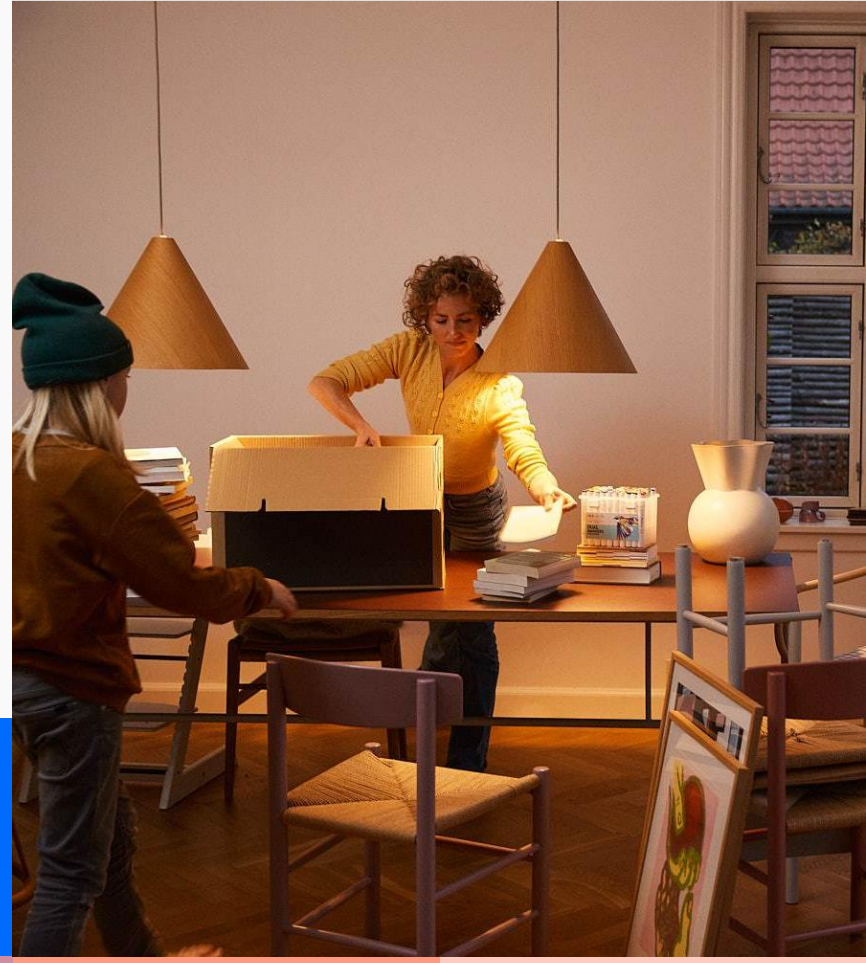
Harnessing AI and IoT to unlock Household Electricity Flexibility for a Smarter Energy Future



By Jack M. Kristensen

SustainED 2025

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Agenda

1 Introduction

Jack Michael Kristensen

VP/Managing Director, FlexPlatform, Andel Energi

Leading the Flexibility Business Unit that own, develop and operate the award winning **FlexPlatform** – a Platform-as-a-Service enabling Demand Side Response to be utilized and marketed.

25 years experience within energy

- Pioneering offshore windfarms
- Liberalization of gas market in 2002
- Consultant of governments, inter-governmental organizations and private companies on energy trading and infrastructure investments
- 10 years as COO at Andel Energi – Denmarks largest energy supplier

Jack Kristensen | LinkedIn

2 Current status in the energy sector

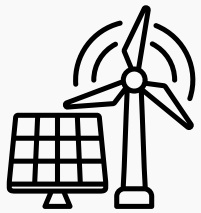
The debate across Europe is centered on three major themes

Liberalization ⟷ Security of supply

Green transition ⟷ Affordability

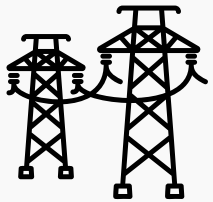
Globalization ⟷ Resilience

The (danish) energy sector is currently experiencing a ”midlife crisis”



Renewable energy projects is canceled/delayed/rescoped

- Capture rates is significantly down
- Offshore wind is struggling getting FID



Grid expansion is more complex and demanding

- Multiple projects is being delayed
- Rising construction costs

Roll out of district heating projectsis delayed

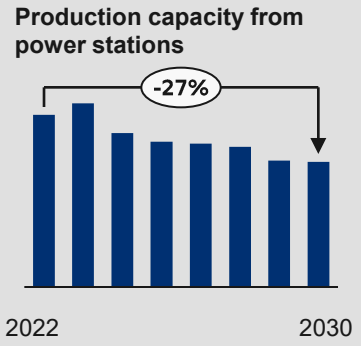
- Cancelation of projects
- Project business cases is not balanced

The growth in intermittent production is causing more imbalances that needs to be addressed

Production from renewable energy is expected to increase, while the capacity from conventional power stations are declining...

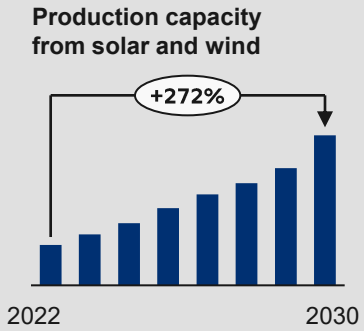
Conventional power stations has so far been the largest contributor to flexibility in the electricity grid

Fase out of the power stations entails that the flexibility needs to come from alternative sources such af to consumers

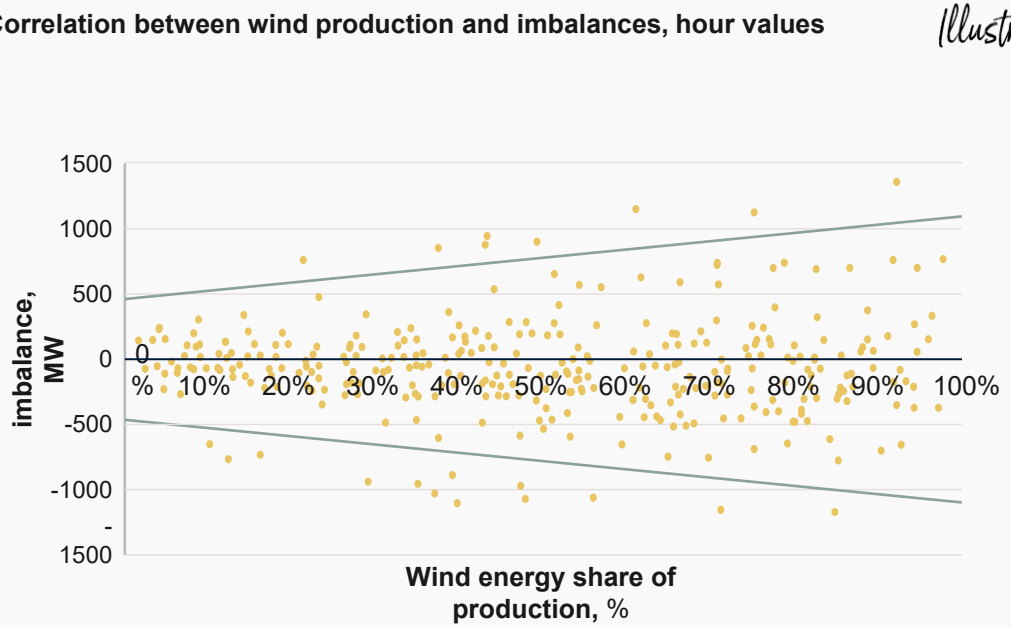


Solar and wind has limited potential to be flexible due to the dependencies to the weather

The strong increase in renewable production will demand more flexibility in the electricity grid



... which increases the likelihood for systemwide imbalances due to an increasing share of renewable energy production

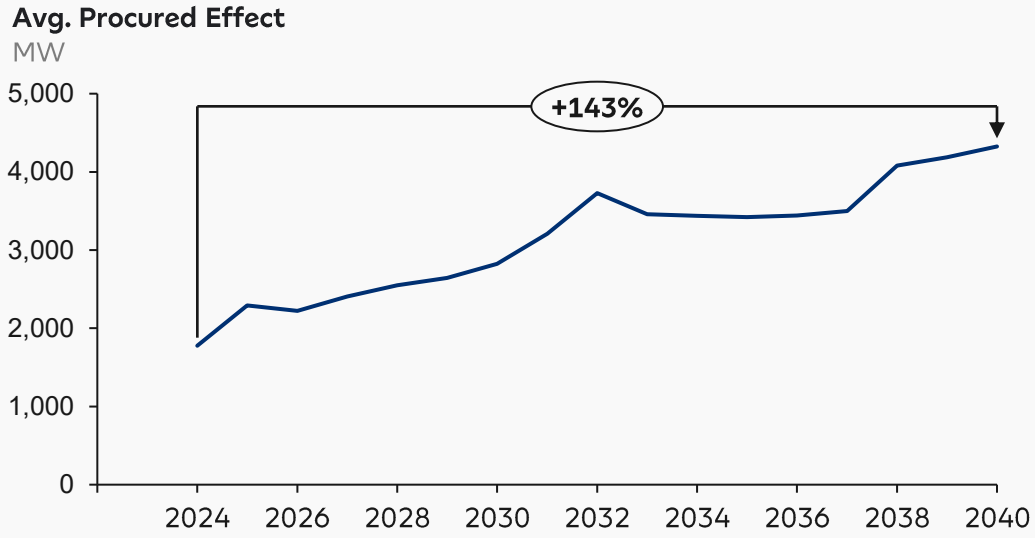


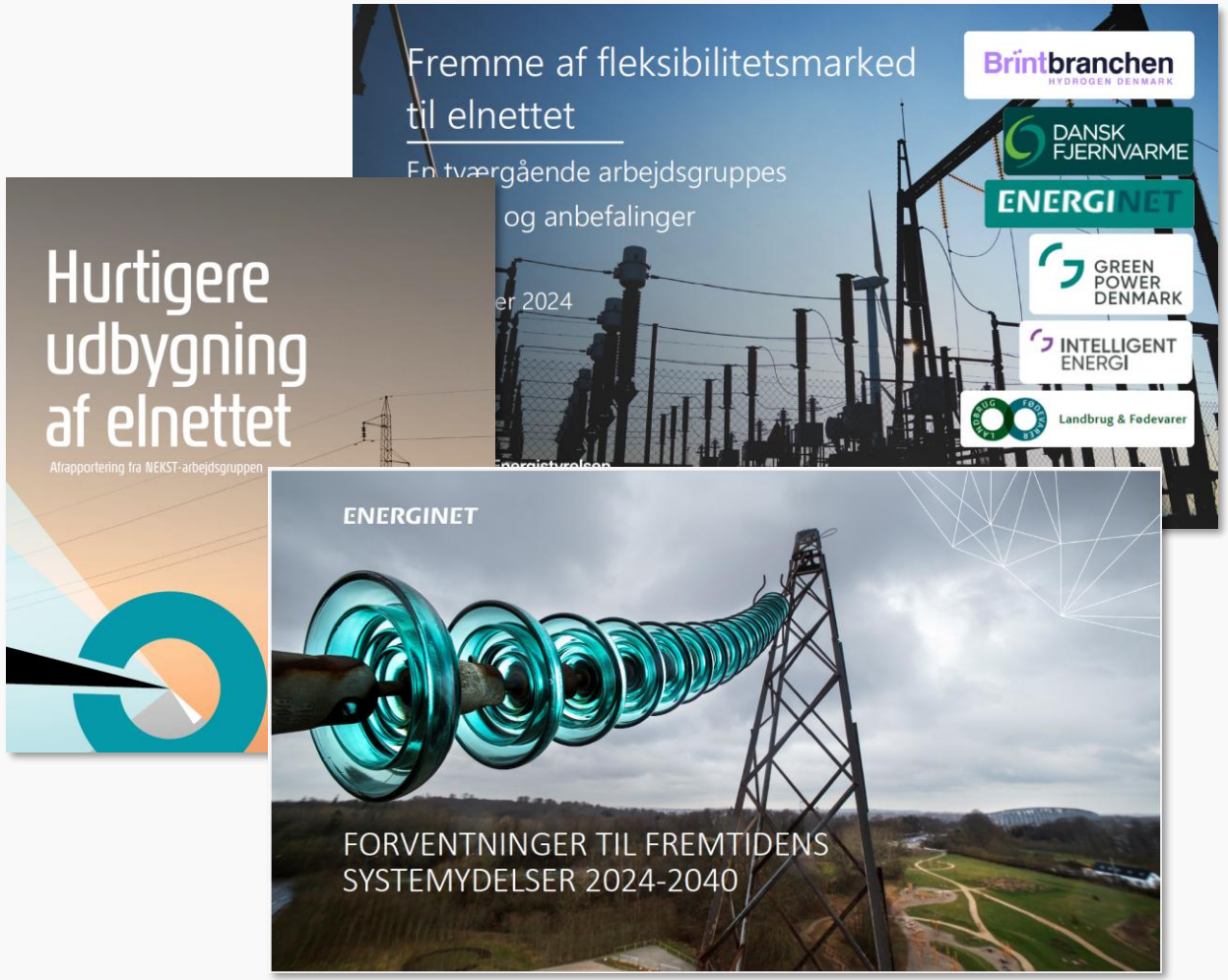
Sources: Energinet AF (2023); IM_analyse

Several analysis are pointing towards adding more demand side response to ensure an efficient transition

Attention from the authorities and grid companies towards flexibility has increased in recent months.

Flexibility is regarded as a key instrument to achieve an efficient transition towards a greener society





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Source: "Forventninger til fremtiden systemydelser 2024-2040", Energinet (2024)

3 Introducing FlexPlatform to unlock flexibility

FlexPlatform secures that energy assets are matched across technologies and can be marketed

HVAC
Flex potential: ~40 %

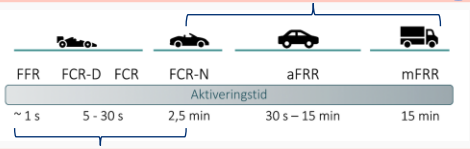
Cooling storage
Flex potential: ~40 %

Process facility
Flex potential: ~25 %

Heat pumps
Flex potential: ~40 %

EV charging
Flex potential ~15%

Manuel og Automatic Reserves



Spot market, Tariff optimization and DSO-market

Aggregator, who markets the flexibility into the relevant markets

Frequency Reserves

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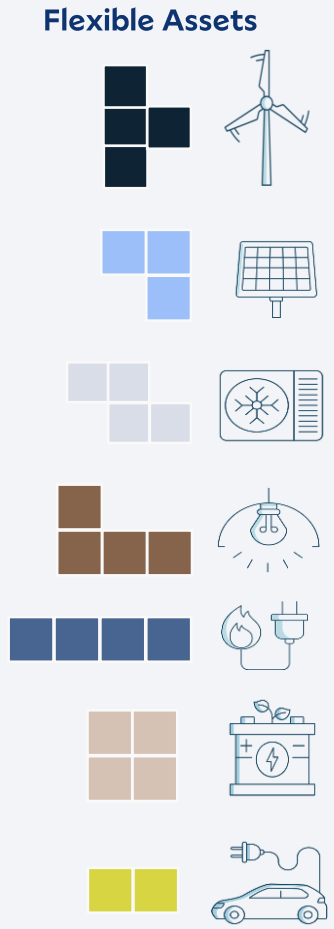
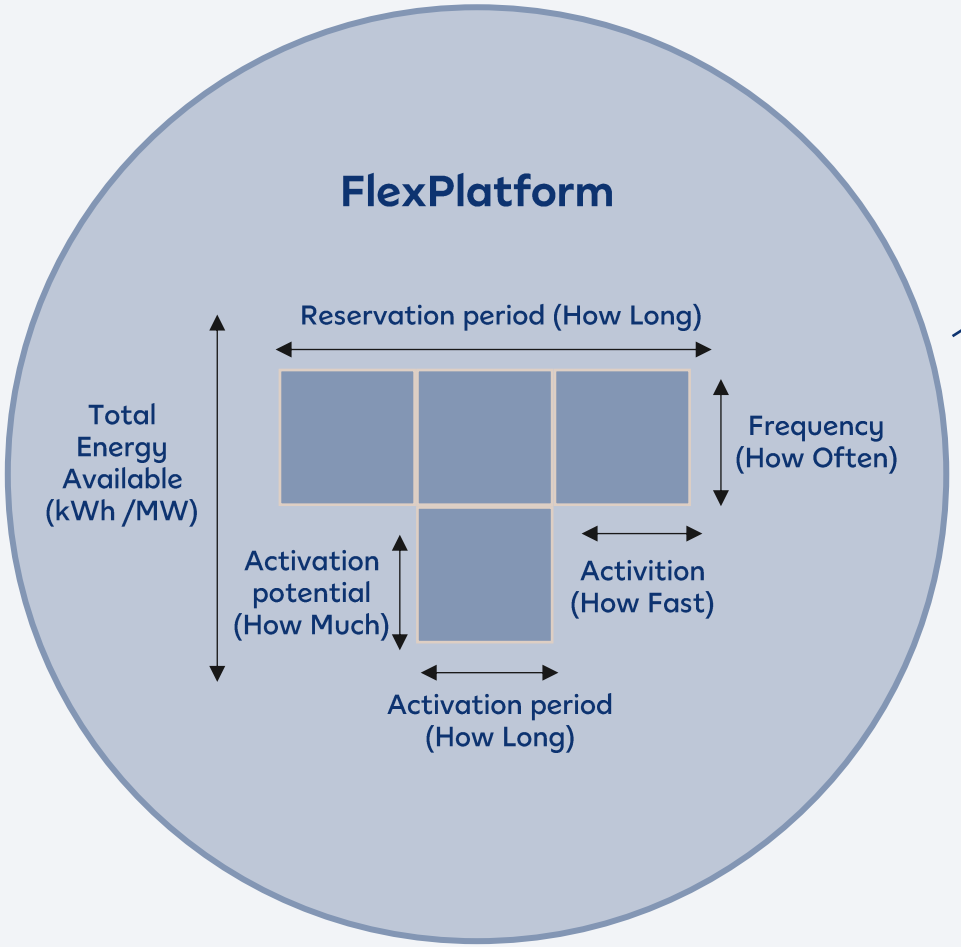
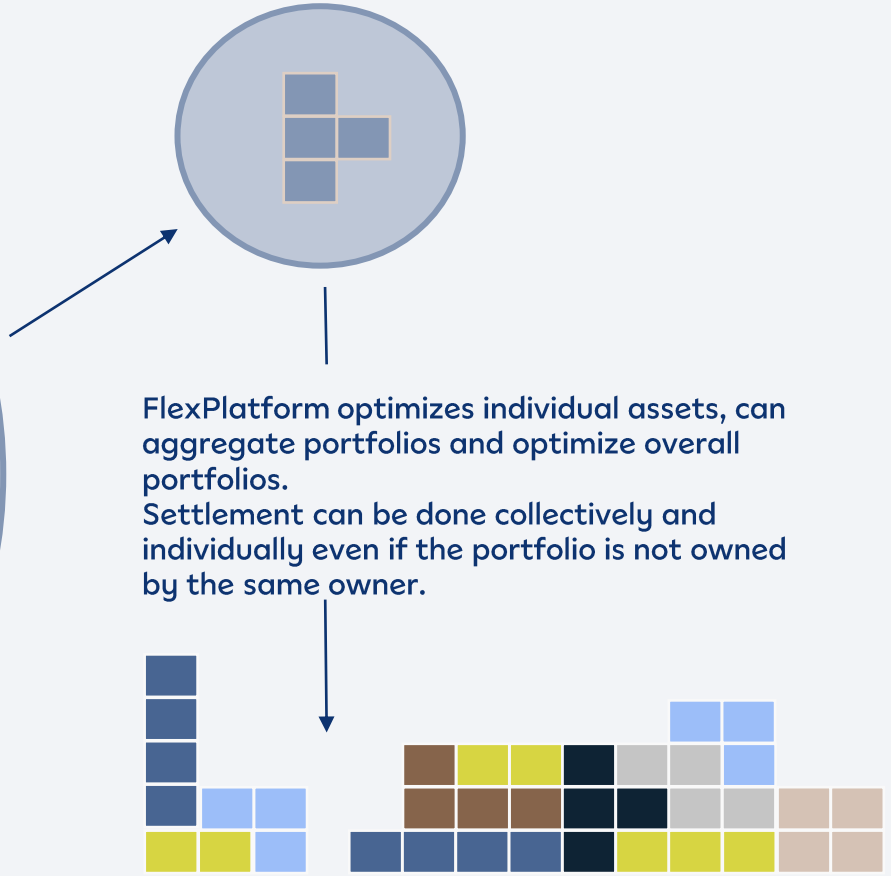
Aggregators are supported by AI and IoT to ensure optimized portfolios

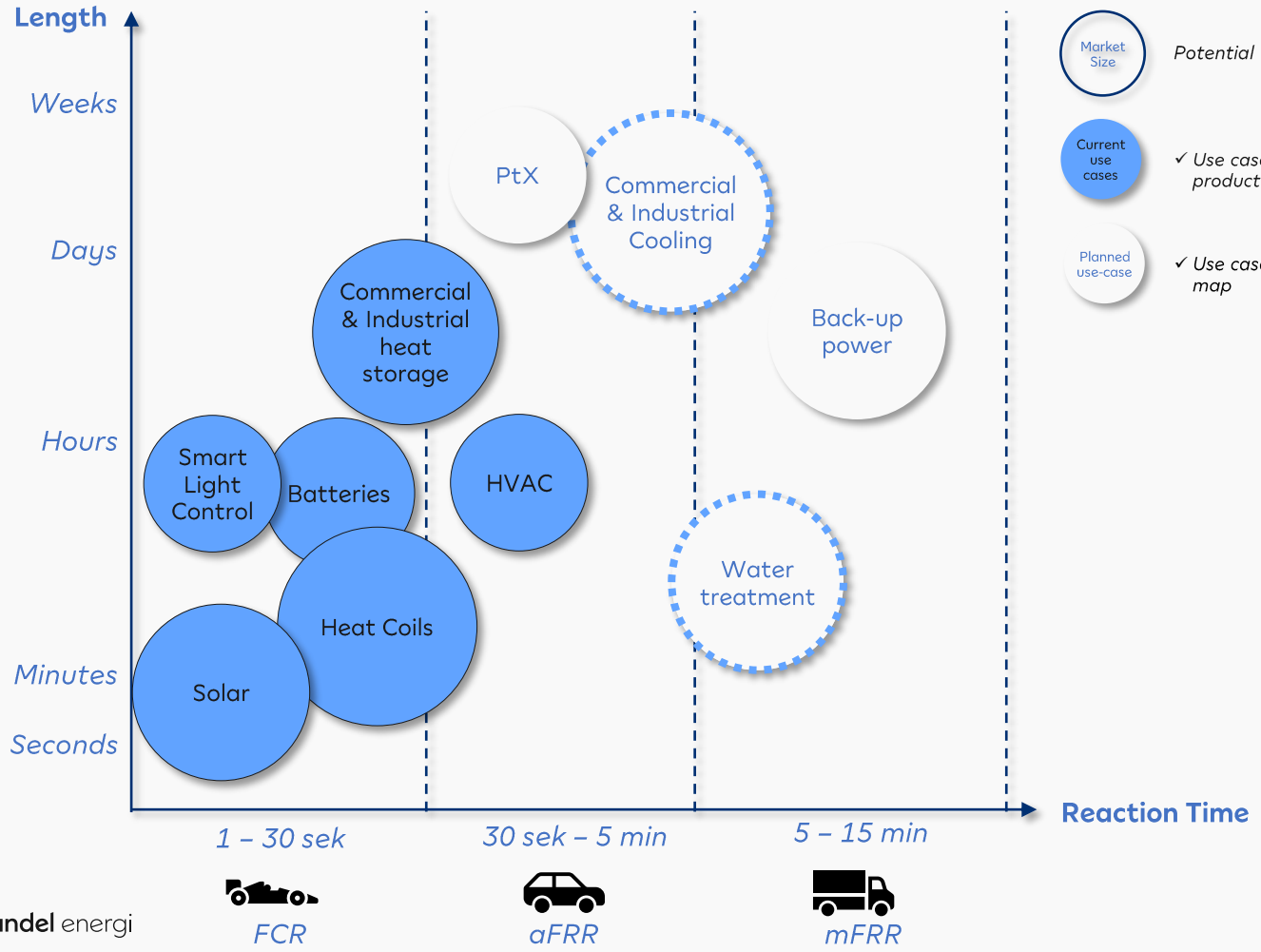






AI and ML forecasts and optimizes Flexibility based on extensive asset data

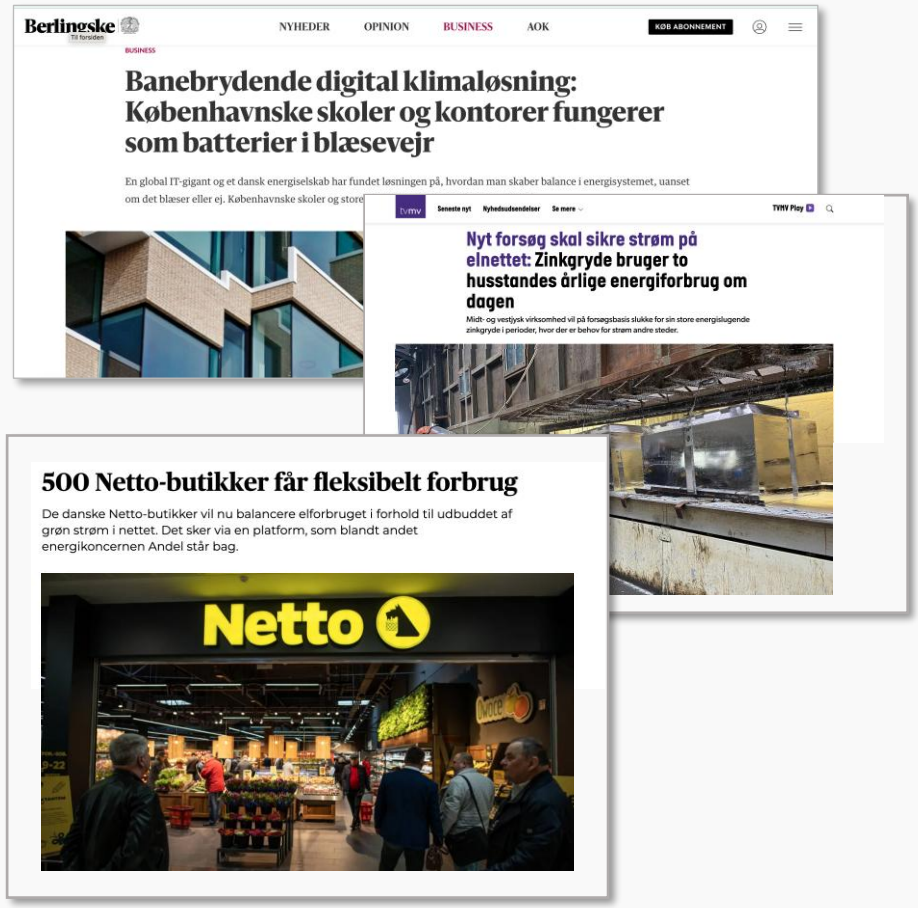
There is a significant amount of flexibility available in our consumption – we just need to reach out for it



Market Size — *Potential*

Current use cases — ✓ *Use cases in production*

Planned use-case — ✓ *Use cases in rood map*



Berlingske

NYHEDER OPINION BUSINESS AOK KØB ABONNEMENT

Banebrydende digital klimaløsning: Københavnske skoler og kontorer fungerer som batterier i blæsevejr

En global IT-gigant og et dansk energiselskab har fundet løsningen på, hvordan man skaber balance i energisystemet, uanset om det blæser eller ej. Københavnske skoler og store

Nyt forsøg skal sikre strøm på elnettet: Zinkgryde bruger to husstandes årlige energiforbrug om dagen

Midt- og vestjysk virksomhed vil på forsøgsbasis slukke for sin store energislugende zinkgryde i perioder, hvor der er behov for strøm andre steder.

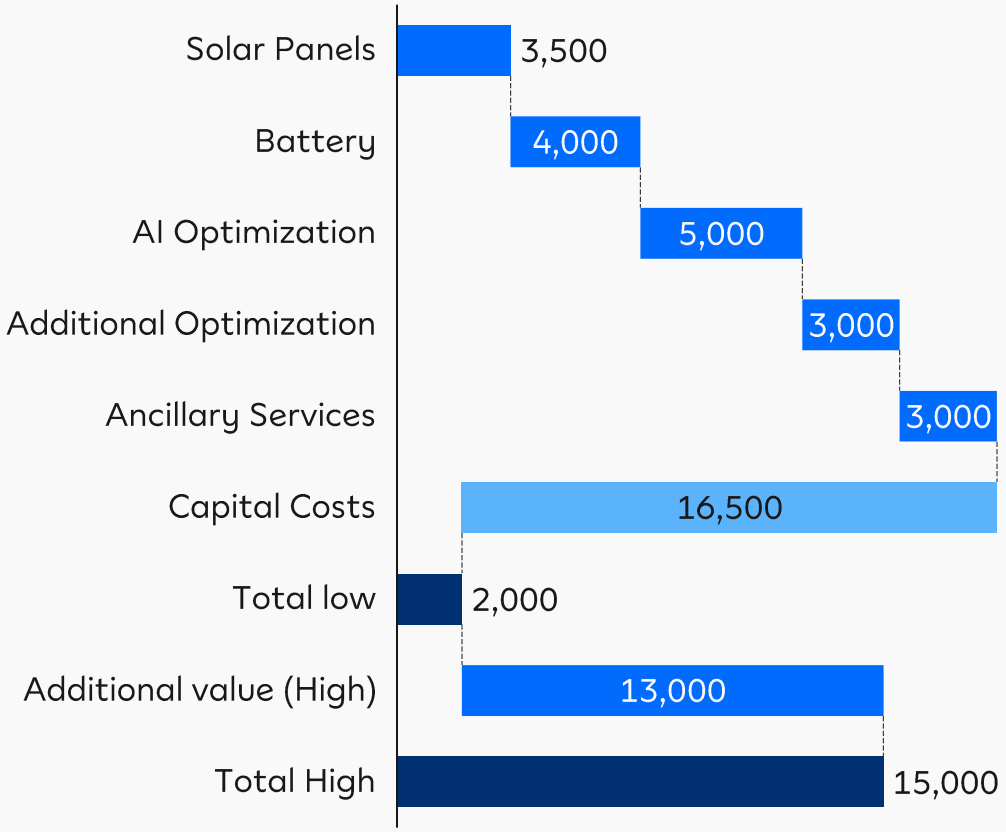
500 Netto-butikker får fleksibelt forbrug

De danske Netto-butikker vil nu balancere elforbruget i forhold til udbuddet af grøn strøm i nettet. Det sker via en platform, som blandt andet energikoncernen Andel står bag.

Netto

Case 1: Solar energy and batteries give the consumer new opportunities and value streams

Value streams for green energy solutions in a one-family home (DKK/Year)



Installation of 6 kW solar panels

Solar panels will produce around 6.000 kWh/year. Approx 30-40% will be used – the rest will be sold to the grid at spot price

Installation of 20 kWh Battery

The battery will extend the usage of solar power to times of day when its not shinning. It will double the usage of solar to 70-80%.

AI optimization of energy balance

Optimization so that solar is curtailed if negative prices and optimize purchase in winter plus orchestrate heat pump and EV charge

Ancillary Services

Selling flexibility to the grid operator(s) and thereby helping stabilize grid balancing

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Case 2: Sustainable solutions for businesses are ready for lift-off

Situation:

- 300 kWp solar panels on top of garages at Andel Ballerup site
- Normal consumption for offices with storage facilities
- Significant sale of surplus production to the grid (incl. at negative prices)

Solution:

- Installation of 2x 100 kWh batteries with 125 kW inverter capacity
- Batteries are built from used car batteries and thereby extending the life of batteries with 10+ years
- Development and implementation of Behind-the-Meter optimization algorithms to ensure further value creation and sale of Ancillary Services

Good economic foundation with payback in 3-5 years and ROI >20%

Reduces environmental impact significant

Extended usage of second-hand batteries

4 Conclusions

Demand Side Response is not a silver bullet that magically solves everything

We still need significant investments and decisions to achieve our goal of a sustainable, affordable and resilient energy sector

1. Amble electricity grid to ensure that the consumers have energy when they need it
2. More efficient data exchange that enables transparency and efficiency
3. Higher standardization across assets to ensure interoperability

Thank you for the attention!