

ADVANCED ENERGY STORAGE CONFERENCE

2024

PART 3

**TAASTRUP
NOVEMBER 28, 2024**



**DANISH
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The most isolated island in Northern Europe, Anholt. We want partial self-sufficiency in electricity

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DANISH TECHNOLOGICAL INSTITUTE

ADVANCED ENERGY STORAGE CONFERENCE 2024



Energy management for a flexible market

Philip Holgersson, Aire Energy

Aire

Energy Management in a **Flexible Market**

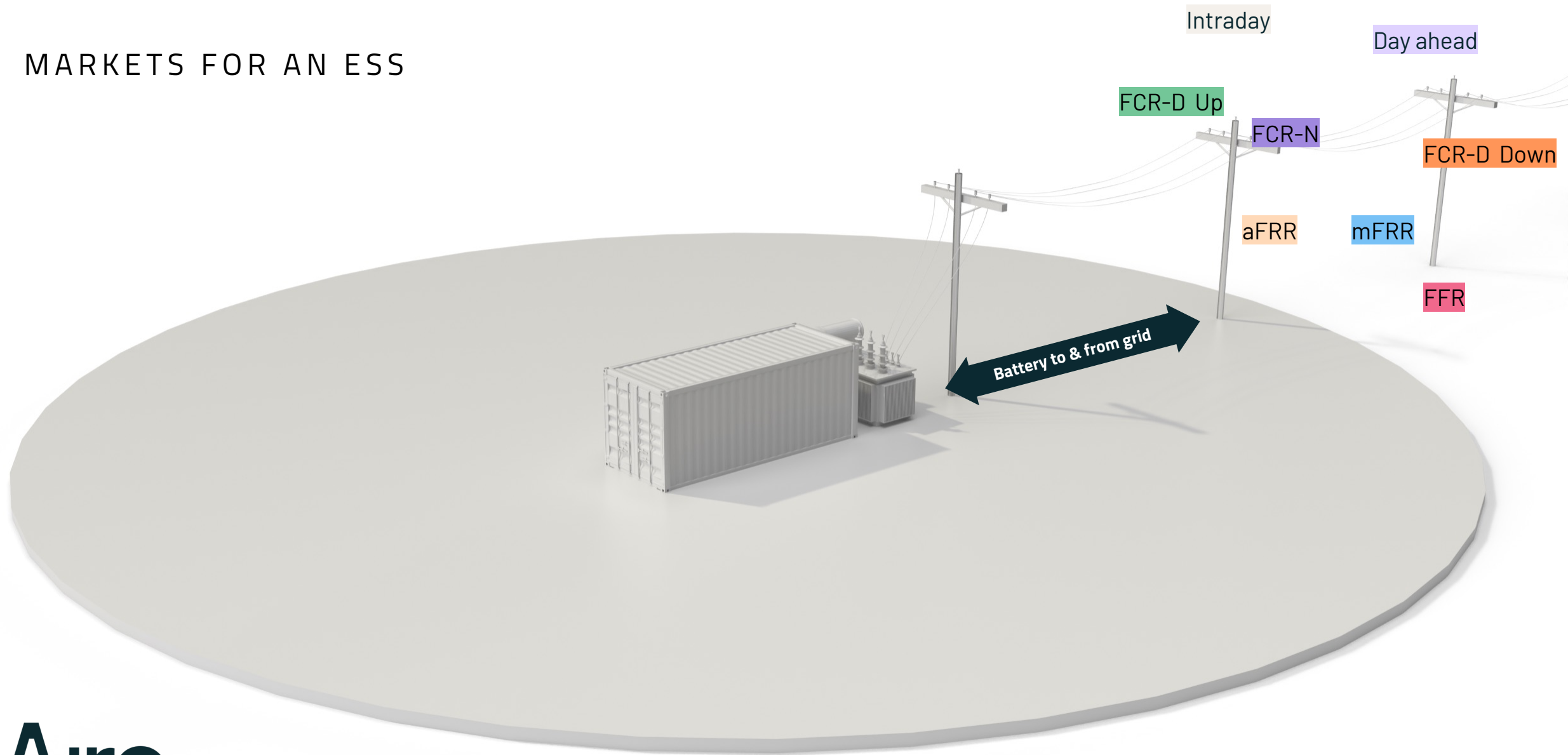
Philip Holgersson
CTO Aire Energy

Aire

Aire is a Swedish company founded in 2022 with the mission to enable flexibility for a sustainable future. We focus on B2B clients, working with resources of at least 100 kW.



MARKETS FOR AN ESS



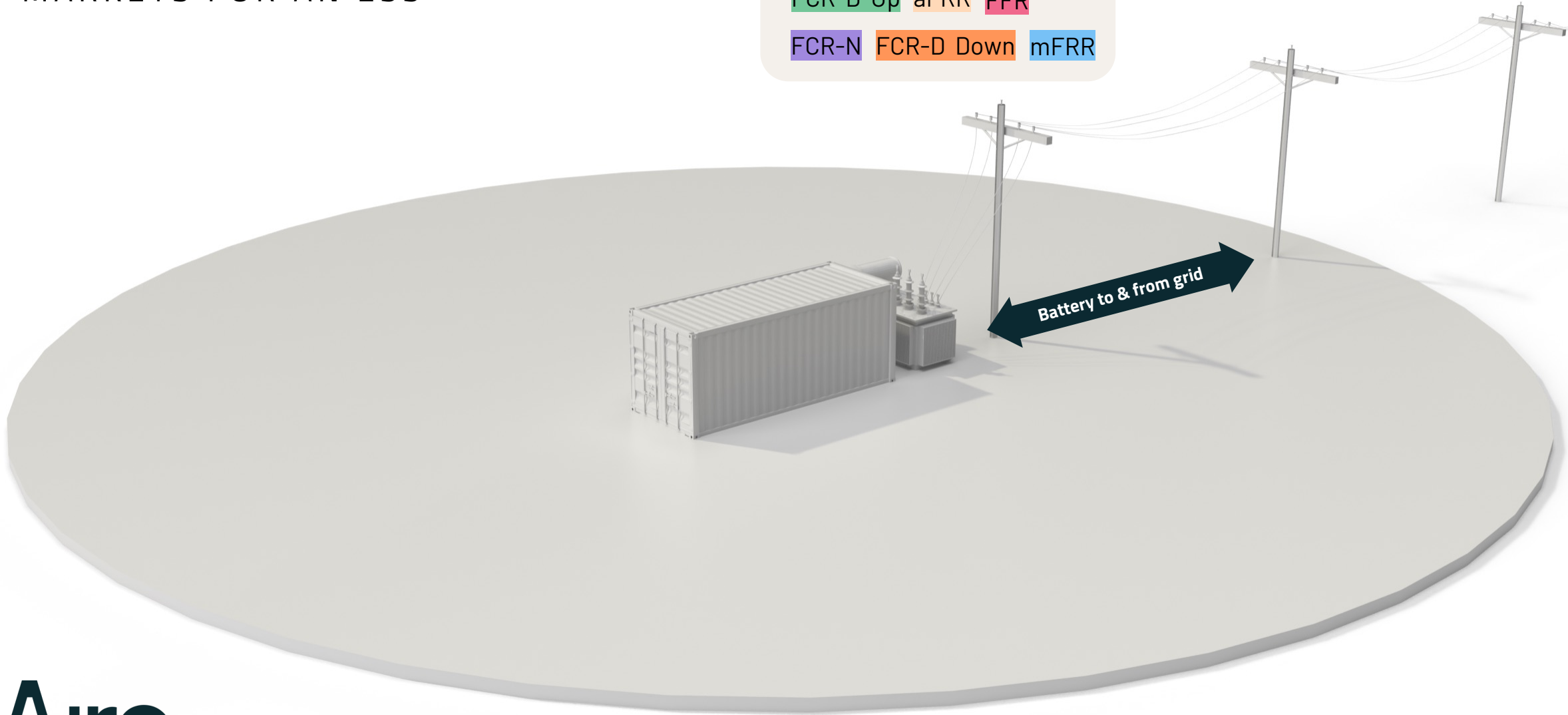
MARKETS FOR AN ESS

ANCILLARY SERVICES

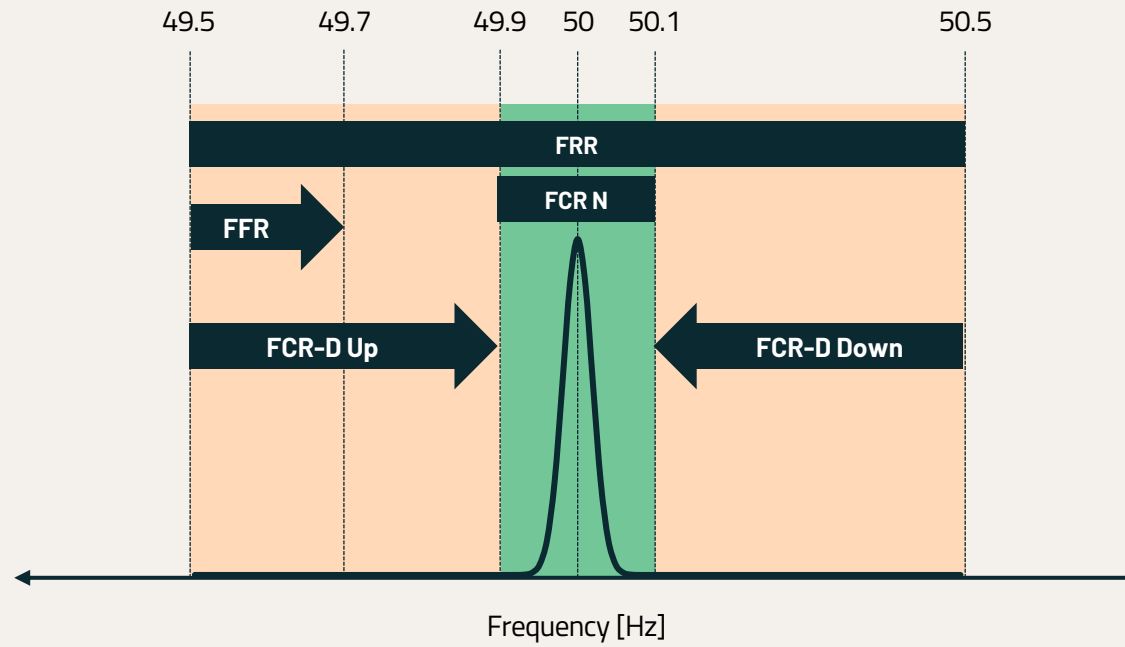
FCR-D Up	aFRR	FFR
FCR-N	FCR-D Down	mFRR

Intraday

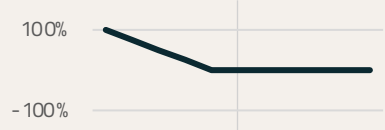

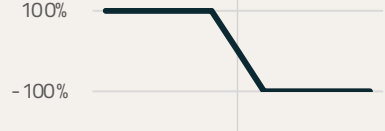

Day ahead



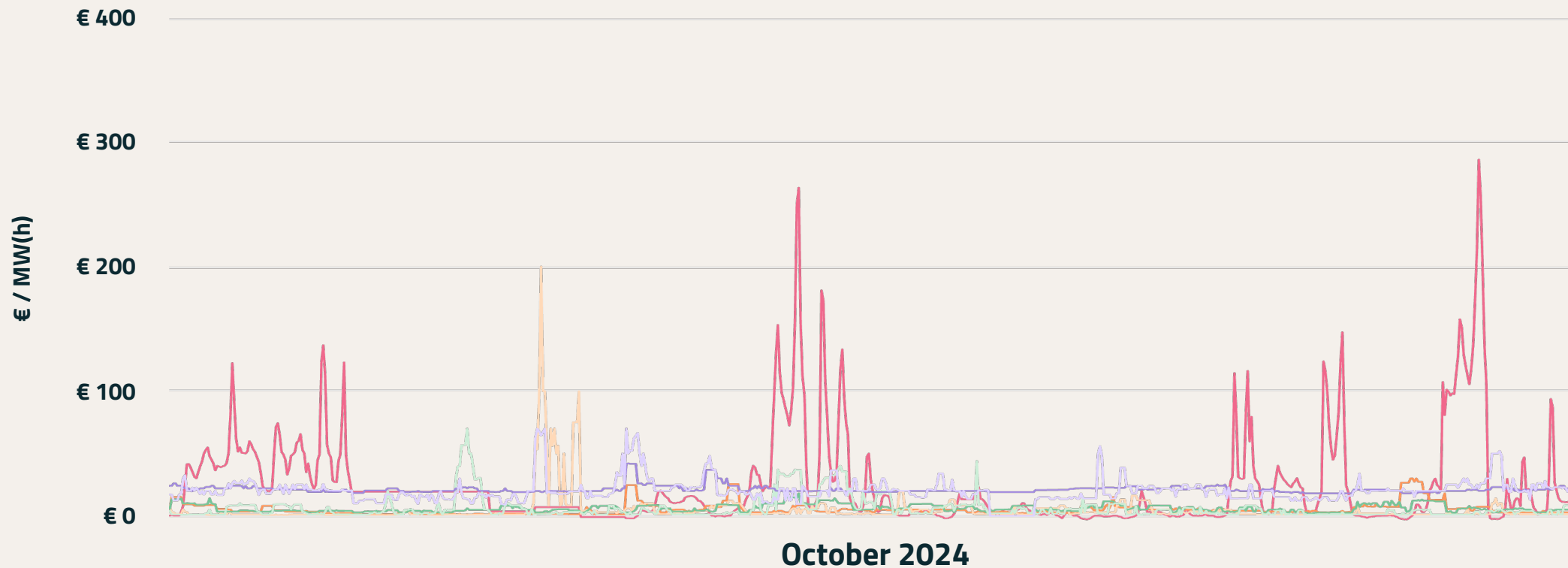
ANCILLARY SERVICES → MAINTAIN 50 Hz



ANCILLARY SERVICES

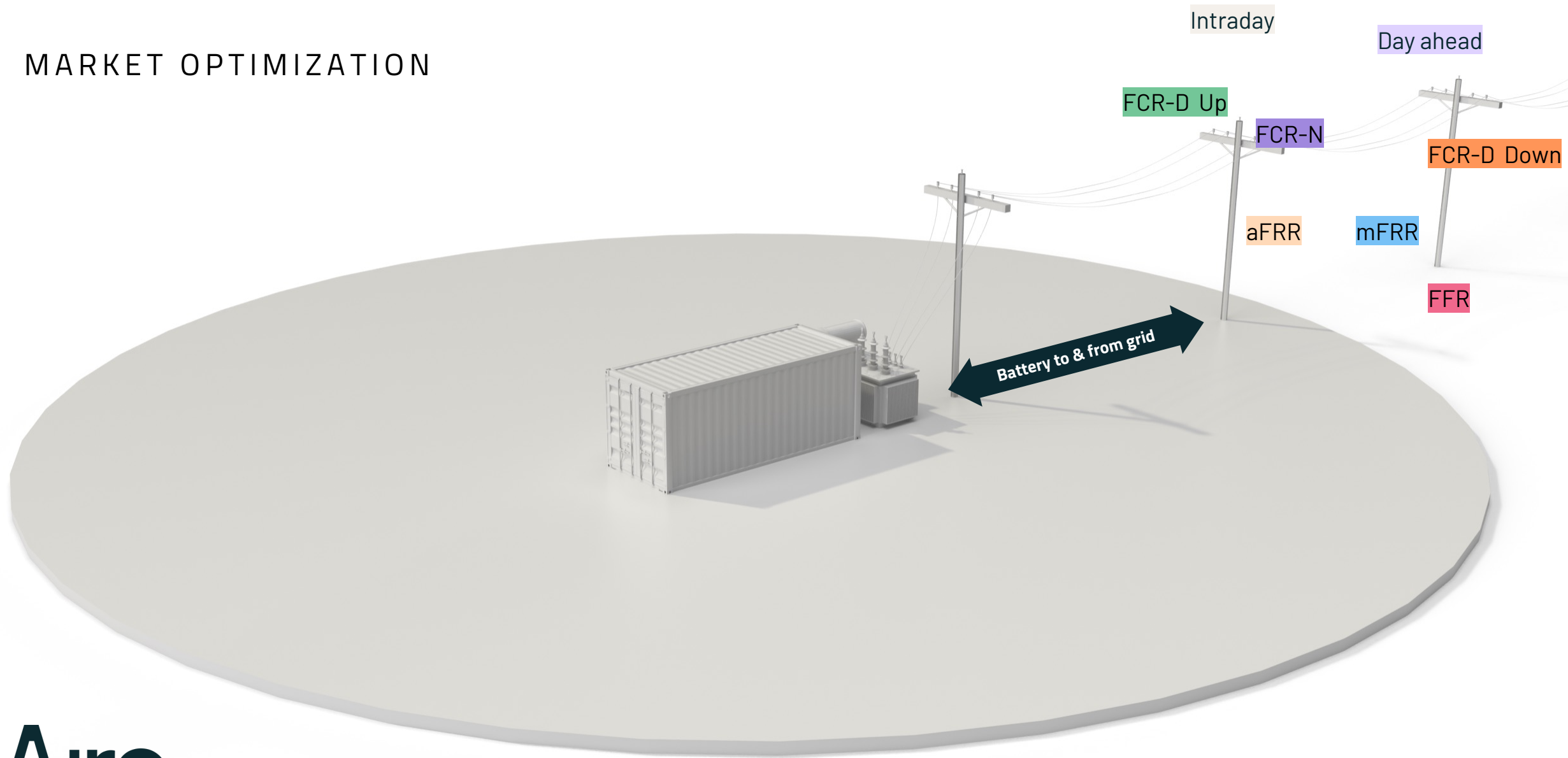
	Activation profile	Endurance	Response Time	Average activation
FCR-D Up		20 min	Seconds	0,05%
FCR-D Down		20 min	Seconds	0,05%
FCR-N		60 min	Seconds	15%
FFR		5-30s	<1 Second	<0,05%
aFRR	Activation signal from TSO	60 min	Minutes	
mFRR	On demand from TSO	60 min	Minutes	

MARKET DYNAMICS

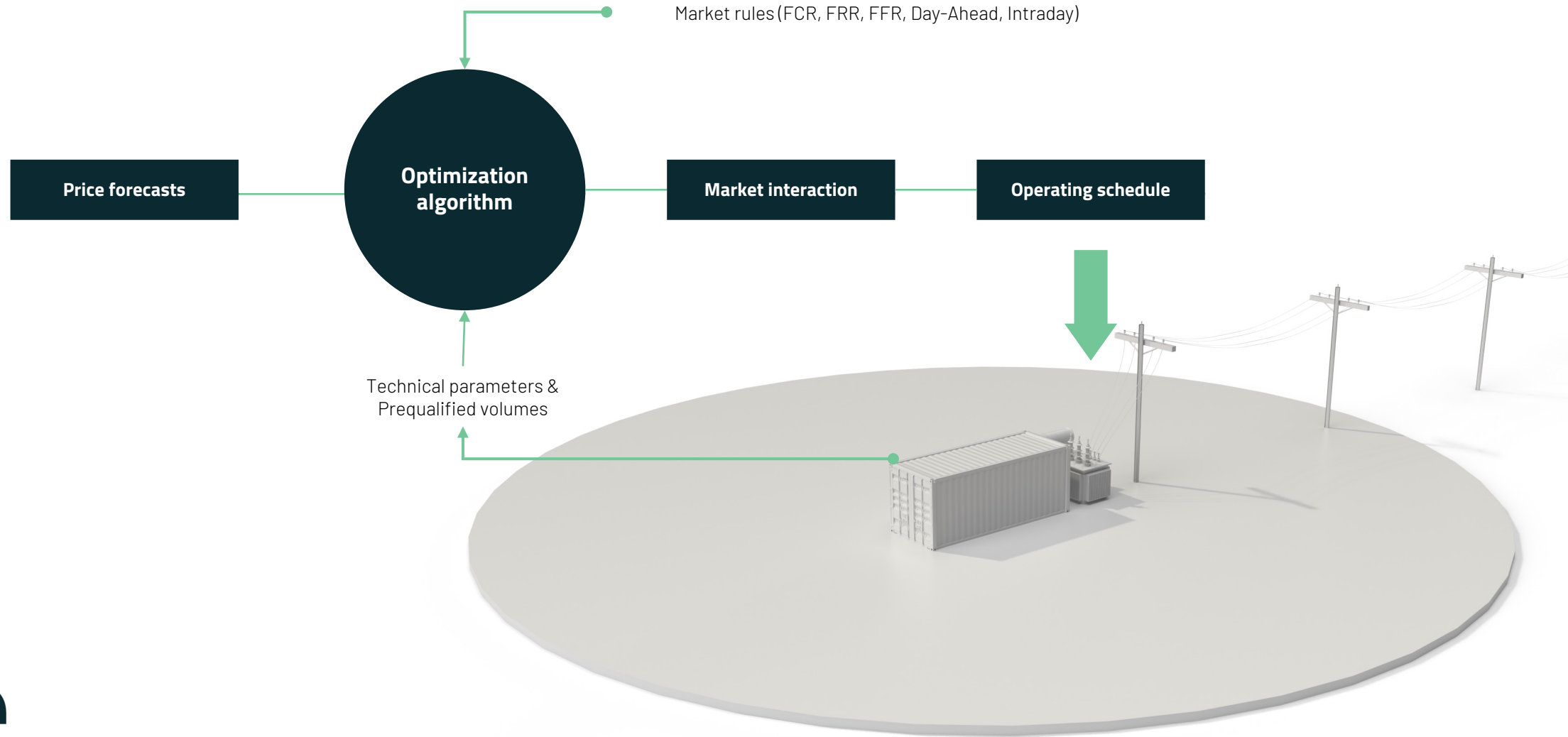


FCR-D Up U1 FCR-D Up U2 FCR-D Down U1 FCR-D Down U2 Spot Price SE4 FCR-N U2 FCR-N U1

MARKET OPTIMIZATION



MARKET OPTIMIZATION



SCHEDULING

The scheduling interface allows for **additional constraints**, which is key to achieving a high degree of utilization for complex sites.

The screenshot displays a scheduling interface with the following components:

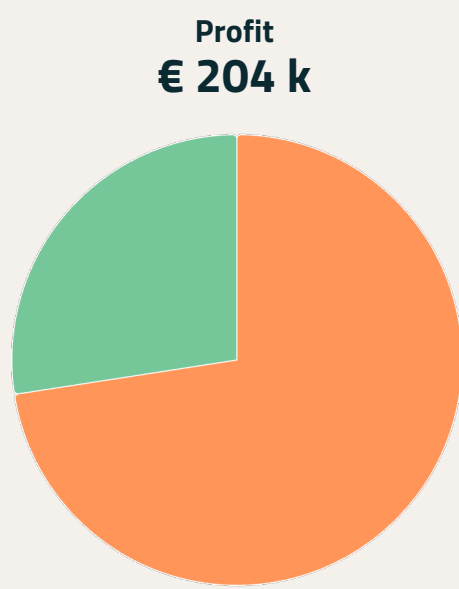
- Navigation:** Status, Schedule (active), Data, Report data, Report files, Issue Tickets.
- Date and Actions:** 2024-11-25, calendar icon, navigation arrows, Edit schedule, Sync SoC.
- Filters:** Accepted, Bid, User Defined, Repeating, and a lambda symbol.
- Time Grid:** Hours from 00:00 to 23:00.
- Constraint Rows:** Maintenance, Prequalification, Max Consumption (2000), Max Production (2000), FCR-D Down U1, FCR-D Down U2, FCR-D Up U1, FCR-D Up U2, FCR-N U1, FCR-N U2, Charge, Discharge.
- SoC Target Row:** Values ranging from 50,00 to 95,00.

Annotations with arrows point to:

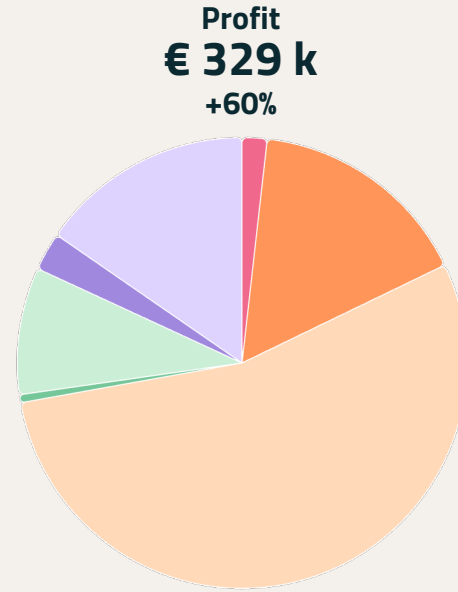
- Adding Consumption Constraints:** Points to the 'Max Consumption' row.
- Adding Discharge Constraints:** Points to the 'Discharge' row.

PERFORMANCE

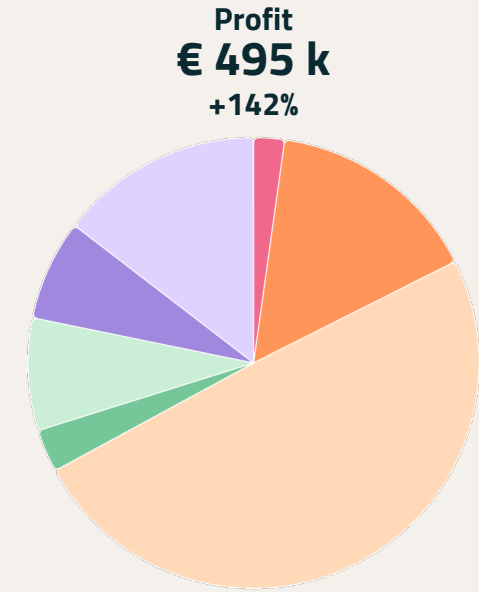
Since Feb 1st 2024 1MW 1C Battery SE4



Baseline



Aire



Maximum



FCR-D Up U1

FCR-D Up U2

FCR-D Down U1

FCR-D Down U2

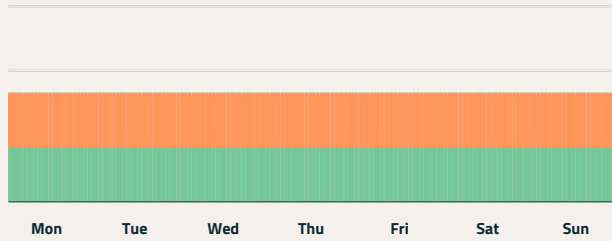
Arbitrage

FCR-N U2

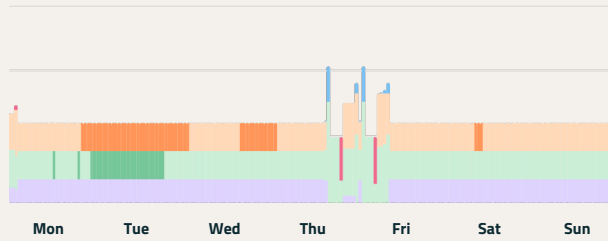
FCR-N U1

EXAMPLE SCHEDULE

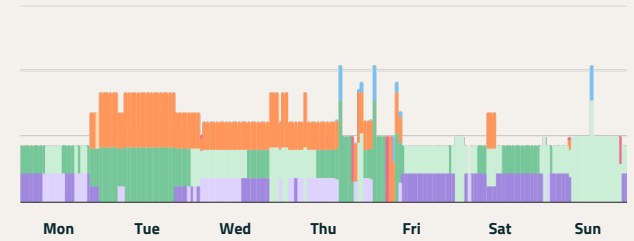
1st week October 2024 1MW 1C Battery SE4



Baseline



Aire



Maximum



FCR-D Up U1

FCR-D Up U2

FCR-D Down U1

FCR-D Down U2

Discharge

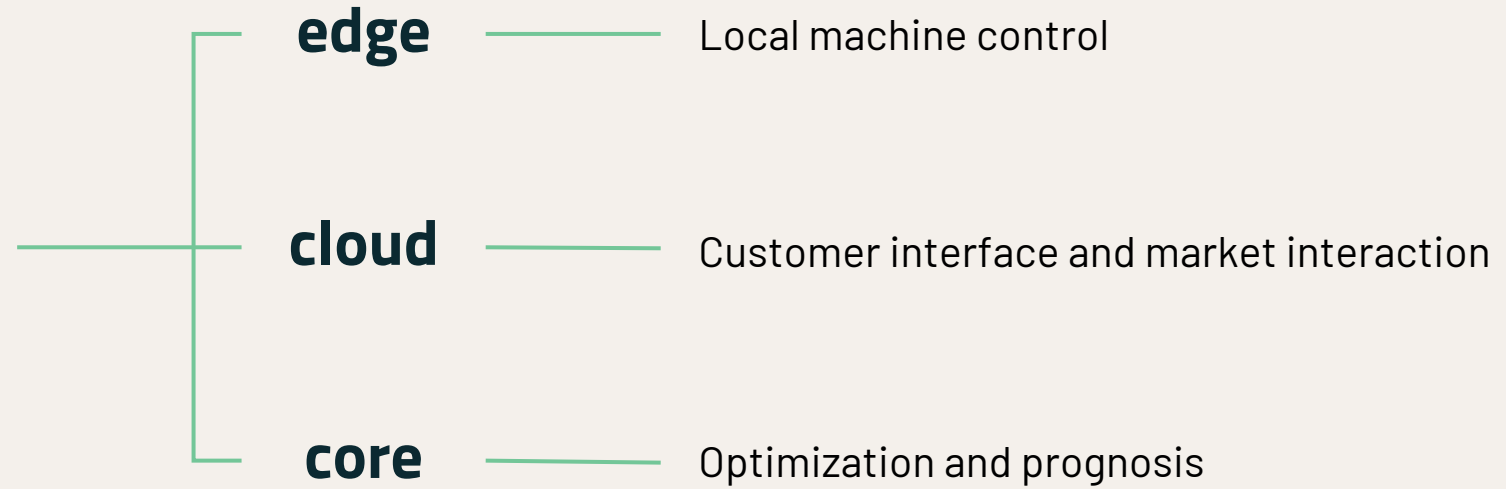
Charge

FCR-N U2

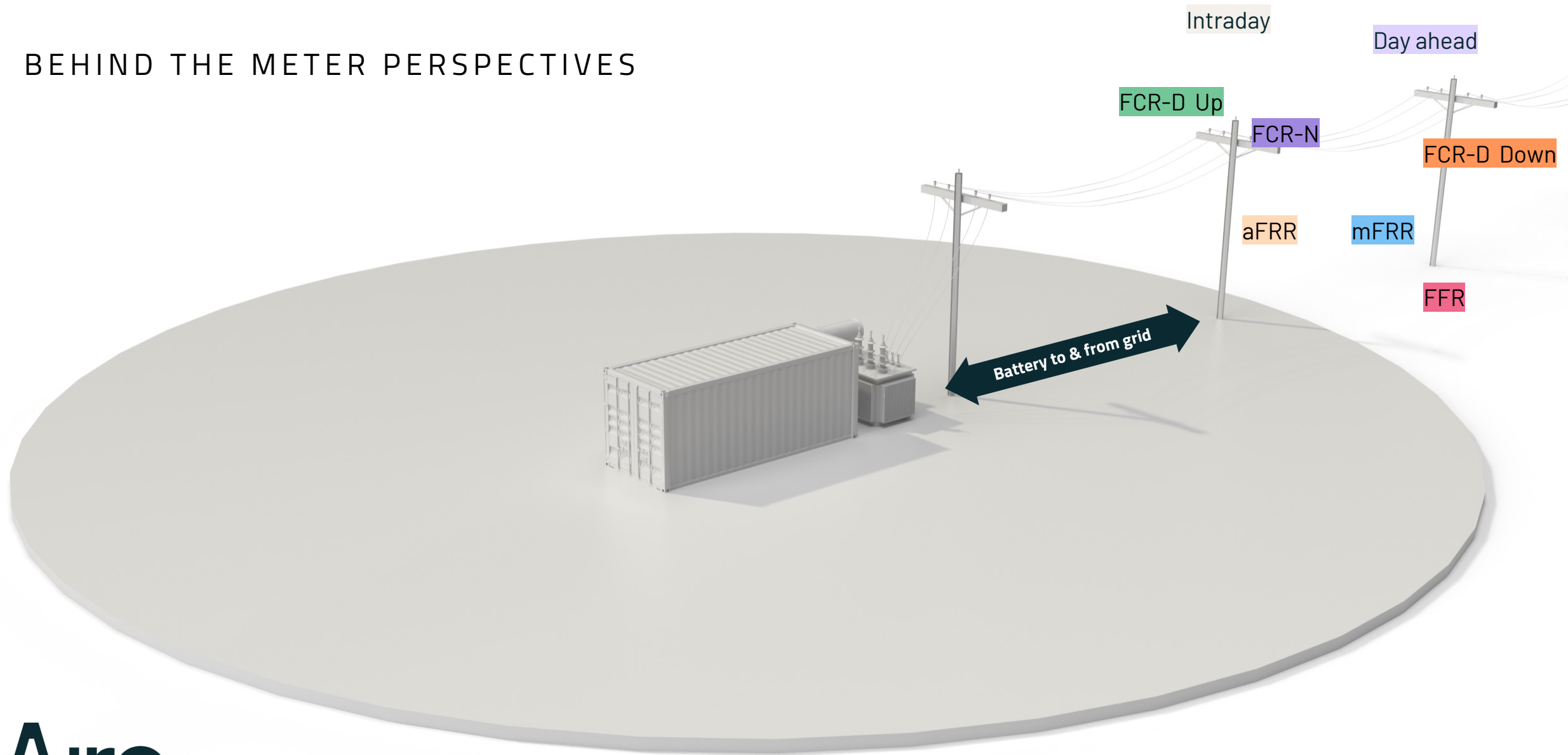
FCR-N U1

INFRASTRUCTURE

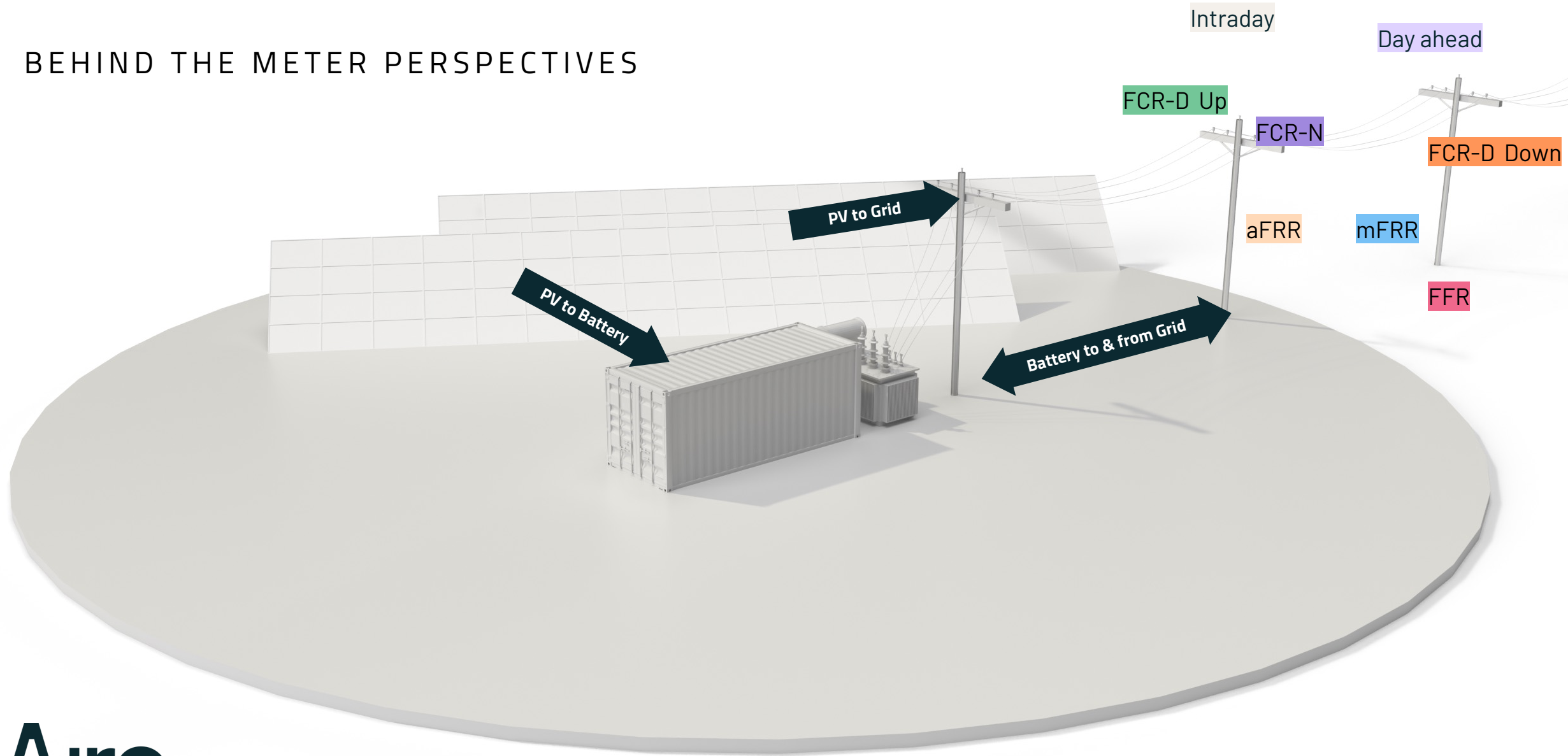
Aire



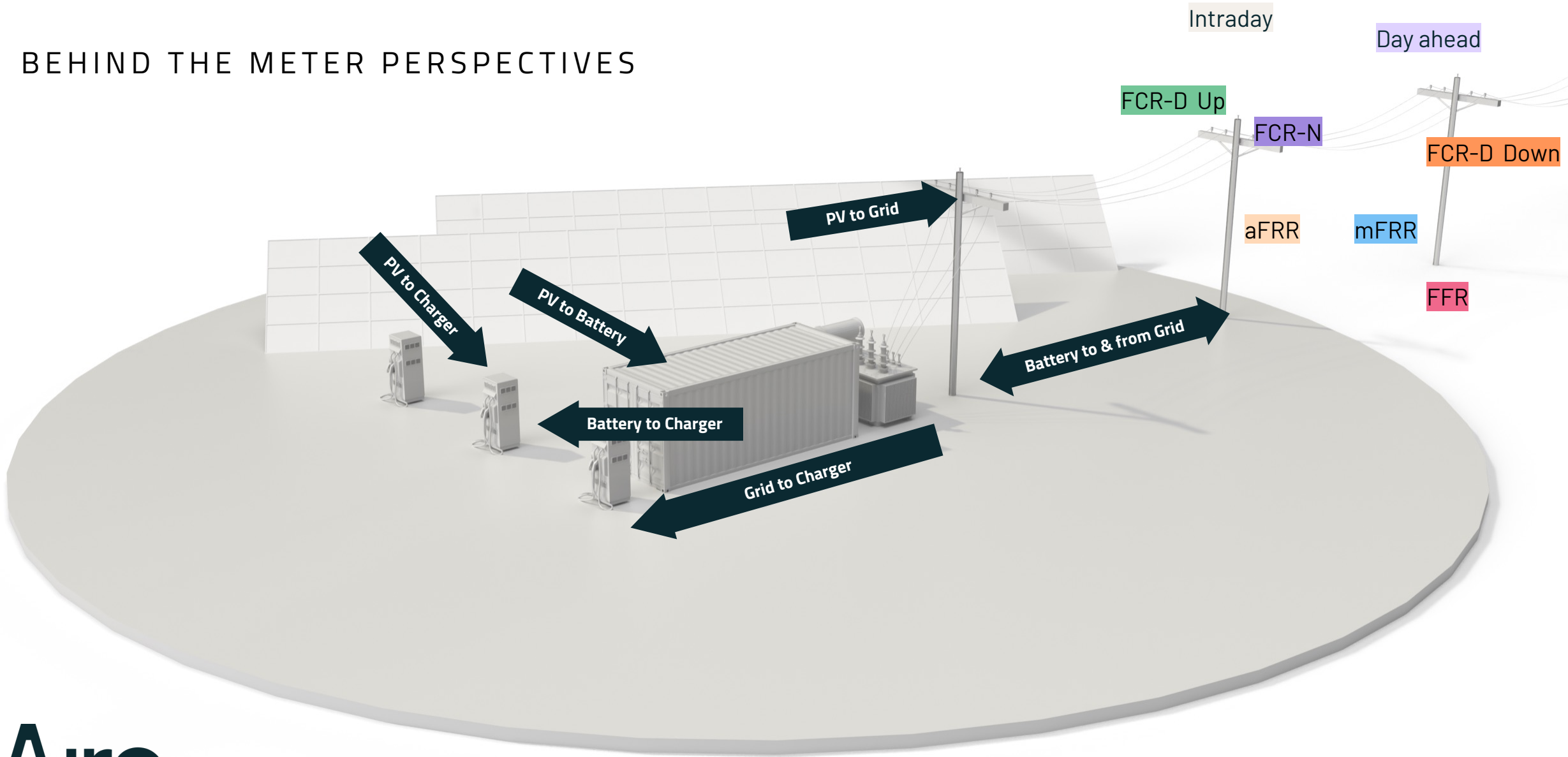
BEHIND THE METER PERSPECTIVES



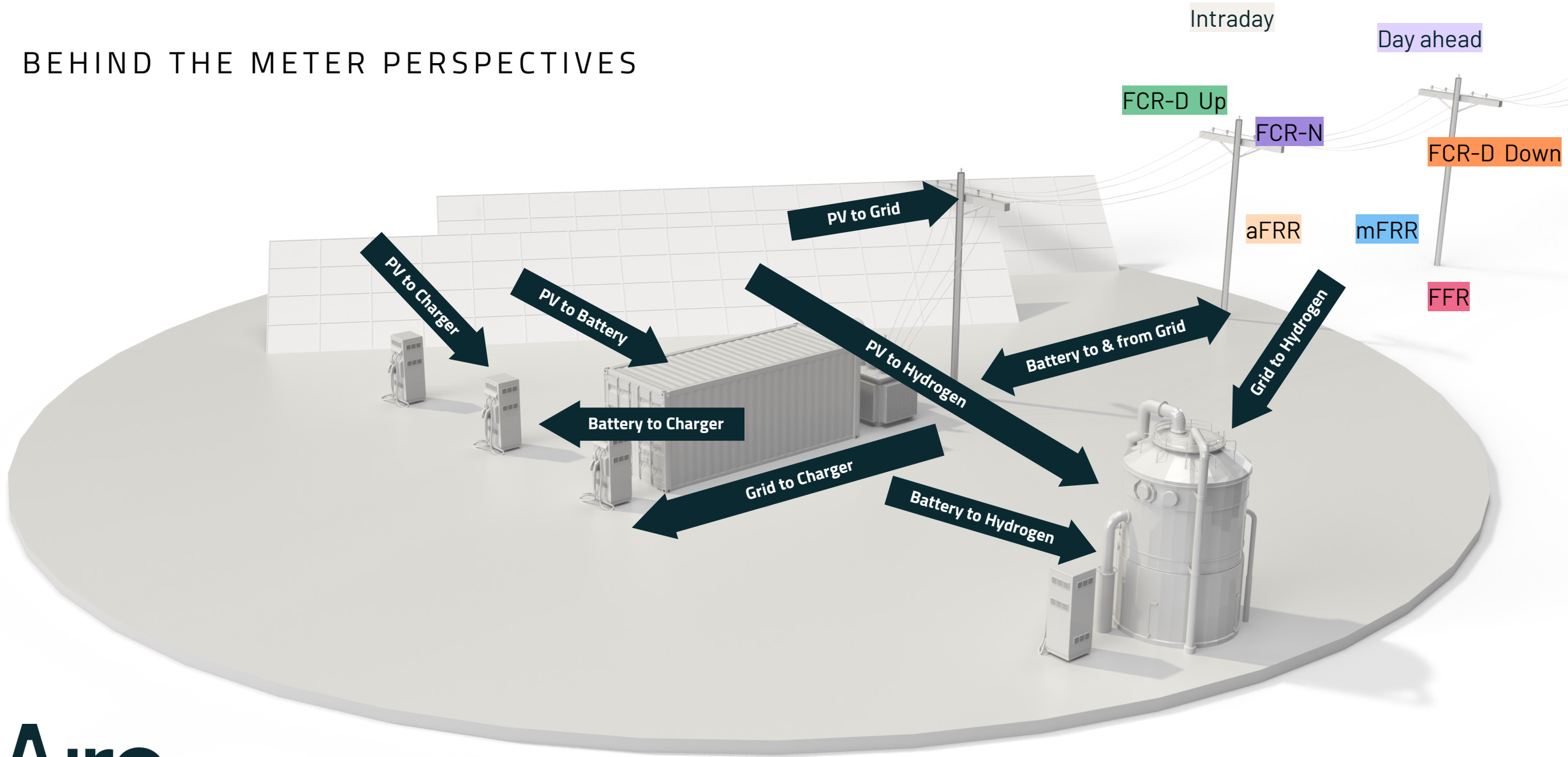
BEHIND THE METER PERSPECTIVES



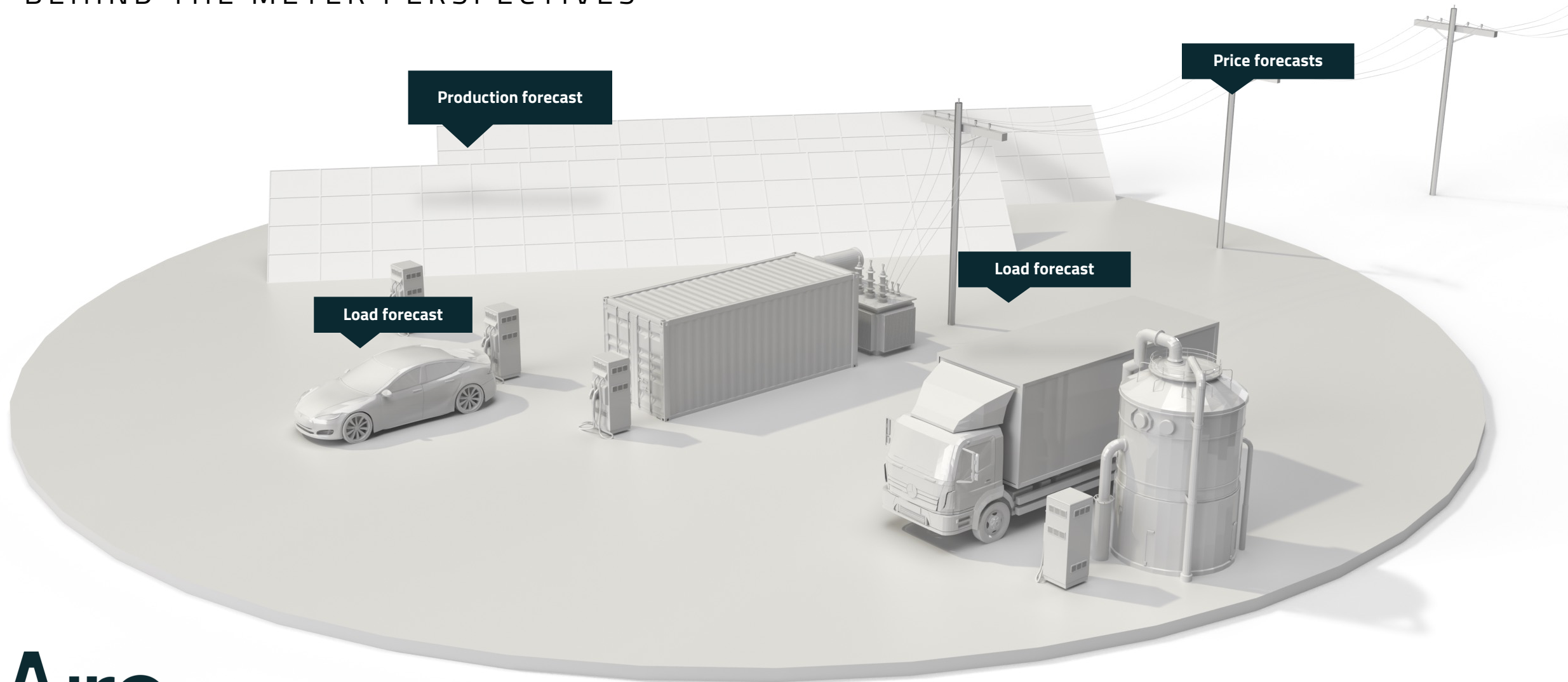
BEHIND THE METER PERSPECTIVES



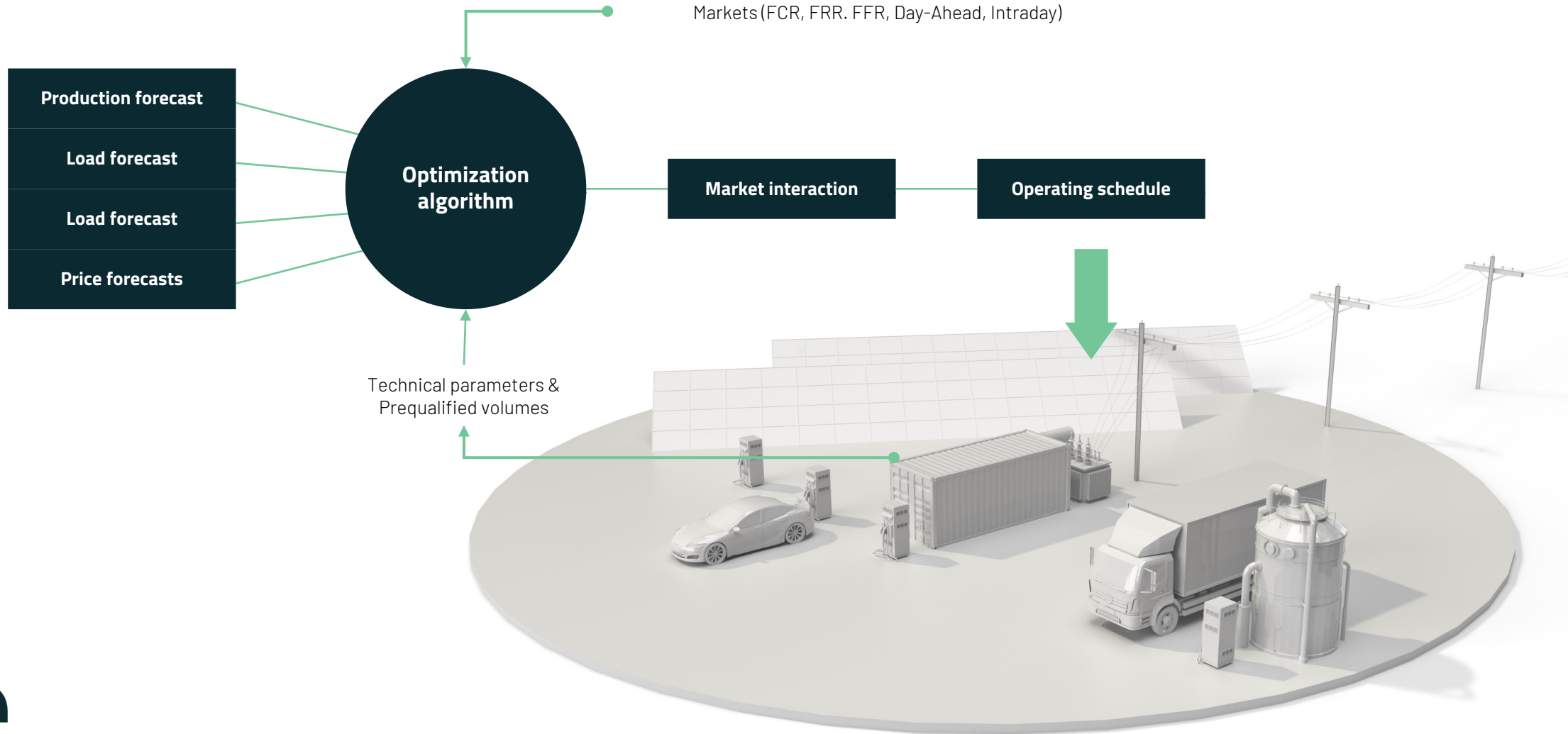
BEHIND THE METER PERSPECTIVES



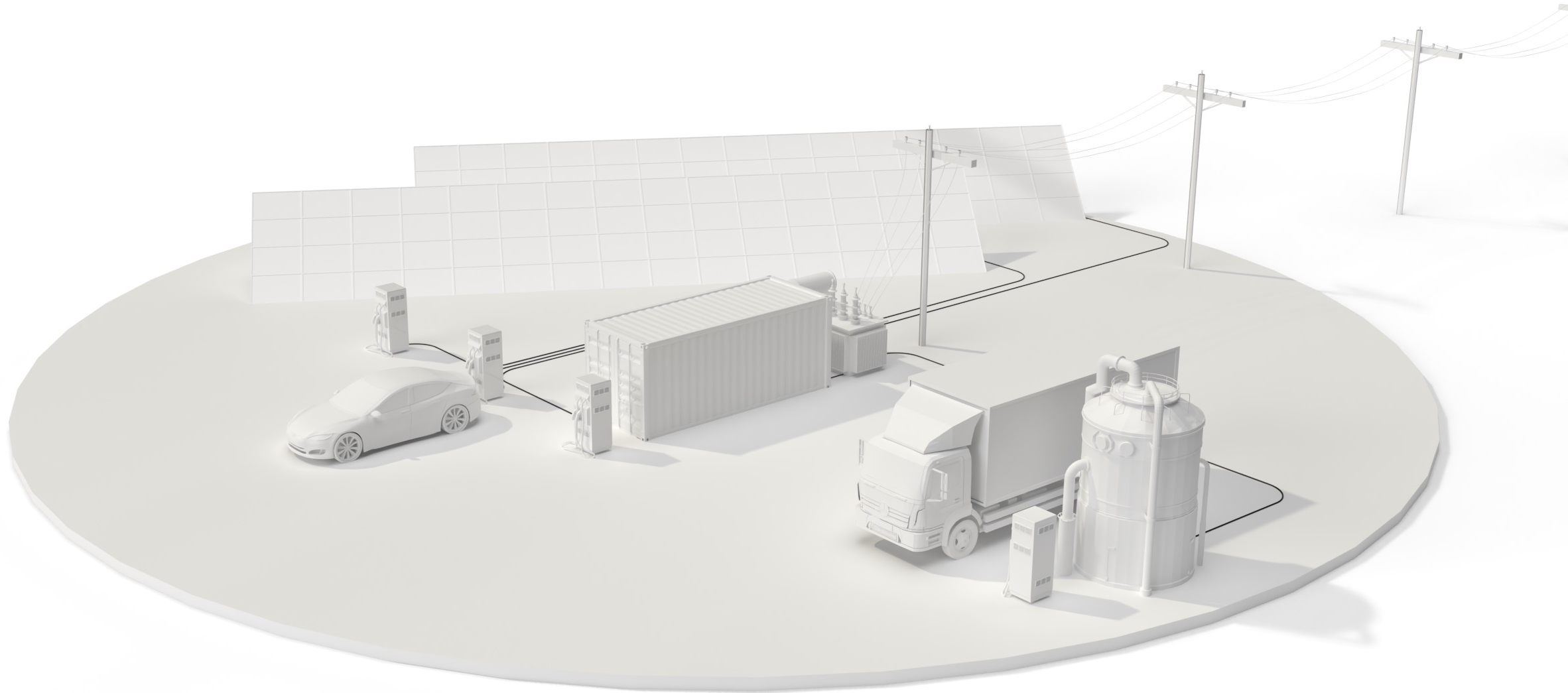
BEHIND THE METER PERSPECTIVES



BEHIND THE METER PERSPECTIVES

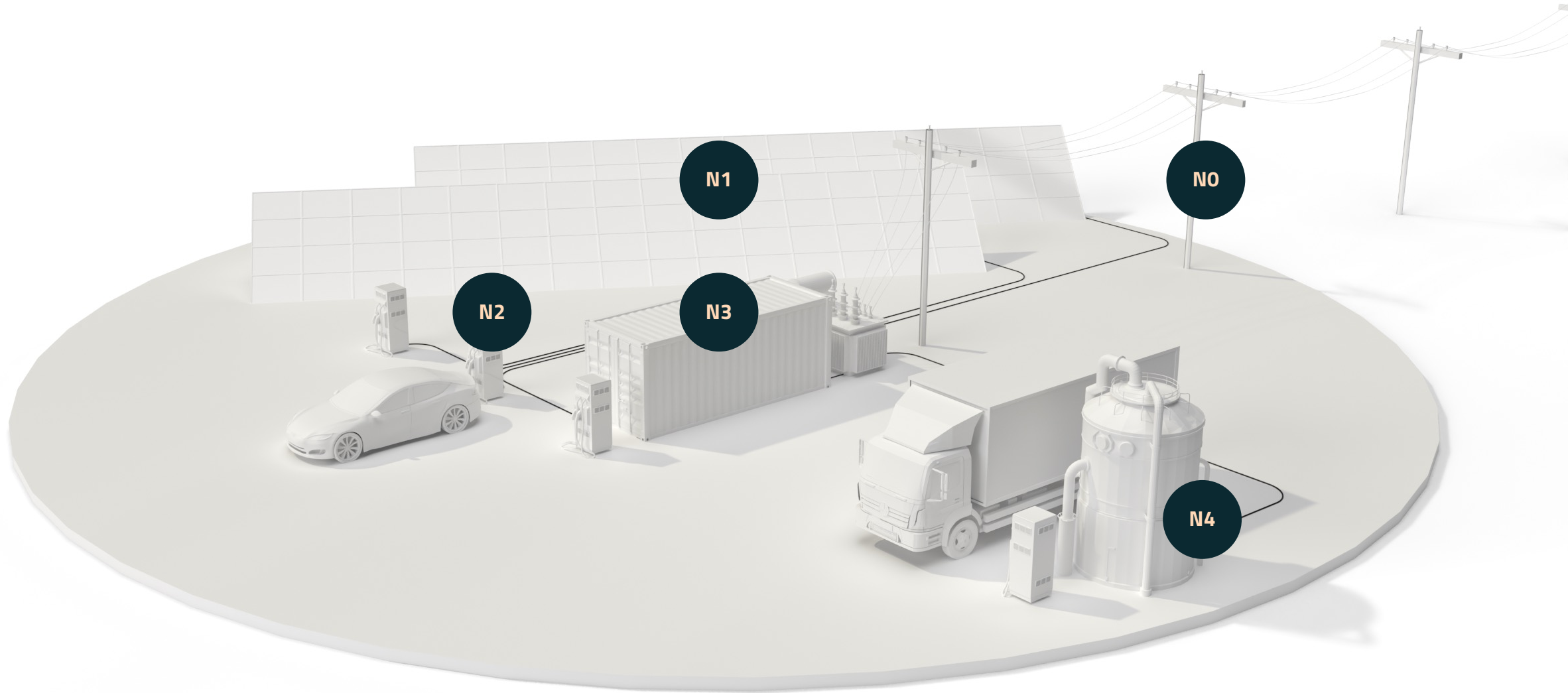


HYBRID SITES



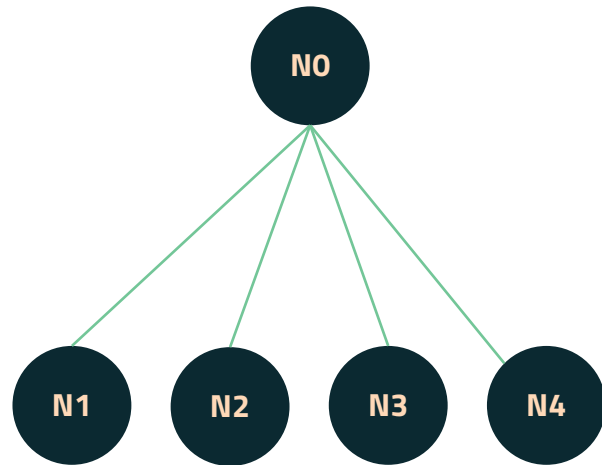
Aire

HYBRID SITES

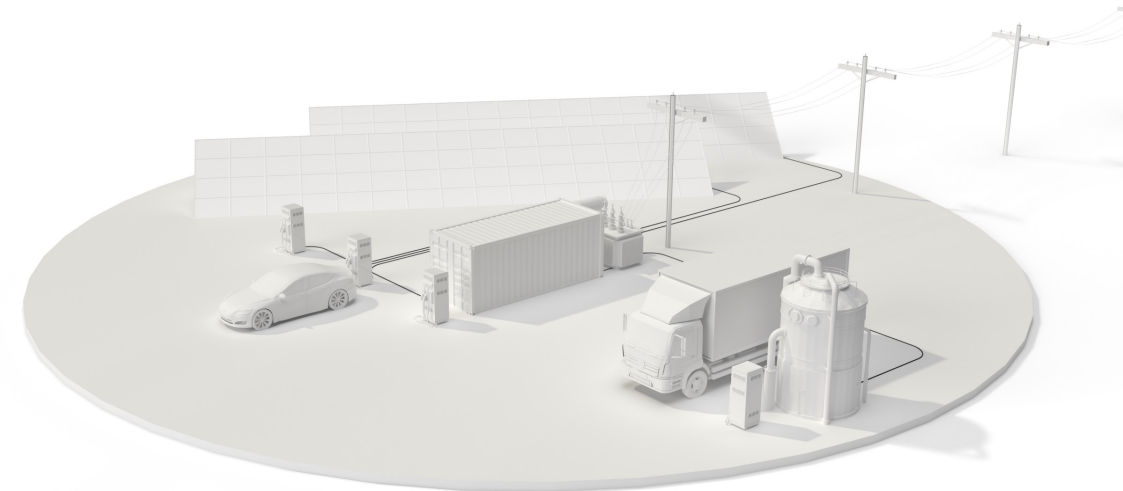
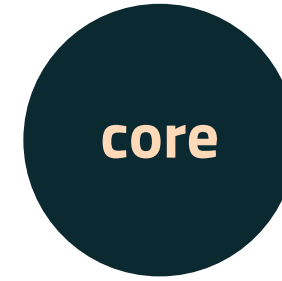


Aire

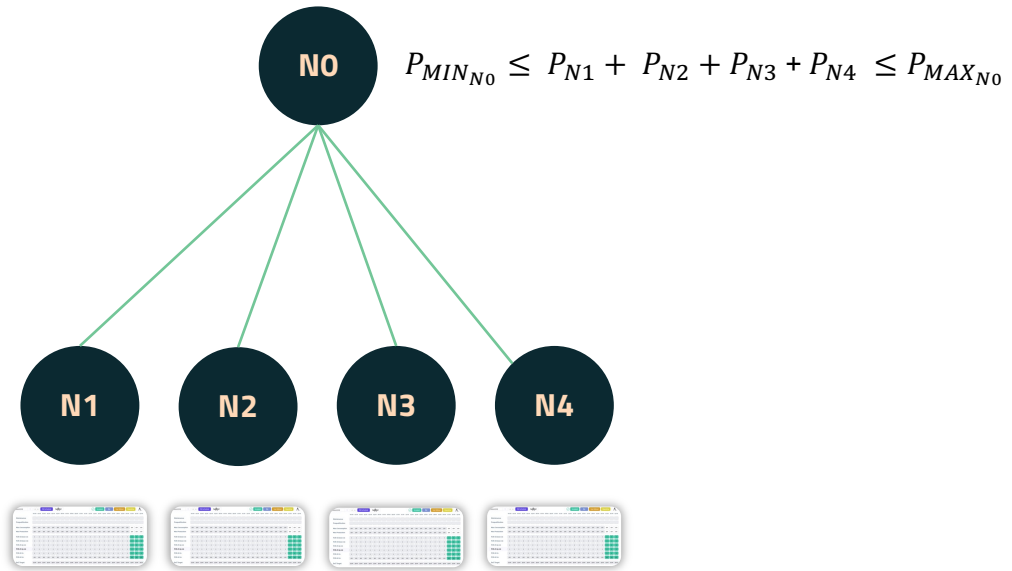
HYBRID SITES



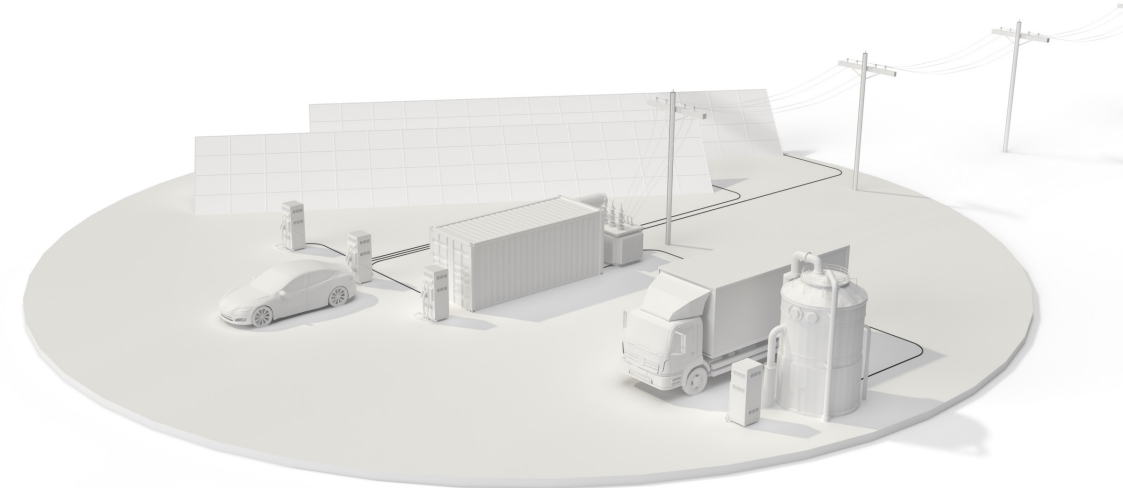
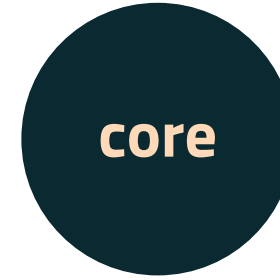
Maximize $\{Profit_{NO} = Profit_{N1} + Profit_{N2} + Profit_{N3} + Profit_{N4}\}$



HYBRID SITES



Maximize $\{Profit_{N0} = Profit_{N1} + Profit_{N2} + Profit_{N3} + Profit_{N4}\}$


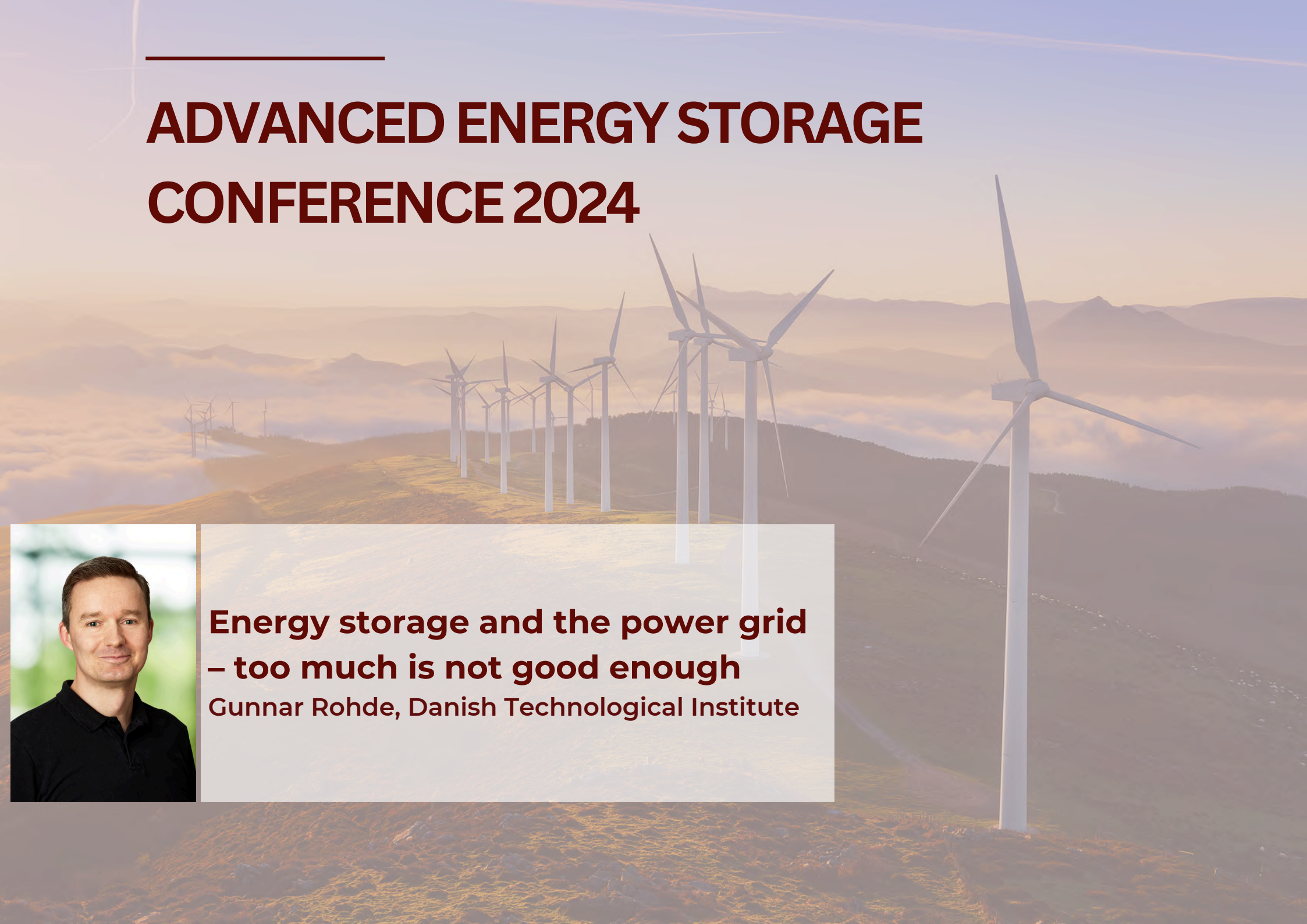


Aire

Thank you!

Questions or comments?

ADVANCED ENERGY STORAGE CONFERENCE 2024



**Energy storage and the power grid
– too much is not good enough**
Gunnar Rohde, Danish Technological Institute



TEKNOLOGISK
INSTITUT

Energy Storage and the Power Grid

Too much is not good enough

Gunnar Rohde

28. November 2024

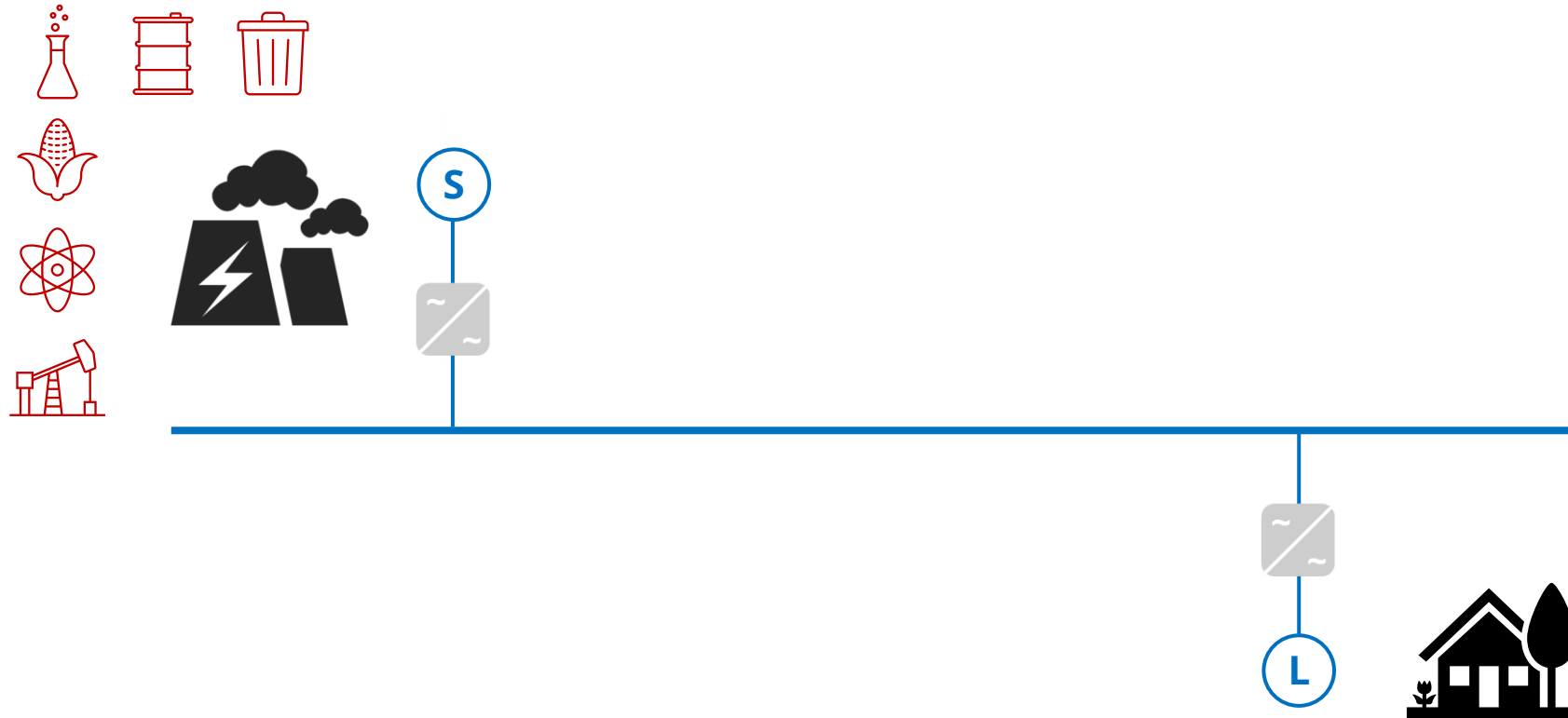
Most energy systems follow a similar architecture



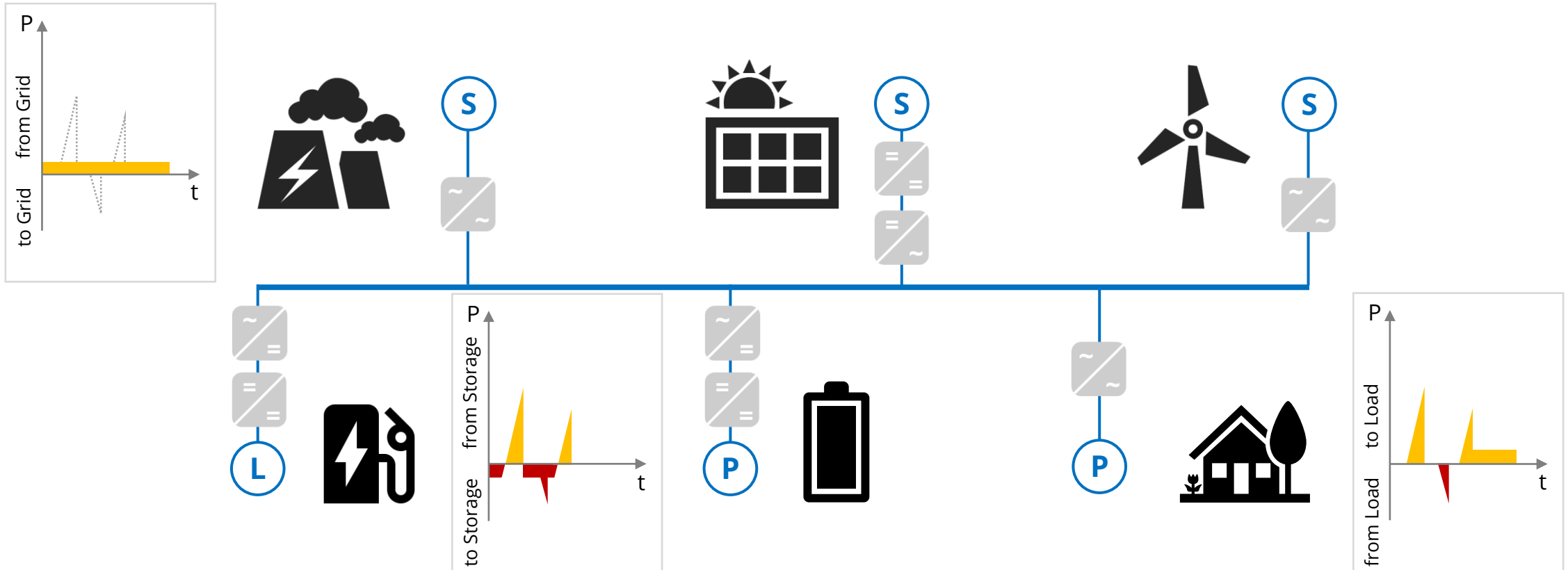
In old days, an energy system was *easy* to control



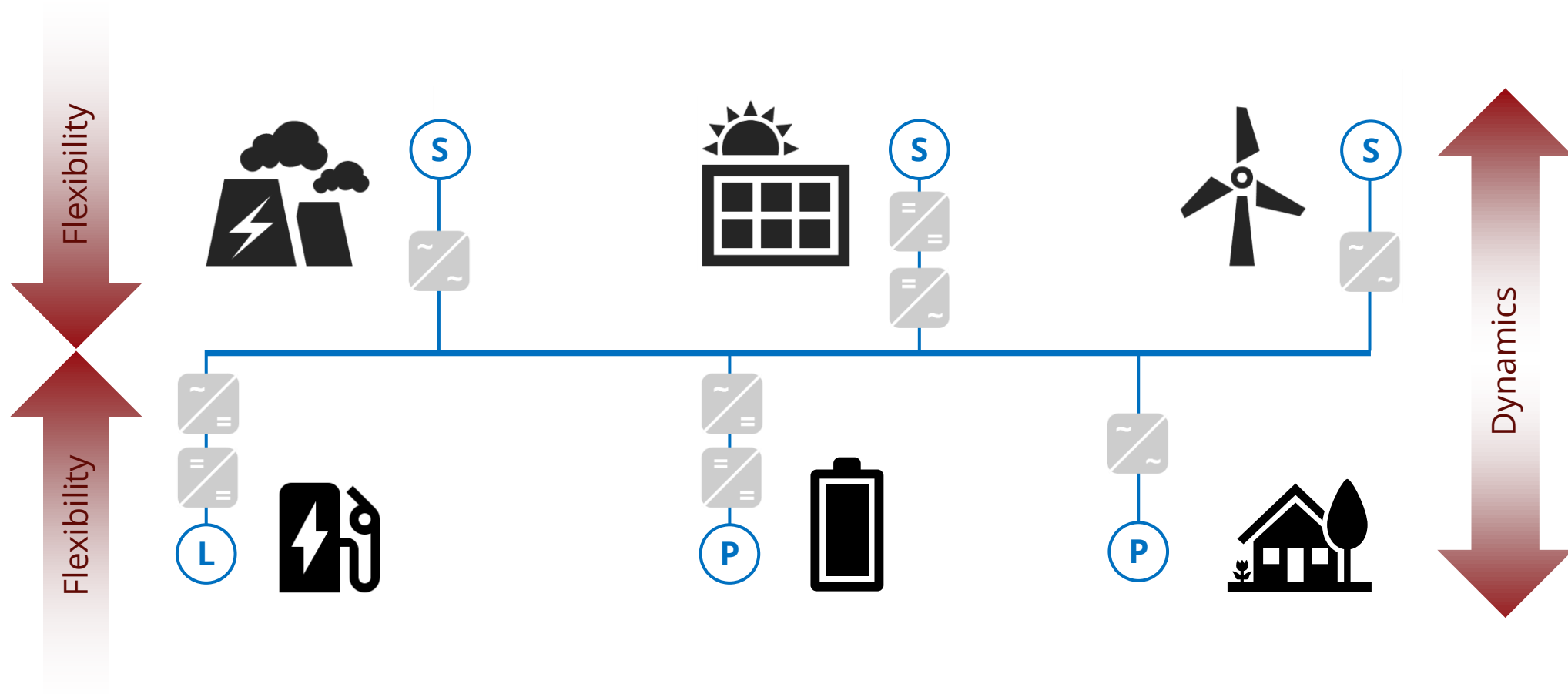
Because there is energy storage



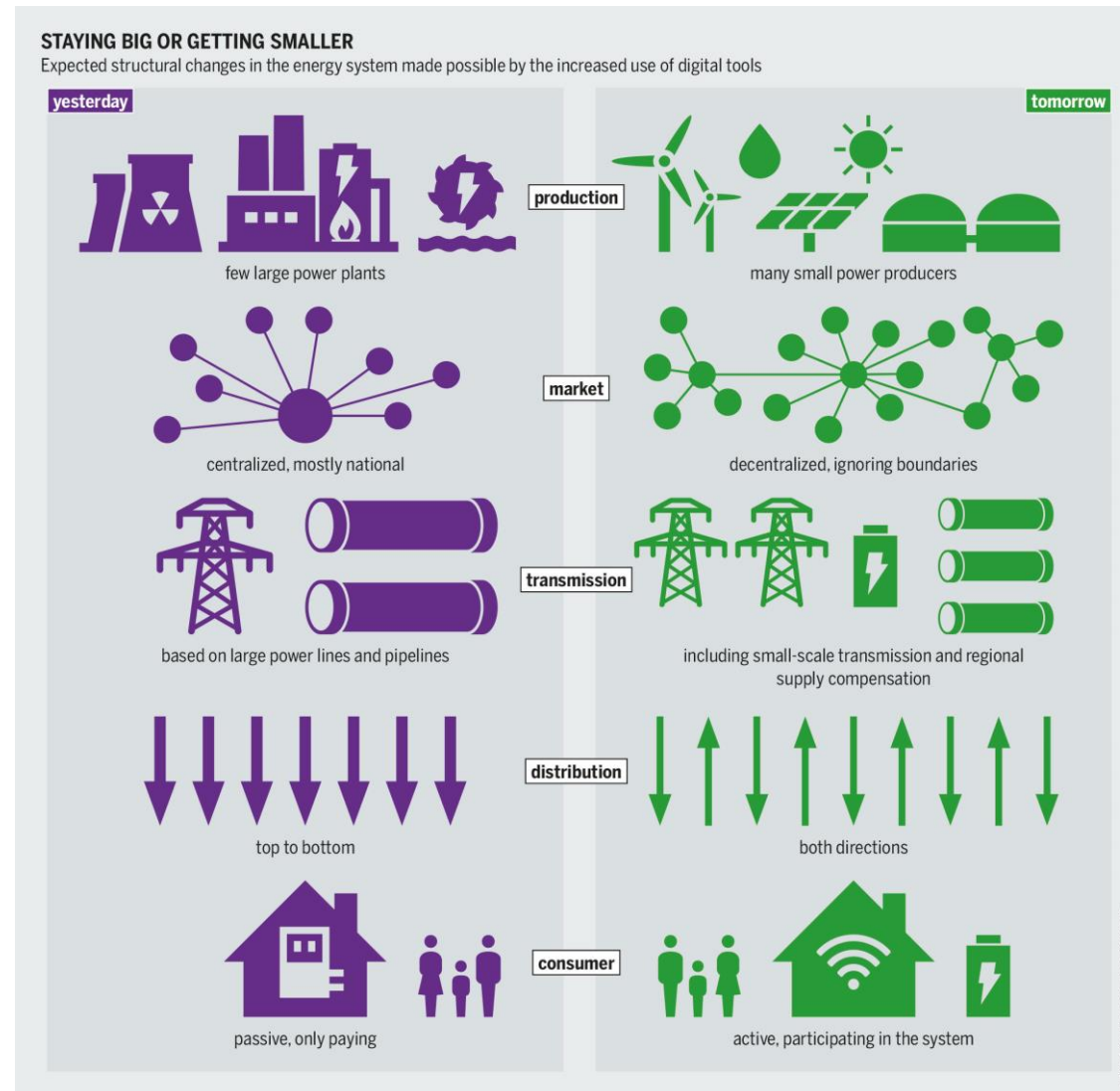
Today, energy systems are in transition



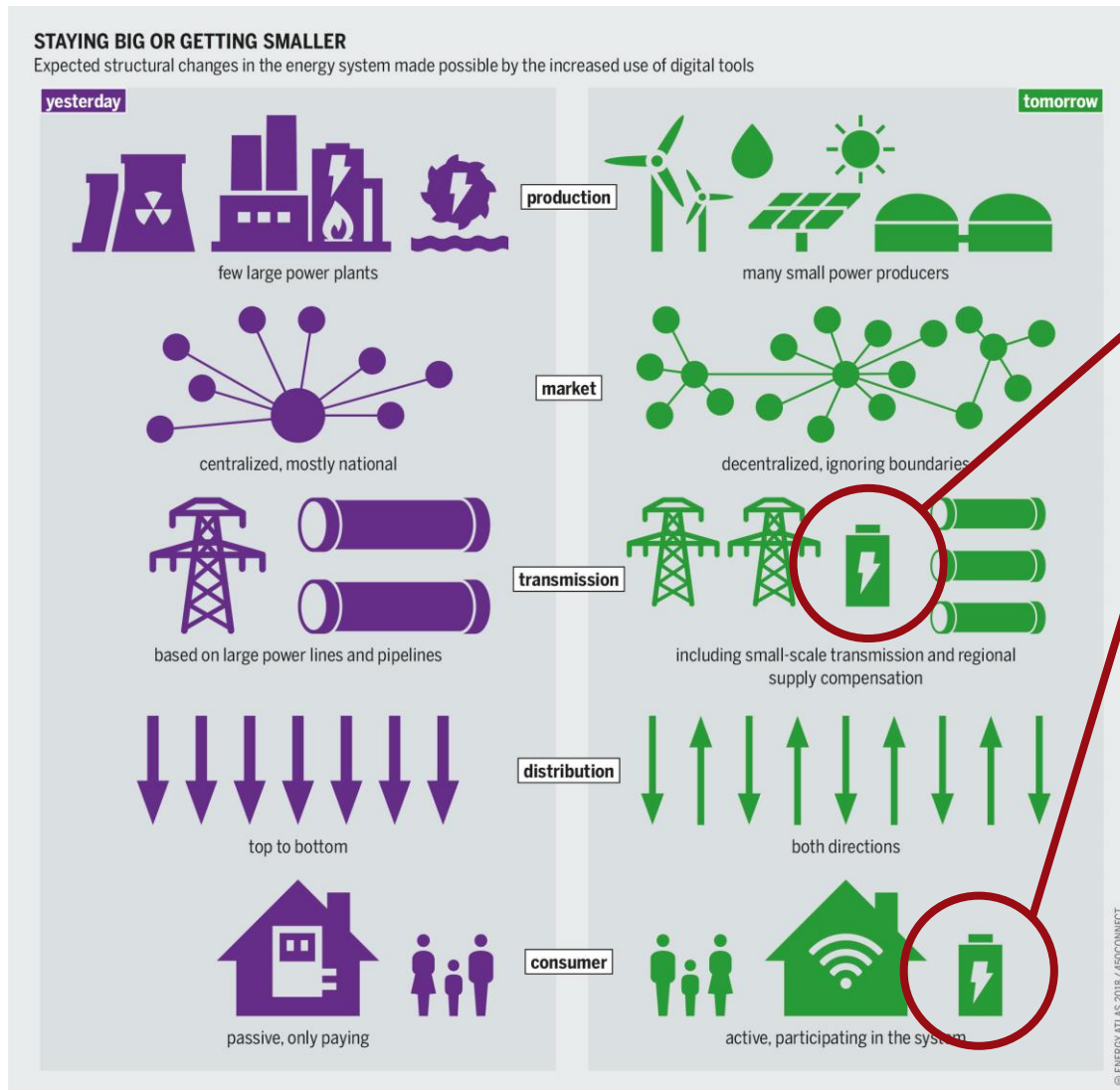
The challenge is sufficient flexibility within energy systems



Smart grids and advanced storage are the primary tools

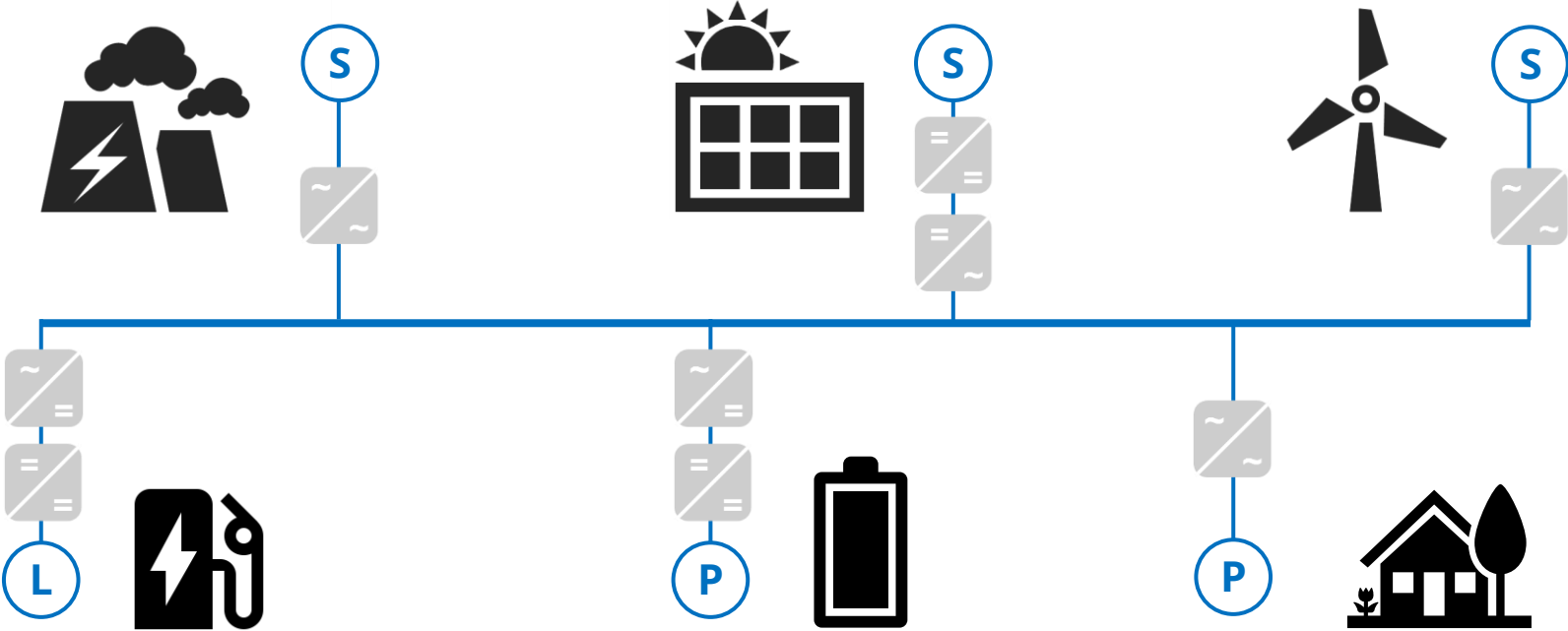


However, a shift from primary to secondary storage is needed

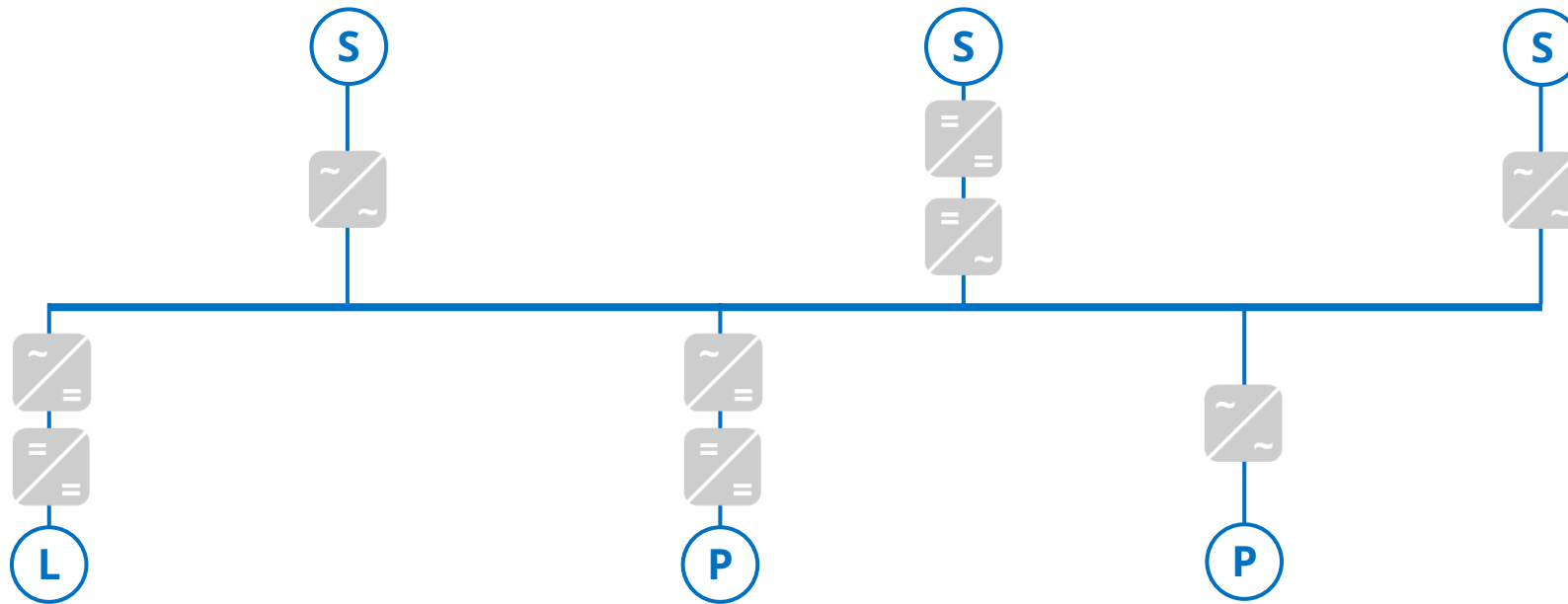


- Where to place energy storage?
- When to charge energy storage?
- When to discharge energy storage?

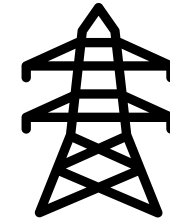
Where to start placing advanced energy storage?



We start at the points of grid connection

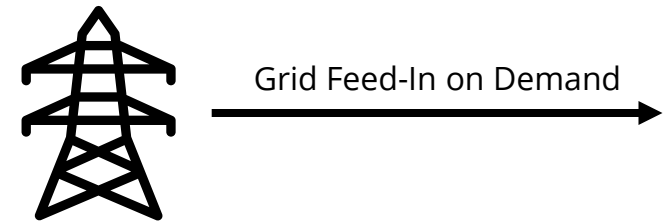


Let us consider a specific point of grid connection

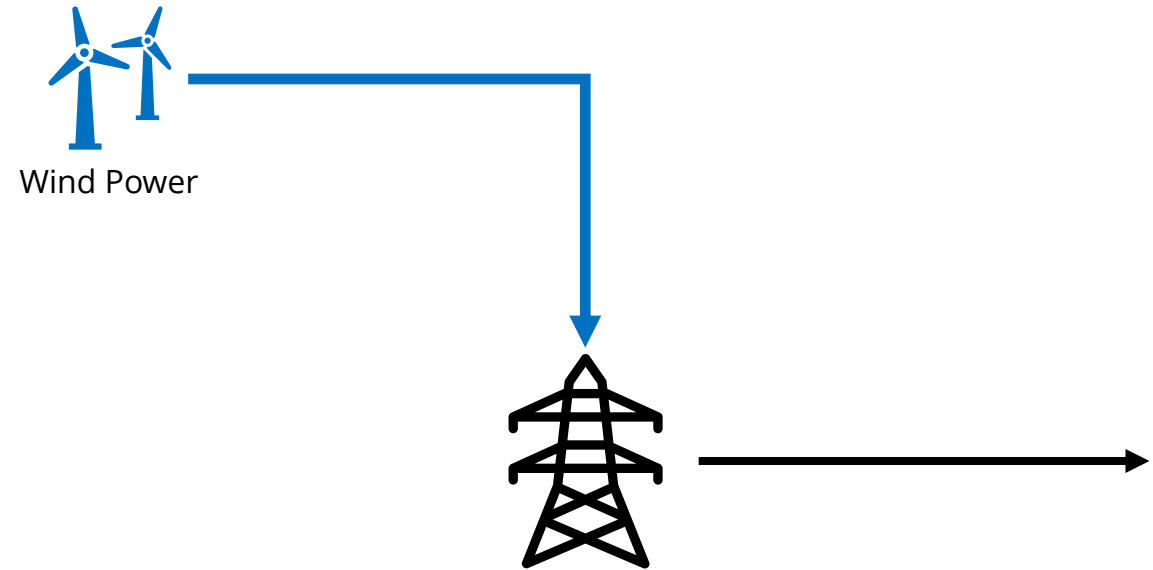


Point of Connection
(PoC)

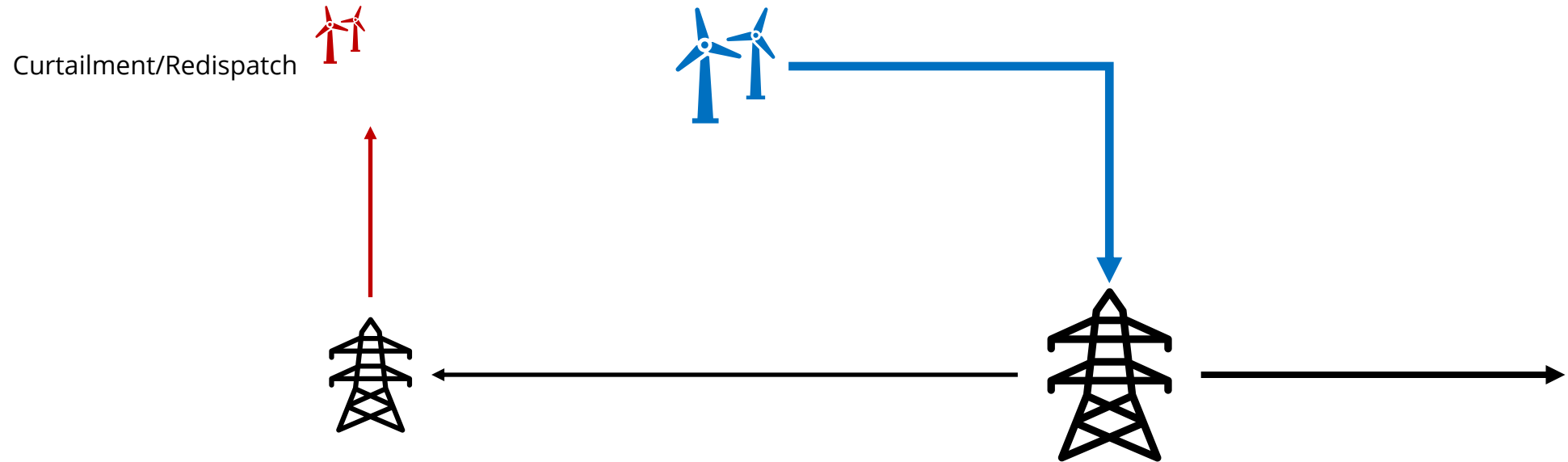
Feed-In should be optimised according to capacity and demand



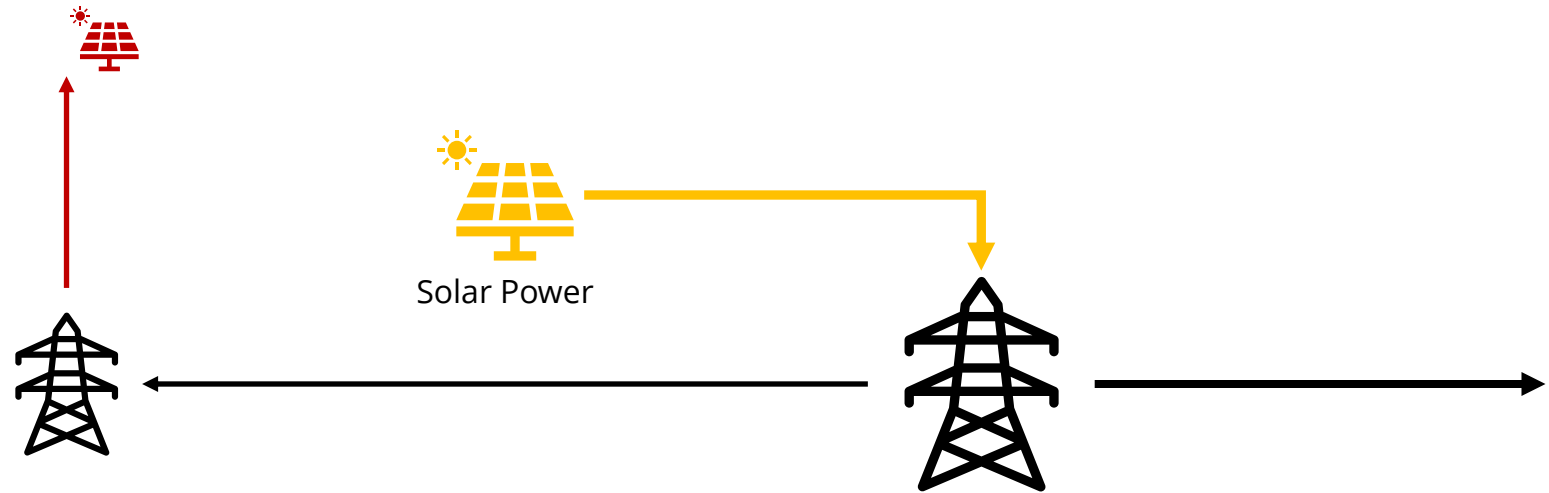
Renewable power dimensioning needs to take volatility into account



During high supply excess power is curtailed/redispatched

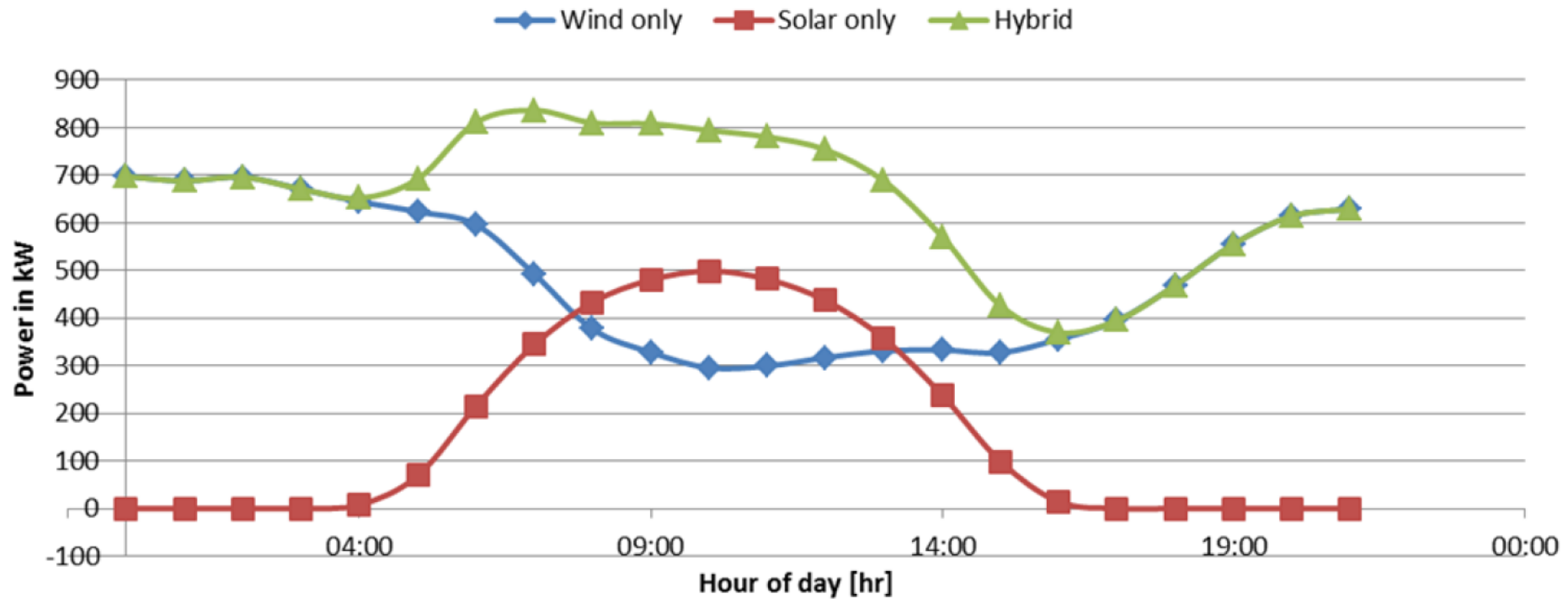


Basically, the same situation with another type of supply

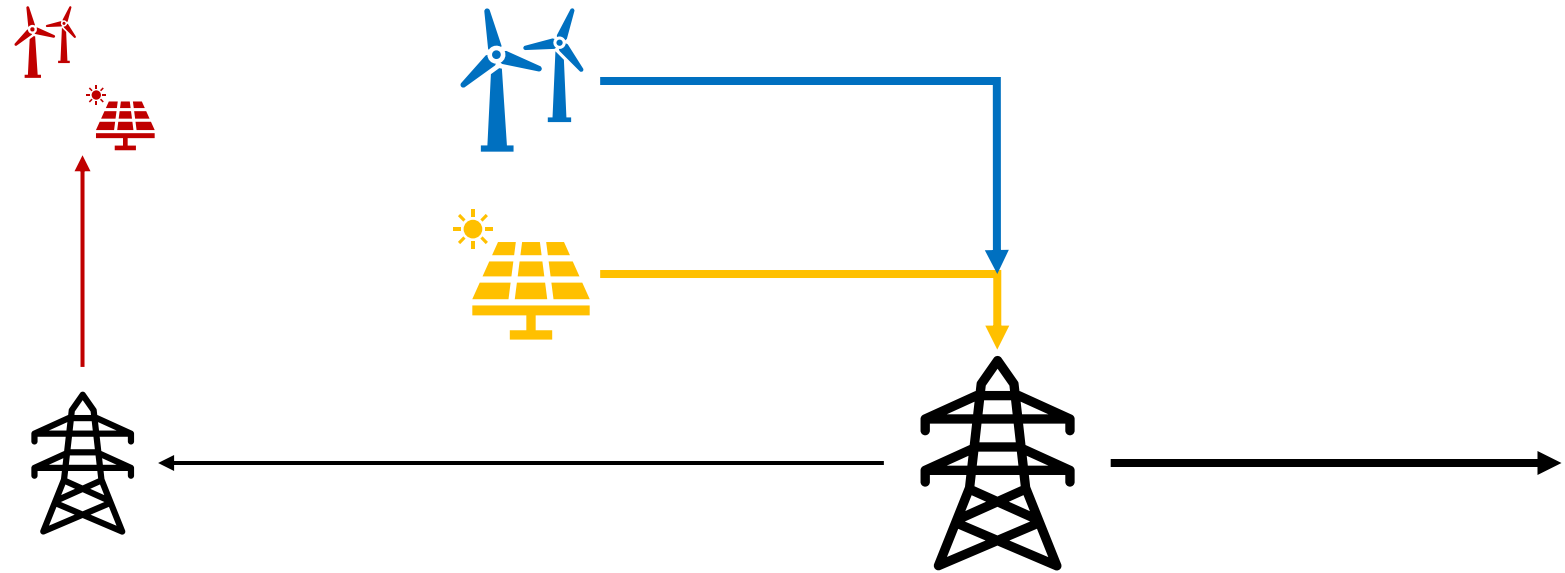


Often, possible synergies are not exploited

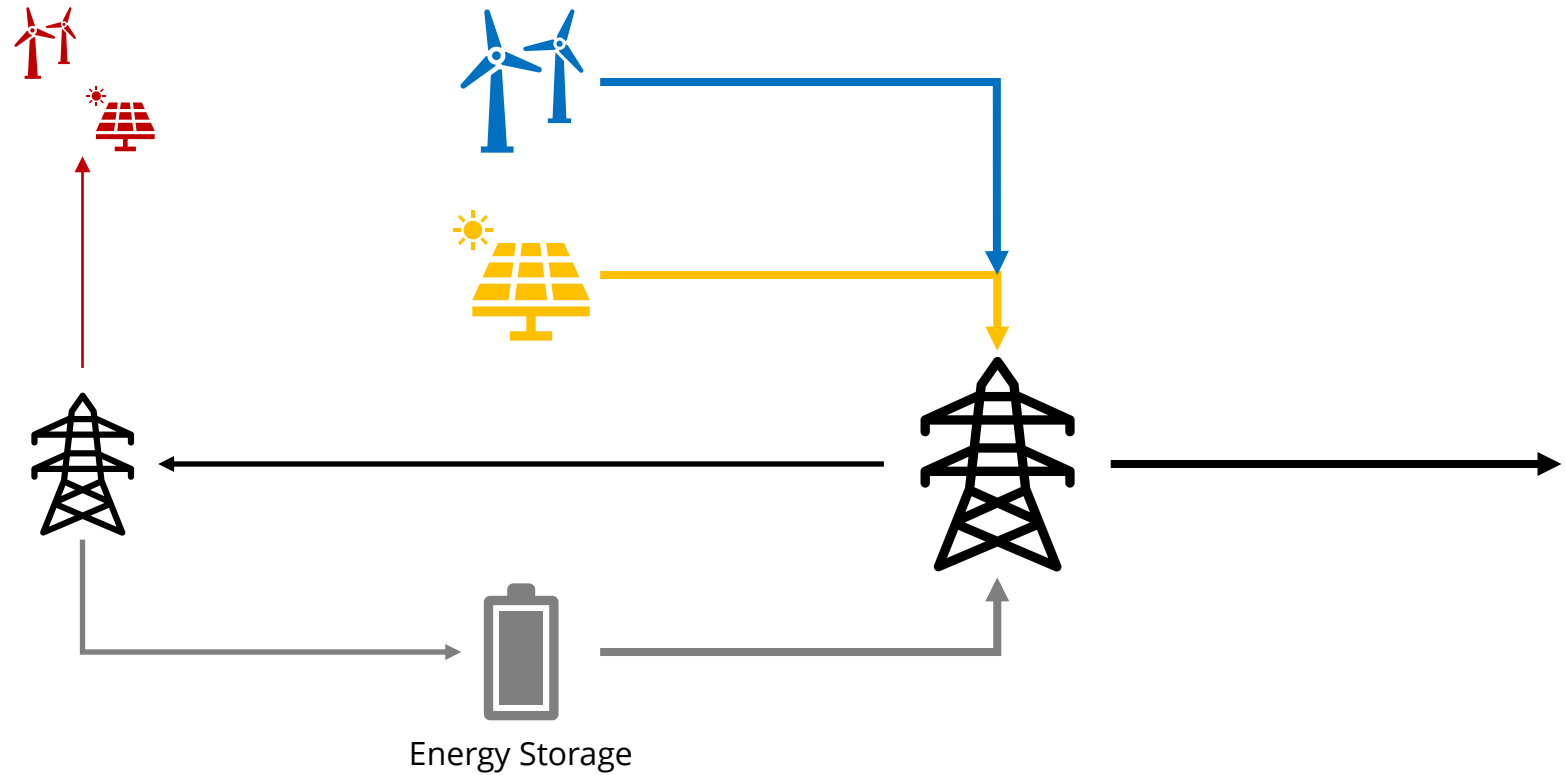
Avg hourly power gen comparison



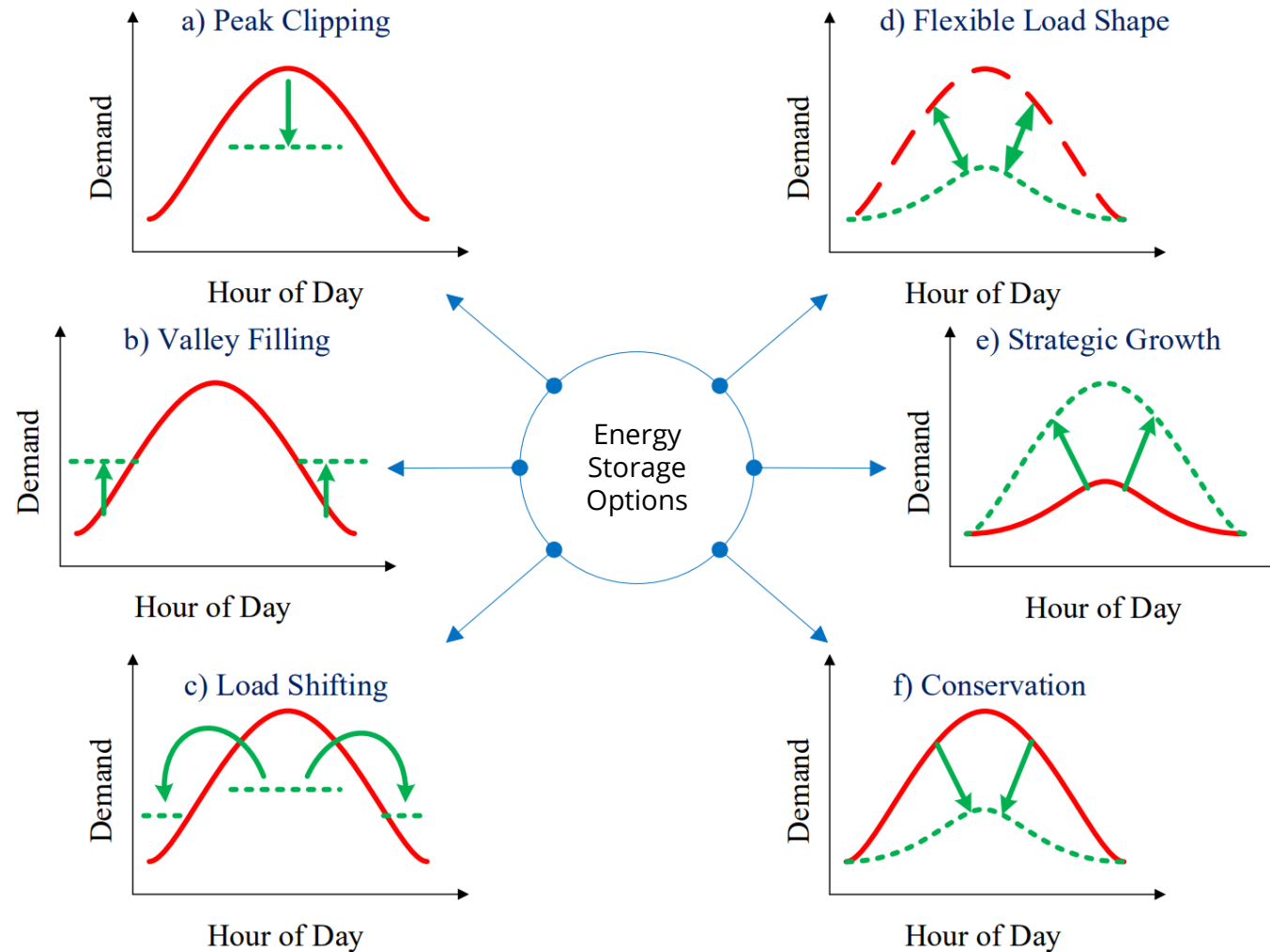
Hybridisation of energy supply reduces curtailment/redispatch



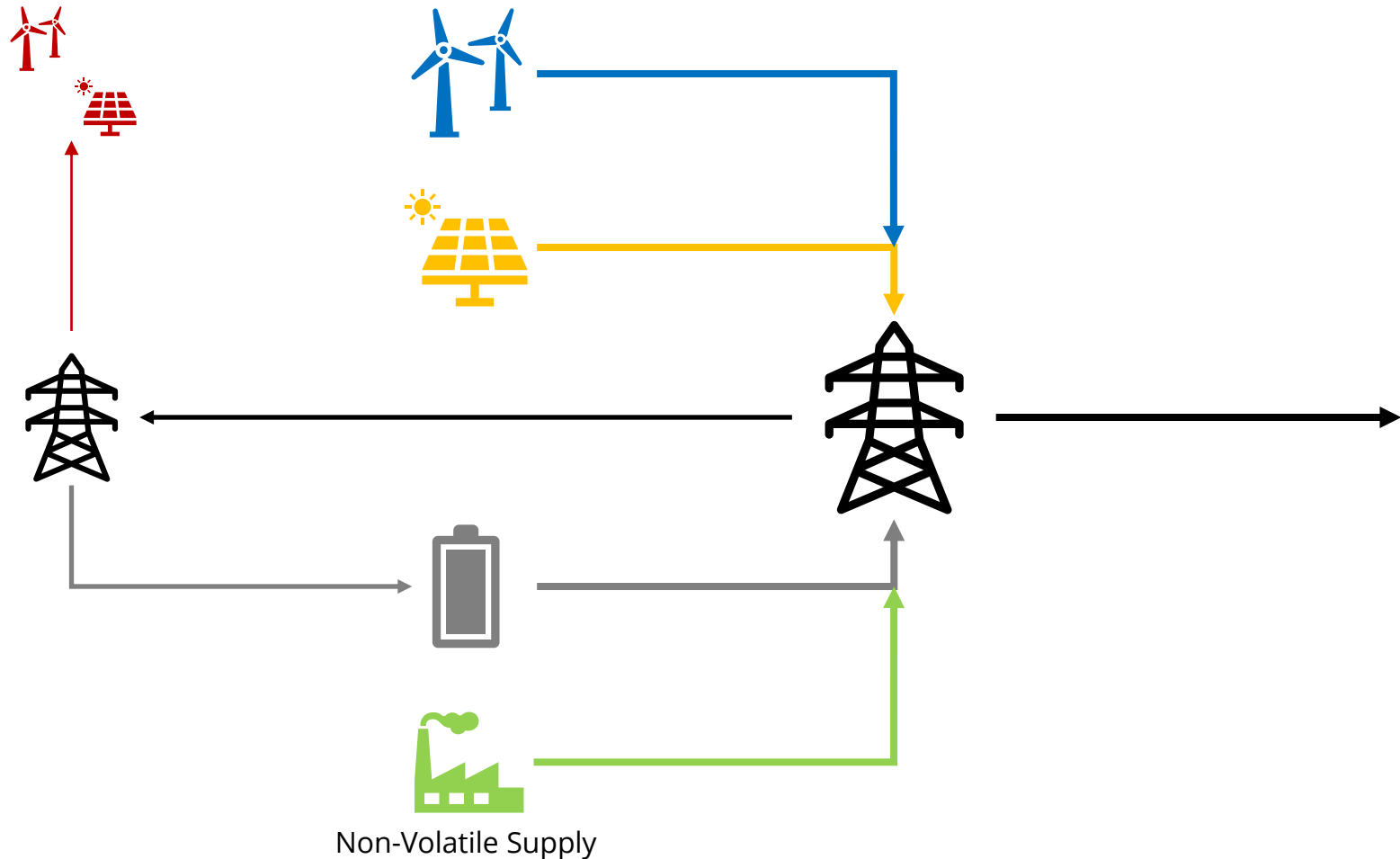
Adding energy storage allows for shifting excess power



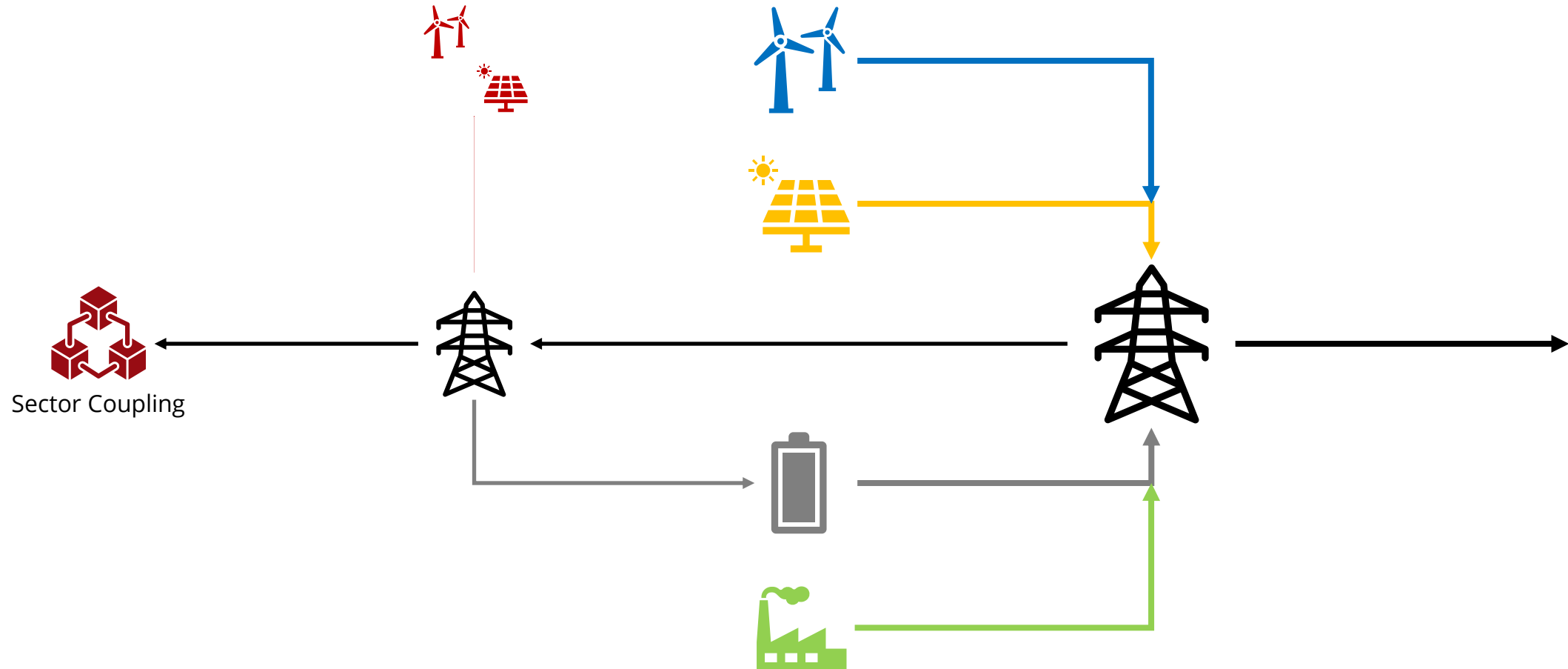
Energy storage offers various options



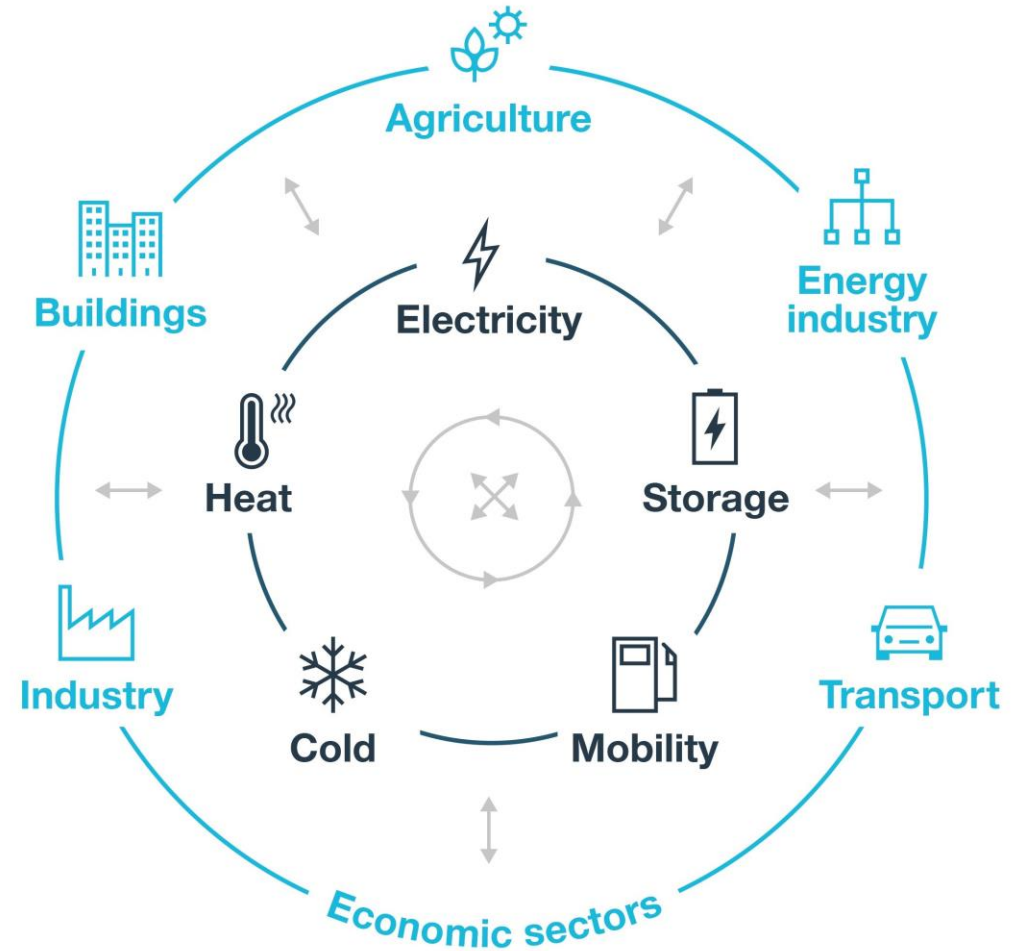
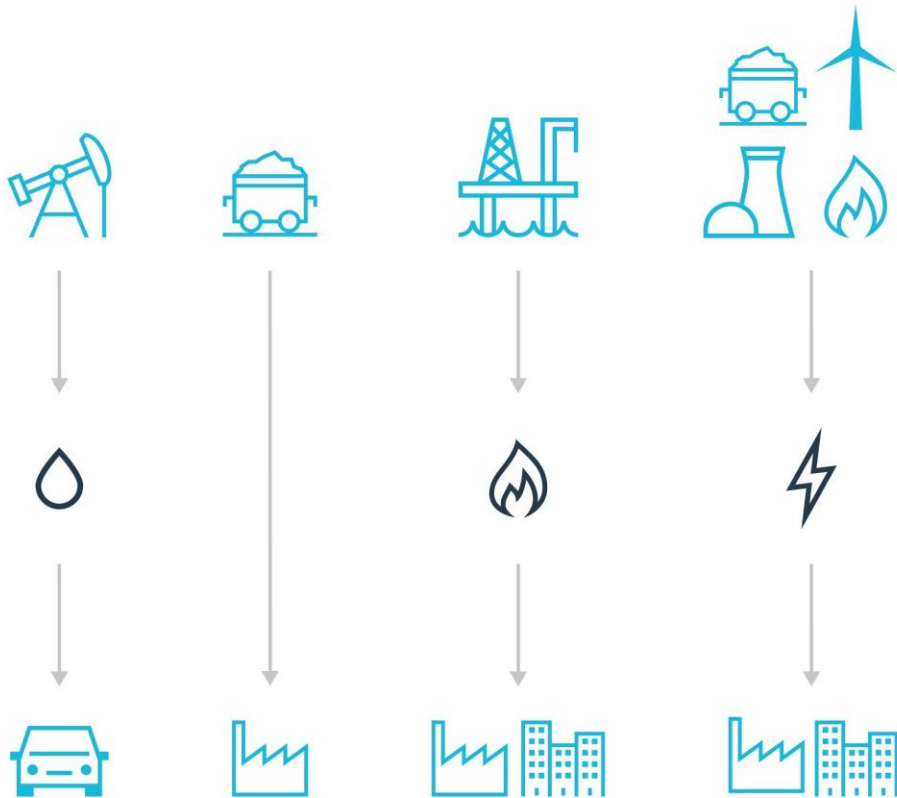
Non-volatile supply can bridge any *Dunkelflaute*



Coupling integrates Flexibility of other Energy Sectors

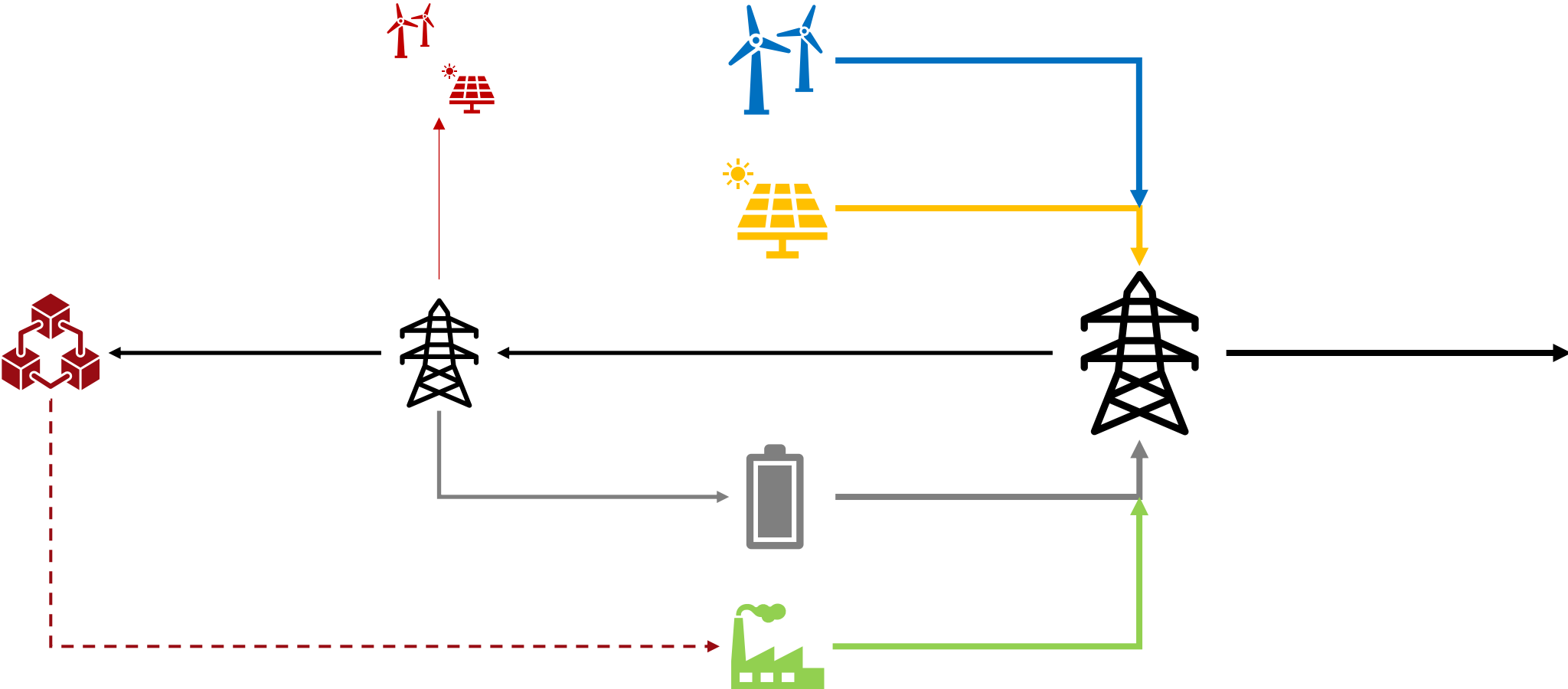


Sector coupling should be another flexibility strategy

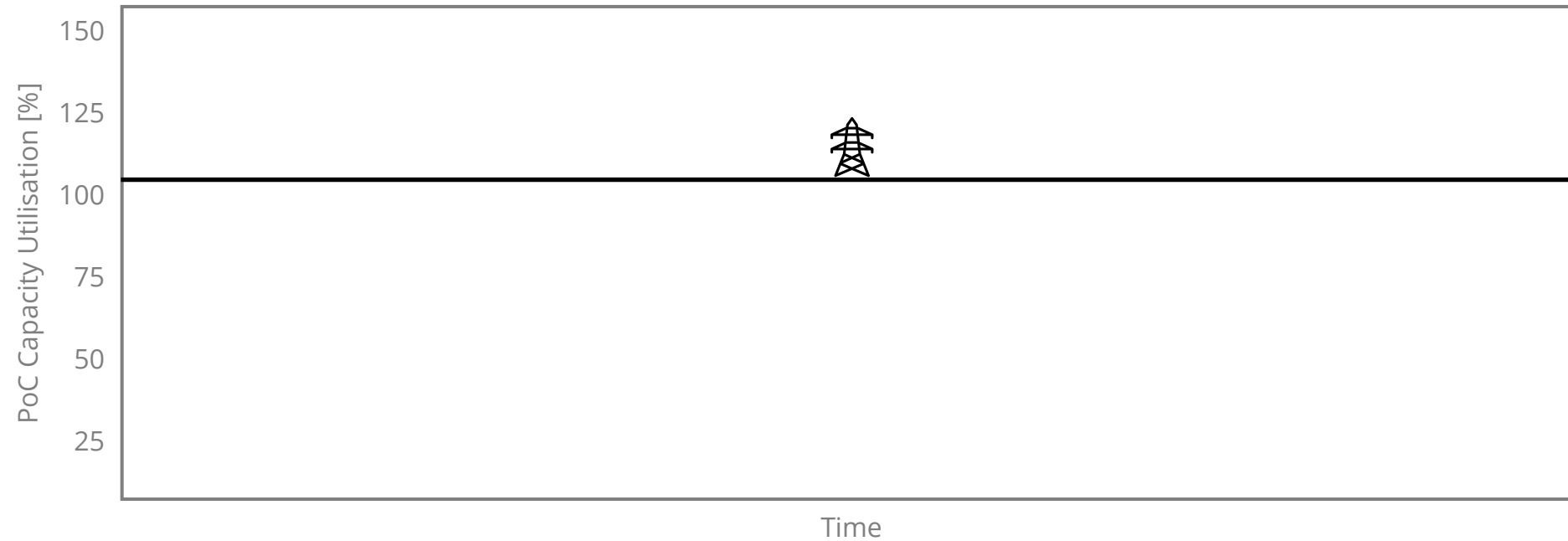


↔ Energy flows between consumers and producers

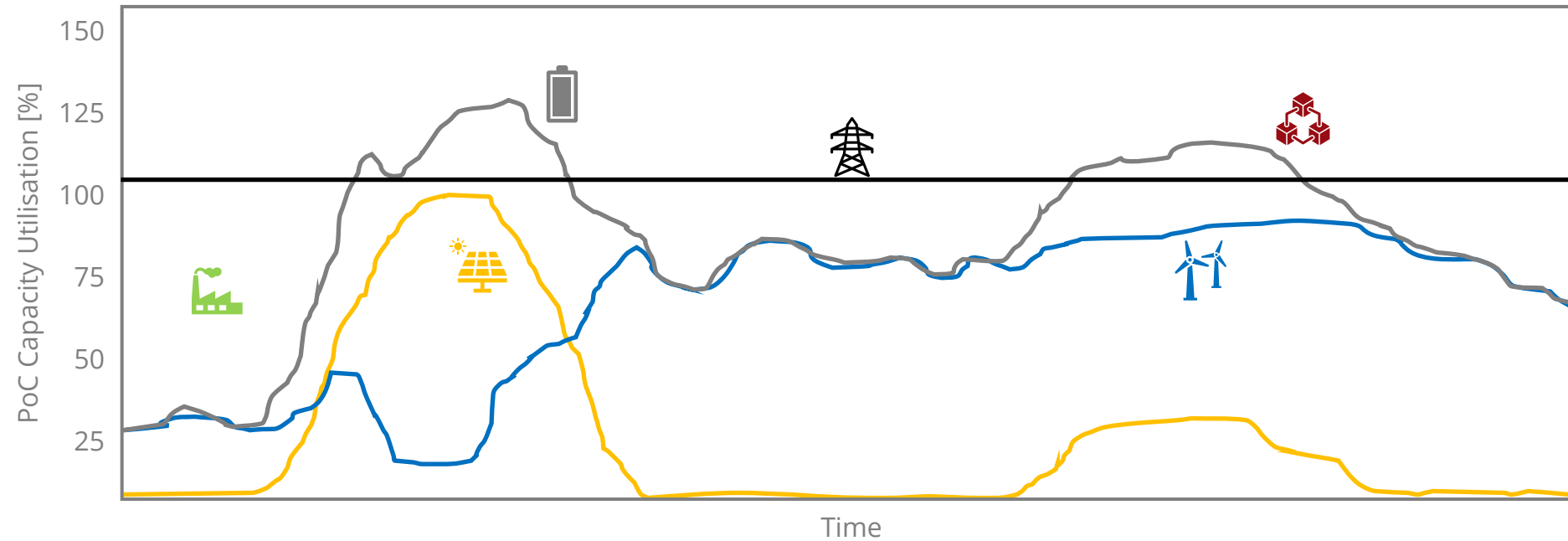
In an optimal scenario, some of the coupled energy is stored



An optimal resource utilisation is the target



With predictive Control, optimal Resource Utilisation is possible



Is there a *positive* example?



Take Aways

1. Advanced energy storage, together with smart grids, constitutes a kind of spacetime for electrification and the green transition.
2. With volatile energy supply, energy storage flexibility is required to balance between the dynamics of supply and demand side.
3. The paradigm shift is that advanced energy storage needs to be implemented within the energy system and moved from primary to secondary storage.
4. An optimal integration of renewable power is mandatory for implementing advanced storage – if no energy is worth being stored, there is no need for storage.
5. If also energy storage is implemented optimally, it should also support the power grid with grid and/or system services – but without destructive interference.
6. Overcapacity at the grid connection points with the integration of energy storage systems can accelerate the roll-out of renewable energies and reduce curtailment or redispatch.

ADVANCED ENERGY STORAGE CONFERENCE 2025



**See you in 2025 for
Advanced Energy Storage 2025**
4 December 2025 - Aarhus, Denmark