Facilitating the UK Energy Transition

In six conceptual diagrams

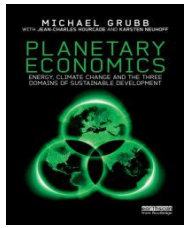
Michael Grubb
Prof. International Energy and Climate Change Policy, UCL

Editor-in-Chief, *Climate Policy* journal

British Institute of Energy Economics 2016 (BIEE) Conference
Innovation and Disruption: the energy sector in transition
Oxford, 21-22nd September

Session on Facilitating the Energy Transition

- The broad economic concepts
- UK electricity transition – key data, key challenges
- Elements of a strategy

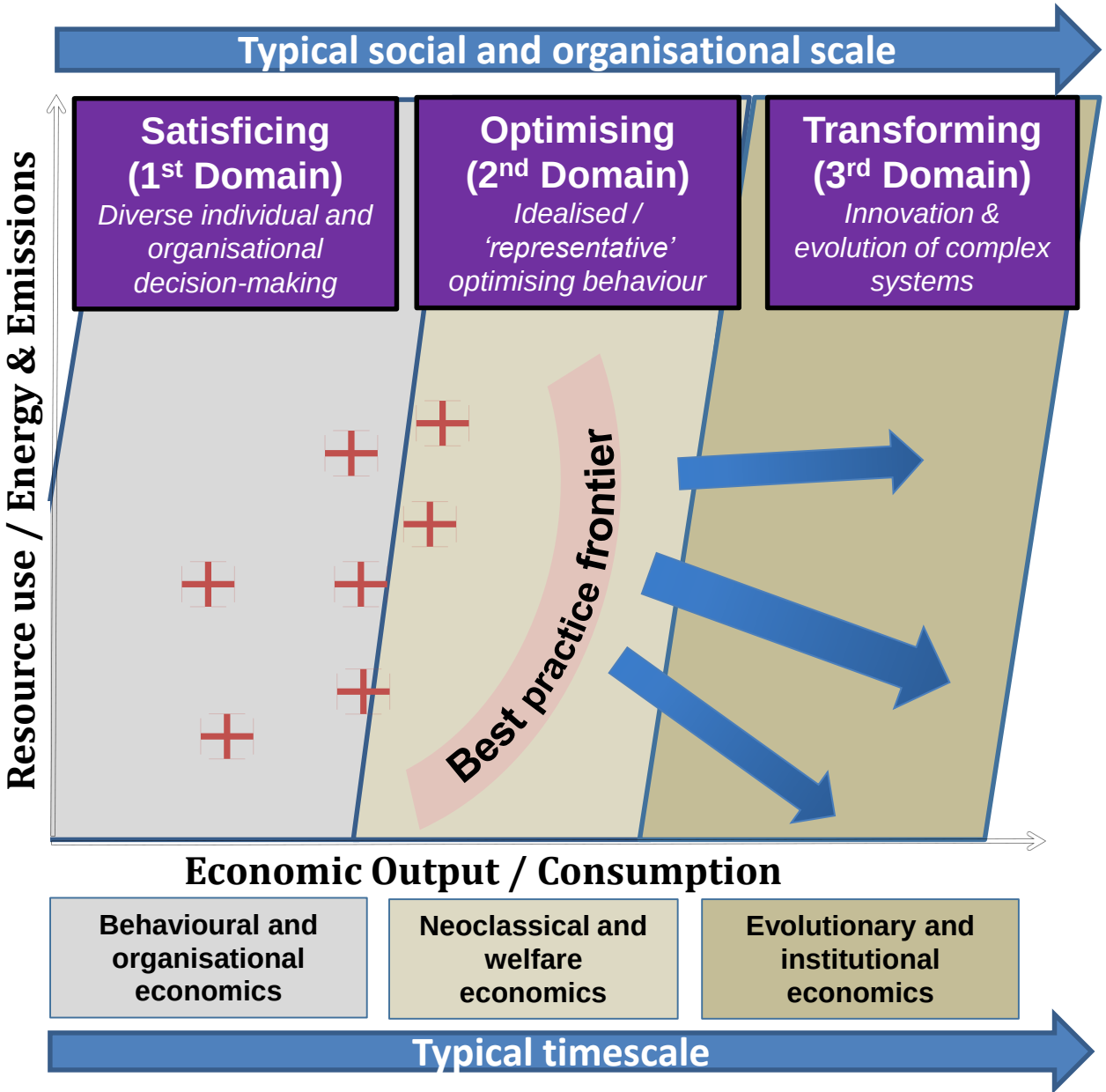


Broadening economic horizons

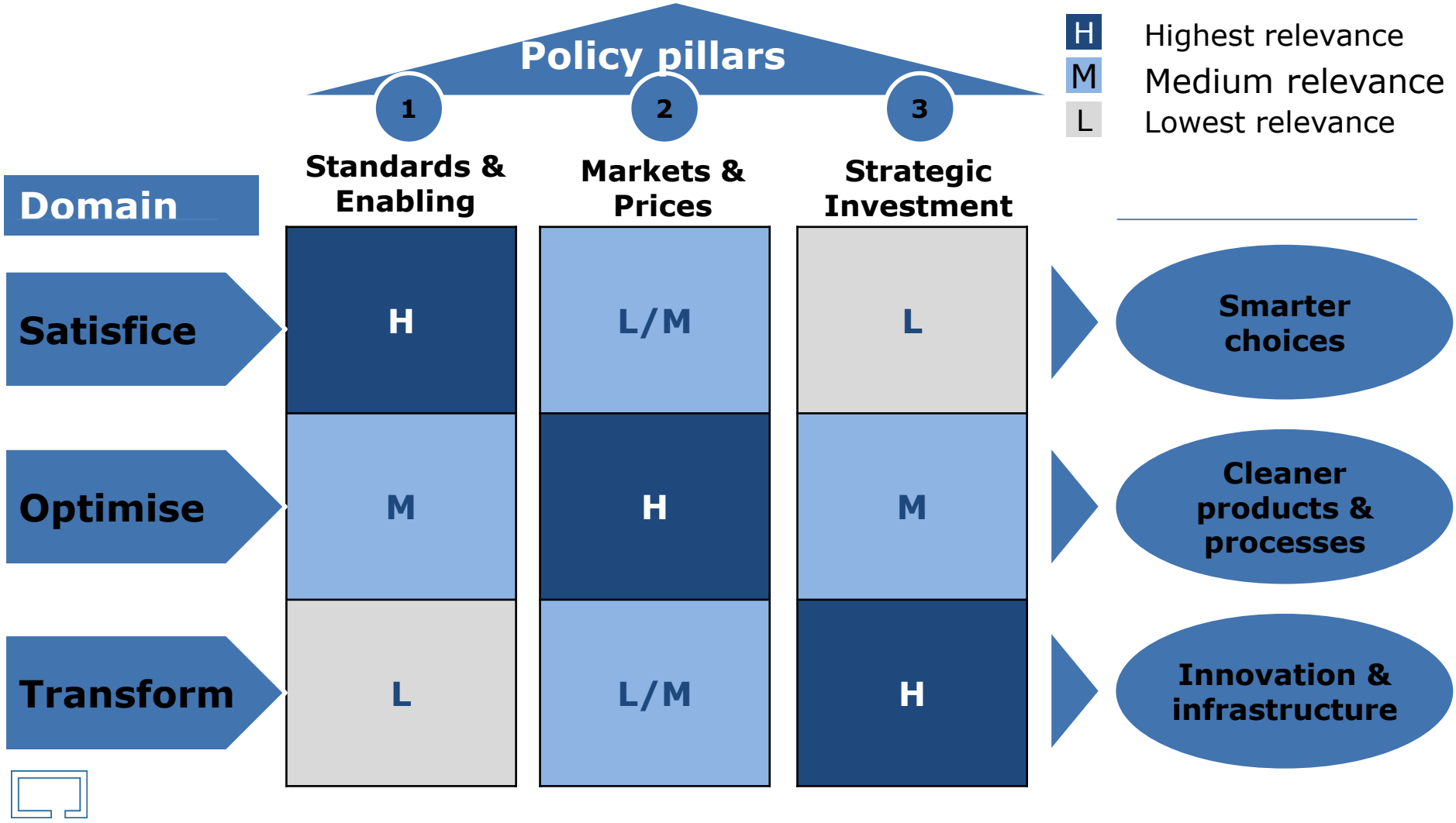
For a problem which spans from

- the inattentive decision-making of seven billion energy consumers, to
- long-term transformation of vast and complex infrastructure-based techno-economic systems

To date, far more progress on energy efficiency and technology / renewables etc policy than carbon pricing



Ideal policy comprises a package which matches the best instrument to the respective domain of decision-making



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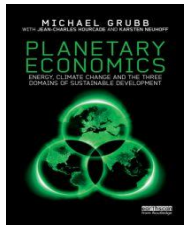
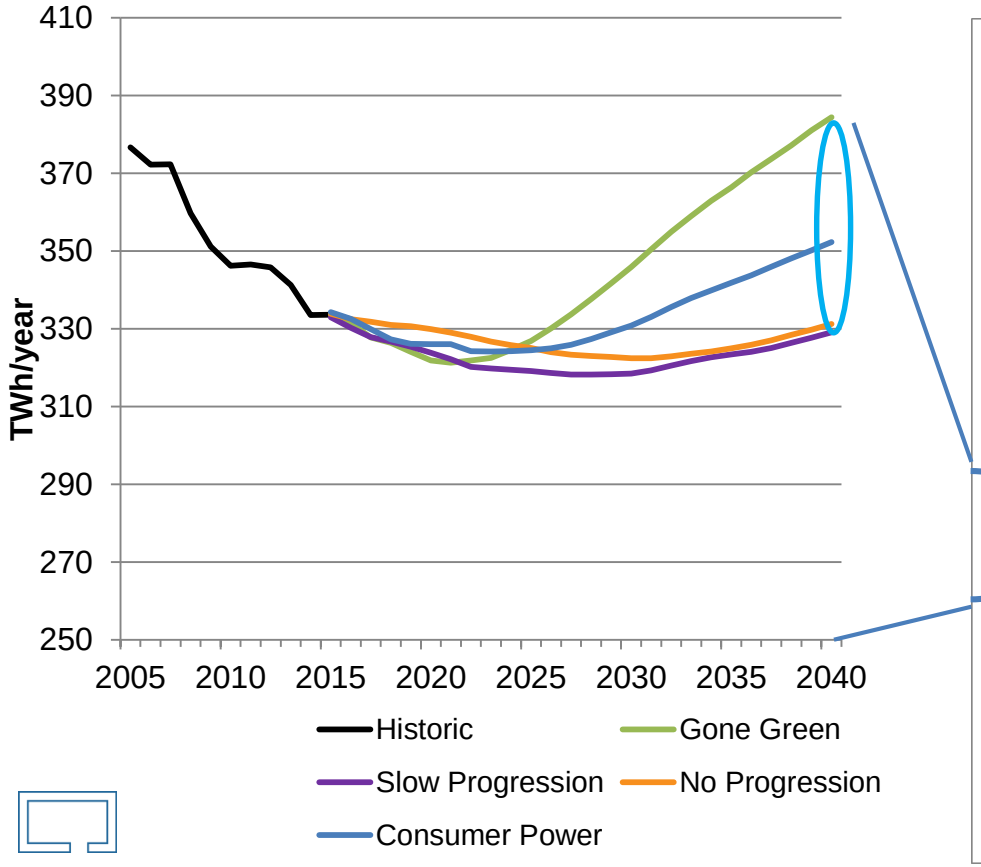


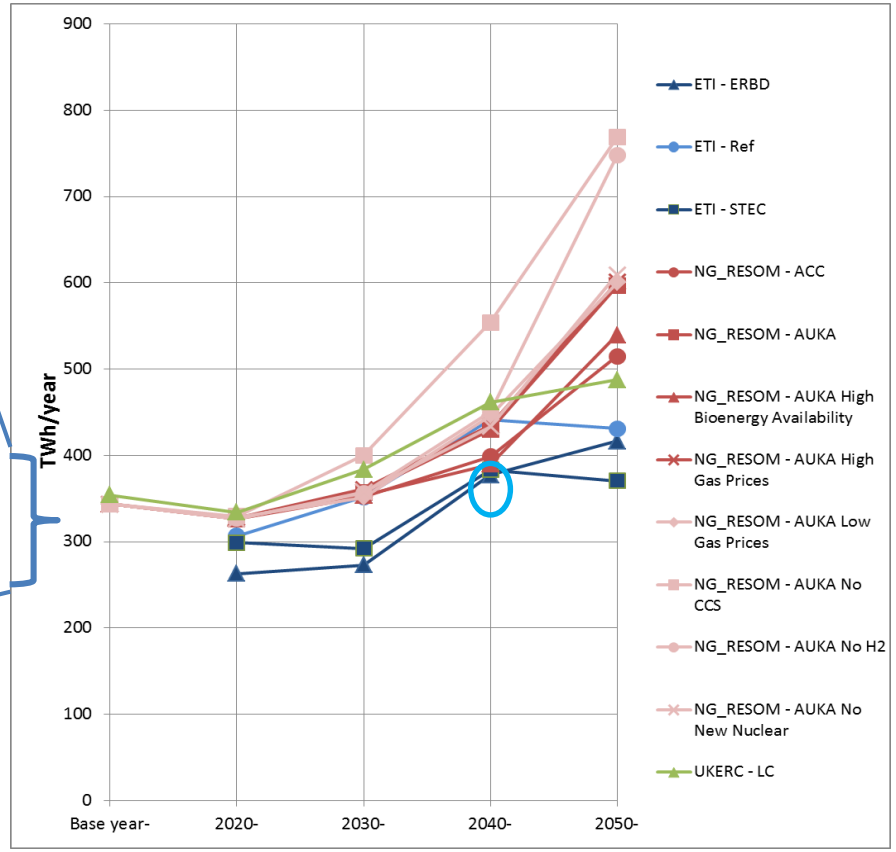
Future GB electricity demand ..

- National Grid's Future Energy Scenarios (FES 2016) show flat/declining demand to 2025 (only +/- 2% !), followed by rapid divergence driven by elec vehicles/heat
- A wide review of low carbon scenarios: demand ranges from c. present to double? by 2050

GB electricity demand in FES 2016 scenarios

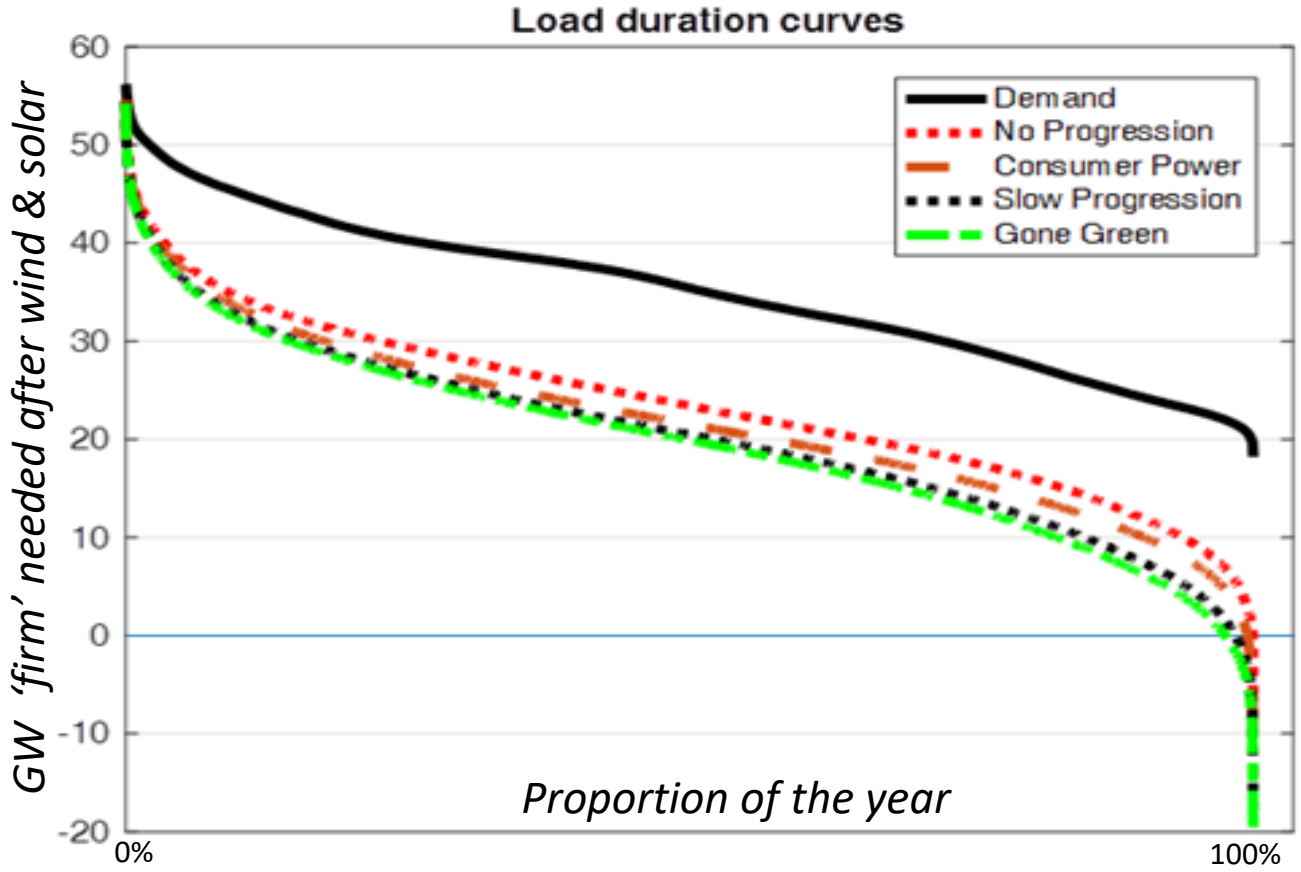


Elec demand in Ofgem review of Low Carbon Scenarios (2014)



By 2030 (except for 'No progression' scenario):

- Growing periods when wind and solar meet all projected demand
- The capacity of 'firm' inputs (like gas, nuclear, biomass, interconnectors, storage etc) required to operate more than half the year is reduced to 20GW overall



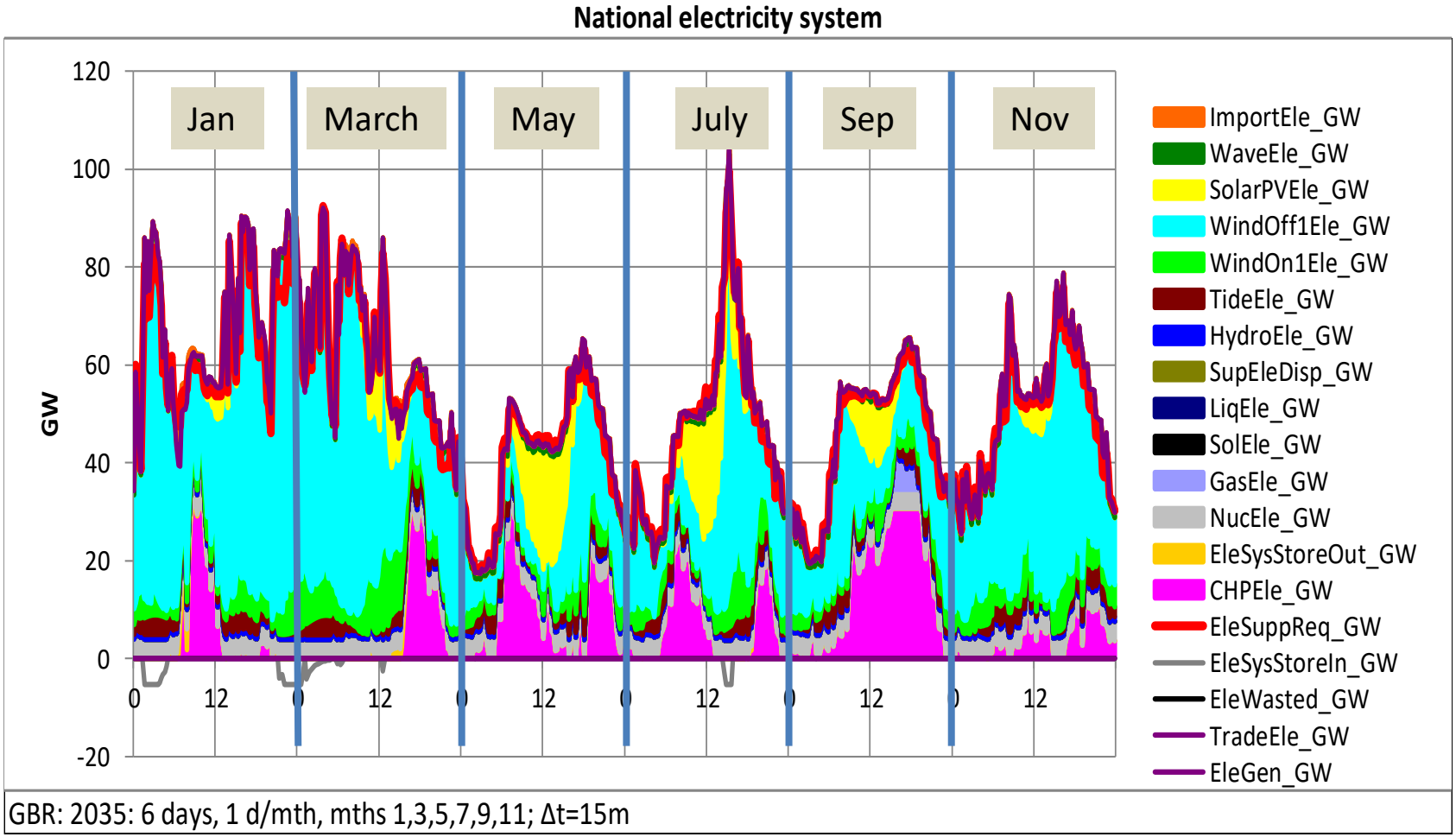
A.Smith and M.Grubb (2016), 'Hinkley Point C and other third-generation nuclear in the context of the UK's future energy system', UCL Energy Institute (Centre for Energy Epidemiology), 15/9/2016
https://www.bartlett.ucl.ac.uk/energy/latest/new_publications/publications-2016/Hinkley-briefing-note.pdf

CfDs an effective transitional instrument, *but very long-lived CfDs in elec markets would wreck rational system operation*

- each trading party offers price per MWh to curtail their output
- National Grid buy these contracts if and as needed, starting with the lowest price first
- if there is surplus from CfD (or ROC) generators, the one with the lowest CfD would bid the least for compensation ..
- So **market will keep the most expensive plant running, and curtail the cheapest:**
- *The precise inverse of economically rational merit order*
- *Eg. by 2030, Hinkley Point operation would force subsequent cheaper nuclear, wind etc off the system right out to 2060*
- *For the big, risky / innovative and very long term investments, have to get away from CfDs – either:*
  - *Long term contracts – trading **contracts** between buyers on basis of average output, not output-metered power; or*
  - *Direct state funding and underwriting*

Stress testing feasibility of extreme systems

Possible GB system operation in 2035: no coal, low nuc/gas but lots of wind, solar, CHP etc)



Possible, but as wind and solar grow and baseload thermal declines, need for balancing services and rapid response increases hugely: only conceivable if integration with transport and/or heat

Source: From DynEMo model; Prof Mark Barrett

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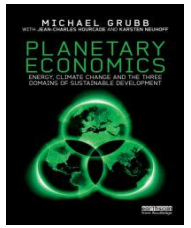
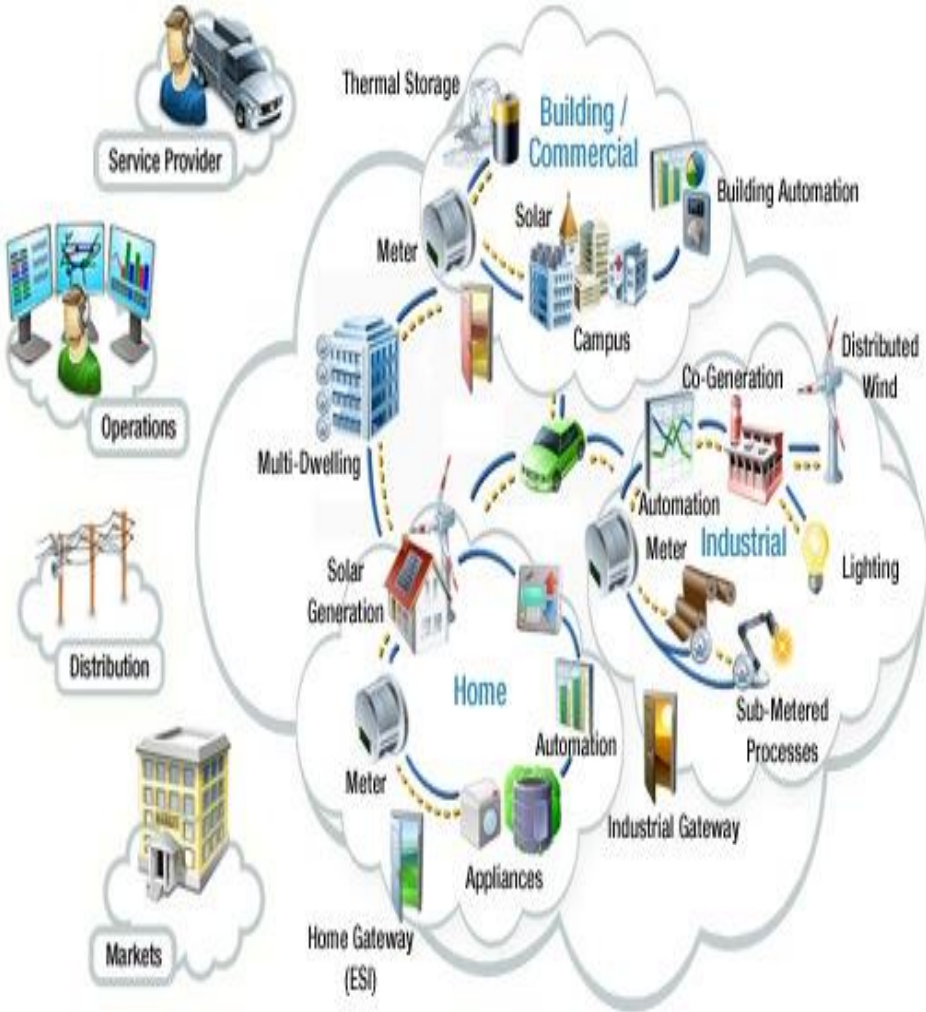


A ‘hollowing out’ electricity system ..

Distributed Service Providers

Combined with

Big generation developments, such as Dogger Bank



TenneT CEO Mel Kroon commented: *'In Germany and more recently in the Netherlands, TenneT has the role of developer and operator of the offshore grid. From this responsibility we have taken the initiative to establish a realistic and achievable plan for further development of the North Sea.The success of the energy transition depends largely on the extent to which we mount a coordinated joint effort in Europe. Cooperation between national governments, regulators, the offshore wind industry, national grid administrators and nature and environmental organisations is a precondition for achieving Europe's environmental targets. The vision we have presented shows the relevance of cooperation in the North Sea.'*

North Sea Infrastructure: the vision

Solar and wind energy will be necessary on a large scale because attainment of Europe's targets for reducing CO_2 emissions depends largely on the production of renewable electricity. Moreover, wind and solar energy are

Source: Prof Jun Dong, North China University of Electric Power

Source: TenneT

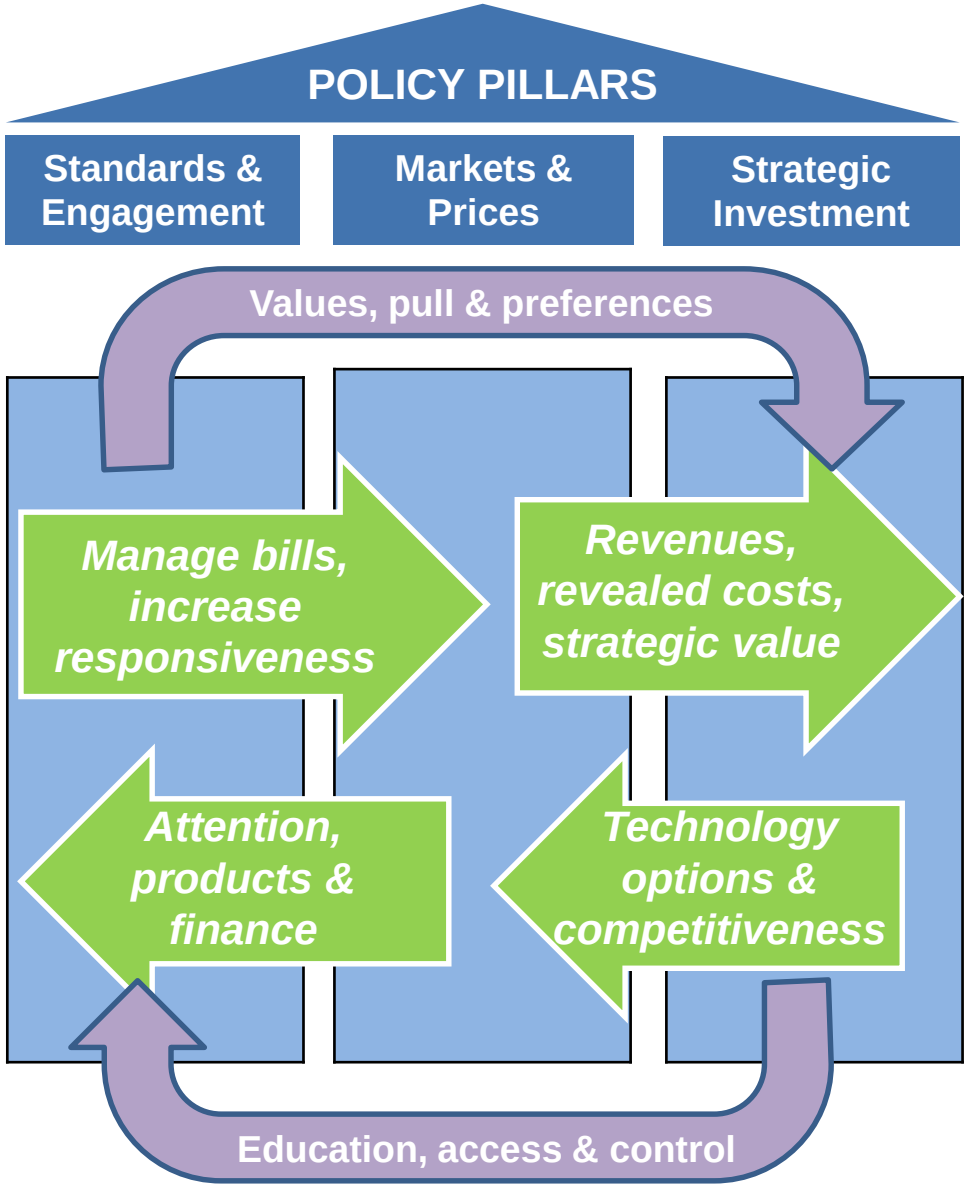
Integrated policies conceptual framework

Need to integrate across all three pillars:

- Enhanced efficiency
- Cleaner products
- Innovation and infrastructure

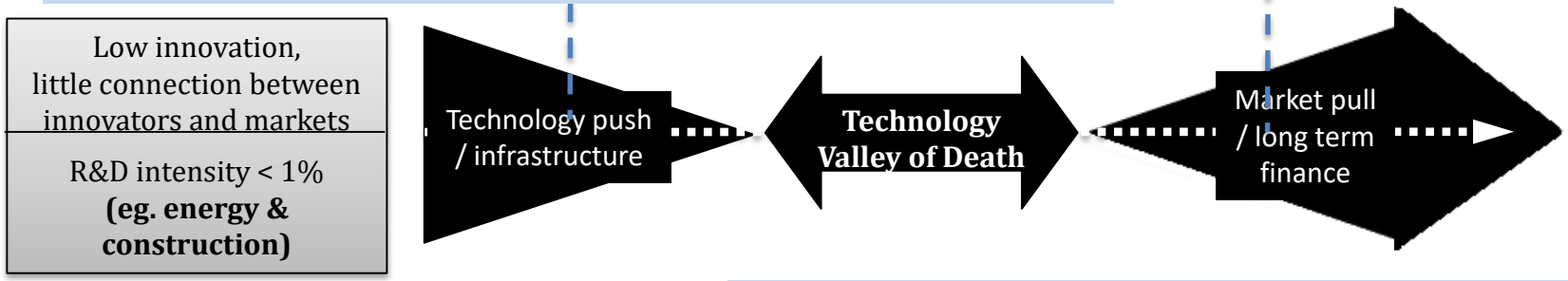
And harness this for *social and industrial strategy*

- Lower resource costs
- Consider carbon pricing including *materials consumption & innovation*
- Accelerate innovation for competitiveness



What is missing to span innovation & strategic investment?

Money ==========➔
(at rising scale)

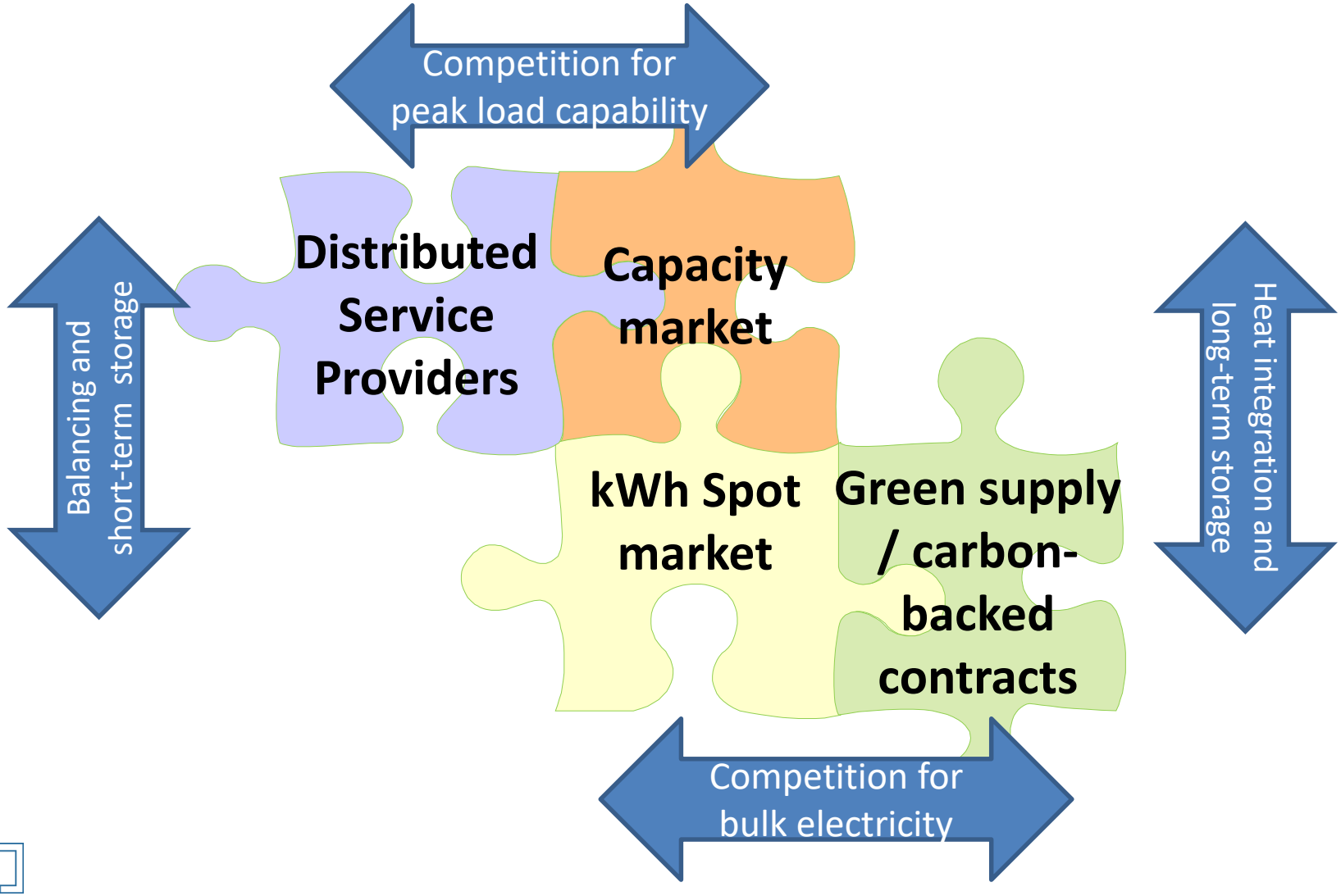


PE Figure 9.7. Innovation intensity & the broken chain

➔ ========== Markets
(credible and strategically growing)

- Carbon pricing *could* make an important contribution to both elements of transition
- Needs to be designed *instrumentally* for these contributions, not as an abstract ideal
- Need integration between public and private, & strategic investment and markets
- Infrastructure important as the technologies expand

To minimise 'state management', the future system could develop competition ***between*** at least four markets



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