

ELECTRICITY GENERATION IN MEXICO WITH GEOHERMAL ENERGY



TECNOLÓGICO
DE MONTERREY®



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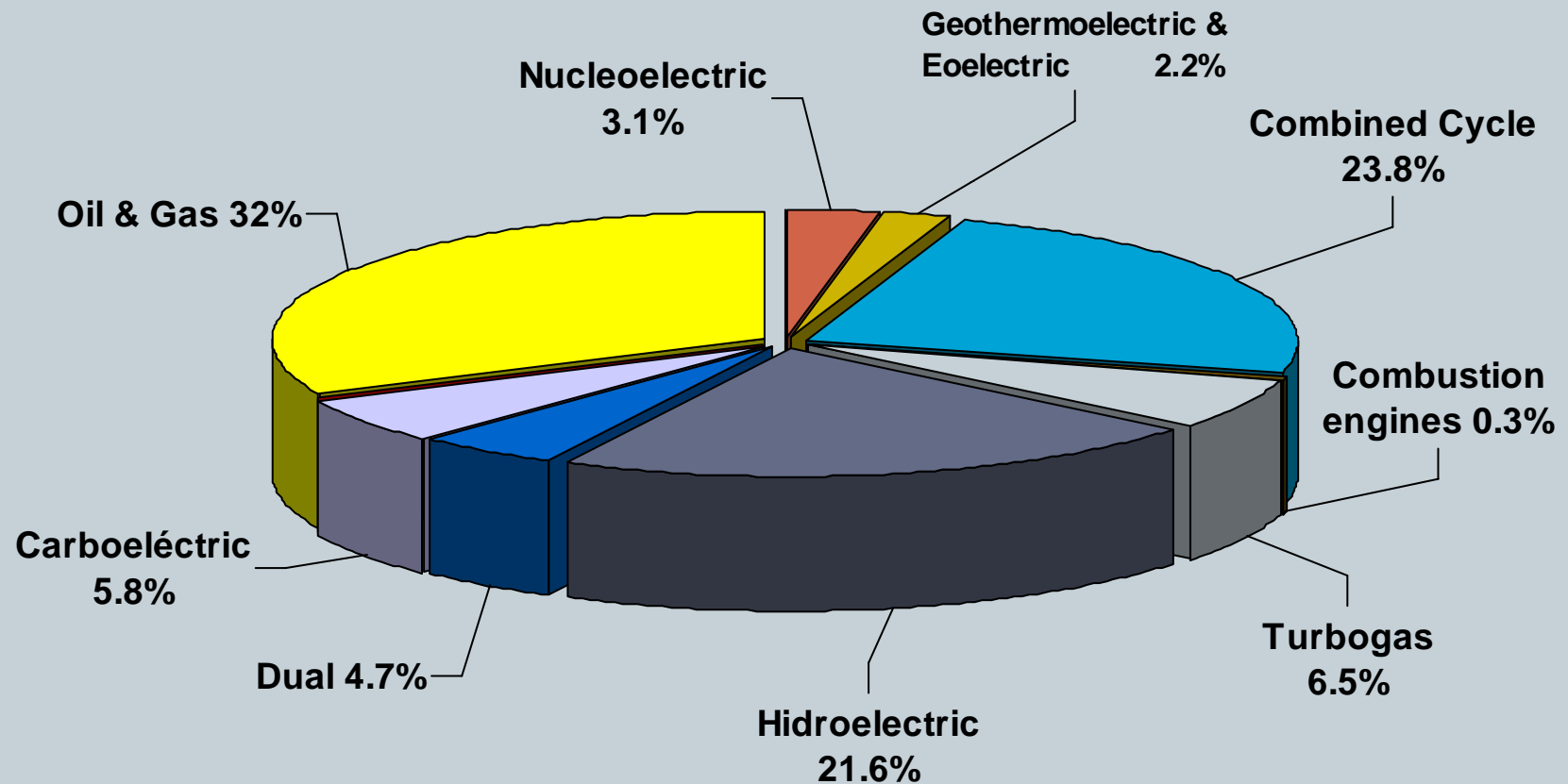
**SOMMERSCHULE
SIEGEN 2009**

National Energy Consumption

National Consumption	Federal Government	States & Municipalities	Industries & Commerce	Homes & Buildings	Transport	Total
Electricity	186.1	26.1	418.8	150.7	4.4	786.1
Natural Gas	1,360.3	0.0	492.5	26.7	0.7	1,880.2
LPG	6.5	0.1	122.8	303.1	58.8	491.2
Gasoline and Diesel	62.1	0.0	121.1	0.0	1,567.1	1,750.3
Other fuels	802.9	0.0	386.0	275.3	121.9	1,586.1
Total	2,417.9	26.2	1,541.2	755.8	1,752.9	6,493.9
	37.2%	0.4%	23.7%	11.6%	27.0%	100.0%

(Petajoules; 2006 projection)

TECHNOLOGIES FOR ELECTRICITY GENERATION IN MEXICO



Renewable Energies in Mexico

Source	World Capacity MW	Mexico Capacity MW	% Mexico vs. World
Geo-thermal	8,365	838	10
Solar	532	14	2.6
Mini-Hydro	27,950	40	1.4
Biogas	35,000	17	0.05
Wind	30,400	2	0.005



MEXICO'S POSITION IN THE GLOBAL GEOTHERMOELECTRIC GENERATION



País	Capacidad (MW)
Estados Unidos	2,851
Filipinas	1,980
México	958
Indonesia	797
Italia	790
Japón	535
Nueva Zelanda	450
Islandia	202
Costa Rica	163
El Salvador	151
Kenya	127
Nicaragua	87
Rusia	79
Guatemala	33
China	28
Turquía	20
Portugal (Islas Azores)	17
Francia (Isla Guadalupe)	15
Otros	20
Total	9.303

- Worldwide, Mexico occupies the third place on the use of geothermal energy
 - after United States and Philippines, from 27 countries that use geothermic to generate electricity.
- The geothermal capacity installed in our country is equivalent to 3 % of the electrical generation for the public service

(www.cfe.gob.mx)



Evolution of installed capacity of Geothermal



Evolución de la capacidad eléctrica instalada. ND = No existe información disponible;
^a Mercado et al. (1982), ^b Hutterer, (1995), ^c Hutterer (2000), ^d a partir de Julio 2000.

PAÍS	1982 ^a (Mwe)	1990 ^b (MWe)	1995 ^b (MWe)	2000 ^c (MWe)
Argentina		0.7	0.7	ND
China	2.0	19.2	28.8	29
Costa Rica			55.0	143
El Salvador	95.0	95.0	105.0	161
Estados Unidos	932.0	2,774.6	2,816.7	2,228
Filipinas	501.0	891.0	1,227.0	1,909
Francia		4.2	4.2	4.2
Islandia	41.0	44.6	49.4	170
Indonesia	32.0	144.7	309.8	700
Italia	446.0	545.0	631.7	785
Japón	220.0	214.6	413.7	547
Kenia	15.0	45.0	45.0	45
MÉXICO	205.0	700.0	753.0	855 ^d
Nueva Zelanda	202.0	283.2	286.0	437
Nicaragua	30.0	35.0	35.0	70
Portugal (Azores)		3.0	5.0	ND
Rusia	11.0	11.0	11.0	23
Tailandia		0.3	0.3	ND
Turquía	0.5	20.6	20.6	20
Otros				56
TOTAL	2,732.5	5,831.7	6,797.9	8,182.2

ENVIRONMENTAL BENEFITS WITH THE GEOTHERMOELECTRIC GENERATION



- **The production of geothermoelectric energy in Mexico avoids**
 - the consumption of 11 million barrels of oil in one year
 - the emission to the atmosphere of 2,5 million tons of CO₂ per year.
- **In addition it has the advantage that**
 - It does not need extra water supply for the process,
 - the electric power is clean,
 - fulfills international standards of noise,
 - is secure and sustainable.



INSTALLED CAPACITY AND ADDITIONAL POTENTIAL (2008).

- The geothermal capacity installed to date is 958 MW distributed in mainly 4 fields:
 - Cerro Prieto, Baja California
 - Los Azufres, Michoacán
 - Los Humeros, Puebla
 - Las Tres Vírgenes, B.C.S.



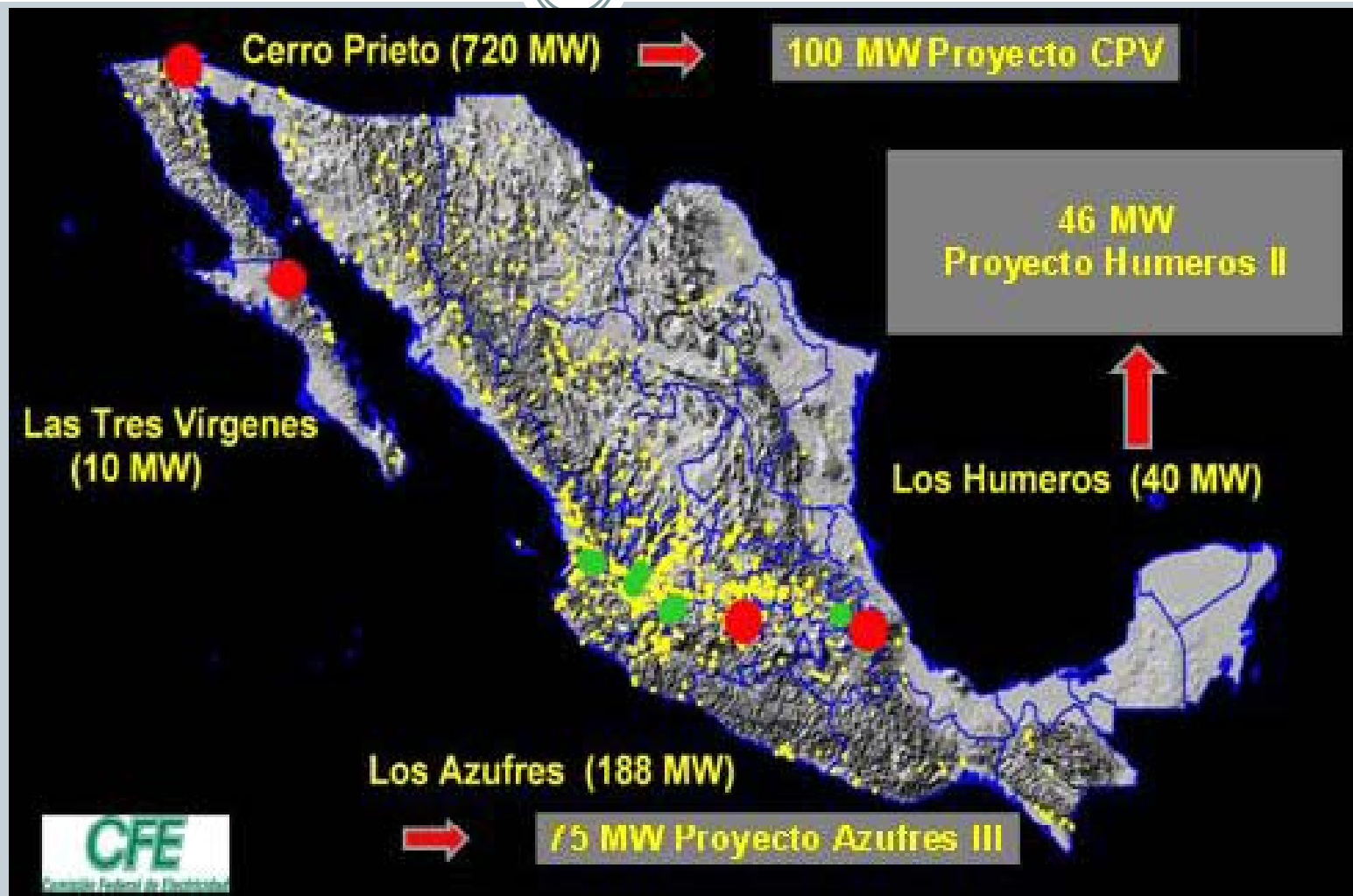
Geothermal fields in commercial operation in Mexico.



GEOHERMAL FIELD	CURRENT CAPACITY (MW)	ELECTRICITY GENERATION (GWh)	PLANT FACTOR	GEOHERMAL ADDITIONAL POTENTIAL (MW)
		2007	2007	Probable
Cerro Prieto, Baja California	720	5592	88.6 %	25
Los Azufres, Michoacán	188	1494	90,7 %	40
Los Humeros, Puebla	40	278	90,6 %	50
Las Tres Vírgenes, B.C.S.	10	29	50 %	5
Total	958	7393	88 %	120



Expansion projects over the medium term in areas of commercial operation



SHORT TERM EXPANSION PROJECTS

- **Cerro Prieto geothermal field.**
 - Actually has 720 MW installed capacity
 - There is a process of Licitation for the geothermoelectric **Central Cerro Prieto V**,
 - ✦ with two turbines of 50 MW each, that will replace to two units of 37,5 MW of Central Cerro Prieto 1
 - The total generation of the field will increase in 25 MW, using the same quantity of steam that is used actually to supply both units of Cerro Prieto 1, taking advantage of the major efficiency of the new turbines.
 - Probable additional potential of 25 MW



SHORT TERM EXPANSION PROJECTS

- **Los Humeros** geothermal field.
 - Actually has 40 MW installed capacity
 - The Geotermoelectric central Los Humeros is in process of licitation of Los Humeros II, in two Phases:
 - ✦ Phase A, with a Unit of 25 MW.
 - ✦ Phase B, with seven (7) Units of 3 MW.
 - Net increase in the generation of 46 MW
 - Probable additional potential of 50 MW



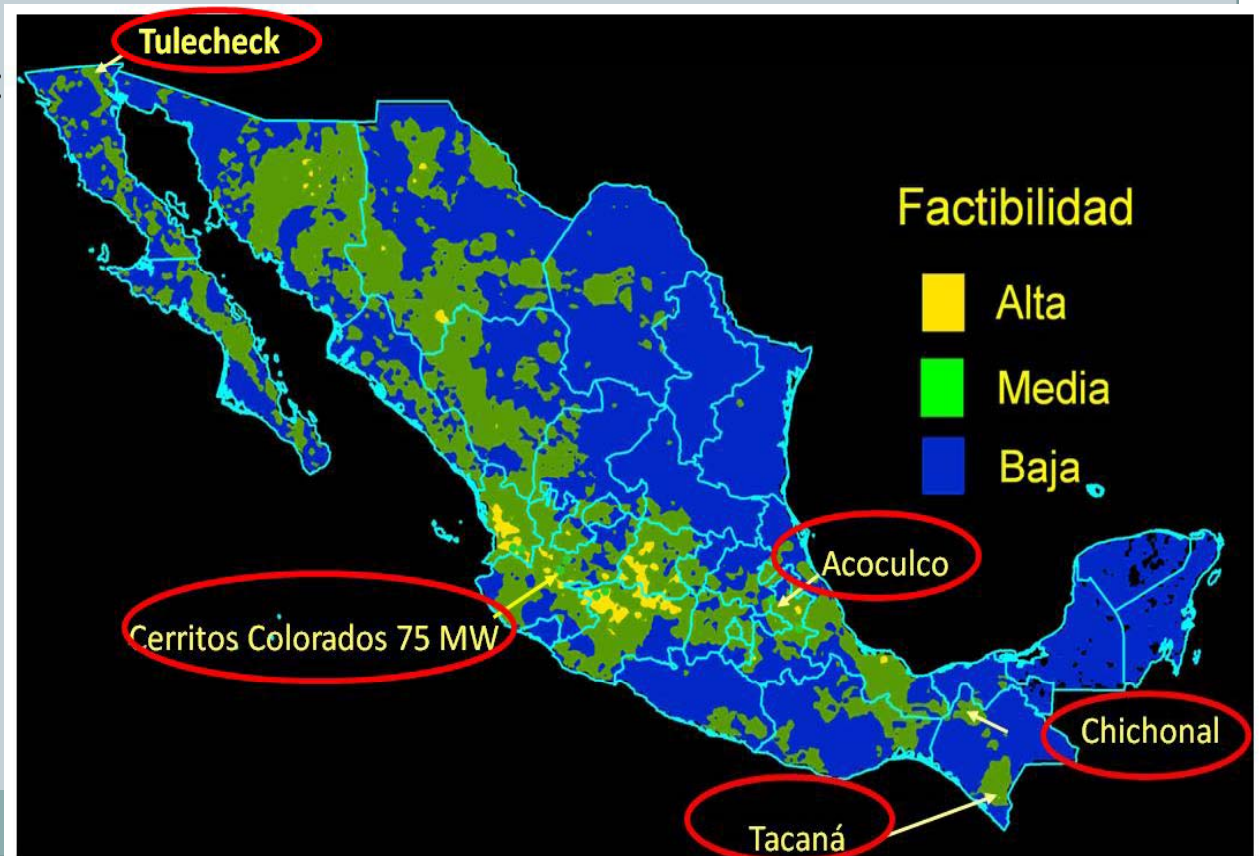
SHORT TERM EXPANSION PROJECTS

- **Los Azufres** geothermal field .
 - Actually has 188 MW installed capacity
 - ✦ There is feasibility evaluation for the installation of two Units, one of 25 MW and other of 50 MW that will replace 7 Units of 5 MW each.
 - The net increase in the generation will be 25 MW.
 - Probable additional potential of 40 MW



GEOHERMAL EXPLORATION OF NEW FIELDS

- Exploratory studies of geology, geochemistry and geophysics have made possible to identify areas of high, medium and low enthalpy with geothermal potential of approximately 525 MW.
- The areas with greatest potential are:



Geothermal projects in exploratory stage.



Project	Objetive	Situation
Cerritos Colorados, Jal.	Installing a unit of 25 MW to condensation.	Under evaluation for environmental impact at the General Directorate of Environmental Impact and Risk of SEMARNAT.
Acoculco, Puebla.	Drilling exploratory wells.	Currently drilling the second exploratory well
Tulecheck, BC.	Harnessing technology binary cycle	Studies are being conducted in order to locate exploration wells with high and medium enthalpy.
El Chichonal, Chis.	Superficial surveys to determine the extent and prospects of the project.	In preliminary studies stage.
Tacaná, Chis.	Superficial surveys to determine the extent and prospects of the project.	In preliminary studies stage.
El Domo San Pedro, Nay.	Locating exploratory wells.	In preliminary studies stage.



Barriers for Renewable Energies in Mexico



- *Public Awareness*
 - The main problem to uptake RE is not technological, but has to do with general knowledge about RE and its benefits
 - They are generally perceived as being expensive and unavailable.
 - Their intermittent nature leads concern to their reliability.
- *Costs and Reliability*
 - In essence it is a myth that RE is more costly than conventional energy, this misconception results from
 - ✦ subsidies to fossil fuels and nuclear energy,
 - ✦ Human health and environmental costs derived from the use of conventional fuels is not incorporated into their price.
- *Legal and administrative barriers*
 - Are related to the uncertainty and the costs associated with ensuring property rights and land ownership for the development of projects
 - ✦ in Mexico, over half of national territory is held in collective ownership regimes,
 - ✦ this causes problems trying to secure the right to use the land for electric generation

THANK YOU for your attention



GRACIAS
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