Early electrifiers: individual profile and impact of the energy crisis

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Overview

A fast adoption of devices that allow the replacement of fossil fuels with low carbon electricity in households' energy consumptions is one of the key pillars of the decarbonization effort. Photovoltaic panels, heat pumps, electric vehicles, and batteries for storing the own panels' production are increasingly popular as tools for decarbonizing energy consumptions of individual households, even if their adoption is proceeding at different speed and with heterogeneous patterns across different countries.

There is, indeed, a growing literature investigating the demographic, behavioural, and contextual drivers of the decision of purchasing each of these devices, also in light of the fast evolution of their prices and technical characteristics. Nonetheless, only few analyses have instead focussed on the interdependencies across the decisions of purchasing more than one device, and on the impact of individual or exogenous drivers on inter-related or joint purchase decisions.

We build on the existing analyses concerning the purchase behaviour for each of these individual devices, and exploit data from an on-line survey distributed between December 2022 and February 2023 on a panel of 5'151 respondents living in Canton Ticino (Switzerland) to develop a discrete choice model describing the demographic, behavioural, and attitudinal profile of the "early electrifiers", that is, individuals owning more than one of the above-mentioned devices. Moreover, we exploit information on the individual perceptions and reactions toward climate change and the recent energy crisis to assess the impact of these two drivers on the purchase decisions.

Methods

Our analysis is based on the data collected through a survey, part of which was developed at the Institute for the Management of Renewable Energies (IWOE) of the University of St Gallen (Switzerland) for the German-and French-speaking regions of Switzerland. The original survey included questions concerning the ownership of each of the four devices, a number of demographic and behavioural characteristics of the respondent possibly impacting the purchase decision, the respondent's stance in some intermediate steps of the purchase decisions, and finally the respondent's opinions on the Swiss energy and climate policies. In agreement with the IWOE researchers, we translated part of the survey in Italian, the official language of Canton Ticino, and added some questions concerning the respondent's stance toward car use, risk of blackouts, risk of nuclear accidents, and perceived effectiveness of the own energy saving or environmental behaviour in tackling the energy crisis or mitigating climate change.

The survey was distributed in on-line format. The invitation to fill-in the survey was sent per e-mail or paper mail by 7 electricity retailers active in Canton Ticino to their customers, either with the retailer's e-newsletter, or with the quarterly electricity bills. As an incentive to fill-in the survey, we offered a monetary prize of 500 CHF to one respondent randomly drawn from all those who decided to leave their e-mail address or phone number at the end of the survey.

Our plan for deriving a joint model for the purchase decisions for more than one of the electrification devices relies on the use of a discrete choice model, possibly including latent classes or latent variables to account for latent constructs such as environmental awareness or risk aversion.

As our survey did not include a proper discrete choice experiment, we plan to exploit the individual answers to the questions concerning the ownership of each of the four devices, namely PV panels, heat pumps, electric vehicles, and batteries, as alternatives of the discrete choice model. The alternatives available for each of the four devices would then be: "Yes, I already own it", "No, but I might buy it in year …", "No, I didn't think about purchasing it yet", and "No, I decided not to buy it".

Within this framework, we plan exploit a nested or cross-nested logit structure to investigate whether the alternative "No, but I might buy it in year …" is more similar to the "Yes" option, or to one of the remaining "No" options.

The utility functions for each of the four devices would then be included within the same discrete choice model by adding, in the utility functions for each device, a scale parameter representing the different magnitude of the heterogeneity of the individual behaviour when deciding about different devices. This strategy has already been used to simultaneously model stated and revealed preference data, and is needed to ensure that the assumption of independent and identically distributed error terms across different devices is preserved.

This model structure will allow us to directly test the impact of demographic and behavioural drivers on the purchase decisions of the four devices as a whole, and investigate the role of attitudinal drivers, such as environmental awareness, concern for the energy crisis, or risk aversion, by means of latent classes or latent variables again impacting at the same time the four devices.
Discrete choice models applied to stated or revealed preference data have been widely used in the past decades in the energy economics and transport literature to analyse the drivers of purchase decisions for specific devices, energy supply contracts, or transport and travel options. Since the early 2000s, a growing literature has also exploited latent variables or latent classes to properly account for drivers such as attitudes or other psychological constructs that are not observable per se, but can be measured within surveys through appropriate indicators. This growing literature is indeed able to provide interesting insights into the "black box" of choice behaviour, shed light on the role of emotional and cognitive factors, and go beyond the insights provided by the typical observable demographic or behavioural factors.

Results

Our results will provide a description of the profile of the early electrifiers in the Swiss Canton Ticino, covering the impact of individual and contextual drivers and, if relevant, accounting for attitudinal drivers described either as latent variables, or as latent classes corresponding to different segments of the population of the (prospective) electrifiers. Next to highlighting the effect of demographic and behavioural drivers, our findings could thus shed light on the role of environmental concern and the weight of the energy crisis in shaping purchase decisions.
The results we will provide will complement the findings of the existing literature explaining the purchase decisions for each device, describe the segments of the population that can be expected to be front-runners in the energy transition, and detect those for whom specific policies or information campaigns could be most effective.

Conclusions

The energy transition process is increasingly requiring a holistic approach to decarbonization, considering at the same time the electricity, heating, and transport segments. Our analysis will reflect this new approach, and hopefully lead to a better understanding of the observable and unobservable factors that distinguish the early electrifiers from the average or more reluctant individuals.
A better knowledge of the drivers behind the purchase decisions and an insight into the expectations, fears, and perceived trade-offs that may shape individual behaviour may be useful for policy makers and commercial providers of each technology, and support the drafting of appropriate policies and information campaigns contributing to a smooth progress toward the decarbonization goal.