E-MOBILITY FROM A MULTI-ACTOR POINT OF VIEW

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Overview

Since the transport sector accounts for almost 25% of all EU CO_2-emissions, a decarbonisation of the transport sector is crucial for reaching GHG reduction targets [1]. Many countries have implemented measures to promote the deployment of electric cars. However, the diffusion of electric vehicles has been slow so far. This reflects a lack of acceptance, poor understanding of the benefits of such vehicles, and the entrenched position of conventional vehicles. In this paper, we apply a multi-actor multi-criteria approach to the assessment of attitudes of different types of stakeholders (including car users, vehicle manufacturers and utilities) towards e-mobility. The attitudes of stakeholders depend on a lot of different factors but the list of factors differs between the stakeholders [2-4]. Hence, for an appropriate assessment of decarbonization of the transport sector it is necessary to consider a wide range of aspects including the weighting of relevant factors by actors. Using a multi-criteria approach we show that stakeholders like car users and vehicle manufacturers will put up resistance if they are urged to switch to e-mobility. Since the assessment of the characteristics of e-mobility is linked to high uncertainty, we conducted intensive sensitivity analyses. According to these analyses it is difficult to cause a shift in the attitude of car users towards electric vehicles, since electric vehicles have a lot of disadvantages for the car users (including loss of comfort). According to our assessment hybrid cars face less resistance since the technology is linked to more benefits/less negative effects for the stakeholders than e-mobility.

Methods

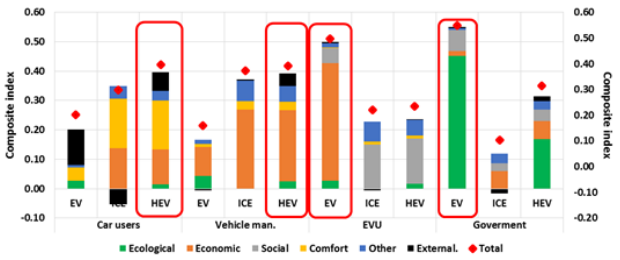
In this study, we assume that (a) there is a set of different actors who differ with respect to their preferences and that (b) the actors can choose between different technologies. A measure aiming to promote a particular technology will be supported by actors if they expect more benefits from using this technology than if they opted for an alternative one. Hence, if the technology promoted by the initial policy measure does not provide more benefits than any alternative, it could be expected that the technology will struggle to gain ground. In addition to the attitudes towards a technology, we take impacts resulting from externalities, representing feedback resulting from activities of other actors, into consideration. Applying a two-order approach we differentiate between (1) effects resulting directly from the decision to opt for a technology by a specific group of actors ("first order effects") and (2) externalities reflecting impacts of an adoption of a technology by one group of actors on other actors ("second order effects"). We consider four different groups of actors: (a) Car user, i.e. individuals who are interested in using a car to get to work or to the shops, (b) vehicle manufacturers, i.e. companies that produce cars, (c) electric utilities, i.e. companies aiming to sell electricity and (d) government representing decision makers who focus on objectives on a national (or at least regional) political level. Regarding the alternatives available to the actors, we consider the possibility of buying and using an electric car (EV), a car with an internal combustion engine (ICE) and a hybrid car (HEV). For an appropriate comparison, we assume that the selected cars are compact/mid-range cars. The specification assigned to the three car categories is based on latest data for selected cars of this category. Applying an MCDA approach we assume that a decision maker will support the technology with the highest overall performance (see e.g., [5, 6]). Regarding the factors which are relevant for the decision making process, we employ a hierarchical approach by clustering all factors firstly into superordinate categories. In a second step these categories are disaggregated into subcategories. The chosen approach consists of four steps: (1) Normalization of the assigned values with the aim of conducting a methodologically reliable comparison of factors with different units, (2) weighting of benefit categories from the perspective of the actors in order to take the relative importance of categories into consideration,

(3) weighting of the different kinds of benefits within a category from the perspective of the actors and (4) aggregation of the weighted values to a composite indicator reflecting the attitude of an actor towards a technology.

Results

The scenario "without externalities" indicates that, under the assumed framework, the actor group "car users" will favour ICE cars. Not surprisingly, vehicle manufacturers also prefer ICE cars, whereas electricity utilities and the government prefer electric vehicles. There are different underlying reasons for the attitude taken by electricity utilities and the government towards EV: the attitude of electricity utilities is mainly influenced by economic aspects whereas the government sets priorities according to environmental factors. If we take cross-over effects (triggered by the positive attitude of the government and the utilities towards EV cars) into consideration, the attitude of car users will change: they will prefer hybrid cars to ICE cars. This change in attitude is linked to changes in cross-over effects. Hence, we change the dummy values reflecting the modified attitude of the car users and recalculate the composite indicators for the different actor groups. The scenario "second order externalities" is based on the modified external effects, i.e. it takes into account that car users have switched from ICE to supporting HEV. It differs only marginally from the scenario "first order externalities". The results confirm the attitude of car users towards HEV. HEV are also preferred by the vehicle manufacturers. Utilities and the Government prefer EV. All in all, ICE cars will become less popular if externalities are taken into consideration. In the scenario "EV", we analyze how the calculated attitude of an actor group towards EV will differ if all actor groups support EV, through their externalities. According to our results, a prioritization of EV by the government, utilities and car users will disproportionately affect the attitude of the vehicle manufacturers. However, the external effects will not be strong enough to change the order of the vehicle manufacturers' preferences significantly, as they do not exceed the original score of the technology on the performance index for this actor. In particular, restrictions regarding range and charging time limit a switch of the car users to EV. To effect a change in the attitude of these two actor groups, either the characteristics of EV or the weighting of the characteristics have to be changed.

Fig. 1Assessment of attitudes towards car technologies



Conclusions

In principle, each measure, whether on an individual, national or international level, causes multiple effects. For an assessment of a measure, it is worthwhile to focus not only on the benefits the measure is aiming to achieve, but also on ancillary effects such as impacts on health and changes in income. Usually, different decision-makers have different attitudes towards a particular technology. Accordingly, decision-makers support measures focusing on technology deployments to greater or lesser degree. Using the example of e-mobility, we show that stakeholders like car users and vehicle manufacturers will show resistance, if they are urged to switch to e-mobility. In our study, we extend the ancillary benefit approach by taking externalities into consideration. These externalities reflect cross-over effects between actor groups. For example, the car users will benefit if vehicle manufacturers spend more R&D funds on e-mobility because they favor e-mobility. Since the assessment of the characteristics of e-mobility is linked to high uncertainty, we conducted intensive sensitivity analyses. These analyses show that it should be feasible to cause a shift in the attitude of car users towards hybrid vehicles but not to electric vehicles, since electric vehicles face a lot of restrictions, including loss of comfort. Regarding the attitude of vehicle manufacturers toward e-mobility, profit margins are a crucial factor.

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