Network Charging Methodologies for Transmission & Distribution Networks

London, 23.10.08

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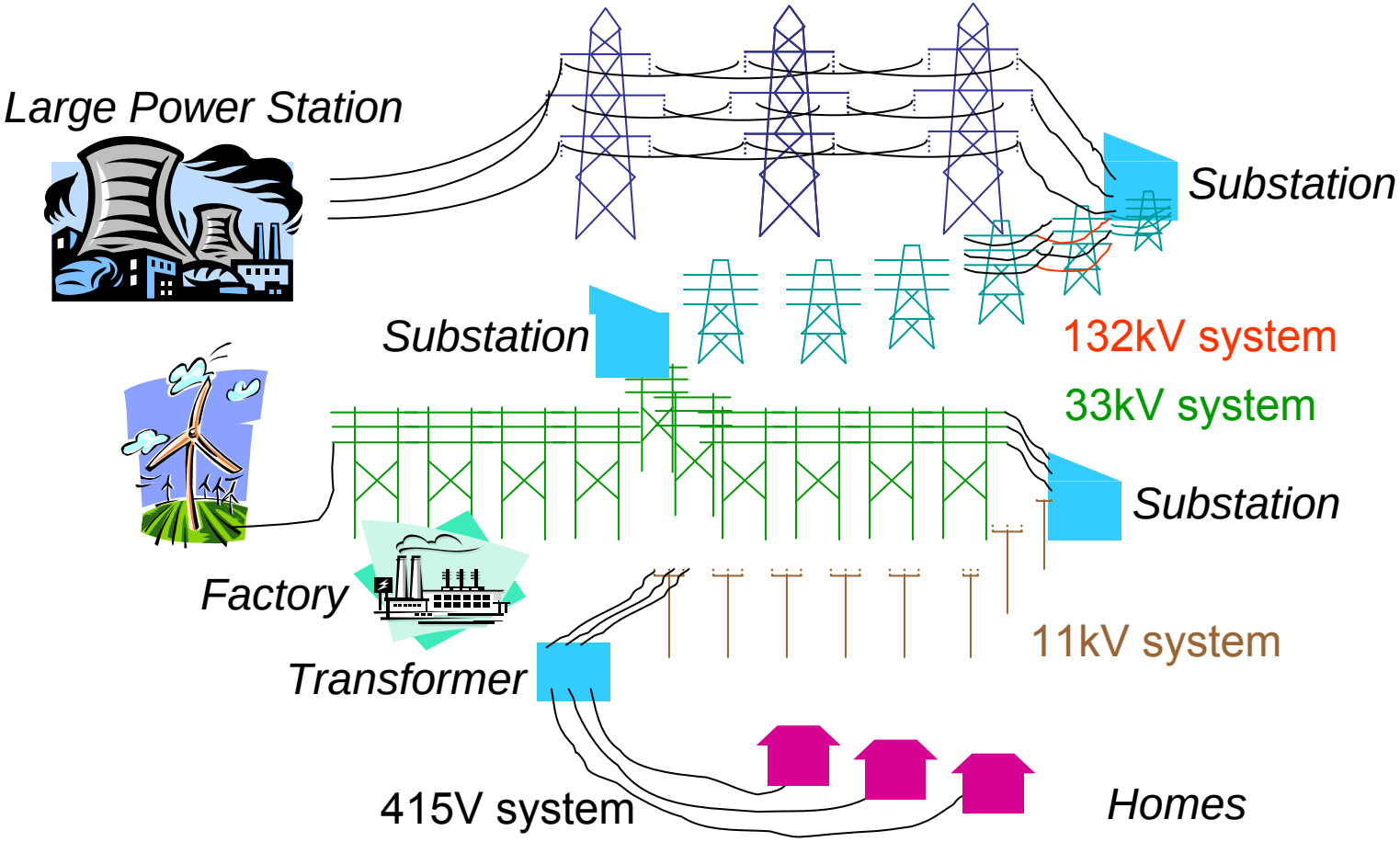
Making networks fit for renewables …

Outline

- **What are network charges?**
- **What different charging methodologies are used in the industry?**
- **How efficient are the differing methodologies?**
- **What improvements can be made?**

Infrastructure networks transfer power from points of generation to points of consumption



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What are Network Charges?

Network charges are charges against generators and suppliers for their use of the infrastructure network

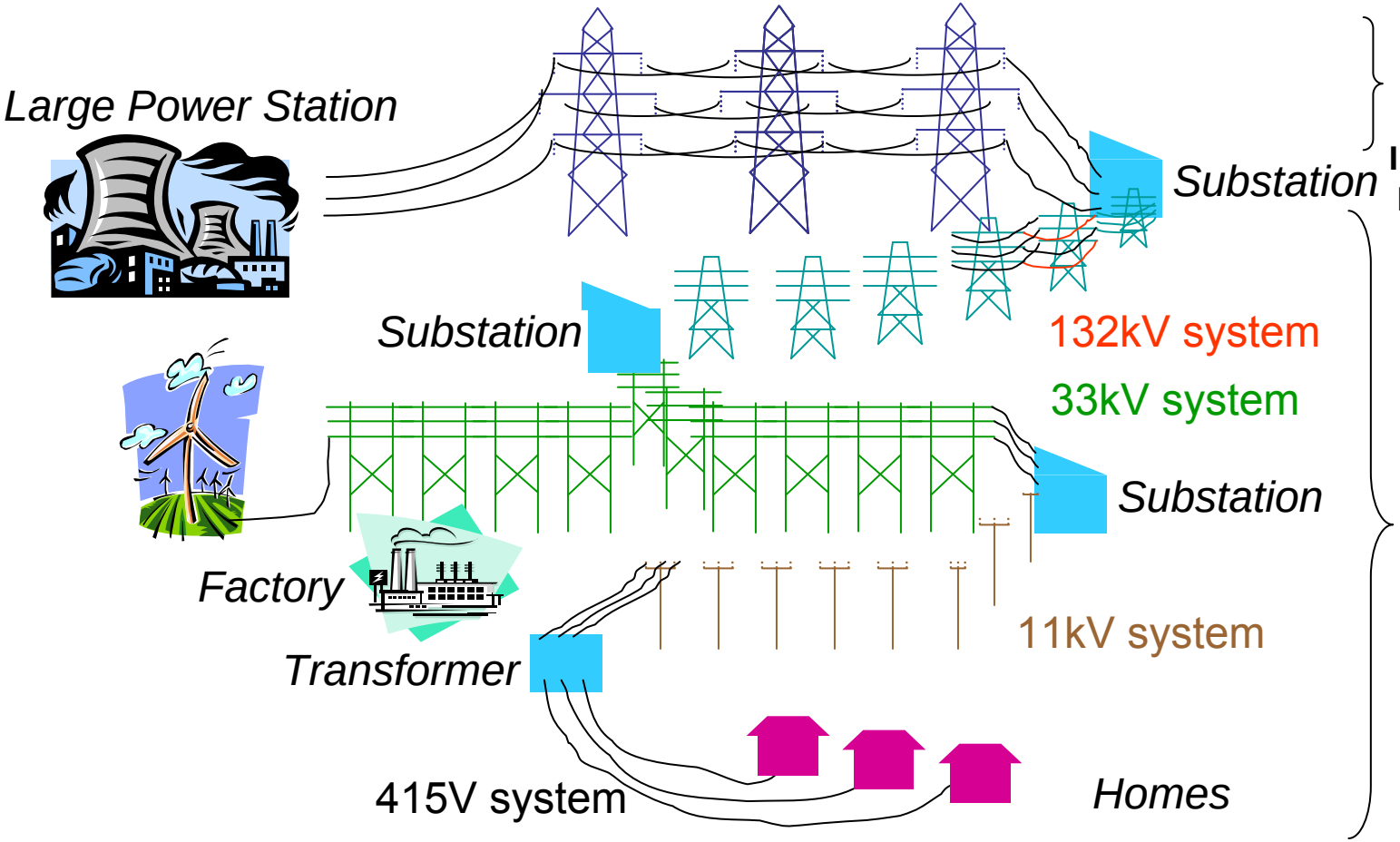
Appropriate network charges should:

- reflect the costs/benefits that users impose on the network
- encourage the efficient use of the existing network
- promote efficient development of the future network

In appropriate network charges could:

- lead to millions of pounds unnecessary investment due to improper sitings of new generation/demand
- act as a barrier to the connection of generation

What Different Charging Methodologies are Used in the Industry (Pre-2007)?



ICRP

Investment Cost Related Pricing

(17 years history)

DRM

Distribution Reinforcement Model

(25 years history)

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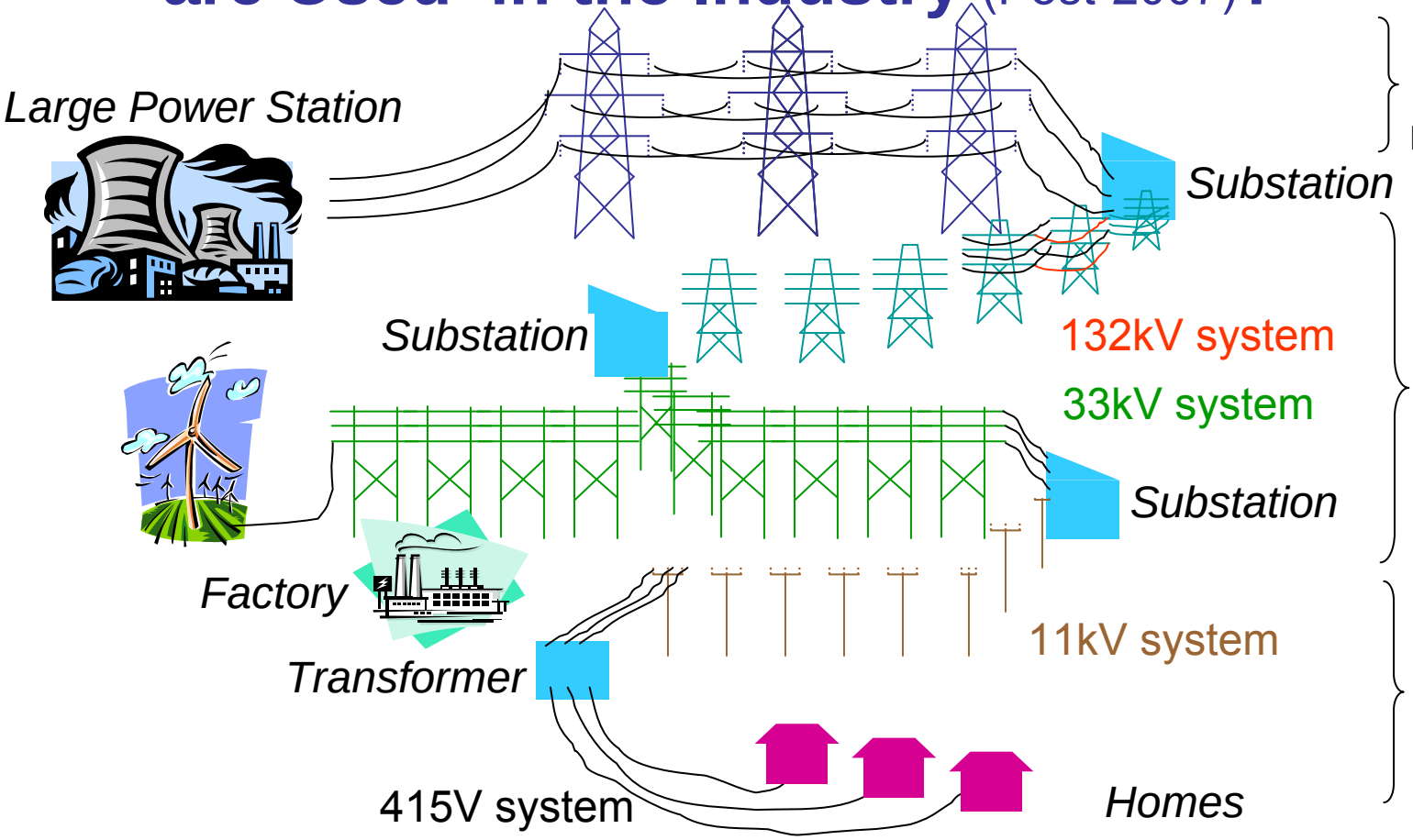
What Different Charging Methodologies are Used in the Industry (Post-2007)?



ICRP

Investment Cost Related Pricing

LRIC

Long-run Incremental Cost Pricing

(New)

DRM

Distribution Reinforcement Model

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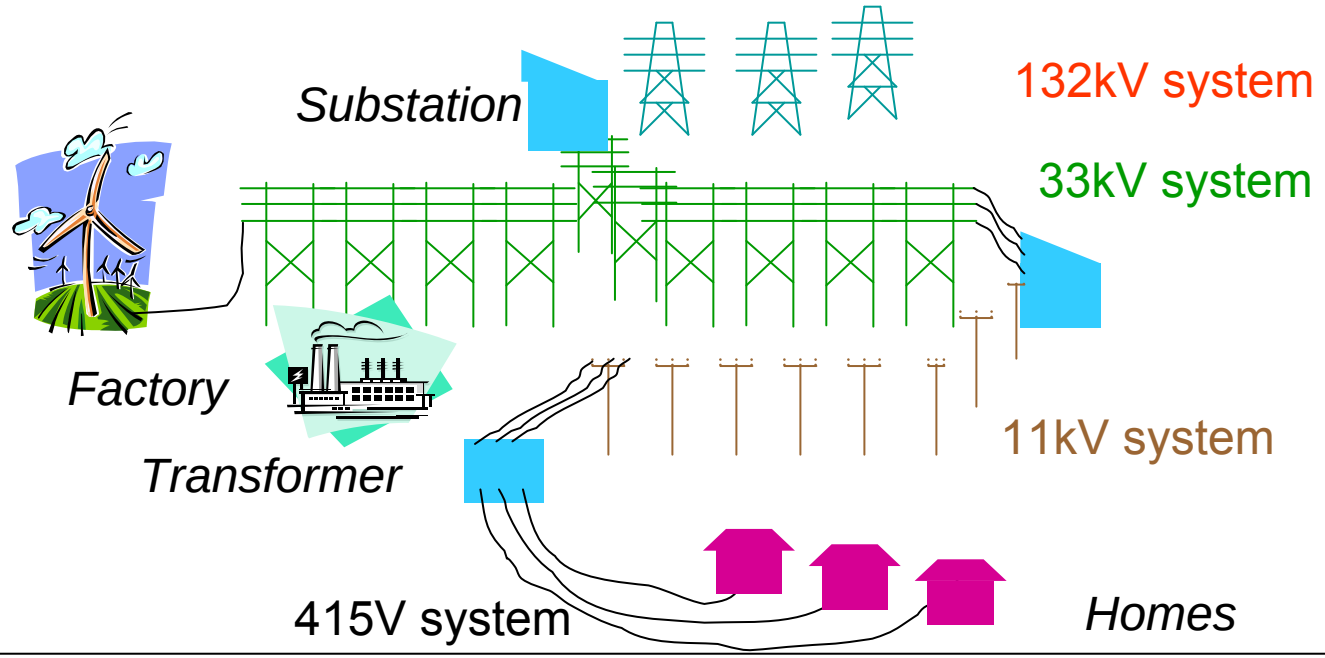
1). Distribution Reinforcement Model (DRM)

(Used by the majority of the DNOs at present)

Principles: Same voltage- same charges regardless of their location;
Customers are assumed to use all upstream network assets



1). Drawbacks with DRM

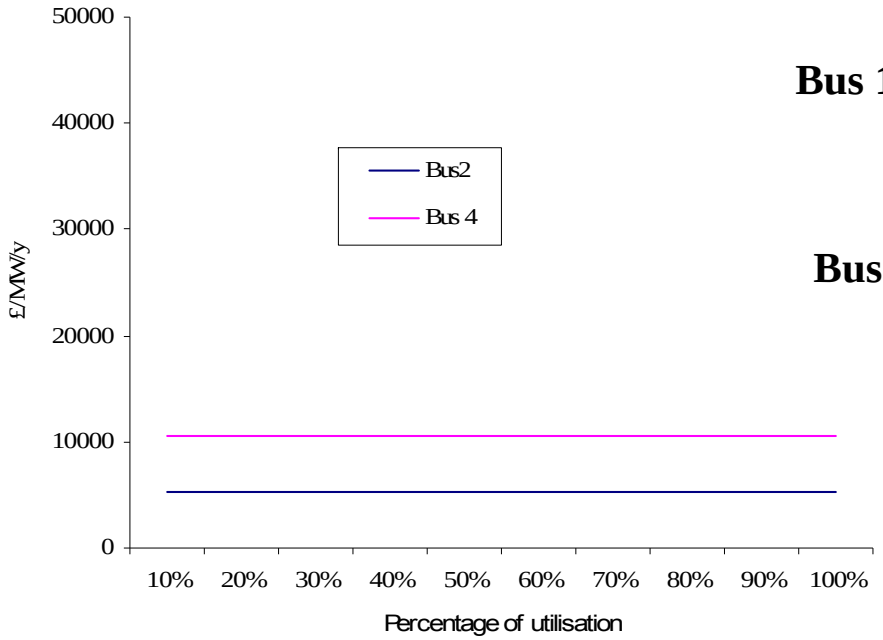
Charges are not locational:

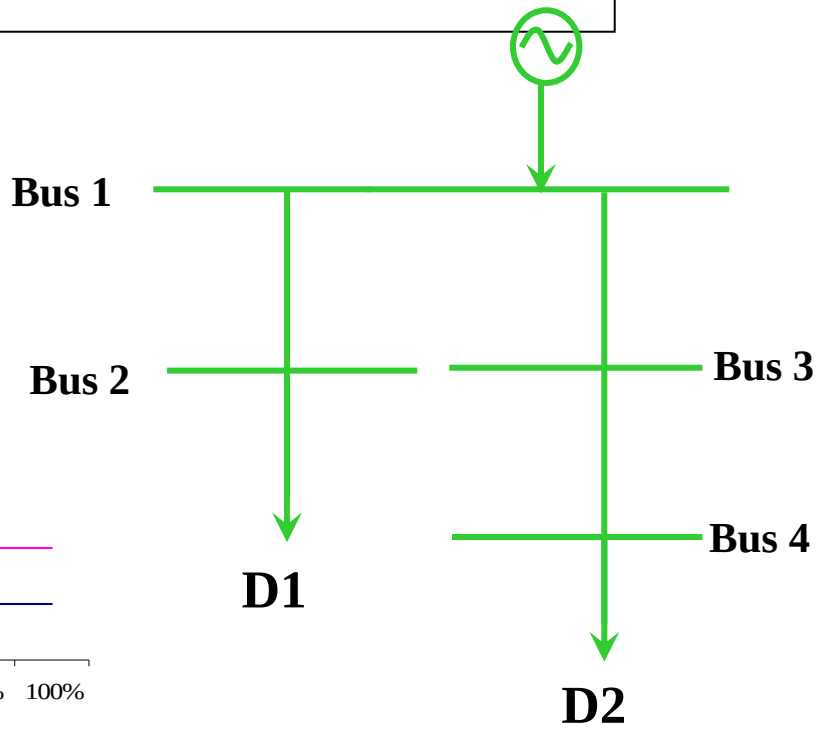
- *No economic message to guide the location of future distributed generators (DGs)*
- *No reward to DGs for the potential benefit they may bring to the network*
- *Cannot facilitate the connection of DGs*
- *Not able to encourage the efficient development of the future network*

2). Investment Cost Related Pricing (ICRP)

(The UK's transmission use of system pricing)

Principle: Locational charges, longer the distance the higher the charges



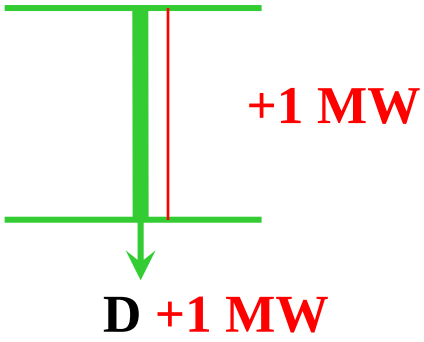


2). Investment Cost Related Pricing (ICRP)

Drawbacks – not cost reflective

1) *No recognition of the degree of network utilization* - assuming existing networks are fully utilised, *any additional power will thus require immediate network reinforcement*

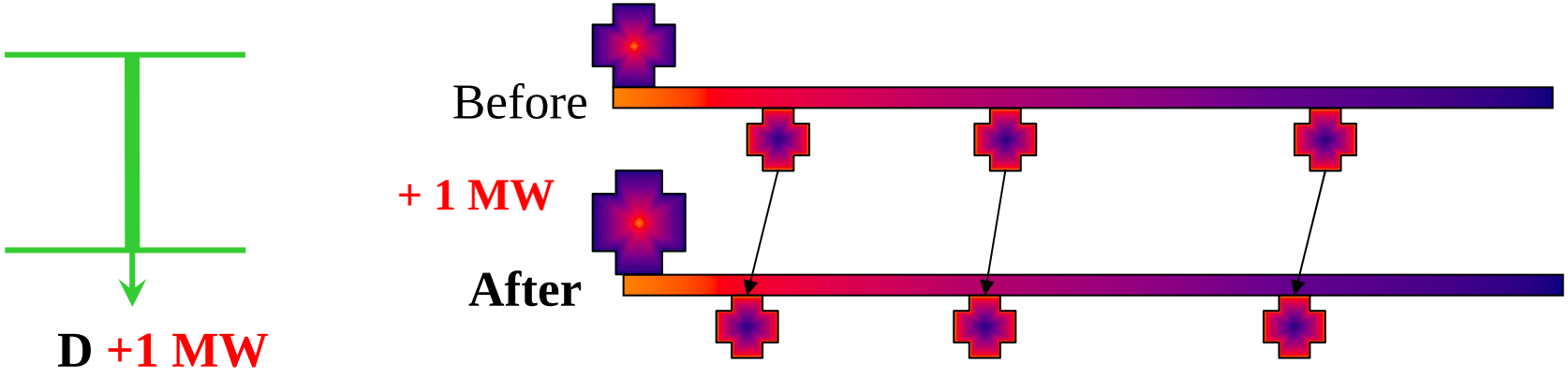
2) *Assuming that the circuit is infinitely divisible, an additional 1MW power flow can be met by the circuit with 1MW capacity*



3). Long Run Incremental Cost Pricing (LRIC)

(Developed by University of Bath in conjunction with WPD & Ofgem)

Principle: Locational charges, based on both the distance and the degree of utilisation (the spare capacity)



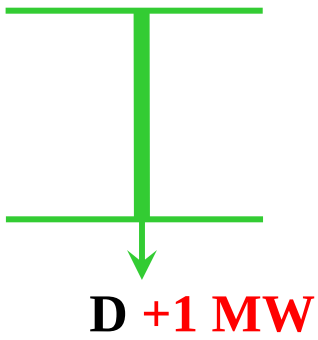
Generators will be rewarded if they defer network investment, will be charged if they advance network investment

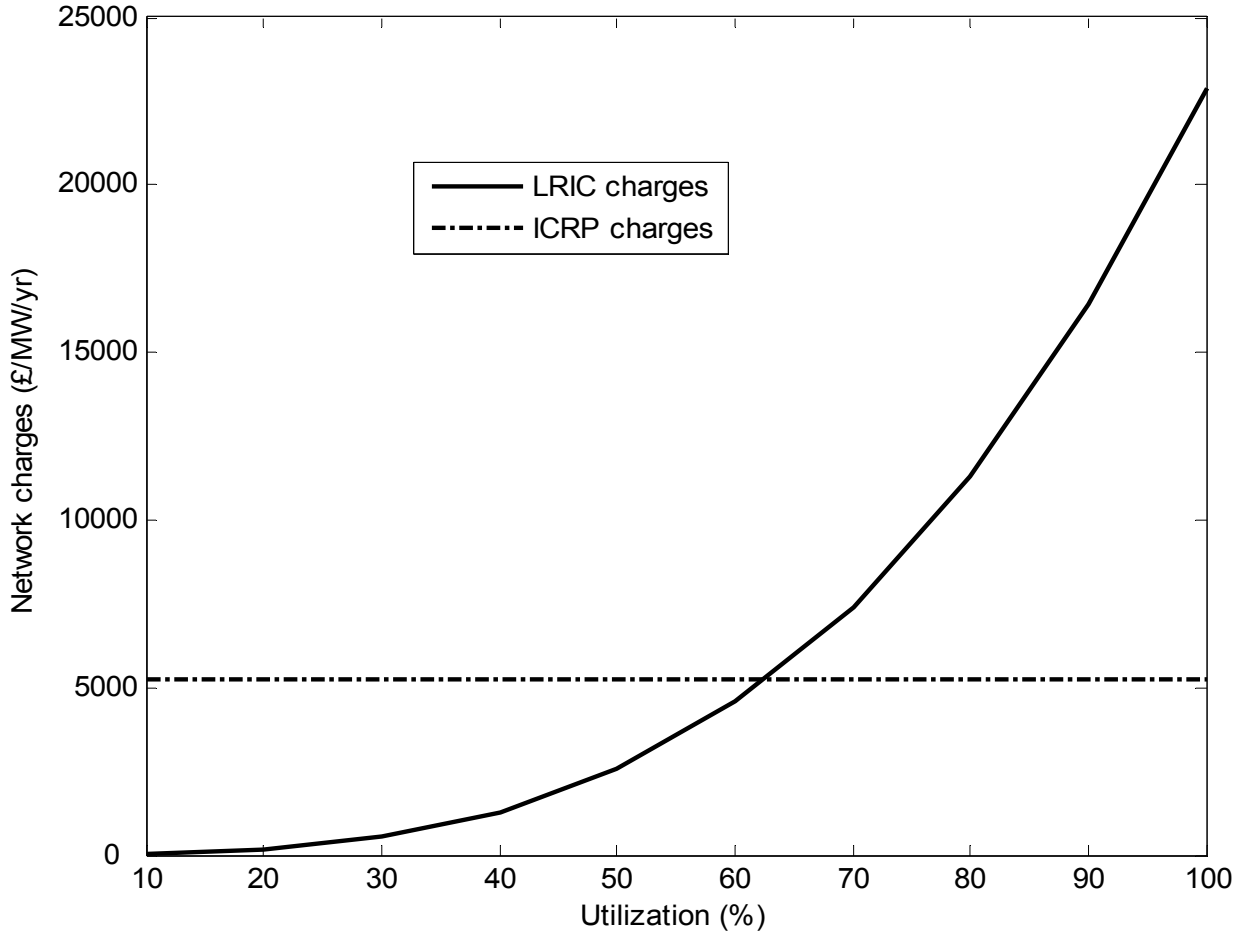
Charges Comparison on a Single Circuit

Line capacity=45MW

Load growth rate=1.6%

Line cost = £236760/yr or £3,195,142

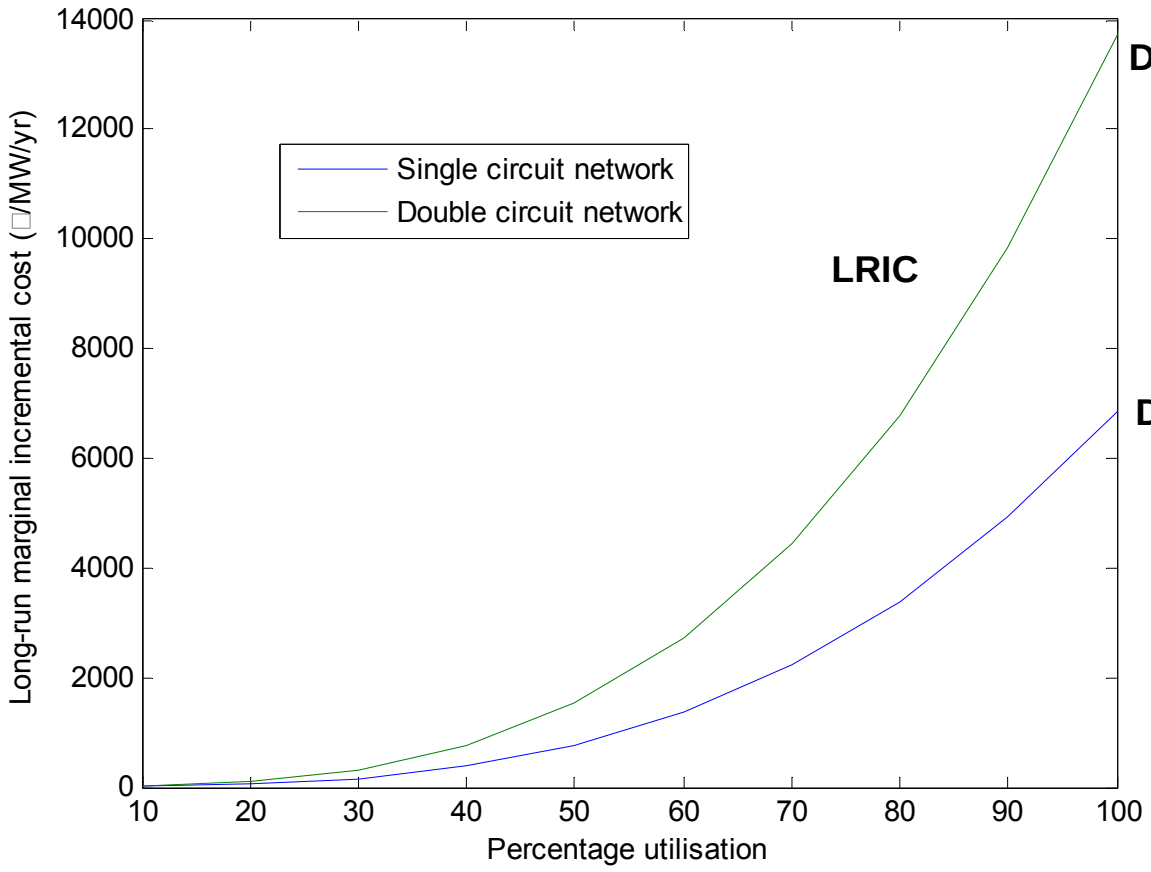


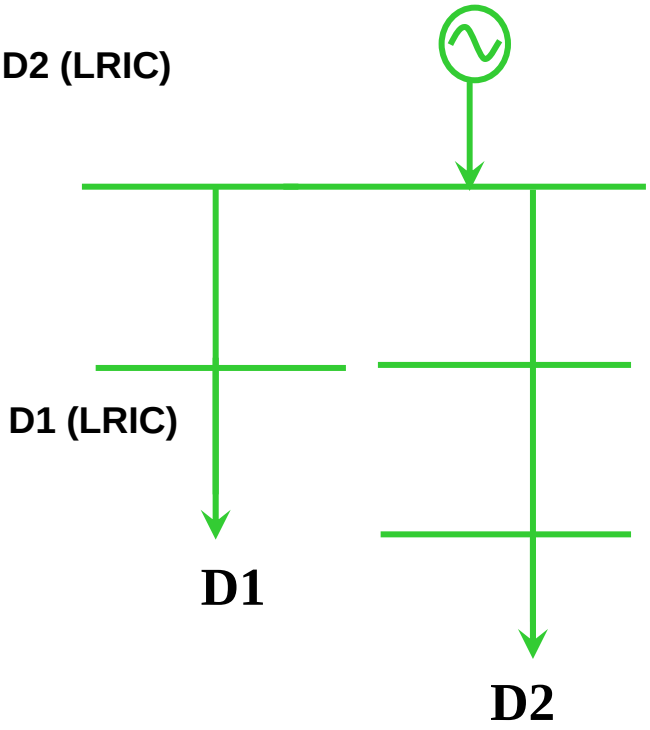


LRIC:
Higher the circuit utilisation higher the charges

ICRP:
Charges the same regardless of the circuit utilisation

Charge Comparison on a Three-Circuit Network





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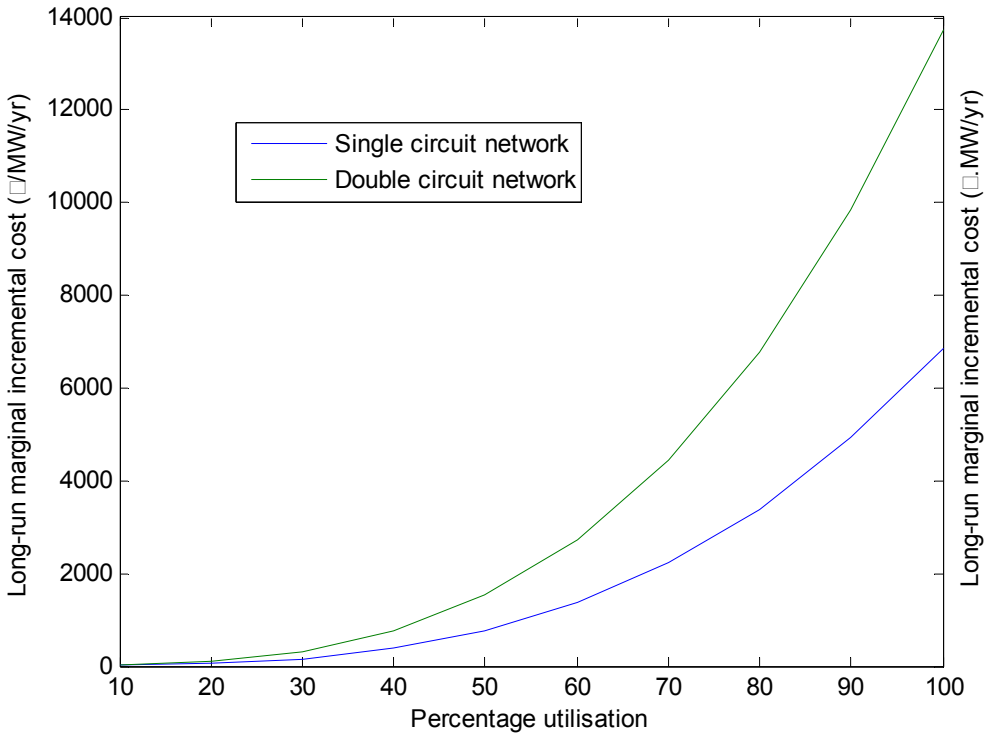
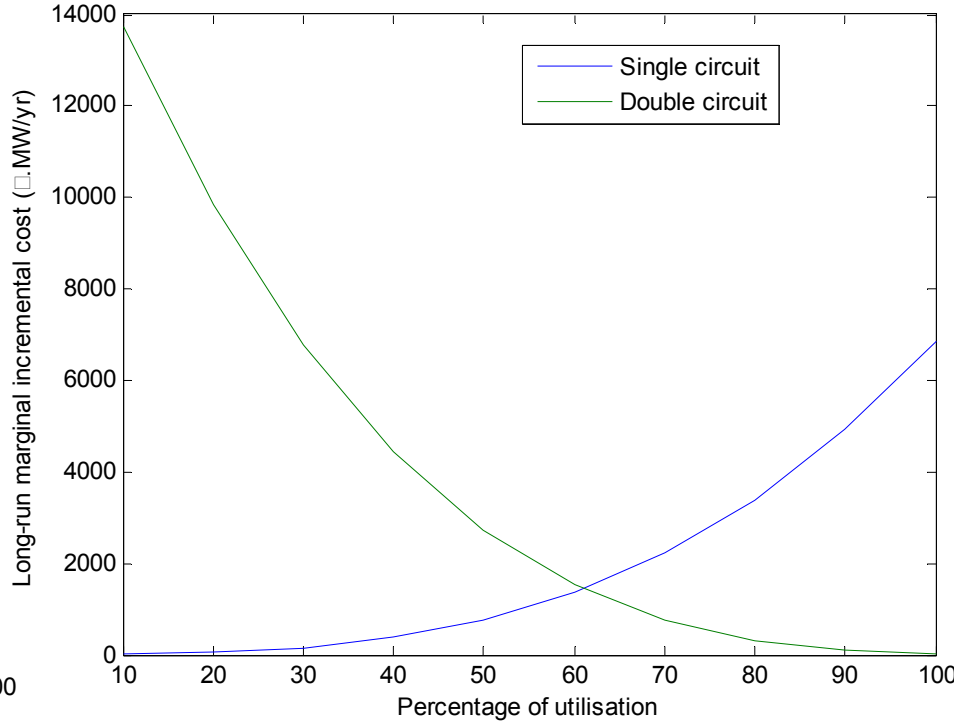
LRIC Pricing
Equilibrium Between Distance and Utilisation





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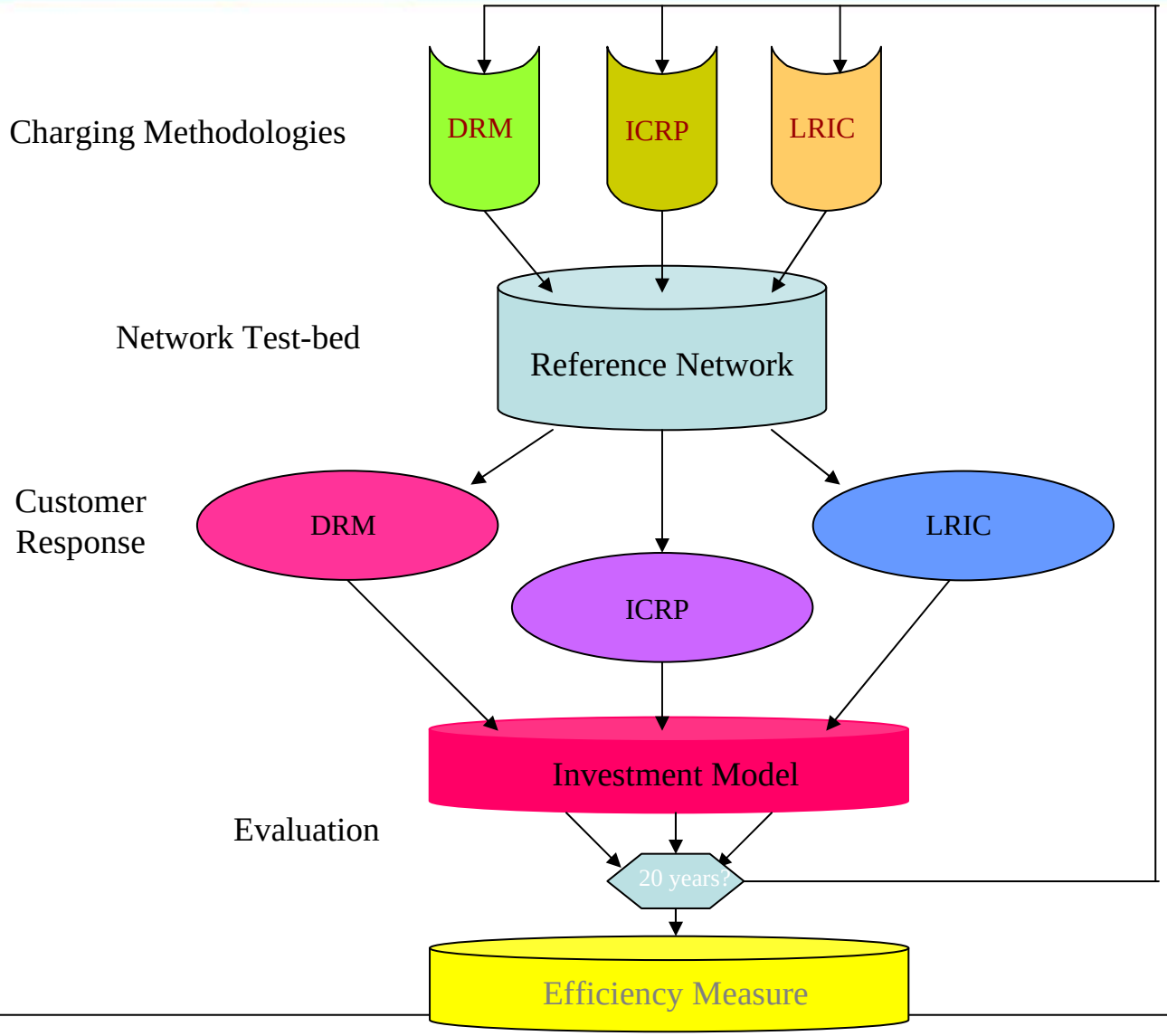
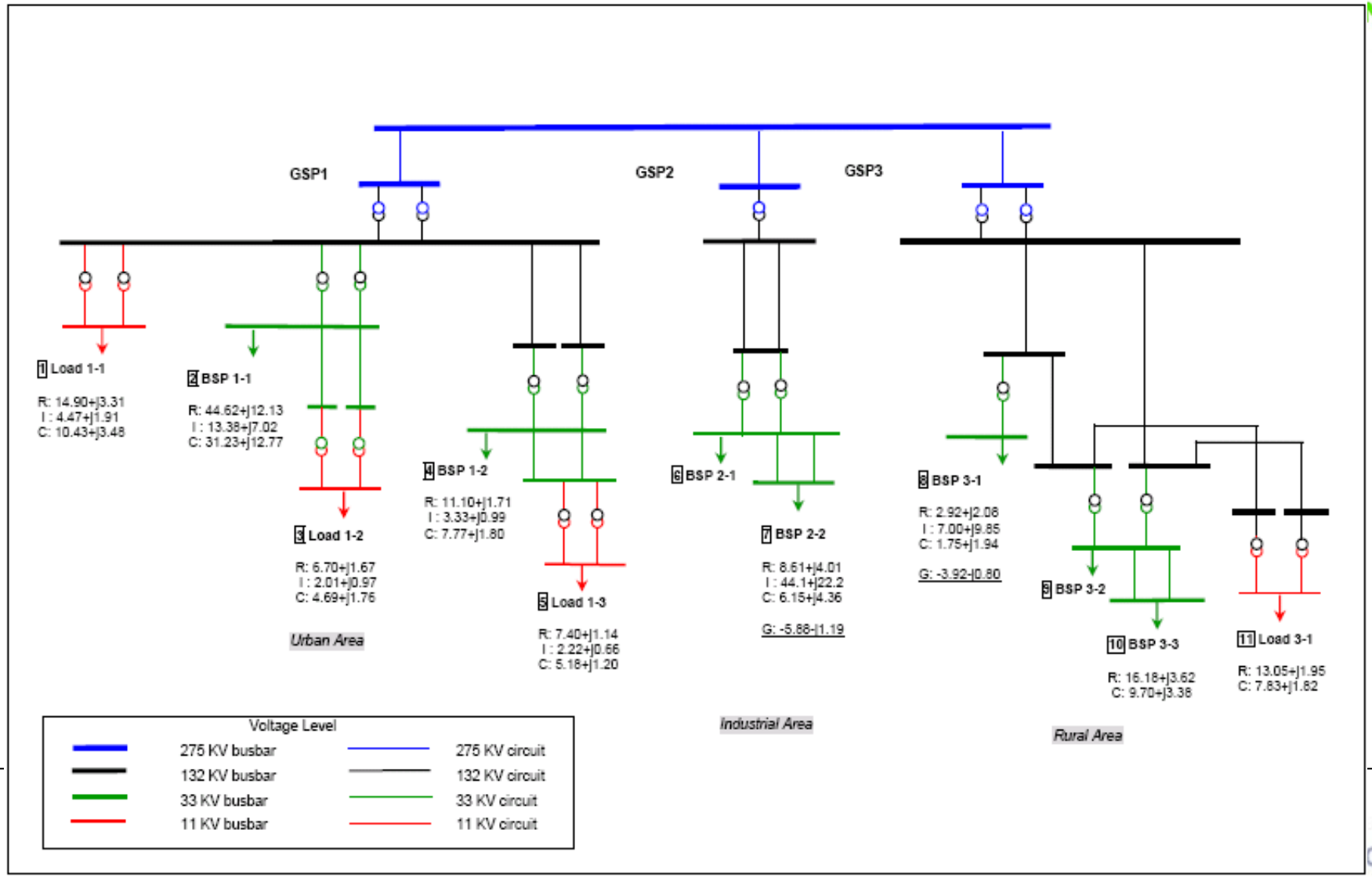


How Efficient are the Differing Methodologies?

Ofgem study

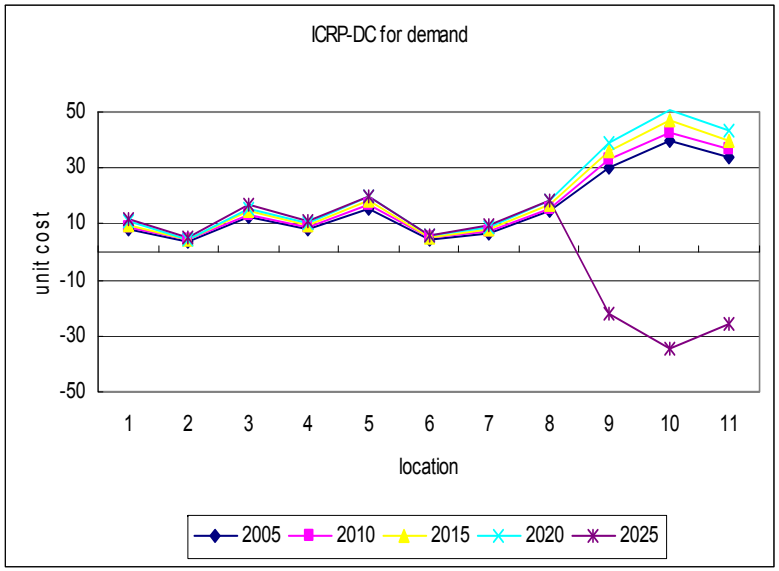
System Reference Model



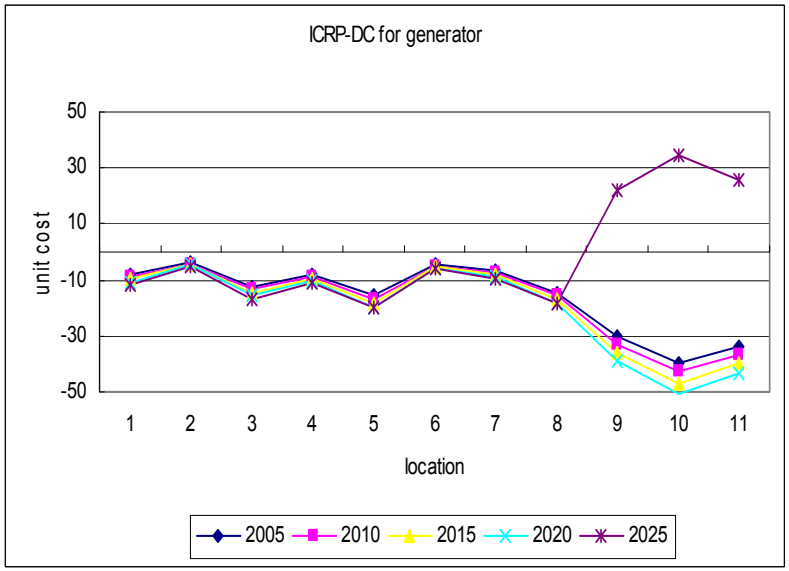
The Evolution of Network Charges Over a 20 Year Period - ICRP

- Prices reflect distance power must travel
- Generation attracted to distant (lightly loaded) part of system
- Reversal of power flow causes reversal of price signal

ICRP demand prices



ICRP generation prices



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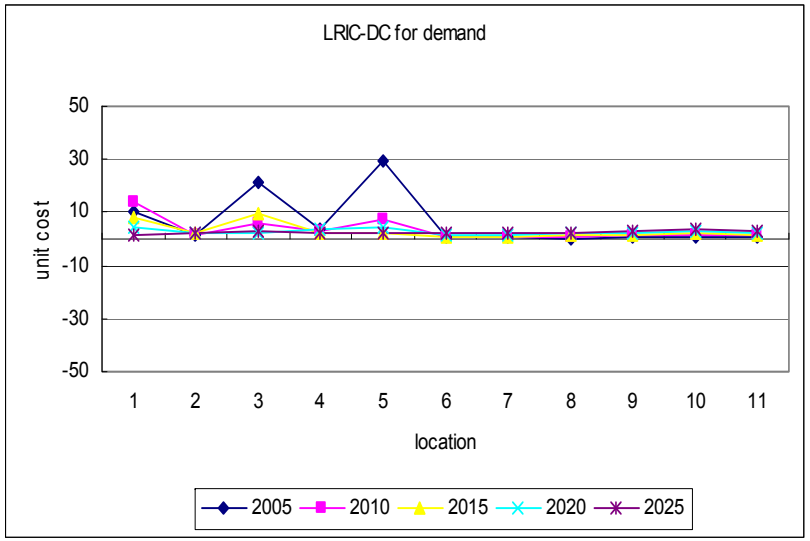
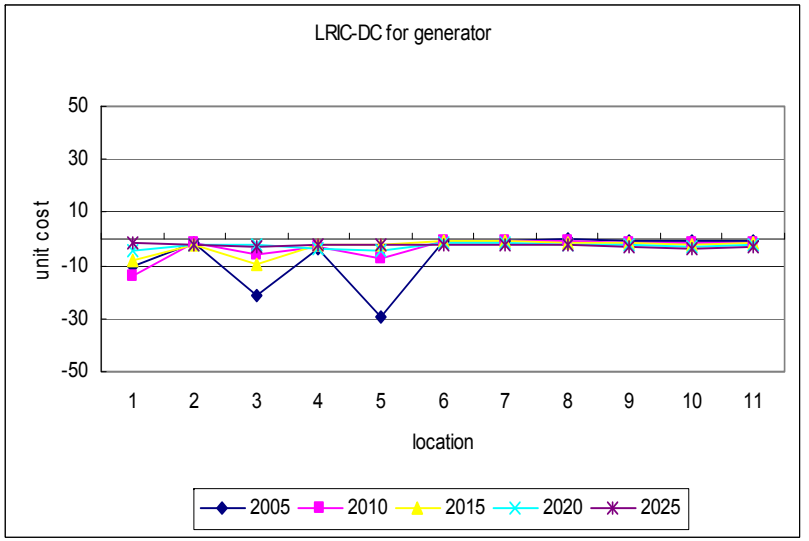
The Evolution of Network Charges Over a 20 Year Period - LRIC

- Nodal prices driven by both asset cost (distance) and utilisation
- Strikingly different pattern of prices to ICRP

LRIC demand prices



LRIC generation prices



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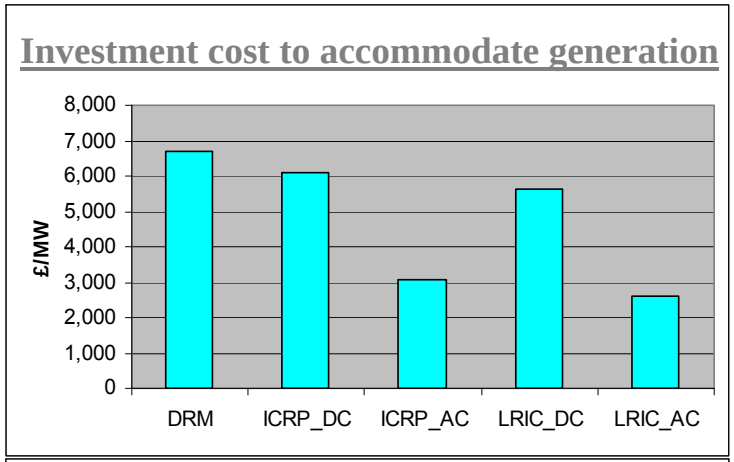
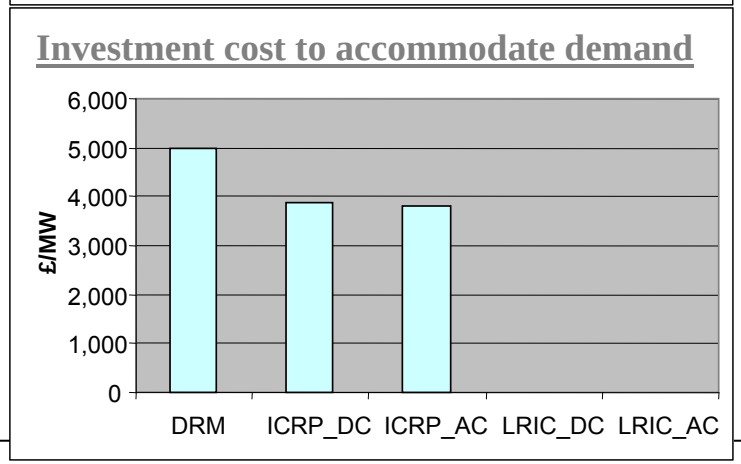
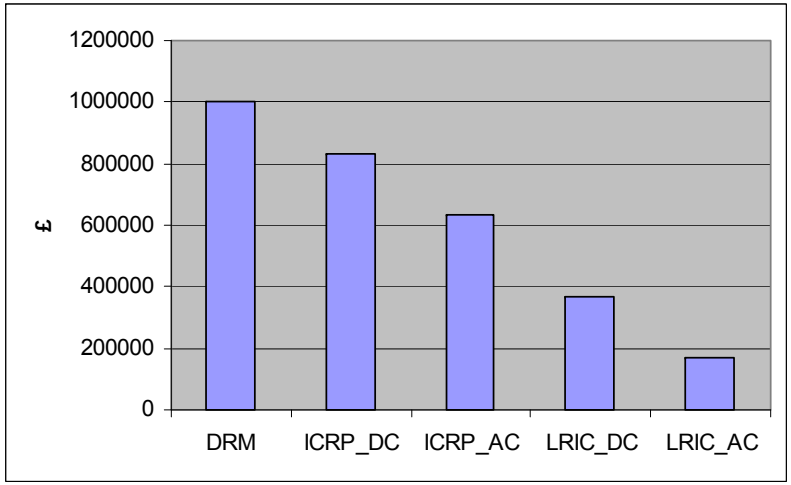
Investment Consequences Driven by Different Charging Models





Overall cost of network reinforcement

2005 to 2025



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Key Findings from Ofgem Study

1. DRM produces the highest investment cost over the study period
2. ICRP causes major activities at the distant nodes
3. Main benefit from LRIC is no requirement to reinforce the system for new demand, as they encourage generation to locate at highly loaded areas
4. Extrapolate the study outcome for the entire UK's DNOs, a cost saving of £200m can be saved by adopting the LRIC-AC model
5. The LRIC has been implemented by the local DNO - Western Power Distribution for their EHV networks since April 2007
6. Ofgem delivered its decision on the 1st October 2008, requiring all DNOs to derive their use of system charges according to Bath LRIC pricing model for their EHV networks.

What Improvements Can be Made?

1. The ICRP model should be extended to reflect the reactive power requirement in the network.
2. The LRIC model could be extended to the transmission network to make better use of the existing network
3. Network charges should reflect the time of use by network customers.
4. Network charges should reflect the other key cost drivers in network investment, such as voltages, fault currents and reliability
5. A fine balance should be struck between cost reflectivity and, simplicity and predictability.