DDP MEXICO

DEEP DECARBONIZATION OF POWER GENERATION IN MEXICO

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The *Deep Decarbonization pathway* (DDP) presented here indicates that Mexico can meet the objectives of the Paris Agreement through profound structural transformations across all economic sectors (See the paper "Deep decarbonization in Mexico").

Electricity generation must lead the way in Mexico's decarbonization, as availability of abundant low-carbon electricity will be key to decarbonize the broader Mexican economy. Generation will have to rapidly transform its technological base while increasing its capacity. This will not come about through incremental adjustments to Mexico's current plans. A different development narrative, which seeks sustainable social and economic development by simultaneously addressing policies, regulation, public prices, and social attitudes, will have to inform national decision making and translate into clear investments – and disinvestments – starting now. This note presents the main system transformations required in the power generation sector to reach a decarbonization pathway, as well as how this differs from current trends and Mexico's climate stated commitments.

DDP

The DDP is an initiative of the Institute for Sustainable Development and International Relations (IDDRI). It aims to demonstrate how countries can transform their economies by 2050 to achieve global net zero emissions and national development priorities, consistently with the Paris Agreement. Analyses are carried out at the national scale, by national research teams. National research teams openly share their methods, modelling tools, data and the results of their analyses to share knowledge between partners in a collaborative manner and to facilitate engagement with sectoral experts and decision-makers.

About this project

The ACT-DDP research project is an international pilot project, which aims at accelerating the implementation of national and sectoral deep decarbonisation through a better dialogue between private companies and governments and for a mutual enrichment of their low-carbon strategies. Through the synergy between two pioneer initiatives, the Assessing low Carbon Transition (ACT) initiative and the Deep Decarbonization Pathways initiative (DDP), the project partners built and tested methodologies and tools for developing national and sectoral deep decarbonisation pathways compatible with the Paris Agreement and assessing company strategies with them.

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KEY FINDINGS

1. Decarbonization of electricity generation is possible, and must occur rapidly to ensure Mexico can reduce its emissions in line with the Paris Agreement goals,

2. This will require focused investments to rapidly roll out renewable generation assets, starting with solar PV and onshore wind, enhancing both utility and distributed applications and business models, like energy as a service, hybrid consumption-production models, integration of communities to the production scheme, etc.

3. Efforts must also be re-directed away from current plans in oil and gas assets and infrastructure, towards electrical transmission to ensure integration across and within regions, including access to renewable sites, as well as eventual inclusion of storage at different levels, to ensure grid stability as renewables rapidly gain share of dispatch (220 TWh stored annually by 2050).

4. System planning must look ahead to map out integrated structural change across the whole energy economy, to enable renewable energy to overtake fossil fuels as leading source of energy by 2040. Important implications for transportation and industry require their own joint analysis so electricity sector solutions enable and benefit from the transformations of those sectors. For example, including electric vehicles (EV) as batteries in the power grid can help balance its load.

A DEEP DECARBONIZATION PATHWAY FOR ELECTRICITY

Deep decarbonization of electricity generation in combination with electrification of energy end uses across sectors are key to decouple the Mexican economy from CO_2 emissions. This pathway (DDP shown below) will require a rapid rollout of renewable generation assets, as well as of greater transmission and energy storage capacity, to rely on renewable energy as the primary energy source of the country by 2040, and while ensuring the grid is reliable as both demand, generation, and intermittency increase rapidly. In contrast, the Current Policy Scenario (CPS) simulates a trajectory through official clean electricity targets set in climate policy documents such as the NDC and the Mid-Century Strategy.

By providing motive power with much less waste heat, electricity can increase efficiencies in many applications. Furthermore, the technologies that can provide zero-GHG energy tend to be electric, so the electrification of sectors that today use combustion will be key and a zero-emission power grid will directly lower the CO_2 footprint of all electricity uses in all sectors.

Mexico's vast renewable resource can provide clean electricity, but it requires a major boost, both in generation capacity (wind and solar especially), as well as in infrastructure for storage, transmission and transformation (to hydrogen, for example). In this regard, reliable power dispatch is possible with the high intermittency of power sources, and without curtailment, by balancing load across the country and storing and transforming surplus electricity.

Figure 1. Installed electricity generation capacity

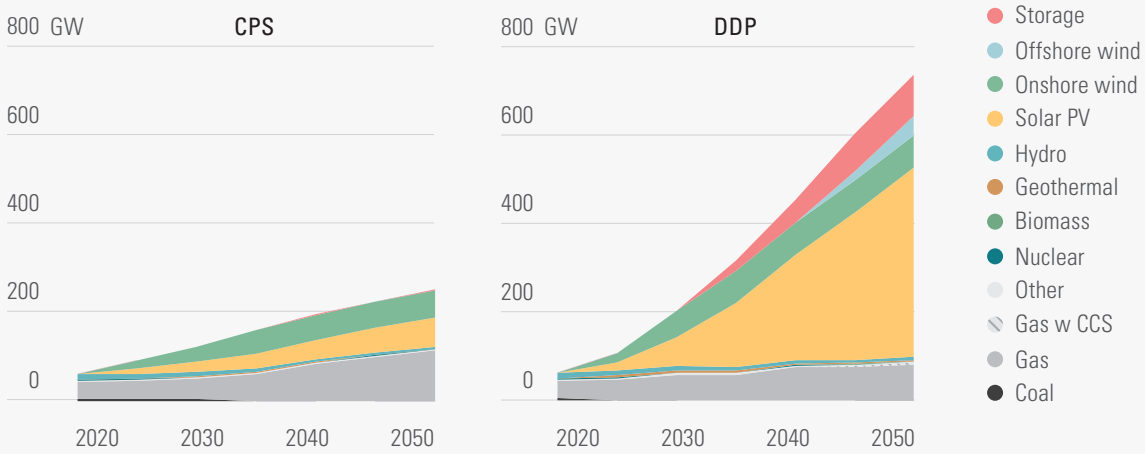
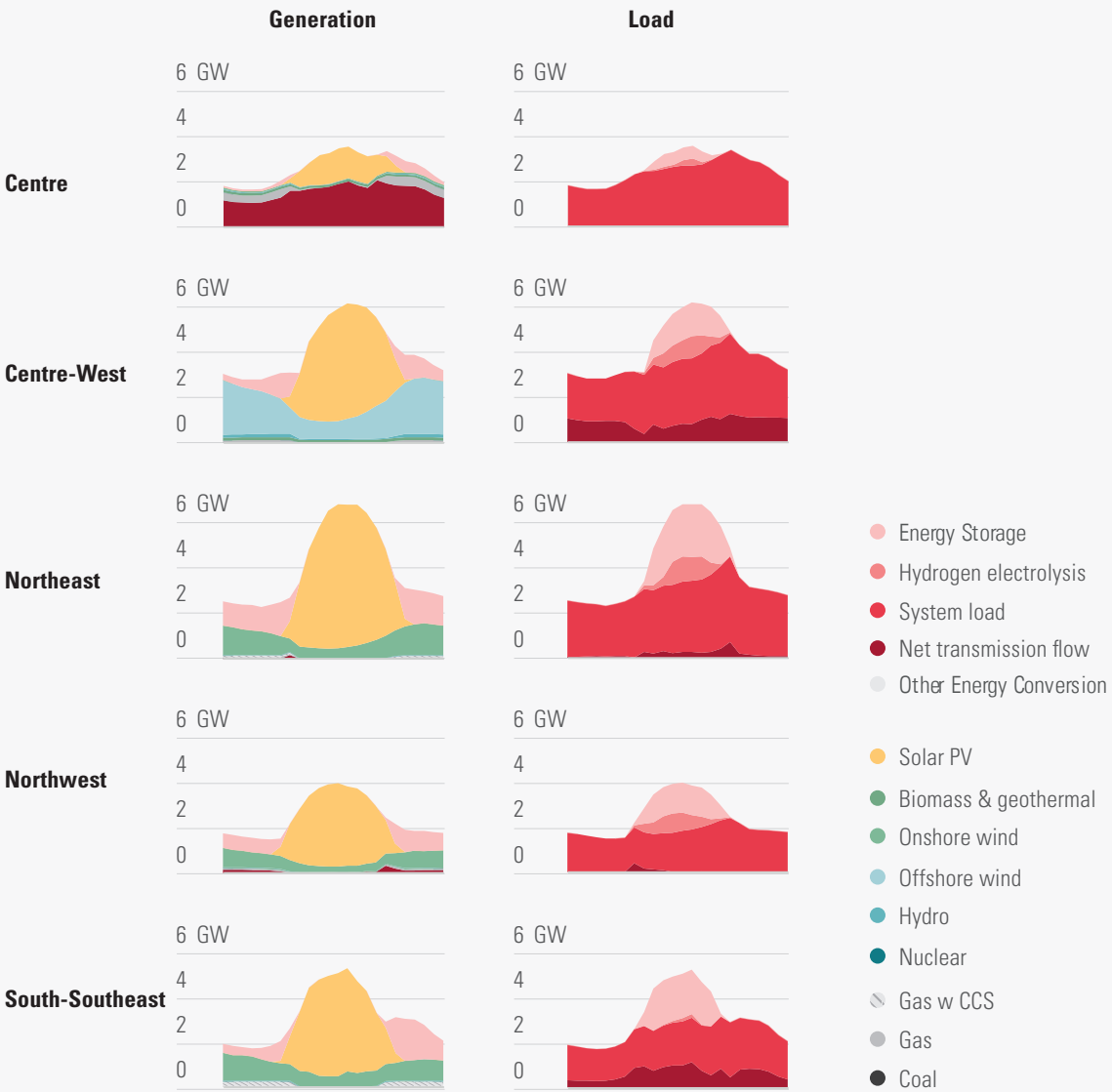


Figure 2. Simulaton of daily regional electricity dispatch under DDP in 2050



CURRENT PATHWAY AND MAIN CHALLENGES

Despite important emissions reductions and a significant sectoral reform over the last decade, electricity generation is one of the highest emitting sectors in Mexico. Historically, the country's electrification was led by state investment through CFE, the state-owned utility. With the exception of local hydropower potential where available, it generally pursued an intense fossil-generation program coupled to the economics of PEMEX, the state-owned oil and gas monopoly, to ensure the financial viability of the energy system as a whole with a vibrant oil economy at its heart. This led to structural effects, including the provision of most energy needs in the industrial, commercial, and residential sectors to be met by fossil fuels (neglecting the solar thermal potential across the country, for example) and a preference for fuel-oil for power generation.

The availability of cheap natural gas from the US shale revolution of the 2000s triggered a switch to this energy source as the fuel of choice for new power generation, leading to a significant reduction of unit emissions from the sector, and underpinning one of Mexico's most significant claims of decarbonization of recent years. However, while switching to natural gas reduces emissions vs a counterfactual, it also locks in emissions – albeit lower ones – from gas and thus it is incompatible with net-zero emissions.

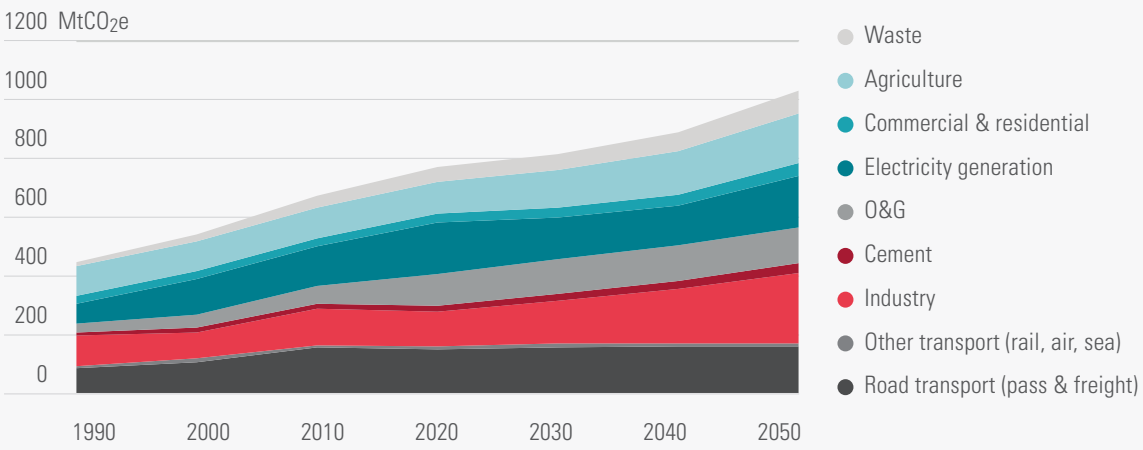
Another important moment in Mexico was the energy reform of 2013-14, which both opened up the market to renewables by enabling renewable capacity auctions and guaranteeing a dispatch order based on price, and establishing an increasing quota of "clean energy certificates (or CEL)" from all power vendors, as a mechanism to ensure increased demand for renewables over time. However, both the initial CEL quota and its projected rate of growth are insufficient to drive a large-scale shift away from fossil generation.

Mexico's climate commitments, stated in its NDC, MCS, and internal policies are for power generation to be 43% "clean"[1] by 2030 and to remain at that ratio, which is a de-facto commitment to 50% fossil generation over the long term. Hence, best-case implementation of sector climate goals is incompatible with decarbonization.

Since 2018, coal and fuel-oil generation has been reactivated in a bid to strengthen PEMEX, undoing any moderate reductions in emissions per kWh of the previous decade of climate policy implementation. Thus, if current trends persist, final energy demand will increase in Mexico and most of it will be provided by fossil fuels. In contrast, the DDP scenario uses zero-carbon electricity to displace most of fossil resources while simultaneously reducing one third the final energy demand vs CPS.

1 This includes renewables, nuclear, and even "efficient combined heat and power and thermoelectric plants with carbon capture and storage".

Figure 3. Annual GHG emissions under CPS



HOW TO KICKSTART DEEP DECARBONIZATION?

1. Decarbonization plans must ensure they can align with, and contribute to, Mexico's economic and social development aspirations. For most sectors this will mean redirecting investment, reducing some activities while increasing others, and generally decoupling natural resource use from economic value-add. In this manner, Mexico's gradual population growth can sustain economic growth and improved productivity and quality of life across the board without a corresponding increase in per-capita energy consumption, while rapidly reducing emissions.

2. The transformations needed to decarbonize the electric grid must begin with an accelerated installation of renewable generation. This must happen at a sufficient rate to meet increasing demand due to electrification in other sectors, while at the same time replacing the use of CCGN and other fossil fuels. This shift to renewable generation must be matched by a redirection away from fossil fuel investments, cancelling planned projects in gas assets (CCGN generators and gas pipelines) and instead building renewable capacity. Further investment across the system must prioritize transmission and storage to access resources, expand the balance area, and address intermittency. Implementing demand management programs and tapping into distributed resources will necessitate investment to upgrade the distribution grid to a "smart" one that can not only accurately measure flows in and out from users, but also coordinate in real time with other elements of the energy cloud (generators, storage or transformation units, etc.).

3. Technology shifts will not succeed without corresponding business shifts. New value propositions and operating models will be needed to quickly integrate distributed resources within a diverse supply and demand landscape – with clear examples in Distributed Generation within the residential sector, and incorporating EV charging and storage to local grids. This innovative vision must also apply to fossil fuel assets, as they are re-assessed based on the role they can play within the transition. This could range from rapid phase down of inefficient fossil generators and higher-cost oil production and processing sites, to shifting modern gas generation assets from a volume-to capacity-market to support grid stability, to the re-configuring of fuel processing plants away from petroleum feedstocks and into the hydrogen-based economy.

4. New policy packages combining alternative instruments (prices, regulation, incentives, service contracts, communication, etc.) can support this shift in investments, exploration of new business models, and engagement with the population towards lasting changes in common practices.

5. Long-term energy planning must adopt a systemic vision to accelerate the transition to zero-carbon electricity by 2050, and to do so while adding value and equality for all society.

OPPORTUNITIES OF THE TRANSITION

The transition of electricity generation in Mexico to a sustainable pathway will present attractive potential opportunities across many economic and social dimensions; and some of them will be of strategic importance to the country. Beyond the reduction in costs stemming from a resource-efficient economy, the structural depth of the transition presents a real opportunity to underpin future development and competitiveness by advancing a domestic high-value and more equitable socioeconomic paradigm.

ECONOMIC GROWTH

- Investment in people, infrastructure and technology increases labor skills and productivity.
- Electrification of the economy based on renewable sources is becoming an irreversible process worldwide, this transformation has a positive net impact on economic growth.

ENERGY SECURITY

- Harvesting energy from a diverse mix of local renewable sources will protect the country from shocks in international commodity prices while ensuring supply for a growing demand.
- Reducing the dependency from imported natural gas will enhance national energy security.

SOCIAL DEVELOPMENT

- Higher investment and public spending present a basis for increasing public services and reducing poverty and inequality.
- Opportunities in new sectors and evolution to a knowledge-based economy stimulate education, labor markets, and create opportunities (green jobs) for more people.

PUBLIC HEALTH

- The reduction in the use of fossil fuels, especially those with high carbon content like coal and RFO, will improve air quality in the country.
- Electrification of homes will reduce natural gas and firewood use, with notable benefits for low-income, exposed population (children and women).