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Comparative assessment of renewable energy development in Baltic States

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ABSTRACT

The paper analyses renewable energy development in Baltic States. Though Baltic States have to implement EU regulations and directives promoting renewable energy sources, the situation in terms of penetration of renewables are quite different. The paper applies comparative assessment approach and compares the trends of the main renewable energy indicators among Baltic States and discusses the main policies and measures implemented inn Baltic States to promote renewable energy sources. The policy recommendations were developed based on performed analysis.

INTRODUCTION

Promotion of renewable energy sources is the priority area of EU. The increased use of renewable energy sources allows to implement other interrelated EU policy goals: climate change mitigation, security of energy supply and increased of competitiveness of energy sector and EU economy. Five main aspects of the EU's energy policy can be singled out, which reinforce each other: Security, solidarity and trust; Fully integrated internal energy market; Energy efficiency; Climate change mitigation policy and Research and innovation. The EU aims to fulfill its obligations under the Paris Agreement and to remain a leader in the production of renewable energy and the implementation of scientific research and innovation. In addition, the EU supports the development of renewable energy technologies, thereby increasing its competitiveness in the global market. As one can see that renewable energy penetration allows to achieve energy decarbonization and is central among other energy union dimensions and targets (Rus et al., 2020; Istudor et al., 2021).

Examining the experience of EU countries in reading RES, it can be observed that the support schemes and their effectiveness differ greatly in the EU member states. Non-uniform support schemes are used, the applicability of which varies across EU countries (Jacobsen et al., 2014). It is also evident that the full potential of cooperation between countries to optimize individual national RES support schemes is not being used (Haar et al., 2017; Caldés et al., 2018; Von Blücher et al., 2020). Cooperation in the field of renewable energy means that a Member State can achieve its RES targets by supporting renewable energy projects in another country, and such cooperation would help to optimize the deployment of RES at the European level and allow for a much more efficient use of available natural resources and existing energy supply networks throughout the EU (Kiefer et al., 2021).

In the three Baltic countries, as the analysis of the scientific literature shows, there are quite similar conditions for the production of electricity from RES (based on natural resources), but there are also very large differences in the volumes of renewable energy production in these countries (Bobinaite & Priedite, 2015). In Latvia, the largest amount of energy is produced from RES, while in Lithuania and Estonia, the volume of this energy is half as much. This is due to many factors, but one of the most important is the different support schemes for the promotion of renewable energy sources.

Lithuania plans to increase the share of energy produced by renewable energy sources in the overall energy balance from 23% in 2020 to 45% in 2030 (International Energy Agency, 2021a), Latvia from 40% to 50% respectively (National Energy and Climate Plan of Latvia 2021–2030), Estonia from 25% to 42% (Estonia's 2030 National Energy and Climate Plan (NECP 2030), 2019). In this regard, the Baltic countries are among the EU states with the most ambitious plans.

The main problems related to the promotion of renewable energy sources and the successful development of renewable energy sources are associated with the relatively high cost of renewable energy in the payback period (only large hydropower plants can be considered an exception). The high cost is determined by the need for large initial investments. However, it is worth noting that after the payback period, renewable energy becomes competitive in the market and must therefore be encouraged.

The paper aims to analyse the use renewable energy sources in Baltic States and develops indicators framework to examine renewable energy penetration in Baltic States. The developed renewable energy indicators framework for comparative assessment of situations in selected countries was performed and case study was described. A system of renewable energy penetration indicators has been developed, which was used to conduct a case study in the Baltic countries. During the scientific research, the main problematic questions were raised, for which solutions were proposed. Recommendations have also been prepared, with the help of which it is possible to demolish emerging barriers that prevent the successful expansion of renewable energy in the Baltic countries.

The structure of the scientific article: the literature review is presented (first chapter), research methods and data are presented in the second chapter, the results of the case analysis are presented in the third chapter, and the conclusions and recommendations are presented at the end of the scientific article.

1. LITERATURE REVIEW

The European Union has set ambitious targets for climate change. In the context of the Energy and Climate Agenda 2030, the European Union currently has a target to reduce its net greenhouse gas emissions by at least 55% compared to 1990 levels (Crippa et al., 2021).

Regarding climate change, renewable energy sources and the possibilities of their wider use occupy the first place in discussions at any level (Moomaw et al., 2012; IRENA, 2019). This situation has arisen because the use of renewable energy sources makes it possible to obtain clean energy, the production process of which does not cause carbon dioxide and other greenhouse gas pollution. In this way, renewable energy sources directly contribute to mitigating climate change. (REN21, 2021). In order to mitigate climate change and achieve the Sustainable Development Goals, it is necessary to switch to the widespread use of renewable energy sources and to abandon fossil fuels. (Meletiou et al., 2019; Zickiene et al., 2022). The development of renewable energy sources has been hindered by their relatively high cost,

as clean technologies have always been more expensive in the market. However, new technologies in renewable energy are currently reducing costs and thus economies can more easily transition to fossil fuel-free development.

In the period 2005-2020, the part of electricity consumed from renewable sources in the EU-27 increased from 16% to 37%, which agrees to an average increase of 1.4 percentage points per year (European Environment Agency, 2021). In 2019, the part was 34%, and about half of all renewable electricity was produced from various sources (wind and solar energy) (European Environment Agency, 2021).

The EU Renewable Energy Directive (Directive (EU) 2018/2001) established a general framework for promoting the use of energy from renewable sources and set a mandatory goal - 32% of energy must be produced from renewable energy sources. This Directive also sets GHG emission reduction criteria for biofuels, liquid bioproducts and biomass and establishes financial support measures for the use of renewable energy.

In order to achieve the goal of energy efficiency in 2030 (at least 32.5%), it will be necessary to reduce energy consumption, especially if energy efficiency is combined with the reduction of GHG emissions by 55% by 2030. In this way, the average annual final energy consumption will have to decrease in all EU countries by at least 9 Mtne. (European Environment Agency, 2021). Meanwhile, in 2005-2020, the decrease was observed by 7 Mtne, including the effects of the Covid19 pandemic (European Environment Agency, 2021).

In November 2020, the European Commission published the Renewable Energy Progress Report, which indicated that the total share of renewable energy sources at the EU level had been growing steadily until 2018. In 2018, the share of renewable energy in the EU was 18.0% (EU-27 – 18.9%) (European Commission, 2020).

In 2015, the EU ratified the Paris Agreement, on the basis of which the goal was set to stop the global temperature rise below 2°C compared to the pre-industrial period. Such a goal envisages that by 2060, global carbon dioxide emissions from the energy sector should be equal to zero. Such an ambitious goal has a significant impact on European climate mitigation policy and energy development goals until 2030. Accelerating the use of RES can play a key role in achieving the targets (IRENA, 2018). Promoting the use of energy from renewable sources is one of the objectives of the EU energy policy. Greater use of renewable energy and energy conservation and greater energy efficiency are important measures to reduce greenhouse gas emissions and meet the 2015 Paris Agreement on climate change.

In November 2016, the European Commission presented the "Clean energy for all Europeans" package. The package, which aims to support the use of renewable energy, proposes a regulatory framework for the period 2020-2030 (European Commission, 2016; IRENA, 2018).

The mix of strategies needed to promote RES depends on the national characteristics of the country. Such as the country's political structure, available renewable resource potential, degree of market liberalization, infrastructure, etc. (Louizidis, 2018). The renewable energy policy of each country is structured in such a way that conditions are created for technological research and development and market development at the same time (Louizidis, 2018; Mazurek-Czarnecka et al., 2022).

In order to achieve individual RES targets, each EU member state uses different policy measures to promote RES. Most of these measures are focused on the energy sector, although heating and cooling and the transport sector play a very important role in the context of RES development. Implemented RES policy measures include regulation, fiscal incentives and public financing (Kügerl et al., 2021). The main and most commonly used renewable energy promotion mechanisms are:

– Subsidies for renewable energy resources. A government action that has a direct impact on the energy market is considered a subsidy. The impact is observed as the price of energy production decreases, the price of energy producers increases and the price paid by energy consumers decreases. Green subsidies are used to promote the development of renewable energy, which help to increase the efficiency of capital allocation in the energy sector (Taylor, 2021). Energy subsidies can take various forms: direct transfers of funds, preferential tax regimes, trade restrictions, provision of energy services directly through the government at less than full cost, regulation of the energy sector.

- Grants for renewable energy resources. Reimbursable grants are funds allocated by the state, which are "lent" without interest and the principal amount of the loan is not returned until the technologies are successfully used in practice (International Energy Agency, 2021b). These funds help to cover some of the costs incurred during the riskiest phase of the technological innovation process, and in some cases lead to investor confidence in the new technology. Reimbursable grants create prerequisites for venture capital to participate in the innovation development stage.
- Soft loans or concessional finance are obtained from government agencies in the later stage of technology development and pre-implementation of a RES project. Loans from banks are rarely available at these stages due to the high risk of technological development and low income potential. Soft loans are characterized by low interest rates and a long repayment schedule (Abu, 2021). Soft loans for RES projects are beneficial in many ways because the repayment period of soft loans is long, the interest rate of soft loans is zero or low, and the repayment period of soft loans can be expected.
- Buy-in tariffs apply in many countries. This is also known as a set price system, which is created by the governments of countries. They determine at what prices energy suppliers must purchase electricity produced from RES (Steward & Hardy, 2020). The green tariff market should be simple, transparent and reliable, especially since governments often reserve the right to monitor feed-in prices, taking into account declining costs and other factors.

The feed in tariff mechanism and the quota system have the greatest success (Resch et al., 2007). Using the first mechanism, higher purchase prices for renewable energy are set. In most cases, a so-called "bonus" is not applied, but a so-called "bonus", which gives renewable energy producers the opportunity to receive a significantly higher total income for the energy sold on the market.

According to the second mechanism, i.e. i.e. in the case of the green certificate system, the energy produced using RES is sold at market prices, but the additional costs are borne by suppliers and consumers, who must purchase a set quota of this energy defined in the green certificates. Trade in green certificates is organized under market conditions. Suppliers who do not purchase renewable energy pay corresponding fines (Stasiukynas, 2011; Streimikienė et al., 2007).

2. METHODS AND DATA

The main renewable energy indicators linked to renewable energy consumption in EU used in this comparative assessment of three countries are linked to three areas: the part of renewable energy in final energy consumption; fossil fuel substituted by renewable energy and GHG avoided emissions due to penetration of renewable energy.

Indicators defining the share of renewable energy in final energy consumption are the following:
- The overall share of renewable energy in gross final energy consumption;
- The share of renewable energy in electricity;
- The share of renewable energy in transport;
- The share of renewable energy in heating & cooling.

These indicators show trends in the use of renewable energy and how countries are achieving their goals in the areas of renewable energy use and development. It is also possible to observe how the countries implement Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

The data used for the calculation of indicators, which according to Regulation (EC) No. 1099/2008 on energy statistics, submitted to Eurostat by national administrations.

The proportion of fossil fuels replaced by the proportion of renewable energy sources is based on the EEA assessment. This assessment assumes that, since 2005, renewable energy sources have replaced an equivalent share of fossil fuels that would have produced the same amount of energy as renewable energy sources. The evaluated quantity of avoided fossil fuels is represented as part of gross inland consumption (total gross inland consumption minus renewables). The method for the estimation of fossil

fuels substituted by renewable energy is defined in detail in the EEA report Renewable energy in Europe — approximated recent growth and knock-on effects.

Replacing fossil fuels with renewable energy sources reduces GHG emissions. Thus, the avoided emissions indicator evaluates the amount of emissions that can be avoided by replacing fossil fuels with a share of renewable energy. The evaluated GHG emissions avoided due to renewables are represented as share of total GHG emissions (with international aviation, without LULUCF). The method for the estimation of the avoided GHG emissions is described in detail in the EEA report Renewable energy in Europe — approximated recent growth and knock-on effects.

Therefore, for comparative assessment of renewable energy in Baltic States case study 6 indicators trends will be compared in three countries by applying graphical analysis and the policies and measures to promote renewable energy in these countries were discussed to define reasons of differences in renewable energy penetration.

3. CASE STUDY

The following section of paper analyses dynamics of renewable energy penetration in Baltic states. In Figure 1 the dynamics of the overall share of renewable energy consumption in final energy is provided for Baltic States during

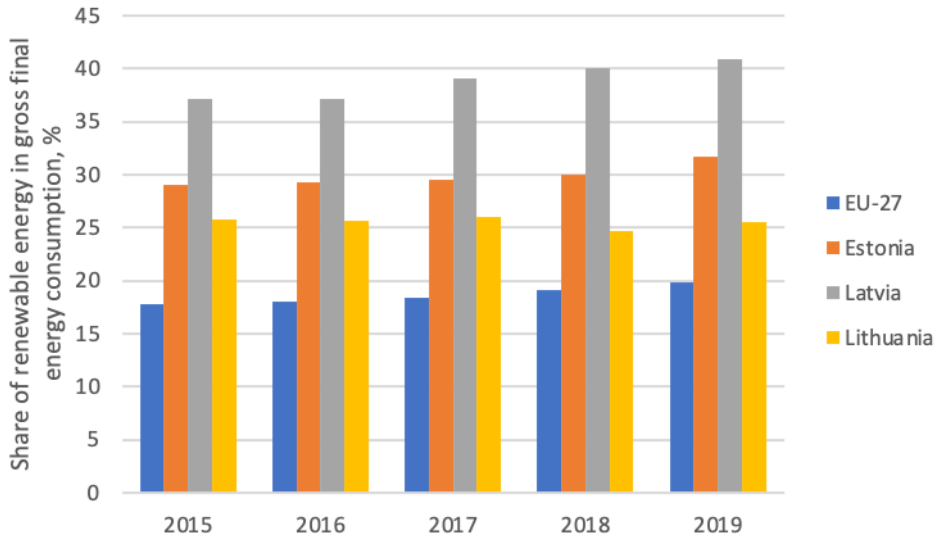

Figure 1. Dynamics of overall share of renewable energy in gross final energy consumption during 2014-2019.

Source: Authors prepared according: ec.europa.eu/Eurostat

Also, one can see from Figure 1, Lithuania has the lowest share of renewable energy in gross final energy consumption though it was by 30% higher than EU-27 average during all investigated period. Latvia has one of the highest parts of renewable energy in gross final energy consumption (more than twice higher than EU-27 level) among EU member states due to favourable geographical conditions linked to the high share of hydro in electricity generation.

In Figure 2 the dynamics of the share of renewable energy in transport in Baltic States during 2014-2019 is provided.

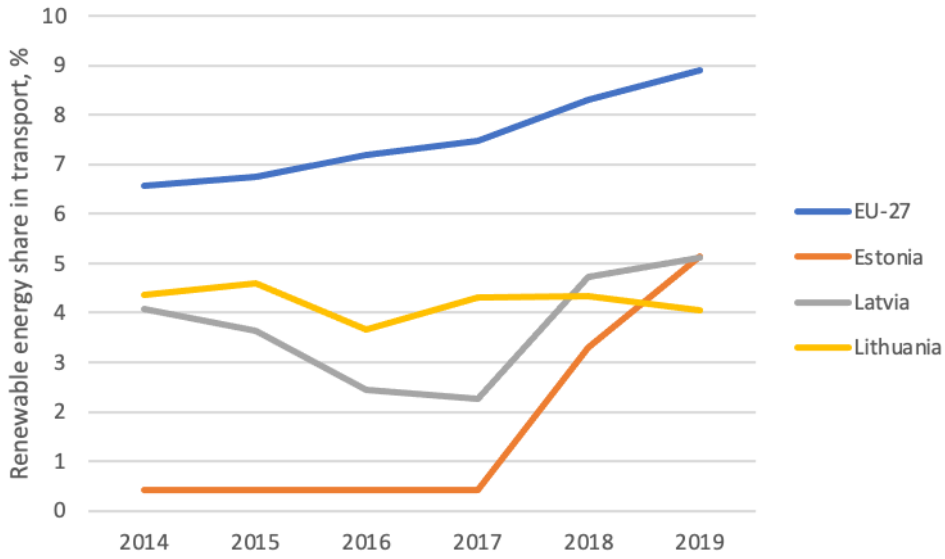

Figure 2. Dynamics of the share of renewable energy in transport in Baltic States during 2014-2019

Source: Authors prepared according: ec.europa.eu/energy/data-analysis

One can notice from Figure 2 that Lithuania has the lowest share of renewable energy in transport in comparison with other Baltic States. In addition, though in Latvia and Estonia the share of renewable energy in transport is growing since 2017 in Lithuania it is slightly declining. The policies and measures in transport sector should be strengthened in Lithuania. Also, the share of renewable energy in transport in Lithuania was more than 2 halves of EU-27 average and 20% lower than Latvian and Estonian level.

In Figure 3 the dynamics of the share of renewable energy in electricity in Baltic States during 2014-2019 is plotted.

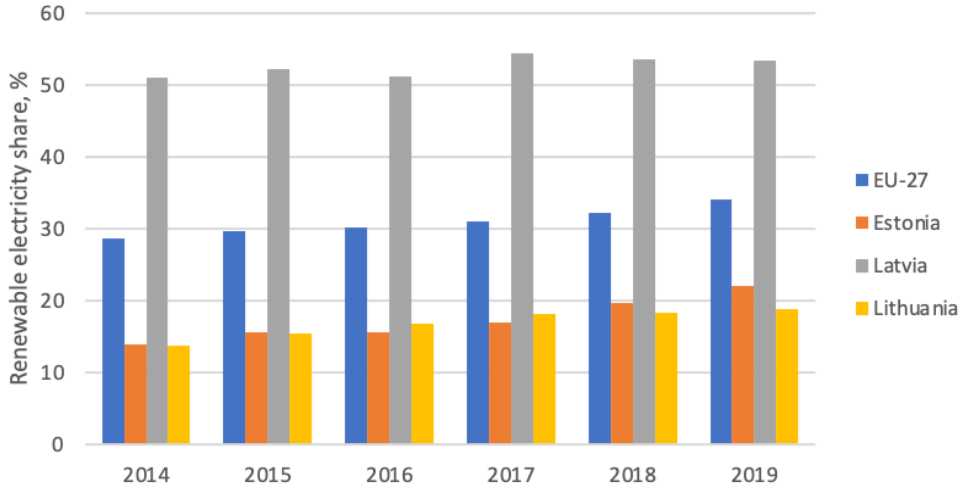

Figure 3. Dynamics of the share of renewable energy in electricity in Baltic States during 2014-2019

Source: Authors prepared according: ec.europa.eu/energy/data-analysis

Also ne can notice the share of renewable energy in electricity was the lowest among Baltic States since 2017. Latvia distinguishes with the highest share of renewable energy in electricity generation from all Baltic States due to large share of hydro dominating in electricity generation. The share of renewable energy in electricity generation in Latvia was 1.5 higher than EU-27 average during all investigated period though in Latvia and Lithuania the share of renewable energy in electricity generation was almost twice

lower than EU-27 average during analysed period. As the share of renewable energy in electricity sector was growing in all analysed countries, it was slightly declining since 2018 in Lithuania.

In Figure 4 the dynamics of the share of renewable energy in heating and cooling in Baltic States during 2014-2019 is provided.

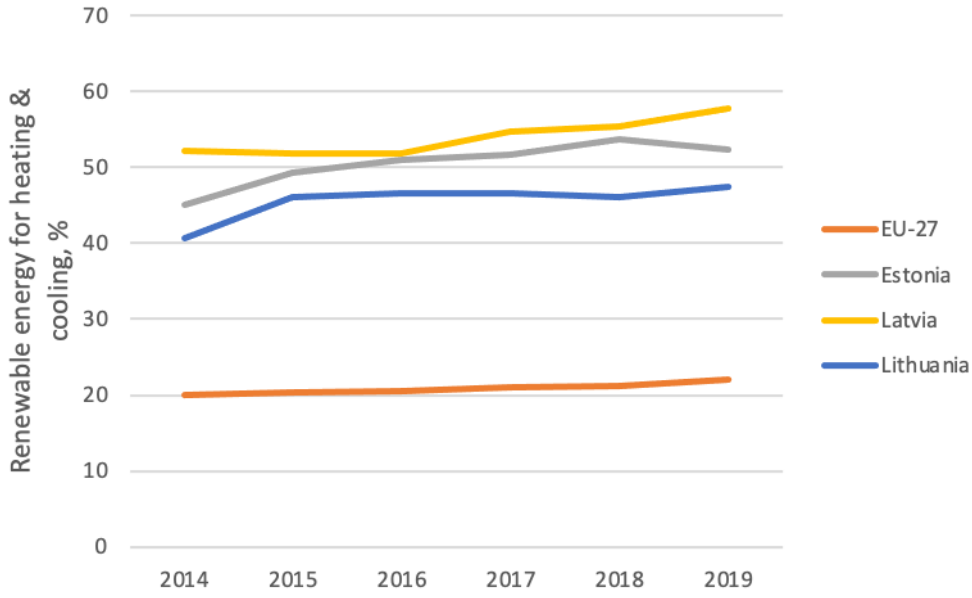

Figure 4. Dynamics of the share of renewable energy in heating and cooling in Baltic States during 2014-2019

Source: Authors prepared according: ec.europa.eu/energy/data-analysis

The share of renewable energy in heating and cooling was the lowest during investigated period again in Lithuania though in comparison with EU-27 average the share of renewable energy in heating and cooling in Baltic States was at least twice higher than EU average during investigated period.

In Figure 5 the dynamics of fossil fuel avoidance due to renewable energy Baltic States during 2014-2019 was provided.

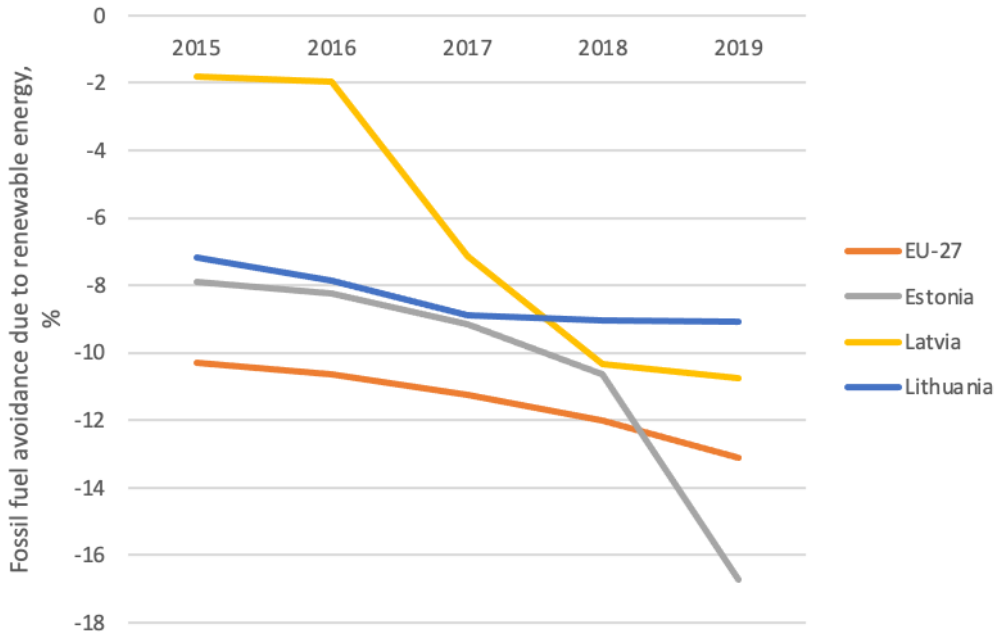

Figure 5. Dynamics of fossil fuel avoidance due to renewable energy Baltic States during 2014-2019, % (2005=0.0%)

Source: Authors prepared according: ec.europa.eu/energy/data-analysis

Estonia has achieved the highest avoidance of fossil fuel due to renewable energy penetration since 2005 following Latvia. Lithuania has achieved the lowest fossil fuel avoidance during investigated period.

In Figure 6 the dynamics of GHG avoidance due to renewable energy Baltic States during 2014-2019 is given.

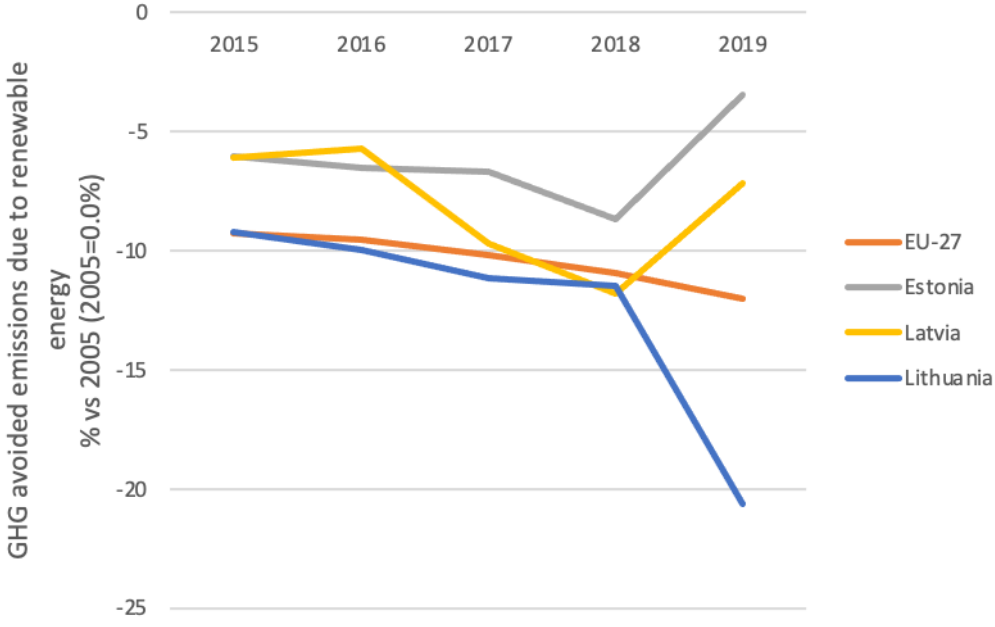

Figure 6. Dynamics of GHG avoidance due to renewable energy Baltic States during 2014-2019, % (2005=0.0%)

Source: Authors prepared according: ec.europa.eu/energy/data-analysis

As one can notice form Figure 6, the highest GHG emission avoidance due to penetration of renewables since 2005 was chieved by Lithuania following by Latvia.

The main implemented policies to promote renewables in transport in Lithuania are Mandatory blending of biofuels into mineral fuels implemented since 2011 and excise duty allowances for biofuels implemented in since 2010. Lithuania has provided policy measures that will help to successfully expand new sources of renewable energy in 2020 - 2030. The main measures are:

- Support for operating costs of generation II biodiesel through mandatory blending;
- Support for financing generation II bioethanol production facilities;
- Investment support for biomethane plant facilities,
- Support for the purchase of public, utility or other commercial vehicles fuelled by compressed natural and/or biomethane gas and
- Support for obligation imposed on operators of natural gas stations, supplying gas for direct consumption in transport.

The existing policies to support renewable energy penetration in electricity sector in Lithuania are: Support scheme for electricity produced from RES; Financial support scheme for energy producers. In this case, EU support and support for cogeneration power plants that use local and renewable energy resources can be used. In Lithuania, preference is given to big cities - Vilnius and Kaunas.

The main foreseen policies and measures to promote renewables in electricity sector in Lithuania in 2020-2030 are: A financial support scheme that targets small power plants; RES development in the Baltic Sea; Industrial deployment of renewable energy sources; The EU supports the use of renewable energy in public and residential buildings; Financing of energy generation from RES and storage solutions, including prosumers; RES communities (EU support) and Integration of RES into transmission and distribution networks.

Though foreseen policies and measures to promote renewable energy in Lithuania corresponds to EU policies and measures developed to promote renewables it is clear from conducted analysis that Lithuanian policies targeting renewables should be strengthened by taking example from Estonia and Latvia. Estonia is good example as country does not have favourable geographical conditions to develop hydro or other renewable energy sources like in the case of Latvia. Estonia has achieved fast penetration of biofuels in transport and fast penetration of wind and solar renewable energy in electricity and cooling and heating sectors due to well-targeted policies and measures in these sectors. For example, there are a number of investment support schemes available to promote the development, installation and use of RES installations in Estonia. In general, the financial support to renewable energy during period 2014-2020 was more than € 490 million. In Estonia since 2016 the introduction of a blending mandate was initiated and the share of biocomponents in petrol and diesel fuel gradually have risen to at least 10% by 2020.

In Latvia, a complex system of promoting the use of renewable energy is used. In this system, energy purchase tariffs are applied, which include a quota system and a tender system. Such a complex system was recognized as quite effective. Meanwhile, in the transport sector, in order to promote the use of renewable energy, the obligation to sell gasoline and diesel mixed with biofuels is being promoted in Latvia. A tax regulatory mechanism is also in place.

CONCLUSIONS

Lithuania distinguishes between Baltic States with the lowest renewable energy penetration indicators. Lithuania has the lowest share of renewable energy in gross final energy consumption and the Latvia has one of the highest shares of renewable energy in gross final energy consumption among EU member states due to favourable geographical conditions and high share of hydro in electricity generation.

Lithuania has the lowest share of renewable energy in transport, electricity and cooling and district heating comparison with other Baltic States. In addition, though in Latvia and Estonia the share of renewable energy in transport, electricity and heating and cooling was steadily growing since 2017 in Lithuania all main renewable energy indicators slightly declining. The most alarming situation was noticed in transport as the share of renewable energy in transport in Lithuania was twice lower than EU-27 average.

Latvia distinguishes with the highest share of renewable energy in electricity generation and in cooling and heating sectors from all Baltic States due to large share of hydro dominating in gross final energy consumption. In Estonia and Lithuania, the share of renewable energy in electricity generation was almost twice lower than EU-27 average during analysed period. In addition, this indicator was declining since 2018 in Lithuania.

Estonia has achieved the highest avoidance of fossil fuel due to renewable energy penetration since 2005 following Latvia however Lithuania has achieved the highest GHG emission avoidance due to penetration of renewables since 2005.

The policies to promote renewable energy penetration in transport need to be strengthened in all Baltic States. Specific attention should be placed for policies and measures to promote renewable energy sources in Lithuania as negative trends of the main renewable energy indicators decline can be noticed in Lithuania. The successful policies and measures to promote biofuels in transport implemented in Estonia and Latvia like through obligation to sell petrol and diesel blended with biofuels should be implemented in Lithuania as well as financial support to renewable energy project based on good practice of Estonia.

REFERENCES

Abu, N., Pervin, S., Alam, Md. (2021), "Financing Renewable Energy Sector (RES) Innovations". 10.1007/978-3-319-95864-4_43. In book: *Affordable and Clean Energy*, pp.645-654, DOI: 10.1007/978-3-319-95864-4_43.

Bobinaite, V. Priedite, I. (2015), "RES-E Support Policies in the Baltic States: Development Aspect (Part I)", *Latvian Journal of Physics and Technical Sciences*, Vol. 52, 10.1515/lpts-2015-0001. DOI: 10.1515/lpts-2015-0001.

Caldés N., Rodriguez I., Lechon Y., del Río P. (2018), "Analysis of the barriers to the use of the cooperation mechanisms for renewable energy in the EU", *Deliverable 4.1, MUSTEC project*, CIEMAT, Madrid.

Crippa, M. et al. (2021), "GHG emissions of all world countries - 2021 Report", *EUR 30831 EN, Publications Office of the European Union*, Luxembourg, 2021, doi:10.2760/173513, JRC126363.

Directive (EU) 2018/2001 of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (2018), *Official Journal of the European Union*, https://eur-lex. europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN (accessed 14 July 2022).

Estonia's 2030 National Energy and Climate Plan (NECP 2030) (2019), *Estonia's Communication to the European Commission under Article 3(1) of Regulation (EU) No 2012/2018*, https://ec.europa.eu/energy/sites/ener/files/documents/ee_final_necp_main_en.pdf (accessed 14 July 2022).

European Commission (2016), *Clean Energy for all Europeans* [COM (2016) 860], European Commission, Brussels, https://ec.europa.eu/energy/sites/ener/files/documents/com_860_final.pdf (accessed 14 July 2022).

European Commission (2020), *Renewable Energy Progress Report*. Brussels, 14.10.2020 COM (2020) 952 final https://ec.europa.eu/energy/sites/ener/files/renewable_energy_progress_report_com_2020_952.pdf (accessed 14 July 2022).

European Environment Agency (2021), "Trends and projections in Europe 2021", *EEA Report*, No. 13. https://www.eea.europa.eu/publications/trends-and-projections-in-europe-2021/file (accessed 14 July 2022).

Haar, L., Haar, L. (2017), "An Option Analysis of the European Union Renewable Energy Support Mechanisms", *Economics of Energy & Environmental Policy*, No. 6. 10.5547/2160-5890.6.1.lhaa.

International Energy Agency (2021a), "Lithuania 2021", *Energy Policy Review*, https://iea.blob.core.windows.net/assets/4d014034-0f94-409d-bb8f-193e17a81d77/Lithuania_2021_ Energy_Policy_Review.pdf (accessed 14 July 2022).

International Energy Agency (2021b), *Renewables 2021. Analysis and forecast to 2026*, https://iea.blob.core.windows.net/assets/5ae32253-7409-4f9a-a91d-1493ffb9777a/Renewables2021-Analysisandforecastto2026.pdf (accessed 14 July 2022)

IRENA (2018), *Renewable Energy Prospects for the European Union. Based on REmap analysis conducted by the International Renewable Energy Agency in co-operation with the European Commission*, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2018/Feb/IRENA_REmap_EU_2018.pdf (accessed 14 July 2022).

IRENA (2019), "Climate Change and Renewable Energy: National policies and the role of communities, cities and regions", *Report to the G20 Climate Sustainability Working Group CSWG*, International Renewable Energy Agency, Abu Dhabi.

Istudor, N., Dinu, V., Nitescu, D.C. (2021), "Influence Factors of Green Energy on EU Trade", *Transformations in Business & Economics*, Vol. 20, No. 2 (53), pp. 116-130.

Jacobsen, H., Pade, L-L., Schröder, S., Kitzing, L. (2014), "Cooperation Mechanisms To Achieve EU Renewable Targets", *Renewable Energy*, No. 63, pp. 345-352. 10.1016/j.renene.2013.09.035.

Kiefer, C. P., Caldés, N., Del Río P. (2021), "Will dispatchability be a main driver to the European Union cooperation mechanisms for concentrated solar power?". E*nergy Sources, Part B: Economics, Planning, and Policy*, DOI: 10.1080/15567249.2021.1885526.

Kügerl, M-T., Tost, M., Leoben, M. (2021), *Renewable Energy Sector Roadmap for Responsible Sourcing of Raw Materials until 2050*, https://re-sourcing.eu/files/final_res_roadmap_2021.pdf (accessed 14 July 2022).

Louizidis, S. (2018), *Recommendations for support of electricity production from RES. INOGATE*. http://www.inogate.org/documents/RES%20support.pdf (accessed 14 July 2022).

Mazurek-Czarnecka, A., Rosiek, K., Salamaga, M., Wasowicz, K., Zaba-Nieroda, R. (2022), "Study on Support Mechanisms for Renewable Energy Sources in Poland", *Energies*, Vol. 15, 4196. https://doi.org/10.3390/en15124196.

Meletiou, A., Grace, M., Darbi, M., Pham-Truffert, M., Locher-Krause, K., Rueff, H. (2019), *EU renewable energy policies, global biodiversity, and the UN SDGs*, http://www.eklipse-mechanism.eu/apps/Eklipse_data/website/EU-RenewableEnergyReport_Final-28062019.pdf (accessed 14 July 2022).

Moomaw, W. et al. (2012), "Renewable Energy and Climate Change" In book: *IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation*, pp. 161 – 207, Chapter: 1, Cambridge University Press.

National Energy and Climate Plan of Latvia 2021–2030, https://ec.europa.eu/energy/sites/ener/files/documents/ec_courtesy_translation_lv_necp.pdf (accessed 14 July 2022).

REN21 (2021), *Renewables 2021 Global Status Report*, Paris: REN21 Secretariat).

Resch, G., Ragwitz, M., Held, A., Faber, T., Haas, R. (2007), "Feed-in Tariffs and Quotas for Renewable Energy in Europe", *CESifo DICE Report*, No. 5, pp. 26-32.

Rus, A.V., Rovinaru, M.D., Pirvu, M., Bako, E.D., Rovinaru, F.I. (2020), "Renewable Energy Generation and Consumption Across 2030 – Analysis and Forecast of Required Growth in Generation Capacity", *Transformations in Business & Economics*, Vol. 19, No. 2B (50B), pp. 746-766.

Stasiukynas, A. (2011), "Analysis of promotion of measures for the use of renewable energy sources in electricity sector", *Works of Young Scientists*, Vol. 1, No. 20, pp. 55-62.

Steward, T., Hardy J. (2020), „Renewable Energy Tariffs: The Problem of Greenwashing", *Policy paper*. https://www.goodenergy.co.uk/media/18782/the-problem-of-greenwashing-october-2020.pdf (accessed 14 July 2022).

Streimikienė D., Ciegis R., Jankauskas V. (2007), *Sustainable energy development*, Vilnius University Publishing House, Vilnius.

Taylor, M. (2020), *Energy subsidies: Evolution in the global energy transformation to 2050*, International Renewable Energy Agency, Abu Dhabi.

Von Blücher, F., Gephart, M., Wigand, F., Resch, G. (2020), *The new renewable energy financing mechanism of the EU in practice. A cooperation case study*, http://aures2project.eu/wp-content/uploads/2020/11/AURES_II_D6_3_EU.pdf (accessed 14 July 2022)

Zickiene, A., Morkunas, M., Volkov, A., Balezentis, T., Streimikiene, D., Siksnelyte-Butkiene, I. (2022), "Sustainable Energy Development and Climate Change Mitigation at the Local Level through the Lens of Renewable Energy: Evidence from Lithuanian Case Study". *Energie*s, Vol. 15, 980. https://doi.org/10.3390/ en15030980.