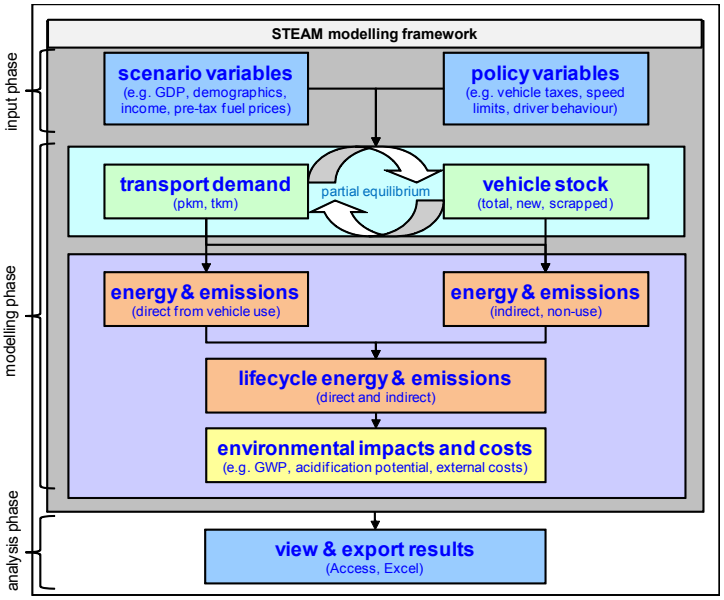
STEAM – Scottish Transport Energy Air pollution Model

What is it?

STEAM is a regionalised version of the UK Transport Carbon Model (UKTCM) and represents a highly disaggregated, bottom-up modelling framework of the transport-energy-environment system for Scotland. Built around a flexible and modular database structure, it simulates future transport supply and demand, for all passenger and freight modes of transport, and calculates the corresponding energy use, life cycle emissions and environmental impacts year-by-year from its base year of 2012 to 2060 and beyond. It takes a holistic view of the transport system, built around a set of exogenous scenarios of socio-economic, demographic and cultural developments. The model is technology rich and, in its current version, provides projections of how different vehicle technologies evolve over time for 770 vehicle technology categories, including 283 car technologies such as increasingly efficient gasoline internal combustion engine vehicles, battery electric vehicles, plug-in hybrid electric vehicles and hydrogen fuel cell vehicles. An overview of the model has been published in Brand et al. (2012).



What can it be used for?

STEAM was designed to explore alternative transport futures to meet carbon mitigation, air quality and energy policy goals. Analysts and decision makers are able to systematically compare a wide range of scenarios and policies, including those focusing on travel behaviour and demand, vehicle ownership and use, fiscal, pricing, eco-driving, fuel obligations, speed limits, technology investment/procurement, 'official' vs 'real world' gaps, and urban area access restrictions. It provides estimates of the full environmental consequences, including pollutant emissions by source, by end user, domestic and 'international', targets vs. cumulative, and so on.

Uncertainty in the outputs is typically assessed by conducting sensitivity analyses around the central estimates or, if time permits, more sophisticated Monte Carlo simulations.

Use in strategy and policy analysis

While STEAM has not (yet) been applied in policy analysis, UKTCM played a key role in:

- Developing the Energy 2050 'lifestyle' scenarios for UKERC (Anable et al., 2011; Anable et al., 2012);
- Exploring the effectiveness of low carbon car purchasing incentives in the UK (Brand et al., 2013);
- Exploring motorway speed limits and CO_2 impacts (UKERC policy brief);
- 'Dieselgate': AQ and CO2 trade-offs and co-benefits of emissions mitigation policy (Brand, 2016);
- Contributing to the UKERC submission to the House of Commons Energy and Climate Change Committee's Second Report of Session 2016–17 of the 2020 renewable heat and transport targets.

UKTCM will be further developed and used in developing low carbon urban freight scenarios for UKERC project 'adVANce': carbon emissions reductions for vans (2016-2018).

We are working on spatially explicit versions of STEAM (LA) and UKTCM (regional, LA), with a 2015 – 2017 timeline, as well as improving the demand model by framing demand around decision making and 'transport user groups' rather than demand sectors/modes of transport – individuals, fleet managers, organisations.

Associated work: MOT project, DEMAND centre transport projects

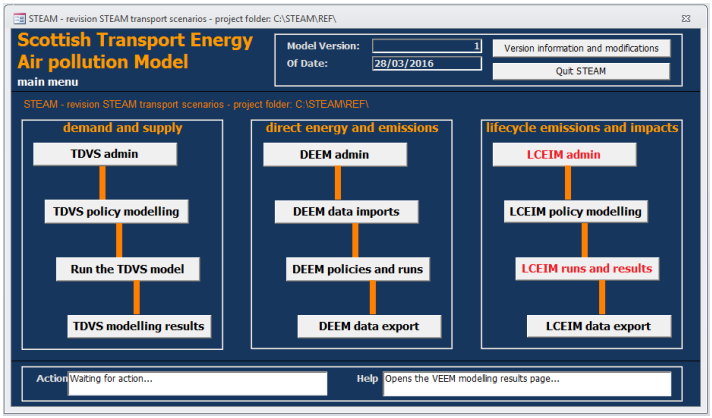
Data needs

STEAM is data rich requiring a significant amount of baseline data, including:

- Travel behaviour and transport demand (by purpose, mode and geographical area);
- Trip frequencies, trip lengths, mode shares, vehicle occupancies, vehicle speeds (road);
- Vehicle ownership and stock (by mode, geographical area, technology, age, etc.);
- Vehicle technology data (prices, efficiencies, market availability, preferences, refuelling, etc.)
- Car/van market and consumer preference data;
- Exogenous input data and projections of demographic, socio-economic, technological and (firm and committed) policy developments (e.g. the relatively complex CO_2-graded road tax and company car tax regimes to 2020);
- Detailed energy use and emissions datasets, including 'official' and 'real world' factors;
- Life cycle energy use and emissions factors.

Availability

To use the model for research purposes, please contact Christian Brand at the Environmental Change Institute. Due to its size (the complete suite of modelling databases uses about 500MB of storage space) the model can only be made available by request. The complexity of the modelling means that in reality only dedicated analysts will be able to use the model appropriately. Contact: Dr Christian Brand



Key references and links

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- Anable, J., Brand, C., Tran, M. and Eyre, N. (2012) Modelling transport energy demand: a socio-technical approach. *Energy Policy*. 41, pp.125 - 138.
- Brand, C., Tran, M. and Anable, J. (2012) The UK Transport Carbon Model: an integrated lifecycle approach to explore low carbon futures. *Energy Policy*. Vol 41, pp. 107-124.
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- Anable, J. and Brand, C. (2011) UKERC Policy Brief: Speed limits and carbon emissions.
- Brand, C. (2010) UK Transport Carbon Model: Reference Guide v1.0. UKERC Energy Demand Theme, Oxford. 131 pp. http://www.ukerc.ac.uk/asset/DEBBE3DC-BC9F-4CA2-A87653B46434DF5A/.