COVID – 19 and the low-carbon transition. Impacts and possible policy responses

26 June 2020

The COVID-19 crisis is an enormous challenge to economies and societies across the world, but it must not derail global efforts to limit warming to well-below 2°C. Addressing the health crisis and providing relief to affected businesses and workers are the main current priorities. However, the post-crisis recovery programmes present an opportunity to more closely align public policies with climate objectives and limit the risk of locking-in carbon-intensive infrastructure. Forthcoming stimulus packages can be designed to orient investment towards sectors and technologies that can accelerate the transition, and improve resilience to future shocks from climate change. The focus of this brief is on the immediate steps that governments can take to ensure that emergency measures implemented to tackle the Coronavirus (COVID-19) crisis do not derail their efforts to address pressing environmental challenges and improve the environmental health and resilience of societies.

The COVID-19 crisis confronts policymakers with challenges and opportunities for climate change mitigation

The COVID-19 pandemic is an enormous challenge to societies and economies across the world. The first immediate priority for governments has been to deal with the health crisis and save lives. As strict containment measures have resulted in a drop in economic activity without precedent in recent history (OECD, 2020[1]), another key priority has been to quickly adopt support policies that minimise the destruction of jobs, incomes, value chains and production capacity. As containment measures and other health policies succeed in slowing the pandemic, many governments are also beginning to roll out policies to kick-start the economy.

However, the magnitude and urgency of the crisis should not let us lose sight of other challenges, such as climate change. Climate change is an existential threat, posing severe risks to individuals, society and to the economy, as exemplified by the increasing frequency and intensity of extreme weather events. Economic losses incurred from weather-related disasters amounted to an estimated USD 337 billion in 2017, and these numbers are expected to grow substantially in the near future (Giuzio et al., 2019[2])..

There is no evidence directly linking the COVID-19 outbreak to climate change. However, COVID-19 is testing our resilience in responding to potential climate-related disasters. Epidemiologists have long warned that the characteristics of today's global society (e.g. shifts in and destruction of wild habitats, greater global interconnectedness, high-density in large urban centres) increase the risk of future pandemics, even if no one could predict when one would happen. Climate change is already underway, but less well understood are the precise conditions under which "tipping points" (such as a collapse of the west Antarctic ice sheet) will be triggered, with potentially devastating consequences. What is well established is that that their probability of happening will increase significantly with climate change (IPCC, 2018[3]).

As such, the COVID-19 crisis can provide lessons about the vulnerability of our societies to high-impact global shocks and on the important role of public policies in mitigating the risks by reducing greenhouse gas emissions, in addition to boosting investments in long-term resilience and prevention. Its global nature is also a reminder that global shocks – pandemics, economic crises and climate-related disasters – are best overcome through co-ordinated international action and by following scientific advice.

Preparation of recovery policies needs to integrate economic, social and climate change objectives

To limit average temperature increases to well below 2 degrees – in line with the international commitments of the 2015 Paris Agreement – global emissions need to be cut to net zero by around mid-century. Over 100 countries have already adopted carbon neutrality goals for 2050, requiring transformative change in many economic sectors. However, countries' commitments to 2030 collectively fall short of what is needed to shift towards a pathway consistent with carbon neutrality. In addition, the identification of detailed strategies to achieve these goals and the implementation of policies have been lacking. Careful preparation of recovery policies presents opportunities to simultaneously address recovery and climate objectives, which critically depend on actions and investments over the next decade (OECD, 2018[4])

The COVID-19 crisis has reduced emissions, but will not reduce climate change if emission reductions remain temporary

The lockdowns imposed across the globe and the associated collapse of economic activity have caused large reductions in greenhouse gas emissions (along with life-shortening air pollutants) from transportation and industrial activity. For example, in China, industrial shutdowns are estimated to have caused a 25%

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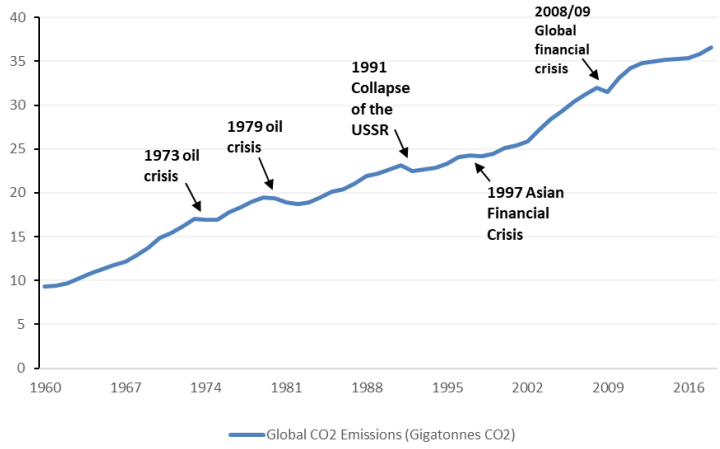
drop in CO_2 emissions in February 2020, compared with the same month in 2019 (Global Carbon Project, 2020[5]). The IEA expects global CO2 emissions to decline by 8% in 2020 compared to 2019 (IEA, 2020[6]). This temporary drop in emissions, however, will be inconsequential for climate change unless followed up with strong climate policy action. First, what matters for climate change is the stock and the composition of greenhouse gases in the atmosphere, not the short-term flows. Second, while past crises, including the 2008 Global Financial Crisis, have all been associated with temporary drops in emissions, these reductions have been more than compensated by stronger growth of emissions in the following years (Figure 1).

Beyond the temporary containment-driven drop in emissions, the COVID-19 pandemic could well trigger permanent behavioural changes in the way people work, travel and trade, which may or may not support climate change mitigation. For example, as businesses realise that they can improve profitability and productivity by cutting on business travel, this could translate into emissions reductions, in particular from air transportation. Changes to international tourism could have the same effect. Similarly, as the economy recovers, behavioural changes – such as more teleworking and more teleconferencing – as well as the potential changes in business models, such as diversifying or shortening of global supply chains and the growth of digital businesses, may help curb emissions. At the same time, as a legacy of the pandemic, people may be less keen on using public transport. This could, at least for a while, increase emissions from car use. It is too early to draw conclusions but the behavioural changes, even if permanent, are unlikely to be large enough to significantly alter the climate problem. For example, air transportation, although growing fast before the crisis, accounted for 2.5% of global greenhouse gas emissions in early 2020.

Figure 1. CO_2 emissions and past economic crises



Note: Adapted from The Economist (2020), based on CO_2 emissions data from Global Carbon Project. CO_2 emissions from the use of coal, oil and gas (combustion and industrial processes), gas flaring and manufacturing of cement.
Source: (Global Carbon Project, 2020[5]).

The COVID-19 crisis puts low-carbon investments at risk

Notwithstanding potential behavioural changes, there is a risk that the crisis might actually make things worse from the climate mitigation point of view. Reducing emissions in the long run requires large investments, from both the public and private sector, in low-carbon technologies – both on the innovation and the diffusion side (IPCC, 2018[3]; OECD, 2018[4]). A combination of features of the COVID-19 crisis poses risks to the prospects of low-carbon investments.

First, overall economic uncertainty is currently at record levels, and much higher than during the Global Financial Crisis, as captured by real-time data such as stock market volatility, business surveys, or news-based indices of policy-related uncertainty. Economic uncertainty tends to induce firms to reduce or

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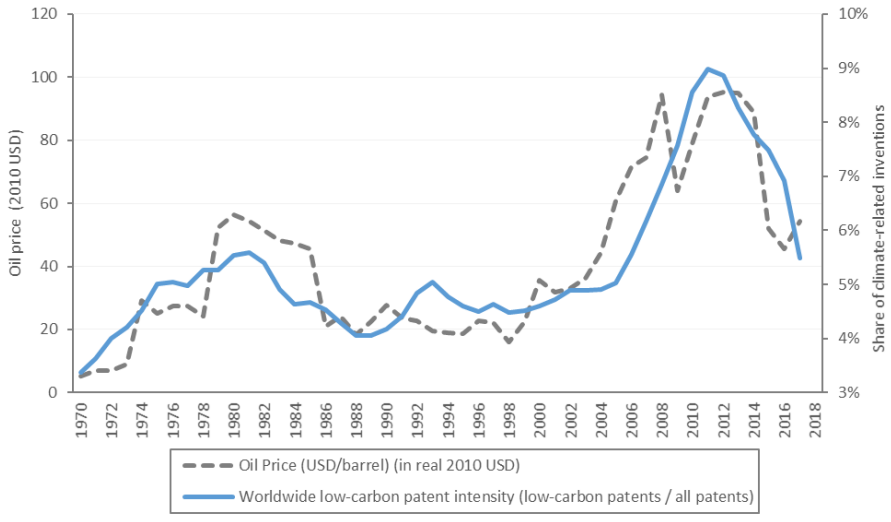
postpone investment and innovation activity as well as to reduce access to financing (Baker et al., 2020[7]), and this is particularly important for investments in the energy sector, which have a long time horizon.

Second, the COVID-19 crisis induced a collapse in demand for oil. Coupled with supply decisions made by key oil producing countries, this led oil prices to plummet by 60% in February and March 2020. By May, oil prices had not yet stabilised despite an OPEC+ agreement on production cuts in April (IEA, 2020[8]). Low fossil-fuel energy prices provide weaker incentives for investment in low-carbon and energy efficiency technology at all stages, from research and development to commercial diffusion. For example, there is ample evidence that fossil fuel prices are positively correlated with global patenting activity in low-carbon technologies (Dechezlepretre et al., 2011[9]), as shown in Figure 2. As current oil prices tend to be a predictor of longer-term price expectations, low oil prices weaken the case for low-carbon investment.

Third, a rapid shift towards a low-carbon economy, necessary to meet the targets of the Paris Agreement while delivering on economic growth ambitions, requires radical new innovations on top of incremental improvements in existing technologies. Young firms tend to be major drivers of such radical innovation (Andrews, Criscuolo and Menon, 2014[10]; Calvino, Criscuolo and Menon, 2016[11]). Both young and small firms are likely to be much more severely affected by the COVID-19 crisis compared to larger or incumbent firms (Bell et al., 2020[12]), as they have poorer access to capital required to smooth over transitory shocks (OECD, 2020[13]).

Finally, the pandemic has interrupted global supply chains, including those for renewable energy projects, which could delay or obstruct their completion (PV Magazine, 2020[14]). Specifically for smaller and younger developers, which tend to be more present in renewable energy than in fossil fuel electricity generation, such delays can imply substantial uncertainty and firms may lack the access to financing to maintain operations (Criscuolo, Gal and Menon, 2014[15]). As a consequence, the IEA forecasts a dip in renewable energy capacity additions in 2020, on the back of supply chain disruptions, lockdown measures, physical distancing and financing challenges (IEA, 2020[16]).[1]

Figure 2. Worldwide low-carbon patent filings and oil prices



Source: Based on data from the European Patent Office's Global Patent Statistical Database and Oil price data from the World Bank.

[1] Followed by a recovery in 2021 under the assumption of continued government support (IEA, 2020[16]). Interestingly, amid a collapse in demand for energy in 2020 Q2, renewable energy generation has held up relatively strongly, largely due to priority dispatch and still increasing capacity (IEA, 2020[6]).

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With historically low oil prices, the fossil fuel industry is also under stress

Economic projections suggest that oil prices may stay below pre-crisis levels well into 2021 (World Bank, 2020[17]; IEA, 2020[8]).

With prices below USD 35 per barrel, oil producers, especially those exploiting costlier resources, are under considerable stress (Carrington and Taylor, 2020[18]). Already, over the past five years, oil and gas firms have been on average less attractive to investors compared with the overall energy market as well as other industries. The fossil fuel sector has also been deemed more risky relative to the overall market around the world. Beta coefficients, a measure of risk relative to that of the stock market, for coal generated energy and oil and gas production and exploration, show that such activities have over the past years been persistently riskier than low-carbon energy sources (Damodaran, 2020[19]).

Regardless of how the fossil fuel sectors weather the COVID-19 crisis, they remain important for energy security. They employ some 1% of the workforce globally, though significantly more in specific regions. Moreover, the fossil fuel industry can provide resources needed for the low-carbon transition, including in supporting innovation in technologies that could transform the sector itself, such as carbon capture use and storage (Herron and Hurst, 2020[20]). The COVID-19 crisis may present an opportunity to rethink the role of the fossil fuel industry in this transition.

Making the low-carbon transition goal part of the post-COVID-19 response

As both fossil fuel and low-carbon investments are under considerable stress, policies have a particular opportunity to tilt the balance towards more sustainable energy sources. In the acute phase of the pandemic, policy makers have focussed on addressing the health crisis and on providing emergency assistance to households and firms (OECD, 2020[21]). But as the health crisis abates, the question will be how to revive an ailing economy and to generate jobs, while avoiding locking in carbon-intensive infrastructure and capital assets that will undermine long-term climate objectives. The recovery from the crisis can be harnessed to speed up the low-carbon transition, taking into account lessons learnt from previous green recovery packages adopted following the Global Financial Crisis ((Agrawala, Dussaux and Monti, 2020[22])and Box 1).

Public policies play a crucial role to ensure that people's well-being is at the centre of a post COVID-19 recovery as well as the low-carbon transition (OECD, 2019[23]). Such an approach will also help boost political and social support for more ambitious mitigation action, and overcome the barriers to change.

Pre-recovery support to firms and industries can help the low-carbon transition

1. Avoid weakening of climate policies

Lifeline support to firms and industries should not be combined with the dismantling or watering down of environmental policies. Backtracking on environmental policies, such as weakening environmental rule enforcement, dismantling carbon markets or lowering vehicle fuel efficiency standards must be avoided (OECD, 2020[24]). Both in the United States and Europe, some industry lobbies have been pushing to weaken standards or to delay the introduction of planned climate policies. Signals from carbon pricing, emissions standards, and other environmental regulations need to be maintained to provide more certainty and long-term stability for low-carbon activities. This is particularly important as energy investments require long-term planning horizons. Moreover, from a political economy point of view, there is a risk that it may be difficult to undo relaxation of environmental standards, even if intended to be temporary. Past experience shows that policies such as fossil-fuel related tax exemptions and free allocations of carbon emissions permits are extremely difficult to phase out.

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Weakening climate policies increases uncertainty for firms, discouraging them from investment and job creation. Such effects are particularly pronounced for firms in policy-sensitive sectors such as electricity production (Baker, Bloom and Davis, 2016[25]). Uncertainty caused by undoing some climate policies could thereby reduce incentives for innovation and investment and harm employment in low-carbon sectors. As a side effect, it could also increase outdoor air pollution, responsible for over 4 million premature deaths per year globally[2] and a key policy priority for many countries. Preliminary research also suggests that exposure to high levels of air pollution – which is linked to respiratory infections – may be associated with a higher share of fatal COVID-19 cases (Wu et al., 2020[26]).

2. Consider making direct support to firms contingent on environmental improvements

Bailouts of ailing companies provide an opportunity for governments to steer investment toward low-carbon production modes and emissions reductions once they are afloat again, and support workers through re-training in low-carbon technologies. First, it is important that firms active in low-carbon technologies be eligible for and covered by policies that ensure access to low-cost financing and flexibility on deadlines, for example on project delivery affected by the pandemic. Such measures may be particularly crucial for smaller renewable energy developers, who may lack the liquidity to endure the delays caused by supply chain disruptions and closure of economic activity, especially if they lose tax benefits or beneficial tariffs because of those delays (Bahar, 2020[27]).

Second, insofar as many fossil-fuel intensive industries are under stress and may require government bailouts, making support contingent on environmental improvements may help to ensure that workers can transition into new technologies and that the transition occurs gradually. Efficiency improvement conditions can also help ensure the future viability of firms in a low-carbon world. For instance, in the United States, the bailout of the car industry following the Global Financial Crisis was used to enforce an agreement on fuel efficiency standards precisely because the automotive industry was losing its competitiveness relative to other companies producing more fuel-efficient cars (U.S. Dept. of the Treasury, 2009[28]; Tollefson, 2020[29]). More recently, calls for linking airline bailouts to emission reductions have been made to better align the industry's performance with the transition (Laville, 2020[30]). Bailouts can be used to require firms or industries to commit to emission reductions targets – in line with carbon neutrality by 2050. For affected industries such as air or maritime travel – which are largely exempt from environmental taxation – bailouts should be accompanied by stronger regulation. The carbon offsetting and reduction scheme for international aviation (CORSIA) can provide a useful starting point. Governments should resist lobbying efforts to delay or weaken such schemes (Topham and Harvey, 2020[31]).

The immediate priority remains to rescue as many viable businesses as possible and in practice this may not be easily compatible with the imposition of conditions such as energy efficiency improvements (Aldy, 2020[32]). An additional concern is the cost-effectiveness of such targeted emission-reduction measures. What is crucial, however, is that the design of support packages be time-limited, targeted, and consistent with longer-term objectives for ensuring a sustainable recovery, while taking distributional impacts into account (OECD, 2020[33]). Furthermore, credible commitments to attaching such strings already before the recovery starts, may be feasible. This would help setting incentives and expectations of investors. Efforts by companies that are already committing to maintaining their emission reduction targets would be taken into account when designing bail-outs – even though pledges may not be sufficient to achieve decarbonisation by mid-century (Hurst and Herron, 2020[34]).

Green stimulus packages to support the longer-term recovery

There has been much talk about how to design economic stimulus, while making progress on the climate agenda (Birol, 2020[35]; Mountford, 2020[36]). The objective of recovery packages will be primarily to reignite

[2] https://www.who.int/health-topics/air-pollution

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growth and rapidly generate jobs, while climate support is also an urgent policy priority with a longer-term horizon; the two are not inconsistent. The majority of EU member countries already advocate that the European Green Deal becomes a central part of the recovery after the COVID-19 pandemic. Sweden has committed to financially support 'green job' creation as an important measure to reduce unemployment within a green stimulus package (Swedish Ministry of Enterprise and Innovation, 2020[37])i

Box 1. Lessons learnt from past green stimulus packages

The OECD has been conducting a review of previous green recovery packages as part of its work on the COVID-19 crisis. The main findings from this analysis are:

- **Investment support without long-term carbon price signals is not sufficient to achieve continued investment in low-carbon technologies.** The removal of fossil fuel subsidies as well as carbon pricing can help align price signals with green stimulus packages.
- **Feed-in tariffs and production tax credits have been relatively successful at supporting the development, diffusion, and adoption of renewable energy.** The post-2008 policy measures, together with declining prices, contributed to the increased share of renewable energy use.
- **Investment in energy efficient building and retrofitting can contribute to successfully maintaining jobs and economic activity in the construction sector while contributing to reducing emissions.**
- **Governments need to take risks by providing financing to businesses working on emerging technologies further from the market, while minimising the risk of fraud.**
- **The design of policies needs to carefully take into consideration countries' domestic settings (level of development, talents, skills, firms and infrastructure).** Previous industrial policies adopted as part of green recovery packages did not pay enough attention to the supply side compared to the demand side.
- **Distributional impacts of green stimulus policies need to be carefully considered.** Managing distributional outcomes is important to ensure a people-centred policy response and to achieve public buy-in for policies.
- **Governments should build ex ante and ex post evaluations into green stimulus packages** to improve the evaluation and monitoring of programmes.

Source: (Agrawala, Dussaux and Monti, 2020[22]; Mundaca and Richter, 2015[38]; Strand and Toman, 2010[39]; Popp et al., 2020[40])

The current crisis is not the first time green stimulus packages have been put in place. Already, following the 2008 Global Financial Crisis, policy makers designed green recovery packages that helped to expand the role of renewable energy – in particular through feed-in tariffs and production tax credits (see Box 1). In this respect, the current crisis offers better conditions for such green stimulus packages, as since then, the costs of renewable and other green technologies have seen steep declines. For example, solar PV prices fell 90% between 2009 and 2018 (IRENA, 2019[41]) and battery prices by 85% between 2010 and 2018 (Bloomberg New Energy Finance, 2019[42]). While feed-in tariffs contributed to investments in renewable energy and thereby helped to lower prices, they may also have over-compensated some projects, as the cost of renewables declined and subsidies remained fixed. Future policies should consider alternative instruments such as renewable energy auctions, which may offer better targeted policy support and avoid such overcompensation (IRENA, 2019[43]).

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Even though this crisis is different from the 2008 Global Financial Crisis, we may be able to learn lessons from the previous green recovery packages (Mundaca and Richter, 2015[38]; Strand and Toman, 2010[39]; Agrawala, Dussaux and Monti, 2020[22]; Popp et al., 2020[40]). Emerging evidence suggests that green stimulus packages can then be particularly useful at reshaping the economy and at delivering growth over the long-term, but not necessarily at generating jobs in the short run (Popp et al., 2020[40]). Hence, green stimulus packages need to be combined with other standard short-term policy measures to revive the economy.

Once the most acute phase of the pandemic is overcome, the focus of governments will shift to designing recovery packages to kick-start economic growth, while improving its resilience and minimising the risks and consequences of a resurgence in infections. Governments should already prepare for the recovery phase and develop a pipeline of projects that can be implemented as soon as the pandemic is under control (OECD, 2018[44]). Such projects should be evaluated upfront (based on cost-benefit analyses) – as well as ex-post – in terms of the expected job gains and their emissions intensities, improving the understanding of economic and environmental impacts of green policy packages. Developing clear metrics to evaluate such projects in terms of their expected job potential and emissions intensity would help channel financial resources more effectively towards a low-carbon transition. The French *Jaune Budgétaire* (Républice Française, 2020[45]) provides for example a set of metrics to measure the 'green' component of projects. Other countries have developed alternative metrics including those for 'green jobs' in the United States and Europe. The alignment of public policies with climate objectives can be achieved through measures in three areas.

1. Investing in low-carbon infrastructure

For most countries, one of the many legacies of the COVID-19 crisis will be high public debt. Yet, the claims on public support are likely to be numerous well into the recovery phase, emphasising the need to spend money in ways that are most effective in reigniting growth, generating jobs and meeting emission reduction pledges. Public infrastructure spending should be based on a cost-benefit analysis and focus on cost-effective projects that have a strong public-good component and that are financially viable over the longer term.[3]

There are many investment opportunities that could support a low-carbon transition such as investments in power system flexibility (e.g. energy storage, smart grids, long-distance and cross-border power transmissions), public transport infrastructure, charging stations for electric or hybrid vehicles, energy efficient retrofitting of buildings, carbon capture facilities, and renewable energy deployment. Their need and efficiency in achieving targets needs to be assessed, taking into account the country's circumstances and low-carbon transition pathways as well as their distributional implications.

More generally, governments should select "shovel-ready" projects to be implemented swiftly as part of recovery packages. Such projects should be prioritised according to the needs and their expected costs and benefits, in particular the potential for job creation but with attention to the contribution to durably reducing emissions. Private financing of projects, including in low-carbon technologies or infrastructure, can be further leveraged through preferential loans, risk-sharing schemes, or increased climate-related disclosure obligations for firms and investment projects.

[3] This note focuses on climate mitigation, but the COVID-19 crisis is also a reminder about the need to strengthen the resilience of societies against future crises, including those attributable to climate change. This includes improvements in public health systems since it is likely that diseases, such as malaria, proliferate with warming climates (IPCC, 2018[3]). Recovery packages may be a near-term opportunity to support such investments, but need to be complemented with long-term policy that provides incentives for building in resilience in infrastructure investments and strengthen business continuity plans. For an analysis of how public policies can strengthen health and resilience in the context of the COVID-19 crisis, see OECD, 2020.

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Retrofitting of buildings

Retrofitting of buildings to make them more energy-efficient addresses simultaneously the necessity to provide much-needed jobs, for example to workers from the construction sector and to progress towards climate change policy targets. Re-training of workers, for example from the construction sector, could help shifting workers from affected industries and reduce unemployment (Motherway and Oppermann, 2020[46]; IEA, 2020[47]). Already before the COVID-19 crisis, OECD Economic Surveys recommended that some countries (e.g. Estonia, Ireland, Israel, or the Netherlands) should provide targeted subsidies for improving the energy efficiency of housing in combination with improved energy efficiency standards and certification. Such policies could now be even more timely and effective. Uncertainties on the overall costs and benefits of retrofitting programmes continue to exist because of high up-front costs of insulation measures, and uncertainty about the true emission reductions due to rebound effects (Fowlie, Greenstone and Wolfram, 2018[48]), Yet the experience with post-2008 stimulus packages has shown that investment in energy efficient buildings and retrofitting can successfully contribute to keeping existing and generating new jobs. For example, it is estimated that the US weatherisation programme – a retrofitting policy – generated at least 25 000 jobs in the initial year and that a total 200 000 jobs were created as a result of the overall programme (IEA, 2020[47]). Similar programmes were also implemented for instance in Germany and Korea, and can be particularly attractive to cushion a collapse in the construction sector.

Renewable energy infrastructure

Depending on the shape and speed of the recovery, capital-intensive energy infrastructure investment – even low-carbon – may not be an immediate spending priority due to excess capacity. The IEA estimates that 2020 global energy demand will be some 6% lower than the previous year – an unprecedented fall, seven times larger than during the Global Financial Crisis (IEA, 2020[6]). The decline is particularly acute in OECD countries and a second wave of lockdowns or deeper economic crisis could push energy demand down even further. Nevertheless, needed replacement of depleted energy production capital should be done in line with climate objectives. In the United States, about 1% of total electricity generating capacity is retired annually and 2-4% added, providing opportunities for a gradual shift towards low-carbon energy sources (EIA, 2020[49]). Moreover, expanding transmission lines and reducing regulatory constraints to deliver renewable energy from often sparsely populated regions that generate renewable energy to regions where the demand for electricity is much higher, can accelerate the transition towards a low-carbon energy infrastructure (Fell, Kaffine and Novan, 2019[50]) In the United States, about 3.3 million people work in the renewable energy sector – about three times as many as in the fossil fuel energy sector. Renewable energy sectors have also seen stronger growth compared to other sectors in the economy (E2, 2019[51]). The 2009 American Recovery and Reinvestment Act provided USD 90 billion to promote clean energy and paved the way for its increasing diffusion and adoption (Aldy, 2019[52]). Already before the crisis, the OECD Economic Surveys have recommended to many member countries (e.g. Belgium, Canada, Chile, Mexico, the Netherlands) to encourage investment in renewable energy and to assess and streamline their support measures. Such measures could become part of a green recovery package to increase the share of renewable energy sources.

Communication networks

The confinement and the need for physical distancing have highlighted the critical importance of digital technologies to continue many business operations as well as social interactions. As our communication networks cope with up to a 60% increase in traffic due to mass tele-working and an increase in tele-conferencing, investment should be steered towards upgrading communication networks, such as universal broadband internet and enabling technologies including Artificial Intelligence (OECD, 2020[53]). To achieve persistent behavioural changes so that the decline of emissions becomes permanent, targeted investments in communication networks can be part of a green recovery package, provided measures are taken also to reduce the environmental footprint of digital technologies. Such measures may also need to

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be accompanied by new regulation that facilitates and encourages behavioural changes over the longer term, which may include flexible working arrangements or a right to work from home when feasible as debated in Germany (Reuters, 2020[54]).

More permanent tele-working arrangements will only be feasible if high-speed internet access is widely available. On average across OECD countries, the share of high-speed fibre internet in total broadband is less than 30%, although large differences exist, with Korea and Japan having around 80% and Italy, Austria, Germany or Greece less than 10% (OECD, 2020[55]). Investing in high-speed internet infrastructure can generate jobs and support economic development – particularly in rural areas which have often been left behind in access to digital technologies. It may consolidate behavioural changes that can induce permanent emission reductions from transportation. Widely-available access to high-speed internet also reduces distributional disparities between regions and income groups and allows rural economies to benefit from emerging technologies and improves their competiveness. An upgraded communications infrastructure may also increase the resilience to future crises. Pre-crisis OECD Economic Surveys and Reviews of Telecommunication Policies recommended investments in communication and broadband infrastructure for several member countries (e.g. the United States, Poland, Mexico, France, Italy, Colombia and Germany), which may now be particularly timely to implement.

Public transport

The COVID-19 pandemic requires careful rethinking of public transport policies and lessons learnt from previous crises may not be directly transferable. Over the past months, public transportation providers have seen steep declines in demand due to the economic shut-down and physical distancing measures. While in the acute phase of the pandemic, public transport may be less frequently used, it will likely continue to play an important role in reducing transport-related emissions, even if teleworking reduces the demand for commuting compared to before the crisis. For instance in Germany the share of people working from home has more than doubled since the crisis – from 12% to 25% – but the vast majority of workers is not able to easily work remotely (AFP, 2020[56]). It is therefore important that governments prevent the potential lockdown-induced bankruptcy of public transport providers due to the current drop in demand (and rather take this opportunity to invest into more hygienic and less polluting forms of public transport). Past recovery packages have shown that investments in public transport infrastructure tends to be an effective green stimulus measure, generating jobs and reducing emissions (Agrawala, Dussaux and Monti, 2020[22]).

Better access to public transport infrastructure facilitates a transition from individual passenger car transport to mass transportation, reducing GHGs, local pollutants, as well as congestion. Investment in public transport also tends to benefit poorer households who may not have access to individual transportation – also during the pandemic. Since investment in public transport infrastructure tends to have long time lags from announcement to implementation, governments should not abolish such investments. The COVID-19 crisis may spark a rethinking of public transport organisation or incentives to spread out working times to respond to the challenge of ensuring passenger loads that allow sufficient physical distancing while maintaining the low-emission potential of public transport. In the same vein, policy support to micro-mobility – both in terms of infrastructure and financial incentives to encourage use – can help provide a flexible, accessible and low-carbon transport alternative.

2. Maintaining government support for innovation and start-ups

Another activity where public support is generally justified is research and development as there is much need for technological progress to bring us closer to a low-carbon world. Public support for private R&D can take the form of grants, tax credits or innovation prizes, but can also be delivered through demand-side policies such as public procurement (OECD, 2011[57]). While not necessarily destined as recovery stimulus per se, public R&D efforts should continue to support the development of technologies further

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from the market. These can include, for example, hydrogen, energy storage or carbon capture and storage. However, especially in times when resources are scarce, it is important to note that any increase in funding needs to be gradual, because the supply of researchers is fixed in the short run and expanding research in clean technologies involves training new scientists to avoid crowding out other socially valuable R&D. Already before the COVID-19 crisis, the OECD recommended to countries (e.g. Japan and Korea) to strengthen links in R&D between private and public actors – universities and governments – and to promote innovation in green technologies. Such policies may be particularly fruitful as a longer term recovery strategy to the COVID-19 crisis.

Importantly, many of the bailout, liquidity-provision, job- and wage-support policies that are being implemented in response to the economic meltdown, tend to focus on saving existing firms. As the recovery sets in, rolling back measures that disproportionately benefit incumbent firms will be needed to re-level the playing field and facilitate the entry and growth of innovative start-ups. They will be crucial for the development of low-carbon innovations.

3. Carbon pricing can help preserve incentives while protecting vulnerable communities

One lesson learnt from the green recovery packages adopted during the Global Financial Crisis was that investment support alone is not enough to make the business case for investing in low-carbon assets. Such packages often lacked the important longer-term signals provided by carbon prices. In the EU, ETS permit prices remained low for many years after the crisis, while in the United States, attempts to introduce a federal carbon price were abandoned. Latest OECD data shows that 76.5% of emissions are priced below EUR 30/tCO_2, a conservative estimate for the social cost of carbon[4] (OECD, 2018[58]).

As a result, investment support during the Global Financial Crisis did not benefit from a clear commitment to long-term carbon pricing trajectories that can render low-carbon investments more viable. For example, the American Recovery and Reinvestment Act of 2009 provided USD 2 billion to develop carbon capture and storage (CCS) technologies for coal-fired power plants. Similarly, in 2009 the European Energy Programme for Recovery (EEPR) dedicated EUR 1 billion to co-finance CCS projects. All such CCS projects were later abandoned as low carbon prices rendered it difficult to attract private financing.

Considering that pressures on public finances are likely to increase and persist for years to come, governments may need to consider options for restoring tax revenues after the crisis (OECD, 2020[59]). Among these options, introducing or strengthening the taxation of carbon emissions could in principle help to increase revenues while raising the incentives for a low-carbon transition. However, the revenue prospects need to be weighed against the fact that the distributional impacts of carbon taxes are likely to require compensatory measures, and in the longer-term, as carbon taxation actually helps drive the transition, the revenue base will shrink, reducing the scope for revenues. Even so, early commitment to the increasing use of carbon taxes in the recovery phase can provide forward guidance to investors and reduce uncertainty – without immediately burdening businesses with new taxes (Van Dender and Teusch, 2020[60]).

For many years, the OECD has recommended the use of carbon pricing policies with clear price trajectories – based on the social cost of carbon – that allow forward planning for businesses and households. The Swedish carbon pricing policy provides a good-practice example, where carbon prices were implemented nearly 30 years ago and have risen gradually from about EUR 23 per ton to EUR 110 per ton of carbon emissions. The policy has achieved significant emission reductions, while maintaining economic growth

[4] The social cost of carbon (SSC) measures the costs to society from burning one ton of carbon. Estimates for the SSC can vary from about USD 30 to about USD 300 per metric ton. Recent evidence suggests that many experts converge on values between USD 80-100 (Pindyck, 2019[81])

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(Government Offices of Sweden, 2020[61]; Andersson, 2019[62]).[5] Alongside carbon pricing, increased disclosure of carbon emissions and better climate-related taxonomies can help making such pricing mechanisms more effective and better align private investments – including in innovation – with climate goals.

At the same time, phasing out fossil fuel subsidies and tax expenditures can generate much needed funding and can leverage wider efforts to broaden a country's tax base while strengthening the alignment of public finances with emission-reduction targets. The latest combined OECD and IEA estimates indicate that governments provided USD 478 billion in fossil fuel support in 2019, more than double that of support given to renewable energy(OECD, 2020[63]; IEA, 2019[64]). Support for fossil fuels has proven to be inefficient in delivering affordable and accessible energy since it is often poorly targeted and therefore can be replaced with better designed policies (OECD/IEA, 2019[65]).

Careful policy design centred on well-being is essential as a lack of public buy-in can stand in the way of carrying out such reforms. The political economy and public acceptability of carbon pricing needs to play an important role in the design of such policies (Carattini, Carvalho and Fankhauser, 2018[66]). Carbon taxes and the phasing out of fossil fuel subsidies carry the risk of disproportionally affecting lower-income households and small businesses, which would magnify the negative impact of the crisis on vulnerable populations. Compensation measures and other complementary policies can be used to offset the distributional impacts of higher taxes or the removal of subsidies (Douenne and Fabre, 2020[67]). Lessons learnt from the successful introduction of the British Columbia carbon tax, where the higher carbon tax is combined with labour and business income tax reductions, could be applied to other countries (Harrison, 2013[68]). Providing lump-sum payments to households and to the most affected firms, as well as boosting investments in green infrastructure can increase public acceptance for such policies (Yamazaki, 2017[69]; Murray and Rivers, 2015[70]; Douenne and Fabre, 2020[67]). More generally, choices and communication regarding revenue use and accounting for local circumstances determine the public acceptability of carbon pricing. Finally, it is important to consider that carbon taxes can often be less regressive than other commonly used climate-related policies such as fuel-efficiency standards (Levinson, 2019[71]; Davis and Knittel, 2019[72]).

[5] In this vein, in June 2020, the Danish government has committed to develop a proposal for a green tax reform by fall 2020, with a uniform tax on GHG emissions across all sectors. Key considerations are revenue neutrality, leakage minimisation and the preservation of an employment and social balance.

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Policy recommendations for a low-carbon recovery

- **Avoid weakening of environmental policies** to reduce policy uncertainty for businesses, to achieve co-benefits and to reduce political economy barriers.
- **Help firms manage liquidity problems across sectors,** including renewable energy and other low-carbon technology sectors.
- **Consider making direct support to firms contingent on environmental improvements** to provide an opportunity for governments to actively manage and soften the transition from fossil fuels to low-carbon technologies. If attaching strings to companies in the pre-recovery phase may be difficult, credibly committing to doing so in the recovery phase may help setting incentives and adjust investors' expectations. It also contributes to ensuring the long-term viability and competitiveness of firms in a low-carbon economy.
- **Make use of opportunities to support behavioural changes that may help a low-carbon transition**, for example through facilitating teleworking and rolling out high-speed broadband.
- **Prepare in advance a pipeline of low-carbon projects for the recovery phase.** Projects need to be evaluated upfront in terms of expected job gains and emissions intensities, both short-term and longer-term. Improving the understanding of economic and environmental impacts of green policy packages using quantifiable metrics will help designing more effective policies.
- **Invest in low-carbon infrastructure and avoid locking-in emission intensive technologies,** to combine job creation with durable emission reductions. Recovery packages will need to support job creation and resilience in the presence of scarce government funds, while being in line with the emission reduction targets of the Paris Agreement. Government support to energy efficiency retrofitting of buildings can for example help absorb job losses from the construction sector, while facilitating a low carbon transition. Investment in energy capacity or capital intensive projects may not be the immediate priority, but needed replacements of depleted energy capital should be done in line with climate objectives.
- **Maintain government support for innovation** to continue the development of low-carbon technologies. In addition to basic research, this includes support for deployment and commercial demonstration to help achieving market scale through risk-sharing between public and private sectors.
- **Ensure incentives for low-carbon consumption, investment and innovation during the recovery through the removal of fossil fuel subsidies and commitment to carbon pricing.** Investment support without price signals is not sufficient to achieve continued investment in low-carbon technologies, while a credible commitment to future carbon prices can provide incentives without immediately imposing the burden on recovering firms. Phasing out fossil fuel subsidies and tax expenditures can also generate much needed funding to reduce pressures on public finances in the recovery phase. Other policy measures including regulations and standards will need to complement carbon pricing in driving the transition.
- **Ensure adequate compensatory spending to avoid unfair burden sharing and other complementary measures to enhance the political acceptability of carbon pricing.**

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