



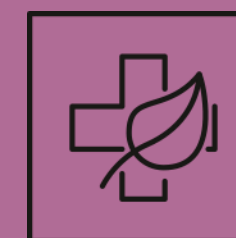
Inverters: the backbone of the grid of tomorrow

Photovoltaik-Wechselrichter: Das Rückgrat des Stromnetzes von morgen

June 2023, Moix Pierre-Olivier
Studer Innotec SA



About us



100% manufactured in Switzerland using 100% renewable energy.



Present in more than 150 countries with a 120+ network of Studer partners



+0.5 GW installed power in renewable energy applications around the world



More than 30 years manufacturing power electronics for battery systems

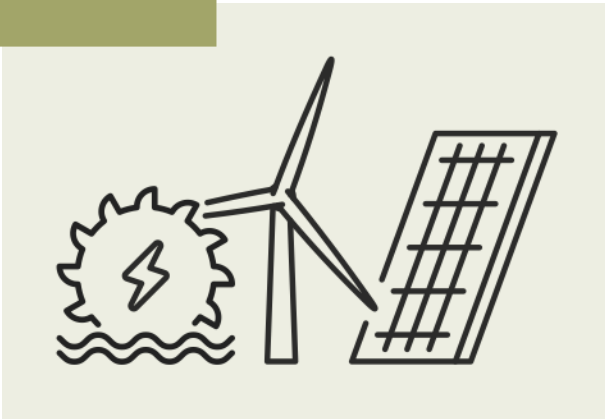


60 people
35% of human resources dedicated to R&D

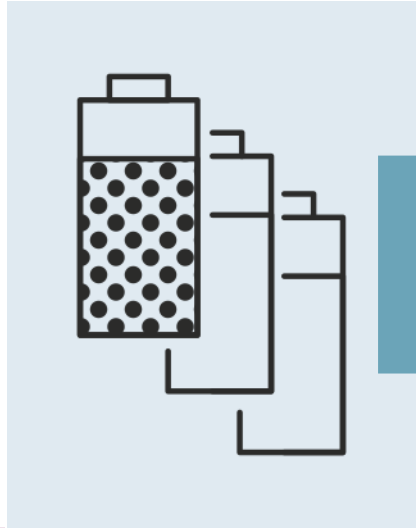


Power electronics
The core of an energy system

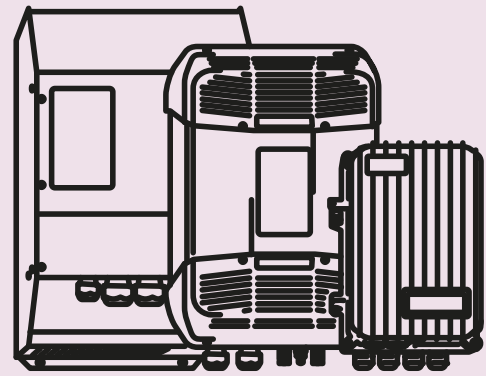
Energy sources



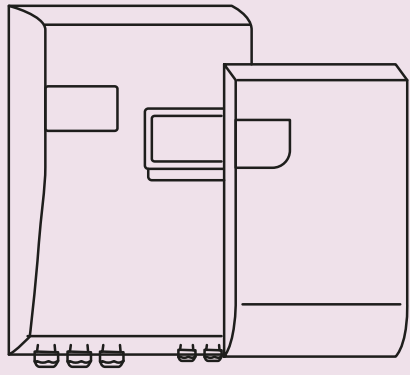
DC



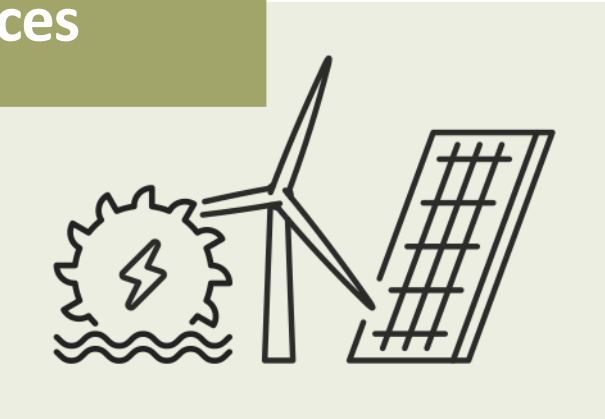
Battery storage



B2B



Renewable sources



AC

Loads

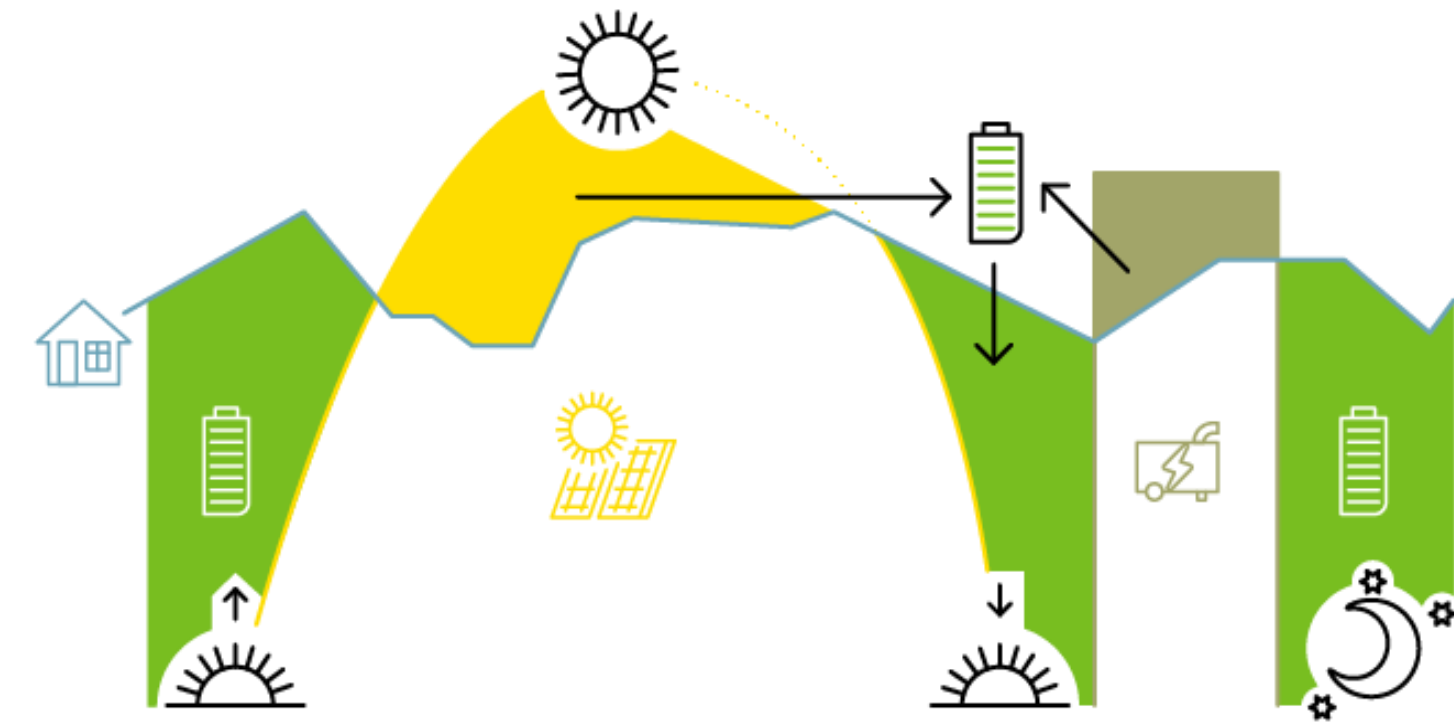


Autarky from the Swiss Alps to your house



Mountain hut at 3256m

OFFGRID

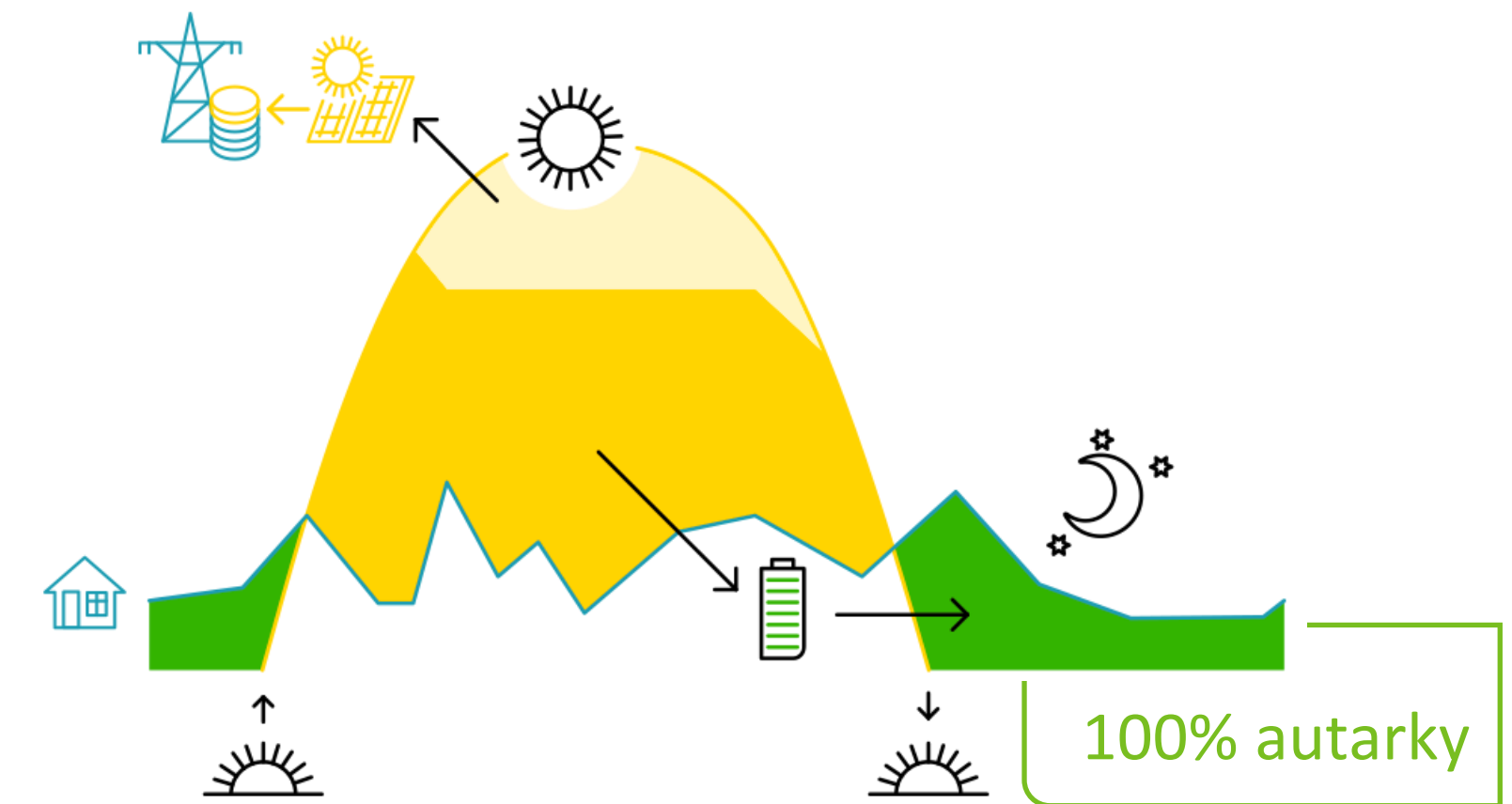


Autarky from the Swiss Alps to your house



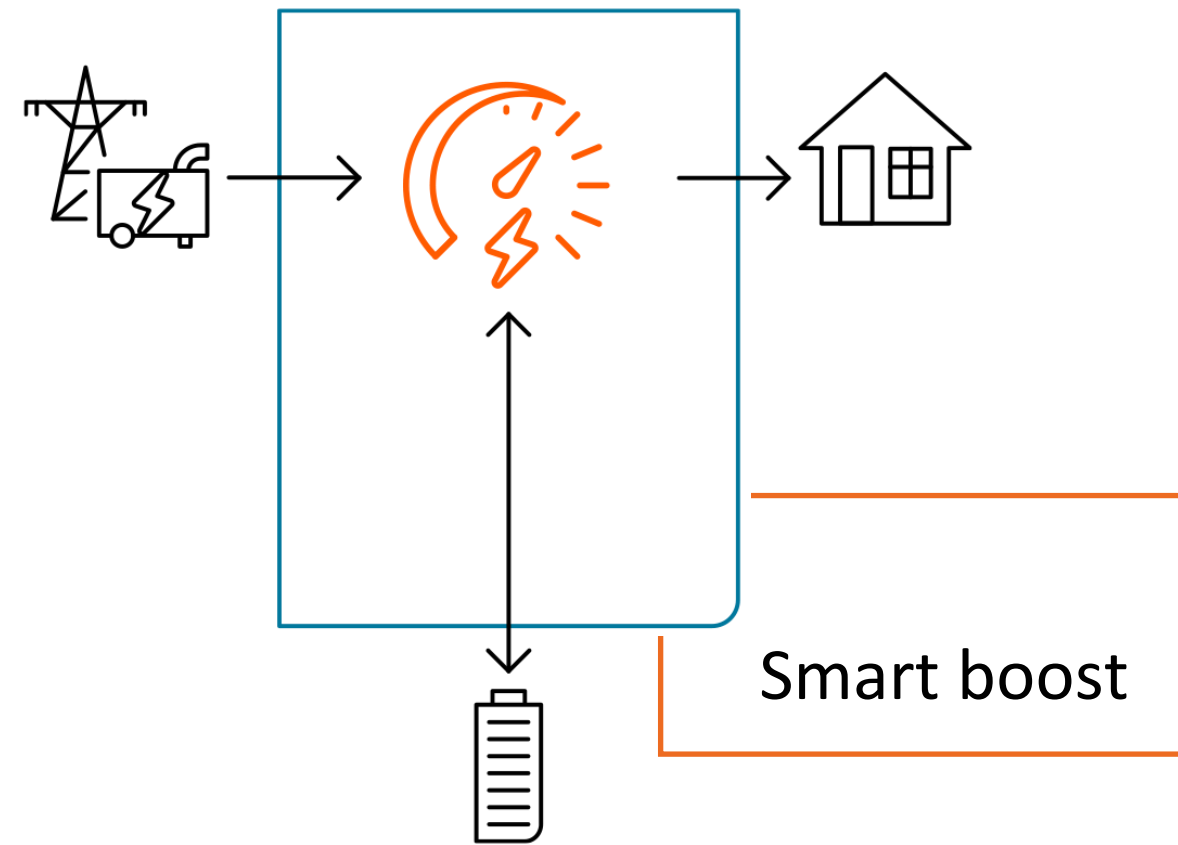
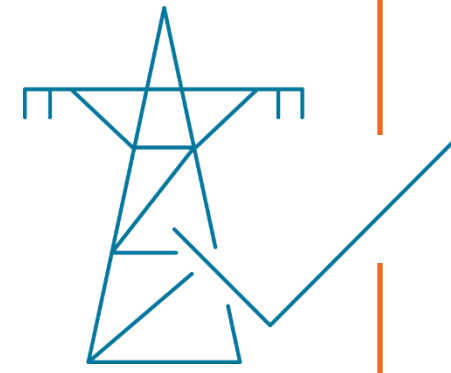
Villa
at 800m

ONGRID



next3 special features

Full grid
interactive



15kVA nominal

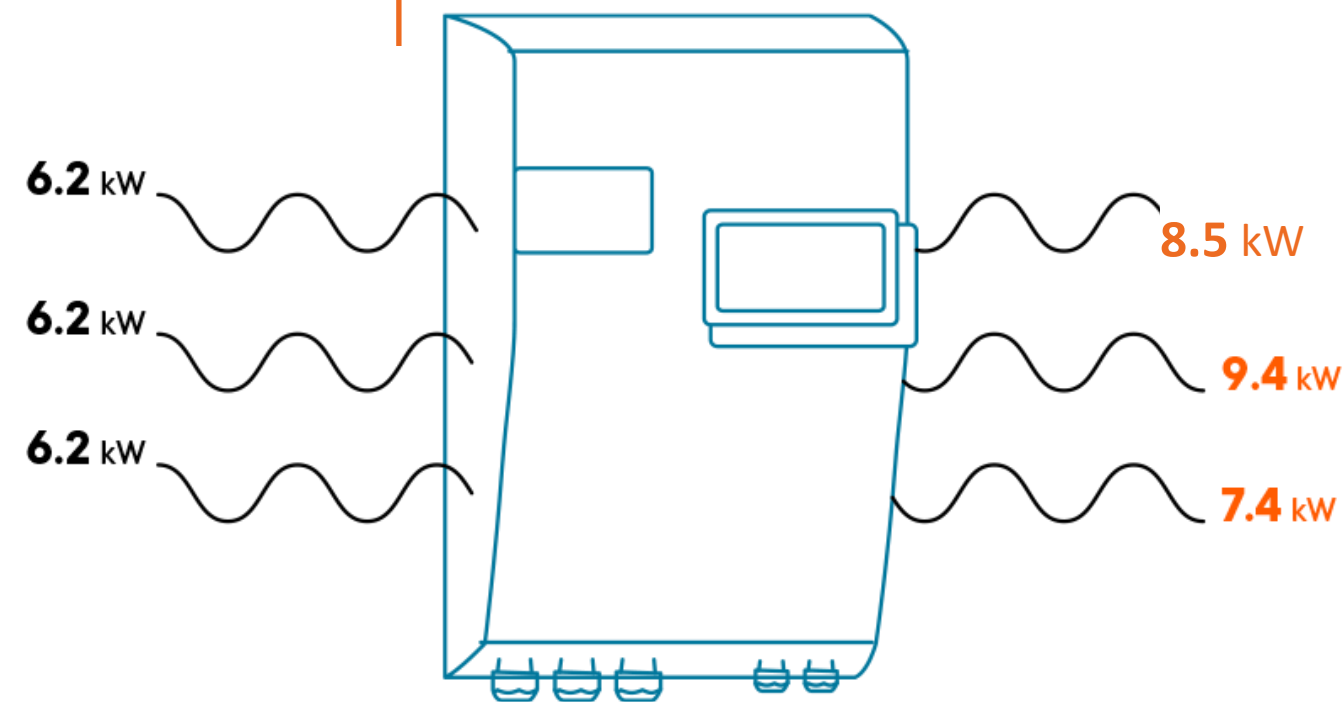
Surge power:

30kVA with
solar

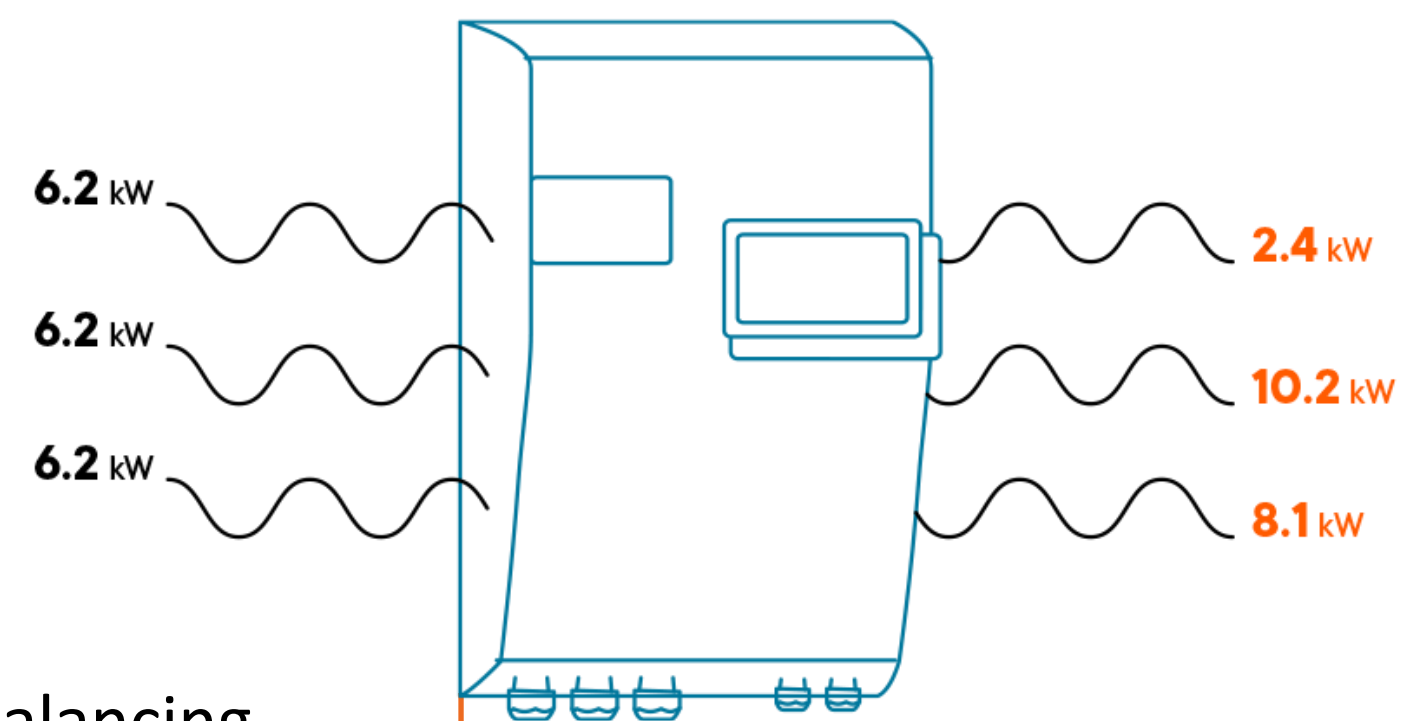
25kVA on batt

10kVA on
1phase

Peak shaving



Phase balancing



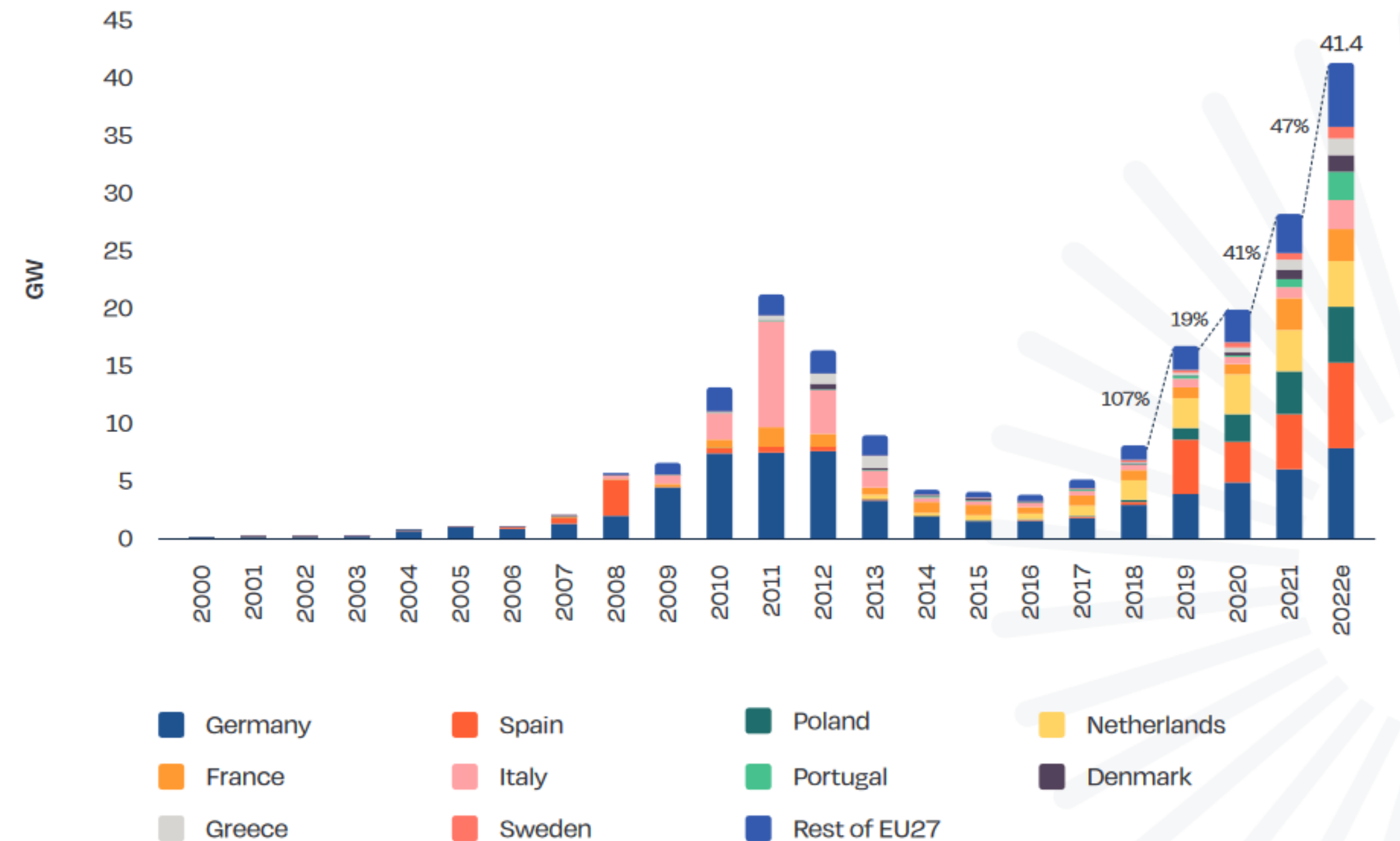
Artificial inertia



Tomorrow

Grid parity and natural growth

FIGURE 2 EU27 ANNUAL SOLAR PV INSTALLED CAPACITY 2000-2022



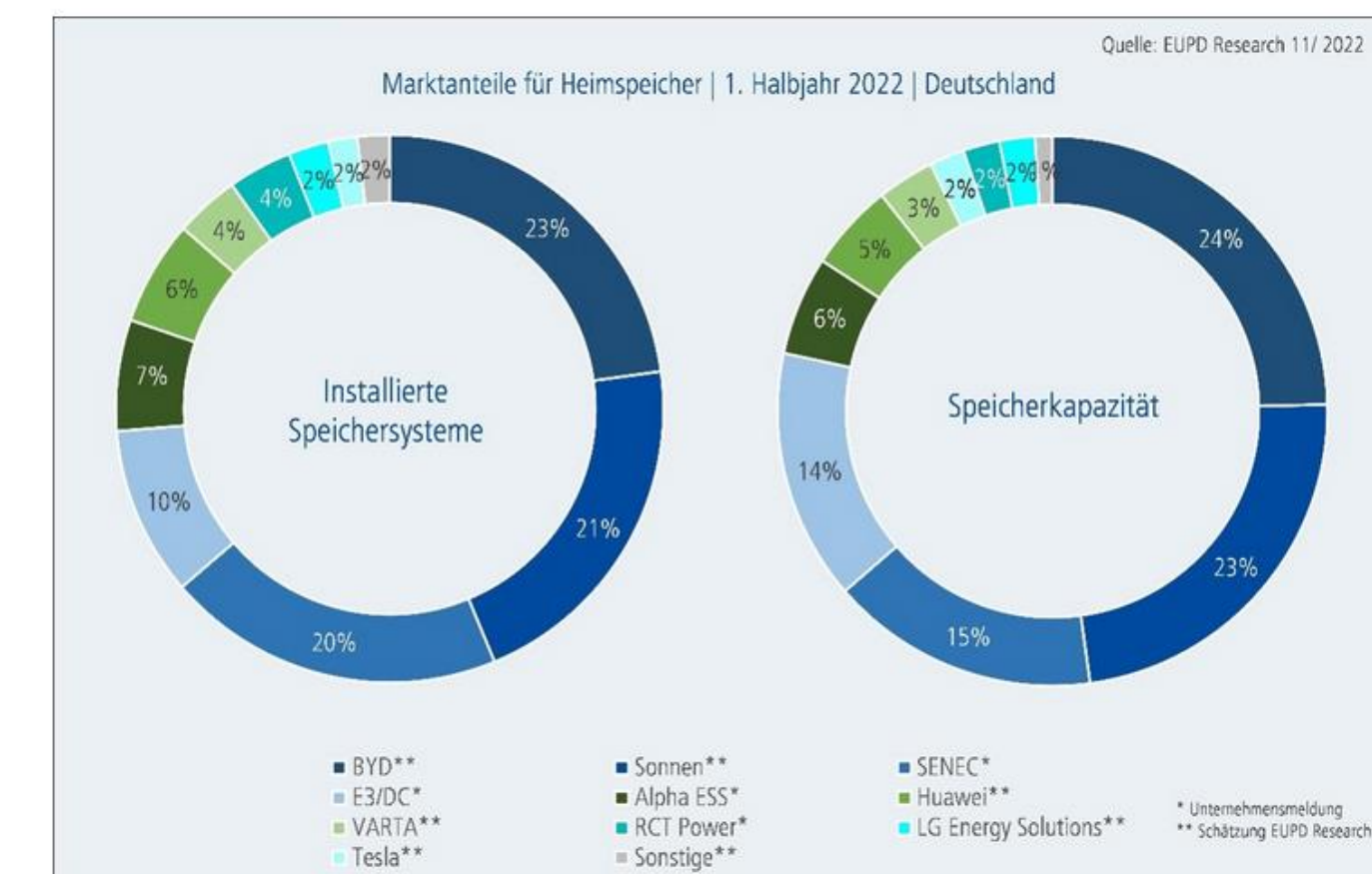
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EUPD Research erwartet Installation von 220.000 neuen Photovoltaik-Heimspeichern 2022 – BYD verdrängt Sonnen an der Spitze

Der Markt für Batteriespeicher in Kombination mit Photovoltaik-Anlagen würde sich bei dieser Zahl gegenüber 2020 mehr als verdoppeln. Erstmals seit Jahren könnte jedoch nicht Sonnen der größte Anbieter hierzulande sein, sondern knapp hinter BYD liegen.

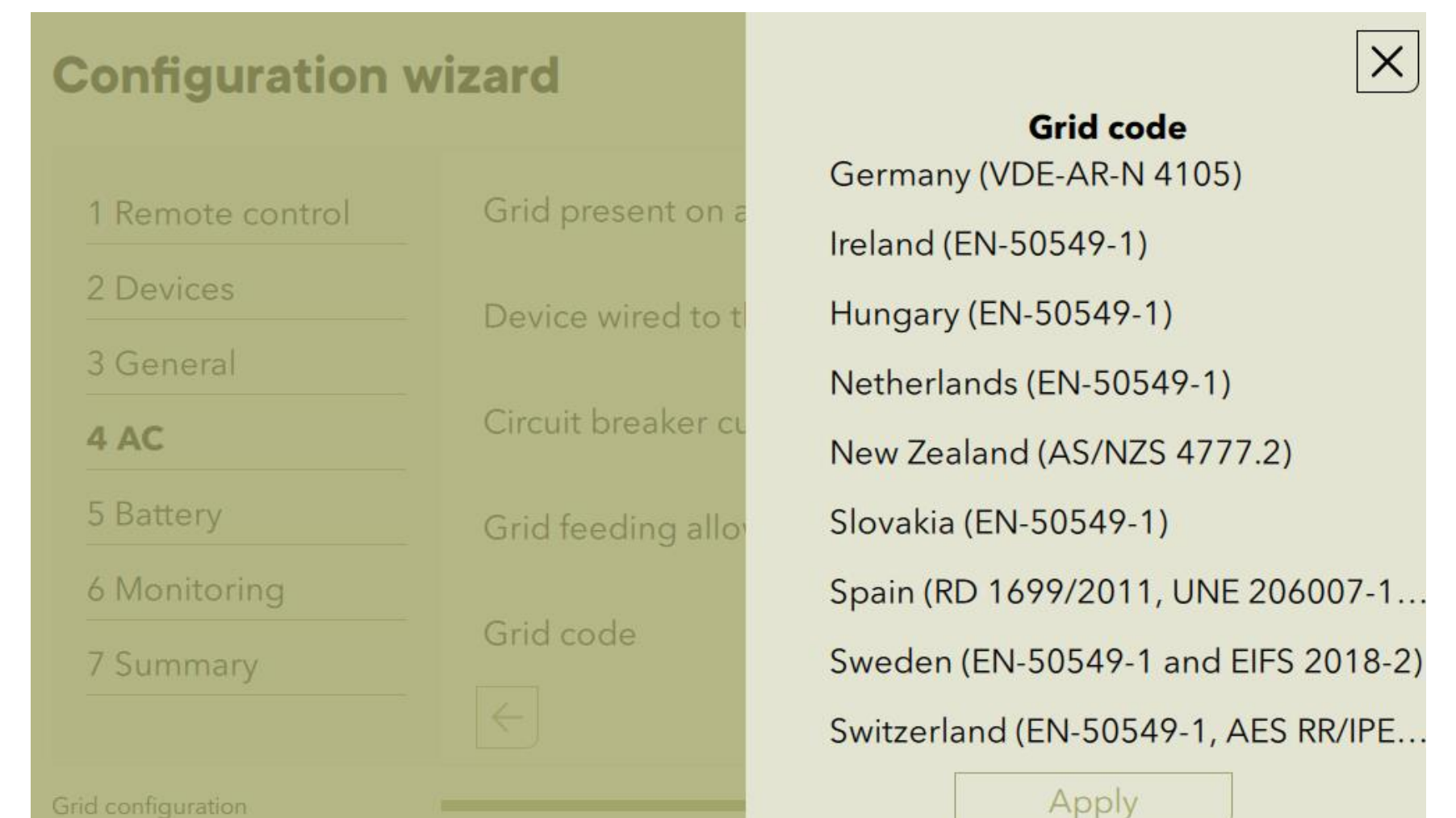
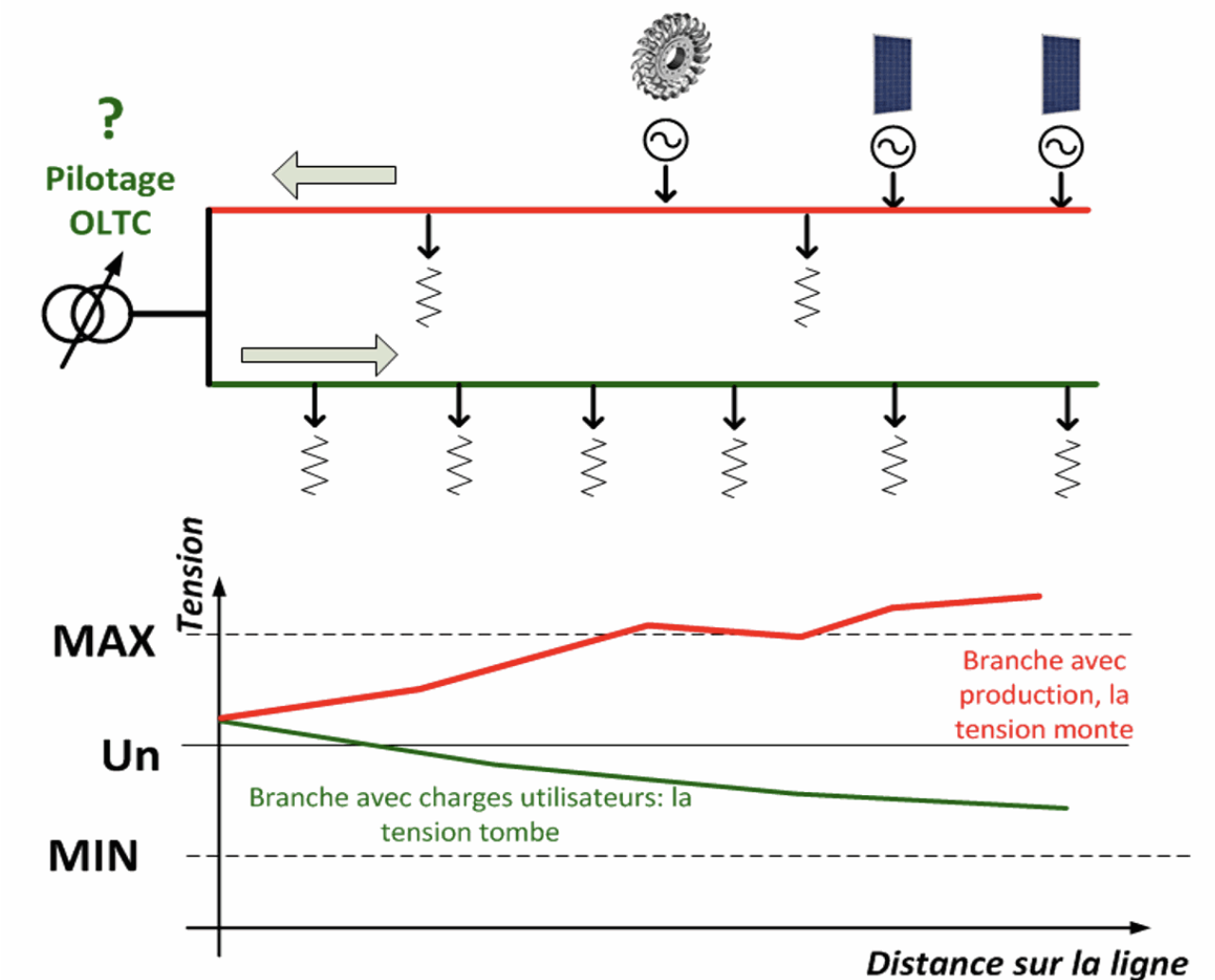
6. DEZEMBER 2022 SANDRA ENKHARDT

HIGHLIGHTS DER WOCHE SPEICHER DEUTSCHLAND



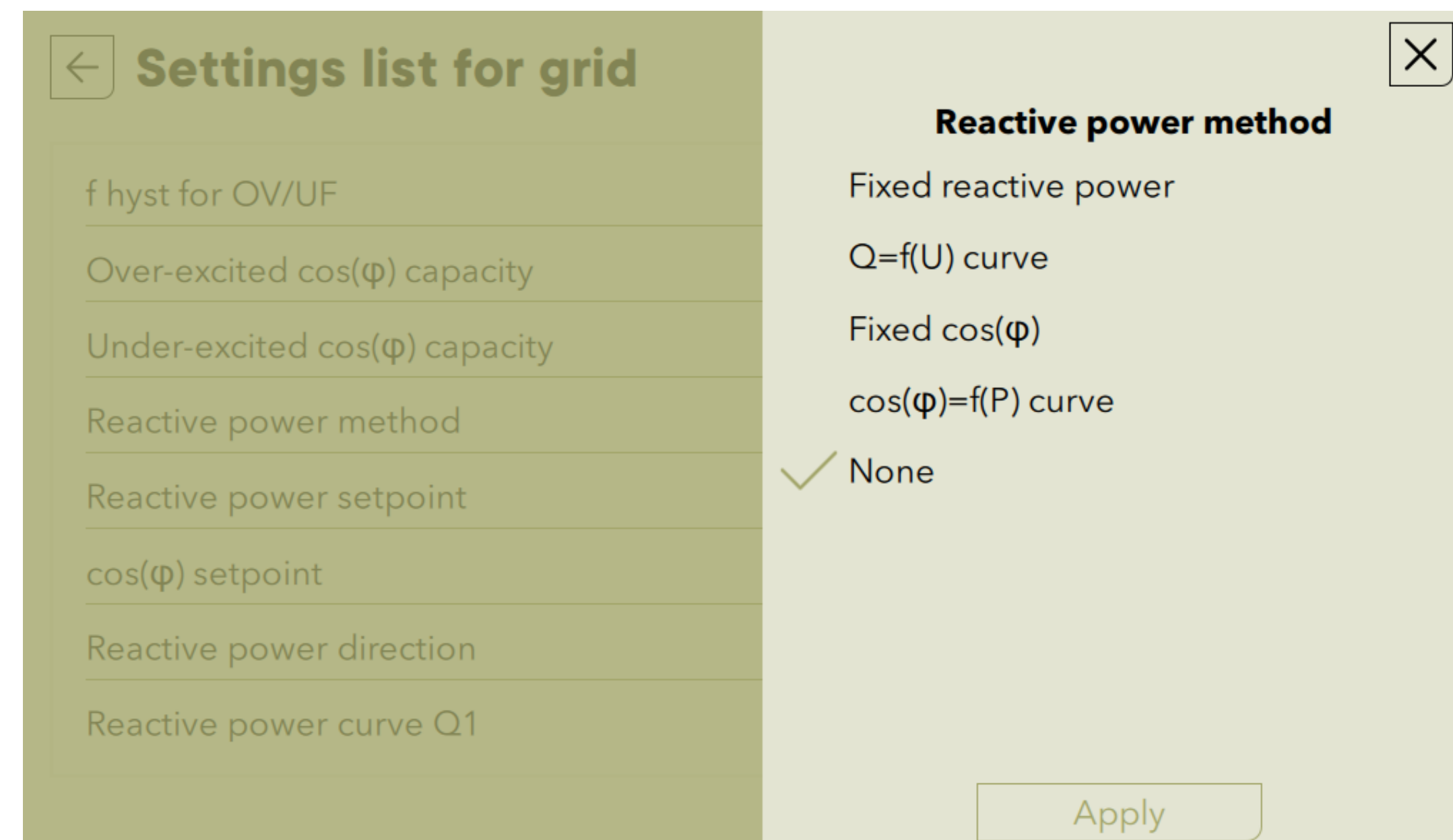
Learning curves and Grid Codes

- Main local troubles have been addressed
 - The DSO learned to anticipate the voltage troubles
 - The inverter have the implemented functionality for what they can do
- Today from the point of view of the inverter one grid code or the other is equal...
 - VDE-AR-N 4105:2018-11
 - EN 50549-1:2019
 - TOR
 - ...
- With a few specificities for local settings (RR/IPE-NR7-CH)



Mandatory today

- Reactive power: try to lower the **local voltage** increase effect associated with power production.
 - Works best with inductive lines
 - Works less efficiently with underground cable
 - **To be activated**
- Active power control (in function of frequency)
 - Participation in primary/secondary/tertiary control
 - 50.2Hz problem addressed
- FRT: Fault ride through
 - Avoid domino effect
- Simplified control with dry contacts inputs:
 - 100%-0%
 - 100%-60%-30%-0%
 - ?? Don't imagine your own rule → no product on the market, just costs for homeowners for little to no impact

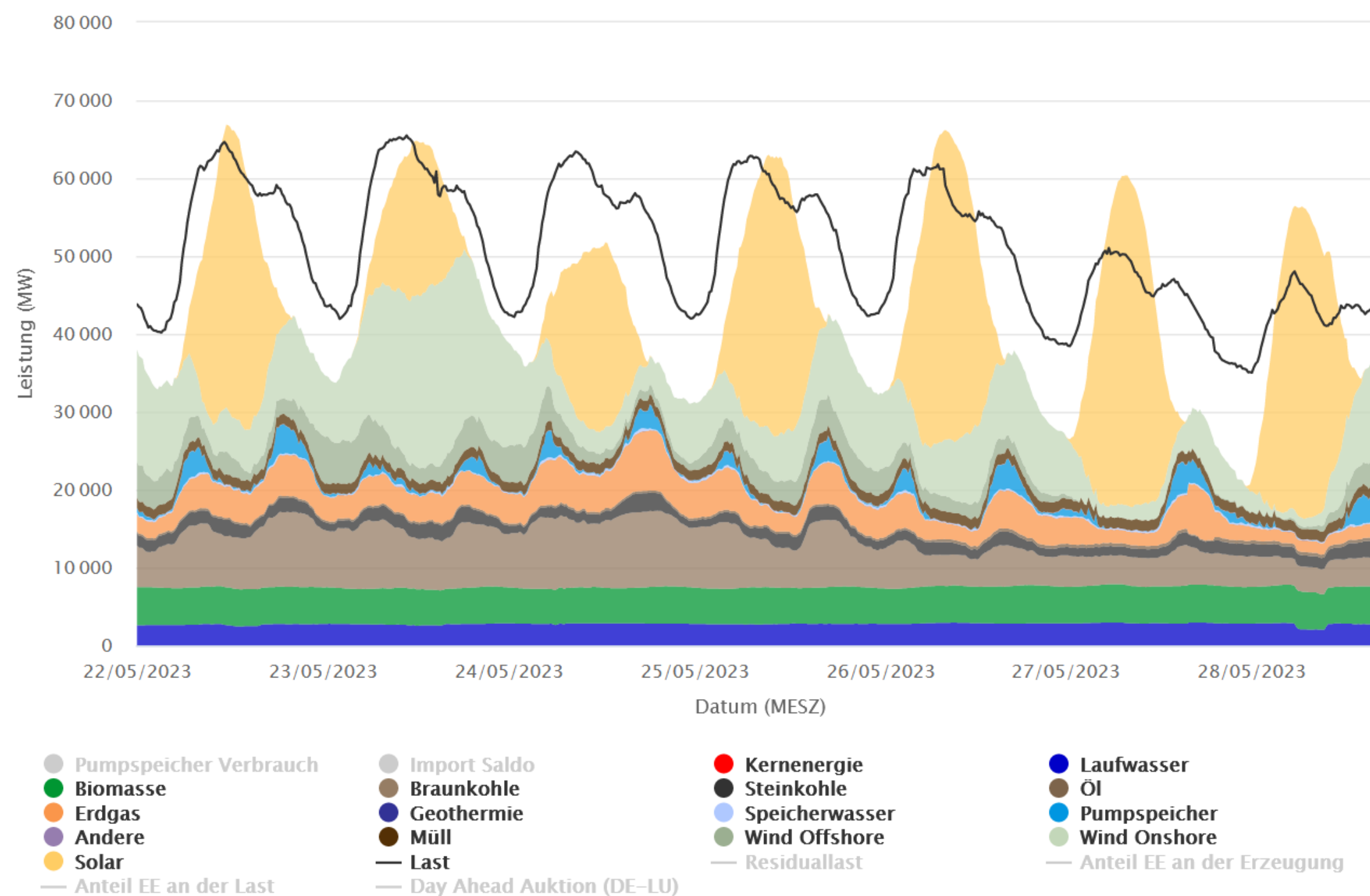


State of our neighbours

Renewable and solar production expected to continue to grow significantly everywhere
 → produced by inverters → soon to a point where **management and curtailments** are necessary

Öffentliche Nettostromerzeugung in Deutschland in Woche 21 2023

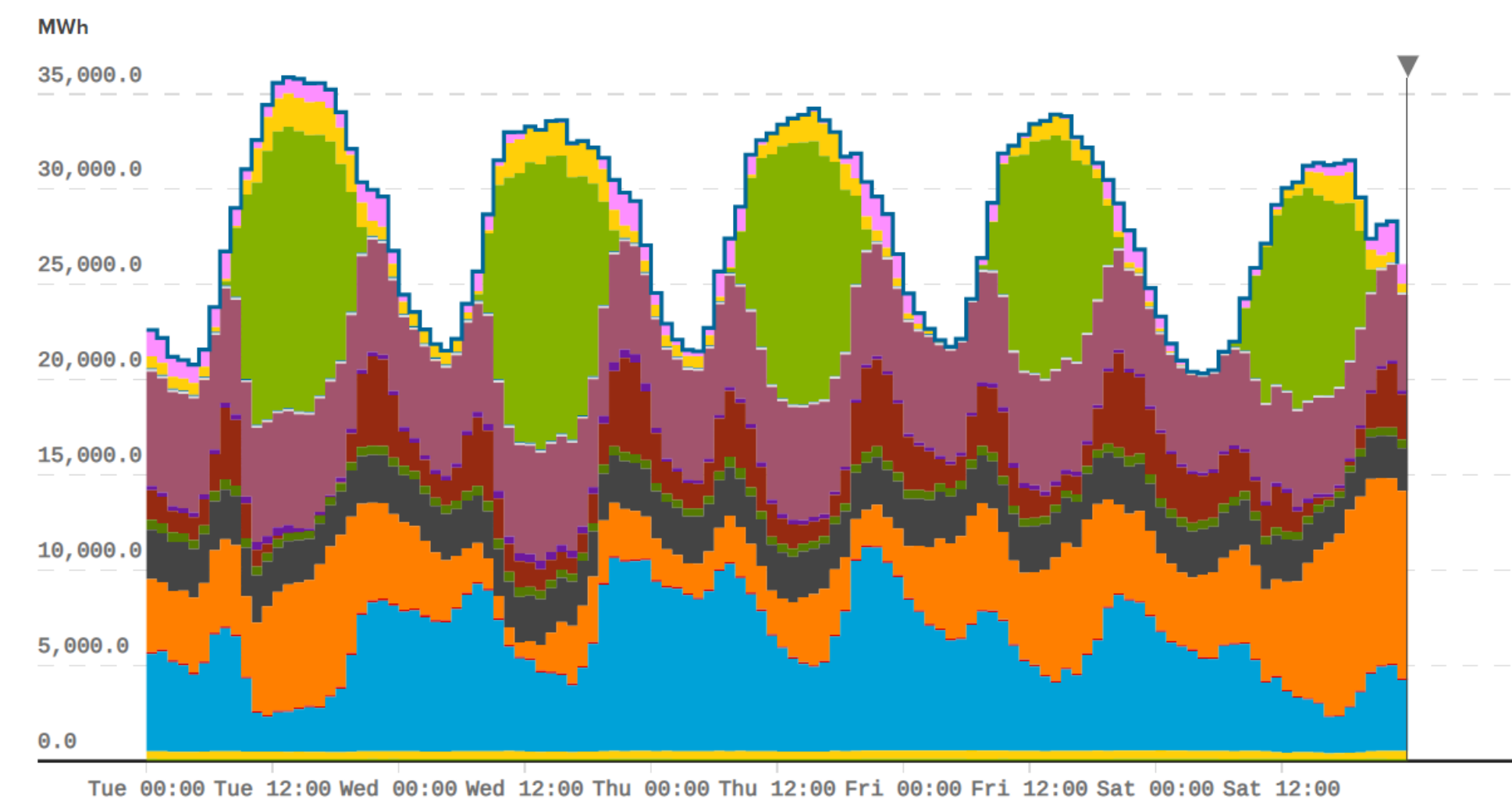
Energetisch korrigierte Werte



<https://www.energy-charts.info>

Spain

FROM 25-04-2023 AT 00:00 TO 29-04-2023 AT 23:55 GROUPED BY HOUR



<https://www.esios.ree.es/en#>

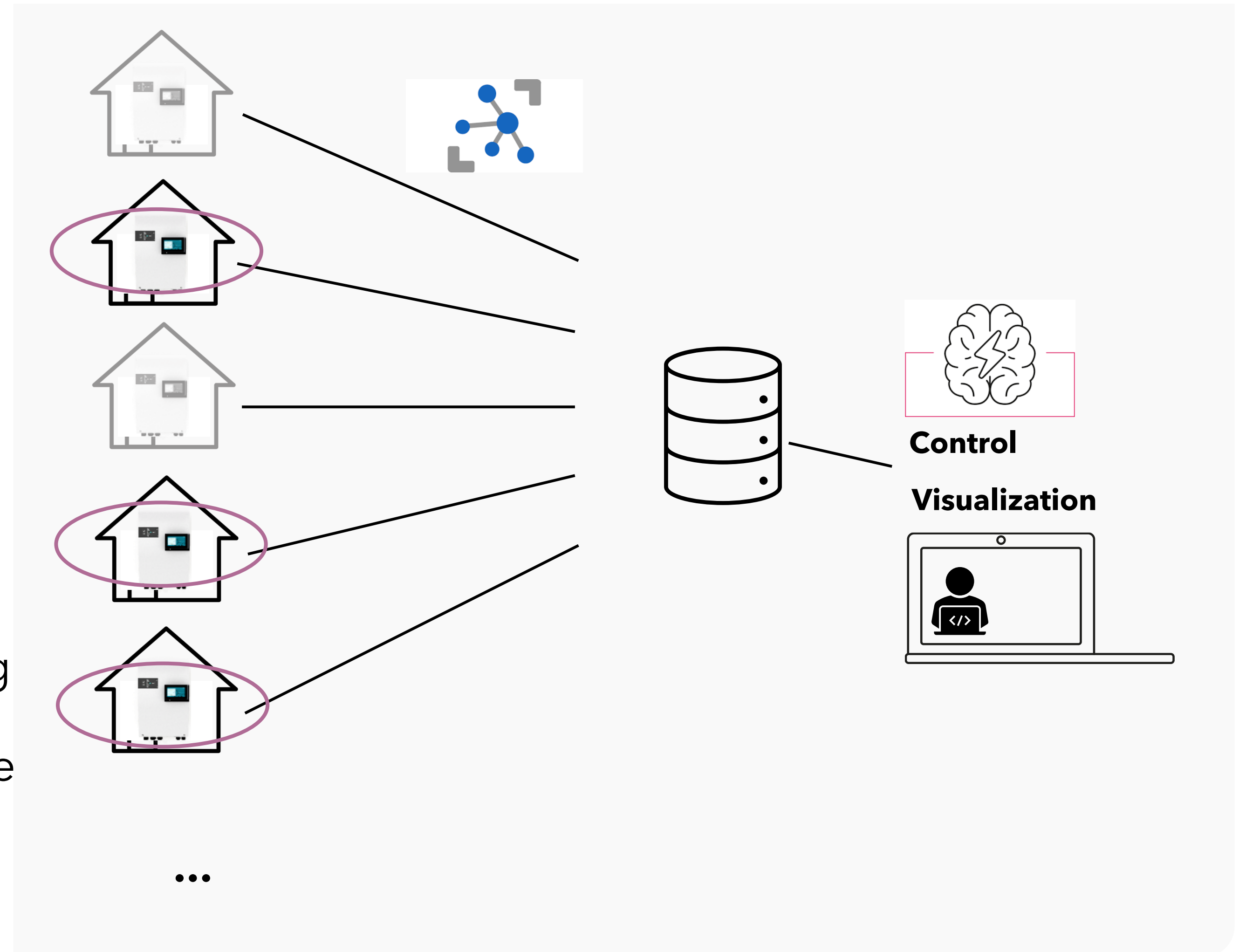
Preparation of the future: VPP

VPP: Virtual Power Plant

1000 next3 is 15MW of power...

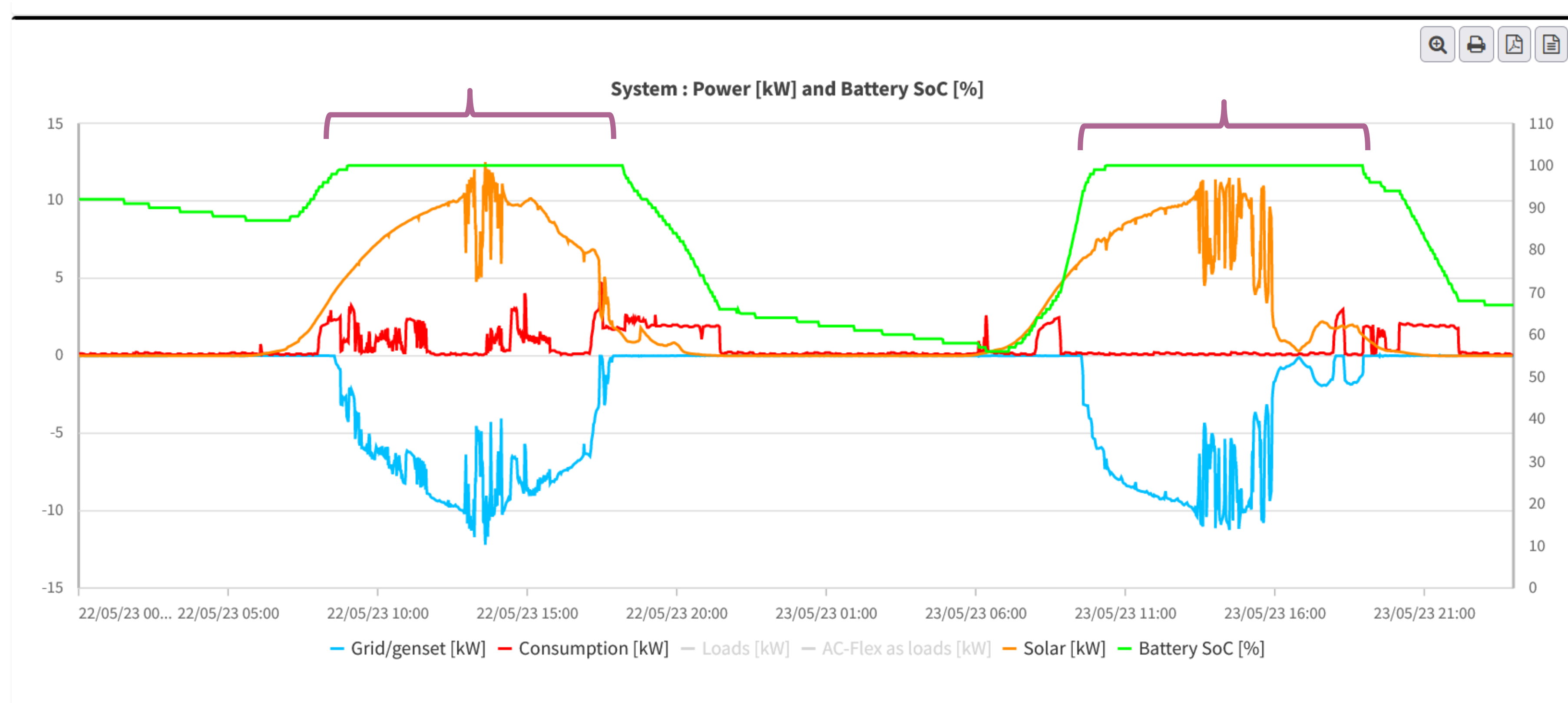
- The whole Switzerland asks for 61 MW of primary reserve for ENTSO-E cooperation
- Flexibility services on energy markets
- Interesting proposal for homeowner

State of the subject: we are developing the control infrastructure based on our standard monitoring infrastructure where we can virtually group systems



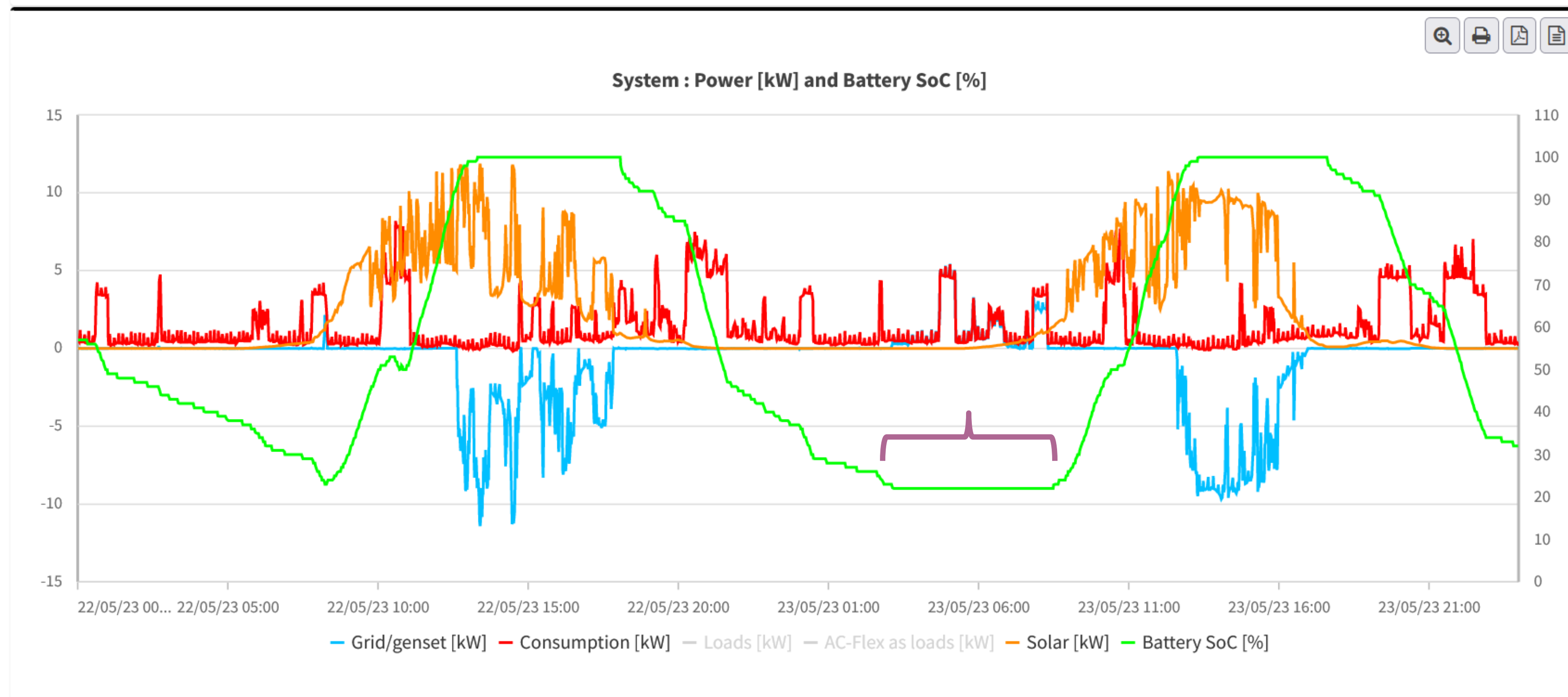
What is the flexibility of the battery inverter?

In **summer**: full most of the day, then it could be recharged at a flexible hour



What is the flexibility of the battery inverter?

In **winter**: empty most of the night, it could be discharged at flexible time



What is the flexibility of the battery inverter?

And more :

- Limit PV production to consumption (grid feeding not allowed)
- Limit or stop the PV production
- Disconnect from the grid
- Charge from the grid

? Who pays ?

Market design to pay for the curtailed power or the flexibility

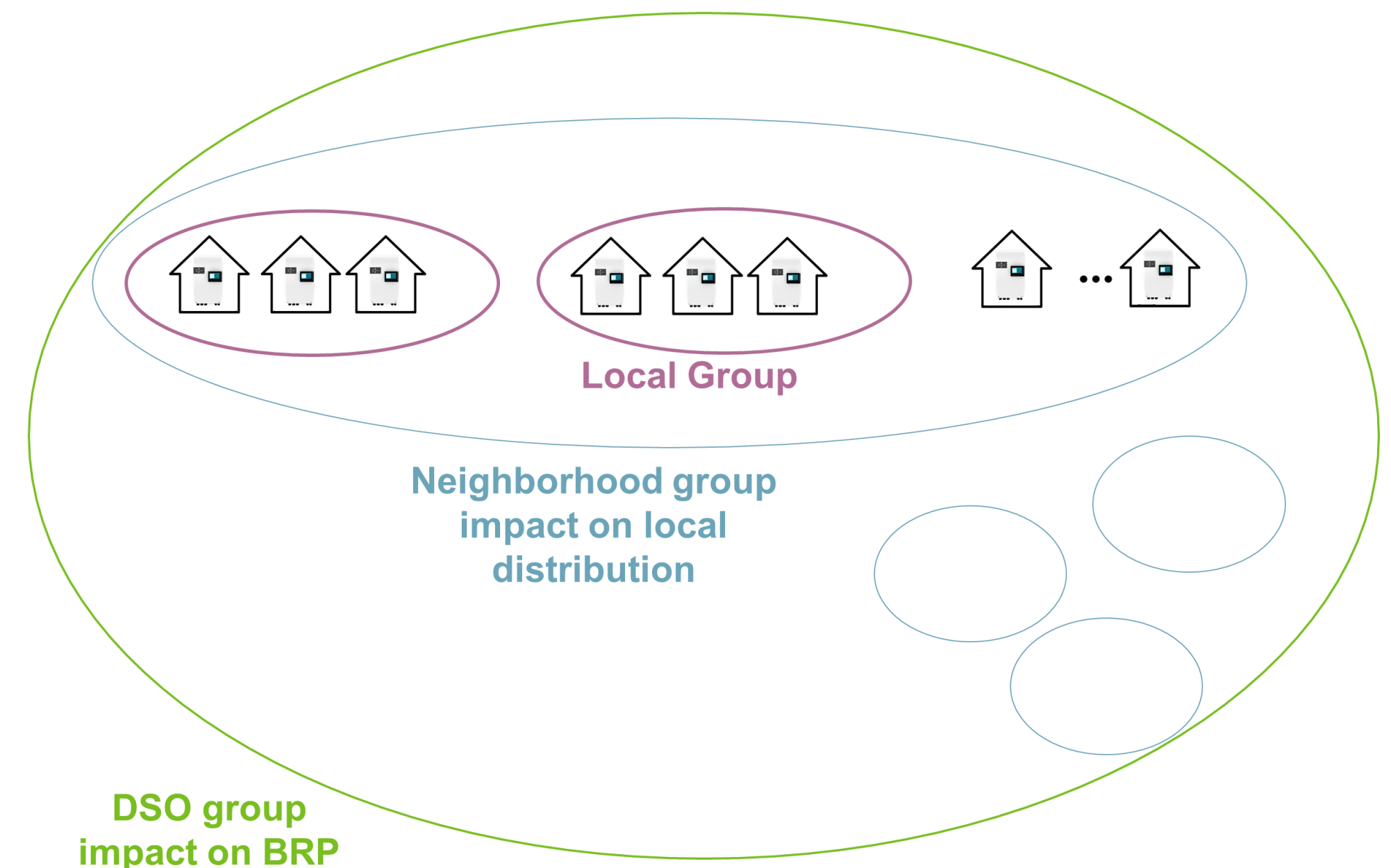
- Discharge to the grid



Swiss **legal framework** to evolve (origin certificate)

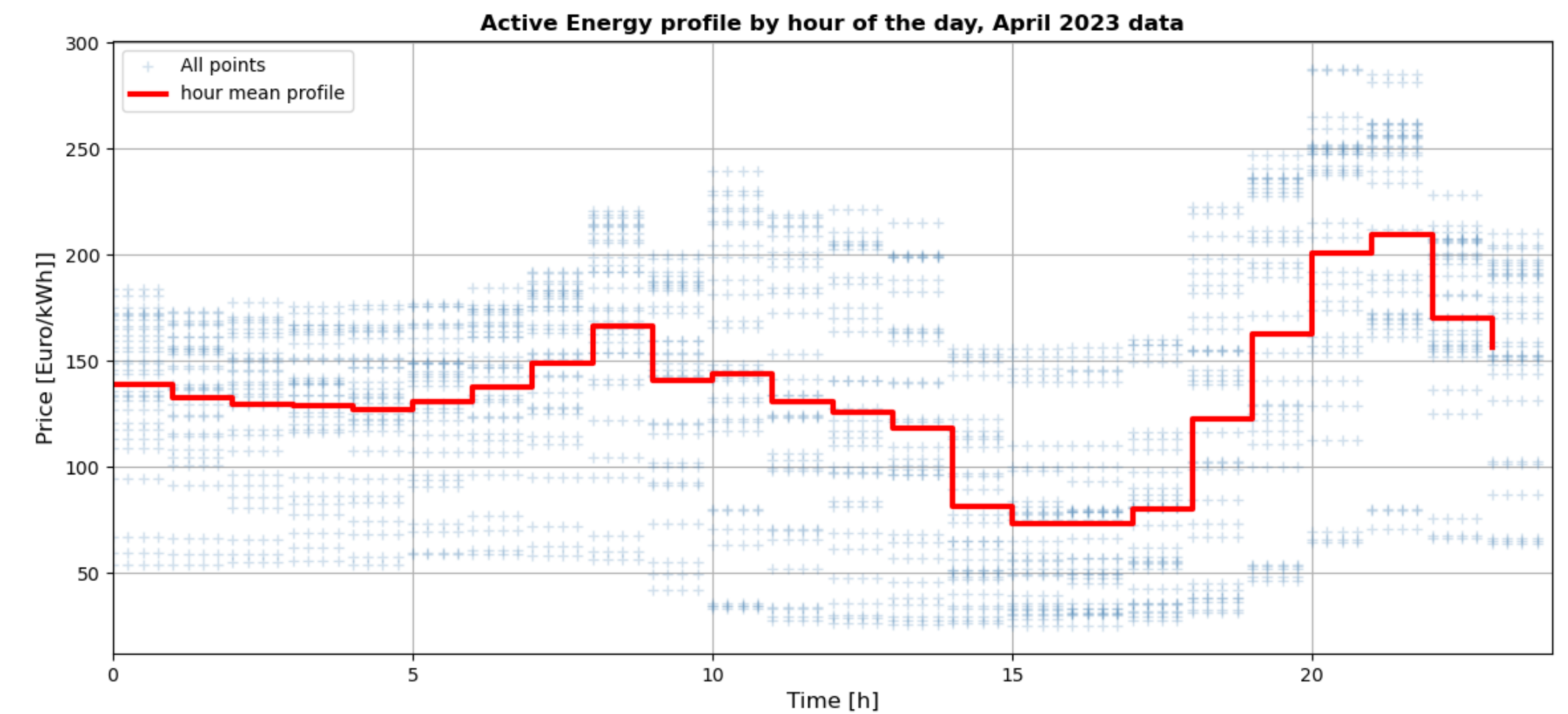
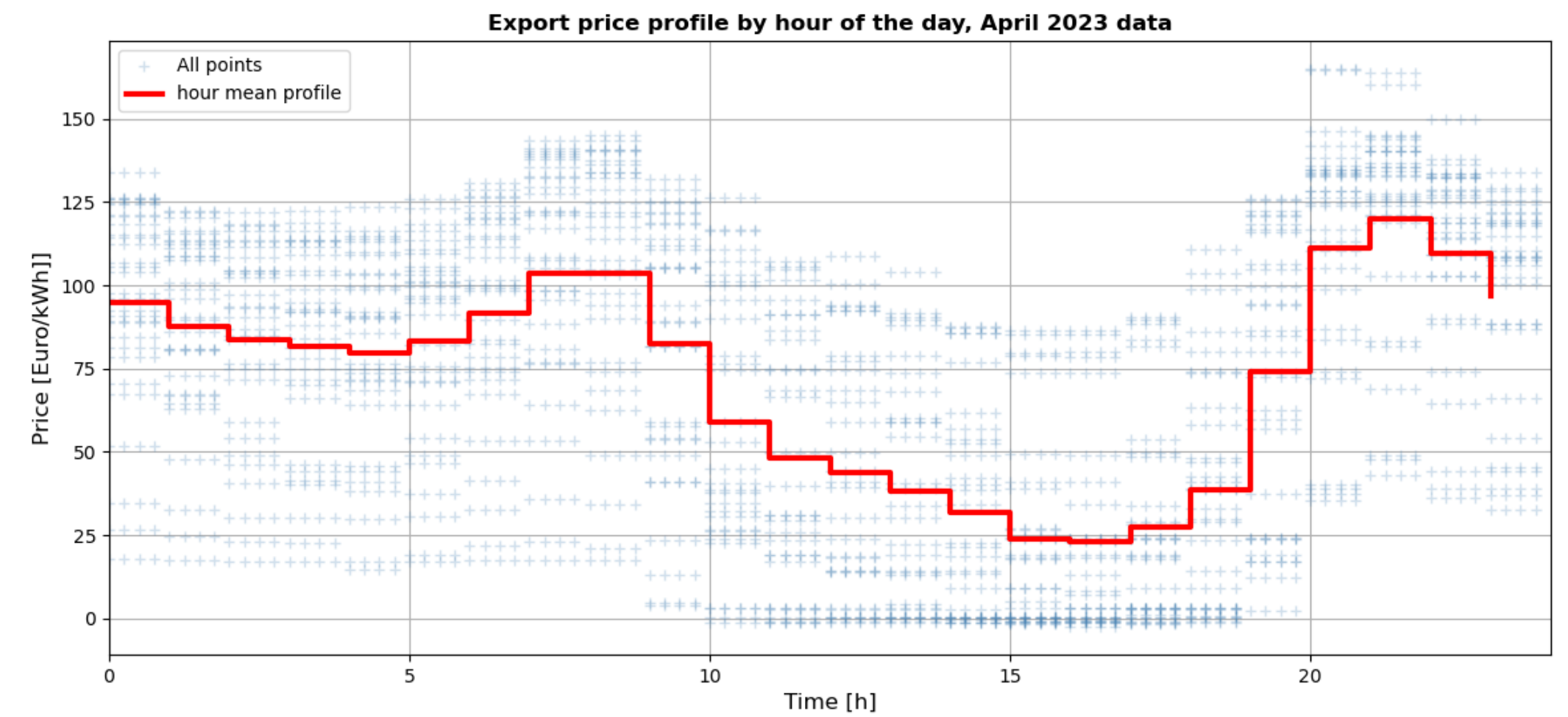
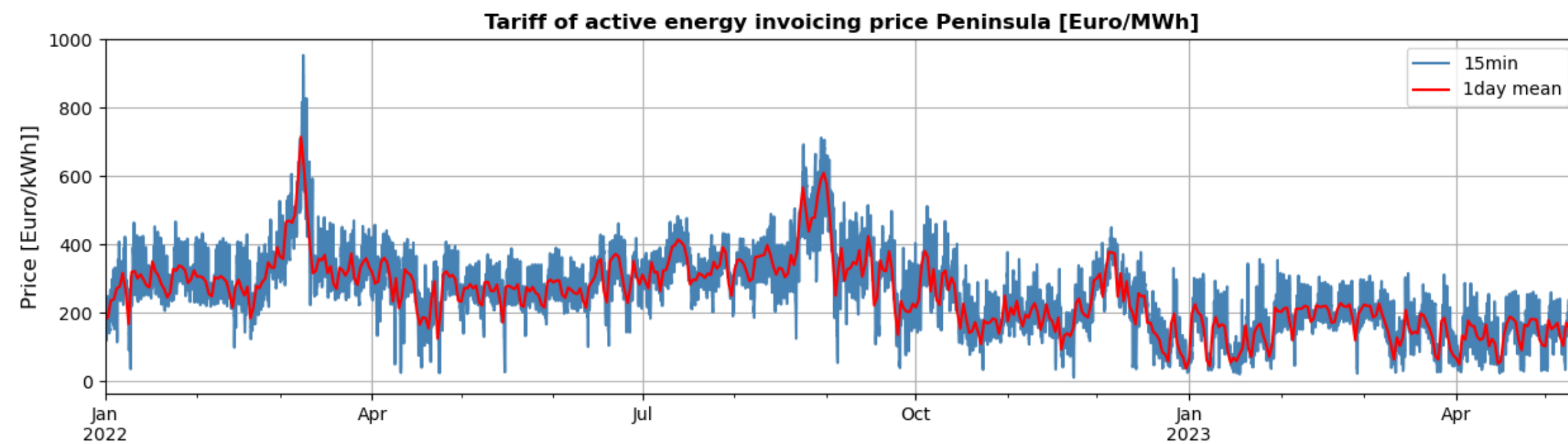
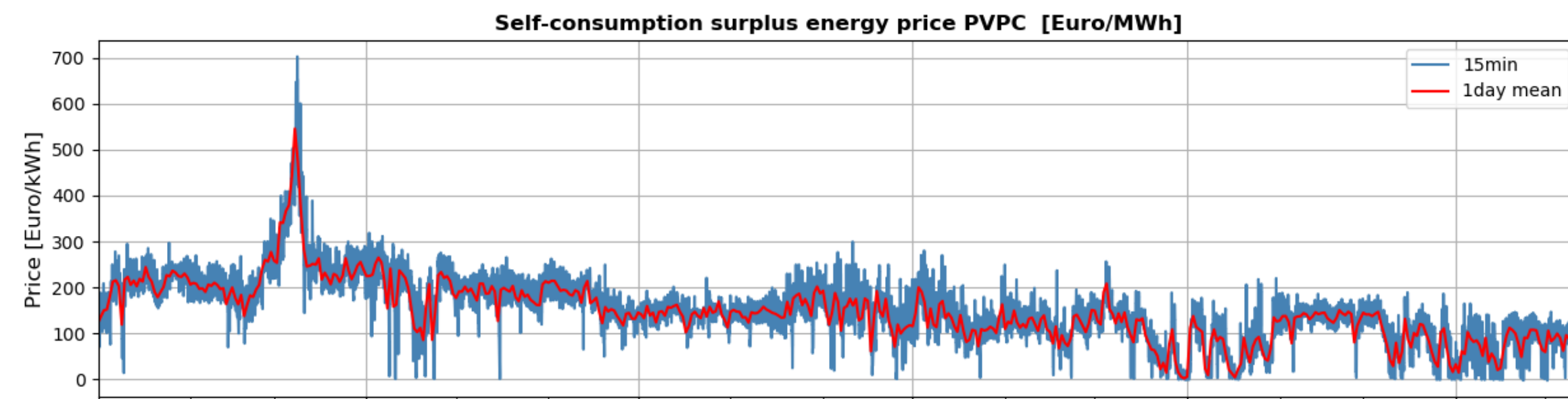
Energy management

- **Individual:**
 - Interest: self-consumption/autarky
 - Collective with incentive: Price of energy : **Example of Spain**
- **Local:** Microgrids, RCP/ZEV, ...
- **Global:** Integration in energy/power management
 - **Balance groups**
 - Ancillary service (!qualification)



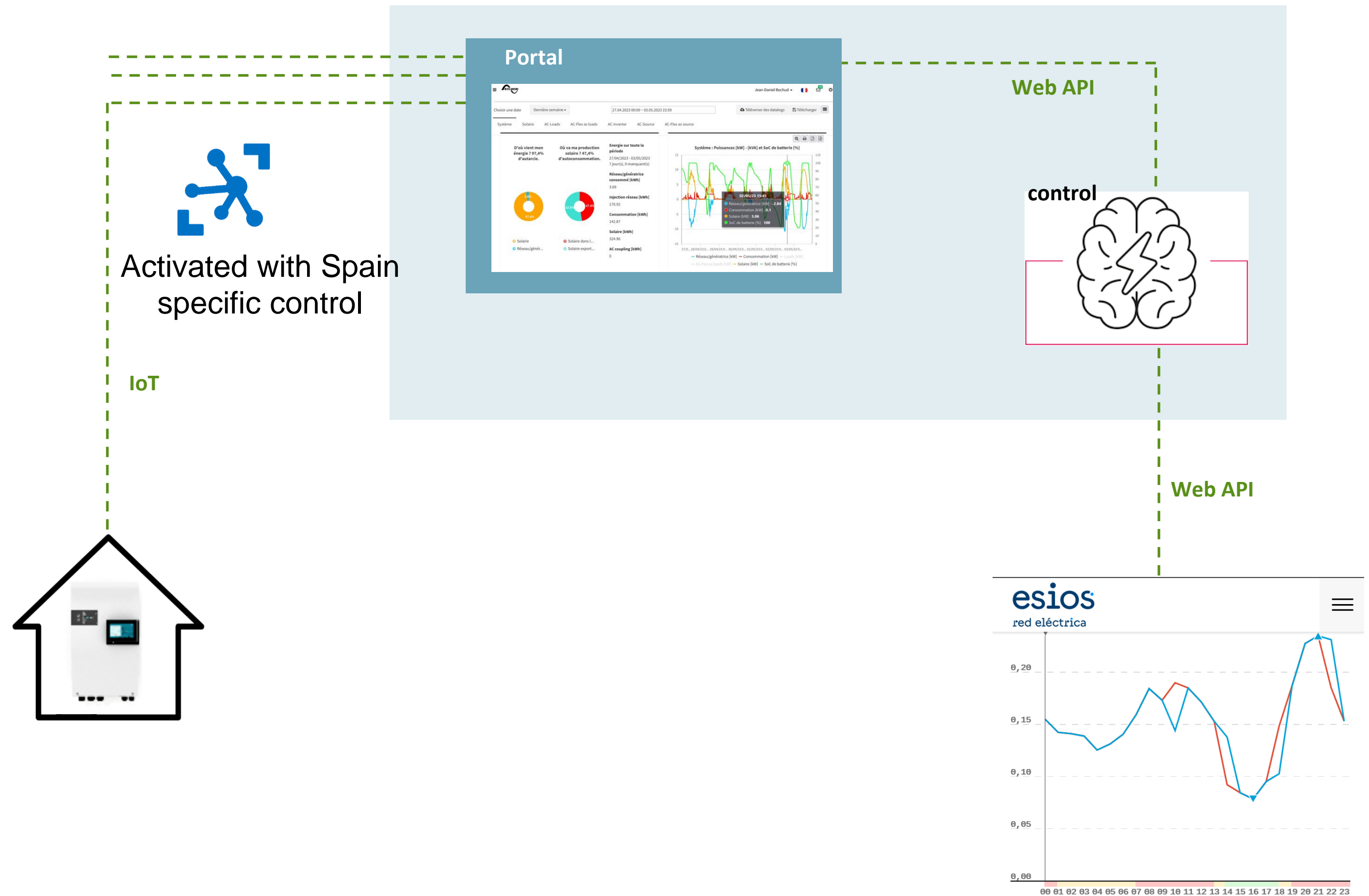
Spain case

- ToU electricity price with smartmeters for import and export
- Published every evening at 21h for the next day



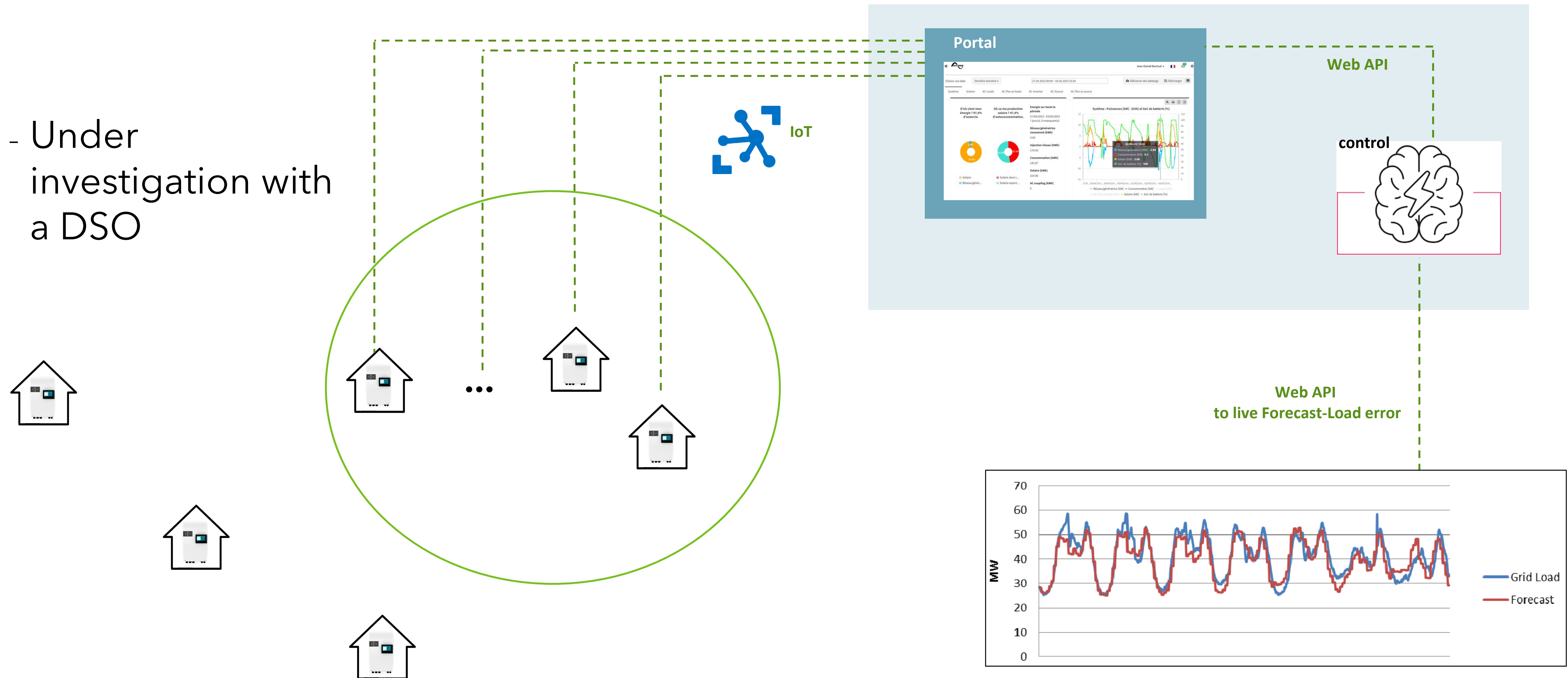
Smart control in Spain

- Existing monitoring portal can be used
- Important asset
- Unbearable otherwise!



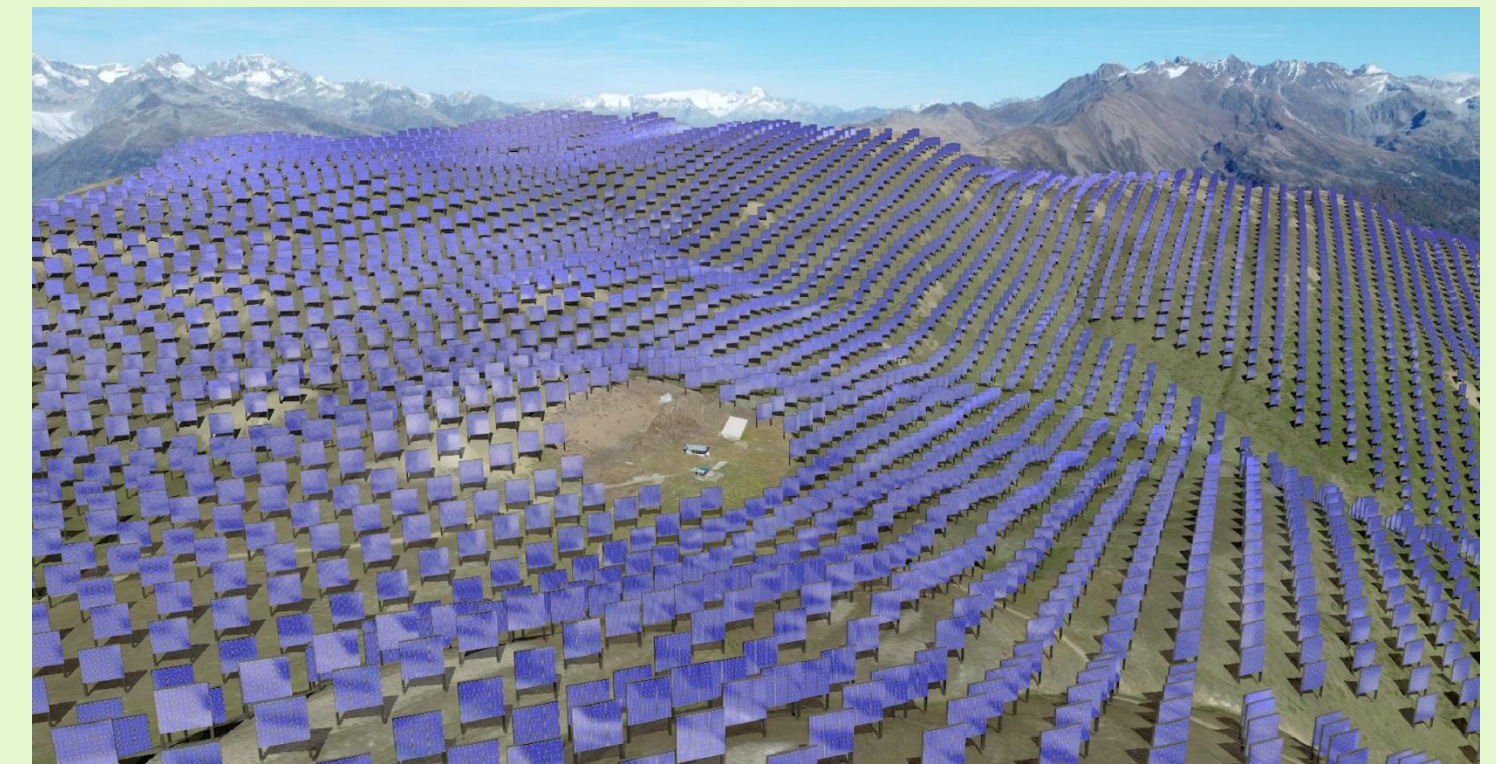
Smart control BRP group

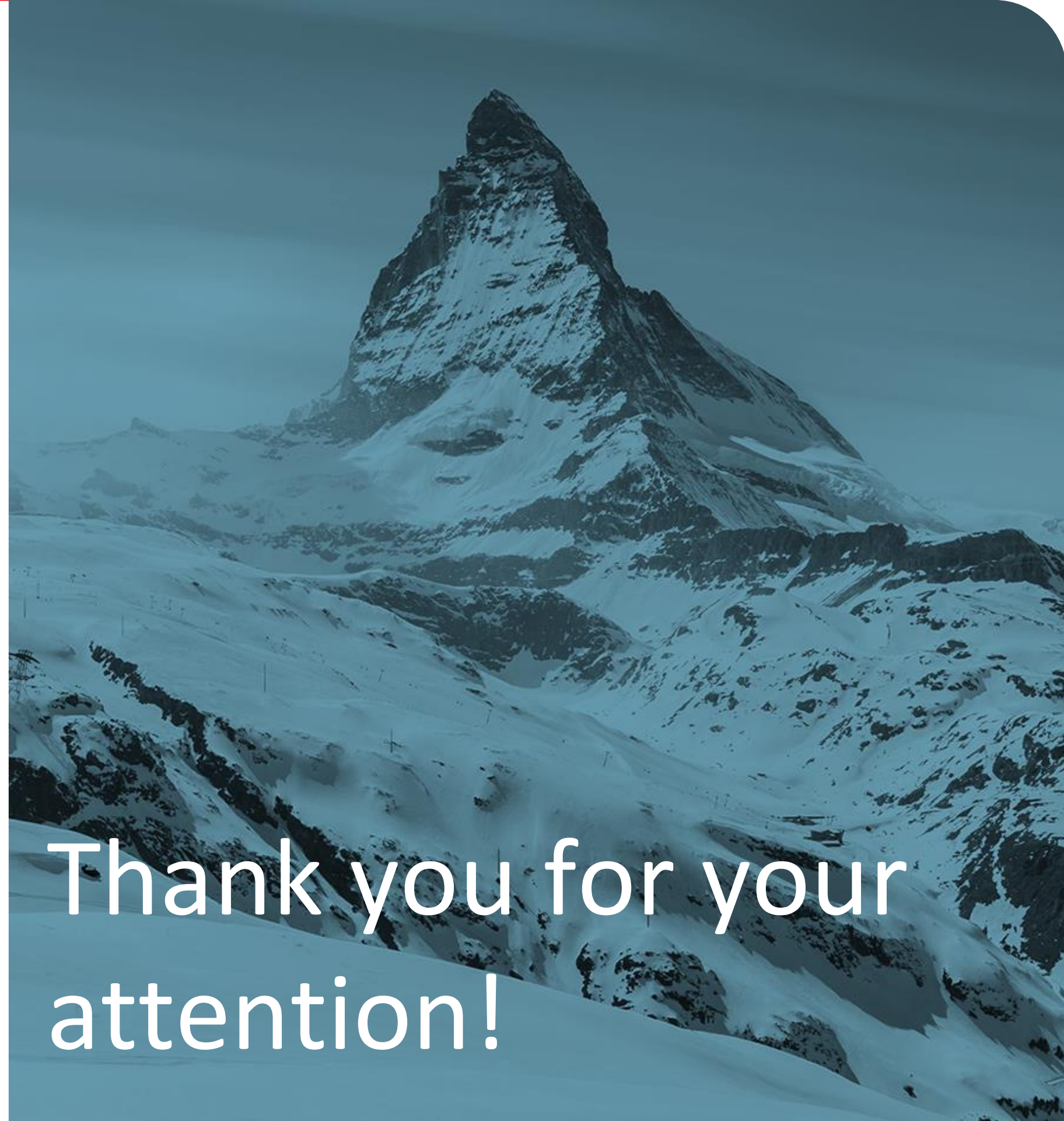
- Under investigation with a DSO



Conclusion

- Active grid support already mandatory for
 - Local voltage problems
 - Frequency control participation (Primary)
- Next step will be in energy management
 - Storage: controlled directly or indirectly (ToU)
 - Curtailments, active or passive
- With or without the « solar initiative » and « solar offensive » to accelerate it, that's where we go.
- In Switzerland, we wait for the legal and business framework, but **Studer** works to be ready technically with the **next3** inverters by answering special need like the Spain case ...





Thank you for your attention!



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Questions?