Chapter

Introductory Chapter: Trends and General Information on Energy Policies in the World

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1. Introduction

This book is a comprehensive book of energy policies. It includes the technical meaning of energy as well as energy policies. In addition to the global scope of energy, it also explains what needs to be done in countries. In the studies, the works made in terms of energy from countries are also presented. Solutions for the energy problem that will continue to form the world of the future are also emphasized. It is obvious that the improvements to be made in energy can minimize the problems between countries in the future.

2. General evaluation of energy policies

Energy needs to be well described before referring to energy policies. Energy includes many phenomena as well as the ability to move. Force creates heat and its derivatives, as it forms the basis of energy. The basic phenomena that make up energy are the kinetic and potential energies as well as the internal energy of the system and/or matter. Energy is a fundamental concept that plays a role in the creation of the universe and planets. In fact, energy such as water energy is a needed resource and is a resource that humanity will always need.

Energy has been utilized in pre-ages, middle ages, and recent times. Humanity has faced many problems and wars in order to secure energy sources. These situations have continued for ages and still continue today. Primary energy resources are the leading ones, and the most important of these are oil, natural gas, and similar energy sources.

In this chapter, it is suggested to solve the energy crisis and problems in a neutral way. Before that, some studies should be mentioned in the literature.

Energy efficiency optimization processes need to be analyzed not only for countries but also for industries as well as for energy consumption [1].

Applications of thermodynamics and heat transfer principles from engineering knowledge are also essential for energy saving in industry processes, in finding energy and exergy efficiencies. Economic analysis should be applied for improvements in energy policy, energy and exergy efficiency results, and energy and exergy efficiency improvements based on existing and regulated scenarios [2].

Alternative energy options have become a serious source of energy due to depletion of fossil fuels. These energy resource options bring about important experimental and prototype studies in order to realize alternative energy and renewable energy systems [3].

It is also necessary to mention the energy economy of renewable energy sources. There are many different studies in the literature on energy economy. In addition to the economic analysis of a wind power plant, there have been some previous studies on the feasibility of wind power plants [4, 5]. The literature includes proton exchange membrane (PEM) fuel cell from other energy systems [6–8]. There is a study on solar energy, which is another renewable energy source, and there is a feasibility study that also includes techno-economic analysis of solar energy [9].

In addition, the implementation of the energy management program plays a meaningful role in achieving the target of energy policies to ensure efficiency in management of renewable energy sources [10]. When determining energy policies, countries should implement the energy management program in industries as a solution. In this way, countries save energy by controlling energy more efficiently and faster.

3. Overview of world energy and aspect of energy policy

Energy policies are now being developed on a long-term basis in developed and developing countries. Globally, the supply of energy to the world is becoming more challenging as the population increases. Countries develop many strategies and plans considering energy while developing strategies. Many countries are turning to alternative and renewable energy sources due to the exhaustion of primary energy sources as well as the emission of pollutants in the environment.

Regarding the power sector, renewable energy systems are growing in the energy sector. As of 2018, 188 GW were installed globally. However, the new power capacity increases have finally stabilized after years of growth. Global renewable energy systems have increased their power capacity to approximately 2378 GW, combining fuel and nuclear power systems. In 2018, more than 90 countries had installed at least 1 GW. Approximately 30 countries have exceeded 10-GW production capacity. Interest in wind and solar PV systems continues to grow and its share in mixed renewable energy systems is growing by approximately 20% in countries [11].

In the transportation sector, the use of renewable energy systems at a lower level is a handicap. Biofuels are popular among renewable energy sources and systems as well as the energy market for home and industry. In particular, interest in electric vehicles with no air pollutants has been increasing worldwide. In addition to the 63% increase in the number of global electric cars, electric bus fleets are gaining importance in cities [11].

In heating and cooling, procurement of energy systems related to renewable energy sources is slow due to energy policy problems. Due to integrated policy approaches, it increases the demands and purchases of energy efficiency in renewable energy sources with the help of advanced technologies [11].

Technological advances in renewable energy sources have seen that the power sector has grown further than the heating, cooling, and transport sector. The main reason for this is that the costs involved in conventional thermal production have become more advantageous compared to renewable energy sources and consequently the tendency toward the power sector increases.

In **Table 1**, indicators of renewable energy can be seen clearly. Renewable energy investment cost was 326 [$ billion] in 2017. In 2018, investment in renewable energy fell to 289 [$ billion] annually. The capacity of renewable power with hydropower existed 2,197 [GW] for 2017 year and 2,378 [GW] for 2018 year. The capacity of renewable power without hydropower became from 1,081 to 1,246 [GW] for a one year. The capacity of hydropower was 1,132 [GW], the capacity of wind power was 591 [GW], the capacity of solar energy with photovoltaic happened 505 [GW], the capacity of bioenergy power was 130 [GW] the capacity of geothermal power got

Investment of the renewable energy	**Cost of investment**	**Year 2017**	**Year 2018**
Annual renewable energy investment related to power	[$ billion]	326	289
Power obtained from the renewable energy	**Unit of power**	**Year 2017**	**Year 2018**
Capacity of obtaining renewable power with hydropower	[GW]	2197	2378
Capacity of obtaining renewable power without hydropower	[GW]	1081	1246
Capacity of hydropower	[GW]	1112	1132
Capacity of wind power	[GW]	540	591
Capacity of obtaining solar energy with photovoltaic devices	[GW]	405	505
Capacity of bioenergy power	[GW]	121	130
Capacity of geothermal power	[GW]	12.8	13.3
Capacity of concentrating solar thermal power	[GW]	4.9	5.5
Capacity of ocean power	[GW]	0.5	0.5
Capacity of bioelectricity generation annually	[TWh]	532	581
Heat of the renewable energy	**Unit of power**	**Year 2017**	**Year 2018**
Capacity of solar hot water	[GWth]	472	480
Transport of the renewable energy	**Unit of power**	**Year 2017**	**Year 2018**
Production of ethanol annually	Liters (billion)	104	112
Production of biodiesel (fatty acid methyl esters) annually		33	34
Production of biodiesel (hydrotreated vegetable oil) annually		6.2	7.0

Table 1.
Indicators of renewable energy in the world [11].

13.3 [GW], the capacity of concentrating solar thermal power became 5.5 [GW] and the capacity of ocean power was 0.5 [GW] in 2018. The capacity of bioelectricity generation for annual became 581 [TWh]. In addition, when comparing biodiesel production capacity from renewable energies with others, it is seen that biodiesel production is at sufficient levels [11].

Figure 1 presents the renewable energy rate for 2018 [11]. These rates are given respectively for: hydroelectric renewable energy capacity, non-hydroelectric renewable energy capacity, wind energy capacity, photovoltaic and solar energy capacity, bioenergy capacity, geothermal energy capacity, solar energy capacity, ocean energy capacity, bioelectric energy capacity as can be seen from the figure. Hydroelectric energy has the highest renewable energy share in the world and its energy share in 2018 is 40%.

In **Table 2**, the energy policy objectives of the countries are carefully questioned [11]. In general, the target numbers of countries' renewable energy sources are presented in the table.

According to **Table 2**, the number of targets for countries with renewable energy targets (national/state/province) reached 169 in 2018. In countries with 100% renewable energy (primary or final energy targets), heating and cooling and transportation targets, the number of targets remains only 1 target. In addition, countries with 100% renewable electricity energy targets reached 65 targets in 2018 [11].

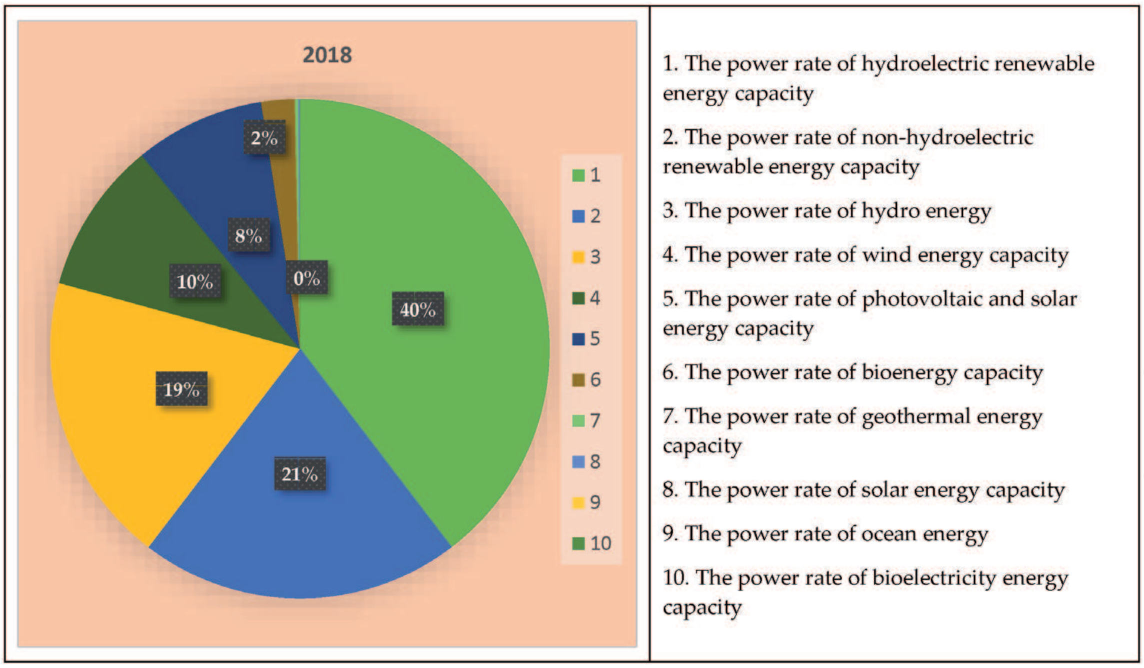

Figure 1.
The power rate of renewable energy in 2018 [11].

Countries with thermal debt and duty (national/state/province based) happened 18 targets in 2018. Countries with biofuel duty (national/state/province based) have been 18 targets in 2018. In briefly, countries with feeding policies (national/state/province based), whose targets became 111, was the highest target in the energy policy [11].

Figure 2 shows the rate of energy policies regarding renewable energy sources for the world in 2018 [11]. These issues can be explained as follows:

Energy policies	Year 2017 (Number of targets)	Year 2018 (Number of targets)
Countries with renewable energy targets (national/state/province based)	179	169
Countries with 100% renewable energy (primary or final energy targets)	1	1
Countries with 100% renewable heating and cooling targets	1	1
Countries with 100% renewable transport targets	1	1
Countries with 100% renewable electricity target	57	65
Countries with thermal debt and duty (national/state/province based)	19	18
Countries with biofuel duty (national/state/province based)	70	70
Countries with feeding policies (national/state/province based)	112	111
Countries with quota policies (national/state/province based)	33	33
Countries participating in the tender held in 2018	29	48
Cumulative tender countries	84	98

Table 2.
Energy policies of renewable energy in the world [11].

Countries with renewable energy targets, Countries with 100% renewable energy, Countries with 100% renewable heating and cooling targets, Countries with 100% renewable transport targets, Countries with 100% renewable electricity target, Countries with thermal debt and duty, Countries with biofuel duty, Countries with feeding policies, Countries with quota policies, Countries participating in the tender held and Cumulative tender countries. When renewable energy resource policies are evaluated, the highest share in renewable energy policies was in the year 2018 with a rate of 29% in the world.

This study shows how the density trend of the final energy is for the world energy policy. Energy density can be explained as the amount of energy per activity of the unit energy output. Thus, it can be seen that if less energy is consumed, the energy density can also be reduced. It is for this reason that the improvement in energy intensity in the world may be brought about by changing some energy policies. Accordingly, the distribution of energy density should be given by years.

Figure 3 indicates an intensity improvement of final global energy. According to the final energy intensity improvement, the ratio between 2000 and 2009 was approximately 1.8%. The change between 2010 and 2014 increased slightly and reached around 2%. In 2015, the energy intensity improvement ratio increased further and exceeded 2%. As of 2016, the trend was downward and approached around 1.5% in 2018 [12].

Figure 4 shows the intensity increase of the final country/region energy. According to the highest of the final energy intensity improvement, the ratio between 2000 and 2009 was occurred approximately 3.0% in the India. The change between 2010 and 2014 was happened around 3.8% in the China. In 2015, the energy intensity improvement ratio increased further and exceeded 5% in the India. China's energy intensity approached around 5.8% in 2016, 5.6% in 2017 and approximately 5.0% in 2018, respectively [12].

Figure 5 shows the global primary energy intensity improvement rate. In case of technical efficiency in global energy intensity improvement rate, changes in energy intensity improvement rate are observed in **Figure 5**. Technical efficiency remains

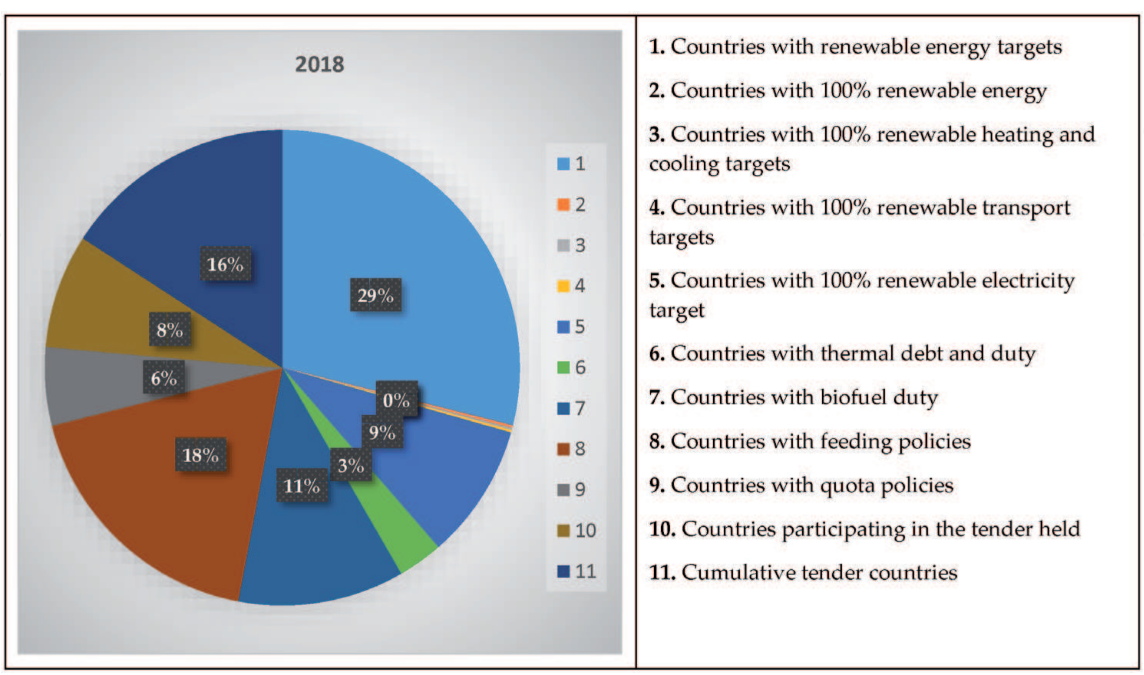

Figure 2.
Rate of the energy policies of renewable energy for the world in 2018 [11].

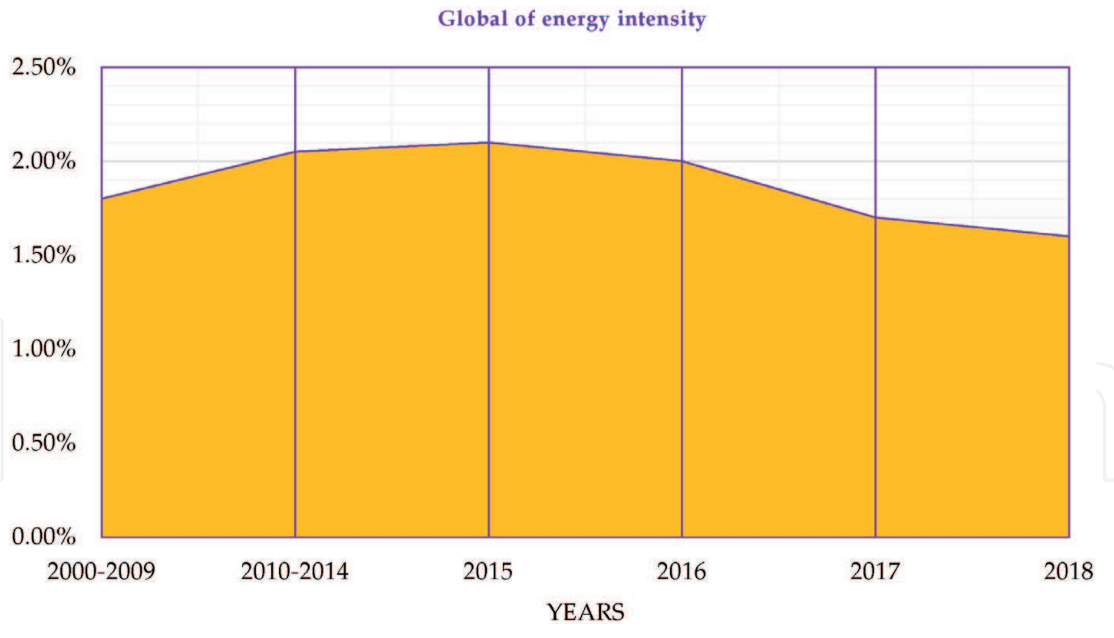

Figure 3.
Global intensity improvement of final energy [12].

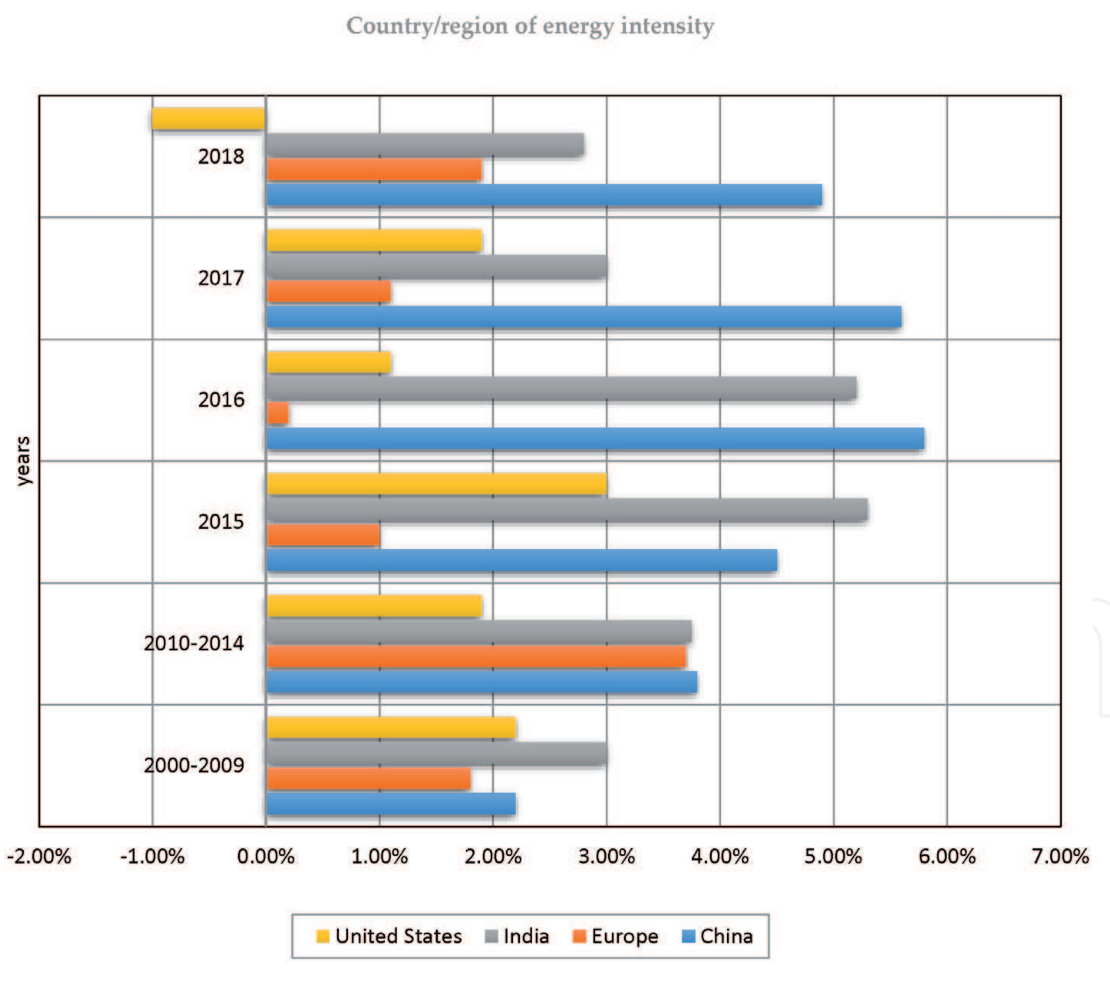

Figure 4.
Country/region's intensity improvement of final energy [12].

the main driver of energy density improvements. Global technical efficiency improvements between 2015 and 2018 prevented 4% more energy consumption in 2018. This technical efficiency has doubled the global primary energy intensity improvement rate in 2018 [12].

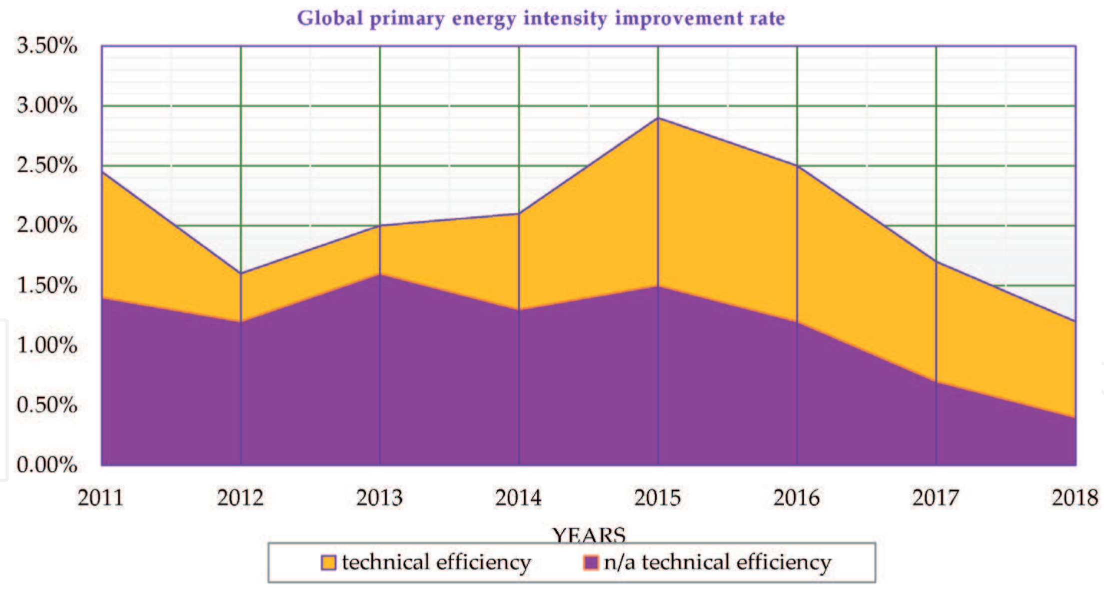

Figure 5.
Global primary energy intensity improvement rate [12].

This book discusses the current world situation regarding the existing energy policies. The interest in energy sources and energy data for renewable energy sources are presented and the energy distribution shares are clearly shown in detail. The biggest problem in energy policies is still the investment cost. Currently, materials and systems of energy systems occupy a significant place in energy conversion. Energy costs can be improved with advanced technological systems.

4. Results and discussion

In this section, it is necessary to determine the global energy targets as well as the current energy data. Energy policies should be considered in the short-term as well as long- and medium-term plans. In short, countries have to take all kinds of measures in their energy policies and wars, turmoil, government stabilization, and human rights into consideration.

Accordingly, in order to shape the world of, the future, 2050 and beyond, arrangements should be made by taking into account the data that can shed light on energy policies.

The increase in geopolitical tensions as well as many other uncertainties such as the oil crises in the world affect the energy policies [13]. In addition, precautions must be taken urgently for emissions-particles and other key factors released during energy production. While energy policies affect these phenomena mentioned above, energy investment costs and system installations are other factors. In addition, disagreements, unrest and wars between countries directly affect energy policies.

Due to key factors, when it is evaluated in terms of countries, it is necessary to reveal what should be done in energy policies in the coming years. Laws and objectives should be regulated accordingly [13]. Governments should focus on sustainable energy resources and sound steps should be taken forward. Stability and order can only be achieved through the establishment and implementation of good energy policies.

The energy history chronology and future energy scenario are presented in **Figure 6**. In 1919, energy consumption was only 1500 Mtoe, while in 2018 it was 14,300 Mtoe. In 1919, only wood, coal, and small amounts of oil were consumed,

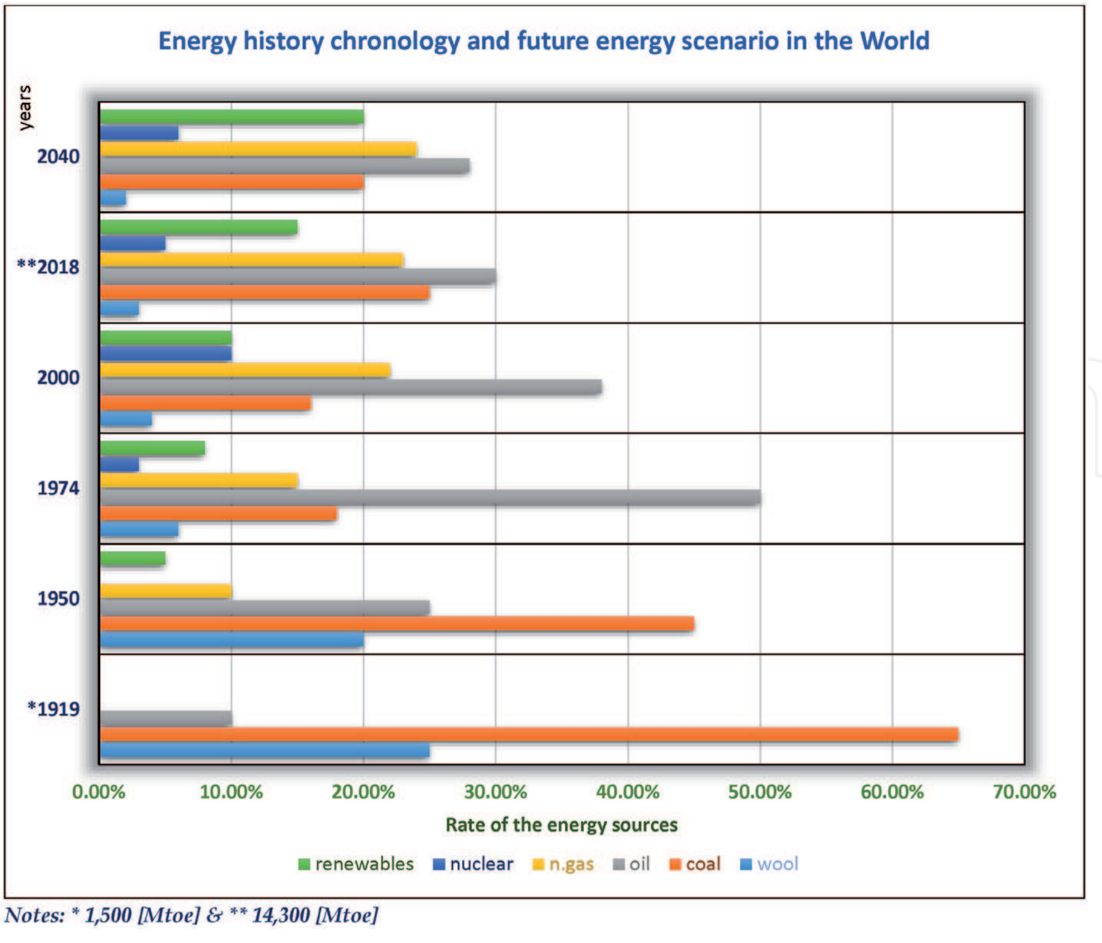

Figure 6.
*Energy history chronology and future energy scenario in the world [13]. Notes: * 1,500 [Mtoe] & ** 14,300 [Mtoe].*

but in 2018 this changed completely. In 2018, petroleum was the first, followed by natural gas. Immediately after, coal and natural gas consumption are listed. Interest in renewable energy sources has also increased. In the 2040 forecasts, petroleum and natural gas are in the forefront, while coal and renewable energy sources are visually equalized in terms of consumption. It is foreseen that the consumption in nuclear energy may be considerable [13].

5. Conclusion

This book indicates the policy of energy in the world. Energy wars continue to occur due to the energy policies of the countries in the world. Energy policies in recent years have a direct impact on the development of countries. Countries are taking steps towards existence by producing short, medium and long term energy strategies. It is also explained in the concluding section on how energy in the general context might be in the future.

There are many factors in the decisions and measures taken regarding energy policies. It is clear that it will play a key role in global warming, as well as the factors that will affect countries' investment costs, geopolitical locations, emissions, and other energy policies.

In **Figure** 7, the energy efficiency now and future energy scenario in the world are emphasized [14]. There has been a decline in the energy consumption curve starting from 2010. According to the forecasts of 2050, energy density ratio is expected to increase while per capita energy consumption decreases. By 2050,

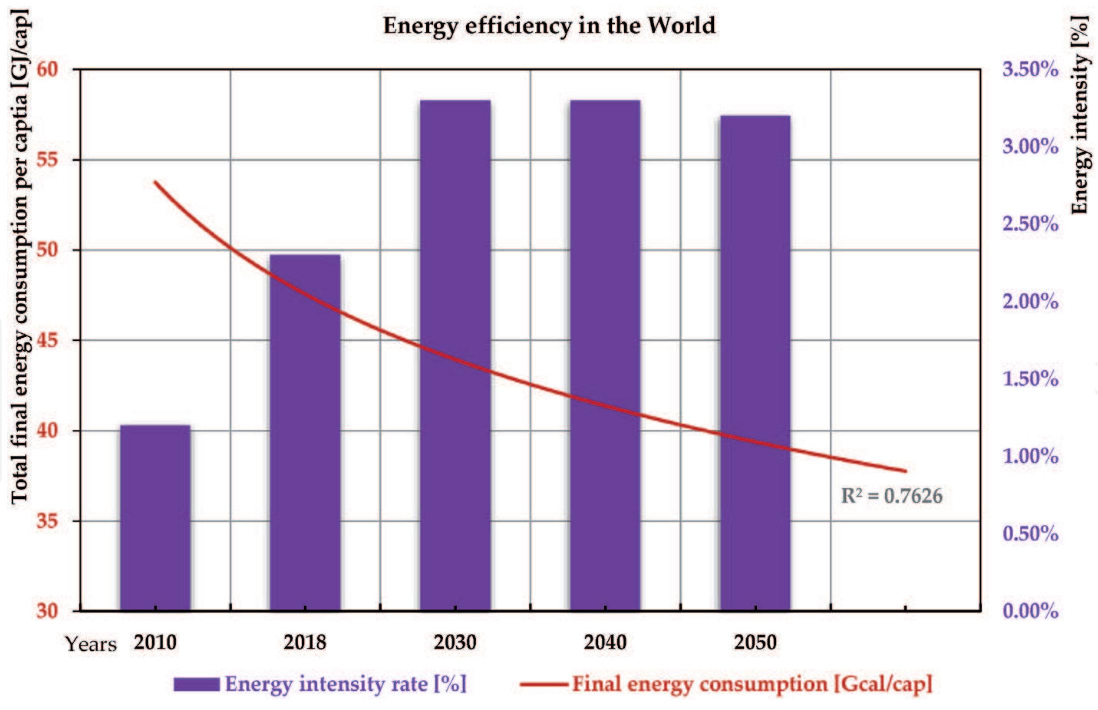

Figure 7.
Energy efficiency now and future energy scenario in the world [14].

energy density and energy consumption are expected to become stable. The regression curve shows that the probability is high.

As a result, the energy policies of the countries in the world are causing many problems today. In addition to many global stresses and tensions, the extent of global warming also raises concerns. Energy strategies should be developed by taking into account both energy efficiency and global warming, cross-country crises, population planning, energy investments and systems, legal regulations on energy costs, and many other parameters. Although advances in technologies bring many benefits, the future energy crises should be minimized.

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Nomenclature and units

%	energy intensity rate
Energy consumption	Mtoe
GJ/ca	total final energy consumption per captia
GW	gigawatt
Mtoe	million toe
PEM	proton exchange membrane
toe	tonnes of oil equivalent
TWh	terawatt hours

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