Flexibility to support the grid

Rixhon Daniel & Bastin Bertrand

22/06/2022

www.cet-power.com

Belgium, Luxembourg, China, India, United States, United Kingdom, France, Germany, United Arab Emirates, Russia, Malaysia, Australia.

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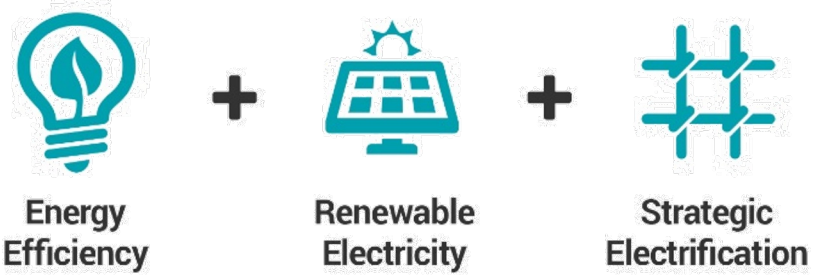
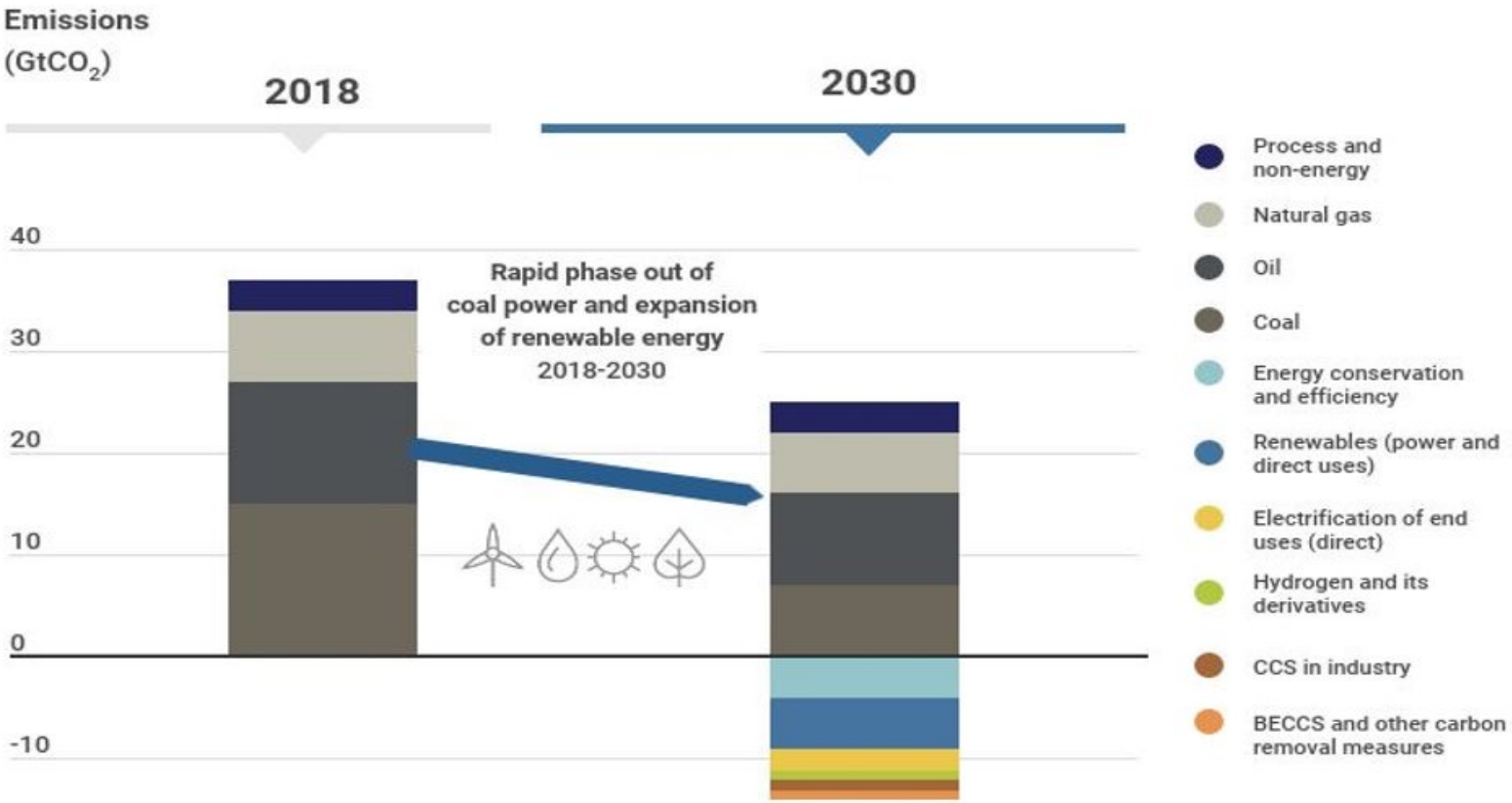
energy
transition

1.5


Energy Efficiency
+
Renewable Electricity
+
Strategic Electrification
=
Pathway To Decarbonization
(80% Reduction in GHG emissions by 2050)



The impact on emissions of replacing fossil fuels with renewables and increasing energy efficiency through 2030

IRENA
International Renewable Energy Agency

CE+T
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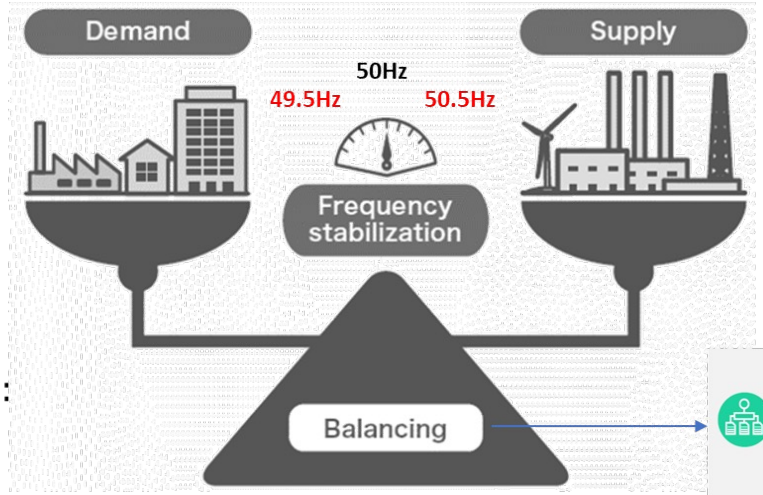
50

✓ Secondary energy

- ➢ Easy conversion / tricky storage

✓ Disruption

- ➢ Disaster, domino effect : transportation, communication, finance, … **safety !**



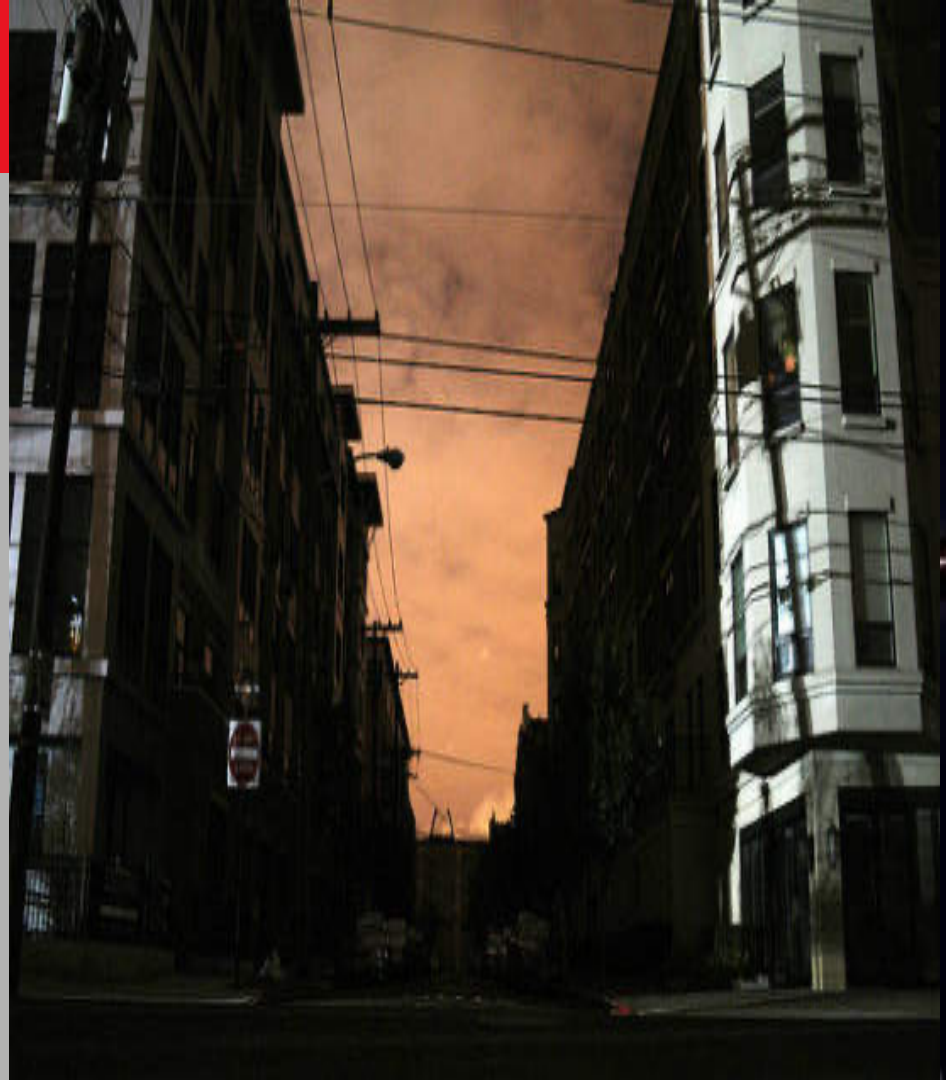
Directive 2019/944 (EMDII)

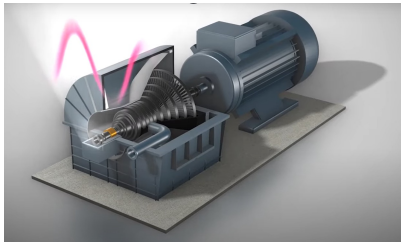
Aggregation

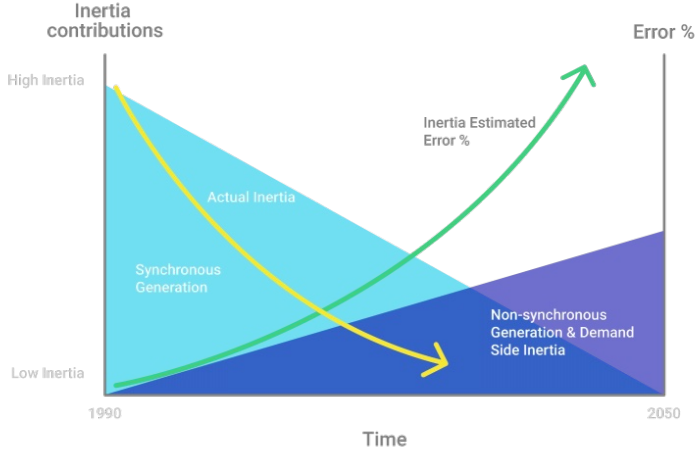
- The directive provides a dedicated framework for aggregators to increase the participation of individuals to the demand response
- Aggregators should be treated as flexibility providers

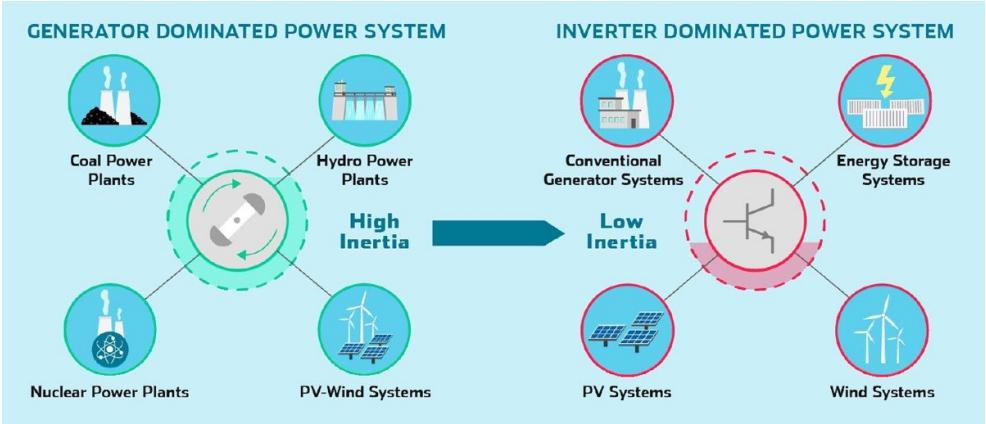
BESS systems located near load :

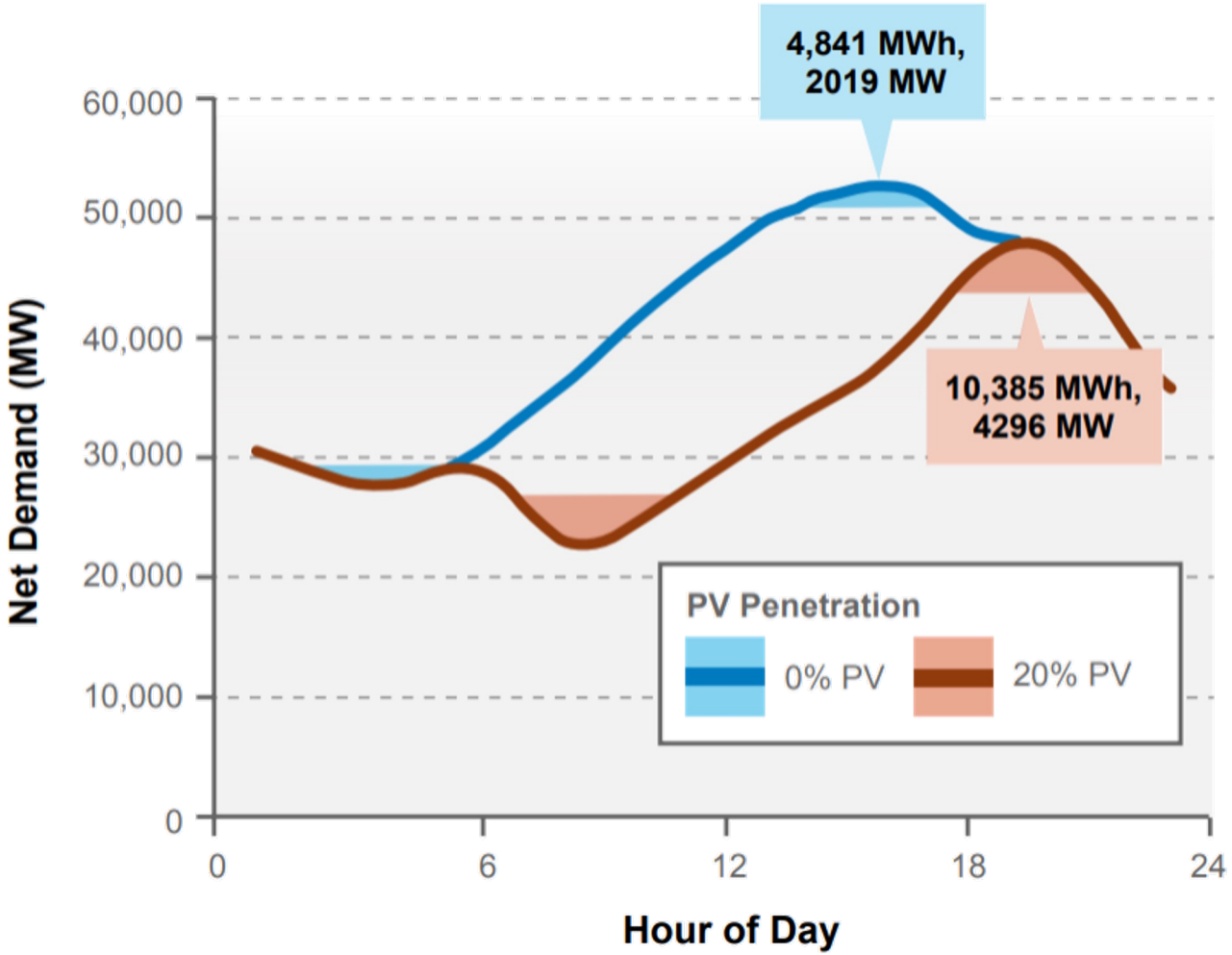
- ✓ Less siting challenges
- ✓ Reduce transmission & distribution losses
- ✓ Relieve congestions
- ✓ Defer transmission & distribution upgrades






Inertia contributions
Error %
High Inertia
Low Inertia
Inertia Estimated Error %
Actual Inertia
Synchronous Generation
Non-synchronous Generation & Demand Side Inertia
1990
2050
Time


GENERATOR DOMINATED POWER SYSTEM
INVERTER DOMINATED POWER SYSTEM
Coal Power Plants
Hydro Power Plants
High Inertia
Low Inertia
Conventional Generator Systems
Energy Storage Systems
Nuclear Power Plants
PV-Wind Systems
PV Systems
Wind Systems


4,841 MWh,
2019 MW
10,385 MWh,
4296 MW
PV Penetration
0% PV
20% PV
Net Demand (MW)
60,000
50,000
40,000
30,000
20,000
10,000
0
0
6
12
18
24
Hour of Day

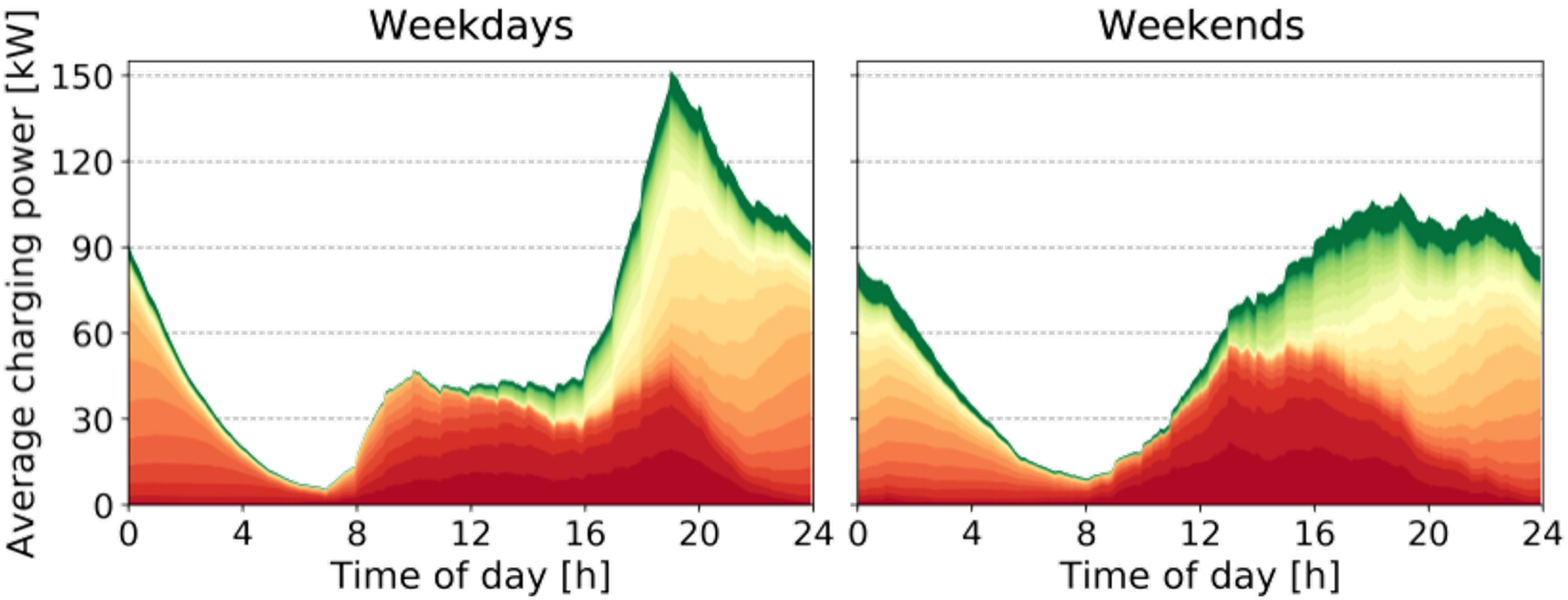
EU Commission is propposing to forbid sales of cars with combustion engines by 2035

Table 10: Europe's Five Largest Economies National Electric Car Deployment 2030-2050 Targets

Country	2030	2040	2050
France	3 million BEVs, 1.8 million PHEVs (2028)	No sales of new cars and vans using fossil fuels	X
Germany	7-10 million BEVs, FCEVs	X	All passenger vehicle sales to be ZEVs
Italy	4 million BEVs, 2 million PHEVs	X	X
Spain	5 million EVs	100% ZEV sales	X
UK	No sales of new ICE (2030)	X	X

Relative to vehicle stock

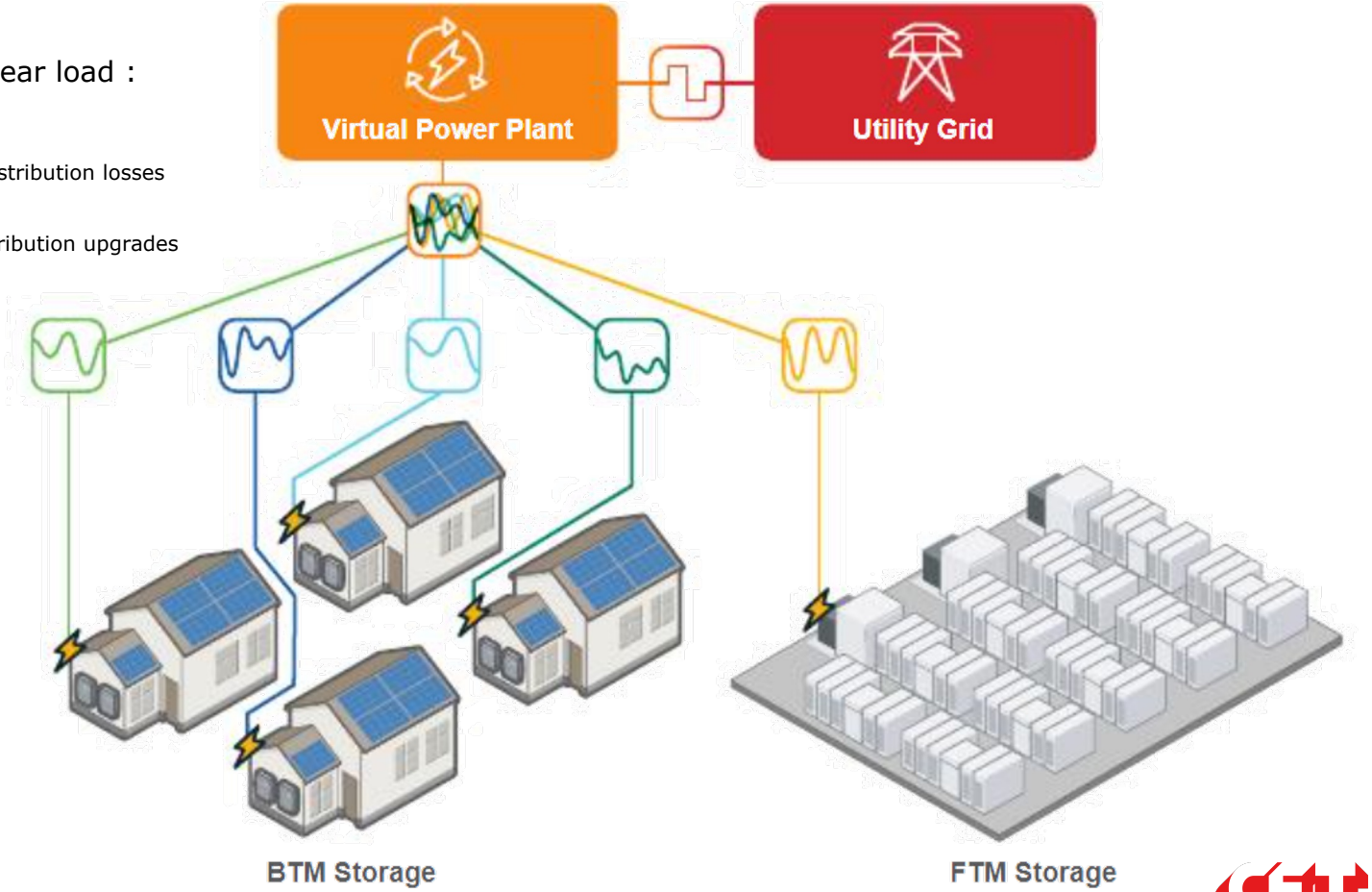
Full ICE phase out or 100% EV target


Weekdays
Weekends
Average charging power [kW]
150
120
90
60
30
0
0
4
8
12
16
20
24
Time of day [h]
Time of day [h]

25,000 TW.HR

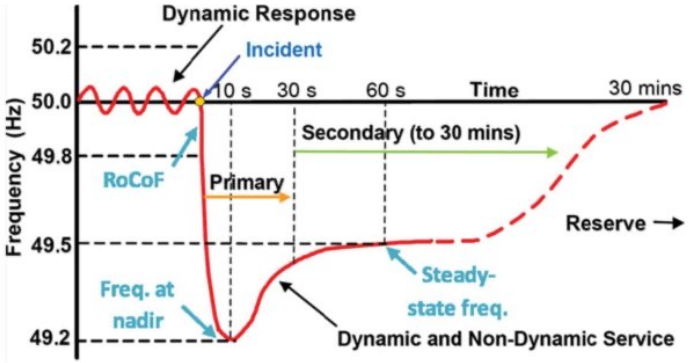
BESS systems located near load :

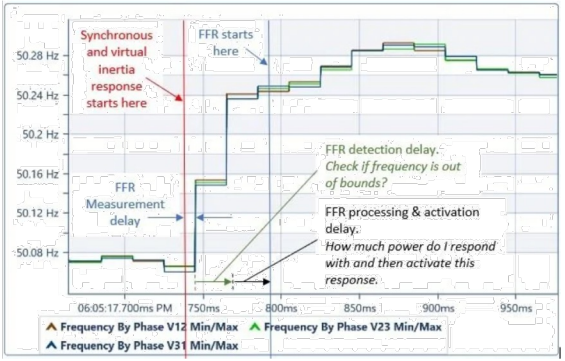
- ✓ Less siting challenges
- ✓ Reduce transmission & distribution losses
- ✓ Relieve congestions
- ✓ Defer transmission & distribution upgrades



ANCILLARY SERVICES EXAMPLE : AUSTRALIA

Focus on fast frequency responses



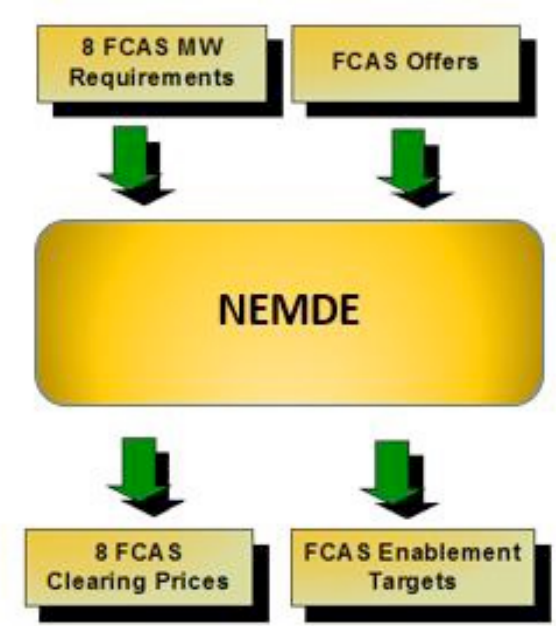


Application	Description	Duration of Service Provision
Arbitrage	Purchasing low-cost off-peak energy and selling it during periods of high prices	Hours
Firm Capacity	Provide reliable capacity to meet peak system demand	4+ hours
Operating reserves		
Primary Frequency response	Very fast response to unpredictable variations in deand and generation	Seconds
Regulation	Fast response to random, unpredictable variations in demand and generation	15 minutes to 1 hour
Contingency Spinning	Fast response to a contingency such as a generator failure	30 minutes to 2 hours
Replacement/Supplemental	Units brought on line to replace spinning units	Hours
Ramping/Load Following	Follow longer-term (hourly) changes in electricty demand	30 minutes to hours
Transmission & Distribution Replacement & Deferral	Reduce loading on T&D system during peak times	Hours
Black-Start	Units brought on line to start system after a system-wide failure (blackout)	Hours

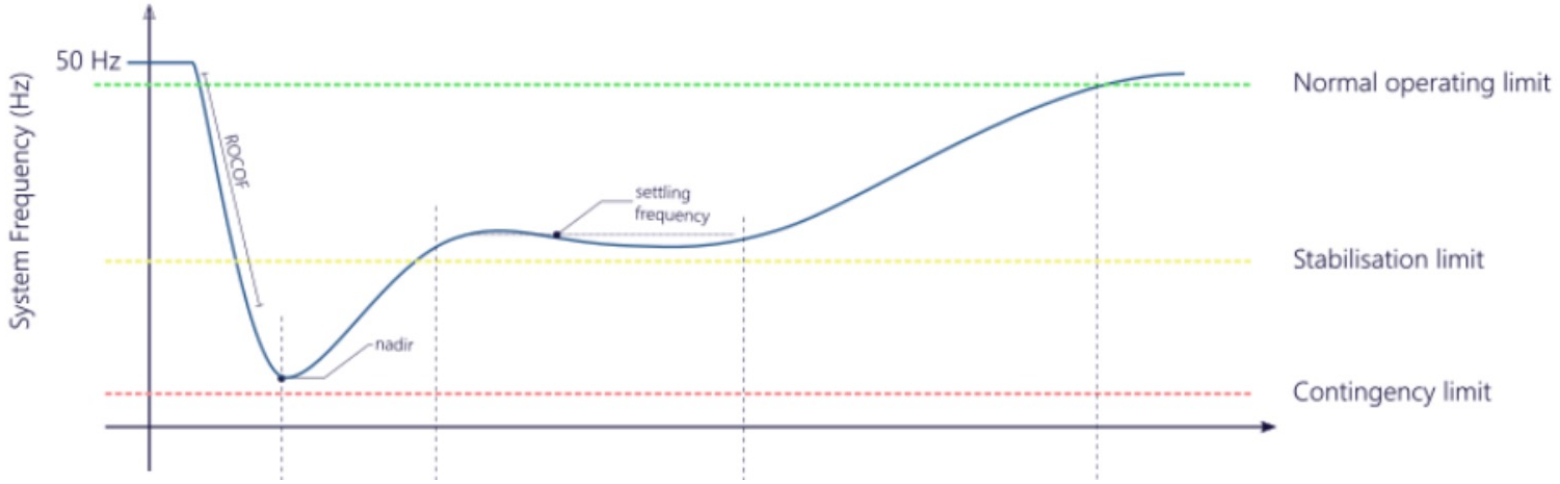
Frequency ancillary services: example for Australia

Contingency
1. Fast raise
2. Fast lower
3. Slow raise
4. Slow lower
5. Delayed raise
6. Delayed lower

Regulation
1. Regulation raise
2. Regulation lower



Contingency – Fast raise

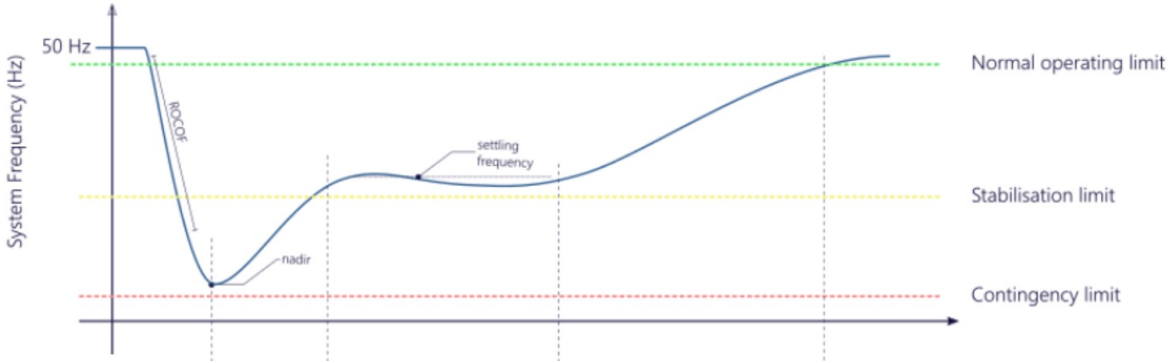


- Stop fast fall of grid frequency
- Amount of power is pre-defined
- Work locally

RoCoF
Rate of change of frequency

nadir
Measure the minimum post contingency frequency

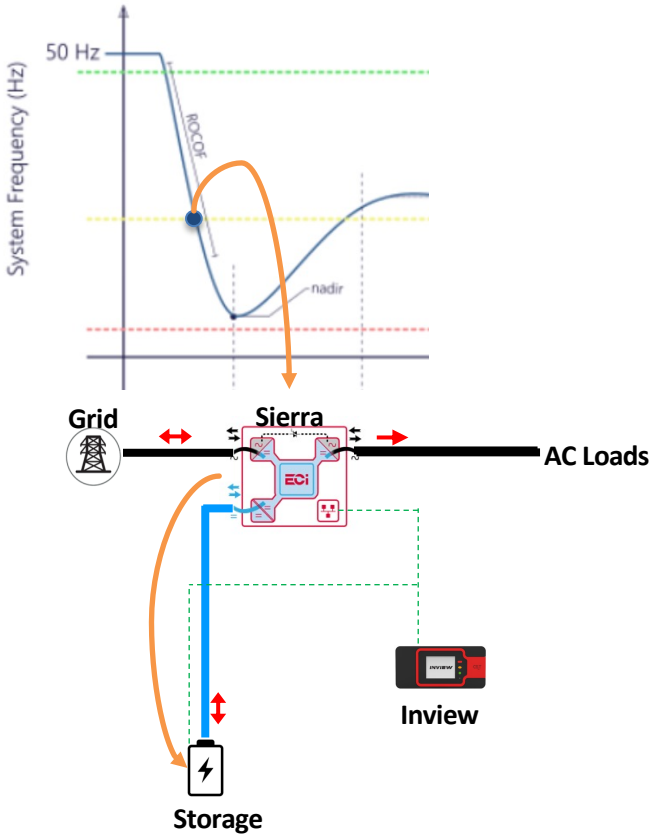
Contingency – Fast raise



RoCof & Nadir = Influence on tripping of other components.

Technologies	Hydro	Wind & Solar	Nuclear	Gas power plant	Batteries
Reaction time	1-2 minutes	Not possible	Hours	5-30 minutes	< 1 s

Contingency – Fast raise



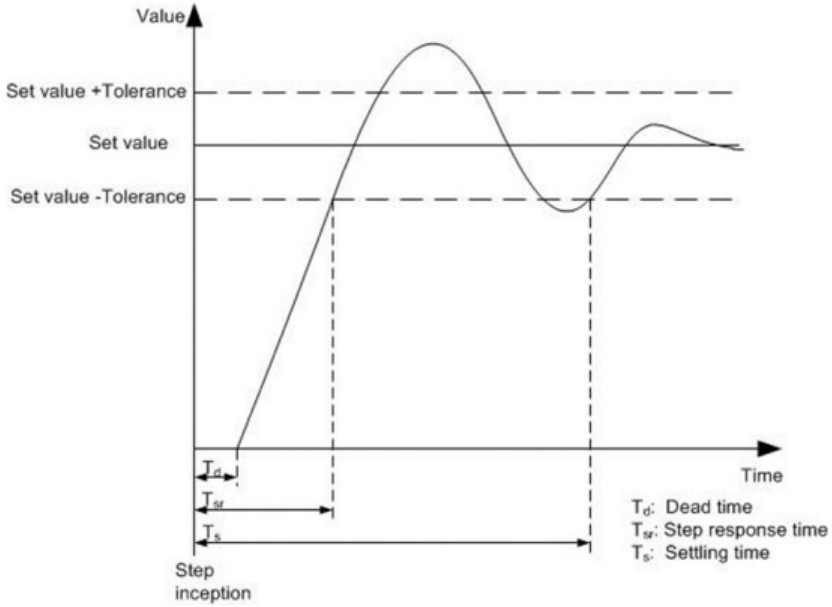
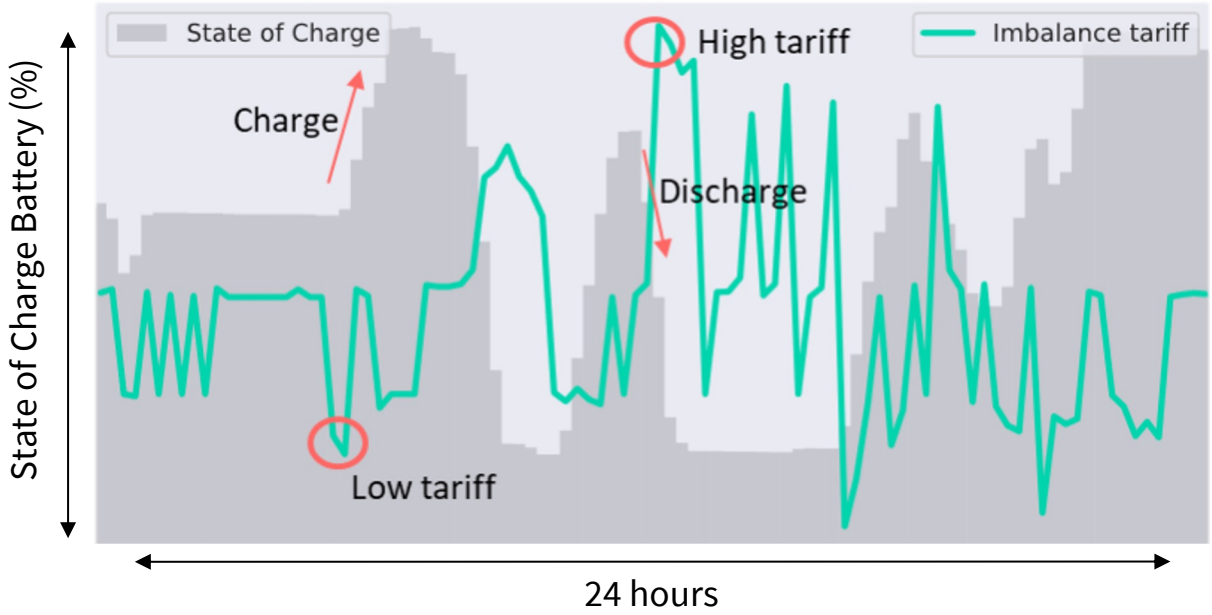


Figure 4 — Timing, step response time and settling time

THE SPOT MARKET

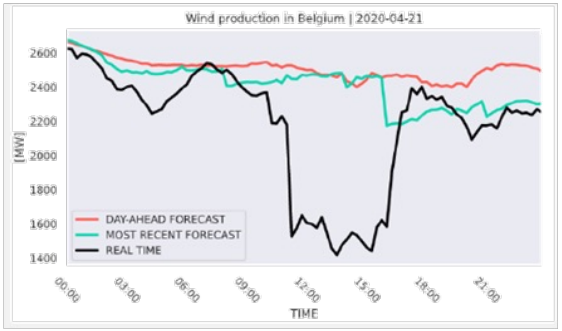
- Use a model that predicts the future imbalance of the grid
- The model uses a variety of input data
  - **Climate Data** (e.g., wind & solar)
  - **Grid Data** (e.g., load, imbalance)
  - **Market Data** (e.g., spot & imbalance prices)
- A decision-based model based on domain knowledge boosted with artificial intelligence



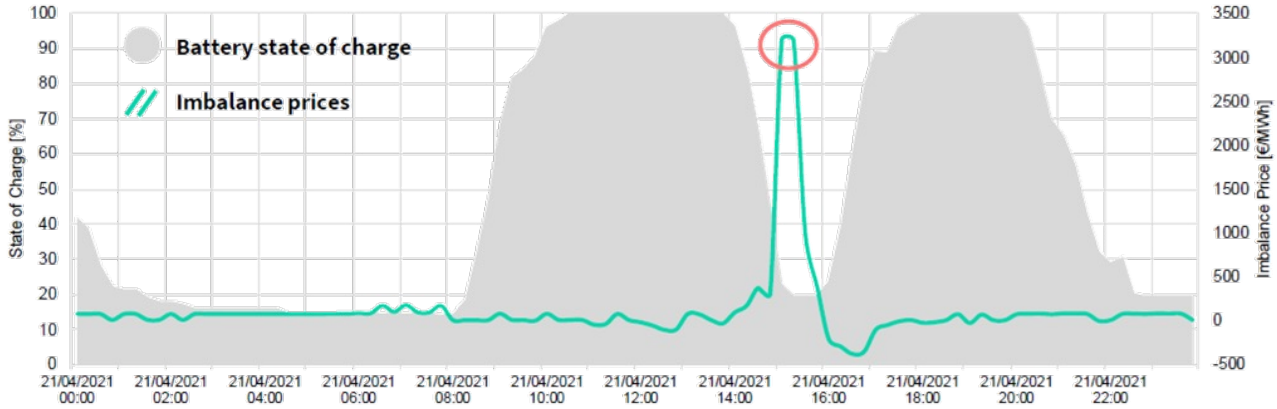
Belgium - Record day April 21 - 2021

Pumped hydro storage under maintenance

Lower winds than expected



Power station disruption



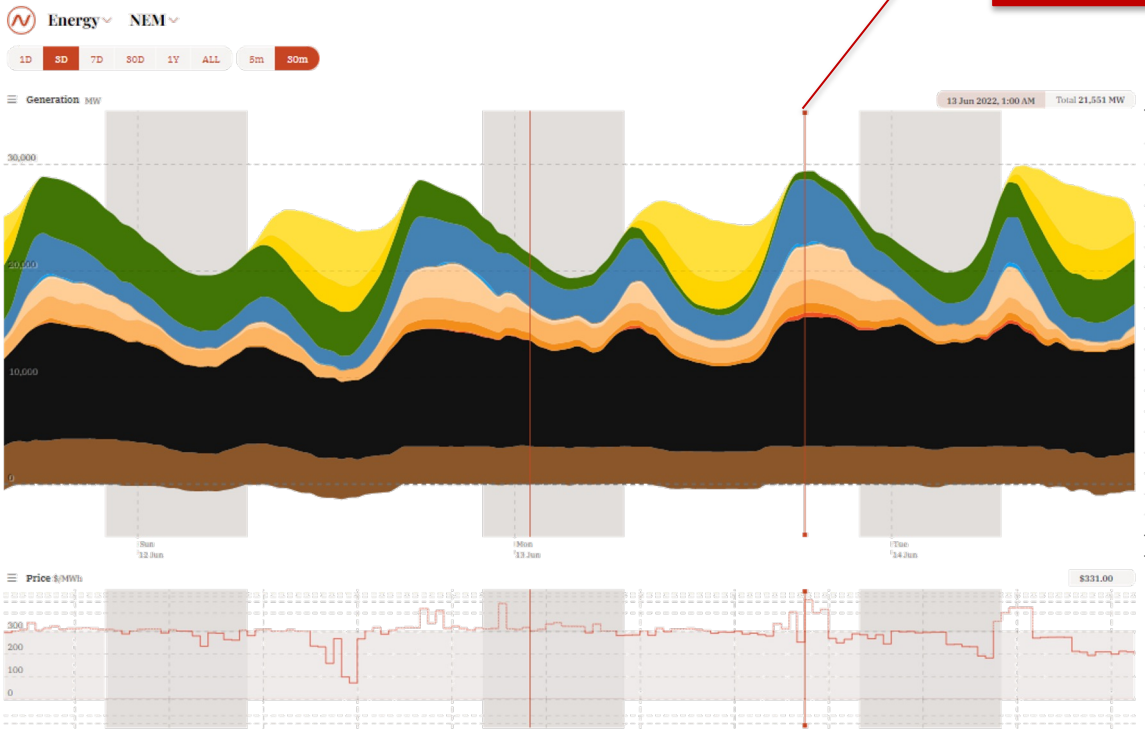
Imbalance prices

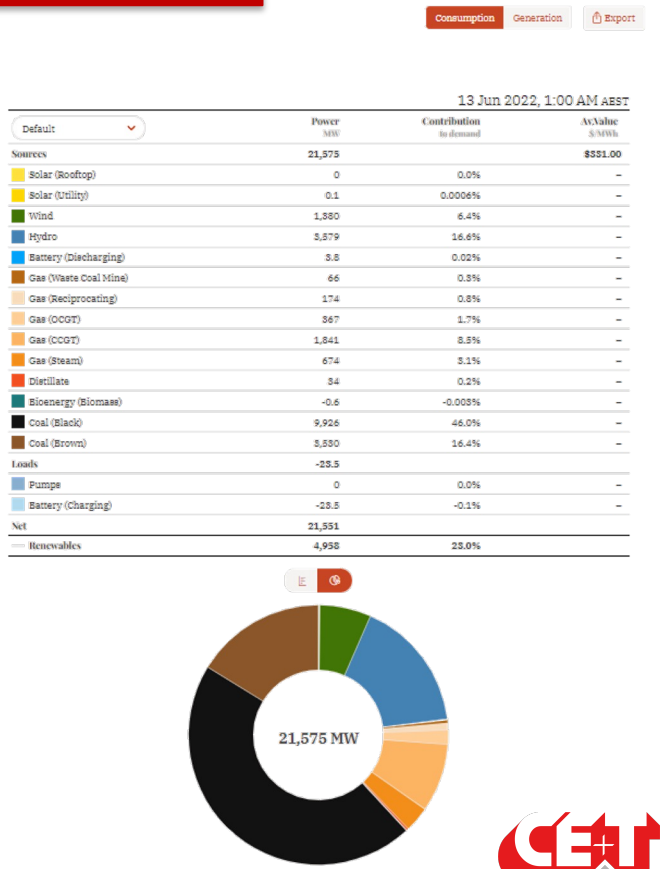
Source : elia

(€/MWh)

Minimum	Maximum
-487.07	3,199.94
-487.07	3,199.94

4300€ / MW.hrs





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SIERRA AT WORK

Orison Panel

2.2 kWh Scalable Battery

- **HIGHLY COST Effective Solution**
- **Scalable 2.2kW/hr Battery**
- **Plugs Directly into standard GPO**
- **Minimal Installation Costs**
- **Battery Expansion easily Implemented.**
- **Open Integration to cloud Demand Management platform**
- **International Standards Approved**

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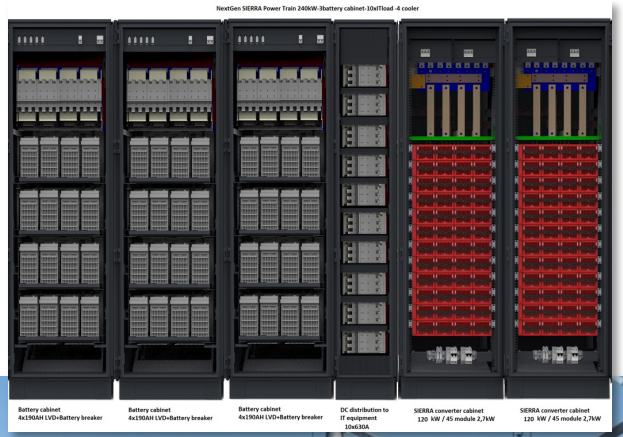

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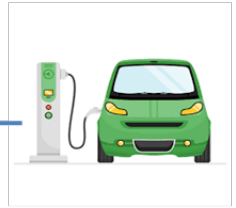
Grid

100 kW



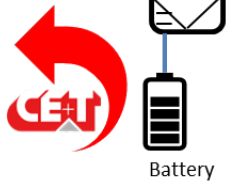
9 Domestic Ev charger (11 kW)

OR

Fast charger (150 kW to 250⁺kW)

Grid

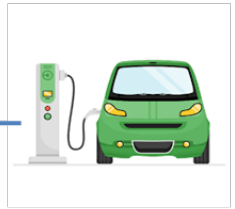
100 kW



Battery

500 kW

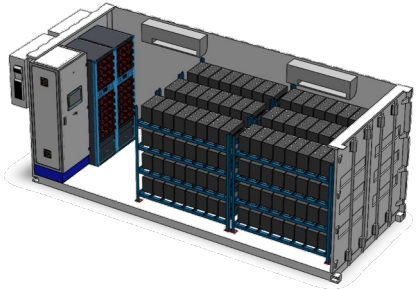
600 kWh



15 Domestic Ev charger

&

2 DC charger 250 kW



*Recharges in 3 hours between 20 and 80% DOD, Average 50 KWh battery

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FLEXIBILITY

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for your attention

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