



Geothermal Opportunities in Mexico

Francisco Flores-Espino

Energy Reforms

Clean Energy Goals

Growing Demand

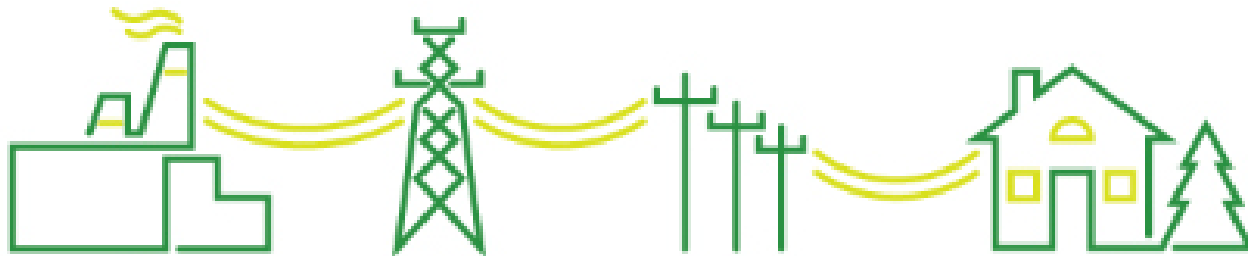
Untapped Geothermal Potential

Mexico's Energy Reforms

- Carbon emission reduction goals
 - 30% below 2000 levels by 2020
 - 50% below 2000 levels by 2050
- Clean Energy Goals
 - 35% by 2024
 - 3.5% annual energy demand growth
 - Between 2016 and 2030, 24.3 gigawatts (GW)
 - ~900 MW from geothermal energy

Mexico's Energy Reforms

- Before the reforms
 - One vertically integrated utility, CFE
 - Private investment: Power purchase agreements (PPAs)



Mexico's Energy Reforms

- Constitutional Reforms and Energy Legislation
 - Ends CFE monopoly
 - CFE generation subsidiaries, IPPs, power marketers
 - Power marketers, large consumers, CFE distribution
 - Independent System Operator, CENACE
 - Open access transmission
 - Wholesale markets
 - Ensure reliability
 - Other mechanisms and incentives

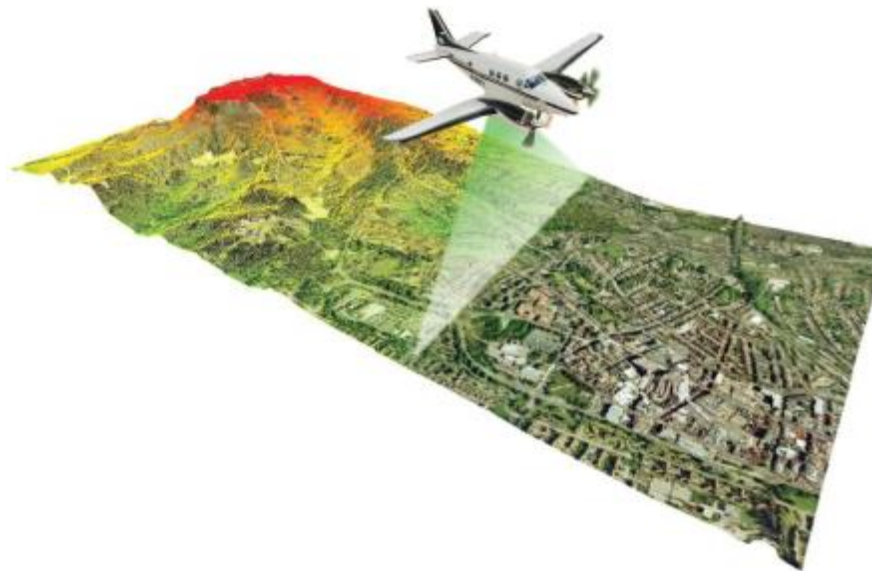
Regulations under the Geothermal Energy Act

- Private companies can participate
- Incorporated in Mexico
- SENER

Stage 1: Survey	Stage 2: Exploration	Stage 3: Geothermal Production
<ul style="list-style-type: none">• Requires registration with SENER• Activities: Surface surveying and geological sampling• No other permit necessary besides registration	<ul style="list-style-type: none">• Requires permit from SENER• Activities: Resource assessment, exploratory wells• Local community consultation may be required• Additional well drilling permit required• Exploration permits last 3 years, can be renewed• Grants exclusive rights• May require environmental impact assessment	<ul style="list-style-type: none">• Requires license from SENER• Activities: Production well drilling, geothermal resource utilization• Local community consultation may be required• Additional water and power production licenses required• Production licenses valid for 30 years, can be renewed• Grants exclusive rights• Requires environmental impact assessment

Regulations under the Geothermal Energy Act

- Stage 1: Survey
 - Requires registration with SENER
 - Activities: Surface surveying and geological sampling
 - No other permit necessary besides registration



Regulations under the Geothermal Energy Act

- Stage 2: Exploration
 - Requires permit
 - Activities: Resource assessment, exploratory wells
 - Local community consultation may be required
 - Exploration permits last 3 years, can be renewed
 - Grants exclusive rights
 - May require environmental impact assessment

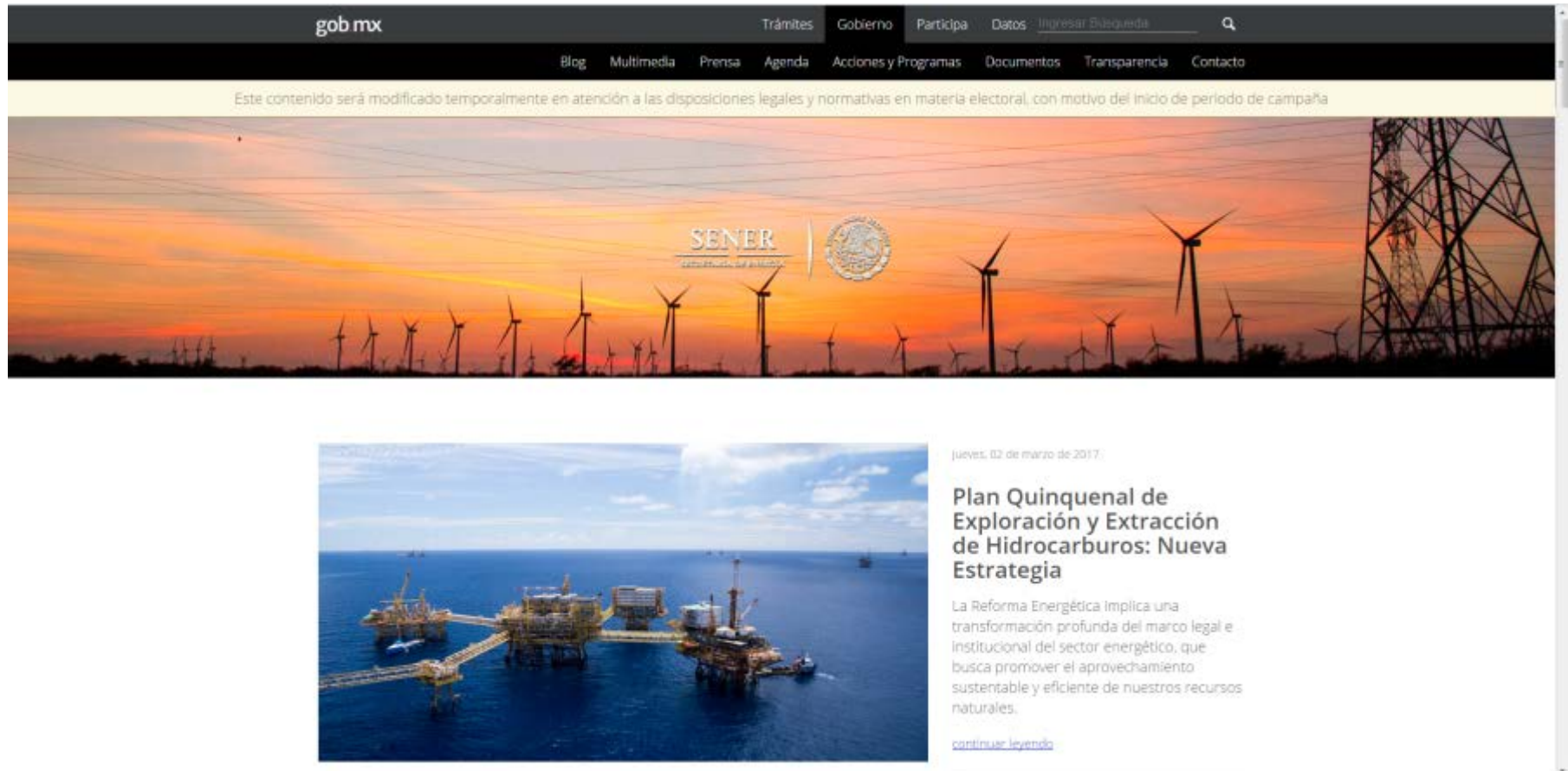


Regulations under the Geothermal Energy Act

- Stage 3: Geothermal Production
 - Requires license
 - Activities: Production well drilling geothermal resource utilization
 - Additional water and power production licenses required
 - Production licenses valid for 30 years, can be renewed
 - Requires environmental impact assessment



Renewable Energy Permitting Portal



The image shows a screenshot of the SENER website. At the top, there is a navigation bar with the 'gob.mx' logo on the left and a search bar on the right. Below the navigation bar, there is a horizontal menu with links for 'Blog', 'Multimedia', 'Prensa', 'Agenda', 'Acciones y Programas', 'Documentos', 'Transparencia', and 'Contacto'. A yellow banner below the menu contains the text: 'Este contenido será modificado temporalmente en atención a las disposiciones legales y normativas en materia electoral, con motivo del inicio de periodo de campaña'. The main banner features a sunset background with wind turbines and the SENER logo. Below the banner, there is a news article snippet with a photo of an offshore oil rig and the following text:

jueves, 02 de marzo de 2017.

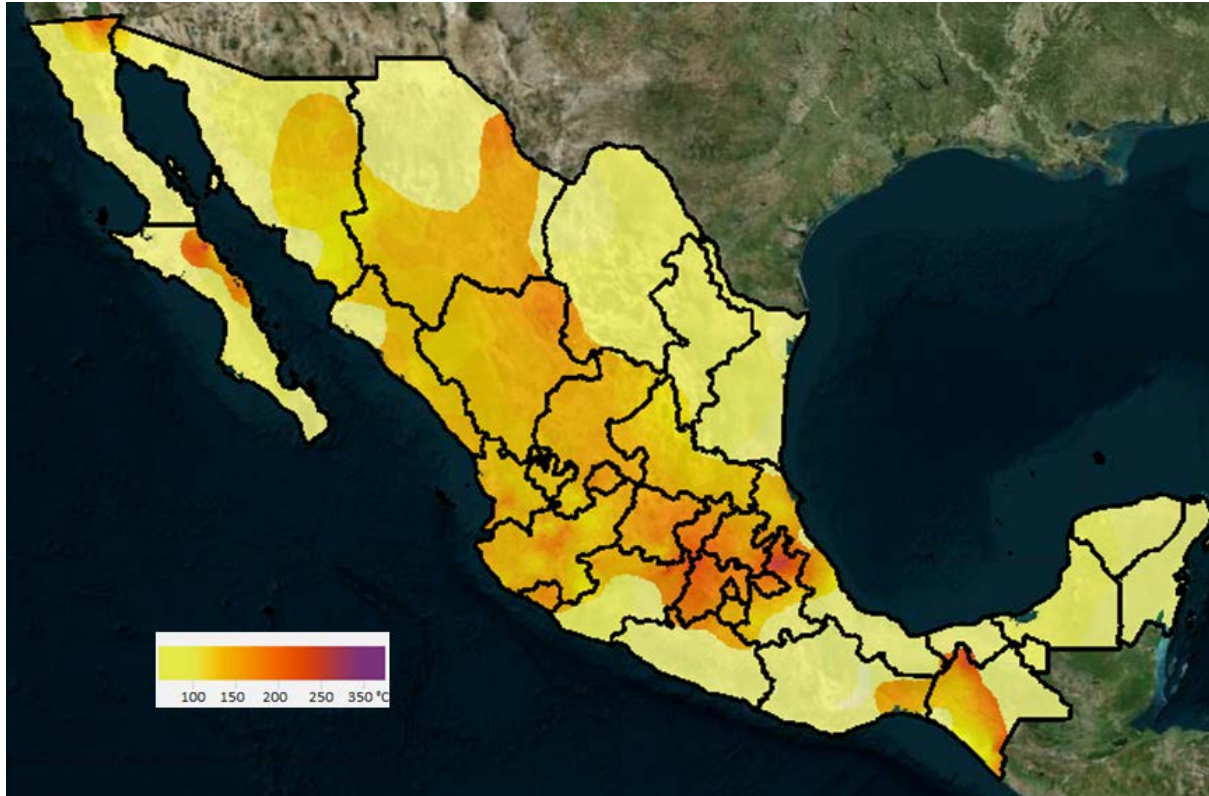
Plan Quinquenal de Exploración y Extracción de Hidrocarburos: Nueva Estrategia

La Reforma Energética implica una transformación profunda del marco legal e institucional del sector energético, que busca promover el aprovechamiento sustentable y eficiente de nuestros recursos naturales.

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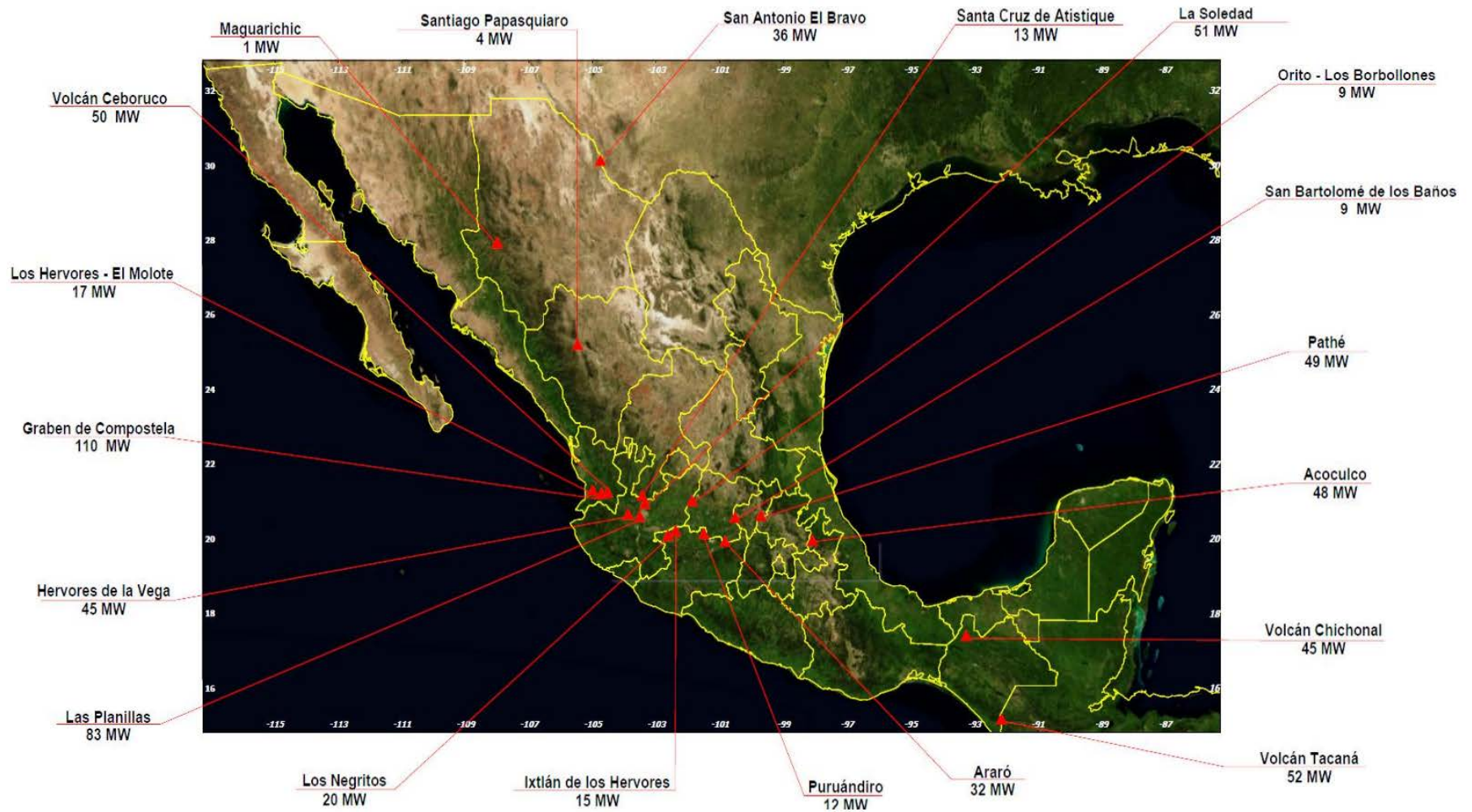
Geothermal Energy Use in Mexico

- Available Resource



<https://dgel.energia.gob.mx/inere/>

Greenfield Sites



Installed Capacity 2004 - 2015



Current Installed Capacity

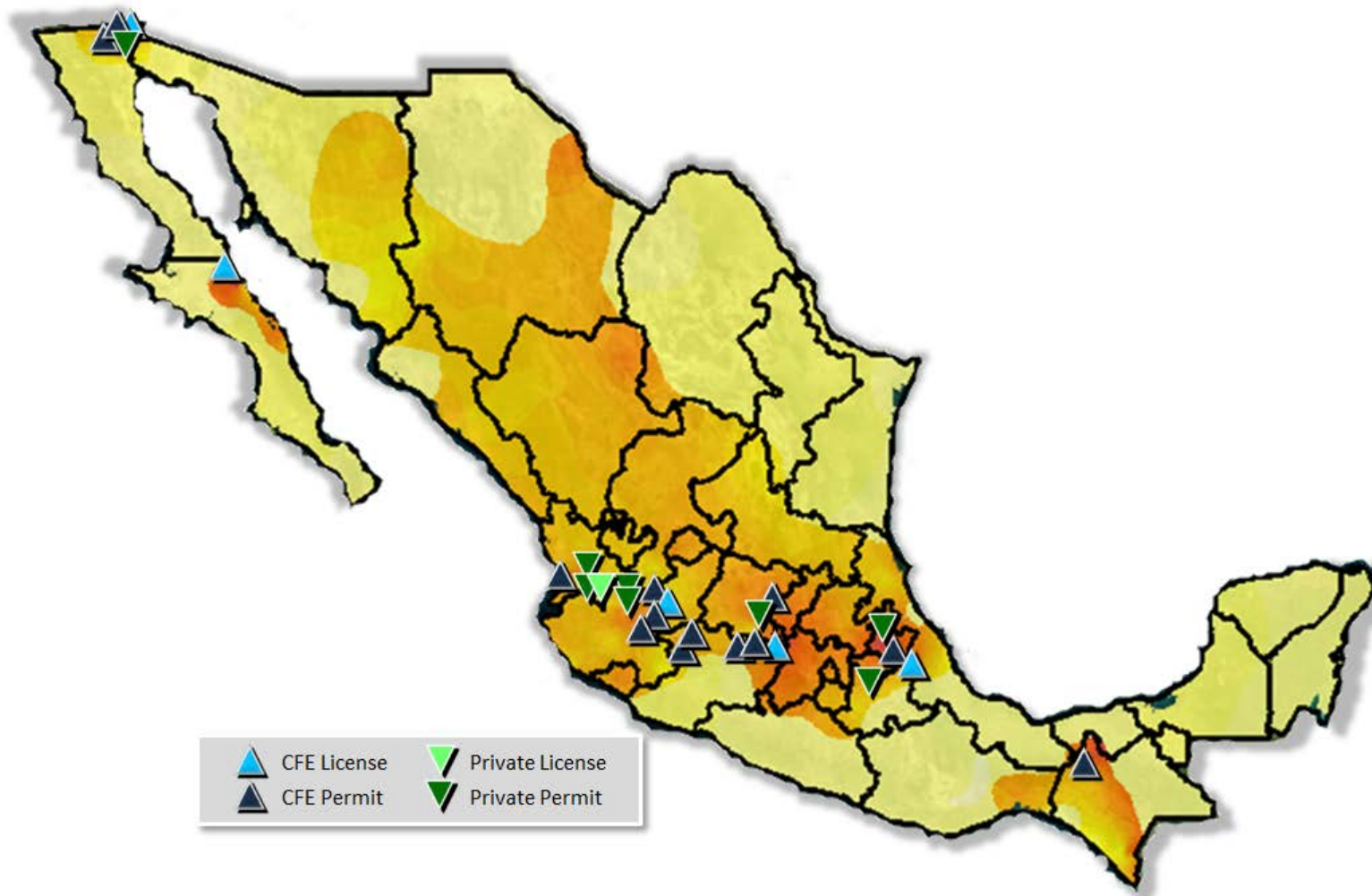


Geothermal Field	Owner	Start of operations	Operating capacity (MW)
Cerro Prieto, BC	CFE	1973	570
Los Azufres, Michoacán	CFE	1982	225
Los Humeros, Puebla	CFE	1990	68.6
Las Tres Vírgenes, Baja California Sur	CFE	2001	10
Domo de San Pedro, Nayarit	Grupo Dragón	2015	25.5
Total			899.1

Existing Geothermal Permits and Licenses

CFE: 13 Permits, 5 Licenses

Private Companies: 8 Permits, 1 License



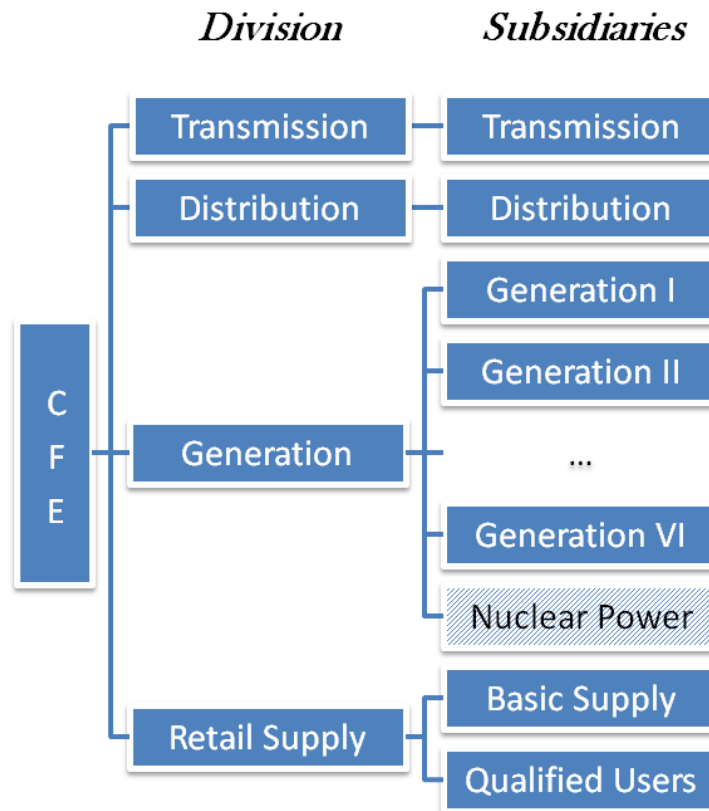
- Free-Trade Agreement and Investment Climate
 - North American Free Trade Agreement
 - Mexico 3rd largest U.S. commercial partner
 - World Bank: Mexico 1st for “ease of doing business” in LAC
- A Growing Market
 - 3.5% demand growth
 - Second largest clean energy investment destination in Latin America

Entrance Opportunities

- Partnerships
- Turnkey Contracts
- Long-term Government IPP Contracts
- Power Purchase Agreements
- Participation in the Wholesale Market

Entrance Opportunities

- Partnerships and turnkey contracts
 - CFE, 13 permits (~450 MW), 5 licenses



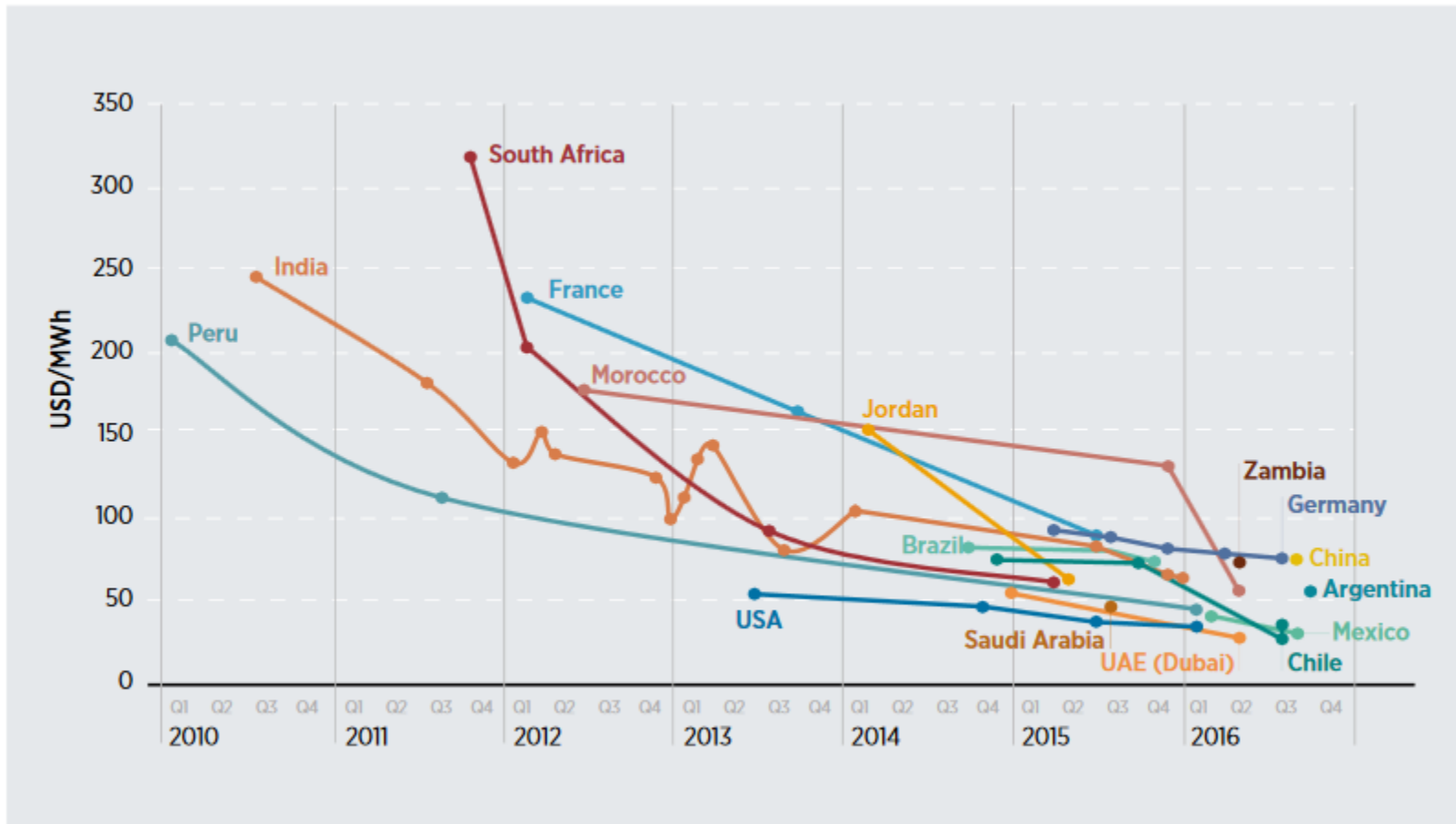
Entrance Opportunities

- Partnerships and turnkey contracts
 - Grupo ENAL, 2 permits
 - Grupo Dragón, 1 license, 2 permits
 - Mexxus RG, 1 permit
 - Storengie, 3 permits

Entrance Opportunities

- Long-term Government IPP Contracts
 - 1st auction
 - Average price \$47.78 per MWh and CEL
 - 2nd auction
 - Average price \$33.47 per MWh and CEL

Evolution of Average Solar Prices in Auctions



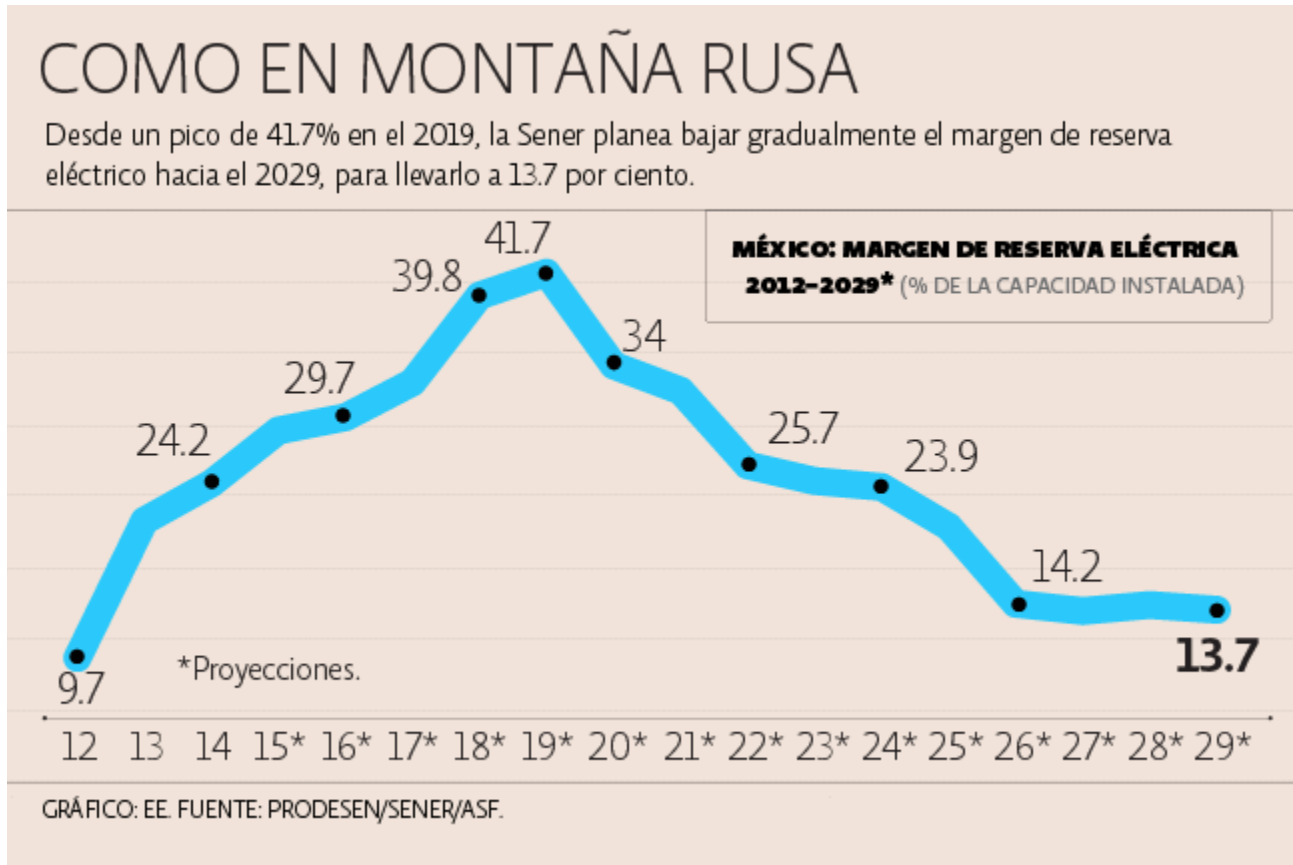
IRENA, 2017 (forthcoming).

Entrance Opportunities

- Long-term Government IPP Contracts
 - Los Azufres III Phase 2

Capacity	25 MW	
Capacity factor	90.5%	
Annual energy production	198,764 MWh	
	Annual total	Per unit
Energy revenues	\$4,969,100	\$25/MWh
CEL revenues	\$2,484,550	\$12.5/MWh
Capacity revenues	\$1,092,500	\$43.7/kW
Total revenue	\$8,546,150	
Approximate revenue per MWh	\$43.00	

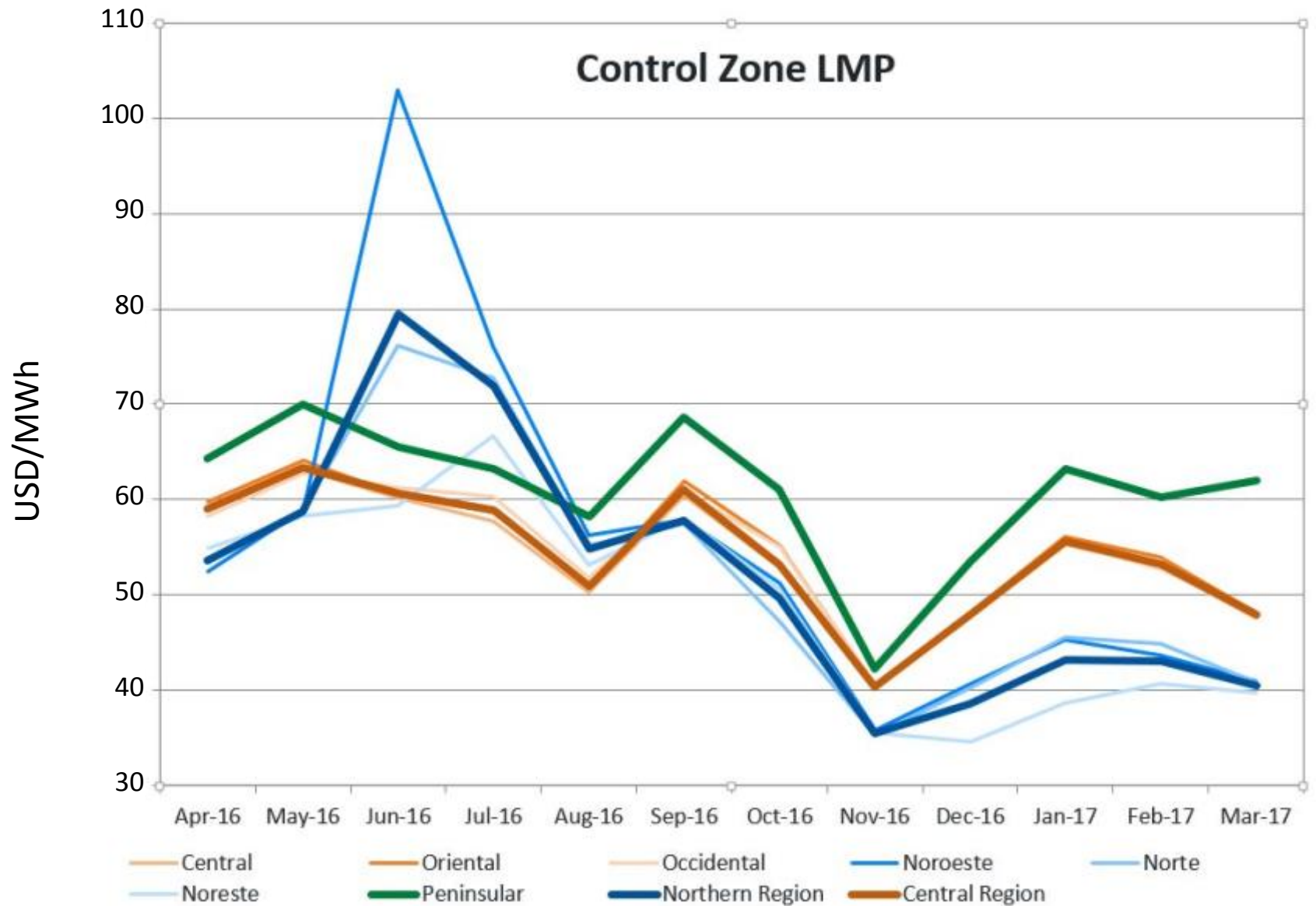
Capacity Reserve Margin in Mexico



Entrance Opportunities

- Power Purchase Agreements
 - Qualified users, power marketers, CFE
 - GTM Media: \$35 to \$60/MWh in the U.S. in 2016
- Wholesale Market
 - Energy
 - Capacity
 - Ancillary services

LMPs in Mexico



Clean Energy Certificates

- 5% CY2018



Opportunities in the Value Chain

Relative Barriers for Exports	
	Exports in general represent a good opportunity for U.S. companies because of the proximity of Mexico and the free trade agreement between the two countries.
Turbines and Generators (Gensets)	Market saturation – Medium to high
	Other barriers – Low
Balance of Plant (BOP)	Market saturation – Medium
	Other barriers – Low

Low
 Medium
 High

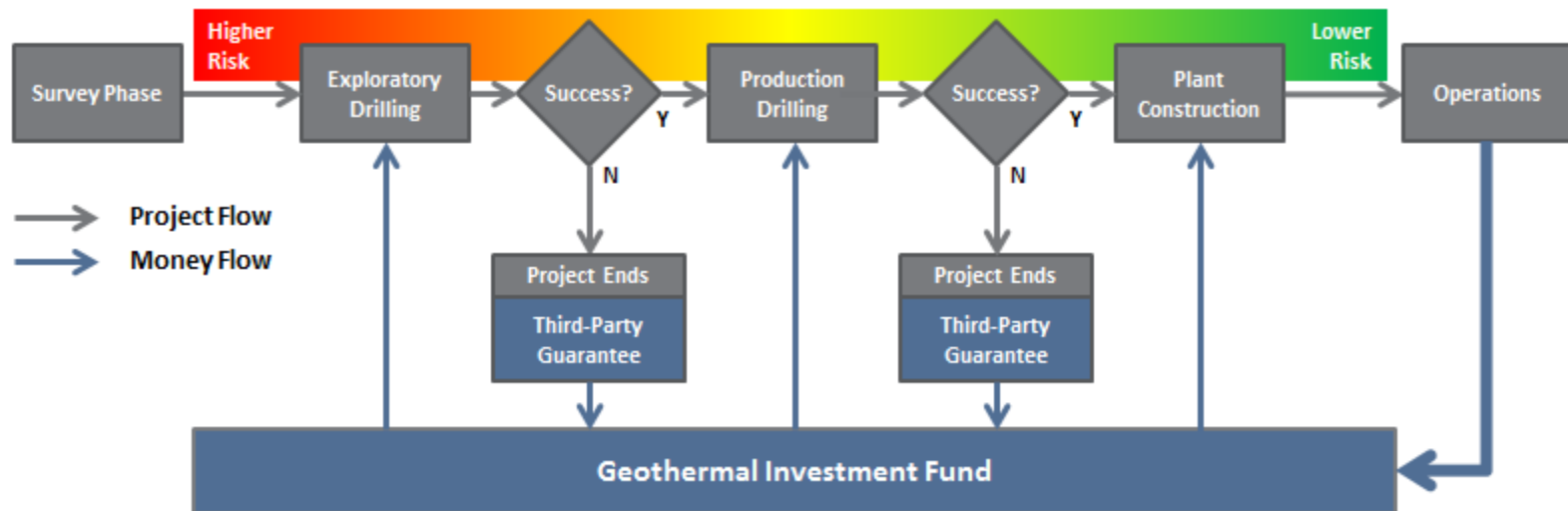
Opportunities in the Value Chain

Relative Barriers for Services	
	The services value chain is not overly saturated in Mexico. However, it is rated as a “medium” barrier because several companies have been participating in the Mexican renewable energy market for years or decades.
Exploration	Market saturation – Medium
	Other barriers – Low
Engineering and Project Management	Market saturation – Medium
	Other barriers – Medium
Drilling	Market saturation – Low
	Other barriers – High
Construction	Market saturation – High
	Other barriers – Medium
O&M	Market saturation – Medium
	Other barriers – Medium to high

Low
 Medium
 High

- Investment Guidance for Foreign Companies
- Tax Incentives and Financing Mechanisms
 - 1-yr depreciation
 - FIBRA E – REITs, MLPs
 - CERPI – pension funds, insurance companies
 - FICAP – investment trust for private equity

- Exploration Drilling Risk Mitigation Mechanism



- National Renewable Energy Inventory and Atlas
 - <https://dgel.energia.gob.mx/inere/>
 - <https://dgel.energia.gob.mx/azel/>

U.S. Government Resources

- International Trade Administration
- Department of State
- Overseas Private Investment Corporation
- Export-Import Bank
- U.S. Trade and Development Agency
- Border Environment Cooperation Commission and North American Development Bank

Appendices

- A – Contacts in Key Organizations
- B – Registration, Permit, and License Minimum Requirements
- C – The Electricity System in Mexico

francisco.flores@nrel.gov
<http://www.nrel.gov/docs/fy17osti/63722.pdf>

www.nrel.gov

