



Governo dos Açores



INNOVATION
sustainable islands' growth
INNOVATION
croissance durable des îles

CORVO – A SUSTAINABLE ISLAND

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OVERSEAS COUNTRIES
AND TERRITORIES
INNOVATION
PAYS ET TERRITOIRES
D'OUTRE-MER



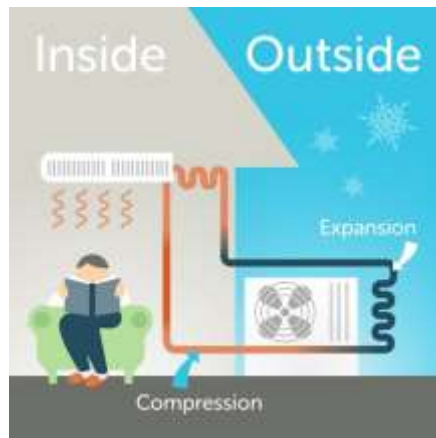
REGIÃO AUTÓNOMA DOS AÇORES
SECRETARIA REGIONAL DA ENERGIA, AMBIENTE E TURISMO
Direção Regional da Energia

Agenda

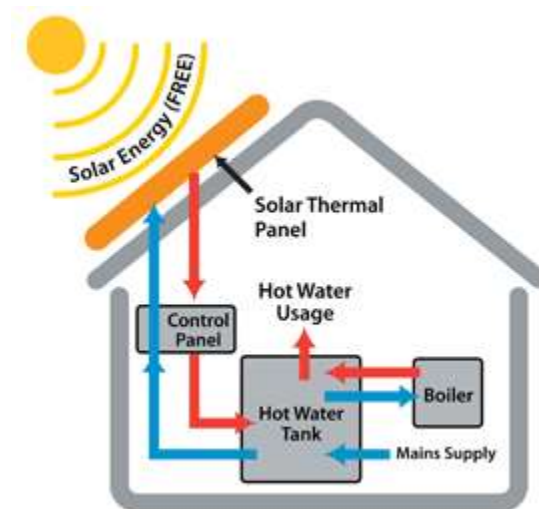
1. Scope and goals
2. Why Corvo Island?
3. Methodology
4. Systems Features
5. Results
6. Conclusions
7. Future Work

1. Scope and Goals

- Reduce the energy dependence on traditional sources;
- Increase the use of renewable;
- Reduce the greenhouse gas emissions;
- Innovative - Azores as a *living lab* to test emerging energy solutions in island context and remote areas for the energy sector;
- *Replace* domestic hot water heating (combustion of butane):



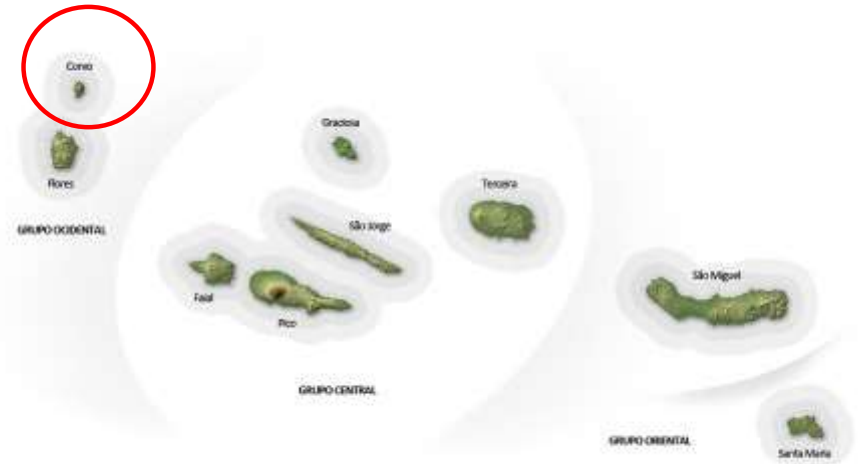
Heat Pumps



Thermal Solar Systems

2. Why Corvo Island?

Corvo is the **smallest** island of the archipelago of Azores. It has a total area of **17.2 km²** and a population of **430 inhabitants**.



Why Corvo?

- Remote Island of Azores;
- Difficulties related to fuel supply;
- Fully dependence of imported fossil fuels;
- Electricity is exclusively generated by diesel engines;
- High costs associated to the transportation of butane bottles;
- Butane price is highly subsidized (2011 \approx 30000 €) - used both for the production of domestic hot waters and cooking.

3. Methodology

- Partnership with Vila Nova do Corvo Municipality.
- The project started in 2011 and was implemented in two phases:

Phase 1:

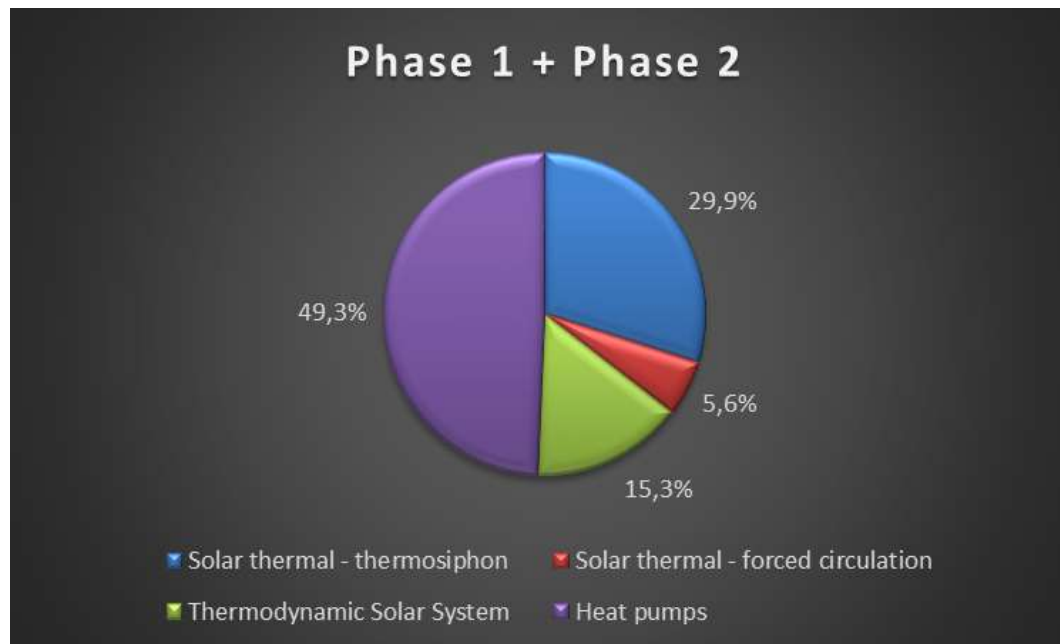
- Thermal solar systems or heat pumps were installed in **35** houses and service buildings, covering approximately **89 users**;
- The total area of installed collectors was **98.6 m²**;
- Estimated cost ~345 000 €;
- Ended in 2013.

Phase 2:

- Thermal solar systems or heat pumps were installed in **109** housing and service buildings, covering approximately **341 users**;
- The total area of installed collectors was **70.2 m²** ;
- Estimated cost ~ **699 906 €**;
- Ended in 2015.

4. Systems Features

	Phase 1		Phase 2			
	Nr. of equipments	COP (average)	Solar fraction, % (average)	Nr. of equipments	COP (average)	Solar fraction, % (average)
Solar thermal - thermosiphon	19		73.6	24		64.9
Solar thermal - forced circulation	8		71.8	0		
Thermodynamic Solar System	0			22	4.3	
Heat pumps	8	3.6		63	3.2	

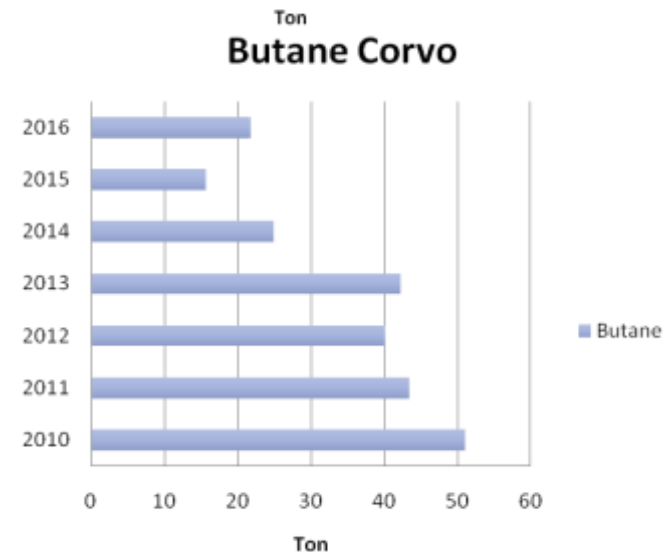
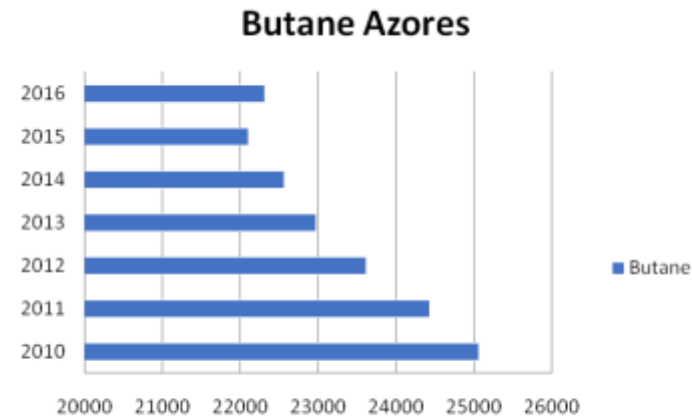


5. Results

In Azores, butane is the main source of energy used both to obtain domestic hot waters and for cooking.

Natural gas is not available.

- From 2010 until 2015, butane consumption decreased **steadily (10%)** in Azores;
- From 2010 until 2015, butane consumption decreased **significantly (64%)** in Corvo;



	2011	2015	%Δ(2011-2015)
Corvo (ton)	43.370	15.675	63.86
Azores (ton)	24440.706	22105.92	9.55

5. Results

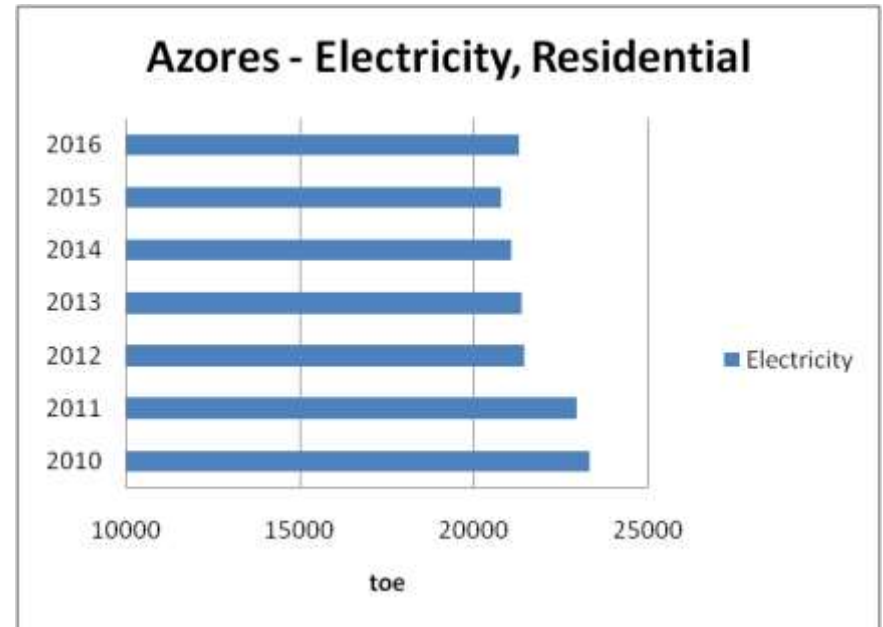
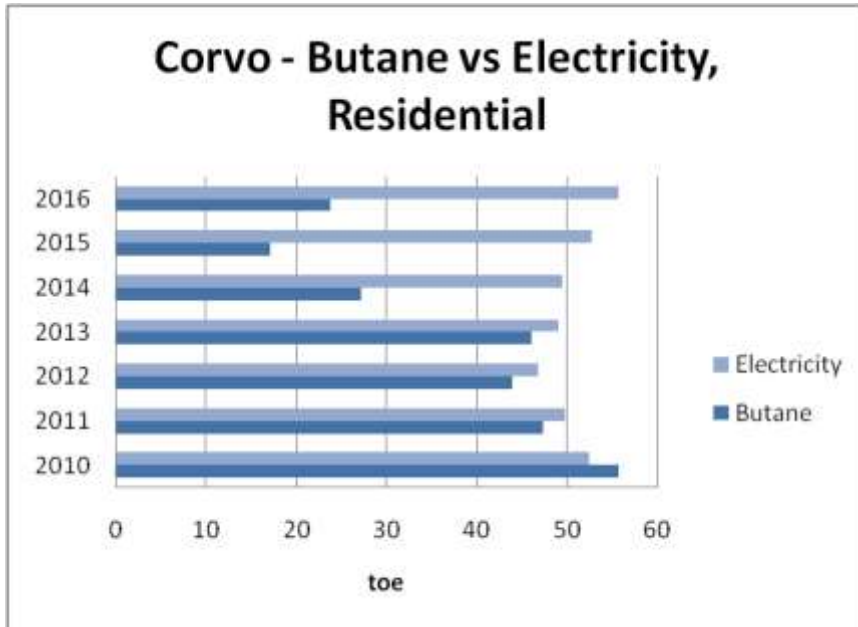
- Calculating the annual energy needed for domestic hot water heating (21.98 toe/year), and comparing with the obtained gas savings (25.72 toe/year), it can be seen that they have the same magnitude.

CORVO - DHW	
Population	430
M-DHW (l/day)	17200
Qa (kWh/year)	255558.2
Qa (toe/year)	21.98
$\Delta(2011-2015)$ (toe/year)	25.72
Data: SREA (Censos 2011)	

- Thus, it is not unreasonable to infer that the gas savings are due to the replacement of the equipments.

5. Results

The **slight increase of electricity** consumption in Corvo can be explained by the replacement of the domestic water heating type of equipments.



6. Conclusions and Future Work

- **We save:**
 - In butane transportation to Corvo (2011 ~30.000€; 2015 ~4000 €);
 - End user consumption – less butane, less money spent in energy;
- **We increase:**
 - The use of local renewable energy sources – means “free” energy;
 - Self-consumption of energy;
- **We reduce:**
 - Fossil fuel dependence;
 - CO₂ emissions : estimated 40 tons/year;
- **Ongoing and future work:**

Analyzing based on technical, economical and environmental point of view:

 - Replicate the scope of this project in other islands;
 - Measures to promote the energy efficiency and the self-consumption of energy;

This project effectively the first step to make Corvo a Sustainable Island



Thank you!

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Project benefits

- Project Economics
- Assumptions:
 - Project life span: 25 years.
 - Discount rate: 1%.
 - Cash-flow = Avoided expenses-maintenance costs
 - Residual value =0

Conclusions

- Conclusions
 - Net present value(25 years)= 86850€.
 - Internal Rate of Return =1,7%
 - Payback time period= 23 years