 16 year period found that medium-sized and one large-sized fires caused an increase in daily mortality of almost 5% and 50%, respectively; this reflected increases of 6% and around 61% in cardiovascular deaths and of almost 16% and 92% for respiratory deaths. Respiratory effects were larger than cardiovascular effects for people over-75 with a stronger lagged effect (Analitis, Georgiadis and Katsouyanni, 2012[78]). Evacuation can be less common among the elderly during wildfire events (Thompson, Garfin and Silver, 2017[79]), not because older people are less willing to evacuate, but rather they have lower level of social supports to play a positive role in informing the decision to do so (Kwan and Walsh, 2017[80]). Evacuation poses its own set of risks, particularly for long-term care residents with higher needs (Claver et al., 2013[81]). The increased vulnerability of older people requires public health and disaster management policy to consider their particular needs.

Differential impacts of air pollution and climate change, by gender

33. **Air pollution and climate change have a differential impact on women and men's health and well-being.** Women have specific vulnerabilities related to their physiological and hormonal constitutions, which were until more recently overlooked in studies (van Daalen et al., 2020[82]). Considerable concerns exist pertaining to the exposure of expectant mothers to pollution and extreme temperatures (see section on Children and Youth), and the harm caused by endocrine disruptors to women's fertility and reproductive health (Rattan et al., 2017[83]). A number of studies have investigated the link between outdoor air pollution and male reproductive outcomes (e.g. semen quality), but results have not been consistent, in part because of the diversity of air pollutants and semen parameters studied (Jurewicz et al., 2018[84]). Moreover, the established correlations between air pollution exposure and poor mental health and dementia in old age highlight specific challenges for women in terms of medical and social care needs, given their longer life expectancy (see subsection on the Elderly).

34. **At the societal level, higher levels of air pollution contribute to the gender gap in paid working hours as the higher care needs of dependent family members fall disproportionally on women.** For example, a study from Chile found that on days of extremely high air pollution, women are more likely to work reduced working hours, in order to stay at home to care for children due to school closures triggered by acute air pollution episodes (Montt, 2018[85]). A 10 μg/m3 increase in PM2.5 is associated with decrease in the working week by almost two hours (Aragón, Miranda and Oliva, 2017[86]).

Moreover, air pollution and climate change impacts are higher in sectors where men are typically overrepresented, for example, agriculture and construction (see subsection on Workers).

35. **Natural disasters are associated with an increase in violence against women.** Evidence from a number of OECD countries, specifically Australia, New Zealand and the United States, show strong rises in the numbers of police call-outs due to incidences of intimate partner violence, and increased demand for women refuges and support services in the aftermath of natural disasters (Parkinson and Zara, 2013[87]) . Elevated levels of violence persist into the displacement period (Anastario, Lawry and Shehab, 2009[88]). Extreme rainfall and storms have been linked to interpersonal violent behaviours including battering, rape and increased instances of intimate partner violence (Mora et al., 2018[89]).

Workers

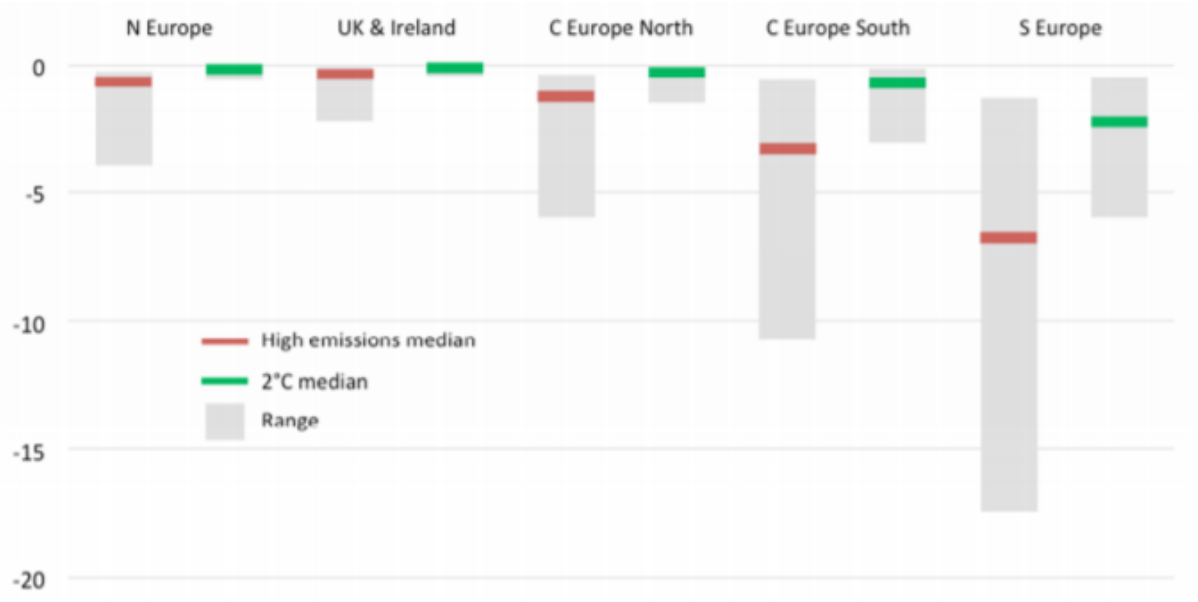
36. **Exposure to outdoor air pollution and climate change differ across job categories and skill levels, leading to more negative impacts on the well-being and productivity of low earners and workers in particular sectors.** For example, more frequent heat waves and extreme weather events (e.g. droughts), and climate-related biodiversity loss affect outdoor workers and workers in industries dependent on ecosystems, such as tourism and agriculture. Similarly, air pollution is likely to affect outdoor manual workers the most. Based on European data, the largest negative effects on worker productivity from increased air pollution (i.e. $PM_{2.5}$) is found in the agricultural sector and to a lesser extent in construction (Dechezleprêtre, Rivers and Stadler, 2019[90]). The higher impact on the agricultural sector is likely due to the combined negative impact on workers' productivity and soil and crop yield. For instance, Chameides et al. (1999[91]) estimates that suspended particulate matter can decreases the direct sunlight reaching plants and is responsible for decreasing crop yields in the People's Republic of China (hereafter 'China') in the region of 5-30%. Wahid et al (1995[92]), Agrawal et al. (2003[93]) and Van Dingenen et al. (2009[94]) also underline the sensitivity of the agriculture sector to higher levels of air pollution. To note, agricultural workers are further exposed to water and soil pollution including from agrochemicals.

37. **Though high and low-skilled workers are both exposed to air pollution, low-skilled workers have overall less choice as regards to job type and its location than high-skilled workers.** Several studies show the negative impact of outdoor air pollution on low-skilled indoor workers' productivity and well-being, for example, fruit packers (Chang et al., 2016[95]); garment manufacturing workers (Adhvaryu, Kala and Nyshadham, 2019[96]); and call centre workers (Chang et al., 2016[97]). At the same time, ongoing OECD research suggests that people who are highly educated and/or in higher-status jobs, as well as immigrants tend to be more often exposed to lower air quality (OECD, 2019[98]). Such an association is partially explained by their more frequent residence in urban locations where air pollution levels tends to be much higher. The increasing evidence on the negative impacts of air pollution on cognitive capabilities (Ebenstein, Lavy and Roth, 2016[99]; Zhang, Chen and Zhang, 2018[100]) further underlines the risk of air pollution for highly skilled workers as well.

38. **Occupational heat strain (i.e. the effect of environmental heat stress on the body) has significant effects on workers' productivity and health** (Flouris et al., 2018[101]; Easac, 2019[102]). On the whole, outdoor workers are likely to be the most affected by the global increase in temperatures**.** By 2030, at the global level, 60% and 19% of the total working hours lost to heat stress are expected to occur in the agricultural and the construction sectors respectively. In North America, Western Europe, Northern and Southern Europe and in the Arab States, however, the majority of working hours lost are estimated to fall on the construction sector (Kjellstrom et al., 2019[103]). At the EU level, (Ciscar et al., 2018[104]) under a high warming scenario (more than +3 degrees), the daily average outdoor labour productivity is projected to fall by over 3% and by 17% in Southern Europe region, (Figure 2.2). Nonetheless, workers in white collar professions are not immune to heat stress in the workplace. For example, the French

Agency for Food, Environmental, Occupational Health and Safety suggests s that by 2050 climate change will affect the productivity and health of workers in European countries employed across most business sectors through heat stress, biological and chemical changes to the environment and more frequent climatic hazards (ANSES, 2018[105]).

Figure 2.2 Variation in daily average outdoor labour productivity due to climate change under a high emissions and a 2°C scenarios



Note: Regional differences from present (%).
Source: Ciscar et. al. (2018[104]). Climate impacts in Europe: Final report of the JRC PESETA III project, https://doi.org/10.2760/93257

39. **Climate change exacerbates biodiversity loss, affecting workers who are the most reliant on ecosystem services such as farmers and fishers.** Climate hazards can affect fisheries through a number a channels, including warming water beyond species' heat tolerance, drought, impact on habitats and consequences of extremes weather events. For instance, heavy storms and flooding can cause heavy metal runoff, which can increase mercury accumulation in fish and in turn decrease market value (Mora et al., 2018[89]). The literature on the impact of climate change for the agricultural sector focuses mostly on crop productivity, and finds largely negative impacts for moderate to high levels of warming at the global level. Livestock, is less well explored - though most of the literature finds negative effects. These include effects of heat and water stress on animal growth and health (Figure 2.3) (OECD, 2015[106]). Importantly, climate change impacts vary considerably at the regional level; for instance, fisheries located in developed countries at more northern latitudes may benefit while agricultural impacts vary considerably according to the region and crops considered. Climate change could make it harder to predict the *el Niño* (warmer) and *la Niña* (cooler) weather disturbances, which can have significant impacts of agriculture and other sectors.

Figure 2.3. Impacts of climate change on crop yields

Percentage change in yields in 2050 relative to current climate

Note: The estimated impacts exclude a CO2 fertilisation effect.
Source: OECD (2015[106]). The Economic Consequences of Climate Change, https://dx.doi.org/10.1787/9789264235410-en

Regions and communities

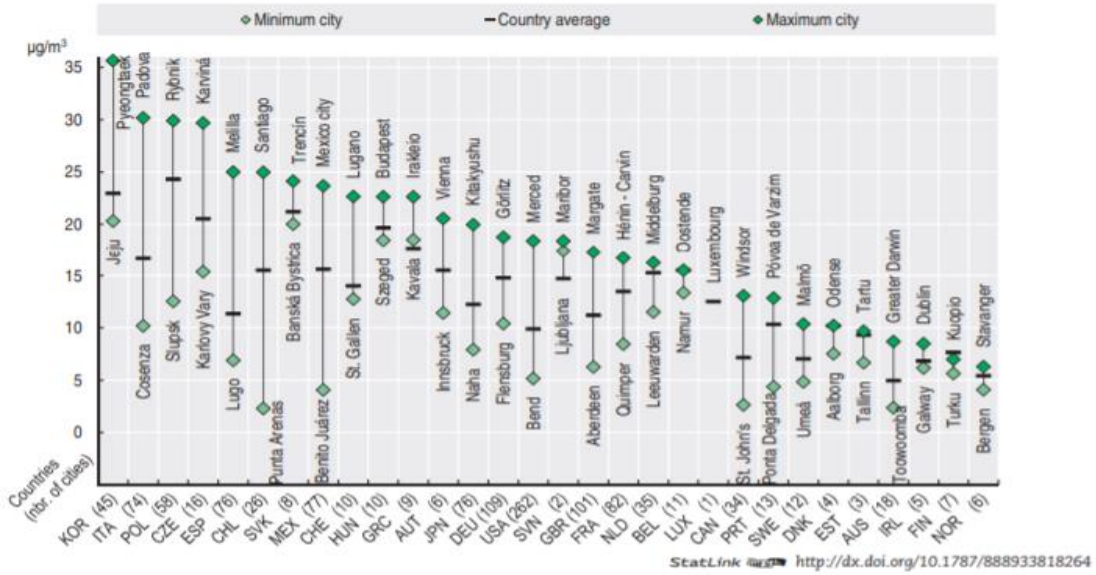
40. **Information available on exposure to air pollution at the regional level shows stark differences within countries.** For example, in Australia, Denmark, and Switzerland, less than 1% of the population is exposed to dangerous levels of PM2.5 but in the least polluted region this percentage is close to 100%. This is also the case among OECD partner countries Brazil and the Russian Federation (hereafter 'Russia') (OECD, 2020[107]).

41. **Living and working in cities exposes individuals to higher levels of air pollution. Within countries, the levels of air pollution vary from city to city (**Figure 2.4**)**. For instance, available OECD data used for Figure 2-4 indicate that the average exposure to $PM_{2.5}$ in Mexico City (Mexico), Santiago (Chile) and Windsor (Canada) is more than five times higher than in other cities these countries. Yet, in Finland, for example, some cities with populations more than 50 000 have air pollution levels that are less than the national average. Overall, at the EU level, based on 2016 data, the share of the urban population exposed to $PM_{2.5}$ and PM10 levels above WHO guidelines was 42-52% and 74-85% respectively, the lowest since 2000 (Guerreiro et al., 2018[108]) Part of the observed differences across regions are driven by climate, altitude, population density, the built environment, and type of economic activity. National and local efforts to reduce air pollution, such as policy and regulation in the transport and energy sectors and economic development, also play a role (OECD, 2018[109]). These locational differences in air pollution and the disparities in exposure by socio-economic status should be considered together to make policy measures more inclusive.

42. **People living and working in urban areas are more likely to be exposed to higher temperatures due to urban heat island (UHI) phenomenon.** The absorption of solar heat by buildings and roads, along with the heating and cooling systems used by buildings and vehicles, and other human activities mean that urban areas can become significantly warmer than surrounding rural areas. The increase in temperature can be considerable; for instance, maximum UHI intensities of 7°C and 8°C were recorded in London (United Kingdom) and New York (United States) (Watkins et al., 2002[110]; Gedzelman et al., 2003[111]) (see Box 2.1.). Importantly, higher temperature could result in higher concentrations of certain pollutants, such as ozone and secondary $PM_{2.5}$ (Lam et al., 2011[112]).

43. **Increases in crime attributable to climate change are unequally distributed towards the most socially-disadvantaged neighbourhoods.** Higher temperature and extreme heat shocks cause spikes in the rate of violent crimes, including domestic crimes and violence against intimate partner. Possible drivers connect to routine behaviour activity theory (warmer weather brings people out of their homes and in contact with others) and heat-aggression theories (extreme heat reduces self-control, disinhibiting criminal behaviour). Studies based on two large US cities show that temperature anomalies or heat shocks increased the rate of crime in urban areas as a whole, with the largest effect felt in the poorest neighbourhoods, up to 50 times higher (Mares, 2013[113]; Heilmann and Kahn, 2019[114]).

Figure 2.4. Urban differences in average exposure to air pollution, 2015



Source: OECD (2018), "Air quality in cities", in OECD Regions and Cities at a Glance 2018. https://doi.org/10.1787/reg_cit_glance-2018-en

44. **Rural communities are particularly vulnerable to climate change.** A quarter of the OECD population lives in rural regions. At the same time, the economy of these regions is often specialised in resource-based industries, which are sensitive to climate change impacts. Climate change is already affecting these economic sectors, namely agriculture, forestry, fisheries, mining and energy, due to increasing frequency and intensity of extreme weather events. Many rural communities are not equipped to adapt and prepare for these climate change challenges. Remoteness, limited economic diversity and population ageing exacerbate their vulnerability (Melillo et al., 2014[115]).

Box 2.1. Cities actions to tackle urban heat waves

Cities are adopting a number of initiatives to reduce the Urban Heat Island effect, ranging from the installation of special materials on roofs and pavements to the planting trees. The City of Los Angeles (United States) has updated the existing building code in order to require all new and refurbished homes to use special sunlight-reflecting and less heat-absorbing materials on roofs. The City of Phoenix (United States) has adopted similar measures in its "Cool Roofs Master Plan" that is complemented by a "Tree and Shade Master Plan" aiming at increasing the numbers of trees in the city. Singapore launched the Skyrise Greenery initiative that is projected to lead to the development of around 200 hectares of skyrise greenery by 2030 (ILO, 2019[103]).

45. **Specific regions are particularly exposed to the threat of air pollution and climate change.** For instance, ice melting, which can be induced by climate change and be accelerated by a number of air pollutants (e.g. black carbon) can have important consequences for the Artic. Furthermore, while most of the Artic regions are distant from large industrial areas, air pollution is nevertheless a reason of health concern and more than 400 000 people are estimated to have died due to air pollution in the Arctic Council countries in 2017 (Lanzi et al., 2021[116]).

3. Who gains and who loses from environmental policies?

46. This section reviews available evidence on the distributional impacts of policies addressing air pollution and climate change. Fossil fuel combustion is the main driver of climate change and it is also a major contributor to air pollution; therefore policies to mitigate one can improve the other. The evidence reviewed here identifies that these policies can have more negative impacts on certain households, demographic groups, workers and regions. While energy and carbon pricing should be central to such green policies, the affordability challenges it poses for certain socioeconomic groups and regions should be duly considered when designing comprehensive policy packages (discussed in Section 4) in light of country and local circumstances. Such equity consideration becomes even more important given that the inequalities and other socioeconomic challenges have been magnified by the COVD-19 pandemic. At the same time, given that the costs of air pollution and climate change are already borne disproportionately by disadvantaged groups as discussed in Section 2, the benefits of policies that successfully abate them could eventually benefit these groups[13].

47. Much of the available analytical work on distributional impacts are on price-based policy instruments such as taxes, charges, tradable permits as well as subsidies and incentives, as reflected in the scope of this section. However, regulatory policy instruments (e.g. emission and energy efficiency standards) are more widely used to mitigate air emissions, and other policy approaches such as spatial planning and investment in public transport also play important roles in reducing air pollution and climate change. Therefore, more analyses on distributional impacts of non-prices based policies would be valuable to deepen the understanding of their equity implications. At the same time, rolling back regulatory standards for air pollution as part of COVID response in favour of certain businesses would only put further burden on people's health and wellbeing (see Section 2).

Individuals and households

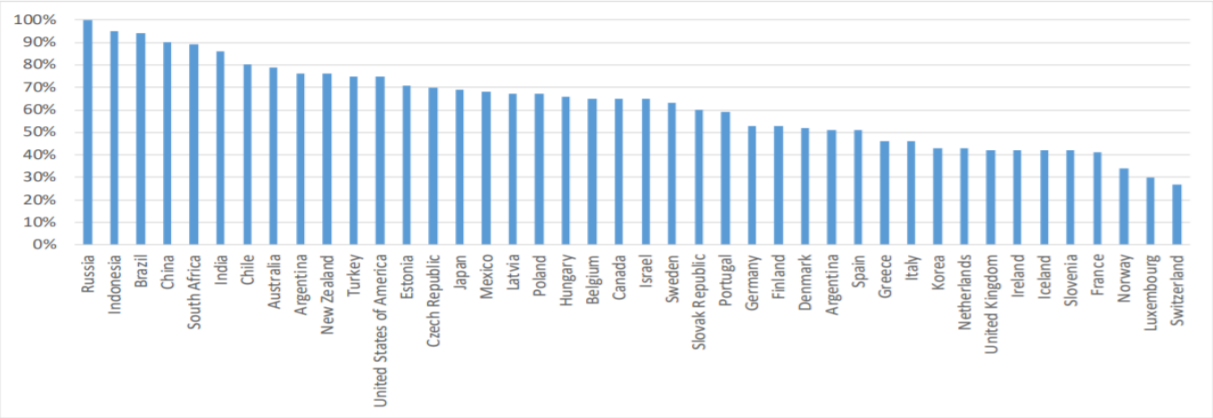
48. **The unsustainable level of emissions of greenhouse gases (e.g. carbon dioxide) and air pollutants can be seen as the result of a large and widespread market failure**: the prices of fossil fuels do not reflect full societal costs of their use (e.g. health impacts discussed in Section 2), thus leading to overconsumption. Taxes on fossil fuel use could correct such market failure, but are often at levels insufficient to reflect its full social cost. For instance, the OECD carbon price gap, defined as the difference between the sum of current taxes on fossil fuel consumption (e.g. specific taxes on fossil fuels, carbon taxes and prices of tradable emission permits) and its estimated climate costs[14], is at 76.5% across OECD and G20 countries (see Figure 3.1). This gap is particularly concerning given that the costs of additional air pollutants, such as $PM_{2.5}$ or $NO_{x,}$ are not accounted for. However, as stated above, it is important to consider country-specific and local socioeconomic circumstances when designing and introducing carbon pricing.

[13]For instance, lowest income groups are more likely to forego medical care due to financial reasons than higher income groups in OECD countries (e.g. 8% of highest-income individuals forwent needed medical care due to financial reasons compared to 26% of people in the lowest income group) (OECD, 2019[254]). However, the monetary savings in medical expenditure may be larger for richer households as they spend more on health care in absolute terms. This is also partially reflected in the fact that the literature often finds that the willingness to pay for improved environmental quality increases in income (Ito and Zhang, 2020[252]; Barbier, Czajkowski and Hanley, 2017[253])

[14] A low-end estimate of the carbon costs today (EUR 30/tCO2) is used to compute the carbon pricing gap.

49. **However, concerns over the distributional implications of higher energy taxes often hold back environmental tax reforms**. Environmental policy measures, such as carbon taxes, subsidies, regulatory tools and mandatory standards in some sectors and for some fuels, can be progressive, proportional or regressive. They are regressive, if poor households spend a higher share of their total disposable income on energy services than richer families. For example, electricity taxes are typically regressive (Flues and Thomas, 2015[117]). They can be neutral or slightly regressive in the case of transport fuel prices in high-income countries; but even progressive in low- and middle-income countries (e.g. Flues and Thomas (2015[117]); Sterner (2012[118])). This is because fuel is considered as a normal good (i.e. quantity consumed rises in proportion to income) in high-income countries, but typically as a luxury good in low- and middle-income countries (Sterner, 2012[118]). In the case of aviation fuel taxes, the effects are less clear and might be progressive (Zachmann, Fredriksson and Claeys, 2018[119]). However, it is crucial that energy tax reforms are designed to avoid exacerbating "energy poverty" as adequate access to energy to warm, cool, and to power basic appliances is essential for ensuring decent standards of living (EC, 2019[25]). Importantly, the revenues from energy and carbon taxes can be used to mitigate the negative distributional implications of the energy tax reforms and to finance required green investments (see paragraphs 78, 80, 98 and box 4.2)

Figure 3.1. Carbon pricing gap



Note: The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.
Source: OECD (2018[120]). Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading, https://dx.doi.org/10.1787/9789264305304-en

50. **As the patterns of energy consumption vary with people's age, older and younger households may be affected differently by energy taxes**. Older households tend to consume more energy for heating and cooling, but less for transport. Liddle (2011[121]) finds that the transport carbon emissions are higher for younger cohorts but residential electricity consumption is higher for households with children or elderly people. This variation in electricity consumption can be due to physiological reasons, but also due to the higher likelihood for younger and retirement-aged adults to live in smaller households and therefore having higher energy consumption per capita (Liddle, 2014[122]; Longhi, 2015[123]). Flues and Thomas (2015[117]) find that older households can spend less than average on transport fuel taxes, but more than average household would on heating fuel taxes. Importantly, if the energy prices are not raised uniformly across all fuels, the distributional impacts will depend on how the use of different fuels (e.g. gasoline, diesel) varies across income deciles and geographies (see also

paragraphs 49 and 69). Also access to alternative heating technologies (e.g. oil or gas heating vs. carbon-free district heating) can contribute to shape distributional implications (Bureau, Henriet and Schubert, 2019[124]). Importantly, the larger adoption of teleworking due to the COVID-19 pandemic increased the vulnerability of working-age population to increase in energy prices for heating and cooling, but may decrease the cost and energy use for commuting to work.

51. **The distributional implications of higher energy prices for different age groups are less often studied in the literature**. The impacts on older people are particularly concerning given the adverse health effects of living in a cold home or the role that air conditioning could have in protecting them from heat waves (see Section 2). These concerns are further aggravated by the higher risks of poverty for older households in OECD countries.

52. **Distributional implications of other pricing instruments introduced to discourage vehicle (and fuel) use should be also addressed.** A common example is the introduction of curb-side parking rates in urban centres to reduce emissions due to cruising for parking because of saturation of on-street parking (i.e. under-pricing of public space). Such policies often offer local resident parking permits at a much lower rate than those offered to non-residents. This design is often justified on the ground that residents contribute to the road maintenance through local taxes but the incorporation of parking costs in local taxes could potentially be regressive since poorer resident households are less likely to own cars (Russo, van Ommeren and Dimitropoulos, 2019[125]).

53. **Standards and other non-market measures are among the most commonly used environmental policies, but their distributional implications have been less researched than for price-based measures.** The limited literature has mostly focused on the US Corporate Average Fuel Economy (CAFE) standards for passenger cars and light trucks, and finds some evidence of regressive impacts (Davis and Knittel, 2019[126]; Jacobsen, 2013[127]; Levinson, 2019[128]). Similarly regressive impacts are found for energy efficiency building code (Bruegge, Deryugina and Myers, 2019[129])while Houde (2018[130]) finds that the removal of the ENERGY STAR certification for appliances in the US market increase consumers' welfare, especially for high income households. This smaller body of evidence in the existing literature on distributional impacts of standards is particularly concerning given their widespread adoption, and the role that they may have in greening some "hard to abate" sectors, such as buildings (e.g. 50% of the EU total energy consumption is linked to the lifecycle environmental footprint of buildings). Interestingly, a recent survey finds a stronger public support for regulatory actions, such as banning least energy efficient appliances, than for increasing taxes on fossil fuels on average across Europe (EC, 2019[25]).

54. **Environmental policies can affect the value of households' assets through two channels**. First, policies and projects that improve the surrounding environmental quality (e.g. a new park) can increase land and home values. Second, some policies that promote investment in energy efficiency technologies (e.g. subsidies for insulating windows or roofs) and in public transportation can also affect asset values (IEA, 2019[131]; Ang and Marchal, 2013[132]).This implies that targeting such measures that improve environmental quality and amenities to lower-income home owners and under-served neighbourhood may eventually contribute to enhancing inequities in house values.

55. **Poorer households, who are less likely to own housing, are less likely to benefit from such environmental measures that enhance asset value**. Furthermore, reduced levels of air pollution can make residential areas become more desirable to affluent households and less accessible to low-income households. Several studies have shown the positive correlation between air quality and house prices (McCord et al., 2018[133]; Chakraborti, Heres and Hernandez, 2019[134]; Carriazo, Ready and Shortle, 2013[135]; Chay and Greenstone, 2005[49]). Lack of financial resources and access to credit can prevent low-income households from accruing the same advantages. If increase in rent prices forces lower income

households to move from the neighbours where green amenities are built, such households would also be less likely to capture the numerous wellbeing benefits connected to access to greenspace (e.g. movement, mental health).

56. **Certain subsidies to promote low-carbon investment may be regressive as they tend to be taken up more by high-income households.** Subsidies for green low-carbon technologies, such as those promoting the installation of rooftop solar panels, are primarily targeted at home owners and are therefore potentially regressive (Claeys, Fredriksson and Zachman, 2018[136]) (Grösche and Schröder, 2014[137]). Similarly, higher-income households are more likely to be able to afford purchasing electric vehicles and therefore benefit more from such subsidies (West, 2004[138]; Tovar Reaños and Sommerfeld, 2018[139]). Also, poorly designed energy efficiency policies risk being regressive if they do not address the multiple barriers for low-income households to invest in these technologies (e.g. limited access to credit, higher likelihood to live in rented housing). Tenants are a group which deserves special attention in this context, as the dynamics of frontloaded energy efficiency investment to decrease energy bills later on is not as straightforward as with home owners.

57. **Designing policy measures to address housing affordability and greening of residential buildings can help to overcome such barriers, while also contributing to creation of related jobs.** Several countries have designed energy efficiency programmes specifically aimed at low-income households (McInnes, 2017[140]). Ugarte et al. (2016[141]) suggests that programs combining energy audits and financial instruments for building renovation tend to be most successful among those targeting low-income households. Contrarily, subsidies for micro-grids in remote off-grid communities or public spending on clean public transportation are more likely to be progressive as they tend to benefit more lower-income households (e.g. redevelopment projects that modernise and green deprived neighbourhoods) (OECD, 2019[3]).

58. **Policies to reduce emissions are likely to affect the prices of several consumers' goods beyond energy.** For instance, food prices may be affected by policies to control emissions in the agricultural sector, which is a larger emitter of number of pollutants and greenhouse gases. Similarly, a larger production of biofuels may also affect crop prices. The distributional impact of such prices change would depend on how consumer preferences for such goods vary according to income. For instance, increase in food prices are likely to be regressive since higher income households tend to spend a lower share of their income on food than lower income households. However, as households' food preferences vary along a number of dimensions (e.g. religion, income) and different food items are likely to be differently affected by policies, it is particularly complex to make broad conclusions (Zachmann, Fredriksson and Claeys, 2018[119]).

59. **Policies to reduce air pollution and mitigate climate change would provide substantial health benefits**. Such policies would mitigate inequalities in a number of the well-being dimensions (see Section 2). For instance, unmet health care needs due to costs are concentrated among lower-income groups in OECD countries (e.g. 8% of highest income individuals forwent needed medical care due to financial reasons, compared to 26% of people in the lowest income group) (OECD,2019). However, the monetary savings in medical expenditure may be larger for richer households as they may spend more on health care in absolute terms. This is also partially reflected in the fact that the literature often finds that the willingness to pay for improved environmental quality increases in income.

Workers

60. **The aggregate effects on employment of the green transition are expected to be limited**. Chateau et al. (2018[142]) show that the overall reallocation of jobs (the sum of created and lost jobs) triggered by a global carbon tax of USD 50 per tonne of CO_2 would be around 0.3% for OECD countries

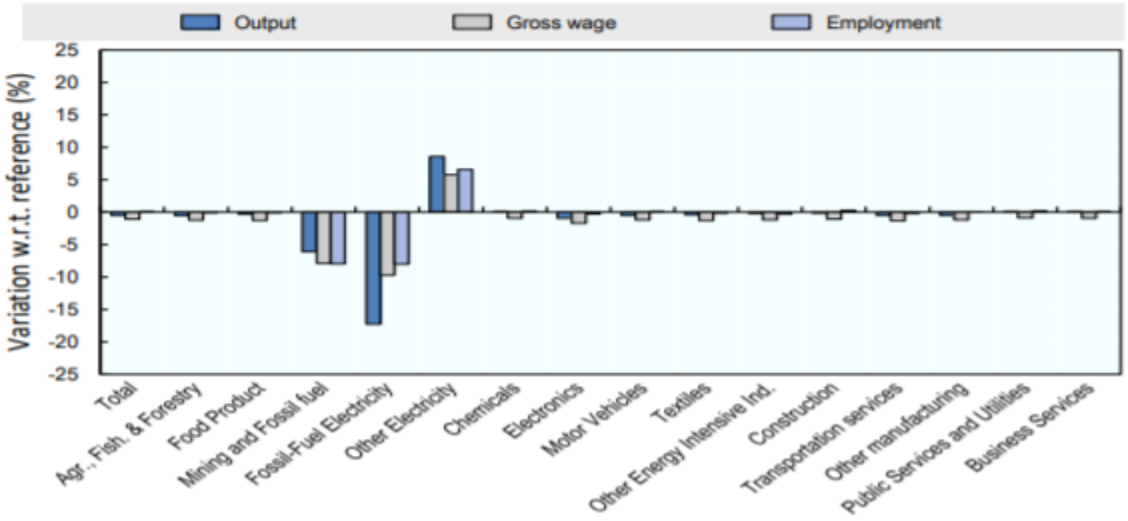
and 0.8% for Non-OECD countries. Similar small impacts are reported by the US Congressional Budget Office (2010[143]), Boeters and van Leeuwen (2010[144]),Hafstead et al. (2018[145]), Eurofound (2019[146]) and the European Commission (hereafter 'EC') (2020[147]). Some other reports, such as (ILO, 2018[148]) and (NEC, 2018[149]), estimate that the green transition could create substantial job gains[15]. Importantly, there are differences according to the policy mix introduced. For instance, Chateau et al. (2018[142]) find that combining a higher carbon price with energy efficiency measures would lead to a higher (but still limited) job reallocations than relying solely on carbon pricing because more sectors would be affected. Hafstead et al. (2018[145])'s two-sector model suggests that employment shifts are smaller under performance standards than emissions taxes. Based on data on French manufacturing firms the econometric analysis of Dussaux (2020[150]) suggests that an increase in the carbon tax on fossil fuel combustion does not affect total manufacturing employment but generates worker reallocation from energy-intensive towards energy-efficient firms. However, the study does not cover process emissions as the French carbon tax is only levied on fuel quantities purchased. Yamazaki (Yamazaki, 2017[151]) studies the impact of the British Columbia's revenue-neutral carbon tax and finds that a small but statistically significant annual increases in total employment. Empirical studies on the impact of policies to support conservation of forests (e.g. creation of national parks, payment for ecosystems services), which can play an important role in climate mitigation for their carbon sequestration capacity, find positive – albeit sometime small - impact on local workers and poverty alleviation (Hegde and Bull, 2011[152]; Robalino and Villalobos, 2015[153]; Beauchamp, Clements and Milner-Gulland, 2018[154]; Alix-Garcia, Sims and Yañez-Pagans, 2015[155]; Sims and Alix-Garcia, 2017[156]).

61. **However, jobs in certain sectors are expected to be more heavily affected by low-carbon policies.** Chateau et al. (2018[142]) find that with a global carbon tax set at USD 50 per tonne of CO_2, employment in fossil fuel extraction and fossil based power generation could decrease by around 8% in OECD countries. The authors also estimate that energy intensive industries could see a modest reduction in employment as the price of energy inputs increases. The largest job gains are expected in low-carbon power generation (see Figure 3.2). The empirical analysis on the British Columbia's revenue-neutral carbon tax finds that the most carbon-intensive and trade-sensitive industries saw an employment fall following the introduction of the carbon tax (Yamazaki, 2017[151]). ILO (2018[148]) confirms results by Chateau et al. (2018[142]) in terms of affected sectors, but suggests more dramatic impacts: ILO estimates that job losses would range between 11% (extraction of gas and petroleum) and 19% (coal-powered electricity generation) but these will be more than compensated by strong job creation in value chains associated with renewable energy, electric vehicles and construction. In the mixed-policy scenario (i.e. carbon tax and energy efficiency standards) considered by Chateau et al. (2018[142]), 73% of total world job destruction still takes place in the energy sector while the 'Transportation services' and 'Construction' sectors would play a larger role in the job creation process. Eurofound projects also found large variations in employment impacts across sectors with job gains in the agriculture, construction, services and renewable energy sectors and job losses in the fossil fuel mining and – temporarily - in the utilities sector due the introduction of a wide green policy package (Eurofound, 2019[146]; EC, 2019[25]). The impact assessment of 2030 Climate Target Plan also finds that the sectoral employment impact can be significant (EC, 2020[147]).

[15] The ILO report is based on an input-output model while the NEC uses the Cambridge Econometrics' E3ME model to estimate the impact of a large policy package, including: regulation of internal combustion vehicles to promote the uptake of electric vehicles (EV), fuel and carbon taxes, public purchasing incentives, removal of fossil fuel subsidies and capital investment subsidies for various energy technologies.

Figure 3.2. Change in output, employment and gross wage by sector associated with a global carbon tax of USD 50t/CO2

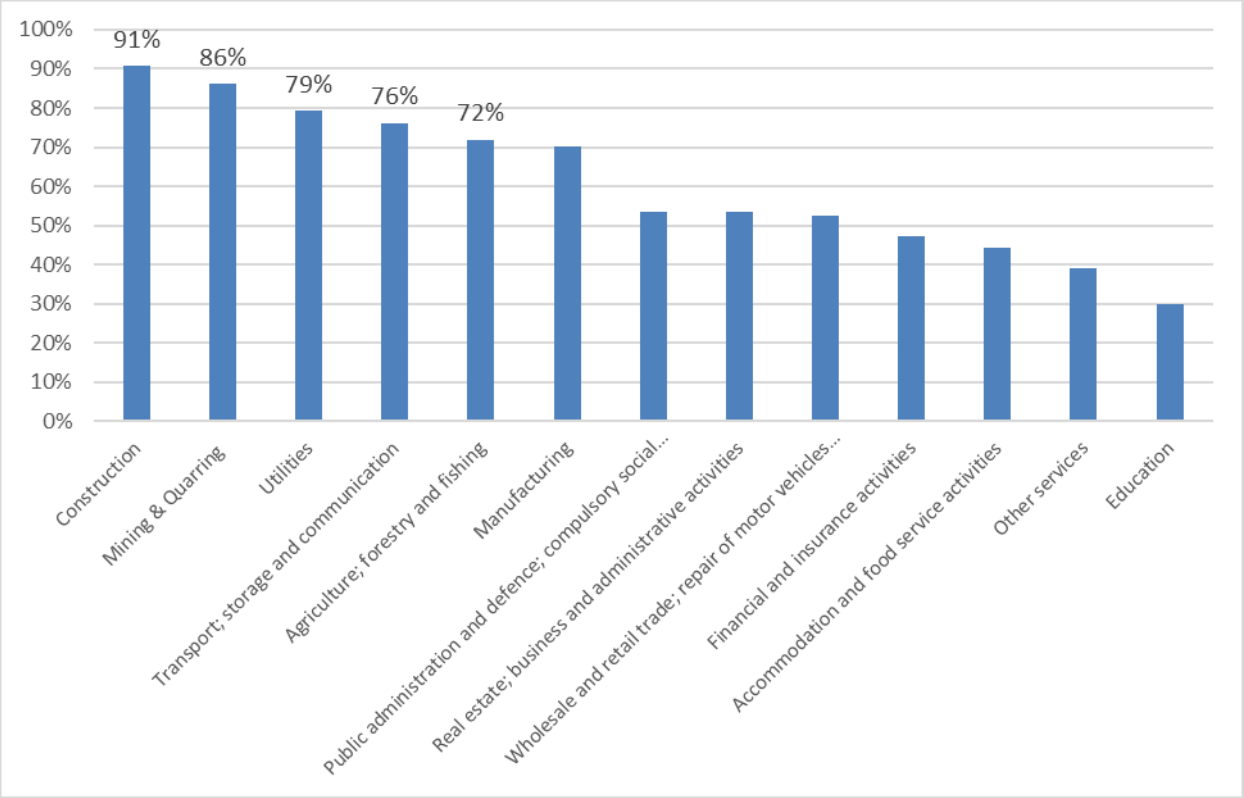
Percentage change w.r.t. reference equilibrium, 2011.



Source: Chateau, Bibas, & Lanzi, (2018[142]). Impact of green growth policies on labour markets and wage income distribution: a general equilibrium application to climate and energy policies, https://doi.org/10.1787/ea3696f4-en.

62. **Low-carbon policies pose different challenges for male and female workers.** First, the workforce of some of the most negatively affected sectors is largely composed by men (see Figure 3.3). This male dominated work-force suggests a potential role for gender-sensitive transition policies in certain regions (Botta, 2019[157]). Furthermore, some studies on past restructuring of coal mining regions provide some evidence of unemployed men crowding women out of the local labour market in the long-term. For instance, Aragon et al. (2017[158]) analyse the effects of mine closures on local employment outcomes by gender and identify negative second round consequences of the closure of UK coal mines on female employment a generation after the closure of the mines. The authors explain the time lag by arguing that ex-miners may have shunned certain jobs they saw as `women's work' while the following generation was more willing to apply to them. However, the literature on both first and second round consequences of mass lay-off of male workers is extremely limited and further research is needed.

Figure 3.3. Share of male employment, selected sectors in OECD countries

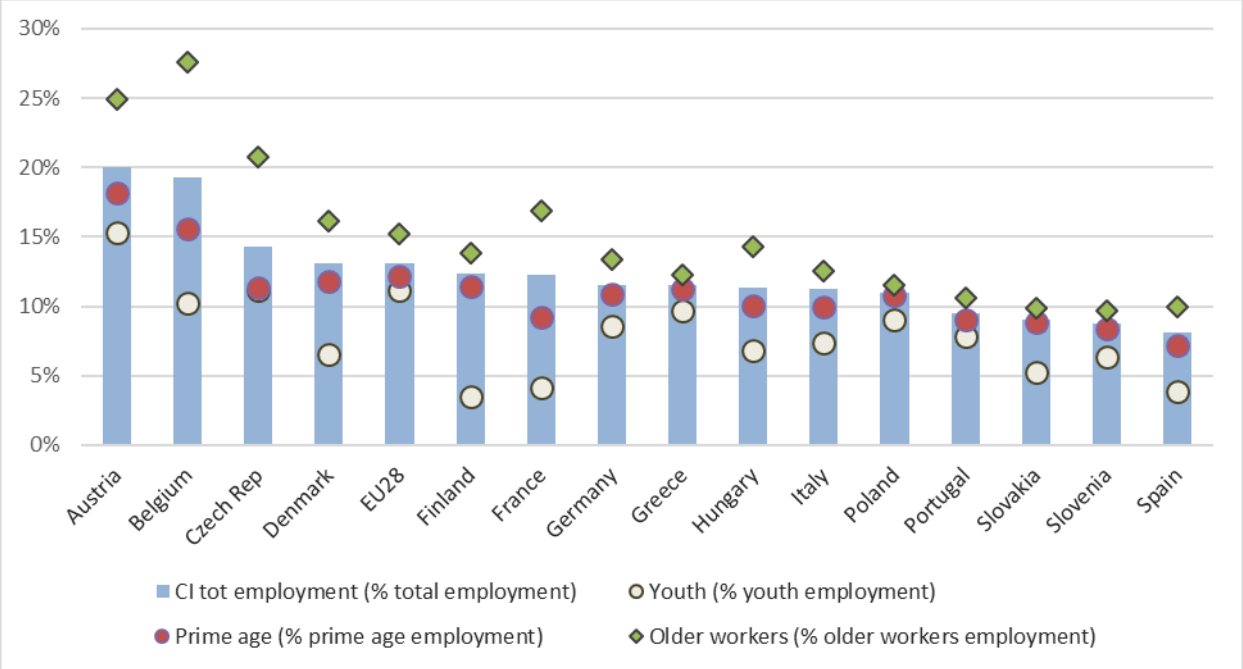


Note: The category "utilities" includes both electric and water utilities.
Source: ILOSTAT, accessed on July 2020.

63. **The expansion of the renewable energy sector could provide women with more opportunities in the traditionally male-dominated energy industry.** The workforce of the renewable power generation sector, which is expected to expand considerably, is characterised by a more balanced gender ratio than the traditionally energy sector. Therefore, female employment may increase in this traditionally male-dominated industry. However, some gender stereotypes seem to persist and women account for almost half of the administrative positions but only for a third of technical and management positions in low-carbon energy companies. The lower likelihood of women to pursue education in tertiary education in science, technology, engineering and mathematics (STEM) and the barriers to female entrepreneurship (e.g. limited access to credit) are among the factors that constrain women's participation in this growing segment of the green labour market (IRENA, 2013[159]; IRENA, 2016[160]). Importantly, such barriers may be higher for indigenous women since these barriers may add to the several market imperfection that limit indigenous people's access credit (OECD, 2019[161]).

64. **Low-carbon policies pose challenges for some older workers.** Preliminary evidence suggests that carbon intensive industries account for a relatively large share of older workers' total employment in certain OECD countries (see Figure 3.4) (OECD, 2012[162]). Older workers are more vulnerable since they often face above-average displacement challenges. They often face longer durations of unemployment spells and larger wage losses once re-employed. In addition, their participation in retraining programs may be limited by cultural bias against learning in old age and by their shorter remaining professional life that may decrease the returns on investing in new skills (OECD, 2005[163]; OECD, 2005[164]; OECD, 2017[165]).

Figure 3.4. Employment in carbon intensive industries as share of total employment for different age cohorts, 2018



Source: Eurostat data, accessed on August 2020, https://bit.ly/3hLEE6d

65. **The distribution of impacts of the low-carbon transition across skill levels seem to vary according to employment structure of sectors, geographical regions and policy mix considered.** For instance, Chateau et al. (2018[142]) modelled a labour market segmented along five job-families and find that that low skilled workers are most affected by the introduction of a global carbon price of USD 50/ tCO2. However, a larger share of high skilled workers are affected in OECD countries than in non- OECD countries (but always less than low-skilled workers) due to their larger role in energy intensive sectors. The EC (2020[147]), when considering a labour market segmented along three job-families, assesses the impact of three different policy packages designed to achieve 55% GHG reductions in the European Union and find that high skilled workers are more negatively affected. However, when reductions in labour tax are included in the modelled package, simulations show small employment gains for the low-skilled workers and no changes for the high skilled. Yip (2018[166]) concludes that low-skilled workers are more likely to be negatively affected by introduction of a revenue-neutral carbon tax in British Columbia (Canada).

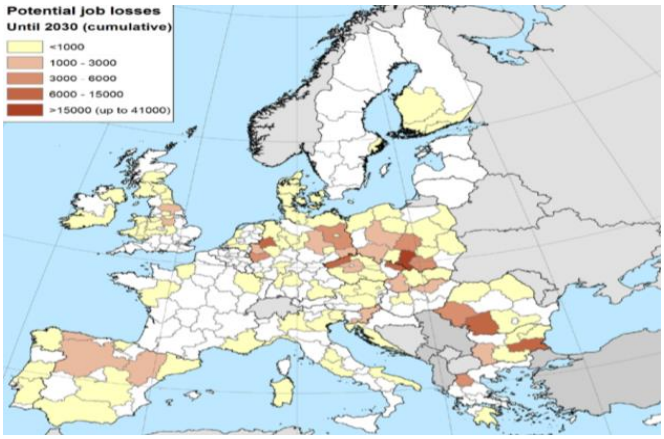
Regions and communities

66. **The jobs losses of the green transition are likely to be geographically concentrated (**Figure 3.5**).** Fossil fuel extractive activities are naturally clustered in resource rich regions. Some evidence suggests that carbon-intensive industries also tend to be geographically clustered in certain countries. For instance, the OECD (2012[162]) analysed the dispersion of carbon-intensive industries in Europe and found that sectors like "coke and fuel production" and "manufacturing of basic metals" are highly localised in several former socialist countries (e.g. Czech Republic, Poland, Slovak Republic). The strong variation of per capita emissions in the United States reported by Cragg et al. (2013[167]) suggests that geographical

concentration may characterise the US economy also. In Canada, around half of Oil & Gas workers are located in the province of Alberta (Statistics Canada, 2020[168]). This locally concentrated impact can be particularly detrimental for indigenous communities, who tend to live in affected regions (OECD, 2019[161]).

67. **This geographic concentration increases the challenges of the green transition, especially for regions whose economy is little diversified**. If government revenues are heavily reliant on the taxes raised through few sectors, then their capacity to finance structural adjustment programs can be severely affected when these industries are progressively phased out (Morris, Kaufman and Doshi, 2019[169]; Elgouacem et al., 2020[170]). Furthermore, certain energy intensive industries, such as steel making, need to operate at certain minimum scale, thus they do not allow to gradually decrease production (and employment). The resulting risk of mass lay-off further underlines the importance of well-designed policy packages (Silva, 2018[171]). Importantly, there are examples of mining regions that successfully diversified their economy (OECD, 2019[172]). In addition, rural residents are likely to be more affected by increases in fuel taxes since they have a more limited access to alternative public transport options.

Figure 3.5. Coal jobs at risk by 2030 in the EU28



Source: Alves Dias et al. (2018[173]). EU coal regions opportunities and challenges ahead, https://doi.org/10.2760/064809

68. **The extent to which new green jobs will be created in the same regions where jobs would be lost is unclear.** If the new jobs are not located in the same regions where jobs are lost, then workers will need to relocate with potentially negative consequences on family life and communities (e.g. loosening of social networks, less time spent with family members who may decide not to move; financial loss due to declining property values). Some workers - especially older ones - may prefer to become unemployed. Overall, this potential divide between where jobs are lost and new ones created may add to the growing concern about disparities in several well-being dimensions across regions and cities within OECD countries. For instance, the productivity of the most productive region is almost twice the productivity of the least productive one (OECD, 2018[174]). Few studies assess the risk of this geographic divergence and further research is needed. Haerer and Pratson (2015[175]) estimate that increase in gas, solar and wind employment generally did not occur in the regions most affected by coal job losses in the United States. Kapetaki et al. (2020[176]) estimated that employment in new renewable power generation could help to offset coal job losses in some, but not all, EU regions. The need of renewable power generation facilities to be located close to the natural resource they exploit, unlike fossil-fuel power plants, is an important factor in evaluating the possibility to replace lost jobs with new jobs in green energy sector (OECD, 2017[177]). Other reasons that may affect the location of new green industries include mover inherent

advantage of certain regions for green transition (e.g. pre-existing industrial/economic structure) or different levels of ambition for and regulatory environment conducive to the green transition.

69. Importantly, the local climate, which influences the demand for heating or cooling, is an important driver to determine the extent to which households in a given region can be more or less affected by changes in energy prices (EC, 2019[25]). Similarly, rural households, which tend to rely more on private vehicles for transportation, are more exposed to the impact of environmetal polices on the gasoline or diesel prices than urban households that usually have acces to better public transportation networks (see also below).

4. Policies for a people-centred green transition

70. Building on analytical work by the OECD and beyond, this section considers policy recommendations and good practices for a green low-carbon transition that is equitable and people-centred. Earlier sections reviewed the nexus between environment and inequalities in different wellbeing outcomes such as health, income and wealth, work and job quality, education and skills. This section considers these wellbeing outcomes as equally important policy goals along with environmental ones. Designing comprehensive policy packages to address these multiple goals for households, individuals, workers and communities, will require maximising synergies and mitigating trade-offs among measures to address individual goals. For example, energy and carbon taxes can have negative outcomes for some socioeconomic groups and regions (see Section 3) but this can be mitigated with compensatory measures (discussed below). This section also considers the role of social policies that could accompany environmental policies to support a green and just transition. In addition, the COVID-19 crisis has hit harder the lower socioeconomic and certain demographic groups, and magnified the need to reverse the trend of growing inequalities. At the same time, the COVID-19 recovery measures represent an opportunity, if designed right, to better align policies for a more resilient, socially equitable and greener future.

71. The COVID-19 crisis has posed an unprecedented challenge to economies and societies, but it must not derail the efforts to address climate and other environmental challenges and achieve the SDGs. Addressing the health crisis and providing relief to affected workers and businesses have been the immediate priorities. In the medium-to long-term, the crisis recovery programmes could contribute to more closely align public policies with environmental objectives and limit the risk of locking-in carbon-intensive infrastructure. This section also addresses considerations for governments to ensure that measures implemented to tackle the COVID-19 crisis do not hamper their efforts to address pressing environmental challenges and resilience of societies. Stimulus packages can also be designed to orient investment towards physical and human capital to "build back better" and to accelerate the inclusive green transition (OECD, 2020[1]; OECD, 2020[2]; OECD, 2019[3]).

Bringing "environmental" and "social" policies together

72. **All households and individuals need to have equal opportunities to adjust and gain from the green transition.** To ensure that, policy packages to promote a green low-carbon transition need to be designed with equity considerations at their core to be acceptable to people, especially as countries focus on measures to safeguard households, workers and businesses impacted by the COVID-19 crisis**.** Thus, incorporating measures addressing environmental sustainability, human health considerations and socioeconomic equity together in policy packages is more important than ever. In addition, when coordinated and sequenced as part of coherent policy packages, accompanying social policies can also help to mitigate any regressive impacts of green policies through protection of the vulnerable (low income households, children, the elderly, displaced workers) and proactively investment in human capital (education, skills) in support of the green transition.

73. **Investing in environmental health helps reduce the inequalities in several dimensions of wellbeing including health, and should be part of the COVID-19 response measures.** Measure to tackle pollution tend to have greater benefits for lower socioeconomic groups, and healthier populations overall help to improve preparedness for future pandemics. The COVID-19 pandemic highlights the need for a comprehensive and integrated approach to human health. Enhancing environmental health through better air quality, water and sanitation, chemicals and waste management, climate change mitigation along

with efforts to safeguard biodiversity, will reduce the vulnerability of communities to pandemics and thus improve overall societal well-being and resilience. Exposure to ambient and indoor air pollution increases the risk of cardiovascular, respiratory and developmental diseases, as well as premature death, and makes individuals more vulnerable to COVID-19. Water access and quality and biodiversity protection are key to battling the spread of pandemics, while effective chemicals and waste management is essential to minimise potential impacts on health and the environment (OECD, 2020[19]).

74. **Workers need a just transition to be ready for the green future.** The green transition may create new jobs requiring new skills; however, some jobs, especially related to fossil fuels extraction and carbon-intensive heavy industries, could come under pressure. Upgrading workers' skills is vital to strengthen their resilience to risks and shocks, particularly in localities where economy is not well diversified and access to education is limited. Comprehensive measures for vocational training and reskilling improve their transferability across firms and sectors can enhance the opportunities, if needed to re-locate. In addition, well targeted income support measures for displaced workers are also needed to help them weather the transition.

75. **Upgrading business models to take environmental and inclusiveness aspects into account does not need to burden the economy.** Businesses need to make informed decisions about their investment in physical and human capital to prepare for a greener low-carbon future. OECD work has shown that increasing stringency of environmental policies does not negatively affect overall productivity at the national level, although there will be winners and losers at the firm and industry levels. In this context, an enabling business environment and investment policies that are fully aligned with social and environmental objectives are crucial so that firms can upgrade and adapt their business models. Competition, trade policies and an environment conducive to quality foreign direct investments are all instrumental to this end (OECD, 2019[178]). SMEs, due to their small size and flexibility, could be well placed to seize untapped opportunities in green products and services (e.g. insulation and solar panel installations); several countries have put in place such green SMEs support measures as part of COVID-19 recovery responses.

76. **Communities should thrive and not get stranded by the green transition.** Poorer communities are generally the least well-prepared to tackle climate change and other environmental challenges, and less able to invest in adaptation measures or mitigation. As policy incentives favour low-emission choices, regions and communities whose economies rely on emission-intensive activities may see local businesses and employment decline or eliminated. When high-carbon assets are stranded or divested, the impact will be felt mostly locally. Regional and community development policies can help to re-vitalise local economies with alternative sources of growth and business models in coordination with green policies across different levels of government.

77. **Unprecedented levels of public spending is being made in response to the COVID-19 crises; many governments have included "green" measures in the recovery and stimulus packages.** Integrating environmental aspects into recovery and stimulus measures is a win-win policy, as it allows governments to progress towards a more sustainable economic model while at the same time boosting the economic activity in the shorter term. The OECD estimated that USD 6.3 trillion of investment in infrastructure is required annually on average between 2016 and 2030 to meet development needs globally. Ensuring that these investments are climate compatible would cost an additional USD 0.6 trillion a year over the same. Furthermore, the additional investment cost is likely to be offset by lower expenditures for fossil fuels due to low-emission technologies and infrastructure (OECD, 2017[177]). At the same time, social investment can also play an important role to prepare the future generations, with environmental education and skill sets fit for jobs and green entrepreneurship. Aligning fiscal policies – the way governments raise and spend money – with well-being and environmental goals is crucial. To

this end, governments are using peer learning opportunities at the OECD, for example within the Paris Collaborative on Green Budgeting and the Coalition of Finance Ministers for Climate Action.

78. **Carbon pricing should play an important role, but with due equity and affordability considerations** especially in light of the strain on household budgets under the COVID-19 crisis. Considering that government spending on the COVID-19 recovery measures are also straining public budgets, energy and carbon taxes are options for restoring tax revenues after the crisis (OECD, 2020[179]) and for financing the green and socially just transition. While earmarking of tax revenue is not considered efficient, evidence suggests that public acceptability of environmental taxes such as carbon pricing increases if corresponding tax revenues are earmarked for environmental or social measures (Maestre-Andrés, Drews and van den Bergh, 2019[180]; Drews and van den Bergh, 2016[181]). Revenues could also be used to offset reductions in taxes on labour or to finance green investments. Hence, when considering the destination of the revenues of energy pricing, and, more generally, on budgetary measures accompanying environmental policy, policy makers should carefully weigh political acceptability and equity aspects against efficiency arguments (see Box 4.2).

79. **A well-coordinated policy package, rather than an array of isolated responses, is needed.** Policies need to simultaneously address the environmental challenges and socio-economic divides. Effectively addressing the social implications of the green transition is essential for reform, taking into account potential labour market, household and industry impacts. This implies the need for closer consultation and coordination across sectors and policy domains (e.g. environment, fiscal, energy, labour, health, social, education) and government ministries to better align and sequence measures over time. For example, the European Green Deal launched in December 2019 is an example of a whole-of-government approach that envisions the use of an entire policy toolbox to deliver on the Paris Agreement (see Box 4.1). Another example of a whole-of-government approach to environmental policies is the one underpinning the OECD report *Accelerating Climate Action - Refocusing Policies through a Well-being Lens.* The report analyses the synergies and trade-offs between climate change mitigation and broader well-being goals across five economic sectors (electricity, heavy industry, residential, surface transport, and agriculture) (OECD, 2019[3]).

Box 4.1. EU's Green Deal

The European Green Deal package enshrines a new policy roadmap to increase the sustainability of the EU economy: increase EU's climate ambition for 2030 and 2050; supply clean, affordable and secure energy; mobilise industry for a clean and circular economy; build and renovate in an energy and resource efficient way; accelerate the shift to sustainable and smart mobility; preserve and restore ecosystems and biodiversity with a zero pollution ambition for a toxic-free environment; and pursue green finance and investment supported by the InvestEU Fund to fight climate change and mobilise research and innovation. It presents a unique opportunity for green growth while seizing the economic opportunities and taking social considerations into account.

In the wake of COVID-19 crisis, the need for the alignment of near-term and long-term priorities emerged. When the EU leaders agreed on a EUR 1.8 trillion package in July 2020 to boost the recovery after the COVID-19 crisis, they considered the advancement of the EU climate transition and related societal objectives enshrined in the European Green Deal – for example, by applying a 30% climate target to all EU spending and focusing 40% of Common Agriculture Policy spending on climate. However, they have at the same time cut down (from EUR 40 to 17.5 billion) the Just Transition Fund that aims to ensure social inclusiveness. This decision may weigh on the political acceptability of the green transition, increasing the urgency of prioritising restructuring of carbon-intensive regions and engaging with citizens and stakeholders on proposed policy packages. As part of a broader process on the adoption of the Climate Target Plan, the EC carried out public consultations with the review of the Renewable Energy and the Energy Efficiency Directives in September 2020, which will be key for achieving the social acceptability of climate and environmental ambitions of the European Green Deal."

Sources: European Council (2020), "Special meeting of the European Council – Conclusions", https://www.consilium.europa.eu/media/45109/210720-euco-final-conclusions-en.pdf; European Commission (2019), "Communication on the European Green Deal", https://eurlex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640&from=EN.; European Commission (2020), "Keynote speech by President von der Leyen at the World Economic Forum", https://ec.europa.eu/commission/presscorner/api/files/document/print/en/speech_20_102/SPEECH_20_102_EN.pdf

Households: Mitigating negative distributional impacts of green policies

80. **Targeted measures to accompany energy and emission pricing can support vulnerable groups in the green and inclusive transition.** Alongside the broader role of fiscal policy as a potential lever for reducing inequalities, a number of measures can be used to alleviate possible regressive impact of pricing emissions. Examples of specific interventions include: transfer payments, revenue recycling and tax swapping, sometimes with revenues earmarked for social spending (e.g. (Flues and van Dender, 2017[182]; Sterner, 2012[118]; Mackie and Haščič, 2019[14]) (see Box 4.2). For instance, Flues and van Dender (2017[182]) find that lump-sum transfers can mitigate any regressive impacts of increases taxes on natural gas, heating oil and electricity. Similarly, Durand, Lasserve and Campagnolo (2015[183]) show that removing fossil fuel subsidies while introducing cash transfers can reduce poverty. Beck et al. (2015[184]) and Murray and Rivers (2015[185]) find that distributional implications of the revenue-neutral carbon tax policy in British Columbia were small, or even positive. The distributional implications of congestion charges, which can disproportionately affect low-income households commuting by car from the periphery to city centre, can be addressed if their revenues are used to provide an affordable and reliable public transport (ITF, 2017[186]; OECD, 2018[187]). Countries interested in minimising the risks of

regressive implications may also decide to initially focus on taxing the types of fuels that have higher demand from high income households. To this end, countries could cooperate to remove tax exemptions on aviation and maritime fuel, particularly for private use, even if such emission account for a small (but rising) share of total domestic emissions (Figure 4.1). In some countries, funds are also made available directly to local governments to address the impact of green measures on the most vulnerable. For instance, the UK Clean Air Fund has been established to finance local government projects to support households and businesses affected by plans to reduce nitrogen dioxide emissions. Examples of possible actions financed include the provisions of incentive to upgrade vehicles and investment in public transport infrastructure (DEFRA, 2018[188]).

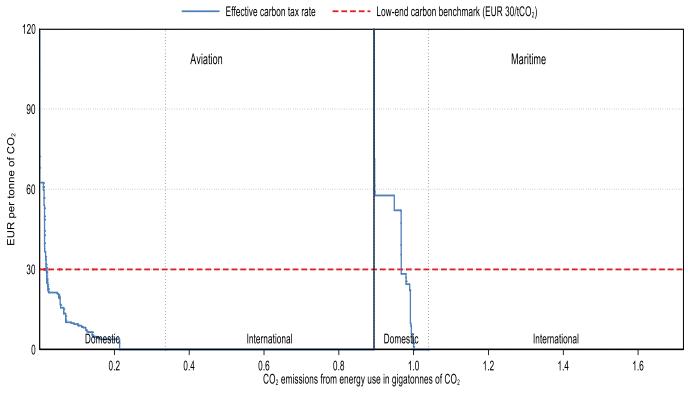
Box 4.2. Recycling carbon tax revenues for spending on social and community support

Pricing carbon emissions at EUR 30 per tonne, which is a low-end estimate of the carbon costs, could raise additional tax revenues amounting to almost 1% of GDP in G20 countries (OECD, 2017[177]). The best use of such revenues depends on a number of country-specific characteristics and priorities. Nevertheless, policy simulations suggest that only a third of these revenues would be needed to mitigate distributional implications of higher energy prices for households (Flues and van Dender, 2017[182]). As such, the remaining funds could be used to finance the support programs for structural adjustment of workers and communities, and required investment in green infrastructure. In earlier experiences with restructuring, considerable financial resources were devoted to facilitate structural adjustments. For instance, when the UK coal mines were closed, the three major national programs to support communities in transition had a budget of almost GBP 1.1 billion (NAO, 2009[189]) while Zpor and Ziółkowska (2018[190]) estimate that around USD 1.4 billion were used to finance the overall cost of coal employment restructuring between 1998 to 2002 in Poland.

Figure 4.1. Effective carbon rates and share of overall household consumptions across uses and income levels

Panel a. Share of income expenditure for different energy services across income levels. **Panel b**. Effective carbon tax rates on carbon emissions from energy use in aviation and maritime

Category name in our report	Share of total emissions (EU28)	Share of expenditure on sector/product in overall household expenditure (Italy)			Engel curve slope estimate†
		Lowest 20%	Average HH	Highest 20%	
Air transport	3.7%	0.1%	0.3%	0.5%	0.07*
Road fuel	12.1%	5.6%	4.7%	3.9%	-0.89***
Agriculture	9.7%	21.8%	16.4%	12.0%	-1.25***
Electricity	23.0%	3.9%	2.0%	1.3%	-0.33
Heating		3.5%	2.4%	1.8%	-



Note for Panel b: 2018 tax rates as applicable on 1 July 2018. CO2 emissions are calculated based on energy use data for 2016 from IEA (2018), World Energy Statistics and Balances.
Source: Zachmann, Fredriksson, & Claeys, (2018[119]). Distributional effects of climate policies, http://aei.pitt.edu/94986/1/DistributionalEffectsofClimatePolicies.pdf . Panel b. OECD (2018[191]), Taxing Energy Use 2018: Companion to the Taxing Energy Use Database, https://dx.doi.org/10.1787/9789264289635-en. StatLink:

81. **Regulatory standards and targeted subsidies to encourage households to invest in low-carbon measures are often used by governments, but empirical evidence of their distributional implications is scarce and mostly focused on the US market.** Examples (see Section 3, paragraphs 53 and below) include product standards, subsidies for low-carbon technologies, such as feed-in tariff for solar panels and tax incentives for electric vehicles (EVs). The limited understanding of their distributional implications is particularly worrying since such instruments are widely used and because these measures do not raise any revenues that could be used to compensate possible distributional implications. To help close this knowledge gap, the OECD Environment Policy Committee is examining the distributional effects of non-tax policy instruments including regulatory standards, tax incentives and subsidies.

A diverse workforce: Preparing for the needs of green and inclusive business

82. **Creating foundations for new jobs aligned with environmental policy objectives requires investing in both human and produced capital**; for instance through vocational training and life-long-learning (including by improving girls' and women's participation in STEM) and effective investment policy frameworks (e.g. by improving the ability of the financial system to support the investment needed for the green transition). Even if the economy-wide employment impact of environmental policies is likely to be modest, some jobs will disappear without direct replacement while others will change as low-carbon technologies will require new skills (EC, 2018).

83. **Making labour markets inclusive and reviving business dynamism would help to manage the costs of green transition.** A suite of policies would be required to this end. These include structural reforms, combined with adjustment measures for affected communities, to facilitate reallocation of production inputs across sectors, thus speeding-up the creation of new green employment (see Box 4.3). Examples include reforms to simplify procedures to start a business, to strengthen competition, to improve insolvency regimes (Adalet McGowan and Andrews, 2017[192]), to promote green technology diffusion and organisational change (OECD, 2018[193]). Some of the COVID recovery plans include support to firms and sectors (e.g. airlines) with both environmental and job protection conditionalities attached, i.e. not rolling back environmental targets (e.g. fuel efficiency improvements, emission reduction) and retaining jobs.

Box 4.3. Looking at the inequality-environment nexus through the productivity dynamics

From a macro-economic perspective, the relationship between inequality and the environment can also be seen through the Nexus Productivity-Equality that the OECD has analysed. Indeed, this work has shown that a slowdown in productivity growth and the increase in inequality have common roots, namely underinvestment in human capital. Because productivity growth depends on investment in human capital, productivity growth is sub-optimal if a large share of the population have insufficient resources to invest in their own skills and quality education for their children. Productivity growth is also a function of competitive pressures and innovation (OECD, 2018[194]). Economic growth and the green transition both depend on the development and diffusion of new technologies and efficient reallocation of resources. Therefore, policies that stimulate technological diffusion and facilitate resource reallocation support both objectives (OECD, 2017[177]).

84. **Active labour market policies can facilitate reallocation of workers displaced due to green policies across sectors.** Labour market policies need to provide the right mix of flexibility and security

to help mitigate the job impacts of green policies. Sufficient flexibility in hiring and redundancy would allow firms to respond to the opportunities and challenges generated by polices to promote the green transition. At the same time, well-designed and targeted unemployment benefits combined with stepping up support through active labour market policies (ALMP)[16] would provide workers with the necessary tools to adapt to new market conditions and transition to new good quality jobs. Countries could consider temporarily increasing unemployment benefit levels or durations to support people who are most affected by the green transition (OECD, 2018[195]). Worker reallocation efforts need to be accompanied by investment in job creation in affected localities (see below).

85. **Skills policies will need to ensure that workers master the right competencies for green jobs**. In most OECD countries, systems are already in place to assess and anticipate future skills needs, also considering the challenges and opportunities associated with the green transition (see Box 4.4). Importantly, there are similarities in skill needs between jobs in certain carbon intensive and low-carbon industries. Examples includes the expertise of workers in the offshore oil & gas and offshore wind industry or those working in the geothermal and petroleum drilling sector. As such, training programs should consider that some workers may need only a top-up to their existing skill sets (Louie and Pearce, 2016[196]; Cedefop, 2010[197]; OECD/Cedefop, 2014[198]) In addition to training, the recognition of skills acquired on the job can also be instrumental to facilitate workers' reallocation. The Flemish 'green experience certificate', for example, which can be awarded to workers after having successfully completed a test, goes in this direction.

Box 4.4. Anticipating skill needs

The French National Observatory for Green Economy Jobs and Skills (*Observatoire national des emplois et métiers de l'économie verte*) is tasked with monitoring implications for jobs and skills of the green transition (OECD, 2016[199]). In Italy, vocational education and training (VET) programs are based on an analysis of the need of local labour markets considering both environmental and social sustainability policies. This process led to the inclusion in the training programmes of skills such as the evaluation of "the environmental impact of energy systems" or "environmental and strategic impact assessments" (OECD, 2017[200]).

Gender aspects

86. **The most negatively affected sectors in the low-carbon transition such as heavy and extractive industries have large shares of men in the workforce**; this suggests the need for gender sensitive policies in certain regions where such industries are concentrated. Several studies have discussed the possible consequences and best practises to manage this predominantly male employment losses, including possible knock-on effects on women's employment in other sectors (Botta, 2019[157]).

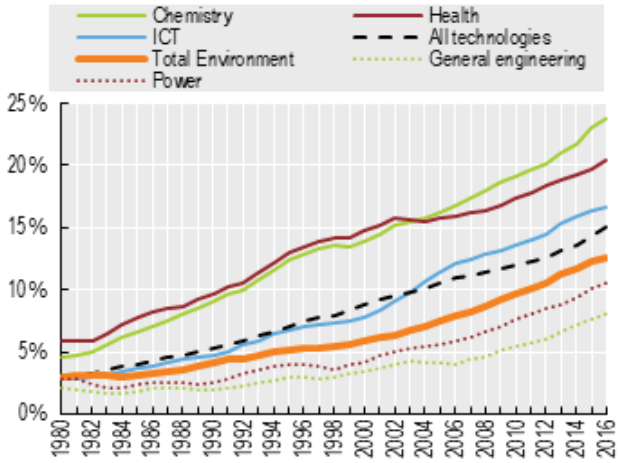
87. **Addressing barriers to female workforce participation and career development may speed up the green transition.** The environmental footprint of firms may be reduced by having a higher proportion of women in leadership roles. A large literature review by Di Miceli and Donaggio (2019[201]) concludes that there is strong and positive correlation between representation of women in business

[16] Governments have an array of active labour market policies at their disposal. For example, job-search training (e.g. consultations to review CVs, discussions on future career progress, advices on job-search strategies), job brokerage services, policies to ease labour market supply-demand matching and training opportunities. Increases in public spending on ALMP can help to raise employment over the medium term (OECD, 2018[195]).

leadership positions and improved environmental performance, more extensive environmental reporting and stronger engagement on environmental issues.

88. **In higher education, lower female enrolment in STEM[17] disciplines is of particular concern.** Though girls outperform boys academically, PISA 2018 results show that among 15 year-olds far fewer girls than boys are among the top performers in mathematics (9.5% vs. 12.3%) and in science (6.2% vs. 7.3%). Overall these differences are small, particularly compared to the gender gap found in reading proficiency (OECD, 2019[202]). It is likely that stereotypes and expectations, rather than performance differences in math and science contribute to the large gender differences in the fields of study chosen in higher education: girls account for less than 1 in 3 engineering graduates and less than 1 in 5 computer science graduates in OECD countries (OECD, 2015[203]). The lower likelihood of women pursuing qualifications in STEM-related fields poses a constraint for their participation in growing sectors, such as the renewable energy industry (IRENA, 2013[159]; IRENA, 2016[160]). It also helps explain the relatively low number of female inventors across all technological domains (as measured by female inventors' names listed in patent documents) (see Figure 4.2). The limited participation of women in technology development potentially slows down the development of new green low-carbon technologies.

Figure 4.2. Women's participation in inventive activities worldwide



Note: Showing a 3-year moving average of counts of priority patent applications (simple patent families), by inventor's country of residence, with patent family size of two or more (excluding singletons). Data for 2016 are provisional. ICT = Information and Communication Technologies, CCM = Climate Change Mitigation, CCA = Climate Change Adaptation.
Source: OECD (2020) *OECD Environment Statistics (database)*; OECD calculations based on extractions from EPO (2019) and using dictionaries from Lax Martínez et al. (2016) and search strategies developed by OECD.

89. **A number of initiatives can help to attract more women towards STEM education needed for green sectors.** These include targeted information campaigns in schools and universities, creation of mentoring programs, providing opportunities for research scholarships in academy and industry, and opportunities for vocational apprenticeship (IRENA, 2013[159]) (see Box 4.5).

[17] STEM stands for Science, Technology, Engineering and Mathematics

Box 4.5. Programs to attract more women towards 'green' sectors

The U.S. domestic C3E program builds on four pillars to close the gender gap and increasing the participation of women in clean energy sectors. First, a senior-executive level Ambassadors program has been created to represent the U.S. C3E Initiative at public forums and to strengthen the recruitment and retention of women in the energy field. In addition, opportunities for networking both offline (through an annual invitation only symposium) and online (through an online community forum) are organised. Finally, an annual award to recognise mid-career women who have demonstrated outstanding leadership and accomplishments in clean energy has been established (C3E, 2019[204]; C3E, 2020[205]).

The "Women of the Construction Sector" (or "les ells du BTP") is an example of multipronged initiative to increase female participation in the low-carbon green building sectors. To this end, the program leverages customised trainings and meetings with a network of women already working in the sector to share their experience and provide mentoring advice (OECD, 2012[206]).

The Austrian Research Promotion Agency developed various programs to support young researchers, including programs targeting women. Examples of funding programs include the as FEMtech Internships for Female Students, which supports internship for female students in scientific and engineering positions in industry, and FEMtech Career, which aims to increase the number of female scientists employed in industrial research (C3E, 2019[204]).

Ageing workers

90. **Policies to mitigate the impact of industrial restructuring on older workers' well-being can include "bridge measures" to pension.** Early retirement, often coupled with income-support measures, are often used to protect the income and assets (e.g. homes) of elderly displaced workers. However, access to early retirement should be strictly regulated and limited, including by the use of incentives to discourage it, in order to safeguard the fiscal sustainability of pension systems. Importantly, the phase-out of entire sectors can affect the solidity of employer-sponsored pensions, thus threatening the retirement plans of workers (see Box 4.6).

Box 4.6. The shrinking coal industry and the risks for retirement plans

The demise of carbon intensive extractive sectors can affect the solidity of employer-sponsored retirement plans since employer's contributions to workers may decline or drastically reduce. This was for instance the case of the US "United Mine Workers of America Health and Retirement Funds" (or UMWA). UMWA is a multi-enterprise retirement fund that risked becoming insolvent by the mid-2020s (UMWA, 2018[207]) due to the numerous bankruptcies of US coal mining companies. As the asset of the Fund started dwindling, the US Treasury recently decided to inject $750 million a year into the fund to cover the unfunded pension obligations. Given that the low-carbon transition may lead to the contraction of several industries connected to fossil fuels extraction, the impact on employer-sponsored retirement plans should be adequately monitored and addressed as needed by public policy interventions (Pollin and Callaci, 2017[208]; Botta, 2019[157]; NYT, 2019[209])

91. **A number of policies can facilitate the reemployment of older workers who face job loss in the green transition but are not close to the pension age.** The limited training opportunities offered to older workers increases the difficulties for them to stay in their existing jobs or find new ones. Retraining programs should be designed in order to encourage and ensure older workers' participation. A key barrier in this regard is that older workers have shorter period to recoup investment in acquiring new skills as they are closer to the retirement age. Public awareness raising campaigns can help address discrimination in the recruitment, promotion and training process, and in employment retention. Countries should also gradually move away from seniority-based practices for setting wages, mandatory retirement age as grounds for dismissal and other age-based hiring and dismissal rules (OECD, 2019[210]) (OECD, 2006[211]) (OECD, 2014[212]). The German "Perspective 50plus" program is an example of a multipronged approach to promote reemployment for older workers (see Box 4.7).

Box 4.7. Perspective 50plus: multi-pronged approach to promote reemployment of older workers

The German 'Perspective 50plus' program, which was introduced to reduce early retirement rates, provides funds to support the activation and labour market integration of older workers. "Regional employment pacts" were given large discretionary power in designing their programs and the funding could be used for skill development activities, profiling, information campaign, promotion of internships, wage subsidies and also innovative measures to address geographical divergence between jobs supply and demand. The programme evaluation found that the programme had better outcomes and lower costs than standard operations, thanks to its focus on training, personalised services and intense interactions between the jobcentre staff and the unemployed (Knuth, 2014[213]; OECD, 2014[212]; OECD, 2006[214]).

One of the measures included interest free loans for buying a car and support to the obtaining of driver's license to increase the mobility of workers. Where trade-offs might exist between the social and greening goals of such programmes, specific measures should be assessed against both environmental and social criteria, and alternative mobility options considered.

Equipping the young with the right skills and opportunities

92. **Young people need to be equipped with the skills and opportunities to enter the labour market in the greener future.** Across the OECD in 2018, 14% of 18-24 year olds were neither employed, nor in education or training (OECD, 2019[215]). Job and income uncertainty can keep young people from reaching other traditional markers of adulthood, leaving them disenchanted and discouraged (OECD, 2018[193]). Policies, such as monitoring and acting on warning signs of drop-out, career counselling, incentivising better links between academic institutions and the industry encouraging early work experience, as well as broader support policies for example for mental health are needed to boost the potential of young people to contribute to new green solutions, industries and occupations.

93. **Education curricula and career counselling services should raise awareness about the green transition and provide up-to-date, wide-ranging information on emerging career opportunities, industries and green jobs.** OECD PISA results show that currently out of the 15-year old students that already have an idea about the kind of work they would like to perform later, one in three cites one of only 10 occupations. Several studies also show that career aspirations of children and adolescents have little in common with projected labour market demands and that aspirations reflected a narrow view of

the world of work (OECD, 2019[216]). Education Ministries should partner with Ministries of Environment and other relevant institutions, social partners and the private sector to anticipate, identify and provide the skills needed for green jobs and the low-carbon transition (ILO, 2016[217]).

Promoting the mobility and social protection of workers affected by green policies

94. **Reforms in housing policies as well as other supportive measures are needed to enhance the geographic mobility of workers and their families who face job losses in shrinking industries**, thus facilitating the access to post-displacement jobs. In many cases, people choose not to move from towns with declining industries because they cannot afford to sell their home for less than what they paid for in order to move to another location where housing costs may be higher. In addition, promoting the movement of people from communities suffering from declining industries may not improve inequalities within these communities. For instance, encouraging people to move may cause communities to see their tax base shrink, making it more difficult to pay for local public services. Furthermore, low-income households in these communities are the least likely to be able to move but will be the most likely to suffer from the closure of local public services. These barriers can be addressed by reforms, for example, to improve access to low-cost housing, streamline administrative procedures for building permits, and lower transaction costs of buying and selling real estates (e.g. stamp duties, acquisition taxes). In addition, providing assistance and advice for critical services (e.g. education, health) will be important to facilitate the relocation for workers and families.

95. **Social security guarantees and entitlements should be adapted in the context of the transition to new employment and types of work.** More than one third of workers in OECD countries are in non-standard employment often as part-time or temporary workers (OECD, 2019[218]). Coverage and entitlements should be portable and linked to workers instead of jobs. Countries could consider new policy approaches to encourage labour mobility, such as individual accounts, universal basic income programmes, and new technological tools that enable better social service delivery, administration, identification of needs (OECD, 2018[193]). In addition, it is important that social dialogue and collective bargaining are strengthen and better coordinated, to promote inclusive growth outcomes, such as a broad sharing of productivity gains and better wages for low-income workers (OECD, 2018[193]).

Regions and communities: Prospects of place-based policies for the green transition

96. **Specific policies can help mitigate the impact of the green transition on affected regions and communities.** Specific environmental policies that can support a just and just green transition vary from one region to another; no "one-size-fits-all" low-carbon pathway exists. Resource-rich regions may see a decline in hydrocarbon extractive industries but may benefit from increased demand for the minerals that underpin low-carbon technologies, such as rare earth for renewables, or leverage former coal mine sites for carbon storage facilities or geothermal power. Industrial regions specialised in energy intensive heavy industries may need to support the technological upgrade of these firms and invest in the required infrastructure for decarbonisation (e.g. carbon capture, utilisation and storage facilities) and job creation. Place-based just transition measures involving investments, social dialogue, social protection, skills and education are needed for the structural reform of local economies for the low-carbon transition. Moreover, regions and rural communities can also contribute to mitigation efforts, while using the green transition as a driver to diversify and develop. For example, rural areas are home to ecosystems that provide food, freshwater, purify air, decompose and detoxify waste, or help with pest control (IPCC, 2019[219]) (OECD, 2011[220]). In this context, certain OECD countries have developed programmes to increase the participation of indigenous communities in the development of the renewable energy sector, such as the Canadian Northern Responsible Energy Approaches for Community Heat and Electricity (REACHE) that prioritises projects with Indigenous leadership (OECD, 2019[161])

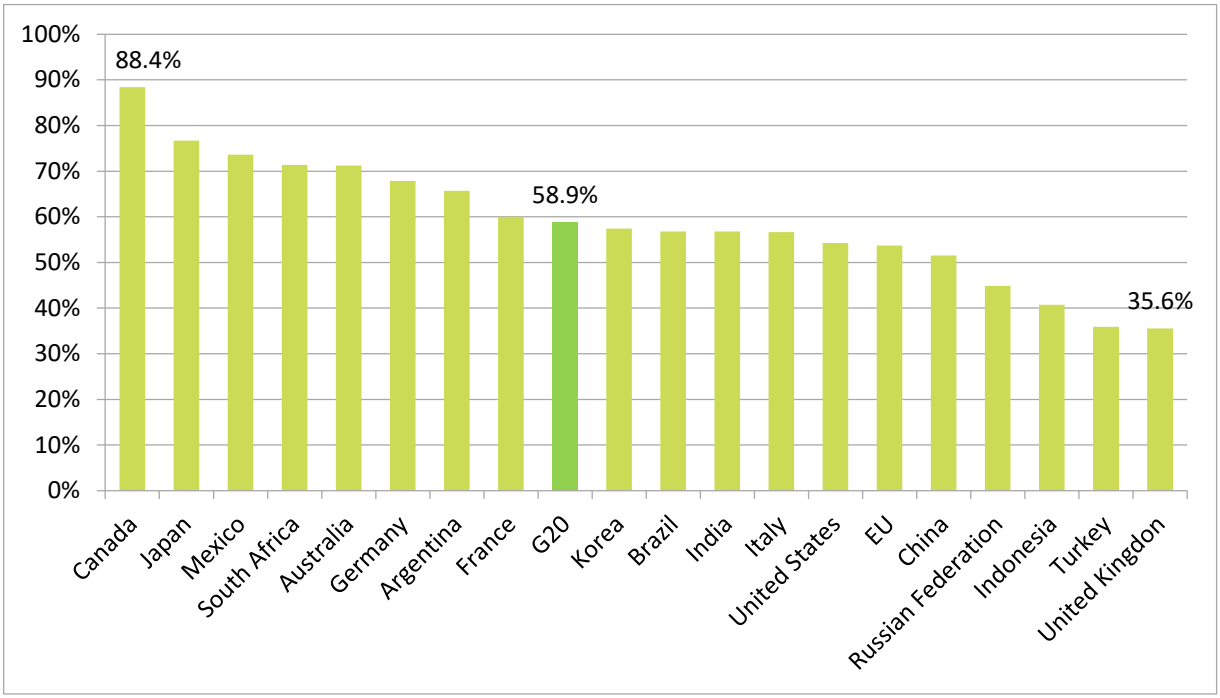
97. **A long-term industry transition approach shared by all local stakeholders is a key element for a successful just transition.** The creation of a vision that is shared by local stakeholders is among the factors characterising successful industrial restructuring in Europe (Galgóczi, 2014[221]; Taylor, 2015[222]; Campbell and Coenen, 2017[223]). Subnational governments play a key role to this end, and the adoption of audience-appropriate communication is crucial to ensure the engagement of all stakeholders (e.g. print, websites, social media, etc.). In Alberta (Canada), an Advisory Panel on Coal Communities has been established to ensure that the concerns of local communities and workers were considered (see Box 4.8).

Box 4.8. Early retirement of coal fired power plants in Alberta, Canada

In 2016 the government of Alberta has announced plans for the early retirement of coal fired power plants. The plan was particularly ambitious since coal-fired power plants accounted for around half of total provincial generation and employed around 3 000, including coal miners. The Government has implemented several initiatives to accompany this structural adjustment. First, an Advisory Panel on Coal Communities was been established to collect the concerns of local communities and workers. Building on the 12 recommendations of this advisory board, numerous initiatives have been introduced, including: top-ups to the employment insurance benefit, relocation grants to support geographic mobility, onsite career counselling and employer-driven training program (Alberta, 2020[224]).

98. **Green public investment and procurement is a key lever available to local governments to support industrial renewal.** Subnational governments account for around 60 % of total public investment across G20 countries. This public demand can be geared towards supporting green industrial regeneration, green infrastructure development and supporting local job creation. For instance, breaking down tenders in smaller work packages can increase their attractiveness for SMEs, which are key local employers, and may support programs for entrepreneurial trainings of displaced workers. Importantly, local officials need to be trained to ensure that green and inclusive development are included into tendering procedures that often consider only cost criteria.

Figure 4.3. Subnational Government investment as a share of public investment in G20 countries, 2013



Note: OECD elaboration based on OECD/UCLG (2016), Subnational around the world: structure and finance.
Note: no data for Saudi Arabia. G20 average is unweighted.
Source: OECD (2017[177]). Investing in Climate, Investing in Growth, https://dx.doi.org/10.1787/9789264273528-en

99. **National skill policies need to be aligned with sub-national programmes to support the local labour market in support of the green transition.** Since large variation in industrial structure and employment opportunities exist across regions in several OECD countries, training programs based on nationally aggregated data may be ill suited to respond to regional labour demands (OECD, 2016[225]). Therefore, ensuring that local governments have the capacity and authority to develop local training initiatives can allow for better targeted training programs. Importantly, the success of these initiatives builds on the development of mechanisms that encourage the engagement of local stakeholders, including SMEs. The Local Apprenticeship Hubs in Manchester (United Kingdom) are often considered a successful experience to this end (OECD, 2018[226]).

100. **Supporting local R&D arrangements can facilitate industrial renewal**. A number of policy instruments are available to local policymakers to this end, including formal and informal university-industry collaborations, innovation incubators and cluster policies. Importantly, such policies generate skill-biased technological change and therefore advantage certain types of workers more than others. To ensure a more even distribution of benefits, innovation and labour market policies need to be well co-ordinated (OECD, 2019[227]).

101. **Well-targeted support measures for SMEs can help them play constructive roles in the green and just transition of communities**. Some of the environmental and low-carbon measures often entails investment in technology, compliance activities, and innovation, which poses a financial burden for SMEs. In addition, in green growth innovation and technics adoption in SMEs requires related worker training as well as a upgrading of managerial skills. National and local governments have introduced policies to enhance access to finance for SMEs for green investment. In regions and communities affected

by job losses due to the decline of carbon-intensive activities, support for green industrial renewal and economic revitalisation could include entrepreneurship training programs could help affected workers to start up own businesses. COVID-recovery measures to support SMEs could incorporate such elements to enhance their environmental performance in addition targeting the goals to maintain liquidity and retain employees.

102. **In certain cases, regenerated past brown industrial sites can become important touristic attractions, thus providing opportunities for local employment.** The most famous case is the Zollverein, which was one of Europe's largest industrial coal facilities and is now a UNESCO World Heritage Site. While not all sites may have such potential, local governments should look into how to ensure that such assets become catalyst for local well-being and not stranded. Local leadership and tightly knit network of local governments, institutions and companies are instrumental to the successful implementation of these policies (Egberts, 2016[228]; Trettin, Neumann and Zakrzewski, 2011[229]).

103. **The need for coherence between national and local policies is particularly acute in countries that are characterised by higher autonomy of local authorities.** The multiplicity of actors calls for the establishment of adequate mechanisms to ensure both horizontal (among the different policy areas) and vertical (among the various levels of government) coordination for a successful green transition.

104. **Different geographical impacts should be investigated with regards to measures for an inclusive green transition.** For example, the lower exposure to air pollutant in rural areas underlines that policies aiming at internalising the environmental and health costs of driving (e.g. higher taxes on diesel and gasoline) typically face an urban-rural trade-off. Urban residents are likely to reap, on average, most of the health benefits of such policies. At the same time, they are less likely to bear its costs given their lower reliance on private vehicles and easier access to alternative transport options, as opposed to rural citizens who are more dependent on personal vehicles for mobility. Geographically blind climate change and air pollution control measures can result in discontent amongst local populations. Regions can easily oppose top-down approaches to the green transition if they are not participating in decision-making. For instance this can happen, when energy transition policies are viewed as "hard" industrial policy that offers limited possibilities for communities to feel some ownership for the interventions and share in the overall vision (OECD, 2012[230]).

Managing the inclusive green transition with efficient and responsive governance

105. **Strategic long-term planning is key to smoothing the green transition.** It is clear that policy instruments will be the most effective when underpinned by a clear, long-term commitment by governments. This provides confidence to the private-sector and civil-society stakeholders that they need to take long-term investment decisions. In this context, the Paris Agreement (Article 4.19) invites signatory countries to create long-term low greenhouse gas emission development strategies (LT-LEDS). So far, 13 countries have already submitted their LT-LEDS to the UNFCCC, including France, Germany, Portugal and the United Kingdom (Aguilar Jaber et al., 2020[231]).

106. **Long-term strategies can help to avoid policy misalignment.** As policies pertaining to different domains (e.g. environment, transport) interact with each other across the economy, the economic signals they create can result in frictions and unintended consequences that come in conflict with a socially just green transition. Numerous misalignments arise from existing cross-cutting and activity-specific policies and frameworks and their interactions (OECD, 2015[232]). Beyond implementing core environmental and social policy instruments, all policies need to be aligned across policy areas (for example, taxes, investment and innovation) to help advance reform and reduce costs associated with the transition (see Box 4.9).

Box 4.9. Interactions between climate and social policies: An example of Seoul

A recent OECD report on Inclusive Growth in Seoul (2018) discussed how climate (adaptation and mitigation) policies may generate opportunities and trade-offs for inclusive growth in cities. In particular, the study recognises that climate change required a systemic policy response that implies addressing a range of economic and distributional consequences. Some policies, such as social policies and programmes, welfare transfers or subsidies for transport and energy, have an explicit aim to reduce inequalities. Others, however, may not explicitly target a reduction in inequalities but can nonetheless influence inclusive growth outcomes due to their strong distributional effects. Likewise, beyond core climate policies, policies outside the climate portfolio also influence climate and inclusive growth outcomes. For instance, local tax policies, which contribute to determining the costs and benefits of land use, can significantly affect emissions and housing affordability.

Source: OECD (2018), *Inclusive Growth in Seoul, Korea: Chapter 2 "Seoul is pioneering efforts to bridge climate action and inclusive growth"*, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264290198-en

107. **Environmental and equity considerations should be embedded as guiding principles for policy-making and budgeting across ministries and levels of government,** by creating institutional mechanisms underpinned in legal provisions that last beyond electoral cycles. France and the UK sent a clear legislative signal by passing climate laws that mandate the creation and implementation of their long-term Low Emission Development Strategies (LT-LEDS) along with carbon budgets from now until 2050 (Aguilar Jaber et al., 2020[231]). Failure to reach these carbon budgets– or update and review their LT-LEDS - would result in judiciary review of Parliament. Recent OECD work on the governance of complex and cross-cutting agendas, such as the SDGs, shows that developing a shared, whole-of-government strategic document at the national level helps ensuring a common vision, shared priories, clarity of responsibilities between institutions and their obligations vis-à-vis stakeholders. A robust measurement and monitoring framework is crucial to monitor progress over time, and readjust policies and priorities (OECD, 2019[233]). The budget as well as public procurement are important levers in reaching a meaningful impact towards reaching the SDGs, e.g. in Finland (OECD, 2019[234]).

108. **To enhance public acceptance of ambitious green policies, governments need to take their citizens along on this journey, responding to their needs and concerns; while encouraging fulfilment of their obligations**. In the OECD countries, trust in institutions, and civic engagement is low, which affects the ability of the government to raise popular support for ambitious action for greening and inclusiveness. In 2018 in the OECD on average, 45% of people were confident in their government, only a slight improvement from 43% in 2008. The lowest level of confidence among OECD countries was only 16%, whereas the highest was 85%. Restoring trust requires effectively informing and involving citizens in decision-making, preventing policy capture by narrow interests and demonstrating the capacity to deliver reliable, quality public services (OECD, 2018[193]).

109. **Governance and policy-making towards the green transition should be participatory through clear and regular entry points in the policy-making cycle for the civil society and citizens.** Across the OECD, only 34% of people feel that they have a say in what the government does (OECD, 2020[235]). Most OECD countries have implemented a requirement to engage stakeholders in developing both primary and secondary regulations, and have developed dedicated modes and tools for engagement, with the most common being informal consultation with selected groups (e.g. social partners), public consultation over the internet, advisory groups or preparatory committees and physical public meetings. The engagement with stakeholders at an early stage of the policy-making process has increased in recent

years, but is not systematic in the vast majority of countries (OECD, 2018[236]). A range of civil initiatives dedicated to the green transition have been emerging over the past decades, demonstrating the demand and need for, as well as the value of more active participation of the civil society in green and climate friendly solutions. Many of these voices have been amplified around the world through the School Strike for Climate, spearheaded by the climate activist Greta Thunberg. A number of challenges, however, still prevent meaningful stakeholder engagement, especially for low-income populations, for example low administrative capacity, difficulties in reaching certain societal groups and weak incentives for stakeholders to participate (OECD, 2018[193]).

110. **Policies with environmental and climate objectives have a higher chance to succeed only if they are made acceptable to stakeholders**, underpinned by a notion that the costs of the policies are shared fairly and by a good understanding of immediate and long-term benefits (or avoided costs) for different groups of population. Many governments have started to actively solicit feedback from the civil society to feed into climate and low-carbon transition policies. For example, the Citizens' Convention on Climate (*Convention Citoyenne pour le Climat*) in France, an assembly of 150 people selected at random, representing the diversity of the French population, has prepared a set of measures to achieve a reduction of at least 40% in greenhouse gas emissions by 2030 (compared to 1990). The legislative and regulatory proposals will be presented either to a referendum, to a vote in Parliament or to direct implementation. Similarly, Germany randomly recruited citizens to participate in the creation of the Germany's LT-LEDS. Over 60,000 people were called, of whom about 2,500 were interested in taking part. In September 2015, 500 citizens of all ages gathered in five different cities to discuss possible mitigation strategies, and proposed 97 strategic measures. Anyone who was unable to attend physically could comment via online dialogue on these proposals (Aguilar Jaber et al., 2020[231]).

111. **The policy-making process should be protected from undue influence to avoid policy capture by narrow interest groups.** Most OECD economies are feeling the legacy of vested interests of fossil fuel and other greenhouse gas (GHG)-intensive industries, reflecting their significant contributions to past (and present) economic growth, for instance in their impact on tax revenues, financial markets, pension funds and jobs (OECD, 2017[177]). Withstanding the pressure from vested interests requires a cross-cutting and whole-of-government ambition and action towards the green transition, including raising awareness of the adverse impacts and costs of continuing the high-emissions economic model. For example, France has introduced legislation requiring institutional investors to evaluate and report on their exposure to risks related to climate change (Officiel, 2015[237]). In addition, in a number of countries, laws mandate the evaluation of impact of projects across a number of dimension (e.g. health, social, economic, and environmental impacts), such as the Canadian Impact Assessment Act.

112. **The private sector has a shared responsibility and commercial interest in driving the inclusive green transition**. A number of partnerships between businesses and governments are taking shape to this end[18]. For example, the Sustainable Energy for All (SEforAll) partnership brings together governments, the private sector and the civil society to accelerate action on SDG 7 (to achieve affordable, reliable, sustainable and modern energy for all by 2030), including 18 private entities. The business case for inclusive and green growth is strong. More equal societies benefit business through a larger middle class and growing consumer purchasing power; enhanced government capacity to invest in education, health and infrastructure; and improved economic and political stability. Businesses which are first-movers in innovative, green technologies and services can reap the greatest market shares and benefits.

[18] On the inclusiveness side, in August 2019, the Business for Inclusive Growth (B4IG) initiative was launched on the margins of the G7 Leader's Summit. Under the leadership of the French President Emmanuel Macron and overseen by the OECD, the B4IG coalition of international businesses has pledged and committed to play their part to strengthen equality of opportunity; reduce territorial inequalities; promote diversity and inclusion; and promote OECD standards.

113. **However, data suggests some divergence between firms and industry-wide initiatives on green action in certain sectors**. For instance, the large majority (85%) of the oil & gas companies surveyed by Climate Action 100+ have assigned clear responsibility for climate change policy to a board member or a board committee, yet nearly all companies (92%) hold memberships with industry associations that have positions conflicting with their internal position on climate (Climate action 100+, 2019[238]).

5. Next steps: Collecting new evidence and updating measurement agenda for the people-centred green transition

114. To further advance the OECD work to support governments to devise policy packages that address inequalities and environmental challenges together, this section outlines next steps that are needed to collect more evidence, draw lessons from country experiences, and update measurement frameworks to better track progress in the people-centred green transition.

115. **A sound measurement agenda in support of meeting interconnected economic, social and environmental challenges needs to focus on three complementary spheres: production, well-being and sustainability.** These three can be broadly defined as data on the economic performance at aggregate level (production), the economic and non-economic outcomes that matter most to people (well-being); and the capacity to generate well-being outcomes over time (sustainability).[19]

116. **No single indicator can cover all aspects of production, well-being and sustainability.** However, some indicators are better suited than others to provide summary views of each sphere and interactions across policy spheres. In light of the urgency to address issues of well-being and sustainability, these indicators need further focus and development. Generally, moving ahead with the cross-sectoral measurement agenda will help policy makers to formulate and assess integrated policies. Statistical groundwork needs reinforcing to this end. The measurement agendas for dealing with interconnected environmental and social challenges need to be pushed ahead along with the implementation of the broader sustainability efforts such as SEEA (System of Environmental-Economic Accounts)[20].

117. **Maximum consistency of concepts and data sources between the three spheres above are vital for efficient and robust measurement.** This requires a measurement framework that brings together core aspects of production, well-being and sustainability. The OECD Green Growth strategy recognises the importance of the three spheres above as it is defined as "fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies" (OECD, 2011[7]). These dimensions are also reflected in the OECD Green Growth Indicators, which captures data on the "Environmental quality of life", "Environmental and resource productivity of the economy", the "Natural asset base" and "Economic opportunities and policy responses".

118. **Over the past decade, the OECD has refined its measurement tools.** Relevant ongoing work that focuses on distributional aspects include: Green Growth Indicators 2017 (OECD, 2017[239]), new geo-spatial data on inequalities in exposure to pollution according to socio-economic status (OECD, 2019[98]), gender differentiated data on economic response, such as innovation (OECD, 2020[240]), analysis of indicators to assess the synergies and trade-offs between limiting climate change, progress towards

[19] OECD, 2020 "Framing the Measurement of Production, Well-Being and Sustainability: a Source Paper for the MCM".

[20] The implementation of the System of Environmental-Economic Accounting (SEEA) is particularly important to ensure that assets are monitored and preserved for future generations. The recently launched UN Program on Natural Capital Accounting and Valuation of Ecosystem Services aims at piloting new system for ecosystem assets and services accounting in several countries (*i.e.* Brazil, China, India, Mexico and South Africa) , including ecosystem services such as carbon storage, is an important step forward to this end (SEEA, 2020). The government of Canada is also working on the development of a Quality of Life Framework to measure well-being, quality of life, sustainability and resilience.

meeting SDGs and improving wellbeing (OECD, 2019[3]); the Inclusive Growth Dashboard to monitor progress on key outcomes and drivers of inclusive growth; the ongoing work on perceptions of inequality and preferences for redistribution, and the monitoring of the "Distance to the SDG targets".

119. **In this context, future work could be directed at further integrating distributional considerations of green policies by developing and standardising new indicators.** The list below highlights a number of proposed and potential work that would go in this direction:

- Indicators on climate change adaptation covering OECD countries with a possible focus on national or sub-national climate change adaptation issues or on specific sectors (e.g. water management, disaster risk reduction), which would allow to have a finer understanding of the challenges of climate change for different communities.
- Indicators on transport accessibility across cities and territories, which could allow to map the distributional impacts of pricing policies in transport.
- Indicators on geo-spatial inequalities in incomes and earnings, which could help to shed light on disparities in households' living standards across regions, thus informing discussions about the distributional impact of environmental taxation and the political economy of environmental reforms.
- Further expanding the geo-spatial data on inequalities in exposure to pollution according to socio-economic status to other pollutants and countries and combining them with the above mentioned geospatial data on income and earnings variables would help to drastically improve the understanding of the distribution of the costs of pollution.
- Joint work with the OECD Centre for Skills to estimate skill transferability across occupations which could help assessing the overall impact of the green transition and the associated emerging skill demands and mismatches.
- Health-related well-being indicators could be a suitable first step to further integrate "quality of life" well-being into the Green Growth Indicators, given the robust evidence on the link between pollution and health outcomes.
- Indicators for transformation potential of regions, including the level of investments required.

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