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Management of Renewable Energy Sources and Technologies for Turkey

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Authors' contributions

This work was carried out in collaboration among all authors. Author BY designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HHS and CK managed the analyses of the study. Author CK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Utilization of alternative sources named as new and renewable energy sources; Due to technological development and difficulties in competing economically with traditional resources, it has not reached the desired level until today. Due to the rapid increase in energy consumption today; It is a fact proved by scientific findings that fossil fuels will be consumed in the near future. Therefore, in the development of countries; Providing timely, reliable, clean and uninterrupted energy, creating a market environment, in other words, successful implementation of energy management have become imperative. Energy has become one of the most important problems of the world countries today. As is known, the lifetimes of energy sources such as coal and oil are limited. In addition, due to the use of fossil fuels; It is a fact that global warming is increasing day by day. In the light of the data obtained, for our energy needs; alternative solutions should be found, renewable energy sources should be evaluated. The importance of renewable energy sources has increased as the problems related to environmental pollution increase, and projects related to them have started to get support. These energy sources can basically be classified as

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hydroelectric energy, wind energy, solar energy, geothermal energy, modern biomass energy and hydrogen energy. Economic and efficient operation of new and renewable energy sources should be transformed into a common understanding in order to provide clean energy. In this study, energy production methods from green energy sources, environmental relations and new technologies used with these energy sources are explained. It has been compared among energy sources; In Turkey, energy management issues are discussed, new and renewable clean energy use efficiency and energy saving and new strategies are determined. In addition, recommendations were made on energy use efficiency and energy saving measures in various sectors.

Keywords: Energy management; renewable energy; fossil fuels.

1. INTRODUCTION

In parallel with the beginning of human life, the need for energy has emerged. With the rapid growth in the world economy, population growth, industrialization and urbanization, energy demand is also increasing. As a requirement of modern life, producing energy at a sufficient level and presenting it to the use of daily life is one of the most basic needs of human life. In recent years, industrialized countries that are net importers in the provision of energy resources, especially petroleum, and developing countries, who want to benefit from energy services, form various policies for energy management. Lighting, transportation, warming, cooking, from communication to informatics, etc. Numerous uses and energy use are indispensable elements of our social and economic activities in today's world. On the other hand, another issue that should not be overlooked is energy production in the context of sustainability.This point highlights the concept of clean energy in energy production. Energy sources are diverse as is known. However, it cannot be said that every energy source is used at the same rate. Energy is also the main component of all types of goods and services. Naturally, the indicators related to energy production and consumption in today's world are among the primary development criteria used in determining social and economic development. The preference of using different energy sources can be linked to different reasons. Among these reasons; geographic, economic, technological and environmental ones can be mentioned. All positive developments created by humanity's efforts to reach advanced civilizations have been achieved through the generous use of natural resources [1]. In today's rural societies, there are still physical and economic difficulties in meeting the energy needs with traditional methods. As a result, it prevents rural residents from demonstrating their production potential at expected efficiency. The use of natural resources in the degree of extinction, environmental pollution will lead to disruption of its natural balance. This situation threatens the future of the human being, which is a part of nature [2]. It is stated that the contribution of renewable energy resources to the world energy in 2025 will be half or even two thirds of fossil fuels' present contribution. The importance of renewable energies can be better understood by gas emissions. According to the reports of the European Union; If renewable energy consumption can be doubled within 10 years, CO_2 emissions in Europe will decrease by 402 million tons every year [3]. It was concluded at the United Nations Climate Change Conferences that “consumption share of clean and renewable energy resources should be at least 25% of all energies”. It has been stated that this goal will be reached within 30 years at the latest, otherwise regions in the world will not be lived and the changing climate conditions will be permanent [4,5]. Energy Saving is like increasing energy efficiency, applying technologies related to reducing CO_2 emissions, developing and using new fuels, increasing the use of renewable energy sources. 10 000 MW photovoltaic solar energy, wind energy and biomass energy target 10 000 MW equivalent energy. Annual total in carbon dioxide emissions if these targets are met. It is stated that a decrease of 402 million tons will be achieved. Also; The establishment of regions that will provide all of their energy needs from renewable energy sources is within the stated targets. Countries with a common environmental awareness will find solutions to the energy problem. Today, R&D studies in the field of renewable energy sources such as wind energy, solar energy and hydrogen energy, which are desired to be used as an alternative to fossil fuels, are continuing. Ecology is the science that studies the relationship between living things and their natural environment [6]. Due to the rise in oil prices, limited resources and environmental problems, the use of green energy

resources is becoming more and more important as an alternative to electricity generation with classical methods based on oil and coal. Green energy sources, wind energy, solar energy, water power, biological fuel energy, the power of the sea waves, geothermic energy, and so on. However, studies over the years have shown that among these, it is more practical and easy to convert wind and solar energy directly into electrical energy [7]. Besides oil and natural gas, coal and nuclear energy can meet the energy needs for a longer period of time. However, both coal and nuclear energy cause serious environmental pollution. With the burning of coal, gases such as Carbon Dioxide and Sulfur Dioxide are formed and cause environmental pollution. The main problem in nuclear energy is the disposal of waste [8]. Technologically, the fossil fuel type used in large quantities in the developed countries as an alternative to wind, biomass and solar energy use facilities are being investigated. In this study, it is aimed to use renewable energy sources in the most economical and efficient way, and the methods of energy production from renewable energy sources, their relations with the environment and the use of new technologies with these energy sources.

2. CLEAN AND RENEWABLE ENERGY POLICIES

Today, 85% of the world's energy consumption demand is met from fossil fuels. Since the vast majority of energy demand is met from fossil fuels, important climate changes are experienced in the world. If there is no solution to the energy problem; ecosystem will deteriorate, so plant and animal species will disappear. It is a fact that today there are problems in energy production activities. Wind, biogas, solar and geothermal energy production conditions, which are among the renewable energy sources that are important in the face of the current energy problem, are capable of meeting local requirements in suitable regions. These are a clean and environmentally friendly energy source. It especially contributes to the protection of air quality. In cities with intense air pollution, poisoning cases are also common. Concern caused by such possible consequences; increased interest in renewable energy and scientific research has gained speed. With the thought of solving the energy problem instead of the fossil fuels used in these studies supported by the governments; The studies on solar, wind, tidal, geothermal and biogas energy systems, which are called green energy sources, continue intensely. The energy demand arising from the increasing population and industrialization cannot be met with the world's limited resources, and the difference between energy production and consumption is growing rapidly. On the other hand, traditional energy production methods are one of the important causes of environmental pollution today [3]. The fact that the fossil fuel reserves in the world are limited and the fact that these will be exhausted in the near future has accelerated the search for renewable energy sources [9].

Solar energy is a renewable energy source. By using natural heating and cooling systems, it prevents unnecessary and excessive commercial energy consumption of buildings and protects environmental balances. Wind energy is a stable, reliable, continuous resource and not dependent on the outside. The period we live in is the beginning of the process in which the risk factors of conventional energy sources increase. These factors are; The fact that many of the classical energy sources will be exhausted in the near future, they create big and irreversible hazards for the environment and are insufficient to feed the developing technology. For these reasons, the diversity of renewable energy sources is increasing today, some of them gain value in terms of economic alternatives and some of them are analyzed economically.

Renewable energy sources do not have a negative impact on the environment in the short and long term [10]. Environmental problems during classical energy production and use are one of the main reasons for abandoning old technologies. Carbon dioxide, sulfur dioxide, nitrous oxide, dust and soot emitted into the atmosphere when fossil fuels are burned, while carbon dioxide and similar greenhouse gases cause global climate change and threaten life in all countries of the world [11]. Strategies, plans and policies required to use renewable energy sources correctly and healthily are increasingly important and reaching important dimensions [12]. Increasing energy efficiency is important for the environmental impact assessment of energy resources. In order to use less energy and harm the environment, system efficiency should be increased. Undesirable side effects resulting from the scarcity and careless use of energy resources require planning and carefully evaluating energy consumption [13].

Renewable energy resources, which were 7.7% in 2005 in total energy consumption, are

projected to increase to 8.5% in 2030 [14]. However, various incentive methods have been developed to overcome the problem that the power plants that use these resources have very high investment costs. For example, Germany provides financial incentives, export credit subsidies, tax or customs exemptions, and financial and tax incentives, including government investment incentives and government-backed loans to promote renewable energy sources [15,16]. In addition, for the use of clean energy communities; Equipped with knowledge, skills and potentials and directing active individuals who are sensitive to entrepreneurial, responsible, environmental, cultural and aesthetic values has become inevitable. Accordingly, the following strategic approaches are gaining importance [17,18]. To create a community of countries that have environmentally friendly and sustainability trainings with a sufficient number of clean energy and environmental management experts, and that use reputable and institutionalized renewable energy. It is to contribute more to national, regional and international development among communities by extending climate and environmental education programs for the use of highly clean energy among countries [19].

3. ENERGY EFFICIENCY

Energy efficiency is a whole of efficiency enhancing measures such as preventing energy losses in gas, steam, heat, air and electricity, recovery and evaluation of various wastes, more efficient energy sources, advanced industrial processes, cogeneration and energy recovery [20]. Energy intensity is used worldwide as an indicator of energy efficiency [21]. Studies on energy efficiency are carried out with programs carried out by public institutions, large companies and universities in both developed and developing countries. The first studies on energy efficiency started in industrialized countries and Japan due to the oil crisis and price increases. It has become an important policy of development strategies of countries since 1980s.

The European Union has started energy efficiency studies with the SAVE program that started in 1991 in order to improve energy efficiency and encourage energy saving in domestic sectors such as industry, trade and transportation. It determined its energy policies with the Green Paper in 1997 and the Green Book "European Strategy for Sustainable, Competitive and Safe Energy" in 2006 [22]. Energy use in the USA was lower than the growth in the economy. The USA, which is a foreign-dependent country in primary energy sources, has prioritized energy efficiency since the 1970s and reduced its energy intensity by 66% from 1980 to 2005 [23].

Turkey's economy grew by 31% during the period 2000-2006, energy use by 24% over the same period has increased the level of energy intensity has not changed. However, intensive studies on energy efficiency have been continuing rapidly in recent years (Table 1) [24].

4. GREEN ENERGY SOURCES

4.1 Solar Energy

The radiation energy released as a result of the fusion process, which we can define as the conversion of hydrogen gas in the sun's core to helium, is solar energy [8]. The sun is a clean and inexhaustible source of energy for our world [25]. Solar energy is mostly utilized by solar cells. Solar cell technology is at a level to meet the electricity production need [26]. As the battery production becomes cheaper and the possibilities of individuals to obtain the energy they need, the concept of energy will gain a new meaning. Parfit [27] Photovoltaic energy production is not yet economical compared to other energy sources. However, as a result of the researches, the costs were reduced. Leading states, such as the USA, Germany and Japan, who are researching solar energy, invest around one billion dollars a year. It is planned to obtain 15% of the world's energy consumption from the sun in 2050 [28]. Today, solar energy has found a very cheap and widespread use in heating and hot water, especially in the equator and temperate climate zones. There are a number of technological challenges regarding the problem of storing electricity produced from solar energy in closed weather and at night [29]. Regarding solar energy, European Union countries are at the forefront. With solar energy, the rate of increase in energy intake can be braked and environmental pollution from fossil fuels can also be prevented [30]. Because the systems set up to obtain solar energy get the energy directly from the sun without the gases released due to combustion [31].

Table 1. Estimated renewable energy resources in 2020 [24]

Power supply	Minimum megaton equivalent oil %		Maximum megaton equivalent oil %	
Modern biomass	243	45	561	42
Sun	109	20	355	26
Wind	85	15	215	16
Geothermal	40	7	91	7
Small Hydraulics	48	9	69	5
Marine Energy	14	4	55	4
Total	539	100	1345	100

4.2 Hydraulic Energy

Hydraulic energy; It is a type of energy obtained by converting the potential energy of water into kinetic energy. Energy is obtained by building dams on rivers and converting the potential energy of water into electrical energy. Hydraulic energy is gaining importance day by day because it is an alternative source, it does not cause any environmental pollution, and operation maintenance costs are low and it is a national resource [32]. In the USA, 10% of the energy need is provided from hydraulic energy. The share of energy produced from hydraulic energy in Turkey has gradually decreased [33]. Among the renewable energy sources, the hydraulic energy installed power has the highest share [34].

Hydraulic power plants are more advantageous compared to thermal power plants and natural gas power plants compared to environmental factors and global trends [35].

4.3 Wind Power

The world wind energy potential is estimated to be 26,000 TWh / year in the area between 50° north and south latitudes and 9,000 TWh / year capacity is available for economic and other reasons [36]. Again according to the studies, it is stated that 27% of the total of the world terrestrial areas are affected by the wind speed higher than the average annual 5.1 m / s. It is calculated that with the assumption that wind energy will be available, it will have an installed capacity of 240,000 GW with a production capacity of 8 MW / km^2.

Fig. 1 shows the distribution of the world technical wind energy potential in 2010. Especially Europe and America try to evaluate their wind energy potential as efficiently as possible. Fig. 2 shows the shares of the installed power according to continent.

As can be seen from Fig. 2, the world wind energy market is formed by America and European countries. Personal use is very high in America. This type of usage is becoming more and more widespread in Europe, too [38]. 90% of the newly established wind farms are installed in America and Europe. Table 1 shows the countries that use wind power plants the most [39].

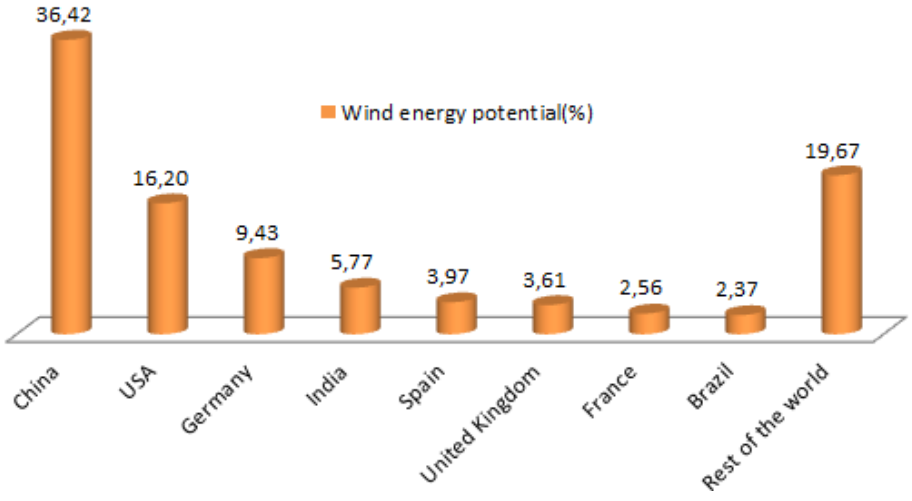

Fig. 1. World technical wind energy potential distribution in 2019 [37]

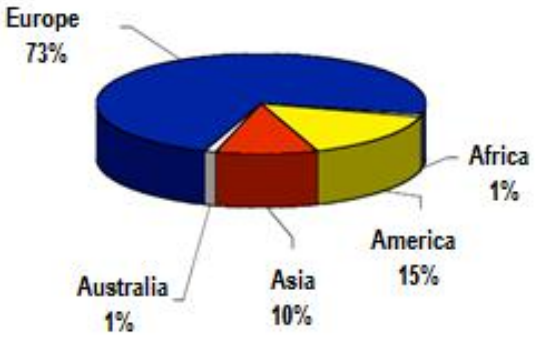

Fig. 2. Sharing of installed power on the continents [21]

Table 2. Countries using the most wind power plants [39]

Country/Region	2019	2018	2017	2016	2015
	MW	MW	MW	MW	MW
China	237,029	209,529	188,39	168,73	148
USA	105,433	96,363	88,775	82,033	73,867
Germany	61,357	59,313	56,19	50,019	45,192
India	37,529	35,129	32,879	28,279	24,759
Spain	25,808	23,494	23,026	23,02	22,987
United Kingdom	23,515	20,743	17,852	14,512	13,614
France	16,646	15,313	13,76	12,065	10,293
Brazil	15,452	14,707	12,763	10,8	8,715
Rest of the world	127,989	116,501	107,204	99,05	89,402
World Total	**650,758**	**591,092**	**540,839**	**488,508**	**436,829**

The worldwide rate of increase in the use of wind energy decreases every year (21%). The reason for this, especially America, Germany, and countries such as Denmark, the speed is decreased to establish new plants [40]. Advantages; It is a clean and emission-free energy source, it does not create greenhouse gases and does not contribute to global warming, it does not have fuel money and operation costs are very low [41]. Disadvantage; Since energy production is dependent on wind, energy loss occurs due to wind cut or decrease, since it is energy dependent on wind quantity, it can only be installed in areas where there is enough wind, turbine costs can be high, but there is a decreasing cost situation [42]. Developments related to wind turbines are increasing day by day with technology. Today, one of the most developed fields in wind turbines is the adaptation of the turbine to electronic systems. For more efficient design, it is to develop system models and simulations in order to comprehend the status, structure and effect of turbulance loads under production and turbine working life. As a result of researches on wind turbines, it is the main objective to increase the usability percentage of wind energy by making better design, development and production.

4.4 Geothermal Energy

Geothermal energy, the heat in the depths of the earth's crust; It is a type of energy that occurs when the heated water emerges as a result of heating the groundwater. It is recommended to use this energy mostly as heat energy. Besides, it is much cheaper for industry than other energy sources. In 1904, electricity was produced from geothermal energy for the first time in Italy. In 1969, the heating of big cities with geothermal energy started in France. 30% of the housing in Turkey may be heated by geothermal energy. Only 2% of the 31500 megawatts of energy is used today [43]. Geothermal energy is utilized in residential heating, hot springs, greenhouse heating and electricity generation.

4.5 Biomass Energy

Organic materials consisting of all kinds of vegetable or animal wastes containing carbon are called biomass. These sources are classified

as vegetable wastes, animal wastes and city and industrial wastes. Biomass, which is the product of photosynthesis directly or indirectly on the earth, reveals the stored solar energy as a result of its reaction with oxygen called combustion. Therefore, energy can be obtained by burning all kinds of biomass. Energy production principles are the same as thermal power plants. The main difference is the use of biomass instead of coal as fuel. Many forms are created for biomass energy to provide energy in different ways. Since renewable biomass and biomass fuels provide environmental benefits, they can easily replace fossil fuels in today's energy use. Moreover, greenhouse gases reduce the emission and carbon cycle and support the development of the rural economy. In addition, the gas obtained by gasification of biomass can be used and made widespread in places where natural gas is used. It is also known that biomass used as an energy source has many disadvantages. Carbon monoxide, which is colorless and odorless, creates a dangerous toxic effect when inhaled. According to the researches, the energy to be supplied from biomass worldwide in 2025 was reported between 1,339.3 Mtep and 3,291.5 Mtep in the World Energy Council Report. The lowest prediction belongs to the World Energy Council.

4.6 Gasification

Gasification is a thermochemical conversion process from which biomass produces gas fuel. In other words, biomass is converted into fuel by a thermochemical conversion. The aim of modernized biomass energy technologies is to reduce the emissions during production and use, while increasing the density of the fuel. The energy content of the produced gas is suitable for use in internal combustion engines, boilers and furnaces. In order to provide full capacity combustion in gasification of biomass, gas with high energy density is obtained when pure oxygen or steam is used as oxidant instead of air [44]. Although it has a low thermal value, it has been started to be used as an energy source by gasifying solid gases in gas engines and turbines, electricity generation or internal combustion engines. It can be used with this method and modernized gaseous fuels can be used like conventional fuels with less harmful emissions.

4.7 Hydrogen Energy

Hydrogen, coal, biomass, natural gas and water are the simplest and most abundant elements in nature that can be obtained from many substances [45]. Hydrogen gas is not free in nature. Therefore, it is not a natural energy source. In order to use hydrogen gas, this gas must first be released. Hydrogen gas can be obtained from both renewable energy sources and fossil fuels. That is, the method used to obtain hydrogen determines whether the released energy will be environmentally friendly. Therefore, the use of hydrogen energy can also trigger global warming. In order to prevent environmental pollution, hydrogen obtained by solar energy is thought to be a near perfect solution. Different methods are used in different parts of the world in order to obtain hydrogen. Researches are carried out in order to obtain hydrogen energy from rivers in Brazil, wind in Argentina, sun in regions near Ecuador, coal in China and the USA. The European Renewable Energy Council is of the opinion that there will be no green energy unless hydrogen is obtained from renewable, clean energy sources. The important thing in this case is whether the hydrogen source is clean or not [46]. Such as Turkey, limited fossil switch to solar-hydrogen system in the near future for a country with a fuel source will be extremely convenient option [47].

5. COMPARISON OF GREEN ENERGY SOURCE

Comparison of energy generation systems has been made in terms of environment and economy.

Table 3. Comparison of dependence and remaining life of energy types

Energy sources	Foreign Dependency / Locality
Oil	Dış
Coal	Yerel/Dış
Natural gas	Dış
Nuclear	Dış
Hydraulic	Yerel
Sun	Yerel
Geothermal	Yerel
Wind	Yerel

Table 4. Comparison of approximate investment and unit energy costs of energy types

Energy sources	Investment cost ($ / kWh)	Production cost (cent / kWh)
Oil	1500-2000	6
Coal	1400-1600	2.5-3
Natural gas	600-700	3
Nuclear	3000-4000	7.5
Hydraulic	750-1200	0.5-2
Sun	Yüksek	10-20
Geothermal	1500-2000	3-4
Wind	1000-1200	3.5-4.5

Table 5. Comparison of environmental effects of energy types

	Climate change	Acid rain	Water pollution	Soil pollution	Noise	Radiation
Oil	+	+	+	+	+	-
Coal	+	+	+	+	+	+
Natural gas	+	+	+	-	+	-
Nuclear	-	-	+	+	-	+
Hydraulic	+	-	-	-	-	-
Sun	-	-	-	-	-	-
Geothermal	-	-	+	+	-	-
Wind	-	-	-	-	+	-

When we look at the tables, renewable energy sources seem to be very advantageous. It is obvious that it will become cheaper in the coming years with the advancement of technology and mass production. It is also very rich in terms of potential of wind energy among renewable energy sources. It is the energy source with the least pollition in terms of environmental pollition.

6. TECHNIQUES AND ENERGY TECHNOLOGIES USED IN ENERGY MANAGEMENT

Cogeneration is the production of energy together from the same system in both electricity and heat forms. This technique is called "combined heat, power systems" or "cogeneration" for short. Benefits to be provided across the country with this technique; reducing reliance on local and imported energy resources through efficiency in primary energy use; electrical energy transmission and distribution losses are eliminated [48]. Compressed air applications consume less energy by controlling the power consumption depending on the changing air demand. Usage of high efficiency engine; As these engines consume 1-5% less energy, they contribute to environmental protection by reducing CO_2 emissions as well as saving energy [49]. Fuel Cells; They are clean, environmentally friendly and high efficiency energy conversion technologies. The total efficiency of fuel cells produced by only chemical reaction without using a steam boiler or turbine can reach up to 80%. It has features such as being small in size, working with high efficiency and using waste heat, and being able to be built close to the user. Wind Energy Technologies; Wind energy used for the production of electrical energy is a source of energy that is abundant in nature and has no cost. Wind turbines are used to generate electricity from wind energy. Although the investment costs are high, the operating cost is gradually decreasing [50]. Solar Energy Technologies; They are solar cells and solar heating systems developed to obtain electrical energy or take advantage of direct sunlight. Solar cells are semiconductor materials that convert sunlight coming into their surface directly into electrical energy. Depending on the structure of these batteries, solar energy can be converted into electrical energy in an efficiency of 5-20%. Solar heating systems use the sun to heat the water. Therefore, it saves energy because it reduces the use of fossil fuels to be used in water heating.

7. CLEAN RENEWABLE ENERGY MANAGEMENT

The more important institutional climate management skills are, the more it needs global climate management. Environmental pollution causes disasters and problems in the ecosystem [51]. In the UN Climate Change Report [52], it is stated that global warming poses a great threat,

the average global temperature increased by 0.76 degrees in the period of 1900-2005, and it will increase by 1 degree with the best scenario until 2100, and these problems are waiting for important solutions. An international agreement on global warming and climate change was signed by signing the Kyoto Protocol in December 1997. The purpose of this protocol, adopted by major countries except the USA, is to reduce the emission of 6 types of greenhouse gases in developed countries. These gases are; carbon dioxide, methane, nitrous oxide, hydrofluorocarbon, perfluorocarbon and sulfur are hexafluoride. According to the data in 1996, 80.5% of greenhouse gas emissions originate from developed countries. Fuel combustion is the most important source of CO_2. Carbon dioxide is the most important greenhouse gas consisting of human activities. Therefore, CO_2 is the most important in emission reduction projects. In this context, the Paris Agreement came into force in 2016, provided that at least 55 parties, which constitute 55% of global greenhouse gas emissions, approve the agreement. The agreement signed by 196 countries and the EU invites all nations to combat climate change. The main objective of the Paris Agreement, which was the first global agreement to enter into force 1 year after its adoption, is to reduce the global temperature rise below 2 degrees Celsius. Unlike the Kyoto Protocol, not only developed countries address the issue, but all countries are called for unity against the global climate change risk. A new form of urban life has begun to be developed in order to protect nature and raise living standards in developing countries. In this form of urbanization, called Eco-city, it is aimed to recycle everything possible and minimize the use of cars. It also includes issues such as building buildings that will use energy efficiently, expanding public transportation, and bringing the working and living areas closer together. Hanging gardens, air-cooled sprinklers, wind turbines and solar panels in modern eco-city buildings will produce most of the electricity consumed in the building and rainwater collectors on the roof will be able to accumulate the water that is in need to a large extent; carbonless vegetable oils will be burned, solar panel will be installed and hydrogen public transportation will be possible. It can be build various structures such as eco-city by raising awareness on environmental and climate issues worldwide. In this regard, sustainable quality of life can be supported in the ecological environment and climate change all over the world through joint national and international initiatives of democratic community organizations.

8. CONCLUSION AND RECOMMENDATION

Turkey's energy resources can not meet the energy needs of the growing population and booming industry. Therefore, difference between energy production and consumption is growing rapidly. The reason for the slow development in renewable energy and generation systems is often attributed to established interest relations, inadequate existing infrastructure, economic conditions, difficulties in finding finance, scientific and technical inadequacies, and lack of information about renewable energy technologies and resources. Considering that the energy resources are running out rapidly, the use of green energy resources should be encouraged and the private sector should be encouraged in this area. For this purpose, it has increased the importance of more efficient use of self resources. Healthy and reliable datasets of renewable energy sources should be created and these datasets should be maintained and updated. E.g; solar and wind energy measurements should be taken locally and continuously and recorded. However, the necessary legal arrangements regarding the energy production monopoly have not been fully made yet. If the legal obstacles on this issue disappear, consumers can take steps to produce their own energy on an individual or company basis and production capacity on green energies may increase. Progress in renewable energy technologies should be followed globally, studies across the country should be encouraged and supported. For renewable energy to become widespread, as in Europe, an attractive market must be created for investors. Investors, users should be encouraged by the state (with tax breaks, loans, etc.). In line with the national and local realities, renewable energy law should be developed together with non-governmental organizations and other actors. A system should be established where sustainable energies are rewarded for their social and environmental benefits and pollutant energies are added to the prices of their social costs. In investment decisions, projects with the lowest social costs should be prioritized in the long term. Alternative energy sources should be used effectively in meeting the rapid increase in energy demand and research in this area should be supported. R&D studies should be accelerated on the basis of universities and companies in order to

eliminate the technical and material deficiencies related to renewable energy sources, in other words, to reduce dependency abroad. Priority national targets and implementation plan, support and investments should be determined which will increase the share of renewable energies in many sectors. Energy use efficiency should also be given importance in industrial production processes. An effective mechanization planning to be made at the enterprise scale should provide a suitable mechanization infrastructure for the enterprise. Energy efficient technologies should be used for the mechanization infrastructure of the enterprises. More support should be provided to institutions involved in such studies. When using energy production methods, care should be taken to protect the environment and the climate.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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