

RED
ELÉCTRICA
DE ESPAÑA

Towards a New Energy Model

**Challenges and solutions to
enable large RES penetration in
the Canary Islands' isolated
power systems**

3rd International Hybrid Power Systems Workshop
Tenerife - May, 8-9 2018



AGENDA

REE at a Glance

The Canary Islands Electrical Systems

A Vision for Tomorrow

The TSO Challenges

What We Are Doing

REE at a Glance

The Spanish TSO



- 4 control centres
- 43.801 km of transmission grid
- 4.360 busbars
- 85.144 MVA transformer capacity

REE at a Glance

TSO in the Canary Islands



The Canary Islands Electrical Systems

- 6 isolated electrical systems on 7 islands
- Low meshed weak infrastructure
- Generation mainly based on fossil fuels
- High wind and solar potential



Size matters...

ENTSO-E

Spanish mainland

Tenerife

El Hierro



0,042 TWh

3,4 TWh ( x80)

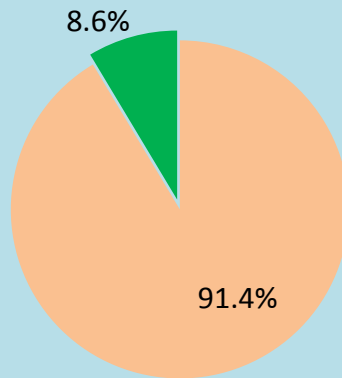
248 TWh ( x6.000)
( x 70)

3.278 TWh ( x78.000)

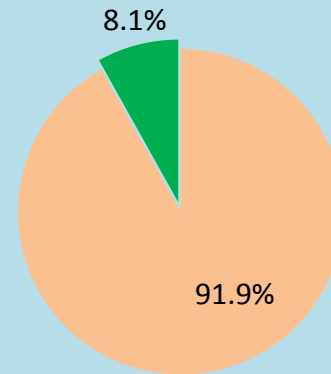
( x 1.000)

Annual demand covered by RES (2017)

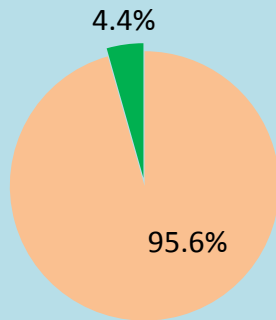
Gran Canaria



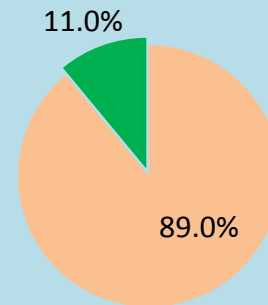
Tenerife



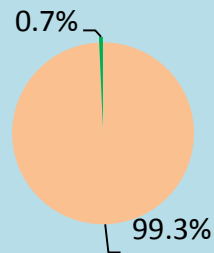
Lanzarote -
Fuerteventura



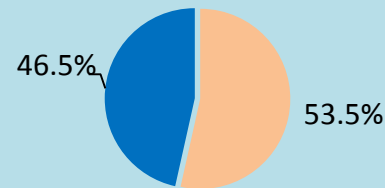
La Palma



La Gomera



El Hierro



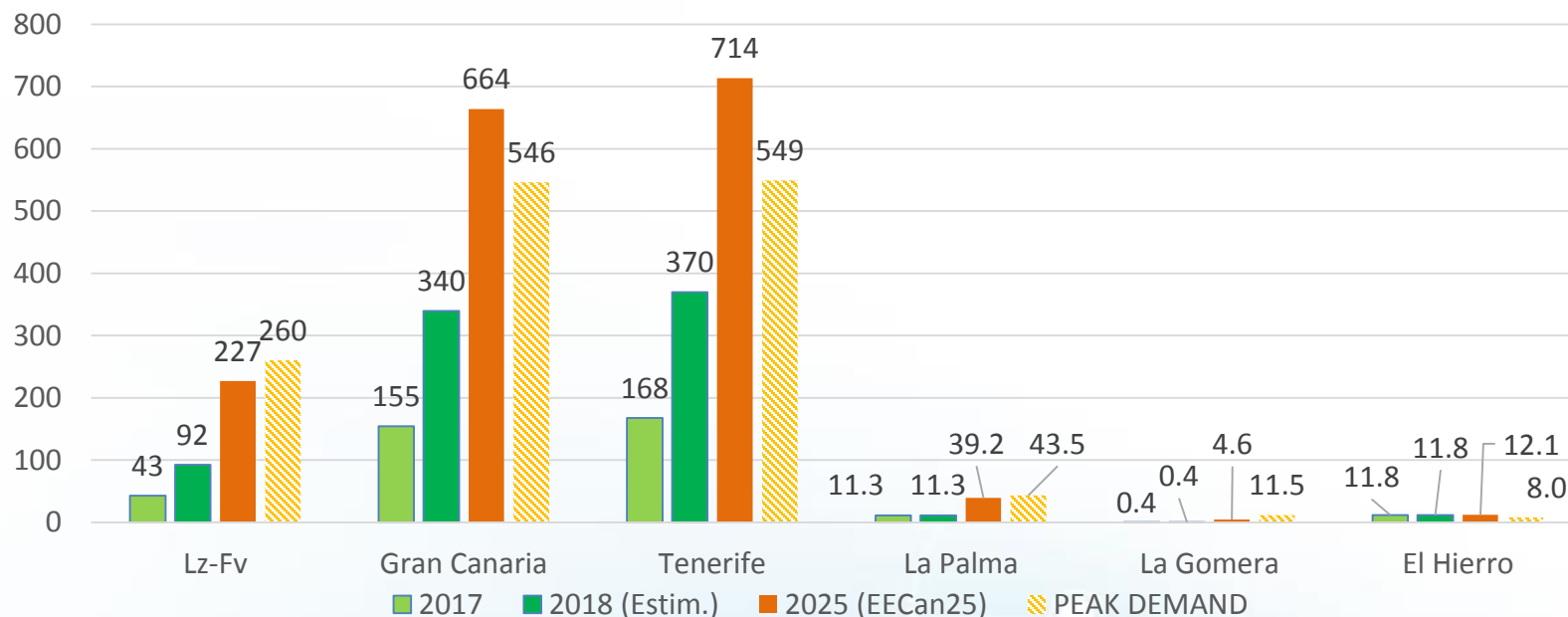
■ TERM ■ EOL FOT ■ HIDRO-EOL-FOT

A Vision for Tomorrow

A BIG move towards renewable energy

- Reducing oil dependency
- Reducing CO₂ emissions
- Exploiting local primary energy sources
- Minimizing system costs

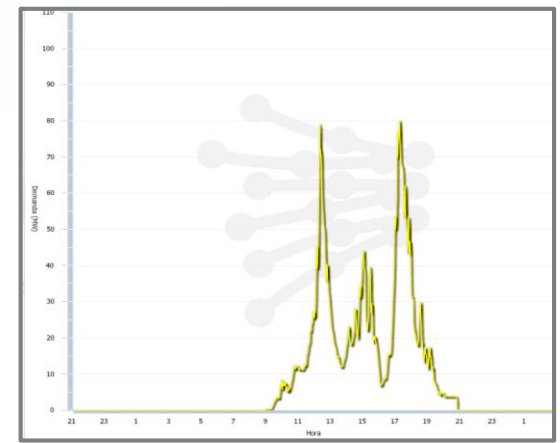
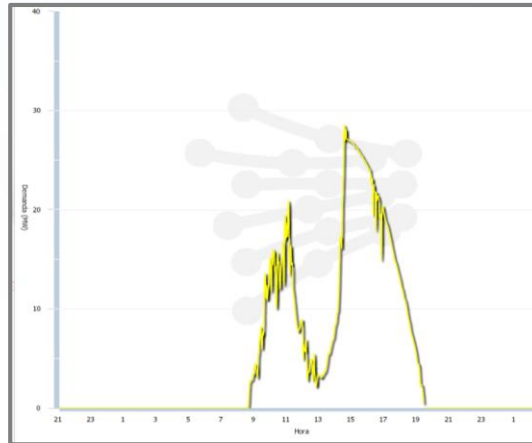
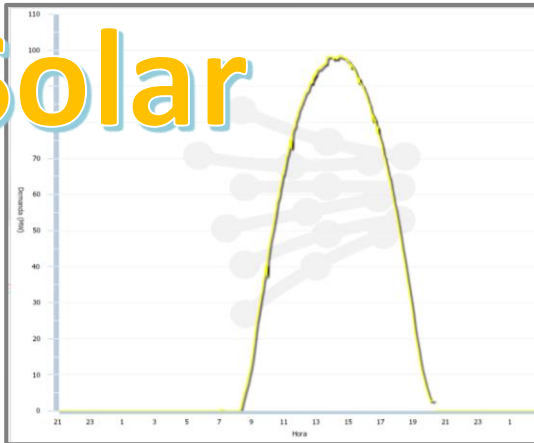
Current and future RES installed capacity vs Peak demand (MW)



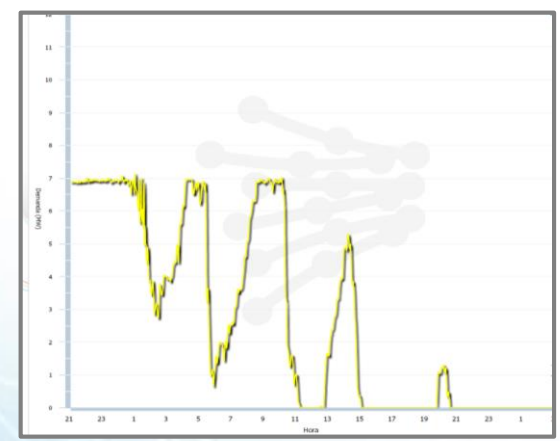
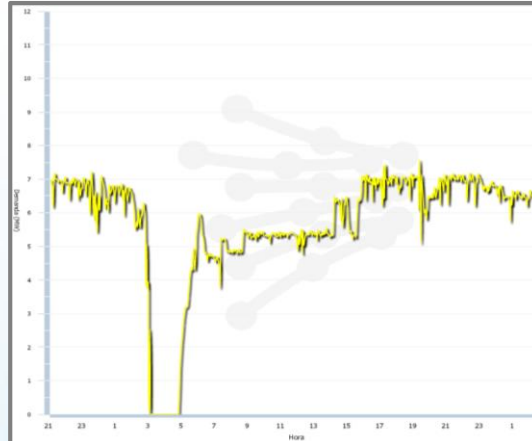
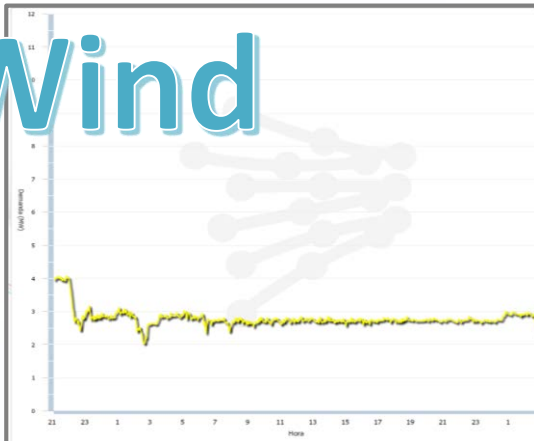
The TSO Challenge

Large amount of non-controllable generation in the energy mix

Solar



Wind



What we are doing

Facing the challenge...

NETWORK DEVELOPMENT



ENERGY STORAGE



INTERCONNECTIONS



R&D



NETWORK DEVELOPMENT



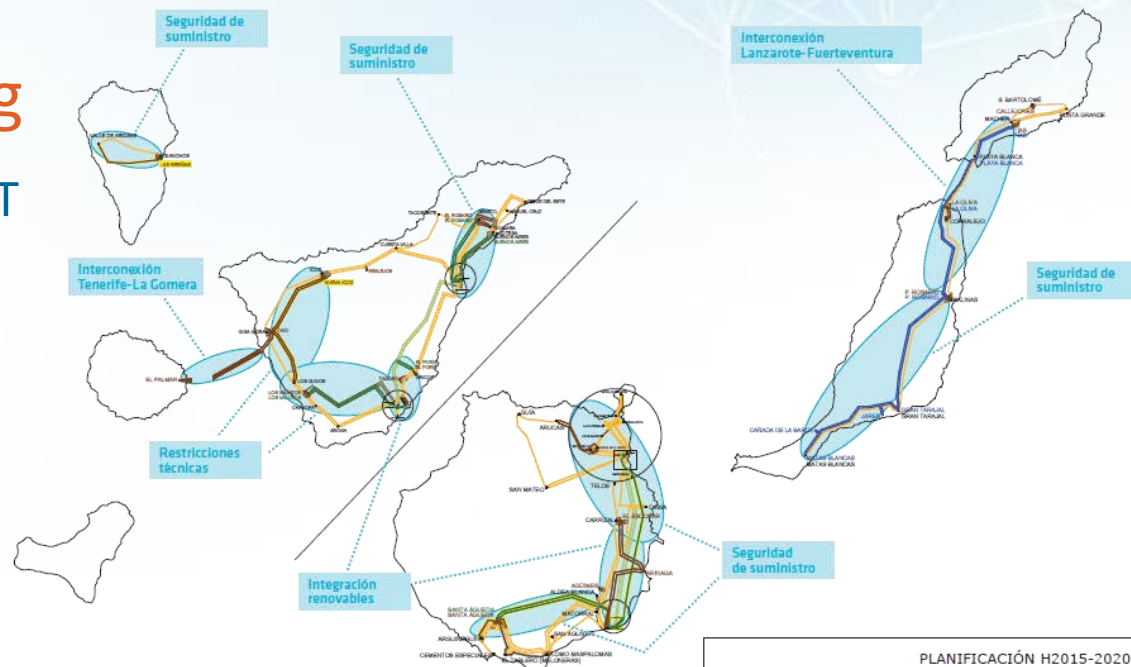
What are we doing

NETWORK DEVELOPMENT

€ Inversión estimada 2015-2020
991 Millones de euros

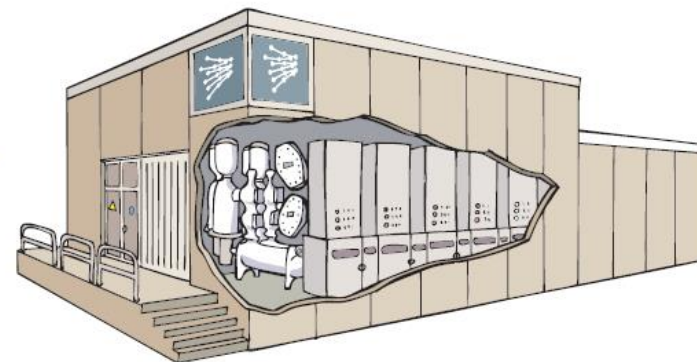
Infraestructuras planificadas 2015-2020

Subestaciones	220 kV	132 kV	66 kV
Nuevas posiciones	73	59	208
Ramas [km de circuito]	220 kV	132 kV	66 kV
Línea	194	236	130
Cable subterráneo	27	13	197
Repotenciación / Incremento capacidad	-	-	11
Enlace submarino	-	20	84
Transformación [MVA]	220/132 kV	220/66 kV	132/66 kV
	90	1.500	1.040
Compensación [Mvar]	220 kV	132 kV	66 kV
Reactancias	-	27	18
Condensadores	-	-	-



	Subestación			Línea c.a.			Cable submarino		
	220kV	132kV	66kV	220kV	132kV	66kV	c.c.	c.a. 132kV	c.a. 66kV
En operación:	●	●	●	—	—	—	—	—	—
Red de partida:	●	●	●	—	—	—	—	—	—
Actuaciones estructurales:	●	●	●	—	—	—	—	—	—
Actuaciones de conexión:	●	●	●	—	—	—	—	—	—
Dados de baja:	●	●	●	—	—	—	—	—	—

* Red de partida: Actuaciones en ejecución.



What are we doing

NETWORK DEVELOPMENT

SE. EL PORIS 220/66 kV

SE. ABONA 220/66 kV

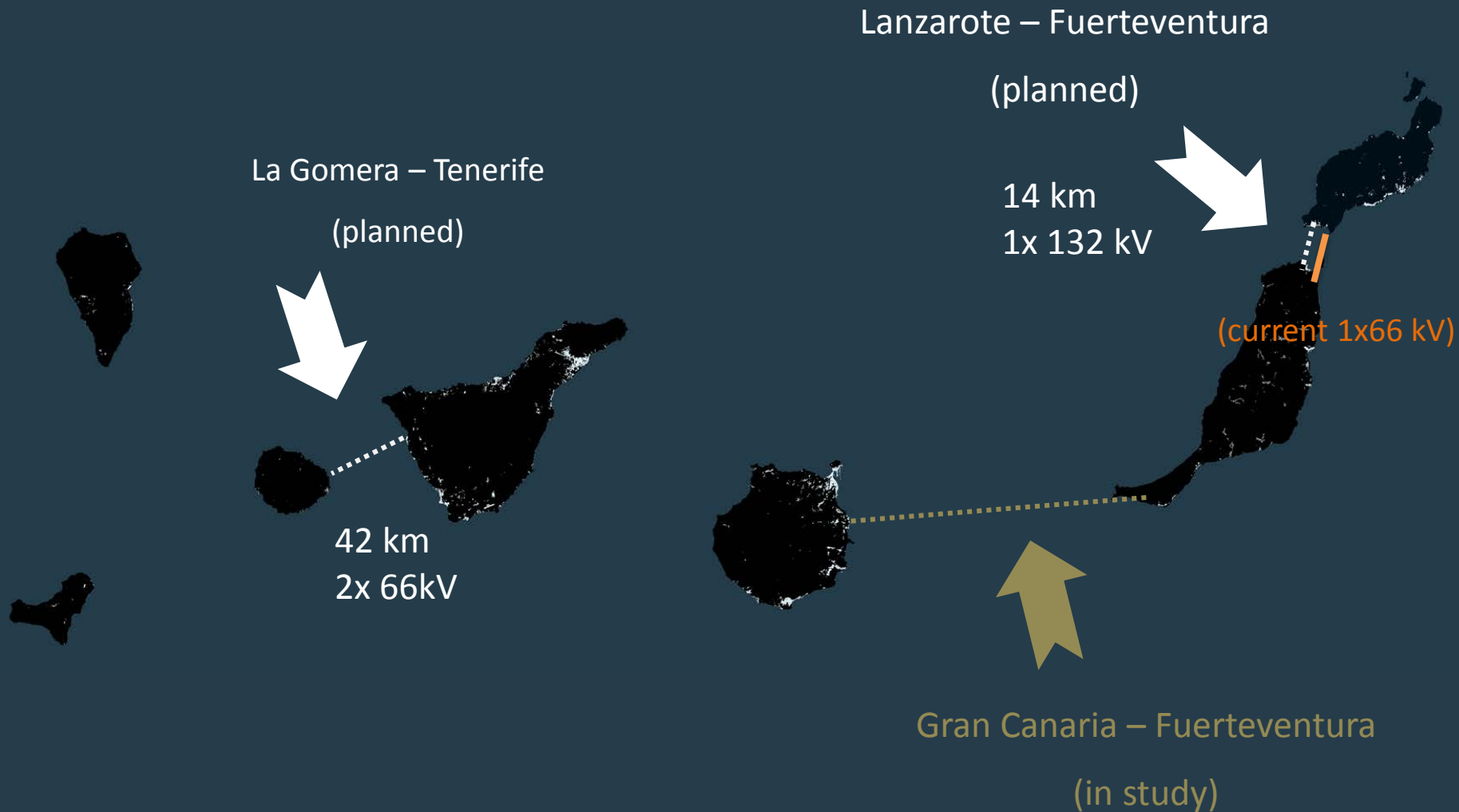


INTERCONNECTIONS



What we are doing

INTERCONNECTORS

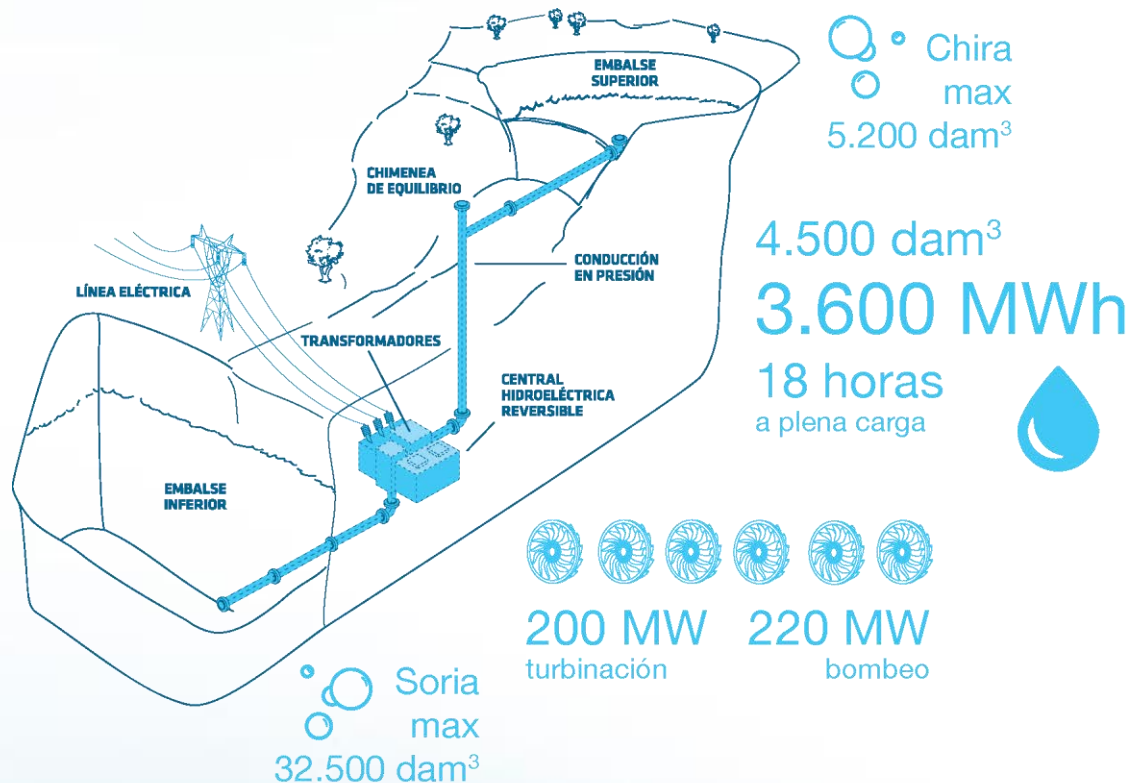
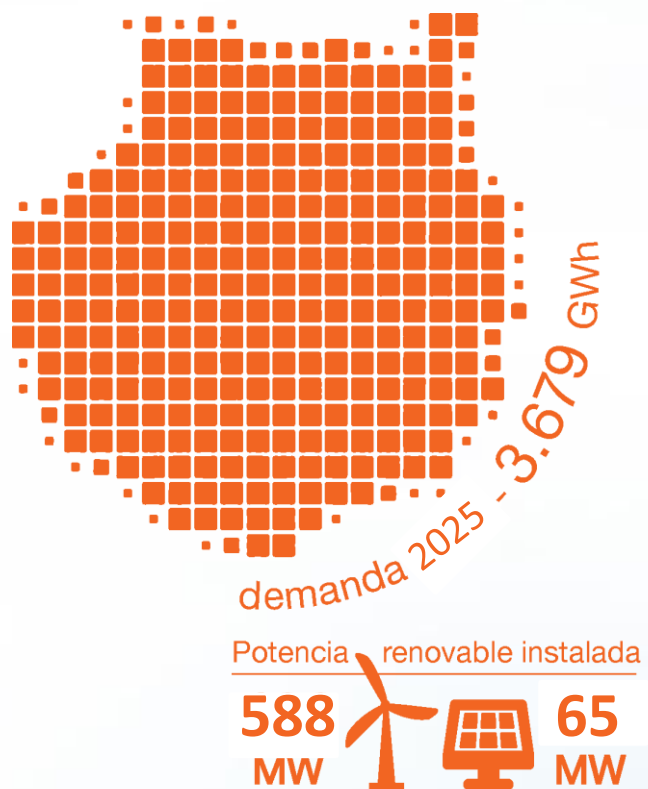


ENERGY STORAGE



What we are doing

STORAGE: SORIA-CHIRA REVERSIBLE PUMPED STORAGE



What we are doing

STORAGE: SORIA-CHIRA REVERSIBLE PUMPED STORAGE



A Project redesigned by the TSO to serve as a tool for:



System stability



Security of supply



RES Integration

Main design requisites

- Units with smooth start and stop maneuvers
- Maximum control over active power both generating/pumping
- Fast transition between operating modes
- Continuous operating range
- Reactive power regulation capabilities (MVar) for voltage control
- Black-start capabilities
- Other: frequency-power regulation, inertial response, transient overvoltage, etc.

What we are doing

STORAGE: CENTRAL HIDROEÓLICA DE EL HIERRO (CHE)



El Hierro island:

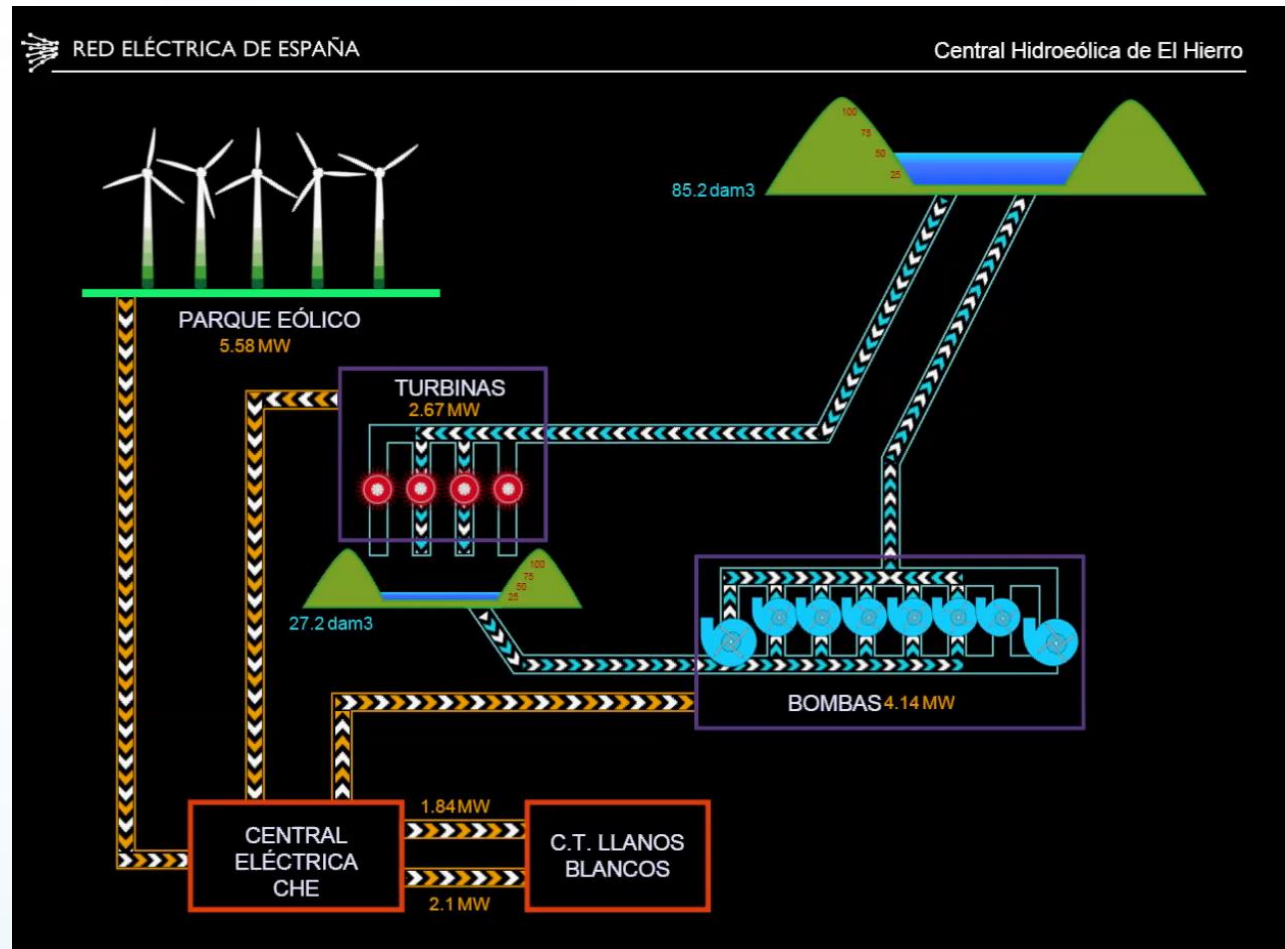
- Peak demand: 7 - 8 MW
- Lowest demand: 3.5 - 4 MW

CHE:

- Owned by Gorona del Viento:
 - Cabildo de El Hierro
 - ENDESA
 - Instituto Tecnológico de Canarias
- Dispatched by the TSO

Technical specs:

- Wind: 11.5 MW
- Pumps: 6.4 MW
- Turbines: 11.4 MW
- Upper reservoir: 380 dam³
- Lower reservoir: 149 dam³
- Roundtrip efficiency: 50%

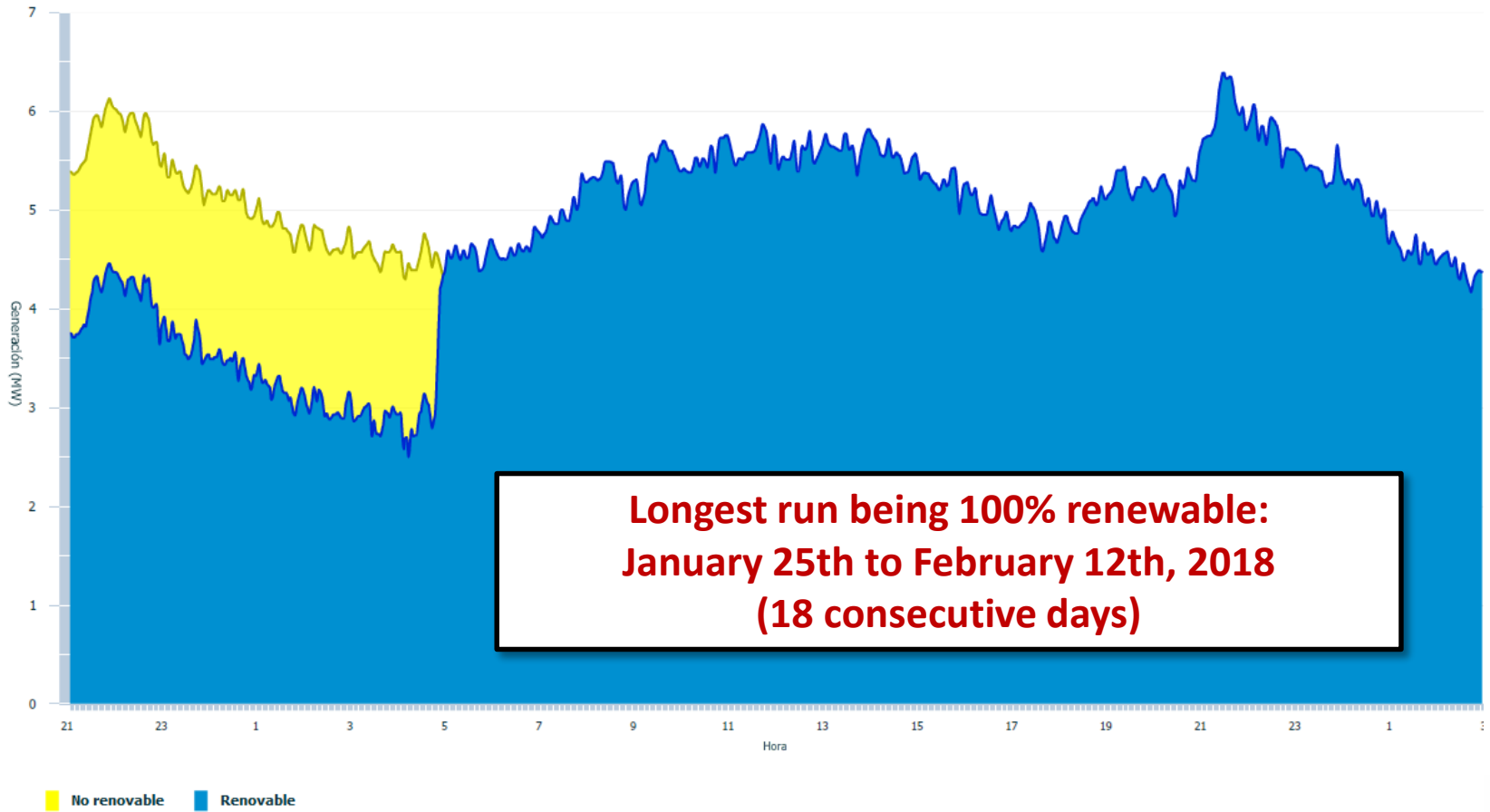


What we are doing

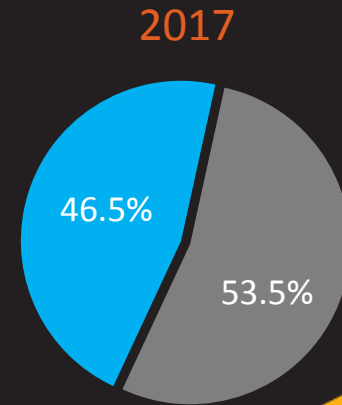
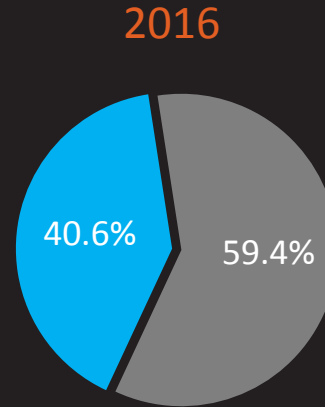
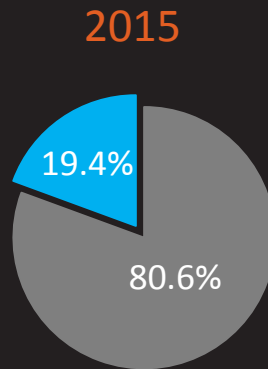
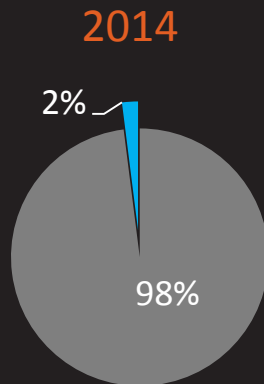


STORAGE: CENTRAL HIDROEÓLICA DE EL HIERRO: 100% RENEWABLE

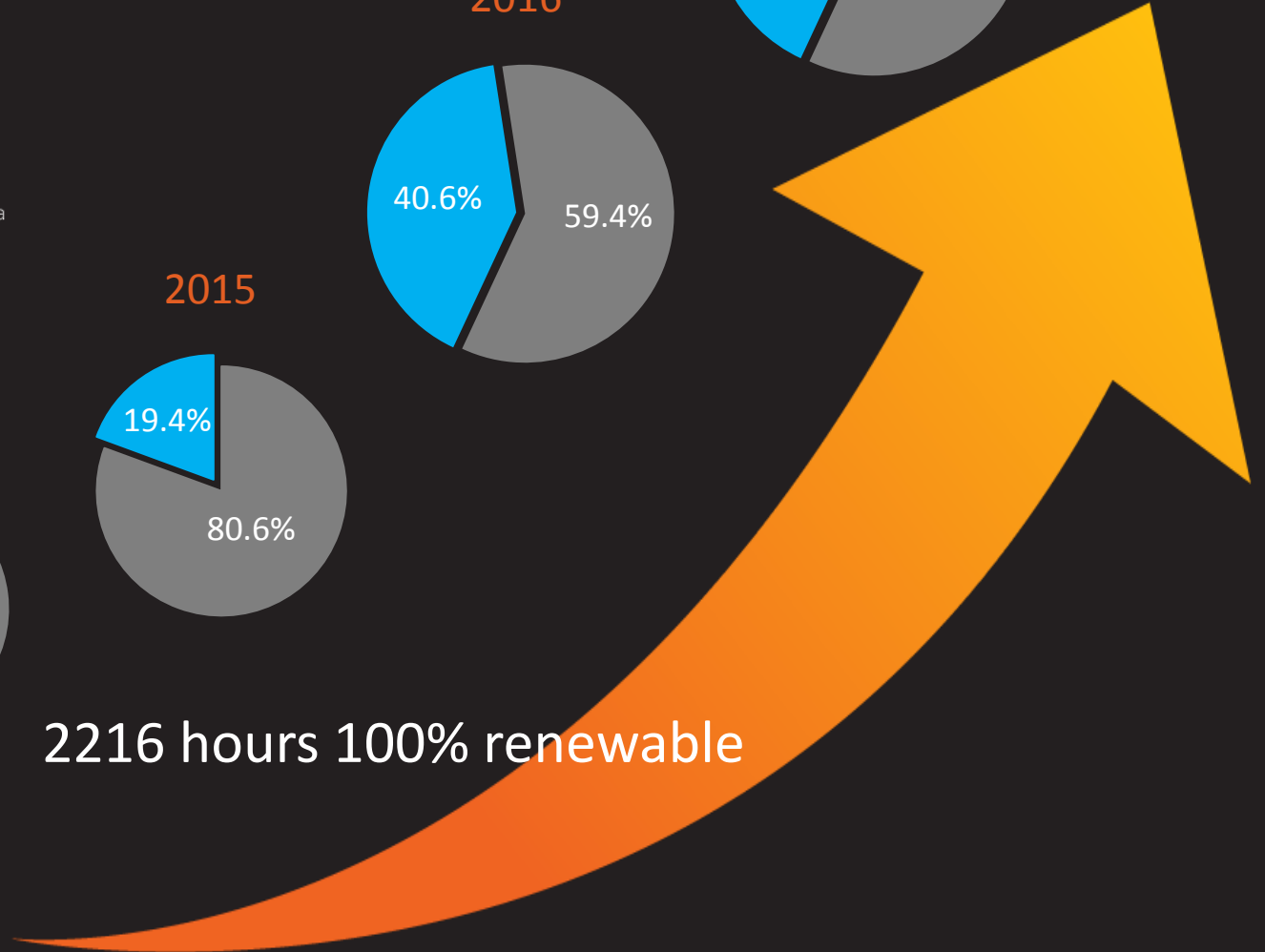
Red Eléctrica de España - Generación Renovable Vs Demanda



RES integration in El Hierro island



2216 hours 100% renewable



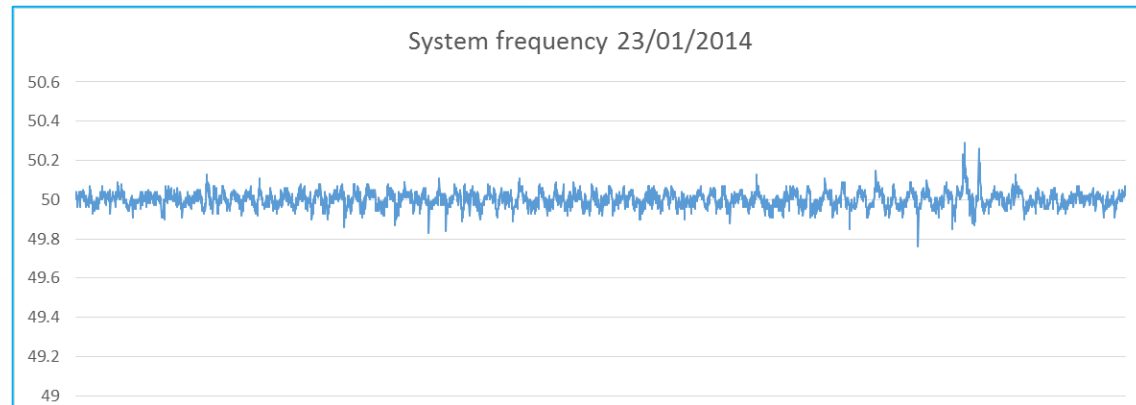
What we are doing

STORAGE: CENTRAL HIDROEÓLICA DE EL HIERRO

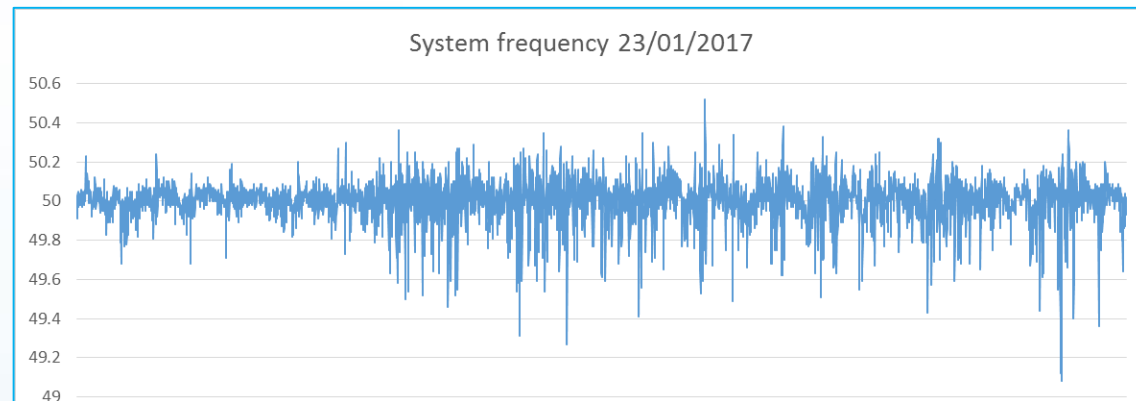


El Hierro system frequency

Before



After



R&D



ALISIOS/OSMOSE

Hybrid storage projects to provide system services

TENERIFE



Multi-megawatt hybrid storage to provide system services in high RES penetration scenarios.

- Managing RES variability
- P-f Regulation
- Inertia emulation
- Voltage control
- Congestion relief



LANZAROTE - FUERTEVENTURA

Hybrid storage to keep security of supply and operating efficiency a low Meshed isolated power grid.

- STATCOM: 25 Mvar
- SUPERCAPACITOR: 10 MW – 55 MWs
- FLYWHEEL: 1.6 MW – 18 MWs
- BATTERY: 3 MW - 1 MWh

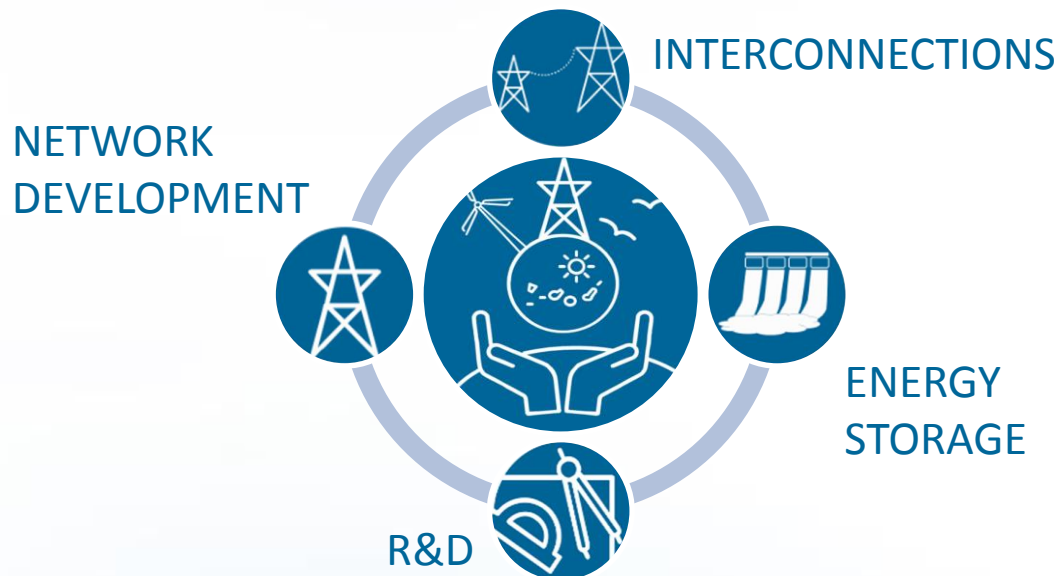


Summary

The Canary Islands face a **big challenge** in its way to a cleaner power system

The **TSO role is key** to achieve the objectives

We are facing the challenge from **different angles**



We are achieving some **promising results**

There is **still a lot of work** to do...



cuidamos tu energía

www.ree.es

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Thank You!