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Analysis of fuel and energy transition in Lithuanian households sector and its sustainable development in compliance with the EU policy

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ABSTRACT

The article provides the analysis of fuel and energy transition in Lithuanian households sector and its sustainable development after the integration of Lithuania into the European Union (EU) and covers the period 2005–2012.

Lithuania has limited quantity of indigenous energy resources and is depended from the import of energy resources, such as natural gas, petroleum and hard coal. Up to the year 2009 about 70–80% of electricity was produced from Ignalina NPP. At the end of 2009, according to the requirements of EU, Ignalina NPP was closed. Lithuania's energy dependence on the imports of fuel increased remarkably from 50.3% in 2009 to about 82% in 2010–2012 and considerably exceeded the EU average 54%. The share of renewable and indigenous energy sources in gross inland fuel and energy consumption increased from 14.7% in 2009 to 19.5% in 2012. About 40.4% of RES and indigenous energy belonged to households sector and 44.9% were transformed in Combined Heat and Power (CHP), and only 14.7% belonged to industry and other sectors.

In article, the sustainable development of Lithuanian and European households were overviewed and recent analysis of Lithuanian households sector was carried out. Dwellings were sorted by the year of construction. Distribution of households by dwelling type and heated area was assessed. Final fuel and energy consumption and distribution by different consumer groups were shown. In 2009–2012 final fuel and energy consumption of Lithuanian households comprised about 65 PJ or 33% of all final consumption. Household's energy consumption by different energy sources was disclosed. In 2012 about 36.5% of household's energy consumption belonged to solid biofuels and about 31.7% to heat energy. Electricity consumptions of households and electricity prices for household consumers were indicated and comparisons with EU-27 countries were made. Lithuanian RES flows diagram was constructed and RES share for households was revealed. The reduction of greenhouse gases emissions in Lithuania and other European countries was indicated.

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Abbreviations: CHP, Combined Heat and Power; EC, European Commission; EPBD, Energy Performance of Buildings Directive; ESCo, Energy Services Companies; EU, European Union; GDP, Gross Domestic Product; GHG, Greenhouse Gases; IEA, International Energy Agency; ktoe, Kilotons of oil equivalents; LEI, Lithuanian Energy Institute; LTL, Lithuanian Litas (1 LTL=0.2896 €); NPP, Nuclear Power Plant; OECD, Organization of Economic Cooperation and Development; PV, Photovoltaic; RES, Renewable Energy Sources; UK, United Kingdom; USA, United States of America; ZEB, Zero Energy Buildings

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1. Introduction

1.1. Sustainable development of the European households

Sustainable development is a fundamental and overarching objective of the European Union, enshrined in the Treaty. The EU sustainable development strategy, launched by the European Council in Gothenburg in 2001 and renewed in June 2006, aims for the continuous improvement of quality of life for current and future generations [1].

Household expenditure in EU rose steadily between 2000 and 2007, but dropped slightly in 2008 and 2009, as a consequence of the economic crisis. In parallel, the number of people per household decreased, reflecting a continuous trend towards more but smaller households. Electricity consumption of households rose substantially in 2000–2009, but final energy consumption decreased slightly mostly as a consequence of the economic crisis. Household consumption (the ultimate end to which production activities are directed) is characterized through the number, size and composition of households and their expenditure patterns. These characteristics influence all indicators in the 'consumption patterns', especially electricity consumption.

Sustainable consumption and production patterns are key elements in tackling climate change. Reduction in energy consumption and changes in the fuel mix, by switching to less carbon-intensive energy sources, is linked to lower CO_2 emissions. Transition to a low carbon economy would be an important step towards meeting this demand for climate stability. The coming sustainable energy transition in the world, past and prospective its history, strategies and outlook were outlined in [2,3].

Buildings occupy a key place in our lives and society as a whole. Yet, the energy performance of our buildings is generally so poor that the levels of energy consumed in buildings place the sector among the most significant CO_2 emissions sources in Europe. While new buildings can be constructed with high performance levels, it is the older buildings, representing the vast majority of the building stock, which are predominantly of low energy performance and subsequently in need of renovation work. With their potential to deliver high energy and CO_2 savings as well as many societal benefits, energy efficient buildings can have a pivotal role in a sustainable future [4]. Sustainability at home, policy measures for energy-efficient appliances was studied in [5].

Achieving the energy savings in buildings is a complex process. Policy making in this field requires a meaningful understanding of several characteristics of the building stock. Reducing the energy demand requires the deployment of effective policies which in turn makes it necessary to understand what affects people's decision making processes, the key characteristics of the building stock, the impact of current policies, etc.

It was estimated [4] that there are 25 billion m^2 of useful floor space in the EU-27, Switzerland and Norway. Half of the total estimated floor space is located in the North and West region of Europe while the remaining 36% and 14% are contained in the South and Central and East regions, respectively.

Residential buildings comprise the biggest share (about 75%) of the EU's building stock and are responsible for the majority of the sector's energy consumption. A substantial amount of the stock in Europe is older than 50 years. More than 40% of residential buildings have been constructed before the 1960s, when energy building regulations were very limited.

The performance of buildings depends on a number of factors, such as the performance of the installed heating system and building envelope, climate conditions, behavior characteristics and social conditions. Data on typical heating consumption levels of the existing stock by age shows that the largest energy saving potential is associated with the older building stock, were in some cases buildings from 1960s are worse than buildings from earlier decades. In 2009–2011, European households were responsible for about 68% of the total final energy use in buildings. Energy in households was mainly consumed by heating, cooling, hot water, cooking and appliances, where the dominant energy end-use in homes (about 70%) was space heating. Buildings are at the pivotal center of our lives. The characteristics of a building, its design, look and feel, and technical standards not only influence our productivity, our well-being, moods and our interactions with others, they also define how much energy is consumed in, and how much heating, ventilation and cooling energy is needed to create a pleasant environment [4].

Buildings cause a significant amount of greenhouse gas emissions, mainly CO_2, altering our planet's climate. By renovating buildings to high standards of efficiency we can demonstrate that ambitious climate change mitigation actions and improvements in living quality can go hand in hand. The European building stock with its unique mix of historical and modern architecture provides both significant opportunities and challenges. Effective policies and incentive schemes to reduce the climate change footprint of buildings require a solid understanding on the current building stock.

Energy use in residential and commercial buildings represents the lion's share, about 40% of the EU's total final energy consumption and CO_2 emissions. Activities related to buildings represent a large part of the EU economy, about 9% of EU GDP [6]. Therefore, the EU buildings sector can play a key role in achieving EU growth, energy and climate policy objectives, while contributing to improved level of comfort and lower energy bills for citizens. Energy efficiency of buildings is an important part of broader initiatives on achieving EU energy and climate change objectives. The potential for cost-effective energy savings is about 30% of the whole sector's expected energy consumption by 2020, which would lead to significant economic, social and environmental benefits. The existing EU core instruments in this context, e.g. Energy Performance of Buildings Directive (EPBD), Eco-design of Energy-using Products Directive, and Energy End-use Efficiency and Energy Services Directive, have proved to be a solid basis for