TECHNISCHE HOCHSCHULE DEGGENDORF

DirektPV

CHARGING ELECTRIC VEHICLES DIRECTLY AND HIGHLY EFFICIENTLY VIA SOLAR POWER THROUGHOUT THE YEAR TO MITIGATE OR COMPLETELY AVOID THE EXTREME LOADS ON THE POWER GRID AS WELL AS PROVIDING FINANCIAL BENEFIT.

„Close-up of an electric car charging station. Electric vehicle in a blurry background" von Ivan Radic auf flickr (https://flic.kr/p/2kA4s7m)

Weitere Infos

DirektPV - Direct charging of electric vehicles from PV systems with the possibility of energy trading between power grid

Project description

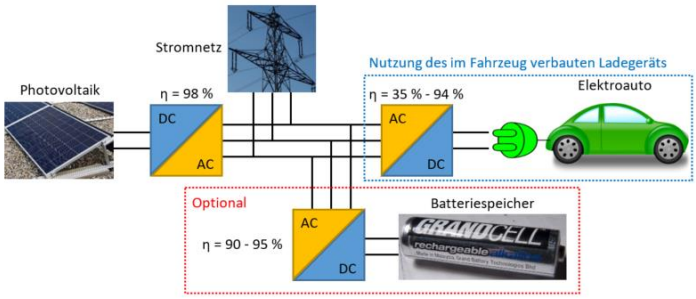
The steady increase of electric vehicles' utilization puts too much burden on the public power grid. The basic concept of the project is to supply electric vehicles directly and highly efficiently with self-generated solar power throughout the year (summer and winter). This minimizes the need to expand the public power grid, which is caused by the increasing number of electric cars. Also, efficient, direct use of solar power makes the vehicles much cheaper to operate. As part of the research project, special power electronic converters are being developed. The converters extract the solar energy that is not being used in the house and charge it directly into the electric vehicle with 99% efficiency. By bypassing the alternating current network, two conversion levels (direct to alternating and back to direct current) are avoided. Thanks to the direct coupling of photovoltaics to an electric car, charging can be carried out much more precisely and with less loss compare with conventional solutions. This means that even in winter, the weak solar irradiance can still be used to charge the electric car, which means that electric vehicles are supplied with completely locally generated green electricity, making them even more environmentally friendly.

Project goal

The aim of the project DirektPV is supplying electric vehicles directly and highly efficiently with solar power throughout the year (summer and winter) in order to mitigate or, ideally, completely avoid the large loads on the public power grid. Technically, the direct use of solar power is already possible, but the previous solutions are only efficient when there is strong solar irradiance in summer. In weak sunlight (winter, cloudy sky), the charging efficiency sometimes drops to 35%, which means that two-thirds of the already low solar power generation is converted into unused heat in this weather. As part of the project, power electronic solutions with an efficiency of over 99% are being researched to solve this problem.

Scientific and technical solution concept

The previous technical solution is shown in the following figure. The generated electricity from the photovoltaic system is fed into the power grid with a solar inverter. This is very efficient, with an efficiency of up to 98%, because PV inverters have been optimized for a high level of efficiency for years. The alternating current meter reports the currently generated PV power to the home charging station (AC wallbox) and the AC wallbox tries to control the charger in the vehicle accordingly. This is only possible to a limited extent. In addition, a battery storage can be integrated into the system, for example to store solar power when the vehicle is not at the charging station. This battery storage can also be used to avoid the low charging efficiency of the electric vehicle when there is low solar radiation. To do this, the solar power is first loaded into the battery storage system and then transferred to the vehicle with high output. This can make sense in terms of energy efficiency, but it doesn't make sense from an environmental point of view, because the solar power then has to be stored in two batteries one after the other. One of the arguments against electric cars is the high CO2 footprint for battery production, then using double storage cannot be justified.



Bisherige Verschaltung einer Elektroauto-Ladung aus einer PV-Anlage

The recently developed DC-DC converter in the project achieves over 99% efficiency and charges the electric car battery directly instead of an additional battery storage device. The very high efficiency is achieved through a special construction and optimization technology of the power electronic systems.

Project partner

Project duration 01.02.2021 - 31.07.2021

Sponsor

Results The conception and project planning has already started. The first results of the TdF can already be presented.

Project participants

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