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Abstract

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Reference

FIRST INSIGHTS ON SOCIO-MARKAL APPROACH APPLIED ON TIMES-ROMANIA COUNTRY MODEL

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Keywords: Energy and Environmental Planning, Demand Side Management, Optimisation Models, Sociological Surveys, Behavioural Change

JEL classification:  
C61 - Optimisation Techniques; Programming Models; Dynamic Analysis  
C83 - Survey Methods; Sampling Methods  
D12 - Consumer Economics: Empirical Analysis

1. Introduction  
In a situation when many options for the organization of the energy and production system, development directions and long-term strategies are possible, optimization models certainly represent the model of choice.  
One such model, MARKAL, is available to scientists and decision makers since the seventies and has evolved into an integrated tool that allows the analyst to prepare and document various determinist or stochastic scenarios of investment paths in the energy sector, avoiding costly mistakes and lock-in effects for decades to come.

2. Modelling consumer behaviour in energy models as virtual technologies  
MARKAL was developed to address issues related to energy supply security and therefore is production-oriented. In many models, demand side is not described in a similar degree of detail especially when it comes to Demand Side Management (DSM) measures. Low-cost or zero-cost measures, if left unbound, are used to their maximum potential and if bound by the modeller, even according to all his erudition and best expert guess, subjectivity is introduced
into the model. Moreover, in a setup where the modeled entity is a region or a city with limited number of some big technologies, such as municipal waste incinerator or a district heating network, there is a need to correct the assumption of linearity by introducing integer or binary variables to reflect the indivisibility of projects. With reducing the model scope, there is another shortcoming of the classical MARKAL model (as well as of its successor called TIMES, The Integrated MARKAL - EFOM System): the more a description of demand side is detailed, the more important becomes the number of decision makers making frequent investment decisions on small amounts with increased subjectivity and irrationality. Among the technologies with a large irrational part in decision making are passenger cars, lighting bulbs and household appliances in general, but also residential space heating. It has been described that people care more about energy that is visible like lighting, compared to invisible energy such as space heating [4]. This finding is compatible with the social theories of environmentally significant behaviour [6], [7], [10].

In order to overcome subjectivity and correct systematic error resulting from the implied hypotheses of perfect information and of perfect economic rationality applied out of the domain of validity of the original country-level MARKAL model, it is possible to include behavioural data. Energy services consumer behaviour patterns are modelled as virtual process technologies and as such, these can be considered together with tangible technologies on the same optimization platform [8]. Two types of virtual technologies are needed to cover all possible cases: moderate use and technology switch [2].

3. Insights from sociological surveys and hypotheses on consumer behaviour

The first demand technology explored was the residential lighting as a unique opportunity to explore the effects of administrative ban on incandescent lighting bulbs [3]. Important parameters are: part of people who behave according to the neoclassic hypotheses of perfect economic rationality, part of people who do not behave rationally but will do so if better informed, and part of people who will never change their behaviour and so an administrative ban on sales of the concerned product will prevent them from using it. Usually, these people may have other, more important reasons than just economic interest, such as cultural or health reasons. Technical coefficients for MARKAL technologies are extracted from specially crafted sociological surveys and soft-linked with the MARKAL model. Quantitative sociological surveys are usually conducted after formulating hypotheses that originate either from classical qualitative sociological surveys, or from ethno methodology surveys. The idea and setup of the approach have been described in [2]. Detailed description of the methodology including the extraction of technical coefficients for MARKAL model from surveys has been published in [9]. Operational research aspects have been published in [8] and technical insights in [3].

In this paper, we present a few results of the surveys on consumer behaviour conducted in the Geneva area by the LEM, Laboratoire d'Etude des Marchés at Haute Ecole de Gestion de Genève. Interesting hypotheses obtained using ethnomethodology survey in 2010 can be resumed as follows:

1. People are more sensitive to energy consumption when it is visible: lights on, running a car engine, energy bill... (what you see is what you try to save).
2. Advertising campaigns encouraging more consumption are prevailing over energy saving campaigns (visibility, efficiency, budget).
3. Savings in domestic energy consumption is financially not interesting enough to be brought to practice (energy is too cheap compared to phone bills, TV plans, gasoline prices...)

In 2011, a classical qualitative sociological survey was conducted, followed by a qualitative
survey to process hypotheses. Interesting results are the part of respondents who claim to have no particular habit or reflex to save energy. In case of electricity or water, the proportion of such people is 2% but in case of heat, 14% of people say they do not have any particular behaviour to save heat in their apartment which is compatible with similar published studies [4]. 31% of questioned people think that the most ecological habit is to sort waste, 21% believe that it is the action to educate the future generations while using public transportation and limiting the use of the car is designed by 13.6% of respondents to both questions (27.2% total). As for the question of turning off lights when leaving a room, the hypothesis that it is not a result of a parental education to do so, could be rejected with a near to zero p-value (qualitative surveys of 2009 and 2011).

The first version of Romania country model based on TIMES is focused on the demand side where the residential sector is described in high detail. The supply side is modelled through virtual imports of energy carriers. Since Romania did not yet implement the general ban on incandescent lighting bulbs, this gives us an opportunity to explore the case and compare it with findings from Geneva area. Figure 1 represents the corresponding minimal Reference Energy System (RES).

![Minimal Reference Energy System](image)

*Figure 1. Minimal Reference Energy System to describe consumer behaviour concerning lighting, see [2]*.

We propose a similar approach to assess the issues of residential space heating. Buildings that usually are modelled as a comprehensive technology will be represented by three separated virtual technologies: the envelope of the building, its heating system, and the thermal behaviour of its inhabitants when it comes to energy savings. This approach compatible with [1] will allow the modellers to fully separate passive measures from heating technology choices and actions to modify the consumer's behaviour to achieve savings through awareness and changing habits.

4. Conclusions

These first steps are conducting to a detailed insight on consumer behaviour integrated into an energy optimisation model in a Romania country level context that, ultimately, will allow the decision makers to create coherent and sustainable policies in order to achieve environmentally sound, yet economically viable development with long term energy policies based both on technological progresses as well as on social change.
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References