Electricity Reform in Mexico

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Managing Director of Electric Industry Coordination

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**Background:**

**Mexican Electric System**

### Generation Capacity (MW)

- **Combined Cycle:** 23,309
- **Steam (Fuel Oil and Gas):** 12,959
- **Coal:** 5,958
- **Simple Cycle:** 3,419
- **Internal Combustion:** 1,312
- **Multiple:** 1,573
- **Hydro:** 12,429
- **Wind:** 2,036
- **Geothermal:** 813
- **Solar:** 56
- **Nuclear:** 1,400
- **Biomass:** 180
- **Other:** 7
- **Total:** 65,452

### Networks (km·c)

- **400 kV:** 23,641
- **230 kV:** 27,543
- **Subtransmission (≥ 69 kV):** 56,851
- **Distribution:** 683,226

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**Generation by Type**

- **CFE:** 57.2%
- **CFE PPA:** 28.4%
- **Private:** 14.3%

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**Conventional 48,530 MW**

**Clean 16,921 MW**
Electric Rates Pre-Reform

- Average rates: **25% higher than in the US**
- Without subsidies: **difference would be 73%**
- Subsidies equal to **0.75% of GDP**

Sources: Sistema de Información Energética (Mexico), Energy Information Administration (USA)
Clean Energy Potential in Mexico

Clean Energy Goals:
35% in 2024, 40% in 2035 and 50% in 2050

<table>
<thead>
<tr>
<th>Renewable Energy Potential</th>
<th>Actual Generation Year 2013 (% of total GWh)</th>
<th>Actual Generation + Proven Resources</th>
<th>Actual Generation + Proven Resources +Probable Resource</th>
<th>Actual Generation + Proven Resources +Probable Resources +Possible Resource</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installed Capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Installed Capacity 2° semester 2014 (MW)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>1,900</td>
<td>1.4%</td>
<td>5.3%</td>
<td>34.8%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>823</td>
<td>2.0%</td>
<td>2.2%</td>
<td>40.0%</td>
</tr>
<tr>
<td>Solar</td>
<td>64</td>
<td>0.01%</td>
<td>0.6%</td>
<td>2,189.4%</td>
</tr>
<tr>
<td>Mini Hydro</td>
<td>419</td>
<td>0.5%</td>
<td>1.7%</td>
<td>24.4%</td>
</tr>
<tr>
<td>Total</td>
<td>3,206</td>
<td>4.0%</td>
<td>9.9%</td>
<td>37.9%</td>
</tr>
</tbody>
</table>

Solar Resources

Wind Resources

Geothermal resources
Mexico's GDP will grow between 0.9 and 2.2% if electricity rates converge with US: IMF

Industry Structure Pre-Reform

Public Service

- CFE
- CFE\(_{PIEs}\)

Self Supply

- PEMEX
- Energies Nouvelles
- Walmart México
- IBERDROLA
- Holcim APASCO
- Hylsa

CFE Dispatch

- CFE
- PEMEX
- Walmart México
- Hylsa
- Holcim APASCO
Objectives of the Reform

Reform Objectives
- Reduce costs and rates
- More clean energy
- Spread the benefits

Reform Principles
- Incentives for value creation and efficient operation
- Decisions through competitive processes
- Open access and non-discrimination
- Transparency

Reform Elements
- Industry Restructuring
- Competitive Market
- Clean Portfolio Standard
- Independent Planning
New Industry Structure

Generation
- Subsidiary “A”
- Subsidiary “B”
- Subsidiary “C”
- Private Parties

System Control and Power Market
- Short Term Transactions
- Spot Market
- Long Term Contracts
- Auctions

Retailing
- Unregulated Supply
- Qualified Users
- Basic Service Users
- Regulated Supply

Consumption
- Unregulated Supply

Transmission

Distribution

CFE and Contracts

CFE and Contracts
Characteristics

Restructuring
- Vertical Separation (G/T/D/S)
- 4 CFE Generation Companies
- Distribution in 16 units

Corporate Governance
- Subsidiaries: 2 CFE, 1 SHCP, 1 SENER y 1 Independent
- CFE CEO presides boards

Chinese Walls
- Separate employees/spaces
- No coordination between competitive segments
- Separate marketing

Benefits for CFE
- Specialized supervision of each activity
- Clear information about the performance of each company
- Planning and finance coordinated among companies

Benefits for the Market
- Vertical separation assures open access to networks for all generators and marketers
- Horizontal separation of generation avoids market power

Restructuring of CFE
# Market Features

<table>
<thead>
<tr>
<th>Market</th>
<th>Periodicity</th>
<th>Market Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy and Ancillary Services</td>
<td>Daily, Hourly</td>
<td>Cost Based</td>
</tr>
<tr>
<td>Capacity</td>
<td>Yearly</td>
<td>Administered</td>
</tr>
<tr>
<td>Clean Energy Certificates</td>
<td>Yearly</td>
<td>Unrestricted offers</td>
</tr>
<tr>
<td>Financial Transmission Rights</td>
<td>Yearly / Monthly</td>
<td>Unrestricted offers</td>
</tr>
</tbody>
</table>

### Auctions and Long Term Contracts

- CRE will set requirements for retailers to contract forward energy and associated products.
- Basic Service Retailers may only contract forward through auctions operated by CENACE.
Short Term Market:
General Characteristics

**Objectives**
- Efficient and reliable dispatch of the National Electric System.
- Correct signals for the location of new electric plants and the use of controllable demand.

**Features**
- Two-Settlement (Day Ahead and Real Time).
- Nodal prices (approximately 2000 nodes).
- Three part offers.
- Co-optimization of energy and ancillary services.
- Economic unit commitment by system operator.
- Cost based offers and market monitoring.
- Initial market based on existing CENACE software.
**First Stage Market**

- Two Settlement Market: DA and RT
- 15 minute dispatch intervals
- No virtual offers are permitted
- Demand Response is not dispatched by CENACE
- Simplified RSG calculation
- Scarcity pricing only applies when there is true scarcity; prices are capped at the highest cost generator

**Second Stage Market**

- Three Settlement Market: DA, HA and RT
- 5 minute dispatch intervals
- Virtual offers are allowed
- CENACE will dispatch demand in the DA and RT Markets.
- Separate RSG calculation per startup and for out of merit dispatch
- Gradual scarcity pricing is implemented as a complement to the capacity market.
Capacity Market: General Characteristics

Objectives

- Installation of sufficient capacity.
- Pay the fixed costs that aren’t recovered in the energy market.
- New investments need long term contracts, but the short term capacity market must pay the right prices.

Features

- Ex-post market to avoid market power concerns and incentives to over-report capacities.
- Demand curve based on the Cost of New Entry.
- Zonal capacity requirements when necessary.
**Objectives**

- Pay for capacity when the system needs it.
- Allow the definition to evolve with the system.

**Definition**

- Availability in the 100 critical hours of the year:
  - First stage: Maximum demand.
  - Second stage: Minimum reserves.
- Intermittent Plants: Availability as generated.

**Exceptions**

- Unavailability is forgiven when CENACE asks to change a scheduled maintenance.
- Unavailability can only be penalized 2 hours per day when on scheduled maintenance.
- Penalties if CENACE discovers unavailability.
**Capacity market**

**Demand Curve**
- CRE sets the minimum and “optimal” capacity requirements.
- CENACE buys capacity in excess of the minimum requirement and charge all LSEs.
  - Combines demand elasticity with fines for non-compliance.

**Ex-post market**
- Generators have absolute certainty about the quantity delivered.
  - The market monitor can implement an obligation to offer capacity without debate about quantity. Availability is monitored during the year.
  - No debate about cost; costs are already sunk.
Clean Energy Certificates

Objectives

- Solve the “missing money” problem for clean generators.
- Let the market make choices over technology.
- Transparency regarding the cost of clean energy.
- Maintain flexibility in case of cost surprises.

Features

- SENER establishes requirements to use a percentage of clean energy.
- Retailers fulfill their requirements by buying Certificates.
- CENACE operates a market once a year.
- CRE verifies compliance and applies fines in case of non-compliance.
Elasticity in the CEC Market

- Without storage of CECs or deferral of obligations, the price would alternate between zero and the value of the fine.

- CEC guidelines permit storage and deferral of up to 25% of obligations.
- The Energy Transition Law establishes cases where up to 50% can be deferred.
- Elasticity guarantees price stability.
FTRs

**Objectives**

- Allow market participants to reduce exposure to congestion prices.
- Assure that generators face correct signals to build and operate plants.
- Preserve legacy rights.
- Avoid restricting dispatch.

**Features**

- Allocation process for Grandfathered FTRs.
- General auctions for new FTRs.
- Special FTR mechanism linked to new construction.
- CENACE will only award FTRs up to the simultaneously feasible capacity of the network.
## Market Implementation Calendar

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Baja California</th>
<th>Interconnected System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Testing and Validation</td>
<td>5-22 January 2016</td>
<td></td>
</tr>
<tr>
<td>Real Time Market</td>
<td>27 January 2016</td>
<td>29 January 2016</td>
</tr>
<tr>
<td>Initial Billing Statements</td>
<td>3 February 2016</td>
<td>5 February 2016</td>
</tr>
<tr>
<td>Binding Invoices</td>
<td>11 May 2016</td>
<td>13 May 2016</td>
</tr>
</tbody>
</table>

### Transitory Rules for Gradual Implementation

- Real Time Market in phases (quantities, prices and dispatch)
- Longer timeframe for initial billing and payment cycle
- Simplified participant registration during an initial period
- Credit requirements suspended until first billing cycle is complete
- Participation will increase gradually as the market matures and earns confidence.

<table>
<thead>
<tr>
<th>Type of Participant</th>
<th>Expected Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>CFE Generation/Basic Retail</td>
<td>Immediate</td>
</tr>
<tr>
<td>New Entrants (2)</td>
<td>Immediate</td>
</tr>
<tr>
<td>Small Self-Suppliers (2)</td>
<td>Immediate</td>
</tr>
<tr>
<td>CFE Subsidiaries and Affiliates (8 or more)</td>
<td>1° semester 2016</td>
</tr>
<tr>
<td>Existing Generators (~10)</td>
<td>1° semester 2016</td>
</tr>
<tr>
<td>Pure Marketers (~10)</td>
<td>2016</td>
</tr>
<tr>
<td>Generators w/ new investment (30 or more)</td>
<td>2017 and beyond</td>
</tr>
</tbody>
</table>
**Auctions**

### Long Term Auctions

Guarantee a stable cash flow that will cover fixed costs, reducing the risk of generation investment.

<table>
<thead>
<tr>
<th>Products</th>
<th>Term</th>
<th>Time to Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>15 years (Cap / Energy)</td>
<td>3 years (or more)</td>
</tr>
<tr>
<td>CECs</td>
<td>20 years (CEC)</td>
<td></td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Medium Term Auctions

Allow retailers to obtain an energy hedge prior to the short-term markets.

<table>
<thead>
<tr>
<th>Products</th>
<th>Term</th>
<th>Time to Contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>3 years</td>
<td>4 months</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1) Attract investment
   - In firm capacity
   - In clean energy

2) Make all technologies compete with each other

3) Ensure efficiency to the buyer:
   - Pay higher prices to generators that produce during valuable hours
   - Reward “good” locations and discourage “bad” locations

---

**Objectives**

- Attract investment
  - In firm capacity
  - In clean energy
- Make all technologies compete with each other
- Ensure efficiency to the buyer
  - Pay higher prices to generators that produce during valuable hours
  - Reward “good” locations and discourage “bad” locations

**Features**

- Generators offer packages with quantities of:
  - Energy
  - Capacity
  - Clean Energy Certificates
- Mixed integer optimization to select complete offers
- Fixed penalties and bonuses based on forecast:
  - For location
  - For time of generation
El requisito de ingresos de CELs depende de la región y la hora de generación.
### Participation in the first Auction for Long-Term Contracts

#### Offers Received for First Auction
- 103 different companies
- 468 distinct technical offers

#### Calendar

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publication of Tender</td>
<td>30 November 2015</td>
</tr>
<tr>
<td>Purchase Offers</td>
<td>20 January 2016</td>
</tr>
<tr>
<td>Technical Sale Offers</td>
<td>4-11 February 2016</td>
</tr>
<tr>
<td>Economic Sale Offers</td>
<td>28 March 2016</td>
</tr>
<tr>
<td>Adjudication</td>
<td>31 March 2016</td>
</tr>
</tbody>
</table>

#### Technology and Project Size

<table>
<thead>
<tr>
<th>Technology</th>
<th>Capacity MW</th>
<th>Energy MWh</th>
<th>Clean Energy Certificates</th>
<th>Project Size MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined Cycle</td>
<td>250</td>
<td>-</td>
<td>-</td>
<td>1621</td>
</tr>
<tr>
<td>Efficient Cogeneration</td>
<td>-</td>
<td>201,480</td>
<td>2,285,951</td>
<td>1710</td>
</tr>
<tr>
<td>Wind</td>
<td>132</td>
<td>47,166,420</td>
<td>48,200,662</td>
<td>5984</td>
</tr>
<tr>
<td>Geothermal</td>
<td>-</td>
<td>199,369</td>
<td>199,369</td>
<td>25</td>
</tr>
<tr>
<td>Hydro</td>
<td>-</td>
<td>531,032</td>
<td>2,661,459</td>
<td>438</td>
</tr>
<tr>
<td>Solar PV</td>
<td>449.4</td>
<td>54,510,817</td>
<td>55,797,704</td>
<td>11,677</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>831.4</strong></td>
<td><strong>102,609,119</strong></td>
<td><strong>109,145,145</strong></td>
<td><strong>21,455</strong></td>
</tr>
</tbody>
</table>
New mechanism:

1. SENER develops the Indicative Generation Expansion Plan

2. CENACE proposes the Transmission Expansion Plan

3. SENER publishes the System Development Program (PRODESENE)

4. SENER decides if new projects are built by CFE or in PPPs
## Achievements to Date

<table>
<thead>
<tr>
<th><strong>Constitution</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>December 2013</td>
<td>• Competition in generation and retail; contracts and PPP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Vertical and horizontal separation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Secondary Laws</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>August 2014</td>
<td>• Wholesale Electricity Market</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Independence of Regulators</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th><strong>CENACE</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>August 2014</td>
<td>• Creation Decree</td>
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<table>
<thead>
<tr>
<th><strong>Universal Serv.</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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<tbody>
<tr>
<td></td>
<td>Sept. 2014</td>
<td>• Creation of the Electrification Fund</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th><strong>Clean Energy</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>October 2014</td>
<td>• Guidelines for granting CEC and establishing requirements</td>
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</table>

<table>
<thead>
<tr>
<th><strong>Clean Energy</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>March 2015</td>
<td>• Clean Energy Certificate Requirements</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Interconnection</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>June 2015</td>
<td>• Interconnection Criteria</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Planning</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>August 2015</td>
<td>• System Expansion Program</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Associations</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>August 2015</td>
<td>• Designation of transmission projects for PPP</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Market Rules</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Sept. 2015</td>
<td>• Electric Power Market Bases</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>LT Auctions</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nov. 2015</td>
<td>• Launch of Tender</td>
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<table>
<thead>
<tr>
<th><strong>Spot Market</strong></th>
<th><strong>Date</strong></th>
<th><strong>Content</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>January 2016</td>
<td>• Market Start</td>
</tr>
</tbody>
</table>
Next Steps

- The Wholesale Electric Market will continue to implement new functions during the next two and a half years.

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjudication of the First Long-Term Auction</td>
<td>March 2016</td>
</tr>
<tr>
<td>Tender for Second Long-Term Auction</td>
<td>April 2016</td>
</tr>
<tr>
<td>Medium-Term Auctions for Energy and Capacity</td>
<td>October 2016</td>
</tr>
<tr>
<td>Auctions for Financial Transmission Rights</td>
<td>November 2016</td>
</tr>
<tr>
<td>Complete Implementation of the Short Term Market</td>
<td>January 2017</td>
</tr>
<tr>
<td>Capacity Balancing Market</td>
<td>February 2017</td>
</tr>
<tr>
<td>Clean Energy Certificate Market</td>
<td>2018</td>
</tr>
</tbody>
</table>
# Conclusions

<table>
<thead>
<tr>
<th>Milestones Reached</th>
<th>Next Steps</th>
<th>Final Result</th>
</tr>
</thead>
</table>
| • Independence of system operator  
  • Market design  
  • First system expansion plan  
  • Conceptual design for CFE separation | • Start of operations for Spot Market  
  • First auction for long term contracts  
  • Implementation of CFE Restructuring  
  • First contracts and associations for transmission | • Transparent market attracts investment  
  • CFE adapts to compete and grow  
  • Expansion of transmission and clean energy  
  • CRE becomes the authority for the power market |
Electricity Reform in Mexico

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