Abstract

c) Synopsis

A lot of electrical devices have to transform alternating current (AC) into direct current (DC) because they work on direct current. Besides that a lot of decentralized energy sources and electrochemical storage produce or work on direct current. To check whether there is a possibility for realization and to show up advantages, we are going to do research on low voltage dc-power grids. We will investigate the feasibility and the necessary components as well as algorithms to operate and control such a DC-grid. With extended algorithms it should be possible to realize a “smart DC-grid”. The economical evaluation will indicate the possibility for realization or the additional demand for research in this area.

d) **Abstract**

Nowadays a significant amount of electric devices work on direct current (DC) but the power is supplied via an alternating current (AC)--grid, thus making it necessary to convert AC into DC for the devices. On the other hand, decentralized generation like photovoltaic, fuel cells or electro chemical storage used for energy optimization are all working with DC, which has to be converted to AC to be feed into the power grid.

The project is based on the idea to substitute or amend the low voltage AC-grid with a DC-grid inside a building or residential area to reduce the necessary transformations from DC to AC and back to DC.
The topic of DC supply is currently under discussion but the demand on research is still very high. To find out in which areas further know-how is necessary to realize a DC-grid it is important to check the following five questions in this feasibility study:

1. Which components are needed for a smart-DC-grid?
2. How could such a smart-DC-grid be operated?
3. How could, as an additional functionality, such a smart-DC-grid be operated as an island?
4. Is a smart-DC-grid economically feasible?
5. Which concept could lead to a realization?

Investigation on State-of-the-Art for components, designing of exemplary grids for different scenarios (AC-DC-combined grid, standalone DC-grid, DC-grid for residential area, DC-grid for an office building …) will make it possible with the developed simulation tool to gather information on the design and operation of a smart-DC-gird. Simple exemplary algorithms for operation combined with Demand Side Management (DSM) should be developed and tested, for instance by using the voltage magnitude for signaling information about the current energy production and state of charge of storage in the SmartDCGrid. Furthermore the advantages and disadvantages compared to a conventional AC-grid should be investigated.
Simulations for the exemplary grids will be done with and without a connection to the AC-grid. If the AC-grid is not available, DC-grids might be economically feasible because the

costs for not delivered energy are much higher than usual energy costs.
The exemplary grids are going to be compared to “business-as-usual” scenarios to find the maximum of costs for the components. This economical evaluation will indicate whether it makes sense to do further research or not.
This project will deliver a large knowledge base for future work on smart-DC-grids. That will make it is possible to develop concepts for a realization with the project partners and external partners.