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TREND PAPER FOR INTERSOLAR EUROPE:
HOW AI IS REVOLUTIONIZING THE SOLAR INDUSTRY

Munich/Pforzheim, February 2025 – The solar industry is increasingly integrating artificial intelligence (AI). From solar cell production to the control of energy management systems and inverters – algorithms are used everywhere. They are able to accurately evaluate large data volumes, and based on the results they can contribute to automation, efficiency enhancement and process optimization. AI is already making an important contribution to the solar industry, driving innovation and growth.

AI in PV production

Researching new materials and cell designs is key to producing ever more efficient, sustainable and durable solar cells. AI can support this research through the machine-controlled analysis of materials. This is done by evaluating data on the physical, chemical and structural characteristics of materials. This can help identify innovative material combinations, and AI can do this faster than science. AI is also able to structure efficient cell design. It can help improve existing material combinations, reducing the consumption of rare or hazardous raw materials.

AI is also used for the data-driven analysis of production equipment, where it identifies the point at which production equipment starts making errors or becomes inefficient and has defects.

AI-supported software programs for installers

AI-supported software programs for installation companies can considerably help installers in their work. When it comes to communication, they can canvass customers through digital messages or telephone bots, provide sales pitches and respond to support queries. AI can help design and plan systems. Ultimately, it is used when installers monitor systems.

Geo AI for solar planners

Geo AI is the machine-controlled evaluation of aerial and satellite images. Planners can use it to identify suitable areas for solar installations – either rooftops or undeveloped land. AI can complete these areas with additional relevant information, such as excerpts from the trade register. A machine-generated preliminary 3D installation plan allows planners and sales people to prepare for their sales pitches.

Predictive maintenance and monitoring with AI

AI can make an important contribution to the maintenance, repair and monitoring of solar installations. When it comes to predictive maintenance, AI evaluates drone-controlled images of solar installations and examines them for functional errors, for example errors caused by dirt on the modules. This allows to identify where maintenance work is necessary before the system output is actually affected.

When it comes to system monitoring, AI takes on important tasks that in the past had to be carried out manually by operation and maintenance (O&M) engineers, which was time-consuming. Here, the algorithm compares very large

amounts of data and examines them for minute changes that may impair the system's function. O&M engineers can now focus on the essential management of operations.

Energy and dispatch management

AI can evaluate historic weather data as a basis for predicting the power generation from intermittent sources of energy. At the other end, AI evaluates data on consumption behavior. This allows grid operators to compare generation and load forecasts effectively, and to manage and plan grid operation, leading to better management of the energy flow in real time. Forecasts and condition assessments are crucial for both power producers and utility companies, as well as grid operators, enabling the transition to intelligent and digitalized power grids (smart grids).

Controlling home energy management systems

Home energy management systems are popular with private consumers who own a combination of solar installation, battery storage system, electric car and heat pump. These systems enable the efficient control of energy consumption and storage on the basis of AI data analysis by using consumption data, smart meter readings and software data, such as weather forecasts.

AI-supported energy trading

Using smart and automatic controls, AI can switch between operating modes, including self-consumption, electricity trading on the power exchange, and, in the case of hybrid power plants or stand-alone storage systems, grid stability services by comparing data on electricity spot prices and grid status forecasts. These types of energy management systems increase the maximum profitability and grid-serving behavior of installations.

Inverters: more efficient, more durable

New and innovative inverters optimize their output based on AI-controlled utilization analyses. This allows them to respond to ambient conditions more flexibly, and to adapt the energy flow in order to be more efficient and extend the inverter's service life.

The solar industry is increasingly integrating AI – the above examples are just some of a host of different tasks that will be performed by AI in the future. Technological innovations, such as AI-controlled software for a multitude of functions, are key drivers of the energy transition. At The smarter E Europe, Europe's largest alliance of exhibitions for the energy industry, you can find the latest AI-controlled solutions. The event will take place from May 7–9, 2025 at Messe München with its four exhibitions, Intersolar Europe, ees Europe, Power2Drive Europe and EM-Power Europe.

For more information, please visit:
www.intersolar.de
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