

RECENT TRENDS IN RENEWABLE ENERGY SECTOR OF EU

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Abstract

The energy efficiency issue attracts everybody's attention all over the world. It is strongly linked with the climate change problem, and a series of solutions and recommendations are offered and prepared to meet these challenges. Recent energy policies are aimed to achieve a gradual and successful transition from conventional energy sources to alternative ones. The main intention is to achieve energy efficiency alongside decreasing the impact of production on the environment. However, historical trends suggest that usually similar policies have been ostensible, as they have only caused an increase in the amount of total energy consumption, rather than to achieve the aforementioned aim. On the other hand, EU countries have addressed a number of approaches to grow renewable energy installations at the national level as well as addressing issues that have arisen during the deployment of renewable energy infrastructures in various nations.

Keywords: renewable energy, energy consumption, energy efficiency

JEL: Q20, Q42, Q49

Introduction

Nowadays, the way of generating energy has been addressed as an important topic, as there are two ways of producing energy, either by using conventional energy sources or renewables sources. The countries across the world have given a lot of attention to develop their energy generating facilities and harness the process of utilizing renewable energy sources. The increasing usage of renewable energy is considered to be one of major trends, since it is willing to satisfy requirements of greenhouse gas reduction and reduce dependency on fossil fuel resources. Besides, there have been individual strategies towards to the transition to renewables led by states, as well as strategies accepted by interested private companies.

On the other hand, states have addressed several ways to develop installation of renewables on national level, as well as tackling loopholes arising in the implementation of renewables' infrastructures in individual countries. EU countries try to achieve its own progress of being able to facilitate the usage of renewable energy sources, as well as trying to reduce greenhouse gas emissions. The analysis conducted within this paper may be able to change in forthcoming future due to consequences of political instability given Russia's hostility and occupation attempts towards Ukraine and instability in oil prices.

Methodology

Our personal motivation in choosing this topic was the actuality of energy-related issues and the occurrence of climate change. The aim of this paper is to examine the energy sector of EU and its

potential transition towards renewable energy. Another objective is to provide information regarding current energy situation in EU. Moreover, information regarding renewable energy sources is also given and the advantages and disadvantages of each current renewable energy are explicitly examined. Climate change is directly related to the usage of conventional energy resources in the majority of today's production sectors. Its hazardous and perilous impact is apparent, and our environment continues to be polluted every day. At present, most countries in the world aim to modify and improve their energy policies in order to tackle this global problem.

The methodological basis of this study is a desktop research based on secondary data and statistics. Initially, the theme for this research was established. Afterwards, we collected relevant data regarding the energy sector of EU from different sources to support the more objective conclusions. Data has been collected from official databases such as Eurostat. Afterwards, data is interpreted to reflect current EU trends and consequences of EU policies. Afterwards, based on the data analysis, conclusion will be derived to what extent EU has been successful in the implementation of its renewable energy policies.

Results and discussion

Climate change is one of the most actual problems that countries try to tackle. Throughout history, the change of the temperature was observed, and when this change was colossal, it had massive negative impacts on the environment:

- Massive melting of the ices in Nordic countries of EU
- The increase of water flooding
- The colossal damage to the forests and wildlife
- High risk of extinction of rare and unique species
- Higher sea surface temperature

The challenges rose to a very massive scale, which necessitated the collaborative action by the biggest international organizations. United Nations has adopted and ratified several measures to tackle climate change and energy challenges. The Sustainable Development Goals (SDGs), also known as the Global Goals, were adopted by all United Nations Member States in 2015 as a universal call to action to end poverty, protect the planet and ensure that all people enjoy peace and prosperity by 2030 (UN 2018). This is also the upgrade of the previous Millennium Development Goals (MDGs). In 2000, the United Nations adopted 8 MDGs to be achieved by 2015. It was an incredibly hard task, and not all the goals were realized. Therefore, the countries which participated in the 2015 United Nations General Assembly decided to adopt SDGs in order to continue to tackle global challenges. One of the main differences between MDGs and SDGs was an energy issue, as the previous concept specifically did not mention energy issues. However, the 7th goal among SDGs is about energy issues, as the UN intends to ensure access to affordable, sustainable, and modern energy for all countries. It is the quintessential issue that is included in the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change.

SDG7 is accompanied by five targets to be achieved by 2030: ensure universal access to affordable, reliable, and modern energy services (7.1); increase the share of renewable energy in the global

energy mix (7.2); double the global rate of improvement in energy efficiency (7.3); enhance international cooperation to facilitate access to clean energy research and technology (7.a), and promote investment in energy infrastructure and clean energy technology (7.b) (Nerini et al. 2018).

Climate change will damage the economies of the EU significantly. Health, forestry, agriculture sectors can be directly affected by this challenge. Flooding and an increase in the temperature of the water surface would cause forests to be diminished. Furthermore, agriculture is going to be damaged, as the problems with irrigation and soil quality will be enhanced. Moreover, there are risks regarding the delivery of health services and health infrastructure. Overall, in any case of no further action, the expected increase in the temperature is 3.5 C, climate damages can be up to 190 billion euros, which accounts for 1.8 % of welfare loss (European Commission 2018). Therefore, it was urgent to take action as a unity in order to stop climate change.

Kyoto Protocol is one of the biggest contracts which united most countries in the world in order to tackle climate change. This treaty is the extension of the 1992 United Nations Framework Convention on Climate Change. It was signed in 1997 in the Japanese city Kyoto. This protocol was effective from 2005 to 2012 (Hågen – Marselek, 2010). There have been 192 parties and 84 signatories in this protocol. The main aim was to reduce greenhouse gas emissions. Certainly, this treaty was not successful enough in order to achieve all the targets. Therefore, the signature of the new agreement was necessary, and most of the countries signed the Paris Climate Agreement.

Paris Agreement was another step to tackle the global climate challenge. It is considered the first-ever universally binding document regarding climate change. This agreement was signed in France's capital Paris in 2015, and it had become effective in 2016. Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change (UN 2015). The EU and its members are also among the approximately 190 signatories. Governments agreed on the following conditions:

- Preventing the increase in the global average temperature more than 2°C above pre-industrial levels as a long-term goal;
- To impede the increase to 1.5°C, hence this would cause a decrease in the risks and hazardous impacts of climate change;
- Decreasing the increase of global emissions as soon as possible, taking into account the longevity of this process for developing countries;
- To implement all possible and quickest solutions to achieve reductions in harmony with advanced science, so as to reach a balance between emissions and removals in the second half of the century.

Since the evolution of the European Steel and Coal Community, energy has been one of the key issues that core European Institutions always addressed. Furthermore, the Lisbon Treaty urges EU countries to act in solidarity when it comes to energy issues. Specifically, after the annexation of Crimea by Russia increased the potential energy security problem. At that time, former European Council president Tusk suggested that similar Euratom, a new organization is necessary within the EU to be responsible for purchasing gas on behalf of EU member states (Misik 2016). Thus, former European Commission President Jean-Claude Juncker reiterated Donald Tusk's preposition regarding the formulation of the Energy Union. As a result of it, the Energy Union was formulated in 2015. The main goal of the Energy Union is to achieve the energy efficiency target by diversifying the EU's energy sources, whereas achieving a fully integrated internal energy market policy. EU formally ratified this document on 5 October 2016. Energy Union has five dimensions in which energy policies are formulated on:

- Security, solidarity, and trust – achieving a sustainable and balanced energy mix and ensuring energy security by providing unity and cooperation between EU countries.
- A fully integrated internal energy market – facilitating the free flow of energy within the EU by eliminating all technical and regulatory barriers
- Energy efficiency – achieving energy efficiency and reducing dependence on energy imports, lower emissions, and stimulating jobs and growth
- Climate action, decarbonizing the economy – the EU is one of the most vocal supporters of the Paris Agreement, and it is eager to be the leader in the area of renewable energy
- Research, innovation, and competitiveness – encouraging breakthroughs in low-carbon and clean energy technologies by supporting research and innovation to instigate energy transition and improve competitiveness (European Commission 2020a).

Initial reports of Energy Union suggest that certain achievements were generated, as energy systems are being modernized, which positively affects the growth of the EU. Furthermore, the EU had increased its initial targets for energy efficiency and renewable sources to a larger scale. Moreover, during the Paris Climate Conference, the EU was able to speak in the name of all member states.

The Union is committed to developing a sustainable, competitive, secure, and decarbonized energy system. EU wants all the countries to follow a similar path and to make energy decisions in unison. The main purpose is to address energy and environmental challenges together, as separate efforts were not satisfactory enough. The Energy Union created the energy and climate policy framework for 2030 to establish ambitious Union commitments to further reduce greenhouse gas emissions by at least 40 % by 2030 when compared with 1990, to increase the proportion of consumption of renewable energy, and to make energy savings in accordance with Union level ambitions, improving the Union's energy security, competitiveness, and sustainability. Directive 2012/27/EU of the European Parliament and of the Council (1) as amended by Directive (EU) 2018/2002 of the European Parliament and of the Council (2), establishes an energy efficiency headline target of at least 32,5 % savings at Union level by 2030. Directive (EU) 2018/2001 of the European Parliament and of the Council (3) sets a binding target of at least 32 % energy from renewable sources at the Union level by 2030 (European Commission 2019a).

A European Union Green Paper from 2006 aimed not only to “complete the internal European gas and electricity markets, to create solidarity between member states in order to enhance a more sustainable, efficient and diverse energy mix and On-line Journal Modelling the New Europe Issue no. 22/2017 180 to create an integrated approach to tackle climate change” but also to “establish a strategic European energy technology plan and a coherent external energy policy” (Haghighi 2007; Bujdosó et al., 2016).

In terms of energy efficiency, the EU picked out its objectives to achieve. Their energy efficiency target is 20% by 2020 and 27% by 2030.

The long-term strategy of the EU is to be climate-neutral by 2050. This purpose is in line and complements the European Green Deal and Paris Agreement.

The increasing emergency regarding climate change makes all countries in the world to take several serious measures. However, this emergency requires actions that necessitate cooperation, collaboration, and responsibility among the countries. With the Paris agreement, the countries are heading in a good direction to address this global challenge together.

EU's energy mix has evolved over time. The accepted policies have accelerated the transition from conventional energy sources to renewables. Moreover, these policies are partially successful in controlling final energy consumption levels. The next figures demonstrate the current energy outlook in the EU.

This map demonstrates the final energy consumption levels of EU countries in 2018. Germany, France, and the UK were the countries that used the most energy in the whole EU, whereas Malta, Cyprus, and Estonia were the countries that used the least energy.

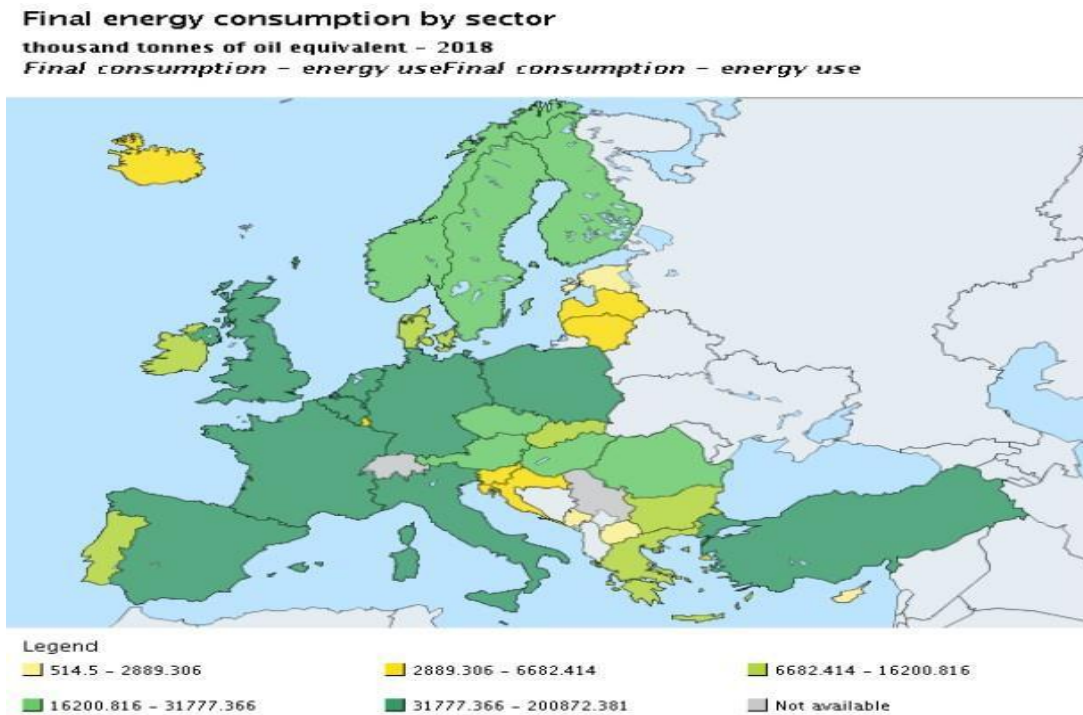


Figure 1. Final Energy Consumption by Sector in the EU

Source: Eurostat, 2020a (Author)

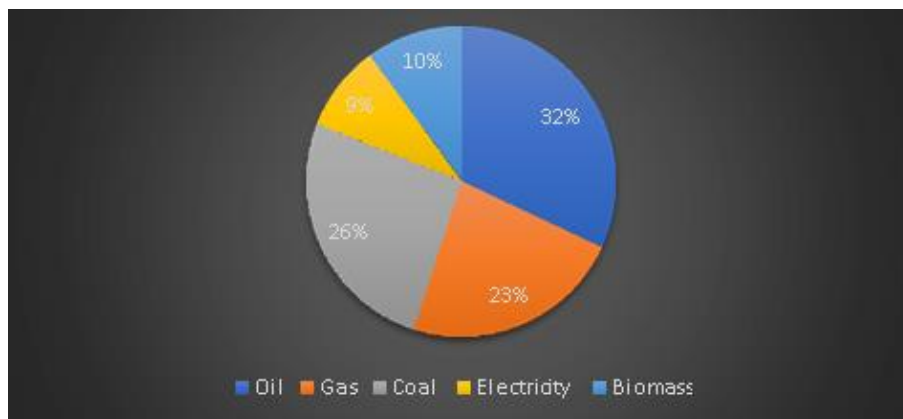


Figure 2. The breakdown of energy consumption by resources in 2018

Source: Eurostat, 2020b (Author)

In this graph, we are able to see the energy breakdown for 2018. Even though the trend suggests slight changes, still most of the used energy is oil, coal, and gas, like most of the 20th century. 32 % of the total energy was comprised of oil and 26 % of the energy from coal. Still, renewables comprise only a small part of total energy consumption, as the usage of biomass was only 10 %. Furthermore, the usage of electricity was the lowest among all energy sources.

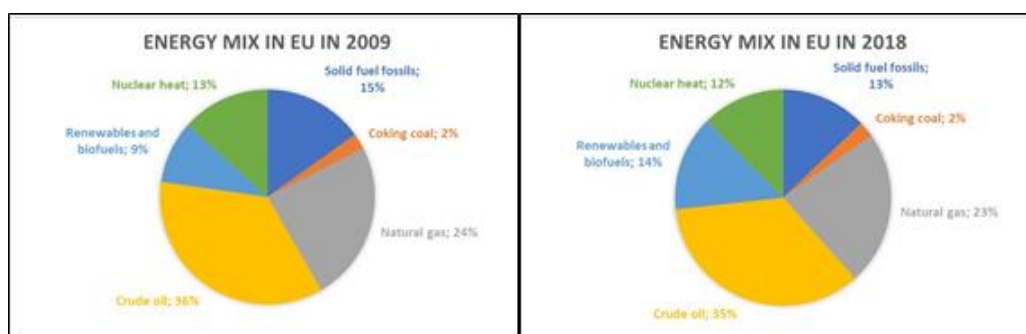


Figure 3. Energy Mix Levels in EU in 2009 and 2018

Source: Eurostat, 2020b (Author)

Here, we can see the situation of the energy mix in 2009 in the EU. Crude oil and natural gas together consisted of more than half of total energy consumption at that time. Renewables and biofuels comprised 9 % of total energy.

This pie chart demonstrates the consumption of the energy mix in 2018. Even though there are certain changes, there was not a dramatic difference in terms of the composition of energy sources. One of the biggest changes was in the increase of renewables and biofuels, as the proportion of this energy source has surged from 9 percent to 14 percent. This factor clearly indicates that the countries in the EU have already initiated the change from conventional energy sources to renewables. We can derive a conclusion that the proportion of renewables will continue to increase since the environmental challenges urge countries to accelerate this process.

According to the data, which is provided by the EU, we can witness the rising demand for importing energy from other countries. From 2000 to 2017, this number increased from 47 percent to 55 percent. In 2019, almost two-thirds of the extra-EU's crude oil imports came from Russia (28%), Nigeria (8.6%), Iraq (8.5 %), Kazakhstan (8.3%), and both Norway,

Saudi Arabia (both 7.1 %). A similar analysis shows that more than three-quarters of the EU's imports of natural gas came from Russia (44.7 %), Norway (21.3 %), and Algeria (12.1 %), while almost three-quarters of solid fuel (mostly coal) imports originated from Russia (42%), Colombia (18%) and United States (13 %) (Eurostat 2020c)⁷. These numbers are worrying since the EU depends on other countries' resources, and therefore, it is completely rational to make a transition towards the renewable energy resources which they can produce themselves.

Certainly, political events also have a great influence on this process. Particularly, several countries and multinational companies can use this energy dependency in order to generate political outcomes. For example, cartels, like OPEC, can yield a big influence in this matter. There was a major oil crisis in 1973 and 1974. OPEC just decided to put an embargo on several countries that supported Israel in the Yom Kippur war. The result was a shortage of the required product, and as a result of it, there was a 400 percent increase in the price of oil. Certainly, this event hurt Europe's economy significantly. Despite the fact that OPEC did not repeat this type of big-scaled measures, they continue to use their resource as blackmail to get political gains and yield influence.

Also, there is an energy security problem. Most oil and gas resources are in the Middle East region, which is in political turmoil for decades. There is instability in this region, and it becomes harder to sustain the security of the pipes in war-torn countries. Thus, switching to renewables will decrease the threat of energy security for the overall world. European Union relies on most of the imports of oil and gas from autocratic countries such as Russia and Persian Gulf countries. Therefore, the EU stands weak in world politics, such as their response to the annexation of Crimea by Russia was not adequate, and EU countries were aware that in any harsh response, their energy

resources could have been cut by Russia. Thus, they need to be a pacifist with those countries to import vital resources.

As EU legislators were already debating ambitious renewable energy requirements as part of the Fit for 55 package, the energy crisis derived from the invasion of Ukraine by Russia in February, 2022, struck. Energy security has become an even stronger reason to hasten the implementation of renewable energy after the invasion. By 2027, the REPowerEU proposal by the European Commission, which was unveiled in May 2022, aimed to reduce the EU's reliance on Russian fossil fuels. The plan, among other objectives, aims to surpass the 40% target previously under negotiation and raise the proportion of renewables in final energy consumption to 45% by 2030 (IEA, 2022).

In the EU, the capacity for renewable electricity is anticipated to treble between 2022 and 2027 as energy security concerns go hand in hand with climatic goals. Numerous European nations adopted or put forth action plans with even loftier goals, boosted government support for renewable energy sources, and tackled associated non-financial issues. The IEA's prognosis for EU growth has been dramatically revised upward (by over 30%) from its previous projection, with Germany and Spain leading the way with increases of 55% and 65%, respectively. Germany has lowered licensing times while increasing renewable electricity requirements, increasing auction volumes, and improving distributed solar PV compensation. For new renewable energy projects, Spain has expanded system capacity and streamlined permitting for solar PV and wind farms (IEA 2022).

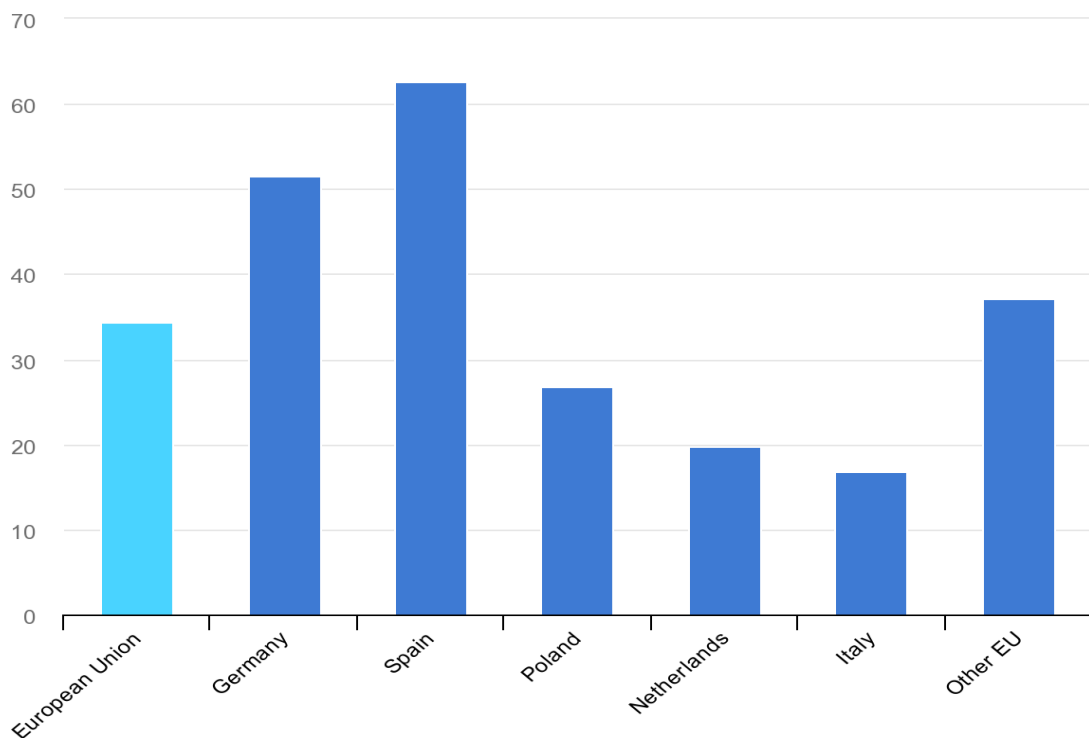


Figure 4. IEA renewable electricity capacity forecast revisions for the European Union and selected countries, December 2021 - December 2022

Source : IEA, 2022

The crisis between Russia and Ukraine has served as a stimulus for the European Union (EU), which is home to many of the biggest renewable energy companies in the world, to further its already notable renewable energy aspirations. A rise in energy consumption could allay some concerns about developers competing for contracts and promote sales growth for the utility sector and its supplier chain (Endowus 2022).

In recent decades, the share of nuclear energy started to increase. First of all, the establishment of nuclear energy plants in the 20th century decreased the reliance on the import of crude oil and gas. Basically, countries started to produce their energy themselves. Additionally, nuclear energy is currently one of the cheapest low CO₂-intensity technologies. It also increases the competitiveness of the European economy (Bencsik and Kovacs 2012; Chudy-Laskowska et al., 2020). Nuclear energy constituted 30% of total energy in 2008. However, it started to decrease after 2011. Due to the impact of the economic crisis, overall energy intensity slightly declined at that period. Furthermore, EU countries became aware of the risks and potential precarious impacts on the environment due to crashes (Svazas et al., 2022). The first historical crash happened in 1986 at the Chernobyl nuclear facility in the present Ukraine SSR, and its impacts still can be felt in that territory. Recently, the disaster of the Fukushima Daiichi nuclear facility (2011) in Japan had a tremendously hazardous and toxic impact on the country and, later on, the reputation of the whole industry. Thus, certain EU countries decided to rescind the usage of nuclear energy and switch to renewables as soon as they can. Germany had already decided to shut down all of its nuclear facilities. After ten years, the share of nuclear energy fell to 26 % (World Nuclear Association 2020).

The main purpose of the transition from conventional energy sources to renewables is the protection of the environment. Because of the usage of conventional energy sources, carbon emissions increase, and as a result of it, the pollution of the environment and nature happens. It instigates climate change, and now the average temperature is above two degrees than it was in the pre-Industrial period. As it is written in Paris agreement, one of the main targets is to decrease the temperature level by 1.5 degrees above the pre-Industrial level (UN 2015).

There are several types of renewable energy sources, and each of them has its advantages and disadvantages.

Solar energy comes from the sun. Sunlight is one of the free and abundant natural resources. If it is used effectively, it is possible to fulfill the whole demand of Earth with solely solar energy. Basically, it is about to conversion of sunlight into heat, electricity, or hot water. The most important advantage of solar energy is its endless quantity. However, the generation of solar energy is not stable, as the fall of sunshine can range based on geographical location, periodical factors in the seasons of the year, even within a day. During nights, it is impossible to get solar energy, and during the hot times, more solar energy can be generated than cold times. Furthermore, getting closer towards polar points in Earth, the possibility of getting solar energy decreases. Even though in the short-term, the costs of using solar energy are relatively higher, in the long-term, this transition will be beneficial for the corporate world as well.

Wind energy is another clean and abundant source. The wind itself is air in motion. It is related to the sun as well since the sun heats different places on Earth in different amounts. The lower pressure is formed by the expansion of hotter air. As a result, the wind is formed by the flow of air from the places which have higher pressure on the places where there is lower pressure. This flow of air is captured in wind turbines, and it is converted into electricity to be put into further use. Like solar energy, no places have an equal amount of wind. However, contrary to solar energy, it can be generated during the night. This energy also does not produce any carbon emissions into the air, and it is completely safe to be consumed.

Hydroelectric energy is another renewable energy source. It is one of the oldest and most commercial renewable energy sources. Dams are created in big water reservoirs, and electricity is produced due to water flows that go through the dam's turbines. One of the most important limitations is that some of the hydroelectric dams use more energy in producing and converting water flows into electricity. Therefore it is not efficient. However, it is completely clean, and with the evolution of technology to a more advanced level, this problem can be solved very soon. Interestingly, this energy is not the most popular one in Europe, as the biggest hydroelectric stations are situated in China, Brazil, USA.

Tidal energy is related to hydroelectric energy. But unlike hydroelectric energy, it is not constant. It uses twice-daily tidal currents to drive turbine generators. However, it is possible to predict the timescale of tidal currents, and it is also another safe energy resource that is environmentally friendly.

Another type of renewable energy is geothermal energy. This energy was created from radioactive decay naturally in Earth's crust when the Earth formed 4.5 billion years ago. Sometimes, this heat is exposed outside when geysers and volcanic eruptions happen. If steam is built nearby these tectonic plates, it can generate electricity by the heated water that is below the Earth's surface. It is generated by harnessing the energy from the heat below the Earth's surface. However, there are some limitations and challenges to produce this energy. First of all, the cost of building necessary and adequate infrastructure is high. Secondly, these facilities are vulnerable to possible earthquakes and other natural events in these tectonic places. Thirdly, not every country has suitable geographic locations where geothermal energy facilities can be constructed. For example, Iceland can rely extensively on geothermal energy due to the availability of geysers in the country, whereas the UK not, even though both countries are situated in the same region.

Biomass also can be used as a renewable energy source. Bioenergy can be generated by burning biomass and getting heat as energy. It is organic, and we can get biomass from plants and animals. For example, using wood to heat homes can be considered as a very common example. This is more environmental-friendly than conventional energy sources, but it exhales carbon-dioxide into the air, which is hazardous. However, during the regeneration of the plants, the same amount of carbon dioxide is consumed. Thus this amount is compensated in nature. However, there are challenges in getting this energy. Technology has not evolved to an adequate level yet in which biomass energy can completely substitute fossil fuels.

Table 1. The usage of each renewable energy source in EU (in megawatts)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Solar	17026	30712	54288	72968	82724	89186	97277	103341	109001	117011
Wind	75274	84358	94002	106177	117007	128705	141476	154123	168515	179062
Hydro	146630	147504	148882	149497	150618	150796	152988	154574	155256	155603
Tidal	218	220	219	225	231	235	232	239	242	244
Geothermal	727	761	776	785	797	839	839	841	848	862
Biomass	13382	14415	16032	16799	17104	18193	18798	19118	19942	22019
Total	253257	277970	314199	346451	368481	387954	411610	432236	453804	474801

Source: Eurostat, 2018 (Author)

This table demonstrates the electricity production capabilities of renewable energy sources for the EU. Even though there is only a slow increase in its production, hydro energy is the most productive energy source. Over a decade, wind and solar energy have also become very prolific, and they are now more available to be used. Tidal and geothermal energy is still difficult to be generated, as the level of technology is not at an advanced level. Overall, there was a surge in the production capabilities of renewables over a decade. 87,48 % increase is a quite success for EU's energy policies. Overall, the total amount of electricity production capabilities for renewable energy was 474801 megawatts in 2018.

Conclusion

Energy efficiency and achieving a successful transition from conventional energy sources to renewables are some of the most important aims of EU governance bodies. While achieving energy efficiency, they should be very careful in managing energy consumption levels.

Given the EU's strictness and stout decisiveness in achieving energy efficiency, in the short-term, some degree of energy efficiency would be achieved in the case of the energy transition. Even now, certain organizations suggest that the usage of renewables over conventional energy sources can generate energy efficiency. Furthermore, as the price for the construction of the dams decreases over the evolution of the technology, the usage of renewables over costly conventional energy sources would benefit nearly all stakeholders. Moreover, contrary to conventional energy sources, it is possible to produce renewable energies domestically and to sell the remaining, which the house owners do not need. Thus, other commercial enterprises will not be able to put high prices on energy since it can be produced by the customers themselves, and it will lead a fairer and more transparent competition. In the short-term, energy efficiency can be achieved with accurate and strict policy-making. In recent years, EU governance bodies' policies regarding energy consumption levels and energy efficiency have been partially successful, as slowly the transition happens, and energy consumption levels stayed stable.

It is quite complex to predict what will happen in the future regarding energy efficiency. However, it is also important to note that given the circumstances of economy, technology, and politics, the transition to renewable energy sources from conventional ones will certainly take some time.

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