Utilities Policy xxx (2017) 1–10

Contents lists available at ScienceDirect

Utilities Policy

journal homepage: www.elsevier.com/locate/jup

# Governance of data and information management in smart distribution grids: Increase efficiency by balancing coordination and competition

Marius Buchmann

*Jacobs University Bremen, Bremen Energy Research, Germany*

ARTICLE INFO

*Article history:*
Received 13 October 2015
Received in revised form
13 January 2017
Accepted 13 January 2017
Available online xxx

*Keywords:*
Smart grid
Data management
Information management
Governance
Coordination

ABSTRACT

Smart grids should increase efficiency by enhancing coordination at the electricity distribution grid level and facilitating new market competition for services on a level playing field. Information management has become a new task in the electricity supply chain and an essential component of smart grids. Governance of information management should balance the goals of coordination and competition. Based on the analysis in this paper, existing participants in the electricity supply chain and the corresponding governance approaches appear to be unsuited to this goal and new governance approaches and roles are needed.



## 1. Introduction

To reduce the costs of integrating renewable generation into electricity distribution grids, the exchange of data about demand, supply, and potential flexibilities must be organized in a neutral and non-discriminatory way. This insight is derived from the current discussions in Germany about the costs related to the energy transition.[1] Among others, key drivers for these costs are the distribution networks. Significant investments are required for these networks to promote the integration of renewable energy resources within the next decades. However, network expansion is costly. Alternative approaches to integrating renewable energy resources into the distribution grid are based on information and communication technologies (ICT), organized under the concept of smart grids. Though there are various definitions for smart grids, the definition of the European Technology Platform for Electricity Networks of the Future (ETP SmartGrids) of the European Commission underlies the current scientific discussion:

> "A Smart Grid is an electricity network that can intelligently integrate the actions of all users connected to it - generators, consumers and those that do both - in order to efficiently deliver sustainable, economic and secure electricity supplies. A Smart Grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies [ …]." (ETPSG, 2010, p. 6)

The concept of smart grids is applied to the distribution grids, i.e. the low-and medium- and high-voltage grids.[2] dena (2013) calculated for Germany that smart applications based on ICT could reduce network investments on the distribution grid level till 2032 by 45%.[3] Similar results were developed by E-Bridge et al. (2014). They calculated that the total costs for distribution

*E-mail address:* m.buchmann@jacobs-university.de.

[1] Germany was one of the first countries to define binding goals for $CO_2$-reduction and high shares of renewable electricity supply (RES) till 2050. Furtermore, Germany plans to phase out all nuclear power plans till 2022. Both policies together are summed up under the headline of the energy transition. Due to the energy transition several changes in the institutional framework of the electricity sector are currently discussed, among them the governance of data and information management. Therefore, we focus our analysis on Germany and the European situation.

[2] in Germany distribution grids are defined as the networks up to 110kV, transmission networks operate at 230 kV or 400 kV.

[3] This number does not include the costs for the operation and maintenance of additional components in the distribution grids. Therefore, the cost reduction potential will in total be lower than 45% but still significant.

http://dx.doi.org/10.1016/j.jup.2017.01.003
0957-1787/

network expansion in Germany could be reduced by 60%.

These studies illustrate that the implementation of ICT in the distribution grids can help promote the integration of RES at lower costs than traditional network expansion. Our analysis focuses on two important effects of smart grids. First, smart grids should increase coordination between the network operator and the network user. Accordingly, investments in the network should be avoided as long as there is a cheaper alternative, e.g., load shifting. Second, smart grids should facilitate new business opportunities for market parties. In other words, it is also expected that smart grids will increase competition in the electricity sector. Both, coordination and competition should increase efficiency in the electricity sector.

With an increasing share of ICT in the distribution grids, the amount of data exchanged to operate the system increases as well. At the same time, more parties become active in data exchange (e.g., distributed generation owners, storage providers, and consumer participating in demand side management programs). These parties might be incumbents from the energy sector, but new market entrants as well.[4] The data exchange between the participants in smart grids (i.e., data handling) is a new and increasingly important step in the electricity supply chain. From an institutional perspective, the primary task of data handling is to ensure that all eligible parties have the same access to the same data; that is, data should be handled on a level playing field. The question then becomes, who should become responsible for this task?

Several issues must be addressed in this context, from sustainability issues, to privacy concerns, to IT operations. Our analysis focuses on an economic evaluation from a new institutional perspective and on the question of which party should become responsible for the operation of the information management system. The paper is structured as follows. Section 2 elaborates further on the issue of data handling and defines information management in smart grids. Section 3 specifies the institutional environment of information management in the energy sector, specifically the liberalization of the energy sector and the different participants that could become responsible for information management in smart grids. Section 4 discusses resulting governance approaches for information management based on the identified roles. Specifically, three cases are discussed:

1. Information management as a monopoly provided by an established or new party in the energy sector.
2. Information management as a task of the distribution system operator (DSO). For the network operators we discuss two options that either treat information management as part of the regulated business (i.e., an integrated task) or as a responsibility of the network operator, but separated from the regulated business (e.g., via organizational firewalls similar to those used in the market unbundling process).
3. Information management as a new service provided by the market actors (incumbents or third parties) from the competitive parts of the energy system (generation and retail services) could become responsible for information management.

Each of the three cases illustrates the challenge of coordination between the DSO and network users in smart grids. From a transaction-cost perspective, integration of the information management by DSOs into their regulated business seems favorable. However, this might result in incentives for DSOs to discriminate against non-associated market parties. The tradeoff between coordination and competition is identified. To address this tradeoff, Ruester et al. (2013) propose further unbundling of the DSOs. The potential shortcomings of such a governance approach for information management is discussed. The conclusion, in Section 5, is that none of the identified roles in the energy sector could govern information management and at the same time adequately balance the goals of coordination and competition.

## 2. The current discussion on data handling from smart metering and the definition of information management in smart grids

Research about the governance of information management is evolving alongside the smart meter rollout in Europe. The European Union requires each member state to implement smart meters for at least 80% of all customers, if a cost-benefit analysis indicates economic potential (EUCOM, 2009). In Europe, only Sweden and Italy have finalized the rollout thus far. Sixteen other member states are planning implementation through 2020, though targets vary from 15% to 80% (CEER, 2013a).

Basically, two models for governing the smart meter rollout are discussed: a regulated approach, with the DSO being responsible for the rollout and a competitive (i.e., unbundled) approach, which leaves implementation to the market. In their summary analysis, Haney et al. (2009) conclude that institutional design can have a significant effect on the results of the cost-benefit analysis and the distribution of benefits. While most European states introduced a regulated model, where the smart meter rollout is an integrated task of the DSO (e.g., in the Netherlands), some have established an unbundled solution with a competitive metering market (e.g., the UK and Germany, although their solutions differ significantly) (Wissner and Growitsch, 2010).

A parallel governance debate concerns the handling of data from smart meters. The EU Commissions Smart Grids Task Force proposes two regulated and one market based concept for data handling (SGTF, 2013). The regulated models delegate the responsibility for data handling either to the DSO or to a new regulated third party. The competitive model is based on standardized market roles. Both the regulated and the market-based approaches are supposed to ensure neutral and non-discriminatory data management and thus help establish a level playing field in smart grids. Ruester et al. (2013) investigated in greater detail how the regulated concept with the DSO responsible for the data management fits into the current institutional framework. From their point of view a further unbundling of DSOs is required to ensure non-discriminatory data management (Ruester et al., 2013).

The discussion about data exchange in smart grids has its roots in the debate over the smart meter rollout. The term data handling was applied to summarize the ICT-related processes for transporting data from the smart meter to the recipient. However, the term data handling falls short in terms of other relevant aspects. Data in smart grids must be allocated, but it also must be stored, aggregated and verified. Governance involves not just the physical flow of data, but the management of the data exchange as well, i.e., who should be responsible for this task, the ICT-system design, and the required infrastructure. This broader perspective on the design of the data exchange in smart grids can be summarized under the concept of information management.

According to Voß and Gutenschwager (2001), information management involves the planning, purchasing, processing, distribution, and allocation of information as a resource for the preparation and support of decision-making processes. Information management implies the design of a framework to efficiently and effectively accomplish these tasks. Applying the information

[4] These new market parties can be defined as third parties. A detailed analysis of the increasing role of third parties in smart grids was developed by Brunekreeft et al. (2015).

Please cite this article in press as: Buchmann, M., Governance of data and information management in smart distribution grids: Increase efficiency by balancing coordination and competition, Utilities Policy (2017), http://dx.doi.org/10.1016/j.jup.2017.01.003