



Reactivating Guatemala's Geothermal Industry: A Preliminary Approach

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Goals

Primary Goal

Promotion of Guatemala's Geothermal resources potential.

Specific Goals

- To update the current Indicative Generation Expansion Plan, including geothermal resources in the “low uncertainty” scenario.
- To promote a new Geothermal law framework.





Geothermal Energy Legal Framework

- Constitution: indicates that all natural resources are State-owned property, hence requiring proper authorization for their exploration and production.
- Current Electricity Law framework (1996) eliminated the Geothermal Law framework existing at that time (Decree No. 126-85).
- RGLE (art 16) develops the proper procedures for obtaining authorization when using geothermal plants for electricity generation.
- RGLE has a “mixed treatment” regarding geothermal resources "upstream" (exploration and production) and "downstream" (electricity generation) activities.





History

- In the 70's several international agencies (JICA, IDB, OPEC, ROCAP / USAID, IAEA, OLADE) cooperated with INDE in identifying geothermal resources.



Guatemala is part of a volcanic region. Sierra Madre (mountainous chain) has 36 volcanoes in an area of 300 km².

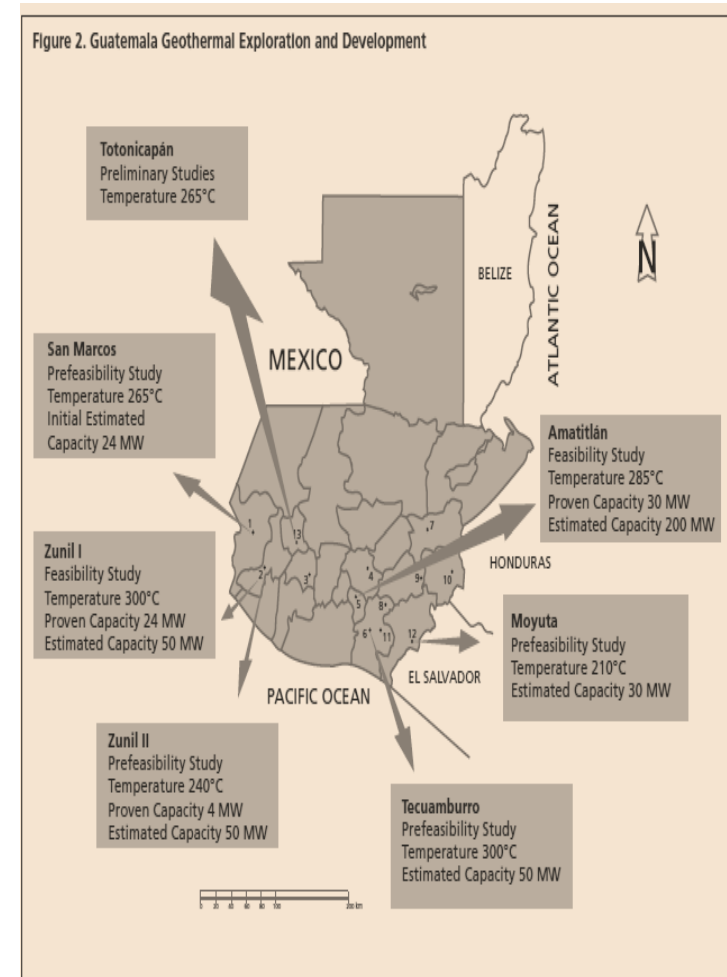
Guatemala has identified more than 12 geothermal important reservoirs.





History

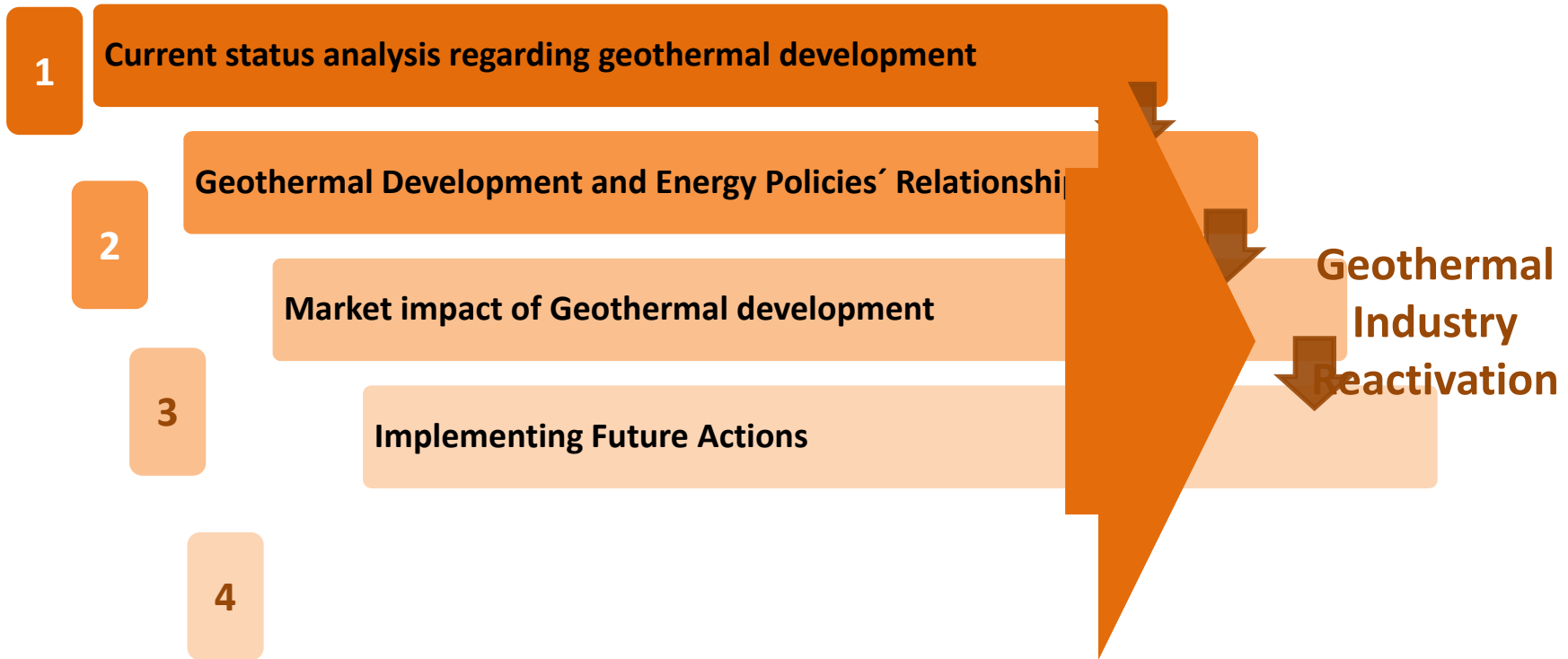
- 1970: INDE started studies with OCTA (now JICA) cooperation.
- 1972: Moyuta field (12): first field in study.
- 1975: Two (2) wells were drilled: Zunil and Amatitlán (2 and 5).
- 1981: INDE and “Bureau de Recherches Geologiques et Minieres (BRGM)” began studies in Totonicapán (13) with funding provided by INDE and OLADE.
- Zunil y Amatitlán: Priority 1.
- San Marcos y Tecuamburro: Priority 2.
- Los Achiotes, Moyuta, Ixtepeque e Ipala: Priority 3.
- Palencia, Retana, Ayarza, Atitlán y Motagua: Priority 4.
- 1993: With cooperation of IAEI Totonicapán: Priority 1.





First Approach Scheme

Geothermal Energy Resources: Current and Future Situation





Current Situation Analysis

Governmental Decree (842-92): defined the geothermal reserve areas in Guatemala.

Geothermal potential estimated in the range of 800 to 4,000 MW. (1000 MW with highest probability).

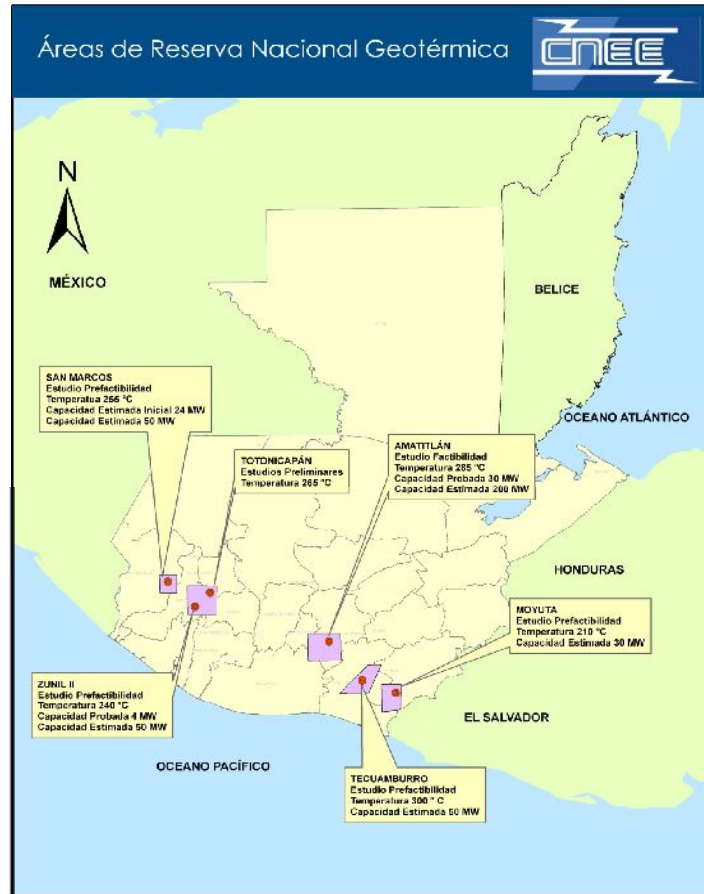


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Current Situation Analysis



INDE has developed studies regarding geothermal resources in Guatemala, owning the main concession areas.



Current Situation Analysis

- Two Geothermal plants are currently operating in Guatemala: **Zunil** (24MW capacity) y **Ortitlán** (25MW capacity).
- Such plants represent the country's main geothermal operating resources (through INDE).

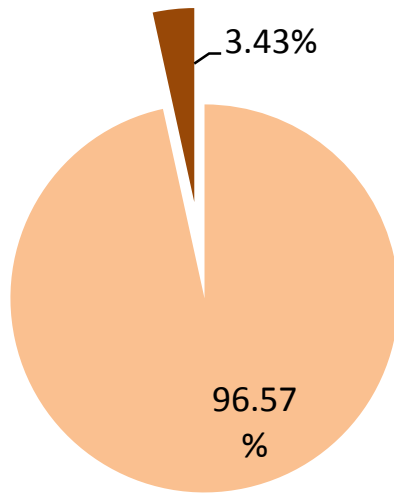




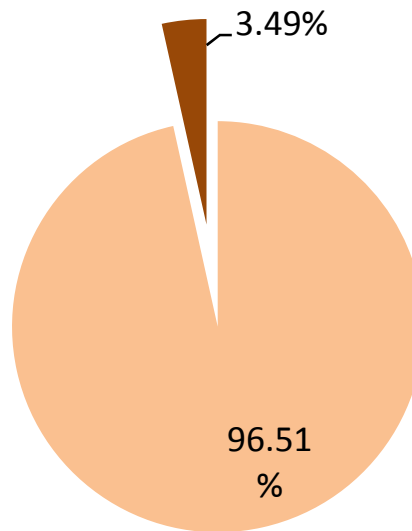
Current Situation Analysis

Geothermal Generation History

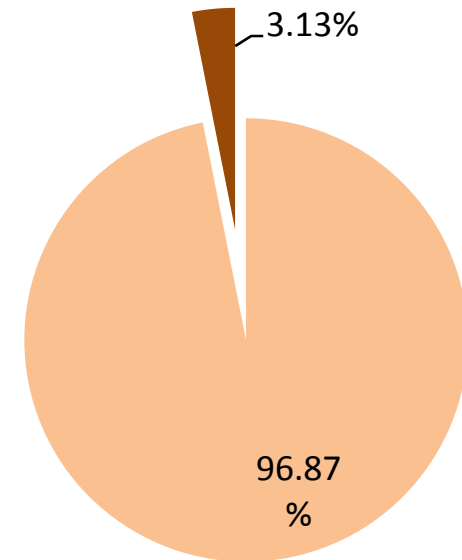
2008



2009



2010



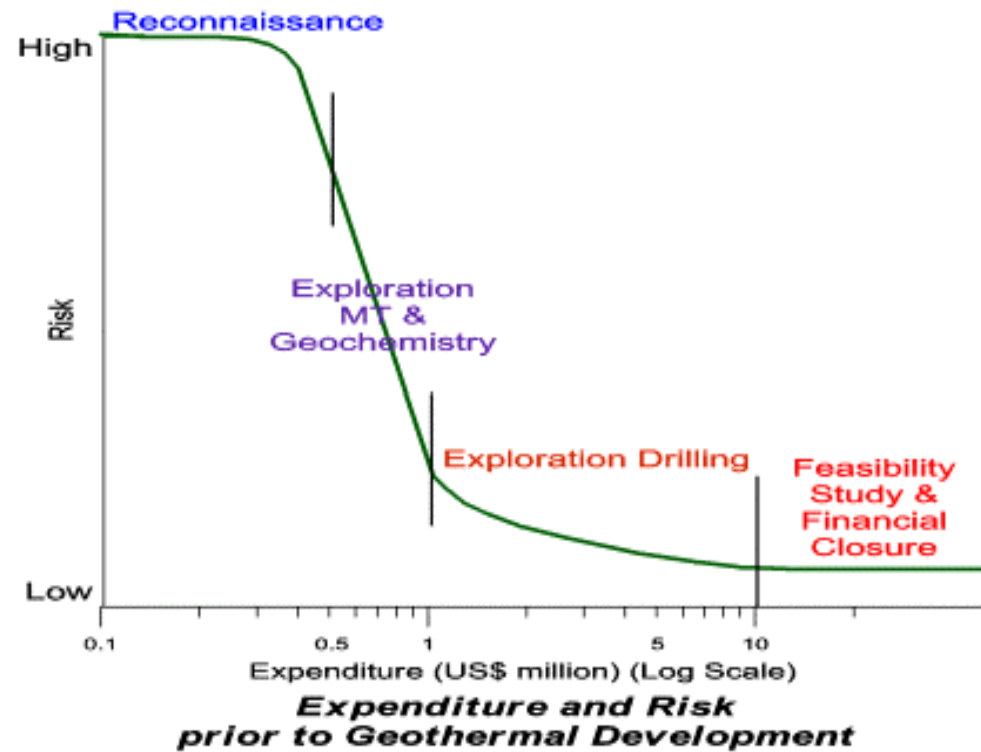


Current Situation Analysis

The main barrier for developing geothermal resources are **Economic Constraints** for the projects.

High risk in early stages (exploratory stage), has taken competition to develop cheaper energy sources such as Hydropower and Natural Gas.

Geothermal Development Barriers





Geothermal Development and Energy Policies' Relationship

Background:

- The Ministry of Energy and Mines (MEM) is the state agency responsible for the formulation and implementation of energy policies in Guatemala, promoting sustainable development for the electricity subsector with binding policies to protect the environment and all natural resources.
- CNEE is the technical arm of MEM (with comprehensive planning functions), contributing to the creation and implementation of such energy policies.





Geothermal Development and Energy Policies' Relationship

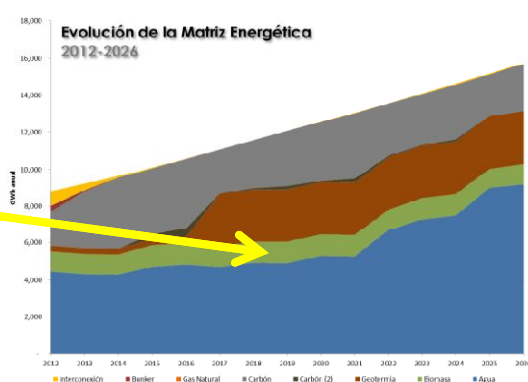
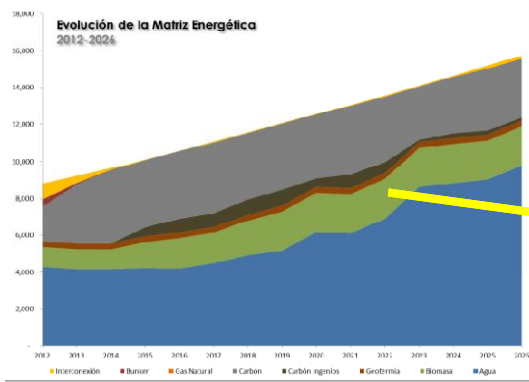
Geothermal Impact Generation Expansion Plan PEG 2012-2026





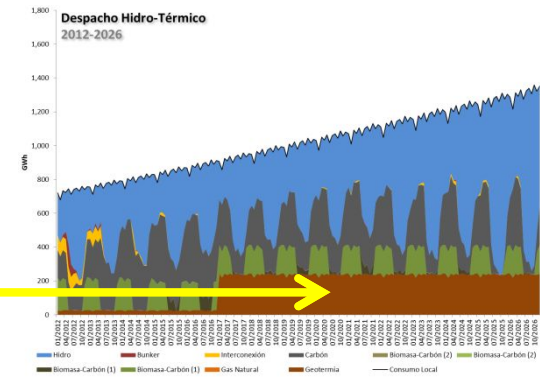
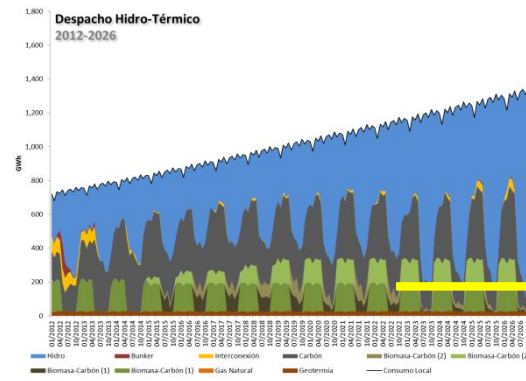
Geothermal Impact

Energy Matrix Impact



The geothermal generation operative characteristics tend to modify the energy matrix.

Geothermal resource is used as base energy (load curve), since it does not depend on seasonality factors as other sources.



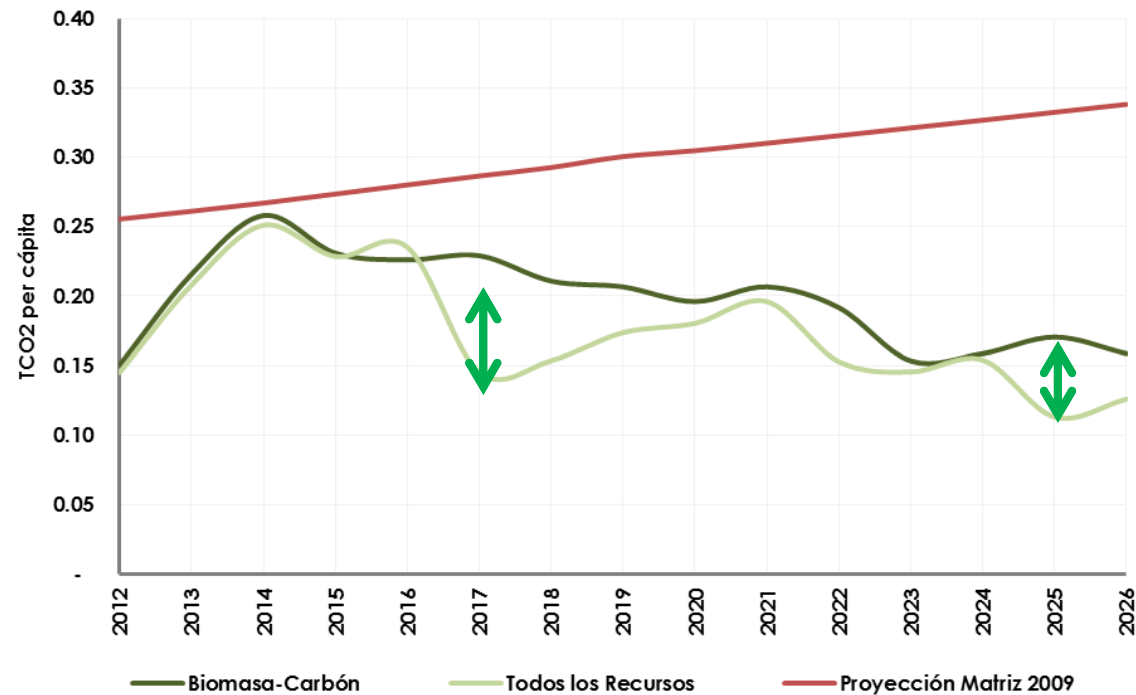
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Geothermal Impact

Environmental Impact



Incorporation of geothermal resources into Guatemala's energy matrix helps reducing **CO2 emissions**, for electric energy generation purposes.





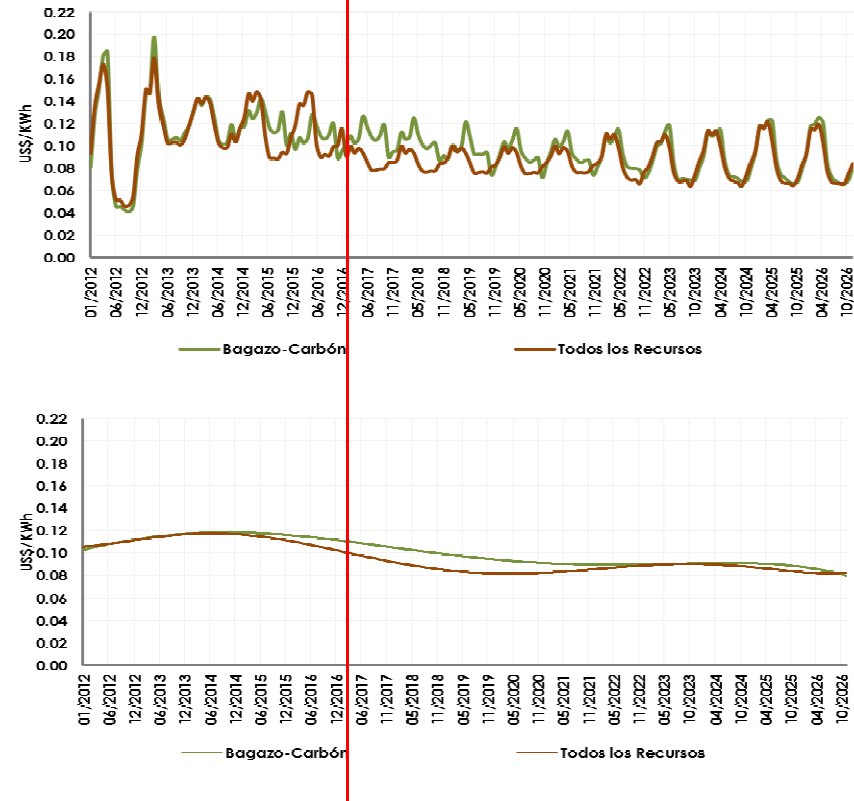
Geothermal Impact

Energy Prices Impact

If projected incorporation date for geothermal resources exceed 2017, energy prices will not be reduced in the short term.

Incorporation of geothermal resources (in the matrix) causes a reduction in both, marginal costs and levelized costs.

Estimated date for geothermal resources implementation (2017)

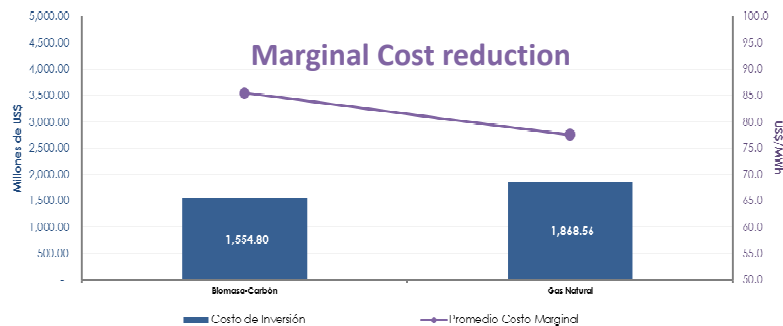
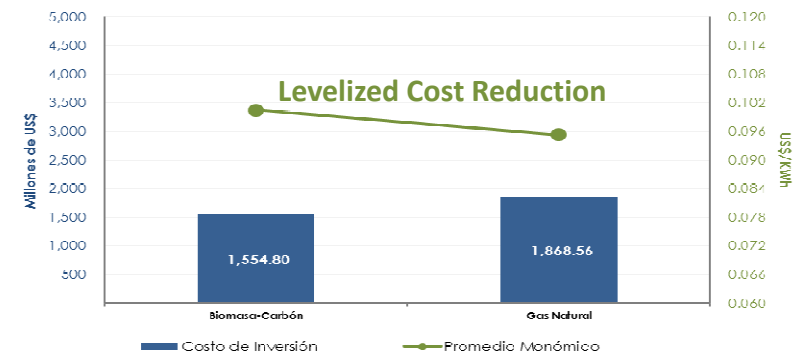
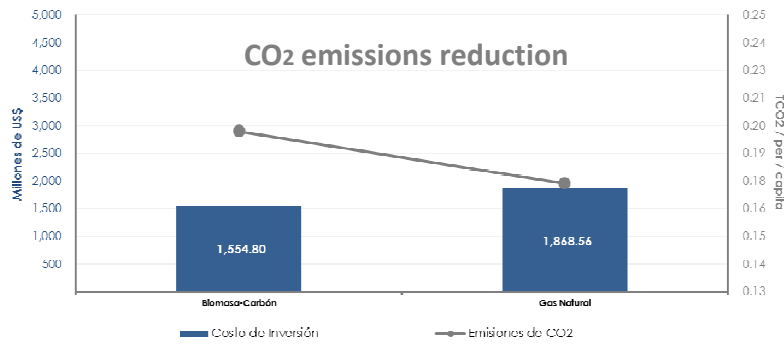




Geothermal Impact

Energy Prices Impact

Plan	Geothermal power included	Total Investment (Millions US\$)	Marginal Cost Average US\$/MWh	Levelized Cost Average US\$/KWh	TCO2 per capita Average
Biomass-Coal	NO	1,554.80	85.48	0.1005	0.20
All Resources	YES	1,868.56	77.59	0.0953	0.17



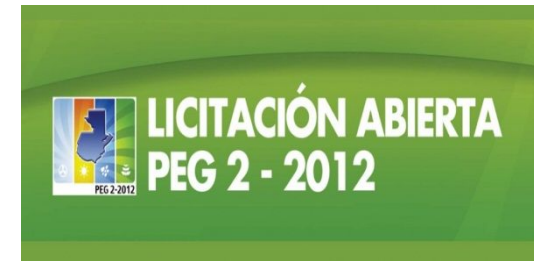
Although investment costs for geothermal resources is high, levelized cost, marginal cost estimations and CO2 emissions are reduced.





Regulatory and Market mechanisms to make Geothermal development possible

Establishing system quotas to implement geothermal energy (obtained from the Generation Expansion Plan results), consistent with the National Energy Policy.



Tender offers' implementation for geothermal exploration concession contracts, including energy purchases (based on explored sites).





National Geothermal Industry Reactivation Program Main Stakeholders

MEM: Develop and implement national energy policies.

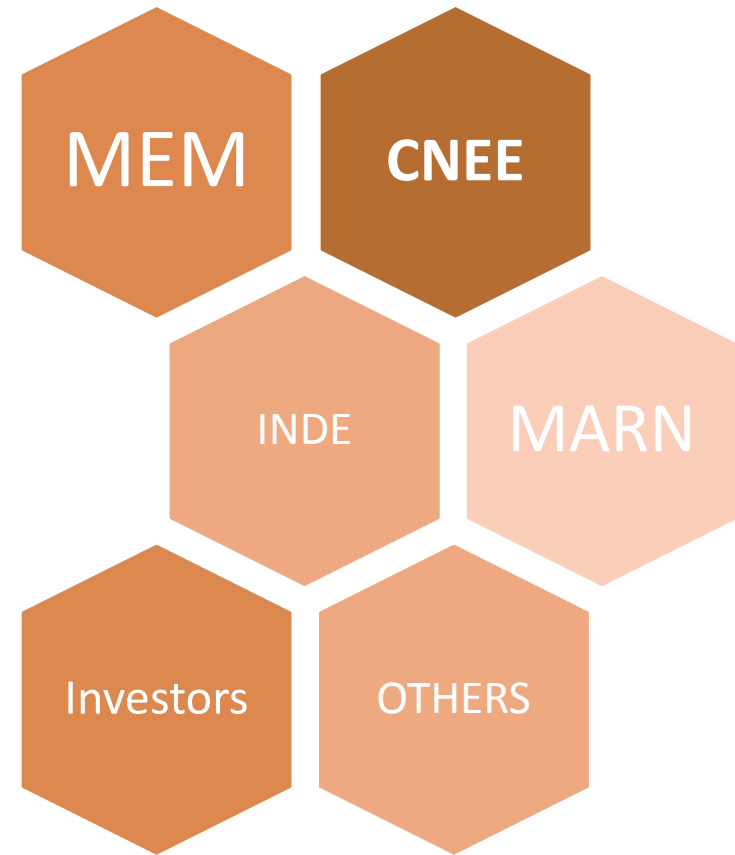
MARN: Formulating and implementing policies for conservation and improvement of the environment and natural resources.

CNEE: Electricity subsector Regulator, acting as MEM's technical body with comprehensive planning functions.

INDE: Planner and executor LGE geothermal resources (also providing technical and human resources).

Cooperating Instances: Cooperating in implementing State policies.

Investors: project's execution following the regulatory institutional framework.





Conclusions

Future Action Plan includes

- Analyzing geothermal resources' current situation regarding exploration and production in Guatemala.
- Developing an action plan for geothermal energy production in Guatemala including main stakeholders, actions, milestones and due dates to be met at each stage.
- Reconciling the exploration and exploitation of geothermal resources with national energy policies.
- Identifying stakeholders in all stages to develop a comprehensive plan for all their activities.





Conclusions

Future Action Plan includes

- Proposal and Implementation of a New Geothermal Law Framework, that would consider the following main aspects:
 - Grants and loans from bilateral sources to be used at the early stages of project development in order to diminish/ eliminate risks burdens.
 - Amending Article 16 of RGLE, since this regulates downstream functions of geothermal resources.
 - Such changes would require a deep analysis of INDE's role (implying a revision of Governmental Decree 842-92 which considers the "Geothermal Reserve Areas" shown in Fig 2) since, under this scheme in 1996, INDE is considered another electricity market stakeholder that would have to compete on equal terms with other stakeholders for geothermal development.





Conclusions

Future Action Plan includes

- Articulation of several measures to facilitate the sector's promotion.
- Promotion of basic research resources development.
- Development of research and development (R&D) programs to solve pending technological challenges.
- Defining mechanisms for reducing initial investments' phase risks (indirect and direct exploration-drilling).





Conclusions

It is expected in the near future, as part of the natural development of the geothermal industry, to

- Encourage the use of multipurpose geothermal energy in the country, aiming to develop good dialogue mechanisms that would include the Government, stakeholder's representatives, productive sectors and society in general remembering that geothermal energy is not only useful for generating "Megawatt hours".
- Promote information exchange on geothermal technology in the region.



Thank you!

