Highly distributed electricity: technical, regulatory and policy challenges

Advanced Energy Conference: *DSO / DSP transition*

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And on behalf of

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Feldheim Energy Village, Germany

University of Strathclyde Engineering

New ‘private wire’ distribution network

37 houses plus small industry

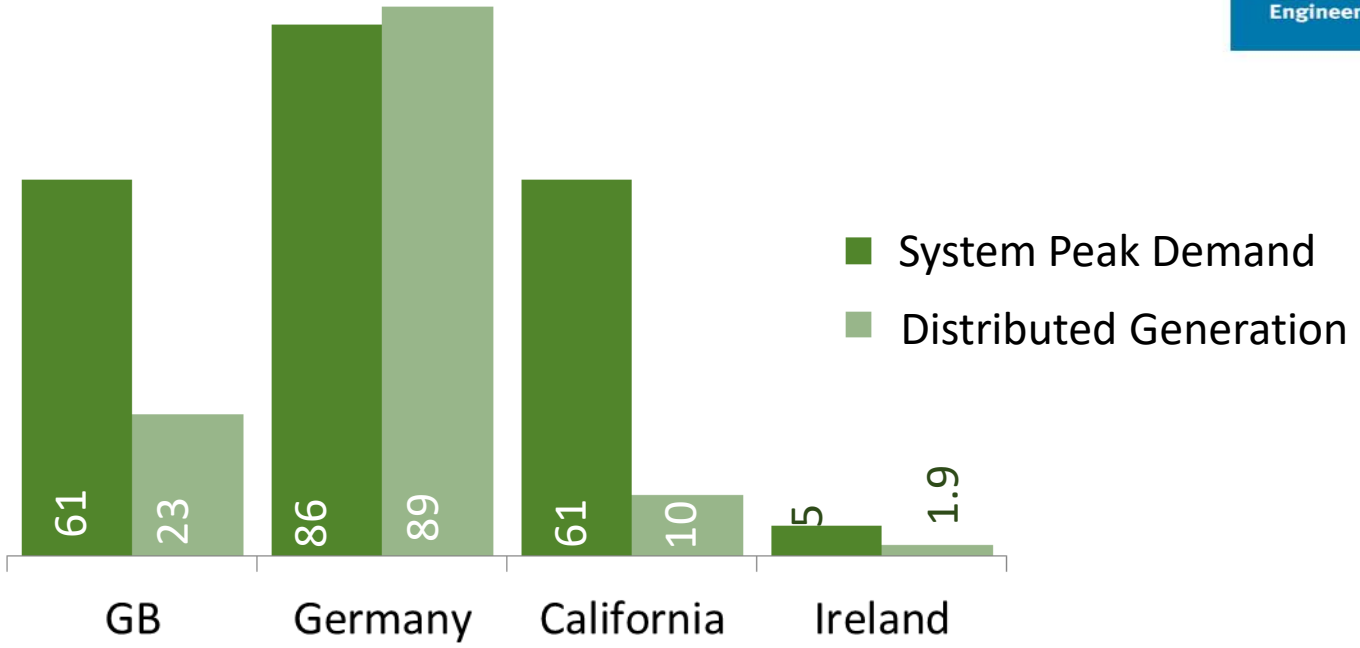
74MW

2MW

0.5MW

Existing Distribution Network

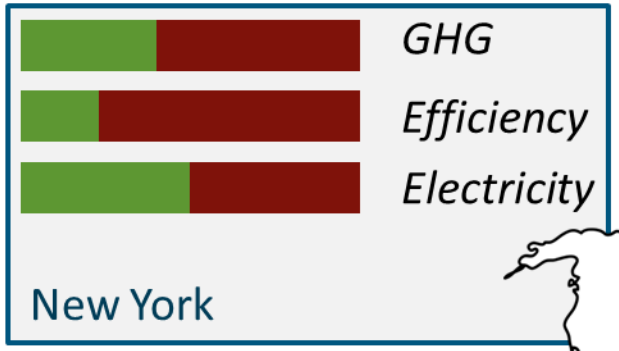
The growth of distributed generation

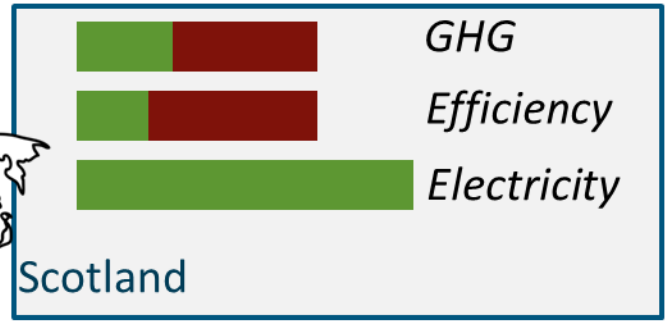


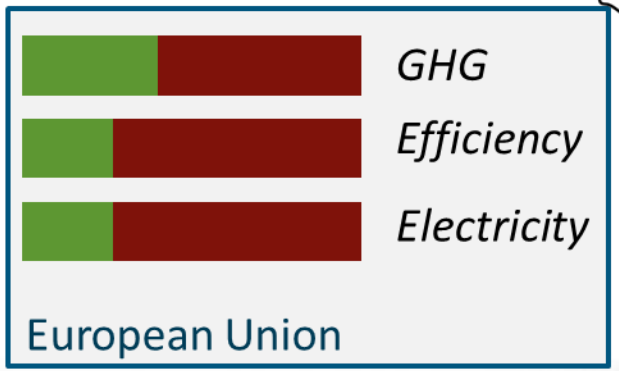
Values in GW

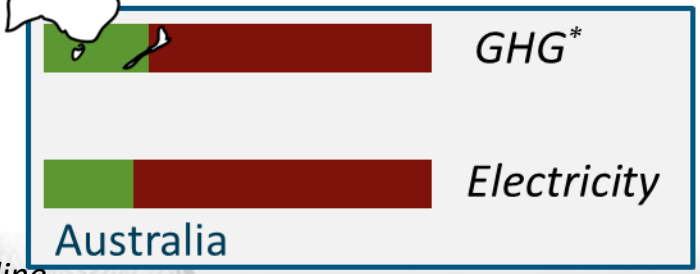
The growth of distributed generation

Why?



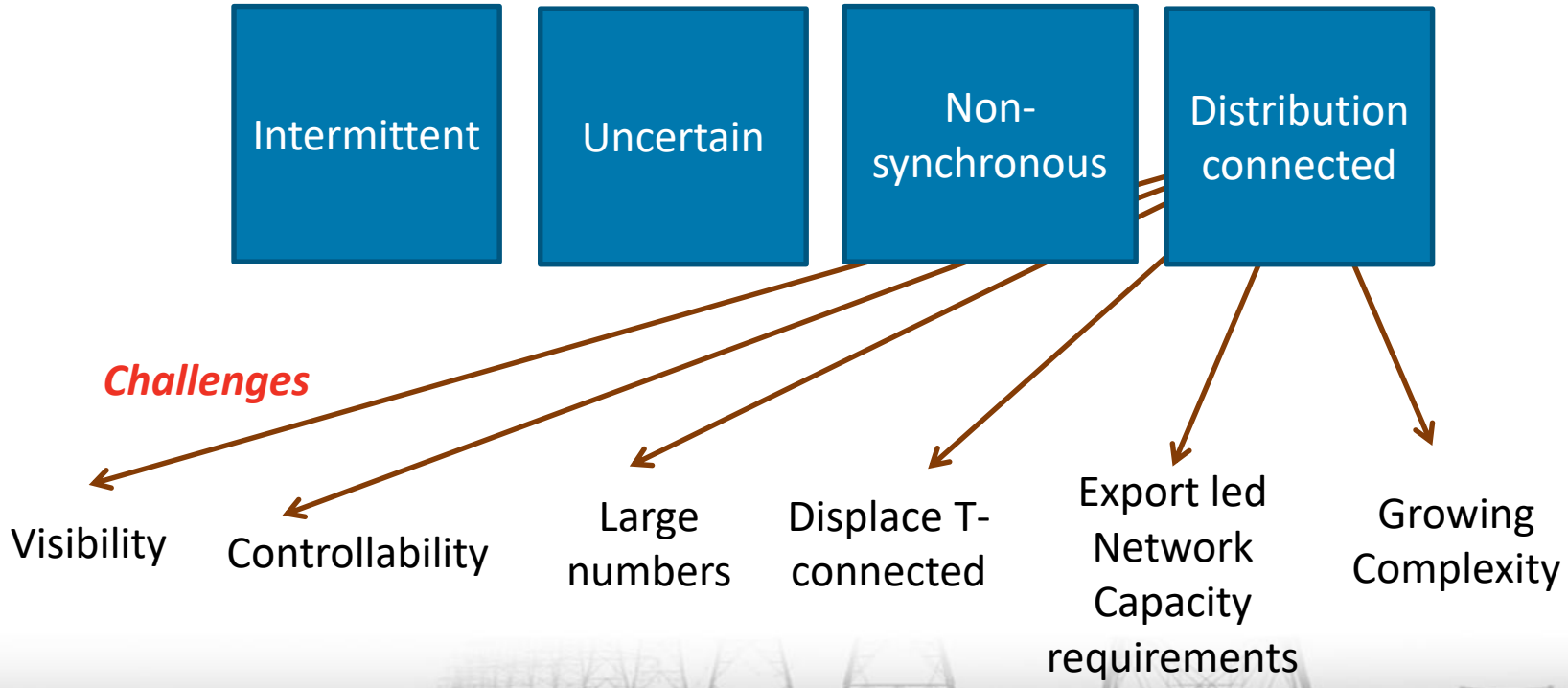




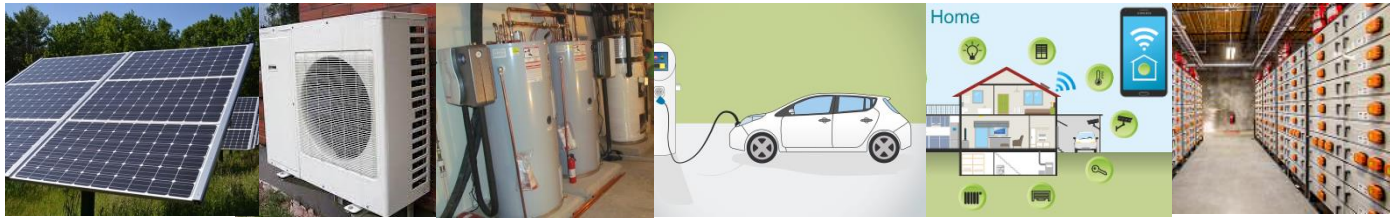


*Australian GHG ambitions against 2005 baseline, others against 1990 baseline

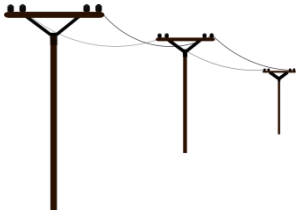
The growth of distributed generation



From DG to DER



Automation



Smart Meters

Six principles for running a highly distributed energy system

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The **overall cost of the system is minimised** within environmental, reliability and quality of supply constraints that accurately represent societal and individual preferences

The system can be **safely operated** in accordance with relevant physical limits

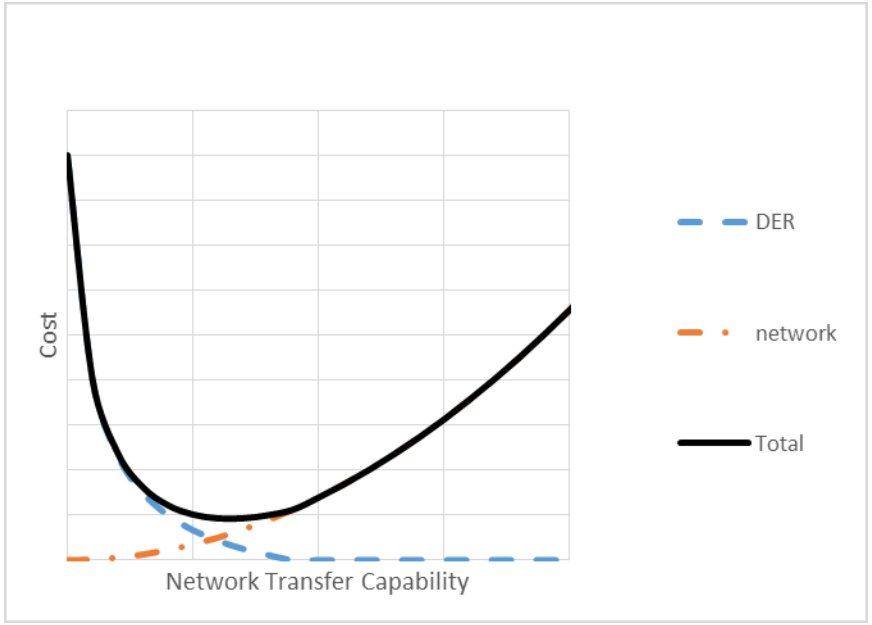
Innovation is encouraged

The **complexity of market arrangements** and incentives is managed such that, **while signals are as reflective of whole electricity system costs as possible**, active participation in different markets is encouraged

Access to the electricity system is **fairly and efficiently facilitated** for users of the system at all scales and voltage levels

Risk and uncertainty is held and managed by those best able

Overall cost of the system is minimised….



Regulated 25 year investments
Owned by DSOs

vs.

Commercial investments

Operation costs

Commercial Risk premiums

Owned by third parties

How best to compare such very different costs?

… within environmental and reliability constraints.

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What is the security standard?

"As load grows, it is economically inefficient to reinforce networks to N-1… Customers on reliable networks [should] move to n – 0.25 … [and] All DG to connect at n – 0 standard" *Recent Work on 'P2' GB Distribution security Standard*

What network access are you expecting?

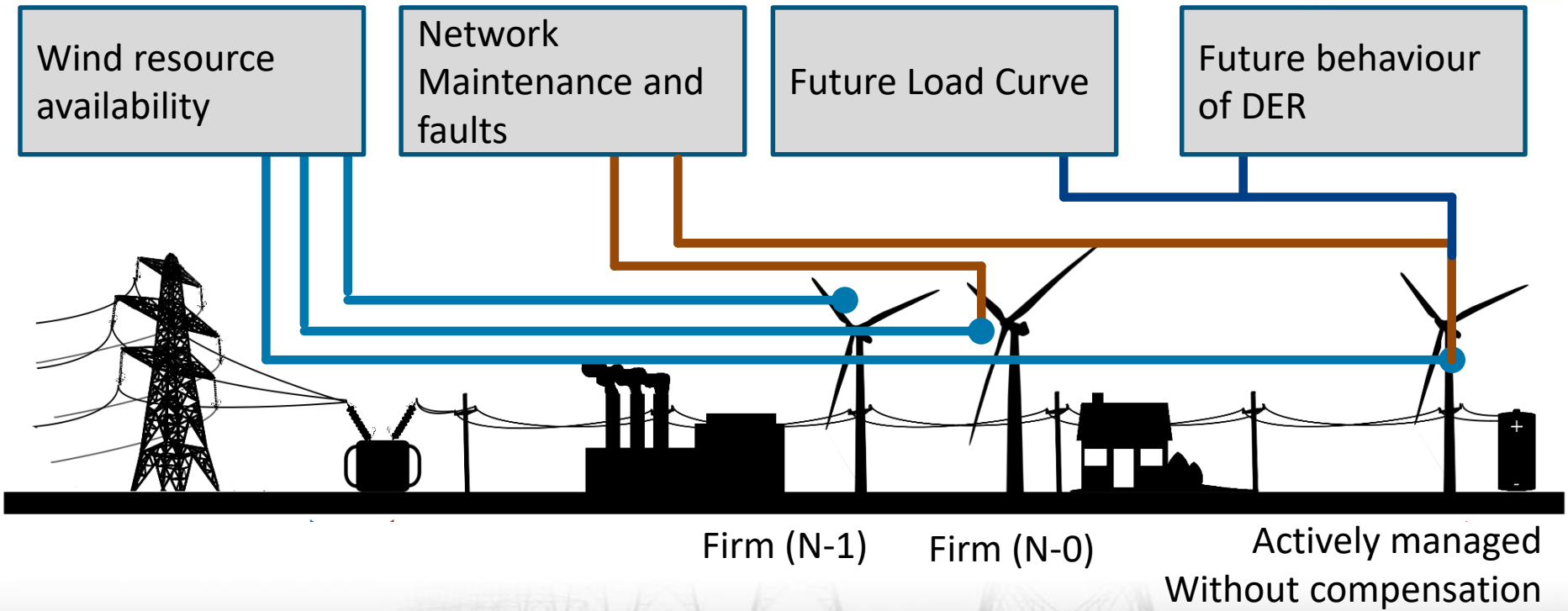
In Italy, a standard domestic explicitly connection = 3 kW

GB, Standard domestic connection ~ 25kW …

But depends on 'Diversity' of Demand

The risk should be held by those who can manage it

Risks



Signals are as reflective of whole electricity system costs as possible?

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Innovation will happen! How is it directed?

vandebron

POWER LEDGER

sonnen

VCHARGE

ovo energy

centrica LEM

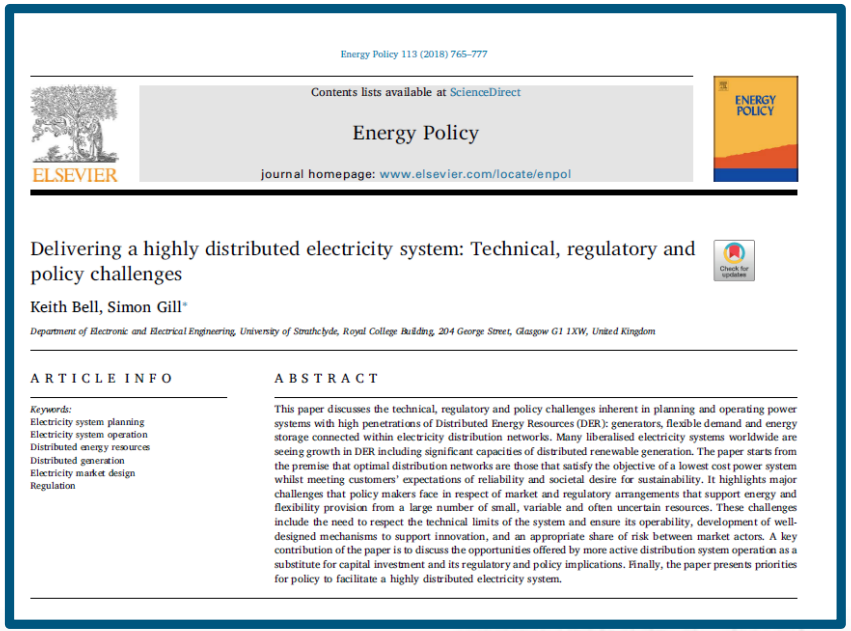
Peer-to-Peer traders in Germany, Holland, Italy and Australia … sharing energy but not managing grid constraints

Technical capability for DER flexibly provision to the system operator .. UK and US
Struggling to get revenue streams from DSOs

'Free Electric Vehicle Charging' Offering in Denmark and UK driven by wholesale prices and system service payments – risks breaking LV diversity assumptions

Cornwall Local Energy Market looking to develop a 'DSP' through a project **not** *led by a network company*

Thanks



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Delivering a highly distributed electricity system: Technical, regulatory and policy challenges

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ABSTRACT

This paper discusses the technical, regulatory and policy challenges inherent in planning and operating power systems with high penetrations of Distributed Energy Resources (DER): generators, flexible demand and energy storage connected within electricity distribution networks. Many liberalised electricity systems worldwide are seeing growth in DER including significant capacities of distributed renewable generation. The paper starts from the premise that optimal distribution networks are those that satisfy the objective of a lowest cost power system whilst meeting customers' expectations of reliability and societal desire for sustainability. It highlights major challenges that policy makers face in respect of market and regulatory arrangements that support energy and flexibility provision from a large number of small, variable and often uncertain resources. These challenges include the need to respect the technical limits of the system and ensure its operability, development of well-designed mechanisms to support innovation, and an appropriate share of risk between market actors. A key contribution of the paper is to discuss the opportunities offered by more active distribution system operation as a substitute for capital investment and its regulatory and policy implications. Finally, the paper presents priorities for policy to facilitate a highly distributed electricity system.

This talk is based on the following paper:
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Paper is available 'open source':

https://www.sciencedirect.com/science/article/pii/S0301421517307851