Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case

   Virtual power plants and DSM

2. What is integrated with DSM

DG	x
Energy storage	
Smart grid technologies	

3. What is the level of commercialization

Research project	x
Demonstration	
Field test	
Existing practice	

4. Where to find more information?

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   - Company

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   - web-site

     http://www.ea.tuwien.ac.at

   - references

     http://www.energiesystemederzukunft.at/results.html/id3671

Description of integrated pilots/demonstrations/field tests/existing practices

5. Objectives of the case

   The aim of this project is to dissipate balance energy locally. For this purpose Demand Side Management (DSM) is a precondition, whereas the local load is controlled in the manner of a virtual power station according to the fluctuations of wind generation.

   Relevant applications of households for DSM are:

   - cooling and freezing
   - washing, drying and dish washing
   - space heating and hot water heating.

   Other applications like cooking, illuminating, consumer electronics and so on can not be used for DSM because the loss of convenience is too high and so consumers would not really accept load shifting in these tasks.

6. Business rationale/model

7. Technologies used

   Used methods and data

   - Estimation of the potential of wind energy and possible construction sites in Austria
   - Estimation of the stochastic behavior of wind and the error of prognosis, compared with historical data and experiences of the network-operators ("Ökobilanzgruppe")
   - Impacts of the injection of wind generated electrical energy on the transmission network
   - Electrical load profile modeling
   - Thermal load profile modeling
   - Methods, Potentials and Impacts of DSM

8. Short description of the case

   Renewables with Demand Side Management

   Due to the increased promotion of electricity from renewable energy sources in the EU-directive 2001/77/EC renewable power generation technologies will be forced.

   Especially in Austria wind energy with a potential up to 1.700 MW can lead to a high grid loading and to an increased demand of balancing energy. The insufficient capacity of the transmission system and the high demand of balancing energy can result in congestions, which form a barrier for the rapid introduction of wind energy.

   Wind power production is characterized by stochastic generation trait and so it can be predicted with limited accuracy. Standard deviations of wind power forecast errors are about 10 % to 20 % of installed wind generation (state of the art). Therefore additional balancing energy of about 20 % of the yearly wind energy generation must be available.

In Austria the main wind potentials are focused in a small region (Burgenland and Lower-Austria) and so wind power generation can lead to a high grid loading.

The analysis of the Austrian high voltage grid shows, that high wind power generation can only be integrated if the grid will be strengthened.

9. Achieved/expected results (operational savings, CO_2, efficiency enhancement)

As a further precondition a sufficient potential for load has to be locally available for DSM and the load has to be flexible in time. These characteristics are given particularly in domestic electrical heating applications. As the energy demand of households is dominated by space heating and hot water, the usage of bivalent (fuel/electric) heating systems can result in a bigger potential for DSM. The wind fluctuations can be balanced locally by switching additional heaters in conventional fossil heating systems (bivalent heating systems).

Furthermore high efficiency can be achieved in the substitution of fossil fuel. CO2-emissions can be saved by reducing balance energy (supplied by conventional thermal power plants) and by reducing domestic fuel.

The resulting load curves of the relevant applications are shown in figure 0.1 to figure 0.3. These loads determine the theoretical DSM potential in the APG-balance zone and in Austrian wind region respectively.

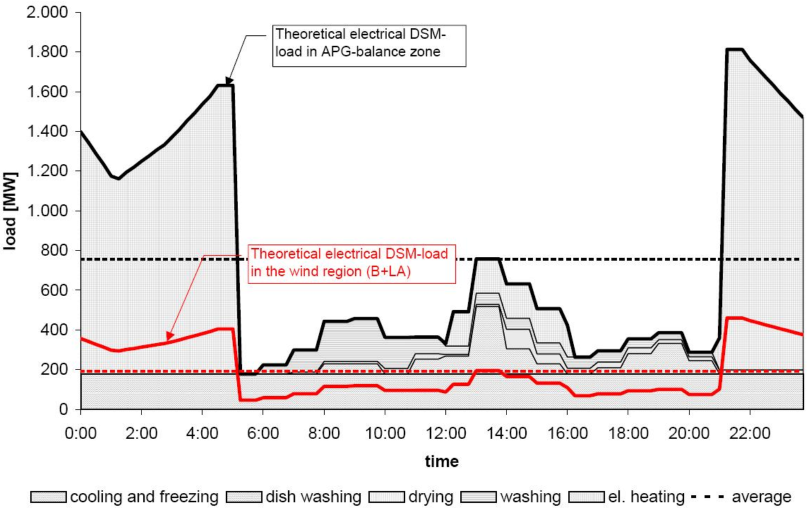

Figure 0.1: Theoretical DSM-Potential of relevant applications (including space and hot water heating) in households on a winter day

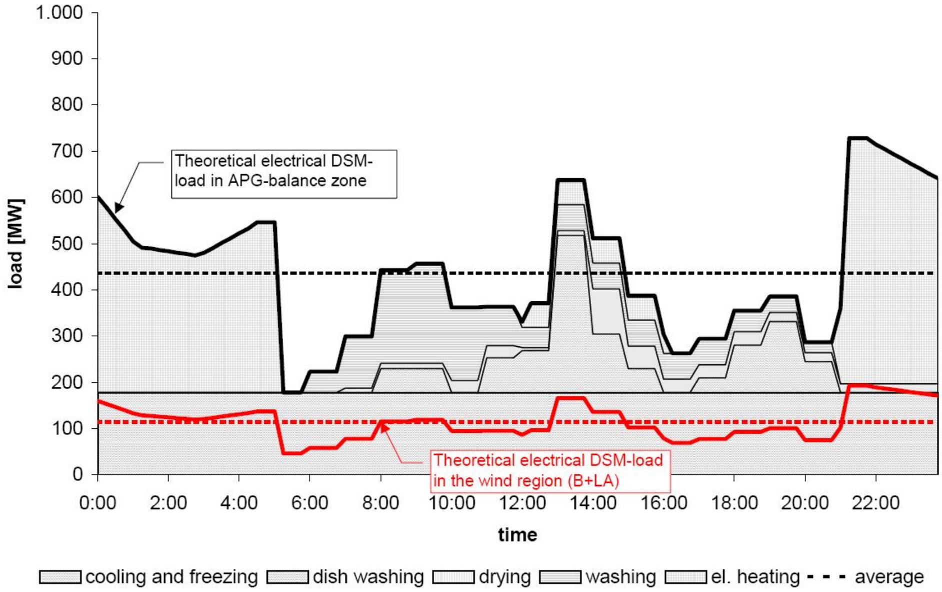

Figure 0.2: Theoretical DSM-Potential of relevant applications (including space and hot water heating) in households on a spring or autumn day

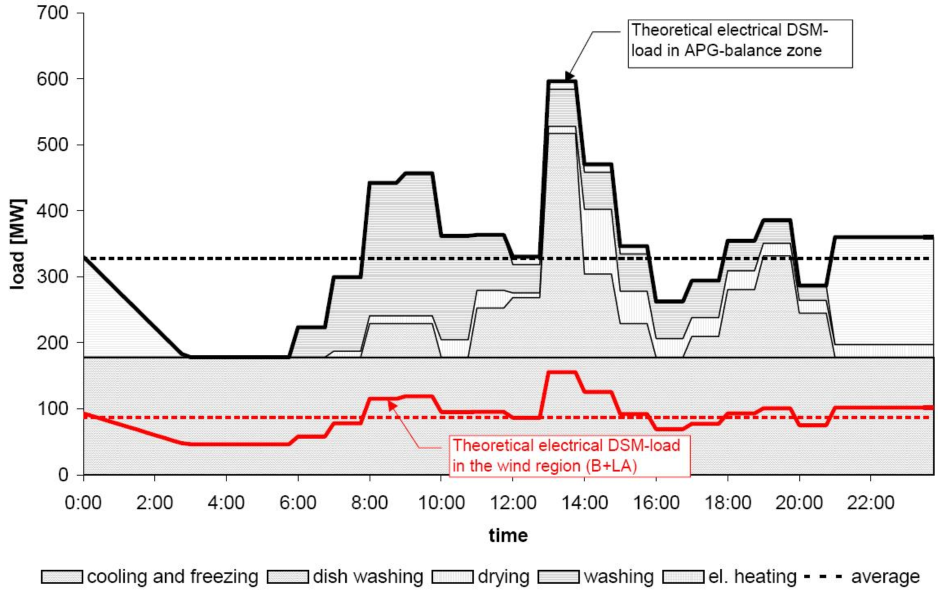

Figure 0.3: Theoretical DSM-Potential of relevant applications (including space and hot water heating) in households on a summer day

Description of integrated pilots/demonstrations/field tests/existing practices

The main results and conclusions of these analyses are:

- The theoretical DSM potential of electrical applications in households is characterized by large daily and seasonal variations. In the APG balance zone it is on average about 757 MW on a winter day, 358 MW on a summer day and 436 MW on a day in transitional period.

- Non-heating applications like washing machines, drying machines, refrigerators and freezers make a small theoretical DSM-potential. The main part within this group gives refrigerators and freezers, which cause a base load of 178 MW.

- Heating applications dominate the theoretical DSM potential. This can be seen in the fundamental seasonal variations of the DSM load.

- In the Austrian wind region (Lower Austria and Burgenland) the average of the theoretical DSM potential of electrical applications in households is 193 MW on winter days, 87 MW on summer days and 114 MW on days in transitional period. Without heating applications it is on average 80 MW per day.

The technical and economical implementations depend on the technical complexity and costs of the control equipment. There must be also financial incentives for the customers to stimulate the acceptance of DSM. The valuation also depends on prices for balancing energy.

10. Lessons learnt

The conclusions of the analyses have shown, that heating applications are the main parts of DSM-potential. The storage abilities of buildings and heat reservoirs suit for load shifting without having any loss of convenience. This potential can be increased by using bivalent (fuel/electric) heating systems i.g. the substitution potential of fossil heating energy (domestic fuel) will result a in a bigger potential for reducing wind related balance energy via DSM.

In the APG balance zone (and Austrian wind region respectively) the theoretical DSM potential of thermal applications in households averages 32 MW (10 MW) on winter days, 3,9 MW (1,1 MW) on summer days and 11 MW (3,3 MW) on days in transitional period per % substituted fossil energy.

So the fluctuations of wind can be balanced locally and this works like a virtual oil spring because of using regenerative wind energy instead of fossil heating energy. Therefore fuels and CO_2-emissions (in households and in balancing power plants) can be saved.

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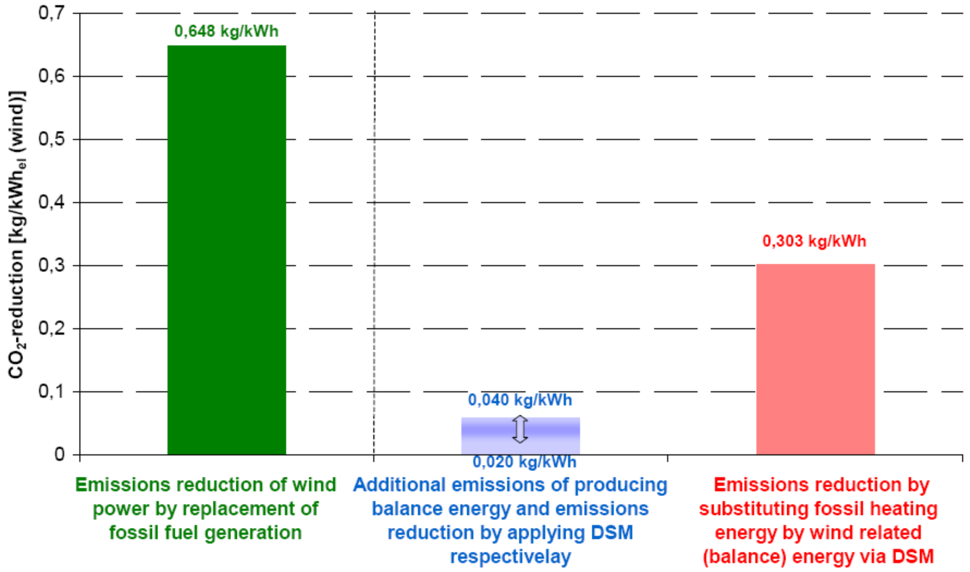

Figure 0.4: CO_2-reductions related to wind and DSM

The results show, that wind related CO_2-reductions are mainly determined by the replacement of conventional thermal electricity production. Additional CO_2-emissions causes by producing balance energy are very small because of the big contingent of pumped storage power plants in Austria. So there are moderate emission reductions by applying DSM.

High CO_2-emission reductions can be effectuated by substituting fossil heating energy by wind related balance energy via DSM. Therefore the use of bivalent heating systems can increase the climate efficiency of wind power plants.

Another effect of using bivalent heating systems can be used if the Austrian high voltage network will be completed adequately: Shut downs of wind power plant as a result of bottlenecks can be avoided by using wind energy locally in the wind region. This will also decrease CO_2-emissions in domestic fuel at least.