Artificial Intelligence in the Energy Transition for Solar Photovoltaic Small and Medium-sized Enterprises

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The global energy transition has been declared as one of the most significant challenges of the 21st century, drawing the attention of policymakers on a governmental and local level. Traditionally, a few quasi-monopolistic companies have dominated energy production and supply by exploiting fossil fuels, such as coal or oil, in a centralized manner. Recently, the status-quo of the energy landscape has been challenged due to the profound environmental harm of conventional energy practices and the sharp decline of finite resources, leading to political and social turmoil. In response, researchers and practitioners have called for alternative sources of energy to stabilize the socio-energy equilibrium through renewable and abundant supply. Among these sources, solar energy has experienced an increase in attention and use, along with a reduction of the associated harvesting costs. This especially holds for small and medium-sized enterprises (SME), which are foreseen to play a vital role in securing and decentralizing the prospective solar energy supply. However, the intermittency of solar power supply due to seasonal and weather variations leads to disruptive uncertainties that can be predicted and addressed by intelligent information systems. The crucial role of information in energy transition is seen on all levels ranging from energy harvesting and storage to distribution and consumption. To this end, intelligent information systems based on artificial intelligence (AI) and machine learning (ML) have emerged as highly promising technologies to cope with these problems. Examples are AI-based information systems aimed to balance the power grid and locally forecast the supply-demand energy ratio, both intended to establish an interactive and decentralized energy ecosystem as well as a scalable way to operate the solar energy business efficiently and sustainably. Unfortunately, the use of AI in critical domains comes with some flip sides that can undermine the trustworthiness of solutions built on top of it. Indeed, the increasing complexity of AI, together with the spread of tools and frameworks making its usage simpler yet more opaque, is resulting in solutions for which it becomes harder to understand and predict all the legal, technological and ethical implications that AI can have for efficient solar energy operations. This is especially true for SMEs which often lack the resources needed to analyze, measure and counter these implications. The aim of this work is to lay the foundations for a systematic analysis of the problem, as a starting point for understanding the information needs of the solar energy transition. In particular, this work draws on empirical findings to i) define the implicit challenges SMEs face regarding understanding and adopting AI in solar energy business, and ii)

propose an information system design framework promoting the use of AI in the ongoing solar energy transition. Drawing on preliminary research results from in-depth interviews, AI immaturity in SMEs persits. The steps needed to level up AI maturity are multidimensional and mostly fragmented in contemporary literature. As a result, a design science research strategy is proposed in this paper to approach this multidimensionality with strong stakeholder acknowledgement.