The conflicting propositions and market models around battery flexibility

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Enabling a 100% green society

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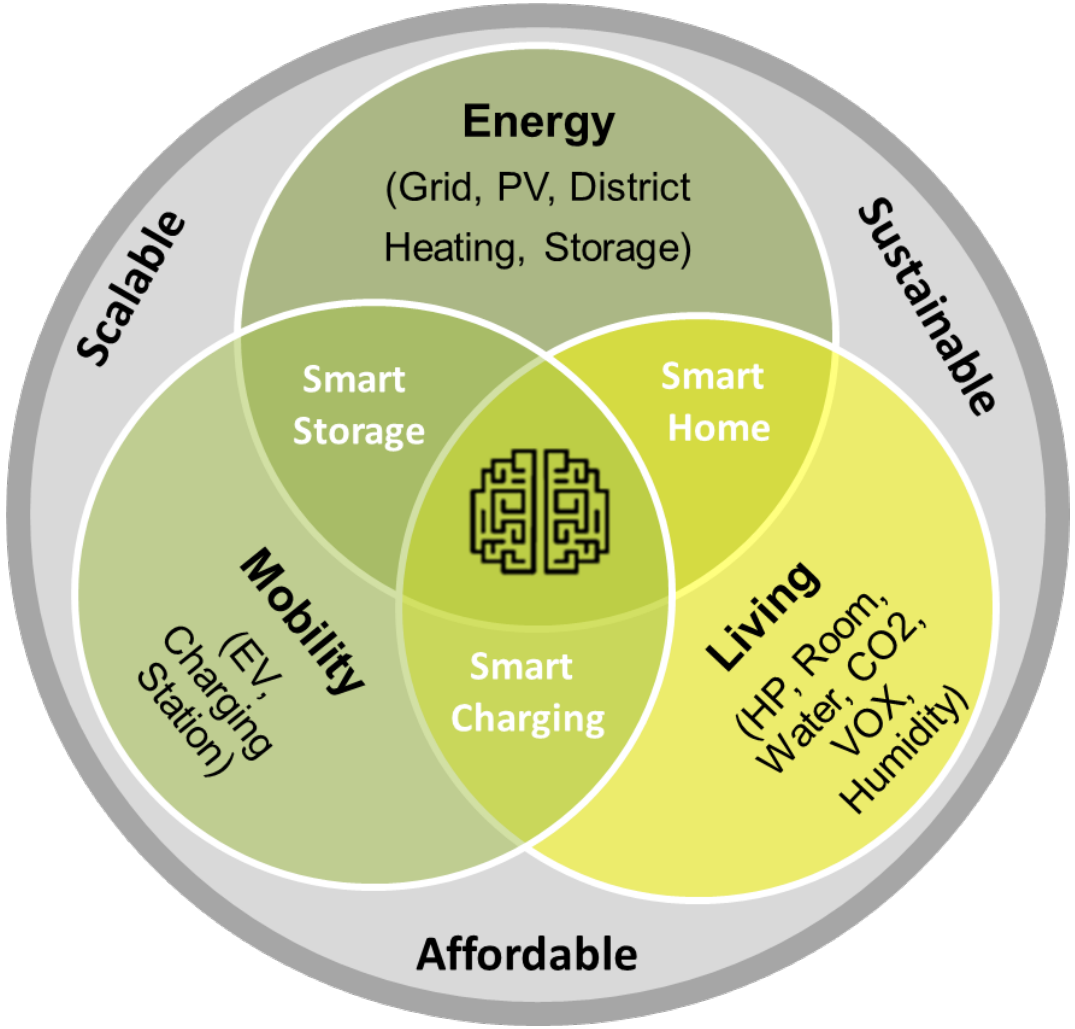
Niels Vanspauwen, Chief Technology Officer

The Convergence of Energy, Mobility, Living & ICT

Driven by sustainability goals, Enervalis provides scalable and affordable ICT solutions on the crossroads of Living, eMobility and Energy



EV Uptake Is Beating Expectations

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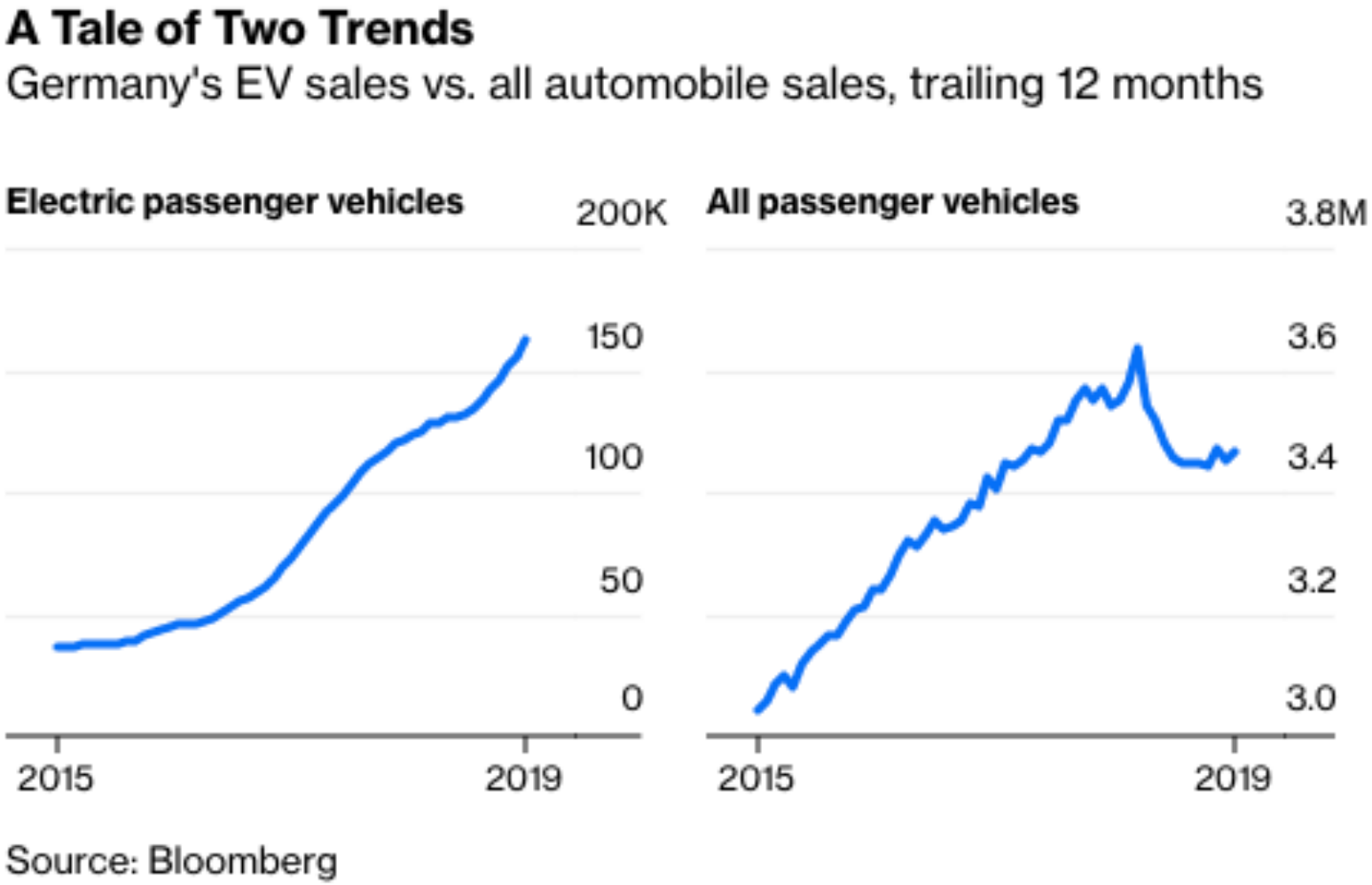


		ACTUAL DATA ($g\ CO_2/km$)				FORECAST DATA			
RANK[1]	CAR MAKER	2016[2/3]	2017[2/4]	2018[2/4]	2021 TARGET	2021[2/5]	DEVIATION[5]	FORECAST 2021 PENALTY (IN MILLIONS OF EUROS)	
1	Toyota	105.5	103.1	100.9	94.9	95.1	0.2	18	
2	PSA	110.4	111.9	113.9	91.6	95.6	4.0	938	
3	Renault-Nissan-Mitsubishi	111.2	111.7	108.2	92.9	97.8	4.9	1,057	
4	Hyundai-Kia	124.7	121.5	118.9	93.4	101.1	7.7	797	
5	Volkswagen	120.4	121.5	121.1	96.6	109.3	12.7	4,504	
6	BMW	122.9	121.5	123.6	102.5	110.1	7.6	754	
7	Ford	120	120.8	122.7	96.6	112.8	16.2	1,456	>14,655
8	Daimler	125.3	127.0	130.4	103.1	114.1	11.0	997	
9	Honda	126.5	127.2	126.8	94.0	119.2	25.2	322	
10	Fiat-Chrysler (FCA)	120	119.9	125.4	92.8	119.8	27.0	2,461	
11	Volvo	121.5	124.4	129.5	108.5	121	12.5	382	
12	Mazda	127.7	130.8	134.8	94.9	123.6	28.7	877	
13	Jaguar-Land-Rover	150	151.7	151.5	130.6	135	4.4	93	

Figure 2. CO_2 emissions and fines forecast for leading car makers in Europe

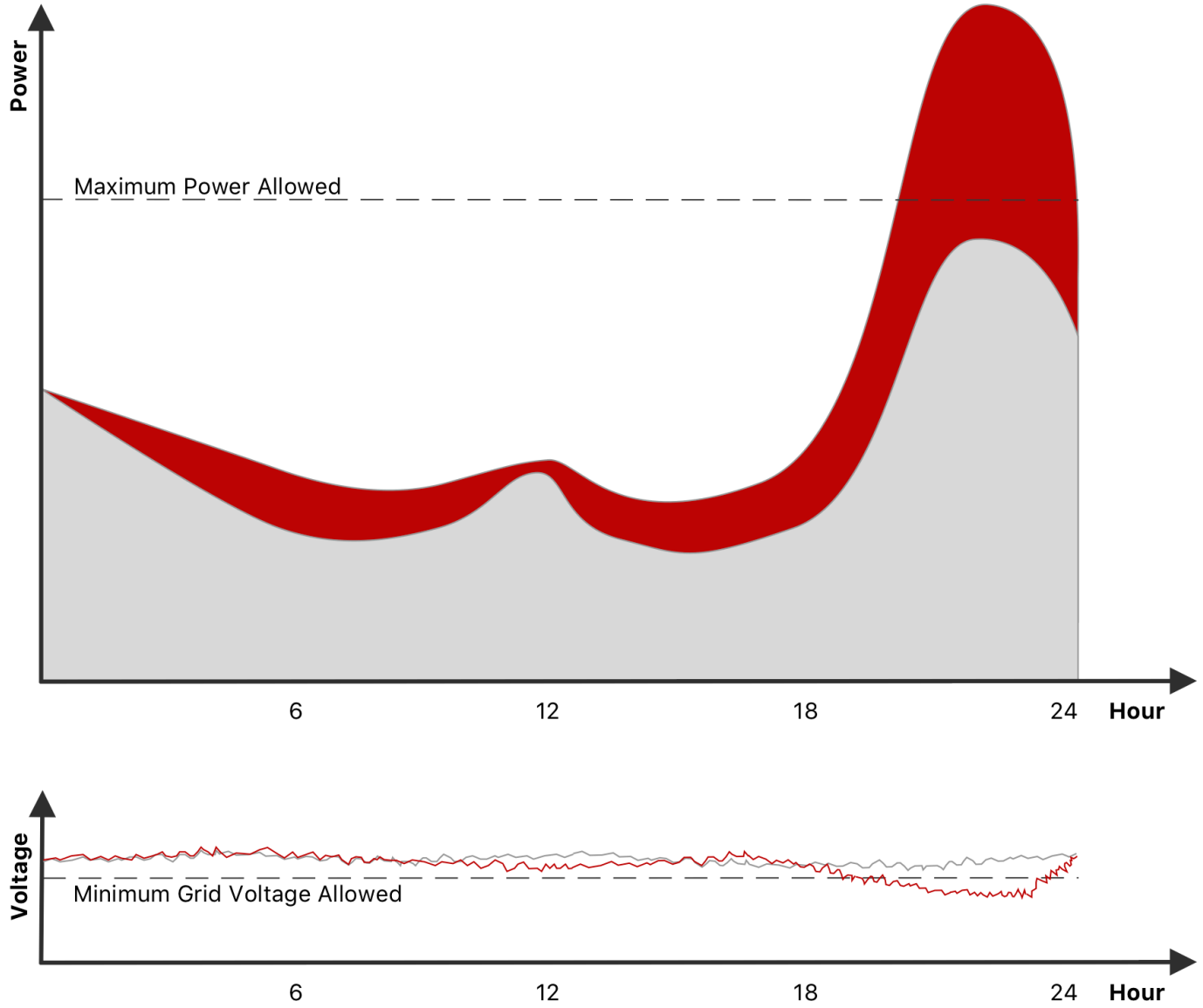
[1] Rank on 2021 forecast
[2] Based on NEDC
[3] Based on data from ICCT
[4] Based on data from EEA
[5] Based on actual data until 2018 and PA forecast estimation

< 0 | 0-2 | > 2

EU Policy is forcing even faster EV uptake, with massive fines on the horizon for all major car manufacturers if they don't act now.

EV's Strain the Grid

- EV pose challenges for the grid at both TSO and DSO level (power, voltage, power quality)
- In particular during evening peak hours
- Evening peak is also expensive, so all we need to do is charge at other times, right?



Why You Need Artificial Intelligence

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Smart charging is an optimization problem:

You minimize energy costs under constraints while maximizing the objective for the consumer

✓ **Objective:** Lowest cost or maximum green with comfort SoC achieved

✓ **Energy costs:** Behind-the-meter, energy markets, ancillary services

✓ **Constraints:** local grid infra constraints, power quality (grid codes), DSO requests

The algorithm works to achieve the objective for the consumer not bound to individual markets.

This could lead to issues on the distribution grid without a proper market structure.

Conflicting Interests

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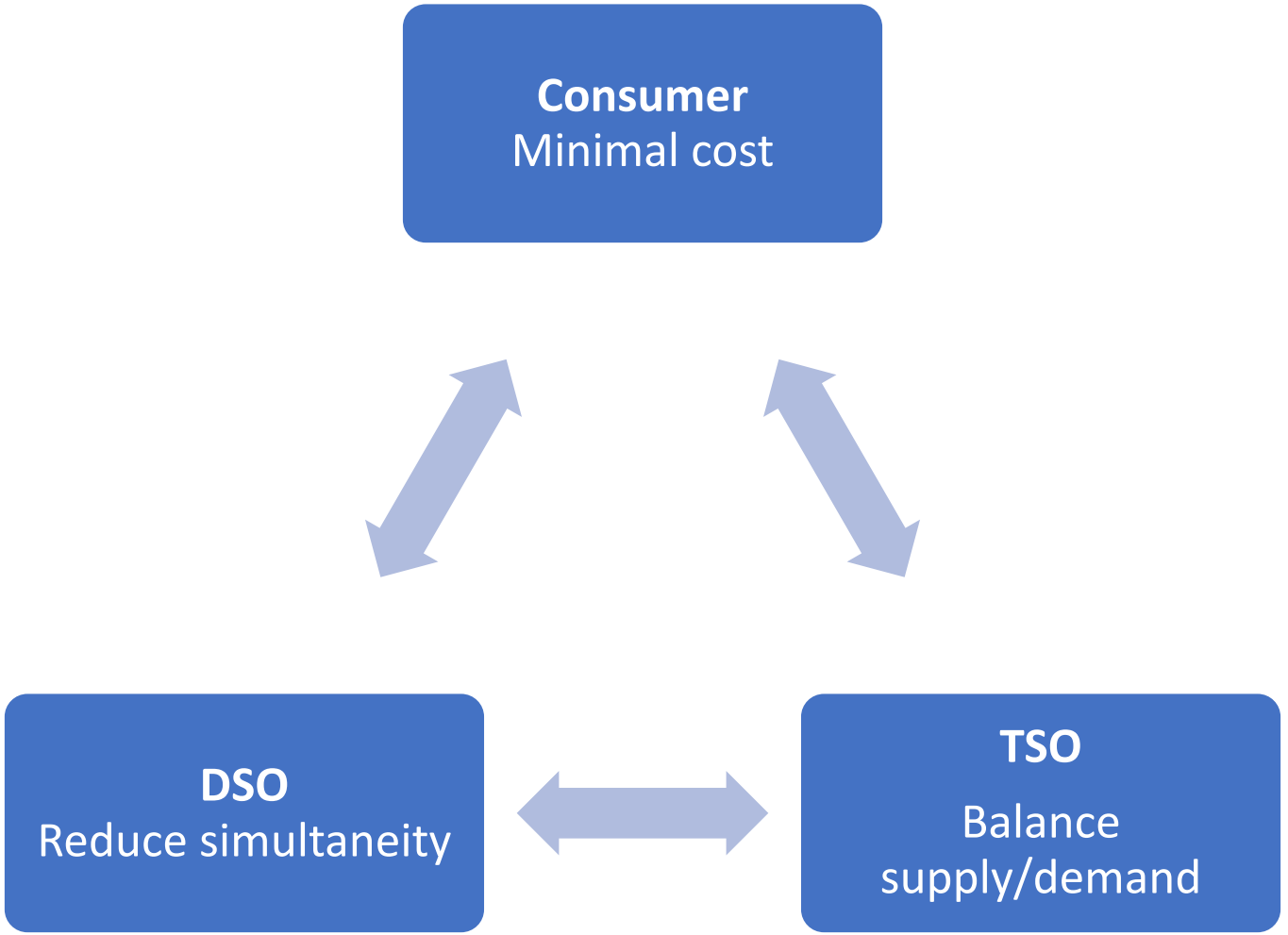
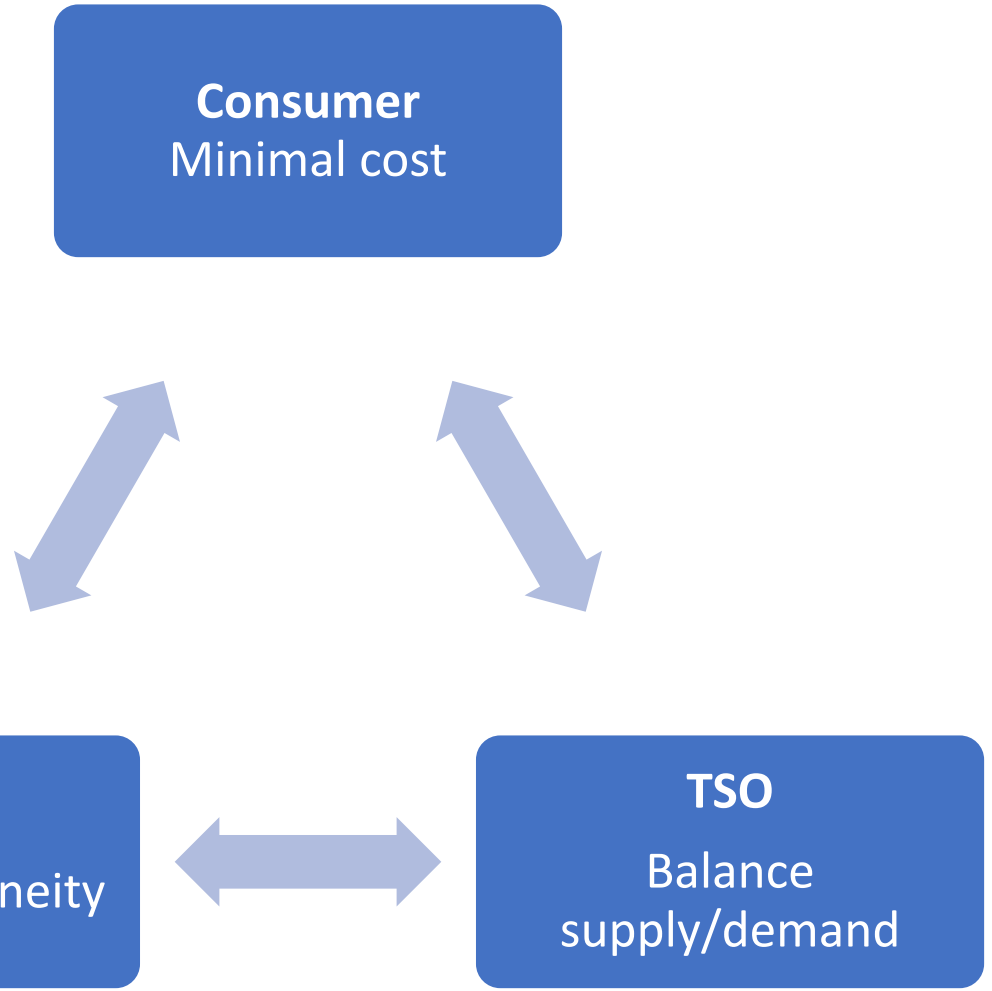


Conflicting Interests – Time-of-use

1. Off-peak price in ToU system
➔ start charging

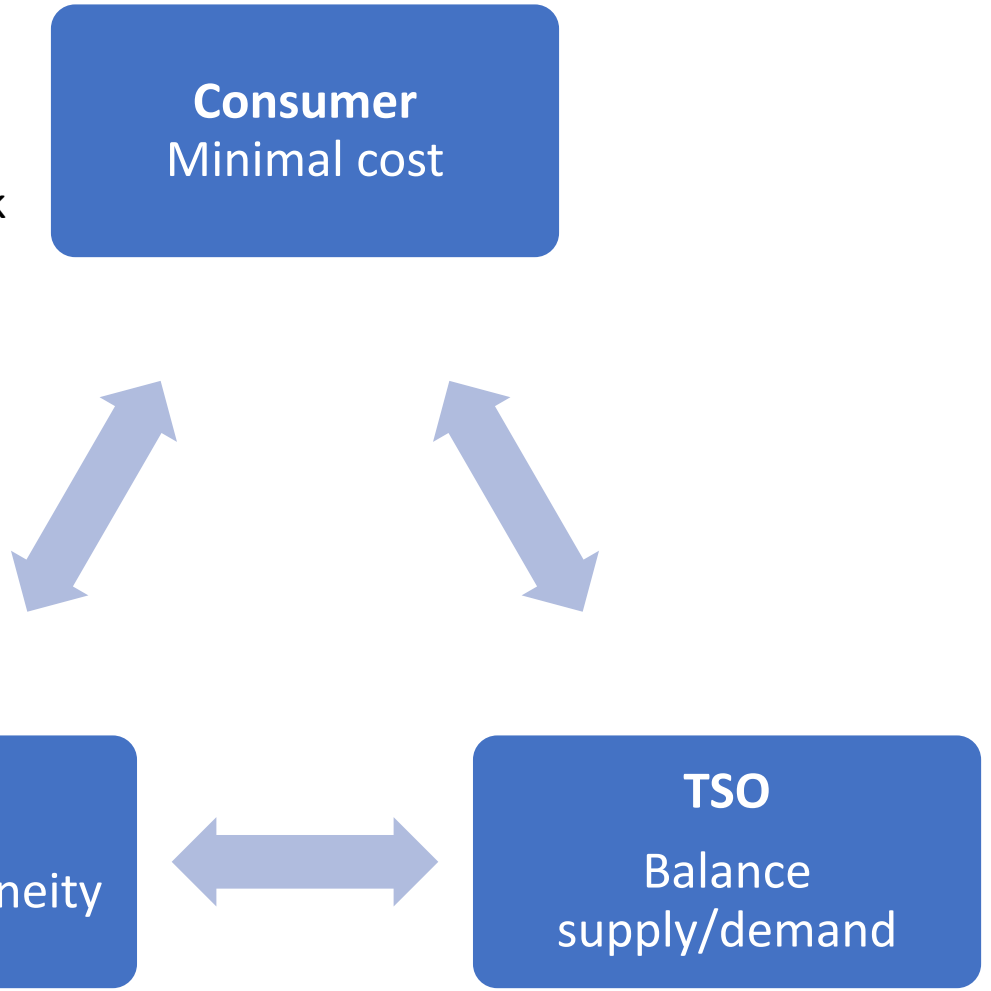


2. Large power peak
➔ Local congestion problem

Conflicting Interests – Capacity Tariff

3. Does penalty outweigh the opportunity?

Did I already have a large peak this year?



2. Disincentivize consumption peak through capacity tariff

1. Imbalance
➔ incentivize consumption

Conflicting Interests – Ancillary Services

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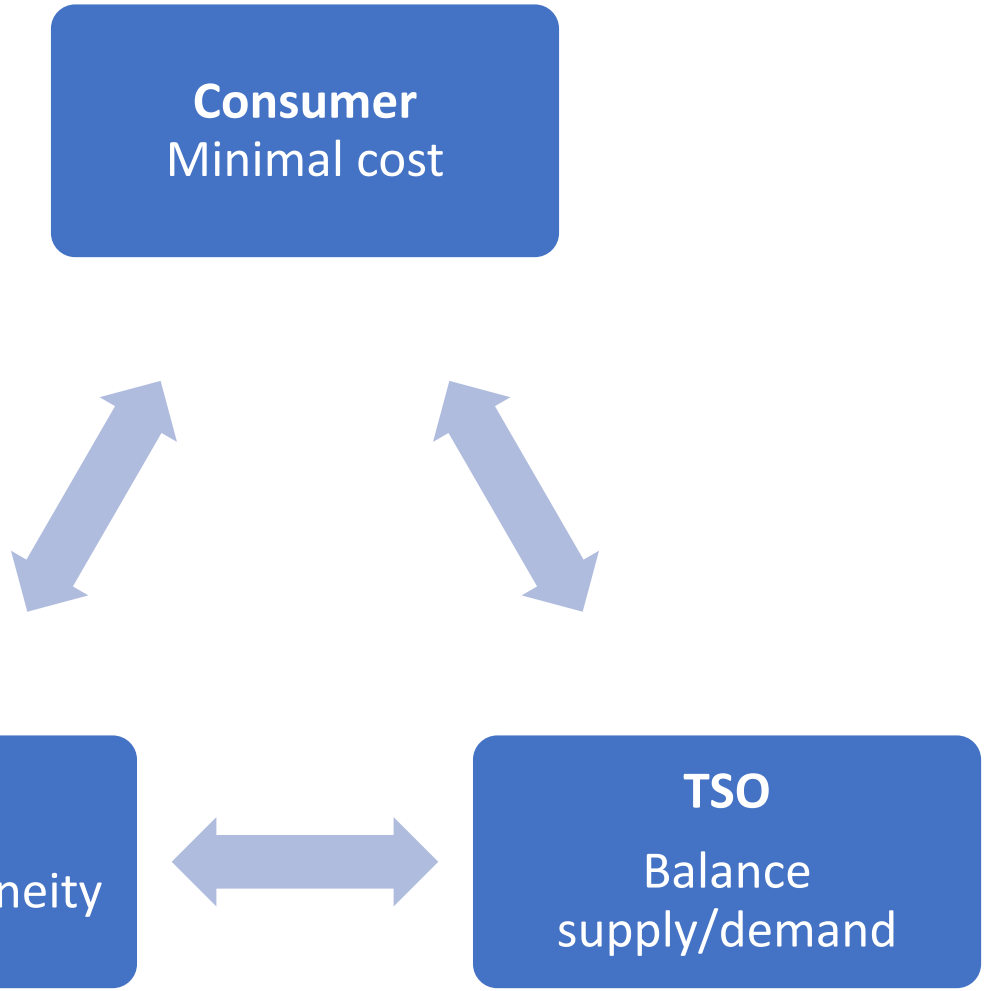
2. aFRR activation
➔ Increase charging power



3. Large power peak
➔ Local congestion problem

1. Excess wind
➔ aFRR activation

Conflicting Interests – Ancillary Services

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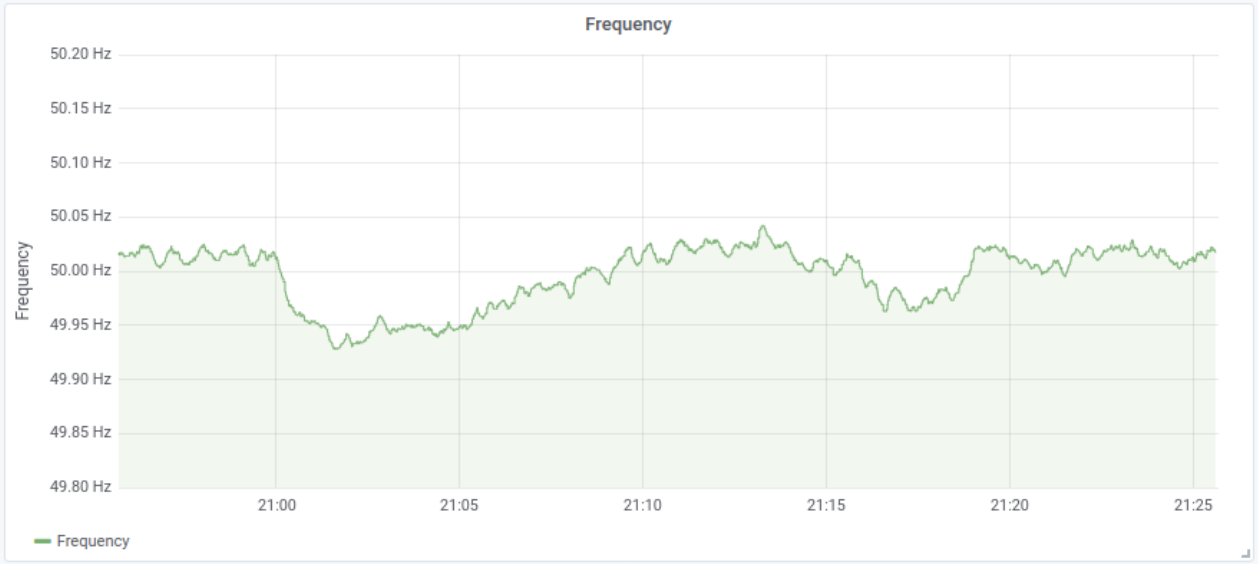
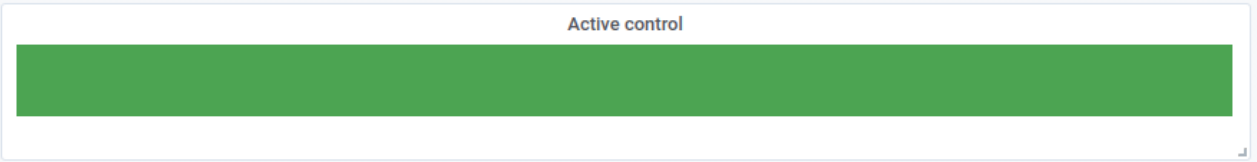
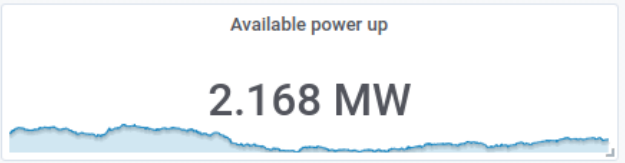
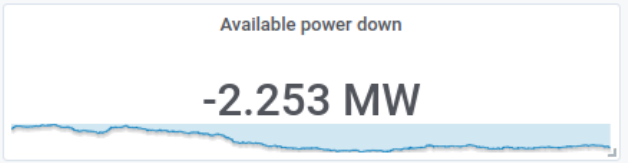
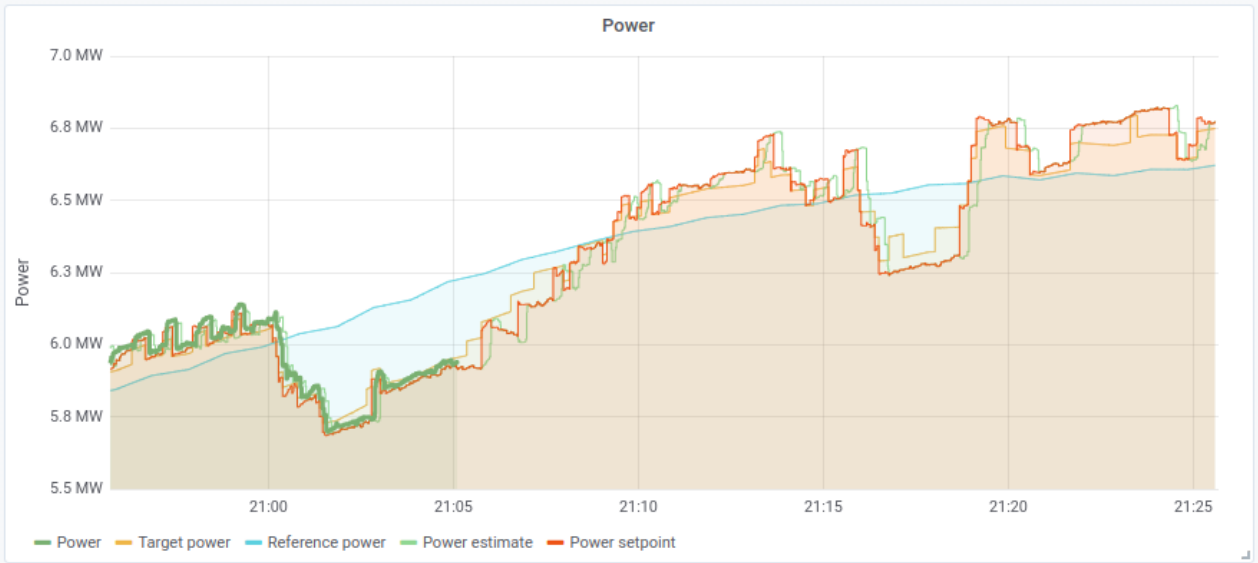
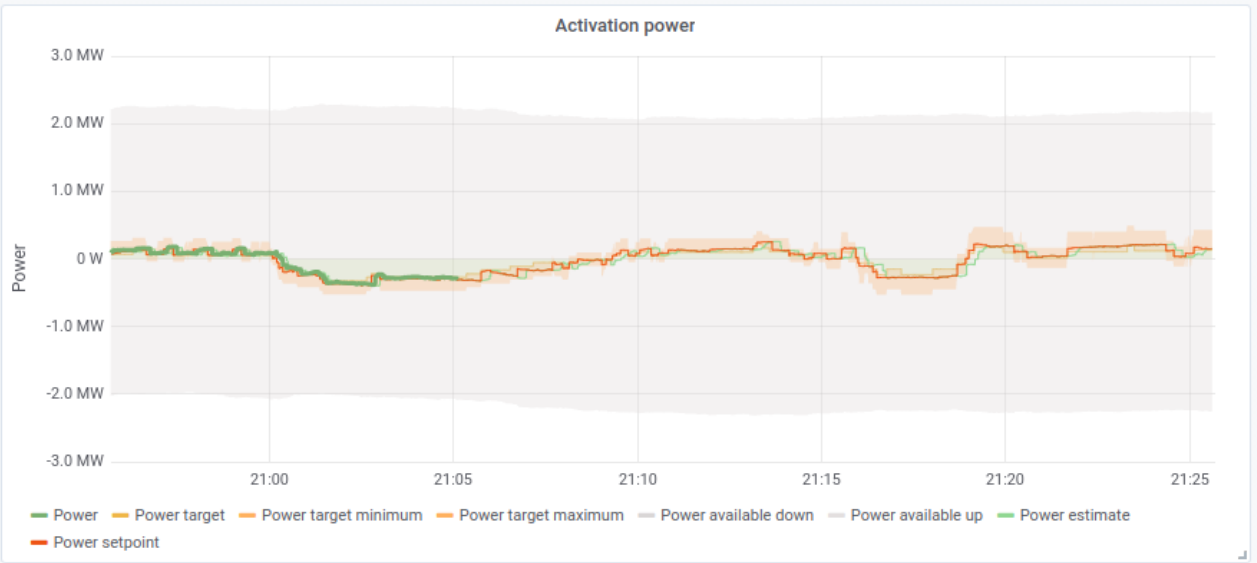






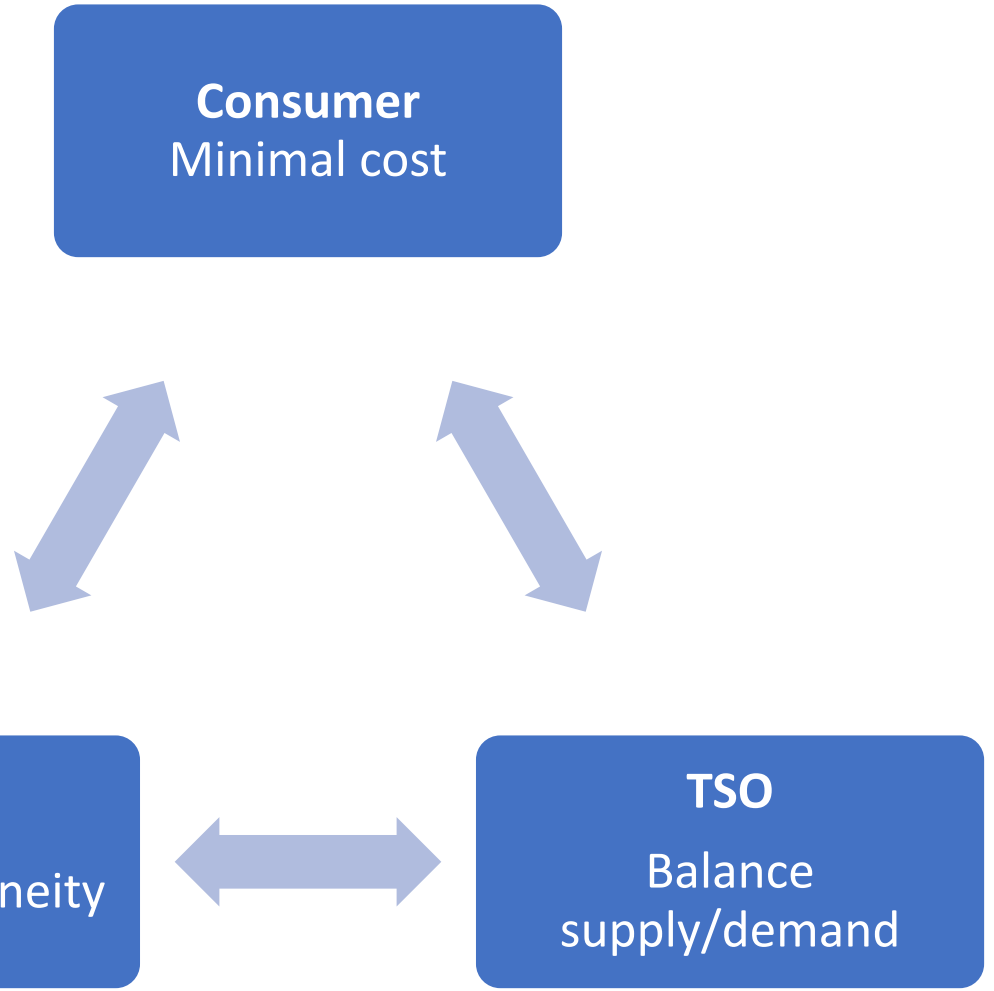






Conflicting Interests – Ancillary Services

1. Large frequency deviation
➔ Maximum charging power



3. Large power peak
➔ Local congestion problem

2. Happy because this helps correct the deviation at low cost

Conflicting Interests – Congestion Markets

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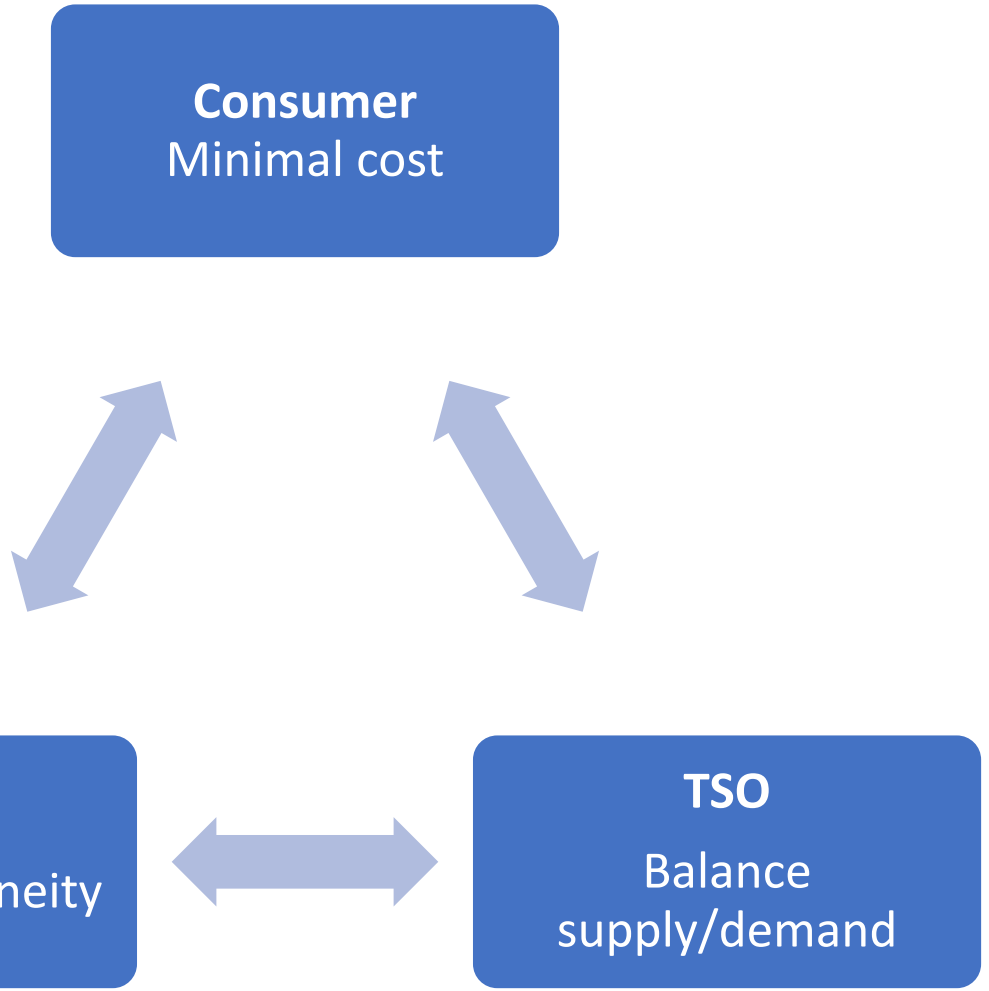
2. Agree to not charge during this period ➔ need to weigh against opportunity cost on day ahead or ancillary markets



1. Expecting more demand than can be fed into the local grid ➔ USEF request

Conclusion and A Future Perspective

- DSO's, TSO's and utilities are competing for access to the same flexible assets
- Interests of individual consumers, DSO's and TSO's are often misaligned, leading to complexity, friction, inefficiency, fines and increased costs for society as a whole
- The root of the problem stems from the fact that every party is attempting to optimize things from their own perspective, rather than taking a system perspective
- If our goal is to transition to renewable energy and a climate neutral society at minimal costs, market mechanisms need to be put in place that incentivize system centric optimization

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Thank you

We believe the world is evolving to 100% green energy production and that most of the energy consumption will be electric.

This is the only way to keep our climate and planet healthy.

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