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Green employment and growth

Integrating climate change and biodiversity into the response to COVID-19

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This note is part of a series looking at *climate change and biodiversity considerations in economic responses to COVID-19*. Other notes look at scoring economic stimulus packages via a green stimulus index, corporate bailouts with green strings attached and international assistance. *This note may be updated as circumstances develop.* This work was undertaken by Vivid Economics as part of the Finance for Biodiversity Initiative (F4B) and funded by the MAVA Foundation.

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Executive Summary

Investing in nature offers an excellent opportunity vis-à-vis COVID stimulus objectives, quickly creating jobs under social-distance conditions, while providing long-term benefits toward the transformational growth countries have committed to. Global under-employment generated by the COVID-19 pandemic is a historic opportunity for governments to accelerate the green transition and stimulate the economy through green stimulus programmes. Interventions in environmentally relevant sectors can protect and restore nature, provide income immediately to unemployed workers, deliver under social distancing guidelines and stimulate economic growth in emerging sectors. Green labour opportunities are currently available and successful implementation in some countries can be expanded at a time when the market is experiencing flux.

This note focuses on three examples of investments in natural capital in:

1. **Rural settings:** investments in the restoration and/or enhancement of ecosystems (e.g. afforestation in degraded land).
2. **Urban and peri-urban settings:** public investments in urban green spaces, like parks and green corridors**.**
3. **Corporate support (or 'bailouts') with nature-friendly strings attached:** public support conditional on achieving either net neutral or net positive practices with regard to habitats and biodiversity

These opportunities can be deployed quickly across many countries. There are examples of successful implementation in response to COVID-19 around the world that can guide efforts in countries with less experience. Furthermore, there is evidence that COVID-19 has increased the appetite of citizens for nature-friendly public policies.

Opportunities in natural capital investment are well matched to current sectors and skills suffering from significant underutilisation, while creating a significant number of additional jobs. Global labour underutilisation has increased more than 10% since the COVID-19 lockdowns started and is projected to

continue growing until Q3 of 2021. The depth of the crisis will permanently impact labour opportunities in hard-hit sectors, including retail, hospitality and travel, food and dining, and other transport.

Importantly, these investments are implementable under social distancing, and offer an opportunity to move away from unsustainable wage support. Current spending to supplement workers' wages is unsustainable. Governments are targeting spending on paycheck protection programmes to safeguard family incomes and restore aggregate demand. These measures can be classified as rescue measure because they are temporary measures. As lockdowns begin to ease, governments are faced with the challenge of taking jobs off life support, and investing in recovery measures that ensure long-term sustainability. The investments in nature proposed here help fulfil future climate and biodiversity commitments (reducing future spending requirements) and enhance the productivity of natural capital (boosting longer term growth).

COVID-19 triggered a global wave of labour underutilisation

Before the pandemic, 50% of the workforce were employed in sectors now at risk of severe economic output decline from COVID-19 and were coincidentally vulnerable populations. ILO estimates 1.6 billion people work in sectors that have been highly impacted by the crisis such as retail, manufacturing, real estate and accommodation.[1] High risk sectors have wages below cross-sectoral averages, meaning that layoffs will have a particularly acute effect on purchasing power among lower income households.

Table 1: Economic impact on hardest hit sectors

	Crisis impact[2]	Baseline employment situation		
	Impact on economic output	Level of employment (million)	Share of global workforce (%)	Wage ratio (avg sector/total avg)
Education	Low	177	5%	1,23
Human health and social work	Low	136	4%	1,14
Public admin and defence	Low	144	4%	1,35
Utilities	Low	27	1%	1,07
Agriculture, forestry and fishing	Low-Med	880	26%	0,72
Construction	Medium	257	8%	1,03
Finance and insurance	Medium	52	2%	1,72
Mining and quarrying	Medium	22	1%	1,46

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[1] ILO Monitor (2020) https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/briefingnote/wcms_743146.pdf

[2] The level of impact on each economic sector resulting from the COVID-19 crisis is estimated by ILO (2020) Monitor. Real time financial and workforce data is used to estimate the severity of the risk of economic output decline on each high-risk sector given the changes required for combating the pandemic.

Art and entertainment	Med-High	180	5%	0,69
Transport, storage and comms	Med-High	204	6%	1,19
Accommodation and food	High	144	4%	0,71
Real estate	High	157	5%	0,97
Manufacturing	High	463	14%	0,95
Retail	High	482	14%	0,86

Note: The wage ratio is a measure of wage dispersion. Here we measure the ratio of wages between the average worker in each sector against the average worker salary across all hard-hit sectors. A ratio below 1 indicates the average worker in that sector earns less that the overall average worker.

Source: ILO (2020), adapted by Vivid Economics

Many sectors will be operating under capacity for at least the next 12-18 months, leaving many workers unemployed or underemployed.[3] Working hours have decreased on average by 13.5% since quarantine measures were implemented globally (see Figure 1). The numbers are particularly large for middle- and high-income countries, especially because they were the hardest hit at the beginning of the pandemic. Aggregate demand is expected to decrease in 2020 and 2021, with a decline in traded goods and services of 11% by the end of 2020.[4] Evidence from the Great Financial Crisis (GFC) suggests that many workers who are now temporarily unemployed or furloughed will become fully unemployed in the future.[5] Unemployment is expected to rise when furlough schemes like the ones currently operating UK and other European countries have ended.[6] In the US, the Federal Reserve Bank predicts unemployment to remain over 9% in 2020 and remain at about 5.5% through 2022.[7]
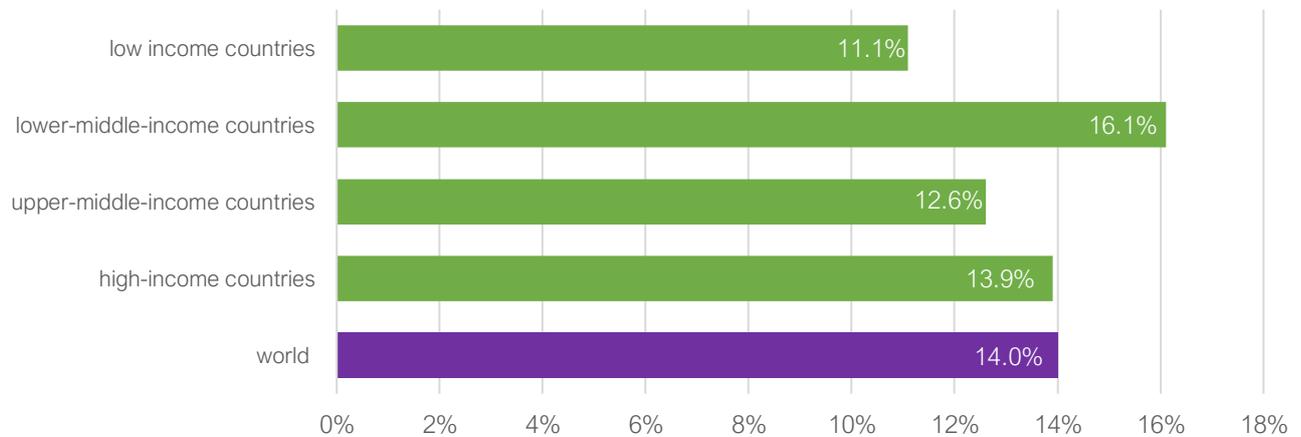
[3] OECD Economic Outlook (2020). http://www.oecd.org/economic-outlook/june-2020/
[4] World Economic Outlook (2020). https://www.imf.org/~/media/Files/Publications/WEO/2020/April/English/text.ashx
[5] Bachmann, et al. (2015). *Labour market dynamics and worker heterogeneity during the Great Recession – Evidence from Europe.* IZA Journal of European Labour. https://link.springer.com/content/pdf/10.1186/s40174-015-0043-0.pdf
[6] Financial Times (2020). https://www.ft.com/content/b26beabf-fd2f-4712-8f0a-633df335672b
[7] NYTimes (2020). https://www.nytimes.com/2020/06/10/business/economy/federal-reserve-economy-coronavirus.html

Figure 1: Q2 decline in working hours estimated by country-level income

low income countries	11.1%
lower-middle-income countries	16.1%
upper-middle-income countries	12.6%
high-income countries	13.9%
world	14.0%

Note: New ILO methodology uses real time data for working hours and therefore does not define a specific baseline scenario for the state of labour. The labour market scenario is defined in real time.

Source: ILO (2020)

Nature-related employment opportunities are well-suited to absorb workers for large at-risk sectors like retail, accommodation and food, and entertainment. Highly impacted sectors report low wage ratios.[8] Because the workforce in these sectors is mostly composed of young people with low (but flexible) specialisation levels, transitioning these workers to jobs related to nature-based solutions (i.e. in the agriculture, forestry and fisheries sectors) is possible at a low cost and in avoidance of future labour market friction. During a recession, job opportunities normally shift towards lower skilled jobs; but with social distancing guidelines, less low skill work in retail and services is available, making sectoral change likely for workers who are historically mobile during recessions.[9] Cross sectoral flows of labour are more likely where skill requirements are similar. As a rough indicator, sectors with similar wage ratios – an indication of the level of specialisation required – will be more amenable to labour flows between them.

## Governments' response to rescue and recover the economy

Governments have spent more than $1.95 trillion USD on paycheck protection programmes that have protected family incomes, but as lockdowns start to ease, innovative recovery measures will need to be implemented. Figure 2 shows the United States and Japan have the highest net amount of fiscal stimulus towards paycheck protection, while Brazil (55%) and then Canada (41%) have the largest share of total fiscal spending directed towards payment protection. These figures are considerably higher with respect to the employee protection measures deployed during the GFC given both the cause of the current economic slowdown and the tools available. During the GFC, developed economies spent an average of 10% of their stimulus funding on labour market measures.[10]

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[8] Wage ratios are defined as the average wage of a worker in one sector relative to the average wage of workers across all sectors
[9] Kallerberg & von Watcher (2017). https://www.rsfjournal.org/content/rsfjss/3/3/1.full.pdf
[10] Topal, P. (2014). https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2531454

Figure 2: Paycheck protection programmes as a portion of fiscal stimulus are higher due to labour disruptions unique to the current crisis
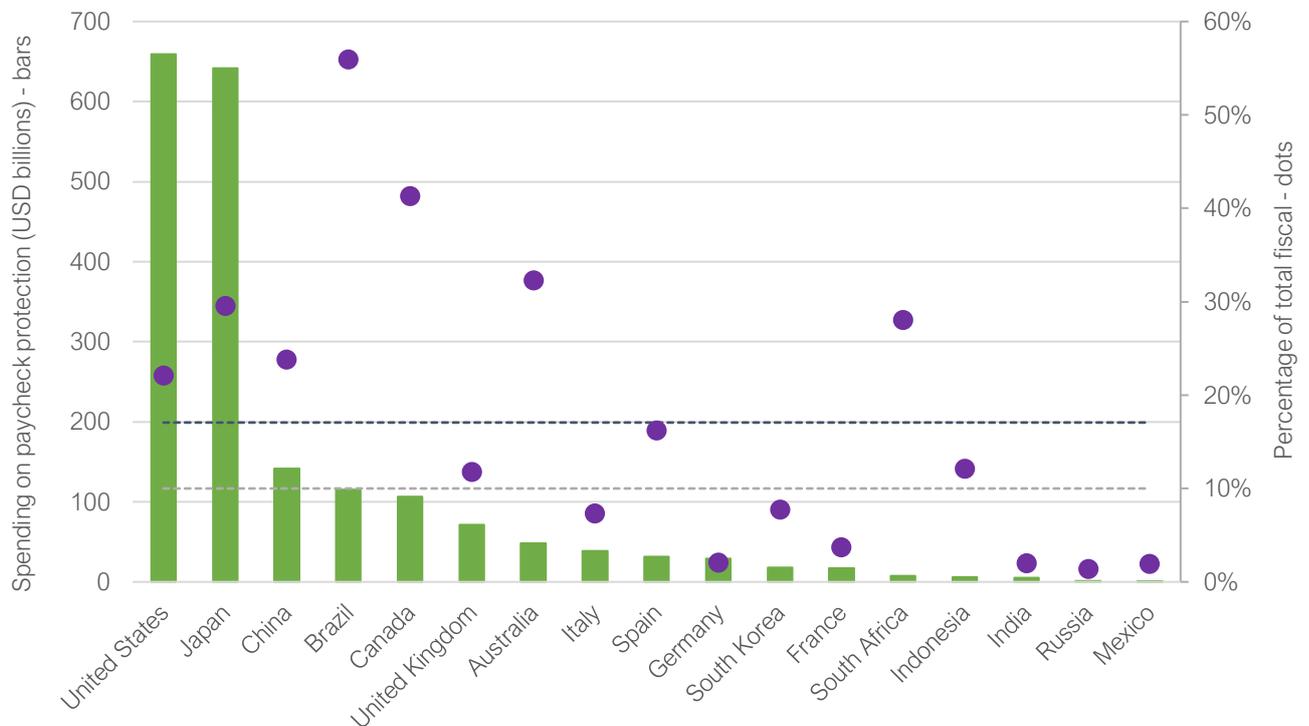
Note: Paycheck protection programmes include all fiscal measures directed towards individuals to compensate for lost income or employers to replace or support payroll. The 10% line indicates the average spending on paycheck protection by developed countries during the GFC, while Vivid Economics estimates 19% of fiscal spending the average amount of stimulus towards paycheck protection or unemployment programmes.

Source: IMF Policy Tracker and other sources; updated July 7, 2020.

Paycheck protection programmes are classified as any stimulus measure which either retains or generates new employment opportunities, thereby securing income to workers during a recession.[11] Schemes include direct coverage of lost wages through government transfers or indirect coverage through lending to businesses conditional on employee retention; short-term work schemes which share the cost of retaining employees at reduced hours between governments and businesses; and unemployment payments or basic income support. Schemes which also generate new employment opportunities include public procurement, particularly in the energy sector, mobilising private sector investment through targeted business stimulus; and government work programmes providing direct employment opportunities funded by the government.

Direct transfers have a lower fiscal multiplier than direct government spending during economic recessions, and unemployment coverage only stimulates spending in the short run unlike secured

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[11]Towards a Global Green Recovery (2009). https://www.pik-potsdam.de/members/edenh/publications-1/global-green-recovery_pik_lse

income which improves aggregate demand.[12] Payment protection programmes keep the labour market on life support but do not provide new jobs, becoming fiscally unsustainable if continued in the long run. Given current historic rates of unemployment and the anticipated depth of this economic crisis, paycheck protection programmes that only retain labour opportunities and do not generate new ones will be insufficient in creating novel recovery spending.[13]

We propose a framework against which to assess stimulus measures ensuring they provide large and immediate employment opportunities, compatible with ongoing social distancing measures, and in line with medium to long run public spending priorities. This adapts the framework suggested by Stern et al. (2009) to analyse low-carbon fiscal stimulus measures in response to the GFC to the current context.[14] Government spending programmes should have the following five characteristics:

- **Timely:** Recovery measures that put people back to work need to come into play as soon as lockdowns start to ease. Projects which do not require lengthy retraining and skill development should be prioritised. Shovel-ready investments can also leverage lower input costs from the economic slowdown.

- **Transitional:** The stimulus needs to be temporary, with funding provisionally available. However, the timeline for a full recovery is uncertain, exacerbated by the possibility of future lockdowns. It is important governments are able to ease stimulus measures quickly in the case of a sharp recovery to minimise already large debt burdens.[15]

- **Targeted job creation**: Estimating both direct and indirect jobs created by $1 million USD investment provides a likely range for the number of jobs anticipated as a result of investment. Job quality, longevity, and skill is assessed using evidence from literature and should focus on workers in hardest-hit sectors or workers experiencing wage loss.

- **Long-run transformation**: Given current disruptions to economic activity, the transition away from high-carbon sectors and to low carbon sectors can be advanced to achieve equitable and long-term sustainable growth[16] in line with global climate goals. Whether the government can reduce future fiscal burden (generating new revenue or reducing future costs), what the cost of lending is to the government, and whether the investments shift the sector into a low-carbon investment trajectory are assessed to determine the transformative nature of the investment.

- **Ensure social distancing:** Maintaining social distancing in implementation of these policies is important, given current recommendations and especially if new lockdowns become necessary. Investing in sectors with low probability of disruption is key.

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[12]NBER (2010). https://www.nber.org/papers/w16759.pdf
[13]NBER (2020). https://www.nber.org/papers/w27097.pdf
[14]Edenhofer, O. & Stern, N. (2009). Towards a Global Green Recovery: Recommendations for immediate G20 action. https://www.pik-potsdam.de/members/edenh/publications-1/global-green-recovery_pik_lse
[15]Infrastructure investments do not deliver this characteristic. An illustrative example is a bridge, where government cannot cut funding until it is finished.
[16] New Climate Economy (2014). https://newclimateeconomy.report/2014/wp-content/uploads/sites/2/2014/08/NCE-Global-Report_web.pdf

Investments in natural capital are a key components of recovery packages

Natural capital investments stimuluate the economy in the short-term, and have positive consequences in the long-tem. Hepburn et al. (2020) surveys 300 experts that agree natural capital investments have higher potential for recovery than other traditional stimulus measures (i.e. infrastructure invesment).[17] From the lens of this paper, this is also the case, where natural capital invesments show the highest scores among all green investments for timeliness, transitivity, job creation potential, long-run transformation, and ability to be implemented keeping social distance.

This note highlights the potential of natural capital investments by comparing them to other green measures and evaluating them against our five key criteria – whether they are timely, transitional, create jobs, stimulate long-term and low-carbon transformation, and comply with social distancing. Ranking descriptions correspond to a scale of 1 to 3, based on the extent that the policies meet the criteria. Policy archetypes that are ranked with 3 across the conditions have the highest potential and should be highest priority interventions to pursue. Figure 3 explains the specific ranking criteria across the four conditions.

Figure 3: Conditional criteria fulfilment for policy recommendations

Conditions	1	2	3
Timely	Projects are not shovel ready, requires 12+ months for development	Pre-approved projects or lab-ready funding, requires some screening	High immediacy, funding or subsidies can be released, shovel-ready
Job creation	Less than 5 jobs per $1 million, no indirect jobs	5-20 jobs per $1 million, some indirect job growth	20+ jobs per $1 million, indirect jobs created with new sectoral development
Long-run transformation	Maintains BAU trajectory, no easing of net fiscal burden	Encourages 'green' uptake, generates some new revenue or reduced costs	Spurs innovation and reforms 'green' sector, generates revenue, reduces future cost
Transitional	Difficult to remove funding before completion (2+ years)	Can remove funding, could lead to partial loss or reduced impact	Incremental funding that can be discontinued at any time
Socially distant	High cost or inability to adapt to social distance protocol	Can adapt to social distancing rules, mostly outside	All work outside or remote

Note: All policies are ranked on a scale from 1-3 for each category using this metric. The framework primarily considers direct jobs created. Given the historically high rates of unemployment at this time, consideration

[17] Hepburn et al. (2020). https://www.smithschool.ox.ac.uk/publications/wpapers/workingpaper20-02.pdf

of job loss effects from transitioning workers into 'green' sectors is not factored into the level of job creation.

Source: Vivid Economics (2020)

The policies analysed using this framework are drawn from the COVID-19 stimulus packages that have been announced since the lockdowns started. Vivid Economics began tracking stimulus packages since the lockdowns were enacted, constructing the Greenness of Stimulus Index. Part of the methodology consists of identifying green policy archetypes that have been implemented in the 17 countries with the largest stimulus packages. Table 2 contains the full set of archetypes, with a brief decription and the scores for each of the categories as outlined in Figure 3. The table describes the logic and evidence behind each score and provides examples already being implemented across the world. It is worth highlighting that while some have been introduced as a result of COVID-19 stimulus packages, many are funded through existing channels that have been augmented for furthering 'green' stimulus.

Table 2: Conditional criteria fulfilment for recommendation of policies

Sector	Archetype	Description	Timely	Targeted		Transition	SD
				Jobs	Long-run		
Agriculture	Bailouts with green strings attached	Requiring limits to emissions and waste, supply chain certification and appropriate restoration commitments in return for direct funding.	3	2	1	3	3
	Nature based solutions*	Afforestation programmes, restoration of wetlands, and forest management investments.	3	3	3	3	3
	Green infrastructure investments	Direct loans or tax rebates and subsidies for low- water irrigation systems, ocean farming, and other low-carbon capital investments.	2	2	2	1	3

Sector	Archetype	Description	Timely	Targeted		Transition	SD
Energy	Bailouts with green strings attached	Direct loans and guarantees towards energy producers and distributors conditional on commitments to decrease emissions and increase energy efficiency.	3	2	2	3	3
	Green infrastructure investments	Direct investment in the form of loans or grants towards renewable energy including solar, wind, biofuels and hydrogen.	2	3	3	1	3
	Green R&D subsidies	Grants or loans for the development and commercialisation of new renewable energy technologies and systems.	2	2	3	2	2
	Subsidies or tax reductions for green products	Extending tax rebates to households for solar, making green energy products including utilities with renewable targets available at a subsidised cost.	3	2	3	3	1
Industry	Bailouts with green strings attached*	Conditions on firms on emissions, pollutions, supply chain requirements, appropriate restoration commitments, and compliance to voluntary agreements or reporting standards.	3	2	3	3	3
	Green infrastructure investments	Low carbon or low emissions public infrastructure for industry including CCS projects for industry, energy efficiency programmes for existing buildings, investment in hydrogen economy and electrification of industry.	1	3	3	2	2

Sector	Archetype	Description	Timely	Targeted		Transition	SD
Transport	Green R&D subsidies	Direct grants or loans available to develop low-carbon materials or processes including low-carbon substitues, hydrogen, and electrification infrastructure.	2	2	3	2	2
Transport	Subsidies or tax reductions for green products	Taxes for the use of primary materials in supply chain, subsidies offered to firms who undertake compliance in supply chain.	3	2	2	2	2
Transport	Bailouts with green strings attached	Conditional bailouts to air carriers, logistics companies for emissions reduction pledges, commitment to biofuel or renewable fuel standards in exchange for loans, and appropriate restoration commitments.	3	3	3	3	2
Transport	Green infrastructure investment*	Building public infrastructure projects including cycleways, low-carbon rail or transit, public walkways, and railroads with consideration to climate mitigation and adaptation.	2	3	3	3	3
Transport	Green R&D subsidies	Loans or research grants to develop electric vehicles, hydrogen vehicles, and low-carbon fuel alternatives for shipping, aviation and vehicle transport.	2	2	3	2	2
Transport	Subsidies or tax reductions for green products	Tax rebates available to consumers for EVs, subsidisation of low carbon transportation including light rail, developing HOV lanes or low-emission zones fees.	3	2	2	3	1
Waste	Bailouts with green strings attached	Directing grants or loans to firms who open incinerate waste without provisions for more sustainable waste management strategies.	3	1	1	3	3

Sector	Archetype	Description	Timely	Targeted		Transition	SD
	Green infrastructure investments	Direct investment in recycling, MSW, waste-to-energy, and methane recapture on existing facilities or new waste management facilities.	2	2	2	3	3
	Green R&D subsidies	Loans or grants for the development of nature-friendly waste management including compost, waste-to-energy and methane recapture technologies.	1	1	1	2	2
	Subsidies or tax reductions for green products	Tax reductions or rebates for recycling, composting including buy-back programmes or subsidisation of environmental producer responsibility (EPR).	3	1	1	3	3

Note: Archetypes are adapted from the Greenness of Stimulus index by Vivid Economics (2020)

Table 2 shows that among the green stimulus measures, the highest potential resides in natural capital investments thorough direct government spending in rural and urban settings (nature-based solutions and urban green infrastructure). Additional policies which excel in all conditions for strong stimulus includes indirects investments through bailouts with green strings attached. These investment archetypes score highest in all five categories, highlighting their suitability for strong recovery measures in response to the COVID-19 crisis.

Investments in natural capital in rural settings

Stimulus investments in nature-based solutions including afforestation and forest restoration, wetland restoration, peatland restoration, mangroves restoration, coastal restoration, sustainable agriculture interventions (e.g silvopasture) and vertical ocean farming. Nature based solutions programmes are ideal for countries with hard-to-reach sectors that will require net positive carbon emissions as a part of the policy response to reach their long term goals. This includes the UK, Canada, Brazil, and other EU countries.

Natural Capital investments in rural settings	
Examples	- Australia: Wildfire preventions and habitat restoration programme (unknown) - Ethiopia: afforestation in degraded and eroded land (unkown) - India: afforestation programme as part of the National Rural Employment Guarantee Act (NREGA) (6 billion- initial) - Pakistan: Tree Tsunami project focuses on promoting industrial plantation, establishing nurseries and natural forests (10 billion)

Natural Capital investments in rural settings	
	• UK: the Woodland Carbon Guarantee (unknown)
Timely	• Land use investments are labour intensive investments that do not require extensive training. • Technology requirements are low, so most countries should find it relatively easy to find the necessary input to get started in a matter of days. • Hiring of agricultural, forestry and conservation workers already occurs on a seasonal rotation, and this workforce is more adaptable to short term or seasonal employment opportunities.
Transitional	• Forest management and sustainable or regenerative agricultural has a low capital cost, most stimulus flows directly to labour cost, leaving no investments unreturned. • The value of afforestation is incremental, so stopping funding at short notice will have little impact on the public and private returns of investment.
Job creation	• General estimates from the 2008-09 economic recovery indicate upwards of 40 jobs per $1 million USD invested can be obtained from a variety of NBS across forestry, agriculture and hospitality.[18] • US estimates saw $1 million USD investement in forestry management creating 17 jobs[19], while EU estimates similarly state $1 million USD in habitat restoration of forest and conservation land results in the creation of 14 direct jobs and 9 indirect jobs.[20] • Indirect jobs are created in the supply chain across sectors including agricultural nursery jobs, transportation positions, eco-tourism. • Previous research by Vivid Economics has estimated land-use planting scenarios for the UK and Scotland to reach afforestation goals, with cost estimates of about $900 USD per hectare for capex and opex.[21] This cost, while not tied to a figure of job creation, will have ancillary benefits to the labour market besides providing temporary forestry jobs, but may also provide jobs in nurseries, transportation, and monitoring/evaluation.
Long-run transformation	• Land use investments require large upfront disbursements but secure high risk-adjusted returns over the long-run. • Lower than usual raw material costs, greater availability of labour and lower interest costs will secure even higher returns in the long run. Land use investments are fundamental to achieving environmental pledges that in other circumstances will be more expensive to achieve. • Overall the investment in resilient infrastructure like NBS projects, can transform the risk profile of agriculture, industrial and energy investments by providing protection against disasters and climate risks.[22]

[18] Nature4Climate (2020). Nature-positive recovery for people, economy and climate. http://4fqbik2blqkb1nrebde8yxqj-wpengine.netdna-ssl.com/wp-content/uploads/2020/07/Nature-positive-recovery_For-people-economy-and-climate_July-2020_Final.pdf
[19] Edwards, P. et al. (2013). https://www.sciencedirect.com/science/article/pii/S0308597X12001182#bib15
[20] Institute for European Environmental Policy, Natura 2000 & Jobs (2017). https://ec.europa.eu/environment/nature/natura2000/pdf/Natura2000_and_jobs_main%20report.pdf
[21]Vivid Economics (2019). https://www.vivideconomics.com/wp-content/uploads/2019/10/WWF_Report_VIVID_Climate_2019_web.pdf
[22]Grantham Institute (2020). http://www.lse.ac.uk/GranthamInstitute/news/a-new-mindset-for-resilience-in-the-face-of-concurrent-climate-and-health-risks/

Natural Capital investments in rural settings

Social distance compliance	• It is likely that new lockdowns will be more selective in the future, and investment in forestry and agricultural programmes take place outdoors and can be done at reasonable distance. • Adaptation in these sectors to social distancing measures require little infrastructure change.

Investments in natural capital in urban settings (active transportation and outdoor recreation)

Investment in green infrastructure—particularly urban areas--is a top priority given it can be incrementally implemented without long term capital commitments. These investments offer opportunities to stimulate a relatively larger amount of new jobs as part of a longer-term stimulus effort,[23] but may take some time to reach scale. Urban green infrastructure is unique because many upgrades require lower level capital investments and can be done piecemeal, with a specific focus on green urban restoration and active transport upgrades.

- Expanding and converting urban roadways into pedestrian and active transport roads.
- Creating green corridors to encourage active transportation and outdoor recreation.
- Converting parking spots to cycle lanes, and building rain gardens to deal with pollution run off from road transport.

Natural capital investments in urban settings

Examples	• UK: nation-wide programme to encourage active transport ($2 billion USD)[24] • Spain: Green corridor in Passeig the Sant Joan in Barcelona ($5 million USD)[25]

[23] http://rael.berkeley.edu/old_drupal/sites/default/files/very-old-site/renewables.jobs.2006.pdf (2010).https://www.sciencedirect.com/science/article/abs/pii/S0301421509007915#:~:text=A%20combination%20of%20renewable%20energy,from%20non%2Dfossil%20supply%20sources.

[24] UK Government (2020). https://www.gov.uk/government/news/2-billion-package-to-create-new-era-for-cycling-and-walking
[25] OPPLA (2020). https://oppla.eu/casestudy/18419

Natural capital investments in urban settings	
Timely	• Converting roads to cycleways and pedestrian walkways can be low capital cost in urban areas, where signage and painting serve to redesignate vehicle lanes for active transport. • Larger investments, such as light rail or electric vehicle infrastructure also receive loans and guarantees faster given deregulation in permitting and approval by many countries. Funding for these measures is currently low-cost, so accessing capital requires less time. • Back-logged and shovel-ready green infrastructure projects scoped by cities and municipalities can be funded for immediate development given the financial structure is already in place.
Transitional	• The magnitude of the COVID-19 economic crisis is so large we anticipate the low cost of financing to continue throughout the next 12 months, and therefore short term projects are ideally suited. • Many green transportation infrastructure projects, especially walkways, cycleways and small scale EV charging ports, have few fixed capital requirements relative to other infrastructure projects. • However, infrastructure, generally, requires fixed modes of production in the long term, making it more difficult to withdraw funding on immediate notice.
Job creation	• Recent estimates include 13-18 jobs produced for each $1 million USD of funding for green transport infrastructure.[26] This number, according to our index, ranks in the middle of the level of desired job creation among green projects. • Research with a specific geographic focus demonstrates this number may vary. In the US, it is estimated 24-41 jobs can be created in the US from $1 million USD in investment in public transport infrastructure.[27]
Long-run transformation	• Active transport makes pro-environmental behavioural changes accessible, stimulating uptake in public transit ridership, cycling and walking. It can be a pivotal point for urban planning and design. • The development of green transport infrastructure will be crucial for the long-term sustainability of travel. Can reduce transport costs in the long term and better transport infrastructure can reduce travel times and raise interconnectivity • Increased ridership on public transport can lead to government revenue boost in long-run.
Social distance compliance	• Social distancing protocol can be maintained in the transport infrastructure sector, given the majority of projects occur above ground and outdoors. • For more intensive infrastructure, including underground rail or bus and rail terminal construction, social distancing protocols will have to be adopted, but will be easier than other sectors.

[26]McKinsey& Co (2020). https://www.mckinsey.com/business-functions/sustainability/our-insights/how-a-post-pandemic-stimulus-can-both-create-jobs-and-help-the-climate
[27]Better Transport (2020). https://bettertransport.org.uk/sites/default/files/research-files/employment_in_sustainable_transport.pdf

Corporate support (or 'bailouts') with nature-related strings attached

Stimulus investments bailouts fulfil most criteria for an effective recovery. Bailouts ensure that existing jobs are not destroyed while simultenously promoting growth in downstream sectors. Job retention makes conditional bailouts efficient, and can force firms to undertake large scale changes over time, preserving competitiveness.

Bailouts with 'green' conditionality	
Examples	• Canada: Orphan oil well clean up programme (1.7 billion) Other examples that have not been implemented yet but are worth exploring. Some examples of conditionality tied to: • Commitments to no land conversion and supply-chain certifications. • Commitments to high quality GHG offsets. • Commitments to environmental reporting. • Agreement to phase out or ban certain inputs (e.g. agrochemicals).
Timely	• Funding can be received immediately to ensure firms can continue to operate through recovery, lowering the risk of firm exit. • Highly immediate. Bailouts can be extended to firms and therefore stabilise employment for those in impacted sectors and maintain income without any shocks to workers.
Transitional	• While bailouts can be granted and dispersed in phases, the government may at any time choose to not agree to future bailouts making each loan decision one-off. • However, these types of measures can create funding lock-in in cases where companies require repeated bailouts. For example, if a government decides to stop bailing out a company and it goes bankrupt, a large part of the previous investment's value will be lost.
Job creation	• Unemployment is sticky (hysteresis) so any measure directed at maintaining jobs instead of creating new ones is highly efficient. • Bailouts ensure jobs are not destructed which makes for a highly efficient measure in terms of employment. • Indirect job creation is high as industries such as cement, steel, manufacturing and chemicals are tied to multiple supply chains
Long-run transformation	• Can force reform on producers that will have long term beneficial consequences for their environmental impact and their long-term competitiveness in a net-zero world. • Government lending is at historical low as regards interest rates. • Currently, investment in hard-to-reach sectors like industry including chemicals, steel, cement, and buildings can provide a pathway for long term emissions reductions and a 'green' strings attached bailout in this sector can provide a commitment by private firms for innovation and deployment of low-carbon technology.

Bailouts with 'green' conditionality	
Social distance compliance	• Many of the requirements can be phased in over the committed compliance period, and social distancing therefore is not as much of a barrier for conditional green bailouts. • In the case of transport, social distancing is more difficult to respect and companies in this sector will be highly affected if new lockdowns are enforced.

Conclusion

As we transition into the recovery phase of the crisis, it is critical that governments invest stimulus recovery funding into sectors and projects that are: timely, transitional, targeted, and respect social distancing. Timely because measures need to be shovel/lab ready to stimulate the economy in a relevant timeframe (weeks or months). Transitional because measures must not lock-in funds in the long-run (e.g. traditional infrastructure projects) to avoid crowding-out private investment in the event of a quick recovery. Targeted because measures need to target sectors that maximise impact in the short-run (i.e. create jobs in depressed sectors) and in the long-run (i.e. are in line with societal objectives). Finally, measures need to respect social distance in case lockdowns or more strict distancing measures are reintroduced.

Some green measures are in the best possible position to stimulate the economy, in particular, investing in nature-based solutions and green transportation infrastructure. Afforestation of degraded land, restoration of wetlands, and other investments in nature-based solutions receive the highest score in all four categories. It is timely because most investment is directed into hiring low-skilled labour that requires minimum training. Transitional because the value of the project is incremental, so if funding is stopped suddenly it will not be affected. Transformational because it creates many jobs per million spend and is aligned with most long-term environmental and social objectives. Finally, all activities are carried out outdoors, making it easy to respect social distancing.

Conditional bailouts are timely because the money can be disboursed to them quickly. They are partially transitional because funding can be stopped quickly, but doing so implies the risk of bankruptcy which in turn would shrink the value of previous investments. Transformative because it avoids jobs destruction from which it will be expensive to recuperate. Finally, it can be carried out remotely.

Green transportation infrastructure is timely because most territories (especially cities) have shovel-ready projects that have been halted because of lack of funding. Transitional because green infrastructure projects in the transportation sector involve short distances and are generally incremental. Targeted because they are labour intensive and are aligned with long term objectives, especially in urban settings. Finally, all activities are carried out outdoors, making it easy to respect social distancing.

Annex I - Paycheck protection and labour support policies

Paycheck protection programmes direct money either through cash transfers to individuals who are furloughed – temporarily suspended by their employers – or to businesses retaining employees at partial or full capacity. Instruments include:[28]

- *Furlough and conditional loans to firms:* Spain, the United Kingdom, United States, Japan, China, Brazil, South Africa and Australia have extended created payment protection programmes as business loans conditional on retaining employees or for payroll coverage.[29] This retains employees at either full or reduced wages. Different countries have implemented this programme on a timescale from two months through six months.[30]

- *Short-term work schemes*: These programmes are shared agreements between the government and employers to continue to pay workers for reduced hours on a temporary basis, with costs shared by the government and firm. Programmes include France's 'partial activity' work scheme, Canada's Employment Work Sharing Programme, and German's Kurzarbeit programme.[31]

- *Temporary unemployment payment or basic income provision:* This strategy was implemented most widely in the US, while other countries have implemented unemployment insurance for self-employed or informal workers, including India, Canada, and Indonesia.

- *Public procurement:* Where the government directly procures labour for government projects. India has undertaken public procurement programmes for nature-based solutions as a result of COVID-19 as we will address below. China has also directly procured infrastructure investment to generate employment opportunities.

- *Mobilising private sector investment through private public partnerships (PPPs):* Given the low cost of government lending, the government could directly enter into agreements with private firms to secure investments for public benefits and grow employment.

- *Government work programmes:* Examples include civil corps, engineering corps, solar corps, and national park ranger expansion. In the US, an expansion of the civilian corps has been proposed as additional spending but has not received approval.[32] In Australia, park ranger programmes have been bolstered under government work programme.

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[28]Towards a Global Green Recovery (2009). https://www.pik-potsdam.de/members/edenh/publications-1/global-green-recovery_pik_lse
[29]IMF Policy Tracker (2020). https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19
[30]The Guardian (2020). www.theguardian.com/world/2020/mar/30/australia-to-subsidise-wages-of-up-to-6m-workers-in-130bn-coronavirus-plan
[31]KPMG Insights (2020). Multiple links from https://home.kpmg/xx/en/home/insights/
[32]Brookings Inst. (2020). www.brookings.edu/blog/up-front/2020/05/15/covid-19-has-made-expanded-national-service-more-important-than-ever/

Annex II - Detailed scoring of other stimulus measures with med-high potential

Subsidies or tax reduction for green products

Table AII-1: Green subsidies, tax rebates induce spending for green products

Intervention	Green product subsidies or tax reduction
Examples of investments	A subsidy or tax rebate is the government supplementing the cost of an externality or a good or encouraging uptake of a product to realise network benefits. Subsidisation of green products results in more optimal level of consumption. Intervention can be at the consumer or producer level. • *Agriculture*: Producers receive tax rate or price support for particular commodity for compliance of environmental standards or supply chain commitments. • *Energy*: tax rebates on energy efficient appliances. • *Industry*: tax rebate available to businesses for purchase of low-carbon inputs including HWPs, metal and plastic. • *Waste*: composting or recycling systems rebate for households. • *Transport:* Lower-efficiency fuels subsidised at the pump.
Timely	Subsidies can be established quickly. Tax rebates can take effect within one year, must push campaign for individuals to take advantage of rebate to realise benefits.
Transitional	Subsidies and tax rebates can be removed or immediately suspending. They are temporary particularly for one-off purchases of durable goods.
Job creation	Direct estimates for job creation as a result of subsidies is sparse, particularly for green job creation. Subsidies or tax reductions for producers of green products raises sales or revenue per unit of output, increasing the number of workers who may be hired in the 'green' portion of each sector.
Long-run transformation	*All sectors:* 20-40% of savings from subsidies and tax rebate is often spent by consumers during a recession, in the first three months.[33] Across all sectors, increased disposable income will boost spending and encourage spending on 'green' goods and services. • *Short- run:*Tax reductions and subsidies have a lower fiscal multiplier than direct government spending, and they cannot stimulate the same spending as secured income.

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[33]Brookings Institute (2019). https://www.brookings.edu/wp-content/uploads/2019/05/ES_THP_AutomaticStabilizers_FullBook_web_20190513.pdf

Intervention	Green product subsidies or tax reduction
	• *Long-run:* the impact is likely small in the long-run. The case of subsidies for households to invest in home-office supplies is worth exploring, but little evidence was found on this.
Social distance compliance	Subsidies or tax rebates require no physical or in-person contact. All administrative and legal work can be done social distance compliant.

Note: Archetype dashboard explains justification for score across sectors, generalisations are made for the programme to account for differences between archetypes applied in different sectors.

Source: Vivid Economics using multiple sources

Green research and development (R&D) spending

Table AII-2: Green R&D spending is a commitment to a long-term trajectory of low-carbon recovery

Intervention	Green R&D spending
Examples by sector	• *Waste:* WTE system development, methane recapture research • *Transport:* Direct loans or grants for the development of low-carbon fuels, biofuels, alternative fuels, electric vehicles, hydrogen vehicles • *Energy:* develop hydrogen, electrification infrastructure and battery storage • *Agriculture:* efficient irrigation techniques, soil research, drought resistant crop research • *Industry*: Research for developing novel cement clinker, low-carbon materials, CCS
Timely	R&D agendas have slow uptake, requiring a fund and screening recipients and research agenda, unless agendas are 'lab-ready'. Does not provide immediate relief.
Transitional	R&D is not temporary and is required for the medium to long term. Suspending budgets could result in losing all value.
Job creation	Investment in R&D funding results in long-run job creation but not immediate employment as skills are not transferrable.
Long-run transformation	R&D subsidies incentivise the development of decarbonisation technologies, which will be critical for the long term prospects of industry. Stimulus funding for R&D investment may generate critical or foundational low carbon technologies necessary for low-carbon transition. Funding can stimulate growth of a new subsector or adoption of new technologies that enable low carbon development.

Intervention	Green R&D spending
Socially distant	Dependent on the sector and type of research conducted. Overall, R&D requires lab or research presence and will require adoption of social distancing protocol. May not be effective in some research settings.

Note: Archetype dashboard explains justification for score across sectors, generalisations are made for the programme to account for differences between archetypes applied in different sectors.

Source: Vivid Economics using multiple sources

Annex III- Real-world examples of priority measures

Increased funding for Australia's wildfire resilience team

As a part of the COVID-19 stimulus recovery, Australian Prime Minister has directed recovery stimulus towards government-managed programmes focused on wildfire prevention and habitat restoration. Focusing increased funding on shovel-ready projects, with a goal of maintaining national parks, upkeeping trails for outdoor activity, and servicing forests for the prevention of wildfires. The goal of this programme is to both maintain and grow employment in this sector while providing a net social benefit of disaster risk management through nature-based prevention.

Funding is directed towards government programmes that already exist and/or are funded by government grants. Bolstering support to these programmes creates local jobs.[34] 26 new temporary jobs have been created through ACT Parks and Conservation Service, as well as via local contractors and agricultural workers who conduct work on wildfire prevention (fencing, restoration, controlled burns).[35] The current roles in the ACT department are currently paid for with the COVID recovery stimulus funding, as well as the new jobs created. While the jobs are temporary (maximum of twelve months) they are providing an employment opportunity by expanding an already existing programme where benefits can be realised during the short term of the programme.

Canada's orphan oil well clean-up job programme

$1.7 billion CAD investment in orphan and abandoned well clean-up is anticipated to bring 5,200 jobs to Alberta.[36] Payments are made directly to provincial governments in the form of loans, with the money to Alberta being channelled through the Alberta Energy Regulator, the industry and government relations group which manages the province's well clean-up programmes.[37] This funding covers labour cost for the environmental improvement of closed and abandoned wells. It is estimated to attract new jobs to provinces which rely on oil and gas for economic activity, while also reshuffling workers in the sector who are currently unemployed due to the oil price collapse. This programme is labour intensive, timely, and will be productive as much funding is granted to the programme, making it a strong temporary solution for economic stimulus through labour efforts.

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[34]Premier SA (2020). https://www.premier.sa.gov.au/news/media-releases/news/$50-million-for-local-projects-to-create-local-jobs
[35]Government of Australia (2020).
https://www.cmtedd.act.gov.au/open_government/inform/act_government_media_releases/gentleman/2020/environment-to-benefit-from-acts-covid-19-stimulus
[36]CBC (2020). https://www.cbc.ca/news/canada/calgary/federal-oil-and-gas-orphan-wells-program-1.5535943
[37]Natural Gas Intel (2020). https://www.naturalgasintel.com/articles/121723-canada-oil-gas-aid-package-to-fund-orphan-well-cleanup-curbing-methane-emissions

Afforestation programmes in Ethiopia

Under the National Green Development programme in Ethiopia, the government plans to plant 4 billion trees on 1.5 hectares of forest land. The programme was initiated given the impacts of drought on soil degradation and erosion, which drastically reduced the country's forest cover.[38] This programme in Ethiopia is a part of the Climate Resilient Green Economy Strategy that is designed by the Prime Minister to plant trees in rural and urban areas.[39] The programme, directly administered by the Ministry of Environment, Forest and Climate Change, will hire labourers for tree planting given the slackness of labour market in the country.[40] This project, given it is embedded in the government's agenda is shovel-ready, requires labour benefits, and maintains the social distancing guidelines that may be necessary into the future.

Active transportation and afforestation programmes in the UK

The UK announced a £2 billion GBP stimulus package to boost cycling and walking infrastructure. This announcement is related to the pre-COVID announcement that sought to boost transport green infrastructure, but the crisis forced policy makers to increase its ambition and speed it up substantially.

In the UK, the goal of sequestering carbon from 1.5 billion trees is being pursued by public and private entities. The private sector as of 2019 is now planting more trees than the state, despite the programme's formation publicly under UK climate change policy.[41] A new development under the UK's tree planting target includes a £50 million GBP scheme to boost tree-planting by offering payments (annual income for carbon units delivered) to farmers who plant trees or woodlands on their unused agriculture land. This payment scheme is not a direct government procurement programme but instead is a subsidy for a pro-environmental behaviour.

The Woodland Carbon Guarantee is a financial incentive where the reward is given conditional on land managers registering to a voluntary standard scheme.[42] Payments are delivered through a long-term contract that pays out based on quantity of carbon sequestered in the project over 35 year period. Financial payment requires independent certification to qualify and can be used in tandem with government grants for tree planting. The main logistical obstacles to afforestation programme include (1) matching demand to nursery supply of trees given nurseries require three year time frames for demand estimation, (2) decline in forestry worker numbers and forest-related research in UK resulting in lower-skilled forestry employees and less productive labour, and (3) landowners must be incentivised to sell or convert their land given other locations may be higher sensitivity or exposed to climate risk that make them second best

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[38] UN Environment (2019). https://www.unenvironment.org/news-and-stories/story/spotlight-ethiopias-tree-planting-programme
[39] Ethiopian Government (2019). https://ngd.essti.gov.et/
[40] UNDP (2011). https://www.undp.org/content/dam/ethiopia/docs/Ethiopia%20CRGE.pdf
[41] The Guardian (2019). https://www.theguardian.com/environment/2019/nov/16/reforesting-the-uk-trees-are-the-ultimate-long-term-project
[42] UK Government (2019). https://www.gov.uk/government/news/government-launches-new-scheme-to-boost-tree-planting

locations.[43] The programme is labour intensive and could be a key nature-based solution funded as a part of economic recovery. This project is ongoing and meets the timeliness and temporary standards.

Afforestation programme in Pakistan

There are currently two nature-based solution programmes currently running in Pakistan from the COVID-19 economic stimulus package. The 10 Billion Tree Tsunami project focuses on promoting plantation, establishing nurseries and natural forests, and promoting honey, fruit, and olive tree planting.[44] The Green Nigehabaan initiative is under consideration and is anticipated to provide job opportunities to youth by employing them in the plantation campaign. The initiative would hire 65,000 people in its initial phase.[45] This programme is designed to stimulate employment opportunities in the green sector while providing support to the agriculture and forestry sectors.

Afforestation and urban energy efficiency programmes in India

India has an existing government work programme, the National Rural Employment Guarantee Act (NREGA), passed in 2005 to bring informal workers into paid employment opportunities and stimulate rural economic growth.[46] The programme has given 2.3 billion days of work to over 40 million households, costing around $6 billion USD.[47] Benefits of the programme were found to include employment insurance for those temporarily without work, increased wage growth for regions where NREGA is an option, and improved public works. This programme, under the COVID-19 economic stimulus recovery announcement will focus on hiring rural labourers for an afforestation programme. Given the scheme has already been proven to provide job opportunities to stimulate spending, has a low upfront cost to government, and can be expanded or contracted in a short period of time, it is a strong example of a nature-based solution for green stimulus.

Urban flood risk reduction investment in Malmo

In Malmo, Sweden, a green roof and building programme was designed to reduce flood risks and bring additional carbon sequestration benefits to this coastal city. The project is designed to improve the sustainability of the neighborhood, provide jobs to the community that experiences high rates of unemployment, and achieve sustainable development goals.[48] The

[43]Carbon Brief (2020). https://www.carbonbrief.org/in-depth-qa-how-will-tree-planting-help-the-uk-meet-its-climate-goals
[44]Newsweek Pakistan (2020). https://www.newsweekpakistan.com/imran-khan-approves-green-stimulus-package/
[45]Pakistan Official Twitter (2020). https://twitter.com/PTIofficial/status/1255146529192415233
[46]Overseas Development Institute (2008). https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/614.pdf
[47] Food and Agriculture Organisation (2010). http://www.fao.org/3/i1025e/i1025e02.htm
[48] Think Nature EU (2018). https://www.think-nature.eu/wp-content/uploads/2018/08/15a-Case-studies-Malm%C3%B6-NBS-MS-workshop.pdf

stormwater and urban greening systems included building natural ditches, reservoirs and retention ponds, in addition to green space for residents in the area. From this programme, unemployment fell in the city of Malmo from 30% to about 6% from 1998-2002, or the years the programme was implemented.[49] Economic uplift was achievable in tandem with ecological sustainability and insurance against climate risk through this urban water and greening infrastructure programme.

Green corridor construction in Spain

In Passeig de Sant Joan, Barcelona, the ENABLE project was designed and implemented to enhance active transport, sustain wildlife and biodiversity in the city, and reduce negative effects of automobile pollution for city residence. This 'green' transportation infrastructure project was one of a few 'green' transport projects funded by EU.[50] The project cost totalled about $4.5 million USD, and primarily converted a roadway into a pedestrian boulevard as well as creating a protected cycle lane and restoring segregated woodlands outside of Ciutadella park.[51] The project was conducted over the course of one year (2010-2011), so its short time scale and small, up front capital cost makes it a strong example of a transformational 'green' recovery investment, where urban space has been redesigned as low-carbon, helping to drive the shift in Barcelona to a more sustainable city design that promotes cycles and pedestrians.

Environmental rebates through RUPES for Indonesian farmers

In the Way Besai watershed on the coast of Sumatra, Indonesia, a reward to upland poor for environmental services (RUPES) programme was introduced in 2005 to reduce sedimentation in water and increase soil conservation practices.[52] This programme offers electricity credits to farmers who undertake practices which reduce water sedimentation in the river as well as extend land rights conditional on committing to these environmental practices.[53] Small-scale coffee farmers have deforested the land and increased the intensity of use on forest land for short-term gain. Similarly, given deregulation that occurred (and was later repealed) in Indonesia, as well as in other countries with large forests including Brazil, has lead to land poaching in an effort to sustain lost rural income. Because of this, the COVID crisis has exasperated the concerns by rural farmers. This programme monetarily rewards ecologically sustainable management practices undertaken by farmers and guarantees land rights conditional on undertaking these management techniques. The programme, funded privately, could be implemented and overseen by a government authority and would be low-cost up front with payments returned in the form of energy credits reducing the debt burden a government would face in financing this programme.

[49] Kazmierczak & Carter (2010). https://orca.cf.ac.uk/64906/1/Database_Final_no_hyperlinks.pdf
[50] OPPLA (2020). https://oppla.eu/casestudy/18419
[51] Naturvation (2020). https://naturvation.eu/nbs/barcelona/urban-green-corridor
[52] World Agroforestry (2008). http://www.worldagroforestry.org/project/rewarding-upland-poor-environmental-services
[53] About Values (2008). http://www.aboutvalues.net/data/case_studies/values_case_study_reducing_sedimentation_indonesia.pdf

State-level energy efficiency programme for COVID recovery

Vermont has passed a Green Stimulus package, utilising $800,000 USD in energy efficiency funds to support local economic recovery while pursuing their established city-wide goal of net-zero emissions.[54] This programme funded both by the city of Burlington and the Burlington Electricity Distributor (BED) has introduced a variety of energy efficiency incentives for low and middle income houses as well as expanding the electric vehicle incentives.[55] This programme fits into the green energy tax rebate and subsidy archetype, and while it may not stimulate the most direct employment opportunities, it can be done while pertaining to social distancing requirements while also carrying little cost, as energy efficiency and electrification measures often have negative social costs and return savings directly to consumers who can spend more easily after taking advantage of the programme. Specific components of BED and Burlington's Green Stimulus package include a $200 point-of-sale rebate for electric bikes, electric heat pump incentives, rebates for residential appliances, and zero interest or discounted lending for weatherization for homeowners.[56]

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[54] Utility Dive (2020). https://www.utilitydive.com/news/its-time-for-a-green-stimulus-heres-how-a-small-vermont-utility-can-show/579757/
[55] VT Digger (2020). https://vtdigger.org/2020/04/07/burlington-sets-green-stimulus-package-as-part-of-response-to-virus/
[56] Burlington Electric (2020). https://burlingtonelectric.com/greenstimulus