TIMES Energy System Models at UCL

WholeSEM – DECC Stakeholder Workshop

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Dr. Hannah Daly

Energy Systems Modelling Team in UCL EI


Prof. Paul Ekins


Prof. Neil Strachan


Dr. Gabrial Anandarajah


Dr. Ilkka Keppo


Dr. Paul Dodds


Mr. Steve Pye


Dr. Christophe McGlade


Mr. Baltazar Solano


Ms. Marianne Zeyringer


Dr. Olivier Dessens


Mr. Will McDowall


Dr. Evelina Trutnevyte


Mr. Will Usher

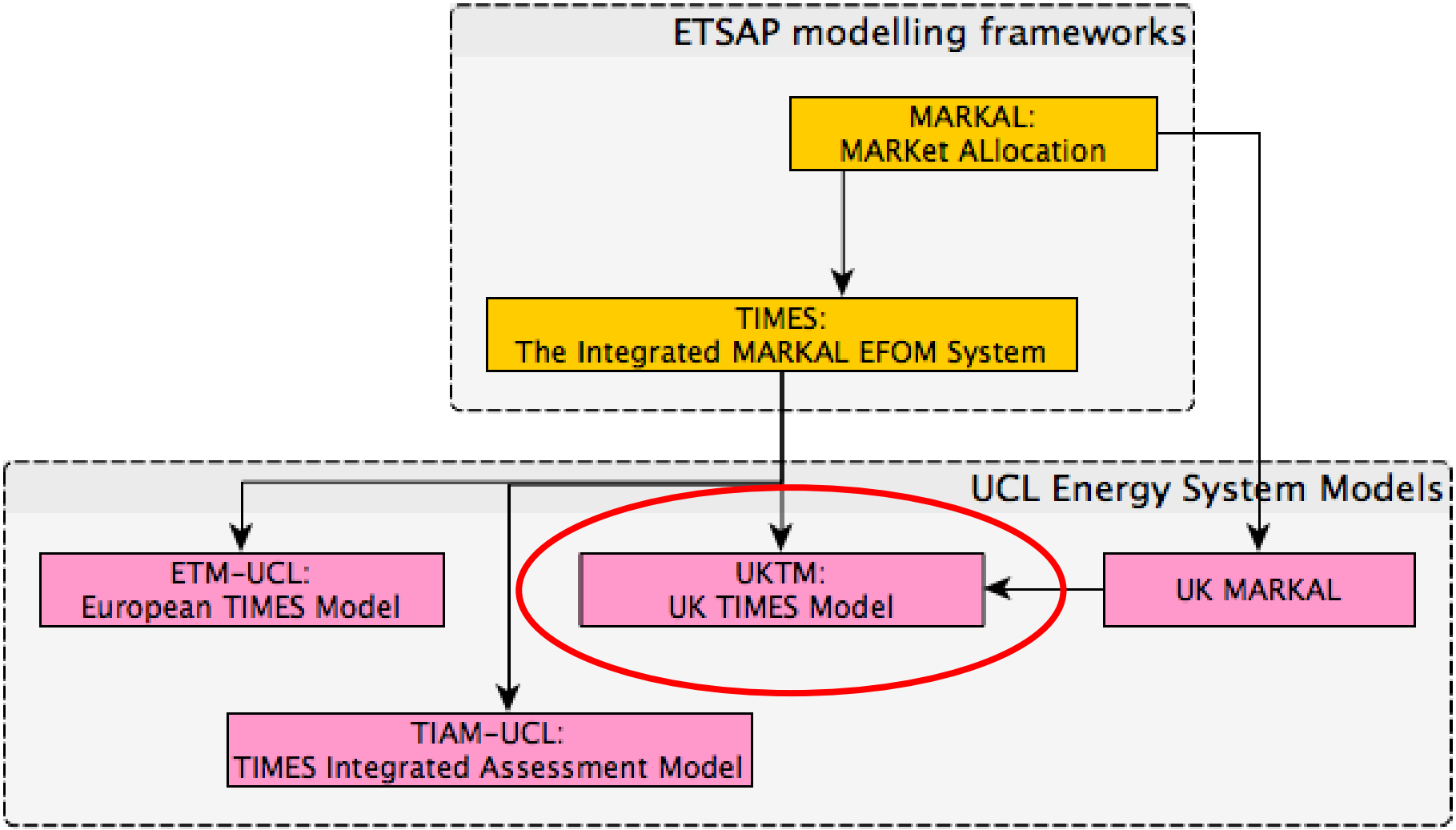

Dr. Matthew Winning


Ms. Nagore Sabio

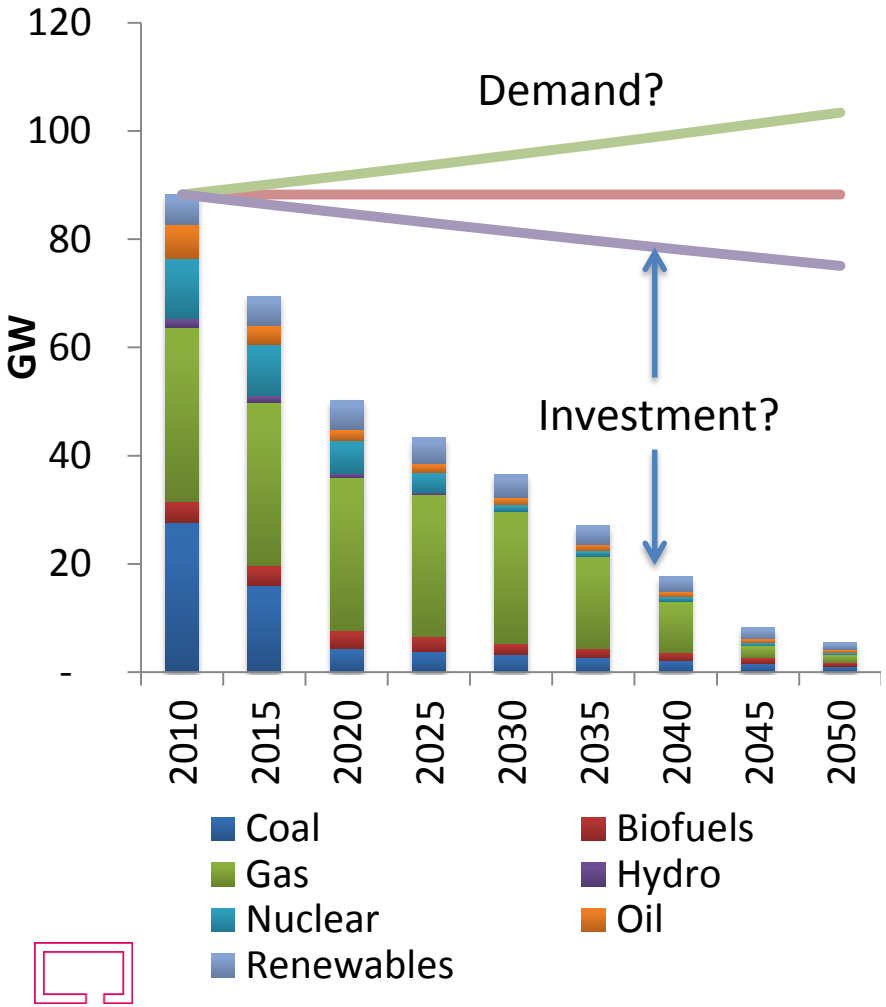

Dr. Hannah Daly

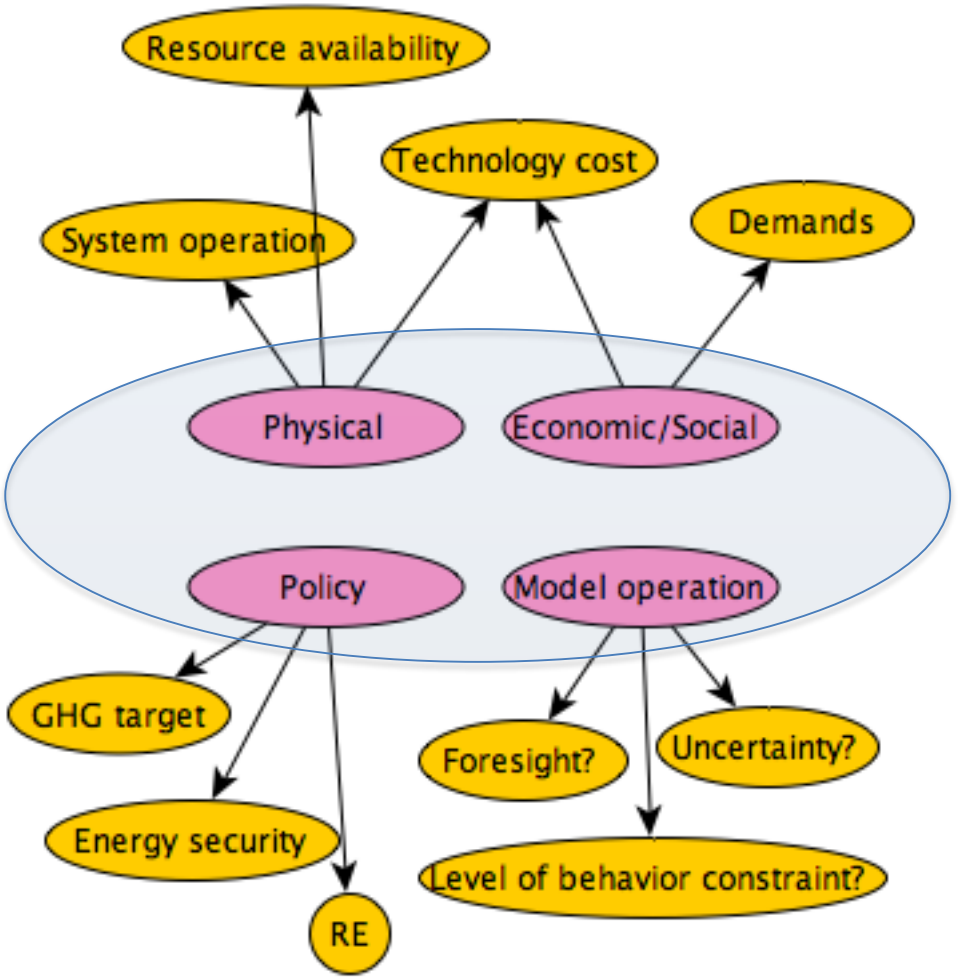

Ms. Birgit Fais

Overview of Platforms & UCL Models



Investment Decisions in UKTM

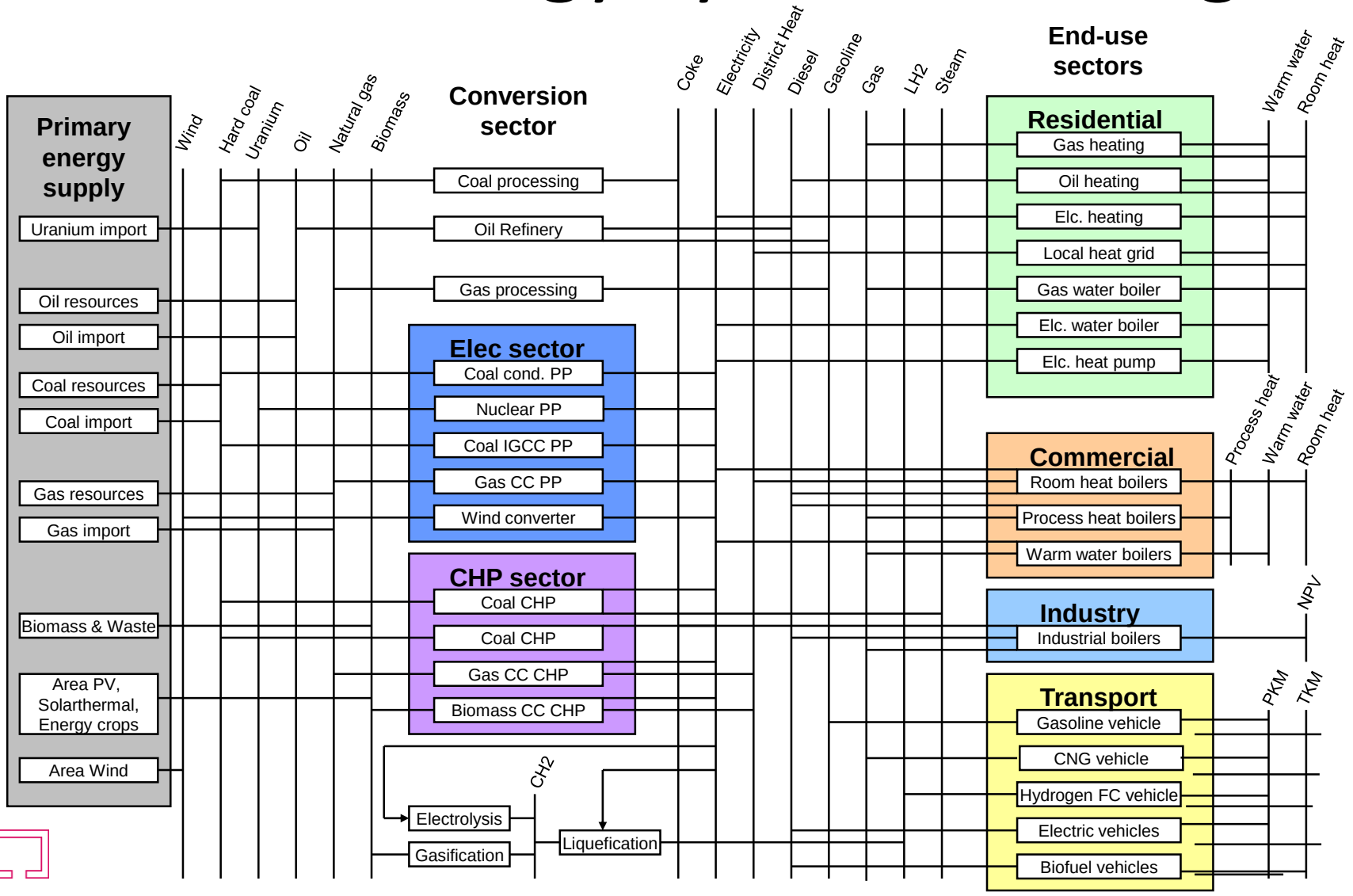




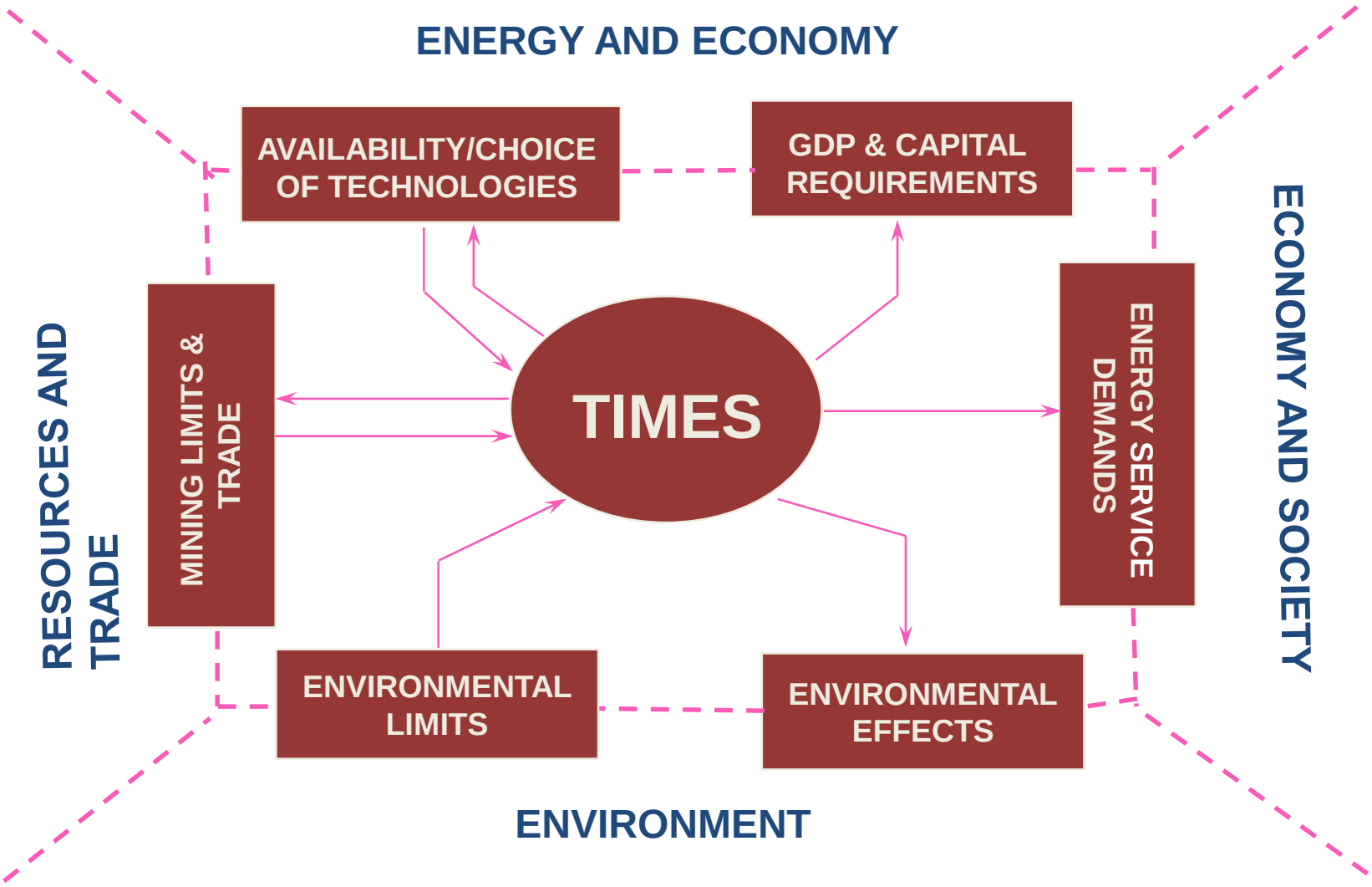
UKTM Model Paradigm

- A **least cost optimization** model based on life-cycle costs of competing technology pathways (to meet **energy demand services)**
- **Partial equilibrium** model assuming “rational” decision making, perfect information, competitive markets, perfect foresight
- **Technology** rich bottom-up model
- An **integrated energy systems** model
- Physical, economic and policy **constraints** to represent UK energy system and environment
- Model and data **validation**
- Emphasis on **sensitivity and uncertainty analysis**
- **Extension** to TIMES-Macro, elastic demand (ED), stochastic, mixed integer, endogenous learning, multi-region, etc.

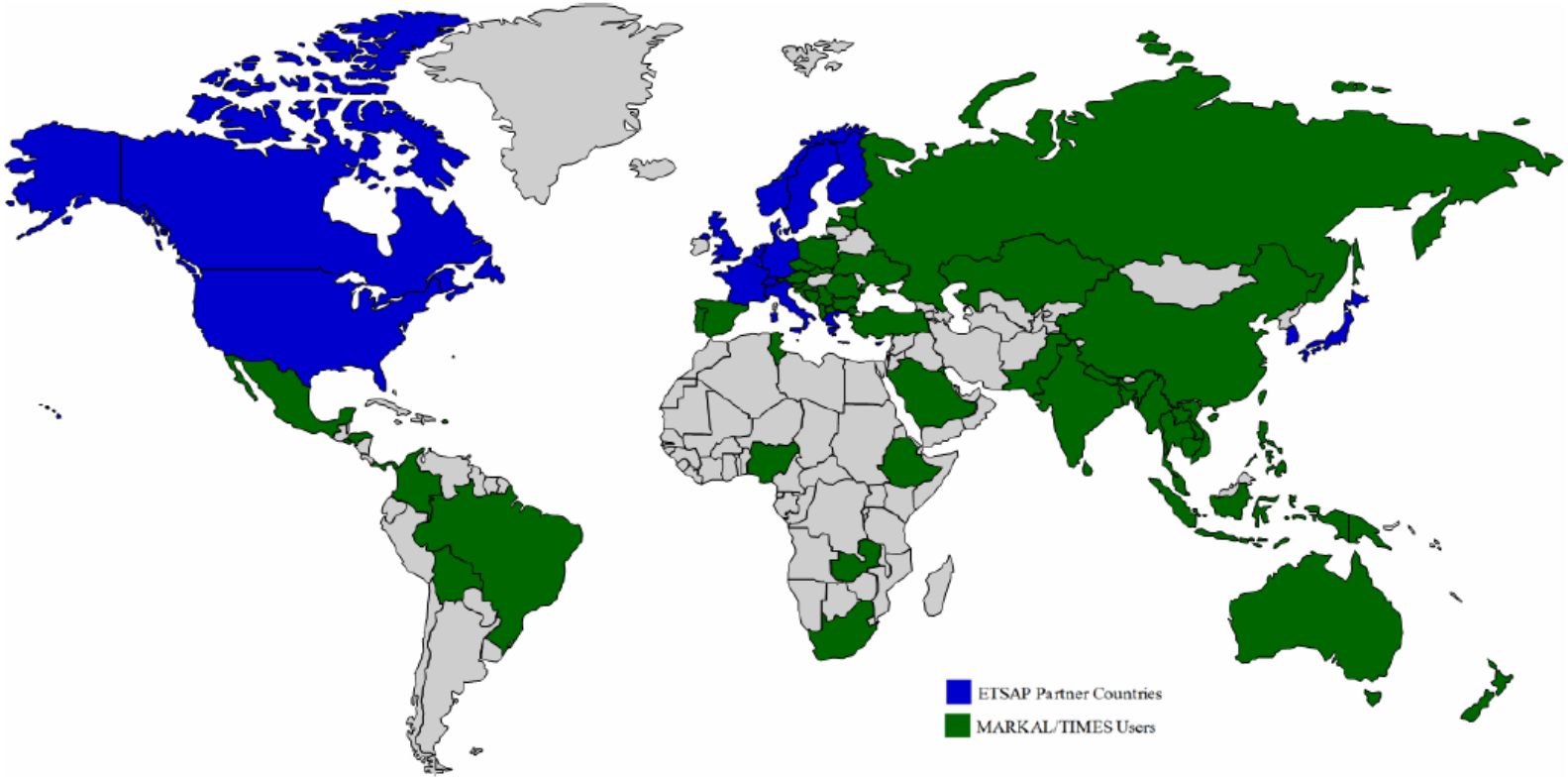
Whole Energy System Coverage



Energy, Economy, Engineering & Environment (E4) Interactions



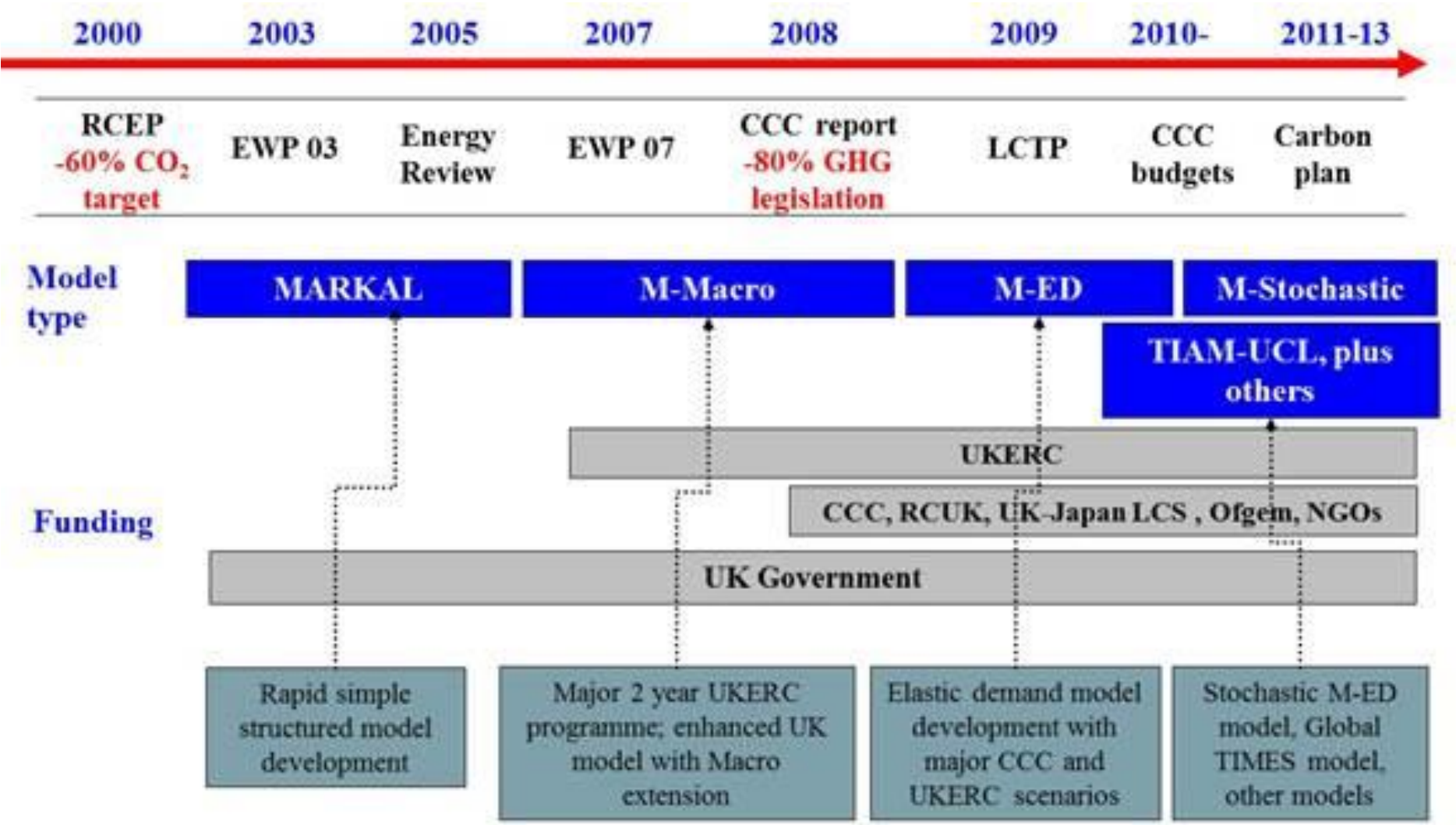
Established international TIMES model platform



Only those countries with at least one MARKAL/TIMES modelling team active during the Annex are "painted."

Source: U Remme, IEA

Strong lineage: UK MARKAL & policy



Why move from UK MARKAL to UKTM?

- **New functionality** of UKTM
  - All **GHG** accounting
  - **Time-slicing** for intermittency and storage across different time slices
  - Improved **industrial sector**: Process based subsectors and mitigation options

- **Comprehensive revision and review** of MARKAL
  - **Transparency** at the forefront of development
    - Data, assumptions, structure is **clear and traceable**
    - Full **replicability of results**
    - **QA processes** implemented to trace model development
  - Revise all **inputs**
    - Using up-to-date, consistent data calibration to 2010
  - User constraints categorized & explicit

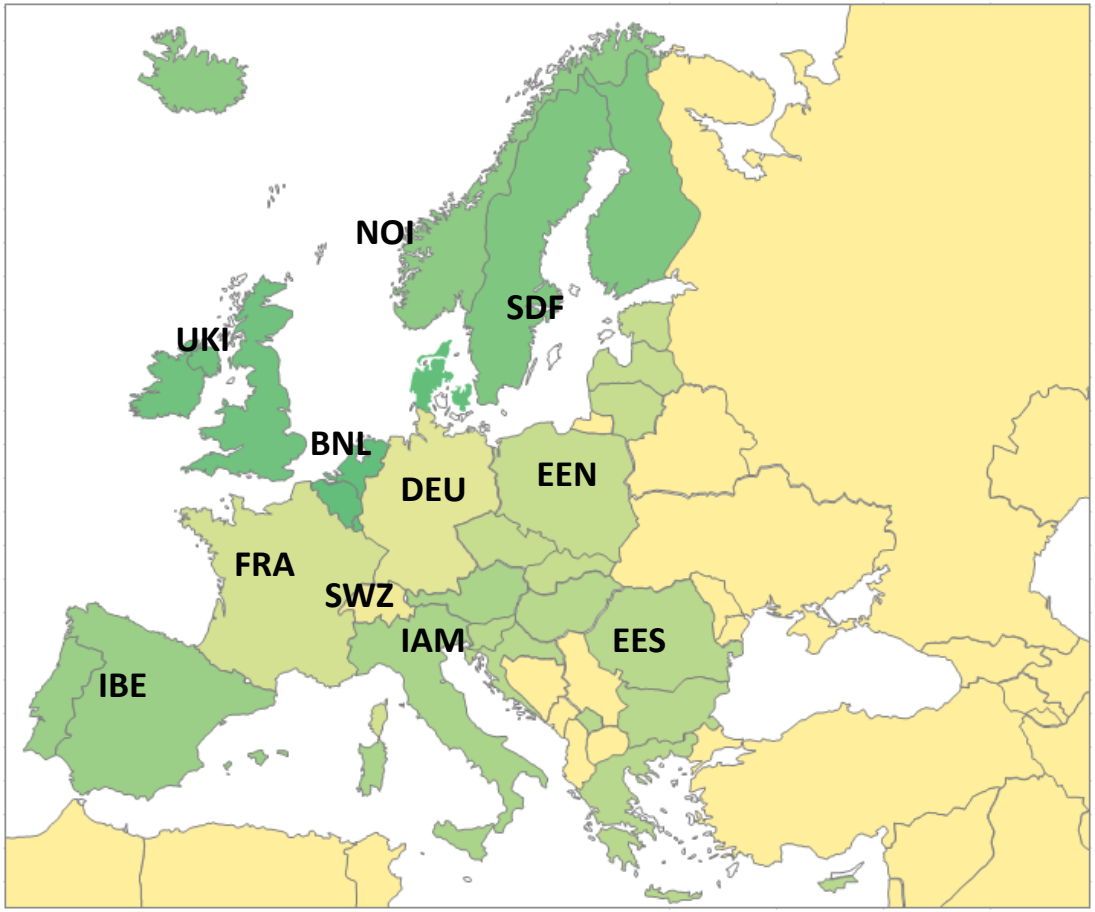
- Many **advantages of TIMES** platform
  - MARKAL tool has been superseded internationally
  - TIMES offers much greater **flexibility**

The future of UKTM in research

- **Technological change:**
  - Endogenous technology learning & diffusion of technologies
  - What role does technological change change play in the transition of the energy system?
- **Spatial and temporal disaggregation:**
  - Multi-region version of UKTM to address spatial and temporal issues in long term transitions
  - UKTM has linkage points to power market model, multi-regional Forseer tool.
- **Behaviour modelling:**
  - Improving behavioural realism beyond own price elasticities
  - What are the mitigation opportunities for the energy system in behaviour change?
- **Modelling to generate alternatives**
  - What are the near-optimal but most different pathways to reaching targets?
- **Macro-economic modelling:**
  - Hybrid Macro version: Endogenous general equilibrium model; link to multi-regional model
  - What is the impact of the energy system on the economy?
- **Bioenergy:**
  - Linking bioenergy resources to land use in the new agriculture and land use sector
  - Land will become a fundamental resource from which bioenergy resources are derived

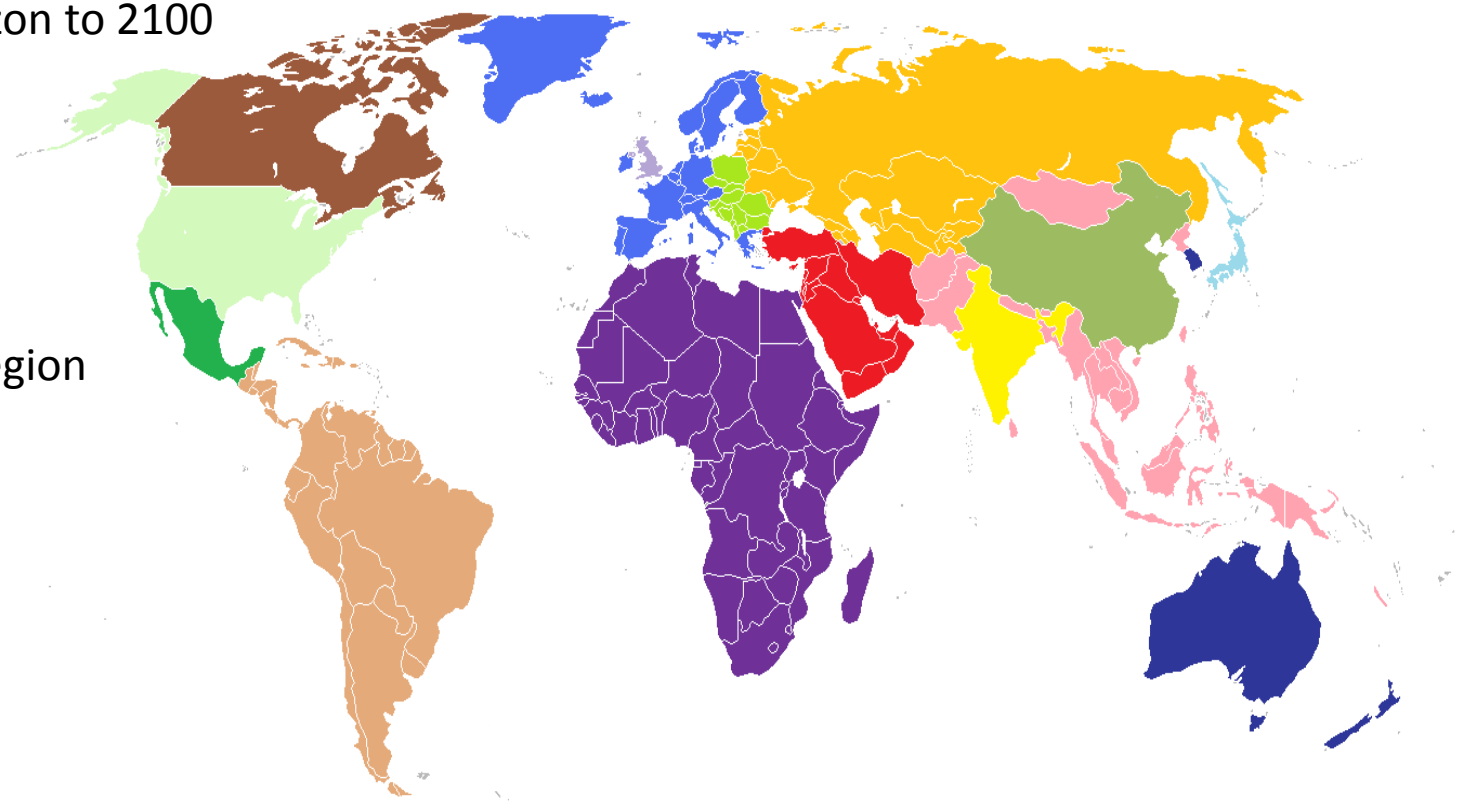
European TIMES Model (ETM-UCL)

- Multi- regional: 11 regions, EU28+3
- Each region is modelled as a separate energy system
- Regions are linked through trade in crude oil, hard coal, pipeline gas, LNG, petroleum products, biomass, electricity and emission permits.
- ETM-UCL designed for and currently used in two FP7 EU research projects (http://cecilia2050.eu/, http://www.emininn.eu/)



TIMES Integrated Assessment Model (TIAM-UCL)

- Multi-emissions, plus a climate module
- Flexible time horizon to 2100
- Global coverage
- 16 regions
- UK is an explicit region



UCL-Energy Models: www.ucl.ac.uk/energy-models