



The contribution of innovation policy criteria to the development of local renewable energy systems

Alejandro Germán Frank^{a,*}, Wolfgang Gerstlberger^b, Carolline Amaral Paslauski^a,
Laura Visintainer Lerman^a, Néstor Fabián Ayala^a

^a Organizational Engineering Group (Núcleo de Engenharia Organizacional – NEO), Department of Industrial Engineering, Universidade Federal do Rio Grande do Sul, Brazil

^b Centre for Integrative Innovation Management, Department of Marketing & Management, University of Southern Denmark, Denmark

ARTICLE INFO

Keywords:

Sustainability
Innovation policy
Policy mix
Renewable energy systems
Germany
Municipalities

ABSTRACT

Renewable energy systems (RES) are becoming a strong component of local sustainable innovation strategies. Using a policy mix perspective, this paper investigates innovation policy criteria from municipalities' locational factors, cooperation activities among stakeholders, and local knowledge about RES as antecedents to see how they leverage the development of local RES. We studied these antecedents at a local level by analyzing a sample of 727 middle and large German municipalities using instrumental variables regression. Our results indicate that policymakers should focus on building local knowledge related to RES for local actors and with enhancing public-private cooperation activities. However, we did not find that locational factors such as direct incentives and energy and emissions reductions have a direct impact on RES. We suggest that these locational factors can provide indirect support for RES, as a starting point for the implementation of other policy criteria which we investigated in our study. Our findings also indicate greater RES development potential when policymakers adopt a facilitator role and support local innovation networks among different actors rather than keeping RES development activities within the municipality itself. In such an innovation network, stakeholders from non-municipality public and private institutions offer additional support to develop a local RES.

1. Introduction

Municipalities around the world increasingly meet economic and technological challenges to prepare for becoming locations which rely exclusively or dominantly on renewable energy (Van Staden, 2014). During this process, many of these municipalities have high interest in replacing conventional energy production with local renewable energy production systems. These municipalities frequently develop innovation policies and activities that contribute to the local renewable energy transition process (IdE, 2014; Schönberger, 2013). However, innovation policymaking in this area is relatively new and policymakers as well as scholars lack an understanding of the underlying drivers, barriers and performance outcomes of these so-called Renewable Energy Systems (RES) (Bergek et al., 2015; Reichardt et al., 2016; Späth and Rohrer, 2012). Moreover, some studies report that such policies might sometimes have both negative and positive repercussions on public support and adoption of RES (Stokes, 2013, 2017), which underscores the need for more research to understand the effective

contributions of renewable energy policies on RES development.

The sparse amount of international literature on local RES development mainly investigates examples in European Union member states like Germany, Denmark, and Sweden. Other examples in the literature investigate aspects of RES development in Canada, the United States, China, and Thailand (Liu et al., 2011; Lund, 2014; St. Denis and Parker, 2009). Our investigation focuses on Germany because of the success this country has achieved in the transition towards RES development, and we thereby address a needed topic of discussion in the RES literature (Rogge and Reichardt, 2016).

To achieve its climate goals by 2050, Germany aims to significantly increase the renewable energy share of its total energy production within the next few years (e.g. BMUB, 2016). This strategic objective for the renewable energy sector has heavily influenced the agenda of German policymakers on the national, regional and local level in the last years. The 'Energiewende' (German for 'energy transition') is the transition towards an energy portfolio dominated by renewable energy. The ultimate goal is as close to a 100% substitution of coal, petroleum,

* Correspondence to: Escola de Engenharia, Universidade Federal do Rio Grande do Sul, Av. Osvaldo Aranha 99 - Sala LOPP 508 – 5° andar, Centro, CEP 90035190 Porto Alegre, RS, Brazil.

E-mail address: frank@producao.ufrgs.br (A.G. Frank).

<https://doi.org/10.1016/j.enpol.2018.01.036>

Received 14 July 2017; Received in revised form 2 December 2017; Accepted 17 January 2018
0301-4215/ © 2018 Elsevier Ltd. All rights reserved.

petroleum gas and other non-renewable energy sources as possible. This overall goal includes important sub-goals such as an 80–95% greenhouse reduction by 2050; a 60% renewable energy share by 2050; 50% increased electricity efficiency by 2050; and associated research and development (R&D) and innovation efforts which intensely support all these sub-goals (BMUB, 2016). The renewable energy transition in Germany already has resulted in a considerable increase of renewable energy production, especially in terms of wind energy. For example, in the period 2006–2016 the ‘installed wind energy capacity’ (both, on-shore and offshore) has more than doubled – from 2215 to 4259 MW – (German Wind Energy Association, 2017). Germany's share of power generation based on renewables amounted to approximately 30% in 2016 (BMWi, 2016). Some of Germany's national-level energy transition efforts are beginning to appear in many municipalities. For example, through broad citizen participation there are now hundreds of local climate protection initiatives along with many newly founded public or public-private municipal energy-saving efforts (Institute Decentralized Energy Technologies, 2014; Schönberger, 2013) and there are approximately 1000 new energy cooperatives (DGRV, 2016).

Our study focuses on German municipalities as level of analysis. This is because they have a very strong constitutional position in the political and administrative multi-level system of federal, state, regional and local administrations, compared to other countries engaged in RES development. This means that municipalities in Germany have the right to implement specific legal regulations for their own local territories. Such municipal regulations refer in the renewable energy sector, for example, to legally binding rules for approval procedures and land-use plans for new plants or statutes for privately owned wind-farms or solar energy parks. Furthermore, municipalities in Germany have the possibility to operate their own local electricity grids and utility companies. Municipal utilities can form public-private partnerships with private firms and public-public partnerships with partner organizations outside the territories of their municipalities (Bulkeley and Kern, 2006; Kuhlmann, 2016; Schönberger, 2013).

In such a context, the few available studies seem to indicate that innovation activity decisions by German municipal policymakers heavily influence local transition processes of the energy system (Bürer and Wüstenhagen, 2009; Rogge and Reichardt, 2016). However, as mentioned, studies show that such decisions can sometimes have a negative effect on the support and expansion of RES (Stokes, 2013, 2017). Thus, there are still open questions regarding the effects that energy policy decisions can have on RES development (e.g. Richter, 2013). Moreover, existing studies in this research area are mostly qualitative case studies. Our study of German local RES aims to fill the research gap in terms of quantitative studies by providing empirical data regarding RES-related influencing policy factors to support an understanding of the dynamics of RES development.

Particularly, there is a lack of empirical research to provide evidence about the contribution of specific policies to local innovation systems in the renewable energy sector. This is especially the case when we refer to a policy mix approach in which various policy instruments play different, but complementary roles in the process of local renewable energy system development (Jorgensen, 2005; Reichardt et al., 2016; Rogge and Reichardt, 2016). We study a number of different, but complementary policy criteria as potential antecedents for local RES development (Cantner et al., 2016; Rogge et al., 2015). Additionally, although there is a growing literature on renewable energy transition and related innovation policies (e.g. Geels, 2010; Jacobsson and Bergek, 2004; Verbong and Geels, 2007), only a couple of studies have so far investigated local innovation policies in particular as they relate to RES (Bergek et al., 2015; Markard et al., 2012). Considering both problems (the lack of empirical understanding of the impact of these innovation policies and the need for investigating aspects of RES at the local level), for this paper we empirically investigate the following research question: *What are the effects of innovation policy criteria as antecedents of local development of renewable energy systems (RES) in*

German municipalities?

Thus, we analyze how three main innovation policy criteria can benefit RES development (Auld et al., 2014; Bassett and Shandas, 2010; Bürer and Wüstenhagen, 2009; Gerstlberger, 2004; Schönberger, 2013): (i) municipal locational factors, (ii) cooperation among stakeholders, and (iii) the existence of local knowledge about RES. This is studied by means of a large-scale online survey across 727 mid-sized and large German municipalities. Although there are considerable differences between the political systems of states like Germany, Denmark, Sweden, Canada, the United States and China, the contributions of our quantitative study point to an important general implication for local, regional and national policy makers in different countries. Our results show that municipalities should be supporting facilitators for RES development, but not the main players for local RES development.

The remainder of this article is organized as follows. Section 2 introduces the theoretical background of our study of local RES and underlying sustainability innovation policy criteria in Germany. Section 3 presents the hypothesis development. Section 4 describes the research method. Section 5 contains the results and Section 6 the discussion of our results. The article closes with conclusions, which form Section 7. In this final section we also point to the limitations of the study, some policy recommendations, and a number of proposals for future research.

2. Policy mix processes leading to development of renewable energy systems

Following Bergek et al. (2008), Kitzing et al. (2012) and Reichardt et al. (2016), we define an RES as a socio-technical system, i.e. a network of actors, rules and material artifacts, that influences the speed and direction of technological change toward the specific use of renewable energy sources to produce electricity, heat/cooling and transportation. An RES can be part of the technological innovation system of a country, region and/or municipality. For example in Germany, one RES is part of a broad concept called the National Innovation System (Bergek et al., 2008; Reichardt et al., 2016). An RES is radically different from conventional energy innovation systems in terms of density, structure, regulatory features and management practices (Tsoutsos and Stamboulis, 2005a, 2005b). The development of an RES implies a socio-technical transition that includes changes in user practices and institutional structures, in addition to the technological dimension and to the development of complementary infrastructure (Markard et al., 2012). The most explored energy sources in this type of system are those related to wind power, solar energy (solar thermal and photovoltaic energy), and bioenergy (Lund, 2009).

Sustainability transitions can support the development of an RES. Such transitions are receiving increasingly scientific and political attention (Markard et al., 2012) and are developing towards the main development strategy of some countries (Rogge and Reichardt, 2016). Additionally, as Lund (2009) explains, RES development is often linked to substantial public support. Prior research found that innovation policies are essential for sustainability transition and, specifically, for RES development (Hoppmann et al., 2014; Jorgensen, 2005; Lund, 2009). However, recent literature on policy support for the renewable energy sector cautions that public support should not hinge on a single innovation policy for the development of RES, but on the combination of different policy instruments in so-called policy mixes for sustainability transitions (Reichardt et al., 2016; Rogge and Reichardt, 2016). The argument for this policy mix recommendation is that socio-technical systems, of which energy systems are a part, are slowed down by multiple markets and by systemic and institutional failures, requiring multi-faceted policy intervention (Reichardt et al., 2016; Weber and Rohracher, 2012).

For this paper we build on the policy mix approach used by others authors such as Guy et al. (2009) and Nauwelaers et al. (2009). We understand policy mix as the combination of government policy

Download English Version:

<https://daneshyari.com/en/article/7397875>

Download Persian Version:

<https://daneshyari.com/article/7397875>

[Daneshyari.com](https://daneshyari.com)