Mexico´s Clean Energy Market Reform: 
Results so far and perspectives

Marcelino Madrigal*, Ph.D. 
Commissioner  
Energy Regulatory Commission, Mexico

Institute of the Americas 
Energy Webinars Series 2017 
August 24, San Diego, California

*The views and opinions expressed in this presentation are those of the author and do not necessarily reflect a position of CRE or other government agency.

Constitutional Reform (Arts. 27 & 28)

- General Law in Climate Change
- Geothermal Energy Law
- Electric Industry Law

Energy Transition Law

- Law of the Coordinated Regulatory Agencies of the Energy Sector
- Independent system operators created for: Electricity Grid and Market, Natural Gas

Law on the Promotion and Development of Bioenergetics

- Hydrocarbons Law
- Petróleos Mexicanos Law
- Hydrocarbons Revenue Law
- Industrial Security and Environmental Protection of Hydrocarbons Sector
- Mexican Oil Fund

Policy maker

Mid & Downstream, Electricity Industry

Upstream

State Productive Enterprise

State Productive Enterprise
The 2013 Reform: A Clean-Energy-Ready Market Reform

**Generation**
- Free participation
- Activity only with permit (CRE)

**Distribution**
- Public service provided by state and can make contracts for public-private investment
- Subject to regulation (CRE)

**Grid and market Independent System Operator**
- Decentralized public institution, before was part of Federal Energy Commission (CFE)
- Operate the national market and wholesale electricity market (MEM), ensuring access to Transmission and Distribution grids.

**Transmission**
- Public service provided by state and can make contracts for public-private investment
- Subject to regulation (CRE)

**Marketing-Supply**
- Competence for operations in MEM and qualified users
- Basic supply service is subject to regulation

Liberalizes and provides the new industrial organization, from generation to distribution and marketing, including the creation of a wholesale electricity market.
Clean Energy Targets

Law of energy transition

Clean energy generation targets

<table>
<thead>
<tr>
<th>Year</th>
<th>2018</th>
<th>2021</th>
<th>2024</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25%</td>
<td>30%</td>
<td>35%</td>
</tr>
</tbody>
</table>

Transition Strategy

Average annual rate of reduction of final energy consumption*

<table>
<thead>
<tr>
<th>Period</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-2030</td>
<td>1.9</td>
</tr>
<tr>
<td>2031-2050</td>
<td>3.7</td>
</tr>
</tbody>
</table>

*Source: Press release, Ministry of Energy of Mexico, 2016

Source: Programa de Desarrollo del Sistema Eléctrico Nacional 2017-2031, Secretaría de Energía

40 millions of users
Mexico is a subscriber of the Paris Agreement and other international efforts to curb emissions

PARIS2015
CONFÉRENCE DES NATIONS UNIES
SUR LES CHANGEMENTS CLIMATIQUES
COP21 • CMP11

<2°C max
global average
temperature increase

187
signatory countries
are invited to submit their
INDCs*

55 ratification
instruments
+ 55% of global GHG*
conditions for entry into
force 1

On March 28th, 2015, Mexico became the first developing country to present its INDC. Mexico has committed to:

25% Unconditional reduction of its Greenhouse Gases and Short Lived Climate Pollutants emissions by 2030

Up to 40% Conditional reduction subject to a global agreement providing an international price on carbon, access to financing and technology transfer

On September 21st, 2016, Mexico ratified the Paris Agreement

NORTH AMERICAN LEADERS’ SUMMIT
OTTAWA 2016

45% reduction of methane emissions in North America by 2025

50% of clean power generation by 2025

Collaborating on cross-border transmission projects

• At least 6 transmission lines currently proposed or in permitting review, such as the Great North Transmission Line, the New England Clean Power Link, and the Nogales Interconnection, would add approximately 5,000 MW of new cross-border transmission capacity.
Market Oriented Transformation of the Energy Sector: Unbundling of Utility and Consumer Empowerment
### Market Design: Various Markets and Products

<table>
<thead>
<tr>
<th>Market Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Short Term Energy &amp; Reserve Markets</td>
<td>Nodal, co-optimized energy and reserve</td>
</tr>
<tr>
<td>II. Short Term Capacity Market</td>
<td>To balance and needs principally acquired in a long-term market</td>
</tr>
<tr>
<td>III. Medium Term Energy Markets</td>
<td>Procure 3-year energy contracts</td>
</tr>
<tr>
<td>IV. Clean Energy Certificates Market</td>
<td>One organized, one bulleting (voluntary) at the certificated system</td>
</tr>
<tr>
<td>V. Long-term markets</td>
<td>Purchase of 15+ year contracts for Energy, Capacity, and Clean Energy Certificates</td>
</tr>
</tbody>
</table>

- **I. Short Term Energy & Reserve Markets**
  - Day Ahead & Real Time Market
  - Started in January, 2016

- **II. Short Term Capacity Market**
  - Capacity Designed as availability in Critical Hours
  - Started in March, 2017

- **III. Medium Term Energy Markets**
  - Financial Transmission Rights
  - August, 2017

- **IV. Clean Energy Certificates Market**
  - Long-term auctions
  - Start in 2018

- **V. Long-term markets**
  - Financial Transmission Rights
  - Started 3rd Auction in April, 2017
Markets, Products and Tenures

Short term
- Energy and Reserves
- Two-Settlement (Day Ahead and Real Time)
- Nodal prices
- Financial Transmission Rights
- Clean Energy Certificates -CEC- (independent of the rest)

Medium and Long Term
- Capacity, Energy and CEC
- Long-term bids: C, E and CEC, contracts will begin (+/-) 3 years after the performance of the bid, with a 15 and 20-years duration
- Medium Term Auctions: Energy, with a 3-years duration
- Annual Capacity Auctions
Clean Energy Certificates Market

Institutional role

- Regular Manage (S-CEL)
- Verify Compliance
- Sanction

Operate the MEM, CEL Secondary Market (Spot / Auctions)

Established Obligations of Clean Energies (Requirement)

Obligated Participants
(Not cleaned consumption is taxed)
- Suppliers
- Qualified Users
- Supply Isolated
- Legacy Interconnection
- Contracts not wholly supplied by Clean Energies

Clean Generators
(1 MWh = 1CEL)

Consume

Generation

System for Management of Certificates and Compliance of Clean Energy Obligations (S-CEL)

Platform that designs and operates the CRE as Administrator, for the management and registration of:

1. Generation and consumption of electricity.
2. Issuance, transactions, liquidation and voluntary cancellation of CEL.
3. Verification of compliance with clean energy obligations.
Open Access and Service Terms for Transmission and Distribution (RES/948/2017)

Allows open access to transmission and distribution networks.

Regulation of new projects for Public and private investment in Transmission (Arts. 30, 31 Electric Industry Law) (A/009/2016)

Fundamental for new projects: example Tender for the line direct transmission by CFE. 600 km, 500 kV, 3,000 MW

Transmission Rates (A/045/2015)

Income required 2016 2,335 millions USD. Example: Tension rates greater than or equal to 220 kV, generators: 2.77 USD/MWh & consumers: 3.49 USD/MWh.

Distribution Rates (A/074/2015)

16 distribution divisions, income required 5,092 millions of USD. An average tariff of 0.1296 USD/MWh

System Operator Charges: Cenace (A/001/2017)

Income required 140 millions of USD, tariffs in USD/MWh for generators 0.1404 & loads 0.3669
A Variables-Renewables-Ready Grid Code

**Operation**
Operational conditions to ensure the electrical supply in conditions of safety and continuity

**Planning**
Conditions that are mandatory compliance in the elaboration of the programs of Expansion and Modernization of the National Transmission Grid (NTG) and the General Grid of Distribution

**Generation**
Technical requirements that must be met by the Power Plant Units that wish to interconnect to the NTG

**Loads**
Technical requirements to be met by Load Centers that intend or are connected to the NTG

For avoid technical losses
Long Term Auctions: the importance of the process and products

**Auction Process**

1) Publication of the Call
2) Auction “Bases”
3) Q&A Meetings
4) Prequalification of Offers
5) Reception and Auction Run
6) Auction Results
7) Contract Signature

Days to complete the auction process
- 1st Auction: 225 days
- 2nd Auction: 263 days

**Auction Products**

- **Energy**
  - Maximum Quantity (15 yrs)
  - Price / Quantity Function
  - Limits by zone (set by CENACE)

- **CEC**
  - By Zone (20 yrs):
    - Maximum Quantity
    - Price / Quantity Function

- **Capacity**
  - Maximum Quantity (15 yrs)
  - Price / Quantity Function
  - Maximum % with late start date

**Generator Offers**

For each package individual/conditioned:

- Quantity per year of the product
- Start Date
- Plant Location

5.1.5; Long-term auction manual
The Auction Model: select offers that maximize welfare & pay as bid

Maximization of economic surplus

\[
\text{Maximizar} \quad \sum_{zp \in Zp} \left\{ \sum_{bp \in Bp_{zp}} \text{Venta}_{Pb} P_{Pb} \right\} + \sum_{bp \in BpE} \text{Venta}_{Ee} \text{Precio}_{Ee} + \sum_{bp \in BC} \text{Venta}_{Be} \text{Precio}_{Be} + \sum_{p \in PAQ} v_p \text{Precio}_{Paquete}_p
\]

Adjustment Factors for Inflation and Exchange Rate

Example: Monthly Factor for payments indexed to the Dollar

\[
FAdls_m = (FTC_m \times 0.7) + (FTC_m \times FIUS_m \times 0.2) + (FIMX_m \times 0.1)
\]

Adjustment Factors Schedules (for intermittent) During Billing

\[
M_{g,m,a} = \sum_{d=1}^{D_m} \sum_{h=1}^{24} (EP_{g,h,d,m,a} * FAH_{zhg,h,m,a})
\]

Adjustment of price offer by location zone during evaluation

\[
\text{Precio OriginalPAquete}_p + \Delta PML_{zg \text{Paquete}_p}
\]

Adjustment factors by location (handicap or advantage) for evaluation.
High participation drives competition

<table>
<thead>
<tr>
<th>Requirements of Basic Service Supplier</th>
<th>Prequalified</th>
<th>Qualified</th>
<th>Winners</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st Auction</td>
<td>Bidders</td>
<td>81</td>
<td>69</td>
</tr>
<tr>
<td>Energy 6.3 TWh at 51 USD/MWh</td>
<td>Technical proposals</td>
<td>366</td>
<td>227</td>
</tr>
<tr>
<td>CEC 6.3 millions at 52.6 USD/MWh</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity 500 MW at 577 USD/MW-y</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Auction</td>
<td>Bidders</td>
<td>68</td>
<td>57</td>
</tr>
<tr>
<td>Energy 10.6 millions at 20 USD/MWh</td>
<td>Technical proposals</td>
<td>517</td>
<td>475</td>
</tr>
<tr>
<td>CEC 10.6 TWh at 40 USD/MWh</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capacity 483 MW at 90,016 USD/MW-y</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Results of the First Two Long-Term Auctions

Increase of 5,000 MW to the current generation capacity in Mexico

<table>
<thead>
<tr>
<th></th>
<th>1st</th>
<th>2nd</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar</td>
<td>44.97</td>
<td>31.70</td>
<td>USD/MWh</td>
</tr>
<tr>
<td>Wind</td>
<td>55.33</td>
<td>35.50</td>
<td>USD/MWh</td>
</tr>
</tbody>
</table>

34 companies from more than 10 countries, including Mexico

6.6 billion of investment in the coming years
Winning companies of the two long-term auctions

**1st Auction / 11 companies**
- Alarde
- Enel
- Acciona
- ENGIE
- Envision
- CanadianSolar
- Aldea
- Alter
- EnerSun
- JinkoSolar

**2nd Auction / 24 companies**
- CFE
- Alten
- Zuma Energía
- EDF
- X-Elíon
- FRV
- IEnova
- Viva
- ENEL
- Q-Cells
- Hanwha
- Vive energía
- Fisterra
- Acciona
- Grenergy
- Mota-Engil
- OPDE
- ENGIE
Mexico auction result in record low PV prices

Mexico’s first power auction was marked by drama, first in a false start announcement of the wrong winners then later by producing the lowest subsidy-free solar project contract we have ever seen. The auction contracted 5.4 TWh of clean energy power from wind and solar and another 5.4m clean energy certificates (CELs) at an average Price of $47.8/MWh.

Italy’s Enel Green Power (EGP) is also attracting attention. In February it won a tender to provide Peru with 20 years of power from solar PV at just under $48 a MWh. Just over a month later Mexico awarded it a similarly lengthy contract to generate solar power in the arid northern state of Coahuila at a price of about $40 per MWh. Bloomberg New Energy Finance (BNEF), a research firm, called it “the lowest subsidy-free solar contract we have ever seen”. EGP’s head of business development, Antonio Cammisecra, says there is a clear trend of falling prices. “We are trying to drive it,” he says.

"If you want to know the true price of renewable energy in America—free from subsidies and mandates—look to Mexico, former Energy Secretary Steven Chu said Friday."

"So I look to the South," Chu said of Mexico’s auction. “This is the best way to actually back out what the subsidies are. What are other economies doing nearby with great wind and great solar the way that we have?"
## A Personal Reflection on Success Factors

<table>
<thead>
<tr>
<th>Category</th>
<th>Success Factors</th>
</tr>
</thead>
</table>
| **Policy**            | • Clear vision and long terms targets  
                         • Comprehensive green and market reform                                      |
| **Regulatory**        | • Clear non discriminatory rules for access to networks  
                         • Stable and predictable T&D rates                                             |
| **Auction Design**    | • Open and consultative process  
                         • Enough time to ensure large participation  
                         • Long-term product and tenure of contracts                                      |
| **Other important factors** | • Mexico is a very large market that just opened  
                                • Good logistics and telecom infrastructure  
                                • Mature capital markets and good financing global market conditions |
The Retail Market is Attractive: Potential Qualified Users

<table>
<thead>
<tr>
<th>Demanda Contratada KW</th>
<th>&gt;= 0 y &lt; 10</th>
<th>1,984</th>
<th>64.5%</th>
<th>738,501</th>
<th>100%</th>
<th>40,251,336</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt;= 10 y &lt; 50</td>
<td>26,498</td>
<td>58.3%</td>
<td>220,340</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 50 y &lt; 100</td>
<td>102,394</td>
<td>52.9%</td>
<td>104,354</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 100 y &lt; 300</td>
<td>273,813</td>
<td>43.7%</td>
<td>30,391</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 300 y &lt; 500</td>
<td>657,149</td>
<td>40.1%</td>
<td>18,295</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 500 y &lt; 1,000</td>
<td>1,199,742</td>
<td>34.2%</td>
<td>7,344</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 1,000 y &lt; 2,000</td>
<td>3,566,949</td>
<td>27.2%</td>
<td>3,052</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 2,000 y &lt; 3,000</td>
<td>7,030,063</td>
<td>23.1%</td>
<td>1,753</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 3,000 y &lt; 10,000</td>
<td>14,999,543</td>
<td>14.1%</td>
<td>429</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 10,000 y &lt; 50,000</td>
<td>46,054,896</td>
<td>6.1%</td>
<td>46</td>
<td>170,269,608</td>
<td>81 users / 1,319 load centers</td>
</tr>
<tr>
<td></td>
<td>&gt;= 50,000 y &lt; 100,000</td>
<td>657,149</td>
<td>3.8%</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>&gt;= 100,000</td>
<td>[VALOR]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average annual consumption per user (KWh)

Number of users accumulated

% of total energy consumption per KWh
New participating and permitted agents spot and retail markets

17
Generators

1
Basic service retailer

4
Qualified Retailer

2
Non-retailer marketer

Qualifed user

Permits issued by CRE
August, 2017

417
Generation permits

29
Qualified retailer permits

1
Basic service retailer permit

13
Non-retailer marketer registration

81
Qualified users registration
(1,319 load centers)

• 21 qualified users (733 load centers) have a market participation contract, but only:
  
  o 6 qualified users (33 load centers) have in operation a market participation contract.

Potential of 4,274 load centers with demand equal or greater than 1 MW
New Behind The Meter DG + Storage Regulations

Variety of Schemes to Choose

Net Metering
- Excess energy accumulates in favor of the generator
- Missing energy is compensated with accumulated energy

Net Billing
- Energy delivered to the General Distribution Grid (GDG)
- Energy delivered by Basic Service Supplier (BSS)

Total sale
- Energy delivered to the GDG

Billing
- Energy delivered by the supplier
- Energy delivered by the generator
- It is paid based on the benefit system (PML)
- The applicable fee is charged
- Market price (PML)

*Users can choose the scheme
The suggested recruitment period is one year
Distributed Generation: The Other Silent Success Story on the Making

Interconnection contracts on small and medium scale

Number of contracts

- Contracts (Annual)
- Contracts (Aggregate)

Installed Capacity (kW)

- Capacity (Annual)
- Capacity (Aggregate)
Number of contracts and installed capacity per tariff group, distributed generation

<table>
<thead>
<tr>
<th>Tariff Group</th>
<th>Number of contracts 2014-2016*</th>
<th>Installed capacity (kW) 2014-2016*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>12,611</td>
<td>48,862</td>
</tr>
<tr>
<td>General low voltage</td>
<td>3,361</td>
<td>21,930</td>
</tr>
<tr>
<td>Public services</td>
<td>106</td>
<td>239</td>
</tr>
<tr>
<td>Agriculture</td>
<td>14</td>
<td>337</td>
</tr>
<tr>
<td>Medium voltage</td>
<td>831</td>
<td>49,598</td>
</tr>
<tr>
<td>High voltage</td>
<td>2</td>
<td>352</td>
</tr>
</tbody>
</table>

(*) Elaborated by CRE, with information from CFE. Data for 2016
DG another step in the evolution towards cost effective, secure, and sustainable energy consumption empowering consumers
Thank you!

@M_Madrigal_M

www.gob.mx/cre  @CRE_Mexico
VII WORLD FORUM ON ENERGY REGULATION

REGULATING IN A TIME OF INNOVATION

EMPOWERED CONSUMERS, DYNAMIC MARKETS, AND SUSTAINABLE INFRASTRUCTURE

CANCÚN, MÉXICO
March 20–23, 2018

SAVE THE DATE

www.wfer2018.org