



# ASIA CLEAN ENERGY FORUM 2026

Beyond Transition: Building Secure, Resilient, Inclusive, and Intelligent Energy Systems

8-11 June | ADB Headquarters, Metro Manila, Philippines



## How Innovation Can Ease Grid Integration

Peter Hulbert, Head of Grid Consulting (APAC)  
Siemens Energy





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## Siemens Energy | A global leader in energy technology

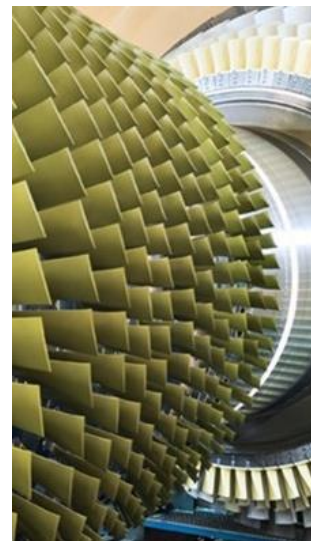
### Wind Power



- #1 Offshore
- #3 Onshore

Product portfolio: up to 15 MW offshore and 7 MW onshore

### Gas Services



- #2 Gas Turbines

Low- or zero-emission power generation  
Product portfolio: from 2MW up to 593MW

### Grid Technologies



- #1 Solutions
- #1 Products
- #2 Service

Product portfolio: Transformers, GIS/AIS, FACTS, HVDC, Solutions and Services

Next generation digital products and solutions

### Transformation of Industry



- #1 Industrial Steam Turbines & Generators
- #2 Compressors
- #2 Electrification, Automation, Digitalization
- #1 H2 Electrolyzers

We support companies and countries to reduce emissions across the energy landscape – for a more reliable, affordable and sustainable energy system

**~1/6**

of global electricity generation is based on our technology

**103,000**

employees work as a team to energize society<sup>1</sup>

**>90**

We are present in more than 90 countries

**€39.1 bn**

in revenue<sup>2</sup>

<sup>1</sup> Number of employees as of September 30, 2025  
<sup>2</sup> Revenue FY 2025



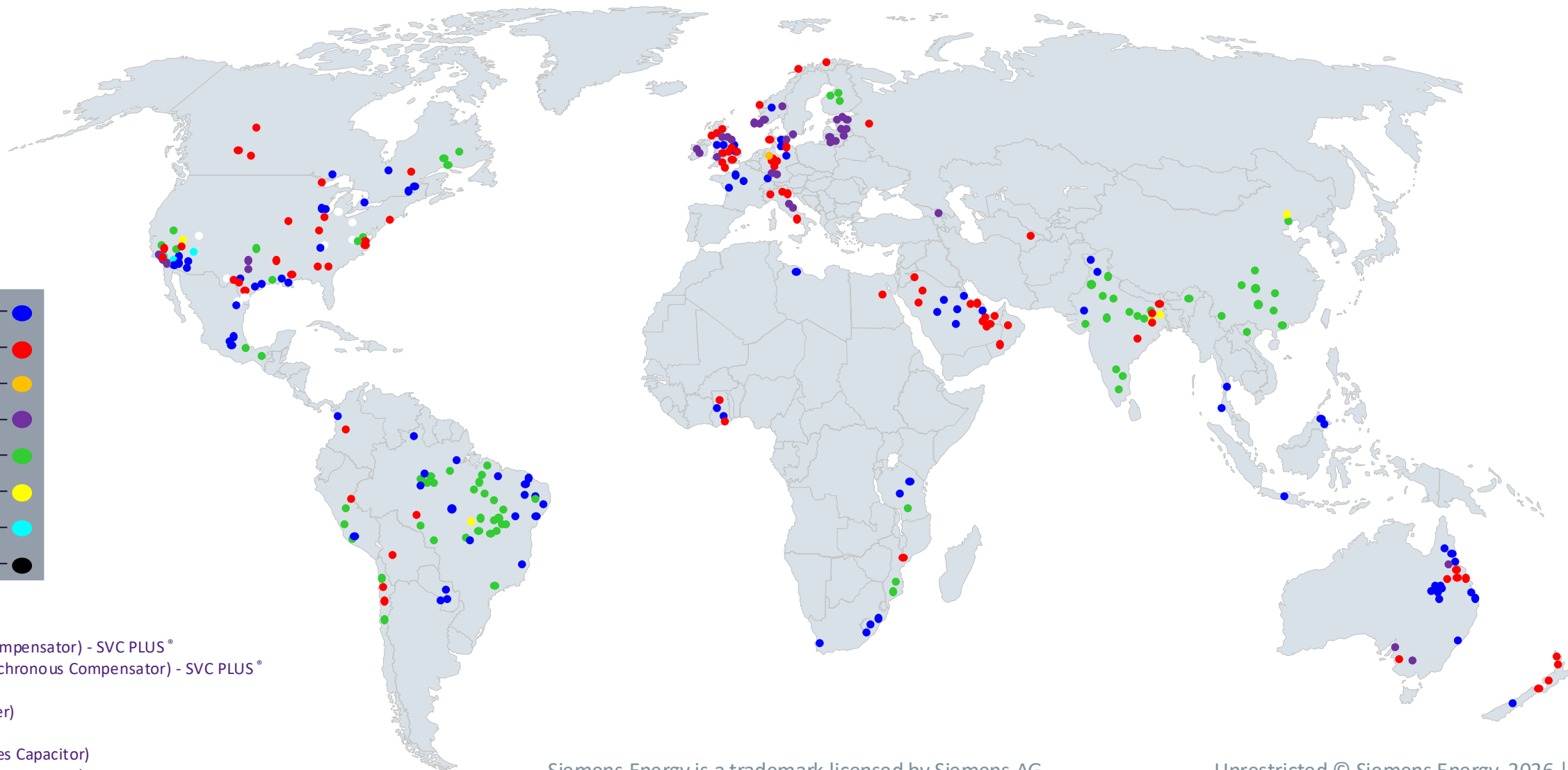
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**We have installed over 600 network stabilisation devices, giving us real-world insights on their operating envelopes**



- SVC – ●
- Statcom (SVC PLUS®) – ●
- E-Statcom SVC PLUS®FS – ●
- SynCon – ●
- FSC – ●
- TCSC – ●
- TPSC – ●
- Others – ●

SVC: Static Var Compensator  
 Statcom (Static Synchronous Compensator) - SVC PLUS®  
 E-Statcom (Enhanced Static Synchronous Compensator) - SVC PLUS®  
 FS (Frequency Stabilizer)  
 Syncon: (Synchronous Condenser)  
 FSC: (Fixed Series Capacitor)  
 TCSC: (Thyristor Controlled Series Capacitor)  
 TPSC: (Thyristor Protected Series Capacitor).



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## Agenda

- Setting the scene
- The traditional arrangement for power supplies
- Shifting the responsibility for power supplies and quality
  - Technically
  - Commercially
- The concept of microgrids
- Making the most of the existing grid through digitalisation
- Innovating the data centre itself



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## Setting the scene – some of the compounding challenges

- Globally grids are going through transition driven by decarbonisation / net zero
  - The transition to renewable energy bringing decentralization of generation and widespread adoption of inverter-based resources from the historic centralised, synchronous-generation based systems
  - Inherent intermittency becomes the new norm requiring stabilization and firming
- Massive uptake of data centres
  - IEA<sup>(1)</sup> suggests data centre demand will double by 2030 and triple by 2035; AEMO<sup>(2)</sup> (Australia) 2% → 12% of system load by 2025
- Nature of data centre loads
  - Conventional data centres
    - Many individual servers running their own individual workloads – incremental and independent load swings
    - High reliability demanded due to many clients and their individual processes
  - AI data centres
    - Consolidated and synchronised processing – large and almost instantaneous load swings
    - Single client demands mean the ability to manage the reliability requirements of effectively a single load

Source 1: [IEA \(2025\), Energy and AI, IEA, Paris](#)

Source 2: [Oxford Economics Australia \(2025\), Data Centre Energy Demand](#)




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## AI-training data centre load pattern

 AI datacenters exhibit unique power consumption patterns, with rapid load transitions—shifting from idle (~40%) to full load (100%) and back within fractions of a second. This is a behaviour that no other load has done before.

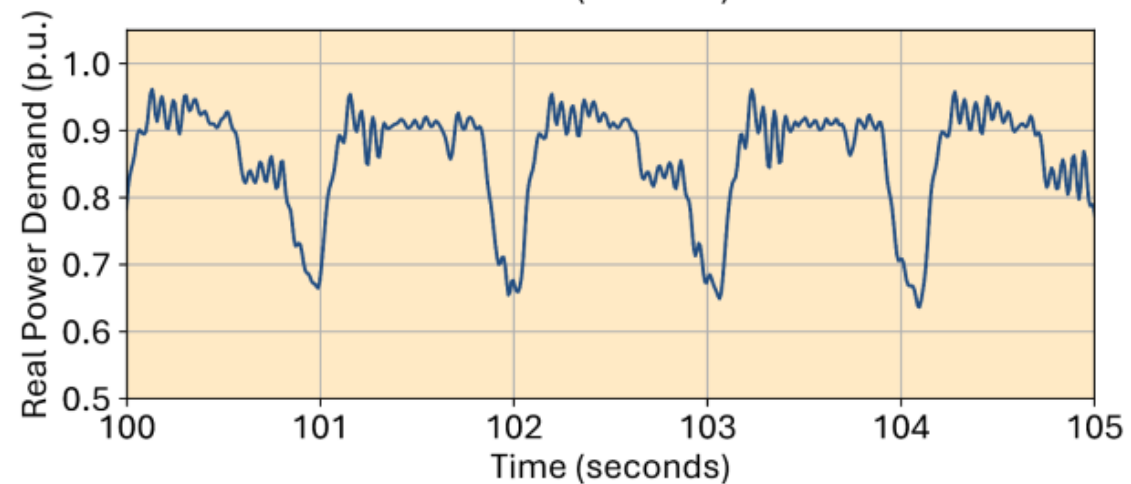
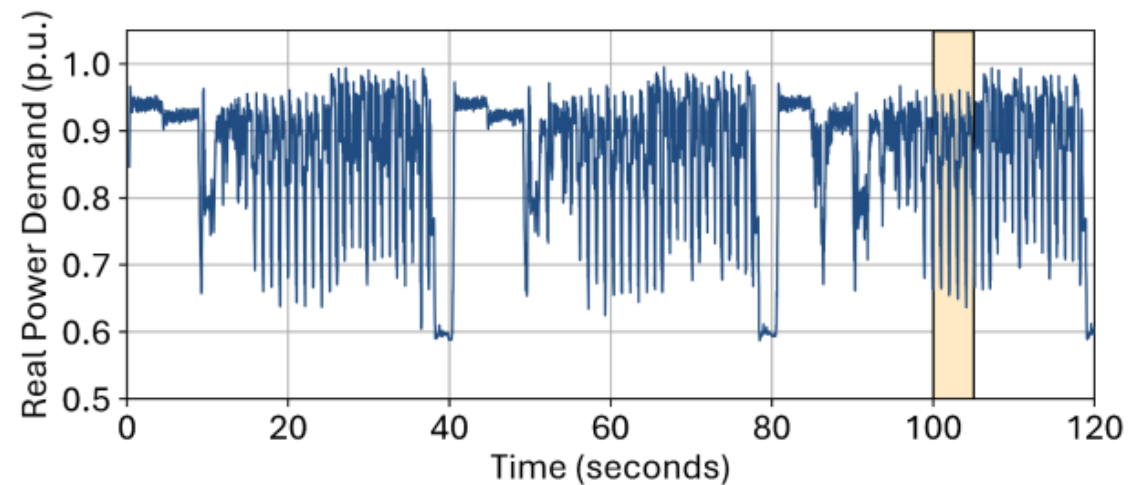
 **Negative Impact on the grid:**

- Effects on nearby generators
- Potential for forced oscillations
- Risk of grid instability
- Voltage sags or flicker, especially in weak grids

 If no mitigation measures put in place such load might damage the nearby electrical equipment (such as generators and turbines at the power plant)

 **Negative concerns on the nearby generators:**

- Torsional resonance
- Local mode oscillations
- Might lead to unavailability due to poor operational behavior
- Premature component damage



Source 3: [NERC White Paper: Characteristics and Risks of Emerging Large Loads](#)



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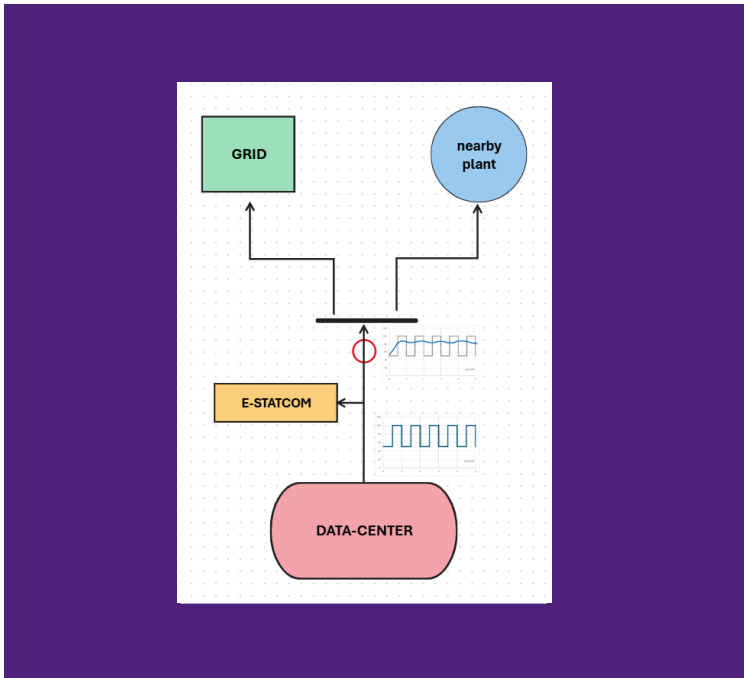
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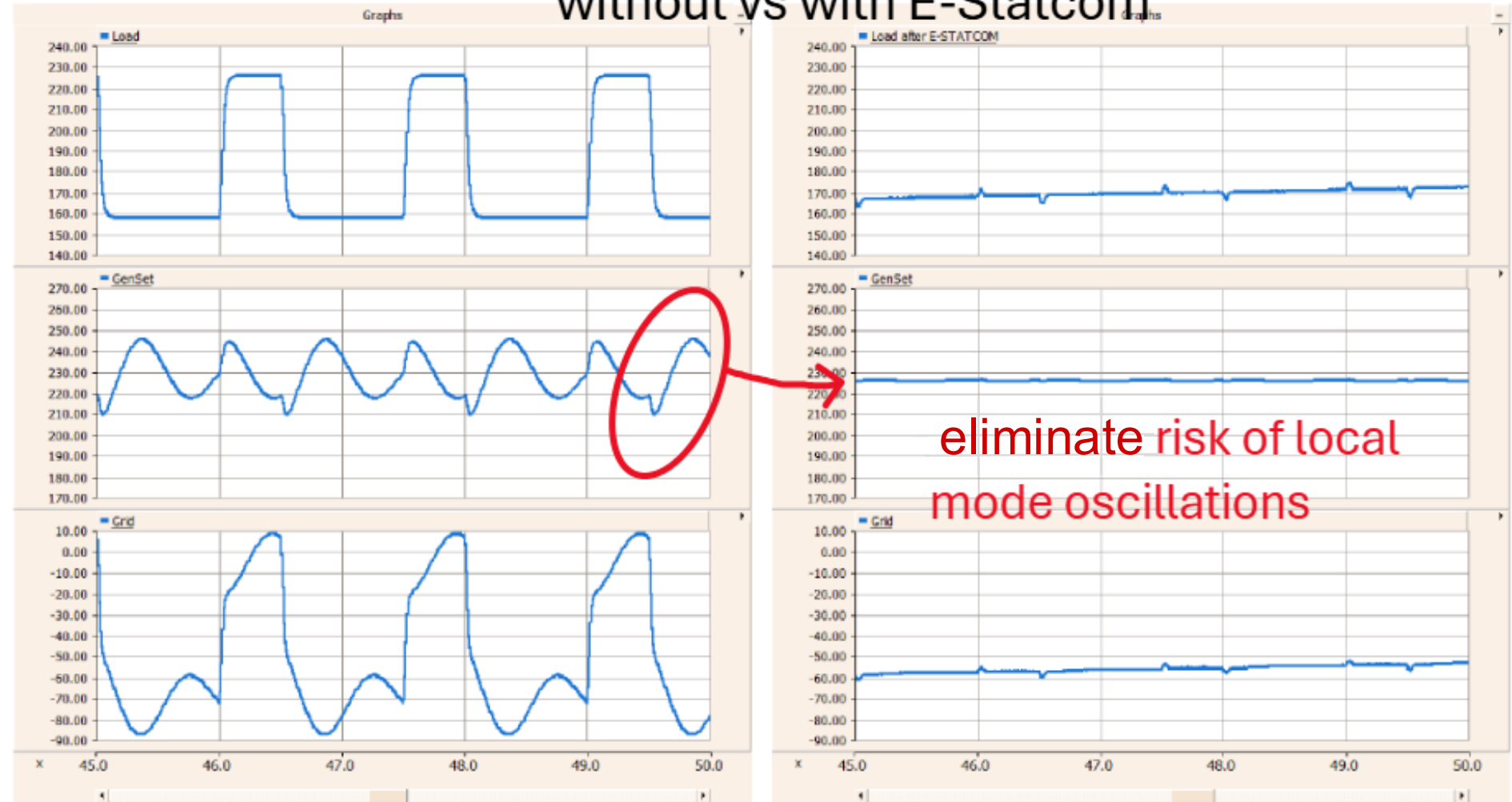


## E-STATCOM as a mitigation measure (example: 1Hz oscillation)

E-STATCOM can reduce load fluctuations by up to 99% in critical local and interarea mode regions (0.1-2Hz)



without vs with E-Statcom





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## The traditional utility-led approach

- Power supply and quality has been managed centrally at the grid level. The grid utility is responsible for providing power to its customers with guarantees around
  - Supplying as much power as required
  - Supplying power within agreed, usually tight, quality limits
  - Managing impacts on the grid caused by large consumer operations
- No longer viable in many instances
- The transition to a data and energy intensive environment bringing
  - Rate of change is too fast and at such scale for utilities to service
    - Data centre development is happening quicker than conventional power grid development/evolution (8-10 years)
    - Long lead times for power generation and grid equipment (4-6 years)
  - The services required by AI data centres are too extreme to be managed by conventional methods on a grid-wide basis
  - Is the grid code fit for purpose for the new situation?
- Therefore, looking for ways to
  - Provide power to data centres
  - Protect the grid from the data centres (and vice versa)



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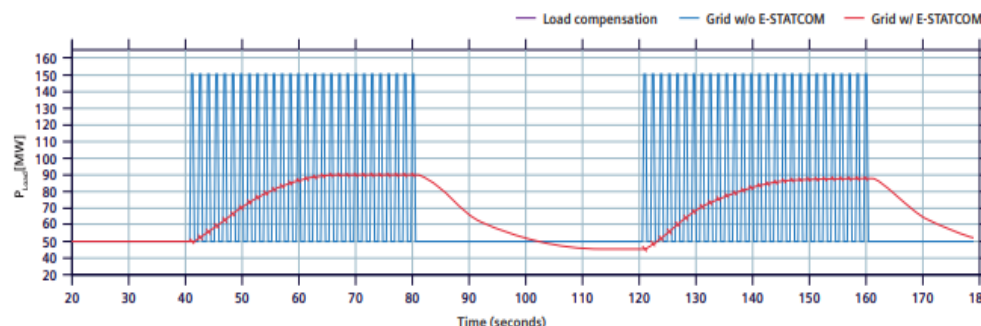
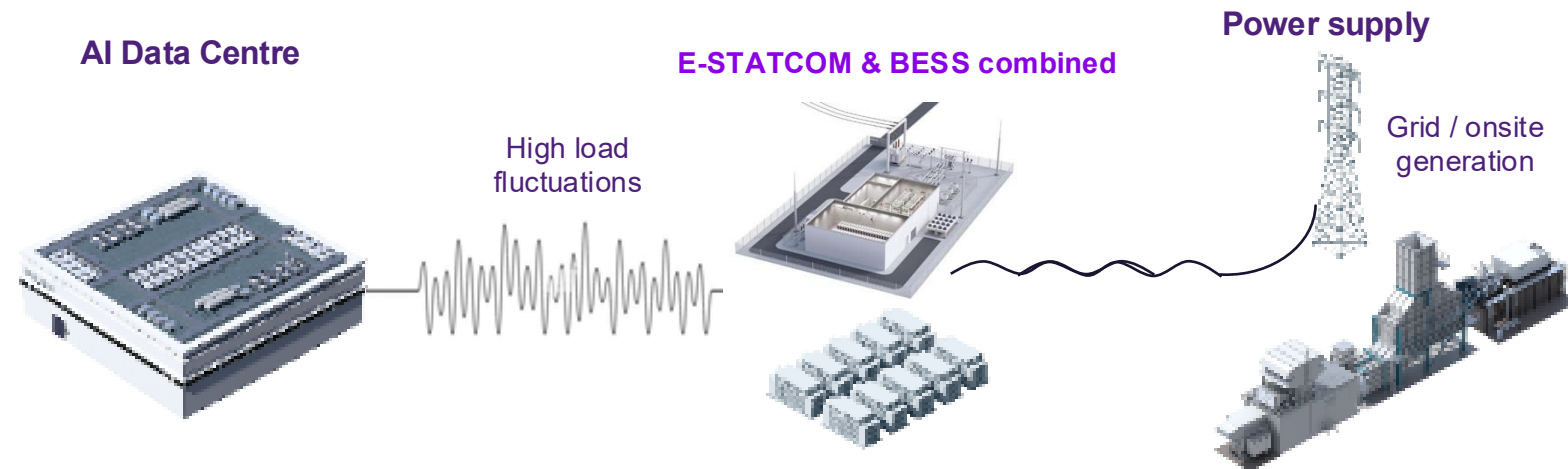
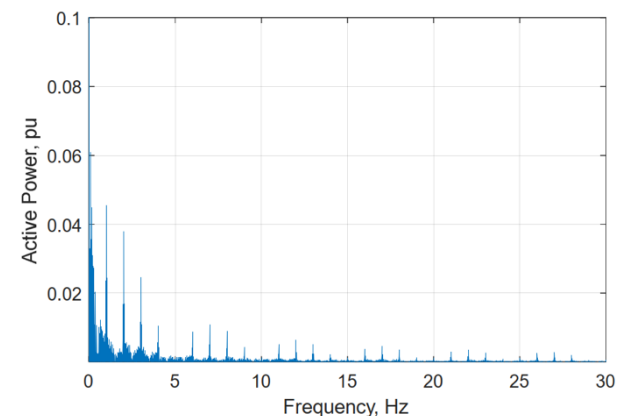
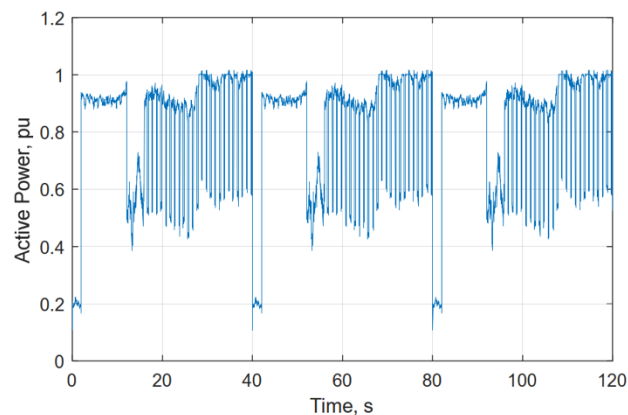
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## Making power quality the responsibility of the data centre developer Technically – by making the data centre provide a manageable load at the point of connection

### AI driven load volatility

- Forced oscillations
- Fault-ride-through capability of the data centres
- Voltage and frequency stability
- Power quality



The E-STATCOM is connected at or behind the point of coupling of the AI data center in parallel to the load and compensates for the active power load swings. At the same time, the E-STATCOM can provide or absorb reactive power from the grid or the load. This stabilizes the electrical system's voltage.



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## Different technologies and configurations will have different technical capabilities depending on definition and application

Grid services	SynCon	SynCon + FlyWheel	BESS GFM	SynCon + FlyWheel + BESS	Sync. generator	STATCOM (SVC PLUS)		E STATCOM (SVC Plus FS)		Shunt reactor
						GFL	GFM	GFL	GFM	
Inertia	+	++	+	++	++	-	-	-	*	-
Voltage support	++	++	++	++	++	+	++	+	++	-
Reactive power – dynamic	++	++	++	++	++	++	++	++	++	-
Reactive power – static	++	++	++	++	++	++	++	++	++	++
Short-circuit power	++	++	+	++	++	-	-	-	*	-
Restoration service	-	-	+	+	++	-	-	-	-	-
Other revenue stack options	-	-	++	++	+	-	-	-	-	-

++	Strong
+	Possible
*	Limited as backup
-	Not possible

**Objective:** Define which technology options and solutions make sense for each of the selected sites. Key considerations are CAPEX, OPEX, Return on Investment, and supply chain impacts.

Table for illustrative purposes only. Actual outcomes will be site-specific as noted above.



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## Making power quality the responsibility of the data centre developer Commercially - through the use of a system strength charge mechanism

Australia is rapidly shifting from synchronous generators to high volumes of inverter-based resources - this reduces system strength and increases the need for deliberate services to maintain frequency control, voltage stability, inertia, power quality, and fault level.

- An annual transmission charge has been introduced under the NEM system strength reforms
- Applies to new or modified inverter-based generators (e.g., wind, solar, BESS) from March 2023
- Paid to the System Strength Service Provider (SSSP), which is the relevant Transmission Network Service Provider
- Reflects the cost of maintaining available fault level (AFL) and system strength (maintaining and controlling stationary and dynamic voltage waveform) at the connection location
- Large inverter-based loads (IBLs, e.g., data centres  $\geq 30$  MW) may soon face SSC obligations similar to inverter-based generators under AEMC's Package 2 draft rule
- System Strength is now a connection constraint and a project cost to generators, and potentially IBLs, influencing project siting, plant design, connection risk, and long-term returns
- SSC applies in QLD, NSW, SA, TAS, and VIC (at declared system-strength nodes).

**South Australia**  
SSSP: ElectraNet  
Average SSUP: 2556 \$/MVA/yr  
System Strength Nodes: Davenport, Robertstown, Para

**Tasmania**  
SSSP: TasNetworks  
Average SSUP: 807 \$/MVA/yr  
System Strength Nodes: Burnie, George Town, Waddamana, Risdon

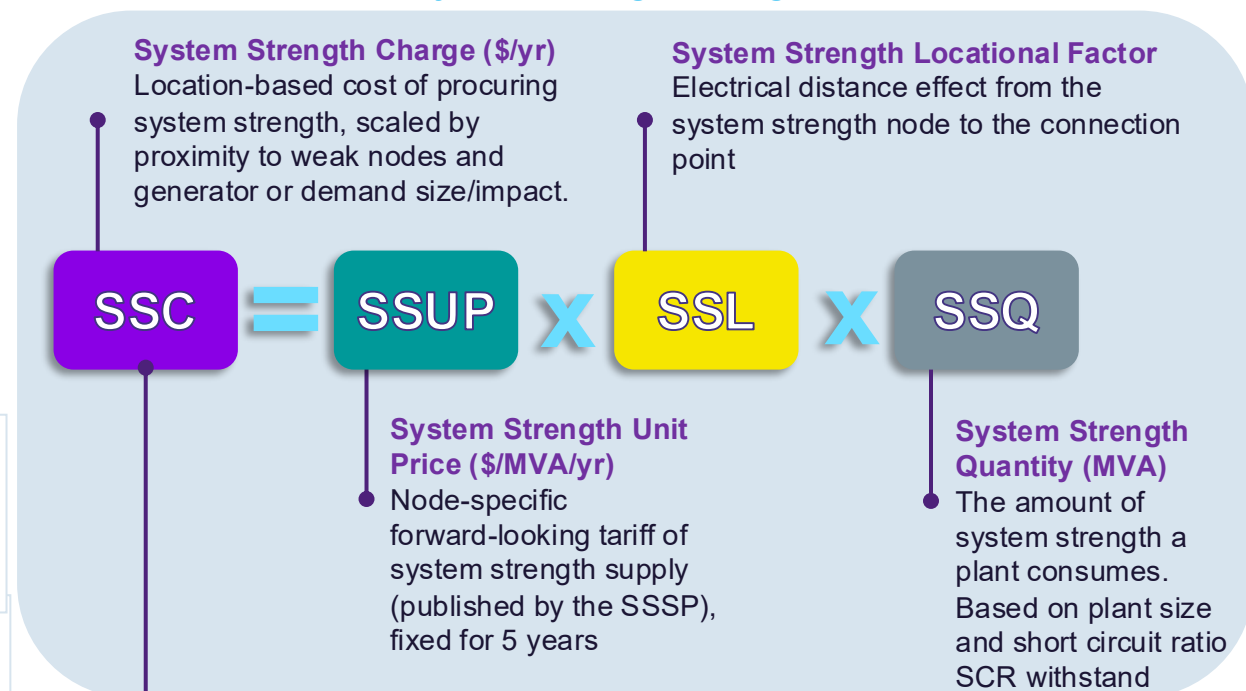


**Queensland**  
SSSP: Powerlink  
Average SSUP: 5188 \$/MVA/yr  
System Strength Nodes: Gin Gin, Greenbank, Lilyvale, Ross, Western Downs

**New South Wales**  
SSSP: Transgrid  
Average SSUP: 2422 \$/MVA/yr  
System Strength Nodes: Armidale, Buronga, Darlington Point, Newcastle, Sydney West, Wellington

**Victoria**  
SSSP: AEMO  
Average SSUP: 4558 \$/MVA/yr  
System Strength Nodes: Dederang, Hazelwood, Moorabool, Red Cliffs, Thomastown

### How is the system strength charge calculated?



Exposure to SSC is therefore driven by location, plant capability/ controls, and the cost of network solutions at the connecting node

$$SSQ (MVA) = (SCR_{withstand} - \alpha) \times P_{rated} \text{ (where } \alpha = \text{Stability coefficient)}$$



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## Handing the responsibility for power quantity and quality to data centre developers The use of microgrids and off grid facilities to avoid grid complications

- A single (or no) point of connection to the utility grid allows the data centre to operate in isolation from, or with limited exposure to, from utility grid requirements or impacts
- Benefits
  - Power supply and quality considerations now the total responsibility of the data centre developer (utility not involved)
  - Isolated operations delivering only what is needed for the data centre
  - Limited interfacing (if any) with the utility power grid
  - Planning and delivery process outside of the traditional utility planning processes
    - Still subject to statutory planning and environmental processes and regulations
- Other considerations
  - Often needs regulation to allow isolated, but connected operations
  - Design of the grid interface at the Point of Connection
    - Technical, commercial, operational



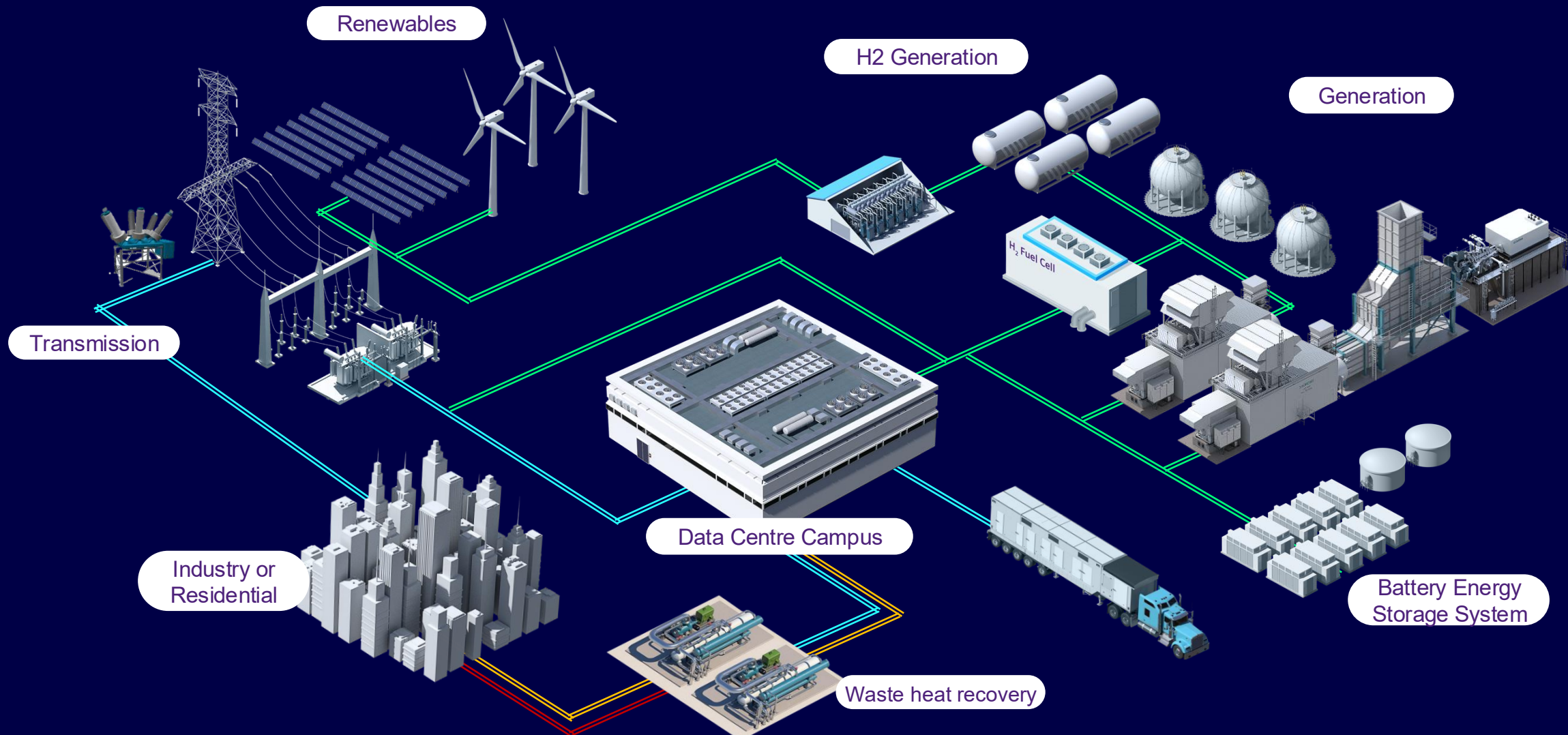
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## Sometimes a microgrid isn't very micro!





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## Recent examples of Siemens Energy microgrid/off-grid data centre projects



### Williams AI Data Centre | USA

#### Off-grid with own generation

- 2x 200MW power plants enabling AI hyperscale data centre
- 29x gas turbines, 31x reciprocating engines



#### On-grid data centre with hybrid generation (grid + own generation)

- AI data centre
- 2GW as backup power connected to 345kV system with weak grid



#### On-grid data centre with power supply from grid

- 500MW of 2 blocks of data centre connecting to 132kV with only stabilisation units connected to the data centre on the 132kV level



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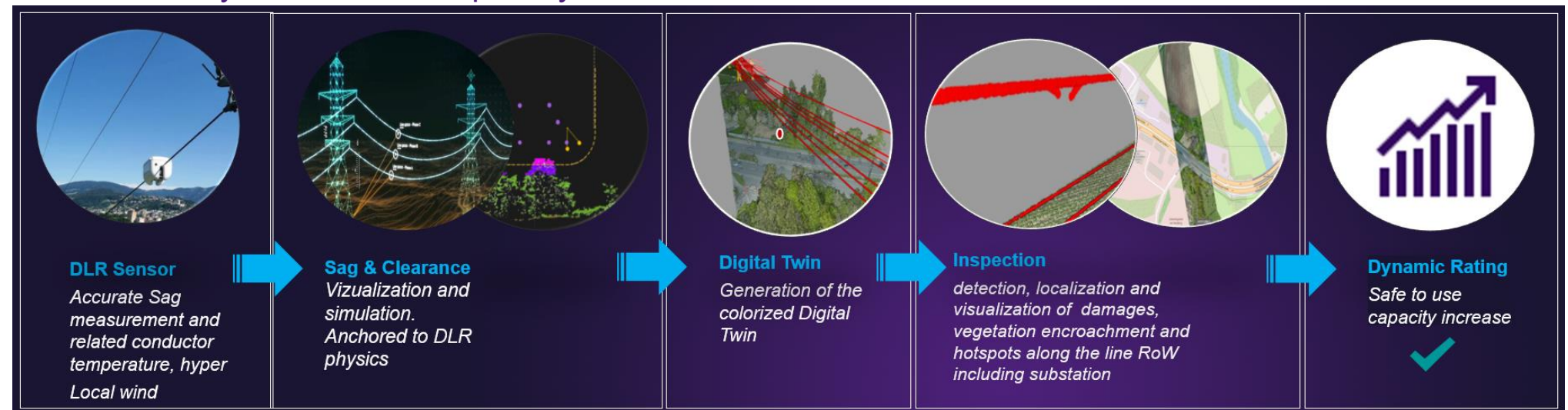
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## Making the most of the existing grid through digitalisation Enhanced Dynamic Line Rating (DLR) and Dynamic System Rating

- DLR itself is not a new idea but can be brought into the digital age
  - Creation and use of living Digital Twin and Advanced Inspection techniques
  - Integration of individual assets into a consolidated system allowing Dynamic System Rating approach to transmission corridors
- Improvements available<sup>(4)</sup>
  - More accurate system forecasting
  - Improved system utilisation and release of additional system transfer capability
  - Reduced curtailment
  - Reduced downtime



Source 4: [Analysis of Digital Transformation Framework and Implementation Pathway for Power Grids in the Context of New Power Systems | IEEE Conference Publication | IEEE Xplore](#)



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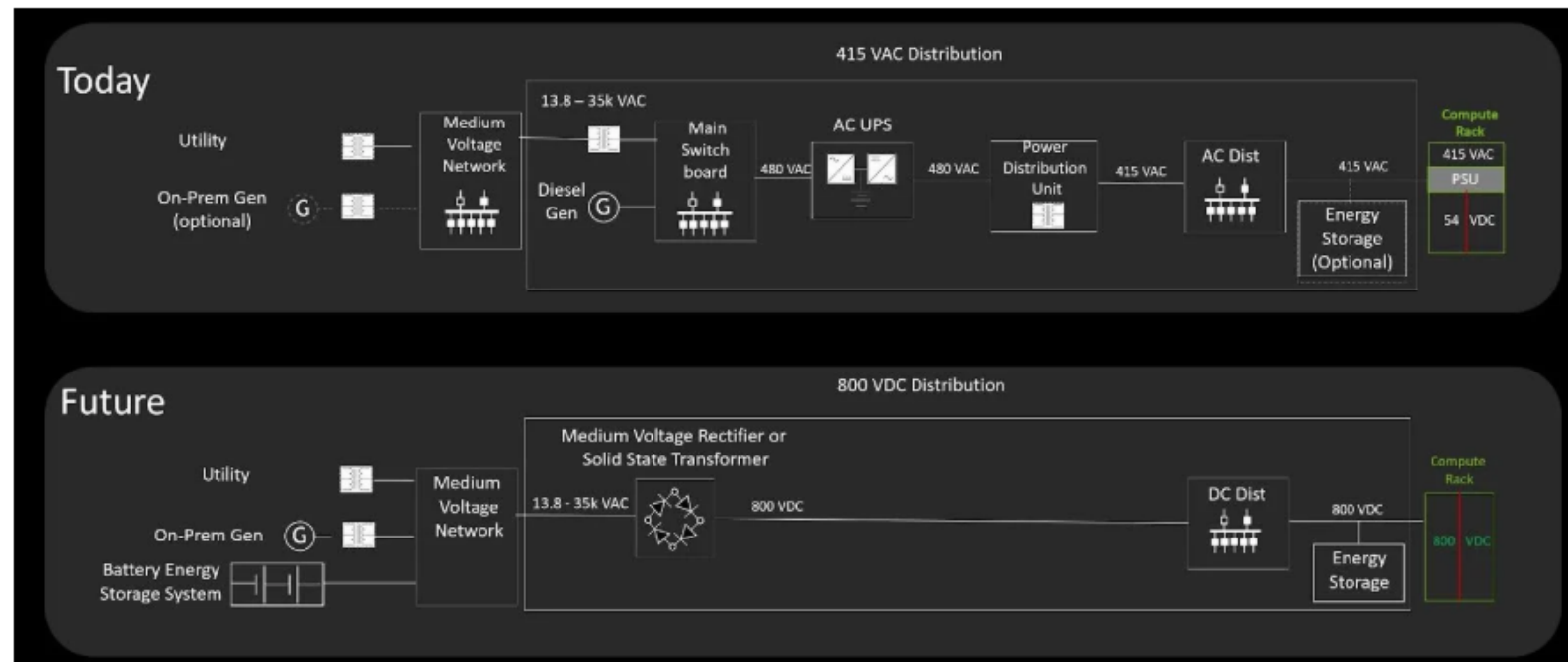
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## Innovation within the data centre

- Innovation of the data centre architecture itself fundamentally changes the services needed to be provided by the grid/microgrid
  - Increased operating voltages eg 800V dc, increased rack sizes and energy density, simplified dc power systems (removing ac)
  - Moving power quality inside the data centre through integration of supercapacitors and BESS into the data centre power system



Source 5: [Building the 800 VDC Ecosystem for Efficient, Scalable AI Factories | NVIDIA Technical Blog](#)



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# Thank You!