Mexico Energy Horizons

Special Report

Navigating challenges, powering opportunities

Latin America Research
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Current challenges and the opportunities ahead

Rystad Energy presents an analysis of Mexico's energy system within the context of the evolving global energy landscape. This report provides a comprehensive overview of the current state of the country's energy sector, highlighting both opportunities and challenges. Our integrated approach draws upon Rystad Energy's expertise across various segments, including oil, gas, power, renewable energy, hydrogen, energy storage and critical minerals.

Given the significance of oil in Mexico's economy and its historical influence on the country's politics, society and culture, our analysis begins with a focus on liquids production. We examine the global shift toward a greener energy mix, addressing the question: "Is there still a place for oil and gas investments in a world with declining demand for oil?" In our view, there is. Production levels from oil developments tend to decline faster than demand, meaning oil production and investment will remain necessary. What will change is that future oil barrels will need to be not only economical but also "sustainable", or low-emission barrels. We benchmark Mexico and state-run energy giant Pemex, in terms of emissions, emission-reduction targets and diversification strategies.

We then turn attention to the challenges facing Mexico's oil and gas upstream segment and how Mexico can reverse its declining production curve. While infill drilling has shown some success in mitigating this decline and will continue to play a role, new development areas are needed for Mexico's production to grow. Deepwater areas have the potential to fuel this growth but are still underexplored, requiring greater exploratory efforts, which come at a considerable cost. The pressure of deepwater exploration on Pemex's finances could be alleviated by farming out underperforming fields.

Turning to Mexico's gas market, the country remains heavily dependent on gas production from the Permian and Eagle Ford basins, with most of its supply delivered via pipelines from the US. Consequently, gas prices in Mexico are closely linked to Henry Hub. However, despite being a net importer of gas, Mexico's proximity to major US supply centers, along with lower labor costs and flexible energy export regulations, has enabled it to enter the liquefaction business.

Most of Mexico's gas demand comes from the power sector, with the country's power generation still heavily reliant on fossil fuels. However, several completed projects, along with more in the pipeline, are expected to change this. While gas is unlikely to be phased out of Mexico's power mix by 2050, most of the country's future generation will likely come from non-hydro renewables. This transition from fossil fuels will require significant investment in transmission infrastructure, particularly as projected demand increases due to the growing penetration of electric vehicles (EVs).

Efforts to limit global temperature increases to 1.9°C will also drive demand for new industries, particularly hydrogen. Although hydrogen production is not new, the shift to cleaner production methods will take center stage. Mexico already has a hydrogen industry in place, but the challenge will be transitioning from grey (fossil fuel-based) hydrogen production to green hydrogen via electrolysis using renewable energy.

With multiple projects already announced and its competitive advantages in supplying the US market, Mexico is well placed to capitalize on the future clean hydrogen market. Furthermore, as an industrial country, Mexico also has advantages in electrolyzer manufacturing, making the hydrogen sector a potential driver for investment and growth.

We also explore the role of vehicle fleet electrification and Mexico's potential through nearshoring of this supply chain, as well as the advantages of the country's well-developed mining sector with considerable lithium reserves.

Green future still requires greenfield investments

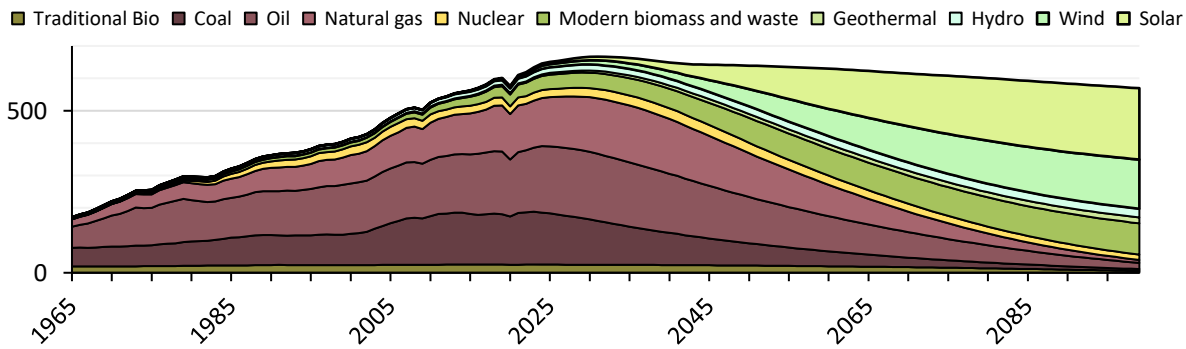
There is a consensus, driven by environmental concerns, public policy, and a shift in collective consciousness, that fossil fuels must be phased out of the global energy matrix. However, the timing and pace of this transition remain debatable. Rystad Energy projects a mean case scenario where oil demand peaks in 2033, followed by a decline of about 32% by 2050. This reduction will be offset by cleaner energy sources, primarily solar and wind, transitioning the energy mix from high greenhouse gas (GHG)-emitting sources to greener, non-GHG-emitting alternatives.

This move is less straightforward when considering the rapid decline in oil supply, inherent in oil and gas reservoirs. As shown in the chart below, currently producing wells meet today's demand, but in a decade, they will produce only about 27% of their current volumes, leaving a significant gap in meeting future demand. Even accounting for forecasted infill drilling, fields already in development, and unsanctioned discoveries, supply will only balance in our lower, "- sigma case", with a cumulative gap of 100 billion barrels of reserves to our mean case between 2032 and 2050.

Navigating this landscape is the main challenge facing countries and companies worldwide. Mexico, therefore, cannot afford to ignore the forces pushing for a greener energy system, nor abandon its role as a major oil producer. The key to a sustainable future will be diversifying away from fossil fuels while simultaneously increasing oil production with lower emissions.

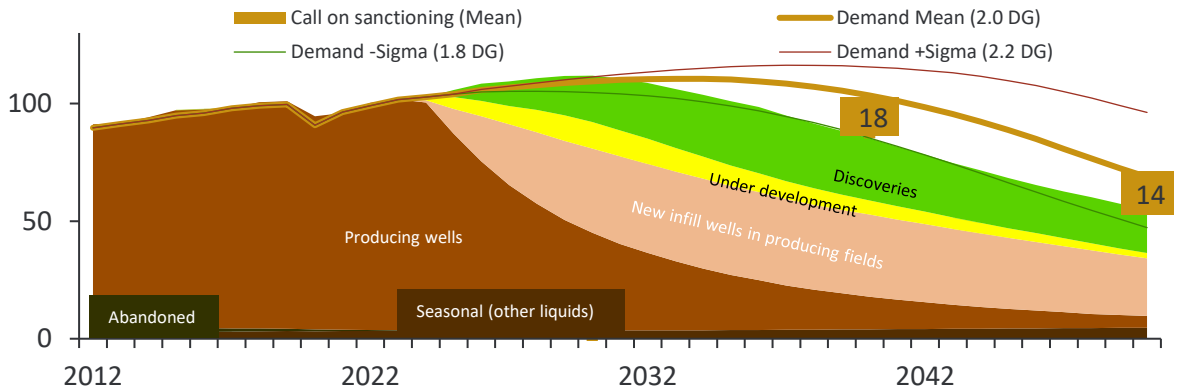
Primary energy capacities in Rystad Energy's 2.0 DG scenario, by energy source

Exajoule (EJ)



Global liquids supply split by well lifecycle category and forecast demand scenarios

Million barrels of liquids per day



Source: Rystad Energy Global Power Mix Analysis Dashboard; Rystad Energy UCube

Benchmarking emissions intensity

Emissions from individual countries are the central piece of the puzzle to balance the need for greater hydrocarbon production with the phase-out of fossil fuels to maintain targets of limiting the rise in global temperatures.

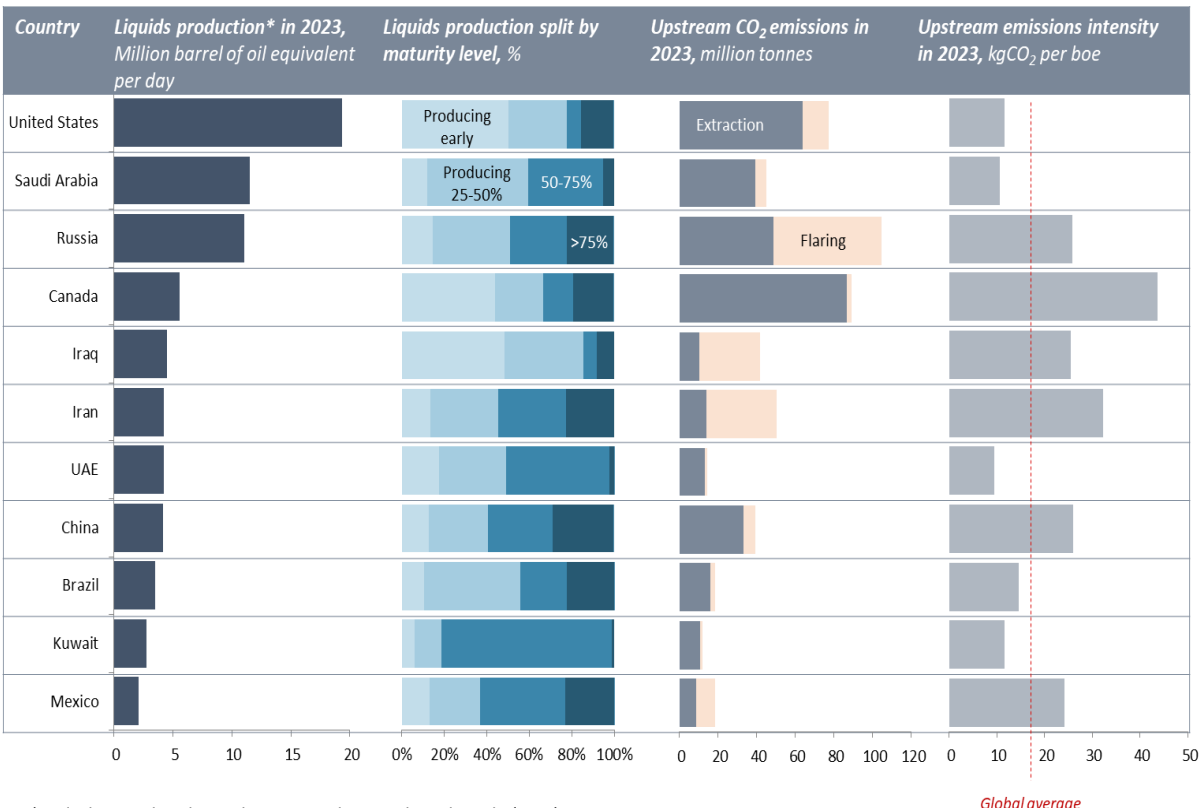
A country's emission profile plays a key role in determining the scale of the efforts required to meet its temperature-limiting goals. In the table below, we have selected the top 11 liquids producers and analyzed the relevant drivers for upstream emissions.

While it is evident that higher production generally leads to greater emissions, normalizing the absolute emissions values by production, as shown in the bar chart in column 5, reveals that the source of emissions, the origin of produced hydrocarbons, and the maturity of the producing fields/acreage have a significant impact on emissions intensity.

We consider the average emission intensity and focus on the six countries above the median, including Mexico, we can identify three with high flaring levels. In Mexico's case, although its overall CO_2 volume is not the highest, approximately half of its emissions come from flaring. At the same time, the country has a significant number of mature fields that have already produced more than half of their initial resources. It is intuitive that younger fields, with higher reservoir pressure, require less energy to produce a barrel of oil equivalent (boe), resulting in lower emissions intensity.

Despite the above, when we look at the US and Canada, it is clear the advantages of early-producing acreage and relatively low flaring are outweighed by the higher extraction emissions required to produce liquids from unconventional plays.

Liquids production and upstream emissions performance for top liquids producers



*Includes crude oil, condensate and natural gas liquids (NGL)
Source: Rystad Energy UCube; EmissionsCube

Plans and targets – Benchmarking Pemex against other NOCs

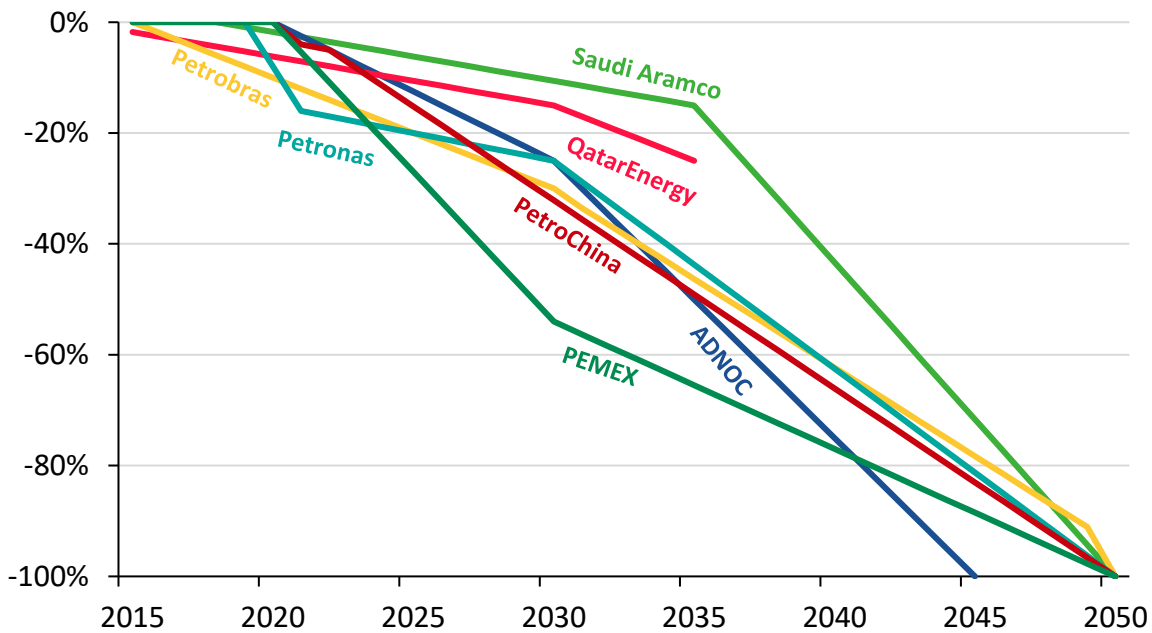
A shift towards more sustainable energy production demands extraordinary effort from various stakeholders. The centrality of oil in most energy mixes, however, imposes greater costs and responsibilities on oil companies, which can seldom ignore the need to reduce emissions.

National oil companies (NOCs) in particular are likely to bear a disproportionate share of the responsibility for achieving net zero targets due to their central role as not only energy producers but often the primary implementers of their government's energy policy. With this in mind, we benchmark Pemex, which is seen as a proxy for overall Mexican policy, against other high liquids production NOCs.

Against its peers, Pemex is the most ambitious in terms of targets, aiming for a 54% reduction in Scope 1 and 2 emissions by the end of the 2024-2030 *sexenio**. This initial push will allow the company more room for a less steep curve toward net zero from 2030 onwards.

In comparison, Pemex's peers generally aim for a more linear reduction in emissions, except for Saudi Arabia's Aramco. Aramco has set a target of only a 15% reduction by 2035, with a stronger push toward net zero by 2050. QatarEnergy stands out by not setting a net zero target, so far only announcing a goal of a 25% reduction by 2035. Meanwhile, the Abu Dhabi National Oil Company (ADNOC) is targeting net zero emissions by 2045, which is at least five years earlier than the rest of the group.

Scope 1 and 2 emissions-reduction targets set by NOCs
Percentage of total emissions



*Sexenio refers to Mexico's presidential term, which is of six years with no reelection
Source: Rystad Energy Ucube; EmissionsCube

Multiple diversification strategies

We have examined companies' policies and plans for achieving their targets. Beyond a range of upstream decarbonization strategies not directly covered in this report, a key trend among oil companies, particularly NOCs, is the diversification of their business models to meet their respective net zero targets. This trend involves increasing capital expenditure (capex) in areas beyond fossil fuel production.

Among the peer group discussed on the previous page, ADNOC stands out. In line with its goal to achieve net zero earlier than the rest, it has announced plans to invest in solar and wind energy, hydrogen, and various forms of carbon capture and storage (CCS).

In contrast, Pemex appears on the opposite end of the spectrum, with its diversification efforts limited to just four areas: carbon capture, CO_2 injection in oil and gas reservoirs, and both blue and green hydrogen production.

NOCs diversification plans

Yes No

		ADNOC	QatarEnergy	Saudi Aramco	PetroChina	PETRONAS	PETROBRAS	PEMEX
Solar	Solar PV	Yes	Yes	Yes	Yes	Yes	Yes	No
	Concentrated solar power	Yes	No	No	No	No	No	No
	Floating solar	Yes	No	No	No	No	No	No
Wind	Onshore wind	Yes	Yes	Yes	Yes	Yes	Yes	No
	Offshore wind	Yes	No	No	Yes	Yes	Yes	No
CCUS	Capture	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	O&G reservoirs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Saline formations	Yes	No	No	No	No	No	No
	Unconventional	Yes	No	No	No	No	No	No
	Utilization	No	No	No	No	No	No	No
Hydrogen	Feedstock: Natural gas	Yes	Yes	No	No	Yes	No	Yes
	Feedstock: Renewables	Yes	No	No	No	No	No	Yes
	End Product: Ammonia	Yes	Yes	Yes	No	Yes	No	No
	End Product: Hydrogen	Yes	No	No	No	No	No	No
	End Product: Methanol	Yes	No	No	No	No	No	No
	End Product: Synthetic hydrocarbons	Yes	No	No	No	No	No	No

Source: Rystad Energy O&G Sustainability Analytics

Declining production: The main short-term challenge

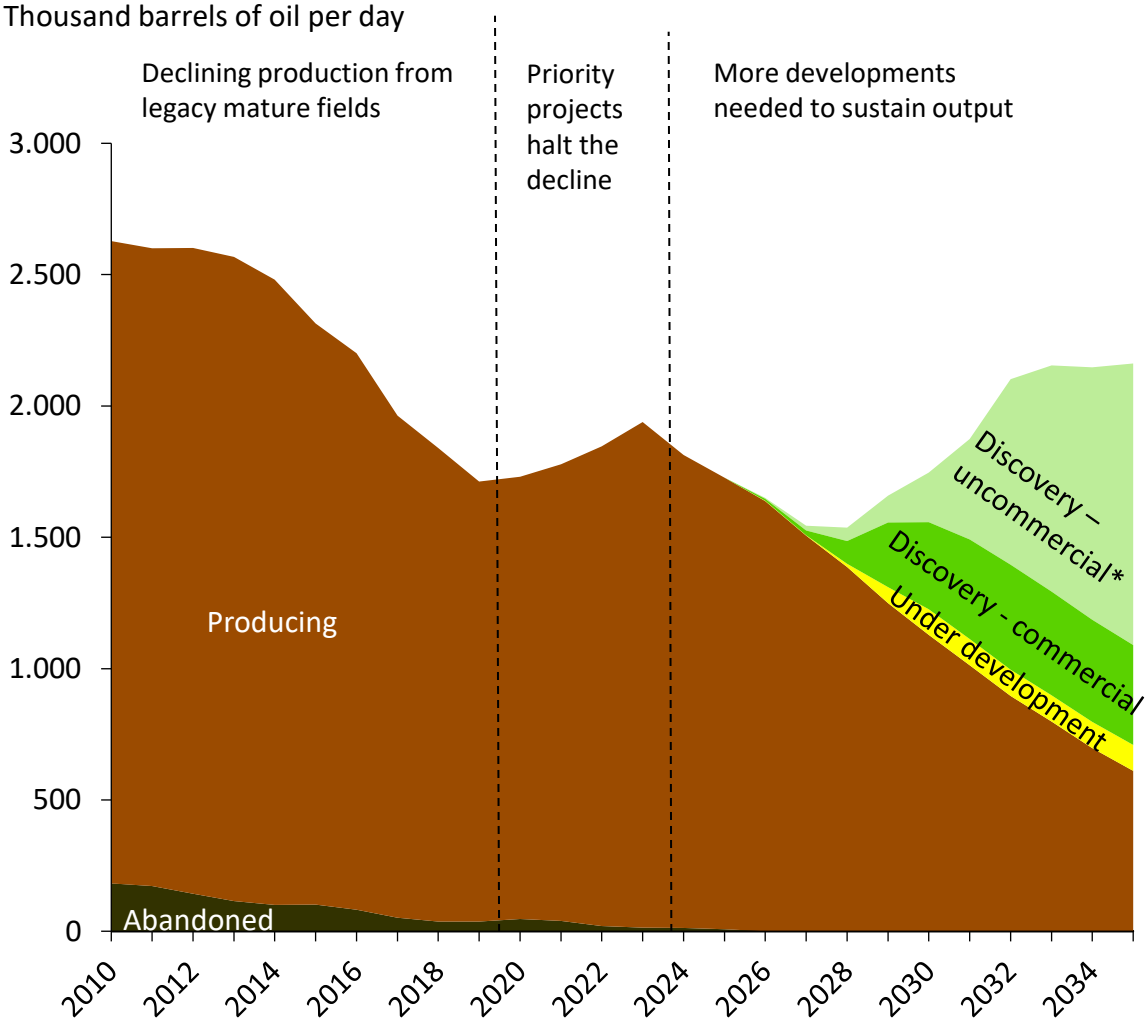
Mexico's production has been in a downward trend for more than a decade, with most of its production coming from legacy mature fields. As shown in the chart below, while priority fields slowed the decline, they could not stop it. This is evident from the peak in 2023 followed by the trend heading down again.

This situation sets the stage for the current challenge Mexico faces in reserve replacement to sustain the country's liquids output.

In Rystad Energy's base case scenario, only the development of new offshore discoveries has the potential to reverse the trend. However, these volumes are not expected to ramp up until the end of this decade, and a significant portion of the discovered reserves are not currently assessed to be commercial.

Mexico liquids production outlook 2010-2035 split by lifecycle

Thousand barrels of oil per day



*Currently deemed uncommercial, but with potential upside upon further appraisal.

Source: Rystad Energy research and analysis; Rystad Energy Ucube; Rystad Energy Upstream Solution

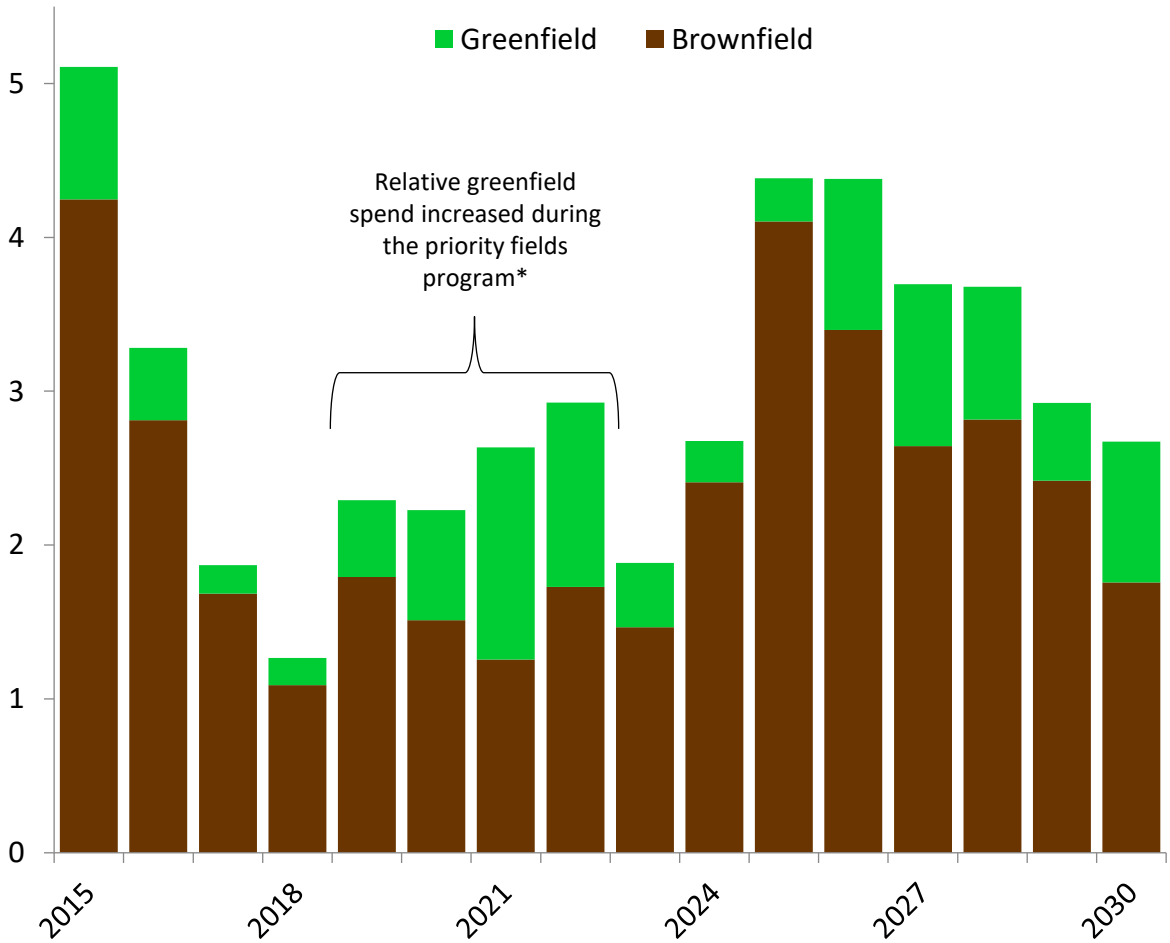
Infill wells set to play critical role in Mexican oil and gas supply

Rystad Energy estimates the oil and gas industry will maintain annual average spending on conventional brownfield projects at about $2.7 billion through 2030. This underscores the importance of continuous supply through the maintenance of existing mature fields and brownfield activity, primarily via infill drilling activity.

This is set to play an important role in prolonging the life of projects by increasing ultimate recoverable volumes, enhancing operational efficiency by maximizing cash flow towards the tail end of production, and supplying much-needed volumes to meet demand.

The contribution of mature fields to Mexican production, together with decreasing conventional discovered volumes, highlights the relevance of brownfield spending.

Mexican conventional upstream greenfield and brownfield well spending
Billion USD



*The priority fields program was announced at the beginning of 2018-2024 sexenio, and aimed to prioritize capex in 23 fields, to increase Pemex's production curve. Source: Rystad Energy research and analysis; Rystad Energy Ucube; Rystad Energy Upstream Solution

Analyzing Mexico’s underexplored deepwater potential

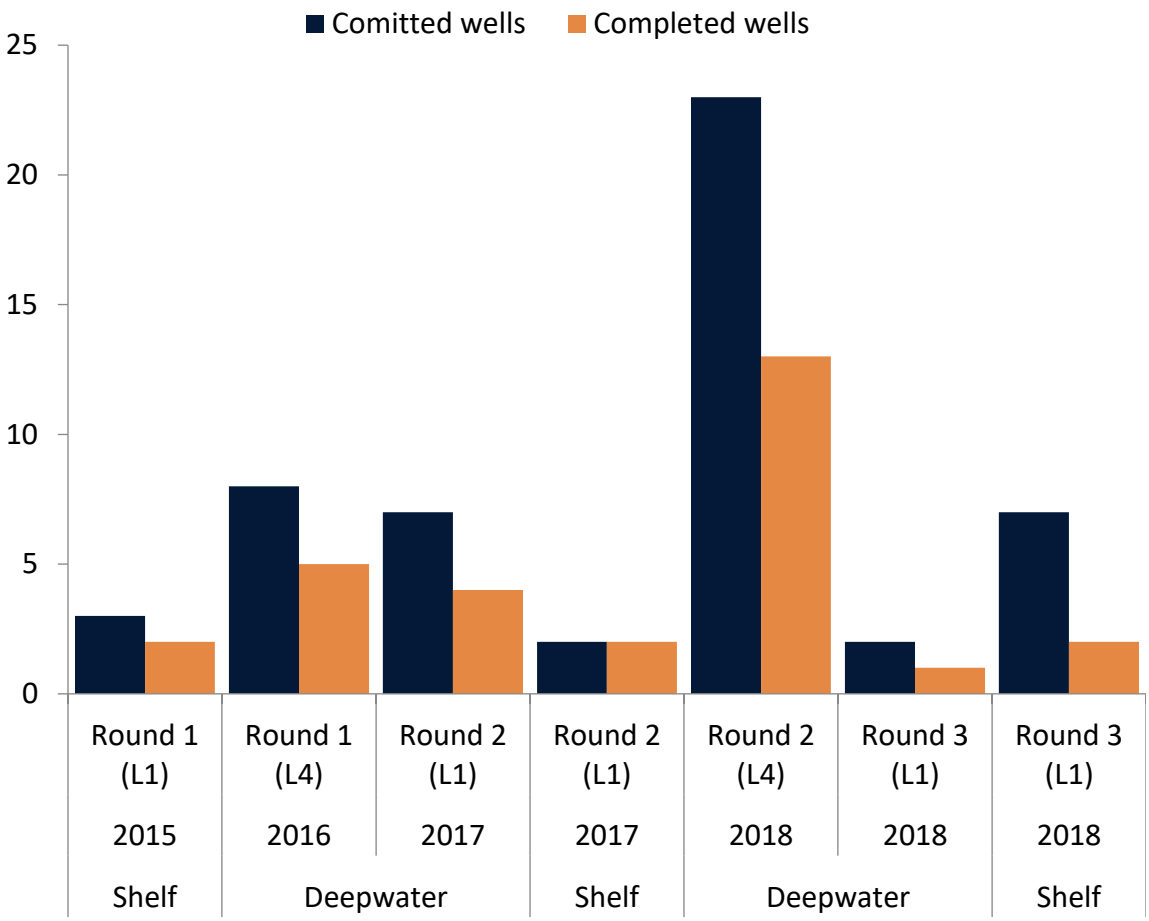
In recent years, Mexico's offshore exploration sector has seen more setbacks than successes. While there have been notable discoveries by players such as Italy’s Eni, US-based Murphy Oil and Spanish giant Repsol, the overall outcomes have fallen short of operators' expectations.

This is particularly evident in the experiences of operators such as supermajors Shell and Chevron, as well as Malaysian NOC Petronas. Despite significant investments and multiple attempts to unlock hydrocarbons, none of their wells have yielded success.

The contrast between committed wells during lease rounds against the actual number of completed wells is more glaring in deepwater, as highlighted in the chart below.

Mexico’s deepwater plays remain underexplored and hold the potential to become the next frontier exploration basin in Latin America.

Committed versus completed wells from Mexico’s offshore lease rounds (2015-18)



Source: Rystad Energy research and analysis; Rystad Energy Ucube; Rystad Energy Upstream Solution

Maximizing the value of Pemex's portfolio through farm-outs

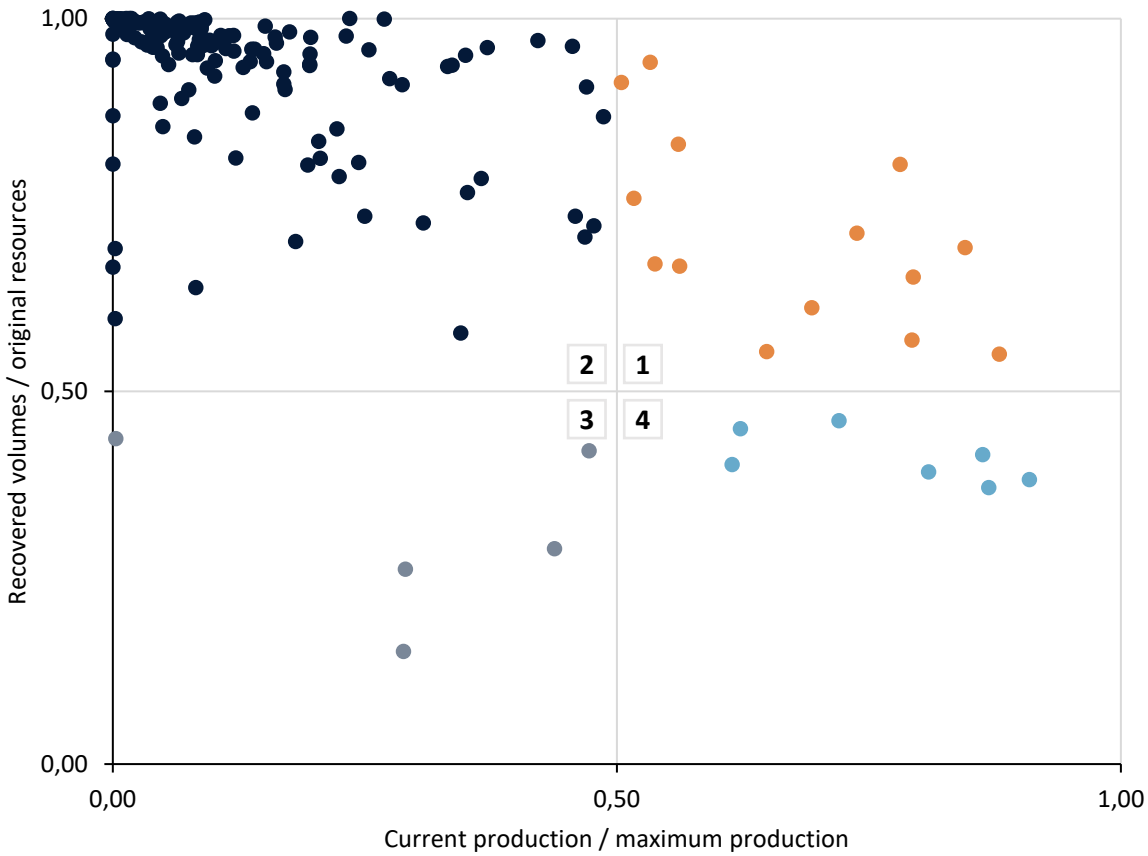
As part of Rystad Energy's analysis, we plotted all Pemex's producing assets in Mexico that have passed their peak production using two key metrics: the ratio of recovered volumes to total resources and the ratio of current production to peak production. This effectively categorizes assets based on their performance and recovery efficiency into four distinct zones:

- **Zone 1:** High-production fields, which have already produced more than half their original resources.
- **Zone 2:** Low-production fields that have produced more than half their original resources.
- **Zone 3:** Low-production fields that have not yet produced half their original resources.
- **Zone 4:** High-production fields that have not yet produced half their original resources.

Rystad Energy's preliminary assessment suggests that mature assets in zones 2 and 3 could be subject to further analysis to determine if they would be farm-out candidates. By doing so, Pemex can focus on applying operational excellence on assets in zones 1 and 4, maximizing the value per barrel produced.

Post-peak production Pemex assets

Recovered volumes by original resources versus current production by peak production.



Source: Rystad Energy research and analysis; Rystad Energy Ucube; Rystad Energy Upstream Solution

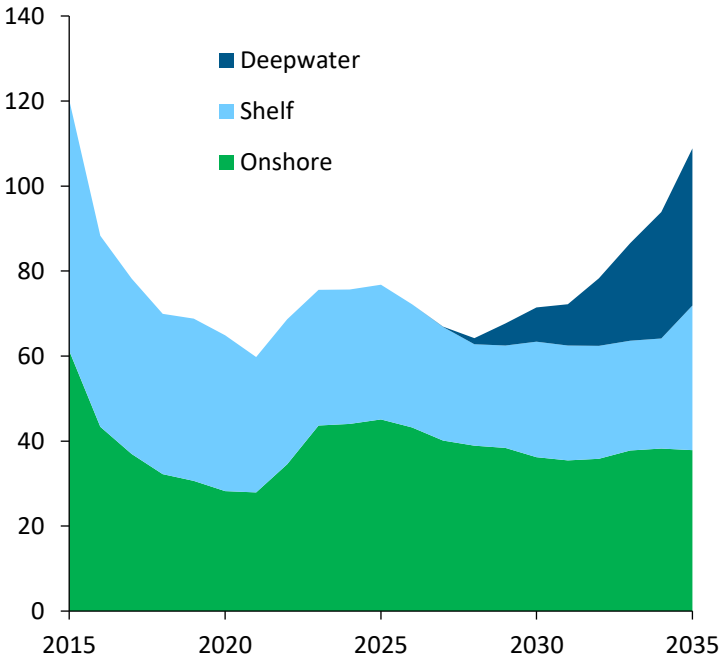
30 MMcmd of competitive gas supply could enter domestic market by 2035

The gas supply scenario in Mexico is similar to that of its liquid hydrocarbons. After a period of declining production in the 2010s, the trend was reversed at the beginning of this decade with the startup of several projects, notably Pemex's onshore Ixachi gas and condensate field. However, this trend of increasing output is unlikely to be sustained for long, since most of Mexico's gas production still comes from mature fields. Currently, over 40% of production comes from assets that are producing the final quarter of their reserves.

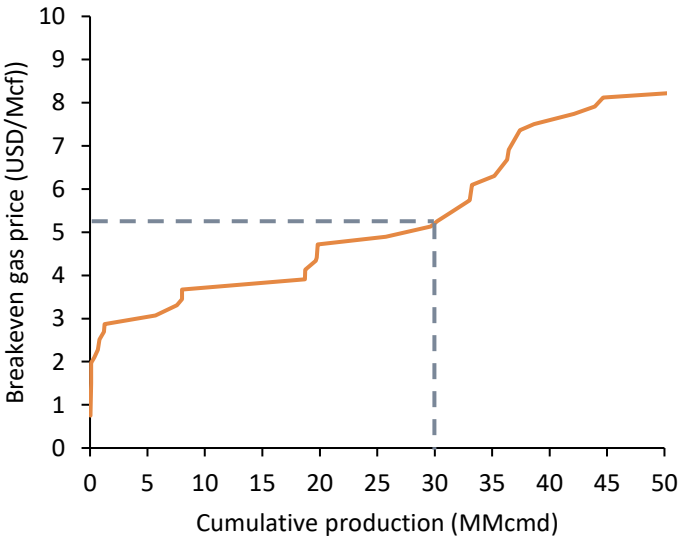
Looking ahead, onshore and offshore shelf assets are expected to sustain gas output above a baseline of 60 million cubic meters per day (MMcmd). Among these two segments, offshore shelf is expected to contribute with more greenfield projects. By 2035, offshore shelf projects that have not yet reached a final investment decision (FID) are expected to account for 67% of production, compared to just 23% from conventional onshore projects.

Rystad Energy's analysis suggests Mexico's domestic gas production is not competitive with Permian shale gas imports from the US. By 2035, less than 30 MMcmd of pre-FID production could have breakeven gas prices below $5 per thousand cubic feet. However, developing these projects could provide more stability in Mexico's gas supply and reduce dependency on US imports, mitigating exposure to Henry Hub gas price fluctuations, which in 2021 surpassed $6 Per Million BTUs.

Mexico gas production split by supply segment
Million cubic meters per day



Cost of gas supply curve for pre-FID projects in 2035
USD per thousand cubic feet (real)



Source: Rystad Energy research and analysis; Rystad Energy UCube

Mexico's gas demand trends

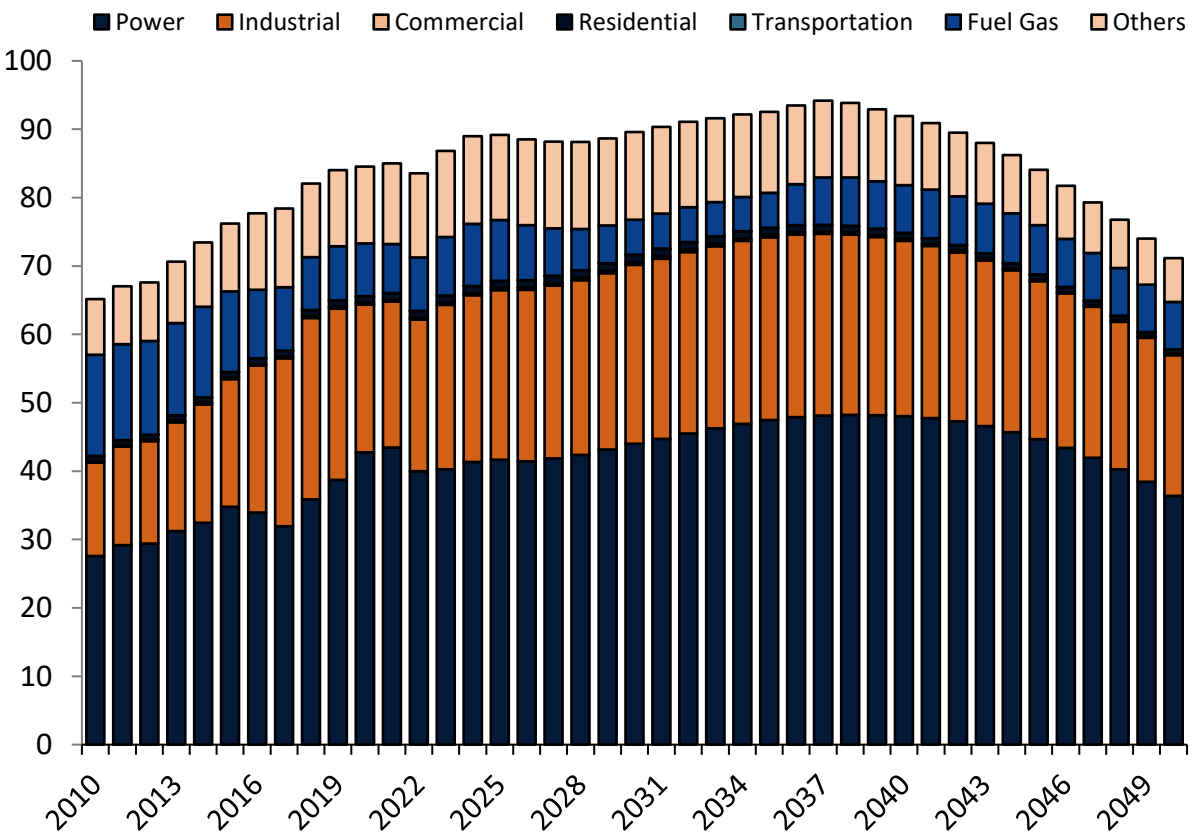
Mexico's gas demand is primarily driven by the power and industrial sectors, with minimal demand from residential heating, transportation and commercial uses.

From 2010 to 2023, total demand increased at an average of 2.3%, mainly pushed by these major sectors. Industrial energy demand peaked at 26.5 billion cubic meters (Bcm) in 2018 and dropped to 21.3 Bcm by 2021 due to the impact of the Covid-19 pandemic. Industrial demand began to slowly recover in 2022, reaching 24 Bcm in 2023.

In contrast, power demand continued to increase until 2021, peaking at 43.5 Bcm before decreasing by 3.5 Bcm the following year.

In the long-term, Rystad Energy expects Mexico to reach peak industrial demand around 2035, with a gradual decline through 2050 due to the sector's transition to cleaner energy. Total demand is expected to peak around 2037, as the power sector's utilization rates decline due to the increasing share of renewables in Mexico's electricity mix.

Mexico gas demand by segment
Billion cubic meters (Bcm)



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; Rystad Energy North America Gas Fundamentals

US imports help balance domestic market

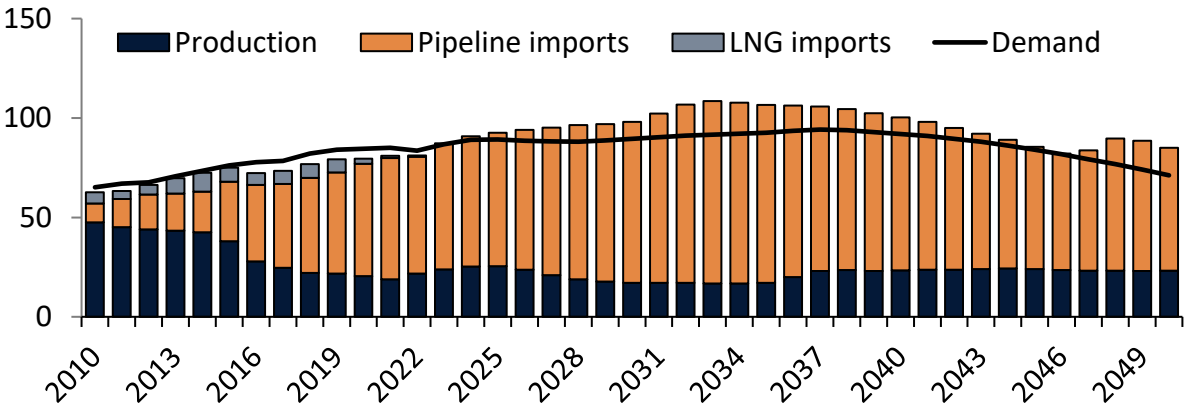
Mexico's domestic gas production has been on a downward trend, with gas imports becoming necessary to balance the market. Liquefied natural gas (LNG) import terminals such as Altamira and Energía Costa Azul were established to provide supply security before 2010. However, LNG imports have been gradually utilized less due to US pipeline imports being more competitive. In 2010, US imports accounted for around 15% of Mexico's gas supply but by 2023 this figure had risen to 73% and is expected to peak at 85% in 2033.

The increase of US gas in the Mexican market has coincided with decreasing domestic production. The competitive price of US gas creates a barrier for new projects, as they must offer a more attractive price than imported gas to conquer market share and require substantial capital investment.

US gas imports offer such a competitive price that an import surplus has enabled Mexico to become an LNG exporter by converting Energía Costa Azul LNG into a liquefaction terminal and creating a new infrastructure for Altamira LNG to enable exports. However, Mexico still has underutilized regasification units in the country to promote supply security, especially during disruptions in pipeline imports.

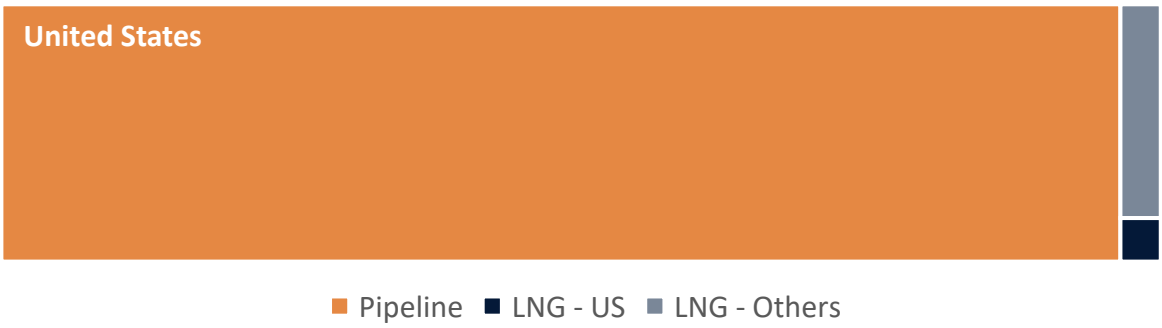
Mexico gas supply and demand balance by source

Billion cubic meters



Mexico gas imports by origin and flow (2010 – 2050)

Billion cubic meters



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; Rystad Energy NorthAmericaGasFundamentals

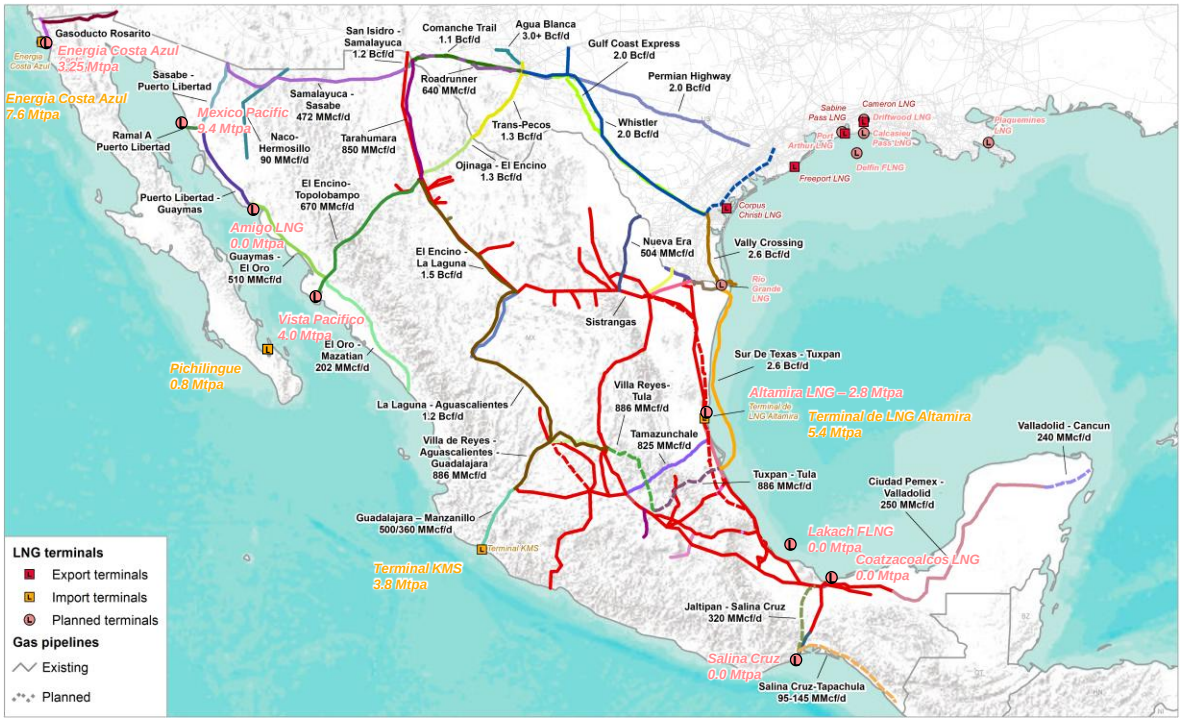
Mexico’s evolving gas infrastructure

Mexico’s gas pipeline infrastructure is designed to connect main supply regions with demand centers. Domestic production is concentrated in the southeast, with established connections to the Mexico City metropolitan region. The country’s largest capacity pipelines are linked to US imports, enabling up to 115 Bcm of gas imports per year. Despite the extensive pipeline infrastructure, the country has some capacity limitations that require future investments to enable the gas supply shift from declining domestic production to higher imports.

The country has four operational regasification terminals with a combined capacity of 17.6 million tonnes per annum (Mtpa) (24 Bcm), however, this is forecast to decrease to 10 Mtpa (13.6 Bcm) following the conversion of the Energia Costa Azul into a liquefaction facility. Most terminals are located on Mexico’s Pacific coast, with only Altamira positioned on the Atlantic coast. Given the Pacific’s more direct shipping routes to Asia, several liquefaction projects have been proposed in Mexico using imported gas from the US. These proposed projects could offer a competitive logistical solution to reduce LNG shipping costs to Asian markets, a region that accounted for nearly 65% of global LNG demand in 2023.

Mexico currently has no dedicated gas storage project, relying only on regasification facilities to guarantee supply security.

Mexico’s gas infrastructure



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; Rystad Energy North America Gas Fundamentals

Mexico's US-dependent LNG exports

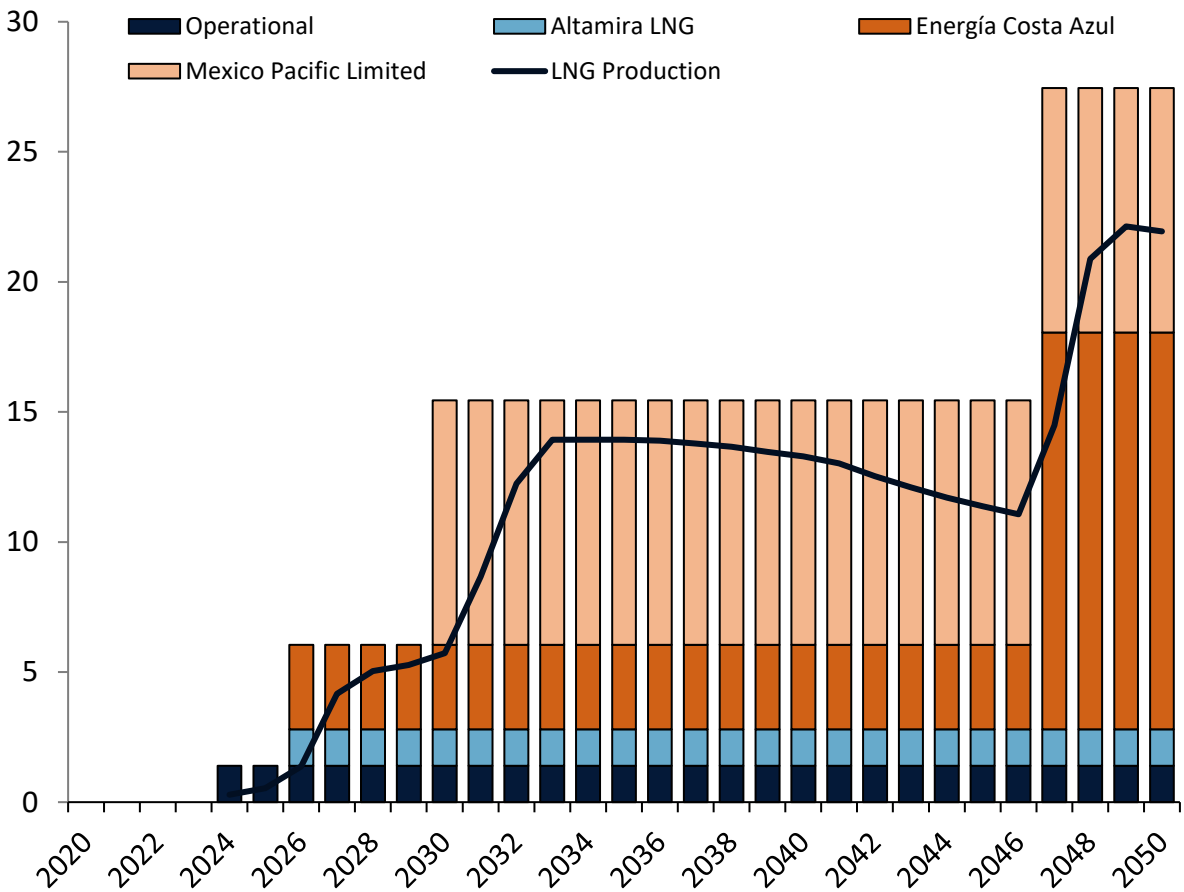
The stability of US gas supply and prices has enabled Mexico to become a global LNG exporter. The first approved project was the conversion of the Energia Costa Azul regasification plant into a liquefaction plant by Sempra Energy in 2020. This was followed by New Fortress Energy (NFE) announcing in 2022 the first train of Altamira LNG, a terminal that utilizes NFE's fast LNG technology, shortening the project's timeline to start up.

Altamira's first 1.4 Mtpa train started operations in 2024, with its first cargo being delivered in August to the Old Harbour floating storage and regasification unit (FSRU) in Jamaica. The second train, with equal capacity, is expected to start operations in 2026, the same year as Sempra's 3.25 Mtpa Energia Costa Azul LNG.

Energia Costa Azul LNG and Mexico Pacific LNG are located on the west coast, providing a geographic advantage to reach Asian markets across the Pacific Ocean. Meanwhile, Altamira LNG faces competition from US projects in the Gulf of Mexico. With these three projects, Mexico has the potential to reach 14 Mtpa of LNG exports by 2033, positioning it among the top 10 LNG exporters globally.

Mexico LNG exports and capacity by terminal

Million tonnes of LNG



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube; Rystad Energy North America Gas Fundamentals

Prices have been ruled by imports

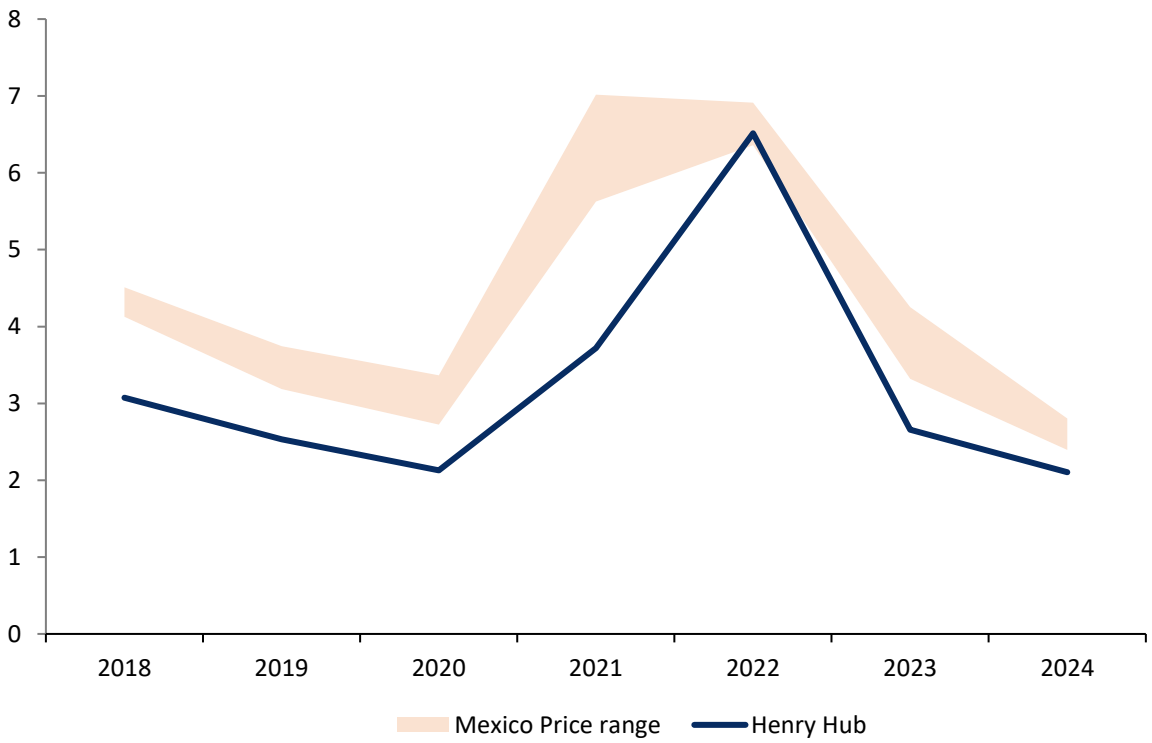
Since most of Mexico's gas supply comes from the US, domestic gas prices have naturally aligned with US pricing benchmarks. The West Texas Waha price hub, located in the Permian Basin, can better represent prices offered to the Mexican market. The indexer used to have a strong correlation with Henry Hub but can present price differences due to infrastructure limitations and regional balances.

Based on this dependence, Mexico has access to one of the most competitive gas sources an import country could have. However, the market is also exposed to international issues. In February 2021, Mexico's Region I for Natural Gas Price references (Baja California, Sonora and Sinaloa) registered an average price of $35 per million British thermal units (MMBtu) due to a winter storm that decreased total Permian production, reducing export flows to Mexico by 20 MMcmd. The incident rekindled discussions over the need for storage facilities and supply security to mitigate price volatility.

The benefit of being exposed to US production is that Mexico is expected to guarantee a long-term competitiveness for LNG export projects on the Pacific coast. However, the negative impact is that regional consumers will be forced to accept US market fundamentals and production crises. Rystad Energy expects that higher long-term demand for US LNG will gradually increase production breakevens in North America, ultimately increasing both US and Mexico market prices for domestic demand.

Mexico gas price range and Henry Hub

USD per million British thermal unit ($/MMBtu)



Source: Rystad Energy research and analysis; Rystad Energy GasMarketCube, Rystad Energy North America Gas Fundamentals

Fossil fuels dominate power mix, but the quest for diversification remains

Mexico has been successful in diversifying its installed generation capacity towards renewables in recent years. From 2018 to 2023, over 3.5 gigawatts (GW) of onshore wind and nearly 9.8 GW of solar PV came online, considering distributed generation. As a result, by the end of 2023, non-hydro renewables totaled 19.7 GW, accounting for 19% of the country's total installed capacity. That capacity comprises 7.5 GW of wind, 7.1 GW of utility PV, 3.1 GW of distributed PV, and 1 GW each of geothermal and bioenergy.

In 2023, non-hydro renewables supplied 14% of the generation mix, twice as much as in 2018. It compensated for the 42% drop in hydro generation, which was affected by one of the most severe droughts in the country. Solar PV represented 7% of the mix, wind 6% and geothermal 1%.

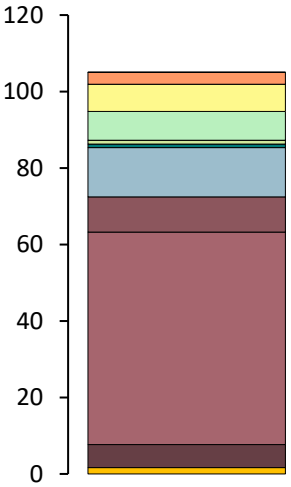
Despite the penetration of renewables in the Mexican generation mix, it remains largely dominated by fossil fuels. Natural gas accounted for 62% of total generation in 2023, followed by liquids (10%) and coal (4%).

Given that the thermal fleet totalled 70.8 GW in 2023, around 67% of the country's installed capacity, decarbonizing its power matrix will require significant efforts from the new administration and coordination with the main stakeholders of the Mexican power sector.

Despite the challenges ahead, diversification towards renewables is key for a sustainable, low-cost and sovereign power matrix, as most of the gas supplying the Mexican thermal plants comes from the US.

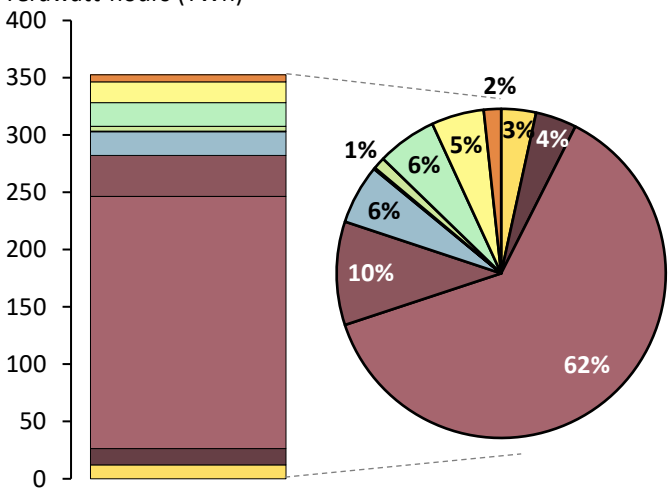
Mexico installed capacity by source in 2023

Gigawatts (GW)



Mexico power generation by source and mix in 2023

Terawatt-hours (TWh)



Source: Rystad Energy research and analysis

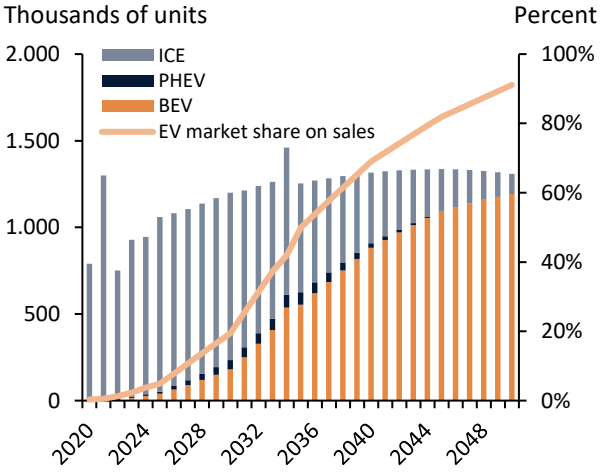
Electric vehicles should boost power demand over the next decades

Power demand in Mexico recovered rapidly after the 3% drop caused by Covid-19 lockdowns in 2020. Between 2021 and 2023, it grew at a compound annual growth rate (CAGR) of 3.9%, mostly driven by the transport and industrial sectors. The country's power demand is projected to grow at a CAGR of 2.2% through 2050, which will require robust investments in generation capacity and grid infrastructure.

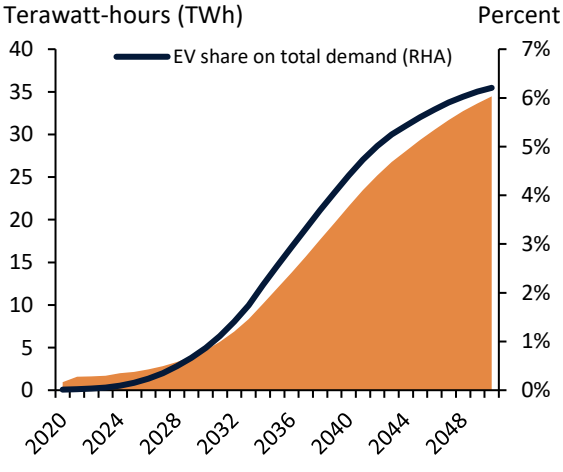
EVs should become one of the main drivers for electricity consumption growth, given they are forecast to account for more than 90% of light vehicle sales by 2050. This segment alone is expected to consume 33 terawatt-hours (TWh) on average that year, accounting for over 6% of Mexico's power demand by that year.

The country has already developed guidelines to start integrating EV charging infrastructure into smart-grid systems to monitor the development of this sector and plan the required infrastructure.

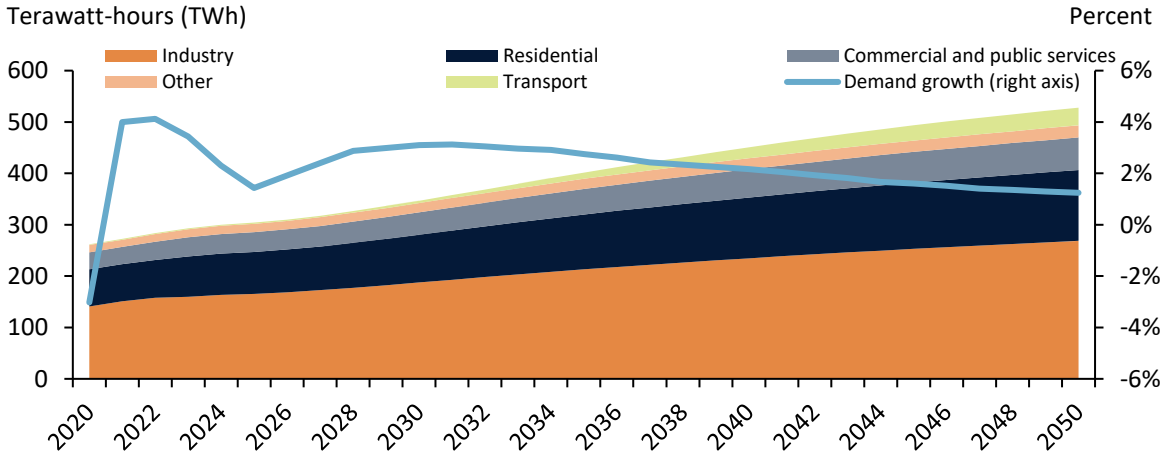
Mexico light-vehicle sales by drivetrain



Mexico power consumption from EV charging



Mexico power demand outlook by sector



Source: Rystad Energy research and analysis

Renewables to lead the expansion of Mexico's energy system

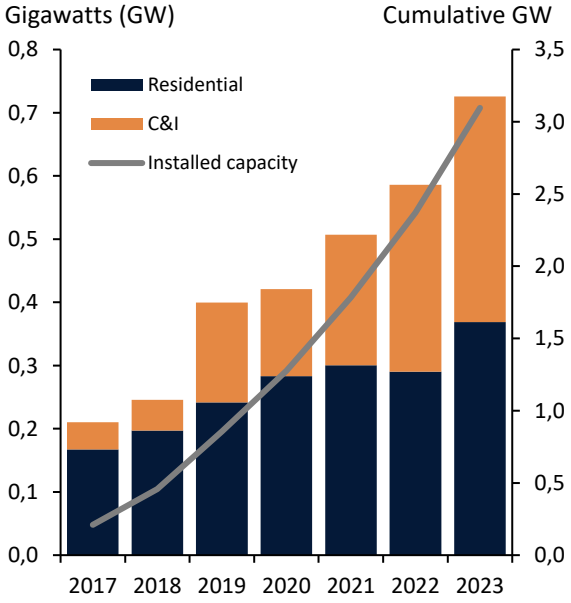
Mexico is blessed with abundant natural resources and has ambitious decarbonization goals. This should enable the National Electric System (SEN) to attract capital and expand through competitive renewable sources. World-class wind speeds in regions, such as in Oaxaca state in the south and the northeastern states of Nuevo Leon and Tamaulipas, enable onshore wind projects with levelized cost of energy (LCOE) below $50 per megawatt-hour (MWh) and an internal rate of return greater than 20%. This represents a significant competitive advantage compared to the global benchmark for this technology.

Similarly, utility-scale PV projects in northern regions such as Sonora, Chihuahua, and Coahuila benefit from high solar irradiance. These states not only host the majority of Mexico's installed solar capacity but also account for most of the new projects under development. Distributed generation (DG) solar projects are also gaining momentum, with nearly 3.1 GW installed by the end of 2023. Of this capacity, 60% comes from low-voltage projects, assumed as residential, with the remaining 40% from medium voltage, assumed as commercial and industrial (C&I). A third of solar DG capacity is concentrated in Jalisco, Nuevo Leon and Chihuahua states. International experiences show that favorable economic conditions for solar DG typically accelerate new connections, and Mexico should have 41 GW installed by 2050.

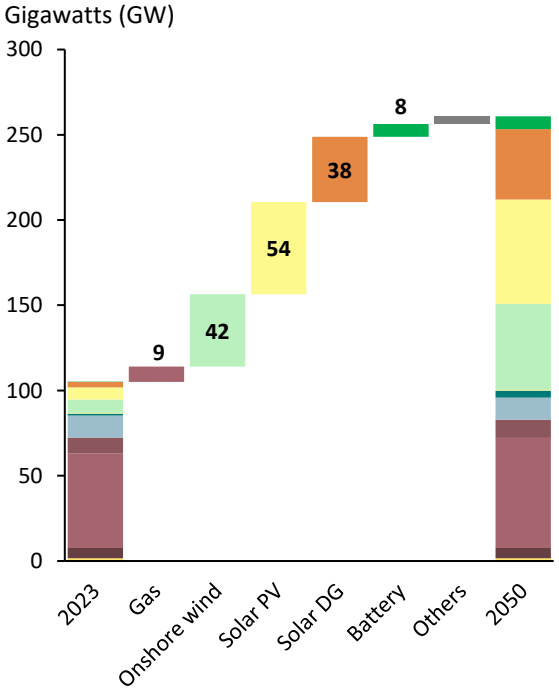
Mexico will need about 117.6 GW of additional capacity from 2024 to 2050 to meet its growing energy demand. Most of these additions should come from utility PV (54 GW), followed by onshore wind (42 GW) and bioenergy (3 GW), considering Mexico's push to decarbonize its power matrix. However, to address the intermittency of these sources, 9 GW of additional gas-fired capacity and 8 GW of batteries will be needed to provide reliability and flexibility to the system.

Streamlining the licensing process and promoting regulatory stability will be necessary to develop the much-needed transmission infrastructure, which has remained virtually unchanged since 2020.

Solar DG capacity additions by category



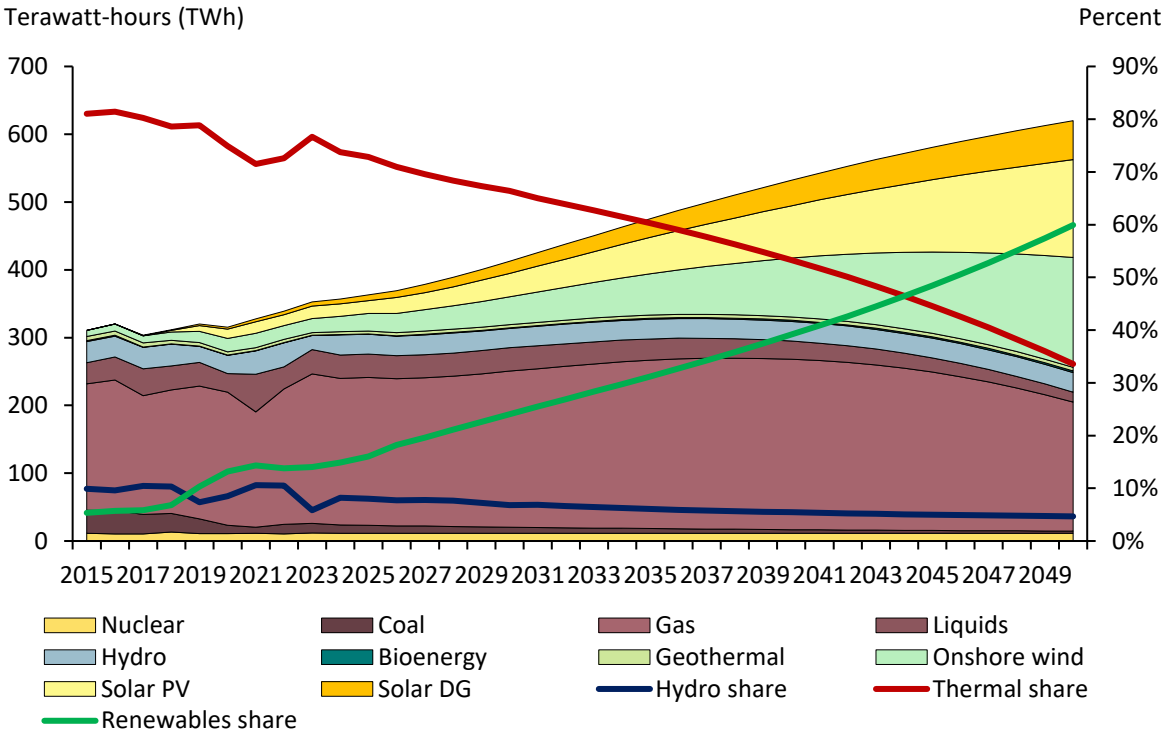
Mexico capacity additions by energy source



Source: Rystad Energy research and analysis

Walking on sunshine: The long, but promising path to clean generation

Mexico power generation outlook by source



Unlike some of its neighbors in Latin America, Mexico's generation mix is heavily dependent on fossil fuels, representing 77% of total generation in 2023. Despite the modest 14% share of non-hydro renewables in the mix, its recent increase indicates that the transition towards a cleaner future has already started. In addition, the current pipeline of projects under construction and expected online up to 2027 should sustain the momentum of renewables. These projects will support Mexico's commitment to reducing emissions from power generation by 53% by 2030.

However, despite rapid demand growth, the lack of investment in transmission infrastructure in recent years is expected to slow the penetration of renewables over the medium term. Transmission networks take much longer to build than generation projects.

Nevertheless, non-hydro renewables are likely to increasingly displace expensive fuel-based generation, reaching nearly a quarter of the power mix by 2030. Assuming the successful implementation of key transmission projects, renewables generation should overtake thermal generation in 2045, which is expected to account for nearly half of the total mix.

The path toward a cleaner generation mix in Mexico could be long and challenging. Gas will likely continue to play a key role in the energy matrix through 2050, serving as the main provider of reliability and flexibility to a system increasingly exposed to weather conditions. By 2050, the share of non-hydro renewables in the mix is expected to grow to 60%, while the share of gas is projected to fall to just 31%, half of its level in 2023.

Source: Rystad Energy research and analysis

New policy is set to increase uncertainties over the power sector

The new administration has just taken office and recently launched a national strategy for the Mexican power sector through 2030, implementing new policies that may bring additional risks for private investors and developers. As a potential consequence, renewable projects that have not yet achieved a final investment decision could be put on hold over the short term, slowing the pace of new additions.

The proposed reform aims to nationalize the energy sector without hindering private investment. It is based on strengthened planning and sovereignty, social justice, system reliability and clear rules to foster private investments. The major change was to turn Pemex and state-owned utility CFE into public service companies. While this grants them more power and autonomy, it also allows greater government Influence in the energy sector.

Under the new framework, CFE is expected to provide 54% of Mexico's power generation, with the private sector accounting for the remaining 46%. The reform also promotes prioritizing dispatch to CFE's plants, instead of the former mechanism based on merit order of costs. In other words, hydro plants and thermal plants from CFE would generate until the 54% share is granted, after which privately owned renewable plants would be allowed to provide power. This could directly affect the revenues from such plants and potentially postpone new investments in renewable projects over the near term. Additionally, generation costs are likely to increase, as renewable generation would be displaced by thermal dispatch from CFE, which would require higher expenses with fuel.

However, another action from the reform is to keep residential tariffs constant in real terms which, combined with increased costs, would result in higher subsidies to be covered by the government. At the same time, the industry sector will likely experience tariff increases as it is not subsidized, which could create an inflationary process, pressuring the government to reduce expenses and subsidies, while limiting its capacity for investments in infrastructure.

Since one of the core focuses of the new strategy is system reliability, there should be room for private investments in the transmission sector moving forward. Over the last five years, transmission infrastructure has remained virtually unchanged, despite robust demand growth and an expansion in generation capacity over the same period. Consequently, transmission bottlenecks and blackouts have become more frequent, exposing the fragility of the Mexican grid and the necessity for further investments. Although CFE has committed to investing nearly $7.4 billion in transmission infrastructure through 2030, additional investments will be required to provide reliability to a system increasingly more exposed to renewable generation.

Battery energy storage systems (BESS) could also become another important driver for private investments. Capital expenditure for BESS is expected to decrease globally with manufacturing capacity expanding in China, while a substantial portion of CFE's thermal fleet is aging and requires high maintenance. The increasing need for reliability, combined with Mexico's decarbonization ambitions, should favor the development of renewable projects with BESS. The ability of the government to promote a safe and favorable environment for developers will be fundamental to the successful implementation of the new plan.

Source: Rystad Energy research and analysis

Project announcements suggest growth in hydrogen demand

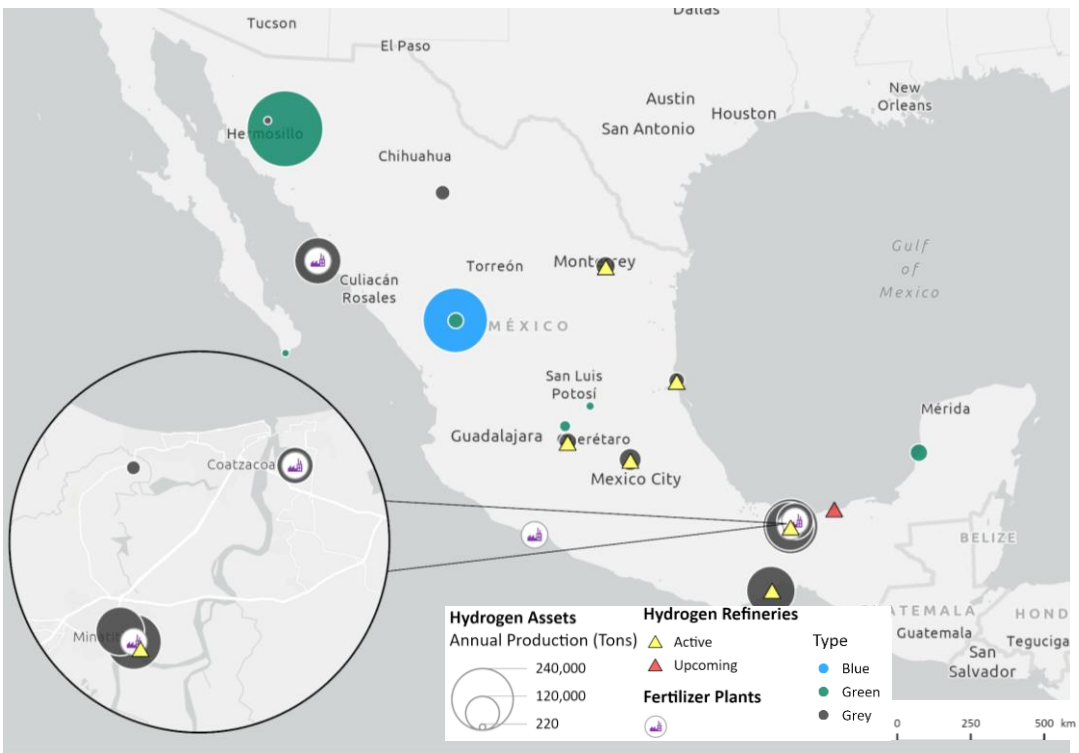
Hydrogen production in refineries and fertilizer plants across Mexico highlights existing infrastructure, which may influence future clean hydrogen projects. Upcoming refineries, mainly concentrated in central Mexico and key industrial areas, imply an expansion in hydrogen capacity to meet anticipated demand. The combination of active refineries and newly planned facilities also points to ongoing investment in hydrogen infrastructure. Additionally, hydrogen production at existing fertilizer plants underscores the role of new projects in supporting the country's ammonia-based fertilizer industry.

Hydrogen production in Mexico is expected to grow, primarily driven by new refineries and merchant capacity. The largest announced production site is close to Hermosillo, near an existing Air Liquide merchant hydrogen plant. When fully operational, the project is expected to reach an annual capacity of 240,000 tonnes. Similarly, Dutch hydrogen developer Tarafert is planning an ammonia plant in Durango City, utilizing both electrolysis and CCS processes to produce clean hydrogen.

The concentration of upcoming projects near key industrial centers, such as Mexico City, Monterrey, and the Gulf Coast, may lead to developing hydrogen projects in areas with existing industrial demand or where demand is expected to grow.

Although Mexico currently relies on unabated hydrogen production, the future is poised for growth and diversification into lower-carbon hydrogen. The strategic positioning of refineries and production sites near key demand centers, such as fertilizer plants and industrial hubs, underscores a clear focus on aligning supply with both present and future needs, supporting Mexico's transition to a cleaner hydrogen economy.

Existing and planned hydrogen production plants in Mexico by production pathway



Source: Rystad Energy Hydrogen Solution

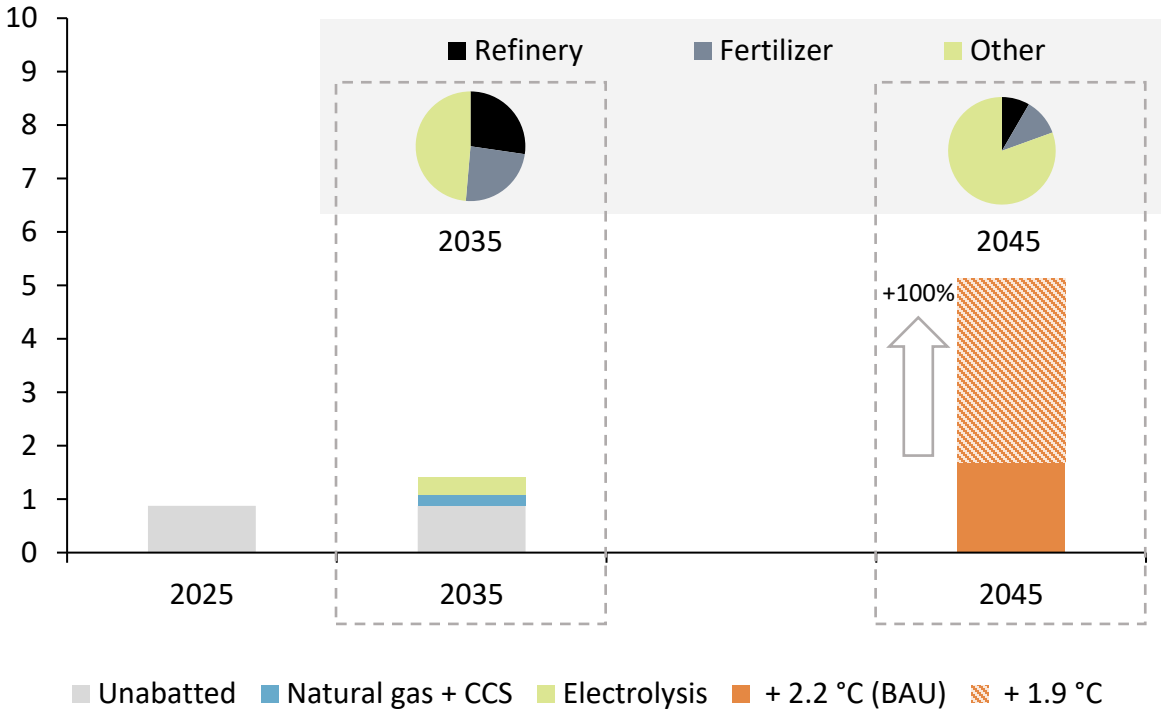
Fivefold increase in hydrogen output needed to achieve 1.9°C goal

Based on recent project announcements, Mexico's hydrogen production is projected to grow by 50% over the next 10 years. However, this growth is still insufficient to meet the requirements of the 1.9°C global warming scenario. To achieve this target, local hydrogen production needs to increase by at least five times the current level of 1 Mtpa, which is primarily used to support Mexican refineries and ammonia-based fertilizer production.

Several recent announcements highlight progress in low-carbon hydrogen projects. These include the Trarafert project, which involves ammonia production from natural gas with CCS, and Aslan Energy Capital's ammonia project, which utilizes electrolysis. These projects represent significant steps toward transitioning to a cleaner hydrogen supply.

Under a business-as-usual (BAU) scenario, which would result in a global temperature rise of 2.2°C, hydrogen production capacity in Mexico is expected to reach 1.7 Mtpa by 2045. However, a production capacity of over 5 Mtpa is required to achieve the 1.9°C climate target, alongside demand growth in additional sectors. By 2045, demand from refineries and ammonia-based fertilizers is expected to account for less than 30% of total hydrogen production, compared to over 50% in 2035 under the 1.9°C scenario.

Estimated hydrogen capacity in Mexico and projected 2045 decarbonization targets
Million tonnes of hydrogen



Source: Rystad Energy Hydrogen Solution

Electrolyzer manufacturing capacity

Mexico has historically played a significant role in the global supply chain for various types of equipment, including automotive parts, electronics, and more. The country now has an opportunity to expand its manufacturing capacity to meet the growing demand for energy transition-related equipment across North and South America.

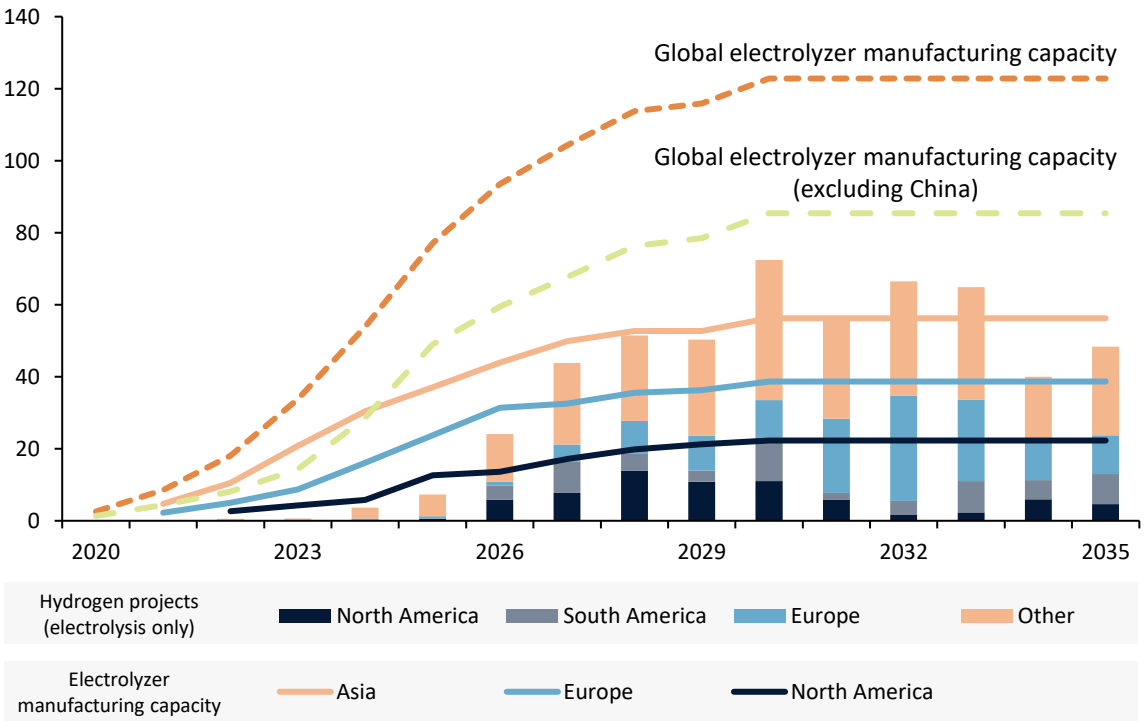
One promising area is the production of hydrogen electrolyzers, which are essential for hydrogen production. As new hydrogen electrolysis projects come online, there will be a need to increase installed electrolyzer capacity.

While global manufacturing capacity for electrolyzers currently exceeds the projected additions over the next decade—partly due to delays in projects reaching a final investment decision—analyzing the Americas separately reveals a potential shortfall in the region's ability to supply its required electrolyzer capacity.

This concern is heightened by manufacturing costs, with the US, for instance, likely to produce electrolyzers at a higher cost compared to China. Additionally, increasing trade barriers in the US and Europe against Chinese products could further drive up the cost of electrolyzers for projects in these regions.

Mexico could emerge as an attractive alternative due to its lower production costs, providing a competitive source of electrolyzers for the US and European markets.

Added project capacity and electrolyzer manufacturing by region
Capacity in gigawatts (GW)



Source: Rystad Energy Hydrogen Solution

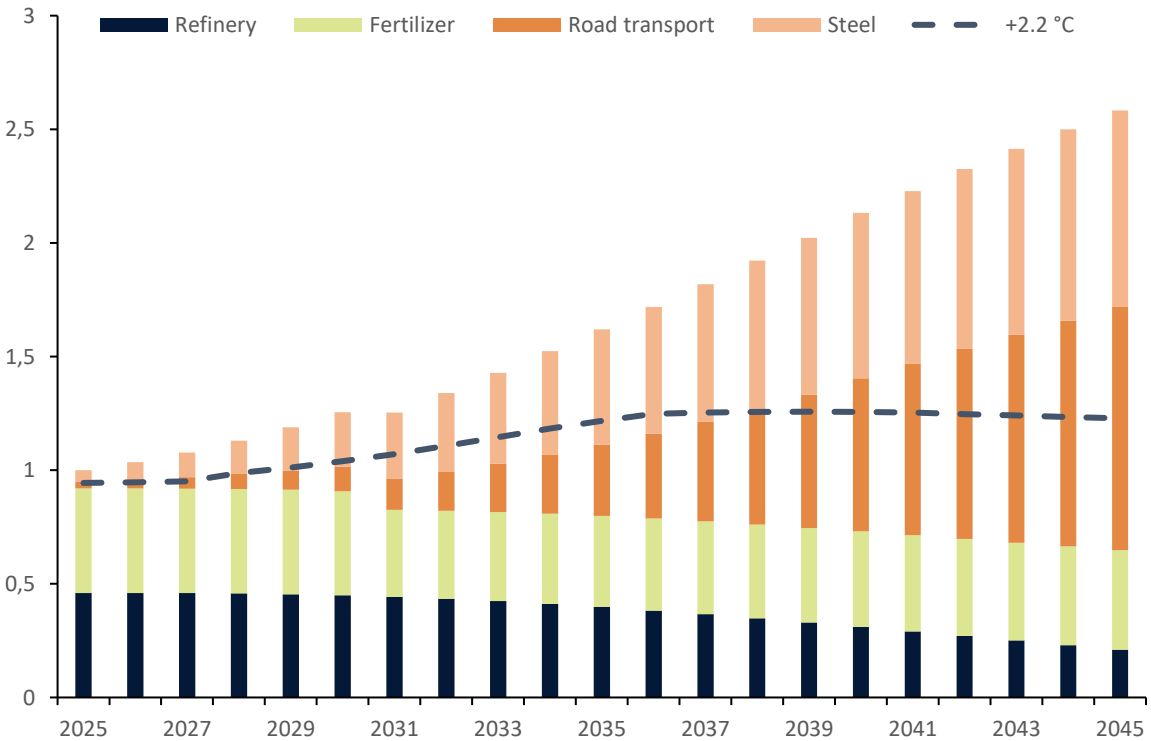
Steel and road transport key sectors for hydrogen development in Mexico

To achieve a 1.9°C global warming scenario, Mexico needs to rapidly reduce carbon emissions in its steel and heavy transportation sectors while gradually phasing out its refineries. Hydrogen will be crucial in this transition as it can help reduce the carbon footprint in these difficult-to-decarbonize segments.

Hydrogen demand in refineries is expected to remain high through the next decade, as facilities such as the Dos Bocas, are yet to reach full production capacity. However, by 2045, refineries will account for a much smaller share of total capacity across the four main segments – refinery, fertilizers, steel, and road transport. Refineries will likely be phased out or operate at limited capacity due to the potential shift towards vehicle electrification. The use of hydrogen in decarbonizing steel and road transport is expected to pick up pace.

Mexico aims to develop around 1 million tonnes of clean hydrogen capacity by 2045 to support these sectors, balancing the need for emissions reductions with practical considerations around current infrastructure and market dynamics. By becoming a regional leader in hydrogen production, Mexico could reduce its emissions and position itself as a key supplier of low-carbon energy solutions to the US and other global markets.

Estimated hydrogen capacity in Mexico and projected 2045 decarbonization targets
Million tonnes of hydrogen



Source: Rystad Energy; Hydrogen Solution

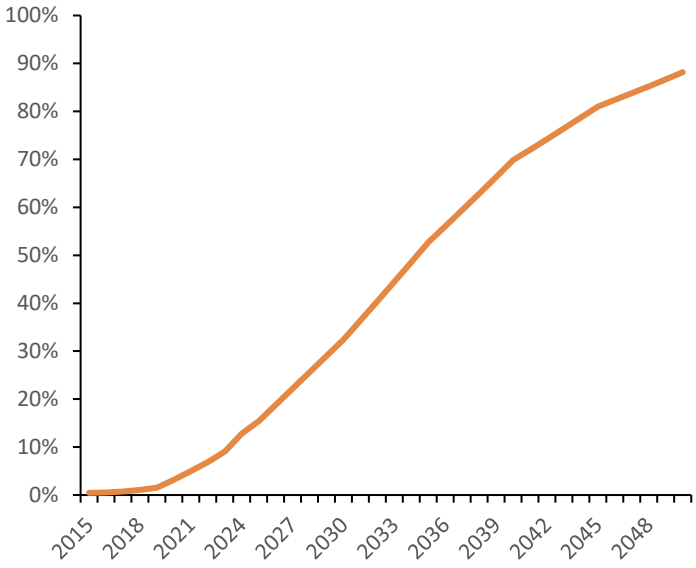
Lithium and batteries: Mexico as a strategic link in the EV value-chain

The phase-out of oil and the transition to a cleaner energy mix implies a shift to an EV-dominant fleet. Rystad Energy estimates that, on average, most countries will have over 30% of their passenger vehicle fleet electrified by the end of the decade. By 2050, this number will rise to 88%, with some countries achieving 100%.

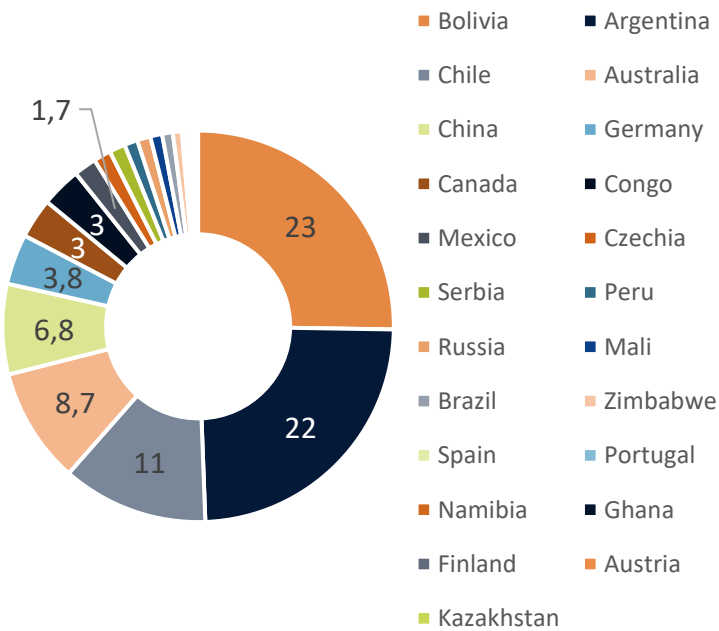
This penetration will significantly increase the demand for batteries, along with their components and raw materials. Mexico is well-positioned to take advantage of this demand surge. Its proximity to the US market and nearshoring – where companies move parts of their supply chain closer to Mexico from the Far East – will play a significant role in attracting investments. Following this trend, US EV maker Tesla announced its Gigafactory in Monterrey in 2023.

Another advantage is Mexico's well-developed mining sector, which is already producing critical minerals such as graphite and cobalt. However, the most critical mineral is lithium. Despite being among the top 10 countries with the most lithium resources, Mexico still does not produce the metal. In 2023, the government nationalized the industry, shortly after having created the mixed capital company LitioMx, which functions as Mexico's national lithium company. This move halted previous private sector efforts, without providing clear guidance on funds or development plans for the industry.

Average EV adoption per year by country
Share of the total national fleet



Distribution of lithium resources by country
Million tonnes



Source: USGS Mineral Commodities Summaries 2024; Rystad Energy BatteryMarketCube and BatteryMaterialsCube

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