AI and Big Data in an application for user friendly design of household PV systems

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Recent global and European energy trends are marked by an increase in demand and disruption in supply. This among other things is driven by the post COVID-19 recovery and the geopolitical crisis related to the war in Ukraine. As a measure to improve own production and move away from fossil fuel dependencies, the European Commission has initiated steps to support decentralized generation from renewable energy sources. This includes both legislation support as well as possibilities for subsidies and funding. This increases the possibilities for households to invest and install own photovoltaic systems connected to the mains grid, where for some power levels additional legislations and permits are not required.

The current state of art and market diffused technologies in photovoltaics offer a variety of solutions that allow for different systems with different technological and economical parameters such as: scale, functionality, availability, initial investment, ROI, etc. The variety and technical specifics of the different PV systems can be overwhelming for users without engineering background. While consulting and design services are available the authors think that the general household users can benefit from a tool that can provide instruction to different system and a comprehensive basic selection and pre-design. In this way support decision making for committing to installing a PV system.

This paper takes into account the aforementioned and proposes an application based on artificial intelligence (AI) and big data, aimed at support for selection and pre-design of photovoltaic systems with power up to 10kW. This power limit is generally sufficient for small and medium grid connected households. The proposed application includes several tools that allow for:

(1) Automated translation and expansion of datasheet parameters of PV panels, grid interface and storage equipment;

(2) System selection based on user preferences – the algorithm can support decision making for choosing between several topologies and system specifics such as: using string connected PV modules or microinverters and using storage or not. The application’s algorithms choose the most appropriate system based on various set of user preferences.

(3) Multi-dimensional optimal pre-design of a PV system.

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The proposed application bases its algorithms on practical data that includes:

(1) Own database – composed of the technical specification of various PV modules and PV system equipment;

(2) Possibility for user data upload – based on simplified equipment datasheet parameters;

(3) Internet based data for geographical specifics, levels of solar irradiation and weather relevant to the user defined installation site.

The paper presents the algorithm in details, and provides verification through accuracy estimation and several example cases. .

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