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Decreasing costs of renewables – Analysis
of energy sector planning and climate policy
in Mexico

Abstract

Mexico is signatory to the Paris Agreement. As such, the country submitted its first Nationally Determined Contribution (NDC) in 2014 in the run-up to the Paris agreement. In the past years, renewable energy systems have seen a massive cost reduction, which should be considered energy sector and climate change mitigation plans (also see Eckstein et al. (2020)). In view of these developments, this study analyses the **process underlying the development of Mexico's NDC** and its revision in 2020 with a particular focus on the energy sector and renewable energy systems. The assumptions underlying the **related energy sector planning document** (PRODESEN) and the relationships to the NDC are assessed. The study is completed by giving a snapshot of political constraints under the current administration of President López Obrador. The study builds on literature review and insights gained from interviews with pertinent Mexican stakeholders.

In Mexico's NDC, emissions are estimated to increase by roughly 50% between 2013 and 2030 in the business as usual (BAU) scenario. The unconditional mitigation target of Mexico's NDC foresees a greenhouse gas (GHG) emissions reduction by 22% by 2030 relative to BAU. In the electricity sector, the NDC aims at a 31% GHG emissions reduction.

- The target setting process remains publicly undisclosed and highly politicized.
- The main **responsibility for the NDC** revision is with the Environment Ministry of Mexico (**SEMARNAT**). SEMARNAT is supported by the National Institute for Ecology and Climate Change (INECC), a body created under the climate change law.
- The **highest level administrative body in the energy sector** in Mexico is the Energy Ministry (**SENER**), responsible for the establishment of targets and strategic transmission investments for renewable energy.
- **The 2020 NDC revision considers only enhanced energy efficiency measures and to a large extent disregards renewable energies in the power sector.**
- **Energy sector planning is described to align to political interests** and not to follow cost optimization, despite the fact that cost optimization modelling exercises have been carried out by SENER and supported by international organizations.

In 2013, Mexico launched a set of regulatory and administrative changes related to the energy sector that are referred to as the **Energy Reform**. This reform

restructured the energy sector, moving **away from state-owned enterprises for power generation (CFE) and oil extraction (PEMEX) to a liberalized market**, open to private actors. This led to competitive bidding and **record-low auction outcomes for solar PV projects** in the Mexican power sector.

- The López Obrador administration, however, builds on fossil resources and state-owned **PEMEX as backbone of economic development**. It perceives fossil fuel extraction as integral part of the Mexican national sentiment and therefore fosters its continued exploration.
- While the laws implementing the reform of 2013 have not been formally revoked, institutional, administrative and procedural practice undermine its effectiveness, making **renewable energy projects in the power sector unlikely** due to limited government support and creating high uncertainty with regard to the regulatory future.
- Under the current administration, government agencies such as **INECC and SEMARNAT have experienced substantial budget cuts**, undermining their institutional capacity to support climate change goals.

In conclusion, despite large potentials and record low costs for renewable energy projects, key energy sector planning documents in Mexico largely disregard low costs of renewable energies. The energy planning paradigm is determined by a **shift away from competitive energy markets towards political patronage, locking Mexico's power sector into a future of higher costs and increased GHG emissions**.

Further Reading

In a companion paper, Eckstein et al. (2020b) discuss the potential to revise the NDC of Mexico based on falling cost projections.

Within the same project, the team of authors has produced two more reports of the same structure for Indonesia (Eckstein et al. 2020a, Ordonez and Eckstein 2020) and Argentina (Nascimento et al. 2020, Kurdziel et al. 2020).

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1 Introduction

The Paris Agreement sets the target to limit the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C (UNFCCC 2015). Article 4 of the Paris Agreement requires each signatory party to assess and submit their Nationally Determined Contribution (NDC) to achieving the target. The Paris Agreement foresees NDCs to be resubmitted with increased ambition every five years, with the first revision due in 2020.

In the past years, renewable energies, most importantly solar PV and wind, have experienced massive cost reductions. In a companion report, Eckstein et al. (2020) show that by considering these falling costs in the revision of Mexico's NDC, renewable energy capacities planned for 2030 could be substantially increased, from 37 GW to 52 GW, at constant investments.

In this study, we assess to what degree the present and future costs of different power sector technologies and particularly renewable energy systems are considered in long-term planning for climate change mitigation and in the energy sector in Mexico. We describe the regulatory and legal basis underlying the NDC revision and energy sector planning as well as the underlying tools. The report also reflects on the current discussion around renewable energy and energy policy in general.

Climate related policies and renewable energy plans and for Mexico are rooted in the General Law on Climate Change and the laws that make up the Energy Reform, respectively. The Energy Reform led to auctions of renewable energy capacities, which resulted in record-low outcomes, undercutting costs of fossil fuel power plants. However, the influence of these auction outcomes on future planning is limited. The latest change in government needs to be considered in this respect. In July 2018, President Andrés Manuel López Obrador came into office, bringing changes to the governance and regulation of the power sector that do not foster the implementation of renewable energy projects.

Section 2 describes the legal framework, institutions and processes underlying the current NDC revision. Section 3 continues with the energy sector, giving an overview of the legislation under the Energy Reform and the changes under the current administration, in order to describe the planning for electricity generation. Section 4 summarizes arguments, which link the current developments in

the energy sector and climate policy making to the political agenda of a national sentiment. Section 5 summarizes and concludes.

This study draws on publications of different authorities. It equally builds on insights collected during bilateral expert interviews and in an online workshop. The interviews were conducted with stakeholders from different research institutes, academia, and other non-government institutions in July and August 2020. Whenever this report cites from one of the interviews, this is indicated by square brackets, as such [Iv01], referring to the overview of the interview sample given in annex A.2.

2 Climate change mitigation planning in Mexico

2.1 Legal framework for climate change mitigation

In 2012, Mexico was among the first countries to adopt a climate change law, the General Law on Climate Change (*Ley General de Cambio Climático* – LGCC), which outlines first steps for the country to combat climate change. In its original version, the law established a 30% GHG emissions reduction target by 2020 in comparison to a BAU scenario, as well as a 50% GHG emissions reduction target by 2050 in comparison to 2000 levels, both conditional on international support (CAT 2019). The law also establishes the National System on Climate Change (*Sistema Nacional de Cambio Climático* – SINACC¹) as a body to facilitate collaboration and communication between key public institutions (Averchenkova and Guzman Luna 2018). As a non-GHG target, the law states that 35% of domestic energy supply should come from clean energy sources² by 2024 (Averchenkova and Guzman Luna (2018), Government of Mexico (2015);). In 2018, the LGCC was amended to be in line with Mexico's NDC and the objectives of the 2015 Paris Agreement (i.e.. setting the target of 31% reduction of GHG emissions relative to the baseline in the electricity sector; Government of Mexico (2018)). As such, the LGCC provides the institutional and legal framework for the implementation of Mexico's NDC.

Mexico's Mid-Century Strategy (*Estrategia de Reducción a Largo Plazo de las Emisiones de Gases de Efecto Invernadero*, MCS, also referred to as long-term low GHG emissions development strategy (LTS)) was submitted to the UNFCCC in 2016, and presents another guiding instrument for national climate change policy in the medium- and long-term (Government of Mexico 2016). As a long-term strategy, the MCS is meant to provide guidance to Mexico's short-, mid- and long-term efforts to tackle climate change. The MCS is planned to be updated every 6 years under the auspices of the Ministry of Environment (Government of Mexico 2016).

1 The SINACC consists of the Inter-Ministerial Commission on Climate Change, the Consultative Council on Climate Change as well as the National Institute of Ecology and Climate Change (INECC), with the Environment Ministry (SEMARNAT) acting as secretariat

2 See Section 3.1 of this study for the definition of clean energy sources

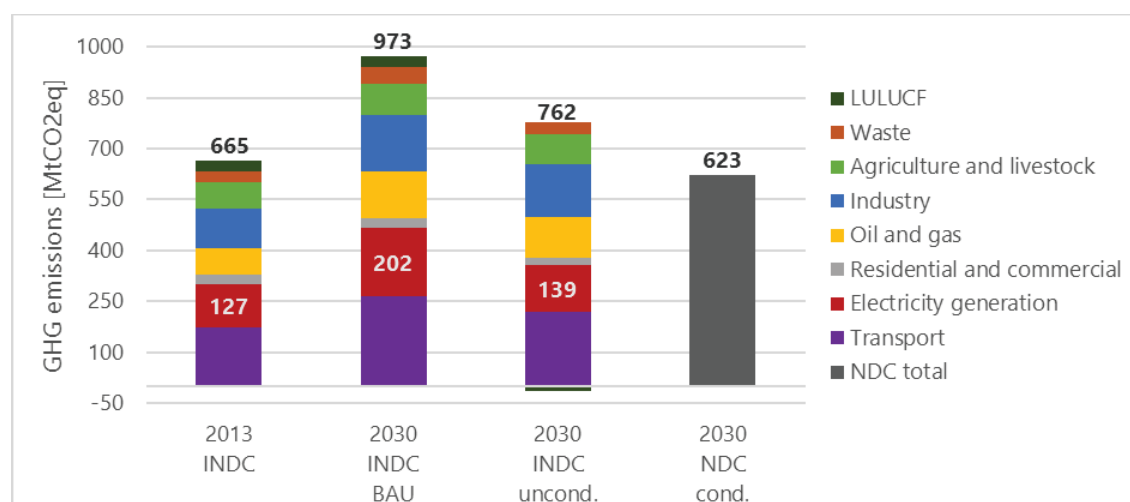
However, the so-called Mitigation Routes (*Rutas de Mitigación*³) have taken the role of the MCS in providing guidance to long term planning [lv04]. This collection of documents prepared by the national environment institute INECC presents a detailed overview of the status quo of different sectors and planned measures to mitigate emissions. However, the electricity sector is not covered, which is why the Mitigation Routes provide no input to the topics covered in this study.

In the NDC emissions are estimated to increase by roughly 50% from 2013 levels to 973 MtCO₂eq by 2030 in the BAU scenario (see Figure 1), The unconditional mitigation target to reduce GHG emissions by 22% by 2030 would limit total emissions to 762 MtCO₂eq, while the conditional target of a 36% reduction would limit total emissions to 623 MtCO₂eq in 2030. In the electricity sector, the NDC aims at a 31% GHG emissions reduction that would bring sectoral emissions down from 202 MtCO₂eq in the BAU in 2030 to 139 MtCO₂eq. The more detailed Intended Nationally Determined Contribution (INDC (Government of Mexico 2015a)) submitted in advance of COP 21 specifies that the share of renewable energies in Mexico's energy mix should reach 43% by 2030. The overarching targets in the NDC remain identical to the targets set in the INDC. These are also in line with the LGCC.

³ Available from <https://www.gob.mx/inecc/documentos/investigaciones-2018-2013-en-materia-de-mitigacion-del-cambio-climatico>

Figure 1: Overall and sectoral targets for Mexico's NDC

The sectoral values are taken from the Intended NDC submitted in advance of the 21st UNFCCC Conference of the Parties (COP 21) in Paris. The INDC includes almost identical values regarding the BAU and the unconditional target. While it does not include a conditional target, it specifies several sectoral mitigation targets. Only the NDC contains a conditional target.



Source: Government of Mexico (2015b)

2.2 Institutional responsibilities and the 2020 NDC revision

The main responsibility for the NDC is with the Environment Ministry of Mexico (Secretariat of Environment and Natural Resources, *Secretaría de Medio Ambiente y Recursos Naturales* – SEMARNAT). SEMARNAT is supported by the National Institute for Ecology and Climate Change (*Instituto Nacional de Ecología y Cambio Climático* – INECC), a body created under the climate change law (LGCC). INECC is responsible for sector analysis and commenting on specific strategies, plans and programmes. Furthermore, INECC can make concrete policy suggestions to SEMARNAT (Government of Mexico 2016).

SEMARNAT is in charge of the update process of Mexico's NDC and is the entity setting the mitigation targets [lv01, lv03, lv05]. At the time of writing, the NDC revision process was not completed but in an advanced stage. The overall process is determined largely by the political agenda of the current government, including the target setting [lv01, lv04]; the underlying target setting process remains undisclosed [lv01, lv03]. SEMARNAT does not pursue higher ambition levels regarding mitigation efforts. International organizations were involved in the process in a supporting role with modelling capacities. However, their role diminished over the course of the process, which is instead led by national polit-

ical actors and entities [lv01, lv04]. In terms of measures, the NDC revision will consider mostly energy efficiency measures to achieve the GHG emissions reduction target and not consider an increase of the share of renewable energy in the electricity mix [lv01].

INECC supports the technical analysis accompanying the NDC revision by providing a cost-benefit analysis of 37 measures from the Mitigation Routes. This analysis is prepared in the form of an Excel-tool, which shows GHG emissions savings and costs separately for the measures. This cost-benefit analysis considers cost data from the National Renewable Energy Laboratory (NREL), the International Renewable Energy Agency (IRENA), the Inter-American Development Bank (IDB) and the International Energy Agency's (IEA) World Energy Outlook and reflects the recent editions of the energy sector planning document PRODESEN (discussed in Section 3.3). The measures considered are shown and discussed in comparison to each other, but no cost optimization is performed. It is planned to make the tool publicly available [lv04].

Other tools and assumptions underlying the current update of the NDC are not known to the public or local civil society organizations [lv01, lv03]. It can therefore not be assessed, whether or to what degree current cost estimates and projections are taken into account in the NDC revision process. There is no evidence that this is the case from the information available. Also, it remains unclear what role the current edition of PRODESEN takes. From this, it remains questionable whether the planning underlying the revision of the NDC builds on adequate tools which could consider falling costs of renewable energy systems. In a companion study, Eckstein et al. (2020) suggest that emissions foreseen from electricity generation in the Mexican NDC could be reduced by 11%, only by considering recent cost developments, which underlines their importance for planning.

Under the current administration of President López Obrador, INECC and SEMARNAT have experienced substantial budget cuts, as part of the government's general policy of reducing public spending [lv03, lv04, lv05]. Related to this, there is now less personnel in general at INECC, particularly with an economics background. This may be one of the reasons for the limited techno-economic modelling capacity underling the NDC update [lv04].

There is limited coordination between SEMARNAT and Mexico's Energy Ministry (*Secretaría de Energía* – SENER), the highest administrative body in the energy sector. SEMARNAT usually takes no role in issues related to the energy

sector [lv01]. As mentioned above, the mitigation planning documents Mitigation Routes (*Rutas de Mitigacion*) do not consider measures in the electricity sector, while other sectors are covered (industry, transport, residential, waste, agriculture, LULUCF) [lv04]. In addition, the importance of SEMARNAT has been decreased under the current administration, further weakening its position towards SENER [lv03]. For example, lighthouse projects in the energy sector, such as the *Tren Maya* railway line construction project on Yucatan peninsula or the Dos Bocas refinery project have been approved despite environmental concerns [lv03].

3 Planning the energy transition in Mexico

3.1 Legal and regulatory framework in the energy sector

The highest level administrative body in the energy sector in Mexico is the Energy Ministry (*Secretaría de Energía* – SENER). SENER is responsible for the establishment of targets and strategic transmission investments for renewable energy (Wood 2018). In 2013, Mexico launched a set of regulatory and administrative changes related to the energy sector that are referred to as the Energy Reform. To implement this reform, Articles 25, 27 and 28 of the Mexican Constitution were amended and further legislation for the energy sector was developed, including the Electricity Industry Law (*Ley de la Industria Eléctrica* – LIE; Government of Mexico (2014)) and the Energy Transition Law (*Ley de Transición Energética* – LTE; Government of Mexico (2015)) (Wood 2018).

Together with several individual legislative measures the LIE mandated the division of the Federal Electricity Commission (*Comisión Federal de Electricidad* – CFE) into nine separate companies that distribute amongst themselves the rights over transmission, distribution and power generation (Wood 2018), removing the monopoly of CFE on the national electric system and opening the sector to private actors. Furthermore, the LIE charged the National Energy Control Centre (*Centro Nacional de Control de Energía* – CENACE) with operating the national electric system. In this function, CENACE is responsible for ensuring non-discriminatory and transparent access to the transmission and distribution grids; organising energy auctions; drafting expansion and modernisation programmes for the transmission network; and contributing to the annual energy sector planning document PRODESEN (discussed in Section 3.3). The Energy Regulatory Commission (*Comisión Reguladora de Energía* – CRE) which is administered by SENER is in charge of implementing the LIE (Wood 2018). As part of this development, the national oil company *Petróleos Mexicanos* (PEMEX) also opened parts of its business to private firms, increasing competition in the supply of oil products.

The LTE, which was passed in 2015, defines Mexico's clean energy targets for three years: 25% of power generation is to be achieved through clean energy sources by 2018, 30% by 2021, and 35% by 2024 (also see Eckstein et al. (2020)). Clean energy sources include wind, solar power, hydropower, geothermal power, and biogas; as well as nuclear power, carbon capture and storage (CCS) and efficient co-generation. The LTE provides SENER with the power to suggest additional tax policies or other financial instruments to the Ministry

of Finance to incentivise the energy transition by encouraging investments into sustainable technologies (Wood 2018).

These constitutional and legislative changes gradually led to the liberalisation of the Mexican energy sector and subsequently opened the market to private national and also international investments. Two long-term energy auctions were held in 2016 and 2017, allowing participants from the private sector to bid for 15-year term contracts to offer their generation and distribution capacities on the energy market (Wood 2018). The auctions led to record low outcomes, with prices for solar PV and onshore wind energy just above 2 cents/kWh (Deign 2017).

3.2 Recent developments of governance in the energy sector

The Energy Reform of 2013 restructured the energy sector, moving it away from state owned enterprises (CFE and PEMEX) to a liberalized market open to private actors. SENER followed this dictum, which is exemplified by the auctions for renewable energies [lv05].

The current administration under President López Obrador has a critical view on the Energy Reform and is trying to roll back some of the private sector and competitive elements entailed in it [lv04, lv05, lv06,]. The administration has switched to an understanding of governance and markets based on state-owned enterprises and follows the idea of a state-controlled energy sector [lv04, lv05]. Government officials under the López Obrador administration claim that the Energy Reform damaged the previous well-functioning system, and that it formed part of a corrupt plan to sell the country to private and foreign investors [lv05]. In this respect, it needs to be highlighted that CFE, in the reading of the government, stands for fossil fuelled power generation, while renewable energy systems are associated with private and notably foreign investors [lv01].

The current situation is perceived as a threat to the energy system and this viewpoint is described in detail in the energy strategy document *Programa Sectorial de Energía 2020–2024* issued in July 2020 (Government of Mexico 2020). In its analysis of the status quo (Art. 5), the document describes the vision of a self-sufficient energy sector that maintains PEMEX and CFE in their roles as main suppliers of fuel and electricity. This is planned to be achieved by increasing the hydrocarbon exploration and processing activities. By following this pro-

gram, the state will be able to rescue the energy sector ("*Rescate del sector energético*").

In consequence, the administration aims to strengthen the position of CFE and PEMEX [lv01, lv04, lv05]. CFE has a much stronger position now than under the previous government and SENER is taking a protective position of the assets of CFE, i.e. gas and coal fired power plants [lv01]. While the power of CFE has been reduced through the Energy Reform, it is aiming to retake monopolistic control [lv03]. The private sector, which is perceived as a threat to the state-owned utility and the current government is therefore strengthening CFE [lv01]. In July 2020, regulations were launched that aimed at allowing SENER to alter the dispatch rules of CENACE to reduce renewable power generation, but this regulation has been stopped in court [lv05]. Auctions for additional renewable energy projects were cancelled in January 2019 (following the official note SENER.100/2019/075⁴; PMCE (2019)).

The objective to strengthen state-owned, fossil fuelled power generation is underlined by activities aiming to link the two state-owned enterprises CFE and PEMEX. For example, SENER fosters the construction of the new Dos Bocas refinery, with the produced fuel oil planned to be supplied to CFE for electricity generation. In parallel, there is an interest by some officials to increase the share of coal fired power plants, using low caloric value coal from Mexico. Under such circumstances, it remains difficult for CFE to invest into renewable energy systems [lv05].

In parallel to this promotion of fossil fuelled power generation and the strengthening of CFE and PEMEX, the government is pursuing the establishment of an emission trading system (ETS), initialized under the previous administration. The ETS is currently in its pilot phase (which started in 2020) and does include power generation by CFE and activities by PEMEX. It remains unclear how the promotion of fuel oil and the ETS can be aligned. This is another example of government action being perceived as contradictory, just as the budget cuts being performed by a government that aims to strengthen state-owned enterprises [lv03, lv05].

4 Available from <https://www.cenace.gob.mx/Docs/MercadoOperacion/Subastas/2018/40%20Acuerdo%20de%20Cancelaci%C3%B3n%20de%20la%20SLP%20No.1%202018%20v31%2001%202019.pdf>, last checked October 8, 2020.

While the laws underlying the Energy Reform of 2013 have not been revoked by the current administration, institutional and administrative changes undermine its effectiveness, particularly for future developments. By realigning the power sector for a continued dependency on fossil fuels and weakening the position of private actors and a liberalized market, it may become increasingly difficult to develop renewable energy projects in Mexico. This is a remarkable development in view of the abundant natural potential and the worldwide record low auction outcomes in the two auctions held under the previous administration.

3.3 Planning for the electricity sector

SENER is the main planning entity in Mexico's energy sector and responsible for planning in the electricity as well as in the oil and gas sectors [lv01, lv03]. Since 2015, the main document that communicates development plans for electricity demand and supply is the Programme for the Development of the National Electric System (*Programa para el Desarrollo del Sistema Eléctrico Nacional – PRODESEN*)⁵. PRODESEN is issued annually by SENER and developed in close cooperation with CENACE. It outlines development plans for total energy capacities of the country, including conventional and renewable energies, for the following 15 years. In accordance with the LTE, the clean energy technologies considered in the PRODESEN are solar PV, wind, hydro and geothermal energy, as well as nuclear energy and efficient co-generation. The share of renewable energy sources in total electricity generation capacity was 25.7% in 2017. The edition of PRODESEN released in 2018 projects a 34.8% share of renewable energy for 2030. Electricity generation from renewable energy sources is projected to include 37.8% wind, 30.8% hydro, 22.7% solar, 4.2% bioenergy, 3.4% geothermal and 1% other (undefined) sources (Eckstein et al. 2020). The 2019 edition does not provide the same level of detail and is methodologically different from the previous editions [lv01]. The edition expected for 2020 has not been released to date (October 2020⁶).

PRODESEN has been regularly published since 2015 and was initially supported through international development cooperation. In the first editions, the optimisation model PLEXOS was used, which optimizes the system over costs.

⁵ Prior to 2015, the plans for the electricity sector were published in the planning document COPAR (*Costos y Parámetros de Referencia para la Formulación de Proyectos de Inversión en el Sector Eléctrico*) developed by CFE.

⁶ In previous year, PRODESEN had been published in May.

However, it is unclear whether this model is still applied today [lv01, lv03]. A list of projects for the power sector with operation and maintenance as well as fuel costs is maintained by SENER, but it is not clear how this list is reflected in PRODESEN. It has been stated that planning documented in PRODESEN has changed from a grey to a black box under the current administration [lv01].

In addition to PLEXOS, a model developed in-house at CFE with support of the National Institute of Electricity and Clean Energy (*Instituto Nacional de Electricidad y Energías Limpias* – INEEL, a research institute in the field of energy) has also been used in the past. The assumptions and methodology underlying this tool are not known outside of these institutions and it is not clear what role this tool plays in current planning [lv01, lv03]. Likely, the planning is based on costs of fuels rather than system costs [lv01]. It has also been stated that CFE plans electricity supply to be set up geographically close to demand centres. This limits the degree to which renewable energy sources can be considered in planning, as renewable energy sources are set up at locations with good resources rather than close to demand centres [lv01].

As is the case for the environmental institutions (SEMARNAT and INECC), the administrative bodies in the energy sector have also undergone budget cuts by the current administration [lv04]. This is particularly true for the planning department of SENER and the regulatory commission CRE [lv03, lv04]. The latter no longer publishes up to date electricity market data as in previous years, due to a reduction of personnel [lv04].

CFE and SENER both have an opposing view towards renewable energy systems as these are associated with higher costs. The concept of levelized costs of electricity (LCOE) is not seen favourably, as it omits integration costs and thus does not reflect true system costs. CENACE as system operator is reported to have a more neutral position towards renewable energy systems [lv01, lv03].

A related and recurrent theme in discussions of renewable energy systems are technical challenges related to their implementation. Technical problems related to temporal variability and intermittency need to be solved and the transmission infrastructure is not able to supply sufficient capacities [lv06]. The transmission and distribution grids are both owned and operated by CFE, this has not been unbundled yet [lv03]. CFE and SENER argue that transmission lines will be overwhelmed by large shares of variable renewable energy [lv05]. However, considering the low share of renewable electricity generation from solar and

wind energy in Mexico currently and the experience in other countries, this issue could be solved (see e.g. IEA (2020)).

4 The role of the current government's political agenda

Some of the points made in the above sections make reference to the political position of the current administration under President López Obrador. This section follows up on these points and shows in what way the political agenda of the government largely determines the current energy sector and climate mitigation planning, a statement also repeatedly made by stakeholders [lv05, lv06, lv07].

The oil resources on the national territory and their exploitation are perceived as a key element to the Mexican national sentiment [lv03, lv05, lv06]. To serve this and increase the annual GDP growth rate to previous values of 5%, the extraction of oil as a fossil resource is an important element [lv03, lv07]. This target is fostered and materialized by the plan to build the Dos Bocas refinery project. This strengthens the position of the state-owned PEMEX, which has faced financial pressure due to a combination of declining output, increased competition, a low oil price environment (Stillman 2020), and also has a strong workers union [lv05]. The fate of CFE is linked to PEMEX via the use of fuel oil for electricity generation. This also reduces the freedom of CFE to invest in renewables, which are perceived as a threat to CFE by the current administration.

The endowment of the country with large natural resources to provide wind and solar energy do not have the same historical weight as oil exploitation and are therefore not upheld with the same vigour [lv06]. This directly affects the electricity generation from renewable sources. Renewable energy systems are perceived to be mainly driven by foreign companies and investors as renewable energy technology would need to be imported (notably from Spain and the USA) [lv03]. The companies are perceived to be enriching themselves on Mexico, with profits being exported [lv07]. Private investments are in general associated with a neoliberal agenda, which the current government rejects, and with corruption, which the government had promised to fight [lv03, lv05].

These two lines of argumentation around fossil resources on the one hand and renewables on the other are used to uphold the opposing position of the government towards renewable energy projects. It is this perception that underlies the statement that the energy sector needs to be rescued, as described by energy strategy document *Programa Sectorial de Energía 2020–2024* (Government of Mexico 2020).

5 Conclusions

This report discusses the role of renewable energies in the context of the 2020 revision of Mexico's NDC. In the past years, renewable energy technologies, most importantly solar PV and wind, have experienced massive cost reductions. In this report, we discuss the process of the NDC revision and the planning made in the electricity sector, in view of these falling costs and in the context of the administration of President López Obrador, who came into office in 2018.

In parallel to the development of the first NDC, the previous administration undertook a reform of the energy sector, opening the market to private investors and restructuring state-owned enterprises, previously dominant in the electricity sector (CFE) and oil extraction and refining sector (PEMEX). The renewable energy auctions held in 2017 and 2018 following the Energy Reform had record low outcomes for solar and wind energy projects. A set of laws and regulations on climate change and the energy sector provide Mexico with a clear legislative and administrative structure for achieving climate targets.

However, the analysis of public documents and discussions with local stakeholders show that the assumptions and tools underlying planning in the energy and climate domain remain largely inaccessible and unknown to non-governmental actors. In climate change mitigation planning, the models underlying the revision of the NDC are unknown even to those working closely with the environment ministry SEMARNAT and the climate change institute INECC. The main planning document in the electricity sector, PRODESEN, has been published yearly since 2015. While the first editions were built on the model PLEXOS, it is unclear which tools were used for the latest update (currently that of 2019). In-house tools developed in parallel and possibly used instead are not publicly documented. In view of the fast and dynamic development of renewable energy costs, it is essential to consider recent cost projections in order to derive realistic targets and scenarios in energy sector planning. But by keeping the related information inaccessible to local stakeholders or the general public, it cannot be assessed what role costs or cost projections for renewable energy systems play in planning in Mexico.

The situation is aggravated by budget cuts under the current administration, reducing necessary capacities in the respective bodies. In addition, the current administration is undermining the Energy Reform and strengthening state owned enterprises. At the same time, renewable energy systems are not developed further. Renewable energy auctions have been cancelled and the gov-

ernment plans to supply the utility company CFE with fuel oil for electricity generation, supplied by the Mexican oil company PEMEX. This links the fate of CFE to that of PEMEX and reduces the freedom of CFE to invest in renewable energy systems. Many of the changes to the current governance and planning process can be traced back to the political agenda of the López Obrador administration, which builds on fossil resources and state-owned CFE and PEMEX as backbone of economic development and Mexican national sentiment.

This development diverges from the path initiated by the previous administration. The Energy Reform and the legal basis for climate change mitigation could provide the basis for well aligned government action to tackle climate change. With record low auction outcomes for renewable energy auctions in the past, Mexico could have successively increased the share renewable energy. A stable environment for renewable energy projects could have enabled the achievement of climate change mitigation targets, which are now threatened by an enhanced development of fossil energy. In following its political agenda, the new administration has spurred a change that may put Mexico off track in achieving climate targets and from realizing a low cost energy system, essential to economic development.

A.1 Policies considered

Table 1: Policies considered in this study

This table lists the main political strategy documents considered in this study.

	Full name Spanish	Full name English	Scope	Time of issuance	Target years	Update cycle
NDC	<i>Contribuciones Determinadas a Nivel Nacional</i>	Nationally Determined Contribution	National/economy wide	2016	2030	5 years
LTS	<i>Estrategia de Reducción a Largo Plazo de las Emisiones de Gases de Efecto Invernadero</i>	Mid-century strategy (MCS)/ Long-term low GHG emissions development strategy (LTS)	National/economy wide	2016	2050	6 years
LGCC	<i>Ley General de Cambio Climático</i>	General Climate Change Law	National/economy wide	2012, amended 2018	2030 2050	None
LIE	<i>Ley de la Industria Eléctrica</i>	Electricity Industry Law	Energy sector	2013	?	None
LTE	<i>Ley de Transición Energética</i>	Energy Transition Law	Energy sector	2014	2018 2021 2024	None
PRODESEN	<i>Programa para el Desarrollo del Sistema Eléctrico Nacional</i>	National Electric System Development Programme	Energy sector	2015	2030	annual
-	<i>Programa Sectorial de Energía</i>	Sectoral Programme for Energy	Energy sector	2020	2020-2024	annual

A.2 List of interviews

Table 2: Index of interviews

This table gives an overview of the interviews conducted for the study.

Interview	Stakeholder	Date
Iv01	Non-government	June 30, 2020
Iv02	Non-government	June 30, 2020
Iv03	Research	July 10, 2020
Iv04	Non-government	July 15, 2020
Iv05	Academia	July 16, 2020
Iv06	Non-government	August 18, 2020
Iv07	Non-government	August 18, 2020

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The views expressed within the report solely lie with the authors.



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