ENERGY POLICY FOR SUSTAINABLE ENVIRONMENT

Edited by
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From the editors,

While energy demand has increased rapidly during the period from the industrial revolution until today, the importance of conservation and sustainability of energy has increased after the OPEC crisis. While the rapid depletion of energy resources in the world forces countries to find new energy types. In addition, the emergence of the negative effects of energy consumption on the environment has made the use of clean energy compulsory, and the number of studies on energy policies has increased and diversified. This study, carried out to contribute to this field, consists of 10 chapters.

In the first chapter of the book, Emin Efecan AKTAŞ prepared a review named "*Energy and Environmental Security for Sustainability: A Theoretical Review"*. His study will contribute to the assimilation of the issue by emphasizing some essential points as a result of the review of the studies carried through to determine the problems and to research the solutions to ensure environmental sustainability.

Ömer Faruk GÜLTEKİN and Füsun Çelebi BOZ in their study named *"Natural Disasters and Renewable Energy Policies*", state that the need arising in both production and consumption causes an increase in dependence on non-renewable energy sources such as oil, natural gas and coal. Therefore, it can be said that developed and developing countries have increased their energy investments, especially in nuclear power plants, depending on the increasing energy needs. However, the interruption of energy supply due to natural disasters has led societies to seek more reliable energy sources. In particular, the damage to the

Fukushima nuclear power plant after the tsunami and the interruption of energy production led to renewable energy sources to come to the fore.

In the third part, Tuba YILDIZ in her study which named *"Sustainable Environment and Renewable Energy Sources: an Empirical Analysis on Turkey*" explored the phenomenon of clean energy to reduce environmental degradation by revealing the dimensions of environmental degradation. YILDIZ conducted ARDL cointegration analysis to examine the relationship between environmental pollution and renewable energy usage. According to the results obtained from the analysis, a significant relationship was found between environmental pollution, GDP and urban population growth rate in the long term.

In the fourth chapter Serhat AKIN, in his study named *"Environmental Policies and Sustainable Consumption*" chronologically puts forth environmental policies on a global scale and suggested sustainable consumption to prevent environmental degradation.

In the fifth chapter Cengiz AYTUN "*Climate Change Denial as a Barrier to Sustainable Environmental Policies*", states that global warming is a scientific fact. However, the public opinion around the world should be aware of this scientific fact. In the post-truth era, people do not question the truth of the news they read. As long as the news confirms his prejudices. This vulnerability is deliberately exploited by climate change deniers. The disinformation activities of climate change deniers constitute an important obstacle to the implementation of sustainable environmental policies.

In the sixth chapter İpek TEKIN in her study which named "*Reconciling Environment and Employment: The Role of Renewable Energy Investments*" investigate the role of renewable energy in job creation from an analytical perspective. In that context, the data on renewable energy generation and jobs created in the sector are displayed and interpreted. The available data show that renewable energy sector creates a significant amount of jobs. Also, not only renewable energy investments themselves but also its employment generation will contribute to economic and social sustainability.

In the seventh chapter of the book Ismet Murat HASEKI and Basak Gul AKAR have demonstrated the importance of agricultural biomass energy in their study, which named "*The Importance Of Agricultural Biomass In energy Consumption Case of ÇUKOBİRLİK*". They claim that cotton straw is a product that can turn into an important biomass resource as a renewable, clean energy production and consumption form. This kind of source has many benefits in environmental, health and economic terms as well as providing energy saving.

In the eighth chapter of the book, Okyay UÇAN and Kubra GÖGER prepared an analysis with Panel Data Analysis in the study named "*Energy Export and Growth Nexus In OPEC Countries: Panel Data Analysis*". In the study, the relationship between energy export and economic growth for the period 1980-2013 in OPEC countries is investigated. For this relationship, crude oil per capita for energy export is considered in kg and real GDP data are taken for growth. In addition, the exchange rate is taken as a control variable. Eviews 9.5, Stata 14 and Gauss 19 programs are used in the analysis of these data. The relationships among the variables are considered theoretically and the relationships among them in the literature are given. Information is given about the tests examined and the results of the application are determined in tables and the coefficients of the countries are interpreted as a whole and separately.

In the ninth chapter Cengiz AYTUN and İsminaz ÇINAR in their study which named “*Environmental and Economic Dimensions Of Sustainable Development*” evaluated the concepts of sustainable development and green economy In addition, renewable energy and recycling issues, which are the main pillars of environmental sustainability in sustainable development, was emphasized.

In the tenth chapter Metin REYHANOĞLU and Özden AKIN in their study named “Energy Efficiency in Organizations: Policies, Strategies, Applications” they analyzed the role of the businesses in energy policies. Leading businesses in the world have begun to take action to reduce energy and carbon consumption. Corporate sustainability programs spread quickly. As businesses increased their analysis work in the environmental field, they began to radically rethink their energy use. It is important for businesses to develop new strategies and practices that include their current strategies and practices and energy efficiency for a sustainable environment. The purpose of this section is to make suggestions about the strategy, goal and energy culture of businesses for energy efficiency. In addition, the things to be done regarding energy efficiency in purchasing raw materials, in production processes, in creating a system for energy efficiency and in cooperation between businesses will be explained.

We hope that our work will guide our friends who follow us and live in a better world.

Assoc. Prof. Cemil Serhat AKIN
Assoc. Prof. Cengiz AYTUN

CHAPTER 1

ENERGY AND ENVIRONMENTAL SECURITY FOR SUSTAINABILITY: A THEORETICAL REVIEW

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INTRODUCTION

The idea that nature and resources are unlimited is both an economic and an environmental illusion. The understanding that adopts the principle of changing the "*unlimited consumption*" pattern that has been going on for thousands of years, and while meeting the needs of today protecting the rights of future generations on the resources and life bases is called the concept of "*sustainable development*". Sustainable development requires a commitment to secure economic policies and management, an efficient and transparent public administration, participation of all relevant parties in the decision-making process in the light of the country-specific conditions of environmental concerns and making progress towards democratic management (Tekeli, 2000: 729; Yıkılmaz, 2003: 118). In line with this requirement, the interdependence and solidarity figured by development and environmental issues have brought a new meaning and dimension to international politics and become the determinants of international economic and political relations.

Furthermore, the implementation of global environmental policies in order not to prevent sustainable development is necessary for environmental cooperation. The fact that the management of environmental funds is under the authority of institutions such as the World Bank, and that global environmental policies go against the interests of multinational companies are major factors that prevent international environmental cooperation. Sustainable development moves away from the better management of environmental resources with these obstacles and focuses on industrialization and growth targets. This causes a differentiation between the content and implementation of the concept. This differentiation reveals the concept of "*sustainable environment*", which defines "*the process of improving, preserving and developing all environmental values that constitute the environment of both today and future generations without jeopardizing the existence and quality of resources that future generations will need*". With this incoming definition, the concept of sustainable development is removed from its basic meaning and purpose, and the argument of those who exclude the *environment* and think of *development* solely with a socio-economic focus is strengthened.

Growth and welfare must be increased together for the *sustainability* of *development*. Since the increase in growth is achieved on the condition that the rate of resources (raw materials and energy) entering into production does not decrease, a model that will ensure the continuity (sustainability) of these resources can be defined as "*environmental sustainability*". In other words, environmental sustainability is a prerequisite for the development to be sustainable. On the other hand, the debates about security are not military-based anymore. Issues experienced in the area of energy and environment frequently bring countries and energy supply companies confronted. These problems cause countries to spend at a high level in both energy and environmental areas and to resort to security practices. Studies and evaluations show that developments in the areas of energy and the environment are also based on *sustainability*. It is anticipated that this study will contribute to the assimilation of the issue by emphasizing some essential points as a result of the review of the studies carried through to determine the problems and to research the solutions to ensure environmental sustainability.

1. THE CONCEPT OF *SUSTAINABILITY*

In recent years, the word *"sustainable"* is frequently encountered in scientific circles. This concept, which is frequently used in public economics and development literature, includes many other environmental and social dimensions. Different dates are given in various studies regarding when and where the concept of *sustainability* was first used. The concept of *sustainability* was first used in the 1980s and refers to *"the use of our existing resources in a way that is sufficient for future generations"*. It is based on the report titled World Conservation Strategy prepared by the International Union for the Conservation of Nature and Natural Resources (IUCN) in 1980. The concept was generally accepted and found a wide area of use with the report titled "Our Common Future" of the World Environment and Development Commission (1987). *Sustainable development* is defined in this report as *"development that meets today's needs without compromising the ability of future generations to meet their own needs."* Today, "*sustainable*" or "*sustainability*" is based on the change and depletion of the resources that exist as a result of global warming in our world. In this direction, the correct use of resources, that is, the use of "*sustainable*" is a must. *Sustainability* is at the exact center of the triangle of energy, economy and the environment, so it is discussed in a wide range from social scientists to natural scientists, from politicians to local and international environmental organizations, as well as governments and intergovernmental organizations. Different branches of science working on this subject have developed different approaches and different definitions due to the multidimensional nature of the concept of sustainability.

There are still disagreements regarding the framework of the concept due to this multidimensionality. On the other hand, the parties of the discussion propose approaches to measure sustainability through the framework they define, set various goals and propose policies to be followed in achieving these goals. Although concerns about sustainability can be traced back to some 18th and 19th-century economists, the emergence of the concept of "sustainable development" coincides with the emergence of environmental concerns in the 20th century. The first wave of contemporary environmentalism movements that emerged in the 1960s and 1970s transformed from traditional concern of nature conservation to awareness of a possible global environmental crisis. Environmentalists affected by this first wave believed economic growth, industrialization, western culture and technology as responsible for environmental problems. Environmentalists have argued that sustaining rapid population growth and industrial activity is not possible without drastically depleting the planet's resources and overloading its capacity to cope with human waste and pollution. During these periods, governments announced measures for local environmental problems due to public pressure; however, they remained indifferent to global environmental problems (Markandya et al., 2002: 17-18). The environmental movement was later interrupted, with some researchers claiming that the situation was exaggerated. The parties of the debate shaped their views within the framework of the speed of technical progress, changes in the composition of output and possibilities of substitution. Those who argue that the situation is an exaggerated claim that developing technology and innovations will be a solution to environmental problems. In this process, governments have behaved lax in implementing the environmental measures they have adopted (Beder, 1994; Cole, 2006: 241). The second environmentalism trend, which started to form in the early 1980s and matured towards the end, managed to find wider support, unlike the first trend. In this way, the concept of "sustainable development" has been adopted and supported by governments, business circles and economists. Undoubtedly, one of the reasons behind the wide support of this trend was the ozone hole in Antarctica, which was first detected in 1984.

Since the concept of sustainable development was introduced, it has been defined many times and in different ways. This situation caused the concept to be ambiguous. Definitions are generally created to reflect the academic branches of those who made the definition. Economists often tend to emphasize the need to maintain a certain level of living standards. Ecologists have been concerned with biodiversity and ecological resilience. On the other hand, sociologists gave priority to the need to protect sociological ties and mutual relations within communities (Cole, 2006: 242; Lees, 2015: 52-53). The first steps taken to define the concept more precisely were on the theoretical level and focused on the economic and environmental dimensions of the debate (Markandya et al., 2002: 17). One of the first contributions to the definition of the concept in terms of the economy was made by Pearce, Barbier and Markandya (1990: 1-22). They argued that the concept meant that no future generation would be worse than the present generation. They based their views on Rawls' theory of justice on the basis of the principle of "intergenerational equality". Accordingly, society should not allow prosperity to decline over time.

Analyzes on sustainable development focused on the economic, social and environmental dimensions of the concept in later times. Munasinghe (2001, 2009, 2015) stated that a new framework called sustainability with an interdisciplinary approach is needed to ensure sustainable development. Figure 1 shows the basic elements of sustainable development and the connections between these elements, according to the approach suggested by Munasinghe. Each area at the corners of the triangle has its driving forces and goals. The economy has tended towards enhancing human well-being, mainly through increasing consumption of goods and services. The environmental domain is focused on preserving the integrity and resilience of ecosystems. The social sphere emphasizes ensuring that people achieve their goals individually and as a group in addition to enriching and strengthening human relationships (Munasinghe, 2015: 10).

Figure 1: Sustainable Development Triangle (Munasinghe. 2015)

The sustainable development triangle was presented for the first time at the United Nations Conference on Environment and Development held in Rio de Janeiro, Brazil in 1992 to emphasize the importance of the inside and sides of the triangle as much as its corners. The reason why issues such as poverty or climate change are at the center of the triangle is that these problems must be addressed in all three dimensions. Methods that connect the economic, social and environmental areas are also of high importance. Some approaches bridge these three areas such as conservation ecology, environmental ethics, energy economics, environment and natural resources economics, ecological economics, sociology economics, environmental sociology, etc. In this study, a theoretical assessment is made on "*environmental sustainability*". In this context, it is thought that energy security and environmental security issues are also important in terms of *environmental sustainability* and will contribute to a better understanding of the issue.

2. ENVIRONMENTAL SUSTAINABILITY AND ENVIRONMENTAL SECURITY

Environmental sustainability focuses on the quality and quantity of the natural environment that provides the necessary life support for the survival of human life, which is the necessity for the existence of an economy unlike economic sustainability, which focuses on the sustainability of growth and consumption under natural resource constraints, This quality and quantity are called natural capital by neoclassical and ecological economic trends.

The natural environment provides basic needs such as food and shelter as well as the suitable climatic and atmospheric conditions for life to survive on earth. It is impossible for any living species in the world, including humans, to exist alone; because all living beings are parts of an ecosystem where they interact with each other and with other non-living beings. For example; When the world ecosystem is considered as a whole, it is obvious that life can also come to an end if the creatures capable of photosynthesis, which is the basis of life on earth, disappear. All parts of an ecosystem are intricately linked. Therefore, if a part of the ecosystem is destroyed or damaged, related consequences will occur in other parts as well. Naturally, the dimensions of these impacts that will occur will vary according to the nature, scale and duration of the damage to the ecosystem, the importance of the affected parts in the ecosystem and the self-healing power of the ecosystem. Since humans are also a part of the world ecosystem, the results of their effects are reflected in other parts of the ecosystem. All living beings in the world compete or alter the environment unconsciously to survive and develop. However, two features distinguish humans from all other living beings. (i) It has the power to endanger and further destroy the ecosystems it depends on for its survival, and (ii) its domination on these ecosystems by spreading to every ecosystem on earth and the ability of using technology (Alpagut, 1997; Ponting, 2008).

Undoubtedly, the most important goal of people during their nearly two million years of existence has been to find ways to obtain their material needs such as food, clothing, shelter and energy from the ecosystems they live in. According to Ponting (2008), the biggest problem of people in connection with this is the inability to balance the various demands of ecosystems with the pressures caused by these demands. People have lived in harmony with the natural environment for hundreds of thousands of years. While the first humans lived in small hunter-gatherer groups using simple tools, this successful and flexible lifestyle caused the least damage to natural ecosystems. Approximately 8-10 thousand years ago, with the transition to agriculture, the number of settled societies increased and the relationship of human beings with the natural environment began to differ. There has been an increase in the world population as a direct result of agriculture. It was necessary to increase the arable lands to feed the growing population and for this purpose, agricultural production was increased by destroying marshes and forest areas. Problems such as soil loss due to deforestation, salinization of the soil as a result of excessive irrigation and desertification caused serious consequences even in the Sumerians period. These activities have caused irreversible damage to the ecosystems humans live in, and in some cases even resulted in the end of human existence in relatively isolated ecosystems. Agricultural production, which was increased by limited increases in productivity and the opening of new lands for thousands of years, started to fall to the second plan after the industrial revolution. The increase in energy needs of the rapidly growing industry with the industrial revolution caused the use of non-renewable natural resources such as coal and oil. With the industry becoming the dominant sector, new ones have been added to the environmental degradation created by people's agriculture-based economy. It should not be ignored that the contributions of energy use also cause environmental degradation. Increasing demand for energy and natural resources in the economic development process is also one of the biggest causes of environmental degradation. Rapid industrialization and, as a result, factors such as modern urbanization and rapid population growth have caused air, water and soil pollution, a decrease in biodiversity, and the problems such as soil loss and desertification have reached even more serious dimensions (Gowdy and McDaniel, 1995; Ponting, 2008; Keleş, Hamamcı & Çoban, 2009; Aytun, et al. 2017: 228).

All these show that the destructive effect of humankind on the natural environment overrides the rate of self-healing of the natural environment. This is where the concept of ecological resilience comes into play. Resilience is the amount of disturbance an ecosystem can absorb/withstand before re-establishing its structure by changing the variables and processes that govern its behavior. It is necessary to understand the underlying multiple steady-state assumption(s) to better comprehend the resilience. Accordingly, there are multiple states of equilibrium in which an ecosystem can be found. Human activities usually cause the resilience of ecosystems to decrease, causing steady-state changes and the sign of the new steady-state reached is a resource crisis for humans (Gunderson, 2000. 431). It is increasingly evident that ecological resilience is based on mechanisms linked to diversity and slowly changing environmental variables. Resilience not only contributes to the provision of many ways useful ecosystem services for communities but also provides a stable environment for people to use these services. In this sense, loss of resilience is undesirable (Adger, 2006: 83). According to Arrow et al. (1995: 520), the reduction of ecosystem resilience is important for at least three reasons. First, when the ecosystem moves from one equilibrium to another, sudden changes in ecosystem functions can lead to sudden decreases in biological productivity and therefore a decrease in the capacity to support human life. Secondly, it may result in the set of options held by present or future generations changing irreversibly or reversibly at an enormous cost (Mäler, 2000: 648). Lastly, sudden and irreversible changes from the usual steady-state balances to other unknown balances will increase the uncertainties. Therefore, the resilience of the ecosystems on which economies depend must be guaranteed for the economic activities of people to be sustainable. In this way, environmental sustainability will also be achieved.

Guaranteeing ecosystems has brought about some changes in the concept of *security*. The concept of national security, which is defined as the prevention of all kinds of threats to the interests of the countries and the existence and future of the people living within their borders, is now diversified with new approaches such as *environmental security, energy security* and *ecological security*. The concept of "*ecological security*", which is put forward as a response to the avoiding of threats caused by factors such as global warming, deforestation, species survival and pollution, is used instead of the concept of "*environmental security*".

This concept explains that the effects of military interventions on the ecosystem result in ecological destruction, and as a result, the concept of ecological migration is formed. It can be said that the most important distinction of ecological security from the environmental security is that it does not perceive the destruction of the artificial environment as a threat, and does not include these destructions in the scope of the definition of security with a narrow ecologist perspective

(Eckersley, 1996: 142). This change in the concept of security has required the concept of sustainability to be addressed in an integrated manner with environmental security to understand and solve environmental problems (Lees, 2015: 43). Environmental security focuses more on intergenerational equality and the impact of societies than sustainability, especially when considered in terms of human meaning. Second, environmental security explores the collapse of classical security policy and/or foreign policy and the environment. Third, environmental security examines the environmental impact of military impacts and explores the possibilities for the military to turn into an environmentalist structure. Finally, perhaps the most important difference in environmental security is its political dimension. Although it has a political dimension, environmental security does not require new policies, but first, a renewed effort to ensure the existence and implementation of sustainable policies (Barnett and Dovers, 2001: 161).

Towards the end of the 20th century, the concept of "environmental security" emerged as a result of the changes in the security area and the presence of threats, and became a candidate to replace classical security strategies (Tuna, 2001: 151). Many views and studies evaluate traditional security and environmental security as separate concepts. Security is not a merely military, economic or environmental issue according to these views. Security is a phenomenon that arises from the interaction of all these elements. The arguments of those who define environmental security within traditional security are based on four foundations (Deudney, 1991: 18): According to the first argument, radical changes in geopolitical conditions after the Cold War have created many threats that require a military solution. If the definition range of the security concept that meets open military threats is expanded, the traditional structure of the security concept will be disrupted. It is secondly argued that internal conflicts led by national security and environmental degradation should not be defined as environmental threats, but should be seen as two separate phenomena. According to the third argument, as the scope of security is expanded, the concept becomes empty. On the other hand, the aim of obtaining a share from the appropriations allocated to military expenditures for environmental protection is abused by various environmental organizations. Almost all studies on environmental conflicts focus on developing countries under the final basis. These countries are sensitive areas in terms of environmental security.

At this point, which kind of environmental problem will threaten security should be well researched, discussed and resolved. Whether there is a security dimension of an environmental problem depends on the perspective of the environment and security (Shaw, 1996: 18; Lees, 2015: 48). However, a change in the quality, quantity and sustainability of environmental resources, unfair distribution of resources and products, reduction or disappearance of living, housing, reproduction and freedom rights mean life is not safe. These changes constitute the content of the concept defined as environmental security

(Uğurlu, 2006: 85). In general terms, the concept of environmental security has three dimensions (Keleş and Ertan, 2002: 240-241).

1. Environmental crisis that will endanger the lives and existence of human species and other living beings on a world scale.
2. The nature of environmental problems that threaten economic and political stability.
3. Distribution of environmental resources and the risk of environmental problems causing conflicts between countries and communities

The definition of environmental security cannot be generalized to the whole world from a single region. Every country, every religion, every race has different values, customs and traditions, beliefs, needs and priorities. A resource that is not so important for a region can be vital for another region. On the other hand, the interplay between environment and security is reacted by the governments of the respective regions or appears less important than other problems. Various stakeholders have different expectations and political sensitivities must also be taken into account. Elements that threaten environmental security, such as the globalization of environmental problems, often have cross-border features. Three distinct variables help to define the importance of environmental security problems as a framework. These are the elements of the strategy; time, place and effect (Barnett and Dovers, 2001: 163). The problems that environmental security focuses on can be defined as macro-scale environmental problems.

3. ENERGY SECURITY AND SUSTAINABILITY

Energy security has existed on national and international grounds from the 1900s until today, but a common consensus based on the concept cannot be established. It has a dynamic character that is affected by conditions over time but can change without losing some of its fundamental points. The innovations that may arise in energy technology, the increase in awareness based on climate change, the increase in sustainable energy resources are just a few of the developments that can reshape energy security (Çıtak and Pala, 2016: 86). Energy security means securing the energy needs of individuals and consumers and protecting the economic interests of both society and the state against internal and external threats. There is still no clear definition of the energy security concept in the scientific literature. It is considered as a concept *"fuzzy", "weak", "difficult to define"* and *"encompassing many factors"*.

Energy security needs to be a system that can not only provide energy to consumers with favorable conditions and reasonable prices but also resist disruptions caused by technological, natural, economic, socio-political and geopolitical reasons (Augutis et al., 2015: 301). The World Energy Council's definition of energy security is based on the concept of *sustainability* and three main elements: *Energy security, energy equity and environmental sustainability*. These three objectives constitute a *'trinity'* (equation with three unknowns), comprising of the public and private sectors, governments and regulators, economic and social factors, national resources, environmental concerns and individual behavior, bringing together complex and interconnected connections (World Energy Trilemma Index).

The International Strategic Research Organization (USAK) generally defines the concept of energy security on four main pillars: "*availability, accessibility, affordability* and *sustainability"*. *Availability* is related to the availability of energy resources and this topic becomes important in the context of supply/demand security. *Accessibility* is whether those who need it can easily access these resources. The *affordability* dimension is in two aspects. The demandant can obtain energy resources within a competitive market mechanism and to meet the price level that will allow economic development and new investments for the energy source supplier. *Sustainability* means that the requested energy can be reached as long as required and without any interruptions. (USAK, 2011). Energy security is related to energy types, economic growth, geoeconomic and geopolitical power balances, security threats, energy infrastructure systems in a broad sense. Energy availability, price, energy infrastructure, environment and energy efficiency are classic energy security elements. On the other hand, energy security has become a multifaceted concept with the influence of importing countries, consumers, energy-intensive industry, exporting and main producer countries, transit countries, oil and gas companies and policymakers (Figure 2). It can be said that energy security has different meanings for different countries and parties (Çıtak and Pala, 2016: 87-88).

The Parties of Energy Security

Importing countries | Exporter-Main producing countries | Transit countries | Oil and gas companies | Policymakers

Consumers

Energy- intensive industry

Figure 2: The Parties of Energy Security (Çıtak and Pala. 2016)

Besides the contribution of energy production and consumption to the development of national economies, its effects on environmental pollution and environmental security are also great. For this reason, it can be accepted that an important element of the relationship between environment and sustainable development as well as between environment and safety is the energy production and consumption policies of countries. Moreover, managers have to find the energy needed by the society and the economy in uninterrupted, reliable, clean and cheap ways and to diversify these sources. Societies have started to look for energy policies and energy security models that take into account the diversity of resources and geopolitical realities, with a planning approach that carefully observes the energy-economy-ecology balance to prevent the irreversible destruction of classical energy resources and backward technologies in the natural environment (Uğurlu, 2016: 86).

The shaping of the energy security perception of the modern era is the 1973 Oil Crisis. The world economy has grown rapidly, and international trade and consequently the need for energy/oil have increased rapidly between 1960-1970 (Karabulut, 2016. 35). The Oil Crisis in 1973 created an atmosphere of insecurity in energy resources for the first time. The problem of energy security, which emerged in two waves in 1973-1974 and 1979-1980, created serious problems for the great powers and especially the Western states. The loss of production due to the slowdown in production caused the contraction and even decline of the industrialized countries' economies. Besides, a serious unemployment problem arose in countries with high energy dependence. The rapid rise in energy prices caused the existing governments to lose their reputation (Bielecki, 2002: 236). There has been intense interest in new and renewable resources all over the world since then. In the mid-1980s, oil prices fell, but the concept of "energy security", which came to the fore as a result of the oil crisis, remained permanent. "*Diversification of energy*" has become one of the indispensable elements of energy policies. The concepts of energy security and resource diversity have led to the inclusion of renewable energy sources in the energy spectrum (Altuntaşoğlu, 2003: 197).

There are two basic elements of energy security as economic and political. The first is actions affecting the quantity and security of energy supply from domestic sources, and the second is actions affecting the energy supply from external sources. These two elements are closely related to each other, particularly for reasons such as the domestic energy supply exerting pressure on energy imports. The external energy supply element creates important problems for national security. Energy security is achieved by managing energy demand, increasing energy supply with domestic resources or increasing supply security with outsourced resources (Deese, 1979:

143). Energy policies will be far from ensuring sustainability and security unless they are handled in an integrated manner with environmental policies. It is possible by diversifying energy to prevent dependence on external resources in the context of energy and to take measures against the occurrence of disruptions such as a decrease, exhaustion, interruption, and shutdown that may arise from any source. It should be taken into account that the energy to be obtained from a single type of source or a higher rate using a resource than others will generate a kind of dependency. If urgent solutions cannot be produced for problems such as interruption or production disruption that may arise from such a source, there will be an insecurity problem in energy. For this reason, it can be assumed that one of the ways to ensure energy security is to "*diversify resources*" (Uğurlu, 2006: 88).

3.1. Resource diversification

Resource diversification can be handled in two axes. The first of these is the diversity between sources in the total energy consumed, and the second is the diversity between the regions from which the source is provided. Sourced regions can be either the own resources of a country within its borders or based on the countries from which it imports. The fact that resources are predominantly met from a certain region will affect the security of the energy supply. Conflicts, natural or human-made destructions that may occur in a certain region may cause ruptures in transmission lines and interruption of the sustainability of energy. If the originating region is within the borders of the country, losses and leaks that may arise from transmission should also be considered. The high share of a single resource type in the total energy consumed is an energy security problem regardless of whether the source is domestic or imported. In the face of a problem such as a decrease, cut-off, or failure that may arise from this resource, the probability of other resources to meet the country's needs is extremely low. On the other hand, the highly consumed resource can be considered as an indicator of the energy dependence of that country. It should be expected that the state of addiction will negatively affect the bargaining ability in purchasing agreements regarding energy to be provided from this source. However, limiting energy security to *resource diversification* will be an approach that narrows the scope of the concept considerably (Uğurlu, 2006: 88-92).

3.2. Price security

Energy security is the situation in which people and businesses in a country, countries or parts of them can access sufficient and necessary energy at affordable *prices* under the assumption of significant risks that may arise from future distribution services (Barton, 2004: 5). Energy supply security is not only the existence of production in a certain place or the determination of the reserve but the ability to integrate and move them into the system at a timely, *cheap* and sufficient level and the sustainability of this (Dokuzlar, 2006: 169-170). At this point, price increases in energy resources should be expected to affect *security* significantly. On the other hand, as competition increases in ensuring the sustainability of the energy source, it is almost certain that the peak in oil production will start a period in which prices increase significantly. The impact of this situation on the global economy (transport, agriculture and industry) is expected to be large.

3. 3. Resource allocation and sharing

The third factor in which energy security is discussed is resource allocation and sharing. Because energy sources are potential causes of conflict. The continental shelf tension between Greece and Turkey experienced in the Mediterranean is the most recent and striking example of this. Efficient use of energy confronts supply countries with demand centers and power centers that want to control the supply of this strategic raw material in global markets. The limited use of energy resources and the unbalanced distribution of resources in the world ensure that energy plays a leading role in determining global policies. Resources are very limited, especially in developed Western countries with high energy consumption. On the other hand, resource intensity in underdeveloped or developing countries, the struggle to have energy resources, to control transportation and trade constitute the basis of hot or cold wars in the World (Çıtak and Pala, 2016: 90-91).

3.4. Political changes and external factors

The fourth issue where energy security is discussed is political changes and external factors. A political change (Iraq War and regime change, Syrian War, etc.) in countries where energy resources are intense will affect the energy security of both the region and the countries that are in contact with that region. Moreover, conflicts in the energy area affect domestic policy and national security. For example, the increase in energy prices can take the domestic economy and the international economy in a negative direction (Deese, 1979: 145).

CONCLUSION

The concepts of energy and environment and the related security issue are evaluated by considering the historical development processes in particular the concept of sustainability, and the multidimensional structure of the idea of sustainability is revealed in this study. The sustainability issue generally focuses on how the consumption can be sustained for the longest time under natural resource constraints. This situation, which causes sustainability to be approached purely from an economic perspective, has resulted in the association of sustainability with economic growth/development, and sustainability and efficiency are discussed together. Even the ecological economy approach has emerged as a reaction to this situation.

Environmental and energy aspects, which are as important as the economic size of sustainability, have been ignored by economic approaches for a long time. However, a more comprehensive analysis for sustainability needs to be put forward in addition to the noticeable increase in the effects of environmental problems (climate change, land loss and desertification, decrease in biodiversity, air, water and soil pollution) on human life and economies. The emergence of ecological economics, which suggests an interdisciplinary and pluralistic approach to environmental problems, has created changes in the environmental view of economic approaches.

Although debates on the meaning of the sustainability concept are continuing, it is now generally accepted that the concept has a multidimensional structure as understood from the theoretical review evaluated in the study. The sustainability issue needs to be resolved with an interdisciplinary perspective. The concept of environmental security comes to the fore when this necessity is addressed together with security. Considering the sustainability of a country's energy policies and energy security in the context of environmental security, these phenomena have to be handled in an integrated manner rather than based on their common points. Within the framework of this harmony, although energy security is the subject of global environmental policies and foreign policy, under the discourse of resource diversification, it is seen that global environmental policies and environmental foreign policies have become the subject of energy security to have a voice in energy production and transmission. The concepts of energy security and sustainable energy policies are sub-headings of environmental security and contain many elements that the traditional security concept covers. Besides, the national policies of the countries in the area of environment and energy can be considered as an indicator of their attitude to security issues.

A distribution model that will ensure the continuity (sustainability) of these resources should be formed for environmental sustainability so that the rate of resources entering into production for growth/development and offered to consumption for welfare does not decrease. Besides, it is equally important to have a realistic distribution between the types of resources. The lifetime of the resources selected during this distribution is also noteworthy. An investment in a short-lived or difficult-to-reach resource should be expected to be a dead investment and such an investment will not comply with the requirements of a sustainable energy policy.

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CHAPTER 2

NATURAL DISASTERS AND RENEWABLE ENERGY POLICIES

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INTRODUCTION

Energy input plays a key role for the development of countries' economic activities. Countries with energy resources reduce their input costs and perform generation at a lower cost, and they move to the forefront in the external market by gaining a competitive advantage in the globalized world. Constant and safe provision of energy to countries is as critical as the energy supply itself. Natural disasters occur as a result of climate changes, and these disasters create problems for the continuous transfer of energy input to economy.

Energy generation systems that perform based on the non-renewable energy sources have constituted the basis of countries' energy policies since the 20th century. As the process of industrialization has gained a momentum, the demand for energy resources has increased for transportation, communication and financial infrastructure. Therefore, countries with energy resources have become strategically important states. However, the countries with limited non-renewable energy resources have looked for new energy resources, such as nuclear power plants, as their dependence on energy has grown. In addition to the variety of energy resources, energy safety is another important concept in this regard. While countries make efforts to increase the amount of their energy resources, they also fight against the factors that adversely affect the infrastructure, such as the transportation and communication networks, as a result of the destruction and wear in the energy systems (Al Kaili, 2014:703).

Covid-19 pandemic has caused more interruptions in the energy sector than anything else in the recent periods, and it has left impacts that will be felt more in the upcoming years. With the effects of climate change that is one of the greatest issues of the modern times, it is clear that the energy sector will undergo a significant transformation process (International Energy Agency, 2020).

According to the estimations affected by the impacts of Covid-19, global energy demand will decrease by 5% while energy-related CO2 emissions will decrease by 7%, and energy investments will decrease by 18% in 2020. Moreover, petrol demand will fall by 8% and coal usage will decrease by 7%, which is an absolute contradiction with the slight increase in the contribution of renewable energy (International Energy Agency, 2020).

Destructions regarding energy systems or infrastructure (such as vandalism or theft) may be caused by humans and occur as force majeure. Natural disasters, such as earthquake, tsunami or hurricane, may damage the critical energy infrastructure elements and cause social and environmental problems as well as loss of life and property (USAK, 2011). Hurricane Katrina and Rita damaged the resources along the Mexican Gulf that constituted 25% of petrol production and 20% of natural gas production in the United States. Moreover, more than 340,000 people in Louisiana could not utilize electricity; this figure was 316,000 in Texas (Kumins and Bamberger, 2006:1). The tsunami incident that occurred in Japan following an earthquake and affected the Fukushima Nuclear Power Plant created adverse impacts on the reactors as cooling systems submerged and caused radioactive substances to spread over the ground upon the explosion in reactor buildings. In addition to the environmental damages, this disaster directed Japan to perform the energy supply through alternative energy resources. Japans' initial plan for 2030 was to perform 53% of its total electricity generation through the afore-noted nuclear plant, which currently constitutes 30% of total electricity generation in the country. In addition, this issue also created impacts for other developed countries such as Switzerland, Germany and Italy, which had a nuclear plant, caused authorities to review the energy policies (World Energy Council, 2013:2).

Natural disasters have adverse impacts on energy infrastructures. Collapse of networks following natural disasters makes the economy more devastating. Collapse of energy infrastructure may temporarily paralyze any economic structure. Following the Hurricane Irma, a total of 11 people dies in a nursing home at Florida owing to the inability to use air conditioning, which shows that natural disasters and their impacts on energy infrastructure pose a life-threatening danger. Hurricane Maria, which has been the cause of the longest power cut in the history of the United States, damaged the electric network in Puerto Rico in 2017. Having totally cut the power delivered to the island, the hurricane resulted in death for thousands of people and cut the power of many hospitals (Uja, 2020).

As a result of the natural disasters, policies that ensure resistance in the infrastructure of critical energy systems and the formations where the resistance of alternative energy resources to the natural disasters is much better come to the forefront, and how the energy systems will be protected against the dangers that do not arise from people constitute the basis of energy policies. As the energy generation systems become more resistant, energy supply is performed in a safer manner and the production activities powered by energy gain momentum. Therefore, increase in the production activities triggers economic growth and help the citizens of a country live in wealth as their income increases.

After determining the specific energy resources, this study assesses the damages which may emerge in countries' energy infrastructures owing to natural disasters and evaluates the energy policies that are designed in line with these factors.

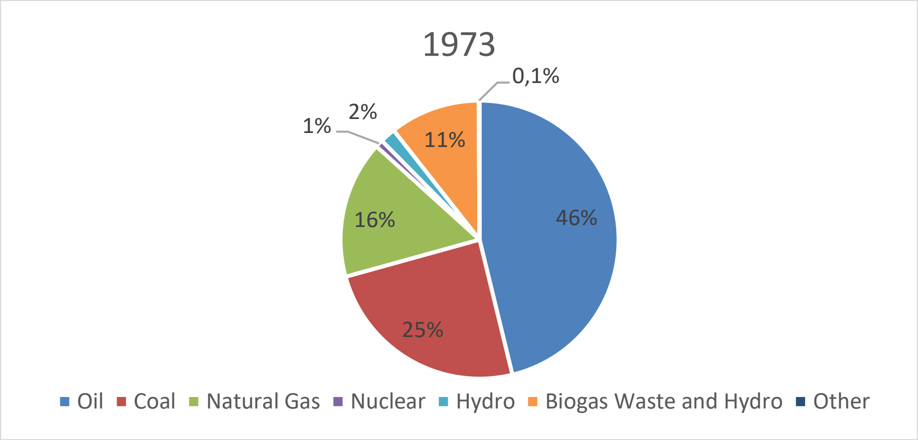
1. RENEWABLE ENERGY RESOURCES AND ESTIMATIONS REGARDING THE FUTURE

Global energy resources are divided into two as follows: non-renewable energy resources such as petrol and natural gas, and renewable energy resources such as solar, wind and bio-thermal energy. Based on generation and consumption, non-renewable energy sources are the ones used the most. In relation with industrialization, the demand for energy has increased and relevant resources have failed to meet this demand in the developed and developing economies due to the increased growth rate in economy and better life standards. Therefore, based on the consumption of non-renewable energy resources, it is safe to state that authorities make efforts to increase the generation of these energy resources. The global population is believed to reach 8.3 billion in 2030, and the rate of growth in energy demand will be 1.6 between 2011 and 2030. The population of countries that have low and moderate income and that are outside the OECD is believed to reach 90% in 2030, and the rate of growth in Gross Domestic Product will reach 70% based on the concept of urbanization, according to estimations. Similarly, the increase in energy demand will be over 90%. For OECD countries, energy consumption rate will be higher by 6% in 2030 compared to 2011, and the income per person will decrease (BP Energy Outlook, 2013:9).

Moreover, according to the estimation made by the International Energy Agency in relation to the energy-based appearance of 2020, renewable energies are believed to increase in all positive or negative scenarios in line with the pandemic. In addition, renewable resources will meet 80% of global electricity demand by 2030. Hydroelectricity continues being the greatest source of renewable electricity. However, the sun will be the main driving force of development as it will break new records of distribution after 2022. Development of renewable generation sources and solar energy and contribution of nuclear energy will be much more effective in 2050. For renewable energies, policies of abandoning coal as well as the increase in renewable energy sources and competition arising from natural gas will result in globally abandoning coal fuel capacity that is equivalent to 275 gigawatt (GW) (13% of the total figure in 2019) by 2025. The estimated rate of increase in the demand for coal in the developing countries within Asia will be significantly lower compared to the previous studies. The share of coal within the mixture of global energy generation decreased from 37% to 28% in 2019, and it is believed to decrease to 15% in 2030 (International Energy Agency, 2020).

Increase in the rate of generation from renewable resources and nuclear energy helps lower the emissions in cost-effective sectors for electricity distribution such as passenger transportation. Therefore, electricity plays a greater role in the general energy consumption. Missions that are more complicated for the transformation of energy sector come to the forefront in the industrial sectors such as steel and cement production, long-distance transportation, and activities of balancing, guaranteeing and sustaining multiple changes that occur in parallel to a complicated energy system. Sustaining the effective tempo of emission reductions requires energy and material efficiency, electrification, and focus on a stronger role for low-carbon fluids and gases to ensure renewable energies play a greater role in the generation processes (IEA, 2020).

The global non-renewable and renewable energy supply indicates that energy generation has increased and petrol is still an important resource of energy even if its share has shrunk. In addition to the increase in the share of natural gas, coal and nuclear power plant, generation of other energy resources such as biomass, solar and wind energy has also grown. The Figure 1 below indicates the distribution of primary energy source from 1973 and 2013.



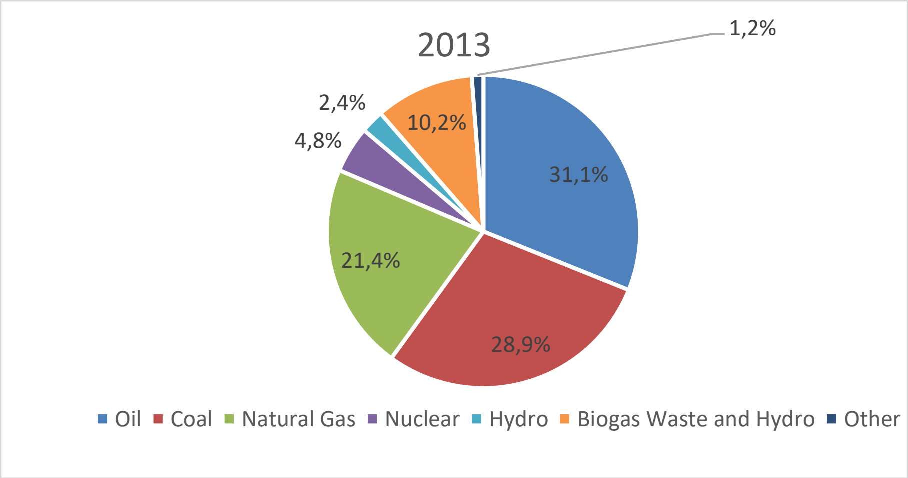
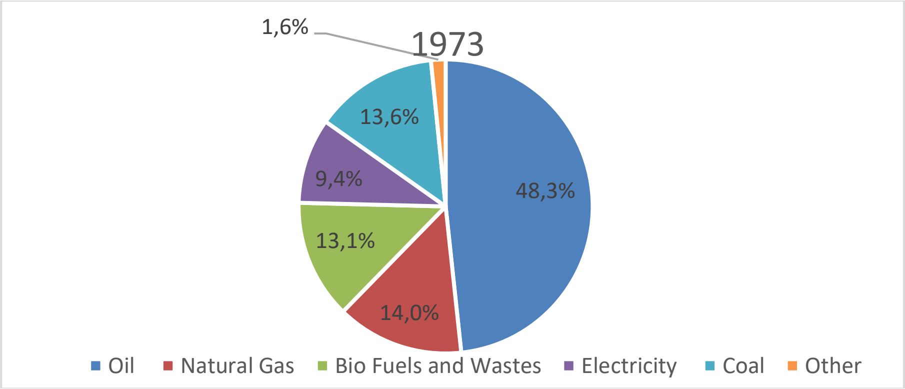


Figure 1: Primary Global Energy Supply in 1973 and 2013
Source: International Energy Agency,2015

Like the increase in energy generation, the increase in consumption has also captured attention. With the increase in the use of energy by the Asian countries that are outside the OECD, such as China and India, the demand for energy has increased. The total final consumption in 1973 was 4.667 mtoe (million tons equivalent petrol), which increased to 9.301 mtoe in 2013. Like production, the consumption of petrol decreased from 48.3% to 39.9%, while the demand for natural gas and electricity increased. However, the greatest change occurred in the demand for electricity: the rate of demand was 9.4% in 1973 and around 18% in 2013, indicating an increase of approximately 100%. Increase of electricity consumption occurred in relation to the increase in using agricultural, commercial and public services, and in the rate of usage seen in residential areas. Another factor is that the consumption of geothermal, solar, wind and other alternative energy resources has increased. The Figure 2 below indicates the distribution in the consumption of energy resources.



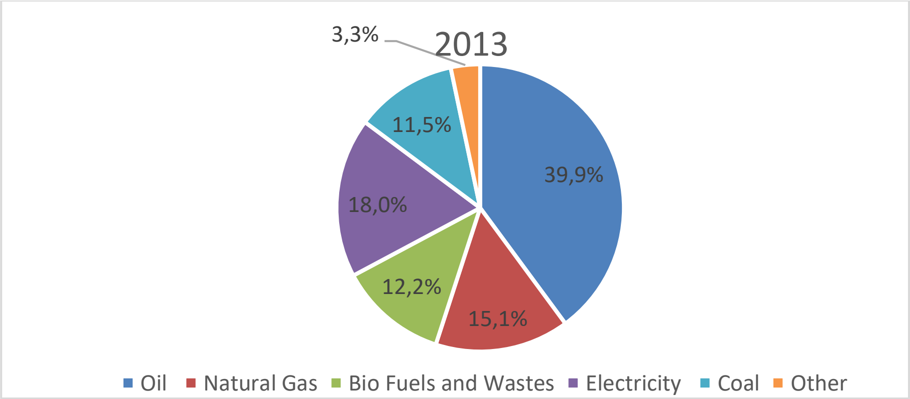


Figure 2: Primary Global Energy Supply in 1973 and 2013
Source: International Energy Agenc

The table below indicates the yearly changes in the share of the renewable energies within the global energy resources.

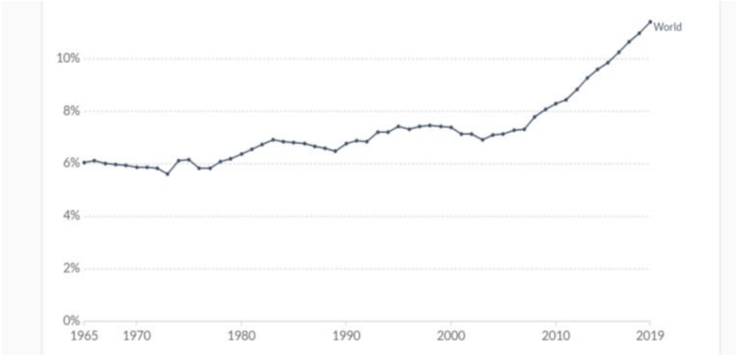


Figure 3: Share of Renewable Energies in Energy Generation
Source: Our World in Data

According to the figure above, the share of renewable energies within the total energy use globally increased by years. Use of renewable energy that rapidly increased after 2007 reached beyond 10% after 2015, and took place at a rate of 11.5% in 2019. With the impacts of Covid-19 crisis, the share of renewable energy resources in energy has increased and it is believed that these resources will have greater shares following 2030.

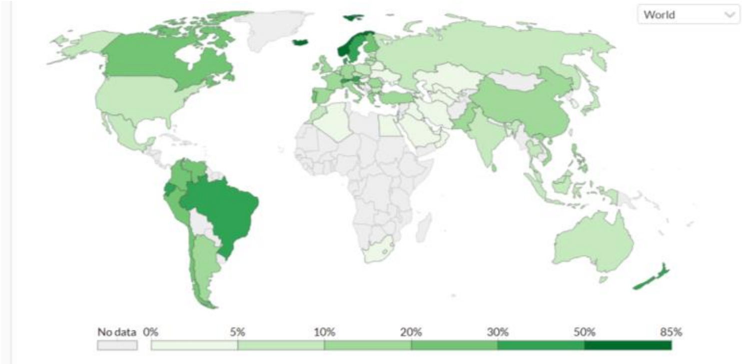


Figure 4: Distribution of Using Renewable Energy per Countries (2019)
Source: Our World in Data

The Figure 4 above indicates the usage-related shares of renewable energy per countries in 2019. Accordingly, the countries capturing attention are Norway, Brazil and certain Latin American and European countries. Norway has the highest share with 66%, followed by Brazil with 45%, Sweden with 42% and Austria with 33%. Turkey's 2019 share was calculated as approximately 18%. Moreover, China's share is 12%, followed by the United States with 8%. Lower rates in China and United States, two countries that have significant shares in production processes, compared to other countries suggests that these two countries sustain their 'polluting production processes'.

The decrease of costs in the renewable energy process helps sustain the share of renewable energies in Europe and spread these renewable energies into other regions. European Union (EU) leads the activities of promoting renewable energy. However, dimension of the subvention load has turned into a limitation for growth in certain markets. The advantage obtained through reduced costs will alleviate the limitation (BP, 2015).

The share of renewable energy sources in the energies used in the production processes has been growing. For instance, renewable energies are dominant in terms of the growth of non-fossil energy in OECD countries, and they contribute to 90% of the net growth in electricity generation from all resources. Rapid growth or renewable energies depends on the policy support in many markets because renewable resources tends to be more expensive than the energies operating through coal or gas. As the volume of renewable energies grows, the load of this policy support may turn into a limitation on growth. To sustain the rapid growth, renewable energy costs need to continue decreasing and the subvention per the power unit may need to be decreased. Additionally, due to technological developments, learning by doing and scale economies, the renewable energy costs are expected to decrease significantly (BP, 2015).

Moreover, the pollution-reducing impact of renewable energy on a global scale as well as the decrease in the personal and social wealth arising from the diseases associated with the pollution and the role of renewable energy in shaping the decisions of policy makers in the developed countries are all critical in this regard. The relationship between the renewable energy and sustainable economic development process indicates a different dimension.

Relevant estimations indicate that renewable energy resources (including the bio-fuels) as the non-fossil fuels will surpass nuclear energy in early 2020s and hydroelectricity power plants in the early 2030s, increasing its current share from approximately 3% to 8% until 2035. Moreover, renewable energy resources annually grow by 6%, and they are believed to contribute to 45% of the increase in energy generation until 2035 (BP, 2015).

In the period following 2050, renewable energy is believed to replace fossil fuels, such as petrol, gas and coal, as the primary resource of energy. More renewable energy will probably mean more bio-fuel and electric vehicle charging stations; infrastructure conditions that will help improve the natural carbon sinks such as forests and wetlands with the purpose of helping the future technology to ensure more natural gas and to obtain and secure the underground carbon safely should be enhanced (Shell, 2020).

2. GLOBAL DISASTERS AND THEIR RELATIONSHIPS WITH ENERGY RESOURCES

In addition to the issues seen in the energy infrastructure, there are random and unpredictable dangers threatening the energy systems: the former includes theft, violations and accidents, vandalism at a low level, social reactions and commercial espionage, while the latter indicates sabotages, cyber and terrorist attacks and natural disasters (USAK, 2011). Therefore, both predictable and unpredictable disasters regarding energy resources may cause changes in energy policies.

The elements damaging the energy resources in the world indicate the disaster that occurred within the pressurized water reactor in the plant on Three Mile Island in 1979. As a result of this disaster, the United States lowered the number of reactors in production although the country aimed to increase these reactors between 1963 and 1979, and disabled 51 reactors between 1980 and 1984 (Saygın, 2011:52). Another accident is the Chernobyl accident that extensively affected the energy structure. It occurred due to performing an experiment that did not suit the regulation on nuclear power plant safety and neglecting the operation procedures (TAEK, 2007:9). It was realized that this accident created severe dangers for the environment and people’s health. Despite the accidents, the importance of nuclear power plants and nuclear energy increased, and the efforts related to nuclear energy gained a momentum. A tsunami that occurred in Japan following an earthquake in 2011 damaged the reactors in Fukushima nuclear power plant, adversely affecting the energy systems in the country. Thus, the future of nuclear power plants has been questioned following this disaster.

The disaster in Fukushima power plant is considered as the first accident which happened due to natural disasters. Prior to this accident, 28% of electricity generation in Japan was based on coal, while nuclear activities covered 27%. Moreover, this figure was 26% for gas, 9% for petrol and 10% for hydro and renewable energy resources. Moreover, Japan planned the share of nuclear power plant as 40% in 2019 and 50% in 2030, aiming to stop the import of fossil fuel. Electricity generation capacity was 49 GW prior to the tsunami; the objective was 52 GW in 2014 and 62 GW in 2019 (RPS Energy, 2011:2). However, following the tsunami, the dependence on energy resources such as petrol and natural gas increased, and policies regarding the energy supply changed. The main part of this policy change is related to the nuclear energy. There are three scenarios related to the future of nuclear energy. **First scenario** (0 percent) was to decrease the share of nuclear energy rapidly, dispose the nuclear wastes and use the renewable energy resources. **Second scenario (15 percent)** was to reduce the dependence on nuclear and fossil fuels, focus on energy efficiency, select flexible technology, conduct the nuclear power plant process once again and/or manage the nuclear wastes. **Third scenario (20-25 percent)** was to gradually reduce the share of nuclear power plant, sustain the dependence on nuclear power plant, need for new nuclear power plants, conduct the nuclear power plant process again and/or manage nuclear wastes, promote the activity of reducing the dependence on fossil fuels economically, and ensure better safety for public and administrative grounds in terms of nuclear energy. Table 1 presents the 2030 energy resource distribution in Japan, reflecting the periods before and after the Fukushima accident. (McLallen, 201:192).

Table 1: Japan's Pre- and Post- Fukushima Energy Policies (%)

		After Fukushima		**Before Fukushima**
Dependency on Nuclear Power	0	15	20-25	53
Dependency on LNG-fired power and co-generation using natural gas (2030)	32	26	23	20
LNG Consumption for the Power Sector million tonnes per year	41	33	29	25

Source: Hayashi M. and Hughes L. (2013) The Fukushima nuclear accident and its effect on global energy security, Energy Policy 59 102-111

According to Table 1, energy generation rate prior to Fukushima accident was around 53% based on the nuclear power. As can be understood from three scenarios Japanese government determined following the accident, (0 percent, 15 percent and 20-25 percent), nuclear energy will be out of consumption in 2030, and energy demand will reach from 20 to 32% based on natural gas. Closing of many nuclear power plants increased the rate of usage regarding other energy resources. Therefore, based on the nuclear power, fossil fuel (natural gas or coal) import increased following the accident in Japan which aims to reduce dependence on energy and generate its own electricity energy.

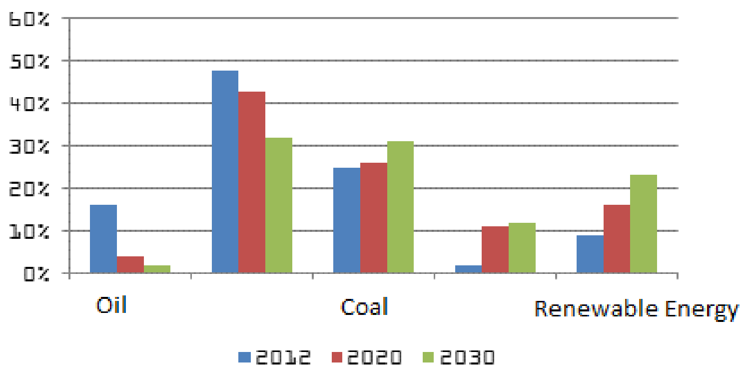


Figure 5: Energy Resources Used in Electricity Generation in Japan
Source: Tanay Vora and Sharad Saxena (2011), Japan's uncertain energy future in the post-Fukushima era, compiled and organized from https://www.mckinseyenergy insights.com/insights/japanyüzdeE2yüzde80yüzde99s-uncertain-energyfuture-in-the-post-fukushima-era.aspx and http://www.nbr.org/downloads/pdf.

The demand for natural gas in Japan decreased while the energy demand increased in the country following the accident. Forty-three percent of electricity generation is covered by natural gas in Japan as of

2020, followed by coal with 26%, renewable energy with 16% and nuclear energy with 11%. In 2030, the share of nuclear power plant will increase but approximately 63% of electricity generation is ensured through coal and natural gas. It is fair to state that the demand for renewable energy resources increased after the Fukushima accident and reached 23%, passing the nuclear power plants. Therefore, the demand for nuclear energy decreased in 2012 but will reach beyond 10% in 2020 and 2030 owing to the increased need for energy. Additionally, the demand for fossil fuels such as natural gas or coal continued in Japan following 2012, but the importance of renewable energy resources grew in time. Therefore, Japan planned to end the dependence on non-renewable energy resources and had to sustain production based on fossil fuels and renewable energy as a result of the natural disaster.

2.1. Global Energy Policies Following Fukushima Accident

Energy-related policies of Japan, the country with the highest number of nuclear power plants after the United States and France, and other developed countries changed following the Fukushima accident (Joskow and Parsons, 2012:5). These changes were abandoning electricity generation based on nuclear energy or limiting the nuclear power plants and seeking new energy resources to meet the increased demand of energy. The discussions of whether nuclear power plants were reliable were performed following the earthquake, and the number of nuclear power plants was rapidly lowered. Therefore, the concept of safe energy generation moved to the forefront as the place of nuclear power plants was questioned.

The decisions of certain countries in terms of nuclear power plant investments indicated that Germany closed at least eight of its 17 power plants, and the law that the activities of other nuclear power plants would be gradually limited and stopped by 2022 was enacted. Switzerland stated that operations would continue throughout the duration of the licenses and that the licenses would not be renewed later. Accordingly, the last reactor in Switzerland will be closed in 2034. France continued licensing nuclear power plants but planned to close all 25 nuclear power plants in 2025 (Joskow and Parson, 2012:17).

As the third greatest nuclear energy exporter in the world, Japan initially had 54 nuclear power plants but reduced this number to 15 later and stated that nuclear energy could be replaced by renewable energy resources for electricity generation. In the long-term plans, the objective is to reduce the share of nuclear power plants in energy generation. The reaction of China to this natural disaster was to revise its nuclear power plants and to take additional measures (Centre for Energy Environment Policy, 2013:19-20). Although the United States reflected its concerns in the highest level possible, the country sustained its nuclear power plant projects. England also did not object to the idea of nuclear energy and stressed that eight new reactors would be completed until 2025. Italians objected to the talks of nuclear power plant in 2011. Moreover, Canada planned to expand the nuclear power plants in the upcoming ten years. Therefore, the most radical measures regarding nuclear power plants were taken by Germany, Japan and Italy (World Energy Council, 2013:15-16).

Hurricane Sandy was among the most devastating natural events affecting the general electricity distribution in Connecticut, concerning more than 500,000 customers and resulting in power cuts more than 15,000 times. The damage on the energy infrastructure caused by the hurricane was so great that power cuts occurred and New York and New Jersey could not have electricity even after the hurricane. Similarly, California has always been exposed to forest fires burning and terminating high-tension transfer lines, causing damages costing billions of dollars. Extensive forest fires in California caused death for at least 44 people in the entire state, while devastating thousands of buildings and forcing many people to leave their houses. In such cases, government authorities and energy companies should make sure that critical infrastructure plants such as electricity power plants operate and emergency response teams, medical staff and critical caring plants have the access to necessary energy resources (Uja, 2020).

Markets of other developing countries indicate different thoughts on nuclear power plants. Countries such as South Korea, Turkey, India, Russia, Brazil and South Africa decided to sustain nuclear power plants and build new ones, while Indonesia delayed its new nuclear power plant project to the periods after 2020. Malaysia decided to sustain building the nuclear power plants in 13 years from 2013. Building the nuclear power plants was approved in other developing countries to meet the need for energy. Therefore, Switzerland and Germany gave the most radical response to the termination of nuclear power plants and made sure the current projects were all aborted. Therefore, the target was to obtain energy safely through other alternative energy resources (World Energy Council, 2013:17).

Moreover, the designing paradigm regarding the measures to be taken for the natural disaster risks arising from nuclear power plants provides the necessary provisions and procedures for the management of severe emergency cases because a devastating natural incident cannot be totally terminated (Katona, 2019).

Table 2 presents the approaches of certain countries in terms of nuclear power plants as the periods before and after the Fukushima accident.

Tablo 2. Nükleer Santralle İlgili Görüşler (Yüzde-2011)

	Pre- Fukushima		**Post- Fukushima**	
Countries	**Favorable**	**Unfavorable**	**Favorable**	**Unfavorable**
Average	57	32	49	43
Austria	13	87	9	90
Belgium	17	79	34	57
Spain	39	42	41	44
Greece	12	86	10	89
Finland	58	38	52	44
France	66	33	58	41
Germany	34	64	26	72
Ireland	34	61	30	67
Holland	51	43	44	50
Poland	36	41	30	50
Turkey	45	51	41	57
Canada	51	43	43	50
USA	53	37	47	44
Japan	62	28	39	47
Check Republic	63	31	61	34
Egypt	65	22	52	37
China	83	16	70	30
Morocco	16	82	35	61
Pakistan	55	24	53	27

Russia	63	32	52	27
Saudi Arabia	52	39	43	48
Brazil	34	49	32	54
India	58	17	49	35
South Korea	65	10	64	24

Source: WIN-Gallup International, 2011

As it is clearly seen in Table 2 the number of people who support nuclear power plants has started to decrease after the Fukushima disaster. The most fundamental phenomenon of this decrease is due to the fact that the number of people who are against nuclear power plant is more than those who support it in Japan, which is the third country in the world generating electricity from nuclear energy and the other reason is that the trust in nuclear power plant decreases. Even though Germany did not have positive views regarding nuclear power plants at first, the number of people who are against it increased compared to those who support it after this accident. If we look from the point of Canada, a developed country, countries such as Poland, Holland, Ireland go against the nuclear power plant. The number of people against the nuclear power plant is higher in other developing markets and Turkey while the number of those supporting it is higher in Pakistan and Russia.

The gravitation of Germany and Japan towards alternative energy policies other than nuclear power plants further increased with the Fukushima disaster. These two countries, in particular, started to be further interested in renewable energy resources. In the beginning, a low level of electricity generation was made dependent upon the renewable energy resource, and the increase in the contribution of this energy resource was aimed to be in the next plans. The renewable energy resources' contribution was performed within a limited level at the beginning of the 1990s in Japan. In later years, investment incentives were provided based on the renewable energy resources and renewable portfolio standard. Therefore, even though conducted studies aimed to increase the contribution of renewable energy resources, electricity generation depends upon renewable energy in Japan only reached the level of 0,24% in 2008 (Huenteler et al., 2012:7). In 2010, the amount of contribution only increased to 2%. (Berraho, 2012:11). It is expected to reach a level of 12% in 2020. Similarly, in German, energy generation dependent upon renewable energy resources has been increased since 1990 (Wittneben, 2012:2). The contribution of this energy resource to the electricity generation was about 13% while this rate is aimed to be 30% in 2020. (Huenteler et al., 2012:8; Ole et al., 2008:8). In this respect, Germany is one of the countries radically limiting their electricity generation by depending upon both fossil fuels and nuclear power plants.

Considering the renewable energy policies of the other developed countries after the Fukushima disaster in the world, Chine aims to allocate 23% of their investments between 2005-2030 even if they continue to perform nuclear power plant projects. China aims to increase their waterpower, one of the biggest energy resources of them, to 300 GW in 2020. They also aim to increase their wind power to 30 GW and solar power to 1.8 GW in 2020; meaning their aim is reaching to 362 GW renewable energy capacity in total (Meisen and Hawkins, 2010:19) No change related to renewable energy resources has been made in the USA after the Fukushima disaster. Their dependency on nuclear power plants and other fossil fuels continues. However, the European Union aims to obtain 20% of its electricity generation from renewable energy resources from 2020 and also to obtain the 5.3% of this electricity through wind power. They aimed to increase the contribution of renewable energy resources to 100% and electricity generation from wind power to 50% in 2050 (The European Wind Energy Association, 2011:1). EU went towards renewable energy resources due to reasons such as increasing energy costs, decreasing greenhouse gas emissions due to climate change, and the Fukushima crisis.

Considering the certain countries within the European Union, England mapped out a route regarding renewable energy in 2011, and they determined that 15% of their electricity, transportation, and heating services shall be obtained through renewable energy as from 2020. Scotland also aims to obtain all of their electricity generations from renewable energy resources while North Ireland aimed this rate to be 40%. And France generating electricity more than 75%, embraced the policy of expansion of the nuclear power plant and becoming more dependent upon it before the Fukushima disaster. However, Japan and Germany decreased their nuclear programs after the nuclear power plant disaster, and this also changed the energy policy of France. Thus, it has been aimed to replace nuclear energy with renewable energy resources and increase the contribution of renewable energy resources (Center for Energy and Environment Policy, 2013:76-83).

The contribution of nuclear power plants is lower in Brazil, one of the developing markets. However, discussions continue regarding the expansion of nuclear power plants due to the public opposition based on the Fukushima crisis. Brazil does not have enough renewable energy resources contribution other than hydro. The contribution of wind energy in electrical energy generation is 0.72 % while the contribution of photovoltaic solar panels is 15 MW. Therefore, plans aim to increase the contributions of wind and solar energy, and the contribution of renewable energy resources is aimed to be 46,5% in electricity generation including hydro. (Berman, 2011: 24-25; Tolmasquim, 2012: 1).

Another country with nuclear power plants in the world is South Korea. In South Korea, 30% of the electricity generation is obtained from nuclear power plants. Therefore, South Korea preferred to continue their nuclear power plant program after the Fukushima disaster and aimed to reach from 23 GWe to 37 GWe in 2029 by increasing their capacity by 70% (World Nuclear Association, 2016). The share of renewable energy resources in electricity generation in South Korea where fossil fuels and nuclear energy constitute a large part of the electricity generation is around 4%. Efforts are made to decrease the share of carbon emissions which will be around 37% in 2030 and to increase the share of non-hydro renewable energy resources (EIA, 2015: 10).

Regarding the nuclear power plants, based on the crisis that occurred in Russia and India, two other developing markets, the process of obtaining more information regarding the reactor has come to the forefront (Joskow and Parsons, 2012:23). Moreover, with the continuation of investments on nuclear power plants, the safety of nuclear energy should be reconsidered. The share of renewable energy resources among the primary energy resources is minor in Russia. Electricity generation from renewable energy was around 0.5% in 2001 (EIA, 2003:9). As of 2020, the target is to achieve 4.5% of electricity generation through this energy resource (IFC, 2011:6). For India, the share of hydro and other renewable energy resource is low, and the share is expected to be 5% in 2035 (IEA, 2012: 26).

Plans are made to reduce the dependence on fossil fuel and nuclear energy in developed and developing countries for energy policies. Countries can reduce the greenhouse gas emissions and prevent the natural disasters created by climate changes by investing in cleaner and more durable renewable energy resources. Moreover, the disasters that occurred in developed or developing countries which perform a significant amount of its electricity generation through nuclear energy made the reliability of power plants questionable. Therefore, it is safe to state that investments in alternative energy resources such as solar or wind will increase in future.

2.2. Hurricane Katrina and Energy Policies

Another energy crisis that emerged owing to natural disasters arose from Hurricane Katrina which was among the most important crises that affected the United States in 2005 and resulted in the loss of life and property. Regarding the energy supply, the hurricane damaged the natural gas processing plants that were located along the Mexican Gulf and constituted approximately 20 of the natural gas production in the United States (Committee on Government Reform, 2005:18). After Hurricane Katrina, 19% of American oil production was destroyed, and 113 oil and gas production platforms were damaged by this natural disaster. At the same time, oil prices rose to $ 70 a barrel during this period, while gas prices were above $3a gallon. 75% of 819 oil platforms in the Gulf of Mexico were evacuated as a result of a hurricane. This has led to a one-third reduction in US oil production. (Amadeo, 2020). However, despite the shrinkage in production, the reservoirs are still believed to contain natural gas and consumption is thought to be ensured from these reservoirs (Kumins and Bamberger, 2005:2).

Other hurricanes in the USA, although to a lesser extent than Katrina and Rita, caused energy infrastructures to be damaged less since hurricane structures were weaker and preparation of these hurricanes was better compared to previous ones. Table 4 presents that electricity generation has also been affected in different ways based on the natural disasters that happened in the USA in 2005 and 2008. Hurricane Katrina damaged 72,447 electric poles and 8,281 transformers while Hurricane

Gustav and Ike damaged 11,478 electric poles and 10,300 transformers; which indicates that damage is lesser at the latter. Similarly, transformer structures were affected lesser during the Hurricane Ike compared to Hurricane Rita and Katrina; 238 transformer structures were damaged during the Hurricane Ike. Negative factors caused by the disaster have been quickly removed through the working of many federal institutions together, detection and evaluation of the damage, restoration efforts, and recovering assumptions. However, destruction was more during the Hurricane Katrina since local administrators were not co-operating and did not intervene in time (US Department Energy, 2009:2). After the Hurricane Katrina in the USA, the relationship between hurricanes and climate change has been started to be discussed. Ocean temperatures and regional climate events may affect the size, intensity, and the number of the hurricane. Also, global warming accelerates the hydrologic cycle by evaporating more water and may cause more storms and more frequent storms by carrying water vapor to higher latitudes (Dale et al.,2010:728). However, 10% of the energy obtained as of 2014 includes renewable energy resources (Center for Sustainable Systems,201:1). References of EIA (U.S. Energy Information Administration) indicate that generation of renewable energy sources within primary energy generation will be 11% in 2030 and the road map of IRENA (International Renewable Energy Agency) estimates that it will reach 27%. Consumption of renewable energy resources within primary energy consumption will be 10% according to EIA and 27.5% according to IRENA (IRENA, 2015).

Tablo 3: The Impacted of Hurricanes in US On Electric Insfracture, 2005 and 2008

		2005		2008	
Insfracture Impacted	**Katrina**	**Rita**	**Wılma**	**Gustav**	**Ike**
Utility Poles Destroyed	72,447	14,817	~14,000	11,478	10,300
Transformers Damaged	8,281	3,580	NA	4,349	2,900
Transmission Structures Damaged	1,515	3,550	NA	241	238
Substations Off-line	**300**	**508**	**241**	**368**	**383**

Source: US Department of Energy, 2009, NA: Not available

CONCLUSION

Increase in economic activities and urbanization and increased population that came to the forefront owing to the increased number of economic activities capture attention as the factor increasing the energy demand. The increase in energy supply does not match the increase in energy demand. Therefore, countries in need of energy may perform their activities of production based on not only the fossil fuels, but also nuclear and other renewable energy resources. Therefore, investments made in nuclear power plants increased to meet the energy demand, and nuclear energy became a significant resource in the generation of electricity.

Natural disasters such as earthquakes, hurricanes, floods cause loss of human life and property and negatively affect the energy infrastructure systems of the countries. Damages on petrol, natural gas, and nuclear power plants may cause the energy need of society to fall short and slow down the generation and consumption activities. In history, there are certain periods in which energy resources were damaged due to various reasons (war, terrorism, flood, earthquake). The most important period is the submerging of the Fukushima nuclear power plant that was thought to generate a large part of Japan's electricity, due to tsunami; which affected the energy policies of the countries. After this incident, Japan was obliged to review its nuclear energy policy which is thought to decrease external dependence regarding energy. Also, other countries started to discuss if nuclear power plants are reliable or not, and new arrangements are made regarding this energy resource in accordance with the revealed opinions.

The biggest change occurred in Japan and German after the Fukushima disaster and the number of nuclear power plants dramatically decreased. German, in particular, completely abolished nuclear power plants and hastened the energy generation dependent upon renewable energy resources. And Japan aims to continue the electricity generation dependent upon fossil fuels by canceling out electricity generation dependent upon nuclear power plant in 2030 and increase the contribution of renewable energy resources to 12%. Considering the other developed and developing markets, the Fukushima nuclear power plant raised awareness regarding nuclear power plants and pointed out the question of whether generations can be made on these power plants or not. Developed countries such as the USA, China, England, and France thinking that nuclear power plants are safe and developing countries such as Turkey, Brazil, and South Korea have planned to increase their electricity generation volume by making investments in nuclear power plants in the future periods. However, both developed and developing countries have long-term plans for cleaner, safer renewable energy resources even if the investments in nuclear power plants increase. For this reason, electricity generation is estimated to increase based on the renewable energy resource in the long term. Disasters other than Fukushima nuclear power plant (such as a hurricane, flood, etc.) negatively affect the safety of the energy supply. Climate change does not have a direct effect on these disasters that occurred in the world; however, its indirect effect is perceived more intensively. In the future, the safety of energy supply will be a discussion topic more than today and renewable energy resources will become more important due to increasing greenhouse gas emissions in addition to climate change and natural disasters.

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CHAPTER 3

SUSTAINABLE ENVIRONMENT AND RENEWABLE ENERGY SOURCES: AN EMPIRICAL ANALYSIS ON TURKEY

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INTRODUCTION

Energy is one of the basic resources to sustain social life. Electricity generation is among the indispensable elements of social life depending on coal, transportation, petroleum products, heating, natural gas and coal (Çoban& Kılınç, 2016: 594). However, in addition to having such benefits in human life, energy also has harmful effects if it is not used carefully due to its polluting effects. The amount of carbon dioxide emitted by fossil fuels such as oil, natural gas, and coal is higher than renewable energy sources.

Since the beginning of the world, human beings have been faced with environmental pollution, sometimes caused by nature's own cycle and sometimes by people themselves. The fact that societies started using fossil fuels since the 1850s caused environmental pollution to increase significantly (Kızılkaya, Sofuoğlu& Çoban, 2014: 256).

With the start of the industrial revolution, the increase in the use of coal resource used in industry causes an increase in the carbon dioxide emission spread to the environment. As production increases in the World, energy use, which is the most important source of production, also increases. Therefore, as long as countries attempt to sustain their economic growth, energy use increases continuously. The increase in using fossil fuels, which have a larger share in energy use compared to other energy sources, causes the amount of carbon dioxide emitted into the air to constantly increase.

Energy is one of the most important and basic inputs of the industry sector (Canbay, 2019: 141). The development of the industrial sector is among the indispensable elements for developing countries as Turkey in order to enter among developed countries after complete their growth and development. Therefore, it is inevitable to increase energy use in order to ensure the economic development of such countries. However, the fact that such countries do not have sufficient technology and opportunities to increase the use of renewable energy resources increases the use of fossil energy resources in these countries. Therefore, the increasing effect of energy use in these countries on environmental pollution is realized. Especially in countries such as Turkey, where majority of energy sources is comprises fossil fuels, the damage caused by the use of energy to the environment is greater.

With the emergence of environmental problems such as global warming, air pollution, increasing use of natural resources and carbon dioxide emission in the early 1990s, environmental and energy issues have become one of the most important problems in the World agenda (Aytun, Akın and Algan, 2017: 1-2 ; Koçak, 2014: 62). Increasing global competition, rapid population growth and the unplanned urbanization as a result of the migration of people from villages to cities due to the desire to live in better opportunities and the unbelievable increase in energy use in recent years, have brought these problems. Especially, the increase in global competition and the fact that countries are in the race to have a stronger structure in terms of economy cause them to want to increase their production more. This causes more energy use and eventually more environmental pollution.

In the first part of the study, studies in the literature about energy and environmental pollution are mentioned. The second part explains the model and data set. The method and application results of the econometric analysis applied are explained in the third part and in the last part; the results of the study and the policy recommendations that can be applied are mentioned.

1. Literature Review

The results obtained from the literature review, national and international studies on the environment and energy and the results obtained are shown in Table 1.

Table 1: Literature Table

Author	**Sample and Period**	**Model**	**Conclusion**
Koçak, 2014	Turkey 1960-2010	ARDL	Energy consumption affects CO_2 emissions positively in the long term.
Akay, Abdieva and Oskonbaeva, 2015	MENA countries 1988-2010	Panel VAR	It is found that causality from carbon dioxide emission to renewable energy consumption. It is also found that the impact of renewable energy consumption on carbon dioxide emission is negative.
Kızılkaya, Sofuoğlu ve Çoban, 2016	Turkey 1967-2010	Johansen Cointegr ation Analysis	In the long term, there is a relationship between CO2 and energy consumption. Energy consumption has a positive impact on CO_2 emission.

Zoundi, 2017	25 African countries 1980-2012	Panel Cointegration	It is found that renewable energy has a negative effect on CO_2 emission and it has an increasing impact on CO_2 emission in the long run.
Usman, Olanipekun, Lorember and Abu-Goodman, 2019	South Africa 1971-2014	Panel Cointegration	The results find in the long run causality running from CO_2 emission, in the short run a causality is found running from energy consumption to CO_2 emission.
Fazal, Rehman, Rehman, Bhatti and Hussain, 2020	Pakistan 1990-2018	Causality analysis	No causality is running from energy consumption towards carbon emission and GHGs emission.
Khan, Ali, Kirikkaleli and Wahab, Jiao, 2020	China 1990-2017	Panel Cointegration	Renewable energy consumption and technological innovation reduce consumption- based carbon emission. Renewable energy consumption significantly cause CO_2 in the long term.

According to the results obtained from Table 1; in study Koçak (2014), 1960-2010 data belong to Turkey were utilized. According to the results of the ARDL cointegration analysis, energy consumption positively affected the CO_2 emission in the long term. Increase in energy use increase CO_2 emission in the long run.

In the study of Akay, Abdieva and Oskonbaeva (2015), panel VAR analysis was performed using the 1988-2010 data of MENA countries. According to the results, a causality relationship from CO2 emission to renewable energy consumption has been found. At the same time, a negative causality relationship from renewable energy consumption to CO_2 emission was found. A bidirectional causality relationship has been found between CO_2 and renewable energy consumption.

In the study of Kızılkaya, Sofuoğlu and Stepherd (2016) 1988-2010 data belong to Turkey are used and Johansen cointegration analysis has been done. Because of the cointegration analysis, a significant and positive relationship was found between energy consumption and CO_2 emission in the long term. Increases in energy consumption increase CO_2 emission in the long term.

In the study of Zoundi (2017), panel cointegration analysis was performed and 1980-2012 data belonging to 25 African countries were used. According to the results of the cointegration analysis, a negative and significant relationship was found between renewable energy consumption and CO_2 emission in the long term. Increases in renewable energy consumption have a negative impact on CO_2 emission.

In the study of Usman, Olanipekun, Lorember and Abu-Goodman (2019), panel cointegration analysis was conducted using 1971-2014 data for South Africa countries. According to results of the analysis, from CO_2 emission to energy consumption in the long run was found in South African countries, while a casuality relationship from energy consumption to CO_2 was found emission in the short run. A one-way causality relationship has been found between energy consumption and CO_2 emission in the long run and in the short run.

In the study of Fazal, Rehman, Rehman, Bhatti and Hussian (2020), the example of Pakistan has been used. According to the results of the causality analysis using 1990-2018 data, no causality relationship between energy consumption and CO2 emission was found.

In the study of Khan, Ali, Kirikkaleli, Wahab and Jiao (2020), 1990-2017 data of China were used in the cointegration analysis. According to the results of the cointegration analysis, renewable energy consumption and technological innovation reduce CO2 emission. A causal relationship is found between renewable energy consumption and CO2 emission in the long term.

According to the results obtained from the literature review, it is seen that there is a positive and significant relationship between energy consumption and CO2 emission. Increases in energy use increase CO2 emission. But there is a significant and negative relationship between renewable energy consumption and carbon dioxide emission. Increases in the use of renewable energy have an effect that reduces CO2 emission both in the long term and in the short term. The less carbon dioxide emitted by renewable energy types compared to fossil energy sources has an effect that reduces environmental pollution. Thus, in recent years, both in developed countries and developing countries, it is trying to increase the share of renewables energy sources in energy use to settlement of environmental awareness.

2. Model and Data

Data on the variables used in the study are the annual data for the period 1984-2018 consisting of Turkey. The model created with the obtained variables is shown in equation 1. CO_2 is used as the independent variable and GDP, FDI, RE, POP and PAT are used as the dependent variables in the model. The natural logarithms of the obtained data were taken to linearize the data of the variables used in the model.

$$CO_2 = \beta_0 + \beta_1 * GDP + \beta_2 * FDI + \beta_3 * RE + \beta_4 * POP + \beta_5 * PAT + \; + \varepsilon_{1t} \qquad (1)$$

The source of the website where the data of the variables used in the model are obtained, and the variables and explanations of these variables are shown are shown in detail in Table 2.

Table 2: Variables In The Model, Explanatios And Sources

Variable	Explanations	Sources
CO_2	**Carbon dioxide emission (CO2), Million tonnes**	OECD Data
GDP	GDP per capita (Constant 2010 US$)	World Development Indicators (WDI)
FDI	Foreign direct investment (Inward and outward flows and stock)	UNCTADSTAT
RE	Renewable energy (Total, % of primary energy supply)	OECD Data
POP	Urban population growth (annual %)	World Development Indicators (WDI)
PAT	Patent applications (nonresidents and residents)	World Development Indicators (WDI)

3. Method and Application Results

In empirical part of this study examined the relationship between sustainable environment and energy in Turkey, ADF (Augmented Dickey Fuller) and PP (Philips Perron) unit root tests have been used in order to analyze stability of the variables. ARDL (Autoregressive Distribution Lag) boundary test was applied in order to analyze the existence of cointegration relationship, since variables came to be stationary from different degrees as a result of unit root tests. After determining the cointegration relationship between the variables, short and long-term coefficients were estimated.

3.1. Unit Root Tests

Unit root tests are analysis methods that examine whether the series are stationary over time. Increases and decreases over time in stationary series occur regularly within a certain period. In order to examine the cointegration relationship between variables, it is necessary to first examine the stationarity of these variables. In order to stabilize the non-stationary series, the differences of these series are removed and inconsistencies in the series over time are eliminated.

The ADF unit root test is obtained by adding a lagged value of the dependent variable to the equation of the DF unit root test (Wooldridge, 2013: 633, Translator: Çağlayan). As a result of the ADF test shown in Table 3, GDP, FDI, RE, POP and PAT variables are stable at I(1) level; CO_2 variable is stable at I(0) level. The lag lengths of the variables are determined according to the Schwarz Criterion information criteria.

PP unit root test assumes that the error terms are unrelated and have a constant variance (Enders, 1995: 239). It is an improved model of DF unit root test. The PP unit root test results shown in Table 3 are the same as ADF unit root test results. If we examine Table 3, as in the ADF unit root test, CO2 variable is stable at I(0) level; GDP, FDI, RE, POP and PAT variables are stable at I(1) level. In the PP unit root test, Schwarz Criterion information criterion was used to find the extension range values of the variables.

Table 3: ADF and PP Unit Root Tests

ADF Unit root test			
	Level	**1.Difference**	**Conclusion**
CO_2	-3,54[-4,22](0)		I(0)
GDP	-3,54[-2,12](0)	-2,95[-6,15](0)	I(1)
FDI	-3,54[-2,18](0)	-2,95[-5,72](0)	I(1)
RE	-3,54[-0,68](0)	-2,95[-6,16](0)	I(1)
POP	-3,56[-2,86](4)	-2,95[-3,13](0)	I(1)
PAT	-3,55[-2,75](1)	-2,95[-4,42](0)	I(1)
PP Unit root test			
CO_2	-3,54[-4,18](0)		I(0)
GDP	-3,54[-2,12](0)	-2,95[-6,30](4)	I(1)
FDI	-3,54[-2,30](2)	-2,95[-5,76](4)	I(1)
RE	-3,54[-0,40](3)	-2,95[-6,15](3)	I(1)
POP	-3,54[-2,23](4)	-2,95[-3,00](4)	I(1)
PAT	-3,54[-2,18](1)	-2,95[-4,44](1)	I(1)

Values in square brackets are t-statistics value at 5% significant level, values in brackets are delay numbers.

According to the results of ADF and PP unit root tests, except CO_2 variable other variables are stable at I(1) level. Since the variables used are stationary at different level values, ARDL cointegration analysis should be done to analyze the existence of cointegration relationship between the variables.

3.2. Cointegration Analysis

ARDL analysis is a cointegration analysis method that can be applied when all variables used in the analysis are stationary at I(1) level or at different levels [I(0) and I(1)] (Pesaran vd., 2001). In the ARDL test, ARDL boundary test is performed to investigate whether there is a cointegration relationship between variables. According to the results obtained from the boundary test analysis:

- ✓ When the F statistic value is above the upper critical value of 5% significance level, it is decided that there is a cointegration relationship between variables.
- ✓ When the F statistic value is below the sub-critical value of 5% significance level, it is decided that there is no cointegration relationship between variables.
- ✓ When it is between the lower and upper critical values at the level of 5% significance, it is considered to be in the unstable region.

Table 4: ARDL Boundary Test

k	**F-statistic**	**Critical values at % 5 significance level**	
5	4,99	Lower bound	Upper bound
		3,12	4,25

The results of ARDL boundary test are shown in Table 4. According to the information obtained from the table, İt is concluded that there is a long-term cointegration relationship between the variables since F statistic value exceeds the upper limit critical value of 5%. It seems that national income, renewable energy use, foreign direct investment and urban population have an impact on environmental pollution in Turkey. Tendencies to reduce the environmental pollution which are an important factor in the development of Turkey in case of a developing country are rapidly increasing in recent years. The increase in the use of renewable energy sources within the concept of energy, which is an important factor in this, stands out.

Table 5: ARDL (1, 2, 1, 0, 0, 0) Model, Long-Term Coefficients

Variable	Coefficient	Std. Error	T-Statistic	Prob
GDP	0,4773	0,1770	2,6959	0,0132*
FDI	-0,0112	0,0160	-0,7036	0,4890
RE	-0,0335	0,1063	-0,3154	0,7554
POP	-0,1119	0,0476	-2,3499	0,0282*
PAT	0,0021	0,0194	0,1085	0,9145
C	0,7736	1,2834	0,6028	0,5528
TREND	0,0250	0,0062	4,0337	0,0006

Table 5 shows the long-term coefficient estimation results of the variables. According to the results obtained from the table, since the Probe value of the GDP and POP variables is lower than Probe value at 0,05 significance level, a long-term significant relationship was found between the CO_2 variable but since the Probe value of RE, FDI and PAT variables is greater than the Probe value with a significance level of 0,05, it seen that there is no long-term significant relationship between CO_2 and RE, FDI and PAT variables. When we examine the coefficient of relationship between CO_2 and GDP and POP variables, an increase of 1 br in the GDP variable increases the CO_2 variable by 0,47 br. It is seen that there is a positive and significant relationship between the CO_2 variable and the GDP variable. However, it is that there is a negative and significant relationship between CO2 and the POP variable. An increase of 1 br in the POP variable reduces the CO_2 variable by 0,11 br.

In Turkey, some close to 80% of the energy sources used are composed of fossil fuels. Therefore, as the energy resources used in production increase during the economic growth process, environmental pollution also increases. At the same time, the increase in infrastructure investment in cities due to the increase in urban population in recent years shows that the importance given to the environment has increased. So, it is seen that environmental pollution does not increase despite the increase in the city population.

Table 6: ARDL (1, 2, 1, 0, 0, 0) Model, Short-Term Coeffients

Variable	Coefficient	Std. Error	T-Statistic	Prob
GDP	0,3702	0,1296	2,8548	0,0092*
FDI	-0,0309	0,0115	-2,6760	0,0138*
RE	-0,3702	0,0740	-4,9998	0,0001*
POP	-0,0868	0,0444	-1,9545	0,0635
PAT	0,0016	0,0152	0,1073	0,9155
TREND	0,0193	0,0064	3,0237	0,0062
CointEq(-1)	-0,7754	0,1599	-4,8488	0,0001

Short-term coefficient estimation results of ARDL analysis are shown in Table 6. If we examine Table 6, we can conclude that there is a significant cointegration relationship between these variables and CO_2, in the short term, since Probe values of GDP, FDI and RE variables are below 0,05. A positive and significant relationship was found between CO_2 and GDP. If GDP variable increases by 1%, CO_2 variable increases by 37%. It is seen that there is a negative and significant relationship between FDI and RE variables and CO_2 variable in the short term. If FDI increases by 1%, CO_2 decreases by 3% and if RE increases by 1%, CO_2 decreases by 3%. Since the Probe value of POP and PAT variables are above the Probe value of 0,05, it is seen that there is no significant relationship between these variables and CO_2 variable in the short term. If we examine the Probe value of the error correction term, it is concluded that the model is meaningful since the Probe value is below 0,05. In addition, the coefficient of the error correction term was found to be -0,77. Therefore, 77% of the imbalances that occur in the short term disappear by decreasing in the lon term. Economy is returning to its normal course in the long run.

Although, İt appears that the effect in the long term renewable energy sources on the environmental pollution; it is seen that it has a decreasing effect environmental pollution the short-term effect in Turkey. In Turkey, it has been a significant increase in the use of renewable energy sources in recent years. But, despite this increase, it remains at a very low rate compared to fossil energy sources. So, the use of renewable energy resources is effective in the short term an environmental pollution, but not in the long term.

According to results obtained from the ARDL cointegration analysis, a significant relationship was found between the CO2 variable and the GDP variable in both the long term and in short term, while a significant relationship was found between the CO2 and RE variable in the short term, but no significant relationship was found in the long-term. In Turkey, the economic growth and energy consumption due to the increase of welfare level are increasing rapidly. However, environmental pollution increases due to the increase in the energy consumption. Therefore, in order to prevent this, it is necessary to increase the use of renewable energy sources that are less harmful to the environment.

CONCLUSION

Energy is among the indispensable elements in today's societies as a production factor for both social life and economic growth. However, considering the place of energy in social life, although it increases the welfare level of people socially and economically, the damage to the environment is too much to ignore. In particular, in countries such as Turkey which the energy consumption is close to 80% of the fossil fuels, energy use causes much more damage to the environment.

With the start of the industrial revolution, the place of energy in human life has become more important. The acceleration of production with the increase in industrialization cause more energy resources to be used. But, the fact that these energy resources are composed of fossil fuels such as oil, coal and natural gas, which have a very high polluting effect on the environment, has led to an increase in environmental pollution. ARDL boundary test was conducted to examine whether there is a long-term relationship between the variables used in the econometric analysis part of the study. In the analysis applied, Carbon dioxide emission (CO2) as independent variable; per capita real national income (GDP), foreign direct investments (FDI), renewable energy (RE), urban population growth (POP) and patent applications (PAT) variables were used as dependent variables. After determining the existence of a long-term relationship between variables as a result of the ARDL boundary test, the coefficient of the variables was estimated. According to the results obtained from the analysis, a positive and significant relationship was found between the CO2 variable and the GDP variable in both the long term and short term. Increases in GDP cause environmental pollution to increase both in the long term and in the short term. A significant and negative relationship was found between POP and CO2 variables in the long term. While a negative and significant relationship was found between CO2 and RE variables in the short term, no significant relationship was found in the long term. The use of renewable energy sources in Turkey seem to affect in reducing the environmental pollution in the short term. In order to maintain this situation, the share of renewable energy sources in energy use should be increased. At the same time, it is important to increase infrastructure investments in cities and to provide a planned urbanization structure in terms of reducing environmental pollution.

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CHAPTER 4

ENVIRONMENTAL POLICIES AND SUSTAINABLE CONSUMPTION

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INTRODUCTION

The struggles of people with nature from the past to the present have led them to seek alternative methods, while the technology created in this process, on the one hand, enables man to dominate nature endangers the future of man. While the rapidly increasing population increased the demand, this demand increased exponentially with the increase of people's awareness thanks to technology. Although the producers were satisfied with this situation, the environmental degradation that became clear in the future forced the countries to take some measures.

Indicating that the increase in income is not an increase in welfare, development economists emphasized the importance of health, education and environmental quality and expanded the scope of economic development that consists only of income. There are many studies revealing that there is a relationship between these variables, which are the major determinants of development. Undoubtedly, income, education and health policies are essential for development. But before these, the environmental conditions in which these actions will be carried out must be improved. While building the development structure, environmental quality will form the basis of this structure.

The concept of environment, which was neglected in growth-oriented economic policies after the Second World War, gained importance after the 1970s. (Aytun, Akın, Algan, 2017). Environmental problems, which have become more prominent on a global scale, have been determinant in shaping these policies. The policies implemented by individual countries were gathered under one roof with the establishment of The United Nations Environment Program (UNEP). Although there have been protocols signed by many countries such as the Kyoto Protocol in the process and success has been achieved, on the other hand, environmental degradation continues on a global scale. This situation causes the review of environmental policies and other suggestions. The concept of environmental degradation, which has been trying to explain its causes on a macro scale until today, should also be explained with micro-bases. Therefore, the aim of the study is to reveal the role of human in environmental degradation and to offer a policy proposal in this perspective. In the ongoing part of the study, first the concept of environmental degradation will be explained, and in the second part, the studies on environment on a global scale will be summarized. In the third part of the study, the role of human in environmental degradation will be revealed and a sustainable consumption policy will be presented as a suggestion in order to prevent environmental degradation.

1. DEFINITION OF THE ENVIRONMENTAL PROBLEM

The concept of Environment, which belongs to the science of biology, is of ecological origin. The social effects of the environment on people have resulted in the adaptation of this concept to social sciences. Environment is the area in which living things live in the narrowest sense. In the broadest sense, the environment is the biosphere-living sphere where there are suitable conditions for life (Kaypak, 2011).

Environmental problems can be defined as air pollution, water pollution, soil pollution and erosion, forest loss, industrial wastes, and environmental damage as a result of excessive production and consumption caused by population growth and unplanned urbanization (ÇEKÜD, 2009). Plants and animal communities are being destroyed because they are consumed excessively for the sake of human needs. Although some events such as natural disasters, volcanoes, heavy rain and floods damage the environment, environmental problems are mostly human-caused (Kaypak, 2010).

People have used the surrounding resources to sustain their existence, while achieving an increase in their quality of life. This increase has caused environmental damage. In this way, environmental quality has been damaged and environmental degradation has occurred due to various human activities. While the failure to replace the consumed resources puts the lives of future generations in danger. The environmental problem is unfortunately still considered as environmental pollution today.

Global climate change is one of the most important global environmental problems that threaten the future of the world. The global warming problem, which is considered being human-induced, causes many vital problems. International dialogue has become mandatory in order to jointly resolve the problems of our common living space.

2. ENVIRONMENTAL PROTECTION ON A GLOBAL SCALE

As the environmental problems grow and deepen, the borderless nature of the problems has been realized and thus, national and international efforts have come to the fore for the solution of the problem (Najam & Cleveland, 2003). It has been understood that countries should develop common strategies against trans-boundary problems such as water pollution in seas and rivers, air pollution that causes acid rain, and global climate change caused by greenhouse effect (Uzel, 2006). These searches and initiatives, which have become widespread rapidly for measures related to environmental problems, have started to be effective in determining both the agendas of the societies and the environmental policies at the global level since the 1960s (Çınar, 2001).In this context, the first serious step taken in the international arena is the United Nations Conference on People and its Environment (Stockholm), which was held in 1972 (Keleş et al., 2009).

The conference, attended by a total of 113 countries, played an important role in raising public awareness on the environment and intensifying the debates on the environment at international level (Ertürk, 2009). At the conference, it was stated that unless the differences between developed and underdeveloped countries are eliminated, improvement in environmental conditions cannot be achieved. It has been argued that there is nothing contradicting with environmental protection, and environmental protection should not constitute an "excuse" to slow down the development. In this context, the concept of "continuous and balanced development" or "sustainable development" has emerged as a new expression of the desired balance between economy, environment and society.

The concept of sustainable development for the first time; It is seen that it is used in the "World Conservation Strategy" report prepared by the International Union for Conservation of Nature and Natural Resources (IUNC) (Keleş et al., 2009). However, the real turning point in terms of concept; In 1983, the establishment of the "World Environment and Development Commission" within the United Nations established. Norwegian Prime Minister Gro Harlem Brundtland was appointed Chairman of the Commission (Pearce et al., 1990). The Commission prepared a report titled "Our Common Future" in 1987. In the report, the concept of "sustainable development", it is defined as "meeting the needs of today without compromising the ability of future generations to meet their own needs" (Pearce et al., 1990).

At the conference held in Geneva under the leadership of World Meteorological Organization (WMO) in 1979, it was first emphasized that climate change and global warming were an international problem. Second conference, "International Conference on the Role and Effects of Carbon Dioxide and Other Greenhouse Gases on Climate Change" was held in Villach Austria (1985 and 1987), "Changing Atmosphere Conference" held in Toronto, Canada (1988),"Ministerial Conference on Atmospheric and Climate Change" (1989) held in Nordwijk, the Netherlands (Türkeş, 2001). The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 and published its first report in 1990. Also, for the first time at the 'Second World Climate Conference' organized by the WMO in Geneva (1990), important decisions were taken to against global warming and climate change. With the increase of global awareness, countries have started to make binding agreements with the effort to act jointly.

The major theme of the Conference in Rio in 1992 was sustainable development. The importance of consumption behaviors in reducing environmental degradation was emphasized in this conference. Guiding the practices at the global, national, regional level accepted at the end of the conference. Rio Declaration, Agenda 21, Convention on Climate Change, Convention on Biodiversity Conservation and Protection of Forest Assets (Mengi and Algan, 2003) have been accepted by more than 170 countries and are included in the understanding of sustainable development in these countries' environmental and other related legal regulations. (Uzel, 2004). In this sense, sustainable development has become both a target to be achieved for these countries and a set of principles that determine their environment and development policies (Aytun, Akın ,2016). Again, as another important result of the conference; It is accepted that the concept of sustainability can only be realized within the understanding of global partnership, and a commission should be established to direct this partnership; United Nations Sustainable Development Commission was established (Tekeli, 2001).

In the Rio conference, it was emphasized that sustainable development can be achieved with sustainable consumption. One of the declared conclusions of the Rio summit is the necessity of changing consumption patterns in order to ensure sustainable development and to minimize the negative effects of human activities on the ecological environment. After this congress, sustainable consumption has become an application that reflects the global policies in the field of environment to the business world and the consumer, and started to be considered as an important part of their practices. This conclusion reached at the summit is that the formation of consumption awareness is one of the absolute requirements for sustainable development.

After the Rio congress, the joint fight against environmental degradation continued with the UN Framework Convention on Climate Change. The convention, which was ratified by 89 countries, entered into force on 21 March 1994. After this contract, the desired targets were not achieved, and the contract was revised with second negotiations between 28 March and 27 April 1995. With this contract called the Berlin Charter, the Conference of Parties (COP1) was established. The signatory countries of this convention made a commitment to reduce their emission volumes by 20% on 1990 basis until 2005.The COP meetings served as a kind of international workshop in the progress achieved in the fight against climate change until the Paris agreement, the retention of commitments and the formulation of forward-looking policies. The texts published after these meetings formed the infrastructure of the following enterprises. The second Conference of the Parties (COP2) was held in Geneva. In 1997, the Third Parties Conference (COP3) was held, and the second written contract Kyoto Protocol was signed after this conference (Warwick and Wilcoxen, 2002).

The targets set after the 1997 COP 3 were revised and it was aimed to reduce the emission rates in 1990 by 5 percent between 2008-2012. While the US did not sign the agreement. Developing countries have been reluctant to set goals. It is especially important for China to remain among the countries that abstain.

The second commitment period under the Kyoto Protocol started on January 1, 2013 and will end in 2020. Along with 28 EU member states, 38 developed countries participate in this commitment. This second period is under the Doha amendment, where participating countries pledged to reduce levels below the 1990s by at least 18%. The EU has committed to reducing emissions by 20% below 1990 levels during this period.

Environmental policies to be followed by the world for the post-2020 period were discussed in the 21st Conference of the Parties held in Paris, France in the last month of 2015. At the end of the negotiations, a new memorandum of understanding called the "Paris Agreement" was published. The Paris Agreement was opened for signature at the United Nations Headquarters in New York between April 22, 2016 and April 21, 2017. In order for this agreement to enter into force, the approval of at least 55 countries that realize at least 55% of global greenhouse gas emissions was required. 127 of 197 signatory countries have ratified the Paris Agreement and the Paris Agreement entered into force on 5

November 2016. U. S., which ratified this agreement in 2016, withdrew from this agreement in 2017.

As can be seen, the practices and policies produced to reduce carbon emissions, which are the main causes of greenhouse gas formation, have not been successful. While creating these policies, the main focus has been on producers. Although the importance of the consumer in combating environmental degradation was emphasized in the statements made on sustainable consumption at the RIO summit, the consumer was not given enough importance in the policies produced later. However, the carbon created is not only formed due to production but also contributes to this increase in consumption. Therefore, policies to be developed for consumers can be an alternative way to success.

2. HUMAN ROLE IN CARBON EMISSIONS

The population of the world is increasing day by day with innovations in the field of health and technological developments. According to the projection studies, it is predicted that the world population will be 9.6 billion in 2050. In this case, people will need the inner world to maintain their current living standards. While 3% of the world's potable water resources are, 2.5% of it is in glaciers. The world population can only drink 0.5% of its water and today 1 billion people cannot reach potable clean water.

In addition to natural causes such as respiration, forest fires and volcanic activities, the main reason for environmental degradation is the innovations brought to modern life by human beings. The energy required for these innovations is mostly provided by the use of fossil fuels. Fossil fuels formed by the carbon accumulation of millions of years contribute to the formation of GHG by releasing more carbon to the atmosphere than nature can absorb.With the transition to a settled life, people's enlightenment, efforts to keep the air temperature at the desired level, access to hot water whenever they want, use of electrical devices increase energy consumption and affect carbon emissions. Household energy consumption is the highest contributor to household GHG formation.

Another reason household contributes to GHG is transportation. Oil is the main fuel used in transportation today. Although electrically powered vehicles are available, long-distance transportation vehicles such as planes and ships operate only with fossil fuel. In addition to human travel, the increase in the number of products demanded by the increasing income and their transportation increase the carbon emission to the atmosphere.

Today the main reason for carbon emissions is the increase in demand for energy. Energy consumption increased by 52% between 1990 and 2017, according to EA report (IPPC, 2014). The areas where energy is used are industrial production, electric vehicles, transportation, household activities and agriculture. Although the contribution rates of these reasons to carbon formation may vary. Transportation, industrial production and the use of electricity share the top three (IEA 2017). As the fossil fuel is cheap and easily accessed, it is expected that it would be the primary kind of energy supply the decade ahead (Kandpal and Garg, 1999).

Considering the energy consumption, it was predicted that the energy shortage in the 1950s would be a problem in the following years and new searches were made in this regard. Commercial and residential energy use is the second most rapidly growing area of global energy use after transport.While the vehicle stock in OECD countries was 550 million in 2002, this figure increased by 32% until 2020, and the distance covered by these vehicles tripled by 40%. Today, the amount of energy consumed by households is 29% of the world energy consumption. The contribution of this energy used to the total carbon emission is 21%.

The food sector that produces food products consumed only by the household consumes 30% of the world energy production and constitutes 21% of the carbon GHG emission generated by this production.

One of the contributions of human to carbon emissions is through the use of industrial products. Obtaining the materials required in the production of the product from nature, the carbon that occurs in the process of mineral production, their transfer to the production point, the development, processing of petroleum-based products such as metals refinery and plastic products, and their delivery to the producer is defined as operational carbon. This is the manufacturer's contribution to GHG. On the other hand, all the carbon emission caused by a final product during the whole production process is defined as Embodied carbon. For this reason, every product contains carbon.

Although producers are blamed in industrial production, consumers are primarily responsible for shaping the product to be produced. For this reason, the carbon capacity of the products is shaped in line with consumer demands. Multi-storey buildings, high-powered engines are produced in line with consumer expectations. Therefore, consumers' demand for industrial products indirectly increases carbon emissions. The role of human beings in increasing carbon dioxide levels is also measured in what we destroy. The rapid consumption of carbon-absorbing forests and the opening of them to urbanization, and the transformation of forest products into products for need is considered as a factor in global climate change.

3. POLICY RECOMMENDATION FOR THE PREVENTION OF ENVIRONMENTAL DEGRADATION: SUSTAINABLE CONSUMPTION

While environmental degradation reaches a dangerous level, it is obvious that these policies do not achieve their goals, while directing policy makers to make macro policies regarding the environment. The main reason for this is that environmental degradation is thought to be production oriented. However, the contribution of carbon consumption to environmental degradation is at least as much as production. Considering that the consumption is realized by the household, these policies should be micro-scale.It was argued by some segments that households had a low contribution to carbon formation, so households were neglected while creating policies to solve the problem. However, considering that all the resources in the world are used in line with human needs, how these needs will be met will determine how much carbon formation will be allowed. The fact that households' contribution to the consumption of resources and environmental degradation in many areas, especially global warming, became apparent, and these problems were widely publicized, brought the concept of sustainable consumption, which is described as a solution proposal, to the fore. At the same time, the increase in the consumption level made it necessary to examine the effects of consumption and to transform consumption trends into a sustainable one.

Sustainable consumption is to meet the demands and needs of the present and future generations in parallel with the economic and social progress within the boundaries of the eco-system in the world in order to lead a better and quality life (ISSD,1994). Sustainable consumption is based on the idea of "use without consuming". Besides, it emphasizes not only "consumption awareness" but also "consumption reduction" phenomenon (Jackson, 2005).

Policies to change the behavior of consumers at all levels of society should be followed to reduce the environmental impact of consumption. In order to move forward in problems related to environmental pollution, ethical consumption behavior should be added to all stages of consumer education starting from childhood, and it should be adopted by consumers through formal and non-formal education. The success of policies produced by policy makers for environmental degradation necessitates the search for new policies. Especially the failures in macro policies bring micro-focused education policies to the fore.

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CHAPTER 5

CLIMATE CHANGE DENIAL AS A BARRIER TO SUSTAINABLE ENVIRONMENTAL POLICIES

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INTRODUCTION

When we talk about environmental problems, today's problems usually come to mind. However, environmental disasters have occurred many times throughout the history of the earth. Living things need a delicate environmental balance in order to survive. Undoubtedly, the formed is not permanent forever. This dynamic equilibrium has gradually changed throughout the history of the earth. As environmental conditions changed over time, living things gradually adapted to these conditions. They have evolved to the very end that they can flourish in their own ecological niche.

The remnants of the past are full of stories of species that have grown increasingly by successfully mastering adaptation to certain environmental conditions, becoming dominant in the ecosystem, living for a while and then disappearing when environmental conditions change. Extinct species often fell victim to these highly specialized modes of existence (Brown 1954:4). At least 5 times in the past 550 million years, there have been events that caused the extinction of more than half of the species in a short time. These mass extinctions constitute an important landmark in the history of life. Almost 99% of all existing species have also disappeared in this way (Benton 2016:114). It is a fact accepted in the scientific world that human beings cause the environmental changes we have faced in the last century. Especially after the industrial revolution, excessive use of coal and oil resources caused the carbon dioxide level in the atmosphere to increase rapidly. Hydrocarbon reserves that had been trapped underground for millions of years were quickly brought to the surface by humans. This period can be considered to be long in terms of human life. However, considering that these reserves accumulate underground over millions of years, the period is short. Researches show that using non-renewable hydrocarbons instead of renewable energy sources causes global warming (Aytun, Akin, and Algan 2017:1).

Critical changes have occurred in environmental conditions around the world since the industrial revolution. Many studies have shown that these changes are caused by human activities. (Keeling et al. 2005; Pachauri and Reisinger 2008; Scripps 2020). In Figure 1, we can see that the carbon dioxide level in the world has fluctuated for 800 thousand years. These fluctuations occasionally led to global warming and cooling. On the graph, we can see that the atmospheric carbon dioxide level has almost doubled in a brief time by the last three centuries (2 Degrees Institute 2018).

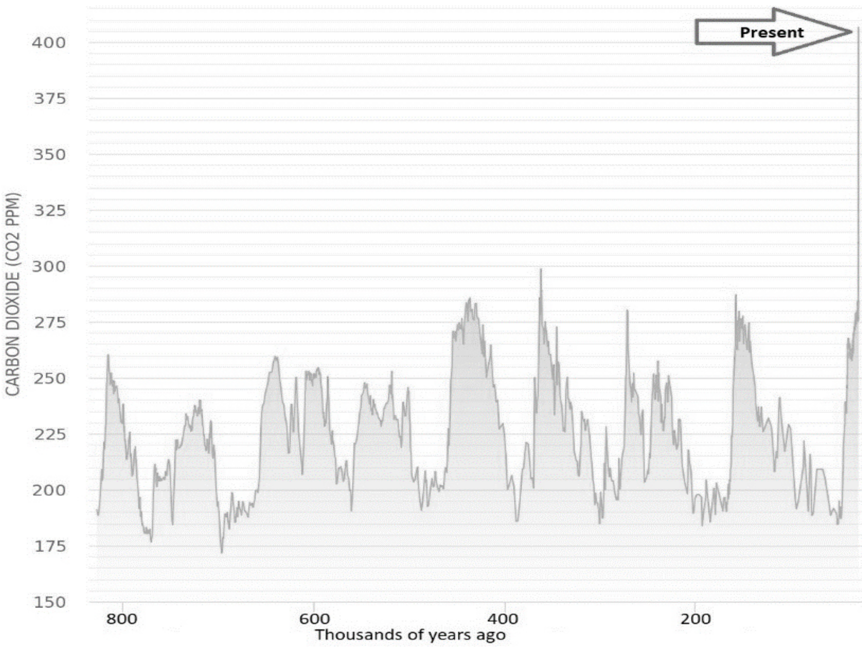

Figure 1. Historical Atmospheric Carbon Dioxide and Temperature Levels

Source: 2 Degree Institute (2018)

When we first focus on the last 10 thousand years and then the last 300 years in Figure 2, it is immediately noticeable that the increase started with the industrial revolution. Atmospheric carbon dioxide, which was 275 (ppm) on average before the industrial revolution, rose rapidly to 400 (ppm). This change is too fast for living life on earth to adapt. Sudden climatic events such as hurricanes, droughts and floods that will occur in a short time will also threaten global security. Droughts because of climate change may also cause migrations and wars.

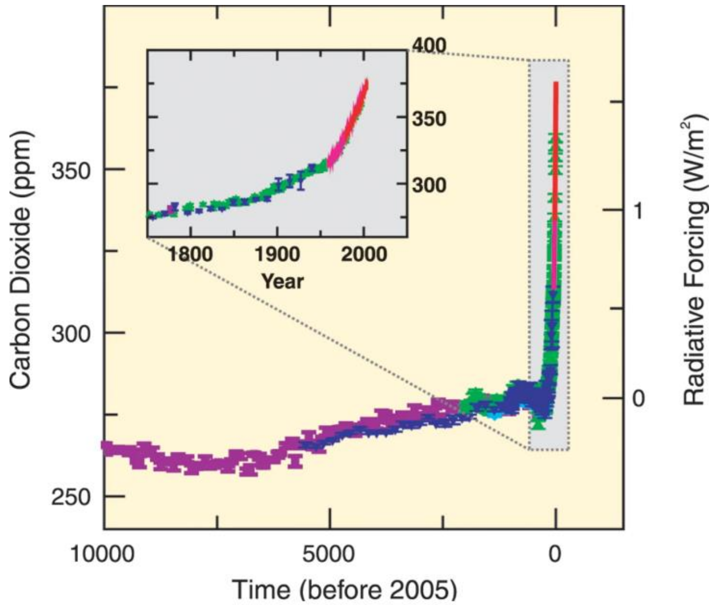

Figure 2. Historical Atmospheric Carbon Dioxide and Temperature Levels

Source: https://www.ipcc.ch/site/assets/uploads/2018/02/fig2-3.jpg

Today, much of our wealth is derived from fossil fuels and our consumption of the fossil fuels causes the rise of atmospheric carbon dioxide. This must be widely accepted by humanity in order to move towards the sustainable environmental policy solutions. We need to leave our understanding of carbon-based development at a rapid rate. Climate change is predicted to cause serious economic and environmental damage if we do not implement effective policies (Stern et al. 2006).

Developed countries owe their wealth to environmental polluting technologies. The increase in the standards of life of the citizens of these countries increased the importance of the environmental quality for them. Although the importance of environmental quality increases in developed countries, there are important obstacles to environmental policies. Therefore, there are many questions to be answered. Will developed countries be able to forego technologies that pollute the environment without compromising their living standards? How fair is it for developed countries to expect developing countries to use clean but expensive technologies? Could environmental measures to be taken by only a few countries prevent global warming? Competing countries expect costs to be paid by others. As humankind, will we be able to overcome these challenges in the future (Aytun 2018:14)?

There are many debates about what climate change policies will be. While these debates acknowledge the problem, it is more about which policies to choose. While these debates are more or less solution-oriented, there are also increasing theses that deny the reality of global climate change. The approach that denies global climate change is one of the biggest obstacles to implementing effective climate policies. In order to implement sustainable environmental policies, we need to understand the mentality of those who deny climate change.

1. Post-Truth Era

Oxford Dictionaries chose *post-truth* as the word of the year 2016. It defined the word as "circumstances in which objective facts are less influential in shaping public opinion than appeals to emotion and personal belief." According to Oxford, it was first used by Serbian-American playwright Steve Tesich in a January 1992 article in this magazine (Kreitner 2016). Tesich wrote that the revelation of the corruption of President Nixon and his cabinet initially disturbed the

American people. Tesich tried to define the social condition he described as "the Watergate Syndrome".

> "The revelations that President Nixon and members of his Cabinet were a bunch of cheap crooks rightly sickened and disgusted the nation. But truth prevailed and a once-again proud nation proudly patted itself on the back; despite the crimes committed in the highest office in our land, our system of government worked. Democracy triumphed.
>
> But in the wake of that triumph something totally unforeseen occurred. Either because the Watergate revelations were so wrenching and followed on the heels of the war in Vietnam, which was replete with crimes and revelations of its own, or because Nixon was so quickly pardoned, we began to shy away from the truth. We came to equate truth with bad news and we didn't want bad news anymore, no matter how true or vital to our health as a nation. We looked to our government to protect us from the truth" (Tesich 1992).

With the examples he gave from the Iran/Contra scandal in the Reagan administration and the first gulf war under the Bush administration, he pointed that the people turned a blind eye to lies rather than hearing the truth (Kreitner 2016). After Tesich posed the problem, Ralph Keyes (2004) named this social phenomenon as post-truth. According to Keyes, the debate between those who think that lying is a social necessity and those who think that societies based on lies will collapse eventually has continued throughout the history of civilization. That's why the anxiety about lying goes hand in hand with the spread of lies. Keyes's claim is that we are no more willing to lie than our ancestors. But today we are much more successful in justifying ourselves when our lie is revealed. We think that we do not harm anyone with these lies. Thus, we rationalize our lies (Keyes 2017:17). In the episode "A Brief History of Lying", Keyes says that human beings' cognitive characteristics develop in parallel with their ability to think abstractly. In short, the power to create an alternative reality was the dominant factor in the development of our brain. We are liars or honest, depending on the circumstances. We prefer whichever our survival probability is (Keyes 2017:35). Apparently, in an evolutionary sense in the past, these behavioral mechanisms have been helpful in our survival. However, nowadays, people can reach outside of their limited social environment more easily. In this way, lies can reach a much wider audience. The harmful consequences of confusion can become more permanent. We are experiencing even worse with the conscious denial of scientific facts such as climate change.

One might think that "Post-Truth" will only affect the uneducated lower class of society. However, it seems to affect the middle and upper classes interestingly (Calcutt 2016). This situation threatens the policies to be implemented to reduce global warming.

2. Climate Change Denial

In the introduction, it was illustrated that the current global climate change is caused by human activities. In early 1995, the Intergovernmental Panel on Climate Change (IPCC), the leading international climate organization, concluded that human activities affect the global climate. By 2001, the IPCC's Third Assessment Report stated that the evidence was getting stronger, and in 2007 the Fourth Assessment named global warming "undeniable". Today, a handful of climate scientists all believe that the Earth's climate is warming and human activity is the dominant cause. (Oreskes and Conway 2010:169). While the scientific evidence was so clear, global warming deniers deliberately ignored it. Public awareness of the current climate crisis was not in the interests of companies that profit from current fossil energy policies. Therefore, the Oil industry spread indirectly, by using intermediaries, that there is a doubt of global climate change (Washington and Cook 2011).

In the post-truth atmosphere, climate crisis denial has six major arguments. With these arguments, it is intended to prevent governments from regulating the fossil fuel industry by spreading suspicion. (Oreskes 2019).

i. The misleading claim that climate change will be "mild and manageable." There is no scientific evidence to support view, which states that the warming increase will not exceed 2 degrees.
ii. "The misleading claim that global well-being actually stems from fossil fuels." No one denies that fossil fuels led the Industrial Revolution and contributed significantly to improving the living standards of hundreds of millions of people. However, the claim that fossil fuels are the core of global prosperity today does not fully reflect the truth. As humanity, our future well-being is at

risk. But "high-carbon growth is self-destructive," according to Nicholas Stern (Stern 2016).

iii. Fossil fuels are cheap energy sources. For this, the inefficiency of solar energy panels or the inadequacies of energy storage technologies are cited as examples.

iv. The argument that fossil fuels are in the advantage of the poor. However, most people in the world cannot actually access energy. In fact, it may be easier for wind and solar energy to reach rural poor people.

v. Renewable energy costs are high. Between 2010 and 2017, battery prices fell nearly 80%. Most experts believe that most storage problems can be solved in the near future.

vi. The argument that greenhouse gas emissions decreased during Trump's presidency. This claim has been proved invalid. And on the contrary, it turned out that CO2 emissions increased during Trump's presidency (Mooney and Dennis 2019).

CONCLUSION

Fossil fuel giants, whose arguments have been debunked, create new lines of defense for themselves. These scientific-looking organizations are financed by giant energy companies (Washington and Cook 2011:159–63). As the first generation organizations lose their credibility, new ones replace them.

As a result, it is clear that global warming is a scientific fact. However, the public opinion around the world should be aware of this scientific fact. In the post-truth era, people do not question the truth of the news they read. As long as the news confirms his prejudices. This vulnerability is deliberately exploited by climate change deniers. The disinformation activities of climate change deniers constitute an important obstacle to the implementation of sustainable environmental policies.

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CHAPTER 6

RECONCILING ENVIRONMENT AND EMPLOYMENT: THE ROLE OF RENEWABLE ENERGY INVESTMENTS

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INTRODUCTION

The increasing importance of renewable energy based electricity and heat technologies rather than conventional power technologies, has intensified interdisciplinary discussions on the benefits and costs of renewable energy generation under the policies on ecological/environmental sustainability in both developed and developing groups of countries.

In other respects, interrelations between ecological/environmental, economic, or social sustainability have been a long-standing concern in the literature (e.g. Forstater, 2006; Ashford et al., 2012). Whether environmental policies would lead to a reduction in greenhouse gas emissions at the local and global level without causing any output loss or not has remained at the forefront of these debates. Since renewable energy promotion has been regarded as one of the fundamental remedies for countries by policymakers in the policy implementation process for abatement of environmental degradation arising from greenhouse gas -mainly carbon dioxide- emissions, the potential effects of renewable energy promotion on employment should be considered for the simultaneous achievement of economic, social and environmental sustainability. Thus, switching from high-carbon emitting electricity resources to low-carbon renewable energy resources emerges as an issue in the current literature on renewable energy and employment generation nexus. International Renewable Energy Agency – IRENA (2020) highlights the fact that renewable energy employment has been growing worldwide since 2012.

Additionally, 11.5 million direct and indirect jobs were created in the sector across the world in 2019.

The employment generation capacity of renewable energy investments and their ability to generate full and 'decent' employment is a debatable issue and has been standing as an unanswered question for a while which should be dealt with more broadly. This study aims to interrelate the facts of environmental protection, renewables, and employment which jointly produce outcomes in a single economy and across the world. Regarding this aim, the role of renewable energy promotion in employment is investigated from an analytical perspective. In that context, following this introduction, sustainable development and its dimensions are explained separately as well as their interdependency. In the second section, the deployment of renewables is discussed in terms of their role in mitigating environmental degradation, and the data on renewable energy generation are displayed and interpreted. Then, employment types and metrics in the renewable energy sector are explained under subsections. This is followed by some relevant statistical data on employment in the renewable energy sector are rendered. Finally, the chapter is concluded with a general assessment and policy suggestions on the issues highlighted in this chapter.

1. SUSTAINABLE DEVELOPMENT: ECOLOGICAL/ENVIRONMENTAL, ECONOMIC, OR SOCIAL?

The reason for the eco-centric approach to come to the agenda in the 20th century is undoubtedly today's "unsustainable" patterns. The attitude of human-beings making themselves the center of the world and reducing nature in their thoughts and actions developed in the history of humanity necessitates the understanding of the relationship between ecology/environment and sustainability more precisely today.

Sustainable development was first defined in the World Commission on Environment and Development – WCED (1987) Brundtland Report as '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs'*. An implication from that statement is that the needs have more than one aspect and sustainability is a development paradigm that has different dimensions. Namely "sustainability triangle" is comprised of the economy, the environment, and social concerns/the equity which emanates from the relationship between human beings and the ecosystem they inhabit.

Lawn (2009) asserts that while the mainstream literature dealing with the concept of sustainable development, it considers economic, social, and ecological/environmental sustainability as independent forms of sustainability. Accordingly, the widely accepted definition of economic sustainability is the maintenance of capital and its accumulation (Goodland, 2002). From the neoclassical point of view, the goal of economic sustainability is to maintain the societies' capacity to produce economic prosperity and to provide the next generations with an equivalent welfare level to the current generations. In this context, economic sustainability is defined as individual well-being, depending on the analysis methods, measured by utility, income, and consumption that does not decrease over time (Vivien, 2008).

Social sustainability, on the other hand, pertains to the maintenance and renewal of social capital by shared values and equal rights, and through society, religious and cultural interactions. Without such care, social capital certainly loses as much value as physical capital (Goodland, 2002). Ecological or environmental sustainability, either of as the third component, actually does not refer to the same meaning. Indeed, environmental issues are related to man's influence on nature in a sense, which distinguishes the term "ecological" from "environmental". As Morelli (2011) emphasizes, the word ecological is characterized as the concept of interdependence of elements within a system and it seems logical to view the environment as a subset of the broader concept of "ecological".

The environmental dimension of sustainable development deals with the conservation of natural capital like water, air, land, forest, and ecosystem services; transferring them to future generations by emphasizing the bearing capacity of ecosystems and biodiversity. In short, is defined by Sutton (2004) as preserving valued things or qualities in the physical environment. Even if these dimensions of sustainability are separately defined, it is non-negligible that economic and environmental concerns have social consequences, and fulfillment of the human needs depends on distributional impacts of each dimension of sustainability. Hence they are interrelated rather being individual concepts.

In addition to the definition of sustainable development by WCED (1987), alternative views by providing an interaction between the economy and the environment would define the conditions of sustainable development as eliminated unemployment and poverty, saved economic and natural resources, and a preserved environmental wealth for future generations. Besides, it is believed that economic sustainability depending on unlimited growth in Gross Domestic Product (GDP) is not ecologically sustainable (among others, Alier, 2009; Kallis, 2011). In other words, the requirements of ecological sustainability are incompatible with the requirements of capital accumulation. A low growth/de-growth of the economy is supported as being a way out for sustainable ecology/environment and the economy, simultaneously (Lawn, 2004, 2009).

In the present research, in a way similar to Ashford et al. (2012), employment phenomenon having social and economic reflections on individuals and the society as a whole is the remainder requirement for sustainability other than the environmental elements. Thus, beyond the approaches above, renewable energy as by supposedly reconciling the conflict between the environment and employment, has been considered as one of the sources to overcome the environmental costs of climate change as well as of creating alternative jobs. In the following sections, renewables and their environmental and employment effects will be examined.

2. ENVIRONMENT, RENEWABLE ENERGY, AND RELATED STATISTICS

Greenhouse gases produced generally by human activities have had a warming effect on Earth's climate since the first industrial revolution. The prominent source of warming has been greenhouse gases like carbon dioxide and methane. Not surprisingly, China and the United States produce the most carbon emissions; and with the European Union countries, these are the top three emitters with a share of about 54% of total global emissions in 2010 (The United States Environmental Protection Agency, 2020).

Most renewable energy sources emit little or no greenhouse gas emissions, so not threaten human health and enhance welfare at the national and global level. Renewables are of great importance to the low-carbon economic base. In addition to concerns about greenhouse gas emission or air quality, investment in renewable technologies is also driven by concerns about energy independence.

A major part of the studies concerning renewables (e.g. Panwar et al., 2011; Shafiei and Salim, 2014; Inglesi-Lotz and Dogan, 2018; Sharif et al. 2019) focuses on the effect of renewable energy deployment on reducing the environmental pollution in developed or less developed countries. These studies point out the necessity of encouraging the use of renewable energy to reduce environmental pollution over time.

Nine years ago, ILO (2011) reported that the share of renewable energy sources in the total global energy supply was about 12%, whereas it was 85% for fossil fuel energy sources as natural gas, coal, and oil. Although investment in renewable power projects to increase the share of renewables in total energy supply have been steadily rising in the last decade[2], utilization of renewables (hydro, wind, solar, biofuels, etc.) has still been limited compared to conventional energy sources like oil, natural gas, and coal (see Figure 1).

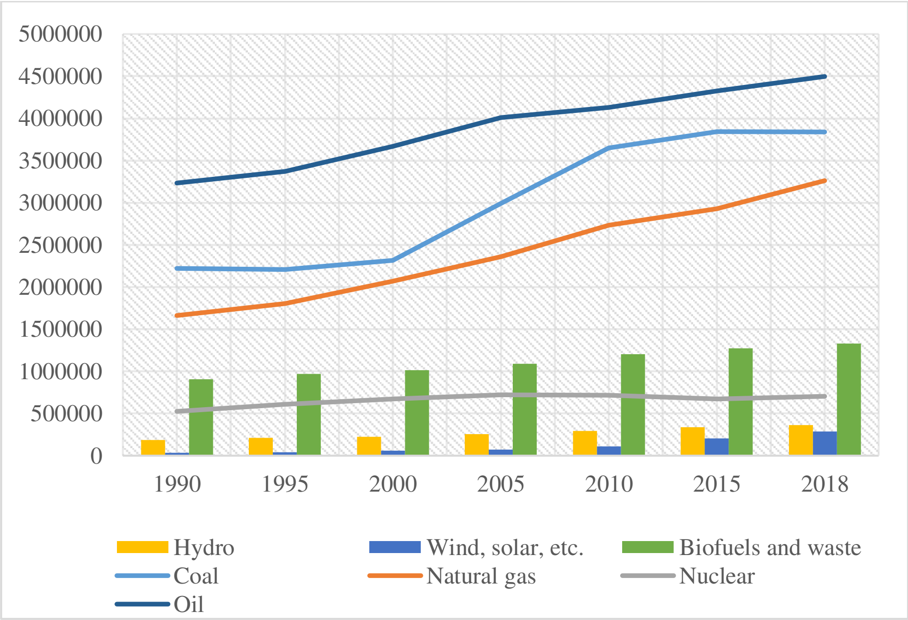

Figure 1: World total energy supply by source (thousand tonnes of oil equivalent-ktoe, 1990-2018)

Data Source: International Energy Agency – IEA (2020)

[2] The Covid-19 pandemic crisis brought with it about a 10% investment fall in renewable power projects in 2020 (International Energy Agency, 2020).

More specifically, Figure 2 shows global investment in renewable energy by technology. As the figure asserts, the investment value of wind energy is the highest among others, as it costs about 143 billion dollars while solar energy is the second with an investment value of 141 billion dollars. What is striking in this figure is the growth of investment in renewables from 2005 to 2019 –albeit not a continuous increase. Solar energy investments have risen from 15 billion in 2005 to 141 billion dollars in 2019 corresponding to an eightfold increase, while global investment in wind energy increased from 26 billion to 146 billion dollars in the same period corresponding to an approximately fivefold increase.

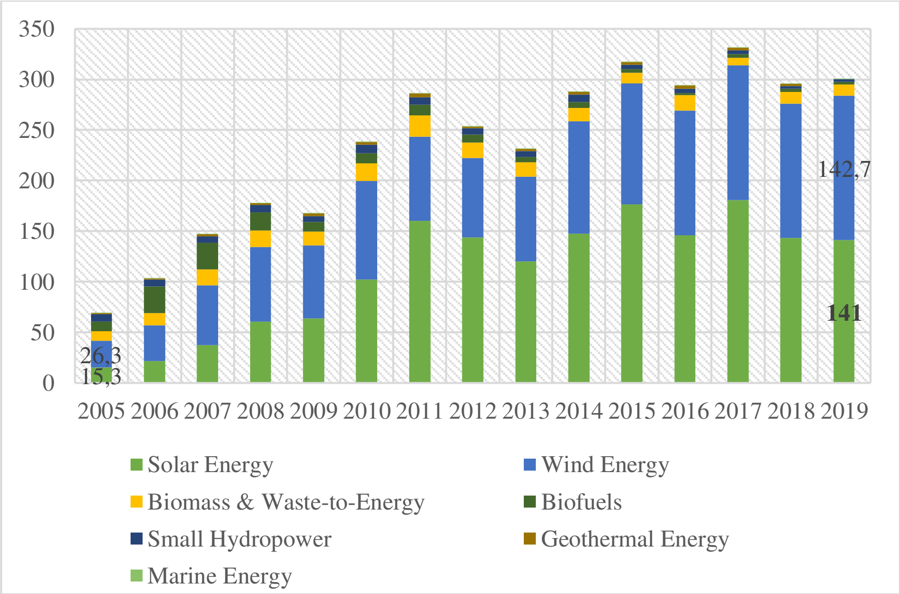

Figure 2: Global investment in renewable energy by technology (new investment in billion dollars, 2005-2019)

Data Source: International Renewable Energy Agency, 2020

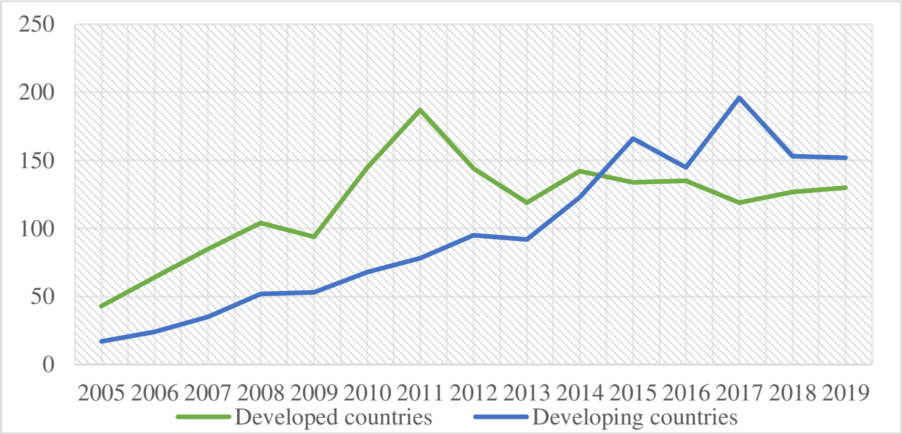

Figure 3: Global investment in renewable energy by development level of countries (new investment in billion dollars, 2005-2019)

Data Source: International Renewable Energy Agency, 2020

Figure 3 depicts the trend in renewable energy investment by development level of countries for the period of 2005-2019. In recent years, investment in renewables by developing countries has exceeded that of developed countries. Figure 3 also illustrates that a relatively non-increasing pattern has occurred in developed countries since 2014.

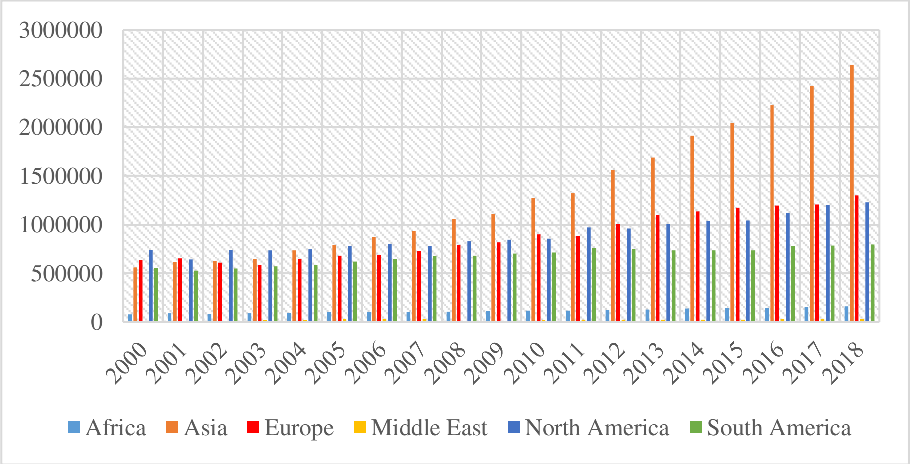

Figure 4: Renewable electricity generation (GWh) by country groups (2000-2018).

Data Source: International Renewable Energy Agency (2020)

Based on regions, Asian countries account for the largest and growing renewable electricity capacity share among developing regions while for other country groups such as Europe and North America the increases are moderate as illustrated by Figure 4.

3. EMPLOYMENT EFFECTS OF RENEWABLE ENERGY INVESTMENTS

The renewable energy industry requires specific skills and value chains, which lead to the creation of new types of jobs (European Environment Agency-EEA, 2017). The job numbers in the sector can be estimated using various methods. There is an array of studies in the field of employment effects of renewable energy deployment, which assess the employment effects of renewables via several methodological approaches (Wei et al., 2010; Cetin and Egrican, 2011; Fragkos and Paroussos, 2018; Chen, 2019).[3]

These methods might be grouped into three categories: *Input-Output (I-O) methods*, analytical methods, or employment-factor approach. I-O methods enable to make of a distinction between different types of employment effects (direct, indirect, or induced) while analytical methods are generally base upon surveys. The limitations of I-O methods are related to their assumption on homogeneity in technologies or calculations which are only at the national level, which may cause aggregation bias. On the other hand, if the answers are unbiased, the *survey method* might provide more accurate data since the data is based

[3] For a comprehensive literature review, see Cameron and Zwaan (2015).

on firsthand information. However, they are unable to account for indirect effects (Lambert and Silva, 2012). Lastly, the *employment-factor approach*, by allowing for technology variation, but only considering direct jobs, calculate the full-time equivalent jobs per unit of product or service.

European Union Energy Initiative – EUEI (2017) reports that renewable energy investments create significant *direct* employment opportunities. Key findings of the research are these opportunities being far greater than those of conventional energy sources and what is inferred proves more than a compensation for the transition from conventional energy to renewables though. Unlike direct employment effects, indirect and induced effects take time to be concretely visible. As far as the report outlines, the measurement of these effects are rather difficult.

3.1. Direct, Indirect and Induced Employment

Employment in renewable energy sectors regarding how it forms can be classified into three categories:

i. *Direct employment* represents the jobs for on-site installation during the construction phase and the operation and maintenance of a power generation plant (e.g. manufacturing of wind turbines) and does not include the employment in the value chain of other manufacturing industries (Hondo and Moriizumi, 2017). In other words, direct employment refers to the employment generated by the renewable energy sector.

ii. *Indirect employment* represents the jobs that are not directly related to the renewable energy sector rather generated in secondary sectors of activity that provide inputs to the main activities of the renewable energy sector, such as the steel industry (Ortega et al., 2015).

iii. *Induced employment*, is generated through additional consumer spending from direct and indirect job earnings (e.g. jobs in unrelated service sectors). Although induced employment does not have a structural link with the renewable energy sector, it indicates employment changes in other sectors due to the developments in this sector. However, whether the jobs induced should be considered "green"[4] remains an ambiguous concern (Meyer and Sommer, 2014).

3.2. Gross versus Net Employment Effects

Another categorization regarding the employment effects is by classifying them as gross and net effects. When measuring employment effects, a distinction is necessary between gross and net effects. Gross employment effects are measured only by considering the positive effects on employment, while net impacts include both positive (created jobs) and negative (displaced jobs) effects suggesting a more realistic approach.

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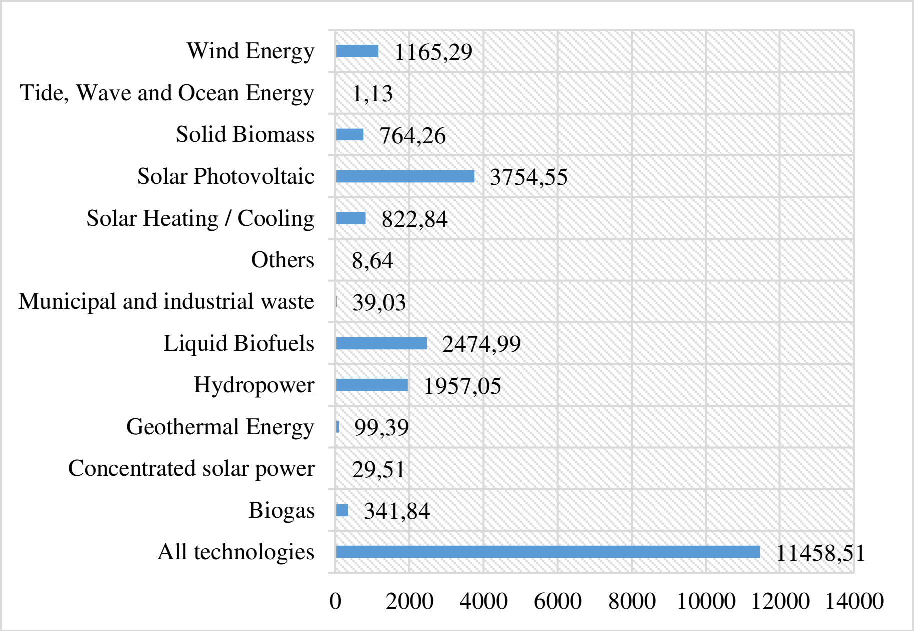
[4] United States Bureau of Labor Statistics (BLS) defines green jobs as "*jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources*". Therefore, employment in renewable energy, energy efficiency, pollution and greenhouse gas reduction, recycling, natural resources conservation, environmental compliance, education and training, and public awareness are all counted as *green jobs* (Environmental and Energy Study Institute, 2019).

3.3. Employment in Renewable Energy Sector: Current Statistics

This section presents the employment trends in the renewable energy industry. In recent years, China, the United States, Brazil, India, and the European Union countries have been the leading countries in the sector (IRENA, 2020). Asian countries, in particular, comprised 63% of total direct and indirect jobs in the renewable energy sector while China alone accounted for approximately 36% of total job creation in 2019.

A body of literature investigating the role of renewables in job creation finds evidence that transition from high-carbon based energy sources to low-carbon energy technologies may not offset the loss of jobs in polluting industries and may negatively affect existing employment, and cause unemployment or underemployment (Lawn, 2009; Rivers, 2013) while a considerable amount of literature revealing evidence that renewable energy investments create a significant number of jobs (e.g. Blanco and Rodrigues, 2009; Ortega et al., 2015) or positive net employment effects (e.g. Wei et al., 2010; Lehr et al., 2012; Fragkos and Paroussos, 2018).



Note: 'Others' include jobs that are not technology-specific.

Figure 5: Renewable energy employment (thousand jobs) by technology in 2019.
Data Source: International Renewable Energy Agency, 2020

Since specific forms of renewable energy technologies can generate an essential part of these jobs, Figure 5 presents data on direct and indirect jobs created in renewable energy sectors by their technology types such as solar, wind, hydropower, and biofuels. As is seen in Figure 5, almost 11.5 million people were employed in renewable energy sectors in 2019. Biofuels, solar, and wind power industries provide the most renewable energy jobs in the world. Moreover, IRENA (2020) states that 32% of these jobs are held by women while the 22% average ratio is recorded for the oil and gas industry.[5] The highest employment is generated in solar energy (solar photovoltaic-PV and solar heating/cooling) comprising about 4.5 million of total employment generated. Biofuels and hydropower energy sources are ranked as second and third by approximately creating 2.5 and 2 million jobs, respectively. Another critical sector in employment generation is the wind energy sector where supported jobs are close to 1.2 million.

Hondo and Moriizumi (2017) by using I-O models have already highlighted the fact that there are distinct differences among renewable energy technologies in terms of their potential for employment generation and these technologies ensure jobs in different industrial sectors depending on technology types. Furthermore, the study finds that these different types of technologies commonly generate more employment in the service industry.

Table 1 provides the data on direct and indirect jobs statistics in the renewable energy industry both by technology and by country (China, Brazil, the United States, India, and European Union) where employment remains concentrated.

[5] There is novel literature on gender diversity effects of employment in the renewable energy sector and on gender (in)equality in the energy workforce (see, for example, Blanco and Rodrigues, 2009; Allison et al., 2019).

Type of technology	China	Brazil	United States	India	European Union (28)
Solar Photovoltaic	2,194,000	15,600	225,000	115,000	96,000
Biofuel	51,000	832,000	311,000	35,000	208,000
Hydropower	308,000	203,000	66,500	347,000	74,000
Wind	510,000	34,000	114,000	58,000	314,000
Solar heating and cooling	670,000	41,000	12,000	20,700	24,000
Solid Biomass	186,000	-	79,000	58,000	387,000
Biogas	145,000	-	7,000	85,000	67,000
Geothermal	2,500	-	35,000	-	23,000
CSP	11,000	-	5,000	-	5,000
Total	**4,078,000**	**1,125,000**	**855,000**	**719,000**	**1,235,000**

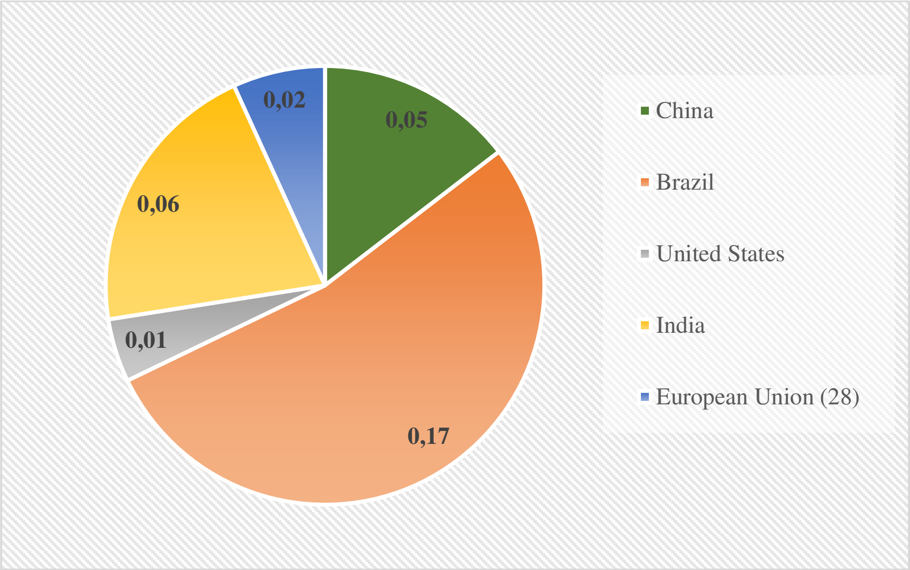
Table 1: Direct and indirect jobs in renewable energy sectors by technology in selected countries, 2019**.**

Data Source: Environmental and Energy Study Institute - Fact Sheet (2019)

Among the countries in Table 1 providing the highest employment in the renewable energy sector, China is by far the leader concerning renewable energy employment in 2019. Indeed, 36% of the world's renewable energy employment is provided by China as mentioned before. Jobs in solar PV and solar heating-cooling technologies together account for about 70% of total jobs in China. As for Brazil, the highest share belongs to biofuel energy in which Brazil is the leader among other countries in Table 1. Also, jobs created in Brazil account for about 10% of the total jobs created in the sector. United States as being invested mostly in biofuels and solar PV, comprises approximately 7% of total employment in renewable energy. India generates more employment in hydropower energy with 347.000 jobs which is the highest among other countries. India also creates about 6% of total renewables employment across the world. 28 countries in the European Union provide 1.235.000 jobs in the sector which is not much higher than jobs in Brazil.

China is a meaningful example in the sector. Chen (2019) estimates for China the relative employment impacts of three renewable energy technologies –solar, wind, and bioenergy- as compared to traditional fossil fuel sectors by using the I-O method. According to the results obtained, with a given amount of spending (jobs per 1 million dollars) for both sectors, whilst total employment generation (direct and indirect) in renewables is around 162, the number declines to 96-97 in the fossil fuels industry. The bioenergy sector generates the highest number of direct jobs in renewables which is significantly higher than the jobs generated in fossil fuel sectors such as coal, oil, and natural gas.

Figure 6 compares the job creation ratios of these countries. For that purpose, the jobs/investment ratio is used as a metric. Brazil records the highest jobs/thousand dollars ratio of 0.17, revealing that 0.17 jobs per 1000 dollars were generated in Brazil in 2019. This ratio is 0.06, 0.05, 0.02, and 0.01 for India, China, the European Union, and the United States, respectively. Although renewable energy generation in Europe has an increasing trend as shown in Figure 4, the jobs/investment ratio remains relatively lower for European Union countries.



Note: Calculated using 2018 data for China

Figure 6: Jobs per thousand dollars invested in renewable energy in 2019 (Jobs/thousand dollars)

***Data Source*:** Author's calculations based on International Renewable Energy Agency Data (2020)

Besides, Cameron and Zwaan (2015) states that for a given level of energy production capacity, renewable energy generation creates more jobs than coal or gas-based energy technologies. Indeed, EUEI (2017) highlights the fact that the net employment effect –measuring the difference between created jobs and displaced jobs- of renewable energy is positive. Moreover, these jobs come with higher labor intensity as declared by EUEI (2017).

CONCLUSION

The renewable energy industry has been targeted as an important investment area in terms of both environmental and economic concerns since the late 20th century. Even if the benefits of renewables, such as climate change mitigation or energy security are commonly accepted, its impact on job creation could not be certainly determined yet particularly due to limited data availability.

In this study, economic, social, and environmental sustainability, the role of renewables in alleviating environmental pollution and generating employment are discussed by considering the binary goal related to environment and employment, rather than conflict between these facts. According to the data presented, developing countries have generated more renewables than developed countries in recent years even if China's effect is dominant at that point. As it is depicted by country-level data, solar and wind energy provide the highest job potential for China while biofuel, hydropower, and biomass provide more jobs for Brazil, India, and the European Union, respectively. On the other hand, data on employment in the renewable energy sector suggested that employment generation differs by technology as a whole. Jobs are mostly created in solar, wind, hydropower, and biofuels energy sectors in which investments are also relatively higher. Furthermore, jobs to investment in renewable energy technologies ratio are also estimated for some countries. The higher ratios for some developing in contrast to developed countries also display the job creation potential of developing countries in the renewable energy industry. It is beyond doubt that not only renewable energy investments themselves but also its employment generation will contribute to economic and social sustainability.

Considering the employment characteristics of different renewable energy technologies, investments in technologies with relatively high employment potential must be a priority. Evaluating the job creation in the context of "decent" jobs will contribute to environmental sustainability within the framework of the notion of *green jobs.* Therefore, the most concrete form of sustainability in an environmental, social, and economic sense will be achievable with new renewables investments, thus employment in the renewable energy sectors, rather than the conventional energy sectors which are neither pro-environment nor pro-labor. In that context, proportional to countries' carbon emissions to the atmosphere, additional environment-protecting policies have got to be enforced to shift the new investments from traditional energy technologies to renewable energy technologies at a country level and across the world. In the first phase, support of governmental feed-in tariff policies and an increase in research and development funds would have a significant role in the deployment of renewable energy investments.

Last but not least, since renewable energy technologies require specific job skills, training, and education programs are of great importance for supporting the transition from conventional energies to renewables and enhancing renewable energy employment.

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CHAPTER 7

THE IMPORTANCE OF AGRICULTURAL BIOMASS IN ENERGY CONSUMPTION (CASE OF CUKOBIRLIK)

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INTRODUCTION

Today, when the energy demand is rapidly increasing on a global scale, fossil fuels are the most important supplier of this need. The most common types of fossil fuels are oil and its products, natural gas and coal. These nonrenewable and consumable energy sources are also the main causes of the increase in greenhouse gas and carbon dioxide emissions. When factors such as population growth and increase in per capita energy consumption are taken into account together, the damages caused by providing energy consumption from these sources are multidimensional, including the environment, health and economy. In this context, it becomes prominent once again that growth and development moves should be considered long-term. In other words, ensuring current and future energy demand with renewable energy sources is vital to get the drift of sustainable development.

In the economic sense, the resources where energy is produced by different methods are named as energy sources and classified in different ways. While there are two major categories of energy in terms of their use (renewable and nonrenewable) energy sources are categorized as “primary” and “secondary” according to their convertibility (Erdem and Senel, 2013):

ENERGY SOURCES	
Based on usability	**Based on convertibility**
A)Non-renewable	**A)Primary**
a)Fossil Origin	Coal
Coal	Oil
Oil	Nuclear
Natural gas	Biomass
b)Core Source	Hydraulic
Uranium	Solar
Thorium	Wind
	Waves-Tides
B)Renewable	**B)Secondary**
Hydraulic	Electricity, gasoline, diesel
Solar	Secondary Coal
Biomass	Coke, petcoke
Wind	Coal gas
Geothermal	Liquefied Petroleum Gas (LPG)
Waves-Tides	
Hydrogen	

Figure 1: Classification of Energy Sources (Erdem & Senel, 2013)

As it can be seen above, biomass is an important energy source in terms of being both renewable and primarily convertible. Currently, bioenergy (energy from bio-based sources) is globally the largest renewable energy source making up more than 2/3 of the renewable energy mix. In the general energy scenario, bioenergy accounts for 13-14% of total energy consumption. In 2017, bioenergy accounted for 70% of renewable energy consumption. However, due to the decreasing use of traditional biomass sources, there is also a decrease in this share (GBS, 2019). This should be perceived as a sign of the importance of biomass as a renewable energy source.

Bioenergy refers to the use of biological commodities (or biomass) especially used for energy purposes. Energy use refers to the use of biomass for electricity and heat generation and the conversion of biomass to secondary products such as biofuels to be used in the transportation sector. Biomass, on the other hand, is renewable organic matter obtained from plants and animals. When we look at the United States of America (USA), we see that the largest source of total annual energy consumption was biomass until the mid-1800s. Continuing to be an important fuel for cooking and heating, especially in developing countries, biomass is also used for transport and electricity generation. From this aspect, in many developed countries, biomass emerges as a way of preventing carbon dioxide emissions from fossil fuel use. Its share in total primary energy use in the United Kingdom (UK) and USA confirms this fact (GBS, 2019; EIA, 2020).

According to the scenario envisaged for bioenergy power generation within the framework of sustainable development goals for the years between 2000-2030, based on bioenergy electricity generation in 2019, an annual increase of 6% is required until 2030 to reach the Sustainable Development Scenario (SDS) level. The actual rate is between 5% and 6%. Recent policy and market developments in developing economies show that positive steps have been taken for bioenergy (IEA, 2020-a).

Renewable energy resources appear to be the fastest growing energy source between 2018 and 2050, with the rapid increase in electricity generation. Cheaper renewable energy technologies, digital applications and the growing role of electricity are the centre point for the realization of many of the world's sustainable development goals. In this context, the importance of using biomass among renewable energy sources should be distinguished as a means of obtaining electrical energy. Biomass usage has increased in China, India, Brazil, the UK, Japan and the rest of the world, and this trend is expected to continue in an upward direction. In this context, China sets an important example. It has launched a new clean heat initiative that is expected to increase the deployment of biomass and waste-fuel cogeneration plants. It is expected that the largest distribution will occur in regions with access to biomass sources and with policies to phase coal-fired boilers out to improve air quality (IEA, 2020-b). When the issue is examined in Turkey particularly, Table 1 shows that the place of biomass in energy generation has reached a noticeable level, but its share is still limited. According to the data in Table 1, while Hydraulics has the highest share with 31.17, biomass constitutes 0.88% of the available power.

Table 1: Distribution of Turkey's Installed Capacity by Sources

Sources	**Installed Capacity**
Hydraulic	28.499
Natural gas + LNG	26.075
Brown Coal + Hard Coal	10.912
Import Coal	8.967
Wind	7.591
Solar	5.995
Geothermal	1.515
Biomass	**800**
Liquid Fuels (Fuel Oil+Diesel+Naphtha+Asphaltite)	716
Waste Heat	362
TOTAL	**91.431**

Source: EGC, 2019

Biomass is converted into energy through various processes. These include direct combustion for heat generation, thermochemical conversion to produce solid-gaseous-liquid fuels, chemical conversion to produce liquid fuels, and finally biological conversion to produce liquid and gaseous fuels. Biomass sources for energy include (EIA, 2020):

- Wood and woodworking waste - firewood, wood pellets and wood chips, timber, furniture factory sawdust and waste, pulp and black liquor from paper mills,
- Agricultural products and waste materials - corn, soybeans, sugar cane, switch grass, woody plants, algae and crop and food processing residues,
- Biogenic materials in urban and industrial solid waste - paper, cotton and wool products, food, yard and wood waste, animal manure and sewage waste.

One of the most promising sectors for growth in bioenergy production is residues from the agricultural sector. It is seen that alternatives providing chemical and biological conversion gain importance in generating energy from biomass in the agricultural field. Since 2019, the sector has contributed less than 3% to total bioenergy generation and raising this share is among the priority targets (GBS, 2019).

Within this framework, in this study on which the relationship between agricultural production and biomass (its potential in electricity generation in particular) will be focused. After the theoretical basis is presented in the light of the relevant literature and the subject is reinforced with the case of "Cukurova Cotton, Peanut and Oil Seeds Agricultural Sales Cooperatives Union (Cukobirlik)", results and evaluations will be shared.

Agricultural Production-Biomass Relationship in the Light of Relevant Literature

The agriculture sector is an important biomass provider. The agricultural biomass resource can be used as an energy source to produce heat, electricity and transport fuels. In addition, it plays an important role in improving the consumption of renewable energy, including bioenergy. Considering that the entire renewable energy supply is also largely provided by biomass for Africa (96%), America (59%), Asia (65%) and Europe (59%), the importance of this renewable energy source becomes clear. Various raw materials that can be obtained from forestry and agriculture in order to produce beneficial final products such as pellets, wood chips, bioethanol, biogas and biodiesel to be used in electricity, heat and transportation have contributed -within the scope of their availability- to the development of bioenergy worldwide. Oilseed plants (canola, sunflower, soybean, etc.), sugar and starch plants (potato, wheat, corn, sugar beet, etc.), fiber plants (flax, hemp, kenaf, sorghum, miscanthus, etc.), protein crops (peas, beans, etc.), vegetable and agricultural residues (branches, stalks, straw, roots, bark, etc.) are vegetable biomass resources (GBS, 2019; MENR, 2019).

Cotton straws are one of the most common agricultural waste in Turkey. However, despite having a great potential in renewable energy generation, not consuming it as animal feed or industrial stock emerges as an issue that needs to be addressed. The conversion of organic matter in the cotton plant stem into bioenergy can provide both renewable energy generation and waste reduction. Composition analysis shows that cotton straw is a suitable raw material for both bioethanol and biogas production (Patel, 2017). Therefore, the place of cotton straws that may be an important source of energy for Turkey in biomass resources should be prioritized.

In this sense, one of the most fundamental studies belongs to El-Shinnawi et al. (1989). In their study testing the biogas production from different crop residues such as corn, rice, cotton straws, although the contribution of rice and cotton straw is limited, high productivity rates were obtained for corn residues.

In the study conducted by Isci and Demirer (2007) for Aydin Province in Turkey, the contribution that cotton waste will make to energy generation through bio-conversion is dramatically revealed. Accordingly, the study, in which it is stated that a significant part of the annual energy demand of the USA can be provided, it is revealed that 40,000 homes in the USA can be supplied with bioenergy to be produced from cotton straw.

Poyraz (2012) made an analysis for cotton straws taken from Eskisehir-Saricakaya-Mayislar. That study concluded that instead of burning them in the fields as waste or using them as fuel in stoves, it is of great importance to convert cotton straws into useful liquid products through pyrolysis[3], which is a very simple and easy method. It was also stated that this conversion can indirectly contribute to the solution of the energy problem.

Adl, et al. (2012) made a technical evaluation on the inexpensive production of bioenergy from cotton straws in certain agricultural lands in China's Zhejiang University - Huajiachi Campus. Accordingly, it was proven that it is possible to produce bioenergy from cotton straws by using inexpensive methods.

Considering the residual and thermal capacities of products, which make up 75% of field agriculture in Canakkale and have residual potential, calculated retrospectively over the last 5-year (2011-2015) average, the energy potential that can be obtained from the wastes left in the fields after the harvest of field crops grown for consumption as foodstuff within the borders of Canakkale Province is considerable (Sumer et al., 2016).

In the study of Patel (2017), in which he tested whether or not economical biogas and bioethanol production could be achieved from cotton straw in India, it is stated that there is a significant, volumetric increase in biogas and ethanol production. In that study, it has been

[3] Pyrolysis is a thermochemical process that can be easily applied to any organic product. It consists of the words "pyro" meaning heat and fire in Greek and "lyse" meaning fragmentation. The process of thermal cracking of organic materials at high temperatures and in an oxygen-free environment is called pyrolysis (PAC, 2007).

revealed that cotton straw wastes can be an important energy source directly for more energy production.

Yoruklu et al. (2020) examined the different pretreatment methods for the transformation of cotton straws in Sanliurfa Province in Turkey into sugar and the process of producing biohydrogen and biomethane from cotton straw. In the study, it has been found that the pre-treatment to be applied to cotton stalks is the most effective method to produce these renewable energy resources. The study also concluded that agricultural wastes can be utilized in hydrogen and methane production and that zero-carbon energy can be produced in fuel cells with the energy obtained from agricultural wastes.

As it can be seen, instead of obtaining the energy demand with non-renewable resources using traditional methods, it is possible to provide this need highlighting renewable energy sources by using wastes for biogas production. However, due to the high initial investment cost of biogas plants and difficulties in supplying sufficient materials, bioenergy production is limited especially in the less developed and/or developing countries just as in Turkey. However, studies revealing that it is possible to produce bioenergy from agricultural residues through some methods to minimize costs (El-Shinnawi, et al., 1989; Isci and Demirer, 2007; Poyraz, 2012; Adl, et al., 2012; Sumer, et al., 2016) ; Patel, 2017; Yoruklu, et al., 2020) encourages taking steps in this direction.

In our country, due to the decrease in cotton production over the years and the increase in consumption in parallel with the development in the textile sector, imports has inevitably increased as the cotton demand cannot be supplied by domestic production. In the 2019/20 season, cotton cultivation areas decreased by 8% compared to the previous year and remained at 477 thousand hectares (TSI, 2020). Considering the burden of this situation on the country's economy, increasing cotton production as well as contributing to clean energy production by taking advantage of even the cotton residue will provide multiple benefits. In this sense, Cukurova is one of the regions that will provide added value for Turkey. In cotton agriculture of 477 thousand hectares in 2019, while Southeastern Anatolia Region (60%) took the first place in terms of the size of cultivation areas, Cukurova (20%) ranked second, Aegean Region (19%) third and Antalya (1%) ranked last (TSI, 2020).

Since cotton passes through many stages in the production-consumption chain, it is a type of corn in which the marketing network until it reaches the final consumer is long-term. In this sense, Agricultural Sales and Cooperatives have a critical responsibility in the process of fulfilling all these stages. Adana, which has the highest population and the second largest cotton production after Hatay, among the provinces covered by the Cukurova Region (Adana, Mersin, Osmaniye and Hatay), which is important in terms of both its share in cotton production and its place in cooperatives, is privileged in this regard (TSI, 2020). Carrying on its activities in Adana, Cukurova Cotton, Peanut and Oil Seeds Agricultural Sales Cooperatives Union

(Cukobirlik) provides benefits both to the region's economy and environment in many ways such as its role of being a supplier and distributor from the producer to the consumer, and its search for methods such as providing bioenergy from agricultural residues.

Case of Cukobirlik

Cukobirlik, where this study was conducted, is a cooperative union founded on 15 October 1940 by 275 partners in Adana, Ceyhan and Tarsus Agricultural Sales Cooperatives to evaluate the products of cotton producers in Cukurova and to provide support to producers in the region. In 1985, it was reconstructed. In 1989, it merged with "Peanut Agricultural Sales Cooperatives Union", the short name of which was "Yerfiskobirlik" and its title was changed to "Cukurova Cotton, Peanut and Oilseeds Agricultural Sales Cooperatives Union".

As can be clearly seen from the Cukobirlik 2019-2023 Strategic Plan prepared in 2019, Cukobirlik serves approximately 34,000 productive partners with 36 Cooperatives covering 11 provinces from Mersin to Bismil, from Batman to Hatay. There are 7 SAW-GIN plants and 5 ROLLER-GIN companies in Cukobirlik, which processes cotton, sunflower, peanut, canola and soybean it acquired through Associated Cooperatives. Since the factories' machinery technology is old, the businesses operate at 60% capacity. Total capacity is 1.048.320 per day (20 hours). Some of the businesses are leased out and some are not operated because there is no commodity to process (Cukobirlik, 2019).

The development of a biodiesel facility to be manufactured in compliance with European Union (EU) requirements was completed on the basis of the provision of service to the Cukobirlik partners within the “Cukobirlik Center Integrated Facilities” with the understanding of “Carry oilseed, take biodiesel!” With 2,000 m2 of open and 800 m2 of closed area, this facility has a processing capacity of 120 tons/day (Cukobirlik, 2019). There is a Central Oil Factory of Cukobirlik on Adana-Mersin highway and an Oil Factory in Ceyhan. Thanks to its modern extraction method, Cukobirlik’s Central Oil Factory can process oilseeds like cottonseed, sunflower, canola and soy. The Central Oil Factory has an average capacity for processing 330 tons per day of cotton seed, 250 tons per day of soy, 250 tons per day of sunflower, 230 tons per day and 230 tons per day of canola. There are 30,000 tons of cotton seed, 5,000 tons of shell, 3,000 tons of pulp, 18,000 tons of crude and neutral oil, 500 tons of refined oil and 8,000 tons of soybeans storage capacity in the Central Oil Factory. While soap is produced in the factory as a by-product, pulp and linter are used as waste products in the feed industry. On the other side, Ceyhan Oil Factory has an average capacity of processing 220 tons per day of soy, 190 tons per day of sunflower and 180 tons per day of canola (Cukobirlik, 2019). In addition, the market value of the region’s mass prices of cotton, sunflower and soybeans is determined by the Cukobirlik price determination. The presence, effectiveness and balancing role of Cukobirlik in the market is also demonstrated by the waiting of the other institutions and organizations operating in the same field for the prices to be announced by Cukobirlik and then to announce their own prices.

As can be seen, the Union providing added value with its many aspects is also important for its region and takes steps to strengthen this position for the economy of the country. Especially when considered in the context of energy, the contribution of agricultural residue capacity is obvious.

CONCLUSION

Societies that have turned their direction towards development will undoubtedly move forward with a perspective in which growth is a means and development is the goal. It is inevitable that development must be sustainable. One of the issues that come to the fore in this cycle is rooted in environmental factors. Ignoring the power of nature on the road to economic enrichment has various negative consequences in the long run. In particular, the damage caused by fossil fuel consumption to nature paints a pessimistic picture for a world that will be entrusted to future generations.

With the emphasis on “for a better tomorrow”, here, the attention is drawn to the way in which energy sources are used. As a renewable and reusable energy source, biomass has a priority in terms of use today. The agricultural sector is an important biomass provider in the production of bioenergy, which is renewable organic substance obtained from plants and animals. Vegetable and agricultural residues (branches, stalks, straw, roots, bark, etc.) have started to be considered as an attractive method of generating energy among plant biomass resources.

Cotton stalks are one of the most-generated agricultural wastes in Turkey. The conversion of organic materials in the cotton stalk into bioenergy should be supported in terms of renewable energy production and should be seen as a part of energy saving. Considering the position of this priority in sustainable development, it is obvious that it also has an enlightening role in terms of economic policies. Beyond being a simple agricultural residue, the cotton stalk, which can turn into an important biomass resource, will serve a much larger mechanism by being a renewable energy provider. In this sense, within the framework of this transformation we met with many examples, supporting every organism that can create added value is essential for countries particularly rich in terms of agricultural areas, such as Turkey, through their economic, environmental, energy policies, etc. One of the only formations that can serve these policies is undoubtedly Agricultural Cooperatives. Cukurova Cotton, Peanut and Oil Seeds Agricultural Sales Cooperatives Union (Cukobirlik), which is an important supplier and seller in its region in this sense, has an important potential in generating biomass from agricultural residues. In this respect, it is thought that with the energy savings to be created by the Union, it will contribute to a much wider development, starting from the local, both environmentally and economically.

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CHAPTER 8

ENERGY EXPORT AND GROWTH NEXUS IN OPEC COUNTRIES: PANEL DATA ANALYSIS

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INTRODUCTION

The organization of petroleum Exporting Countries (OPEC) was establish by Iran, Iraq, Kuwait, Saudi Arabia and Venezuela at the Baghdad Conference held on September 14, 1960. Later on, Qatar (1961), Libya and Indonesia (1962), United Arab Emirates (1967), Algeria (1969), Nigeria (1971), Ecuador (1973), Gabon (1975), Angola (2007), Guinea. (2017) and Congo (2018) also participated in the organization. Ecuador suspended its membership in 1992, then rejoined as of 2007. Similarly, Indonesia froze its membership in 2009, then decided to rejoin in early 2016, and finally left again by the end of 2016. Moreover, Gabon left the organization in 1995, then rejoined as of 2016. Despite all, Qatar terminated its membership at the beginning of 2019. By the end of 2019, there are 14 OPEC member countries.

Throughout the 1980s, growth in OPEC countries has been determined by three main factors. These factors include the maximum level of current energy; the impact of petroleum prices on economic activities in high-consumption countries; and chronic issues such as inflation, unemployment environmental problems, and government interventions in industrialized countries. OPEC countries are powerful enough to influence the first two factors, but the declining reactions of petroleum- importing countries played an important role in the growth of OPEC countries during the late 1980s. The 1990s revealed new supply options such as the use of hydrogen and electricity along with the technological improvements due to the concerns of the governments of petroleum-importing countries. Moreover, social changes such as the disintegration process in the Soviet Union and the economic as well as the commercial impacts of China on the world economy have also been accelerated. At the 109th meeting held in the early 2000s, OPEC determined the crude petroleum price band within a range of $ 22-28 per barrel. In a short period of one year, supply disruptions occurred in Venezuela, Iraq, and Nigeria for various reasons (war, etc.). Besides such problems, the fact that many governments in the EU earned more than the petroleum-producing countries from the final petroleum products through high tax rates brought up the economic growth issue in OPEC countries. In the EU member countries, 70% of the price of the final products goes to the state's treasury through taxes, whereas only 20% goes to producing countries. The world's overall demand for petroleum was 76 million barrels per day in the 2000s, 89 million barrels per day in 2010, and it is expected to be 107 million barrels per day as of 2020. OPEC meets approximately 50% of the world's demand in these amounts. The significance of the relationship between the amount of crude oil that is the subject of growth and production in the community of countries with such an important export item cannot be ignored.

The study continues with a literature review considering the relationship between energy export and economic growth. Following the introduction of the dataset and methodology, the analysis results are explained with tables. Consequently, the study is finalized with the conclusion part. This article differs from the current literature due to its selection of country group with analysis period and it includes distinct and up-to-date econometric analysis.

1. Theoretical Background and Literature Review

Oil prices pass to the economy of a country that export energy through its fiscal channel and export channels. Whenever oil prices show an increase, the oil-exporting country is exposed to larger capital inflows in foreign currency, resulting in an appreciation of the domestic exchange rate. The appreciation of the domestic exchange rate causes a decrease in the price of imported goods, which usually make up a large portion of the total consumer goods of energy exporting countries. Therefore, with the increase in oil prices, the general price level decreases and the monetary policy response and interest rate decrease due to the Taylor rule. Next one is the fiscal channel. Since the export of energy resources is highly taxed, the country exporting the energy with an increase in oil prices will result in a financial surplus and an increase in government spending, which will eventually lead to an increase in GDP (Alekhina and Yoshino, 2018).

Table 1: Contemporary Studies on Energy and Economic Growth Nexus

Author(s)	Period	Countries	Methods	Results
Bakırtaş and Çetin (2016)	1992-2010	G-20 Countries	Panel Unit Root and Pedroni Panel Cointegration	A long-term relationship was found between renewable energy consumption and economic growth. It was concluded that economic growth increases renewable energy consumption.
Şimşek and Yiğit (2017)	1990-2015	BRIC-T	Panel VAR Analysis and Dumitrescu Hurlin Panel Causality	A unilateral causality was observed from gross domestic product to renewable energy, oil prices, and carbon emissions.
Altıntaş and Koçbulut (2017)	1960-2012	Developed Countries	Zivot and Andrews Unit Root, Gregory and Hansen Threshold Cointegration and Toda-Yamamoto Causality	It was concluded that economic growth has a long-term positive impact on energy consumption. For Austria and Iceland, bilateral causality was found between economic growth and energy consumption, whereas a unilateral causality was detected between Portugal and the USA.
Kesbiç and Salkım Er (2017)	2004-2014	EU - Turkey	Pesaran Stationarity Analysis, Westerlund Cointegration Test and Granger Causality	No causal relationship from renewable energy consumption to economic growth was detected, whereas a unilateral causality was found from economic growth to renewable energy consumption.
Karadaş vd. (2017)	2004-2012	EU Member Countries	Panel Unit Root and Toda - Yamamato Causality	According to the analysis results, a bilateral causal relationship was observed between the energy demands and growths of the EU member states.
Güllü and Yakışık (2017)	1971-2010	MIST Countries	Johansen Cointegration and Granger Causality	A unilateral causal relationship from economic growth to energy consumption and carbon emissions was found.
Özkök and Atay	1980-2011	G7 Countries	Panel Unit Root, Panel Cointegratio	A long-term relationship was found between CO2 emissions, energy consumption, and economic growth variables. A bilateral causality was detected between the CO2 emission

Polat (2018)			n and Panel Causality	and GDP variables. There was also a bilateral causal relationship between energy consumption and GDP variables.
Başar and Akyol (2018)	1992-2013	Developed and Developing Countries	Panel Data Analysis	It was observed that energy consumption had an adverse and significant impact on economic growth. The impact of carbon emissions on economic growth was found significant and positive.
Ballı vd. (2018)	1992-2013	BDT Countries	FMOLS and Dumitrescu-Hurlin	Bilateral causality was observed between energy consumption and economic growth variables.
Syzdykova (2018)	1991-2016	Central Asian Countries	Panel Data Analysis	A bilateral causal relationship was found between energy consumption and economic growth. Moreover, the feedback hypothesis was confirmed to be valid.
Gövdeli and Başkonuş Direkçi (2018)	1980-2013	OECD	Pesaran CADF, Westerlund Durbin- H, and CCE	A cointegration relationship was detected between oil consumption and economic growth variables. In the interpretation of the long-term cointegration coefficients, the elasticity coefficient was positive.
Hayaloğlu vd. (2019)	1990-2017	OECD	Simultaneous Panel Data Analysis	For OECD countries, a bilateral causal relationship was found between energy consumption and economic growth.
Altiner (2019)	1971-2014	MINT	Emirmahmutoğlu and Köse Granger Causality	There was no causal relationship between economic growth and energy consumption for the overall panel. Upon considering the countries separately, unilateral causality from economic growth to energy consumption was detected for Mexico, whereas no causal relationship emerged in other countries.

The literature review in Table 1 indicates that studies have focused mostly countries except OPEC countries. So the studies here include energy consumption and growth relationship. However, there is not so much paper investigating the relationship between growth and energy export. The relationship between energy exports and economic growth can be either positive or negative (Auty, 1990; Rudd, 1996).

2. Dataset and Econometric Methodology

This study covers the 1980-2013 period for 11 OPEC countries[3]. Real GDP (World Bank definition: constant 2010 US$), Energy export (World Bank definition: kg of oil equivalent per capita) and Foreign Exchange Rate (World Bank definition: LCU per US$, period average) series are used. Real GDP, energy export, and exchange rate data are obtained from the World Bank's database. The annual data are used for these variables. The variables and abbreviations used in the analysis are presented in Table 2.

Table 2: Variables Included in the Analysis

Code	Definition	Source
RGDP	Economic Growth	World Bank*
ENERGY	Per Capita Crude Oil Export (in kilograms)	World Bank*
FOREX	Foreign Exchange Rate	World Bank*

Note: **The World Bank: http://data.worldbank.org (Access Date: 12.05.2019)*

The panel data analysis method is used to test a long-term relationship among the variables included in the study, to determine the direction of such relationships if any, and to determine the causal relationship among them. Accordingly, panel unit root tests are used to determine the order of stationarity of variables Reese & Westerlund (2016) due

[3] Angola, United Arabian Emirates, Algeria, Ecvador, Indonesia, Gabon, Iraq, Iran, Nigeria, Saudi Arabia and Venezuela.

to the distinctive nature of the hypothesis Hadri and Kurozumi (2012) (Reese and Westerlund, 2016; Hadri and Kurozumi, 2012). Subsequently, a panel cointegration test Westerlund (2006) is performed for detecting the existence of long-term relationships among the series (Westerlund, 2006). Pesaran (2006) CCE test is performed to estimate the long-term relationship associated with this (Pesaran, 2006). With the Dumitrescu & Hurlin (2012) test, the direction of the relationships among the variables is determined (Dumitrescu and Hurlin, 2012). Eviews 9.5, Stata 14, and Gauss 19 package software are utilized to briefly explain the tests and the results are reported in the data analysis.

2.1. Cross-Sectional Dependence and Homogeneity Test

For the cases in which cross-sectional dependence occurs in panel data studies, the second-generation unit root tests should be performed. In panel data analysis, there are the Breush-Pagan (1980) CDLM1, the Pesaran (2004) CDLM2 and the Pesaran (2004) CDLM tests for investigating the cross-sectional dependence (Breusch and Pagan, 1980), (Pesaran, 2004; Pesaran, 2007). Here, CDLM1 and CDLM2 tests are valid whenever T> N, whereas the CDLM test can be performed in both cases. In the cross-sectional dependence test, the null hypothesis is established as “there is no cross-sectional dependence”. The homogeneity test should be investigated prior to proceeding to other analyses in panel data studies. In the study, the homogeneity of the independent variable coefficient is investigated with the Slope Homogeneity Test (Delta Test) developed by Pesaran and Yamagata (2008) (Pesaran and Yamagata, 2008). The null hypothesis of this test claims that "slope coefficients are homogeneous", whereas the alternative hypothesis claims that "slope coefficients are heterogeneous" (Özkök and Polat, 2018: 37).

2.2. Panel Unit Root Test

Prior to conducting the econometric analysis of a panel data series, it is necessary to determine the order of which the series are stationary. In this context, the most common means to test stationarity is the unit root test. Second-generation unit root tests are used whenever cross-sectional dependence occurs. The Panicca (Panel Analysis of Nonstationarity in Idiosyncratic and Common components on Cross-section Average) test of Reese & Westerlund (2016), based on common factor modeling as one of the current second-generation panel unit root tests that take the cross-section averages into account, is used in the study. The null hypothesis used for this test claims the existence of "unit root", and the alternative hypothesis claims the existence of "stationarity" (Reese and Westerlund, 2016: 971). Furthermore, the Hadri and Kurozumi test, one of the stationary tests, is also included to the analysis. The null hypothesis of this test means "stationary", and the alternative hypothesis means "unit root".

2.3. Cointegration Analysis

In the conducted studies, if the variables are found to be non-stationary in their levels, the test that would be performed is the cointegration test. Panel cointegration tests tend to vary according to the cross-sectional dependence results. Tests that do not take cross-sectional dependence into account are Pedroni (1999), Kao (1999) and Johansen-Fisher cointegration tests. Westerlund's (2006) test is a structural break cointegration test that takes the cross-sectional dependence into account (Johansen, 1988; Kao, 1999), (Pedroni, 1999; Westerlund, 2006). In cases where structural breaks occur in the variables used in the analysis, cointegration tests that examine the existence of a long-term relationship between the variables can also yield deflective results (Westerlund, 2006). For this reason, although the impacts of structural break have to be taken into consideration in cointegration tests, Westerlund's (2006) test developed for this purpose is used in the study. The null hypothesis of this test suggests "there exists cointegration relationship under structural breaks", whereas the alternative hypothesis includes the opposite situation (İlgun, 2015: 78-79). The CCE (Common Correlated Effects) estimator developed by Pesaran (2006) is used to make long-term coefficient interpretations of variables (Pesaran, 2006).

2.4. Dumitrescu-Hurlin Panel Causality Test

Causality analysis is used to investigate the existence and direction of the causal relationships among the variables. The direction of the relationships can be either unilateral or bilateral.

There is no restriction in the Dumitrescu-Hurlin panel causality test except for the condition of stationarity at level [I(0)] for variables. That is to say, in the case of T>N or T<N, it can be performed with or

without cross-sectional dependence and cointegration relationship among series. In the Dumitrescu-Hurlin panel causality test, the HNC asymptotic part is used when the number of observations exceeds the number of sections (T>N), whereas the HNC semi-asymptotic part is valid when the number of sections exceeds the number of observations (N> T) (Özkök and Polat, 2018: 38).

3. Empirical Findings

The analysis results consist of five sections. The first of these is the cross-sectional section dependence and homogeneity test results. In the second section, the unit root test results; in the third section, the cointegration test results; in the fourth section, the prediction of the model; and in the last part, the causal relationships are presented.

Table 3: Cross-Sectional Dependence and Homogeneity Test Results

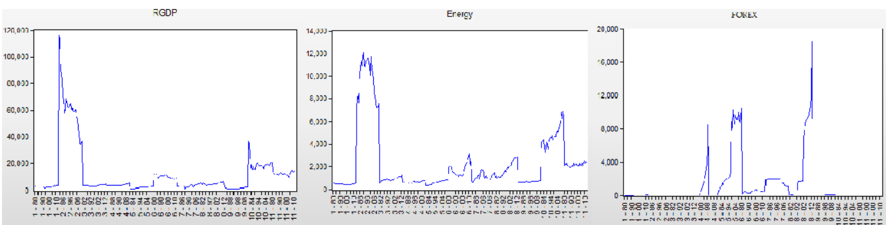
OPEC	Cross-Sectional Dependence			Homogeneity
SERIES	***CD_{LM1} (BP, 1980)***	**Pesaran Scaled LM**	**CD_{LM1} (Pesaran, 2004)**	**Pesaran and Yamagato (2008)**
FOREX	684.5096 (0.000)	58.97257 (0.000)	16.17570 (0.000)	4.402 (0.000)
ENERGY	99.39863 (0.002)	3.184434 (0.015)	3.664322 (0.0002)	7.599 (0.000)
RGDP	243.2249 (0.000)	16.89773 (0.000)	7.099628 (0.000)	1.747 (0.040)

Note: *The Probabilty values are indicated an parentheses.*

In the analysis, the time dimension (T = 34) and the cross-sectional dimension (N = 11) are given, the the Breush-Pagan (1980) test is performed since T>N. In line with the results given in Table 3, it is concluded that cross-sectional dependence exists among the series at a 1% significance level. Furthermore, the null hypothesis claiming that

“H0: The Slope Coefficients are Homogenous” is rejected at a 1% significance level according to the Pesaran & Yamagata (2008) test and slope coefficients are found to be heterogeneous. Since the series contains both cross-sectional dependence and are heterogeneous, it is subjected to one of the Second-Generation unit root tests, namely, Reese & Westerlund (2016) and Hadri and Kurozumi (2012) (Hadri and Kurozumi, 2012; Reese and Westerlund, 2016). According to the results of the unit root tests given in Table 4, the null hypothesis proposed in the Reese & Westerlund (2016) test is accepted, but it is understood that the null hypothesis proposed as “H0: Stationary” in the Hadri and Kurozumi (2012) test is rejected and the variables contain unit root at level. For this reason, by taking the first difference of the variables, it is seen that they are all integrated in the first order.

Figure 1: Level Value Graph



As seen in Figure 1, it is observed that there are trends and constant terms in all three series.

Table 4: Unit Root Test Results

Reese and Westerlund (2016)						
OPEC	**At Level**			**1st Diff.**		
	Constant + Trend			**Constant + Trend**		
SERIES	**Pa**	**Pb**	**PMSB**	**Pa**	**Pb**	**PMSB**
FOREX	1.507 (0.934)	1.897 (0.977)	2.743 (0.997)	-47.29 (0.000)	-18.85 (0.000)	-3.11 (0.000)
ENERGY	1.275 (0.899)	1.617 (0.947)	2.246 (0.98)	-16.16 (0.000)	-8.17 (0.000)	-2.77 (0.002)
RGDP	0.769 (0.779)	0.883 (0.811)	1.179 (0.881)	-37.61 (0.000)	-14.30 (0.000)	-3.21 (0.000)

Hadri and Kurozumi (2012)				
OPEC	**At Level**		**1st Diff.**	
	Constant + Trend		**Constant + Trend**	
SERIES	**P-normal**	**Choi-normal**	**P-normal**	**Choi-normal**
FOREX	4.876 (0.000)	-4.487 (0.000)	0.305 (0.380)	-1.020 (0.154)
ENERGY	3.799 (0.000)	-3.833 (0.000)	0.420 (0.337)	1.856 (0.968)
RGDP	3.490 (0.000)	-3.703 (0.000)	0.476 (0.317)	-1.195 (0.116)

Note: *In the R-W (2016) test, the maximum lag length is determined as 3 and the Schwarz Information Criterion is selected. In both unit root tests, the plots of the series are examined and the section with trends is selected as the model.*

Table 5: Cointegration Test Results

Westerlund (2006)			
Constant + Trend			
OPEC	**LM statistics**	**Bootstrap P-value**	**Cointegration Result**
RGDP - ENERGY	54.587	0.430	VAR
FOREX - ENERGY	71.137	0.260	VAR
FOREX - RGDP	95.208	0.170	VAR

Note: *The number of bootstrap iterations is 1000. Two breaks are included for the model with constant and trend.*

Upon considering the results obtained in Table 5, the null hypothesis claiming that "H0: There is cointegration" is accepted in all levels of 1%, 5%, and 10%, although it is concluded that there are long-term relationships among economic growth, energy export, and exchange rate variables. Since this test reveals the existence of cross-sectional dependence, bootstrap probability values are checked.

Cointegration coefficients are estimated using the CCE (Common Correlated Effects) method developed by Pesaran (2006), which takes the heterogeneity and cross-sectional dependence into consideration since there is a cointegration relationship between the variables. The estimation results of the cointegration coefficients of the series are reported in Table 6.

Table 6: Estimation of the Cointegration Model

RGDP		ENERGY	FOREX
OPEC	***Pesaran CCE(2006)***	3.43 (0.000)	-14531.54 (0.450)
Note: Prob > chi2=0.0001; the model, on the whole, is significant			
RGDP		ENERGY	FOREX
Angola	***Pesaran CCE(2006)***	8.37 (0.000)	9.87 (0.000)
RGDP		ENERGY	FOREX
UAE	***Pesaran CCE(2006)***	2.72 (0.000)	-202924.8 (0.008)
RGDP		ENERGY	FOREX
Algeria	***Pesaran CCE(2006)***	3.50 (0.000)	1.53 (0.683)
RGDP		ENERGY	FOREX
Ecuador	***Pesaran CCE(2006)***	2.77 (0.003)	-0.051 (0.005)
RGDP		ENERGY	FOREX
Indonesia	***Pesaran CCE(2006)***	3.54 (0.000)	-0.087 (0.001)
RGDP		ENERGY	FOREX
Gabon	***Pesaran CCE(2006)***	-0.65 (0.020)	0.90 (0.475)
RGDP		ENERGY	FOREX
Iraq	***Pesaran CCE(2006)***	0.061 (0.891)	-0.64 (0.136)
RGDP		ENERGY	FOREX
Iran	***Pesaran CCE(2006)***	1.79 (0.000)	0.04 (0.190)
RGDP		ENERGY	FOREX
Qatar	***Pesaran CCE(2006)***	7.24 (0.000)	1.66 (0.343)
RGDP		ENERGY	FOREX
Kuwait	***Pesaran CCE(2006)***	4.88 (0.000)	42515.73 (0.001)
RGDP		ENERGY	FOREX
Libya	***Pesaran CCE(2006)***	3.53 (0.020)	548.93 (0.009)

Note: *The probability values are indicated in parentheses.*

Upon considering the results obtained from Table 6, it is seen that the panel analysis result is statistically significant in OPEC countries which are selected according to CCE cointegration estimator results. While the increase in energy export positively affects economic growth, the increase in the exchange rate negatively affects economic growth. Upon considering these results on a country basis, Gabon is seen as the only country in which a negative but statistically significant relationship between economic growth and energy export exists, whereas Indonesia, Iran, Qatar, Kuwait, and Libya are the countries in which the variables are statistically significant and positively correlated. Iraq is seen as the only country in which economic growth and energy export are positively correlated and statistically insignificant.

Table 7 indicates the Dumitrescu-Hurlin (2012) panel causality test results. Since there is cross- sectional dependence among the variables in the study, the bootstrap probability values are considered in the Dimutrescu-Hurlin panel causality test. According to the test results, the null hypothesis claiming that “economic growth is not the cause of the exchange rate” is rejected at a 1% significance level. Likewise, the null hypothesis claiming that “economic growth is not the cause of energy export” is rejected at a 5% significance level, although it is seen that there is a unilateral causal relationship from economic growth to both energy export and exchange rate.

Table: 7 Causality Test Results

Dumitrescu & Hurlin (DH) (2012)					
Hypotheses	H_0: ΔEnergy ↛ ΔRGDP				**Result**
OPEC	Panel Z	10%	5%	1%	ΔENERGY ↮ ΔRGDP
	0.356	1.76	2.39	3.39	
Hypotheses	H_0: ΔRGDP ↛ ΔEnergy				**Result**
OPEC	Panel Z	10%	5%	1%	ΔRGDP ↣ ΔENERGY
	3.85	1.80	2.53	3.88	
Hypotheses	H_0: ΔFOREX ↛ ΔRGDP				**Result**
OPEC	Panel Z	10%	5%	1%	ΔFOREX ↮ΔRGDP
	0.023	1.99	2.82	4.90	
Hypotheses	H_0: ΔRGDP ↛ ΔFOREX				**Result**
OPEC	Panel Z	10%	5%	1%	ΔRGDP ↣ ΔFOREX
	5.26	1.81	2.44	3.94	
Hypotheses	H_0: ΔENERGY ↛ ΔFOREX				**Result**
OPEC	Panel Z	10%	5%	1%	ΔENERGY ↮ ΔFOREX
	1.49	1.94	2.60	4.00	
Hypotheses	H_0: ΔFOREX ↛ ΔENERGY				**Result**
OPEC	Panel Z	10%	5%	1%	ΔFOREX ↮ ΔENERGY
	1.50	3.11	4.50	8.15	

Note: *"↣" denotes unilateral causality, whereas "↮" denotes no causal relationship. The number of bootstrap iterations is 1000. The maximum lag length is selected as 3 using the Schwarz Information Criterion (SIC). The variables are analyzed after taking the differences at the level.*

4. Conclusion

There are many studies in the literature examining the relationship between energy consumption and the real GDP. The vast majority of these studies focus on developed and developing countries. It is important for policymakers to comprehend the relationship between energy consumption and economic growth in order to design effective energy and environmental policies. The overall conclusion obtained from these studies is that there is no consensus on the existence or direction of the relationship between energy consumption and economic growth in the literature.

However our study investigates energy export and the growth relationship. In this study, annual energy export and real GDP panel data obtained from 11 OPEC countries (Angola, United Arab Emirates, Algeria, Ecuador, Indonesia, Gabon, Iraq, Iran, Nigeria, Saudi Arabia, and Venezuela) are used over the period from 1980 to 2013. The aim of this study is to determine whether or not a relationship between energy export and real GDP exists, to investigate the causality between these variables, and then to detect the degree of this relationship. Moreover, the foreign exchange rate is included in the model as a control variable.

In panel data, the existence of cross-sectional dependence and homogeneity should be determined first, then appropriate unit root and cointegration tests should be performed. Following cointegration, the performed causality tests figure out the direction of the relationship among the variables, while the degree of the relationship with the long-term coefficients is estimated. The study is completed by selecting up-to-date tests from the literature that are appropriate for the data. According to Westerlund (2006) panel cointegration test results, it is detected that energy export, exchange rate, and GDP variables are co-integrated. Upon the overall consideration of the countries, it is seen that the panel analysis results are statistically significant in the selected OPEC countries. The rise in energy export positively influences economic growth, whereas the increase in the exchange rate negatively influences economic growth. The country-based results are summarized in detail. Upon considering the causality results, unilateral causal relationships are detected from the GDP to the exchange rate, and from the GDP to energy export.

The empirical results of this study provide policymakers with a better comprehension of the energy export-economic growth nexus in order to formulate energy policies in related countries. Whenever energy export positively stimulates economic growth, the benefit of energy export is indicated to exceed the externality cost of energy export. On the contrary, if an increase in economic growth leads to a rise in energy export, the externality of energy export would hinder economic growth. Under such conditions, a protection policy is required. Since there is no evidence for that energy export causing economic growth in the country groups included in this study, policymakers should take the degree of economic growth in each country into consideration when an energy exportation policy is generated. The increase in alternative energy use areas indicates that this subject deserves to attract further attention. The inclusion of different variables and comparisons that can be made with different country groups would contribute to the literature.

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CHAPTER 9

ENVIRONMENTAL AND ECONOMIC DIMENSIONS OF SUSTAINABLE DEVELOPMENT

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INTRODUCTION

The development of technology, globalization and rapid change in world trends have affected societies in many ways. These changes have socio-economic, environmental and ecological dimensions. In the socio-economic dimension, the concept of economic growth and development appears. Economic growth is a state of increasing per capita national income through social innovations. Increase in physical capital investments increases production; hence an increase take place in both personal well-being and public revenues. Economic development is the improvements in individual welfare caused by the developments in human capital investments.

The common purpose of state administrations is to ensure economic growth and development. States have made policies by considering this purpose. But the policies implemented have many effects on the environment and society. This issue reveals the environmental and ecological dimensions of technology and globalization. Environmental destruction resulting in free market conditions is an important source of negative externalities. This situation has revealed the necessity of environmental regulations. There are concepts that societies need to care about in order to develop healthily. The most important of these are green economy and sustainable development.

In this study, the concepts of sustainable development and green economy will be evaluated. In addition, renewable energy and recycling issues, which are the main pillars of environmental sustainability in sustainable development, will be emphasized. Finally, the concept of economic sustainability that supports economy-environment cooperation will be discussed.

1. The Relationship of Economy and Environmental Order

Rapid population growth as a result of globalization and industrialization has led to an increase in environmental destruction and a decrease in natural resources. This issue has not been taken into account by classical economists with the idea that natural resources are unlimited in the world Keynesian economists have given priority to issues such as economic development and lowering inflation. For these reasons, until the 1970s, the idea of eliminating the environmental damages that emerged in line with the economic growth and development purposes has taken place. Thus, it is seen that environmental problems are constantly postponed and come to the point of accumulation. (Yalçın, 2016, p.751).

With the increase in production in the 1980s; such environmental problems as the decrease in natural resources, increase in environmental pollution and global warming has been observed. It can be said that these environmental problems are linked to rapid population growth. The interdependence between the environment and the economy also indicates that environmental values may be harmed for the sake of economic growth and development criteria.

The first platform where economic activities and environmental problems are discussed was the United Nations Human Environment Conference (Stockholm Conference) held in Stockholm in 1972. After this conference, environmental issues began to be discussed internationally (Bozloğan, 2005, p.1018).

2. Green Economy

According to the report published by UNEP (United Nations Environment Programme) in 2012, the green economy is defined as "the economic model that seriously reduces environmental risks and ecological shortages while ensuring human welfare and social equality." (UNEP, 2011, p.16).

The idea of eliminating or reducing negative externalities that increase as a result of the growth in the production scale is one of the main goals of the green economy. The main problem of interest to the green economy is how economic activity affects the environment. There are ecological sustainability indicators to evaluate the effects of economic activities on individual well-being and the environment. These indicators are listed as follows: (Aşıcı, 2012, p.54).

- Environmental Sustainability Index
- Environmental Performance Index
- Environmental Vulnerability Index
- Index of Sustainable and Economic Welfare
- Green Net National Product

The common feature of these indicators is the thought that GNP is insufficient in evaluating environmental problems (Aşıcı, 2012, p.54).

On the other hand, the concepts of sustainable development and green economy are not competing concepts that can be used interchangeably. Green economy is the existence of economic growth and development indicators in a quality and sustainable life (Yalçın, 2016, p.750).

3. Sustainable Development

The concept of sustainable development is included in the “Our Common Future” report of the World Commission on Economic Development (WCED). With this report, sustainable development has started to become popular. According to the definition made by WCED, sustainable development is the situation that future generations meet today’s needs by having the ability to meet their own needs (WCED, 1987, p.8). This definition of WCED has been effective in developing a “global view” for the future.Furthermore, WCED expressed that sustainable development should be applied simultaneously with the economic, environmental and equality principles (Bansal, 2005, p.197; Mebratu, 1998, p.494).

Advocates of sustainable development have different views on what is to be sustained and developed, how to connect the environment and development how long it will take to do this process. The perspective in Table 1 will be useful for understanding these uncertainties. The first column included nature, life support and community under the heading “what is to be sustained”. In the second column, under the heading “What is to be developed”, there are three categories as people, economy and society. (Parris ve Kates, 2003, p.561).

Table 1: Taxonomy of sustainable development goals

What is to be sustained	What is to be developed
Nature	**People**
Earth	Child survival
Biodiversity	Life expectancy
Ecosystems	Education
	Equity
	Equal opportunity
Life Support	**Economy**
Ecosystem services	Wealth
Resources	Productive Sectors
Environment	Consumption
Community	**Society**
Cultures	Institutions
Groups	Social Capital
Places	States
	Regions

Source: (Parris ve Kates, 2003, p.561).

Sustainable development is concerned with providing a better quality of life for present and future generations. In order to provide this situation, four basic goals must be met simultaneously in the world (Aytun and Akın, 2016; Zabihi vd., Habib, 2012, p.571):

- Social progress which recognizes the needs of everyone
- Protection of the environment at effective levels
- Ensuring the prudent use of natural resources
- Maintenance of high and steady levels of economic growth and employment.

3.1. Environmental Sustainability

Many scientists, such as Mill, Malthus, and Goodland, define environmental sustainability as "conservation of natural capital"

(Morelli, 2011, p.2). Especially population growth, global warming and environmental pollution damage this natural capital. Spread of greenhouse gases, depletion of the ozone layer and pollution caused by industrialization are other variables that create disruptive effects on the natural environment. These variables directly affect basic substances such as water, air and food, which have important functions in an individual's life (Bansal, 2005, p.198)

Here, renewable energy and recycling, which are the main pillars of environmental sustainability, will be emphasized.

3.1.1. Renewable Energy

The roots of the debate on whether limited natural resources will continue to provide life support with the increase of population date back to the 1800s and the writings of Malthus. In his work "An Essay on the Principle of Population" written in 1798, Malthus mentioned that the population grew geometrically, but that agricultural production progressed arithmetically and therefore the population had to be controlled. According to Malthus, if this problem is not solved, natural resources will be exhausted and people will live in poverty (Basiago, 1999, p.146).

Sustainability is a redefinition of the relationship between the environment, people and the responsibilities of the present generation for future generations". Sustainable development requires a balance by ensuring sustainability in social, environmental and economic areas. One of the most important arguments on this subject is to handle the problems in a holistic approach. The need for more energy has emerged with the experience of situations such as improvement in living standards, population growth and economic growth. On the other hand, the need for energy, which is the "main input of social and economic development" in many countries around the world, is increasing day by day. However, the limited energy resources and their constant decreasing tendency direct the countries to use their energy efficiently (Seydioğulları, 2013, p.19-20).

With the emergence of environmental awareness in the 1990s, renewable energy was given attention. It can be said that this awareness arises from the understanding that energy production and consumption have many negative effects on the environment. An example of these negative effects is the damage caused by non-renewable energy sources such as coal and oil to forests and biodiversity in the seas. In addition, the view that renewable energy sources are "clean energies" has become widespread (Cited from Çağlar, 2010, p.1, Seydioğulları, 2013, p.20).

With globalization and population growth, it has been thought that energy resources will be exhausted and will not be sufficient. Therefore, natural and self-regenerating energy sources were needed. Renewable energy sources can be divided into types such as wind, solar, geothermal, biomass, hydrogen and wave energy. Because renewable energy sources are not depleted and do less damage to the environment than fossil fuels, more attentions is given to renewable energy sources in all over the world. The most well-known renewable energy sources that help sustainable development are wind and solar energy.

As a result; in line with the aim of ensuring sustainability, renewable energy resources were used in case of energy shortage. Renewable energy resources have become one of the main pillars of energy policies, with minor damage to nature, having the power to meet the endless energy need and supporting development goals.

3.1.2. Recycling

The rapid development of technology with the Industrial Revolution has caused nature to be overloaded, many resources to be depleted, destroyed and turned into waste. These issues have also had negative repercussions such as global warming, energy scarcity, and environmental pollution.

"Sustainable waste management" is an issue that focuses on achieving sustainable development. A sustainable waste hierarchy is a system with goals such as recycling and recovering of this waste. Waste management has great importance for the sustainable use of natural resources, human environment, and health. For this reason, the development and applicability of systems for recycling come to the fore in development strategies (Çakır and Boduroğlu, 2012, p.2-4).

4. Economic Sustainability

Economic sustainability is economic development that does not have a negative impact on the environment. Economic capital needs to be increased to ensure economic sustainability; however, this increase should not result in a decrease in natural capital (KTH Royal Institute of Technology, 2018).

A sustainable economy is an economy model that increases individual well-being by using fewer resources and causing minor damage to the environment.

CONCLUSION

There is no general definition of sustainable development and sustainability. Sustainable development first emerged with environmental concerns. Later, it played an important role in country policies for purposes such as economic growth and efficient use of natural resources. Sustainable development is the state of meeting today's needs by having the ability to meet the next generation's needs. For these reasons, sustainable development has economic, social and environmental dimensions (Gedik, 2020, p.211).

Environmental sustainability includes renewable energy and recycling. Energy is one of the most important conditions for sustainable development. But the lack of resources and the use of energy sources that damage the environment have led to the prominence of the energy issue. In order to ensure the conditions of sustainable development and reduce environmental problems, countries must prioritize their energy policies and evaluate alternative energy sources. Each country should expand the usage area of renewable energy resources and use these energy resources efficiently in order to have a sustainable development level. The basic foundations of environmental sustainability are waste management and recycling. Because living in a clean nature is the major tool for development and improvement of the quality of life.

Economic sustainability is an element that requires environmental dimensions in economic growth. States should make policies by taking the economy-environment cooperation into account. Emphasis on environmental values will bring along developments and improvements in the welfare of the individuals, and thus, economic activities will accelerate. If these issues are provided, sustainable development will also be achieved.

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CHAPTER 10

ENERGY EFFICIENCY IN ORGANIZATIONS: POLICIES, STRATEGIES, APPLICATIONS

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INTRODUCTION

Businesses have to deal with the unpredictable, uncertain and often the unknown. Even when things are running smoothly and in stable times, important and unexpected events effect on political or market changes, which creates uncertainty and causes problems for businesses. There can be an unforeseen devastating change in businesses at any time through a sudden virus outbreak (for example, for the reflection of Covid19, which emerged in Wuhan province of China in 2020 and was declared a pandemic, on SMEs, see Fairlie, 2020) or a nuclear accident (For the effects of Japan's Fukushima Nuclear Power Plant accident on the operations of the businesses in the region, see Gulati, Casto, & Krontiris, 2014). Whereas, businesses generally tend to maintain their current status and settled to established business models. However, when businesses are subjected to severe pressure, they have to change their current position.

In general, the decrease in energy resources in the world increases the uncertainty and the obligation of change for organizations and requires them to develop new policies for the future. At the same time, it is of great importance to use existing energy resources more effectively and efficiently for all businesses. In the next few decades, businesses may face many consequences, from severe climate impacts to negative energy. Besides to rising global temperatures, rising sea levels, and the rottenness of extraordinarily weather events, there are incremented risks to infrastructure, human health and agriculture (Maiorano, 2019). For this reason, businesses need to determine important strategies in the field of energy efficiency to gain advantage over their competitors (Angels, Kunkis, & Altstaedt, 2020). These strategies include decreasing the emission of greenhouse gas emissions into the atmosphere, largely associated with the burning of fossil fuels, in order to reduce climate change around the world (Maiorano, 2019).

While there is still a gap in the world in formulating climate mitigation targets and implementing de-carbonization targets, businesses have started to anticipate a phasing out of fossil fuel-based power generation. In these important developments, creating a common vision for the future of businesses is an important strategy. De-carbonization of energy producing enterprises in the energy sector infers renewal carbon-containing fuels with non-fossil alternatives. Fossil fuels are old energy storage vehicles that manufacturers have produced for thousands of years. Economic system is contingent on energy produced from fossil fuels, complete de-carbonization could lead to a radical change in terms of economy and society. It is possible to say that they should be aware of the concept of de-carbonization in their businesses and start taking the necessary measures and applications from this area. Businesses should formulate the carbon-free future in advance, anticipate legal regulations and adjust their corporate goals accordingly. Therefore, climate policy is a basic element in creating future strategies (Angels et al., 2020).

Conventional energy providers show the major changes in energy systems in the coming years as a requirement of the Paris Agreement on Climate Change, and these changes are in an uncertain situation in affecting profitability and long-term survival of businesses. Electricity generating companies experience management task complexity in this sense and they have to develop important strategies for themselves and their future (Angels et al., 2020).

A traditional economic view suggests that workers are less stimulated to save energy in their job than outside job since monetary rewards are more indirect at job. Nevertheless, leader enterprises have linked the success of the individual to the success of the organization by making energy performance a urgency for everybody. At the same time, they find ways to take advantage of their employees' intrinsic motives to increase productivity, reduce pollution, and innovate by going beyond external monetary rewards. Many employees find that when asked for making a difference in this way, they respond with energetic and creative solutions that result in significant savings in resources and energy (Prindle & Finlinson, 2011).

The increase in environmental awareness due to consumer, society and government regulations, and the concerns of business partners and management for this cause the necessity of energy efficiency because of a sustainable competition. The aim of this chapter is to explain what kind of policies and strategies should be followed in order to ensure energy efficiency for a sustainable environment. Which types of applications should be included in accordance with these strategies constitute the sub-objective of the chapter. In this context, the fight against uncertainty due to the energy transformation of the organizations that follow certainty is explained, and then applications of the policies and strategies followed for ensuring energy efficiency are discussed. The theories that reflect the perspectives of researchers in the analysis of organizations' practices in relation to energy efficiency are examined in the next heading. Finally, the strategies that corporates can follow in the implementation of energy efficiency are listed as sub-headings.

1. From uncertainty to certainty for organizations?

Energy efficiency can be explained within the scope of uncertainty theory from the perspective of companies demanding certainty in uncertainty. In the theory of uncertainty, there is chaos and cosmos based on ancient roots that resulted to risk awareness of human beings.

Risk is generally defined as an undesirable situation that occurs as a result of decision-making in situations where alternatives and the possible consequences of these alternatives exist (Knight, 1921). The main reason for the occurrence of risk is uncertainty, and the origin of uncertainty is the condition of having more than one consequence. Uncertainties related to energy efficiency applications in businesses involve the reliability of technology, information systems, human error, risks encountered while purchasing new technology equipment, climatic conditions, employee behavior, and the performance of energy service companies (Cooremans, 2012; Maiorano, 2018). At the same time, financial risks and uncertainties associated with energy efficiency projects may include negativities such as future energy price, implementation failure, hidden costs and rebound effect (Maiorano, 2019).

Energy efficiency investments can also lead to reduced risks of decreasing geopolitical tensions, extreme climate events, energy and carbon prices, energy supply and legal proceedings (Cooremans, 2012). Energy efficiency measures in businesses may require making decisions earlier and a change in the way processes are completed. This situation may require changes in managerial duties in corporates, changed procedures and processes between personnel and teams, and changing work routines. It also includes the development of new skills in employees to adapt to the increasing complexity associated with the application, operation and maintenance of new technologies. The uncertainties include the consequences for these changes.

March (1981) states that in order to manage uncertainty, it is necessary to create a balance between the sensitive change processes of enterprises and certain elements of "foolishness". Some of the unlikely events that would not make sense to ignore may happen in the future. It can be difficult to predict whether these events will happen. If it cannot be predicted, it will also make innovations for transformation risky. It can be said that innovations in energy efficiency in the first place may therefore not be worth the risk (March, 1981). But the point is that this is necessary. The solutions that March (1981) proposes for trying and promoting innovation are cross-business collaboration for risk sharing (managerial incentives and allocating additional time and resources).

According to DeCanio (1993), he says that manager compensation is also effective in uncertainties related to energy efficiency. According to him, in risky situations involving energy efficiency, it affects the decision-making process and even managers can distort the results. For example, shareholders with varies portfolios of assets may have a large risk desire, while executives may be more risk opposed due to the effects of the personal consequences of failure relative to the return on success.

Maiorano (2018) researched approaches to increase energy efficiency in the service sector. He found that they have different approaches that organizations to deal with uncertainty explain some heterogeneity in practices. To deal with the uncertainty they face when implementing energy efficiency, organizations use two opposing approaches. These approaches also provide a framework for the form of uncertainty theory in organizations' approach to energy efficiency. These two approaches are “demanding certainty” and “managing complexity”. Maiorano (2018) conducted field research in hospitals to test these approaches. Hospital administrations that feel over budget or patient pressure use energy efficiency to cope with uncertainties. Under the requirement to demand certainty approach, businesses hope they can identify and control uncertain resources associated with energy efficiency. This approach is based on the fact that the external environment can be controlled, and the uncertainties in the environment can be evaluated and understood. Some uncertainties arise from the responsibility of the business management, even out of control. In the managing complexity approach, management understands the uncertainty in processes and accepts the inherent risk and reward trade-off in a reasonable manner. Management accepts to absorb the risks and unwanted consequences.

2. Policies and strategies implemented by corporates for energy efficiency

Leading businesses in the world have begun to take action to reduce energy and carbon consumption. Public pressure on this issue is increasing. [3]. Corporate sustainability programs and innovations in energy efficiency are spreading.[4] A study involving heavy industry manufacturers, computer and chip manufacturers, finance and textile enterprises shows that while enterprises' energy use accounts for less than 5% of their revenues, the vast majority of them are corporate energy use (Prindle & Finlinson, 2011).

This awareness reveals the emerging perception among business leaders that the era of cheap energy and free GHG emissions is over and that they are facing the era of carbon-constrained energy markets (Prindle & Finlinson, 2011). Energy use has shifted from a low cost problem to a major environmental and sustainability problem in the eyes of top managers. In a study, reducing carbon emissions is the most important reason for companies to initiate efficiency strategies (Prindle, 2010). In addition, the research revealed that CEOs are the segment that struggles most for the success of the efficiency efforts of businesses.

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[3] For example, ElectricChoice.com (2020) ranks the top 100 companies in energy efficiency in the United States.

[4] For the most innovative energy companies see fastcompany.com (2020).

The Pew Center's report, which is experienced in corporate energy management, lists the measures taken by leading companies to reduce their energy use as part of their energy efficiency and greenhouse gas reduction strategies. In this project, which was carried out by surveying businesses and conducting in-depth case studies, it demonstrated the seven criteria of high-efficiency businesses. These are (Prindle, 2010):

a) **Efficiency as a core strategy:** Energy efficiency is an integral part of corporate strategic planning and risk assessment for businesses with pioneering strategies. This situation should not be seen as another cost management problem or a simple sustainability strategy. Energy efficiency has been part of the corporate culture for successful initiatives this century.

b) **The requirement of leadership and organizational support in sustaining efficiency:** When energy efficiency is truly an essential part of the organization, managers can talk about it without thinking. CEOs and executives frequently voiced their commitment to efficiency in their speeches.

c) **Having energy efficiency missions:** The corporates has SMART energy efficiency missions that are Special, Measurement, Account, Responsibility, Real, Time. These occur when the energy efficiency of organizations is really a part of the business. The factors that make energy efficiency strategies type and unique to these goals are that they are organization-wide, translated into business unit goals, specific enough to be measured, specific target dates, linked to action plans to achieve these strategies in all business units, and have features that are updated and strengthened over time.

d) Relying on strong route and performance measurement system: Establishing an effective energy monitoring and performance system requires the collection of many different and excess data. In a sample system, data should be collected regularly from all business units. Data collection and reporting should be done in detail. It should include a feedback mechanism that supports the correction. Energy performance data should be widely shared internally and externally. The system must be constantly improved.

e) Transformation major and sustained resources into efficiency: Effective effort in a business requires resources, people and capital. One of the three basic ways leading businesses invest resources in efficiency strategies is to have an energy manager and a team with adequate operating resources. The second is that business leaders find capital to finance projects. Finally, businesses need to invest in human capital.

f) Requiring performance objectives and mesasures for energy efficiency: Leading businesses not only designed their strategies but also followed their applications with energy metering performance systems. By setting energy performance targets, they rewarded the successful employees.

g) Evaluating the results of energy efficiency: The best companies in this field make energy efficiency a living part of their story. They use their productivity achievements prominently in both internal and external communication. Energy efficiency becomes part of the story, identity and culture the company tells about itself. The best programs include both an awareness-raising internal communication plan and external efforts documenting employees and commitments and achievements.

3. Theories of corporates' perspectives on energy efficiency

König (2020) argues that industrial enterprises should create a culture related to energy efficiency. He also says that they should develop a multi-level perspective in organizational decisions related to energy efficiency. These perspectives developed will both facilitate the understanding of decisions to be taken regarding energy efficiency and provide a multi-level model for empirical research. König (2020: 2) focused on how these companies decide on energy efficiency issues and what they direct or constrain in his study in small and medium-sized enterprises in Germany. For this purpose, by combining multidisciplinary concepts and theoretical approaches such as sociological neo-institutional theory, the translation perspective on diffusion, the attention-based view of the firm, barriers to energy efficiency and energy culture tried to come to a conclusion. These approaches, which determine the perspectives of enterprises on energy efficiency, are given below.

3.1. Neo-institutional organizational theory

Neo-institutional theory describes the actions and structures of organizations by implying to norms, and models outside of organizations. The theory states that many programs, structures, and practices in organizations gain legitimacy through the social construction of reality. Suchmann (1995) defines legitimacy as a generalized perception or assumption that an entity's actions are appropriate within some socially constructed norm, value, or belief system. Therefore, when a business is measured against the social values, norms and beliefs of its environment, its decisions and actions are considered legitimate if they seem desirable and appropriate. According to Scott (2008), the expectations of the enterprises consist of regulatory, normative and cultural-cognitive elements and add stability and meaning to social life with resources and activities. According to him, new norms, energy laws, government or organizational measures are perceived and interpreted with a specific cultural-cognitive eye.

The determination of certain applications and structural elements by businesses are indicators of an increasing institutionalization process. The diffusion of organizational practices such as energy efficiency measures is based on internal and external resources (Strang & Soule, 1998). There are a number of influential actors in the formation of legitimacy, such as government and political groups, professions, associations, social movements and networks (Walgenbach & Meyer, 2008). Within the framework of this theory, promoting energy efficiency can be defined as an institutionalization project. In particular, government and policy makers seek to drive the spread of energy efficiency through taxes, policies and grants. In addition, businesses are not passive actors here, but can offer interactive policies and perspectives on the spread of energy efficiency.

3.2. The translation perspective on diffusion

This approach is inspired by actor network theory and developed in the context of science history and technology studies. Theorists with this point of view assume that organizational practices and structures do not propagate in any original form, but that they are adapted and translated in the local conditions of the enterprises. In this sense, diffusion socially mediates the spread of practices within a population. In this sense, diffusion makes it meaningful and valuable by developing a collective understanding of the appropriateness and value of energy efficiency practices (Strang & Meyer, 1993). Strang and Meyer (1993) determine spreading both culturally and relationally. Diffusion can be accelerated and reoriented by theorizing and modeling ideas. Energy efficiency applications are theorized in certain events such as professional, political and organizational discourses and provide application models (Maguire & Hardy, 2009). Theorizations on energy efficiency in organizations can include appropriate measures to be taken regarding energy efficiency, strategic or investment decisions. Efforts to increase energy efficiency do not only mean innovation, but also the adoption of new practices and the abandonment of old practices. Maguire and Hardy (2009) state that abandonment of applications is due to the problem. Viewing as a problem undermines the current meanings of practices and cognitions. Accordingly, enterprises consider energy efficiency issues such as energy saving behavior of employees, energy costs, organizational structures or management practices as a problem. Theorizing and problematizing processes require the attention of businesses and their members (Maguire & Hardy, 2009).

3.3. The attention-based view of the corporates

Ocasio (1997) developed the attention-based theory of view to explain the strategic decisions and behaviors of businesses. This theory seeks an answer to the question of how businesses behave and adapt to environmental changes, and how they pay attention to particularly important issues. Meaning is more important than recognizing and paying attention, and it refers to coding, interpreting, and focusing by spending effort and time on a set of issues (problems, threats, and opportunities) and answers (solutions and programs) facing the business. Attention-based view explains the selectivity of organizational attention, the variability of attention processes and the nature of organizational decisions and actions with three basic principles. Those are (Ocasio, 1997):

a) **Attention focus**: What actions the decision makers of an enterprise take depends on the issues and the answers they focus on.

b) **Attention to situations**: The issues and responses that decision makers focus on are limited to the specific context or situation they are in.

c) **Structural allocation of attention**: The situation in which decision makers in the business find themselves depends on how the business regulates its attention to the issues and the answers they give. The company structures and distributes its attention in different situations with the organization of resources, social relations, formal and informal rules.

4. A model proposal for the implementation of energy efficiency in the corporations

Barriers to energy efficiency practices are generally classified as institutional barriers, organizational barriers, behavioral barriers and barriers conditioned by the market (Sorrell, Schleich, Scott, O'Malley, Trace, Boede, Ostertag, & Radgen, 2000). Thollander, Palm and Rohdin (2010) classified these obstacles as technical system, technological system and socio-technical system. The classification of barriers to energy efficiency is often the result of different theoretical perspectives. Economic perspectives generally follow neo-classical theory. While behavioral perspectives are based on transaction cost economics, psychology and decision theories, organizational perspectives are based on organizational theories (König, 2020).

The point to be considered in the implementation of energy efficiency in businesses should cover all processes of the organizations. This means that all activities from input to output are carried out with a common awareness of energy efficiency. For this, firstly it needs the creation of a culture for energy efficiency. The most important element in the creation of this culture is leadership. On the other hand, due to the different features in its processes, it is necessary to establish a special system for the purchase of raw materials and supplies, as well as energy efficiency in production. In order to ensure the financial sustainability of enterprises, energy efficiency must be harmonized with marketing practices and public relations, and thus they must announce to the public what they performed. In order to obtain the results of energy efficiency, a series of recommendations are listed under the following sub-headings for enterprises.

4.1. Creating a culture for energy efficiency

Culture can be broadly defined as a mixture of knowledge, ideology, values, norms, laws, and daily rituals that characterize a social system (Hatch, 1997). Energy culture emerges through interactions between material culture, practices and norms. Schein (2004) defines organizational culture as a model of common fundamental premises embedded in norms and structures for mastering external adaptation and internal integration. In general, organizational approaches make it possible to establish principles related to energy culture. These principles can be listed as multilevel perspective and interdependence, problematization and theorizing of responses as a link between levels, organization as a cultural attention processing system, individual characteristics of institutional employees (Ocasio, 1997).

Creating culture should include raising awareness of energy efficiency of CEOs, mid-management, shareholders and employees. Creating a culture for energy efficiency should encompass all stakeholders, from suppliers to dealers. In this context, a total quality management perspective can help.

4.2. Energy efficiency in raw material and supplies purchase

The selection of environmentally friendly raw materials and semi-manufactures is important in the use of supply materials in production. Because energy efficiency starts with supply. In addition, if the environmentally sensitive supply goods are not used, there will be negativities in the public and consumer perceptions about the energy efficiency of the enterprises.

4.3. Creating a system for energy efficiency in production

In ensuring energy efficiency in the manufacturing process, first of all, the selection of the machines should be started. Machines that use the least amount of energy should be selected. In addition, a lean production system should be established as much as possible, a system that will provide mass customization should be used. Industry 4.0 applications should be followed for this. Factory, smart buildings and office designs that will bring energy efficiency should be preferred. Renewable energy should be selected as energy, a system should be established for this purpose, or energy companies that generate renewable energy should be preferred.

4.5. Reflecting energy efficiency in products and services and corporate relations

The increasing competitive environment causes changes in the structure of production and consumption, which encourages companies to focus on high total factor productivity. Total factor productivity can be achieved by investing more in intangible assets. In short, economies enjoy higher growth performance as intangible assets are concentrated (Ökten, Okan, Arslan, & Güngör, 2019). The most important area where intangible assets are used as competitive power and evaluated as positive image on the society is the field of marketing and public relations.

Within the scope of marketing, it should be designed to emphasize the energy efficiency of the marketing mix (price, promotion, distribution and product). Image studies should be conducted on the necessity of energy efficiency in public and corporate relations. For example, a positive image should be created in order to enter the sustainable index.

CONCLUSION

Three dimensions that make up the energy efficiency climate in businesses are very important. The first dimension is how the problems related to energy efficiency and the answers given to these problems are perceived in groups within the organization. The second dimension is how these perceptions are evaluated and the third dimension is future expectations. These dimensions generally shed light on the careful processing of the enterprise regarding energy efficiency (König, 2020).

It is important to determine which normative and cultural influences arise in the decisions that businesses make or will take regarding energy efficiency. The impacts that hinder the successful implementation of energy efficiency programs need to be revealed. Knowing which actors determine the problematization and conceptualization of energy efficiency is important in terms of perceiving the issue as legitimate and reliable. In addition, it is necessary to know why businesses that use less energy follow energy efficiency more closely than businesses that use more energy. It is important to know what and what factors motivate these businesses.

Energy efficiency practices can create complexity in businesses. Businesses should conduct further research to outline how employees and senior management deal with uncertainty. It should also be able to see the impact of complexity on processes and, consequently, how it can affect organizational practices (Maiorano, 2019).

Finally, it is recommended that government and policy makers use multi-stakeholder, collaborative, open-system approaches to research, identify and consensus across different contexts and levels of analysis that inform about rationality, risks and benefits. These approaches ensure that the policy is in the best position to not only encourage innovation, but also contextualize the risk taking required to achieve their goals (Maiorano, 2019).

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