

Buena Gobernanza Hacia la Transición Energética

Programa Regional Seguridad Energética y
Cambio Climático



Daniel Chacón

Mexico's Electricity Industry in the Previous 70 Years

- **State monopoly** for the whole electricity value chain
- Until 1992, no regulation at all. In 1992 the **Energy Regulatory Commission** was created with little power
- **Centralized electricity decision making** was conducted by CFE and economically supported by the Treasury Ministry
- Electricity was considered strategic for the State and as a **“Public Service”**
- Capacity ~60 GW; 98% coverage by 2013
- **80% fossil sources**. Rest: big hydro (16%) and nuclear (4%)

Energy Transition Law (ETL) Timeline

**Sep
2013**

Energy Reform (ER) discussions begin. ICM provided inputs

**Dec
2013**

Energy Reform constitutional changes approved

**Feb
2014**

Deputies' Renewable Energy Commission asked ICM to provide inputs for a new ET Law

**Aug
2014**

Most of ER secondary laws approved except ET law

**Oct
2014**

ET Law discussions with SENER

**Dec
2014**

ET Law approved by Deputies Chamber

**Feb
2015**

ET Law expected to be approved by Senate

**Feb
2015 to
Dec
2015**

The Battle for the ETL: senators allied with steel industry chamber

**Sep
2015**

Electricity Market Basis published

**Sep
2015**

First Power Auction Basis published

**Dec
2015**

ETL approved. Compulsory clean energy goals mandated

**Mar
2016**

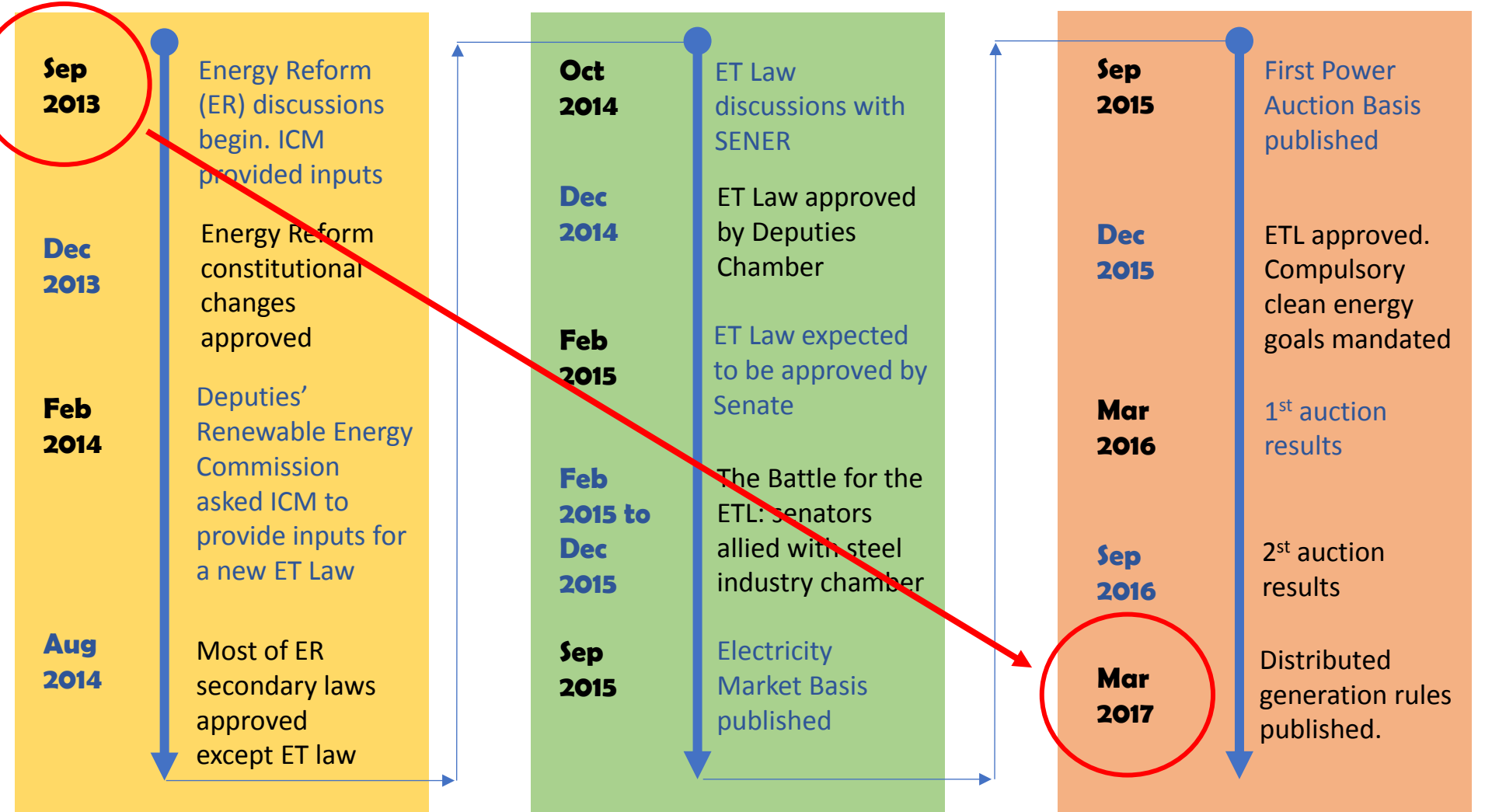
1st auction results

**Sep
2016**

2nd auction results

**Mar
2017**

Distributed generation rules published.



Clean Energy: Where we are and where we go

CLEAN ENERGY CERTIFICATES

CATEGORY	TECHNOLOGY/SOURCE	2015				2016				
		Installed capacity		Gross generation		Installed capacity		Gross generation		
		MW	%	GWh	%	MW	%	GWh	%	
CLEAN ENERGIES	RENEWABLE ENERGIES	HIDROELECTRICITY	12,488.50	18.36	30,891.54	9.98	12,588.99	17.13	30,909.34	9.68
		WIND	2,805.12	4.12	8,745.15	2.83	3,735.42	5.08	10,462.57	3.28
		GEO THERMAL	883.60	1.3	6,330.98	2.05	908.60	1.24	6,148.29	1.93
		BAGASE	670.18	0.99	1,187.26	0.38	798.34	1.09	1,276.37	0.40
		PHOTOVOLTAIC	170.24	0.25	190.26	0.06	388.61	0.53	214.79	0.07
		BIOGAS	80.80	0.12	203.57	0.07	83.17	0.11	194.84	0.06
		HYBRID	0.05	0.00	0.05	0.00	0.07	0.00	0.00	0.00
OTHER CLEAN	EFFICIENT COGENERATION	583.05	0.86	3,795.22	1.23	1,036.01	1.41	5,053.01	1.58	
	NUCLEAR	1,510.00	2.22	11,577.14	3.74	1,608.00	2.19	10,567.17	3.31	
	BLACK LIQUOR	25.50	0.04	27.36	0.01	25.50	0.03	37.99	0.01	
	REGENERATIVE BRAKES	6.61	0.01	3.60	0.00	6.61	0.01	3.60	0.00	
CLEAN ENERGIES SUBTOTAL		19,223.64	28.26	62,952.13	20.34	21,179.31	28.81	64,867.98	20.31	
FOSSIL ENERGIES SUBTOTAL		48,801.04	71.74	246,600.66	79.66	52,331.12	71.19	254,495.55	79.69	
TOTAL		68,024.68	100.00	309,552.79	100.00	73,510.43	100.00	319,363.53	100.00	

Energy Transition Law (ETL)

35% @

2024

30% @

2021

25% @

2018

20% by

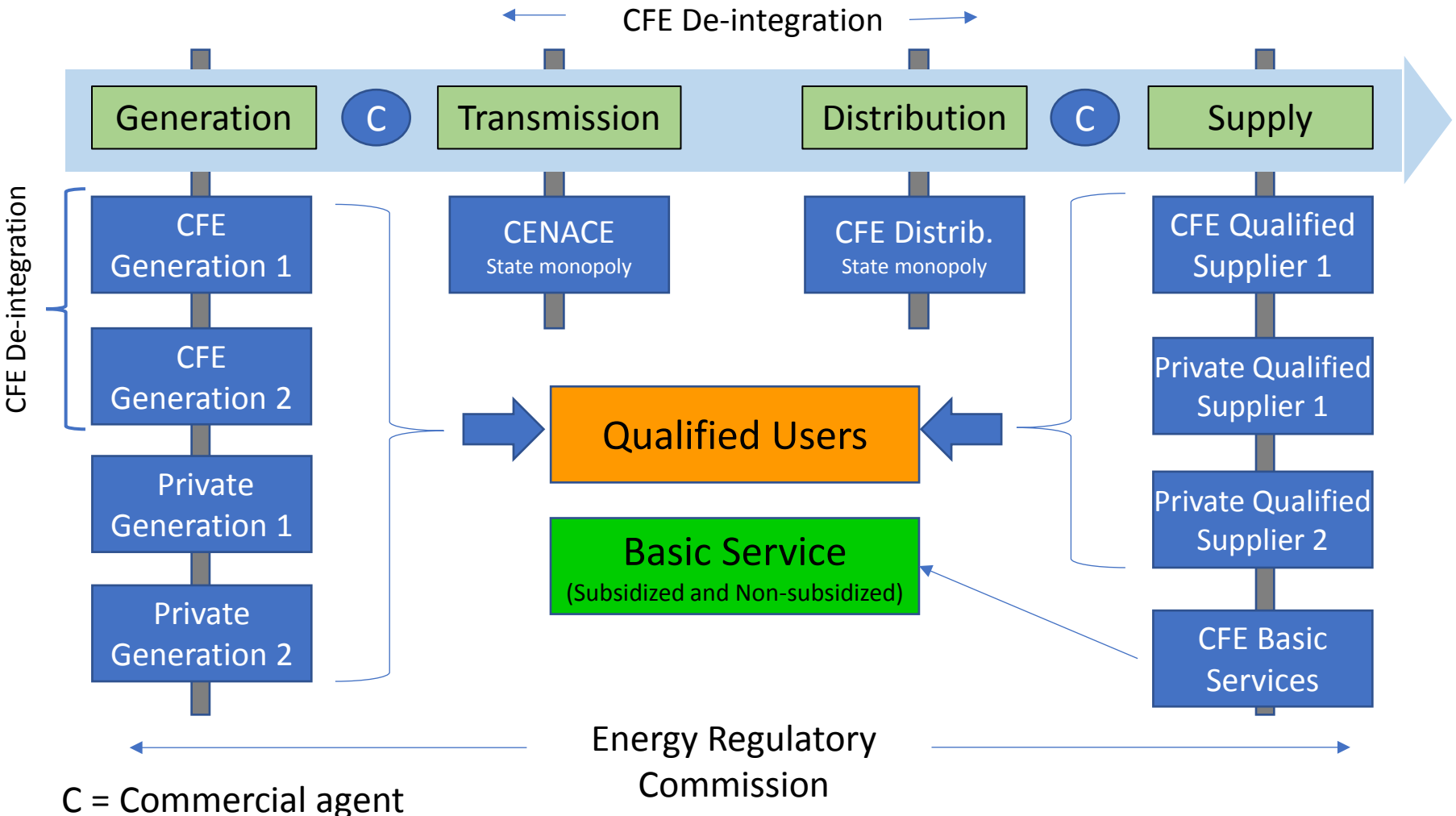
2015

Market Approach

- Non discriminated access
- Independent transmission provider
- Flexible transmission service with tradable congestion revenue rights
- Transmission pricing reform
- Open and transparent energy spot markets; day ahead and real time markets for energy and ancillary services
- Congestion management through locational marginal pricing
- Market monitoring
- CELs
- Others



New Market Structure





ETL Results: Energy and CELs Auctions

5,000 megawatts by 2019
6,600 million USD

1^a. Long term auction

2085 megawatts by 2018
47.7 USD/MWh average price
2,600 million USD.

2^a. Long term auction

2891 megawatts by 2019
33.47 USD/MWh
4,000 million USD.

Long Term Power Auctions (LTPA) Results

First LTPA: March 31 , 2016

- CFE's maximum prices: \$51.04 USD/MWh; \$25.64 USWD/CEL; \$577.37 USD/MW (capacity)
- 10 winners
- 5,402,881 MWh/year; 5,380,911 CEL/yr
- Installed capacity, MW: Wind 394; Solar 1,691; Other zero capacity

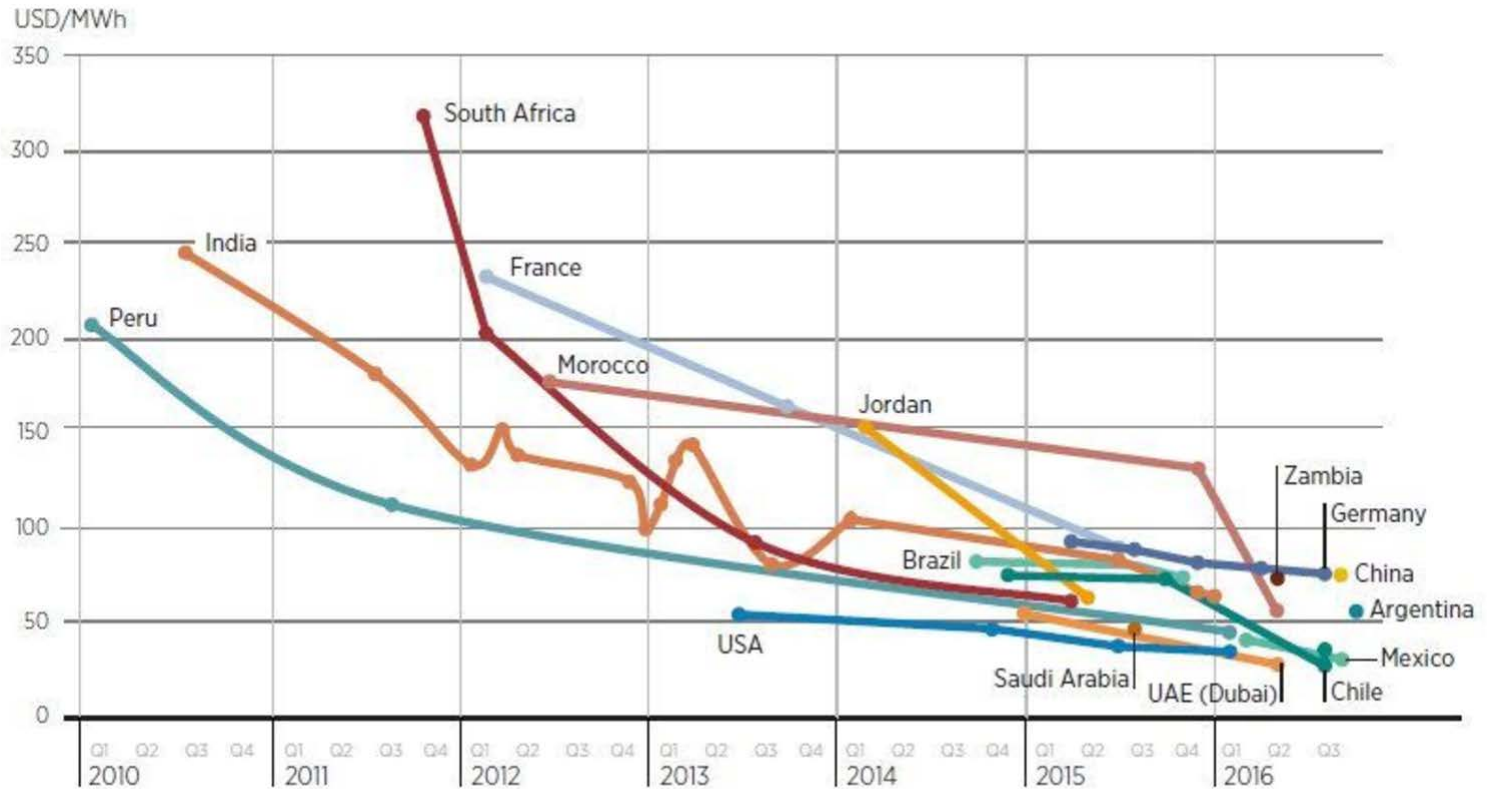
- Minimum PRICES, USD/MWh (energy+cels): Wind **\$42.85**; Solar **\$35.46**
- Average PRICES, USD/MWh: Wind \$55.33; Solar \$45.06

Second LTPA: September 30 , 2016

- CFE's maximum prices: \$45.01 USD/MWh; \$20.00 USWD/CEL; \$90,016.31 USD/MW (capacity)
- 56 winners
- 8,909,819.2 MWh/year; 9,275,534 CEL/yr
- Installed capacity: Wind 1,038.05 MW; Solar 1,853.25 MW; Combined Cycle+ 992.10 MW

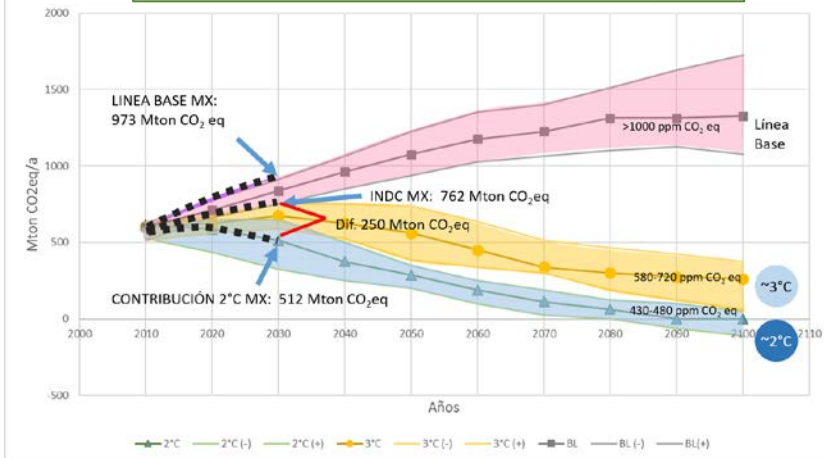
- Minimum PRICES, USD/MWh (energy+cels): Wind **\$32.00**; Solar **\$25.03**
- Average PRICES, USD/MWh: Wind \$35.77; Solar \$31.81

Figure 2.3 Evolution of utility-scale solar PV auction prices around the world



Source: IRENA, 2017a

Country's emission paths



Mexico's NDCs: -22% GHG

Emisiones de GEI (MtCO₂e)

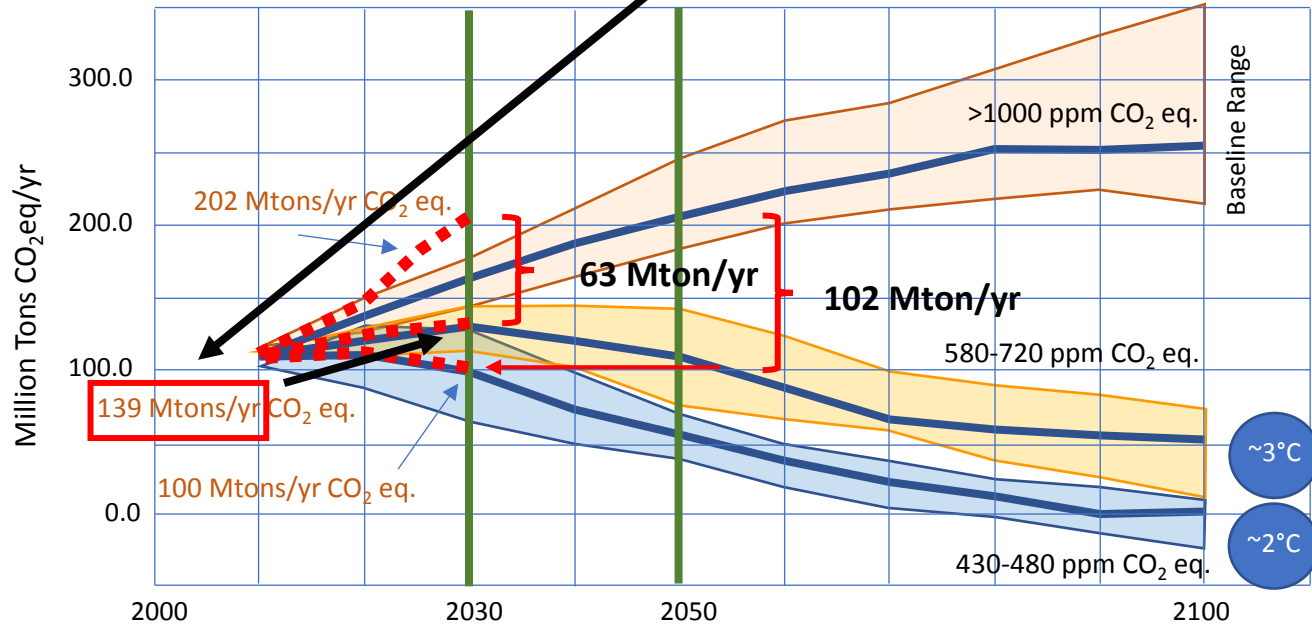
Meta al 2030

	Línea base				No condicionada
	2013	2020	2025	2030	2030
Transporte	174	214	237	266	218
Generación de electricidad	127	143	181	202	139
Residencial y comercial	26	27	27	28	23
Petróleo y gas	80	123	132	137	118
Industria	115	125	144	165	157
Agricultura y ganadería	80	88	90	93	86
Residuos	37	40	45	49	35
USCJUS ¹	32	32	32	32	-14
EMISIONES TOTALES²	665	792	888	973	762

-22%

NOTAS:
¹ USCJUS: Usos del suelo, cambio de uso del suelo y silvicultura.
² La suma de los valores de los sectores puede no coincidir con el total por efectos del redondeo.

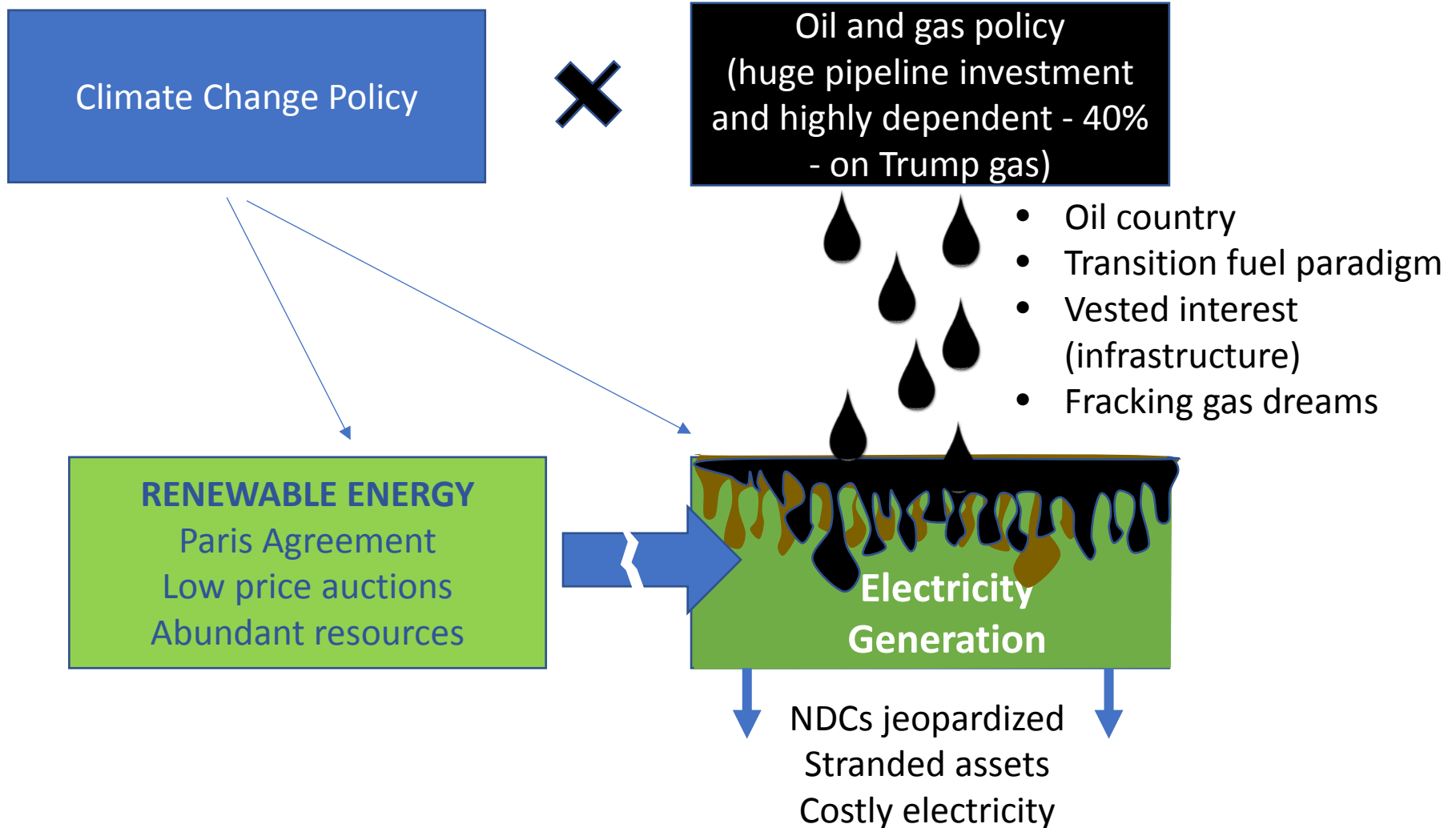
Emissions Paths at Different Temperatures, Mexico's Electricity Sector



Gaps

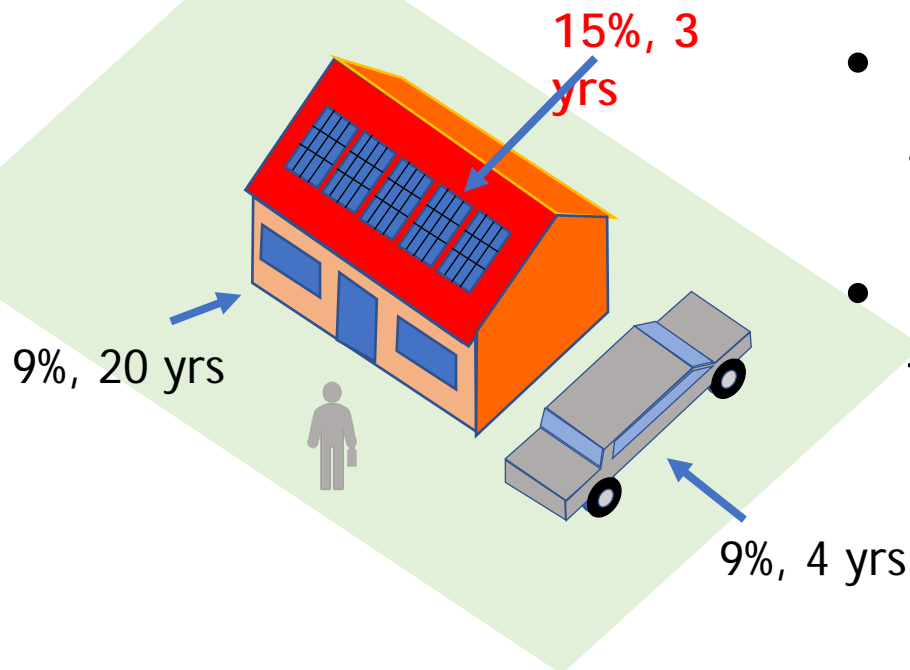
- **INERTIA**: Lack of a clear Natural gas generation plants, gas pipelines expansion.
- **FINANCING**: Mexican financial sector risk aversion. Fear to the unknown
- **GRID/BASELOAD PARADIGM**: Fear and resistance to major RE penetration. Fear of instability
- **SUBSIDIES**: Residential sector's highly subsidized electricity is a deterrent to distributed generation

Gap 1: Oil&Gas policies partially overriding energy transition

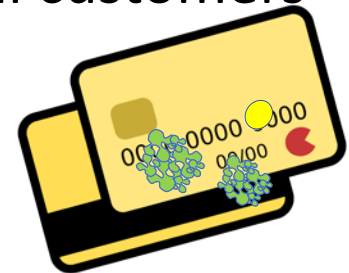


Gap 2: Financing

Small, but potentially massive, projects have no affordable financial schemes

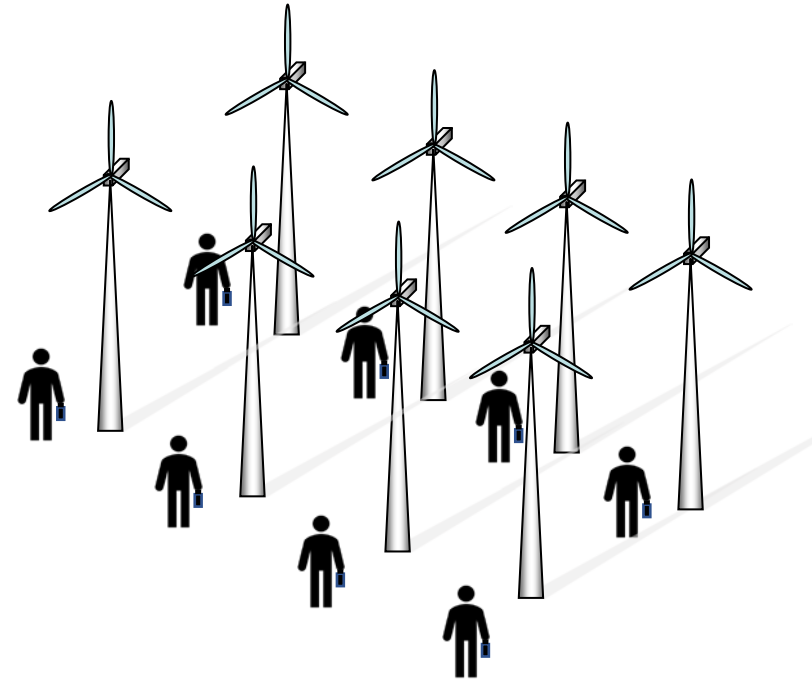


- Unchartered waters for most financial agents
- Technical matters conceal unknown risks for financiers
- Non parametric, and non standardized products worsen risk perception
- Unaffordable credit conditions for most potential customers



Gap 2: Lenders favor big projects

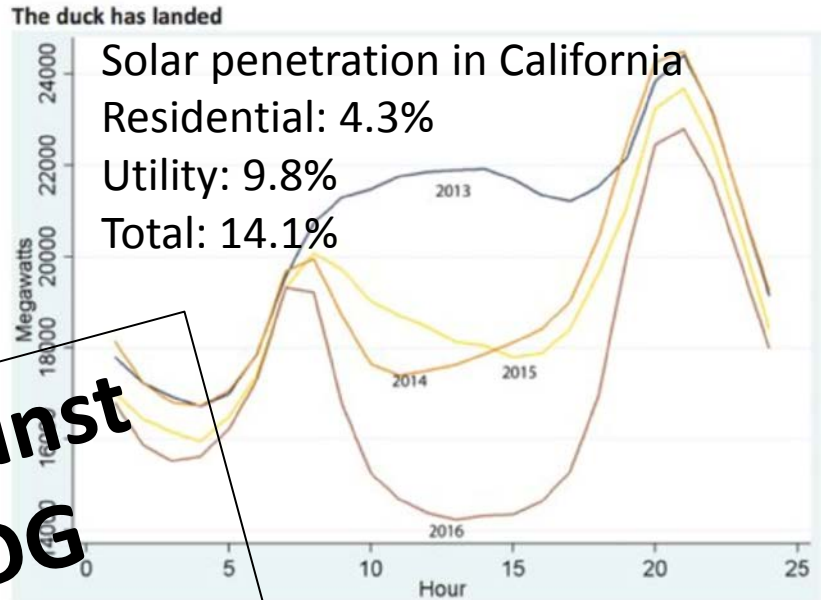
- Most bidders were highly experienced and very professional **international companies** with sound corporate policies. Bidders included ENEL, Acciona, Q-Cells, EDF
- Projects size favors **scale economies**
- Biggest bidders got **favorable financial** conditions
- Legal and regulatory framework as well as **15 years** contract terms for energy and 20 years for CELs increased investors confidence
- PV **equipment prices** in the international market have been remarkably cheaper in recent years, and labor costs in Mexico are lower than in other countries
- Contract conditions assume **yearly deliveries** which are cheaper to achieve than monthly deliveries
- Mexico's **macro economics** conditions foster investors confidence
- **Guarantee of seriousness** is worth around 90,000 USD per project, plus 9 USD per offered MWh, and 4.5 USD per CEL
- International auctions **prices are consistent** with Mexico's prices, particularly in LATAM (see next graph)
- CFE contracts, **backed by Mexico's sovereign debt**, are very attractive to lenders



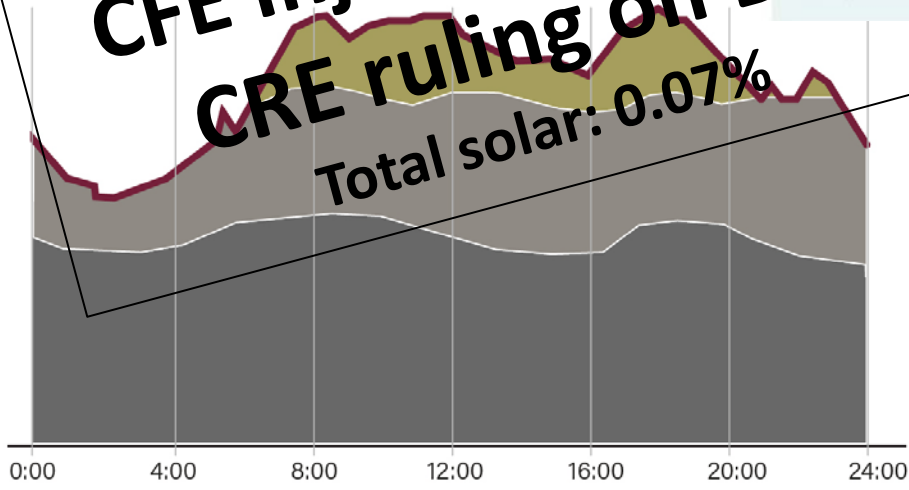
Big Projects have plenty of financing mechanism

Gap 3: Grid Instability/Baseload Paradigm

California's Duck Curve due to high solar penetration



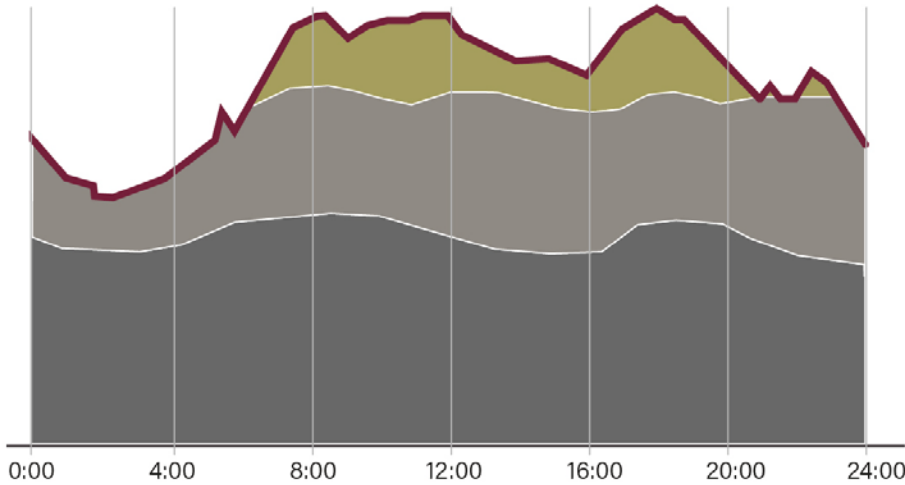
CFE Injunction against CRE ruling on DG
Total solar: 0.07%
















Baseload Paradigm

Deconstructing Baseload

A) The Baseload Paradigm



	Power generation	
■ Peak	   	
■ Intermediate and dispatchable	 	
■ Baseload	 	   

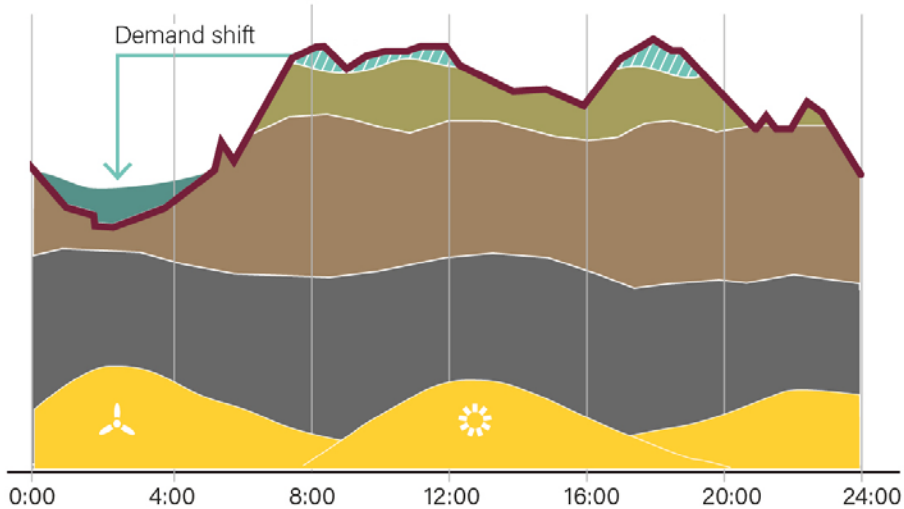
-  Coal-fired
-  Oil-fired
-  Diesel generator
-  Nuclear
-  Natural gas-fired
-  Hydro-power
-  Bio-power
-  Solar PV and CSP
-  Geothermal power
-  Wind power

Deconstructing Baseload



- Adjustments in grid operation
- Develop forecasting systems for renewable generation
- Improve control technology
- Improve operating procedures for efficient scheduling and dispatch

B) The Early Transition



Power generation	
Demand shift	→ to early morning lows
Peak	
Intermediate and dispatchable	
Baseload	
Variable renewable energy	

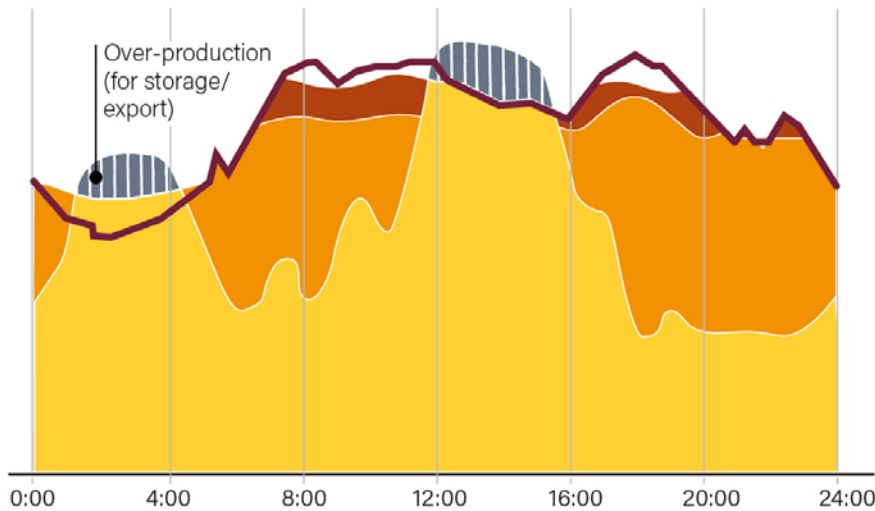


Deconstructing Baseload

- Advanced resource forecasting
- Grid reinforcements and strengthen interconnexions
- Improved information and control technologies for grid control
- Widespread deployment of storage technologies
- Greater efficiency and scope of demand response
- Coupling electricity, heating and cooling, and transport systems



C) A New Paradigm STORAGE, DIGITALIZATION AND BLOCKCHAIN

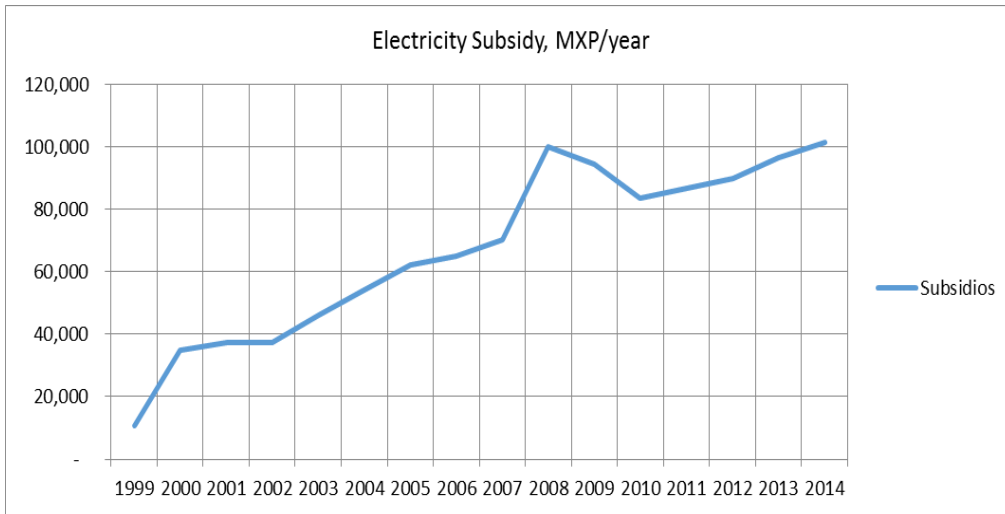


	Power generation
Over-production	→ for storage or trade
Storage or import/trade	from solar and wind peaks
Dispatchable	*
Variable renewable energy	

* CSP with thermal energy storage

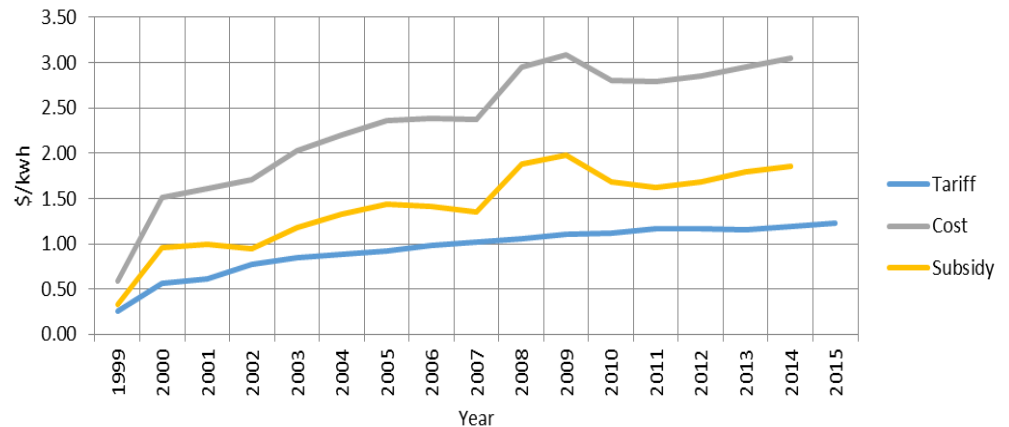


Gap 4: Subsidy for Electricity in Mexico

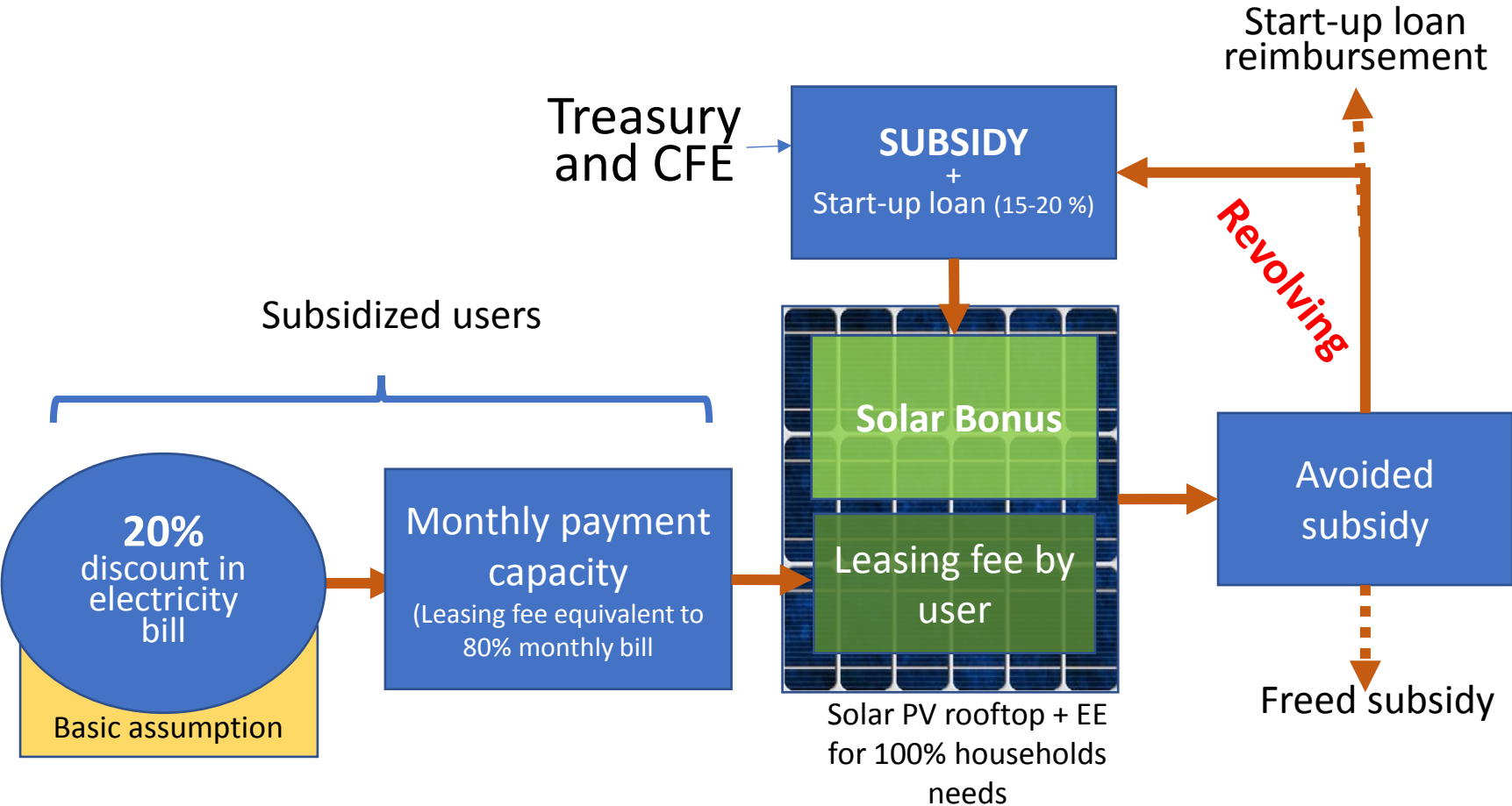


2016's Residential subsidy amounted **6.6 billion dollars**.
 Less than **5 years** of subsidy are enough to install a solar rooftop on **30 million houses** for free

However, despite the high electricity subsidy, there are 12 million houses in "*energy poverty*"



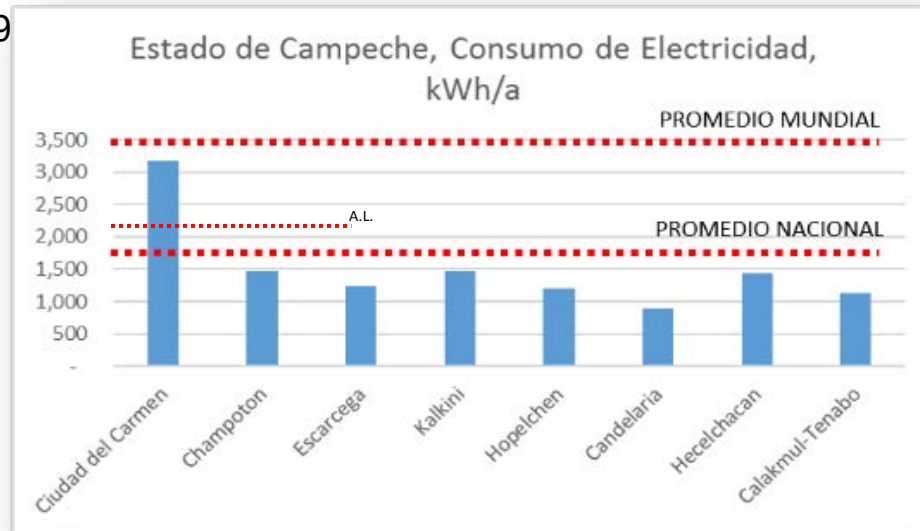
Gap 4: Solar Bonus as a way for subsidy elimination



Gap 4: Solar Bonus as a way to solve the energy poverty

HOUSES IN ENERGY POVERTY

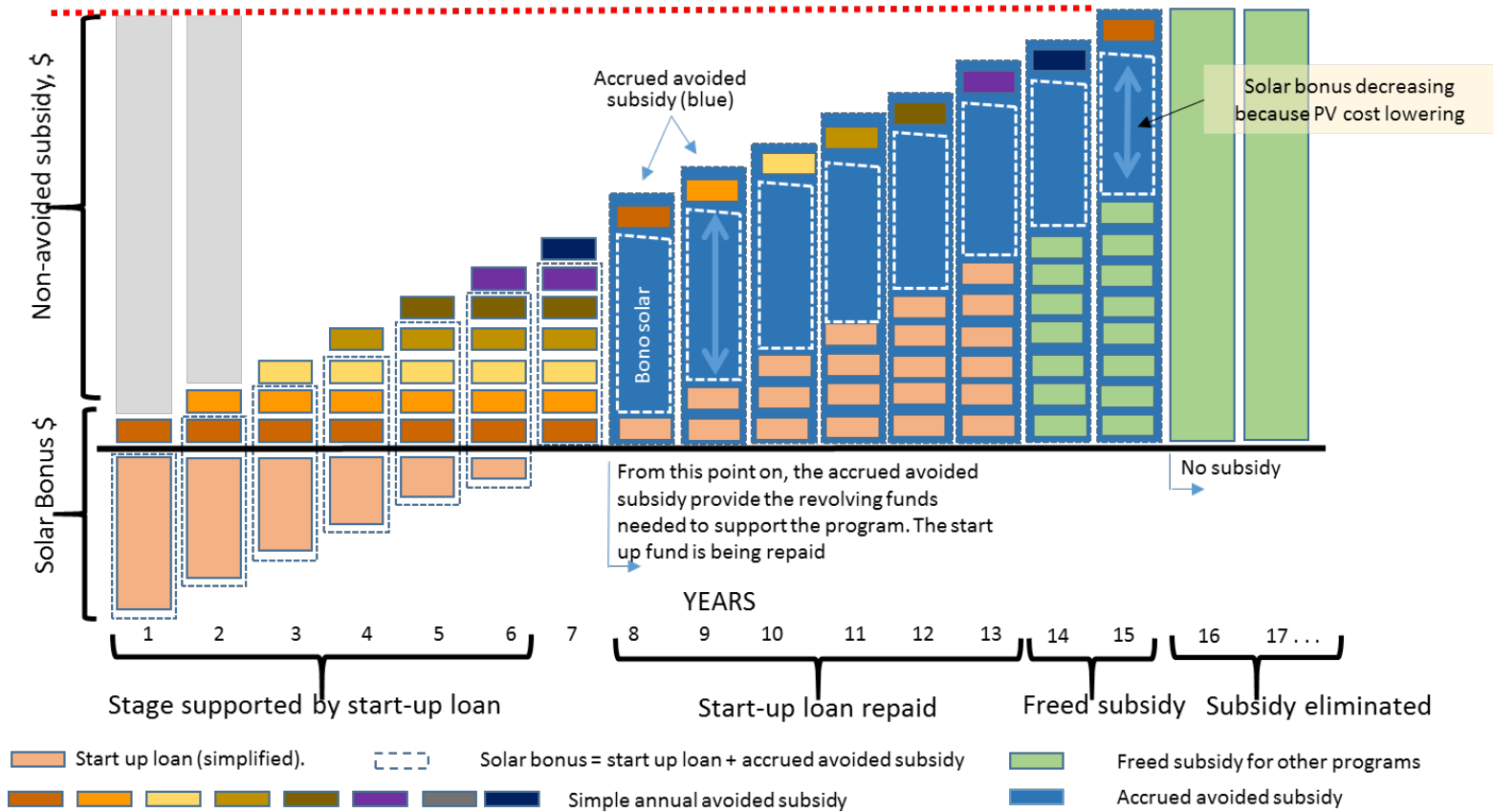
Nacional	12,383,325
Edo. de México	1,007,109
Guanajuato	838,281
Chiapas	798,172
C. de México	392,530
Yucatán	219,324



- Solution to electricity subsidy
- NDCs compliance
- Help in energy poverty
- Environmental, economic and social benefits

Solar Bonus Financial Mechanism

70% subsidio capitalizable y 70% cobertura solar

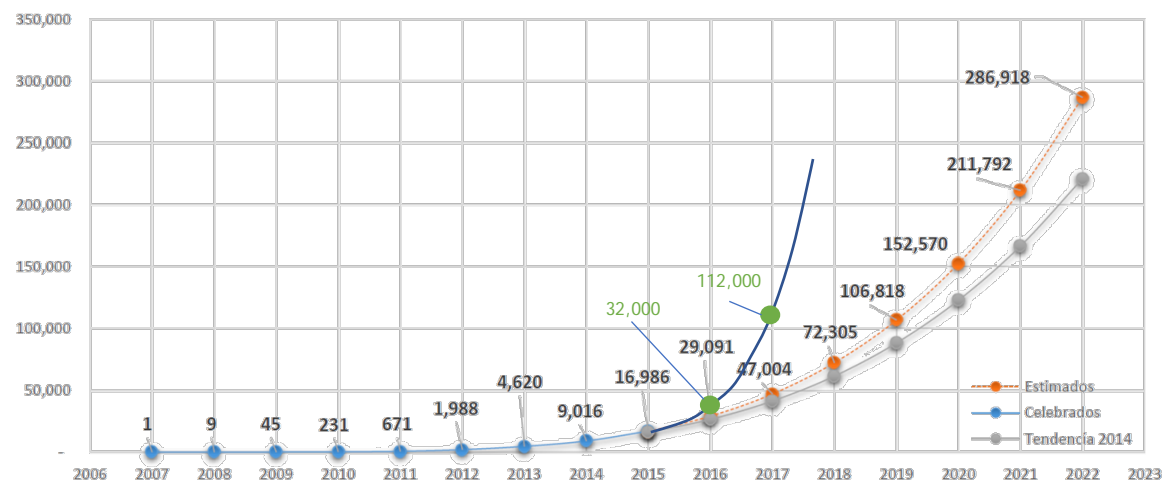


DISRUPTIVE Distributed Photovoltaic Generation



Small and medium size solar PV interconnexions

Contratos



La tendencia se estimó sólo en función del crecimiento de los contratos celebrados vistos en años anteriores.
 Tendencia con base a la información del cierre 2015 (naranja)
 Tendencia con base a la información del cierre 2014

Año

¡ GRACIAS !

DANIEL CHACON-ANAYA

daniel.chacon@iniciativaclimatica.org