Challenges of the photovoltaic production in islands: towards decarbonization

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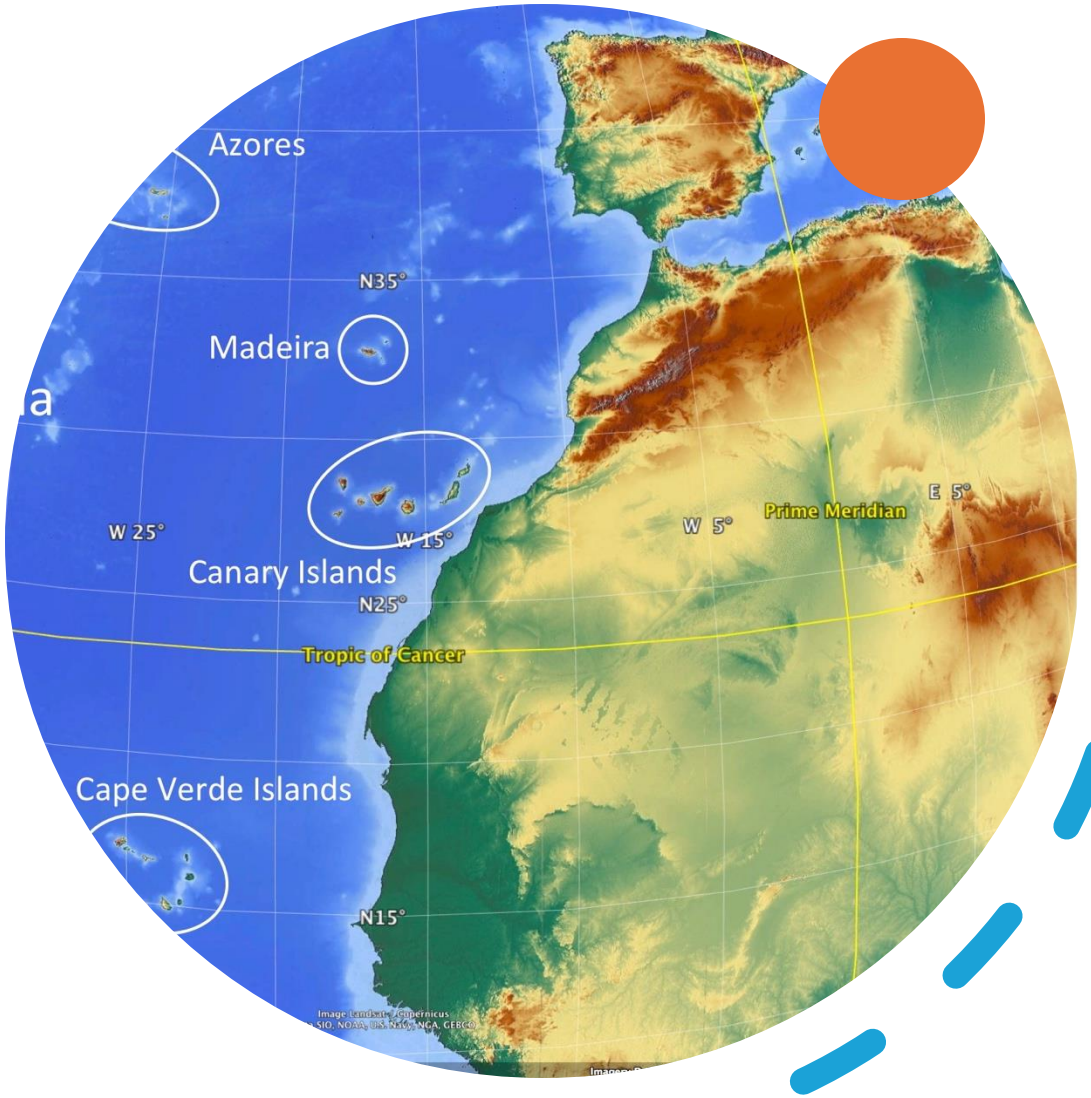
University of La Laguna (ULL)

- 19132 students who are pursuing both undergraduate and postgraduate courses,
- 1611 lectures
- 259 researchers
- 776 administrative and service personnel.

Index

Isolated systems

- In Europe, there are about **300 islands** (6% of the territory) for **14 M-inhabitants**.
- Agenda 21: “the islands are specific from both environment and development point of view; they are very fragile and vulnerable and in the context of sustainable development, **energy is the cornerstone** of their planning strategies”.
- First European Conference on Sustainable Island Development: “**Non-renewable energy sources must be considered as provisional solutions**, unsuitable as a long-term solution to the energy problem in islands“.

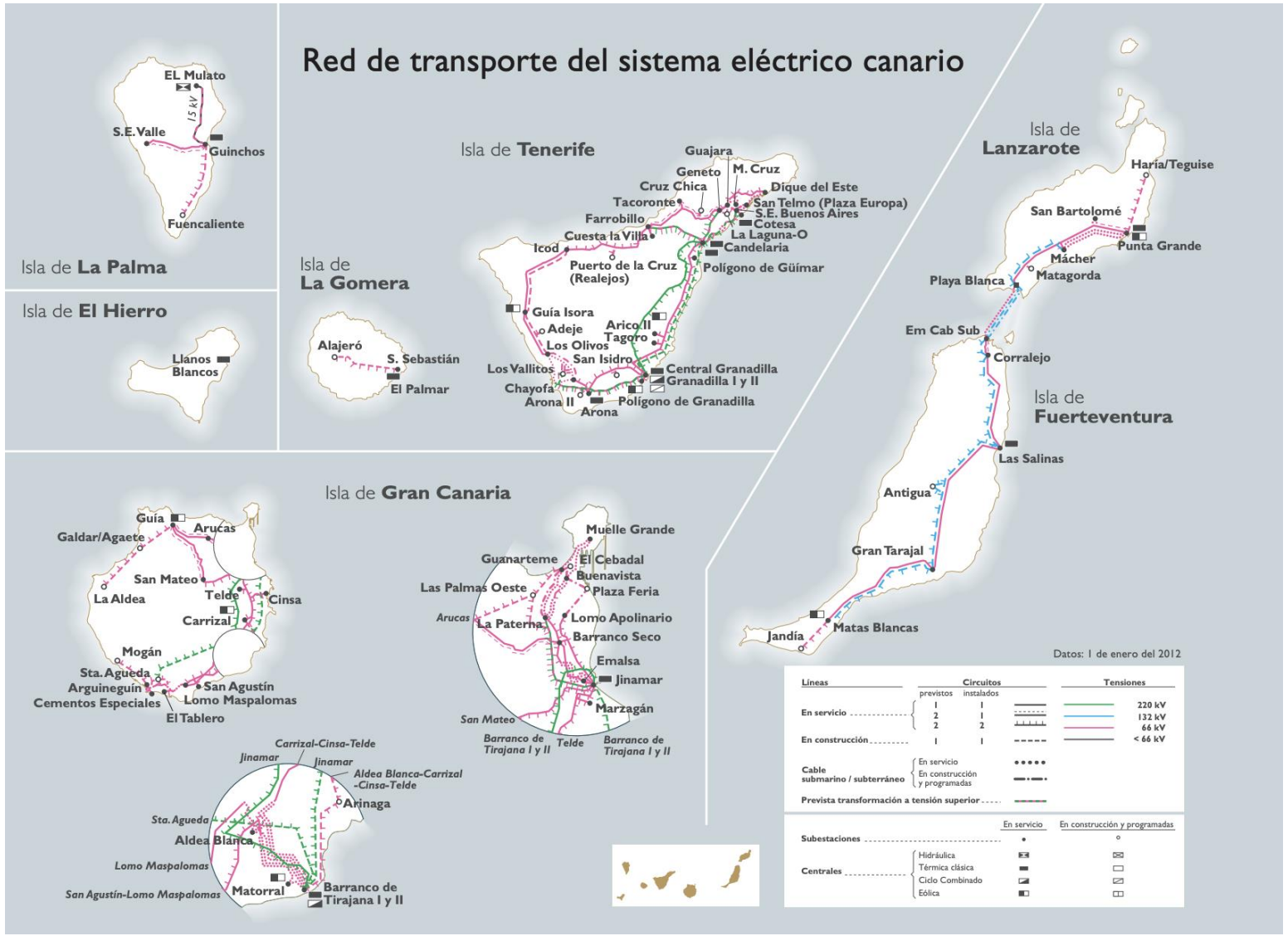


Gilles Notton, Importance of islands in renewable energy production and storage: The situation of the French islands, Renewable and Sustainable Energy Reviews, 47(2015), 260-269.

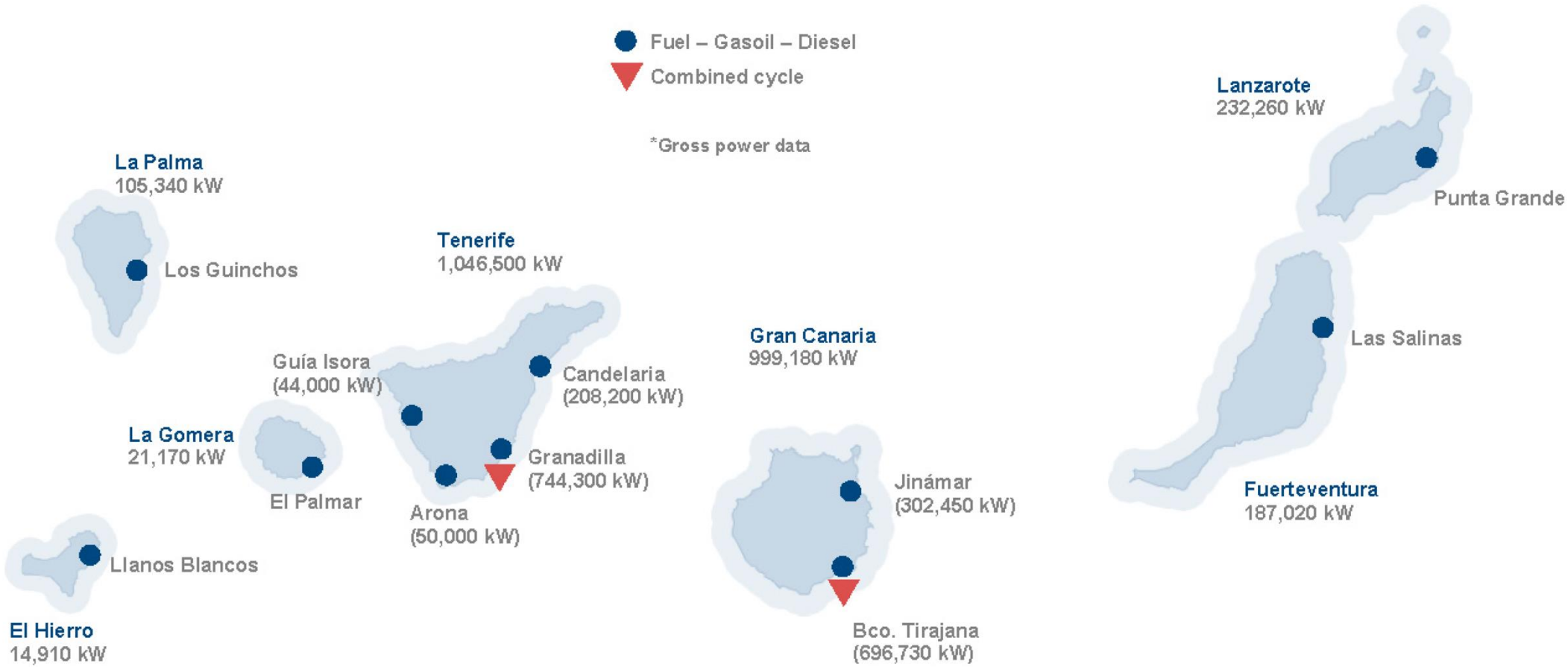
Installed power in isolated systems in Spain

Subsystem	Installed Capacity (MW)	Number of Plants	Average Size (MW)
Melilla	94	8	12
Ceuta	98	10	10
La Palma	105	11	10
El Hierro	15	9	2
La Gomera	21	10	2
Tenerife	1046	23	46
Gran Canaria	999	20	50
Lanzarote–Fuerteventura	419	25	17
Mallorca–Menorca	1944	32	61
Ibiza–Formentera	331	16	21
Total NMS	5074	164	31
Total Mainland	54,692	190	336

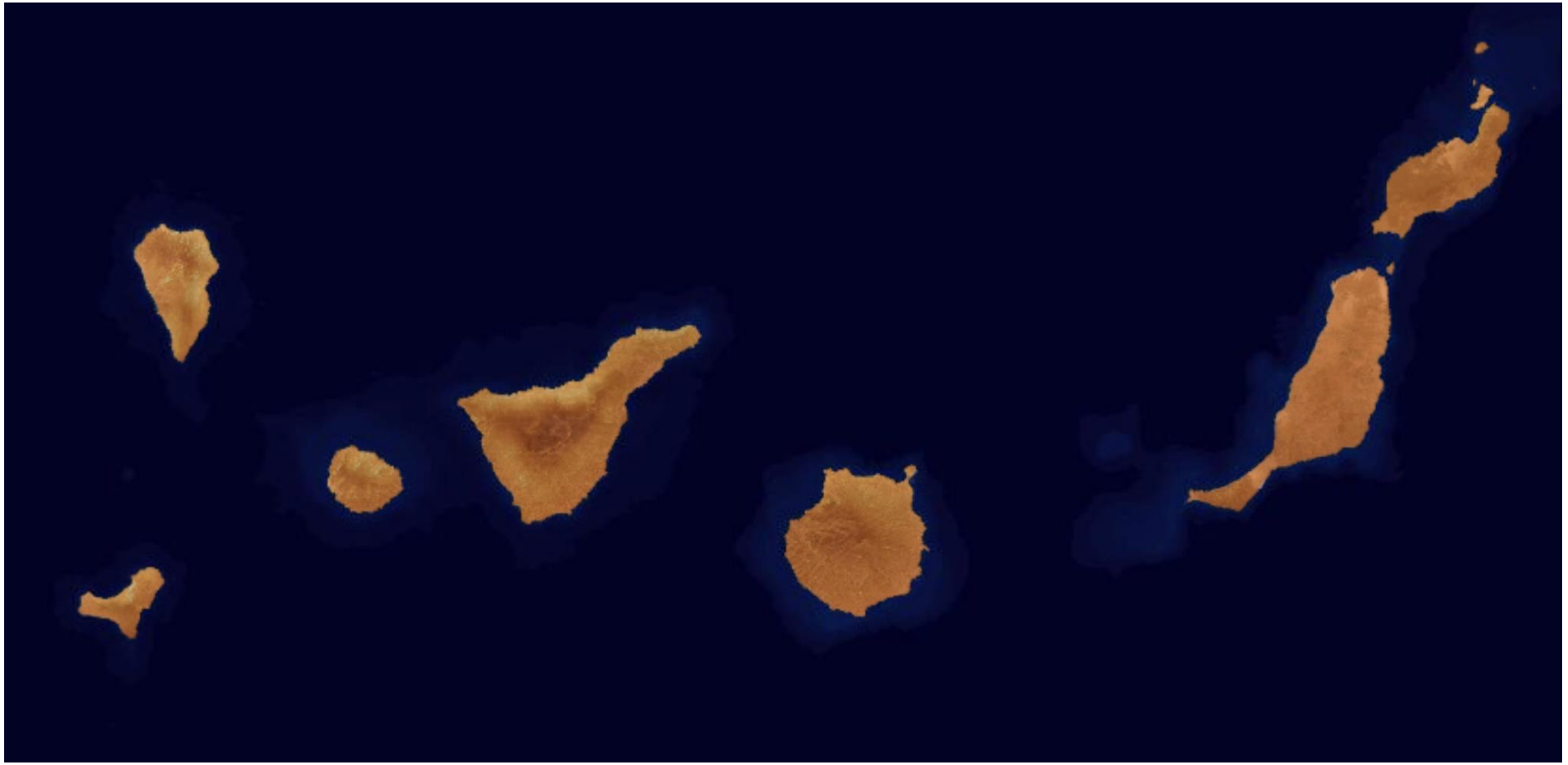
Electrical connections in Canary Island



Conventional generation in Canary Island



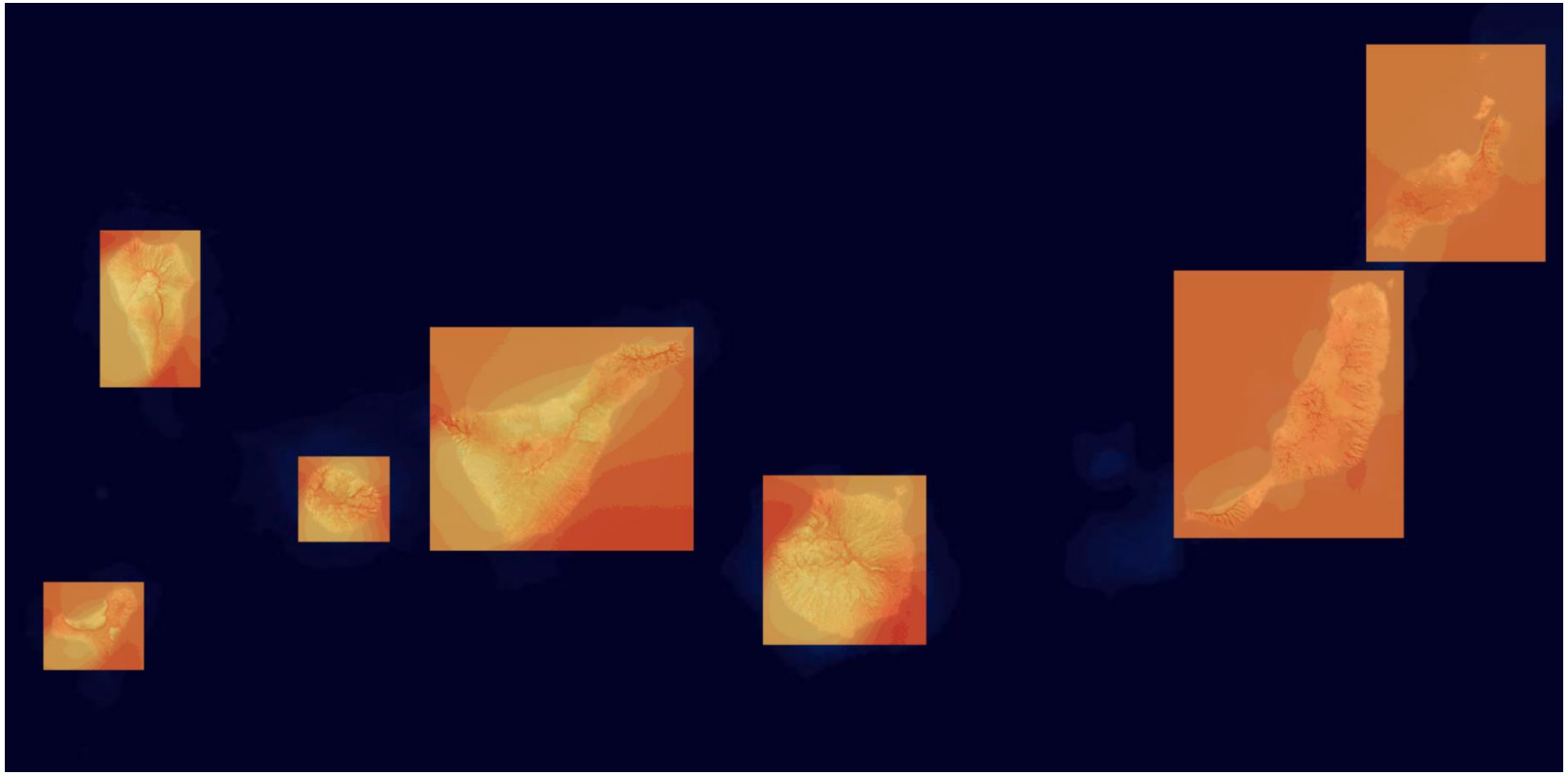
Canary Island: Solar resource

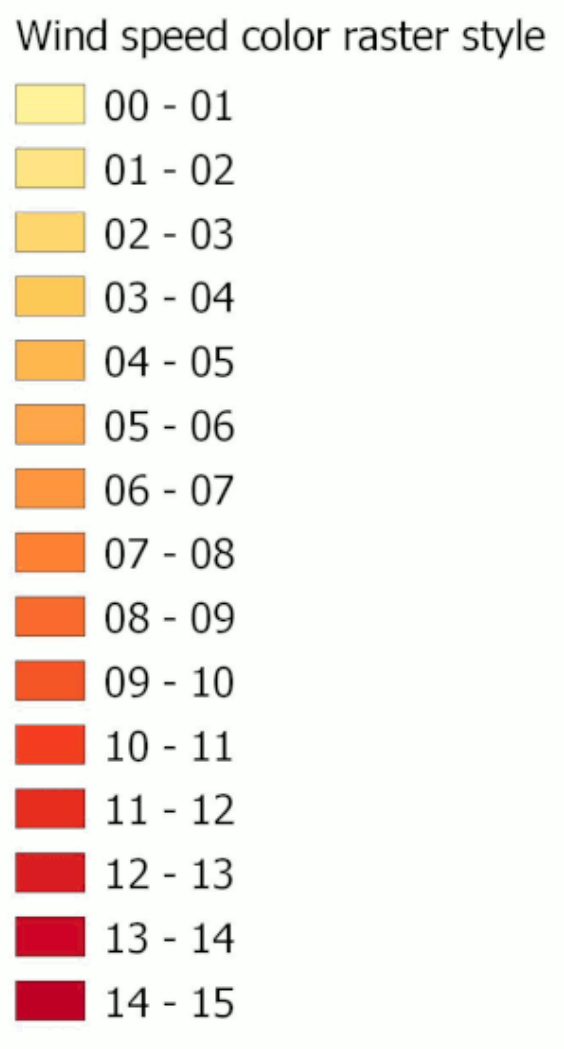


Irradiance color raster style

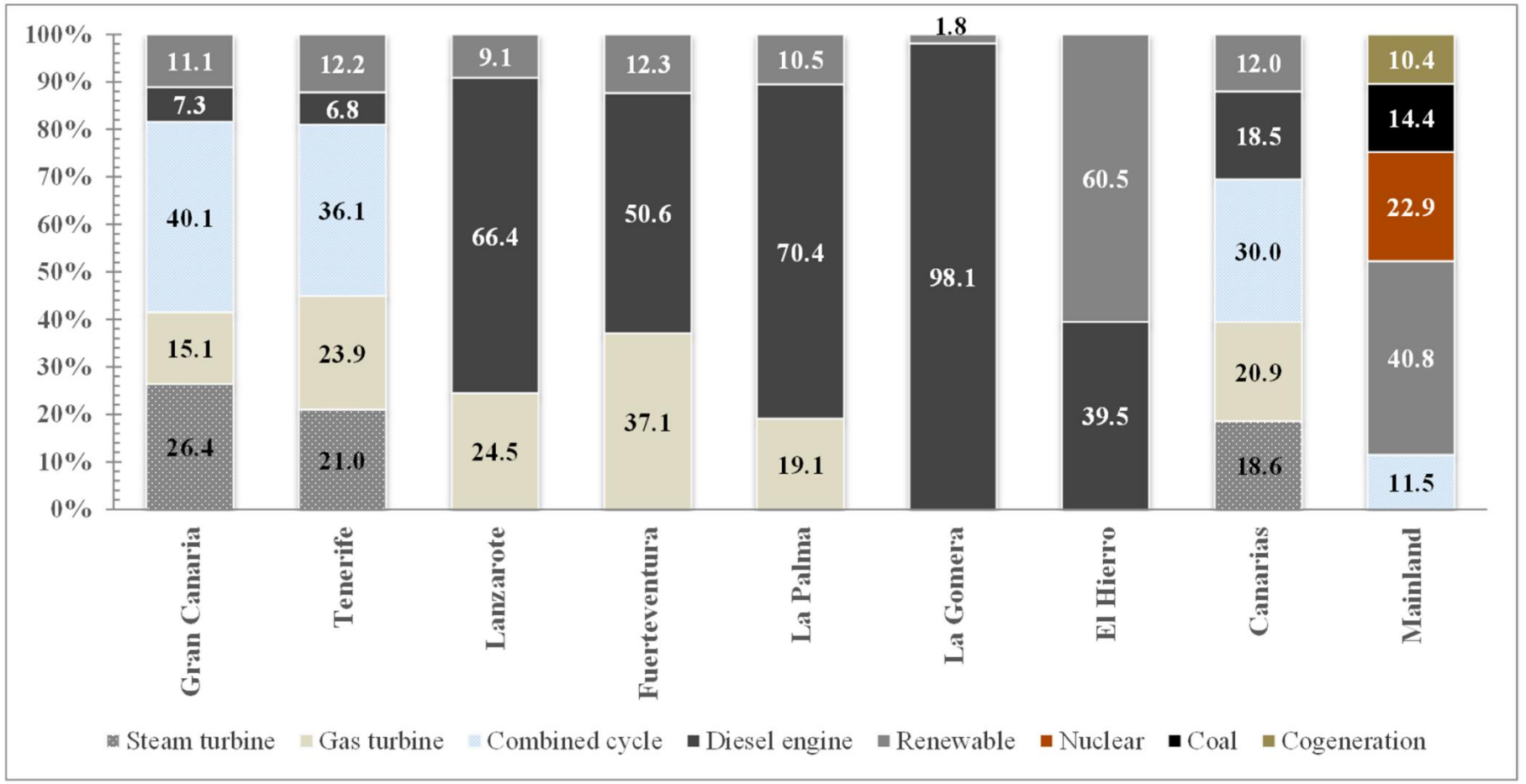
- < 900
- 900 - 999
- 1000 - 1099
- 1100 - 1199
- 1200 - 1299
- 1300 - 1399
- 1400 - 1499
- 1500 - 1599
- 1600 - 1699
- 1700 - 1799
- 1800 - 1899
- 1900 - 1999
- 2000 - 2099
- 2100 - 2199
- 2200 - 2299
- 2300 - 2399
- 2400 - 2499
- 2500 - 2599
- 2600 - 2699
- >= 2700

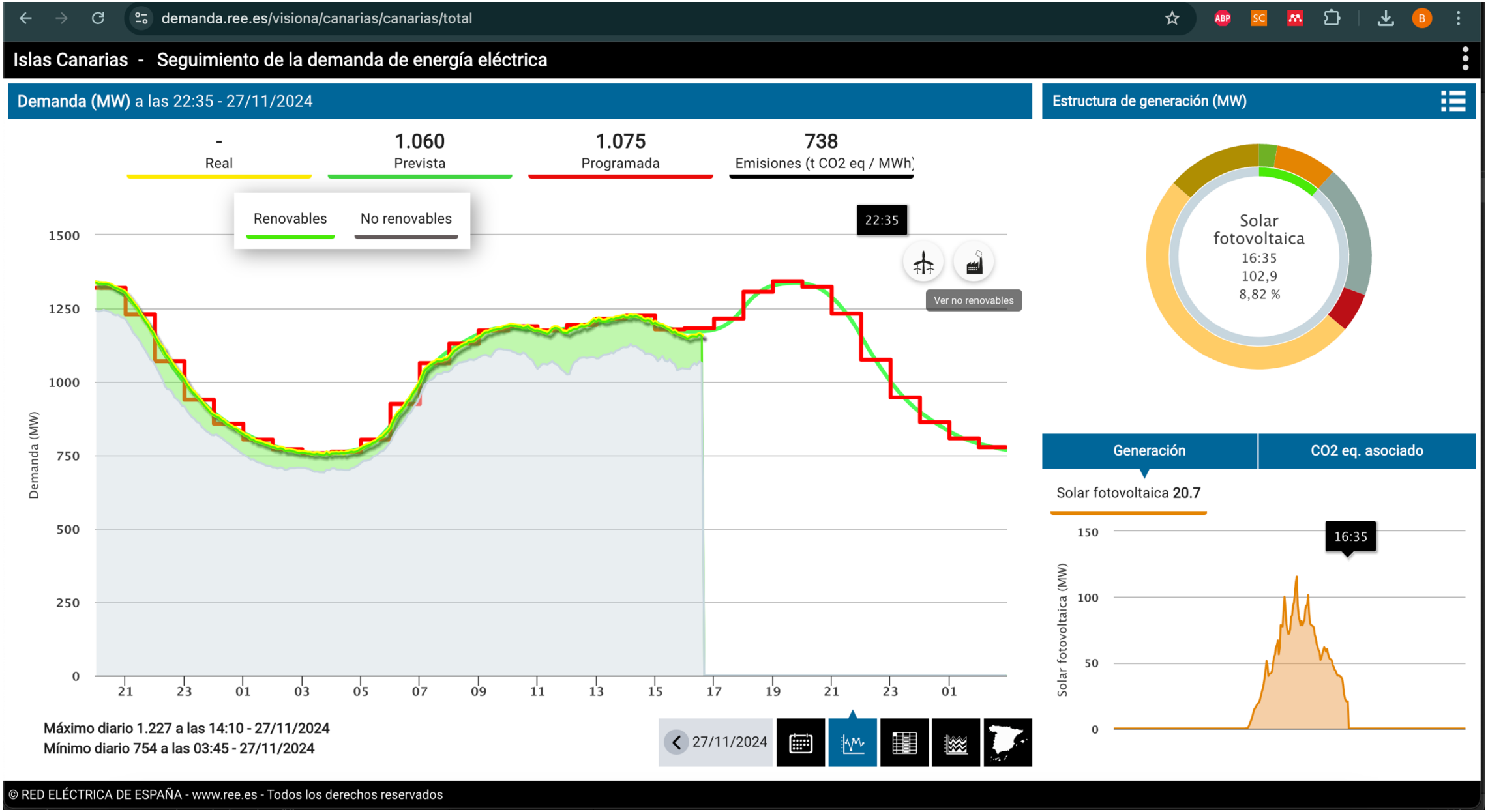
Canary Island: Wind resource





Canary Islands




demanda.ree.es/visiona/canarias/canarias/total
Islas Canarias - Seguimiento de la demanda de energía eléctrica
Demanda (MW) a las 22:35 - 27/11/2024
-
Real
1.060
Prevista
1.075
Programada
738
Emisiones (t CO2 eq / MWh)
Renovables
No renovables
22:35
Ver no renovables
Demanda (MW)
1500
1250
1000
750
500
250
0
21
23
01
03
05
07
09
11
13
15
17
19
21
23
01
Máximo diario 1.227 a las 14:10 - 27/11/2024
Mínimo diario 754 a las 03:45 - 27/11/2024
27/11/2024
Estructura de generación (MW)
Solar fotovoltaica
16:35
102,9
8,82 %
Generación
CO2 eq. asociado
Solar fotovoltaica 20.7
16:35
Solar fotovoltaica (MW)
150
100
50
0
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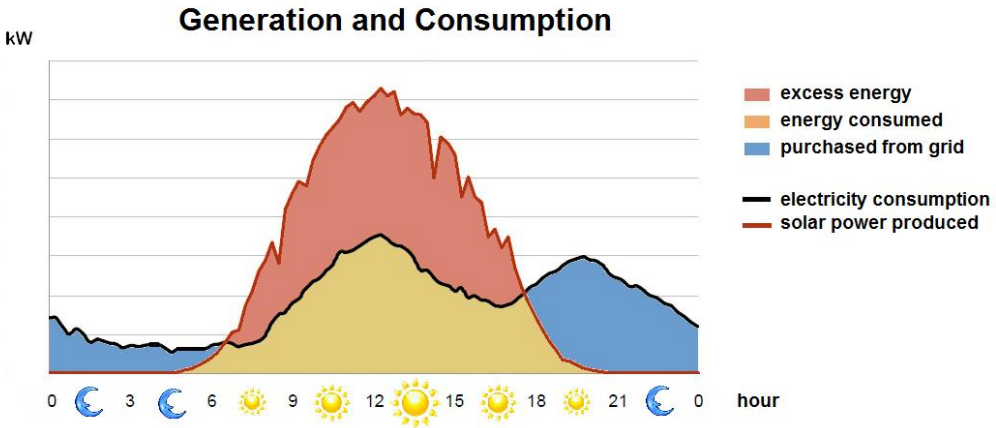
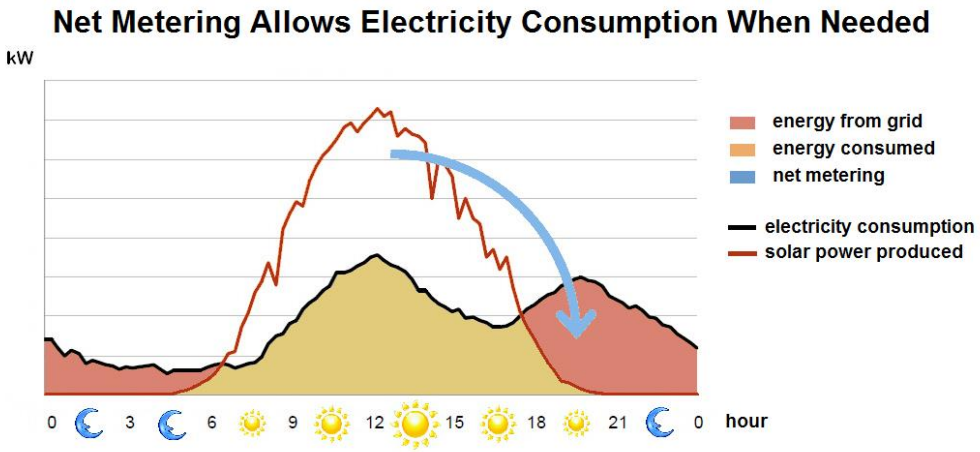
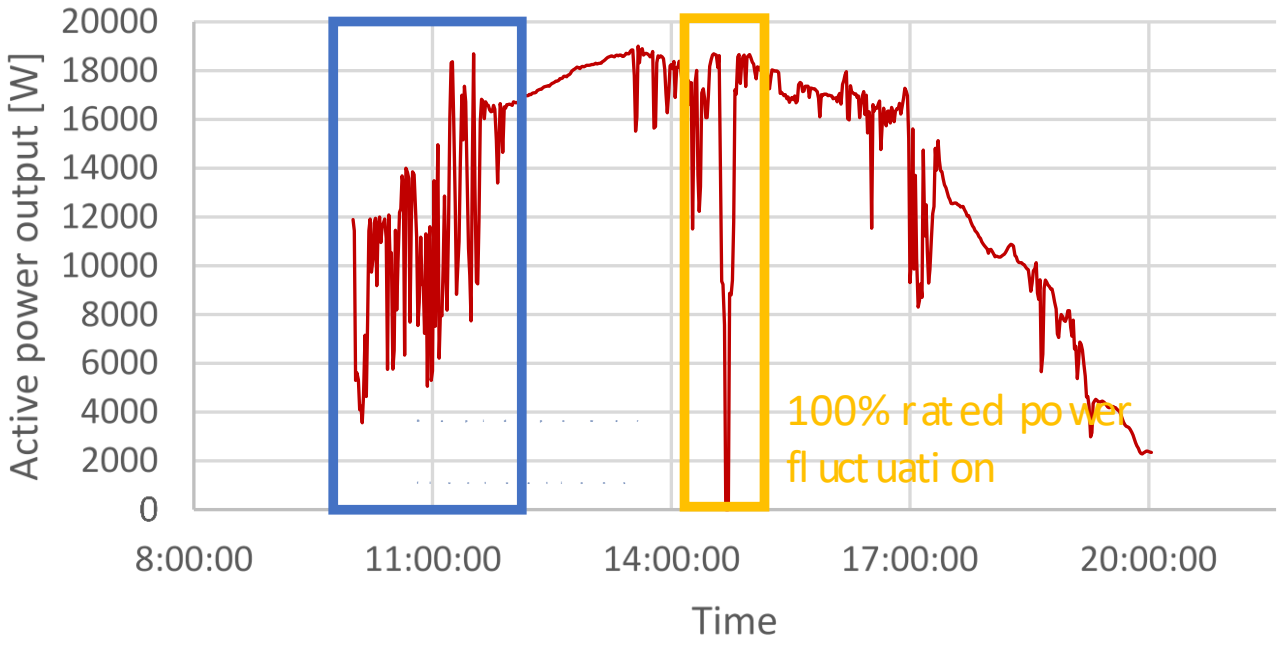
RE constrains

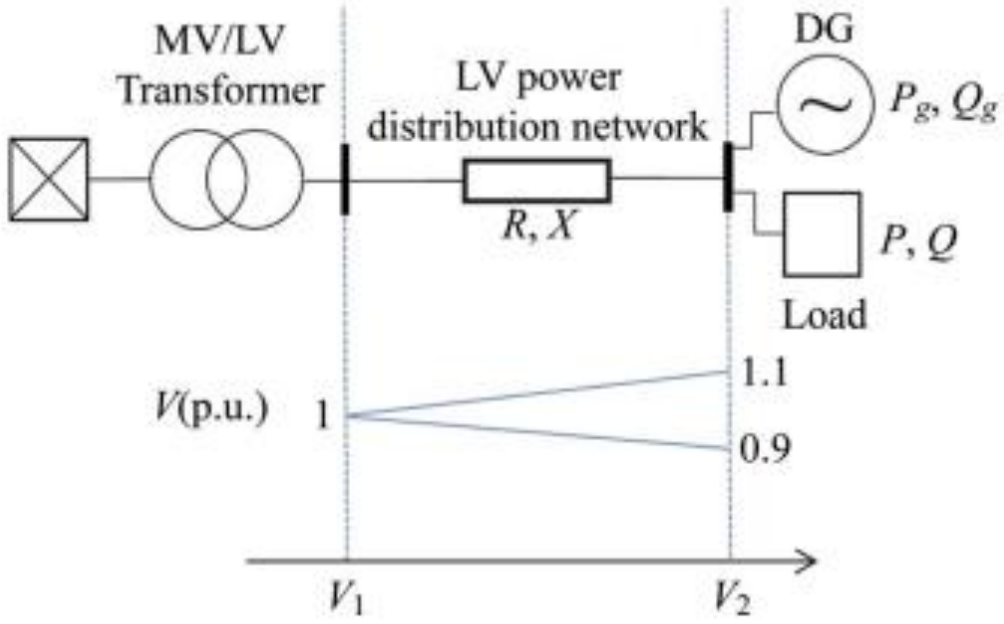
Deferred consumption and variability

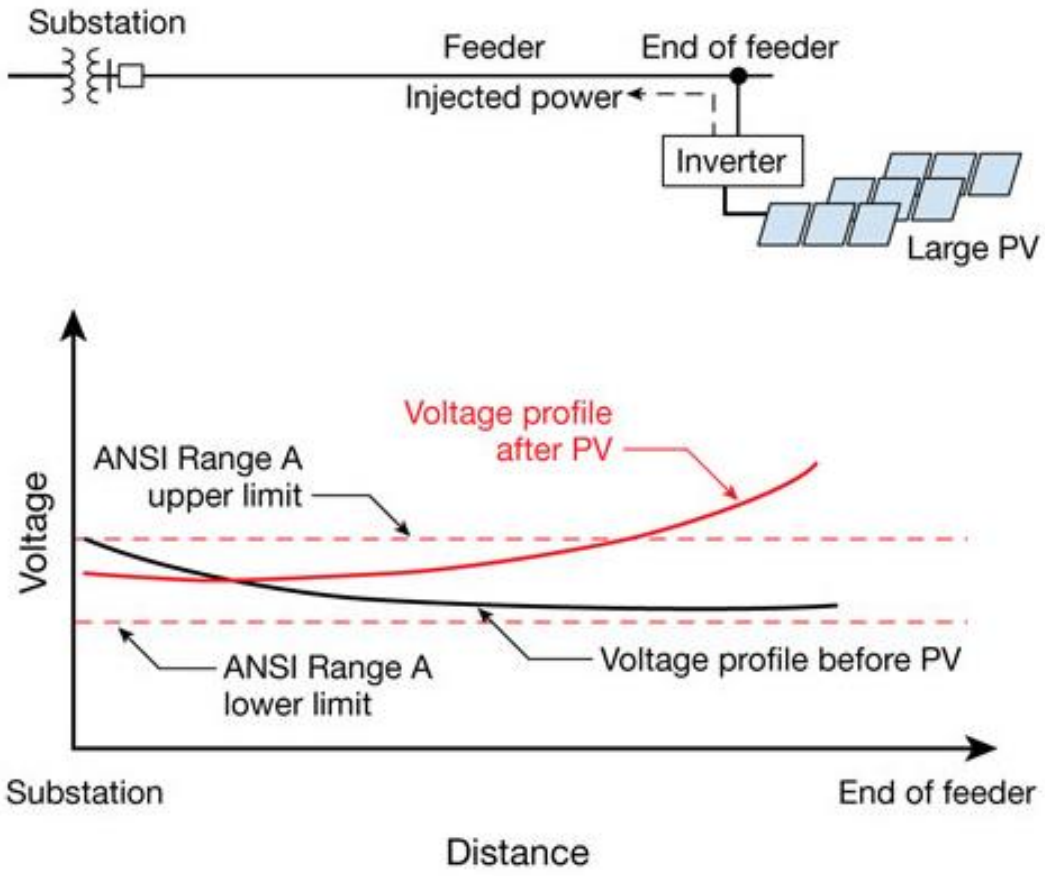




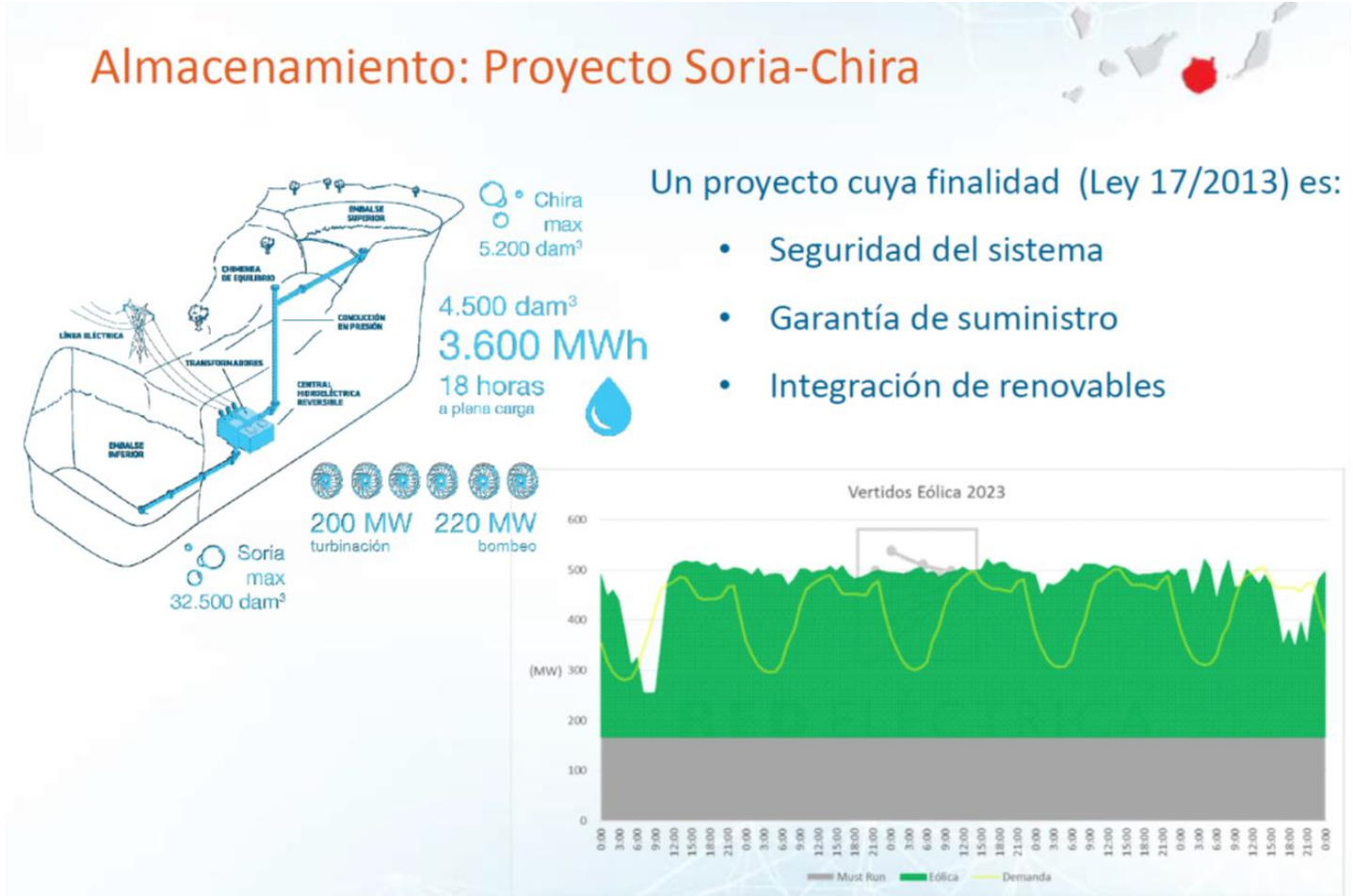


Voltage


MV/LV
Transformer
LV power
distribution network
DG
P_g, Q_g
R, X
P, Q
Load
V(p.u.)
1
1.1
0.9
V_1
V_2


Substation
Feeder
End of feeder
Injected power
Inverter
Large PV
Voltage profile
after PV
ANSI Range A
upper limit
Voltage
ANSI Range A
lower limit
Voltage profile before PV
Substation
End of feeder
Distance

Large scale storage

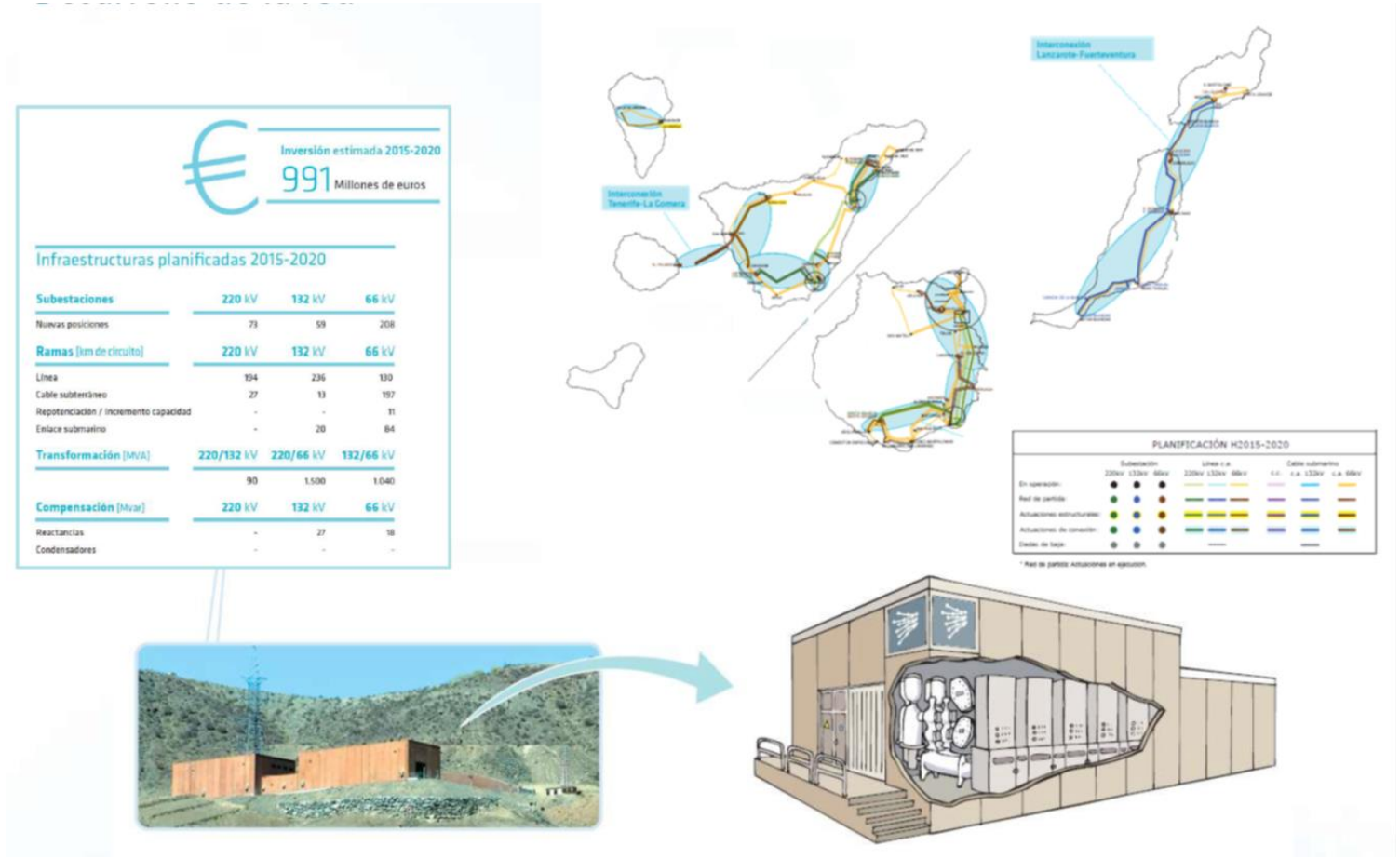


Huge public investment

Time

Retribution framework

Distributed Storage



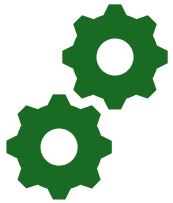
Private investment

Retribution framework

Remuneration framework

RD 738/2015

Fuel prices



REE

Technical framework

Accumulation?

Market-liberated costs

Internalized costs

ALISIOS/OSMOSE

Hybrid storage projects to provide system services

TENERIFE

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

- *Managing RES variability*
- *Frequency stability*
- *Inertia emulation*
- *Voltage control*
- *Congestion relief*

ALISIOS

LANZAROTE - FUERTEVENTURA

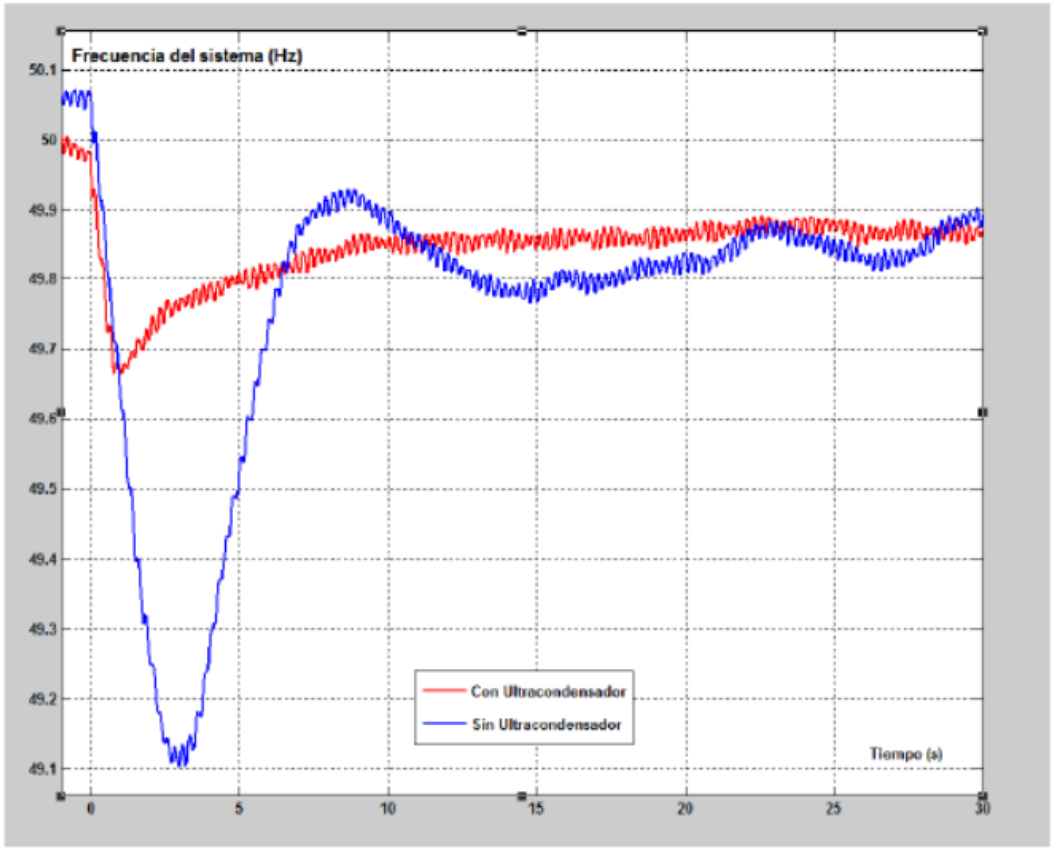
Hybrid storage to keep security of supply and operating efficiency a low Meshed isolated power grid.

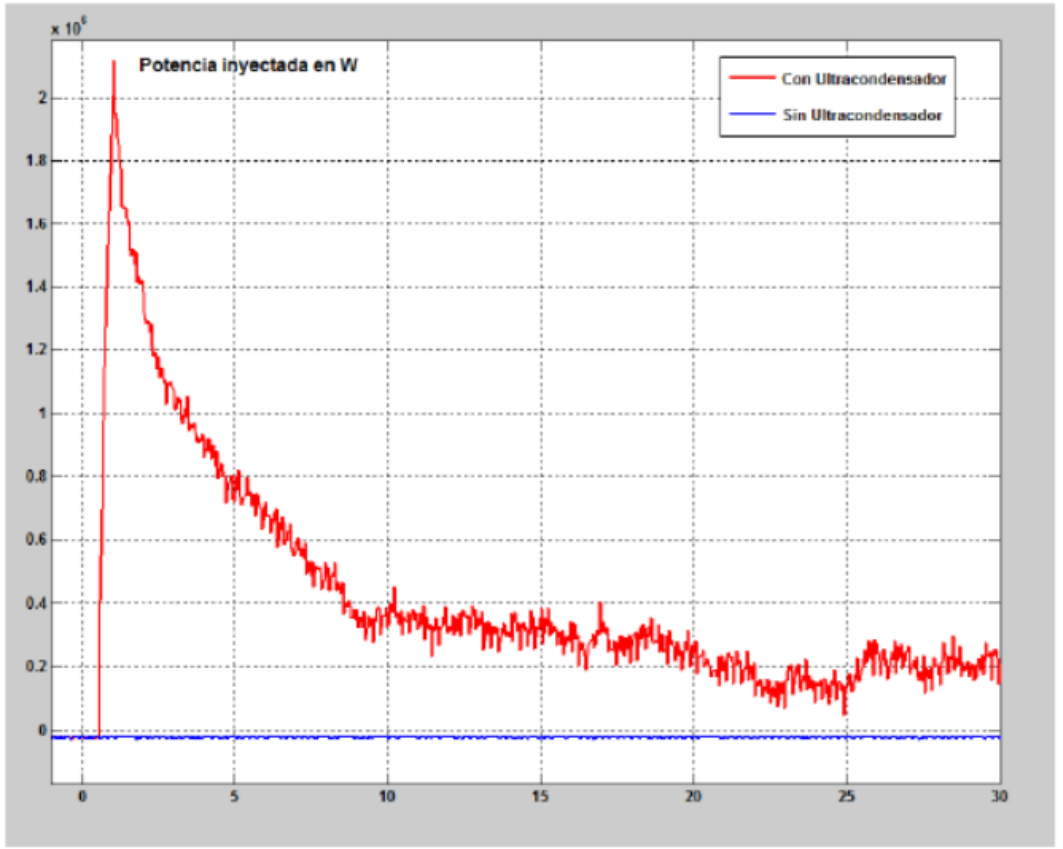
- *STATCOM: 25 Mvar*
- *SUPERCAPACITOR: 10 MW – 55 MWs*
- *FLYWHEEL: 1.6 MW – 18 MWs*
- *BATTERY: 3 MW - 1 MWh*

OSMOSE

HORIZON 2020

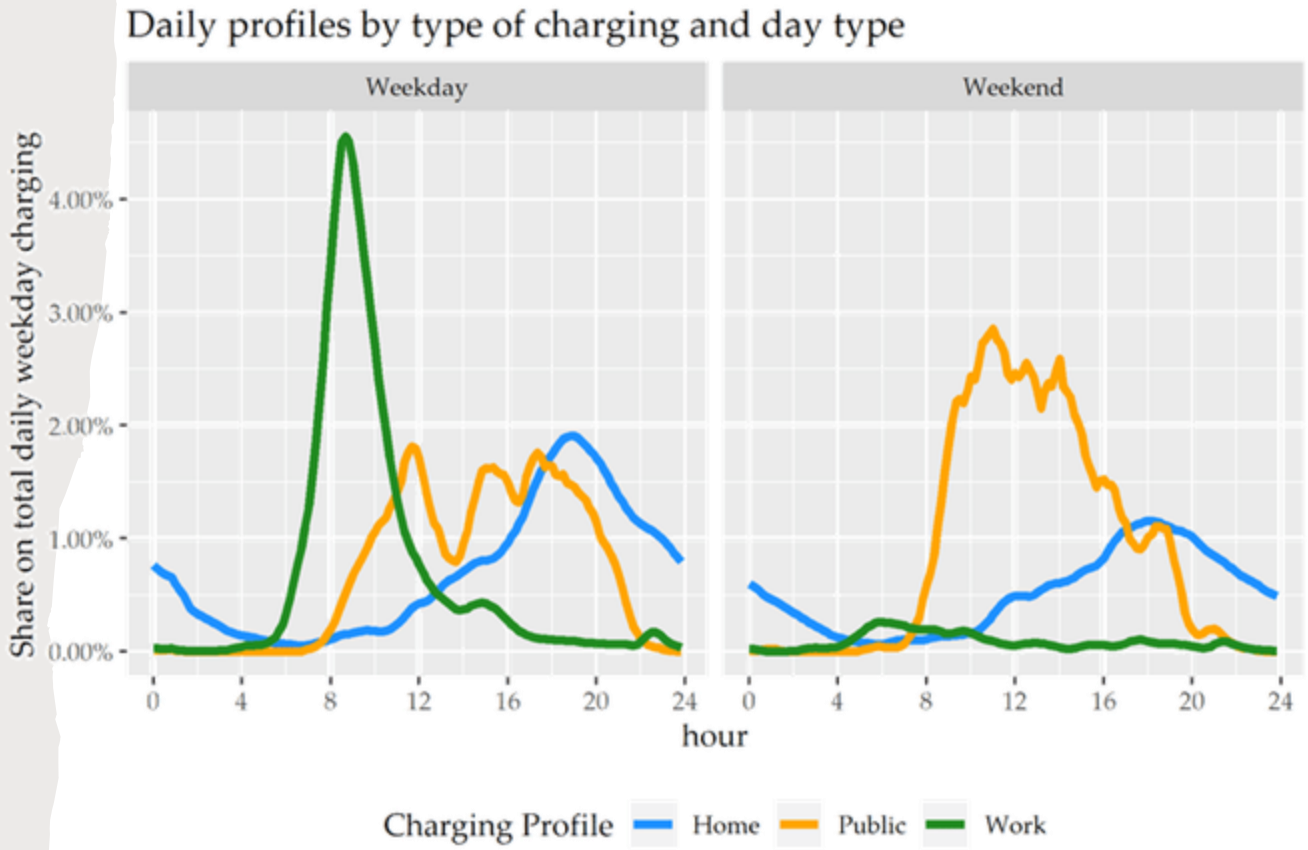
Not just energy: voltage drop and synthetic inertia





Electrical Mobility

- Infraestructure
- Forecasting
- V2G
- Orography
- Human behavior



Challenges for H_2

Energy vector	Need to increase the RE generation system between 6 and 12 times Competitive system with accumulation (eff. 85%)
Efficiency in use:	19% using CO_2 capture to obtain Methane 41% fuel cell for mobility
Importation and sovereignty	External dependency

Merci pour votre temps!

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