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HONDURAS COUNTRY UPDATE PAPER

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ABSTRACT

In Honduras, the geothermal resources has been evaluated mainly for electricity production purposes, by the national utility, with emphasis on medium size projects to be interconnected to the national grid.

Currently Honduras has a maximum electrical consumption approaching 3.5 TWh/year, which has been increasing at an average rate of 10% annually. Hurricane Mitch was a devastating blow to the economy and has temporarily slowed the energy demands. However, it is anticipated that the growth rate will resume as soon as the agricultural sector, which is the larger consumer of electricity in the country, restructures itself. Honduras has an install capacity of 883.8 MW of electrical power, consisting of roughly 50% of hydropower, with the majority supplied by the Francisco Morazán (El Cajón) facility (300 MW) and approximately 43.1% of the remaining 50% of the thermal capacity is provided by the private sector. More than 90% of electrical power was generated via hydroelectric means until 1993. However, economical and financial problems of the national utility prevented the expansion of the country's hydroelectric install capacity.

To keep the average growth of the demand, and taking in consideration that only the 50% of the population has access of the electricity now, Honduras needs strategies for installing power plants using all its the available resources. Therefore, Geothermal sources can be implemented if an adequate policy of promotion is establish.

GEOTHERMAL RESOURCES

As a result of the modest geothermal potential identified during the regional programs promoted and financed by United Nations and USAID during the seventies and eighties and due to

the fact that we do not to have any geothermal plant in operation, the investigation entered a lethargic period. The only effort to continue with the investigations has been made by the national utility, The Empresa Nacional de Energía Eléctrica (ENEE), trying to obtain financing to continue with the studies.

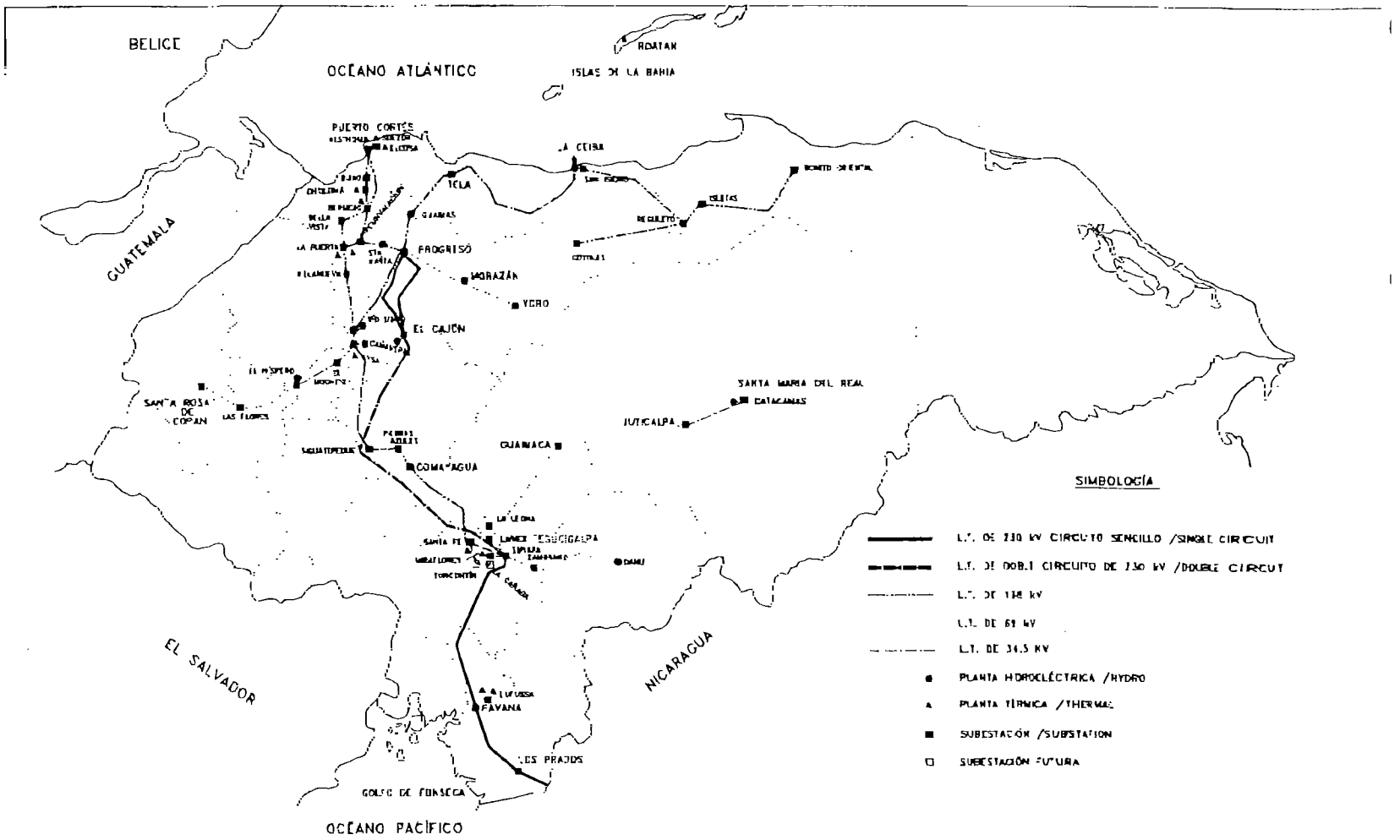
As the majority of the Central American countries, Honduras energy sector started a changing process to pass from a state own company to an open private participation. These changes started in 1994, with the purpose of promoting the participation of the private sector in the generation and distribution of electric power market. Until now, this participation has been concrete only for thermal plants and small cogeneration projects. Therefore, a new frame law was send to Congress at the end of 1999, with the purpose to update the existing one in order to facilitate: the participation of the private sector and the changes in the structure of the national utility.

To have success in promoting private developments of geothermal resources, Honduras needs to update the inventory of the geothermal resources and to determine the economical and environmental viability of the most potential sites. Cooperative programs can play an important role in this planning stage, as they are doing, supporting others renewable resources. The state owned company is in the process of privatization, therefore, does not have plans to build any new plants, but will continue planning and promoting the development of renewable energy projects.

During the first stage of the regional project " Desarrollo de los Recursos Geotermicos en America Latina y El Caribe", financed by European Commission and CEPAL, the factors that condition, promote and restrict the integral development of geothermal resources in the area, were identified.

As a result of this, Honduras was included in the second phase of the project. The component was plan to start in May 1999, with the following actions: a) Institutional support, b) Regulatory framework, c) Evaluation of the inventory of geothermal resources, and d) Promote Platanares and Pavana projects to private developers. Unfortunately, it was not possible to develop any of the components due to changes in the project definition by the financial agencies.

Regarding the utilization of geothermal energy for direct heat, until now, this is only use for bathing and swimming. To promote the utilization for other purposes, it is necessary to evaluate the resources and support the use.



SISTEMA NACIONAL DE TRANSMISIÓN DE ENERGÍA 1999

EMPRESA NACIONAL DE ENERGÍA ELÉCTRICA
DEPARTAMENTO DE PLANEAMIENTO DEL SISTEMA
REPÚBLICA DE HONDURAS, C.A.

TABLE 1. PRESENT AND PLANNED PRODUCTION OF ELECTRICITY

	Geothermal		Fossil Fuels		Hydro		Nuclear		Other Renewables (specify)		Total	
	Capac-ity MWe	Gross Prod. GWh/yr	Capac-ity MWe	Gross Prod. GWh/yr	Capac-ity MWe	Gross Prod. GWh/yr	Capac-ity MWe	Gross Prod. GWh/yr	Capac-ity MWe	Gross Prod. GWh/yr	Capac-ity MWe	Gross Prod. GWh/yr
In operation in January 2000			451.1	1404.6	432.7	2142.3			6	1.89	889.8	3548.79
Under construction in January 2000					25	40.5					25	40.5
Funds committed, but not yet under construction in January 2000			210	1563	50	200					260	1763
Total projected use by 2005			661.1	2967.6	507.7	2382.8					1174.8	5352.29

Note: Other renewables corresponds to cogeneration with biomass

TABLE 2. UTILIZATION OF GEOTHERMAL ENERGY FOR ELECTRIC POWER GENERATION AS OF 31 DECEMBER 1999

1) N = Not operating (temporary), R = Retired. Otherwise leave blank if presently operating.

2) 1F = Single Flash
2F = Double Flash
3F = Triple Flash
D = Dry Steam
B = Binary (Rankine Cycle)
H = Hybrid
O = Other (please specify)

3) Data for 1999 if available, otherwise for 1998. Please specify which.

Locality	Power Plant Name	Year Com-missioned	No. of Units	Status[1)]	Type of Unit[2)]	Unit Rating MWe	Total Installed Capacity MWe	Annual Energy Produced 1999[3)] GWh/yr	Total under Constr. or Planned MWe
Total									

Note: up to this date, Honduras has no power generation using geothermal energy

TABLE 3. UTILIZATION OF GEOTHERMAL ENERGY FOR DIRECT HEAT AS OF 31 DECEMBER 1999

[1] I = Industrial process heat
C = Air conditioning (cooling)
A = Agricultural drying (grain, fruit, vegetables)
F = Fish and animal farming
S = Snow melting
H = Space heating & district heating (other than heat pumps)
B = Bathing and swimming (including balneology)
G = Greenhouse and soil heating
O = Other (please specify by footnote)

[2] Enthalpy information is given only if there is steam or two-phase flow

[3] Capacity (MWt) = Max. flow rate (kg/s)[inlet temp. (^{o}C) - outlet temp. (^{o}C)] x 0.004184 ($MW = 10^6$ W)
or = Max. flow rate (kg/s)[inlet enthalpy (kJ/kg) - outlet enthalpy (kJ/kg)] x 0.001

[4] Energy use (TJ/yr) = Ave. flow rate (kg/s) x [inlet temp. (^{o}C) - outlet temp. (^{o}C)] x 0.1319 ($TJ = 10^{12}$ J)
or = Ave. flow rate (kg/s) x [inlet enthalpy (kJ/kg) - outlet enthalpy (kJ/kg)] x 0.03154

[5] Capacity factor = [Annual Energy Use (TJ/yr)/Capacity (MWt)] x 0.03171
Note: the capacity factor must be less than or equal to 1.00 and is usually less, since projects do not operate at 100% of capacity all year.

Locality	Type[1]	Maximum Utilization					Capacity[3]	Annual Utilization		
		Flow Rate	Temperature (^{o}C)		Enthalpy[2] (kJ/kg)			Ave. Flow	Energy[4]	Capacity
		(kg/s)	Inlet	Outlet	Inlet	Outlet	(MWt)	(kg/s)	(TJ/yr)	Factor[5]
Tamara	B	4.0	53	36			0.285	2.2	4.933	0.550
Gracias 1	B	4.5	57	41			0.301	4.1	8.653	0.911
Gracias 2	B	3.0	56	46			0.126	2.6	3.429	0.866
TOTAL							0.711		17.015	0.759

Note: please report all numbers to three significant figures.

TABLE 5. SUMMARY TABLE OF GEOTHERMAL DIRECT HEAT USES AS OF 31 DECEMBER 1999

[1] Installed Capacity (thermal power) (MWt) = Max. flow rate (kg/s) x [inlet temp. (°C) - outlet temp. (°C)] x 0.004184
or = Max. flow rate (kg/s) x [inlet enthalpy (kJ/kg) - outlet enthalpy (kJ/kg)] x 0.001

[2] Annual Energy Use (TJ/yr) = Ave. flow rate (kg/s) x [inlet temp. (°C) - outlet temp. (°C)] x 0.1319 (TJ = 10^{12} J)
or = Ave. flow rate (kg/s) x [inlet enthalpy (kJ/kg) - outlet enthalpy (kJ/kg) x 0.03154

[3] Capacity Factor = [Annual Energy Use (TJ/yr)/Capacity (MWt)] x 0.03171 (MW = 10^{6} W)
Note: the capacity factor must be less than or equal to 1.00 and is usually less, since projects do not operate at 100% capacity all year

Use	Installed Capacity[1] (MWt)	Annual Energy Use[2] (TJ/yr = 10^{12} J/yr)	Capacity Factor[3]
Space Heating[4]			
Air Conditioning (Cooling)			
Greenhouse Heating			
Fish and Animal Farming			
Agricultural Drying[5]			
Industrial Process Heat[6]			
Snow Melting			
Bathing and Swimming[7]	0.711	17.015	0.759
Other Uses (specify)			
Subtotal			
Geothermal Heat Pumps			
TOTAL			

[4] Includes district heating (if individual space heating is significant, please report separately)
[5] Includes drying or dehydration of grains, fruits and vegetables
[6] Excludes agricultural drying and dehydration
[7] Includes balneology

Note: please report all numbers to three significant figures.

TABLE 6. WELLS DRILLED FOR ELECTRICAL, DIRECT AND COMBINED USE OF GEOTHERMAL RESOURCES FROM JANUARY 1, 1995 TO DECEMBER 31, 1999

[1] Include thermal gradient wells, but not ones less than 100 m deep

Purpose	Wellhead Temperature	Number of Wells Drilled				Total Depth (km)
		Electric Power	Direct Use	Combined	Other (specify)	
Exploration[1]	(all)					
Production	>150° C					
	150-100° C					
	<100° C					
Injection	(all)					
Total						

Note: No activity was carried out during this period.

TABLE 7. ALLOCATION OF PROFESSIONAL PERSONNEL TO GEOTHERMAL ACTIVITIES (Restricted to personnel with a University degrees)

(1) Government
(2) Public Utilities
(3) Universities
(4) Paid Foreign Consultants
(5) Contributed Through Foreign Aid Programs
(6) Private Industry

Year	Professional Person-Years of Effort					
	(1)	(2)	(3)	(4)	(5)	(6)
1995		2				2
1996		1				1
1997		1				
1998		2			1	
1999		2			2	
Total		8			3	3

Note: The personnel did not work full time in geothermal activities, only when was requerided

TABLE 8. TOTAL INVESTMENTS IN GEOTHERMAL IN (1999) US$

Period	Research & Development Incl. Surface Explor. & Exploration Drilling	Field Development Including Production Drilling & Surface Equipment	Utilization		Funding Type	
			Direct	Electrical	Private	Public
	Million US$	Million US$	Million US$	Million US$	%	%
1985-1989	2.0		0.13		6.1	93.9
1990-1994	0.1					100.0
1995-1999	0.3		0.1		25.0	75.0