Under Enrique Peña Nieto’s administration (2012–2018), Mexico opened its electricity sector to private investment. This initiative, known as Reforma Energética, aimed to attract private investment for expanding and modernizing the electricity infrastructure and increasing efficiency. The reform led to a transformation in the power sector. In 2015, the Ministry of Energy published electricity market rules explaining how the wholesale market should operate.

As part of the rules introduced by the reform, Mexico embraced ambitious climate goals, including a goal of 35% energy from clean generation by 2024. For this purpose, the energy reform created Clean Energy Certificates (CECs, or CELs in Spanish) and a mandate for loads to hold CELs. These certificates are an incentive to investors and increase clean electricity generation. From 2015 to 2017, three long-term electricity auctions were organized for a volume of 7,563 MW of installed capacity. Winning projects, mainly renewable projects, signed 15- or 20-year contracts with the Comisión Federal de Electricidad (CFE).

In December 2018, President Andrés Manuel Lopez Obrador took office. His administration has already made some announcements and changes related to the power sector. He has stated that he will maintain the energy reform but strengthen the national energy companies. The following list shows some of the actions the new administration has made so far:

- The new administration has stated that CFE should be a dominant market player. As a result, a large portion of CFE plants that are not competitive and were expected to retire will continue to operate.¹

- The new administration canceled the fourth electricity auction, which was planned for 2019. The government has stated that CFE should build and operate its own plants instead of purchasing electricity from private players. However, the latest plan published only shows 2,557 MW of clean plants for the next five years.² The government has not announced new mechanisms for complying with the clean energy goals set by law and included in international agreements.
• A 3,000 MW transmission line project between Oaxaca and Morelos was canceled, and so was the Baja California transmission interconnection.

• The rules of how CELs are awarded were modified in October 2019. The administration considered the previous rules unfair to CFE because the CELs were awarded to new clean energy plants and not existing ones. The new rules award certificates to all clean power plants regardless of their start date of operation. This is expected to have a significant impact on CEL prices.

According to official statements included in the National Development Plan (Plan Nacional de Desarrollo) 2018–2024, changes are expected to help CFE keep its position as a dominant player.

The Wholesale Electricity Market
The Mexican Wholesale Electricity Market (Mercado Eléctrico Mayorista, or MEM) started operations in 2016, first in the Baja California Interconnected System (BCA) and the National Interconnected System (Sistema Interconectado Nacional, or SIN) in January, then in the Baja California Sur Electric System (BCS) in March. These three systems are not interconnected; however, the BCA system is connected to the California Independent System Operator in the United States. Since operations commenced, the National Center for Energy Control (Centro Nacional de Control de Energía, or CENACE), the electric system and electricity market independent operator, have been reporting hourly local marginal prices (LMPs). When the market started operations, it had 2,360 nodes; since then, additions and rearrangements have taken place, leading to 2,476 nodes (2,340 in SIN, 108 in BCA, and 28 in BCS).

The MEM is currently a cost-based short-term energy market with a day-ahead and a real-time market. Nodal prices are determined through an auction-style process. Generators send hourly bids to CENACE indicating a volume of electricity and its matching price. According to its consumption forecast, CENACE determines how much electricity is required every hour. The resulting electricity price corresponds to the bid with the lowest price that can satisfy demand. For example, if demand for hour 3 is 30 MWh and three bids are received (Bid 1: 10 MWh @ 500 MXN/MWh, Bid 2: 20 MWh @ 600 MXN/MWh, and Bid 3: 15 MWh @ 700 MXN/MWh), CENACE would choose Bids 1 and 2 and the resulting price would be 600 MXN/MWh. This price would be paid to generators 1 and 2. Nodal price differences happen because of physical restrictions, losses, and network congestions; final users pay the final corresponding price.

To date, the CFE and, on a smaller scale, some private companies are participating in the markets. When the market began, CFE was bidding as a single company while it underwent separation into different generation companies (CFE Gencos I to VI). Since 2016, the market has attracted a significant number of participants. Up to December 2019, there were 100 market participants holding signed contracts: 67 generators (generadores), 23 qualified suppliers (Suministrador de Servicios Calificados, including 6 CFE Gencos), 8 energy traders (Comercializador no suministrador), 1 intermediary generator (Generador de intermediación), and 1 utility service supplier (Suministrador de Servicios Básicos) as CFE Suministro Básico.

The MEM was planned to have a second phase for an hour-ahead market, removing constraints to allow free bids. However, the plan has been postponed partly because more tests are required, and price inconsistencies have been found for this market.
Figure 1 shows the daily average LMP for the three systems (SIN, BCA, and BCS) from January 2016 to December 2019.

![Figure 1. Daily Local Marginal Price by System (USD/MWh) 2016–2019](image)

Note: The average LMPs are weighted by load across the system nodes.

On average, the lowest prices have appeared in the BCA system. The BCS system has experienced the highest prices due to a lack of natural gas in the region. As can be observed in Figure 1, on some occasions prices of the different systems spiked and deviated from the seasonal trend. This unusual behavior can happen for various reasons, such as a lack of rain for hydro generation, problems with natural gas supply, increases in fuel prices, or grid congestion. For example, the spike experienced on the BCA system during the second week of August 2018 was related to an outage at a thermal power plant.

Since the market began, the BCS system has experienced the most volatile prices. While the standard deviation in BCS has been 52.4 USD/MWh, in the SIN it has been 29.5 USD/MWh.
Prices in the BCS system are also more susceptible to seasonality because of weather-related consumption patterns and a limited generation park. Higher electricity consumption happens in hotter summer months due to air conditioning and refrigeration systems. There is a lack of natural gas in the Baja California Sur region, which leads to plants running on more expensive fuels like diesel and fuel oil. During hot months, diesel plants set nodal prices. This leads to clear changes in nodal prices during colder months, when fuel oil plants can satisfy demand at a lower cost. In Mexico, the average fuel oil and diesel prices are 12 USD/MMBtu and 24 USD/MMBtu, respectively. See Table 1.

Table 1. **Price Evolution (USD/MWh) by System**

<table>
<thead>
<tr>
<th>Year</th>
<th>Statistic</th>
<th>SIN</th>
<th>BCA</th>
<th>BCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>Average</td>
<td>47.04</td>
<td>30.62</td>
<td>126.39</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>148.41</td>
<td>68.10</td>
<td>216.66</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>20.66</td>
<td>16.06</td>
<td>56.17</td>
</tr>
<tr>
<td>2017</td>
<td>Average</td>
<td>66.35</td>
<td>32.12</td>
<td>136.15</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>205.42</td>
<td>129.63</td>
<td>243.04</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>24.19</td>
<td>15.34</td>
<td>72.62</td>
</tr>
<tr>
<td>2018</td>
<td>Average</td>
<td>83.38</td>
<td>49.77</td>
<td>155.95</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>206.83</td>
<td>495.04</td>
<td>362.98</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>28.47</td>
<td>15.34</td>
<td>92.60</td>
</tr>
<tr>
<td>2019</td>
<td>Average</td>
<td>73.00</td>
<td>41.31</td>
<td>180.79</td>
</tr>
<tr>
<td></td>
<td>Max</td>
<td>152.44</td>
<td>270.67</td>
<td>302.11</td>
</tr>
<tr>
<td></td>
<td>Min</td>
<td>15.89</td>
<td>6.99</td>
<td>60.43</td>
</tr>
</tbody>
</table>

The highest price ever experienced on a node was in San Luis on 8 January 2019 at 1,248.2 USD/MWh. The lowest price ever experienced was in Ensenada on 18 May 2018 at −68.9 USD/MWh.

For 2016 and 2017, there was a nodal price cap corresponding to the production cost of the power plant with the highest production cost in the system. In 2018 this price was increased to 110%, adding 10% every month until the second phase of the MEM is introduced.

Energy imports and exports are subject to price caps and are defined for the SIN and BCA. In 2019 the minimum import/export prices were −250 USD/MWh and −75 USD/MWh for SIN and BCA, respectively. Maximum import prices are the same for SIN and BCA; these prices are defined every month. The highest import price in 2019 was in December at 1,410 USD/MWh.
See Figure 2 for daily average prices by region, 2016–2019. The price spikes in August and September 2018 were due to an unexpected heat wave that dramatically increased electricity demand.\textsuperscript{10} In the Peninsular region, the September 2018 spike was because of a plant outage related to a lack of fuel (the region has had serious problems with natural gas supplies). The spikes observed in April and May 2019 happened when two thermal plants were unavailable in the Peninsular region.

Table 2 shows the average prices by region and their changes since 2016 with respect to the previous year.

From 2017 to 2018, prices mainly increased due to higher fuel prices. In 2019 fuel prices decreased and the capacity margin increased, resulting in lower prices compared with 2018.\textsuperscript{11} See Table 2.
Table 2. **Average Price (USD/MWh) and Changes by Region**
2016–2019

<table>
<thead>
<tr>
<th>System</th>
<th>2016</th>
<th>% Change</th>
<th>2017</th>
<th>% Change</th>
<th>2018</th>
<th>% Change</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>46.84</td>
<td>44</td>
<td>67.34</td>
<td>26</td>
<td>85.15</td>
<td>–5</td>
<td>80.70</td>
</tr>
<tr>
<td>Noreste</td>
<td>44.10</td>
<td>32</td>
<td>58.34</td>
<td>18</td>
<td>69.09</td>
<td>–19</td>
<td>55.79</td>
</tr>
<tr>
<td>Noroeste</td>
<td>48.02</td>
<td>29</td>
<td>61.80</td>
<td>18</td>
<td>72.87</td>
<td>–37</td>
<td>45.65</td>
</tr>
<tr>
<td>Norte</td>
<td>46.36</td>
<td>43</td>
<td>66.22</td>
<td>25</td>
<td>82.98</td>
<td>–29</td>
<td>58.75</td>
</tr>
<tr>
<td>Occidental</td>
<td>47.54</td>
<td>42</td>
<td>67.47</td>
<td>26</td>
<td>84.70</td>
<td>–12</td>
<td>74.91</td>
</tr>
<tr>
<td>Oriental</td>
<td>46.58</td>
<td>43</td>
<td>66.52</td>
<td>26</td>
<td>83.68</td>
<td>–2</td>
<td>82.13</td>
</tr>
<tr>
<td>Peninsular</td>
<td>53.51</td>
<td>59</td>
<td>85.21</td>
<td>44</td>
<td>122.57</td>
<td>4</td>
<td>127.62</td>
</tr>
</tbody>
</table>

Capacity is also traded at the MEM, and the first capacity balancing market became operational in February 2017. Power is accounted for in the availability in the 100 critical hours of the year (calculated ex post). These hours were initially those with the highest demand, and since 2019 they have minimum reserves. Table 3 shows the prices resulting from the Capacity Market (Mercado de Balance de Potencia) that have taken place so far.12

Table 3. **Capacity Prices (USD/KW-year)**

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIN</td>
<td>63.78</td>
<td>36.89</td>
<td>06.11</td>
</tr>
<tr>
<td>BCA</td>
<td>132.47</td>
<td>30.88</td>
<td>16.80</td>
</tr>
<tr>
<td>BCS</td>
<td>65.52</td>
<td>143.19</td>
<td>286.66</td>
</tr>
</tbody>
</table>

Market participants must pay these prices when their capacity demand exceeds what is awarded by their contracts. These prices have been volatile due to the long-term parameters used in the methodology for determining capacity prices, such as levelized cost for reference technology, reserve margin planning, income for reference technology plants in different regions, and spot market prices. According to the Independent Market Monitor,13 the current procedure for determining capacity is not adequate because it does not provide correct signals of where new capacity must be installed.

**Mexico’s Fuel Supply**

In Mexico, fuel usage for electricity generation has considerably changed over the past 20 years. Many fuel oil plants have been converted to natural gas. This transition has been motivated by different factors, such as environmental policies, low natural gas prices in the region, and higher efficiency of combined cycle plants. From 2009 to 2019, Mexico’s natural gas demand grew by 30%. During the same period, electricity generation from fuel oil plants decreased 46%. On the other hand, installed natural gas capacity plants increased 17%. See Figure 3.
According to a survey conducted by CENAGAS in 2019, gas consumption could reach a value of 14,500 MMcfd by 2024, representing an increase of 80% compared with today’s levels. In its latest forecast, the Ministry of Energy has a more conservative figure of a 30.3% increase by 2032. What is certain is that gas consumption will see a significant increase in the coming years.¹⁴

Most of Mexico’s gas production is associated gas from the Southeast region. This has two major implications. First, reservoirs in that region are on a mature phase, meaning oil and gas production are declining. Second, after an enhanced oil recovery strategy in Cantarell Field, large quantities of nitrogen were injected into the reservoirs. As a result, natural gas production has high levels of nitrogen (according to the National Hydrocarbons Commission, around 22%), which limits domestic natural gas heating power and usage. To satisfy natural gas demand, Mexico has increased its imports from the United States. See Figure 4.
In 2018 the National Hydrocarbons Commission canceled bidding rounds 3.2 and 3.3 for natural gas exploration. Under the current scenario, it is very unlikely that Mexico will be able to reduce its natural imports from the United States in the coming years.

Market Analysis and Assessment

NERA offers market assessments for North American, European, and Asian markets and provides a full range of economic due diligence services. These include customized market price forecasts, review of contracts and fuel supply and transport arrangements, and operating margin projection, which lead to detailed asset valuation and risk assessment. In addition, NERA has vast experience assisting utilities, independent power producers, and government entities with market design and implementation issues.

Specific to Mexican wholesale energy market analysis, NERA offers a wide range of capabilities and can provide tailored solutions and analysis that best suit a situation, whether it’s by region, load zone, or node.
Notes

3 Acuerdo por el que se modifican los Lineamientos que establecen los criterios para el otorgamiento de Energías Limpias y los Requisitos para su adquisición, DOF 28 October 2019.
5 Cost-based means that generators can only bid at production cost. Such costs are audited and verified by the Market Monitoring Unit (Unidad de Vigilancia del Mercado), which is in charge of the Ministry of Energy.
8 PRODESEN 2019, Base de datos de Precios de Combustibles.
9 Bases del Mercado Eléctrico, Diario Oficial de la Federación, September 2015.
12 Centro Nacional de Control de Energía, Informe Ejecutivo Mercado Para el Balance de Potencia.
14 For more details, see Veronica Irastorza and John B. McNeece III, “Crude Exports, Gas Imports Possible Development Path for Mexico,” Oil & Gas Journal, December 2019.
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