

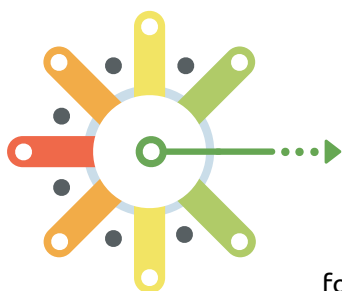
A government roadmap for addressing the climate and post COVID-19 economic crises

Climate Action Tracker

UPDATE

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Summary and conclusions



The COVID-19 pandemic presents the world with an unprecedented policy challenge for effective economic stimulus in uncharted territory: not only will it have a severe impact on the global economy likely to exceed that of both the 2008-09 Global Financial Crisis (GFC) and the Great Depression, it will take place against the backdrop of the ongoing climate crisis.

In acknowledging the magnitude of this unprecedented challenge, the priority for governments must first be the immediate emergency response focussing on saving lives, supporting health infrastructure, food availability, and the many other urgent social and economic support measures such as short-term job allowances, direct cash handouts to citizens, or targeted liquidity support to SMEs.

The COVID-19 pandemic and the climate crisis are closely interlinked, in that the pandemic seriously affects economies and therefore greenhouse gas emissions, making future developments and the resulting emissions gap very uncertain. The question of how the economic recovery is designed remains crucial in shaping the long-term pathways for emissions and determining whether the Paris Agreement's 1.5°C temperature limit can be achieved.

COVID19 could well exacerbate climate change impacts as governments divert some of the resources tagged for climate change to address the pandemic. In the worst-case scenario, economic stimulus will be obtained at the expense of already-achieved climate policies.

Global emissions, GDP and the COVID-19 pandemic

The economic damage caused by the COVID-19 pandemic will undoubtedly cause global CO₂ emissions from fossil fuels and industry to fall in 2020 by at least 4–11% and possibly also in 2021 by 1% above to 9% below 2019 levels.

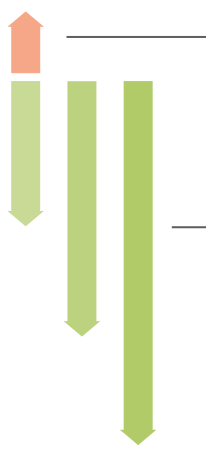
However, this is nothing to celebrate, and as our study shows, if low carbon development strategies and policies are not rolled out in the economic stimulus packages responding to the COVID-19 pandemic recovery, emissions could rebound and even overshoot previously projected levels by 2030, despite lower economic growth.

Taking into account the short term (2020-2023) economic projections of the IMF and other international organisations the Climate Action Tracker developed two broad economic recovery pathways.

- ▶ One we have termed "optimistic recovery" where, after a downturn for a few years, economic growth rates return to those that were foreseen prior to the COVID-19 pandemic and reach previously projected levels of economic activity for 2030 several years later.
- ▶ The second "pessimistic recovery" pathway is where global economic growth rates take longer to recover and do not fully return to those anticipated even at the beginning of 2020, leading to a substantial delay in reaching levels of economic activity originally projected for 2030.
- ▶ We then combined these two economic recovery pathways with five scenarios of responses to the COVID-19 pandemic: fossil fuel rebound, post-COVID-19 current policies, weak green stimulus, moderate green stimulus and strong green stimulus.

The **post-COVID-19 current policy scenario** shows the economic consequences of COVID-19 will do little to bend the emissions curve downwards: they mainly delay the increase. If current trends for low carbon energy sector investments were maintained and the optimistic recovery scenario applied, global emissions would fall between the range of pre-COVID-19 estimates projected by the CAT for current policies.

Under our **pessimistic recovery scenario**, with present investment patterns maintained, emissions would flatline from present levels and lie close to the range the CAT estimated in December 2019 (pre-COVID) for Paris Agreement NDCs.



- The **fossil fuel rebound scenario** shows that if there is a slowdown in low carbon investment and move back towards fossil fuel technologies and infrastructure at a significant scale, even our most pessimistic recovery scenario, with its lower economic growth, will result in emissions significantly higher than Pre-COVID19 current policy estimates for 2030.
- The **three green economic stimulus packages** focus on low-carbon energy system development and infrastructure and would have a fundamental effect on reducing emissions by 2030. Our analysis shows that the level of emissions reduction is related very strongly to the scale of the green economic stimulus. By “green economic stimulus” we essentially mean rapidly switching investments away from carbon intensive systems towards low and zero carbon green systems - and this does not entail an overall massive increase in investment compared to what would otherwise be needed.

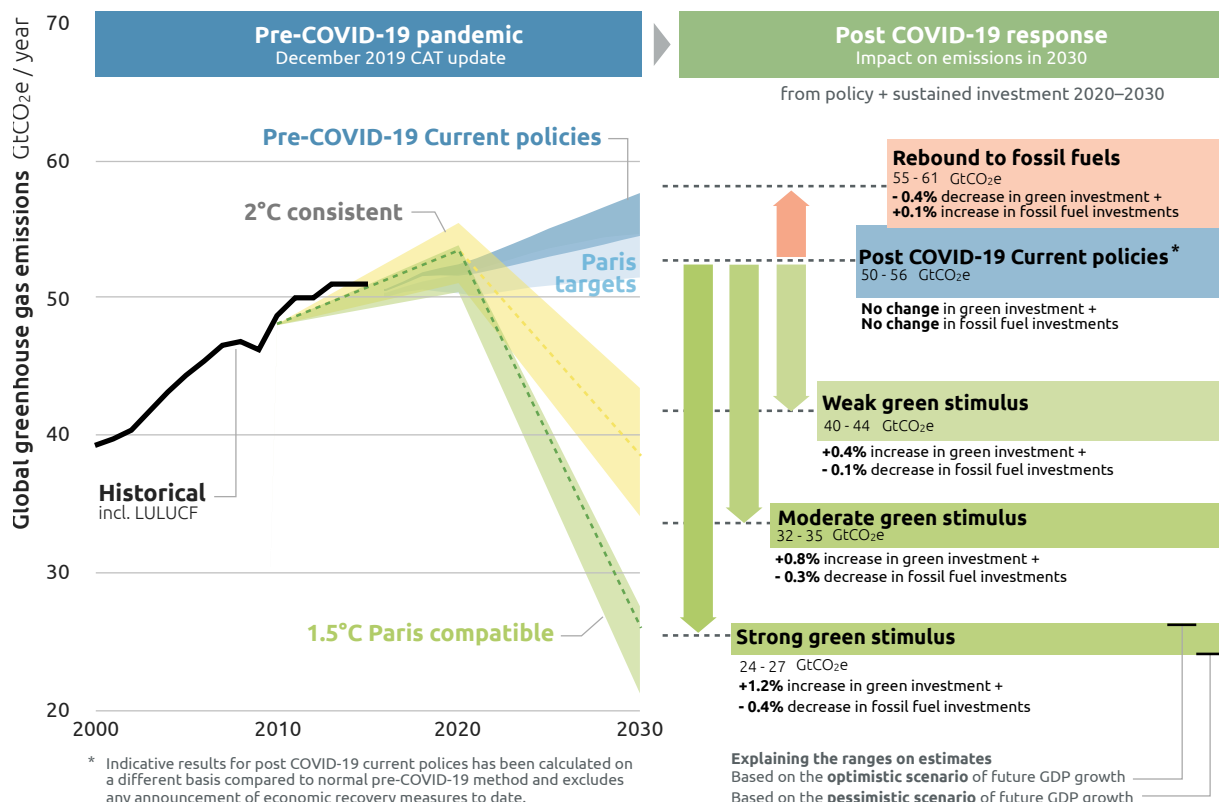
From our COVID-19 recovery scenarios, we find that strategies that invest in green energy infrastructure - including energy efficiency and low and zero carbon energy supply technologies - have by far the strongest effect on reducing emissions.

A critical message for policymakers is that the rate and speed of the economic recovery from COVID-19 is secondary to the speed and degree to which investments are switched towards low and zero carbon energy, infrastructure, transport and other systems.

The future emissions intensity of the economy is very strongly path-dependent, meaning that greener investments now and in the next few years will avoid locking in high emissions in 2030, carbon intensive energy sources, and the future potential stranding of these high-carbon assets.

Green stimulus to fight the COVID-19 economic crisis and the climate crisis

Strong climate policies plus sustained investment can provide valuable jobs, revitalise economies and get the world on track to meeting the 1.5°C Paris Agreement goal



A green stimulus framework for policymakers in response to COVID-19



















As governments grapple with the critical task of dealing with the very real impacts of COVID-19 on the health and welfare of their populations, they are now also developing their economic stimulus packages to assist in economic recovery.

We have outlined a green stimulus framework that contains key criteria that policymakers must consider for any green stimulus interventions in order to successfully address short-term needs with long term benefits.

COVID-19 recovery presents both opportunities and threats to enhancing our resilience to climate change. The likely promotion of employment-generating building and infrastructure projects as a key pillar of COVID-19 recovery planning provides a chance to rethink our critical infrastructure, raise standards and develop innovation solutions.

THE DO'S AND DON'TS OF GREEN ECONOMIC RECOVERY

Green stimulus interventions and harmful actions to avoid

 Energy and electricity supply	 <ul style="list-style-type: none"> ▶ Direct support for zero-emissions technologies and infrastructure ▶ Fiscal reform on fossil fuel subsidies
	 <ul style="list-style-type: none"> ▶ Revive plans for 'shovel-ready' fossil fuel power plants ▶ Waive oil and gas industry environmental regulations ▶ Bail out fossil fuel companies without conditions for zero-emission transition
 Land-based transport and mobility	 <ul style="list-style-type: none"> ▶ Financial incentives for zero-emission vehicles ▶ Direct investments in low-carbon public transport
	 <ul style="list-style-type: none"> ▶ Roll back emission standards for cars ▶ Support to automobile companies without conditions for zero-emissions transition
 Aviation	 <ul style="list-style-type: none"> ▶ Conditional sector support for aviation industry (e.g. bailout) and accelerated R&D efforts
	 <ul style="list-style-type: none"> ▶ Roll back regulations and taxes (e.g. ticket taxes) ▶ Recalibrate CORSIA baseline without substantially improving entire scheme
 Industry	 <ul style="list-style-type: none"> ▶ Support uptake of efficient appliances, lighting, and digital devices ▶ Low-carbon technology R&D and pilot projects (e.g. steel and cement)
	 <ul style="list-style-type: none"> ▶ Roll back climate measures and regulation (e.g. industry levy for supporting renewable energy) ▶ Support for industry without conditions for zero-emission transition
 Buildings	 <ul style="list-style-type: none"> ▶ Support for energy efficient retrofits of existing buildings ▶ Support for accelerated construction of low and zero-energy buildings
	 <ul style="list-style-type: none"> ▶ Stimulus programmes for new buildings without energy efficiency criteria
 Land-use & environmental protection	 <ul style="list-style-type: none"> ▶ Large-scale landscape restoration and reforestation efforts
	 <ul style="list-style-type: none"> ▶ Roll back environmental regulations ▶ Dismantling enforcement of state protection for natural habitats

While the full implications of COVID-19 are still playing out, early studies show that an internationally coordinated strategy and approach is necessary, without which it will be devastating for many economies, and it could end up trapping especially the more vulnerable developing countries in poverty for decades. For example, Small Island Developing States are still recovering from cyclones, and some have experienced them during the pandemic. The double-whammy of climate impacts and COVID-19 will make these countries even more vulnerable, not least because the pandemic could affect critical funding needed for adaptation and building resilience.






The temptation to prioritise 'shovel ready' projects may favour business-as-usual, carbon-intensive approaches. It may also lead to a relaxation of planning regulations and building standards, leading to the wrong type of developments in the wrong places.

There are myriad benefits from a "green" stimulus that will help deliver employment, climate change mitigation and other benefits including reduced air pollution, job creation, energy security, enhanced access to energy. These and economic benefits are all opportunities that governments can seize in emerging into a post-COVID-19 world.

However, this requires bold action and thinking. The question is whether policymakers will take advantage of these opportunities. There are examples below - with more in the main report - of positive, green initiatives that are already going forward.

Preliminary proposals of green stimulus interventions under discussion





There are few initial proposals of "positive" green stimulus packages being drawn up by governments, some of those below are from the 2008-09 GFC economic recovery.

-  The Austrian government announced on 17 April 2020 that any state aid to support Austrian Airlines should be tied to specific climate conditions (Morgan, 2020), with options including a pledge to reduce short-haul flights, increased cooperation with rail companies, heavier use of eco-friendly fuels and bigger tax contributions.
-  Many European policymakers have called for using the EU Green New Deal as a blueprint for economic recovery packages of EU Member States, for example by accelerating the implementation of the strategy's 'renovation wave' to increase energy efficiency of existing buildings (Mariani, 2020).
-  The African Union and the International Renewable Energy Agency (IRENA) agreed to work closely to advance renewable energy across the continent to bolster Africa's response to COVID-19 (IRENA, 2020).
-  Germany substantially expanded its programme to promote energy efficient retrofits through fiscal measures and concessional loans between 2008-2010 as part of its economic recovery package.
-  The American Recovery Act of 2009 promoted the improvement of residential energy efficiency of over 800,000 homes between 2009-2012 with federal support, green stimulus interventions that triggered energy savings and created over 200,000 jobs.



Actions to avoid

Meanwhile, fossil fuel-based industries are intensively lobbying for their future, pressuring governments to adopt policies and interventions that favour them but not the climate, and they are finding such favour in some quarters. We have listed these as “do no harm” examples of what governments should reject as they move forward.

-  The US Senate is discussing a USD\$2 trillion rescue package for automakers and a massive bailout to its oil and gas industry (Shepardson, 2020). In the US, the Environmental Protection Agency has moved to cancel the Obama-era fuel efficiency standards for new cars and dropped a raft of anti-pollution regulations to favour industry.
-  In Australia Federal and State governments are pushing for the expansion of coal mines and LNG export facilities, without any acknowledgement that the world needs to move away from coal and gas (Farand, 2020b).
-  China approved in March 2020 five new coal-fired power plants with a total capacity of around 8 GW, more than the total for 2019 (Farand, 2020b).
-  The South Korean government is planning a USD 825 million bailout of Doosan Heavy Industries & Construction Co. without any condition to promote renewables (Farand, 2020b; Gokkon, 2020).

Reduced economic growth, even in the longer-term arising from economic damage caused by the COVID-19 will not fundamentally change emissions in the direction needed to meet the Paris Agreement goals. Unless Governments take affirmative and positive action to ensure that the stimulus and response measures they put in place focus on low-and zero carbon development, there is a risk of a winding back of policies and hence emissions being even higher in 2030 than would otherwise have been the case.

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Introduction

The impact of the COVID-19 pandemic on the global economy will be severe, and is likely to exceed both the 2008-09 GFC and the Great Depression in the 1930s (Gopinath, 2020). In the USA, 6.6 million jobs were lost in a week in early April (U.S. Department of Labor, 2020). The World Bank estimates that COVID-19 will result in nearly 24 million people remaining trapped in poverty across East Asian and Pacific regions in 2020 alone (World Bank, 2020c). Like climate change, COVID-19 will disproportionately affect those without the capacity to cope with its impacts - e.g. St Lucia lost 13,000 jobs in one day: approximately 16% of its total labour force (Gumbs et al., 2020).

Governments around the world are responding to COVID-19 with monetary and fiscal measures aimed at lessening the impact on the impoverished, workers, businesses, supporting the health care system and ensuring financial markets continue to function (IMF, 2020a). How these stimulus and economic recovery packages are designed will have a lasting impact on the make-up and structure of economies in the medium to long term.

During and in the immediate aftermath of the crisis, greenhouse gas emissions are expected to fall as a result of the restrictions put in place to flatten the COVID-19 curve and get the pandemic under control. However, the emissions slowdown will not be sustained, unless governments implement recovery packages that also enable a transition to low carbon economies and societies.

While the full implications of COVID-19 are not yet known, preliminary studies show that an internationally coordinated strategy and approach is necessary, without which it will be devastating for many economies, particularly developing countries that could end up trapped in poverty for a long time (World Bank, 2020a).

It is also expected that COVID-19 will exacerbate climate change impacts as governments divert some of the resources tagged for climate change to address the pandemic. Given all of the above, it is important that decisions taken to revive economic activity also address climate change (Thomas, 2020).

In December 2019, prior to the COVID-19 crisis, the Climate Action Tracker projected (Climate Action Tracker, 2019) global temperature increase would reach 3.0 °C above pre-industrial by the end of the century with current policies and 2.8°C if countries met their pledges and targets. The projected temperature increases show that governments have made limited progress in recent years. Economic recovery and stimulus packages for COVID-19 present an opportunity for governments to ramp up climate ambition and action.

Global impacts of the COVID-19 pandemic on economics and emission projections

In this chapter, we analyse the short and medium-term implication of the COVID-19 pandemic and where global emissions could be in 2030. Our analysis establishes a link between the choices made by governments in stimulating economic recovery from the pandemic and global emission levels in 2030.

Plausible economic outcomes of the COVID-19 pandemic

Economists agree that the economic impact of the COVID-19 pandemic will be severe in 2020 and likely for 2021, with variations in order of magnitude and duration. The long-term impacts of COVID-19 on economic growth over the next decade, however, are less clear.

We have developed a range of global scenarios for 2030 GDP growth based on a suite of shorter-term economic projections, and combined with estimates of growth returning to pre-pandemic levels. Whilst these and other studies have also looked at the national level, specific economic activities, sectors or on trade, this study has focused at the global scale. There is a high degree of uncertainty in these estimates, due to uncertainty in how the pandemic itself will play out and given the economic consequences of measures to mitigate its effect are still unknown.

Uncertainties range from the speed of vaccine development and whether there are subsequent waves of COVID-19 infections to how deep the initial economic shock of the lockdown will be or how effective fiscal stimulus and other policy measures will be to lessen that impact and speed up the pace of recovery.

To account for these uncertainties, we show the range from recent economic projections which reflect variations in the underlying assumptions on the extent of short-term impacts (IMF, 2020b; McKinsey & Company, 2020). Table A 1 in the Technical Annex provides an overview of the economic impacts for the different short-term scenarios relative to the GDP (global) of 2019.

The most optimistic scenario is the IMF baseline, in which the virus is contained in 2020 without a second outbreak - resulting in a return to pre-pandemic GDP levels over the 2020-2021 timeframe. The most pessimistic near-term scenario we consider is the McKinsey A1 scenario in which there is a strong downturn and muted recovery and GDP achieves pre-pandemic levels only in Q3 of 2022.

There are currently no 2030 projections for the recovery and potential adverse long-term impacts of the COVID-19 pandemic on GDP growth trends from the IMF, WTO, OECD, World Bank or other sources. We therefore extend the available short-term projections to develop plausible "optimistic" and "pessimistic" global GDP recovery scenarios up to 2030. These estimates should not be interpreted as predictions of the future, but rather are meant to illustrate possible bounding cases.

The "optimistic" long-term recovery scenario assumes a return to the growth trends of the pre-crisis long-term forecast previously produced by the OECD (OECD, 2020). To produce a "pessimistic" recovery scenario, we make a stylised assumption that a slower long-term recovery would result in about 10% less growth than the prior OECD long-term forecast (OECD, 2020).

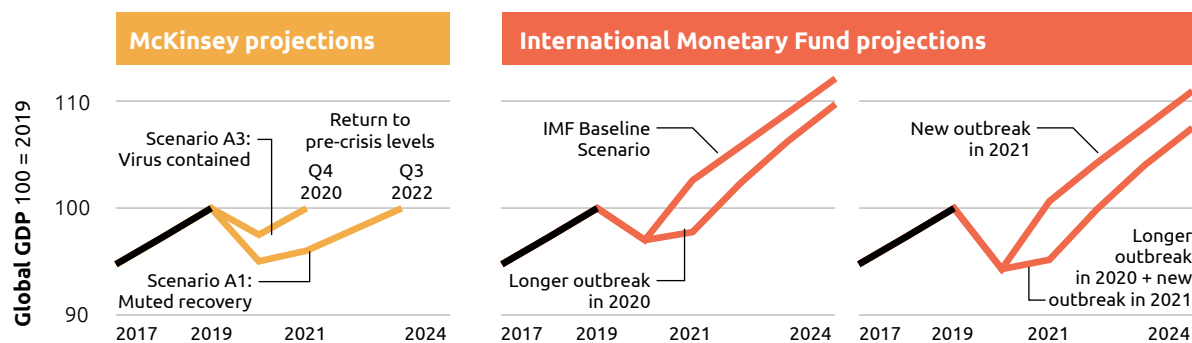
The "optimistic" recovery scenario assumes that the pandemic does not affect the long-term trend in global GDP growth assumed to be close to 3.4% p.a., while the "pessimistic" recovery scenario assumes that there is a significant adverse impact on long-term growth rates (as, for example, found by the IMF in assessing the long-term impacts of the 2008-09 GFC (IMF, 2018).

The optimistic recovery scenario results in a 33% increase in GDP in 2030 compared to 2019 and effectively lags behind pre-COVID-19 projections from the OECD by approximately one year.¹ The

¹ Estimated using the full range of GDP reductions described in the Annex to this report, combined with application of the full range of changes in carbon intensity of energy and industry as a function of GDP assumed in the 2019 WEO for 2020 and 2021. If the reductions in carbon intensity assumed in WEO 2019 current and stated policy scenarios slow down, then the emission reductions shown here may be slightly less than calculated here.

pessimistic recovery scenario results in significantly slower growth over the coming decade. It is limited to an 19% increase in global GDP in 2030 compared to 2019 levels, reaching growth levels from pre-crisis projections with a five-year delay.

Estimating the economic impact from the COVID-19 pandemic Latest short-term global GDP projections



Long-term global GDP optimistic and pessimistic projections

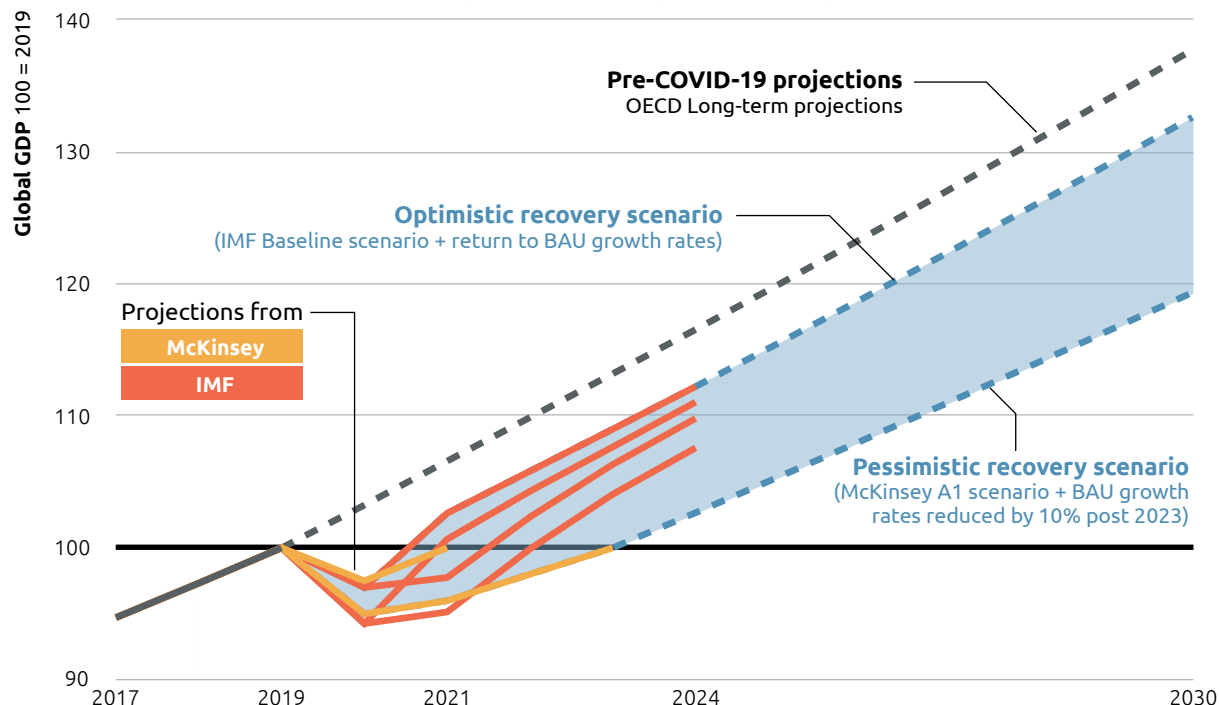


Figure 1: Global GDP scenarios used to estimate response to COVID-19 Pandemic. The “optimistic” recovery scenario assumes a fast return to global GDP growth close to 3.4% p.a (OECD, 2020), whereas the “pessimistic” recovery scenario assumes a significant adverse impact on long-term growth rates, returning to sustained growth rates 10% lower than this.

Global emissions: from short-term reductions to a long-term decoupling of economic growth and GHG emissions?

Global CO₂ emissions have decreased in the immediate aftermath of all economic downturns in recent history (Global Carbon Project, 2019; Peters et al., 2012), and the impact of this pandemic-induced downturn will be no different. In 2019, prior to the emergence of COVID-19 as a global issue, the IEA reported that energy and industry emissions had flatlined at close to 2018 levels (IEA, 2020b).

In the near-term, and based on the range of GDP estimates in Section 2.1, we estimate a drop in total energy and industry CO₂ emissions in the range of 4–11% over the course of 2020 and in 2021 1% above to 9% below 2019 energy and industry CO₂ emission levels, depending on the size and length of the economic downturn and effects on the carbon intensity of economic activity.²

However, narratives that present a short-term reduction in emissions due to the pandemic as a positive result for progress in combating climate change are short-sighted: achieving the Paris Agreement long-term temperature goal and the decarbonisation of the world's economy will require rapidly scaled up low carbon investment, economic transitions and R&D, which could be slowed or halted because of the recession (Schleussner et al., 2020).

Indeed, prior trends in post-crisis emissions are highly dependent on the mode of recovery. The 2008-09 GFC is an example of how recovery without structural change in energy consumption can result in quickly returning to pre-crisis emission trends. Fiscal stimulus packages focussing on energy-intensive activities such as construction were likely to have contributed to this trend (Jotzo et al., 2012).

While the nature of the COVID-19 crisis is different from any of the economic crises the world has seen in the last half-century, if not longer, the question of how the economic recovery is designed remains crucial in shaping the long-term pathways for emissions and whether or not the Paris Agreement's long term 1.5°C temperature limit can be achieved.

Whilst the first priority of governments is to put in place COVID-19 protection measures to protect lives and livelihoods the next essential step is recovery measures and plans. However, in designing the required stimulus programmes (IMF, 2020b; McKinsey & Company, 2020), they can also choose to do so in a manner consistent with limiting climate change and protecting lives and livelihoods into the future (Masson-Delmotte et al., 2018). This requires a focus on energy investment³ and infrastructure and decoupling economic development and emissions (Haberl et al., 2020).

Achieving the scaling-up of low carbon investment does not require a significant increase in total investment that would otherwise have occurred, but rather a shift in its distribution. In a multi-model analysis of energy investment required to meet the 1.5°C target, McCollum et al. (2018) find that investment in low-carbon sources will need to overtake fossil investments by 2025, and account for 80% of energy-sector investments a decade later. Improving energy efficiency measures may also reduce the required supply-side investments by 10% to 50% (Grubler et al., 2018; IPCC, 2018; McCollum et al., 2018).

² Estimated using the full range of GDP reductions described in the Annex to this report, combined with application of the full range of changes in carbon intensity of energy and industry as a function of GDP assumed in the 2019 WEO for 2020 and 2021. If the reductions in carbon intensity assumed in WEO 2019 current and stated policy scenarios slow down, then the emission reductions shown here may be slightly less than calculated here.

³ Decoupling GDP from emissions will require substantial investments in the energy sector to support the transition to a zero-emissions energy supply and promote energy efficient measures (Masson-Delmotte et al., 2018). Average annual investments will have to increase by a factor of six (range: 4-10) about 2015 levels by 2050.

The scenarios underpinning the McCollum et al. (2018) study⁴ can be used to estimate plausible 2030 emission levels from both our optimistic and pessimistic COVID-19 recovery scenarios.

We calculate the emissions-intensity of GDP in 2030, and plot it against the annual green investment⁵ share of GDP, finding a linear correlation between the two parameters (see Figure 2). For reference, we include the CAT estimate of our pre COVID-19 policy trajectory⁶, which lies inside the estimated range derived from McCollum et al. (McCollum et al., 2018).

Importantly, these scenarios implicitly include investments, policies, and mitigation actions as well outside of the energy sector through the use of an economy-wide carbon budget, and therefore our estimates are conservative, providing a lower bound of what could be needed to achieve these levels of emissions reductions.

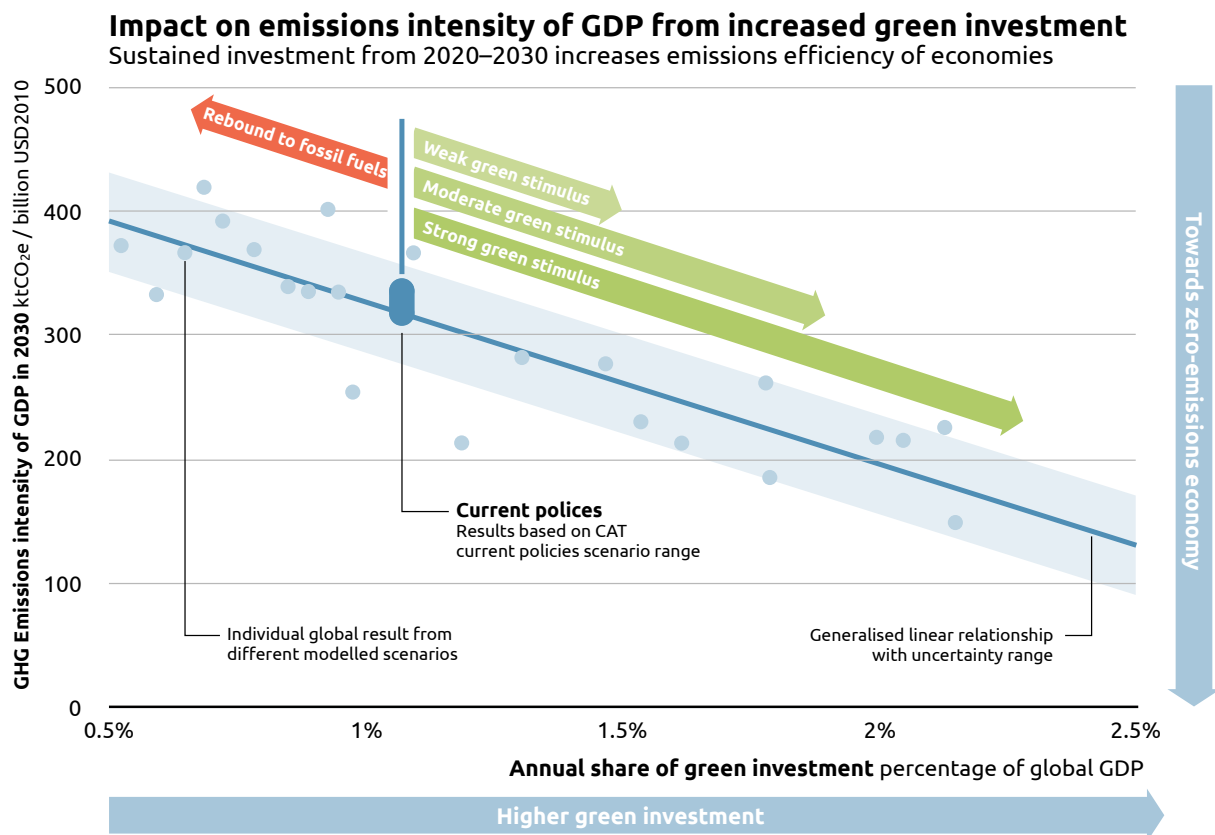


Figure 2: Relationship between green investment in period 2020-2030 and GHG emissions intensity of GDP in 2030. CAT analysis based on data from McCollum et al. (2018).⁵

To assess the potential emission levels in 2030 based on different modes of economic recovery and sustained investment in low-carbon technology, we combine the projected GDP pathways with central estimates of the relationship between low-carbon investment and emissions intensity of the economy (see Figure 2).

⁴ McCollum et al. (2018) is comprised of a scenario cohort from six Integrated Assessment Models which meet certain climate targets in a cost-effective manner. We analyse the 24 scenarios in the study and calculate the sustained annual green investment share (IIASA, 2019), as a share of GDP over a 30-year time horizon. Four scenario types are defined per model. Current Policy scenarios assume ongoing policies are maintained until 2030 and equivalent effort is applied thereafter. NDC scenarios assume implementation of all NDCs until 2030 and equivalent effort is applied thereafter. 2°C scenarios assume current policies are followed until 2020 and then policies are employed thereafter to achieve an ~1000 GtCO₂ carbon budget. 1.5°C scenarios follow the same approach, but use an ~400 GtCO₂ carbon budget.

⁵ These green investments include investment in energy efficiency improvement, and low carbon energy sources.

⁶ The Climate Action Tracker's Current Policy emission projections from its December 2019 update are plotted out against the annual share of green investment in GDP from 2014-2018 from the IEA World Energy Outlook 2019, assuming that the current structure of investments persists over the next decade (Climate Action Tracker, 2019; IEA, 2019b).

We have constructed four scenarios of future investment distribution (see **Figure 3**), that stylise various degrees of investment shifts from fossil to low-carbon technologies. The scenarios contain the increases (+0.4%, +0.8%, +1.2%) or decreases (-0.4%) in green investment (covering the full range of data points) and their corresponding change in fossil fuel investments within the IAM scenarios.

We then compared the resulting emissions estimates from these scenarios with one that holds investments constant to today's values – i.e., assuming that recovery does not change the fundamental composition of the global economy and energy system – in **Figure 4**.

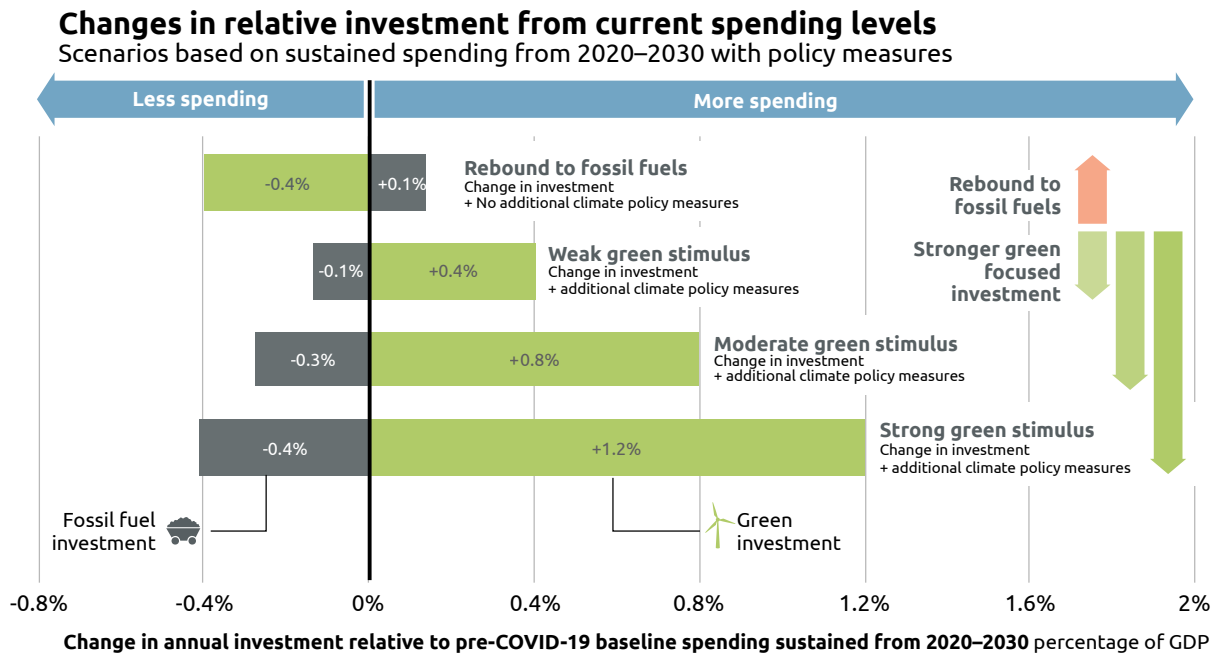


Figure 3: Stylised scenarios for post COVID-19 investment structures that can be initiated by a climate-focused recovery from COVID-19.

Findings

A first, very strong, finding is that if there is a rebound to fossil fuel investment at significant scale, then even the pessimistic recovery scenario, with its lower economic growth, will result in emissions significantly higher than pre-COVID19 global current policy estimates for 2030.

A second important finding is that the economic consequences of COVID19 will do little to bend the emissions curve downwards: rather, they delay the increase. If current trends for low carbon energy sector investments on the order of ~1.1% GDP annually were maintained and the optimistic recovery scenario applied, global emissions would fall between the range of estimates projected by the CAT pre-COVID19 for current policies (~56 Gt/yr).

Under the pessimistic recovery scenario, with present investment patterns maintained, emissions would flatline from present levels and lie close to the range estimated pre-COVID19 for Paris Agreement NDCs (~50 Gt/yr).

The third main finding is that a green economic stimulus package focused on low carbon energy system development and infrastructure will have a fundamental effect on reducing emissions by 2030. The level of emissions reduction is related very strongly to the scale of the green economic stimulus. It is important to emphasise that the green economic stimulus referred to here is essentially a switching of investments away from carbon intensive systems towards low or zero carbon green systems and does not entail an overall massive increase in investment.

Green stimulus to fight the COVID-19 economic crisis and the climate crisis

Strong climate policies plus sustained investment can provide valuable jobs, revitalise economies and get the world on track to meeting the 1.5°C Paris Agreement goal

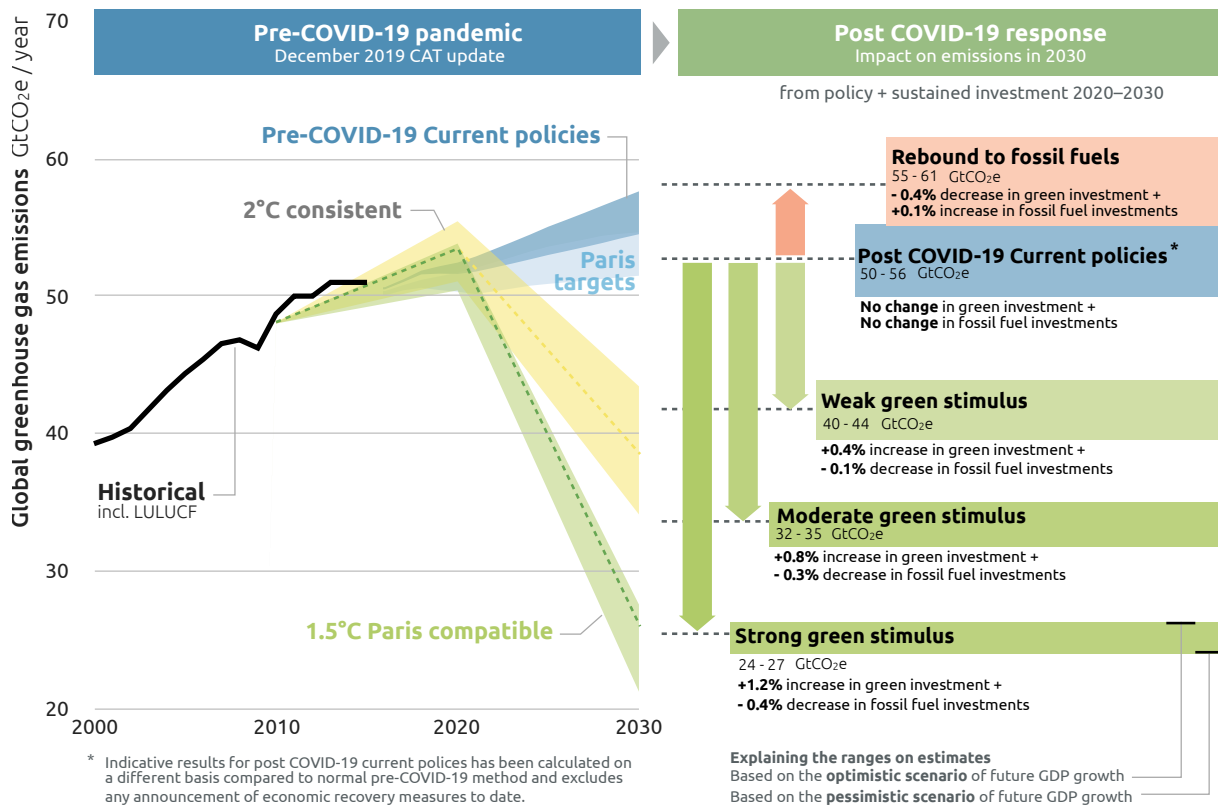


Figure 4: Benefits of a coordinated combined climate-mitigation economic stimulus that can kick-start the transition to a low-carbon economy that is achieved by sustained green investment over the next decades.

When comparing the relative contribution on potential 2030 emissions levels between the optimistic and pessimistic recovery from COVID19 uncertainty in future GDP growth and the magnitude of low-carbon investments, we find that by far the stronger effect is the degree to which recovers invest in green energy infrastructure, including energy efficiency and low-carbon supply technologies.⁷

Importantly, the level of economic of recovery from COVID19 is secondary to the speed and degree to which that activity transitions towards carbon neutrality. In other words, the future emissions intensity of the economy is path-dependent: greener investments now avoid lock-in to carbon intensive energy sources and potential future stranding of high-carbon assets.

⁷ Whereas the difference in economic activity can explain variations about 4 to 5 Gt/yr of CO₂-eq emissions, the degree of sustained investment in mitigation solutions explains a potential difference of 35 to 39 Gt/yr. These numbers are based on Table A 2 in the Technical Annex that provides uncertainties related to both economic activity and investment behaviour.

Opportunities and rationales for key sectoral economic recovery actions

A green stimulus framework to guide policy and decision-making in response to COVID-19

The impacts of the COVID-19 pandemic on public health, social security and economic prosperity mandates a phased approach by policymakers (Fischedick & Schneidewind, 2020; Hallegatte & Hammer, 2020b).

In acknowledging the magnitude of this unprecedented challenge, the priority must be the immediate emergency response focussing on saving lives, supporting health infrastructure, food availability, and many other urgent social and economic support measures such as short-term job allowances, direct cash handouts to citizens, or targeted liquidity support to SMEs. At the time of writing, in April 2020, immediate emergency responses were already underway in most countries worldwide.

Following these urgent emergency actions, governments are now racing to come up with economic stimulus responses to address the economic and financial fallout of the COVID-19 pandemic – both at a national and international level.

A green stimulus framework in practical terms

Governments are facing an unprecedented scope of decisions on how to stabilise and support their economies in direct response to the COVID-19 pandemic. An emerging body of literature contributes to a concept of a green stimulus framework in response to the COVID-19 pandemic outlining key criteria or interventions for consideration by policymakers when deciding on immediate emergency response and the subsequent economic recovery responses (Hallegatte & Hammer, 2020a, 2020b).

'Green stimulus' generally includes all policy interventions "to stimulate short-run economic activity while at the same time preserving, protecting and enhancing environmental and natural resource quality both near-term and longer-term" (Strand & Toman, 2010).

The green stimulus framework outlines key criteria that should be considered by policymakers for any green stimulus interventions in order to successfully address short-term needs with long term benefits. The World Bank (2020b) has developed a first draft of a sustainability checklist for discussion, outlining key questions to assess each of these criteria in more detail.

- 1 Activating economic stimulus and job creation within next 18 months**
Green stimulus interventions considered should promote safeguarding existing jobs, creating new job opportunities for unemployed workers, and should have a (short-term) economic multiplier effect. These impacts should ideally come into effect immediately.
- 2 Enabling inclusive growth prospects and enhanced resilience beyond 18 months**
Green stimulus interventions should contribute to develop human (e.g. skill development and health), natural and physical capital (e.g. uptake of more efficient technologies) to foster inclusive growth and poverty alleviation. Green economic recovery packages as part of wider climate action efforts could deliver up to USD 26 trillion in net global economic benefits and 65 million new low-carbon jobs in 2030 (Mountford, 2020). Interventions should also enhance resilience of societies and infrastructure for future external shocks like pandemics, natural disasters, and climate change.
- 3 Promoting decarbonisation and sustainable growth prospects**
Green stimulus interventions should accelerate the uptake of low-carbon technologies and respective infrastructure to enable sectoral transitions towards full decarbonisation. Interventions should also remove existing barriers and avoid costly stranded assets.

These key considerations provide a reference framework for policymakers to practically determine and differentiate between “do good” and ‘do no harm’ in their economic recovery responses (The Club of Rome, 2020). These are useful in avoiding past mistakes experienced during the response to the 2008-09 GFC, and to provide valuable reference points – both positive and negative – but most importantly to grab the opportunity and make a green recovery a reality.

The range of green stimulus interventions available for policymakers

Governments have a range of green stimulus interventions at their disposal for targeted interventions in different sectors of the economy. Table 1 introduces key types of interventions identified in relevant literature (Brown et al., 2009; Höhne et al., 2009; IILS, 2011; Strand & Toman, 2010), ranging from direct investments by governments to scaled-up educational programmes for temporarily unemployed workers. This range of policy interventions generally applies to each sector of the economy. Policymakers should carefully assess which interventions address the challenges ahead most effectively under consideration of the green stimulus framework in response to the current crisis.

Type of intervention	Description	Examples across sectors
Direct investments and government purchasing	Direct investments in deployment of low-carbon technologies and government purchasing of low-carbon goods and services	<ul style="list-style-type: none"> ▶ <i>Investment in renewables</i> ▶ <i>EV purchases for public car fleets</i> ▶ <i>Low carbon government procurement guidelines</i>
Economic incentives	Economic incentives that overcome disadvantages to incumbent technologies to accelerate the uptake of low-carbon technologies	<ul style="list-style-type: none"> ▶ <i>Tax credits for zero-carbon technologies</i> ▶ <i>Low-interest loans for retrofitting residential buildings</i>
Conditional sector support (“bailouts”)	Financial support tied to conditions for low carbon development for companies that would otherwise risk insolvency due to external shock	<ul style="list-style-type: none"> ▶ <i>Equity or government guarantees for automobile and/or aviation companies pending on emission performance standards implemented in predefined timeframe</i>
Fiscal (reform) measures for additional revenue streams	Removal for existing fossil fuel subsidies or introduction of new taxes on fossil fuel use for generation of additional revenue streams	<ul style="list-style-type: none"> ▶ <i>Use the opportunity of very low oil and gas prices to phase-out fossil fuel subsidies or raise taxes</i>
R&D funding and roll-out of pilot projects of low-carbon technologies	Funding interventions to accelerated R&D and roll-out of low-carbon technology pilot projects, potentially linking to technologies considered for highest plausible ambition pathways	<ul style="list-style-type: none"> ▶ <i>Funding for pilot projects in heavy industry sector such as hydrogen-based steel making</i>
Scale-up of skill development programs	Scale-up of skill development and educational programs to meet rising unemployment	<ul style="list-style-type: none"> ▶ <i>Accelerated funding for skill development and vocational training programmes in the buildings sector to address need for specific skills for energy efficient retrofits</i>



The multiple benefits of “greening” stimulus packages

Many countries will be injecting huge amounts of resources into their economies in efforts to revive them after COVID-19 impacts. This recovery presents both opportunities and threats to enhancing nations’ resilience to climate change and reaping multiple benefits that would advance sustainable development goals.

These are benefits that will, in the short term, create jobs, grow economies sustainably and, in the long term, build national competitiveness. These can take many forms, but here are a few key examples of such benefits:



Reduced air pollution

Diseases associated with air pollution lower the economic productivity of workers while creating a burden on health care systems due to significant costs. The Centre for Research on Energy and Clean Air has recently analysed the global economic costs of air pollution from fossil fuels, estimating that 4.5 million people died due to air pollution from fossil fuels in 2018, with economic costs estimated at US\$2.9 trillion (Myllyvirta, 2020). If the current growth paths are not changed, this figure is likely to increase. Decisionmakers could avoid these deaths and costs through international efforts to pursue sustainable development paths.



Job creation

Low carbon investment creates new job opportunities, increases the quality of jobs, while boosting employment and creating new industries. An analysis shows developing the clean energy sector can create sharp increases in employment when the transition is consistent with a 1.5°C pathway, estimating a total of 68% more jobs than in a business as usual scenario (UNDP, 2016).



Energy security & independence

Renewable energy supports and enhances security of energy supply. This is important for economic development, and for countries without their own supply of primary energy sources, it also reduces the burden and costs of dependence on fuel imports.



Enhanced access to energy & affordability

The recent drop in renewable energy technology costs provides an opportunity for greater access to clean energy, especially for those who live in remote areas. Lower technology prices encourage scaling up of low carbon development projects with the potential to stimulate employment that is critical to economic activity and growth (GEF, 2012), and in closing the energy poverty gap.



Economic growth

Analysis undertaken in 2018 shows that low carbon development could deliver at least USD\$26 trillion economic benefits globally by 2030 (The New Climate Economy, 2018). However, this would require bold leadership and action from governments across the world.

Analysis of potential economic recovery responses for key economic sectors



















COVID-19 recovery planning provides an opportunity for governments to rethink their critical infrastructure, raise standards and develop innovative solutions. As policymakers prepare their economic recovery packages, it is important they avoid a narrow focus on the “quick wins” that favour business-as-usual approaches that will lock in countries to decades of high-carbon and unsustainable development (Mountford, 2020).

Table 2 below presents a synthesis of key green stimulus interventions in five key economic sectors available for policymakers in the very short term. We have identified the range of interventions based on recently published literature on the green economic recovery response and relevant

literature on lessons learnt from the 2008/2009 financial crisis. We have also identified the “do no harm” actions to avoid.

The proposed interventions can directly build upon - and be integrated with - existing project pipelines such as national development plans, transport or water master plans, or Nationally Determined Contributions under the Paris Agreement – or be packaged as new proposals created specifically for the post-COVID-19 stimulus (Hallegatte & Hammer, 2020b).

Table 2: Overview of sector-level analysis on green economic recovery action

THE DO'S AND DON'TS OF GREEN ECONOMIC RECOVERY	
Green stimulus interventions and harmful actions to avoid	
 Energy and electricity supply	 <ul style="list-style-type: none"> ▶ Direct support for zero-emissions technologies and infrastructure ▶ Fiscal reform on fossil fuel subsidies
	 <ul style="list-style-type: none"> ▶ Revive plans for 'shovel-ready' fossil fuel power plants ▶ Waive oil and gas industry environmental regulations ▶ Bail out fossil fuel companies without conditions for zero-emission transition
 Land-based transport and mobility	 <ul style="list-style-type: none"> ▶ Financial incentives for zero-emission vehicles ▶ Direct investments in low-carbon public transport
	 <ul style="list-style-type: none"> ▶ Roll back emission standards for cars ▶ Support to automobile companies without conditions for zero-emissions transition
 Aviation	 <ul style="list-style-type: none"> ▶ Conditional sector support for aviation industry (e.g. bailout) and accelerated R&D efforts
	 <ul style="list-style-type: none"> ▶ Roll back regulations and taxes (e.g. ticket taxes) ▶ Recalibrate CORSIA baseline without substantially improving entire scheme
 Industry	 <ul style="list-style-type: none"> ▶ Support uptake of efficient appliances, lighting, and digital devices ▶ Low-carbon technology R&D and pilot projects (e.g. steel and cement)
	 <ul style="list-style-type: none"> ▶ Roll back climate measures and regulation (e.g. industry levy for supporting renewable energy) ▶ Support for industry without conditions for zero-emission transition
 Buildings	 <ul style="list-style-type: none"> ▶ Support for energy efficient retrofits of existing buildings ▶ Support for accelerated construction of low and zero-energy buildings
	 <ul style="list-style-type: none"> ▶ Stimulus programmes for new buildings without energy efficiency criteria
 Land-use & environmental protection	 <ul style="list-style-type: none"> ▶ Large-scale landscape restoration and reforestation efforts
	 <ul style="list-style-type: none"> ▶ Roll back environmental regulations ▶ Dismantling enforcement of state protection for natural habitats



Energy and electricity supply



Direct support for zero-emissions technologies and infrastructure

Direct investments in zero-emissions technologies and related infrastructure present a key green stimulus intervention opportunity in the energy and electricity supply. Given the electricity sector must fully decarbonise by 2050, such direct investments, particularly in renewable energy, must not only align with the Paris Agreement, they will have the potential to create direct employment and economic multiplier effects in the short-term while fostering technological innovation and structural benefits for economic development (Bahar, 2020).

- ✔ Governments should provide targeted financial support for continued growth of renewables in 2020 and beyond (Bahar, 2020). This support ranges from extending deadlines for commissioning projects beyond 2020, to continuing and extending existing policy measures proven to accelerate cost-effective deployment of renewable capacity. Such support assists an industry to navigate the external shock of the COVID-19 pandemic: similar measures after the 2008-09 GFC proved highly effective in creating short-term employment opportunities (Strand & Toman, 2010). The African Union and the International Renewable Energy Agency (IRENA) have already agreed to work closely to advance renewable energy across the continent to bolster Africa's response to Covid-19 (IRENA, 2020).
- ✔ The accelerated development of large-scale energy infrastructure projects - for example in the field of smart grids, electric-vehicle charging, and digital connectivity - lay the foundation for a more efficient, resilient and future-proofed energy system (IEA, 2020a).
- ✔ Economic recovery packages can include funding the early decommissioning of ageing fossil fuel plants and oil wells under the condition of direct replacement with renewable-plus-battery combinations (Liebreich, 2020). Such early decommissioning, in combination with the replacement, could be packaged with concessional debt or debt guarantees.
- ✔ Green stimulus measures can further support accelerated R&D and pilot funding for not-yet fully commercialised zero-emission technologies with significant cost reduction potential (Bahar, 2020). Examples might include floating offshore wind farms, marine technologies and low-carbon hydrogen production (Bahar, 2020).

Learning from previous 'good practice' experience: American Recovery Act of 2009

- ▶ The *American Recovery Act of 2009* created almost one million 'clean energy' jobs in the wind and solar industries between 2009 and 2015 (CEA, 2016; Lashof, 2020).
- ▶ Loan guarantees to support more than \$40 billion of investment and tax credits supported more than 100,000 projects across the US.
- ▶ Additional measures included (1) seed funding for the *Advanced Research Projects Agency-Energy (ARPA-E)* investing in 475 transformative energy technologies with USD 1.25 billion in private sector follow-on funding or funding for the *Smart Grid Investment Program* helped to support the installation of 16 million smart meters by 2016
- ▶ A recent good example of where governments could start and lead by example in their COVID-19 interventions, include a case of Nigerian government that has powered one of the hospitals dedicated for COVID-19 treatment, with two solar hybrids mini grids (REA, 2020).



Fiscal reform on fossil fuel subsidies

The IEA has estimated 2018 fossil fuel subsidies at more than USD \$400 billion (Matsumura & Adam, 2019). The data also shows these have been increasing, reflecting failure on the part of governments. An example is the G20 which committed to phasing out “inefficient” fossil fuel subsidies over ten years ago and still has very little to show for it. These huge figures show the scale of resources that could be made available for the necessary transition to low carbon economies and societies. Fiscal reforms are needed to effect the changes.



One such reform that has been implemented in a handful of countries is subsidy swaps from fossil fuels to clean energy, which effectively reallocate some of the savings from subsidy reform to fund the clean energy transition (Bridle et al., 2019). Such subsidy swaps have direct sustainable development benefits, including job creation, skill development, gender equality and improving public health. Savings realised through subsidy reductions could be further invested in solutions that promote a Just Transition and more resilient economies.

There are many opportunities to implement fiscal reforms and channel the resources to cleaner development. As noted in recent IEA commentary, even the recent drop in oil prices is one such good opportunity. This could see more than 40% of the current global fossil fuel subsidies, meant for oil, channelled directly towards clean energy transitions (Biol, 2020).

Learning from previous ‘good practice’ experience: Morocco and Ethiopia

- ▶ Examples of countries that have successfully implemented subsidy switching include Ethiopia and Morocco. Ethiopia has managed, as a direct consequence of these reforms, to introduce blending ethanol and gasoline, with a continuous improvement, having started at 5% in 2008, and moved to 10% in 2011. Loan guarantees to support more than \$40 billion of investment and tax credits supported more than 100,000 projects across the US.
- ▶ In Morocco, fossil fuel subsidies were also reduced, for example, to increase the role of renewable energy in the energy mix, particularly in solar energy (Merrill et al., 2016). Morocco is a renewable energy leader in the Arab group of countries, with a target of 42% renewables in 2020. A recent good example of where governments could start and lead by example in their COVID-19 interventions, include a case of Nigerian government that has powered one of the hospitals dedicated for COVID-19 treatment, with two solar hybrids mini grids (REA, 2020).



“Do No Harm” examples of actions to avoid in the energy and electricity supply sector

Learning from previous experiences is important in order to avoid implementing interventions that could result in a carbon lock-in, especially the lessons learnt of the mostly inadequate recovery response to the 2008-09 GFC. Under consideration of the green stimulus framework and, government would be well-advised to undo the (fragile) progress on climate action achieved to date.



Policy makers should avoid unlocking previously mothballed pipelines of ‘shovel-ready’ fossil fuel power plants (Carbon Tracker Initiative, 2020; Farand, 2020b; Lombrana, 2020b). Some countries might be tempted to reactivate projects they had previously discontinued due to economic and environmental concerns - to benefit from the short-term gains in employment and economic activity. For example, by March 2020, China had already approved five new coal-fired power plants with a total capacity of around 8 GW, more than the total for 2019 (Farand, 2020b).



Governments should resist bailing out fossil fuel companies without attaching environmental conditions for a future transition toward renewable energy technologies, such as the proposal under discussion in the South Korean government’s plan for a USD 825 million bailout of *Doosan Heavy Industries & Construction Co.* without any condition to promote renewables (Farand, 2020b; Gokkon, 2020).

- ❌ Governments should resist waiving regulations for oil and gas industry such as the US Environmental Protection Agency (EPA) suspending its enforcement of environmental laws of air and water protection (Milman & Holden, 2020) or the proposal by the Canadian Association of Petroleum Producers to pause all climate policy development, not to pass legislation to implement the UN Declaration on the Rights of Indigenous Peoples, suspend the lobbying registry, and not to enforce or update several policies from carbon pricing, pollution monitoring, migratory bird protection, rail safety and methane leak detection (Environmental Defence, 2020).



Land-based transport and mobility



Financial incentives for uptake of zero-emission vehicles

Automobile manufactures have seen vehicle sales drastically drop during economic lock-down of the COVID-19 pandemic. Instead of funding expensive 'bailouts' for car companies as part of the economic recovery packages, targeted green stimulus intervention could drastically ramp-up demand for zero-emission vehicles to accelerate the transition towards zero-emission mobility fleets (Liebreich, 2020).

- ✅ A range for financial incentives conditional to distinct CO₂ criteria such as tax breaks, tax exemptions, 'cash-for-clunker' scrappage schemes (Bannon, 2020b), or other financial subsidies for electric vehicles or electric two-wheelers might effectively accelerate demand in the private and corporate sales segments.
- ✅ Other green stimulus interventions such as direct government purchasing can further focus on accelerated switch to electric delivery vehicles, buses, taxis, shared mobility vehicles, and all publicly owned vehicles (Liebreich, 2020).

Same but different: adding CO₂ criteria to traditional 'cash-for-clunker' scrappage policies

- ▶ After the 2008-09 GFC, several countries raised domestic car sales using scrapping payments in their stimulus packages. Only very few countries, e.g. Italy, added some conditions for CO₂ emission standards for newly purchased vehicles (IHS Global Insights, 2010).
- ▶ Where countries implemented such programmes without CO₂ criteria, e.g. Germany or Japan, the environmental impacts remained vague depending on many factors such as current standards in fuel efficiency (vis-à-vis older cars subject to the programme), the age of vehicles, the scope of subsidies, and the programmes' timing (IILS, 2011).
- ▶ Adding distinct CO₂ criteria to 'cash-for-clunker' scrappage policies could foster uptake of zero-emission vehicles, two-wheelers and delivery vehicles while creating employment opportunities, significantly reducing air pollution levels in urban areas, fostering the car industry's swift transformation to a low-carbon economy (Bannon, 2020b).



Direct investments in low-carbon public transport

The drop in urban air pollution levels in cities worldwide during the COVID-19 economic shutdown received widespread attention. While pollution levels are likely to directly increase again after the long-awaited loosening of restrictions, the promotion of low-carbon urban transport solutions fostered by green stimulus interventions can have lasting impacts on improved human health and enhanced urban mobility.

- ✔ Green stimulus interventions can initiate and accelerate large-scale public transport infrastructure projects such as creating cycling lanes, deploying public electric-vehicle charging points, or large-scale deployment of street-lighting upgrades (IEA, 2020a), or rail and road infrastructure to enable use of sustainable public transport. These infrastructure investments create local employment opportunities in urban areas while supporting the foundation for future-orientated urban mobility. Some cities like Milan have already announced an ambitious reallocation of street space from cars to cycling and walking in direct response to the coronavirus crisis (Laker, 2020).
- ✔ Closely linking to the accelerated uptake of zero-emission vehicles outlined above, governments and local authorities can accelerate the uptake of electric (mini-)buses, two-wheelers, taxis and delivery vehicles in urban agglomerations (Liebreich, 2020). For example, such direct purchasing can accelerate existing programmes to purchase zero-emission buses in major urban agglomerations such as the Zero Emission Bus Rapid-deployment Accelerator (ZEBRA) programme in Latin American cities such as Medellin, Mexico City, São Paulo, and Santiago de Chile (P4G, 2020), or the 32 signatories of C40 Green and Healthy Streets Declaration to only procure only zero-emission buses from 2025 onward (C40, 2019).



“Do No Harm” examples of actions to avoid in the land-based transport and mobility sector

While focusing on green stimulus interventions, policymakers should ‘do no harm’ by dismantling the fragile progress in advancing the sector’s transformation towards zero-emissions mobility previously achieved.

- ✘ Policymakers should avoid rolling back CO₂ targets and efficiency standards for car manufactures as, for example, the US Environment Protection Agency’s complete roll-back of U.S. vehicle emissions standards in March 2020 (Shepardson, 2020) or similar proposals by interest groups of European car manufactures for EU CO₂ regulations for 2020-2021 (Bannon, 2020b; Poliscanova, 2020).
- ✘ Any unconditional support to automobile companies without distinct climate safeguards, for example, as proposed by US Senate discussing a USD\$2 trillion rescue package for automakers (Shepardson & Klayman, 2020), results in a lock-in uptake of inefficient vehicles and inadequate infrastructure.






Aviation



Conditional sector support for aviation industry (e.g. bailout) and accelerated R&D efforts

The grounding of a vast majority of airplanes on national and international connections to contain the spread of the COVID-19 pandemic severely impacts airlines and airports. At the time of writing, several countries such as Portugal or South Africa were discussing the level of appropriate state funding for their national flag carriers (Acton, 2020; Reuters, 2020; Sguazzin, 2020), while the USA had already reached an initial USD 25 billion agreement with US American airlines (Rushe, 2020).

If governments were to opt to support the aviation industry to protect workers and to provide targeted financial support, their interventions should also incentivise future low-carbon improvements of the aviation sector.

-  Policy makers can opt to directly tie financial support to airlines to specific conditions, such as eliminating the tax exemption for jet fuel once conditions improve, increased use of sustainable fuels, or even strict targets on GHG emissions (Bannon, 2020a; Harvey, 2020; Todts, 2020). Such conditional support for aviation companies can be aligned with loan guarantees or grants for advanced aviation fuel project to reduce economic uncertainty for other private investors (Pavlenko et al., 2019).
-  By integrally linking to conditional financial support, green stimulus interventions could further target accelerated R&D and pilot projects of low-carbon technologies in the aviation sector (Harvey, 2020), for example on electric battery or hydrogen planes for short distances routes and accelerated research on biofuels and synthetic fuels for long-distance routes (Energy Transitions Commission, 2019).
-  In a similar manner as for aviation companies, financial support for airports can be linked to distinct conditions such as decarbonising all ground operations or improving infrastructure to fuel low-carbon airplanes.





Learning from others: First governments intend to link bailout of airlines to climate targets

- ▶ The Austrian government announced on 17 April 2020 that any state aid to support Austrian Airlines would be tied to specific climate conditions (Morgan, 2020), with options including a pledge to reduce short-haul flights, increased cooperation with rail companies, heavier use of eco-friendly fuels and bigger tax contributions.
- ▶ Governments could look at examples in other sectors for inputs on how to negotiate financial support, or “bailouts”, with stringent conditions attached. For example, in 2008, the U.S. government agreed with the U.S. automobile industry that the sector’s bailout would be conditional on them meeting stringent fuel efficiency standards.
- ▶ The French parliament voted down an amendment to the Amending Finance Law on 17. April 2020 that would have requested companies benefiting from state aid (for example AirFrance-KLM) to report their carbon footprint, a trajectory for reducing their emissions in accordance with the Paris Agreement, and its investment plan to make it concretely happen (National Assembly of France, 2020). This vote against the amendment was strongly condemned by civil society organisations (Greenpeace, 2020).



“Do No Harm” examples of actions to avoid in the aviation sector

State aid such as bailouts and other measures to support struggling aviation companies should ‘do no harm’ by disincentivising future innovation in the aviation industry. Examples include:

-  Rolling back existing or planned regulations, research programmes or taxes jeopardising the very limited progress achieved in some countries to date, for example unconditional tax breaks proposed for air transport sector in Russia (Farand, 2020b).
-  The Carbon Offsetting and Reduction Mechanism for International Aviation (CORSIA) is meant to help the international aviation sector reach the International Civil Aviation Organisation’s target of climate neutral growth from 2020 levels. For the purpose calculating the offsetting obligation CORSIA called for a baseline as the average of 2019 and 2020 emissions.
-  Because of COVID-19, actual 2020 emissions will be substantially lower than anticipated only a few months ago, so keeping average 2019-2020 emissions as CORSIA’s baseline is likely to substantially increase offsetting requirements for airlines.
-  The International Airline Transport Association (IATA) has therefore called for only 2019 levels to be used to calculate the baseline (ERAA, 2020). This would constitute an ambition reduction of an existing regulation that was already expected to have close to no impact on aviation emissions due to an expected oversupply of eligible offset credits and associated low prices (Farand, 2020a; Pavlenko, 2018; Warnecke et al., 2019). So if the CORSIA scheme is to be amended, it should be in a way which strengthens its ambition rather than lowering it (Topham & Harvey, 2020).






Industry sector



Support the accelerated uptake of efficient appliances, lighting, and digital devices

Governments can facilitate the scrapping of inefficient appliances by providing incentives to consumers to replace inefficient products with more efficient technology replacements. Green stimulus interventions can target the accelerated uptake of efficient appliances, lighting, and digital devices for effective economic stimulus while promoting energy efficiency and sustainability agenda (IEA, 2020a; Motherway & Oppermann, 2020).

-  Financial incentives such as ‘cash-for-clunker’ scrappage payments or VAT reductions for household appliances such as refrigerators and digital devices create job creation throughout the manufacturing, transport, and retail supply chains (IEA, 2020a; Motherway & Oppermann, 2020). Any such replacement policy would need to build upon well-established energy efficiency standards and labels and encourage purchases of high efficiency products.
-  Green stimulus interventions can initiate large-scale replacements of street lighting in urban and rural areas promoting an upgrade of public infrastructure, energy efficiency gains, and economic stimulus impacts. For example, India’s Street Lighting National Program has upgraded around 11 million streetlights with efficient LEDs fostering local employment (IEA, 2020a). In addition, large-scale investments in the ‘digital’ infrastructure such as fibre-optic networks enable an economic modernisation in the age of digitalisation (Lombrana, 2020).
-  Considering early replacement of inefficient appliances, direct support and investments can target state-of-the-art circular economy programmes to allow for sustainable recycling.

Learning from previous experience: The Colombian 'Return and Save' program in 2017 to replace one million refrigerators within five years

- ▶ Colombia's 'Return and Save' programme announced in 2017 aims to replace one million refrigerators within five years, targeting low and medium-income households (Ministry of Mines and Energy of Colombia, 2018). The subsidy offers a reduction of the value-added tax on the most efficient refrigerators from 19% to 5%, while old appliances are removed and delivered to authorised agents for recycling and refrigerant disposal (under Montreal Protocol commitments).
- ▶ The Colombian government expects that the reduction in VAT revenue will be offset by the reduction in energy use and related energy subsidies given that new refrigerators used 25% less energy than the old units, rendering the programme budget neutral (IEA; UNEP, 2018; IEA, 2019a).
- ▶ The programme will create approximately 2,000 direct and 10,000 indirect jobs, while promoting the recycling industry and better use of materials in the economy (IEA; UNEP, 2018; IEA, 2019a).



Accelerated funding of R&D and pilot projects of low-carbon technologies

The slowdown of economic activity affects production and operations of many heavy industry sub-sectors such as steelmaking or cement production (Onstad, 2020; Tarasenko, 2020). Green stimulus interventions targeted at other sectors such as the automobile industry might indirectly re-stimulate demand, but private companies might face budget constraints for accelerated R&D and the roll-out of pilot projects for low-carbon technologies of industrial processes. Any interventions by policymakers should envision:



Green stimulus interventions that can target the accelerated roll-out of large-scale demonstration projects of low-carbon industrial production technologies such as steelmaking using direct reduced iron with hydrogen and electrolysis (Fischedick & Schneidewind, 2020). Some steelmaking companies are setting up such first demonstration plants for hydrogen-based steelmaking (Ker, 2020; Pooler, 2020), which might come under pressure if corporate revenues were to drop for a prolonged period.



"Do No Harm" examples of actions to avoid in the industry sector

While green stimulus interventions can support the industry in direct response to the COVID-19 pandemic, policymakers should follow the principle to 'do no harm' when deciding on any stimulus intervention. Examples include:



The rollback of existing climate measures and regulation jeopardising the very limited progress some countries have achieved to promote low-carbon technologies, for example as the proposed suspension of the German industry levy for the support of renewable energy (Dohmen, 2020).



Similar as for other sectors like the energy or transport sectors, any unconditional support or bailouts for industry companies without distinct climate safeguards disincentivises the transition to urgently required low-carbon technologies of tomorrow, especially in these hard-to-abate sectors such as steelmaking or cement.






Buildings sector



Support for energy efficient retrofits of existing public and private buildings

An increase rate of thermal retrofits, electrification of water/space heating, and more efficient appliances all provide key opportunities to increase energy efficiency of public and residential building stock. At the same time, such improvements can advance socially just housing, while generating local 'future-proof' employment and attenuating the adverse health effects of inappropriate housing in developing and developed countries alike.

For these reasons, the European Green Deal includes a 'renovation wave' as a key part of its building modernisation efforts (Mariani, 2020) – something that could be easily applied as one of the key pillars of many stimulus packages in Europe and elsewhere.

-  Policymakers at the federal, regional and municipal level can direct investment into energy efficient retrofits of public buildings such as social housing, schools, healthcare facilities, and government offices (IEA, 2020a). Analysis suggests that around 60% of expenditure on home energy efficiency retrofits goes towards labour, delivering strong employment growth benefits. These are jobs that could lessen the impact of the economic crisis created by COVID-19.
-  Besides publicly-owned buildings, governments can scale up existing programmes providing financial incentives such as low-interest loans or tax breaks for energy efficiency retrofits - or newly created new ones if no such programmes currently exist (IEA, 2020a). Such programmes deliver jobs creation and economic stimulus across urban and rural areas, and foster follow-up investments by private actors.
-  Subsidies for purchases of thermal water heating, heat pumps, and rooftop solar PV and battery storage present another opportunity for green stimulus interventions. The instalment of such technologies in residential and commercial buildings creates multiple local employment opportunity, especially in regions most affected by the current crisis. For example, in 2015, the Indian government set an ambitious renewable energy target of 175GW by 2022, with 40GW planned for decentralised and rooftop solar projects. This was also expected to upskill the workforce, which would also be required in future deployments, and therefore creating job opportunities (Garg & Buckley, 2019).

Learning from previous 'good practice' experience: Buildings sector

- ▶ Policymakers can learn from several successful programmes around the world over the last decade, for example as a response to the 2008-09 GFC, that showcase robust and scalable mechanisms and procedures to foster energy efficiency improvements to deliver targeted result.
- ▶ Germany, for example, substantially expanded its programme to promote energy efficient retrofits through fiscal measures and concessional loans between 2008-2010 as part of its economic recovery package (Sauter & Volkery, 2013). This way, the German government promoted around 420,000 retrofits in 2009 and 2010 with significant economic multiplier effects of invested public funds.
- ▶ In a similar manner, American Recovery Act of 2009 promoted energy efficiency improvements of over 800,000 residential homes between 2009-2012 with federal support (CEA, 2016). These interventions triggered energy savings and created over 200,000 jobs (Motherway & Oppermann, 2020).
- ▶ Governments from developing countries can learn from such previously programmes in developed countries to scale-up energy efficiency improvements also including appliances such as thermal solar heating as part of their economic recovery response (Aznar et al., 2019). Such measures might particularly target low- and medium income households. Some developing countries such as China have already adopted buildings codes for newly constructed buildings (Yan et al., 2017).



Support for accelerated construction of low- and zero-energy buildings

Decreased income and increased job insecurity will affect the construction of new dwellings. Whenever construction takes place, the willingness to bear the additional costs of zero energy houses - estimated at between 6.7 and 8.1% in the USA for single-family homes for example (Petersen et al., 2019) - will decrease significantly. Green stimulus interventions aiming at low- and zero-energy buildings could mitigate the crisis in the construction industry and create a basis for carbon neutral building stock.



The construction of zero-energy buildings can be facilitated by preferential loans and reduced taxes on low carbon construction materials, under the conditions of fulfilling strict efficiency standards. The standards should also include elements that could make the new builds an integral part of smart, low carbon infrastructure. This particularly includes the development of EV charging infrastructure and power storage, which could also be used to stabilise the electricity grid.



Adoption of building codes targeting better energy efficiency would allow the development of standardisation of construction materials and - due to the economies of scale - decrease their costs. Standardised building types at high levels of energy efficiency would increase their affordability and allow for easier quantification of savings on energy costs (Di Foggia, 2018; IEA, 2020a) To increase their uptake experts and stakeholders should participate in their development (Madan et al., 2019).



“Do No Harm” examples of actions to avoid in the buildings sector

The inert character of the building sector means that today’s investments will have repercussions for emissions pathways for decades to come. Therefore, when implementing economic stimulus packages to accelerate growth in the construction sector, governments should avoid missed opportunities as seen in some countries’ economic stimulus response to the 2008-09 GFC.



Most recent analysis for EU Member States shows that finds that progress is slowing in some areas such as improving energy efficiency (EEA, 2019). For example, in response to the 2008-09 GFC, Cyprus made EUR 250 million available for the construction sector with a strong focus on job creation, targeting first time home buyers and upgrading of new school buildings (ILO, 2009). EU Member States as well as other countries worldwide should aim to maximise impacts on all three dimensions of employment, economic stimulus, and energy efficiency improvements in their economic recovery packages this time to avoid a carbon-lock in of long-lasting buildings stock.



Similarly, as part of its recovery package in May 2009, the Dominican Republic introduced tax and rates exemptions for low-cost housing projects without any distinct criteria for energy efficiency (ILO, 2009). Such valuable social housing initiatives for low-income families should aim to consider high energy efficiency standards as a lack of these might result in high maintenance and energy costs.



Land-use sector and environmental protection

In the months preceding the COVID-19 pandemic, the land use and forestry sector had already been under immense pressure from the widespread wildfires and deforestation in Australia, the Amazon Rainforest Basin, and the Congo Rainforest Basin throughout 2019 and early 2020. The land sector's importance for biodiversity and wildlife protection as well as its role as a natural carbon sink mandates that government must enhance their environmental protection efforts during this time of crisis.

- ✔ Policymakers can opt for large-scale landscape restoration and reforestation efforts to create short-term (and mostly temporal) employment opportunities and longer-term environmental benefits such as watershed protection, better crop yields, and forest products (Hallegatte & Hammer, 2020b; Saha, 2020). Some countries such as South Korea have previously integrated green stimulus interventions such as river and forest restoration as part of their economic recovery in 2008/2009 (Strand & Toman, 2010; UNEP, 2009). Such large-scale green stimulus interventions in the land use sector need to be carefully designed to ensure long-term sustainability and should be mainly used in addition to ambitious green stimulus interventions in other economic sectors.

While interventions for reducing emissions and enhancing emissions from land use and land use change will be essential for achieving the Paris Agreement long-term temperature goal, these must not replace aggressive measures to decarbonise economies and rapidly reduce greenhouse gas emissions from burning fossil fuels (IPCC, 2019).

Early action is critical in the land sector as some options will lose their viability if they are delayed – for example, peatlands may degrade beyond repair if restoration is not urgently pursued, and any delay in mitigation that contributes to further warming could reduce the sequestration capacity of soils and vegetation (IPCC, 2019).



“Do No Harm” examples of actions to avoid in the land-use sector

Given the fragile state of ecosystems worldwide, governments must ensure that any interventions in the land-use sector as a response to COVID-19 respect the principle of ‘do no harm’:

- ✘ Governments should resist loosening - or entirely rolling-back - existing regulations. For example, the US EPA suspended its enforcement of environmental laws of air and water protection in March 2020 (Milman & Holden, 2020) – a move that had been favoured by many representatives of the oil and gas industry (Niranjan, 2020).
- ✘ Governments should avoid the dismantling of enforcement of state protection of natural habitats. For example, the Brazilian law enforcement has substantially scaled back field and monitoring missions in the Amazonian areas just before the start of fire season in April 2020 (Jordan & Athayde, 2020; Reuters in Brasília, 2020; Watts, 2020). While the spread of the COVID-19 pandemic might temporarily affect law enforcement operations, governments should make appropriate protection available for enforcement agencies' staff members to ensure continued operations.

Technical Annex

Short-term GDP Projection Data

Table A1: Yearly growth rates for various scenarios related to the COVID-19 pandemic and for comparison the pre-COVID-19 long term forecast of the OECD.

	2020	2021	2022	2023	2024
Non-COVID-19 reference OECD	3.47%	3.23%	3.10%	3.01%	2.95%
McKinsey A1	-5.00%	1.05%	2.08%	2.04%	
McKinsey A3	-2.50%	2.56%			
IMF Baseline	-3.00%	5.80%	3.10%	3.01%	2.96%
IMF long outbreak	-5.74%	6.78%	3.61%	3.22%	3.15%
IMF new_outbreak	-3.00%	0.77%	4.69%	3.88%	3.28%
IMF new_and_long_outbreak	-5.74%	0.93%	5.01%	4.15%	3.38%
WTO Optimistic	-2.50%	7.40%			
WTO Pessimistic	-8.80%	5.90%			

Uncertainty of emission projections

Figure 2 in chapter 2 contains the various model scenarios and are illustrated uncertainty range around the central linear estimate that is used for the emission projections in 2030. The limited number of scenarios only allows simple assessment of the prediction uncertainty by using the standard deviation of the scenarios of the linear model. Assuming a normal distribution results in a standard deviation (STD) for the emission intensity in 2030 of about ± 29 kt CO₂ eq / billion USD₂₀₁₀. Table A2 provides the GHG emission projections in 2030 for the central estimate and ranges for a possible lower (-1 STD) and upper (+1 STD) range complementing the data in Figure 4 in Chapter 2.

Table A2: Values and ranges of the GHG emission estimates for the year 2030

Green investment	GDP pathway	GHG emissions in 2030		
		central projection	lower estimate	upper estimate
Rebound to fossil fuels	pessimistic	55.1	50.8	59.4
	optimistic	61.2	56.4	66.0
Post-COVID-19 current policy	pessimistic	50.0	45.6	54.3
	optimistic	55.5	50.7	60.3
Weak green stimulus	pessimistic	39.6	35.3	43.9
	optimistic	44.0	39.2	48.8
Moderate green stimulus	pessimistic	31.8	27.5	36.1
	optimistic	35.4	30.6	40.2
Strong green stimulus	pessimistic	24.1	19.8	28.4
	optimistic	26.7	22.0	31.5

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The Climate Action Tracker (CAT) is an independent scientific analysis produced by two research organisations tracking climate action since 2009. We track progress towards the globally agreed aim of holding warming well below 2°C, and pursuing efforts to limit warming to 1.5°C.

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