Beyond Energy Action Strategies
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ELECTRIC BASED MOBILITY AS AN INSTRUMENT FOR PROMOTING RENEWABLE ENERGIES: THE CASE OF THE CANARY ISLANDS

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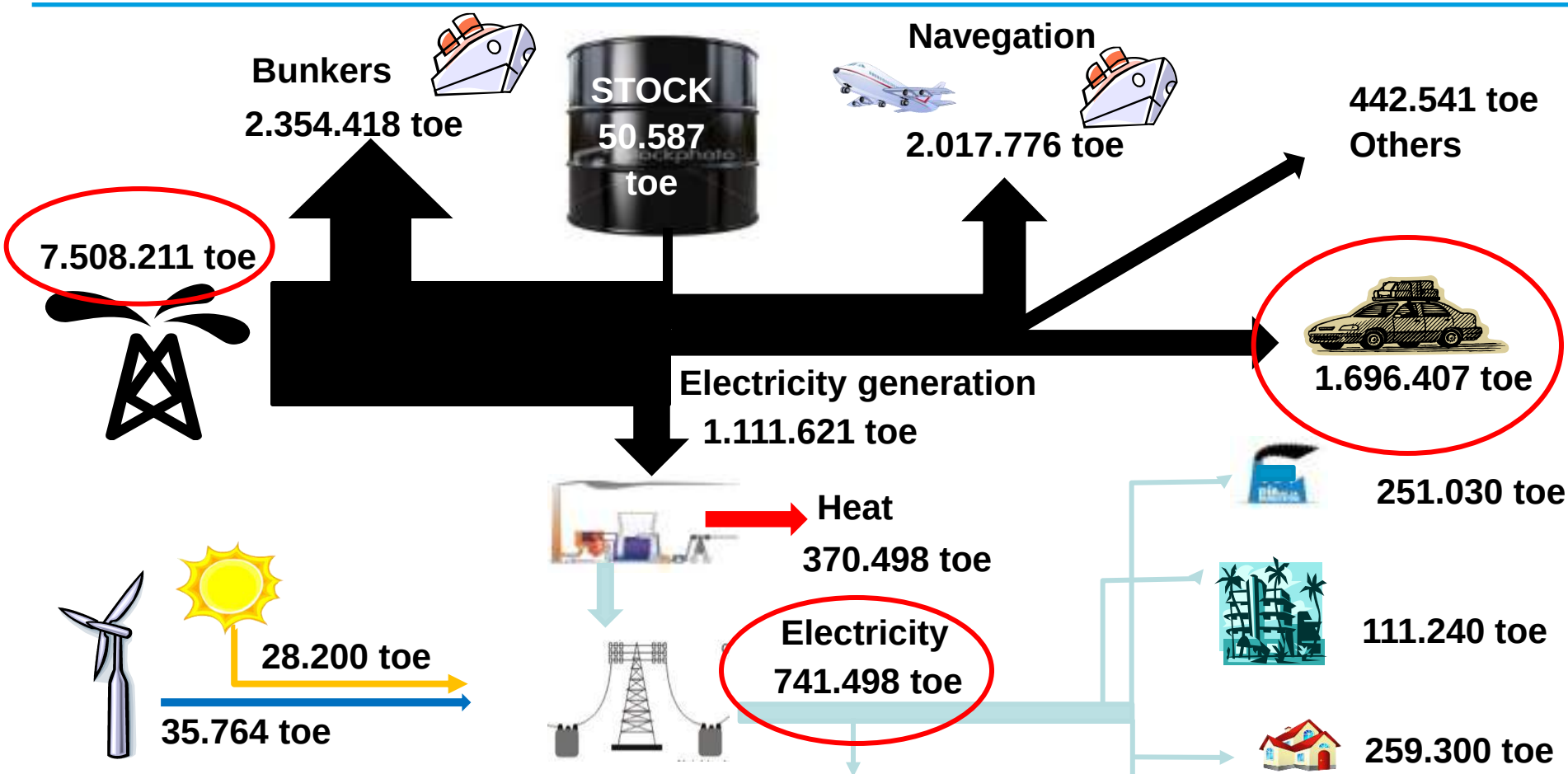
ENERGY BALANCE 2013
CANARY ISLANDS



Energía primaria Interior	5.268.344 Tep
GDP (mil €)	40.299.350
Nunber of residents	2.118.679
Primary energy intensity	0,13 Tep/k€
Per capita energy consumption	1,54 Tep/hab
Per capita elec. Consumption	4.070 kWh/hab
Electricity energy intensity	0,21 kWh/€

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ELECTRIC POWER AND ENERGY (2013)

TOTAL	
Power (MW)	3.040,9
Energy (GWh)	9.078,6

EERR 7,26% (658,76 GWh)

LANZAROTE	
Power (MW)	251,0
Energy(GWh)	840.9

TENERIFE	
Power (MW)	1.270,6
Energy(GWh)	3.608

LA PALMA	
Power(MW)	117,7
Energy(GWh)	262,4

GRAN CANARIA	
Power (MW)	1.150,3
Energy (GWh)	3.585,3

LA GOMERA	
Power (MW)	23,2
Energy(GWh)	71,2

FUERTEVENTURA	
Power (MW)	213,0
Energy (GWh)	664,9

EL HIERRO	
Power(MW)	15,1
Energy(GWh)	45,9

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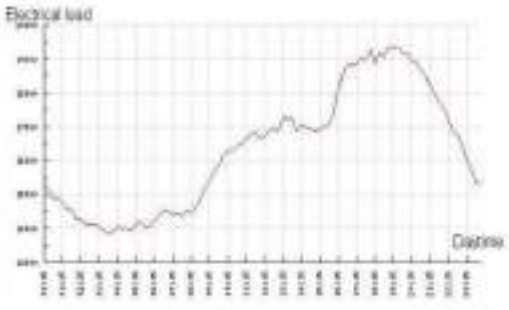
CHARACTERISTICS OF ELECTRICITY DEMAND

- **No constant energy demands, due to low specific weight of the industry**
- **Large differences between the low valley and evening peak-demand hours**
- **No significant seasonal changes**



	Demand (GWh)	Power (MW)			
		Installed	Peak	Valley	Max/Min
Gran Canaria	3,585.341	1.150.30	553	270.8	2.04
Tenerife	3,608.000	1.270.60	547	267.9	2.04
Lanzarote	840.939	251	140	68.1	2.06
Fuerteventura	664.876	213	111	64	1.73
La Palma	262.375	117,7	42	19	2.21
La Gomera	71.184	23,2	11.5	7.6	1.51
El Hierro	45.904	15.1	8.6	5.1	1.69
TOTAL	**9.078.620**	**3.040.90**			

Diesel only
- **La Gomera**
- **El Hierro**
- **La Palma**

Steam units:
- **Gran Canaria**
- **Tenerife**

Combined cycles
- **Gran Canaria 463,2 MW**
- **Tenerife 456,8 MW**

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BARRIERS TO RES PENETRATION

ABUNDANT WIND RESOURCES

- The Trade winds: fairly regular winds with seasonal variations
- Significant drop in speed in winter. Strongest winds in summer
- Relatively high variation along the day

RESTRICTIONS OF THE ISLANDS ELECTRICAL SYSTEMS

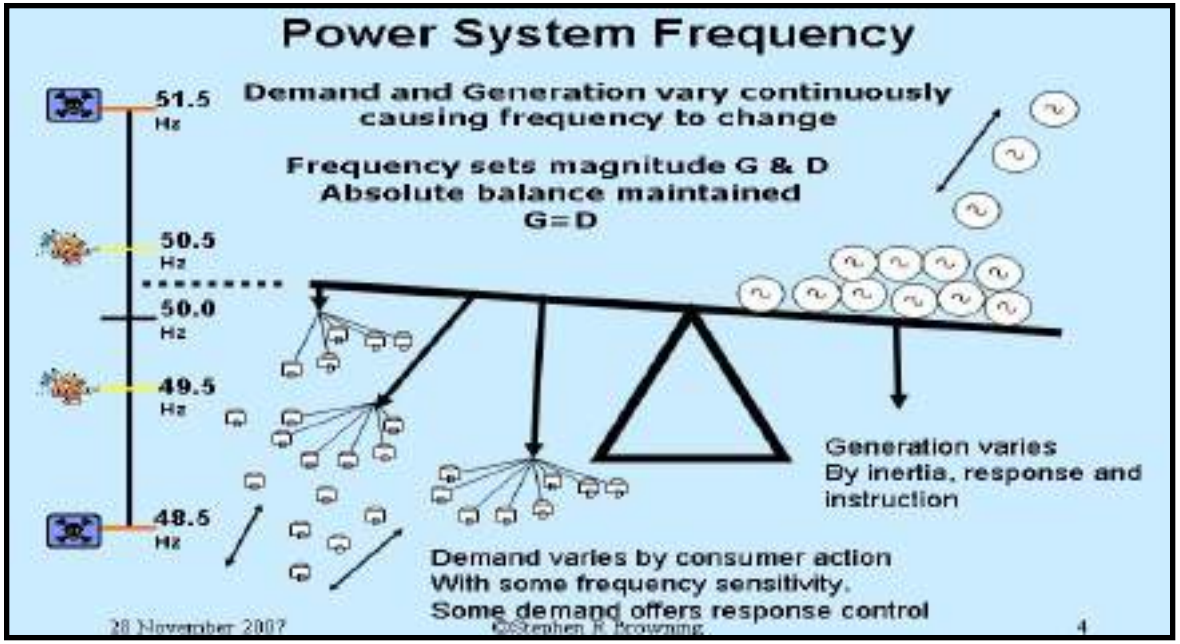
- Small and weak electrical grids
- Important restriction regarding RES integration

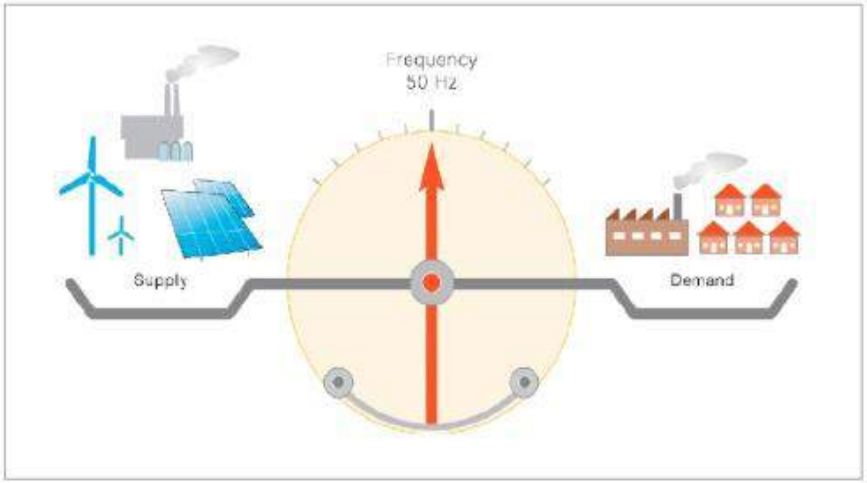
CURRENT RES GENERATION

- Contribution of RES electricity in: 7.13% (647.32 GWh)
  - Wind power, 3.98%, 151.6 MW
  - Solar energy (PV), 3.14%, 179.4MWp
- Ambitious goals set by the Regional Government

New challenges in the operation of the electrical islands systems

VOLTAGE AND FREQUENCY REGULATION

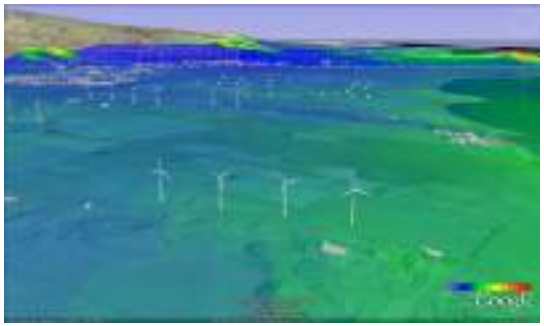




SUBMARINE INTERCONNECTIONS

An effective solution to reinforce the island electrical grids in high RES penetration scenarios.

- **Lanzarote and Fuerteventura (interconnected)**
- **Tenerife and La Gomera (approved)**
- **Fuerteventura- Gran Canaria (in study).**



New challenges in electrical systems

WEATHER FORECASTING MODELS

Forecasting of RES power generation can be made with a fairly high level of reliability through:

- **Statistical analysis**
- **Physical climate models**

Reliable forecasting is key in the strategy for planning and scheduling generation, meeting the criteria of preferential grid access to RES, while ensuring secure supply.

STORAGE FOR RES

Excess production of RES at valley hours of the demand curve would be stored, and afterwards supplied to provide energy during peak hours.

The first reversible pumped-hydro system in El Hierro is currently in operation. Other systems are planned in: Gran Canaria, Tenerife , La Palma and La Gomera.

New challenges in storage and demand management

DEMAND MANAGEMENT

- **The increase of unmanageable RES in the energy mix of the islands poses difficulties in peak-hours of electrical demand. A key issue is to modify and optimize the daily electricity consumption profile by flattening the demand curve.**
  - ***Demand Management (interruptible service and automatic load shedding)***
  - ***Demand Response to price signals***

- **Peak shaving, filling valley-hours with demand manageable deferrable loads*: ELECTRIC VEHICLES***

BARRIERS AND OPPORTUNITIES FOR INCREASING RES THROUGH EVs

- Small and weak electrical island grids → Limited RES penetration
- Higher penetration of RES → 2020 target: 150 to 1,025 MW of wind
- Scenarios of high RES penetration → Negative effect in stability

Manageable electric loads permit higher RES penetration

- Manageable load → In opposite to non-manageability of RES
- Charge of EVs in valley hours → Improve of RoI of wind farms
- Sustainable mobility → Political goals on emission control
- Less fuel in transport → Lower fossil fuel imported

Road transport: 54% of internal market consumption

EFFICIENCY OF EVs VERSUS ICEVs

Electricity produced in a centralized way in the fossil fuel power plants of the archipelago, will always be more efficient than burning fuel on vehicles equipped with ICE, with an efficiency of approximately 20%.

Thermal efficiency of generation technologies installed in the Canary Islands

With average 35% efficiency in Generation, and 63% after losses of Transport and Distribution, Battery charge, Battery discharge, Conversion of mechanical power from the electric motor. Overall efficiency of 22% for EVs

	Thermal efficiency
Vapour (Rankine)	35 %
Diesel	46 %
Gas	23 %
Combined Cycles	47 %

The benefits of EVs is that power is partly generated by RES, depending on the energy mix of the island

IMPACT OF EVs ON THE ELECTRICAL ISLANDS SYSTEMS

- Achieving zero emission road transport in the Canary Islands is possible if its enormous wind and solar energy resources were used for powering electric mobility.
- EVs as a potential manageable load, is an strategic tool for advancing in maximizing RES penetration in the small and weak electrical island grids.

Possible negative impacts should also be studied rigorously

- The large-scale deployment of EVs will result in an increase of electricity demand, with relevant implications on power generation, transport and distribution infrastructure.
- If not properly managed, EVs could introduce an additional factor of instability in the systems.
- Electrical infrastructures should grow at the same pace as new demand.

POTENTIAL IMPACT ON THE DISTRIBUTION GRIDS

- **Charging of EVs has to be properly managed and controlled according to indications of the TSO, priority given to valley hours of the demand curve.**
- **Of particular concern is the potential negative impact that the development of a dense network of ultra-fast charging stations increments peak demand.**
- **Attention to minimizing the possible negative impacts of EVs on the distribution grids, and assessing the investments needed to support a large-scale deployment of EV, while maintaining the criteria of grid security.**
- **High recharging electricity demand may jeopardize security of supply by overloading the medium to low voltage transformer.**
- **This require reliable estimation of consumer's behaviour (2.1 million residents, 12 million tourists every year).**

BARRIERS TO THE DEVELOPMENT OF EVS IN THE CANARY ISLANDS

A strategy to effectively remove existing economic, administrative, technical and market barriers. Key ideas:

- **High price of EV due to the current lack of technological maturity of EVs compared to ICE vehicles.**
  - **In the short term public subsidies to lower the purchase price of EVs.**
  - **Lower maintenance costs and energy price (electricity compared to fuel cost for ICE), somehow helps to off-set the initial higher price of the vehicle.**
  - **The expected reduction of costs throughout the value chain of electricity, especially in the cost of RES generation technologies will be a benefit for EVs.**

- **The Canary Islands, an exceptional scenario:**
  - **The biggest drawback of EVs is their limited autonomy and recharge time of several hours.**
  - **The islands of the archipelago exhibit small geographic size, high density of resident population, large number of tourists and a large number of existing vehicles and low seasonal variation.**
  - **Therefore, to deploy EVs in the archipelago is easier than in continental regions of Europe.**

STRATEGY FOR THE INTRODUCTION OF EVS

As EVs gradually penetrate, the impact on the electrical demand curve will also increase progressively, and may become important. Key ideas:

- **The simplest and most effective way to properly encourage owners to recharge their electric vehicle in period of low demand is a tariff scheme that discriminates by prices (Demand Response).**
- **It is necessary to include capacity for Demand Management, to enable the system operator, under certain conditions, to force the reduction of consumption by performing load shedding to restore system balance.**

The strategy for the introduction of the EVs in the Canary Islands should be done in the context of a smart grid.

Fuente
www.ree.es

- **Information has to be gathered from individual EV regarding how far they drive, and how long they are parked. Therefore, to create a load profile of the of EV fleet.**
- **Vehicles and charging stations must be "intelligent" (interactivity between the EV and both the utility and the system operator) for an effective Demand Management**

CONCLUSIONS

- **Maximizing RES penetration in the islands electrical systems is one of the main goals of the Canary Islands Regional government energy policy, marked by the need to reduce dependence on foreign energy and to reduce carbon emissions.**
- **Promoting electric vehicles will enable a better use of the potential of RES in the archipelago, and allow advancing to a zero emission road transport.**
- **The introduction of EVs would require a important investment in:**
  - **RES generation**
  - **Recharging infrastructure**
  - **Strengthening of the electrical island grids**
  - **The own cost of purchasing the EVs fleet**

There are social and economic benefits, in terms of positive externalities, justify the public support for the initial development of EVs.

Thank you

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