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Renewable heating: Perspectives and the impact of policy instruments

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HIGHLIGHTS

- Modeling of RES-Heat policies in the building sector.
- Application of the model Invert/EE-Lab for the cases of AT, LT, UK.
- RES-Heat use obligations are effective but should be integrated in policy packages.
- The design of use obligations has substantial impact on the RES-H technology mix.
- National renewable energy action plans are not always consistent with policies.

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ABSTRACT

In the light of the EU directive for renewable energy (2009/28/EC) this paper deals with the question how various policy instruments could impact the development of renewable heating technologies. The paper applies the simulation model Invert/EE-Lab for the building related heat demand in selected European countries (Austria, Lithuania and United Kingdom). The resulting scenarios up to 2030 are compared to RES-Heat targets from literature, stakeholder consultation processes and the targets in the national renewable energy action plans submitted by EU Member States in 2010. The results demonstrate that use obligations for renewable heating can be effective in achieving RES-Heat market growth. However, in order to attain a balanced technology mix and more ambitious targets, policy packages are required combining use obligations with economic incentives and accompanying measures. Technology specific conclusions are derived. Moreover, conclusions indicate that the action plans are not always consistent with policy measures in place or under discussion.

1. Introduction

1.1. Motivation

Traditional renewable heating (RES-H), in particular biomass heating, is well established in several European regions. Moreover, new technologies (solar thermal systems, heat pumps, modern biomass boilers) have gained importance in recent years demonstrating significant growth rates. However, comparing the share and type of renewable heating in different regions reveals crucial differences. At the level of European energy policy, the promotion of renewable energy carriers in the heating sector has been neglected in favor of a focus on energy efficiency (*Directive 2002/91*/EC, 2002, *Directive 2010/31/EU, 2010*) for a long time. With the European Directive for renewable energy (Directive 2009/28/EC, 2009) the heating sector only recently became a focus of European energy policy. In particular, the national renewable energy action plans (NREAPs) that member states were asked to submit by mid-2010 had to include targets for renewable energy in the heating sector and corresponding policy instruments for achieving these targets. This requirement raises the questions, which policy instruments will be needed to achieve these targets and what are the associated policy costs.

1.2. Research question

The core research question of this paper is: What is the impact of selected policy instruments on the deployment of RES-H technologies in different European countries in the light of the NREAP targets?

This includes a series of sub-questions:

– What is the impact of policies and other drivers (in particular energy prices) on the deployment of RES-H technologies?

Abbreviations: GEV, Generalized extreme value; IIA, Independence from irrelevant alternatives; MNLM, Multinominal logit model; NLM, Nested logit model; NREAP, National renewable energy action plan submitted in 2010 according to the (*Directive 2009/28/EC*); RES-H, RES-Heat, renewable energy for heating; RHI, Renewable heat incentive, policy scheme investigated for the case of UK; WTP, Willingness to pay.

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– What are the differences between use obligations and investment subsidies in reaching a high penetration of RES-H?
– How do the NREAP RES-H targets relate to the results of this paper?

1.3. Approach and system boundaries

These questions are investigated for a set of three European countries, representing different climate conditions, traditions in applied heating systems, RES-H penetration levels etc: Austria, United Kingdom and Lithuania.

Austria has been chosen as example of a central European country with a relatively high penetration of renewables in the heating sector. United Kingdom is an example of western European countries with a low share of renewable energy carriers. Finally, Lithuania represents a country with a significantly lower disposable household income. Furthermore, also typically for several Eastern European countries, the share of biomass based heating systems is already high, yet the majority of installed systems are traditional systems with low conversion efficiency (e.g. cast iron stoves).

The focus is on the space heating and domestic hot water demand within the residential and service sector. Industrial heat demand is not dealt with in this paper. The time frame of our scenario analysis covers the period 2007 to 2030. However, there is a special focus on the year 2020 and the fulfillment of the corresponding targets according to the NREAPs.

While a considerable list of studies focus on policies for building renovation and thermal building standards (e.g. Beerepoot and Beerepoot, 2007; Boonekamp, 2006; Hansen, 2009; Nässén and Holmberg, 2005; Noailly and Batrakova, 2010; Schimschar et al., 2011), our focus lies on policies for a further penetration of renewable heating systems.

The basic approach of the study underlying includes the following steps:

– Possible ranges of RES-H targets are investigated and compared to the NREAP values. RES-H target ranges are derived based on a literature analysis, a bottom-up and a top-down approach. Finally the outcomes of these approaches were discussed (and partly revised) during a national stakeholder discussion process in each country.
– Simulations of energy demand up to 2030 and the corresponding technology diffusion are carried out for different policy and energy price settings using the energy system model Invert/EE-Lab. The model is used to develop four scenarios for each of the investigated countries: two policy scenarios for two different energy price scenarios. The policy scenarios were selected based on a stakeholder discussion process within each country.
– The results of these two steps are presented in figures showing the starting value for 2007, the NREAP target value for 2020, the RES-H target ranges (based on literature analysis and stakeholder process) for 2020 and 2030 and the outcome of the four simulation runs (two policies in two price scenarios).
– Conclusions are derived based on a cross-country comparison. In the last step we carry out a cross country overview as well as a technology-comparison and derive conclusions with respect to the design of RES-H policies and the perspectives of RES-H in the investigated countries.

1.4. Structure of this paper

In Section 2 the key methodological approaches of this paper are described: (1) a concept for deriving RES-H policy target ranges and (2) the modeling tool Invert/EE-Lab. Moreover, Section 2 contains the basic assumptions and key input data for the scenario development. In Section 3 we present the results of the analysis. For each country this includes a comparative discussion of NREAP targets, policy scenarios and RES-H target ranges (according to literature, bottom-up analysis and stakeholder consultations). Finally, Section 4 includes a discussion of the results and conclusions.

2. Methodology

2.1. Deriving RES-H policy target ranges

Three approaches provide the data basis and scientific grounding for the target setting process: Existing scenarios and literature, scenarios based on a top-down model (results from the model Green-X (Resch et al., 2009)) and the bottom-up approach. Thereby, special focus is on the bottom-up approach which is explained in more detail below. Based on these results a stakeholder consultation and discussion process has been carried out resulting in a range of RES-H targets for different technologies and sectors. It should be noted that this process took place in all the countries during the period from summer 2009 to early spring 2010. That is, before the NREAPs were submitted. These processes were carried out within the framework of the Intelligent Energy Europe project “Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)”. More detailed descriptions and assumptions can be found in Kranzl et al. (2009), Gatautis et al. (2009), and Xie and Connor (2010).

The literature review compared national scenarios for the future deployment of RES-H technologies for each investigated country (partly derived from overall energy scenarios and partly derived from partial technology specific scenarios). The core objective was to select scenarios ranging from conservative to ambitious for RES-H (Haas et al., 2007; Austrian Federal Ministry of agriculture, forestry, environment and water management, 2006; Müller et al., 2009; Gromann et al., 2008; Haas et al., 2008; Kalt et al., 2010; Weiss and Biermayr, 2008; Fink et al., 2009; Lutz, 2007; LITBIOMA, 2008; LEI, 2007; BERR, 2008; DECC, 2010; DTI, 2007; Enviros, 2008; NERA, 2008; NERA/AEA, 2009; Pöyry, 2008).

The bottom-up approach uses disaggregated data for the building stock, available roof area, currently existing heating systems and so on. The general methodological steps applied for this bottom-up approach are as follows: (1) Definition of key parameters for the possible future diffusion of the renewable technologies based on a standard *S*-curve approach (Resch et al., 2009). (2) Besides this standard approach determining the scenario of the technology diffusion a certain rate of thermal renovation within the building stock is assumed (different construction periods are treated separately). (3) Additional checks are carried out regarding basic consistency e.g. with current annual installations from historic observations, total amount of RES-H in different building classes, etc.

The different approaches led to a range of RES-H penetration up to 2020 and 2030. Based on these results preliminary ranges of possible RES-H targets were derived for the years 2020 and 2030. These preliminary results were the basis to set up a questionnaire which was used in a stakeholder consultation process. In the main part of the questionnaire ranges of RES-H for different sectors and technologies were suggested. The stakeholders were asked to assess whether to their mind targets should be set in the upper, middle or lower area within this range or should be amended up or downwards this range. Separate consultation processes took place in each of the investigated countries. Between 21 and 140 questionnaires were sent out in each country. (In Lithuania the