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 Rohracher, 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,
policies to local innovation processes (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 Nauwelaeirs et al. (2009). We understand policy mix as the combination of government policy
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