CHAPTER

5

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Like norms, incentives and regulation are powerful. By preventing or promoting specific actions, they influence behavior directly. They also operate indirectly by reinforcing norms or signaling their change.

How can incentives and regulation advance human development in the Anthropocene?

This chapter explores three areas of opportunity: in finance, so that resources are directed toward investments that reduce planetary pressures; in prices, so that they better capture social and environmental costs; and in collective action, especially at the international level.

What consumers choose to buy, what firms produce and trade, where investors put their money and how governments cooperate are all shaped by incentives. They are not the only drivers of behaviour—social norms matter a great deal (chapter 4)—but even if people do not change their minds, they may still respond to incentives that can either increase or ease planetary pressures. This chapter focuses on how incentives help explain current patterns of consumption, production and investment and other choices that lead to the planetary and social imbalances documented in part I. It explores how these patterns could evolve in ways that would ease planetary pressures and advance human development in the Anthropocene. It does this by considering three domains: finance, prices and international collective action.

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First, finance, which encompasses mobilizing resources from firms and savings from people to reward investments that reduce planetary pressures and to penalize or restrict investments that increase those pressures. What is the role of public entities that oversee financial markets and of monetary authorities? And what developments in financial markets indicate the direction of change that may already be occurring? For instance, highly carbon intensive firms listed on European stock exchanges (such as oil extraction, air transport and petroleum refining firms) suffered larger than average declines in stock value after the outbreak of Covid-19, possibly signalling that financial markets see carbon-intense industries as not having as bright a future as others.[1] And with the Covid-19 pandemic there has been a sharp slowdown in economic activity, especially in transport and mobility, so sharp that seismic monitors have picked it up.[2] That raises the potential for locking in some of the behavioural changes that have eased pressure on the planet during the pandemic.

Second, current market prices do not reflect the social costs of planetary pressures, distorting economic decisions and leading to overuse of resources and excessive environmental degradation relative to what would occur if prices reflected those costs. Even worse, government subsidies compound the distortions. For example, subsidies for fossil fuels are not only a large fiscal burden—at over $317 billion in 2019[3]—but they also encourage behaviour that impedes the transition to renewable energy sources, with direct and indirect costs to people amounting to $4.7 trillion globally in 2015 (6.3 percent of global GDP) and $5.2 trillion in 2017 (6.5 percent).[4] Eliminating subsidies would have reduced global carbon emissions by 28 percent and deaths due to fossil fuel air pollution by 46 percent in 2015.[5] Further, since a very large share of the benefits in developing countries accrues to higher income households, subsidies exacerbate inequalities.[6]

So the chapter discusses the potential for reflecting in market prices the social costs of greenhouse gas emissions and incorporating in economic decisions the value of biodiversity. A key obstacle to removing fossil fuel subsidies is the political economy of addressing the short-term and immediate financial implications for those who benefit from the subsidies, which are easier to navigate in a context of historically low oil prices during the Covid-19 pandemic.[7]

Third, international collective action, addressing the structure of incentives that countries face when they make decisions with implications beyond their borders. This challenge has been studied extensively in the context of providing global public goods.[8] Examples of achievements through international collective action include eradicating smallpox in 1980[9] and adopting the Montreal Protocol to address depletion of the ozone layer. International cooperation is needed because a single country removing all fossil fuel subsidies and putting in place measures that account for the social cost of carbon would not be enough—and in most cases would do very little—to ease planetary pressures.[10] So countries have to come together in some way. The landmark Paris Agreement on climate change[11] has offered a beacon of hope,[12] bringing an unprecedented number of countries on board but only after long

negotiations.[13] Even then, the pledges—the nationally determined contributions—under the agreement do not guarantee that its goals will be reached, though they represent the single largest ever commitment to mitigation.[14] Recent studies warn that even if global emissions are reduced enough to keep global temperature rise below the agreement's 2 degrees Celsius goal, dangerous scenarios are probably avoidable only by getting greenhouse gas emissions to net zero by 2050.[15] Thus, it is important to understand how incentives can support international collective action.

Harnessing finance to incentivize transformation

Mobilizing financial resources is essential for the investment in people, infrastructure, technology and broader social change required to transform our world, as called for by the 2030 Agenda for Sustainable Development.[16] So is ensuring that those resources are channelled in ways to advance that transformation. For example, cumulative global investment in low-carbon power between 2020 and 2040, based on stated energy policies, is about $16 trillion (figure 5.1). But to reach net-zero emissions by 2050, that would have to increase to more than $27 trillion, with other shifts in energy efficiency and grid networks as well as lower investment in fossil fuel power and oil transport and refining. Such shifts call for a wide range of changes in incentives, with governments playing a key role, but they can also emerge as a result of pressure from the investors who entrust their savings to financial firms.[17]

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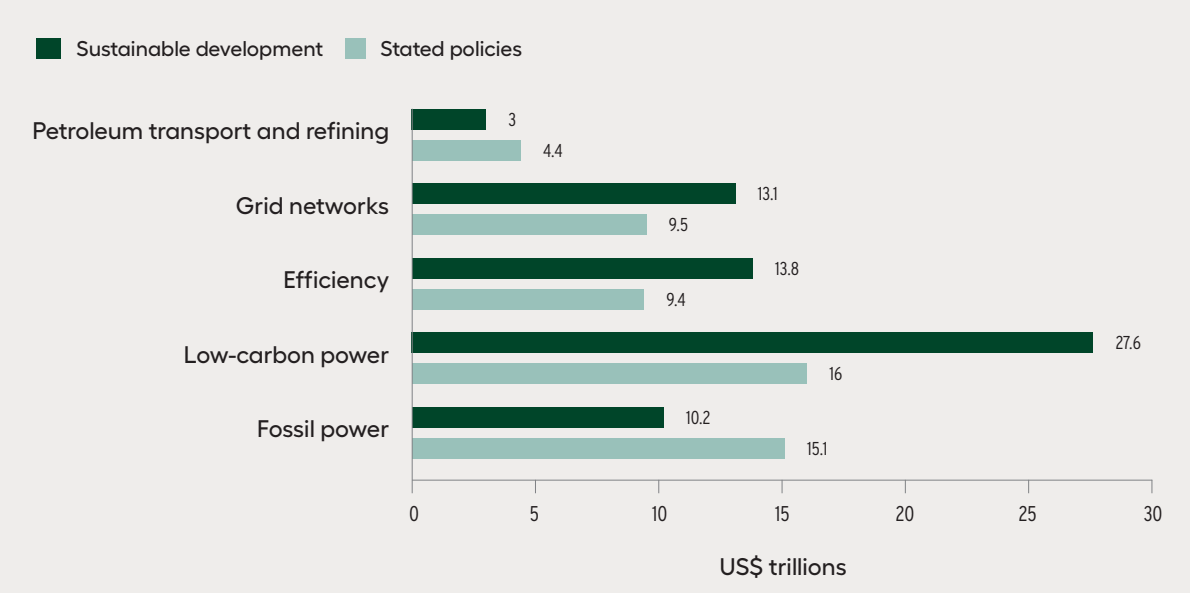
Drawing on financial markets

That investment in renewable energy sources remains below future needs, especially in developing countries, opens up opportunities.[18] In 2018 lower-middle-income and low-income countries, with well over 40 percent of the world's people, accounted for less than 15 percent of renewable energy investment, while high-income countries, with just over 15 percent of the world's people, accounted for more than 40 percent.[19] The difference comes largely from a lack of access to funding in

Figure 5.1 Incentives are required to shift finance towards low-carbon energy



Source: Fickling 2020.

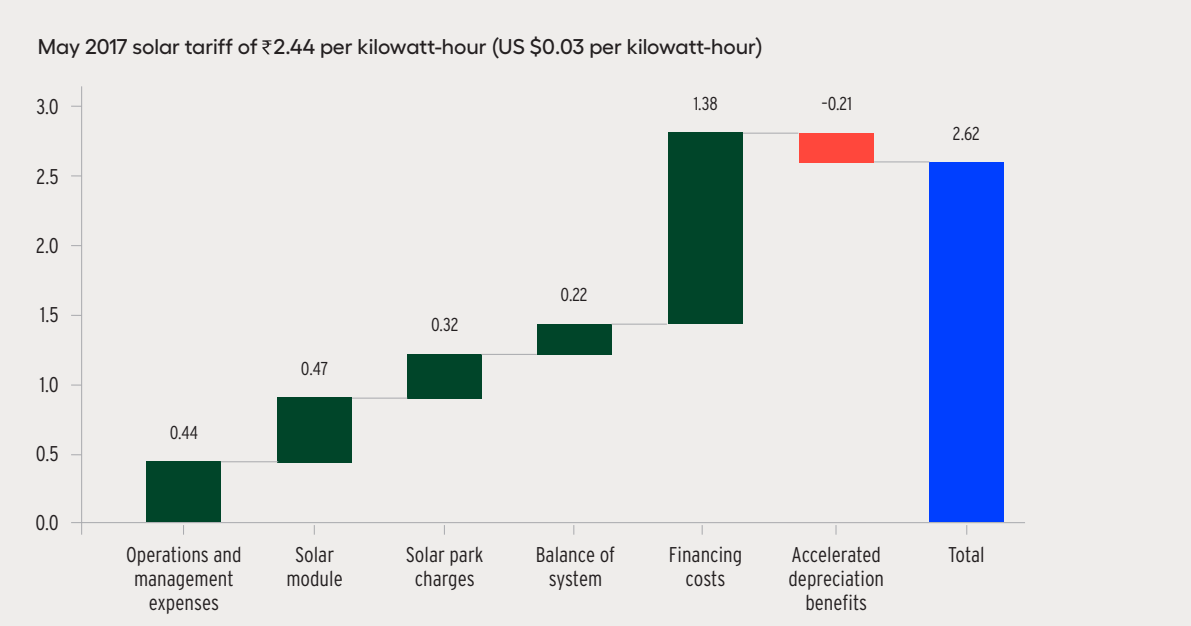
developing countries, which in turn has major impacts on the price and competitiveness of green energy.

Take India, where financing costs account for 50–65 percent of renewable energy tariffs (figure 5.2).[20] Solar tariffs have consistently fallen in India since 2010.[21] But since a high share of the tariff is the cost of capital, even big declines in equipment costs could lower tariffs only so much. The cost of capital is high, even with a maturing market, partly because of the perceived risks in renewable energy investments. So policy had to reduce risk perceptions and improve the bankability of renewable energy projects. Large solar parks were attractive to international investors, and when the bids were backed by central and state government guarantees or credible offtakers (such as the Delhi Metro Rail Corporation), tariffs fell sharply.[22] The government aimed to improve the availability and pricing of project debt finance over time, facilitating lower cost investment.[23]

Incentives can thus lower the cost of finance and improve access to domestic and foreign institutional capital. Options include pooled de-risking of projects across different geographies; solar parks that allow developers to adopt a plug-and-play model and shorten construction timelines; and greater transparency about policies, deployment and project performance to reduce perceived risk.[24]

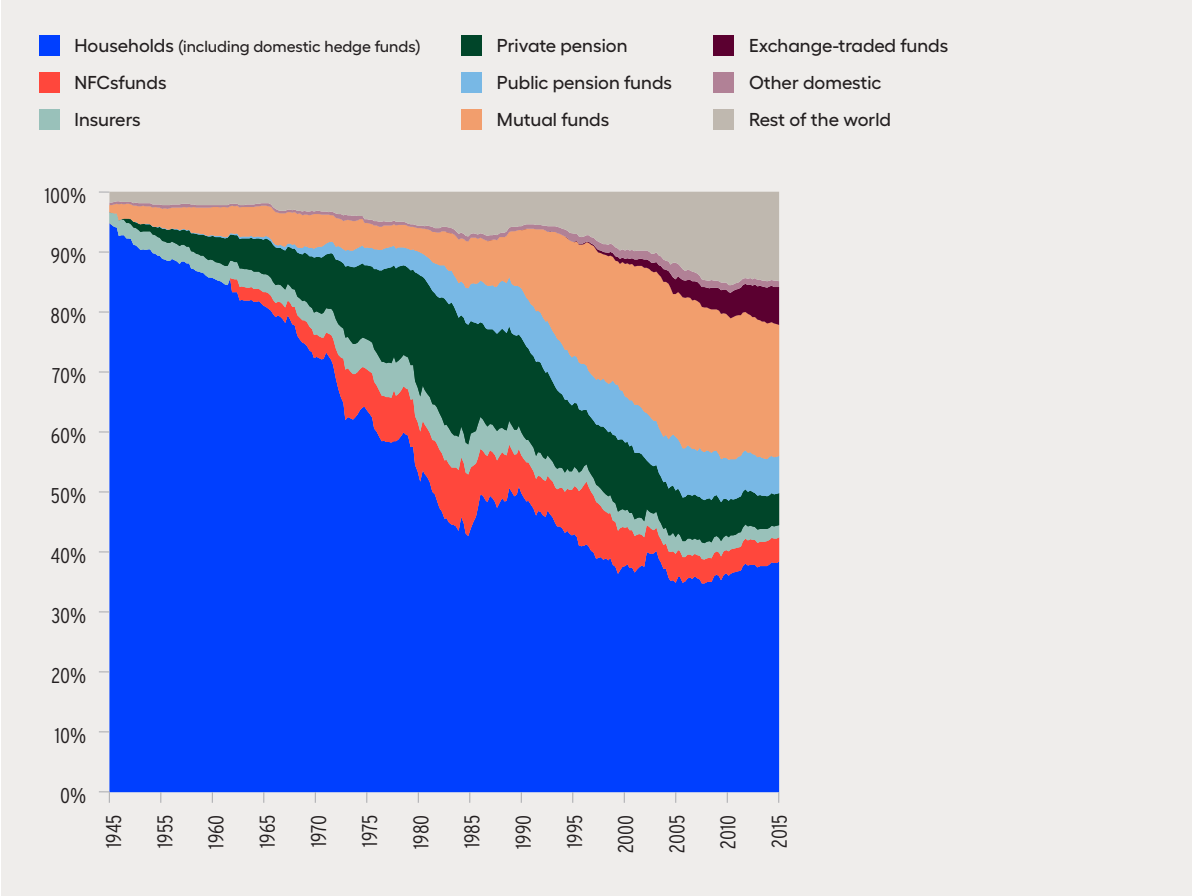
Opposition is growing to allocating savings to investments linked to fossil fuels or activities that threaten sustainability. Younger people, such as those born in the 1980s and 1990s, are more than twice as likely as those in other generations to invest in companies or funds that target social or environmental outcomes—and they will inherit as much as $24 trillion in wealth over the next decade and a half or so.[25] Some of this wealth is now channelled through financial intermediaries (such as pension funds and asset managers holding mutual funds) that manage savings on behalf of households, especially in the United States (figure 5.3). Partly because of investor pressure, large pension funds, both public and private, have divested some or all of their fossil fuel–related investments. For example, the National Employment Savings Trust—the United Kingdom's largest pension fund—recently decided to ban investments in any company participating in arctic drilling, tar sand extraction or coal mining. With 9 million members, the trust will shift £5.5 billion towards more climate-friendly

Figure 5.2 The cost of finance accounts for the largest share of historically low solar tariffs in India



Note: Based on estimates of the levelized cost of energy of an electricity generation asset, which is the net present value of the unit cost of electricity over the lifetime of an asset. Several factors determine the levelized cost of energy or tariff of grid-connected solar power plants. This figure is the component-wise breakdown of the solar tariff in India in 2017. It includes operations and management, solar module, solar park charges, balance of system (costs related to civil works, mounting structures and other preoperative expenses), and financing costs and accelerated depreciation benefit (government incentives that lower the tax burden in the early years of a project).
Source: CEEW 2020.

Figure 5.3 Financial intermediaries hold an increasing share of savings on behalf of households in the United States



Source: Braun 2020.

investments, based in part on the anticipated green recovery from the Covid-19 pandemic.[26]

Institutional investors under public mandates, such as pension funds and sovereign wealth funds, often have a dual responsibility—to generate profit and to abide by international agreements, including environmental treaties.[27] Large intermediaries that hold company stocks have acquired a larger share of the ownership of firms—in the United States, from 1 percent in the 1990s to almost 10 percent today for S&P 500 companies.[28] They have a greater say in the strategic management of firms and can pressure for more sustainability-focused activity. In addition to strong statements of commitment to sustainability, some evidence suggests a strong and robust association between firm ownership by the three largest asset managers and subsequent reductions in carbon emissions.[29]

Green bonds—first issued in 2007 by the European Investment Bank—are debt securities designed to fund environmentally friendly investments. Issues of new green bonds increased from less than $1 billion in 2008 to $143 billion in 2018.[30] Green bond issuance in 2020 by the end of the third quarter was led by the United States ($32.3 billion) followed by Germany ($21.4 billion), with an estimated cumulative outstanding issuance totaling $948 billion.[31] Recent evidence suggests that green bonds certified by third parties improve the environmental footprints of firms (but are issued at a premium over ordinary bonds and are held more closely).[32] Certification is thus a critical mechanism of green bond market governance.[33] Given the lack of standardization in the field, some governments and international organizations are stepping up, as with the European Union's consultation on the establishment of a Green Bond Standard.[34]

Additional efforts are under way to scientifically assess the impact of green bonds and other sustainable investments, given the phenomenon of

greenwashing—unverifiable assertions by some firms about the sustainability of their investments. Specifically, the environmental performance of green bonds can be more accurately assessed by metrics on their outputs, outcomes and impacts. For wastewater treatment these criteria would cover the volume of wastewater treated (in cubic metres per day), reductions in pollutant concentration in affected water (milligrams per litre), the size of downstream beneficiary populations (in thousands) and the length of improved fish habitat stream (kilometres).[35]

One reason that incentives are changing in financial markets is the growing realization that financial assets are themselves vulnerable to the risks of climate change. A 2015 study projects that climate change will pose a risk of cumulative losses until 2100 that could range from $4.2 trillion to $43 trillion.[36] A more recent report estimates that more than half the world's GDP—around $44 trillion—is either moderately or highly dependent on nature and ecoservices.[37] Climate risks are now being incorporated even in mutual funds that aggregate government debt, with one firm recently launching an exchange-traded fund focused on sovereign bonds, which weights countries based on their climate change risk. Two sovereign bond indices, one weighted by climate risk and the other unweighted, show significant differences in the weights of different countries, based on the assumption that climate change can substantially affect governments' finances and therefore their creditworthiness.[38]

Engaging financial and monetary authorities

Financial and monetary policy to manage climate risks—and to shape incentives for financial players and investment more broadly—has been increasing (spotlight 5.1). Central banks can reduce both financial and climate risks, since many of them are hybrid institutions, combining public and private elements. The Network for Greening the Financial Sector, launched in 2017, comprises central banks and supervisors working together to help countries cope with the economic and financial impacts of climate change. A recent network report analysing the risks in mitigating climate change found that costs can be lowered if the transition starts early and is orderly.[39]

Central banks can deploy several tools to cope with such risks, including adjusting interest rates or expanding balance sheets by purchasing bonds. Unfortunately, only a few central banks (12 percent of 135 surveyed) have taken the financial risks associated with climate change into account and introduced mandates explicitly addressing sustainability.[40] Nearly half the central banks have no explicit or implicit objectives related to sustainability. But many have recently started to integrate environmental risks into their core policy frameworks.[41]

"Central banks can reduce both financial and climate risks, since many of them are hybrid institutions, combining public and private elements.

Central banks can also coordinate with governments, academia, private firms and civil society so that monetary policy works with fiscal, prudential and carbon policies to support an energy transition.[42] And as financial regulators, central banks can monitor market conditions (the liquidity and premiums of green bonds), catalyse a stable scaleup of green financing and identify obstacles to the emergence of green markets.[43]

The Finance Initiative of the United Nations Environment Programme is another relevant example.[44] This partnership with 300 global financial actors—including banks, investors and insurance companies—mobilizes private finance for sustainable development. Its goal is to make the global financial sector fit-for-purpose in serving both people and the planet. The partnership supports several principles for the global financial sector, including:

- Principles for responsible banking, covering a third of all global banking.
- Principles for sustainable insurance, covering 25 percent of the world's insurance firms.
- Principles for responsible investment, covering 50 percent of the world's institutional investors.

The Financial Stability Board, an international body that advises key institutions of the global financial system, created the Task Force on Climate-Related Financial Disclosures to help companies voluntarily disclose climate-related financial risks to their lenders, investors and insurers (box 5.1).

The Group of Thirty recently published a report on mainstreaming the transition to a net-zero economy,

Box 5.1 The Task Force on Climate-Related Financial Disclosure

The Task Force on Climate-Related Financial Disclosure is a voluntary market-led initiative for firms to disclose pertinent and prospective information on potential financial impacts of climate change.[1] It comprises commercial companies from various sectors, financial entities and investment fund managers. They bring to the present the issues arising from future climate change (through the analysis of various possible scenarios) and emphasize risks and opportunities related to the transition to a lower carbon economy.

The task force's motivation is to give investors and external stakeholders a basis for properly valuating assets and investment projects. That would better guide the market in mobilizing financial resources to facilitate the transition to more sustainable and resilient activities.

The task force invites companies to disclose estimates of three impacts of their production processes: direct emissions generated by the companies (scope 1), indirect emissions (scope 2) and emissions generated throughout the entire value chain, backwards through suppliers and outsourced processes and forward to the companies' consumers and distribution logistics (scope 3).

The task force's 2019 progress report recognizes the difficulty of revealing information on environmental sustainability and identifying valid scenarios to carry out its analysis and make forecasts. It also recognizes that the first steps in this direction are only just being taken, that the methodologies for evaluating the financial risk spreads between green and brown assets are incipient, that the data are limited and that there are no common standards.

However, surveys by the task force indicate that the number of companies implementing its recommendations is increasing and that the main motivations are the reputational benefit and the pressure from investors to provide information on climate-related risks and to recognize how important they are or will be. Financial regulators and supervisors are expected to require that the recommended disclosures be formally incorporated in company reports. Risk-rating firms may also soon begin to incorporate the disclosures in their evaluations. The (UK) HM Treasury (along with the Bank of England and other regulators) issued a roadmap towards mandatory climate-related disclosures in line with the task force recommendations for all major UK companies and financial institutions by 2025.[2]

Notes
1. Bernal-Ramirez and Ocampo 2020; TCFD 2019. **2.** United Kingdom HM Treasury 2020.

exploring how the decisions of investors, financial institutions, regulators and governments will affect sustainability in the short and medium terms. Those decisions are important not only for the planet but also for the sustainability of economies. The report's recommendations can accelerate countries' transitions to net-zero emissions and improve their long-term economic and financial prospects.[45]

The International Monetary Fund's Global Financial Stability Report went even further, suggesting that companies be mandated to disclose their climate risk exposure because voluntary efforts were not enough.[46] That view is based on the major financial market failure of inadequate representation of climate risks in asset prices and financial balance sheets. This lack of transparency implies that investments affected by climate risk are de facto subsidized.

The European Central Bank president recently questioned the principle of market neutrality—where central banks purchase assets that mirror the composition of the bond market on the grounds that trusting markets that do not price in climate change and its effects is increasingly risky.[47] And the US Federal Reserve Board issued a report concluding that climate change increases the likelihood of dislocations and disruptions in the economy, which in turn are likely to increase financial shocks and financial system vulnerabilities.[48]

The Bank for International Settlements—an international organization coordinating financial and monetary cooperation among central banks—points out that integrating the analysis of risks related to climate change into existing monitoring of financial stability is particularly hard. Climate change has physical, social and economic dimensions

characterized by radical uncertainty and involves complex dynamics.[49]

Traditional backward-looking risk assessments are thus insufficient for predicting how climate risks will evolve. "Green swan" risks are climate-related events that could create extreme financial disruptions and cause future global financial crises.[50] Central banks can help both by developing forward-looking risk assessment tools and by coordinating systemwide policies to mitigate climate change. Examples include developing new international financial mechanisms, integrating sustainability into accounting and financial practices and pricing carbon.

The Sustainability Accounting Standards Board, an independent body, ratifies accounting standards to better reflect the impact of various economic processes on sustainability. A current project involves assessing the interest of investors in incorporating risks and opportunities related to the use of plastic in standards for the paper and chemicals industries. As regulations and consumer preferences for packaging shift away from plastic, this line of research can help investors more accurately assess the risks and opportunities of investing in these industries.[51]

The SDG Impact Standards for private equity, debt and venture capital funds can help their managers consider the positive or negative effects of investment practices on people and the planet. The four standards focus on strategy and purpose, operations and management, transparency and performance reporting, and governance practices.[52]

Impact investing is another recent innovation in investments related to social or environmental aims. For example, social impact bonds pay returns to investors depending on prespecified social or environmental objectives. More than 80 such bonds have a total investment value of $375 million.[53] Especially when the costs of a project cannot be covered with private benefits—the bonds allow governments or other entities interested in social benefits to support a positive net present value for investors, which traditional debt financing cannot.

Multilateral development banks are also very important in the ecosystem of climate finance. In 2019 they accounted for $61.6 billion in climate financing, 67 percent of which was invested in low- and middle-income countries. More than three-quarters of the total financing was directed at mitigating climate change. The remaining quarter went to climate change adaptation.[54]

Finally, a recent trend in investment and credit analysis involves taking into account environmental, social and governance criteria in assessing risk, returns and impact. Environmental, social and governance analysis allows the identification of emerging risks to credit quality as well as the preparedness of firms to cope with such risks. This can reduce portfolio risk as issues in these areas can often cause sudden changes in regulation and consumer tastes, so incorporating them into investment strategies reduces exposure to such risks—which may be rare but could be very large.[55]

In contrast to the specialized sphere of green bonds, environmental, social and governance investing is becoming part of mainstream processes, especially for investors in fixed-income products.[56]

Making choices during the response to and recovery from the Covid-19 pandemic

Financial and monetary authorities are playing a central role during the Covid-19 pandemic. Their choices shape incentives that can encourage a transitioning to a net-zero emissions economic system and reducing socioeconomic inequalities (box 5.2; see also spotlight 5.2).[57]

"Financial and monetary authorities are playing a central role during the Covid-19 pandemic. Their choices shape incentives that can encourage a transitioning to a net-zero emissions economic system and reducing socioeconomic inequalities.

It has been argued that, in addition to aligning banking business models with a green and inclusive recovery, financial institutions can support this process in four ways. First, they can rebuild public trust by supporting households and firms through the difficult process of recovery. Second, they can more closely align shareholder engagements with the broader interests of all stakeholders, such as customers and staff. Third, the banking sector can focus on helping small businesses, workers and communities. Fourth, banks can offer new products and services so

Box 5.2 The Covid-19 pandemic and a green recovery

By José Antonio Ocampo and Joaquín Bernal

The Covid-19 pandemic has provided vivid evidence of the fragility of global systems and raised awareness of the possible shocks for the global economy in reaching tipping points if nothing is done to reduce greenhouse gas emissions. The pandemic and climate change both affect human lives and economic wellbeing, and both have a substantial negative distributional impact. They have both also made evident the need for policymakers to cooperate on building more holistic approaches to identify and manage global risks that have been neither fully considered nor priced in a framework of multilateral cooperation.[1]

The time is now for national and international authorities to take climate change into account in engineering a green recovery to the pandemic. Their coordination is needed, alongside business and civil society, to align their response measures with the Paris Agreement and the Sustainable Development Goals.

A wide variety of policy actions can be taken in this direction. Reducing the carbon footprint by promoting sustainable investments, with a longer term view of returns on investment projects that includes putting a floor on the carbon price (or reducing emission ceilings), phasing out subsidies to carbon-intensive sectors and conditioning support for businesses to survive the current crisis on their moving towards a more sustainable future. And for financial and monetary policy, authorities could advance climate-related prudential regulation and supervision to minimize financial institutions' climate-related risks. They could also adopt ecological accounting frameworks, with the possible obligation of all agents to disclose their exposure to brown activities. And they could have central banks more accurately reflect climate risks in their balance sheets and operations.

Note
1. Pereira Da Silva 2020.

that households and firms can save and invest in ways that support that transition.[58]

More broadly, the response need not stop at supply-side solutions for shifting economies and technologies; it can also pursue demand-side transformations in societies and human behaviours. The starting point could be human aspirations—individual or communal—that by interacting with economic and energy processes aggregate into changes at scale. This broadened approach also calls for knowledge to be codeveloped with people from marginalized communities.[59]

A review of 130 studies relating to green and inclusive recoveries highlighted several options that would encourage structural reforms supportive of this transition:[60]

- Increasing the price of carbon dioxide and reducing carbon subsidies that harm the environment.
- Removing regulatory obstacles to green investments and introducing such regulatory requirements as a minimum quota for electric cars.
- Offering training and continuing education programmes for people who lost or will lose their jobs.
- Making the financial system sustainable by pricing environmental risks into investment and lending decisions.
- Increasing corporate transparency in reporting on social and environmental aspects of their operations.

Otherwise, fiscal measures of countries recovering from the Covid-19 pandemic could entrench the fossil fuel–intensive economic system. A recent survey of 25 major fiscal recovery packages assessed their implementation speed, economic impact, potential for climate impact and overall desirability. Several policies had a high potential for both economic and climate impact: investing in education, training and natural capital; green physical infrastructure; green research and development; and energy efficiency retrofits for residential and commercial purposes. But in low- and middle-income countries investing in rural support was seen as more important than clean research and development.[61]

For the Group of 20 countries the recovery from the Great Recession offers useful lessons, pointing to the need for much more than short-term fiscal stimuli. A green and inclusive transition would require long-term commitments (5–10 years) for reforming pricing and public spending. Correctly pricing pollution and carbon emissions and removing subsidies for fossil fuels can accelerate the transition process, lower its cost and yield resources for public investment. Public spending could prioritize developing smart grids and transport systems, supporting private sector efforts in innovating and green infrastructure, and investing in sustainable cities and networks of charging stations.[62]

Indeed, some policies can help countries face both the Covid-19 pandemic and climate change. Labour-intensive green infrastructure projects, planting trees, lowering labour taxes and pricing carbon emissions can boost economic recovery from the pandemic. Helping some low-emission yet labour-intensive service sectors such as restaurants, culture, education and health care can help fight climate change.[63] Some proactive measures are being taken, such as the European Union's €750 billion recovery package, which includes support for wind energy. [64]

Shifting prices, changing minds

Greenhouse gas emissions continue to rise, with no sign of peaking.[65] The overall emissions gap is wide—in 2030 annual emissions need to be 15 gigatonnes of carbon dioxide equivalent lower than what countries have collectively committed to in order to meet the 2 degrees Celsius goal and 32 gigatonnes of carbon dioxide equivalent lower for the 1.5 degrees Celsius goal.[66]

Regulations and pricing are both essential and can be self-reinforcing in reducing emissions. In fact, the majority of environmental policies around the world take the form of regulation.[67] Designing effective regulations on, for example, air quality, land use or deforestation and setting emissions standards can play a broader role in bringing about technical advances to deal with carbon emissions. What began as efforts in California to address smog eventually turned into a national-scale regulatory effort in the United States, with the creation of the US Environmental Protection Agency (1970), the Clean Air Act (1970) and its eventual amendments. Despite initial resistance from automobile companies and complaints that technology to meet the demanding regulations on automobile emissions did not exist, these regulatory actions eventually spurred technological innovation to meet the regulatory standards.[68] This shows that regulation can not only lead directly to reductions in emissions but also drive technological change.[69]

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Reflecting the social costs of emissions in carbon prices could dramatically shift incentives for what is consumed, produced and invested in—helping correct what Nicholas Stern has called the greatest market failure in history.[70] Such a change would shift incentives in a decentralized way, giving societies and economies new parameters for determining how to steer creativity and innovation and which firms and economic activities are viable and potentially changing behaviours ranging from how people move around to what they eat.

Pricing carbon: Potential and reality

Advancing carbon pricing—having market prices for carbon that more closely reflect the social costs of emissions—can be achieved in various ways, including cap and trade programmes or carbon taxes. A cap and trade programme sets the maximum allowable emissions and lets emissions permits be traded. Companies receive a certain amount of permits—low emitters sell their permits to high emitters at a price that emerges from the exchanges. The market mechanism sets the price. For carbon taxes governments set a tax on emissions, making their price more closely reflect social costs to discourage reliance on fossil fuels. The world now has 61 carbon pricing programmes, 48 of them national,[71] covering 20 percent of global greenhouse gas emissions. But less than 5 percent of them are priced at levels consistent with reaching the Paris Agreement goals.

Setting a carbon price is highly contentious. Theoretically the price of carbon should be equal to the social cost of carbon, in order to limit emissions to the desired level and increase the relative price of high-emissions products. In 2016 the Interagency Working Group on the Social Cost of Carbon—a partnership of US government agencies—estimated the social cost of carbon at $51 per tonne. That year, at the recommendation of the 22nd session of the Conference of the Parties, a high-level commission on carbon prices was established to guide countries in developing carbon pricing instruments.[72] The commission—through consultation with experts in the field—concluded that the price should be at least $40–$80 per tonne of carbon dioxide by 2020 (and $50–$100 by 2030), accompanied by a supportive policy environment to be effective.[73] Yet in 2020 only four countries had a price above $40 (table 5.1). (See also chapter 7 for more on estimates of the social cost of carbon.)

Only a few countries report substantially lower emissions after introducing carbon prices, likely because the prices are too low. Part of the reason is that it is politically difficult to raise prices to levels that could make deep decarbonization possible.[74] But carbon pricing alone may not work, or have political support, if people lack alternatives and are simply asked to bear a higher burden. So carbon pricing would be best implemented as part of a broader set of policies and programmes that can elicit wider public support and greater behaviour changes (box 5.3).

Sweden has the highest price, $138 a tonne. Carbon prices were set in 1991 with tax rates increasing over time, which disincentivized high emissions in homes and industries.[75] The government of Sweden also reduced taxes in other sectors, such as labour taxes, to balance the rising costs due to higher energy taxes. By 2017 emissions were 26 percent lower than in 1991, while the economy was 75 percent larger.[76] Fossil fuels for heating have been slowly phased out, down 85 percent since 1990 and now only 2 percent of total emissions. In 2013 the United Kingdom introduced carbon taxes on electricity produced from coal. The tax rate was increased to $18 per tonne of carbon by 2015 and led to the gradual reduction of coal-fuelled electricity from 40 percent to 3 percent by 2019.[77]

Public acceptability of carbon prices is key.[78] Well designed carbon pricing programmes can help counter adverse distributional effects through redistributive efforts (transfers or public services, including public transport) or pay for equivalent tax cuts in other areas to compensate for higher energy prices, which can boost public support.[79] These programmes could include cash transfers, labour tax cuts, carbon dividends or installation of clean energy equipment such as rooftop solar, solar heating or biogas or distribution of energy-efficient stoves.[80] When carbon taxes are part of more comprehensive policies to curb emissions, they become more widely supported. Transparency and clear communications on how these revenues are used also boosts acceptability among the public. Tax progressivity may also matter at the international level. The world's 10 largest emitters account for 45 percent of total emissions while the bottom 50 percent account for only 13 percent.[81] This highlights the dual challenge of curbing emissions and addressing environmental inequality. However, the distributional impact of carbon pricing across countries is not determined by emissions level or income alone, with great heterogeneity across countries, even in the same income group, depending on the structure of their economies and trade patterns.[82]

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There is also concern that carbon pricing will affect the competitiveness of the private sector. But the impact on the economy is expected to be positive, as highlighted in spotlight 5.3. Economists suggest that carbon taxes will in fact spur technological innovation and advance large-scale infrastructure development.[83] In British Columbia, Canada, the loss of industrial competitiveness hurt only a few companies. The region is now home to a thriving community of 200 clean energy producers generating more than $1.7 billion in total revenue.[84] Carbon pricing creates long-term competitiveness by lowering costs, increasing efficiency and enhancing product quality.[85] And as it pushes markets towards newer forms of technology, it also incentivizes

Table 5.1 Carbon prices vary and are much lower than estimated social costs of emissions

Country or subregion	2020 price ($ per tonne of carbon dioxide)	Year of implementation	Greenhouse gas emissions covered in the jurisdiction	
			Million tonnes of carbon dioxide	Percent
Carbon taxes				
British Columbia (Canada)	30	2008	42	70
Chile	5	2017	58	39
Denmark	28	1992	25	40
Finland	73	1990	40	36
France	53	2014	171	35
Iceland	31	2010	1	29
Ireland	31	2010	32	49
Latvia	11	2004	3	15
Mexico	3	2014	378	46
Norway	60	1991	47	62
Poland	0	1990	17	4
Portugal	28	2015	23	29
South Africa	7	2019	512	80
Sweden	138	1991	44	40
Emissions trading systems				
Alberta (Canada)	22	2007	132	48
Australia	11	2016	344	50
Beijing (China)	13	2013	85	45
California (United States)	17	2012	375	85
Chongqing (China)	2	2014	122	50
European Union, Iceland, Liechtenstein and Norway	31	2005	2,255	45
Fujian (China)	4	2016	200	60
Guangdong, except Shenzhen (China)	4	2013	367	60
Hubei (China)	4	2014	208	45
Kazakhstan	1	2013	182	50
Korea, Republic of	18	2015	489	70
Massachusetts (United States)	8	2018	15	20
New Zealand	23	2008	45	51
Quebec (Canada)	17	2013	66	85
Regional Greenhouse Gas Initiative[a]	6	2009	108	18
Saitama (Japan)	6	2011	7	18
Shanghai (China)	6	2013	170	57
Shenzhen (China)	5	2013	61	40
Switzerland	20	2008	6	11
Tianjin (China)	4	2013	118	55
Tokyo (Japan)	6	2010	13	20

a. A cooperative effort among the US states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont and Virginia.
Note: The sources of carbon emissions covered vary largely across countries. When implementing carbon prices, policymakers often start with the power sector and large industrial firms but exclude other emissions sources such as energy-intensive manufacturing.
Source: Human Development Report Office based on data from the World Bank Carbon Pricing Dashboard.

Box 5.3 Impediments to effective carbon pricing mechanisms

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While carbon pricing is the most well known climate change mitigation tool, it is not generating investment at the pace and scale needed for transition to a cleaner energy system.

To maximize the efficiency of carbon pricing, several market impediments and government failures need to be addressed:

- **Knowledge spillovers.** Knowledge and research and development in renewable investment cannot be left only to the private sector, as they are public goods to some extent. Spillovers from research and development and technology diffusion could prevent companies from capturing the entire return of their investment, leading to suboptimal investment in the absence of public support. While these spillovers are common to emerging technologies—and may be addressed to some extent by intellectual property protection and other regulations—public research and development support and targeted fiscal incentives (such as capital grants, tax credits and feed-in tariffs) are warranted to stimulate private investment in long-lived, low-carbon technologies whose future returns are uncertain because of changing mitigation policies. For example, setting carbon prices while providing public research and development spending in renewable technologies has proven successful in mobilizing investment in emerging markets.[1]
- **Entry barriers.** Economies of scale and sunk costs favour established traditional technologies because energy-efficient power generation and renewable energy often involve higher upfront costs (such as the fixed costs of setting up factories, assembly lines and supply chains for parts of electric vehicles) and larger uncertainties, deterring firms from investing until they are confident of the market size of clean technologies. Thus, public support and regulations (for example on renewable generation shares) that provide more certainty on demand for clean technologies are critical. For example, banning incandescent lights bulbs could ensure that the demand for efficient LED light bulbs is sustainable and promote the development of affordable and highly efficient LEDs.
- **Network externalities.** Coordination failures could prevent market forces alone from deploying interlocked network technologies in which additional infrastructure needed for one investor can benefit other firms, as with electric vehicles and charging infrastructure. Public investment in such infrastructure as robust power grids and charging stations for electric vehicles, as well as international coordination, would be essential.
- **Market distortions and government failures.** Lack of information; misalignment across policies, regulations and markets; and unsuitable investment conditions hamper investment in renewables. Regulations that improve information disclosure about product energy efficiency or carbon content could allow agents to make informed choices and boost adoption of low-carbon technologies. Regulations that impose disproportionately higher costs on new entrants—such as the 2015 rule in Canada that requires investment in carbon capture and storage in new coal plants while allowing long adjustment periods for existing firms—are a deterrent.[2] Removing inconsistent policy incentives, such as simultaneously subsidizing renewables and fossil fuels, will be crucial for public credibility and support for the transition to low-carbon energy.
- **Financial market imperfections.** Incomplete and imperfect capital markets, long-run uncertainties, political risks and insufficient knowledge to assess low-carbon projects hamper their financing. Crucial to addressing financial sector short-termism and mobilizing private financing are financial instruments (prototype green bond contracts and benchmark indices of environmentally friendly securities) that reduce the risk-weighted capital costs of low-carbon investments and rebalance risk perceptions between low-carbon and brown projects, along with regulations to encourage disclosure of stranded asset risks in fossil fuels.[3] Also needed are shifts in the portfolio choices of central banks and institutional investors and further participation of multilateral or national development banks to act as trusted conveners to bring in other financing institutions.

(continued)

Box 5.3 Impediments to effective carbon pricing mechanisms *(continued)*

- **Distributional effects.** Carbon pricing will inevitably increase energy prices, at least in the short term, and could affect consumer purchasing power. Complementary policies are needed to protect the most vulnerable (households, regions and businesses), to ease their transition and to overcome resistance and opposition (from specific groups, such as owners and employees in the coal industry and fishers and farmers who depend on diesel).[4]

Policies to overcome the bottlenecks should be appropriately designed, scaled and targeted but should remain flexible. Governments should avoid policies that lock in particular technologies, fuel choices and technology-specific targets.[5] In this respect, fixed subsidies per kilowatt-hour of renewable energy are more flexible than investment-based incentives, regulations that force the adoption of new technologies regardless of their future costs and feed-in tariffs that guarantee minimum prices per kilowatt-hour but do not permit supply responses to changing market conditions.[6]

Governments should increase research and development support initially and then gradually reduce support once technologies are widely deployed and used by firms and households.[7] As renewable-based electricity approaches cost parity with fossil fuel–generated power, subsidies could be shifted from research and development to deployment and then progressively phased out. Supporting upstream development and manufacturing of clean technologies tends to be more cost effective than supporting downstream consumption because upstream providers face less competition.[8] While conditioning agricultural subsidies on adopting environmentally friendly practices can help reduce negative environmental impacts, removing environmentally harmful subsidies could prove more effective.

Today's historically low interest rates combined with the need to kickstart the global economy offer a unique opportunity for governments to transition to low-carbon pathways. Governments could attach green strings to fiscal supports—bailouts, grants, loans, tax breaks or equity purchases—to push industry towards a viable low-carbon future. To further incentivize companies to adopt cleaner technologies, stimulus packages could consider provisions to convert the type of aid provided—loans can be converted to equity, and grants to loans—if climate change–related conditions are not met.

Notes
1. Ang, Röttgers and Burli 2017. **2.** OECD 2017. **3.** Bhattacharya and others 2016; Stiglitz and others 2017. **4.** See, for example, IMF (2019b) and OECD (2017) for simulation outcomes. **5.** Pomázi 2009. **6.** IMF 2019b. **7.** Acemoglu and others 2012; Acemoglu and others 2016. **8.** Fischer 2016; Requate 2005.

education gains and skill-based development, which advances development.[86]

Despite the implementation challenges, the evolution towards carbon pricing continues around the world. Building on its regional experience, China launched its first National Energy Trading System in 2017.[87] The programme, linked to the country's nationally determined contributions under the Paris Agreement, covers 3 billion tonnes of carbon dioxide from the energy sector, making it the world's largest, nearly twice the size of the next largest (the EU Emissions Trading System).[88] China's programme is expected to affect 30 percent of national emissions.[89]

Canada's new Pan-Canadian Framework on Clean Growth and Climate Change enacted a nationwide tax on oil, coal and gas, starting at $15 per tonne of carbon dioxide in 2019 and rising to $38 by 2022.[90] The initiative aims to be revenue neutral by returning all the proceeds to households and businesses as rebates, thereby strengthening public acceptability and minimizing regressive impacts of the tax.

Interest in and momentum for market mechanisms to manage carbon are increasing across Africa. More than 34 countries have indicated an interest in market mechanisms for their nationally determined contributions.[91] Many international entities are providing knowledge and capacity-building support to develop the enabling conditions for these tools. South Africa is the only country in the region with a carbon pricing programme. Since less than half of Africa is electrified, the technology and resources used to expand electricity will have a huge bearing on future emissions.[92]

As noted earlier, an important step towards shifting incentives in addition to carbon pricing is removing fossil fuel subsidies. But the sharp decline in fossil fuel consumption during the Covid-19 pandemic in 2020 will lead to an estimated $180 billion decline in fossil fuel subsidies, a drop of 43 percent, compared with 27 percent in 2019.[93] As noted above, this period of low fuel and energy consumption provides for a favourable context to make a decisive move towards phasing out fossil fuel subsidies.[94]

Making biodiversity economically visible

As chapter 2 noted, biodiversity is being lost at an alarming rate.[95] The latest Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services report found that 1 million species are threatened with extinction, many within a few decades.[96] Stocktaking of progress by the Global Biodiversity Outlook suggests that the world has not achieved a single one of the Aichi Biodiversity Targets.[97]

Changing incentives to preserve biodiversity is difficult given the complexity of the fabric of life. A key challenge is that biodiversity remains undervalued in current markets, despite the increasing appreciation of its contributions to people—thanks to such initiatives as The Economics of Ecosystems and Biodiversity,[98] the European Union's Mapping and Assessment of Ecosystems and Their Services[99] and the comprehensive mapping of nature's contributions to people.[100] In turn, better measurement of policy interventions is crucial (spotlight 5.4).

"Changing incentives to preserve biodiversity is difficult given the complexity of the fabric of life. A key challenge is that biodiversity remains undervalued in current markets, despite the increasing appreciation of its contributions to people.

Incentives to preserve biodiversity can assume different forms—and need not be shaped only through the recognition of the benefits that the biosphere and its diverse ecosystems bring to humans. As the pathbreaking Economics of Ecosystems and Biodiversity initiative argued, where there is strong recognition of the fundamental dependence of people on the diversity of life, through cultural or spiritual values, there is no need to invoke benefits.[101] For instance, the preservation of natural parks that host wildlife has benefitted from the shared value that society puts on them, without any incentive linked to prices. But appreciating the benefits and vast economic values that ecosystems provide can help change incentives.

Consider how our understanding and valuing of wetlands has changed over time. Wetlands were historically considered places that bred diseases (such as malaria and yellow fever) and were to be avoided. Now science has established that wetlands are rich ecosystems that serve as habitats for diverse species and provide a variety of services such as wastewater treatment, flood protection and removal of excess nitrogen and phosphorous from water. And they are a rich food source for a variety of animals, birds and plants as well as a shelter for migratory animals.[102] Pantanal, the largest wetland in the world, is a rich ecosystem that spans Bolivia, Brazil and Paraguay and is home to 4,700 species. Attracting many tourists and contributing to soybean production and cattle farming, the economic activities in this wetland generated $70 billion in 2015.[103]

Valuing biodiversity has also taken on much political importance in several countries. In 2020 the United Kingdom's Chancellor of the Exchequer commissioned an independent global review of the economics of biodiversity. It analysed the sustainability of the services we receive from nature and what needs to be done to safeguards the world's natural wealth. An important reminder of the report is that human actions are derived from human knowledge and understanding of our nature.[104] Echoing the discussion in chapter 4, part of the problem in undervaluing nature results from our perceptions, shaped in part by what we are taught as children. The report suggests starting with reforms in the education system that deepen the appreciation and understanding of nature from a young age. Growing urbanization has detached us and our children from nature, and major changes in behaviour and social norms would come from bringing this understanding into our nurturing and education systems.

Historically, governments have regulated biodiversity conservation by protecting key habitats. About 15 percent of the earth's terrestrial and inland water

and 4 percent of the world's oceans are protected.[105] But incentives can also be harnessed to protect biodiversity through a range of market mechanisms. Regulatory frameworks that set a cap on the impact on species or habitat create incentives in which owners of land or habitats can exchange offsetting credits with those who need to mitigate their impacts. Still, these mechanisms may be seen to violate ethical stances that value nature's intrinsic and relational values (chapters 1 and 3).[106] The design and implementation of the programmes are critical to avoid adverse selection and moral hazard.

> "For climate change and biodiversity loss, individual actions and even national actions will not do enough to ease planetary pressures.

Payments for ecosystem services provide incentives for biodiversity preservation. The beneficiaries of the ecosystem services pay those who facilitate their provision (box 5.4). For example, farmers upstream are paid to reduce the amount of fertilizer they use and thus help maintain the water quality downstream. Beneficiaries are those farther downstream, such as fishers, water plants or communities, who make the payments. While some basic forms of payments for ecosystem services existed earlier, they came into the mainstream in the mid-1990s. Since then, payments for ecosystem services programmes have grown considerably, with as many as 550 around the world making payments of more than $36 billion.[107]

Enhancing international and multiactor collective action

For climate change and biodiversity loss, individual actions and even national actions will not do enough to ease planetary pressures. This section explores the challenges in activating collective action that transcends borders and the possible incentives to mitigate those challenges.[108]

Chapter 4 described how learning translates to values that may turn into stable social norms. It is important to recognize the link between those norms and international collective action. The norms are not restricted to one country. Particularly in the information age, where ideas zip across borders, the formation of norms can transcend national borders. Powerful norms—whether on conserving energy, using electric vehicles or reducing meat consumption—can then galvanize global public policy. It can be argued that recent international agreements such as the Paris Agreement on climate change are responses to heightened concerns about climate change.

That the vast majority of countries have signed international environmental agreements to ease planetary pressures suggests that we are not confronting a challenge at all (figure 5.4). Clearly, what is needed is not an examination of the act of signing but an understanding of differences in effectiveness across agreements—why some seem to provide stronger incentives than others. The Convention on Biological Diversity was signed at the 1992 Rio Earth Summit.[109] As we approach the end of the United Nations Decade on Biodiversity 2011–2020, progress towards global biodiversity targets, including those under the Sustainable Development Goals, has been lacking, as noted above.

Also important to consider: the evolution of agreements and how they may embed opportunities to respond to challenges, such as the flexibility that the Paris Agreement affords countries in approaching climate change.[110] It is setting in motion a catalytic process in which past action creates fertile ground for future action, leading to virtuous cycles of ambition and national climate commitments and action.[111]

Despite its flexibility, the Paris Agreement is based on voluntary compliance and lacks an enforcement structure or even Kyoto Protocol–like targets for individual countries.[112] This may result in freeriding, or some parties making little or no effort to address the challenges. Trade restrictions, such as those included in the Montreal Protocol, are a possible enforcement mechanism to prevent freeriding.[113] They were also discussed for the Kyoto Protocol.[114] Such restrictions would involve generalized tariffs imposed on countries that do not participate. This approach could give incentives for all countries to engage in an international agreement to cut emissions.[115]

Yet such a broad-based tariff restriction may also face challenges (box 5.5). In 2015 the Kigali Amendment to the Montreal Protocol was negotiated to phase out hydrofluorocarbons—a potent greenhouse gas—that the Kyoto Protocol did not include. With the trade restrictions in place, the protocol includes strong incentives for compliance.[116] This chapter

Box 5.4 Payments for ecosystem services in New York and Tanzania

Land management in the Catskills for clean water supply

A programme of land management in the Catskills region of New York state is an early example of payments for ecosystem services. New York City's water is regarded among the cleanest in the world, comparable to bottled mineral water. About 90 percent of the city's water comes from the Catskills–Delaware Watershed: 1.1 billion gallons are delivered every day to 9 million New York City residents.[1] The purity and cleanliness of this water are of great significance for the healthy lives of city residents.

The search for a clean sustained source of water for the city started in the 1830s, when it was decided to find water farther north rather than using unreliable local sources that would have met only short-term needs. In the 1980s the city began to worry about the quality of various water sources, including the Croton River and the Catskills–Delaware Watershed. A big challenge with the Catskills area was that only 30 percent of the land was owned by the public; the rest was used for private farming, woodlot forestry and tourism. Facing growing competition, Catskills farmers were using intensive agricultural practices and concentrated livestock management that increased pollutant runoff into soil, streams and lakes. Unsustainable land management and forestry, with the added pressure of a growing tourism industry and road construction, continued to degrade the environment, thus increasing nonpoint pollution.[2] Because of concerns about the safety of this water, consensus began to emerge that the water needed to be filtered.

But the cost of a filtration facility was very high, estimated at $5 billion, plus annual operating costs of $250 million. The water authority wondered whether it might be more efficient to manage the pollution sources rather than allow the water to be polluted and then spend resources to clean it up. Many water regulators thought it would be too difficult to track and manage the various sources of pollution. Even so, the commissioner of the New York City Department of Environment Protection conducted a series of education sessions with local farmers and businesses during which the department expressed concerns and options and the farmers shared their side of the story about competition and costs.

The open consultation expanded both parties' knowledge and understanding and allowed both to think collectively about solutions. A better environment with sustained local business opportunities was of interest for all. Eventually, the Whole Farm Program was established in the early 1990s, a proposal by local farmers to tackle pollution while helping local businesses thrive. Each farmer received a technical team to provide guidance on pollution control and advice on integrated business management. This enabled farmers to lower pollution without any additional costs. The city paid for the staff costs and capital costs for the pollution control, and farmers joined the programme on a voluntary basis, with the condition that at least 85 percent join within five years to ensure a critical mass for success.[3]

The ingenuity of this payments for ecosystem services programme enabled the city to maintain the high quality of its water and the region to enjoy a better quality environment. Filtration was no longer an issue. The model gained global recognition. Delegations from around the world, including Chile, Colombia, India, Ireland, France, the Republic of Korea, Singapore and Uzbekistan, have visited the region to learn about its innovative practices.[4]

Ecotourism in Tanzania

The United Republic of Tanzania is among the most biodiverse countries on the planet, and about 38 percent of the country's land area is protected for conservation.[5] But as in many countries, concerns have been raised that the protected areas may not be fully respected when there are no local incentives for conservation.

The Simanjiro Plains border a protected national park and are home to important wet season grazing areas for wildebeest and zebra. The plains are managed mainly by the Maasai, whose traditional livestock practices include seasonal grazing that protects the area. But the land has come under growing pressure from smallholder farming conversion. And the plains are an attractive tourist spot with operators running wildlife tours. Increased smallholder farming threatens the ecosystem, resulting in less grazing areas for wildlife, less area for the Maasai's traditional livestock practices and fewer opportunities for wildlife tourism.

(continued)

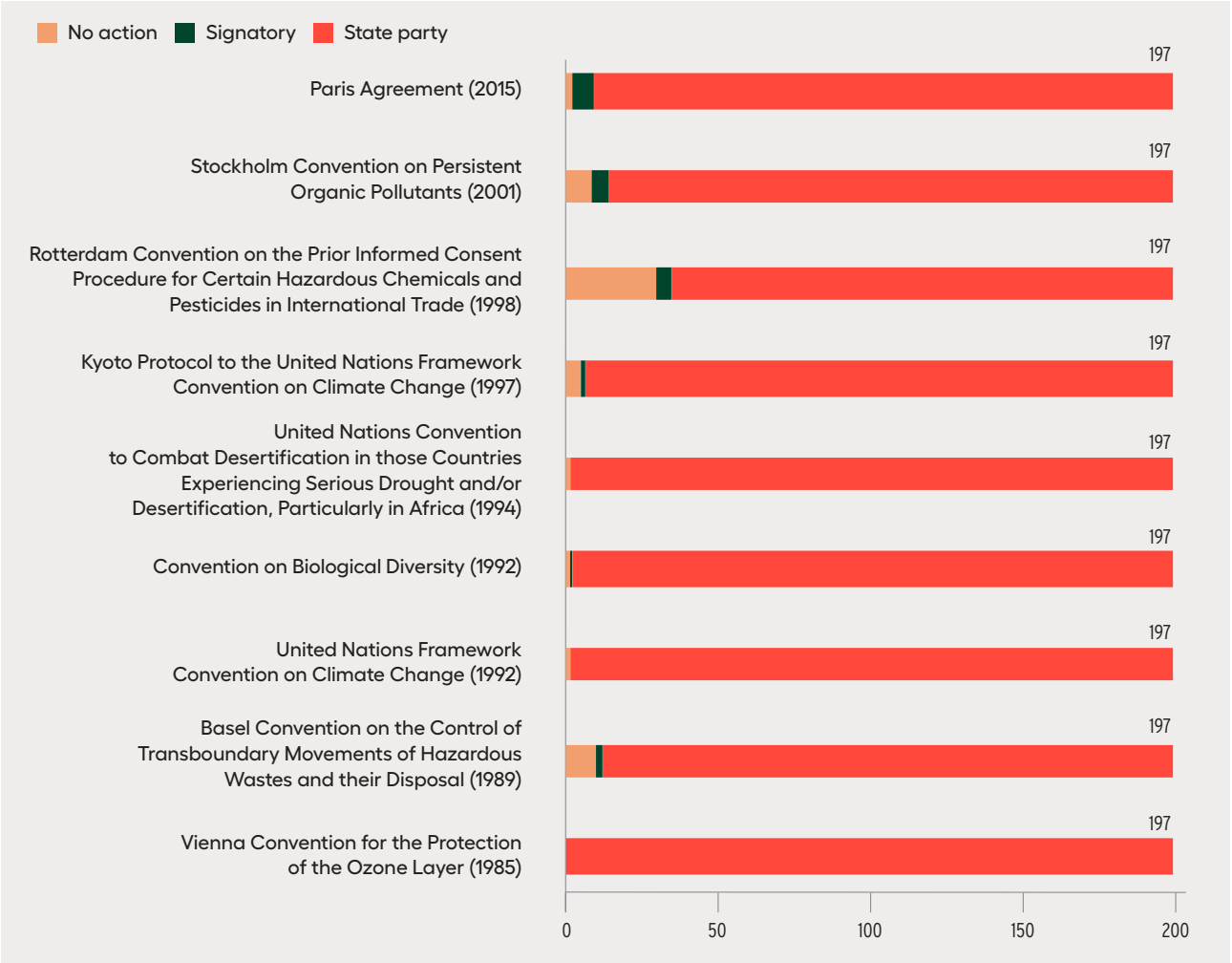
Box 5.4 Payments for ecosystem services in New York and Tanzania *(continued)*

A project in which tour operators pay local villages a fee for preventing agricultural production and illegal hunting on the plains was tested in the area of Terrat. The details of the agreement, including the fee level, number of instalments and who should manage the funds, were decided collectively by local tour operators, local villages and civil society organizations working in the area. Involving the local community was crucial for building support and ensuring compliance. Including tour operators and civil society organizations already known in the area created trust among the stakeholders. The fee was set low enough that operators could contribute but high enough to create a discretionary income stream for the local village. This built further support for the project, as the village could decide collectively on where to allocate the funds.[6]

The payments for ecosystem services scheme has since been expanded to other villages in the area and remains a model for similar projects to preserve biodiversity while supporting local economic development and poverty reduction.

Notes
1. Watershed Agricultural Council 2019. **2.** Appleton 2002. **3.** See also Chichilnisky and Heal (1998). **4.** Dunne 2017. **5.** FAO 2016. **6.** Ingram and others 2014.

Figure 5.4 Most countries have ratified international environmental treaties



Note: Includes the 197 countries that are parties to the United Nations Framework Convention on Climate Change.
Source: Human Development Report Office based on United Nations (n.d.).

Box 5.5 Trade-related incentives in international treaties—credible and effective?

Leakage is one issue that international agreements confront. Suppose there is an international treaty in which parties agree to reduce their carbon emissions by putting in place appropriate domestic policies. A country that is not a party to the treaty will not adjust domestically with a carbon tax or a permits system, and goods imported from that country would have an unfair advantage over goods produced by countries that are parties to the agreement. A country that is a party might impose carbon tariffs on imported goods or adjust border taxes applied to imports from countries that are not parties to the treaty.

Border tax adjustments would neutralize the leakage. But they have to be comprehensive and based on emissions embedded in the production of a whole range of imported goods. They are hard to estimate.

Trade restrictions can also be designed to deter nonparticipation directly. This would involve broad restrictions, such as no trading privileges for a country that does not participate or a country that has joined but then is found to be in noncompliance. The problem is that this may fail to be a credible threat. Broadly, countries also harm themselves when they suspend the trading privileges of a country not joining.

If economically powerful countries do not participate in treaties or are not in compliance, these threats are not credible. Ending trade relations with an important trading partner is likely to be costly. These incentives also apply in the case of groups addressing a collective action problem in general.

Moreover, adding strong enforcement and penalties can have other consequences. Parties may want to water down the agreement during the negotiation in order to ensure the punishments are not imposed. The trade-related provisions in the Montreal Protocol were effective, turning the phasing out of chlorofluorocarbons into a coordination game characterized by tipping points. The effectiveness of across-the-board climate-related trade restrictions remains to be tested.

Source: Barrett 2008; Kotchen and Segerson 2020.

explores different dimensions of what may stand in the way of countries coming together. It illustrates the broader challenges in achieving international collective action to ease planetary pressures and points to possible ways of changing incentives to encourage shared action.

Reducing uncertainty, targeting groups

One challenge related to climate change—but relevant more broadly—involves uncertainties in the underlying planetary processes and their implications. In the case of the climate system, there is uncertainty about how much temperatures will increase with growing atmospheric concentrations of greenhouse gases (called climate sensitivity)[117] and about possible thresholds after which the consequences of those increases in temperature would be catastrophic (see chapter 2 for more on tipping points in the Earth system).[118] Collective action is harder when uncertainty about this type of threshold is large, so reducing this uncertainty can enhance incentives to bring about behavioural changes to address climate change.[119]

When uncertainty about the threshold is large, abatement is a prisoner's dilemma. Even if every country plays its part in reducing the risk of crossing a threshold, each country has an incentive to scale back on its abatement. By doing so, a country reduces its abatement costs considerably but increases the chance of catastrophe only slightly. When every country faces these incentives, the most likely outcome is low overall abatement effort.[120] But when the threshold is less uncertain, incentives change: It turns from a prisoner's dilemma into a challenge of coordination, which might be easier to achieve than cooperation.

Given the key role of the level of uncertainty, early warning signals can be pivotal in reducing uncertainty. A Climate Risk Atlas for Developing Countries has been proposed to measure vulnerability to climate shocks.[121] This international exercise could feed into national and regional processes to develop climate risk indices.[122] These would then be linked to disaster risk reduction plans. For developing countries this

would fill a critical gap in measuring vulnerability to climate change and could also act as an early warning system for climate shocks.

“But many examples of cooperation in managing natural shared resources have been documented, by self-organized mechanisms of incentives to oversee common resources at small and medium scales. One reason is that behaviour is driven not only by self-interest but also by how others behave, taking us back to social norms.

Group-level policies, based on group performance rather than individual practices, could enhance incentives for collective action.[123] In these instances rewards or penalties are based on rights allocated to a group. This can be done when group outcomes are more easily monitored than actions of individuals or countries within the group or when transaction costs are lower in dealing with the group. For example, monitoring individual farms to determine the contribution to a water pollution problem (nonpoint pollution) may not be feasible. But the quality of the affected water body is easily monitored.

An example of group-level arrangements is collective payments for ecosystem services programmes, discussed above. In a study of the impact of payments for biodiversity conservation in Chiapas, Mexico, communities that participated in a payments for ecosystem services programme had lower deforestation rates than nonparticipating communities.[124] And Ecuadorian farmer communities that participated in a collective payments programme strengthened their grazing restrictions.[125]

Learning from the local level

The examples also show that a variety of mechanisms can provide incentives for cooperation. The challenge of cooperation is often framed as a tragedy of the commons: Actions by individuals result in socially suboptimal outcomes. There is at least one outcome that yields higher returns for all involved, but individual choices do not produce that outcome. This has been used extensively for the study of climate change and the governance of natural resources.[126]

But many examples of cooperation in managing natural shared resources have been documented, by self-organized mechanisms of incentives to oversee common resources at small and medium scales.[127] One reason is that behaviour is driven not only by self-interest but also by how others behave, taking us back to social norms.[128] This also means that the mechanisms are very context specific, and since they often are based on incentives requiring trust and reciprocity, they may work only at smaller scales.[129]

But even for challenges at the global scale, such as climate change and biodiversity loss, much can be done even when global cooperation is difficult. As Elinor Ostrom puts it, “Rather than only a global effort, it would be better to self-consciously adopt a polycentric approach to the problem of climate change in order to gain the benefits to multiple scales as well as to encourage experimentation and learning from diverse policies adopted at multiple scales.”[130]

There are also benefits to addressing global challenges at the local level.[131] For example, efforts to reduce greenhouse gas emissions also reduce particulate matter pollution in a city or region, providing local cobenefits.[132] A review of 239 peer-reviewed studies found that the cobenefits of climate mitigation policies alone—reduced air pollution, enhanced biodiversity, increased energy security and improved water quality—often outweigh the mitigation costs.[133] In the United States, among all the major Clean Air Act rules issued by the Environment Protection Agency over 1997–2019, cobenefits make up a sizeable share of the monetized benefits in the cost-benefit analysis.[134] These are examples of the provision of joint goods—actors’ contributions provide both a public good and a private benefit to the contributor.[135] Many mitigation actions entail cobenefits, which provide incentives for communities to come together to invest in, say, renewable sources of power for household energy use. Power that is not needed is contributed to the network, potentially reducing costs for everyone. These actions also reduce greenhouse gas emissions. Similarly, investment in better waste disposal facilities generates local benefits and helps reduce global emissions.[136] Discussions and initiatives at the community level matter.[137]

It is also important to recognize the asymmetries in preferences, benefits and costs across actors.[138] For example, Costa Rica has already harnessed

hydropower and largely decarbonized electricity production.[139] There are also differences between nation-states and other kinds of actors such as multinational corporations and civil society organizations. National governments may be susceptible to political capture by narrow interests, with fossil fuel interests opposing climate action.[140] Given that fossil fuel industries are geographically concentrated, the opposition to cooperative action may also be concentrated. Where those interests are not present or do influence power, collective action may emerge more easily.

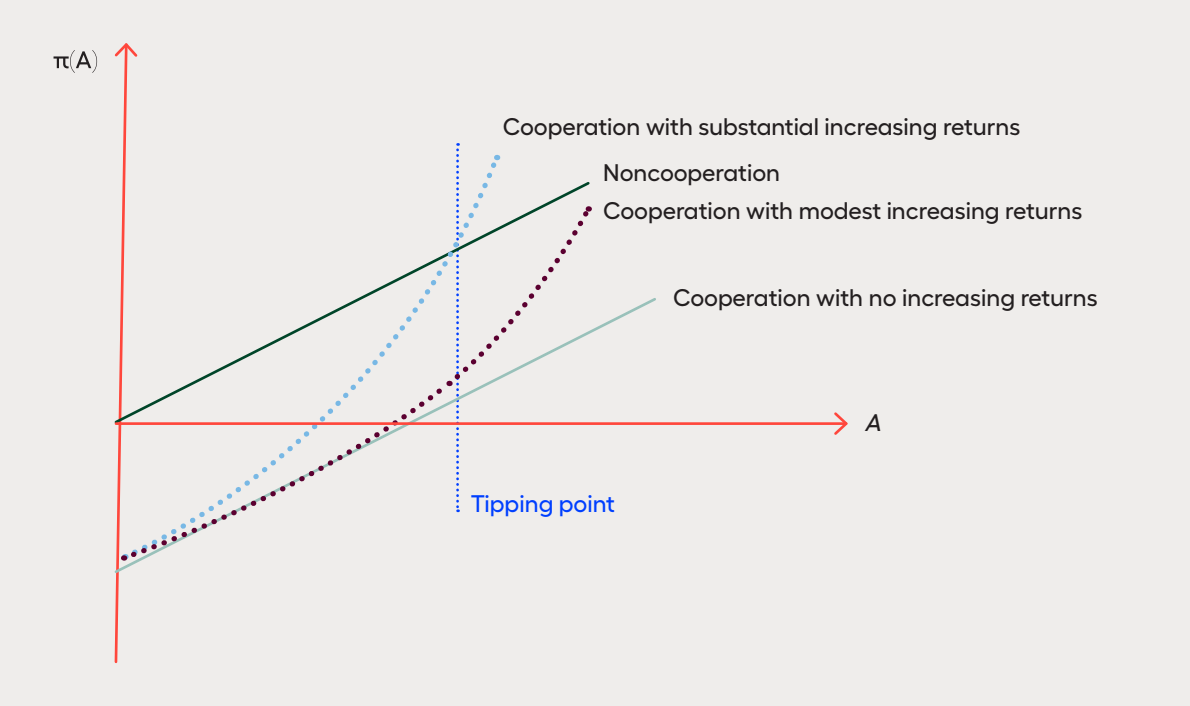
Leveraging increasing returns: The more the merrier

Many collective action problems exhibit increasing returns, meaning that benefits for any actor grow as the number of actors that contribute expands.[141] This changes the incentives for cooperation from where individual benefits are independent of the number of contributors (figure 5.5).

Increasing returns to actions can emerge from feedback loops. These can include incremental decline in costs following deployment of new technologies, such as green energy or new agricultural processes (chapter 3). In the international arena, learning effects can be a powerful channel of increasing returns. Denmark, for example, passed on to China's electric grid operators what it had learned about operating a grid with variable wind power.[142] In developing its national emissions trading system, China has drawn on a great deal of international expertise.[143]

Increasing returns can also accrue through network effects. Catalytic converters introduced in the 1970s dramatically reduced harmful automobile emissions.[144] Catalytic converters and unleaded fuel are complementary technologies. After the technology was introduced in Germany, gas stations in Italy, responding to tourism business from Germany, started providing unleaded fuel, making the eventual adoption of unleaded fuel in Italy far easier, due to the network effects.[145] For electric cars, once a critical

Figure 5.5 Catalytic cooperation with increasing returns



Note: The vertical axis represents the payoff to actor *i* from collective action as a function of *A* (how much others are contributing—the horizontal axis). Without increasing returns the individual payoff to actor *i* from not cooperating is always higher than that from cooperating. But increasing returns imply that the payoffs to individual *i*'s actions depend on *A*—that is, how much has been contributed already. If increasing returns are strong enough, the cooperation curve intersects the noncooperation curve at a certain level of *A*, a tipping point occurs for cooperation to become strictly preferable.
Source: Hale 2020.

threshold is reached for charging stations, network benefits can help lock in the new technology. Through the choice of technical equipment, some international agreements—such as the International Convention for the Prevention of Pollution from Ships —have leveraged network externalities to achieve international cooperation.[146] Prior action can also change norms and political processes, pointing to another route to increasing returns.[147]

> "Many collective action problems exhibit increasing returns, meaning that benefits for any actor grow as the number of actors that contribute expands. This changes the incentives for cooperation from where individual benefits are independent of the number of contributors.

Recognizing and leveraging increasing returns can help shape more effective incentives to mobilize international cooperation—with substantial gains attained incrementally and dynamically.[148] For some actors—state or nonstate—private benefits may be high enough for them to act as first movers. On climate, based on recent efforts, the European Union can be seen as a first mover with enough scale to trigger increasing returns.[149] And the actions of the first movers can change the parameters enough for other actors, both governments and firms, to also contribute to collective action.[150]

In this sense the Paris Agreement can be seen as catalytic, a pivot providing opportunities for increasing returns to take hold, especially as awareness of the cobenefits of climate action increases. In allowing for voluntary, flexible national commitments while also bringing into the fold nonstate and subnational actors such as cities, regions and activist groups, it broadens the range of actors engaged.[151] Reflecting the dynamic and changing nature of preferences, the agreement allows actors to update their pledges. It is thus a pledge, review and ratchet mechanism. It can lead to a virtuous, upward spiral of ambition.[152]

The risk: Increasing returns do not take hold, and there is a race to the bottom instead.[153] But recognizing the potential for increasing returns opens the possibility for new mechanisms to provide incentives for international collective action and for seeing existing agreements, such as the Paris Agreement, in a new light. Using the logic of increasing returns, catalytic incentives to encourage unilateral, early mover actions and then enhance the diffusion of increasing returns from the actions of early movers to more recalcitrant actors could help reach a tipping point of comprehensive or near-comprehensive action. Flexible, nonpunitive international agreements provide space for actors for whom individual benefits may exceed the costs of action. Allowing nonstate and subnational actors—including civil society organizations, multinational corporations and cities—to demonstrate policy actions increases the likelihood of prodding first-mover champions, who can change the incentives for other to join in once increasing returns take hold.

Recognizing differentiated responsibilities and abilities

Climate change is a challenge shared by everyone, but countries have recognized that there are differentiated responsibilities. Group of 20 members account for 78 percent of global emissions.[154] Most of the carbon dioxide emissions in the atmosphere today are a result of historical emissions from developed countries.[155] And developing countries are at the receiving end of the impacts of climate change, as the 2019 Human Development Report documented and this Report highlights.[156] So the climate change challenge is fundamentally one of climate justice.[157]

To address these differences, the Montreal Protocol incorporated the principle of common but differentiated responsibilities and respective capabilities, which recognized the unequal distribution of responsibility between industrialized and developing countries.[158] Developing countries were given easier initial limits and expected to eventually get to the same final endpoints as rich countries. The Kyoto Protocol took this a step further, with no limits on emissions from developing countries.[159] But this may have diminished developed countries' commitment to its success.[160]

The balancing act between designing equitable and efficient governance systems and the realities of international negotiations has played out in the discussions on climate change. As countries negotiated the post–Kyoto Protocol regime at the 15th session of the Conference of the Parties in Copenhagen in 2009, disagreements on key issues and deep mistrust led to a flawed and weak deal. The following years,

negotiators fought their way back from the brink with the Cancun Agreements then the Durban Platform, which laid the foundation for the Paris Agreement in 2015. Among the key issues at stake was differentiation, or the various levels of commitments by richer and poorer countries. This was delicately addressed in the Paris Agreement negotiations and paved the way for it to become the first universal deal and to launch an entirely new era of climate action.[161]

Innovating to enhance collective action

As noted, local leaders and stakeholders are often able to self-organize to manage a common resource through effective rules. Looking at the factors that make these arrangements possible may suggest innovations to bring about collective action at other scales. For instance, the sustainability of the systems devised depends on the quality of monitoring and enforcement. It also depends on actors' willingness and ability to monitor one another.[162]

Monitoring and enforcement are also crucial for the success of global agreements. Many of the mechanisms in the Paris Agreement—including the monitoring and review mechanisms—have not been fully defined, which may hamper its effectiveness. As noted, the agreement is built on a pledge, review and ratchet structure. Parties are expected to adhere to their nationally determined contributions, publish biennial reports tracking emissions and progress towards implementation and update their nationally determined contributions in a five-year cycle. The biennial reports are subject to technical review and feedback. This review process is expected to feed into a five-year global stocktaking. But many of the details still need to be filled in. The evolution of the transparency and accountability mechanisms and the global stocktaking could make the agreement more effective.[163] The pledge and review process on the global stage would add peer pressure and help raise ambitions but could also empower domestic constituencies by providing a hook to hold policymakers to account.[164]

In the first opportunity for countries to upgrade their nationally determined contributions in 2020, some countries have announced increased ambitions. China announced that it will peak its emissions before 2030 and achieve carbon neutrality by 2060.[165] Saudi Arabia is setting up its first utility-scale wind power farm, which will be the largest in the Middle East.[166] Japan, the world's third largest economy, announced its commitment to net-zero emissions by 2050.[167] The Republic of Korea, the world's 11th largest economy, also committed to net-zero emissions by 2050.[168] Their revised nationally determined contributions, to be submitted by the 26th session of the Conference of the Parties in 2021, are expected be consistent with these aims. As noted above, action by some countries can create favourable conditions for others to act.

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A hallmark of the Paris Agreement is that it diversifies climate leadership and includes nonstate and subnational actors, including civil society, the private sector and city governments.[169] All will have to step up their ambition and action. The United Nations Framework Convention on Climate Change process continues to engage with nonstate stakeholders and leverages their participation, while civil society organizations and others can tailor their advocacy towards the model of national pledges, implementation and review. Many stakeholders are stepping up. During Climate Week 2020 some of the world's biggest companies—including AT&T, Morgan Stanley and Walmart—adopted aggressive timetables for reducing emissions. General Electric announced that it will no longer build new coal-fired power plants.[170] Building on the potential for multiactor engagement can strengthen incentives for cooperation, especially given the ease of global communication across people and civil society and the economic interconnections associated with global value chains—though incentives to cooperate are also shaped by broader geopolitical developments and the connection of international commitments to interests of national constituencies.[171]

Addressing inequalities can also play an instrumental role in enhancing incentives for cooperation.

Inequality reduces the space for deliberative thinking and collective action (chapter 1). As the 2019 Human Development Report noted, higher inequality is associated with less communication and information sharing among different interest groups.[172] This results in less willingness to contribute to public goods.[173] Chapter 3 shows how inequalities parallel losses in biosphere integrity.[174]

Inequality also shapes perceptions of unfairness across countries. Differentiated responsibility and climate as justice will continue to shape the international dialogue. Under the Paris Agreement, countries make voluntary commitments while being mindful of their national capacities.[175] Differences across countries can be narrowed also with better access to technology and innovations that enable decarbonizing pathways (chapter 3). There is great potential for increasing developing countries' access to technology, credit and finance to close these gaps, which could also enhance incentives for cooperation.[176]

Trust and reciprocity are central to collective action.[177] Norms of trust and reciprocity, how they come about, what policies help promote them and how they can be sustained are important elements in the success or failure of collective action. They have direct implications for incentives for international cooperation. The stronger the reciprocal preferences of governments, the more effective systems of pledging, reporting, reviewing and stocktaking will be. Addressing climate change as a challenge of justice and reducing inequalities within and across countries may enhance actors' willingness to reduce emissions in a way that increases others' willingness to do the same.[178] This would be a more general template in which to frame incentives in order to enhance international collective action to ease planetary pressures.