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MODELLING OF THE DEVELOPMENT OF LITHUANIAN INDIVIDUAL HEATING: INFLUENCE OF INVESTMENT SUBSIDIES FOR RES HEATING SYSTEMS

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Overview
In the face of economic crisis, growing cost of resources and pervasive environment pollution, the problem of efficient and energy-saving consumption becomes increasingly important on a global scale. Energy consumption in households makes a significant share of the total energy consumption, therefore increasing use of renewable energy sources (RES) and improving efficiency of energy consumption in individual dwelling-houses are considered to be among the key directions towards improvement of the overall situation.

Implementation of investment subsidies or other support schemes to promote RES that are used for heating purposes and preparation of hot water in individual houses has an impact on consumers' preferences, use of one or other kind of heating devices, one or another kind of fuels. Therefore all analysis regarding impact of possible implementation of RES support schemes in Lithuania cannot be based on statistical information about past situation. In this case, the relevant information can be obtained from modelling the future heating systems in one or another type of conditions, or in the case of one or another development scenario.

The main objective of this research is to create a mathematical model which could allow investigating impacts of different RES support measures on development of heating in Lithuanian individual dwelling-houses and to assess possible influence of investment subsidies for RES heating systems.

Methods
This model was developed using MESSAGE modelling tool. In this linear programming model a variety of heating systems of Lithuanian individual houses was represented and all processes from fuel supply until satisfaction of consumer's needs in space heating and hot water were covered.

Selection of future technologies for space heating and hot water preparation in the developed mathematical model for analysis of heating system development is based on minimization of total system cost. Taking into account preferences of people, described in the paper, this is fully appropriate for Lithuanian conditions. However, it is necessary to mention that other factors were also taken into account when preparing the mathematical model. Some of behavioural bounds were introduced into the mathematical model in order to represent different aspects of heating system development that are not in line with cost minimization criterion. Therefore it was possible to create rather correct representation of Lithuanian conditions in the mathematical model for the analysis of heating system development.

This mathematical model also includes investment subsidies that could be used to promote RES heating technologies. This in the model was represented in compliance with consumer approach, i.e. consumer choices under certain circumstances were modelled. Governmental support for

renovation of heating systems in the model was shown as reduction of required investments for installation of particular technology. Various levels of investment subsidies and parameters related to uncertainties about future are be reflected in different scenarios. In this research not only support level and basis from which support is calculated but also fuel prices and discount rate were used as variable elements in different scenarios.

The prepared mathematical model for modelling the development of heating systems in Lithuanian individual houses can be also applied for analysis of other support options.

Results

Introduction of investment subsidies for RES heating systems would make significant change in stock of heating technologies but would have only a modest impact on the overall RES consumption in Lithuanian household sector.

Looking to the RES penetration rate rational support is about 20-30% from total installation cost or 40-50% from equipment cost.

Reduction of total fuel consumption in 2030 makes 3.5% in the case of high fuel price scenarios and high discount rate, and 6.9% in the case of low fuel price scenarios and low discount factor.

Due to introduction of investment subsidies for RES heating technologies estimated increase of RES wood consumption may reach 2.9% in 2015 and 17.1% in 2030. Relatively moderate increase of RES consumption can be explained by the fact that existing solid fuel boilers even without any support scheme use biomass. Therefore total consumption of RES at the beginning of the study period makes about 74% and until 2030 without support schemes reduces by 12 percentage points. Implemented RES support schemes only increase this comparatively high share of RES in total fuel balance of Lithuanian household sector.