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THE CASE FOR LMP IN GREAT BRITAIN
LESSONS FROM INTERNATIONAL EVIDENCE AND RECENT MODELLING STUDIES

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Locational Marginal Pricing and the transformation of energy systems around the world

Context: potential market failures in current market designs	• Constraints in transmission and sparse generation location: the assumption of a single national market or few "price zones" is inaccurate • Missing market for locational signals
Why do locational signals constitute an increasing tension?	• Energy transition is changing wholesale markets • Network congestion becomes more frequent and increases costs for the ESO – constraint management becomes crucial • Management of the network through locational signals is relevant to Net Zero goals as new renewable capacity will need to be accommodated in the near future
LMP as a potential solution: locational signal is in the wholesale price	• LMP as a "best practice" for an evolving electricity system – most famous examples are U.S. markets • GB is considering the impacts of LMP – recent study estimates £24 billion in social benefits and £51 billion in consumer benefits over 15 years

In this presentation we will cover:

- Key theoretical benefits of LMP
- Main case studies on jurisdictions that have introduced LMP (including the recent study commissioned by Ofgem and NERA's analysis of the Australian NEM)

The key benefits of LMP derive from more efficient locational signals and dispatch

LMP incentivises more efficient dispatch

- **Short-term benefits:** LMP allows the System Operator to dispatch the lowest cost plants to meet system load (subject to constraints)
- **Long-term benefits:** As the system evolves, the variable cost of generation may fall because of better-located generation and storage

The scope and size of potential benefits varies depending on the specific characteristics of the market:

- Level of congestion and congestion management processes
- Firm generator access v. non-firm
- Generation mix

Studies internationally suggest that capital cost savings from more efficient location may be the most material benefit – but we have few estimates

Evidence from other jurisdictions (NYISO ex-post study)

- NYISO: Published estimated savings of USD 500 million per annum (in 2010$)
- However, it is unclear how the USD 500 million figure was derived and exactly what benefits it covers
  - Likely an **overestimate**

New York ISO
Independent System Operator

Evidence from NERA's electricity market modelling for the NEM

- We estimate benefits of AUD 367 million per annum on average for the NEM (from 2026 to 2040), or AUD 1.7 billion in NPV terms
- In NERA's estimate, this is about 90% higher than benefits from more efficient dispatch (of existing plants)
- Our modelling study relies on long-term capacity planning studies under LMP and zonal pricing

AEMC
AUSTRALIAN ENERGY MARKET COMMISSION

The recent GB study assumes the same capacity levels in all scenarios, therefore does not record capital cost savings

- The study holds overall capacity by technology constant across scenarios (but allows re-siting)
- More efficient siting enables lower prices and increased wind export, but no capital costs savings
- This likely **underestimates** the potential benefits from LMP
  - However, some benefits may arise from non-economical plant available for production in LMP scenario

ofgem

Additional benefits accrue to consumers and/or generators through transfers

Beyond the evidence on benefits to the system from the implementation of LMP, market participants could be affected by distributional impacts depending on the existing and reformed market design

Changes in **wholesale prices**

Average LMP < National Price

↓ Generator Revenues

Generators → Transfer → Consumers

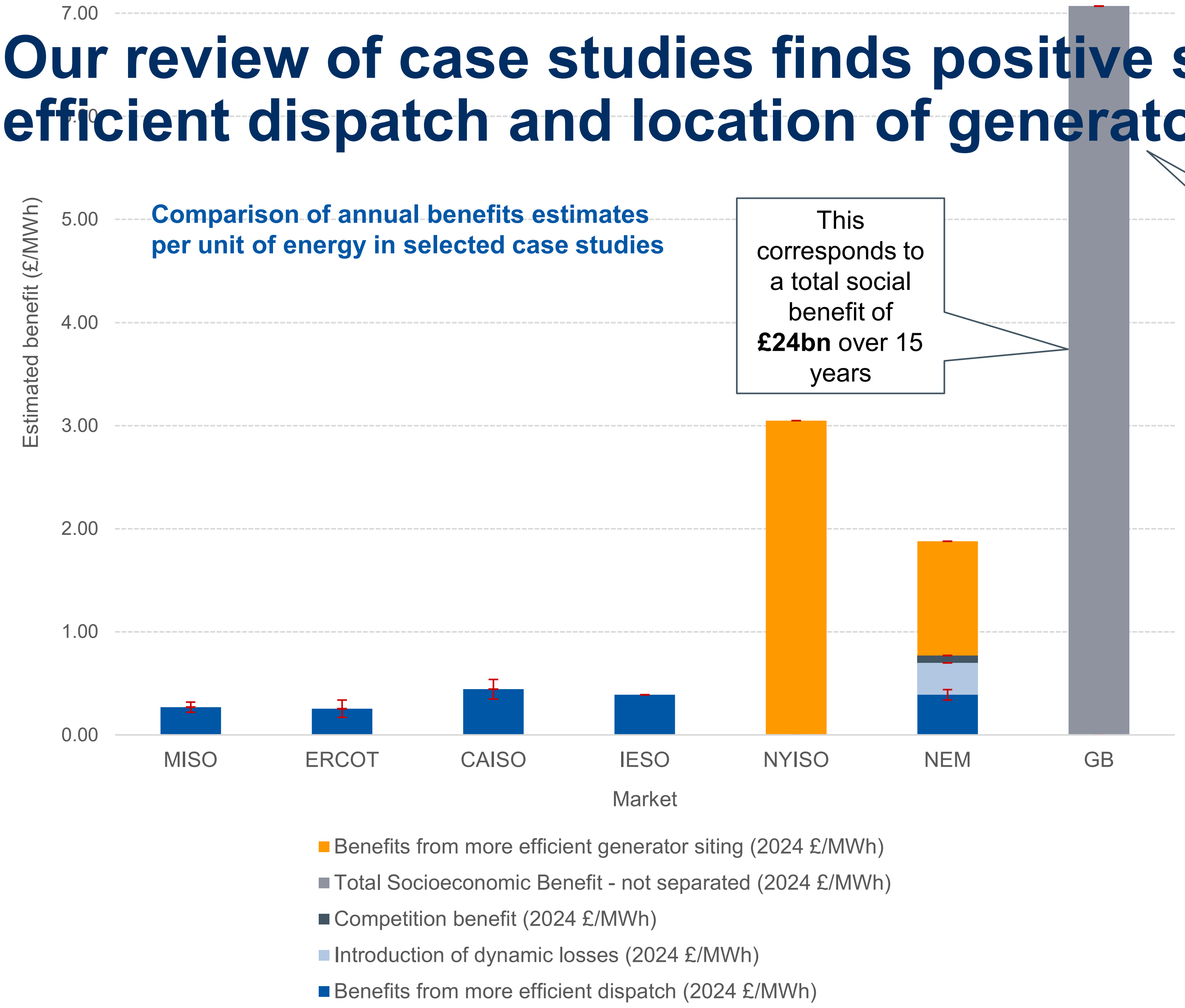
Changes in **Out-Of-Merit (OOM) Payments**

	National Pricing	LMP
Constrained OFF plant	Compensated with OOM DOWN payment	Low LMP, no compensation Generator → Transfer → Consumer
Constrained ON plant	OOM UP payment to generate	High LMP Generator ← Transfer ← Consumer

The evidence on the GB study suggests high transfers to customers in the base case (£51bn total customer benefits v. £24 bn society benefits)

Our review of case studies finds positive social benefits from efficient dispatch and location of generators and storage

Comparison of annual benefits estimates per unit of energy in selected case studies



This corresponds to a total social benefit of **£24bn** over 15 years

What drives the high social (and consumer) benefits estimates for GB?

Key assumptions:

- The status quo is **national**
- The **base case assumptions** are conducive to high benefits (great electrification vs. slow transmission development)

Conclusions

There is potential for LMP to bring benefits to consumers and society in GB, although current benefits estimates may be overly generous

There are several influences that may explain the high estimate for GB relative to other jurisdiction…

- Our comparison controls for inflation, currency and market size, but the size of the benefits depends on the arrangements in place in each market and the assumptions in each study

↑ Consumer LMP

↑ Status quo with *national* price

↑ Preferred scenario maximises benefits

↑ High *consumer* benefits because of current arrangements

↓ No capital cost savings

↓ No disorderly bidding incentives in status quo

… However, all jurisdictions surveyed show clear evidence of net benefits

- GB arrangements in particular present the opportunity for high *consumer* benefits
- There is a case for LMP in GB, although we currently do not have all information to verify estimates

Additional Materials

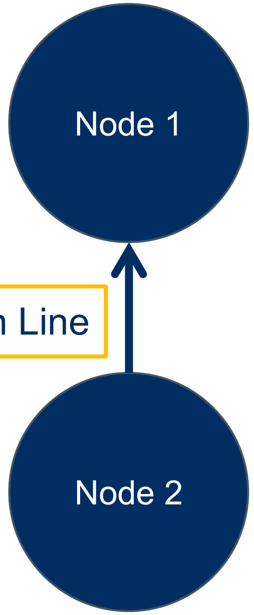
An illustration of dispatch under LMP: consider a simple two-node system

In the absence of congestion, the price of power is the same across nodes because of the uncongested transmission line, and is set by the solar plant

Load: 100 MWh

Price: 0 $/MWh

Generation	Capacity (MW)	SRMC ($/MWh)
Solar #1	70/80	0
Gas #1	0/50	10
Gas #2	0/50	10



30/100 MW Transmission Line

Generation	Capacity (MW)	SRMC ($/MWh)
Solar #2	50/50	0

Load: 20 MWh

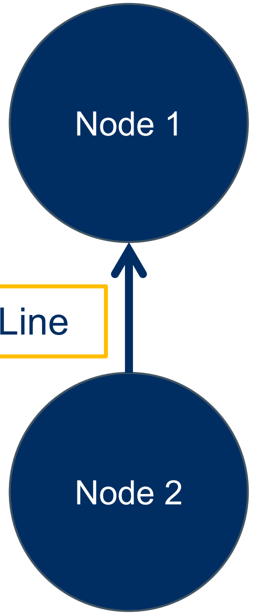
Price: 0 $/MWh

If instead the transmission line has a lower capacity, the price of power differs across nodes due to congestion. At Node 1, the price is set by the gas plant; at Node 2, by solar

Load: 100 MWh

Price: 10 $/MWh

Generation	Capacity (MW)	SRMC ($/MWh)
Solar #1	80/80	0
Gas #1	5/50	10
Gas #2	5/50	10



10/10 MW Transmission Line

Generation	Capacity (MW)	SRMC ($/MWh)
Solar #2	30/50	0

Load: 20 MWh

Price: 0 $/MWh

Case study overview: Regulators and policy makers have introduced LMP since the 1990s

	NYISO	MISO	SPP	ERCOT	CAISO	IESO	NEM	GB
Generator LMP?	✓	✓	✓	✓	✓	✓	✓	✓
Consumer LMP?	✗	✗	✗	✗	✗	✗	✗	✓
LMP Year	1999	2005	2007	2010	2009	2023	TBD	TBD
Motivation	Move to comp. market	Move to comp. market	Move to comp. market	High intra-zonal congestion	High intra-zonal congestion and strategic bidding	High intra-zonal congestion	High intra-zonal congestion and strategic bidding	Address congestion/energy transition
Annual Load in TWh	147 (1999)	595 (2006)	210 (2007)	319 (2010)	207 (2009)	143 (2021)	196 (2018/9)	286 (2022)
Benefits from more efficient dispatch	✗	✓	✓	✓	✓	✓	✓	✓
Benefits from efficient generator siting	✓	✗	✗	✓	✗	✗	✓	✓
Capital cost savings from more efficient siting	✓	✗	✗	✗	✗	✗	✓	✗

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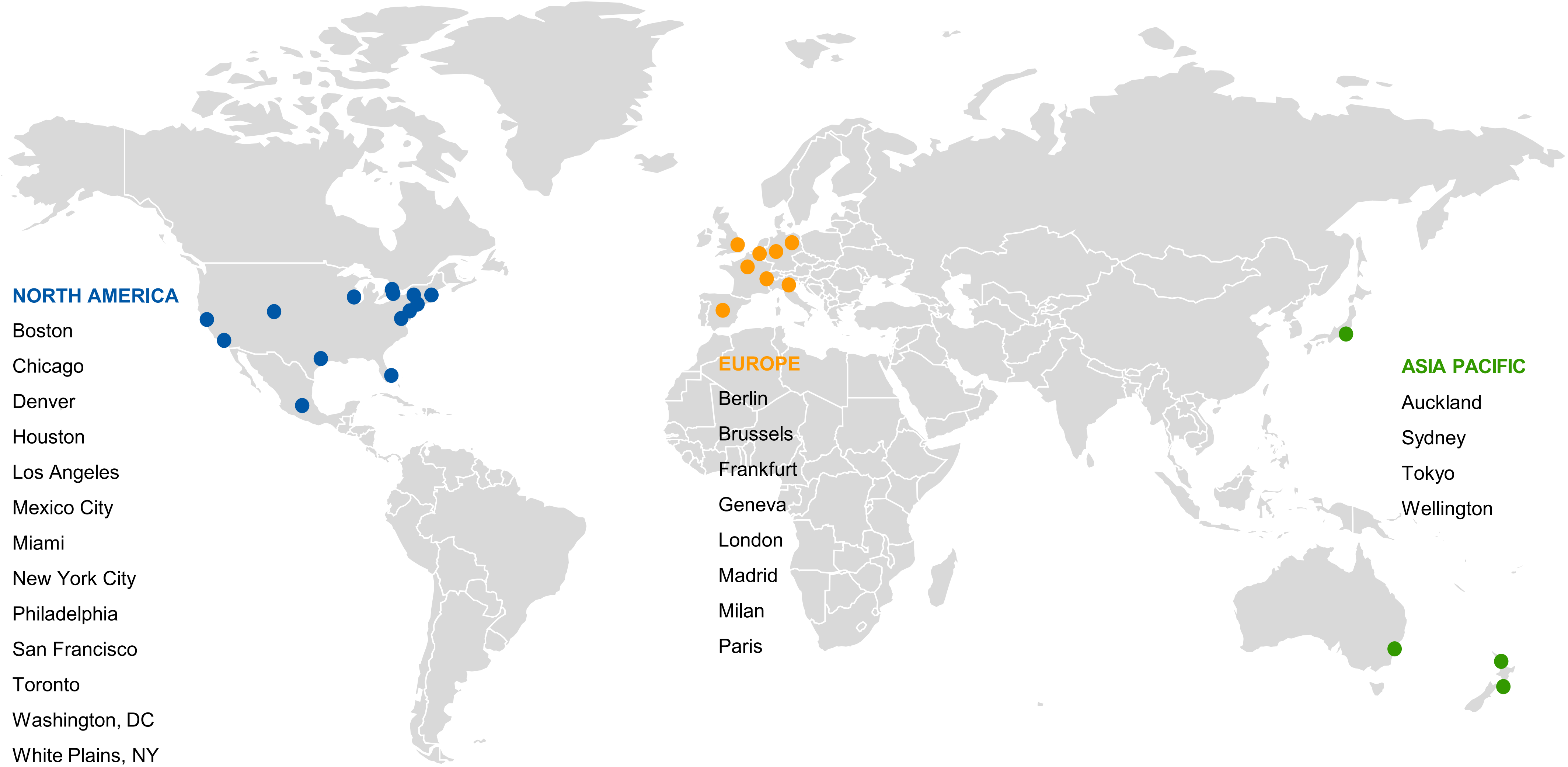

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