From photovoltaic generation to end users with minimum losses

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Web: http://solartestbed.se/om-projekten/fran-solel-till-anvandare/
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Location: The RISE research villa (Forskarvillan), Borås
Possible to visit: Yes

Background

A complete system with solar power generation, battery storage, load control, a direct current (DC) network and DC loads is demonstrated in a single-family house. The study uses an integrated approach, where the system ranges from electricity production in the solar cells to the use in household appliances as well as installation technology products. The project will also measure the impact on energy efficiency, when using an internal DC grid which does not require conversion back and forth between DC and AC.

Implementation of the project

The project is conducted by RISE in a full-scale experimental one-family house. The house contains a system that includes solar cells, batteries, a DC grid, a control system, household items and installed products such as a heat pump, air conditioning units and pumps. As a part of the project, there is also an intention to further develop household products and systems that are adapted to DC power.

Within the project, there are is number of installations and experiments that are deigned to try novel ideas of the power system:

- An internal DC system, that makes use of solar generated direct current directly in products adapted for DC. Normally, DC is converted to AC for transmission and distribution, and then often converted back again to DC for use in electrical appliances. In addition to limiting conversion losses, this also has the ability to increase the power quality in the network, as phenomena such as harmonics can be avoided.
- Optimization of the system, which could lead to a lower usage of electricity.
- The integration of a battery storage and its impact on the internal energy system. Its main use is to store excess solar generated electricity and move the energy usage in time, but it could also be used to help with peak shaving and thereby stabilize the surrounding grid.

In addition to this, the use of direct current is believed to influence safety in a positive manner.

Benefits

As mentioned above, the combination of these features could improve the power grid in numerous ways. Local installations, where electricity is generated and used without any DC/AC conversions, limit losses. It also decreases the need for electricity from the external grid, especially if combined with a battery storage. This benefit the DC grid owner and in addition makes the surrounding grid more stable. A DC grid also avoid some undesired effects from AC, such as distortions that stem from harmonics.

Scalability

DC grids are in practice limited to smaller installations, as the electrical losses in larger systems are considerable and direct current is impractical for large scale systems. Direct current is likely to be used in a larger scale in the future.

Interoperability

A DC system is, by definition, not one to one interoperable with the AC system, even if they can be connected and serve different purposes. However, local DC systems show good interoperability with for example solar power generation.

Investment horizon

As many DC products are not readily available, it is hard to estimate the investment costs for this kind of project.

International potential

Local network systems are of interest at many locations globally, especially areas with a high penetration of renewable generation and remote areas with a weak or no connection to the national grid.