Lot 33 Preparatory study Smart appliances

Under multiple framework contract N°ENER/C3/2012-418-Lot N°1

Project team at Stakeholder Meeting 30 May 2016:
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Scope of Lot 33 – Definition Part 1

Smart appliance is an appliance that supports **Demand Side Flexibility** (DSF)

- It is an appliance that is able to **automatically respond to external stimuli** e.g. price information, direct control signals, and/or local measurements (mainly voltage and frequency);
- The response is a **change of the appliance's electricity consumption pattern**. These changes to the consumption pattern is what we call the 'flexibility' of the smart appliance;

Scope of Lot 33 - Definition Part 2

- Whereby:
  - The specific technical smart capabilities do not need to be activated when the product is placed on the market; the activation can be done at a later point of time by the consumer or a service provider.
  - A distinction might be made later in the process between appliances able to communicate and process external signals and (non-communicating) appliances automatically reacting to local power quality measurements.

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Scope of Lot 33

The DR potential of a group of appliances is defined by:

- a **shifting potential** = the amount of energy that can be shifted, expressed in [MWh/h]
- **average maximal shifting period** = the maximum number of hours [h] that the demand of the appliance can be shifted, i.e., to consume later/earlier in time than initially planned

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Scope of Lot 33

- **Interoperability** is key: similar appliances of different manufacturers should support interoperable communications
- Focus on appliance and on potential flexibility generated, ***independent of how the flexibility is used in a specific energy market structure***
- Study supports an **as wide as possible** range of DR business cases and energy markets

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Scope of Lot 33 – Products and end-users

- Focus on energy related products within the scope of the Ecodesign and Energy Labelling Framework Directives
- Focus on end-devices
- Study may also prove to be relevant for other products e.g. BACS, EV chargers
- Smart meters: aspect of energy consumption
- Focus on appliances for residential consumers
- Large-scale industry applications are out of scope
- Include 2 commercial cases:
  - HVAC in tertiary sector
  - Commercial refrigeration in supermarkets

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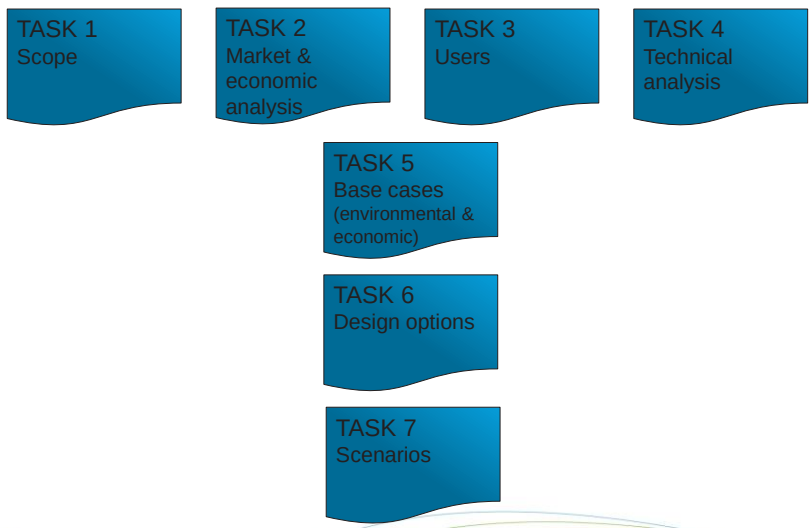
MEErP Tasks



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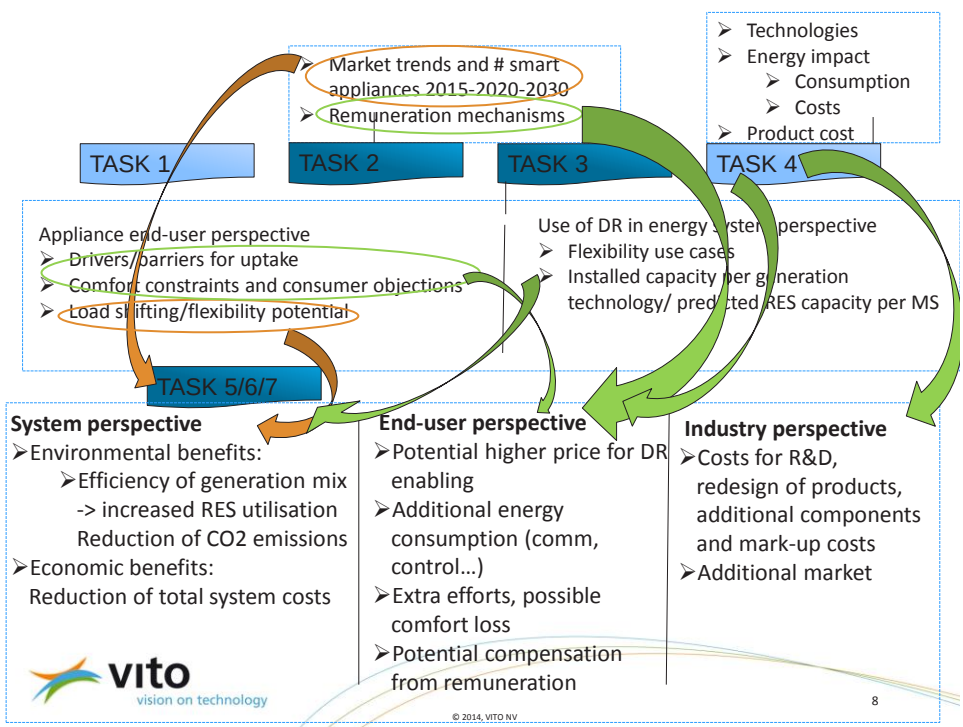

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REVIEW OF TASK 2 REPORT

Sarah Bogaert, VITO/EnergyVille

Main changes of Task 2 report

- Underlying sources of installed stock data made more transparent
- Information about status Smart Meters updated European Smart Grids Task Force Expert Group 1 report (2015)
- Update of installed base figures:
  - Commercial refrigeration: made coherent to JRC technical report (2014) for Lot 12
  - Storage water heaters/batteries: updated with industry data
- Update of estimations on share of smart appliances based on input from industry e.g. HVAC
- Flexibility potential of hybrid appliances cannot be isolated in the analysis – very small market and no data on installed base

Main changes of Task 2 report

- Remuneration mechanisms added:
  - Distribution grid fee power component minimization
  - Feed-in tariffs lower than consumption tariff

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REVIEW OF TASK 3 REPORT

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universitätbonn

Wuppertal Institut für Klima, Umwelt, Energie GmbH

Jasmin Geppert – University of Bonn

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Main changes of Task 3 report

- Commercial refrigeration has been included in Task 3 report:
  - Based on input data from industry, it has been possible to deduce daily consumption patterns of compressors in commercial refrigeration appliances in dependence on three different climatic zones and for different seasons of the year.
- Detailed analysis of storage water heaters has been included in Task 3 report:
  - Typical pattern of daily load curves for storage water heaters (continuously heating and for those heating during the night only) have been deduced from input data provided by industry.

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Stakeholders' comments and changes of Task 3 (1)

- **Comment:** Risk of underestimation of DR potential of refrigerators if they are out of scope
- **Changes:** Refrigerators were included in Task 6 despite their "medium" DR potential.

- **Comment:** Distinction between conventional and heat pump tumble dryers requested because of different power ratings and power demand curves.
- **Changes:** Both types have been distinguished.

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Stakeholders' comments and changes of Task 3 (2)

- **Comment:** Potential social (distributive) impact of remuneration schemes, which may put vulnerable consumers at disadvantage, is lacking.
- **Changes:** Topic has been added to subsection "consumer rights".

- **Comment:** More detailed technical analysis required regarding security/privacy of data stored in smart appliances
- **Changes:** Topic presented at stakeholder meeting 30 May 2016 – analysis by external expert will be included in Task 3 report

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REVIEW OF TASK 3 REPORT

HVAC : TOTAL ENERGY DEMAND

Marcel Perret-Gentil/Philippe Rivière
Armines/Mines ParisTech

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Required information for HVAC

- Electric heating demand for Residential & Tertiary buildings
  - Hourly demand profile for each country of EU28
- Electric cooling demand for Residential & Tertiary buildings
  - Hourly demand profile for each country of EU28

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Global Inputs

- To build a heating / cooling hourly load curve the following inputs are needed:
  - **Weather hourly data**: outside temperature, radiation and humidity → common for Residential and tertiary
  - **Building typology**: Insulation, windows, internal gains, occupancy profiles, comfort air inside air temperature, ventilation → different for tertiary and residential
  - **How many buildings are electrically heated** (joule effect / heat pumps) and/or cooled → different for tertiary and residential

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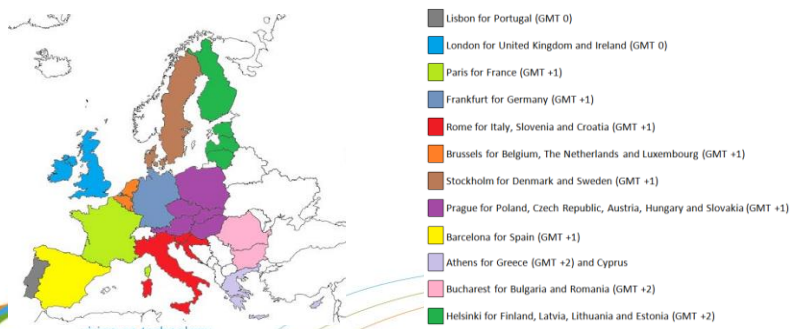
Inputs : Weather data

- 12 climatic zones were established within Europe (respecting each country's time zone)
- Weather data (temperature and radiation) for one city that represents the zone's average weather conditions for 2014
- The data corresponds to observations of real time weather data for 2014



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Inputs: Tertiary

- 9 different buildings were thermally simulated using dynamic simulation software : Office building (small, medium and large), Hotel, Supermarket, Shopping Mall, Hospital and Retirement Home
- The distribution of the service sector per country and the total m^2 were issued from (BPIE, buildingdata.eu)
- Insulation : constant
- The number of buildings that are heated electrically are expressed in *% m^2*
- The share of direct electric heating and heat pumps are issued from different studies for each country (Episcope, RES h/c 2009)

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Inputs: Residential

- Energy simulation platform Smart-E → heating/cooling demand
- Distribution of residential dwellings built by Smart E using statistical data
- Insulation values were adjusted by correction factors issued from DG Ener Lot 1 Ecoboilers per country
- The share of direct electric heating and heat pumps are issued from different studies for each country (Episcope, RES h/c 2009) and in some cases extrapolated (Luxembourg, Malta, Cyprus, Estonia, Latvia)

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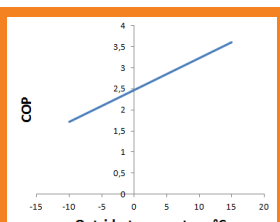
Assumptions

- For air conditioners and heat pumps, the following equations were used to estimate COP and EER

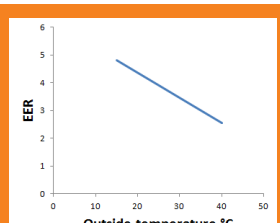
$$COP = COPnom * (1 + 0{,}025 * (Text - 7)) \; with \; Text \; in \; °C$$

$$COPnom = 3$$



$$EER = EERnom * (1 - 0{,}03 * (Text - 35)) \; with \; Text \; in \; °C$$

$$EERnom = 3$$



Partial load corrective coefficients were considered equal to 1 for all the simulations

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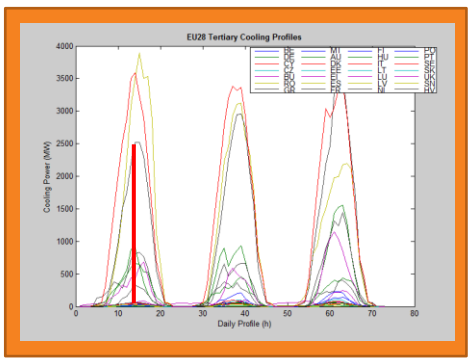
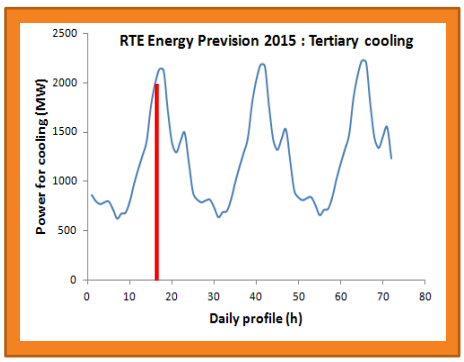
Results : Tertiary Cooling

Weekly profile rough data



Smoothed RTE data



- Three days in mid July 2014
- Most important countries : Italy, Spain, France and in second order Germany, Greece and Bulgaria
- Feedback from RTE, mainly to verify orders of magnitude and shape of the curve for FR
- Annual consumption : 48 TWh (model) , 42 TWh (Rivière, 2012)

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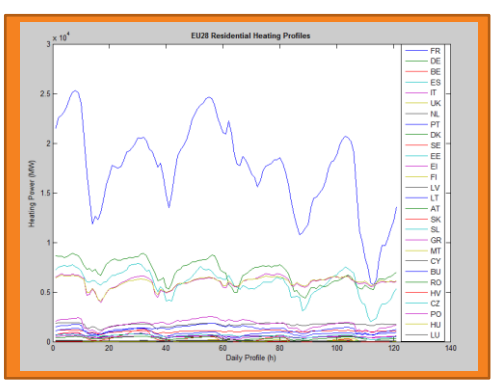
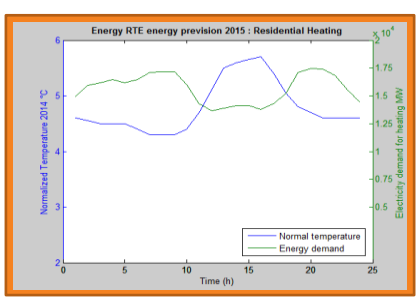
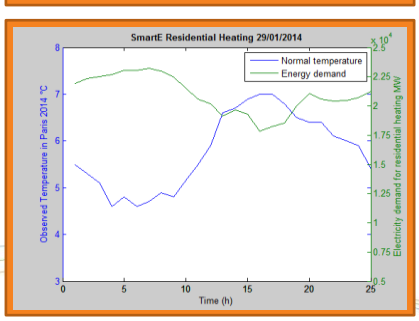
Results : Residential Heating







- Weekly and daily profiles for early January 2014
- Leading countries : France in first order followed by Germany, UK, Italy and Spain
- Feedback from RTE, mainly do verify order of magnitude and shape of the curve for FR
- Annual consumption : 187 TWh (model) in 2014 vs. 152 TWh (Bertoldi, 2009) in 2009

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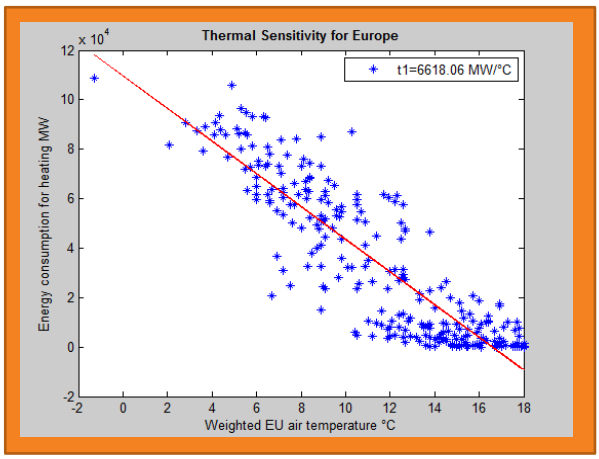
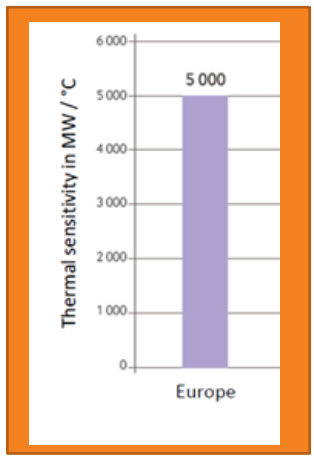
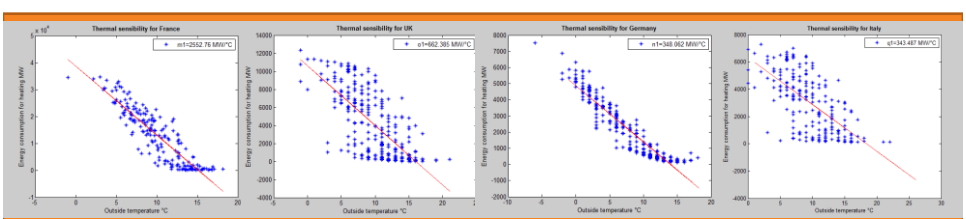
European thermal sensibility (heating)

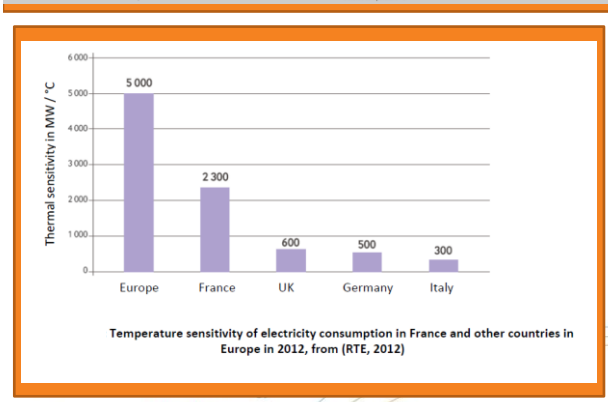




- Residential + tertiary heating consumption for EU 28
- Weighted temperature according to electrically heated squared meters
- Feedback from RTE in 2012
- Slope orders of magnitude are plausible compared to RTE data (temperature regression from grid load) → Higher slope for simulation (more electric heating in 2014, lower temperatures…)

Feedback from the grid





- Slope orders of magnitude are plausible compared to RTE data (temperature regression from grid load)
- More dispersion for the UK and Italy

REVIEW OF TASK 4 REPORT

Jan Viegand, Viegand Maagøe A/S

Main Comments

Appliance modifications, energy and costs	• Main updates here – Detailed over the next slides....
Technical comments	• Revised and updated text where needed
Editorial comments	• Revised and updated text, shortened text for some product descriptions. More references added
Selection of appliances	• Same as for all tasks
Lack of sales and stock data	• Provided in Task 2
Smart meters	• Brief text and data added
Relation to the power system	• Treated in Tasks 5 and 6 and coming Task 7 report on scenarios
Incomplete dataset	• Data added, though not much data available
Comments-answer table uploaded on web site	

Appliance modifications, energy and costs

- Clarified and added text on assumptions and basis for the analysis
- Added stakeholder input, where received
- Detailed descriptions of needed modifications
- Collected, analysed and reported data on energy consumption and costs

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Energy Consumption

- Reassessment of data for network connections
  - Bluetooth Classic, Bluetooth 4.0, Wi-Fi, ZigBee, Z-Wave, Ethernet
  - Incl. data from new IEA 4E EDNA report[1]
- Assumption dc: Max 0.6 W
- Power supply: 80-90 % efficiency at the load

[1] "Energy Efficiency of the Internet of Things. Technology and Energy Assessment Report. Prepared for IEA 4E EDNA". April 2016.

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Costs

Existing networked appliances

- Not fully DSF ready
- Smaller productions
- Often proprietary technologies
- Often premium product
- More recent being networked
- Often not optimised
- High price

DSF appliances

- Assumed larger series of redesigned products in a smart grid market
- Analysed needed additional components and modifications
- Collected component market prices and industry experts estimations

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Task 4 cost input to Task 6 report

- A networked appliance only needing software modifications, testing, documentation etc.: 5-10€
- A non-networked appliance also needing a network connectivity module etc.: 15-20€

Assuming larger product series in a context of a future smart grid market, cost levels at manufacturer's level including testing and documentation

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Thank you for all your input!