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Who gains and who loses in the shift to electric vehicles: impact assessment through multi-criteria multi-stakeholder analysis

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Abstract

Studying the case of the subsidy for electric vehicles in Great Britain ("plug-in car grant"), this research suggests an integrated impact assessment approach by coupling policy issue system modeling with stakeholder preference elicitation.
In particular, we utilize fuzzy cognitive mapping to model the policy issue as a dynamic and complex system. We further simulate the subsidy policy in the model to estimate the changes in select policy aspects. The simulation outcomes are assessed through perspectives of stakeholder groups. For the latter task, nine stakeholder groups were identified and profiled by conducting content analysis and applying the novel CAR method.
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1. Introduction

Assessing policy impacts is a prerequisite for any public policy and associated interventions. Impact assessment, in general, analyses attainment of intended goals along with other likely affects and consequences of a policy initiative. Policy impacts, in general, are usually considered to fall into the three categories: economic, social and environmental. These categories result in three corresponding types of traditional impact assessment, with their corresponding methodologies. Obviously, approaches tailored to a particular category cannot analyse intervention's

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impact comprehensively, e.g., due to ignoring possible interactions between the categories. A systems approach is required in order to analyse the policy issue complexity and provide holistic overview of possible outcomes (1).

Furthermore, while conventional impact assessment focuses on expected effectiveness of interventions in fulfilling a predefined set of goals, the goals might not represent interests of all the important stakeholders. Moreover, stakeholders differently perceive importance of the goals. Ignoring stakeholder preferences in the assessment might result in conflicts between stakeholders, resistance to the change implementation, and ultimately not balanced and comprehensive solution, which risks to undermine initial intentions of the intervention. Thus, policy impact assessment should analyse not only the likely objective outcomes, but also analyse what threats and opportunities those outcomes create for different stakeholders.

One of the domains where different interacting systems create significant complexity for policy makers is transportation. A recent challenge in the domain is a transition from conventional cars to electric cars. Electric cars are automobiles that are propelled by electric motors, using electrical energy stored in rechargeable batteries. While in most countries the market share of electric vehicles (EVs) is insignificant, Norway enjoys over 22% of the share. Moreover, Norway has recently announced the complete ban of petrol powered cars by 2025 (2). This example, albeit exceptional, shows feasibility of the complete transition.

The UK government also committed intention and efforts to promote uptake of EVs in the country. The Office for Low Emission Vehicles was introduced as a cross department body, with the budget over £900 million to support the early market for ultra-low emission vehicles. A few particular programmes were introduced to improve the uptake. A widely known programme is the Plug-in Car Grant - the subsidy (upto 5000 GBP) for individuals towards purchase of electric cars. The measure seems effective, as the The Society of Motor Manufacturers and Traders celebrates a 226% sales rise for hybrids and pure EVs in 2015 (3). Yet, it is unclear what costs (of any nature) are to be paid, and how other stakeholders will be affected.

As part of this study we aim to conduct an independent impact assessment of the aforementioned subsidy programme as part of the broader transition to EVs. To this aim this study suggests a practical methodology for a comprehensive multi-stakeholder policy impact assessment.

The remainder of the paper starts with the overview of barriers, facilitators and other details on the transition to electric vehicles. Further, we present the methodology built upon mixed methods to couple system modelling of a policy issue with stakeholder preferences modelling. In the later part, we demonstrate application of the methodology to the case of the subsidy to EVs in the UK as part of a broader transition to EVs. We present preliminary results and demonstrate what kind of analysis the employed approach can enable. Conclusions and future developments conclude the paper.

2. The silver bullet of electric vehicles

Electric mobility is not a novel concept: the first EVs appeared in the 19th century, deemed to prevail over petrol and steam cars. However, the current environmental concerns such as global warming and air pollution have boosted the development of electric mobility. Besides, the environmental benefits, the EVs are expected to change many other spheres of life. The rest of the section provides a literature summary, overviewing motivations and concerns regarding EV market expansion.

2.1. Environmental concerns

As climate change has recently gained much priority on the global political agenda, EVs are promoted as one of the main means to reduce the CO_2 emissions, thus fighting the global warming. Indeed, the decarbonisation of road transport could result in substantial carbon emissions reduction. In the UK a quarter of all CO_2 emissions come from transport; and road vehicles represent 90% of this environmental impact (4). This fact has become a prevailing argument for the transition among policy makers.

Yet, it's worth noting that EVs can only be as green as the electricity used to charge their batteries (5). CO_2 would be still released not only at the point of electricity generation, but at EVs production as well. Thus, although the EV is approximately five times more efficient than the average fossil fuel-powered car (6), the engines of modern petrol-powered cars can be still more efficient than some fossil fuel power plants (7). Hence, in order to

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