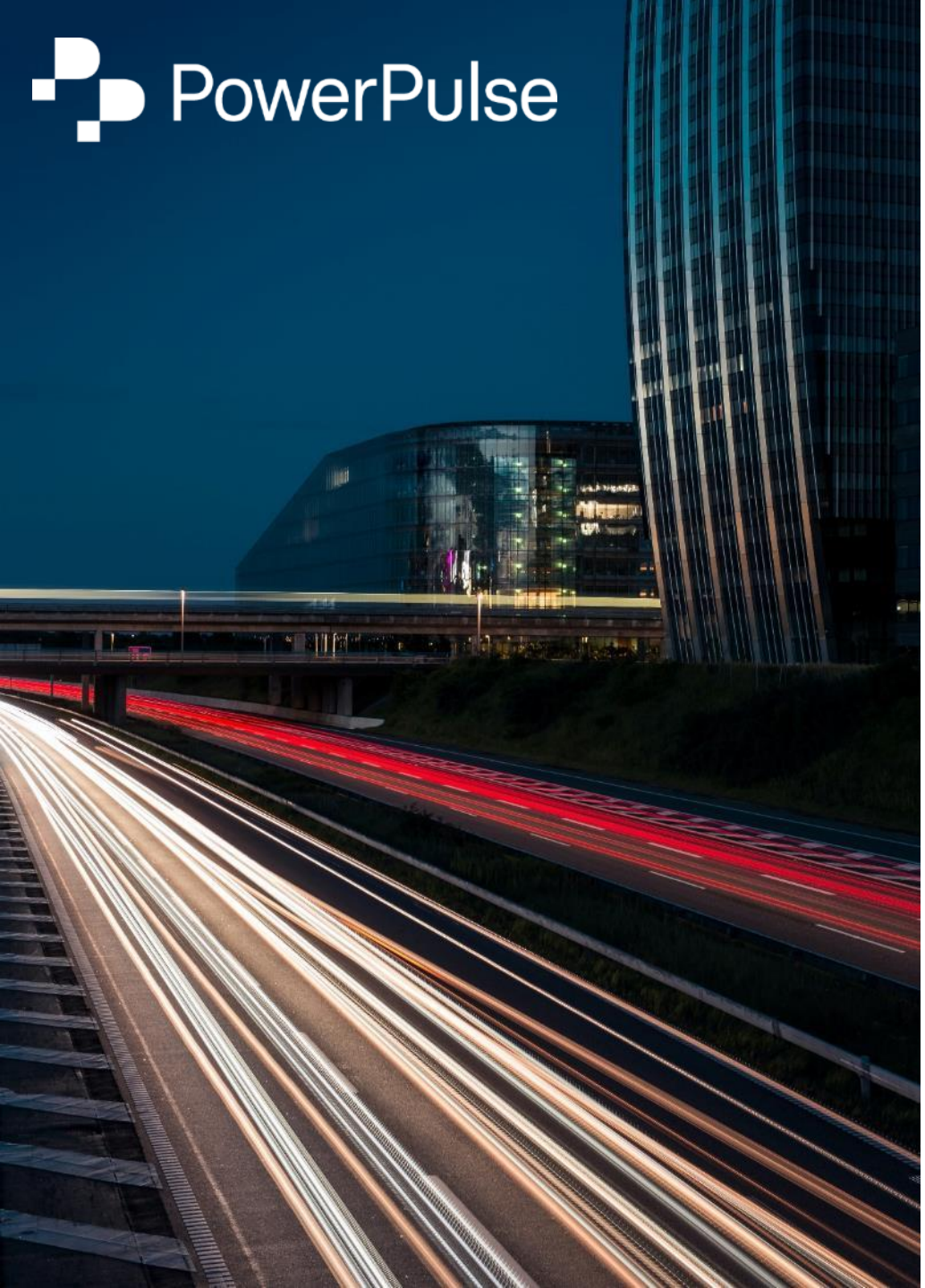


Financial opportunities of industrial flexibility

Smart Energy Academy

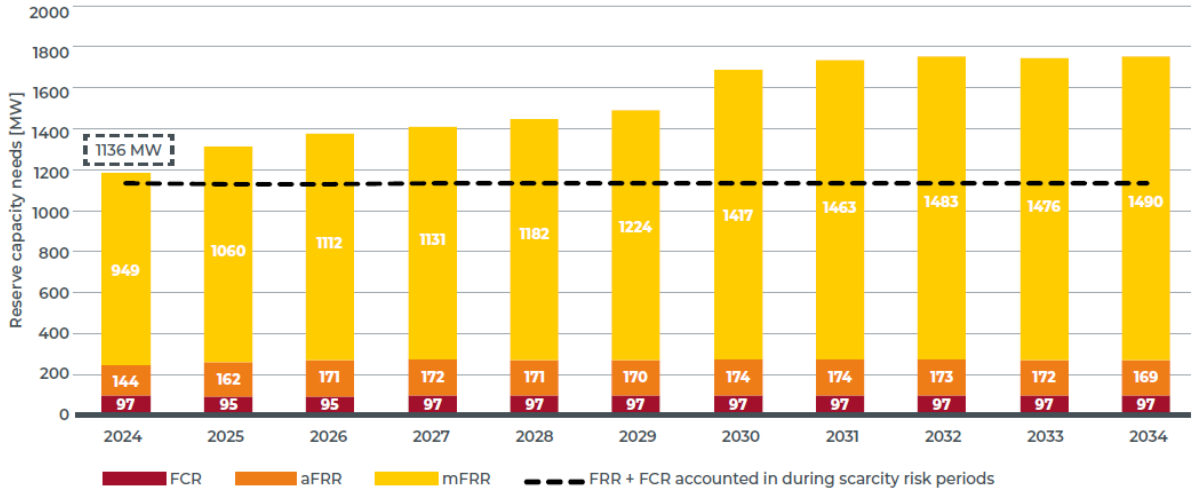
21 November 2024

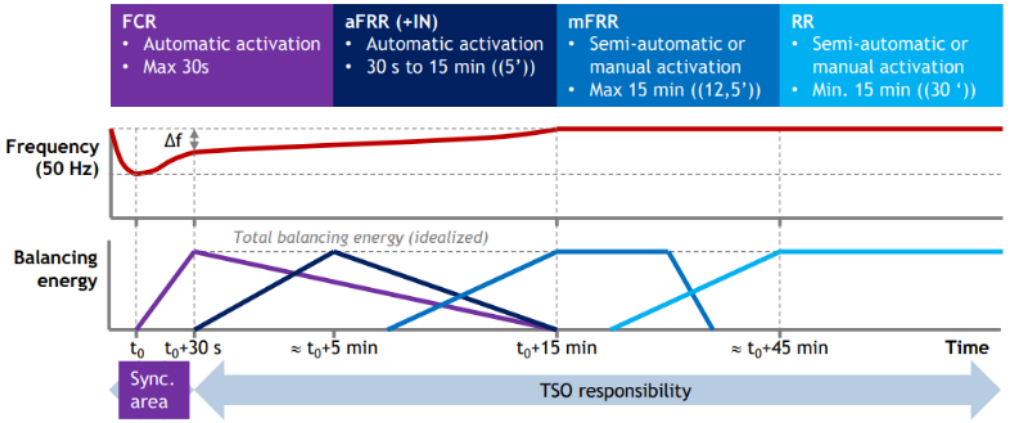
- **Flexibility opportunities**
- **Examples**

Flexibility needs for 2024-2034 are rising sharply

PowerPulse

FIGURE 3-124 — PROJECTION OF ELIA'S RESERVE CAPACITY NEEDS TOWARDS 2034



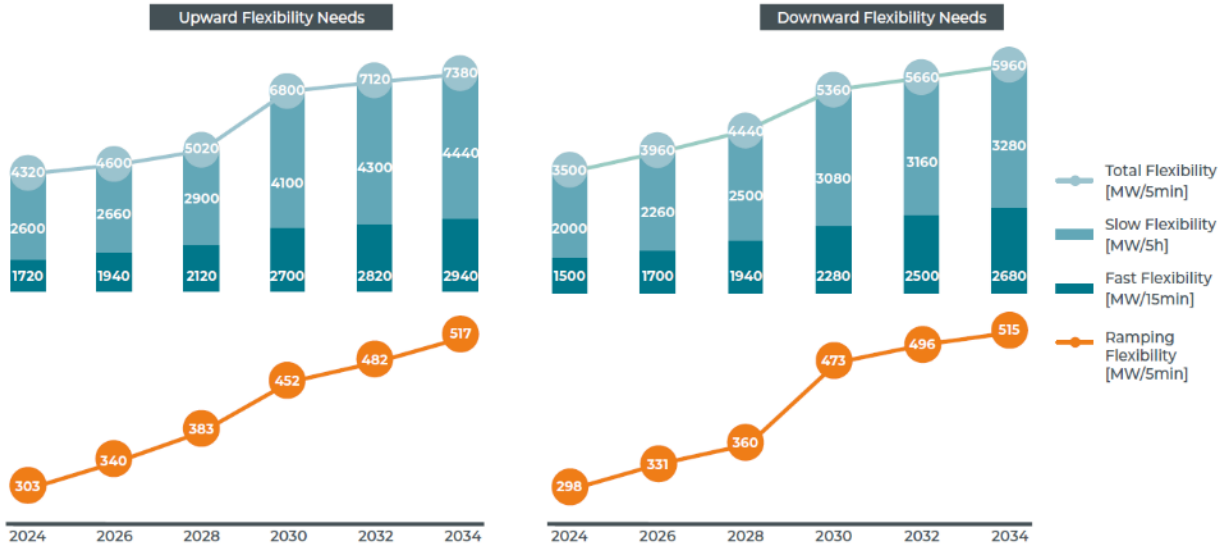


Ramping flexibility:
real time variations on generation and demand

Fast flexibility:
real time forecast errors and forced outages

Slow flexibility:
intra-day forecast updates and forced outages longer than a few hours

FIGURE 6-1 — EVOLUTION OF FLEXIBILITY NEEDS BETWEEN 2024 AND 2034 IN THE CENTRAL SCENARIO



Source: Elia Adequacy report 2024-2034

Flexibility opportunities in industry

PowerPulse

Batteries

Electric vehicles

Fridge + Freezer

Manufacturing equipment

Heat pump

HVAC

Renewable energy assets

Financial opportunities for flexible assets

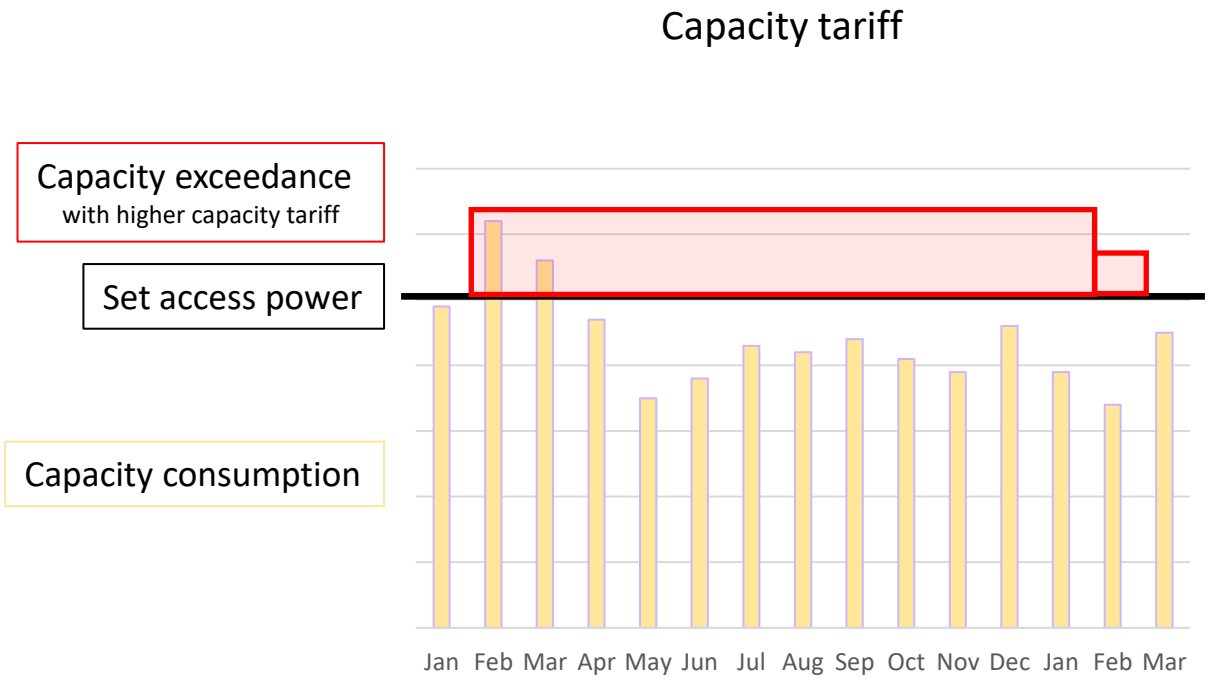
PowerPulse

1. **Peak shaving**
2. **Day ahead optimization**
3. **Self-consumption of renewable energy**
4. **Reserve markets**
5. **Imbalance markets**

Financial opportunities for flexible assets

PowerPulse

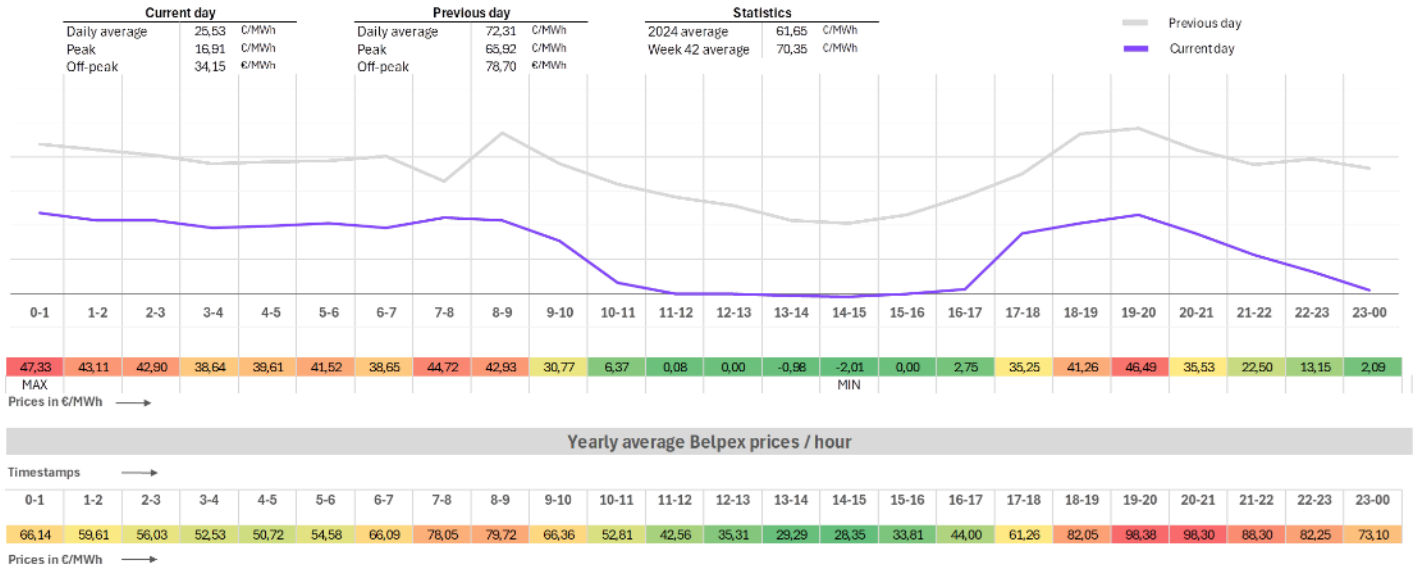
1. **Peak shaving**
2. **Day ahead optimization**
3. **Self-consumption of renewable energy**
4. **Reserve markets**
5. **Imbalance markets**



Financial opportunities for flexible assets

PowerPulse

1. **Peak shaving**
2. **Day ahead optimization**
3. **Self-consumption of renewable energy**
4. **Reserve markets**
5. **Imbalance markets**



Financial opportunities for flexible assets

PowerPulse

1. **Peak shaving**
2. **Day ahead optimization**
3. **Self-consumption of renewable energy**
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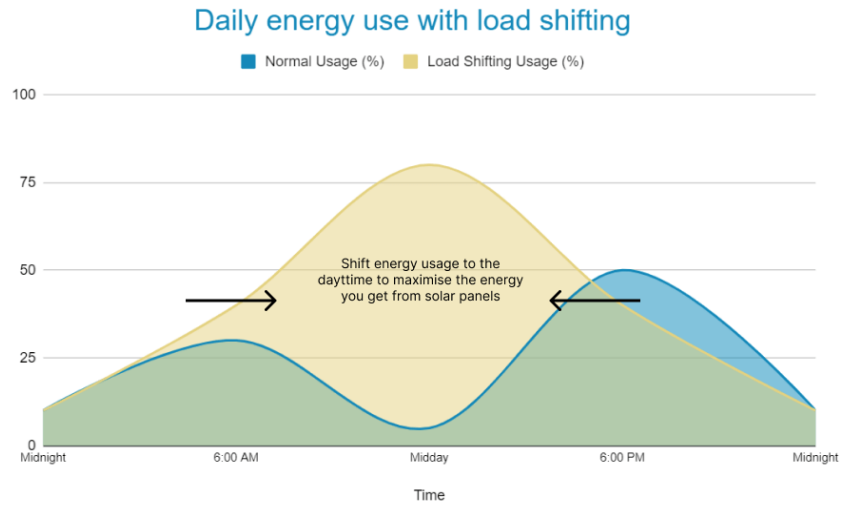
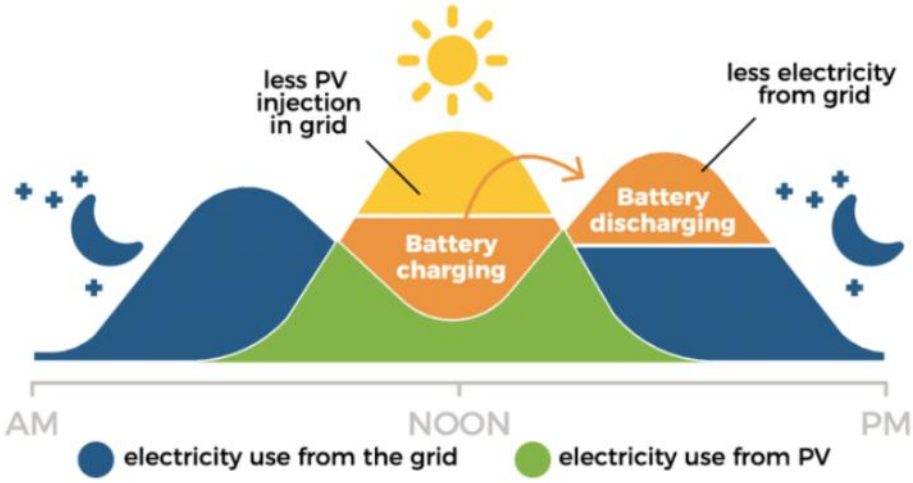


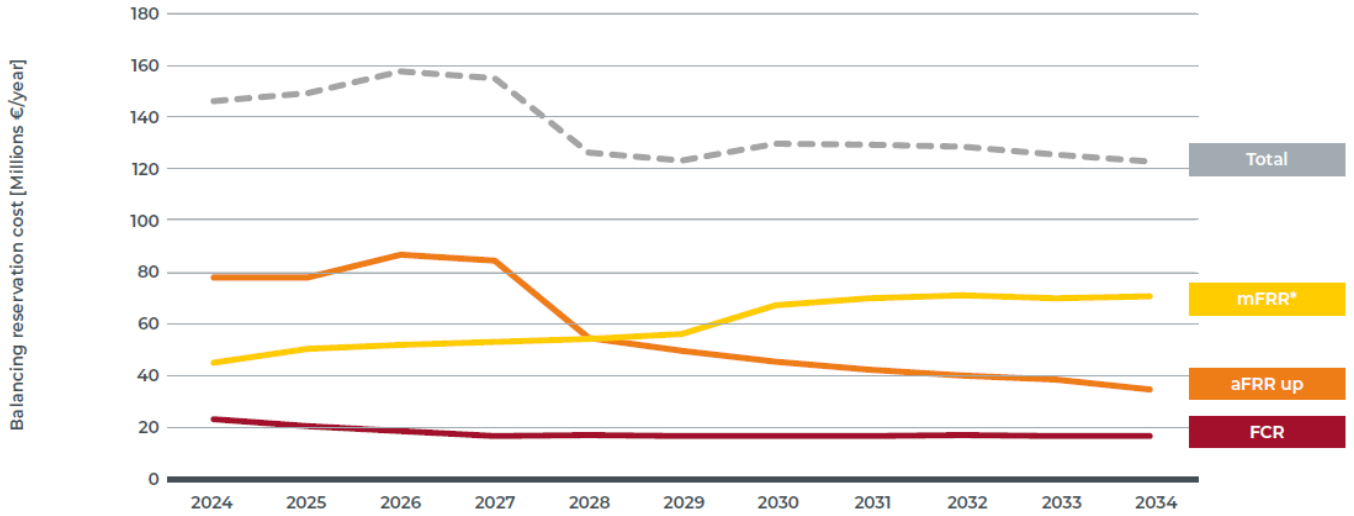


Financial opportunities for flexible assets

PowerPulse

1. Peak shaving
2. Day ahead optimization
3. Self-consumption of renewable energy
4. Reserve markets
5. Imbalance markets

FIGURE 3-119 — EXPECTED BALANCING RESERVATION COSTS FOR THE PERIOD 2024-2034

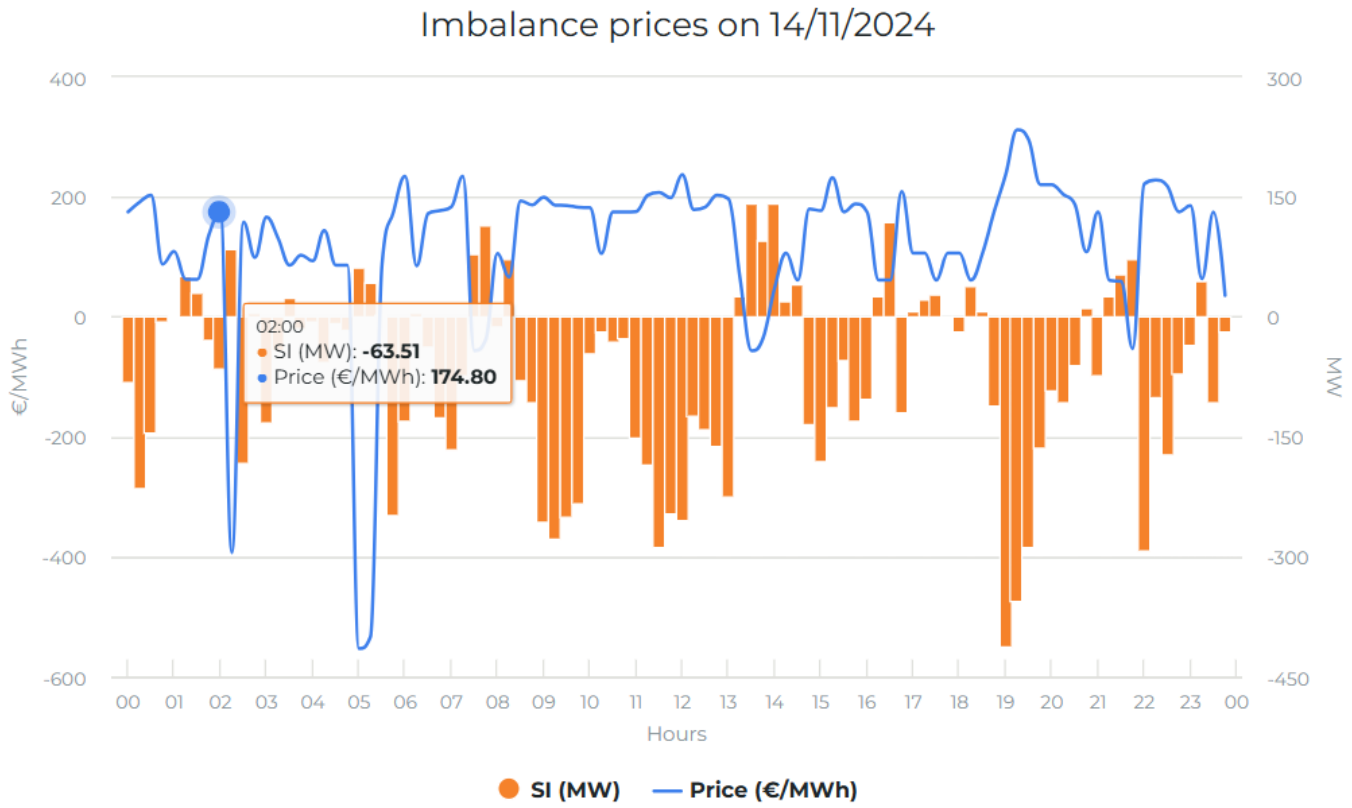


*mFRR reservation costs exclude the costs related to 250 MW from inter-TSO

Financial opportunities for flexible assets

PowerPulse

1. Peak shaving
2. Day ahead optimization
3. Self-consumption of renewable energy
4. Reserve markets
5. Imbalance markets



- Flexibility opportunities
- **Examples**

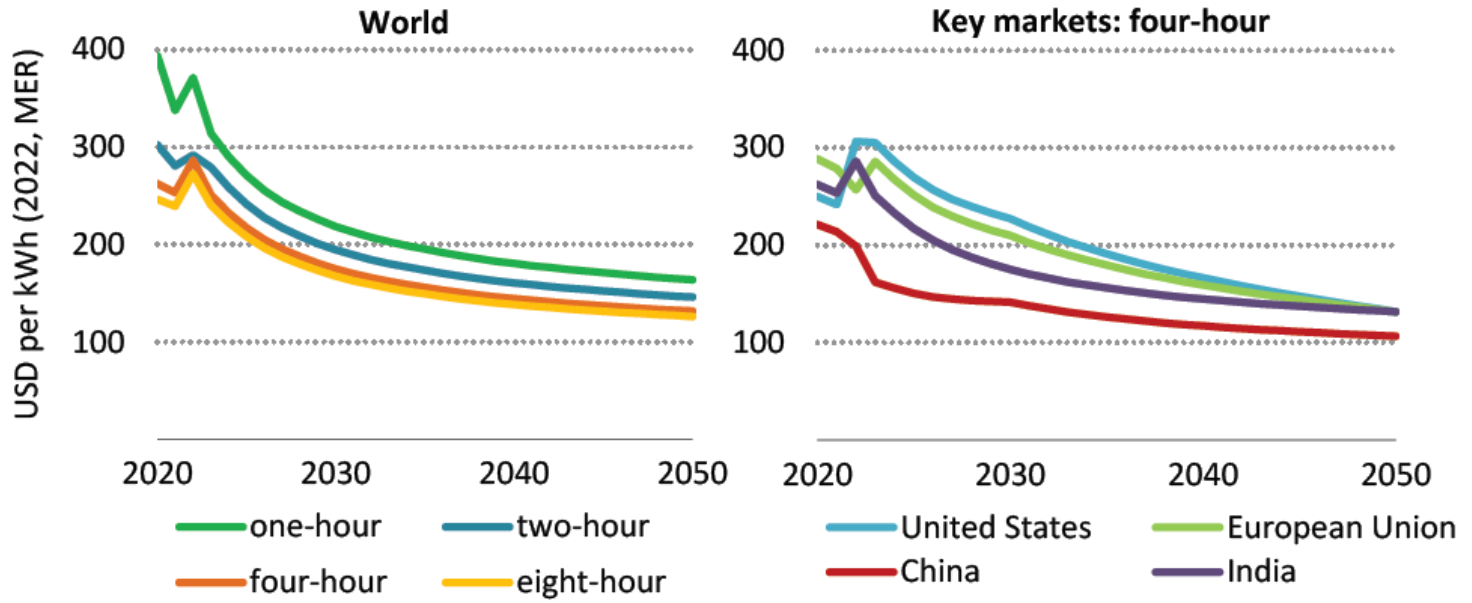
Battery prices are dropping

PowerPulse

Batteries

IEA Battery report April 2024

Figure 2.22 ▷ Average total system capital costs of utility-scale batteries globally and in key markets in the STEPS, 2020-2050

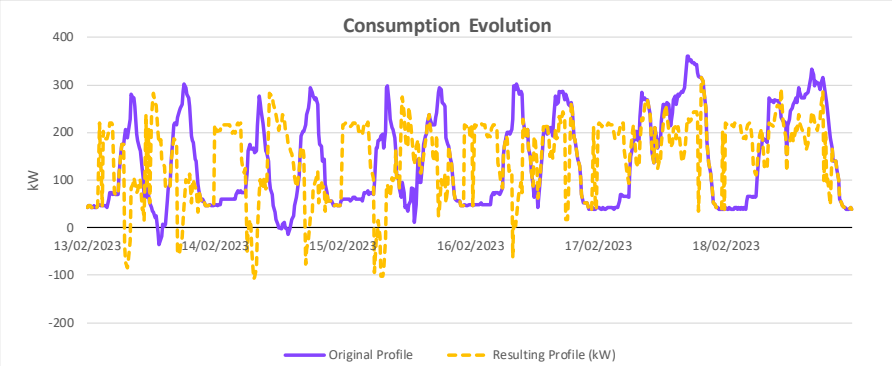


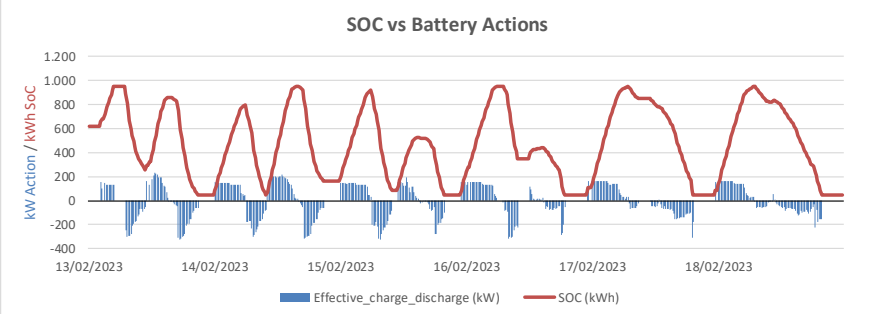
Total upfront costs of utility-scale battery storage decline 30-40% by 2030, with the cost range narrowing in key markets

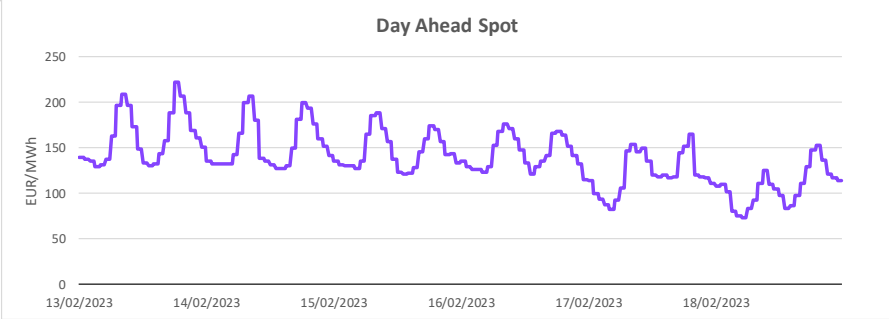
Note: MER = market exchange rate.

Battery Actions – Day ahead + peak shaving + Self-consumption

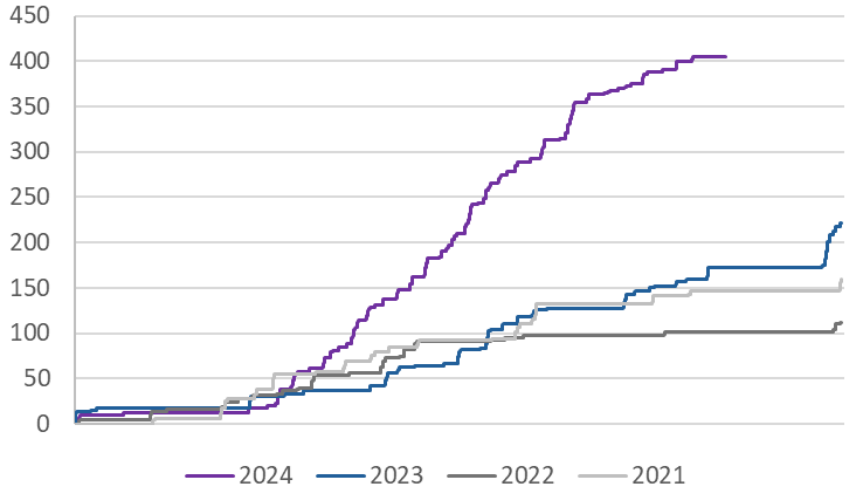
Assumption: 1 MWh - 0,5 MW battery





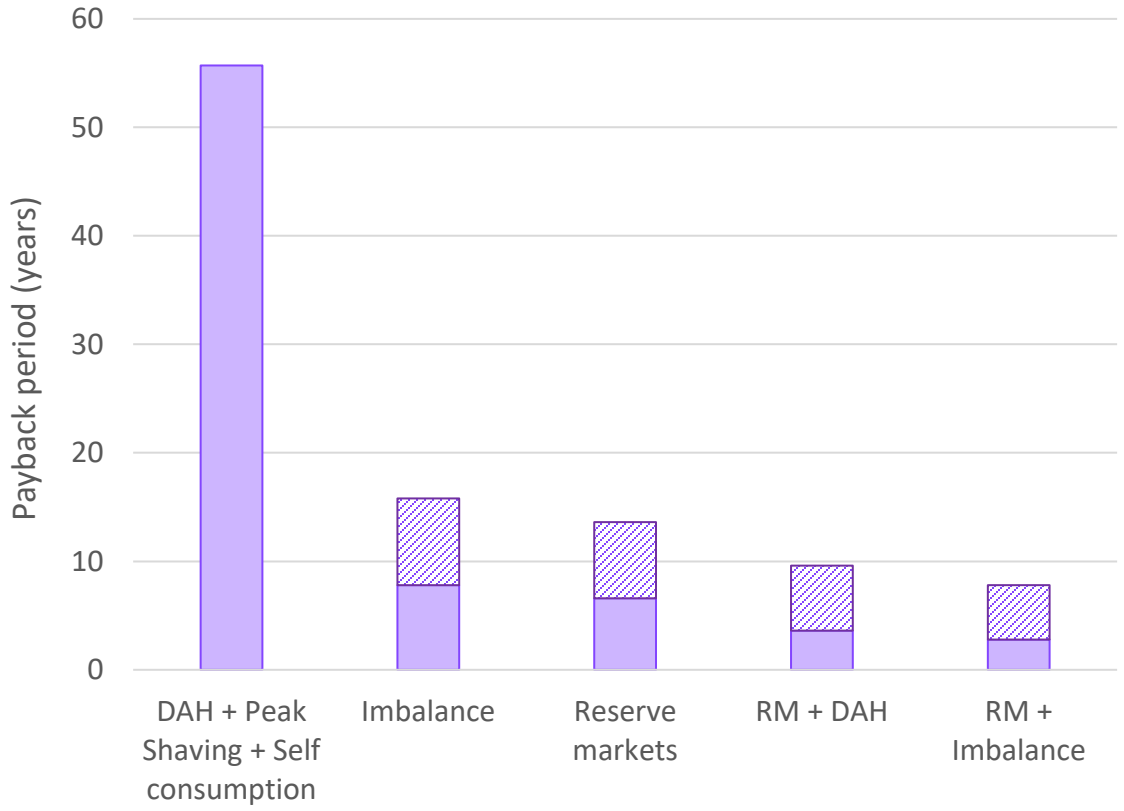


Cumulative number of negative hourly spot prices in Belgium over the last years



Batteries can be profitable with value stacking

Assumption: 1 MWh - 0,5 MW battery

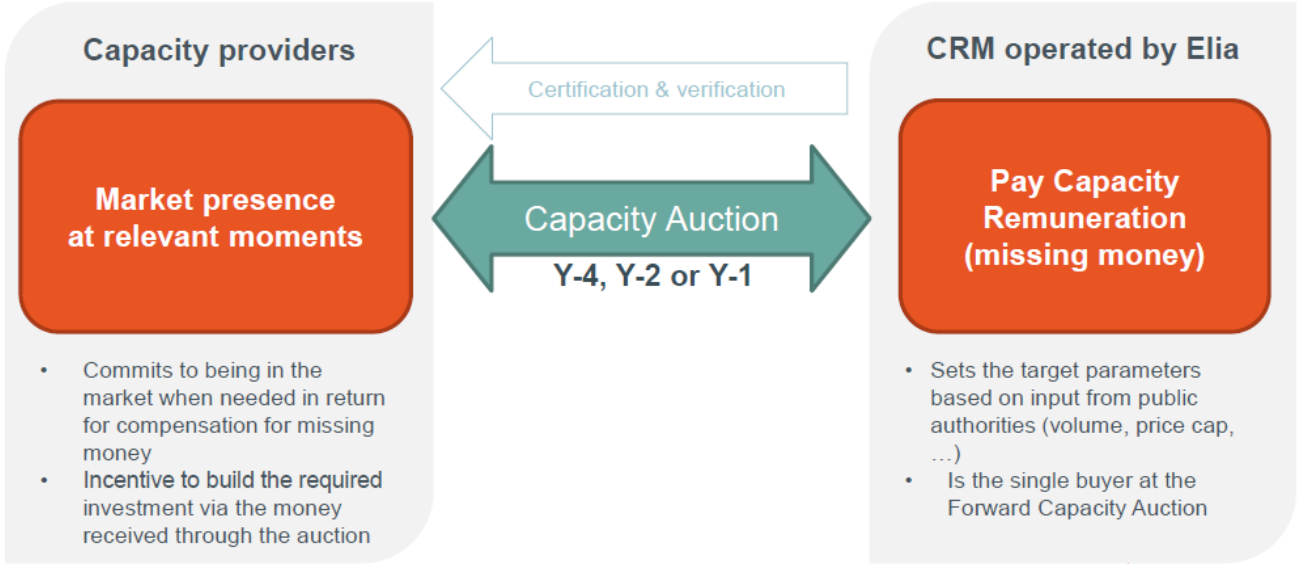


- **Every individual business case is different**
- With a lifetime of 8,000 cycles or 15 years, load shifting (DAH + Peak shaving + Self-consumption) leads to a negative business case
- Imbalance and reserve markets lead individually to positive business cases
- **Stacking of values leads to the highest value**
- Combination of markets leads to a significant need for schedule optimisation

Financial opportunities for flexible assets

PowerPulse

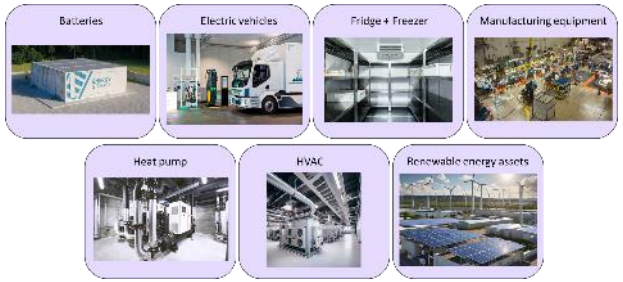
1. Peak shaving
2. Day ahead optimization
3. Self-consumption of renewable energy
4. Reserve markets
5. Imbalance markets
6. CRM



- Flexibility opportunities
- **Examples**

Combination of several flexible assets with energy management system

PowerPulse



Demand

- EV ◆
- E-Boiler ◆
- Site Demand ■
- Heat Pump ◆
- Site Demand ◆
- BESS ◆

Keep below transformer power

Production

- Steerable Production ◆
- Renewable Production ■

◆ Steerable ■ Non-Steerable

EMS System

Cloud operated / Locally installed

Connected through gateway to each different asset

Common functionalities

- Match Production & Demand by steering
- Perform forecast of demand/production profile
- Custom Dashboards
- Communication with external parties
- Reporting (for example external carbon accounting)
- Scenario Simulation

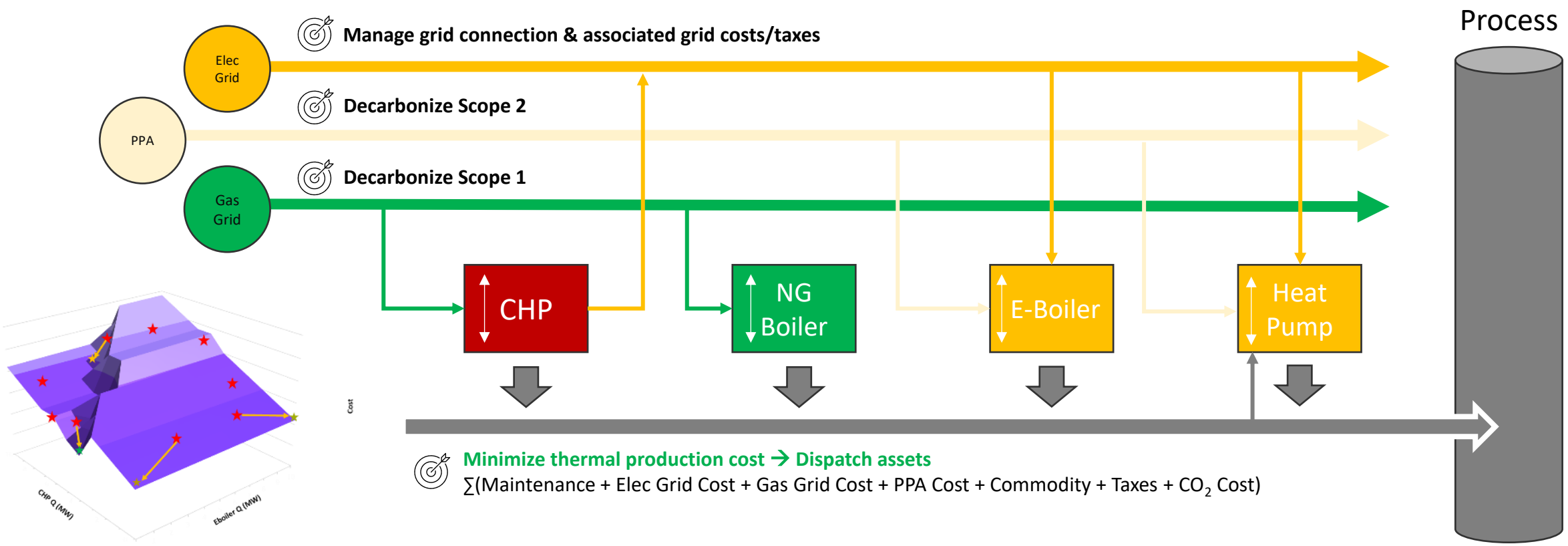
Energy management system optimising both electricity and heat

PowerPulse

Parameters to be included:

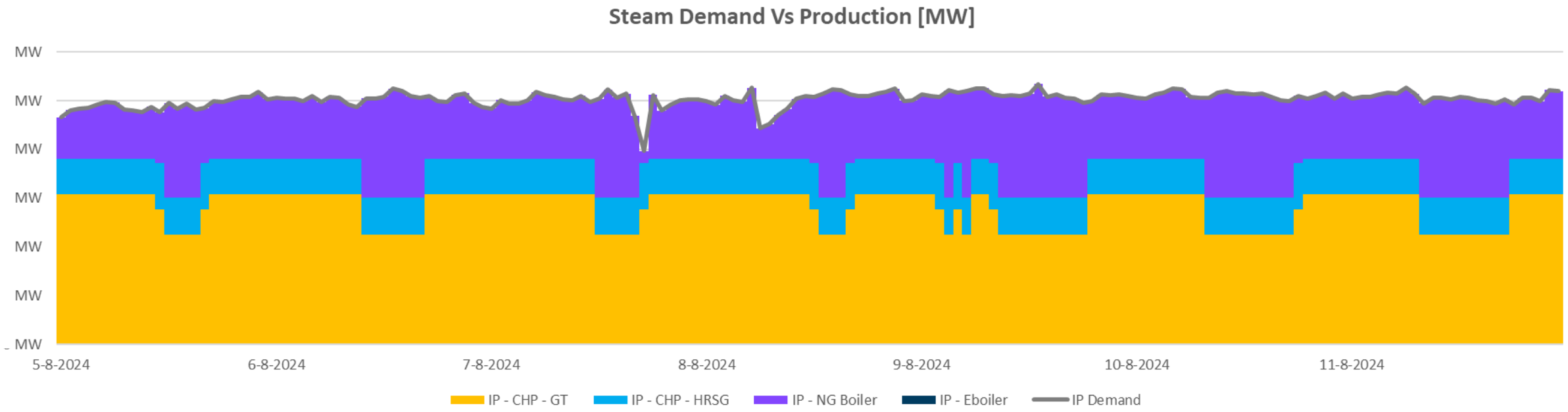
- Electricity & Gas price
- Constant machine efficiencies
- Non-commodity price
- Offtake/Injection position
  - ➔ non-linear effects make classic optimization techniques challenging
- Offtake/Injection
- CHP operating window
- Non-linear efficiency curves
- Ambient T°C
- CHP Certificates
- Related energy flows

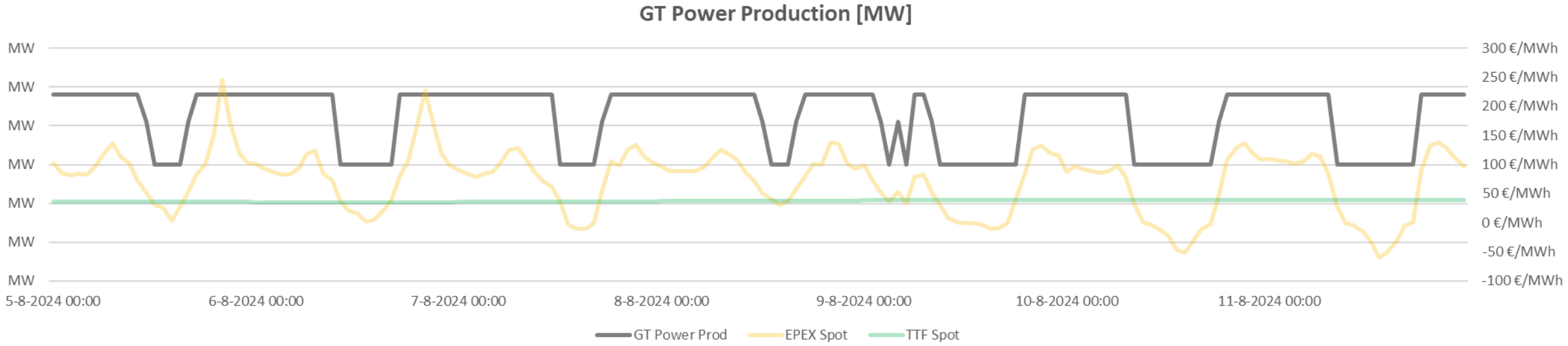
- **Operating electric assets in a traditional baseload operation is not economically viable**
  - Dispatch required between different assets depending on different external market prices and contract structure
- Focussing on different weights in optimization algorithm
  - Financial Savings / Decarbonization / Maintenance Costs



Balancing steam demand while optimizing power production

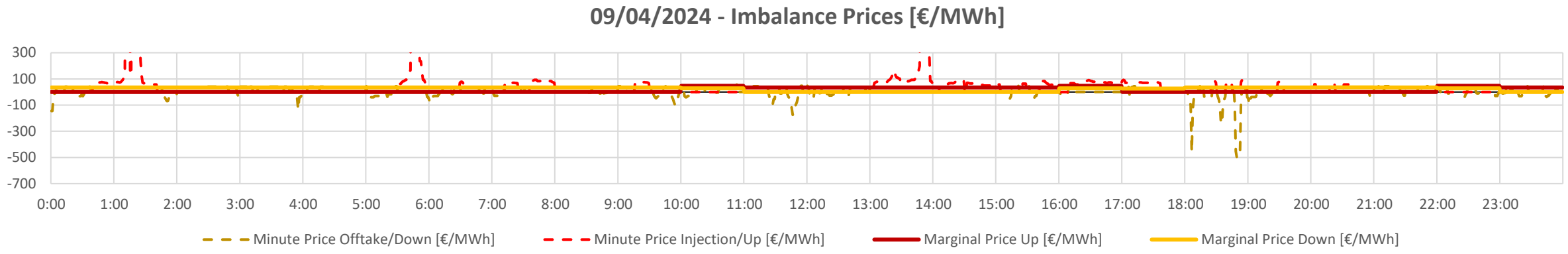
PowerPulse

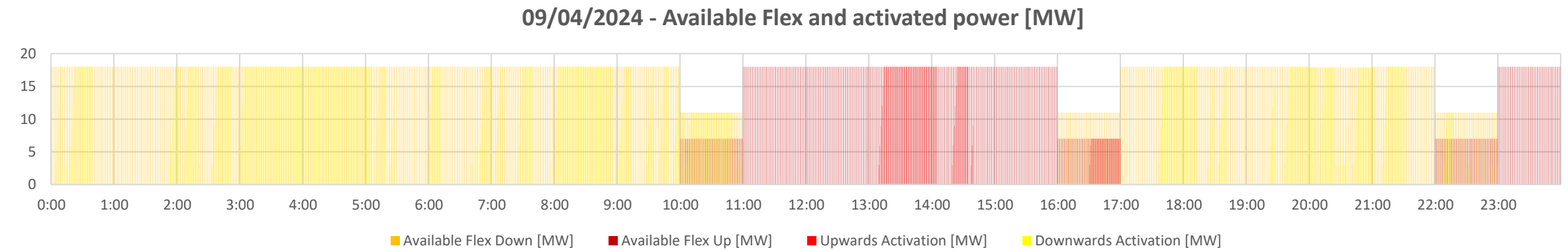


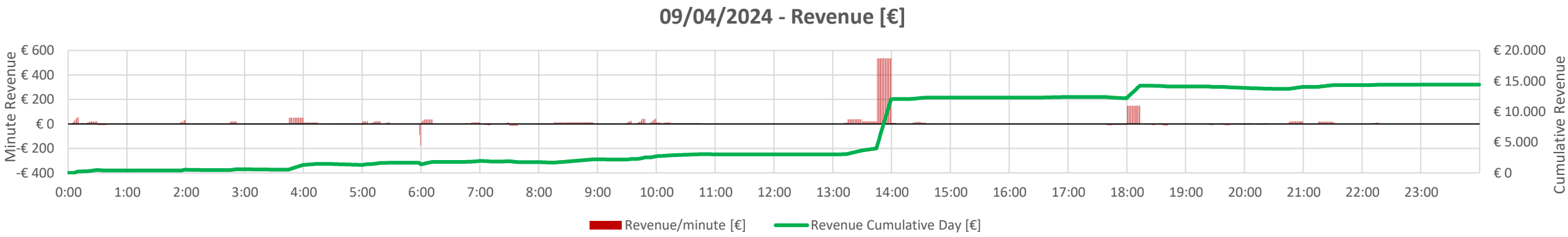


Intraday – Steering Actions on minute basis

PowerPulse



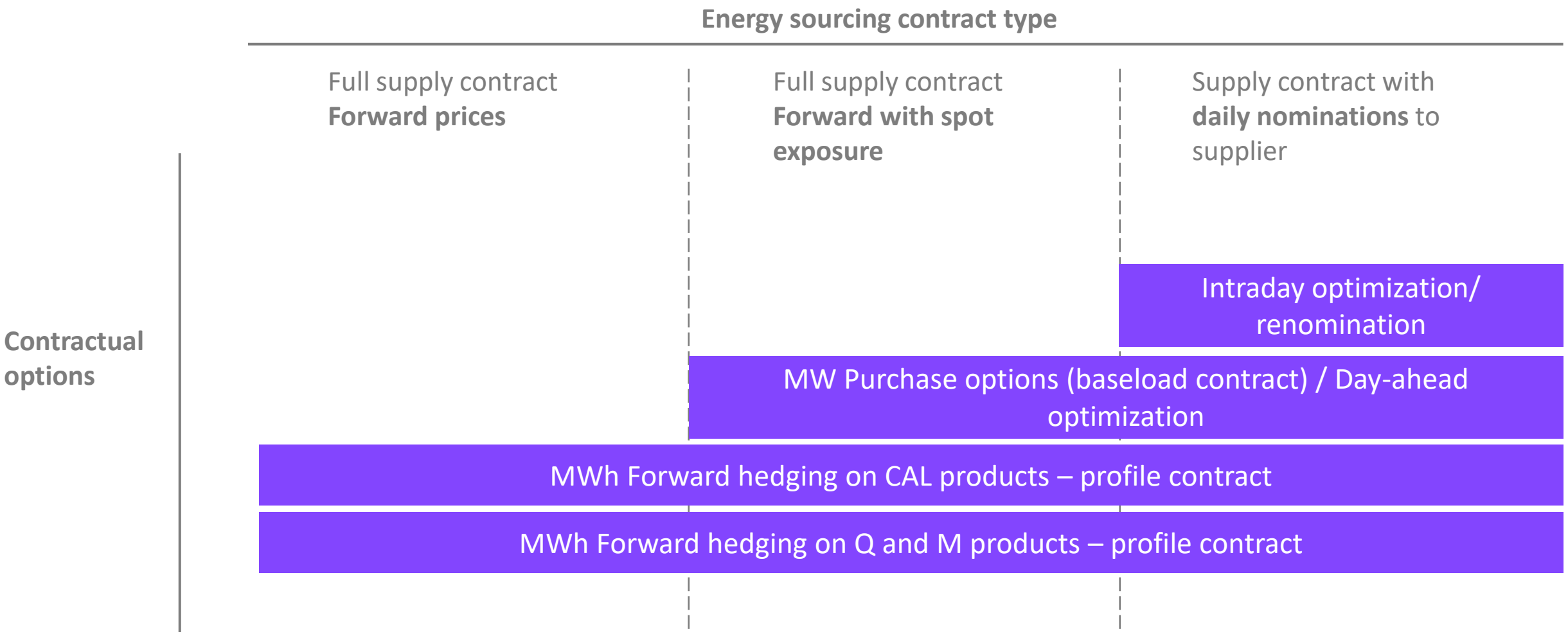




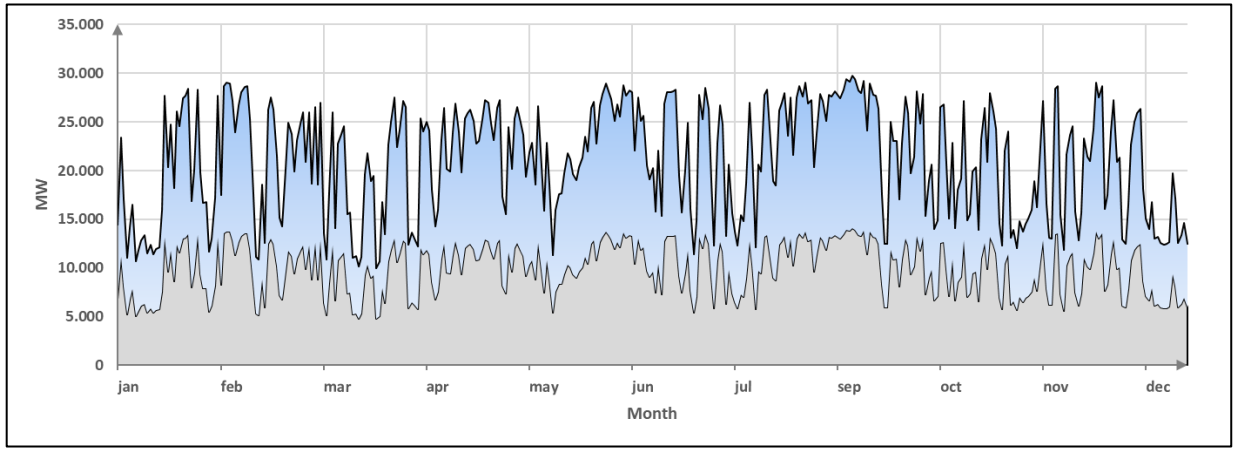
- Flexibility opportunities
- **Examples**

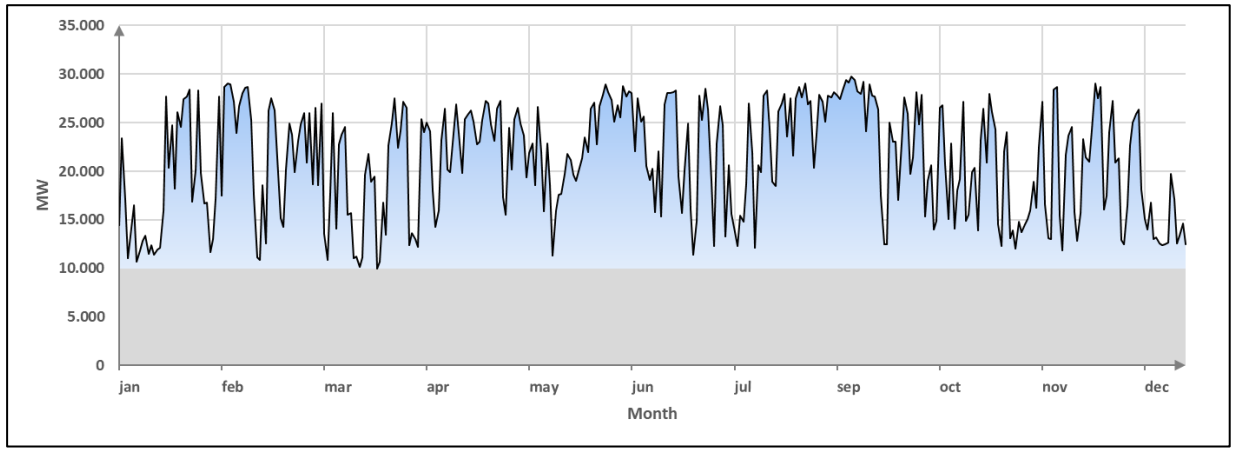
Flexibility in an energy contract

PowerPulse



Hedging strategy: profile load vs baseload





Profile load hedging

- Hedging a percentage of the cost price on forward:
  CAL-basis (standard – option Q and M)
- Up to 100% price fixation possible (0% - 100% of the cost) for the expected consumption volume (set in contract).
- Different peak and off-peak price formula
  multiplier and add-on costs
- Spot indexation possibility: monthly average spot
- **Volume tolerance** or **bandwidth** applicable
  full flex in the past, actual **severe restrictions** (post energy crisis)
- **Expensive price formula** as the main risk is on the supplier side

Baseload hedging

- Hedging a fixed capacity (24/7 flat block) on forward
  CAL-basis (standard – option Q and M)
- No possibility to hedge 100% of the cost.
- Hedging against predefined consumption volume
- Spot indexation is standard (hourly – weighted average spot price)
- No volume tolerance or bandwidth applicable (Take-or-Trade).
- **Cheaper price formula** as the main risk is on the consumer side
- Future proof strategy
  optimization on-site flexibility (EV, heat pump, batteries,…)

Baseload - spot prices vs hedging strategy on forward

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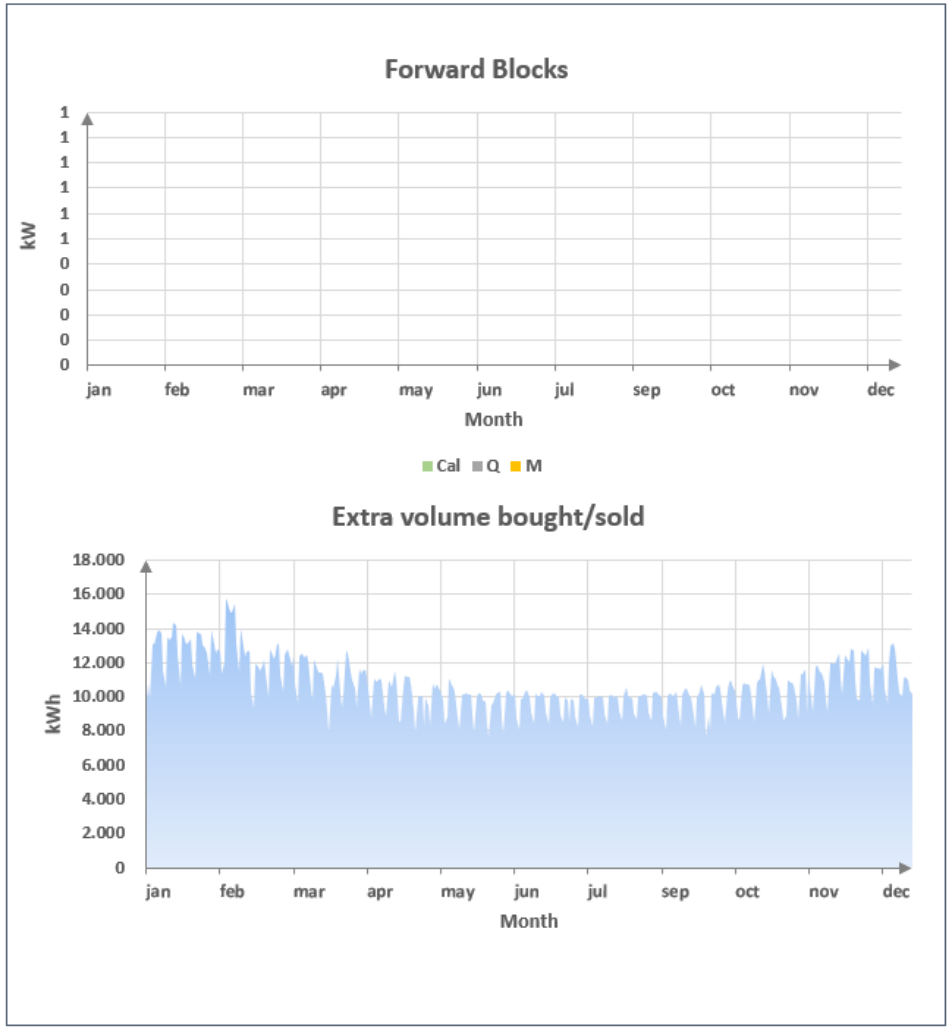
Electricity consumption profile: **aggregated consumption profile**

spot market strategy



MW hedging strategy

Conclusion

PowerPulse

Flexibility opportunities

1. Peak shaving
2. Day ahead optimization
3. Self-consumption of renewable energy
4. Reserve markets
5. Imbalance markets
6. CRM

Flexibility examples

1. Batteries
   - Every business case is different
   - Value stacking is the most profitable
2. Combination of flexibility assets
   - Optimising both heat and electricity
   - Energy management system
3. Energy contracts
   - Hedging vs. spot and profile vs. baseload
   - Assembling of blocks to fit profile