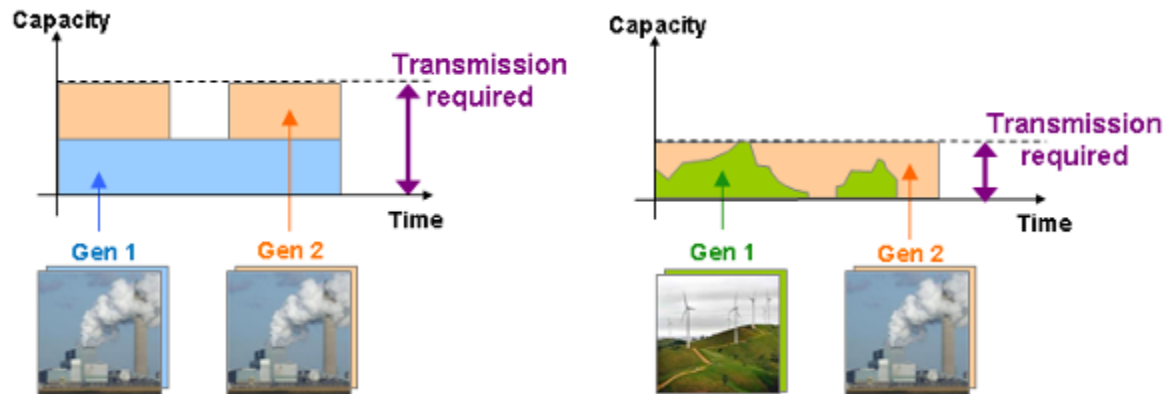# Sharing

Andy Wainwright

National Grid

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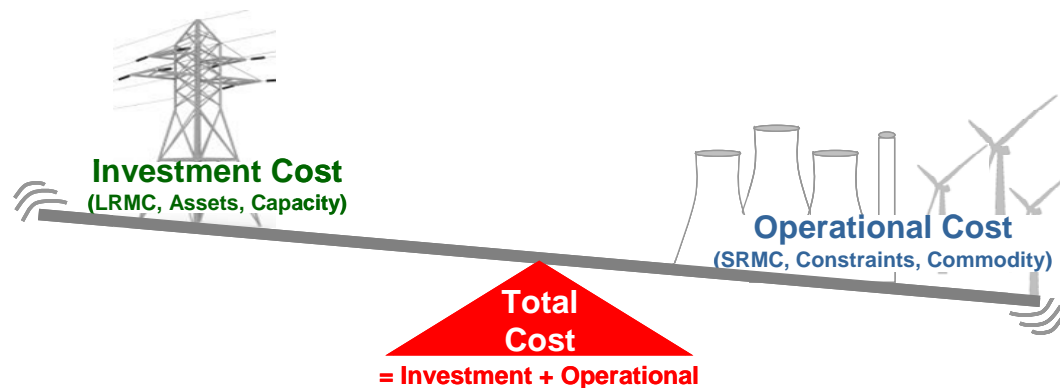# Sharing under CMP213

- Sharing on the wider system

  - Reflecting recent developments in transmission investment drivers (GSR009)

    - Proposed changes to the Transport Model

  - Reflecting the impact of individual users

    - Proposed changes to the Tariff Model

  - Workgroup developments

    - Diversity

    - Hybrid annual load factor

- Sharing on the peripheries of the system

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# Sharing – Defect

- Increasing variable generation = increased network sharing

- On wider system greater proportion of investment driven by cost benefit analysis (GSR-009)

Investment Cost
(LRMC, Assets, Capacity)

Operational Cost
(SRMC, Constraints, Commodity)

Total Cost
= Investment + Operational
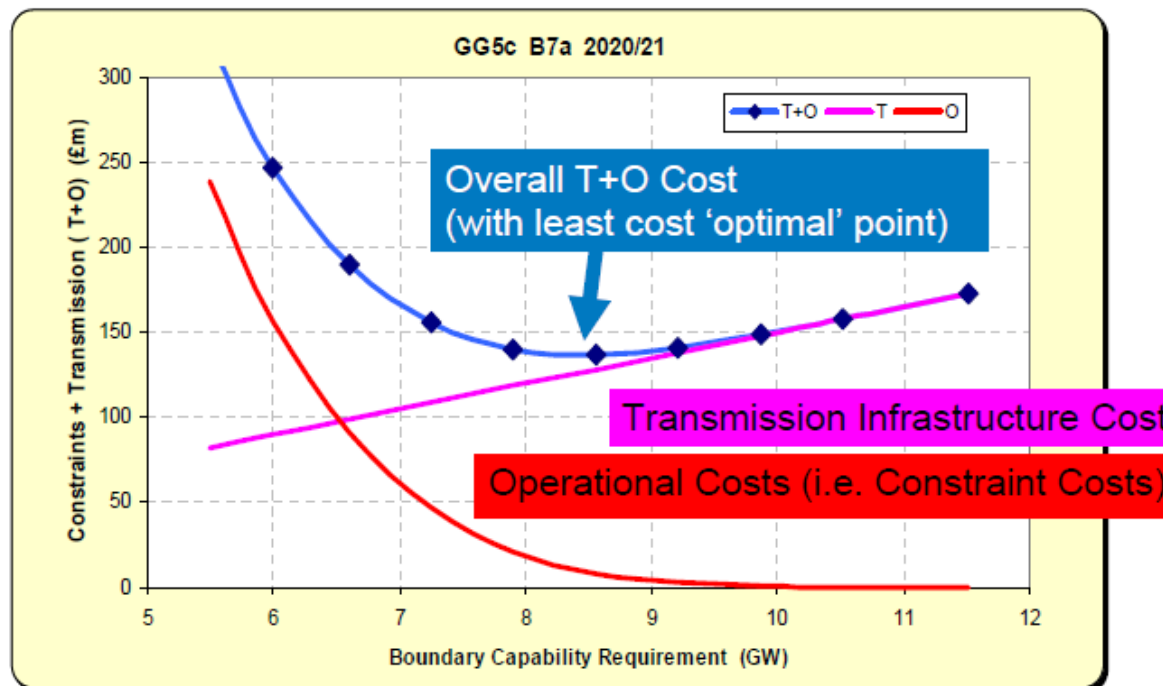
3

Capacity Sharing – Theory

- Explicit information is not available (TAR)

- Implicit assumptions must be made

- For investment driven by "year round" conditions, these should reflect assumptions made in cost benefit analysis

£

Constraints (SRMC)

Reinforcements (LRMC)

time
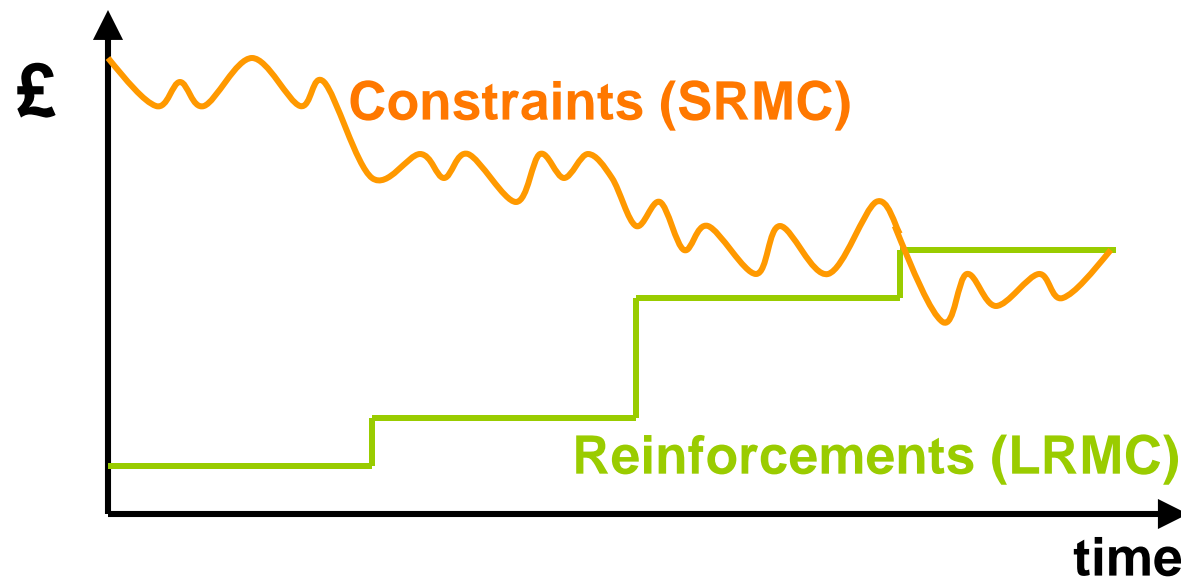
- TSOs incentivised to balance SRMC and LRMC

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GSR-009: Review of NETS SQSS for Intermittent

- Total transmission cost = operational + infrastructure

GG5c B7a 2020/21

Overall T+O Cost
(with least cost 'optimal' point)

Transmission Infrastructure Cost

Operational Costs (i.e. Constraint Costs)

- GSR-009 set out to create deterministic standards from detailed cost-benefit analysis (CBA)

http://www.nationalgrid.com/uk/Electricity/Codes/gbsqsscode/LiveAmendments/
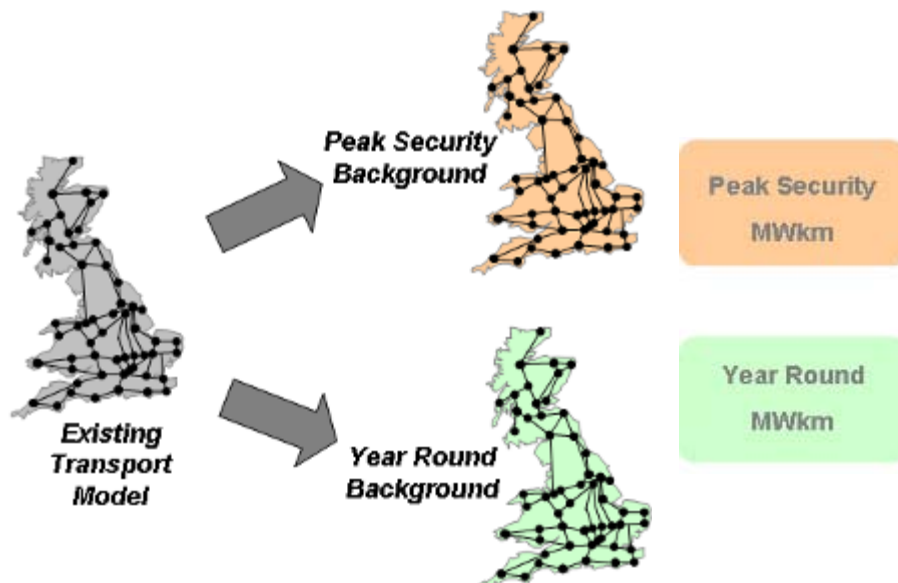
GSR-009: Outcomes

- Split planning background into peak and pseudo-CBA

- Fixed scaling factors for some generation

Generator Type	TEC	Current Methodology	Peak Background	Pseudo-CBA Background
Intermittent	5,460	65.5%	0%	70%
Nuclear & CCS	10,753	65.5%	72.5%	85%
Interconnectors	3,268	65.5%	0%	100%
Hydro	635	65.5%	72.5%	66%
Pumped Storage	2,744	65.5%	72.5%	50%
Peaking	5,025	65.5%	72.5%	0%
Other (Conventional)	61,185	65.5%	72.5%	66%

Values in grey vary depending on the total demand level, whilst values in black are fixed scaling factors

Supported by full blown CBA for large investments

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Translating GSR009 into TNUoS methodology

Peak Security
Background

Peak Security
MWkm

Existing
Transport
Model

Year Round
Background

Year Round
MWkm

- Sharing takes place on the wider network

- Dual backgrounds in the Transport Model – SQSS

- Circuits selected as either Year Round or Peak Security based on higher MW flow
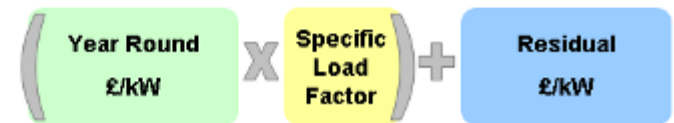
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Reflecting Characteristics of individual users

- Separate tariffs consistent with network planning

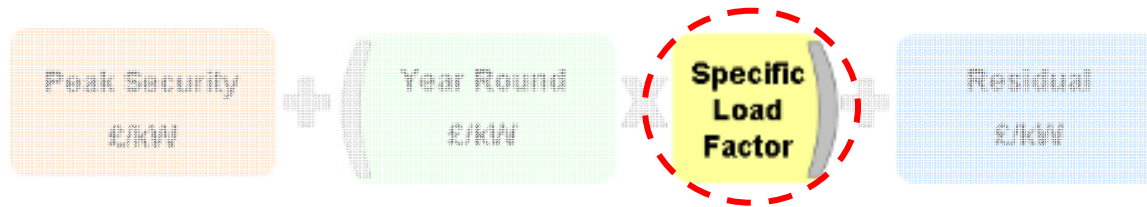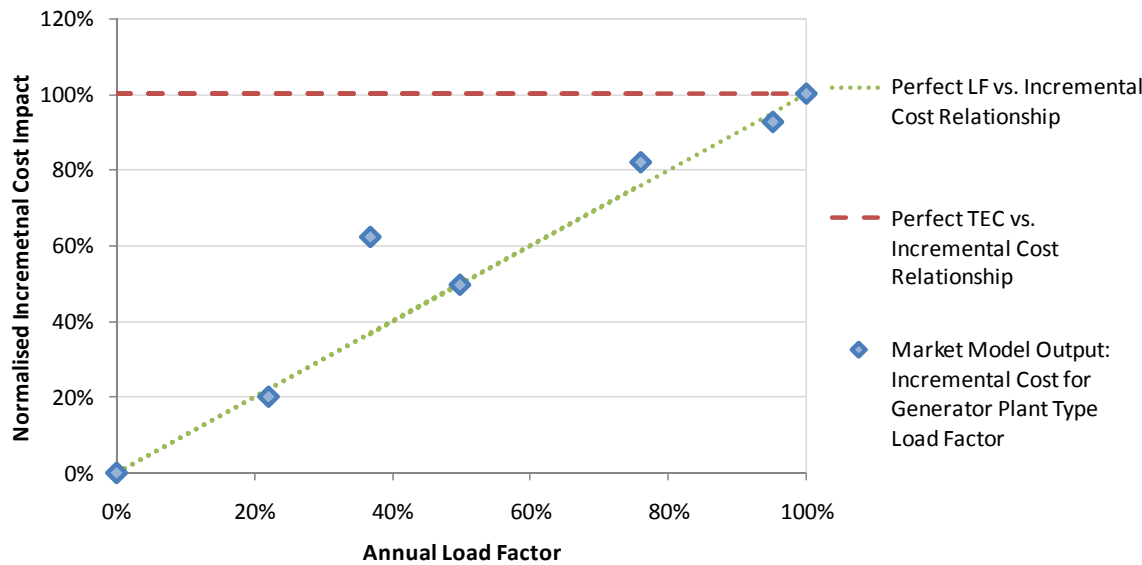- Generator specific load factor multiplier for year round

Conventional Tariff =

| Peak Security £/kW | + | (| Year Round £/kW | X | Specific Load Factor |) | + | Residual £/kW |

Intermittent Tariff =

| (| Year Round £/kW | X | Specific Load Factor |) | + | Residual £/kW |

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Is load factor a reasonable proxy?

Peak Security ¢/kW + Year Round ¢/kW × Specific Load Factor + Residual ¢/kW

■ Many characteristics of a generator contribute to incremental impact on network costs

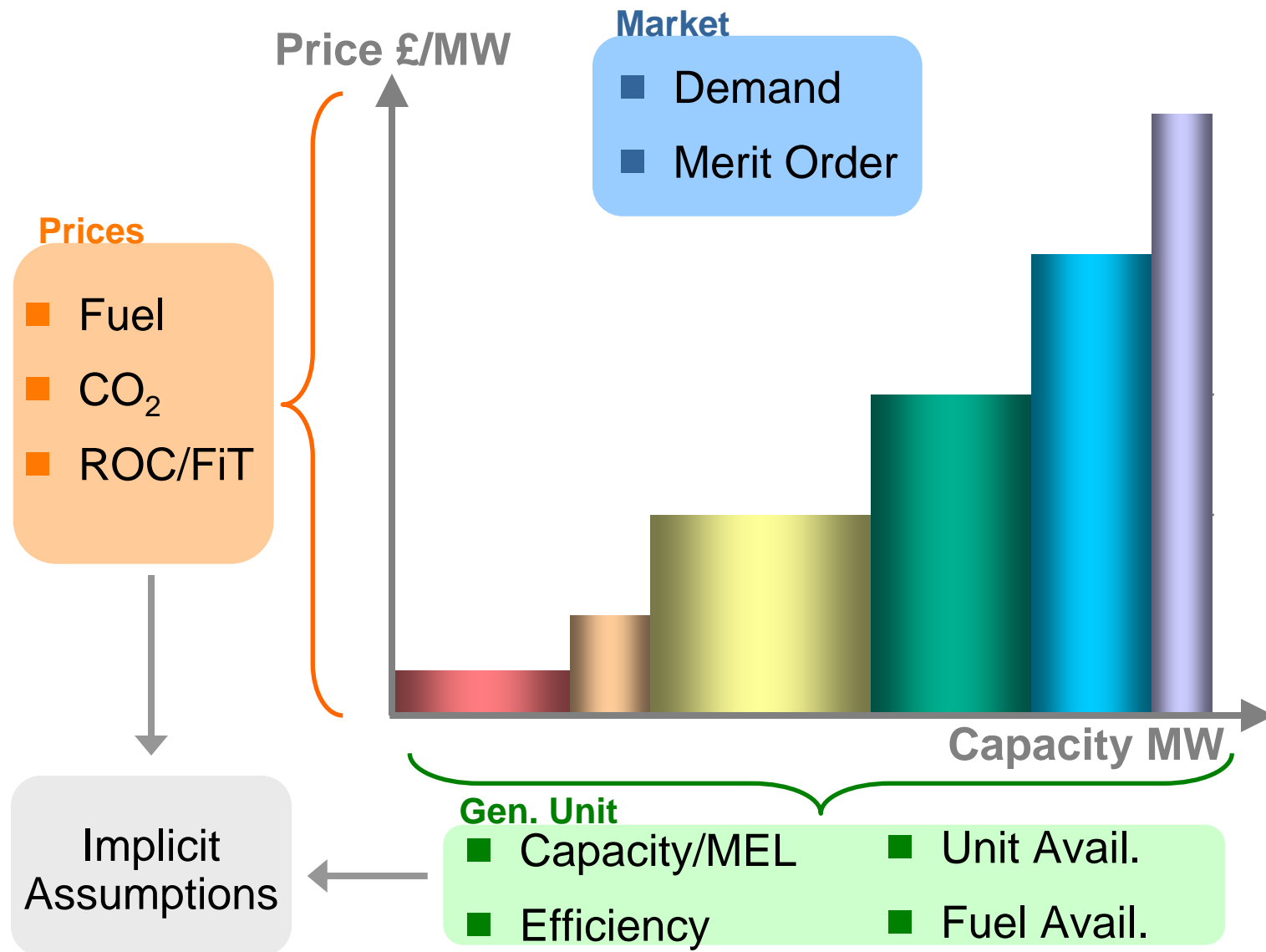**Market Model Outputs vs. Theoretical Perfect Relationships**

Normalised Incremetnal Cost Impact (y-axis: 0% to 120%)
Annual Load Factor (x-axis: 0% to 100%)

······· Perfect LF vs. Incremental Cost Relationship

— — Perfect TEC vs. Incremental Cost Relationship

◆ Market Model Output: Incremental Cost for Generator Plant Type Load Factor

■ Market model; relationship between generators and network costs

Original; balances simplicity with cost reflectivity

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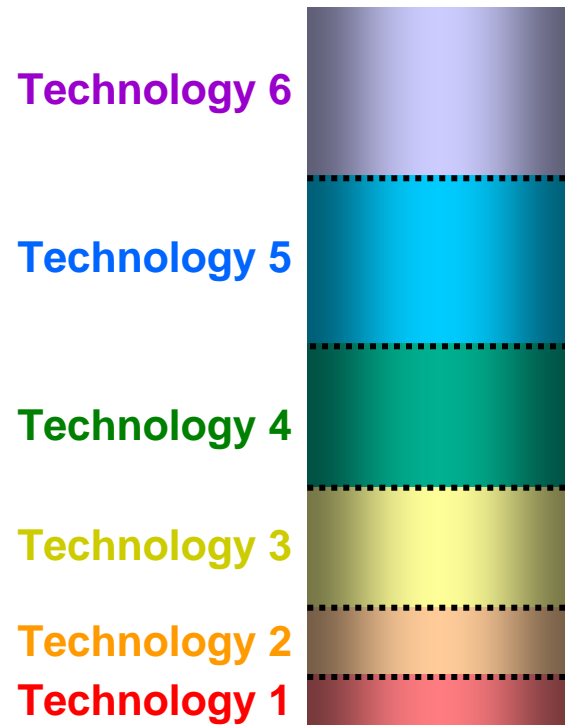
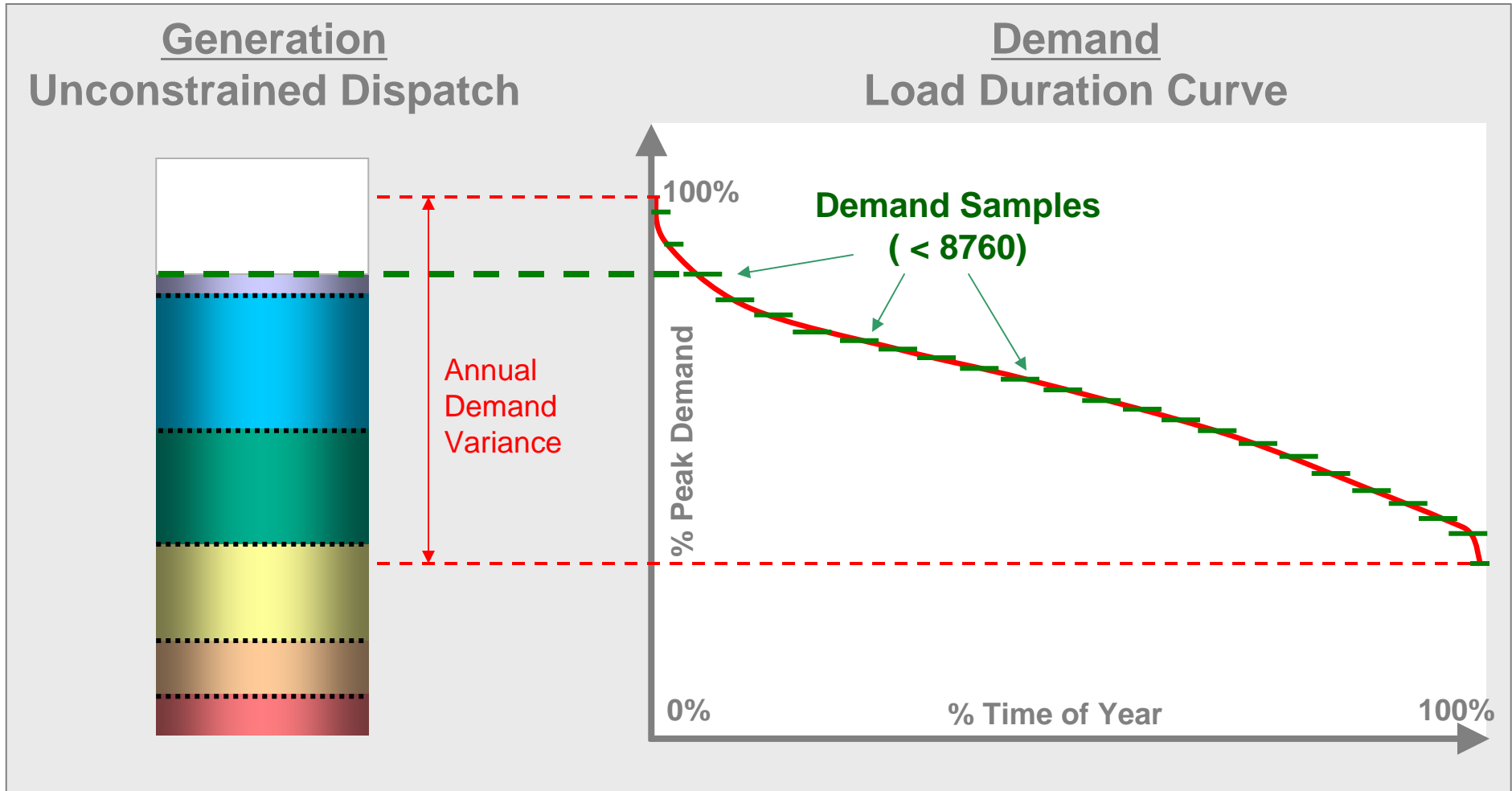# Basics of a Market Model

Unconstrained Dispatch

- Fuel Price
- CO_2 Price
- ROC/FiT Price
- Capacity
- Unit Avail.
- Fuel Avail.
- Efficiency
- Demand
- Merit Order

Prices

- Fuel Price
- CO_2 Price
- ROC/FiT Price

Gen. Unit

- Capacity
- Unit Avail.
- Fuel Avail.
- Efficiency

Market

- Demand
- Merit Order

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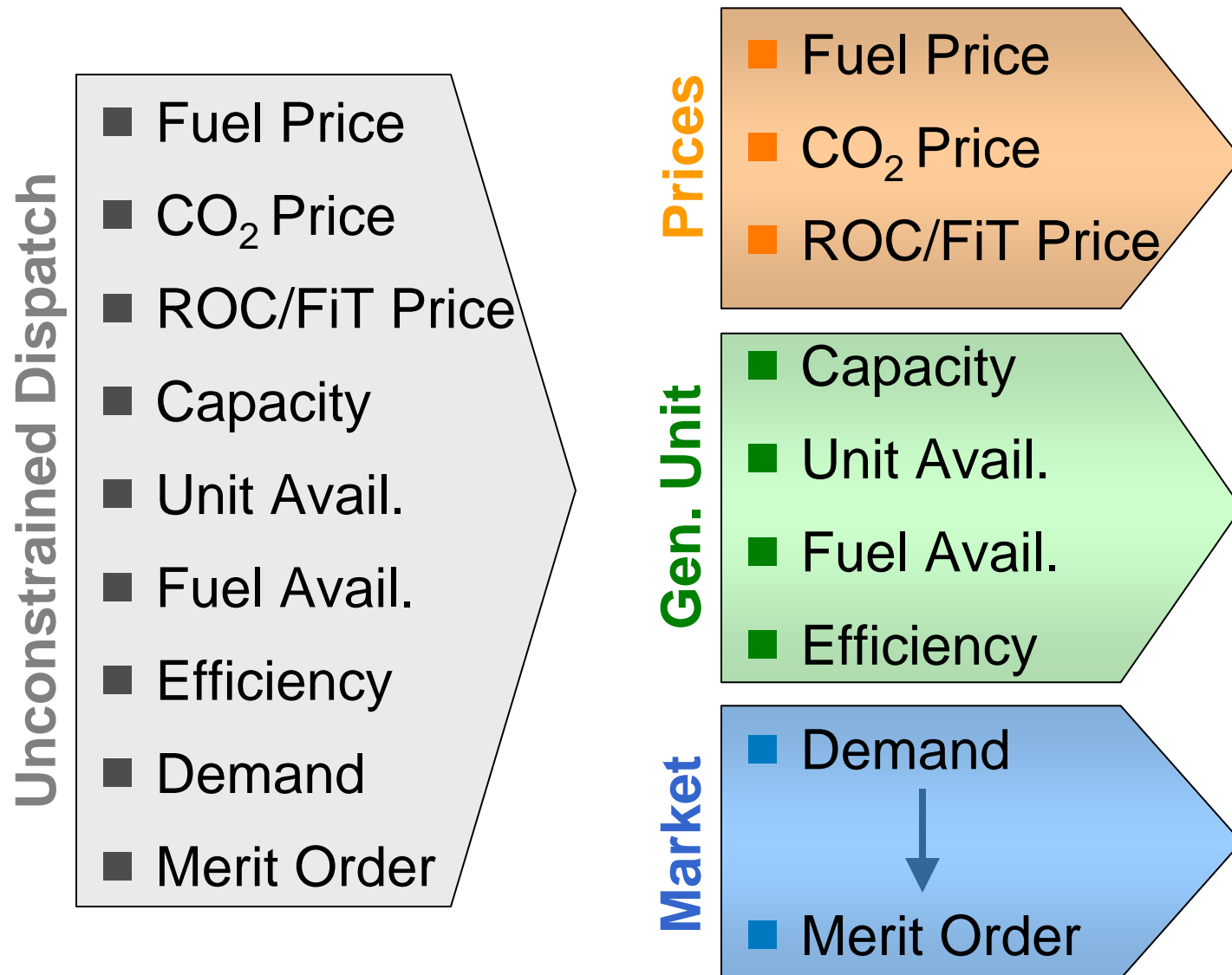
Market Model - Generation Inputs

Price £/MW

Market
- Demand
- Merit Order

Prices
- Fuel
- CO_2
- ROC/FiT

Capacity MW

Implicit Assumptions

Gen. Unit
- Capacity/MEL
- Efficiency
- Unit Avail.
- Fuel Avail.

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Market Model - Generation Merit Order

Technology 6

Technology 5

Technology 4

Technology 3

Technology 2

Technology 1

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Market Model - Unconstrained Dispatch

Generation
Unconstrained Dispatch

Demand
Load Duration Curve

Annual
Demand
Variance

100%

**Demand Samples
(< 8760)**

% Peak Demand

0%   % Time of Year   100%

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Market Model - Network Capability

Unconstrained Dispatch
(One Demand Sample)

Technology 6

Technology 5

Technology 4

Technology 3

Technology 2

Technology 1

} Zonal Capacities
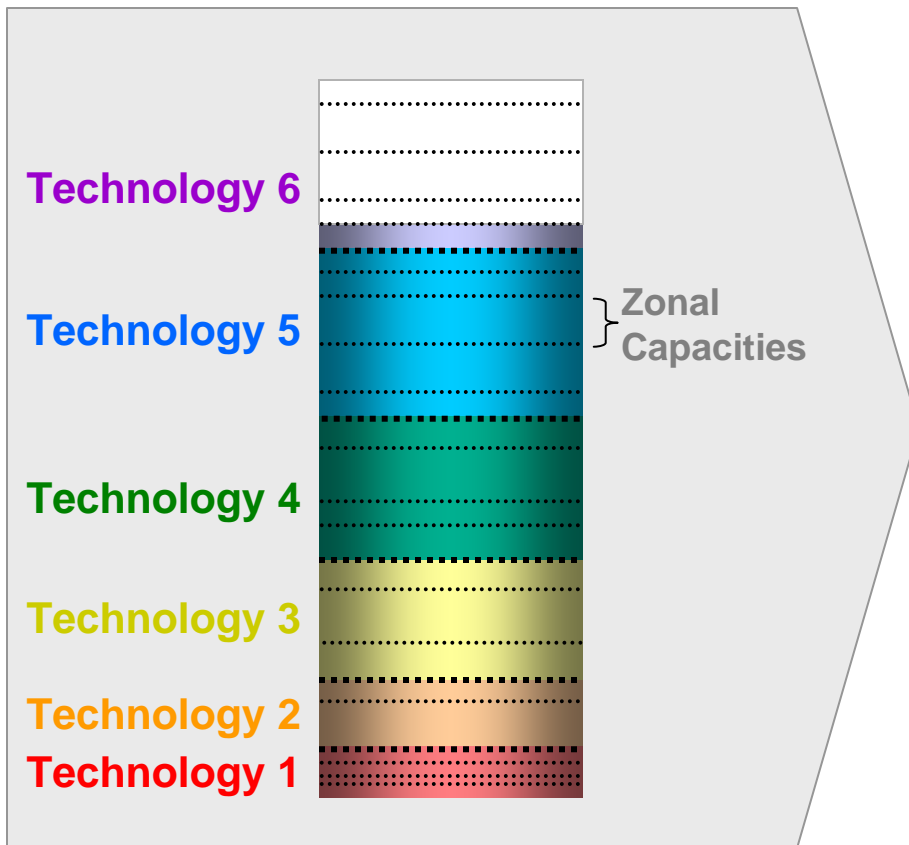
Zonal Network Representation

G1 = 10GW
D1 = 5GW

Boundary Flow = G1 − D1 = 5GW

Boundary Capability = 4 GW

Circuits (1GW each)

G2 = 45GW
D2 = 50GW

Boundary Flow > Boundary Capability
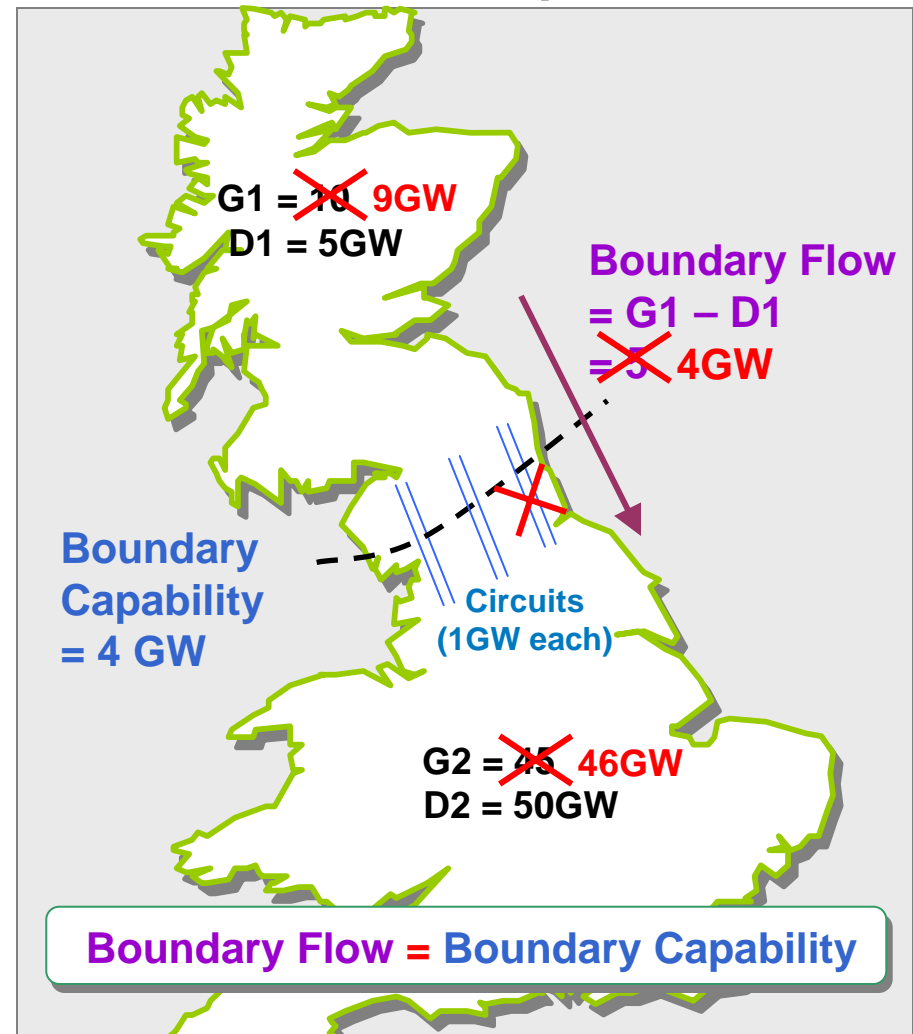
Elements Influencing Constraint Costs

Unconstrained Dispatch

Prices
- Fuel Price
- CO_2 Price
- ROC/FiT Price

Gen Unit
- Installed Cap.
- Unit Avail.
- Fuel Avail.
- Efficiency

Market
- Demand
- Merit Order

Constrained Dispatch

Network
- Capability
- Seasonal Avail.
- Outage Avail.
- Investment

BM
- Bid Price
- Offer Price
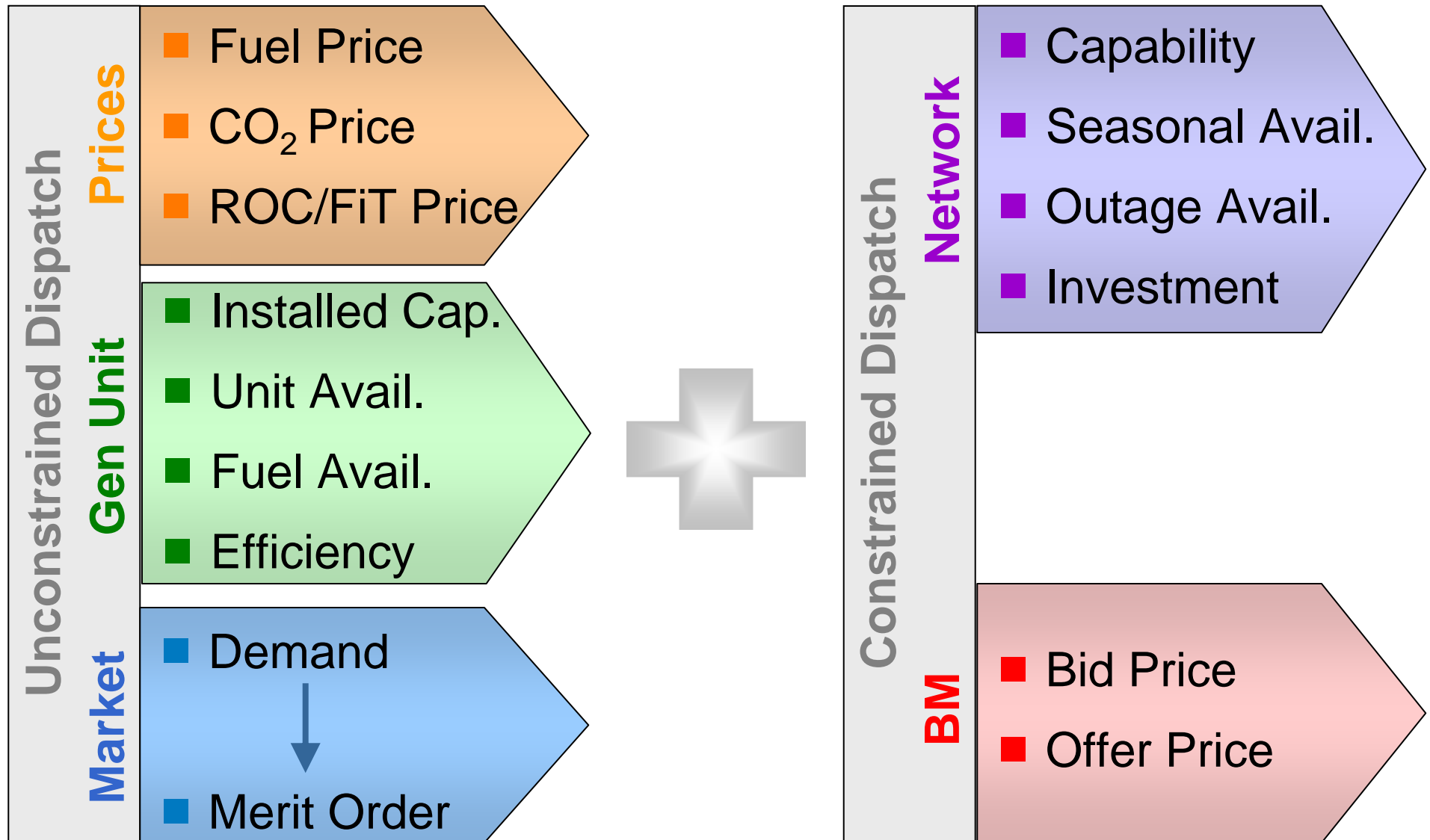
Key elements affecting incremental cost
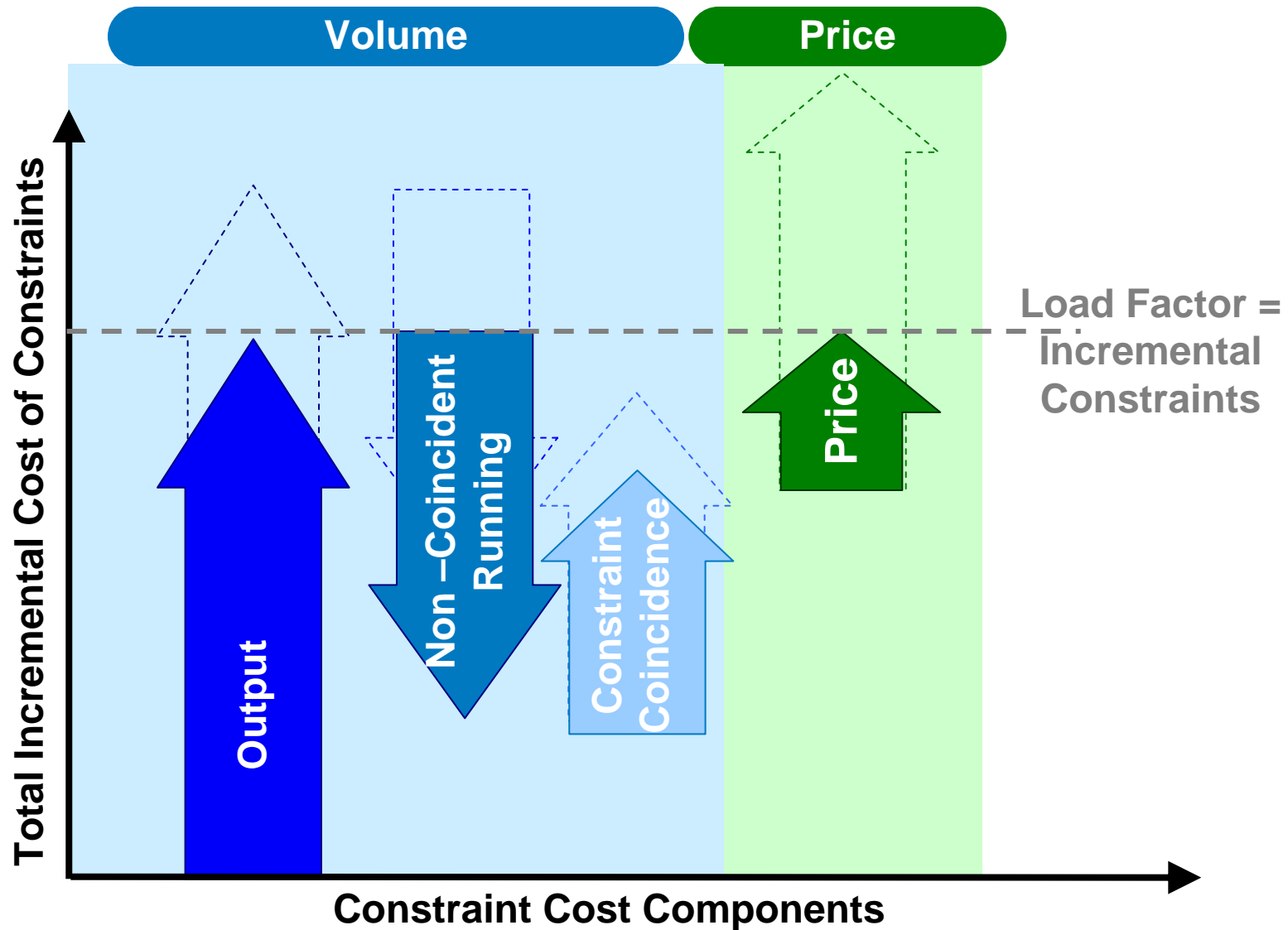
Diversity Alternatives –
Effect of Bid/Offer Price

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Low Carbon Plant   **Non Low Carbon Plant**

LRMC

Incremental Constraint Costs (£/MW)

(Plant setting bid price is infra-marginal)

(Plant setting bid and offer prices are both marginal plant types)
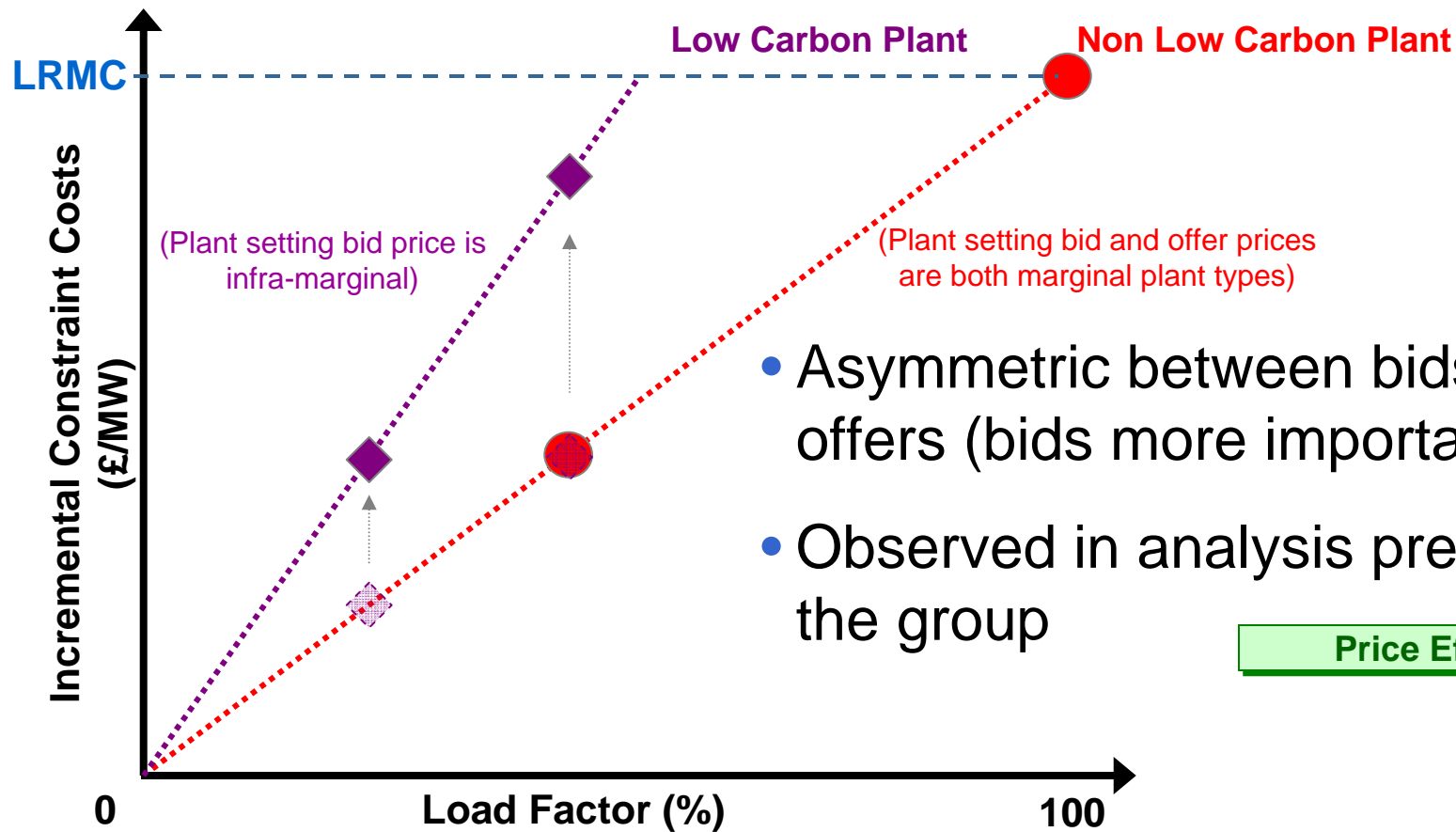
- Asymmetric between bids and offers (bids more important)

- Observed in analysis presented to the group

Price Effect

0   Load Factor (%)   100

- In areas with insufficient diversity of plant the SO may be forced to accept bids from infra-marginal plant

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Export constrained zones – Simplified Analysis
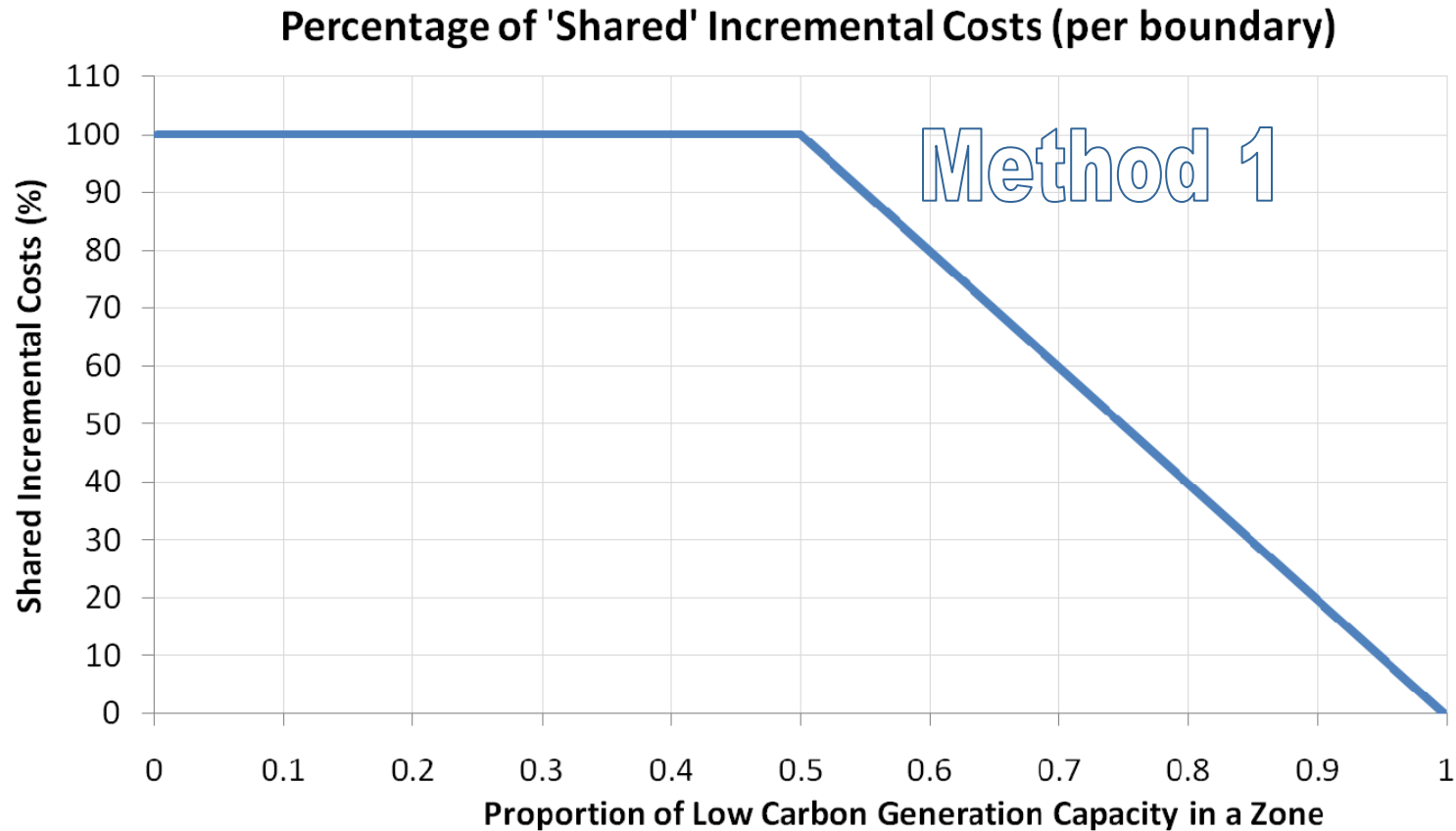

Load Factor and Incremental Cost Ratio (Normalised)
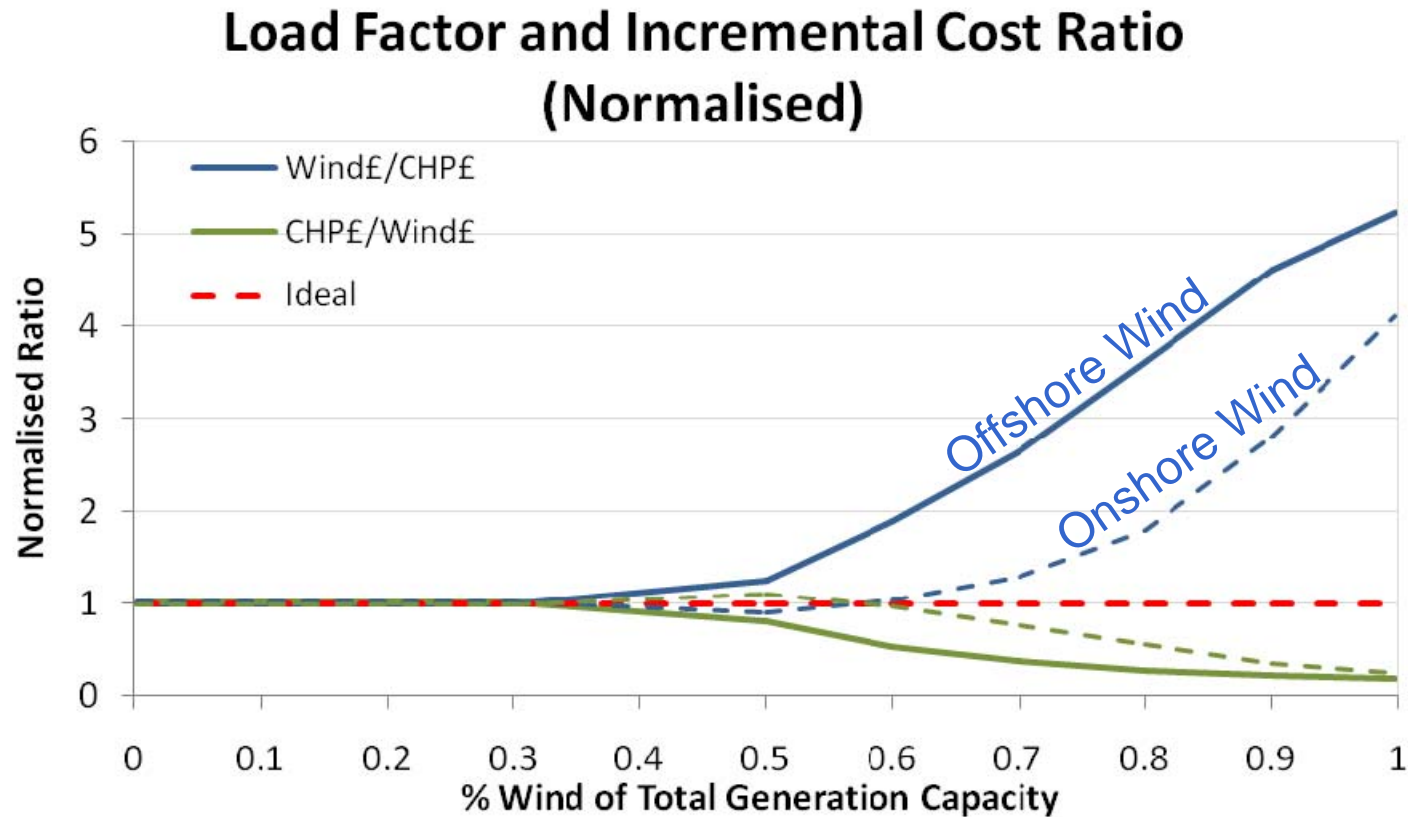
- Simplified 'test zone' analysis served to corroborate hypothesis and help quantify effect

Diversity 1

Percentage of 'Shared' Incremental Costs (per boundary)

- (YR Shared incremental £/kW) x **ALF** x TEC
- (YR Not-shared incremental £/kW) x TEC

Diversity 2
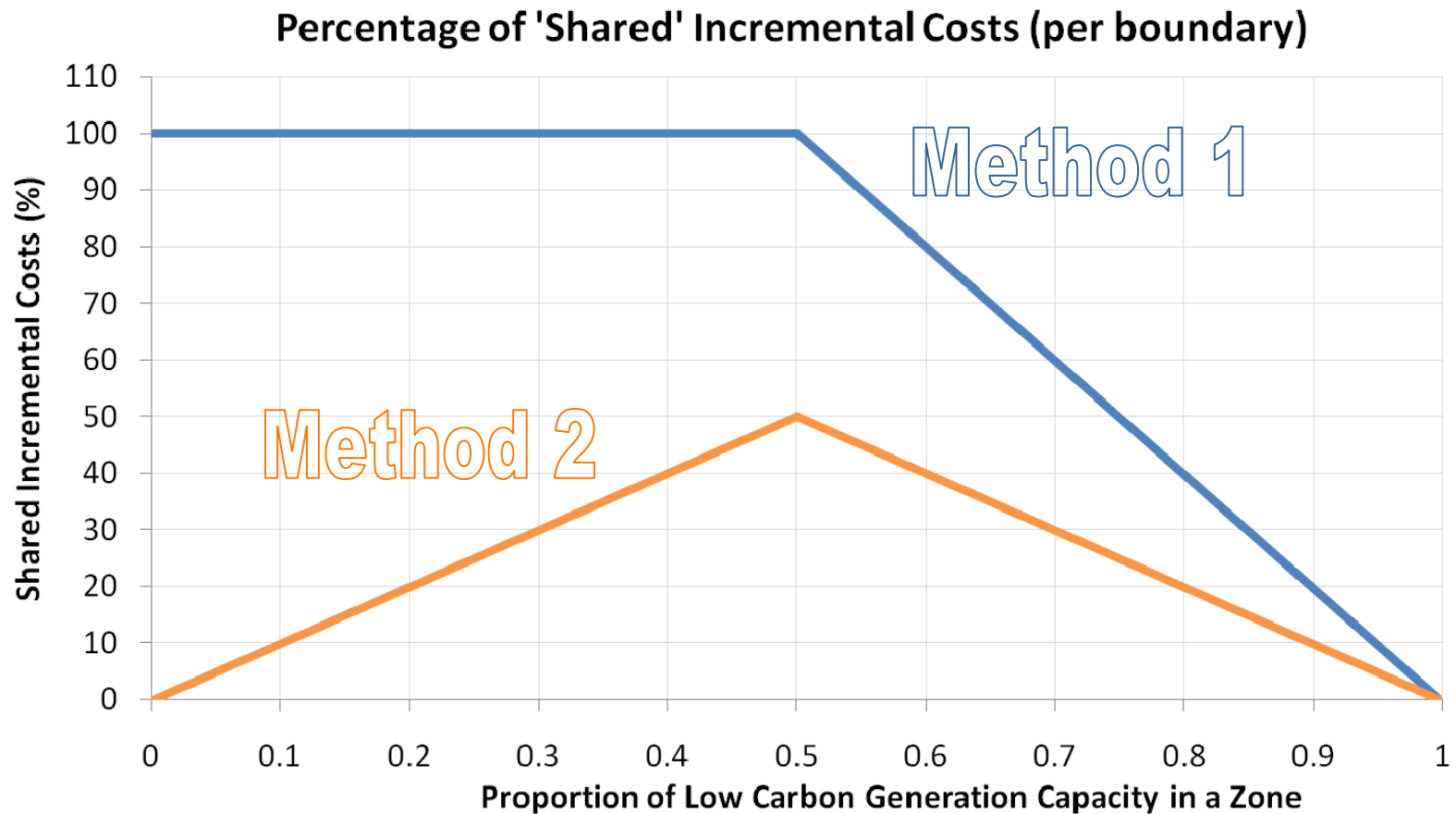
Percentage of 'Shared' Incremental Costs (per boundary)

- (YR Shared Incremental £/kW) x **ALF** x TEC
- (YR Not-shared Incremental £/kW) x TEC

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Diversity 3

Zonal Sharing Factor (per boundary)

Method 3

Zonal Sharing Factor (%)

Proportion of Low Carbon Generation Capacity in a Zone
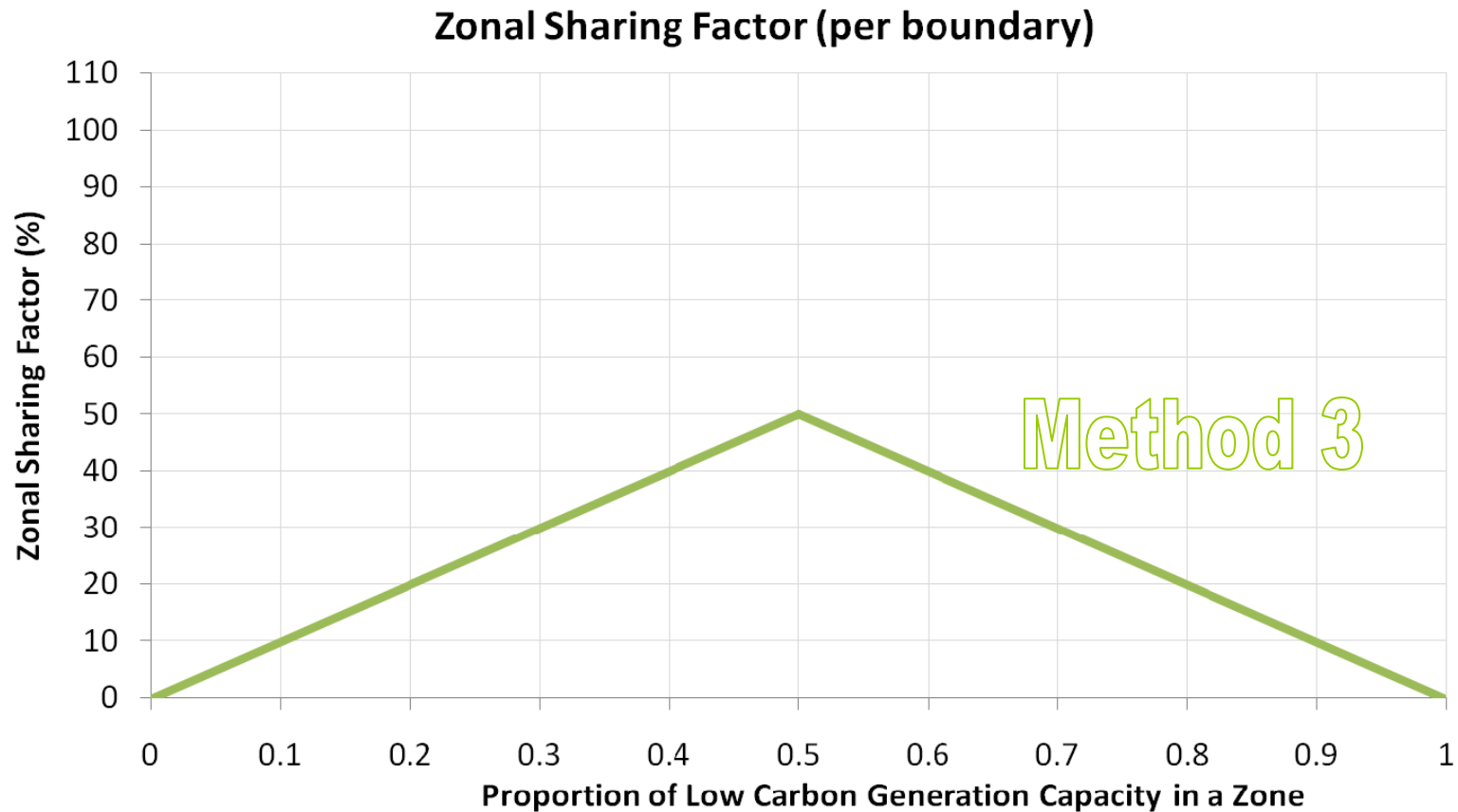
■ (Incremental £/kW) x **ZSF** x TEC

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Sharing under diversity alternatives

LC/C

Boundary Shared km

Zone A Totals

Boundary 1 — 100/0

Boundary 2 — 70/30

Boundary 3 — 50/50

Boundary 4 — 20/80

Method 3
Method 2
Method 1

Shared
Not Shared
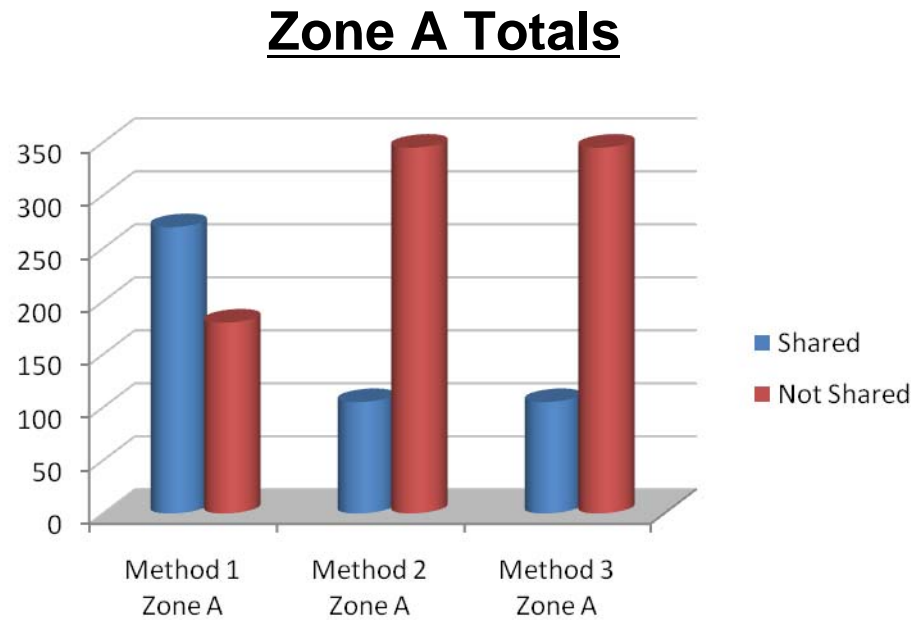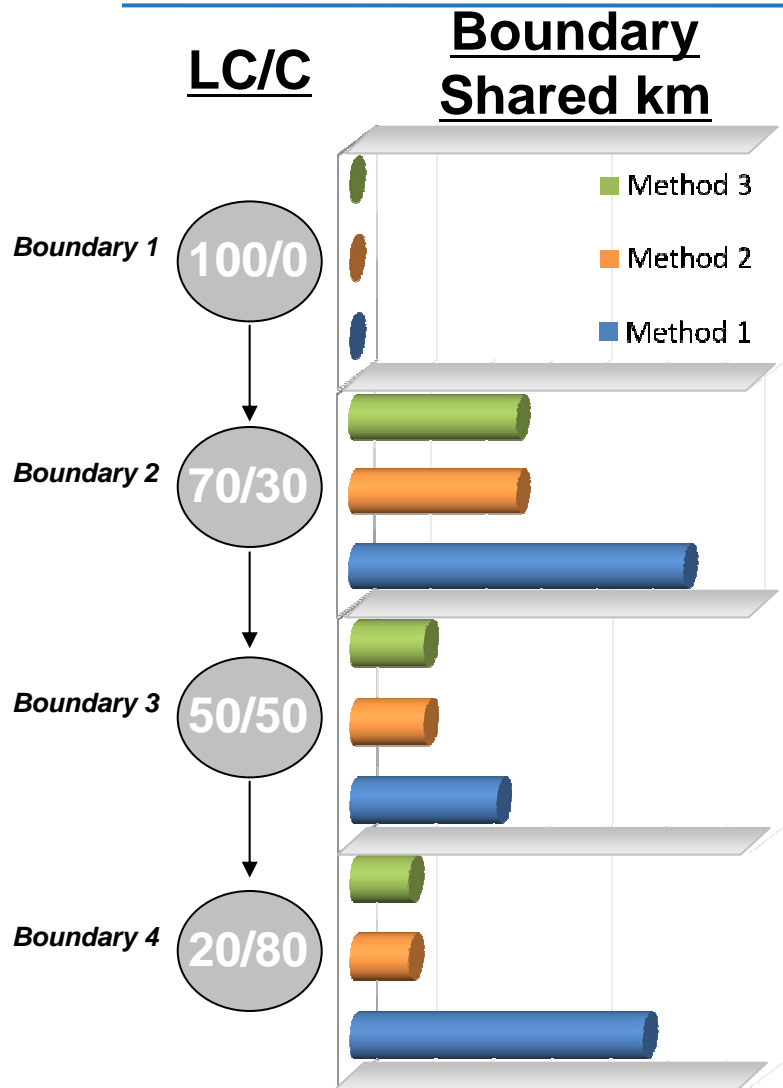
■ Zonal totals made up of aggregate of relevant boundaries

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Load Factor Alternatives

- Workgroup concerns over ability of original to reflect step changes in user outputs.

- Alternative for user to provide own forecast if different to National Grid calculated ALF

  - Hybrid Alternative

- Penalty payments if forecast is inaccurate

Sharing at the peripheries of the system

- Diversity impacts potentially greatest at peripheral parts of system

  - Local circuits still built for capacity

- These are managed implicitly in diversity options

- For Original, propose to alter MITS definition to improve cost reflectivity

  - Radial circuits

- However, sharing could still exist on such circuits

  - Heriott-Watt work; CCF

Herriot – Watt Analysis
& Counter Correlation Factor

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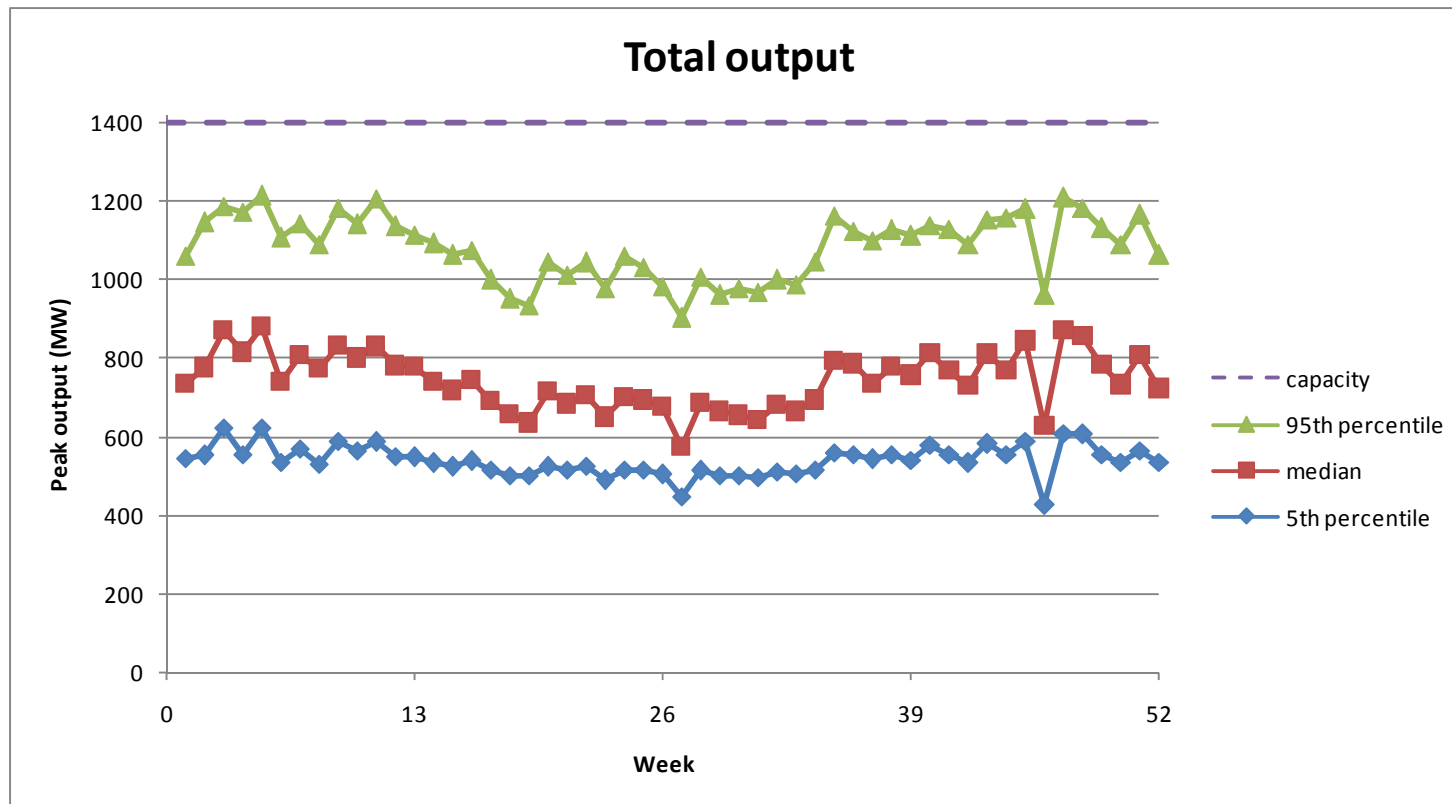
- Potential for counter correlation of low carbon technologies

  - Could be reflected in radial circuit designs by TOs

  - Use of counter correlation factor (CCF)