



Mexico's Push for Solar Power Plants and Distributed Generation

Utility Scale Solar in Mexico

Business cases, market developments and outlook



Intersolar Europe Conference 2018

Joscha Rosenbusch, Principal Advisor

Programa Energia Solar a Gran Escala en México (DKTI-Solar)



Program “Energía Solar a Gran Escala en México”

German Climate and Technology Initiative - DKTI

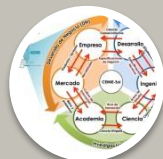
Objective:

Improve the technological, financial and organizational conditions for large scale solar energy applications in Mexico

Areas of work:



Policy, strategies
and regulations



Technology and
innovation



Market
development



Solar financing
capacities





Program “Energía Solar a Gran Escala en México”

German Climate and Technology Initiative - DKTI

On behalf of



Federal Ministry
for Economic Cooperation
and Development

11/2015 - 04/2020

**PV
Power
Plants**



**Solar
Process
Heat**



Public



Academia & Innovation



Private



Counterparts



Financing



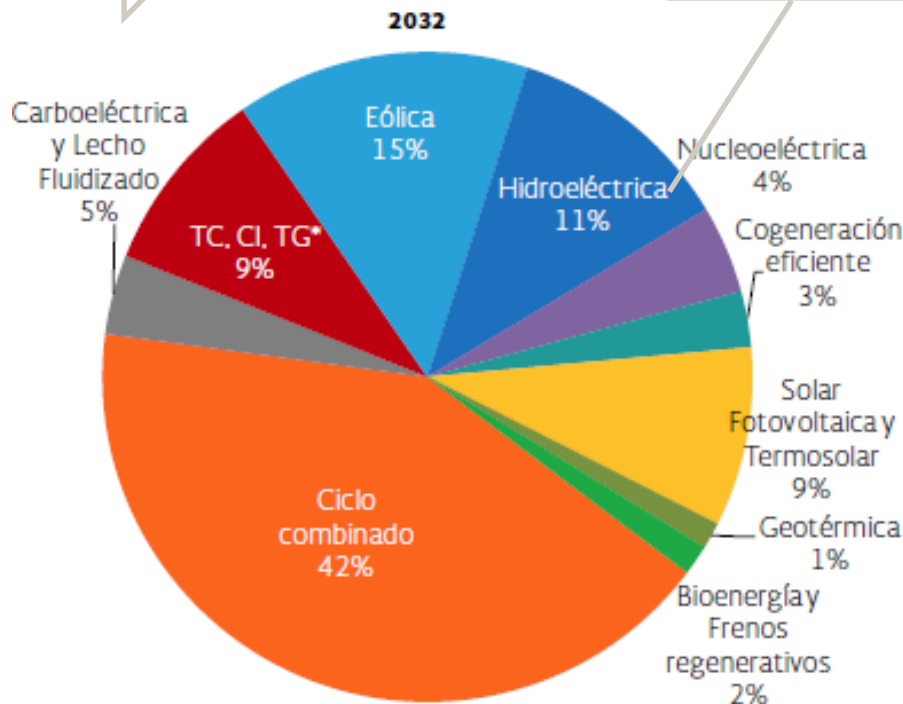
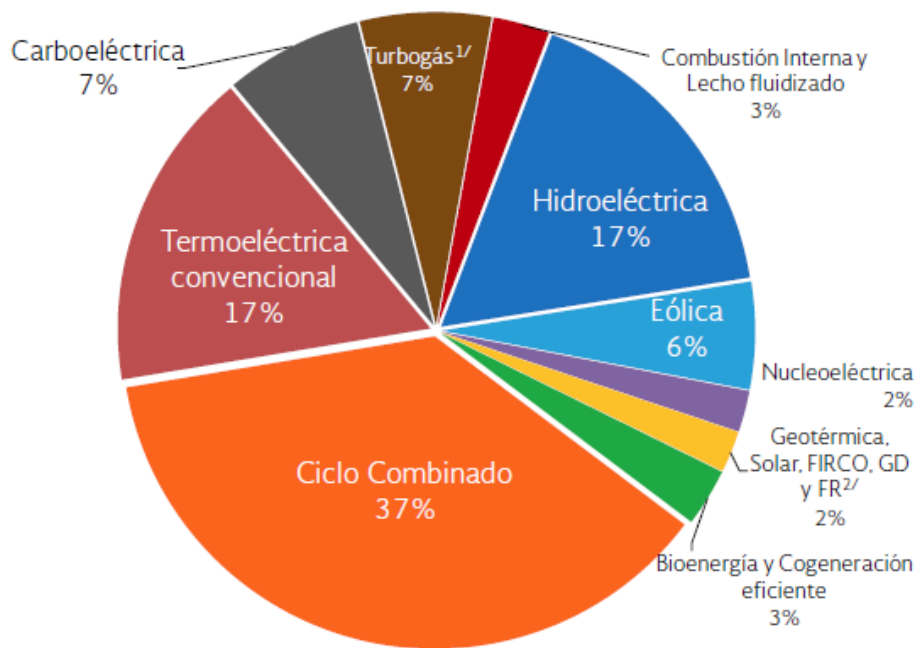
Power capacities: Status quo and additions until 2032

2017: 76 GW

+54 GW

2032: 130 GW

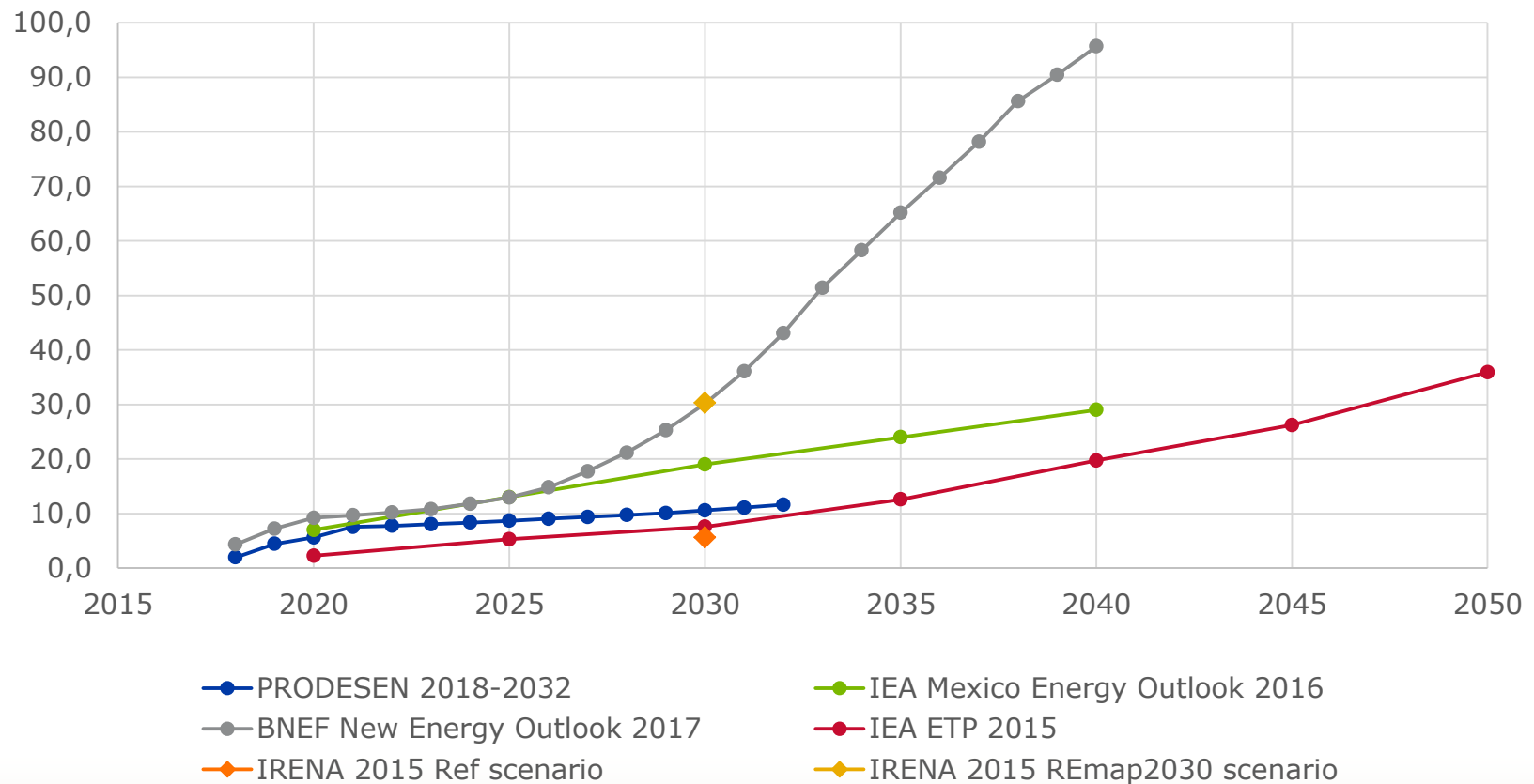
**11,7 GW
Solar PV**





Solar Market Growth Projections

PV Installed Capacity (GW, cumulative)





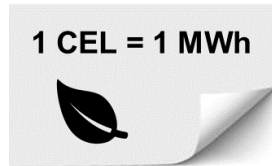
Framework & Incentives for Solar

Accelerated depreciation	100% of investments in machinery and equipment used for renewable energy generation. Include fixed assets, expenses and deferred charges. Min 5 years operation
Clean Energy Certificates (CELS)	Mandate to generate 5% of overall consumption by clean energy in 2018. All market participants that consume electricity in the system must comply with the mandate and can use CELs to meet obligations. Solar is a sources eligible for CELs.(1CEL=1MWh)
Wholesale Electricity Market & Auctions	Regulated Auctions for Electricity suppliers (eg CFE) for clean energy, capacity and CELs
Distributed Generation	Billing credit for excess electricity generated by RE facilities of retail electricity consumer
Sustainable Energy Fund	R&D Renewable energy and energy efficiency. Projects and calls managed by SENER and CONACYT
other	Non-discriminatory network access; reation of wholesale markets, Improved information provision; simplified approval processes

Source: GIZ, BNEF, Ley del Impuesto sobre la Renta, SENER, Ley Federal de Derechos



CEL: Clean Energy Certificates (Certificados de Energía Limpia)



Markets

- Wholesale market
- Long term auctions
- Bilateral deals

Rationale

- Convert clean energy generation goals into consumption obligations
- Additional incentive / income for clean energy generation

Mechanism

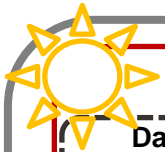
- Consumption obligation (% annual consumption for large consumers and supplier (Load Serving Entities))
- Eligible for CEL generation: new clean energy plants post 08/2014



Year	2018	2019	2020	2021	2022	2023
Oligation	5%	5.8%	7.4%	10.9%	13.9%	Tbd 2020
Mio CEL / a	~ 13	~ 16	~ 21	~ 33	~ 45	...



Wholesale Electricity Market



Short Term Energy Market

- Day Ahead (2016)
- Real Time (2016)
- Hour Ahead (late 2017)

Trading of energy and ancillary services based on MLP / PML and zonal prices for ancillary services

Capacity Balancing Market

(2016 ex-post 2017)

Operates annually, for the immediately preceding year, with the purpose of performing sale and purchase transactions of Firm Capacity not covered or committed through the Electricity Coverage Contracts.



Bilateral contracts



Medium- to long-term PPA contracts with large consumers or qualified suppliers.



Clean Energy Certificates (CEL) Market

(2018)

Operated by CENACE (at least 1 a year), allowing Load Serving Entities to satisfy their CEL obligations.

Financial Transmission Rights Auctions

(2016)

Grant the titleholder the right to receive the charge or the obligation to pay the difference of the Marginal Congestion Components of the Locational Marginal Prices of the Day-Ahead Market, between the destination and origin nodes.

Auctions

- Medium Term (2017) Energy and Firm Capacity
- Long Term (2015) Energy, CEL, Firm Capacity

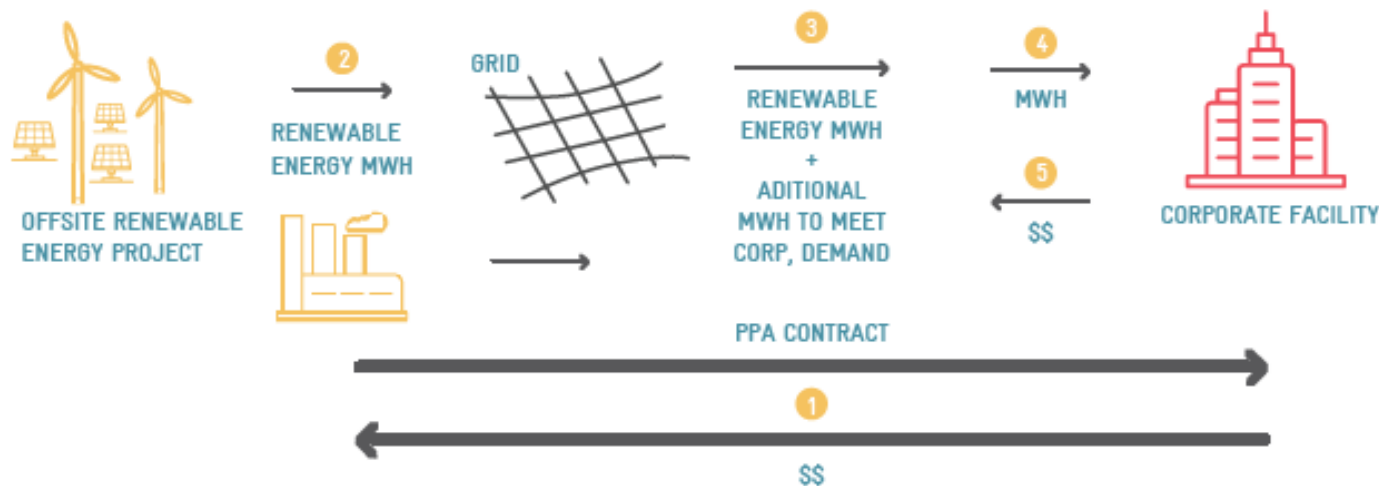


(start year)



Direct PPAs

- Bilateral contracts can be closed by qualified suppliers or directly with generators
- Most PPAs in Mexico have been closed under permits from previous law (auto-abasto).
- Very little transparency in the market: no benchmarks exist for pricing

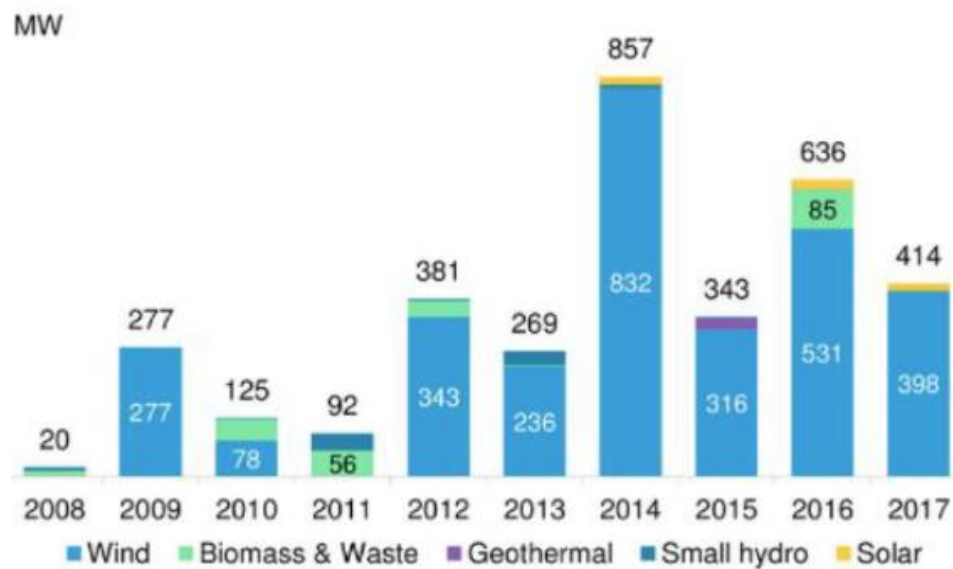




Corporate PPA

- From 2008 to 2017, RE capacity installed with grandfathered corporate PPAs reached a total of 3.4 GW
- Large dominance by wind, but solar is starting to become attractive
- Users shy away from signing long term PPAs (because of uncertainty in CFE price development and lack of historical data) and typically only want to commit to 2,3 and in some rare cases 5 years

Corporate PPAs under grandfathered rules(2008-2017)



Source: CRE, Bloomberg New Energy Finance



Products in the Long Term Auctions



Capacity

- 15-year contracts on offer
- Bids in \$/MW
- Firm capacity, able to generate at the system's 100 most-critical hours
- Projects sign a contract to have a given amount of capacity available at a determined zone and dispatch electricity to the spot market when required



Energy

- 15-year contracts on offer
- Bids in \$/MWh
- Only clean energy technologies to participate in the auction (both baseload and intermittent)
- If the source is intermittent, hourly benchmarks references (*factores de ajuste horario*) will be applied to determine final revenue
- Non-intermittent source pricing is much simpler with contracts paying at a straight \$/MWh rate.



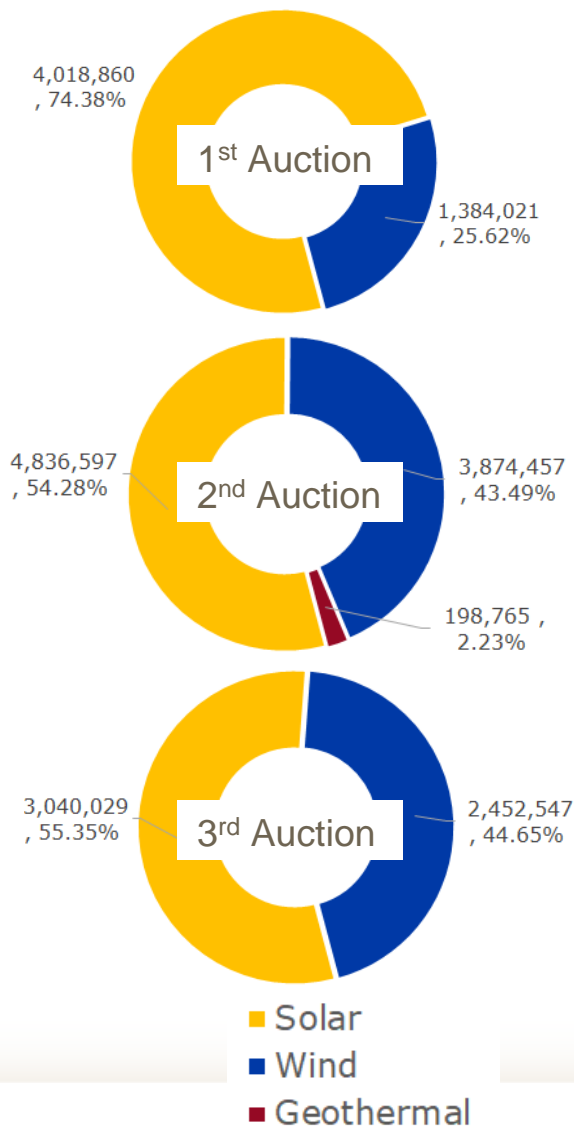
- 20-year contracts on offer
- Bids in \$/CEL
- Clean energy-only
- Projects may be located in any part of the grid system



Auction results

Auction	1st (2015)	2nd (2016)	3rd (2017)	
Expected Investment (billion USD) ¹	2.6	4	2.4	
Solar PV	2.1	2.5	1.6	
Wind	0.5	1.5	0.8	
Products traded / Buyer	CFE	CFE	CFE	Non CFE
Capacity (MW/year)	0	1,187	592	
Solar	0	184	10	
Eólica	0	128	83	
Energía (MWh/año)	5,402,881	8,909,819	5,003,172	489,403
Solar	4,018,860	4,836,597	3,040,028	
Eólica	1,384,021	3,874,457	2,452,547	
CEL (CEL/año)	5,380,911	9,275,534	5,422,185	530,390
Prices (USD/MWh+CEL)				
Solar Weighed avg	\$45.06	\$31.89	\$20.77	
Solar Min	\$35.46	\$25.70	\$18.90	
Solar Max	\$68.16	\$37.60	\$23.30	
Wind Min	\$42.85	\$32.00	\$17.76	
Wind Max	\$66.92	\$39.20	\$19.55	
Exchange rate (MXN/USD)	\$17.32	\$19.152	\$19.185	
Sum peak capacity of winning plants (MW)	2,085	3,883	2,562	
Solar	1,691	1,853	1,323	
Wind	394	1,038 ²	689 ³	
Geothermal	-	25	-	
Hydro	-	68 ⁴	-	
Combined Cycle - Nat Gas (capacity only)	-	899	-	
Turbogas (capacity only)	-	-	550	
Total projects	16	22	16	
Solar	11	17	9	
Wind	5	5	5	

Energy (MWh/year)





1^{era} Subasta



Compañías:

11 compañías ganaron 18 ofertas en 7 estados de la república.



Inversiones:

2.6 mil millones USD (en 3 años).



Capacidad:

2,085 MW de capacidad



Energía:

5,403 GWh/año



CEL:

5.38 millones de CEL/año



Potencia:

No se asignó.

2^{da} Subasta

Compañías:

23 compañías ganaron 56 ofertas en 8 estados de la república.

Inversiones:

4 mil millones USD (en 3 años).

Capacidad:

2,871 MW de capacidad

Energía:

8,910 GWh/año

CEL:

9.28 millones de CEL/año

Potencia:

1,187 MW/año

3^{era} Subasta

Compañías:

9 compañías ganaron 16 ofertas en 8 estados de la república.

Inversiones:

2.4 mil millones USD (en 3 años) en 15 nuevas centrales eléctricas.

Capacidad:

2,562.5 MW de capacidad

Energía:

5,493 GWh/año

CEL:

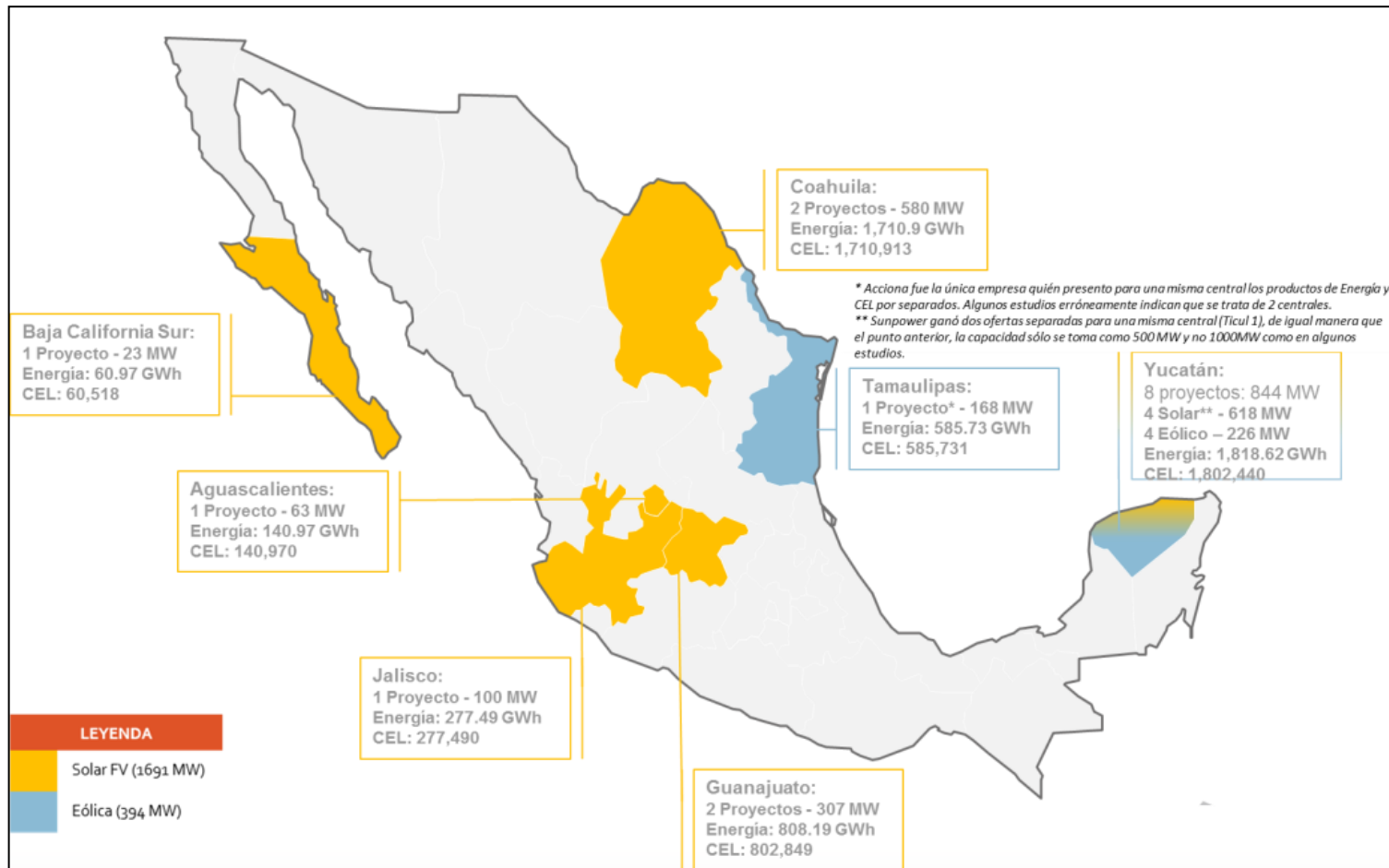
5.95 millones de CEL/año

Potencia:

592.61 MW/año

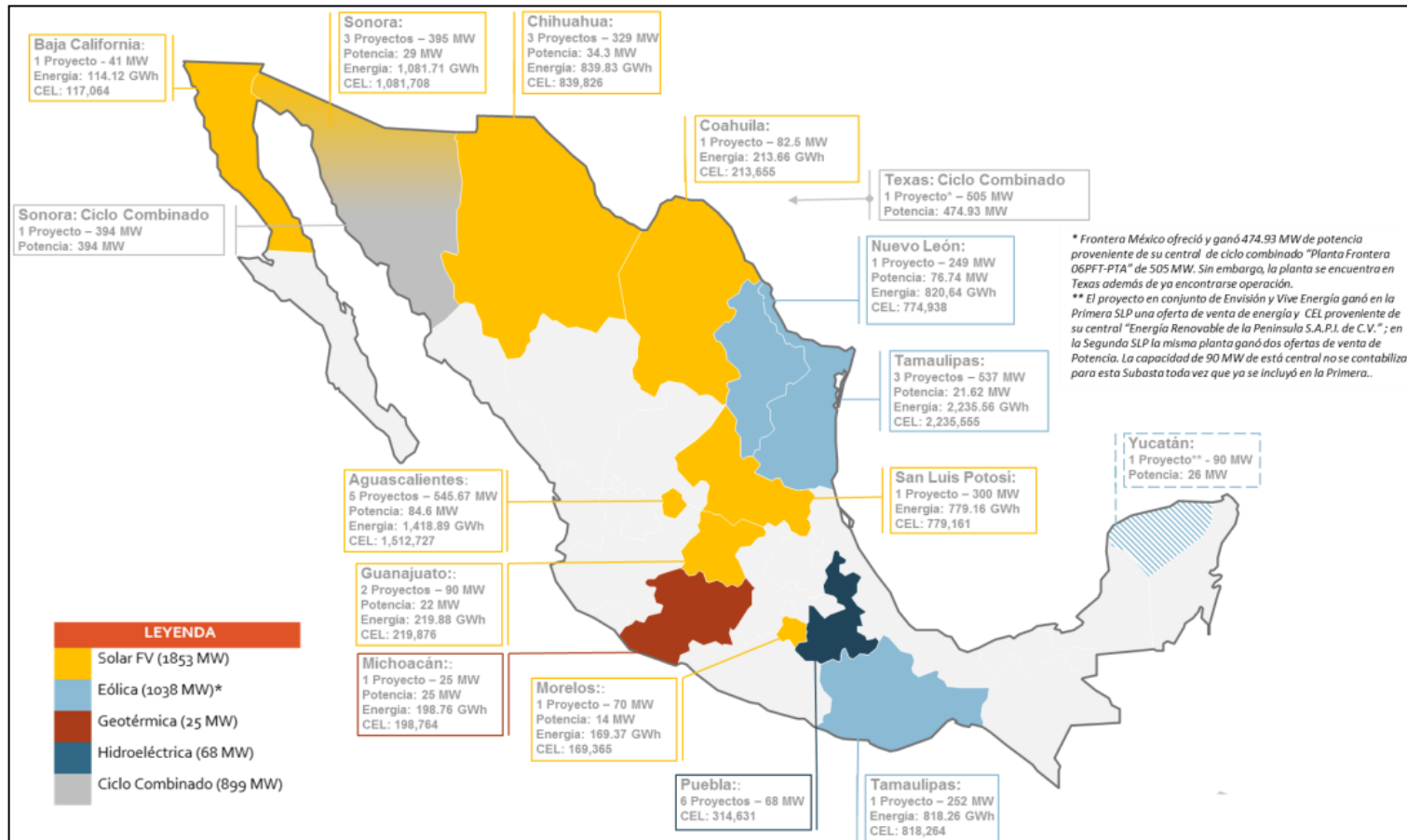


Locations of winning bids – 1st auction



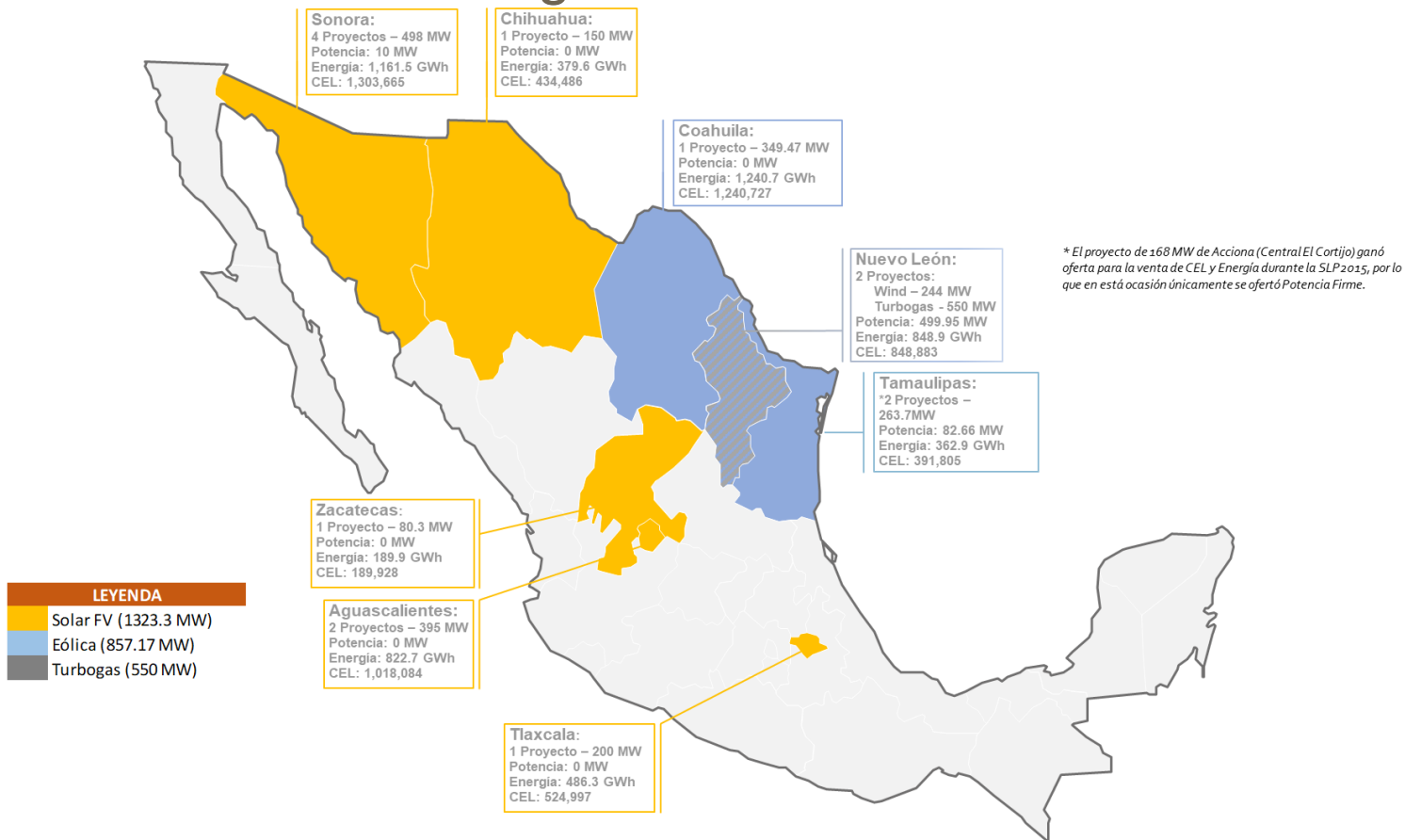


Locations of winning bids – 2nd Auction





Locations of winning bids – 3rd Auction





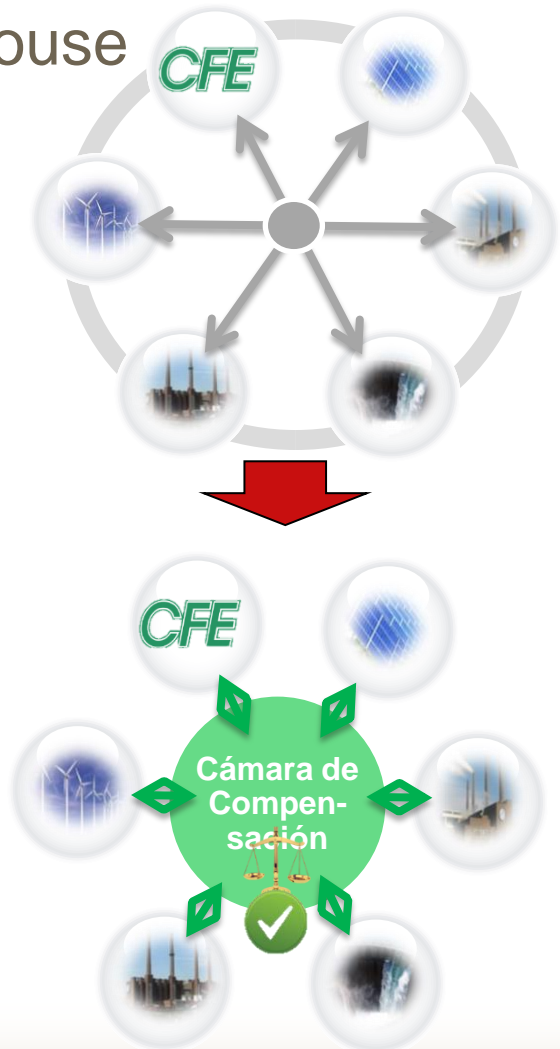
Cámara de Compensación - Clearing House

Objectives

- Risk management mechanism: reduced off taker risk, increased bankability
- Centralized contract administration
- Facilitate purchase for buyer other than CFE

Design

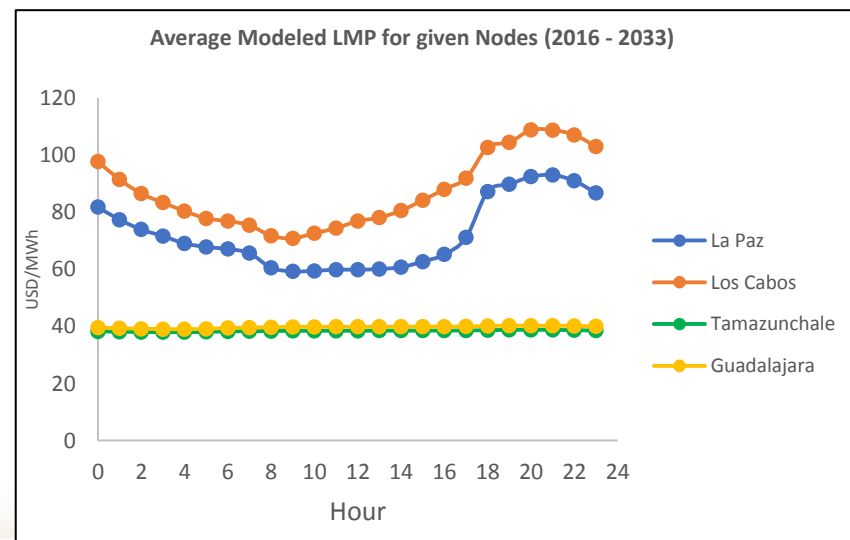
- Counterpart of all contracts (middleman for buyer and seller)
- Receives and administers individual guarantees
- Net neutral payout position
- Centralizes management of payment and collection





Direct sales in Spot Market

- PML: National Marginal Cost + Congestion charges + Losses
- Mexico counts with 2384 different nodes, each of which has different LMP
- Prices vary hourly
- Electricity prices are highest in the Baja California Peninsula due to fewer generation options and missing interconnection to neighboring regions
- There is a summer price peak because of high demand
- Merchant risks is a barrier for bankability





Source: IRENA Global Atlas