

The Economic Case for Greening the Global Recovery through Cities

Seven priorities for national governments

National governments can steer their fiscal stimulus efforts towards investing in sustainable cities, creating numerous green jobs today and decisively opting for low carbon economic prosperity tomorrow. This paper demonstrates how national government decision-makers and key urban stakeholders can shape fiscal stimulus packages for a green, resilient and inclusive economic recovery in the aftermath of the global health pandemic.

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Authors

Manisha Gulati¹, Renilde Becqué², Nick Godfrey³, Aziza Akhmouch⁴, Anton Cartwright⁵, Jason Eis⁶, Saleemul Huq⁷, Michael Jacobs⁸, Robin King⁹, Philipp Rode¹⁰

1. Senior Advisor, Coalition for Urban Transitions. 2. Senior Consultant, Coalition for Urban Transitions. 3. Director, Coalition for Urban Transitions. 4. Head of Division, Cities, Urban Policies and Sustainable Development, OECD. 5. Economist, African Centre for Cities. 6. Executive Director, Vivid Economics. 7. Director, International Centre for Climate Change and Development (ICCCAD), 8. Professorial Fellow, Sheffield Political Economy Research Institute, University of Sheffield. 9. Director of Knowledge Capture and Collaboration, WRI Ross Center for Sustainable Cities and Senior Advisor to the Coalition. 10. Executive Director, LSE Cities, London School of Economics and Political Science.

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Executive summary

Cities are at the epicentre of the COVID-19 crisis. To date, the global conversation has been centred around the immediate impact in cities in terms of public health, how the lives of urban residents have come to a grinding halt, and how the impact is being borne disproportionately by the poor and vulnerable in urban areas. But the crisis has also demonstrated the critical importance of cities. The writing on the wall is clear: when cities stop working, so does the global economy. And now that national governments and international financial institutions are already pledging unprecedented levels of funding to revive economies, it is critical that this stimulus is directed to the places and people that are most impacted – cities and their residents.

This paper therefore sets out the economic case for national governments making major investments in sustainable cities and in urban infrastructure, to stimulate a green, resilient and inclusive recovery, while creating local jobs, particularly for vulnerable groups. We identify seven priorities for investment, with actionable policy proposals to transform cities. These investments are in the areas of construction and real estate, clean mobility, renewable energy, active transport, nature-based solutions, waste and resources, and research and development for clean technologies. Chosen on the basis of criteria such as the potential to generate jobs and social, environmental and health co-benefits, investments in these areas are financially sustainable beyond this initial stimulus. Our research shows that there if the stimulus is directed at these sectors, it can create much needed economic security in the short term, while at the same time making rapid strides towards the longer-term goal of low-carbon economic prosperity.

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PART A: Invest in sustainable cities for a transformational recovery

The scale of the great lockdown

As the year 2020 has unfolded, COVID-19 has rapidly shifted from primarily being a public health emergency to becoming a full-blown economic crisis. Economies around the world have ground to a halt, with billions of people home-confined, often at the cost of their jobs, education and economic security. Although the full economic consequences remain to be seen, the crisis is projected to cause a cumulative loss of over US\$12 trillion to the global economy over two years (2020–21).¹ Current estimates for job losses by the end of June 2020 are the equivalent of 400 million full-time jobs (14% of working hours), based on pre-crisis employment levels², while 28% of the global workforce – 1.25 billion people – work in sectors at risk.³ It is not just formal employment that has been hard hit. In the global south, up to 80% of urban employment is in the informal sector.⁴

Some of the biggest challenges from the crisis are likely to be a significant rise in income inequality and poverty. Estimates suggest that up to 400 million people worldwide could be pushed into extreme poverty, adding to the roughly 700 million in poverty prior to the pandemic.⁵ A large share of the new extremely poor is projected to be in South and Southeast Asia and Sub-Saharan Africa.⁶ These are also countries where large numbers of urban citizens live in precarious, densely packed and underserved slums, characterised by high levels of informal employment and often an inability to adhere to social distancing measures, especially where the inhabitants are trying to avoid starvation. Poverty is also likely to increase dramatically in a range of middle-income countries in Asia, where economic progress has been relatively fragile and many of the previously poor population had only just moved above the poverty line when COVID-19 hit.⁷

Preventing the development gains attained over the past century from going backwards makes shaping the economic response more challenging than simply managing the immediate economic slowdown. Governments have launched the first of what is likely to be many waves of fiscal and monetary stimulus: at least US\$11.5 trillion has already been committed, and current estimates are that the total reconstruction spend may reach US\$20 trillion.⁸ While the first order of priority in this economic emergency must be to protect incomes and businesses, there are important choices to make about the shape and content of economic rescue and recovery packages, including which sectors to protect, what kind of infrastructure to prioritise, how to design specific support measures, which groups in society to target, and what kinds of incentives and conditions to attach to the packages.

The crisis also poses risks to the prospects of urgently needed low-carbon investments. Reducing emissions in the long term requires large investments in low-carbon technologies from the public and private sector. However, economic uncertainty created by the crisis is likely to induce firms to reduce or postpone investment and innovation activity, which is particularly important for investments in the energy sector.⁹ Additionally, the prevailing low fossil fuel energy prices risk providing weaker incentives for investment in low-carbon and energy efficient technology at all stages.¹⁰ Finally, the disruption in global supply chains, including those for clean technologies, could delay or obstruct the completion of many low-carbon projects, especially clean energy projects.¹¹

Because much of the financial stimulus is expected to end up funding long-lived infrastructure assets, national governments need to ensure that these investments concurrently respond both to current priorities and to the impetus to build a better future. The COVID-19 crisis has had uneven impacts not only across countries, but also across cities within the same country.¹² Stimulus must be directed towards the places and people most impacted. Clearly, cities need to be prioritised, since the impact of the crisis is borne disproportionately by people who live in cities, specifically the poor and vulnerable.

Cities at the epicentre of the challenge and the solution to recovery and transformation

Investing in cities offers national governments an unprecedented opportunity for a green and inclusive recovery. Cities are at the centre of the COVID-19 crisis. Urban areas are home to 55% of the world's population and responsible for over 80% of global gross domestic product, so cities are on the frontline of the unfolding crisis, and those in the developing world are hardest hit. Not surprisingly, it is in the world's cities that the impact of job and income losses, a global economic downturn, and increasing poverty and inequality levels is being felt most urgently. However, investing in cities also offers among the most promising opportunities to accelerate the transition to a resilient and low-carbon future while responding to the crisis with speed and impact.

Major urban infrastructure investments have some of the highest potential to unleash new economic activity, create local jobs, increase public health outcomes and set cities on a path of prosperity and sustainable long-term development. These investments span areas such as energy-efficient buildings (including affordable housing), low-carbon transport systems, renewables-based distributed energy systems, the preservation and incorporation of natural capital into the urban landscape, and better managing and retaining critical resources in local economies. Investments across these areas are estimated to hold the potential to unlock a direct economic dividend worth at least US\$24 trillion by 2050, alongside supporting the equivalent of at least 87 million jobs in 2030 (mostly from building efficiency improvements) and 45 million jobs in 2050 (mostly in the transport sector).¹³ These dividends are possible because cities concentrate people and allow for relatively low unit costs of service delivery, enable the crowding in of private capital, and incubate innovation, business models and institutional arrangements. In doing so, they help to reduce barriers to entry to market for businesses.

Investment in cities also boosts resilience to future pandemics and climate change.

As COVID-19 has shown, our collective capability to survive and recover from such events necessitates coordinated, cost-effective multi-sector resilience planning.¹⁴ Cities need to be at the heart of such planning. As cities are the confluence of people, economy and assets, when they stop working, so does the global economy. Cities have the ability to boost a national economy's resilience to a wide range of economic, health and environmental risks. Cities around the world have been assessing the multiple impacts of the crisis and have already begun designing and implementing ambitious place-based recovery packages and strategies that take into account a range of environmental and inclusion criteria.¹⁵ Moreover, given the interconnectedness of systems in cities, investment in resilience for cities lessens the impact of cascading failure.¹⁶ The costs for climate change and future pandemic preparedness rise the longer countries postpone acting decisively.

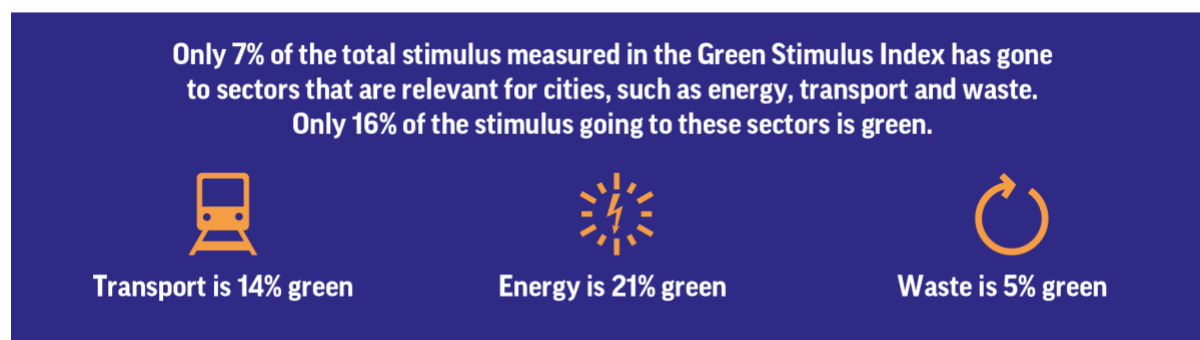
Investing now in resilient urban infrastructure and system preparedness pays itself back many times over. As climate change impacts threaten urban infrastructure in cities through different internal hazards (e.g., organisational deficiencies leading to inabilities to cope) and external hazards (e.g., environmental, social, technological and economic factors), enhancing the resilience of engineered structures, organisations and communities becomes a priority.¹⁷ In coastal cities, the economic cost of good adaptation to climate and extreme weather threats is one-tenth of the cost of no action.¹⁸ Adding the wider benefits of sustainable investment, such as enhanced quality of life as well as the ability to generate numerous jobs, many of which provide meaningful employment to people at lower to medium skill levels, turns economics costs into benefits.

Cities: an investment opportunity still to be tapped

Despite the clear immediate and longer-term opportunities available, economic rescue and recovery packages have generally not been explicitly directed towards cities. This is a significant missed opportunity, given that the current spending window is unlikely to be repeated as government budgets across many countries become squeezed post-stimulus. Analysis conducted for this paper by Vivid Economics through their existing Green Stimulus Index (GSI)¹⁹ concluded that only a fraction of this stimulus has been directed towards “green” measures, running the risk that the pattern of recovery will delay countries even further on their path to a sustainable (urban) future, or lock them in entirely to an unsustainable pathway. However, stimulus spending has been earmarked for or provided to sectors such as energy, transport and waste,²⁰ which are particularly relevant for cities, alongside investments in health care. Although the data are still emerging, especially in the global south, some city-relevant, low-carbon stimulus measures do exist and these offer examples that could be built upon:

- The UK has provided a US\$1.97 billion support package to Transport for London to cover revenue lost due to reduced ridership. This measure is expected to be in place for a year and is conditional on the increase in congestion charge from £11.50 to £15. An additional \$2.5 billion in funding for cycling and pedestrian infrastructure has been earmarked nationwide.
- Italy has increased subsidies for household rooftop solar photovoltaics (PV) installation from 50% to 110%.
- France has increased funding for electric vehicles (EVs) and EV infrastructure, including US\$390 million in green research and development for vehicle manufacturing. The country has also extended a subsidy for household rooftop solar PV installation and announced a fast-track process for renewable energy projects.
- China has extended subsidies on electric vehicles to 2022 and announced US\$379 million in funding for EV charging infrastructure.
- Germany has scaled up its eco-friendly car purchase incentive scheme, giving a boost to electric vehicles and hybrids, besides planning to reform its tax system to ensure that higher-emitting vehicles pay higher taxes from January 2021.²¹
- The European Commission has announced significant funding for a Just Transition Fund to reduce reliance on fossil fuels, as well as funding for home energy efficiency and

green heating, natural capital and circular economy initiatives, renewable energy technologies, EV sales and charging infrastructure.



The need for national governments to work in partnership with local leaders

Cities are acting, even as budgets shrink. Some city governments are making low-carbon investments under their own urban recovery strategies, based on existing national fiscal transfer arrangements and / or own source revenues. It is now critically important for national governments to support them because much of the financing required for these investments will either be provided by or mediated through national governments. This support will also be critical in light of the strong pressures on cities' expenditure and decreasing revenues that many local authorities face, which in turn will exacerbate the shortage of services exposed by this pandemic and reduce their long-term investment capacity. Reduced use of public transport, supply chain disruptions, weakened exports and investments, as well as restricted travels for both business and tourism, are likely to affect the revenue bases of many cities – and local authorities – in the medium and long term. Despite revenue streams being affected, the expenses of local authorities will continue to increase to provide and enhance access to basic services and to transform public spaces in line with the demands placed by this pandemic. In fact, subnational governments have been a major investor, accounting for 64% of environmental and climate-related infrastructure investment in the OECD, for example, between 2000-2016.²² However, the absence of national spending in cities under the recovery packages will only deplete local authorities' ability to reinforce basic services and transform public spaces in line with the pandemic, even forcing them to make hard choices and implement service cuts.

How can national governments help? Many policies required to enable and shape investments in cities are set at the national level, such as national spatial planning guidelines, building energy codes or energy efficiency standards. Many more national policies, although not urban-specific, hugely influence investment outcomes in cities, such as national energy, tax, housing and transport policies. For example, over half of the abatement potential identified in cities comes from decarbonising electricity grids, which are typically overseen by national and provincial/state governments.²³ Indeed, worldwide, national and state governments have primary authority over a full one-third of urban mitigation potential (excluding decarbonisation of electricity), including from improved cement production processes and more stringent energy efficiency standards for appliances, lighting and vehicles. National government leadership will therefore be critical for realising the investments that local governments are making or hoping to make.

PART B: Priority areas for urban investment by national governments

The Coalition's analysis identifies seven key areas for national governments to consider steering investments towards to deliver a sustainable city-focused green and inclusive recovery. These areas yield substantial economic dividends, create millions of jobs, and have great potential to deliver quick, durable and inclusive economic, health and environmental outcomes. These are:

1. Green construction and retrofits;
2. Clean mobility;
3. Renewable energy;
4. Active transport;
5. Nature-based solutions;
6. Waste and resources; and
7. Research and development for clean technologies.

These sectors offer governments the opportunity to invest in projects that can be easily implemented. Importantly, they offer opportunities to attract sustained private sector investment beyond the initial public spend. They also provide opportunities to build the kind of longer-term clean, resilient and inclusive economic transformation that the world needs.

The investment areas have been chosen on the basis of the following five criteria:

1. Incremental investment – the incremental investment required relative to grey and brown investments;
2. Carbon reduction – their emission reduction potential;
3. Job potential — their ability to create jobs;
4. Ease of implementation — the ease of delivering investments; and
5. Wider benefits – their range of social, environmental and health co-benefits, such as reductions in air pollution, improvements in public health and liveability, and a lowering of household energy bills.

Box 1: How to read the policy cards provided with each priority investment area

The analysis for each sector is supported by a policy card.

The policy card includes:

- **A score card:** This provides the potential for each sector to deliver on the five criteria using a **low, medium or high range**. The order of magnitude suggested in this score card is indicative based on a synthesis of the literature and will vary from country to country. The scoring example provided to the right shows a medium score on top, and a medium to high score at the bottom.
- **Main policy options:** The main policy options available to countries to realise the investments in the sector. Note:
 - Depending on governance structures and the degree of (de)centralisation, in certain countries some of the main policies listed are the domain of state or city governments rather than national governments.
 - The policy options include: policies that can typically be deployed quickly and with a large, immediate impact; policies that can be considered critical steps in the short term towards longer-term goals of sustainable and resilient urban development; and policies that usually take longer to design and implement from scratch unless a country already has a suitable existing policy environment in place, and/or was in the advanced stages of designing such a policy pre-COVID.
 - An in-depth assessment is not provided regarding which of the listed main policies can most easily be implemented in the very short term to support immediate recovery efforts of a particular jurisdiction. This assessment would need to be carried out on a country-by-country basis.
- **Push or pull policy:** Push policies refer to mandatory measures, regulations or policies from government, such as building codes which create clear requirements and boundaries for investment behaviour. Pull policies on the other hand are enabling policies, which create predictable economic incentives to shift investment behaviour, such as through fiscal incentives for renewable energy uptake.
- **Best delivered in combination with:** This refers to policies beyond the particular sector that are generally important to pursue in conjunction with those for this sector, to achieve greater impact.
- **Job potential vs. grey/brown industries:** A comparison is provided between the typical job creation potential of green solutions in this sector per US\$1 million investment vs. the same potential for business-as-usual solutions using a range of estimates, the sources of which are included in the endnotes.



GREEN CONSTRUCTION AND RETROFITS

Create low-carbon built environments where people will love to live

Main policy options:

- Mandatory energy efficiency building codes for new and existing buildings
- Minimum energy performance standards (MEPS) for high energy-consuming appliances
- Government leading by example (on retrofits) for public (managed) building stock, including affordable housing units
- Energy audit and benchmarking schemes
- Green building or infrastructure rating schemes
- Financial and non-financial incentives
- Efficient and clean energy use, and resilience features incorporated into affordable housing and essential infrastructure programmes
- Green public procurement regulations and guidelines including for low embodied carbon construction materials

Best delivered in combination with:

- Renewable energy expansion
- Electrification of heating, cooling, cooking
- Removing high grid electricity subsidies
- Removing fossil fuel subsidies
- Cool roof and cool pavement programs

Incremental investment



Carbon reduction



Job potential



Ease of implementation



Wider benefits



Push or pull policy:

While push policies such as mandatory building codes are essential to achieve minimum low-carbon and energy efficiency levels, pull policies such as targeted fiscal incentives can help actors go further, achieving greater energy and carbon reductions, as well as (vice versa) supporting a transition towards more mandatory requirements.

Job potential vs. grey/brown industries



Investment potential

Major growth in future building and infrastructure stock

Africa, India and Southeast Asia in particular face the enormous task of shaping the next generation of cities. More than 2.5 billion urban dwellers will be added to the world by 2050, 90% of them in Africa and Asia. Already today at least 1.2 billion city dwellers lack access to affordable and secure housing,²⁴ while 2.4 billion lack access to safe water and sanitation.²⁵ Moreover, about 1 billion people lack reliable access to energy, and a similar amount lack sustainable access to cooling, while climate change is increasing the occurrence of deadly heat.²⁶ Other more developed regions face an aging and energy-inefficient building stock in urban areas, which requires retrofitting in order to meet countries' climate goals. Buildings and infrastructure form the essential fabric of our rapidly growing urban landscapes, and cities will have to be lead actors in shifting the world towards a decarbonised construction sector.²⁷

High net benefits of resilient infrastructure investment

The Global Commission on Adaptation already found that the **net benefit of investing in resilient infrastructure** over the next decade in developing countries would be US\$4.2 trillion over the lifetime of new infrastructure, with a US\$4 benefit for each US\$1 invested.²⁸

^a McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate. McKinsey.com, 27 May. Available at: <https://www.mckinsey.com/business-functions/sustainability/our-insights/how-a-post-pandemic-stimulus-can-both-create-jobs-and-help-the-climate>.

Garrett-Peltier, H., 2017. Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling*, 61(C): 439–47.

^b McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate.

Emission reduction potential

Buildings can deliver almost 60% of cities' carbon abatement potential

Buildings account worldwide for 40% of CO₂ emissions from energy²⁹ and offer the greatest and lowest-cost potential for emission reductions at around 6 Gt CO₂e/year.³⁰ In cities, 58% of the urban abatement potential can in fact be attributed to the buildings sector.³¹

Potential to rapidly support economic recovery in the short term

Job creation potential

Energy efficiency as an attractive stimulus investment

Investments in energy-efficient and zero-carbon buildings can create local jobs and deliver economic stimulus. Previous energy efficiency stimulus investments have produced US\$2 or more in direct energy cost savings alone for every US\$1 invested, and approximately 18 jobs per US\$1 million invested.³² The majority of these new jobs are tied to local communities, providing opportunities for different skills levels distributed across the workforce including in deprived areas. With a large number of companies in the construction and renovation market being small and medium-sized enterprises (SMEs), such jobs hold the potential to be secure for years pending the scale of the investment and subsequent market uptake.

Jobs growth experience from previous economic downturns

Energy efficiency has proved to be a lasting force

In the 11 years since the last global economic crisis, the clean energy sector has added 11 million jobs, with every US\$1 million shifted from fossil fuels to renewable energy and energy efficiency producing a net increase of five jobs.³³ Investing in efficient buildings is also helpfully labour intensive in the early stages of design and construction – research suggests that every US\$1 million in spending generates 7.7 full-time jobs in energy efficiency.³⁴

Immediate action-ready opportunities

Construction and real estate sector at the forefront of economic recovery

All buildings and infrastructure will need to be net zero carbon by mid-century, with national building codes for new and existing buildings, and public procurement policies playing an important role in transforming urban markets.³⁵ **The construction and real estate sectors have also often been at the forefront of economic recovery plans:** while consumer demand is depressed, public sector demand can boost confidence and speed up recovery. Particularly retrofitting buildings, such as public buildings – schools, hospitals, affordable housing – in order to bring them up to or beyond code, can provide an initial wave of demand for the construction sector when larger projects may not yet be shovel ready. In addition, public procurement can be rapidly designed to prioritise materials with a lower carbon content, thus sending a clear signal to the market and up the supply chain.³⁶

Using social distancing requirements as an opportunity for building retrofitting

Speed of implementation is critical for the current recovery packages countries put together.

Building retrofitting can often be undertaken more rapidly than new building or infrastructure projects and thus provide a fast-acting and climate-friendly opportunity.³⁷ Moreover, in the immediate aftermath of the COVID-19 pandemic, many public buildings may stay partly or entirely closed while physical distancing remains in place. This gives governments a unique opportunity to undertake energy retrofitting work, while minimising occupant disruption. Energy efficiency retrofits therefore are the most obvious option for shovel-ready, local green investment.³⁸

Ease of implementation

Urban density as a prerequisite to sustainable urban development

The social distancing required to stop COVID-19 has raised fundamental questions about the shape of the modern city, including the residential building fabric and whether this should favour sprawling developments with predominantly low-rise housing units or more dense neighbourhoods with a mixture of low-rise to medium- or high-rise residential buildings. Nonetheless, what matters is whether density is well integrated and well planned. A World Bank study of 284 Chinese cities, for instance, found no clear relationship between density and COVID-19 transmission risk. In fact, higher density often meant more efficient delivery of key services, while making it easier for people to stay mostly at home.³⁹ Importantly, **many highly effective low-carbon infrastructure options are only economically viable at certain levels of density**, as it takes less land, materials and energy to physically connect households and firms when they are closer together, while also reducing transmission losses. Higher population densities therefore reduce per capita investment needs for many types of infrastructure, while access to a higher concentration of users can also reduce per capita operating costs.⁴⁰

How it can support marginalised or vulnerable population groups

Community-driven upgrading of informal settlements increases urban resilience

Enhancing urban resilience has to go hand in hand with more inclusive development policies and practices. Participatory upgrading programmes can help to transform slums into neighbourhoods that are dense, liveable and affordable, which is an untapped opportunity with few large-scale examples available today.⁴¹ Cape Town, however, shows the potential through a pilot, which invested in retrofits for poor-quality housing in low-income neighbourhoods, upgrading 2,000 homes while generating over 2,300 jobs in the process and providing valuable skills training to a diverse workforce.⁴² National governments have important roles to play, including: reforming minimum plot sizes and maximum floor-area ratios that limit density and increase costs; reforming construction regulations to allow for incremental housing solutions as the incomes of residents permit; providing funding for core infrastructure to both municipal governments and organised communities; and allowing collective ownership to resist the pressures of gentrification.⁴³

Supercharging investment in critical public services and climate-resilient infrastructure

Investment in affordable water, sanitation and hygiene services, particularly in poor urban communities, as an example should increase by a factor of 40 to ensure universal urban access. Providing city dwellers with access to fundamental services, such as clean water, sanitation, affordable housing and essential urban infrastructure, can make cities more climate and pandemic resilient.⁴⁴

Consideration of the potential for green construction and retrofits to support economic recovery in the medium term and of its wider benefits are included in the Annex.

CLEAN MOBILITY

Promote clean and shared transport for connected, accessible cities

Main policy options:

- Developing a public transport masterplan
- Setting targets for public transport modal split
- Giving public transport subsidies to retain quality service levels
- Making transit-oriented development an urban design requirement
- Assigning dedicated bus and high occupancy vehicle lanes
- Road pricing and parking fees to discourage private vehicle use, as well as to help make up for fare shortfalls for public transport
- Amending parking requirements to stipulate maximum rather than minimum amount of parking to be provided
- Differentiated parking fees, distinguishing between clean vehicles and fossil fuel-powered vehicles
- Setting ambitious EV deployment targets
- Investing in EV infrastructure
- Phase-out date (2030) for fossil fuel-powered vehicles

Best delivered in combination with:

- Renewable energy expansion to decarbonise the electricity grid
- Electric battery disposal and recycling schemes

Incremental investment



Carbon reduction



Job potential



Ease of implementation



Wider benefits



Push or pull policy:

A combination of foundational push policies, such as setting clear requirements or phase-out dates, with a variety of pull incentives, such as dedicated vehicle lanes and the use of pricing to spur the uptake of more sustainable transport options, is required.

Job potential vs. grey/brown industries



Investment potential

Cost-competitiveness of EVs approaching tipping point

The automotive sector has been severely hit by the global economic downturn resulting from COVID-19. This sudden stop comes at a critical moment in the deployment of EVs. The cost-competitiveness of EVs versus internal combustion engine vehicles is approaching tipping point. **This tipping point should be reached in the 2020s for EVs to dominate car and two/three-wheeler purchases** and enable a 100% EV fleet by mid-century. However, to do so we need economies of scale and learning curves driven by growing EV sales.⁴⁵

Attractive multipliers for targeting public transport and EV investment as part of stimulus

COVID-19 has also struck a massive blow to public transport, an absolutely essential component of a transition to a low-carbon, resilient, safe and just urban environment.

Ridership has gone down by 50–95%.⁴⁶ The SARS crisis of 2003 led to lower demand for up to six months after the epidemic had eased.⁴⁷ Many governments have started to intervene to protect public transit systems from going bankrupt.⁴⁸ Despite this, in some cities, such as Tokyo and Hong Kong, public transport is already seeing quite high uptake again.

Meanwhile, post-COVID analysis for Europe points to urban rail and bus rapid transit schemes, as well as manufacturing EV and expanding EV charging networks to come with **attractive multipliers, delivering a gross value add of about US\$2 for every dollar invested**.⁴⁹

^c McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate.

^d WHO, 2014. Unlocking new opportunities: Jobs in green and healthy transport. World Health Organization, Geneva. Available at: <https://thepep.unece.org/sites/default/files/2017-05/Unlocking-new-opportunities-jobs-in-green-and-health-transport-Eng.pdf>.

Emission reduction potential

Transport sector can deliver a fifth of cities' carbon reduction potential

Cities can cut 90% of their emissions with measures that are technically feasible today, with 21% of the potential coming from the transport sector.⁵⁰ Transport also contributes up to 70% of urban air pollution, and air pollution is strongly suspected of contributing to COVID-19 susceptibility, with initial research showing that a minor 1 g/m³ increase in long-term PM_{2.5} exposure may lead to a 15% increase in the COVID-19-related death rate.⁵¹ **Ending the sale of fossil fuel-powered motorbikes, passenger cars, vans and buses by 2030** will be an important step in decarbonising cities.⁵²

Potential to rapidly support economic recovery in the short term

Job creation potential

Transport investments providing strong socio-economic benefits

Public transport is an investment that can create long-term jobs quickly while reducing polluting emissions, congestion and traffic accidents, and improving people's access to jobs and other opportunities.⁵³ Analysis shows that bus rapid transit and urban rail schemes take a shared top place, together with active transport, for job creation potential per €1 million invested, based on 12 priority low-carbon post-COVID stimulus measures considered for Europe. Rapidly expanding EV charging networks does not fall far behind in its ability to create jobs in the near future.⁵⁴

Jobs growth experience from previous economic downturns

Sustainable transport delivers more jobs than other transport investments

In 2009, in the midst of the global financial crisis, already more people in Europe were employed in green than in traditionally polluting industries. The largest share, around 2.1 million, came from sustainable transport.⁵⁵ In the USA, economic stimulus investments after the global financial crisis generated 31% more jobs per dollar through public transport than new construction of roads and bridges.⁵⁶ In South Korea, investment in public transport, biking and railroads after the crisis created an estimated 138,000 jobs,⁵⁷ 15% of the total jobs created under the entire programme.⁵⁸

Immediate opportunities

Dedicated vehicle lanes to increase sustainable transport uptake

Governments should defend and invest in their public transport systems to provide and maintain safe, efficient, affordable and high-quality services; and provide subsidies, if needed, to maintain the levels of service and sanitation measures required during recovery. Additional action-ready opportunities include the implementation of **transit priority lanes** for buses and bus rapid transit systems to help increase transit capacity, travel times and access to jobs,⁵⁹ as well as **high-occupancy EV vehicle lanes** to encourage greater vehicle occupancy (thereby reducing the total number of cars on the road) and the uptake of EVs.⁶⁰ In Beijing, for instance, a month after the end of lockdown, private cars on the road were at 71% of normal value, while bus, subway and taxi were at 30%, showing the risk of the pandemic reinforcing private car use and its associated externalities.⁶¹ Governments therefore have an immediate opportunity to incentivise sustainable transport uptake to ensure that they can keep their cities moving safely and sustainably post-pandemic.

Electrification incentives for mobility services, shared mobility and delivery vehicles can boost demand and fast-track EV uptake

With many countries supporting their vehicle manufacturing industry as part of economic recovery and stimulus measures, such support could be made subject to setting a production phase-out date for fossil fuel-powered vehicles. This should be combined with a focus on investments required to drive the shift to shared, electric mobility. In addition, governments can introduce policies stimulating EV demand in the form of **scrapping or e-**

conversion schemes for vans, minibuses and delivery vehicles. To ensure that these schemes are adequately supporting cleaner and better urban mobility, they should: (1) enable a shift from personal car ownership to mobility services; (2) increase the utilisation and quality of individual vehicles; and (3) minimise embedded emissions by maximising design lives and the re-use of vehicle components. The latter measures require careful planning and implementation, generally over a longer period of time.

Ease of implementation

Finding new ways to fund public transport

Funding public transport with fares alone has proven to pose continued challenges in many jurisdictions, and in a constrained economy, existing public funds to close this now rapidly increased gap may not prove a viable solution beyond the short term. **Economic stimulus programmes could explore innovative and new approaches to revenues**, such as reallocating capital expenditure from road budgets to intra- and inter-city rail and bus systems,⁶² by adopting congestion pricing and parking fees to internalise the cost of driving, in order to not only raise money but also reduce demand for private vehicles and encourage use of alternative modes of transport.⁶³ London's congestion charge, for instance, generated almost US\$190 million in net revenue in 2019, which is being reinvested back into the city's transport system in line with the Mayor's transport strategy.⁶⁴ Such investment sources could be used to increase both the quantity – more routes, higher frequencies – and the quality of public transport, such as by investing in overdue maintenance or more modern and comfortable vehicles.

How it can support marginalised or vulnerable population groups

Compact and connected urban developments boost equity

Compact, transit-oriented developments with high-quality public transport and active transport options provide much **more equitable access to jobs, education and essential services than large highway networks**.⁶⁵ Many essential workers in lower-income groups rely heavily on public transport services to get to their place of work. Brazil's social housing programme Minha Casa, Minha Vida has shown how such a programme can drive compact, connected and coordinated development, benefiting 1.8 million people through improved access to public transport and higher rates of walking and cycling.⁶⁶

Consideration of the potential for clean mobility to support economic recovery in the medium term and of its wider benefits are included in the Annex.

RENEWABLE ENERGY

Invest in renewable energy generation and electrification for low-carbon cities



Investment potential

Major growth in future energy demand

A **massive expansion in the supply of energy will be needed**, since successful urbanisation in developing countries will drive an enormous increase in energy demand to provide universal access to energy, support economic activity, and electrify cooking, heating, transport and other end uses.⁶⁷ The Energy Transition Commission (ETC) forecasts a **four- to five-fold increase in electricity demand globally by 2050**.⁶⁸

Renewable energy competitive with fossil power, also in COVID-19 times

The **levelised cost of electricity** generated from solar PV and offshore wind is now often competitive with fossil fuel power, and capital costs are projected to fall further.⁶⁹ **Despite the recent fall in fossil fuel prices**, renewable power is cheaper than fossil fuel-based thermal power generation in many major markets.⁷⁰ Moreover, investing in fossil fuel risks future stranded assets. Nonetheless, in many locales, renewable energy projects are at risk due to disruptions as a result of the lockdowns.

Emission reduction potential

Renewable energy can deliver half of cities' carbon reductions

Fully half of the abatement potential that cities could achieve today through technically feasible measures comes from decarbonising urban electricity.⁷¹

^e McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate.

IRENA, 2020. The post-COVID recovery: An agenda for resilience, development and equality. International Renewable Energy Agency, Abu Dhabi. Available at: https://irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Post-COVID_Recovery_2020.pdf.

^f McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate.

Potential to rapidly support economic recovery in the short term

Job creation potential

Clean energy sector as a lasting force

In the 11 years since the last global economic crisis, the clean energy sector has added 11 million jobs. Green industries have also shown to create more jobs per amount invested than fossil fuel industries, with every US\$1 million shifted from fossil fuels to renewable energy and energy efficiency producing a net increase of five jobs.⁷² Recent analysis by IRENA suggests that investing in a clean energy transition could create an additional 42 million jobs in the energy sector by 2030 compared with today, while doubling the size of the workforce in renewable energy to over 17 million people.⁷³

Jobs growth experience from previous economic downturns

Renewable energy as a driver of job creation after crisis

Renewable energy generates more jobs in the short run when jobs are scarce in the middle of a recession, which boosts spending and increases short-term GDP multipliers.⁷⁴ This is confirmed by **history which has shown that making clean energy a priority in stimulus packages can be a driver of job creation in the following years.** After the 2008 financial crisis, the US recovery spending prioritised funding for clean energy, creating 900,000 jobs over a five-year period.⁷⁵

Immediate action-ready opportunities

Fast-track current renewable energy applications

Due to the pandemic and subsequent lockdowns, many renewable energy projects have stalled and local skilled staff and equipment are sitting idle. In the USA, for instance, by April 2020 already an estimated 600,000 jobs in clean energy had been lost due to COVID-19 restrictions, representing 18% of the US industry's workforce.⁷⁶ To get the sector moving again, governments have an opportunity to accelerate the process from planning to shovel-ready by fast-tracking permitting for new projects (e.g. via simultaneous rather than sequential procedures and deploying capacity in relevant administrative services, including streamlining of processes).⁷⁷ Furthermore, governments can lead by example by targeting government-owned buildings such as schools, as well as public housing, for onsite renewables deployment.

Ease of implementation

COVID-19 strengthens the case for clean energy

More than ever, the **economic case for clean energy expansion is highly compelling**, especially when national governments remove fossil fuel subsidies and price carbon emissions. Nigeria, for instance, has used the collapse in oil prices to remove fuel subsidies. Previous attempts to remove subsidies led to anti-government protests. The decision is thought to save at least US\$2 billion a year, at a time when the country needs funds to deal with the pandemic and subsequent recovery.⁷⁸

How it can support marginalised or vulnerable population groups

Alleviating energy poverty

The UN predicts that a global recession following COVID may **plunge as many as 420 million people into extreme poverty**, defined as earning less than US\$2 a day, in addition to the 734 million people already there. About 1 billion people lack reliable access to energy, and a similar amount lack sustainable access to cooling.⁷⁹ Emerging economies must massively expand the supply of affordable clean electricity to meet their economic and human development goals.⁸⁰

Consideration of the potential for renewable energy to support economic recovery in the medium term and of its wider benefits are included in the Annex.

ACTIVE TRANSPORT

Foster pedestrian and cycling schemes for healthy, active citizens



Investment potential

Safe, shared streets an essential investment for urban resilience

Urban land is expensive and in demand. Streets make up the majority of public space, and their design fundamentally shapes a city's identity, appearance and connectivity. Urban sprawl and streetscapes predominantly designed for cars rather than people lower a city's resilience and make it harder for cities to function effectively during times of crisis. Although some road-related spending is necessary, two-thirds of transport experts recommend that governments shift national transport budgets from building roads to supporting both public and active transport. In cities, this spending should **support slow, safe and shared streets rather than fast, wide roads**.⁸¹

Active transport a low-cost investment opportunity

Analysis of post-COVID stimulus measures for Europe also shows that developing **active transport infrastructure comes with considerably lower capital requirements than many other stimulus measures**.⁸² In the German city of Freiburg, for instance, where cycling is responsible for nearly 20% of total number of journeys within the city, the costs of cycling infrastructure amount to just 1% of all the costs of the city's traffic and transport amenities.⁸³

^g McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate.

IRENA, 2020. The post-COVID recovery: An agenda for resilience, development and equality. International Renewable Energy Agency, Abu Dhabi. Available at: https://irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jun/IRENA_Post-COVID_Recovery_2020.pdf.

^h McKinsey, 2020. How a post-pandemic stimulus can both create jobs and help the climate.

Emission reduction potential

Cycling as a win-win with high carbon reduction benefits

There is a strong case to invest in infrastructure to support cycling – from protected cycle paths and mass bike parking facilities to bikeshare programmes – to help economies recover while curbing carbon emissions, reducing air pollution and protecting human health. Each kilometre cycled avoids 250 g of CO₂ emissions.⁸⁴ This number is significant given that average emissions of new cars registered in 2019 in the EU28, Iceland and Norway were 122.4 g CO₂/km.⁸⁵ **Copenhagen's cyclists are collectively estimated to avoid 20,000 tonnes of carbon annually,⁸⁶ equivalent to 50 million miles driven in passenger vehicles.⁸⁷**

Potential to rapidly support economic recovery in the short term

Job creation potential

Active transport has high job creation potential

Active transport, together with bus rapid transit and urban rail schemes, **shares the top place for its job creation potential for every €1 million invested**, based on 12 priority low-carbon post-COVID stimulus measures considered for Europe.⁸⁸ Taking France, for instance, it's estimated that per €1 million of turnover in the cycling industry there are nearly 10 jobs, compared with about 2.5 per €1 million of turnover in the car industry. Studies for the USA and UK showed that active transport creates many jobs in the construction phase. On average, cycling projects generated well over 11 jobs for each US\$1 million invested, compared with nearly 10 jobs in pedestrian-only projects and less than 8 jobs for road-only projects.⁸⁹

Jobs growth experience from previous economic downturns

Cycling industry is a major employer, even in times of crisis

After the global financial crisis and resulting high focus on job creation, the European Cyclist Federation commissioned a study to understand how many people in Europe work in the cycling industry, which showed that 655,000 people work in the European cycling sector, exceeding those in Europe working in mining and quarrying (615,000), or the steel sector (350,000).⁹⁰

Immediate action-ready opportunities

Cycling helps keep cities connected during crisis times

Already over 150 cities, from Bogota to Lisbon, have used the COVID-19 pandemic to rapidly expand cycling paths along major mobility corridors by assigning existing road space to cycling or by building new cycle paths.⁹¹ In many places, **emergency workers have also started to realise that cycling can be the fastest and safest way to get around.**⁹² Throughout the two-month lockdown of Wuhan in China, volunteers used bicycles to deliver necessities to residents stuck at home, while some bikeshare companies made their services free of charge to provide access for medical workers and those with urgent needs.⁹³ Cycling also proved to be a resilient and reliable mode of transportation during the 2017 earthquake in Mexico City.⁹⁴ After the devastation of thousands of buildings left many roads inaccessible to motor vehicles, the city depended heavily on personal bikes and its bikeshare system for first responders and volunteers to distribute first aid and supplies.⁹⁵

Ease of implementation

COVID-19 creates more citizen buy-in for active transport

Opinion polls in many countries show that people are noticing the clean air, uncongested roads, the return of birdsong and wildlife. Citizens have been **asking whether “normal” was good enough; could we not “build back better”.**⁹⁶ This provides an unprecedented

opportunity to rapidly expand active transport infrastructure, as large numbers of people who would usually revert to motorised transport modes have tried out more active transport modes and have experienced the benefits. A clear example of modal shifts in response to a crisis came after the London terrorist attacks in July 2005 on three London underground trains and a bus. Although the damaged underground lines reopened within weeks, the attacks had longer-lasting impacts on the city's commuting patterns, with cycling trips remaining high for the rest of the year. A contributing reason was also the introduction of a congestion charge, leading to persistent changes in preferred travel modes.⁹⁷

How it can support marginalised or vulnerable population groups

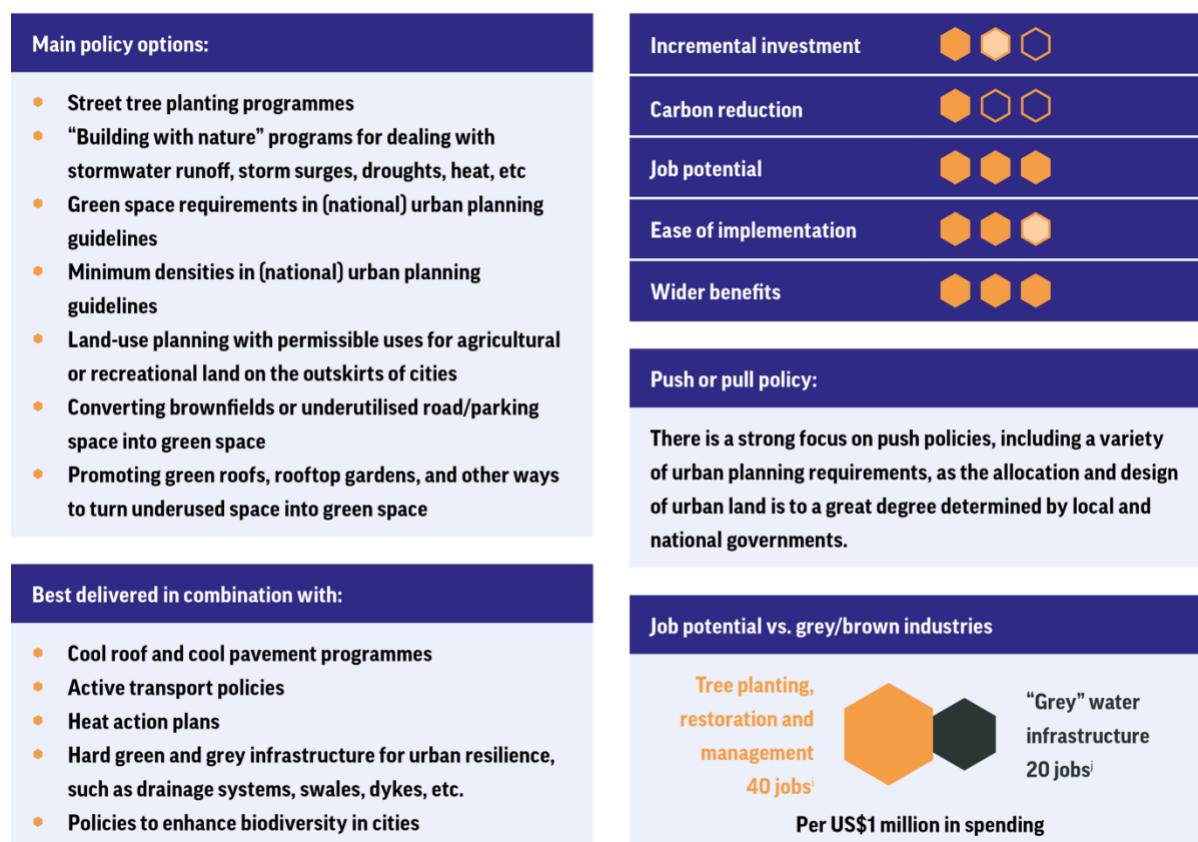
Active transport boosts access to essential services and jobs

By transforming city spaces to reallocate more road space to walking, cycling and public transport, urban citizens, particularly those in lower-income groups, are provided with more affordable ways to access economic opportunities or essential services and to travel to essential jobs.⁹⁸ In Brazil, the social housing programme Minha Casa, Minha Vida benefited 1.8 million people through improved access to public transport and higher rates of walking and cycling.⁹⁹

Consideration of the potential for active transport to support economic recovery in the medium term and of its wider benefits are included in the Annex.

NATURE-BASED SOLUTIONS

Deliver green spaces that benefit citizens and their cities



ⁱ Garrett-Peltier, H. and Pollin, R., 2010. Job Creation per \$1 Million Investment. University of Massachusetts Political Economy and Research Institute. Available at: https://grist.files.wordpress.com/2010/02/job_creation_for_investment_-_garrett-peltier.pdf.
^j Garrett-Peltier, H. and Pollin, R., 2010. Job Creation per \$1 Million Investment.

Investment potential

Trees provide enormous benefit in curbing air pollution and reducing dangerous heat exposure

A 2016 report by the Nature Conservancy in collaboration with C40 showed that in general **cities stand to benefit from tree plantings, both in terms of heat and particulate matter reduction**. Investing less than US\$4 annually per resident on tree planting along streets in 245 cities studied, collectively housing a quarter of the world's population, could improve the health of millions of people and reduce high temperature-related mortality in the assessed cities by 2.4–5.6%. The biggest calculated returns on investment were in South Asia and Africa, as a result of high pollution levels, warm climates, and trees and labour being relatively cheap.¹⁰⁰ In addition, a recent report by Vivid Economics for the UK's National Trust shows that a US\$6.9 billion capital investment in urban green infrastructure would deliver US\$252 billion in physical health and wellbeing benefits to the most disadvantaged communities in the UK, pointing to high multipliers in tandem with the enhancement of active travel, biodiversity, carbon capture and air quality which green infrastructure provides.¹⁰¹ Obviously, the cost of such green infrastructure investments will differ by country, in particular because labour costs vary considerably and are lower in developing countries.

Emission reduction potential

Trees sequester carbon and reduce residential electricity use

Under a maximum street tree-planting scenario for 245 cities, net carbon sequestration would increase by 2.7 million tonnes of CO₂ a year, while residential electricity use would decrease by about 1 to 5%. Combined, the total impact of the maximum street tree-planting scenario would see an annual reduction of between 7.0 million and 35 million tonnes of CO₂.¹⁰² These estimates do not account for the potential for carbon sequestration from other green urban features that are not street trees. In a study of 35 Chinese cities, green spaces amounting to just over 6% of urban land use sequestered around 18.7 million tonnes of carbon a year,¹⁰³ while, according to the Berkeley Food Institute, forests, croplands and urban trees currently offset 11.5% of carbon emissions in the USA.¹⁰⁴

Urban sprawl can push agriculture into forest areas, destroying natural carbon sinks

Many cities have traditionally been built in close proximity to fertile lands, with 60% of the world's croplands lying on the outskirts of urban areas.¹⁰⁵ **Losing cultivated lands to urban uses** such as poorly planned, low-density urban sprawl **can also trigger the further loss of natural habitats**. For instance, croplands in Brazil, the Democratic Republic of the Congo and Myanmar have continued to expand since 2000, even though local urban areas have been displacing agricultural lands. Instead, agriculture has pushed further into forest areas,¹⁰⁶ the degradation and destruction of which not only destroys carbon sinks but also creates grave human health risks, including those of future pandemics.¹⁰⁷

Potential to rapidly support economic recovery in the short term

Job creation potential

Tree planting and management comes with high job potential for lower-skilled labour

Research shows that for **every US\$1 million invested in reforestation and sustainable forest management, nearly 40 jobs can be supported**, from growing saplings in nurseries, to operation of machinery, and workers to transport and plant new trees.¹⁰⁸ It is assumed that these estimates provide a good proxy for the job potential stemming from expanding urban greenery, and this translates to a high job creation potential versus many other stimulus efforts. An additional benefit is that many of these jobs would also be available to local, low-skilled workers, who are more likely to face the economic consequences of COVID-19. Separately, research points to more than 10 million people in the USA being employed in green infrastructure installation, maintenance and inspection in 2015.¹⁰⁹

Jobs growth experience from previous economic downturns

Tree planting has been deployed before to tackle mass unemployment after crisis

After the First and Second World Wars, several countries implemented large-scale tree planting programmes in part to provide employment to the many citizens and soldiers who found themselves unemployed at the end of the war. In the USA, between 1933 and 1943, nearly 3 million workers and their families received financial support through the Civilian Conservation Corps, established by President Roosevelt. Together they planted 3 billion trees, while many young people employed through the Corps also learned important skills.¹¹⁰

Immediate action-ready opportunities

Natural capital spending is a fast-acting policy that rapidly deliver benefits

Speed of implementation is critical for many of the post-COVID recovery packages. **Fast-acting climate-friendly policies include natural capital spending** (e.g. afforestation, expanding parkland, wetland and catchment management), as worker training requirements are low, many projects have minimal planning and procurement requirements, and most aspects of the work meet social distancing requirements.¹¹¹ In India, it has been suggested that the many informal and migrant workers who now find themselves out of work due to the pandemic could be supported through an existing employment guarantee scheme that delivers cash in hand for planting native trees where ecologically appropriate, supporting nursery development and the creation of green infrastructure that supports water conservation and recharge.¹¹²

Ease of implementation

Now is the best time to invest in expanding a city's natural capital

COVID-19 and the resulting lockdowns have made many citizens appreciate the value of clean air, the return of birdsong and wildlife,¹¹³ and in many cities green urban spaces have proved an invaluable asset for citizens otherwise cooped up inside. Moreover, there is an increasing need for investment in the expansion of urban parks and other green spaces, such as public squares, due to social distancing requirements resulting from the pandemic. With lower-income groups being particularly hard hit by the economic consequences of the pandemic, stimulus measures that focus on expanding a city's green assets are a win-win from a health and employment perspective, and are likely to receive broad citizen support.

How they can support marginalised or vulnerable population groups

Vulnerable groups more likely to suffer from urban heat island effects

Already today more than 3 billion people live in the tropics and subtropics, with the top 30 of the hottest cities in the world all found in developing and emerging countries. A large number of these cities experience the so-called **urban heat island effect**,¹¹⁴ which is primarily caused by the replacement of natural surfaces with hard impervious (asphalt and concrete) surfaces. For a city with a population of 1 million or more, this can result in **an increase in temperatures of as much as 4–7°C** in comparison with adjacent vegetated areas,¹¹⁵ and on a clear, calm night, this temperature difference can even be as much as 12°C.¹¹⁶ Urban heat islands can also aid in the **transmission of certain diseases**, such as dengue.¹¹⁷

Furthermore, outdoor working environments, which apply to much informal employment, may result in **productivity losses during hot weather** of 60–70% in the sun.¹¹⁸ In many cities, informal workers and citizens living in low-income neighbourhoods with low-quality housing are the ones most prone to suffer from heat stress. Urban tree cover can provide critical support to vulnerable citizens by reducing heat exposure and lowering temperatures in outdoor and nearby indoor spaces.¹¹⁹

Consideration of the potential for nature-based solutions to support economic recovery in the medium-term and of their wider benefits are included in the Annex.

WASTE AND RESOURCES

Support workers and create a circular economy for clean resource-smart cities



Investment potential

Green recovery provides high value add, but needs diversified strategy

Not only has COVID-19 spurred a further surge in single-use items that are disposed after first use, it has also negatively affected complex international recycling markets. Low oil prices will also encourage the use of more virgin plastics, rather than recycling plastics. At least 24 million people globally work in the recycling industry, of which at least 15 million are working informally. **Investing in recycling, reuse and repair keeps cities from drowning in (littered or landfilled) waste, while it rapidly provides numerous jobs for vulnerable groups.**

Emission reduction potential

Better resource management is key to major carbon reductions

Cities are responsible for a growing share of waste – 1.3 billion tonnes of global municipal solid waste were annually generated in 2016, which is expected to rise to 3.4 billion tonnes in 2050.¹²⁰ Recent analysis by Material Economics points to waste and resource interventions, such as **reuse, repair, remanufacturing and recycling holding the potential to reduce emissions associated with our materials use by a third.**¹²¹

However, the World Bank has recently warned that ambitious 2050 goals for curbing carbon from operational emissions (such as in buildings, transport and energy systems) are liable to substantially increase resources pressures and associated embodied carbon emissions if

^{k, l} Goldstein, J. and Electris, C., 2011. More Jobs, Less Pollution: Growing the Recycling Economy in the U.S. Tellus Institute, Boston, MA. Available at: <https://www.tellus.org/tellus/publication/more-jobs-less-pollution-growing-the-recycling-economy-in-the-u-s>.

not managed properly, pointing to the importance of including consumption-based carbon in low- or zero-carbon targets.¹²²

Potential to rapidly support economic recovery in the short term

Job creation potential

Better resource management holds even higher job potential than clean energy

The International Labour Organization (ILO) has found that, with an aggressive shift to more recycling, reuse and repair through a circular economy scenario,¹²³ **45 million jobs could be added to the waste management sector by 2030, as well as 50 million jobs in related circular economy services such as repair and remanufacturing.**¹²⁴ Already, before COVID-19, in many countries informal sector waste pickers, such as the 3.7 million waste pickers in Indonesia, have long worked at the forefront of efforts to keep cities and villages free from waste and litter, while making sure finite resources can have a second life after their first use.¹²⁵

Jobs growth experience from previous economic downturns

Investment in green activities can create and save many jobs during the crisis

Although limited data are available on the job growth potential of better waste management from previous downturns and crises, in general it is clear that green recovery investments have delivered major job benefits in the past. An example is the American Recovery and Reinvestment Act (ARRA or the Recovery Act), which was signed into law in early 2009 as a response to the financial crash of 2008 that devastated the US economy, destroyed millions of jobs, created millions more long-term unemployed, and forced a major tax-payer bailout. It committed US\$93 billion in public investment to green economy activities across a range of industry sectors, which by the end of 2010 already resulted in **creating or saving nearly 1 million American jobs.** It provided **jobs for some of the country's most vulnerable workers**, such as those in the lower and middle of the wage distribution and those with less than a four-year college degree. Moreover, it increased the USA gross domestic product (GDP) by \$146 billion through its green economy investment.¹²⁶

Immediate action-ready opportunities

Supporting recycling protects vulnerable jobs and prevents cities being overwhelmed with waste

Lockdown orders have made it challenging for informal workers to collect recyclables. At the same time, waste collection is one of the few essential industries that has to maintain operations during lockdown times. Several major Southeast Asian cities, for instance, have been producing hundreds of tonnes of additional medical waste a day as part of the COVID-19 pandemic, risking local waste management facilities being overwhelmed.¹²⁷ Household waste is up as well, with reasons ranging from virus scares, pervasive mask-wearing and increased home deliveries of food. Landfills often don't have the ability to cope with sudden and potentially prolonged spikes in waste.¹²⁸

Incineration, on the other hand, provides few to no informal income opportunities, and risks spewing toxic fumes into the air if incineration plants are not equipped with the most modern emission abatement technologies. Urban air pollution is now acknowledged as a contributor to higher COVID-19 mortality rates.¹²⁹ In India, the government encourages citizens to use reusable masks,¹³⁰ while Bangkok is considering recycling face masks as fill for roads.¹³¹ **Cities therefore have an immediate opportunity to protect informal workers and create decent reuse, recycling and repair jobs, while preventing an urban waste crisis by supporting the waste recycling sector and finding new ways to reuse, recycle or repair common items.** For instance, national government can help cities invest in infrastructure to support the sharing of products such as tools, to create easy-access capacity for repair of common appliances and devices, and provide fast-track permitting for businesses supporting circular economy interventions.

Ease of implementation

COVID-19 as an impetus to see waste processing as an economic and rebuilding opportunity

COVID-19 is creating a tidal wave of waste and cities are at the heart of it. This is also leading to an increase in urban waste littering and all the dangers to human and animal health that come with it; many locales, from Japan to Kenya, France to Hong Kong, are seeing a surge in littered masks along roads or washing up on beaches. Some places have lifted or postponed single-use plastic bans and now stand to deal with the consequences of it. In a city such as Bangkok, plastic consumption by households is up more than 60%. To prevent this pandemic from drowning cities in waste, stimulus funds can be used to **support and build local capacity to recycle waste into new commodities, seeing it not just as an environmental problem but as an economic development and rebuilding opportunity**.¹³² This should include the development of well-functioning markets for secondary resources.

How they can support marginalized or vulnerable population groups

Recycling, reuse and repair rapidly supports job opportunities for the urban poor

More than 1 billion people live in slums and informal settlements globally. As much as 50-80% of employment is informal in cities in developing economies.¹³³ All of Africa's urban landscapes, for instance, are shaped by the phenomenon of rapid growth, with cities swelling with people displaced by desperate situations, such as war, drought, and famine.¹³⁴ Arriving with few resources and looking for security, these people often end up in informal settlements with few options.¹³⁵ Many of these urban settlers are essentially surviving day-to-day, lacking the resources to bring in an income without defying lockdown orders. Millions of informal workers are self-employed as waste pickers. Aggressively expanding recycling, reuse and repair of discarded waste products will support millions of additional formal and informal jobs – which often require little or even no education – whilst keeping cities cleaner, healthier and safer, and helping to preserve resources for future urban generations.

Consideration of the potential for waste and resources to support economic recovery in the medium term and of their wider benefits are included in the Annex.

RESEARCH AND DEVELOPMENT FOR CLEAN TECHNOLOGIES

Foster a culture of green innovation for long-term benefits

Main policy options: <ul style="list-style-type: none"> • Tax incentives, grants and subsidies • Business support schemes and platforms • Business challenges and awards • Multi-stakeholder collaboration platforms • Non-financial incentives, such as expedited approvals • Frontrunner policy frameworks • Enhanced access to financing • Risk mitigation facilities 	Incremental investment 
	Carbon reduction 
	Job potential 
	Ease of implementation 
	Wider benefits 
Best delivered in combination with: <ul style="list-style-type: none"> • Ambitious stated and quantified, carbon reduction goals, sending clear signals to market • Carbon tax • Carbon emission standards • Phasing out of fossil fuel-based technologies and subsidies • Clean energy subsidies • Intellectual property laws incentivising private sector R&D 	Push or pull policy: <p>Strong pull policies, such as incentives, support schemes, challenges, access to financing, and risk mitigation, can all help to create a culture of innovation.</p>
	Job potential vs. grey/brown industries <p>Clean R&D has been shown to be able to create major job gains through direct, indirect and induced jobs, including many jobs in manufacturing. The certainty around the direct job growth potential per US\$1 million in spending is insufficient to provide a comparison.^m</p>

Investment potential

Investment in research and development in clean technologies among most attractive recovery policies

Innovation in technologies and business models is a major driver of economic growth. Stimulus packages can champion the development and early deployment of innovations, which have the potential to drive competitiveness and contribute to carbon reduction. This is the case, for instance, for: low-carbon materials; circular business models; digital solutions for energy efficiency; distributed renewable energy, smart grid and micro grid deployment; EV charging infrastructure; and shared and micro mobility solutions, among many others.

Governments are able to support the development of these new economic sectors at relatively low cost, as the scale of investments required in these activities is much lower than in power and construction.¹³⁶ Spending on research and development (R&D) in clean technologies was also identified as one of five post-COVID fiscal recovery policies with the highest economic multipliers combined with a high positive climate impact.¹³⁷ This will also be critical given the economic uncertainty that is expected to reduce or postpone investment and innovation activity.

Emission reduction potential

Investment in R&D in clean technologies as a public good to cut global emissions

While advanced economies are anticipated to emit less than 25% of global (production-based) carbon emissions by 2040, emissions from developing and emerging economies will likely continue to increase, and could make up 75% of global carbon emissions by 2040. To effectively reduce emissions globally, a much stronger focus on R&D in clean technologies will therefore be essential, as **technological improvements**, whether occurring in advanced or emerging economies, **quickly become public goods that may allow developing and emerging economies to leapfrog**, building a more decarbonised economy from the ground

^m Atkinson, R., 2010. Create Jobs by Expanding the R&D Tax Credit. ITIF, 26 January. Information Technology and Innovation Foundation, Washington, DC. Available at: <https://itif.org/publications/2010/01/26/create-jobs-expanding-rd-tax-credit>.

up.¹³⁸ National governments can therefore actively take responsibility for shaping clean tech and low-carbon markets by steering innovation to solve public goals.¹³⁹

Potential to rapidly support economic recovery in the short term

Job creation potential

Investment in R&D in clean technologies can generate millions of jobs in manufacturing and installation

Investments in R&D in clean technologies can help these technologies to take off and reach tipping points, thereby showing considerable potential for direct, indirect and induced job growth. Research from the USA, for instance, showed that between 2003 and 2010 **new cleantech segments produced explosive job gains. Roughly 26% of all clean economy jobs in the country were found in manufacturing, compared with just 9% in the broader economy.** This was the result of many green technologies being quite manufacturing-intensive, thereby creating more jobs for low- and middle-skilled workers.¹⁴⁰

Jobs growth experience from previous economic downturns

R&D tax credits show potential for high job multiplier and GDP impact

A 2010 study, published not long after the global financial crisis, found that **expanding the USA's R&D tax credit could help with economic recovery by increasing the nation's GDP by US\$66 billion, while creating 162,000 additional jobs in the near term.**¹⁴¹ This would come down to about 27 jobs (direct, indirect and induced) for every US\$1 million of tax credit provided to companies. Jobs would range from those in scientific fields to industries providing research equipment, as well as jobs resulting from an increase in demand in various industries, particularly manufacturing. This points to a high potential multiplier, including a boost to manufacturing jobs.¹⁴²

Immediate action-ready opportunities

Best innovation policies for R&D in clean technologies to incorporate into stimulus packages

Around US\$20 billion a year is spent globally on R&D in clean energy, a number that has hardly increased in past years,¹⁴³ compared, for instance, with US\$600 billion in annual military spending in the USA alone. R&D in clean technologies is therefore a considerably overlooked tool to curb global carbon emissions.¹⁴⁴ Governments can focus on **three major types of policy interventions** for R&D in clean technologies as part of their stimulus packages:¹⁴⁵

- Continued innovation support to bring clean/green technologies to market, with a focus on early-stage development and industrial-scale demonstration;
- Public financial support mechanisms, like loan guarantees, dedicated to new green technologies to de-risk and lower the cost of capital for early deployment;
- Regulations and mandates to create demand at scale for new products over the next decade, including a ratchet-up mechanism which will tighten obligations over time. Examples are, for instance, lifecycle emissions regulations for passenger vehicles and buildings.

Ease of implementation

Low-carbon innovation strongly correlated to oil prices and price on carbon

Upticks and declines in low-carbon innovation have in the past decades shown a strong correlation¹⁴⁶ with oil prices and whether carbon emissions are priced. The lack of carbon pricing and a sharp drop in oil prices in the years before COVID-19 have already resulted in a decline in low-carbon innovation levels. The fact that carbon pricing is effective is shown by the European Union's carbon trading scheme (EU-ETS), which obliges 12,000 industrial facilities to purchase allowances to cover carbon emissions and has increased innovation activity in low-carbon technologies among regulated companies. Companies subject to the EU-ETS have reacted by filing 30% more patents in low-carbon technologies,

particularly in renewable energy, energy storage, energy efficiency and carbon sequestration. This effect on innovation occurred when the price of carbon on the market was about US\$35/tonne of CO₂ and when firms expected prices to remain at a high level in the foreseeable future, for which long-term regulatory consistency is crucial. A survey among OECD and G20 countries indicated that approximately 70% of emissions are not priced at all and only 4% are subject to a carbon price above US\$35.¹⁴⁷ To help clean innovative R&D to accelerate through other means than by providing direct positive financial incentives, governments can signal clear intent to start pricing carbon in the near future.

How it can support marginalised or vulnerable population groups

Prior investments in IT innovation have proven their worth for the vulnerable during COVID-19

Efforts to develop, deploy and sustain innovations in IT systems during “normal” times have been paying off during the COVID-19 pandemic, enabling governments to adapt quickly and provide the solutions that are needed as part of the response. For example, Argentina’s social protection agency (ANSES) has been able to provide, without intermediaries, an emergency income to 8 million people who work in the informal sector, thanks to an existing digital platform and IT systems in place, which provide remote access to numerous services. When COVID-19 arrived, broadband connectivity in Argentina had already been improved by 500% in the past five years, with 90% of the population having internet access in their homes or via their phones, making for successful deployment of IT systems in protecting the poor.¹⁴⁸

Consideration of the potential of research and development for clean technologies to support economic recovery in the medium term and of its wider benefits are included in the Annex.

PART C: Three cross-cutting policy reforms

In addition to the seven sectoral recommendations, this paper also recommends national governments consider **three cross-cutting reforms**. These fiscal, finance and governance reforms will enhance the impact and effectiveness of their investments, including through governments' ability to crowd in private investment beyond the immediate, current economic recovery stimulus period. The reforms are:

- **Fiscal reforms that eliminate fossil fuel subsidies and make it attractive for the private sector to invest in low-carbon infrastructure and services:** Structural trends combined with the current economic downturn suggest that coal, oil and gas prices are likely to remain low for the foreseeable future.¹⁴⁹ Countries that are major energy importers can use the opportunity to remove remaining fossil fuel consumption subsidies, made unnecessary in a period of low prices, and increase fossil fuel taxes without triggering significant consumer price increases. These reforms could provide a useful source of fiscal revenues in a period of high counter-cyclical public spending. On the other hand, oil- and gas-producing countries and coal-rich economies can invest in an early phase-out of the least competitive assets, the diversification of their economy, and supportive measures for workers and regions which will be impacted by the transition. Nigeria, for example, has used the collapse in oil prices to remove fuel subsidies and save an estimated US\$2 billion a year, savings that are critical for dealing with this pandemic.¹⁵⁰ Where possible, national governments should establish a carbon price to reflect carbon's true social, economic and environmental costs. When combined with revenue redistribution to support low-income and marginalised groups that tend to spend a greater share of their income on fuel, carbon pricing can redress inequality, while enabling the market to determine the most efficient way to reduce emissions. This has shown to be particularly effective in spurring private sector investment in innovation.
- **Developing national strategies for cities:** Few national governments have robust plans to deliver economic and social development in the context of the global health and climate emergency. Given the growing share of people, economic activity and emissions concentrated in cities, national governments should consider placing cities at the heart of their national development and climate strategies. This with a view to building a national system of cities in which people can thrive, rather than just survive – as is currently the case in many of the world's cities. A comprehensive national strategy, focused on cities that have liveable density and connectivity and are clean and inclusive, could eradicate poverty, reduce inequality and avoid climate catastrophe. Yet today, fewer than two in five countries have a national strategy for cities. The global monitoring of national urban policy in 2018 also demonstrates that countries have not yet paid strong enough attention to climate resilience and environmental sustainability in the national urban policies that do exist.¹⁵¹ Such a strategy should be grounded in a shared vision for the future of cities, including embedding resilience in critical urban infrastructure by way of standards and guidelines across all systems and sectors intersecting with cities, as well as legislation and policy.¹⁵² When underpinned by genuine partnership between national and local governments, including for coordinated public investment across levels of government, it can inspire every line ministry to approach urban development in a considered and purposeful way, de-risk low-carbon investment by providing clear signals to private actors, and empower local governments to go farther and faster on low-carbon, climate-resilient development.
- **Fiscal support for local governments and reforming municipal financing systems:** Given the stresses on many local government budgets and the potential collapse in local tax revenues due to falls in property occupancy and sales taxes (and associated risk to municipal credit ratings), national governments will now need to consider a far-sighted approach to working with other tiers of government. They need to ensure that adequate

revenue streams exist and that coordinated spending decisions and financing choices are made, especially in lieu of the implications of new planned national debt and equity injections in many countries. This will include the need for national governments to collaborate with state and local governments to reconsider transfer systems and establish tax (and spending) systems that raise sufficient revenue and incentivise sustainable choices and behaviours over the longer term. National and local financing frameworks need to be able to mobilise private investment for sustainable urban infrastructure at scale, and work with multilateral and national development banks and development finance institutions to crowd in concessional and grant-based finance. Financing instruments that governments can explore, in addition to reforms to traditional public taxation systems, include: land-based financing instruments to enable governments to benefit from the relationship between more productive use of land and land values; the responsible use of debt financing to distribute the costs of infrastructure projects equitably over the generations who benefit; and well-designed partnerships with the private and third sectors to secure private sector and community group capabilities in the design, construction and management of infrastructure projects, as well sharing risks. All of these instruments need to be firmly grounded in a government's ability to pay so as to effectively manage potential liabilities and risks.

ANNEX

GREEN CONSTRUCTION AND RETROFIT

Potential to support economic recovery in the medium term

Residential and commercial retrofits spurring a second wave of demand

Building efficiency spending and green infrastructure projects stand out as the policy types considered to offer the best combination of high economic multipliers with positive climate impact, as part of COVID-19 fiscal recovery policies.¹⁵³ Whereas public buildings can fuel the first shovel ready wave, **energy retrofitting of a broader set of residential and commercial buildings can offer the second wave of demand for the construction sector.** However, this will require government-backed schemes to ease the upfront cost and achieve economies of scale in order to incentivise a wave of retrofits in a depressed economy.¹⁵⁴

Sustainable infrastructure fuelling a third wave of demand

Beyond buildings, major investments are also required over the coming years to **build the infrastructure that can support sustainable urban development**, such as EV charging infrastructure, expansion of rail and metro, and resilient and safe waste and sanitation systems. Although these investments may be less shovel ready than building retrofits, if planning starts today, they could constitute a **powerful third wave of demand for the construction industry within 12–18 months.**¹⁵⁵

Wider benefits

Lower energy bills are beneficial in a depressed economy

The immediate opportunity to invest in building retrofits will benefit occupants – business, governments and residents alike – in the medium term with lower energy bills. This may also help contribute to local governments' return to financial equilibrium by lowering their operational costs.¹⁵⁶

Kick-starting the green innovation machine

In the long run, public investments in building decarbonisation and sustainable, resilient infrastructure offer high returns by driving down the costs of the low-carbon transition. Harnessing such opportunities could even result in “kick-starting the green innovation machine”, with high spillovers that benefit the wider economy.¹⁵⁷

CLEAN MOBILITY

Potential to support economic recovery in the medium term

Expanding sustainable options for individual urban transport

Illnesses and premature mortality associated with air pollution from road transport have been estimated to cost US\$1.7 trillion in OECD countries alone.¹⁵⁸ Added to this is the toll of traffic accidents, which normally kill around 3,700 people a day, exceeding global daily COVID-19 deaths. Governments have an opportunity to avoid a fallback to high levels of private vehicle use, and associated inefficiencies, by not only supporting public transport systems to survive and expand, but also by **developing two/three-wheelers on hire and car-sharing schemes and expanding mobility as a service platforms**, providing urban citizens with a greater variety of individual mobility options.¹⁵⁹

Wider benefits

Better air quality means a lower COVID-19 death rate

Beyond being a green stimulus investment, **public transport offers many benefits to society**, such as being more efficient than private vehicle use and emitting less carbon and

air pollutants per person.¹⁶⁰ Air pollution already kills more than 7 million people prematurely every year,¹⁶¹ and the long-term exposure to it is likely to increase COVID-19 mortality.¹⁶²

Quality public transport can increase household purchasing power during a downturn

Public transport provides a much safer and equitable mode of transport than the widespread use of private vehicles.¹⁶³ Moreover, in a depressed economy the high cost of car ownership will weigh heavily on households who have seen their incomes reduced as a result of the pandemic. Good public transport, as well as expanding the options for active transport such as cycling and walking, can **boost the purchasing power of households by considerably lowering their transport costs**, while at the same time ensuring that people of all income levels can continue to access jobs and essential services.

Quality public transport supports essential workers to do their job

High-quality public and active transport options also provide a boon to urban resilience, as the current COVID-19 crisis has brought to light, with **essential workers being able to reach their jobs** and continue to provide their services in large part due to the availability of such transport options.¹⁶⁴

RENEWABLE ENERGY

Potential to support economic recovery in the medium term

Renewable energy considered one of the most desirable recovery investments

When comparing a set of post-COVID fiscal recovery policy measures, clean energy infrastructure investment is among the top five most desirable. This is based on long-run economic multipliers and the potential for positive climate impact and the perspective comes from an April 2020 survey of 231 finance ministry officials, central bank officials and other economists, representing 53 countries including all G20 nations.¹⁶⁵

Wider benefits

Better air quality means a lower COVID-19 death rate

Fossil fuel power plants – which are responsible for about a third of the air pollution in countries such as China – cause hundreds of millions of work days lost, billions of health care costs as well as millions of premature deaths each year.¹⁶⁶ Researchers at the Harvard University T.H. Chan School of Public Health have discovered a **link between COVID-19 related deaths and long term exposure to particulate matter air pollution**. A minor 1 g/m³ increase in long-term PM_{2.5} exposure leads to a 15% increase in the COVID-19 related death rate.¹⁶⁷ Switching to renewable energy nullifies the operational emissions associated with energy generation, directly benefitting the health of urban citizens, including their susceptibility to diseases such as COVID-19.

Lower energy prices are beneficial in a depressed economy

Over the past few weeks, power prices have dropped in many countries reflecting both lower demand and greater reliance on renewable generation. **In a depressed economy, businesses and households alike could benefit from lower energy bills underpinned by a renewable expansion**.¹⁶⁸

Resilience during times of crisis

Distributed energy resources can provide greater resilience for communities, by providing continuous power for critical infrastructure like hospitals and fire stations. These are particularly important considerations during a health crisis or an extreme weather event made worse by climate change.¹⁶⁹

ACTIVE TRANSPORT

Potential to support economic recovery in the medium term

Cycling can support local businesses to recover

As social distancing eases and people return to patronising local shops, cafes and restaurants in person, **bicycle use** can also **provide** proven stimulus to economic activity **on main streets and commercial areas**.¹⁷⁰ Studies even suggest that cyclists spend on average three to five times more than car drivers with local businesses, and that cycling infrastructure is correlated with higher local retail sales.¹⁷¹ In New York, the implementation of separated bike lanes has increased trade at local businesses by up to 50%.¹⁷²

Active transport pays itself back through reduced externalities from air pollution

COVID-19 has also led to **citizens glimpsing fragments of what a future city could look and feel like**. The air in many cities has – for a short period of time – been the cleanest in decades due to a dramatic decline in vehicle traffic, with walking and biking adopted by many as preferred modes of transport. Citizens' demand for cleaner air is likely to stay for some time. Air pollution is responsible for at least 7 million premature deaths each year, and residents with pre-existing respiratory conditions have been shown to be more vulnerable to COVID-19.¹⁷³ In addition, 1.2 billion workdays are lost every year due to air pollution, while related health care costs reach US\$21 billion. Smog can also lead to brain drain when skilled workers leave for cleaner cities.¹⁷⁴

Wider benefits

Active transport keeps health costs down

Active transport also positively impacts on public health costs by reducing air pollution.

Regular cyclists are estimated to have a 40% lower chance of getting cancer, to be 40% less likely to die prematurely and be more than 50% less likely to have heart disease.¹⁷⁵ Transport for London has calculated that, if every Londoner walked or cycled for 20 minutes a day, the country's National Health Service would save about US\$2.1 billion in treatment costs over the next 25 years.¹⁷⁶ Governments can also financially incentivise people to cycle, with cyclists in the Netherlands being able to claim the same compensation amount for work trips for every kilometre cycled as they would when using a car.¹⁷⁷

Well-designed neighbourhoods provide residents with daily needs within walking or cycling distance

With many cities currently rethinking urban mobility, including the rapid rollout of walking and cycling infrastructure at low costs,¹⁷⁸ more and more governments are committing to a policy of **creating complete neighbourhoods, in which most residents can access all their basic daily, non-work needs by foot or bike**. Such sufficiently dense and well-connected neighbourhoods incorporate a range of housing options, grocery stores and other services, such as quality public schools, open spaces and recreational facilities, and access to frequent public transport. Milan, for instance, has committed to the 15-minute city as a framework for recovery, guaranteeing essential services, particularly healthcare facilities, within walking distance for all residents, while preventing a surge in car travel post-lockdown.¹⁷⁹

NATURE-BASED SOLUTIONS

Potential to support economic recovery in the medium term

Natural capital investment offers high multipliers for recovery

A recent survey of 231 central bank officials, finance ministry officials and other economic experts from G20 countries on the **relative performance of a set of post-COVID recovery policy measures**, in combination with evidence from literature, **resulted in five clear**

winners, each offering high economic multipliers and positive climate impact. One of the top five was natural capital investment for ecosystem resilience and regeneration, including restoration of carbon-rich habitats and climate-friendly agriculture.¹⁸⁰

Urban sprawl risks creating food insecurity

Green urban spaces don't just provide for citizens' essential needs, as the pandemic has shown with parks and other natural areas being some of the few places that saw an increase in visitors during lockdown. Well-planned dense cities also preserve precious agricultural and recreational lands on the edge of the city. Many cities have traditionally been built in close proximity to fertile lands. In fact, 60% of the world's most fertile agricultural lands are in the direct proximity of cities. The expansion of mega-cities in Africa and Asia will be responsible for 80% of the world's projected farmland loss due to rising urbanisation by 2030. Many of these lands currently produce staple crops, such as maize, rice, soya beans and wheat, which are cornerstones of global food security. Besides the question of food sufficiency – Egypt, for instance, may lose 60% of its maize and 40% of its rice field to urban uses – this also makes cities vulnerable to supply chain disruptions during crises if food has to be imported from further afield, with COVID-19 providing a clear example.¹⁸¹

Wider benefits

Revaluing our cities' natural capital delivers many benefits

The science is clear: deforestation and fragmentation of landscapes have increased the risks of the outbreak of infectious diseases like COVID-19. This calls for revaluing nature and the pivotal role it can play in preventing future pandemics.¹⁸² Moreover, urban green areas including parks and lakes have seen a surge in traffic during COVID-19 lockdowns (at least as long as they remained open), underlining the important role they play for our mental and physical health. **A new approach to city planning should bring open spaces, watersheds, forests and parks into the heart of how we think about and plan cities.**¹⁸³ For instance, planting three shade trees per building in US cities, while making roofs and pavements reflective could decrease the country's cooling demand by a massive 20%.¹⁸⁴ Prioritising nature-based solutions can also help to: support better health outcomes; reduce the risks of extreme heat, drought and flooding, as well as vector-borne diseases; contribute to climate adaptation; improve urban liveability; and even serve as extra space to host emergency services.¹⁸⁵

Well-planned density which embraces greenery and active transport fares better

Social distancing has raised fundamental questions about the shape of the modern city. Even though density may seem to be a disadvantage during COVID-19 times, **what matters most is whether density is well integrated and well planned.** Multi-storey buildings with green spaces, pedestrian paths and other ways to safely and efficiently connect urban environments can have the same density as a neighbourhood filled with single-storey, unplanned homes and limited urban service provision, but will have a very different potential for contagion during a pandemic. A recent World Bank study of 284 Chinese cities even found no clear relationship between urban density and COVID-19 transmission risk, with many cities with lower population densities having higher infection rates.¹⁸⁶

WASTE AND RESOURCES

Potential to support economic recovery in the medium term

Resource taxing and producer responsibility support economic recovery

The COVID-19 virus recalls lessons from previous global systems failures, such as the global financial crisis, which highlighted the structural vulnerability and inherent instability of our global financial, energy and food systems and how actions or impacts in one system can cross over into others with stealth and speed.¹⁸⁷ To encourage responsible resource management, policy-makers need to redesign their fiscal framework to price in externalities: while relatively high taxes on labour in many countries encourage companies to minimise their labour costs, resources tend to be untaxed and their use unrestrained, without accounting for the cost in adverse externalities. This in turn leads to low virgin material prices, sometimes even lower than recycled feedstock as is currently the case with plastic.¹⁸⁸

Taxing resources and pollution instead sends a clear price signal,¹⁸⁹ and can encourage greater labour “consumption” through value retention activities, with job growth essential for the post-COVID-19 recovery. This can be combined with extended producer responsibility policy instruments, which makes companies responsible for paying for what happens when their products turn into waste.¹⁹⁰

Wider benefits

Rampant resource consumption puts major strain on cities, from health concerns to water stress

Natural resources are fundamental to nearly everything we create or consume in cities, and have been fuelling tremendous economic growth. Particularly in the past 50 years, the extraction of raw materials has rapidly surged.¹⁹¹ Yet their supply, long assumed to be endless, is by no means guaranteed in the decades to come. Even today, we continue to ignore their finite nature. Only about 10% of plastic packaging waste, for instance, ends up being recycled, typically in lower-value applications.¹⁹² Instead, **plastic continues to end up in the ocean – gradually replacing fish by floating plastic – and wash up on beaches, block urban waterways contributing to floods during times of heavy rainfall, and support the spread of mosquito-borne diseases such as dengue due to stagnant water left behind in plastic packaging.** This trajectory of runaway resource consumption and mounting piles of waste puts raw materials under threat from increased use. Moreover, natural resource extraction and processing are estimated to contribute over 90% of global biodiversity loss and water stress. The latter should be an immediate concern to cities, as an increasing number of cities struggle to provide their citizens with fresh water year round and several cities have reached Day Zero in recent years, representing the day on which they ran out of water. This all points to a highly compelling case to tackle the way we use and dispose of resource head on.

RESEARCH AND DEVELOPMENT IN CLEAN TECHNOLOGIES

Potential to support economic recovery in the medium term

Harnessing the power of big data for cities

Many R&D-related decisions, as well as data aggregation, take place at the national level. At the same time, many decisions on issues such as the containment of any epidemic or pandemic, climate change resilience and equity are made at the local level. To help cities harness the power of big data in response to sustainability and equity challenges requires empowering them with granular, regularly updated data streams that can provide better evidence for decision-making. Resilience is all about interdependencies, which means that we have to **start building more comprehensive, community-based datasets to**

understand and better address the challenges ahead.¹⁹³ An example is a dashboard being prototyped by the World Bank in collaboration with the government in Colombia, which helps policy-makers in cities on a near real-time basis monitor the interplay between virus spread, health sector readiness to address new clusters of infections, and the readiness of economic sectors to operate safely.¹⁹⁴

Wider benefits

Investments in clean technology R&D can have large global spillovers

Policies that stimulate R&D and innovation in clean technologies do not necessarily require international coordination, do not have to deal with the “leakage” problem that certain carbon pricing policies face, and can have large global spillovers. After all, even if advanced economies are able to reduce their carbon emissions to zero by 2050, they will still feel the effects of worsening climate change if developing and emerging economies, which are estimated to be responsible for three-quarters of emissions by 2040, do not decarbonise at the same pace. Clean technologies R&D investment is therefore also considered a measure that may have greater beneficial impact on carbon reduction than the often-cited measure of removing fossil fuel subsidies.¹⁹⁵ A recent study in *Nature* suggests that the global removal of such subsidies would lead to no more than a 5% decrease in global CO₂ emissions at best.¹⁹⁶

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