Malawi Renewable Energy Symposium
Lilongwe, Malawi
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University of Strathclyde Engineering

The future of smart grids – UK experience and vision for Malawi

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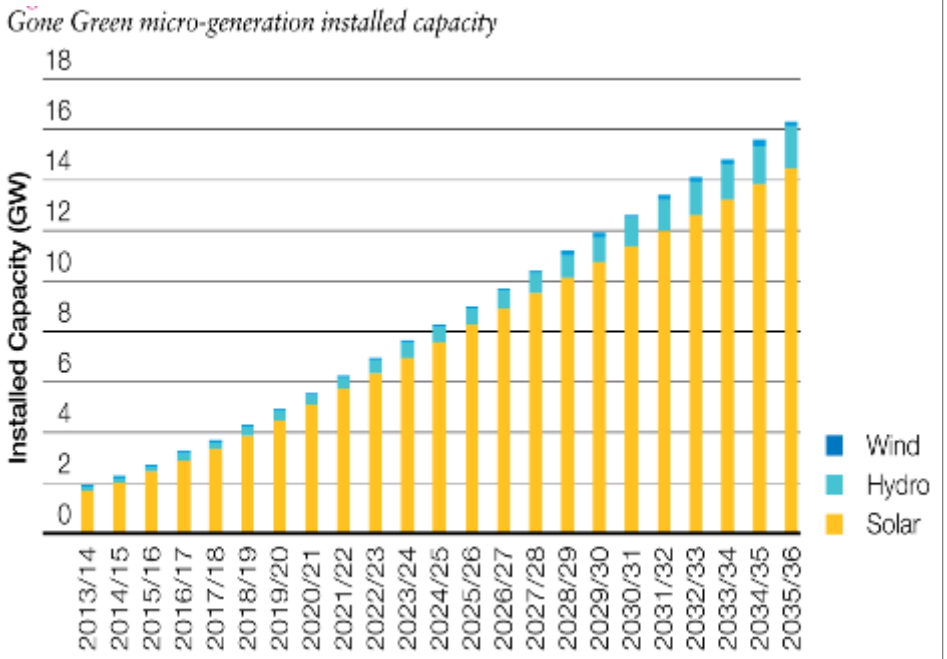
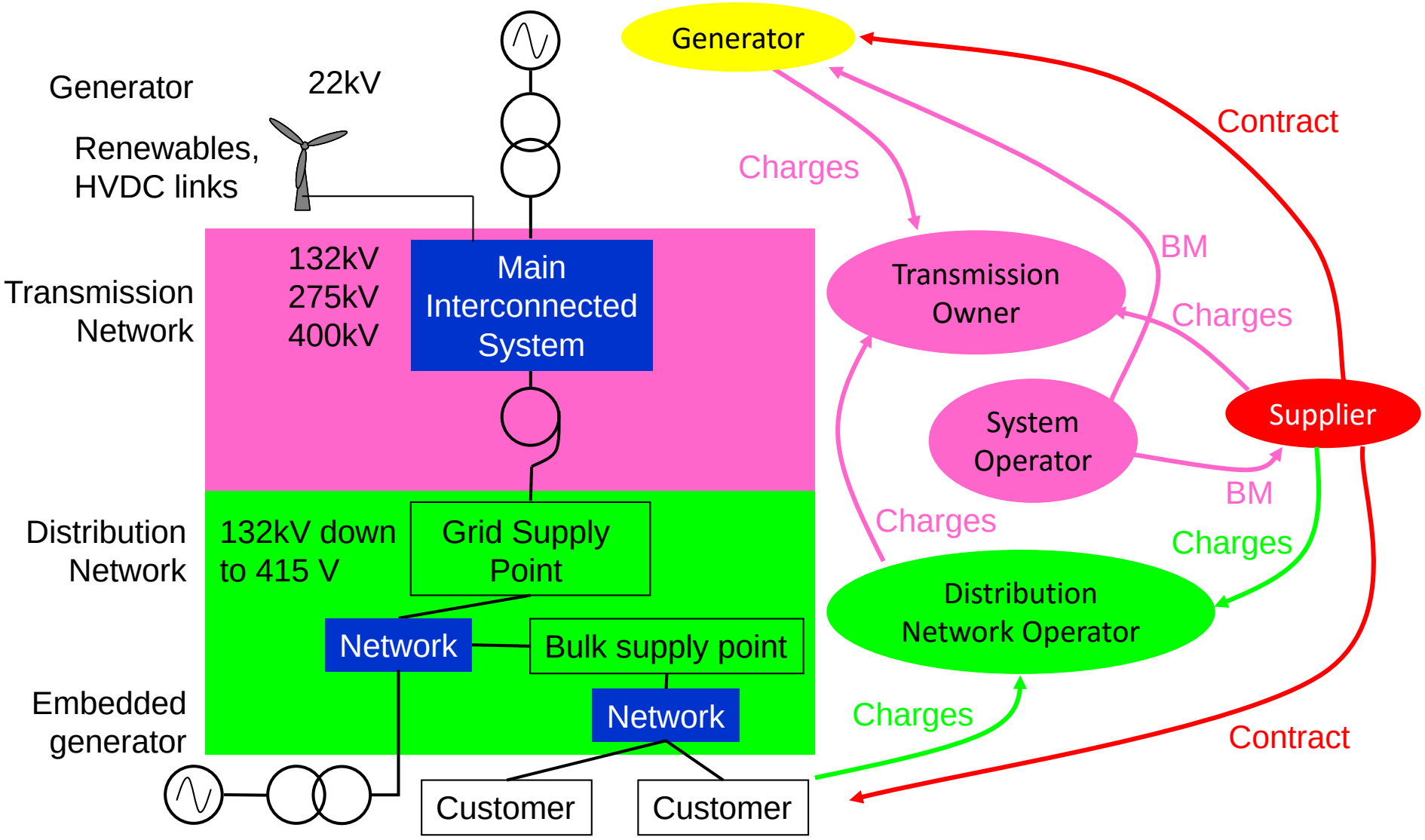
Overview

- The “traditional” power system in the UK
- The future: selected challenges
- Innovation in the UK
- Example projects and facilities
- Recommendations for Malawi



The power system in the UK

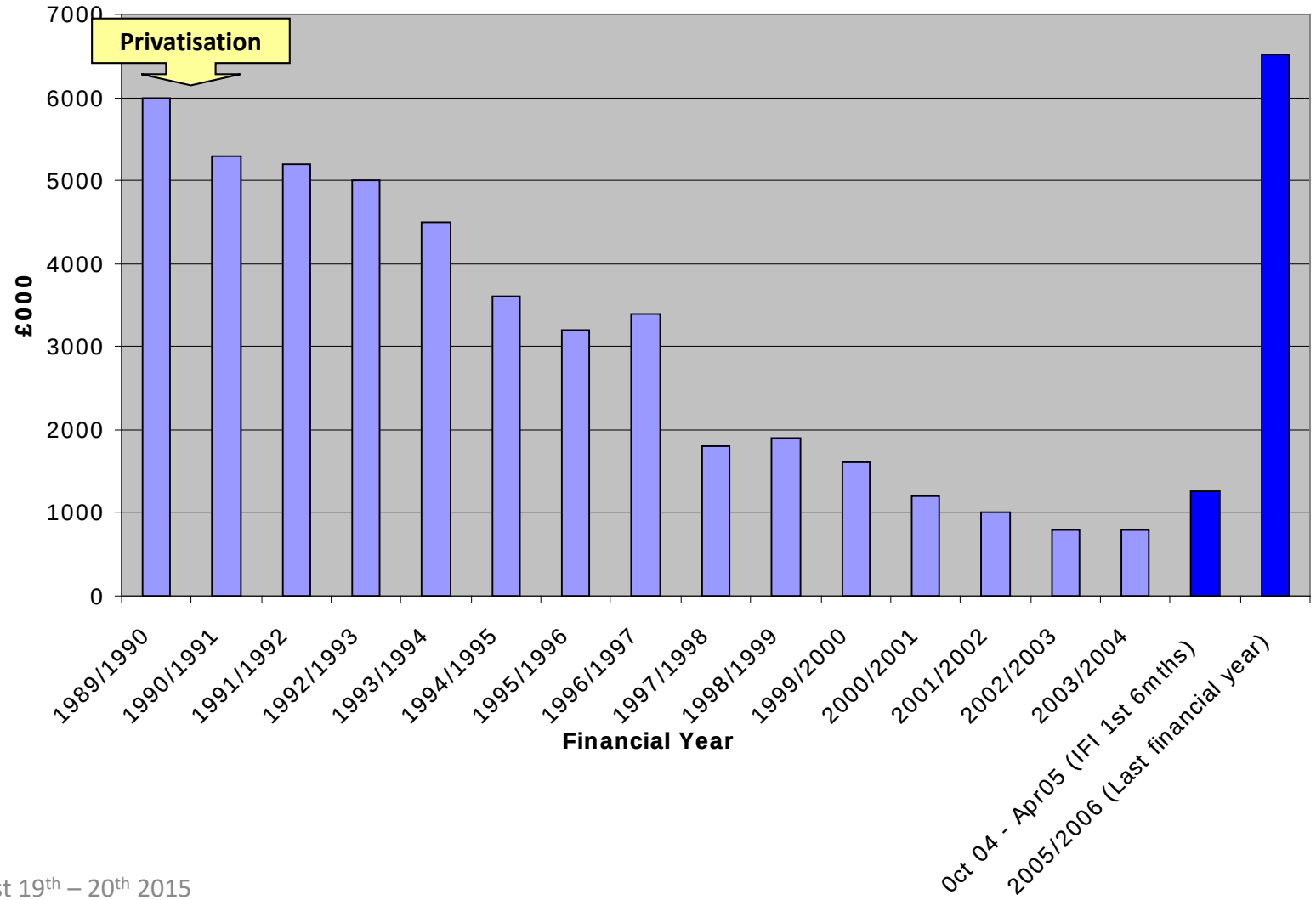


Keith Bell, Strathclyde

Drivers for innovation

- Renewables, de-carbonisation of generation and demand
  - Renewables massively distributed
  - System will behave *completely* differently in future

Drivers for innovation in GB - history



Drivers for innovation - now

1. Introduction – The Requirement to Innovate

In the UK, the energy sector faces significant challenges. The demands of moving to a low carbon economy and meeting our renewable targets whilst maintaining safe, secure and reliable energy supplies will lead to profound changes in its design and operation. Network companies will need to invest an estimated £32bn by 2020. This is a doubling of the average rate of investment over the next 10 years compared with that for the last 20 years. This is only part of the £200bn or more which has to be spent on energy infrastructure.

As the Energy Minister has publicly stated, "£200bn represents the biggest energy challenge of our lifetime." These targets include:

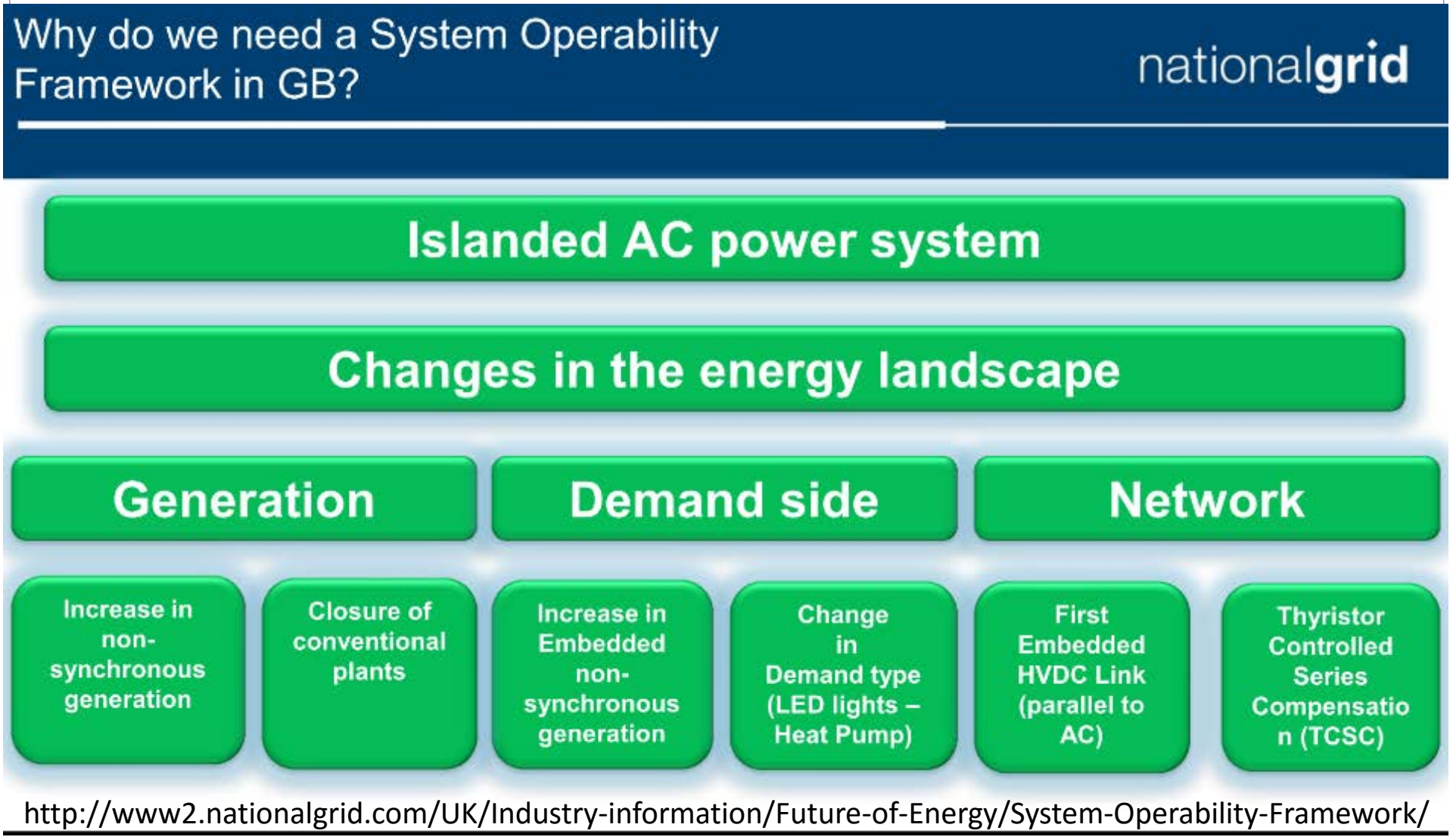
- The UK Climate Change Act (2008) to reduce CO2 by at least 26% by 2020 and greenhouse gas emissions by 80% by 2050
- The Scottish Government has recently increased its national target from 50% to 80% of Scottish electricity consumption to come from renewables by 2020
- Legally-binding UK targets to deliver cuts in greenhouse gas emissions, with 15% of our energy to come from renewable sources by 2020 which equates to 30% of electricity from renewable sources.

In order to meet the challenges of developing the transmission network in a sustainable and economic manner, a range of existing and innovative solutions will be required. To

Future energy mix in GB

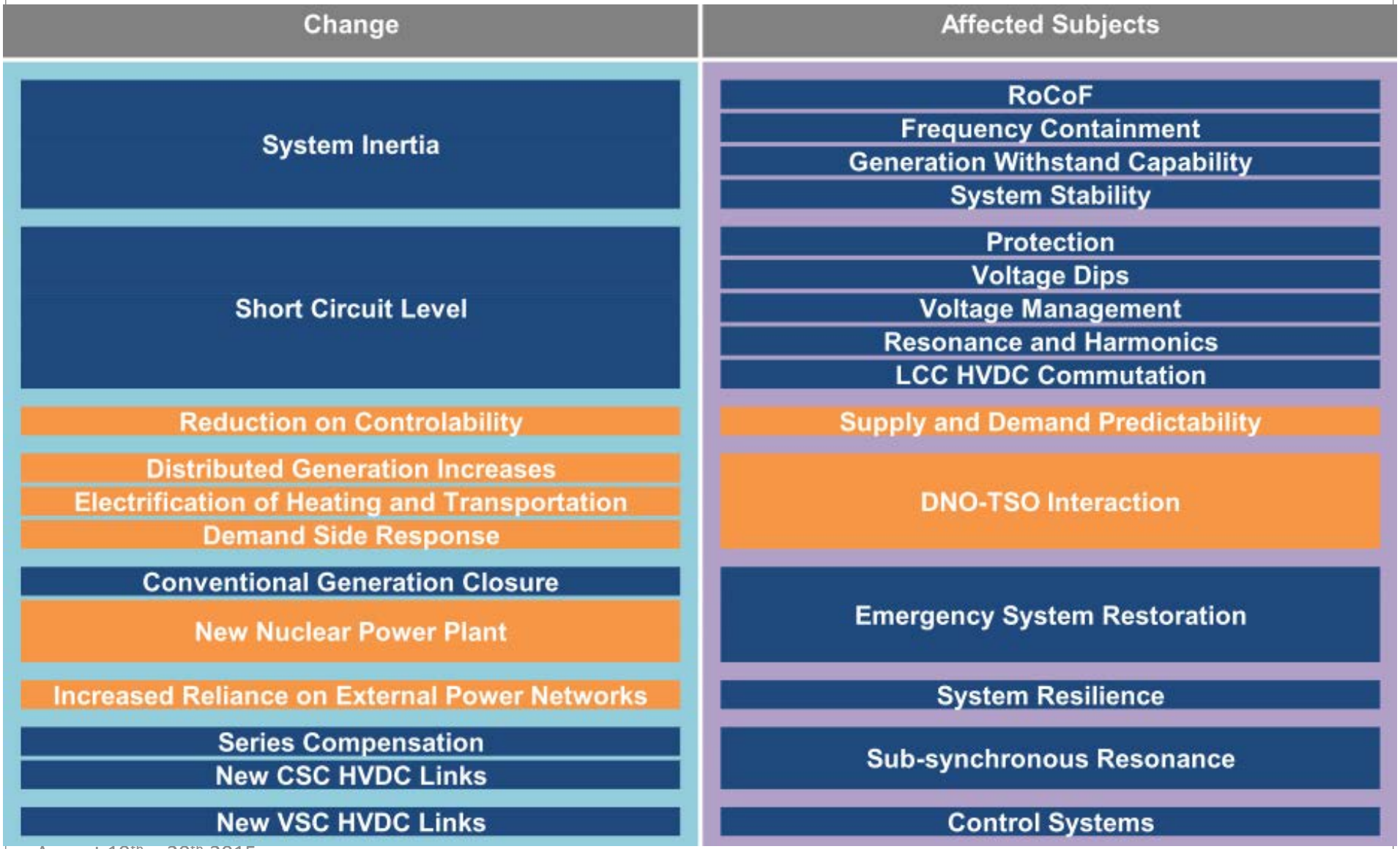
Gone Green	2013	2020	2035
Electricity			
Peak demand/GW	60.5	59.3	68.1
Annual demand/TWh	345	338	366
Total capacity/GW	91	106	163
Low carbon capacity/GW	28	50	109
Interconnector capacity/GW	4	6	11
Residential HPs/Millions	0.1	1.2	10
EVs number/Millions	0.01	0.6	5.4

Challenges



http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/System-Operability-Framework/

Challenges



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Microgrid boundary

Synchronous generator (main grid)

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- Energy networks
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  - Project highlight: ACCEPT
  - Project highlight: Esters

Bye bye blackouts!

An international research collaboration is developing new Phasor Measurement Units to prevent power system protection from triggering unnecessary blackouts.

The National Grid, which has to balance electricity generation and consumption across the UK in almost real time, is under constant strain. Relatively small excesses in generation or peaks in demand could lead to disaster.

...e grid is under constant observation. System Integrity Protection Schemes

...manches...ac.uk/research/

Did you know?
In 2003 blackouts in America and Italy each disconnected 50 million people.

Research links

ACCEPT on EPSRC Research Persepectives

ACCEPT on Research Atlas

Shreddable loads

...ts

Facilities to investigate, *demonstrate* and *test* solutions

Power Networks Demonstration Centre

Features

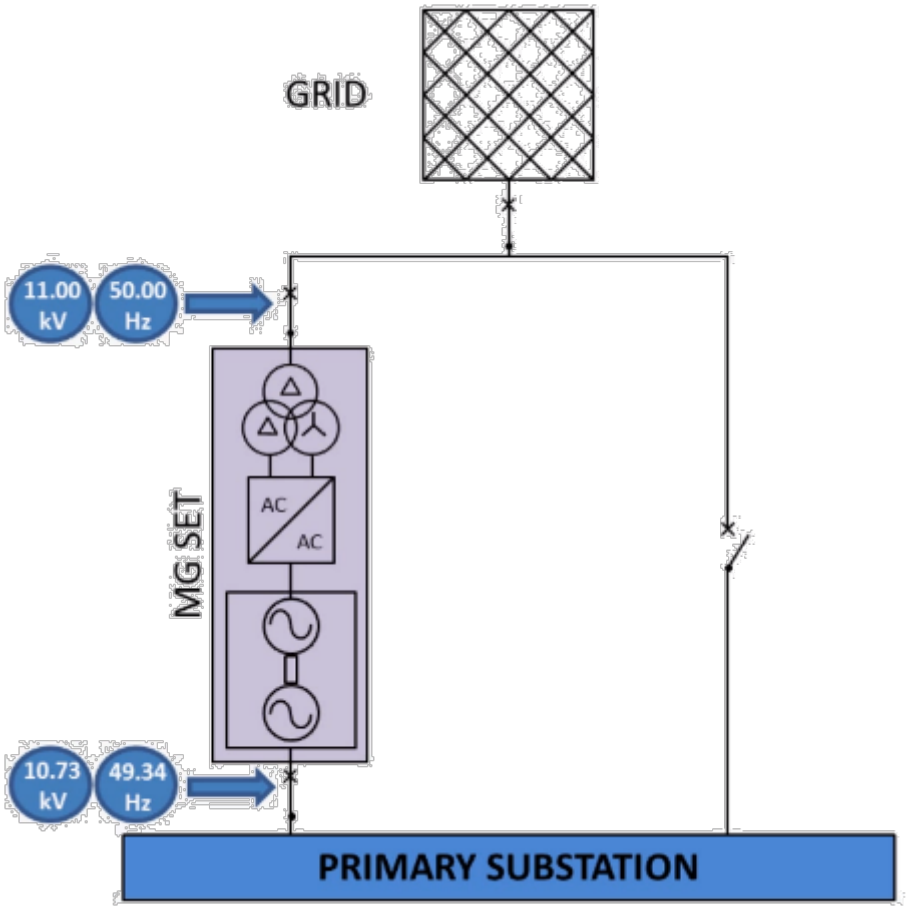
- Realism
- Flexibility
- Control room, industry-standard SCADA system, laboratories

- Accelerated testing (voltage, frequency, unbalance, power quality, faults…)
- Enhanced instrumentation and recording

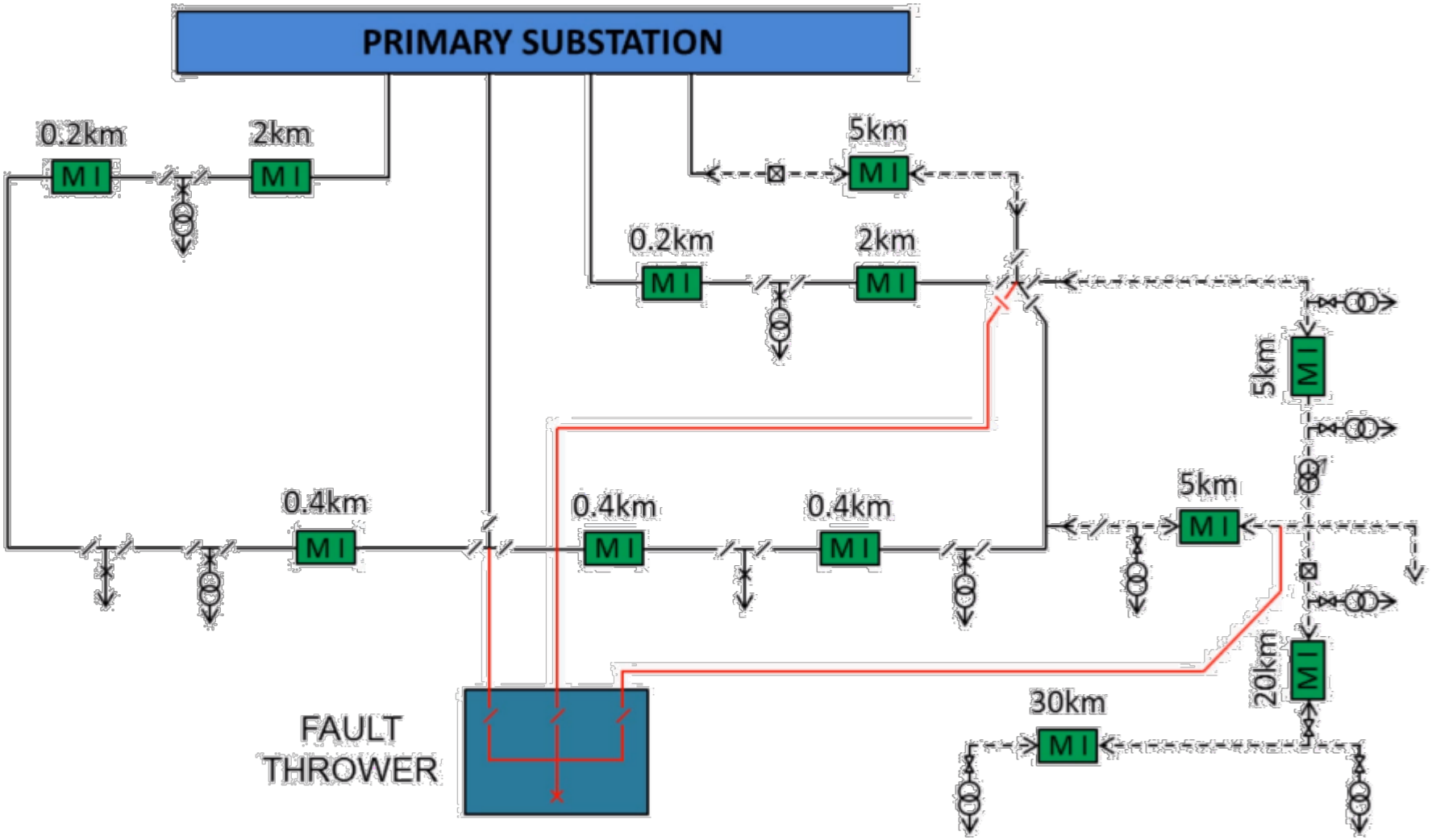
Applications

- Innovation projects
- Accelerated pre-field trials and tests
- “Crash” testing
- Investigations
- Training and CPD

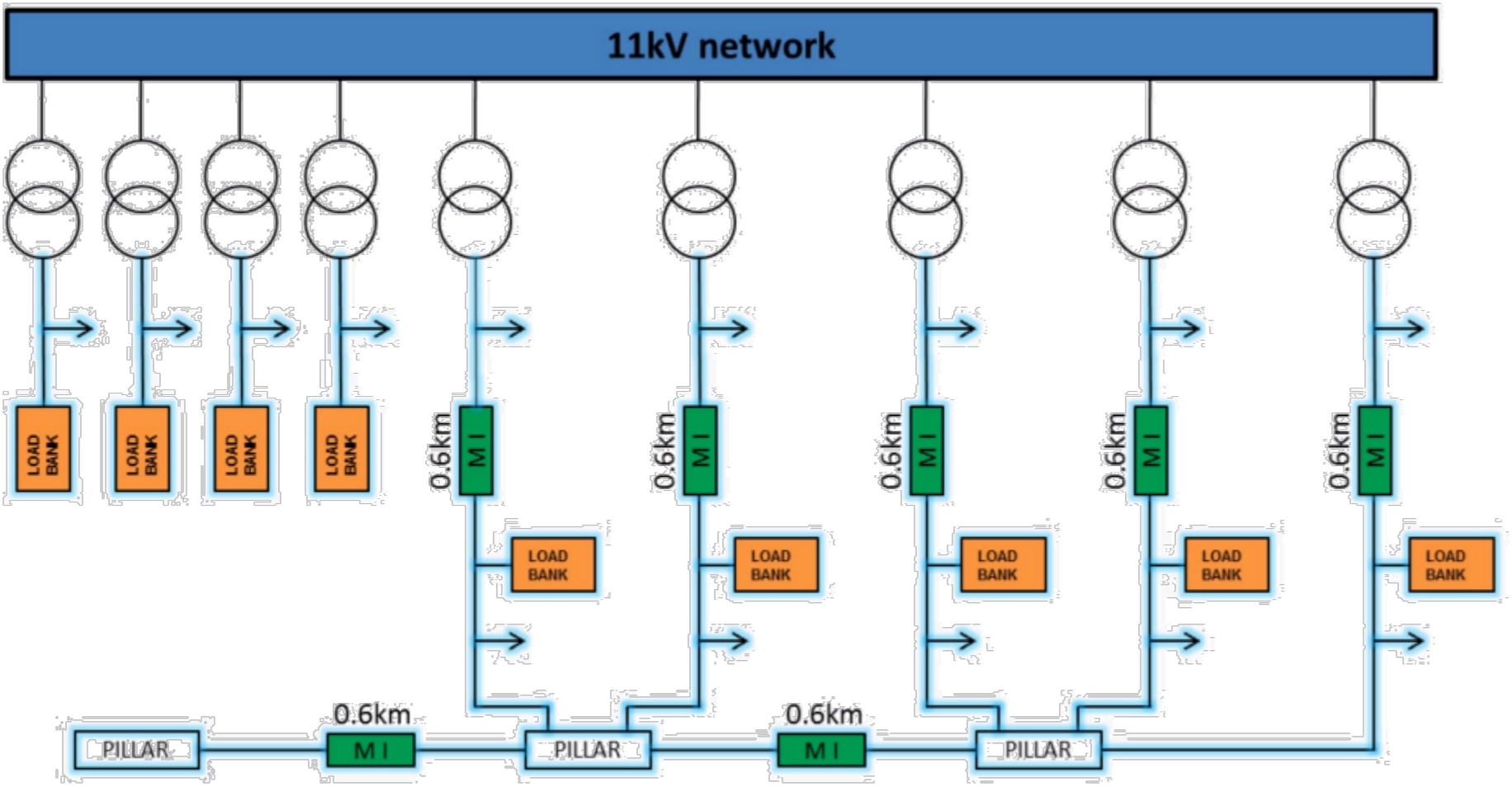
Grid or islanded modes of operation



11 kV network



LV network


11kV network
LOAD BANK
LOAD BANK
LOAD BANK
LOAD BANK
0.6km
M I
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M I
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PILLAR
0.6km
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PILLAR
0.6km
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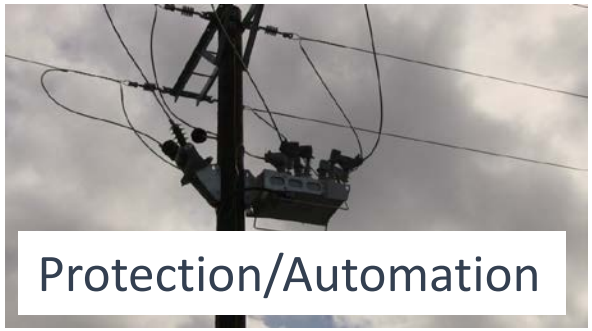
PILLAR

Components

Switchgear

Voltage regulator



Protection/Automation

Secondary substations

Load banks

We are still learning….

EAST!

- This is only the beginning – PNDC is flexible
- We will react to industry, government and academic requirements - work with us

Conclusions

- Opportunity to define a true “smart” and “future-ready” power system in Malawi
  - Collection of “microgrids” - grid-interconnected, but could be split in “defence” mode?
  - Control and operation – “smart” functions?
  - Role of DC?
  - Role of energy storage?
  - Sensing, communications?
- Share in UK experience: exchange knowledge, innovate and demonstrate potential solutions through partnerships
- Education and research:
  - Our Centres for Doctoral Training are available now

Thanks for listening

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Engineering

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