

How Smart Appliances Can Help to Optimise the Local Use of DER

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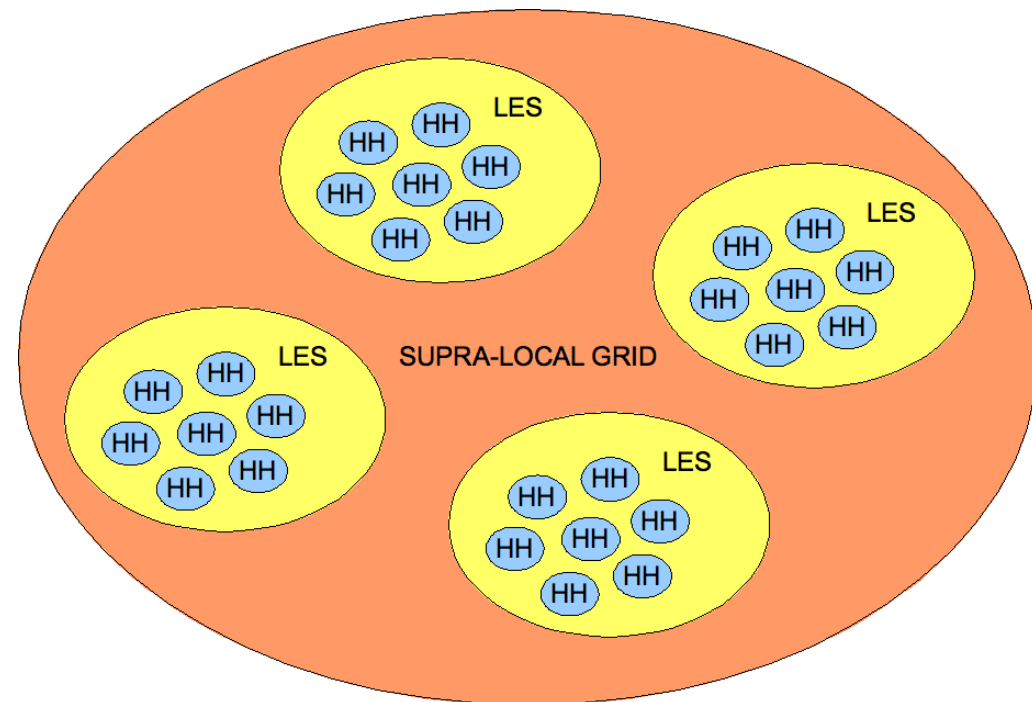
Overview

- ▶ What was the objective?
- ▶ Model architecture & abilities
- ▶ Overall results
- ▶ A detailed look
- ▶ Summary
- ▶ Outlook

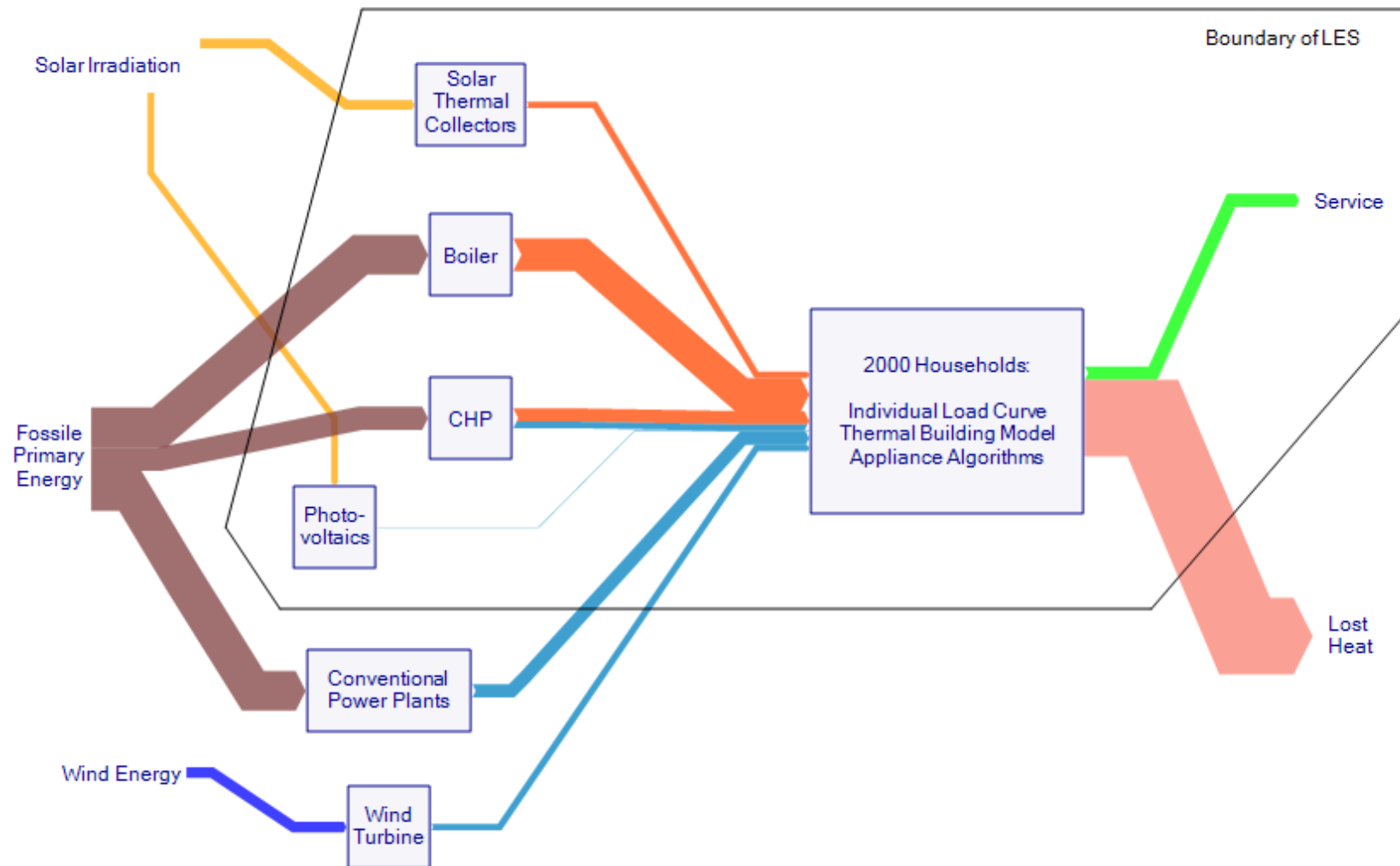
Local Energy Systems (LES)

▶ A Local Energy System is defined as an agglomeration of households and small enterprises within an area, where meteorological circumstances are constant and the distribution of heat is meaningful considering nowadays technology.

- Heat is balanced inside LES
- Electrical boundary at the low/medium voltage transition
- Local renewable energies (RES) are fed into local energy system
- Objectives:
 - Optimising local RES share of consumption
 - Smoothing electric volatility



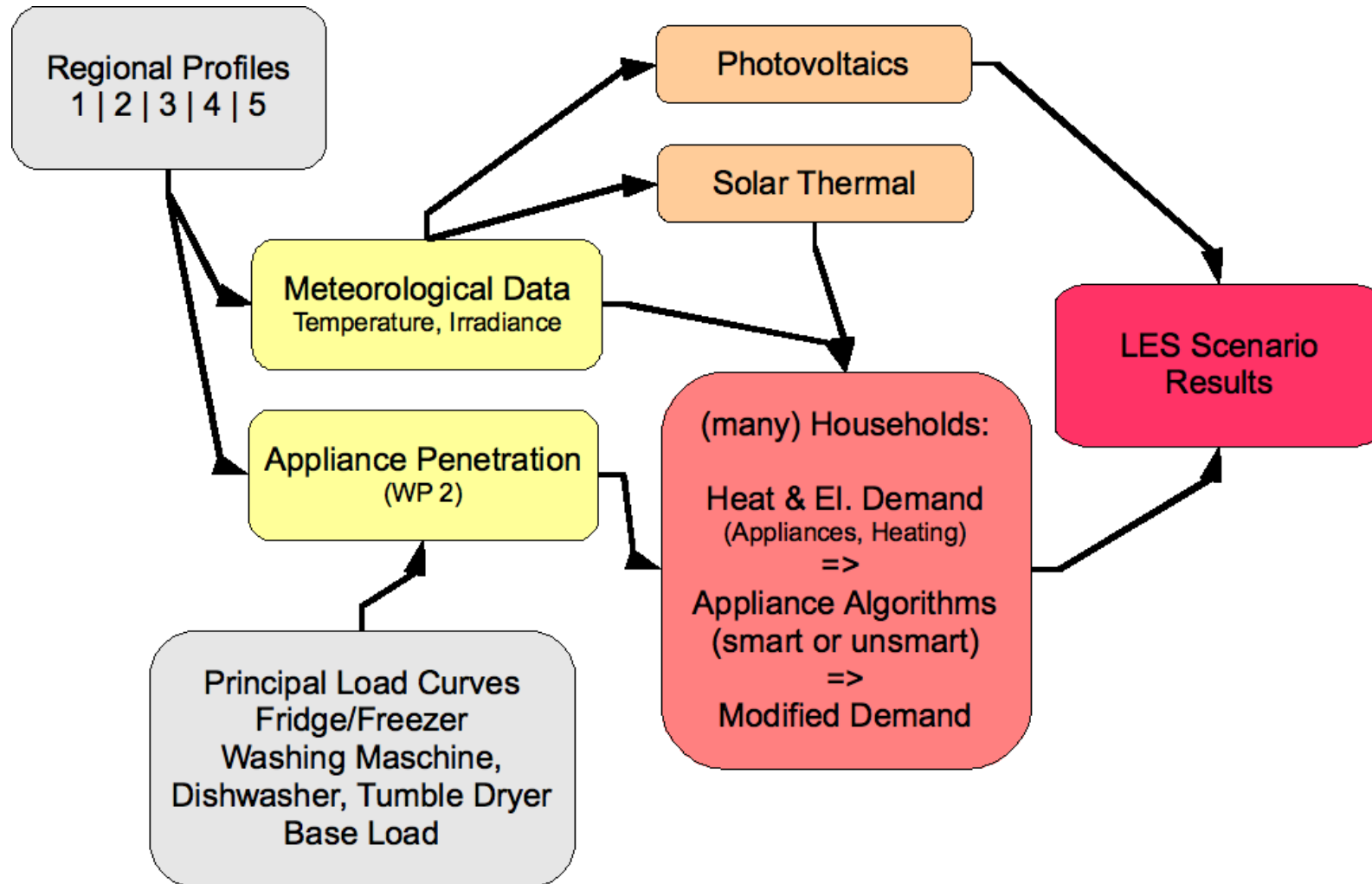
Energy Flow

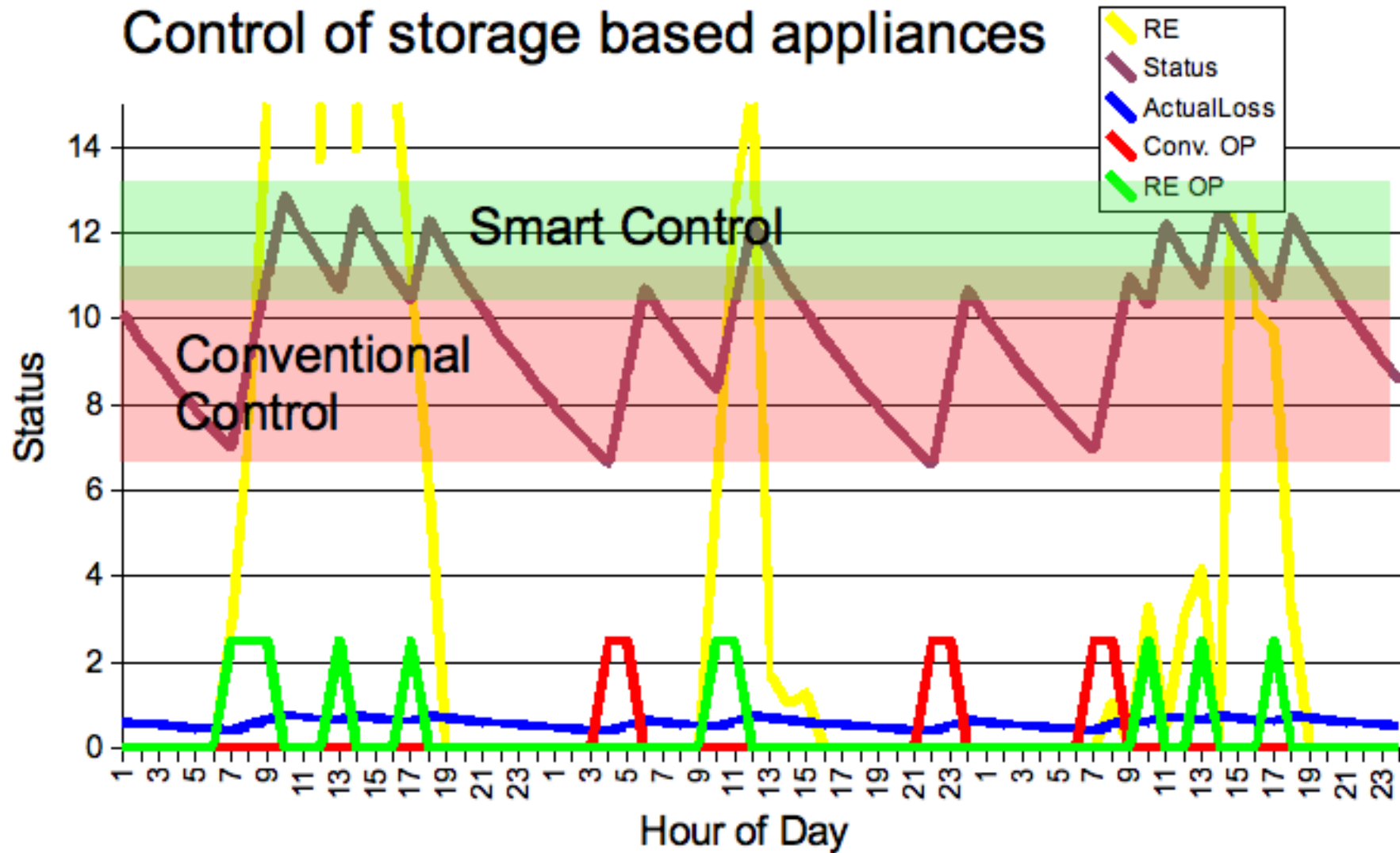


Smart-A Regional Classification

	Region A "South of Europe"	Region B "Scandinavia"	Region C "New member states"	Region D "Germany/ Austria"	Region E UK
Generation Flexibility	Low	High	Medium	Medium	Medium
Demand Profile	Summer Peak	Winter Peak	Winter Peak	Winter Peak	Winter Peak
Intermittent Generation Installed	Medium (rising)	Low (rising)	Low (rising)	High	Low (rising)
Appliances Penetration	Type B	Type D	Type C	Type D	Type E

Model Architecture



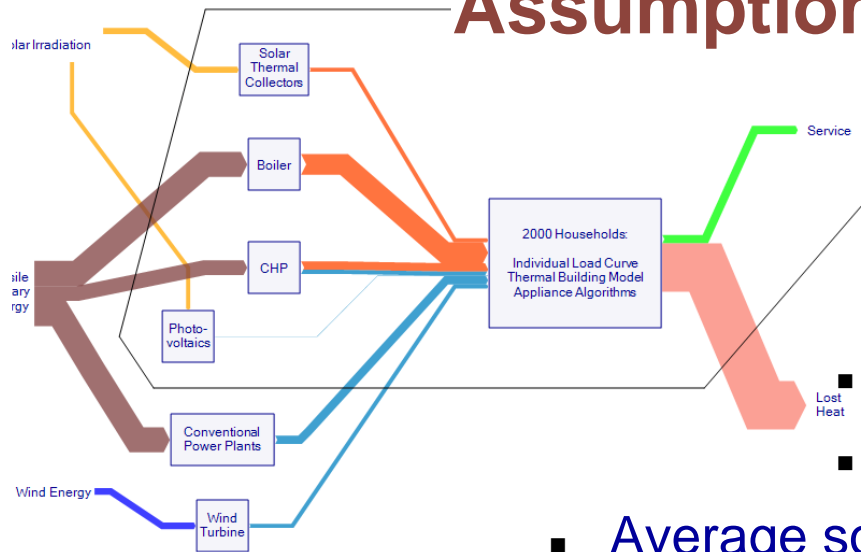


Current Model Properties

Calculations based on

- ▶ Standard meteorological data (DOE & TRY)
- ▶ Load curves for hot water, door openings, non-thermal loads and base load
- ▶ Thermal submodel for heat and hot water demand, integration of micro-CHP
- ▶ Randomized appliance properties
- ▶ Randomized variation of load curve probabilities
- ▶ Calculation of heat and appliances per household
- Summarizing hourly marginal cost and primary energy equivalents

Assumption in current LES models



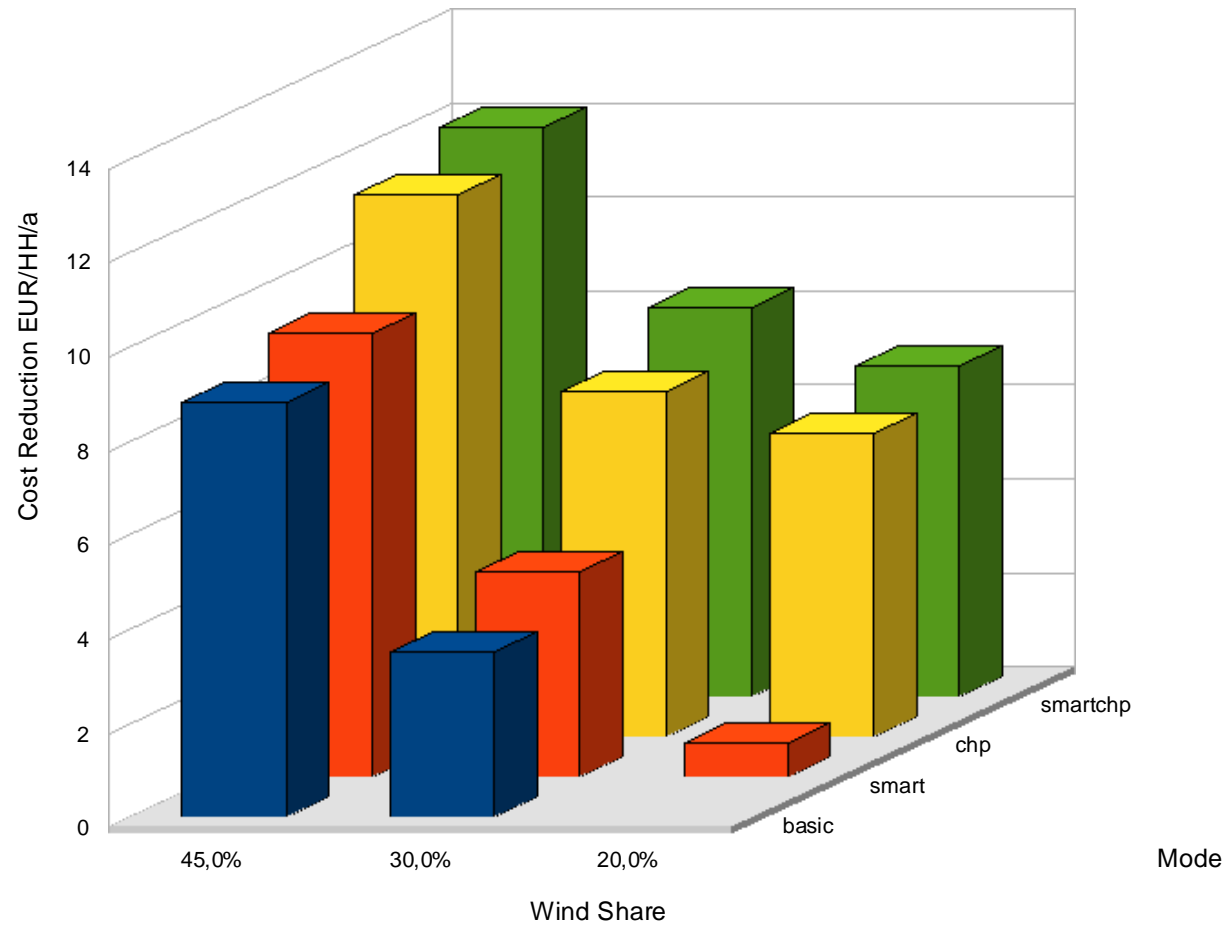
- 2000 households (HH)
- Average PV area: 4m²/HH, efficiency 12%
- Average solar thermal area: 1 m²/HH, efficiency 45%
- Domestic hot water per HH and day: 4 kWh
- 100% penetration of refrigerators and washing machines
- When micro-CHP is used, 10% penetration
- Efficiency of micro-CHP: 7% electric, 85% thermal

Sensitivity analysis on scenarios

- basic: 2000 Households, no smart appliances, no micro-CHP
- smart: As *basic*, but with smart appliances. Assumption: All refrigerators, freezers and washing machines operate smart
- chp: As *basic*, but with micro-CHP (heat-driven)
- smartchp: As *basic*, with a combination of smart appliances and micro-CHP
- Different wind power shares (20, 30, 45%) in national grid.

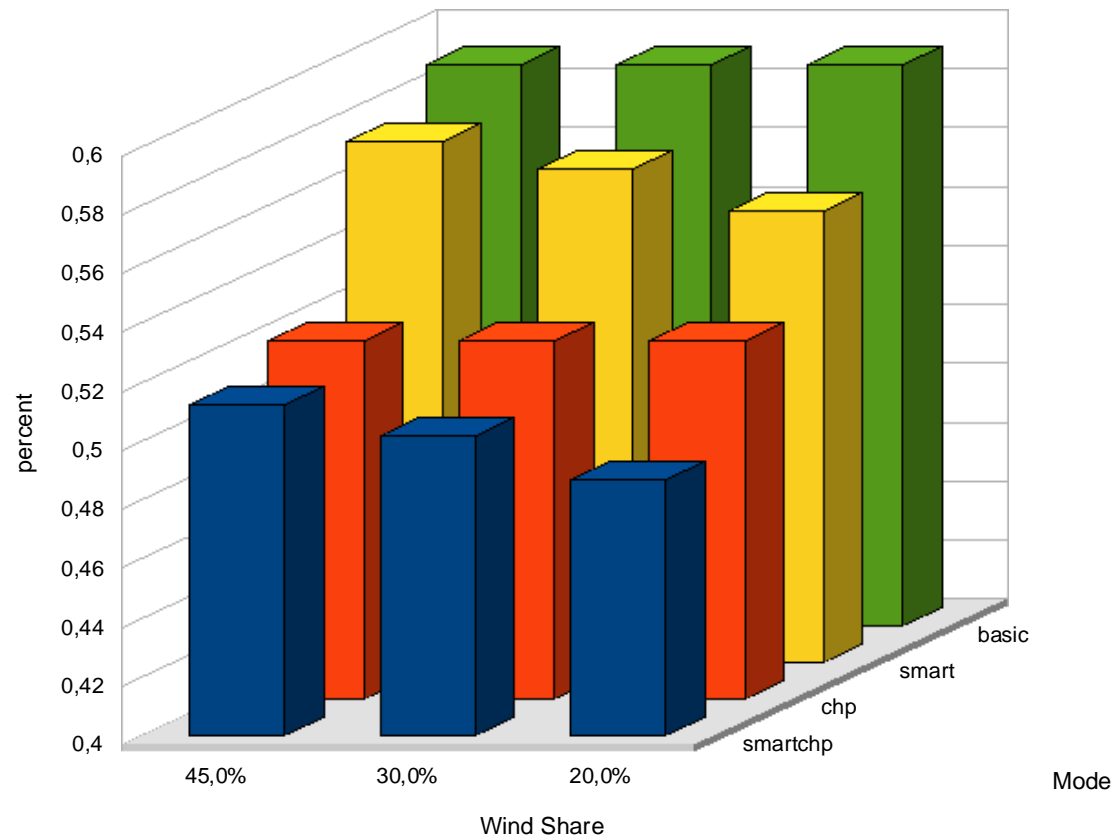
Overall results: Reduction of marginal cost

Italy, Cost Reduction per HH

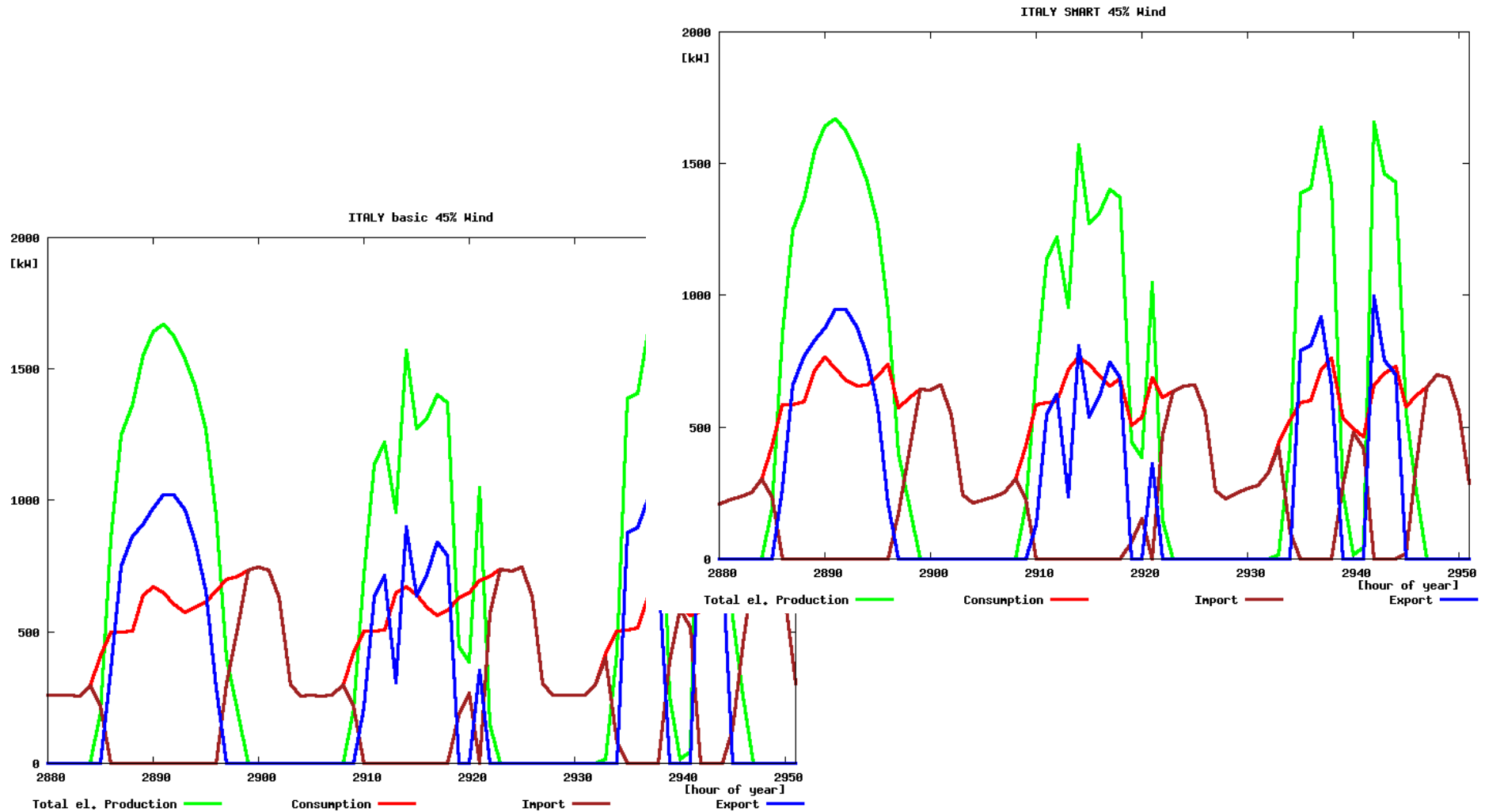


Overall results: Import of electricity

Italy, imported electricity in part of consumption



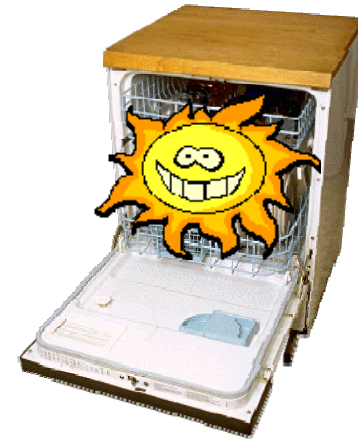
Detailed data of the 120th day



Summary

- ▶ Effect increases with RE/DER share
- ▶ No benefit according to PE equivalents
- ▶ Micro-CHP with considerable PE effects
- ▶ Methodology can be expanded on e.g. electric cars

Outlook



- ▶ Extension over all regions
- ▶ Towards communication standardization
- ▶ Opportunities for demonstration