SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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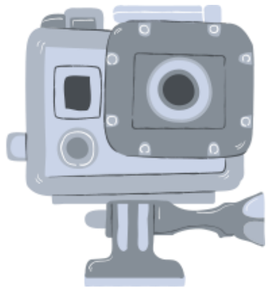
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

UNIT 2

SMART GRID TECHNOLOGIES – Smart Appliances

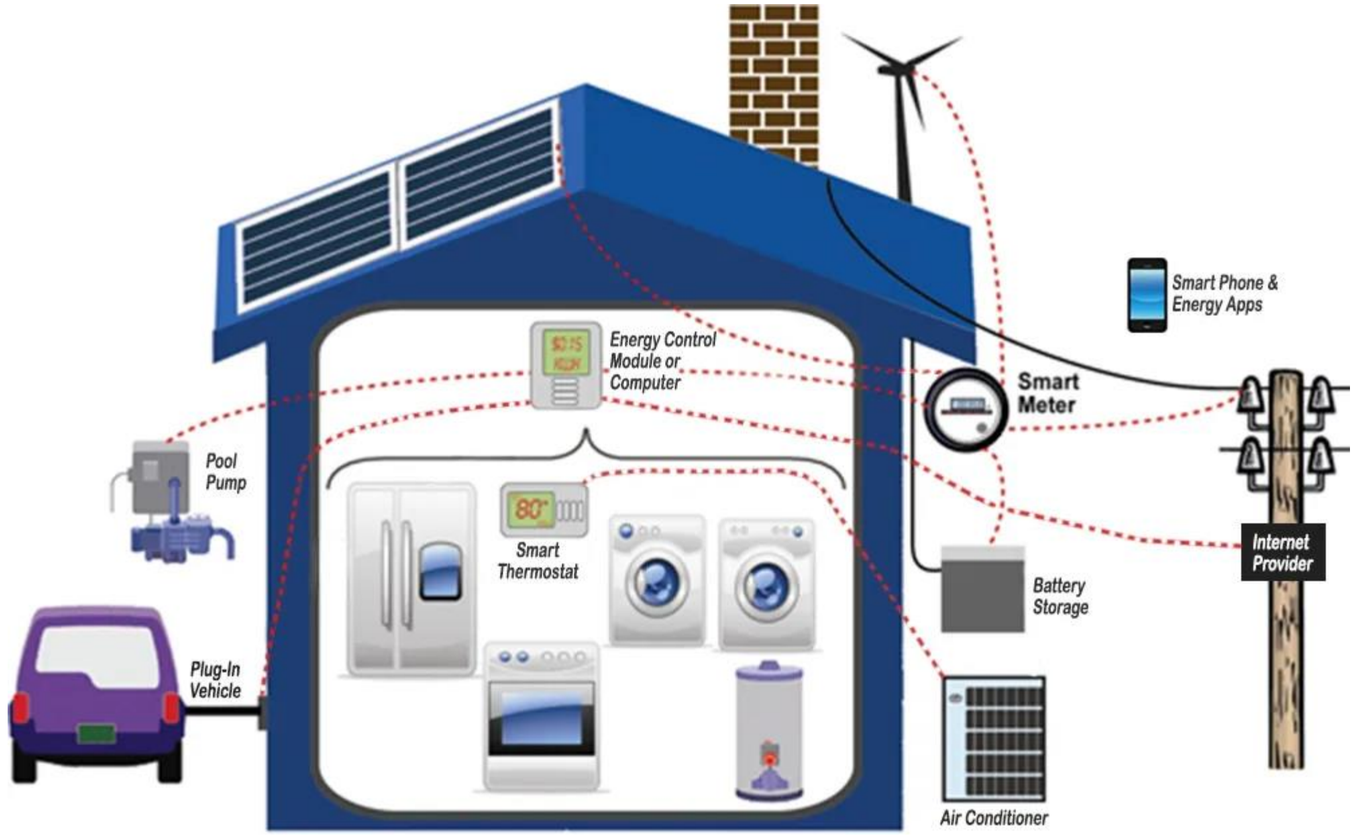
19EEE308 – SMART GRIDS
III year / VI Semester



- **Smart appliances** enable users to connect, control, and monitor their appliances allowing them to save time, energy, and money.
- For example, they can schedule run times to fit personal schedules, take advantage of cheaper off-peak energy, or maximize solar power utilization to save time, money, and the environment.

Intelligent Appliances

EDITABLE STROKE



- ✓ Household electrical loads relevant to become smart appliances may be typical white goods such as refrigerators, freezers, dishwashers, ovens, stoves, washing machines and tumble dryers as well as air conditioners, circulation pumps for heating systems, electric storage heating systems and water heaters.

Smart appliances basically operate on two principles

a) **Modification of the starting time of an appliance cycle**

b) **Interruption of regular appliance operation.**

In the first principle the user selects the finish time and the appliance selects the operation shift within this constraint.

In the second option , a normal operation is interrupted for a limited period of time which still conserves the consumer comfort – e.g. room temperature does not fall below the 20˚C for more than 4 hours

CASE STUDY

Washing machines catching the sun (Jouw Energie Moment, NL)

The project Jouw Energie Moment (NL) had the goal to create learning experiences in a real life environment about the technical, economic and social possibilities for making household demand of energy more flexible and sustainable. The project installed smart washing machines, smart meters and interactive displays in several households. Their purpose was to reduce and shift their demand to hours of high solar electricity production.

The service provider introduced flexible pricing for ToU tariffs. Through the user friendly display the consumer had an insight to the potential financial saving stemming from flexible pricing. By choosing the most sustainable periods at daylight hours for the smart appliance operation the consumer changes his consumption behaviour to get incentives. Apart from feedback information via the in-house display (IHD) the consumers were also provided with a smart washing machine that could be remotely controlled (via the display). This allowed for the automatic scheduling of washing cycles to periods of high PV production. In the image on the left the interface of the IHD can be found, while on the right the electricity consumption for washing is compared between participants of this project (green line) and the average EU household (pink line). Clearly much of the energy demand during peak hours for this activity has been shifted to day-time hours.

Real Time Pricing (RTP) - Benefits

Figure 1: User interface on a smart appliance from the project 'Jouw Energie Moment' (Left) and Daily pattern of average consumption for washing in project (green) compared to EU average (pink) right (S3C Deliverable 3.2)

According to their operation principles there are three types of smart appliances:

- **Fully automatic**: the consumer has no influence on the operation. It is suitable for refrigerators and freezers.
- **Set and forget:** suitable for the washing devices, when the consumer defines the (daily) operation interval when the process needs to be finished and leave the smart appliance control to do the job.
- **Case by case decision:** at every operation cycle the consumer is asked how to proceed. E.g. via dedicated "smart" button it instructs whether to use an ordinary process or the operation is controlled by some demand response procedure. This is proper for the behavior appliances (electrical hobs, hoods, ovens) for a situation when the user needs to decide on some external parameter, i.e. electricity market price before he starts operation.

Smart Appliances (SA) - Benefits

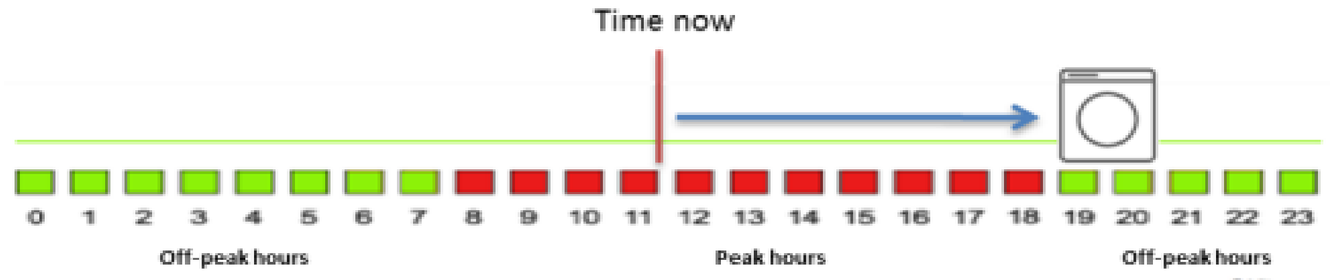


Figure 2: Scheduling of the appliance operation with respect to the price of electricity
Source: RSE internal documentation

Recommended smart appliance functionalities to cover those requirements are:

- Consumption: to display information to the consumers about their energy consumption (e.g. used energy, instant power consumption, etc.) together with additional features such as dispatching such information through Home Area Network (HAN) to in house display.
- Price: to communicate on energy price with the service provider through the smart meters, if dynamic tariffs are offered by the service provider.
- Cooperation: to operate cooperatively with service provider in order to optimize the energy usage through load shifting and/or load shedding. For example, to reduce the overall peak consumption the consumer may implement the consumption power limit. This will result in the smart appliance shifting the load to the off-peak time interval.
- Connectivity: Built in wireless connectivity (WiFi) to avoid construction work for wiring.
- Interaction: Shift autonomously consumer usage according to information coming from the external sources:

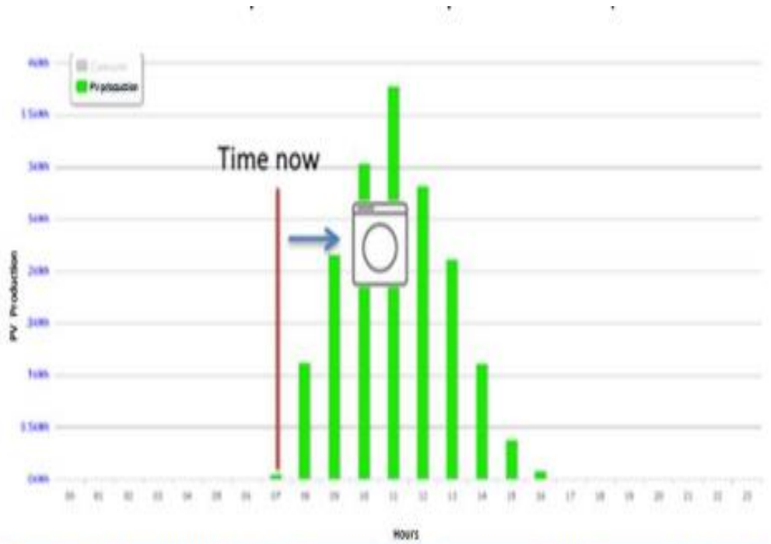


Figure 3: Scheduling of the appliance operation with respect to the source of production of electricity
Source: RSE internal documentation

Summary

Activity

KEEP
LEARNING..

Thank u

SEE YOU IN NEXT CLASS