The PV LED Engine - a new generation of intelligent solar powered LED lighting

Digging down cables for small electrical applications in the urban environment is extremely expensive due to the high labour cost associated with it. Small stand-alone PV applications powered by 0.5-50 Wp can become very attractive since e.g. in Copenhagen in Denmark the cost of digging down cables in the city is about 1000 $ per meter so the cost savings on the cable digging can easily pay for the solar cells. The requirements to the products from the municipalities are high so if e.g. the products are for lighting purposes the reliability of the product meeting some specified amount of light is very important. The willingness to pay for such high-end stand-alone PV applications is though high but it is essential to be able to evaluate if the product will work in a given environment in both the development and dimension phase of the product and as a credible proof tool towards consumer/buyer/decision makers. The barrier for exploiting this potential seems to be the lack of knowledge and tools for dimensioning and designing PV applications for the urban environments. The authors investigated the many PV dimensioning tools on the market and found none addressing exactly this issue and in the present project the design and simulation tool for small PV applications for the urban environment is developed. The tool is advanced in its calculations on the solar irradiation parameters being very different in the urban environment compared to roof top applications both spectrally and in intensity variations. Weather parameters based on Typical Meteorological Year (TMY) for a given position on the globe is used for the solar irradiation calculations dissolved spectrally by the models proposed by D. R. Myers[1] and simple assumptions about the geometrical and optical properties of the environment of use. Their radiation parameters are iterated mathematical by the optical properties of the materials in front of the solar panel and assumptions about the soiling parameters. Lab measurements of solar cells/panels under different lighting conditions (spectrally and intensity) makes it possible to simulate performance of real solar panels of different technologies in the addressed environment since detailed electrical characteristics is known by the measurements. Optical parameters for the protection layer (in front of the solar panel) are put into a material library so the optimal choice can be made for a given application. Relevant light emitting diodes and batteries are characterized electrically to have detailed knowledge of the whole energy system. The consumption side of the model is quite advanced making it possible to create different lighting scenarios depending on the purpose of the lighting product and its ability to dispose intelligently over the energy. To validate the model high-end PV products on the market have been bought, simulated and the whole electrical system been measured. The consumption of energy is quite advanced making it possible to create different lighting scenarios depending on the purpose of the lighting product and its ability to dispose intelligently over the energy. To validate the model high-end PV products on the market have been bought, simulated and the whole electrical system been measured. The simulation tool has already shown weak spots in the energy chain of a large number of stand-alone PV applications for the environment the vendors promised them to work in. It is possible to evaluate if different PV technology is better suited for the environment and if e.g. the battery technology is suited for the temperature challenges the product also meets. Since the products are meeting a large amount of low light conditions compared to roof-top PV installation it also seems relevant to develop an electrical circuit for a PV harvester module with more "gears" where one is optimized for low light conditions. The market for electrical harvester modules seems to meet those requirements far from optimally to the present project group's knowledge.

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