Pathways to Deep Decarbonization, a Problem Solving Approach for a 2℃ Society

By the SDSN/IDDRI Deep Decarbonization Pathways Project Team
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Introduction

The Fifth Assessment Report (AR5) from the Intergovernmental Panel on Climate Change (IPCC) [IPCC, 2013 & 2014] underscores the dangers to human well-being of a business-as-usual scenario where average global temperatures rise by 4°C or more. Governments around the world have adopted the target of keeping the global rise in mean surface temperature below 2°C compared with the pre-industrial average [UNFCCC, 2010]. This target translates into a limitation on global cumulative emissions of approximately 1,000 $GtCO_2$ during the transition to a net-zero emission economy. Yet, current voluntary pledges – even if fully implemented – fall short of what is needed. According to the UNEP Emission Gap Report, existing commitments to reduce emissions are 8 to 10 GtCO2e below the minimum needed in 2020 to retain a 66% chance of staying within 2°C [UNEP, 2014].

As a benchmark for the transition to be implemented, global per capita emissions will need to fall to less than 2 tCO_2e by 2050, where developed nations currently range from approximately 10 to 20 tCO_2e per capita today [DDPP, 2014]. Realizing such a reduction in emissions requires unprecedented problem solving on all fronts: technological diffusion and innovation, infrastructure building, financing mechanisms, policy frameworks, institutional arrangements, business models, and consumer behavior. This problem solving is best organized around coherent visions of the required transformation, which take the form of deep decarbonization pathways (DDPs) to 2050.

To make a strong and convincing case for action at the national level, DDPs must be country-specific and developed by local experts. They need to fit within countries' development strategies and align with their socioeconomic and environmental goals. They need to demonstrate that the short- and long-term challenges countries face, such as economic development, poverty eradication and job creation can be addressed in parallel to deep decarbonization. However, few countries have created such pathways. The Deep Decarbonization Pathways Project (DDPP) offers an approach to develop such analysis.

Overview of the Deep Decarbonization Pathways Project

An initiative of the Sustainable Development Solutions Network (SDSN) and the Institute for Sustainable Development and International Relations (IDDRI), the DDPP seeks to understand and show how individual countries can transition to a low-carbon economy and how the world can honor the 2°C limit.

The approach of the DDPP is to have country research teams develop national-scale pathway analysis for deep decarbonization by 2050, consistent with the 2°C limit and development objectives. Currently, the DDPP comprises 15 Country Research Teams composed of leading researchers and research institutions from countries representing 70% of global GHG emissions and at very different stages of development: Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Japan, Mexico, Russia, South Africa, South Korea, the UK, and the US.

The 15 Country Research Teams have conducted detailed analysis that is summarized in a report describing technically feasible pathways that realize deep reductions in CO_2 emissions in each country [DDPP, 2014]. While national circumstances and

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approaches differ, key insights can be derived from this comprehensive analysis:

- Deep decarbonization is compatible with continued prosperity and realization of development goals as demonstrated by the rise of activity levels in key sectors. The analysis shows potential for significant decoupling of economic growth and carbon emissions, where an 88% reduction in carbon intensity of economic activity is realized on average over the 15 pathways.
- All national energy systems share three common pillars of deep decarbonization.
  (1) Energy efficiency and conservation: Greatly improved energy efficiency in all energy end-use sectors including passenger and goods transportation, through improved vehicle technologies, smart urban design, and optimized value chains; residential and commercial buildings, through improved end-use equipment, architectural design, building practices, and construction materials; and industry, through improved equipment, production processes, material efficiency, and re-use of waste heat.
  (2) Low-carbon electricity: Decarbonization of electricity generation through the replacement of existing fossil-fuel-based generation with renewable energy (e.g. hydro, wind, solar, and geothermal), nuclear power, and/or fossil fuels (coal, gas) with carbon capture and storage.
  (3) Fuel Switching: Switching end-use energy supplies from highly carbon-intensive fossil fuels in transportation, buildings, and industry to lower carbon fuels, including low-carbon electricity, other low-carbon energy carriers synthesized from electricity generation or sustainable biomass, or lower-carbon fossil fuels.
- No silver bullet exists and a combination of options are required for deep decarbonization. While these options depend on existing technology, they require international cooperation in the form of directed technology change to ensure the deployment of low-carbon technology at scale. One of the vehicles for this scale-up would be low-carbon technology public private partnerships (PPPs) to accelerate research, development, demonstration and deployment (RDD&D).
- The timely deployment of required low carbon infrastructure calls for reorientation of investments to ensure continued reductions in emissions and to avoid the risk of lock-in into carbon-intensive patterns.
- Some sectors are more difficult to decarbonize through purely technical solutions, notably the industrial and freight sectors. While improved efficiency, fuel switching and mode shifting offer significant reduction potential, there is a need to explore shifts in economic structure to realize very low emission levels.

Policy implications

At the national level, the country-specific deep decarbonization pathways provide invaluable input into on-going discussions of climate change mitigation options, and bring into clear focus the magnitude of the required changes. The deep decarbonization pathways serve to inform national governments as they prepare their Intended Nationally Determined Contributions, and help to initiate needed discussion of these Contributions is some countries.

The DDPP exercise illustrates the role of deep decarbonization pathway analysis as a framing element for any serious mitigation planning effort. This type of analysis needs to be incorporated into the UNFCCC negotiation process, where the COP21 global agreement would include a commitment by each country to develop and make publicly available a (non-binding) deep decarbonization pathway to 2050. In the context of international negotiations, this would:

- Support the development of ambitious Intended Nationally Determined Contributions (INDCs) for the Paris agreement, notably by serving as a basis for discussions and review of the mitigation pledges;
- Provide long-term vision of the low-carbon transition, putting INDCs in context, and assisting with the evaluation of different components of the near-term proposals; and
- Identify strategic areas for a global technology push.

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