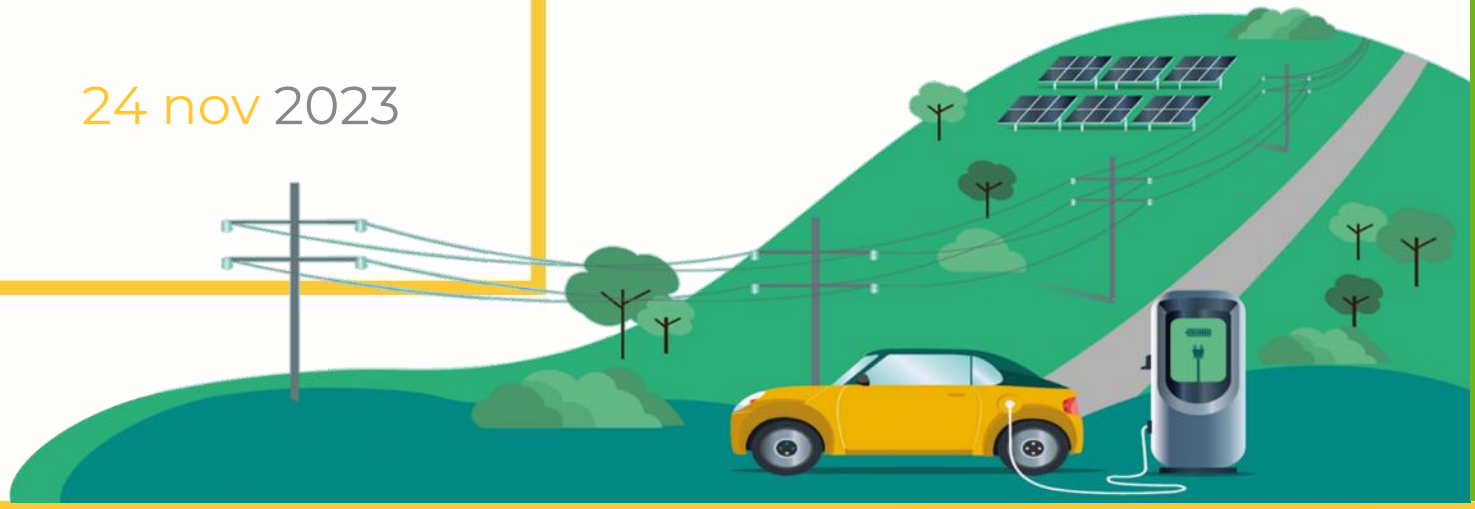
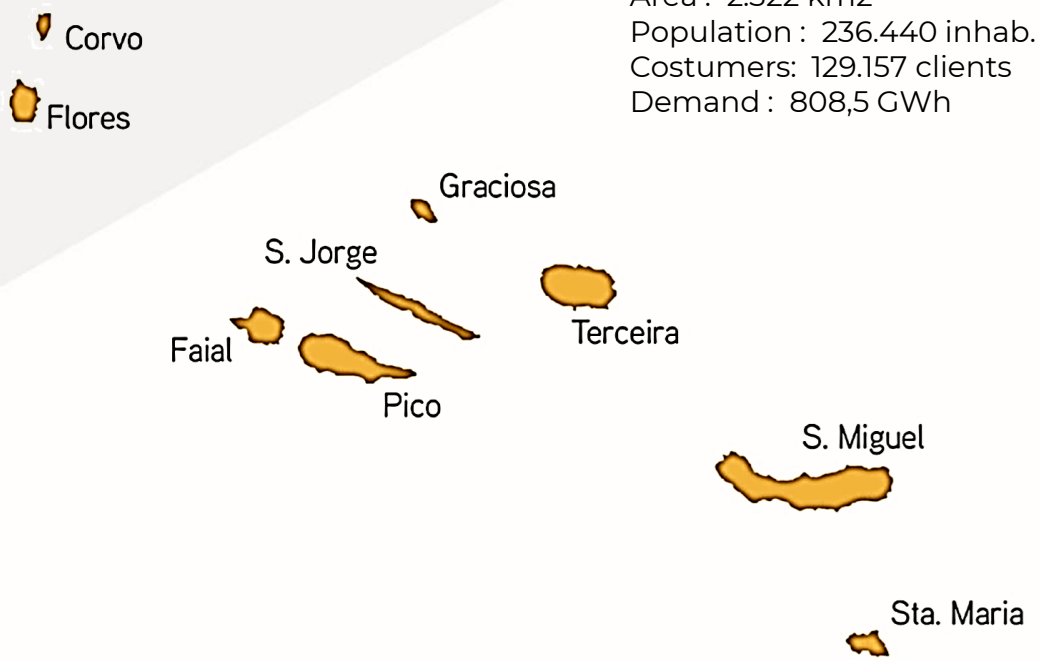
EDA
Electricidade dos Açores

Project Vehicle-to-Grid Açores

24 nov 2023



Azores Archipelago



Area : 2.322 km2
Population : 236.440 inhab.
Costumers: 129.157 clients
Demand : 808,5 GWh

nine small independent electrical systems, without the capacity of exporting or importing renewable energy

electric interconnections between islands are expensive and not yet economically feasible

Project V2G Açores

Project Partners

galp — Supplier of an integrated mobility solution

Automobile Technology	Charging Technology	Management & Aggregation Platform	Grid Operator
NISSAN	MAGNUM CAP ELECTRICAL POWER SOLUTIONS	NUVVE	EDA Electricidade dos Açores

Regulatory Framework

ERSE ENTIDADE REGULADORA DOS SERVIÇOS ENERGÉTICOS

Direção-Geral de Energia e Geologia

Governo dos Açores

INESCTEC — Research and development / Data analysis

Project V2G Açores

Project Goals

10 Nissan Vehicles
7 x Leaf
3 x NV-200

Used during the day
Plugged overnight

- 10 EV fleet with V2G capability
- one V2G charger per EV (DC, CHAdeMO, 11kW)
- while parked, the cars perform a set of services for the user and the grid
- 15h/day of V2G operation per EV (car connected to the charger)

Reduce energy costs for the client	Services to the Grid	Compensation of Renewable Energies
• Time of use tariffs • Peak Shaving	• Peak Reduction • Frequency Regulation • Voltage Control • Demand Response • …	• Use V2G to compensate the fluctuation of solar or wind energy production

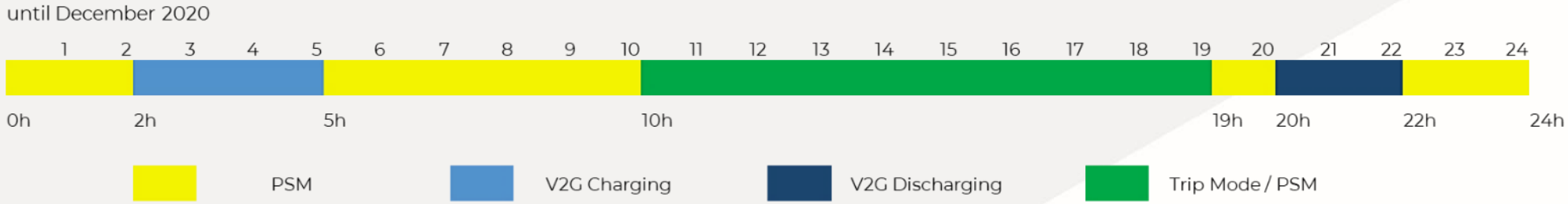
NUVVE

live dashboard showing the power flow, connection status, and SOC

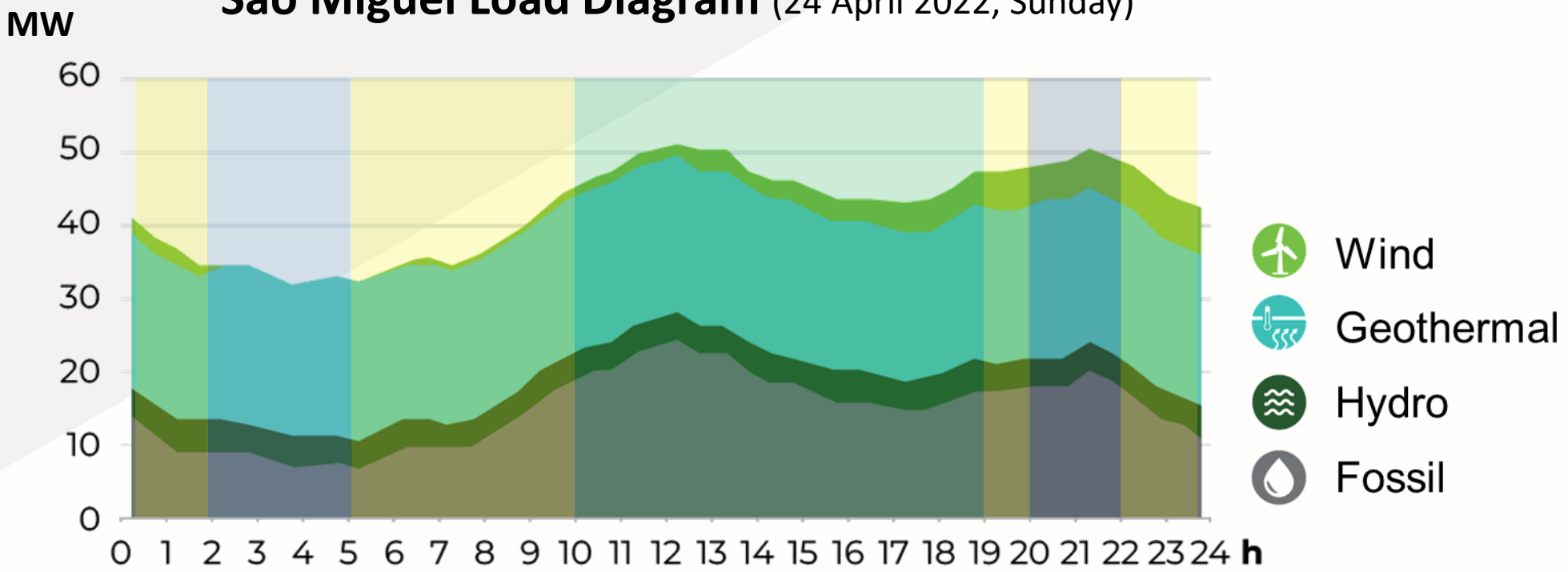
Project V2G Açores

Use Case Scenario 1 - Load Shifting

ToU (Time of Use Profile for all vehicles)



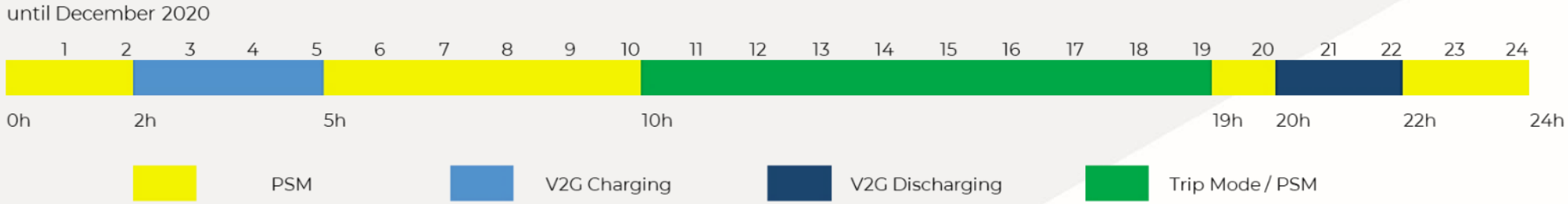
São Miguel Load Diagram (24 April 2022, Sunday)



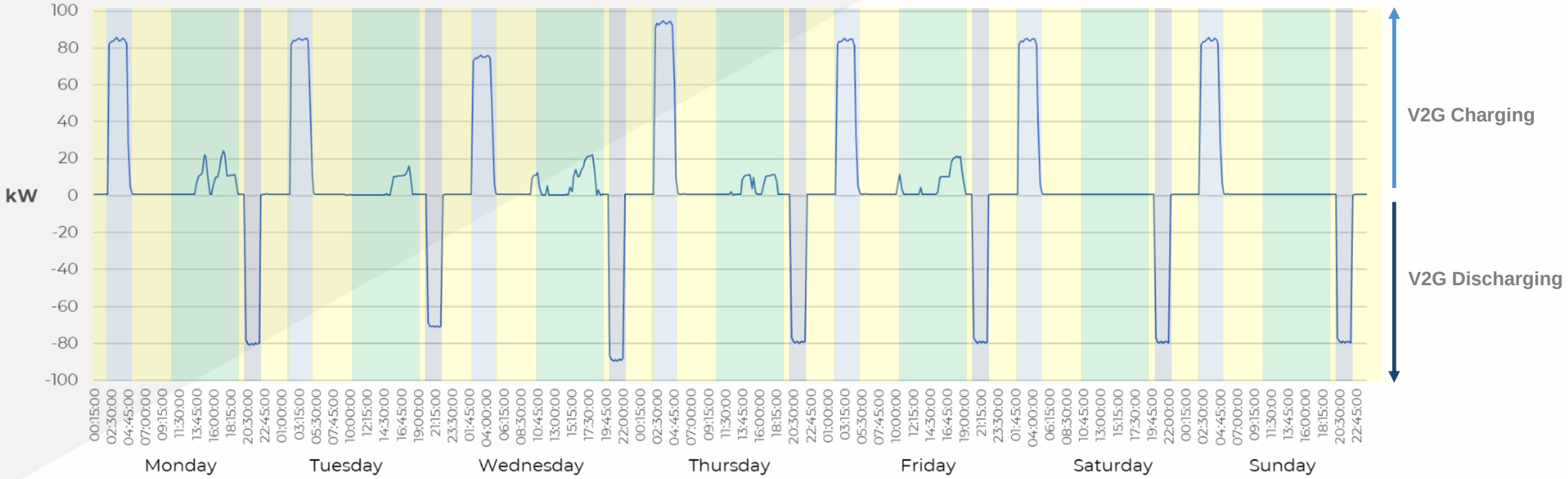
Project V2G Açores

Use Case Scenario 1 - Load Shifting

ToU (Time of Use Profile for all vehicles)

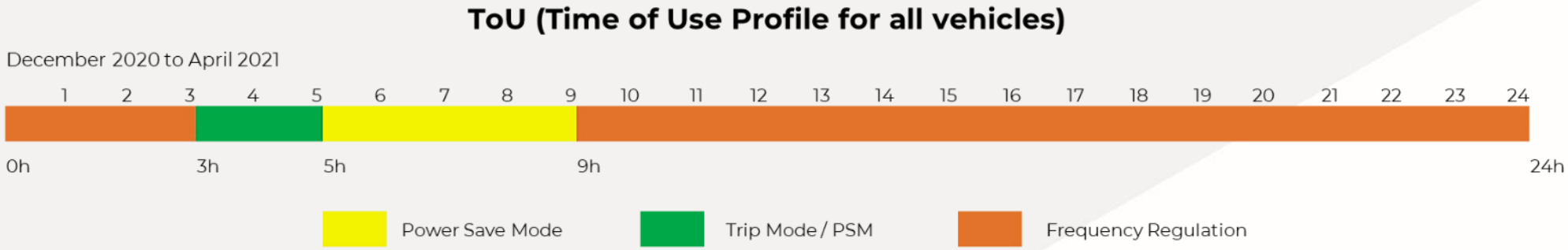


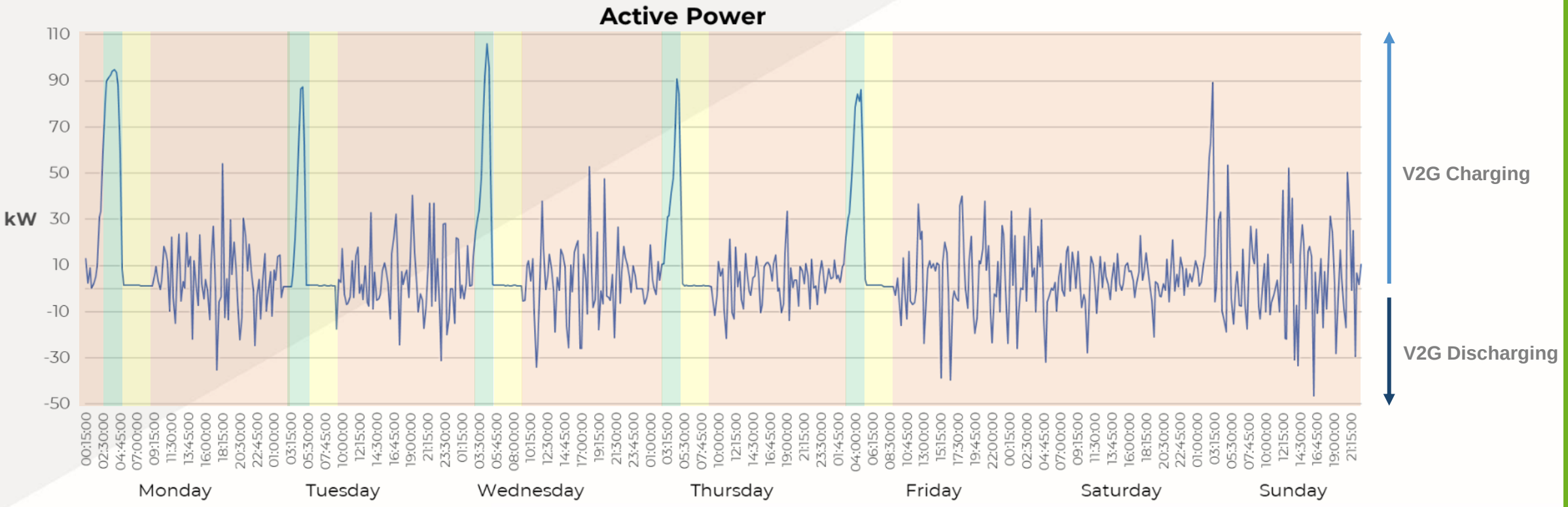
Active Power



Project V2G Açores

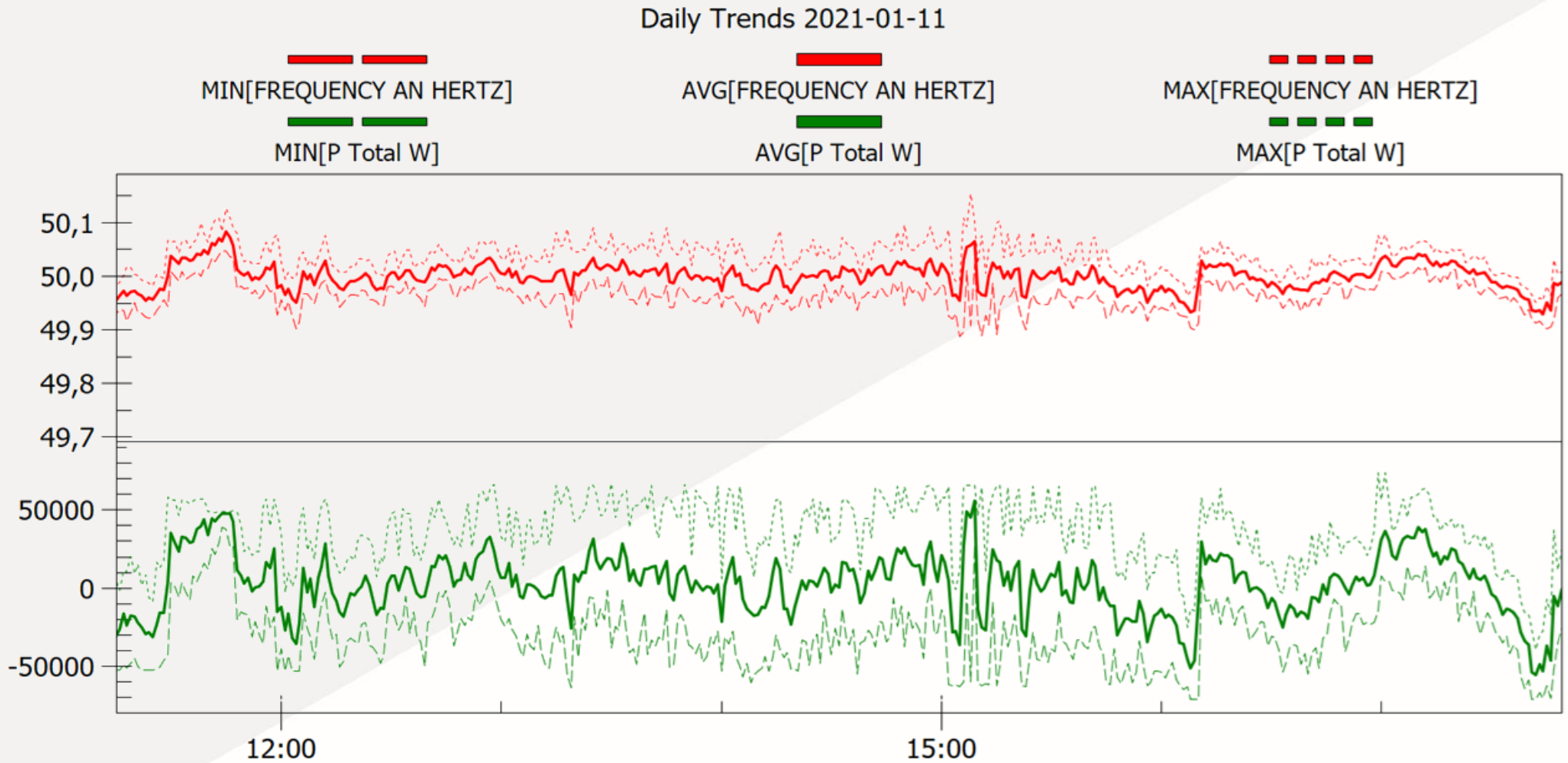
Use Case Scenario 2 - Frequency Regulation





Project V2G Açores

Use Case Scenario 2 - Frequency Regulation



Grid Frequency

V2G Charging

System Power Requested (V2G)

V2G Discharging

Project V2G Açores

Big Numbers

Time period
≈581 days

Driven kilometres
≈129 000 km

Average km/month
≈600 km

Average kWh/100km
15.5 kWh

Average km/kWh
6.6 km

Average State of Health
91,8 %

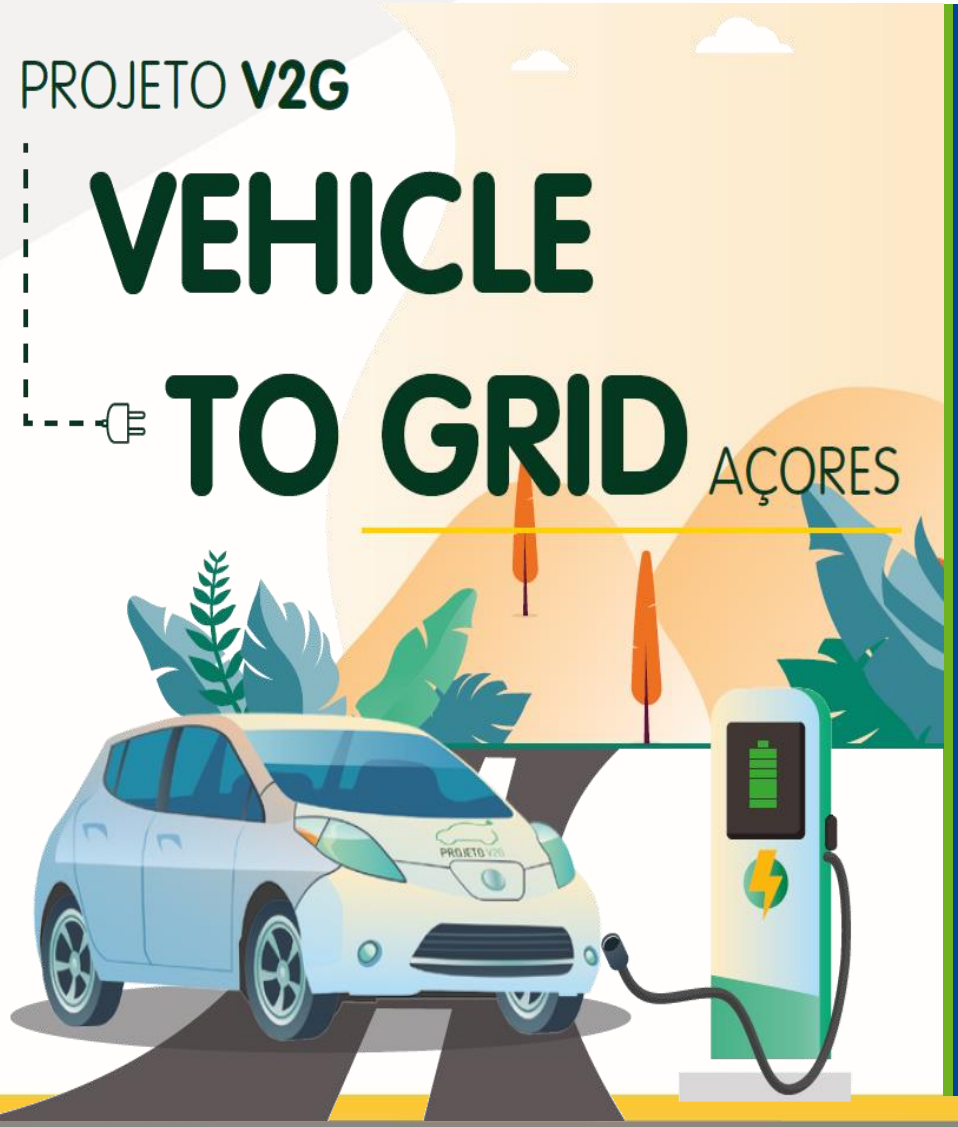
Energy Consumption
197.8 MWh

Energy Discharged
108.6 MWh
(enough to power 32 homes and to avoid the emission of 15,2 tons of CO_2)

Energy in Mobility
19.5 MWh

SoC restriction
30% - 90%

Equivalent Number of full cycles
495



Project V2G Açores

Conclusions

Charging EVs without any optimized strategy may cause additional diesel power plant units to start.

With an optimized strategy, the EVs can **increase renewable energy integration** during periods of low demand, reducing the curtailment of renewable power.

With an optimized strategy and V2G technology, the EVs can **avoid the start up of diesel units** by returning stored energy to the grid during peak loads.

However:

- the efficiency of battery charging and discharging processes must be taken into account when analyzing financial benefits.

The integration of V2G technology EV fleet with **frequency regulation capability** may contribute for the reduction of frequency nadir in the event of a power loss.

However:

- frequency regulation can only be carried out during the period in which the EVs are connected to the charging stations;
- existence of delays compromises the benefits of EVs participation in frequency regulation.

EVs can represent a considerable storage resource: in small islands only a small amount of the total battery capacity is used for mobility.

Vehicles with V2G technology used to provide power system services (load shifting and frequency regulation) showed **similar battery degradation to other EVs** without this technology, used for similar transportation purposes.


EDA
Electricidade dos Açores
Obrigado
Thank you