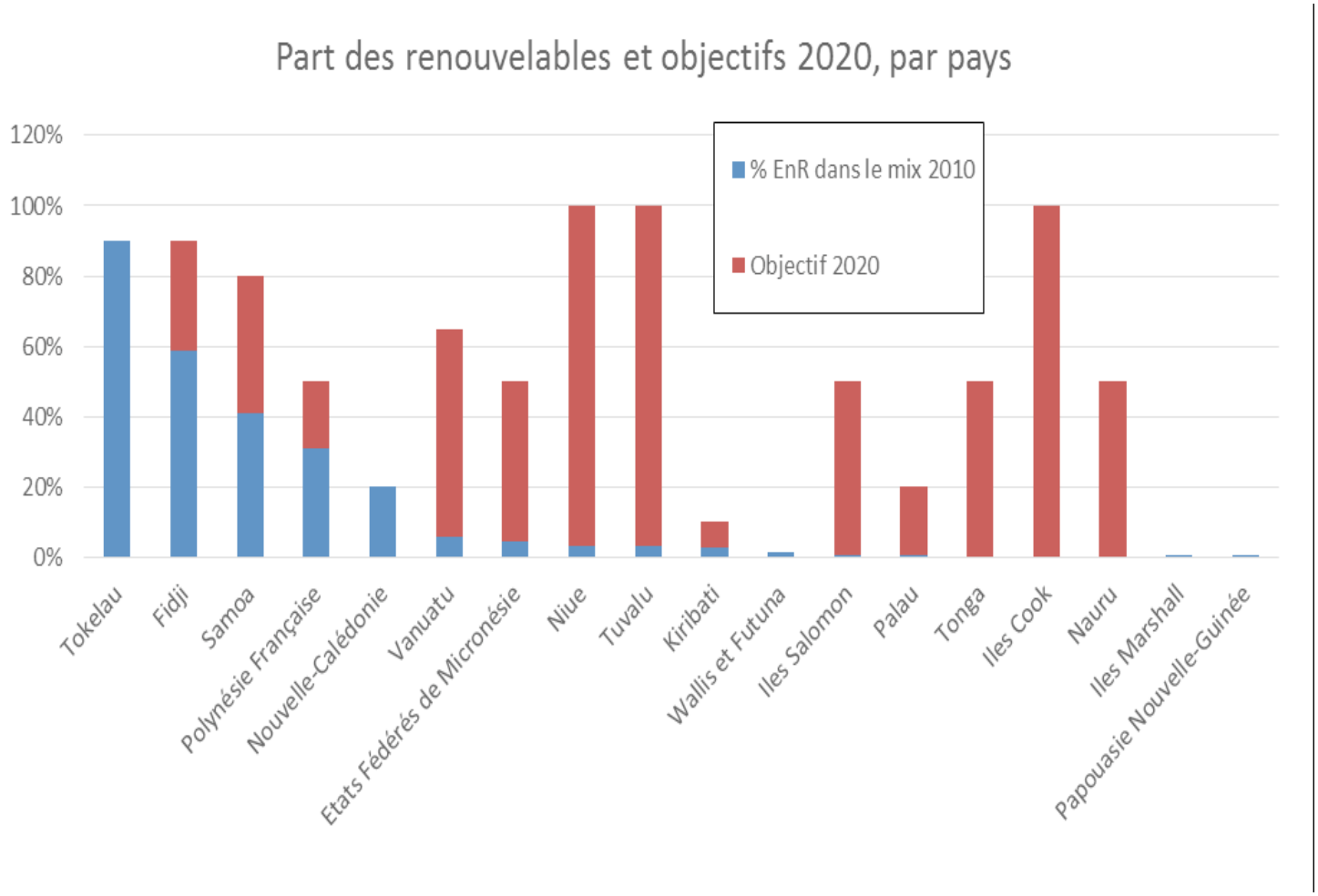
TROPICAL ISLANDS : REDUCING ENERGY IMPORTS, THE CASE OF FRENCH POLYNESIA

SMALL ISLANDS OF THE PACIFIC ARE VERY CONCERNED BY SUSTAINABLE DEVELOPMENT. THEY MET IN APIA RECENTLY AND PUBLISHED A COMMUNIQUΓ :

« We, the Heads of State and Government and high-level representatives, having met in Apia from 1 to 4 September 2014 at the third International Conference on Small Island Developing States, with the full participation of civil society and relevant stakeholders, reaffirm our commitment to the sustainable development of small island developing States. This can be achieved only with a broad alliance of people, governments, civil society and the private sector all working together to achieve the future we want for present and future generations. »

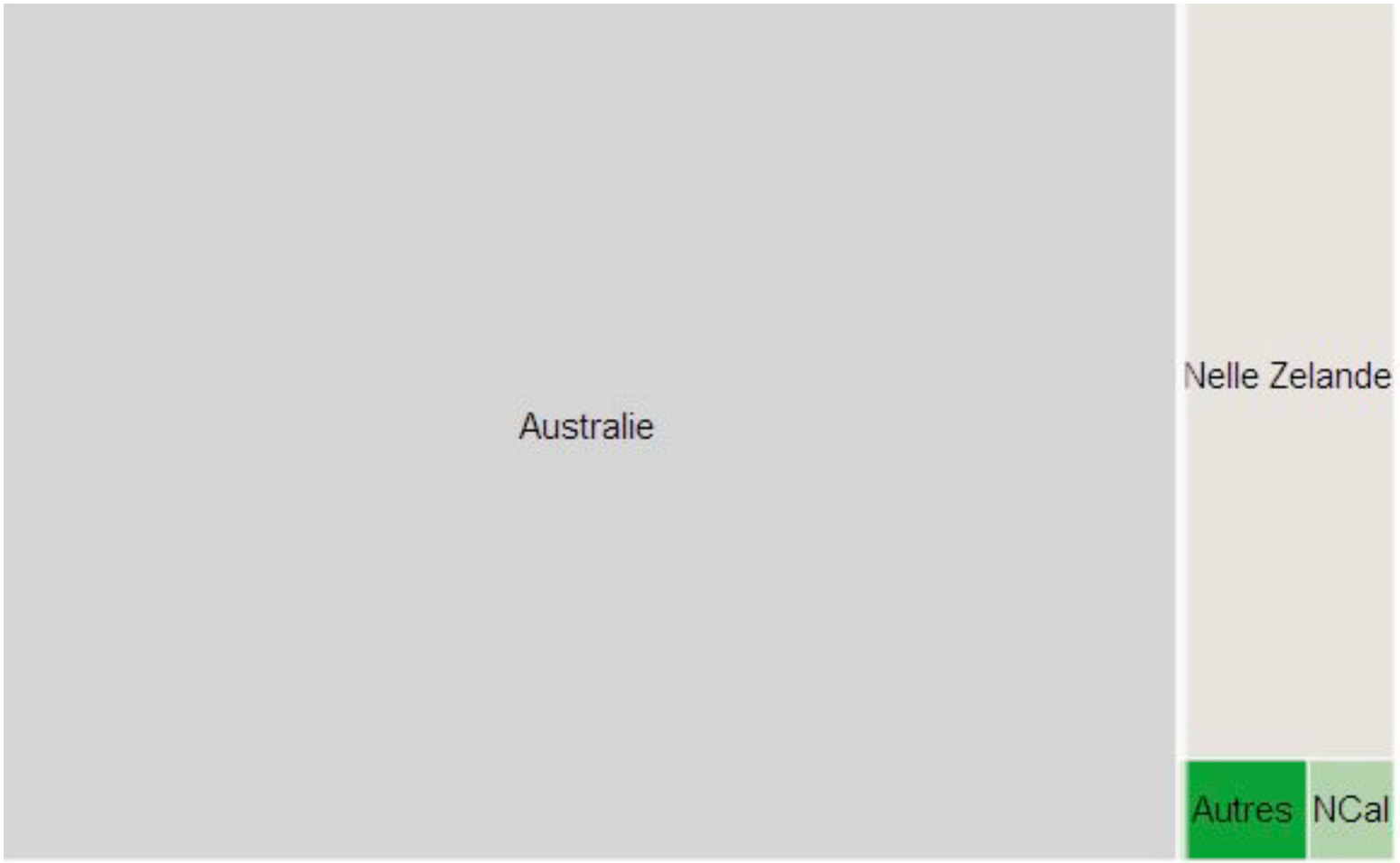
ENERGY SECTOR IS OF PRIME IMPORTANCE TO THIS AIM..

.
« We recognize that dependence on imported fossil fuels has been a major source of economic vulnerability and a key challenge for small island developing States for many decades and that sustainable energy, including enhanced accessibility to modern energy services, energy efficiency and use of economically viable and environmentally sound technology, plays a critical role in enabling the sustainable development of small island developing States. »



From AFD report oct 2014

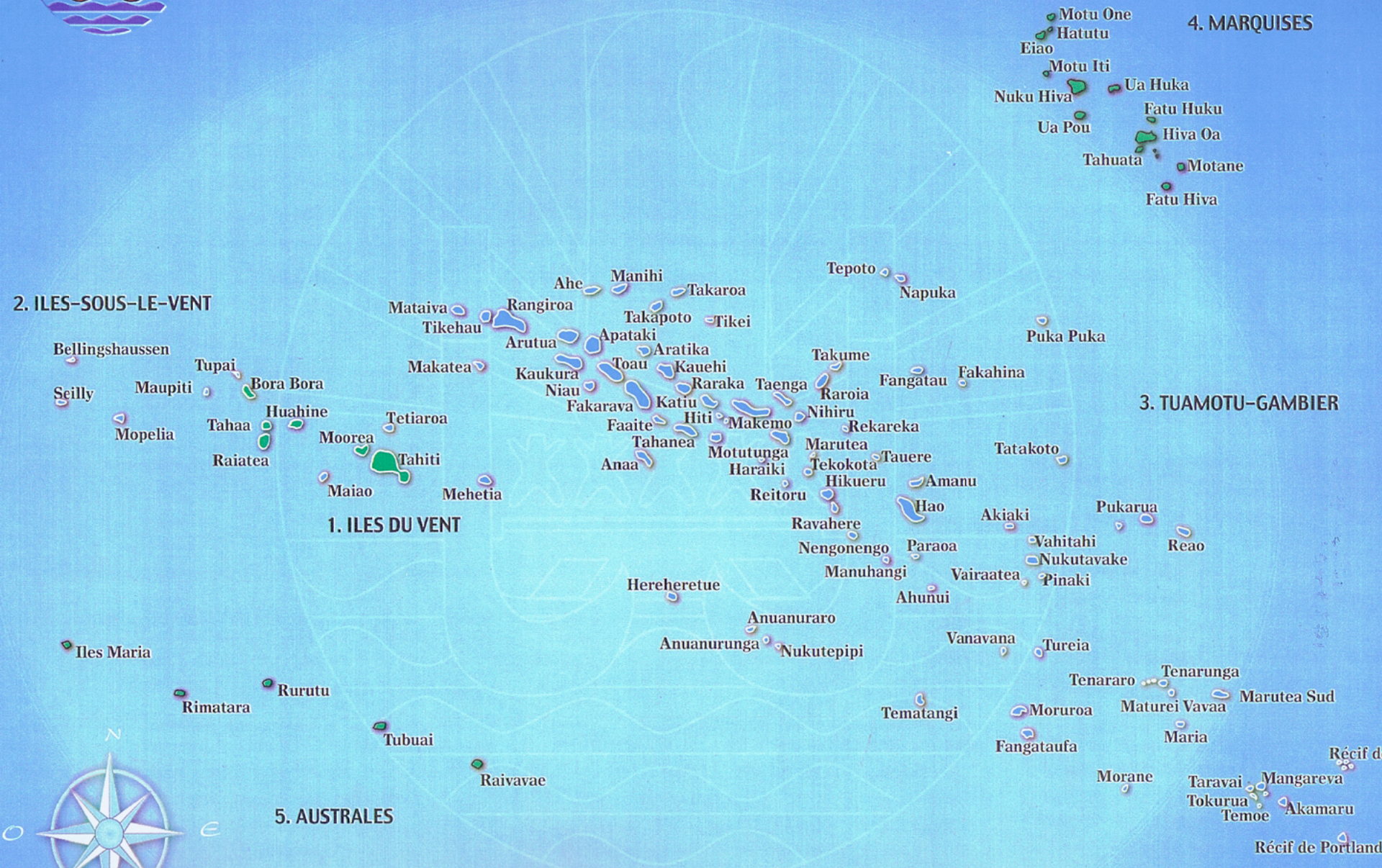
Electricity production in the Pacific



Australia 244GWh, New Zealand 40GWh others 5.4 GWh
From AFD report oct 2014

THE CASE OF FRENCH POLYNESIA

MINISTÈRE DE L'ÉQUIPEMENT, DE L'AMÉNAGEMENT, DE L'URBANISME ET DES PORTS



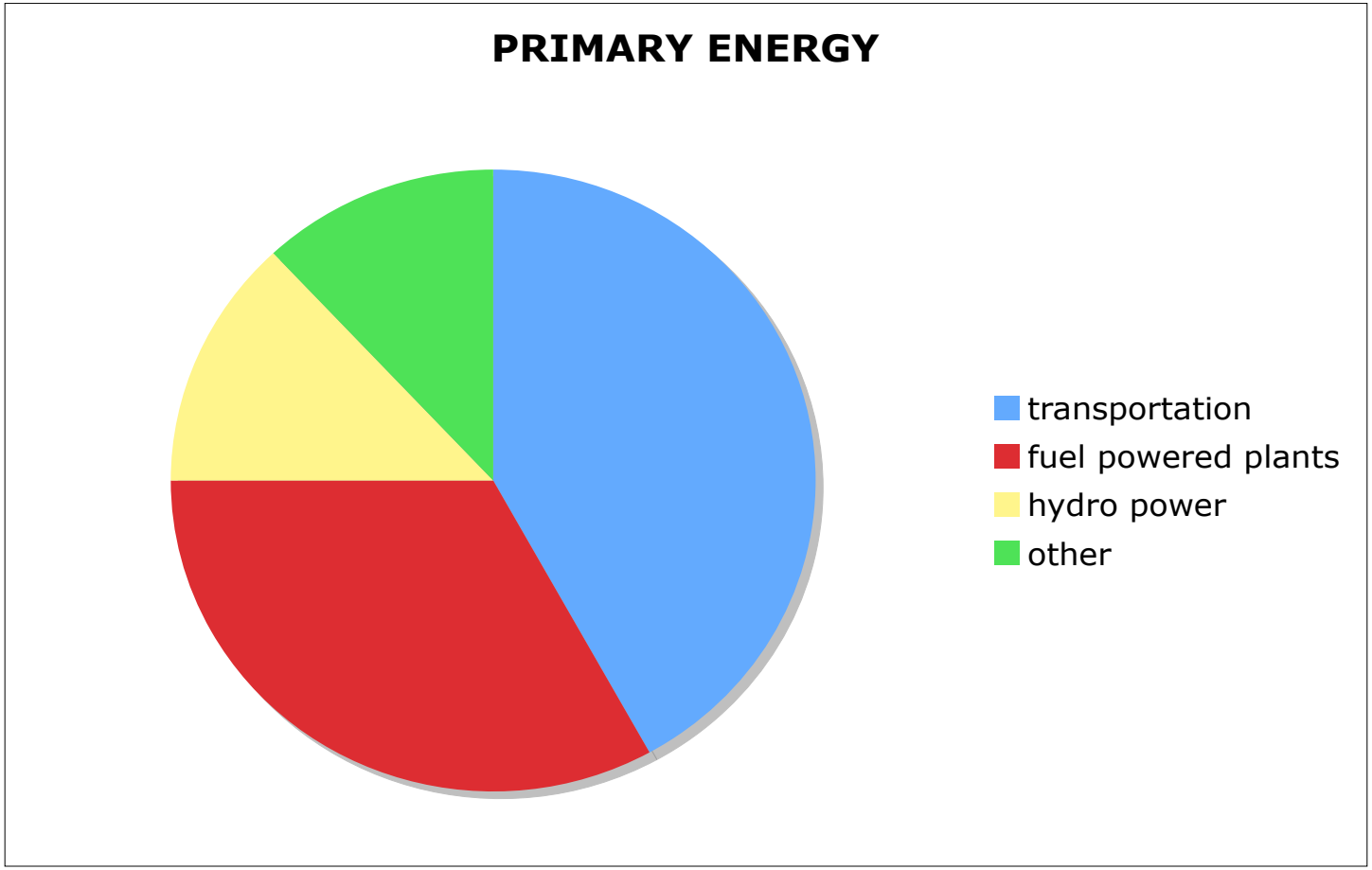
CONSTRAINTS ARE NUMEROUS:

1 Distance between islands (same problem as in many Pacific countries).

2 Main economic resources are energy-thirsty.

3 Social, educational, health obligations lie heavy on government choices.

4 Population is spread irregularly over the islands. 66% of the total population live on Tahiti and consume 77% of the electricity production.



Fuel imports 134 000 t in 2013
Gasoline imports 46 000 t in 2013
Total value 28 billion XPF (31 million USD)

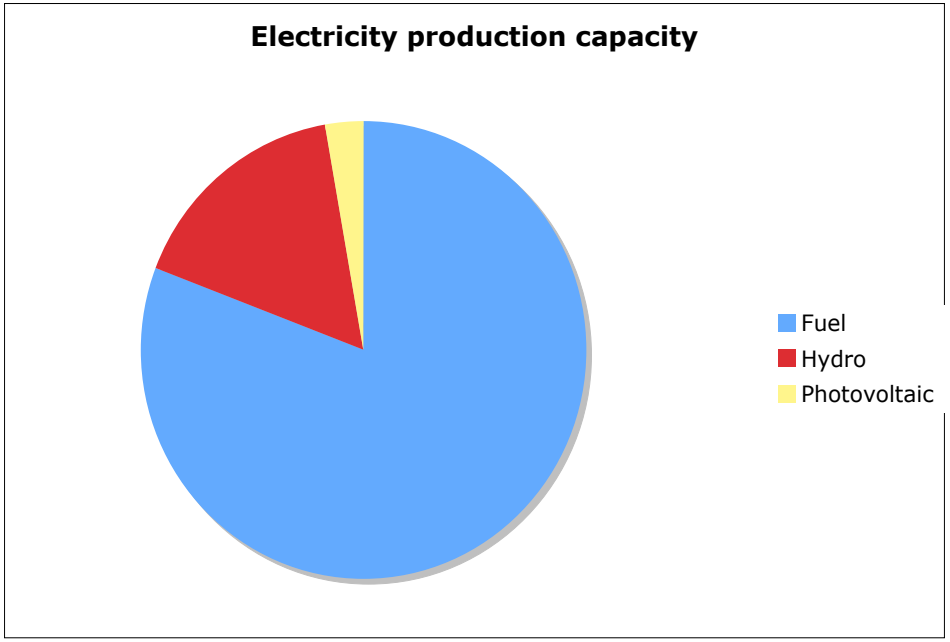
FRENCH POLYNESIA OBJECTIVES

1 Government works on an energy transition project to be presented next year.

2 Quantitative energy objectives have already been set: 50% electricity from renewables in 2020, 70% in 2030 (some say 100%)

3 Energy savings and resources are identified

ELECTRICITY PRODUCTION ON TAHITI



1 Potential of the fuel powered plants is big enough to take care of intermittent or limited production from other sources: 232 GW (hydro 47, PV 8).

2 There is still a potential for hydroelectricity on Tahiti (about 30 MW)

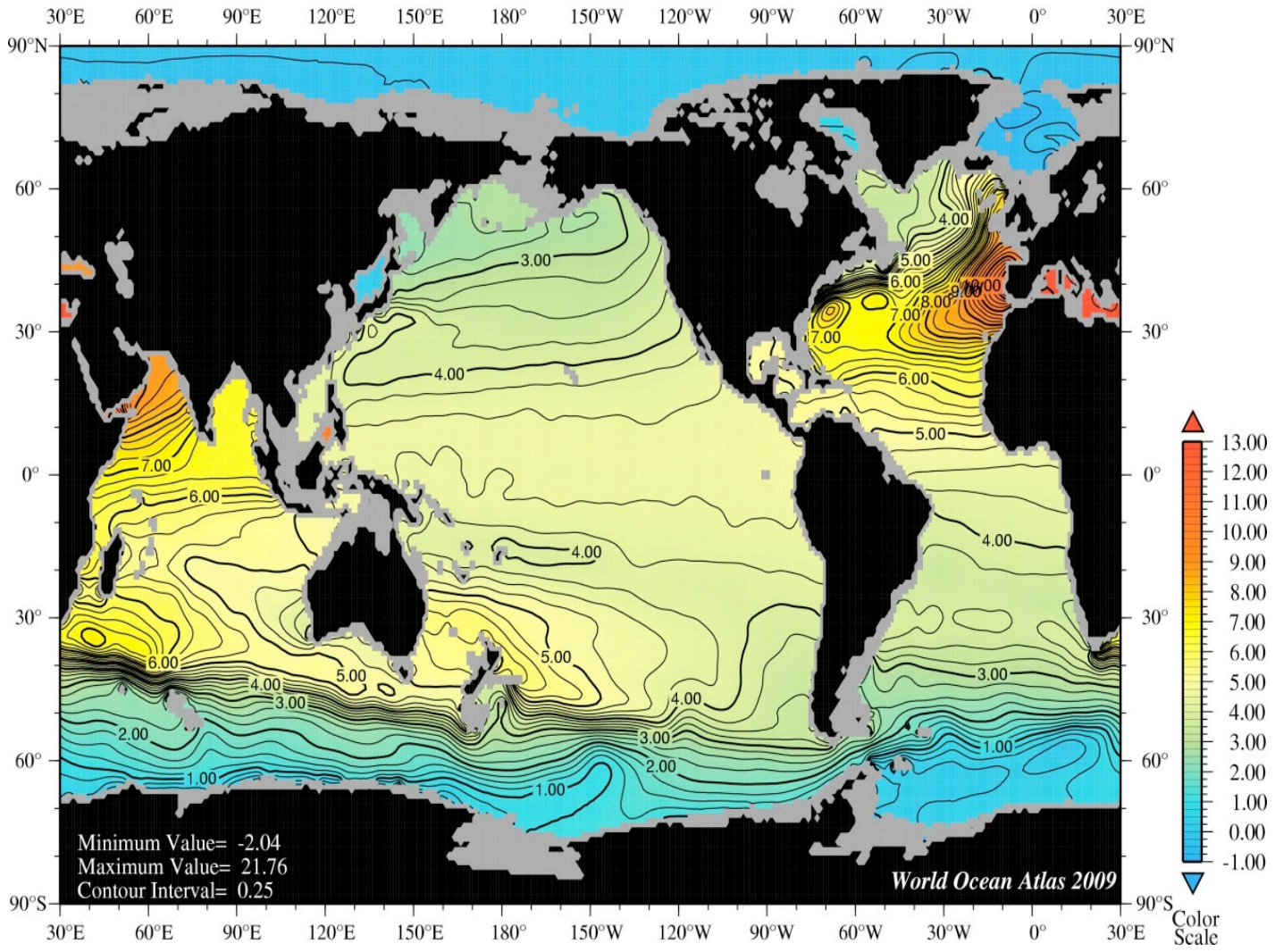
ENERGY SAVING IS THE MOST OBVIOUS CHOICE

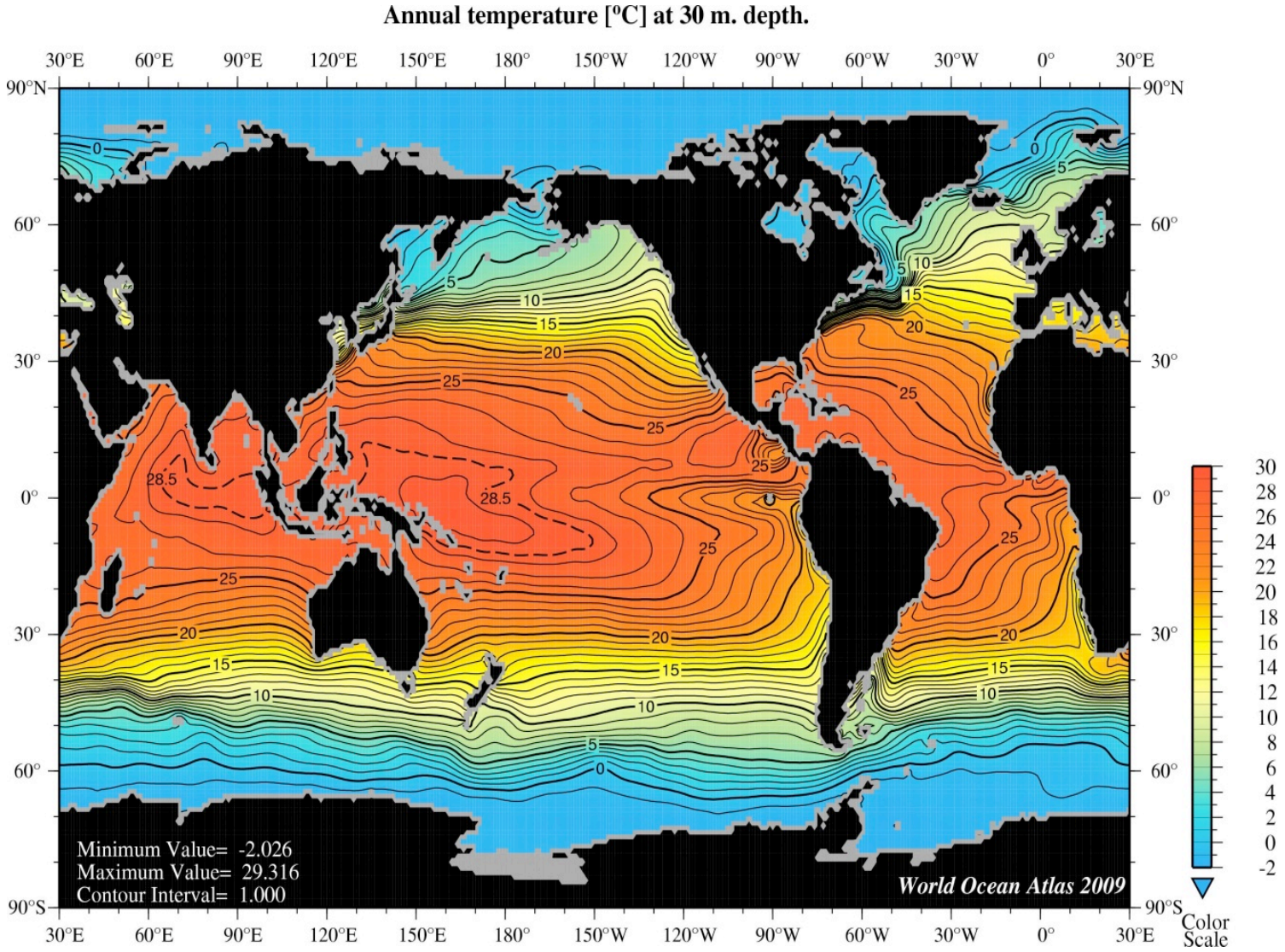
1 In a tropical country cooling buildings is essential, especially for hospitals and hotels.

1 Cold water is available to do the job from deep sea.

2 Better still, water is nutrients rich (refer to NELHA presentation).

Annual temperature [°C] at 1000 m. depth.




Annual temperature [°C] at 30 m. depth.
30°E 60°E 90°E 120°E 150°E 180° 150°W 120°W 90°W 60°W 30°W 0° 30°E
90°N
60°
30°
0°
30°
60°
90°S
Minimum Value= -2.026
Maximum Value= 29.316
Contour Interval= 1.000
World Ocean Atlas 2009
30 28 26 24 22 20 18 16 14 12 10 8 6 4 2 0 -2
Color Scale

FRENCH POLYNESIA GOES SWAC

1 The first initiative was taken by the owner of the Pacific Beachcomber Intercontinental hotel in Bora Bora in 2006.

2 The result was satisfying enough to justify a second, more ambitious initiative, on Tetiaroa, Marlon Brando Island.

3 And, finally, a government project has been started for the hospital.

1 BORA BORA

InterContinental
BORA BORA RESORT & THALASSO SPA

PACIFIC
BEACHCOMBER

The Intercontinental BoraBora Hotel

First hotel in the world to use deep sea water for airconditionning and spa in 2006

Sea water collected at 915 m deep

Pipe length 2412 m

Pipe diameter 400 mm

The Deep Ocean Spa utilizes the benefits of deep-sea water and minerals extracted from the Pacific Ocean.

The 13,200 square-foot spa complex houses 14 treatment rooms for deep sea water hydrotherapy, beauty treatments and gentle energy therapy.

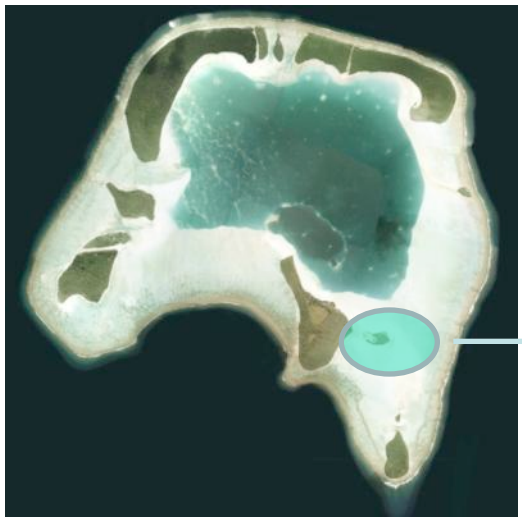
2 TETIAROA

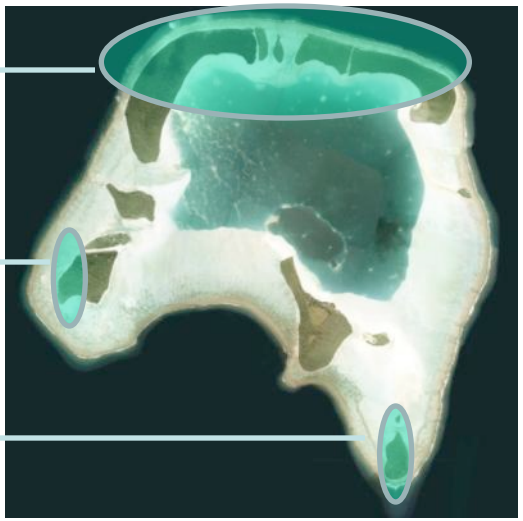
TETIAROA
MARLON BRANDO'S PRIVATE ISLAND

PACIFIC BEACHCOMBER

tetiaroa FRENCH POLYNESIA

Tetiaroa
Environmental Biodiversity





PACIFIC BEACHCOMBER

tetiaroa FRENCH POLYNESIA


plan de l'atoll
motu HONUEA
motu ONETAHI
PACIFIC
BEACHCOMBER
tetiaroa
FRENCH POLYNESIA


Residences
Technical area
Staff Village
Eco-Station Research facility
Western Beach Villas
Gardens
Spa
The Brando Hotel
Residences
Southern Beach Villas

Sustainability Goals for The Brando:

- **Net Zero Energy Use**
- **Site Water Balance**
- **Materials : Local, Recycled, Renewable**
- **Carbon Neutral Transportation**
- **Market Recognition (Validation - LEED)**

SOLAR Energy
Voltaic panellings

SWAC
2,4 MW f
Pipe Ø 450 mm
Intake: 950 m deep

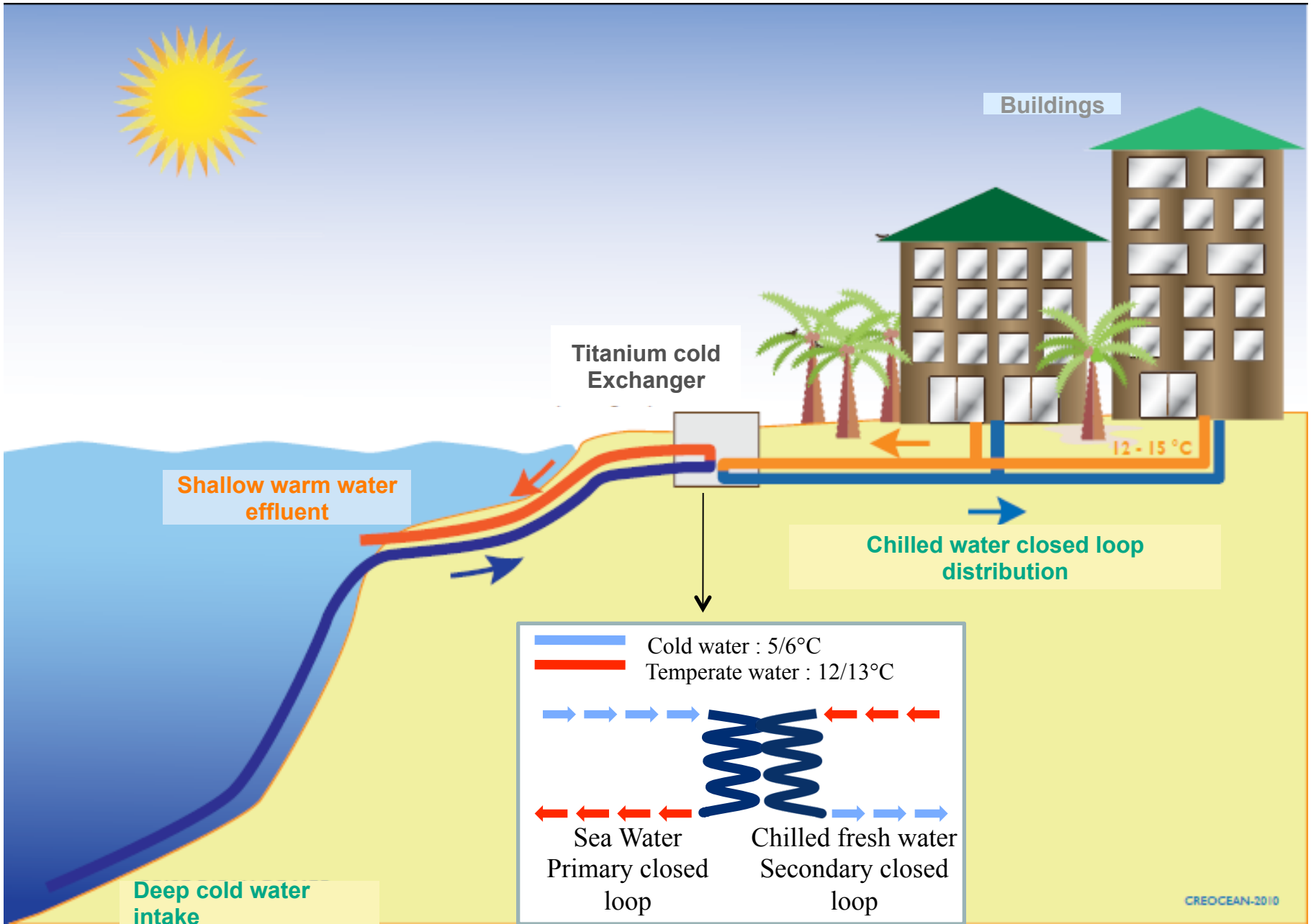
Zinc-Bromine Flow-Batteries
- 20 + years Service Design Life
- 1000's of Deep discharge cycles over service lifetime
- « Environment friendly », made from highly-recyclable materials

« BIOFUEL » Energy
Coconut - Coprah oil Generators

PACIFIC BEACHCOMBER

tetiaroa FRENCH POLYNESIA

CENTRALISED SEA WATER AIR CONDITIONING



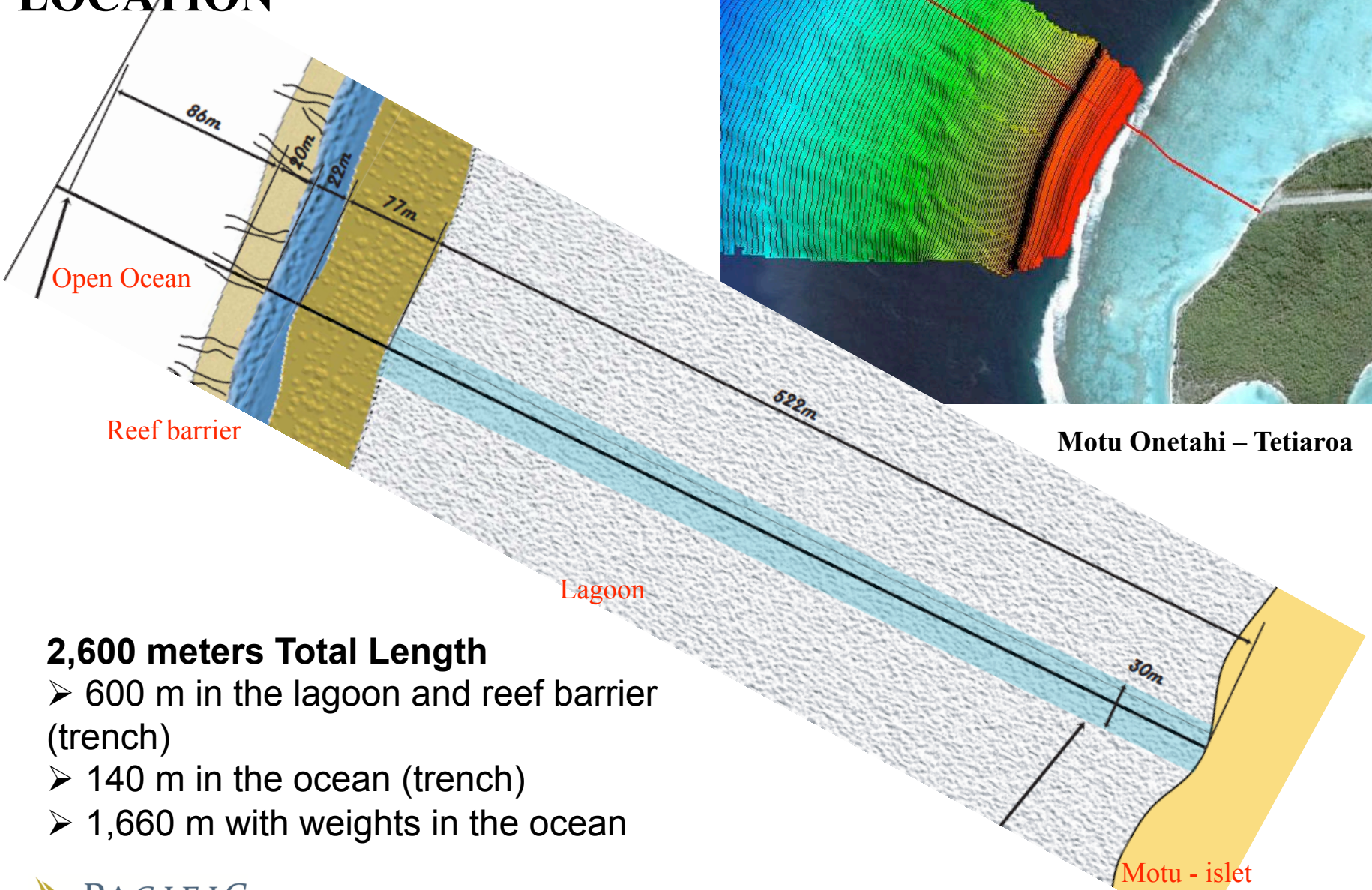
The Brando, Tetiaroa – SWAC 2011

SWAC Specs

- Refrigerating power : 2,4MWf
- Pipeline
  - Diameter: 450mm
  - Length: 2600m
  - Max. Depth: -960m

- October 2011 → Immersion
- Open ocean marine work: underwater trench between 0/20m deep
- Closed lagoon (no communication with open ocean: logisitcs, access)
- Need for maximum environmental protection/preservation

TETIAROA SWAC – LOCATION



Motu Onetahi – Tetiaroa

2,600 meters Total Length

- 600 m in the lagoon and reef barrier (trench)
- 140 m in the ocean (trench)
- 1,660 m with weights in the ocean

PACIFIC BEACHCOMBER

tetiaroa FRENCH POLYNESIA

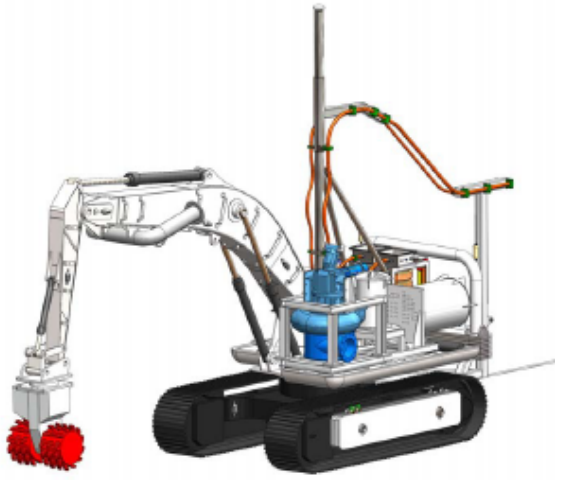
SWAC CONSTRUCTION - METHOD

Selection of appropriate method to create required trench on the ocean floor (depth between 0 à 20 m), with challenging technical requirements in a difficult environment

1st proposed alternative:
Use of explosives

→ Criticism, questions
Search for more options →

2nd proposed alternative:
Underwater mechanical excavator (guided from surface)



2 major factors taken into account:

- Maintain a "cork" on the reef during creation of trench, to avoid the opening of an artificial pass between open ocean and lagoon
- Environment protection around the site (geotextile films to prevent pollution, protection against oil derived products…)

SWAC – IMPACT STUDY ON ENVIRONMENT

Impact of works Follow-Up

Ciguatera Monitoring

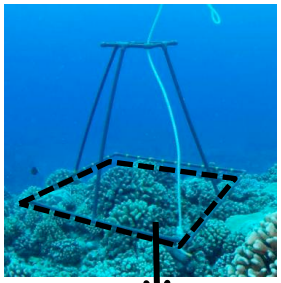
Reference Point in May 2009
Fish and algae in lagoon and outside barrier reef

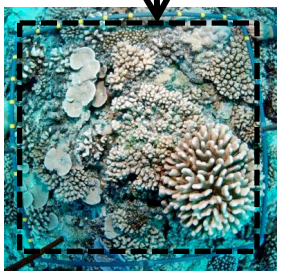
Water monitoring (physical and chemical states)

Multi-parameters Measurements (water turbidity, T°, O_2, S, pH…)
Tracking of « milky » clouds

Reef Check

Photographic and quadrate method
Records in November 2009, in February 2010 (following cyclone Oli), Reference Point in April 2010





Corals Transplantations

Moving corals in lagoon (trench)
Monitoring of corals health and repositioning of colonies to initial locations

SWAC – TOWING FROM TAHITI ISLAND TO TETIAROA AFTER ASSEMBLY

PACIFIC BEACHCOMBER

tetiaroa FRENCH POLYNESIA

TETIAROA MIX

Energy	**Puissance**	**Production**
Photovoltaic	899 kWc	1 GWh/a
Electricity generators on coconut oil	6 units 160 kVA (phase 1) + 6 units160kVA (phase2)	1, 92 GWh/a phase 1 2,455 GWh/a phase 2
Cooling	2,4 MWf	SWAC – Pipeline 450 mm
Storage by batteries		ZBB – 40 units 50 kWh

3 HOSPITAL

- The first hospital, Vaiami, was built in 1848. Three doctors, one pharmacist and about ten nuns from Saint-Joseph de Cluny where considered enough at that time to take care of the patients.
- The second one was a military hospital, Jean Prince, in 1966. It was open to civilian patients, but closed in 1998.
- The third one was Mamao, which started operations in 1970, and closed in 2010, when the new general hospital, Taaone, opened.

A LARGER CAPACITY WAS NEEDED

The new Taaone hospital comprises:
- 441 beds for (381 in Mamao),
- 26 beds for day treatment (20 before)
- 20 dialysis units (18 before).

Occupation rates are high: 83 on average and more in some departments like nephrology (92 %), general medicine (94 %), surgery (87 %).

Accordingly, costs had risen , specially in terms of energy use.

EVERLITE Architecture Lumière

Hopital de Papeete (Tahiti), Couverture Danpalon 10, SY, 600 mm, Cristal, 2100 m², Art International Architectes (75), Entreprise Normacadre, 2008

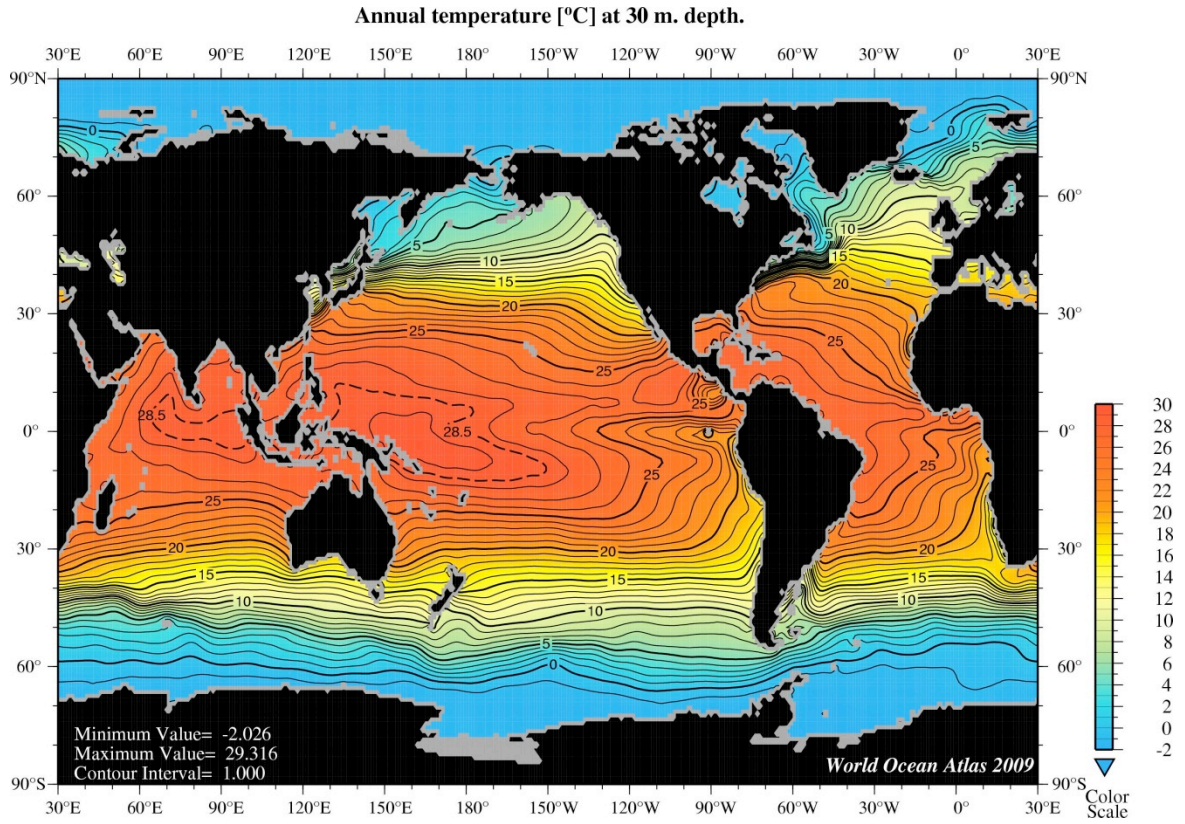
F0178B

A huge electricity bill to be reduced

1° The first step was to reduce consumption. That was successfully implemented: consumption was cut by about 25%, but the annual bill stays high: about 900 million XPF (around 10 million USD) out of which 570 million (6.3 million USD) are spent for hospital air conditionnig.

2° The second step is to substitute a SWAC system to the cold generating units. Cost estimates are at 3 billion XPF (around 32 million USD), to be confirmed by the result of the call for tender. Financing by part subsidies, part long term borrowing. Savings expected to reach 250 million per year (2.7 million USD) during the loan period. French Polynesia fuel imports should be diminished by 4%.

TOWARDS AN OTEC ?



Let’s go back to a previous slide

OTEC technologies could supply the total worldwide power generation capacity with zero impact on ocean temperature profiles; 98 countries and territories have been identified as having viable resources; the technologies are particularly suitable for remote islands in tropical seas; existing barriers include high up-front capital costs and lack of experience in building at scale.

IRENA report August 2014