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Implementation of different policy strategies promoting the use of wood fuel in the Latvian district heating system: Impact evaluation through a system dynamic model

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ABSTRACT

The Latvian district heating system historically is characterized with a high share of imported natural gas. The paper looks at the situation where specific policy tools significantly increase the proportion of renewables, in particular of wood fuel, in the energy balance.

Within this context a system dynamics model was developed to identify the most suitable policy from the long term perspective for the replacement of the fossil fuel with the local biomass at the district heating.

The policy instruments included in the model are: national subsidies for replacement of fossil fuel technologies, short-term informative campaign to decrease the investment risks related to the use of wood fuel-based technologies, implementation of Research and Design strategies aimed at the increase of efficiency of the wood fuel technology, and implementation of the Emission Trading Scheme and the CO_2 taxation.

The modelling results show that national level climate policy measures are substantial for promoting the use of renewable energy. The combinations of the above mentioned policy instruments significantly increase the share of wood fuel in the Latvian district heating system. In addition, the Emission Trading Scheme confirms its essential role in promoting the use of renewable energy within the district heating sector.

1. Introduction

The EU (European Union) has long been one of the leading actors in the international forum fighting the climate change. Renewable energy in line with energy efficiency is an integral part of European energy and climate policy. With its 20-20-20 targets, implemented in Directive 2009/28/EC has committed to: reduce GHG (green house gas) emissions for at least 20% below the 1990 level; to increase the share of RES (renewable energy sources) to 20% of the EU energy consumption, and to reduce primary energy use for 20% by 2020. The EU member states undertake various national and EU level policies and measures to reach the outlined targets, all of them are implemented under the REAP (Renewable Energy Action Plan) of the EU MSs (Member States). On this base the increase of the bioenergy sector in all its own different production routes is foreseeable in the very next future.

In fact in many countries with moderate to cold climates, where the demand for space heating and hot water is a major element of the total energy demand [1], the heating sector has a high potential to reduce GHG emissions, increase energy efficiency and employ a higher share of renewable energy [2]. Connor at al. (2013) [3] outlined that despite the substantial economic, environmental and social benefits, there is considerably less experience in applying support mechanisms to the heating and public debate over support is much less advanced. Authors performed a comprehensive analysis of RES-H (Renewable Energy Sources for thermal energy production) support mechanisms and evaluated advantages and limitations of their applications. They concluded that addressing the need for more sustainable sources of heat will have to become a major component of renewable energy policy if nations are to achieve long term targets for CO_2 emission reduction. This conclusion echoes former findings that heat supply systems based on renewable energy sources are an important element of

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the future fossil fuel independent energy systems [1] but innovative support instruments are a prerequisite for renewable energy progress in the heat market [4].

A discussion of the implications of renewable energy support policies in the heat sector has gained increasing attention over the past years. Several EU and national level studies have been carried out to investigate policy strategies towards transition from a fossil fuel-based energy supply to a RES-based system. Kranzl et al. [2] analyze the impact of selected policy instruments on the deployment of RES-H technologies in selected European countries (Austria, Lithuania and United Kingdom). Results of the study show a high relevance of biomass for the current and future situation of the RES-H sector in several European countries. Authors suggest that the key challenge for countries with a currently high share of biomass in the national heat supply mix is to ensure the replacement of old heating systems by modern biomass boilers or other RES-H systems. Meanwhile in countries where RES-H penetration is currently low, the application of policy packages is required to combine economic incentives and accompanying measures having major impact on RES-H penetration. Considering the variations in RES-H penetration among Member States, Steinbach et al. [5] analyzed the impact of different policy harmonization options in the heat sector of EU Member States. They concluded that not necessarily a high level harmonization of RES-H policy needs to be introduced; efficient technology portfolios operated at the Member State level may also lead to increased economic efficiency.

Several papers concern the architecture of renewable heat policy in particular EU Member States. In the year 2007 a paper co-authored by Jehlickova and Morris [6] examined the policy instruments used by the Czech government to encourage the use of wood fuel in Czech households. They found that the financial incentives and dissemination of information have boosted the growth in the use of biomass; however, it was suggested that energy policy design should involve the bottom up approach to a larger extent. In another study, Nast et al. [7] examined the effect of national legislative framework to promote renewable energy in the German heat market. Authors outlined the importance of long-term effects of investment planning in the energy market and stressed the necessity for strong political commitment in order to promote growth in the RES-H market. More recently case studies of Lithuania and Austria have been reported in the literature. Perednis et al. [8] analyze the existing use of wood fuel in district heating systems and power generation in Lithuania and evaluates possibilities for further increase of solid biomass resources. Further a paper by Konstantinaviciute et al. [9] investigates the role of renewable energy sources in Lithuanian heating sector and the existing support measures. Authors highlight the need for faster structural changes of fuel consumption to increase the share of renewable energy sources in the Lithuanian district heating sector. The other nationally focused paper, co-authored by Kranzl et al. [2] provides an overview of the current status and future prospects of renewable heat market in Austria up to 2030.

Previous studies confirm that policies for design of the best strategies of RES-H penetration are still being developed in the EU. Together with such countries as the Czech Republic, Austria, Finland, and Lithuania, Latvia falls into the group of the European countries represented by a currently large share of renewable energy sources for heating (mainly solid biomass). Despite the high share of RES-H penetration compared to the other European countries, there are several aspects that should be considered. The majority of installed traditional solid biomass systems in Latvia and as well in the other Eastern European countries have low conversion efficiency and it is questionable to which extent they will be replaced by modern biomass heating systems. Kranzl et al. [2] conclude that the achievable growth of RES-H strongly depends on the economic conditions (i.e. energy prices and policies). We suggest that the transfer from fossil to renewable-based energy systems should be addressed not only from the perspective of economic efficiency, but also from the social dimension. Latvian case study has shown that even despite price benefits offered by the wood fuel, energy dependency on imported natural gas resources is still evident in the heating sector of Latvia. A strong lobby at political level is observed and needs to be overcome.

Another question of interest is related to the future of the district heating as a source of heat generation. Much of research in this field has been performed by Lund et al. [10,11]. In his study of 2010 Lund et al. [10] conclude that expansion of district heat generation is beneficial from both economic and environmental aspect. Further expansion of district heating is possible in the EU and can ensure more effective utilization of local renewable energy resources [12]. On the other hand, Mathiesen et al. [13] draw attention to the availability of biomass resources in the EU and suggest that the demand of biomass for heat should be reduced by enabling the use of other renewable energy sources. At the same time they point out that choosing district heat instead of decentralized systems would considerably reduce the biomass consumption.

Within this background Latvia undertakes and develops different measures in the NREAP (National Renewable Energy Action Plan) in order to increase the share of renewable energy in total gross final energy consumption up to 40% by 2020. Despite the fact that Latvia presents nowadays the second highest RES share in the European Union (around 35%), important long term improvements are required not only for the main energy sectors but also for environmental, social and economic aspects.

Nowadays Latvia finds itself in a contradictory situation. Increase in the natural gas import has taken place over the last years despite the significant targets set by the Directive 2009/28/EC and the sustainable development criteria, as well as the increase of the energy security and the energy independence. Moreover despite the comparatively large share of renewable energy sources in the primary energy balance, its local potential is not fully exploited.

On the other hand, it is evident how the evolution from the current fossil based primary energy system is facing the social dilemma that it reflects. From a systems perspective the conflict between individual and collective interests and situations in which short-term self-interest is at odds with the long-term collective interest has been well described by Peter Senge (1990) [14].

In Latvia in order to optimize the exploitation and use of local RES (renewable energy sources) in the light of set target within the Latvian NREAP different state supporting actions are available for different action groups [15]: support on investment for district heating system efficiency improvement measures; support on investment for development of renewable energy plants; support on investment for the transition to renewable energy technologies in different sectors (households, public sector and industrial sector), introduction of a fossil energy tax, implementation of the Emission Trading Scheme, informative campaign and public outreach measure to promote the use of local RES [16].

Driving the attention to the Latvian energy sector and specifically to the district heating system Latvia is one of the EU Member States with a large proportion of district heating system at urban and rural level. Data presented by Ministry of Economics of the Republic of Latvia show that in 2010 the share of thermal heat produced by the district heating sector was 22% [17,18]. According to other sources [19] the district heating provides more than 30% of the amount of thermal energy consumed in the household and technological sector.

Data related to the district heating sector between the years 2000 and 2008 [18,20] show that the centralized heat produced

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