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## Article

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# The Formation of the Contemporary Renewable Energy Sector and its Role in the Industry Development

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## ABSTRACT

Currently, renewable energy (RE) is one of the core issues brought up monthly on the global market. The created green energy policy and support of the most advanced countries are aimed at its development. State-of-the-art technology, necessary scope of knowledge, and optimal conditions for using renewable sources of energy altogether are the factors for focusing on the development of the industry. The core purpose of the research was to reveal facts of the current formation of the RE sector. As a result of the research, we found out that the RE sector is currently achieving its peak of popularity. The issue is of worldwide relevance, and the leading countries focus their efforts on supporting the industry, while municipalities extensively implement such facilities in large cities. RE resources are also used in such areas as the transportation, cooling, heating, and energy industry, and many others.

**Keywords:** Renewable energy, Biofuel, Municipal energy sector, Power generation

**JEL Classifications:** K3, Q42, Q48

## 1. INTRODUCTION

Renewable energy (RE) has proven to be efficient in numerous areas of the global industry; therefore, it makes sense to review each of them in detail and consider the vigorous growth of the sector during the recent years.

### 1.1. The Most Productive Year of RE Formation — 2017

2017 is rightfully considered the most productive period for the development of the RE sector due to a large total capacity of established facilities. However, there are new challenges beyond the energy sector. In 2017, it went through numerous changes, each of which is directly associated with RE resources (The Green Paper towards a European Strategy for the Security of Energy Supply CEC, Europa, 2006). These changes caused a drastic depreciation

of crude oil and signing contracts for the purchase of RE at the most affordable price. In addition, there was a significant growth in the energy accumulation demand, as well as a milestone event that took place in Paris and largely determined further prospects of the industry.

Today, one can safely state that RE is the prevalent power source that is able to provide the entire world with resources. This was supported by the consistently growing competition between facilities and technologies operated with RE resources, political benevolence, open funding market, and the need to turn the modern energy sector into an industry that would not harm the planet and the population. Thanks to it, new markets with distributed renewable power generation show a stable growth in developed countries (Buyanov, 2018).

Besides, 2017 was the year of the first agreement on the development of the RE sector. All global organizations and communities regarded the RE sector with favor and elaborated numerous legal and social documents aimed at regulating the RE sector and creating optimal conditions for its further development.

In addition, a great impact on the development of the RE sector had the adoption of the UN Convention regulating climate changes through introducing alternative power facilities and intensive replacement of conventional sources of energy. In the course of the event, 195 countries agreed on the need to eliminate the factors that can lead to a global warming. Many countries proclaimed their intention to implement a RE development policy and significantly increase its efficiency based on a preliminary strategy. The representatives of approximately 140 of 190 countries repeatedly mentioned the plan for the RE sector development and complete substitution of conventional energy sources that deplete the planet's resources and have a destructive impact on the planet (Zakharova, 2013).

For example, RE-based facilities with the total capacity of 140 GW were commissioned in the beginning of 2017, which is an unprecedented number for the recent years. Biofuel production also shows an impressive growth (Bakhtizina, 2015) against the background of continuous fluctuation of the prices for fossil energy sources, which was also affected by the political situation in many countries and financial crises in Europe.

### 1.2. Global Funding of the RE Sector

Global funding of the RE sector has reached an impressive level. The development of the sector keeps being regularly funded despite the US Dollar strengthening and a fall in prices for fossil energy sources over the recent period. For 6 years, the RE sector has been allocated by an order of magnitude more investments than the conventional energy sector (Renewable energy: Development through China, 2018).

Beside the rapidly increasing funding by private investors and corporations, there is a notable involvement of large banks that do not hesitate to support the sector development and invention of new facilities for RE generation. Thanks to international communities, green bonds have been introduced as a new investment instrument (REN21, 2018). The major organizations that establish and develop foundations started their integration into the large market of RE resource development. Despite the high risks, many investors enter the markets without a doubt in pursuit of high returns as well as the creation of optimal conditions for the successful transition of the Earth's population to using alternative energy sources (Buchnev, 2015).

### 1.3. Technology Improvement of the RE Sector

Along with the expansion of the investment activities, a stable process of the RE technology improvement was observed. Major research centers managed to achieve better efficiency and broaden the scope of application of intelligent networks along with an impressive breakthrough in the software field. In addition, energy accumulation also improved in the industry. Heat pumps are an advanced solution in the field of heating and cooling and their application scope grew considerably in 2017.

The number of direct and related jobs reached 8 million for this period. The biofuel production and solar energy sectors demonstrated the fastest growth in terms of employing professionals for building and maintaining facilities. Thanks to the development of water power plants, additional 1.5 million jobs were created. Remarkable is the great contribution of such countries as Brazil, India, China, and the USA in developing the RE sector and increasing its role in the world financial and energy markets (European Institute for Innovation and Technology. MSc RENE Master's in Renewable Energy, 2019).

The technical, economic, and market transformation of the RE sector is accelerating all over the world, involving an increasing number of countries in the energy race, which launch more facilities aiming to provide the planet with alternative energy. The year 2017 was the time of a technological breakthrough, when the sector came to the modern power market under favorable financial conditions (Likhachev, 2015).

## 2. RESEARCH METHODS

In this research, we used the following methods that allowed us to obtain the required information:

- Subject analysis;
- Synthesis of crucial information blocks and their combination;
- Comparison;
- Classification.

Each of these methods provided us with crucial data and allowed us to conduct a competent analysis based on such data.

## 3. RESEARCH RESULTS

### 3.1. RE in Electrical Energy Industry

The capacity of the electrical energy industry has risen most significantly, with every region demonstrating a stable growth in this field. Over 75% of newly commissioned facilities are wind and solar power generating plants, which is rightfully a record-breaking achievement. The rest 25% includes hydraulic and other power generating facilities. Experts note that the annual increment in the total capacity of RE facilities put in service exceeds that of any other conventional energy plants. It should be noted that the number of facilities commissioned by the end of 2017 was enough to provide 23% of the world population with energy, which is the most substantive fact of the RE sector formation (BP Statistical Review, 2015).

#### 3.1.1. Geothermal stations

The energy generated by geothermal stations and plants strongly competes with conventional energy sources and is favored by many countries and governments. Ground-based RE facilities are resilient to external factors and highly competitive. As shown by research in Africa and Latin America, the majority of the population massively abandon conventional energy and express their support for the RE sector formation (European Commission Guidance for the Design of Renewables Support Schemes, 2019).

### 3.1.2. *Small generating plants*

In 2017, giant generating stations owned by investors and major companies were used for the global-scale production of RE. However, a drastic growth in the use of small generating plants is being observed on the modern market. For example, Bangladesh is the largest market for independent production of solar energy. Countries that have just joined the energy race also experience a gradual propagation of small systems, including minor grids using RE. These grids ensure a complete coverage of most regions with alternative power.

### 3.1.3. *Industrial consumers, producing power*

Experts observe a significant growth in the number of European and North American industrial consumers, which produce power by themselves with RE facilities (Sheina and Pirozhnikova, 2016).

### 3.1.4. *Cooling and heating sector*

Nowadays, the share of RE is about 8% of the total ultimate consumption for cooling and heating buildings. The industry is gradually switching to using biomass as a source of energy, as well as consumes a small part of solar resources. At the same time, about 75% of the world consumption uses organic resources.

Despite the stable development of facilities and heat production based on RE sources, there was a drastic decline in demand in 2016 due to a drastic drop in the oil price. However, this trend was temporary and was not able to affect the future of RE (Worldwatch Report 182, 2017).

It is worth noting that governmental support of the cooling and heating sector is at a low level unlike other RE applications. In general, growing industries always accept major challenges (Krinitcki, 2011). Many experts note numerous signals around the world, which evidence the awareness of the population and politicians of the need to switch from conventional sources of power used for cooling and heating buildings.

### 3.1.5. *Solar energy*

In Europe, solar energy is rapidly being implemented in central heating systems. However, despite the strong interest of governments, investors, and major companies to RE, new cooling facilities are a rare phenomenon.

## 3.2. *RE in Transport Sector*

The share of RE makes more than 4% of the total fuel volume currently. Most often, the biofuel produced naturally is used. The year 2016 was marked by significant achievements, such as the rapid development of new markets, as well as application of RE-based fuel in aviation (Soloviev, 2016).

The sector of vehicles fueled by liquid natural gas keeps rapidly developing, creating a solid background for implementing biomethane in Europe. Invention of new technology and methods for producing energy for electric vehicles hold the leading positions in the current market. Every year, new car models are developed and old models are upgraded. These cars successfully cope with their tasks and use electric power only (Bessel et al., 2016). Worth noting is the fact that the RE technology keeps being used in building and maintaining charging stations for electric cars.

However, we should also mention the insufficient governmental support of the RE sector as related to the transport industry. They do not provide it with as much support as they do for the electric energy sector (Shklyaruk, 2015).

Despite this fact, we expect alternative energy to come into the spotlight as the fuel for vehicles. Taking into account the active efforts of major car manufacturers that launch the production of electric cars at a fast pace, the world should expect serious changes in the nearest future.

It should be mentioned that the majority of measures aimed at supporting the RE sector, which were approved in 2016, focused on the production and use of biofuel for vehicles. The RE source support is developing slowly in such areas as aviation and railroad transport.

By the end of 2016, the mandates for using biofuel were in effect only in 65 countries. The current political regulations feature support for the development of the biofuel of new generation. However, many support actions are aimed at using the alternative fuel of only the first generation.

The support for the trend of electric car production rendered by the leading countries should be mentioned. Every year, a large number of charging stations appears, the production scope increases, the technology of electric car production is improved, and the price for such cars reduces significantly (Chubais, 2019). Most importantly, the rapid implementation of artificial intelligence has laid a solid foundation for the government-level support for the development of the electric vehicle manufacturing industry.

## 3.3. *Support Measures in RE Field*

### 3.3.1. *Political acts in the field of RE*

By the end of 2016, the majority of the leading countries created and successfully implemented the policy of support and considerable development of the RE sector with administrative tools wielded by politicians. This subject was in the spotlight in the course of the climate summit that took place in France and mostly determined the future of RE in each industry.

In 2017, the number of countries that enacted and supported political acts in the field of RE rose significantly once again. More than 170 countries set themselves challenging goals with respect to the RE sector support. 145 of them are already successfully implementing the developed plans and strategies, as well as setting objectives at the municipal and national level (Kobets, 2017). Despite the rising number of political acts enacted in the advanced countries, many states have lowered their ambitions and interests, which can be due to the political situations and regular crises in them.

### 3.3.2. *Technological development of RE production*

The leading countries are focused on the technology of RE production. It particularly refers to solar and wind power, the production of which is rapidly developing in the European and North American countries (Report Progress towards Completing the Internal Energy Market, 2014). By the end of 2016, nearly 110



entities implemented systems of discounted rates at the municipal level, enabling to increase power generation by facilities and create optimal conditions for the industry development (Stroikov, 2018).

However, along with the technology development and introduction of new projects for the implementation of RE sources, it is expected that the adopted strategies will be supported by many countries, which have just entered the world market, as well as by the advanced countries in Europe and Asia (Buchnev, 2016).

### 3.3.3. *Tenders*

Tenders play a significant role in the formation of the RE sector today. Many countries have switched to discounted rates, as well as successfully regulate pricing in the power generating sector. By the end of 2017, more than 60 countries regularly opened tenders and preferably purchased energy at discounted rates. This trend is particularly peculiar of the EU countries, which have common interest and systematically support the RE sector development policy.

### 3.3.4. *Tax policies, allowances, and grants*

In addition, it is worth noting that the majority of countries have implemented a system of accurate estimate of power sales revenues. Important tools used for planning, developing, and supporting new projects are tax policies, allowances, and grants. Many countries successfully and comprehensively implement these efforts and are rapidly switching from conventional to RE resources. Taking these facts into account, we can state that the energy industry is currently switching to RE and receiving support from the leading countries, unions, and associations, which creates a perfect background for the development of new production technology, modern projects, and for their support.

During the period of the RE sector formation, 21 countries were granted special mandates for RE sector support in terms of cooling and heating. However, no other entities at the municipal and national levels expressed their intention to join it (Allayeva, 2018). Due to the slow development of the renewable power in this industry, the only tool for the potential capacity development are tax incentives.

### 3.3.5. *Packages of actions*

Support measures in this field have always been insufficient. The situation did not change even in 2016. The adopted strategies and political acts are related more to heating rather than cooling. They are specialized in using low-capacity solar-powered heating plants. The initiative is promoted through the introduction of a large number of solar-powered water-heating plants for heating commercial and private buildings.

Taking into account the prospects and existing measures for the RE sector development, only 47 countries have an effective package of actions for supporting the heating and cooling industry. The intentions of RE application in this segment were clearly set out in a document that includes the climatic obligations of the UN Convention (Averus, 2014).

### 3.3.6. *Support on the level of local city authorities*

Municipalities and large cities keep rapidly expanding their influence as the leaders of the global industrial shift to RE sources. The significant role of such authorities and local climate objectives have contributed to the integration of global technologies related to the RE applications. This fact was remarked at the Paris Convention and welcomed by many countries.

Large metropolises rely on joint regulatory measures, mandates of countries, and direct purchase of energy to support the RE sector at their maximum purchasing capacity.

In 2016, numerous large cities, including Graz and Amsterdam, assumed the obligations to develop the supply of heat energy based on renewable sources. Other cities (Banff and Capetown) took impressive actions to support the use of RE for electricity supply. As for the development of the car manufacturing industry, the national governments of countries, such as Vietnam, Kenya, and Mexico, are worth noting for having fulfilled the mandate for the share of biofuel in the aviation sector.

The drastic expansion of the trend has paid off. New members joined the international movement, such as Uralla, Byron, Oxford, San Diego, Rochester, and Vancouver. The number of participating large cities around the world keeps steadily growing, and the participants have assumed the obligations to develop and promote the industry worldwide.

Currently, the cities keep on taking supportive actions and work together to achieve their common goals. The development tools that have a significant impact on the future of the RE sector are implemented through a membership in highly rated partnerships (Mayors' Contract, as well as Mayors' Agreement) (Stroikov, 2017).

### 3.3.7. *The support at the national and municipal level*

The support at the national and municipal level greatly influences the future of the RE sector. New cities take the initiative, rapidly develop the industry, and use their mandates to apply it in numerous activities. Thanks to it, we expect a rapid transition of the humanity from conventional resources to RE sources, which will enable us to improve the quality of life and protect the planet from the devastating effect of the conventional resource extraction industry and pollution.

### 3.3.8. *Formation of the RE sector in Russia*

For the last 5 years, the modern RE sector in Russia has been firmly established as a standalone energy industry. As reasonably noted in the political assembly in St. Petersburg, a rapid transition of the energy sector to a multipolar structure of power generation and consumption is closely linked with various economic, social, and political processes. These include the excessive number of crises in the financial and economic situations of countries that resulted in nationwide threats and abandonment of the use of prospective single energy carriers. The trend of a rapid growth of population in the countries that were potential power consumers dictated the need to switch to alternative energy sources, which was the only right solution in the conditions of resource scarcity.

In the Russian Federation, the main role in the governance, development and improvement of the energy sector is given to the state, since the market, like any other element in economic activity, has its drawbacks — market failures. One of the determinant factors that require government regulation is the monopoly structure of the energy sector (Savchina et al., 2017).

In the Russian Federation, the prospects of the RE sector are very promising. Firstly, the country has sufficient resources and competent workforce for developing new projects and technology for generating and consuming alternative power. Secondly, its favorable geographical location makes it possible to use the majority of power generation methods, including sunlight, high and low tides, as well as air and water flows. This is why we expect rapid changes and intensive development of the RE sector in Russia in the nearest future.

#### 4. CONCLUSION

Unlike conventional areas, the RE sector features the uniqueness of energy sources, as it includes not only fixed-state resources, but also the resources that can replenish themselves or are limitless. Thanks to that, energy can be generated without harming the planet with the help of various natural processes, such as solar radiation, biomass, geothermal heat, air and water flows, as well as high and low tides of water bodies.

Originally, power was predominantly generated by transforming the energy from renewable sources, such as air and water flows, as well as wood stock and biomass. Every revolutionary technology, starting from steam engines, and then electric motors, boosted the transition to and application of other fuel-based power carriers. The share of hydrocarbons, including coal, kept increasing during a long period simultaneously with hydraulic resources. The situation did not change until there were significant changes in power generation, which boosted the transition from the conventional system of resource consumption to a combined one.

The growing negative impact on the environment and the state of the planet with expected unfavorable consequences contributed to a significant growth in the fields of alternative and green resource application, as well as to a rapid increase in the share of their actual application in all industrial areas. The structural changes in the balance of the world energy industry are also due to the integration of information and intellectual technology into many areas of economic activities, as well as the operation of major power generators and consumers.

In connection with the current trend of rapid development and use of RE sources, we can observe a significant growth of interest to RE in the construction industry. Nowadays, efficient solution for power-related and environmental requirements becomes the top priority obligation for the majority of business areas, in which RE can be used solely and conventional resources can be abandoned.

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