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Energy balancing demand - How much is needed and where?

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Basics and state of the art

What is energy balancing demand? Energy balancing demand occurs if load and electricity supply is not balanced. As it can be seen in figure 1 there are different terms which have to be differentiated. "Negative energy balancing demand" occurs if there is more electricity produced then consumed (e.g. during strong wind scenarios). In the opposite case "positive energy balancing demand" it is necessary to put electricity to the grid.

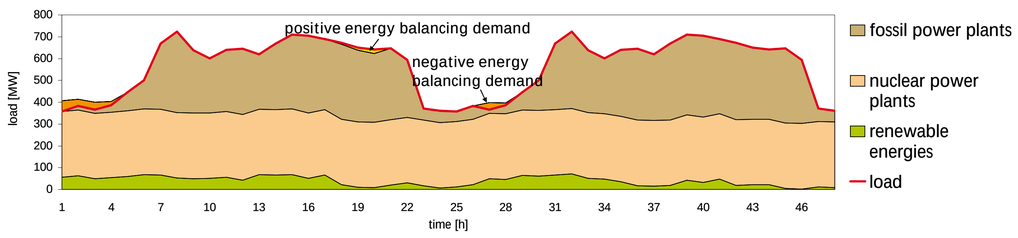


Figure 1: The different kinds of energy balancing demand.

In the case of Germany there are allready situations today in which energy balancing demand exists. In figure 2 the load profile for the german EnBW control area for December 2009 is shown.

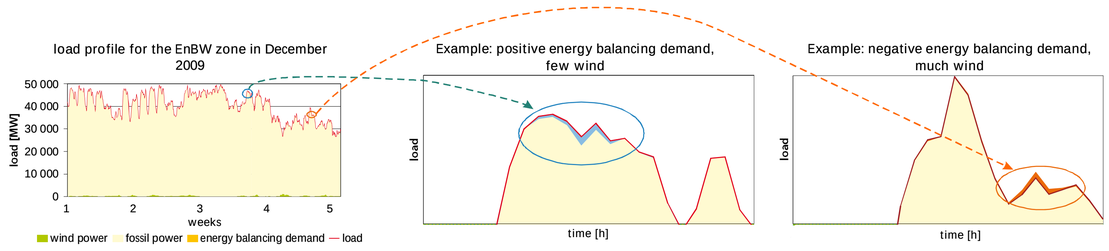
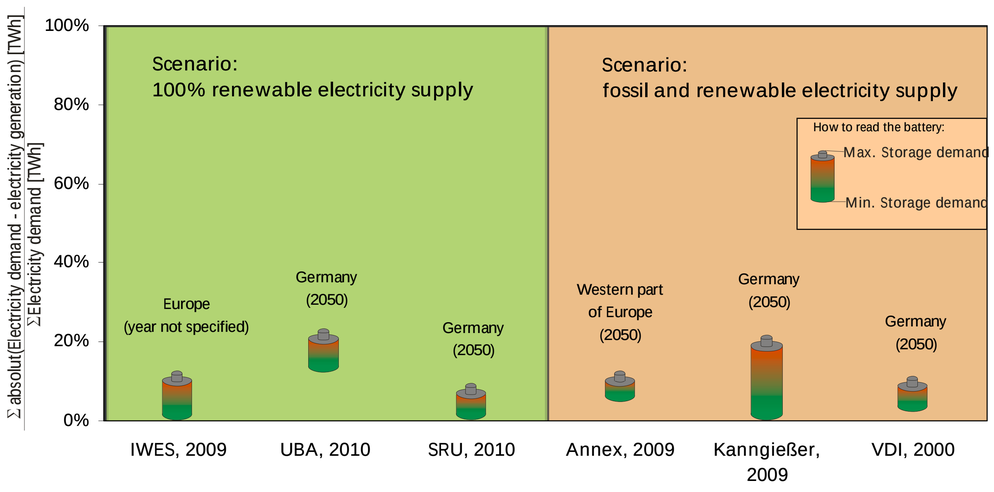


Figure 2: Example of allready existing energy balancing demand in Germany (data: EnBW).

It is obvious that only for few hours energy balancing demand is needed. Today it could be resolved by electricity im- and export with the bordering regions and by the cut off of wind power plants. But with the increasing extension of renewable energies the mismatch between load and generation will increase.

Comparison of studies

There are no studies which estimate the energy balancing demand but some estimate the energy storage demand. It is a special kind of energy balancing demand and it gives a direction how much the energy balancing demand could be. The figure 3 compares the results of the existing studies. The battery symbol shows the estimated energy storage demand which is calculated as the sum of the absolute positive and negative storage demand. The most studies estimate it for the year 2050.



"Design of transport and storage capacities for a future European power supply system with a high share of renewable energies", Fraunhofer-Institute for Wind Energy and Energy System Technology (IWES) and Siemens, paper, March 2009.

"Energy goal for 2050: 100% renewable electricity supply", study of Federal Einvironment Agency (UBA), July 2010, Dessau-Roßlau.

"Climate-friendly, reliable, affordable: 100% renewable electricity supply by 2050", German Advisory Council on the Environment (SRU), May 2010, Berlin.

"Future grid storage – Capacity requirement: an IEA Prospective", Shin-itchi Inage, Annex Workshop, Fredericia, October 2009, Denmark.

"Estimation of energy storage demand without grid restrictions.", Unpublished study, A. Kanngießer, Fraunhofer-Institute UMSICHT, December 2009, Oberhausen.

"System technology for a climate-friendly electricity supply in Germany for 21st century", V. Quaschning, Association of German Engineers (VDI), 2000, Düsseldorf.

Figure 3: Comparison of different studies calculating the prospective storage demand.

- None of the studies consider for grid restrictions within the investigated country.
- The studies from UBA, SRU, IWES and Kanngießer consider for limited im- and export capacities. Therefore the compared results show at the top of the battery symbol the storage demand for the case of no im- and export.
- The demand in the scenarios with a 100 % renewable energy supply is slightly higher.
- Method: Every study has a general load profile and time series for the electricity supply.

⇒ A model is necessary which estimates the local energy balancing demand with respect to the grid situation.

MELENA - Model

The development of MELENA (model for the estimation of the local energy balancing demand) is at the beginning and at the moment the theoretical base is elaborated. In Figure 4 the method of MELENA is shown.

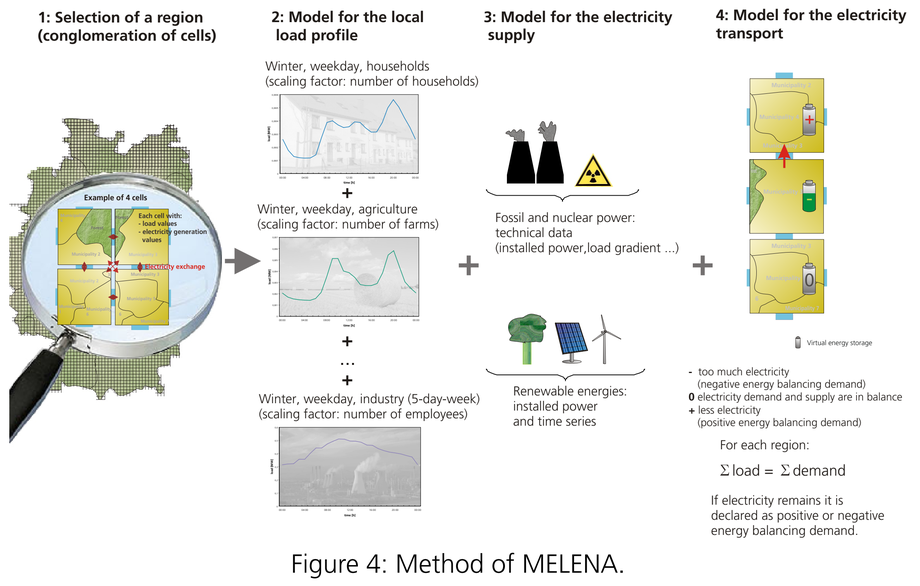


Figure 4: Method of MELENA.

The model consists of 4 partial models. The first includes the whole statistical data which is used for the generation of the demand curve (second partial model). At the moment these two partial models are nearly completed. To show how the results of MELENA could be and what conclusions they allow, a very small region of Germany is selected. For this example there is no im- or export. The modelling results for one year are shown in Figure 5.

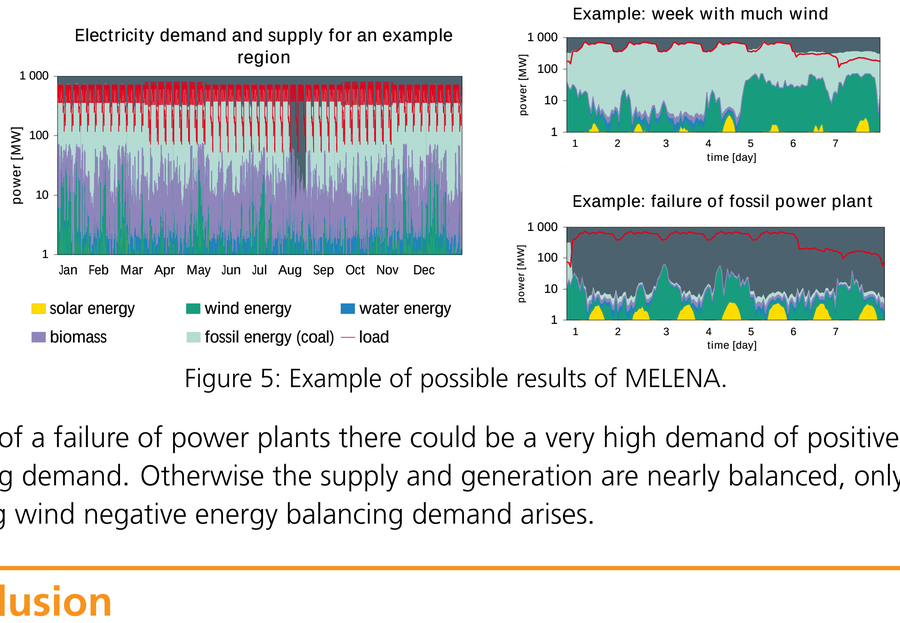


Figure 5: Example of possible results of MELENA.

In cases of a failure of power plants there could be a very high demand of positive energy balancing demand. Otherwise the supply and generation are nearly balanced, only in cases of strong wind negative energy balancing demand arises.

Conclusion

- With the increase of renewables the energy balancing demand will also increase.
- Results of MELENA give an overview in which typical areas (rural,urban etc.) energy balancing demand could occur and which type.
- The model is the first step to analyse the possible applications for electricity mismatch. It could be analysed where it is reasonable to use demand side management or storage systems.

Acknowledgement

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