RES UTILISATION DEVELOPMENT IN LITHUANIAN RURAL PLACES

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Abstract
Energy transition from the fossil fuel dominating to the one based on renewable energy sources (RES) takes acceleration with the internationally recognised need to stabilise the global warming. Therefore, there is a general consensus that the initiative of the wide use of RES is manifold in its nature making an impact not only on the environmental issues, but also adding to the so desired customer involvement and rural development as well. Rural dimension in reaching the EU targets should arguably be a priority as RES utilisation is decentralised in its nature.
Despite the fact that EU with its main strategic documents gives a clear direction on RES utilisation through wider involvement of citizens, especially in rural places, there are certain grounds for stating that a current situation and future insights among EU Member States still differ. Lithuanian case was chosen to explore the sustainability gaps regarding the RES utilisation development in rural places. Literature review is employed to choose the most suitable way aiming to explore and evaluate the RES utilisation development in rural places regarding the sustainability issues. This article adds to understanding and evaluating the main obstacles of the well balanced RES utilisation development in rural places.
Key words: rural development, energy, RES, sustainability.

Introduction

The newest worldwide agreement made in Paris on 12th of December, 2015 leaves no doubt that the world politics turns into a new era of wider utilisation of renewable energy sources (RES) and, consequently, more extensive spread of clean energy technologies. Decisions made in the Paris UN climate conference have to come into effect in the year 2020. It is extremely important that all countries, despite their level of economic development, are involved in and responsible for tackling the climate change. At the core of the agreement is a commitment that the world will aim to stabilise global warming well below two degrees above pre-industrial levels, and even less if possible.

This direction towards the cleaner world development has started with the Kyoto protocol and later on lots of other agreements were made among different and most concerned countries. European Union (EU) arguably takes the leading position regarding the RES utilisation support and spread of clean energy technologies. This unceasing development has started from united political will regarding the perspective on clean development expressed in corresponding strategies followed by the necessary directives, guidelines and corresponding quantitative requirements. It is worth to mention that requirements are only for minimum level to be achieved.

The EU way of RES utilisation had started recognising the need to promote RES as a priority measure in 1998 because their exploitation contributed to the environmental protection and sustainable development. Moreover, it was stated that this spread can also create local employment, have a positive impact on social cohesion, contribute to security of supply and make it possible to meet Kyoto targets more quickly (the European Parliament and the Council of the European Union, 2001). Furthermore, the European Parliament in its resolution on electricity from renewable energy sources and the internal electricity market (the European Parliament, 2000) underlined that binding and ambitious renewable energy targets set and approved at the national level are essential for obtaining proper results and achieving the EU targets. This inspired to accept the first EU directive on the promotion of electricity produced from renewable energy sources in the internal electricity market. This directive was amended several times and later on in 2010 came into force even more comprehensive document known as 'Energy 2020: A strategy for competitive, sustainable and secure energy' – to reduce greenhouse gas emissions by 20%, rising to 30% if the conditions are right, to increase the share of renewable energy to 20% and to make a 20% improvement in energy efficiency (EU, 2010). Furthermore, European Commission has adopted the Energy Roadmap 2050 where it provides a pattern of energy production and use in order to perform decarbonisation and efficient use of renewable energy (EC, 2011).

There is a general consensus that the initiative of the wide use of RES is manifold in its nature as it makes an impact not only on the environmental issues, but also adds to the so desired customer involvement and smoother regional, in most of the cases, rural, development as well. For instance, rural dimension in reaching the EU targets should be of the highest priority as RES utilisation is decentralised in its nature. Therefore, a great majority of rural areas

have the potential for being self-sufficient in their energy production (Peura & Hyttinen, 2011) through diversity of RES.

Despite the given possibilities and the fact that EU with its main strategic documents gives a clear direction, there are certain grounds for stating that the current situation and future insights in EU Member States still differ. The proportion of gross electricity produced using RES differs widely from one country to another, ranging from 7.3% in Hungary to 70% in Austria, with an average of 27.5% across countries in 2014 (Eurostat, 2016). One of the reasons could be the lack of balance or, more precisely, sustainability regarding the RES utilisation development. Consequently, the main aim of this article is to explore and evaluate the RES utilisation development in rural places regarding the sustainability issues, taking as an example the case of Lithuania. The tasks are the following: to perform literature analysis regarding the evaluation of RES development sustainability, to perform the evaluation of RES development sustainability issues, and to draw conclusions.

Materials and Methods

Sustainability and consequently sustainable development could be understood as a process of achieving a balance between the three most important aspects such as environmental, economic and social ones. Other authors emphasize the link between sustainability and energy sustainability describing it as balance between economic growth and efficient and secure energy supplies together with a clean environment (Hossein *et al*., 2012).

Underlying the dynamics of the sustainable development, which allow moving towards a better life (Streimikiene & Siksnelyte, 2016), the economic, social, technological and environmental aspects are analysed. These aspects create the acronym ESTE. The economic aspect is explored using indicators corresponding to the growth of economics and competition; the environmental aspect is evaluated utilising the indicators of impact on the environment and efficient use of resources; and the social aspect is explored using the indicator of social exclusion. It is worth adding that the research was performed with regard to the electricity sector.

The aspect of dynamic corresponds to our day life where huge differences occur even among EU countries. It is clear when comparing socio-economic conditions, despite the efforts of harmonisation, the specific national and regional legislative framework, and the multiple and different point of views of stakeholders (Berardi, 2013; Ruggiero *et al*., 2014). In other words, authors emphasize the importance of the political (Thygesen & Agarwal, 2014) and legal aspects which clearly can send significant motivation towards faster spread of RES utilisation. Enrichment of the indicators falls into well known acronym PESTLE, corresponding to the investigation of political, economic, social, technical, legal and, last but not least, environmental aspects.

Investigating the overall countries' energy status, Tofigh and Abedian (2016) as the main aspects distinguish the following four: Social, Technological, Economic, Environmental and Political (STEEP), determining 5 key indicators: Total Primary Energy Consumption per Capita for the Social aspect, Electricity Distribution Losses for the Technological aspect, Energy Intensity for Economic aspect, Carbon Dioxide Emission for Environmental aspect and the Total Renewable Electricity Net Generation as best fitting for Political aspect to be evaluated.

PEST method also serves as one of the instruments characterising the energy systems in terms of policy background, energy use and infrastructure, as well as market behaviour and community attitude for sustainable development (Cosmi *et al*., 2015). Therefore, having the aim to evaluate the RES utilisation development in rural places with regard to the sustainability issues, the lacking aspect of environmental issues should be added to perform the well balanced evaluation.

The earlier given analysis shows the importance of the political aspect in the spread of RES. When evaluating the overall status of it, the total renewable energy net generation could be the proper indicator. Therefore, taking into account the nature of rural aspect it would be worth to take the indicator of permissions issued to develop the RES excluding the cases of big biofuel generators located in big cities. The number of permissions issued is a result of overall political and legal environment of the country. On the other hand, this indicator is quite easily quantitatively accountable.

Political aspects are tightly related with others, for example, the adequacy of processes in general, and particularly, renewable energy, while they are key in achieving a greater equality, democratic management, quality of life and environmental sustainability, particularly in the rural areas (Belmonte *et al*., 2015). Therefore, the most influential economic indicator arguably is the tariffs of the power produced using RES. This is the strongest driving force for citizens to take an active role as this is tangibly related with the expanded possibilities for development of well-being in rural places alongside of farming and other activities such as craftsmanship. As it is widely recognised, today we experience an increased need for rural re-development and social innovation (Gobattoni *et al*., 2015).

As the community position in RES development plays a significant role, it is very important to take

this into consideration when exploring the social aspect of the sustainable development. Most of the social sciences literature on renewable energy and communities is still very much focused on the factors of acceptance and resistance (Delicado *et al.*, 2016). On the other hand, evaluating customer involvement as one of the indicators of the social aspect it is worth to measure an amount of small and medium-sized business ventures as this business in most of the cases is local or even community based. Industrialized countries are implementing various methods to promote polycentric and decentralized energy supply concepts in order to include different options for citizen beneficial participation (Yildiz *et al.*, 2015) in the wider RES utilisation.

Analysing the possible indicators in relation to the technological aspect of sustainability, there are lots of choices, such as adequate technology and resources based on the conditions and infrastructure of the place (Belmonte *et al.*, 2015), losses in the grid while considering technology, as well as innovation, efficiency, research and development (Tofigh & Abedian, 2016). Even having the most advanced, innovative and efficient solution to generate electricity or/and heating or/and cooling, it is still nothing without proper connection to the grid. That is the reason why possibility to connect to the grid is taken as the most significant indicator which could heavily affect the RES development especially in the rural places. In this case, the technical quality is proved in the operation of technology, prior knowledge of users and successful use by other groups (Belmonte *et al*., 2015).

Often the indicators exploring the impact on the environment are the following: greenhouse gas emissions (Cosmi *et al.,* 2015; Tofigh & Abedian, 2016; Streimikiene & Siksnelyte, 2016), and the share of RES in the total energy generated (Streimikiene & Siksnelyte, 2016). It is reasonable to assume that the indicators characterising the share of RES in the total amount of energy generated is the right choice as the RES development does not stipulate the greenhouse gas emissions. Moreover, the nature of the long-term trend could bring some valuable insights as well.

Summing up, in order to explore and evaluate the RES utilisation development in rural places with regard to the sustainability issues, the following aspects should be taken into account: *political* aspect with the indicator of a number of permissions issued to develop the RES, *economic* aspect with the indicator of tariffs of the power produced using RES, *social* aspect with the indicator of amount of small and medium-sized business ventures, *technological* aspect with the indicator identifying possibility of connection to the grid, and *environmental* aspect with the indicator of the RES share in the total amount of energy generated. This kind of exploration and evaluation needs longitudinal data sets as it allows to look at trends and changes of phenomena over time. Consequently, the secondary data analysis (official data from EUROSTAT, Lithuanian National Commission for Energy Control and Prices, and Lithuanian transmission system operator JSC Litgrid) is used and results obtained are later on discussed using systematic analysis, generalization, comparison, and abstraction. The analysis was done using the longest available data time range and including the newest available data as well.

Results and Discussion

The indicator of a number of permissions issued to develop the RES can be explored in two ways: either by taking into consideration the amount of permission units or presenting the amount of capacity allowed to install according to the permissions issued. In order to have an overall picture, a comparison of both kinds of data is given in Table 1 and Figure 1.

In respect of data given in Table 1, the development of a single kind of RES is quite smooth changes except the solar case when a big boom happened in years 2012 and 2013. The amount of permissions issued jumped more than a hundred times from 14 in 2011 to 1462 in 2013. On the other hand, this huge amount of permissions corresponds only to around 60 MW of the capacity installed. In connection with the facts given, it can be assumed that business ventures developing solar energy are really few.

Table 1

Units of permissions issued, 2002 – 2015

Number of units	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bio	0	1	1	0	0	3	3	2	3	4	5	3	4	8
Hydro	22	6	12	9	8	4	8	3	5	4	14	1	0	3
Solar	0	0	0	0	0	0	0	0	0	14	154	1462	12	64
Wind	1	0	2	1	1	5	9	6	8	27	14	25	37	18

Source: prepared by authors using JSC Litgrid data.

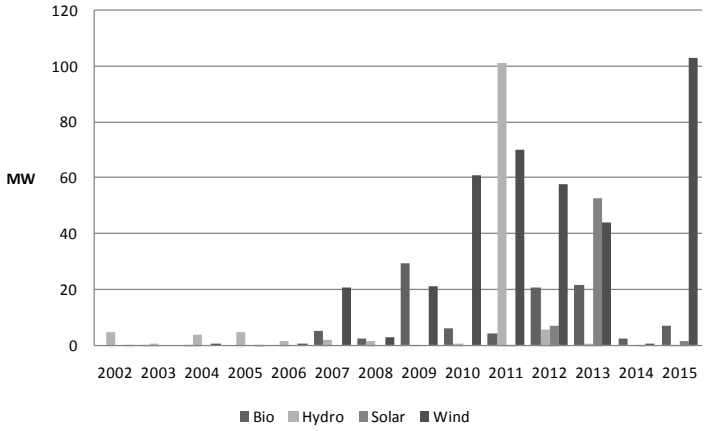

Figure 1. RES capacity installed, 2002 – 2015.

Source: prepared by authors using JSC Litgrid data.

Table 2

Development of tariffs and share of RES in Lithuania, 2007 – 2015

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bio, ct k^{-1}Wh	5.79	6.37	8.69	8.69	8.69	14.50	11.80	8.60	7.00
Hydro, ct k^{-1}Wh	5.79	5.79	7.53	7.53	7.53	8.10	8.00	7.00	6.90
Solar, ct k^{-1}Wh	0.00	0.00	0.00	47.20	47.20	41.70	21.90	14.50	14.40
Wind, ct k^{-1}Wh	6.37	6.37	8.69	8.69	8.69	10.70	10.00	8.00	7.40
RES %	16.7	18.0	20.0	19.8	20.2	21.7	23.0	23.9	25.0

Source: prepared by authors using the data provided by the NCC and Eurostat.

Figure 1 indicates a wavy development of the capacity installed. Solar jump stopped just after the boom period of the years 2012 and 2013. Wind was constantly growing till the year 2011 and later on decreased almost to zero in 2014 and regained in 2015 with 100 MW of capacity installed. It is worth mentioning that there were no significant disturbances regarding the technologies itself. Everything is due to the major changes in legislation and regulation – purchasing tariff for solar power dropped twice, changes occurred in relation to wind quota mechanism etc. The analysis leads to a conclusion that political decisions fail to support sustainability.

Exploring the economic aspect with the indicator of tariffs of the power produced using RES, it is tempting to make it in correlation with development of the share of RES in Lithuania. Data given in Table 2 identifies the constant growing of tariffs for power produced using RES till the year 2012. As it was already mentioned before, tariff setting procedures together with other regulations were changed in 2013. Starting from this year tariffs are getting lower. Despite this fact, the share of RES is constantly growing. Therefore, correlation between bio, hydro and wind purchasing tariffs and the share of RES could be characterised as positive but only a moderate one (average correlation equals to 0.44). Solar case is so extreme that it should be excluded from the correlation analysis.

The growing share of RES when tariffs took a downward trend could be explained by the depreciation of technologies, namely, wind and solar. One could only imagine how intense could the growth be without regulative intervention which nearly stopped the RES development for a year regarding wind case, and in solar case this suspension continues up to now. Nevertheless, Lithuania is one of nine EU countries fulfilling targets set in Energy 2020 (Figure 2).

It is worth adding that potential of RES utilisation is far bigger in Lithuania (Gatautis *et al*., 2009) than the level already reached. There are however no reliable statistics about the potential of these sources because they are in principle inexhaustible (Peura & Hyttinen, 2011). On the bases of the above data it is possible to conclude that the indicator of the RES share in the total amount of energy generated is satisfactory and alongside it has opportunities to be improved.

The aim to explore the social aspect with the indicator of amount of small and medium-sized business ventures is not so easy to reach as there is

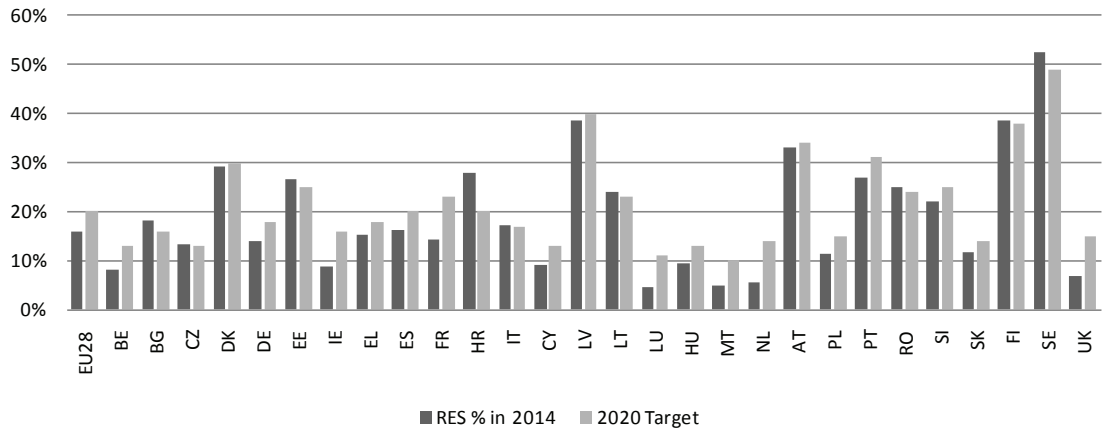

Figure 2. Overall share of energy from RES comparing with 2020 targets.

Source: prepared by authors using Eurostat data.

lack of the data directly attributable to this issue. Arguably small business is the backbone of job creation and extremely important for innovation in the clean energy sector. Small business contributes to social stability and even strengthens the democracy in the country as well (Pažėraitė & Krakauskas, 2012). Moreover, looking to maximize the local value of RES development, economic returns from the local ownership are observed from 1.5 to 3.4 times greater than compared to absentee ownership (Farrell, 2011). Energy sector is by no means capital intensive one and consequently dominated by big companies. RES utilisation development, especially solar technologies, provides real possibilities for the small businesses to take part in the energy sector as well.

According to the Statistics Lithuania, small and medium businesses create nearly two thirds of the country's GDP and employees more than 70% (Statistics Lithuania, 2016). Small and medium-sized businesses in electricity sector, by contrast, comprise only nearly 6% (Table 3). Actually, electricity sector is the one which could explore the situation while production in district heating sector is owned mostly by municipalities and some big companies.

The share of small and medium-sized businesses was extremely small and comprised less than 1% till the year 2010. Actually, subsequent growth is not that big but closure of Ignalina nuclear power plant made changes in the total production amount of the country and correspondingly to the proportional share of RES. However, nowadays the share of small and medium-sized businesses in the field of RES corresponding to 6% looks unsatisfactory in comparison with Germany which has replaced around 31% of its nuclear and fossil fuel generated electricity with green power, produced overwhelmingly from moderately sized onshore wind, solar PV, hydro, and bio-energy installations (Hockenos, 2014).

Possibility of connection to the grid also plays an important role in RES development in rural places. Despite the fact that lots of business entities would like to develop wind generation in the western part of Lithuania, transmission system operator refuses connections because of a weak grid. But there again the expenses assigned to compensate the RES connection to the grid are shrinking (Table 4). Moreover, no single Euro is assigned to grid expansion or strengthening in order to satisfy RES development needs.

Table 3

Share of electricity produced by small energy ventures

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Solar, GWh	0	0	0	0	0	0	0	0.1	2.3	44.8	73
Hydro, GWh	61.5	66.1	55.8	95.9	72.7	74.3	93.2	90.3	96.4	91.9	71.5
Wind, GWh	1.2	1.4	0.5	5.2	13.7	11.3	10.2	43.8	114.4	104.8	115.7
Share from total electricity produced, %	0.3	0.5	0.5	0.7	0.6	0.6	1.8	2.8	4.2	5.1	5.9

Source: prepared by authors using Litgrid data and Energy in Lithuania (2004 – 2005, 2009 – 2014).

Table 4

Amount of expenses assigned to compensate the RES connection to the grid, 2007 – 2015

MEur	2007	2008	2009	2010	2011	2012	2013	2014	2015
RES connection to the grid	11.6	3.9	8.7	0	0.23	0.05	0.13	-0.05	3.06
Expantion of the grid because of RES	0	0	0	0	0	0	0	0	0

Source: prepared by authors using datafrom Lithuanian National Commission for Energy Control and Prices.

Previous research (Pažėraitė & Krakauskas, 2012) also proves that this unsatisfactory situation has been taking place already for several years. This technological aspect together with the political one and also taking into account the regulatory issues prevent more intense RES development.

Conclusions

1. As the initiative of the wide use of RES is manifold in its nature and it makes an impact not only on the environmental issues, but also adds to the so desired customer involvement and smoother regional, in most of the cases, rural, development as well. For instance, the rural dimension in reaching the EU targets should be of the highest priority as RES utilisation is decentralised in its nature. Therefore, a great majority of rural areas have the potential of wider development because of the RES utilisation.
2. Political aspect of the RES utilisation development in Lithuanian rural places is explored with the indicator of a number of permissions issued to develop the RES, economic aspect with the indicator of tariffs of the power produced using RES, social aspect with the indicator of amount of small and medium-sized business ventures, technological aspect with the indicator identifying the possibility of connection to the grid, and environmental aspect with the indicator of the RES share in the total amount of energy generated.
3. RES development lacks the sustainability taking into account political, economic, social, technological and environmental aspects in Lithuania. The evaluation shows that situation is not satisfactory as the political decisions fail to support sustainability; regulative intervention regarding the tariff setting together with quota procedure and unfavourable grid position towards RES seriously injured the RES development. Consequently, the share of small and medium-sized businesses looks unsatisfactory, especially in comparison with more advanced countries. Only the environmental indicator shows a satisfactory situation as in spite of everything Lithuania is one of nine EU countries fulfilling targets set in Energy 2020.

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