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THE BIG MEXICO RENEWABLE ENERGY REPORT

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Renewables Now - February 2018

Renewables Now

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Mexico is one of the hottest global renewable energy markets and is currently the second largest power market in Latin America with US$110 billion of investment in the generation, transmission and distribution sectors forecast until 2030.

Only five years ago, the generation, transmission, distribution and supply of electricity were all exclusively managed by the state-owned utility (and monopoly), the Comisión Federal de Electricidad (CFE). The energy sector attracted little foreign investment and had only a few operational renewable energy projects. All that changed in 2014, when, as part of a package of reforms, the government passed the Electricity Industry Law (Ley de la Industria Eléctrica) and started the process of a profound transformation of the power market - from a vertically integrated utility controlled sector - to a liberalised generation market with more opportunities for private companies.

Clean energy has been an integral part of the power reform from the onset. Decarbonisation objectives have been integrated into the design of the electricity market reform itself in the form of quota obligations for clean energy certificates (CELs), a market design that informs investors about the value of investments in new clean energy investment by time and location. (IEA:2017)

In 2018, the minimum level of consumption from emission-free technologies which needs to be proved via CELs is set at 5% for all large consumers, including CFE. This will increase to 5.8% in 2019, 7.4% in 2020, 10.9% in 2021 and 13.9% in 2022 as Mexico chases after an aggressive mandate to generate 35% of its power from clean sources by 2024.

Developed as a key piece of analysis for the MIREC WEEK Congress, this report will give you an overview of the ongoing energy reform and the power sector transformation in Mexico – in retrospective and in perspective up until 2030. We will analyse in detail the results from energy auctions so far, the new auction design and the role of the clearing house that made its debut in the November 2017 auction. Key grid upgrades and energy storage development come next. Last but not least the report will offer some insights on finance and key market participants.

POLICY BACKGROUND AND ENERGY REFORM PROGRESS

The energy overhaul was a result of the 2012 election of Mexico's president of Enrique Pena Nieto, who had promised a range of reforms to boost the economy during his election campaign. Mexico's Congress approved constitutional changes to enable the energy reform in December 2013. This was followed by a package of secondary legislation, issued in August 2014, which includes nine laws, among them the Electricity Industry Law, and 12 amended laws.

Before the reform, the country's energy sector was a state monopoly, controlled by state oil and gas giant Petroleos Mexicanos (PEMEX) and state power utility CFE. Declining oil and gas production, widespread inefficiencies and high electricity prices, however, warranted a change, and the energy reform opened the sector to private investors in a bid to attract needed capital and technology and reduce costs via efficiency and competition.

In the electricity sector, Mexico had allowed limited private participation since the 1990s. Independent power producers (IPPs) could sell power to CFE under long-term contracts, with the other options for private involvement including self-supply, cogeneration, small power production and import and export.

THE NEW REGULATORY FRAMEWORK

The liberalisation of the energy markets required a redefinition of regulatory roles too.

Centro Nacional de Control de Energia **(CENACE)**, was created in August 2014 as a decentralised public body to operate the national electricity system and, from 2016, the wholesale electricity market as well. CENACE took on some of the functions of CFE, which had hitherto acted as system operator. The responsibilities of the new body include guaranteeing fair access to the transmission and distribution grids. It is also tasked with preparing expansion and modernisation programmes for the transmission network for approval by the Secretariat of Energy (SENER) and incorporation in the Development Programme of the National Electric System (abbreviated as PRODESEN in Spanish).

CENACE organised Mexico's first three long-term electricity auctions together with SENER. From the next auction, it will cooperate with Comision Reguladora de Energia (CRE), the Energy Regulatory Commission.

CRE was created at the start of 1994 as a result of the partial opening of the electricity sector. It became the regulator for the electricity and gas sectors in 1995 and got additional powers with respect to other aspects of the hydrocarbons industry and renewable energy generation in 2008.

The 2013 energy reform strengthened the body by providing it with budget autonomy. In addition, its commissioners are now elected by the Senate from names proposed by the president.

CRE is tasked with promoting competition in the sector and adequate national coverage, protecting the interests of users, and ensuring the reliability, stability and security of supply. In electricity, its responsibilities include the regulation of electricity generation and interconnection contracts; tariffs for basic electricity services; and quality of the power grid. CRE's remit also covers overseeing the electricity wholesale market and verifying the requirements for CELs. Its responsibilities include the regulation of

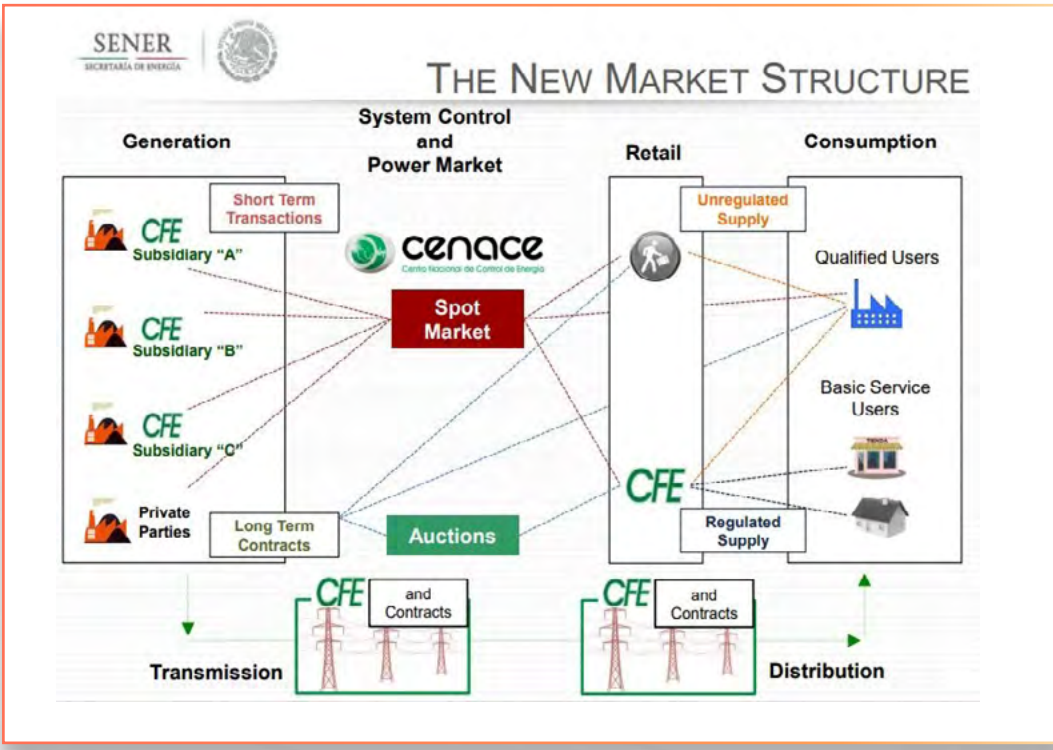
- Transportation, storage, distribution and sale of oil and gas products
- Power production and interconnection contracts
- Tariffs for basic electricity services
- Efficiency and quality of the national power grid.

CRE also makes the rules for the electricity wholesale market operation and oversight, and the verification of the criteria for clean energy certificates.

SENER is Mexico's ministry of energy and is in charge of conducting the country's energy policy. According to the Electricity Industry Law, SENER is responsible for coordinating the restructuring of the electricity sector. Along with CRE it was entrusted with establishing the terms for the unbundling of CFE. SENER was responsible for issuing the initial electricity market rules and overseeing the wholesale electricity market in the first year of operation. It also monitors the achievement of Mexico's clean energy targets.

The Energy Transition Law reiterated an objective for Mexico to generate 35% of its electricity from clean energy sources, including nuclear by 2024.

The reform transformed power monopoly **CFE** into a productive state enterprise with budget autonomy and a new board of directors. The company, created by the government back in 1937, retained exclusive rights over the transmission and distribution of electricity. The reform has split CFE into subsidiaries for transmission, distribution and power generation, each focused on profit generation for its owner, the Mexican state. The different subsidiaries started operations in early 2017.



SOURCE: SENER

"THE REFORM HAS SPLIT CFE INTO SUBSIDIARIES FOR TRANSMISSION, DISTRIBUTION AND POWER GENERATION, EACH FOCUSED ON PROFIT GENERATION FOR ITS OWNER, THE MEXICAN STATE."

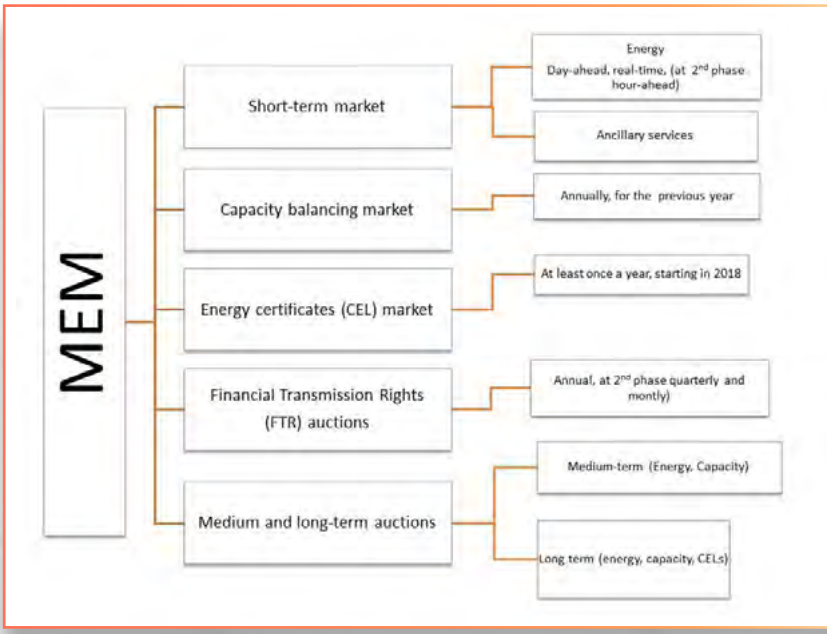
GENERAL STRUCTURE AND PARTICIPANTS

Mexico's energy reform provided for the creation of a wholesale electricity market (Mercado Eléctrico Mayorista, or MEM) in Mexico, which would allow private companies to produce and sell electricity and compete with CFE and each other. In 2015, SENER published the Bases del Mercado Eléctrico, which laid out the electricity market's design and operating principles which were to be implemented in two phases by the end of 2018.

MEM consists of short-term markets (day-ahead, hour-ahead, real-time and ancillary services), medium-term auctions (three-year energy and capacity contracts), long-term energy auctions, Financial Transmission Rights (FTR) auctions, a capacity balancing market and the 20-year clean energy certificates (CEL, in its Spanish acronym) market for instruments equivalent to 1 MWh of energy from clean sources. Certain parties, known as "load serving entities" (large consumers and energy traders), are required to purchase CELs in proportion to the amount of energy from non-clean sources which they have purchased in the market or by means of bilateral agreements.

In 2018, energy retailers and large users must purchase CELs for 5% of the total electricity consumption they served throughout the year. The requirement will go up to 5.8% in 2019.

(See graph for detailed MEM structure).



SOURCE: CENACE, JANUARY 2018

The market started operations in 2016, operated by CENACE. It is currently mostly a cost-based short-term energy market with a day-ahead market and a real-time market.

CFE continues to be the only provider of electricity to "basic" residential users and small- and medium-sized commercial users under regulated tariffs. However, the new market structure allows large energy consumers to source their electricity needs in different ways. They could conclude a bilateral contract directly with power generators, use the service of Qualified Service Suppliers or, if a user has an expected demand of 5 MW or more and annual consumption of 20 GWh, it may register as Qualified User Market Participant and bid in the auctions to purchase energy, capacity and CELs.

A detailed description of the different market player roles is given in the table below:

MARKET PLAYER	DESCRIPTION
POWER GENERATOR	Represents one or more power generating plants
QUALIFIED SUPPLIER	Represents load centres of qualified users that do not participate directly in MEM
QUALIFIED USER	End-user with estimated demand of over 1 MW, buys energy from qualified supplier
MARKET PARTICIPANT QUALIFIED USER	Represents load centre for own consumption, procures electricity directly in the market
NON-SUPPLYING BROKER/ MARKETER	Trades energy without representing physical assets
BASIC SERVICE SUPPLIER	Represents load centres corresponding to basic service users
BASIC SERVICE USER	End-user receiving energy from a basic service supplier
LAST RESORT SUPPLIER	Represents qualified users for a given period of time, usually under emergency grid situations

> "THE NEW MARKET STRUCTURE ALLOWS LARGE ENERGY CONSUMERS TO SOURCE THEIR ELECTRICITY NEEDS IN DIFFERENT WAYS."

The MEM had a total of 80 market participants at the end of January 2018, according to a list of participants with contract and transactions in the Wholesale Electricity Market, published by CENACE. Of these, 38 were power generators and 27 were qualified suppliers, of which only 6 had actually started operation in MEM by the end of 2017. Most have signed a contract to operate as a qualified supplier in the second half of 2017 and two -- Genmak Energía, S.A.P.I. de C.V and Zenith Holding México, S.A. de C.V -- in January 2018. The same is true for the 11 registered non-supplying brokers, 9 of whom have signed their contract as such between June 2017 and January 2018.

NEW AUCTION DESIGN AND THE ROLE OF THE CLEARING HOUSE

In the first two long-term auctions for clean energy CENACE had only one off-taker -- government-owned utility CFE. The 2017 auction was the first to allow basic service suppliers, qualified suppliers, last-resort suppliers and market participant qualified users to also participate as buyers.

This has been made possible by the introduction of the Cámara de Compensación (CdeC), or the Clearing House. The independent entity will act as counterparty between sellers and buyers in the long-term auctions, assessing the financial credibility of the market participants and socialising the risk of default.

Previously, the guarantees of performance under the contracts awarded in a tender were provided by CFE. This role has now been passed on to CdeC, which will collect and hold specific guarantees, the minimum of which will depend on whether the guarantor is a seller or a buyer. These minimum amounts will be determined in the auction guidelines for sellers and by CdeC for buyers.

In other words, with the introduction of a clearing house, the PPA's risk will not be a specific company but the Mexican electricity market as a whole. However, the CdeC will have a safety net in the form of a reserve fund into which all parties will pay to give it liquidity, and will also house the performance guarantees from each party.

To encourage private investment in clean energy, the reforms introduced the long-term auctions (LTAs). The auctions are neutral between qualifying technologies, and all transactions are completed under the terms of standardised electricity coverage contracts of 15 years for electricity and capacity, and 20 years for CELs. Only clean energy technologies, which according to Mexican legislation include renewables, nuclear, efficient cogeneration and carbon capture, can compete to supply electricity. Conventional generators can only submit offers to provide firm capacity.

Mexico has so far conducted three long-term power auctions, which, according to SENER estimates, will attract a total investment of around USD 9 billion, mainly for the construction of solar and wind power plants.

The first two LTAs were held in 2016. During the first auction 5.4 TWh was assigned, with several wind and solar firms winning contracts. In the second auction 8.9 TWh of renewable generation projects won contracts. The third LTA was completed in November 2017 and contracted 5.5 TWh of clean electricity.

Solar was the leading technology by a far margin in the first tender and remained the leading one in the subsequent two auctions.

A quick summary of contracted capacity by technology is given in the table below.

Contracted capacity	1st auction	2nd auction	3rd auction
Solar	1691 MW	1853 MW	1323 MW
Wind	394 MW	1038 MW	689 MW
Geothermal		25 MW	
Gas			550 MW
Average price per MWh	USD 41.8	USD 33.47	USD 20.57

SOURCE: RENEWABLES NOW WITH DATA FROM SENER

The high investor interest is evident from the very competitive prices achieved in the three tenders. Between the first and the second tender, held just six months apart in 2016, prices fell 30%, which saw projects win contracts at an average price of USD 33.47 per MWh plus CEL in the September 2016 auction. In the latest tender in November 2017 the average price per MWh plus CEL plunged to USD 20.57, comfortably below the global blended levelised cost of energy (LCOE) for gas and coal, which currently ranges from around USD 40 to USD 80, figures by GTM Research show.

AUCTION I

The inaugural auction was launched in November 2015 and completed in March the following year. Eleven companies secured contracts with 18 winning bids. They were selected out of 69 participants who submitted 227 offers.

LIST OF WINNERS IN 1ST MEXICO LTA

	Company	CELs/ year	Power (MWh/year)	Projects' capacity (MW)	Location (state)
1	Sunpower Systems Mexico S. de R.L de C.V. (SunPower Corp)	263,815	269,155	100 (solar)	Guanajuato
2	Enel Green Power Mexico, S. de R.L de C.V. (Enel Green Power)	2,249,947	2,249,947	330 + 250 +207 solar	Coahuila Coahuila Guanajuato
3	Energia Renovable de la Peninsula, S.A.P.I. de C.V. (Vive energia - Envision Energy International)	275,502	275,502	90 (wind)	Yucatán
4	Recurrent Energy Mexico Development. S. de R.L de C.V. (Recurrent Energy - Canadian Solar)	140,970	140,970	63 (solar)	Aguascalientes
5	Consorcio Chacabal (Aldesa Energias Renovables S.L.U.)	230,888	230,888	30+30 (wind)	Yucatan
6	Vega Solar 1, S.A.P.I. de C.V. (SunPower)	725,450	740,135	500 (solar)	Yucatan
7	Jinkosolar Investment Pte. Ltd. (Jinko Solar)	502,713	502,713	100 + 70 + 18 (solar)	Jalisco Yucatan
8	Photoemeris Sustentable, S.A. de C.V. (Alter Enersun Renovables)	53,477	54,975	30 (solar)	Yucatan
9	Energia Renovable del Istmo II, S.A. de C.V. (Acciona Energia Mexico, S. de R.L. de C.V.)	585,731	585,731	168 (wind)	Tamaulipas
10	Sol de Insurgentes, S. de R.L. de C.V (Thermion Energy)	60,518	60,965	23 (solar)	Baja California Sur
10	Consorcio Energia Limpia 2010 (Alarde Sociedad de Energia, S.A.)	291,900	291,900	76 (wind)	Yucatan
	Total	5,380,911	5,402,881		

The winning projects will supply a total of 5,402,881 MWh of electricity per year, with solar accounting for 74% of that and wind for the remaining 26%.

Italian energy company Enel was the biggest winner with about 1 GW of solar capacity across three projects. The list of successful bidders also included US solar company SunPower and its subsidiary Vega Solar, Spanish group Acciona with a 168-MW wind project and China's Jinko Solar. There was no interest in the firm capacity component as the price suggested was too low.

The winning projects in the first auction were located across seven states, with a concentration of eight projects in the state of Yucatan. Projects in the Yucatan peninsula were also contracted at a higher price because bids were adjusted to take into account the value a project would provide to the system based on its location. The locational adjustments were one of the reasons to which the price fall between the first and second auction was attributed as the significance of these adjustments was greatly reduced in the second auction. Other factors cited were increased investor confidence and the depreciation of Mexican currency. In addition, besides cost declines and the appeal of the market's potential, the steadily declining prices across the auctions may reflect the revenue streams available to project developers as they can also sell surplus generation at nodal prices, participate in the capacity market, or sell CELs on the secondary market.

"MEXICO HAS SO FAR CONDUCTED THREE LONG-TERM POWER AUCTIONS WHICH WILL ATTRACT AROUND US$9 BILLION"

AUCTION II

The second auction was launched in April 2016 and the results were announced in September that year. In addition to 1,853 MW of solar and 1,038 MW of wind projects, a 25-MW geothermal project of CFE was also successful. A further 68 MW of hydropower secured only CELs and a 90-MW wind project -- a firm capacity contract.
Renewables managed to grab a share of the firm capacity awards, the biggest part of which went to two combined-cycle plants, one of CFE and one in Texas, the US.

This time CFE had offered to buy a larger volume of electricity and 8,909,819 MWh of supply was procured, which represents 83.4% of the proposed amount and an increase of 65% from the first tender.

A total of 57 companies submitted economic offers in the competition, out of which 23 entities secured contracts. The major auction winners included Zuma, a company backed by Actis and Mesoamerica, with 725 MW of projects, and Cubico Sustainable Investments with 540 MW of projects, including in partnership with Alten Energias Renovables.

Spanish solar developer Fotowatio Renewable Ventures won a 300-MW solar project, while the Mexican unit of EDF Energies Nouvelles secured 252 MW of wind and 90 MW of solar.

The projects were more widely dispersed across the country. Aguascalientes in central Mexico and Tamaulipas in northeastern Mexico were the leading states with 545.67 MW of solar and 537.05 MW of wind projects.

	Company	CELs/ year	Power (MWh/year)	Firm Capacity W)	Project Capacity (MW)	Location (state)
1	AT Solar (Acciona-Tuto Energy)	478,260	478,261	29	180 MW (five projects) solar	Sonora
2	Energia Sierra Juarez Holding S. de R.L de C.V. (Ienova)	117,064	114,116	-	41 solar	Baja California
3	Enel Green Power Mexico S. de R.L de C.V.	399,129	399,130	-	100.05 wind	Tamaulipas
4	Eolica de Oaxaca S.A.P.I de C.V. (EDF)	818,264	818,265	-	252 wind	Oaxaca
5	Quetzal Energia Mexico S.A.P.I de C.V. (Zuma)	393,611	393,611	-	148 solar	Chihuahua
6	Comision Federal de Electricidad (CFE)	198,764	198,764	400	25 geothermal 394.1 combined cycle	Michoacan Sonora
7	OPDE	289,508	289,509	-	82.5+29.67 solar	Coahuila Aguascalientes
8	Generadora Fenix S.A.P.I de C.V.	314,631	-	-	68 MW (6 projects) hydro	Puebla
9	Parque Eolico Reynosa III, S.A.P.I de C.V. (Zuma)	1,613,416	1,613,417	-	387.5 (5 projects) wind	Tamaulipas
10	Kamet Energia Mexcio, S.A.P.I de C.V. (Zuma)	353,466	353,466	-	125 solar	Sonora
11	Consorcio Guanajuato (X-Elio)	146,957	146,958	12	30+30 solar	Guanajuato
12	X-Elio Energy, S.L.	363,136	363,137	30	80+70 solar	Chihuahua Morelos
13	Parque Eolico El Mezquite S.A.P.I de C.V. (Cubico)	774,938	820,636	77	249 wind	Nuevo Leon
14	Energia Renovable de la Peninsula, S.A.P.I de C.V.	-	-	30	90 wind	Yucatan
15	Frontera Mexico Generacion S. de R.L de C.V.	-	-	475	505 combined cycle	Texas US
16	Consorcio ENGIE Solar Trompezon (Engie)	338,851	342,630	-	126 solar	Aguascalientes
17	Consorcio SMX (Ienova)	285,606	278,358	10	100 solar	Aguascalientes
18	Tractebel Energia de Altamira, S. de R.L de C.V. (Engie)	223,010	223,010	22	49.5 wind	Tamaulipas
19	Consorcio Fotowatio	779,161	779, 162		300 solar	San Luis Potosi
20	HQ Mexico Holdings, S. de R.L de C.V. (Q-Cells)	252,444	252,445	18	101.08 solar	Coahuila
21	Alten Energias Renovables Mexico Cuatro, S.A. de C.V.	812,417	722,044	75	5x30 solar	Aguascalientes
20	HQ Mexico Holdings, S. de R.L de C.V. (Q-Cells)	252,444	252,445	18	101.08 solar	Coahuila
21	Alten Energias Renovables Mexico Cuatro, S.A. de C.V.	812,417	722,044	75	5x30 solar	Aguascalientes
22	Bluemex Power 1 S.A. de C.V. (EDF)	249,982	249,982	-	90 solar	Sonora
23	Green Hub S. de R.L de C.V. (Grenergy)	72,919	72,919	10	30 solar	Guanajuato
	Total	9,275,534	8,909,819			

AUCTION III

The third tender, launched in April 2017 and completed in November 2017, should lead to the construction of 15 power plants in the country, nine solar farms totalling 1,323 MW, five wind farms with a combined capacity of 689 MW and one 550-MW gas plant. The power purchase agreements (PPA) awarded are for the supply of 5,492,575 MWh per year, some of which will be purchased by Spanish utility Iberdrola and Mexico's Cemex, which participated alongside CFE as buyers.

The major winners include French utility Engie which secured 687.8 MW of capacity, consisting of one wind project of 100.8 MW and three solar schemes totalling 587 MW. Enel again featured on the winning list with four wind projects representing 593 MW of capacity. French renewables company Neoen was awarded a 377-MWp solar project.

LIST OF WINNERS IN 3RD MEXICO LTA

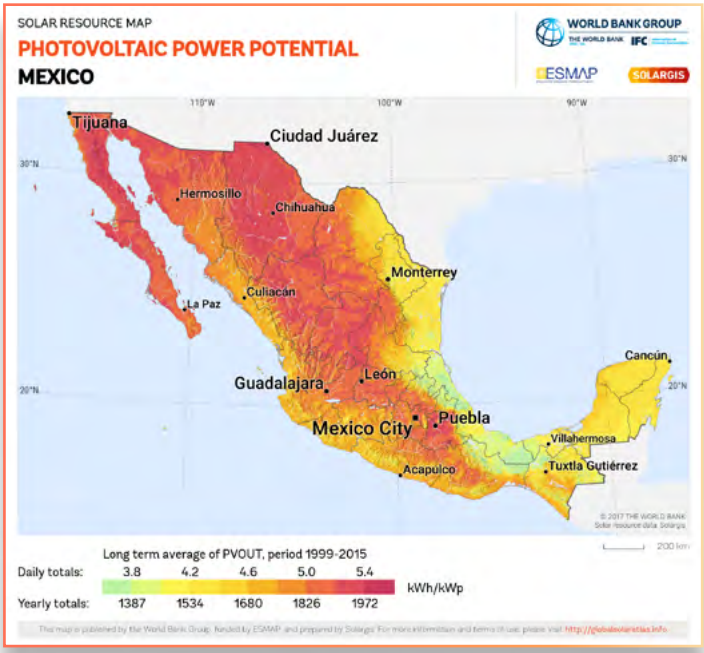
	Company	CELs/year	Power (MWh/year)	Firm Capacity (MW)
1	Enel Rinnovabile S.A. de C.V. (Enel)	2,089,610.00	2,089,611.65	-
2	Consorcios Engie Solar-Eolico (Engie)	1,653,620.00	1,508,906.05	30.62
3	Neoen International S.A.S. (NEON SAS)	770,864.00	616,692.00	-
4	Canadian Solar Energy Mexico, S. de R.L. de C.V. (Canadian Solar)	764,826.00	652,083.00	-
5	X-ELIO ENERGY, S.L. (Gestamp - KKR & Co)	483,727.00	435,354.48	10.00
6	Mitsui & Co., Ltd. and Trina Solar (Netherlands) Holdings B.V	189,928	189,928	-
7	Compania de Electricidad los Ramones S.A.P.I. de C.V. (Invenergy Investment Company LLC)	-	-	499.95
8	Energia Renovable del Istmo II S.A. de C.V. (Acciona)	-	-	52.04

> "THE THIRD TENDER, COMPLETED IN NOVEMBER 2017, SHOULD LEAD TO THE CONSTRUCTION OF 9 SOLAR FARMS (1,323 MW) AND FIVE WIND FARMS (689 MW)."

SOLAR IRRADIATION AND RESOURCE MAP

While solar radiation around the globe is unevenly distributed, studies have defined the most favourable belt for solar energy production to be between 15°N and 35°N. Semi-arid regions in this belt have the greatest amount of solar radiation, more than 90% of which comes as direct radiation because of the limited cloud coverage and rainfall.

Mexico's total territory lies between the latitudes 14°N and 33°N and the longitudes 86°W and 119°W, meaning that it is one of the few countries that lie 100% within the most favorable sun belt on the planet.

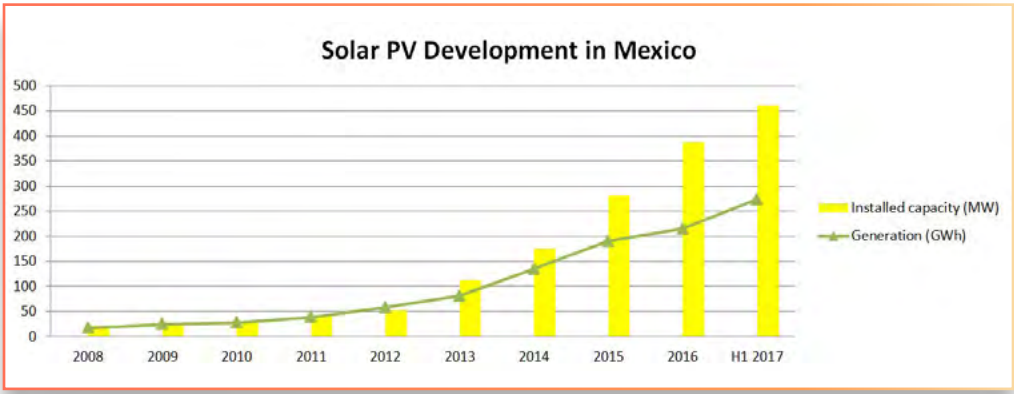


It receives twice as much solar radiation as Germany. Daily radiation ranges between 4.4 kWh/m2 and 6.3 kWh/m2 of solar energy (Mexico Institute Woodrow Wilson International Center for Scholars). The daily average stands at 5.5 kWh/m2. In the Northwest it can exceed 8 kWh/m2 in spring and summer (IRENA:2015). In the Northeast and Baja California, solar radiation may reach 8.5 kWh between April and August.

On average, Mexico enjoys 2,190 hours of sunshine per year, mainly in the state of Baja California, Coahuila, Chihuahua and Sonora (Inventario Nacional de Energias Renovable, SENER).

CAPACITY & GENERATION GROWTH 2008 - 2017

Thanks to the falling cost of solar equipment, the opening of the Mexican electricity market, the introduction of instruments to stimulate investment in renewable energy, including auctions by the government, and increased competition on the energy market, the share of solar power in Mexico's energy mix is seen to grow in the coming years. The pace of capacity additions is already quickening as you can see in the chart below.



The latest available figures by the Mexican government (Reporte de Avance de Energías Limpias Primer Semestre 2017, published in January 2018) show that the country's total installed power generation capacity stood at 74,046 MW at the end of June 2017. The share of photovoltaic solar power was negligible at just 0.62% of the total with an overall installed capacity of 460.86 MW.

In December 2017, Mexico's Secretariat of Energy (SENER) said that the Villanueva 3 solar PV park of Enel Green Power Mexico had started commercial operations, becoming the first winning project from the country's first long-term power auction to feed power into the national electricity system. Villanueva 3 will gradually reach a capacity of 250 MW. Overall, the winning solar projects from that first auction, launched in November 2015, represent a total capacity of 1.7 GW.

As more projects move towards completion, Mexico's cumulative solar capacity will be doubling and tripling in the coming years.

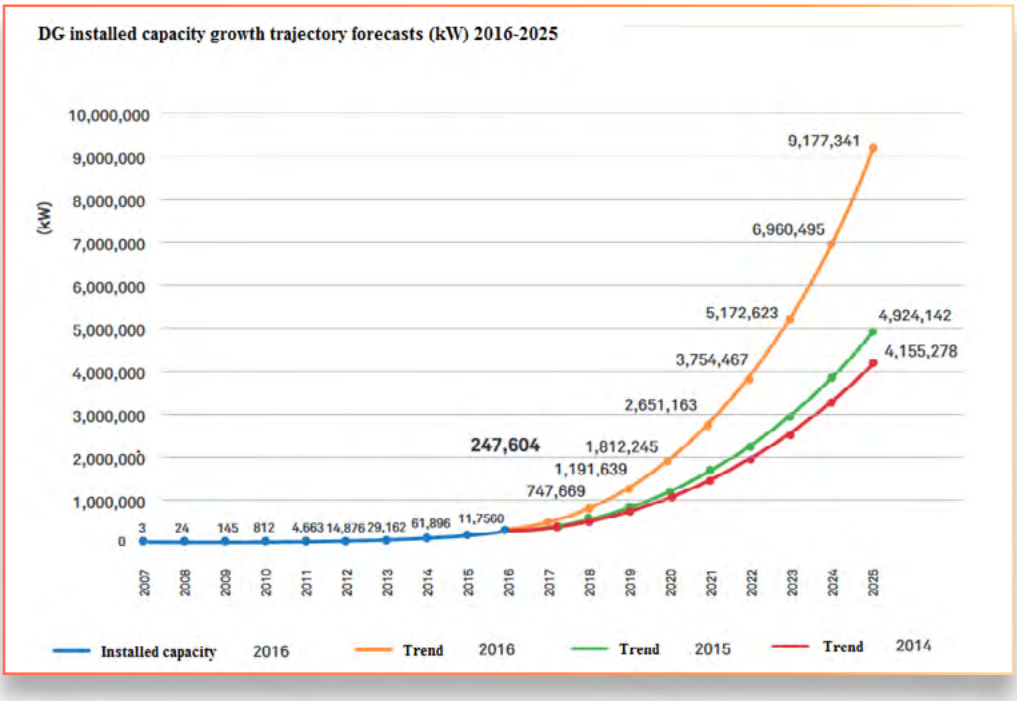
SOLAR PV DEVELOPMENT IN MEXICO

In terms of distributed generation (DG), Mexico reached 247.6 MW of DG capacity at the end of 2016, up by 110% year-on-year. Solar installations smaller than 30 kW accounted for 50% of the total, while 48% were solar systems bigger than 30 kW but smaller than 500 kW. The remaining 2% were biogas systems.

According to a recent report by the Mexican Banks Association (ABM) and the Mexican Climate Initiative (ICM), the country's total DG capacity could surpass 9,177 MW by 2025, if the pace of growth remains similar to that in 2016. Even with the more modest pace of growth from 2015 or 2014, the projected growth curve is pretty steep.

FORECASTED INSTALLED CAPACITY BY 2020/2030

SOURCE: ABM & ICM REPORT

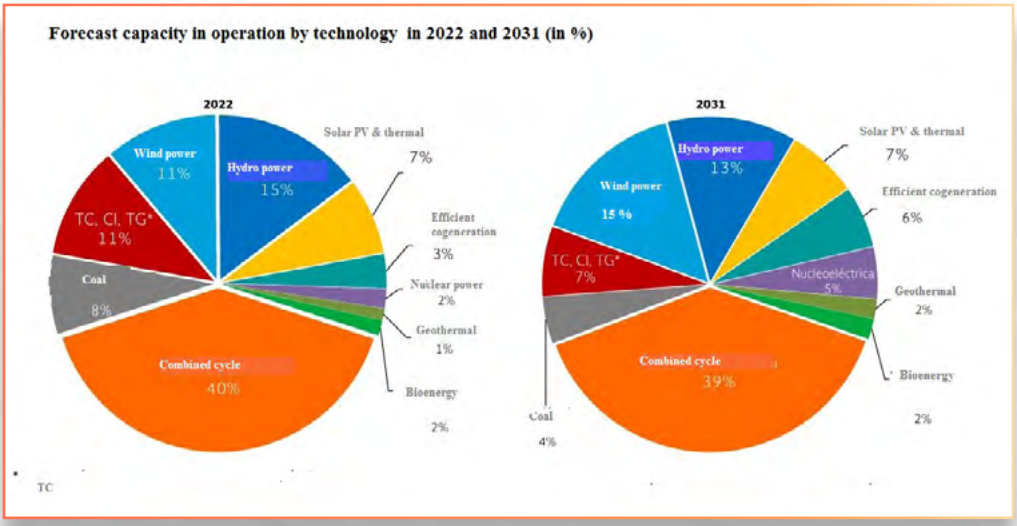


In December 2017, the government published a roadmap for solar development with the aim of reaching 22 GW of installed PV capacity in 2030. It is expected that by that year Mexico will have 9 GW of large-scale power plants and 13 GW of DG solar systems. An interim goal of 5 GW large-scale and 2 GW DG solar has been set for 2024.
The expansion of Mexico's utility-scale solar power capacity will be

driven mainly by the projects that have won contracts in clean energy auctions and the increasing competitiveness of solar power, as costs fall. According to GTM Research, in 2018 the country will, for the first time, join the list of gigawatt-scale solar markets.

On June 1, 2017, the Ministry of Energy in Mexico released its infrastructure development programme for the National Electric System -- PRODESEN (Programa de Desarrollo del Sistema Eléctrico Nacional) for the period 2017-2031. It includes details about power generation capacity and the fuel mix, investments to be made in the national electricity system, and demand and capacity projections. The document shows that 55,840 MW of utility-scale power generation capacity will have to be installed in the 15-year period to meet growing demand. The share of renewables in new deployments will be 63%, coming from wind, solar and efficient cogeneration.

The combined share of solar PV and solar thermal power plants in new large-scale capacity additions to 2031 is estimated at 14%, while their share in Mexico's cumulative power capacity is expected to reach 7% in 2031. The solar share of Mexico's power output is expected to stand at 3%.



PROJECT LANDSCAPE AND CONSTRUCTION TIMELINES

Utility-scale PV project construction in Mexico is largely driven by the three auctions the government has held so far. A fourth one is expected to be announced this year.

Winning solar projects in the first two auctions are located in Baja California Sur, Aguascalientes, Jalisco, Guanajuato, Coahuila and Yucatan and have to be completed in 2018. The second auction awarded contracts to solar projects in Baja California, Sonora, Chihuahua, Coahuila, San Luis Potosí, Guanajuato, Aguascalientes, Morelos and Yucatan. PV projects in Sonora, Aguascalientes, Tlaxcala, Chihuahua and Zacatecas secured contracts in the third auction.

Several solar power plants are being built outside tenders, such as Iberdrola's 105-MW Hermosillo project in Sonora, which will sell its power to private customers on the market, and IEnova's 110-MW Pima Solar park in the same state, which will sell all of the power to steel company Deacero SA de CV under a 20-year power purchase agreement (PPA). Both are to start power generation in 2018.

KEY PROJECTS FROM AUCTION I AND II

The Mexican government announced at the end of March 2016 that SunPower Systems, Enel Green Power, Recurrent Energy, Vega Solar, JinkoSolar and several other companies have won solar contracts for roughly 1.7 GW in the first long-term auction. Enel was the biggest winner across three projects -- the Villanueva 1 and 3 solar power plants, with a combined capacity of 754 MW in direct current (DC) in the state of Coahuila, and the 238-MW DC Don Jose project in the state of Guanajuato.

Enel said at the end of March 2017 that it has started construction works at the two Villanueva projects, scheduled to go into service in the second half of 2018. Villanueva 3 has been producing power since December 2017 and the full capacity is gradually being commissioned. Construction of Don Jose started in April and it is to enter operation in 2018.

In the second long-term power auction, Acciona Energia and Tuto Energy won contracts for the 227-MWp Puerto Libertad solar park in Sonora and later announced that they will expand the capacity of the facility by 50% to 339 MWp, or 270 MW, after signing an additional private purchase agreement to supply power to a major Mexican industrial group. The start of construction was announced in early February 2018, and the solar power plant has to be up and running by the first quarter of 2019.

Cubico Sustainable Investments in the summer of 2017 reached financial close on the 350-MWp Solem solar project in Aguascalientes, which has to enter into service in the fourth quarter of 2018. In October 2017 it was announced that the first panels had already been installed. Cubico is partnering in the project with Alten Energias Renovables.

Zuma Energia, a joint venture of Actis and Mesoamerica, will bring online by mid-2019 the 158-MWp Orejana solar park in Sonora and the 179-MWp Santa Maria solar park in the neighbouring Chihuahua. The projects reached financial close in November 2017.

Fotowatio Renewable Ventures (FRV), part of Abdul Latif Jameel Energy, said in January 2018 that it is preparing to start construction of the 342-MW DC Potosi Solar Farm solar plant in San Luis Potosí, after having secured financing. Power generation is to commence in 2019.

Sempra Energy, through its Mexican unit IEnova, won contracts for the 53-MW DC Rumorosa Solar farm in Baja California and the 133-MW DC Tepezalá II Solar park in Aguascalientes in the second auction. Construction on both projects is to begin in 2018, with the start of operations scheduled for the first half of 2019.

"UTILITY-SCALE PV PROJECT CONSTRUCTION IN MEXICO IS LARGELY DRIVEN BY THE THREE AUCTIONS THE GOVERNMENT HAS HELD SO FAR."

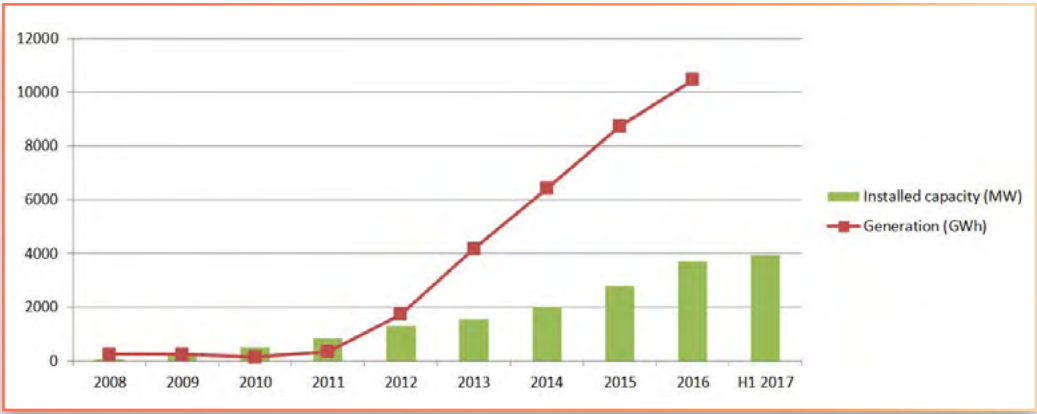
WIND SPEEDS AND RESOURCE POTENTIAL

Recently developed wind turbines nowadays can operate at wind speeds as low as 3 m/s and up to 14 m/s. In parts of Mexico, such as certain areas in Oaxaca, Baja California, Sonora and Tamaulipas, wind speeds can reach 12 m/s in the first quarter of the year and in November and December. The country's overall wind power potential is estimated at 50 GW. (PRODESEN:2017)

Depending on the actual wind resource, these 50 GW of theoretical potential can be divided into 20 GW with an average capacity factor of 35%, 10 GW at an average capacity factor of 27% and 20 GW at 20%.

CAPACITY & GENERATION GROWTH 2008-2017

According to government figures Mexico had 3,942.2 MW of installed wind power generation capacity at the end of June 2017, all of which comes from large-scale onshore wind power plants. There were no distributed generation wind systems installed by the end of the year. The wind farms' output for 2016 is estimated at 10,463 GWh, or roughly 3% of the country's total power. In the first half of 2017, wind power generation reached 5,094 GWh.



SOURCE: RENEWABLES NOW, DATA FROM SENER, GWEC

> **"MEXICO'S OVERALL WIND POWER POTENTIAL IS ESTIMATED AT 50 GW."**

As in most places around the world, wind power installations in Mexico are not evenly distributed in geographical terms. The table below shows the states in which there were more than 100 MW of wind capacity installed at the end of 2016.

STATE	CAPACITY (MW)
Oaxaca	2,347
Nuevo León	274
Coahuila	201
San Luis Potosí	200
Jalisco	179
Tamaulipas	167
Baja California	166

SOURCE: SENER

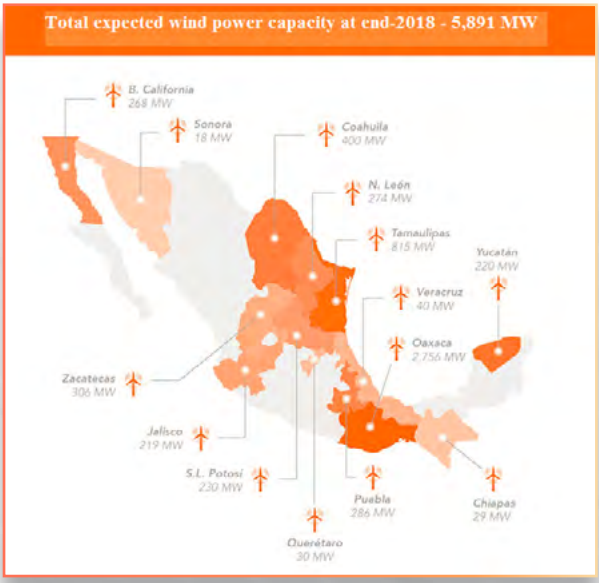
FORECAST INSTALLED CAPACITY BY 2020 / 2030

According to the PRODESEN program, 55,840 MW of utility-scale power generation capacity will have to be installed in the period 2017-2031 to meet growing demand. The share of wind in new capacity additions is estimated at 24%, which corresponds to roughly 13,400 MW.

In the years 2022 and 2031 wind farms will represent 11% and 15%, respectively, of Mexico's total installed power generation capacity. In these two years, the Mexican government expects the share of wind in the country's power output to grow to 10% and 15%.

According to the Mexican Wind Energy Association (AMDEE), Mexico's wind power capacity will grow by some 2 GW between 2016 and 2018. The country is forecast to have 5,891 MW of wind farms at the end of 2018. The leading state will be Oaxaca with 2,756 MW, followed by Tamaulipas with 815 MW and Coahuila with 400 MW.

AMDEE expects that capacity to surge to 12,896 MW by 2020-2022.



SOURCE: AMDEE

PROJECT LANDSCAPE & CONSTRUCTION TIMELINES

Similar to solar, wind energy in Mexico is currently expanding as a result of the auctions held by the government. In the first auction, wind wins were more modest than solar, as only 394 MW of wind projects secured contracts. The list includes one project in Tamaulipas and four in Yucatan.

The second auction, however, saw the share of wind in total awards rise. Projects in Nuevo Leon, Tamaulipas, Oaxaca and Yucatan won firm capacity, electricity and CEL contracts for just over a gigawatt of wind power plants.

The third auction was won by five wind farms with a combined capacity of 689 MW in the states of Coahuila and Tamaulipas.

In Mexico there is also significant demand for wind power outside auctions. Major global companies like Mars Inc and HSBC, and local firms like Mexican brewer Grupo Modelo, have signed wind power purchase agreements (PPAs) in line with sustainability goals.

KEY PROJECTS FROM AUCTIONS I, II AND III

Acciona Energía said in March 2017 that construction had started on the 168-MW El Cortijo wind farm in Tamaulipas. It is to enter service in the third quarter of 2018. In November, Acciona announced that the capacity of the wind farm will be increased to 183 MW and that it has won another contract for it in the third Mexican auction.

Enel SpA won a contract for the 93-MW Salitrillos wind farm in Tamaulipas in the first energy auction. It said in January 2018 that construction has commenced. The park is expected to enter into service by 2019.

In August 2017, Zuma Energia announced financial close for the Reynosa wind farm of 424 MW in Tamaulipas. The project secured contracts in the second Mexican auction. It will be built by Acciona under a contract awarded by Zuma. Commercial operation is expected to commence at the end of 2018.

Again in August, Cubico Sustainable Investments said it had reached financial close on the 250-MW El Mezquite wind project in Nuevo Leon. Completion is planned by the fourth quarter of 2018, together with the 350-MWp Solem solar power complex.

The Mexican unit of EDF Energies Nouvelles (EDF EN) has to put in operation in the first quarter of 2019 the 252 MW of capacity at its Gunaa Sicarú wind farm in Oaxaca. It was secured in the second auction. The company is developing it as a 300-MW project.

In the third long-term auction in Mexico, Enel secured the biggest share of the power supply and CEL awards with four wind projects with a total capacity of 593 MW. The lowest prices in the auction were for the Italian company's 100-MW Amistad II and 149-MW Amistad IV wind projects at MXN 340.73 and MXN 340.99 per MWh, respectively. The plants are due to enter into operation in the first half of 2020.

FINANCING CLEAN ENERGY IN MEXICO

Clean energy investment globally reached USD 333.5 billion in 2017, up 3% from 2016 and the second highest annual figure ever, according to Bloomberg New Energy Finance (BNEF).

In Mexico, investment surged by 516% to USD 6.2 billion, helped by large wind and solar project financings.

Renewable energy projects in Mexico, just like in other parts of the world, mostly rely on traditional financing methods such as syndicated loans and non-recourse project finance debt, low-cost loans from development banks or multilateral lending institutions, and financing from private equity funds and institutional investors, or export credit agencies. The MIREC WEEK free market report "Clean Energy Finance in Mexico" already offers a good overview of the traditional finance sources and can be found on the content section of the website - www.mirecweek.com.

A newer instrument -- green bonds -- is gaining popularity also, and the potential in that area is huge.

> **"IN MEXICO THERE IS SIGNIFICANT DEMAND FOR WIND POWER OUTSIDE OF THE AUCTIONS"**

GREEN BONDS

According to the Climate Bonds Initiative (CBI), Mexico has claimed the title of the sixth largest green bond issuer for 2017 with a single deal in which Mexico City Airport Group issued USD 4 billion via two tranches in September 2017. The proceeds will be used to finance a new, solar-powered airport. Development bank Nacional Financiera SNC (Nafin), which is a major financier of renewable energy projects, and Mexico City is also on the list of local green bond issuers.

Last year, 57 Mexican investors with MXN 4 trillion, or USD 225 billion, in assets under management committed to support the growth of the local green bond market.

Globally, the climate-aligned bond universe reached USD 895 billion, according to a report by the Climate Bonds Initiative from September 2017. This includes unlabeled climate-aligned bonds at USD 674 billion and labelled green bonds at USD 221 billion. Energy was the second largest proponent with USD 173.4 billion outstanding. Of that wind, solar and mixed renewable energy accounted for 63%, and hydro for 27%.

DEVELOPMENT BANKS & INTERNATIONAL FINANCIAL INSTITUTIONS

A trend is quite visible when looking at the finance deals for renewable energy projects in Mexico -- local government-owned development banks are helping hundreds of megawatts of wind and solar capacity get built.

The National Bank of Foreign Trade (Bancomext), Nacional Financiera SNC (Nafin) and the National Bank for Public Works and Services (Banobras) took part in a number of project financing deals in the past year. The North American Development Bank (Nadbank) also helped a number of projects.

Nafin is already an issuer of “Climate Bond Certified” green bonds. It is also supported by the European Investment Bank (EIB), with which it signed a Memorandum of Understanding (MoU) in March 2017 for the two institutions to work more closely together to support economic development priorities in Mexico.

"The signature of this Memorandum of Understanding with the EIB represents a great opportunity to promote collaboration between both institutions, mainly in a topic that has become of special relevance to Nafin: sustainable development. Working together with the EIB in renewable energy projects, and sharing experiences and best practices on this area, will allow Nafin to support the Federal Government's climate change goals and international commitments," Jacques Rogozinski, Nafin's Director General said at the time.

In October it was announced that the EIB is extending USD 100 million in loans to Nafin to be passed on as loans to private sector borrowers for renewable energy projects.

Bancomext in 2016 signed a memorandum of understanding (MoU) with its German counterpart KfW and German development agency GIZ (Deutsche Gesellschaft fur Internationale Zusammenarbeit) to support renewables in Mexico. The parties said at the time they would share experience in financing renewable energy projects with a focus on solar in Mexico.

Banobras has developed a Sustainability Bond Framework in accordance with which it intends to issue sustainability bonds to finance projects in renewables, energy efficiency, sustainable transport and other categories related to sustainable development in Mexico.

RENEWABLE ENERGY FINANCE TRANSACTIONS IN MEXICO

In the past year, several huge projects, winners in the first two energy auctions, reached financial close in Mexico.

Zuma Energía, an 80/20 joint venture between growth markets investor Actis and Mesomerica Investments, in August 2017 announced USD 600 million in project financing for the 424-MW Reynosa wind project. Zuma said at the time that this was the first project to achieve financial close on project financing out of those which won PPAs in the long-term electricity auctions in 2016.

"Zuma's success also suggests the auction mechanism and its structure within the national electric model has been successful in allowing the bankability of renewable energy projects which will contribute to their increasing competitiveness," the company said.

That success was soon followed by financial closings for several other major projects. Details are available in the table.

Project	Capacity	Project owners	Secured financing	Lenders	Equity
Reynosa Wind Farm	424 MW	Zuma Energía (80/20 JV of Actis & Mesomerica)	USD 600 million project financing	Bancomext, Banobras, Santander, EKF	Not disclosed
El Mezquite wind farm	250 MW	Cubico Sustainable Investments - majority; Alten Renewable Energy - minority	USD 220 million non-recourse project finance debt	Nadbank, Bancomext, Banobras	Close to USD 200 million of equity
Solem solar complex	350 MWp	Cubico Sustainable Investments - majority; Alten Renewable Energy - minority	USD 230 million non-recourse project finance debt	Inter-American Investment Corp (on behalf of IADB*), Canadian Climate Fund for the Private Sector in the Americas, China Co-Financing Fund for Latin America & the Caribbean, IFC (USD 45 million), Bancomext, Banobras and MUFG**	Tamaulipas
Orejana and Santa María solar parks	158 MW + 179 MW	Zuma Energía (80/20 JV of Actis & Mesomerica)	USD 294 million project financing	Bancomext, Banobras, Nafin and Nadbank	Not disclosed
Potosí Solar Farm	342 MW DC	Fotowatio Renewable Ventures (FRV)	Not disclosed	KfW, Bancomext, ING	Not disclosed

***IADB STANDS FOR INTER-AMERICAN DEVELOPMENT BANK GROUP**
****MUFG STANDS FOR MITSUBISHI UFJ FINANCIAL GROUP**

"We are seeing the energy reforms play out and attract new players and international funding. Mexico has compelling fundamentals for investing in power generation, including superior natural resources, an evolving and supportive regulatory framework and a deep project finance capacity," Michael Harrington, board member of Zuma and partner and head of Mexico at Actis said in November 2017.

Historically, Mexico's relatively expensive natural gas and oil-powered generation fleet combined with ageing transmission lines have contributed to increasing electricity costs, pushing companies to source electricity through direct PPAs (WBSCD, 2017). With the country undergoing a significant energy market reform, Mexico's corporate PPA market stalled last year as market regulations are being finalised, but additional drivers have appeared and the pace is expected to pick up again this year.

NEW REGULATORY FRAMEWORK

Legislation now requires utilities, energy traders and large consumers to source a certain amount of electricity from clean energy sources. The minimum level of consumption from emission-free technologies which needs to be proved via CELs is set at 5% in 2018. This will increase to 5.8% in 2019, 7.4% in 2020, 10.9% in 2021 and 13.9% in 2022 as Mexico chases after an aggressive mandate to generate 35% of its power from clean sources by 2024.

The energy reform is also modifying the way corporate PPAs can be contracted. Previously, under the self-supply rules any capacity contracted would have been subject to a relatively small 'postage stamp' fixed wheeling (transmission) cost. From 2017 onwards, Qualified Users can also participate in the wholesale market and procure electricity directly from a generator, or through an energy trader. Clean energy projects will have to issue clean energy certificates and the transmission and distribution costs will vary based on voltage and region.

KEY INDUSTRIES & BUYERS

Not surprisingly, energy-intensive industries are the ones that see renewable energy procurement as an increasingly attractive option, especially considering CFE's latest increases in electricity tariffs for the industrial and commercial sectors.

The table below gives a quick summary of the most active industries and some of the companies in them.

INDUSTRY	KEY OFF-TAKERS
Mining	Industrias Peñoles, Arcelor Mittal, DeAcero, Minera Mexico, Minera Roble, Minera Maple, Cobre del Mayo, Minera Monteverde
Infrastructure & Construction	ICA, Grupo Aeroportuario del Centro Norte (OMA), Grupo Aeroportuario del Sureste (Asur), Cemex, Saint-Gobain, Industrias Unidas
Industrial	Grupo Alfa, Kimberly-Clark, Decoplas, Grivatec, Metalsa, SRG Global México, Metalsa
Food & Beverages	Grupo Bimbo, Nestlé, Herdez, Arca Continental, Coca-Cola FEMSA, Grupo Modelo, AB InBev
Automotive	Nissan Mexicana, Volkswagen, BMW México, Continental Automotive, FCA Mexico, Delphi, Metalsa
Telecoms	Axtel, Totalplay
Financial services	GNP, Citibanamex
Retail	Wal-Mart de México, Soriana, FEMSA, Coppel, Home Depot, Elektra

In 2017, the most notable corporate renewable energy procurement came from Belgian AB InBev which announced in May that its worldwide renewable electricity transformation will begin in Mexico -- home to the company's largest brewery in Zacatecas.

AB InBev has signed a power purchase agreement with Iberdrola for 490 GWh per year. Iberdrola will build and install 220 MW of onshore wind capacity in the state of Puebla. Energy generation is expected to begin in the first half of 2019.

Energy storage is a cornerstone tool for enabling the transition from fossil fuels to renewable energy supply and it finds application both in front-of-the-meter (utility & wholesale electricity market) and behind-the-meter (customer) applications. As Mexico is planning larger shares of variable generation like wind and PV in the very near future, grid enhancement and integration of energy storage technologies will be a must for cost-effective management of the power grid.

So far, there are no notable energy storage projects in operation in Mexico but the country would be an easy fit for storage companies looking to do business abroad. Plans for two such investments were already announced last year.

ENERGY STORAGE IN MEXICO

In 2016, Mexican conglomerate Grupo Bal and US energy firm AES Corporation created a 50/50 joint venture – Ener AB, to undertake electricity generation projects in Mexico.

On the sidelines of last year's MIREC WEEK event, Malaquias Encarnacion, Business Development Director at Ener AB, told a reporter at S&P Global Platts that the company is looking into a battery storage investment with a capacity of as much as 90 MW to provide peaking power, frequency modulation and reserve capacity services.

Ener AB intended to use the system to back up a 300-MW solar power plant the joint venture planned to bid into Mexico's third electricity auction

Ener AB was not among the winners in last year's auction, so no further development plans have been announced but theoretically frequency regulation and other ancillary services remain a possible business case for energy storage systems.

General Electric (GE) is also reported to be developing Mexico's first ever grid-scale energy storage projects to aid the integration of wind and solar into electricity networks.

Mexican financial newspaper El Financiero reported in August that the US multinational has five such systems at an early-stage of development.

GE Grid Solutions Latin America's head of digital solutions, Rodrigo Salim, told another Mexican newspaper, El Economista, that energy storage technologies will be used for grid stabilisation in Mexico in less than three years' time.

There have also been a number of feasibility studies into storage on the Baja California Sur peninsula, a region that has traditionally been isolated from the rest of Mexico's electricity grid. In an initiative driven by Hector Olea, President of Mexican solar association ASOLMEX, early results indicate that there is strong potential for energy storage on the peninsula as an alternative to a costly sub-sea transmission connection with the mainland. The vision for Baja California Sur is one of a region with electricity needs potentially serviced 100% from renewable energy.

While energy storage projects will take a year or so to materialise, grid upgrades are taking a more distinct shape.

MEXICO'S ELECTRICITY GRID – STATE OF PLAY AND PLANNED DEVELOPMENT

Mexico's transmission and distribution network, or Sistema Eléctrico Nacional (SEN), includes the national interconnected system, or Sistema Interconectado Nacional (SIN), and the isolated network of Baja California in the northwest. The Red Nacional Transmisión (RNT) or national transmission network covers 53 regions, of which 45 are interconnected within the SIN. The other eight regions are located in the Baja California Peninsula. Of these seven are interconnected, while the Mulege region in the central part of Baja California has no interconnections.

The SEN comprised 104,133 km of transmission lines and 197,435 MVA of transformer capacity of 69 kV to 400 kV at the end of 2016.

The table on next page gives details of transmission capacity per region.

REGION OF CONTROL	CAPACITY AT END-2016 (IN MW)
Central	11,400
Oriental	16,550
Occidental	12,450
Noroeste	6,060
Norte	4,110
Noreste	18,670
Peninsular	3,210
Baja California	1,488
Baja California Sur	270
SIN TOTAL	72,450
SEN TOTAL	74,208

As part of its energy reform, the Mexican government has allowed private players to finance, operate, maintain and expand the transmission and distribution (T&D) network. Smaller, standard transmission upgrades remain the responsibility of the Federal Electricity Commission (CFE), while some larger, non-standard projects expanding the SIN to isolated areas such as the Baja California Peninsula and the Island of Cozumel, will be awarded under competitive solicitations.

One auction, for a 1.5-GW transmission line to connect the isolated Baja California grid to the SIN, is currently in progress. Its start was announced in December 2017 and by the end of January it had attracted the interest of 45 companies from Brazil, China, Colombia, India, Mexico, Spain and the US. Mexican and international companies or consortia compete to finance, build, operate and maintain the 1,400-km transmission line. It will run between Mexicali, Baja California on the Mexico-US border and Hermosillo, Sonora, and will use high voltage direct current (HVDC) technology. Investment in the Baja California-SIN project is estimated at USD 1.1 billion.

Links to the Baja California peninsula and connections to the USA and Central America are on the Mexican government's list of top priorities for expanding and revamping the national transmission network. A major goal is to prepare the system for the rise of production and demand in the future.

Under PRODESEN, transmission and distribution projects in Mexico will account for 19% of the USD 107 billion of energy investments in the period 2017-2031. More specifically, the projected share of government investment in transmission is 11%, or nearly USD 12 billion, leaving 9% or USD 9.6 billion for distribution expansion and modernisation projects and smart grids.

Investments in transmission will include various interconnection projects, 23,772 km of new transmission lines and 58,099 MVA of additional transformer capacity.

The table shows planned investment under PRODESEN in transmission and distribution by year in MXN billion.

PRODESEN prioritises projects that will facilitate the addition of more clean energy into the power mix, and the revamping of T&D infrastructure to support the implementation of the Wholesale Electricity Market and Smart Grids.

SOURCE: SENER.

	Transmission (MXN billion)	Distribution (MXN billion)
2017	24.75	13.49
2018	27.28	16.2
2019	44.1	14.96
2020	44.63	15.45
2021	35.88	14.13
2022	19.18	12.98
2023	6.22	11.76
2024	3.13	10.38
2025	3.93	7.54
2026	3.73	7.66
2027	2.77	7.76
2028	1.6	8.00
2029	0.99	8.17
2030	0.7	8.31
2031	0.59	8.43

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