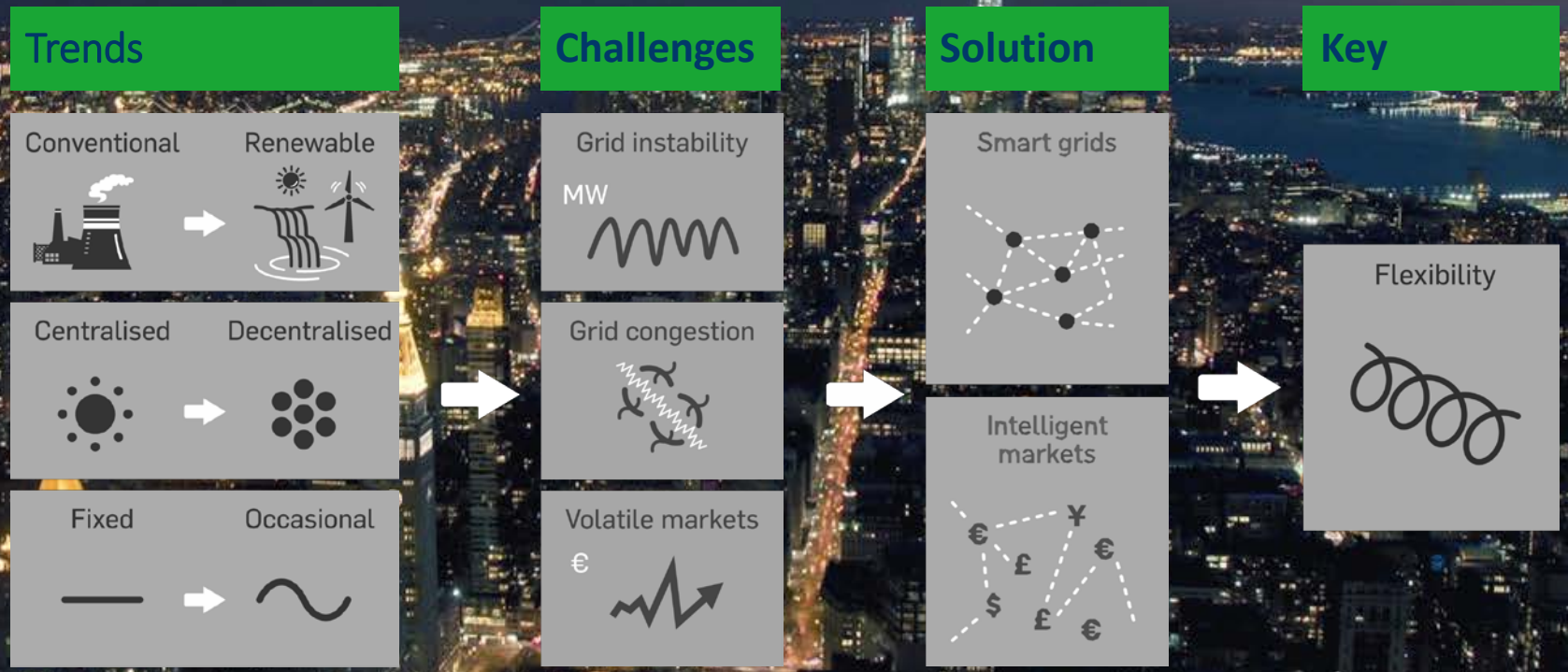
NODES

European Marketplace for Decentral Flexibility

Hallstein Hagen
NODES AS

A New Reality



NODES established

Creating the marketplace of the future supporting the drive to an emission free society

Facilitating optimal use of flexibility in the grid by offering an open, integrated marketplace to all flexibility provides and grid operators

Nord Pool

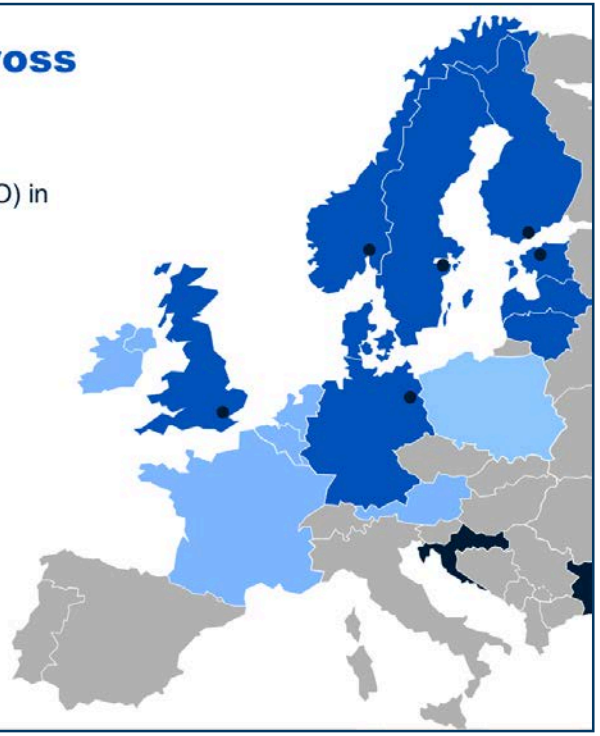
Nord Pool expanding across Europe

Nominated Electricity Market Operator (NEMO) in **15 European countries**

Delivering systems and operations to Power Exchanges – Bulgaria and Croatia

Tailored services to TSOs

Offices in Oslo, Helsinki, Stockholm, Tallinn, London and Berlin



NORD POOL

Total traded volume in 2016

≈500 TWh

European intraday:	**5 TWh**
UK day-ahead:	**109 TWh**
Nordic Baltic day-ahead:	**391 TWh**

NORD POOL

Agder Energi

Agder Energi AS

- Production, distribution and sale of renewable energy and related services
- 4th largest producer in Norway with 8.1 TWh in mean annual production
  - 49 power stations
- 4th largest DSO/grid operator
- Headquartered in Kristiansand

agder energi

Agder Energi in Germany

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The Changing Role of DSO → the market must still:

- Facilitate competition
  in supply, generation and flexibility services
- Provide Neutral markets
  for more efficient energy system operation
- Promote innovation, flexibility and non-network solution
- Managing the coordination
  of services at the local level
- Maximizing utilization
  of the electrical and communication network for the customers

- Tipping point
  20-40% Renewable share
- Fundamental changes
  in current market design required

Our approach

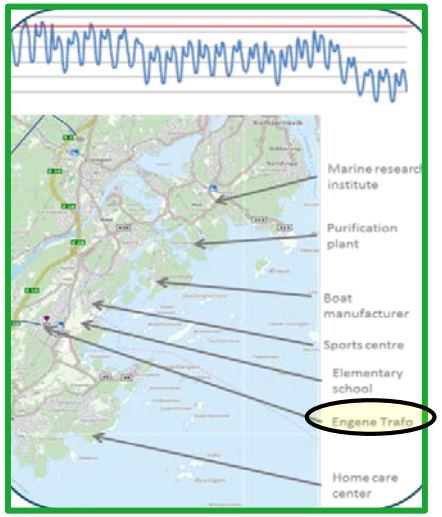
Bottom Up!

Distributed energy resources, integrated market available to both DSO & TSO – let the market do the job!

Live proof of concept demonstrated investment deferral at Engene substation in Norway

Phase 1
Alternative to grid investment

- Developed a cloud based solution to avoid overload in short periods
- Accessed available flexibility in distribution grid
- Optimised load based on available flexibility, price weather data and production in the area
- All data delivered in real time by use of advanced analytics and machine learning



Phase 2
Develop a marketplace concept

- Prototype for a marketplace for decentral flexibility
- Developed concept for business models and roles for the flexibility market
- Alignment to EU winter package and dialog with Norwegian regulator
- Deferred grid investment of approx. EUR 4,5 M



Microsoft

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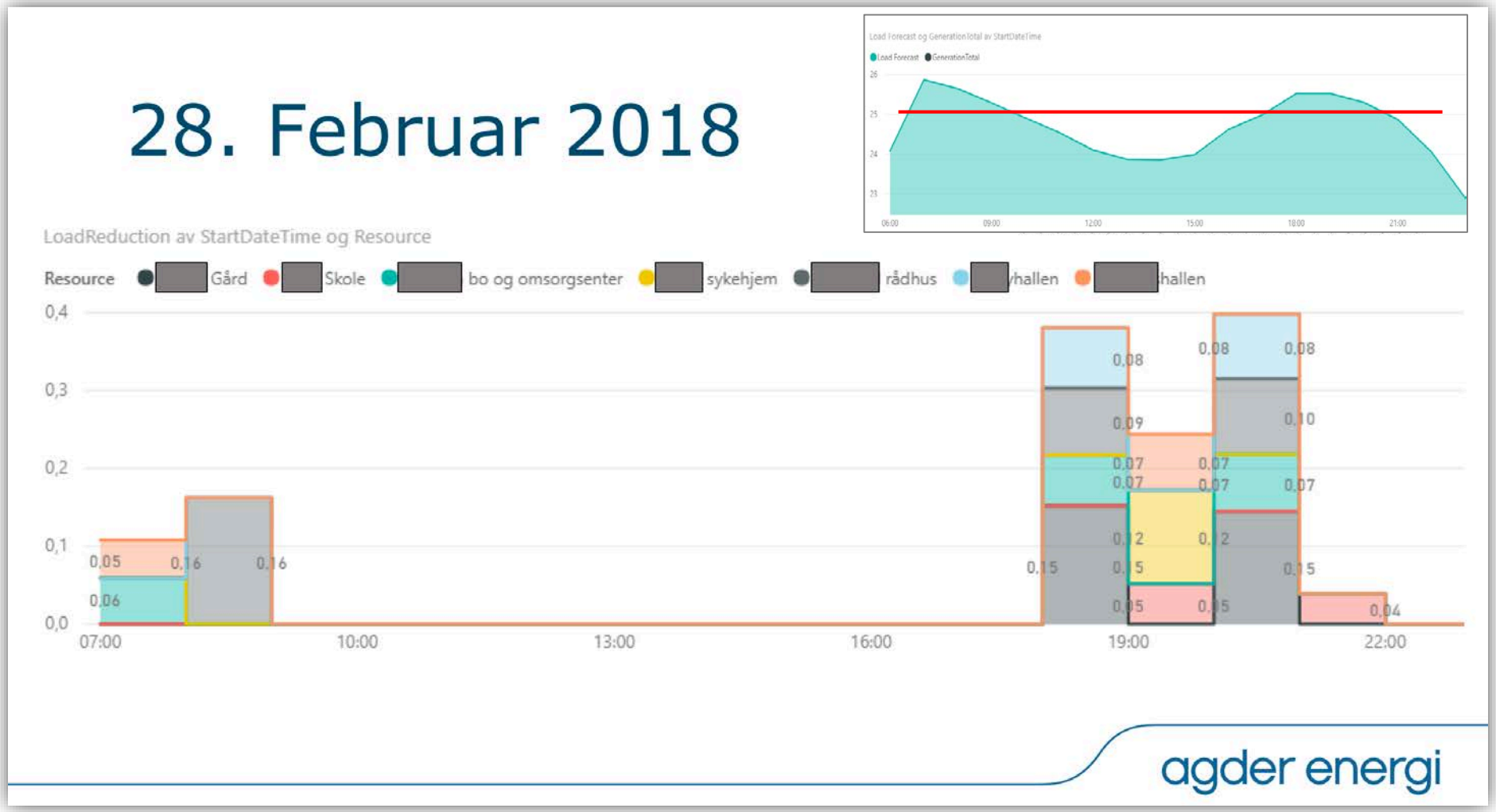
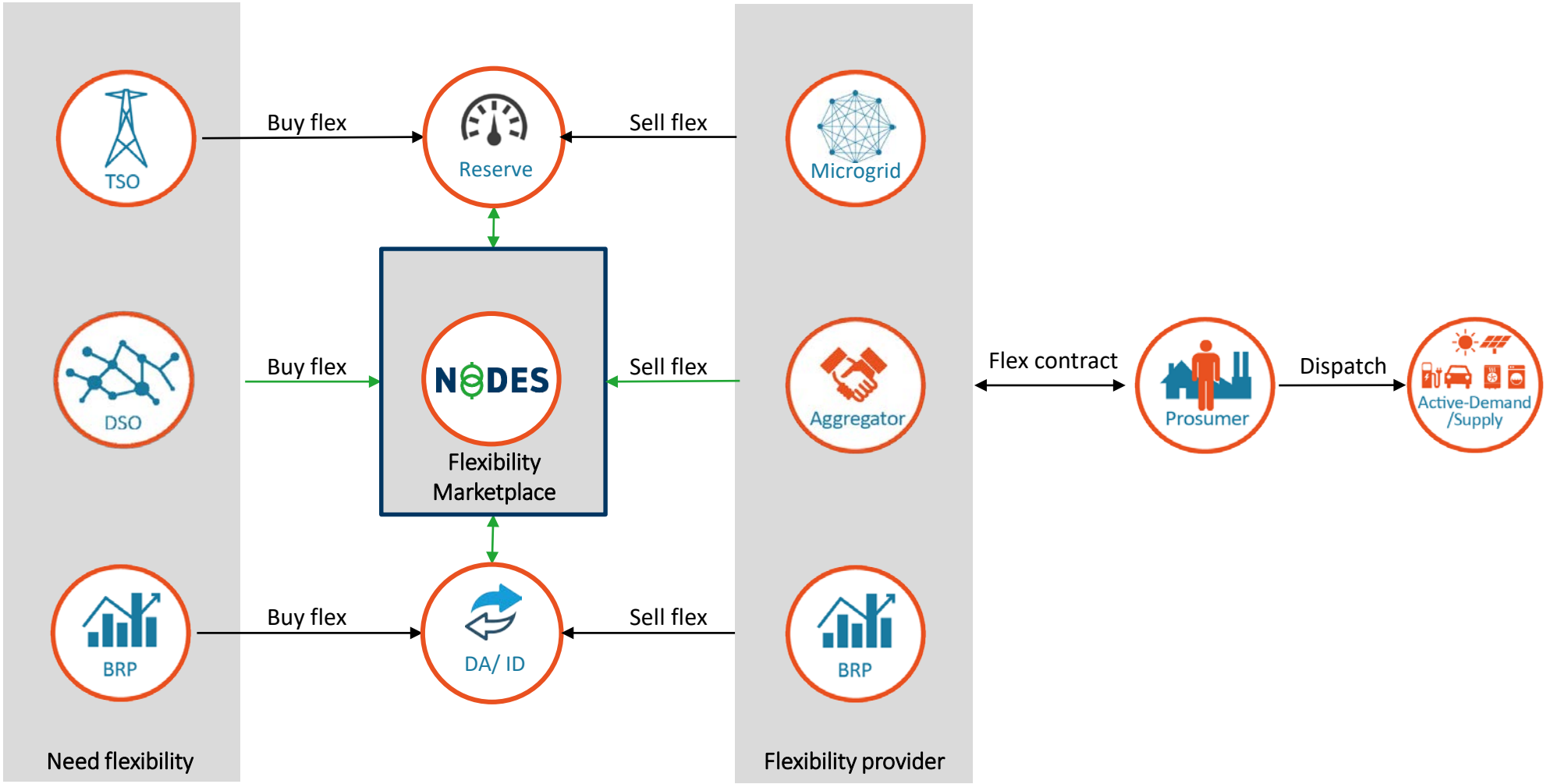
ENGENE Substation

Live proof of concept



NODES – connecting markets

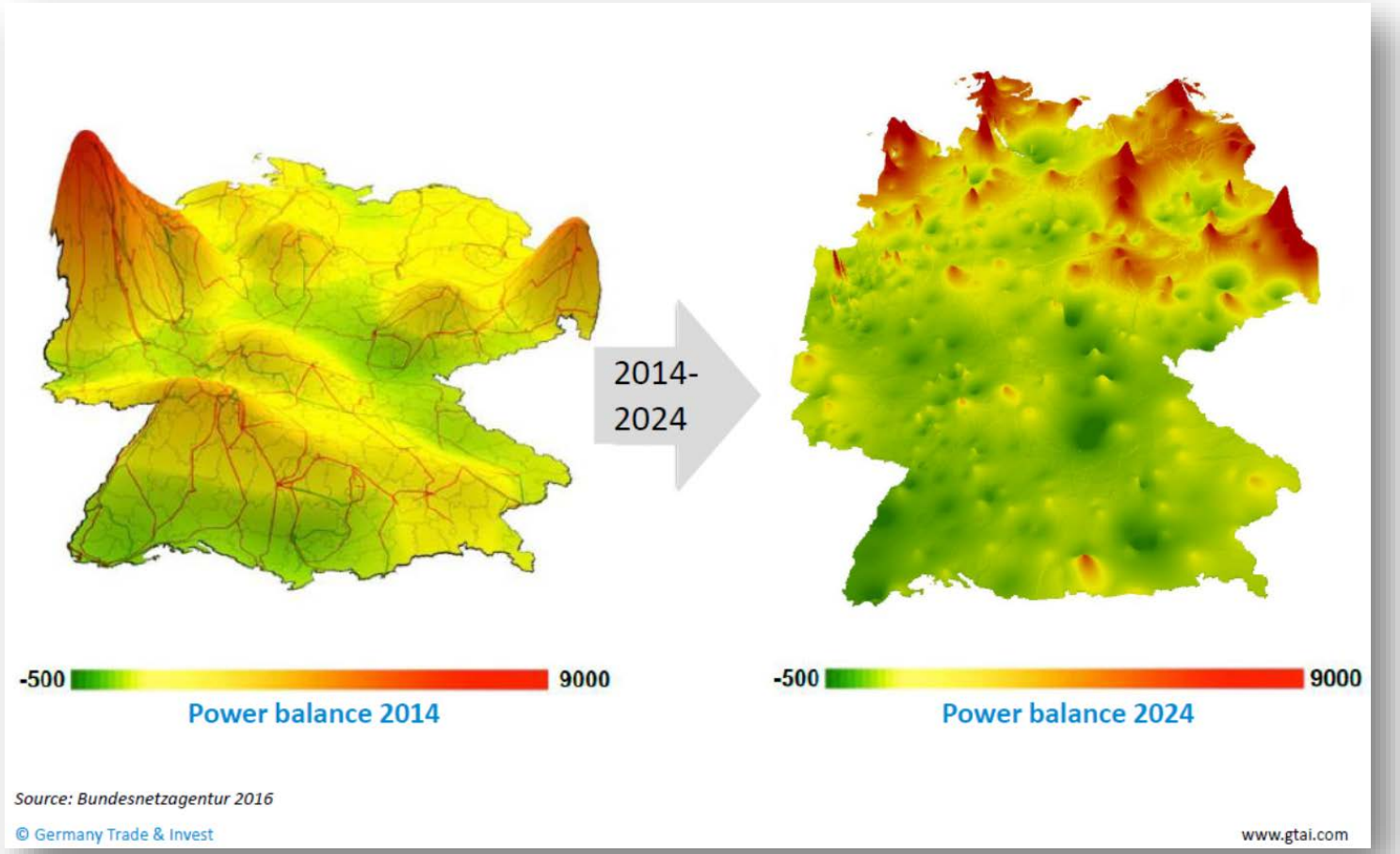


In summary

- Grid companies will be able to buy the flexibility they need on NODES to perform their new role as DSO
- The value of flexibility will be visible on NODES
- NODES integrates with existing markets so that all (DSO/TSO and BRPs) can buy the available local flexibility
- The value of flexible assets increase because NODES will connect to existing markets so that it can be traded any time, not only when the DSO needs it locally
  (which may only be 3-4 times on cold winter days)
- NODES facilitates the use of flexibility (OPEX) as an alternative to grid investment (CAPEX)
- NODES believe that more flexibility will be available because of facilitated market access

CONNECTING MARKETS

Grid bottlenecks
generation units are geographically far from consumption



The costs of grid congestions are rising…

95% of RES in Germany are connected to the DSO grid

Source: BDEW „Redispatch in Deutschland“