Global Load Management
Interest Group

40th PLMA Conference

Nov 4, 2019-11-04, St. Petersburg, Florida

GLM Overview

Goal

Enlarge PLMA's scale by promoting the exchange of ideas among DR and DER practitioners around the world

Chairs:

- Scott Coe, GridOptimize
- Jon Hilowitz, Orange & Rockland Utilities
- Ros Malme, Skipping Stone

Executive Sponsor:

- Michael Brown, NVEnergy

GLM Activities

- Handle requests from international organizations for PLMA membership, PLMA materials usage, PLMA conference speakers
- Track requests and report to board on international interest
- Provide venue for international topics both via webcasts and at conferences

GLM Activities: Contemplated

- On-site, overseas workshops to bring expertise to new countries
- “Utility Exchange” to pair US and international utilities with similar profiles
- Collaboration via on-line tools
- Support international training opportunities
- “Opportunity Clearing House” for international utilities to solicit solution from US providers
- Awareness training, focusing on educating policy makers on DR/DER facts

Flexible Wind Power

How European generators can earn more by producing less

40th PLMA Conference – Global Load Management| 04/11/19 | Next Kraftwerke

Evolution of European utility business

Advantages…

- Forecastable
- Dispatchable
- Reliable

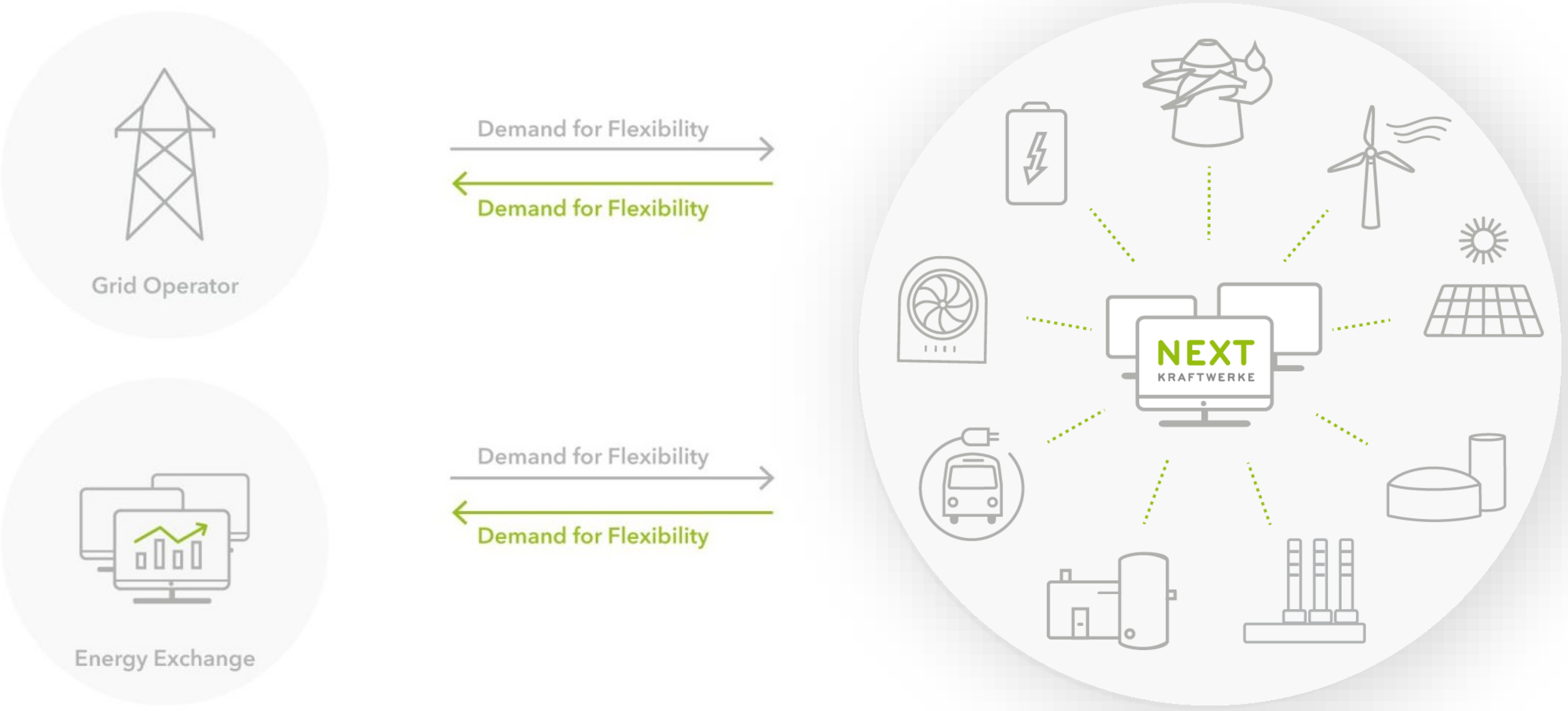
…and disadvantages

- Emissions
- Large investments
- Long planning cycles

Evolution of European utility business

	1990	2018	
Number of power plants in Germany	800	1,600,000	Decentralisation
Number of spot exchanges in Europe	0,00	12	Liberalisation
Number of LTE connections (global)	0,00	1,134,000,000	Digitisation
Energy sources	Fossil & nuclear energy sources	Renewable & fossil energy sources	Nuclear phase-out & decarbonisation

What is a Virtual Power Plant?



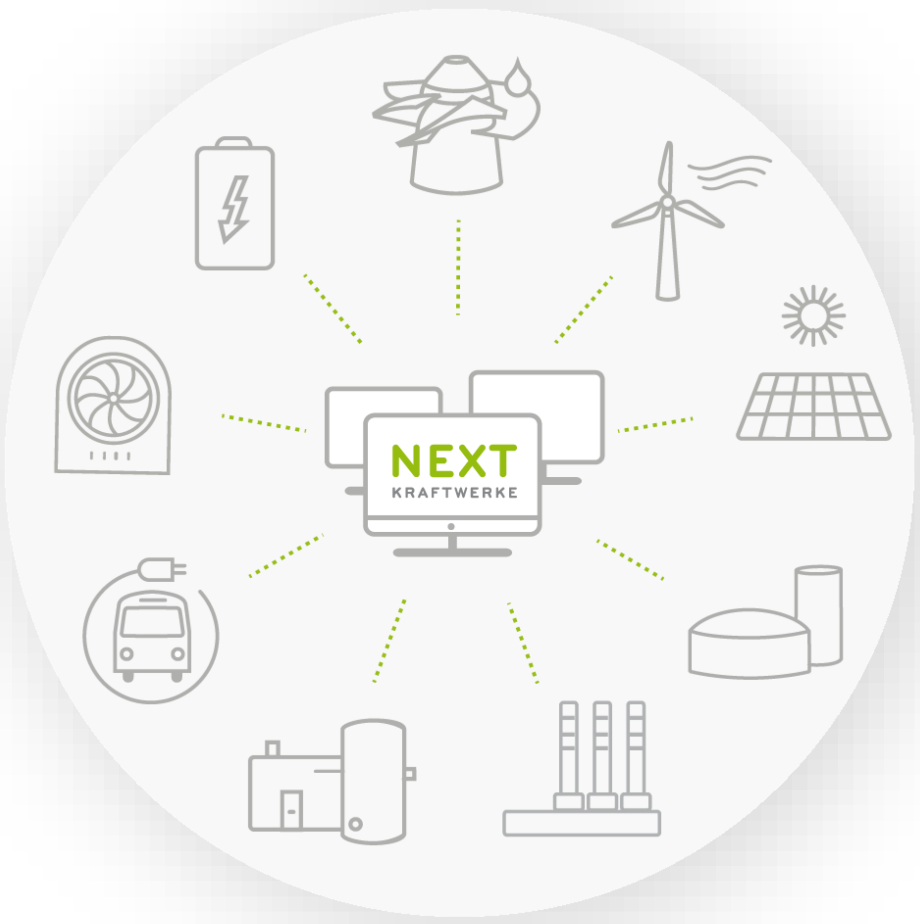
What does a Virtual Power Plant do?

Use cases

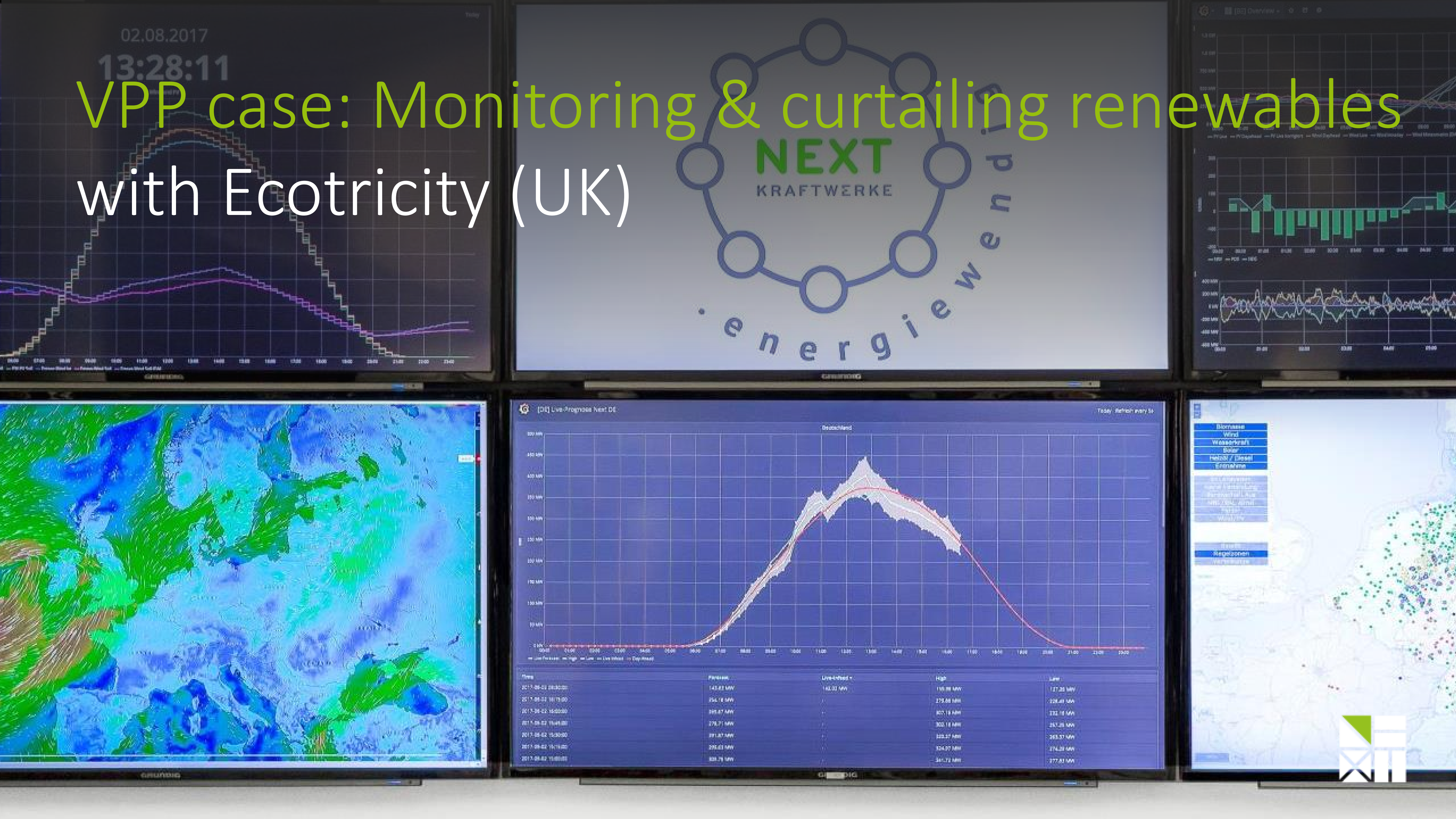
Renewables live monitoring & forecasting
Improving renewables trading

Asset Dispatch & Control
Control decentral assets based on parameters

Balancing Services:
Provide ancillary services to grid operators

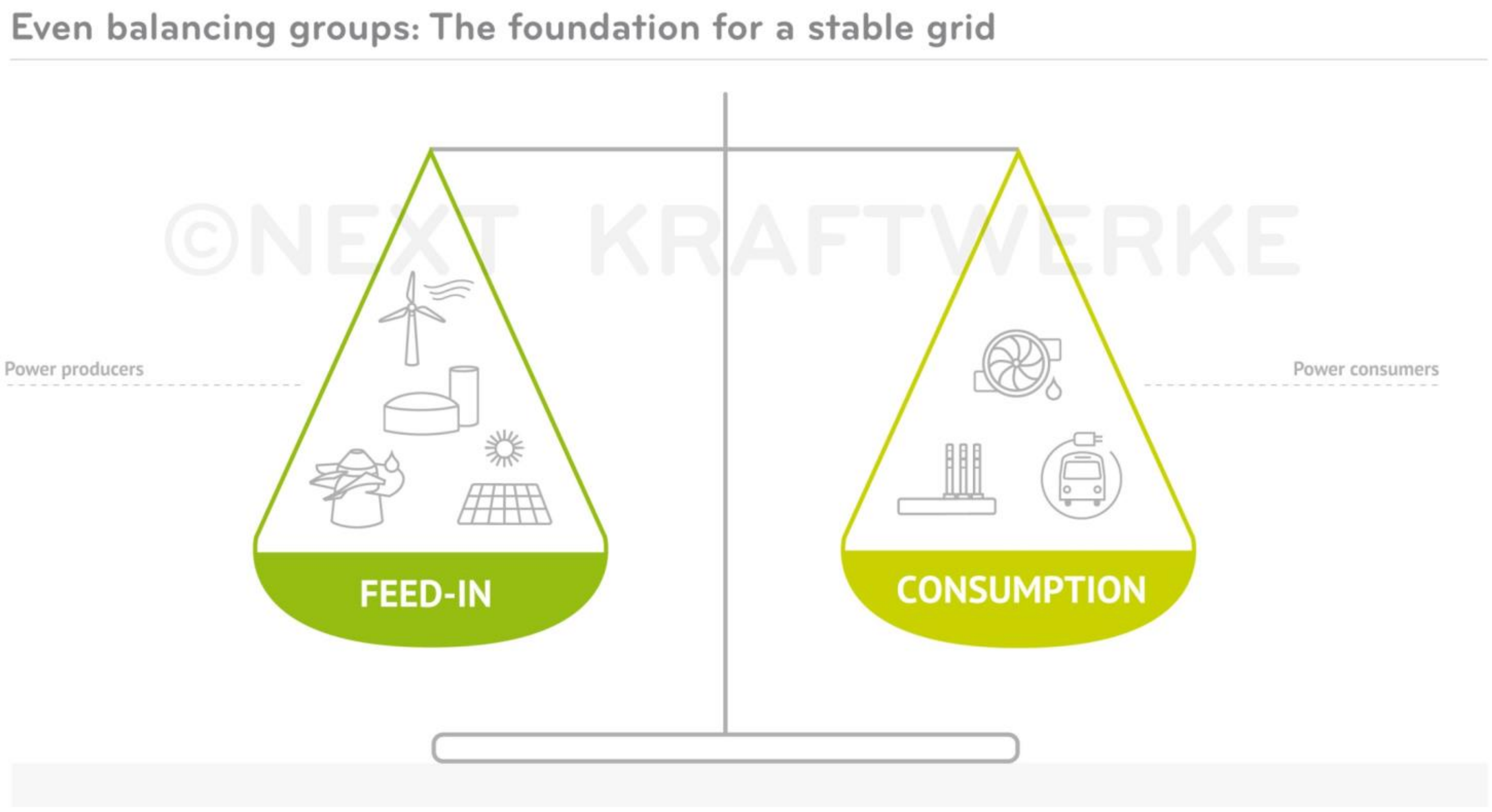


VPP case: Monitoring & curtailing renewables with Ecotricity (UK)



Why monitoring & forecasting

The utilities' balancing challenge

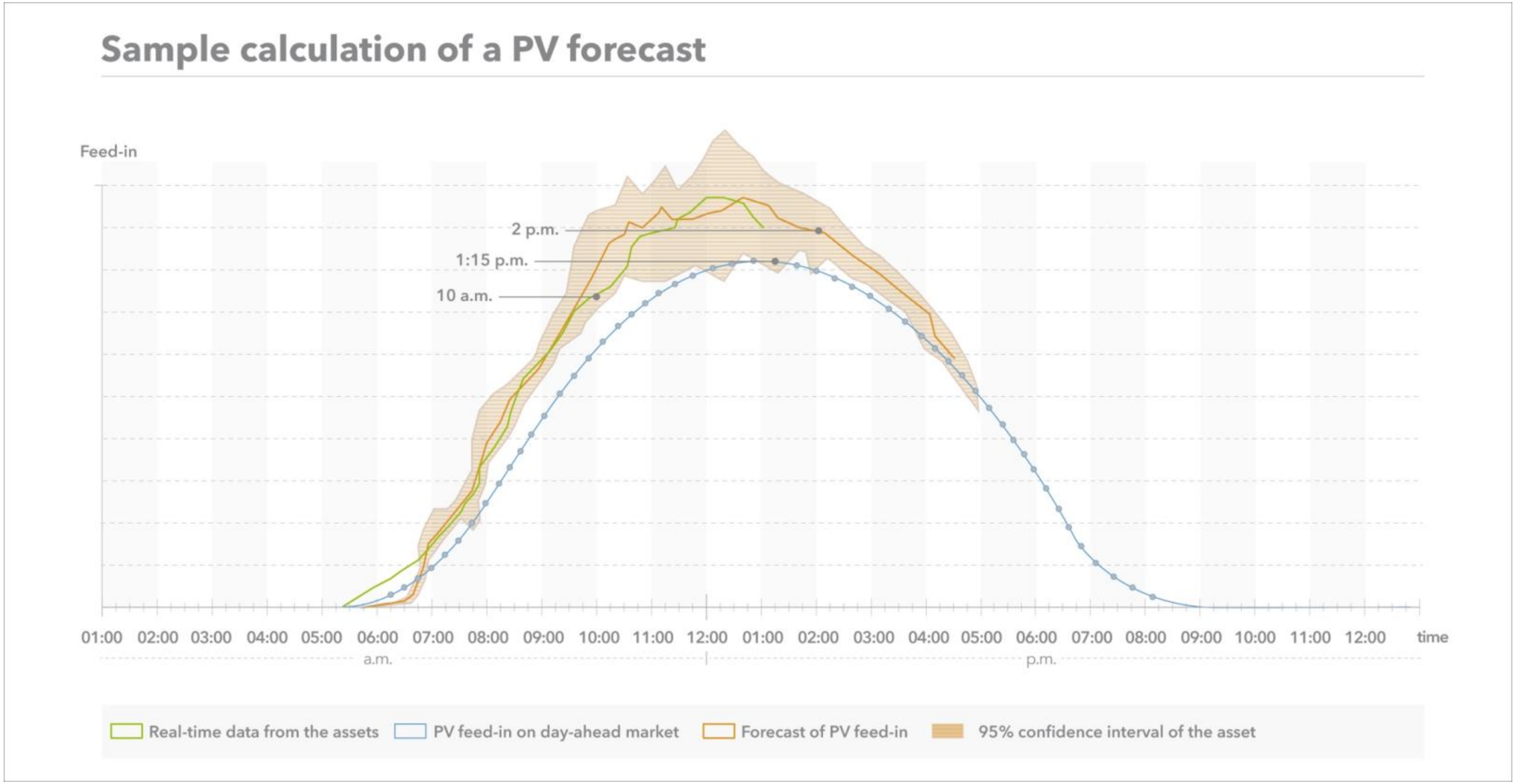


Live monitoring & forecasting

The recipe for a renewables forecast

Live monitoring & forecasting

Optimized trading through forecasting based on live data



Ecotricity: curtailing wind power

Ecotricity is Great Britain's first green energy utility. They…

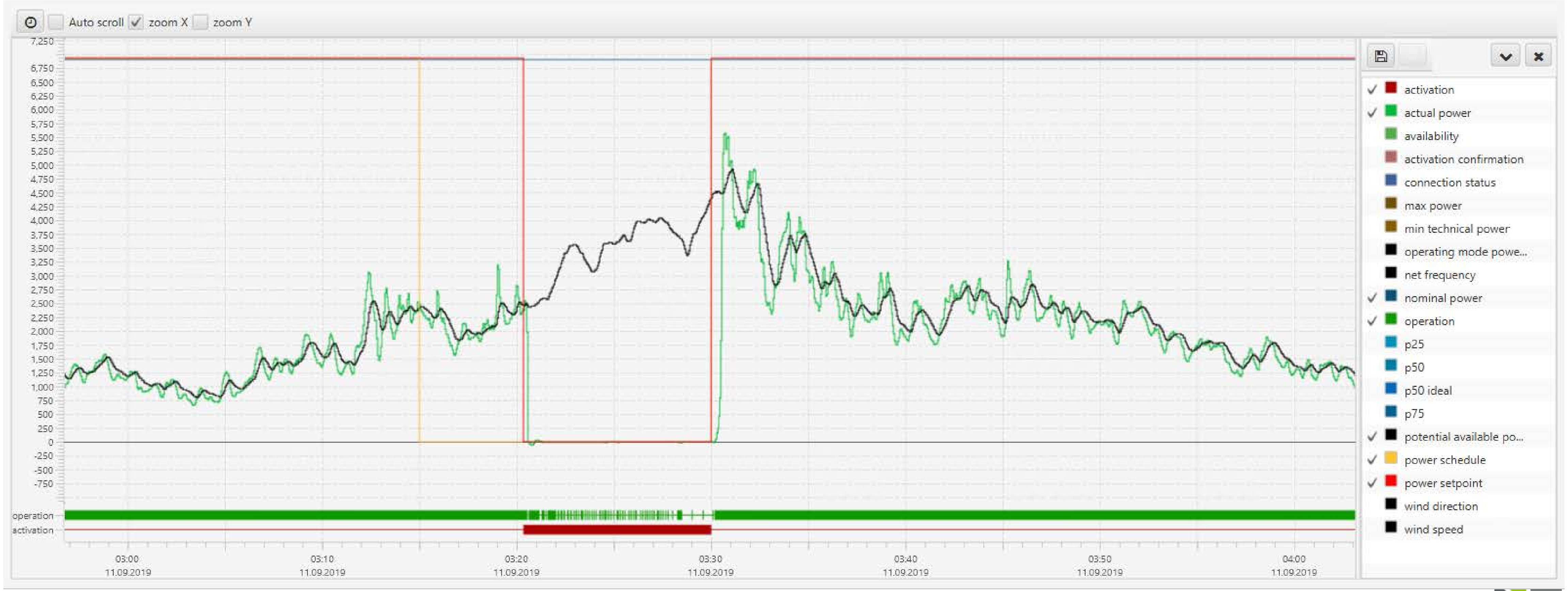
- supply green energy to C&I and residential customers
- produce & off-take renewable electricity
- partnered with Next Kraftwerke to develop a VPP business

Mark Meyrick, Head of Trading and Smart Grids at Ecotricity: "Ecotricity is, more than any other supplier, subject to intermittency (due to our renewable generation). So flexibility is something we absolutely need for our own portfolio, as well as for providing intelligent flexibility services to a wider pool of clients."

Ecotricity: curtailing wind power

Optimizing imbalance costs in short-term trading of renewables

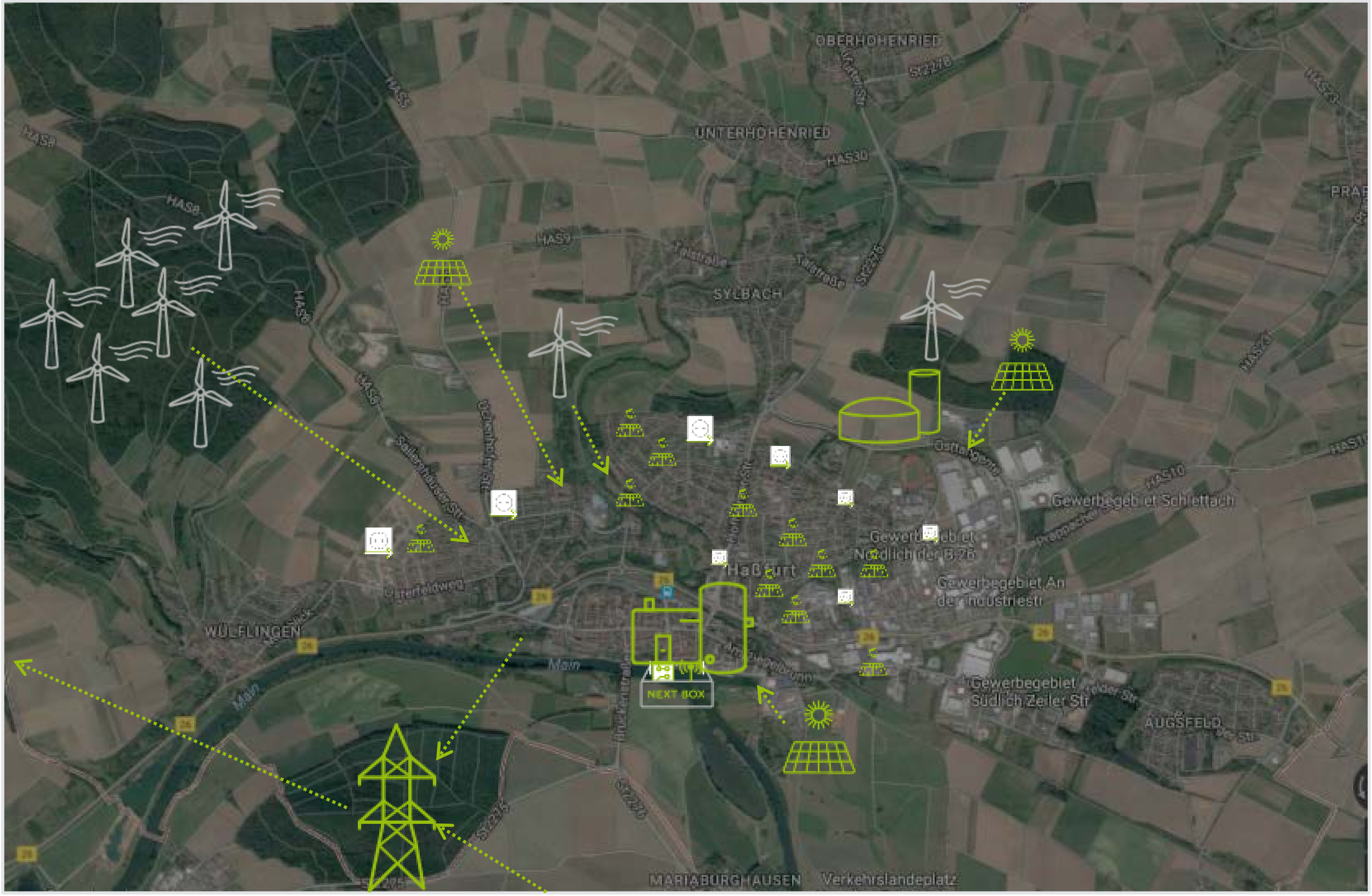
- Example illustration of curtailment through the VPP system, e.g. during extreme wholesale prices



VPP Case Study: dispatching power-to-gas with Greenpeace Energy (DE)

The city of Haßfurt

The distribution grid´s components

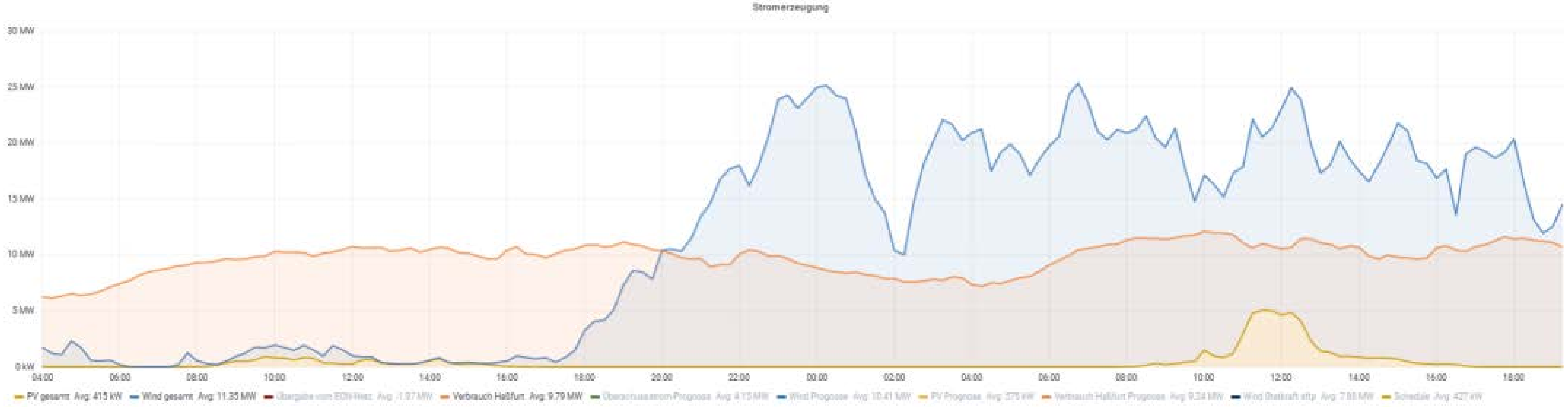


The gas grid

OBERHOHENRIED
UNTERHOHENRIED
SYLBACH
Haßfurt
WÜLFLINGEN
AUGSFELD
MARIABURGHAUSEN
Verkehrslandeplatz
Gewerbegebiet An der Industriestr
Gewerbegebiet Südlich Zeiler Str
NEXT BOX

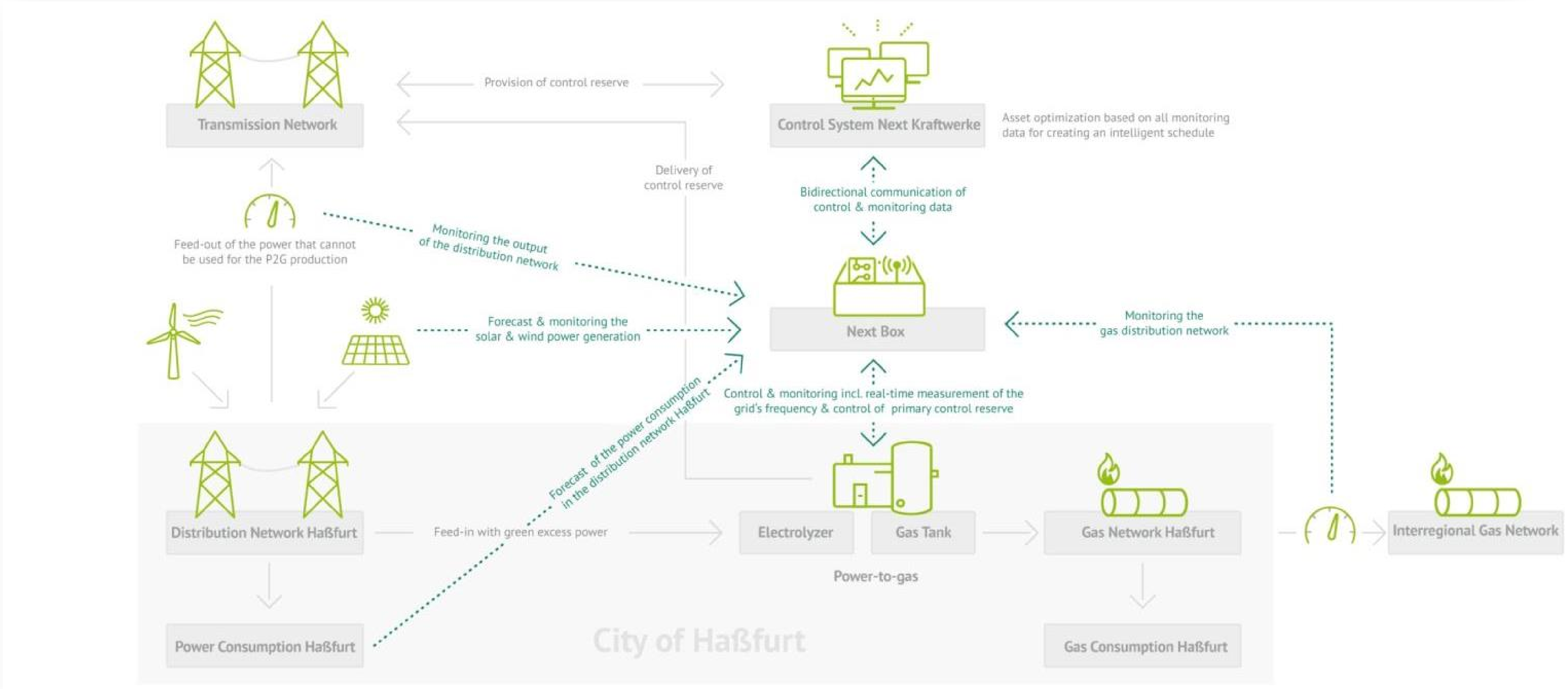
Optimization through the VPP

Generation from wind + Generation from PV – consumption of municipality = excess electricity



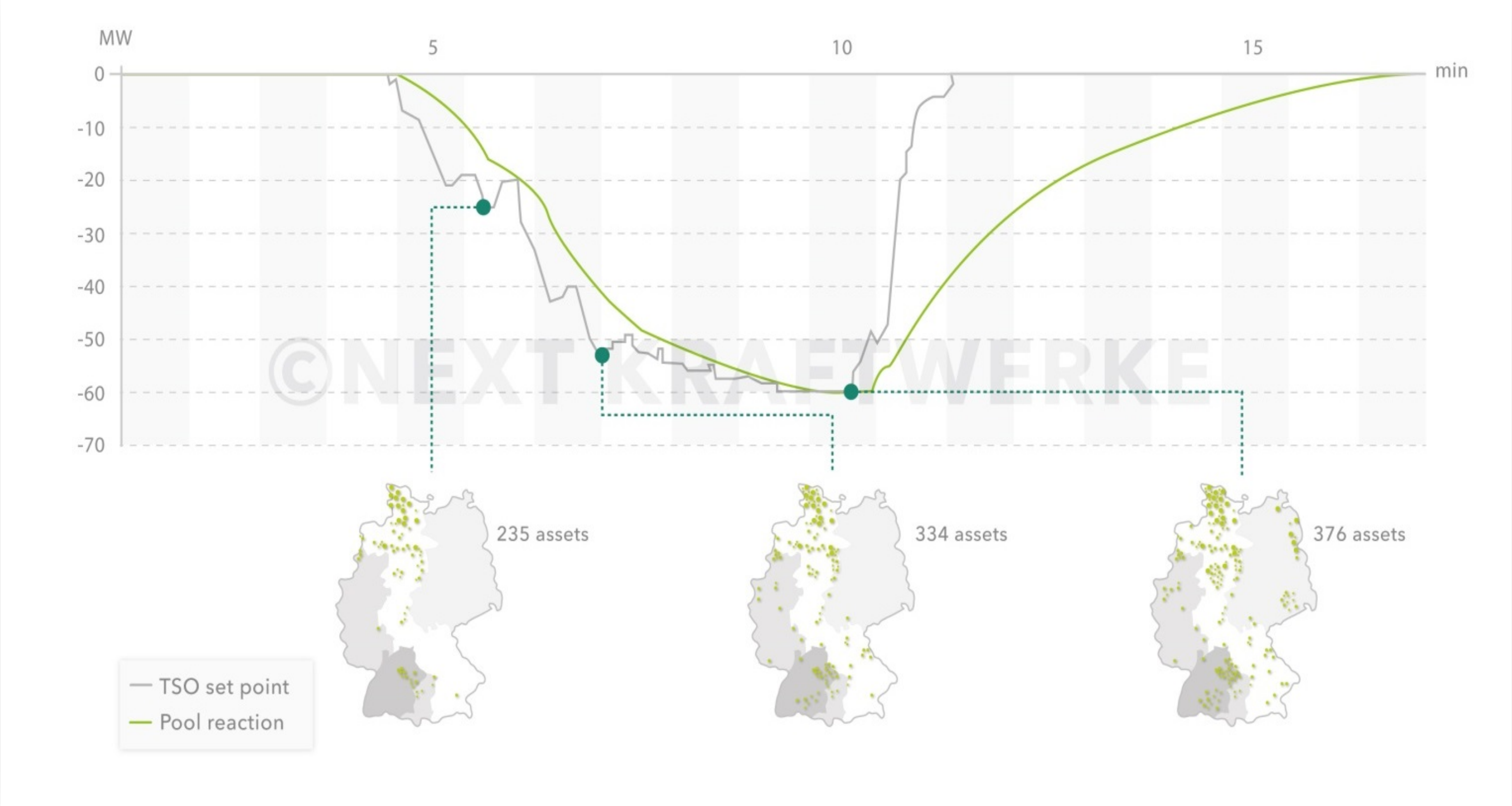
Power-to-gas system overview

VPP integration of the power-to-gas unit Windgas Haßfurt



One of many: balancing services at scale

Example activation of DER for secondary (spinning) reserves (mFRR) in Germany



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The Next Box

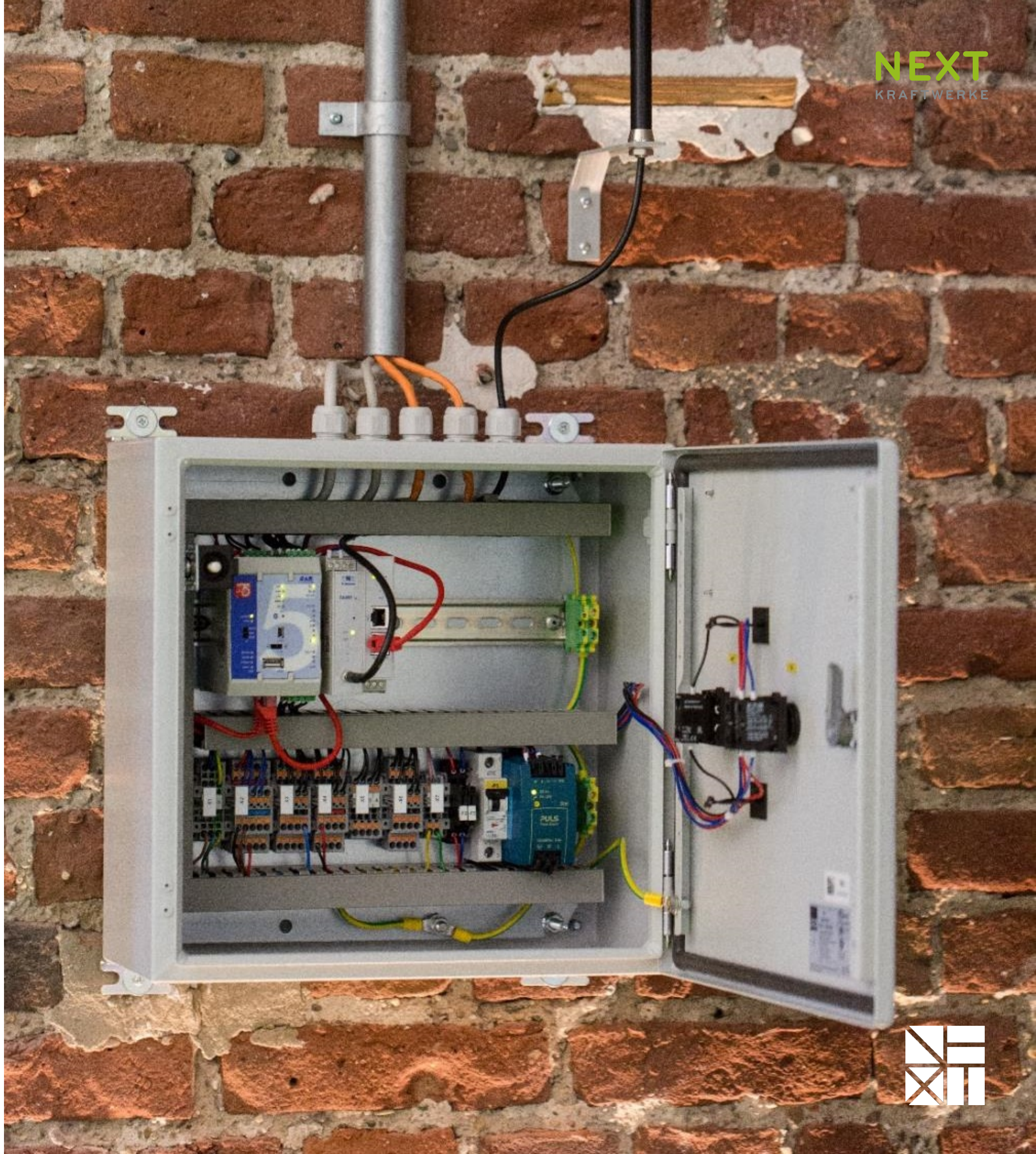
Connect, collect & control

The Next Box connects the asset with the VPP

- Installed on site, connected to local SCADA
- Direct control via PLC possible
- Communication via closed user group (private APN)

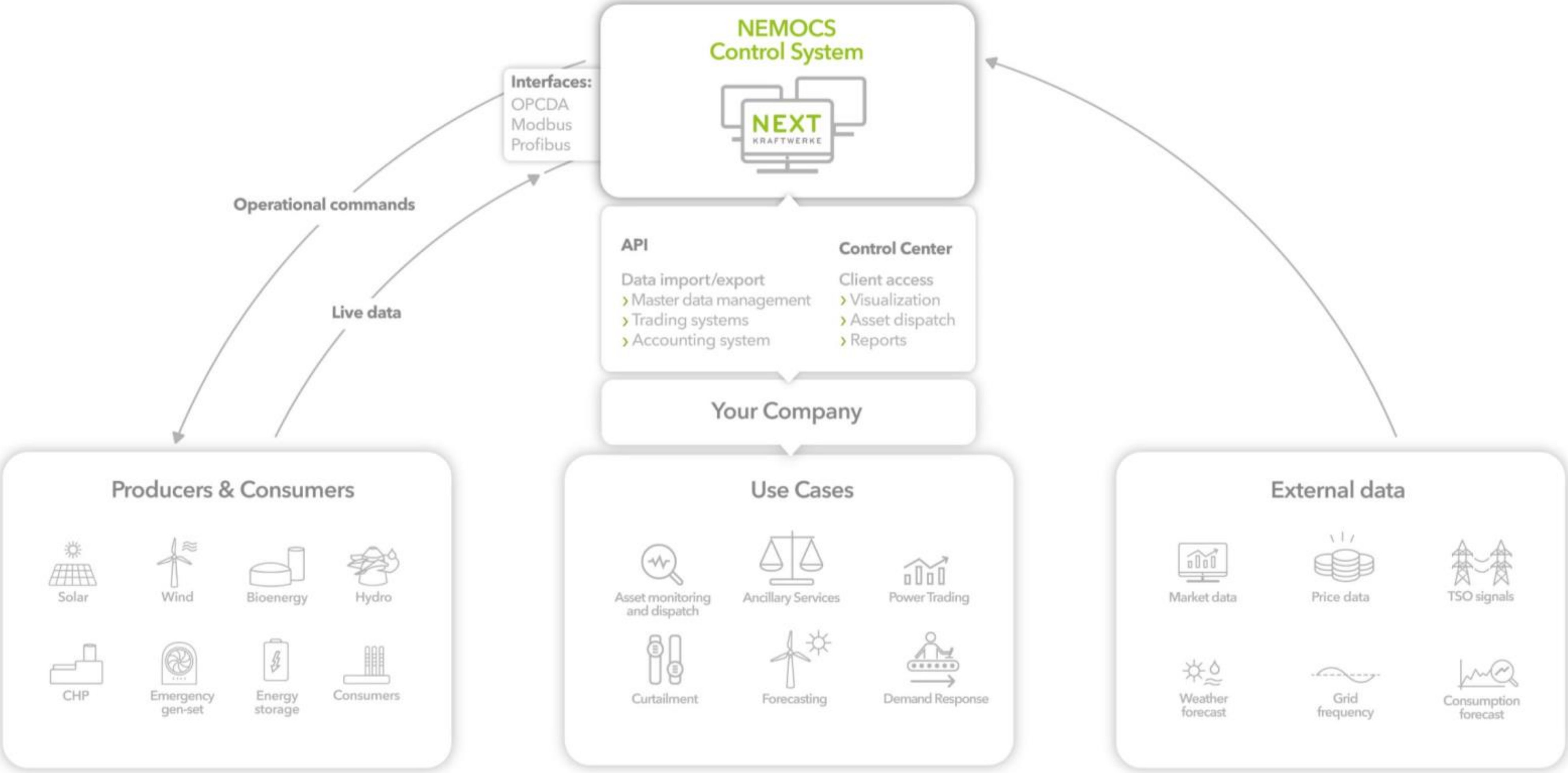
Examples of exchanged data points

Designation	direction	Unit
Active power	receive	kW
Availability signal	receive	0/1
Grid connect	receive	0/1
Activation	send	kW
Set point	send	kW
SOC of battery/gas tank	receive	%
Frequency	receive	Hz



Overview

NEMOCS as platform for your VPP & DR use cases



Our Virtual Power Plant

"In 2009, we started with our vision of a Virtual Power Plant. Today, we operate one of the largest Virtual Power Plants in the world."

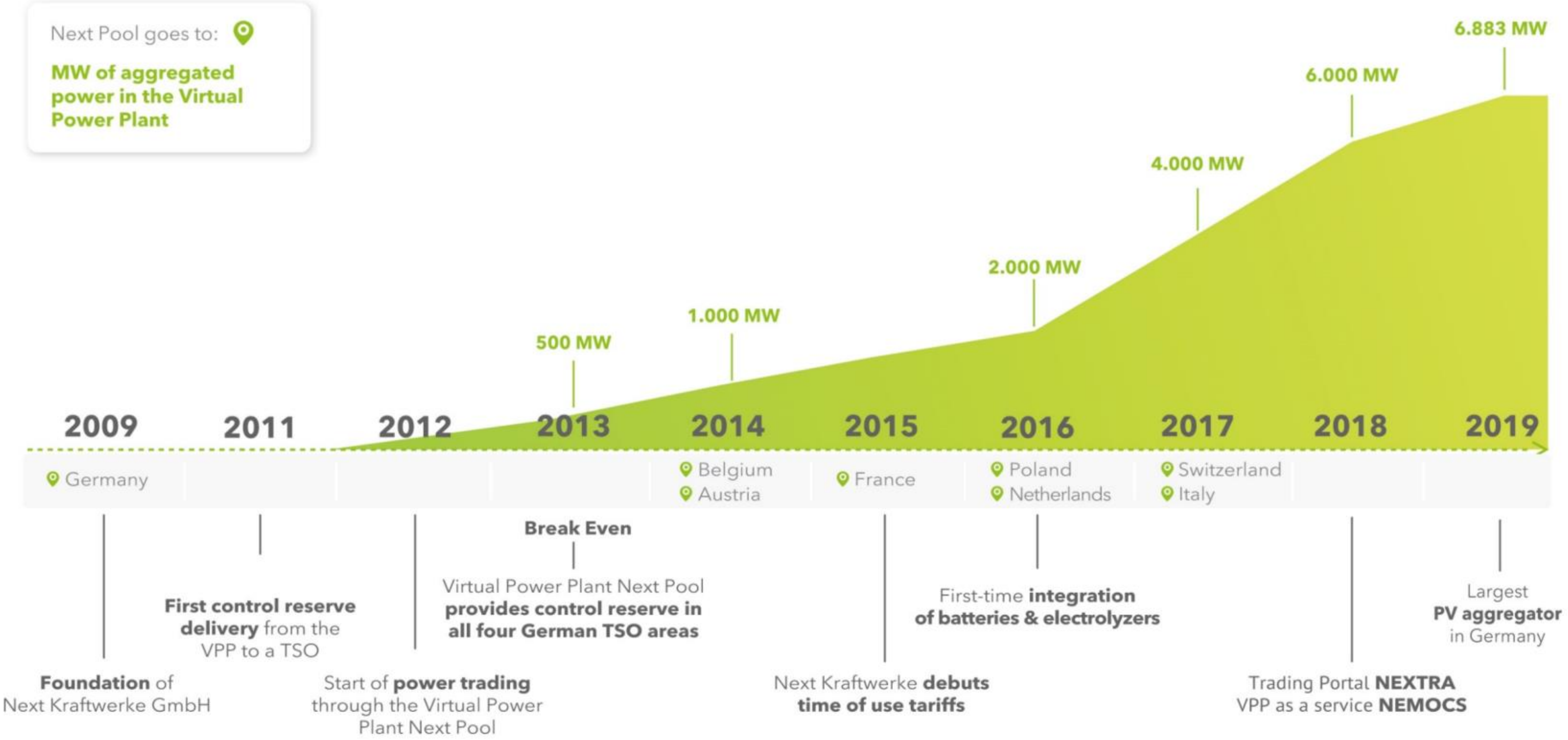
Jochen Schwill & Hendrik Sämisch
(Founders & CEOs)

Aggregated Power: **6,000 MW**

Aggregated Assets: **6,500**

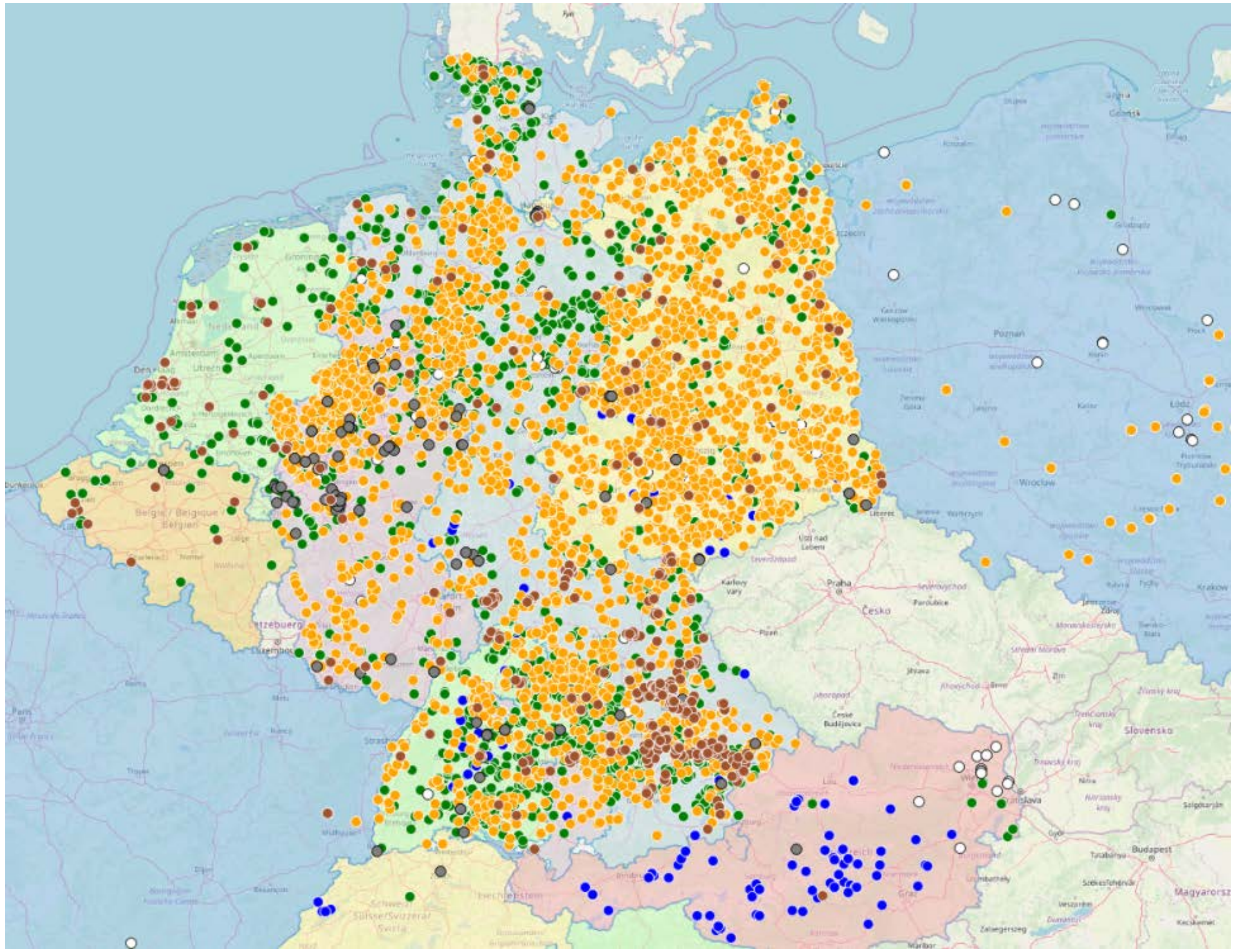
Providing services to: **8 system operators**

Milestones



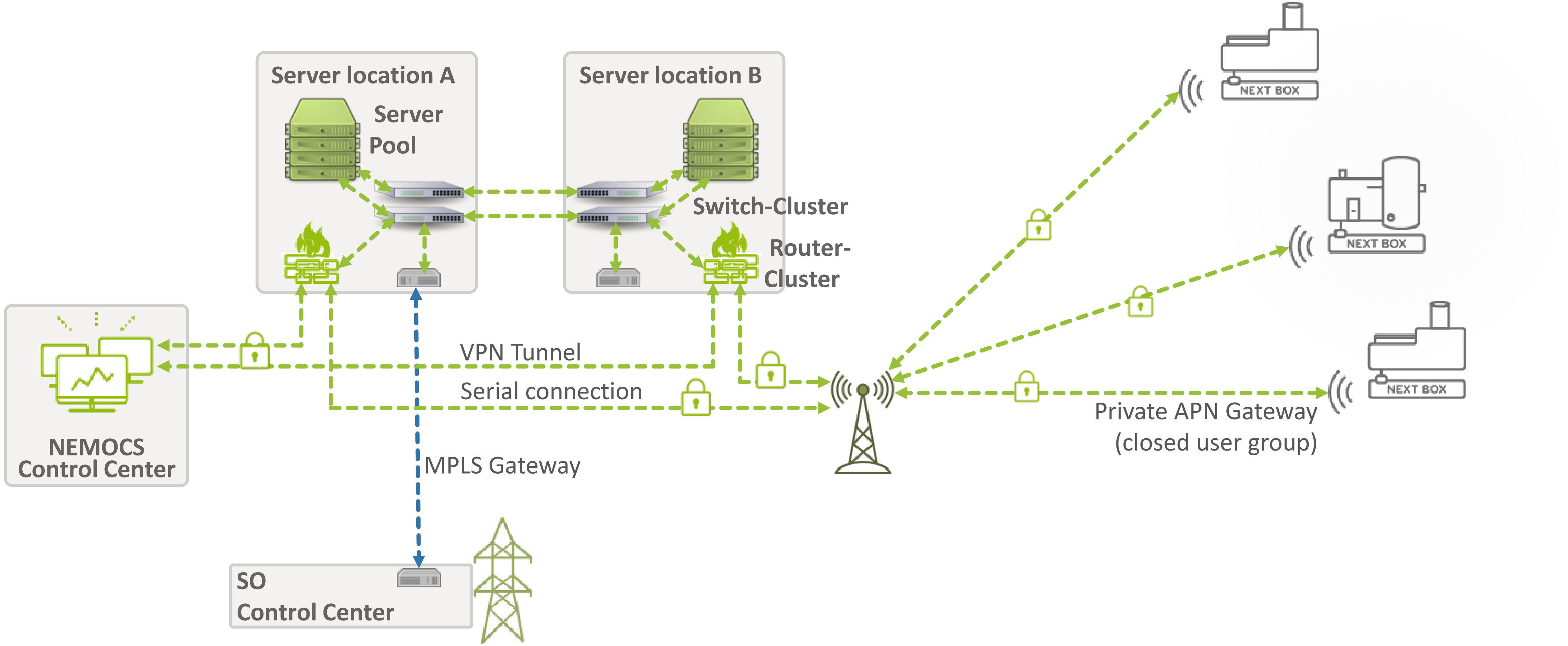
Next Pool goes to:
MW of aggregated power in the Virtual Power Plant
500 MW
1.000 MW
2.000 MW
4.000 MW
6.000 MW
6.883 MW
2009
2011
2012
2013
2014
2015
2016
2017
2018
2019
Germany
Belgium
Austria
France
Poland
Netherlands
Switzerland
Italy
Foundation of Next Kraftwerke GmbH
First control reserve delivery from the VPP to a TSO
Start of power trading through the Virtual Power Plant Next Pool
Break Even
Virtual Power Plant Next Pool provides control reserve in all four German TSO areas
Next Kraftwerke debuts time of use tariffs
First-time integration of batteries & electrolyzers
Trading Portal NEXTRA
VPP as a service NEMOCS
Largest PV aggregator in Germany

What is a Virtual Power Plant?



VPP infrastructure

High level draft of example layout



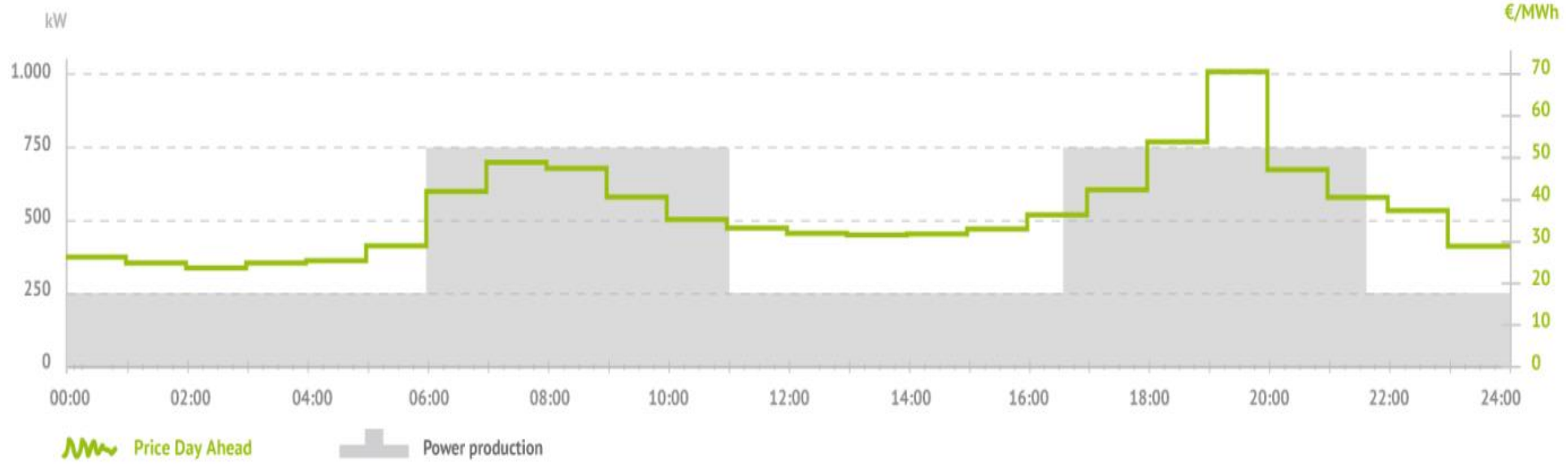
Dispatching of distributed generation

Controlling of decentral assets through price based schedules

Through the NEMOCS Control Center, or via an API, your connected assets can be dispatched and controlled in real-time

Your Benefits

Allowing for higher revenue by trading your dispatchable generation & flexible demand based on wholesale market prices



"With his biomethane CHP, Stefan Kienz produces power when it most valuable, based on dispatch signals from the VPP."

Demand side flexibility: pumps

Optimizing Energy Costs – Active Dispatch of Consumers

Overview - *Water pumps*

- Consume power when the demand at the power exchange is low and power costs less
- Price forecasts in different time intervals available

Benefits

- Harmonizing power supply and demand for the entire system
- Saving up to 30% on energy costs

Regulatory Barriers

- Grid charges for peak demand

Matthias Reimers shifts the power consumption of his pumps to times with lower power prices.

2nd life EV batteries - their role in the energy storage landscape

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Mark BAILEY
Chief Commercial Officer
Connected Energy (UK) Ltd
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Energy storage using 2nd life EV batteries

E-STOR 1200/720 installed on an industrial site in Belgium

Who we are…… a leading innovator with global reach

- Connected Energy is an award winning UK company that provides world leading energy storage systems and services.
- Dedicated to the design, manufacture and operation of world class energy storage systems.
- A business underpinned by a management team with a diverse set of skills and experience from the automotive and energy sectors.
- Backed by strategic investors Macquarie, Engie and Sumitomo to achieve ambitious international growth

ENGIE
MACQUARIE
Sumitomo Corporation

Hardware and software **system integrators**

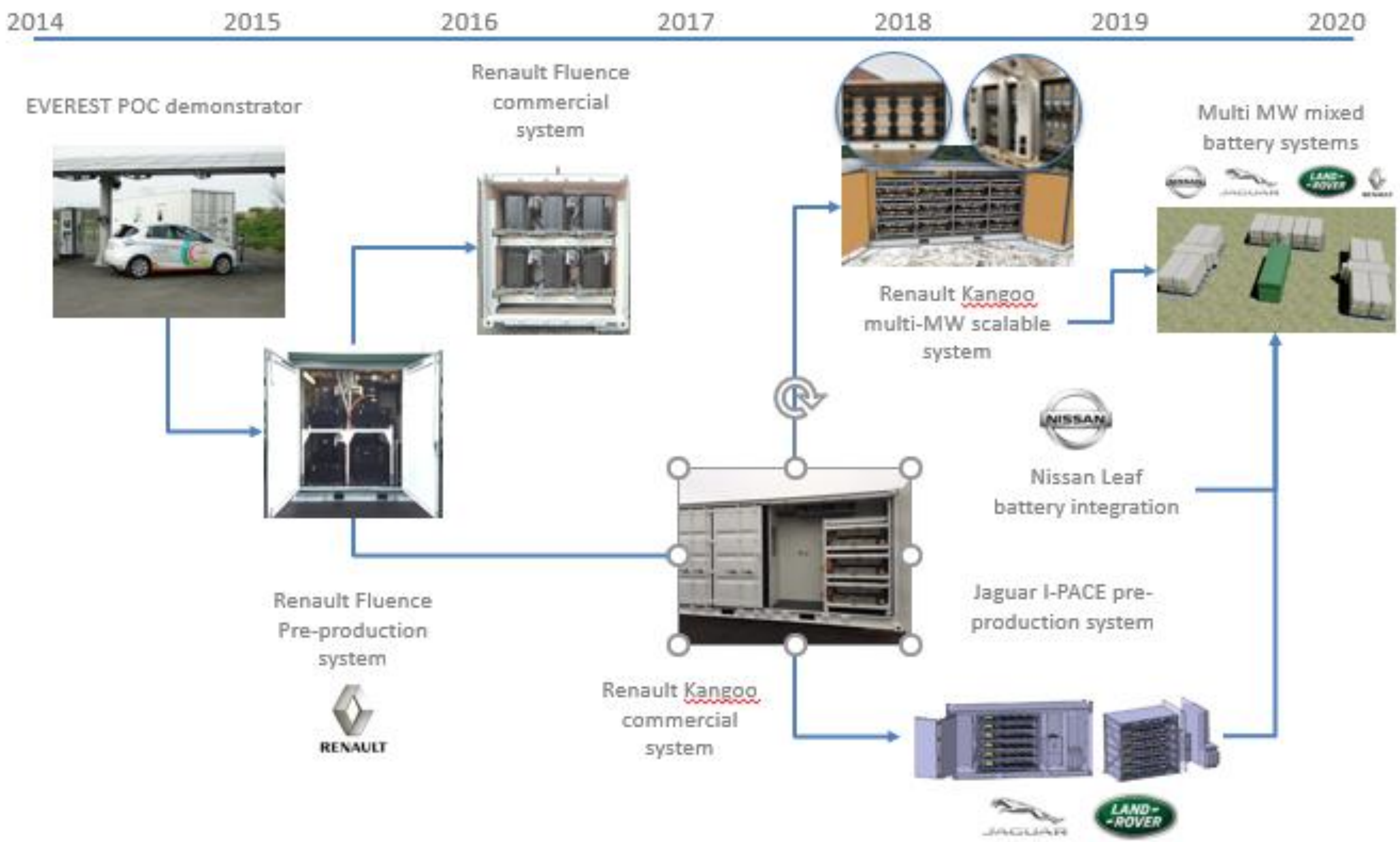
Manufacturing **supply chain developers**

Sales, operation and customer **service providers**

The E-STOR energy storage system

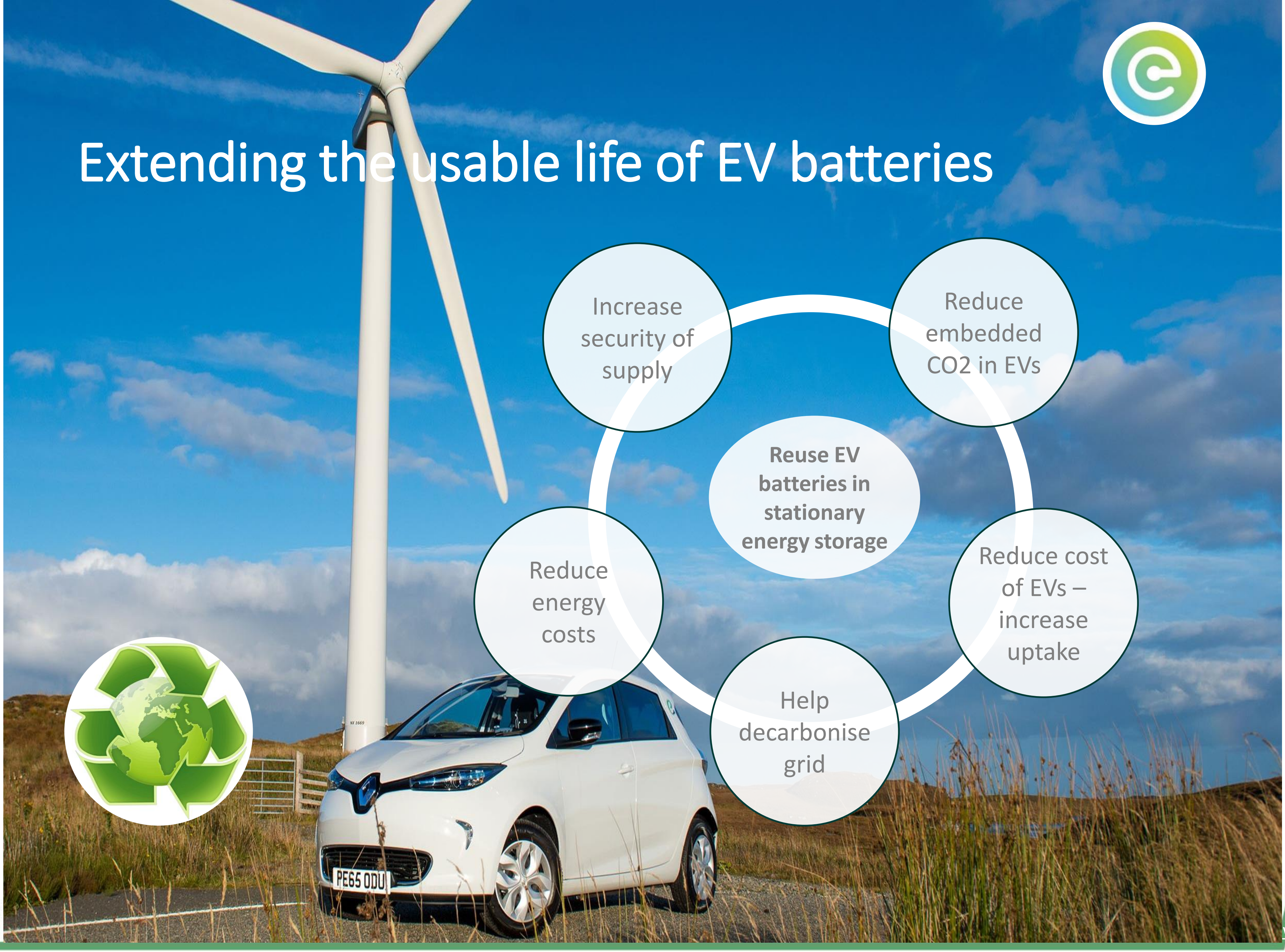
- Installed, operational and proven technology
- Modular, flexible design for low cost scalability.
- E-STOR uses (second life) EV batteries.
- **Battery/OEM agnostic**
- Integrates existing, reliable technologies.
- Operating system monitors performance and optimises system.
- Simple, low cost installation and maintenance.
- Includes variants for niche applications
- Adds sustainability to the EV and energy value chains

Integration & product development



Projects installed and in development

Extending the usable life of EV batteries

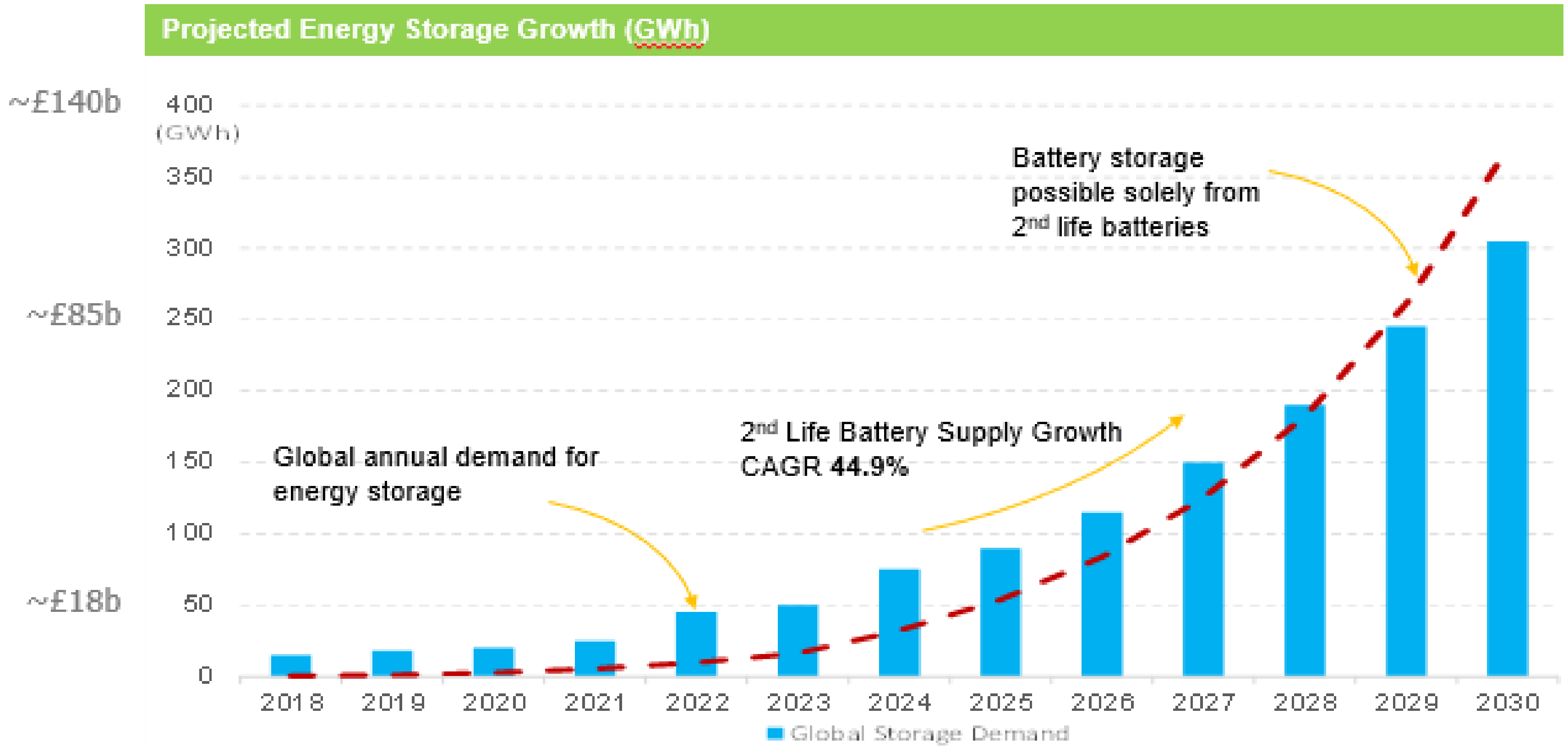


Reuse EV batteries in stationary energy storage

- Increase security of supply
- Reduce embedded CO_2 in EVs
- Reduce cost of EVs – increase uptake
- Help decarbonise grid
- Reduce energy costs

2nd Life EV battery - market opportunity

- The benefits of using 2nd life batteries and further harnessing their embedded natural resources is immense when compared with manufacturing new batteries

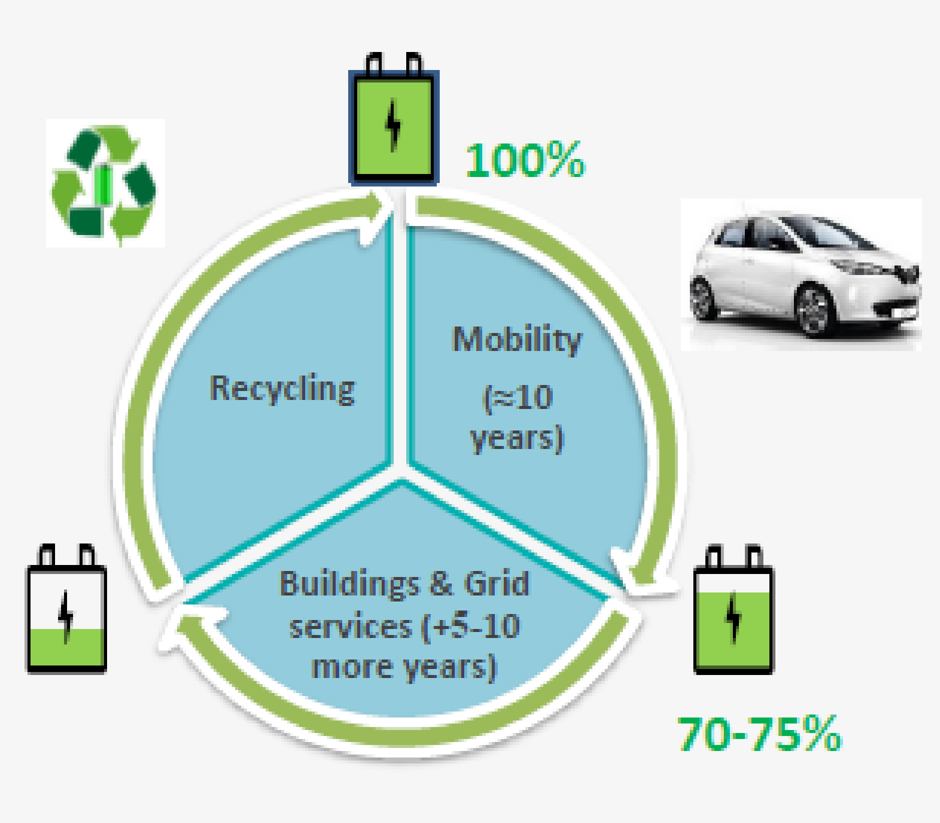


Note 1: Global Storage Demand – BNEF, Nov 2017: https://about.bnef.com/blog/global-storage-market-double-six-times-2030/
Note 2: EV battery Forecast – IEA, 2018: https://lnkd.in/fMaCYwa

- £18bn global energy storage market by 2023
- By 2030 the global demand for energy storage could be met by 2nd life EV batteries

Using EV 2nd life batteries: an attractive solution

- High Safety level
- Technical performance
- Affordable: lower price than a new battery
- Better environmental impact of the EV
- Less use of resources
- Excellent sustainable and circular economy credentials



Behind the Meter Battery Storage

- The 6 "C"s of Battery Storage
  - Consumption
  - Cost Avoidance
  - Cost of System
  - Choice of Flexibility Service
  - Capacity Market
  - Cycles
- Define the sweet spot capex v return
- Additional Benefits
  - Carbon
  - UPS
  - Security
  - Sustainability
- Future Proofing

Revenue certainty in UK

- **Transmission Charge avoidance (TRIADs)** – National Grid has published tariffs until 2024, giving assets security until then
- Risk – possibility of a reduced tariff after 2024

- **Distribution Charge avoidance (DUoS)** – Tariff published up to April 2021.
- Risk – Future tariffs will likely have a lower spread therefore reduced revenue potential

- **Capacity Market** – Programme is just reinstated, this revenue stream has the longest guarantees.

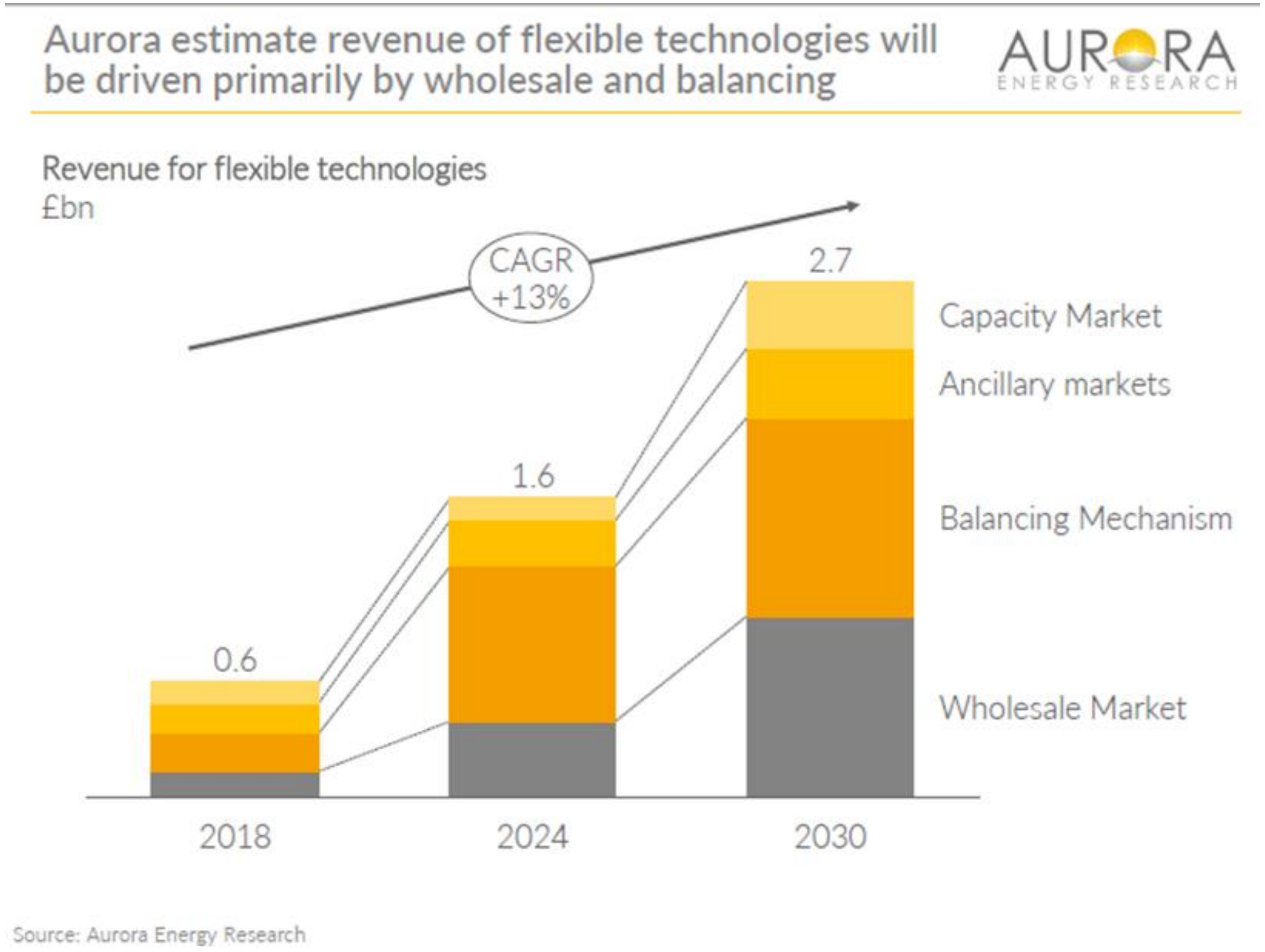
- **FFR** – Market price has stabilised
- Risk – As National Grid no longer procures long term contract, revenues are dependent on securing capacity in monthly tenders

- **Constraint Management** – Seasonal programme that is dependant on regional (post code) zones.

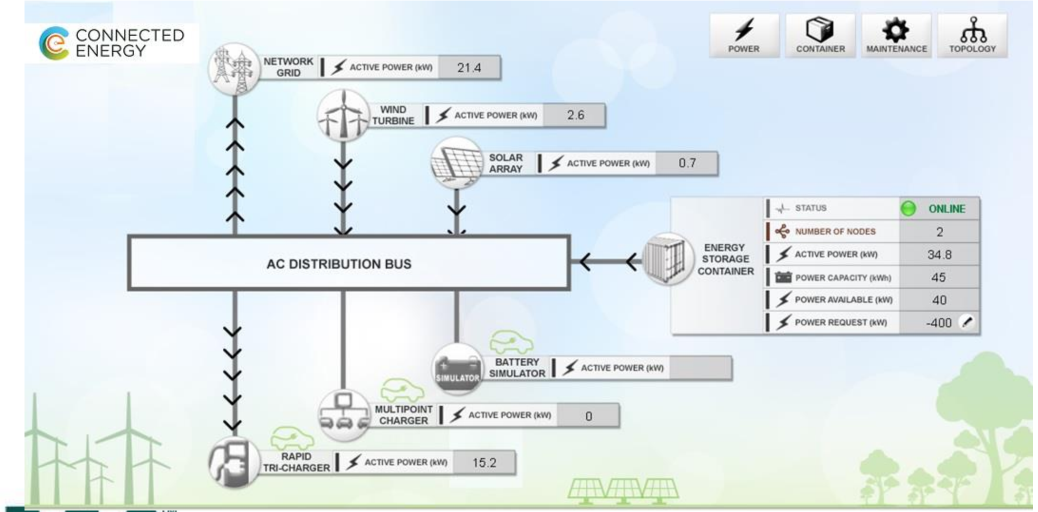
- **BM trading** – This is stream providers no guarantees and is dependant on the asset getting dispatched at appropriate strike price levels
- Risk – Asset needs to be aggregated with others to increase dispatch frequency

Changing value in flexibility

- Eroding FFR Value
- Increasing value in real-time energy trades
- Increasing DSO Ancillary services market
- Reduction in Revenue security
- Volatility driven by intermittent generation set to increase
- A merchant approach is the way forward?
- Trans European Replacement Reserves Exchange (TERRE)

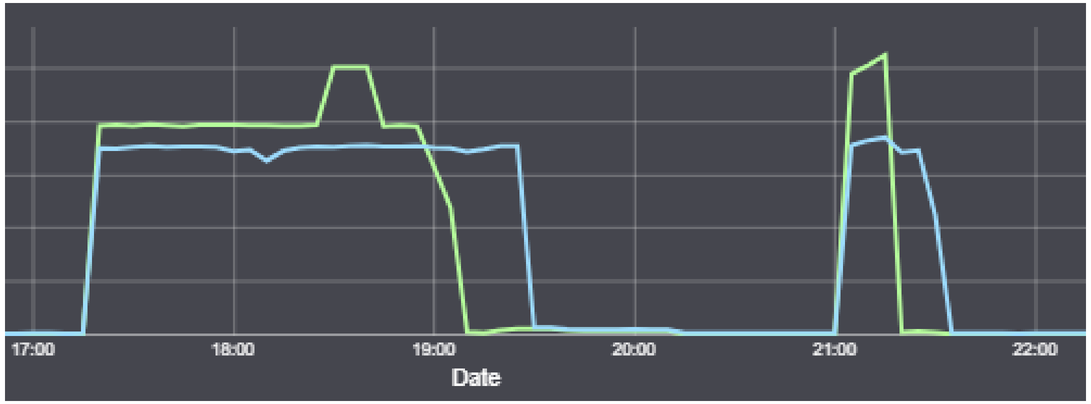


Case study - EVEREST micro-grid at Lotus Cars, Hethel UK



- Includes E-STOR system, PV charging canopy, micro wind turbine, 1 x 50kW and 6 x 22kW EV chargers
- **Functionality:**
  - E-STOR provides energy cost benefits by charging and discharging according to an arbitrage schedule
  - E-STOR maximises the value of the renewable generation by storing when not being used on site.
  - When EV chargers are in operation E-STOR fills gap between available on site generation and EV charging load.
  - Active load management is employed when required – e.g. if the site has additional loads from R&D activity.
  - Reactive load management is used at other times.

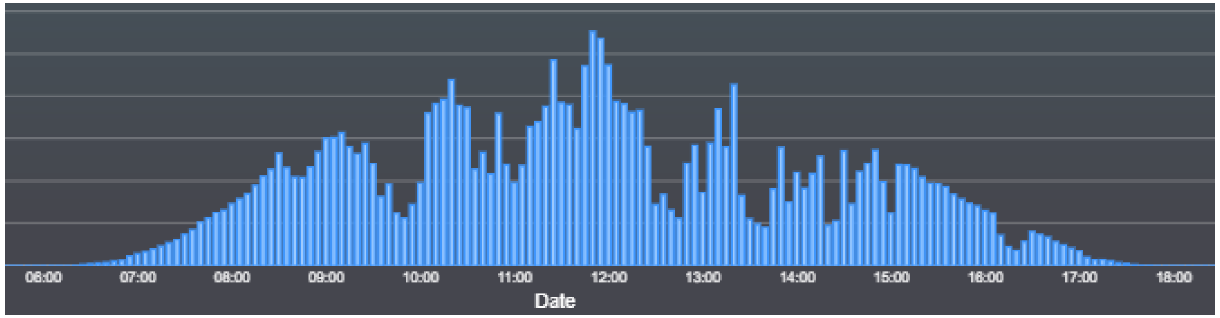
Case study - Grid-Load management in Kircheim, Germany

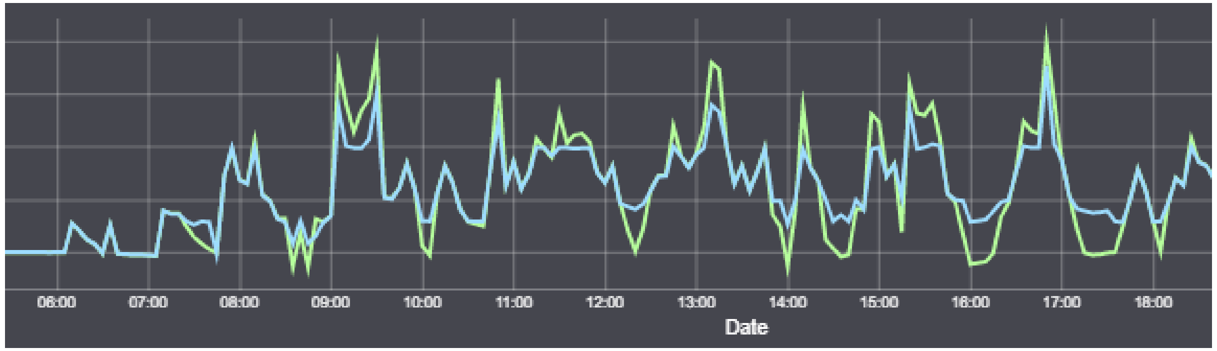


- E-STOR in operation on motorway service station in Germany. A similar system is also operational in Belgium.
- The E-STOR actively manages the loads of 1 x 50kW EV rapid chargers.
- 1 50kW charger have been installed on a 40kVA connection.
- The E-STOR actively manages the loads so the chargers do not exceed the connection capacity – which is also subject to other site loads.

The green line indicates the load that would occur if the E-STOR unit was not in place and the blue line indicates the actual load that has been managed by the E-STOR system

Case study - EV charging hub in Dundee, Scotland



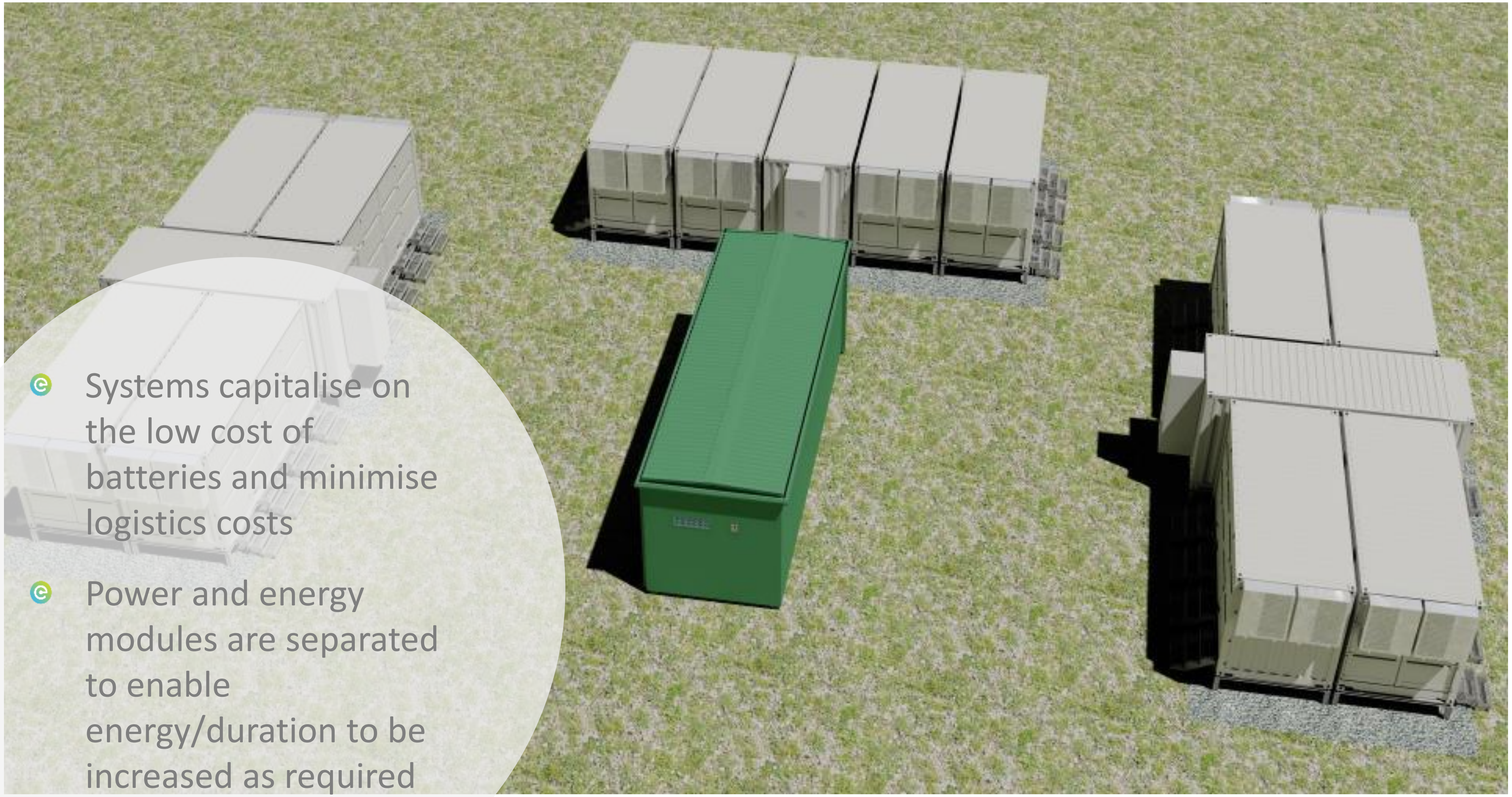


- Dundee City Council has a fleet of Nissan Leaf vehicles and these chargers are amongst the most heavily used in the UK.
- The hub is a pilot to demonstrate how EV charging can be achieved from an integrated system using PV canopies and energy storage.
- The E-STOR system is controlled to maximise the value of the PV generation by using it to feed the chargers whilst also controlling the maximum grid load.
- As utilisation continues to increase the scale of the storage system will also be increased.

Case study – industrial site in Brussels, Belgium

- Location: Brussels, BE
- Category: Industrial
- Global Battery recycler
- E-STOR 1200kW/720kWh
- Services:
  - European grid balancing
  - Dynamic frequency response
  - Power quality improvement and back-up

Large split system configuration



- Systems capitalise on the low cost of batteries and minimise logistics costs
- Power and energy modules are separated to enable energy/duration to be increased as required

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