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Application Européenne de  
Technologies et de Services

# Dominica Geothermal Project and Interconnection with Neighbouring Islands

Assessment and Cost-Benefit  
Analysis

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# 1. Project Background

- Geothermal Potential in Dominica
- Electricity Consumption growing steadily
- Generation mostly based on costly imported fuels: electricity price to final consumer 2 to 3 times higher than Europe / U.S.
- Emission of CO<sub>2</sub> and pollutants to be reduced in Guadeloupe and Martinique

# 2.1. Power Consumption

	Guadeloupe	Peak Load (MW)	Martinique	Peak Load (MW)	Dominica	Peak Load (MW)
2004	1430 GWh	221	1380 GWh	218	70 GWh	13
2000-10 Growth	3,5 to 4%		3 to 4%		1%	
2010-20 Growth	2,5 %		2,5 %		3%	
2010	1781 GWh	280	1560 GWh	253	80 GWh	15
2020	2300 GWh	360	2000 GWh	330	100 GWh	20

## 2.2. Power Generation

(end 2005)	Guadeloupe	Martinique	Dominica
Installed Capacity	440 MW	420 MW	20 MW
Generation	74% HFO/Gas-oil 15% Bagasse/Coal 3% Hydro 3,5% Geothermal (GB1, GB2) 4,5% Wind	100% Imported Fuels	40 % Hydro 60 % Diesel (Gas-oil)
Pollution	180 MW not compliant with EU NOx Directive	200 MW not compliant with EU NOx Directive	
Utility	EDF	EDF	DOMLEC

## 2.3. Medium term needs - Base

Dates / Options	Guadeloupe	Martinique	Dominica
2010	40 MW	-	5 MW
2012	-	40 MW	-
2014	40 MW	-	-
Diesel	Upgrading existing HFO Units / New Units	Upgrading existing HFO Units / New Units	New Plant
Bagasse / Coal	One site only	One site only	
Renewable (other than project)	GB3 mostly	Limited	Under evaluation

## 3.1 Development scenarios

### ➤ **Scenario 1: Minimum Development**

- Dominica 5 MW

### ➤ **Scenario 2: Medium Development**

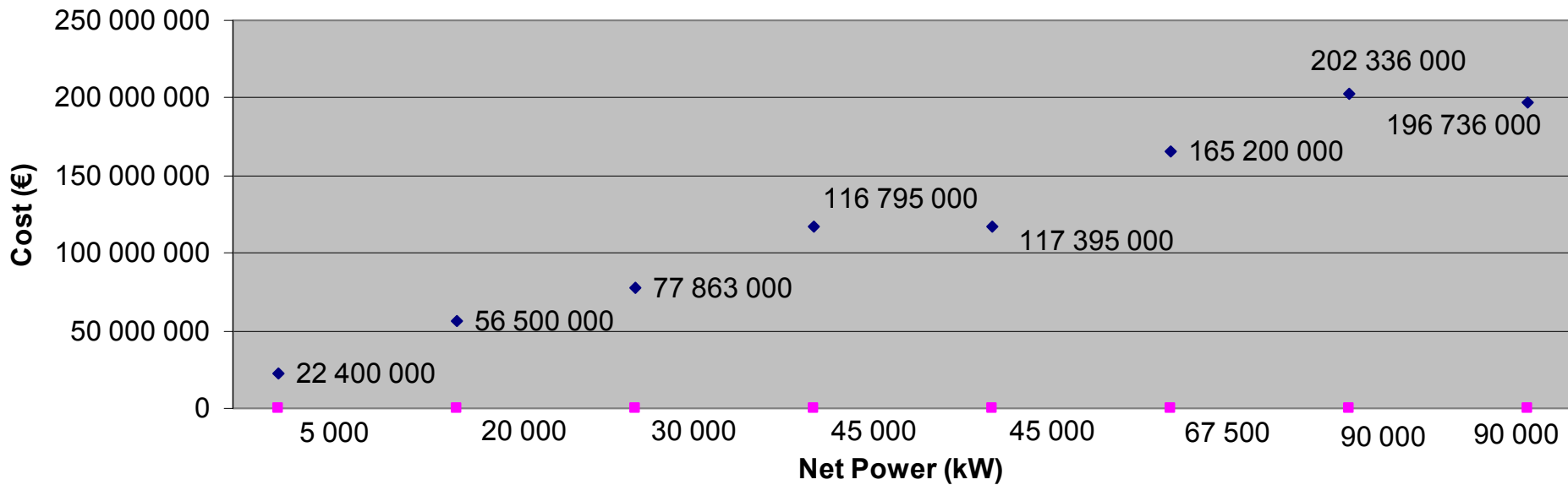
- Guadeloupe+Dominica 20 to 30 MW, Martinique+Dominica 30 MW
- Guadeloupe + Martinique + Dominica 45 MW

### ➤ **Scenario 3: Maximum Development**

- Guadeloupe + Dominica 45 MW, Martinique + Dominica 45 MW
- Guadeloupe + Martinique + Dominica 90 MW

# 3.2. Geothermal Investment

**Development Cost  
( Production Drilling+Steam Field+Power Station )**





## 3.3. Interconnections

- Line routes: see following figure
- Submarine cables: depths of less than 1000 meters
- Overhead lines avoiding protected areas
- Selected voltages: 63 kV and 90 kV
- Main Characteristics
  - See 63 kV example below



The French West Indies comprise two overseas departments of France: Martinique, and Guadeloupe with its dependencies of Marie-Galante, La Désirade, Îles des Saintes, Saint-Barthélemy, and Saint-Martin.

<b>Generation (MW)</b>	<b>Inst. (MW)</b>	<b>Costs (MUS\$)</b>	<b>Con. (yrs)</b>	<b>O&amp;M (%/yr)</b>	<b>Volt. kV</b>	<b>Cost (MUS\$)</b>	<b>Supplied MW</b>
<b>Scenario 1:</b>		<b>Minimum</b>					
<b>Losses</b>		<b>2.0%</b>					
Dominica 5	5	26.9	2	5%	11	0,0	4.9
<b>Scenario 2:</b>		<b>Medium</b>					
<b>Losses</b>		<b>8.6%</b>					
Guadeloupe 2*10	20	67.8	2	4.0%	63	24.0	18.3
Guadeloupe 2*15	30	93.5	2	3.7%	63	29.6	27.4
Martinique 2*15	30	93.6	2	3.7%	63	30.0	27.4
G+M 3*15	45	140.2	3	3.7%	63	59.6	41.1
G+M 2*22.5	45	140.9	3	3.7%	63	59.6	41.1
<b>Scenario 3:</b>		<b>Maximum</b>					
<b>Losses</b>		<b>9.0%</b>					
Guadeloupe 2*22.5	45	140.9	3	3.7%	63	33.6	41.0
Martinique 2*22.5	45	140.9	3	3.7%	63	34.6	41.0
G+M 3*30	90	242.8	4	3.7%	63	68.2	81.9
G+M 2*45	90	236.0	4	3.7%	63	68.2	81.9

# 4. Cost-benefit Analysis

## ➤ 4.1. Basic Assumptions

- **2\*45 MW, 63 kV AC link to Guadeloupe and Martinique**
  - Investment includes all drilling costs
  - 61 km overhead lines (in Dominica); 128 km submarine cable
  - Total investment 308.6 MUS\$
- **Baseline Generation Costs (roughly based on crude oil price of 60 US\$/bbl):**  
120 US\$/ MWh (Guadeloupe, Martinique) ; 170 US\$/ MWh (Dominica)
  - **Sensitivity Analysis: 40 US\$/bbl**
- **Discount rate : 11% (sensitivity 8% and 14%)**
- **Tons of avoided CO2 and pollutants not included in monetary benefits**

# 4. Cost-Benefit Analysis

## ➤ 4.2. Results

- According to fuel costs (40 to 60 US\$/bbl)
  - Internal Rate of Return between 13% and 23%
  - Payback on investment between 13 and 6 years
- According to discount rates (8 to 14%)
  - Cost of delivered geothermal kWh from 0.08 US\$ (8%) to 0.091 (11%) to 0.103 (14%)
  - Cost of diesel option at 0.135 US\$/kWh

# 4. Cost-Benefit Analysis

- Avoided tons of CO<sub>2</sub> Emissions
  - 420 kton/y, or
  - 8.4 MUS\$/y for a value of 20 US\$/ton
- Avoided other pollutants (NO<sub>x</sub> in particular)
  - Not quantified, but overall benefits are expected in French islands

# 5.1 Next steps

- More precise evaluation of power links' costs, including bathymetric studies and analysis of cable laying conditions, and study of overhead line routes
- Economic optimisation of project phasing and development, based on preliminary drilling results, corresponding geothermal generation costs and power links' costs
- Network operation studies (in particular stability studies) to determine the technical feasibility of combined operation of geothermal units and islands' interconnected networks

## 5.2. Replicability

### Preliminary Assessment of Possibilities for St. Kitts & Nevis and St. Lucia:

- St. Kitts and Nevis: 2\*5 MW with interconnection link, total 50 MUS\$, delivery cost 0.12 US\$/kWh
- St. Lucia: 2\*5 MW, total 45 MUS\$, delivery cost 0.11 US\$/kWh
- Equivalent Diesel generation cost: 0.14 US\$/kWh under current fuel cost conditions
- Pre-feasibility studies are recommended, including analysis further interconnections to neighbouring islands



## 5.3 Conclusions

- If geothermal resource is confirmed, the Project is economically attractive under a wide range of assumptions
- Expected Rates of Return make Project suitable for PPP scheme
- Differences in kWh delivery costs show that other similar projects can be attractive with interconnections:
  - Cost of delivered geothermal kWh from 0.08 US\$ to 0.11
  - Cost of diesel options from 0.135 to 0.15 US\$