

FACTSHEET

Stochastic Model of Appliances Energy Consumption

PART OF SMART SOLUTION 3: SMART ENERGY-SAVINGS TENANTS



LOW
ENERGY
DISTRICT



- Enables designers and engineers to accurately generate appliances' load profiles according to building type, number of occupants and stock of appliances.
- Aims at a better design of household installations, improving the estimation of energy savings.
- Provides tenants with detailed information about the appliances' consumption, comparing their energy consumption with high performance appliances.
- Aims to influence consumer decisions to improve their appliances' energy labels.

Barcelona

Technical partner:

[IREC](mailto:msanmarti@irec.cat), Barcelona Energy Agency: msanmarti@irec.cat

City contact:

Barcelona City Council: rfuriod@bcn.cat



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What is the solution?

The Stochastic Model of Appliances Energy Consumption is a tool that provides detailed load profiles for electric devices. This tool is able to generate the load profile of 15 different appliances, according to the characteristics of the household: the building type (single family house and multifamily house), the number of occupants (from 1 to 5 occupants) and the equipment stock (type and energy labelling).

The tool has two main applications, and consequently two different target groups:

Designers and engineers: Usually, energy consumption related to appliances is considered the same for all households. In that sense, the tool is able to estimate the energy consumption introducing the main characteristics of the households: type of building, number of occupants and stock of equipment. The results of the tool are the annual consumption and 3-min load profile.

End users, tenants: The energy labelling provides information about the energy consumption of the appliances. Comparing the energy labelling of different appliances it is possible to estimate the energy savings, based on normal use, more accurately than previous methods of estimation.

The tool has been designed to be integrated into common commercially-available energy building performance simulation tools.

How does it work?

The Appliances' Stochastic Model is a statistical model based on Time Use Data (TUD). The TUD is a European harmonized survey done in Spain by the Spanish Statistical Office (Instituto Nacional de Estadística, INE). TUD describes what the people are doing at every moment of the day, providing occupancy patterns and relating them to the use of the appliances (e.g. if the activity is "laundry", then the washing machine is matched to the activity). The structure of the Appliances' Stochastic Model is shown in Figure 1. To run the tool, the building type (single building or block of apartments), the number of occupants and the appliances' stock (type of appliances and energy labelling) must be selected.

As a result, the model will produce the following information:

- a) detailed profiles of the appliances' consumption, with a resolution of 3-minutes (Figure 2);
- b) a summary of the annual energy consumption of each appliance;
- c) an energy comparison with more efficient appliances.

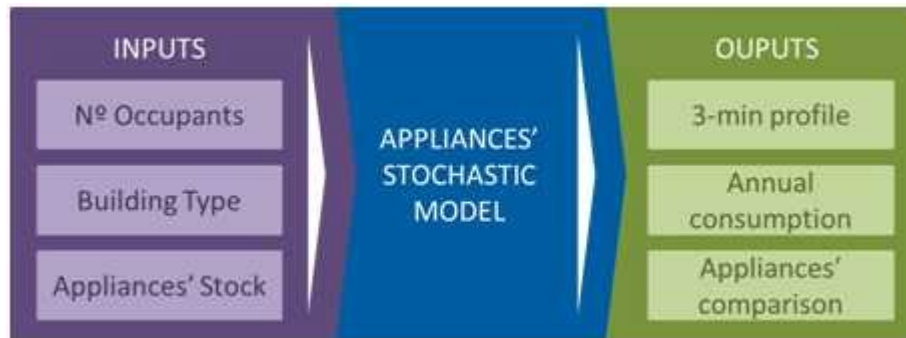


Figure 1: Stochastic Model structure for appliances

Integration with other smart solutions

This solution is included under Measure 3.1 Dynamic price models, as the stochastic models of electricity demand of appliances in households could be used to foresee tenant behavior and their interaction with the power grid. The model results will be compared with the monitored real consumption gathered in Measure 3.1 'Virtual Energy Advisor' in order to further validate the model in the Mediterranean climate context.

Expected Impacts

The Stochastic Model of Appliances' Energy Consumption is expected to be integrated in energy simulation tools and platforms to provide detailed information about the energy consumption of appliances in residential buildings.

From the point of view of the professional sector, this tool will generate detailed

information related to electrical devices consumption. The aim is to design complete strategies to reduce and manage the energy consumption including all the energy uses of the residential sector, and not only thermal ones (heating, cooling and domestic hot water).

From the point of view of the end-user, the tenants will have on-hand accurate and personalised information related to their own consumption profile and will be able to improve energy performance of their homes.

The most important impact of the Appliances' Stochastic Model is to raise knowledge about appliances' consumption among citizens, in order to instigate appropriate strategies to improve energy efficiency in the residential sector and to contribute to consumer behaviour-change.

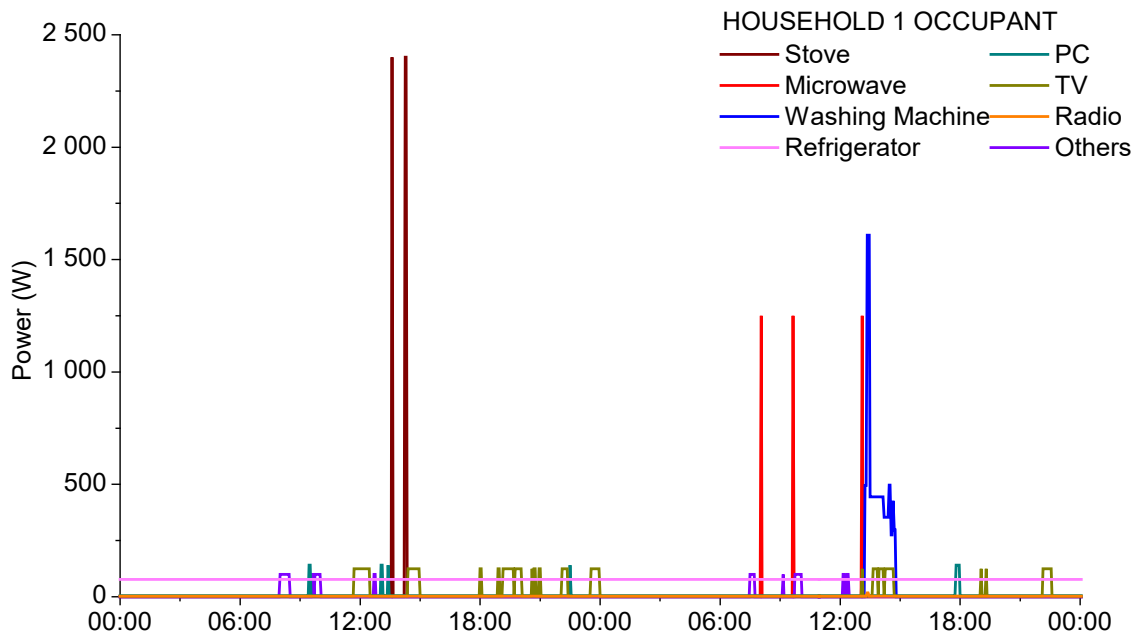


Figure 2 Appliances' load profile for a household with 1 occupant across two winter days

Potential for replication

The presented methodology for modelling the electricity consumption of appliances in the residential sector is applicable to residential uses in general, with a great impact especially on the trends of progressive electrification of households.

It must be considered that the appliances' use is highly dependent on social

behaviour, which is different from one country to another. Since the model developed by IREC is currently based on Spanish data, the presented results are exclusively valid for Spanish households.

However, the tool is based on a harmonized European survey (Time Use Data) and it can be adapted to other countries using their Time Use Data and validating the results with their own monitored data.