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## The UK TIMES model

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## Introduction

- Why have we built a new model?
- What have we learned from UK MARKAL?
- What are the requirements for UK TIMES?
- How might we want to develop UK TIMES in the future?
- What (new) features do we want in UK TIMES?
  
- Model reputation and outreach

**Process, not outputs**

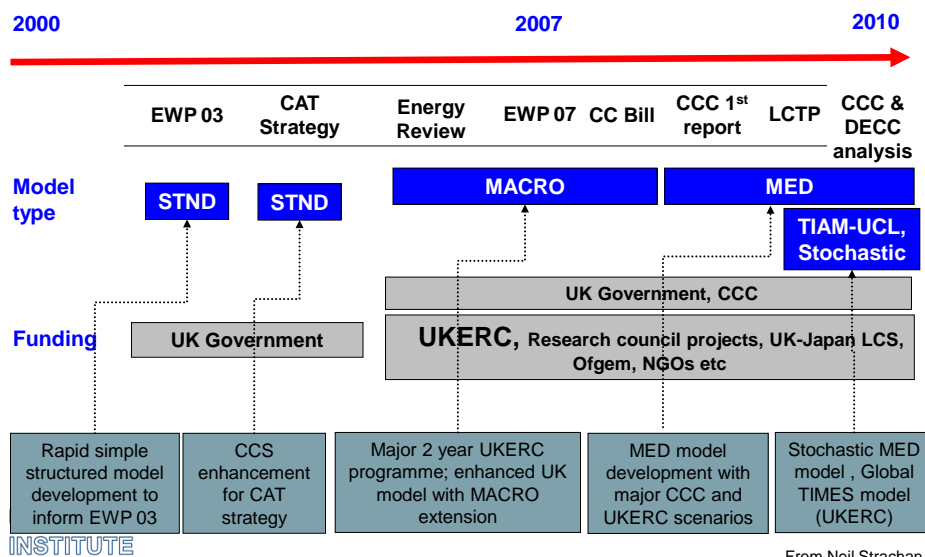
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## Why have we built a new model?

- TIMES features that are not available in MARKAL
- Flexibility of TIMES
- Transparency of inputs
- Re-calibrate UK model
- Implement improvements across the RES
- Add new features
- Availability of international support

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## What have we learned from UK MARKAL?



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From Neil Strachan

## Reputation of UK MARKAL

- Very strong input to the UK policy process
  - Better regarded by government economists than engineers
  - Transparency issues, despite the availability of a comprehensive manual
  - Other tools are now also being used for policy (DECC 2050 Calculator, ESME Monte Carlo model)
  
- Mixed reputation among academics
  - Unique in the UK research community
  - Many energy scientists feel it has too much influence – “A simple solution to a complex problem”

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## Review of UK MARKAL

- Model archaeology
  - Examined input and output changes between UK MARKAL versions
  - Concluded that:
    - Model data has been continuously updated over time
    - Maintained a balance between model detail and overall complexity
    - Some errors introduced through mis-understandings between teams
    - Inconsistencies from using data from different sources with different underlying assumptions
    - Inconsistencies from only updating some technologies in a sector
    - No long-term vision
  
- Research versions of UK MARKAL

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## What are the requirements for UK TIMES? Govt

1. **Least cost pathways:** what is the least cost pathway to 2050?
2. **Targets:** what is the effect of a more ambitious 2050 GHG target on costs and technology use?
3. **Scenarios:** if, say, CCS fails, what is the implication for cost and technology use? Or, say, “what if the UK fails to reduce energy demand across the economy – what are the implications for how much nuclear/CCS/renewables we may need?”
4. **Decision points:** if we want, say, a hydrogen network when do we have to start building the infrastructure? What would the impact be of a delay in starting the build the network?
5. **Cost uncertainty:** what impact does uncertainty about future costs have on our pathway choices?”
6. **Emission projections:** what are projected emissions in 2050 as a result of existing and planned policies?
7. **Impact assessment of a policy package:** what is the cost of a more ambitious 2050 target?
8. **Technology policy:** what is the effect of UK RDD&D on the cost of, say, electric cars? Or, what is the value of early deployment of, say, offshore wind in order to bring costs down for later cost-effective deployment?
9. **Spatial implications:** what are the spatial implications of building more, say, nuclear?
10. **Embedded emissions:** what are the process / embedded / lifecycle emissions associated with a given pathway?
11. **Energy balancing:** how robust is a given pathway to troughs and peaks in energy supply and demand?

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## What are the requirements for UK TIMES? Policy

- Clearly separate technology from policy
  - UK climate change mitigation policies:
    1. **command and control regulation** (minimum standards, banning things);
    2. **economic instruments** (eco-taxes, emission trading);
    3. **information-based approaches;** and,
    4. **negotiated agreements** and voluntary approaches to agree emission reductions.

Ideally, UK TIMES would be able to examine the impacts of as many of these policies as possible.

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## How might we want to develop UK TIMES in the future? Internal workshop

- Interseasonal and other storage on different spatial and timescales
- Demand response disaggregation
- Materials (industrial goods, food, water)
  
- Myopia and path dependency
- Stochastic modelling
- Macro and CGE modelling – WholeSEM project
- Behavioural modelling – ADVANCE project
  
- 2-region model for Scotland autonomy
- Link to larger TIMES and other models (e.g. network models)

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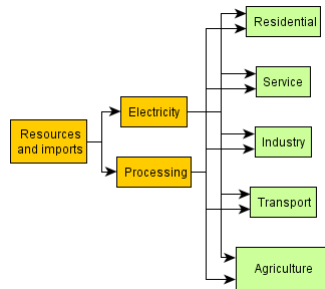
## What are the requirements for UK TIMES? Practical

- Transparent
  - Input data
  - Assumptions
  - Strengths
  - Weaknesses
- Properly documented
- Quality assurance – e.g. version control
  
- Used appropriately – training for users

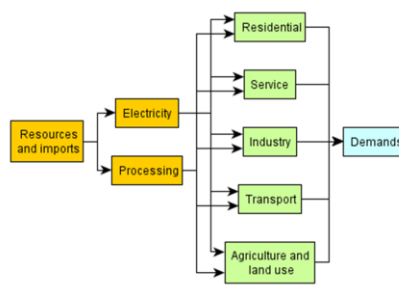
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## Structural differences between UK TIMES and UK MARKAL

### UK MARKAL



### UK TIMES



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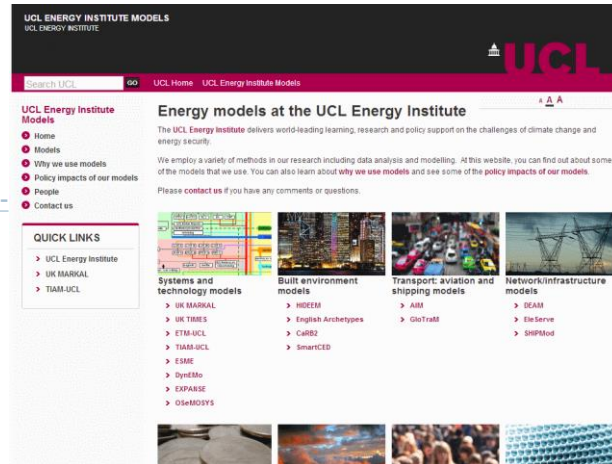
## What new features are in UK TIMES?

- Interseasonal and other energy storage
- Other energy infrastructure
- New time slices (4 intra-day x 4 seasonal)
- Non-CO<sub>2</sub> greenhouse gases
- New CO<sub>2</sub> re-calibration: all energy and non-energy emissions accounted by matching technologies to UK NAEI statistics
- Non-energy mitigation options
- Non-energy atmospheric CO<sub>2</sub> removal and sequestration

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## Model reputation and outreach

- More transparent
- Better documentation
- New website: [www.ucl.ac.uk/energy-models](http://www.ucl.ac.uk/energy-models)
- Training government scientists
- Better QA



## Conclusions

- UK TIMES has been created for a number of reasons
  - New features
  - More general improvements over UK MARKAL
  - International support
- Consultation process to facilitate a good design
  - Discussions with stakeholders, particularly government
  - Internal discussions
  - Short- and long-term model requirements considered
- Transparency, QA, reputation important – “a new start”

**Thank you for listening**

**Questions?**

