Global Geothermal Development Plan **(GGDP)**
Energy Sector Management Assistance Program **(ESMAP)**

Geothermal Development in El Salvador | Update

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Outline

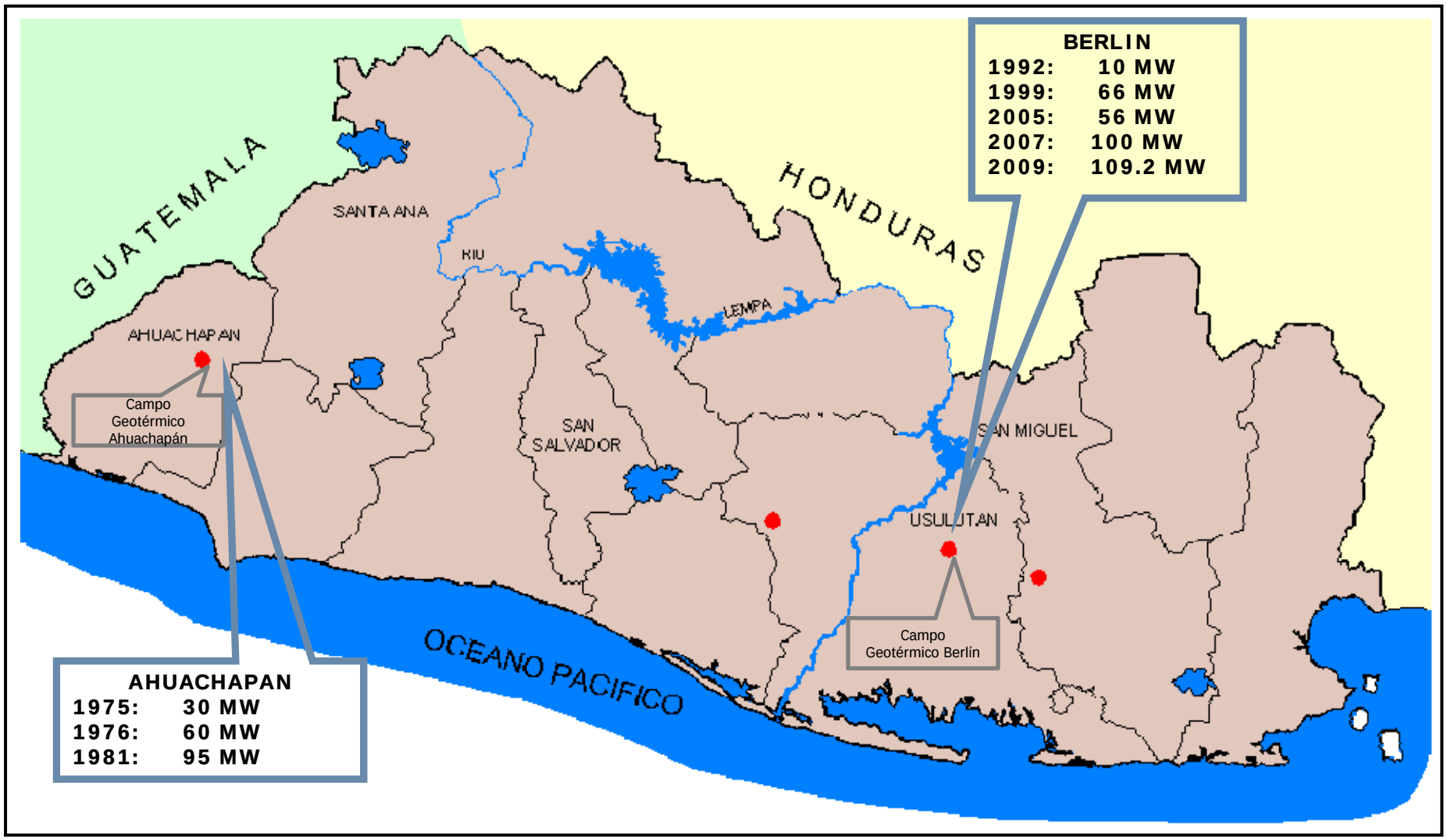
1. Introduction
2. Geothermal Fields in Operation
   a) Ahuachapan Field
   b) Berlin Field
3. Participation of Geothermal Energy Production in electricity market
4. Exploration Activities in other Areas
5. Future Plans
6. Important Aspects in Exploratory Drilling Wells

1. Introduction

Information about **El Salvador**

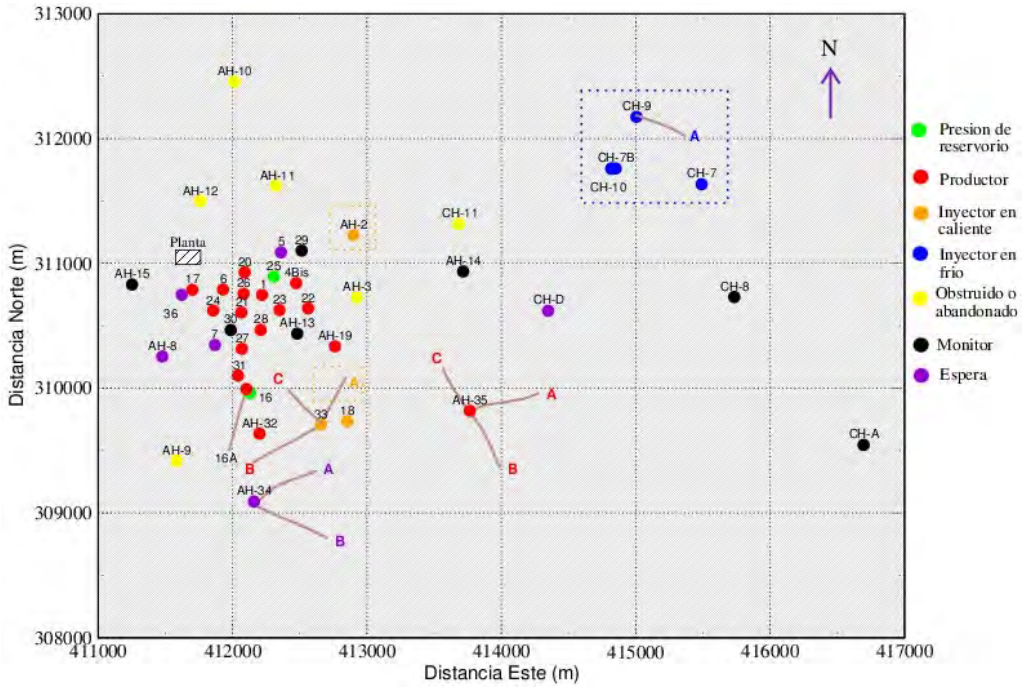
- Area: **21,040 km²**
- Population: **~7.2M**
- PIB: **~$ 22 Bn**
- Electricity demand: 5997 GWh in 2012
- Use of Geothermal Energy = Electricity generation
- LaGeo is actually the only geothermal electricity company in El Salvador

2. Geothermal Fields in Operation



A. Ahuachapán Field Info

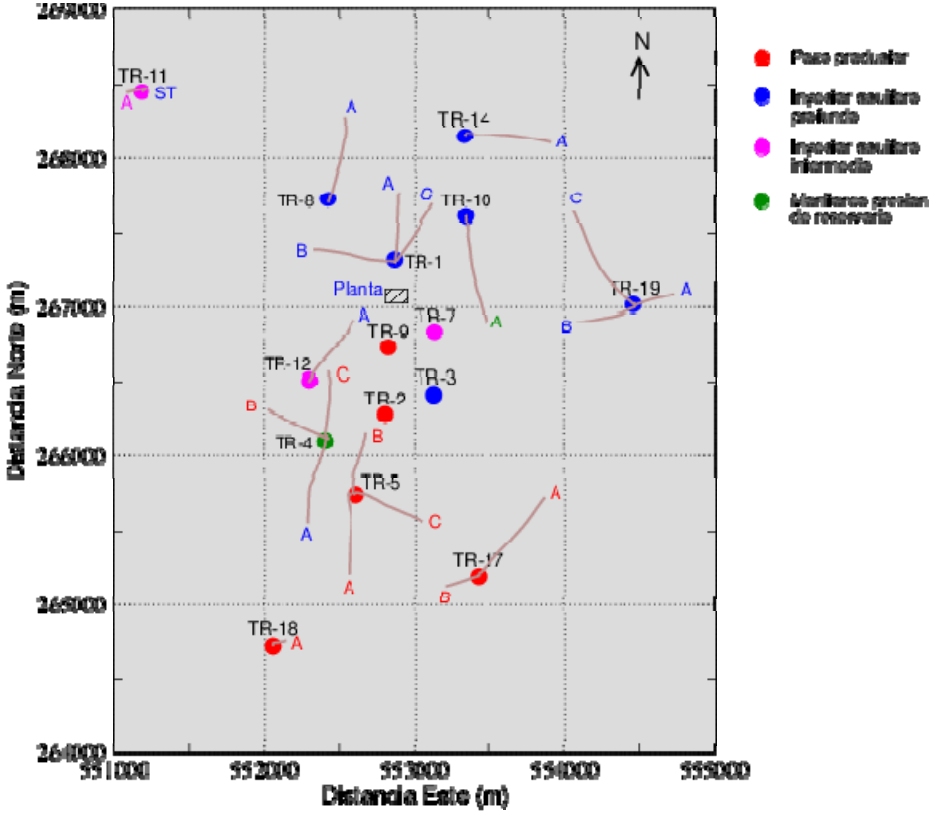
- Installed capacity: 95 MW; Two 30 MW single flash units (Mitsubishi) and one 35 MW double flash unit.
- In use 18 production wells and 7 injection wells
- Reservoir Temp. 210-240°C, Turbine pres. 5 bar,
- Steam flowrate 160 kg/s, Flowrate waste water for reinjection 600 kg/s.
- Actual Electricity generation 84 MW



Location of wells

B. Beriín Field Info

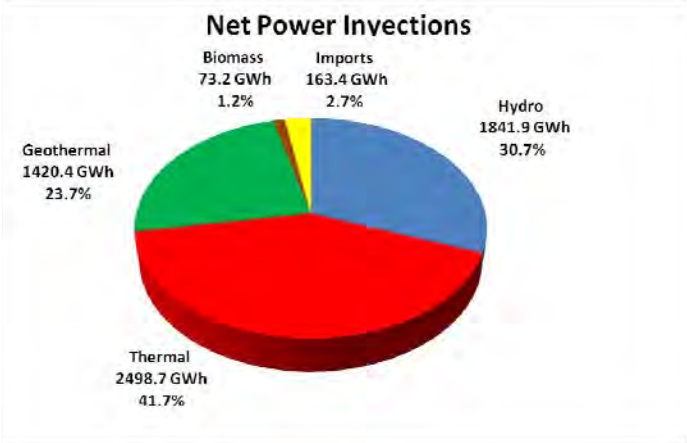
- Installed capacity: 109 MW; for Two 28 MW Condensing units (Fuji), one 44 MW cond. units (General Electric) and one Binary (bottoming) 9 MW unit
- In use 15 production wells and 19 injection wells
- Reservoir Temp. 280-300°C, Turbine pres. 6-9 bar
- Steam flowrate 212 kg/s, Flowrate waste water for reinjection 620 kg/s.
- Actual Electricity generation 104 MW



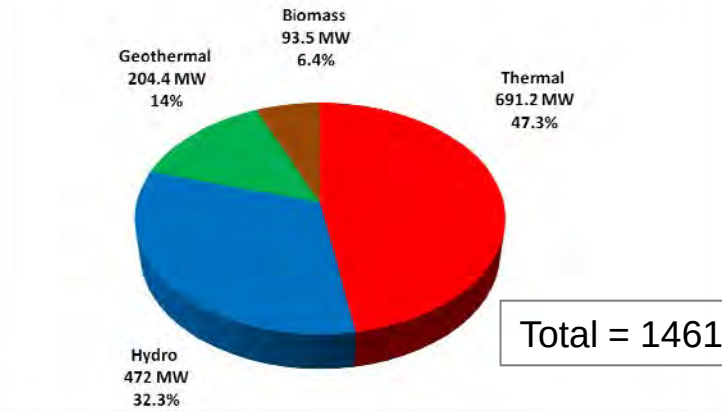
Location of wells

3. Participation of geothermal in the Power market in El Salvador

- LaGeo's participation in the power market has evolved to Geothermal with 23.7% on 2012
- The total generation on 2012 was 1421 GWh.
- LaGeo actually has registered 2 projects in the United Nations framework Convention in climate change (UNFCCC):
  - Berlin Project phase 2 (U3) with actual reduction of 140,000 Ton CO2 / year
  - Binary Cycle Berlin Project (U4), with actual reduction of 40,000 Ton CO2 / year.



- Total Power demand El Salvador at 2012: 5,997.7 GWh
- Peak Power demand El Salvador : 957 MW
- Annual growing demand rate : 2.2%



Installed Capacity by source up 2010

4. Exploration drilling activities in other areas

a) Chinameca Geoth. Field

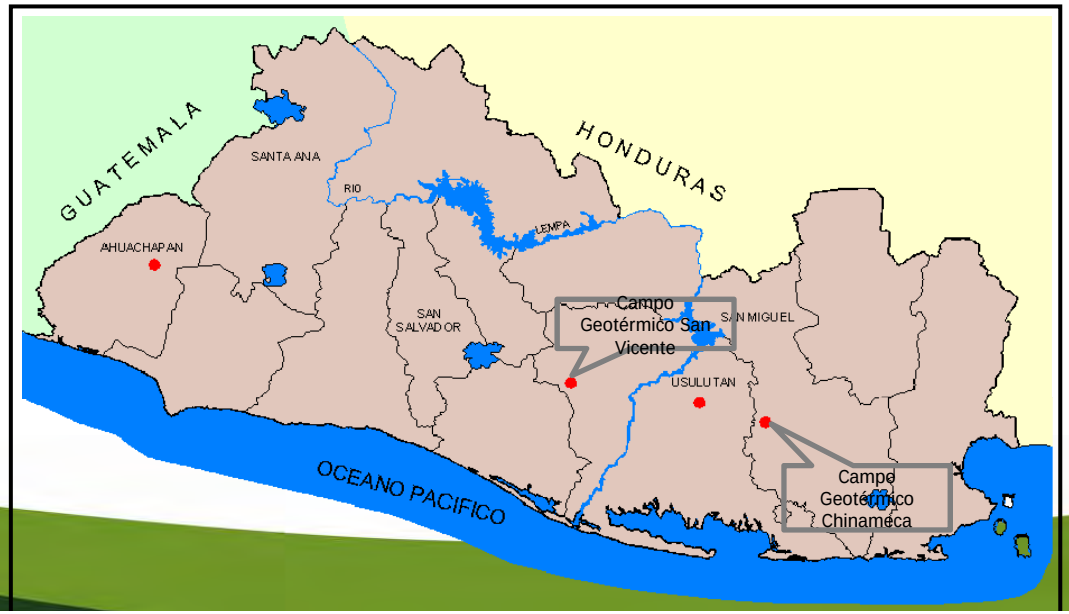
CHI-3 site and El Limbo volcano in Chinameca field

- The Chinameca field is actually in the deep exploratory drilling phase.
- Since 2008, has been drilled 4 wells with depths up to 1840 m,
- Has encountered a reservoir temperature of 230°C.

b) San Vicente Geoth. Field

SV-1 site and San Vicente volcano

- In San Vicente field has been drilled 6 wells, since 2006, up to 2500 m with temperatures about 240°C.
- The last well has encountered good permeability conditions.



5. Future Plans

In the period 2014 – 2017 LaGeo's plans:

- Increase the Berlin capacity in 25 - 30 MW with a new condensing unit (U5) and other binary power plant unit.
- Increase the generation in Ahuachapan on 5-9 MW with the repowering of Unit 2.
- Continue the feasibility phase / development of the Chinameca Field, projecting to install a 50 MW condensing Unit capacity,
- Continue the development of the San Vicente Field, installing a new condensing unit of 30 MW.

6. Important Aspects in Exploratory Well Drilling

Positive Aspects:

A) General

- National policies to develop the country's natural resources
- Reduce the Power generation from Oil-based resources

B) Technical

- Carry out geocientific subsurface studies to define the field area thru: Geophysics, Geochemistry, Geology
- For the deep well drilling, define the targets to increase the success of well result with the aid of geological structures such as faults, fractures, etc.
- Increase the use of directional drilling to reach multiples targets in the reservoir.
- Wellsite geology by analyzing cuttings and core samples to define the reservoir characteristics.
- To take measurement to define the reservoir conditions: Pressure an temperatures Profiles, spinners and "Inyectivity" tests.
- To do frequent well flow tests to know the well conditions, after the drilling ends.

F. Important Aspects in Exploratory Well Drilling (Continued)

C) Social

- To do a social campaign to inform the nearby community on the project´s plan
- As the implementation of environmental management during the drilling: to reduce the impacts to the neighboring community such as noise control, good practices for managing wastes from drilling.
- To hire local person in the project to help increase the people´s incomes.

Negative Aspects:

A) General

- Less financing for small projects
- Long periods to obtain the environmental permits for drilling
- No Polices of incentives to develop the natural resources.
- Local policies to charge local taxes to the exploratory activities.

F. Important Aspects in Exploratory Well Drilling (continued)

B) Technical

- Lack of results during the firsts wells, thus obtaining limited knowledge of the deep information.
- The unavailability of technical support and services for the deep exploratory drilling.
- No availability or permit to use local resources for the drilling: for ex. Fresh water from rivers and surface well.

C) Social

- Impacts of noise from the drilling equipment to the neighboring community (very close to the sites),
- Visual impacts for the construction of the civil works (pad and roads).
- Impacts produced for the traffic of the trucks with the drilling equipment: dust in the air, breakage of electrical lines of houses along the road.
- Earthquakes in the Area, related for the community to the drilling operations

Thank you

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