



UK Research Activities on Advanced Distribution Automation

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Outline

- Introduction and Background (ADA vs. ANM)
- UK Nationally Coordinated Activities in ANM
- UK Research & Development Activities in ANM
- Future Directions for ANM in the UK



Introduction and Background

Advanced Distribution Automation (ADA)

vs.


Active Network Management (ANM)

Advanced Distribution Automation (ADA)

- Takes existing network automation further
- Main focus is on system reliability
- Addresses key utility drivers in the US and UK:
 - Distribution reliability
 - Capital and operating cost control
 - Customer focused operation
 - Connection of distributed and renewable generation
- Primary and secondary system solutions

Active Network Management (ANM)

- Focused on the economic integration of distributed and renewable resources into distribution networks
- Focused on secondary system solutions
- Seeks to overcome barriers to generation connection:
 - Power flows
 - Voltage control
 - Fault level
- *‘Real-time control of generation, load, storage and network devices based on real-time measurements, communications and control’*



UK Nationally Coordinated Activities in Active Network Management (ANM)

Distribution Sector Working Groups (WS3 and WS5)

- DTI/Ofgem sponsored technical work groups commissioned to investigate ANM solutions
- ‘Best practice’ guides and ETRs published to promote ANM solutions
- Distribution network operators encouraged to consider these options in DG connection planning

UK Technical Architecture Project

- Established as a UK power sector activity by the IEE
- Remit to undertake research and development work to address future power system needs addressing the issues:
 - Distributed Energy Resources
 - Asset Renewal
 - Liberalised Market Frameworks
 - Lower Carbon Energy Systems
 - Efficient, Cost Effective Solutions

UK Technical Architecture Project

- Identify and propose network development strategies facilitating the efficient planning, connection and operation of:
 - Current and future generation technologies
 - Static and responsive demand
 - Energy storage devices
 - Network auxiliary plant and equipment

UK SuperGen Initiative

- UK Research Councils funded programmes in several areas of power generation, networks and end-use:
 - *Networks; Biomass /Biofuels; Marine Power; Hydrogen technology; Photovoltaics; Conventional power plant lifetime extension; Fuel cell technologies; Energy storage; Distributed power systems.*
- Several aspects of microgrids, minigrids and system automation and system management being addressed.

UK SuperGen Initiative

- ‘Future Network Technologies’ and ‘Highly Distributed Power Systems’ consortia tackle network management and automation issues:
 - Microgrid control
 - Adaptive protection
 - DG management
 - Responsive demand
 - ‘Cell’ based control of multiple resources

DG Incentive, RPZ and IFI

- Distributed Generation Incentive: 1.5£/kW/yr for for all additional DG connected
- Registered Power Zones: additional 3£/kW/yr for innovative solutions to DG connection
- Innovation Funding Incentive: 0.5% of revenue for technological development and demonstration
- Active Network Management is a key area of distribution company plans for innovation expenditure

DTI Programme

- UK Department for Trade and Industry (DTI) fund technological development related to network management and DG
- ANM has been a key area in recent years
- Focused funding for ANM within newly launched programme

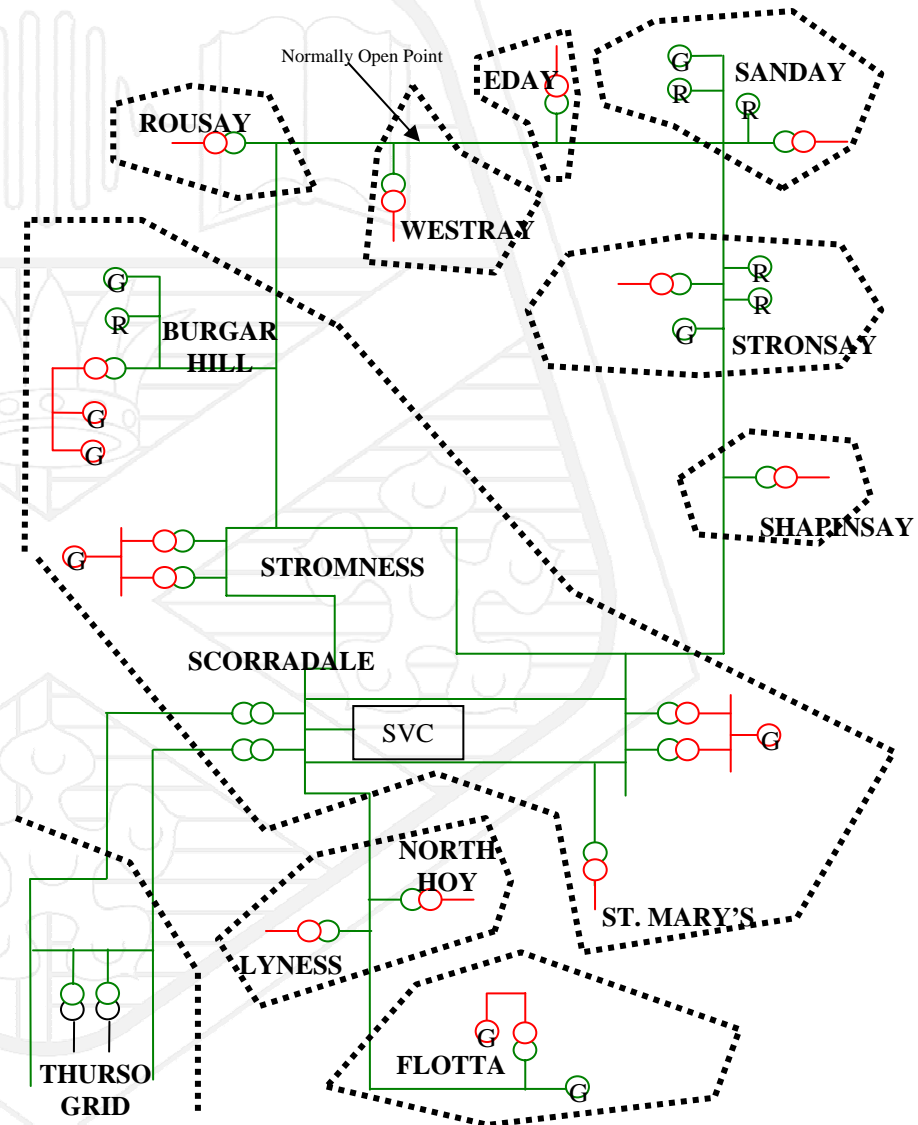
UK Research & Development Activities in ANM

Active Management Concepts Development:

- Power Flow Management
- Voltage Control

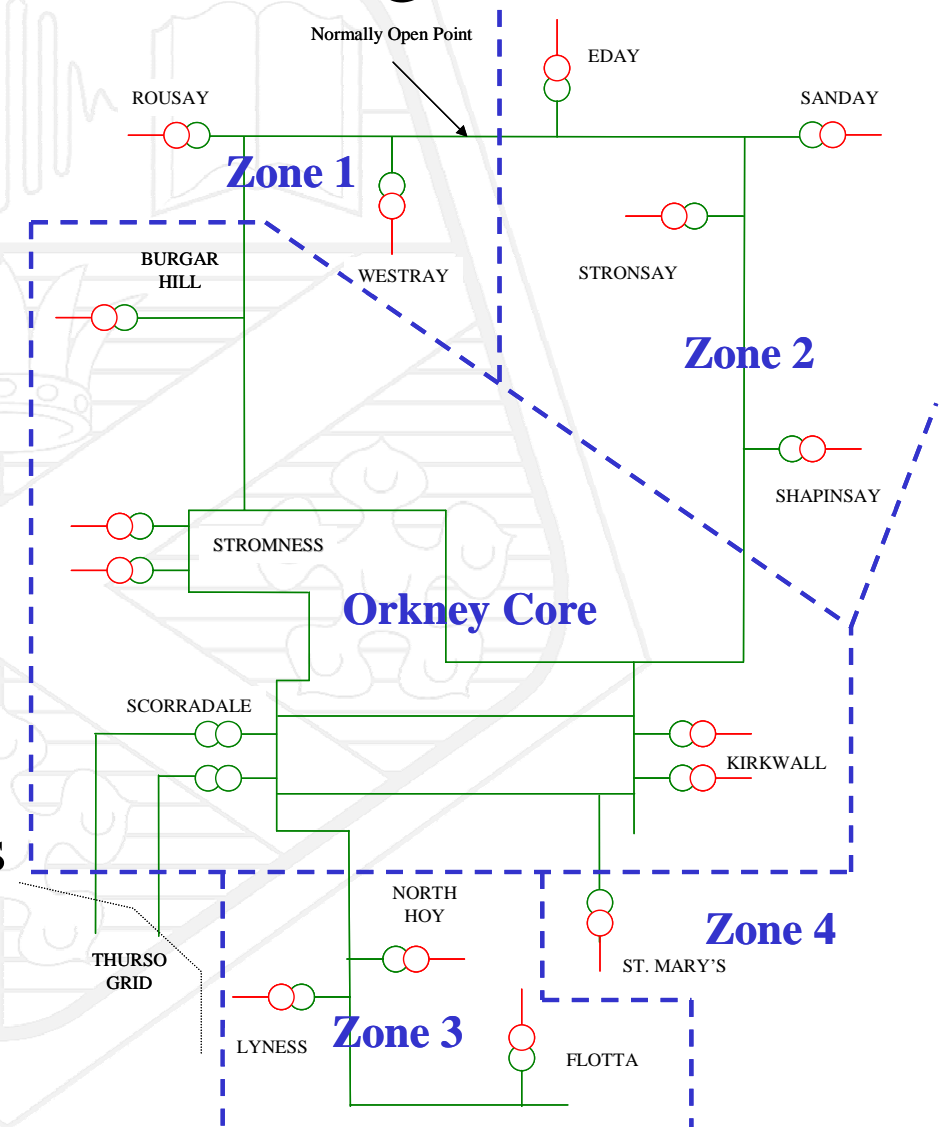
Background to Orkney Active Power Flow Management Scheme

- Two 33 kV submarine cables from the mainland: 30 MVA and 20 MVA.
- 7 MW min / 31.5 MW max load.
- 26 MW firm generation.
- 20 MW non firm (I/T) generation.
- Further generation needs to be load / generation following.
- Network Capacity 71.5MW.
- ≈ 25 MW of potential managed generation capacity.



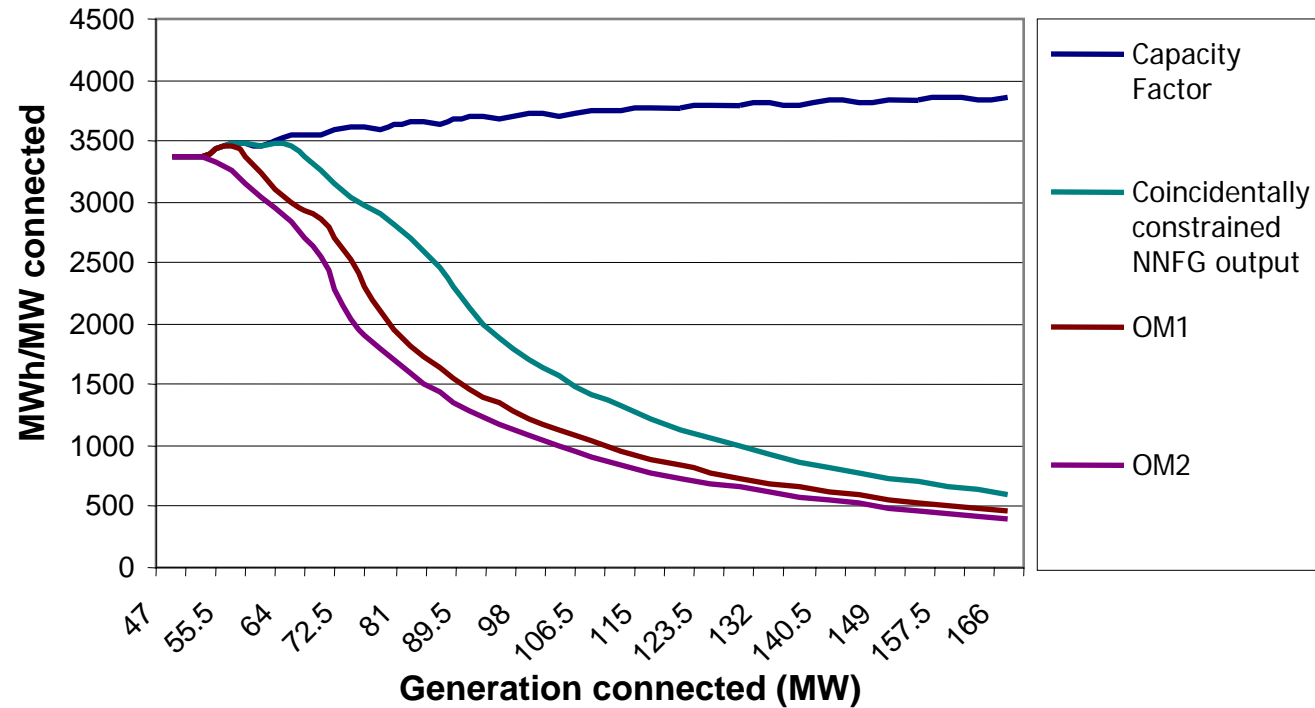
Concept for Orkney Active Management Scheme

- Q compensation solves voltage issues, no fault level issues
- Thermal capacity of network optimised with an operating margin
- Logic control based on measurement of primary system parameters
- Digital Radio for communications
- Ensures network security and operational flexibility for the DNO



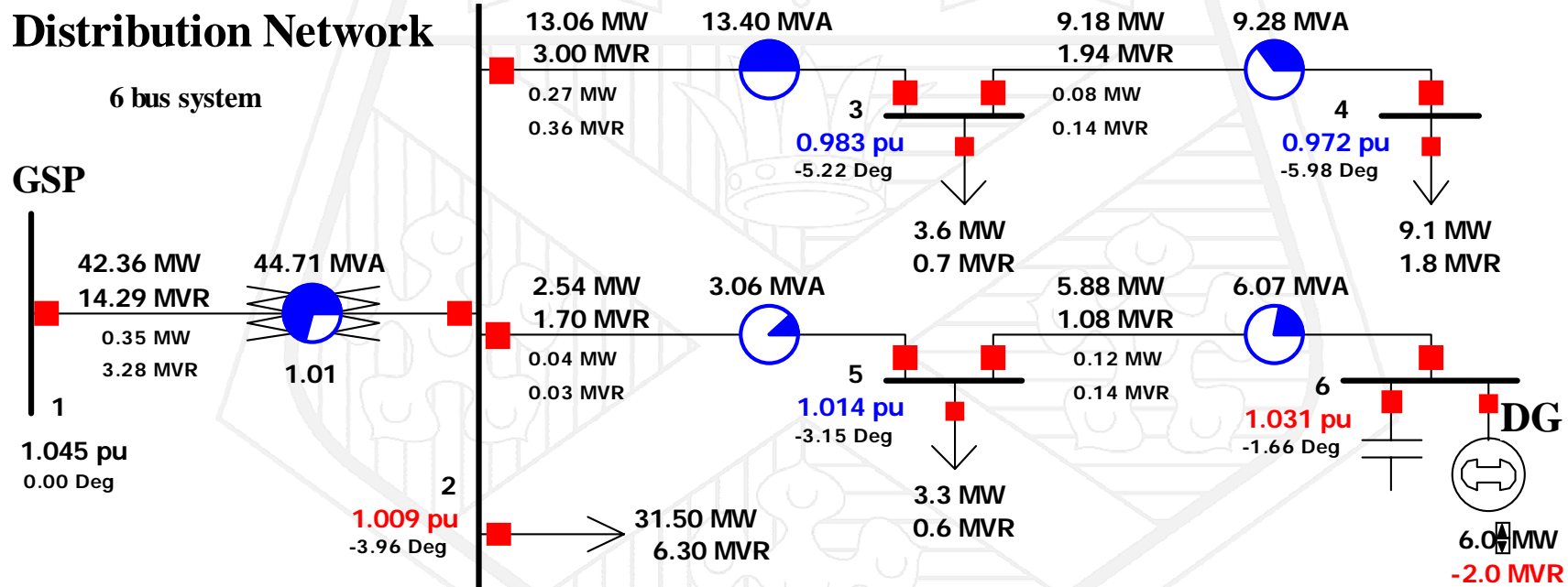
Additional Renewable Capacity Result

Energy Output from Scheme (MWh/MW connected)



Operating Margin	1	2
Trim Min Load	2	3
Trim Max Load	8	10
Trip Min Load	2	3
Trip Max Load	7	10

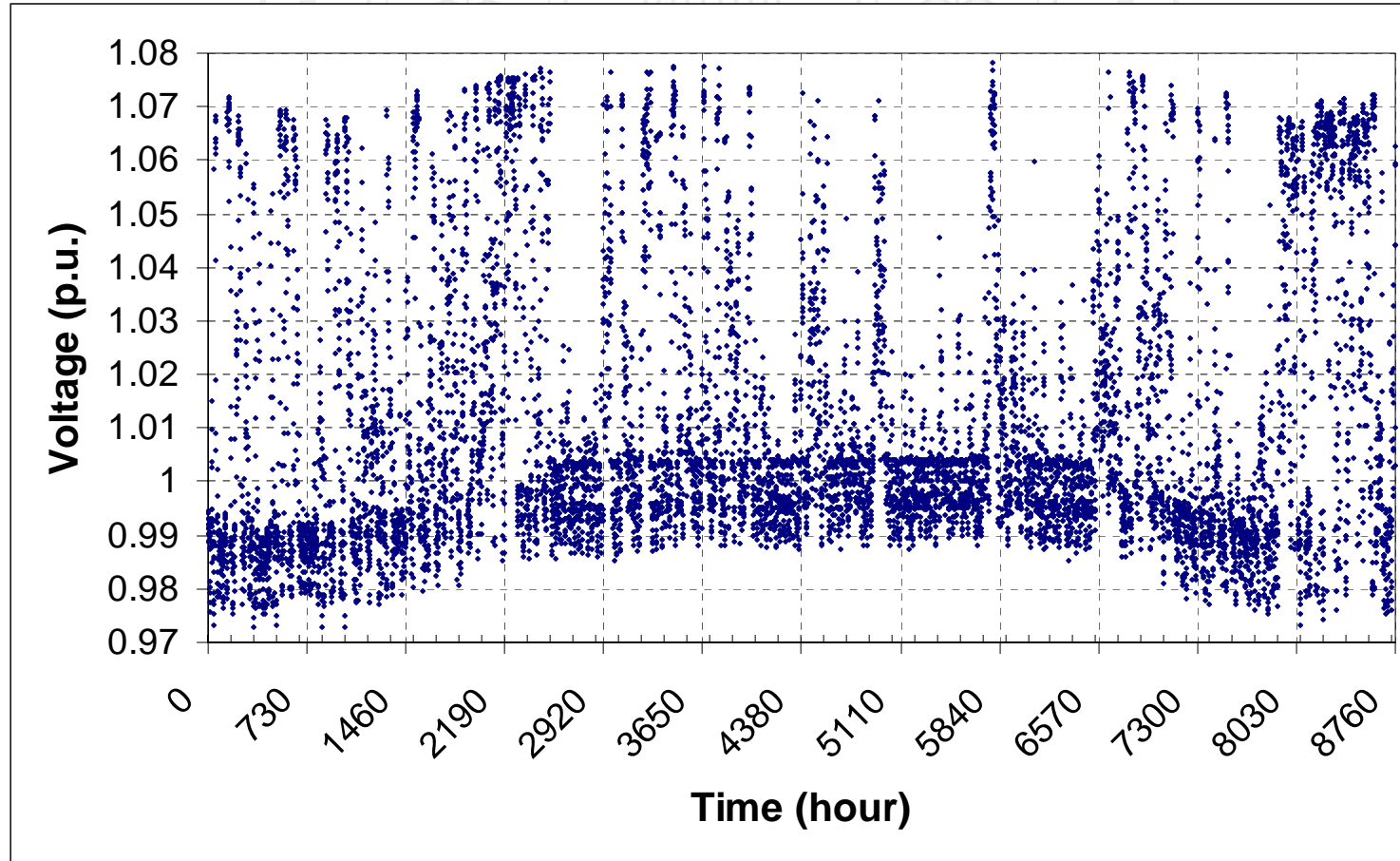
Voltage Constrained DG on Simple Distribution Network



Note: worst case is defined maximum generation and maximum load, producing the greatest divergence in voltages on the two feeders.

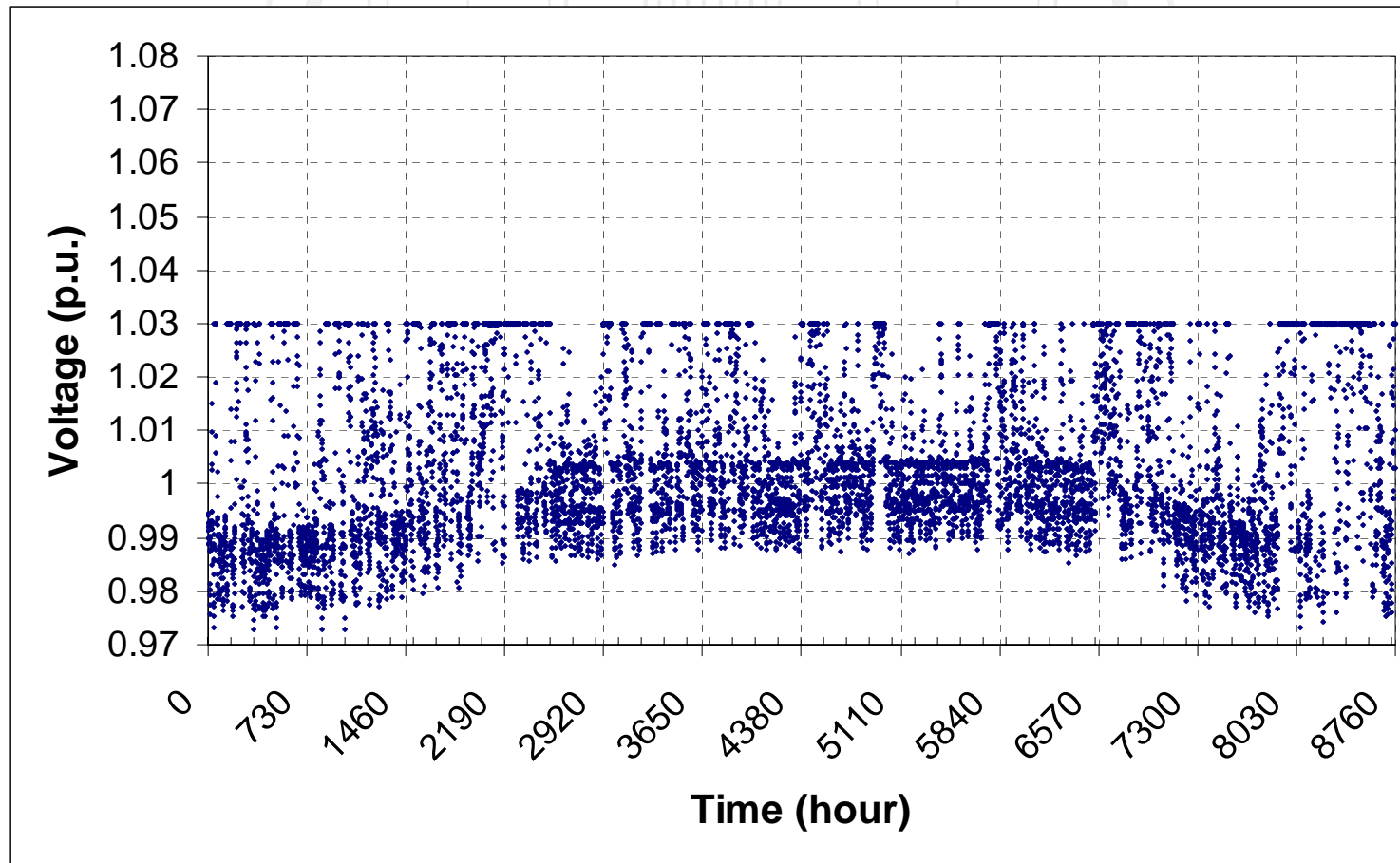
Courtesy of Univ. Manchester – partners of Univ. Strathclyde in UK DTI Centre for Distributed Generation and Sustainable Electrical Energy

Annual Voltage Profile

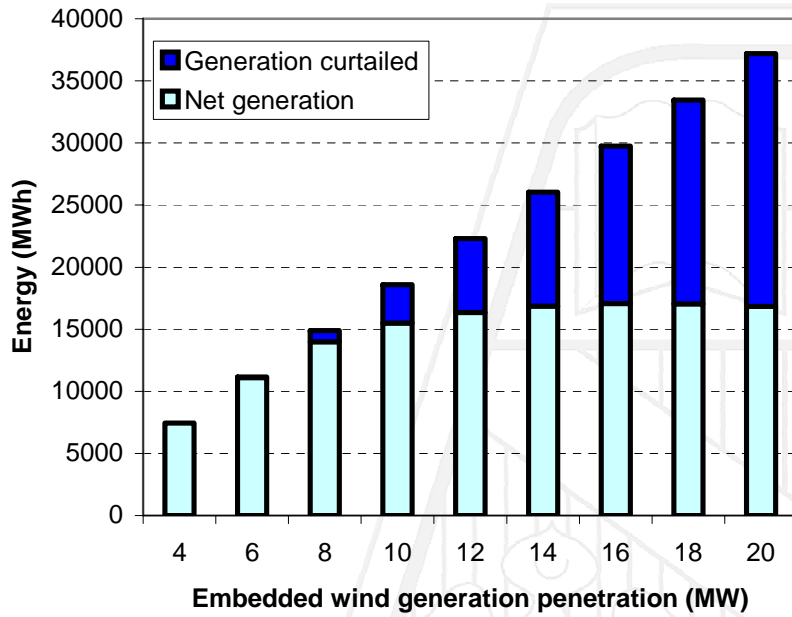


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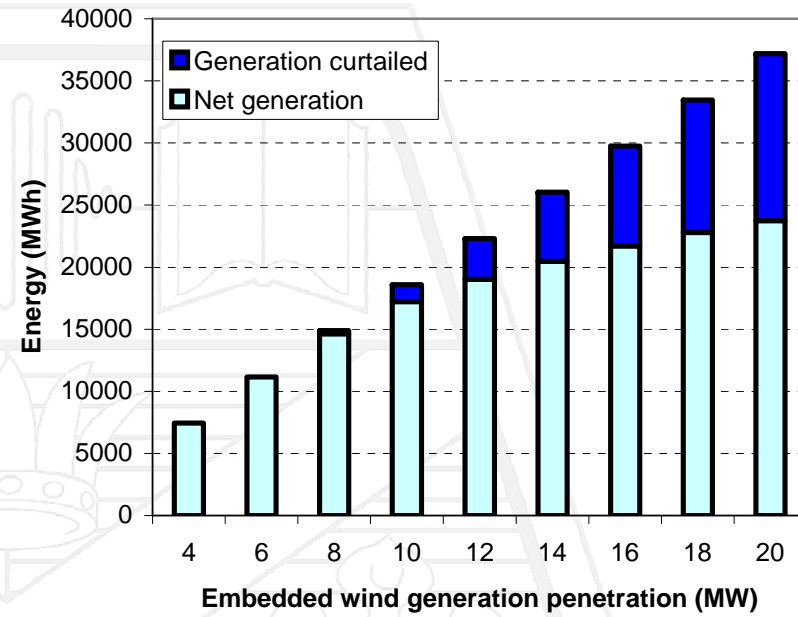
Voltage Limits Applied



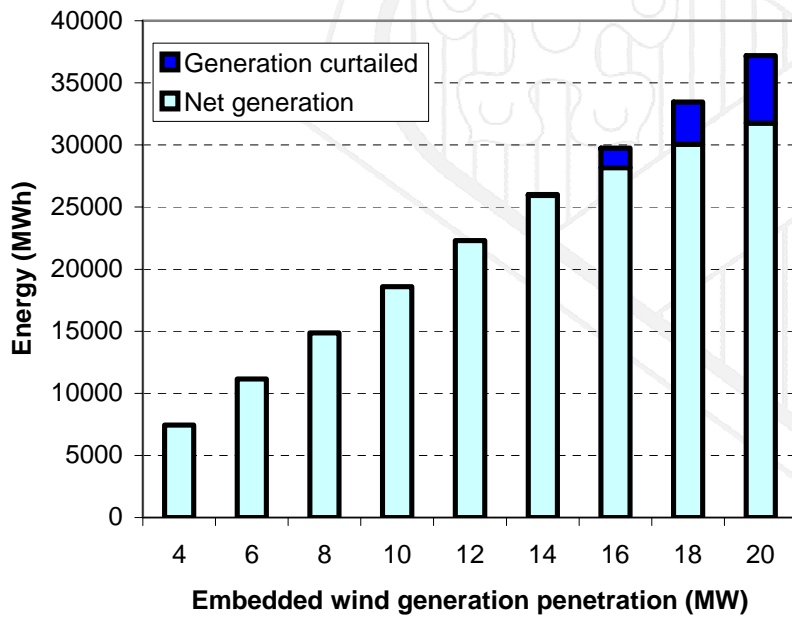
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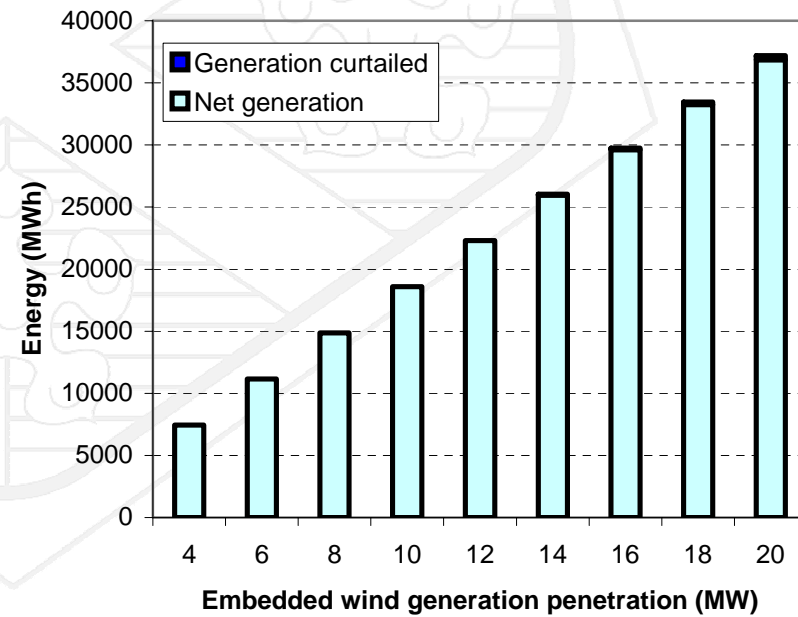
Active dispatch only



Reactive power mgmt.



Area based OLTC control



OLTC + Voltage regulator



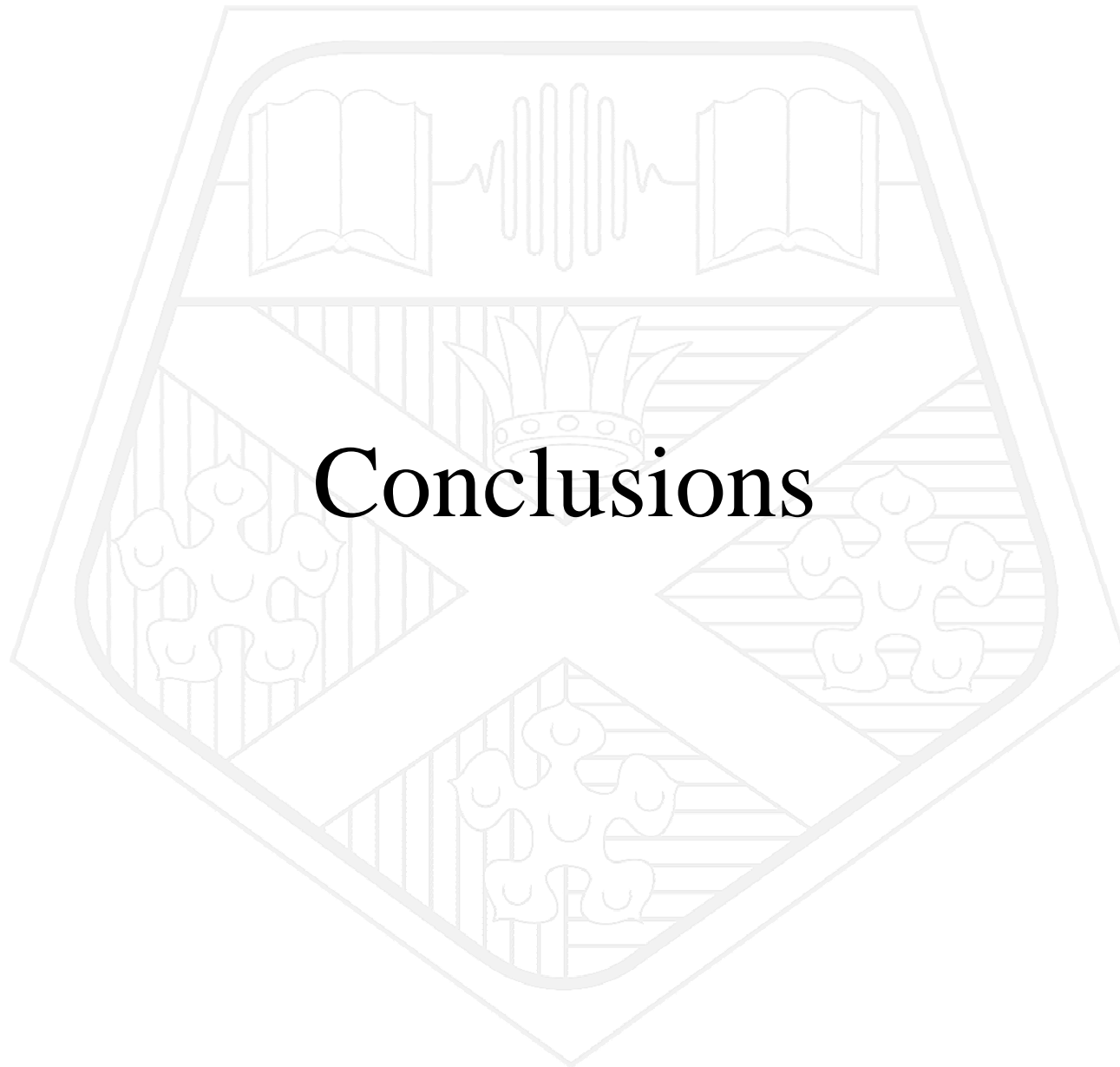
Future Directions for ANM in the UK

Future Directions

- **NOW** – Automation of primary substations and some MV feeders
- **2010** – Roll out of feeder automation and active generation management
- **2020** – Integrated approaches to MV network automation and generation management
- **2030** – Further integration of network and generation management with load and storage management in area-based active management schemes.

Key Technologies for Active Networks

- Responsive generation
- Responsive demand
- Power electronics
- Distribution automation
- Communications
- Energy storage



Conclusions

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- Strong parallels between distribution automation and active network management exist
- Substantial programmes of research, development and demonstration for active network management are underway
- Active network management offers the prospect for more economic integration of renewables into power systems
- Integrated network automation and generation management possible in future