DDP MEXICO

DEEP DECARBONIZATION OF URBAN PASSENGER TRANSPORT IN MEXICO

Jordi Tovilla, Daniel Buira & Thalia Hernández of Tempus Analítica A.C.

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"). This note presents the main system transformations required in the urban passenger transportation sector to reach a decarbonization pathway, as well as how this differs from current trends and Mexico's climate stated commitments.

Decarbonization of passenger transport, historically one of the largest sources of emissions in the country, is crucial to reach net zero emissions by mid-century. But to fully decouple personal mobility from emissions, several changes are needed encompassing many dimensions, from the spatial organization of our cities, to technologies available, and people's behaviors. These transformations 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.

This project is supported by the Fonds Français pour l'Environnement Mondial (FFEM) and by in-country French representatives such as the local French Development Agencies (AFD) and French embassies.

FONDS FRANÇAIS POUR L'ENVIRONNEMENT MONDIAL

IDDRI

KEY FINDINGS

1. Upgrading zoning, housing, and infrastructure development regulation to modify the urban structure towards one where households, jobs and services are more homogeneously distributed rather than concentrated and separated, and where the space is designed around people rather than cars, could reduce daily travelled distances (at least 10% vs the baseline estimation) and encourage the modification towards healthier habits. All while satisfying service demand in a growing and dynamic economy in a more equitable manner.

2. Developing world-class integrated mass transport network and services of trains and buses, with improved ride comfort, accessibility, and journey times compared to car mobility, to induce modal shift from private cars towards these systems.

3. Developing comprehensive instruments to rapidly electrify drive-train technologies, in public transport, service vehicles, and private light vehicles to effectively replace all vehicle fleets over 35 years. This transformation must consider the parallel and unprecedented reduction in car private ownership and the rapid increase of new mobility-as-service platforms already present today and that can be key in shaping the sector in the near future.

A DEEP DECARBONIZATION PATHWAY FOR TRANSPORTATION

Deep decarbonization of the transport sector is achieved by 2050 considering interventions at the three main levels of drivers of urban passenger's GHG emissions: demand for personal mobility, energy intensity per passenger transported, and carbon footprint of the energy used to do so.

To reach carbon neutrality, passenger transport must reduce its annual emissions by 89% down to less than 20 $MtCO_2e$ by 2050. This will necessarily imply a reduction in gasoline and diesel consumption of 93% and 100%, respectively, by that time. As a result, the DDP scenario requires only half the energy of the baseline scenario and produces only one eighth of the emissions.

To achieve this goal, some deep structural changes are required. Firstly, the distances people travel everyday need to be reduced. Intensive daily commuting in Mexican cities is partially caused by a very unequal distribution of jobs and services (schools, hospitals, stores, recreation, etc.) within the city, forcing ever larger groups of people to travel ever longer distances every day to reach those jobs and services. The DDP explores a 19% reduction of urban daily mobility demand by 2050 vs the CPS as a simulation of people having to travel shorter distances, and shorter times, to fulfill their daily activities in the future. Neighborhoods where everything is at a close distance not only reduce travel times, but also enable a wider use of non-motorized transportation and many social and economic benefits.

Secondly, a generalized modal shift from cars to public transport would significantly reduce the energy used to transport each passenger, especially in medium and big cities. As trains and buses increase their coverage to replace car travels and accessibility to transportation services for the general population is increased, the average distance that people need to walk every day to reach these services can be reduced. Spreading this modal shift to larger segments of the population would reduce congestion in the roads, allowing for

shorter travel times for all, regardless of the transportation mode. In order to keep people's preference for low-carbon low-energy transportation modes (transit) these must be more convenient, both in cost and time, over the private car alternatives for most journeys.

Thirdly, decarbonization can only occur if fossil fuels are eradicated from transportation. Hence, technologies must evolve quickly and fleets of both, public and private vehicles, must rapidly shift to electric powertrains. For example, in order to reach sufficient levels of electrification, the share of new sales of lightweight vehicles that are electric should equal that of current ICE before 2035, and reach 85% by 2040. The resulting demand for gasoline in 2050 in the DDP is 93% less than it is today.

Finally, niches that are difficult to electrify, such as aviation and heavy-duty vehicles for freight transport, need to switch to zero carbon fuels like biofuels or synthetic liquid fuels. This will present another important connection between the power grid decarbonization directing some of the excess of solar PV peaks to electrolysis to produce hydrogen, and the conversion of current oil-processing assets to enable them to produce bio and synthetic fuels, highlighting the importance of holistic long-term planning of the transformation of the energy system as a whole.

Figure 1. Transportation final energy demand

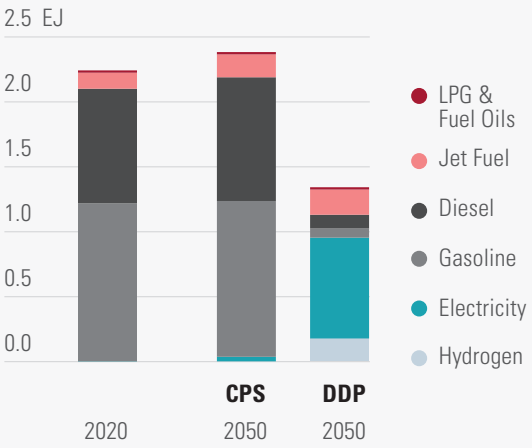


Figure 2. Transportation CO2 emissions

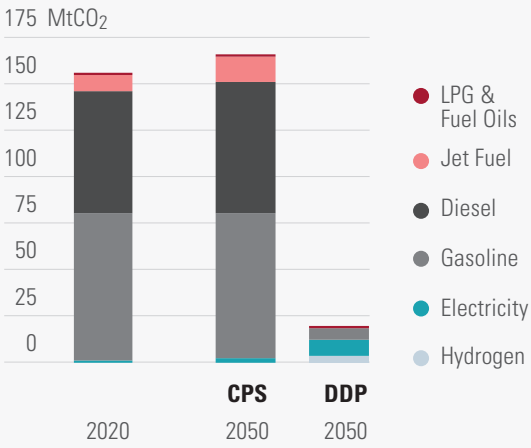


Figure 3. Modal distribution of everyday urban mobility

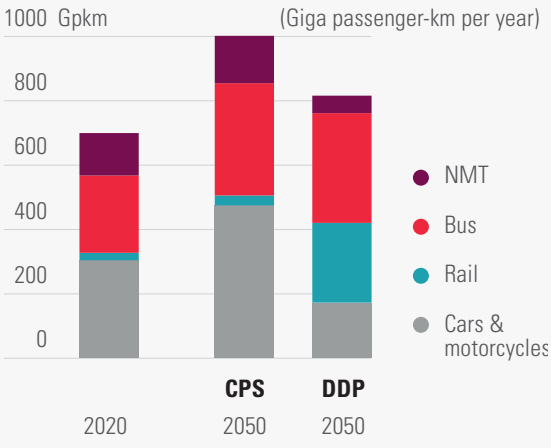
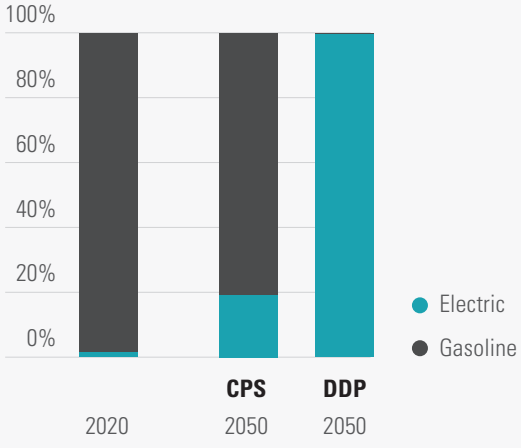


Figure 4. Sales composition of new light-duty vehicles



CURRENT PATHWAY AND MAIN CHALLENGES

Historically, the high demand for mobility due to an unequal distribution of jobs and opportunities in Mexican cities combined with the disproportionate use of private vehicles with low occupancy rates has yielded sub-optimal results in various dimensions:

- High energy demand and emissions per passenger-km.
- High congestion, which in turn increases travel times and road accidents.
- Poor air quality.
- Legacy road infrastructure that is currently locking-in cars dependency, while competing directly for public resources that could otherwise be invested in upgrading and expanding dedicated space for mass transit systems or biking.

As a consequence, current mobility-transport dynamics are not only detrimental for the environment – the transport sector amounts for nearly a fourth of all GHG emissions – but they also increase exposure to energy security risks, such as volatility in prices and future carbon taxes on fuels imports.

The Current Policy Scenario (CPS), reflects a full implementation of Mexico's NDC and Mid-Century Strategy (the main policies in place to fight climate change), while projecting other recent trends in Mexico. Non-discretionary demand, related to trips to work, education or other everyday activities, will increase the passenger kilometers notably by 44% between today and 2050, with car trips accounting for the largest share of this demand (55% more trips compared with 2020). As a result, the private vehicle fleet increases from 20.3 million in 2015 to 56.5 million in 2050; with fleet efficiency improving from 12 to 19.6 km/L (2015-2050) but EV sales accounting for a marginal part of the increase.

A very public face of the current dependency on foreign fuels is the large imports of gasoline and the price consumers pay at the pump for it. Since 2018, Mexico's central administration has explicitly set the goal of energy "sovereignty" and has tried to reinstate PEMEX in the central role it had within the energy-economic-political system in the past. Under this new directive, PEMEX builds a new refinery in Tabasco and has acquired another one in Texas the last year, bringing the total number of refineries from six to eight.

If current trends persist in the future, all the risks identified above: higher GHG and pollutant emissions, higher energy expenditures, poorer air quality, infrastructure lock-in and sunken assets, congestion, etc. will by amplified, making it very difficult to change into a pathway of sustainability and net-zero carbon.

Figure 5. Historic oil fuels imports

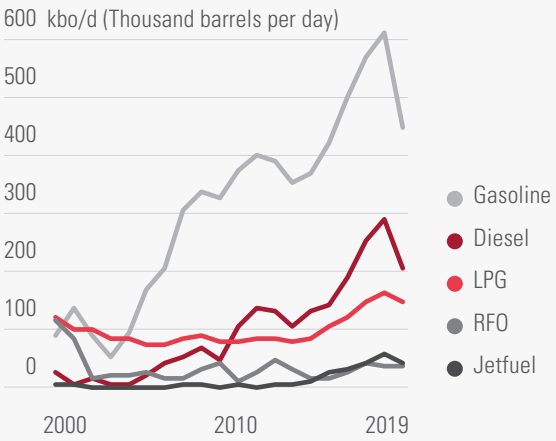
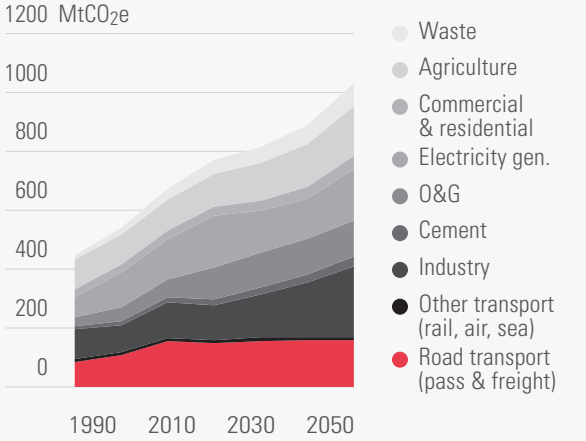


Figure 6. Annual GHG emissions under CPS



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. Passenger transport is a pillar of economic activity and has a considerable impact across all sectors. Therefore, the sector needs to go through an unprecedented transformation that will not come about by incremental changes to existing dynamics, plans, policies and instruments. Decarbonization of transportation presents a great opportunity to shift towards a new development model, with an emphasis on people's well-being and all other SDGs, and that simultaneously addresses policies, regulation, prices, innovation, business models, and social attitudes, to inform decision-making in all cities across the country.

3. Better planning and managing land use towards more livable cities are key. For example, creating walkable economically-dynamic and diverse neighborhoods well-connected to the rest of the city, allow to choose non-motorized and alternative modes of transportation over their cars. Land-taxes that are lower in the central parts of cities can help curb sprawl in the outskirts while attracting fresh investment and redevelopment in central vacant lots. Strengthening local tax collection and revenues can also increase the capacity of local governments to develop their cities. Pilot interventions can be started even at a small one-street scale.

4. While upgrading our neighborhoods, it is very important not to lose sight of the extended metropolitan system so they are well connected to the whole. Urban development plans for all midsize and large cities must include the expansion of the coverage of low-emissions integral multimodal public transport networks, that are efficient, safe and comfortable for all.

5. Accelerating technological evolution to electric power trains, both in the private and the public fleets, will probably require a combination of incentives and price signals to motivate changes in the purchase decision-making process of owners. New electricity charging and distribution infrastructure must be developed. This will need upgrading the regulation of electricity distribution to promote a dynamic and participative market that can attract investment and innovative business models.

6. Decarbonization of transport through electrification requires a rapid expansion of renewable generation capacity and the development of a hydrogen supply industry to diversify the energy system, provide storage for renewable electricity surplus, and serve as input to zero-carbon synthetic liquid fuels in niche applications like aviation and heavy freight. The first large-size renewable electrolysis projects are being piloted at present, usually as PPP's between electricity and water authorities and the private sector.

7. There will be plenty of opportunities and new niches for the creation of new business models, services and products in the transition to a net-zero economy. The involvement of the private sector companies in all the transport value chain will be crucial to achieve this goal.

OPPORTUNITIES OF THE TRANSITION

The transition of passenger transport 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.

New companies and new business models will need to be developed. *Mobility as a service* and shared mobility systems that prioritize low carbon modes should be part of the new model of all cities in the country, as world-class transit systems with extensive penetration. Private sector companies will not only find opportunities along the transport value chain (e.g., providers of high-quality electric vehicles, locally based suppliers, etc.) but in new niches and markets that go beyond the traditional boundaries of transportation, for example when electric cars start also helping balance the electricity grid, acting as storage units for renewable power.

Public-private partnerships will probably play an important role, for they combine many advantages of the private sector (like access to capital or specialized skills) with those of the public sector (larger focus on societal benefits and longer lifetime of projects, for example) to lower the risks of capital-intensive projects. This scheme has proven successful to expand and operate Mexico City BRT system. However, given that changes will involve much of the public space, channels for participation of society at large will be needed.

ECONOMIC GROWTH

- Systematically improving investment in transit infrastructure will be a catalyst for economic growth in cities, as mobility and economic activity are both facilitated.
- New companies, markets and products in the transport sector will create value while supporting the transition to a net-zero economy.

ENERGY SECURITY

- The sector is highly dependent on imported fossil fuels; electrifying the system and local renewable energy will protect from shocks in international commodity prices while ensuring supply for a growing demand.
- Reducing the disproportionate share of energy dedicated to transportation today will release economic and energy resources for strategic activities, such as the infrastructure development for the energy transition.

SOCIAL DEVELOPMENT

- Upgrades to the urban structure to make them more "livable cities" will instantly improve the quality of life of all citizens, as mixed use and diverse neighborhoods provide a better context for continued socio-economic, technologic, cultural, and personal development.
- Multimodal transport networks will reduce commuting times while being a source of jobs.
- Much of the public space that is currently dedicated to cars (streets and parking lots), can be repurposed for entertainment, sports, meeting places, and overall well-being of citizens.

PUBLIC HEALTH

- The reduction in the use of diesel and gasoline will improve the air quality of all cities in the country.
- The reduction of motorized transport will reduce accidents, noise, and stress levels in the population.
- Increasing the share of non-motorized will have direct positive impacts on health.