National Centre for Energy Systems Integration

UNIVERSITY of STRATHCLYDE
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CENTRE FOR ENERGY POLICY

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Modelling the Distribution of Costs from Network Upgrades for Electric Vehicles (EVs)

EPSRC National Centre for Energy Systems Integration flexible fund project

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The UK and Scottish Governments have set ambitious targets for the roll out of electric vehicles (EVs). Both government and the car industry are predicting a rapid expansion in EV ownership over the next couple of decades. With that comes a shift in demand away from petrol and diesel fuels and towards electricity. The mass roll out of EVs will have a profound impact on the electricity system, and it is likely to require upgrades to the electricity network itself, which will carry significant costs.

Project overview

This project integrates energy and economic system modelling approaches to investigate the crucial question of **who ultimately pays for the costs of upgrading the power network to facilitate the intended roll out of EVs.** Our approach facilitates consideration of a range of indirect, and possibly unanticipated and unintended, economic and distributional consequences of network development for EVs through impacts on markets, prices and incomes across the economy.

We set the analyses in the context of different scenarios regarding electric vehicle roll-out, charging, and wider economic and energy system conditions. In turn, impacts on incomes in particular may affect both the actual pathway of the roll out, and who ultimately pays for required actions. The project involves collaboration between the University of Strathclyde's Centre for Energy Policy and SP Energy Networks (SPEN).

Who is this research of interest to?

The question of how upgrade costs are ultimately distributed is of key interest to a wide range of stakeholders. We are therefore engaging widely through this project, and providing outputs in an accessible form.

Our results will be of particular interest to:

- policy makers in the Scottish Government, BEIS, DfT and Treasury;
- SPEN as our project partner, as well as wider energy industry actors, and in particular other electricity distribution network companies;
- think tanks and NGOs working on transport decarbonisation, energy consumer issues and climate justice;
- local government stakeholders involved in decision-making about EV charging planning.

Our research question

As with any large-scale infrastructure development, there will be cost and consumer price implications that in turn are likely to have wider economic impacts. Our core research question is: **what is the ultimate distribution of newly configured system costs across different household income groups?**

This will involve considering the knock-on effects across the economy of changes to the price of electricity faced by both residential and commercial users, and how this impacts spending power and demand from different final consumers, including different types of households.

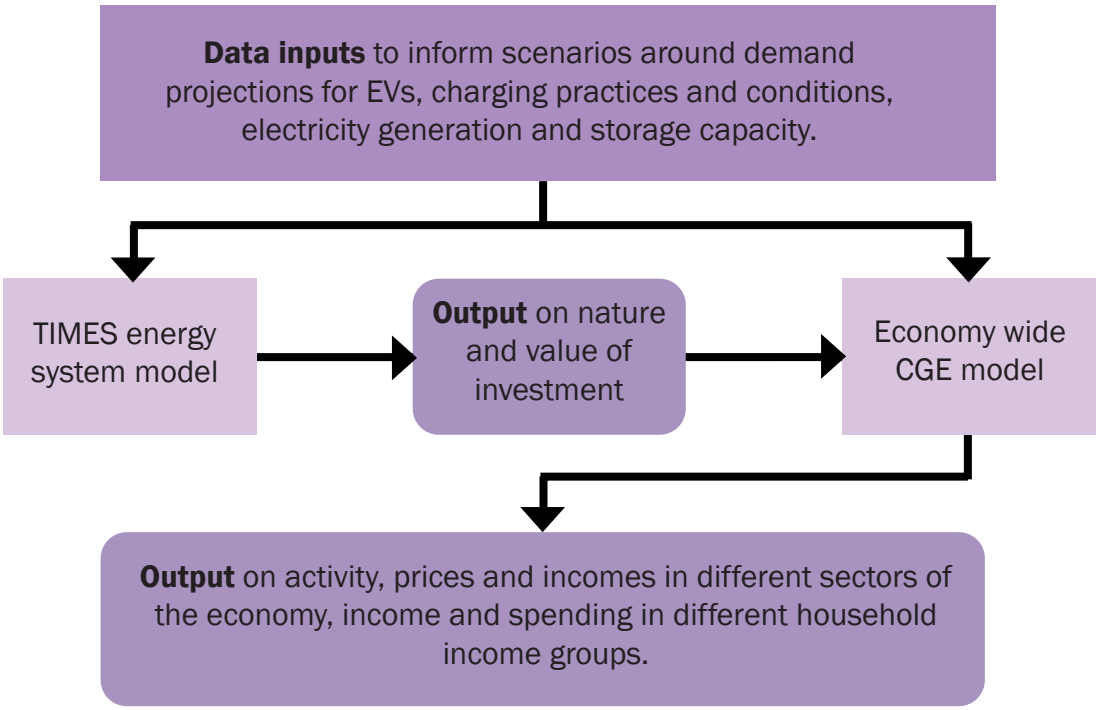
Research strategy

We will use two models – the TIMES energy systems model and the Centre for Energy Policy's economy-wide computable general equilibrium (CGE) model. Use of TIMES will allow us to consider how the roll-out of EVs will impact the energy system, generating a range of new costs (including infrastructure investment), under different scenarios regarding the charging system, storage capacity etc.

We will then use the CGE to consider how these costs impact through economy, in the context of both the EV and energy system scenarios, but also different market and macroeconomic conditions.

Crucially, use of the CGE lets us consider the range of indirect, and possibly unanticipated and unintended, economic consequences of upgrading the network to support EVs.

The following diagram shows how the two models work together in our project:



Using the TIMES whole energy system model

We are setting up a range of scenarios to analyse in the TIMES whole energy system model. These will link to existing scenarios identified by, for example, Ofgem and National Grid, and allow us to consider different levels of EV penetration on the network and the impact of 'smart' versus 'dumb' charging on projected system costs.

We will take outputs from the TIMES model relating to (a) the costs of upgrading and running the network; and, (b) transport system costs and feed those into our economy-wide CGE model as information to inform economy-wide model simulations.

Using the economy-wide CGE model

The CGE model allows us to consider the question of 'who pays' on a dynamic basis over time, under different scenarios. We are looking at how households and businesses respond to the changes in costs of using an upgraded electricity system, and how this plays out in prices and incomes across the UK economy.

The distribution of the benefits of switching to EVs may shift over time. The new transport services (potentially with gradually reducing transport running costs) enabled by electricity network upgrades may not be enjoyed by many current system users, e.g. people who are not in the first wave of EV users. We aim to incorporate consideration of issues such as this via our integrated approach.

Research outputs

We will engage with a broad range of stakeholders to inform our scenarios and to ensure our project outputs are as useful as possible. Anyone interested in engaging directly with the project should contact **ragne.low@strath.ac.uk**. We will also make outputs available on-line.

Two briefing papers setting out initial findings (in December 2018) and final conclusions (March 2019) will be available on the CEP website (visit **www.strath.ac.uk** and search for "Centre for Energy Policy").

We will also produce at least one academic paper for submission to a peer-reviewed journal(s) that will also be made available on an open access basis.