



Geothermal market development in Mexico

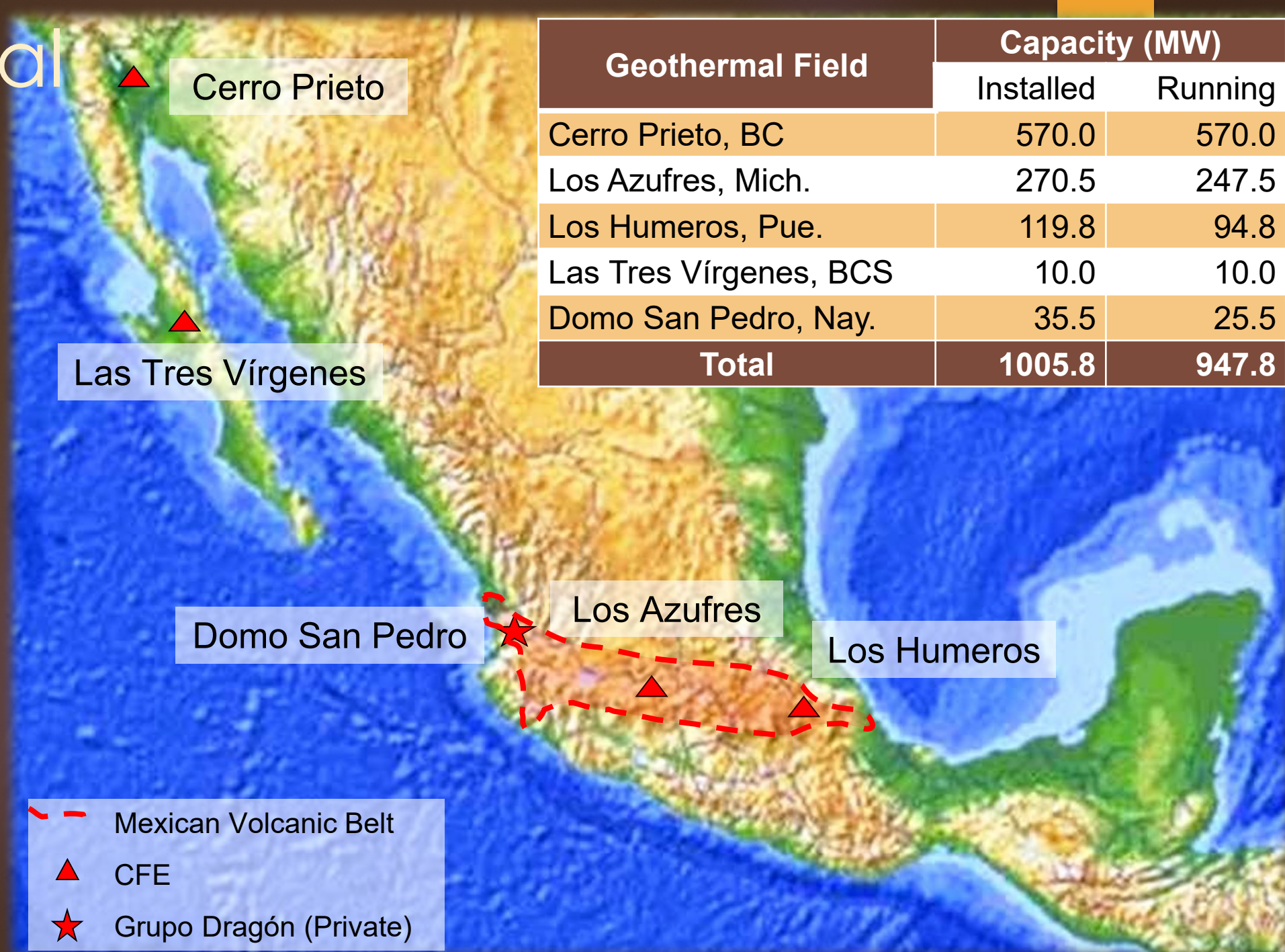
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WEBINAR, DECEMBER 5, 2019

Geothermal electric power in Mexico

It represents
~1.4% of the
electric capacity
in the country,
and provides
~1.7% of the total
generation (in
2018)



Origins of geothermal development

1955

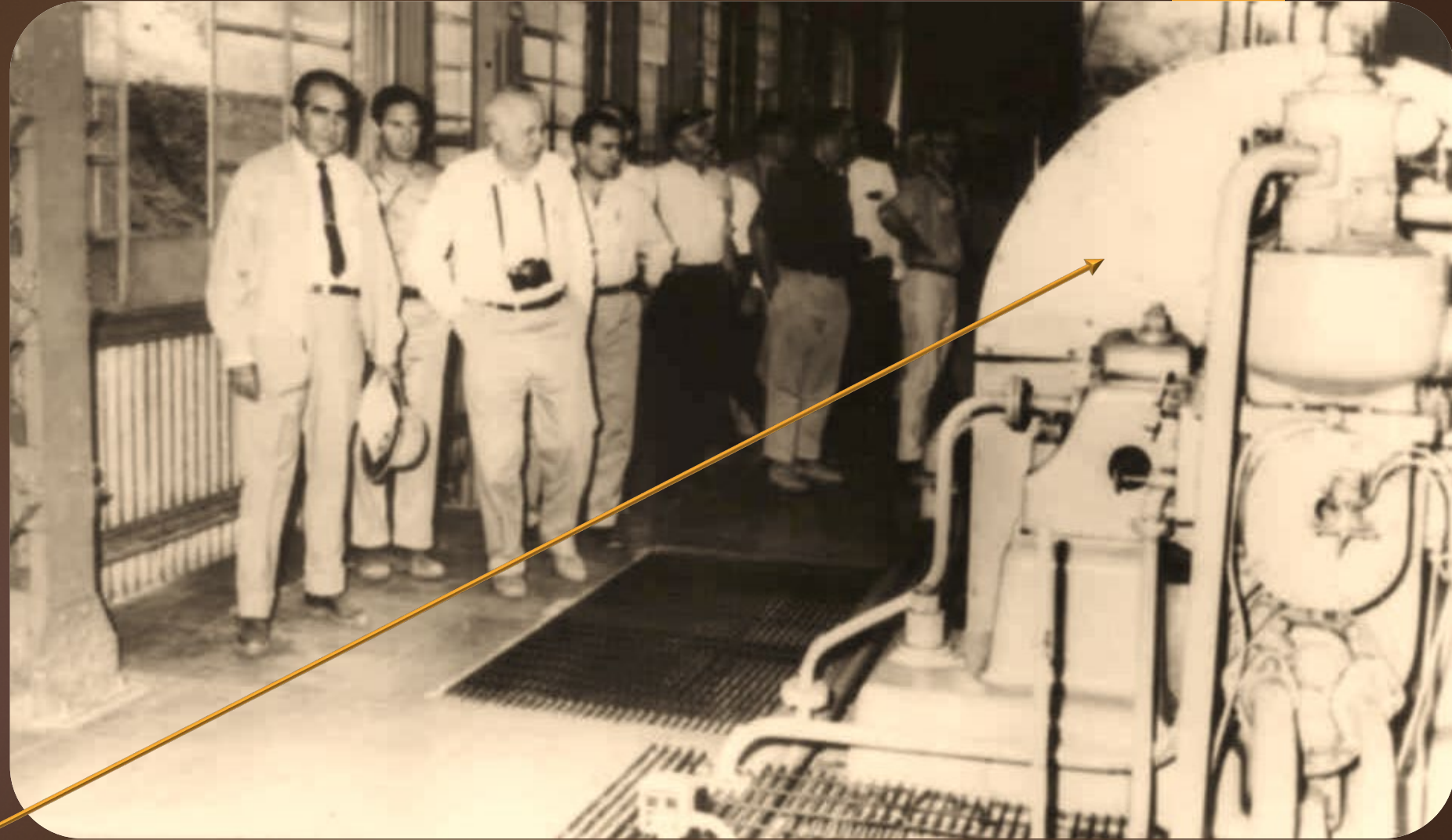
- The National Commission for Geothermal Energy is funded
- The first exploration well is drilled in Pathé

1958

- The first exploration well is drilled in Cerro Prieto

1959

- The first geothermal power plant (3.5 MW) starts operations in Pathé



Modern development: Cerro Prieto (1973), Los Azufres (1982), Los Humeros (1990), Las Tres Vírgenes (2001), Domo San Pedro (2015)

Geothermal market legal framework

Geothermal Energy Law (August 2014) and its regulations

Stage:	Reconnaissance	Exploration	Exploitation
Legal instrument:	Registration	Permit	Concession
Validity span:	8 months	3 years (one possible extension of 3 years)	30 years (or more)
Main activities:	Only regional geological and/or geochemical surveys	- Detailed geological and geochemical studies. - Geophysical surveys - Mandatory drilling of 1 up to 5 exploration wells - Roads and other civil works	- Drilling of production and injection wells - Superficial gathering installations - Construction and installation of power plants - Operation and development of the wellfield

Maximum extension of a single geothermal zone is 150 km²

Current concessions & permits

Under the Geothermal Energy Law, SENER has issued:

13 exploration permits granted to CFE in 13 geothermal zones in the states of Baja California, Chiapas, Guanajuato, Hidalgo, Jalisco, Michoacán, Nayarit and Puebla

15 exploration permits in the same states plus Baja California Sur, granted to the following private companies: Grupo Dragón, Grupo ENAL, Mexxus-RG, Storengy-RG, Geolnova, PI Ingera, Diamante, Argaman



Six exploitation concessions:

- Cerro Prieto, Los Azufres, Los Humeros, Las Tres Vírgenes and Cerritos Colorados granted to CFE
- Domo San Pedro to Grupo Dragón

Up to
November
2018

Additional zones: The 2011 report

- Report commissioned by the Inter-American Development Bank and the Energy Regulatory Commission of Mexico
- Gathering of available info on the most important geothermal zones in Mexico
- Description, location and main geological & geothermal features of each zone
- Two preliminary models (one volumetric and other of gradual de-compression) were applied to each zone, both coupled to Montecarlo iterations, to estimate the geothermal-electric potential



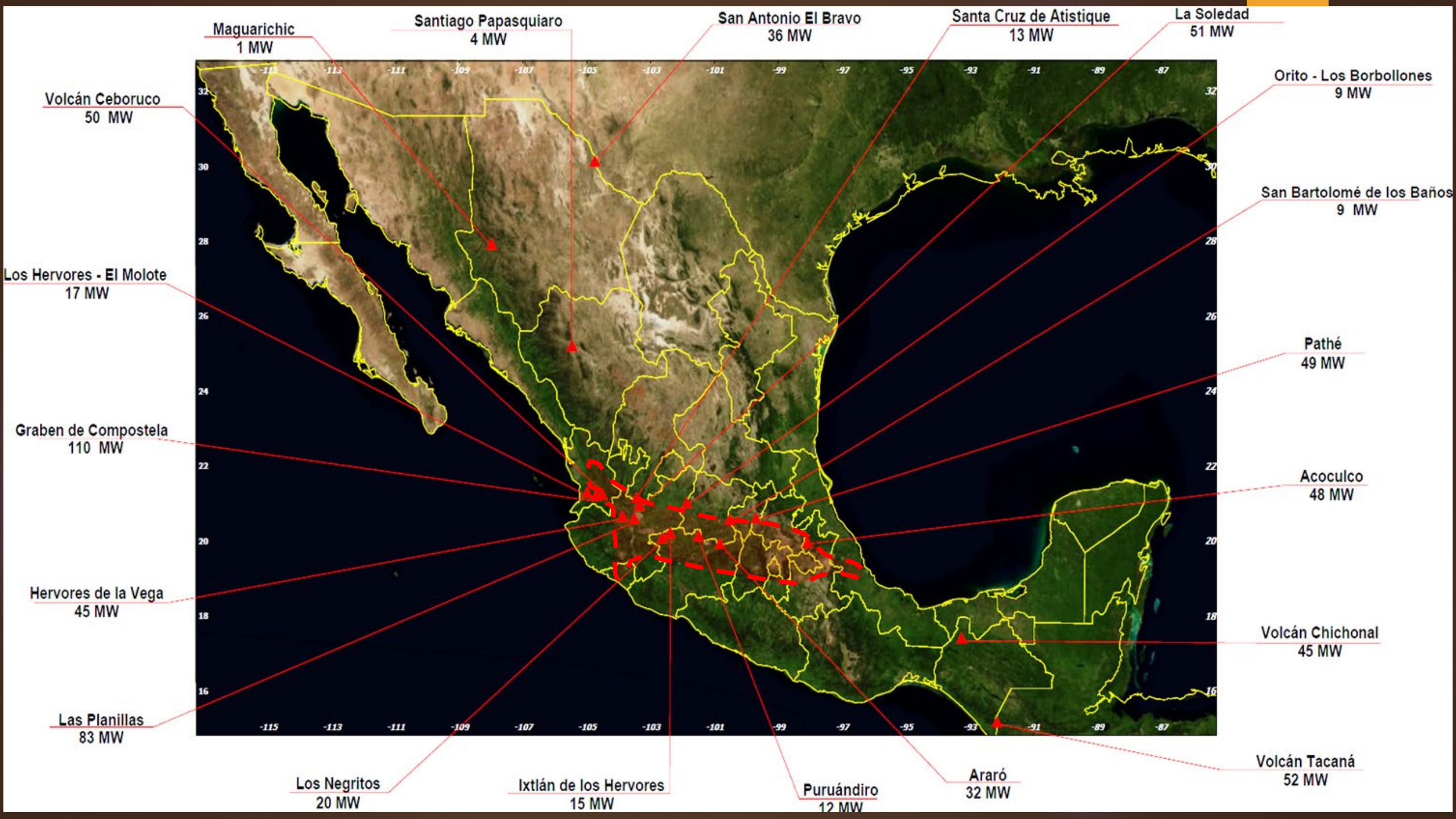
Evaluación de la Energía Geotérmica en México

**Informe para el Banco Interamericano de Desarrollo y la
Comisión Reguladora de Energía**

México, DF, mayo de 2011

**Preparado por:
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Ornelas Celis, Ing. Salvador Espindola, Ing. Isaías Hernández**



Potential in
each zone

CFE

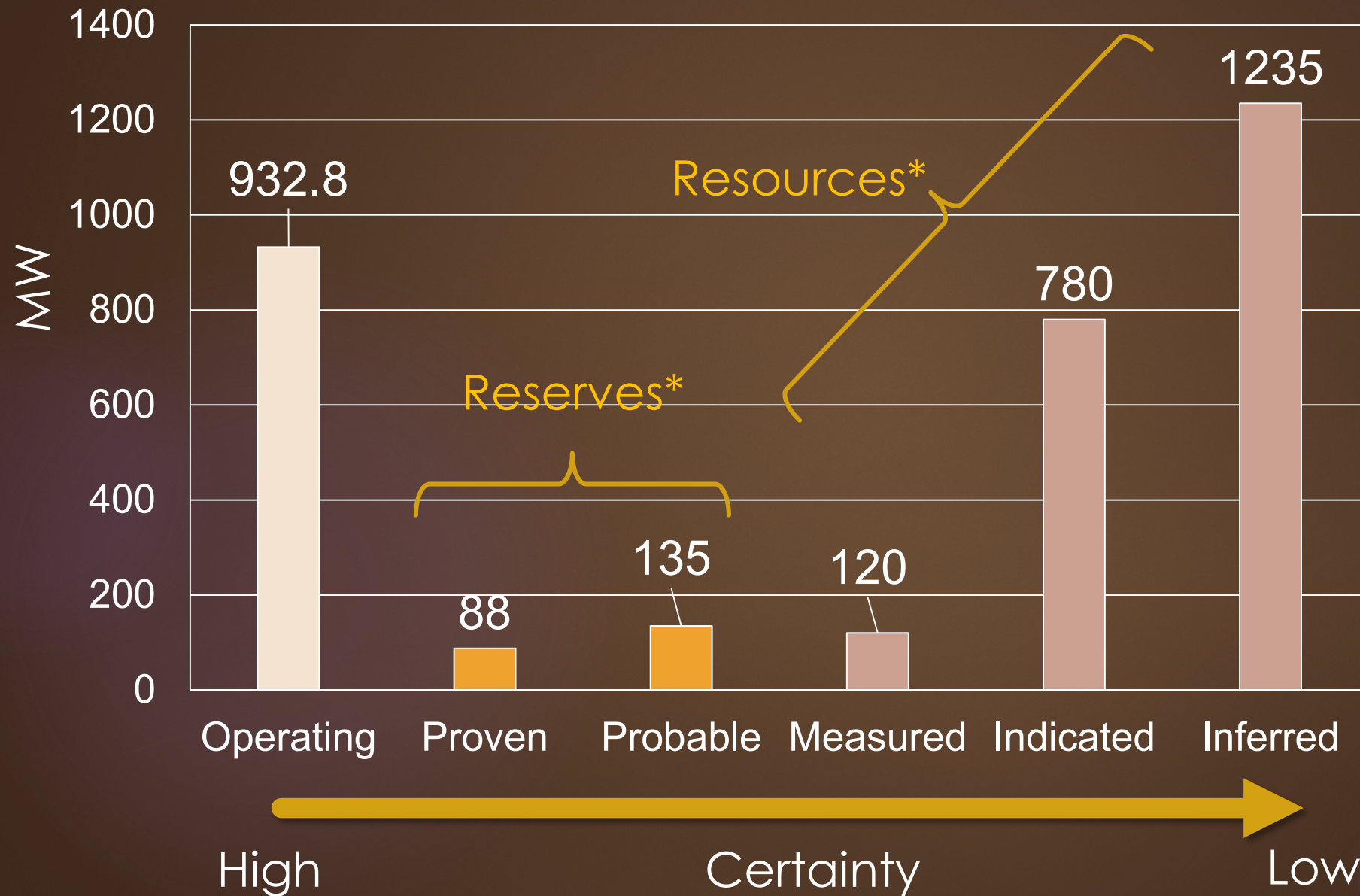
Other

“Free”

*Currently
Domo San
Pedro

GEOHERMAL ZONE	STATE	PRELIMINARY POTENTIAL IN MW		
		Volumetric model		De-compression model
		Probable value	Rank (90%)	
1. La Soledad	Jalisco	52	10 – 94	51
2. Las Planillas	Jalisco	70	26 – 113	83
3. Pathé	Hidalgo	33	6 – 61	49
4. Araró	Michoacán	21	5 – 37	32
5. Acoculco	Puebla	107	38 – 177	48
6. Ixtlán de los Hervores	Michoacán	17	0 – 23	15
7. Los Negritos	Michoacán	24	3 – 44	20
8. Volcán Ceboruco	Nayarit	74	34 – 113	50
9. Graben de Compostela*	Nayarit	105	35 – 175	110
10. San Antonio El Bravo (Ojinaga)	Chihuahua	27	10 – 43	36
11. Maguarichic	Chihuahua	1	0.2 – 1.7	1
12. Puruándiro	Michoacán	10	3 – 17	12
13. Volcán Tacaná	Chiapas	60	21 – 99	52
14. El Orito-Los Borbollones	Jalisco	11	1 – 21	9
15. Santa Cruz de Atistique	Jalisco	12	2 – 22	13
16. Volcán Chichonal	Chiapas	46	9 – 84	45
17. Hervores de la Vega	Jalisco	45	20 – 71	45
18. Los Hervores-El Molote	Nayarit	36	12 – 59	17
19. San Bartolomé de los Baños	Guanajuato	7	3 – 12	9
20. Santiago Papasquiaro	Durango	4	1 – 7	4
Total		762		701

Total estimated geothermal potential



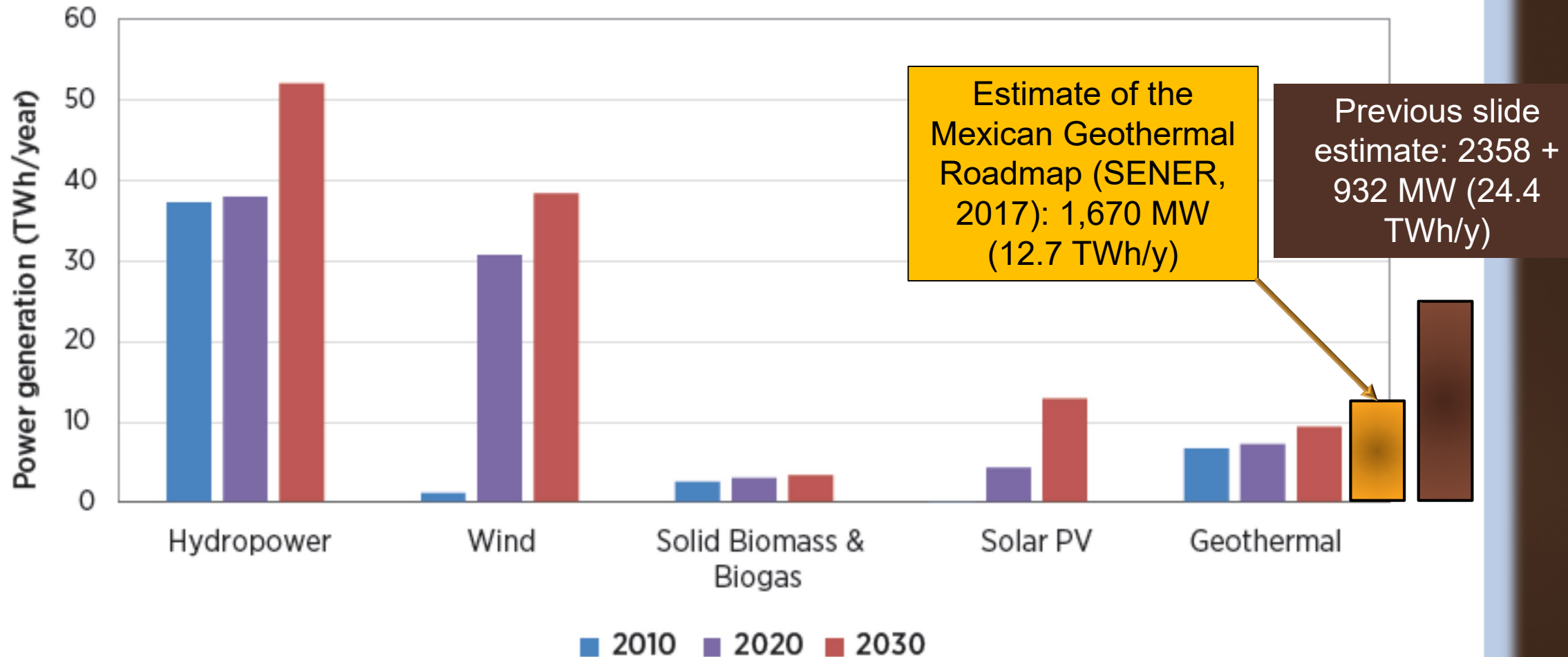
**TOTAL:
2358 MW**

Includes only hydrothermal (or conventional) geothermal resources at $T \geq 150^{\circ}\text{C}$

*Terms according to the Australian code.

Comparison to other estimates

Figure 13: Reference Case renewable power generation growth, 2010-2030 IRENA, 2015



Geothermal direct uses

Vision of the Mexican Geothermal Roadmap for Direct Uses (SENER, 2018): "To have by 2030 a developed national market of geothermal direct uses with an installed capacity of 3,800 MWt."

