

## European Virtual Smart Grid Lab

SES 11814, Deliverable A1300-AD1306

# Interactive User Application for Energy Scheduling

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## Select Energy Schedule Application

The interface of the Select Energy Schedule Application can be accessed at:

<http://www.csc.kth.se/~andelund/EITCO2Cost/>

The interface is generated from the simulation data that are scheduling when appliances should be run. The work presented here has been done in cooperation with Alessandra Parisio and her group at KTH/Electrical Engineering. They develop scheduling algorithms to schedule when appliances should be run. Several examples of user interface have been developed to illustrate the simulation data for energy costs and CO2 emission for the end-users. It is possible to select the time schedule that works best for him / her, given the price of electricity and carbon emissions, depending on what is prioritized. See also document 11814-AD1300-AD1306\_Annex.pdf for more details.

### EIT 2013 - Select Energy Schedule

Version 1.2

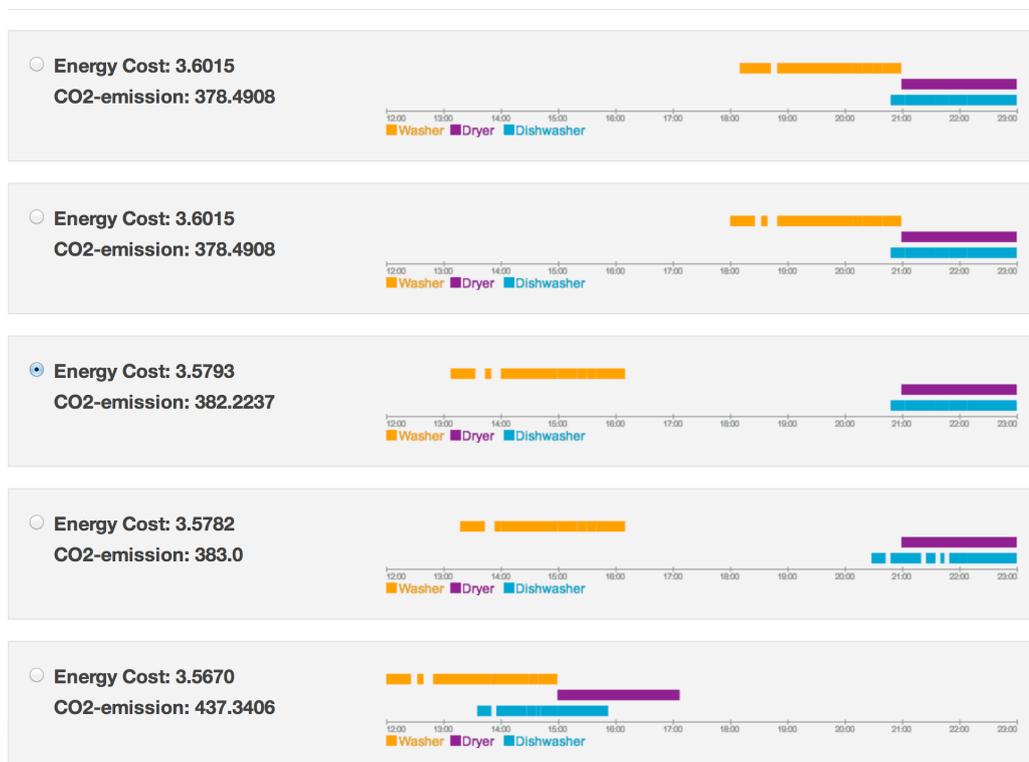


Figure 1: Energy scheduling – select the scheduling that fits you best.

The different schedules shown in Figure 1 are based on simulation data. The data, costs for the energy and CO<sub>2</sub> emissions, are based on the simulation results from the optimization algorithms that KTH is developing.

More concrete, a user wants to schedule 3 appliances and provides a certain preference time interval for that. He can also set a parameter, let us call it lambda, representing the importance he/she assigns to the energy price and to the CO<sub>2</sub> costs (emission).

The algorithm for the appliances aims at solving a multi-objective problem. The solution is a trade-off between the price and the CO<sub>2</sub> costs depending on the lambda value. For instance:

- If a user cares only about the price, we will get the optimum minimizing only the price;
- If a user cares only about the CO<sub>2</sub> emissions, the schedule will be such that the appliances are processed when the electricity mix is the most green one can have during the time intervals specified by the user;
- If a user cares about both objectives and assigns the same importance to both, the solution will be such that the weighted sum of the two objectives is minimized;

You get a different solution depending on the importance you assign to each objective (price or CO<sub>2</sub> costs).

The data comes from the *Active House* project data, within the *Stockholm Royal Seaport*. The technical specifications of the appliances have been given from Electrolux.

The interfaces were made to illustrate how the results of the optimization algorithms with given parameters (lambda) could be displayed to users.

- What decisions do users want to be able to do?
- What kind of data (about price and CO<sub>2</sub> costs) do users need to make decisions?
- How detailed information do users want/need to make decisions? It is obviously different for different users how detailed information they want.
- What kind of parameters do users need to set?

To improve the algorithms and discuss the results with end users, it is an advantage to display the results graphically in any way. i.e. control and determine when the appliance shall run. There is a great potential to use this interface to show for end user how they could interact with this kind of system. It is an example of how users can interact with a system where they can get an overview of how they can take into

account the price of energy and CO<sub>2</sub> emissions and control their household appliances. See also document 11814-AD1300-AD1306\_Annex.pdf for a more in-depth discussion.

An appliance has different processes (steps) when running in a particular program. In some cases, the appliance can take a break in the program (pause, "rest"). The interface takes into account that some appliances can be divided into sub processes.

The schedule shows how this might look like for example when a washing machine is running. This is just a simulation example and the data come from KTH's optimization algorithms. If this should be an interface to real appliances, it must of course be adapted to the appliance. It requires knowledge of the appliances and its processes, and when/and if they can take breaks in various programs (the specification of an appliance). If this type of system should work in reality and be linked to real appliances, it requires knowledge of how they run and how they can be controlled.

Our examples of interface are more simplified for the user than the graphical interface that Ericsson has implemented (Activity internal deliverable 11814 A1304 TD1301). The different user interfaces presents data for different user groups. The interfaces can complement each other - for expert users and ordinary users.

## Demonstration

This document also presents the work that has been done in cooperation with the European research project ME<sup>3</sup>GAS (<http://www.me3gas.eu/>). The goal of ME<sup>3</sup>GAS is to put consumers in control of their energy efficiency and appliances at home without compromising comfort or convenience.

Within the carrier project ME<sup>3</sup>GAS several applications have been developed for the smart home. For example, applications for energy saving (see deliverable 11814-AD1300-AD1306\_Annex.pdf). The method is to save energy by completely power off the devices when they are not used, i.e. the devices are not in stand by mode when not used.

A concept movie has been made within the project ME<sup>3</sup>GAS together with the EIT ICT Labs activity SES 11814 “European Virtual Smart Grid Lab” for the task “11814-A1304, JP1 - Smart Home Communication”. The movie is produced by Olov Ståhl and Jonas Söderberg at SICS. The video shows the system and the applications (the Swedish Pilot) about reduction of standby energy consumption in a household and at an office. For the video see <http://www.youtube.com/watch?v=n34P840Zf5A>.

The system consists of several parts. It is a complex system, which requires several systems components to communicate with each other to let it be possible to run/test the applications. Anyone who is interested in this system, please contact SICS to discuss with the project manager for ME<sup>3</sup>GAS which system components that are required to perform tests. Currently work is going on to upload code for certain parts of the system on sourceforge.net. The project has not bundled the system in a suitable format yet but in the near future there will be some sort of package.