

Grid harmonization: a North American perspective

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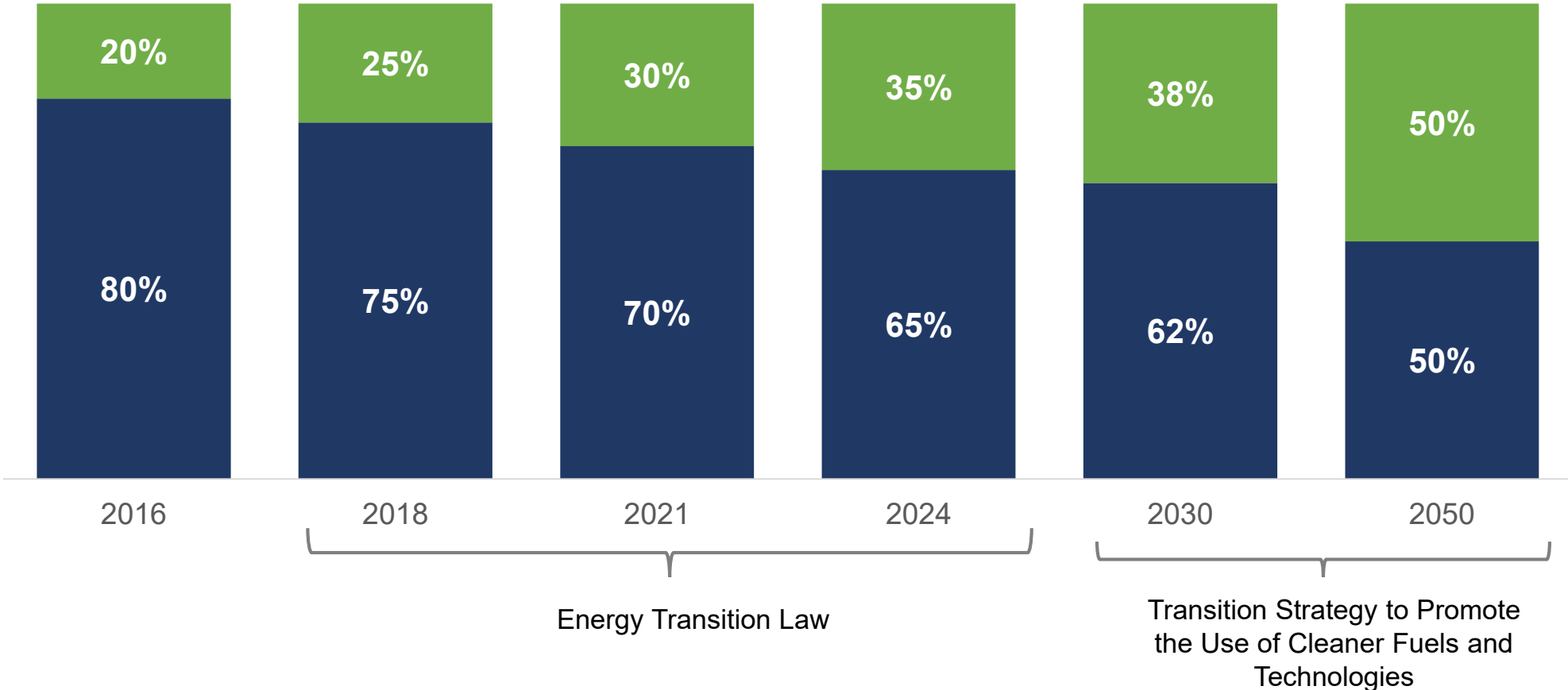
May 6th, 2019



Mexico, the North American region, and the entire world are moving towards increasingly decarbonized and decentralized electric systems. Taking advantage of these transformations will require further technical harmonization and institutional cooperation at the regional level







In this regard, the Mexican law establishes clean power generation targets

■ Conventional Power Generation ■ Clean Power Generation

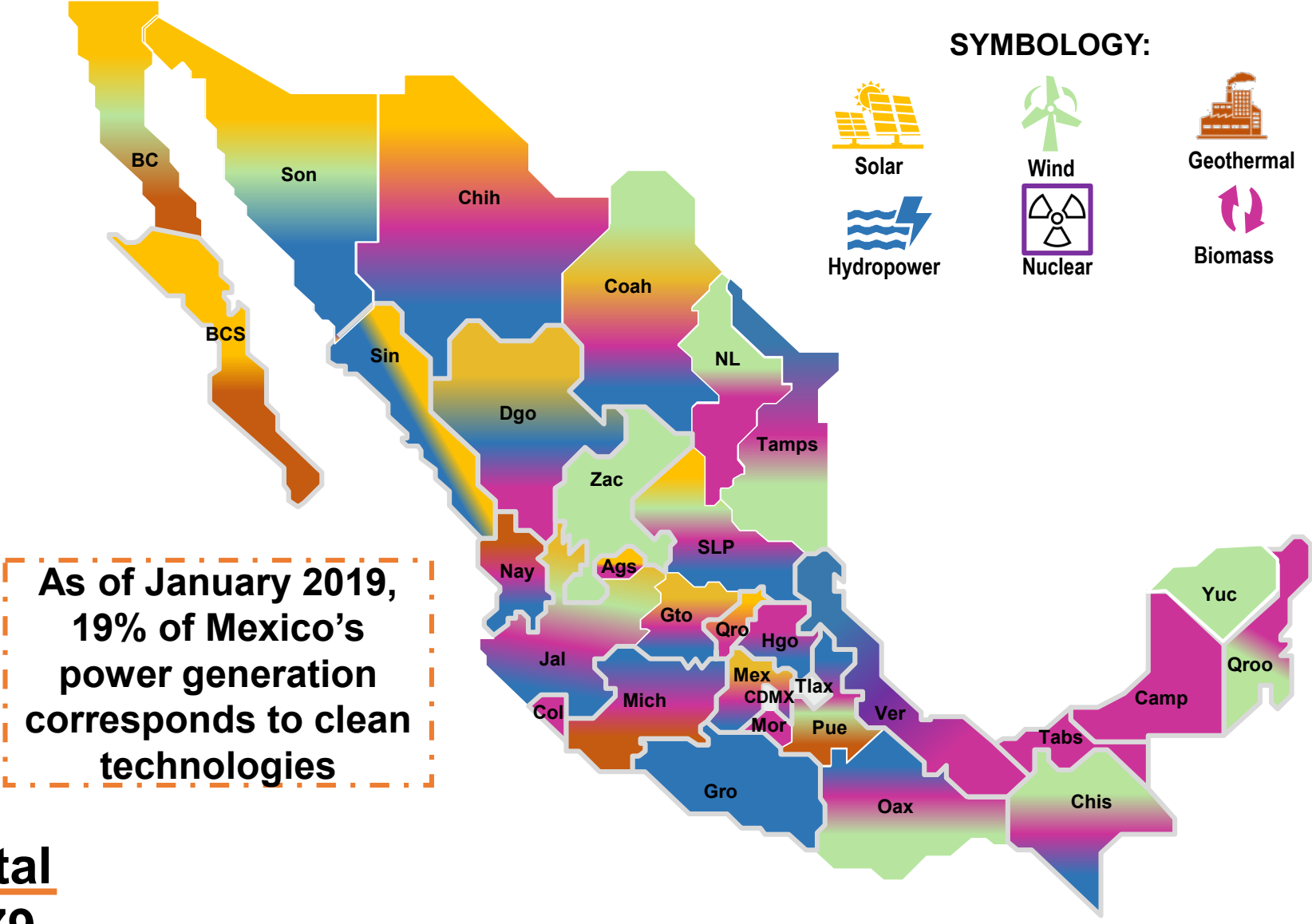


Mexico's National Development Plan 2019-2024, established the goal of **35.8%** of clean power generation for 2024

Currently, almost 280 clean electricity plants operate in 30 states of Mexico, which represent an installed capacity of 24 thousand MW (30% of the total installed capacity in Mexico)¹

State						
Aguascalientes	4					2
Baja California	1	2		1		
Baja California Sur	3			1		
Campeche						1
Chiapas		2	7			3
Chihuahua	8		2			2
Coahuila	3	2	1			2
Colima						1
Durango	9		1			2
Guanajuato	3		1			1
Guerrero			4			
Hidalgo			1			2
Jalisco	3	2	13			8
México	2		3			2
Michoacán			14	1		2
Morelos						3
Nayarit			4	1		2
Nuevo León		3				3
Oaxaca		24	2			4
Puebla		1	21	1		3
Querétaro	1					2
Quintana Roo		1				1
San Luis Potosí	1	1	3			4
Sinaloa			6			2
Sonora	6	1	3			
Tabasco						3
Tamaulipas		8	1			2
Veracruz			13		1	21
Yucatán		2				
Zacatecas		2				
Total	44	51	100	5	1	78

**Total
279**



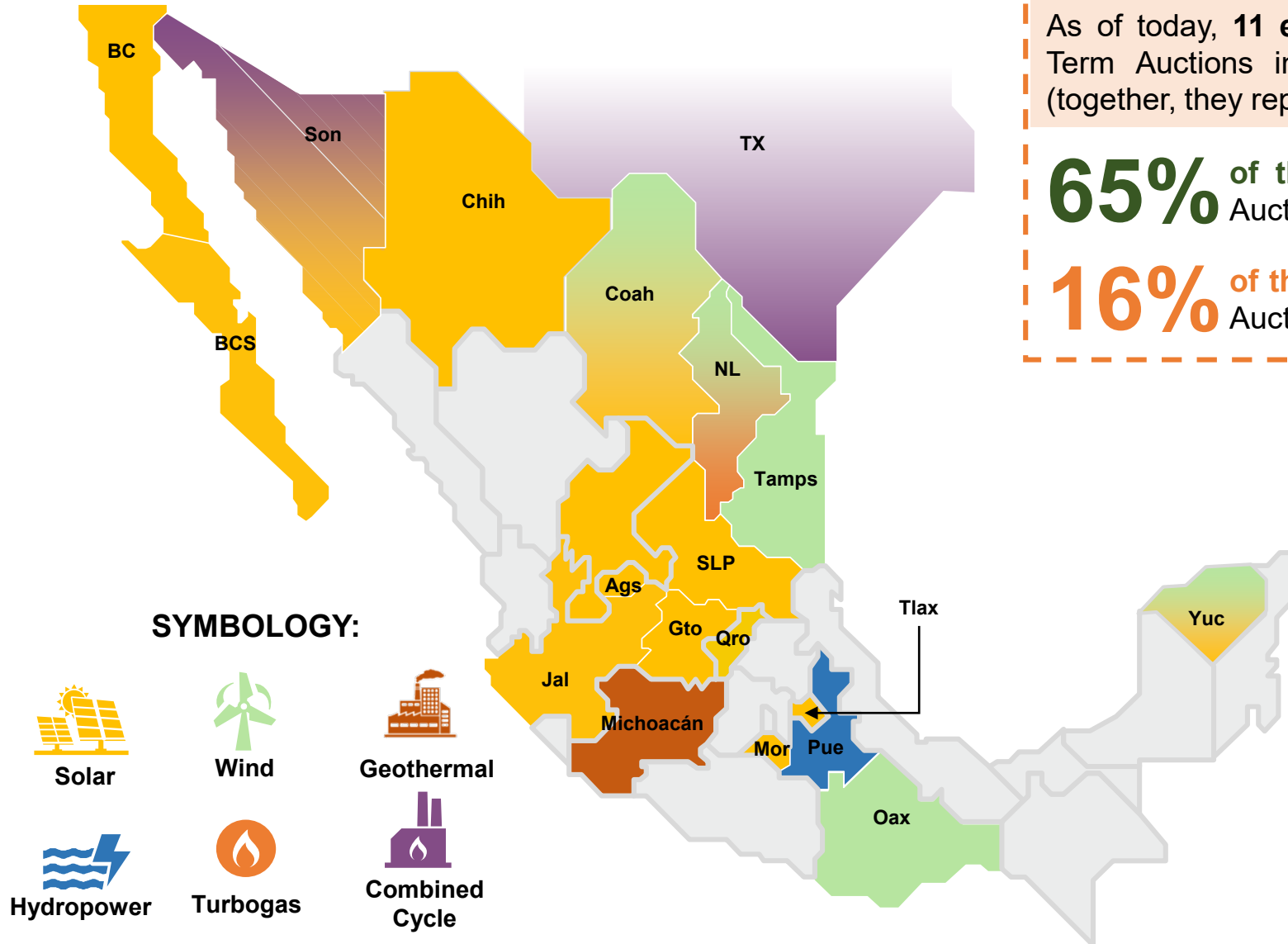
1/ Installed Capacity: 81 thousand MW. CRE's information as of 2018 3

A successful mechanism which has fostered the adoption of renewables in Mexico has been the undertaking of Long Term Electricity Auctions. As a result of the three Auctions carried out so far, 70 new electricity plants will be developed in 19 states in Mexico, representing 9 billion dollars of investment in the upcoming years

As of today, **11 electricity plants** associated to the first two Long Term Auctions in 7 states of Mexico **have started operations** (together, they represent an installed capacity of 1.6 thousand MW)

65% of the contracted capacity in the **first** Long Term Auction (2 thousand MW) is **currently in operation**

16% of the contracted capacity in the **second** Long Term Auction (3.1 thousand MW) is **currently in operation**

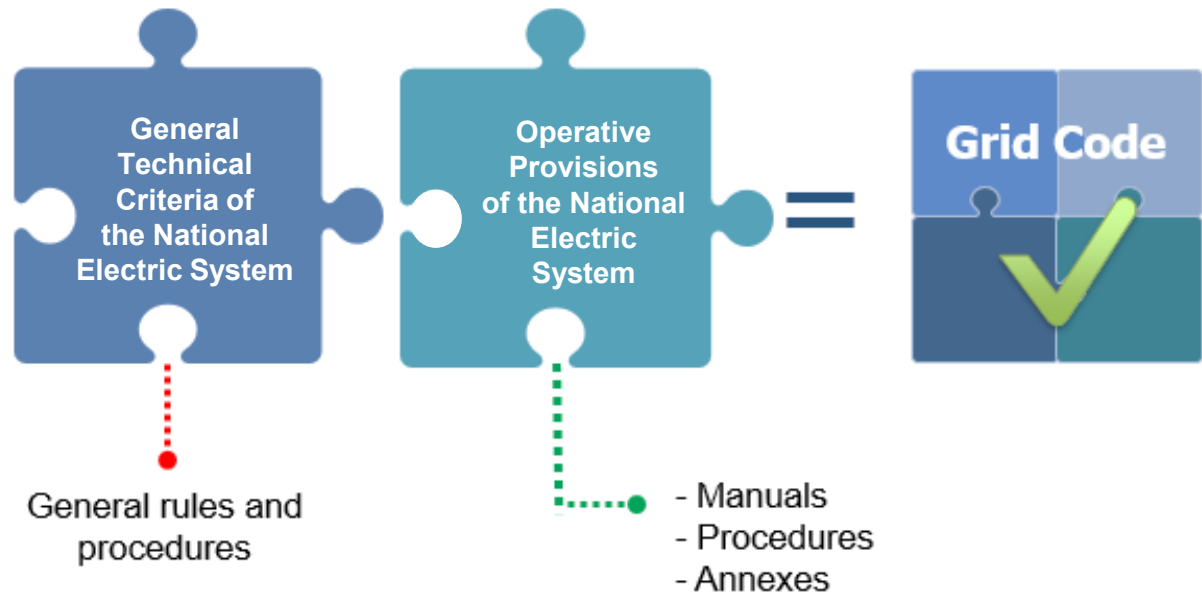


Average auction prices ^{1/} (USD/MWh+CEL)			
	1st	2nd	3rd
Solar	44.97	31.22	21.34
Wind	55.33	33.27	18.48
Winners			
Companies	11	23	8

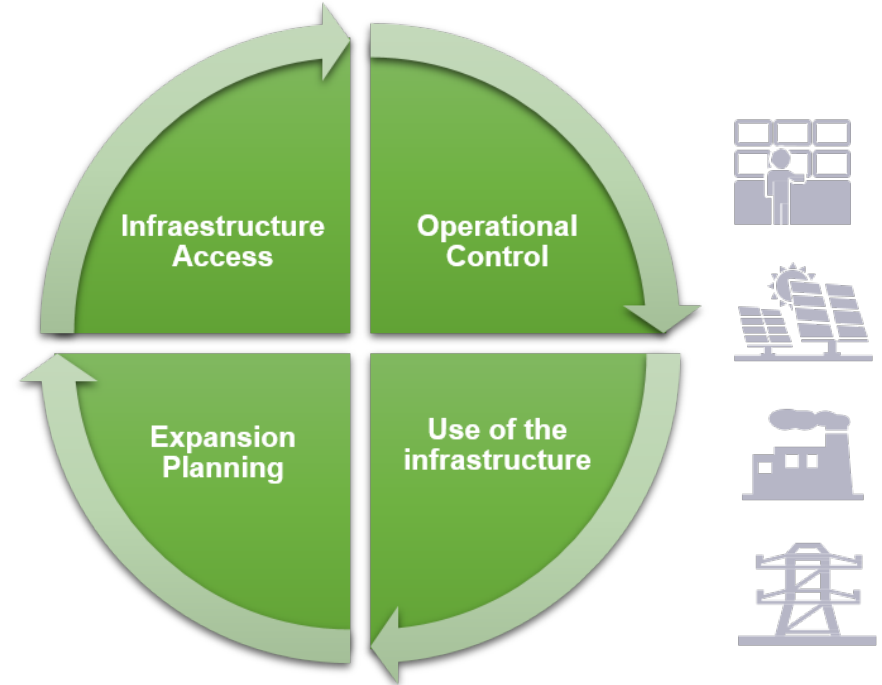
1/ Weighted average of offers of packages that only offered Energy and CELs. Exchange rate (MX / USD) used by LTA: 1st 17.3192, 2nd 20.17, 3rd 19.185

As Mexico increases the adoption of technologies such as distributed generation and electricity storage, our grid will become more decentralized. Consequently, a more reliable management of the grid is paramount. Therefore, in April 2016 CRE issued the Grid Code, Mexico's regulation in which common reliability standards can be put in place

The Grid Code contains the **minimum technical requirements** to ensure the **efficient development** of all processes regarding: **planning, operation, access and use of the National Electric System**



Scope of the Grid Code



The objective of the Grid Code is to **establish the technical criteria** to allow and encourage the **National Electric System to be developed, maintained, operated, planned and modernized** in an efficient, coordinated, transparent and economical manner.

In an effort to attain more coordination at the regional level, CRE is currently working with Mexico's Independent System Operator (CENACE) and NERC to develop shared grid reliability protocols to strengthen energy security on both sides of the border

1

Cybersecurity:

Information sharing about Cybersecurity and Mexico's participation in GridEx: a simulation exercise on how the actors involved would respond to and recover from cyberattacks that threaten the electric system

2

Reliability Standards:

Review of the Reliability Standards recommended by NERC to include in Mexico's Grid Code. For example, in the Baja California region 10 NERC reliability standards were adopted^{1/}

3

Reliability Assessment:

Peer review of Mexico's 2017 Reliability Report. NERC and CENACE shared proposals about the inclusion of new performance indicators for Mexico's National Electric System

4

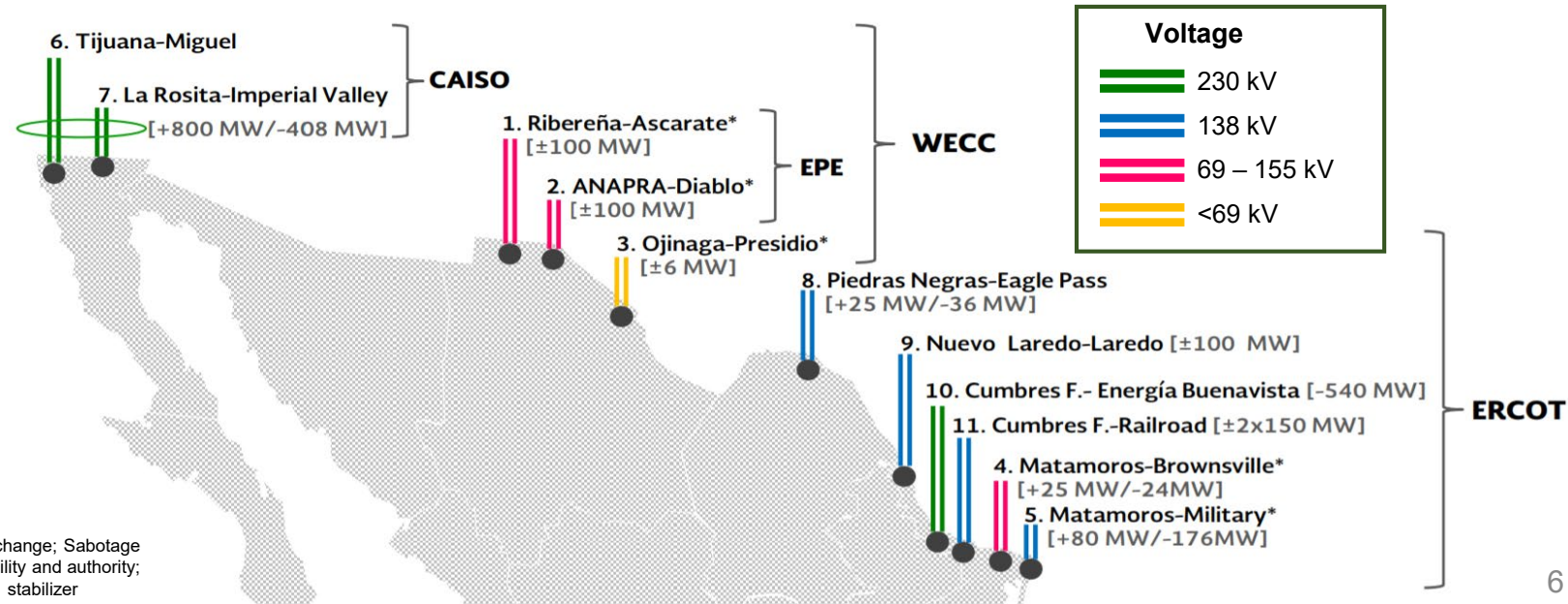
Operational Reliability:

Through a simulator, NERC shared restoration procedures to be followed by CENACE in cases of complete blackouts. As a result, CENACE included these procedures on its 2018 working plan

✓ Mexico supported the U.S. during the power outage in California in 2011. In return, the U.S. supported Mexico in 2016, when there was also a power outage in Baja California.

✓ Additionally, in May 2017, Tamaulipas and Texas worked together during the power outage registered in Matamoros and Reynosa

Mexico has 11 interconnection points with the United States



^{1/} Reliability Criteria for Baja California region: Real power balancing control performance; Inadvertent interchange; Sabotage reporting; Interchange information; Interchange transaction implementation; Operating personnel responsibility and authority; Operating personnel training; Operating personnel credentials; Automatic voltage regulators; Power system stabilizer

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