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WORKING PAPER

A socially inclusive economic transition for Mexico: Identifying the opportunities and benefits of enhanced climate action

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HIGHLIGHTS

- Even though climate change poses a threat to development, and that Mexico has expressed a commitment to address it, the country's climate policies lack ambition and clear implementation measures.
- Advancing a low and just carbon transition could help Mexico mobilise investment, improve competitiveness, enhance development, and address social vulnerability. Estimates show a potential gain on jobs (763,455 jobs or 3.5 percent of the total formal jobs registered in July 2023) and additional 24.95 billion USD in Mexico's GDP by 2050, equivalent to 1.6 percent of 2022's GDP.
- Policy levers that lie within the energy, cities, and land use systems offer the greatest social, environmental, climate, and economic benefits.
- In the energy sector, more renewables, energy efficiency in buildings, and methane abatement, offer the greatest potential emissions abatement as well as economic and social benefits.
- In cities, curbing emissions from buildings, transport, and waste can contribute to both mitigation and socioeconomic goals.
- In the forest, agriculture, and land use sectors, measures such as restauration and sustainable management of ecosystems that support both mitigation and adaptation are optimal, especially if they also benefit local communities and help conserve nature.
- Estimates state the level of investment needed for complying with NDC commitments close to 100 billion USD, whereas associated efficiency gains and co-benefits could be set somewhere between 100 to 157 billion USD, avoiding as many as 26 thousand deaths by 2030.

EXECUTIVE SUMMARY

Climate change is one of the greatest threats to development. A growing ammount of evidence reveals the potential benefits of enhanced climate action. The 2018 New Climate Economy (NCE) report estimates that global benefits could reach 26 trillion USD, compared to a business-as-usual (BAU) situation, and according to the Global Commission on the Economy and the Climate, more than 65 million green jobs could be created by 2030, while saving close to 700 thousand, lives worldwide.

The effects of climate change on the population, productive sectors, and critical infrastructure, combined with the growing evidence on the effects of the climate emergency on economic growth, social inequality, and poverty, have become the main drivers of climate action. As of September 2023, a total of 93 countries, representing 79.3 percent of global greenhouse gas (GHG) emissions, have communicated net zero targets.

In Mexico, there is compelling evidence that transitioning to a low carbon and climate-resilient economy can help reaching goals such as poverty alleviation, job creation, social inclusion, energy security, and economic growth. The most promising areas for the transition are renewable energy, construction, and the agricultural sector.

Mexico's potential abundant resources to generate renewable energy is 2,593 gigawatts (GW); this is an amount 26 times the total generation capacity in 2023 and 76 times the energy renewable capacity reported by Mexico's Ministry of Energy the same year.

GHG mitigation measures in the construction sector are economically feasible and would have a positive impact in low-income households, where 58 percent live in energy poverty. Twenty two percent of Mexico's population still use firewood for cooking and more than 10 thousand deaths are attributable to the use of solid fuels. Among them, women and children are the most exposed. For social and economic reasons, GHG emission-abatement measures should be implemented anyway, independently of the climate change urgency.

Around 100 million people live in cities, and these have the largest potential for GHG emission abatement. In the transport sector, measures to "avoid" the need to travel by motorized and polluting trips, "shift" to more sustainable modes and "improve" technologies to reduce emissions have an annual abatement potential of 86 percent of projected unabated emissions by 2050 and may save more than 75 thousand lives by improving air quality. Climate action in the transport sector would benefit mostly low-income populations living in remote peri-urban areas, which tend to spend 15 percent more money and four additional hours per day, and around 40 percent of household spending, while the nationwide average is less than half that figure.

Mexico is the 11th largest country in agricultural production and the 7th largest global producer of livestock. However, in rural areas, 48.8 percent of the population lives in poverty — 65.2 percent if only indigenous people are accounted, and 73 percent of indigenous women in rural areas. Achieving net-zero deforestation could strengthen community resilience and create new employment opportunities. Restoring and sustainably managing ecosystems can provide benefits that are nearly 2.7 times greater than the costs.

The transition to a more sustainable, low-carbon and resilient model of development needs to focus not only on technological change, but also on closing structural social gaps. It is crucial and urgent for Mexico to integrate climate and environmental objectives into its social development agenda. Policy priorities and investments need to recognize climate change as a key factor that may worsen social inequality and affect the country's ability to develop in the future.

This working paper examines the question of whether Mexico can achieve its sustainable development aspirations while advancing a climate agenda aligned with global commitments, and how. It identifies the sectors and policy interventions which offer the greatest opportunities, based on a review of available literature, interviews with experts, analysis of available data, and existing results.

Further analysis is needed about the specific conditions necessary to implement these policies and, their impact on social development and on a multidimensional analysis on human prosperity. This paper serves as a first step that requires more in-depth analysis, which, along with an engagement and communicational strategy, will be carried out in a next stage.

1. INTRODUCTION

Mexico's current federal administration has prioritized social development and poverty alleviation in the context of growing social inequalities and economic hardship, exacerbated by the COVID-19 pandemic, the subsequent disruption of supply chains and rising inflation, as well as the Ukraine war. Despite growing evidence of the socioeconomic benefits of healthy ecosystems and low-carbon and climate resilient measures, Mexico's social development agenda does not yet integrate climate and environmental objectives.

By the end of 2022, the government announced an enhanced Nationally Determined Contribution (NDC) with a new non-conditional GHG mitigation target of 35 percent below BAU by 2030, up from the previous target of 22 percent below BAU (SEMARNAT-INECC 2022). The government also announced new investments to abate emissions in the energy and transport sectors and to slow deforestation and land degradation, stating that the benefits of these investments would far outweigh the costs.

However, these steps fall short of decarbonizing the economy at the pace required to tackle the global climate emergency and keep global warming below the 1.5°C limit by the end of the century (IPCC 2018). Mexico's emission trajectory is aligned with a pathway above 4°C of temperature rise and is the only G20 country without a long-term net zero GHG emissions target (WRI 2023). Despite structural socioeconomic problems that are being exacerbated with climate change impacts, Mexico has failed to integrate its development objectives with an environmental and climate agenda that offers great opportunities to close social gaps and produce higher living standards.

This working paper examines whether Mexico can advance its sustainable development agenda while enhancing climate action, and what sectors and policy levers to focus on to achieve the greatest impact. It summarizes arguments from existing literature and available evidence on whether more rapid decarbonisation would be compatible with development aspirations. It addresses the Mexican context, the main developmental challenges and existing policy priorities to confront the concurring social, economic, and climate crises. It explores specific shifts in the energy, cities, and land use systems that would potentially achieve the greatest impact; it also proposes some key policy levers that would be needed, and outlines next steps.

1.1 Methodology

This report relies on the review of the available relevant country-specific academic and non-academic publications, the analysis of data, new sectoral modelling, and inputs from experts and stakeholders. The research approach combines a literature review, interviews and consultations, data compilation, and scenario analysis using an economy-wide systems dynamic model for Mexico. It applies the latest version of the Energy Policy Simulator (EPS)[1], as explained in chapter three, which is designed to analyze the effects of climate mitigation policies quantitatively, accounting for interactions, and provides a series of co-benefits, including avoided deaths.

In reviewing existing literature, the working paper attempts to provide an illustration of the results of analyses that have responded the following two questions: first, which development challenges does Mexico have in terms of poverty and social inequality that are exacerbated by the effects of climate change? Second, where are are the main socio-economic opportunities for climate action?

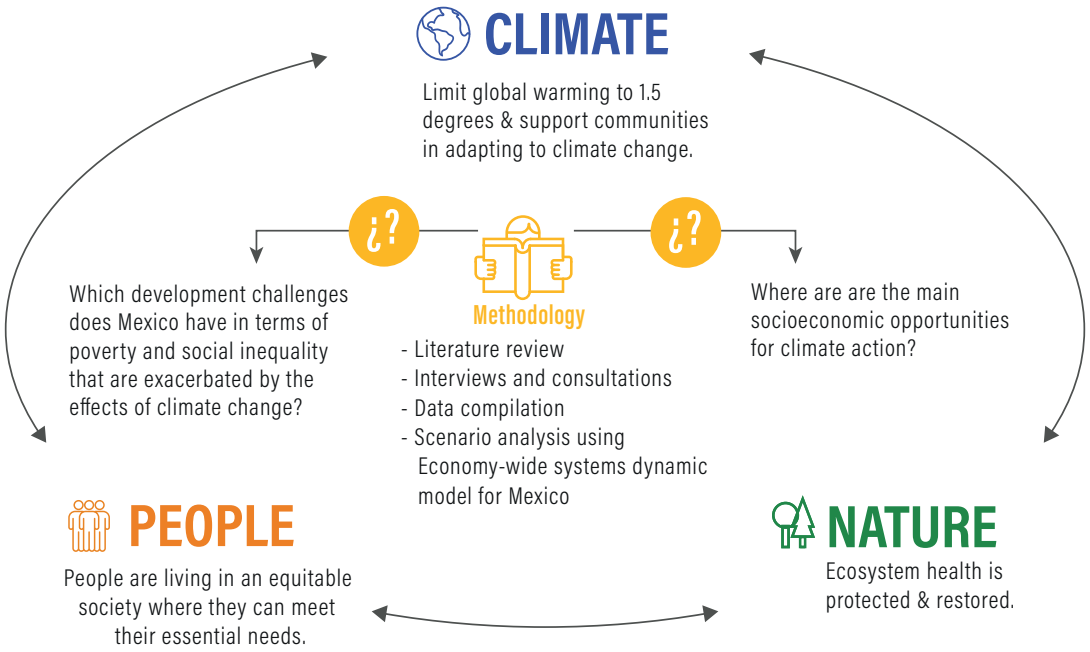
The purpose of reviewing existing literature addressing these questions is to get a broad perspective on the measures that have been identified for Mexico which would have a positive impact on socioeconomic variables and climate change. The review includes both economy-wide as well as sector-specific analyses.

Most of the publications consulted were peer reviewed and official documents. Estimations, nevertheless, are usually based on assumptions, so they should be taken with caution, since in most cases they are designed to guide policy making but should not be taken as predictions.

To collect insights from climate experts and stakeholders, nine semi-structured interviews were conducted (see Appendix 1). Also, to get inout and recommendations, two meetings were organized in 2023 with the members of the Advisory Committee for the New Economy for Mexico, integrated by key actors in the national climate change agenda (see Appendix 2).

Next steps from this work will cover the following topics: (1) sectoral and macroeconomic modelling; (2) political economy and distributional impacts analyses to assess the socioeconomic effects of climate and economic policy measures across various groups of the population; (3) analysis of potential feasibility and enabling implementation conditions; and (4) an enhanced engagement with experts and relevant stakeholders, including the advisory committee mentioned above (see Figure 1).

Figure 1 | **Scenario analysis using the Energy Policy Simulator**



Source: WRI

2. SOCIAL AND CLIMATE CONTEXT IN MEXICO

This chapter presents an overview of the Mexican social and climate context, focusing on its main challenges, priorities, and aspirations. The context provided is general, mainly because it will frame the analysis and discussions that follow.

2.1 Socioeconomic outlook

During the 2014-2019 period, Latin America and the Caribbean experienced the slowest economic growth recorded in decades, with an annual GDP growth rate of 0.3 percent (CEPAL 2021b). The COVID-19 crisis only worsened the situation, causing the region's economy to shrink by 7.6 percent which, coupled with an unemployment rate of 10.3 percent, exacerbated poverty and inequality (CEPAL 2022).

In the global slowdown that followed the pandemic, Mexico's economy contracted 8.5 percent in 2020 (INEGI 2021a), exacerbating vulnerabilities stemming from a sluggish economic growth, social inequalities, and climate and environmental crises. In 2021 the economy recovered slighly, with a GDP growth of 5 percent (BANXICO 2022), and a 3.1 percent growth in 2022 when GDP values recovered to pre-pandemic levels (INEGI 2023a).

In Mexico, poverty and social inequality are major challenges. 36.3 percent of Mexico's population is poor and in rural areas a greater percentage (48.8 percent) of the population lives in poverty, increasing to 65.2 percent if only indigenous people are accounted, and to 73.1 percent of indigenous women living in rural areas (CONEVAL 2023). Mexico is one of the most unequal countries in the world where, over the 21st century, the richest ten percent of the population income share has been at least 50 percent, whereas the bottom 50 percent has not increased its share from ten percent (Chancel et al. 2023).

Even though the unemployment rate is relatively low (less than three percent), Mexico is among the top ten countries in the world with the highest percentage of informal employment, leaving a broad share of the population in a vulnerable situation; around 30.6 million people (INEGI 2022). 50 percent of the population does not have access to social security, 39 percent lack access to nutritious and good quality food, and 28 percent cannot access medical services (CONEVAL 2023).

Throughout Latin America, the recession erased more than a decade of progress in women's participation in the labor force (CEPAL 2021a). In the case of Mexico, women make up most of the population but only 40 percent of the workforce. Women's informality rate (55.5 percent) is higher than men's

(INEGI 2020), and their average pay is lower, 86 pesos for every 100 that a man earns, on top of spending 2.5 times more hours in home duties per week (IMCO 2022).

The federal government has prioritized poverty alleviation, boosting investments and regional development, particularly in the traditionally poor southern regions. Due in large part to a wage policy aimed at increasing the real purchasing power of workers and the formalization of employment (Quintana 2023), the most recent official data reveals that between 2018 and 2022, 5.1 million people moved out of the poverty line (CONEVAL 2023).

2.2 Climate change impacts and vulnerability

Over the previous two decades, Mexico ranked ninth among the countries suffering the greatest economic losses due to disasters (UNDRR and CRED 2018). Between 1970 and 2019, there have been 202 disasters related to weather, climate, and water extremes, which led to over 6,500 deaths and 51.2 billion USD in losses (WMO 2021) and between 2000 and 2018, 83 percent of all municipalities have had a disaster declaration for floods, extreme rains, cyclones, and droughts. Climate change will likely increase the frequency and severity of such events (INECC 2022).

During 2021 and 2022, Mexico suffered one of the worst droughts in decades, and it is estimated that 31 of Mexico's 32 states will suffer further from water stress over the next ten years (Moody 's 2021). If this trend continues, it will limit the country's capacity to generate hydroelectricity and achieve its clean power generation targets (Moody's 2021). In terms of domestic agricultural production, lack of climate action could reduce the yield of major crops by up to 20 percent over the next two decades, and by 80 percent towards the end of the century (SEMARNAT-INECC 2018). Loss of cropland can lead to food insecurity and malnourishment, displacement, and permanent migration, especially for rural families. The federal government has projected that by the end of the century climate change inaction would translate to accumulated costs equivalent to somewhere between 50 percent and twice the national GDP of Mexico from 2010 (SEMARNAT-INECC 2018).

Climate change impacts and environmental degradation have added to socioeconomic stress, particularly of vulnerable social groups including women, children, and indigenous peoples (CONEVAL 2023). Changing in precipitation regimes and increased temperatures will exacerbate the water stress which most of the cultivated areas suffer (INECC 2022) and will increase pressure on revenues of a large portion of Mexico's population which relies on climate-dependent agriculture (i.e., 13 percent of Mexico's employed population). These individuals will have to find different ways of earning a living, in many cases outside their places of origin. In fact, weather-related disasters uprooted more than 100 thousand people in Mexico during 2020 and 11 thousand in 2022 alone (IDMC 2023). It is estimated that, between 2020 and 2050 in Mexico and Central America, the number of internal climate migrants will double, reaching up to 3.9 million (World Bank 2018).

Climate change is one of the greatest risks to development, threatening the progress made over the past 50 years in global health and poverty reduction (IPCC 2022, WHO 2021). It is crucial and urgent for Mexico to integrate climate and environmental objectives into its social development agenda. Policy priorities and investments need to recognise climate change as a key factor that may worsen social inequalities and affect the country's ability to grow in the future.

2.3 The development case for decarbonisation

There is a growing body of evidence about the benefits of promoting a more resilient and decarbonised economy. The 2018 New Climate Economy (NCE) report estimates that global benefits could reach 26 trillion USD by 2030, compared to BAU (NCE 2018). To show a contrast, compared to BAU, Brazil's plans for a "new climate economy" are expected to add 535 billion USD to its GDP, with 3.7 billion USD in additional agricultural production and 2 million additional new jobs by 2030, (Romeiro et al. 2020).

As of September 2023, a total of 93 countries, representing 79.3 percent of global GHG emissions, have communicated net zero targets (WRI 2023). More than one thousand cities globally have also established some sort of net zero emissions goal, and over two thousand companies (21 of them Mexican) have announced science-based emission reduction targets (SBT). These are all signs of an economic and technological transformation that will have significant impacts on worldwide value chains, including in countries heavily reliant on manufacturing such as Mexico.

A growing body of research points out the fact that green investments generally create more and higher quality jobs. One study estimates that, globally, green investments will generate between 1.1 and 3.7 times more jobs per 1 million USD than unsustainable investments (Jaeger et al. 2021). The Global Commission on the Economy and Climate found that more than 65 million green net jobs could be created by 2030, while saving close to 700 thousand lives worldwide (NCE 2018). The International Labor Organization and the Inter-American Development Bank determined that the transition to a net zero emissions economy will represent the creation of 15 million net jobs in Latin America and the Caribbean by 2030, in sectors such as sustainable agriculture, forestry, renewable energy, manufacturing, and construction (OIT and IBD 2020).

It is estimated that, if no action is taken, climate change will push up to 130 million people into poverty over the next ten years, and could cause over 200 million people to migrate internally by 2050 (Nishio 2021). Mexico has opportunities to leverage decarbonisation to achieve social development goals and avoid the replication of structural inequalities.

2.4 Mexico's climate policy

Mexico contributes with 1.3 percent of global GHG emissions and is currently the 14th largest emitter globally (WRI 2022). Over the last nine years, the annual GHG emissions growth rate has deaccelerated, to 0.3 percent (INECC 2021b). This stems from Mexico's recent economic troubles as well as from a reduction on the use of oil and coal, more efficient power generation, more renewable energy, and much more reliance on natural gas (SENER 2019). Out of total GHG emissions, 64 percent are related to energy use and generation, and nearly 20 percent to agriculture, forestry, and land uses[2].

Mexico has recognized the need for action, and showed that it can lead change. In 2012, with the publication of the General Climate Change Law (LGCC for its acronym in Spanish), Mexico became the second country to pass comprehensive climate change legislation. At the time, the LGCC positioned Mexico as a leader in terms of formal legal and institutional arrangements to address climate change.

In 2020 Mexico went on to submit an enhanced NDC. Its mitigation target was deemed regressive by a federal court, and therefore contrary to the Paris Agreement. For that reason it was overturned. In 2022, at the 27th Conference of the Parties (COP27), Mexico submitted a new enhanced NDC, emphasising adaptation to climate change as a national priority with additional lines of work in the areas of water crisis and food security, as well as specific lines of action that were not contemplated in the mitigation component.

It terms of mitigation, the country deepened its pledged emission cuts from 22 to 35 percent below BAU by 2030, with additional investments that would add up to 48 billion USD between 2022 and 2030. The statement explains that the benefits of this substantial investment will outweigh the costs, and that they will allow Mexico to become part of the new low-carbon economy, leading to the transformation of global energy, food, and agricultural systems required in a net-zero emissions world. It declared as well that this transformation will allow the Mexican economy to become much more competitive (Gobierno de Mexico 2022).

Mexico is currently one of 27 parties to the United Nations Framework Convention on Climate Change (UNFCCC) to have a long-term Strategy (LTS) in place, which sets a GHG abatement target of 50 percent below 2000 levels by mid-century (CAT 2023).

At the same time, despite substantive progress, particularly in terms of building a comprehensive institutional and legal framework, Mexico is still falling short when implementing its commitments. Even with recent announcements and new climate policies, Mexico is currently not on track to meet its medium- and long-term climate goals, meaning its current trajectory would not enable it to cut emissions even 22 percent below BAU, let alone 35 percent below BAU by 2030 (CAT 2023). In regards to long-term commitments, even with its recently enhanced NDC, Mexico is currently the only G20 country without a mid-century net-zero target.

The contrast between current plans and what is at least technically possible is stark. An alternative NDC, presented by a civil society organisation at COP27, argues that Mexico could achieve, with available technologies and feasible policies, up to a 47 percent reduction in GHG emissions by 2030 below BAU. These efforts would require external financial support, reaching 256 billion USD between 2022 and 2030 (ICM 2022), which is roughly equivalent to ten percent of the total annual GDP in 2022.

Mexico's current decarbonisation trajectory differs from the goals enshrined in its commitments and laws. In addition to aligning mitigation efforts with an emissions trajectory that achieves a 40 percent reduction in the country's GHG emissions by 2030, climate objectives and policies should consider the great potential they have to reduce the country's large socioeconomic gaps of poverty and social equity.

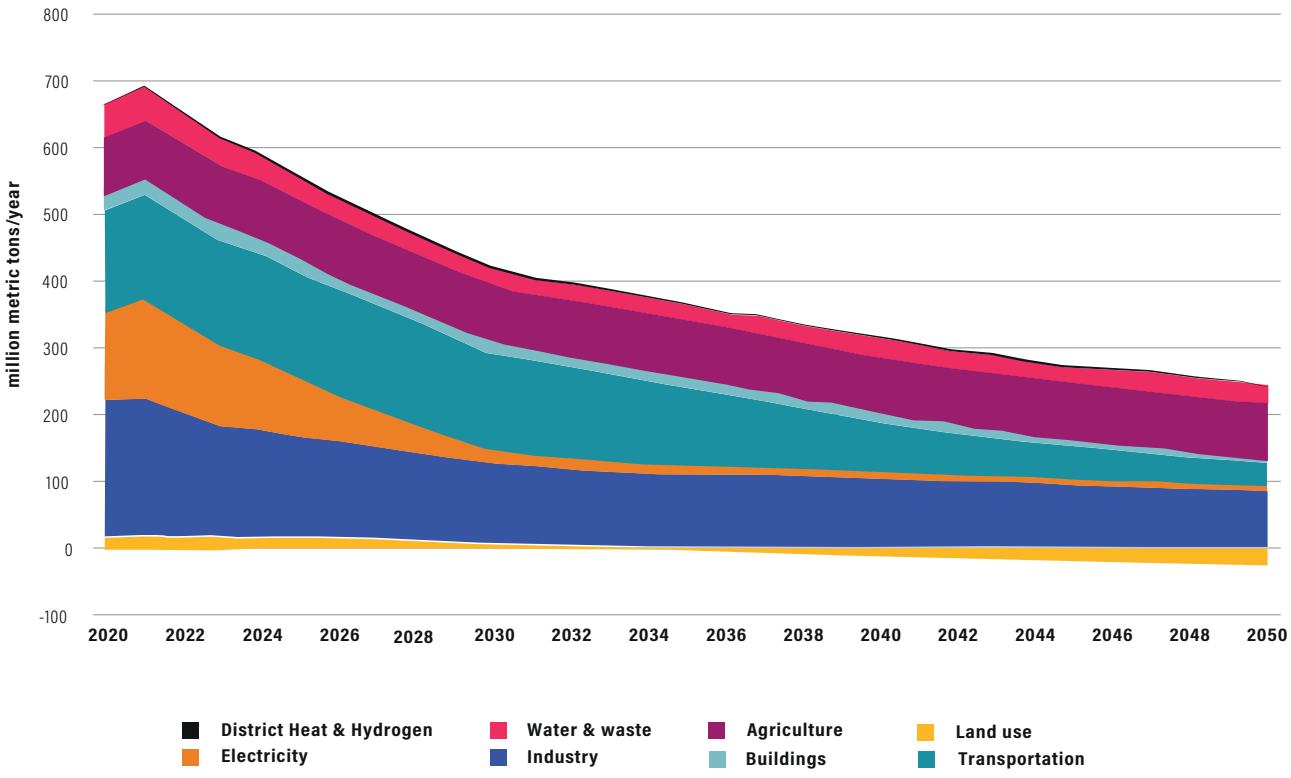
3. SYSTEM-WIDE TRANSFORMATION OPPORTUNITIES IN MEXICO

Despite slow implementation of commitments so far, it may still be possible to reach Mexico's initial 22 percent below the BAU target, through a combination of policies and measures that are technically and economically viable (Flores Montalvo et al. 2019). Some argue that Mexico could even reach the 35 percent target (ICM 2022), but only if the country acts up quickly and decisively, through a combined effort of all relevant economic activities and actors. The main climate change policies needed are spread among agriculture, waste, fossil fuel production, and forests. To curb energy demand and emissions, actions in cities and transport are likely the most powerful mitigation tools (Elizondo et al. 2017).

Recent WRI's modelling analysis with the EPS-Mexico (EPS 2022) shows that a combination of 26 policy levers across different sectors would make it possible to abate emissions to an annual 220 million metric ton of CO_2eq in 2050 —about one third of current annual emissions (see Figure 2). Additionally, this will bring gains in jobs (763,455 jobs or 3.5 percent of the total formal jobs registered in July 2023) and additional 24.95 USD billion of Mexico's GDP by 2050, equivalent to 1.6 percent of 2022's GDP (World Bank 2023).

Other analyses are roughly consistent with these findings. A study looking at decarbonisation pathways aligned with a 1.5 and 2°C limit global warming, finds that interventions should focus on shifting from fossil fuel electricity to renewables as the main energy source before 2040. The same study recommends adopting policies and building infrastructure that favors public transport modes and vehicle electrification,

Figure 2 | **Emissions trajectories by sector in the energy policy simulator (EPS) mitigation scenario**



Source: WRI 2022

and improving land use, agriculture, and forest management practices to reduce emissions and increase carbon absorption (Buira et al. 2021). Another analysis published by the INECC highlights transport, land use, and construction as the sectors offering the most cost-effective opportunities for achieving the mitigation target of Mexico's 2015 NDC (INECC 2021a).

In summary, the most cost-effective policies from our mo-delling and the literature can be grouped into three major systems: 1) energy; 2) cities, and 3) land use (including forests and agriculture). These three systems have been identified as the primary drivers of rising GHG emissions and the degradation of nature. Additionally, our model analysis finds that pursuing these policies will not clash with Mexico's priority of fighting poverty and fostering development. Indeed, moving these sectors in a more sustainable direction is key for achieving a socially inclusive economic transition in Mexico.

3.1 Clean, affordable and reliable energy

Energy systems contribute roughly to 64 percent of GHG emissions in Mexico (INECC 2021b), below their 76 percent share of global emissions (WRI 2022). Fossil fuels still make up 87 percent of Mexico's energy mix, above the G20 average of 80 percent. Solar, wind, geothermal, and biomass account for 4.7 percent of Mexico's energy supply. Their share in the total energy mix rose by about 35.3 percent between 2015 and 2019 (Climate Transparency 2021). In 2019, the power sector produced 171 $MtCO_2eq$ (million tonnes of carbon dioxide equivalent), which roughly represents 23 percent of total national emissions (INECC 2021b).

Cross-model and policy scenario analyses have shown that some energy decarbonisation pathways would rely more on increased electrification and on the use of natural gas, while others would be more dependent on efficiency improvement and increased use of biofuels, among other measures. However, in all cases the use of clean energy sources and a reduced role for oil is required if the aim is to reduce emissions at least in half by mid-century (Veysey et al. 2016). Key policy recommendations include a substantial ramp-up in renewable energies, energy efficiency, and further legal enforcement (Elizondo et al. 2017).

Far deeper and quicker cuts may be possible than what is currently set in policies and commitments. One decarbonisation scenario analysis for the energy sector reveals that GHG emissions could be reduced by as much as 79 percent below BAU by 2035 through a set of 36 mitigation measures (Grande-Acosta and Islas-Samperio 2017).

To decarbonise the energy sector, Mexico would need abundant financial and technical resources. These would be needed to design and implement an energy storage policy, increased penetration of utility-scale renewable generation plants and distributed generation, and to increase the flexibility of the electrical system. Large investments would also be needed to modernize the transmission and distribution networks, operated by the state-owned company, the Comision Federal de Electricidad (CFE).

In addition, policies at the national and subnational levels need to ensure that all households have secure access to electricity and meet their energy demands. Although almost 99 percent of homes in Mexico have access to electricity (World Bank Data 2021), 36.7 percent of Mexican households are energy deprived or lack at least one of the services or economic goods that are considered basic to satisfy fundamental human needs (Sánchez and Graizbord 2016)[3]. Women are the ones who suffer the most from this type of poverty, as they dedicate 2.5 more times to unpaid work than men, usually in activities within the household.

The energy transition in the electricity system needs to focus not only on technological change, but also on closing social gaps by increasing access to energy goods and services for households that are lagging, as well as for reducing poverty and generating jobs. The following sections describe some of the challenges and opportunities in renewable energies, energy efficiency, and the oil and gas industry.

Renewables

According to the National Atlas of Zones with High Potential for Clean Energy (SENER 2016), Mexico has a generation potential of 2,593 GW, which is 26 times the 2023 generation capacity (SENER 2023) and 76 times the energy renewable capacity reported by Mexico's Ministry of Energy the same year. According to the Mexico 2050 Calculator, it would be technically feasible to achieve 100 percent of electricity coming from renewable sources by 2050, although the optimal mix of clean energy sources would change among scenarios (Elizondo et al. 2017).

A decarbonised electric system in Mexico by 2050 is thus feasible, with renewables emerging as the cost-optimal technologies to achieve it (Solano-Rodríguez et al. 2018). Electricity decarbonisation will be crucial to achieve economy-wide emission reduction targets, since several sectors will rely on access to clean power to meet their own goals (Buira et al. 2021).

Reaching Mexico's 2015 NDC target would require cutting the electricity sector's emissions 63 million tons below the baseline (equivalent to nearly ten percent of Mexico's total GHG emissions today). The NDC update, targeting a 35

percent reduction of emissions below BAU by 2030, would require raising electricity capacity from photovoltaic (PV), wind and geothermal sources, and promoting distributed renewable generation, to reach a total of 40 GW of clean electricity capacity by 2030 (Gobierno de Mexico 2022), which would represent a growth of 15 percent of the 34 GW of current installed generation capacity with renewables (INECC 2021a).

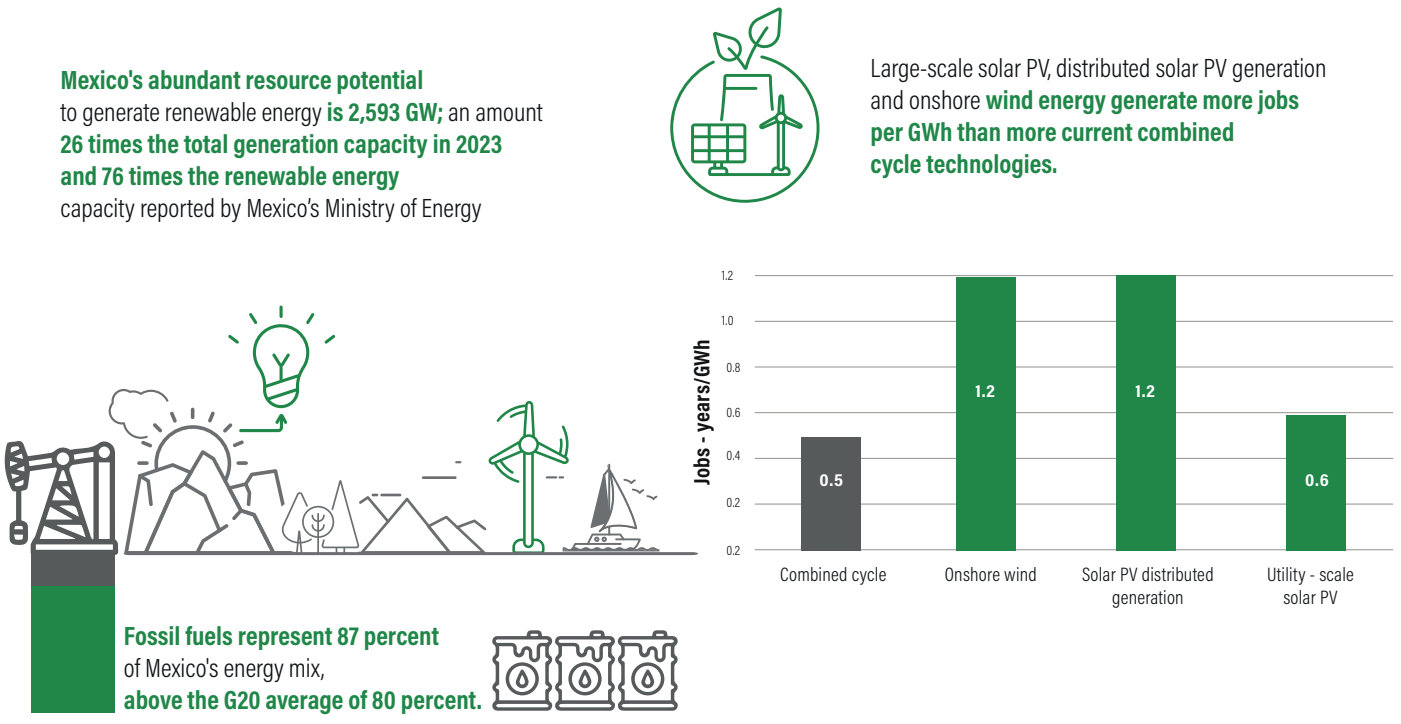
The Global Green Growth Institute (GGGI) developed an NDC scenario where total installed capacity reaches 156 GW by 2030, with 90 GW of clean energy and retirements of 11 GW of conventional fossil fuel-based (GGGI 2020). Under this scenario, the addition of renewables' installed capacity by 2030 will result in the creation of about 1.5 million total job-years (GGGI 2020). The assessment estimates that utility-scale solar photovoltaic, solar PV distributed generation, and onshore wind generate more jobs per GWh than a combined cycle technology, with onshore wind technology and solar PV distributed generation producing the highest number of jobs per unit of electricity output (see Figure 3) (GGGI 2020).

Mexico has a skilled workforce and the industrial capacity to absorb the substantial investments that would be needed for an energy transition (Buira et al. 2021). Expanding solar PV and onshore wind capacity can increase at least 46 percent in direct high skill jobs and qualification levels for the 2020-2030 period, under the Mexico 2015 NDC scenario (GGGI 2020). Economic and labor policies need also seek to increase the participation of women. In Mexico, only three out of ten professionals of science, technology, engineering and mathematics (which yield a better payment than other fields) are women (IMCO 2022a), and women only held a quarter of total jobs in the oil state industry (Petróleos Mexicanos, PEMEX) in 2019 and 17 percent in the electric sector (Mexico Evalúa 2021). Gender inequalities are underlying conditions that challenge a just transition in Mexico (see Figure 4).

Improved transmission planning, coupled with the development of renewables, could deliver increased energy accessibility, stimulating economic development, and decreasing electricity costs. Southern Mexico could emerge as a key hub for clean energy, enabling increased economic activity and potentially becoming an energy exporter to other parts of the country and to Central America (DOE US 2022).

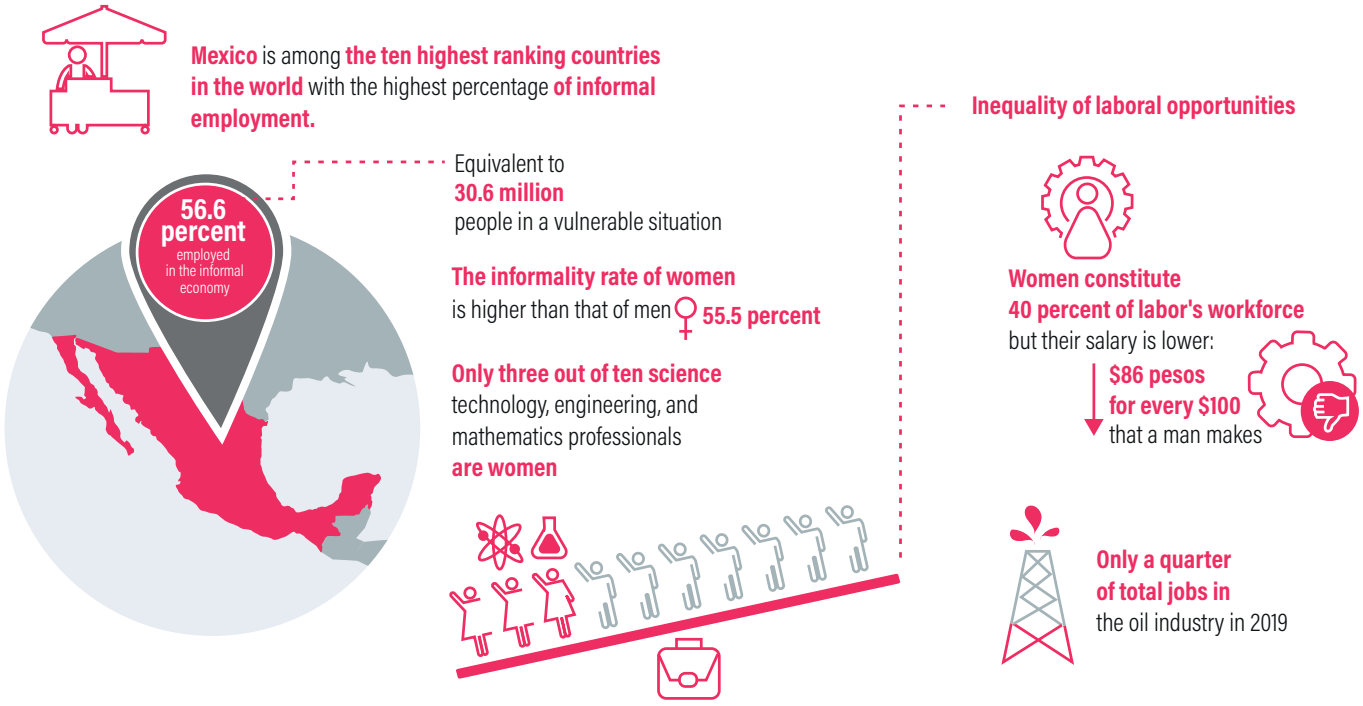
The energy transition will also improve health conditions and will help communities currently exposed to pollution from power facilities, leaks and spills of liquid and airborne pollutants, and transport emissions. According to some estimates, fully implementing the 2015 NDC target could boost employment in the electricity sector by 38 percent, and the benefits (avoiding social costs) from reducing PM2.5-related mortality could reach 2.7 billion USD (Gioutsos and Ochs 2019).

Figure 3 | **Landscape on green jobs potential in Mexico's energy sector**



Source: WRI with data from SENER (2023) and GGGI (2020)

Figure 4 | **Women's unequal participation in Mexico's workforce**



Source: WRI with data from INEGI 2020, IMCO 2022 and Mexico Evalúa 2021.

Energy Efficiency

Globally, energy efficiency remains one of the most cost-effective ways to reduce emissions (CUT 2019, IPCC 2021), so it should be considered before other alternatives. Energy efficiency is considered "the first fuel to achieve clean energy transition in a secure manner" (IEA 2021).

The National Commission for the Efficient Use of Energy (CONUUE) has led the way, with the publication of several Official Mexican Norms (NOMs) and voluntary standards for energy efficiency. It has also built capacities among different economic sectors, and has fostered incentives to increase the access and penetration of energy efficiency programs, technologies, and standards.

At the national level, the Transition Strategy to Promote the Use of Cleaner Technologies and Fuels, the guiding instrument for clean energy and energy efficiency policies based on the Energy Transition Law, sets a goal of 1.9 percent annual reduction of final consumption for the period 2016-2030 and a 3.7 percent per year between 2031 and 2050. This may seem ambitious but it is still below the four percent annual reduction proposed by the International Energy Agency (IEA) on its net zero pathway by 2050 (IEA 2021).

Overall, demand-side measures are an integral part of any mitigation pathway for Mexico (Veysey et al. 2016). The adoption of energy efficiency targets in the construction, transport, and industrial sectors provides an opportunity for enhancing Mexico's NDC, with several co-benefits such as job creation. Implementing industrial energy efficiency measures, aligned with the NDC target of 22 percent abatement of emissions below BAU by 2030, could create nine thousand direct jobs in industries and services that provide efficient technologies and solutions (Gioutsos and Ochs 2019).

The residential sector, which comprises almost 25 percent of national electricity consumption, has a challenge for addressing its emissions (SENER 2021). GHG mitigation measures for the residential sector included in Mexico's 2015 NDC are economically feasible and would lower costs and save money, meaning that they should be implemented regardless of climate change. They would also have the greatest positive impact in low-income households (INECC 2021a).

Despite its many advantages, energy efficiency policies are not highly successful. Political, technical, legal, and financial barriers are largely to blame. Successful implementation of large-scale energy efficiency programs requires long-term commitment, but it is often difficult for politicians to plan for the long term. In addition, financing mechanisms need to

be tailored to local markets and must be supported by appropriate policies, regulations, and incentives to phase out and eliminate energy-intensive practices and technologies.

Methane emissions from oil and gas

Methane emissions represent roughly 33 percent of total GHG emissions in Mexico. They grew 48 percent in the 1990-2019 period, with an average annual growth rate of 1.8 percent (INECC 2021b). According to one recent study that relies on satellite data, about 4.7 percent of gas produced in Mexico is leaked into the atmosphere – a quite high figure by global standards (EDF 2021). Official government data (INECC 2021b) report that the oil and gas sector contributes with only ten percent of total methane emissions, although this is widely seen as an underestimate, particularly regarding emissions from fossil fuels processing. Based on satellite observations, other studies calculate that emissions average nearly 20 percent more than those officially reported in national inventories (Lu et al. 2021). The largest discrepancy is in the oil and gas sector, with onshore facilities emitting ten times more than government reports say (Zavala-Araiza et al. 2021).

Mexico signed the Global Methane Pledge at COP26, in Glasgow, committing to a 30 percent abatement of the levels registered in 2020 for methane emissions by 2030. Both the 2015 NDC and the enhanced NDC submitted at COP27 set a 14 percent GHG mitigation goal for the oil and gas sector by 2030 as compared to the BAU scenario. It includes, prominently, pledges to reduce gas venting and fugitive methane emissions (SEMARNAT 2020, Gobierno de Mexico 2022). In 2022, at the Major Economies Forum, Mexico announced that methane emissions from PEMEX would be reduced by 98 percent by 2030, but did not provide any specifics about how that would be achieved, except for the fact that two billion USD would be invested in this measure alone (SRE 2022).

The civil society NDC presented at COP27 estimates that available technologies and policies could abate emissions from the oil and gas sector by a little more than 50 percent by 2030, three times the established goal in the NDC for this sector. According to this proposal, reducing natural gas venting and flaring is the measure with the greatest abatement potential (11.9 $MtCO_2eq$ annually by 2030), followed by co-generation (5.3 $MtCO_2eq$), and finally the curbing of fugitive methane emissions (4.5 $MtCO_2eq$) (ICM 2022).

Preventing methane leaks could also save money. One study estimates that 1.3 million tons or 200 million USD worth of methane is wasted in Mexico every year (EDF 2021). Curbing methane emissions could also bring health co-benefits, because it would reduce exposure to ozone, black carbon, and criteria pollutant emissions, which damage airways, aggravate lung diseases, cause asthma attacks, increase rates of pre-term birth, cardiovascular morbidity and mortality, and heighten stroke risk (Global Clean Air 2023).

Policies of increasing Mexico's crude oil production, the lack of infrastructure to process gas, and the absence of incentives and institutional capacity to ensure and monitor compliance with their regulatory programs in the sector, are not allowing the country to advance in its climate goals.

Decarbonisation pathways in key sectors of Mexico's energy system are technically feasible. However, these pathways face political and social challenges. Firstly, politically, renewables and electrification actions lack support and would need to show that these actions do not only benefit energy producers but the economy in general through the creation of green jobs and indirect economic positive impacts trough the value chain. Secondly, lack of political will and support results in lack of resources devoted to obtaining credible data that could provide a certain guide on the reduction impacts from promoting low-cost abatement technologies such as those from methane. Thirdly, the reorganisation of the energy sector and its labor force needs to be carefully planned to ensure a just transition. Those that may be left out in the process of a transition to a low-carbon future must be able to reap the benefits from it in terms of high-quality jobs and improved living conditions.

3.2 Sustainable cities

Worldwide, cities contribute with nearly 75 percent of carbon emissions. Mexico is among the ten countries with the largest urban population in the world, with around 100 million people living in cities with more than 2,500 inhabitants. In 1950, 43 percent of the population lived in cities; in 1990 the percentage reached 71, and by 2020 it was 79 percent[4] (INEGI 2020a).

Cities can and must play a crucial role in strengthening and meeting Mexico's climate commitments. The largest potential for GHG emission abatement among Mexican cities lies in construction, transport and waste. The Coalition for Urban Transitions (CUT 2019) estimates that by adopting a bundle of low-carbon measures in the construction, transport and waste sectors, Mexican cities could reduce their GHG emissions by 34 percent (98 $MtCO_2eq$) by 2030 and by 87 percent (284 $MtCO_2eq$) by 2050, relative to a baseline scenario. Almost one-fifth (19 percent) of this abatement potential stands in Mexico City alone; 28 percent in cities with between one to five million residents, such as Monterrey, Guadalajara and Puebla, and more than half in cities with less than one million residents. Rapid urbanization without enough planning exacerbates environmental degradation and reduces the quality of life for urban dwellers (see Figure 5).

Figure 5 | **Climate opportunities in Mexican cities**

Source: WRI with data from Semarnat 2022, Carbonplan 2023 and Badillo 2023.

People living in urban areas are also highly vulnerable to climate change and bad air quality, mainly produced by fuel combustion of transport. In the last 15 years, the frequency of heat waves in cities has increased (Semarnat 2022) and it is estimated that in 2030, one million people living in 168 Mexican cities would face highly dangerous heatwaves for more than a month (Carbonplan 2023). Air pollution causes around 48 thousand deaths per year. In Mexico City alone, between January and August in 2023, just around 23 percent of the days registered good air quality (Badillo 2023).

There is a growing momentum among subnational entities, including both state and municipal governments, to get ambitious and support climate action. State governments, particularly, are showing their willingness to adopt climate change mitigation and adaptation goals and programs. The empowerment of states and municipalities, their growing capacity to attract resources independently, and to establish their own financing schemes for mitigation and adaptation actions, could help them mobilize public and private investment, and to define decarbonisation routes according to local circumstances.

One of the steepest barriers to more substantive progress includes the subnational governments' need to increase capacities to integrate climate policies with efforts to improve air quality, promote sustainable mobility, and provide better access to green and healthy urban and peri-urban environments.

The effectiveness of these strategies also depends on implementing cooperation and coordination mechanisms among national and subnational governments, the private sector, and civil society, as well as on developing an adequate capacity to implement mitigation strategies (IPCC 2021).

Buildings

In Mexico, buildings consume nearly 18 percent of total power generated (SEMARNAT 2020a). They are also in the center of the climate agenda because of their close links with public health, air quality, poverty, and living conditions for the most vulnerable groups in Mexico (INECC 2021a). In developing countries, buildings have a lifespan of over 50 years, so any measure to improve them provides lasting benefits.

More than a third of households in Mexico live in energy poverty (Sánchez and Graizbord 2016), 58 percent of households with incomes below the poverty line and 79.1 percent of the indigenous ones live in housing deficit (CONEVAL 2019). 28 million people (22 percent of the population) still use firewood for cooking (INSP 2021), which implies a significant health risk especially for women and children who spend more time indoors and imposes significant pressure on forests.

Developing energy efficiency measures alone provide more than half the abatement potential in cities globally (CUT 2019). In addition to being cost-effective, decarbonisation scenarios assume that energy efficiency can help build-

ings approach net zero GHG emissions by mid-century (IPCC 2021). Improving residential lighting alone could cut emissions by 1.8 $MtCO_2eq$ annually, and in the commercial and service sectors it could add an additional 0.3 $MtCO_2eq$ (ICM 2022).

At the city level, construction codes and standards are the most common tool for promoting energy efficiency, but other complementary options include efficiency-improvement targets, investments in retrofitting public buildings, incentives and finance, and performance information and certification (Becqué et al. 2016). According to the IEA, the global implementation of energy efficiency measures in the construction sector could represent almost 5.8 billion tons of emissions savings by 2050, and a reduction of GHG emissions by 83 percent below the BAU scenario (WRI 2016).

Improving energy efficiency can also help reduce air and water pollution, and improve public health. In cities, construction retrofitting has a great job-creation potential, offering huge opportunities for the sector, which employs a large share of low-skilled workers (CUT 2021).

Major obstacles to decarbonise construction include insufficient knowledge and awareness from subnational governments on incentives and benefits to promote energy efficiency measures, and a lack of institutional capacity to promote governance structures with the private sector to scale these measures, among others (IPCC 2021). Policies are usually a local responsibility, and municipal governments have a constant turnover of officials and legal limitations to access funding, as mentioned before.

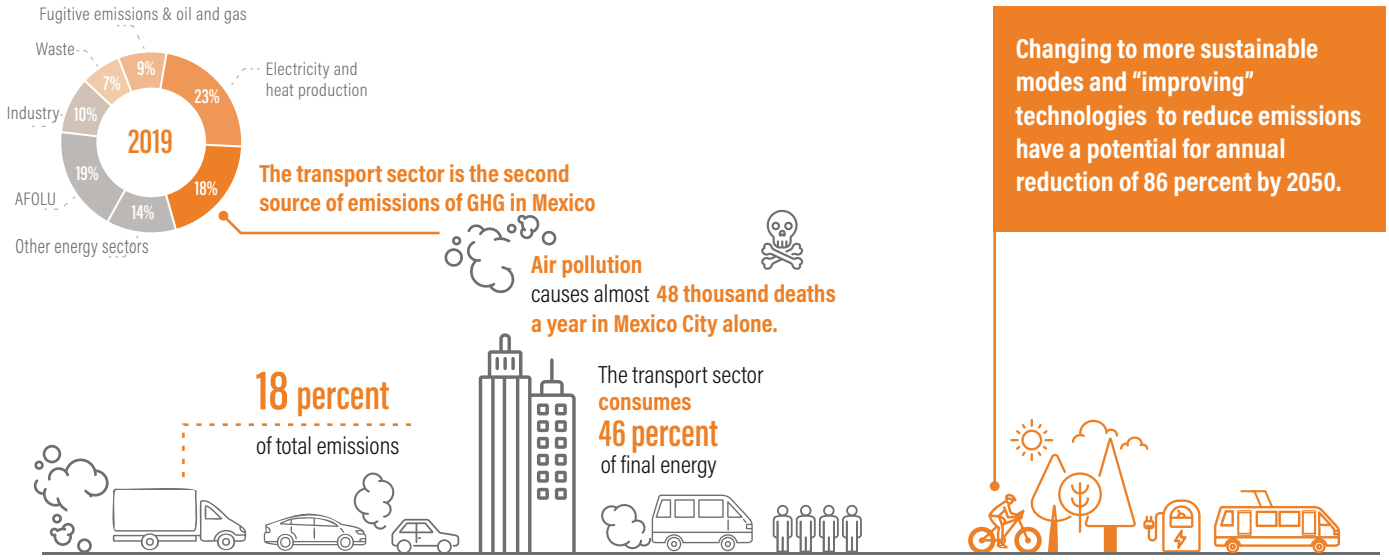
Transport

The transport sector is the second largest source of GHG emissions in Mexico. It represents 18 percent of total emissions and consumes 46 percent of final energy. GHG emissions from transport have grown faster than in any other sector in absolute terms, climbing at an annual rate of 1.7 percent per year from 1990 to 2019 (INECC 2021b). Under the BAU scenario, they are projected to double by 2050 (ICM and CT 2019). Road vehicles are responsible for more than 90 percent of the energy consumption of the transport sector in Mexico (SEMARNAT-INECC 2018), with an increase of nearly 3.4 times in the total vehicle fleet between 2000 and 2021 (from 15.62 to 53.12 million) (INEGI 2023).

Emissions, pollution and traffic congestion are some of the main effects of urban models oriented to private car ownership and bad quality public transport. As urban mobility is essential for urban dynamics, transforming urban transport has the potential to improve living conditions for all citizens (see Figure 6).

Sectoral modeling carried out by WRI Mexico, using the EPS tool, refers to a potential annual abatement potential of 30 percent by 2030, and 86 percent to reach 44 $MtCO_2eq$ by

Figure 6 | **Why is it necessary to decarbonise the transport sector**



Source: WRI with data from INEGI, 2020 and IMCO, 2022.

2050 instead of 317 $MtCO_2eq$ within the BAU scenario, if it implements a comprehensive decarbonisation strategy in the transport sector (ICM and CT 2019). The strategy would evolve around the "Avoid" (the need to travel by motorized and polluting trips), "Shift" (to more sustainable modes of travel), and "Improve" (technologies to reduce emissions in private, public and freight transportation) paths (Dalkmann and Brannigan 2007). Actions will be needed in all three areas, from long-term land use planning and zoning regulations that promote connected streets, mixed uses, and compact development (avoid), to inducing and implementing public transport and cycling (shift), to fueling vehicles cleanly and efficiently (improve) to decarbonise the sector.

These measures reduce the size of the vehicle fleet by eight percent in 2030 and 40 percent in 2050. Under it, the penetration of electric and hybrid vehicles would climb to 23 and 91 percent respectively for those same years. Vehicle efficiency would improve between 10 and 15 percent for off-road transport (vehicles that drive off paved roads or streets, such as tractors, cranes, bulldozers, etc.), and more than double for on-road vehicles. According to this analysis, by 2050 these measures would lower transportation energy demand by 66 percent and GHG emissions by 80 percent below BAU, which would be consistent with a 2°C of global warming, although not enough to get to a 1.5°C trajectory (ICM and CT 2019).

It is estimated that, between 2020 and 2050, actions in the transport sector of Mexican cities could contribute with around 29 percent of the emissions cuts needed nationwide to be consistent with the scenario below 2°C (CUT 2021). A scenario analysis that assessed the combined effects and costs of 21 measures, including structural changes in freight and passenger mobility, new motor technologies, biofuels, price signals, transportation practices and regulations, and urban planning strategies, concluded that these measures could collectively cut emissions by 56 percent in 2035 compared with the baseline scenario (Islas-Samperio et al. 2019).

The lack of access to transport is a leading cause of urban inequality. It means that, for many, opportunities for employment, education, entertainment, and health services are out of reach. In Mexico City, less than 19 percent of the population has nearby access to the mass transit system (Metro, BRT, suburban, and/or light rail), and almost 47 percent do not have a vehicle. The mostly low-income population living in remote peri-urban areas, tends to spend 15 percent more money and four additional hours per day on transportation than the population living in urban areas. In 2020, transport represented 18.6 percent of household spending nationwide, but up to 40 percent among lower income households (WRI 2021).

To provide urban residents with a better quality of life and health through equitable access to jobs and core services, while addressing the climate crisis and air pollution, Mexico needs an integrated and sustainable urban mobility system interconnected with an urban development planning through coordinated and efficient governance mechanisms that can ensure access to finance and enable environments to advance towards equitable, connected, and competitive cities.

Urban waste

Cities can mitigate GHG emissions and provide social and economic co-benefits by improving waste management, both for municipal solid waste (MSW) and wastewater. In 2019, emissions from municipal waste amounted to 54 $MtCO_2e$, equivalent to 7.37 percent of Mexico's emissions (INECC 2021).

Almost 70 percent of countries in the world, including Mexico, have created national institutions responsible for developing policies and supervising regulation of the waste sector, but implementation differs by country and even by region. In that sense, waste management operations are commonly handled locally, where capacities are often limited (Flores Montalvo and Loutfi Olivares 2020).

Mexico's 2015 NDC included a specific measure to promote methane recovery and use in municipal landfills and water treatment plants. Under the unconditional target, this was expected to cut methane emissions by 28.6 percent below BAU by 2030 (SEMARNAT 2020). The 2022 updated NDC includes a section on waste, enumerating measures that will be promoted, such as integral management of MSW, and better practices in treating municipal and industrial wastewater, reuse, recycling, composting, and bio-digestion (Gobierno de Mexico 2022). It lacks specifics about implementation plans but does mention a National Circular Economy Strategy, which should be forthcoming. The civil society NDC, also present at COP27, proposed a mitigation target of 39.1 percent by 2030 for this sector, which could be achievable through the recovery and use of biogas from wastewater and MSW treatment plants, plastics recycling, and waste-to-energy projects (ICM 2022).

This sector's mitigation potential in Mexico has hardly been studied, and a diverse array of models analyzing potential mitigation pathways pay scant attention to it, focusing instead on transport, energy or land use, where the largest portion of emissions lies. The co-benefits of improved waste management and increased circular material flows include new business opportunities, jobs, and improvements on resource efficiency. Expanding wastewater treatment coverage and reusing properly treated wastewater would improve water quality, energy security, and human and ecosystem health, and would curb GHG emissions as well (Gioutsos and Ochs 2019). Technical barriers to advancing these policies include inadequate waste management facilities, and capacity and financial constraints.

3.3 Forests, agriculture, and land use

Small producers, indigenous people, and rural communities are the guardians of Mexico's forests and its diverse ecosystems, and their means of living as well as their social and cultural systems depend on the products and ecosystem services provided by rural territories, which makes restoring and protecting Mexico's forests and natural ecosystems not only a key element of the climate agenda but also the main mechanism to promote development and social equity.

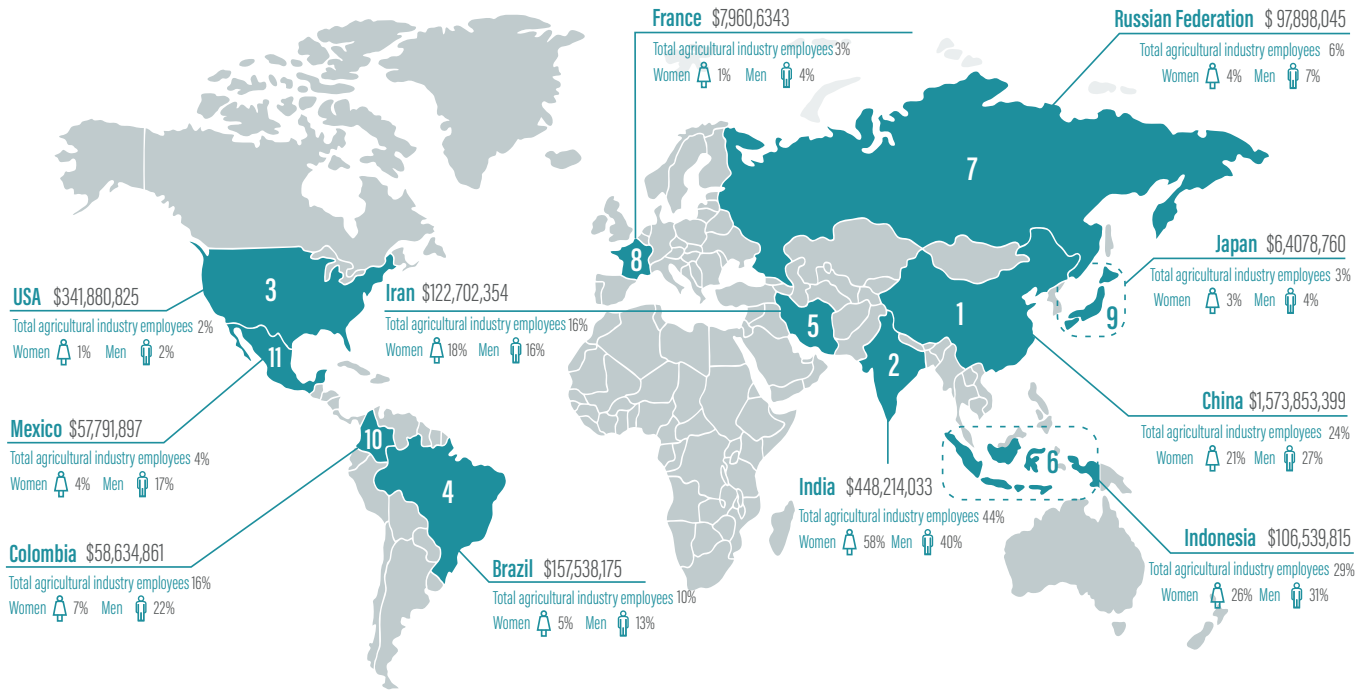
Five of the Mexican states that are considered the most biologically rich (Oaxaca, Chiapas, Michoacan, Veracruz, and Guerrero) are also those in which half of Mexico's traditional, communally owned "ejidos" and indigenous communities are located (Toledo et al. 2001). In total, around 51 percent of the national territory (CESOP 2019) and 80 percent of the land under forest use (CONAFOR 2019), are owned by ejidos and communities, respectively.

Mexico is the 11th largest country in agricultural production and the 7th largest global producer of livestock. However, in spite of accounting for less than 4 percent of Mexico's GDP, agriculture employs 13 percent of the population, financially supports 19 percent of households, and uses close to 70 percent of the territory (CEDRRSA 2019). Despite its socioeconomic importance, there is a great gender inequality in the population that works and depends on this sector (see Figure 7).

Labor informality of workers in agriculture reached an 84.1 percent in 2023 compared to the 55 percent national rate, and only 11 percent of those formally employed are women (Secretaría de Economía 2023) as well as three out of ten people with an ejido or communal land certificate (Inmujeres 2020).

Food production is especially vulnerable to effects from climate change. Almost 75 percent of the cultivated land in Mexico consists of rainfed agriculture with high sensitivity to shifts in rainfall patterns, and 60 percent of soils show some level of degradation (SEMARNAT 2022). The more mechanised and water-intensive agriculture is located in the north, the region most susceptible to droughts and water scarcity. It is estimated that the percentage of households living in extreme poverty in rural Mexico would increase by 11 points because of climate change, and would lead to a rise of more than 20 percent Gini index, the inequality coefficient (CEPAL 2017).

Figure 7 | **Ranking of agricultural production and employment by gender in the world**



Note: Data from Gross Production Value of Agriculture per year in 1,000 USD. Employment percentages considered are based on the total country-level workforce. Data disaggregated by gender considers only workforce in the agricultural sector. *These percentages by gender do not add up to 100% because the World Bank statistics consider also an entry for children who are part of the workforce.*

Source: WRI with data from INEGI 2020, World Bank 2021 and IMCO 2022.

Food production remains a main driver of deforestation and an important source of GHG emissions. In 2019, it accounted for 19 percent of Mexico's total emissions, of which almost 80 percent was from cattle (INECC 2021b). Emissions associated with land use change increased almost 122 percent between 2000 and 2019, due to land being converted from forest to pasture and agriculture, mainly in the tropics (SEMARNAT 2022). Between 2001-2018, an average of 212 thousand hectares of forest were lost every year (CONAFOR 2018), and although the annual growth rate of deforestation has decreased since 2016, Mexico is still far from reaching its NDC target of net-zero deforestation by 2030. On the contrary, if food consumption continues growing, supported by an agriculture model that keeps pushing for the expansion of cultivated lands, both biodiversity and ecosystems that keep land productive will be harmed.

Achieving net-zero deforestation would strengthen community resilience and create new employment opportunities, diversify incomes, and become an important driver of water resources protection, while it would also contribute to flood prevention and drought alleviation (Gioutsos and Ochs 2019).

Estimates show that steps to protect, restore, and sustainably manage ecosystems, including forests, provide benefits nearly 2.7 times greater than the costs (INECC 2021). For the agriculture sector, GHG mitigation costs are estimated to be in the order of 1.6 dollars/tCO_2eq for 2030. Switching from nitrogen fertilisers to biofertilisers is the single measure that offers the greatest abatement potential, with co-benefits such as improving water quality (INECC 2018). This, due to the mitigation of nitrous oxide emissions to the air, and to the reduction of nitrogen contamination in water bodies.

The conservation and restoration of coastal ecosystems is particularly important. In addition to preserving ecosystem services, it also has great potential to contribute to climate change mitigation and adaptation. Mexico is currently home to the world's fourth largest mangrove area (Simard et al. 2018), which stores an estimated 1.29 gigatons of CO_2eq (Global Mangrove Alliance 2020). Avoiding degradation and deforestation of mangroves could enable Mexico to reach an estimated six to ten percent of the total mitigation target from the Land Use, Land-Use Change and Forestry (LULUCF) sector set in Mexico's 2015 NDC (Adame et al. 2018). Protecting coastal ecosystems would directly benefit 20 percent of Mexico's population who live in coastal areas, and who depend on the services provided by coastal ecosystems, such as fisheries, water quality, firewood, recreational services, flood control, and protection from coastal erosion and saline intrusion.

Projections show that Mexico can adopt a feasible land-use pathway that ensures food security, sets a limit to agricultural expansion, preserves natural ecosystems, and contributes to the mitigation of emissions (FABLE 2020). A key question that remains for further analysis is whether it is possible to affordably change agricultural and land management practices without making it harder to feed Mexico's growing population, and how.

It is relevant to stress that mitigation options exist in the agriculture, forestry, and other land use sector (AFOLU) which, when sustainably implemented, could help deliver large-scale GHG emission reductions and enhanced removals. In that sense, they are complementary and cannot be expected to fully compensate for delayed action in other sectors (IPCC 2021).

4. DECARBONISATION MAKES SENSE FOR THE MEXICAN ECONOMY AND SOCIETY

The updated 2020 NDC recognises that Mexico has "a myriad of opportunities to undertake changes leading to the diversification of its energy matrix, and to lead transformational changes in its productive sector focusing on the population's welfare and in the protection and sustainable use of its cultural and natural wealth" (SEMARNAT 2020, 9). Decisions over a climate and energy pathway for the country will have a considerable positive and sustained impact on the economic and social development of the country (GIZ 2020).

The WRI's analysis (Flores Montalvo et al. 2019) is consistent with these findings. It shows that, by following a path aligned with its 2015 NDC mitigation target of 22 percent below BAU by 2030, Mexico could achieve several benefits. The policies it would need to implement are both technically and economically feasible, and the average cost of implementing them is 12 USD/ton of CO_2- equivalent (tCO2eq), which is less than half the average social cost of carbon or the average estimated cost of damage done by each additional ton of carbon emitted. Besides, more than 60 percent of the policies required would have negative costs, since the investments needed would more than pay for themselves in the short term. Implementing these measures would require investments close to 100 billion USD between now and 2030, representing about 0.8 percent of GDP annually. The returns would be greater, reaching almost 105 billion USD, counting only the gains from improved efficiency and some health co-benefits from reduced exposure to air pollutants.

Much of the rest of the world is quickly moving along a decarbonisation pathway. If it lags or fails to move at the same pace, Mexico could find itself at a competitive disadvantage in the global marketplace. This could have repercussions for the employment and could affect socioeconomic and financial stability. For example, accelerating global efforts to electrify transport could push down demand for oil by more than 70 percent by 2030 (Carbon Tracker 2020). Another

prime example is in the transport equipment industry, which represents 3.5 percent of Mexico's GDP, 25 percent of manufacturing jobs and 37 percent of exports. The industry will need to accelerate the adoption of more efficient, clean, and climate resilient processes to widen its competitive advantages in global and regional markets. It may do so in response to market forces, but having the right policies in place would make this transition much smoother.

Developing a decarbonisation pathway offers a platform and opportunity to close social gaps and avoid replicating structural inequalities by reducing vulnerability to the effects of climate change of the most vulnerable groups. It can also lead to the creation of jobs, including greater participation of women, reducing energy poverty, improving levels of health and wellbeing in cities, and lowering risks of rural communities to losses of agricultural and forestry income, among other benefits.

5. CONCLUSIONS AND NEXT STEPS

Stronger climate action aligns with Mexico's social aspirations as well. Proving and demonstrating how this is possible can help Mexico enact and implement policies needed to reach its enhanced GHG mitigation targets and aim for even higher goals. The government will need concrete evidence that transitioning to a low carbon and climate-resilient economy can help achieve urgent priorities such as poverty alleviation, economic growth, social and gender equality, inclusion, and energy security. This is particularly necessary as Mexico copes with fiscal pressures, inequality and informality of employment, the provision of public services, climate vulnerability, and economic difficulties.

Although there are still important gaps in our knowledge, several existing robust analyses demonstrate the economic and social advantages of pursuing decarbonisation in Mexico. The federal government itself recognizes this, in its rhetoric, policy statements, and legal framework. Yet it falls short in its climate implementation. This makes it the only G20 country without a net-zero emissions target. Thus, it is not complying with commitments enshrined in its own laws or NDCs.

The analysis so far points to barriers that may thwart even the most cost-effective, socially, and economically sensible policies. Some of these have to do with who wins and who loses, and the balance of power between them. Others may stem from legal or institutional limitations, politics, or a lack of leadership. The next stages of our analysis will explore these obstacles further, looking concretely at the case of Mexico. Clearly, more needs to be done to inform national and subnational authorities and decisionmakers across sectors, with a compelling narrative about the potential benefits and opportunities for Mexico of investing in a low-carbon and resilient just transition, but also about the risks and disadvantages of not doing so.

This working paper contributes to this effort by reviewing relevant evidence and identifying feasible and cost-effective interventions in terms of GHG emissions abatement and the creation of jobs. It is a milestone towards a more comprehensive analysis, building on the NCE approach, which will include original macroeconomic and sectoral modelling, political economy and distributional impacts analyses, as well as a further assessment of enabling conditions and barriers to implementation. Our future research will include participatory processes, with the collaboration of experts and relevant stakeholders. It will provide new knowledge and evidence as well as a strategy to communicate information more effectively to broader audiences, and to engage with policymakers.

Crucial decisions are coming. It is expected that enhanced climate action, decarbonisation and resilience will emerge as key topics among presidential candidates and campaigns in the 2024 general election, and as an urgent matter for many voters. This initiative will help inform the search for a path forward and will provide input for decision making at all government levels and across relevant sectors of society. Furthermore, it can contribute to a new National Development Plan that prioritizes climate action to boost social and economic development.

APPENDICES

Appendix 1. List of interviews conducted

1. Carabias Lilo, Julia. Personal communication between the author Andrés Flores Montalvo, former Climate and Energy Director at WRI Mexico, Adriana Lobo Almeida, former Executive Director at WRI Mexico, Carolina Campos Hernández, Advisor of the Executive Director at WRI Mexico, and Julia Carabias, Researcher UNAM. August 13, 2021.
2. De Buen Rodríguez, Odón. Personal communication between the author Andrés Flores Montalvo, former Climate and Energy Director at WRI Mexico, Carolina Campos Hernández, Advisor of the Executive Director at WRI Mexico, and Odón de Buen, former General Director, National Commission for the Efficient Use of Energy. July 21, 2021.
3. Delgado Peralta, Martha. Personal communication between Angélica Vesga, Public Affairs and Communications Director at WRI Mexico, Carolina Campos, Advisor of the Executive Director at WRI Mexico, and Martha Delgado, former Under-Minister of Multilateral Affairs at the Mexico's Ministry of Foreign Affairs. June 12, 2021
4. Del Villar Alrich, Rafael. Personal communication between the author Andrés Flores Montalvo, former Climate and Energy Director at WRI Mexico, author Avelina Ruiz, Climate Manager at WRI Mexico, Adriana Lobo, former Executive Director of WRI Mexico, Carolina Campos Hernández, Advisor of the Executive Director at WRI Mexico, and Rafael del Villar, Chief Advisor to the Governor, Bank of Mexico. June 24, 2021.
5. Fernández Bremauntz, Adrián. Personal communication between the author Avelina Ruiz, Climate Manager at WRI Mexico, Adriana Lobo, former Executive Director of WRI Mexico, and Adrián Fernández, Director of the Mexico Climate Initiative and former Director of the National Institute of Ecology. June 11, 2021.
6. León Tovar, Rufino. Personal communication between Angélica Vesga, Public Affairs and Communications Director at WRI Mexico, and Rufino León Tovar, President of the First Chamber of the Federal Court of Conciliation and Arbitration. July 23, 2021.
7. Medina, Carla. Personal communication between the author Andrés Flores Montalvo, former Climate and Energy Director at WRI Mexico, Carolina Campos Hernández at WRI Mexico and Carla Medina, Corporate Affairs Director, Zuma Energía. August 13, 2021.
8. Pichardo Lechuga, Ignacio. Personal communication between Angélica Vesga, Public Affairs and Communications Director at WRI Mexico, Carolina Campos, Advisor of the Executive Director at WRI Mexico, and Ignacio Pichardo, Mexican Politician. July 14, 2021.
9. Sarukhán Kermez, José. Personal communication between Adriana Lobo Almeida, former Executive Director at WRI Mexico, Carolina Campos Hernández, Advisor of the Executive Director at WRI Mexico, and José Sarukhán, former General Coordinator of the National Commission for the Knowledge and Use of Biodiversity. August 11, 2021.

Appendix 2. Members of the Advisory Committee for the New Economy for Mexico

1. Adrian Fernandez, General Director ICM
2. Alejandra Navarrete, Government and Multilateral Liaison Officer, Ocean Foundation
3. Eduardo Vega, Director, Faculty of Economics, UNAM
4. Enrique Provencio, Coordinator of the University Program for Development Studies, UNAM
5. Ernesto Herrera, Executive Director of Reforestamos Mexico
6. Isabel Studer, Founder of the Global Institute for Sustainability
7. Israel Hurtado, President of the Mexican Hydrogen Association
8. Jesarela López, Director of Analysis and Management, INEGI
9. Maria Eugenia Ibarrarán, Academic Researcher of the Ibero-American University Puebla
10. Mariuz Calvet, Director of Sustainable Finance for Corporate Banking Mexico and Latin America.
11. Miguel Ruiz Cabañas, Director of the Sustainable Development Goals Initiative at Tecnológico de Monterrey.
12. Monserrat Ramirez, Director of Sustainability at ConMexico.
13. Sandra Guzmán, Founder, GFLA
14. Jorge Rickards, Director General, WWF
15. Alejandra Navarrete, Government and Multilateral Liaison Officer, Ocean Foundation
16. Enrique Provencio, director of the university program for development studies, UNAM
17. Andrew Rhodes, former manager of the ocean's agenda, SRE

ENDNOTES

1. The EPS is open source and widely documented (Energy Innovation 2023).
2. In a CO_2eq comparison basis, 67 percent is carbon dioxide (CO_2) and 24 percent methane (CH4). The remaining is nitrous oxides and fluorinated gases.
3. Energy poverty is understood as lacking at least one of the services or economic goods that are considered to satisfy fundamental human needs: i) electricity, ii) entertainment, iii) water heating, iv) food cooking, v) food refrigeration, and vi) thermal comfort at home (García and Graizbord 2016).
4. According to INEGI, a population is urban when it has more than 2,500 inhabitants.

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We do not think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.