Philosophical Considerations on the Design of Smart Grids

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1. Abstract

The future of the developed, developing and emerging countries in a global world strongly depends on the availability and transport of energy. It is believed that the near future the consumption of energy will continuously grow. Security and sustainability have become major priorities to both customers and electric companies. Deployment of sustainable / renewable energy sources is crucial to a healthy relationship of society and the environment.

The electric power grid is a crucial part of society infrastructure and needs constant attention for maintaining its performance and reliability. Sometimes called the largest machine man has ever made, the grid is a widespread, interconnected system that is as strong as its weakest link. The electrification of our society has empowered countless advances in other fields such that the US National Academy of Engineering ranked it as the greatest engineering achievement of the last century [2].

Successful smart grid deployment requires a systemic perspective, as most of the smart grid benefits are systemic in nature. System integration and full engagement of customer are crucial elements of this development [3]. Project investments in Europe currently amount to over 5 billion euros and estimated 56 billion by 2020 [4].

The electrical infrastructure of the future will be much more complex than the current one. It will have to integrate traditional and sustainable energy sources, present and new distribution systems, customers with quite different consumption patterns, and smart control systems. However, at this moment there are no comprehensively enough engineering models and tools that can cope with the higher level of complexity of future electric grids. Consequently, engineers use traditional models to design the next generation of electrical infrastructure with the result that important interactions between technical systems will be overlooked; non-technical dimensions like social behavior of customers or moral dimensions of smart control systems will be ignored; and the justified interests of economically weak stakeholders will be neglected.

It is of utmost importance that engineering models and tools will be developed that do justice to the complexity of electrical grids, the complexity of our technological society, and the complex relation between man, technology and nature. Fundamentally, philosophy as a discipline would be most well-equipped to give insight in the vast complexity that electrical engineers have to deal with. However, a philosophical approach cannot be taken for granted. Most people believe that philosophy is at best an interesting game of reason but not a discipline that

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can solve any problem. Tom Morris cites in his book *Philosophy for Dummies* (1999) in a humorous way, a statement from Voltaire, who in self-mockery says on the alleged 'not so practical' inset of philosophers as such: 'if he who hears does not understand what he who speaks means, and if he who speaks himself does not understand what he means, that is philosophy' (Morris, 1999, p.14). It was, of course, meant as a joke; however for many this will be recognizable towards their own prejudices about philosophers.

The authors of this paper believe that a philosophical approach may be extremely useful if:

(1) It gives tools and concepts to criticize present approaches in engineering, economics and politics;
(2) It gives more insight in the complexity of future micro, super and smart grids;
(3) It shows a direction how to develop more efficient, human-oriented, environmental friendly, and sustainable electrical systems.

Among the lessons learned from several smart grid European projects and reported on [3] were: the difficulties encountered during the data collection process; the lack of quantitative data to perform analysis; the recognition of the higher complexity of the system and the lack of proper integration; the difficulties with the setting of business models; the lack of consumer involvement; the need for proper ICT infrastructure; the need of better data protection and security; and the need for legislative framework to ensure proper division of responsibilities. The report highlights that "a scan of the collected projects seems to suggest a lack of specific attention t the social implications of Smart Grids."

This paper has the following set-up: first, a description of smart grids characteristics is presented (section 2). Then the societal implications are discussed (section 3), followed by the need of philosophy to deal of the complexity of the smart grid system (section 4). Some analysis considerations and tools are the introduced followed by case studies and applications (section 5). Finally some recommendations for the development of an overall framework is presented (section 6).

2. References

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