



Model linking across scales

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Multi-scale modelling review

Review criteria:

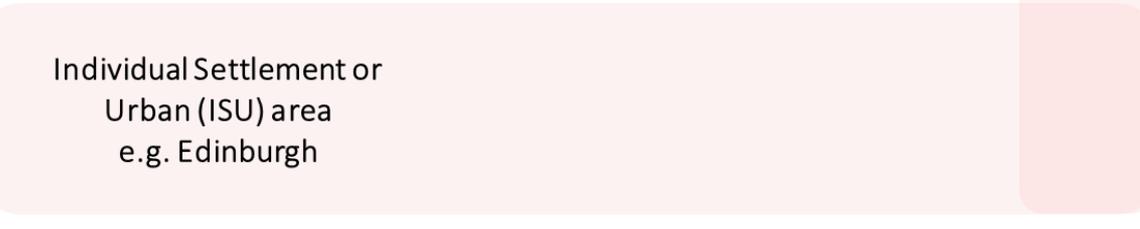
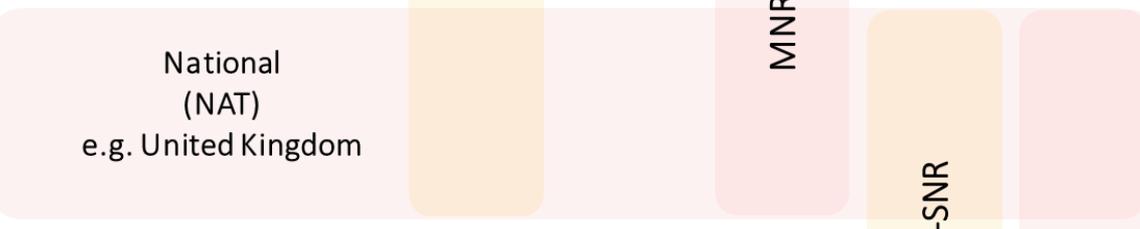
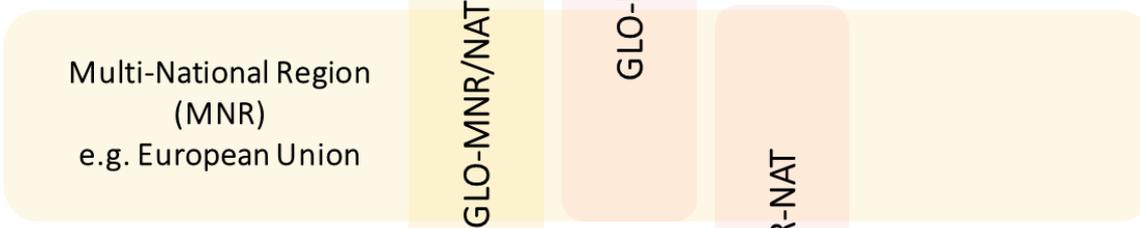
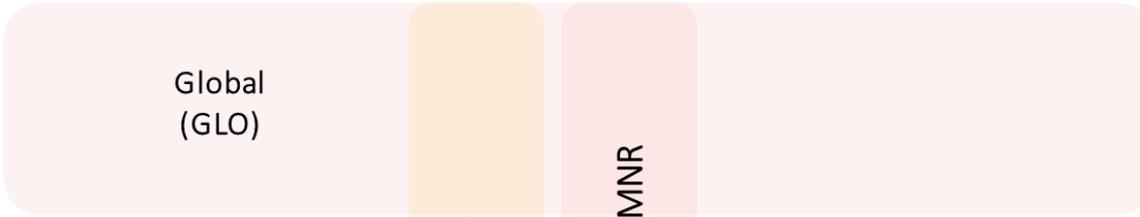
- Peer reviewed
- Includes hard-linking *and* soft-linking across scales
- Multi-scale analysis of real-world regions
- “Whole system” analysis across multiple supply and/or end-use sectors i.e. not single-sector models

Systematic review (1970-Present), yielded:

- 40 models or multi-model studies that fit all criteria
- 15 studies of interest that do not fit all criteria - (e.g. power sector only; urban energy models which in most cases did not cross scales)



Multi-scale modelling review



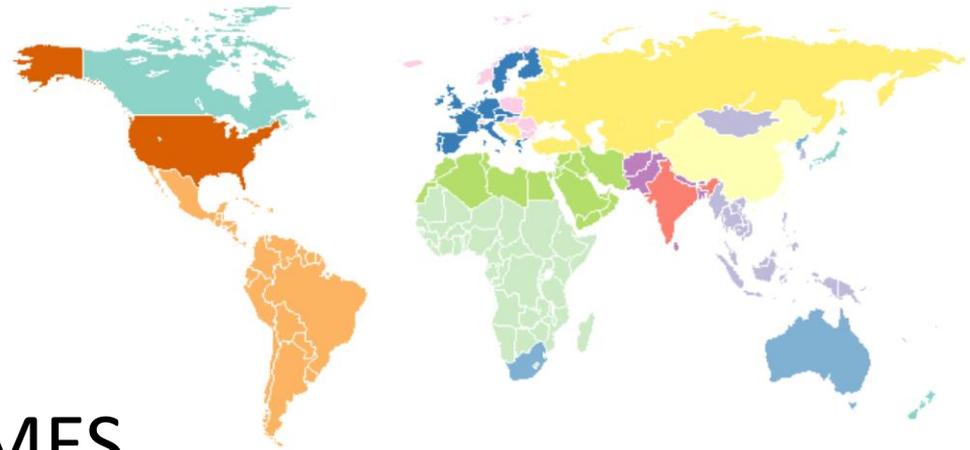
Multiple examples

... only a handful of studies

Very few



Examples



- 2-region MARKAL
- US multi-region TIMES
- JRC-EU-TIMES plus NEPLAN



2-Region MARKAL

- Separate-but-linked ‘Scotland’ and ‘Rest of the UK’ Regions
- Analysis of Scottish targets
- Was developed wholly at UCL – not commissioned by government
- Was presented to Scottish government – but not widely used



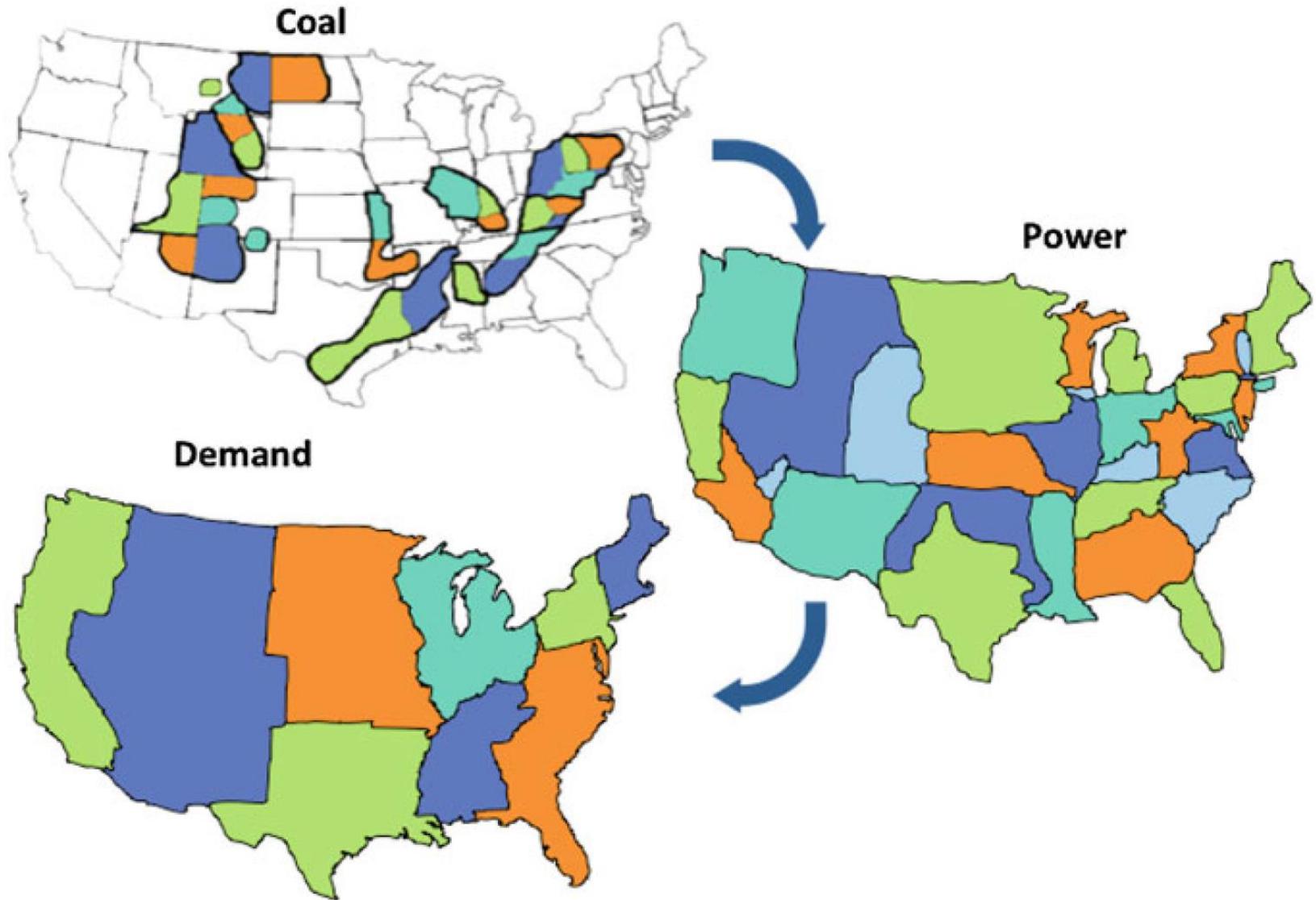
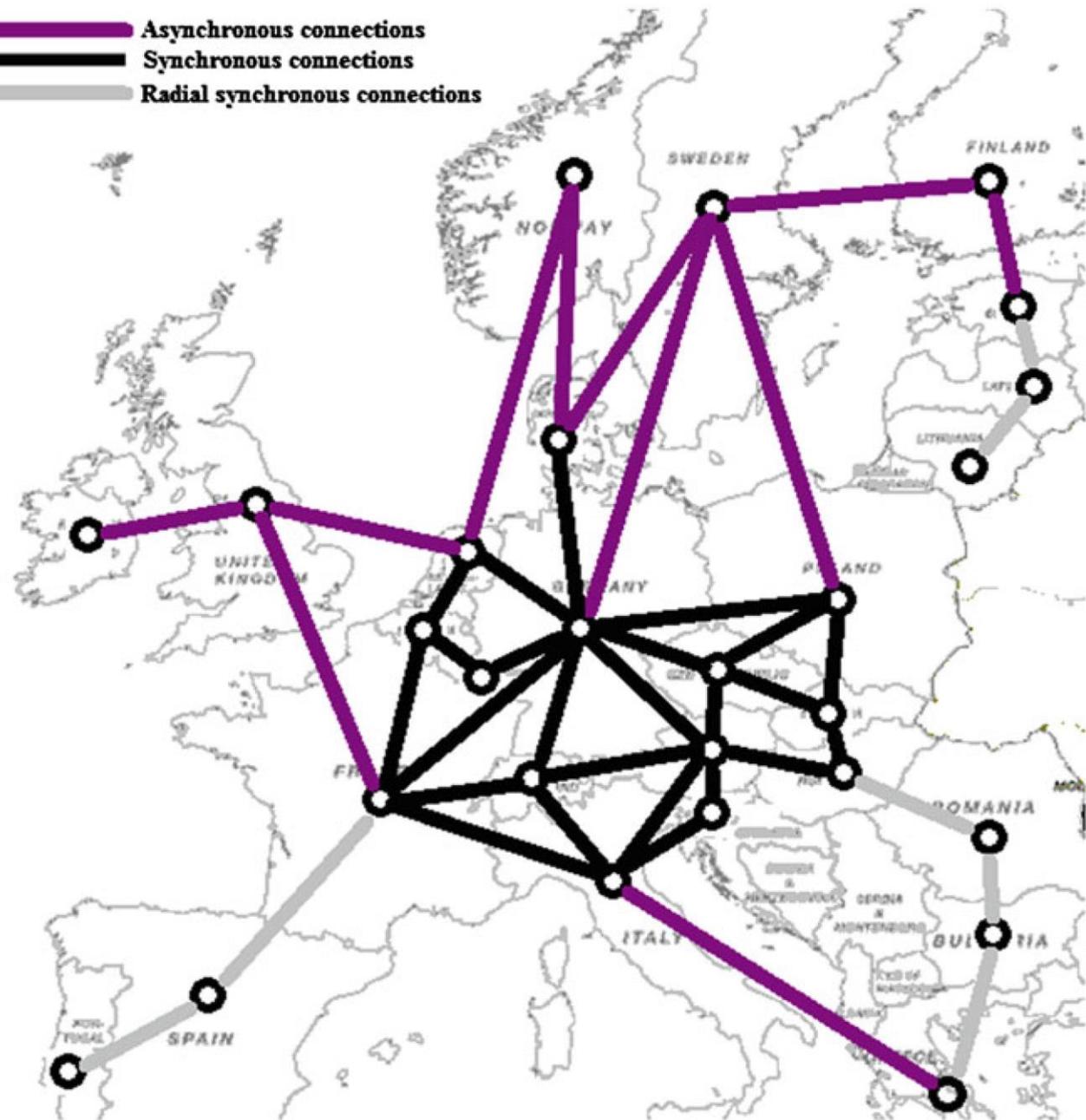


Fig. 1 FACETS coal, power, and demand regions

Asynchronous connections
Synchronous connections
Radial synchronous connections



Nijs et al. 2015 –
linking JRC
European TIMES
with NEPLAN



Fig. 4 Simplified model of European grid at the base year of study

Rationales & Challenges

Capturing more information & feedback in your model (=“better model”?)

- Capturing finer scales: better representing spatially-granular processes (power systems; transport infrastructure)
- Broadening to wider scales: Embedding analysis within consistent boundary conditions: global learning; prices
- Disaggregating/aggregating to match politically-relevant boundaries
 - Capture policy divergence across regions (e.g. EU PRIMES)

Challenges: Not necessarily more helpful for decision-makers at other scales; harder to interpret



Rationales & Challenges

Multi-scale models for shared understanding across scales

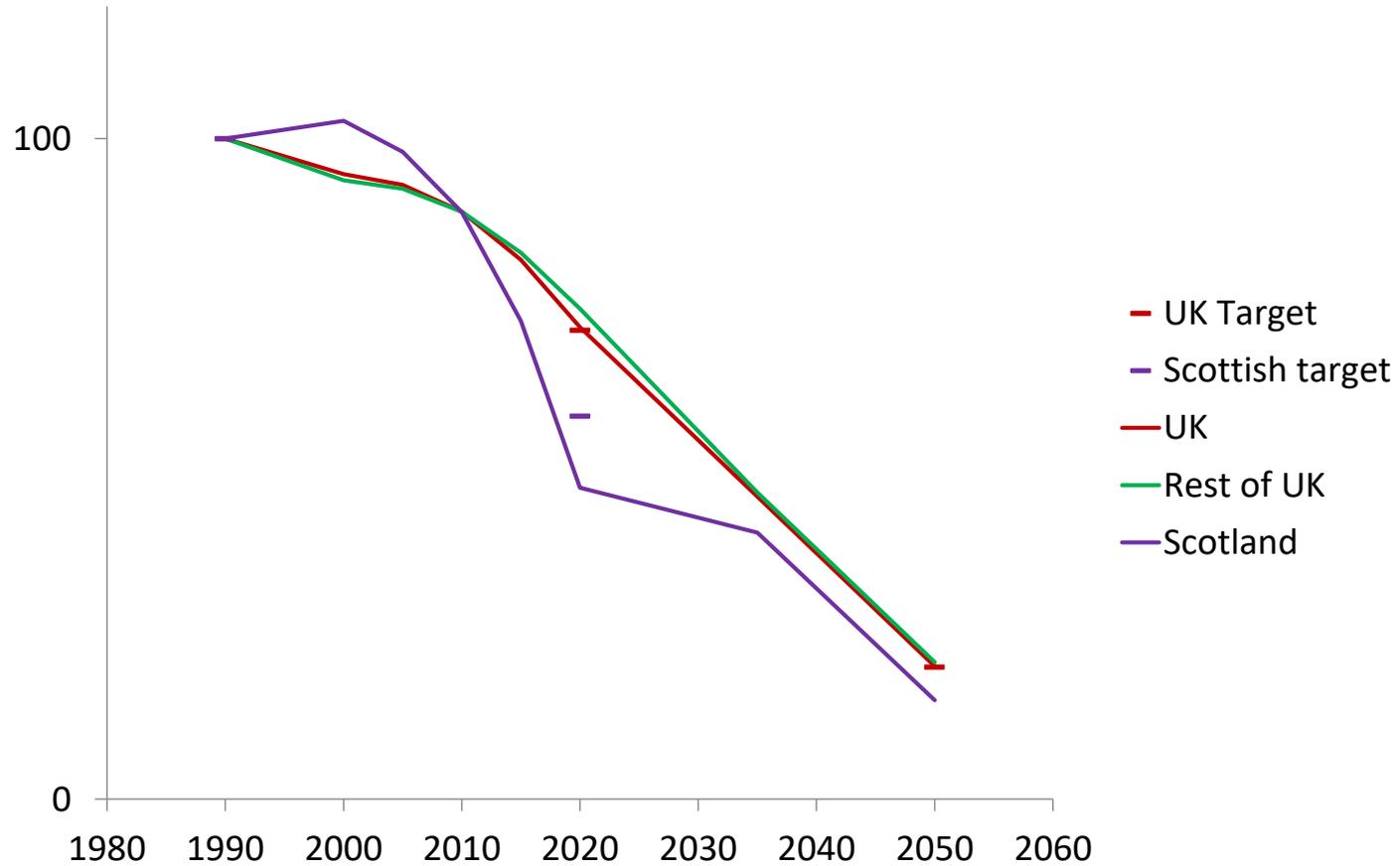
- Analysis that simultaneously serves needs of decision-makers across scales? Consistent, integrated perspective
- (Dis)aggregation to relevant decision-scales
- But major challenges:
 - Different relevant decision-rules (perfect-foresight optimisation vs. predictive simulation)
 - Different goals – decentralised optima, c.f WITCH model?
 - Legitimacy and ownership



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2-Region MARKAL



Anandarajah & McDowall 2012; *Energy Policy*

