An Overview of the barriers for sustainable development of GEOTHERMAL ENERGY potential in Nisyros-GR, Pantelleria-I and Guadeloupe-FR Islands.

A. Desplan, F. Boissier, H. Traineau, R. Nannini, G. Sideris, C. Karistas

Increasing policy makers' awareness and public acceptance
Athens, Greece, Workshop6

Géosciences pour une Terre durable
brgm

An observation in 3 stages

> 1st observation :

energy production in the peripheral islands, by the means of fossil energy, present two major disadvantages :

- a high level of production cost,
- environmental nuisances (pollution & risk).

> 2nd observation :

Geothermal energy presents some advantages :

- No pollution risks from the transport (local energy),
- No pollution from the combustion of the fossil energy,
- In the Islands, very competitive with fuel power plants,
- average availabilité upper than 90%

> 3rd observation :

In some Peripheral European Islands, Geothermal resources exists, or more were proved or tested - like in Greece (Aegean,..), in Italy (Aeolian,..), in France, in Portugal –

***but this energy was not frequently developed*.**

Géosciences pour une Terre durable
brgm

The GE- ISLEBAR project

- So the question is : Why ?

- The GE Islebar project was funded by the european FP5 to explore this question

- Partners :
  - **BRGM, France**
  - **CFG, France**
  - **CESEN, Italy**
  - **MENTOR, Greece**

GE ISLEBAR = “REMOVAL OF BARRIERS TO THE DEVELOPMENT OF GEOTHERMAL RESOURCES IN EUROPEANS PERIPHERAL ISLANDS”

> **Objectives :**

> **firstly to:**

- find the causes which made obstacles to the development of this kind of energy,
- make a comprehensive assessment of the barriers

> **secondly to propose some solutions to solve difficulties, or to overcome those barriers.**

Géosciences pour une Terre durable
brgm

A tale of three islands….

Guadeloupe :

- **Development of a 4 MW geothermal power plant**
- **Followed by a 10 MW extension**
- **Opportunities of direct uses…**

Pantelleria :

- **Project of a power plant**
- **Project of a spa near Lago di Venere**

> Nisyros :

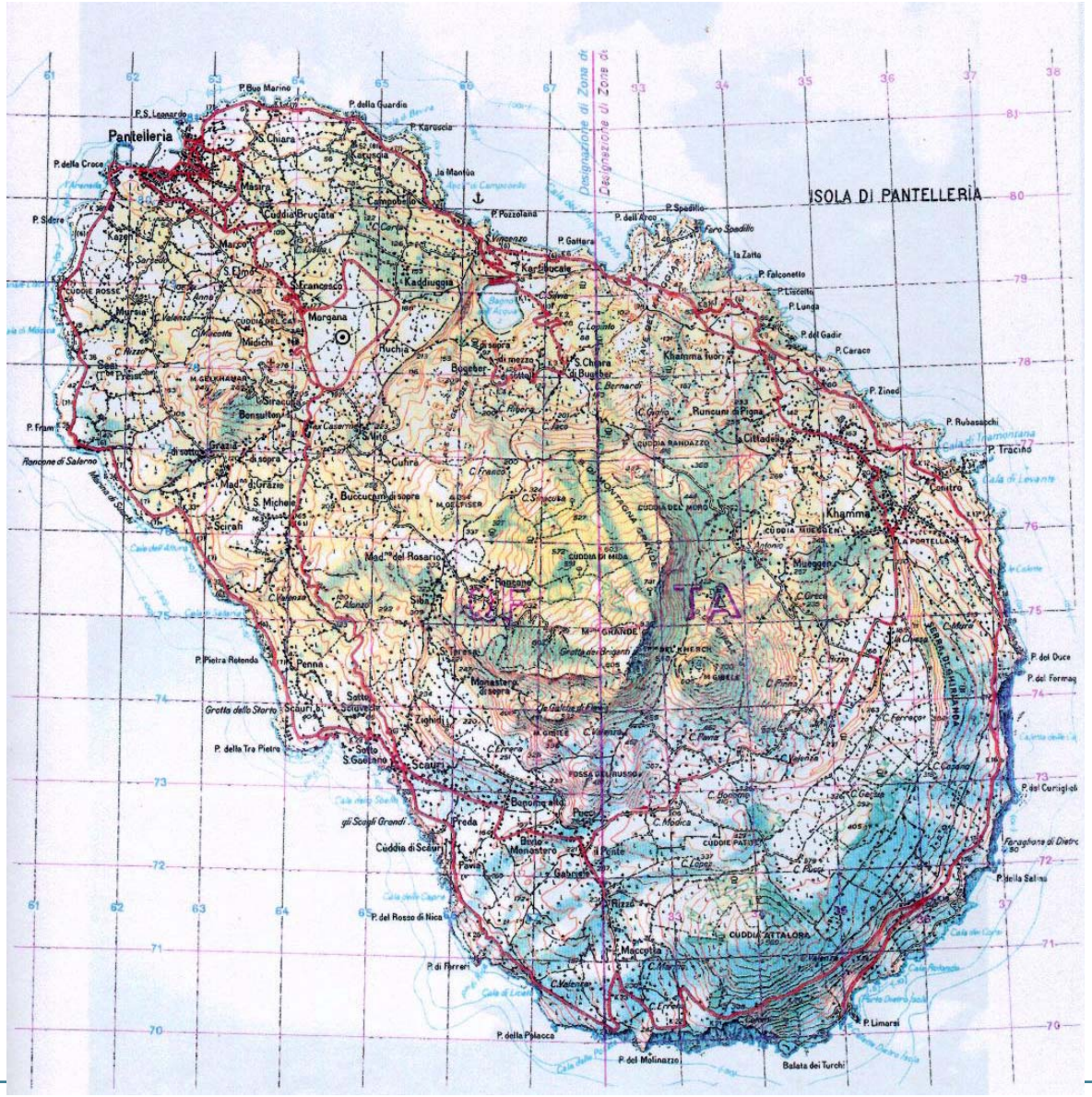
- **Project of power plant**
- **Project of a desalinisation unit**

Géosciences pour une Terre durable
brgm

A (temporary ?) failure story : Pantelleria

Géosciences pour une Terre durable
brgm

Presentation of Pantelleria Island



brgm
Géosciences pour une Terre durable

Some figures about Pantelleria

> *Superficie : 83 km²*

> *Population :*

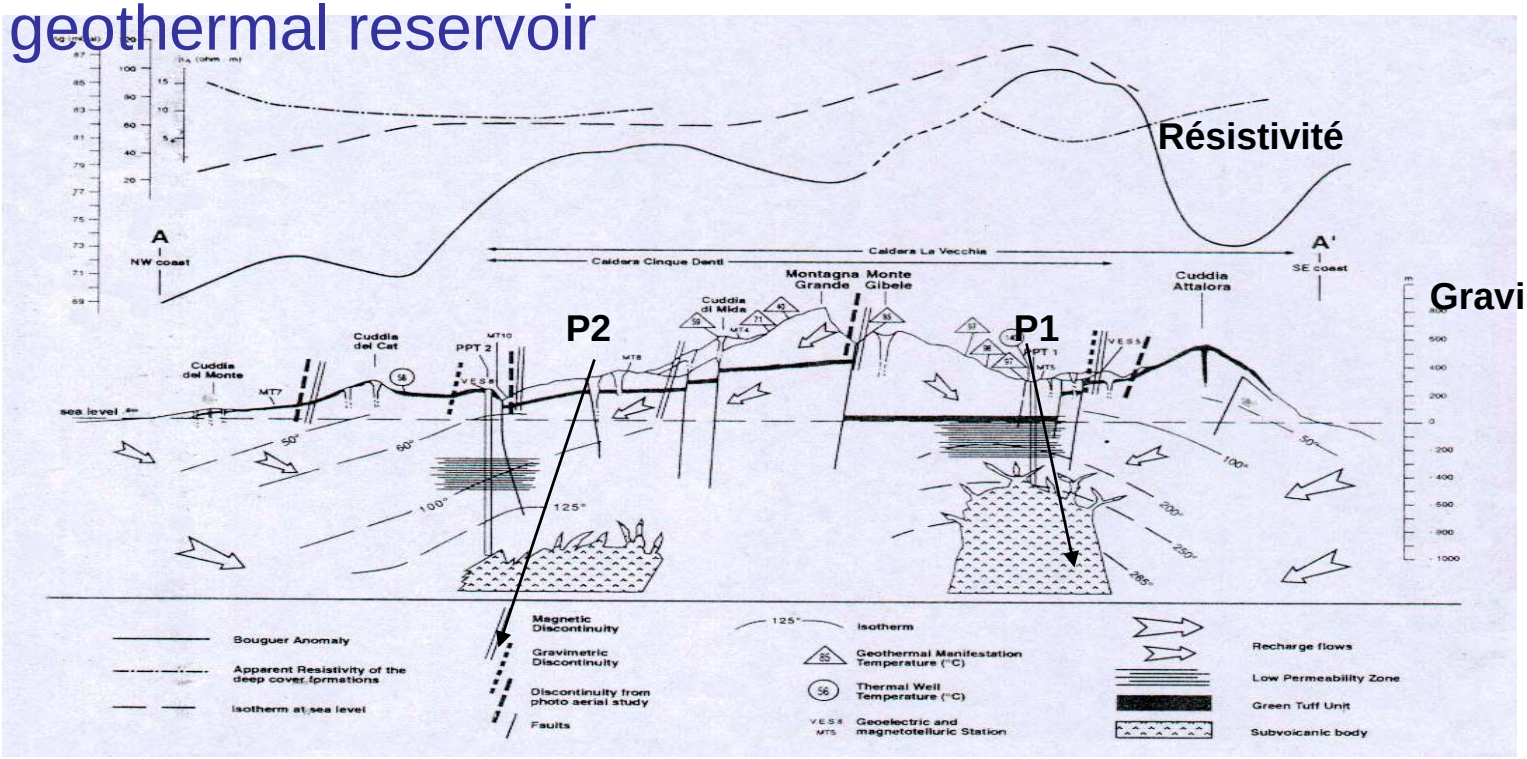
- ***8 000 inhabitants***
- ***100 000 visitors per year***

> *Economy based on agriculture and tourism*

> *Energy demand :*

- ***Summer : 2 to 7,5 MW***
- ***Winter : 1,6 to 5,4 MW***

Simplified model of fluid circulation in the Pantelleria geothermal reservoir



> *1990-1994 : exploration*

- ***Multidisciplinary surveys***
- ***Two exploratory drillings***

Project prepared on Pantelleria : 2,5 or 5 MW power plant

> *Project planned in 3 phases :*

- ***1st Phase – Additional Investigations***
- ***2nd Phase – Drilling of Exploration/Exploitation Wells and Tests***
- ***3rd Phase – Design, Installation and Start-up of the Power Plant***

> *Total cost :*

- ***13 M€ in a 2,5 MW scenario***
- ***19 M€ in a 5 MW scenario***

> *Technical-economic analysis :*

- ***Pay back time in 10 years without grant***
- ***pay back time in 4 years assuming a 70% grant***

Géosciences pour une Terre durable
brgm

But… nothing happened :

- **The mining concession in charge of Ente Minerario Siciliano is expired.**
- **The two exploration wells (and also the productive one) have been “closed” and abandoned.**
- **The Consortium for the implementation of the project has not been established.**
- **The regional Agency for mining activity and natural resources (EMS – Ente Minerario Siciliano) has been dismanted**

An assessment of the barriers for this project

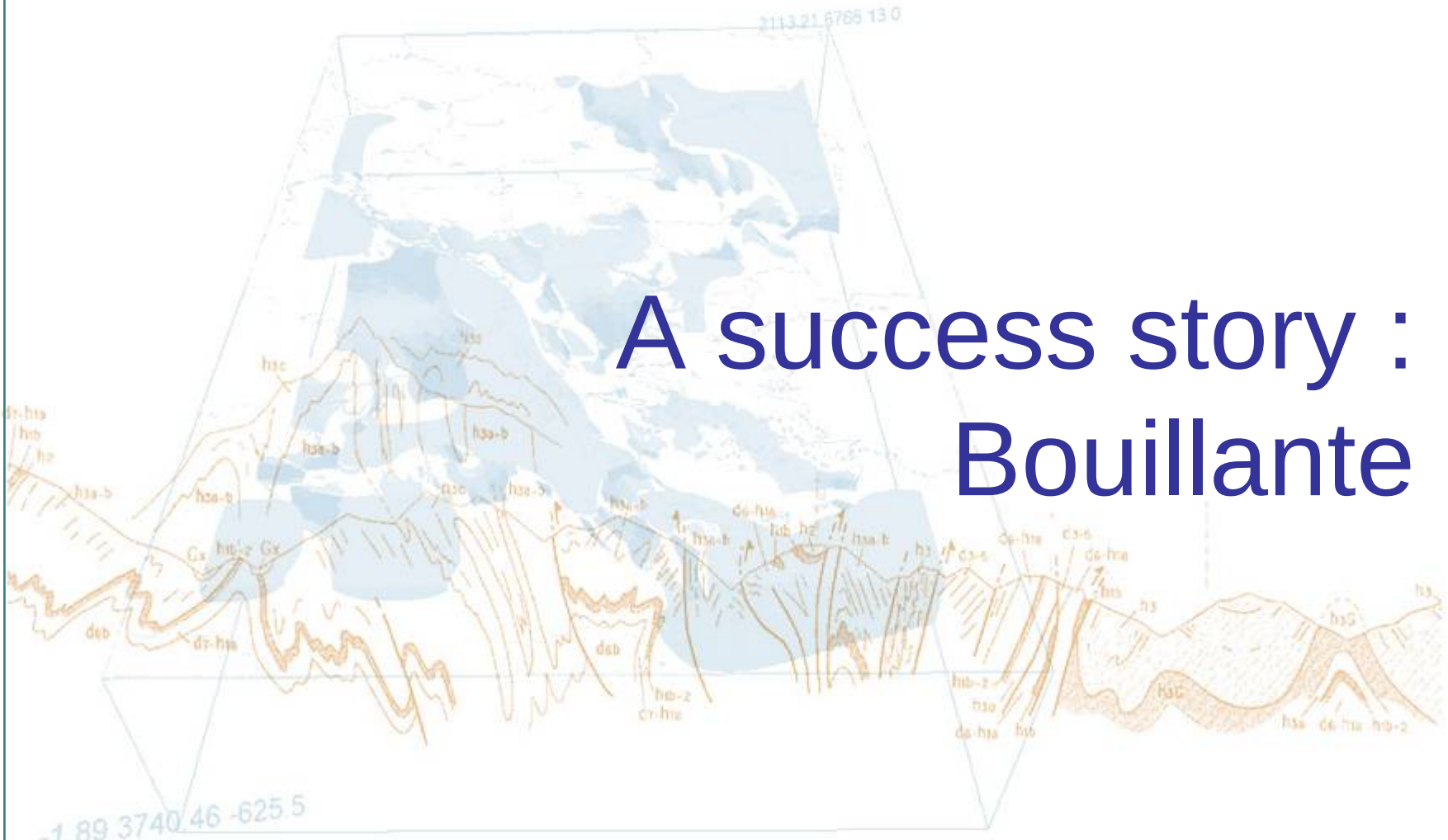
> Some good assets :

- The quality of the expected resource is qualified as quite good, as well as the technical feasibility of the plant
- The economy of the project was good, provided grants could be obtained
- The energy demand was sufficient, with no more competitive alternative energy resource.

> But others barriers jeopardized the project :

- The visual impact was identified as a problem
- There were hostile local groups :
  - Farmers
  - Environmental groups
- And last but not least : there was a lack of a strong entity in charge of the overall organisation

A success story : Bouillante



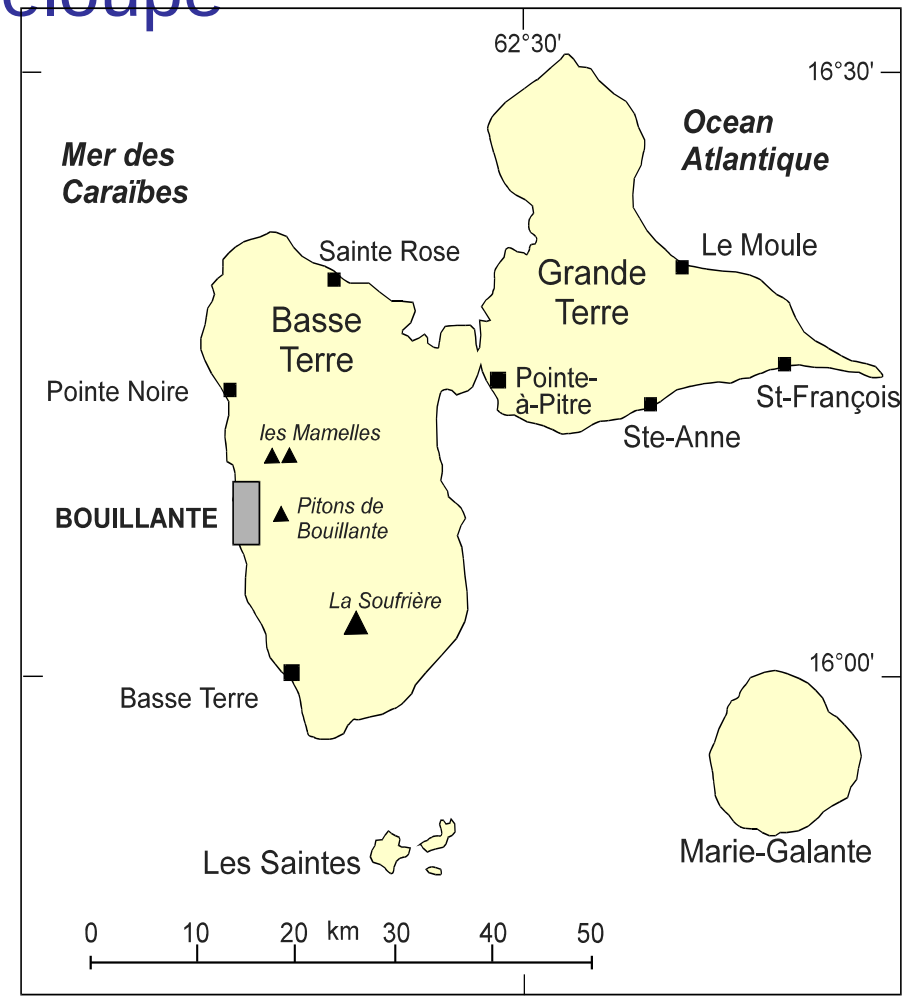
Géosciences pour une Terre durable
brgm

Some facts about Guadeloupe

<u>Guadeloupe</u> : 1,520 km2
: 420,000 inhabitants

Activity : Tourism
Agriculture
Public services

Weather : tropical, humid
Air Temp. : 19 - 32°C
Sea water T: 28 - 30°C



The story of the Bouillante geothermal exploitation

- **investigations and exploratory drilling carried out between 1963 and 1999.**
- **The Bouillante geothermal resources are exploited for electricity generation since 1986 when a first 5 MWe power plant was implemented by EDF.**
- **In 2000, a new project aiming to implement a second power plant started. This new 10 MWe plant operates since 2005.**

Panorama of the Bouillante Bay and the Bouillante City.

Bouillante population : 8,000 inhabitants **Activity : Tourism**
Bouillante area : 44 km2

The actors of the Bouillante geothermal exploitation

1986 to 1995

EDF : Plant owner and operator

EURAFREP : Wells owner and steam supplier

From 1996

GEOTHERMIE BOUILLANTE S.A. : Wells and plant owner, and operator, and investor

EDF : The French Electricity Company (public company)
EURAFREP : a French oil drilling company (private)
BRGM : The French Geological and Mining Survey (public entity)

GEOTHERMIE BOUILLANTE S.A. : a private company with two shareholders
BRGM Group (60%)
EDF Group (40%)

Local socio-economic benefits generated by the Bouillante geothermal plant

Direct benefits

- Plant staff :10-12 employees

- Activities of local sub-contractors involving skilled and unskilled workers for M&O (about 100-300 000 /year); much more during drilling and building phase.
  - electrical,
  - piping, welding, insulation,
  - civil works, painting, guard, plant routine maintenance,
  - accommodation (hotel, restaurant, …)

- Taxes for the local municipality budget.

Géosciences pour une Terre durable
brgm

Local/Regional socio-economic benefits generated by the Bouillante geothermal plant

Indirect benefits and attraction

- Attractive image of a Community/Region using a local renewable energy;

- Tourist attraction (tens of visitors per week);

- Lower electricity production cost (0,08 €/kWh) compare to the production cost of diesel plants (0,15 €/kWh). This has a beneficial impact for the "National Balance Fund" which supports the difference between the production cost (higher in islands than in France) and the selling price for the customer (similar whatever the place);

- Oil saving generated by the exploitation of geothermal resources. This reduces the amount of oil importations;

Environmental benefits

- Use of geothermal resources in place of diesel for electricity generation greatly reduced gas emissions (CO_2, SO_2) and other forms of air pollution (dust) responsible of acid rains and greenhouse effect.

- Use of local geothermal resources doesn't require any long transport by sea or land, any refining or treatment processes after extraction, avoiding risks of pollution.

- Land use for extraction of geothermal resources (wells, pipelines) is small compared to land use for other fossil energy sources (oil, gas, coal).

- Geothermal resources are renewable, not subject to be exhausted, and will be available for future generations.

Public acceptance

The exploitation of the Bouillante geothermal resources always benefited from a high level of public acceptance. There was no report of local hostile attitude or misleading opinions.

Some frequently reported attitudes and opinions of the local community about exploitation of geothermal resources are (among others):

- Visitors and tourists are attracted by the environmental-friendly use of the geothermal resources;
- There is a strong demand for visiting the plant and for a better understanding of the exploitation of geothermal resources (tens of visitors per week);
- Sub-marine hot springs (well developed in the Bouillante Bay) represent an attraction for divers which are a significant part of tourists visiting Bouillante;

Géosciences pour une Terre durable
brgm

Public acceptance

- The low-level sulphur smelt (in the Bouillante area) is ascribed to the expression of a natural energy source related from the underground volcanic activity and not as a pollution problem related to a plant.

- Bouillante inhabitants never expressed any fear about environmental damage or health effect, before and during the geothermal plant operation;

- Geothermal resources are considered as part of the natural patrimony (like mountains, forests, land, sea,…). Their exploitation is considered as a positive environmental attitude coexisting with a sustainable development project.

- the local community is proud of its geothermal resources and proud to supply electricity to other community.

- Only point of conflict : Noise caused by the operation of the plant

Public acceptance : WHY ?

The positive attitude of the local community is tentatively ascribed to several factors (without any ranking) :

- It considers direct and indirect socio-economic benefits (rate of unemployment in Guadeloupe is high);
- First experiences (drilling in the 1970's and implementation of the 5 MWe plant in the 1980's) were properly managed by the actors, especially by EDF (the National Electric Company).
- The Bouillante Municipality, the Regional Council, the local administrations, strongly supported the Project;
- Because of the involvement of EDF as investor and operator of the first plant, the exploitation of the geothermal resources has been considered like a ‘public utility’ providing electricity to the community.

A benchmark of the three case studies

Géosciences pour une Terre durable

brgm

Methodology of GE-ISLEBAR

> Classification of the barriers

> Each barrier has been considered as a criticality

> a "criticality index" has been assigned to each criticality in proportion to its ability to obstacle or hinder the implementation of the project :

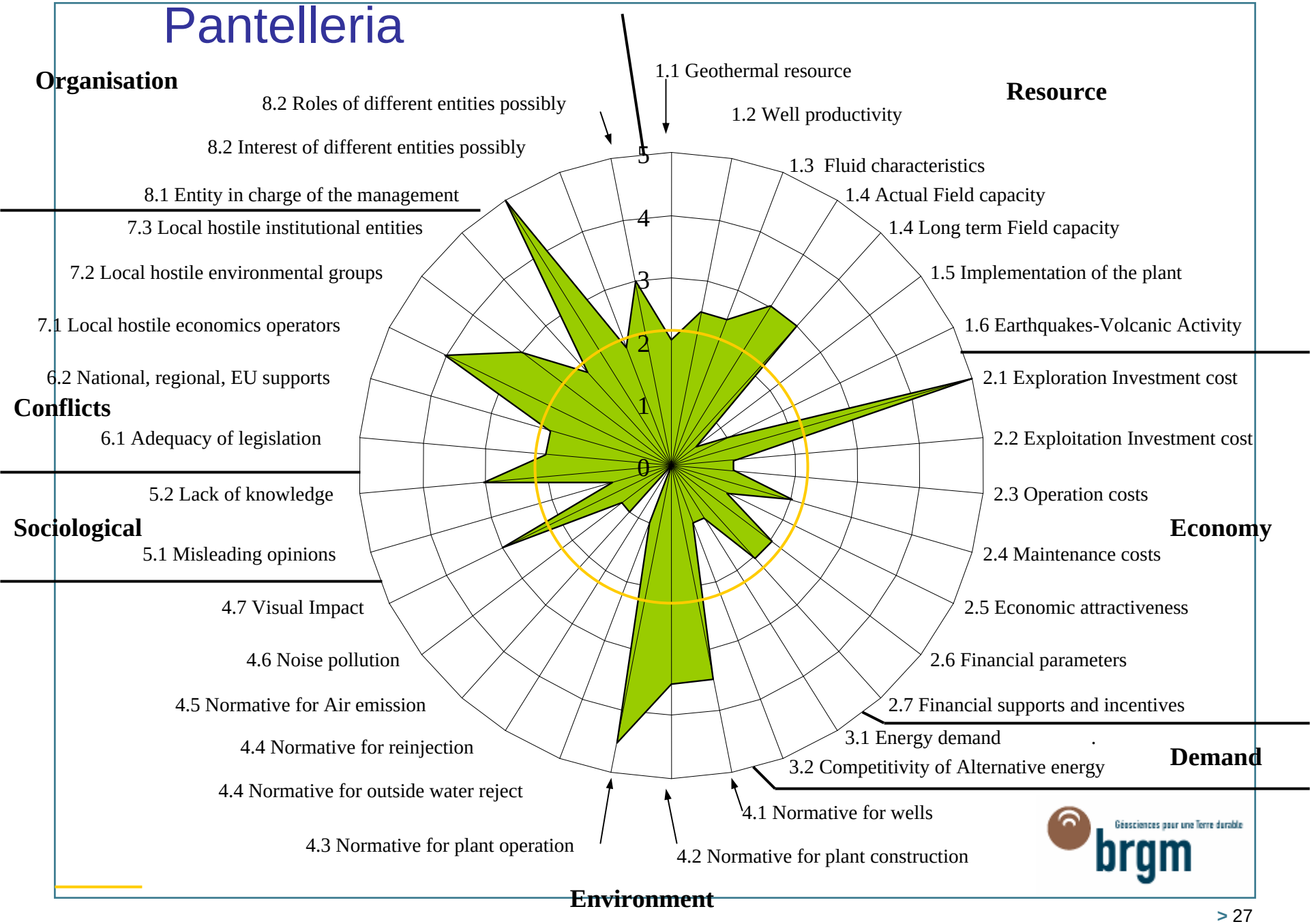
- **From very low**
- **…to very high**

A classification of the barriers

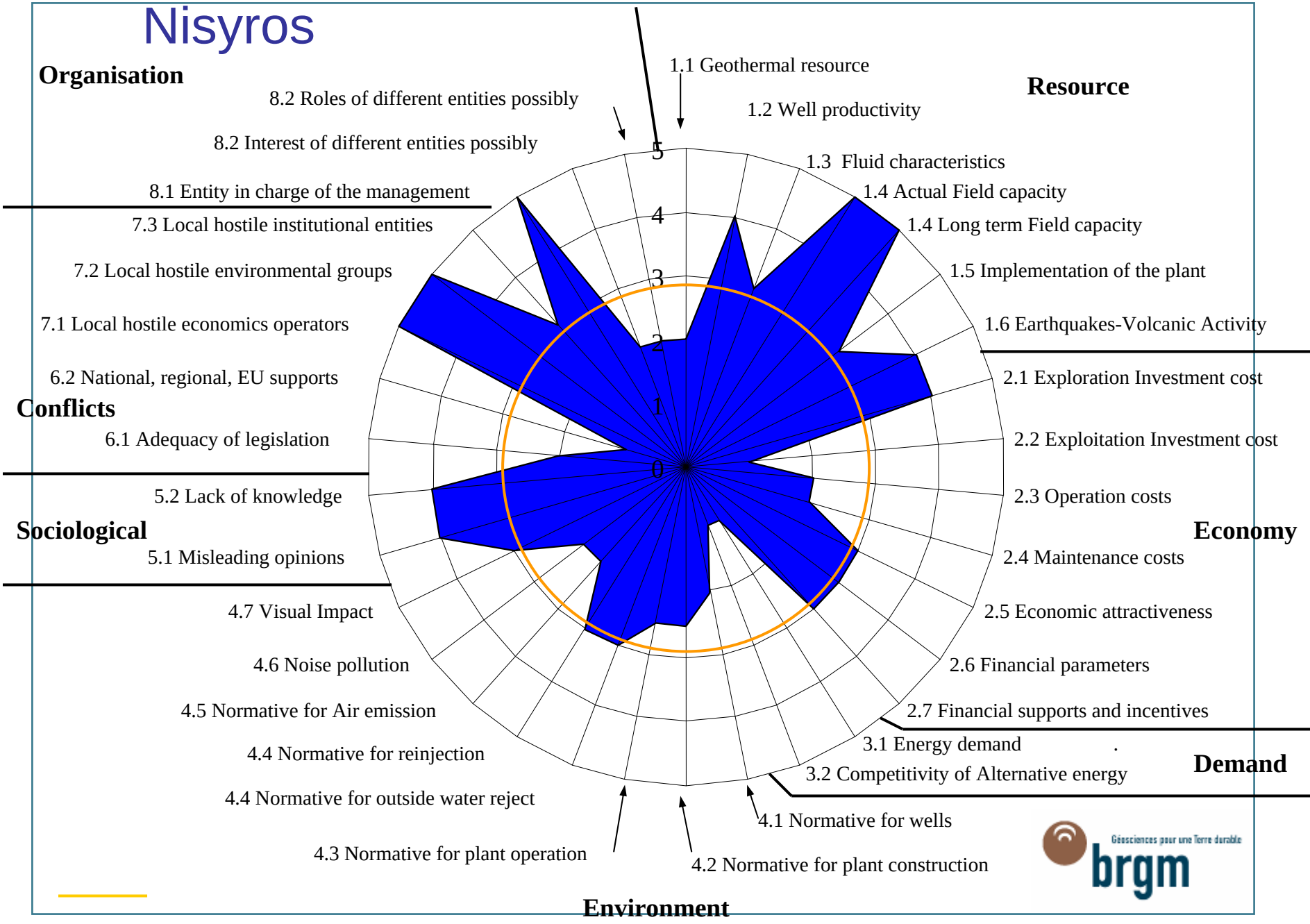
> 7 types of barriers were selected :

- Resource (Geothermal resource, Well productivity, Fluid characteristics, Actual Field capacity, Long term Field capacity, Implementation of the plant, Earthquakes-Volcanic Activity)
- Project economy (Exploration Investment cost, Exploitation Investment cost, Operation costs, Maintenance costs, Economic attractiveness, Financial parameters, Financial supports and incentives)
- Demand (Energy demand, Competitivity of Alternative energy)
- Environment (Normative for wells, for plant construction, for plant operation, for outside water reject, for reinjection, for Air emission, Noise pollution, Visual Impact)
- Sociological aspects (Misleading opinions , Lack of knowledge)
- Conflicts of interest towards the project (Adequacy of legislation, National, regional, EU supports, Local hostile economics operators, Local hostile environmental groups, Local hostile institutional entities)
- Organisation of the project (Lack of entity in charge of the management, competition between different entities, confusion among the roles of different entities)

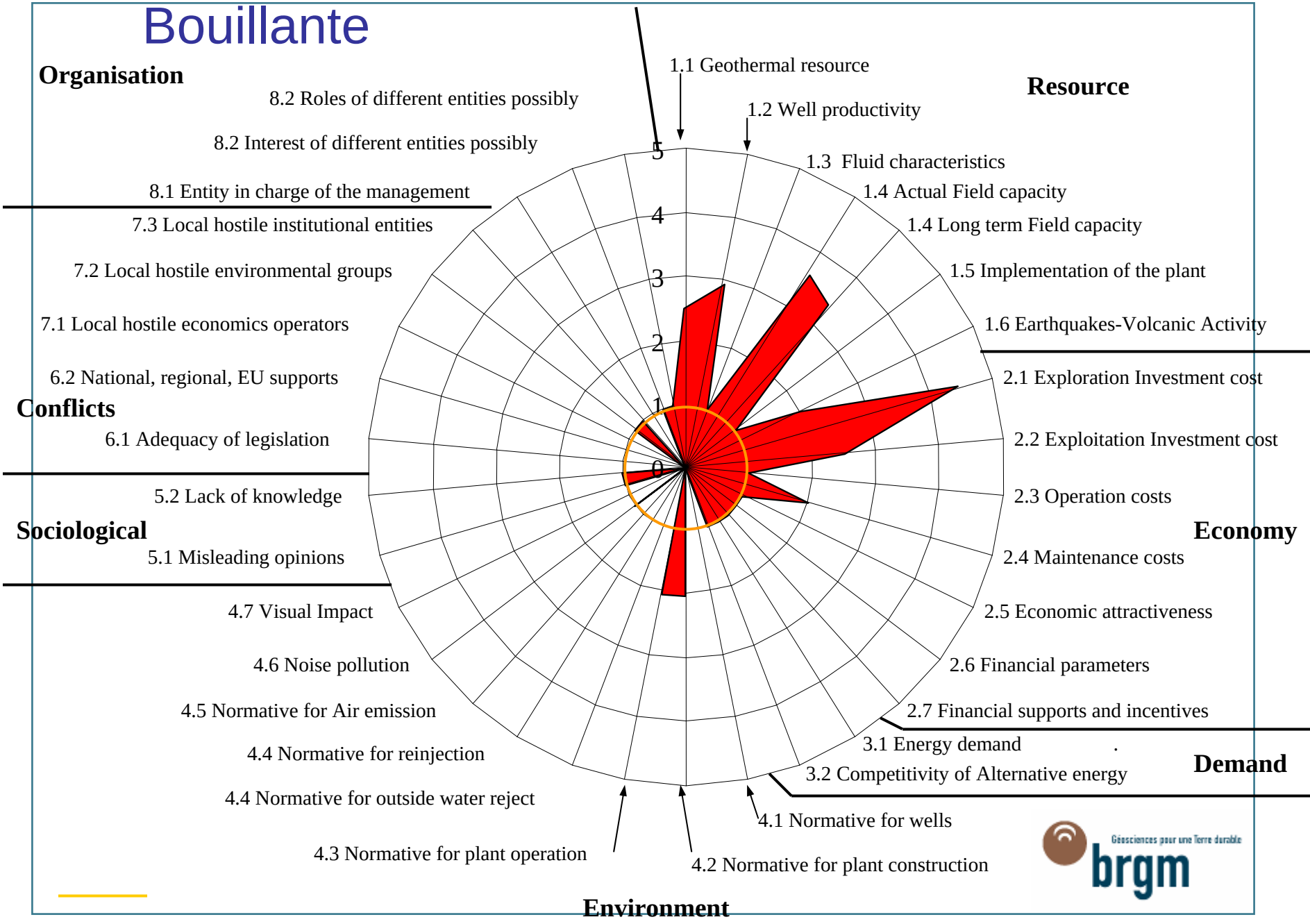
Pantelleria



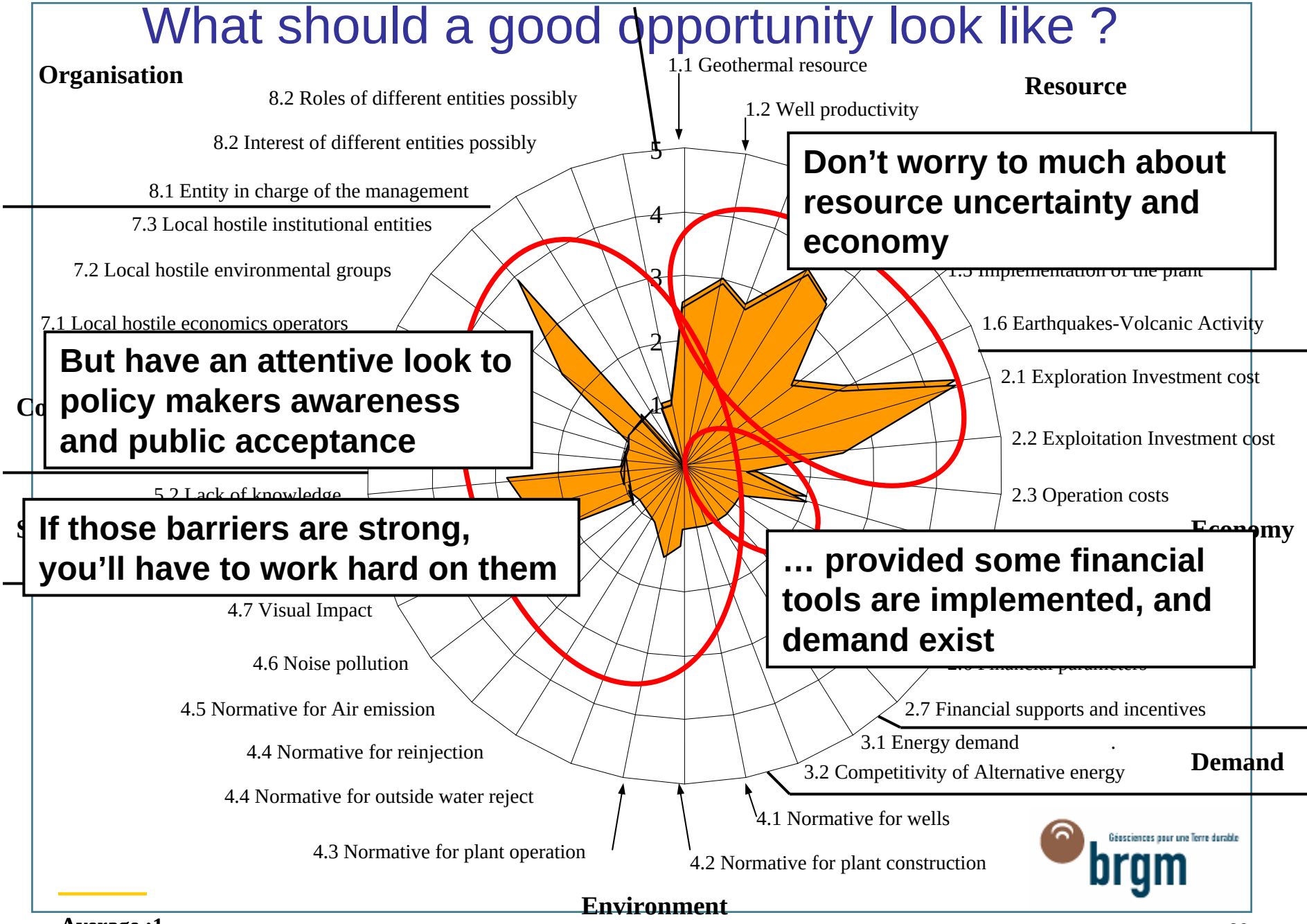
Nisyros


Organisation
8.2 Roles of different entities possibly
8.2 Interest of different entities possibly
8.1 Entity in charge of the management
7.3 Local hostile institutional entities
7.2 Local hostile environmental groups
7.1 Local hostile economics operators
6.2 National, regional, EU supports
Conflicts
6.1 Adequacy of legislation
5.2 Lack of knowledge
Sociological
5.1 Misleading opinions
4.7 Visual Impact
4.6 Noise pollution
4.5 Normative for Air emission
4.4 Normative for reinjection
4.4 Normative for outside water reject
4.3 Normative for plant operation
4.2 Normative for plant construction
4.1 Normative for wells
3.2 Competitivity of Alternative energy
3.1 Energy demand
Demand
2.7 Financial supports and incentives
2.6 Financial parameters
2.5 Economic attractiveness
2.4 Maintenance costs
2.3 Operation costs
2.2 Exploitation Investment cost
2.1 Exploration Investment cost
Economy
1.6 Earthquakes-Volcanic Activity
1.5 Implementation of the plant
1.4 Long term Field capacity
1.4 Actual Field capacity
1.3 Fluid characteristics
1.2 Well productivity
1.1 Geothermal resource
Resource
Environment
0
1
2
3
4
5

Bouillante


Organisation
8.2 Roles of different entities possibly
8.2 Interest of different entities possibly
8.1 Entity in charge of the management
7.3 Local hostile institutional entities
7.2 Local hostile environmental groups
7.1 Local hostile economics operators
6.2 National, regional, EU supports
Conflicts
6.1 Adequacy of legislation
5.2 Lack of knowledge
Sociological
5.1 Misleading opinions
4.7 Visual Impact
4.6 Noise pollution
4.5 Normative for Air emission
4.4 Normative for reinjection
4.4 Normative for outside water reject
4.3 Normative for plant operation
Environment
4.2 Normative for plant construction
4.1 Normative for wells
3.2 Competitivity of Alternative energy
3.1 Energy demand
Demand
2.7 Financial supports and incentives
2.6 Financial parameters
2.5 Economic attractiveness
2.4 Maintenance costs
2.3 Operation costs
2.2 Exploitation Investment cost
2.1 Exploration Investment cost
Economy
1.6 Earthquakes-Volcanic Activity
1.5 Implementation of the plant
1.4 Long term Field capacity
1.4 Actual Field capacity
1.3 Fluid characteristics
1.2 Well productivity
1.1 Geothermal resource
Resource
5
4
3
2
1
0

What should a good opportunity look like ?



Average :1