DDP MEXICO

DEEP DECARBONIZATION 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. This note presents the main system transformations required throughout the whole economy to reach a decarbonization pathway, as well as how this differs from current trends and Mexico's climate stated commitments.

All changes required, either technological, behavioral, in business models, or even to create whole new industries and new services, will have to be swift, coherent with the rest of the economy and with the climate targets, and also directed towards solving the most pressing domestic issues (poverty, energy, food and water insecurity, etc.). Success on this endeavor 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.

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. Reaching carbon neutrality in Mexico is feasible. It requires reducing 90% of greenhouse-gas (GHG) emissions by 2050.

2. Given that GHG emissions in the country mostly originate in the use of fossil fuels, an accelerated energy transition away from Oil & Gas (O&G) and towards renewable energy (RE), of which it has plenty resources, is crucial. RE must replace fossil fuels as primary energy source by 2040.

3. Decarbonization of the electricity grid, along with increasing electrification and energy efficiency in all other sectors can jointly reduce 74% of present energy related emissions. Efforts must be re-directed away from current plans in O&G assets and infrastructure, towards the power transmission and distribution network to ensure integration across and within regions. It requires, for example, access to distributed and centralized renewable sites, as well as the inclusion of storage at different levels, to ensure grid stability as renewables rapidly gain share of dispatch (220 TWh will be stored annually by 2050).

4. Cities will host close to 80% of Mexicans in 2050. Changing their structure will not only be necessary to decarbonize the transport sector, the largest single source of emissions in the country, but it can also drive broad socioeconomic development as it promotes a more equitable distribution of services and opportunities.

5. Industry will pursue high-efficiency in energy and resources use, while experimenting with new business models more aligned with circular economy principles, and while also being heavily influenced by the concurrent fossil fuel phasing-out process and the opening of new niches.

6. Agricultural and livestock practices must change as markets also evolve to accommodate and value low-carbon produce and activities. The transformations in land use, food systems and productive schemes have the potential to alleviate endemic rural poverty while simultaneously help restore ecosystems, biodiversity and CO_2 natural sinks.

7. System planning must look ahead to map out integrated structural change across the whole economy, to create synergies between the energy transition, the infrastructure evolution in each sector, and indeed changes beyond the energy economy, such as in land use and food systems.

A FULL-ECONOMY DEEP DECARBONIZATION PATHWAY FOR MEXICO IS POSSIBLE

The pathway presented here achieves deep decarbonization of the full Mexican economy by 2050 by considering interventions at the three main levels of drivers of GHG emissions in all energy-related sectors (buildings, transportation, industry, and energy production): level of activity, energy intensity, and carbon footprint of energy supplied. In the case of non-energy sectors, estimations used a similar decomposition approach using other intensity indicators, such as carbon intensity per capita or per unit of value produced.

Reaching national carbon neutrality is possible but requires a progressive decrease in emissions until achieving a reduction of 90% in 2050 vs 2020, down to 51 $MtCO_2e$ in 2050. This will need important changes in the sectors with largest emissions (electricity generation, transport, and industry), and in the main sink of CO_2 in the country: the AFOLU sector.

A significant increase of energy efficiency and electrification in residences, businesses and industries can displace most fossil fuel demand in these applications, but renewable electricity must be rolled out rapidly to replace fossil fuels as primary energy source by 2040, and to satisfy increased demand due to electrification in other sectors.

Passenger transportation shifts demand, modes and technologies, as cities change to better distribute services and opportunities within them, reducing travel distances. Instead of relying on gasoline vehicles, a rapid deployment of electric vehicles, both in the heavy-duty public and in the light-duty private fleets must happen. The latter should see sales composition of EVs saturate by 2045.

Innovation and low-carbon fuels can guide industrial activity as fossil fuels decline. The contraction in oil production will reflect the rapid reduction in national demand for gasoline and diesel, while opening new markets for zero-carbon fuels, technologies and products.

Agricultural emissions, originating mainly from the use of fertilizers in agriculture and livestock breeding, must be stabilized as forestry absorptions are increased to offset them.

Due to the accelerated energy efficiency gains and technological changes it applies, the DDP scenario (right side of the figure above) reduces final energy demand by a third compared to the Current Policy Scenario (CPS, left side of the same figure) by 2050.

Figure 1. GHG emissions in the Deep Decarbonisation Pathway (DDP)

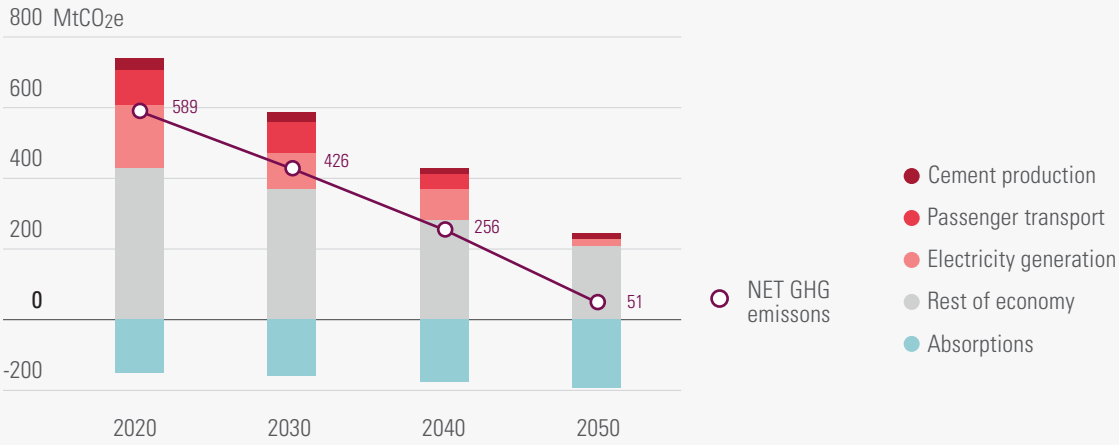
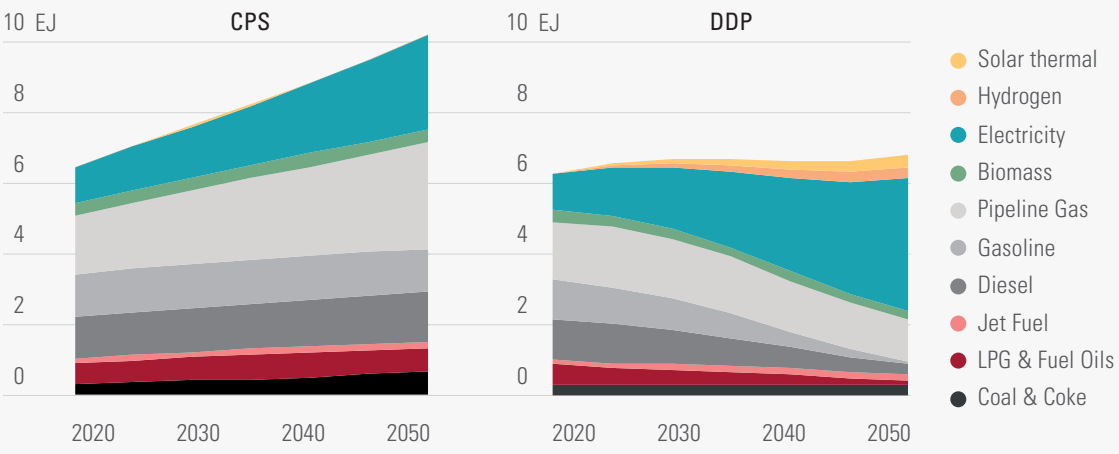


Figure 2. Final energy demand per fuel



BUT THE CURRENT PATH IS NOT ON TRACK

Despite being perceived as an international climate leader, the enactment of high-level climate related national laws, and the reorganization of environmentally related central institutions, GHG emissions in Mexico have kept augmenting in the last decade. Historically, the country's dependence on the oil & gas industry has created not only locked-in legacy infrastructure – in the energy sector but also, for example, in the vast road network and infrastructure built to date – but has also served to develop official narratives of energy nationalism. Coupled with chronic underinvestment, dwindling oil reserves, and record low oil prices, the state-owned company PEMEX has been under severe financial and operational stress in past years. Current administration's efforts to regain control of the State in both the O&G and electricity markets favoring government owned companies over private producers has caused even greater uncertainty in the future of the domestic energy sector, which has only added to the problems already faced by PEMEX and CFE, the homologous state-owned electricity utility.

In Mexico, GHG emissions are mostly CO_2 from the combustion of fossil fuels for energy use, and a fifth of them corresponds to methane and nitrogen oxides from agriculture, livestock and waste. The transportation sector is the largest source of GHG emissions, followed by electricity generation, industry, and oil and gas. The country remains with a large CO_2 footprint in general and an increasing dependency in fossil fuels imports.

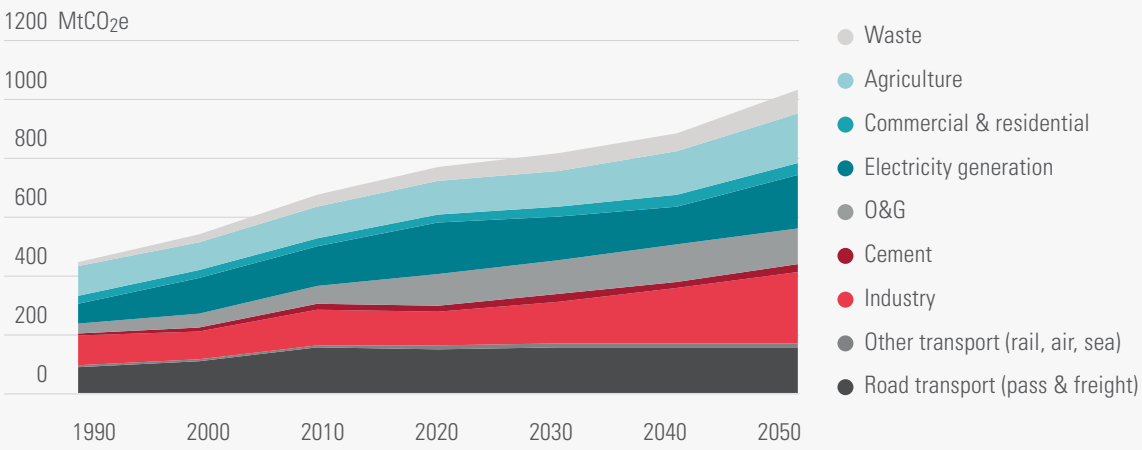
The Current Policy Scenario (CPS), reflects a full implementation of the main policies in place to fight climate change: the Mexico's NDC and Mid-Century Strategy (MCS), while projecting some recent trends in Mexico towards the future.

The economic activity, as measured by GDP, is projected to grow at a 3% annual rate, an optimistic adaptation of the average in the previous couple of decades (+2%). Within the economy, the services sector reaches 70% of GDP in 2050, from 62% in 2015. Consequently, the share of industry which includes all primary and secondary activities (fishing, agriculture, oil and gas, manufacturing, construction, etc.) is reduced to 27% of domestic GDP by 2050.

The decades-long urbanization process will keep going albeit at slower pace than in the past as Mexican population is already 74% urban, that is considering the population of all cities and towns larger to 11,500 people. By 2050 we estimate that 77% of all population could be living in an urban context representing more than 114 million people. Currently, medium size cities are experiencing the largest growth and the CPS projects this trend to continue in the future, with highly heterogenous socioeconomic urbanization patterns and underinvestment in public transit infrastructure, maintaining the perverse incentives towards private car usage, congestion, low air quality, road accidents, and high GHG emissions.

The CPS also projects a slight recovery of the crude oil production from its currently decreasing trend to

Figure 3. Annual GHG emissions in Mexico 1990-2050 under CPS



the levels observed in 2010 (around 2.5 million barrels per day, 37% higher than in 2019), which is the traditional output targets set by recent administrations. In this pathway electricity is kept being produced mainly from natural gas, as Mexico's climate commitments, stated in its NDC, MCS, and internal policies are for power generation to be 35% renewable by 2024 and to remain at that ratio, which is a de-facto commitment to 50% fossil generation over the long term. As demand for gas, gasoline and diesel continue to increase through to 2050, GHG emissions increase 43% vs. 2020 levels.

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. A central element of the energy transition is the decarbonization of the electric grid through the rapid expansion of renewable generation capacity and auxiliary transmission, distribution, and storage. Simultaneously, electrification of energy uses across all other sectors (residential, commercial, industry and transport) must proceed swiftly along with a steadfast increase in efficiency in those same uses. The oil & gas industry must start a strategic phase-out as investments are redirected towards renewable electricity.

3. Urbanization must happen differently in most cities, not only to manage future personal mobility and freight demand, but as a driver itself of wellbeing and prosperity for the general population. Promoting a more homogeneous distribution of opportunities and services in walking friendly neighborhoods would allow for localized economies to thrive while providing the market concentration needed for the development of world-class public transport systems.

4. Technologically, an accelerated transition towards electric vehicles for both, the public and the private fleets, must happen to reduce transport GHG emissions to zero. For example, an EV rollout timeline towards 50% of LDV sales being reached by 2035 should be put in place.

5. As domestic and international demand for oil products declines, the O&G industry should start its strategic decapitalization to eventually terminate operations in the second half of the century. At present, suspending investment and build of new oil and gas projects, including the expansion of upstream and downstream activities, and of gas pipelines. Some of the present infrastructure could be redirected towards emerging energy industries, such as that of zero-carbon hydrogen, bio, and synthetic fuels.

6. The rural context must undergo a similar transformation than the urban one. Identification and adoption of agricultural, forestry conservation, and food distribution best practices applicable to the local contexts, could reduce emissions from crops and livestock while increasing food security for all population and boosting development for the lowest income sectors in Mexico.

OPPORTUNITIES OF THE TRANSITION

The transition of 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 socio-economic paradigm.

ECONOMIC GROWTH

- Investment in people, infrastructure and technology increases labor skills and productivity.
- Industry prepares for international competitiveness in the new economy by improving energy efficiency, reducing costs and innovating. Some new business models, products, and services have the potential for higher value add.

ENERGY SECURITY

- Currently most of the gas and gasoline is imported, while the public treasury depends on crude oil exports; obtaining energy from a more diverse mix of local renewable sources, along with a sustainable tax reform, will protect the country from shocks in international commodity prices while ensuring supply for a growing demand.

SOCIAL DEVELOPMENT

- Changes in urban structure and the built environment improve the quality of life of all population.
- Higher investment and public spending present a basis for increasing public services and reducing poverty and inequality.
- Opportunities in new sectors and the 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 will improve air quality in the country.
- The increase in public transport and non-motorized mobility will help reduce both, the negative impacts of sedentary lifestyles, and the road accidents observed in car-centric urban designs.
- The electrification of homes will reduce natural gas and firewood use, with notable benefits for low-income, exposed population (children and women).