Economic aspects of renewable energy use – application of support schemes based on a particular biogas plant in Slovakia

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Slovakia committed to the objectives related to the mitigation of climate change´s pace. The most important acts include reducing energy consumption and increasing the share of renewable energy in gross final energy consumption of the country. Regions are challenged by a fundamental transformation of energy. The main aim of this paper was to evaluate the use of renewable energy sources in Slovakia, as well as the procedural and economic side of support mechanisms allowing progress in the use of renewable energy sources. The secondary aim was to economically assess the impact of support schemes for the effectiveness of investments and make recommendations on renewable energy use for the next period based on an example of a biogas plant in Slovakia. Slovakia has experienced the development of biogas installations after the year 2009. By 2013, Slovak market significantly promoted investments in biogas plants, but in 2014, there was a downturn in the installation of new ones. A database for the analysis was obtained from real data of a specific biogas plant in Slovakia. Results of the analysis declare that financial support mechanisms from the country and the EU are a major determinant in the development of biogas plants in Slovakia with a positive impact on important economic indicators of effectiveness. This process will also support the achievement of the objectives of Target 2020.

Key words: *renewable energy sources, non-renewable sources, biogas plants, support schemes, investment efficiency, energy transformation*

Introduction

At present, energy policy and the issue of renewable energy (RE) use is being under discussion very frequently in both, scientific and professional community. Climate changes, increase in economies' dependency on oil and other fossil fuels, in import, energy price increase, and others make economies of the countries more vulnerable. Development of renewable energy sources (RES) is a priority for the EU. One of the objectives of the Energy Union Strategy is the EU to be a world leader in the RE (Erbach, 2016).

The policy of RE use in the EU is relatively young. However, its realisation has become more intense by adopting White Paper for a Community Strategy and Action Plan in 1997 (EP, 2015). In this document, the EU defined its goals, i.e. to cover 12 % of energy consumption and 22.1 % of electric energy consumption by using RE till 2010 (White Paper, 2007). The EU adopted various measures that focus on a support of RE in the form of technological programs or particular strategic initiatives. EU policy is limited in the longer term, which prevents the destabilising effects of short-term national political changes (EP, 2015). The defined objectives in White Paper (1997) appeared to be insufficient for a development of RE sector. The Commission and the European Parliament set a legally binding objective, 20 % rate of RE per energy consumption in the EU till 2020 in the following paper, Renewable Energy Road Map — Renewable energies in the 21st century (C&EP, 2007). Simultaneously, they set up the way of optimising those processes that are related to RE in energy policy and at energy markets in the EU. The new legislative framework was presented in order to support and use RE in the EU. Its primary aim was to provide a long-term stability that is inevitable for taking rational investment decisions in the business communities in RE sector, which would lead EU to more ecological, secure and competitive energy future. The new directive of RES, Directive 2009/28/EC on the Promotion of the Use of Energy from Renewable Sources that was adopted in 2009 determines that 20 % of energy consumption needs to be covered by RES till 2020 in the EU. This primary aim was divided into few binding national objectives depending on different starting positions of Member States. There was also determined an obligation for all Member States to reach 10 % rate of RE in transportation fuels by 2020 (Directive 2009/28/EC). Individual EU Member States adopted own national RE action plans in 2010. The last report - The Renewable Energy Progress Report (COM/2015/0293) states that EU and a majority of Member States reach stable progress in meeting their objectives for 2020. However, it is also possible that some Member States will have to intensify their effort or cooperate with the other Member States.

The share of energy from RE in gross final consumption of energy in the EU-28 has increased in 2004 from 8.5 % to 16.00 % in 2014. It almost represents a double increase, and it is an evidence of progress in meeting the targets determined by strategies of Europe 2020. The EU Member States set out the following target by 2030, to

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reach a share of RES in gross final consumption of energy on the level of at least 27 %. This share of energy from RES in gross final consumption of energy increased in all EU Member States since 2004. The highest increase was evident in Denmark (from 14.9 % in 2004 to 29.2 % in 2014), Sweden (from 38.7 % to 52.6 %), Italy (from 6.3 % to 17.1 %) and Austria (from 23.3% to 33.1 %). The lowest progress was visible in the Netherlands, where this share of energy increased from 2.1 % in 2004 to 5.5 % in 2014 and in Luxembourg from 0.9% in 2004 to 4.5% in 2014. The present leader in share of RE in gross final consumption is Sweden (52.6 %), then Lithuania and Finland (both 38.7 %). Luxembourg reached the lowest share of energy in 2014, where only 4.5 % of energy consumption came from RE. In Slovakia, the share of energy consumption from RE was 11.6 % in 2014. The share of energy increased by 5 % in comparison to 2004 (Eurostat Database) (Fig. 1).

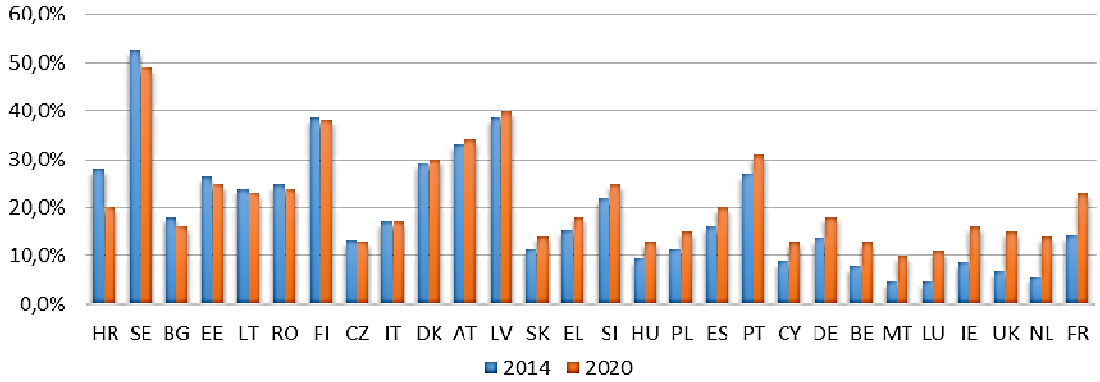

Fig. 1. Share of renewable sources in gross final energy consumption in EU-28 in 2014. Source: Eurostat Database.

The national targets that were met by nine countries (Croatia, Sweden, Bulgaria, Estonia, Lithuania, Romania, Finland, Italy and Czech Republic) with relation to Directive 2009/28/EC.

In the context of the above facts, the goal was formulated and the contribution of the paper. The main aim of this paper was to evaluate the use of RES in Slovakia, as well as the procedural and economic aspect of support mechanisms allowing progress in the use of RES. The secondary aim was to economically assess the impact of support schemes for the effectiveness of investments related to its operation and make recommendations on RE use for the next period based on a specific example of a biogas plant (BGP) in Slovakia.

Overview of research studies

Key policy of the lines of support for the use of RE in the EU has a significant platform of explicitly defined objectives: *"The use of renewable energy is projected to increase substantially in the European Union to reach a share of 20% in final energy consumption and 10% in renewable energy in transport by 2020"* (Directive 2009/28/EC). The issue of achieving the EU target for RE by 2020, analysis of the development process and insurance of this goal with the associated barriers and the policies of RES, are a subject of many studies, research teams (e.g. Scarlat et al., 2015; Klessmann et al., 2011; Proskurina et al., 2016; Arasto et al., 2012; etc.). Many research studies show that support for bioenergy derived from biomass contributes to the Target 2020 and the development of the low-carbon economy in the EU countries. Biomass remains the major source of RE in the EU-28, accounting for more than 62% of all renewables (AEBIOM, 2015). Further development in the use of biomass in the EU will depend on supportive policies in each member state. For this reason, the implementation of stable, sufficient in scope and harmonised support schemes are getting more into attention. The aim of these support schemes is also the increasing of investors´ confidence to invest in the production of bioenergy, into the development of biomass supply chains (e.g. Scarlat et al., 2015) and the development of science and research in this area (Araste et al., 2012). Among the critical factors of the implementation of efficient and effective policies to attract sufficient investment the administrative and grid barriers such as modernization of the infrastructure of energy networks, removing barriers in the electricity sector, implementation of standards for sustainable biomass and mitigation of energy demand by increasing of efforts in energy efficiency are counted (Klessmann et al., 2011).

According to the targets of those researches – preference of procedural aspects in the area of RES, these research studies can be described as "procedural". In the context of the definition, another group of research studies aimed at the "result" is interesting. The dominant ones in them are also many economic and non-economic (environmental) criteria. In many of these studies, the authors examined what impact the use of biomass/biogas has to the reduction of energy dependency and greenhouse gas emissions of individual countries (e.g. Paiano and Lagioia, 2012; Mezzullo, McManus and Hammond, 2013; Hijazi et al., 2016; Kanianska et al.,

2011). The authors agreed that electricity from biogas has a less negative impact on the environment and lower emissions compared to the production of electricity from fossil fuels. Kanianska et al. (2011) quantified in their work the amount of biomass that is available, but so far not used for energy purposes in Slovakia and The Czech Republic. At the same time, their efforts were a quantification of consumed fossil fuels and corresponding CO_2 emissions that can be saved by the use of biomass. They found that the use of yet unused volume of biomass could help to reduce the total CO_2 emissions by 9.2 % in Slovakia and 5.4 % in the Czech Republic, and thus contribute to improving the environment in relation to climate change. Italian authors Paiano and Lagioia (2012) assessed in their study the availability of residual biomass in the territory of Italy, to evaluate the potential of bioenergy, particularly for electricity and heat. Their findings highlight the importance of appropriate policy to promote the use of bioenergy, which can help eliminate emissions in the economy, increase the reliability of energy supply and support the development of many rural areas.

A Portuguese research study by Carneiro and Ferreira (2012) also brings an interesting finding. They investigated the BGP in Portugal in terms of the use of energy crops and the impact of the implementation of support schemes. Availability, heterogeneity and resource costs are major obstacles to effective development and dissemination of these technologies. The study's authors concluded that the feed-in tariffs might not be sufficient facts to attract interest from private investors for the implementation of projects of construction of BGP. The need to create a specific redemption price should reflect the perceived risk of the project and the strategic and environmental value of these investments. Similar studies were also carried out in Poland to analyse the implementation and development of agricultural BGP. Even in this country research studies show significant conditionality of development of agricultural BGP impact from external factors, such as infrastructure, legislation and financing (Chodkowski-Miszczuk and Szymańska, 2013). Biogas from agricultural BGP is becoming increasingly important in the process of energy production (Piwowar, Dzikuć and Adamczyk, 2016). Even more interesting, most recent research works value the results pages of the process biomass use and its progression.

Based on the comparative study of authors Proskurina et al., 2016, we found a marked difference in addressing the issue between EU countries. The authors provide an overview of the current status of studies on the use of biomass in the EU countries and the current share of all types of biomass, used for the production of energy. In the context of the present review, we can say that very little attention is devoted to this topic in Slovakia, whether in terms of scientific research, or even scientific studies. This consequent fact encouraged us to focus on the issue of economic aspects with the aim of preparing a research platform that would support subsequent investigations of Slovak research teams. Under examination in assessing the economic aspects in the use of RE was also the implementation of support schemes important for the development of BGP in Slovakia. Practical applications of the use of support schemes in the current conditions in Slovakia declare a case study from real data, referred to in subsection “Case study”.

The Current state of RE in Slovakia

The Slovak Republic has a duty to increase the RE use in proportion to gross final consumption of energy to 14 % according to Annex 1 Directive 2009/28/EC by 2020. However, Slovakia failed to fulfil this obligation by 2014, but the consumption of RE has significantly changed during the last decades. The share of RE consumption in gross final consumption of energy increased from 6.4 % in 2004 to 11.6 % in 2014 (Fig. 2).

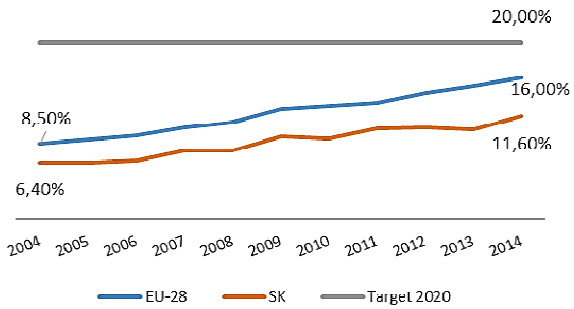

Fig. 2. Share of renewables in gross final energy consumption in Slovakia, 2004 – 2014. Source: Eurostat Database.

In Slovakia, the Act No. 309/2009 Coll. on the Promotion of Renewable Energy Sources and High-Efficiency Cogeneration and on amendments to certain acts (Act 309/2009 Coll.) provides support of RE. This Act supported function of the electricity market in terms of RE and it formed a stable business environment. Similarly, it provided a long term guaranteed feed-in tariffs for 15 years, and thus it determined a direction of electricity production by using RE as the construction of small and decentralised facilities represented an

advantage. Ministry of Economy of the Slovak Republic adopted the National Action Plan in 2010 that defined targets and trajectories for RE, as well as it created an overview of all policies and measures that focus on a support of RE' use (ME&C SR, 2010).

The RE are also regulated by the Decree No. 80/2015 Coll. of Regulatory Office for Network Industries (RONI) that establishes rules for electricity and gas market. The Decree also determines a level of feed-in tariffs. There are other acts that regulate RE in Slovakia: Act No. 382/2013 Coll. amending and supplementing Act No. 309/2009 Coll. on promotion of renewable energy sources and high-efficiency cogeneration as amended by the Energy Act No. 251/2012 Coll. amended by Act No. 391/2012 Coll. that regulates the conditions of energy business, market access, rights and obligations of energy market participants, measures focusing on secure supply of electricity and gas, and also a function of national electricity and gas market, rights and obligations of persons with possible prejudice to their rights and obligations by energy market participant. The performance of central government in energy and a performance of state surveillance and control of energy business. The development of biomass as an important field of RES is supported by Biomass Action Plan for 2008 – 2013. The goal of this Plan is to highlight the importance of biomass availability and real possibilities of Slovakia, the problems related to the use of biomass and the implementation of the commitments of Slovakia in the field of RES (MA&RD SR, 2008).

The support of RE generation is primarily based on postulates:

- Exhaustibility of global non-renewable fossil energy source reserves and their availability.
- Environmental consequences – in order to eliminate negative influences of energy on the environment.
- Elimination of energy dependency on fuel import from abroad (at present, the share of net import and the sum of gross final national energy consumption in Slovakia represents more than 60 % - Figure 3) (Zamkovský, 2016; ME&C SR, 2010).

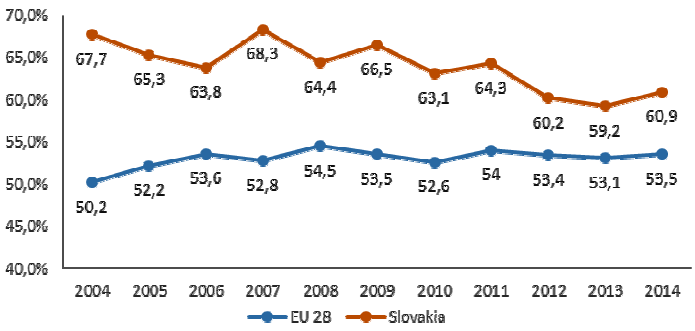

Fig. 3. Energy dependency in EU-28 and Slovakia, 2004 – 2014.
Source: Eurostat Database.

RE represents an indigenous energy resource that increases both security and a partial diversification of energy supplies, and simultaneously it decreases economy dependency on non-stable oil and natural gas prices (for instance gas crisis at the beginning of 2009). Biomass energy generation is preferred and financially supported (especially by a system of legal, administration and economic measures that secure their own energy security, etc.). Support of RE generation represents a form that supports innovations and information technologies, while also focusing on an indicator of new working opportunities that are connected with RE implementation and control (Fáber et al., 2012). Each system brings both advantages and disadvantages which may be formulated as risks in the process of RE use. The most significant are: production fluctuation (especially electricity production by solar and wind energy that negatively influences security and reliability of electricity system operation), higher financial burden (e.g. feed-in tariff that is made from solar energy is much higher than the electricity market price), no option to replace the present consumption of fossil fuels (e.g. solid biomass is exhaustible and degradable, and these qualities limit its potential). Also, a real energy contribution of biofuels, especially liquid ones, is disputable (EROEI indicator - Energy Returned on Energy Invested is officially not use in Slovakia) (Zamkovský, 2016).

Structure of RE in Slovakia

There exist certain differences in a structure of RE among the EU-28 that reflect natural assets and climate conditions. Slovakia belongs to those countries with the negligible potential of RES (MA&RD SR, 2008). The primary RE production is increasing in Slovakia. In 2014, it reached 1 440.8 thousand TOE that represents a 22.8 % share of a total production of primary energy. Figure 4 presents the most important individual RE items in Slovakia in 2014, where belongs a biomass (wood & other solid biofuels + biogas + biofuels + renewable waste) with 70.40 % share of primary production. Water energy had the second most significant share within RE

(25.12 % of total capacity), and the third was solar energy (3.96 %). The lowest share of primary production had wind energy (0.03 %).

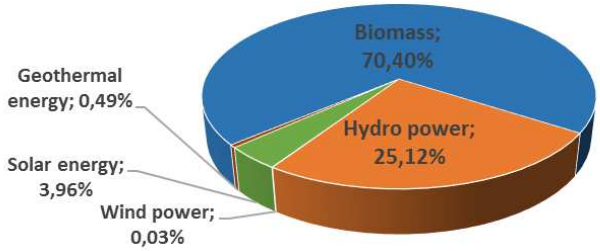

Fig. 4. Share of individual RE items on a total capacity of primary renewable energy production in Slovakia, 2014. Source: Eurostat Database.

It is obvious that a biomass represents a significant available RE source in Slovakia and it may be used as follows: generation of heat energy, electric energy and biofuels. Biomass is produced as a by-product or waste in agricultural or forestry production. In the agricultural sector, a development of biomass use for energy purposes lags behind in spite of a biomass potential and ambition to meet the target of energy security increase that results from Directive 2009/28/EC (AEBIOM, 2009).

Projects that focus on a biomass energy potential followed by its use and subsequent realisation is a financial burden for many companies. Thus, it is important to support facilities that produce net energy forms of biomass by forming and implementing the correct support schemes and mechanisms.

RE support schemes

The European countries, including Slovakia, implement various mechanisms in order to support energy generation out of RE and also the formation of new RE systems. Their formation and implementation are determined by geographical location, natural conditions of a country and conditions of adopting the support measures. The individual Member States determine support schemes individually as each scheme may have a different level and character. It is difficult to set an optimal level of RE support which provides a space for private investors and consumers in order to make a mutual arrangement. Private investors offer electricity at the lowest prices. On the other hand, consumers are willing to pay a certain maximum price in order to reach the lowest prices. The proper solution would be a support in the amount of a difference between the maximum price paid by a consumer and a minimum price offered by an investor (RONI, 2016).

RE support schemes in Slovakia

There are many support schemes of RE generation and formation of RE new systems. Valid stimulation systems are based on either a voluntary approach of electricity consumers or central measures' principle. Green tariffs (consumer is voluntarily willing to pay more for green electricity), other forms of financial stimulations, tenders, green taxes and negotiable green certificates, etc. that belong to the most frequently applied support systems in Europe. The system of guaranteed feed-in tariffs and financial stimulations (grant, tax benefits and soft loans) belong to the most spread system of RE support in Europe and Slovakia, as well (RONI, 2014; 2016).

Feed-in tariffs

The system of guaranteed feed-in tariffs operates on a principle of compulsory purchase of electricity generated from RE when a price per guaranteed period is defined in advance. In Slovakia, the primary objective is to guarantee a price for 15 years, while feed-in tariffs for RE electricity consists of two prices. The loss of electricity price is the first part, and it is defined as an arithmetic average of electricity prices used to cover the loss of all operators of regional distribution systems. The second part represents a supplement that is a difference between electricity price and loss electricity price (ME SR, 2013; 2015). The RE electricity feed-in tariffs are determined by the Regulatory Office for Network Industries via the Decree for actual year. The Decree No. 260/2016 Coll. from 09/30/2016 effective as from 2017 states the feed-in tariffs at a lower level than in 2016. Motivation to invest in a construction of new RE will be probably decreasing.

Financial support

This form of a support scheme is usually provided as a non-repayable financial contribution, but it may have a form of a repayable grant, such as soft loans, tax benefits, etc. (ME SR, 2015). The funds are provided by the State Budget of the Slovak Republic and EU Structural Funds. Overview of selected measures that promote RES by providing non-repayable grant is followed:

- **Slovakia – Rural Development Programme 2007 – 2013**

The National Rural Development Programme (RDP) of the Slovak Republic 2007 – 2013 was adopted by the Committee on Development on the 20th of November, 2007 in Brussels. RDP defines the framework for rural development policy and promotes rural development activities for the period 2007 – 2013. It also includes measures that lead to a support of BGP construction (RDP SR, 2007 - 2013).

o *3.1 Measure: "Diversification into non-agricultural activities"*

This measure primarily focuses on an increase of rural employment by means of organising supplementary productions of non-agricultural character, reconstruction and modernization of production objects in order to use RES, construction. An applicant of the non-repayable grant may only be a legal and natural person doing business in agriculture for which the share of the annual income from primary agricultural production in total income amounts to at least 30 %.

Tab. 1. Present status of administration calls of the SR 2007 – 2013 to measure 3.1 to 12/31/2014 [EUR].

Measure 3.1 (311) Diversification of non-agricultural activities to 12/31/2014					
Year of a call	**Number of accepted requests registered by IS**	**Capacity of applied funds**	**Number of contracts**	**Number of discarded projects**	**Capacity of accepted funds**
	809	370 800 234	229	578	100 624 779
Measure 3.1 (311) Diversification of non-agricultural activities – biogas plants only					
2008	9	11 966 342	7	2	8 967 582
2010	36	52 204 568	12	24	6 824 208

Source: RDP SR, 2007 - 2013

There were announced two calls for the measures mentioned above, in 2008 and 2010. However, there was not announced any call for this measure in 2011 – 2014. There were 229 projects, which were adopted cumulatively for this particular measure and during the whole period of this project by 12/31/2014. These projects cost 100 624 779 EUR of public funds. By the end of 2014, all 578 projects were discarded due to new legislation, insufficiency of funds for a given measure, lack of proof of annual revenues share from agricultural primary production to total revenues, and other. Absorption of 77 % was a result of 409 payments that represented 87 194 635 EUR during the whole period. However, 184 projects in the amount of 81 150 198 EUR ended by the end of 2014 (RDP SR, 2007 - 2013).

- **Slovakia – Rural Development Programme 2014 - 2020**

The National RDP of the Slovak Republic 2014 – 2020 was adopted by the Slovak Republic Government Decree No. 231/2014 from 05/14/2014. The RDP is mainly focused on the increase of competitiveness of agriculture and forestry sectors. Measures that support an increase of efficiency and share of RE use are a part of this programme. The support is realised as follows: (RDP SR, 2014 - 2020)

o *4.1 Measure: "Investment support for agricultural businesses"*

It includes investments that are related to biomass use, which was primarily produced by livestock production with a supplementary biomass function produced on agricultural land out of waste biomass types.

The fundamental support rate of total eligible expenditures: 50 % in the case of less developed region (except Bratislava Region), 40 % in the case of other regions (Bratislava Region). There were accepted four applications in the amount of 1 065 884 EUR in relation to this measure by 12/31/2015.

o *6.4 Measure: "Investment support for creation and development of non-agricultural activities"*

This measure includes investments for facilities' construction in order to use energy biomass that would generate electricity and heat by biogas combustion that was produced in the process of anaerobic fermentation; the maximum power of 500 kW is necessary to generate heating, while a certain part of the energy is connected to the network. The amount of support out of total eligible expenses for micro and small companies: 55 % in the Slovak Regions: PO, KE, BB, ZA and 45% in the Slovak Regions: TN, NR, TT, BA.

There were accepted four applications of non-repayable grant in the amount of 2 763 366 EUR within this measure call.

Tab. 2. Overview of project measures in SR 2014-2020 according to measures to 12/31/2015 [EUR].

	Measure	**4.1**	**6.4**
Accepted applications NFP registered in IS	Number	4	4
	Requested grant	1 065 884	2 763 366.16
	Limits (EU+SR = public expenses in total during 2014 - 2020)	10 000 000	5 000 000
	Limits (EU part 2014 - 2020)	7 420 360	3 706 550
	Approved projects	0	0
	Realized payments	0	0

Source: APA, 2015

Probably, late implementation of measures resulted in a low number of terminated projects (in this case, there are none of these projects).

- **Operational Programme Quality of Environment 2014 – 2020**
  Priority axis 4: Energy efficient low-carbon economy

The primary target during 2014 – 2020 is to implement such measures which would focus on a transition to a low-carbon economy by using RES and improving energy efficiency. The total budget from European Regional Development Fund for this purpose is 1 612 472 049 EUR (less developed regions of the SR) and 2 656 424 EUR (more developed regions of the SR) (OP QE 2014 -2020).

- *4.1 Measure: "Promoting the production and distribution of energy derived from renewable sources SR "*

A particular target of this measure is an increase electricity and heat generation from RES in Slovakia by supporting perspective and innovative technologies. This will contribute to achieving the planned share of RES in gross final energy consumption in the year 2020. Introducing these technologies will partially contribute to creating jobs and reducing CO_2 emissions.

Green for the Households

This new national project is supposed to meet 4.1 Measure. Green for the Households focuses on a support of small facilities' formation in order to use RE in households, such as family houses and apartment blocks. The main aim of this project is an increase of a share of RE use in the households and decrease of greenhouse gas emissions. The total sum of non-repayable grant for this project is 45 million EUR, while 8 418 935.46 EUR are the funds provided (SIEA, 2016).

Renewable energy production and distribution support

The primary aim of this project is to provide information about obtaining long-term financial resources for investment projects that build new and modernise already existing environmental infrastructure in Slovakia using repayable financial instruments, such as loans, capital injections and guarantees. The financial instruments should contribute to the sustainable and effective use of RE and thus providing appropriate conditions for all citizens in Slovakia. The budget is 5 882 353 EUR.

Case study – application of RE support schemes in a selected BGP in Slovakia

The principal aim of this case study is to analyse an impact of accepting the RE support schemes that are typical of Slovakia to provide efficiency of an investment project that focuses on BGP construction. The study aims at highlighting the importance of a support of such investment plans from state's side, or EU funds, as it represents a long-term financial burden, or simply investment projects, which are less attractive for business subjects. In Slovakia, BGP were built after 2009, when Act No. 309/2009 Coll. of RE was adopted. The number of BGP increased from 65 to 92 in 2012. It represents an increase of more than 70 %. The Slovak market was supporting investments into BGP till 2013, but in 2014, the development of BGP decreased.

Generally, there are 111 BGP connected to distribution network according to the data of the Regulatory Office for Network Industries to 06/30/2015 in Slovakia. It is more than it was last year, just by Four stations. Total power is on the level of 103 MW, and the planned annual generation of electricity is 810 526 MWh. Most of the BGP has usually power between 0.9 – 1.0 MW (RONI; Energie-portal.sk, 2015).

Evident increase in BGP and production was obvious in Europe by 18.00 % in comparison to 2013 (Figure 5). As it is stated in Biogas and Biomethane Report 2015, a report published by the European Biogas Association (EBA), there were 17 240 BGP, with a total installed capacity of 8 293 MW_{el}, in Europe at the end of 2014 (EBA, 2015).

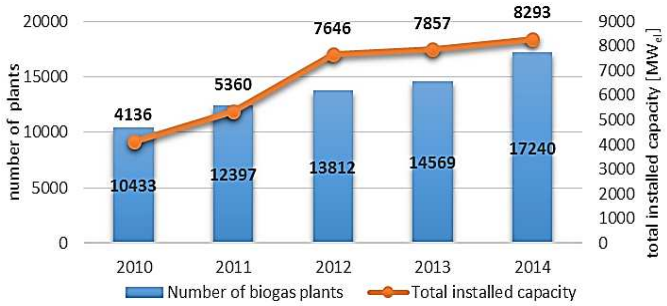

Fig. 5. Number of biogas plants and total installed capacity in Europe, 2010 – 2014. Source: EBA, 2015.

However, this increase was uneven in the whole of Europe. Some countries were not supporting biogas energy generation, and they even did not implement new mechanisms into operation, such as the Czech Republic, Hungary and Austria. On the other hand, there &re such European countries that increased their biogas market by implementing many new BGP (e.g. the UK, once the UK doubled the number of BGP; France and Belgium) (EBA, 2015).

One of the countries with the highest number of BPS are Germany, France and Italy. These countries are a clear example that the dynamics of the biogas market depends on the support schemes, in particular, the feed-in tariffs. For example, in 2013 Italy had the highest feed-in tariffs of all EU countries (Torrijos, 2015).

Database and applied methods

Analysed sample consists of financial data selected company in the period 2016 - 2029. These data are forecasted on the basis of previous trend and sources available. The analysed company operates since 2013, and its main activity is a production and preparation of livestock feeding stuff. In 2015, the company suffered a loss, but it was lower than in the previous years. Year-on-year revenues increase significantly contributed to loss decrease. The overall indebtedness of the company was in the amount of 110 % that year, but it is estimated that it will decrease in the next years. The favourable financial situation is expected in the following years.

In 2015, the analysed company invested into BGP construction which processes biomass and manure from agricultural and animal production in order to expand its activity. Biogas and digestate are the final products of this process. The primary reason of BGP construction is a sufficient amount of biological material and also an option to deliver electricity to the public distribution network. Similarly, there are few agricultural cooperatives that produce such raw materials that are inevitable for BGP operation.

Assumptions of the analysis

- Corporate tax rate is in the amount of 22 % (valid value of tax rate for 2015).
- The discount rate is in the amount of 4.8 % (represents a long-term interest rate, which finances this investment).
- The duration of the investment project is 14 years.
- The cash flow is calculated by indirect method as follows (Eq. 1):

$$CF_t = (R_t - C_t - D_t) * (1 - TC) + D_t - \Delta NWC_t; \quad (1)$$

Where:
R – revenues of company,
C – company costs,
D – depreciation,
TC – corporate tax rate,
ΔNWC – change in net working capital.

The analysis was performed by using the traditional methods of investment projects efficiency evaluation (static and dynamic methods) by means of which an eligibility of individual alternatives to a given investment project was evaluated. The applied static methods (e.g. average annual revenues, average payback period, average percentage return and simple payback period) are based on the costs and benefits data character, while calculating their average per the whole life period and disregarding time factor (Kislingerová et al., 2007). This method is frequently used in spite of many insufficiencies that may influence a strategic decision-making in terms of investing. Dynamic method (net present value, internal rate of return, profitability index, payback period) is also called as discounted-cash-flow (DCF). They remove the primary defect of static methods, and

they implement a discount rate into efficiency investment evaluation. This rate conveys time factor, money time values, liquidities and the levels of risk. Simplicity, clarity, applicability and simple results' interpretation represent advantages of these dynamic methods (Scholleova, 2009).

Five different situations may be illustrated on the basis of given:

1. Alternative – starting (real) situation – the company finances an investment project by a long-term loan that represents high-interest expenses.
2. Alternative – an investment project is financed out of own resources - the company is economically self-sufficient, and it does not have any interest expenses.
3. Alternative – an investment project is supported by EU grant (or state grant) within a program of RE support (structural EU funds). This grant presents 70 % - 30 % out of an initial investment. The project is exclusively financed by a given grant.
4. Alternative – an investment project is financed by a long-term loan and supported by tax allowance – the company does not pay corporation taxes during the first five years of a project lifetime.
5. Alternative – an investment project is supported by an increase of feed-in tariffs (increase by ¼ of the initial amount of feed-in tariff) that is guaranteed by a state for 15 years. It is also financed by a long-term loan.

Results and discussion

The results of the static and dynamic methods mentioned above that were applied to evaluate the investment projects' efficiency in the individual model situations are provided in Table 3.

Tab. 3. Overview of the individual investment alternative efficiency.

	1.	**2.**	**3. non-repayable grant (% of initial investment)**					**4.**	**5.**
Static methods	Real situation	Own financing	70 %	60 %	50 %	40 %	30 %	Tax holiday (5 years)	Feed-in tariff increase
Ø annual return	221 061	438 684	248 229	309 163	252 011	337 846	255 792	240 796	361 461
Ø payback period	7.78	3.92	2.08	2.22	3.41	3.05	4.70	7.14	4.76
Ø % return	12.86	25.52	48.13	44.96	29.32	32.76	21.26	14.01	21.03
Payback period	9.51	2.35	5.41	5.15	6.22	5.58	7.004	8.77	6.92
Dynamic methods									
NPV	182 155	2 890 210	1 713 323	2 137 243	1 407 441	2 074 646	1 101 559	418 043	1 589 868
IRR (%)	5.80	29.91	21.68	22.77	16.04	19.06	12.31	7.16	12.95
Profitability index	1.11	2.68	4.32	4.11	2.64	3.01	1.92	1.24	1.92
Real payback period	12.68	2.76	5.97	5.68	7.09	6.29	8.28	11.16	8.15

Source: own calculations according to available company's data.

In case a company invests into BGP construction, and it is financed by a long-term loan, while this company did not accept any RE support schemes, a real payback period of such a project is 12.68 years. Project lifetime is in this case estimated to at least 14 years. The IRR is higher than a level of a risk, and NPV is positive, i.e. an investment will give rise to company value. The project is acceptable in this scenario. However, in comparison to other investment alternatives, this initial (real) investment project is disadvantageous. All projects are acceptable from the point of the NPV view as the NPV value is higher than zero. The highest NPV is generated by the alternative that takes into consideration financing from own resources, then the alternative of a grant in the amount of 60 % out of the initial investment. The crucial criterion is a real payback period. Then the most suitable alternative is own financing on the basis of this criterion. In case this criterion is not taken into consideration (financially difficult investment and the investment from own resources is not possible), the lowest real payback period has an investment project supported by a grant in the amount of 60 % and 70 % out of the initial investment.

Tax holiday that is given to a company for five years has almost no influence on a given investment. Higher guaranteed feed-in tariffs have a greater positive effect on investment project efficiency as tax holiday alternative.

It may be stated that the most suitable alternative for the company is an investment project with its own financing. This statement is supported by provided analysis. However, it is still a model situation as these investments are long-term and represent a financial burden. The second most appropriate alternative is state grant accepted by the company or EU grant. The state and / or EU support schemes have a crucial significance in the RE and have a positive influence on investment efficiency – they shorten a real payback period for investment and give a rise of company value.

As previously mentioned, the development and utilisation of BGP installations in Slovakia were recorded only in the five-year period (from 2009-2014), and from 2014 there was a downturn. The reason is mainly

the lack of procedural settings of regulatory and support mechanisms that would increase support in the use of BGP. Important in this regard is the integrated regional energy planning, which would remove the regulation on the trans-regional level. Many governments do not have sufficient financial, human or technical capacity, causing incoordination of local energy and the related non-harmonized use of public and private funds. Effective planning in the energy sector requires the development of new strategies for the use of biomass to generate energy. These must be conceptually based on regional limits, on the evaluation of existing measures and the use of schemes financed from public funds to promote the energy use of biomass, etc. In this process evaluation mechanisms are also necessary which would consist of a platform system of qualitative and quantitative indicators enabling the monitoring of the results of the supported projects throughout their lifecycle in the context of the sustainability criteria, energy, climate, and regional environmental priorities. The quality of analytical outputs related to the evaluation mechanisms requires the creation of databases containing data related to biomass utilization in Slovakia, including information on available useful regional potential, concentration of important national, sectoral and subsectoral documents evaluation of existing support measures and the potential design of the new support schemes in line with the sustainability criteria, etc. Particular importance is played by an administrative process that should not be an obstacle in obtaining authorization for the establishment of technologies for RE, particularly for small-scale projects. It would also be useful to support research activities related to the disposal of waste from these processes.

Conclusion

Slovakia is among the countries with the negligible potential of RES. The usable biomass energy potential is up to 44% of all RES. The potential of biomass energy is mainly in the production of heat. Currently is only a quarter of usable biomass potential used. The Higher rate of utilisation might be possible by active application of existing technologies that are constrained by legislative, administrative and environmental criteria. In the EU, there are a lot of RES support mechanisms, depending on geographic location, natural landscape features and scope of support measures. Scheme of support of each Member State shall be determined individually, and various forms of support may be different in size and character. The problem is to determine the optimal level of support for RES, which gives rise to a clash of views of private investors and consumers. There are several schemes for the promotion of energy from renewable sources and the construction of new RE systems. An important role in using them is played by regions. Their task is to ensure the fundamental transformation of energy, efficient regulatory processes associated with the elimination of over-consumption, optimising the use of local RE sources, taking action in relation to respecting the limits of the environment so that the transformation of the energy in the long term remains sustainable. In Slovakia, there is very little attention devoted to the presented issue, whether in terms of scientific research, or even scientific studies. This consequent fact encouraged us to focus on the issue from the economic point of view, to prepare a research platform that would support research for subsequent Slovak teams. We reviewed the use of RES in Slovakia, as well as the processes and economics of support mechanisms allowing progress in the use of RES. Our international comparison pointed out to trends in the use of RES, as well as to still untapped potential for further exploitation and the need for development and implementation of other support mechanisms that would reflect the national and regional particularities of raw materials policy. Based on the specific example of a BGP in Slovakia we assessed the impact of support schemes for the effectiveness of investments related to its operation and made recommendations on the use of RE for the next period.

Slovakia is currently providing non-repayable financial contributions to support renewable sources of energy from the state budget and structural funds for the Rural Development Programme 2014 – 2020 and Operational Programme Environment Quality of 2014 – 2020. The most commonly used forms of support for renewable energy sources in Slovakia are a system of feed-in tariffs and financial stimulation, particularly grants.

For analytical data processing, a case study form has been selected. Specific indicators to evaluate the economic efficiency of the projects have been applied. As shown in the results of analyses, financial support mechanisms from the state or EU are major determinants in the development of BGP in Slovakia with a positive impact on important indicators of effectiveness. Aid in the form of feed-in tariffs will be a very motivating element in the future production of RE and construction of BGP because of the redemption of price by a regulatory authority for the following year. For this reason, it will be necessary to evaluate the existing support acts and to design new support schemes in order to ensure progress in the use of renewable energy sources. It is also necessary to appeal on the permanent monitoring of the cost-effectiveness of mechanisms to promote RES and translating the results into their regulatory and stabilising mechanisms. This is the only way to achieve the objectives of Target 2020.

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