MEXICAN GEOTHERMAL RESEARCH AGENDA

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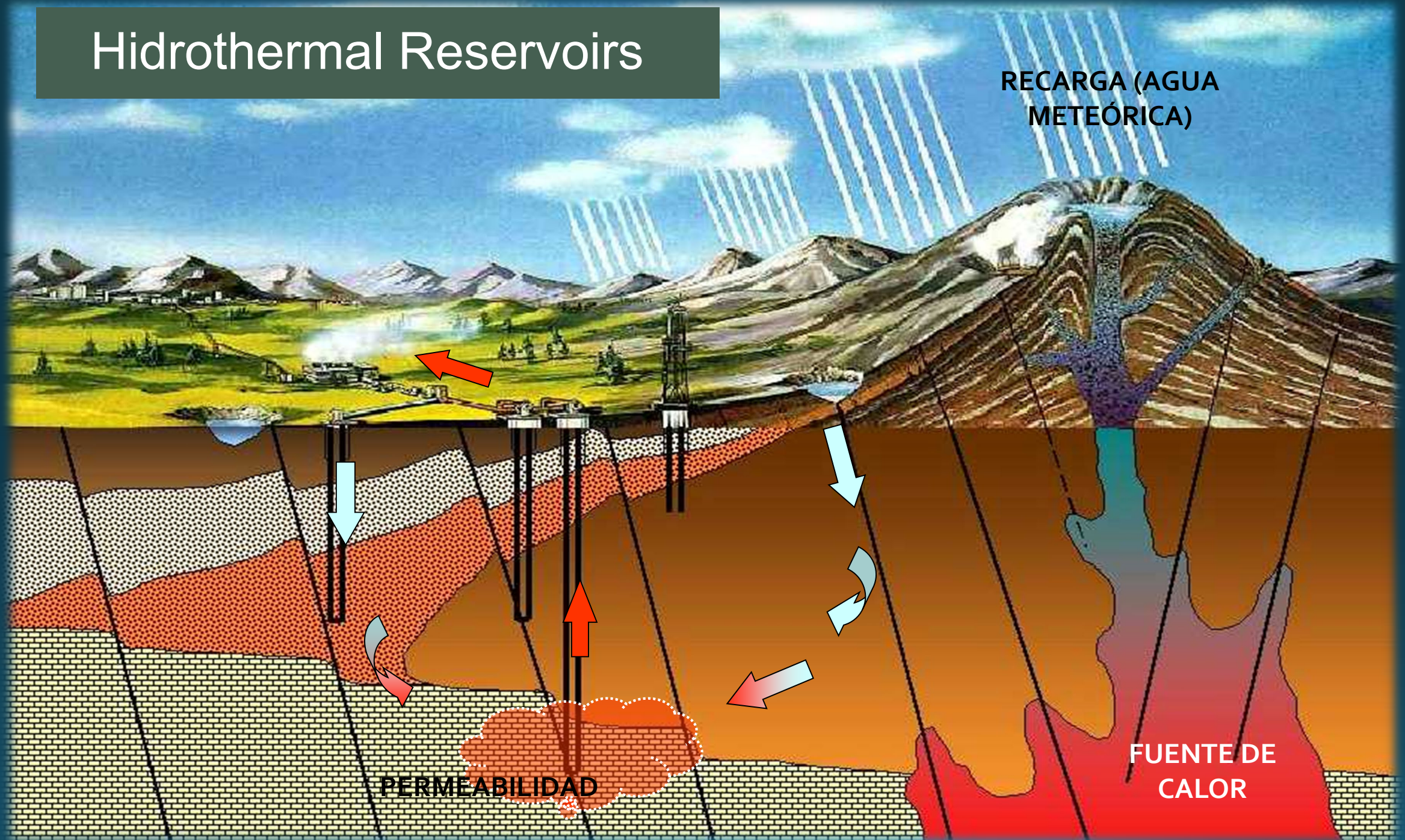
Geothermal Fields in Mexico

Field	Capacity (MW)	
	Installed	In operation
Cerro Prieto, BC	570.0	570.0
Los Azufres, Mich.	246.6	223.6
Los Humeros, Pue.	93.9	78.9
Las Tres Vírgenes, BCS	10.0	7.0
Domo San Pedro, Nay.	35.5	23.5
Total	**956.0**	**903.0**

Faja Volcánica Mexicana
CFE
Grupo Dragón
Celaya. Grupo CARSO. Exploration stage.

Hidrothermal Reservoirs



GEMex Proyect is focused:

Los Humeros for develop a Super hot geothermal system (SHGS)

+

Acoculco for Enhancemed Geothermal System (EGS)

Prospects for SHGS in Mexico

LOS HUMEROS

- Possibly in Mexico there is no other SHGS

Prospects for EGS in Mexico

- Possibly, at present, the best alternatives to develop this type of systems are in:

The same geothermal fields already in operation in areas where permeability has not been found but high temperatures have been measured above 250 ° C, as is the case of the W zone of Los Humeros geothermal field.

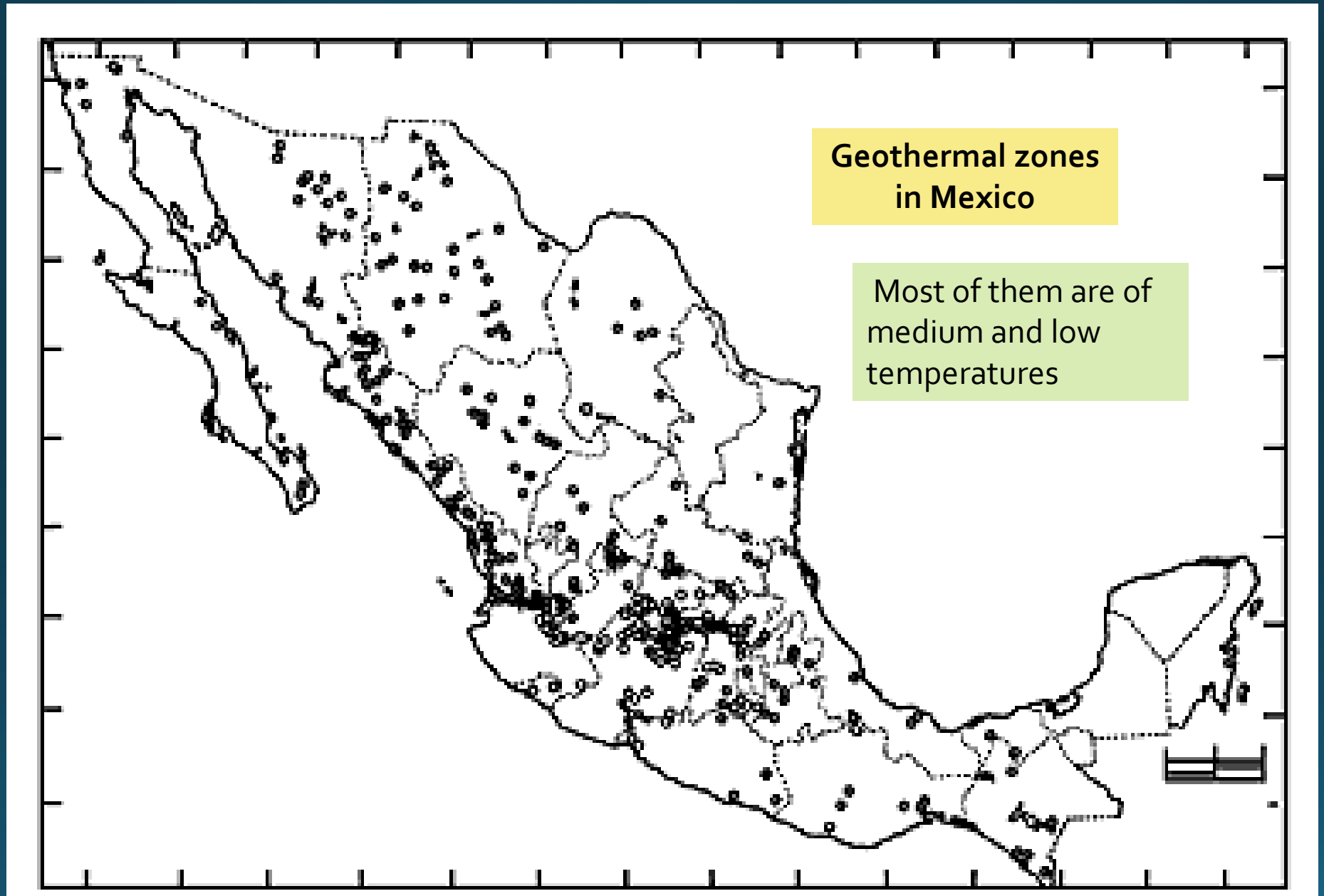
THE FUTURE OF GEOTHERMAL ENERGY IN MEXICO

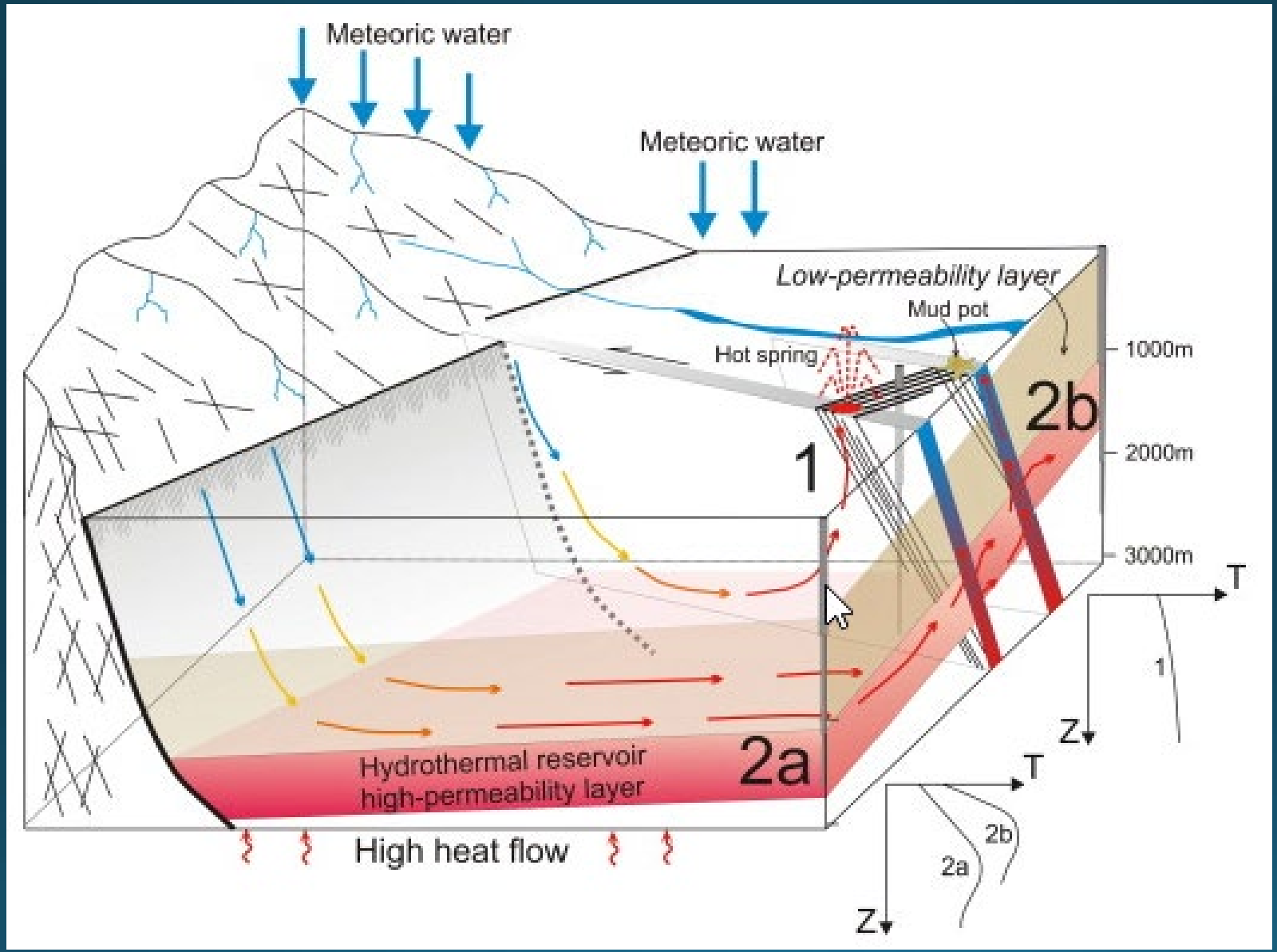
Strengthen mature fields in operation. (Reservoir engineering) → **Los Humeros, Cerro Prieto, Tres Vírgenes**

Medium temperature zones : 150° - 200°C → **Binary cycle electricity production**

Cascade production in media and and high temperature areas → **Los Azufres, Los Humeros + New fields**

Low temperature zones: Direct uses → **New fields**


Geothermal zones in Mexico
Most of them are of medium and low temperatures

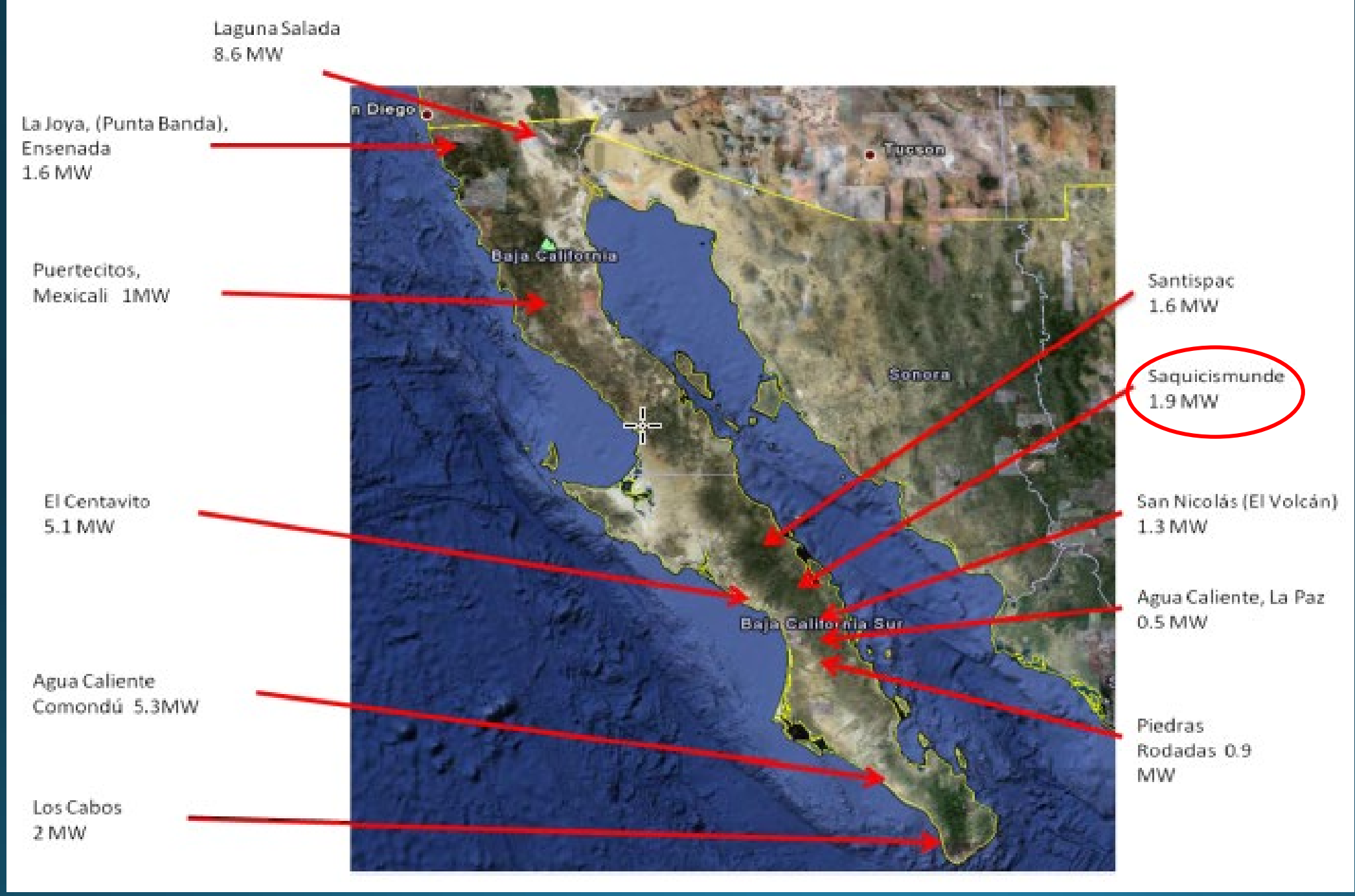


Non-magmatic active geothermal play system in active extensional terrains, in Inga S. Moeck, 2014

TIPO DE YACIMIENTOS GEOTÉRMICOS EN BAJA CALIFORNIA

ZONA GEOTÉRMICA	TIPO
W de Las Tres Vírgenes, BCS	A
Saquisismunde (El Centavito, Agua Caliente). B	I-B
Valle de Mexicali, BC	I-B
Laguna Salada, BC	B
Ensenada	B
San Felipe	B
Bahía Concepción, BCS	B
La Paz, BCS. Baja	B
Los Cabos, BCS	B

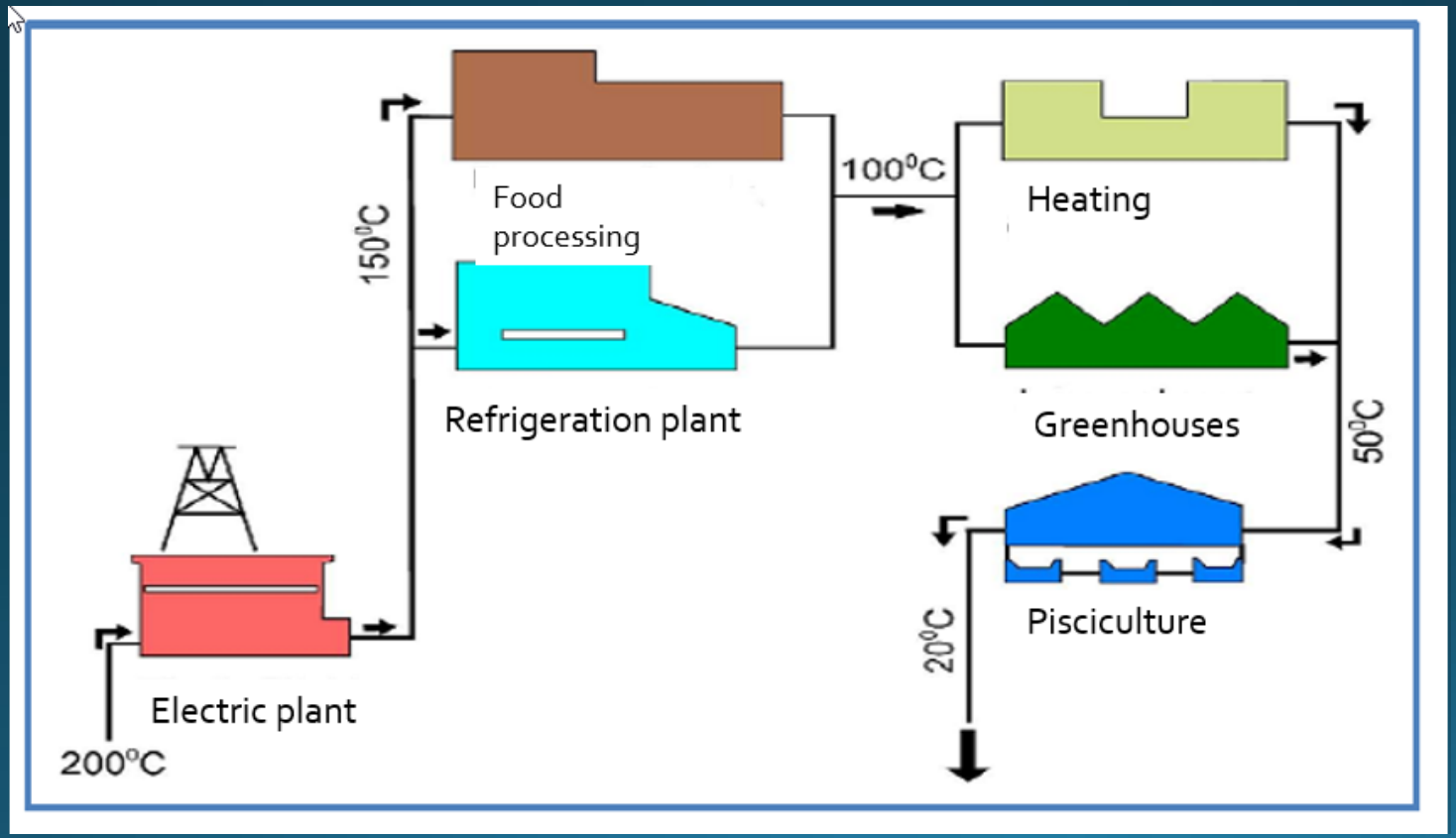
Temperatura: A (alta): >180°C, I (intermedia): 180-100°C, B: Baja: <100°C


Laguna Salada
8.6 MW
La Joya, (Punta Banda),
Ensenada
1.6 MW
Puertecitos,
Mexicali 1MW
El Centavito
5.1 MW
Agua Caliente
Comondú 5.3MW
Los Cabos
2 MW
Santispac
1.6 MW
Saquicismunde
1.9 MW
San Nicolás (El Volcán)
1.3 MW
Agua Caliente, La Paz
0.5 MW
Piedras
Rodadas 0.9
MW
Tucson
Baja California
Sonora
Baja California Sur

NEW RESEARCH LINES FOR GEOTHERMAL ENERGY IN MÉXICO. INEEL

- **Mature geothermal fields**
- Nodal analyzes for identify the dynamic behavior of reservoir through the particular behavior of each well. Using this technique it is feasible identify the pressures drawdown in the reservoir along the undergorund flow till to wellhead.
- Mass and energy balance developments for identifying appropriate exploitation designs in each geothermal field in order to achieve equilibrium between exploitation and recharge.

- **Optimization and integral uses of geothermal fields in operation (Cascade uses)**
- After discharging in turbine, taking care the uses of thermal energy at different flashing stages, the first one at 7 bars, second at 5 bars and finally the low enthalpy fluid.



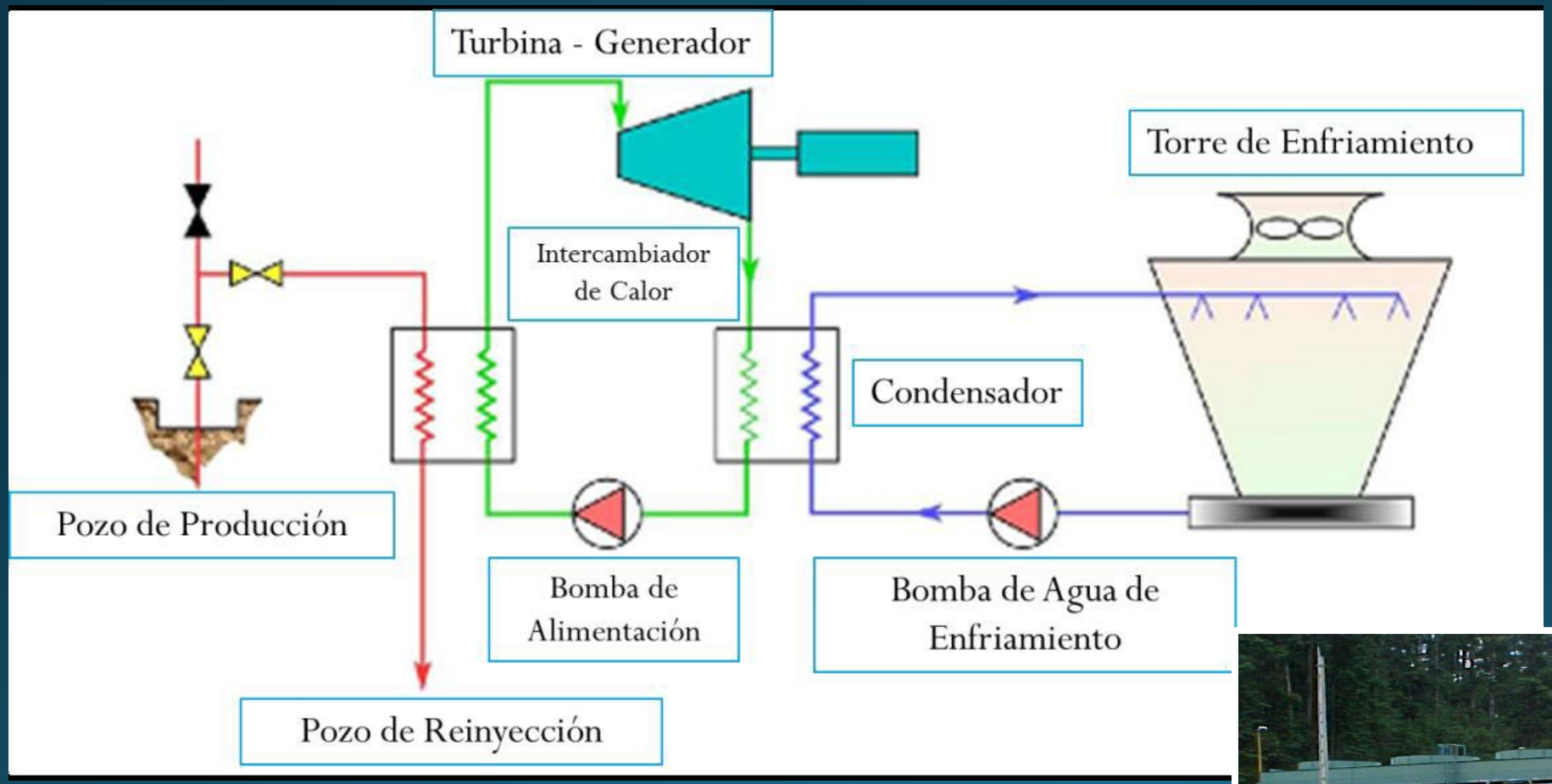
- **Researches of underground flow in geothermal systems (Integral Geohydrology)**
- Geochemical studies for determining reservoir behavior, water movement, main chemical índices for identify aquifer changes and its associated recharge. Laboratory studies for identify chemical tracers that have better performance in geothermal environments in order to identify reservoir properties, flow velocity, directional permeability among others.

- **Heat secondary recovery**
- Evaluation of heat remaining in declining geothermal wells or retired from exploitation systems (Using binary cicles, supercritical CO_2 or any other work fluid).

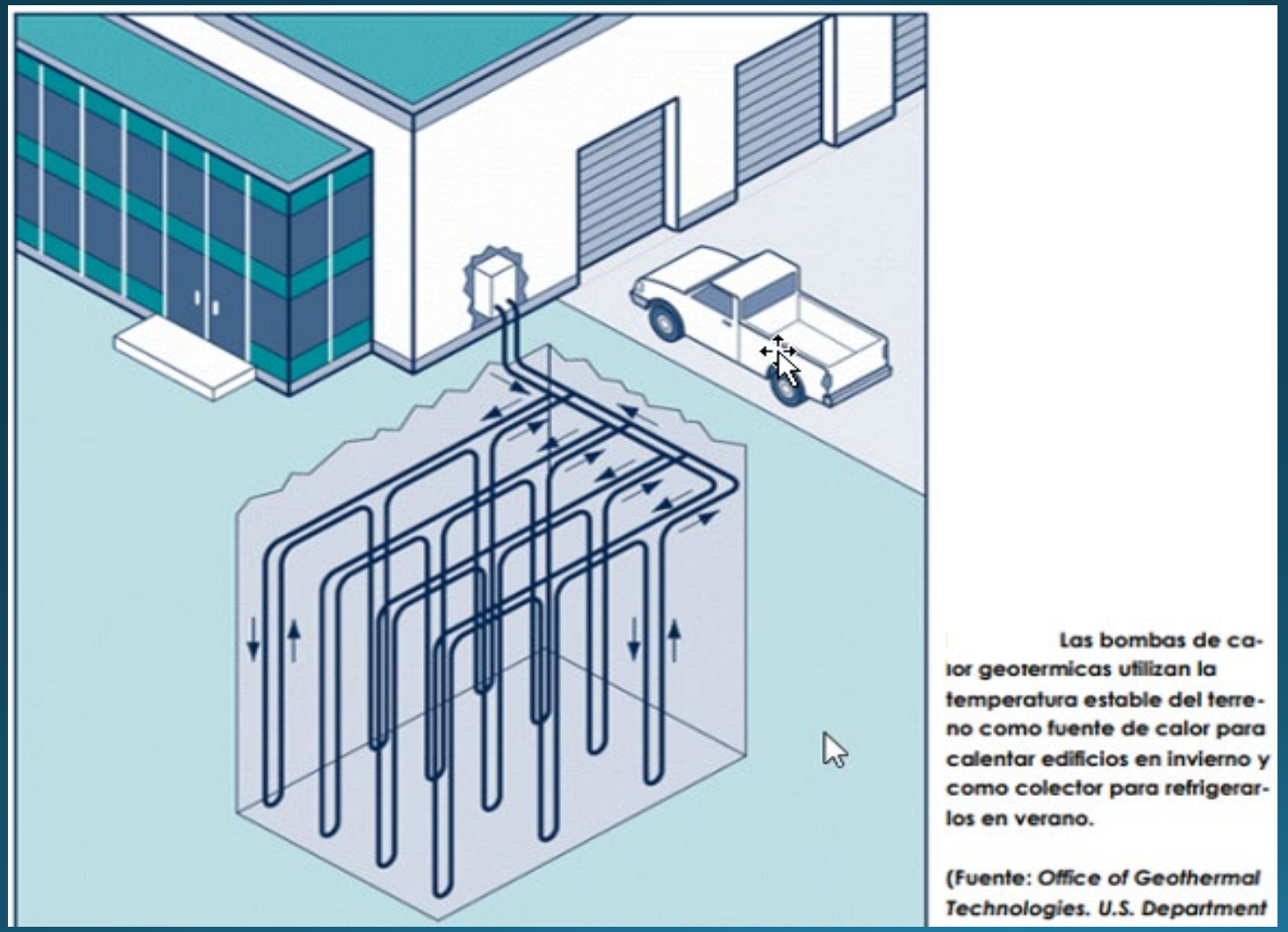
- **Heat pumps**
- Electrical energy potentiation using heat pumps.

- **Storage batteries**
- Research Project for development energy storage systems wich would be produced in wells away from transmission net.

Plantas de ciclo binario



DIRECT USES



Las bombas de calor geotermicas utilizan la temperatura estable del terreno como fuente de calor para calentar edificios en invierno y como colector para refrigerarlos en verano.

(Fuente: *Office of Geothermal Technologies. U.S. Department*

BOMBAS DE CALOR

- **Material development**
- Development of material and equipment for using at geothermal reservoir conditions.

- **Society and environmental**
- Development of techniques for introduce to communities benefits of geothermal developments. Methodologies applications for environmental care and achieve its restore conditions in cases of damage.

MEXICAN GEOTHERMAL GROUP

DISCIPLINES:

GEOLOGY: José L. Macías. UNAM. Campus Morelia. Adrián Jiménez UMSNH.

HYDROLOGY : **Thomas Kretzschmar**. CICESE

FLUID GEOCHEMISTRY : **Rosa Ma. Prol Ledesma**. UNAM. Geofísica, Edgar Santoyo UNAM. INER, Enrique Portugal, INEEL, Ruth Villanueva, UNAM, Campus Morelia.

GEOPHYSICS: **José M. Romo**, CICESE. Marco Pérez CICESE, **Claudia Arango**, UNAM. Geofísica.

- **HYDROTERMAL MINERALOGY**. Georgina Izquierdo, INEEL, Eduardo González, UNAM-CeGEO
- **RESERVOIR ENGINEERING**. Alfonso Aragón,INEEL.

Specialized Laboratory System

Comité Administrativo Interno

Coordinación Adjunta de Administración

Laboratorio de Yacimientos Geotérmicos	Laboratorio de Fluidos Geotérmicos	Laboratorio de Análisis de Rocas	Laboratorio de Microanálisis	Laboratorio de Modelación numérica y visualización	Laboratorio de Análisis Isotópico	Laboratorio de Vulcanología y Granulometría	
U. Experimental de Ingeniería de Yacimientos Geotérmicos (CICESE)	Unidad de Geoquímica Avanzada (CICESE)	Unidad de Petrología (INEEL)	Unidad de Microtomografía (UNAM-CGEO)	Unidad de Simulación de Procesos Geotérmicos (CICESE)	Unidad de isótopos estables (INEEL)	Unidad de vulcanología y granulometría (UNAM-IGF-Morelia)	Gestión de Calidad
U. de Petrología Experimental (UNAM-IGF-Morelia / UMSNH)	U. de Geoquímica de fluidos geotérmicos (UNAM-IGF-CU)	Unidad de Microanálisis de rocas (CICESE)	Unidad de Microanálisis (UNAM-IGF-Morelia / UMSNH)	U. de Sist. de Información Geográfica (UNAM-IGF-Morelia)	Unidad de Isótopos Geotermales (CICESE)		
Unidad de Petrofísica y Mecánica de rocas (INEEL)	Unidad de Química de fluidos (INEEL)	Unidad de Petrofísica (UMSNH / UNAM-IGF-Morelia)					

Sede CICESE
Sede UNAM
Sede INEEL
Sede UMSNH

Áreas de apoyo en sede CICESE

- Taller de preparación de muestras
- Taller de manufactura metal-mecánica
- Taller de instrumentación geofísica y electrónica

www.cemiegeo.org

SENER SECRETARÍA DE ENERGÍA | FONDO DE SUSTENTABILIDAD ENERGÉTICA | CONACYT | CICESE

The Mexican geothemal group has these laboratories

THANKS..!!