

Global trends in renewable energy development

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Abstract—The paper deals with modern trends in global renewable energy development. Despite the fact that nowadays the dynamic deployment of renewable energy capacities is observed around the world, global energy market continues to be based on non-renewable energy resources. In the paper the drivers for global renewable energy market development and their impact on renewable energy plants construction are examined. The analysis has shown that the main driving forces for world renewable energy sector growth are policy factors, especially implementation of well-designed support mechanisms to promote energy production from renewables. As such support tools were mainly implemented in power sector, now it holds leading position, while insufficient implementation of motivational tools in transport, heating and cooling sectors slowed down their development. In addition, the main challenges, which inhibit increasing the competitiveness of renewable energy on the global energy market, are outlined.

Keywords — renewable energy, trends, policy, investment, global energy market.

I. INTRODUCTION

Modern trends in the world energy sector are characterized by the stable involvement of renewable energy resources in energy generation. The dynamic development of world renewable energy market is caused by a number of important problems, namely: increasing global demand for energy [1]; depletion of fossil fuels stocks [2]; dependence of most countries on the import energy resources [3]; negative impact of conventional energy on environment, etc. [4].

At present, stimulating the renewable energy development has become a common effort of world's countries. In 2018, 179 countries had goals to achieve an appropriate share of energy from renewable energy resources in the countries' energy mixes [5]. In addition, in 2018 many countries' government revised previously set renewable energy targets.

However, despite the fact that new revised targets became more ambitious in scope, targets for energy transformation across the economy remain insignificant. Thus, as of the end of 2018 only about 10 countries had overall economic goals for at least 50% renewable energy and only Denmark has a target for 100% renewables in total final energy consumption [5].

Nowadays only a few countries in the world have achieved significant success in developing renewable energy, where its share has exceeded the 50% barrier [5], while in most countries non-renewable energy recourse continue to dominate in energy markets.

The purpose of the study is to investigate the main factors, which influence renewable energy development, their impact on deployment of generating capacities and main barriers that slow down global renewable energy sector growth.

II. DRIVERS FOR RENEWABLE ENERGY GROWTH

At present, renewable energy development depends on a number of factors, among which [6, 7]:

- geographical factors (renewable energy potential: level of solar radiation, wind speed, etc.);
- economic factors (level of country's economic development; cost of generating traditional energy; subsidies for extraction of fossil fuels, etc.);
- policy factors (long term strategies for renewable energy sector development; setting indicative targets to increase the renewable energy share in country's energy mix; introduction of policy mechanisms aimed at stimulating energy production from renewables; commitments under international treaties to reduce greenhouse gas emissions, etc.);
- technological factors (the level of renewable energy technologies development, technical condition of electric grids, research and development capabilities, etc.);
- social factors (awareness of energy consumers regarding economic, social and environmental benefits of renewable energy; willingness of energy consumers to pay a higher price for energy from renewable energy resources, etc.).

It should be noted that nowadays among the above listed factors the greatest impact on the renewable energy development policy factors have. It caused the fact that today cost of energy production from renewables significantly exceeds the cost of energy production from fossil fuels. Therefore, at present "green" energy cannot compete freely with traditional technologies of energy generation. As a result, the successful development of renewable energy depends directly on state support, in particular the implementation of well-designed mechanisms aimed at motivating green energy generation and consumption.

Nowadays different countries around the world use various support schemes to foster renewable energy development. The most well-known among them include:

- the feed-in tariff is a special tariff to purchase energy generated from renewable energy sources. The feed-in tariff implies a long-term contract under which state purchases "green" energy, generated during a certain period, in order to guarantee the return of investment and obtaining profit by investors. The feed-in tariff is the most frequently used tool to promote renewable energy in the world. As of the end of 2018 this tool is used by 111 states or provinces around the world [6]. Its adaptation to energy markets of different countries

caused the emergence of its various modifications: fixed feed-in tariff, adjusting feed-in tariff, front-end loaded feed-in tariff, the feed-in premium etc. [8, 9, 10];

- the renewable portfolio standard implies imposing mandatory quotas to provide generation of certain share of electricity from renewable energy sources. Quotas can be imposed on any participants of the energy market (consumers, producers or suppliers). Under this mechanism, producers sell electricity at the market price of conventional electricity. Additional generation costs are covered by the sale of green certificates. Green certificate is a commercial product that represents the ecological value of green electricity and confirms the generation of a certain amount of electricity from renewable energy resources. The funds from these two components should provide the necessary revenue to cover the electricity generation cost and getting profit (it is used in the USA, Denmark, Norway, Australia, Poland, Romania, etc.) [11, 12];
- the net metering is a support tool for households' electricity consumers who own renewable power capacities. It implies the installation of two-sided meters that allows to measure the electricity flowing both in the forward and in the opposite direction. The net-metering system is a good incentive for private households to install renewable power facilities, as it guarantees them that electricity excess will be sold to the grid at retail price. At the end of the billing period, the consumer pays only for the difference between consumed and supplied electricity (it is used in the USA, Italy, Denmark, Cyprus, Greece, Japan, Singapore, etc.) [13];
- the tender schemes imply the announcement of the tender for the construction of renewable energy plants. The authority lists the desirable characteristics for renewable energy facilities (installed capacity, specific timing of implementation, environmental impact, etc.) after which potential investors participate in the competitive process, providing the most advantageous proposals. The winner of the tender receives partial state financial compensation for investment project implementation (it is used in Belgium, Hungary, Israel, Slovenia, Spain, the United Kingdom, etc.) [14];
- tax and customs initiatives in most cases relate to full or partial exemptions from the payment of income tax, value added tax and customs duties for equipment and components used for renewable energy plants construction (it is used in Austria, Canada, Ukraine, the Czech Republic, Switzerland, etc.) [14, 15].

It is worth noting that creating an effective policy for renewable energy markets is a complex process. At present, there is no perfect support scheme to guarantee successful deployment of renewable energy capacities. Therefore, most of the countries around the world use several mechanisms simultaneously.

Despite the fact that based on renewable energy resources it is possible to generate electricity, produce heat and fuel for motor vehicles, leading sector in implementation of state support measures is power one (fig. 1).

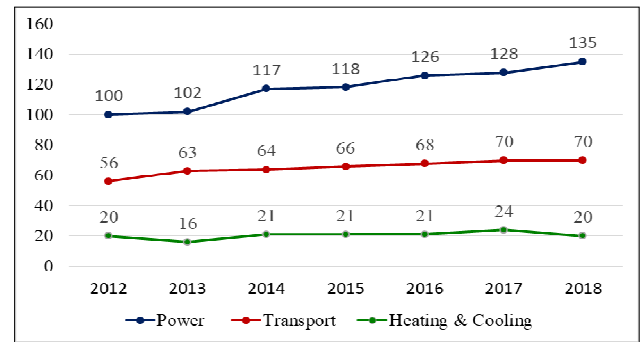


Fig. 1 – A number of countries with renewable energy policy by sector 2012–2018 [5]

Thus, according to the fig. 1, as of the end of 2018 135 countries around the world have introduced special incentive mechanisms in power sector, while such mechanisms in the transport sector were introduced by 70 countries, in the heating and cooling sectors only by 20 ones. As a result, at present renewable power sector is the most developed among other sectors.

III. TRENDS IN GLOBAL RENEWABLE ENERGY MARKET DEVELOPMENT

The introduction of motivational mechanisms in the countries' renewable energy sectors greatly increased its investment attractiveness. The dynamics of global investment flows in global renewable energy sector is shown in fig. 2.

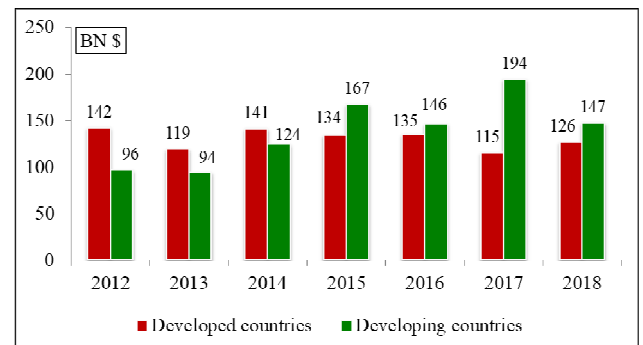


Fig. 2 – Global investments in renewable energy, 2007–2018 [16]

Thus, global investment in renewable energy sector in 2018 amounted to 273 billion US dollars, down by 11.7% compared to 2017. The main reason for these trends was the reduction of costs for the implementation of investment projects in solar energy sector and changes in China's photovoltaic market. In 2018, the Chinese government faced with the problem of financing the feed-in tariff. As a result, it was decided to limit a number of new solar power plants that would be eligible for the feed-in tariff. This has led to a significant decline in solar investment in China, with the second-half total for 2018 estimated at \$ 15.4 billion, compared to \$ 22.4 billion in the first half of 2018, and \$ 35.3 billion in the second half of 2017 [16].

In the structure of the most attractive renewable energy sectors for investments in 2018, the leading positions were held by solar and wind power sectors. They accounted for 48.9% and 47.2% of the total new investments respectively. Other sectors remained far behind [16].

China became the leader in investing in the renewable energy industry in 2018, having invested \$ 88.5 billion. It is followed by the United States – \$ 42.8 billion, Japan – \$ 17.6 billion, Australia – \$ 9.2 billion, and the United Kingdom – \$ 8.8 billion [16].

It should be noted that over the past years the investments of developing countries in renewable energy sector have been exceeding the amount of financial resources invested by developed countries. This is primarily due to a sharp increase in electricity demand in developing countries, in particular in such countries as China and India.

In general, total investment in global renewable energy plants in 2018 far exceeded investment flows in new energy capacities based on fossil fuels and nuclear power plants (fig.3).

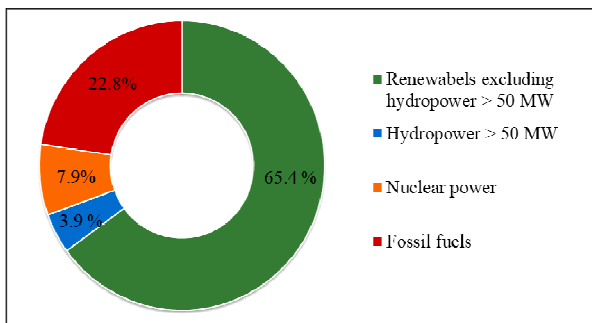


Fig. 3 – Global investment in new power capacities by types in 2018, % [5]

The introduction of economic mechanisms and significant investments in the “green” energy sector in recent years has contributed to considerable increase in the number of generating capacities and their capacity. In should be noted that the largest contribution renewable energy sources have been made to the electricity sector (fig.4).

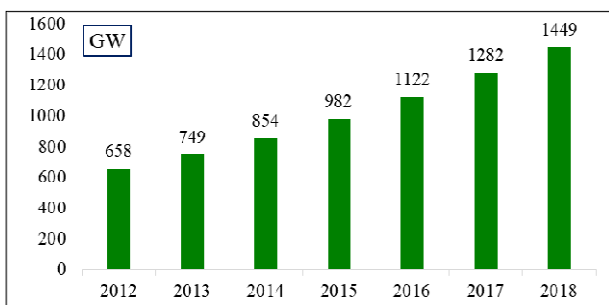


Fig. 4 – Total installed capacity of renewable energy power plants in 2012-2018, GW [16]

Thus, as of the end of 2018, the total installed capacity of renewable power facilities reached almost 1.45 TW, having doubled compared to 2013.

It is worth noting that the increase in renewable energy generating capacities in 2018 took place regardless of the decrease in investment flows into the sector, which was made possible, first of all, due to the reduction in the cost of some

renewable energy technologies, especially wind turbines and photovoltaic panels.

The active commissioning of new renewable energy facilities continues to influence the change in the global structure of electricity generation (fig. 5).

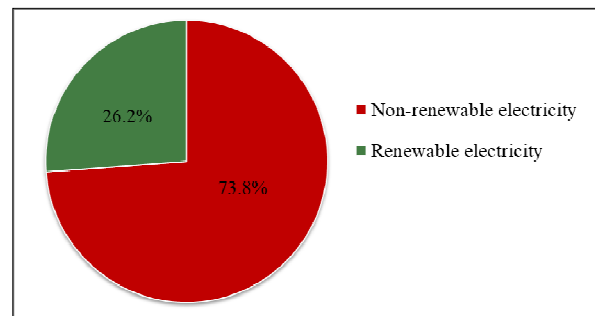


Fig. 5 – Share of electricity from renewable energy resources in global electricity mix in 2018, % [5]

So, at the end of 2018, renewable energy resources provided 26.2% of the world’s electricity generation. The largest share belonged to hydropower plants – 15.8 %, the second position was held by wind power plants – 5.5 %, the third solar power plants – 2.4 %, contribution of other renewables was insignificant.

The Top-10 world leaders in electricity consumption from renewable energy recourses include Canada, Sweden, Denmark, Portugal, Chile, Germany, Spain, Italy, Ireland and the United Kingdom (fig. 6).

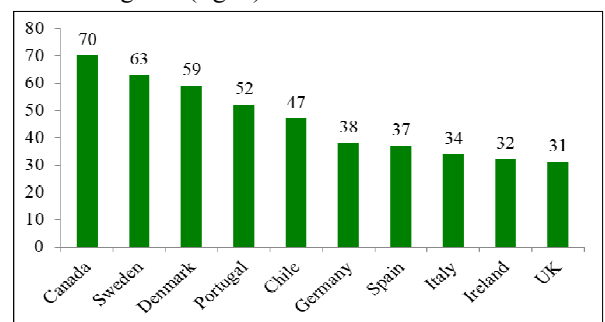


Fig. 6 – Top-10 countries in electricity consumption from renewable energy recourses as of the end of 2018, % [17]

At the same time renewable energy covered only 8% of global heat demand, while global demand for heat energy is approximately half of the final energy consumption. Energy demand for heating is still largely based on fossil fuels and provides nearly 40% of global CO₂ emissions [5].

Share of renewable energy in transport sector amounted to 3.3% of which 3% was liquid biofuels and 0.3% – renewable electricity [5].

It should be noted that the development of the renewable industry has a positive impact on the world labour market. Thus, in 2018, the total number of jobs in the renewable energy sector amounted to 11 million. The largest employer was the solar energy sector, where 3.6 million people worked in 2018 [5].

So, it can be concluded that nowadays global renewable market is actively developing. However, conventional energy is still playing a huge role in covering global energy demand.

At present, there are a lot of challenges for intensive development of renewable energy capacities, the main of which are considered in the next section.

IV. CHALLENGES FOR GLOBAL ENERGY SECTOR DEVELOPMENT

The main challenges for competitiveness of renewable energy in the global energy market are:

- the need for substantial investments for implementation of projects in renewable energy field. Many low-income countries are unable to disseminate renewable energy technologies and create the conditions for development of domestic ones. Higher level of economic development directly affects the renewable energy growth, since the typically offers more public and private financial resources [18];
- subsidizing fossil fuels energy consumption. Nowadays, governments in many countries continue to use energy subsidies to help poor energy consumers. Thus, in 2018, the amount of global subsidies for fossil fuels consumption amounted to \$ 400 billion that is significantly higher than the amount of investment in renewable energy [19];
- insufficient awareness of the population regarding the advantages of renewable energy, which is caused by the lack of appropriate informational and education policy regarding clarification about advantages and the need for financial support of renewable energy [20].

So, development of renewable energy faces with a lot of economic, political, technological and social barriers, which must be minimized to accelerate this sector development.

CONCLUSION

In recent years, a wide range of strategies have been implemented by countries around the world to foster the renewable energy development. Effective implementation of support mechanisms, setting indicative targets for increasing the share of renewables in the countries' energy mixes have been the key to the rapid deployment of "green" energy facilities. The study has shown that sectors with insufficient governmental support make a small contribution to increasing the share of renewables in the global final energy consumption. Therefore, it can be concluded that, at present, only consistent state support can be a guarantee of large-scale deployment of renewable energy capacities, which in long-term perspective will bring significant social and environmental benefits for the global community.

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