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How many cyclists does it take to change a power system?

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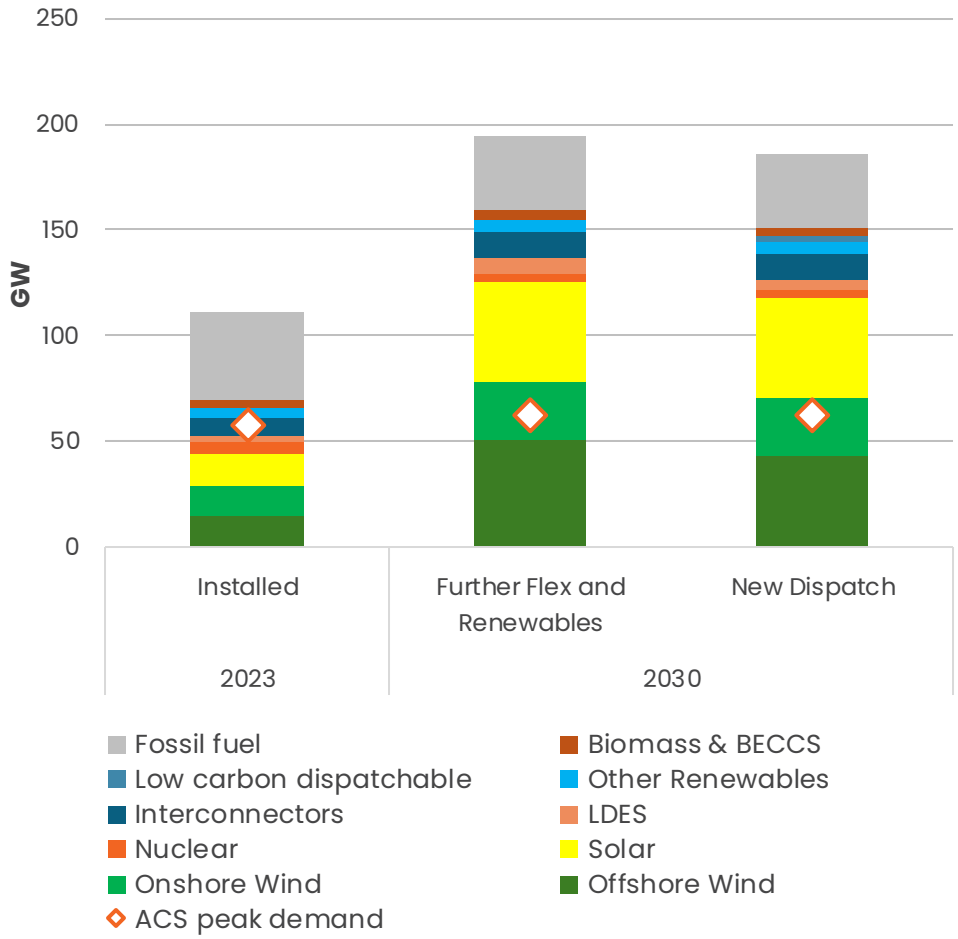
The basic thesis

- Decarbonisation of the future GB energy system is predicated on electrification of (current) fossil fuel demands, and the reduction of the carbon intensity of electricity to/below zero
- The shift of personal transport from liquid fossil fuels to electric vehicles is a key element of Net-Zero
- The future electricity system will be designed to meet:
  - The larger total demand for electricity
  - The peak residual demand under adverse conditions
- Hence any substantial modal shift from EVs to active transport reduces the need for future new electricity generation

=> Does investment in cycling infrastructure represent a net positive from the point of view of the future power system?



Source: NESO: Clean Power 2030 workbook https://www.neso.energy/publications/clean-power-2030

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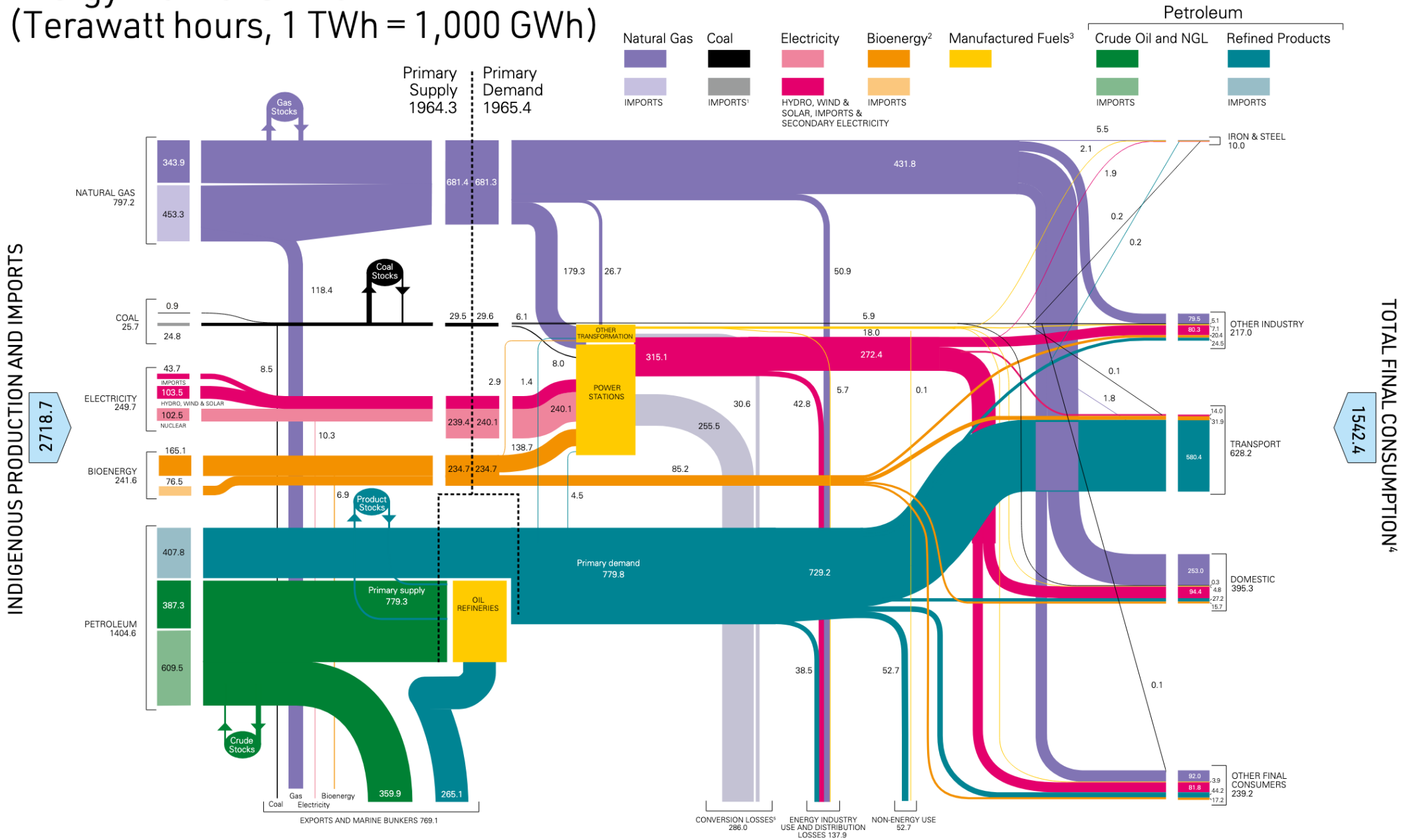
Energy Flow Chart 2024
(Terawatt hours, 1 TWh = 1,000 GWh)



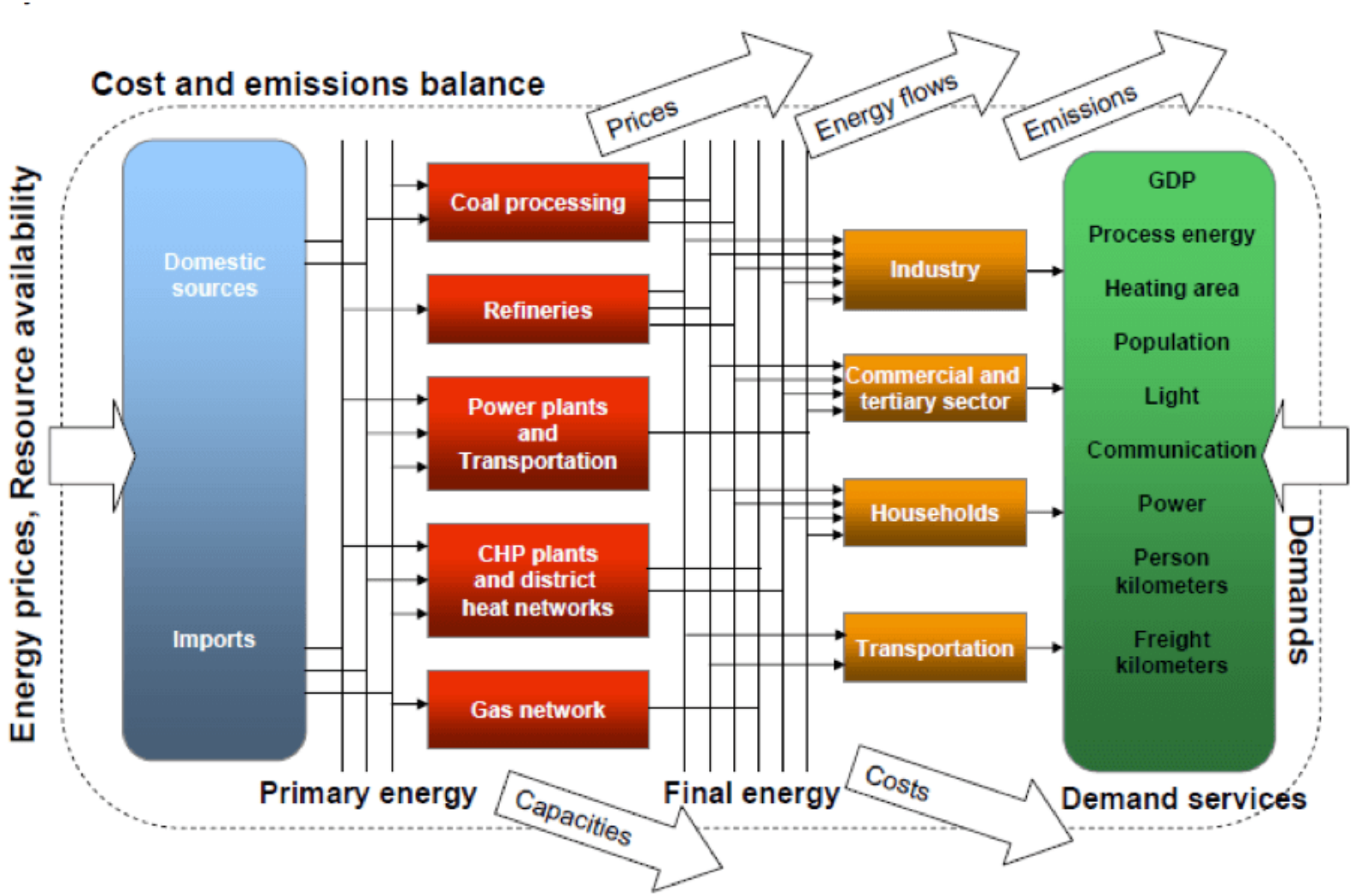
FOOTNOTES:
1. Coal imports, exports and power stations include manufactured fuels.
2. Bioenergy is renewable energy made from material of recent biological origin derived from plant or animal matter.
3. Includes heat sold.
4. Includes non-energy use.
5. Conversion losses from power stations apply to thermal sources (coal, oil, gas, nuclear and bioenergy) only; there are no such losses from non-thermal sources (hydro, wind and solar).

This flowchart has been produced using the style of balance and figures in the 2025 Digest of UK Energy Statistics, Table 1.1. (gross calorific values basis)

Department for Energy Security & Net Zero

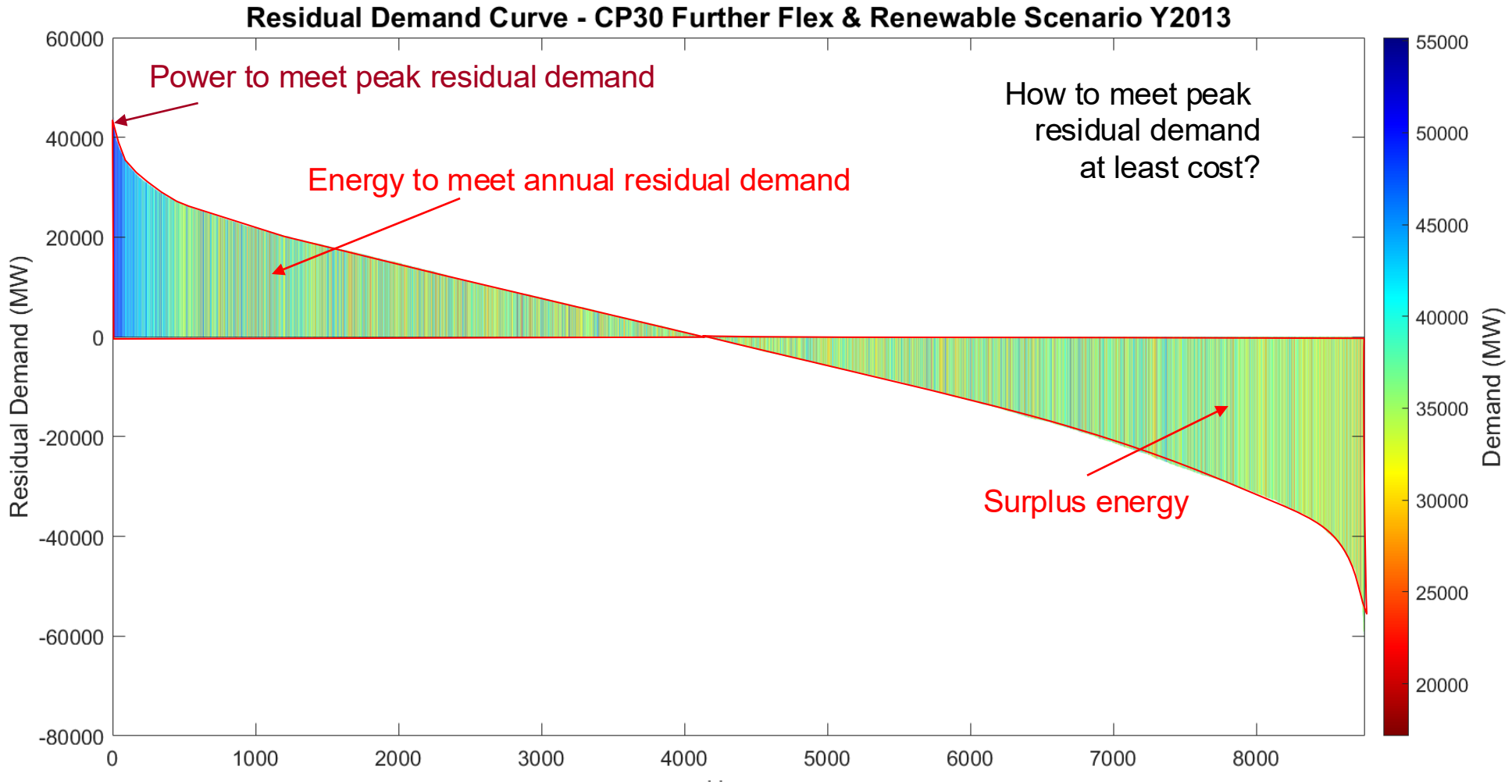
OFFICIAL STATISTICS Accredited

Modelling the future energy system



https://www.climatexchange.org.uk/projects/using-the-times-model-in-developing-energy-policy/

‘Residual demand’ in the 2030 power system



- In each hour residual demand = demand – (wind + solar)
- Does not include electrolysis demand

Analysis by Callum MacIver, University of Strathclyde

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Active Transport as an alternative to traditional generation capacity

- A large part of assumed demand growth is from electrification of transport
  - Energy demand – total amount of energy that must be supplied
  - But also peak power demand – substantial volumes of coincident EV charging

- If we can shift some proportion of transport demand from EVs to active transport
  - Reduction in total energy consumption
  - Reduction in peak demand

- This means potential to reduce the size of future power generation build-out
  - Less energy demand – reduction in bulk energy provision (e.g. nuclear)
  - Lower peak demand - reduction in low-capacity factor peaking plant (e.g. gas)

⇒ If we spent the equivalent of the capital cost of a new power station on active travel infrastructure, would this reduce the need for >1 power station to be built?

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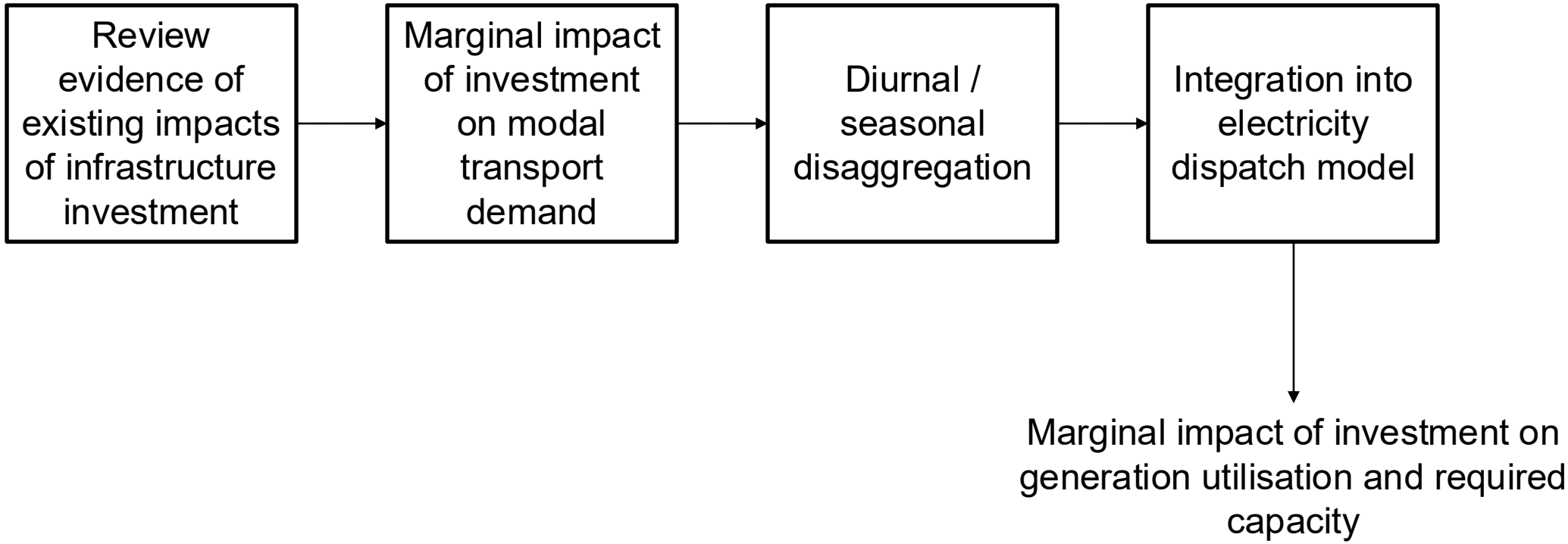
Assessing the potential impact



Example displacement of capacity





Hinkley Point C - two 1,630 MW reactors, commissioning in 2029-2031

Will meet around 8% of energy demand and 3% of peak power demand

Expected final cost to be around £46bn

New Hydrogen CCGT power plant

Potentially £1.5bn - £2.5bn for 1GW plant

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Initial findings

Clear displacement of energy demand

- £1bn of investment in cycling infrastructure removes 5-23TWh/year of electrical energy demand otherwise used to charge EVs
- Investing cost of a 1GW hydrogen CCGT power station would reduce total energy demand by 0.8-2.8 power stations

Less clear case for reduction in required capacity

- Peak cold spell demand remains key driver – seasonal benefit not clear
- Already potentially ameliorated by smart charging with EVs

=> A strong case to be made for better inclusion of active transport interventions in carbon budgeting



Further issues

- Locational issues – network constraints / opportunities
  - Urban vs rural differential
  - Depth of opportunity
- Not only about generation capacity
  - other forms of flexible demand / smart charging
  - interconnection
- Seasonal disaggregation is not clear
  - relationship to cold spell peak demand is key
  - system design for resiliency
- Latent transport demand and relationship to fuel poverty
  - Other co-benefits
- Difficulty of translating to policy
  - Public vs private investment
  - How to inform/improve existing modelling

=> I'm just an engineer – would love to talk to social scientists to further understand how to improve and refine this argument beyond techno-economics!