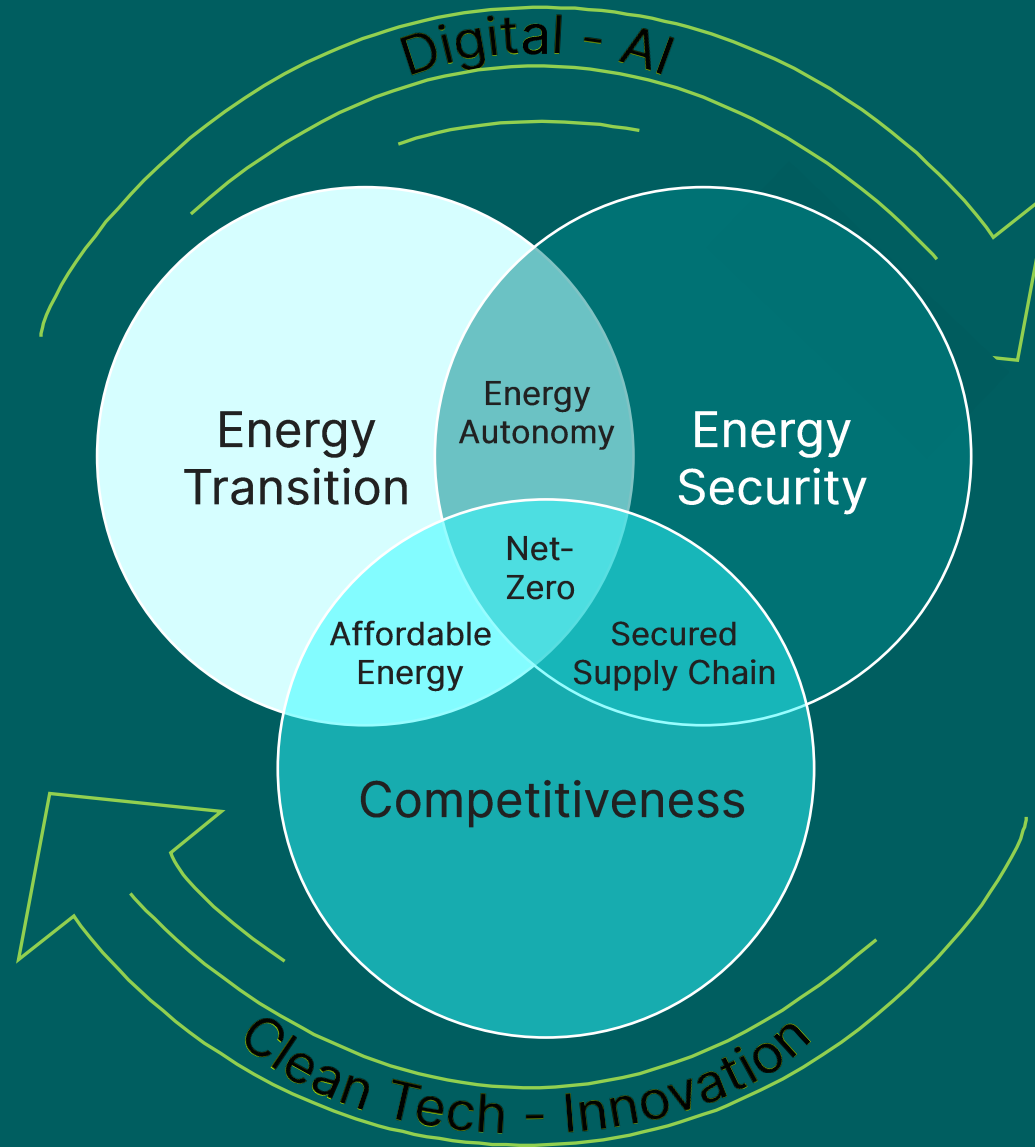


GRID FLEXIBILITY & STABILITY

13 November 2025

The changing nature of reaching net-zero



DISRUPTION VELOCITY



- Increase in Nature extreme disruptions (severe weather, natural disasters, geomagnetic storms, wildlife)
- Ramp-up of armed and hybrid conflicts (terrorism, sabotage, cybersecurity threats)

ELECTRIFICATION DENSITY



- Exponential growth of grid assets
- Increased technical failures with growing grid complexity
- Human factor / mistake

DECARBONIZATION VARIABILITY



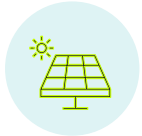
- Higher variability of load and generation
- Distributed-Energy Resources with bidirectional energy flows

Why do we need flexibility?

UTILITY GOAL: **NET ZERO**



Electrification



Renewables
(Large and small scale)

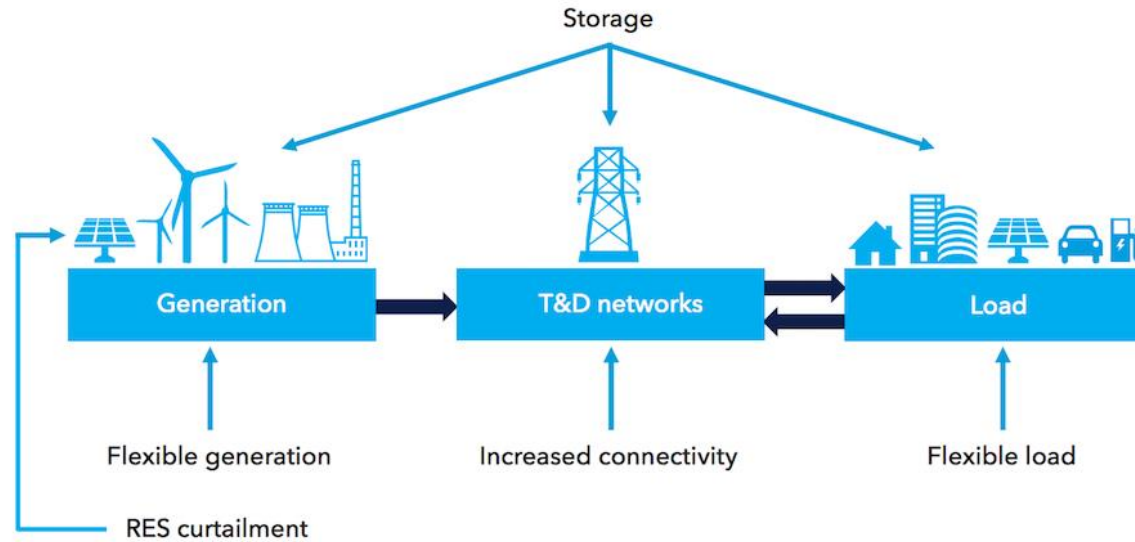


Figure 15 - Flexibility sources in the electricity supply system

CHALLENGES

Network capacity issues

- Datacenters, EVs/heating adds 50-100% to the load

New electrical patterns

- Back feeds
- High voltages
- Protection Issues
- Balancing
- Intermittency across T&D

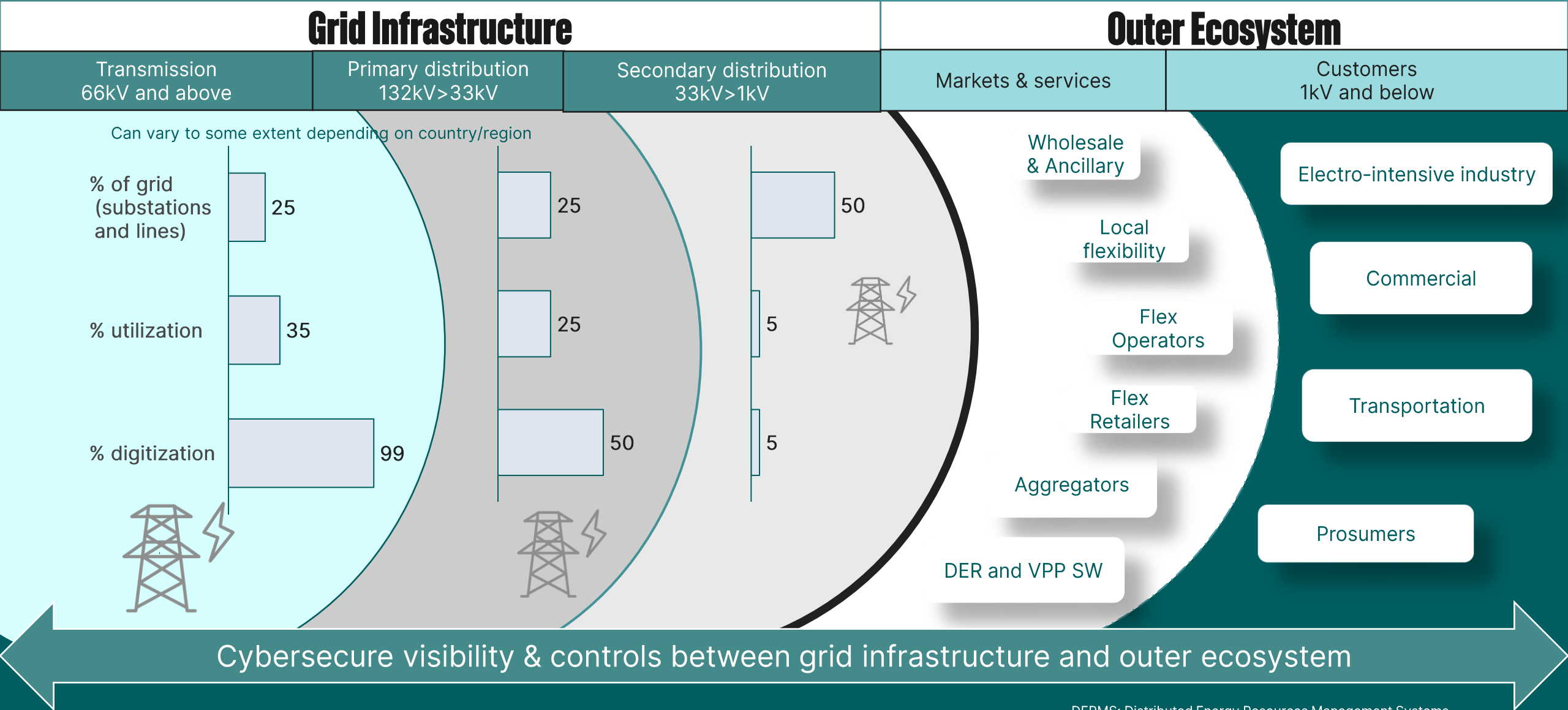
New stakeholders

- Rapid proliferation of aggregators and DER service providers

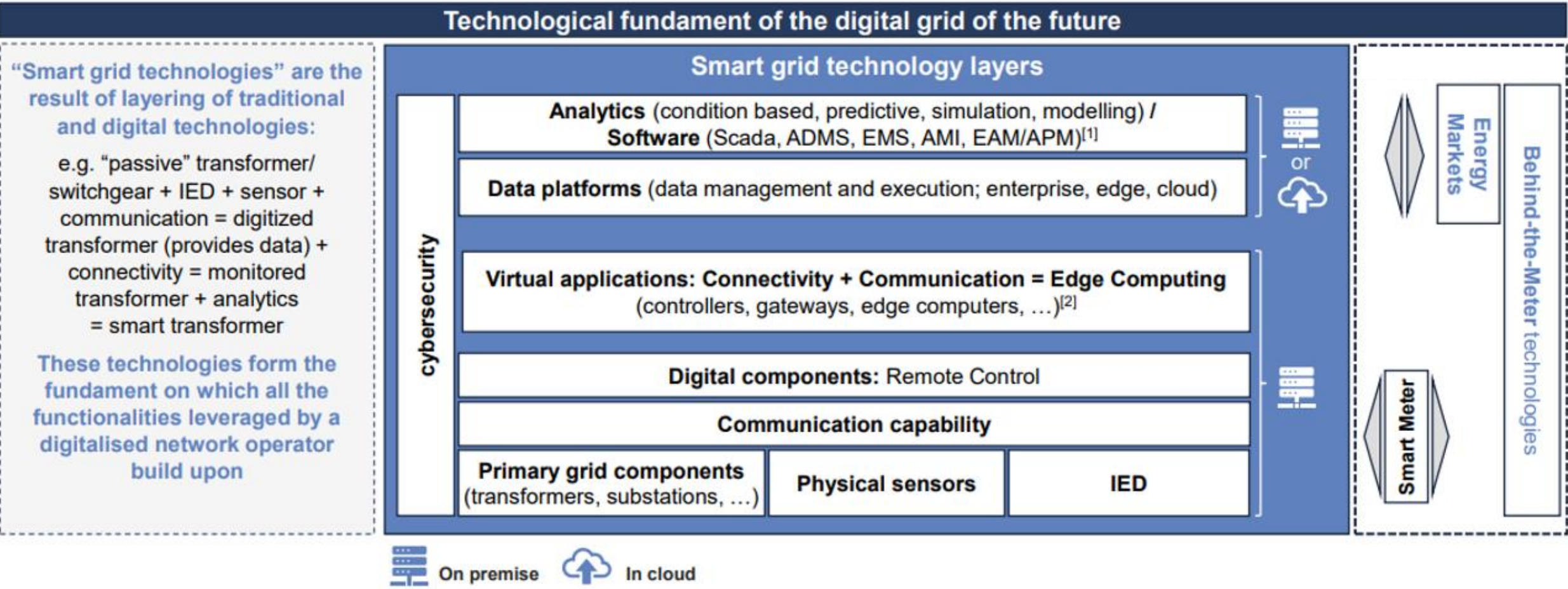
New regulations

- FERC 2222
- EU Network Code Reform for Demand Response

Transform traditional networks to enable renewables and DERs: full network visibility and control is a pre-requisite

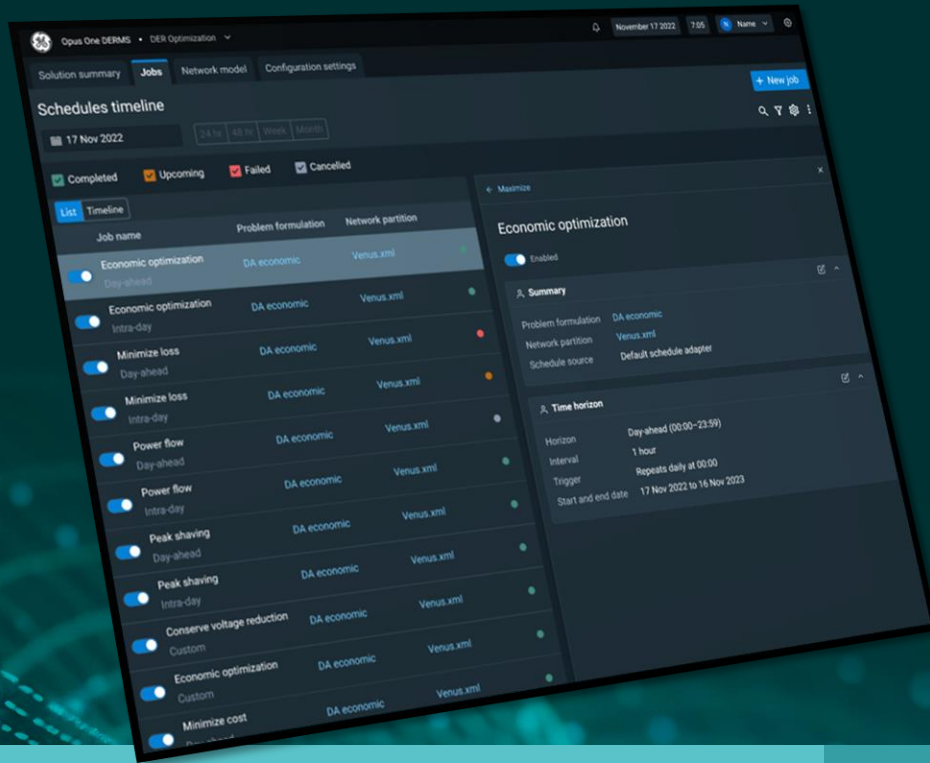


Grid digitalization is needed for more than just flexibility: security, affordability and sustainability



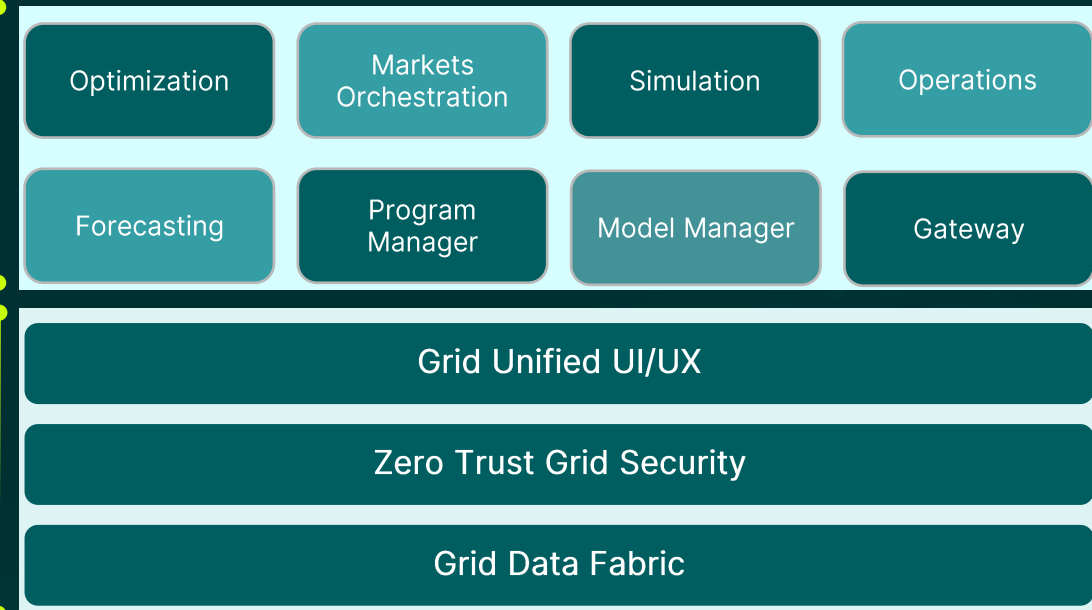
Accelerate your DER journey with GridOS DERMS

The leading modular DERMS for grid operators



GridOS
DERMS
Modules

Powered by
GridOS
Platform



- Operates standalone or integrates with ADMS/SCADA/AEMS for unified grid orchestration
- Deployment flexibility on-prem or cloud
- Leverage across grid-centric DER use cases

Connect any DER

- GridOS DERMS brings certified compatibility with industry standards, such as OpenADR and IEEE 2030.5
- Partnerships with leading Edge DERMS and flexibility markets to ensure integration with any DER.

Optimize grid operations

- Only GridOS DERMS is powered by GridOS, the industry's first end-to-end grid orchestration platform
- Purpose-built with patented grid model-based technology, including look-ahead grid power flow optimization.

Scale at your pace

- GridOS DERMS' suite of modules enables you to start with essential capabilities and expand as your DER penetration increases.
- Full use case support for planning, operating, and transacting DERs.

DERMS implementation details

1. **Discovery phase** – identify the information, data & performance gaps that need to be filled to maximize the value the solution delivers. For example, RTU/substation monitoring data to provide a data source for Forecasting
2. **Network model management** – Deploy foundational elements of solution including Model Manager DERMS module as a tool to ingest, maintain and federate the network model data (as-built, planned, as-operated, as-switched, etc)
3. **Look ahead elements** – Deploy Forecasting and Optimization DERMS modules to provide the identification of needs – e.g. when, where, & to what extent congestion is expected to occur.
4. **Solution identification** – Deploy Optimization module functionality, alongside market and contractual information held within Program Manager DERMS module in order to compute the most optimal solution to the congestion identified.

Must haves:

- Do they have **suitable, scalable and adaptable forecasting capabilities** to provide the fundamental look-ahead insight required for a pro-active congestion management solution?
- Is their network and DER data siloed or inaccessible and would they benefit from a **grid data fabric architecture** – not just for congestion management but to enable new and emerging responsibilities?
- When partnering with technology providers, can they be sure that **their data and infrastructure will be protected from cyber and security threats**?

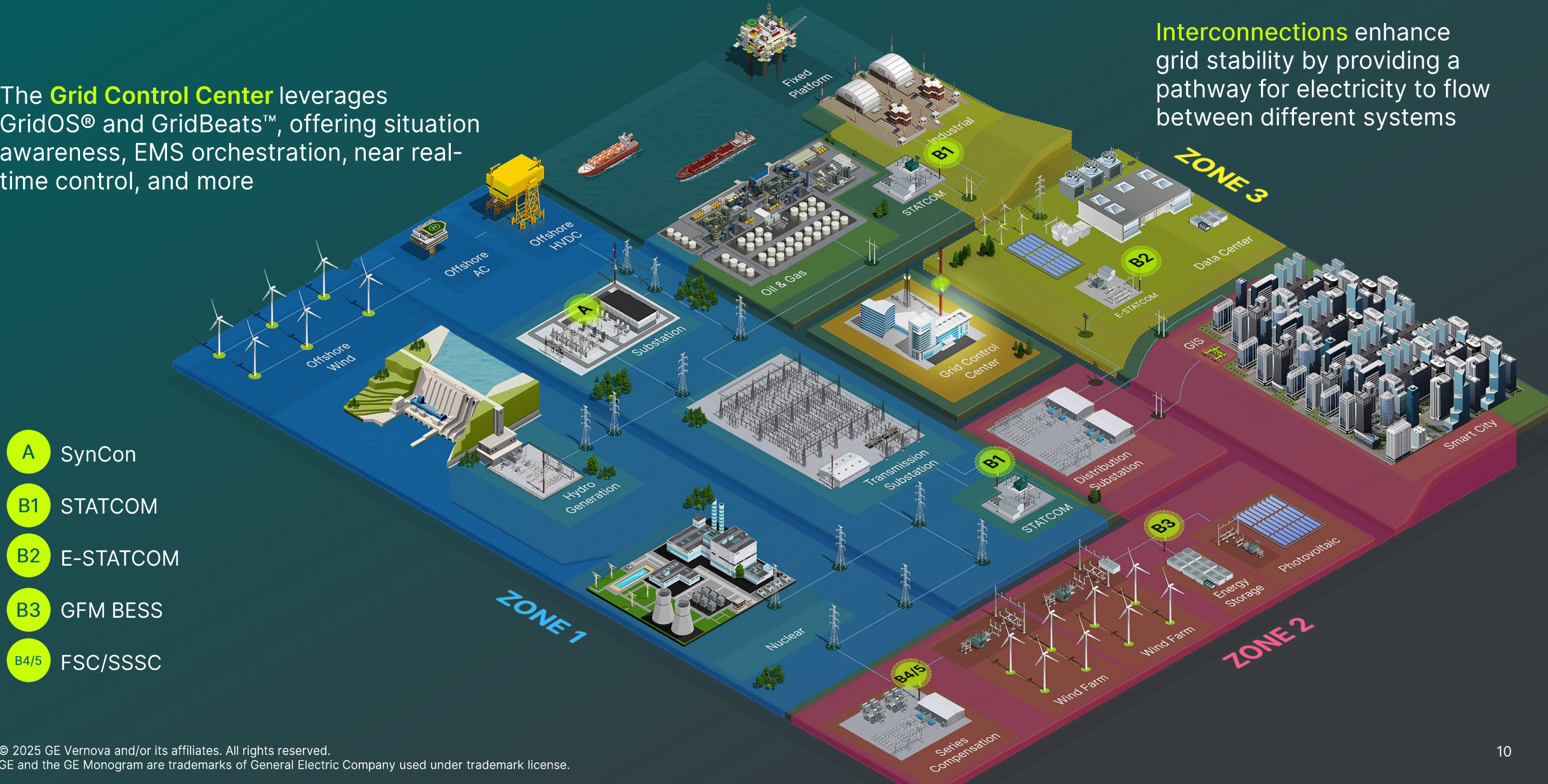
DERMS use cases

Location/date	Challenges	Solution	Results
DER flexibility market demonstration project Scotland & Central Southern England 1Q2021	Increased penetration of renewables and EVs	System analysis and market trading platforms implemented to enable flexibility request, response and contracts to instruct dispatch schedules	Facilitated long term contracts between industry and flexibility markets, while maintaining network integrity and driving optimization
Local demand-side flexibility project United Kingdom 3Q2020	Increased level of modern customers and prosumers	Based on Universal Smart Energy Framework (USEF), forecast integration and visualization, constraint and flexibility need identification, contract registration and management, and market orchestration.	Aggregators demonstrated the ability to respond to FlexRequests with at least one Flexibility Offer in 94% of cases. enables operators to request flexibility and calculates market settlement. A total of 55.2 MWh of flexible energy was ordered, with 45.5 MWh successfully delivered.
Gateway, Forecasting & Optimization United States On-going	Uphold grid reliability, resiliency, and the seamless integration of several millions of DERs and EVs.	Grid Management System (GMS), streamlining distribution operations through a unified platform with secure communication, machine learning forecasting, compute optimization to address congestion and voltage issues, while modeling and communicating with SCADA.	Enable large amounts of DERs and EVs, while maintaining system resilience and stability and optimizing CAPEX/OPEX spends.

Grid flexibility & stability solutions must go hand in hand

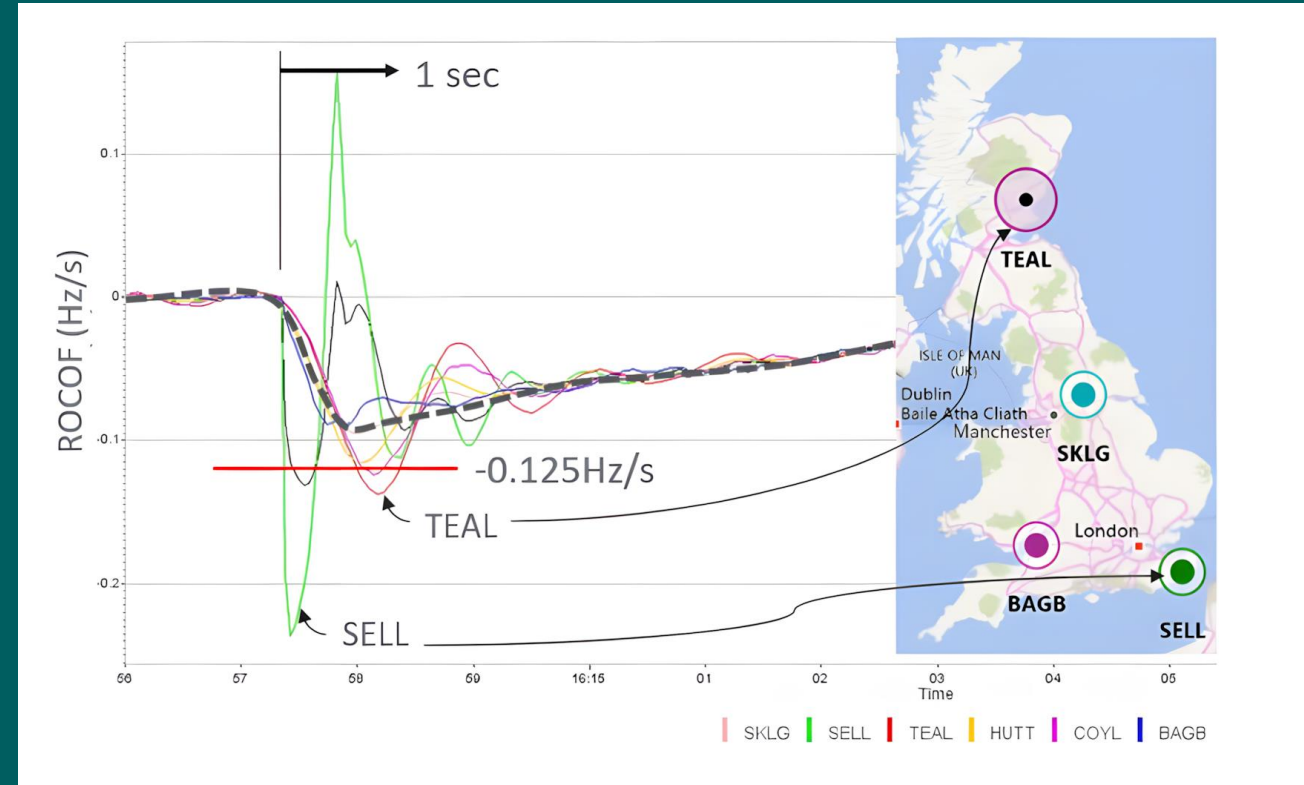
The **Grid Control Center** leverages GridOS® and GridBeats™, offering situation awareness, EMS orchestration, near real-time control, and more

Interconnections enhance grid stability by providing a pathway for electricity to flow between different systems



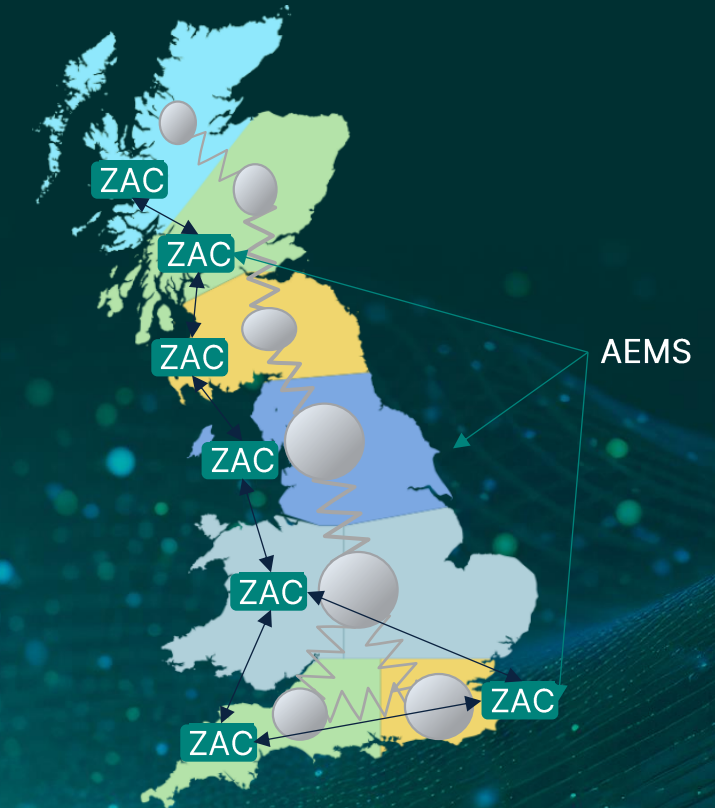
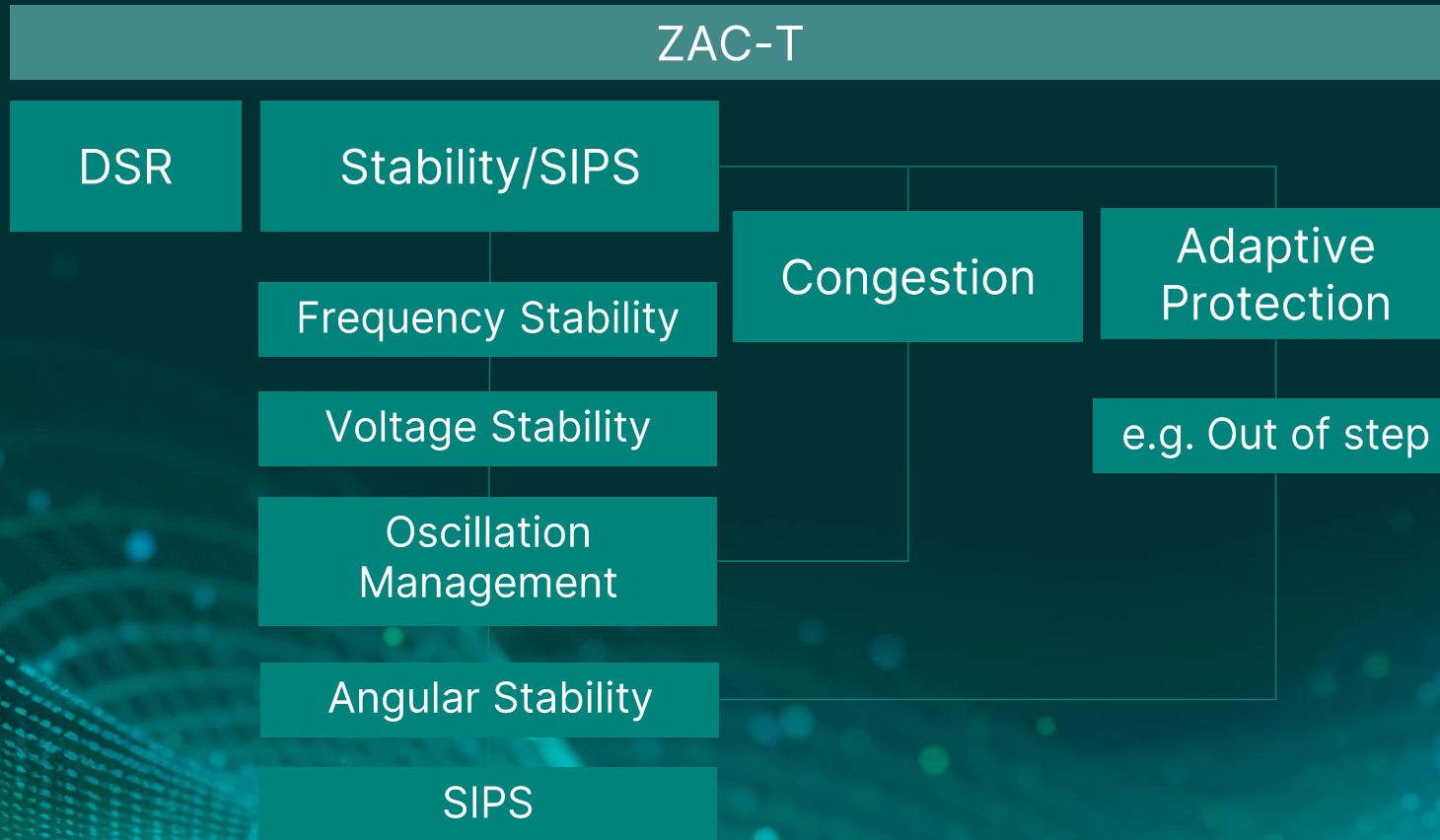
Advanced Grid orchestration solutions – UK experience

- ✓ Unified information Diverse information sources made accessible to applications in a unified way
- ✓ Near real-time observability of high-resolution dynamic data through WAMS providing resources for stability monitoring and control
- ✓ Forecasting functionality with load flow and contingency analysis to navigate future grid situations
- ✓ Secure communication of automated and human controls to the relevant resources and subsystems
- ✓ Zonal Control: Complexity of overall grid operation being managed by central systems providing high-level requirements applied to intelligence in the field that manages a local or network zone level of control



The benefit of wide-area observability is evidenced in a generation loss event (see Figure above), which shows significant dispersion in frequency and RoCoF between locations in the first few seconds of the event.

Zonal Autonomous Control (ZAC) transmission applications



ZAC-T layer providing transmission level autonomy, linked to neighboring zones and provisioned from central orchestrator

DSR – Demand Side

Response ZAC – zonal autonomous control

SIPS – System Integrity Protection Schemes

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PORTFOLIO OF SOFTWARE-DEFINED AUTOMATION SOLUTIONS FOR GRID DIGITALIZATION

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BETTER VISIBILITY	FASTER DEPLOYMENT
INCREASED RESILIENCE	ENHANCED OPERATIONS



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Substation Monitoring



GridBeats™
Digital Substation



GridBeats™
Autonomous Distribution



GridBeats™
Asset Management



GridBeats™
Cybersecurity



Virtualization

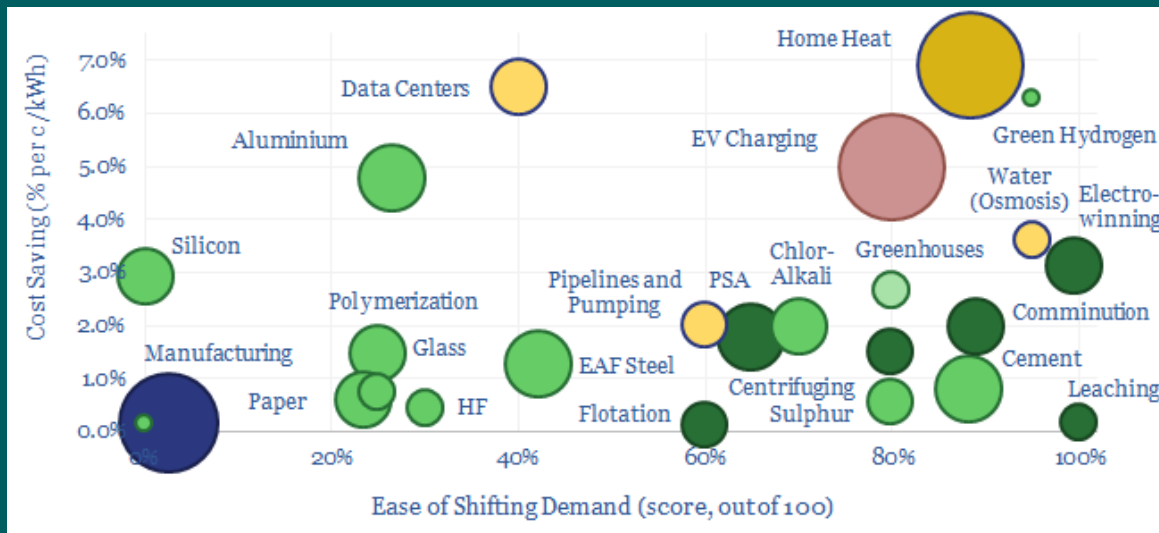
AI/ML

Cyber/Cloud

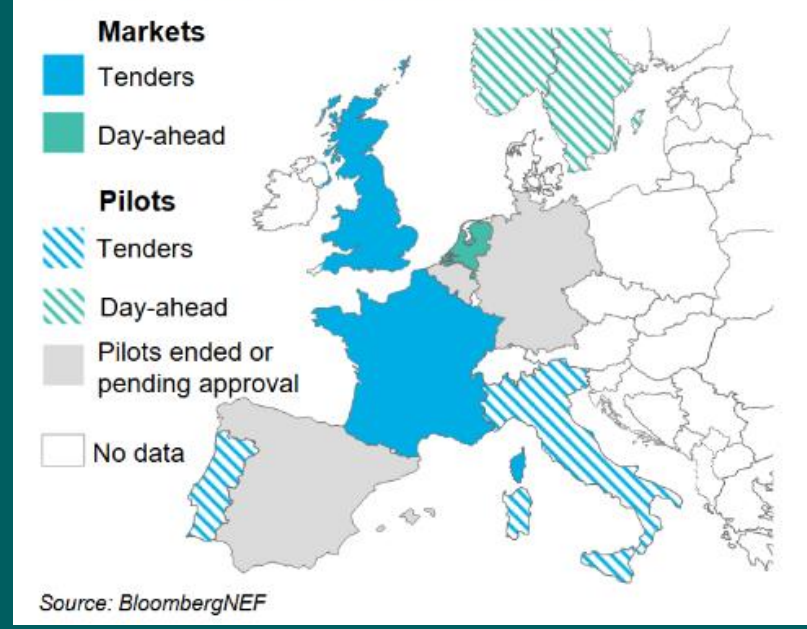
GridBeats™
THE HEART OF THE GRID

Policy needed to drive flexibility demand

Policy to drive more savings via flexibility markets



Status of local flexibility markets



Fund and deploy technology to enable flexibility

Source: Thunder Said Energy; Demand shifting: electrical flexibility by industry?



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