Energy Research & Social Science 9 (2015) 178–187

Contents lists available at ScienceDirect

Energy Research & Social Science

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

Original research article

Towards a sustainable grid development regime? A comparison of British, Norwegian, and Swedish grid development

Hogne Lerøy Sataøen [a,*], Ole Andreas Brekke [a], Susana Batel [b], Martin Albrecht [c]

[a] Stein Rokkan Centre for Social Studies, UNI Research, Bergen, Norway
[b] College of Life and Environmental Sciences, University of Exeter, UK
[c] School of Architecture and the Built Environment, KTH Royal Institute of Technology, Stockholm, Sweden

ARTICLE INFO

Article history:
Received 20 October 2014
Received in revised form 3 March 2015
Accepted 20 August 2015
Available online 30 August 2015

Keywords:
Grids
Governance
Infrastructure-planning

ABSTRACT

Currently, huge investments are being made in the electricity infrastructure in Europe. However, one third of the European grid investments are delayed, even though the majority of the population in Europe is in favour of a greener energy mix. This paradoxical situation is connected to the fact that although interdependent, the production and transportation sides of renewable energy sources are treated as two distinct processes. The two types of infrastructure undergo separate processes for development consent and are the target of opposition from various citizen groups. In this article we compare the British, Norwegian, and Swedish grid development regimes in order to analyse their opportunities and challenges. The comparison demonstrates that the regimes differ on significant aspects, e.g. different historical trajectories, technological setups, arguments, and main drivers. The article highlights the importance of achieving sustainable energy systems by relying on a sensible strategy for grid development, and the importance of moving beyond the focus on a sustainable, "green-fuelled" grid.

1. Introduction

In this article, we compare the British, Norwegian, and Swedish grid development regimes (GDR) in order to analyse their opportunities and challenges for creating a sustainable energy infrastructure.[1] This is important, because throughout Europe, electricity grids are undergoing major transformations. There are many drivers behind this transformation. One of them is the new international legislation aiming to foster renewable energy generation [1,2]. New, renewable energy is mostly embedded in centralized electricity systems and thus located at the fringes of the power grid. Connecting these energy sources to the existing grid involves both the construction of new lines and the upgrading of existing network [3]. Other drivers of the current changes include the export and import of energy to other countries, the goal of an integrated European electricity market, and increasing focus on security of supply are also important triggers [4]. Thus, in the last few years, investments in upgrading and developing transmission lines[2] have increased throughout Europe. Within the EU, it is estimated that grid investments of well over 600 billion euros are needed [5,p.49]. One third of the investment will take place in the transmission grid, and the estimate includes building new capacity *and* refurbishing and replacing existing assets [5]. In their 10 year Network Development Plan for 2014, Entsoe-e (the European network of transmission system operators (TSOs) for electricity) estimates investments until 2030 of approximately 150 billion euros on transmission grid projects of pan-European significance alone [6]. Grid

* Corresponding author. Present address: Department of Administration and Organization Theory, University of Bergen, Bergen, Norway.
E-mail addresses: Hogne.sataoen@uni.no (H.L. Sataøen), Ole.brekke@uni.no (O.A. Brekke), S.Batel@exeter.ac.uk (S. Batel), martin.albrecht@abe.kth.se (M. Albrecht).

[1] Whenever we use the concept 'sustainable' in regard to GDRs or the electricity grid, we are using it as in the common definition of sustainable development or sustainability (see Section 1.1) applied to the deployment and development of high voltage power lines. Sustainability thus both refers to the challenge of restructuring the electricity grid to accomodate renewable energy sources, as well as the social and environmental sustainability of new grid developments.

[2] This study has focused upon transmission/central grid and not the distribution grid systems in the three countries. The transmission grid is the "motorway" of the grid system, linking producers and consumers. In Norway and Sweden there are three grid levels, whereas the grid system in UK is more centralized with two levels.

http://dx.doi.org/10.1016/j.erss.2015.08.011
2214-6296/

developments of national and/or local significance come in addition.

Although huge investments are being made, grid development is a complex process, where results can be difficult to achieve. Several institutions are involved, and projects are often faced with constraints and resistances. Cases of opposition to the new grid have arisen frequently throughout Europe in the last years and have led to delays and withdrawal of projects [7,8]. Much in line with observed conflict patterns regarding the placement of renewable energy facilities [9], research on public responses to high-voltage power lines has showed that, while people in general are favourable to grid developments, scepticism increases the closer people live to developments [7,10–12].

This "double opposition" to energy innovation, both to the placement of new renewable energy facilities and to grid development, has the potential to seriously delay the transition to "greener" energy systems. One third of grid development projects in Europe are delayed, mostly because of social resistance and longer than initially anticipated permitting procedures [6,p.99], even though the majority of the population in Europe is clearly in favour of a greener energy mix. This paradoxical situation is connected to the fact that although interdependent, the production and transportation sides of renewable energy sources are treated as two distinct processes within the planning procedure. The two types of infrastructure have to go through separate processes for development consent, and due to differing environmental and social impacts, they may be the target of opposition from various citizen groups. Although production and transportation of electricity are interdependent processes, studies of transition to renewable energy tend to focus upon issues of production [9,13], while the *transportation* side of renewable energy has often been left unaddressed [14]. This part of the renewable energy system has mainly been seen as a consequence of the deployment of new energy generation infrastructures and not as a distinct process. In addition to investigating opportunities for more renewable energy production, there is also a need to investigate challenges and opportunities related to grid development in its own right.

This is the backdrop of the present article, which seeks to deepen our understanding of grid development through a comparison of the British,[3] Norwegian, and Swedish regimes for grid development. By contrasting these countries, we are answering the following questions: Which opportunities and challenges exist for creating a sustainable energy future within different GDRs? Are there lessons to be learned from different regimes that could form the basis of a more sustainable GDR? In order to answer these questions, it is important to examine the development of electricity grids as socio-technical systems [15], meaning that not only must technological factors be considered, but also social, political, regulatory, and cultural factors [9,16]. It can be argued that the social and political dimensions remain under-examined in the literature on energy issues [17,18].

As we pursue the answer to the above questions, we will scrutinize and compare the British, Norwegian, and Swedish GDRs regarding their historical trajectories, their planning system for new electricity infrastructure, and the main arguments at stake. The main reasons for choosing these three countries relate to their comparability. They are located in relative close proximity to each other, in the North West region of Europe, and share many common traits both historically and on socio-cultural and political-administrative levels. All three countries also partake in the evolving pan-European electricity grid. At the same time however, they also display interesting differences both in the historical development of their electricity grid, and in ways of organizing grid development, as we will show in more detail in the following sections. Such differences makes it possible to use them as contrast fluids for each other, in order to uncover distinctive traits of each of the three GDRs. We will return to the comparative strategy for the study in the methods section, but first we will present the two theoretical framings of our study, mainly the notions of socio-technical systems, sustainability and policy regimes.

1.1. Background and theoretical framework: socio-technical systems, sustainability and politico-administrative regimes

1.1.1. Socio-technical systems and sustainability

As a starting point for analysing the development of Large Technological Systems (LTS), Hughes describes electricity grids as a seamless web of interrelated and interconnected factors in a "socio-technical ensemble" [19,p.285]. He conceptualizes this as a "socio-technical system" and refers to the interacting factors as being technical, scientific, political, institutional, economic, organisational, cultural or social [15,p.2,6]. In the same vein, the socio-technical transition literature and especially the work around the multi-level perspective (MLP) framework takes up the dynamics between those socio-technical elements described above and explains them as interrelated processes of co-evolution [20–23]. Compared to Hughesí work, the MLP literature has introduced socio-technical regimes as an analytical category within a socio-technical system [24,p.33]. Through that, Geels essentially refers to the relatively stable, incumbent regime as one of the levels within the multi-level perspective. Below the socio-technical regime are the niches where radical innovation can incubate, possibly challenging the regime, and above are deep structural trends in the socio-technical landscape that influence the regime [24,34,35].

In this paper, we understand electricity grids as socio-technical systems. As such, it is important to specify the link between the technological, social, political, regulatory, cognitive and cultural conditions for grid development. Following the conceptualisation of socio-technical systems and the MLP, system innovation – for instance, towards more sustainability across different dimensions and scales of activity – requires changes not only in technological setups, but also in markets, regulations, politics, and in society at large [15,25,26][15,25,26, p.1215]. Verbong and Geels e.g. point out that a major transition on a European scale has happened in the electricity sector when changes in the institutional framework led to a market-based system controlled by managers instead of the previous top down system controlled by engineers [26,p.1214].

Another quality of socio-technical systems is their development along certain paths or trajectories that incrementally improve the way the system operates within the established logic, what is often described as "path dependency" [15,p.465]. Path dependency points to how certain laws, institutions, and rules can create disincentives for change, "because so much is already invested in the existing ways of doing things" [27,p.42]. As Unruh [28] argues, industrial economies have become locked into fossil fuel-based energy and transportation systems through path-dependent processes. Today, however, focus on sustainable development, energy transitions, new renewables, and more binding legislation regarding GHG gasses, has fostered a desire for a greener, carbon-neutral, and more diversified electricity supply. According to Bridge et al. [29] the spatial aspects of renewable energy production, transmission and transition is neglected in the research literature. Still, they argue that "spatial processes shape energy systems and influence their capacity for transformation" [29,p.332]. Such spatial and geographical aspects regards e.g. scaling, location, landscape and territoriality, and are especially important when grid development is concerned as it involves transportation routes over long distances across a wide variety of different landscapes and municipalities.

[3] In the following comparison, we are using data from England and Wales, excluding Scotland.