

Key Actor Perspectives on Smart Grids

A qualitative study on barriers and incentives for the development of smart grids in the Swedish power market

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Abstract—This paper aims at investigating how the implementation of smart grids takes place in the context of the Swedish power market. We performed an exploratory study that in its first step has pinpointed the key actors involved in smart grid implementation. In this respect, we have identified several public and private organizations that are relevant to the development, making, operation and use of smart grids such as power transmission and distribution system operators, producers, energy service providers, researchers, regulatory authorities etc. Subsequently, we focused on analyzing the motives and incentives of those key actors and thus identifying the potential challenges, in terms of barriers and opportunities. We applied theories on technological development and industrial networks in order to shed more light on the phenomenon under investigation.

Keywords—smart grid; implementation; key actors; incentives, barriers; opportunities

I. INTRODUCTION

Smart grids are expected to play a key role in realizing European energy, environment and climate policies. The political goals among other things involve increasing efficiency in electricity use and the share of renewables in power production, which in turn entail boosting consumption flexibility and investments in intermittent energy sources. The theoretically available gains of implementing smart grids are well documented in the scientific literature, yet the actual realization of them seems to be tardy. Seeing as the core of the necessary technological advances to this end are already behind us, technological barriers are probably not the main reason why smart grids, despite the well-documented and hence anticipated economic and environmental gains, are slow to emerge in the Swedish power market.

This state of affairs suggests that the implementation of smart grids is associated with other than technological barriers. Accordingly, the complexity of the implementation process needs to be confronted with the involved actors' perceptions. Against this background, this study aims at assessing the

motivations and incentives of key actors, and thus identifying the potential barriers and opportunities in bringing smart grids to fruition in Sweden. Hence, one key research question is how the involved actors perceive smart grids? The paper is organized as follows. First, we offer some theoretical insights based on the roles and perceptions of actors during the technology implementation. Following a short methodological note, we then conclude by highlighting our research results based on the empirical data we collected in Sweden.

II. DIFFERENT ACTORS' PERCEPTION ON SMART GRID IMPLEMENTATION

When implementing a new technology the initiative of certain actors is often important to induce other actors to combine their resources in new ways to devise new technical solutions, as well as to perform certain activities [1]. This is, however, not a linear and predictable process. Actors need to be coordinated together and they all have to gain something from the technology implementation. Our starting point is that the development and implementation of a technology inevitably build on close interactions between providers and users [2, 3] as few companies can realize innovations by using only their internal assets.

As pointed out by [4], many opportunities as well as tensions might emerge among the involved actors when the new technology is implemented and embedded into an already existent context. One reason is the actors' different perceptions of the technology in terms of the benefits that they can achieve by adopting it. Moreover, actors might have diverse understandings of the technology complexity, how the technology will impact on the overall socio-economic system and affect their possibilities to achieve their own business goals. Thus, each actor might have a different view on the economic deal resulting from the technology development, implementation and use.

It is rather clear that the actors' perception of the technology influence the implementation and adoption of it. Opportunities and barriers do emerge from the technology

implementation and all the actors involved might play different role in facilitating or hindering this process.

III. A NOTE ON THE METHODOLOGY

This is a still ongoing study that so far includes 9 semi-structured face-to-face interviews with different actors involved in the implementation of smart grids in Sweden, from industry, university and policy sectors. In addition to the interviews, data was also collected through participant observations at webinars where experts from different business and research areas discussed various smart-grid related issues.

The informants were identified by means of the authors consulting experts in the smart grid field of research. We collected data with the explicit task to identify the key players involved in the implementation of smart grids. Moreover, our interviews dealt with issues such as barriers and opportunities that induce the various actors to participate in the smart grid process.

Barriers and incentives that emerge from the implementation of smart grids were investigated in relation to financial, technological, political and psychological dimensions.

IV. A PRELIMINARY ASSESSMENT OF SMART GRID IMPLEMENTATION IN SWEDEN

The *financial dimension* related to smart grid implementation was perceived as a barrier to the smart grid implementation process by almost all the actors included in this study. For instance, seeing as the electricity price level in Sweden is considered to be fair among consumers, there is at this point no obvious motivation for pushing the smart grid implementation ahead until there is an efficient and critical balance between electricity demand and offer. There is also uncertainty regarding the monetary flows, which are expected to derive from the financial investments necessary for implementing smart grids.

From a *technological point* of view smart grids represent a complex system built of different artifacts and components. The Swedish grid is stable and it is able to satisfy the electricity demand at almost all times. Moreover it shows ability to incorporate alternative sources of energy, especially renewables. All actors agree that the technology necessary to accommodate and coordinate alternative energy sources is very reliable. However, in order to achieve a fully intelligent grid, the actors involved will have to identify, negotiate and agree to

standards. There are many different highly technological and very complex parts in a system of this magnitude, which means that its functionality is dependent on how the components are assembled and adapted to each other. Thus we concluded that the technological dimension of smart grids in Sweden does not represent a barrier *per se*.

From a *policy perspective* the smart grid implementation in Sweden is still an open issue. The regulations to some extent offer companies incentives to reduce customer demand, but will need to create a new system of rate structures in order to reward consumption flexibility. All the actors seem to share the opinion that the lack of incentives is something that acts as a barrier, but they have a rather positive attitude to the Swedish policy commitment for supporting the “green” incentive system in the same way as the recycling strategy.

The last dimension we have considered to be relevant in our study deals with the *psychological* side of the smart grid implementation in Sweden. Our respondents agree that Swedish consumers will most probably react positively to a different electricity market that requires them to actively make a decision to change their consumption pattern, reduce their energy usage and hence their costs. In addition to this, Swedish consumers are very keen on generating and selling electricity back to their local utility. It seems that Swedish people are generally aware of the potential of smart grid implementation.

In light of the fact that the most important barrier to realizing smart grids is the involved actors’ lack of economic incentives, it seems that government intervention in terms of policy instruments are required to this end. This means that it is ultimately an ideological issue; in other words, is it a state affair or is it the power market alone that is supposed to make them happen.

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