

A Scottish TIMES model: an overview

What is TIMES?

TIMES is a Whole System Energy Model (WSEM). Such models aim to capture the main characteristics of an energy system and are particularly useful for understanding the strategic choices that are required to decarbonise an economy.

The Scottish TIMES model is a high level strategic model, covering the entire Scottish energy system and containing many thousands of variables covering existing and future technologies and processes.

The model combines two different, and complementary, approaches to modelling energy: a technical engineering approach and an economic approach. The model uses this information to identify the effectiveness of carbon reduction measures in order to provide a consistent comparison of the costs of action across all sectors.

The aim of the model is to capture the main characteristics which affect the deployment of technologies, their costs and associated greenhouse gas emissions for Scotland as a whole given a range of policy and other constraints. This allows consideration of the strategic choices which Scotland faces as it seeks to decarbonise its energy system.

How TIMES is being used in developing the Climate Change Plan

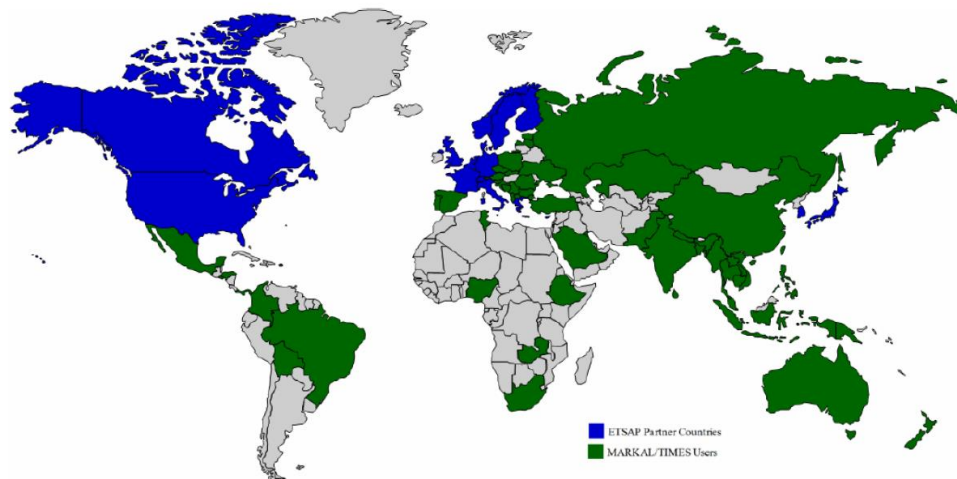
The development of the draft Climate Change Plan draws significantly on the Scottish TIMES model. TIMES helps us understand least-cost ways of achieving emission reductions by assessing how effort is best shared across the economy, taking account of both individual sectors and how those sectors interact. This approach allows us to develop an optimal pathway for meeting Scotland's statutory climate change targets. The pathway contains a carbon envelope for each sector along with suggested measures needed to live within the carbon envelope. Examples of measures include the introduction of new energy technologies or the penetration of electric vehicles. Policies and proposals can then be developed to realise the measures.

Because the model interacts with non-energy sectors such as land use and waste, TIMES is able to provide a system-wide view of how we can most effectively deliver our targets.

ANNEX: HOW THE MODEL WORKS

TIMES models are a standard tool

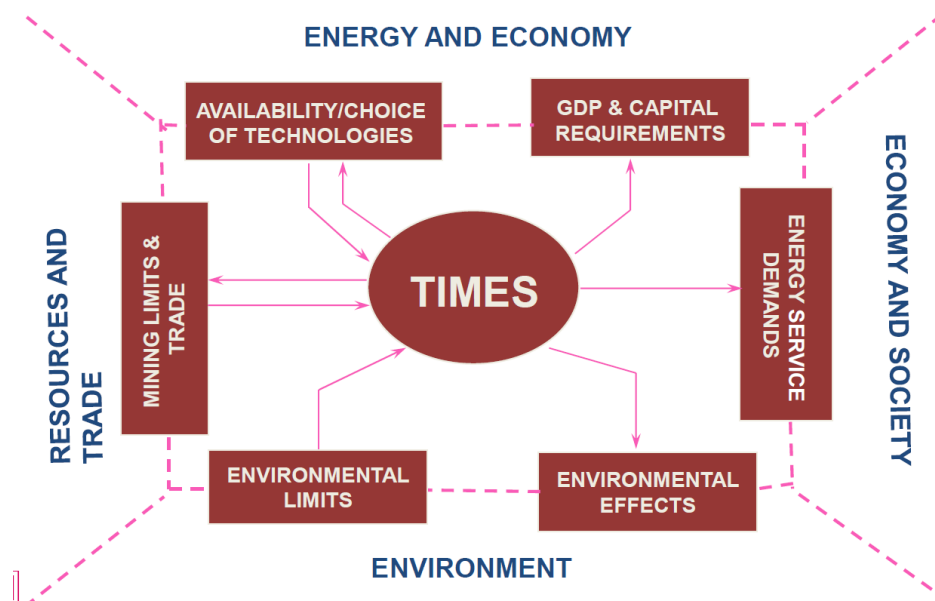
The development of the TIMES modelling framework is co-ordinated by the International Energy Agency. It is rapidly becoming the de-facto standard tool for whole-systems energy modelling in Europe and North America. In the following map, blue shaded countries indicate that the country's Government is a formal member of the IEA modelling community; green shaded countries indicate that the modelling framework is being used by academic institutions in that country.



The energy system

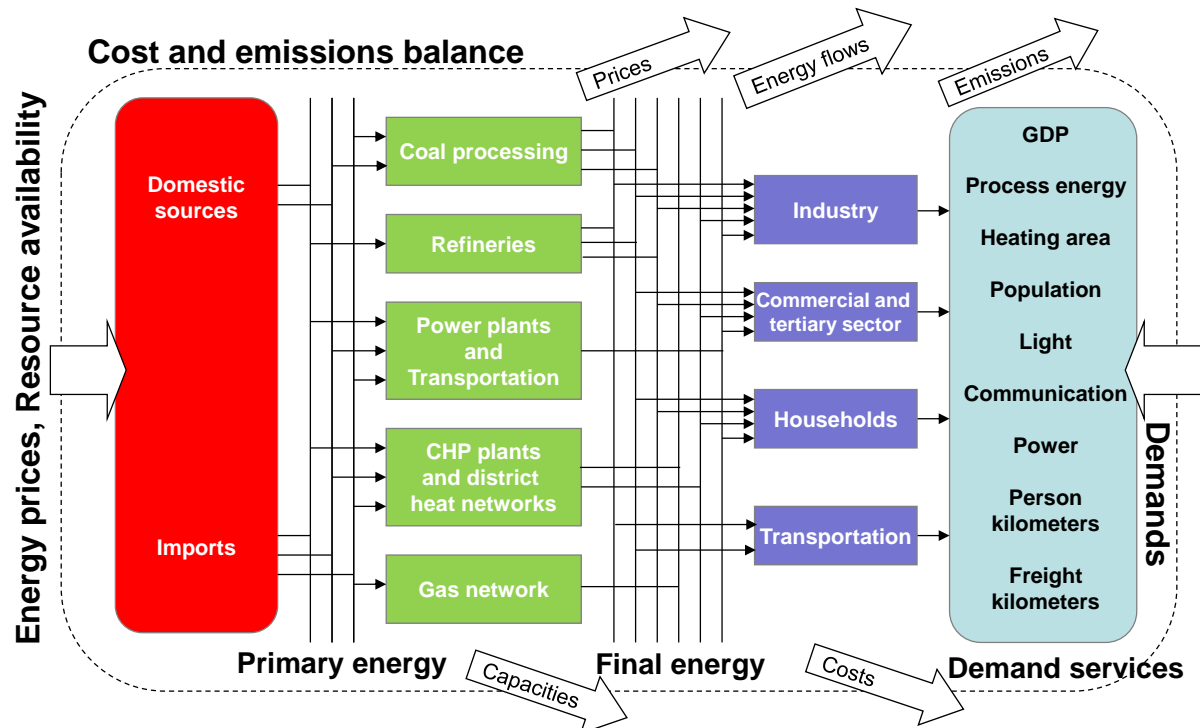
The TIMES model is classed as a whole systems energy model. Essentially this means that the model attempts to articulate the entirety of all flows of energy within an economy, although in practice these models are generally extended to include land-use and forestry and, as such, consider all processes with connotations for net greenhouse gas emissions.

The model also considers the interactions between this energy-system and the prevailing environment, the wider economy, natural resources, trade, and end-users of energy.



The existing energy system

The starting point of the Scottish TIMES model is a detailed representation of the energy system containing the processes and technologies currently in use in Scotland.



The above diagram is a simplified representation of the energy system showing the following main parts:

- Resources (red) – includes current and potential availability of 'traditional' energy sources such as oil and gas, but also includes sources such as wind, biomass, wave/tidal and solar. Trade is also included in this section.
- Conversion (green) – includes the range of technologies and industrial processes used to convert resources into usable energy – from the production of petrol to the generators atop wind turbines.
- Consumption (Blue) – Details the range of potential uses (energy-services) for the energy being converted and distributed by the system, along with the technologies used to convert into a usable form, e.g. Light, heat, computing and refrigeration.
- Demands (Light blue) – details a range of information shown to influence the amount of energy-services required. These are generally specified via other models, e.g. GDP growth will influence many of these demands.

Transitioning the current energy-system into the future

The key use of the model is to explore at a strategic level how the energy / climate system in Scotland might change as we move through the period of the Climate Change Plan (and beyond).

As we move into the future, existing technologies and processes will require replacement, possibly with more efficient alternatives, as they reach the end of their natural or economic lifetimes.

In responding to these changing conditions, the model will make a series of investment decisions in order to ensure that demands for energy continue to be met. In effect, the model identifies the investments to be made at any given point in time which represent the lowest overall cost solution to meet demand subject to the constraint of delivering this within the emissions permitted by Scotland's Climate Change targets.