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Local Demand-Responsive Energy Management Algorithms – Energy Box

ENERGIA para a SUSTENTABILIDADE

ENERGY for SUSTAINABILITY • Efs | UC

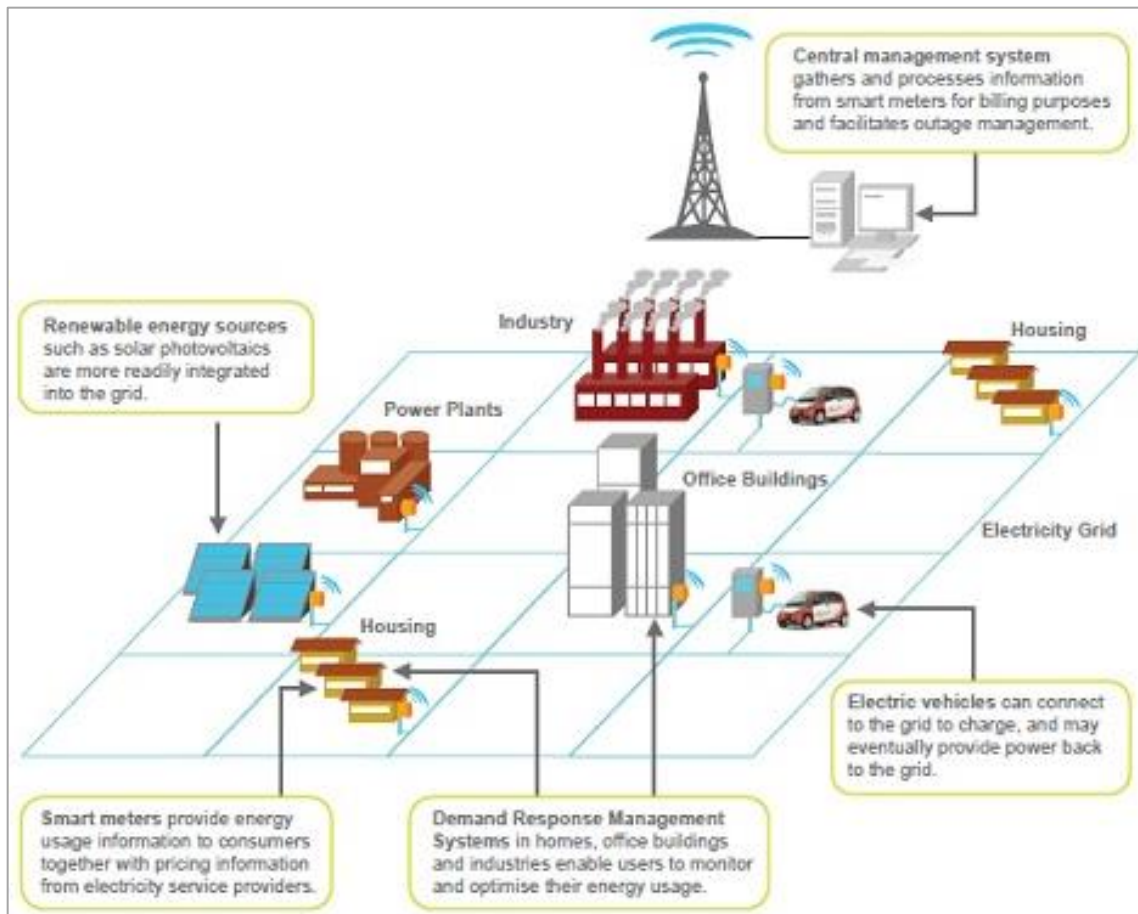
Ana Soares

Supervisors:

Prof. Álvaro Gomes, DEEC-UC

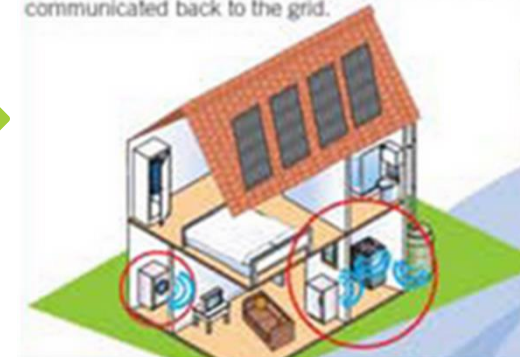
Prof. Carlos Henggeler Antunes, DEEC-UC

Context



Consumer Devices

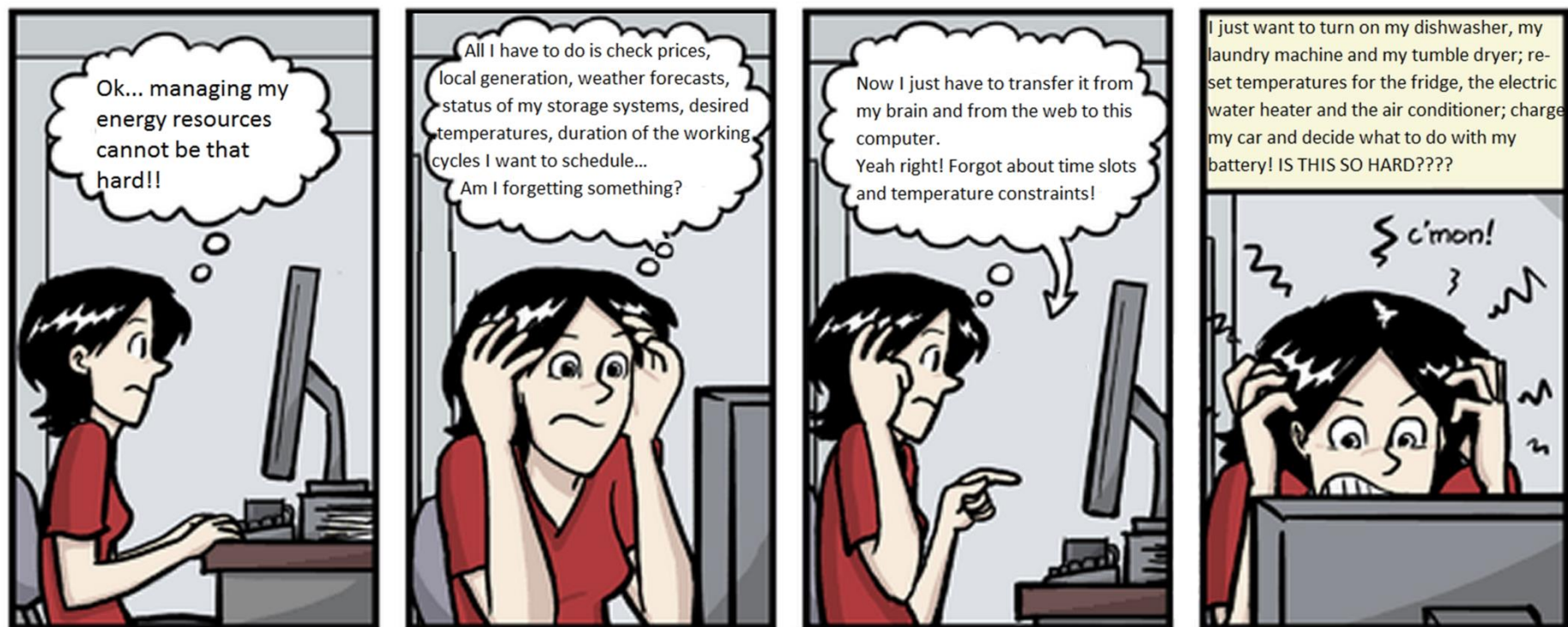
These devices are typically behind the meter and receive price signals to make "smart" decisions regarding energy use. Ultimately, their decisions are communicated back to the grid.



Source: <http://blog.gogreensolar.com/search/label/enphase%20energy/page/8>

Source: <http://www.cleantechinvestor.com/portal/smart-grid/5860-spotlight-on-singapore-smart-grid-city.html>

Problem

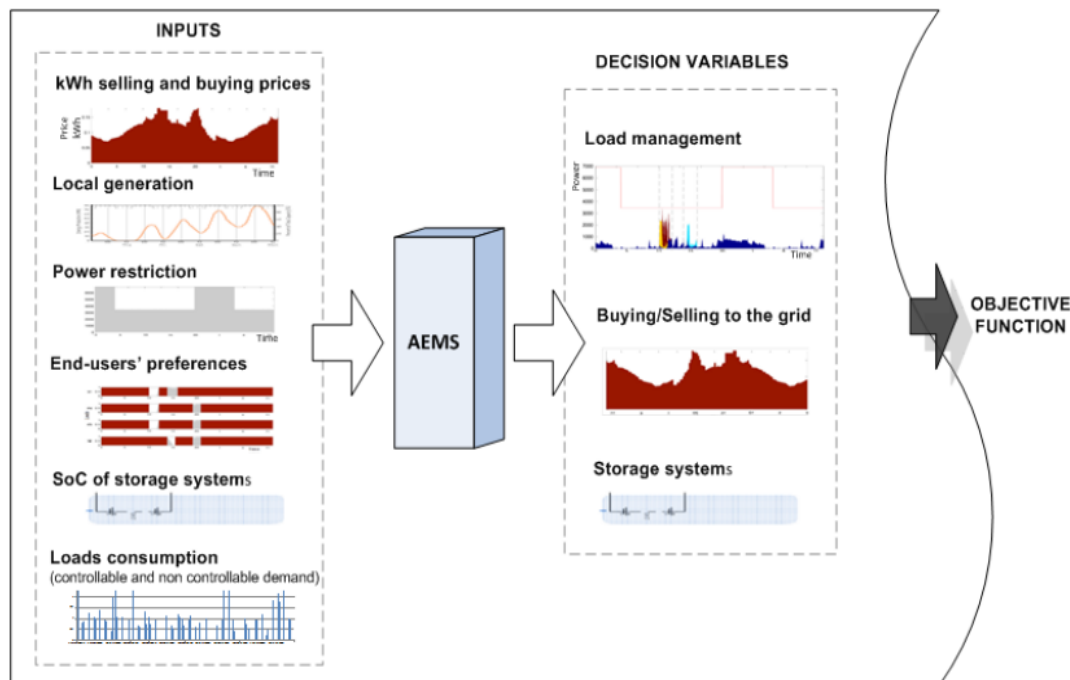


Re-adapted from www.phdcomics.com

Research Question + Solution



In a smart grid context how can the use of different domestic energy resources be optimized and the potential impacts from the end-user's perspective assessed?



→ Multi-objective model considering explicitly cost and user's preferences evaluation aspects in order to assess their trade-offs and identifying a good compromise solution to the user.

Source: Soares, Lopes, et al., 2012

Case Study

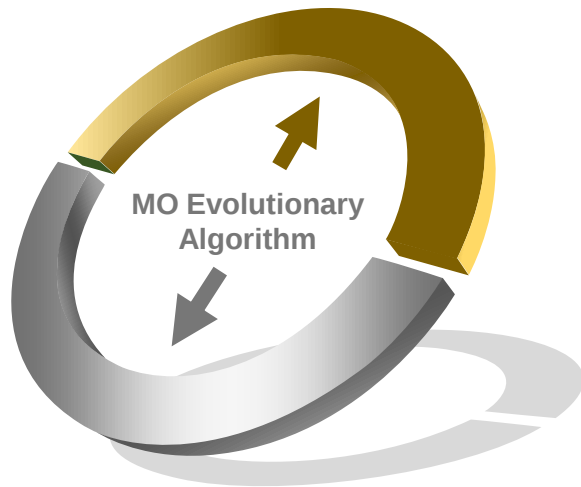
Aim: minimize the end-user's electricity + minimize penalty concerning end-user's dissatisfaction.

Manageable loads: dishwasher, laundry machine, tumble dryer, electric water heater, air conditioning, cold appliances, electric vehicle, stationary storage systems.

Constraints:

- Contracted power level;
- End-users' preferences concerning the admissible and preferable time periods for operation of each load;
- Amount of usable power in each period of time to account for variations in the (non-manageable) base load;
- End-users' desired temperature for thermostatically controlled loads;
- End-users' deadline for charging the PHEV;
- Available electricity locally produced .

Evolutionary Algorithm



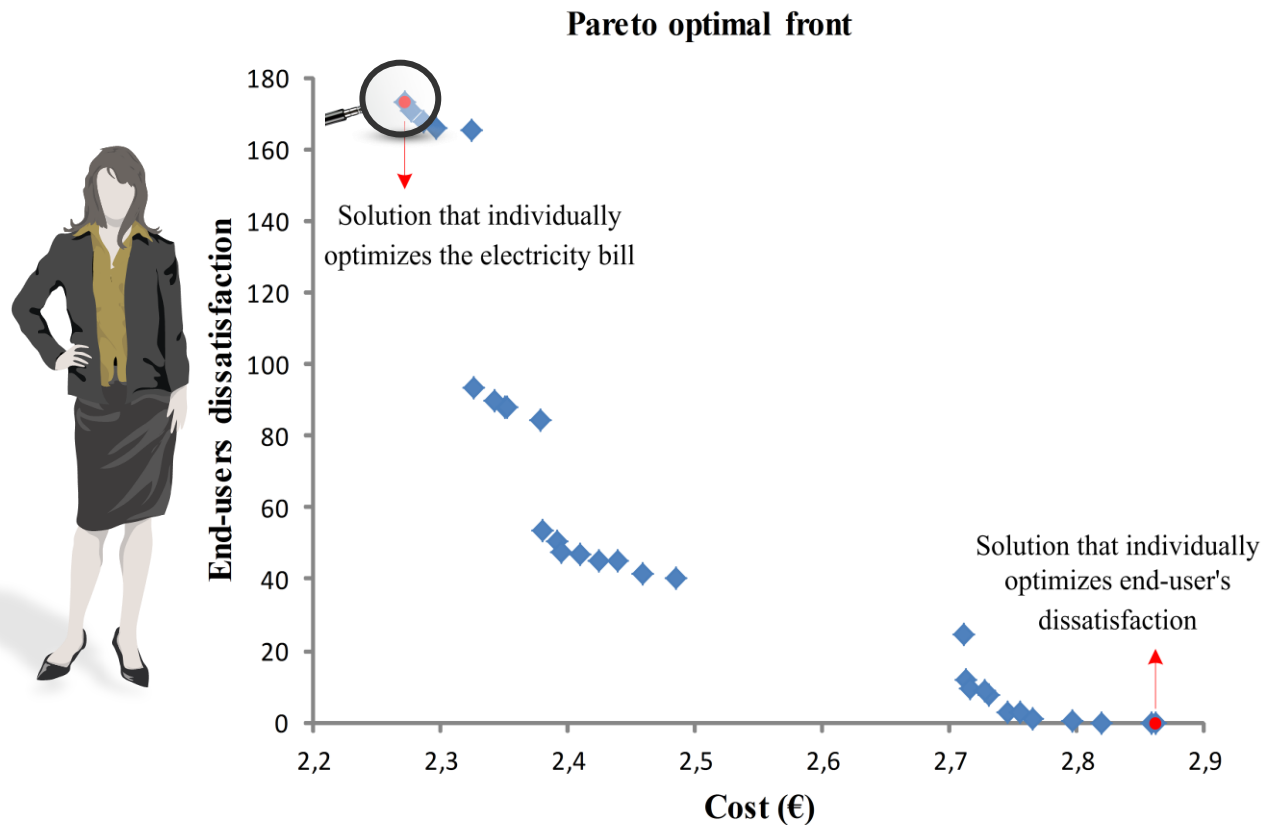
How is this being done?

- Control actions over manageable loads
 - delay or anticipate the working cycles while respecting end-users' preferences
 - change temperature set point and / or the values of the dead band in the case of thermostatically controlled loads
 - change the power consumption profile of specific appliances
 - decide when to store/sell or use energy stored

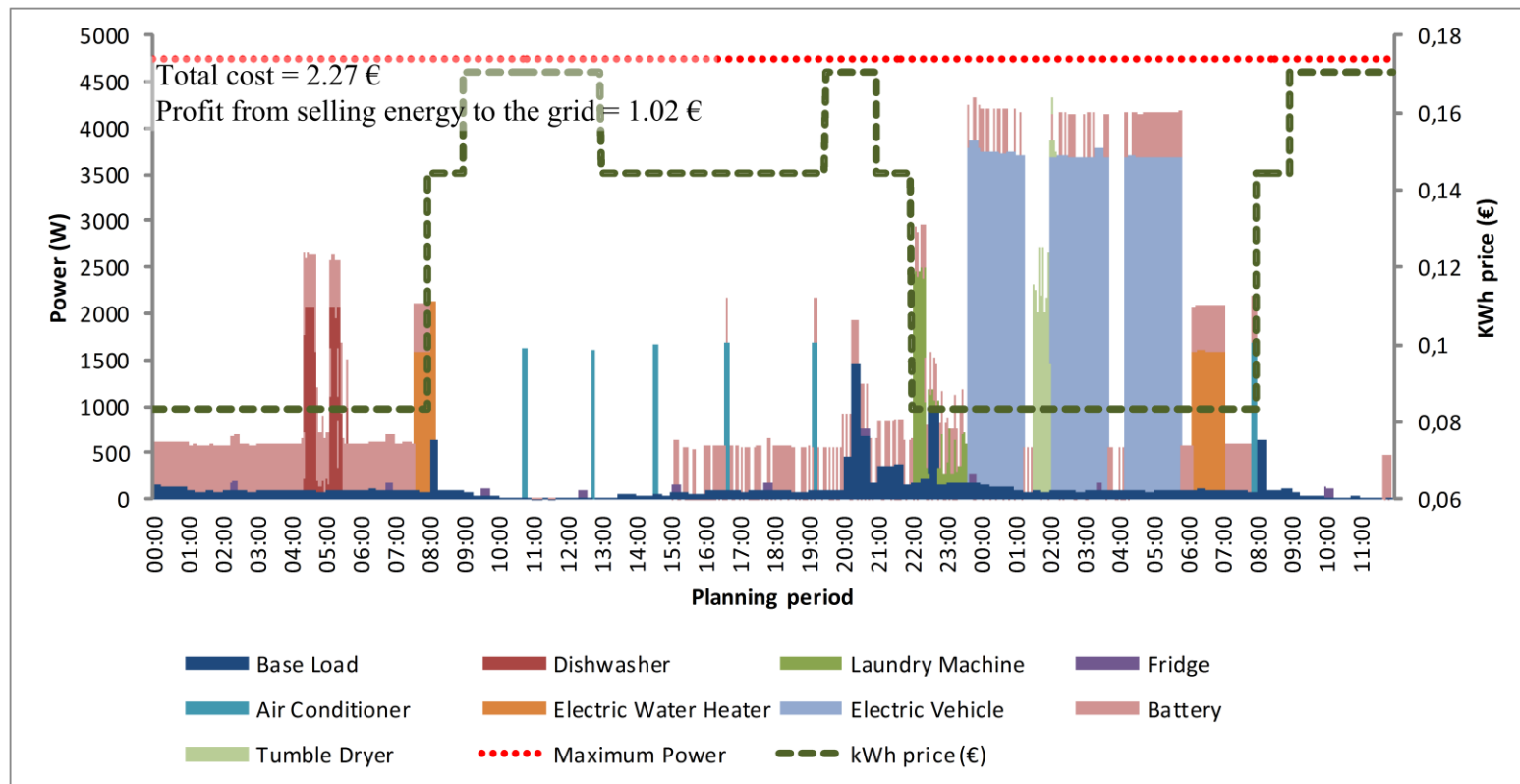
In order to adequately simulate the manageable end-use loads, different models have been used:

- ❖ **Data** from **audits** for shiftable loads;
- ❖ **Assumptions** concerning the charging profile for electric vehicles.
- ❖ **Physically based models** for thermostatically controlled loads (air conditioning systems, electric water heaters, cold appliances) and stationary storage systems

Some Results



Some Results



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