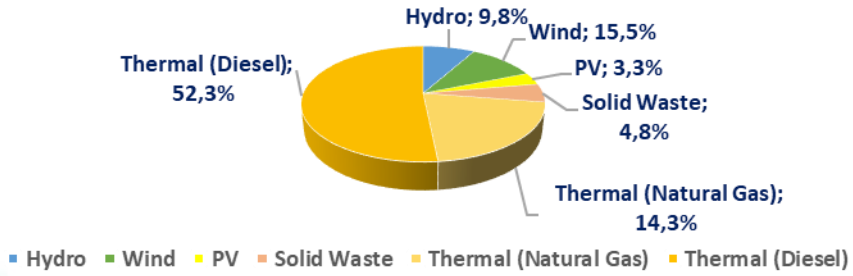
EEM - Madeira (Portugal)

System/grid services in isolated electric systems

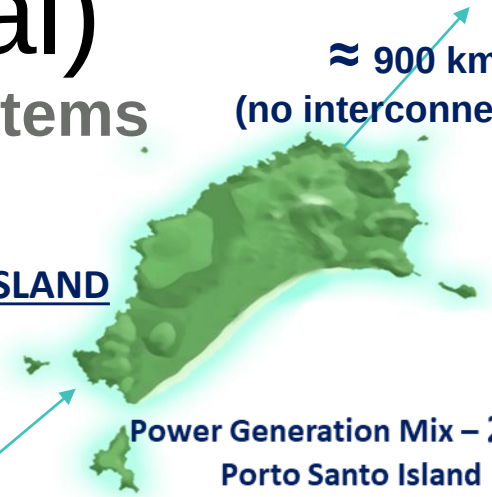
AUTONOMOUS REGION OF MADEIRA

Power Generation Mix – 2022– Madeira Island

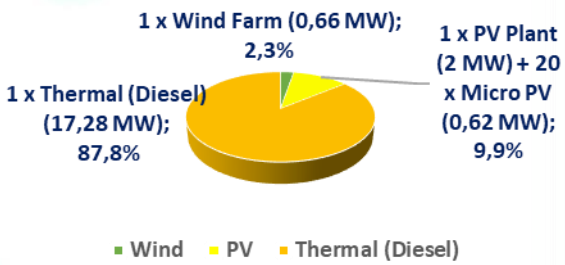


≈ 900 km (no interconnection)

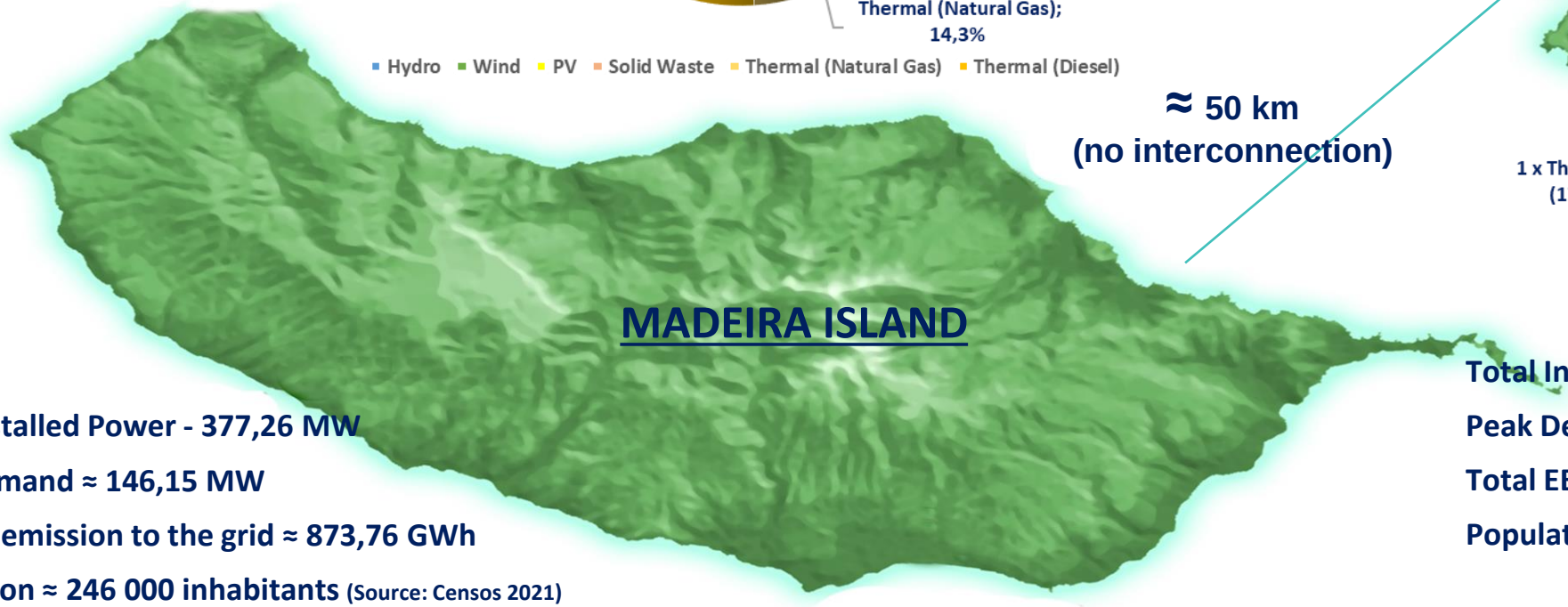
PORTO SANTO ISLAND



Power Generation Mix – 2022 Porto Santo Island



≈ 50 km (no interconnection)



MADEIRA ISLAND

Total Installed Power - 377,26 MW

Peak Demand ≈ 146,15 MW

Total EE emission to the grid ≈ 873,76 GWh

Population ≈ 246 000 inhabitants (Source: Censos 2021)

Area: 741 km²

Total Installed Power - 20,57 MW

Peak Demand ≈ 7,9 MW

Total EE emission ≈ 36,57 GWh

Population ≈ 5 151 inhabitants*

*(Source: Censos 2021)

Area: 42,48 km²

Source: EEM

TOTAL POPULATION ≈ 251 000 inhabitants

EEM Clients ≈ 136 411 Madeira / 4 766 Porto Santo

EEM - Madeira Island (Portugal)

System/grid services in isolated electric systems

Capabilities to assure the electric system safety operation:

- A-Inertia capability
- B-Frequency regulation capability:
  - B1-Primary regulation
  - B2-Secondary regulation
- C-Voltage regulation capability
- Short-circuit capacity

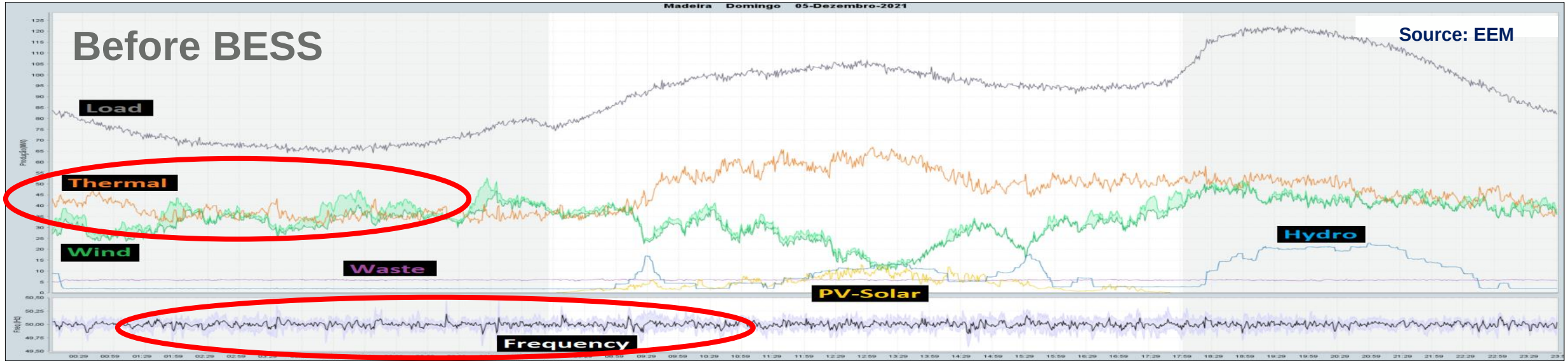
Critical issue: high values of df/dt (RoCoF)

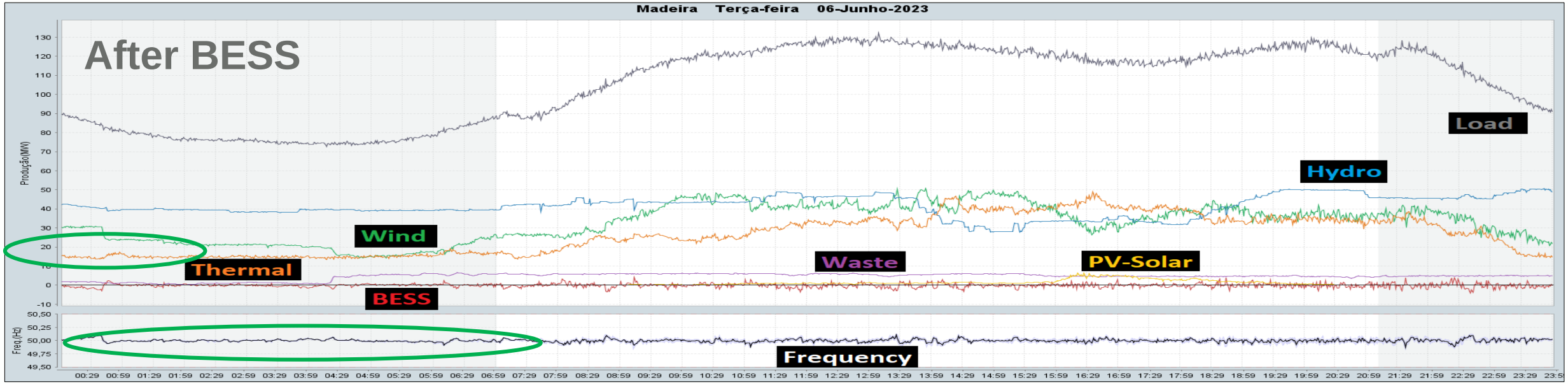
Traditional mix system generation	System services			
Technology	A-Inertia	B1_Frequency primary regulation	B1_Frequency secondary regulation	C-Voltage regulation
Thermal Generation (Gas, Fuel/Diesel engines)	X	X	X	X
Hydro	x	-	x	X
Wind	x	-	-	x
PV	-	-	-	x
Waste incineration	x	-	-	x
Result	**X✓**	**X✓**	**X✓**	**X✓**
Result without thermal generation	**x**	**-**	**x**	**X✓**

Mix system generation, without thermal	System services			
Technology	A-Inertia	B1_Frequency primary regulation	B1_Frequency secondary regulation	C-Voltage regulation
Synchronous condenser with inertia	X			X
Battery Power Plant	-	X	X	X
Hydro reversible (Storage, pumping and operation as a synchronous condenser)	x	-	X	X
Wind	x	-	-	x
PV	-	-	-	x
Waste incineration	x	-	-	x
Result without thermal generation	**X✓**	**X✓**	**X✓**	**X✓**

EEM - Madeira Island (Portugal)

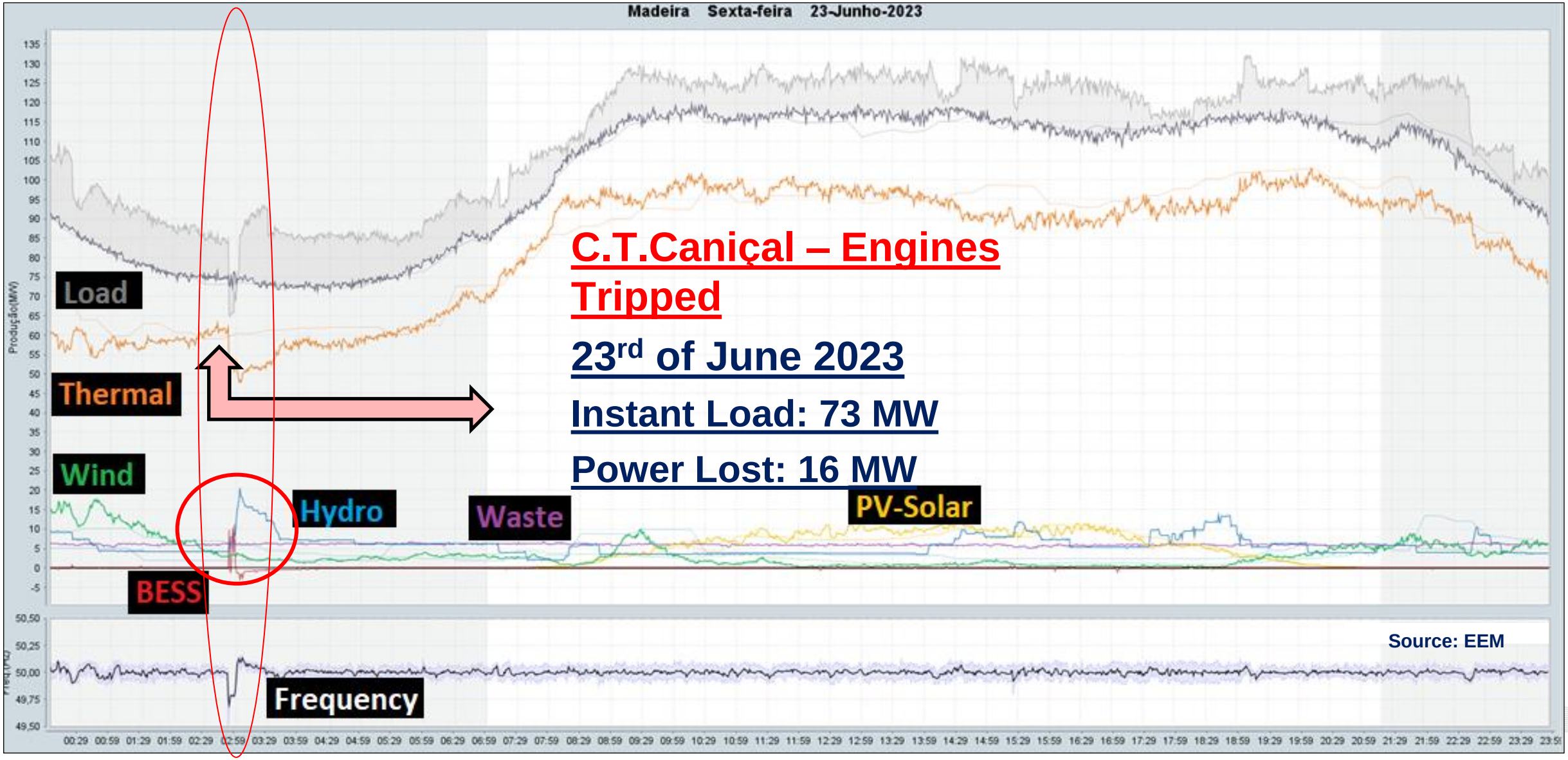
Lessons learned?





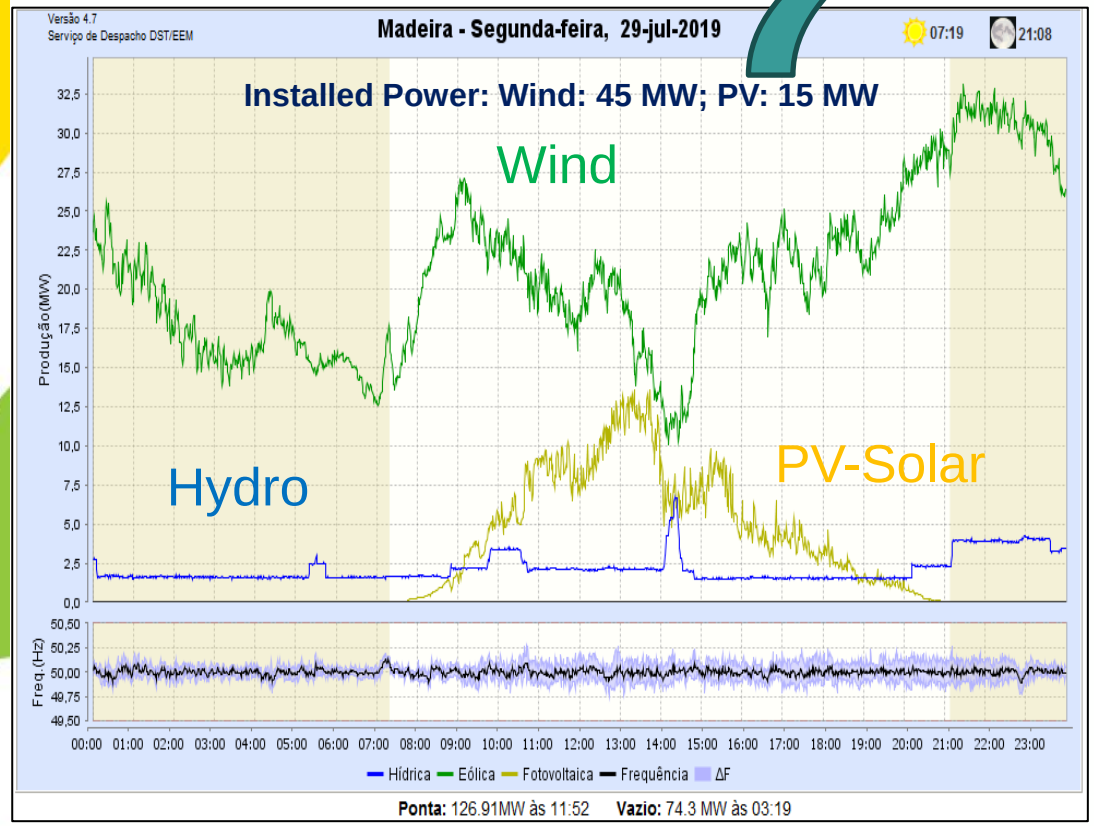
EEM - Madeira Island (Portugal)

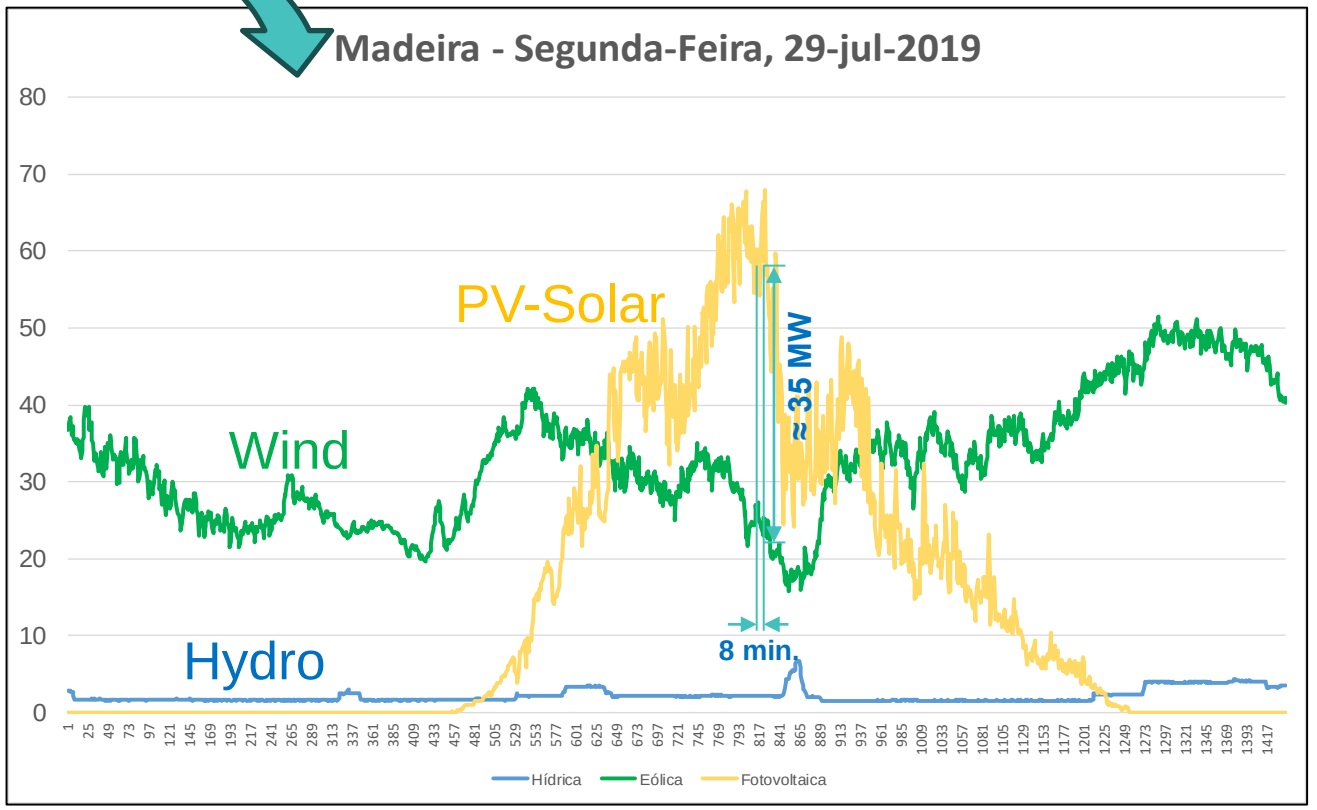
BESS support and importance for System Security:



EEM - Madeira Island (Portugal)

The Challenge of RES Volatility in small islands





Source: EEM

Installed Power:

- Wind: 45 MW → **70 MW**
- PV-Solar: 15 MW → **75 MW**

From 25% to 50% RES

EEM – Porto Santo Island (Portugal)

The Challenge of RES Volatility in small islands