

Setting Climate Action Objectives for Pursuing the 1.5° C Target

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Climate Change Roundtable

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Executive Summary

This report identifies policy levers and strategies, particularly around the decarbonization of the power sector, which can help global emissions decline by 2020 in order to reach the 1.5° C target. It outlines the transformative changes needed to enable carbon dioxide emissions to fall to zero by 2050, and it explores the potential contributions and research priorities around techniques that mimic or enhance biological and geological sinks.

Policy interventions and strategies that could help drive the pursuit of a 1.5° C trajectory include:

- Decarbonize the power sector, with the goal of doubling the share of renewable energy by 2020 from 2015.
- Scale up circular economy strategies.
- Expand the coverage of carbon pricing.
- Phase out fossil fuel subsidies.
- Transform biological land use from a carbon source to a carbon sink.
- Support research and development to identify medium- and long-term solutions for challenging sectors, particularly steel, cement, aviation, and agriculture.
- Transition to a low-carbon transport sector, with the goal of eliminating manufacturing of vehicles with internal combustion engines by 2030.
- Modernize existing building stock and ensure the sustainable construction of new structures.

The report states that climate action can be taken by stakeholders at national and local levels, as well as by cities, regions, businesses, and investors. It identifies policy overlaps and cobenefits. It calls for ensuring that climate change actions are just and equitable.

Key areas for action include:

- Preventing lock-in to coal and other high emissions infrastructure, and instead achieving lock-in to renewable energy and carbon neutral alternatives through reforms in international financial and development institutions. This should be the highest priority.

- Scaling up concepts such as the circular economy, which could close by approximately half the emissions gap between the current global trajectory and the additional action needed to maintain a 1.5° C warming pathway.
- Turning biological land use from a carbon source to a carbon sink through strategies that provide the highest levels of carbon capture while supporting other priorities of cities, states, and local communities.

The report also examines where the policy landscape is headed over the next few years, with a particular focus on key milestones in 2018.

About the Report

This report draws on the major discussion points and policy recommendations from the roundtable “Setting Climate Objectives for Pursuing the 1.5° C Target,” held as part of the Stanley Foundation’s 57th annual Strategy for Peace Conference, October 26–28, 2016, at the Airlie Center outside Washington, DC. The findings included in this report are those of the chair, Andrew Higham, chief executive officer of Mission 2020; the rapporteur, Amy Weinfurter, research associate at Yale University; and the roundtable organizers, Stanley Foundation associate program officer Rei Tang and program associate Mark Conway.

Additionally, this report draws on the working papers commissioned for the roundtable discussion and other resources as noted. Conference participants neither reviewed nor approved this report. Therefore, it should not be assumed that every participant subscribes to its recommendations, observations, and conclusions.

The Stanley Foundation’s 57th annual Strategy for Peace Conference gathered experts and policymakers from academia, government, international organizations, and civil society in autonomous roundtables where experts focused on policy ideas, challenges, and recommendations in four key global issue areas: climate change, genocide prevention, nuclear security, and global governance. Additional information about the conference is available on our Web site www.stanleyfoundation.org/spc-2016.cfm.

The rapporteur, Amy Weinfurter, prepared this report following the conference. It contains her interpretation of the proceedings and is not merely a descriptive, chronological account. Participants neither reviewed nor approved the report. Therefore, it should not be assumed that every participant subscribes to all recommendations, observations, and conclusions.

Introduction

The Paris Agreement commits the global community to “[h]olding the increase in the global average temperature to well below 2° C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5° C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change.”¹ The dangers of climate change, including extreme weather events, water availability, agricultural yields, sea-level rise, and risk of coral reef loss, increase substantially as the world moves past a 1.5° C temperature increase.² Delaying climate action also postpones the benefits of the shift to a decarbonized society, such as reduced air pollution; enhanced water, food, and energy security; and the creation of new jobs and markets around renewable energy and resource efficiency.

While the global community has taken important steps toward mitigating global warming, it will be necessary to increase the speed, scale, and ambition of these efforts in order to avoid the worst impacts of climate change. Maintaining a 1.5° C trajectory will require reaching a turning point in global greenhouse gas emissions by 2020. Global carbon dioxide (CO₂) emissions will need to fall to zero by 2050, concurrent with dramatic declines in other greenhouse gases, including methane and other short-lived climate pollutants. A 1.5° C pathway also includes the deployment of strategies that mimic or enhance biological and geological sinks after the 2040s.³

The mandate and key milestones in pursuing a 1.5° C trajectory are clear. The global community now faces the challenge of defining the priorities, crafting effective strategies, and marshaling the resources to realize a decarbonized society.

Policy Priorities

Roundtable participants identified policy interventions and strategies that could help drive the pursuit of a 1.5° C trajectory. These action areas are summarized below and discussed in greater depth in the following sections:

- Decarbonize the power sector, with the goal of doubling the share of renewable energy by 2020 from 2015.
- Scale up circular economy strategies.
- Expand the coverage of carbon pricing.
- Phase out fossil fuel subsidies.
- Transform biological land use from a carbon source to a carbon sink.

- Support research and development to identify medium- and long-term solutions for challenging sectors, particularly steel, cement, aviation, and agriculture.
- Transition to a low-carbon transport sector, with the goal of eliminating manufacturing of vehicles with internal combustion engines by 2030.
- Modernize existing building stock and ensure the sustainable construction of new structures.

Reaching each of these goals will require promoting policy learning and transfer, sustainable behavior, and innovation in low-carbon technologies, as well as internalizing the benefits and costs of different products and processes.⁴

Crosscutting Goals and Strategies

Several recurring themes and common strategies ran through the roundtable's discussion of short-term and long-term efforts to pursue a 1.5° C pathway. These are summarized below and discussed in greater depth in the following sections:

1. **Tailor decarbonization strategies to national and local contexts.** Although the 1.5° C target brings the urgency of climate action into sharper focus, this goal should not tempt the climate community into searching for silver bullets; mitigation and adaptation strategies will need to be tailored to national and local contexts. Domestic ownership of the response to climate change will help ensure the success and long-term survival of these efforts.
2. **Build national and local capacity at a global scale.** It will be essential to build capacity at the national, regional, and local levels to advocate for and implement climate solutions. Local ownership of climate action strategies can help anchor policy visions in the people and institutions that will be responsible for delivering them. This support may be especially important for the implementation and revision of countries' climate action plans or nationally determined contributions (NDCs), which many governments are still working to understand and translate into action.
3. **Foster and leverage climate action from cities, regions, businesses, and investors.** Identifying high-impact actions with both short- and long-term impacts, as well as priorities for policy development and investments, can help guide city and region (subnational) and businesses and investor (nonstate) climate action responses. Determining ways to increase subnational governments' access to financing and to connect them to sources of funding can enable them to scale up their activities. Policy transfer and cooperation between global, national, and local levels of climate action can generate virtuous cycles of increasing ambition.
4. **Support nonstate and subnational actors' movement into a common rhythm of committing to and reporting on increasingly ambitious action.** Enhancing and harmonizing the monitoring, reporting, and verification of subnational and nonstate climate action can help communicate the impact of these activities and illustrate their contribution to global goals. Harmonizing their voices would also amplify calls for the national policy reforms and support to deliver these commitments.

5. **Implement policy interventions in concert.** Policy interventions are often most effective when they reinforce each other. In Germany, for instance, several policies helped support the success of feed-in tariffs by mobilizing financing and training workers in renewable energy technologies. Though many countries have established feed-in tariffs or similar policies and goals, fewer have implemented the supportive mix of additional strategies needed to make these interventions effective. Identifying the secondary legislation commitments and complementary strategies needed to support ambitious targets or policy goals could strengthen their effect.
6. **Determine the policy overlaps between climate change and other goals,** such as sustainable development. In particular, strengthening the linkages between climate action and sustainable development goals can help reinforce both agendas.
7. **Communicate the cobenefits and opportunities associated with addressing climate change,** such as improved resource efficiency; enhanced energy, water, and food security; public health benefits; and poverty reduction. Pursuing a 1.5° C target also strengthens efforts to address industrial poverty and energy poverty, and enhance quality of life. Creating positive and concrete narratives that illustrate the transformational change associated with the pursuit of the 1.5° C target will be particularly important for constituencies worried about the potential losses associated with the transition to a decarbonized world.
8. **Create climate movements that extend beyond the usual suspects** (i.e., climate-focused nongovernmental organizations operating primarily in the Global North) to tap into new sources of support around key priorities. These partners can help frame, communicate, and implement strategies for efforts to decarbonize the power sector and “shift the trillions” away from fossil fuels and toward renewable energy, among other goals.
9. **Describe, in concrete detail, the impacts of climate change and the possible forms a transition to a decarbonized economy might take.** Developing domestic and local storylines, by referencing historical events and local experiences, can help convey the impacts of climate change. Tangible visions of the transformation to a decarbonized society can identify compelling linkages between climate action and other complementary national and local agendas, generating buy-in toward the pursuit of a 1.5° C pathway.
10. **Build a just and equitable transition to a 1.5° C world.** Efforts to transition away from fossil fuels and to deploy sustainable infrastructure should be socially inclusive. Climate action strategies should support the populations most vulnerable to both the impacts of climate change and the effects of the transition to a decarbonized society.

Going Further, Faster: What Are the Key Next Steps to Meet the 1.5° C Goal Between Now and 2020?

Current country commitments address approximately half of the gap between a business-as-usual emissions pathway and a 1.5° C pathway. The global community must identify ways to cut an additional 15 billion tons of CO₂ in order to keep the 1.5° C target within reach.⁵ Coal, which is used primarily to provide electricity, accounts for the largest share of global CO₂ emissions, generating approximately 10 gigatons of CO₂ annually.⁶ Shifting the power sector away from coal and toward renewable energy will be a critical step toward meeting the goals of the Paris Agreement, cutting emissions from the energy sector by approximately one-third.⁷

Maintaining a 1.5° C limit on temperature rise will also require dramatically cutting greenhouse gas emissions in other sectors. For instance, decarbonizing the power sector will expand the benefits of the rise of electric mobility, as electric cars and buses draw power from a cleaner grid. Low-carbon modes of transport, such as electric vehicles and public transit, can reduce the impact of oil, the second-most carbon-intensive fuel and one of the leading sources of CO₂.⁸ Mode shifts, the continued development of mass transit, and the introduction of carbon-neutral aviation and shipping fuels can also help further decarbonize this sector. Decreasing the reliance on oil would also improve air quality and strengthen the trade balance of oil-importing countries.

Decarbonizing the building sector will also be critical to pursuing a 1.5° C pathway. The building sector's energy use is expected to double or triple by 2050 (relative to 2010) without significant mitigation actions.⁹ Efforts to reduce this sector's greenhouse gas emissions will depend on country-specific strategies; many developed countries face challenges in retrofitting existing structures, while many developing countries' emissions will depend on standards that guide the construction of new structures. Introducing stricter standards that modernize housing and facilitate the adoption of net-zero and low-emission technologies would lower both short- and long-term emissions from this sector.

Strategies for pursuing ambitious climate action will also need to target the land use, land-use change, and forestry sector, transforming it from a net source to a net sink of

greenhouse gas emissions. Agriculture and land-use change generate approximately one-fourth of global greenhouse gas emissions, though many areas also sequester and store carbon. Lowering this sector's emissions land use will require management strategies that simultaneously prevent environmental degradation, increase agricultural productivity to feed a growing global population, and enhance resilience to climate change.¹⁰ Efforts to maintain or enhance existing carbon sinks or to implement incentive systems for reducing emissions must balance these complex management challenges and ensure social safeguards for land use.

The ambition of the 1.5° C pathway also calls for deep emissions cuts in more challenging sectors, particularly agriculture, steel, cement, and aviation, that will require improved technology and behavior change. Current investment in research around resource efficiency and recycling, as well as crop and animal management and sustainable land use, must begin immediately to keep medium- and long-term emissions reductions within reach.¹¹

All of these sector transformations involve a shift toward sustainable infrastructures. Sustainable infrastructures encompass clean and efficient gray infrastructure (such as renewable energy systems, public transit, and efficient buildings) as well as green infrastructure (such as forest landscapes, wetlands, and watershed protection) that sequester carbon or provide ecosystem services.¹² Strategic policy design can help drive this transition and ensure its durability. While some policy changes may trigger sudden, transformational changes, this shift can be supported by "path dependent" policy interventions that gradually "ratchet up" their requirements over time. These approaches incrementally increase their durability, expand the populations they cover, and build new coalitions of support. For instance, directing carbon tax revenues to local school boards helped broaden the support for this policy within British Columbia and made the tax more difficult to reverse. Four processes can foster similar evolutions: lock-in, which occurs when an intervention immediately gains durability and no further historical processes are needed for it to remain durable; increasing returns, where a benefit of a policy or initiative increases over time; self-reinforcing interventions, where the costs of reversing a policy grow over time; and positive feedback, where the early adopters or supporters of an intervention increasingly benefit as the population covered by the intervention expands.¹³

Decarbonizing the Power Sector

Transitioning the power sector away from coal represents the most efficient and effective way to lower global emissions. Coal accounts for the largest share of global CO₂ emissions, and most of it is used to provide electricity.¹⁴ Many alternatives, such as solar and wind power, are already cost competitive¹⁵ or can be made so with financial instruments.¹⁶ Alternative clean energy sources have grown in availability and importance, driven, in part, by the falling costs of renewable energy and energy storage technologies. Environmental concerns and competition with renewable energy sources have already prompted the closure of existing coal-fired power plants and the prevention of new projects.¹⁷ However, more needs to be done to fully capture their potential and to speed the decarbonization of the power sector.

Deploying the existing capacity of coal-fired power would lead to an overshoot of the least-cost pathway to the goals of the Paris Agreement. Halting the construction of new coal plants and closing those in operation as soon as possible will be essential to

keeping a 1.5° C pathway within reach. It will also be important to ensure that coal is not replaced exclusively by natural gas. Although natural gas is less carbon intensive than coal, overreliance on this fuel could lead to an overshoot of a 1.5° C and 2° C pathway.

Shifting away from coal as quickly as possible will help make the 1.5° C pathway as cost-effective as possible. Redirecting investments into renewable capacity and support infrastructure, such as grids, will prevent the lock-in of unsustainable infrastructure and reduce the risk of stranded assets. In addition to reducing emissions, scaling up renewable energy will also create jobs related to goods and services; expand energy access, particularly in decentralized areas where grid access is difficult; protect public health by reducing air pollution; and enhance energy security, particularly for countries heavily reliant on fossil fuel imports.

Coal's Social and Political Context

Decarbonizing the power sector will also mean grappling with the social and political context around coal. In many countries, coal provides mass employment and fosters a strong cultural identity among workers who might struggle to transition to other areas of work. Fossil fuel jobs are also often tied to specific regions and skill sets, making an employment transition to other sectors more difficult. Identifying policies and strategies to support these communities and to build pathways from coal to other areas of employment will be critical to a just transition to renewable energy. Coal workers' trade unions, for instance, could provide one starting point for these discussions. Research that explores the economic and social complexity associated with the transition away from coal in different contexts would also help inform these efforts.

Strategies to decarbonize the power sector will also need to account for coal's powerful lobby and highlight alternative sets of interest groups to balance and counteract their influence. These alliances should leverage factors beyond climate change, such as public health and the falling costs of renewable energy. The Netherlands, for example, phased out coal in the country's southeastern region because of a combination of economics and concerns about the health of miners. The drivers away from coal or toward renewable energy will vary within each region.

Bottlenecks and Gaps

Efforts to decarbonize the power sector face a number of bottlenecks and gaps:

- Many countries have a deep knowledge of how to implement coal projects—they understand the risks, investment strategies, and process for managing each stage of project. There is a need to **develop alternate packages of renewable energy development** that are similarly comprehensive.
- There is a **lack of examples and research** around the phaseout of coal in developing countries. Most examples occur in developed countries, and their lessons may be less applicable to developing and emerging economies. Finding ways to illustrate and make these alternative development trajectories attractive to developing countries will be important to ensuring their wider uptake.
- In many countries, the supply chain of renewable energy is global, outside of the domestic context. **Building local capacity** will enable renewable energy to provide

jobs across the range of its value chain. Increasing local capacity will also enhance countries' ability to maintain their existing renewable energy infrastructure.

- There are a few missing pieces in the road map for shifting the power sector away from fossil fuels, particularly with regard to natural gas and carbon capture and storage (CCS). It is important to **understand the role natural gas and CCS will play in the decarbonization of the power sector** to prevent a lock-in of natural gas and avoid an overreliance on CCS. For instance, while a number of banks have retreated from lending to new coal developments overseas,¹⁸ there is not a similar pressure around investments in natural gas. Clarifying the strategy for addressing CCS and natural gas could help prevent similar gaps and discrepancies.

Trade and Finance Bottlenecks

Several trade and finance bottlenecks also hinder the shift away from coal:

- **Divestment is not occurring at the scale that is needed.** Coal investments are less capital intensive than oil and gas, and in many contexts, conditions may favor coal investments over those in renewable energy.
- **Trade barriers can increase the cost of renewable technologies.** Some progress on tariffs may be forthcoming in an agreement negotiated by 17 members of the World Trade Organization, but more discussion and progress are needed around liberalizing access to services, developing common standards, harmonizing testing certifications and requirements, and addressing the increase in the use of trade remedies, which increase the costs and lower the appetite for investment in renewable energy.
- **Financing for renewable energy is often project specific.** Financial instruments and policies that facilitate investment in renewable energy need to be consistent and capable of deployment at scale.

Strategies and Solutions

Strategies for overcoming obstacles related to knowledge gaps and trade and finance bottlenecks, and facilitating a more rapid decarbonization of the power sector, include:

- **Support developing countries' shift to alternate development pathways.** For instance, the approach of recent amendment to the Montreal Protocol, which provides financial support and offers a phased approach for the transition away from climate pollutants, could be adapted to support the transition away from coal.
- **Create targeted examples of decarbonization pathways.** Research can explore the social and economic aspects phasing out coal in developing countries. This analysis can help identify how coal could be phased out in the most cost-efficient and socially beneficial way. Discussions of counterfactual development pathways (i.e., what an emerging economy's energy choices would have been if the current renewable energy technology had been available 10 years ago) could also help create examples of alternate development pathways.

- **Identify country- and sector-specific decarbonization strategies.** Many countries simultaneously demonstrate the greatest leadership and potential for expanded renewable energy and support high rates of growth in the use of fossil fuels. Country-specific conversations with key emitters or sectors could help further shift these countries toward renewable infrastructure. Countries where this kind of engagement could be most useful include:
 - Growing economies in Asia: China, India, Indonesia, Vietnam, and the Philippines.
 - North African countries simultaneously expanding coal and renewable energy: Morocco and Egypt.
 - Large developed economies: United States, Australia, and Turkey.
- **Communicate renewable energy's cobenefits.** These include the falling costs of renewable energy and storage technologies, the health benefits and improved quality of life associated with cleaner air, job opportunities in renewable energy goods and services, and expanded energy access (particularly through distributed renewable energy, which may be feasible where grid-connected energy is not). Renewable energy can also enhance energy security, particularly for countries that rely on fossil fuel imports that affect their trade balances and leave them vulnerable to volatility in these markets.
- **Build redundancy into investment plans around renewable energy** to make the transition away from coal more robust and secure.
- **Explore ways to engage the fossil fuel industry.** Strategic partnerships with the fossil fuel industry could help fund and identify solutions to the equity concerns around the transition away from coal.
 - CCS and biochar could provide new economic opportunities to coal communities, though a great deal of uncertainty still surrounds CCS in particular. Implementing these activities would require a broader exploration of the role of these kinds of carbon storage techniques in the overall strategy to address climate change.
 - In some instances, it may be possible to recruit the fossil fuel industry to fund the transition to a decarbonized economy. In Mexico, for example, workers in the fossil fuel industry are being retrained to shift into other sectors; fossil fuel subsidies are helping support the transition to renewable energy; and fossil fuel revenues are being used to finance reforestation.
 - The struggles of the energy market and coal industry over the past few years have already displaced many working in these industries. The economic struggles they are facing could create an opportunity for governments to purchase companies that are now worth much less.
- **Leverage public-private partnerships.** Public-private funding could help develop solutions for just transitions, adaptive resilience, and country-specific decarbonization strategies. For instance, this funding could be linked with the

implementation of countries' NDCs. Funding should carry a stipulation that any discoveries made with this support must be made publicly available, to ensure that solutions can spread.

- **Pursue strategies to address methane and black carbon.** Many low-cost emissions-reduction opportunities around methane and black carbon could be pursued immediately.
 - For instance, the United States, Canada, and Mexico's trilateral initiative to cut methane emissions 40 to 45 percent by 2025¹⁹ could help build momentum around this issue and would have a significant mitigation impact if scaled up globally.
 - Gas flaring north of 66° N is responsible for nearly half of the black carbon deposition in the Arctic.²⁰ Most of this gas flaring occurs in Russia. The upcoming Finnish leadership of the Arctic Council could offer an opportunity to discuss opportunities to reduce gas flaring, and the subsequent loss of albedo, in the Arctic.

Transformational Change

In addition to bending the curve of global CO₂ emissions by 2020, pursuing the 1.5° C target will require enabling global carbon dioxide emissions to fall to zero by 2050. In addition to decarbonizing the global energy system and drastically reducing emissions from other sectors, delivering this rapid decarbonization will require fundamentally changing market and business systems. Circular economy strategies, carbon and water pricing, and shifts in finance and trade offer some especially promising avenues toward transformative change.

Circular Economy

Circular economy strategies reduce the input of raw materials, improve the use of existing assets, and reduce the output of waste.²¹ Approximately half of global emissions relate to materials; cutting these emissions by 20 to 30 percent would have a significant impact on the world's carbon budget. Taking full advantage of the emissions reductions potential of the circular economy could close by approximately half the emissions gap between the current global trajectory and the additional action needed to maintain a 1.5° C warming pathway. Resource efficiency may also be a precondition to other avenues of decarbonization; for instance, it will be necessary to increase the very low (less than 1 percent) recycling rates of rare earth minerals to avoid resource constraints around renewable energy.

Some policymakers have begun working to realize the potential of circular economy strategies. In 2015, for instance, the European Commission introduced a Circular Economy Package to help support the adoption of circular business practices across European Union member countries. This initiative has been particularly successful in fostering circular economy strategies in Germany, France, Denmark, the Netherlands, and the United Kingdom. Efforts to support the circular economy typically address market and regulatory failures that may hinder resource efficiency, or attempt to stimulate market activity, by setting targets, changing public procurement policy, developing platforms for collaboration, and offering financial or technical support to businesses that complement efforts to minimize barriers.²²

Delivering these reductions and ramping up the circular economy will require:

- **Reforming taxes.** Reducing the tax and social security burden on labor, and applying taxes to the extraction of raw materials and emission of greenhouse gases, would incentivize a resource-efficient economy while protecting job opportunities.
- **Improving the business case for opportunities in the circular economy.** Think tanks, academia, and research organizations could help identify opportunities

to demonstrate and communicate the economic potential of these strategies. Governments should reduce barriers to the entry and expansion of new business models around the circular economy.

- **Leveraging city leadership.** While a circular economy will require effective policymaking at all levels, cities could be especially well positioned to facilitate this transition. The high concentration of businesses in or near urban areas, high levels of consumption within cities, and cities' frequent role as incubators of innovative environmental management strategies help position them as leaders in the deployment of circular economy strategies. The C40 Cities network, for instance, has begun to explore policy packages around sustainable consumption.
- **Considering alternate metrics.** There is a disconnect between the way the impacts of the carbon economy are measured by the research community and by businesses. Exploring ways to connect or link these measurement systems could be helpful in tracking and guiding the deployment of circular economy strategies.
- **Socializing the concept of a circular economy.** Transitioning to a circular economy will require making reuse and recycling part of everyday life for citizens, government, and businesses.

Carbon and Water Pricing

Approximately 12 percent of global greenhouse gas emissions are covered by a carbon price. To pursue a 1.5° C pathway, this coverage will need to grow dramatically. The World Bank and the International Monetary Fund have set a goal to expand coverage to 25 percent of global emissions by 2020, and to 50 percent of global emissions by 2030.²³ The Carbon Pricing Leadership Coalition, which launched at the 21st Conference of the Parties in December 2015, aims to support the expansion of carbon pricing policies that simultaneously create jobs, maintain competitiveness, encourage innovation, and support meaningful mitigation.²⁴ The coalition's membership, which includes 74 countries and over 1,000 companies, speaks to the growing momentum around carbon pricing. Increasing levels of participation can accelerate the progress toward a global market and reduce fears about a carbon price's potential to diminish competitiveness. An international market could dramatically increase the efficiency of climate action, reducing the cost of climate mitigation by 32 percent by 2030 and by more than 50 percent by 2050.²⁵ As carbon prices are implemented, they will need to address concerns about equity and ensure that pricing does not create additional costs for low-income households or unfairly burden different regions.²⁶

Carbon pricing can take many forms, from an explicit price on carbon, through a carbon tax or emissions trading system, to an implicit price on carbon, such as energy efficiency or product standards. Current carbon prices are typically low and account for just a small percentage of the cost that a ton of CO₂ causes.²⁷ Addressing the asymmetry across different carbon prices, and moving carbon prices closer to the true cost of carbon, will be crucial to unlocking their potential to support a 1.5° C pathway.

Pricing strategies could also encourage a more efficient use of water, whose availability is closely tied to climate. Many water-stressed areas, which are especially vulnerable to the impacts of climate change, subsidize water, often for agricultural use. Pricing

water could encourage a shift to drought-resistant crops or more efficient irrigation methods. Any water pricing strategies will need to address concerns about equity and maintain access to safe drinking water. Efforts to implement a price on either water or carbon will also need to draw on a compelling social and business case.

Strategies to more broadly and effectively deploy a price on carbon and/or water include:

- **Tailor carbon pricing policies to unique country circumstances** by aligning them with national climate change policies and the projected development and emissions of the national economy. Ninety countries identified the use of some form of carbon pricing as a means to implement their NDCs.²⁸ The Paris Agreement, and in particular Article 6, could become an avenue for guidance around counting a price on carbon toward the implementation of national climate action plans. Many carbon pricing options aim to support a low-carbon development pathway, but honing these tools to specific national circumstances will require additional work.
- **Implement carbon pricing along with a suite of complementary policies**, such as performance standards for vehicles and buildings, renewable portfolio standards, and fiscal instruments, such as tax exemptions for efficient appliances.
- **Support the implementation of existing carbon pricing policies.** The World Bank's Partnership for Market Readiness, for instance, supports monitoring, reporting and verification, and data collection, and helps establish baselines. The International Carbon Action Partnership and Carbon Pricing Leadership Coalition also build capacity around emissions trading.²⁹
- **Remove fossil fuel subsidies** to prevent the signals of carbon pricing from being drowned out by a competing market force. The current low price of oil could open a window of opportunity for introducing and escalating these reforms.³⁰
- **Ensure that the messaging around carbon and water pricing focuses on opportunities** to make these instruments profitable, foster innovation, and generate new forms employment.
- **Broaden a price on carbon beyond CO₂** to include other greenhouse gases, such as methane.
- **Incorporate carbon pricing into trade agreements.** This could help facilitate the eventual alignment of different carbon pricing programs.

Finance

Maintaining a 1.5° C trajectory will require shifting trillions of dollars toward sustainable infrastructure and diverting capital away from fossil fuels. Deploying sustainable infrastructure, rather than traditional infrastructure, does not need to cost much more but will require a shift in investment strategies.³¹ This transition must occur on a large scale: by 2020, an estimated \$5.7 trillion will need to be invested annually in green infrastructure, with much of this total focused on the developing world. Meeting this goal will require shifting the \$5 trillion in business-as-usual investments toward green investments and generating an additional \$700

billion; currently, approximately \$360 billion is mobilized through public and private climate investments.³² In addition to expanding the overall investment total, the global community must determine which production and investment signals can increase the capital entering emerging markets, to support critical infrastructure and development activities, within the next several years.

There are a number of promising places for intervention:

- **Green bonds** can help mobilize capital and may be especially important to enabling cities to meet a large need for new infrastructure. Large asset owners are currently struggling to unlock the capital needed to finance green infrastructure developments. This form of financing can also help ensure that this new infrastructure locks in low-carbon pathways.
- **Securitization** can also mobilize large amounts of capital. This process involves the conversion of an asset into marketable securities (often loans), often for the purpose of raising capital by selling them to other investors. Many companies are beginning to securitize solar loans, and, as the ability to collect financial and risk data grows, the ability to securitize will rise.
- Incorporating more renewable energy benefits into **power-purchase agreements** could help support the broader deployment of clean energy. These agreements could offer a hedge or option on the price of power over the long term.
- **Financial technology** could find ways to incorporate environmental, social, and governance factors into investment decisions. For instance, algorithms that help determine retirement portfolios could incorporate the benefits of clean technologies or reflect the environmental preferences of the account holders.
- Currently, the same **business models** guide the financing of both conventional and renewable energy, though the risks involved in these processes are very different. There is a need and an opportunity to develop business models and financial instruments that more accurately assess and value renewable energy. Most large-scale transformations rely on some degree of government support as the most effective business model is determined.
- The activities of **export credit agencies**, which provide government-backed loans, guarantees, and insurance to exporting agencies, have mostly fallen under the radar. Engaging with the Berne Union, a union of export credit agencies, could identify ways to make export credit agencies' finance activities consistent with the goals of the Paris Agreement.
- **Innovation funds**, modeled after those that support innovation and entrepreneurship in California's Silicon Valley, could help build social and financial capital to support the shift toward a decarbonized economy.

A number of strategies for shifting the trillions of dollars have promising foundations but could be catalyzed to effect more ambitious and rapid change:

- Despite broad agreement on the need for **phasing out fossil fuel subsidies**, there has been little progress in moving forward with these reforms. In 2014, global fossil

fuel subsidies and tax breaks amounted to approximately \$550 billion. In the past three years, 40 countries and more than 20 cities have begun or accelerated subsidy reforms, and in May 2016, G-7 leaders committed to eliminating inefficient subsidies by 2025.³³ Supporting the implementation of this commitment, and encouraging the G-20 and other countries to adopt similar targets, will be critical to the success of carbon pricing policies. Enhancing or requiring the full disclosure of fossil fuel subsidies—for instance, through the World Trade Organization—could serve as a first step toward their eventual removal.

- Enhancing or requiring the **disclosure of climate risks** across the entire finance system could shift funds away from fossil fuels and toward climate-friendly infrastructure. The Financial Stability Board Task Force on Climate-Related Financial Disclosures “is developing voluntary, consistent climate-related financial disclosures for use by companies in providing information to lenders, insurers, investors and other stakeholders.”³⁴ These findings could be leveraged to create a coalition of investors, banks, and finance ministries prepared to lead the implementation of these recommendations and introduce environmental “red lines” that new entrepreneurs or enterprises cannot cross.
- **Blending public and private capital** can help mobilize investment in developing countries, build domestic financial capacity, and transform critical sectors. In El Salvador, for instance, the national government collaborated with international development banks to shape renewable energy policies and launch a renewable energy auction. During the first auction, only projects with concessional funding from development banks were bid on. However, once these projects were proven, their example helped mobilize finance from the private sector. Similar stories echo the catalyzing role private-public partnerships can have in unlocking finance to address climate change.
- **Unlocking finance mechanisms in cities** can help scale up the climate action leadership that is already occurring there. While some municipalities have begun to act, many are still waiting to move from pilot projects to a broader adoption of climate action projects and policies. Finance mechanisms that support climate initiatives can make them more politically palatable. Tools that support the valuation of cobenefits, such as cleaner air and water and improved quality of life, would also strengthen the ability to make the financial case for climate action.
- **Mobilizing demand for emissions credits prior to 2020** could help ensure that the low-hanging fruit available through the Clean Development Mechanism and other market mechanisms does not rot.
- **Diversifying portfolios to invest in a wide range of technology.** Guidelines for investment should avoid choosing winners and losers but can offer principles for assessing investments, such as their compatibility with the 1.5° C trajectory, their cobenefits, and the extent to which the activities are themselves resilient to and unlikely to be undone by climate change. Efforts to diversify the clean technologies represented in investment portfolios could borrow from a strategy employed by the US Food and Drug Administration, which expedites the review of medications for neglected disease to help drive innovation.

Trade policy and climate policy are deeply intertwined. Effective trade policies can help incentivize and reinforce countries' climate actions, deploying the goods and services to support a decarbonized economy at the lowest cost and greatest scale. Leveraging trade to support climate goals will involve removing obstacles to and encouraging the broader deployment of key technologies and services. These policies will need to drive climate action forward without choosing winners and losers or discriminating between different solutions.

Key priorities for harnessing trade's potential to achieve a 1.5° C pathway include:

- **Remove trade barriers** that increase the costs of renewable energy and other clean technology. Some progress on tariffs may be forthcoming in an agreement negotiated by 17 members of the World Trade Organization, but more discussion and progress is needed around liberalizing access to services; developing common standards; harmonizing testing certifications and requirements; and addressing the increase in the use of trade remedies, which increase the costs and lower the appetite for investment in renewable energy.
- **Address the carbon embedded in trade** by improving methodologies for measuring this, as well as developing tools that enable countries to easily distinguish between products with different levels of carbon.
- **Develop subsidies to support clean energy.** In 2014, global renewable subsidies totaled \$135 billion, a sum insufficient to combat the \$550 billion spent on fossil fuel subsidies and tax breaks in the same year.³⁵ Achieving a 1.5° C pathway will require reversing this trend.
- **Leverage trade agreements** by incorporating explicit or implicit carbon pricing and fostering access to environmental goods and services.

Mimic or Enhance Biological and Geological Sinks

A diverse array of strategies mimic or enhance biological or geological carbon sinks by amplifying natural aspects of the carbon cycle, capturing and storing carbon from biofuels, or removing carbon directly from the air. Key strategies for enhancing biological and geological sinks include:

- CCS.
- Bioenergy with CCS.
- Direct air capture.
- Enhanced weathering.
- Afforestation and reforestation.
- Soil carbon storage.
- Biochar.
- Ocean sequestration.

Although the extent of these technologies' contributions to mitigation efforts remains uncertain, most climate models assume they will enter into force beginning in 2040. Strategies to absorb and store carbon will need to complement, rather than replace, other efforts to mitigate climate change but could still potentially be deployed at a scale large enough to rival the current extent of the fossil fuel industry. Understanding the ethical, research, policy, and technical questions around these strategies will be vital to guiding their implementation.

Many of these technologies are at early stages of development. Additional research around their respective costs, energy requirements, water and land use, and social and environmental impacts will be necessary to guide their implementation. It will also be necessary to better understand their mitigation potential. Models that incorporate these technologies rely on a broad range of assumptions, and pre-2040 activities should strive to reduce the reliance on efforts to mimic or enhance biological and geological sinks as much as possible. Researchers should identify the conditions under which the general public will accept or resist different technologies,

and the broader climate community should ensure these insights inform the design and implementation of specific projects. For instance, CCS involves finding ways to store carbon, which may remind some audiences of the risks associated with sequestering nuclear waste.

Turning Biological Land Use From an Emissions Source to Sink

Unlike many other techniques to mimic or enhance biological or geological carbon sinks, many land-use interventions are already under way. Implementing these interventions successfully could provide 15 to 35 percent of the mitigation needed to move the world toward a 2° C warming pathway by 2030.³⁶ Capturing this mitigation potential and transforming land use from a net source to a net sink of greenhouse gas emissions will require protecting existing sinks and introducing management practices that reduce emissions from current emissions sources.

These efforts can draw on lessons learned from existing strategies for building cooperation around land-use decisions. It will be crucial to identify models that make different strategies acceptable to decision makers and local stakeholders. For instance, many cities and regions already support afforestation and soil amendment initiatives to capture cobenefits in watershed protection and the support of agricultural production. In China's Loess Plateau, restoring 640,000 square kilometers of land lifted more than 2.5 million people out of poverty.³⁷ New climate action could take advantage of similar synergies in land use, sustainable development, and mitigation by identifying the strategies that provide the highest levels of carbon capture while supporting other priorities of cities, states, and local communities. The instruments outlined in Articles 5 and 6.8 in the Paris Agreement could help frame cooperation around these discussions.

Next Steps: Looking Toward 2018

A number of key events coalesce in 2018, creating a key political moment that could help maintain and build momentum toward pursuing a 1.5° C pathway. Efforts to define and work toward the ideal policy and communication outcomes from these events will need to begin now.

Some of the key milestones in 2018 include:

- The **Facilitative Dialogue**, where countries will collectively assess their progress toward the Paris Agreement's goals of bending the curve of emissions and achieving net-zero emissions. The dialogue will inform countries' efforts to either submit new or to update existing NDCs.
- A **summit of nonstate actors**, where cities, regions, companies, investors, and civil society organizations will convene to assess their climate-action contributions. Nonstate actors will use the summit to aggregate the total effect of their commitments to the goals of the Paris Agreement and estimate the impacts of their efforts in 2025, 2030, and 2050. Participants will also be encouraged to redouble their commitments and estimate the projected impact that these new, scaled-up climate actions make to global goals.
- The release of the **Intergovernmental Panel on Climate Change (IPCC) special report** on the impacts of global warming of 1.5° C above preindustrial levels and related global greenhouse gas emission pathways.
- **Other high-level forums**, which could reinforce specific goals and conversations. In 2017, the G-7 Forum in Italy and the G-20 Summit in Germany create opportunities to raise the profile of and harmonize conversations around key climate action priorities, such as the removal of fossil fuel subsidies. **Canada's leadership of the G-7 in 2018** could offer an especially powerful opportunity to highlight and harmonize the conversation around sustainable infrastructure, and the **2017 High-level Political Forum on Sustainable Development** could build the connection between the sustainable development and climate agendas.

A number of communications challenges and opportunities surround the 2018 moment. Over the next few years, the climate community's overarching goal will be to ensure that the political space to constrain warming within ambitious thresholds stays open. Communication efforts will also need to broaden and emphasize that peace, prosperity, and security depend on an ambitious pathway to limit global temperature rise. Specific outreach goals and strategies include:

- **Support country-specific analyses and dialogues about the delivery and ambition of NDCs.** The Facilitative Dialogue will only be as useful as the preparation that occurs in the year leading up to it. Domestic pressure and multistakeholder conversations made it possible for countries to submit their intended NDCs ahead of Paris Climate Conference and will continue to be crucial to the implementation and revision of these plans. Countries' creation of their long-term decarbonization strategies could also create a window for expanding multistakeholder consultation into national decision-making processes.
- **Support and amplify the contributions of subnational and nonstate actors.** The summit of nonstate actors will demonstrate interventions that national governments can support or amplify in order to reach their targets and enable nonstate actors to communicate the national policy reforms that would help them move faster and farther. Other gatherings of nonstate actors, such as the June 2018 ICLEI World Congress in Montreal, can help further support efforts to coordinate reporting and drive up national ambition.
- **Prepare a "landing strip" of research and communications to contextualize the findings of the IPCC special report.** Researchers should be encouraged to finalize and publish any relevant literature, particularly studies that speak to the impact of NDCs; assess the likely regional impacts of temperature rise; and provide practical information on adaptation. Communication efforts should also maintain sight of the opportunities associated with more-ambitious climate action. IPCC chapters often separate discussions of the costs and opportunities around mitigation. Communication efforts should integrate this information to highlight the benefits of action and the costs of a slower response to climate change. This report, as well as the IPCC's Sixth Assessment Report, which is scheduled to be released in 2022, can help foster a discussion about the difference in impacts at different levels of global temperature rise.
- **Contextualize the findings of climate assessment models.** Models often exclude considerations of lifestyle changes, political will, and the nonlinearities in the climate system, which could play a large role in informing potential pathways to a 1.5° C trajectory.

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