

Scalability and replicability analysis of large-scale smart grid implementations: approaches and proposals in Europe

A. Rodriguez, R. Cossent, P. Frías

Abstract— Smart grid solutions offer a great potential to achieve a more efficient integration of renewable energy in the distribution network. Numerous pilot projects have been launched to test smart grid solutions in real-life systems. However, the results observed are subject to the specific context of the demonstrators. Therefore, conclusions drawn may not be directly applicable to the implementation of the same solutions in different locations or at a larger scale. The scalability and replicability analysis (SRA) of smart grid implementations aims to understand the effect of the context and infer the impacts that may be expected from smart grid solutions. SRA is a very valuable tool to support policy-makers and the industry in shaping the strategy for sustainability and smart grid deployment. This paper reviews existing approaches and proposals for the SRA of smart grid solutions and describes European research and demonstration projects that have dealt with SRA from various perspectives. Subsequently, a comprehensive methodology for SRA of smart grid solutions is described in detail. The core of the SRA methodology is technical analysis based on simulation that allows quantifying the impact of smart grid implementations under different conditions. Additionally, the methodology incorporates the analysis of the economic, regulatory and social aspects to identify drivers and barriers for scaling-up and replication of smart grid implementations. Furthermore, the proposed methodology is illustrated through its application to the case of medium voltage automation for the improvement of continuity of supply.

Index Terms— Electricity distribution; replicability; scalability; smart grid.

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