THE DEEP DECARBONIZATION PATHWAYS PROJECT

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OVERVIEW

The purpose of this case study is to show how the design framework of the 2013–15 Deep Decarbonization Pathways Project (DDPP) (Bataille et al. 2016a; Bataille et al. 2016b; IDDRI/UNSDSN n.d.; Argyriou et al. 2016; Sachs et al. 2016), inspired by principles emerging from the analysis of different low emission scenarios in the context of the French Debate on Energy Transition (2012–14) and influenced by deep emissions reduction work from California (Williams et al. 2012), can be useful for the design of low emissions development strategies consistent with global cumulative emissions targets at the global, national, regional, city, and sectoral levels.

In the years leading up to the COP 21 Paris Agreement, a number of global studies showed how global temperature rise might be limited to +2°C from pre-industrial levels (Moss et al. 2010). These studies included the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (Edenhofer et al. 2014) and the annual International Energy Agency (IEA 2015) 2DS series of annual scenarios.[1] These studies, however, provided insufficient granularity at the national level and were almost solely focused on emissions mitigation. They provided little guidance for target setting and policy formation in the context of real countries with competing development goals, including, among others, growth, energy security, and poverty alleviation. The DDPP was therefore purposefully patterned on the voluntary, nationally based, bottom-up post-2009 Copenhagen approach that led to the Paris Agreement. It was an exercise in creating an additive, long-run global low emissions development pathway from discrete national studies that represented national circumstances, including a country's development priorities, institutions, economic structure, political situation, endowment in renewable energy and other key resources, and many other factors. The specific purpose of the DDPP was to inform short-term domestic policy at the national level by providing a long-term trajectory backcasted from sectoral and national 2050 targets consistent with the long-run cumulative global emissions trajectory.

This case study is structured as follows. The next section provides an overview of the DDPP process as related to the organizing institutions, country teams, their scenarios, and the global results and lessons that resulted. A following shorter section describes how the lessons learned from the DDPP can be used for national technical and policy Deep Decarbonization Pathway (DDP) processes.

CONTENTS

1. THE DEEP DECARBONIZATION PATHWAYS PROJECT (DDPP)

1.1 Overview and context of the DDPP

Global net-zero emissions will be necessary by 2050–80 if we are to limit average warming to the range of +1.5–2°C relative to pre-industrial temperatures (Edenhofer et al. 2014; Fuss et al. 2014; Rogelj et al. 2015a; Peters et al. 2017; Millar et al. 2017). This will require a complete transformation of every country's energy supply and demand, agriculture, and land-use systems, with profound effects on associated stakeholders (various levels of government, indigenous peoples' organizations, businesses, labor unions, farming associations, households, nongovernmental organizations [NGOs], etc.). It is unreasonable to expect a net-zero emissions strategy to survive any country's political process unless several conditions have been met for all affected stakeholders:

1. Have key stakeholders been educated about and, in the main, convinced of the necessity of the deep target?
2. Have they been canvassed for their opinions and effective inputs on different technical and policy options for their sector and the economy as a whole?
3. Have these options been translated into transparent, quantitatively consistent, and comparable cost and effectiveness estimates? Are key path dependent choices and consequences highlighted?
4. Given the necessary mitigation options, have policies and policy packages been offered with reasonable evidence of their effectiveness in implementing the options?
5. Have the stakeholders had a chance to review and critique the outcome of 3 and 4 above?

One approach to the process described above was used for the global Deep Decarbonization Pathways Project, the first phase of which ran from 2013 to 2015 to inform the Twenty-First Conference of the Parties (COP 21) and the Paris Agreement then being negotiated (Bataille et al. 2016a; Argyriou et al. 2016; Sachs et al. 2016; Bataille et al. 2016b). The country-level pathways proposed in the DDPP were for the final purpose of informing short-run national transformations compatible with ambitious long-term climate goals. In other words, a key purpose of the DDPP was to show that deep decarbonization by 2050 and beyond was possible from a national viewpoint contingent on earlier action, and what the national and global enabling

conditions might be. A related key objective was to demonstrate the value of midcentury strategies to inform the identification of national commitments that were consistent with both the global climate goal and national socioeconomic priorities.

The quantitative goals of the DDPP, grounded in the post-Copenhagen, pre-Paris context, were based on a 50 percent chance of meeting the 2°C target, with the IPCC AR5 and the IEA 2DS scenarios being used for guidance (see Table SPM.1 of the Summary for Policy Makers in Edenhofer et al. 2014). The "well below 2°C" target agreed to in Paris is a more stringent objective (Rogelj et al. 2018; Rogelj et al. 2015a) but could be accommodated using tighter benchmarks (see next paragraph) and wider emissions coverage (e.g., land use) in future DDP exercises (see Subsection 1.4).

Local research teams from 16 countries[2] were recruited, with widely varying modeling capabilities and initial mindsets regarding domestic emissions reduction potential. The modeling teams were given the collective goal of keeping cumulative emissions under the IEA's 2014 2DS "50% chance of 2°C" carbon budget. Each of the teams was asked to produce several long-term physical and economic maps to a 2°C future by backcasting from characteristics of the 2050 emissions goal. The teams were free to establish their own scenarios consistent with the 2°C target, but they were given guidance on the availability of key low emissions technologies (e.g., wind and solar generation, carbon capture and storage, net-zero buildings, nonfoodstuff biofuels, vehicle and grid battery storage) based on global research and development and commercialization efforts. They were also given a nonbinding benchmark of 1.7 metric tons CO_2e per capita in 2050.[3] In the end, some country teams came in above and some below the benchmark. To check whether the level of cumulative global ambition achieved by the individual country pathways was consistent with the 2°C carbon budget, the pathways were aggregated using the DDPP common reporting template. Please see the DDPP synthesis report for details (Deep Decarbonization Pathways Project 2015).

The common reporting template, referred to as a "dashboard," was also used to describe the type and scale of sectoral changes and measure the physical investment in key technologies, equipment, and infrastructure. These were used in the global synthesis report to derive global conclusions. As part of the final country reports, the teams were also asked to write up technical and possible policy scenario storylines to describe what happened in the scenarios in their jurisdiction. The teams then conducted varying levels of outreach in their home countries (see Subsection 1.3).

The collective teams' modeling results and storylines iteratively evolved through learning from each other and from the collective results, until interim and final sets of results were published in September 2014 and December 2015 prior to Paris. The country team reports became part of their (widely varying) national climate policy conversations and were influential in the policy processes of several countries (Subsection 1.3) (Argyriou et al. 2016). The DDPP reports and outreach by the Institut du développement durable et des relations internationales (Institute for Sustainable Development and International Relations, IDDRI) and the Sustainable Development Solutions Network (SDSN) were also instrumental in showing that long-term strategies can be a vital complement to the nationally determined contributions. Partly as a result of this advocacy (one of the primary negotiators of the Paris Agreement, Laurence Tubiana, was previously the head of IDDRI), country parties are invited to "formulate and communicate long-term low GHG emission development strategies" (Art. 4.19), to be filed with the United Nations Framework Convention on Climate Change (UNFCCC). These have since come to be known in some contexts as "midcentury strategies."

1.2 Institutional structure, governance, and funding of the DDPP

The DDPP process, coordinated by IDDRI and the SDSN, was designed from the outset to reflect key principles eventually incorporated in the voluntary, nationally based, bottom-up Paris Agreement. Prior to 2014, IDDRI was involved in a large, multistakeholder French national debate on climate policy, and the SDSN was inspired by work on deep emissions reductions done by and for the state of California (Williams et al. 2012). The two institutions wanted to combine these experiences and insights at the global level in the lead-up to COP 21. The two institutions jointly ran the process, trading management as appropriate to the time and task. Overall funding for collective activities in the project (secretariat, workshops, outreach) and to subsidize the participation of some country research teams, notably from developing countries, was largely provided by the Children's Investment Fund for the Future and internal funds of the SDSN and IDDRI, but most of the developed country teams were self-funded except for travel to DDPP meetings. Modeling teams from 16 separate countries were recruited based on their capacity to explore deep decarbonization, with widely varying modeling capabilities. While some worked with government, the teams chosen were deliberately not typically part of a UNFCCC negotiating team (had they been, they would have likely simply reverted to their official negotiating positions). While some teams

were involved with negotiations,[4] they deliberately kept these activities separate from the DDPP process to allow for enhanced ambition in the project.

1.3 Country examples of the influence of the DDPP

Given that the findings of the DDPP were meant to be published before COP 21 to influence the negotiations, the DDPP was intended to stretch technology and policy imaginations in the target countries, and to make stakeholder groups aware of the stringent nature of the 2°C challenge. To varying extents in different countries, it has succeeded in this aim (Argyriou et al. 2016). For many if not most of the DDPP countries, this was the first full study broad and stringent enough to be called 2°C compliant. As such, it went beyond what had been the normal scope of debate.

The U.S. DDPP report (Williams et al. 2014), prepared by Energy and Environmental Economics (E3), Lawrence Berkeley National Laboratory, and Pacific Northwest National Laboratory, pushed the U.S. conversation on climate policy from incremental emissions reductions to wholesale transformation of the energy system to eventual elimination of greenhouse gas (GHG) emissions and was highly influential in the formulation of the U.S. Mid-Century Strategy (White House 2016, 1–111) under the Obama administration. This momentum has continued at the state level, where much of the implementation power resides, and DDPs have played an explicit role in policy discussions and policy formation in the states of California, Washington, Oregon, New York, and the region of New England. DDPs have been developed by a number of prominent NGOs, business organizations, and electric utilities, which also play an important role in U.S. policy.

The UK DDPP report (Pye et al. 2015) team (University College London Energy Institute) developed the integrated energy models used by the UK government and the UK Committee on Climate Change (CCC) for the analysis underpinning the UK Climate Change Act 2008, which legislated for a long-term 2050 target. It was used in subsequent analyses in 2012 and 2016 for the interim targets for the period between now and 2050. The UK debate and the team's role in it meant that the United Kingdom was perhaps in the most advanced position heading into the DDPP process. The UK DDPP report (Pye et al. 2015) and subsequent work by the same team (Pye et al. 2017) helped orient the debate on the need for a net-zero emissions target, the adoption of which has been agreed but with no concrete decision at the time of this writing. The CCC will provide new guidance on this in 2019.

The University of Cape Town Energy Research Centre team that produced the South African DDPP report (Altieri et al. 2015; Altieri et al. 2016) has been involved in the country's domestic climate policy debate since the early 2000s. The team's work on long-term mitigation strategies, beginning in 2005–7 and continuing to the present, has been instrumental in both the long-term Peak, Plateau, and Decline emissions pathway and framework policy, the foundation of South Africa's approach to climate change, and the recent decision to apply a carbon tax in South Africa starting in 2019.

The Australian DDPP report (Denis et al. 2014), led by Climateworks Australia and the Australian National University and subsequent efforts by Climateworks Australia (Argyriou et al. 2016), succeeded in shifting the parameters of the Australian debate on long-term emissions trajectories, and enabled the translation of the evidence base for net-zero emissions into strategies and outcomes for government and business. It did this by providing a transparent, structured, and solutions-focused identification of actions toward low carbon transformation. This was instrumental in the adoption of net-zero 2050 targets by the states of Victoria, South Australia, New South Wales, and Queensland, and the Australian Capital Territory.

The Canadian DDPP report (Bataille et al. 2015; Bataille et al. 2018), by Carbon Management Canada and members of Navius Research Ltd.,[5] brought the concept of near full decarbonization from hazy science fiction to a public space where the technical, economic, and policy means could be fairly debated. It was the first study developed by domestic experts that brought concrete insights able to inform the design of domestic policy packages compatible with ambitious climate goals like the one introduced by the Paris Agreement, and was highly influential on the Canadian Mid-Century Strategy filed with the UNFCCC (ECCC 2016). The Canadian DDPP policy package was included in a submission (Bataille et al. 2015) to the 2015 Alberta climate policy process and cited in its deliberations (Leach et al. 2015). This supported the development of recognizably similar policy in Alberta, and the overall structure of the policy package has also helped inform carbon pricing policy at the Canadian federal level, as part of the Pan-Canadian Framework on Clean Growth and Climate (ECCC 2017).

In France, from where the DDPP pathways design framework emerged in an early form, the DDPP team (Économie du développement durable et de l'énergie [Economics of Sustainable Development and Energy] at the University of Grenoble and the Centre international de recherche sur l'environnement et le développement [International Center for Research on the Environment and Development, CIRED])[6] used its DDPP study (Criqui et al. 2015) to explore the major uncertainties and trade-offs in the decarbonization process, specifically with respect to adaptive management to accommodate uncertainty and prevent emissions lock-in (Mathy 2016). The DDPP team particularly explored the role of residential and commercial building stock efficiency in supporting decarbonization under multiple energy supply futures. Its analysis appeared in key accompanying documents to French legislative processes on the energy transition (Argyriou et al. 2016).

Stakeholder engagement varied widely between teams. While all would have briefed their governments at some point, there were varying levels of engagement with domestic stakeholders, from wide, formal processes such as those carried out by France, the United Kingdom (through the UK Committee on Climate Change), some Australian states, the Canadian province of Alberta in 2015 (Argyriou et al. 2016), Environment and Climate Change Canada (ECCC) in 2016, and Natural Resources Canada (i.e., the "Generation Energy" process) in 2017, to processes treated solely as academic exercises.

1.4 The future of the DDPP

The 2013–15 round of the DDPP was based on a "50% chance of 2°C" scenario, similar to the goal of the IEA 2014 2DS. The Paris Agreement is based on a more ambitious target: 66 percent chance of 2°C or 1.5°C. To accommodate the Paris Agreement, the DDPP would need to be rerun from this perspective with tighter long-term benchmarks and addition of land-use emissions. Attempts to find the resources to fund a 1.5°C version of the DDPP were unsuccessful. Arguably, part of the difficulty was discomfort with the negative emissions technologies that underlay most of the global IAM 1.5°C scenarios (perhaps less so now given advancing knowledge), and few global studies had yet been done that do not use negative emissions (van Vuuren et al. 2018; Grubler et al. 2018).

Africa and Latin America, except for South Africa and Brazil, were not included in the first DDPP. Some studies have already been conducted for Latin America (Grottera et al. 2015; La Rovere et al. 2013a; La Rovere et al. 2013b; Zevallos et al. 2014; Delgado et al. 2014; Sanhueza and Ladrón de Guevara 2013). A six-country Latin American DDPP, funded by the Inter-American Development Bank, is now in progress, and discussions are ongoing about an African study, with an as-yet-unknown number of participating countries.

Beyond GHG emissions and climate change, however, low emissions development strategies are about coplanning to meet not just climate goals but also socioeconomic goals like those with respect to income, welfare, air quality, and education. To deepen incorporation of these development objectives, new analytical tools and benchmarks are required to allow the translation from an "energy supply and demand" point of view to a broader perspective on low emissions development for all countries, for example, one based on the Sustainable Development Goals. The South African (Altieri et al. 2015) and Indian DDPP reports (Shukla et al. 2015), which used explicit development indicators as well as emissions indicators, provide examples of how this may evolve.

2. LESSONS FROM THE DDPP FOR NATIONAL DDP PROCESSES

Ideally, each city, region, state or province, and country would eventually have some sort of iterative stakeholder education, input, and review process to arrive at a politically robust policy package to engage in a net-zero emissions transition. The stakeholders would include all sectors of the economy and society required to implement the plan, those affected, and those with the power to implement, support, or block the process. National Deep Decarbonization Pathway stakeholders would include national, regional, and city governments working with indigenous peoples' organizations, sector associations, businesses, energy utilities, labor unions, experts, civic groups, and NGOs. In this section I extrapolate how the lessons learned from the DDPP can be used for sectoral, regional, and national technical and policy DDP processes.

2.1 An inclusive, rigorous, and jurisdictionally appropriate stakeholder process is required

The DDPP design framework provides organizing principles for the definition of the national long-term strategies specified in the Paris Agreement. It is not a methodology to be owned and run by a specific institution or government. It is rather an approach, applied at the appropriate jurisdictional level for a given objective, to support a shared process for strategy, scenario, and pathways design among diverse groups of stakeholders to inform policy formation across multiple objectives, whether related to energy or not (objectives related to climate, development, access to modern energy sources, air quality, etc.), which is ultimately the responsibility of governments. It provides a structure for national governments to conduct consultations with stakeholders to educate them, solicit their input, and identify mitigation measures and implementation policy packages. This pathway design framework could also be used by nonstate actors such as businesses and sectoral associations, regional and city governments, NGOs, or international bodies to define their contribution to the Paris objective. One important channel where this pathway design framework could be mobilized is the 2050 Pathways Platform initiative (2050 Pathways Initiative n.d.), which aims to support nations, regions, and cities seeking to devise long-term, net-zero-GHG, climate-resilient, and sustainable development pathways.

2.2 Basic education is required for all stakeholders

For a net-zero policy package to survive the long-term political process in any country, all key stakeholders must have a basic understanding of climate science and the need for the net-zero objective. Several actions are necessary for this core condition to be met, as well as for stakeholder education with regards to basic mitigation strategies such as energy efficiency, decarbonization of electricity generation, and switching to electricity. First, most countries already have mitigation studies; based on these, short briefing notes in plain language should be prepared by an appropriate government institution or trusted NGOs. Second, also based on these existing studies, briefing services should be offered to all stakeholders to bring them up to equivalent basic knowledge. Third, once they have reviewed the briefing documents, stakeholders should be invited to provide input to the national climate policy debate. Stakeholders who can offer a subsectoral, sectoral, or economy-wide strategy and evidence for how to meet the national net-zero emissions goal should be invited to submit this for formal consideration and consolidation alongside all other offered strategies.

2.3 The stakeholder process is an opportunity for alignment of stakeholder languages, bridging of understanding of concepts, and iteration of visions

The DDPP pathways design framework provides a concrete method for enabling a constructive dialogue among stakeholders and decision-makers on system-wide transitions (Rosenbloom 2017; Turnheim et al. 2015; Geels et al. 2016; Cherp et al. 2018), based on alignment of conceptual languages, bridging of understanding of key ideas, and iteration of alternative visions until a working majority is achieved among stakeholders and decision-makers.

To begin, stakeholders would offer their initial strategies to achieve overall goals. Once translated into a common language as expressed by the dashboard data and drivers, these stakeholders' visions could serve the purposes of conceptual alignment and bridging of understanding. They would then be quantified and additively checked through modeling and the dashboard for quantitative and practical consistency with long-term development and climate objectives. The process would be repeated, and strategies adjusted, until one or more working long-term low emissions development pathways and a working political majority were achieved (Fortes et al. 2015).

Building on the last stage, to work toward maximum stakeholder inclusion and buy-in, a concrete first step would be to ask all stakeholders to submit their options for technological and policy options in a common qualitative and quantitative reporting template. All stakeholders and experts would be encouraged to be as quantitative as possible in describing how they believe the net-zero target can be achieved, including providing a technical and policy story for how their proposed sectoral or economy-wide scenario would be achieved. The task of the appropriate level of government is to find commonalities and differences in these options and combine them into a limited set of scenarios in qualitative and quantitative form for review by stakeholders. To provide quantitative rigor, prevent double counting, and assess policy interaction, the combined scenarios would ideally also be simulated by professional modelers familiar with the region using a modeling framework that combines the technological transformational detail with macroeconomic dynamics

to capture the structural change, gross domestic product (GDP), investment, and employment story.[7]

The combined scenario and modeling results would be translated into a simple-to-understand output dashboard for each sector and the entire economy and used for iterative stakeholder education and workshops. Specific care would be needed for those stakeholders most directly affected by decarbonization efforts (e.g., agriculture and large emitters—and their workforces—that compete in global markets). Transparency would be more important than completeness in the results; stakeholders need to be able see themselves in the results and affirm what is being displayed is achievable, and under what circumstances.

2.4 Stakeholder learning and confidence building is the means, not the end, to achieving the necessary goal (e.g., net-zero emissions)

In all the work to educate stakeholders and secure buy-in, the fundamental goal cannot be lost. The process must fundamentally be about turning the stakeholders who must act (e.g., by making million- and billion-dollar investments) toward the necessary overall goal, in this case cumulative global emissions consistent with a 50 percent chance of 2°C in the DDPP, and overall net-zero emissions by later this century. For example, it can be fairly said that the intent of the California process was to drive the energy supply-and-demand stakeholders toward that state's goal of -80 percent by 2050, rather than be driven by them. A major part of this effort was building confidence in the approach within the energy sector itself. One of the more significant aspects of the DDPP's legacy is that the E3 work underpinning the California process came out of the utility and regulatory arenas, which have requirements specific to location and process as well as methodological and legal tests, a very different test for rigor than that applied to global integrated assessment models (IAMs). From the perspective of the DDPP country teams, IDDRI and SDSN, the DDPP was the first successful bridge between the regulatory analysis world and the IPCC/UNFCCC/IAM world, which was generally too vague and distant to affect investment decisions where they are made, at the subnational level. Some NGOs find "policy formation" an adequate end goal, but in the DDPP project team's view, it is not; what is crucial is whether the necessary physical investments actually get made and business and household behavior changes. In California, it can be said that the investments have been made and businesses and households are in the process of adjusting their behavior. The policy was formed after the real decision-makers decided, to a significant extent based on the E3 team's analysis, that they could afford it.

2.5 Key enabling conditions that emerged from the DDPP

Three key global enabling conditions emerged from the DDPP that bear some expansion: technology development and transfer, finance for marginal investment and adaptation, and supporting institutions.

At least one technically plausible technological option for very low or net-zero emissions must be provided for each end-use in each sector to open imaginations. When the DDPP began in 2013, even the "50% chance of 2°C" goal was considered ludicrous in many sectors and by many parties. By providing at least one option for each sector to reduce its emissions, thereby negating the argument that the transition is "impossible" while allowing stakeholders to see themselves in the transition, it spurred the imagination of more options. It also implied the necessary cooperation on technology development and transfer. In the end the specific national pathways and technological details in the DDPP reports are likely to be wrong in the details, but they will have helped trigger the process to find the eventual options.

Technology transfer is as important as technology development in the climate policy context. It will require policy and financing to achieve the balance between, on the one hand, there being enough incentive for innovators and businesses to drive net-zero emissions innovation fast in a risky environment and, on the other, ensuring that the new technologies are available at reasonable cost for all who need them globally.

Finance is critical for adaptation, technology development, capital-constrained countries, and capital-intense sectors. Finance is critical to developing countries, because they are capital-constrained to start with, but the marginal financial requirements for developed countries are small compared to their annual capital turnover. The costs are also very focused on a few key sectors, including, but not limited to, the electricity sector for decarbonization and increasing generation, buildings for retrofit requirements, cities for transit and other infrastructure, and heavy industry for pilot projects. Capital limitations must be considered in the policy package.

Every decarbonization pathway has needs for specific supporting institutions, be they institutions focused on monitoring, labor-force education, research and development funding, or other related efforts. These must also be considered in the implementation policy package.

2.6 Who implements the pathway, and corrects it if it goes off course?

Once a clear mapping of different options and their impacts are derived via a DDP process, a nationally appropriate implementation policy package needs to be assembled by the appropriate level of government. The policy package would recommend implementation instruments (carbon pricing, performance-based or command-and-control regulations as appropriate, etc.), oversight, reporting and progress assessment components, and associated supporting institutions. Key among these would be an arm's-length oversight institution that would conduct a policy effectiveness assessment and prescribe adjustment of individual policies and the overall plan through time. The UK Committee on Climate Change, with its five-year carbon budgets and yearly monitoring, is the current gold standard for governance in this area (Rüdinger et al. 2018).

Finally, key to success of the DDP policy process would be cross-party participation to the extent possible, to prevent backsliding with changes of government. Ultimately, the need for and stringency of climate policy must be depoliticized, and the debate instead focused on the choice of policy instruments to achieve the long-term goal of net-zero emissions (Rogelj et al. 2015b).

ENDNOTES

1. The IEA has since added a sustainable development scenario that explores access to energy and air quality.
2. Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Mexico, Russia, South Africa, the United Kingdom, and the United States.
3. See Deep Decarbonization Pathways Project (2015). Based on the IPCC AR5 SPM (Edenhofer et al. 2014; see Table 6.3 for cumulative emissions budgets) and the 2014 IEA 2DS scenario.
4. Notably, the South African, Indian, and Chinese teams, as well as individuals from other teams, were directly involved in the Paris Agreement UNFCCC negotiations.
5. The author of this case study was previously executive director of Navius Research Ltd., which he left in 2015 to join IDDRI.
6. CIRED is a joint research unit between the Centre national de la recherche scientifique (National Center for Scientific Research), the École des ponts Paris Tech (Paris Tech School of Bridges), the École des hautes études en sciences sociales (School for Advanced Study in Social Sciences), Agro Paris Tech, and the Centre de coopération internationale en recherche agronomique pour le développement (Center for International Cooperation in Agronomic Research for Development).
7. Ideally, a bottom-up optimization or simulation model (which tells the technology story) would be combined with an electricity dispatch model as well as a top-down macroeconometric or computable general equilibrium model (which tells the structural change, GDP, investment, and employment story). The modelers would be tasked with clearly documenting what they could and could not capture in their modeling from the stakeholder surveys, to be saved for future modeling developments and documentation.

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ABOUT THE LONG-TERM STRATEGIES PROJECT

World Resources Institute and the United Nations Development Programme, working closely with UN Climate Change, are developing a set of resources to help policymakers integrate long-term climate strategies into national policy making.

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This project contributes to the 2050 Pathways Platform and is undertaken in collaboration with the NDC Partnership.

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This vision and direction of the project is guided by the project's advisory committee: Monica Araya, Richard Baron, Ron Benioff, Pankaj Bhatia (co-chair), Yamil Bonduki, Rob Bradley, Carter Brandon, Hakima El Haite, Claudio Forner, Stephen Gold (co-chair), Emmanuel Guerin, Ingrid-Gabriela Hoven, Dr. Martin Kipping, Carlos Nobre, Siddharth Pathak, Samantha Smith, Marta Torres Gunfaus, Laurence Tubiana, and Pablo Vieira.

For more information about the project, and to view the expanding set of resources, visit www.longtermstrategies.org.