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Centroamericana

# The application of UNFC and its Geothermal Specifications in the SICA Region

specific cases of El Salvador and Costa Rica

**20th June 2023**

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# ¿What is the Central American Integration System (SICA)?



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Economic and political community whose fundamental objective is the achievement of the integration of Central America, to constitute it as a region of Peace, Freedom, Democracy and Development.

## 8 member countries



Belize



Costa Rica



El Salvador



Guatemala



Honduras



Nicaragua

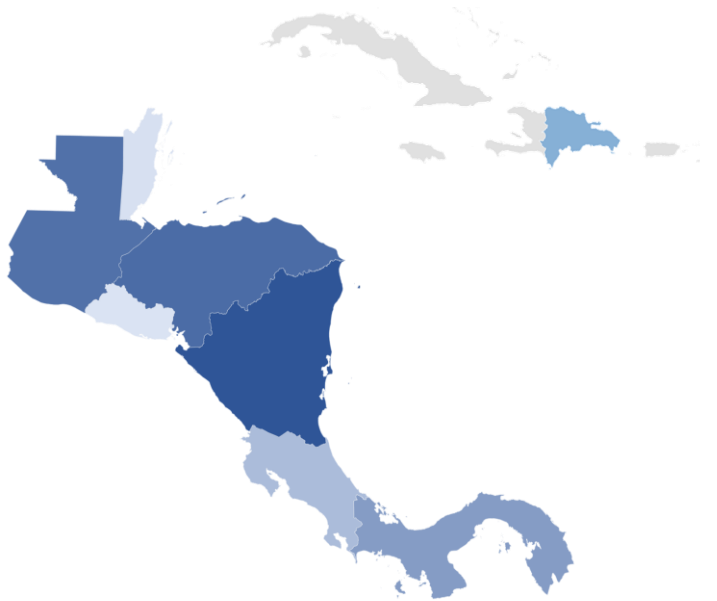


Panama



Dominican Republic

# General data



- 61 million inhabitants
  - 58% its under 30 years of age
  - 47% is part of the Economically Active Population (EAP)
- produces only 0.3% of global carbon dioxide (CO<sub>2</sub>) emissions and 0.4% of Greenhouse Gas (GHG) emissions
- 74% of the total electricity production comes from renewable energy sources
- 5.7% of the regional electricity production comes from geothermal energy (El Salvador and Costa Rica being the main contributors)

# The Geothermal Potential in the SICA Countries Members



Central America, due to its location in the Pacific Ring of Fire, boasts abundant geothermal resources primarily used for electricity generation. However, there is still limited knowledge regarding their potential and usage in other areas.

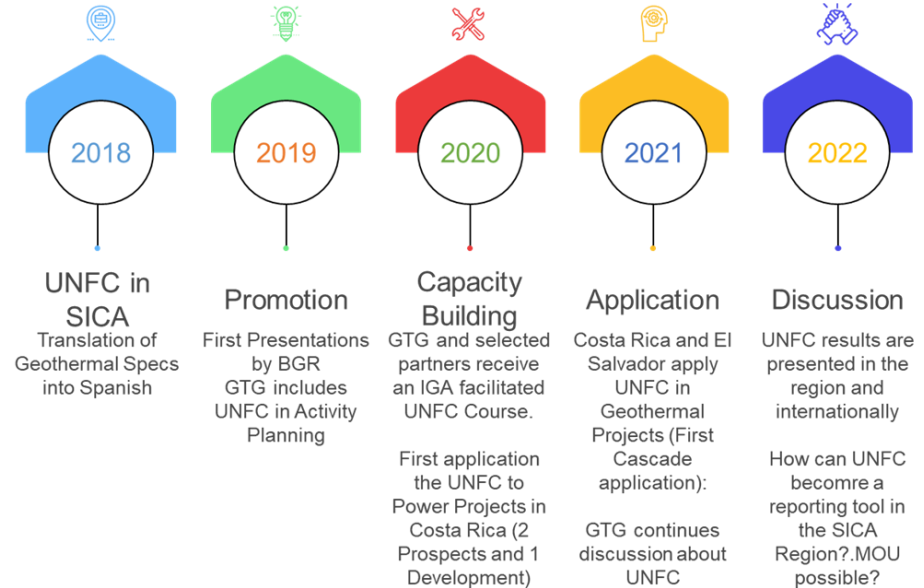
In the specific cases of El Salvador and Costa Rica, both countries are renowned for their development of geothermal projects. El Salvador has been a pioneer in the use of geothermal energy in Central America, while Costa Rica has achieved a high percentage of electricity generation from renewable sources, including geothermal energy.

## GTG- Geoscientific Technical Group for Geothermal

- The Central American Sustainable Energy Strategy 2030 aims to ensure the energy supply of SICA member countries while promoting sustainable development and international cooperation in clean energy and advanced technologies.
- **Established in 2018** by the **Energy Minister Council of the Central American Integration System SICA.**
- **Advisory services for the energy ministers** (revision and provision of Documents and the development of recommendations regarding Geothermal Development).
- Formal SICA procedures with Temporary Presidency (presidency turning every 6 months): Actual PPT is Belize.
- Last Operational Planning under PPT Panama until 2024 (2 year plans) **including the continuation of efforts to implement UNFC.**
- **First Technical Group of its function in the region.**

# UNFC in the SICA Region

The ultimate goal is to integrate this tool into the region, harmonizing and standardizing criteria to ensure its comprehensibility across all SICA member countries. This concerted effort will significantly contribute to the advancement of geothermal development in the region, maximizing opportunities for its promotion and utilization as a sustainable energy source.



## UNFC in the SICA Region

The **ultimate goal is to integrate this tool into the region, harmonizing and standardizing criteria to ensure its comprehensibility across all SICA member countries.** This concerted effort will significantly **contribute to the advancement of geothermal development in the region,** maximizing opportunities for its **promotion and utilization as a sustainable energy source.**

Through the GTG, **our aim is to enhance knowledge and foster collaboration in the field of geothermal energy, while also sharing our experiences with other regions,** such as Albania, within the framework of the UNECE. **Although the contexts may vary, the experiences gained in our region hold value, and these cooperative mechanisms can be equally advantageous.**



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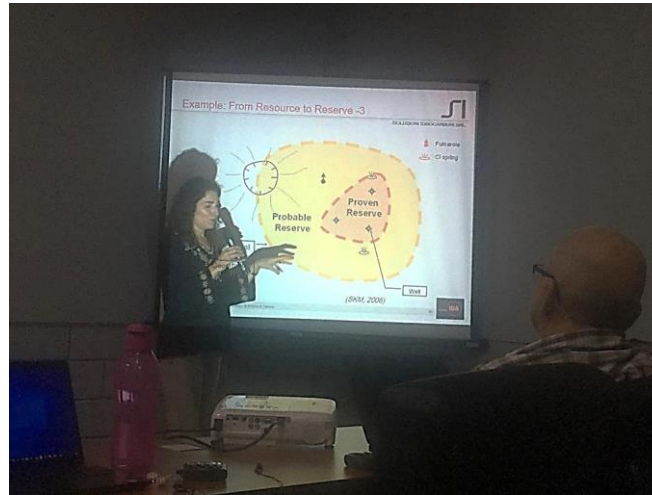
# UNFC- Application in El Salvador

20th June 2023

Elizabeth Henriquez (LAGEO, El Salvador)



# Introductory course on UNFC



February 11-14, 2020, in Costa Rica, given by Dr. Gioia Falcone (IGA)  
and sponsored by BGR

Main objective is to provide an overview of UNFC and eventually  
implement it in member countries of SICA

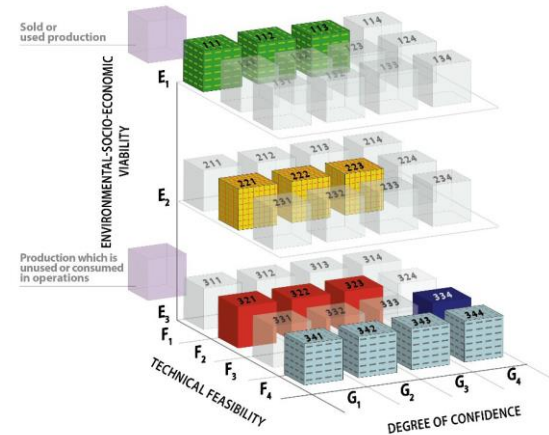
# UNFC: Project-based system to describe resources reflecting their maturity and uncertainty

## Category definitions Codification



UNFC Classes defined by categories and sub-categories					
Total products	Produced	Sold or used production			
		Production which is unused or consumed in operations			
	Class	Sub-class	Categories		
Known Sources	Viable Projects	On Production	1	1.1	1, 2, 3
		Approved for Development	1	1.2	1, 2, 3
		Justified for Development	1	1.3	1, 2, 3
	Potentially Viable Projects	Development Pending	2*	2.1	1, 2, 3
		Development On Hold	2*	2.2	1, 2, 3
	Non-Viable Projects	Development Unclassified	3.2	2.2	1, 2, 3
		Development Not Viable	3.3	2.3	1, 2, 3
Remaining products not developed from identified projects		3.3	4	1, 2, 3	
Potential Sources	Prospective Projects	[No sub-classes defined]	3.2	3	4
	Remaining products not developed from prospective projects		3.3	4	4

\*Potentially Viable Projects may satisfy the requirements for E1



Jones, A.: 2023

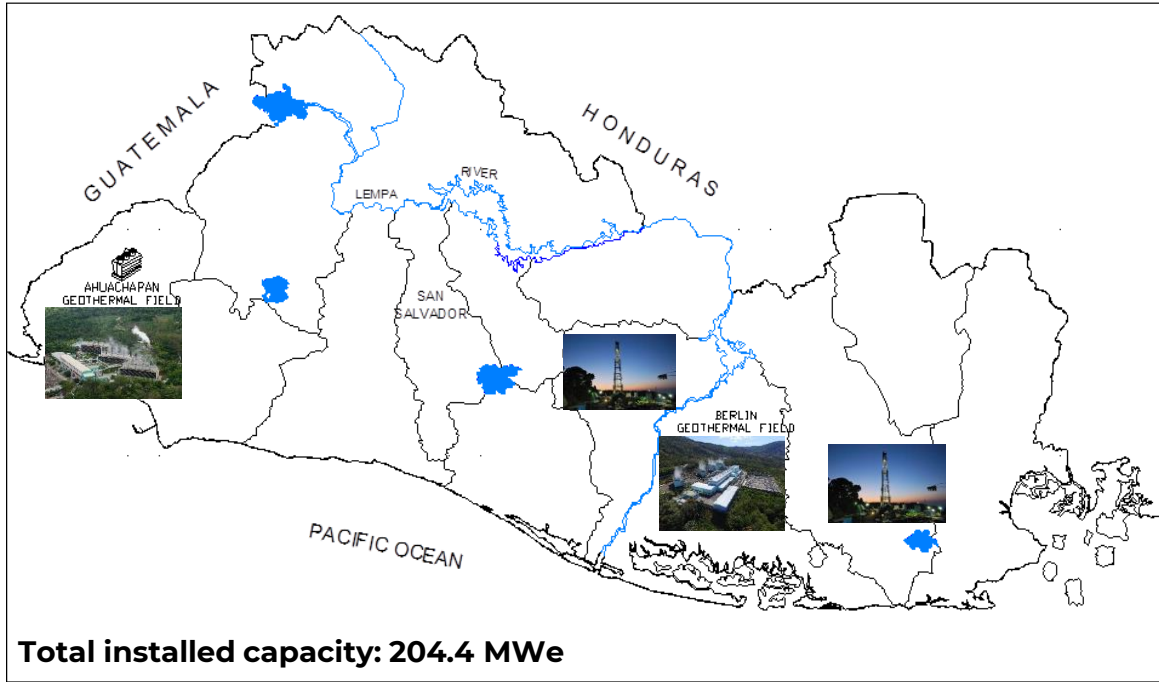
# El Salvador



- Smallest country in Central America
- Known as the Land of Volcanoes
- Area: 21.041 sq. km
- Characterized by major hydrothermal areas, hot springs, fumaroles
- 1960's: Geothermal reconnaissance began in El Salvador by UN.
- 1970's: Geothermal exploration started in Ahuachapán and Berlín
- Geothermal energy for power generation



# Geothermal Fields in El Salvador



LAGEO: state owned geothermal company in El Salvador with 2 geothermal fields in Ahuachapán and Berlín and 2 geothermal projects in San Vicente and Chinameca.

Total installed capacity: 204.4 MW

The geothermal production in El Salvador is over 25 % of the energy matrix of the country.

# Team evaluation LAGEO 2021 (Geologists, geochemists and geophysicists)



Worksheet 1 – Evaluator and Project Owner

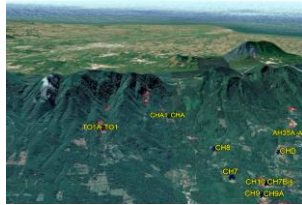
Worksheet 2 - Project Definition

Worksheet 3 – Socio-Economic and Regulatory Factors

Worksheet 1 - Evaluator and Project Owner		
1	Owner/developer of the geothermal project	LAGEO S.A. de C.V.
2	Name, qualifications, experience, governane and affiliation of the Evaluator	Multi-disciplanry group, Gerencia de Estudios (E. Henriquez, P. Santos. M. Garcia, E. Melara, M. Rivera, H. Selva, C. Pullinger)
3	Evaluator's relationship to the Project owner	Permanent employees LAGEO. CV included.
4	Additional requirements that might be imposed by the local regulatory authorities	NA
5	Date of information	Based on documents: ENEL (2005), LAGEO (2021a) y LAGEO (2021b)
6	Evaluation date	18/8/2021
7	Audience for the report	Finance institutions and investors
Worksheet 2 - Project definition		
1	Name and location of the Project	Department of Ahuachapán, 100 km west of San Salvador, SE part of Ahuachapán geothermal field, northern flank of Cuyanausul volcano
2	Prurpose of the Project	Production of 5 MW
3	Geothermal Energy Project (electricity and/or heat)	Electricity
4	Non-energy products	NA
5	Reference Point	Geothermal power plant
6	Significant mass or energy fluxes (apart from the main geothermal fluid and energy flux) that will affect the overall energy conversion process	NA

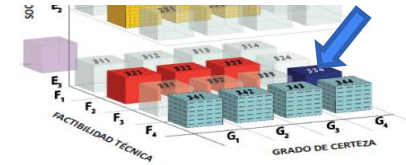
# UNFC in El Salvador

## CUYANAUSUL GEOTHERMAL PROJECT



### CLASSIFICATION

E3/F3/G4  
E3.2/F3.1/G4.1,  
G4.2, G4.3



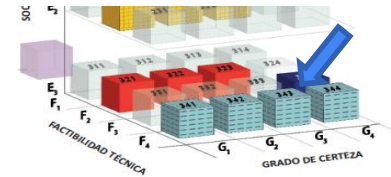
• 4 deep wells, high temperature resource of 270°, production potential not known, initial development 5-10MW estimated

## COATEPEQUE GEOTHERMAL AREA



### CLASSIFICATION

E3/F3/G4  
E3.3/F3.2/G4.1, G4.2,  
G4.3



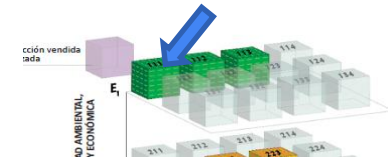
Surface exploration (no well), temp. 220-245°C; Initial development of 5 MW estimated; Uncertainty on the environmental permit

## CHINAMECA GEOTHERMAL PROJECT



### CLASSIFICATION

E1/F1/G1,2,3  
E1.1/F1.3/G1, G2, G3



8 wells; Average well temp. 235°C ; Production capacity of 18-22 MW

# Summary of classification



	Project	UNFC 2019	Observation
Operation	Ahuachapán	E1.1; F1.1; G1 136 MW, G2 112 MW	Extraction and sale occur at present and have been proven to be economical according to market conditions.
	Berlín	E1.1; F1.1; G1 235 MW, G2 199 MW	Extraction and sale occur at present and have been proven to be economical according to market conditions.
Development	San Vicente	E1.1; F1.3; G1 33 MW, G2 16 MW, G3 26 MW	Sufficient detailed information to determine the feasibility of extraction and sale but no funds have been committed for development.
	Chinameca	E1.1; F1.3; G1 66 MW G2 53 MW, G3 11 MW	Sufficient detailed information to determine the feasibility of extraction and sale but no funds have been committed for development.
Pre-feasibility	Cuyanausul	E3.2; F3.1; G4.1 37 MW, G4.2 17 MW, G4.3 26 MW	Existing wells do not allow to determine potential of extraction and sales but information justifies additional evaluation and drilling of a new well.
	Coatepeque	E3.3; F3.2; G4.1 39 MW, G4.2 37 MW, G4.3 53 MW	Surface exploration, drilling wells is justified to determine feasibility of extraction and sale. Uncertainty of obtaining environmental permits.
	Conchagua	E3.2; F3.2; G4.1 42 MW, G4.2 23 MW, G4.3 36 MW	Surface exploration, drilling wells is justified to determine feasibility of extraction and sale..
	Chilanguera	E3.3; F3.2; G4.1 21 MW, G4.2 15 MW, G4.3 23 MW	Surface exploration, drilling wells is justified to determine feasibility of extraction and sale. Uncertainty of obtaining environmental permits.
	Obrajuelo	E3.2; F3.2; G4.1 30 MW, G4.2 37 MW, G4.3 55 MW	Surface exploration, drilling wells is justified to determine feasibility of extraction and sale. Uncertainty of obtaining environmental permits.



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# UNFC- Application Costa Rica

20th June 2023

Leonardo Sólis (ICE, Costa Rica)



# Costa Rica



- Known for achieve around 6.5% of the worldwide biodiversity.
- Area: 51.179 sq. km
- Characterized by hydrothermal areas, hot springs, fumaroles
- 1960's: Geothermal reconnaissance began in Costa Rica by UN.
- 1979: First geothermal well was drilled in Miravalles
- Geothermal energy for power generation



# Geothermal Fields in Costa Rica

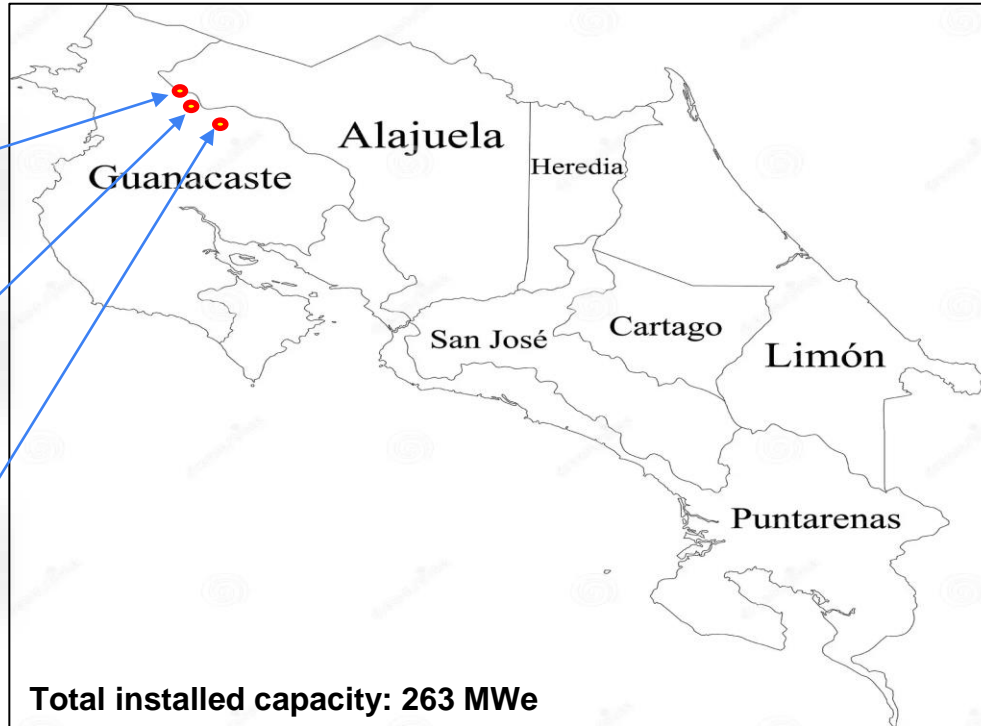
Borinquen I



Las Pailas



Dr. Alfredo Mainieri



ICE: state owned geothermal company in Costa Rica with 2 geothermal fields in Miravalles and Las Pailas.

Total installed capacity: 263 MW

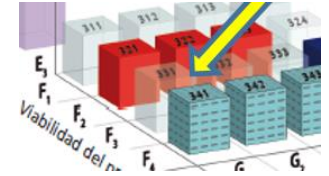
The geothermal production in Costa Rica is over 14 % of the electrical matrix of the country despite geothermal installed capacity just around 7% of the total installed (Hydro, biomass, eolic, solar, fossil and geothermal).

# UNFC in Costa Rica

POCO SOL  
GEOHERMAL  
PROSPECT



**CLASSIFICATION**  
E3.2/F3.3/G4.1



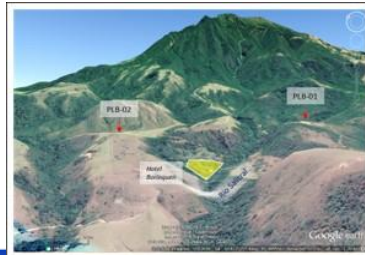
GEOHERMAL  
PROSPECT  
PLB-01  
BORINQUEN



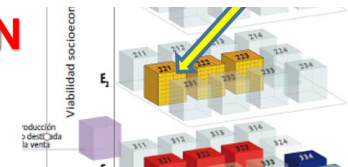
**CLASSIFICATION**  
E1/F1.3/G2



BORINQUEN I  
GEOHERMAL  
PROJECT



**CLASSIFICATION**  
E1.1/F1.2/G1



# Summary of classification



	Project	UNFC 2019	Observations
Operation	Dr.afredo Mainieri	E1.1; F1.1; G1 163 MW	Extraction and sale occur in the present and have been proven to be economical according to market conditions.
	Las Pailas	E1.1; F1.1; G1 97 MW	Extraction and sale occur in the present and have been proven to be economical according to market conditions.
Development	Borinquen I	E1.1; F1.2; G1 55 MW	Sufficient detailed information exists to determine the feasibility of extraction and sale, the project is underconstruction.
	Borinquen II	E1.1; F1.3; G1 55 MW	Sufficient detailed information exists to determine the feasibility of extraction and sale, project has been incorporated into the Electrical Generation Expansion Plan 2022-2040.
Pre and Feasibility	Project 1 (PLB-01)	E1.1; F1.3; G2 12 MW	Sufficient detailed information exists to determine the feasibility of extraction and sale, project has been incorporated into the Electrical Generation Expansion Plan 2022-2040.
	Project 2 (PLM-55)	E1.1; F1.3; G2 12 MW	Sufficient detailed information exists to determine the feasibility of extraction and sale, project has been incorporated into the Electrical Generation Expansion Plan 2022-2040.
	Project 3 (PLM-54)	E1.1; F1.3; G2 12 MW	Sufficient detailed information exists to determine the feasibility of extraction and sale, project has been incorporated into the Electrical Generation Expansion Plan 2022-2040.
	Poco Sol	E3.2; F3.3; G4.1 70 MW	Surface analysis has been carried on. Further research must be undertaken.

# Opportunities

- UNFC is a tool to standardize the classification criteria for the project study and development.
- UNFC indicates the maturity and uncertainty of resources.
- UNFC can be updated, so the evolution of the project can be observed over time.
- UNFC is useful to present project portfolio to potential investors.
- UNFC is a highly useful tool for decision making with regards to the maturity of the projects and highlighting the needs of funds, research and/or logistical adjustments, etc.
- UNFC helps in tracking the evolution of the stages of exploration and development (history) of projects.
- The UNFC process must be enriched by the expertise of countries with long history on geothermal applications, which have not been given sufficient participation on this matter.



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