The ITRC approach to forecasting the future demand for infrastructure

ITRC conference: The future of national infrastructure systems and economic prosperity

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ITRC Aim *and* Ambition

***Aim*:** To develop and demonstrate a new generation of simulation models and tools to inform the analysis, planning and design of national infrastructure

***Ambition*:** Enabling a revolution in the strategic analysis of NI provision in the UK…

…whilst at the same time becoming an international landmark programme recognised for novelty, research excellence and impact

Key research questions

How can infrastructure capacity and demand be balanced in an uncertain future? Model future demand for infrastructure services recognising the interdependencies that exist between sectors in the economy.

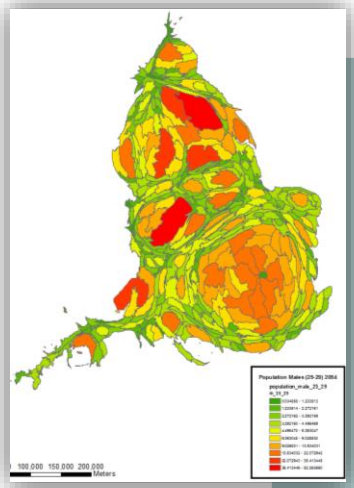
What are the risks of infrastructure failure and how can we adapt National Infrastructure to make it more resilient?

How do infrastructure systems evolve and adapt?

Objectives of Cambridge input into Work Stream 1

- How can infrastructure capacity and demand be balanced in an uncertain future?
- A simulation framework that embeds a number of models for the analysis of long-term strategies for infrastructure provision
  - A regional multisectoral economic model
  - Uses inputs from a demographic model (Leeds University)
  - Enables individual capacity/demand assessment modules (CDAMs)

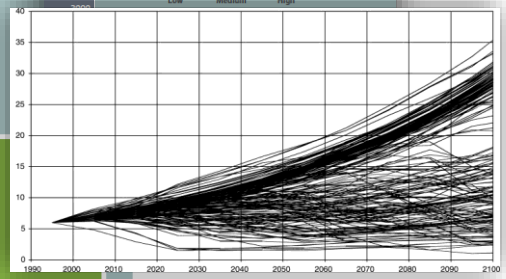
Progress: systems modelling framework



High resolution demographic projections

Regional multi-sectoral economic model

National infrastructure database and analysis archive

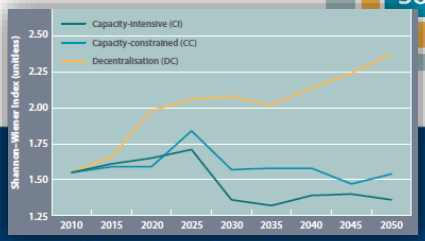


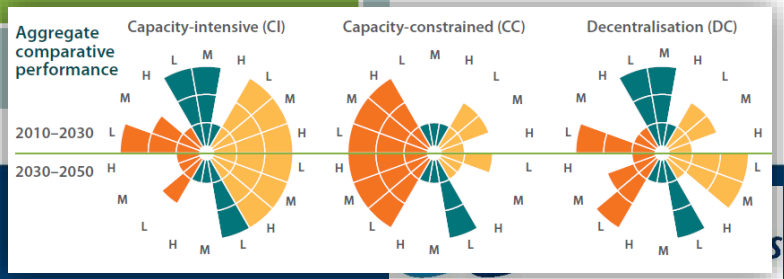
Capacity/Demand Assessment Module (CDAM) for each NI sector

- Energy
- Transport
- Water & wastewater
- Solid waste

Module for:

1 Sampling scenarios & uncertainties
2 Specifying options & strategies for infrastructure provisions
3 Specifying CDAM model runs
4 Post-processing & visualising results



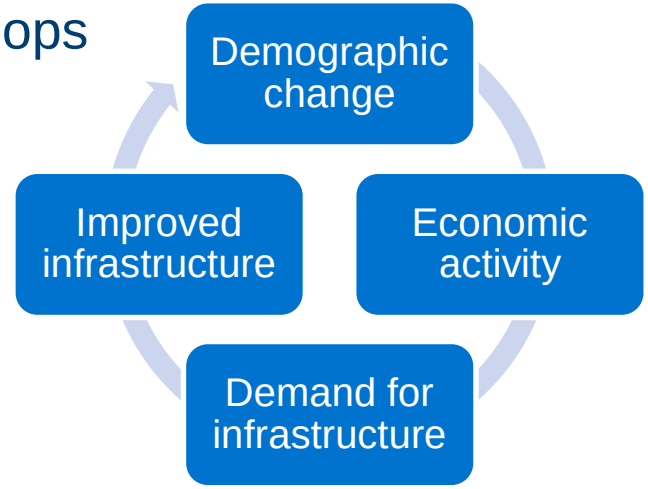


Forecasting the future demand for infrastructure

- Key challenges to forecasting
- Drivers of infrastructure service demand
- ITRC approach to forecasting
- Conclusions

Key challenges to forecasting

- Need to couple demographic, economic and infrastructure models but considerable problems of concept and measurement in all three models
- Powerful feed-back loops



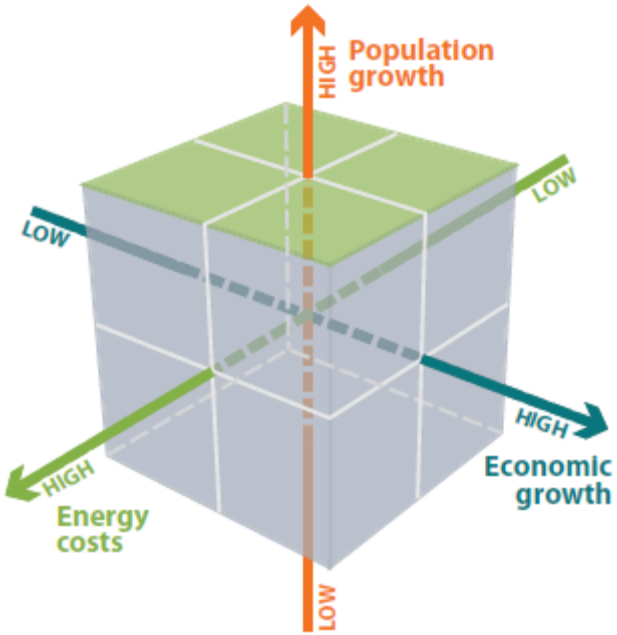
- Forecasting needed at different spatial scales but serious data limitations

Key drivers of infrastructure service demand

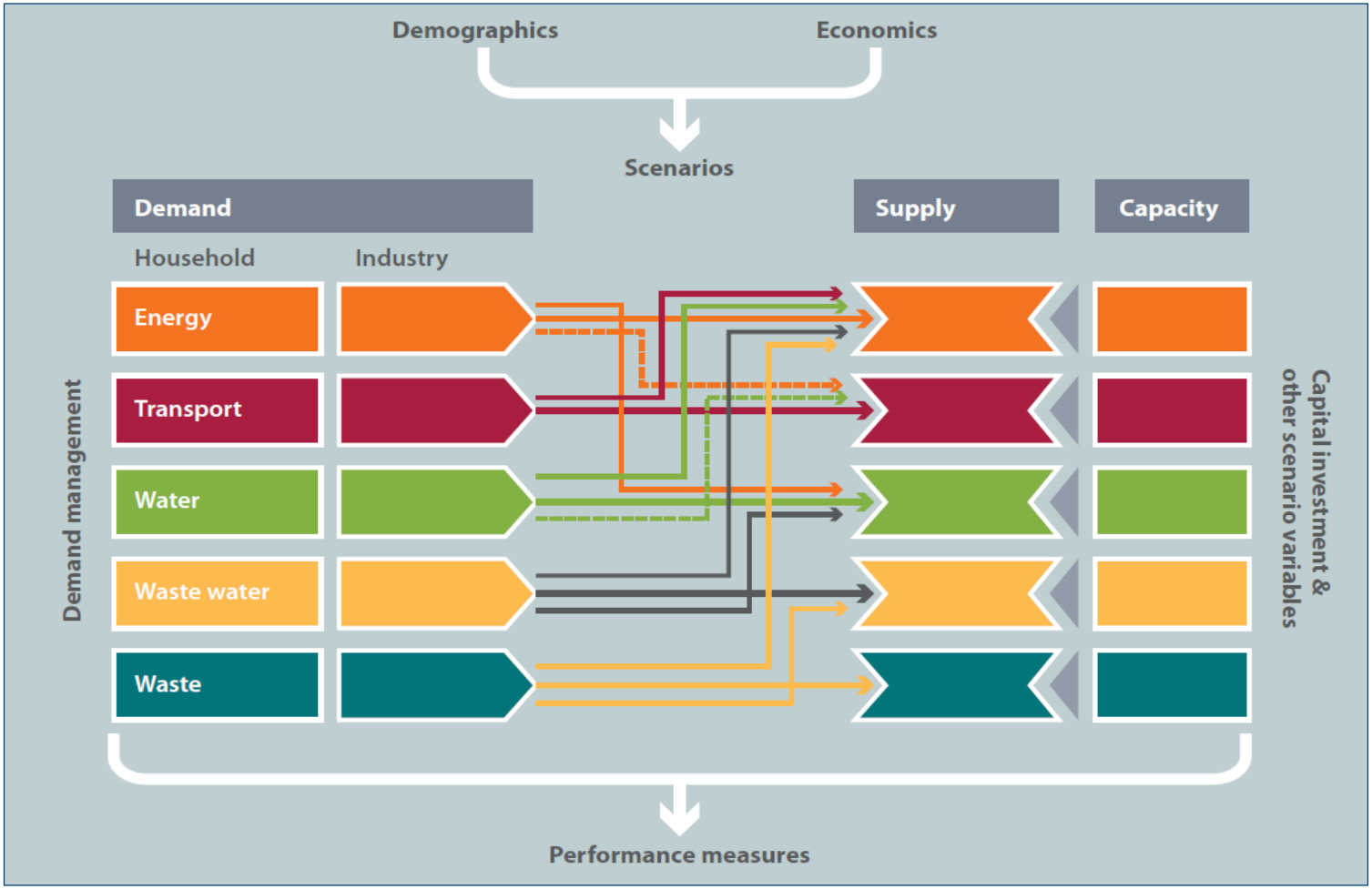
- Infrastructure assets are long lived - decisions today must consider expected future trends; nature of these long-term trends is uncertain and hard to predict
- Infrastructure service demand is driven by long-term global changes in population, the economy, society and the environment
- Demographic trends
  - urbanisation
  - aging population
- Patterns of spatial and sectoral economic activity driven by
  - technology
  - trade and specialisation
- Don’t forget the powerful feed-back loops

ITRC approach: scenario analysis

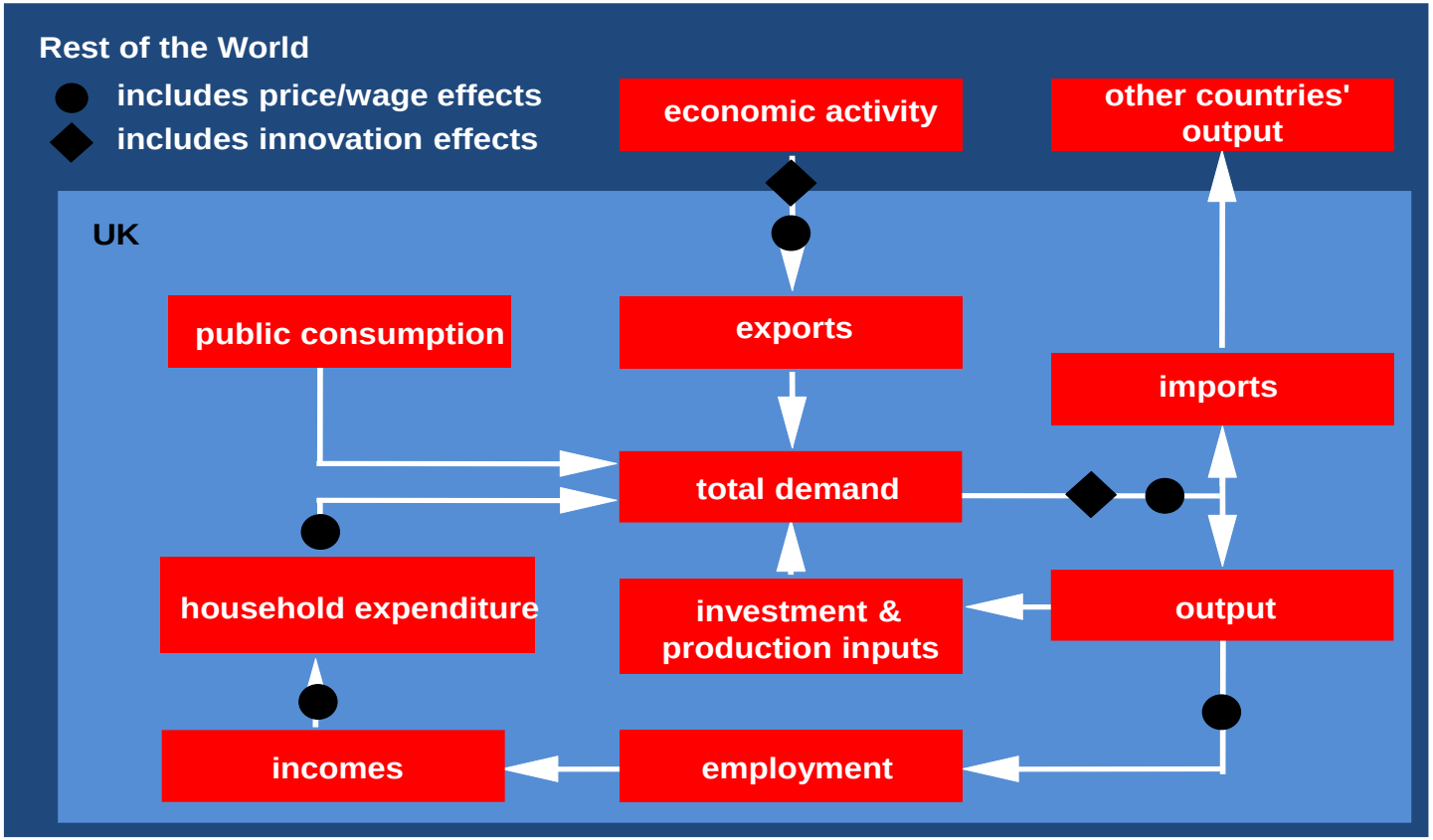
- Alternative scenarios with long-term projections of economic and demographic change in the UK
- Designed to represent a set of alternative future conditions for infrastructure planning, to provide a consistent and cross-cutting framework for the analysis of demand and supply of the different infrastructure sectors
- To be interpreted as providing an ‘envelope’ of potentially realistic outcomes defined across three key dimensions



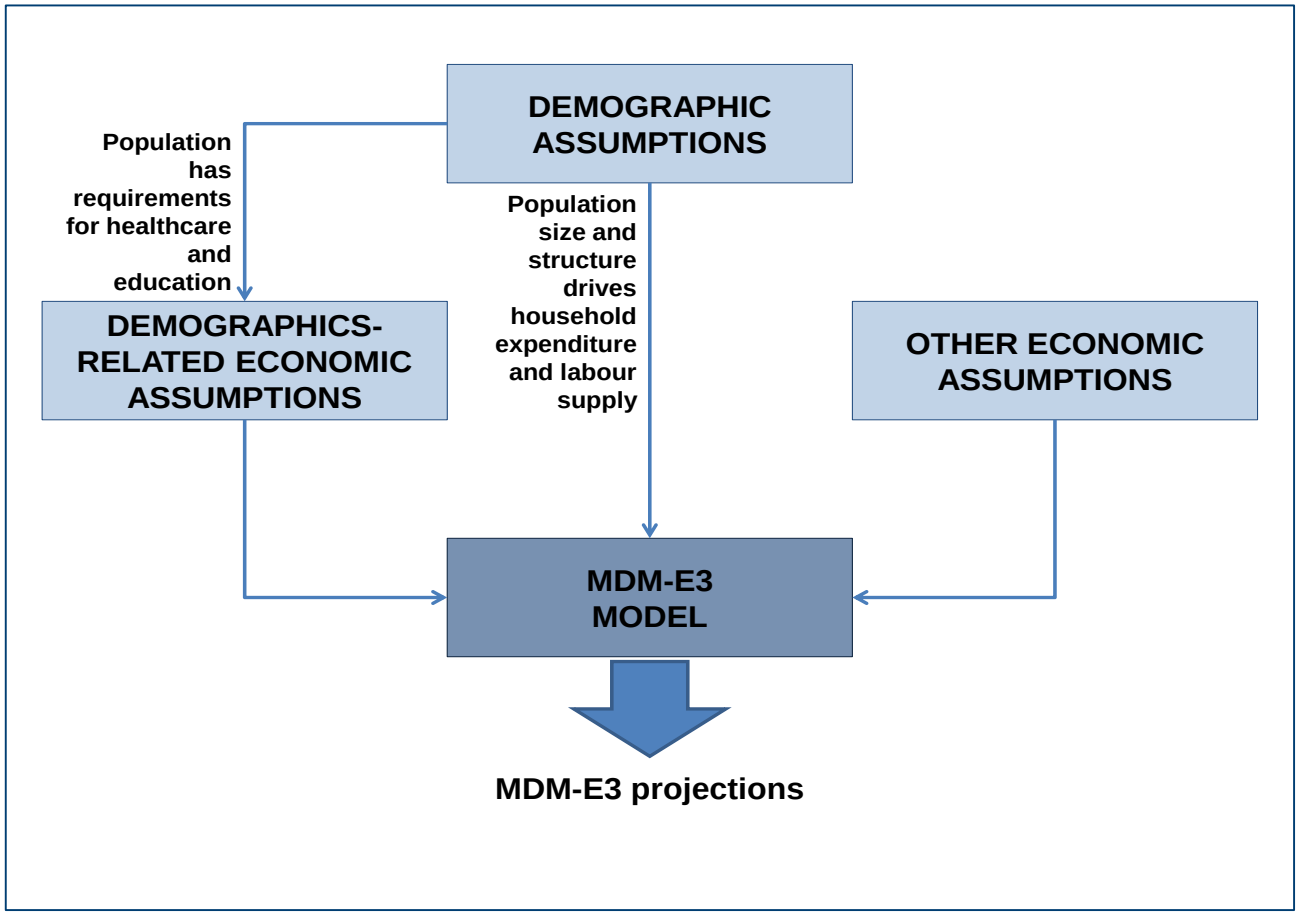
ITRC approach: systems modelling framework



Using the MDM-E3 model to simulate the dynamics of the UK economy



Modelling the impacts of demographic change in the economy



Key results

- MDM-E3 outputs feed forward into the individual infrastructure Capacity/Demand Assessment Modules (CDAMs)
- Scenario assumptions
  - population
  - energy prices
- GDP
- Household expenditure and income
- Output and employment by region and industry

Conclusions

- The modelling provides a consistent and cross-cutting framework for the analysis of demand and supply of the different infrastructure sectors
  - recognising the interdependencies that exist between sectors and agents in the economy
- The alternative scenarios present different implications for infrastructure-service provision and future network configuration
  - variation in sectoral and spatial patterns of economic growth
  - changes in demographic structure
- However, some feedback loops are absent from the existing framework
  - from the economy to demographic change
  - from the stock of infrastructure to the economy