Scottish TIMES - a national energy system perspective

Michael Kenefick

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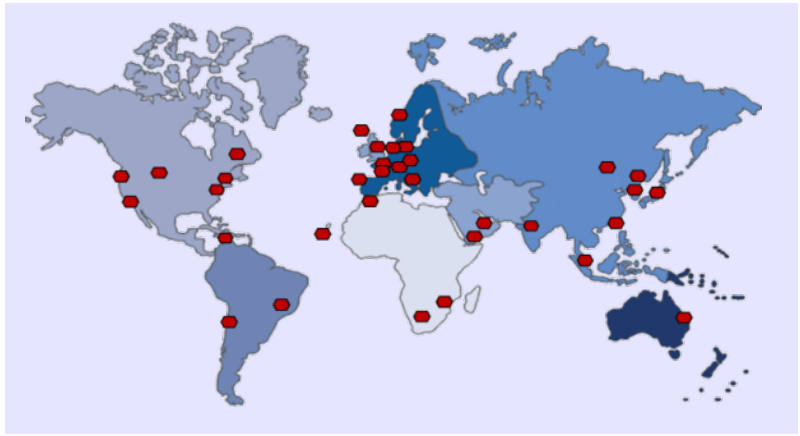
E4tech: Strategic thinking in sustainable energy

- International consulting firm, offices in UK and Switzerland
- Focus on sustainable energy
- Established 1997, always independent
- Deep expertise in technology, business and strategy, market assessment, techno-economic modelling, policy support…
- A spectrum of clients from start-ups to global corporations



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Contents

1. **Introduction to Scottish TIMES**
2. Model structure and data
3. Policy uses

The development of a Whole System Energy Model for Scotland is driven by RPP3

- The primary purpose of the project is to develop a model which will:
  - allow the exploration of Scotland-specific energy futures
  - consider interactions between various sectors
  - support the formulation of co-ordinated policies and proposals for RPP3

- In delivering the model we also want to do the following:
  - Inform stakeholders of model strengths and limitations
  - Ensure wide acceptance of the model and underpinning data within the relevant communities
  - Equip Scottish Government analysts with the skills to independently operate and update the model ('building capacity')
  - Ensure that the model outputs are presented clearly
  - Encourage cross-sectoral cooperation and coordination

Acknowledgments

- The Scottish TIMES model was commissioned by Scottish Government
- E4tech led an original consortium of E4SMA, KanORS, Imperial College Consultants and Systra.

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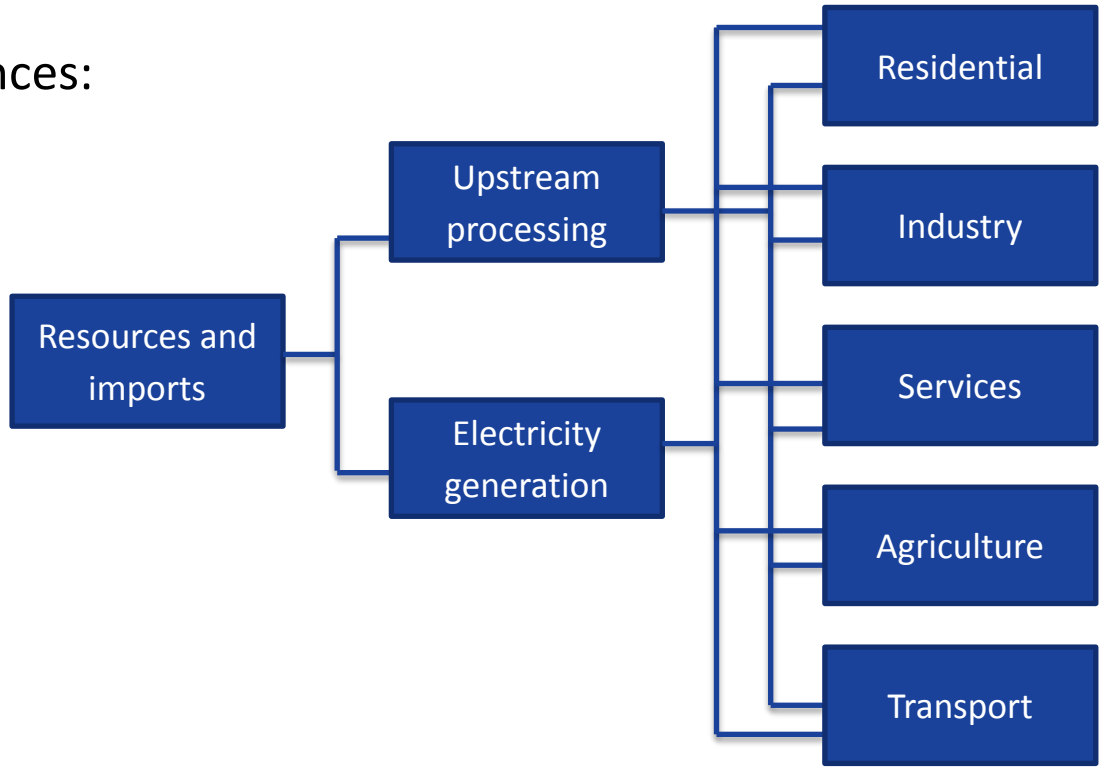
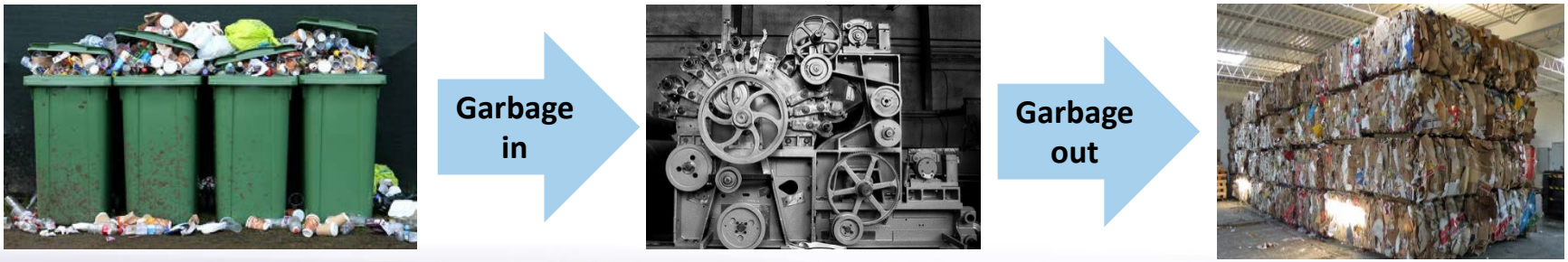
Scottish TIMES adopts the same sectoral structure as UKTM

- Same supply and demand sectors as UKTM
- Commodities and processes broadly aligned with notable differences in each sector
- Several important differences:
  - Base Year = 2012
  - Several sectors segmented differently
  - Scotland-specific stock and deployment potentials
  - Unique scenarios & constraints

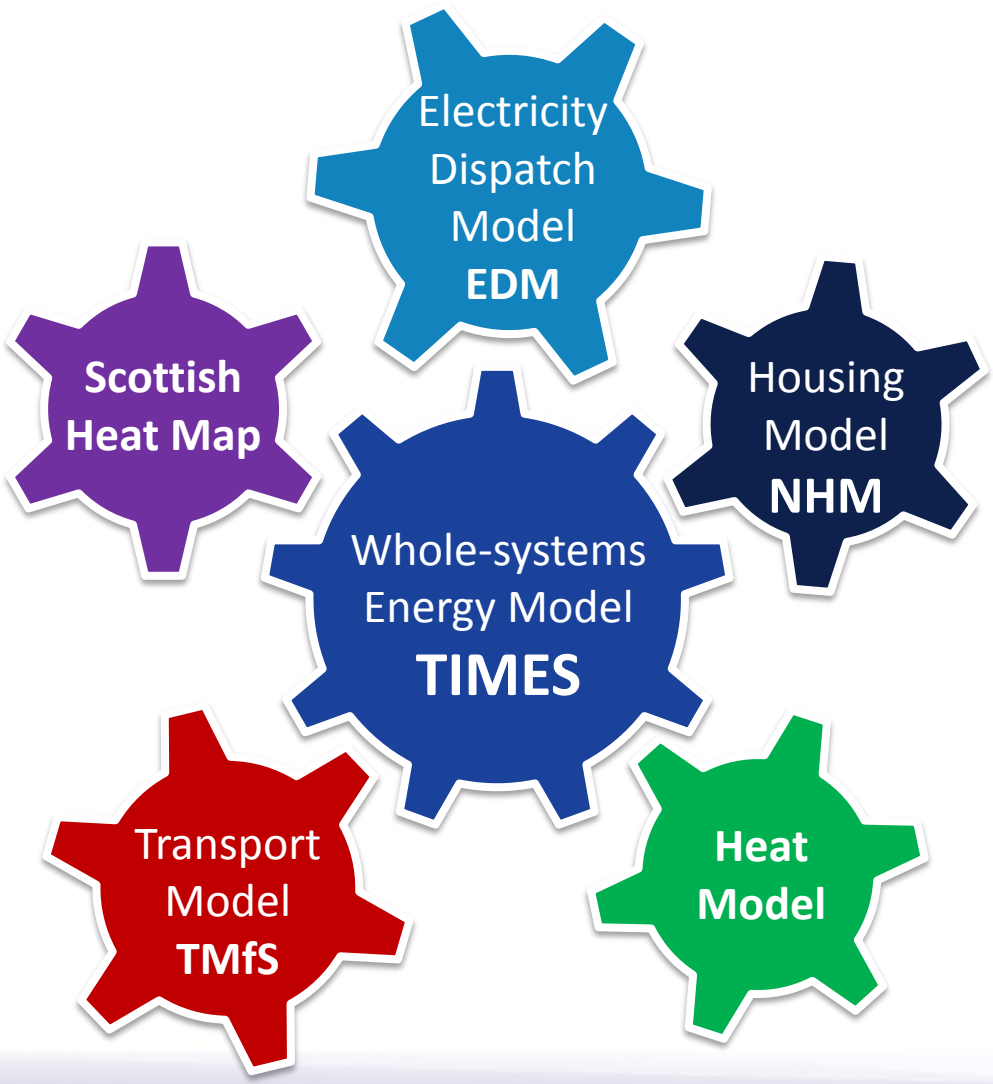


Commentary on data inputs

- Getting consistent, harmonised data is challenging
  - Future commodity / energy service demands
  - Fuel prices
- GHG Inventory vs. Energy balance vs. Bottom-up estimates
  - Energy balance not always consistent with inventory (demands in residential, transport)
  - Bottom-up estimates not always consistent (e.g. SHCS estimates of household heat demand)
- Importance of reliable projections for LULUCF contributions



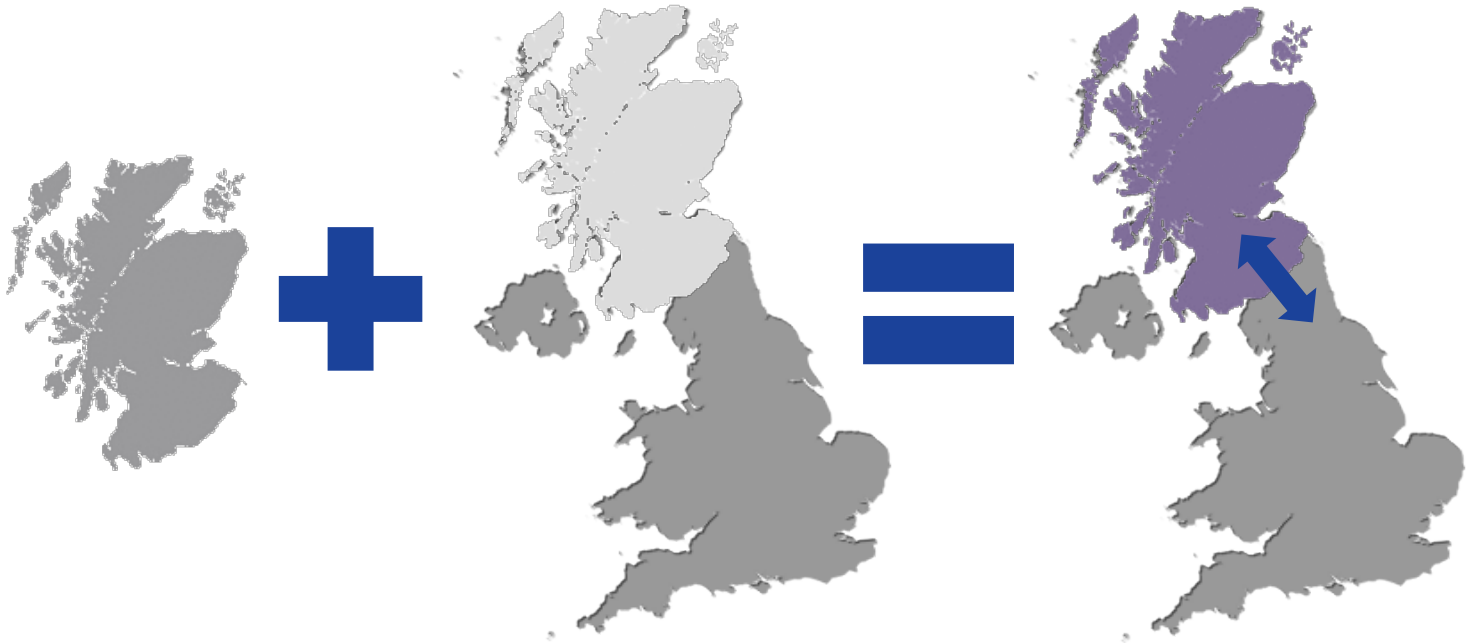
Soft-linking to Scottish sectoral models



- Scenario results from Scottish TIMES can be sense checked by running them through sectoral model
- Can provide useful additional insights into the results from the TIMES model and can also usefully scrutinize specific TIMES results in greater detail

Potential link between Scottish TIMES and UKTM

- Recalibrating the UKTIMES model to link Scottish TIMES and run as a regional model
- More representative model of the endogenous flow of resources and power between the two regions



Scottish TIMES **Recalibrated UK TIMES** **Regional TIMES**

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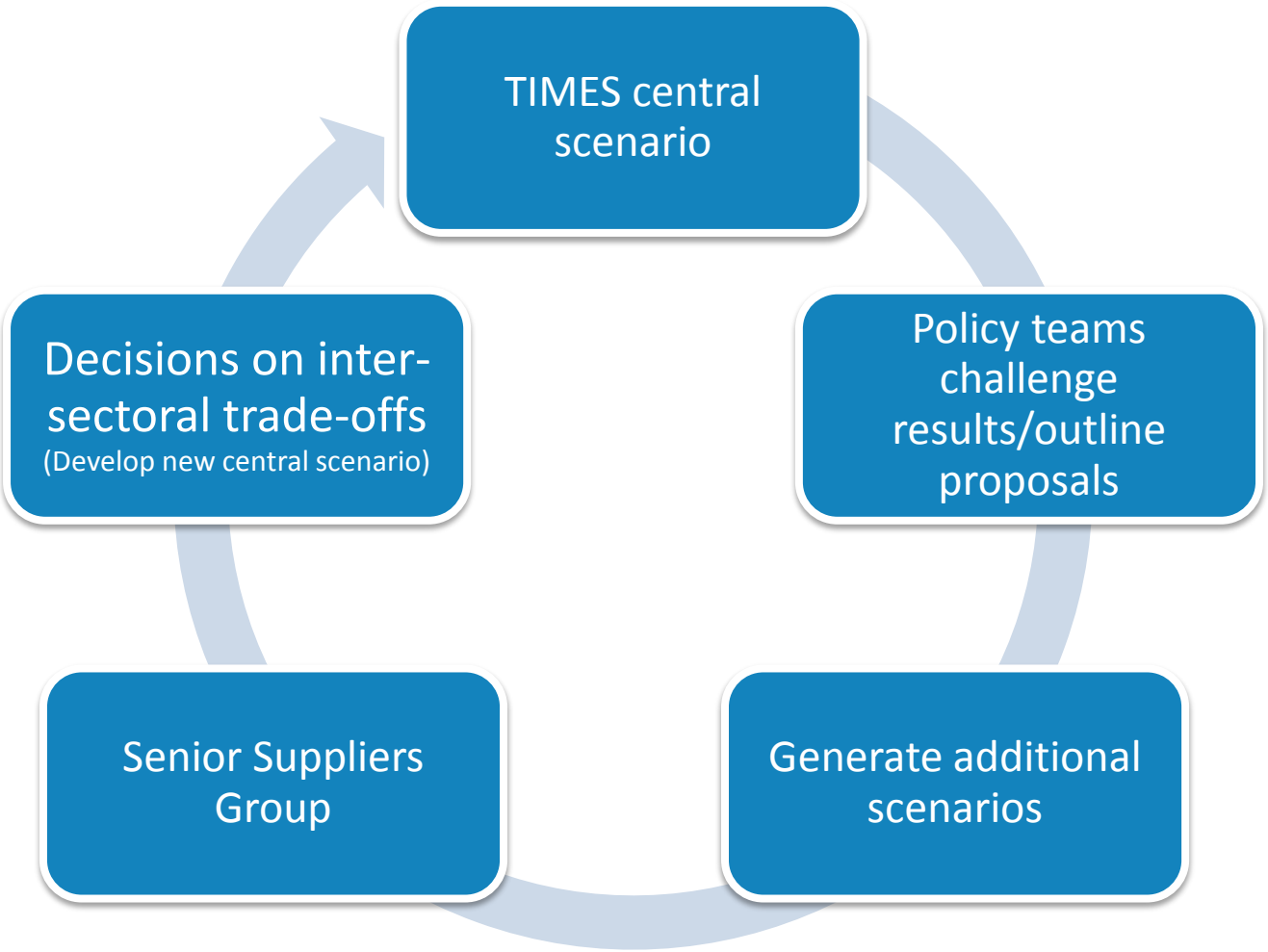
Example applications of Scottish TIMES

- Carbon budgets (e.g. RPPs)
  - An evidence base for carbon budget levels
  - Implicit CO_2 price over time
- Economy-wide abatement strategy
  - Balance and timing between sectors for abatement action
  - Aggregate costs, sector costs and cost profile
- Impacts of minimum standards regulation
  - E.g. vehicle efficiency, condensing boilers, building efficiency, etc.

How are the policy teams using the model

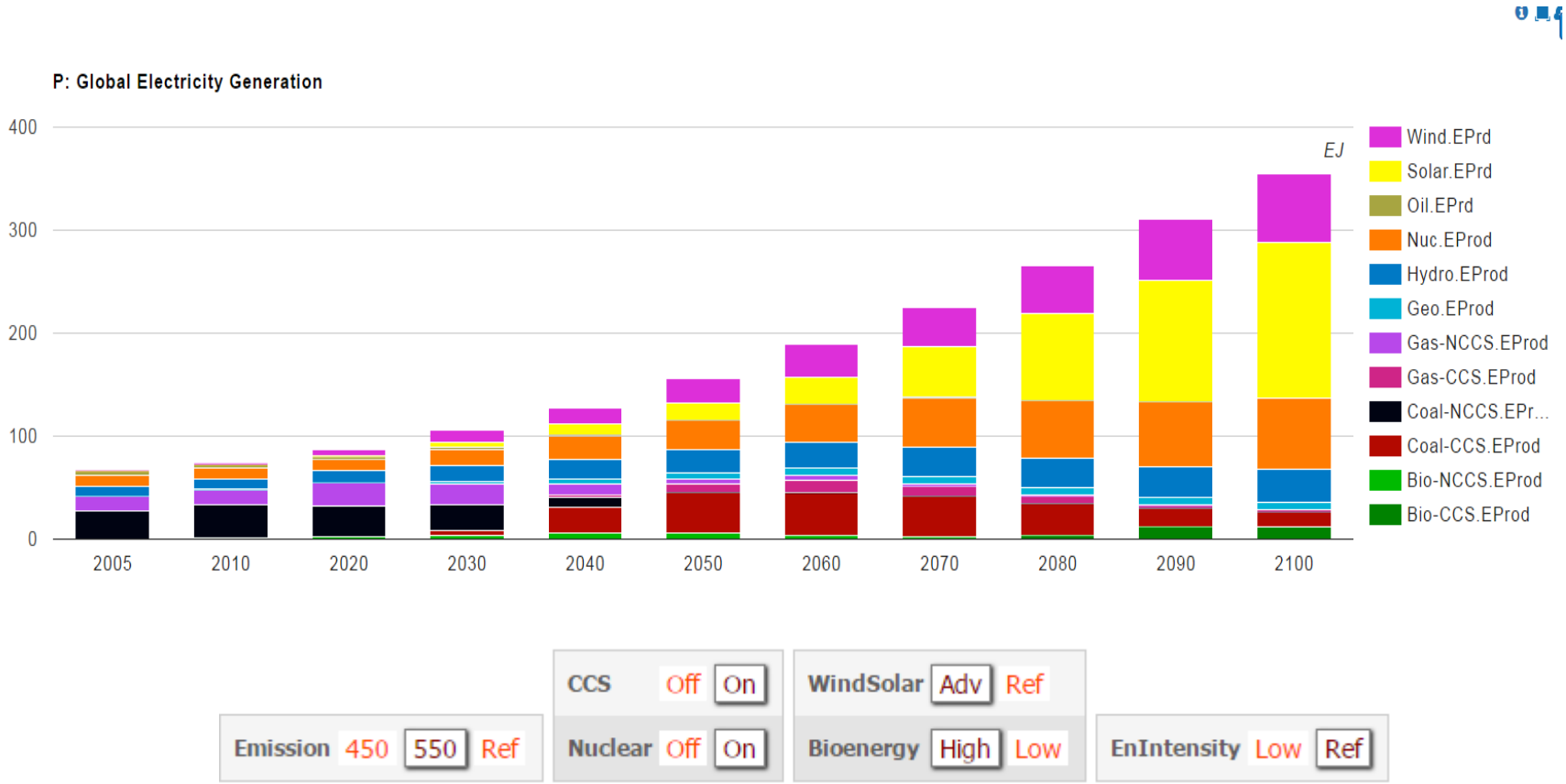


Policy teams viewing the model results via VEDAViz

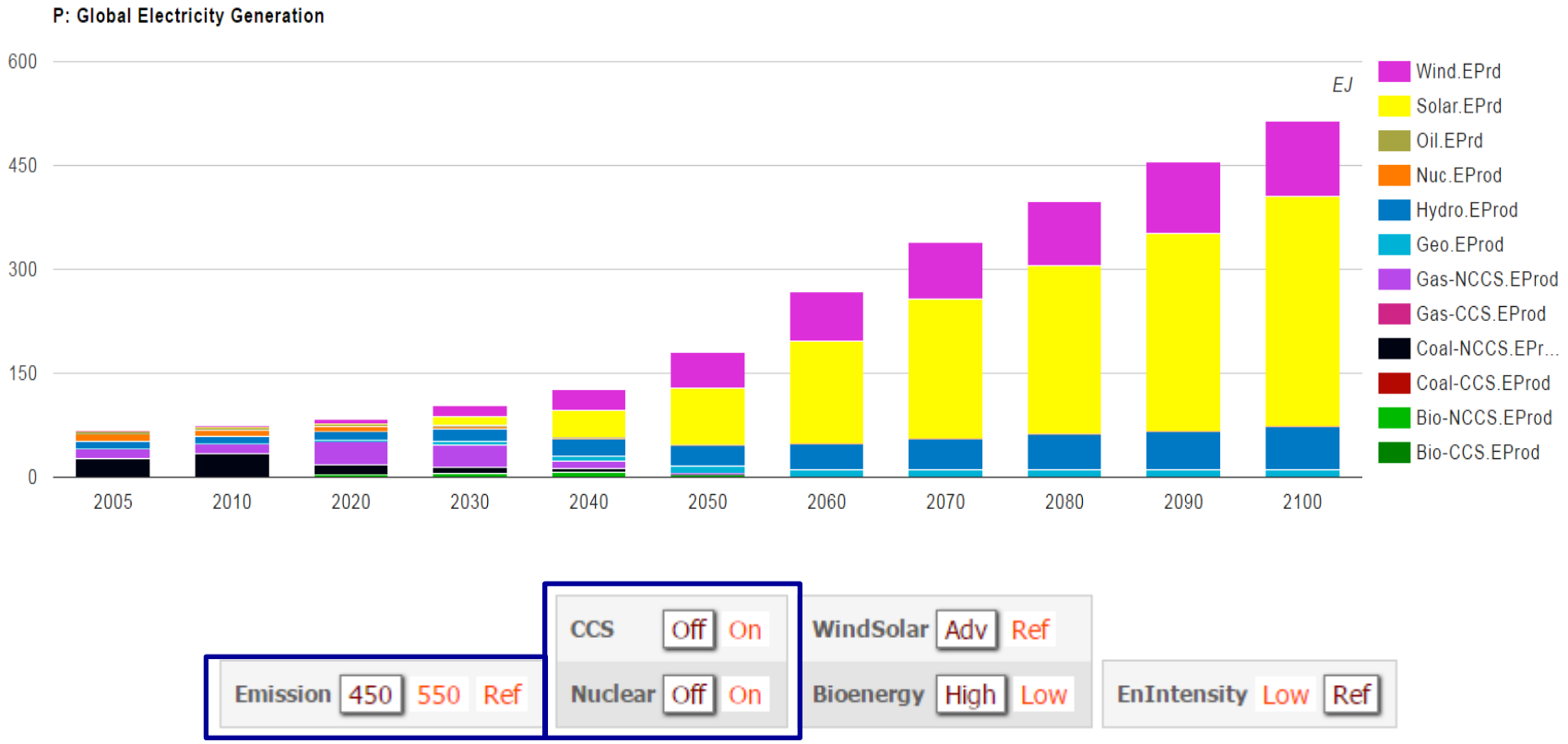
- Converts the model into an interactive portal for policy makes and stakeholders,… without a need to know the model (inspired by DECC calculator)
- Dynamic graphs and tables engage policy teams more effectively than conventional static charts
- Portals are available for each sector as well as overall which represent dozens of model runs and scenarios which can be toggled on/off
- Examples from the TIAM-World model

VEDAViz Portal

Reference Scenario

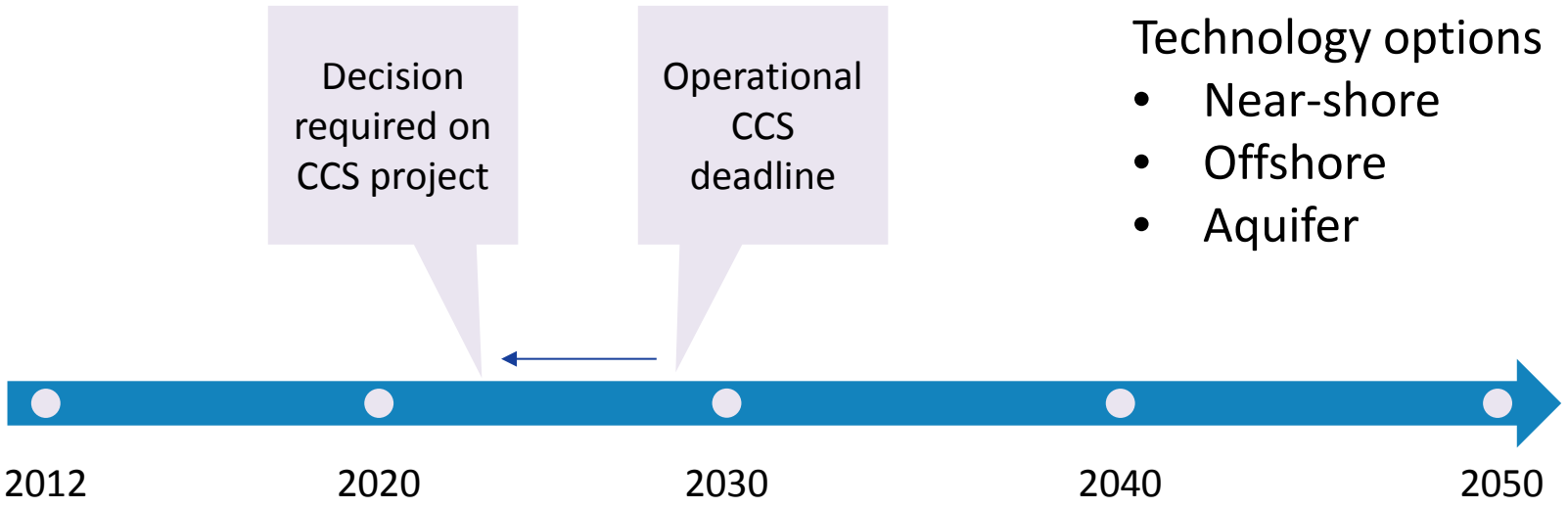


Change the model scenarios



Addressing the policy uncertainty

- Have a large number of scenarios and running numerous permutations examining various situations
- Explicitly factoring in the technology into the policy questions
- CCS example



Looking forwards

- Modelling
  - Model refinements
  - Soft-linking
  - Stochastic element to inputs
- Policy
  - Further rounds of the modelling/policy engagement cycle over the summer.
  - Firm up policies in order to meet the required amount of GHG abatement.
  - Public engagement on proposals and the outputs of TIMES (late Summer)
  - Publish the 3rd report of proposals and policies in relation to climate change by end-2016

Thank you for your attention!

Michael.Kenefick@E4tech.com

Annex

Open Discussion….

1. The importance of transparency and how will it be achieved with STM?
2. STM is built in a modelling framework supported by an international network. Should Scotland engage and what would the benefits be?
3. Is a process of scientific peer review appropriate for STM?
4. STM uses a whole systems approach. How can it interface with sector-specific or other types of systems models?
5. What are the limitations of STM and how can these be addressed?

Scottish Electricity Demand Model – SEDM

- Models potential electricity generation scenarios in Scotland and the rest of GB out to 2050
- Can be run as capacity expansion model or as dispatch model
- Scottish TIMES will provide additional features not available in SEDM, such as levels of electrification of heat and transport (endogenous within Scottish TIMES) and the impacts on peak load evolution.
- Use scenario results from Scottish TIMES for an individual year (say 2030 or 2050) to populate the SEDM short term model
- SEDM can then provide a more refined picture of the operation of the power system and market (flexibility and market adequacy) including short-term operational requirements, reliability metrics, market prices and revenues of generators

National Housing Model – NHM

- Micro simulation model developed for DECC by the Centre for Sustainable Energy (CSE)
- Calculates residential energy consumption and related carbon emissions in the UK residential sector by simulating
  i. individual household heating behaviour with respect to consumption and
  ii. household investment decisions regarding energy efficiency measures and low carbon heating technologies.
- Scottish TIMES will have a detailed perspective on the energy system, while NHM has a detailed perspective on households.
- Can run a number of Scottish TIMES least-cost pathways through the NHM simulation model
- NHM can provide a useful test of the robustness of the results from Scottish TIMES and used to generate policy roadmaps

Transport Model for Scotland - TMfS

- A strategic transport model, which provides a broad representation of transport supply and estimates of transport demand
- Provides a generalised, multi-modal representation of travel demands and infrastructure supply for the base year and future forecast years
- Comprises three key sub models – a demand model, national public transport model and a national road model.
- Scottish TIMES has a detailed perspective on the energy system, while TMfS has a detailed perspective on transport.
- Can compare scenario results on the future car (and LGV/HGV) stock from energy system optimisation (Scottish TIMES) with simulated (TMfS) to help inform the choice of timing and framework of policy measures

General model assumptions

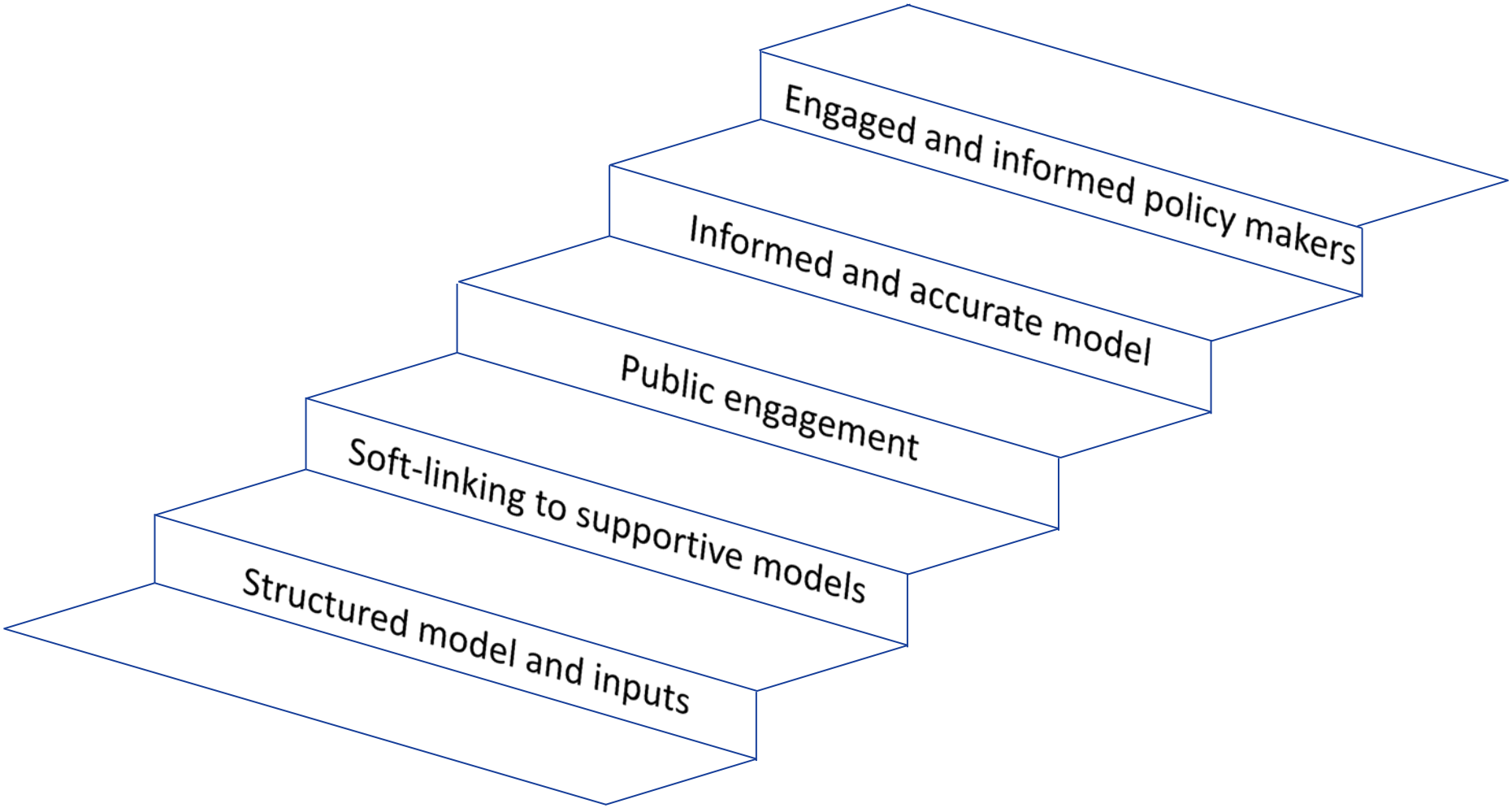
- **Macro-economic assumptions:**
  - **Population**: TELMoS / TMfS (consistent with ONS central projection)
  - **GDP**: Unofficial Scottish Government estimate
  - **Discount rates**: UKTM (v1.2.2) assumptions (inc. DECC technology-specific hurdle rates for power)
- **Greenhouse Gas assumptions:**
  - **2012-2050 trajectory**: Unofficial Scottish Government estimate (fixed targets extrapolated)
  - **2012-2020 Non-ETS trajectory**: based on published ETS cap
  - **Emission coefficients**: Defra/DECC GHG Conversion factors
- **Other:**
  - **Fuel distribution costs**: UKTM (v1.2.0)
  - **Infrastructure costs**: UKTM (v1.2.0)

Supply sector data updates

- **Resources**
  - Several UKTM ‘mining’ processes characterised as ‘import’ processes
  - Pellet imports added
  - Gas interconnectors with Norway, Ireland, England
  - UKCS is treated as another trading port
- **Processing & Waste**
  - Scottish stock (Grangemouth refinery, Argent biodiesel plant, pellet production capacity etc.)
  - Wide selection of processes for advanced biofuels
- **Electricity**
  - Scottish stock & retirement profiles
  - Rural/urban transmission costs distinguished
  - 9x onshore wind tranches, 2x offshore

Demand sector data updates

- **Residential**
  - Scottish housing stock split by urban houses, rural houses, flats
  - Provision for multiple district heating cost tranches
- **Services**
  - Public / Private split
- **Transport**
  - Short (<40km) and long passenger car journeys distinguished
- **Industry**
  - Chemicals, Cement, Iron & Steel, Food & Drink, Pulp & Paper, Other
  - Decarbonisation options include CCS, low carbon fuels, new/more efficient processes
- **Agriculture, land-use and forestry**
  - Scottish Agricultural MACC
  - Afforestation and peatland restoration processes


Engaged and informed policy makers
Informed and accurate model
Public engagement
Soft-linking to supportive models
Structured model and inputs