



Mapping renewable energy policy development at the state level in Mexico

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Executive summary

This report maps renewable energy policy development at the state (provincial) level in Mexico and tracks early experiences with renewable energy deployment in four selected Mexican states. “Renewable energy policy” refers to policy instruments that state governments have adopted to facilitate renewable energy deployment (e.g., long term climate and energy strategies, subsidies), and the institutionalization of these instruments through the establishment of state entities responsible for their implementation (e.g., state energy agencies).

Because energy governance in Mexico has historically been considered a federal matter, there is a lack of publicly available information about renewable energy policy activities at the state level. There is no central database tracking policy development, or systematic review of the states’ experiences. Therefore, the report reviews renewable energy policies and experience with renewable energy development at the state level by conducting desk-based analysis (of academic studies, media articles and official websites) and interviews with local stakeholders.

The report finds that several states have changed their institutional design to give a higher priority to energy issues and develop their renewable energy potential over the past two decades. Some states have included renewables in their strategic plans, some mention them in their development plans, while others have included them in their environmental planning, energy efficiency plans, or specific renewable energy development plans. To date, ten states have published their own energy laws.

State governments have also promoted renewable energy deployment through the implementation of policy instruments targeting both the supply and demand side of the energy market. States have evaluated their renewable energy potential, made commitments to buy renewable energy, lowered local property taxes, subsidized solar panels on rooftops, and made financial resources available for the construction of transmission lines. The most advanced states have developed energy information systems which facilitate synergies among relevant actors and ensure the transparency renewable energy plan implementation.

The report identifies 13 states that have established Energy Agencies or Commissions, taking energy issues away from local ministries and giving these dedicated agencies a higher level of authority. Such agencies signal that state governments are paying more attention to energy issues and need new institutions to coordinate the state’s involvement in renewable energy development. The Energy Agencies or Commissions have been designed with different levels of authority. For instance, some are granted the authority to sign collaboration agreements with renewable energy developers, while others are not.

The policy developments documented in this report mark an important shift in Mexico’s energy governance, which has historically been considered a federal matter. According to the Constitution, the Federal Government is responsible for planning and controlling the national electricity system, including all power generation, transmission, and distribution activities. Since 2013, private companies can generate electricity under the Energy Regulatory Commission (CRE) regulation. The Energy Reform (2013) and General Law on Climate Change

(2012), however, recognize states as key partners for increasing the share of renewables in Mexico's energy mix.

While the willingness to support renewable energy development is high among many states, their ability to do so is limited by the highly centralized market structure and current federal administration's energy policy agenda, which is centered around fossil fuels and aimed at limiting private investment in the power sector. Under the current administration, authorizations from CRE have stalled, leaving companies unable to start operations. States are frustrated by the "administrative silence" from the federal agencies and lack of transparency in federal processes related to permits and licenses.

In this context, distributed generation has emerged as a focus area for state governments, along with energy efficiency and electrification of transportation. Distributed generation may face lower opposition and fewer regulatory barriers from the Federal Government. Distributed generation promotion policies, solar households, and solar *ejidos* (common lands) are found to be successful policies that can be replicated in other states.

The report takes a close look at the experience with renewable energy development in four states: Jalisco "The entrepreneur"; Oaxaca "The pioneer"; Puebla "The pending promise"; and Tamaulipas "Renewables complementing fossil fuels". The cases were selected based on the following three criteria: variety in renewable energy policy choices; renewable energy potential; and political party affiliation. The report finds that the state profiles vary, reflecting different policy priorities and local characteristics, including renewable energy potential, state capacity, and socio-economic development.

State governments are also found to be crucial to the coordination of renewable energy development across different levels of government. They act as conduits between local industry and the federal authorities, and between federal and municipal authorities. Such coordination is not homogeneous. It depends on the leadership of the governors, political party alignment, and the institutional framework. Often, it also depends on the personal efforts of key actors.

The case studies suggest that coordination between the federal and state government on renewable energy development has worked well in the past when the policy agenda between the two levels was aligned, but such coordination is currently very limited. The extent to which large renewable energy projects develop at the state level depends on their timing. Those that started before the current federal administration came to power have advanced more smoothly than those initiated after 2018.

Some states are making a significant effort to learn from each other, and new structures are emerging to facilitate such learning. National and international organizations such as the Mexican Climate Initiative and the World Resources Institute assist various Mexican states in planning, implementing, and funding energy strategies. They also promote networking among states, initially through the Governors Alliance for the Climate, followed by the Mexican Climate Community.

State energy agencies in Campeche, Jalisco, Nuevo León, Querétaro, Quintana Roo, Puebla and Tamaulipas have also promoted the idea of an association for energy agencies. Jalisco, Tamaulipas, Yucatán, Mexico City, Sonora, Puebla, Nuevo León, Quintana Roo, and Guanajuato have been proactive in looking for assistance from expert institutions and other associations to design and implement their plans and strategies.

The findings from this report suggest that more can be done to coordinate efforts. For instance, one problem that the states have encountered is that solar panel providers and installers vary significantly in terms of prices and quality, which can be confusing for consumers. Jalisco's Energy Agency now certifies panel providers, so that households have better information on the quality of their service. Such certification schemes could be done in collaboration with other states. Similarly, the development of green supply chains could be conducted at a macro-regional scale rather than by individual states.

Furthermore, due to the lack of standardized practices, there is little agreement on how to measure the social impact of renewable projects. Some firms import practices from other countries where they operate, others cater to local needs, thereby generating joint benefits. However, social unrest and opposition to renewable energy projects is quite common.

The widening gap in policy priorities between federal and state decision makers is unfortunate. As noted in this report, the potential to develop renewable energy is distributed across a diversity of Mexican states. Moreover, decisionmakers at the state level pursue renewable energy not only for the sake of the climate and environment, but because they view renewable energy development as means to reach other social and economic policy goals: affordable electricity for their population and businesses, industrial and economic development, and health. These are policy goals that, in principle, they share with the federal government.

The mapping of renewable energy policies and experience with renewable energy development at the state level was conducted through desk study and interviews. Interviews were carried out with decisionmakers, industry actors and environmental organizations. Based on this material, a relatively positive storyline around renewable energy emerges. However, a review of the scholarly literature and news articles also uncovered many instances in which renewable energy development engendered local opposition.

1. Introduction

This report maps renewable energy policy development at the state (region) level in Mexico. Renewable energy policy in this context refers to a variety of policy instruments that state governments have adopted to facilitate renewable energy deployment, such as subsidies or long-term climate and energy strategies, and the institutionalization of these instruments through the establishment of state entities responsible for implementing them (e.g., state energy agencies). The report does not evaluate the effectiveness of renewable energy policies.

Energy governance in Mexico has historically been considered a federal matter and Mexico's 32 state governments have limited responsibilities and capabilities according to the current legal framework. However, the General Law on Climate Change from 2012 and the Energy Reform of 2013 both recognize the shared responsibilities for renewable energy development across different levels of government.

Along with changes in the federal legal framework, state governments have started to express increased interest in promoting renewable energy. As documented in this study, numerous states have integrated renewable energy goals into local planning tools. Ten states have adopted renewable energy laws, while 13 states have created their own energy agencies. The motivations behind these developments vary from state to state, reflecting both internal drivers (e.g., political leadership, local industry demand) and external drivers (e.g., international companies seeking business opportunities).

The more active participation of state governments in renewable energy development has so far received little attention in Mexico. There is no central database to track policy development at the state level, nor any systematic reviews of the various experiences with renewable energy policy development. Existing research on renewable energy policy in Mexico tends to focus on the federal level (Matsuo and Schmidt 2019; von Lüpke and Well 2020; Villavicencio et.al 2020). This report therefore applies an explorative approach to gain a comprehensive overview of renewable energy policy activities at the state level. In addition, the report delves further into the experience with renewable energy policy development in four selected states.

The more active role of state governments in renewable energy policy development marks an important shift in Mexico. This shift, however, is not unique to Mexico but reflects a global trend. Energy transition is not only about moving away from fossil fuel to clean sources of energy. The decentralized characteristics of renewable energy have enabled new types of actors from communities, households, and local governments to take on a more active role in energy governance. Globally there is also an increased recognition of the important role local and sub-national governments play in the transition towards a low carbon, decentralized, and smart energy system.

The ability of state governments to facilitate renewable energy development, and eventually the effectiveness of the policy instruments documented in this report must be analyzed in the context of Mexico's federal political system. Based on the experience from other countries, it is clear that that a federal system can both be an opportunity and a barrier to energy transition (Karapın 2020; Saurer & Montast 2021). Federalism may provide opportunities for experimentation with policies and renewable energy development models at the sub-national level. If successful, such policy innovations can diffuse upwards and become part of federal legislation. This dynamic on the other hand, depends on both the existing distribution of authority and the position of the federal government on energy transitions issues.

In Mexico, the ability of state governments to facilitate renewable energy development is largely hindered by a highly centralized power market structure, coupled with the reluctance of the current federal government to promote and approve private investment, and its desire to refocus on fossil fuels (Lozano-Camargo, et al., 2019, Vita Garza et al, 2019). In 2013, the country sought to reduce the demand for fossil fuels for power production through its Energy Reform. Tenders for renewable energy and a progressive reduction in costs promoted the addition of wind and solar capacity. With the change of administration in 2018, the Federal Government turned its attention back to fossil fuels, and recentralized energy decision making into the hands of the two state energy entities CFE (Federal Electricity Commission) and the Mexican oil company PEMEX. New evidence from the business plans of CFE underline the current lack of investment in renewable energy (Esparza Rosales, 2022).

Another key challenge for state governments' ability to facilitate renewable energy development is local opposition. Energy transition has caused social conflict in locations where renewable energy facilities are built. There are many reasons why this happens, some being low payments for the land and long leases (Ávila-Calero, 2017), corruption among different actors (community members, government authorities, and renewable energy companies), a lack of respect for human rights (Gardner, 2019), little to no benefits for local communities (Velasco-Herrejón, 2022; Oviedo Toral et al, 2022; IASS, 2020), and ecosystem degradation (Greenpeace, 2021). Often several of these problems overlap (Petróleos Mexicanos; Elizalde & Severiano, 2020, Berezowsky, 2023; Vásquez, 2015).

This report is based on both primary and secondary sources. Interviews were mainly conducted with decision makers, industry, and non-governmental organizations (NGOs). We first talked to actors that could provide insights into the general trends across all states, and then state decision-makers and industry actors operating in four selected states. Community perspective has mainly been covered through review of scholarly literature and media.

As a first step, we mapped renewable energy activities across all states. To identify legislation, programs, or projects, we first identified the type of energy authority in each of Mexico's 32 states. Some states have an energy agency or commission, others have offices within local ministries, and some did not have any structure within the local ministry. Once we were clear on the type of office, we then looked on their websites to identify whether the state had projects, programs or laws that addressed this topic.

Initial mapping showed that several states have recently implemented renewable energy policies and/or established energy agencies. To select states for in-depth analysis the following criteria were used:

1. The state has pursued a combination of institutional designs (agencies or offices, energy law). Three of the chosen states have agencies, while the fourth has an office within the ministry. One of the states has a law on renewable energy while the remaining three operate under the existing legal framework.
2. States with high solar or wind capacity and/or high potential to develop capacity. Two of the cases have the highest wind and total renewable energy capacity in the country,

another has a balance of generation from wind and solar, and the other has considerable potential to generate renewable energy.

3. Representing different political parties. Three of the states are aligned with the current ruling party, while the fourth state has an opposition party in charge.

The states selected were Jalisco, Oaxaca, Puebla, and Tamaulipas (see Figure 1), representing the diversity of Mexican states as evaluated against the four criteria above:

1. Puebla, Tamaulipas, and Jalisco have been actively advancing state energy policy, have changed their institutional framework, and established energy agencies.
2. Oaxaca and Tamaulipas have a high installed capacity of wind, and Jalisco of solar, including distributed generation. Even though Puebla does not have much existing installed renewable energy capacity, the state could add more than 1,500 MW of utility state capacity according to IRENA.
3. Jalisco is governed by an opposition party to the Federal Government. Puebla is ruled by the same party as the Federal Government. Oaxaca and Tamaulipas changed government during the project and are now ruled by the same party as the Federal Government.

The report is structured as follows. Chapter 2 provides an overview of the policy and regulatory environment shaping renewable energy development in Mexico at the federal level. In Chapter 3, we provide some figures for renewable energy potential and current capacity. Chapter 4 details the authority of state governments in energy decision making and renewable energy policy activities across all states, and Chapter 5 describes the experience of renewable energy development in the four cases. We provide some concluding remarks in Chapter 6.



Figure 1. Map of Mexico highlighting the states selected for case studies

2. Energy governance in Mexico

Key insights

- The 2013 Energy Reform changed the institutional framework and opened up the power sector for private investment. The Constitution was amended, and the Electricity Industry Law (2014) and Energy Transition Law (2015) were enacted.
- The Reform created novel instruments such as Clean Energy Certificates (CECs), provided for wholesale markets as well as auctions for energy and capacity markets, and attracted a sizable amount of investment.
- When President López Obrador came to power in 2018, a counter-reform started. He put new auctions for renewable energy on hold and proposed a higher share of coal and fuel oil for power generation. Several attempts have been made to change the legal framework in alignment with these decisions.
- Mexico's international climate-change commitments were updated in 2022 and now include a 35% GHG emission reduction target by 2030.

There have been significant changes in the legal framework governing the energy sector in Mexico over the past decade. First, the 2013 Energy Reform designed a new electricity market, changed the operation of CFE (the Federal Electricity Commission) and incentivized new investment in generation, especially from renewable sources. The reform set the stage for the participation of private investment in the country's energy transition. As result, investment in both renewable generation and capacity have grown over the years (IEA, 2016, 2017; Alpizar-Castro and Rodríguez-Monroy, 2016, Chanona, 2016).

In 2018, however, the current Federal Government started a counter-reform. Their main objective has been to reposition CFE's control over the electricity market. To date, this move has only been partly successful by limiting the entrance of other private competitors into the electricity market, and it has led to high level of uncertainty regarding the role of renewables. Some of the implemented changes prioritize fossil fuels over renewable energy generated by private companies. Mexico's climate change and energy transition legislation however remain unchanged.

The 2013-2014 Energy Reform

In 2013, Mexico significantly reformed its energy sector, changing the rules and players in both the electricity and hydrocarbon sectors. Acknowledging the need for private investment in the energy sector to promote economic growth, the reform revised Articles 25, 27, and 28 of the Constitution to attract both domestic and foreign investment to the energy sector. It also modified existing conditions for hydrocarbons and electricity.

The reform led to a change in the perception of the Mexican energy sector as a strategic sector whose services needed to be exclusively supplied by the government. The constitutional amendment allowed for the participation of private firms, including foreign investors, in electricity generation. Until then, the Constitution had provided CFE, the state-owned utility, with exclusive rights over electrical energy generation, transmission, distribution, and sales. CFE has been plagued by inefficiencies, such as transmission losses, subsidies, and a lack of investment in potentially profitable businesses. As a result, Mexico faces high electricity costs and lacks competitiveness when compared to its main trading partners, such as the US (Rousseau, 2018).

The goal of the electricity reform was to move from a vertically integrated structure to a more diversified set of companies that would coexist with CFE in a more competitive environment. The changes to the existing legal framework opened up generation activities to the private sector, which could now compete with state-owned power plants. All transmission and distribution activities – considered a natural monopoly – remained under CFE. Private investors, however, were allowed to build and operate gas pipelines under contracts with CFE.

The National Energy Control Center (CENACE), the system operator, became an entity independent of the CFE administration. That is, CENACE would operate autonomously and independently and continue to oversee the operational control of the national electricity system, but now acting as an independent system operator (ISO). It also became the operator of the wholesale electricity market, with a non-discriminatory access policy to the national

transmission and distribution networks. The Government's decision to create an ISO supported the efforts to limit CFE's monopoly power.

A new Legal Framework

An Electricity Industry Law (2014) was enacted to make the Energy Reform possible. It defined the conditions for establishing a new market design, including the coexistence and competition between CFE and private actors. It also enumerated the responsibilities of the new ISO, confirmed the duties of the Energy Regulatory Commission (CRE), and reformed the Ministry of Energy (SENER). Among its new tasks, SENER was given authority to set yearly targets for renewable energy, as well as for the deployment of any transmission investment required for the integration of renewable sources of electricity generation.

A crucial aspect of the Reform was that the Energy Transition Law (2015) was adopted (in addition to changes in the Constitution and the definition of the Electricity Industry Act). It allowed the three levels of government to sign agreements with other actors in the market to finance clean energy and energy efficiency projects. The law also "defined" the sources of clean energy for electricity generation, which included renewables (hydro, wind, solar, geothermal), nuclear, and technologies such as carbon capture and storage.

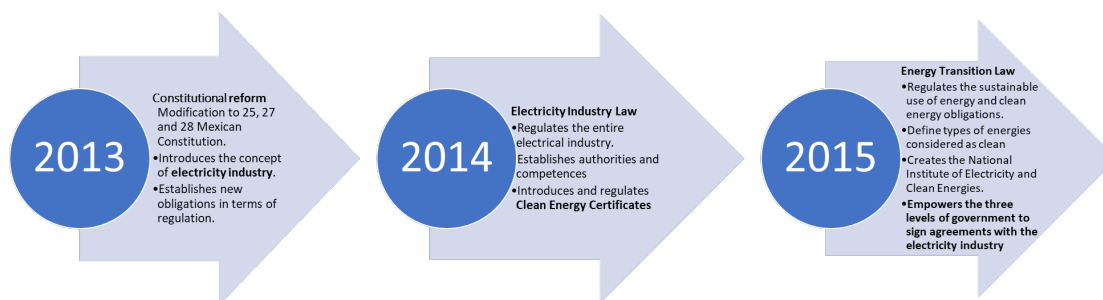


Figure 2. Main changes to the Mexican Legal Framework

All in all, the changes shaped a new electricity market. This market, in turn, included several sub-markets and novel instruments such as Clean Energy Certificates (CELs). A CEL is a title

emitted by the regulator (CRE) and delivered to power generators using clean energy sources (mainly renewables). These titles can then be traded in the market to comply with the requirements of clean energy consumption faced by load centers. Furthermore, consumers with demands higher than 1 MW could select suppliers, once classified as qualified users. This meant that they were not bound to CFE and could buy energy from private suppliers. Residential users remained linked to CFE.

The new market design viewed the introduction of renewable energy as an integral part of overall energy use. The new market was promoted by the obligation to purchase CELs, matching the right to receive CELs depending on the quantity of clean energy generated, and was expected to provide consumers and investors with information about the price, location, and timing of renewables (Wilson Center, 2018). These obligations, in turn, were closely coordinated with the Nationally Determined Contribution (NDC) that Mexico submitted as a signatory of the Paris Climate Agreement.

Recent reforms to the Institutional Framework

This Energy Reform initially resulted in a successful set of auctions for both oil and gas, as well as renewable energy. A sizable amount of investment was committed, and the auctions resulted in low costs for renewable generation (Senado de la República, 2018, García, 2017). However, in 2018 a new administration came into power and severely questioned the value of the above-mentioned reform.

The López Obrador administration put new auctions for renewable energy on hold, de-emphasized the use of renewables for electricity generation, and proposed a higher share of coal and fuel oil for power generation. In addition, the federal administration made the decision to build a new refinery in Mexico (Dos Bocas) and to buy a refinery in Texas (Deer Park). These changes have altered the direction of Mexico's overall energy policy and are likely to alter Mexico's energy trajectory, and consequently the energy sector's impact on the environment.

In 2018, a new energy policy document was released, aimed at increasing the domestic production of fossil fuels, invoking national security arguments. With a shrinking international

market for heavy crude oil, the strategy sought to channel the resulting fuel oil into power generation. New rounds of auctions for renewables were also cancelled. That policy change, however, was contested in court, since it required changes to the Constitution as well as to the Electricity Industry Law.

A new set of attempts to change the law and the Constitution followed. In February 2021, the administration released an initiative to change the Electricity Industry Law. It was approved in March but contested by renewable energy producers in court in April. The contestation was denied by the Supreme Court but created an opportunity for the industry to initiate lawsuits (Amparo proceedings) against the Government. Nevertheless, the current Federal Government's energy policy has led to uncertainty in the renewable energy industry.

The 2021 Electricity Industry Law inhibits the development of new clean energy and perpetuates the consumption of fossil fuels through three mechanisms: i) a change in the rules around the order of dispatch for power generation, ii) expansion of the application of CELs, thus reducing their effectiveness, and iii) the suspension of new auction rounds to deploy renewable generation. According to the law, the new order of dispatch, meaning the energy that would first be provided, would not depend on the marginal costs of generating the power but give priority first to CFE's hydro and nuclear generation, followed by geothermal and CFE's thermal and natural gas plants electricity. Only then would solar- and wind-based power generation be allowed into the system. Second, the Clean Energy Certificates can now be delivered to all clean sources, including old hydropower plants belonging to CFE. This change increases the supply of CELs and lowers their price and hence their effectiveness as an incentive for new renewable energy investments. Third, the suspension of new auctions reflects the loss of interest in increasing renewable sources for electricity generation.

In September 2021, the Federal Government sent a new set of constitutional reforms to Congress for approval. The reforms intended to re-establish government control over the oil, gas, and electric power industries. In electricity, the proposal called for exclusive control by the Federal Government of all power activities (see Table 1). CFE would also regain control over the national electricity system, including the re-assimilation of CENACE, the system

operator that had become independent of CFE in 2013. Under this scenario, the integration of power plants using renewable sources would be limited, since most of the investment had been made by the private sector. The initiative also proposed the abolition of the chief regulating institutions of the energy sector (such as CRE, for example), as well as the economic instruments created to increase the use of renewables (notably the CELs). The constitutional amendments did not, however, receive enough votes from Congress to continue the approval process.

Table 1. Constitutional changes proposed in 2021 (selected changes proposed for electricity)

| Summary of the decree initiative of the federal executive in October 2021 | |
|---|--|
| 1 | Permits and sales contracts with the private sector are canceled |
| 2 | Federal Electricity Commission becomes the highest authority in the electricity sector |
| 3 | CFE must reintegrate its subsidiaries and affiliates |
| 4 | CENACE joins CFE |
| 5 | Self-supply permits will not be recognized or acquired by CFE |
| 6 | CFE will determine transmission, distribution and user rates |
| 7 | Clean Energy Certificates are canceled |

Despite the counter-reform efforts by the current Federal Government, Mexico’s climate commitments and renewable targets remain unchanged and binding, as stated in the General Law on Climate Change (2012) and in the Energy Transition Law (2014). In the General Law on Climate Change, Mexico declared its intention to contribute to mitigation, with three main targets: reduce greenhouse gas (GHG) emissions by 30% relative to business as usual for 2020 (with explicit targets for emissions reduction in the electricity sector), increase clean energy for power generation to 35% by 2024, and reduce GHG emissions by 50% relative to the year 2000 by 2050. Mexico’s national determined contribution (NDC) was updated in 2022 and now includes a 35% GHG reduction by 2030. According to the 2013 Energy Reform, a combination of public policies and partnerships or agreements with the private sector should facilitate the country’s transition to a low-carbon growth path. In addition, clean energy goals have also been confirmed in Mexico’s free trade agreements, such as the North American Agreement (USMCA), and in its NDCs.

3. Mexico’s untapped renewable energy potential

Key insights

- Renewable energy potential is distributed across the country.
- The use of renewable energy sources for power generation has been growing slowly but steadily since 2017.
- In recent years, the use of solar and wind energy is growing, while geothermal is stagnant and hydropower is in decline.
- Oaxaca and Tamaulipas produce mainly wind energy, Jalisco produces half wind and half solar, and Puebla – a marginal producer at the time of our research – has the capacity to generate power using all five RE sources.

Mexico has enormous potential to become a clean energy hub, owing to its renewable energy resource availability and its current low costs. Indeed, up until 2021, renewables have steadily increased their share of Mexico’s total electricity generation. According to IRENA (2015), solar capacity – large-scale and distributed generation – in Mexico could amount to 30 GW by 2030. Furthermore, an additional 30 GW could be supplied by wind capacity. Since 2017, the share of renewables has increased, except for the projected data for 2022 (see Figure 3).

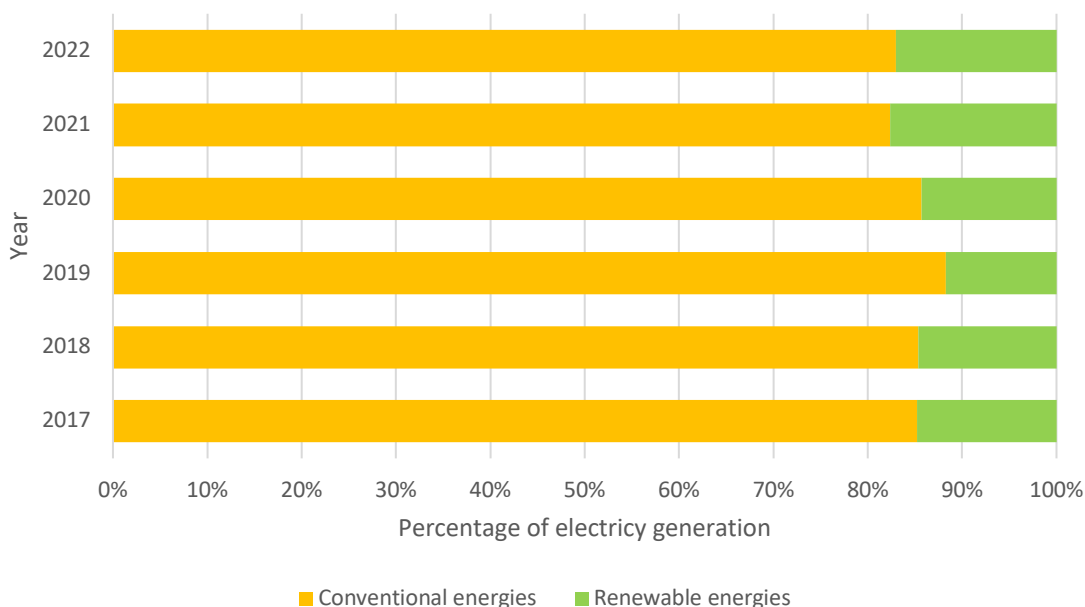


Figure 3. Energy generation by type of source, % GWh generated, 2017-2022

Source: Sistema de Información Energética, 2023.

Hydropower was, and continues to be, the main renewable source in the country. Its importance, however, has declined over time, while solar and wind capacities have increased. The decline of hydropower can be explained by the fact that plants require specific conditions, their potential has been reached over many decades, and adequate sites have already been developed. Hydro plants are getting old, and the Federal Government believes that renovating old plants will significantly increase hydropower production, but there is not enough evidence supporting this. Other sources, by contrast, are relatively recent and more cost-effective. According to IRENA (2022) the global weighted average levelized cost of electricity (LCOE) from solar photovoltaics in 2022 was 0.048 USD/kwh (the same as the average LCOE from hydropower), and it was 0.033 from onshore wind. Those were the lowest costs for utility-scale renewable power generation technologies.

Deployment of wind farms preceded solar projects in Mexico, but solar electricity generation has grown rapidly since 2018. According to the Ministry of Energy, by 2030 both sources will be adding 30,000 MW of capacity installed in the country (see Figures 3 and 4). However, hydropower is expected to increase significantly in the near future, since the Federal Government intends to renovate old hydro plants.

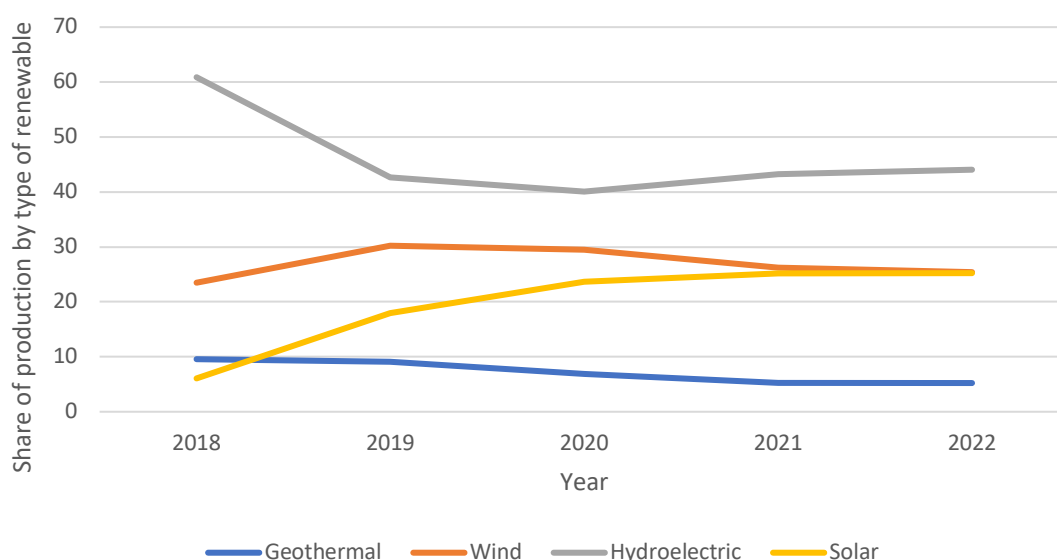


Figure 4. Share of production by type of renewable energy

Source: PRODESEN.

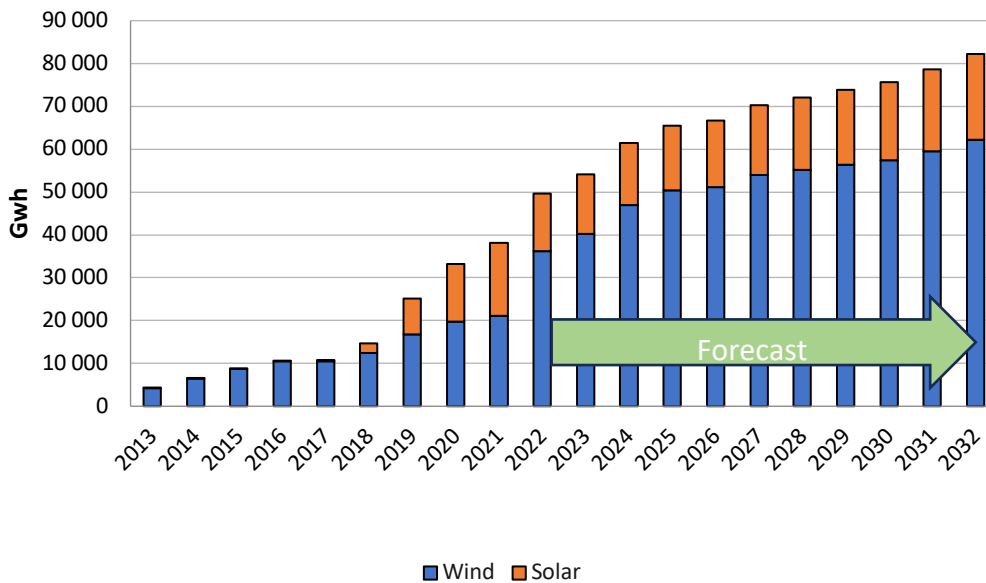


Figure 5. Evolution of installed capacity by wind and solar technologies

Source: PRODESEN.

The deployment and development of renewable energy in Mexico varies among states. Currently, Oaxaca and Tamaulipas are the states with the highest installed capacity of wind power (Figure 6). In terms of installed solar capacity on the other hand, the states of Sonora, San Luis Potosí, and Chihuahua are at the top of the list. Other states such as Jalisco and Coahuila produce both wind and solar power.

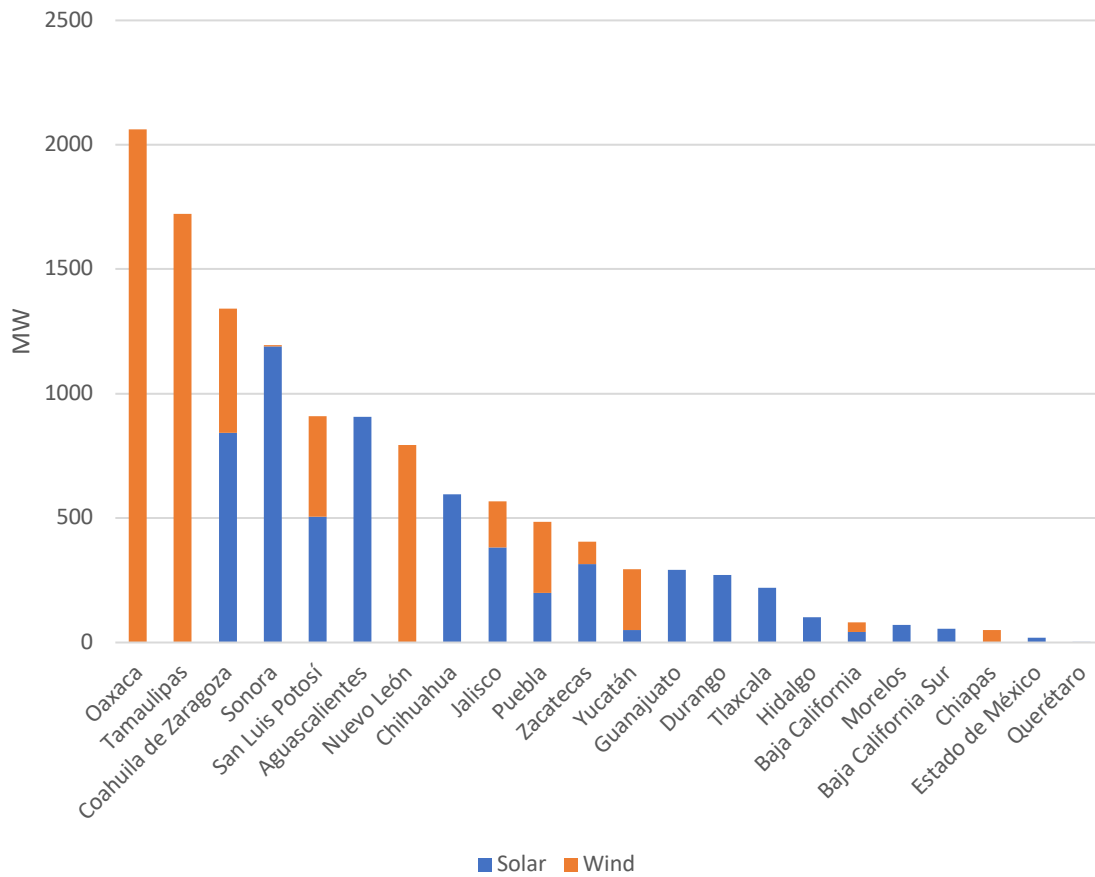


Figure 6. Capacity installed, by state

Source: Obtren, Observatorio de Transición Energética de México, 2022

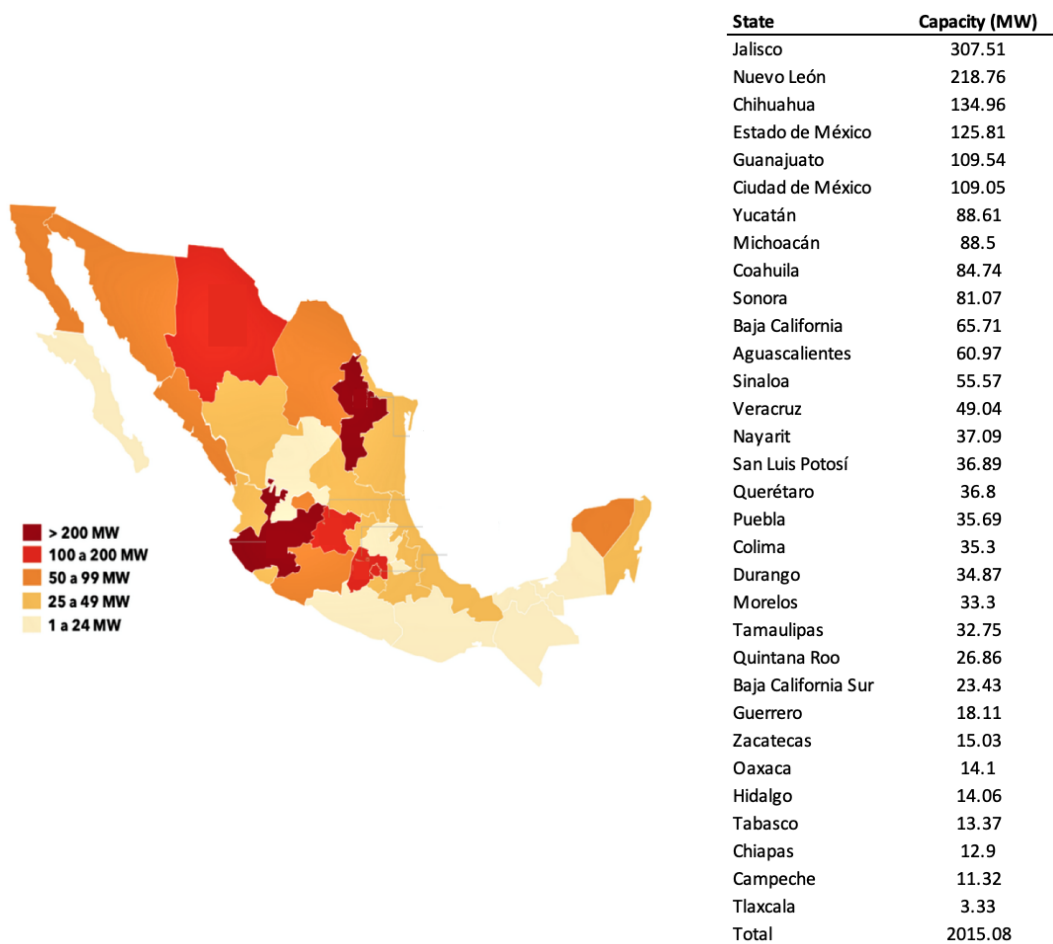


Figure 7. Map of solar installed distributed generation capacity

Source: ASOLMEX, 2021.

As a general conclusion, Mexico has significant RE potential across its territory, but the available sources may vary by state. Forecasts show that power generation from both wind and solar sources will increase in the coming years.

4. Mapping renewable energy policy development at the state level

Key insights

- Renewable energy policies have developed differently among states, with evaluation of renewable energy potential, tax reductions, subsidies, and access to finance.
- The most progressive states have developed energy information systems, to enhance collaboration and transparency; some states have installed Energy Agencies or Commissions, taking energy issues away from local ministries and giving these agencies greater authority.
- Renewable energy projects that started before the current federal administration have advanced more smoothly than those initiated after 2018.
- Distributed generation has been the cornerstone to support energy transition at the subnational level. Distributed generation policies, solar households, and solar *ejidos* (common lands) are considered successful policies.
- States are learning from each other through formal alliances in the environmental sector, and informally in the energy sector.

State authority in renewable energy development

Historically, the energy-related decisions of state governments and municipalities (local governments) have been limited to the type of energy to be supplied to public infrastructure. States have the freedom to develop laws and policies and manage their own financial resources. Municipal governments' authority extends only to public lighting, although they also have some leeway in the use of their own resources.

States and municipalities do, however, exert influence on the implementation of renewable energy projects, as well as other infrastructure development. Construction permitting and land-use planning require the involvement of municipalities, and the relationship between the federal and municipal level is formalized in the Law on the Use of Renewable Energy and Financing of the Energy Transition (promulgated in 2008 and abrogated in 2015 for the introduction of the Energy Transition Law). Furthermore, in the General Law on Climate Change (2012) and the Energy Transition Law (2015), as well as in the Constitution, states were recognized as key partners in the national ambition to increase the share of renewables

in the overall energy mix. The three levels of government (Federation, states, and municipalities) are obliged to promote renewable sources of energy to reduce GHG emissions. States can also sign collaboration agreements with industry to facilitate access to financial resources for renewable energy and energy efficiency projects.

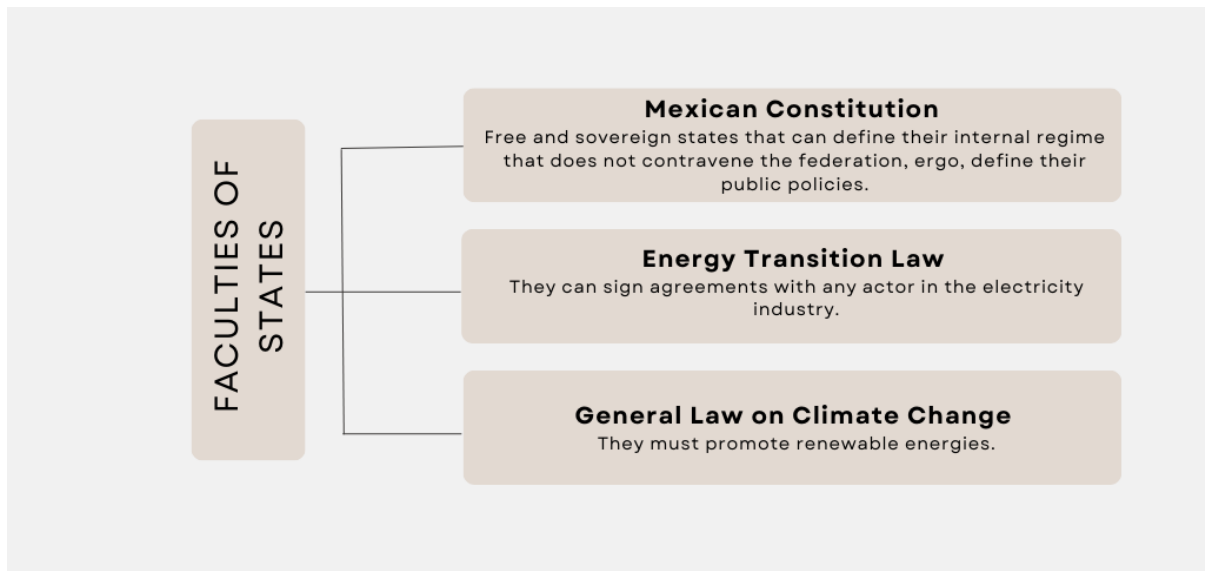


Figure 8. Faculties of states

Our interviewees highlighted three energy transition-related policy domains where state and local governments exert a relatively high degree of authority: distributed generation, electrification of the transportation sector, and energy efficiency. Particularly relevant for this study is that end-users (households, companies) only need to change to bi-directional meters in their homes in order to install behind-the-meter, distributed renewable generation. They do not need to obtain explicit authorization from regulators. In the case of large projects, on the other hand, a set of requirements must be fulfilled, and authorizations are required from the federal regulators.

Renewable energy policy development

Since states have the constitutional right to legislate (as long as they do not contravene federal laws), energy policies have developed differently according to capacity and potential generation, laws, plans, programs and projects, and the type of entity in charge. In addition,

the political party ruling the state may choose to support or block the increased use of renewable energy.

Over the past two decades we find that several states have changed their institutional design to give a higher priority to clean energy issues and to develop their renewable energy potential. For example, some states have included the topic of renewables within their strategic plans, others have mentioned it in their development plans, while still others have included it in their environmental planning, energy efficiency, or specific renewable energy development plans. To date, ten states have published their own energy laws, which refer to renewable energy.

In addition, 13 state governments have established Energy Agencies or Commissions, taking energy issues away from offices within local ministries and giving these agencies a higher level of authority. Hence, states with agencies or commissions may send the signal that they are a suitable place to invest in renewables or other energy projects.

Table 2 provides an overview of states that have changed their institutional framework to accommodate renewable energy development.

Table 2. Mapping renewable energy policy development at the state level

| State | Agency | Office within local ministries | Programs | Projects | Local legislation |
|---------------------|----------------|--------------------------------|----------|----------|-------------------|
| Aguascalientes | | X | X | | |
| Baja California | X | | X | X | X |
| Baja California Sur | | X | | | |
| Campeche | X | | | X | |
| Chiapas | | X | | | |
| Chihuahua | | X | | | X |
| Ciudad de México | | X | X | X | |
| Coahuila | Not identified | Not identified | X | | X |
| Colima | X | | | | X |
| Durango | | X | X | | X |
| Guanajuato | | X | X | X | |
| Guerrero | X | | X | | |
| Hidalgo | X | | X | | X |
| Jalisco | X | | X | | |
| México | X | | | X | |
| Michoacán | | X | | | |
| Morelos | X | | | | |
| Nayarit | Not identified | Not identified | | | |
| Nuevo León | | X | X | | |
| Oaxaca* | | X | | X | X |
| Puebla | X | | X | X | |
| Querétaro | X | | | | |
| Quinta Roo | | X | X | | X |
| San Luis Potosí | Not identified | Not identified | X | | |
| Sinaloa | | X | | | |
| Sonora | X | | | X | X |
| Tabasco | | X | X | | |
| Tamaulipas | X | | | | X |
| Tlaxcala | Not identified | Not identified | | | |
| Veracruz | | X | | | |
| Yucatán | | X | | | |
| Zacatecas | X | | | | |

In the remainder of this chapter, we summarize some of the findings from the interviews that are not case specific.

The decrease in renewable energy costs and the high capacity of modern wind turbines have made renewable energy generation more attractive in a wider range of geographical areas. The state of Chiapas made a commitment to buy renewable energy for government use, and Jalisco, Guanajuato, Querétaro, Zacatecas, and Durango have shown interest in similar purchases. Sonora and Chihuahua have expressed interest in developing solar energy projects while Puebla and Jalisco are open to the possibility of promoting projects in both solar and wind.

State-initiated renewable energy policies are best understood as they relate to other local concerns such as climate change, energy needs, and health and development policy. Local authorities are generally aware of the impact of fossil fuels on health. This, in turn, motivates their desire to generate more electricity from renewable sources and to initiate mitigation actions (including the use of renewable energy). An additional benefit for the municipalities is that the fiscal system in Mexico explicitly enables municipalities to collect taxes. When local authorities increase their collection of taxes, they also receive a higher share of the federal budget. Together with the taxes imposed on wind projects, for instance, municipalities receive more resources from the Federal Government, allowing them to increase funding for social projects.

Some states place more emphasis on rural areas, their capacities, and the need to generate income for rural communities. The Ejido Solar program, in Sonora, Guanajuato and Jalisco, supports rural communities and has implemented distributed solar generation projects, using the energy generated for their own use or selling it to agents outside the community. State governments throughout the country are currently analyzing the best way for renewable energy policies to generate additional benefits for the communities, given their economic and social environment.

The demand for renewable energy may also come directly from the private sector, since transnational firms must fulfill certain sustainability commitments, including the use of cleaner sources of energy. In addition, firms interested in generating electricity from

renewable energy sources work with authorities at the state and municipal levels to create the necessary conditions to operate, such as the granting of a license.

State governments have promoted renewable energy deployment at an early phase by evaluating their renewable energy potential, and they have developed plans and programs tailored to local characteristics. States with higher levels of renewable energy capacity have also developed energy information systems, a process which facilitates synergies among actors and provides transparency to the implementation of decarbonization plans. These plans are coordinated with higher level policy instruments, such as the state development and energy plans. The participation of state environmental authorities is crucial, since there are also local flora and fauna considerations (such as the impact of wind turbines on birds and butterflies).

Renewable energy can also be promoted by lowering local property taxes on renewable energy firms and subsidizing solar panel installation for households. States such as Nuevo León and Tamaulipas have also made resources available to finance additional transmission lines for renewable generation in their states.

In addition to adopting a range of instruments to achieve renewable energy goals (innovative plans and programs, pilot projects, and regulations), state governments also act as conduits between local industry and federal or municipal authorities. Tamaulipas, Nuevo León, Coahuila and the Yucatán Peninsula have all invited firms to invest in wind power generation and have asked the Federal Government to invest in upgrading transmission lines. They have organized energy events and facilitated conversations with landowners.

State governments have also assisted the renewable energy industry in overturning municipal authorities' attempts to levy additional taxes (which were seen as double counting). That said, however, municipal officers have usually sought to promote investment in renewable energy. In regions with organized crime, both states and municipalities have intervened to safeguard renewable energy projects.

State authorities interested in renewable energy are eager to work towards sustainable energy development. In doing so, they have teamed up with environmental organizations, other states' energy agencies, or their own ministries of environment and economic

development. They share their experiences on renewable energy implementation with other states in seminars and events that they organize, and they identify strategies and instruments that foster the development of renewables. The states of Jalisco, Tamaulipas, Yucatán, Mexico City, Sonora, Puebla, Nuevo León, Quintana Roo and Guanajuato have been proactive in looking for assistance from experts, institutions and other associations to design and implement their plans and strategies.

The current Federal Government, however, has strongly opposed the use of solar and wind resources, instead advocating the use of fossil fuels from state-owned Pemex for electric power generation. Nevertheless, some states continue to design and implement renewable energy policies. The industry looks at the current situation from a long-term perspective and trusts that commercial partners and international companies will keep demanding greener products and services.

State authorities are familiar with the situation in their local area and can consider potential conflicts with the local population or industry or enabling factors related to local socioeconomic conditions when drafting public policies. As part of this analysis, we have not evaluated whether states have been able to take on this role. In fact, most of our interviewees did not mention local opposition. However, there are several instances of community unrest and social conflict because local people see renewable energy projects, supported by authorizing authorities, as “land grabbing” (Ávila-Calero, 2017). In authorizing renewable energy projects, state authorities may also violate communities’ rights by imposing fast-track decision-making processes.

5. Renewable energy in four Mexican states

OAXACA: THE PIONEER

Key insights

- Oaxaca was the first state to successfully develop wind energy projects. At present, the installed capacity of wind power in the state is 2750 MW. The potential is estimated to be 10,000 MW.
- The early experiences with wind development in Oaxaca reflect the traditional mode of energy governance in Mexico, with the Federal Government taking the lead.
- The state also took an active role by launching promotion campaigns to attract foreign investment and assisted in negotiations between landowners and firms.
- The state also co-financed transmission lines to facilitate renewable energy development.
- A local industry has developed around wind turbine construction.
- The role of the state authorities' role was initially to guarantee social peace and stability for the viability and continuity of renewable energy operations, but the state government has increasingly faced social resistance.

Context

The state of Oaxaca is home to more than 4 million people, produces 1.6% of national GDP, and accounts for less than 1% of foreign direct investment (INEGI, 2022). Oaxaca was the first state in Mexico where renewable energy projects were designed and executed, and the state currently has the highest level of total wind power generation in Mexico (González-Ávila et al., 2006). During the 1990s, President Salinas de Gortari implemented a policy of openness in trade and investment, which included the promotion of investment in renewables. According to a former government official from Oaxaca, several foreign companies showed interest in investing in wind generation in Mexico, and wind energy was the first economically viable renewable energy technology to be rolled out on a large scale in the country. Oaxaca had clear advantages in renewable energy, from strong and constant winds in the La Ventosa region, and from geothermal sources.

The first projects were designed and carried out in Istmo de Tehuantepec in 1994, using small aerogenerators. A former local politician mentioned in an interview that the early experience

with renewable energy development in Oaxaca reflected the traditional mode of energy governance in Mexico. The initiative started at the national level, and the project was funded and implemented by the Federal Government. The Federal Government also received advice from foreign governments and firms.

In the mid-1990s, Mexico underwent a serious economic crisis, and wind power generation projects were effectively put on hold until 2004, when investors renewed their interest in wind power investment. From that point on, the growth in renewable power generation in Oaxaca state accelerated. From 2005, foreign firms (mainly from Spain) began investing in Oaxaca and other states. At that time, the law limited the development of renewable projects to self-generation (generation for the same companies that owned the power plant), and projects were developed along these lines.

Companies seeking to implement wind power projects negotiated directly with local landowners and municipal authorities to secure access to land. These companies held discussions with representatives of communal land (ejidos) and private property owners. The first phase of these negotiations involved studies and projects. The companies then rented land to install, produce and dismantle turbines.

Because energy was a policy issue handled exclusively by the Federal Government in the 2000s, a formal relationship between local and federal authorities was missing. This was problematic, as new wind power projects required the involvement of local governments, to secure local construction permits and approve changes in land use from agricultural to industrial purposes. After some experience gained through these early renewable energy projects, a new federal law was enacted: the Law on the Use of Renewable Energies and Financing of the Energy Transition (2008). This was later integrated into the Energy Transition Law (2015). Local governments could then have a formal voice in the implementation of wind power generation projects.

Another key consideration was the development of a local industry to produce inputs and retrain the workforce. At that time, in the 2000 and 2010s, all technology was imported into Mexico; the local economic benefits from the renewable energy industry were distributed among the owners of the land, operating company personnel, and workers in the construction

industry. Following efforts to build local professional capacities, Istmo de Tehuantepec now provides specialized human resources that assist in the construction of wind power projects in other countries.

Oaxaca is considered to have considerable potential for the development of a wind power industry. At present, the state's installed capacity is 2750 MW, but it could potentially reach around 10,000 MW. Whether or not this is feasible in practice is still uncertain. Transmission line expansion projects have been cancelled, owing to a variety of factors, such as local opposition to projects and social unrest due to perceived low level of benefits for the local population, and policy changes at the federal level.

Experience with renewable energy policy development

Despite the dominant role of the Federal Government in a wind power industry in Oaxaca, one finding from this study is that the state government was also actively engaged in positioning Oaxaca as an attractive location for investment in wind power. In the early stages of wind development in the state, the local authorities were active in making land available for wind farms. The state Ministry of Economic Development engaged with experts in other countries to gain knowledge on the potential for implementing wind power generation in Oaxaca. Public officials from Oaxaca visited Spain, Denmark, Germany, and other countries that were known for their development of renewable energy projects. potential investors visited to the state, authorities assisted them in generating interest among property-owners.

In addition to promoting Oaxaca as an interesting wind investment location, the state government also facilitated negotiations between the industry and landowners. The designated wind power locations run through a specific area in the state, and only those municipalities located within it could participate in the negotiations. Our interviewees argued that this made the negotiations easier, as the parties already had a common interest in the selected sites. This also allowed the landowners to negotiate their compensation.

However, despite these efforts and some success stories, wind development in Oaxaca has generated social unrest and led to legal battles between communities and renewable energy companies following disagreements over land leases. Additionally, communities blame companies for, falsifying signatures, and approving agreements without a quorum, as

well as buying the approval of common property leaders and government authorities. A persistent related problem is the lack of transparency: projects are not fully explained to communities in advance of negotiations, violating their right to free, prior and informed consent (Gardner, 2019).

Negotiations between investors and local authorities and federal authorities have mainly been with the Energy Regulatory Commission (CRE) and the Ministry of Energy (SENER), who handled the coordination efforts and negotiations, and this process seemed to work for the first few years. The current administration, however, changed its position on RE and halted all ongoing initiatives. In the future, more investment in energy transmission and distribution is going to be required in Oaxaca. Previously the Federal Government co-financed the construction of lines and substations with the industry in states like Tamaulipas and Nuevo León. CFE was also deeply involved in renewable energy projects and got involved in the first developments in Oaxaca.

Our interviewees viewed the implementation of renewable energy projects as positive for the state. Besides increases in employment, there have been positive regional economic impacts on the service industry, with tangible benefits accruing to hotels, restaurants, gas stations, and others. Renewable energy companies have also contributed to improving local livelihoods by working with municipalities to provide safe drinking water, dispose of sewage, build schools and clinics, and pave roads. In times of emergency, such as the earthquakes of 2017, the industry contributed to school reconstruction efforts. They also support students who attend international events in various venues, often with positive results. However, even though social conflict was not identified as an issue by interviewees, there is plenty of information about this, both in academic papers and in the local news. Sometimes local opposition has been so strong that it has stopped projects, notably the Mareña wind farm, which was proposed on the lands of the Indigenous Huave (Ikoot) people in southern Oaxaca state.

JALISCO: THE ENTREPRENEUR

Key insights

- Jalisco is the state with the highest number of interconnection contracts and the highest capacity in distributed generation.
- Renewable energy has been a key element of the state's sustainable development strategy and climate policies. The state has a State Climate Plan which received an international award in 2021.
- The state has focused its attention on distributed generation that does not require federal authorization, and energy efficiency measures.
- The state has implemented a progressive and broad policy mix for renewable energy, supporting innovation, subsidizing the installation of renewables in households, and providing soft loans to the industry. The government is also in the process of developing subsidies for electric vehicles.
- The Energy Agency established in 2013 is active in outreach and training seminars, it certifies panel providers, and deliver training programs for public servants.
- Jalisco also promotes constant communication with other states' authorities to strengthen the learning curve for the 2050 targets and has developed a network of organizations working towards the same goal.

Context

The state of Jalisco is home to more than 8 million people, produces 7% of Mexico's national GDP, and accounts for close to 10% of the country's foreign direct investment (INEGI, 2022). It is the state with the highest number of interconnection contracts (a necessary step for distributed generation) in the country, and 55% of total distributed generation in the state goes to households and solar farms. Our interviewees highlight four characteristics as critical for enabling the growth of renewables in the state: the leadership of the governor and the state's institutional capacities; the state's geographical conditions; the development of the local industry for the renewable value chain; and an industrial base including transnational companies in Jalisco that demand renewable energy.

Jalisco's current governor has played a fundamental role in the development of renewable energy policy in the state. From the beginning of his term, he viewed energy as a key element of economic and environmental development. The Energy Plan of Jalisco, promoted by his government, is closely tied to the topic of sustainable development. In 2019, the governor

participated in COP25 in Madrid. Shortly afterwards, he opposed a federal plan to build a gas-fired power plant in Jalisco. The project was eventually shelved.

Local conditions also played a part in Jalisco's desire to develop renewables. The state does not produce oil and gas, nor does it house any fossil fuel refineries. Indeed, fossil fuel storage capacity in Jalisco is severely limited. It does, however, have several regions that are conducive to wind, solar and geothermal power generation. Furthermore, it is well interconnected as far as point-to-point electricity transmission is concerned.

Jalisco also has an impressive industrial base, including agribusiness, handicrafts, automotive, construction, electronics and information technology, electric power, pharmaceutical, fashion, furniture and chemical products (INEGI, 2022) The state has attracted investment using an environmental, social, and governance (ESG) approach and there is growing demand for clean energy from transnational companies to comply with the industry's sustainability goals. The size of the industrial base, combined with the economic growth of the state, would seem to guarantee energy demand for future renewable energy projects.

Nevertheless, the development of renewable energy in Jalisco has faced challenges that limit its expansion. First, like other state governments in Mexico, they have limited authority to implement energy projects given that the federal authorities can block RE development. A second challenge to renewable energy implementation was the 2020 COVID pandemic. The situation forced the state to switch strategies and resources.

Experience with renewable energy policy development

Jalisco state is participating in climate initiatives such as the UNFCC "Race to Zero" 2050 carbon budget and has a decarbonization agenda with targeted policies and programs (information extracted from interviews with state authorities). The idea is to boost renewables and advance the efficient use of energy. Thus, the state is working with both the supply and demand sides of the market.

Jalisco's Energy Agency was created in 2016 to take advantage of the opportunities introduced by Mexico's 2013 Energy Reform. The initial intention was for the Energy Agency to act as a qualified user and supplier of energy. However, controversies brought on by the Federal Government on further development of power generation based on clean sources

put a halt to this plan and forced the local government to look for other ways to develop sustainable energy sources that do not need federal authorization, such as distributed generation (solar plants on ejidos or common lands, biodigesters and small-scale hydro power), as well as energy efficiency. To implement such projects, the state government actively looks for international sources of finance. At the municipal level, there are renewable energy projects in public buildings, schools, and hospitals. So far, all these efforts have been successful but at a small-scale.

When the current administration came into power in Jalisco state in [2018], it moved the Energy Agency from the Ministry of Innovation to the Ministry of Economic Development. The economic cabinet carries out institutional plans in a coordinated manner with the four ministries involved (Economic Development, Work and Social Security, Science and Technology, Tourism, and Agriculture and Rural Development), and the budget is planned accordingly.

The Energy Agency is active in outreach and training seminars, and delivers training programs for public servants, as well as congresses and webinars that bring together different subsectors. One problem that the state has encountered is that solar panel providers and installers have a wide range of prices and quality, which can be confusing and misleading for the average consumer. The Energy Agency has started certifying panel providers, so that households have better information on the quality of their service.

The Jalisco Business Development fund (FOJAL), a local public fund for business promotion, provides soft loans for entrepreneurs, with a preferential interest rate for projects related to distributed power generation and energy efficiency. The fund also provides grants of up to 70% of the cost of solar panel installations. Support for the transition to electric and hybrid vehicles is also being provided, and a trust fund has been established for the provision of energy in industrial parks. Our interviewees from the state Government explained that there are many companies in Jalisco that operate in the informal sector, and these companies cannot access the state's renewable energy incentives because they are not registered.

The government also strongly encourages the development of power generation from renewable sources in the state. Through the Energy Agency, the government assists firms

interested in setting up renewable energy power plants by facilitating procedures, generating databases on potential demand, and grouping consumers so that plants can reach the scale needed to operate.

Renewable energy policy in Jalisco also includes support for innovation, research and development. The Energy Agency initially sat within the Ministry of Innovation and promoted its participation in innovation projects. The State Council for Science and Technology makes calls for research projects on pressing local issues. Before each annual call, the Council holds meetings with other institutions to gain information on current sectoral challenges. Climate change and topics related to it, such as renewable energy, are now a top priority.

Renewable energy policy development must be understood in the context of the state's climate policies and sustainable development goals. Jalisco has set a goal to reduce emissions by 45% by 2030 with respect to 2010 CO₂ emissions (Gobierno de Jalisco, 2021) and several instruments and public institutions in the state work towards this goal, most prominently the ministries of Economic Development and Environment (SEDECO and SEMADET). The state has a State Climate Plan which received an international award in 2021. The plan frames climate change as a multifaceted and complex issue that must be addressed by both public and private entities. Jalisco also strives to target social needs through renewable energy development (including energy access). The State Plan of Governance and Development connects each topic with the appropriate sustainable development goal (SDG).

The Business Alliance for the Climate, a working group involving the private sector and the state government of Jalisco, was created in 2021 with the overall goal of decarbonizing the state. It serves as a channel to access research or project calls and mitigation initiatives, and to articulate industry concerns, such as: additional costs of mitigation, interpretation of federal regulations, and clean energy needs to comply with the industry's environmental commitments. The Alliance also acts as a forum to share ideas on new policy instruments, such as a state carbon tax and a state law on emissions. The Alliance consists of representatives from business associations, 64 companies, state government offices (including SEDECO and SEMADET); the technical secretariat includes representatives of the NGOs the Mexican Climate Initiative (ICM) and the World Resources Institute (WRI). Additional support is provided by several other NGOs and international agencies.

State authorities are in constant communication with various federal environmental authorities, particularly the Ministry of Natural Resources (SEMARNAT). Local delegations from federal offices such as CFE, CENACE, and Pemex are in close contact with state ministries. CRE does not, however, have any type of relation with the state or federal offices. Aware of this situation, state authorities are thinking of assisting the industry with navigating federal requirements.

Jalisco state is actively involved with the Mexican Climate Community, an initiative from state environmental authorities and civil society organizations where state climate delegates exchange information and experiences. Various Mexican state energy agencies are also attempting to form an association (analogous to the National Association of Environmental Authorities, ANAAE, where state environmental officials exchange information and experiences), but as yet there is no formal structure. Other states that also promote this idea are Nuevo León, Querétaro, Puebla, Quintana Roo, Campeche, and Tamaulipas.

In addition, municipalities within Jalisco state periodically meet to share common problems and learn from each other. Experts from academia and civil society are invited to these inter-municipal meetings, and the state government ensures the continuity of this structure by providing salaries for its administration. Renewable energy projects are discussed at these meetings.

Other key actors working with the state authorities on renewable energy sector development include international cooperation agencies, such as the German Development Agency (GIZ), the Danish International Development Agency (DANIDA), and the state government of California, USA. NGOs such as the World Resources Institute (WRI) and the Mexican Climate Initiative (ICM) are also partners in certain renewable energy initiatives.

PUEBLA: THE PENDING PROMISE

Key Insights

- Renewable energy projects in Puebla started with isolated private investment efforts. An explicit state policy was developed in 2019, and one of the first steps was to form a State Energy Agency.
- The State Energy Agency is the chief coordinator between the state and the Federal Government. It also coordinates the activities of several ministries at the state level. The agency's actions are aligned with the State Development Plan, and initiatives such as the Special Program on Sustainable Energy Development.
- Investment promotion plans have been developed at the state level to help attract investment. Such plans sometimes involve reducing taxes or providing subsidies for the installation of power generation projects in Puebla.
- When the Puebla state renewable energy policy was first drafted, a green fund was envisioned to channel resources from renewable energy projects to cover social needs. Lack of funds has put a halt to these plans.
- A Center for Innovation and Competitiveness has been created within the state Ministry of Economy. They have organized activities such as an energy forum to promote scientific and technological innovation with community-based projects.
- As a late bloomer in the development of renewable energy, most projects have been halted in Puebla, due to a lack of federal-level authorizations.
- Given the current political situation and the state's limited capability and resources to support renewable energy developers, the State Energy Agency is now focusing its efforts mainly on energy efficiency, in addition to attracting equity investment in renewable energy projects. They are also promoting electric mobility, development of green hydrogen, and smart technologies.
- In order to consolidate its renewable energy potential, the state must overcome local challenges such as high transaction costs associated with the fragmentation of land ownership, the prevalence of organized crime, and the lack of rule of law.
- Renewable energy is also perceived as a means to reduce energy poverty, but communities have to be brought on board to secure this in a conflict-free environment.

Context

The state of Puebla is home to 6.5 million people, produces 3% of Mexico's national GDP, and accounts for 2.9% of foreign direct investment into the country (INEGI, 2022). Puebla is currently not a major renewable energy producer in Mexico (it ranks 16th in terms of total renewable energy generation by states). However, it is a resource-rich state with the potential to develop geothermal, hydro, wind, solar, and biomass. With such a diversity of clean energy

sources, firms from several countries, including Italy, Spain, and the US, are interested in investing in the state.

In 2006, the first international private renewable energy companies started to invest in Puebla, especially in wind power generation. State decisionmakers and the Federal Government both supported this venture, and the first wind farm was built. In recent years, however, other companies have not fared as well. Renewable energy companies planned their projects based on Mexico's 2013 Energy Reform. When changes were made by the subsequent federal administration, they were stuck with investments that had little chance of being profitable. While some firms have protested changes to the Electricity Industry Law, most firms have resisted filing lawsuits against the Federal Government, fearing the great losses which that could entail.

Our interviewees, both government officials and entrepreneurs, argued that since 2018, i.e., this administration, federal energy policy has been the main barrier to renewable energy development in Puebla. Current federal energy policy has served as a deterrent to attracting private capital for the development of renewables in the state. Despite the state government's best efforts, neither CRE nor CFE have granted the federal permits required to produce and sell the power generated through renewables into the Mexican electricity network. Additional uncertainty for renewable energy producers is created because CENACE can block projects by not granting the producers a "right of way" to cross long distances to reach the transmission network.

Other barriers include the very low rent paid to landowners for the use of land to install wind or solar parks, and the cumbersome process of negotiating rent charges, due to the land-ownership structure in the state, that may involve dealing with hundreds of landowners with small plots in states like Puebla. Approximately 60% of these landowners have no ownership documents, which increases transaction costs significantly. Other barriers mentioned by our interviewees include insecurity due to the presence of organized crime and the lack of rule of law. Often existing private firms must negotiate with drug lords to protect their people and investments.

Volkswagen and Audi, among other firms, have committed to using renewable energy for their production processes as have their suppliers that produce many types of inputs for these vehicle producing companies. This has required more renewable energy to be produced within Puebla state to satisfy these companies' needs and promote their growth. Additionally, the state guarantees RE producers that a certain amount of electricity will be consumed by firms located in Puebla.

The challenge is thus to promote renewable energy projects at the state level while dealing with federal constraints. State governments have therefore been trying to identify areas in which states have more authority over energy policy. These include distributed power generation and energy efficiency. Puebla is also preparing for potential renewable energy sector development that may be made possible, depending on the results of the 2024 federal elections.

Experiences with renewable energy policy development

Renewable energy projects in Puebla started with isolated private investment efforts. An explicit state policy was developed in 2019, and one of the first steps was to form a State Energy Agency.

Political leadership was crucial to the promotion of renewable energy in Puebla. Puebla's former governor (2018-2022) was very interested in enabling the implementation of renewable energy projects in the state. He ordered the design of the institutional framework to a multidisciplinary team to invest in solar and geothermal energy. Investment promotion plans have been developed at the state level to help attract resources. Such plans sometimes involve reducing taxes or providing subsidies for the installation of generation projects. However, the COVID-19 pandemic and changes in federal energy policy made it impossible to carry out these plans, in effect reversing the state policy that was meant to attract private capital for renewables. As of 2023, the State Energy Agency is seeking to attract equity investment in renewable energy projects, promote a shift away from fossil fuels, and improve energy efficiency and innovation in areas such as electric mobility, development of green hydrogen, and smart technologies. Puebla currently has a total of 13 renewable energy projects.

The state also provides political support in negotiations between federal agencies, municipalities, and landowners. The State Energy Agency is the chief coordinator between the state and the Federal Government. It also coordinates the activities of several ministries at the state level. The Agency's actions are aligned with the State Development Plan, and initiatives such as the Special Program on Sustainable Energy Development at the state level. Both the State Development Plan and the Special Program described above are aligned to SDGs in Agenda 2030.

When Puebla state's renewable energy policy was drafted in 2019, a green fund was envisioned to channel resources from renewable energy projects to cover social needs. This fund was to receive resources from the Vehicle Verification Program (to check that vehicle emissions are within the norm) among other sources, and it was designed to provide public lighting to municipalities. However, the verification program came to a halt during the pandemic and the fund was never created.

An ever-growing number of federal authorities are clashing with state level ministries and agencies over renewable energy investment in Puebla. In past federal administrations, prior to 2018, firms were able to work together with federal authorities such as CFE, CENACE, CRE, and SENER, but recently CENACE and CFE have taped the meetings for security purposes and to protect themselves given the lack of trust in their counterparts. State governments have lost the clout to obtain the required permits from these federal agencies for private clients in their states. This has resulted in an "administrative silence" from federal agencies, at least in Puebla. Lack of transparency is also a growing barrier. Federal agencies such as the National Institute of Anthropology and History (Instituto Nacional de Antropología e Historia, INAH) now need to approve specific areas of energy projects as well. Owing to scarce resources within such agencies, however, the firms themselves must pay for the studies that the agencies carry out. SEMARNAT approves the environmental impact assessments, but again owing to scarce personnel and resources, they take a lot of time to grant authorizations.

A Center for Innovation and Competitiveness has been created within the Puebla state Ministry of Economy. They have organized activities such as an energy forum to promote scientific and technological innovation in community-based projects. Projects proposed by

universities and other local actors have been funded, including projects related to green hydrogen and other decarbonization projects.

Puebla state's efforts are now focused on changing the mindset of local society regarding energy use. Energy efficiency is a first step, as well as technical support for customers to adopt better practices, such as smart technologies. This is to be achieved through activities to share experiences and making energy innovation accessible to both consumers and producers. Given the constraint of federal regulations, the focus is now on figuring out how to reduce energy consumption by the state government and encouraging energy efficiency. Energy efficiency projects are expected to reduce demand for power. Currently the state government is subsidizing 20% of total costs while the Trustfund for Electric Energy Savings (Fidecomiso para el Ahorro de Energía Eléctrica, FIDE) other public finances are covering another 30%.

Puebla state ministries, such as the Ministry of Mobility, are looking at the possibility of adopting electric vehicles and buses, and an electric vehicle plant was considering locating in Puebla. This will require additional power from renewable sources. Several sustainable mobility projects carried out by universities will also demand further renewable energy. Social programs, such as solar schools, water pumping systems in rural areas, and agricultural irrigation projects, will increase the demand for renewable energy as well.

There is currently no communication with the Federal Government regarding energy, and little communication with CFE or CRE. Furthermore, local research institutions such as the Puebla State Council for Science and Technology (Consejo de Ciencia y Tecnología del Estado de Puebla, CONCYTEP) are not devoting resources to this area. Given these constraints, there are only scattered generation projects in Puebla, particularly aimed at schools that remain within the state's jurisdiction.

Both governmental authorities and private firms in Puebla emphasize that there is a definite need for coordination of public-private renewable energy ventures, since public funds are not sufficient to meet investment needs.

Similar to other states, renewable energy activities have also generated community opposition in Puebla. Issues including low land rental charges, impacts on local ecosystems, failure to pay workers, promised employment opportunities that have not materialized, and

illegality of environmental and social impact assessments have led to such conflicts (Gardner, 2019; Ávila-Calero, 2017). This is also documented in depth in the local media like La Jornada de Oriente, E-Consulta, and Animal Político, among other local printed and digital newspapers.

Our state government interviewees also argued that, even though renewable energy projects have been used to promote equity, by reducing energy poverty and improving living conditions for communities, more could be done. Renewable energy generators can provide more benefits to the community than they currently do (Oviedo Toral et al, 2022; IASS, 2020). Firms sometimes argue that the investments they make in local infrastructure, such as road construction, are primarily for the benefit of local communities. Such benefits, however, would seem to accrue more for the firm than for the community at large. Finally, although some collaboration has taken place between the regional offices of CFE to tackle energy poverty in places with no, or low levels of, electrification, these efforts have not been sufficient.

TAMAULIPAS: RENEWABLES COMPLEMENTING FOSSIL FUELS

Key Insights

- Tamaulipas ranks second in wind energy generation, just behind Oaxaca.
- The State Energy Commission supports private investment in renewable projects, while also promoting the use of fossil fuels and production of fertilizers.
- The construction of transmission lines has been critical for attracting wind developers to the state.
- The State Energy Commission was created in 2017 and serves as a coordinator between wind developers and federal authorities.
- Given the importance of revamping conventional and renewable energy in the state, the current state government is considering turning the State Energy Commission into the Ministry of Energy Development.
- State decisionmakers are advocating the development of a Mexican turbine that could be produced in Tamaulipas and are promoting industrial supply-chain development.
- Expansion of renewable energy, mainly solar energy, is a core element of the current state government's strategy to alleviate energy poverty in Tamaulipas.
- Both the past and current administrations claim to have had a good relationship with the Federal Government, however even in Tamaulipas, renewable energy projects are currently on hold while waiting for federal permits.

Context

The state of Tamaulipas is home to 3.5 million people, produces 2.7% of national GDP, and accounts for 3.5% of foreign direct investment (INEGI, 2022). Tamaulipas is a fossil fuel intensive state, with large-scale oil and natural gas exploitation. It is well known for its oil refining capability, and has a large oil refinery, Refinería Madero, located in Ciudad Madero that started operations back in 1914. More recently, the state has also become one of the leading wind energy states in Mexico, just behind Oaxaca in terms of total power produced. The first wind plant started operations in 2016 in El Porvenir, with a total capacity of 54 MW. Thirteen other wind parks have been developed in Tamaulipas, following the model promoted by the neighboring state of Coahuila.

Experience with renewable energy policy development

Before the Tamaulipas State Energy Commission was formed in 2017, state authorities helped private investors in power generation from renewable sources to secure further finance, by helping attain a pool of resources, to build transmission lines, and this, in turn, led to an

increase in power generation from renewable sources. Further expansion of distribution infrastructure, however, is required if further power is to be generated from renewables.

Prior to the current administration that started in 2022, the Tamaulipas state government focused on capacity building of the local work force, and the maintenance of turbines. They also enacted regulations to foster sustainable energy and promote the energy transition. Since 2022, the current administration has been advocating the development of a Mexican turbine that could be produced in Tamaulipas, promoting industrial supply-chain development. Other renewables are being explored, particularly green hydrogen, which would be financed by foreign firms.

In 2017, the State Energy Commission was created under the Ministry of Economic Development. Now it is a public decentralized entity belonging to that same ministry, but with greater technical freedom to act independently. According to its commissioner, it has the de facto authority of a state ministry. During the previous administration, the State Energy Commission has been the chief promoter of private investment by attracting capital investment and helping obtain generation and distribution permits from federal authorities such as CRE and the Federal Ministry of Energy. Currently, the planning strategies of the State Energy Commission are aligned with the SDGs, and thus part of its mandate is to contribute to sustainable development.

Under the current state administration, the Commission is expected to be transformed into a new state Ministry of Energy Development. One of the goals of this ministry will be to build new transmission lines to transport wind energy produced by independent electricity producers. There are, however, significant disagreements between the previous and current administrations regarding the need to build transmission lines. The previous administration maintained that there were sufficient transmission lines to distribute all the electricity produced in the state, whereas current authorities insist on the need to build more lines.

The current state government is exploring distributed power generation and other renewable sources of energy, such as green hydrogen. Offshore wind energy is also being explored. Many small RE parks that produce mainly for their own consumption but have some extra

electricity are interested in selling that electricity but permits for this are not presently being granted by the Federal Government.

Both the previous and current administrations claim to have had a good relationship with the Federal Government. It is important to mention that the state and the federal level ruling parties are currently aligned and were also aligned during the previous federal administration.

In both periods, the Federal Ministry of Social Welfare has helped sponsor renewable energy, particularly by providing electrification for marginal communities in rural areas across Tamaulipas. The state government is using solar power in highly marginalized rural communities to cover their basic energy needs. This seems to indicate that there is still an interest within the current federal administration to work on access to renewable energy, more as a social program to reduce energy poverty.

In the past, coordination across state energy agencies was particularly vibrant. This coordination took place through the Energy Officials Civil Association and the Federalist Energy Group. Some of these associations still exist or have been transformed into working groups.

According to our interviewees there have not been any significant conflicts between firms and communities in Tamaulipas. Renewable energy companies have supported communities, particularly through health, environmental protection, and economic development programs. Most programs are tailored to the specific communities' needs.

6. Concluding remarks

The purpose of this report has been to map renewable energy activities at the state level in Mexico. We have mainly focused on the development of incentives for the deployment of renewable energy. Here we have identified a variety of incentives and the institutionalization of renewable energy strategies through the establishment of Energy Agencies. States also play a key role in early market development, and as a coordinator between municipalities, landowners, the Federal Government, and renewable energy companies.

Given our focus, we have mainly talked to state decision-makers, industry representatives, and NGOs. One weakness of this report is therefore that we have not sufficiently covered the community perspective on renewable energy development in Mexico. In all states except Tamaulipas we identified social unrest and community mobilization against renewable energy development. More research could be done to explore the lessons learned from the negotiations between renewable energy providers and local communities and landowners.

Appendix

Table A1: Interviewees

| Interviewee (Sector) | State | Date |
|---|-------------------|--------------------------|
| 1. Former Regulator | Federal | |
| 2. Social Civil Organization | Federal | 28/09/2022 |
| 3. Renewables association representative | Federal Oaxaca | 23/11/2022 |
| 4. Government official | Jalisco | 22/11/2022 |
| 5. Government official | Jalisco | 23/11/2022 |
| 6. Two government officials | Jalisco | 24/11/2022 |
| 7. Private sector and former government official | Jalisco | 10/11/2022 |
| 8. Government official | Jalisco | 9/11/2022 |
| 9. Government official | Jalisco | 30/11/2022 |
| 10. Former politician and industry representative | Oaxaca | 14/11/2022 |
| 11. Government official | Puebla | 12/10/2022 14/10/2022 |
| 12. Private sector | Puebla | 25/11/2022 |
| 13. Government official | Puebla | 16/11/2022 |
| 14. Researcher | Puebla | 28/11/2022 |
| 15. Government official | Tamaulipas | 10/11/22 |
| 16. Former government official | Tamaulipas | 11/11/2022 |
| 17. Private sector | Puebla | 05/12/2022 |
| 18. Social Civil Organization | ONG | 12/12/2022 |
| 19. Social Civil Organization | ONG | 07/12/2022 |

Table A2: Interview guide

| Topic | Estimated time | Guiding question | Additional questions for the section |
|---|----------------|---|--|
| Introduction | 5 min | | |
| First section. State policy on renewables | 10 min | We would like to know about your experience developing the state policy on renewables in the state of ... | Can you talk about the advantages that this state has for developing policies on renewables? |
| | | | What are the barriers that you have encountered while implementing the policy? |
| Second section. Implemented instruments | 10 min | What are the instruments that you have applied to foster the use of renewables? | Supply push instruments: innovation, research and development |
| | | | Demand pull instruments: taxes, medium, and long-term targets |
| | | | Public investment, certifications, green industry labels |
| | | | Capacity building, credits or investment facilities |
| | | | Instruments complementing the strategy: carbon tax, for instance |
| Third section. Coordination with other entities: state governments and other government levels (municipalities and the Federal Government) | 10 min | What type of coordination with the Federal Government, other states, and municipalities do you have? | For regulation compliance |
| | | | To design and define policy |
| | | | To follow up on advances |
| Fouth section. Coordination with other state policies | 10 min | How does this policy fits with targets in other areas or with social objectives? | Other sectors (education, social) |
| | | | Use of mechanisms to foster economic growth or green growth |

| | | | |
|--|--------|--|--|
| Fifth section. Just energy transition | 10 min | Is the Renewables policy a tool for achieving a fair energy transition? | Do you consider this policy circumstantial to the current state of affairs in the state or do you foresee a permanent renewables policy? |
| | | | Is this policy and its instruments used also for achieving equality and poverty diminishing goals? |
| Closing | 5 min | Would you like to add something else to what's been discussed here? Do you think that there are relevant issues for the policy that we have not talked about? | |
| | | Who else should we interview to have a clearer vision of the current and past situation in relation to the promotion of renewable electricity? | |

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