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## Ensuring a Post-COVID Economic Agenda Tackles Global Biodiversity Loss

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### Summary

The COVID-19 pandemic has caused dramatic and unprecedented impacts to both global health and economies. Many governments are now proposing recovery packages to get back to normal, but the 2019 Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services Global Assessment indicated that business as usual has created widespread ecosystem degradation. Therefore, a post-COVID world needs to tackle the economic drivers that create ecological disruptions. In this Perspective, we discuss a number of tools across a range of actors for both short-term stimulus measures and longer-term revamping of global, national, and local economies that take biodiversity into account. These include measures to shift away from activities that damage biodiversity and towards those supporting ecosystem resilience, including through incentives, regulations, fiscal policy and employment programs. By treating the crisis as an opportunity to reset the global economy, we have a chance to reverse decades of biodiversity and ecosystem losses.

## Introduction

The COVID-19 pandemic has caused severe impacts to global economies on a scale not seen in more than a generation. Stay at home policies, widespread travel cancellations, and restrictions on many communal activities have all dealt a blow to daily economic interactions. Many affluent countries hit hard by the virus, including the US and countries within Europe, have been planning and implementing massive investments of government stimulus in attempts to stave off dramatically rising unemployment and risk of fiscal collapse. Many are casting these efforts as an attempt to ‘return to normal’ or ‘get the economy back on track’. But recent assessments of the state of planetary health from the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and other global bodies tell us that a return to normal, pre-pandemic business as usual is not acceptable, and will undermine future prosperity of humans and the planet.<sup>1</sup>

Rapid degradation of ecosystems and biodiversity over the past 50 years has put enormous stress on the natural systems that supply humanity with food, water and other benefits from nature.<sup>2</sup> The IPBES Global Assessment (GA) report, released in May 2019, linked these changes to direct drivers such as land and sea-use change (particularly agricultural expansion), direct exploitation of wild species, climate change, invasive alien species and pollution, all of which, in turn, are shaped by indirect drivers, such as demographic and social changes and economic interests.<sup>1</sup> In particular, the global economy has expanded rapidly over the last half century, and the accelerating scale of capital accumulation and trade flows in the contemporary era have led to telecoupled and spillover effects<sup>3</sup>, including large-scale habitat destruction that has been linked to the emergence of novel viral diseases, such as COVID-19 (Figure 1).<sup>4</sup> Such ecological degradation has long been known to pose substantial threats because of its potential to undermine the natural resources on which much economic activity is based, but until the emergence of COVID-19, such risks seemed distant to many.<sup>5</sup>

Now we are at a crossroads. We must not only address the short-term economic pain caused by the pandemic, but also think about what kind of economy we want and need for a sustainable, just, and equitable future in the long-term. Quick fixes to get economies back on track are likely to fail to address the deep pre-existing sustainability and inequality challenges we face, requiring care and consideration of nature and justice to be part of any solution. Evidence suggests that many citizens of the US and EU countries agree that a post-COVID-19 world must reflect attention to values like improving the environment, tackling climate change, and ensuring social equity.<sup>6</sup>

While many scientists and politicians have been making the arguments for a COVID-19 recovery that is low-carbon<sup>7</sup>, there has been much less attention to how to include biodiversity and ecosystems in such transitions. Discussions of nature-related actions related to the current pandemic have primarily focused on closing wildlife markets as a potential source of novel viruses, expanding protected natural areas, or reducing tropical deforestation.<sup>4,8,9</sup> While these can all be important actions, they do not necessarily get at the heart of the wider issues and drivers that create economic demands and ecological disruptions in the first place. Further, concrete policies to promote better management of biodiversity and ecosystems have not been prioritized in the majority of economic recovery packages; most proposed measures, when they include attention to the environment, have focused on climate. Only a few countries have identified nature-based investments or policies in their stimulus proposals (Figure 2), and even there, support is generally well under 10% of total funding.<sup>10</sup> A number of countries, the US and China among them, have allocated essentially zero stimulus funds to biodiversity or ecosystems.

In fact, there are a number of steps and policies that would aid economic reconstruction while at the same time addressing many of the root causes of biodiversity loss, including connections with zoonotic diseases. At the minimum, recovery packages should ‘do no harm’ to ecosystems, and at their most ambitious, longer-term efforts could transform the global economic system to better address a number of interlocked biodiversity, climate, and well-being challenges. We revisit some of the analysis from the IPBES GA to help provide suggestions on transforming economic processes, policies and institutions to reduce pressures on natural systems and encourage a resilient recovery, which in turn might make pandemics driven by the human-wildlife interface less likely in the future. The tools that we discuss below should be seen as a range of potentially useful options for a variety of actors and contexts; while not every country, locality or company will be able to do all of them, our analysis is meant to show that we do have a suite of approaches to rebound and restructure economies in an ecologically-transformative manner (Table S1).

## Immediate needs and short-term priorities

### *Shift from harmful subsidies to beneficial ones*

In an era of rising fiscal red ink, environmentally harmful subsidies make neither economic nor ecological sense. In 2015, agricultural support potentially harmful to nature amounted to US\$100 billion in OECD countries alone, while

fossil fuel subsidies, which generate both end carbon emissions and water and land pollution at sites of extraction, processing and disposal, range between US\$300-680 billion per year and result in estimated global damages of US\$5 trillion in reduced natural functioning, offsetting any economic advantage they confer.<sup>11</sup> Additionally, many governments subsidize fishing by national fleets, estimated to be over US\$35 billion per year, often encouraging overfishing and exceeding the net economic benefit obtained.<sup>12</sup> Overall, the amount of finance mobilized to promote and preserve biodiversity is conservatively estimated to be outweighed by environmentally harmful subsidies by a factor of ten.<sup>11</sup>

Subsidies are not in and of themselves inherently bad; they are a useful tool for governments to make investments in areas that can promote ecosystem resilience. However, many of the original goals of subsidies, such as maintaining economic viability of rural areas or supporting new industries, can be equally well achieved by promoting public goods rather than supporting over-exploitation. Yet subsidy reform is often challenged by vested interests<sup>13</sup>; for example, the recent turmoil in global oil markets has increased lobbying for retaining fossil fuel subsidies rather than ending them. Studies of subsidy reforms undertaken by a handful of countries suggest the need to: act quickly when presented with windows of opportunity that may be outside the influence of domestic policy makers and unrelated to the environment (for example, current health crises); build alliances between economic and environmental interests in common; devise targeted measures to address potential impacts on competitiveness and income distribution; build a robust evidence base on the social costs and benefits of reform; and encourage broad stakeholder engagement.<sup>14</sup>

Existing positive subsidies related to biodiversity that could be improved and expanded include support to farmers who conserve and better provision ecosystem health on their lands, an approach used in both the US Conservation Reserve Program and the EU Common Agricultural Policy (CAP). However, in both cases, positive subsidies to encourage environmentally-friendly farming practices (for example, conservation set-asides, organic agriculture, integrated farm management, and preservation of landscape of high-value habitats) are usually outweighed by other subsidies that lead to overproduction, agricultural expansion, or livestock production that contributes to greenhouse gas emissions.<sup>15, 16</sup> To achieve benefits from positive subsidies to agriculture, evidence suggests they need to be spatially targeted to areas of high biodiversity in order to disincentivize extensification, rather than current models of enrolling volunteers or larger farms, and focus on results-based payments for the most ecologically valuable practices.<sup>17, 18</sup>

One additional form of public subsidy that can be used to support biodiversity-friendly food production is through public procurement. Just as government purchases of medical supplies has spurred needed production for the COVID-19 response, the power of public purchasing of food grown using biodiversity-protecting approaches can increase local production of more sustainable food choices and encourage an upscaling of investments.<sup>19, 20</sup> While there have been strong debates about whether or not organic and other low-resource input agriculture may lead to lower yields, implying a risk of increased expansion of agricultural land, there is evidence that new forms of knowledge-intensive practices that are supported by and protect ecosystem services in agriculture can in fact deliver healthy, sustainable and affordable food, especially when combined with other measures, such as dietary changes to reduce consumption of meat and dairy.<sup>21, 22</sup> Specific sustainable intensification practices, depending on context, can include precision agriculture, enhanced biocontrol/integrated pest management, ecological infrastructure (e.g. grass strips or permaculture), and diversified agro-forestry or agro-pastoral systems; these approaches have in common a focus on improving agro-ecological functions such as nutrient cycling, soil conservation, and biodiversity promotion (especially for pollinators and soil health).<sup>23</sup>

### ***Expand new taxation policies for environmental harms***

Environmental policy has a long history of using environmental taxes to reduce pollution and increase resource use efficiency, such as gas taxes or plastic bag fees; however, very few direct consumption or other taxes have been designed specifically to preserve biodiversity. Many taxes on activities or products exerting negative (and often indirect) effects on ecosystems and biodiversity rely either on the polluter-pay principle or on the user-pay principle, which can serve to nudge people towards certain behaviours, but most existing taxes are too low to significantly reduce negative impacts.<sup>24</sup> Well-designed pricing mechanisms serve as both consumer incentives and can raise sources of revenue for local, state and national governments.<sup>25</sup> A wide range of ecosystem-related taxes could be increased and expanded, including resource extraction taxes (e.g. timber); pesticide taxes; diffuse pollution taxes, including water pollution charges and taxes; air pollution and gasoline taxes, given that air pollutants harm ecosystems through acidification and eutrophication of inland waters; carbon taxes; and waste and packaging taxes.<sup>26</sup> The experience of a recent increase in the carbon tax in France, which was met by protests from the Yellow Vests movement, may seem a discouraging example, but in fact well-designed taxes that include a way to address equity concerns so that they do not unfairly fall on certain populations are likely to receive more public support.<sup>27</sup>

For example, proposals for a carbon fee or tax that is paired with a dividend or rebate to households can help solve these problems, since a majority of mostly low and middle income families would receive more money back than they would spend in higher taxes in a progressively designed scheme.<sup>28</sup> Others have also suggested using carbon taxes to directly support biodiversity efforts, such as Costa Rica's fuel tax that funds payments for forest protection programs.<sup>29</sup>

Public education efforts are essential to convey the message that environmental taxes are incentives that have measurable environmental impacts and are not merely instruments for financing the state budget. Psychological factors also matter, and one promising approach is *bonus-malus* (Latin for good-bad) schemes, in which negative behaviours are taxed and positive ones subsidized; such a mechanism is widely used in insurance premiums and has a proven incentive effect. In France, a bonus-malus was applied to car purchases starting in 2009 according to their CO<sub>2</sub> emissions, leading to an increase in buyers of small-engine cars and an even bigger drop in purchases of large ones.<sup>30</sup> The idea could be adapted to budget-balanced 'ecological bonus-malus' schemes that punish or reward according to the damage to biodiversity inflicted or avoided.<sup>31</sup> Concerningly, however, rather than seeking to increase taxes on some industries causing environmental damage or pursue novel financing strategies, some post-COVID recovery packages are actually moving in the opposite direction by reducing taxes and relaxing regulations, a short-term strategy for economic stimulus that is likely to have longer-term negative health and environmental consequences (Figure 2, Table S2).<sup>32</sup>

Governments can also seek to reform tax havens and retain more revenue at home in an era of tightening belts. Offshore and hidden accounts reduce the amount of financing available to governments for global public goods provisioning and provide bad actors with opportunities to avoid financial scrutiny, reducing the impact of policies such as certification or supply chain monitoring. A recent study found that 70% of known fishing vessels implicated in illegal fishing are flagged in a tax haven, and that nearly 70% of foreign capital to the largest companies raising soy and beef in the Amazon, prime drivers of deforestation, were channelled through tax havens.<sup>33</sup> Preventing companies who use tax havens from reaping any benefits of post-COVID recovery money from public coffers is one possible approach.

#### ***Guide recovery to support biodiversity and do no harm***

In the short term, as the private sector seeks grants and loans to shore up payrolls and ensure the possibility of longer-term viability, governments can seek to prioritize support for those businesses that do not harm biodiversity and put restrictions on those that accept investment. For example, after the 2008-9 automotive company bailout in the US, the Obama administration had leverage to work with car manufacturers to increase fuel economy standards, and the 2009 American Recovery and Reinvestment Act provided numerous loans and tax credits towards greener vehicle development.<sup>34</sup>

Similar plans could be required for businesses receiving COVID-19 bailout funds, including having biodiversity risk mitigation plans, requiring disclosures of impact, or building ecosystem considerations into decision-making, particularly for industries with demonstrated impacts on and risks to biodiversity (e.g. agribusiness, apparel, mining, and energy among others).<sup>35</sup> Other relevant examples of conditionality could include requirements for the cruise industry to minimize their considerable contribution to ocean pollution<sup>36</sup> while airlines could be required to tackle reduced carbon emissions as part of their receipt of public funds (currently being required in France's stimulus). So far, Canada has proposed that bailout funds to large corporations will require adherence to carbon disclosure standards, while the 'no significant harm principle' of the EU states that none of the expenditures in the budget from 2021-2027 can be spent on things that would have negative impacts on environmental priorities. Beyond these examples, currently few strings are being attached to stimulus or bailout money in other countries. Conditionality measures and standards would need to be combined with transparency as to where bailout funds and stimulus investments are being directed, so as to harness public scrutiny of these efforts.<sup>37</sup> While there may be concerns that conditions on bailout assistance could technically affect competitiveness, bailouts can themselves confer an unfair competitive advantage; therefore, net outcomes would depend on the balance between these forces, and it can be reasonable to limit that advantage by imposing conditionality.

#### ***Fund ecosystem-focused work programs and income support***

In the immediate aftermath of the economic crisis, government-supported work programs can be essential in reducing widespread unemployment, and conservation jobs in particular can be scaled up rapidly. Just as the Works Progress Administration and Civilian Conservation Corps were used in the US during the Great Depression, jobs in ecological restoration and green infrastructure could be a source of both employment and ecological benefits.<sup>38</sup> Given current demands for increased racial justice, and the disproportionate impact COVID-19 has had on communities of colour in the US in particular, such employment programs can be targeted to these harder-hit areas,

such as in urban ecosystem restoration and green infrastructure.<sup>39</sup> A recent survey of economists found that stimulus measures focused on green sectors (both biodiversity and climate) were rated among the most positive potential measures, delivering both short and long term economic and societal benefits, while airline bailouts were rated as the worst stimulus option.<sup>7</sup> Experience shows that these investments work; marine restoration projects funded as part of the American Recovery and Reinvestment Act (ARRA) in 2009 generated more jobs per million USD invested than many other sectors, such as fossil fuels.<sup>40</sup> A study submitted to Australia's government estimates that AUS\$4 billion in conservation-oriented post-COVID stimulus would create over 50,000 jobs working on nature-related activities.<sup>41</sup> Many payments for ecosystem services (PES) programs globally have been used to support employment in activities such as invasive species removal, reforestation and restoration, and other investments in both people and nature and these could be rapidly upscaled as they usually have more demand than finances allow.<sup>42</sup>

The COVID-19 pandemic has also opened space for consideration of emergency “universal basic income” (UBI) proposals, such as paying US\$2000 per person monthly until the pandemic subsides, as a quick, efficient, non-bureaucratic method to put cash into people's hands.<sup>43</sup> There are a range of potential variations on UBI as a way to realise a ‘social protection floor’, an idea that was approved at the 2012 UN Convention on Sustainable Development Rio+20 conference. UBI in developing countries can be a particularly useful way of alleviating poverty, which in turn can have knock-on effects such as preventing deforestation.<sup>44</sup> In developed country contexts, UBI can be more controversial, in part because of its apparent cost, and in part because of arguments that more benefit can be achieved with a given amount of revenue through more targeted or conditional benefits (e.g. means-tested welfare payments, or unemployment insurance).<sup>45, 46</sup>

What has often gone unmentioned in these discussions is that UBI could have biodiversity impacts as well, although the overall environmental consequences of UBI are still under discussion, with little empirical evidence so far.<sup>47</sup> A subsistence-level UBI has been suggested as a way to facilitate simpler lifestyles with smaller ecological footprints, and to valorise unpaid work (often performed by women) such as child raising, work in the arts, or volunteer activity that typically has a lower carbon footprint than paid labour but which provide significant public benefits.<sup>48</sup> Recent proposals for a “conservation basic income” have made the argument that poverty alleviation and environmental goals could be packaged together and applied to everyone living near areas of high conservation value.<sup>49</sup> The cost of UBI subsidies could be raised via environmental sources like carbon or pollution taxes in which the revenue is then redistributed, or by redesigning development aid to recipient countries. Other related programs, such as conditional cash transfers (CCT), have shown that direct payments can result in both positive and negative environmental behaviours depending on context and thus must be designed carefully; one recent analysis of a CCT program in Indonesia shows that it reduced deforestation, although it was not designed for conservation ends<sup>50</sup>, while a CCT in Sierra Leone was associated with higher rates of forest clearance.<sup>51</sup> Overall, the effectiveness of payments (conditional or not) will be dependent on whether incentives are structured in appropriate ways, and whether the hoped-for pro-environmental outcomes are considered locally legitimate.<sup>52</sup>

### **A roadmap for longer-term economic strategies**

In the longer-term, both governments and market actors must aim to achieve a more sustainable economy that better integrates the protection of nature. The GA assessed a series of possibilities, based on evidence of effectiveness of existing policies and scenarios of what future worlds might look like, declaring a need for “incorporating the reduction of inequalities into development pathways, reducing overconsumption and waste and addressing environmental impacts, such as externalities of economic activities, from the local to the global scales.”<sup>1</sup> Below we focus on some key steps that can be taken to ensure such transformative economic changes (Figure 3).

#### ***Rethink production and supply chain models***

Shorter and more localized supply chains are likely to be inevitable in a post-COVID-19 world, as the current just-in-time models have revealed themselves to be vulnerable to interruptions.<sup>53</sup> Many already faced systemic risks inherent in tightly connected yet fragile commodity chains and the dependency of businesses on ecosystem services that are overused or increasingly homogenized.<sup>54</sup> For example, over the past several decades, commodity chain verticalization in agribusiness has created the conditions for overproduction, driven in part by private equity investments that pressure many producers to cut costs, the collapse of international commodity agreements that have resulted in increased production even when not met by demand, and current trade rules that encourage unsustainable sourcing.<sup>55</sup> The experience from COVID-19 is likely to significantly alter a number of production systems, thus there is a need to be proactive in maximizing positive ecological impacts and minimizing negative welfare impacts of supply-chain changes.

Food production is the supply system of primary global concern; some national governments have restricted exports of food in response to the crisis, and many are now seeking to balance food security concerns with

developing more localized supply chains that can contribute to food sovereignty.<sup>56</sup> Shortening food chains involves reducing intermediaries (such as wholesalers, processors, or shippers) and focusing on better linking supply with markets, including direct-to-consumers (e.g. farmers' markets, community-supported agriculture), expanded community food production (e.g. urban gardens, seed exchanges), and decreased corporate control (e.g. cooperatives rather than vertically-structured agribusinesses).<sup>57</sup> Such steps have the potential to lead to local foodsheds that increase traceability and consumer confidence, improve product quality (including freshness and health concerns), as well as to lower environmental impacts (including reduced packaging, decreased food waste, and closing nutrient cycles, although the impact on carbon emissions remain highly dependent on context).<sup>58</sup> However, shifting from global supply chains to more localized production will be challenging in balancing efficiency with resilience, and will need to be planned with the participation of multiple stakeholders, including consumers. While some previous studies of "buying local" have warned about decreasing welfare from less consumption due to higher prices<sup>59</sup>, from a sustainability perspective, this definition of welfare is inadequate. There are also non-economic social benefits of shorter supply chains that can be recognized, including reconnections of cities and neighbouring rural populations and fostering senses of stewardship, culture and place.<sup>60</sup>

At the same time, global trade will continue to be needed, particularly as many areas cannot supply sufficient food locally.<sup>61</sup> Thus these efforts can be supported by reformed trade agreements, which need to shift from their dominant focus on trade liberalization towards securing fairness, equity and sustainability, including rules that provide greater policy space for governments to prioritize and support local production standards.<sup>62</sup> Work within WTO has aimed at eliminating economically distorting subsidies, but could be expanded by creating a true "green box" for biodiversity-friendly initiatives to encourage elimination of ecologically harmful subsidies and overproduction stimulated by trade. Other trade reforms include the EU's consideration of carbon border taxes to discourage leakage, and similar steps could be taken for green production supply chains that avoid land-based emissions and preserve biodiversity in particular.<sup>63</sup> Reforming global trade and production will also require multinational corporations to move away from the paradigm that their primary business aim is to maximize dividends for shareholders, which often encourages unsustainable overproduction.<sup>64</sup>

### ***Rethink ways to reduce excess consumption***

Consumption is a major driver of unsustainable production, and the GA noted that countries could focus on "improving standards, systems and relevant regulations aimed at internalizing the external costs of production, extraction and consumption (such as pricing wasteful or polluting practices, including through penalties); promoting resource efficiency and circular and other economic models; voluntary environmental and social certification of market chains; and incentives that promote sustainable practices and innovation."<sup>65</sup> The COVID-19 pandemic may accelerate trends towards reduced consumption, given massively reduced travel and rethinking of what counts as a good quality of life.<sup>65</sup> However, many immediate stimulus measures that have been proposed focus on *increased* consumption, such as reductions in VAT taxes, without much attention to the ecological impacts of such actions (Figure 2, Table S2).

Steps to reduce excess consumption can include both incentives and regulations: targeting consumer behaviour with tools such as education initiatives, choice architecture, and collaborative consumption (such as sharing and reuse), as well as resource use caps and taxes and changes in subsidies that encourage overproduction.<sup>66</sup> Concerns about 'individual choice' likely need to be reframed in terms of 'freedom to enjoy a good quality of life within ecological boundaries' in order to foster more support for such ideas. Universal agreement on what upper consumption limits should entail is not likely to be achieved, but work on how to operationalize concepts like 'consumption corridors' and 'doughnut economies' for acceptance by the public is gaining political traction.<sup>68</sup> The concepts of circular economies and decoupling resource use and economic growth (or even exploring degrowth) are also increasingly popular topics of discussion and research, but not yet widespread in empirical practice.<sup>69</sup> Some have posited that transitions within economic sectors, such as from resource-intensive production of natural resources to more service or financially-oriented economies (which may be accelerated by COVID-19 work-from-home trends), would lead to smaller environmental impacts. Evidence suggests, however, that consumption by those working in the services sectors may outweigh gains from shifts in production, indicating that both production and consumption strategies need to go hand in hand.<sup>70</sup> Overall, the conclusion of several recent reports is that no sustainable future that meets both human needs and stays within planetary boundaries is possible without decreases in excess consumption.<sup>71,72</sup>

### ***Shift fiscal policies to reflect environmental values***

Currently governments have a great deal of concern about how they will balance budgets and manage long-term fiscal stressors, particularly subnational authorities with yearly requirements for balanced budgets and the inability to borrow or go into debt. This is forcing hard choices that have long-term consequences; for example, New York

City, facing a budget deficit of US\$7 billion in lost tax revenue since the pandemic, has proposed a more than 10% cut to the city's parks department budget, despite green space having been an important physical and mental health benefit during lockdown policies.<sup>73</sup>

In light of these challenges, ensuring that state fiscal policies continue to reflect environmental values is important, and novel financing can help subnational areas balance their budgets. For example, ecological fiscal transfers (EFT) are a policy instrument used to redistribute tax revenues among public actors based on ecological or conservation-related indicators (such as the quantity and quality of protected areas or forest areas). These fiscal redistribution formulas can be a means to compensate municipalities for their conservation expenses or paying for the spillover benefits of related areas beyond municipal boundaries.<sup>74</sup> To date, there are only a few countries globally that have implemented EFT (such as Brazil, India, Portugal and France), although there is good potential to do so with low transaction costs.<sup>75, 76</sup> For example, in 2015, India started distributing 7.5% of its national-level tax revenue based on state forest cover indicators, and from 2020 onwards will use 10%.<sup>77</sup> Such approaches can be encouraged and expanded to assist local governments in supporting conservation while also providing opportunities for citizens to enjoy more green spaces.

### ***Incentivize financial sector on nature-related risks***

For the financial sector, including banks, wealth and pension funds, private equity, insurance companies, and others, a mix of regulations and incentives can encourage investments in industries and technologies that reduce pressures on nature.<sup>78,79</sup> The FIRE sector (finance, insurance and real estate) is increasingly implicated in biodiversity loss; for example, privately funded large-scale land acquisitions in many tropical countries, particularly for export commodities, have been linked to higher rates of deforestation, even outside the investment lands<sup>80</sup>, and increased farmland prices resulting from investments in specialized real estate trusts may drive agricultural expansion that leads to ecosystem alteration.<sup>81</sup> Trends towards securitization, represented in commodity index funds, futures markets, and derivatives markets have grown dramatically, are increasingly complex and often traded in algorithmic automation, and are mostly disconnected from actual material flows of goods.<sup>82, 83</sup> Futures contracts are a key factor in the production and trade of agricultural commodities such as soy, coffee, and palm oil, and while they offer potential income stability to manage risks for producers, they are also an opportunity for speculation and hedging on price movements that have environmental implications. While there is a robust debate on whether agricultural derivatives markets contributed to higher and more volatile food prices in 2007-8, there is growing evidence that speculation at least played a role in exacerbating price spikes, which in turn drove investment in the expansion of production.<sup>84</sup>

As such, a precautionary approach with respect to financial speculation and nature-related financial risk is warranted, given potentially catastrophic tail risks or tipping points that remain largely unknown and are inherently difficult to predict accurately.<sup>54, 85</sup> As has been recently experienced with both pandemics and climate change, the potential negative economic impact of finding oneself on the wrong side of such tail risks is so high that the most economically efficient approach would be to err on the side of caution.<sup>86</sup> The 2008-9 market crash was partly driven by a change in asset value behaviour at the margins and consequently inspired a set of precautionary financial regulations<sup>87</sup>; thus similar investments that could cause multi-trillion dollar losses through environmental harms could be considered at least as risky, and regulated accordingly.<sup>78, 88</sup>

Given the importance of understanding and managing risk, engaging the financial sector can therefore be an important potential pressure point to curb the negative impacts of public and private actors on the environment.<sup>89</sup> <sup>90</sup> The Network for Greening the Financial System has noted that central banks can play a key role to ensure environmental standards are set and met, with the EU's new sustainable finance guidelines as one example; these standards provide for liability of banks for the socio-environmental impact of their investments, and could be accelerated in the post-COVID recovery.<sup>91</sup> Indeed, research shows that banks that adopt environmental standards show less exposure to risk.<sup>92</sup> Emphasizing the risks of 'stranded assets' (such as oil reserves) has been an effective strategy to guide divestment in the fossil fuel sector<sup>93</sup>; this model could be translated to biodiversity concerns, such as by emphasizing the risks that come with agribusiness investments that might have liabilities around pesticide pollution or loss of crucial pollinators.<sup>94</sup>

While securities, derivatives, and other speculative financial instruments can bring considerable ecological and economic risks, more secure options exist in capital markets, such as 'green' bonds, which raise funds for both private and public investment in sustainable projects, and these may seem more attractive in a recovery economy. Green bonds have raised hundreds of billions for renewable energy and infrastructure for low-carbon futures<sup>95</sup>; however, similar initiatives for biodiversity are not yet in place, as less than 3% of the existing bond market goes to agriculture and forestry investments.<sup>96</sup> Green Investment Banks (GIBs) are another tool being pioneered, with government guarantees, insurance or minimum returns on investment as inducements to increase private financing.



While most GIBs have targeted low-carbon infrastructure, there is potential for these banks to extend their work in biodiversity investments (e.g. in ecological restoration).<sup>97</sup>

Improved financial standards also need to be tied to public disclosure of information. Studies of corporate social responsibility standards, labelling and certification, and other voluntary actions suggest that these approaches can be effective given the right circumstances.<sup>98</sup> For example, a small number of asset managers and institutional investors hold considerable shares of companies implicated in ecosystem changes in the Amazon and boreal forests, which could be a leverage point.<sup>99</sup> Shareholder activism and socially-conscious investment around climate often uses information from the Carbon Disclosure Project to evaluate risks and impacts of participating corporate entities<sup>100</sup>; similar reporting and disclosure around biodiversity and ecosystem impacts could help direct investment as well as provide reputational boosts.<sup>101</sup> However, these voluntary instruments are usually limited due to a lack of systematic monitoring and reporting of impacts of sourcing practices; concerns about ‘greenwashing’; and insufficient economic benefits for companies to adopt sustainable practices in the first place.<sup>102</sup> Investment standards and statutes could expand fiduciary responsibilities to address some of these problems<sup>103</sup>; for example, use of third-party beneficiary standing would allow outside parties to take legal action if principles adopted by companies are not followed.

### ***Ensure continued international conservation funding***

Although governments will be financially strapped for the foreseeable future, there will still be a need to support global funding for conservation and sustainable development initiatives, both in the immediate short-term as well as over time. Currently, most countries spend only a fraction (less than 1%) of their GDP on ‘biodiversity-related activities’, either for domestic support or foreign environmental aid<sup>104</sup>, and while private investment has been substantial in the past, it is likely to be under strain given current economic challenges.<sup>105</sup> Even before the pandemic, existing funding was insufficient: for example, fully implementing activities under the existing Aichi Biodiversity Targets was estimated to require up to US\$440 billion in investment to seriously tackle biodiversity loss.<sup>106</sup> Increasing corporate contributions towards conservation, such as from agribusiness and fishing industries that depend on healthy ecosystems, has been suggested as part of a revamped global biodiversity accord.<sup>107</sup>

Now, needs are even greater. Rising unemployment and food insecurity in the global South as a result of COVID-19 will likely increase pressure on local ecosystems, such as expansion of agriculture or the wildlife trade, which enhances the risk of future epidemics. There is already evidence that falling ecotourism dollars and reduced ranger activity as a result of COVID-19 has had seriously negative consequences in many conservation areas.<sup>108</sup> Some small-scale fisheries, which employ 90% of people in the fishing industry, have virtually collapsed as China has no longer imported their products since the virus emerged.<sup>109</sup> Thus ensuring employment and livelihood protections for these workers in resource sectors and expanding conservation areas has been suggested by some NGOs as a priority for global aid packages.<sup>110, 111</sup> However, increasing funding for nature conservation alone will not be sufficient if the indirect drivers of biodiversity loss are not addressed, and therefore needs to be in concert with the other steps outlined above, some of which can raise potentially significant amounts of revenue to help close funding gaps.<sup>112</sup>

### ***Address inequality in sustainable recoveries***

Economic inequality is problematic on its own, but it also generates poorer environmental outcomes; for example, income inequality is associated with excess consumption and higher carbon emissions among richer classes<sup>113, 114</sup> and more unequal countries also tend to have higher rates of loss of biodiversity.<sup>115</sup> Inequality works in several ways, by both increasing risks and changing collective incentives to tackle environmental problems. For example, burdens of environmental risk also tend to fall on those of lower income classes; poorer and minority communities often face ‘pollution inequity’, in that they are not just exposed to more pollution but their ecological footprints are smaller and they cause less pollution.<sup>116</sup> Inequality can also decrease people’s motivation to participate in biodiversity conservation measures if they do not see the potential benefits of doing so<sup>117</sup>, and can undermine democratic decision-making to protect collective public goods.<sup>118</sup>

Traditional policies to tackle inequality, such as fairer taxation, fees on wealth transfer, and other measures, can be combined with attention to biodiversity: for example, VAT taxes on luxury goods with higher negative environmental costs.<sup>119</sup> Minimum wage policies also have potentially positive environmental impacts<sup>120</sup>, and sustainable life cycle assessments for products could, for example, include living wages for employees as a criteria.<sup>121</sup> Moving towards a more sustainable economy may create inequalities in and of itself, such as job displacements in certain sectors (e.g. fossil fuels).<sup>122</sup> The concept of just transitions captures the idea that any transformation to a more sustainable economy should not fall on the backs of those already suffering

disproportionate impacts. Combining economic measures to reduce inequality with stimulus investments in major retooling of energy, land use and other sectors can help facilitate this more just transition.<sup>123</sup>

### ***Adopt new economic metrics and models***

The GA called for “a shift beyond standard economic indicators such as Gross Domestic Product (GDP) to include those able to capture more holistic, long-term views of economics and quality of life.”<sup>121</sup> Changing the metrics used to assess the economy reflects the increasing evidence of the limitations and biases of dominant measures of welfare such as GDP and the ways in which they promote economic growth and associated unsustainable practices.<sup>124</sup> Replacing or broadening them with alternative measures of social welfare would allow inclusion of diverse values and indicators of well-being.<sup>125</sup> Metrics like the Index of Sustainable Economic Welfare or the Genuine Progress Indicator (GPI) often subtract ‘bads’ like environmental degradation and biodiversity loss in monetary terms and add in “goods” not traditionally included in GDP, such as the value of unpaid work.<sup>126</sup> Other approaches such as Material Flow Accounting and Natural Capital Accounting that incorporate environment and ecosystems, and which can account for the movement of resources across geopolitical borders, have been developed in the past two decades.<sup>127, 128</sup> Increasingly, accounting systems such as the UN System of National Accounts are adopting these new metrics<sup>129</sup>, and local, regional and national governments have shown interest in these measures as well.<sup>130</sup> While there is as of yet insufficient empirical evidence of the effectiveness of the new environmental accounting approaches, they are helpful as a tool to facilitate dialogue on the diverse values of nature.

### **Conclusion: Envisioning a Sustainable Economic Future**

Disruptive change has been identified as an important impetus to dramatic sustainability transformations.<sup>131</sup> We currently have a unique opportunity to seize the moment and consider the economy we want and need for a sustainable, just, and equitable future in a post-pandemic world.<sup>132</sup> Simply tinkering with the status quo was always likely to be inadequate to meet the large-scale challenge represented by the biodiversity crisis, therefore taking advantage of the current COVID-19 situation to change course and rethink both conservation and how we manage the global economy is opportune.<sup>133, 134</sup> Societies now have to decide if they try to get back on the previous development path, or define a new one. Most of us have now had novel experiences around what is truly ‘essential’ during a pandemic, and insofar as the definition of sustainability includes providing what is necessary for a dignified and good quality of life within planetary boundaries, the baseline for this has likely shifted since early 2020.

Social tipping points are defined as the emergent thresholds where small socio-economic changes may suddenly shift into nonlinear outcomes, often driven by positive feedback or cascading mechanisms.<sup>135</sup> Although there is disagreement as how these tipping points emerge, examples of these ‘contagious processes’ include rapid technological uptake, changing social norms and behaviours, and economic shifts that are hard to predict but often take on a life of their own.<sup>136, 137</sup> External shocks may (but not always) precipitate such tipping points, and there are numerous examples of both positive and negative policy change in the aftermath of crises, including the passage of the Clean Water Act in the US after widely-publicized river disasters, or Germany’s shift away from nuclear power after the Fukushima nuclear accident of 2011.<sup>138, 139</sup> What these ‘focusing events’ have in common is that they are nonroutine, such that existing interest groups become disrupted and new coalitions come about, political and policy learning rapidly increases, and crisis management becomes valued in the aftermath.<sup>140</sup> Thus successfully translating shifts in norms or new baselines for action into agenda setting and policy diffusion for sustainability is likely to require new interest group engagement, diffusion of ideas through social networks, and acknowledgement of the value of multiple scales for action.<sup>141, 142</sup> At the same time, corporations seeking transformative change have utilized strategies that have included a mix of information sharing on new practices, corporate leadership, and political coalition building.<sup>143</sup> (Figure 4)

To date, however, paths toward a remade post-COVID world have been limited. While there was extremely rapid policy action in the stay-at-home orders and enormous budgets that were passed for economic relief, the fact that we are not seeing significant progress on tying stimulus measures to more fundamental recalibration is worrisome, and indeed, some post-COVID recovery measures are taking us in the wrong direction. Reducing taxes, subsidizing fossil fuel production, and relaxing environmental regulations are all ‘recovery’ steps currently being taken by countries from Canada to Vietnam (Figure 2, Table S2). Even more ambitious proposed policies, like the Green New Deal in the US, which focuses on investments in both low-carbon infrastructure and ecological restoration, tackles problems primarily through a vision of expanded Keynesian economics.<sup>144</sup> Such an approach does not adequately address the larger issue of how to reform the global economic drivers of biodiversity loss and climate change we have outlined here, such as telecoupled international trade and financialization of production.

Integrating nature across economic and public sectors will require bold visions that few countries seem willing to undertake, although a handful of roadmaps to ‘build back better’ have been proposed by influential

organizations.<sup>145, 146</sup> Piecemeal steps, particularly those that treat biodiversity, climate and COVID as separate problems are unlikely to bring about transformative change, and there is evidence for public support in the US at least for combining climate, social, and economic policies together.<sup>147</sup> A toolbox approach, such as that presented here, in which a range of options are assessed and deployed in policy mixes is likely to be more effective than single silver bullet solutions, and clear linkages between short-term recovery and longer-term investment is needed.<sup>25</sup> This is because our existing problems are complex with numerous drivers and hence many tools are needed over time, but also because political necessity requires a range of options that appeal to different audiences and which can be taken up by different actors.<sup>31,54</sup>

How to move policymakers or business leaders to increase their ambitions remains a crucial question, but major environmental reports, including the GA and the recent finding that countries have missed all twenty Aichi targets, have drawn attention to the lack of progress towards sustainability, revealing the limits of our current approaches and the slowness of change.<sup>148</sup> The COVID crisis may have provided an opening for possibilities that were not available even six months ago, as the public has increased their expectations of engagement from multiple levels of government and the private sector. Overall, envisioning and implementing a new economic paradigm that tackles the many challenges we face will be a substantial task, requiring a transformative vision that takes advantage of this unique crisis situation before us; such an approach will entail a reshaping of the multiple incentives and policies that steer the global economy in ways that preserve, rather than undermine, biodiversity and which sets our world on a path to ecological and social sustainability.

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#### **Declaration of Interests**

Pamela McElwee is on the Advisory Board of One Earth. The other authors declare no competing interests.

#### **Resource Availability**

##### **Lead Contact**

Further information and requests for resources should be directed to and will be fulfilled by the Lead Contact, Pamela McElwee ([pamela.mcelwee@rutgers.edu](mailto:pamela.mcelwee@rutgers.edu)).

##### **Materials Availability**

This study did not generate new unique materials.

##### **Data and Code Availability**

The data on existing and proposed COVID recovery plans generated during this study for Figure 2 were generated from the websites <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19>, <https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions>, <https://www.energypolicytracker.org/region/g20/> and <https://www.climateinteractive.org/ci-topics/great-recovery-policies/>. Links to the sources for specific monetary values can be found via a dataset available at Mendeley: <http://dx.doi.org/10.17632/whf4hkfwdx.1> and in Table S2.

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### Figure 1. Economic Drivers of Biodiversity Loss and Ecosystem Change

The Global Assessment identified five main direct drivers of ecosystem change over the past 50 years (orange circles), leading to different aspects of nature decline (green circles). Economic pressures were identified as a key indirect driver in the GA, and important elements of changes in economic supply and demand that drive ecosystem loss are shown here (blue circles).

### Figure 2. Post-COVID Economic Stimulus and Recovery Packages

As of September 15, 2020, a number of governments have adopted or proposed economic recovery packages, including stimulus funding, in response to the COVID-19 pandemic. Only a limited number of countries have included climate or biodiversity measures in their packages, and a number have introduced measures that would have negative impacts (such as reducing environmental taxes or regulatory enforcement). Data on recovery proposals for selected countries can be found in a public dataset as noted in Resource Availability.

### Figure 3. Actions to Reform the Global Economy to Reduce Impacts on Nature

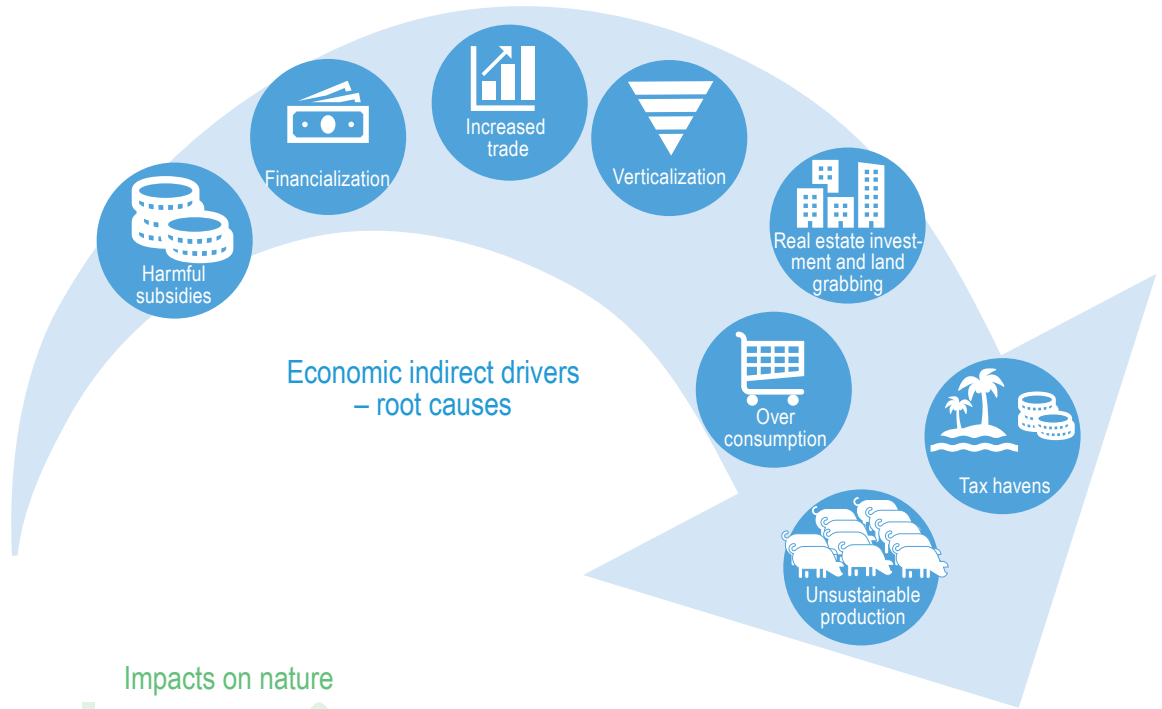
Both short and long-term actions across multiple sectors and actors are needed to address global economic impacts on biodiversity.

### Figure 4. Enabling Policy Change through Crises and Social Tipping Points

Both 'social tipping points' (in which small changes move across a threshold into a rapid non-linear transformation), and external crises (such as disasters) create new ways of envisioning and engaging in policy change. Empirical examples of policy change suggest that new agendas are set and policies diffused through several mechanisms within both government and the private sector.

# Government fiscal policy and budget

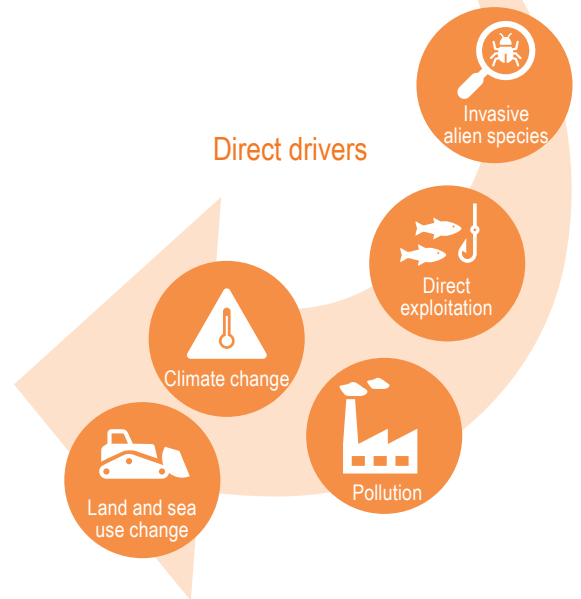
# Markets and economic growth

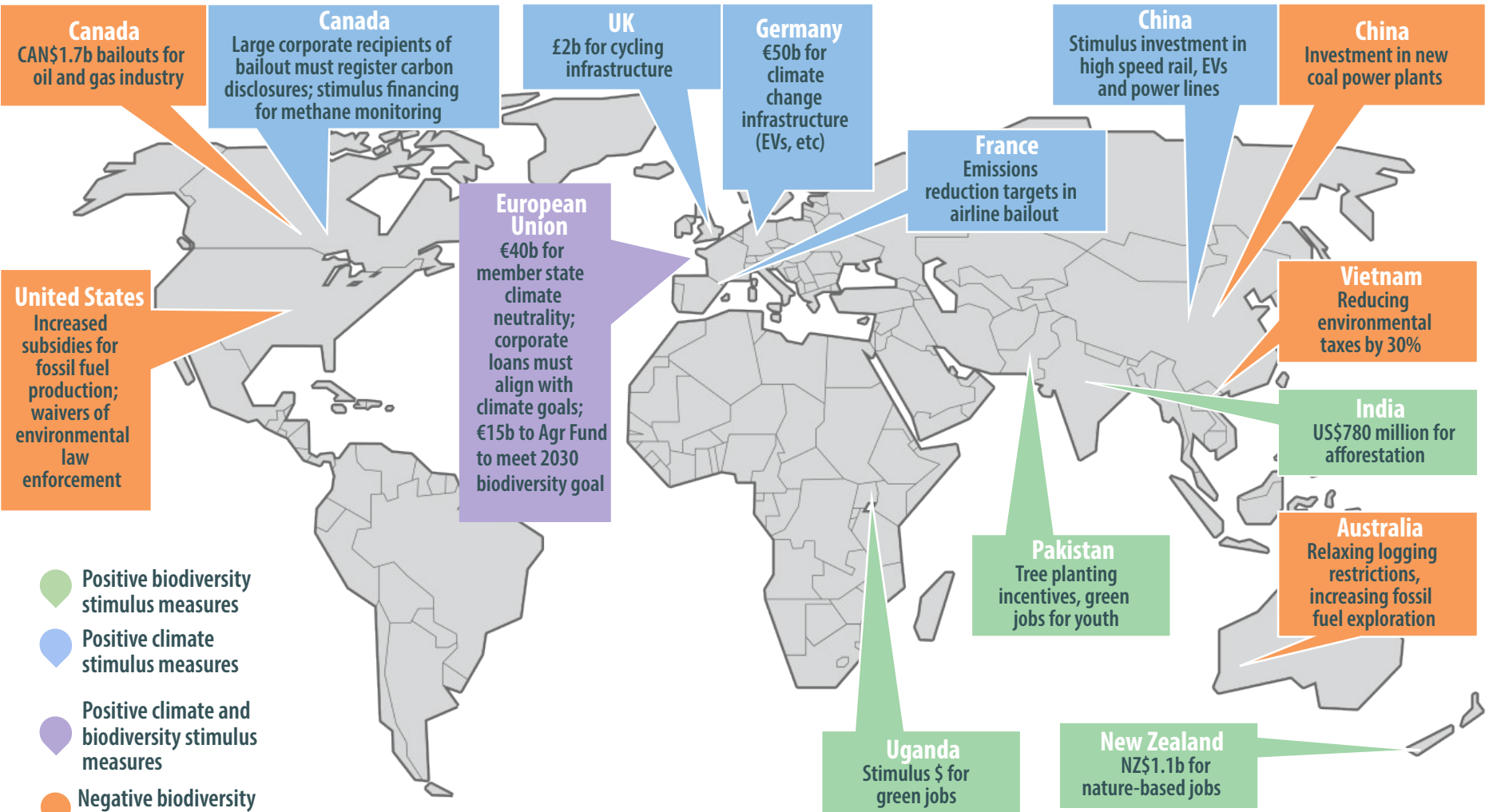


## Impacts on nature



## Direct drivers





- Positive biodiversity stimulus measures
- Positive climate stimulus measures
- Positive climate and biodiversity stimulus measures
- Negative biodiversity or climate measures

## Short term actions

Government monetary & fiscal policies

- Eliminate harmful subsidies and shift to positive ones
- Public procurement of sustainable goods
- Increase public support for sustainable agriculture
- Increase environmental taxation, including bonus-malus schemes and offshore accounts
- Stimulus relief funds criteria



Private sector

- Meet bailout conditionality
- Increase standards for greener private investment
- Shorter & sustainable supply chains



Employment policies

- Green work programs and payments for environmental services
- Universal Basic Income



## Longer term measures

Government monetary & fiscal policies

- Central bank risk measures & sustainable finance guidelines
- Ecological fiscal transfers
- New institutions to encourage private financing
- Reduce inequality through tax and wage policy, ensure just transitions

Private sector

- Rethink production models and create more resilient supply chains
- Improve circular economies
- Incentivize greener private investment
- Disclosure standards, reporting & liability

Consumers

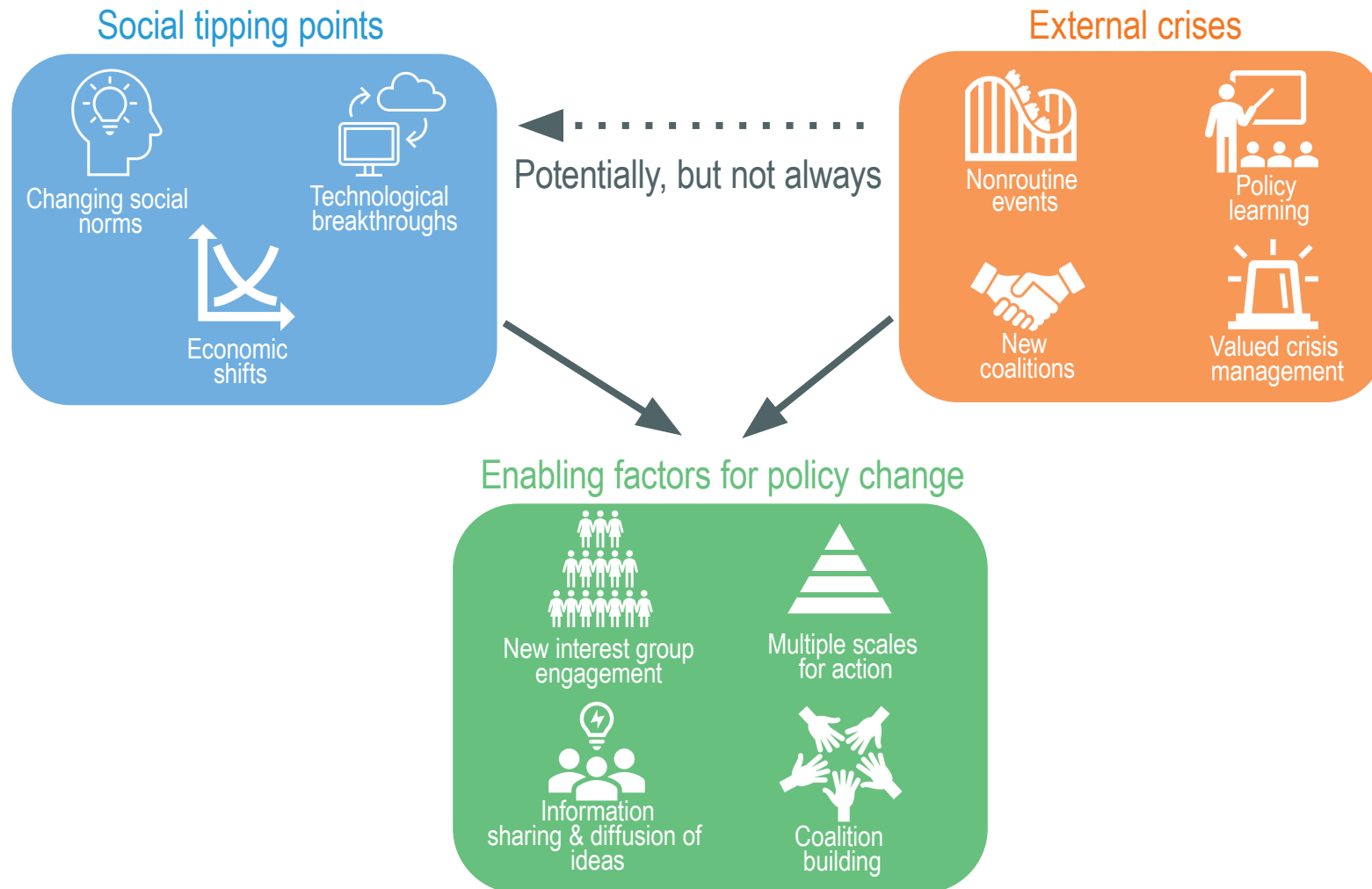
- Rethink excess consumption through nudges, caps and taxes

Trade & aid

- Fairer trade rules
- Ensure international aid & funding

Metrics

- Alternative measures of social welfare
- New metrics for environmental goods and bads in accounting



**Table S1: Key Policy Concepts and Existing Implementation**

Term	Definition	Where currently used & by what actors
<b>Public fiscal policies</b>		
Environmentally harmful subsidies	Government budget support for activities potentially harmful to nature, often with price distorting effects. Can include income or price supports, tax exemptions, direct payments, and other mechanisms.	Number of national governments to support fossil fuels, agriculture and fishing (e.g. US tax code that allows tax exemptions and changes in depreciation for oil & gas production)
Positive subsidies	Government budget support for activities beneficial to nature, often designed to correct market failures or generate environmental services/benefits	Used by national governments (e.g. US Conservation Reserve, EU Common Agricultural Policy) and subnational governments (e.g. tax exemptions and budget support)
Green public procurement	Use of public purchasing contracts to buy goods with reduced environmental impact; can serve to drive innovation or lower prices for goods.	National, subnational and local government entities (e.g. school districts, transport agencies); nearly all OECD countries have some form.
Ecological fiscal transfers	Use of ecological indicators (such as forest area) as part of fiscal redistribution formulas (e.g. from central governments to municipalities)	EFT is used in Brazil to distribute state-level value-added tax, and in Portugal, France and India to distribute national-level tax revenues to lower governments.
Environmental taxes	Aimed to reduce pollution and increase resource use efficiency by raising the cost of activities	National, subnational and local governments in many parts of world. Examples include timber extraction taxes; pesticide taxes; pollution taxes; carbon and gasoline taxes; and waste and packaging taxes.
Border adjustment taxes	A tax levied on goods based on the site of their end consumption, rather than production. Can be used to counteract imports produced in places without carbon taxes or regulations (e.g. to avoid leakage)	EU has considered placing a BAT tax on imported goods based on their carbon emissions, as EU producers have been subject to carbon emissions pricing since 2005.
Bonus-malus policies	Negative behaviors are taxed and positive behaviors subsidized; for example, high emissions vehicles have a higher price while low emissions receive rebates.	Commonly used by businesses (e.g. automobile insurance premiums that go up after an accident). France and Italy have national CO <sub>2</sub> -based bonus-malus for vehicle purchases.

Green employment	Public financing of job creation in 'green' sectors or industries, for example in ecological restoration or building low-carbon infrastructure	National and subnational governments provide a number of grants and job guarantees that can be used to boost employment (e.g. US Clean Water State Revolving Funds)
Universal Basic Income	Everyone regardless of income level received a fixed amount of money from the state that is not conditional.	Spain is currently piloting a UBI of up to €1015 a month, but it is not universal (only for poorest households); other small pilot tests in recent years in Kenya and Finland.
Just transitions	Idea that any transformation to a more sustainable economy should have mechanisms to support those who may suffer financially (e.g. loss of jobs in fossil fuel industries as result of carbon regulations)	International Labor Organization has issued just transition guidelines. Many countries have included welfare support for communities impacted by fossil fuel regulations, including Germany, Costa Rica and Spain. Most funds pledged used for retraining of workers.
<b>Private sector investments and policies</b>		
Bailout conditionality	Conditions attached to the acceptance of loans or other financial assistance.	Corporate bailouts with public money have used conditionality in past (e.g. US auto industry bailout in 2009 that coupled higher fuel efficiency standards).
Biodiversity risk mitigation measures	The use of assessment tools to avoid damage to biodiversity from policies or investments	Lenders and businesses often use multiple tools to screen for risk (e.g. Equator Principles for financial institutions; Social and Environmental Impact Assessments for corporations). Governments often use 'mitigation hierarchy' in decisions on biodiversity risk.
Disclosures of biodiversity impact	Corporate reports on non-financial impacts that are released to shareholders and public; such disclosures aim to provide transparency around risks	Some companies in France are required by the Commercial Code to disclose biodiversity impacts in reporting; the Global Reporting Initiative is example of voluntary assessment.
Regulations on securitization	Reducing nature-related financial risk by tightening restrictions on securitization (bundling of nontraded assets or debt and risk transformed into a tradable asset)	Regulations on commodity index funds, futures markets, and derivatives markets are in place in some countries, although there has been a trend towards deregulation (e.g. Commodity Exchange Act in the US). Most new regulations (Dodd-Frank in US, MiFID II in EU) not specifically designed for biodiversity impacts.
Avoiding stranded assets	Refers to assets that have become liabilities or worth less than expected. Can refer to the risks facing fossil fuel	Financial Stability Board Task Force on Climate-related Financial Disclosures has supported using concept; activists have



	producers if aggressive carbon targets are enacted, or other businesses facing devaluation or other risks from environmental change or regulation.	successfully used to urge divestment from fossil fuel companies. Not yet widespread with regard to biodiversity risks.
Sustainable finance	Generally refers to taking into account environmental, social and governance (ESG) factors when making investment decisions.	National central banks can play role in building biodiversity into monetary policy through regulations or transparency. EU's new Sustainable Finance Guidelines aims to raise €1 trillion in sustainable investments over next decade. Many new 'green' investment vehicles in recent decades to encourage private investment (e.g. green bonds, impact investing)
Corporate social responsibility standards	Voluntary standards adopted by businesses to meet fiduciary responsibilities while identifying and being transparent and accountable for social or environmental impacts	Although most Fortune 500 companies do not systematically record their activities regarding biodiversity, a few small initiatives have started (e.g. 'Biodiversity in Good Company' Initiative)
Third party beneficiary standing	An initiative to use contract law principles so that outside parties have 'standing' to take legal action if principles/standards adopted by companies are not followed.	Some countries' legal systems allow for third party, but not yet used for businesses not following their ESG standards.
<b>Public and/or private or joint financial exchanges</b>		
Payments for environmental services	A conditional transaction in which a provider of an ecosystem service is paid by a user or buyer of the service if the service is provisioned.	PES in use worldwide, often organized by governments or NGO intermediaries, and with range of payers (governments, consumers, businesses).
Green bonds	Tradeable fixed-income instrument to raise investment funds in which the proceeds are used to fund 'green' activities such as low-carbon development	Entities that have rights to issue bonds against assets for collateral, which can include governments or businesses. \$250b in green bonds issued in 2019, with US and China largest markets.
Green investment banks	Public capitalized entity to facilitate private investment for environmental aims, with government guarantees, insurance or minimum returns on investment as inducements to increase private financing.	UK, Japan, Australia, Switzerland and Malaysia have national GIBs. Some US states have GIBs and some cities. Largest banks have multiple billions in funding, mostly targeting low-carbon infrastructure.
<b>Trade and multilateral/bilateral aid</b>		

Biodiversity 'green box' for trade	Support to biodiversity-friendly initiatives to encourage elimination of ecologically harmful subsidies and overproduction stimulated by trade	WTO 'green box' refers to a permitted action; currently no specific biodiversity related 'boxes' in WTO
Conservation aid	Many types of funding for conservation channeled from multilateral, bilateral or private sources; can include direct development aid, debt for nature swaps, loans, etc.	Major multilateral aid donors for biodiversity protection include Global Environment Facility and Green Climate Fund; many OECD countries have designated 'green' aid channels.
<b>Consumption policies and approaches</b>		
Consumer choice architecture	The design of how choices are presented to consumers (such as the placement of goods within a supermarket). Can be used to 'nudge' consumers toward greener alternatives	Used by many businesses and institutions: e.g. universities have made vegetarian meals in dining halls the 'default' choice; utilities opting in consumers to energy efficiency measures automatically.
Resource caps	Limits on total use of specific resources (mostly within production systems), aimed to realize absolute reductions rather than simply increasing costs (as in taxes).	Corporate Automobile Fuel Economy (CAFE) standards in the US are akin to resource caps.
Consumption corridors & doughnut economies	Corridors refers to defining minimum and maximum limits on consumption that would meet individual needs without imposing detriments on others; Doughnut economics refers to a visual framework for aiming to meet social benefits within planetary boundaries.	Both ideas are highly conceptual and no specific policies in place yet.
Circular economy	An economic system that aims to design out waste and pollution and keeps resources in continuous use rather than exploiting new ones in a closed 'loop' system that is regenerative.	Some businesses adopting cradle to cradle production approaches; many nations and subnational governments have recycling mandates. But no clear example of fully circular economy yet.
<b>Metrics, methods and concepts</b>		
Decoupling and degrowth	Refers to idea that economic growth and resource use need not be related by seeking ways to decrease resource use and consumption.	Many EU countries and some US states have decoupled economic growth from carbon emissions (e.g. growth has increased, CO <sub>2</sub> emissions have declined). However, absolute decoupling has not been achieved anywhere; degrowth still considered mostly conceptual.

Alternative measures of social welfare	Moving away from standard measures of welfare such as GDP (Gross Domestic Product) and HDI (Human Development Indices) as they promote economic growth and associated unsustainable practices. Alternative measures usually account for environmental 'goods' and 'bads' in calculations.	Examples include Index of Sustainable Economic Welfare and the Genuine Progress Indicator. Bhutan uses Gross Happiness Index. Not yet widespread but Belgium and some US states have shown interest in using new measures.
Environmental or ecosystem accounting	Tools to incorporate environment and ecosystems into accounting standards, using either financial accounting or non-monetary measures of stocks and flows. Can be useful for understanding natural assets and movement of resources across borders.	Material Flow Accounting and Natural Capital Accounting are two commonly used approaches. The United Nations hopes to use System of Environmental-Economic Accounting by 2021.

**Table SM2. Examples of COVID-19 economic recovery stimulus packages as of Sept 15, 2020**

<b>Cou ntry</b>	<b>Total stimulus spending</b>	<b>Climate positive measures</b>	<b>Climate negative measures</b>	<b>Biodiversity positive measures</b>	<b>Biodiversity negative measures</b>
<b>USA</b>	Over US\$2 trillion CARES act package, including household payments of \$1200 <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U</a>	Some financing for clean energy through extension of solar/wind tax credits; some support for public transport like Amtrak <a href="https://www.energypolicytracker.org/country/united-states">https://www.energypolicytracker.org/country/united-states</a>	Financial support to fossil fuel producers of around US\$72 billion <a href="https://www.energypolicytracker.org/country/united-states">https://www.energypolicytracker.org/country/united-states</a>	None specified	EPA waiving enforcement of rules and penalties during 'emergency' <a href="https://www.energypolicytracker.org/country/united-states">https://www.energypolicytracker.org/country/united-states</a>
<b>Can ada</b>	CAN\$250 billion stimulus, including expanded unemployment and wage subsidies; over CAN\$200 billion in liquidity and tax deferrals for businesses <a href="https://www.canada.ca/en/department-finance/services/publications/economic-fiscal-snapshot/overview-economic-response-plan.html">https://www.canada.ca/en/department-finance/services/publications/economic-fiscal-snapshot/overview-economic-response-plan.html</a>	Recipients of corporate loans (over CAN\$300m in revenue) must publish annual reports on climate investments and how their operations support the country's Paris commitments <a href="https://pm.gc.ca/en/news/news-releases/2020/05/11/prime-minister-announces-additional-support-businesses-help-save">https://pm.gc.ca/en/news/news-releases/2020/05/11/prime-minister-announces-additional-support-businesses-help-save</a> ); financial support for EVs, renewables and energy efficiency of around CAN\$4 billion <a href="https://www.energypolicytracker.org/country/canada">https://www.energypolicytracker.org/country/canada</a>	Oil and gas industry received CAN\$1.7 billion in direct stimulus (e.g. for cleanups) <a href="https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat">https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat</a> )	None specified	
<b>Euro pean Unio n</b>	€750 billion package is called "Next Generation EU", including Recovery and Resilience Facility of €540 billion	Just Transition Fund up to €40 billion for member state climate neutrality; Corporate recipients of stimulus money must track whether their funds are being used in alignment with the EU's climate goals		Proposed €15 billion reinforcement for the European Agricultural Fund for Rural Development for transition necessary in line with European Green Deal <a href="https://www.carbonbrief.org/coronavirus-tracking-how-">https://www.carbonbrief.org/coronavirus-tracking-how-</a>	

	<a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#E">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#E</a>	<a href="https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions">https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions</a> ); no support for fossil fuels; significant support for EV infrastructure <a href="https://www.energypolicytracker.org/country/european-institutions">https://www.energypolicytracker.org/country/european-institutions</a> )		<a href="#">the-worlds-green-recovery-plans-aim-to-cut-emissions</a> )	
<b>Germany</b>	€280 billion recovery plan, including some UBI for households with children <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#G">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#G</a>	€50 billion fund for addressing climate change including €2.5 billion on EV infrastructure/batteries and consumer rebates for EV purchases and other investments in green energy <a href="https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat">https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat</a> )	Airline bailouts with no conditionality; some financial support to fossil fuel energy producers <a href="https://www.energypolicytracker.org/country/germany">https://www.energypolicytracker.org/country/germany</a> )	€700million US for sustainable forest management <a href="https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat">https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat</a> )	Reduction in VAT to increase consumption <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#G">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#G</a> )
<b>France</b>	€315 billion in loan guarantees, over €130 billion in spending on health and work sharing <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#F">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#F</a>	€7 billion Airline bailout must meet national climate goals (50% reduction of emissions by 2030); subsidies for EVs and higher bonus-malus for personal vehicle purchases of clean cars; €2 billion for hydrogen R&D <a href="https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions">https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions</a> )	Deferral of taxes on diesel <a href="https://www.energypolicytracker.org/country/france">https://www.energypolicytracker.org/country/france</a> )	Support to farmers to transition to reduced impact farming <a href="https://www.energypolicytracker.org/country/france">https://www.energypolicytracker.org/country/france</a> )	
<b>United Kingdom</b>	~£350 billion in multiple packages; tax cuts, business loans and grants; paycheck guarantees, UBI payments	£2 billion for cycling infrastructure; R&D support for hydrogen; support for decarbonization in buildings/industry; nearly ~ £3 billion support for London public transport and	Support for road building and automotive sector <a href="https://www.energypolicytracker.org/country/united-kingdom">https://www.energypolicytracker.org/country/united-kingdom</a> )	£40m for green recovery challenge fund to create jobs in restoration <a href="https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions">https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions</a> )	

	<a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U</a>	green infrastructure ( <a href="https://www.energypolicytracker.org/country/united-kingdom">https://www.energypolicytracker.org/country/united-kingdom</a> )			
<b>Uganda</b>	~US\$370 million in stimulus and health spending ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U</a> )	None specified		Investment in labor-intensive public works programmes in the Roads and Water and Environment sector ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#U</a> )	
<b>Pakistan</b>	US\$7 billion in stimulus ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#P">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#P</a> )	None specified	Reduced fuel prices ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#P">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#P</a> )	Existing 10 Billion Tree planting initiative to get stimulus funds; green jobs for youth; proposal for debt for nature swaps ( <a href="https://www.thethirdpole.net/2020/05/04/pakistans-green-stimulus-to-combat-covid-19-protect-nature/">https://www.thethirdpole.net/2020/05/04/pakistans-green-stimulus-to-combat-covid-19-protect-nature/</a> )	
<b>India</b>	US\$22 billion stimulus in March, including UBI and grain subsidies; \$226 billion additional proposed ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#I">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#I</a> ), currently being allocated in tranches	Solar subsidies; net zero pledges for railways; EV infrastructure support ( <a href="https://www.energypolicytracker.org/country/india">https://www.energypolicytracker.org/country/india</a> )	Relaxation of regulations on coal and aviation sector; stimulus to coal mining ( <a href="https://www.energypolicytracker.org/country/india">https://www.energypolicytracker.org/country/india</a> )	US\$780 million for afforestation, including tribal communities ( <a href="https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions">https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions</a> ); agricultural subsidies for improved cold chain storage and post-harvest waste ( <a href="https://thetechportal.com/2020/05/15/india-covid-19-economic-package-agricultural-infrastructure-fund-agri-tech-startups/">https://thetechportal.com/2020/05/15/india-covid-19-economic-package-agricultural-infrastructure-fund-agri-tech-startups/</a> ); sustainable development of marine and inland fisheries	<a href="#">Stimulus measures in agriculture (loans, minimum price supports) could encourage expansion of agriculture</a>

				with UBI to fishers during fishing bans ( <a href="https://www.livemint.com/news/india/nirmala-sitharaman-live-updates-fm-to-release-3rd-part-of-economic-package-11589537389953.html">https://www.livemint.com/news/india/nirmala-sitharaman-live-updates-fm-to-release-3rd-part-of-economic-package-11589537389953.html</a> ); investment in beekeeping and agricultural pollination ( <a href="https://www.livemint.com/news/india/nirmala-sitharaman-live-updates-fm-to-release-3rd-part-of-economic-package-11589537389953.html">https://www.livemint.com/news/india/nirmala-sitharaman-live-updates-fm-to-release-3rd-part-of-economic-package-11589537389953.html</a> )	
<b>China</b>	Over US\$600 billion stimulus including bonds, cut in VAT, tax exemptions, and subsidies ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#C">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#C</a> )	Investments in high speed rail and EV infrastructure; UHV power lines for renewables ( <a href="https://www.energypolicytracker.org/country/china">https://www.energypolicytracker.org/country/china</a> )	Cuts in price of electricity; investment in new coal power plants and coal mining (although new Paris Accord announced in Sept may change this) ( <a href="https://www.energypolicytracker.org/country/china">https://www.energypolicytracker.org/country/china</a> )	None specified	
<b>Vietnam</b>	US\$1.16 billion stimulus for households and businesses. Cut in bank interest rates & tax breaks (US\$12 billion in value) ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#V">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#V</a> )	Incentives for solar ( <a href="https://www.energypolicytracker.org/country/vietnam">https://www.energypolicytracker.org/country/vietnam</a> )	Cut environment protection tax by 30% on jet fuel; reduction in electricity prices for consumers ( <a href="https://www.vietnam-briefing.com/news/vietnams-support-policy-recover-economy-resolution-84.html/">https://www.vietnam-briefing.com/news/vietnams-support-policy-recover-economy-resolution-84.html/</a> )	None specified	Fee exemption for industrial water use in 2020 ( <a href="https://www.vietnam-briefing.com/news/vietnams-support-policy-recover-economy-resolution-84.html/">https://www.vietnam-briefing.com/news/vietnams-support-policy-recover-economy-resolution-84.html/</a> )
<b>Australia</b>	AUS\$180 billion in relief for wages and	Support for hydrogen R&D; investment in EV	Suspension of fees for gas exploration; proposed	None specified	Relaxation of logging permits in some states

	businesses ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#A">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#A</a> )	infrastructure ( <a href="https://www.energypolicytracker.org/country/australia">https://www.energypolicytracker.org/country/australia</a> )	unconditional bailout of airlines; support for gas pipelines ( <a href="https://www.energypolicytracker.org/country/australia">https://www.energypolicytracker.org/country/australia</a> )		( <a href="https://www.theguardian.com/australia-news/2020/apr/03/decision-to-renew-victorian-logging-agreements-criticised-after-summer-bushfires">https://www.theguardian.com/australia-news/2020/apr/03/decision-to-renew-victorian-logging-agreements-criticised-after-summer-bushfires</a> )
<b>New Zealand and</b>	Over NZ\$50 billion in COVID recovery funds ( <a href="https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#N">https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19#N</a> )	NZ\$800m for public transport, clean energy and adaptation ( <a href="https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat">https://www.climateinteractive.org/ci-topics/great-recovery-policies/#section-1-nat</a> )		NZ\$1.1billion proposed for nature-based employment support (restoration of wetlands, etc.) ( <a href="https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions">https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions</a> )	

Sources: <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19>, <https://www.carbonbrief.org/coronavirus-tracking-how-the-worlds-green-recovery-plans-aim-to-cut-emissions>, <https://www.energypolicytracker.org/region/g20/> and <https://www.climateinteractive.org/ci-topics/great-recovery-policies/>