Consumer preferences and the energy transition

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Overview

In the aftermath of the Fukushima nuclear accident in 2011, the Swiss Federal Council and Parliament discussed and approved an update of the national energy strategy, providing for the gradual decommissioning of the existing nuclear plants in the country. The new "Swiss Energy Strategy 2050" encompasses a wide set of actions: among these, the provisions concerning the electricity sector focus on ensuring the security and sustainability of electricity supply by upgrading the country's generation fleet and transmission and distribution grids. A first bundle of practical measures fosters therefore the expansion of renewable-based, low carbon generation facilities to make up for the decreasing contributions from nuclear plants. Within this scenario net productions from hydroelectric plants, already contributing to almost 60% of national productions, are held roughly constant, whereas productions from non-hydro, renewable-based plants should see a fourfold increase by 2035 with respect to 2015 levels. Solar and wind are expected to play the main role, with smaller contributions from biogas, wood, waste, and geothermal energy.

The technological, economic and regulatory challenges posed by the energy transition are constantly studied from a supply-side perspective. In recent times increasing attention has been paid to demand-side aspects as well, in order to assess the potential contributions from demand response and evaluate the acceptance of new technologies from both local communities, and individual consumers. This approach is particularly relevant to the Swiss case, as energy policies and infrastructural projects can be hindered by means of national and cantonal referenda . Accurate information concerning citizens' preferences and their drivers is thus crucial in order to design successful policies, and facilitate the achievement of the desired energy policies and infrastructural goals.

The goal of this study is contributing to the shaping and management of the energy transition in Switzerland by assessing the preferences of Swiss residential consumers with respect to the primary energy sources used for generating electricity, while accounting for their preferences with respect to variations in the risk of experiencing short and long blackouts. By means of a discrete choice (DC) experiment on stated preferences, we model the respondents' preferences toward the above-mentioned features of electricity supply, and account for the influence of socio-economic, behavioural and attitudinal variables thereon. The information we gather on consumers' preferences toward greener supply options and their willingness-to-pay (WTP) for a safer supply can inform decision-making as regards the kind of investments and the amount of resources that could be available for specific objectives. Our analysis of consumers' tastes and on the drivers of their heterogeneity, on the other hand, may support the definition of policies and strategies that minimize local opposition and facilitate the achievement of the desired goals.

Methods

We use a DC experiment on stated preferences collected via a web-based survey, administered to a sample of 1006 respondents, stratified as to be representative of the whole Swiss population.The survey includes:

- Questions regarding demographic variables possibly affecting consumers' preferences
- A set of 30 attitudinal statements that the respondents are asked to evaluate on a 7-points Likert scale. The topics covered include attitudes toward: nuclear, coal- and gas-fired generation, the use of renewable energy sources for generating electricity, local impacts of wind generation, electricity imports, blackouts, increases in electricity prices, climate change, and environmental pollution,
- Seven choice tasks, where consumers choose one out of five alternative electricity supply contracts for their own dwelling. The contracts differed by the following the kind of primary energy source used (nuclear energy, hydroelectric energy, wind, sun, and an unspecified energy mix with a variable contribution from unspecified renewable energy sources), the price of electricity in CHF cent/kWh, and the number of short and long blackouts per year.

Results

After a preliminary analysis via a multinomial logit model and a principal component analysis of the respondents' evaluations of the attitudinal statements, we specify a hybrid DC model with two latent variables (LV), corresponding to a pro-environmental attitude (LV1) and to a positive stance toward nuclear and thermal generation (LV4). Our results can be summarized as follows:

- Respondents do not show strong ceteris paribus preferences for specific primary energy sources: alternative-specific constants are indeed not significant,
- There is a strong variability in the sensitivity to price increases for each primary energy source: price coefficients are more negative for the Nuclear and Wind alternative, and closer to zero for Sun and Hydro,
- The coefficients for a further reduction in the frequency of short and long blackouts with respect to current levels are not significant. On the contrary, the coefficients for an increase in the frequency of short and long blackouts are negative and significant, with the former coefficient approximately equal to one third of the latter. The hypothesis of a discrepancy between WTP and WTA values with respect to security of supply is thus confirmed in our analysis,
- The coefficients for a decrease and an increase in the contribution of renewable energy sources in the Mix alternative are not significant,
- Younger respondents are more sensitive to the kind of energy source used, and women are more likely to oppose nuclear generation,
- Latent constructs also play an important role in defining consumer preferences:
  - LV1, corresponding to a stronger pro-environmental attitude, has a positive and significant coefficient in the utility function of the Mix alternative, specifically in the interaction with a dummy variable corresponding to an increased share of renewables in the Mix.
  - LV4, corresponding to a positive attitude toward nuclear and thermal generation, has instead a positive and significant coefficient in the utility function of the Nuclear alternative: respondents with higher LV4 values are hence more likely to choose the Nuclear alternative,
- As regards the demographic and behavioural variables behind the above-mentioned latent variables:
  - LV1 is positively correlated to engagement in green behaviours, higher education levels, residence in a city, previous blackout experiences, and a lower degree of energy literacy,
  - LV4 is instead positively correlated to energy literacy, and negatively correlated to engagement in green behaviours, higher education, and the facts of being a German native speaker and a Swiss national.

Conclusions

The main messages we can draw from our analysis are the following:

- Consumers' preferences toward alternative technologies are mainly driven by three factors: a pro-environmental attitude (LV1), a positive stance toward nuclear and thermal generation (LV4), and a varying sensitivity to price increases, with generally lower values for renewable energy sources, with the exception of wind.
- A stronger pro-environmental attitude does not imply a specific preference for a single renewable energy source: environmentally conscious consumers are instead more likely to go for a greener supply irrespective of the renewable energy source used for generation. Given the relatively low price sensitivity observed for the Mix alternative, this leaves considerable room to the policy maker (or electricity suppliers) interested in greening the economy (or their own supply portfolio) in the most sensible or cheapest way,
- Environmental consciousness is generally higher in cities and among households with a higher education title; observed pro-environmental behaviours represent a good predictor of a higher environmental consciousness, but energy-literate respondents usually score lower values in LV1,
- A higher energy literacy is generally associated to a more positive attitude toward nuclear and thermal generation. This suggests that providing accurate information may help minimizing or managing opposition to generation technologies that are usually perceived as undesirable for environmental or safety reasons,
- Green behaviours seem to be adopted less often by those respondents who score higher values in LV4. This suggests that respondents perceive their environmental friendly actions as an effective strategy for reducing more "polluting" productions, and hence might be ready to modify their behaviour in order to contribute to the energy transition, for example by engaging in energy saving measures or subscribing green energy contracts.