Business Models for Flexible Generation, Supply and Networks

Lewis Dale
Regulatory Strategy Manager, National Grid plc

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  - Separation of System Operator & Transmission Owner
- Evolving system
- The system operational responses
- Network access – Tx & Dx theoretical considerations
  - Access regime examples
  - Efficient access arrangements for future needs

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Introduction to National Grid

Regulated networks

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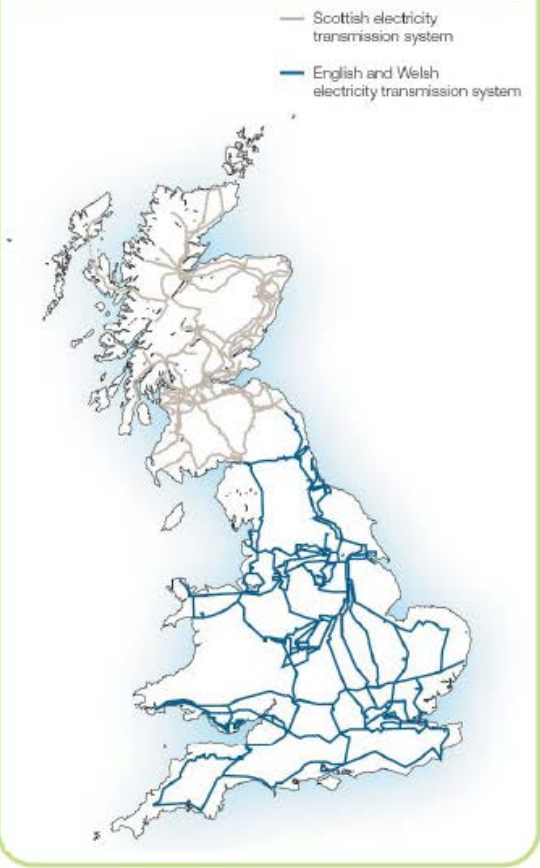
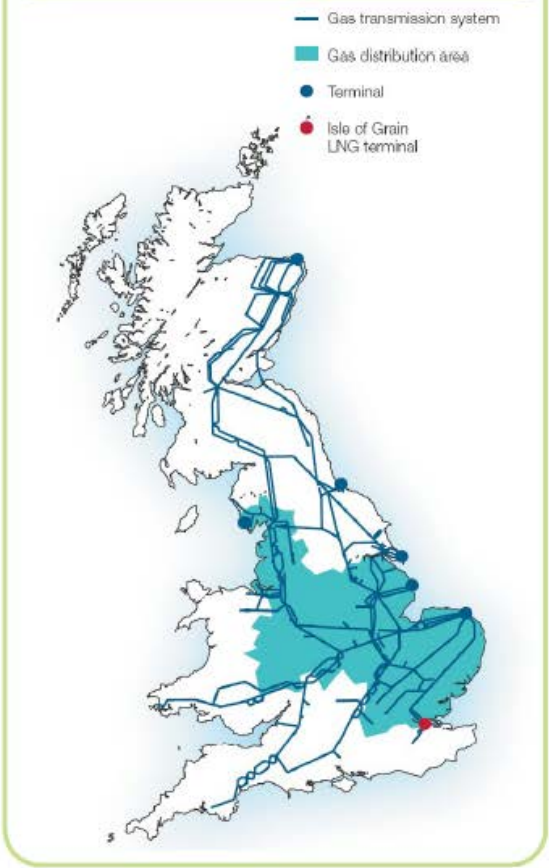
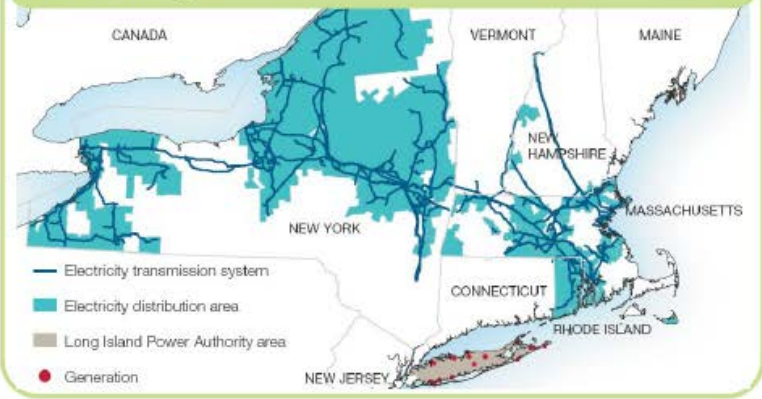
Electricity – UK



Gas – UK



Electricity – US



Gas – US

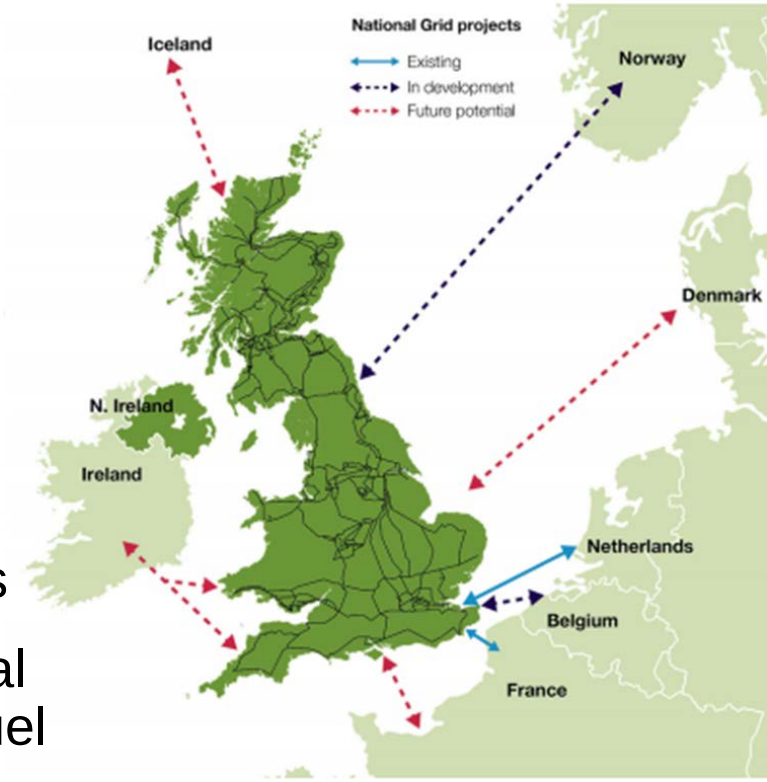
UK and US

Electricity and Gas

Transmission & Distribution

Non price regulated businesses

- LNG importation terminal, Isle of Grain UK
- Electricity Interconnection:
  - IFA France-England 2GW
  - BritNed Netherlands-England1.2GW
  - New interconnectors to Belgium & Norway under construction
- Metering: installation and maintenance (including 15m gas meters)
- Xoserve gas market settlement services
- US LNG road transportation, commercial services relating to solar installations, fuel cells and other new technologies



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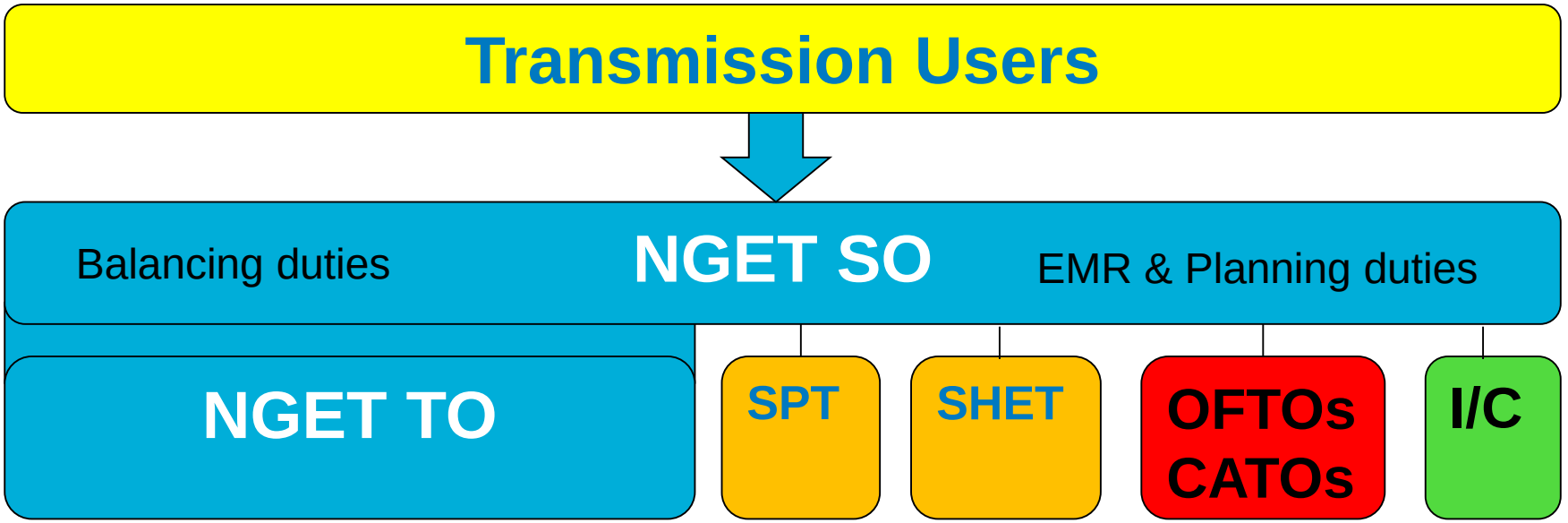
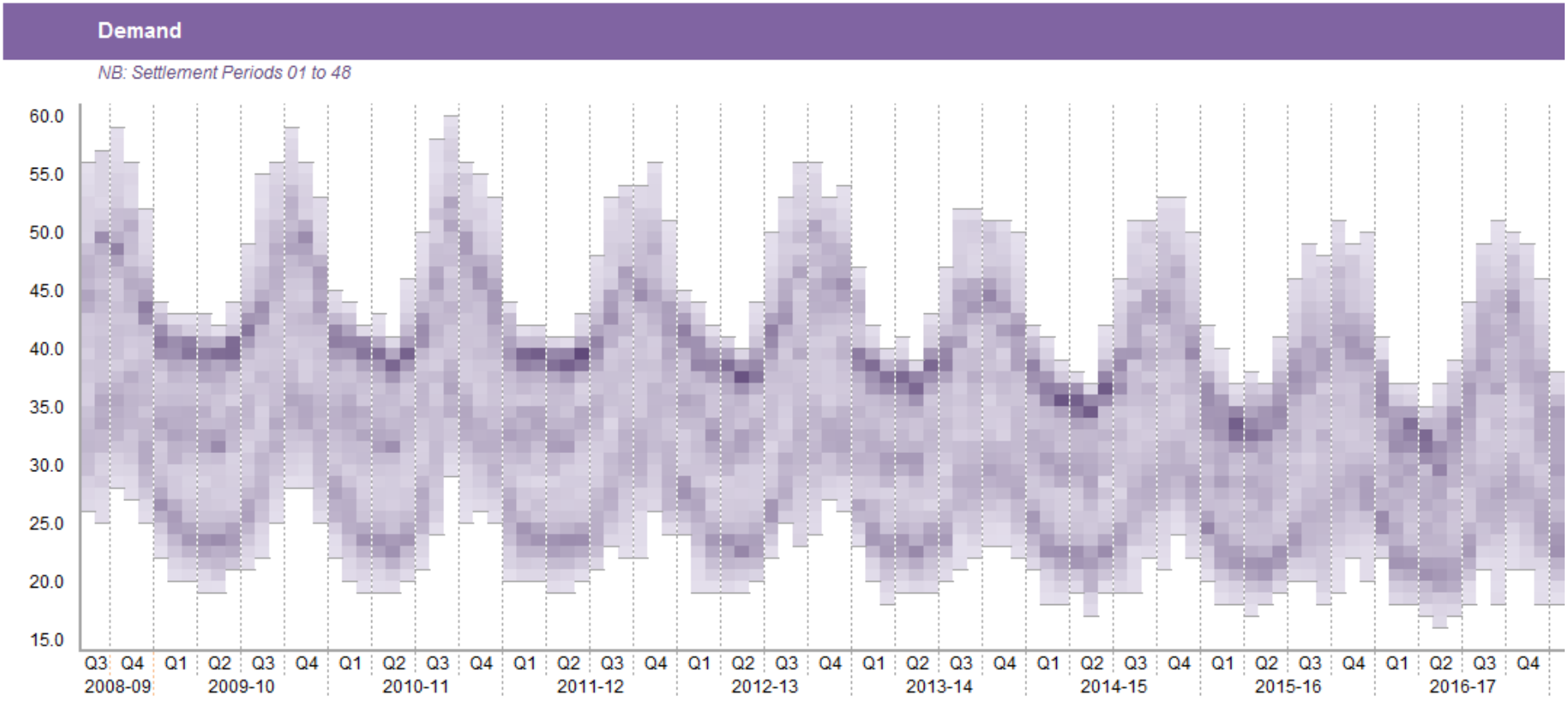
Why separate NGET SO & TO functions?



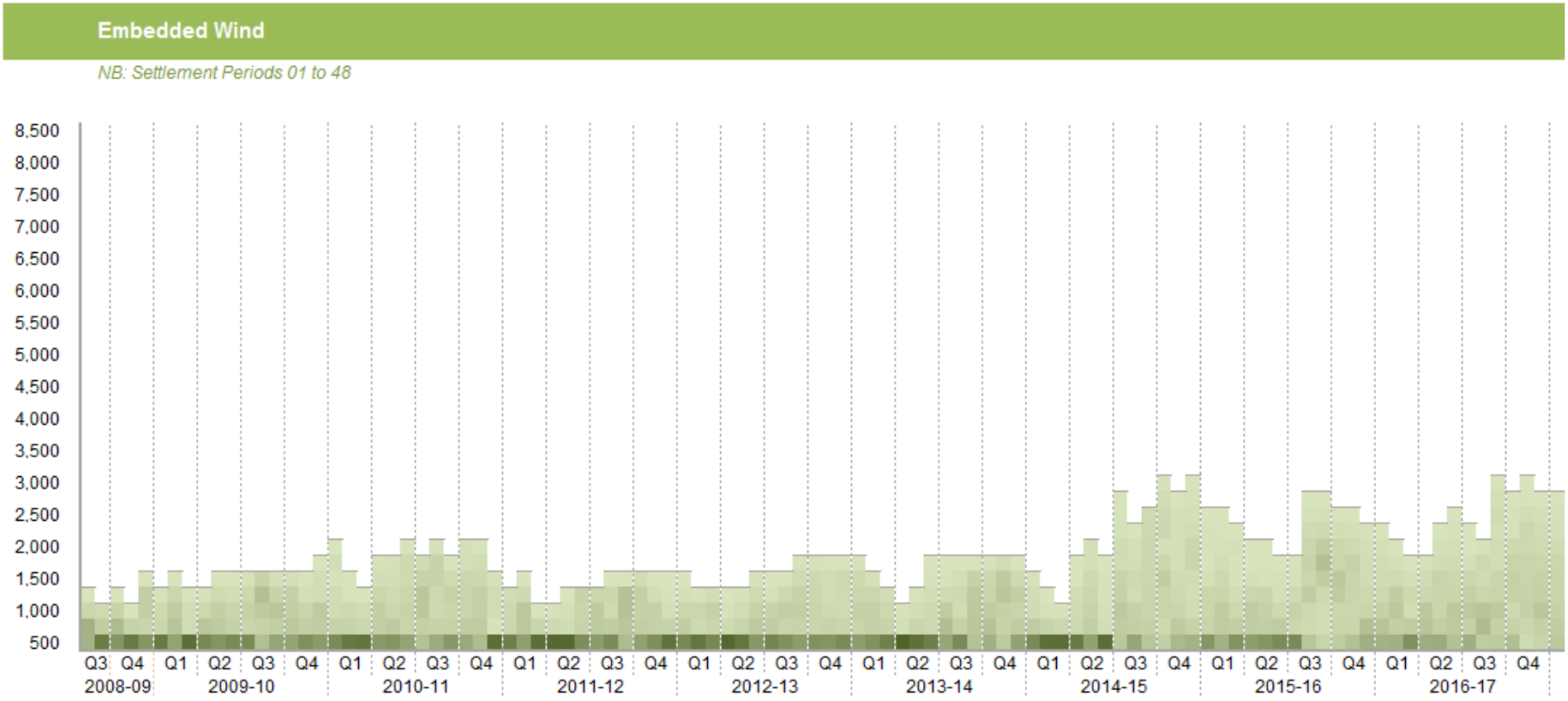
- Achieving and demonstrating SO is unbiased:
  - Capacity & balancing services vs transmission services
  - NG vs other network and interconnector owners
  - Incumbent vs new entrant transmission service providers
- Uniform terms for onshore TOs
- Parent company guarantee remains for SO cash flow risks

Evolving system

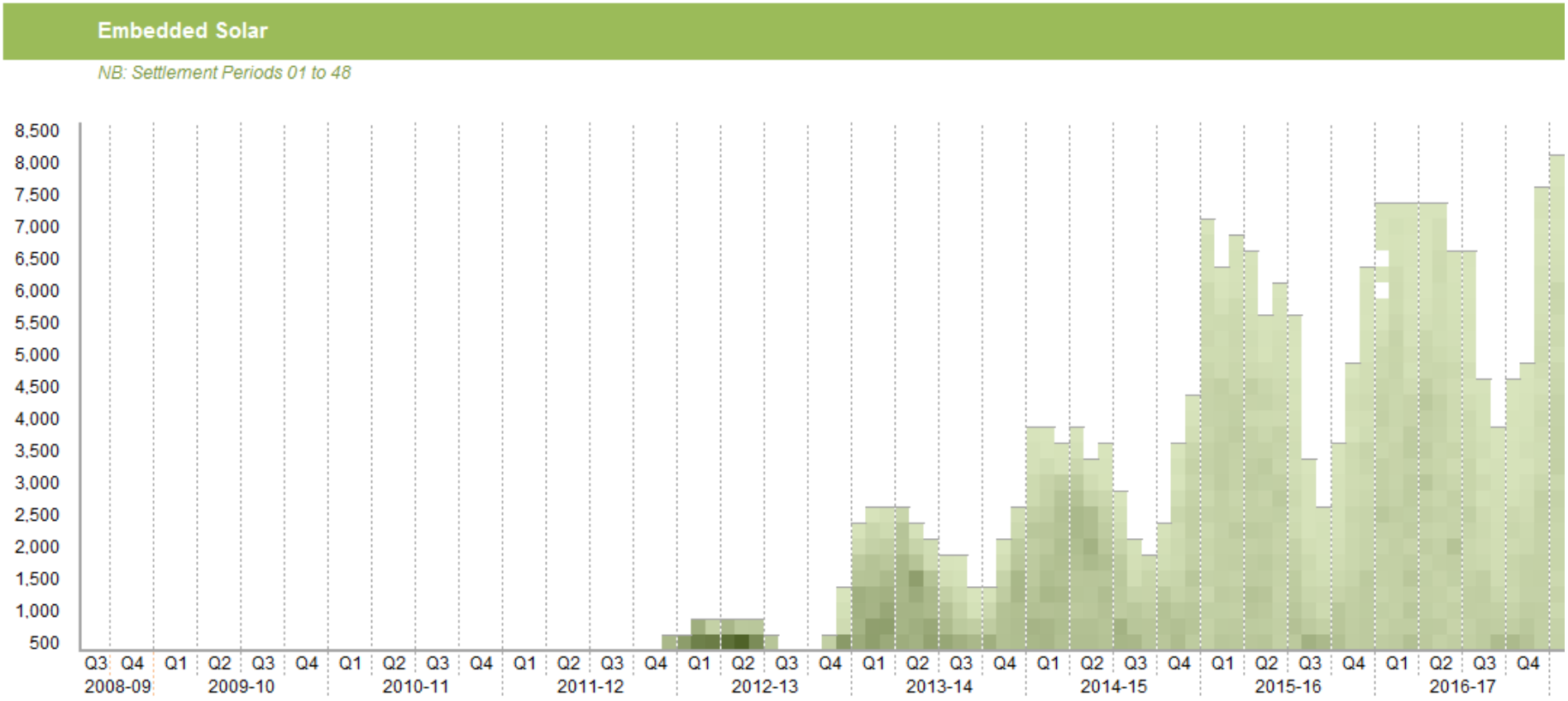
Evolution of demand



Evolution of embedded wind



Evolution of embedded solar



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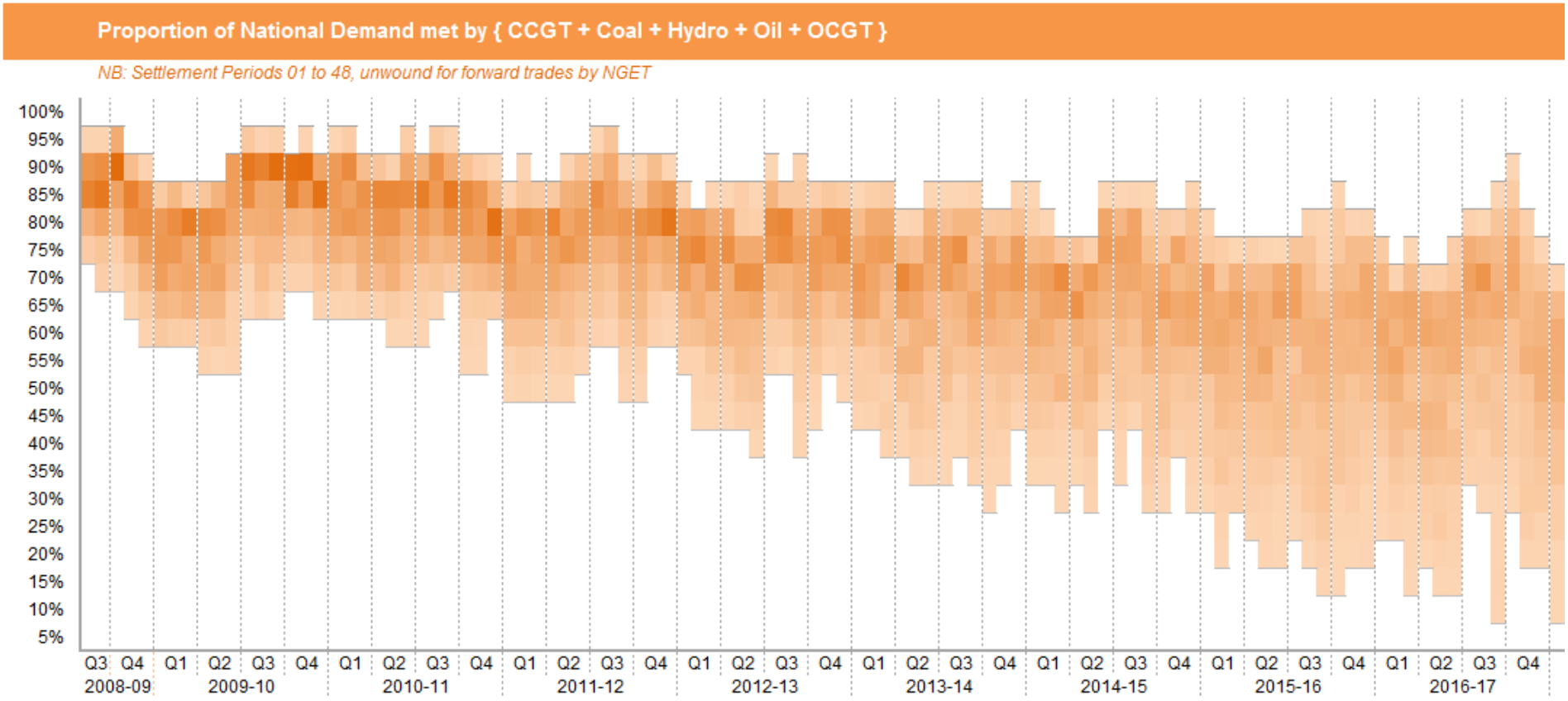
Evolution of the generation mix



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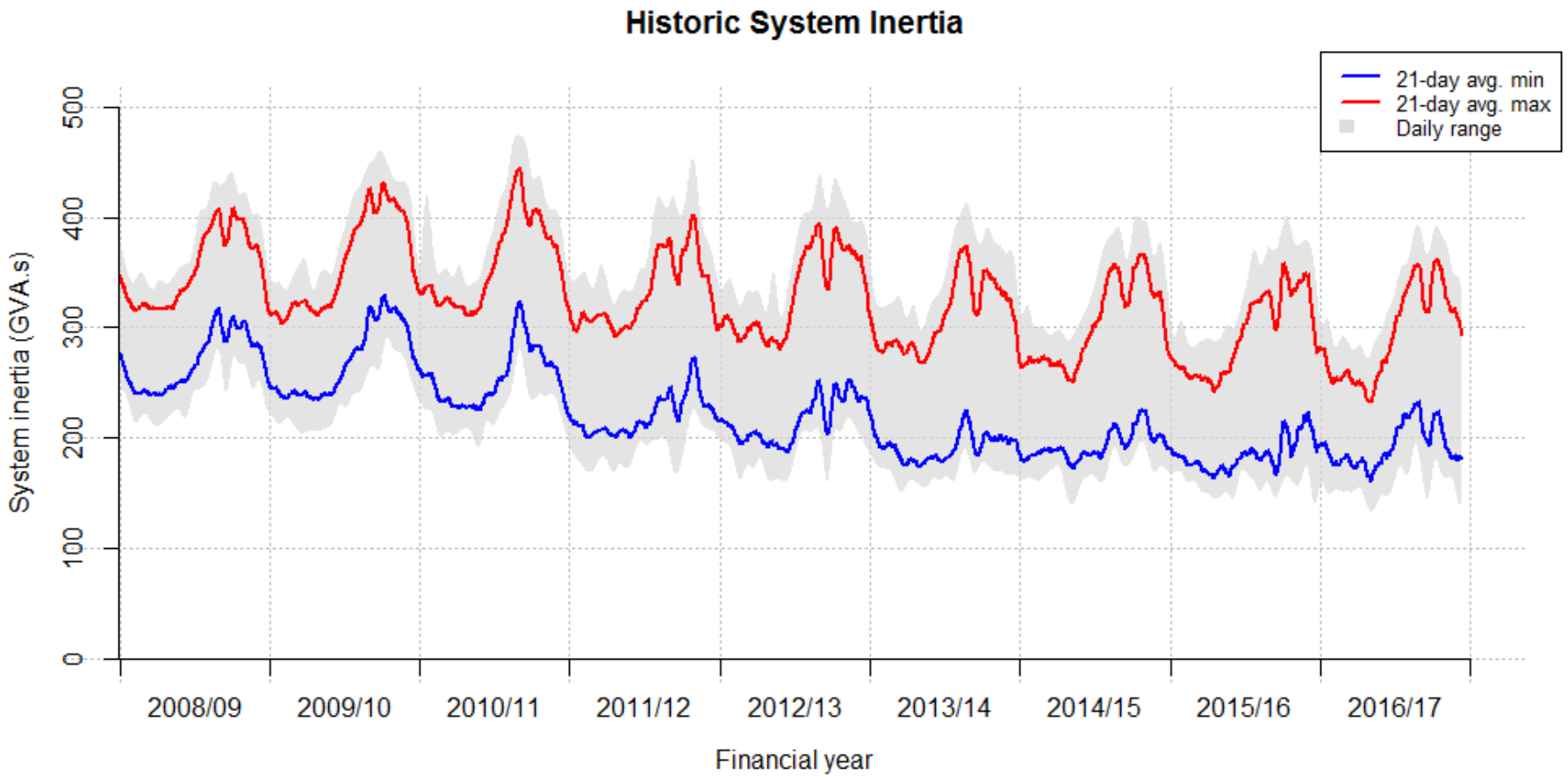
Evolution of system inertia



Operational Responses

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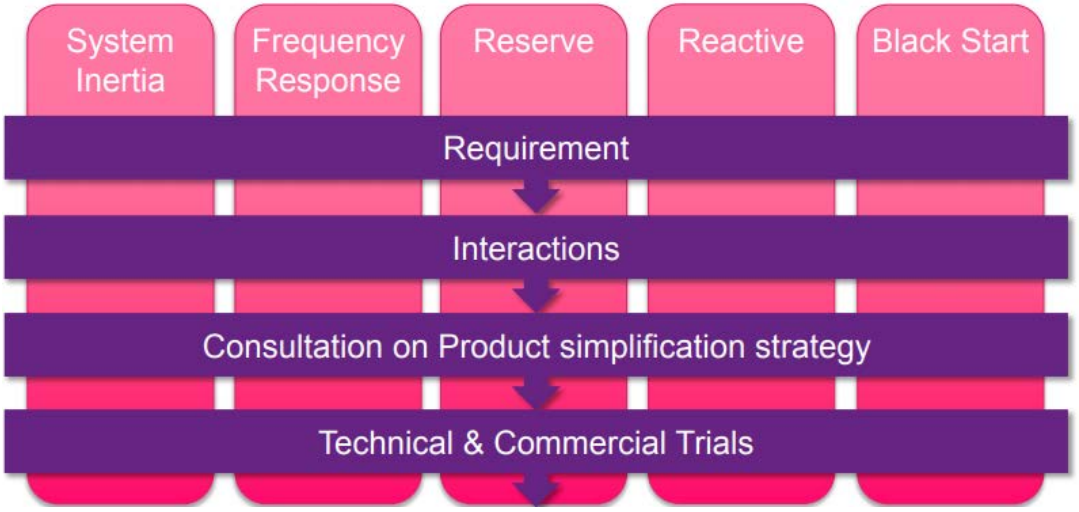
National Grid System Operator Initiatives

power responsive

a stakeholder-led programme, facilitated by National Grid, to stimulate increased participation in the different forms of flexible technology such as DSR and storage.

Flexibility Workstream

System Needs & Product Strategy



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SNaPS Ancillary Services Vision

- New Procurement Approaches
  - More real time markets in line with EU aspirations
  - Pay-as-clear auctions
  - Trials of both in the next year
- Wider Markets
  - Investigate access to the Balancing Mechanism for non-BM parties
  - Understand how new technologies and business models can be commercialised
  - Understand (with industry) potential changes which may be needed to both wholesale and capacity markets to strengthen investment signals

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Other UK Developments

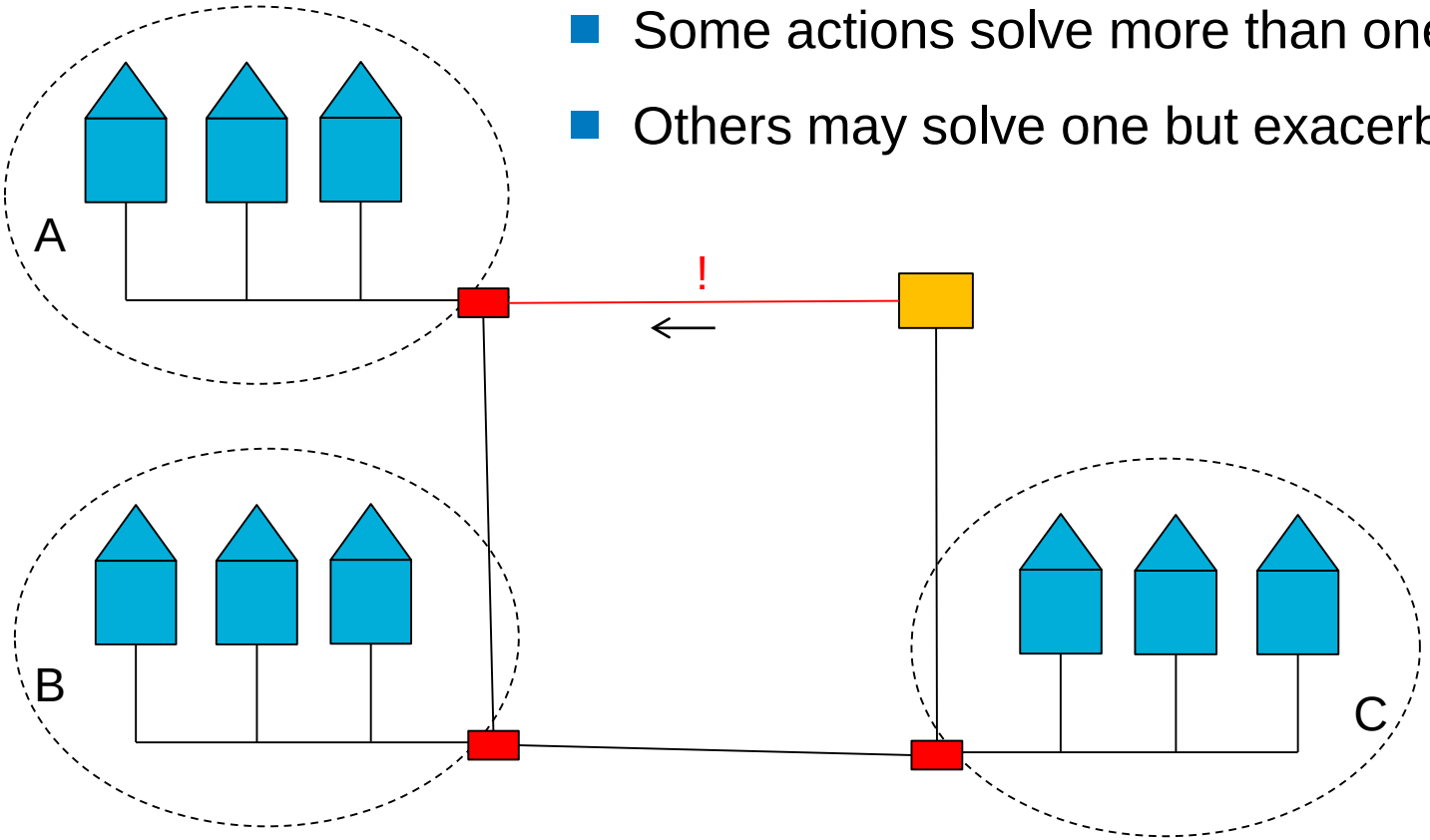
- Increased participation in system balancing:
  - P344 proposes that bidding and despatch will work similarly for both BM and non-BM providers. Rules and obligations will lie mostly in Grid Code (not BSC). Envisages need for adjustments to be made to the imbalance positions of:
    - BM participants who are providing balancing services
    - The Suppliers of non-BM participants who are providing balancing services
  - Project TERRE ("Trans-European Replacement Reserves exchanges") is a cross-border balancing project which is designed to fulfil the requirements of the forthcoming European Electricity Balancing Guideline

Network access

Recognising network capacity is finite and occasionally limited

Congestion countermeasures

- Different locations have different effectiveness
- Constraints will be active at different times
- Some actions solve more than one issue
- Others may solve one but exacerbate another



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System objectives

- **Objective (primal): satisfy all constraints at lowest total consumer cost**
  - Do we know the service costs? (eg. what is cost of demand turn down?)
  - Can optimisation be segmented into control areas? (which constraints active? Which priorities for conflicting actions?)

If solved, marginal value at each location = sum of constraint shadow prices. This suggests:

- **Objective (dual): maximise service provider profits/satisfaction subject to discovery of service prices (at each location) to solve each constraint**
  - In theory, same optimum as primal (subject to certain conditions)
  - Service provider profit motive gives scope for competition & innovation
  - Decentralisation facilitates multiple operating areas
  - Some market power / pricing issues to manage

- Spot prices signal the benefit of adjusting and the cost consequences of not adjusting
- Spot prices will be volatile – producers and consumers will need forward signals and hedges

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Examples (different ways of doing it)

US PJM

- Spot: Energy (5 min node price)
  - Always apply (subject to minimum connections)
  - Derived from central dispatch
- Hedges:
  - Energy: financial contracts for difference (forward traded at hubs)
  - Access: financial transmission rights (ISO primary auction with secondary trading)

European

- Spot: Energy (zone markets)
  - Apply subject to market access rights
  - Pool prices, Power exchange & OTC prompt, (often informed by imbalance prices)
- Hedges:
  - Energy: Market forward contracts
  - Access (to interconnection):
    - Physical rights auctions

But UK has an incomplete market

Wholesale/Tx

- Spot:
  - Energy: Prompt wholesale (informed by imbalance)
  - Access: None? (Some observable in BM?)
- Hedges:
  - Energy: forward contracts
  - Access: entry/exit products with administrated price (TNUoS)

Distribution

- Spot:
  - Energy: Supplier hub arrangements
  - Access: None? (Some observable from congestion measures?)
- Hedges:
  - Energy: supplier contracts
  - Access: entry untradeable deep connection, exit DUoS

Tariff signals modified (distorted) to reconcile revenues

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Efficient access needs

- Transparent (locational) spot service prices
  - Decoupling of network revenue recovery issues
- Simple opt-in or hedge-out options
  - Clarity of default service under energy/access contracts
    - Basic energy + home generation + electric vehicle charging?
  - Standardisation of basic services and their settlement
    - Turn-up / turn-down
  - Automation ready interfaces