

Smart Domestic Appliances Provide Flexibility for Sustainable Energy Systems

Leonardo Webinar
21 August 2009

Christof Timpe
Öko-Institut



Intelligent Energy  Europe

The sole responsibility for the content of this presentation lies with the authors. It does not necessarily reflect the opinion of the European Communities. The European Commission is not responsible for any use that may be made of the information contained therein.

Partners in the Project “Smart Domestic Appliances in Sustainable Energy Systems (Smart-A)”

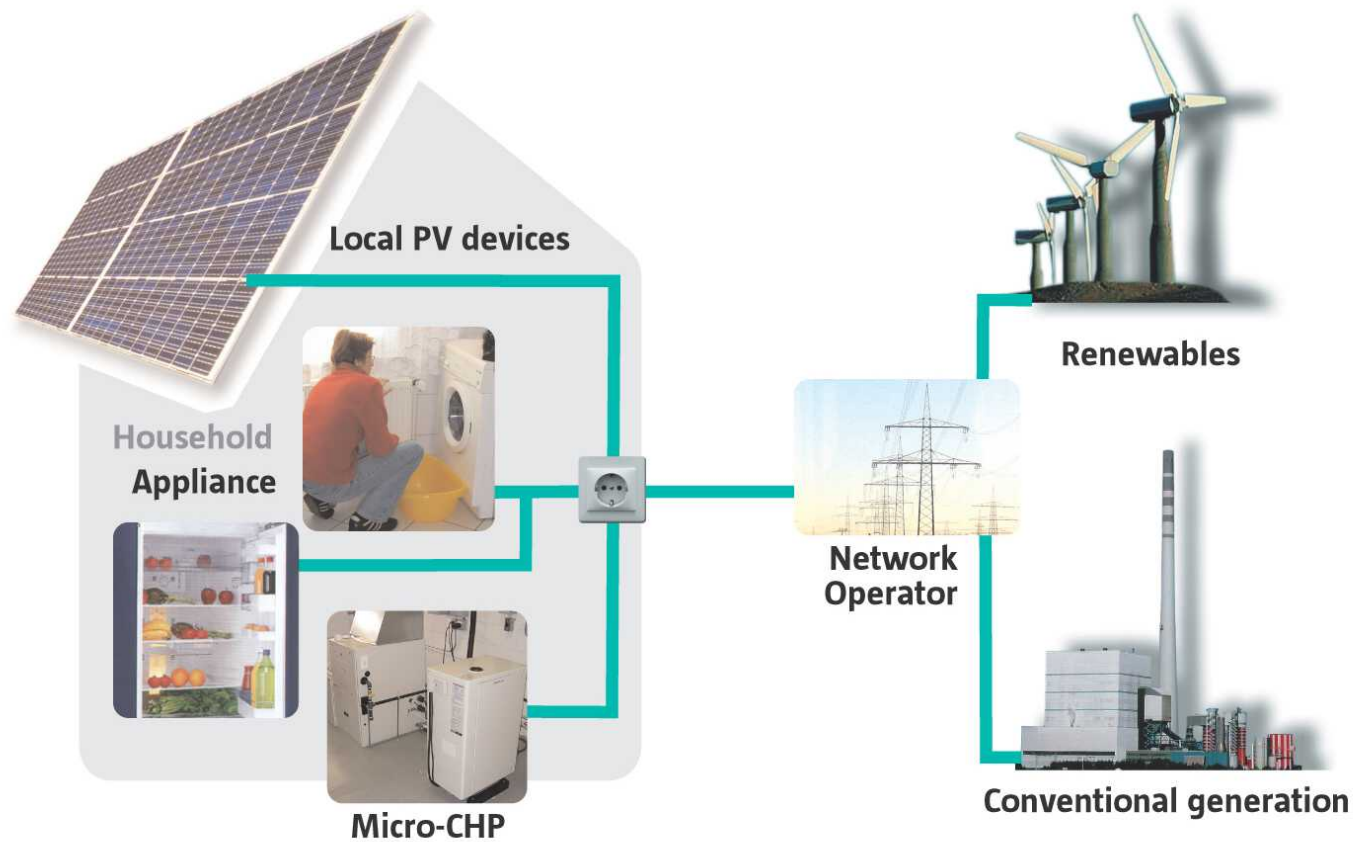


Official Partner

Overview

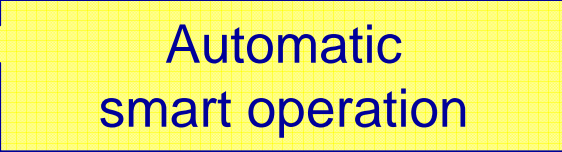


- The Smart Appliances Vision
- Demand Response Options by Smart Appliances
- Consumer Acceptance of Smart Appliances
- Model Results
 - Benefits provided by Demand Response Devices
 - Cost of Smart Appliances
 - Comparison of Cost and Benefits
- A Snapshot on the Actors Involved and Incentives Required
- Conclusions

The Smart Appliances Vision

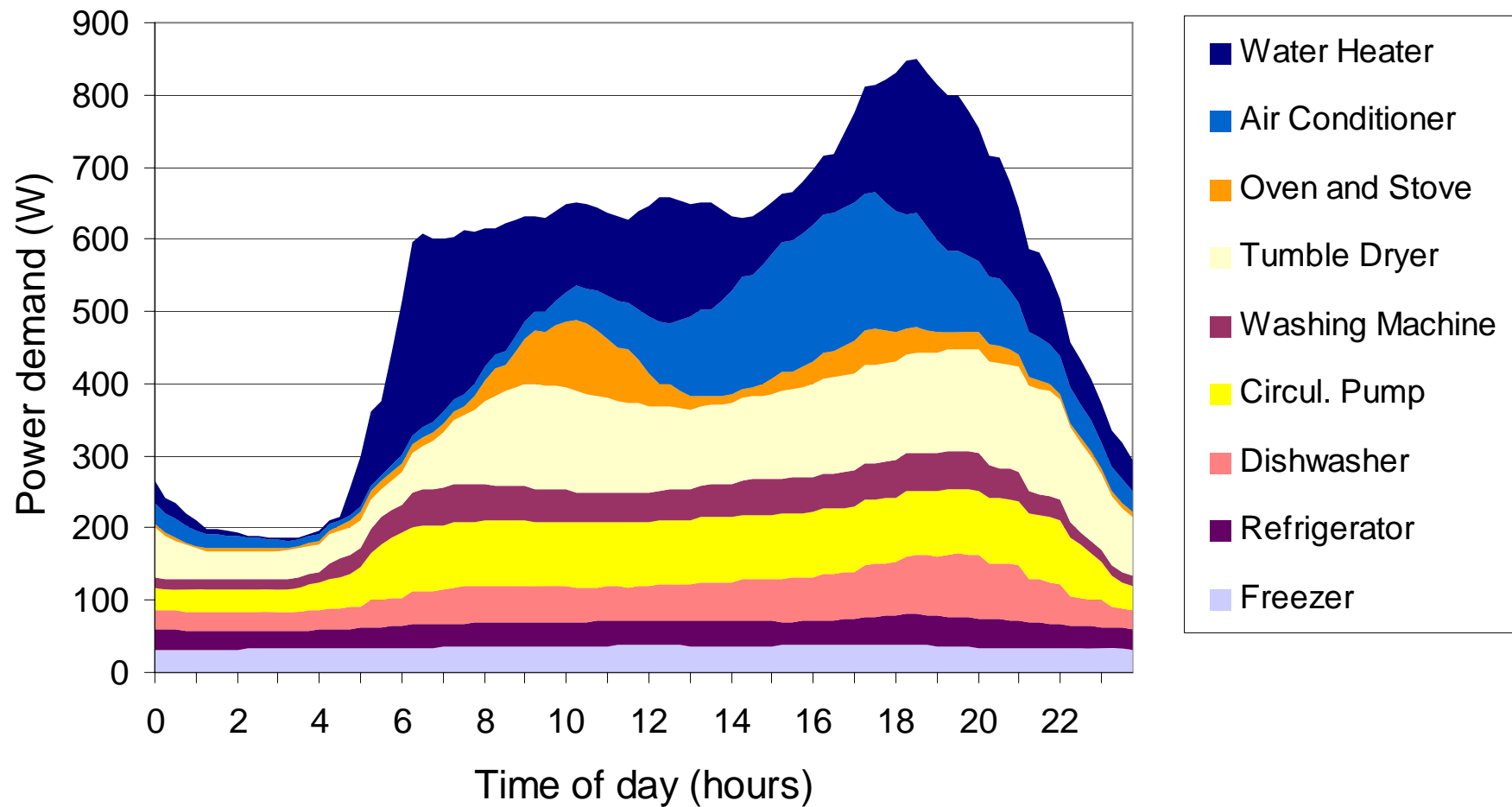


© Öko-Institut e.V.

Examples Illustrating the Smart-A Vision

- The freezer receives a signal from the local electricity network operator that a load peak is expected around noon, and therefore it stores cold in the morning to avoid operation during peak time.  Automatic smart operation
- The user switches on the dishwasher in the morning and leaves for work. The appliance optimises the timing of its operation based on heat supply from the solar heat system.  Low-level consumer interaction
- The washing machine checks the weather forecast from the Internet and signals to the user that a sunny day allows for the use of a programme with higher temperatures.  Complex consumer interaction

Appliance Load of a Generic European Household



Demand Response Options for Appliances

Smart Timing of Appliances Cycles

Washing Machine, Dryer:	Typical <3 hrs.; Maximum 9 hrs.
Dishwasher:	Typical <6 hrs.; Maximum >12 hrs.
Refrigerator, Freezer:	n/a
Other Appliances:	Typical <15 mins. ... 1 hr.

Interruptions of the Appliance Cycle

Washing Machine:	Typical <10 mins.
Dryer:	Typical <30 mins.
Dishwasher:	Typical <10 mins.
Refrigerator, Freezer:	Typical <15 mins.
Other Appliances:	Typical <15 mins.

Consumer Objections and Wishes



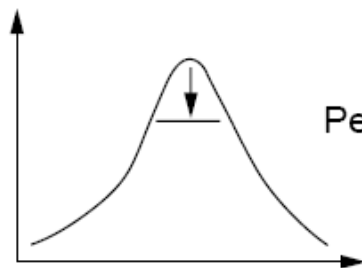
- Higher investment cost
- Consumers want to be able to retain full control over their appliances
- Health and safety issues (fire, flooding, food might be compromised)
- Doubts about maturity of the technology
- Scepticism about the ecological benefits



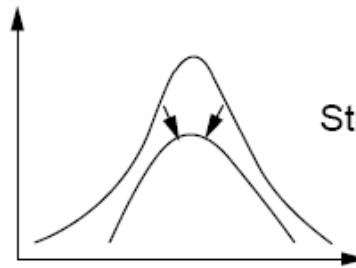
- Economic Incentives
- Enhanced safety functions
 - Overloading signal
 - Temperature surveillance
 - Water stop
 - Detection of technical faults
- Enhanced comfort and usability
- High quality service & support
- Attractive design

Pictures © PIXELIO

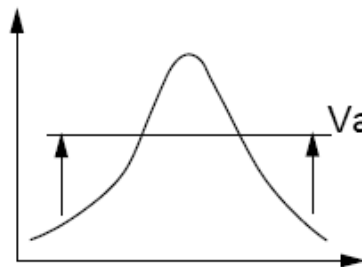
Applications of Demand Response – Requirements of Sustainable Energy Systems



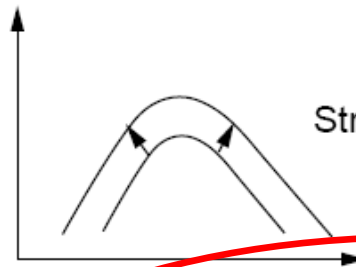
Peak clipping



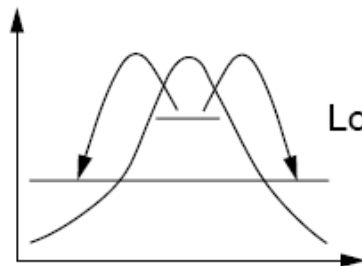
Strategic conservation



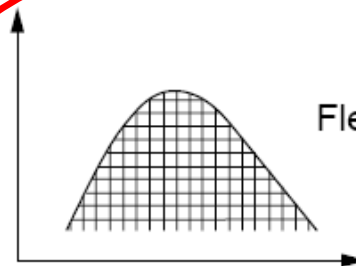
Valley filling



Strategic load growth

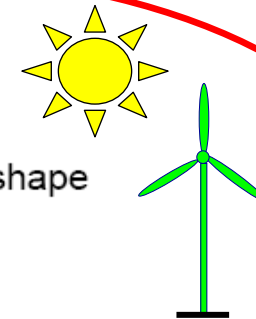


Load shifting



Flexible load shape

The key challenge of the future: Balancing out variable wind (& solar) generation.

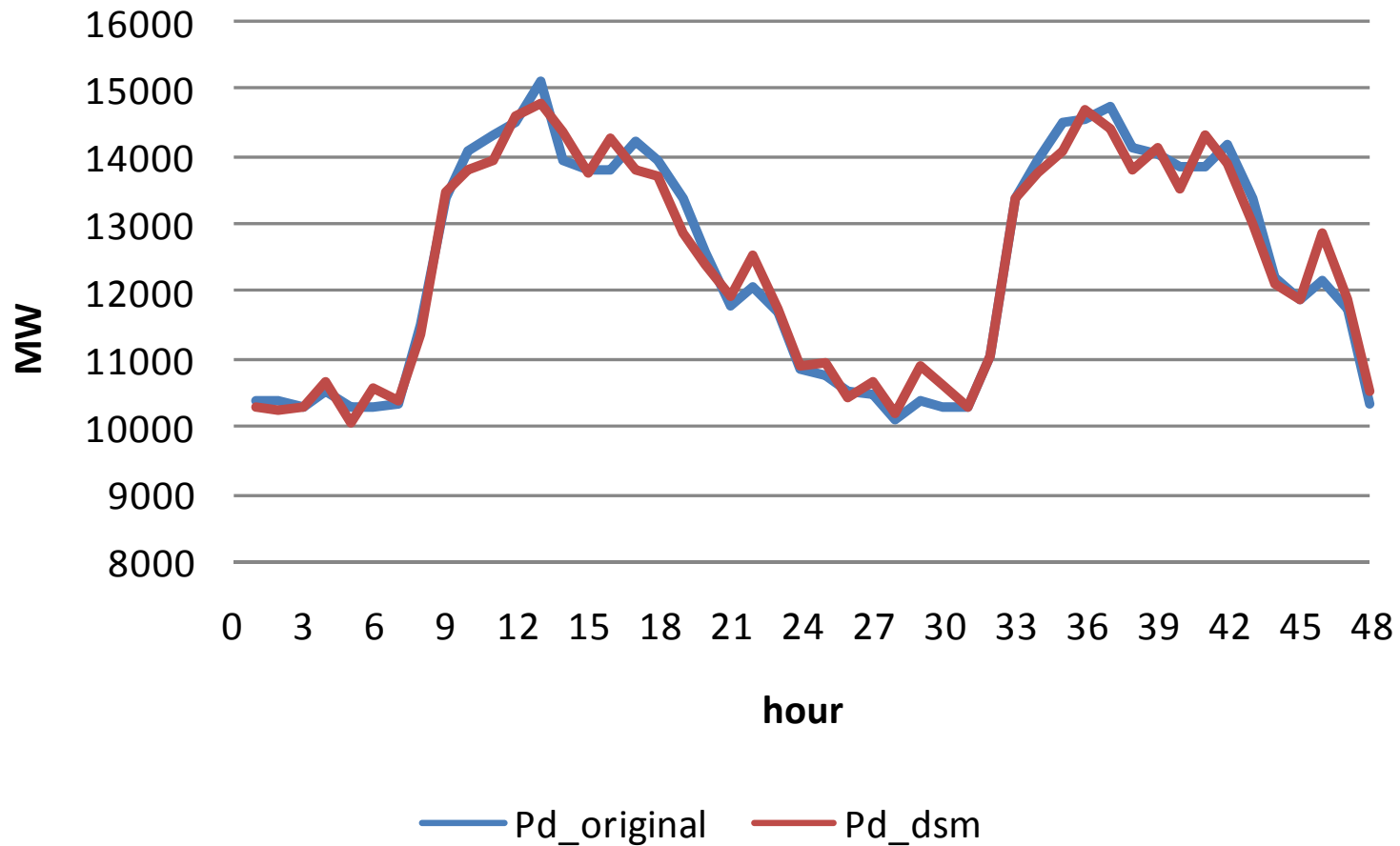


Source: Abatavicius & Pyrko, 2006

Determining the Economic Benefits of Smart Appliances in Sustainable Energy Systems

Step 1: Value of Demand Response Devices for Balancing Wind Generation

Sample View on a Model Run



Model A: Value of Generic 1kW DSM Device

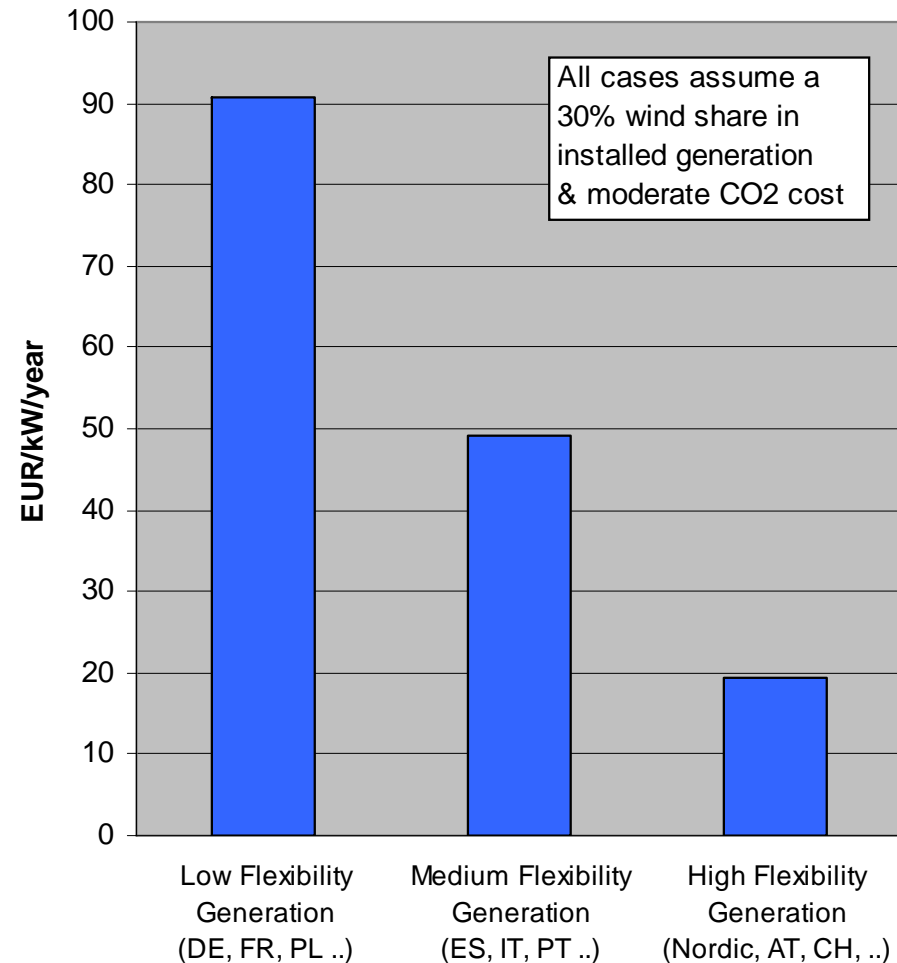
Effects of introducing DR into system balancing in energy systems with high shares of wind:

- Reduced requirement for “spinning reserve” from part-loaded fossil fuel plants
- Reduced necessity to shut down wind plants in order to ensure system stability

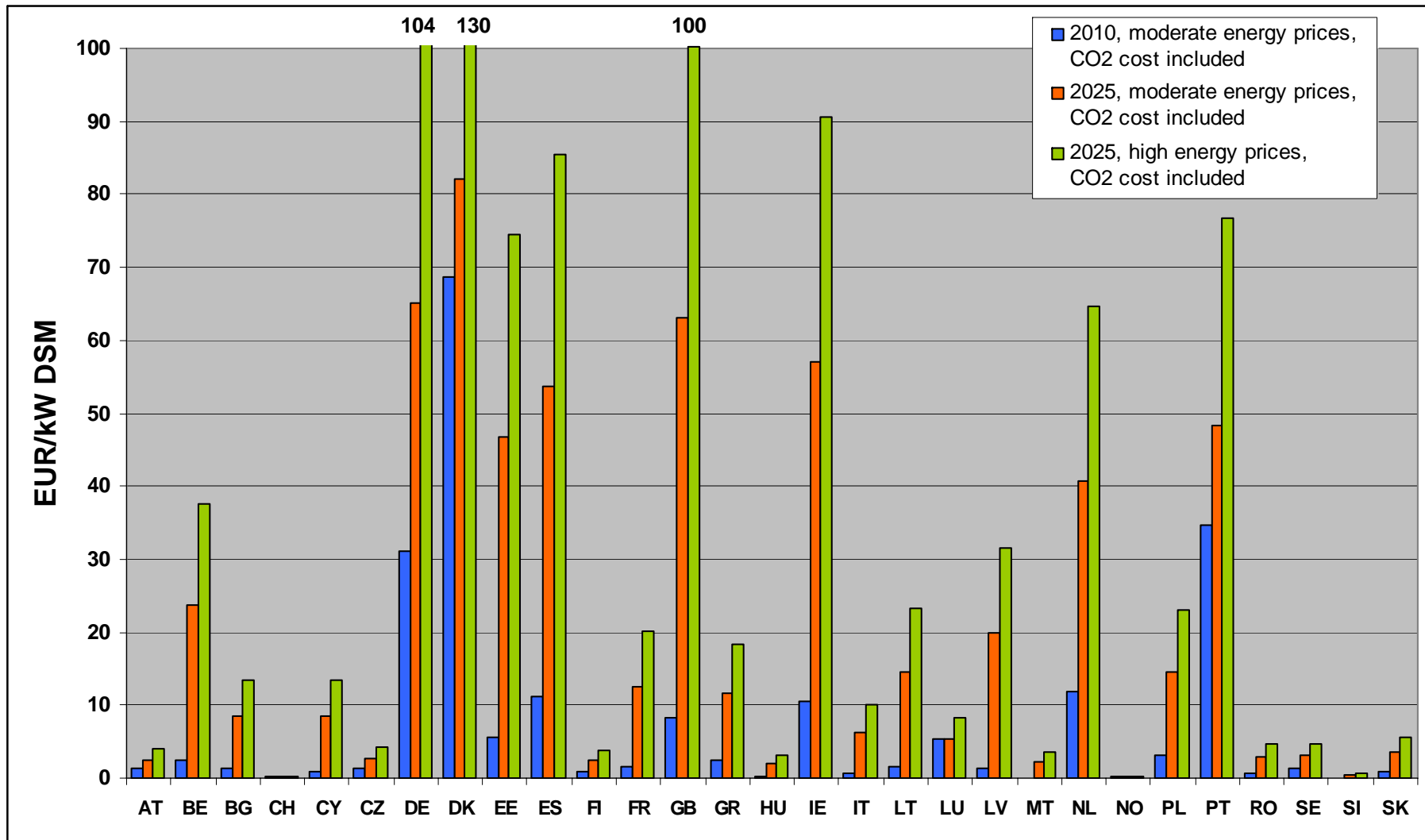
Both effects result in:

- Reduced use of fossil fuel
- Reduced CO2 emissions

The figure shows the annual value per kW of DR load.



Model A: Application to EU29 Countries

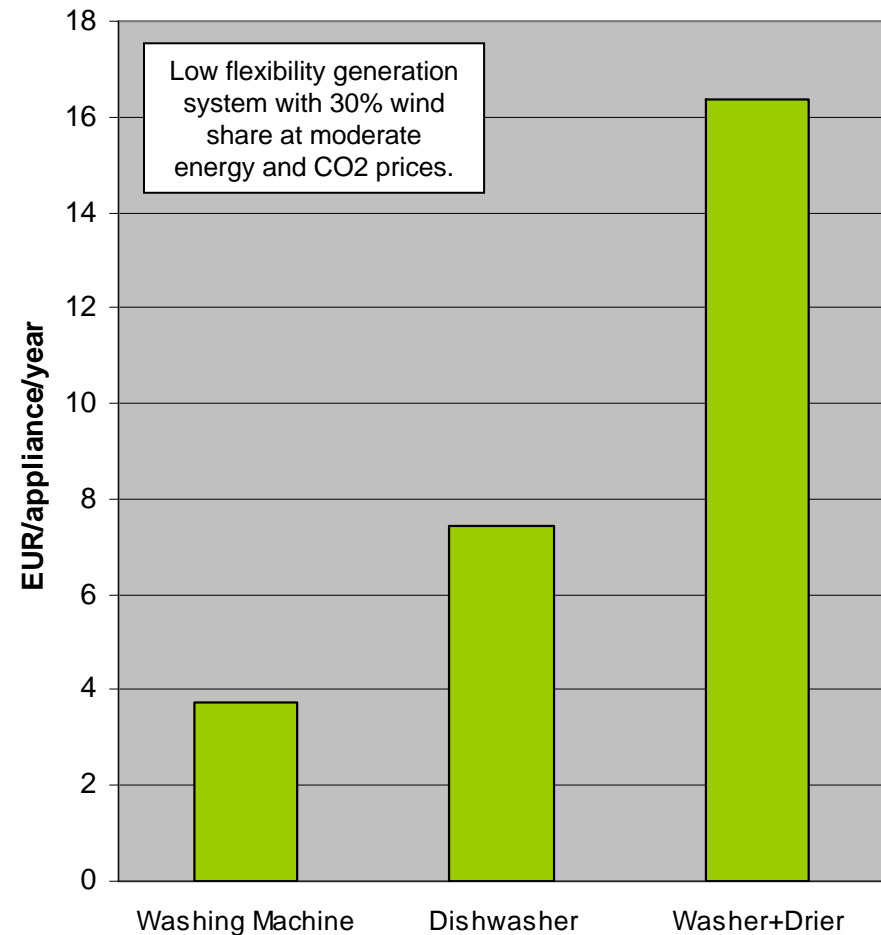


Model B: Value of Selected Appliances

The value of individual appliances is driven by:

- The degree of flexibility offered (duration of the load shift)
- The volume of energy shifted per appliance

The figure shows the annual value of three selected appliances used for DR.



Determining the Economic Benefits of Smart Appliances in Sustainable Energy Systems

Step 2: Cost of Enabling Smart Appliances as Demand Response Devices

Cost for Providing DR by Appliances

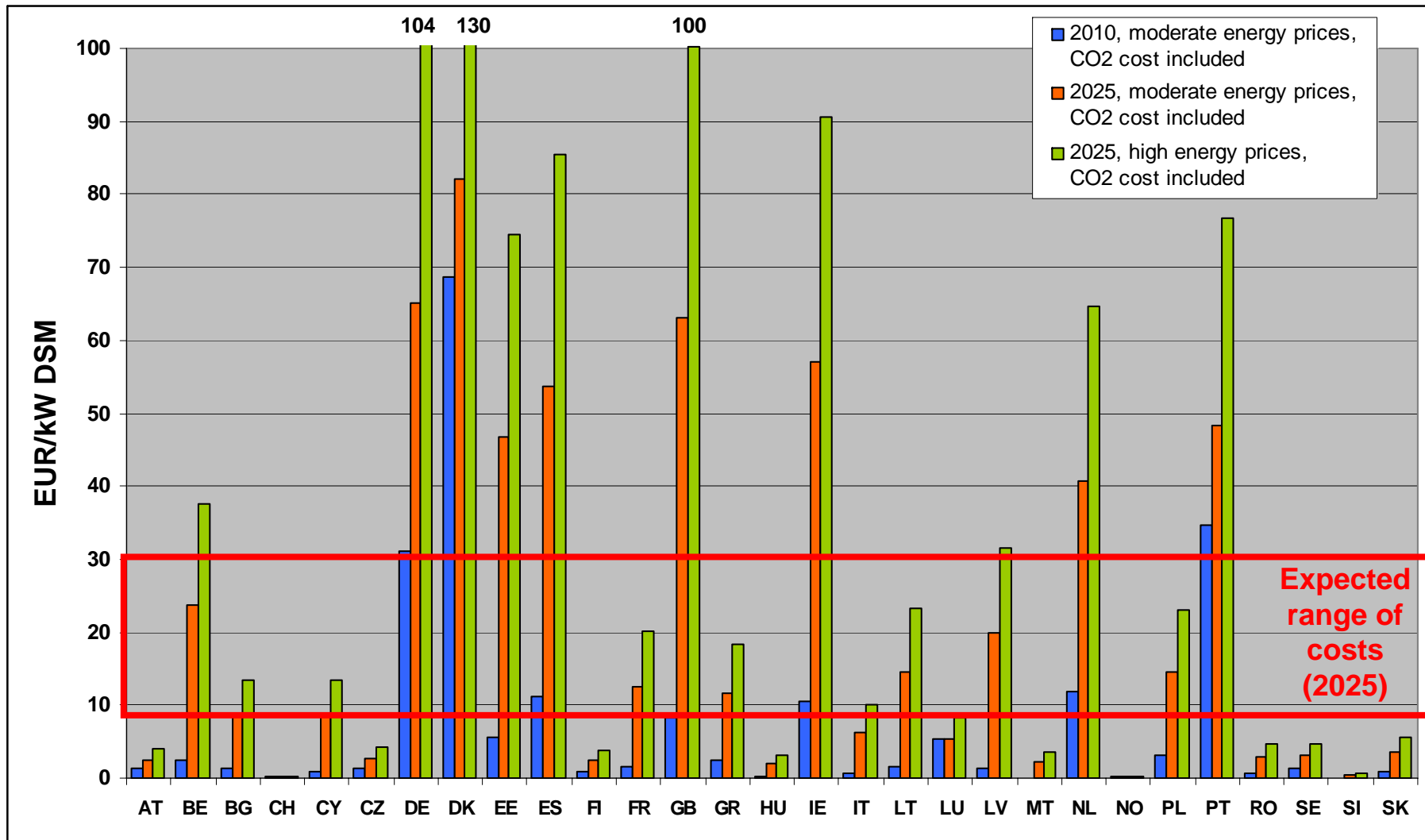
The following cost items are relevant

- Additional production cost for the Smart Appliance
 - Significant reductions expected through mass production
- Investments in an in-house communication hub
 - In the future, this function can be taken over by any WLAN system.
- Cost for additional electricity consumption of Smart Appliances
 - Expected average value: 1 W extra for SA “ready to operate”.
- Smart Meters are not really required for Smart Appliances operation, Also, Smart Meters can provide other services to consumers as well.
 - No extra cost have been taken into account here.

Determining the Economic Benefits of Smart Appliances in Sustainable Energy Systems

Step 3: Comparison of Cost and Benefits of Smart Appliances

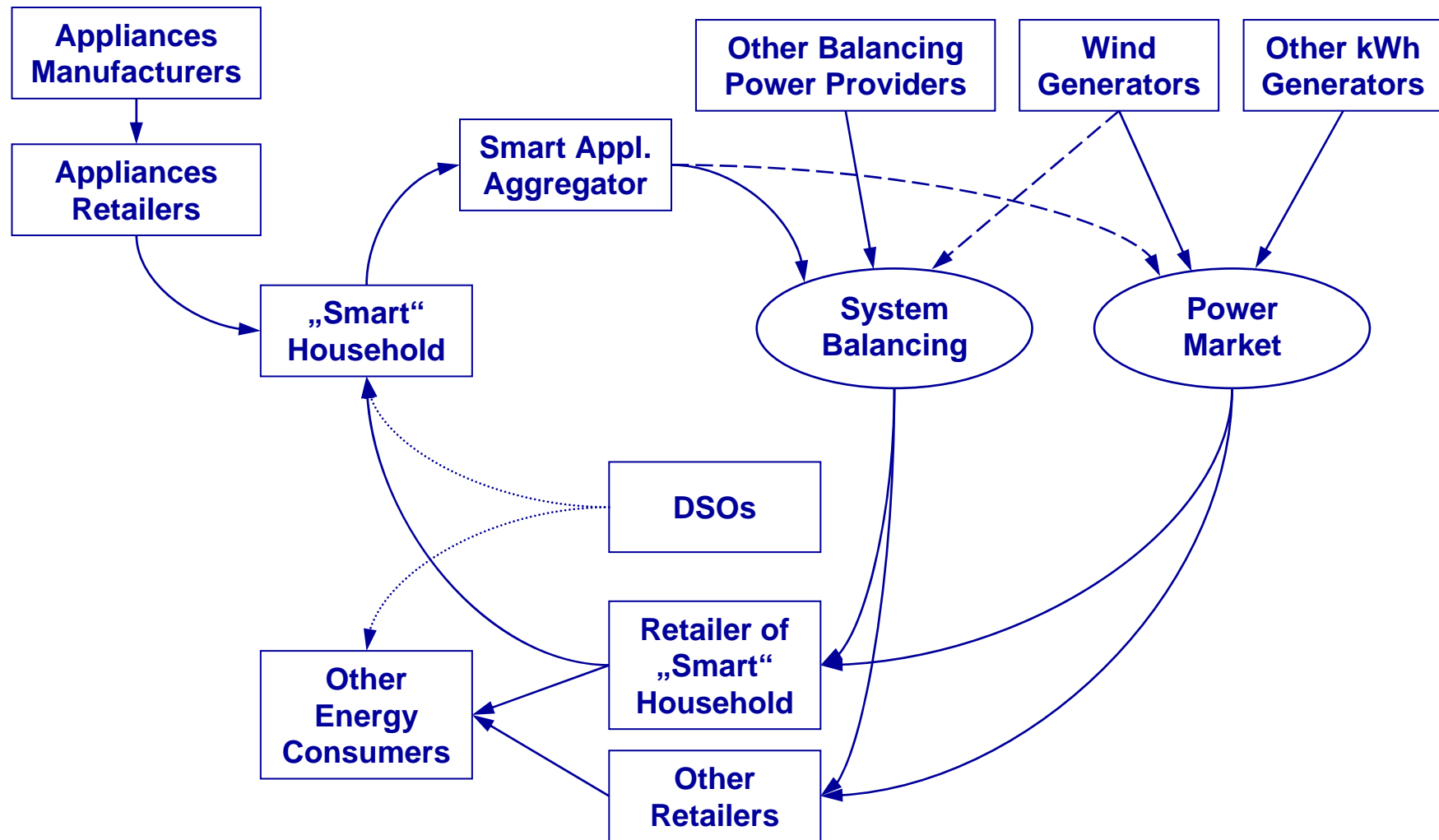
Comparison of Cost and Benefits



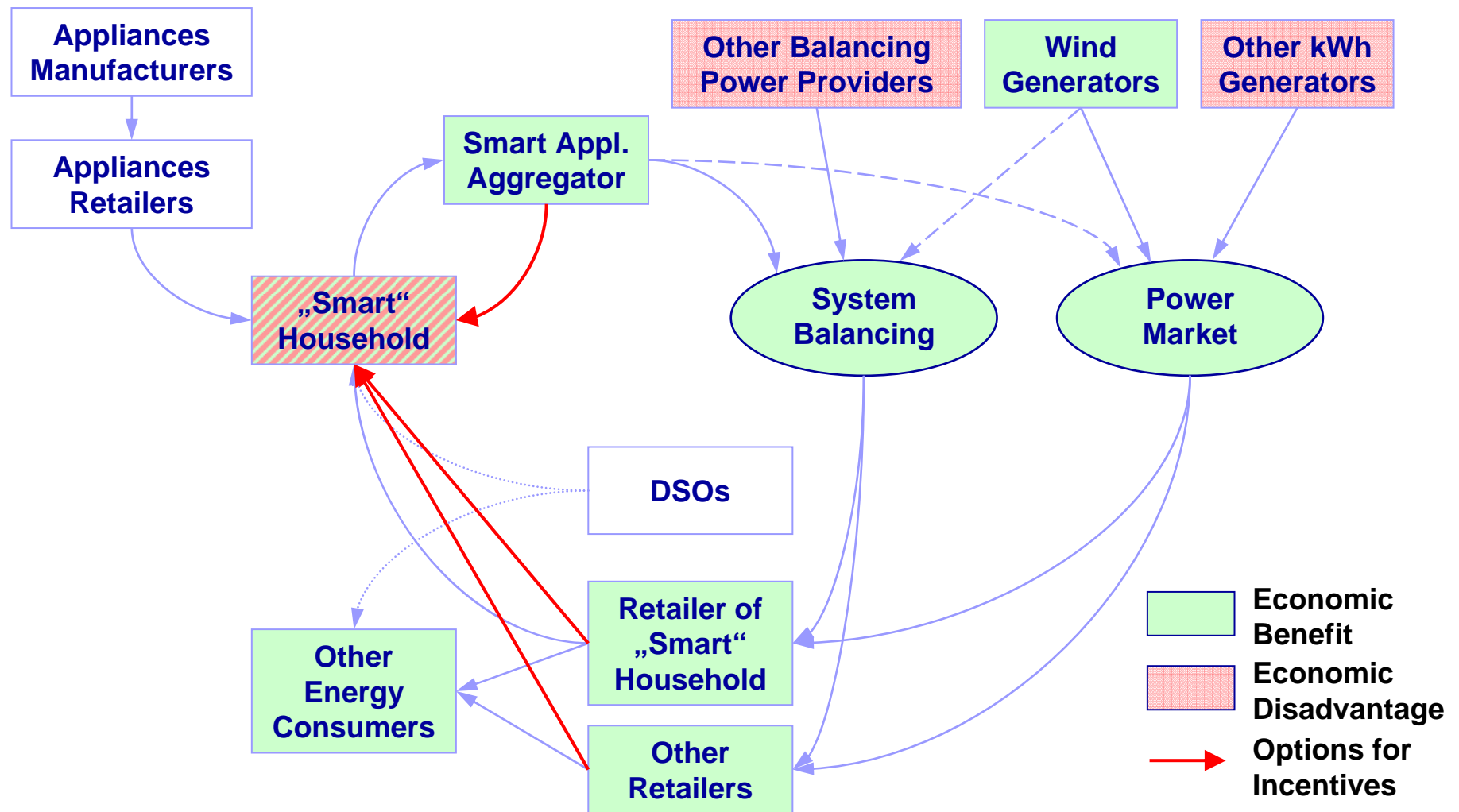
A Few Words of Caution

- Models A and B only looked at benefits of Smart Appliances used for balancing wind power.
 - Additional benefits can be gained by other applications, e.g. managing local or regional network congestions.
- The analysis is based on a number of rough assumptions.
 - Du to these uncertainties, the results should be regarded as rough estimates rather than precise results.
- The analysis is performed on a country-by country basis.
 - To the extent that balancing markets in the EU become better connected, differences will be reduced.

A Snapshot on the Actors Involved



A Snapshot on the Actors Involved



Conclusions on Smart Appliances (SA)

- Domestic appliances offer a variety of load management options. Technical constraints and consumer preferences define the limits.
- Consumers tend to accept SA if their daily routines are not changed and comfort and safety are maintained.
- From a system perspective the value of SA is driven by the flexibility of the conventional generation mix and the share of wind & solar energy.
- Typical values of SA for balancing wind generation are moderate. Not all EU countries seem to offer viable potentials for SA.
- SA can have significant value, when contributing to congestion relieve and reducing congestion costs.
- Incentive mechanisms are needed to give the right signals to the actors involved in Demand Response through SA.

Many Thanks for Your Attention!

Christof Timpe

Smart-A Project Coordinator

Oeko-Institut e.V. –
Institute for Applied Ecology
Freiburg - Darmstadt - Berlin

PO Box 50 02 40,
79028 Freiburg, Germany

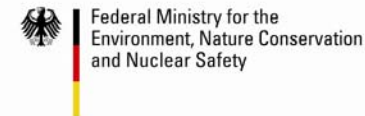
Ph.: +49-761-452 95-25

c.timpe@oeko.de

<http://www.oeko.de>

Project Website

<http://www.smart-a.org>



Intelligent Energy  Europe