FROM ZERO TO HERO

Wise Energy Use Volunteering Scheme for Youngster

Intellectual Output-1

NATIONAL REPORT - TURKEY

Co-funded by the Erasmus+ Programme of the European Union

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SYMBOLS AND ABBREVIATIONS

EU	: European Union
EPB	: Building Energy Performance Regulation
UN	: United Nations
GBA	: Green Building Association
EPC	: Energy Identity Certificate
ESOs	: European Standard Organizations
EEA	: Energy Efficiency Association
EESD	: Energy Efficiency Strategy Document
ISES	: International Solar Energy Society – Turkey section
NAPCC	: National Action Plan on Climate Change 2011-2023
IMSAD	: Association of Building Material Industrialists
SME	: Small and Medium Budget Enterprises
KOSGEB	: Small and Medium Industry Development Organization
SEPEV	: Zero Energy and Passive House Association
Parliament	: Grand National Assembly of Turkey
TS	: Turkish Standard
TTMD	: Turkish Installation Engineers Association

PREFACE

The emergence of energy problems and energy-environment-built environments, which are threatening the future of the world and accepted as a global problem, have been the primary agenda of the countries for nearly 30 years. Economic crises and the climate change resulting from increasing industrialization and construction due to the development process of cities have created the need to use the existing energy in an efficient and economical way and have also drawn attention to the preservation of natural balance and environmental problems. On the other hand, with the energy dependence caused by industrialization, the supply of the needed energy in continuous, reliable, clean and cheap ways and the diversification of resources have started to gain importance.

People today spend most of their time in buildings / built environments they constructed. Most of these buildings were built with the tendency to design and build within the cycle of function, attraction, and initial cost, in a way that stands against and destroys nature in terms of their properties and contents. Additionally, they are away from all contexts such as topography, climate, local materials, and construction techniques brought about by place and location, grounding on solutions with subsystems based on the consumption of primary energy resources. Besides the fact that they are very different from old buildings with the devices and new technologies they contain, the modern buildings consume incredible amounts of energy. The remedy lays in the development and dissemination of approaches based on energy-efficient and environmentally responsible design strategies. Built environments should be reconsidered within the framework of sustainability principles, their relations with nature should be evaluated seriously, environment-friendly, environmentally sensitive and/or environment-conscious design approaches should be acquired, energy efficiency should be taken into consideration, resource utilization and ecological balance protection should be considered, the integrated use of renewable energy sources as active and passive methods should be used.

This is all about culture of building and life. Increasing individual and social awareness about energy problems and energy efficiency, changing the expectations and preferences of people about the elimination of the problems about energy with a high awareness within the built environment they live in, in other words, developing an energy-oriented life culture is extremely important. In this context, the EU project "From ZERO To Hero: Wise Energy Use Volunteering Scheme for Youngster" developed within Gazi University, has chosen young people who will build the future as the

target audience with the cooperation of universities, non-governmental organizations, and private sector partners from Turkey, Italy, Spain, and the Netherlands. Teens/young people are expected to show a tendency to develop energy-oriented approaches in their habits, expectations and preferences in the buildings and all built environments in which they live, and they are also expected to question, evaluate, provide solutions for energy efficiency in their future personal development and/or career plans within the framework of increasing levels of their awareness.

In this project, where four intellectual outputs will be prepared, initially, national reports are prepared, which analyze each country's energy, energy efficiency, and energy policies, as well as analyzing survey results that measure the level of awareness/knowledge of the target audience. Second intellectual output focuses on preparing training modules that can be accessed through social media, where young people/teens spend a lot of time, and then focuses on quizzes, where they can test themselves. Third intellectual output predicts the preparation of educational cards which will be developed with methods other than widespread educational methods and which will improve the level of knowledge and interest level step-by-step. The fourth intellectual output aims the preparation of the e-learning website and videos based on zero-energy buildings.

CHAPTER 1
INTRODUCTION

1.1. Overview of Energy Issues and Physical Situation in Turkey

Environmental pollution resulting from the development of industry, rapid population growth and urbanization is one of the most important problems of today on a global scale. Environmental effects caused by environmental pollution are classified as climate change, ozone depletion in the stratosphere, acidification, nutrient accumulation, human poisoning, ecological poisoning, depletion of resources, photochemical oxide formation, pollution (air, water, soil) and biodiversity damage [ISO 14040, 2006]. The main source of these effects is cities due to the energy need, which increases by 4-5% each year [Gültekin 2018]. In this context, the issue of 'efficient use of energy' in cities has become a strategic issue by gaining great importance in all sectors of the world and has become one of the priority development goals of countries.

The most important factor triggering energy efficiency policies in the world is the energy and oil crisis of the 1970s. With the emergence of the concept of environmental protection in the 1980s, the concept of energy efficiency has become indispensable in energy and development policies [Yıldırım et al. 2016]. The Brundtland Report, published in 1987 by the United Nations World Commission on Environment and Development, made it a necessity to take urgent, decisive and serious measures to make energy more efficient [Brundtland 1987]. Without reducing the amount and quality in production, without hindering economic development and social welfare, different measures are taken today in each country about 'energy efficiency', which is defined as minimizing the amount of energy consumed [Bayraç 2010, UCTEA 2012].

Energy is consumed extensively in the industry, transportation, and construction sectors around the world. The construction sector is responsible for 50% of greenhouse gas emissions, 40% of pollution in drinking water and 24% of air pollution in the world (Gültekin and Karaca, 2017). In addition, 17% of clean water resources, 25% of forest products and 40% of energy resources are consumed by the construction sector (Gültekin and Yavaşbatmaz, 2013). In parallel with these rates, the problem of efficient use of energy has become the most important problem in the field of urban planning and building design. Within this framework, countries have begun to turn to energy-efficient urban planning and energy-efficient building design approaches and policies.

Turkey is one of the foreign-dependent countries in terms of energy. 28% of the energy consumed in

Turkey is financed from its domestic resources, 72% are imported and this rate is increasing day by day (Gültekin and Alpaslan, 2013). In this context, it is of great importance to develop approaches and policies that will enable the evaluation of domestic resources, in accordance with the requirements of Turkey and following current technologies and studies related to energy in the world. These policies and approaches, which should also be applied in the field of urban planning and building design, are important in terms of keeping the habitable environments of future generations in use, disseminating the use of renewable energy sources and efficient use of energy while using today's energy resources. (Yıldırım et al., 2017-1). Energy efficiency policies aiming sustainable development, supply security, low cost energy production, protection of the environment and human health should be considered as a process involving social consciousness, the right technologies, public and legal regulations (Yıldırım et al. 2017-2).

Turkey is a growing country with the construction sector and the share of the construction sector in GNP has averaged 8% in the last 10 years (Kara et al., 2016). In order to increase the contribution of the construction sector to national income, it is of great importance to encourage energy-efficient building design and to increase the energy efficiency of the existing building stock (Farahbakhsh, 2014).

When the current building stock in Turkey is examined, it can be said that the dependence on fossil energy sources in buildings is high. Today, the reduction of fossil resources and the rise in energy prices necessitate the use of renewable energies in the construction sector. In addition, the rapid increase in building production and the increase in the need for user-oriented comfort are causing an increase in the rate of energy consumption day by day (Gültekin and Farahbakhsh, 2015). In this case, the design of energy efficient buildings, which use renewable energy sources, are sensitive to environmental problems, do not disturb ecological balances and provide the necessary conditions for human comfort and health, must be among the basic responsibilities of the Turkish construction sector. Commonly used energy-efficient building design systems on a global scale should be expanded on a Turkish scale and awareness of the use of renewable energy resources in buildings should be increased. In this context, this project is of great importance in terms of contributing to the awareness of young people about the energy problems in the construction sector and demonstrating the necessity of considering energy efficient building design parameters, resources and systems in building design.

1.2. Scope of report

In this project, it is aimed to raise awareness about the energy efficient building design approach and to shed light on young people in this regard. In line with this goal, the aim of this national report is to determine young people's awareness of environmental problems, climate change, energy, energy-efficient building design and zero-energy buildings in built environments and to measure their learning desires.

In line with the purpose of the study, two types of surveys were created through Google Documents Forms. The survey forms were applied to the participants on a voluntary basis by e-mail technique. There are two types of target participant groups within the scope of the project. The first of the participant groups includes young people, the other includes sector representatives. The survey for young people was conducted from 1 May to 29 May 2019 for a period of 28 days. 531 young people from 48 different provinces participated in the survey. The survey, which was applied to industry representatives, was conducted to get the opinions and suggestions on the energy efficiency of buildings and zero-energy buildings. The survey was conducted from 4 May to 29 May 2019 for 25 days. 206 sector workers from 48 different provinces participated in the survey.

This report includes data on energy, energy efficiency, building energy performance, relevant legislation, climate change, energy-efficient building design parameters and passive/active systems in building designs. Within the scope of this report, certain data on energy, energy efficiency, building energy performance, relevant legislation, climate change energy-efficient building

design parameters and passive/active systems in building design were reached and these data were reached via information from various articles, congress papers, master's and doctoral dissertations, scientific books, internet sources and green building associations.

This report, prepared within the scope of the problems and constraints mentioned above, consists of five chapters. In the introduction chapter of the report, energy consumption caused by the construction sector in the world and Turkey was examined, the problems encountered in reducing this consumption were identified and the necessity of energy-efficient building design was demonstrated. The aim, method and scope of the study were determined within the framework of the identified problems, requirements, and constraints.

In accordance with the aim of the study, the national situation in the context of energy and built environment was examined in the second chapter of the study. Statistical data on energy provision and use were determined in Turkey. General definitions of energy and built environment were investigated in the light of scientific studies. Information was given about national problems in energy-efficient building design. In addition, environmentally friendly/ energy efficient building approaches in Turkey were examined together with current application examples.

In the third chapter of the study, national policies and strategies were investigated in the context of energy efficiency. The legalization process of energy efficiency in Turkey was examined. Laws, legislative regulations, regulations, action plans and strategy documents related to energy performance were explained chronologically. Ministries and associations working on this issue in Turkey and their job descriptions were determined.

In the fourth chapter of the study, the potentials, activities and curriculums in the Turkish education system in the context of energy and energy in buildings were examined and current situation was assessed. In addition, a survey was conducted to determine the level of national awareness of zero-energy buildings. The survey was applied to two separate groups: youth and industry representatives. Every demographic characteristics of each stated groups were examined within the context of gender, age, and education. Moreover, the awareness levels of each group on zero-energy buildings were evaluated. Cross-comparisons were made, and evaluation findings were discussed.

In the last chapter of the study, the awareness levels of young people and industry representatives on zero-energy buildings were discussed. Problems and constraints regarding the use of energy-efficient building design parameters, resources and systems in Turkey were discussed. The findings of the report were interpreted in order to address these problems and to raise awareness on the issue in the Turkish construction sector. The contributions of zero-energy building design to the construction sector and the environment were evaluated and suggestions were made on how to expand this approach at the national level.

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CHAPTER 2
NATIONAL SITUATION CONCERNING ENERGY AND BUILT ENVIRONMENT

2.1. Energy Supply and Consumption

Energy is the most important requirement for all activities carried out for the maintenance of daily life in built environments. In this context, adequate energy "supply and consumption" is one of the leading problems of societies. There are two main sources of energy supply: fossil fuels and renewable resources. In the period that began with the industrial revolution, fossil fuels have become widely used due to advances in production technologies and their cost-effectiveness, and as a result, they have had a superior position in the face of renewable technologies (Çukurçayır and Sağır, 2008). However rapidly increasing population and urbanization raised concerns about the energy use, supply difficulties, depletion of non-renewable energy sources and severe environmental impacts (ozone depletion, global warming, climate change, etc.) According to the International Energy Agency (IEA) data, energy supply and consumption show a serious negative trend.

In the last 16 years, energy supply has increased by 56.8% from 8,773,719 KTEP (Kilo Tons of Equivalent Petroleum) to 13,761,449 KTEP. (Figure 1a). Energy consumption increased by 52.3% from 6,270,990 KTEP to 9,555,323 KTEP (Figure 1b), and current estimates suggest that this upward trend will continue. (Perez, Ortiz and Pout, 2008)

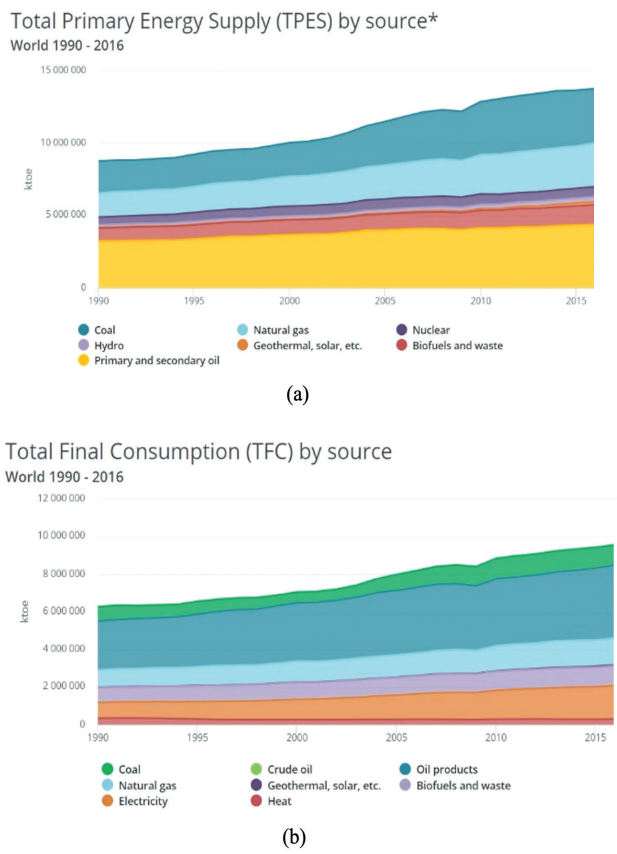

Figure 1. Total energy supply on Earth (a), (1990-2016) (URL-1), total energy consumption on Earth (b), (1990-2016) (URL-2).

Population and income growth is one of the main factors in increasing primary energy consumption. Depending on the developing industry and urbanization, it is estimated that the population will significantly increase global energy demand. This surplus effect, which is largely generated by countries outside the OECD (Organization for Economic Co-operation and Development)[1], the projections on population, Gross Domestic Product (GDP) growth rate, and primary energy demand are seen in Figure 2. According to current situation trends and forecasts, primary energy consumption is increasing at a higher rate than the population.

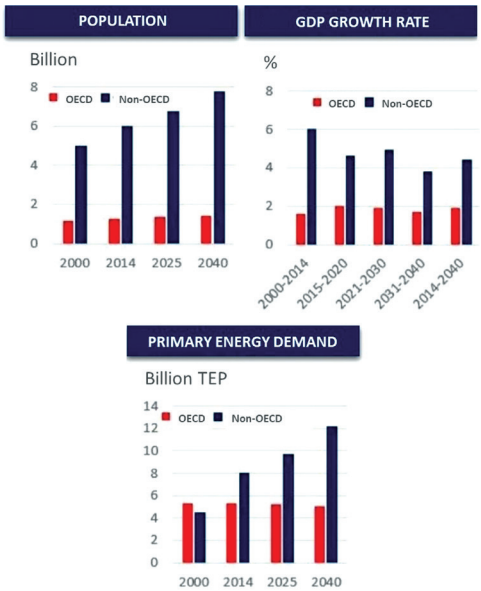

Figure 2. Population, GDP growth rate, and primary energy demand predictions (URL-4)

According to estimates, with an average annual increase of 9.8%, renewable energy sources have the highest growth rate in the period up to 2040, and this rate is projected to be 16.1% by 2049.

Despite the decrease in the growth share of fossil fuels during the period, these fuels continue to be the dominant source. Under current policies, the scenario shows that global electricity demand will increase by 80%, with an average annual increase of 2.3% by 2040. The distribution of the world's primary energy demand by region and resources is given in Figure 3. (URL-4)

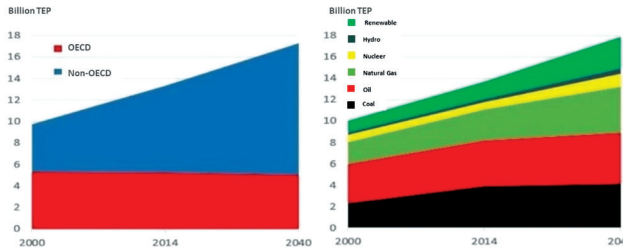

Figure 3. Distribution of World Primary Energy demand by region and resources (URL-4)

When we look at Turkey, we see a picture of an increase in the overall value in the world at a much higher rate. Between 1990-2016, energy supply increased by 165.7% from 51,437 CTEP to 136,718 (Figure 4a), while energy consumption increased by 142% from 40,394 CTEP to 97,846 CTEP (Figure 4b).

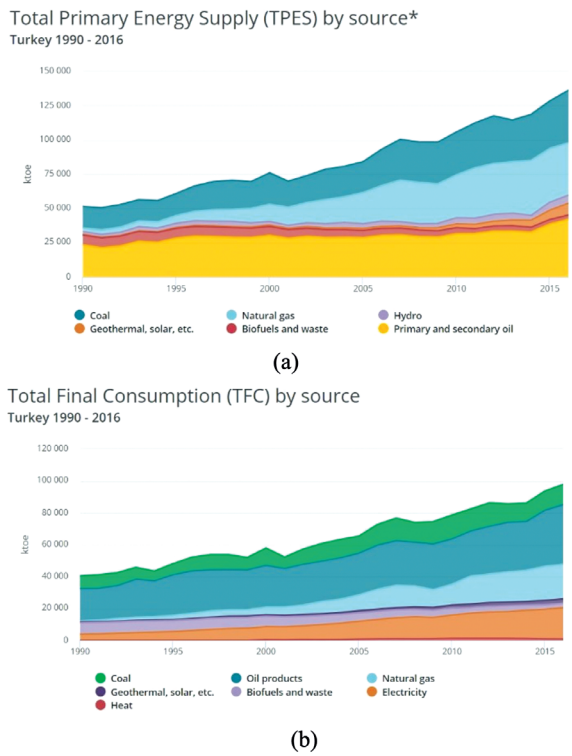

Figure 4. Total energy supply in Turkey (a), (1990-2016) (URL-5), total energy consumption in Turkey (b), (1990-2016) (URL-6).

1 *It is an organization, in which 36 industrialized or developing countries with democratic structures and market economy work jointly to solve the economic, social, and administrative problems of globalization and to take advantage of the opportunities of this process. (URL-3)*

In 2016, the proportion of electric energy generated from thermal power plants was 67.63% of total electrical energy production. These ratios are, from high to low, respectively; 33.74% from coal-fired power plants, 32.1% from natural gas + LNG-based power plants, 0.97% from liquid fuels, and 0.80% from renewable + waste-generated energy. Thermal power plants are followed by hydraulic power plants with a share of 24.6% (Table 1).

Table 1. Distribution of Turkish electrical energy production by primary energy sources (GWh) (URL-4)

		2014		2015		2016	
PRIMARY ENERGY RESOURCE		ELECTRICITY GENERATION (GWh)	SHARE IN TOTAL PRODUCTION	ELECTRICITY GENERATION (GWh)	SHARE IN TOTAL GENERATION	ELECTRICITY (GWh)	SHARE IN TOTAL GENERATION
COAL	COAL+ IMPORTED COAL+ ASPHALTITES	39.647	15,70%	44.830	17,12%	53.778	19,67%
	LIGNITE	36.615	14,50%	31.336	11,97%	38.460	14,07
LIQUID FUELS	FUEL OIL	1.663	0,66%	980	0,37%	1.103	0,40%
	MOTORIN	482	0,19%	1.244	0,48%	1.548	0,57%
	LPG		0,00%		0,00%		0,00%
	NAFTA		0,00%		0,00%	2	0,00%
NATURAL GAS +LNG		**120.576**	**47,90%**	**99.219**	**37,90%**	**87.820**	**32,10%**
RENEWABLE+WASTE		**1.433**	**0,57%**	**1.758**	**0,67%**	**2.179**	**0,80%**
THERMAL		**200.417**	**70,50%**	**179.366**	**68,52%**	**184.889**	**67,63%**
HYDRAULIC		**40.645**	**16,10%**	**67.146**	**25,60%**	**67.268**	**24,60%**
WIND		**8.520**	**3,40%**	**11.652**	**4,45%**	**15.492**	**5,67%**
GEOTHERMAL		**2.364**	**0,90%**	**3.424**	**1,31%**	**4.767**	**1,74%**
SOLAR		**17.Nis**	**0,01%**	**194**	**0,07%**	**972**	**0,36%**
GRAND TOTAL		***251.963***	***100%***	***261.783***	***100%***	***273.387***	***100%***

According to current tables, the situation in the world and in Turkey confirms the relationship of energy consumption to economic development and population growth and questions the adequacy of global policy initiatives by increasing energy efficiency (including renewable and green technologies). Globalization, improving living conditions in developing regions and developing communication networks, supports the lifestyles of developed countries and undoubtedly it increases the energy needs for consuming models which will consume fossil fuels and create a significant environmental impact. In this sense, it is concluded that the existing energy and socio-economic systems are unsustainable. (Perez, Ortiz and Pout, 2008)

2.2. General Definitions of Energy and Built Environment

Population, transportation opportunities, agricultural growth, industrialization and rapid growth in technological outputs are causing an increase in the energy deficit on a global scale and increasing energy consumption causes damage to the nature. In this context, global warming, climate change, ozone depletion, renewable energy, sustainability are often discussed and solutions started to be produced. In near future, due to the possible depletion of easy accessible energy sources such as coal, natural gas, and oil, considering that predicted fossil fuels will not meet the increasing energy needs, many countries have focused on researching environmentally friendly renewable energy sources such as solar energy, wind energy and bioenergy on a global scale.

In this context, on the agenda of social, economic and environmental improvement of sustainable development (URL-7), which is a development model that can meet the needs of today's generations without sacrificing the opportunity to meet the needs of future generations, the issue of energy comes to the fore. Energy is one of the main factors that enable people to maintain all vital activities such as housing, health, protection, nutrition, and education, but also accelerate the socio-economic and environmental progress of developed and developing countries (Karataşlı, Özer and Varinlioğlu, 2016). As it is seen, the concept of energy has been one of the most important guiding factors such as political, economic and social development of countries. Inadequate energy demand will adversely affect every stage of vital criteria, economic, cultural and social development. Therefore, as a result of the increase in consumption and the expected continuity of this increase, uninterrupted access to energy has become a necessity for the vitality of vital functions.

While climate change, caused by fossil fueled energy consumption, has many life-threatening impacts such as forest fires, droughts, high rainfalls and floods, harsh winter seasons, temperature rise, and

additionally, environmental pollution has also many adverse effects on human life (Turkey's Energy Outlook (MMO), 2018: 1).

Energy consumption is increasing rapidly in the built environments and it is important that efficient use of energy and renewable energy solutions become a priority. Energy consumption in residential and commercial buildings on a global scale continued to increase by 20% to 40% in developed countries and exceeded other major sectors such as industry and transport. In this context, factors such as increased building comfort and time spent on buildings will also increase energy demand in the future. All this data enables the problem of energy efficiency in buildings to be on the agenda of energy policies at regional, national, and international levels. (Perez, Ortiz and Pout, 2008)

As a growing consumer country, Turkey is also known as a country with a regional energy trade center. However, Turkey's place and importance in the world energy market remains on the rise. Likewise, energy demand has been increasing in recent years and it is envisaged that the increase in demand in this direction will continue. In addition, increased energy demand is unlikely to be met with existing limited domestic resources. (URL-8)

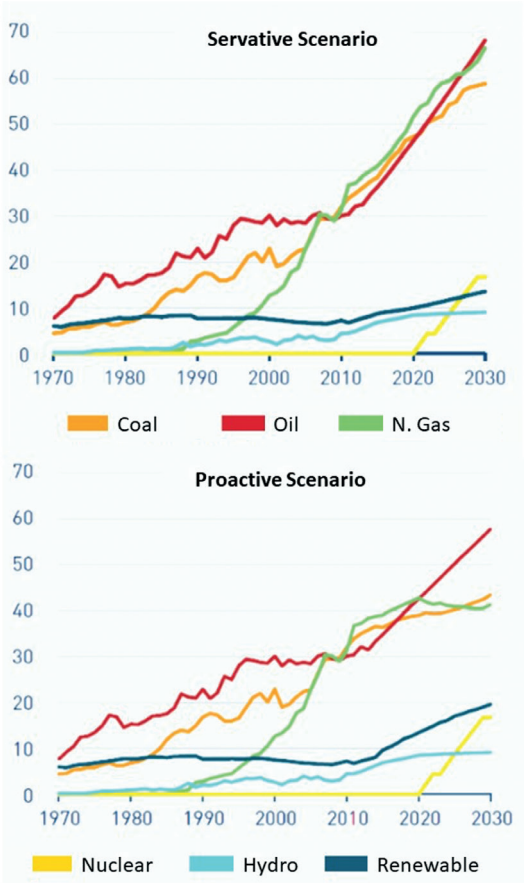

Figure 5. Turkey primary energy resource demand (MTPE) between 1970-2030 (URL-8)

In the "Mediterranean Energy Perspectives (MEP) – Turkey" report prepared by OME (Observatiore Mediterraneen de l'Energie), fossil fuels in Turkey, which meet 90% of the demand according to 2012 data, are seen as the most demanded type of energy. This demand is differentiated as oil (28%), coal (30%), and natural gas (32%). In addition, the remaining 10% of energy consumption is met from renewable energy sources. Natural gas, which has become widespread since the 1990s, had the smallest share of energy demand in 1990 with a share of 5%; it was higher than oil in 2010, and coal in 2011, and it has become the most widely used fuel (URL-8). Turkey's primary energy resource demand, depending on fuel types between 1970 and 2030, is shown in Figure 5.

In policies and programs for climate change, the issue of increasing energy efficiency in buildings stands out as a priority area of study. Because buildings are long-lasting structures that consume a lot of energy in the economic sector. According to the building census data of TSI (Turkish Statistical Institute) in 2000, the number of buildings increased by 78% from 4.3 million in 1984 to 7.838.675 million in 2000; according to the data of the same period, the number of housing increased by 129% to 16.2 million. (URL-9)

Similarly, according to the data of the TSI (Turkish Statistical Institute), as of 2017, there are approximately 9,1 million buildings in Turkey and approximately 87% of these are housing. Among these data, the number of households is over 22 million. Additionally, more

than 100,000 new buildings are added each year to the number of buildings in Turkey, and this data is included in the building occupancy permit statistics (URL-10). Based on these statistical data, it can be said that the number of buildings in Turkey is increasing rapidly. In addition, these data show that energy efficiency measures in buildings should be taken in the most accurate way as soon as possible. With the use of renewable energy sources in the new buildings, efficient application of energy and improvement of existing buildings will save a significant amount of energy. It is seen in figure 6 that the housing group and the service buildings used together with this building group have a significant majority compared to the other buildings.

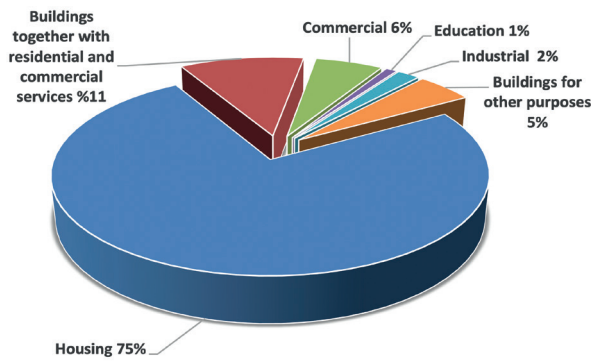

Figure 6. Ratio of building types in building stock according to the purpose of use (TSI, 2000) (URL-11).

When the 2012 data of the Ministry of Energy and Natural Resource (MENR) is analyzed, it is seen that the building sector, which includes residential and commercial buildings, consumes 35% of the total energy consumed in our country (Figure 7). Looking at the data between 2002 and 2012, it is observed that energy consumption increased by approximately 70% in the building sector in this 10-year period. The main motives behind the increase rate can be listed as increasing figures in population, housing, commercial buildings, and urbanization itself. The share of the building sector in the total electric energy consumption, which is one of the most important types of energy, is determined as approximately 50% (MENR, 2013). (URL-11)

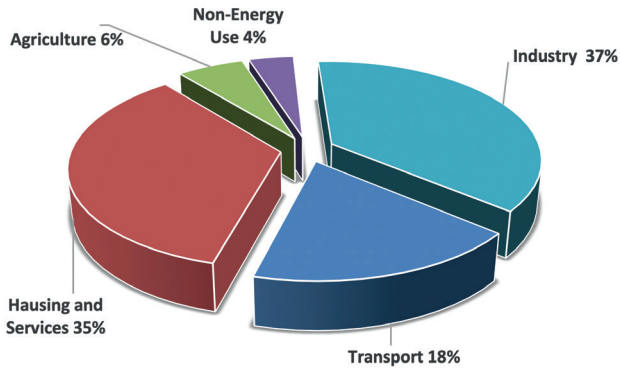

Figure 7. Distribution of final energy consumption to sectors 2010 (URL-12)

Coal, which is used in many economic sectors including industry, heating, and power generation, has been the most important source of total energy supply in Turkey. Natural gas, on the other hand, has the smallest share of energy demand in 1990 with a rate of 5%. However, passing oil in 2010 and coal in 2011, natural gas reached the most consumed fuel position (URL-8).

More than a third of the energy resources consumed in Turkey are used for heating and cooling purposes, and coal usage for heating is around 14 million tons per year. Considering that the use of natural gas will begin in almost all provinces; it is expected that the use of natural gas in heating will increase. According to 2008 data, in the building sector, the rate of electricity consumption is 24%, the rate of renewable energy types consisting of solar, geothermal, wood, and plant residues is 21%, and the highest rate is of natural gas consumption with 26% (URL-11).

The building sector has been rapidly developing in recent years; while the final energy consumption was 19.5 MTOE (Million Tonnes of Oil Equivalent) in 2000, it increased by 66% and rose to 32.4 MTOE in 2015. In the building sector, the energy supply increased by an average annual rate of 4.4% and the share of the building sector in the final energy consumption reached to 32.8% and it surpassed the industry sector in terms of the energy consumption (Figure 8). (URL-10)

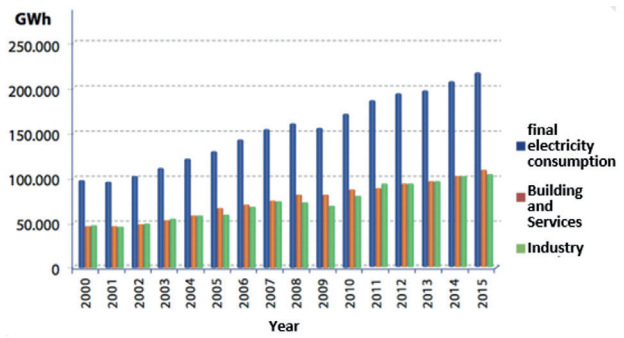

Figure 8. The change in the sectoral energy consumption between 2000 and 2015 (URL-10)

Similarly, while the building and services sector had a share of 47.4% in the electricity consumption according to the data of 2000; this construction group surpassed the industry sector with a share of 49.9% in 2015. Again, in this period, it was determined that the average demand growth rate was 9% and total annual growth rate was 135% (Figure 9). (URL-10)

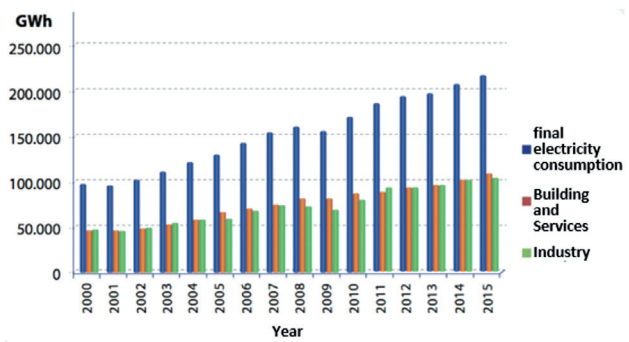

Figure 9. The change in the electricity consumption of the building and services sector between 2000 and 2015 (URL-10)

The building sector is divided into two sub-categories, that is, the commercial/service buildings and the houses. (URL-13) Today, 35% of the final energy consumption goes to the houses and the commercial/public buildings. The largest part of this consumption goes to the heating and the hot water demand (Figure 10). (URL-14)

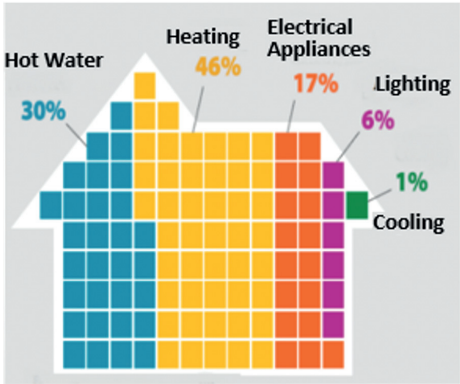

Figure 10. Distribution of the energy consumption in a house (URL-14)

When the electricity consumption pattern in the houses is examined, it is observed that this electricity consumption changes from house to house depending on the device infrastructure and the livelihood level of the family. That said, about 20% of the electricity used in the houses is consumed by the electrical and electronic appliances. Among the electronic appliances, the refrigerators have the highest share in the electricity consumption in houses. (URL-15) The Electrical Power Resources Survey and Development Administration states that the refrigerators account for the highest consumption in the domestic electricity consumption with a share of 30%. While the lighting follows the refrigerator with a share of 28%, the electric ovens ranks third with a share of 10%. The television has a share of 10%, dishwasher 7%, washing machine 7%, iron 4%, hair dryer 2%, and vacuum cleaner about 2% (Figure 11). (Yumurtacı and Dönmez, 2013)

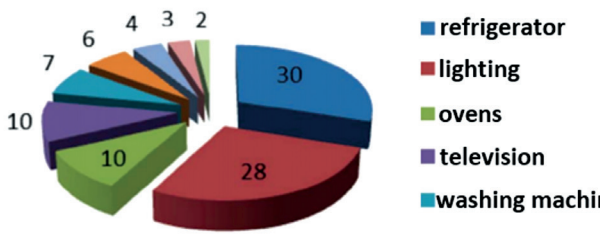

Figure 11. The electrical energy consumption in houses (Yumurtacı and Dönmez, 2013)

In this regard, the significant reductions have started to be achieved in the energy consumption with the energy-efficient household appliances. For example, it has been seen that the best refrigerator available today saves 75% energy compared to 1990 and the washing machine saves 44% energy and 62% water compared to models released in 1985. On the other hand, while the dishwasher consumed 2 kWh/cycle at 60 °C in 1980; today, this consumption has fallen below 1 kWh and the water consumption has decreased to one third. Similarly, the electrical appliances and devices in the A energy class or more have started to be produced in the Turkish market in recent years. Therefore, it has come into prominence that, in order to reduce the energy consumption caused by the electrical devices, some important decisions should be taken to replace the old appliances in use with the new energy-efficient appliances (URL-15)

The plasma TV sets, LCDs, and the split air conditioners have recently emerged as other important sources of energy consumption in Turkey. Especially with the increase in summer temperatures in recent years, there has been a great increase in the air conditioner sales in the southern regions. This leads to a rapid increase in the electricity demand in the summer months. This problem constitutes a high cost and negative situation for the current energy system and solving this problem is a guide in the steps to be taken for the energy efficiency. (URL-15)

2.3. Identifying the Problems

Thanks to the atmosphere, almost half of the sun's rays reaching the earth are reflected from the earth. The rays reflecting from the surface of the earth, are sent back to the earth thanks to the gases in the atmosphere, also known as greenhouse gases, such as carbon dioxide, methane, aqueous vapor, ozone, and nitrogen oxide. Thus, the average temperature, which would have been around -18 °C, reaches 15 °C, a temperature level that allows the humans, animals, and plants to survive. This natural effect caused by the greenhouse gases is called "greenhouse gas effect." However, in the process which started with the industrial revolution, the rate of the greenhouse gases in the atmosphere increased by 40% (from 280 ppm to 394 ppm), causing the natural balance to deteriorate and leading to climate change.

According to the Intergovernmental Panel on Climate Change (IPCC), [2]in 2004, of the increase in the human-generated greenhouse gas emissions, 56% was caused by the carbon dioxide generated in the use of fossil fuel and 17% was caused by the deforestation.

The science world states that, in order to minimize the devastating effects of the climate change, the increase in the average temperatures should be limited to 2 °C at maximum. In order to achieve this goal, the CO_2 content in the atmosphere must not exceed 450 ppm (parts per million). However, it is predicted that this increase will continue with the existing policies and practices. (URL-17)

The effect of climate change is not just about the increase in temperatures. As a result of the serious adverse effects on both the natural and built environment; not only the plants, animals, and ecosystems but also the human communities are at serious risk.

The effects of the climate change on the natural environment

Its effects on the air and natural habitats: The increase in temperatures due to the climate change causes the mid seasons to disappear and the precipitation regime to change. This new order causes the climate zones to shift to the high-altitude regions and brings about the change in the habitats. In this regard, a natural environment, the balances of which have changed and deteriorated, becomes an additional stress factor for the ecosystems and species trying to adapt to these conditions. (URL-18)

2 *Intergovernmental Panel on Climate Change (IPCC) was founded in 1988 by two UN-affiliated organizations, that is, United Nations Environment Program (UNEP) and World Meteorological Organization (WMO). The purpose of IPCC is to evaluate the social and economic impacts and risks of the climate change and, in the light of the data obtained, to guide the decision makers. (URL-16)*

Furthermore, the changing temperature and precipitation patterns cause the oceans to warm up, the sea level to increase, the coastal flooding to occur, the sea water to become more acidic and, consequently, have negative effects on the biodiversity and ocean-based people. (URL-19)

Its effects on the human health: The global climate change has many consequences that affect the human health and lead to deaths, such as the infectious diseases, storms, flood hazards, and the malnutrition depending on the temperature, rise in sea level, and precipitation patterns.

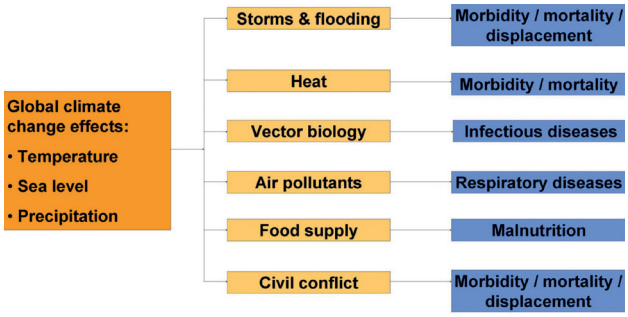

Figure 12. Potential effects of the global climate change on the human health (Quattrochi, 2012)

The effects of the climate change on the built environment

Its effects on the air quality: The air quality depends on weather conditions and is sensitive to the climate change. The studies have revealed that there is a correlation between the pollutant concentrations, which determine the air quality, and the meteorological variables. These studies show that even the climate change alone will change the summer surface ozone (O3) by 1–10 ppb in the polluted regions in the coming years and this situation will have great effects on the urban areas. It has also been reported that the climate change will affect the PM concentration in the polluted environments in the coming years by 0.1–1 mg/m3 (the amount of material in 1 m^3 of air in milligrams). (Jacob and Winner, 2009)

Urban heat island effect: It has been known that the built areas have the urban heat islands (UHI) which can be warmer up to 5-6 °C compared to the rural areas due to the higher absorption of the heat by the hard surfaces of both the high buildings and the streets compared to the vegetative surfaces. In addition to this, the urban areas have lower wind speeds, less convective heat losses and evaporation (Wilby, 2007). For these reasons, the urban warming not only increases the magnitude of the future warming trends, but also increases the intensity of heat waves. (Quattrochi, 2012)

Its Effects on the buildings and infrastructure: The extreme weather events such as the heavy rainfall, storm, hurricane caused by the climate change and the problems such as the rise in the sea level and the heat waves cause great negative effects on the built environments. These climatic events directly affect the performance and service life of the buildings and infrastructure. In this regard, the increasing temperatures affect the water demand and usage patterns. The changes in the rainfall regime and the runoffs (rainfall that flows away over the ground due to not being absorbed by the soil) cause a decrease in the groundwater resources. Furthermore, the floods and torrents occurring in the cities, where the heavy downpours are seen due to the change in the precipitation regime, adversely affect the wastewater treatment plants and the rainwater management systems. The rise in sea level, storm surge, and the heavy downpour damage the urban infrastructure, including the roads, buildings, and the industrial facilities in the coastal areas. Furthermore, the excessive precipitation and extreme temperature adversely affect the transport infrastructures such as the highways, railway lines, and the airport runways.

Another problem caused by the increasing temperatures is the changes in the energy supply and use. It is predicted that the higher summer temperatures will increase the use of electricity and energy for cooling and the warmer winters will reduce the energy demand for heating. However, as a result, it is predicted that the net energy use will increase. (Wentz, 2015).

2.4. Environment-Friendly/Energy-Efficient Building Approaches in the Country

The energy efficiency is a concept which completes and horizontally cuts the national strategical targets like providing the supply security in energy, increasing the efficacy of the fight against climate change, making the energy costs sustainable, protecting the environment, and decreasing the risks due to the dependence on the foreign resources. Today, when the importance of the sustainable development is being understood more and more, the value of the efforts for the energy efficiency also increases at the same rate. Thus, the primary and important components of our national energy policy are as follows: enhancing the energy efficiency in all the stages from the energy production and transmission to the final consumption, decreasing the energy density either on sectoral basis or in the macro level, and preventing the unconscious usage and the wasting (URL-15).

Turkey is aware of the fact that climate change is a multidimensional and complex challenge which poses serious environmental and socio economic consequences and threatens national securities. It also recognizes that its range of potential impacts represents one of humanity's most important threats facing future generations. In this regard, Turkey also recognizes the importance of international cooperation to reduce the greenhouse gas emissions leading to climate change, and to combat climate change. In order to contribute to the global efforts to reduce the impacts of climate change, taking into account its own special circumstances and capacity, Turkey has developed the "National Climate Change Strategy." The Strategy includes a set of objectives to be implemented in the short term (within one year), the mid-term (undertaken or completed within 1 to 3 years), and long term (undertaken over a 10-year period). The Strategy will guide the actions to tackle the climate change during the period of 2010-2020 (URL-20).

These strategic goals, which will contribute to the efforts to reduce the energy consumption, will be updated as necessary, in light of emerging national or international developments. With this strategy, Turkey sets a goal of contributing to the global efforts against climate change within its own capabilities and in line with the basic principle of the United Nations Framework Convention On Climate Change "common but differentiated responsibilities." And it presents its national mitigation, adaptation, technology, finance and capacity building policies. (URL-20)

Turkey explains its national vision within the scope of climate change as follows:

> "is to become a country fully integrating climate change related objectives into its development policies, disseminating energy efficiency, increasing the use of clean and renewable energy resources, actively participating in the efforts for tackling climate change within its special circumstances and providing its citizens with a high quality of life and welfare with low carbon intensity." (URL-20)

The green building regulation has been published by the Ministry of Environment and Urbanization and it is aimed with this regulation to design green buildings and settlements with brand value specific to our country. In this context, it is aimed to increase and expand sustainable green buildings and residential areas which are based on renewable energy, environmentally friendly, produced from energy-efficient local materials in the construction sector. (URL-21).

It is important that the Energy Efficiency Law No. 5627, which is considered as one of the important steps taken in this field, and the Energy Performance in Buildings Regulation developed in connection with this, is applied for each building. This document regulates the efficient and efficient use of energy resources and energy in buildings, covering important information about the classification of energy consumption and needs of the buildings to a minimum level to ensure the sustainability of the environment, as well as the prevention of energy waste, the efficiency of the heating and / or cooling systems used in the building, the insulation characteristics and the level of greenhouse

gas emissions. In this context, Energy Performance Certificates began to be issued in Turkey since 2011 and 220,000 buildings have been certified in the scope of this application. An efficiency of 20% - 40% has been achieved in 76% of the certified buildings, while 40% - 60% efficiency is achieved in 22% of them (URL-22).

It is aimed to prepare the infrastructure in order to increase the "Energy Performance Certificate" applications in existing buildings, and to be guiding for increasing the thermal insulation and other efficiency increasing applications. With this application, energy efficiency potential in buildings will be determined and this potential will be realized to the maximum extent. Technologies that will enable energy efficiency and priority projects for construction materials will be determined in cooperation with industry. In the building and industrial sectors, energy management in accordance with the standards will be implemented with certified energy managers (URL-20).

The first and only project in terms of the concept of Zero Energy Buildings (ZEB) in our country was carried out by the Electrical Power Resources Survey and Development Administration (EIE) (URL-23). This project uses renewable energy sources in its environment and uses energy efficiently and effectively. The Energy Efficiency Training Building is constructed as a two-floor building and is 275 m^2. New technologies such as solar energy, thermal insulation techniques, geothermal (ground source heat pump) energy systems, natural lighting, daylight control system, composite wall for heating/cooling and fiber optic lighting system are used in the building. Fossil fuel is not used in the building, but instead, some of the electricity demand and the entire heating and cooling demand are supplied by these systems (Figure 1) (URL-24).

Picture 1. The Energy Efficiency Training Building (URL-25)

The hot water need is met by vacuum-piped solar collectors. Almost all of the electricity required for the building is produced by 5 kW (kilowatt) solar cells. Through the greenhouse section and the trombe wall devised on the south side of the building, some of the heat demand required in winter is obtained from solar energy. The hot air trapped in the greenhouse area by means of the trombe wall (Fig. 13) and the special low- e[3] coated glasses move upwards in this area and are transferred to the interior by means of an air duct controlled by an automatic control system. The hot air comes back to the trombe wall area through the return duct located in the lower section as a warmer air after releasing its heat to the indoor environment. As long as there is solar energy, this movement continues permanently (URL-25).

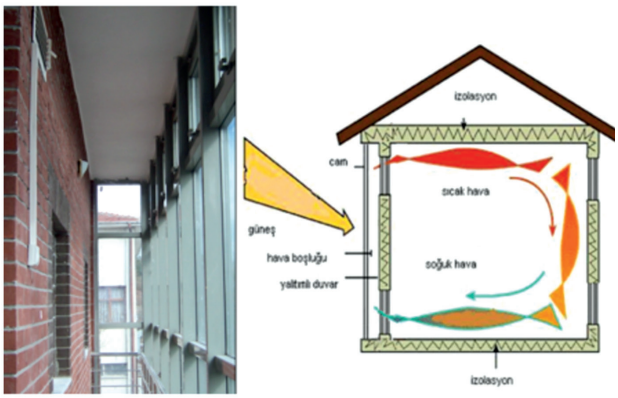

Figure 13. Trombe Wall (URL-25)

3 *Here, the 'Low-E' term stands for 'Low Emission'. It refers to the heat reflecting characteristics of the glass surface. The 'Low-E' coating is too thin to see with the eyes. It is manufactured by covering the glass surface with metal oxide or a metal. A glass with this feature both reflects the infrared energy that emits light and heat, holding the heat on the side where it is created, and allows the light to pass through. (URL-26)*

All of the building's cooling need and a large part of the heating need is supplied by the ground source heat pump. The heat pump with a depth of 80 meters meets the heating or cooling needs of the building by passing the heat of the cold and hot fluid -depending on the season- to the interior by means of fan coils, using the soil temperature measured at 8-10 C° in summer and winter conditions through 3 wells. Thermal insulation is provided by applying sheathing on the walls, floors and ceilings of the building. The glass surfaces used in the windows are coated with low-e. Horizontally perforated bricks are used in the interior partition walls. In the interior, the special type of paint with vacuum globules in it contributes to the insulation with this feature. 6 cm of insulation material is applied on the exterior of the building, which is composed of vertical perforated bricks. With all these applications, at least 70% less heat loss was observed in the building compared to a similar uninsulated building (URL-25).

Fiber optic lighting system was used in the foyer area on the lower floor of the building. The light arranged in a single point is directed to reach every point of the building by means of fiber optic cables in the system created in order to obtain an efficient lighting system. Use of T5[4] luminaires with electronic ballast is preferred in all parts of the building except this section. Daylight controlled lighting system was used in a way to be able to dim down in the training hall. In cases where the use of daylight is sufficient for illumination, the daylight control system is prevented from being on. In cases where the use of daylight is inadequate, the preferred system is illuminating the environment with the most suitable light for the space. With this lighting system, in addition to achieving 75% savings in energy consumption, the quality of the lighting level is observed as well (URL-25).

Modular composite wall panel system was applied in order to increase the efficiency of the energy cycle of the heat pump. This system is a new technology product, and the most important feature of the system is specified as that it provides heating and cooling in low temperature ranges and provides comfortable environment conditions by balancing the humidity rate. In addition to all these, an electrical outlet, telephone line, lighting equipment on a wall can be placed in this system. It delivers the air through the small air vents located on the composite wall (Figure 14) which receives the air it brings to the appropriate conditions by means of cold or hot fluid obtained from the heat pump. It provides comfortable air conditioning by way of distributing the air is to the entire surface and giving it to the indoor environment (URL-25).

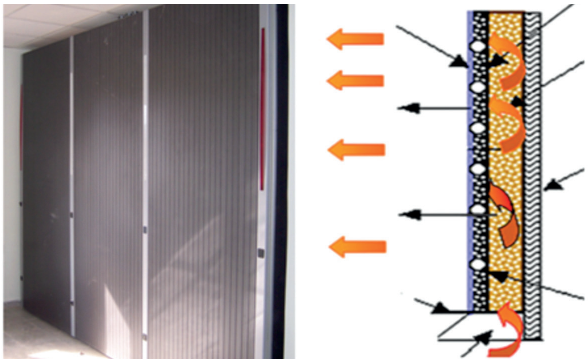

Figure 14. Composite wall panel emitting soil heat (URL-25)

Hacettepe University Health Sciences Library at Sıhhiye Campus, which was designed in 2014, is another example of the projects that aim to increase energy efficiency in buildings. In this project, it is aimed that all working environments have natural ventilation and natural lighting. In this context, through the courtyard in the middle of the building, the working spaces are provided with daylight from different directions. A microclimate was created with the landscape design arranged in this courtyard, and all rooms were provided with fresh air from this area on the basis of the cross ventilation principle (Figure 15) (URL-27).

4 It is defined as an A2-class electronic ballast used over 50.000 hours with lower power loss. (URL-28).

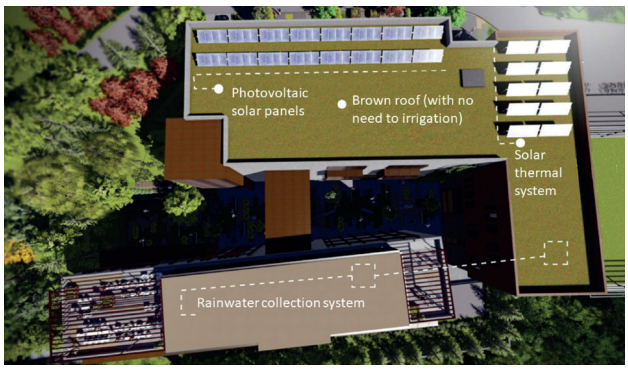

Figure 15. Top view of Hacettepe University Health Sciences Library at Sıhhiye Campus (URL-27)

The double-wall application on the south facade functions as a trombe wall and supports sound control. In the project, where the building shell is used as a thermal mass, it is aimed to supply the air heated in the intermediate space to the system during the winter months. In the summer months, it is purposed to create the chimney effect by throwing off the heated air and to ventilate the working places accordingly. In order to prevent heat losses in the building where natural lighting analyzes are applied, the amount of span of the facades is optimized. By means of the generated models, the form, density and depth of the sunshades were optimized. The building shell is designed to prevent condensation and to be highly insulated (URL-27).

"The Project on Improving Energy Efficiency in Buildings" is carried out by the General Directorate of Renewable Energy (YEGM) within the Ministry of Energy and Natural Resources and it is an endeavor where the United Nations Development Program (UNDP) is the implementing agency and is supported by the Global Environment Fund (GEF). Within the scope of this project, exemplary buildings have been designed for the Ministry of National Education and the Ministry of Environment and Urbanization with the aim of sustainability. In scope of the project carried out under the leadership of Ekodenge company in collaboration with Willen Associates architecture company from Germany and Atelier Ten sustainability engineering group from England, MEB Ankara Eryaman Cezeri Green Technology Technical and Industrial Vocational High School and General Directorate of Land Registry and Cadastre Sincan - Etimesgut Region Service Building were designed (Figure 16) (URL-27).

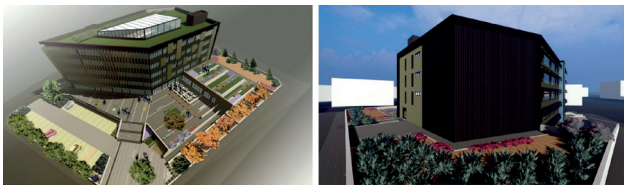

Figure 16. General Directorate of Land Registry and Cadastre building designed by Ekodenge, Atelier Ten, Willen Associates partnership (URL-21)

The overall objective of the project referred to as the Project on Improving Energy Efficiency in Buildings is the reduction of greenhouse gas emissions and energy consumption in Turkey. In addition, the introduction of the Integrated Building Design Approach (IBDA) through training and demo buildings comes into prominence. These designs, which are produced to support the formation of leading institutions, practitioners and rules in this field, can also be seen as important educational tools (URL-27).

In both projects of General Directorate of Land Registry and Cadastre Sincan - Etimesgut Region Service Building (Figure 16) and MEB Ankara Eryaman Cezeri Green Technology Technical and Industrial Vocational High School (Figure 17); natural lighting analysis and facade optimization are performed. In addition, passive support for heating through solar chimneys and solar walls, and cooling and heating support with pre-cooling / labyrinth system are purposed. Environmental and mechanical features such as underfloor heating and cooling, energy efficient ventilation and cooling with Chilled Beam units, energy efficiency with building automation, heat recovery systems, environmentally friendly material selection, social areas supported by landscape and green roofs, and economical water usage are handled in both projects in an integrated way (URL-27).

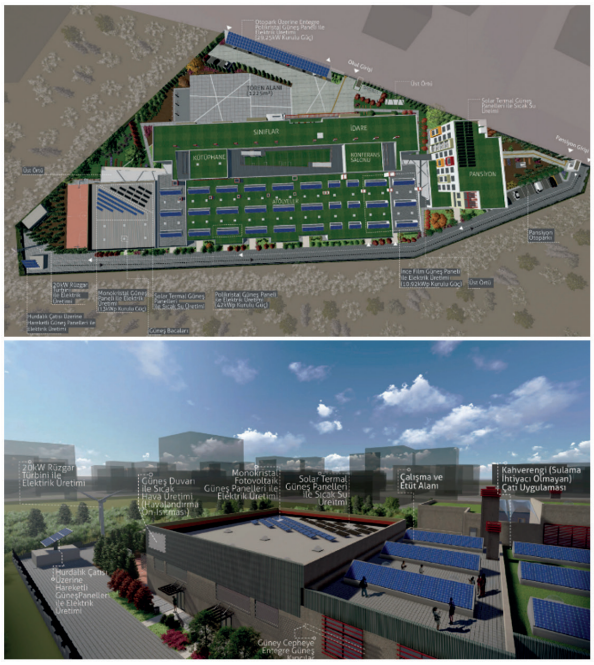

Figure 17. MEB Ankara Eryaman Cezeri Green Technology Technical and Industrial Vocational High School (URL-27, URL-21).

As can be seen, the preparation of regulations concerning the improvement of energy efficiency in buildings in Turkey is being carried out. At the same time, projects on increasing energy efficiency in buildings in order to reduce energy consumption and greenhouse gas emissions and to raise public awareness have started to become widespread with the cooperation of many leading institutions.

2.5. What might Turkey gain with Zero Energy Buildings?

The extensification of environmentally sustainable buildings using renewable energy sources will have many benefits, both nationally and internationally, such as reducing energy demand and carbon emissions of buildings. Thanks to reduced energy usage with ZEB, comfort and health conditions can be improved and indoor environment quality will also increase positively. When the necessary applications for ZEB are realized, the energy consumption in the buildings will decrease significantly. ZEB has the potential to significantly improve communities in terms of economy, flexibility, environmental quality and energy independence (Pless, Polly and Zaleski, 2018).

In addition to environmental, economic and social benefits, ZEB offers effective recommendations for achieving global goals such as building sustainable and developing communities, addressing climate change and driving economic growth. In addition to reducing or eliminating negative impacts on the environment by using less water, energy or natural resources on an urban or building scale, they can also have positive impacts on the environment, such as increased biodiversity. ZEB will bring many benefits at the national level, especially on the economic scale. It will offer cost savings by increasing water and energy efficiency in utility bills (Perlova et al., 2014).

One of the important elements of sustainable development is the reduction of energy consumption in buildings. The policy of the EU member states aims to reduce energy consumption in the construction sector in a very concrete way. Directive 2010/31 / EU, adopted by member states in 2010, introduced the concept of NZEB (Nearly Zero-Energy Buildings) (Romanska-Zapala et al., 2018). Because the certification of a building's energy efficiency is a very important tool for assessing the quality of buildings, their impact on the user and the environment. For this reason, it is very important to form a building certificate for ZEB. In addition, certification of the actual energy demand of buildings can provide solutions for energy consumption. A high degree of energy efficiency can be achieved through certification (Fedorczuk-Cisak, Furtak and Radziszewska-Zielina, 2019).

The implementation of pilot projects to increase the number of energy-efficient buildings in Turkey is very important in terms of providing practical experience for increasing the number of zero energy buildings (ZEBs) and speeding up the process. It will also provide great benefits for people to learn about issues such as the applicability of highly energy-efficient buildings, cost, how buildings look, technologies used in buildings, and user experiences. Innovative industrial organizations can promote their products through such projects, while designers can demonstrate their ability in this particular (Erhorn and Erhorn-Kluttig, 2014).

Within the scope of building groups having the 1/3 share of energy consumed in Turkey, 15% of energy is used for hot water, electrical appliances, lighting and cooking, while other consumption is for heating and cooling. From this point of view, it is apparent that the importance of energy conservation in buildings and the steps to be taken in this direction are very important. As a result of this data, the importance of increasing the number of zero-energy buildings in Turkey and taking important practical steps concerning energy efficiency is becoming clearer.

An example of a reduction in energy consumption and other benefits in rehabilitated buildings is the Gründerzeithause in Wien, Austria (Table 2, Table 3).

Table 2. Before and After of the rehabilitated Gründerzeithause Building (D'Agostino et. al, 2014)

	Year of building: 1850-1873
	Number of Apartments and Blocks: 8
	Type of Property: Commercial property for rent
	NZEBR Project Year of Renovation: 2014
	Duration: Approximately 6 months
	Cost: 1.6 Million €
	Finance: Vienna City grant, 143,000 €; State loan, 292,000 €; own funds of the property owner
	Energy Performance Rise Disclosure: Rose to Category A.

Table 3. Before and After of the rehabilitated Gründerzeithause Building (D'Agostino et. al, 2014)

	Orlglnal Building	After NZEBR
Walls	Brick or stone walls, without insulation*	All facades were repaired and insulated.
Floors	No insulation	The basement ceiling were provided with thermal insulation.
Roofs	-	-
Windows	Double glass windows*	Passive house windows were installed
HVAC	Natural ventilation Central (oil, gas) heating*	Control led ventilation: a central ventilation unit with heat recovery (recovery rate of 82%). A groundwater heat pump for hot water and heating.
RES	-	a photovoltaic system on the roof.
Energy consumption	151.27 kWh/m^2, a (93,5 MWh/a)	11.11 kWh/m^2, a (9,2 MWh/a)
Energy generation	-	-

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CHAPTER 3
NATIONAL POLICIES AND STRATEGIES IN THE CONTEXT OF ENERGY EFFICIENCY

Beyond fulfilling the requirements of user health and comfort in the built environment, when determining energy-effective and efficient design strategies aimed at conserving the energy used, reducing all negative environmental impacts of buildings including carbon footprints and using renewable energy sources, there is a need for legal arrangements where criteria and limits are set out. With the developments in the context of this need, agreements, mergers and changing sensitivities have emerged between countries over time. Improving policies covering the titles of energy security and protection of the climate with a single and integrated approach in global, economic and technological contexts With a single and integrated approach in global, economic and technological contexts, drawing attention to environmental concerns growing in parallel with the energy sector, such as global climate change, constitutes Turkey's priority agenda as well as in all countries of the world. The energy and environmental policies developed are based on the principles of ensuring the diversity of resources, which is among the basic elements of energy supply security, taking and extending energy saving measures and increasing the use of renewable energy resources.

3.1. Legalization Process of Energy Efficiency in Turkey

Energy efficiency is the conversion of each unit of spent energy into more services and products without compromising on quality and comfort conditions. The most important factor in energy efficiency is energy saving, and one of the most important indicators is energy density (Bayraç, 2010). In countries with weak and defective building stocks within the framework of energy efficiency, the amount of energy consumed per gross national product which is called as the energy density is revealed to be very high based on scientific data. Energy density values which are between 0.09 and 0.19 in developed countries are around 0:38 in Turkey and they do not display a decreasing tendency although energy problems are on the agenda on such a scale. Therefore Turkey, when considering the energy consumption values, is one of the countries with great energy demand despite the progress it made in recent years in the field of energy efficiency. In terms of energy supply security, it is not yet a self-sufficient country. Turkey, being not rich in petroleum and natural gas resources, the most used resources for energy, is among the countries with low energy potential in the world energy resources richness ranking. However, in terms of hydroelectric power and coal reserves, it

possesses considerable energy richness. Furthermore, it has significant potential in terms of renewable energy sources such as solar energy, geothermal energy and wind energy due to its geopolitical and geographic location (Akova, Beyhan, 2015).

Turkey has made its presence felt in some way both as a participant and as an observer in the period starting from when the concept of energy efficiency, which was anticipated to contribute to providing energy supply security, gained importance after the first oil crisis in 1973 until now. However, the legal dimension of improving energy efficiency and making the appropriate policies and legal arrangements to minimize environmental damage has been realized after the *"Law No. 4519 on the Appropriation of the Approval of the Final Act of the European Energy Charter Conference, the Decisions establishing the Energy Charter Agreement and its Annex and the Protocol on Energy Efficiency and Related Environmental Matters"* was published in the Official Gazette dated 06 February 2000 and numbered 23956 (Beyhan, 2017).

The first step in Turkey after February 2000 is the promulgation of "Law No. 4990 on the Acceptance of our Accession to the UN Framework Convention on Climate Change" in the Official Gazette No. 25266 dated 21 October 2003. With the effectuation of Law No. 5836 accepted by the Grand National Assembly of Turkey on 5 February 2009 promulgated in the Official Gazette No. 27144 dated 17 February 2009, regulation of the procedures and principles for monitoring, reporting and verifying gas emissions that lead to the formation of greenhouse gases caused by human-induced activities envisaged by the Kyoto Protocol is legalized. In addition, within the framework of Turkey's National Program for the Adoption of the EU Acquis, the National Program of 2003 set forth the objectives of "harmonization of legislation on energy efficiency" and the 2008 National Program set forth the objectives of "harmonization and preparation of energy performance legislation in buildings" (Beyhan, 2017) .

The Energy Efficiency Law no. 5627 covering the subjects of the establishment of an administrative structure for the efficient execution, monitoring and coordination of energy efficiency activities, authorizations to be made on the issue of energy efficiency, the duties and responsibilities of various organization, community education and awareness-raising, various support mechanisms for the popularization of renewable energy sources and for sectoral practices, regulations on incentives and regulation of the penalties for those who do not meet legal requirements was enacted on 2 May 2007. With the law, it was decided that the procedures and principles to be applied in residential buildings whose total construction area is determined in the regulation, in service buildings and commercial buildings, in connection with energy performance in buildings covering the standards, norms, information gathering and control procedures, minimum performance criteria for architectural design, heating, cooling, hot water, thermal insulation, lighting and electrical installations will be prepared jointly by the Turkish Standards Institute and the General Directorate of Renewable Energy and the work of the regulation to be put into force by the Ministry will be initiated (Beyhan, 2017).

The "TS 825 - Thermal Insulation Rules in Buildings", which was first adopted by EU standards on 29 April 1998 and entered into force before the regulation and is mandatory to be applied in all buildings as of 14 June 2000, is still within the scope of the mandatory standard applied by the concerned persons, institutions and organizations. "The Regulation on Energy Performance in Buildings (REPB)" promulgated in the Official Gazette No. 27075 on 5 December 2008 - which aims at determination of the calculation rules for the evaluation of all energy use of a building by taking into account the external climate conditions, indoor requirements, local conditions and cost-effectiveness, classification of primary energy and carbon dioxide emissions, determination of minimum energy performance requirements for new and substantially renovated buildings, evaluation of the applicability of renewable energy sources, control of heating and cooling systems, limitation of greenhouse gas emissions, determination of performance criteria and application principles in buildings and protection of the environment - (URL-1) was revised by "the Regulation on the Amendment to

the Regulation on Energy Performance in Buildings" published on 1 April 2010 in order to reduce the differences that occur following the processes in the EU. Thus, as required by the EU directive 2010/31/EU, Energy Identity Certificate application has been introduced as of 1 January 2011 for newly constructed buildings and it was stated that existing buildings were required to obtain Energy Identity Certificate by May 2, 2017 in Turkey as well (Beyhan, 2017).

Provisions covered by all these legal arrangements for the different disciplines involved in the design and construction of buildings, including serious responsibilities regarding the nature of the buildings and the manner in which they are associated with their environment, require an ecologically balanced, sustainable development and competent technical practices of the built and natural environment, including the rational use of available resources, in the creation of living environments that offer a quality compatible with human dignity.

3.2. Legislation and Regulations on Building Energy Performance

Since 1998, the objectives of efficient use of energy set forth by the regulations and standards prepared and put in force in order to ensure/increase energy efficiency, which is among the first in the actions of combating climate change, prevention of waste, alleviating the burden of energy costs on the economy and increasing the efficiency of energy resources and energy to protect the environment have been on the agenda of the country in the design and construction of built environments.

3.2.1. Energy Efficiency Law No. 5627

Energy efficiency policies and measures are based on the Energy Efficiency Law no. 5627 effectuated on 2 May 2007. This law consists of several sections to regulate the establishment of an administrative structure for the effective conduct, monitoring and coordination of energy efficiency studies, the authorizations for the execution of energy efficiency services, the duties and responsibilities of various organizations, public education and awareness-raising, various support mechanisms for the popularization of renewable energy sources and sectoral practices, regulations on incentives and fines to be imposed on those who do not meet legal requirements. With the law, it was decided to prepare the procedures and principles regarding energy performance in buildings covering norms, standards, minimum performance criteria about the subjects of architectural design, heating, cooling, thermal insulation, hot water, electrical installation and lighting, procedures and principles regarding energy performance in buildings including information collection and control procedures, in cooperation with the Turkish Standards Institute and the General Directorate of Renewable Energy, and to prepare a regulation to be put into force by the abrogated Ministry of Public Works and Settlement, which is now the Ministry of Environment and Urbanization (URL-2). Within the scope of the aforementioned regulation; an energy identity document containing information about the building's energy need, insulation characteristics, efficiency of heating and/or cooling systems and energy consumption classification of the building is envisaged as part of the construction projects prepared.

3.2.2. Legal Regulations Regarding Thermal Insulation Rules in Buildings

The step taken before the regulation regarding the isolation of buildings in Turkey is the issuance of the standard TS 825 Rules of Thermal Insulation in Buildings. The standard, which has become the mandatory standard for all buildings since 14 June 2000, took its final form after being revised in 2008, 2010 and lastly in December 2013. The purpose of this standard is to limit the amount of energy used in the heating of buildings in our country, thus to increase energy saving; and to determine the standard calculation method and values to be used in the calculation of energy needs. Also with TS 825; it is aimed to determine the design option that will provide ideal energy performance by applying the calculation method and values described in this standard to various design options of a new building, to determine net heating energy consump-

tion of existing buildings, to determine the amount of savings to be achieved by applicable energy saving measures before applying a renovation project to an existing building, and to estimate the future energy needs of the building sector at the national level by calculating the energy needs of various buildings that can represent the building sector (TS EN 825). The amendments made in the revision of 2013, when the standard took its final form, are the activities aimed at increasing energy saving. In this context, one of the noteworthy changes in the new version of the standard is that the number of regions in the degree day table according to the provinces, which was 4 in the previous version, was increased to 5 according to the needs emerging in the process (Öztorun, 2017).

3.2.3. Construction Products Regulation

Within the framework of EU technical legislation; as a result of the harmonization studies of EU's Construction Products Directive (CPD) numbered 89/106 / EEC, the *Construction Products Directive* have been issued in Turkey and production in accordance with international standards has been made compulsory. This Regulation was designed to determine the principles and procedures about putting and keeping the building materials on the market by establishing the rules for the performance characteristics of the building materials and the CE marking of the materials.

The products covered by the Construction Products Regulation are subject to technical specifications. Having a technical specification for a product is related to the existence of a *harmonized standard* (harmonized norm) or European Technical Assessment for that product. That is, any building material with a harmonized standard or European Technical Approval must bear the "CE" mark within the scope of the Regulation and these products are called products in the *regulated area* (Öztorun, 2017).

On the other hand, the products in the unregulated area in EU technical legislation implementations are defined as products where there is no common EU legislation. The Ministry of Environment and Urbanization developed the "G" marking application in order to establish certain rules regarding the control and safety of these products that are not subject to the Construction Products Regulation. To this end, "the Regulation on the Criteria for Construction Products" prepared by the Ministry of Environment and Urbanization was published in the Official Gazette dated 26.06.2009 and numbered 27270 and entered into force on 01.07.2010. The regulation at issue includes the practices that take the model of the Construction Products Regulation established for the purpose of adapting the EU Directive 89/106 / EEC to the Turkish legislation. Another application is the introduction of the "National Technical Assessment" procedure similar to the "EU Technical Assessment" process regarding affixing the CE marking for the products in the regulated area in the Construction Products Regulation with this Regulation (URL-3).

3.2.4. The Regulation on Energy Performance in Buildings (REPB)

The Regulation on Energy Performance in Buildings (REPB) was published in the Official Gazette dated 05.12.2008 and numbered 27075 in order to regulate the principles and procedures regarding the effective and efficient use of energy and energy resources in the buildings, prevention of energy waste and protection of the environment based on the provisions of the Energy Efficiency Law no. 5627 and entered into force one year after its publication. In 2010, amendments were made to the regulation by taking into consideration the opinions received, unclear points and various correction needs.

With the REPB Regulation; it is aimed at the determination of calculation rules for the evaluation of all energy use of a building, taking into account external climatic conditions, indoor requirements, local conditions and cost-effectiveness, classification with regards to primary energy or carbon dioxide (CO_2) emissions, determination of minimum energy performance requirements for new buildings and existing buildings to be renovated at a significant rate, evaluation of the applicability of renewable energy sources, control of

heating and cooling systems, limitation of greenhouse gas emissions, determination of performance criteria and application principles in buildings and protection of the environment (URL-1).

The Regulation on Energy Performance in Buildings covers works and transactions regarding calculation methods related to the preparation and implementation of building projects and energy identity documents on the issues related to the energy usage of the building such as architectural design, mechanical installation, lighting, electrical installation in existing and new buildings, standards, methods and minimum performance criteria, authorizations for energy identification certificate (EIC) issuance, building controls and inspection activities, supply of energy from cogeneration system and renewable energy sources, generating the building inventory across the country and keeping it up-to-date, and training and awareness-raising activities aimed at improving energy culture and productivity awareness in society. The Regulation obliges new and existing buildings larger than 1000 m^2 to obtain Energy Identity Certificate (URL-1).

Energy Identity Certificate (EIC) is a mandatory document in accordance with the Energy Efficiency Law No. 5627 and the Energy Performance in Buildings Regulation issued accordingly and it contains information regarding classification of buildings' minimum energy requirement and energy consumption in order to prevent energy waste by effective and efficient use of energy and energy sources in the buildings and thus to protect the environment, greenhouse gas emission level, insulation properties and efficiency of heating and/or cooling systems. With this document, the energy classification of buildings is made from A to G. Class A indicates the most efficient level, while Class G indicates the lowest efficient level. While there is no minimum energy classification level for existing buildings, new buildings or buildings under construction must be designed and constructed in such a way that the energy identification certificate class is at least class C (URL-4). With the implementation of the Regulation on Energy Performance in Buildings and Energy Identity Certificate, it is aimed to increase the use of renewable energy resources in buildings in Turkey.

3.2.5. National Action Plan on Climate Change 2011-2023 (APCC)

In order to evaluate the measures related to combating climate change and adaptation policies within the scope of the development program, Turkey's National Action Plan on Climate Change was approved by the High Planning Council on 3 May 2010 and entered into force. The action plan setting out the national targets on climate change states that and it is aimed to render Turkey a country where national vision within the context of climate change is created, development policies and climate change policies are in compliance, clean and renewable energy sources are used in a widespread and integrated manner, which provides a clean and reliable environment for its citizens with low-carbon density (URL-5).

The objectives addressed in three main topics as increasing energy efficiency in buildings (Objective B1), increasing the use of renewable energy (Objective B2), and limitation of greenhouse gas emissions from residential areas (Objective B3) are set as follows (Climate change action plan 2011-2023):

OBJECTIVE B1.1. Establishment of thermal insulation and energy-efficient systems that meet the standards in commercial and public buildings with a total usage area of 10 thousand m^2 with at least 1 million houses in 2023

OBJECTIVE B1.2. Effective implementation of Energy Performance in Buildings (EPB) Regulation and other energy efficiency regulations in all buildings until 2017

OBJECTIVE B1.3. Developing the tools to provide the necessary financial support for energy efficiency, renewable energy and EPB in buildings until the end of 2013

OBJECTIVE B1.4. Issuance of "Energy Identity Certificate" for all buildings until 2017

OBJECTIVE B1.5. Reducing annual energy consumption by 10% in 2015 and 20% by 2023 in public buildings and facilities

OBJECTIVE B2.1. Supplying at least 20% of the annual energy needs of new buildings from renewable energy sources as from 2017

OBJECTIVE B3.1. Reduction of greenhouse gas emissions by at least 10% compared to existing settlements (which are selected as pilot and greenhouse gas emissions of which are determined by 2015) by 2023

3.2.6. Energy Efficiency Strategy Paper 2012-2023 (EESP)

Due to the fact that Turkey's road map in the field of energy efficiency must be prepared with a strategic and dynamic perspective, a strategy document regarding energy efficiency was prepared and published in the Official Gazette dated 25.02.2012 and numbered 28215, and became effective in order to ensure that public, private and non-governmental organizations act in a participatory and collaborative manner, to create a policy integrity that is result-oriented and supported by concrete objectives, to identify the actions to be taken to achieve these objectives, and also to define the responsibilities that organizations will undertake in the process. In this context, actions that could be effective in fulfilling the aim of disseminating environmentally friendly buildings with high energy efficiency using renewable energy sources were determined and energy use was regulated (Energy efficiency strategy document 2012-2023).

Considering the steps taken for this purpose, strategic targets and action plan prepared at building scale are given below (Energy efficiency strategy document 2012-2023).

In 2023; at least 10.000.000 residences and commercial and service buildings with total usage area over 10.000 m^2 will have thermal insulation and energy-efficient systems meeting the specified standards. With the revision of the current legislation in line with the EU practices, maximum annual energy demand including heating, cooling, lighting and transportation will be provided according to the function of the building, the climatic conditions of the region where it is located, the architectural design and the construction status in compliance with the compulsory standards in force; on the basis of meeting the energy demand from energy-efficient and/or clean energy sources and technologies, the maximum amount of CO2 emission allowed to be released into the atmosphere will be determined and construction of new buildings exceeding these limit values will not be allowed.

At least 1/4 of the building stock in 2010 will be transformed into environmentally friendly sustainable structures that obtain at least 20% of the annual energy demand from renewable energy sources by 2023. With the revision of the relevant legislation, new buildings will be required to have certificates with comparable characteristics at the national or international level, indicating that they are sustainable by taking into consideration the development levels, land values, development plans and natural energy opportunities in the vicinity (Energy efficiency strategy document 2012 -2023).

3.2.7. National Energy Efficiency Action Plan (2017-2023)

The National Energy Efficiency Action Plan covers 55 actions concerning horizontal issues involving buildings and services, energy, transportation, industry and technology, agriculture and all sectors. The Action Plan, which covers technological, economic, social and environmental dimensions, takes into account innovative and best practices, prioritizes participation, stakeholder management, and which is prepared within the framework of the principle of efficiency and effectiveness, includes resource efficiency at the point of increasing competitiveness. The plan was developed in a flexible, measurable and updateable manner according to changing conditions, open to process and method innovation (URL-6).

The National Energy Efficiency Action Plan aims for making support models more effective in energy efficiency, the development of sustainable financing mechanisms, the development of sustainable purchasing

and, energy efficiency culture, awareness and consciousness in public and private sectors, encouraging on-site production and consumption, positioning smart cities and smart networks in terms of energy efficiency, increasing energy efficiency in industry, transportation and agriculture, expanding district heating systems, increasing the use of alternative fuels and resources within the framework of energy efficiency, expanding sustainable environment friendly structures and increasing the efficiency of energy efficiency in all sectors within the scope of making existing structures more efficient (URL-6).

Within the framework of the action plan, the following objectives have been determined in the building and services sector (URL-6):

B1-Determination and Sharing of Best Practices on Materials and Technology Used in the Construction Sector: Developing a guideline for each of the different materials, equipment, and technologies used in building to be built or to go under qualified renovation, including energy performance criteria, financial indicators, and efficiency analysis

B2-Building a Database Including Energy Consumption Data for Buildings: Developing an inventory of the number and typology of buildings in urban and rural areas with the main features related to buildings in Turkey, collecting actual energy consumption and emission data of buildings of a certain size, establishing a national database for benchmarking and evaluating buildings in terms of energy efficiency

B3-Defining the Energy Saving Goal for Public Buildings Purpose: Defining annual goals for increasing energy efficiency in public buildings

B4-Improving Energy Efficiency in Municipal Services: Identify opportunities and implement measures for municipalities in energy efficiency primarily in the fields of, but not limited to, water supply, wastewater treatment, solid waste collection, solid waste recovery and disposal.

B5-Rehabilitation of Existing Buildings and Improving Energy Efficiency: High-efficiency windows with thermal insulation in the building sector, National Energy Efficiency Action Plan 2017-2023, raising awareness of end-users, direct or indirect support and imposing obligations to increase energy efficiency in areas such as lighting, whiteware, heat pumps, boiler, and elevator motors.

B6-Encouraging the use of Central and District Heating/Cooling Systems: Switching to central and district heating systems and thus providing energy savings in public housing and large residential units as well as increasing the utilization rate of renewable energy for heating/cooling purposes

B7-Increasing the Energy Identity Certificate Possession Rate of Existing Buildings: Improving the technical and administrative capacity for issuing Energy Identity Certificates and increasing the ownership of energy identity certificates in existing buildings through awareness-raising activities.

B8-Encouraging the Certification of Sustainable Green Buildings and Settlements: Promoting the use of green certificates covering the topics of increasing efficiency in water use in addition to the energy performance of the built environment, improving comfort conditions, using natural materials, waste management, and environmental impacts through the certification of sustainable green buildings and settlements.

B9-Promotion of Energy Efficiency in New Buildings: Encouraging investments to increase the minimum energy performance class of the new and to be purchased/leased buildings, which is currently C, to the B or A class, and providing direct or indirect support to the building owners

B10-Improvement of Energy Performance in Existing Public Buildings: Increasing energy efficiency investments in public buildings by using Energy Performance Contracts (EPC), which enables the investments necessary for energy efficiency measures to be met with savings.

B11-Expanding the Use of Renewable Energy and Cogeneration Systems in Buildings: Defining the necessary legal framework for increasing the use of renewable energy sources and cogeneration systems in buildings and encouraging sustainable, environmentally friendly buildings with low carbon emissions directly or indirectly

B12-Resource Allocation for Energy Efficiency Etude Programs and Etudes for SME Buildings: Extension of the etude support applied for SMEs by KOSGEB (SMEs Development Organization) to be applied for commercial and service buildings of certain sizes outside the public sector which are not obliged to carry out etudes

3.3 Institutional Frameworks

In Turkey, the studies related to the supply and consumption of energy and arrangements about energy resources are carried out by the general directorates and infrastructure organizations affiliated to the ministries, in particular, the Ministry of Energy and Natural Resources and the Ministry of Environment and Urbanization, and by many institutions and independent organizations in order to ensure efficient use of energy by addressing the issue in the context of built environment.

The Ministry of Environment and Urbanization carries out its activities in order to carry out business and operations related to planning, construction, transformation and environmental management with a regulatory, supervisory, participatory and solution-oriented approach in order to create cities and settlements with high quality of life compatible with sustainable environment (URL-7);

The Ministry of Energy and Natural Resources, on the other hand, carries out its activities in order to provide the highest contribution to the welfare of the country by evaluating energy resources and natural resources in an efficient and environmentally sensitive manner (URL-8).

The most influential independent organizations that work on energy efficiency in Turkey are as follows:

Energy Efficiency Association (ENVER): It serves to raise awareness for the effective and efficient use of energy, to make scientific and technical researches and to share the results with public institutions and citizens (URL-9).

Zero-Energy and Passive House Association (SEPEV): It is an association that aims to adapt the passive house standards and methods to Turkey's climatic conditions and to be a pioneer in the spread of zero-energy buildings in Turkey (URL-10).

The Green Building Association (ÇEDBİK) is an association founded to pioneer the development of the building sector in light of sustainable principles and to pioneer the transformation of the market. It significantly contributes to raising awareness in Turkey about sustainable urban transformation, energy efficiency and green buildings (URL-11).

International Solar Energy Society-Turkey Section (GÜNDER) continues its activities in line with the aims of developing science and technology in the application of solar energy, encouraging basic and applied research and development on solar energy, promoting the use of solar energy and encouraging education in the fields related to solar energy (URL-12).

Turkish Society of Plumbing Engineers (TTMD) serves in line with the purposes of contributing to Turkey's development, in this context, creating healthy, safe, hygienic, comfortable and livable environments in different types of buildings where people spend 80-90% of their time, producing energy-efficient and environmentally safe solutions by using the opportunities of nature and cooperating with other occupational and expertise groups in accordance with these aims (URL-13).

Association of Turkish Construction Material Producers (Türkiye İMSAD) is an association aiming to raise public and sector awareness about safe and high-quality construction materials, which continues its activities with the aims of growing the whole sector and contributing to the creation and implementation of rules (URL-14).

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CHAPTER 4
KNOWLEDGE LEVEL AND AWARENESS IN THE COUNTRY

4.1. Potentials, Activities and Curriculums for Education in the Context of Energy Activity in Energy and Structures

In this chapter of the national report, a project was conducted in order to understand activities that were/will be conducted on "energy efficiency in the built environments" within the curriculum of the National Education in Turkey. In this research, initially it was focused on the secondary education curriculum of the Ministry of National Education in Turkey, and separate examinations were conducted on the curriculums of Science High Schools and Anatolian High Schools. Subsequently, with a focus on Higher Education, a study was conducted on the relevant departments of 8 prominent universities in Turkey.

An Overview of the Curriculum in the Secondary Education

In the initial research, the course contents of the Secondary Education were examined through scanning method via internet (URL-1) and no course content on energy efficiency in the built environments was found in the curriculums of normal high schools. As per the contents of the Science High Schools, it was observed that, under the titles of "Conservation of energy and conversion of energy ", "Efficiency", and "Energy resources", there were various subjects such as the cost, accessibility, and ease of production of the energy resources; considering its impacts on the community, technology, and environment; emphasizing the necessity to use the energy economically; explaining the relationship between energy saving and energy efficiency over the energy performance certificates. (URL-2 :20, 2018)

In the scanning conducted specially for vocational high schools, it was observed that Cezeri Green Technology Vocational and Technical Anatolian High School, Turkey's first renewable energy high school, was opened on Tuesday, September 26, 2017 (URL-3). In addition, among the Vocational and Technical Anatolian High Schools, it was observed that a total of 69 "Renewable Energy Technologies" (URL-4) branches are providing education on solar energy systems or wind energy systems education as an alternative for high school students. In this context, it was observed that there were important courses about energy in line with the "Vocational and Technical Anatolian High School, Anatolian Vocational, and Anatolian Technical Program, Renewable Energy Technologies Field Framework Curriculum" in the 9th, 10th, 11th, and 12th grades within the "Renewable Energy Technologies" branch (Figure 1) (URL-5: 5-6, 2017).

FIELD/BRANCH COURSES	FIELD COMMON COURSES	VOCATIONAL DEVELOPMENT
		RENEWABLE ENERGY SYSTEMS
		RENEWABLE ENERGY MECHANICAL DRAWING
		VOCATIONAL ELECTRIC-ELECTRONIC
	BRANCH COURSES	VOCATIONAL TRAINING IN BUSINESS
		INSTALLMENT OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		MANAGEMENT OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		BASIC AUTOMATION OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		ADVANCED AUTOMATION OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		INSTALLMENT OF THE WIND ENERGY PLANT
		MANAGEMENT OF THE WIND ENERGY PLANT
		BASIC AUTOMATION OF THE WIND ENERGY PLANT
		ADVANCED AUTOMATION OF THE WIND ENERGY PLANT
		COMPUTERIZED 3D MODELING

FIELD/BRANCH COURSES	FIELD COMMON COURSES	VOCATIONAL DEVELOPMENT
		RENEWABLE ENERGY SYSTEMS
		RENEWABLE ENERGY MECHANICAL DRAWING
		VOCATIONAL ELECTRIC-ELECTRONIC
	BRANCH COURSES	
		INSTALLMENT OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		MANAGEMENT OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		BASIC AUTOMATION OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		ADVANCED AUTOMATION OF THE SOLAR ENERGY (PHOTOVOLTAIC) PLANT
		INSTALLMENT OF THE WIND ENERGY PLANT
		MANAGEMENT OF THE WIND ENERGY PLANT
		BASIC AUTOMATION OF THE WIND ENERGY PLANT
		ADVANCED AUTOMATION OF THE WIND ENERGY PLANT
		COMPUTERIZED 3D MODELING

Figure 1. Courses within the curriculum (URL-5: 5-6, 2017).

Apart from these two examples, no course was detected on energy in the secondary education. For this reason, it is clear that the "non-formal" learning styles, which we propose within the scope of the project to turn the gap in this field into opportunity, will respond to the desires of young people to learn.

An Overview of the Undergraduate and Graduate Courses

Istanbul Technical University (ITU), Mimar Sinan University (MSU), Middle East Technical University (METU), Yıldız Technical University (YTU), Gazi University (GU), Erciyes University (EU), Eskişehir Technical University (ETU), Anadolu University (AU), and Karadeniz Technical University (KTU) which have exceled in architecture, urban regional planning, mechanical engineering, and energy engineering in Turkey were selected and examined. In this context, energy and related subjects were investigated within the scope of undergraduate and graduate courses given in the related fields.

First, there are courses of "Renewable Energy, Energy Planning and Management, Conventional Energy, Energy Science and Technology" within the departments of the Energy Institute in the ITU (URL-6). In addition, one of the two programs given is the Master's and PhD Program on "Energy, Science, and Technology".

In this context, the courses given in Table 1 are provided in the Energy, Science, and Technology Master's and PhD Program under the "Department of Renewable Energy" (URL-7).

Table 1. Courses offered in the Department of Renewable Energy in the ITU (URL-7)

COURSE CODE	COURSE NAME
EBT527E	Wind Energy and Conversion Technology
EBT553	Solar Energy and Conversion Technologies
EBT535	Energy Management in the Industry
EBT537	Energy Quality
END513	Advanced Statistical Analysis
EBT529E	Geothermal Energy
EBT511E	Nuclear Reactor Theory

EBT513	Computational Methods in the Energy Systems
EBT527E	Wind Energy and Conversion Technology
EBT537	Energy Quality
MTO512	Wind Energy and Systems
EBT616E	Energy Storage Technologies
EBT553	Solar Energy and Conversion Technologies
EBT542	Photovoltaic Power Systems
EBT620E	Signal Processing and Analysis in Renewable Energy Systems
EBT546	Special Issues in Energy Science and Technologies
EBT525E	Passive Solar Energy Systems
EBT544	Energy Efficient Lighting Technologies
EBT528	Active Solar Energy Systems
EBT624E	Thermoelectric Energy Conversion
EBT549E	Solar Thermal Power Plants
EBT509	Coal Science and Technology
EBT544	Energy Efficient Lighting Technologies
EBT546	Special Subjects in Energy Science and Technologies
MET607	Experimental Design
EBT525E	Passive Solar Energy Systems
EBT551E	Zero Energy Buildings

In the architecture department, the "Environment Control and Construction Technologies" field is a master's program under the Department of Architecture, providing education only at master's level (URL-8).

Environment Control and Building Physics Work Group

- Air Conditioning in Architecture
- Thermal Comfort
- Design of energy-efficient buildings
- Design of smart energy-efficient buildings
- Energy efficient improvement
- Passive houses
- Building energy performance modelling and simulations
- Building energy certification
- Building integrated renewable energy systems
- Cost optimization in energy efficiency
- Architectural lighting
- Visual comfort
- Natural lightening
- Artificial lightening
- Energy-efficient lightening design
- Lightening energy performances in the buildings
- Lightening design performance modeling and simulations
- Acoustic design in architecture
- Auditory comfort
- Sound insulation
- Acoustic design of the fronts
- Acoustic design of the saloon
- Noise of the city and noise map
- Aural architecture
- Soundscape
- Acoustic design performance modeling and simulations
- Certification for the acoustic design
- Fire protection
- Fire safety in the buildings
- Spread of fire in the enclosed areas
- Fire simulation
- Health equipment
- Water requirement in the buildings
- Planning the supply and the disposal systems
- Wet area designing
- Sustainability and Ecology in Architecture
- Design and certification of green buildings
- Zero-carbon building design
- Water conservation in the buildings
- Rainwater catchment systems in the buildings
- Green building feasibility studies
- Acoustic design for sustainable buildings
- Design and certification of green buildings in acoustic terms
- Sustainability in the design of lightening.

Figure 2. Basic research areas of the "Environment Control and Building Physics Working Group" in the "Environment Control and Construction Technologies" field (URL-8)

In this context, the courses provided in terms of the project subjects can be listed as "Low Energy Efficient Building Design", "Sunlighting in Architecture", "Energy Conservation in the Built Environment", "Water Efficiency in Buildings" (URL-8).

Structural Sciences is a graduate program under the Department of Architecture and only provides doctorate level education. "Energy Efficient, Ecological, Sustainable Building and Settlement Design", "Energy Conservation in Heating, Cooling and Lighting", "Energy Performance in Buildings", "Solar Architecture", "Natural Lighting System Design Research Areas", "Effects of Climate and Energy on Settlements Design" and "Energy Management in Lighting" courses are offered (URL-9).

Within the scope of the Urban and Regional Planning Doctoral Program, "Energy Conservation in Urban Planning" course is given (URL-10).

When the undergraduate courses of ITU Department of Architecture are examined, certain courses such as renewable energy, zero-energy buildings are not among the compulsory courses in the architecture department. "Solar Housing", "Energy Efficient Housing", "Energy Conservation Legislation and Practices" courses are given as elective courses (URL-11).

There is no course on energy subjects in compulsory courses within ITU Mechanical Engineering program. "Energy Management" and "Renewable Energy Systems" courses can be taken as elective courses (URL-12).

Energy subjects are not included in the compulsory courses at Yıldız Technical University (YTU) Architecture Department (URL-13). "Solar Energy in Architecture" is a master's degree and "Energy Efficient Design" are graduate courses given within the PhD program (URL-13).

Within the Department of Mechanical Engineering at Yıldız Technical University, there are no courses with energy subjects among the compulsory courses. However, there are elective courses offered such as "Energy Economy", "Optimization in Energy Systems", "Renewable Energy Systems", "Energy Management", "Solar Energy and Heat Pump Systems", "Renewable Energy in Air Conditioning Systems", and "Nuclear Power Plants, The Basics of Energy Storage" (URL-13).

There are no elective or compulsory courses with energy subjects in the Urban and Regional Planning Department of Yıldız Technical University (URL-13).

Within the Mechanical Engineering Energy master's and doctoral program of Yıldız Technical University, there are courses such as "Energy Efficiency", "Energy and Environment", "Renewable Energy Systems", and "Geothermal Energy Systems" (URL-13).

There are no compulsory undergraduate courses with energy subjects in Mimar Sinan University Department of Architecture. However, there are courses such as "Energy Efficient Design, Sustainable Building Technologies, Energy Efficient Structures, Active Solar Energy in Buildings" among the elective courses (URL-14).

Mimar Sinan University Architecture Department Graduate Courses include Sustainable Architecture and Construction Technologies (URL-14).

There are no undergraduate courses with this subject at METU Department of Architecture; however, "Energy Considerations in Architecture II", "Energy Considerations in Architecture II", "Energy Analysis of Buildings" courses are given in the graduate program (URL-15).

There is a renewable energy research field among the undergraduate courses of METU, Department of Mechanical Engineering, and following courses are offered at the undergraduate level: "Energy Conversion Systems", "Utilization of Geothermal Energy", "Introduction to Solar Energy Utilization", and "Design of Renewable Energy" Systems", while "Advanced Solar Energy Utilization" is offered at graduate level (URL-15). There is no course related to the subject of this project among the compulsory undergraduate courses offered at Gazi University Department of Architecture. The courses "Solar Energy Application in Buildings", and "Building Climate and Energy Relations" are offered within the scope of elective courses (URL-16).

The courses with energy subjects such as "Energy and Building Envelope Analysis" and "Energy Efficient Building Design" at the graduate level in Gazi University Architecture Department.

At the undergraduate level of the Department of Energy Engineering at Gazi University, "Renewable Energy Technologies" course is offered as a compulsory course, while the following courses involving energy subject are offered as elective courses "Solar Energy and Systems", "Wind Energy and Systems", "Geothermal Energy and Systems", "Energy Efficiency", "Wind Turbine Design", "Energy Storage Systems", "Solar Cell Technologies" and "Renewable Energy Systems" (URL-16).

There is only "Energy Efficiency" course offered at the graduate level in Gazi University Department of Energy Engineering, and only "Advanced Energy Transformation Technologies" course is offered at the Mechanical Engineering graduate level. There are no courses in this field at the undergraduate level.

There is no course about energy in the undergraduate courses at the Department of Architecture of Anadolu University (URL-17).

There is no course on energy at the undergraduate level of the Department of Architecture at Erciyes University. The course "Energy Efficient Lighting Design" is offered at the graduate level. Erciyes University Mechanical Engineering Department offers "Wind Energy and Turbine Design", "Energy Management", and "Solar Energy, Energy Storage Systems" courses at undergraduate level. There is no course on this subject in graduate school. As per the Department of Energy Systems Engineering, "Energy Resources, Energy Storage Systems", "Solar Energy and Systems", "Wind Energy and Systems", "Solar Energy Applications", "Energy Systems Design and Implementation", and "Energy Efficiency and Management" courses are offered at the undergraduate level. Among the graduate courses is "Wind Energy Conversion Systems" (URL-18).

Within the Department of Architecture of Karadeniz Technical University, "Energy Conservation Regulations and Practices" course is offered at undergraduate level, and "Energy Effective Design in Architecture" is offered at graduate level. In the Department of Mechanical Engineering, "Renewable Energy Sources" and "Energy Management" are offered at undergraduate level, while the "Solar Energy and Applications" are offered at the PhD level.

It is observed that the number of undergraduate courses involving energy is very limited in architecture departments of majority of the examined universities. Moreover, the existing courses in this field are elective, which means that they are left to the student's initiative. Similarly, it is observed that there are not enough courses in this field at the graduate level. No courses with energy subject was encountered at the departments of Urban and Regional Planning (except one course in the ITU PhD program). Examining the energy engineering in particular, it is observed that there are many courses in this field at Istanbul Technical University.

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4.2. Survey results concerning the awareness levels of the youth

Within the scope of the project, in order to measure young people's awareness and learning desires about environmental problems, climate change, energy, energy in the built environments, impact of energy, structural design, and zero-energy buildings, a survey was prepared in the "google documents[5]" form and it was sent to the youth through e-mails entirely on a voluntary basis. The survey was kept open for 28 days between 1 May and 29 May 2019 and the results were collected. In this section of the national report, evaluations are presented concerning the responses of 531 young people participated in the survey from 48 different provinces.

In the first part, the demographic characteristics of the young people participating in the survey were given and the harmony was evaluated between the participants and the target audience. As shown in Figure 1, all participants are in the appropriate age groups for our target audience, 47.6% of them are high school students between the ages of 15 and 18. The proportion of the gender of the participants is shown in Figure 2.

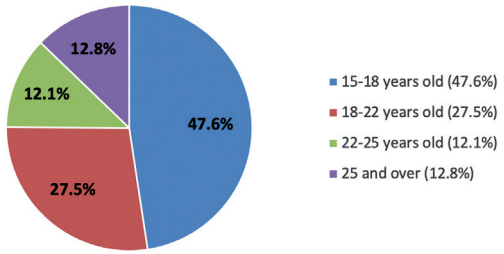

Figure 1. Age distribution of the survey participants

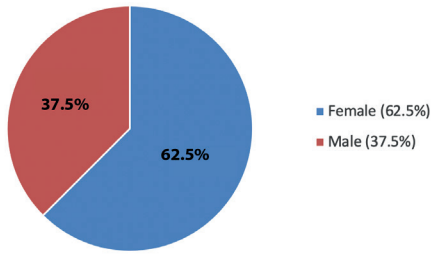

Figure 2. Genders of the participants of the survey

Figure 3 shows the distribution of the cities in which survey participants live. In this chart, it is understood that the cities where the participating young people live are in a variety that can represent all 7 regions of Turkey.

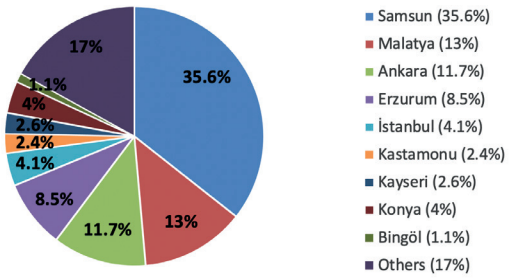

Figure 3. The cities where the survey participants live

Figure 4 shows the educational status of the young people surveyed. While, 51.8% of young people are high school students, 32.4% are undergraduate students. These ratios are another indicator that the survey has reached the project target audience.

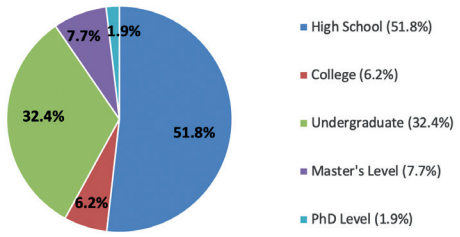

Figure 4. Educational status of the survey participants

5 *https://docs.google.com/forms/d/e/1FAIpQLSfgzBmdIbWFL0Kz-wCUtdll705eqCozlWTGevyVMotmEl8M8A/viewform*
https://docs.google.com/forms/d/e/1FAIpQLSfgzBmdIbWFL0Kz-wCUtdll705eqCozlWTGevyVMotmEl8M8A/viewform

In the second part, the awareness levels of the youth surveyed on CLIMATE CHANGE were measured. Figure 5 shows the answers to the question **"Have you heard the concept of climate change?"** It is understood that 95.9% of the youth have heard this concept.

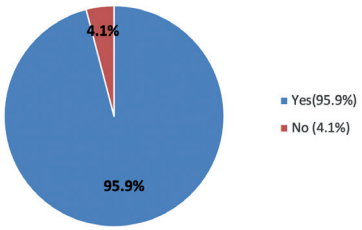

Figure 5. Answers given to the question "Have you heard the concept of climate change?"

Among the same group of questions, the answers to the question **"What do you think is the climate change?"** were prepared multiple-choice and the youth were asked to mark the answers they thought were relevant. As shown in Figure-6, 304 out of 531 young people primarily associated the climate change with the option "The rise in global average temperatures"; while 290 described climate change as "A change caused by human activities". The most impressive result here is that 25 (4.7%) of the 531 young people said they had no idea. (Figure 6)

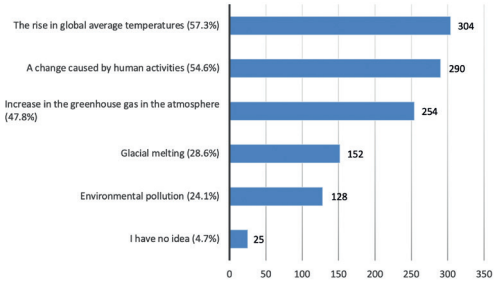

Figure 6. Answers to the question "What do you think is the climate change?"

Similarly, among the multiple choice answers given to the question **"What may be the main causes of climate change?"**, the most preferred options for young people are **Air, water and soil pollution, Unproductive consumption of natural resources, Industrial activities/wastes.** (Figure 7)

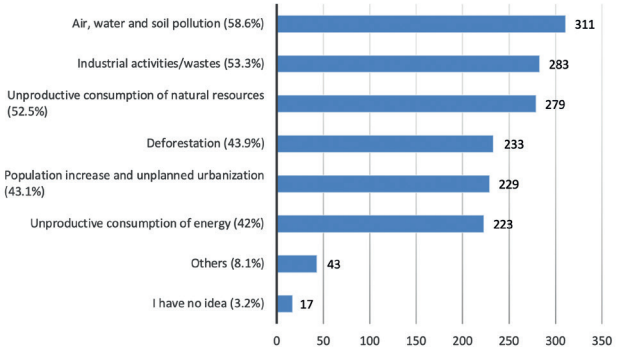

Figure 7. Answers to the question "What may be the main causes of climate change?"

The answers to the question "Where do you get information about climate change, environment, and energy?", which is one of the most important questions in this group, became an indicator that the right platform has been chosen to educate the target audience of the project. In other words, websites and social media maintain the potential to be effective platforms for educating this age group. On the other hand, the data demonstrate that "television" can still be used as an effective means of informing. The fact that 98 out of 531 students (18.5%) stated that they were receiving information on this subject through the **Projects (European Union, TUBİTAK, BAP, UNDP and others)** can be interpreted as an indicator demonstrating that these projects did not reach young people and there is a need to increase the visibility of these projects. Consequently, achieving the synergy between the project and internet has the potential for an effective way to reach young people. This comment became, one more time, an indication that the FROMZEROTOHERO project was built on the right foundations. Considering that the impact of schools and teachers is also quite high (36.5%), cooperation with schools and teachers will be important especially during the dissemination process of our project. (Figure 8)

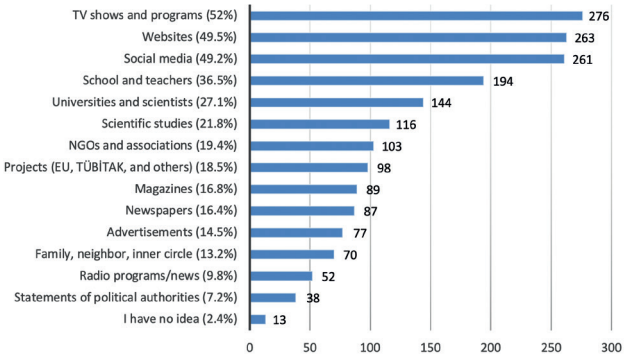

Figure 8. Answers to the question "Where do you get information about climate change, environment and energy?"

The answers to the question **"Do you think climate change and environmental problems are affecting your quality of life?"** show that young people are concerned about the environment with a proportion up to 95%. (Figure 9)

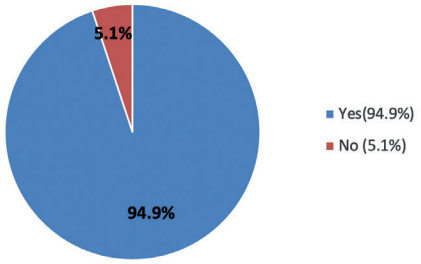

Figure 9. Answers to the question "Do you think climate change and environmental problems affect your quality of life?"

Answers to the multi-choice question **"How should be the individual struggle for reducing climate change and environmental problems?"** were as follows: use of environmentally friendly and recyclable products by 69.5%, energy and water saving by 61%, keeping the environment clean by 60.8%, waste sorting by 58.8%, and use of energy efficient products and systems by 51% of the participants. In the light of these results, it is possible to conclude that activities should be carried out to increase the knowledge and awareness levels of young people about energy efficient products and systems (Figure10).

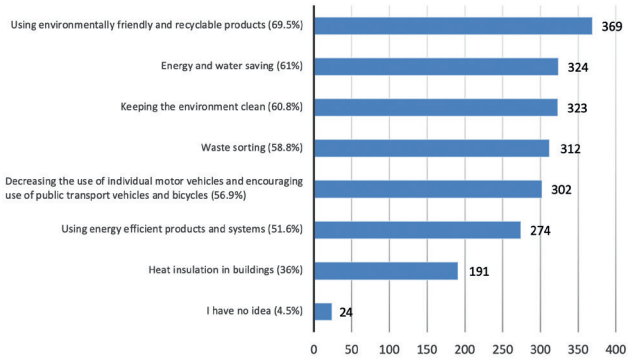

Figure 10. Answers to the question "How should be the individual struggle to reduce climate change and environmental problems?"

The answer to the question **"Do you want to learn more about climate change?"** clearly demonstrates the desire of the youth to learn about this issue. (Figure11)

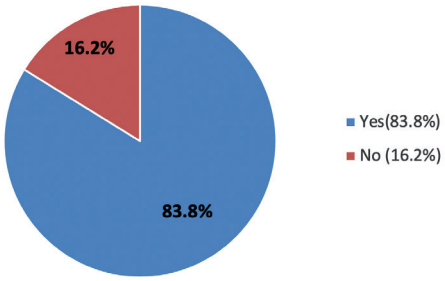

Figure 11. Answers to the question "Do you want to learn more about climate change?"

The first question of the 3rd part of the survey, which aims to measure ATTITUDES AND BEHAVIORS CONCERNING THE USE OF ENERGY of the youth, is **"How aware are you of the environmental impact of energy consumption?"**, and it was prepared with a 5-point likert scale. According to this 5-point scale, which was limited to "I have no knowledge about environmental impacts" and "I actively follow these issues and try to learn more", approximately 40% of young people stated that they had an average awareness of this issue. On the other hand, another 17.5% group expressed high awareness (Figure 12).

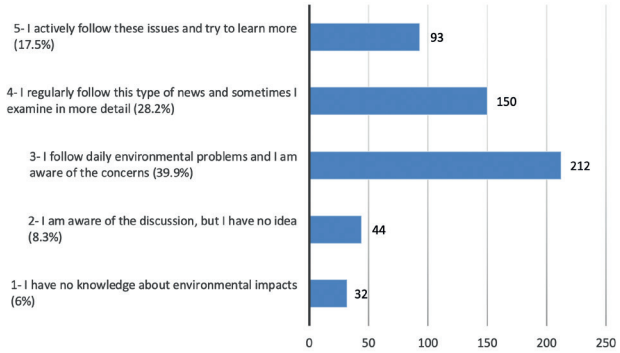

Figure 12. Answers to the question "To what extent are you aware of the environmental impact of energy consumption?"

The question "Do you have an attempt to reduce energy consumption at home?" was answered as YES only by 77,6% of the participants, which is a rate lower than expected (Figure 13).

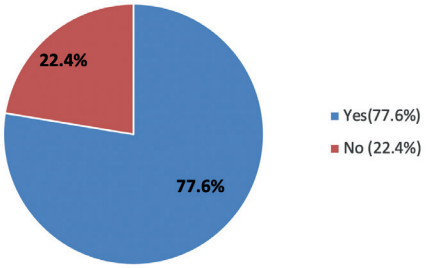

Figure 13. Answers to the question "Do you have an attempt to reduce energy consumption at home?"

The answers to the question **"What measures can be taken to reduce energy consumption at home?"** are also presented as multiple-choice, and the youth demonstrated the level of their awareness by the following choices: using A+ and above household appliances by 68.2% and use of renewable energy for electricity and water production (solar, geothermal, wind, biogas, etc.) by 64.6%. Contrary to expectations, only 58.6% of respondents preferred heat insulation in buildings as a measure to reduce energy consumption at home. The fact that only 19 participants stated that they "have no idea" about this issue demonstrated that the group without awareness is a small minority (Figure 14).

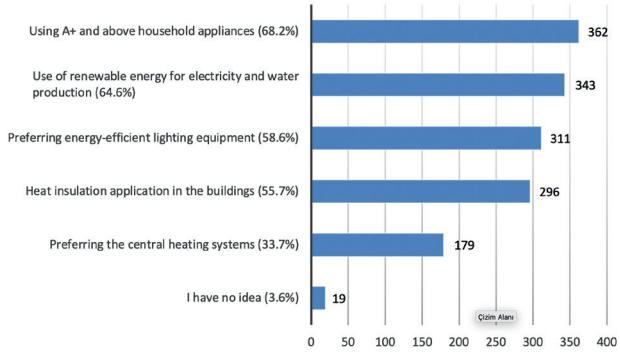

Figure 14. Answers to the question "What measures can be taken to reduce energy consumption at home?"

As a continuation of this question, the question **"What do you think is energy efficiency?"** was asked to the youth. Among the participants, 29.2% of respondents preferred "reducing energy consumption without conceding comfort and performance conditions", while 26.4% opted "preventing energy losses" and 26% choose "recycling and reuse of various wastes". Only 4.1% of the respondents stated that they had no idea about the issue (Figure 15).

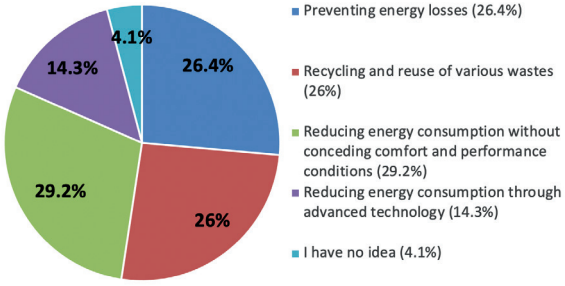

Figure 15. Answers to the question "What do you think is energy efficiency?"

When young people were asked what they were doing individually about environmental problems and energy studies, 70% reported that they supported efforts to reduce energy consumption, while 13% said "I'm not sure whether it's important, I want to learn more", only 6% said they weren't worried about it, and 1% said they thought it was exaggerated (Figure 16).

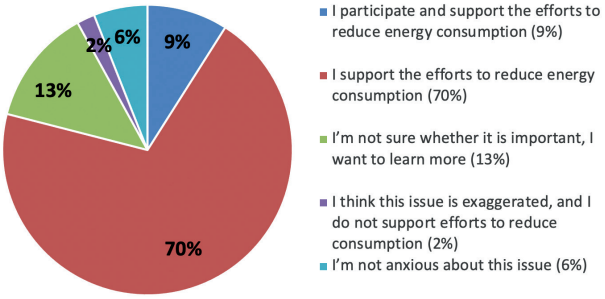

Figure 16. Answers to the question "What are you doing concerning the environmental problems and energy studies?"

The next part of the survey was conducted to raise awareness about **RENEWABLE ENERGY AND RENEWABLE ENERGY RESOURCES** for young people. The first question of this section was asked as "What do you understand from renewable energy?" and it was designed as a multiple-choice question. Among the students, 73.3% said renewable energy is recyclable, while nearly 60% stated that this energy is sustainable, and half of the respondents added that it is "not polluting nature and environmentally friendly". Only 12 of the 531 students said they had no idea. It is understood that the vast majority of students are aware of renewable energy (Figure 17).

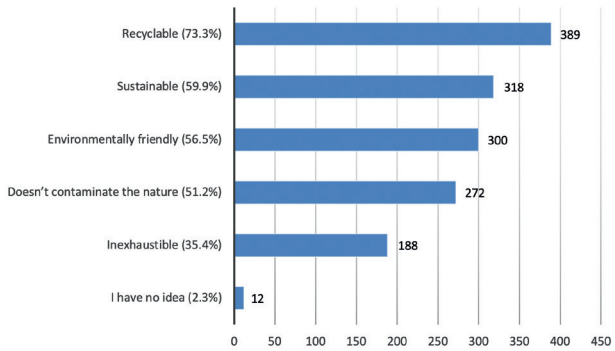

Figure 17. Answers to the question "What do you understand from renewable energy?"

Students were asked "what the renewable energy sources are" this time, and 86.8% marked "wind and solar energy". Majority of the students were dubious about whether other options were renewable energy sources and confused fossil fuels with renewable ones. A group of 3.6% stated that they had no idea (Figure 18). Based on the answers to this question, it may be concluded that students should be informed more about this subject. In this context, it is of vital importance that some of the training materials to be produced in the project should include what renewable energy sources are, how they are obtained, how they are used, and how they can be integrated into structures.

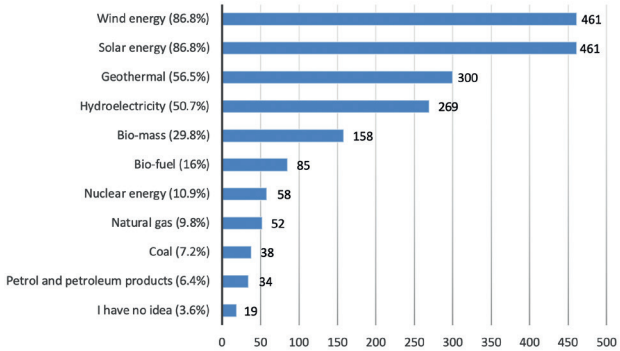

Figure 18. Answers to the question "Which of the following are renewable energy sources?"

How can the renewable energy sources be used in buildings? The answers to the question show that the majority of the youth (87.2%) have an idea about solar panels, and 64.2% have an idea about wind turbines. The surprising result of the survey was that only 31.1% of the respondents marked "photovoltaic panels" option. The proportion of those who say they have no idea rose up to 7%. In this case, the content of the educational materials to be prepared within the scope of the project begins to become clear (Figure 19).

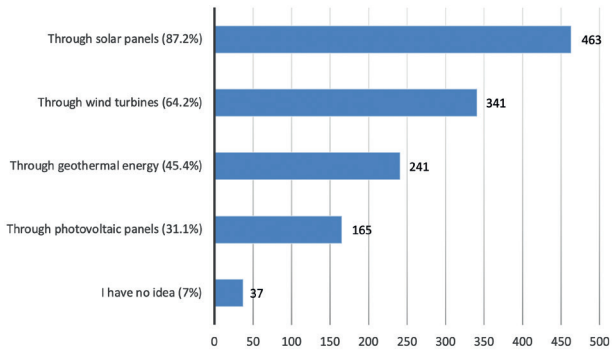

Figure 19. Answers to the question "How can renewable energy sources be used in buildings?"

The majority of the answers to the question "Which of the following are effective in improving energy efficiency in buildings?" were the "heat insulation" option. Over 50% of the youth demonstrated their awareness by marking other possible options. Another group of approximately 50% demonstrated that they did not have awareness or knowledge by not marking the options such as correct orientation of the building, heat recovery, and efficiency of the equipment used, which are the most important topics in buildings that will improve energy efficiency. The proportion of those who said they had no idea is still about 3%. The results are guiding the possible content of educational materials (Figure 20).

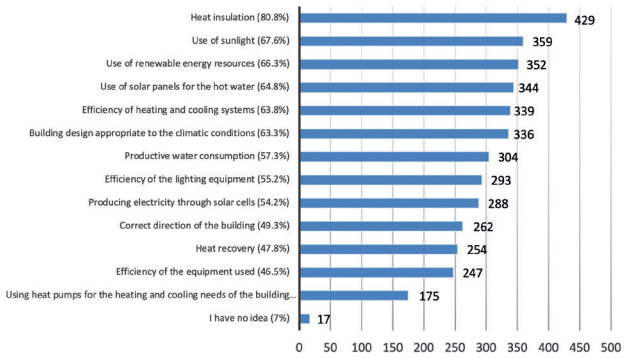

Figure 20. Answers to the question "Which of the following is effective in improving energy efficiency in buildings?"

In the question "What may be the effects of heat insulation in buildings?", 84.4% of young people preferred the "it reduces energy consumption" option, and 11.3% expressed their confusion/unawareness by opting for "energy consumption increases". While 1.1% choose "it had no effect", a group of 3.2% selected "I have no idea" (Figure 21). It is understood that a group of 20% of students need more training to correctly understand thermal insulation.

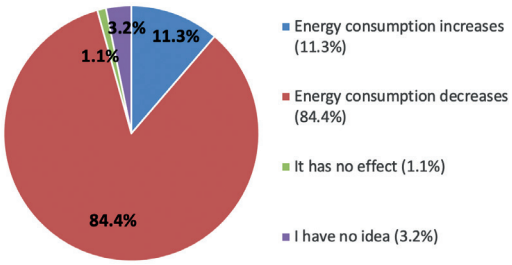

Figure 21. Answers to the question "What are the effects of heat insulation in buildings?"

For the question "Do you know anything about zero-energy buildings?", 32.8% of the youth answered YES, while 67.2% answering NO. The vast majority of the youth do not know about "zero-energy buildings" (Figure 22).

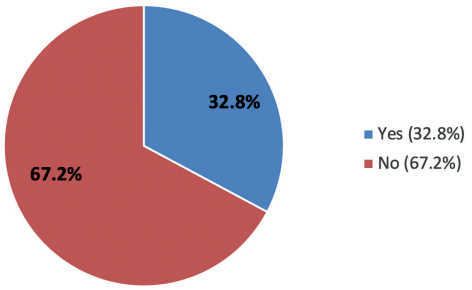

Figure 22. Answers to the question "Do you know about zero-energy buildings?"

The question "What do you think a zero-energy building might be?" was answered by the youth mostly as "sun, earth, and wind can be used as the renewable energy sources" and "they are the buildings that produce at least as much energy as they use through a year using a renewable energy source". As can be seen in Figure 23, young people do not appear to have clear knowledge of what a zero-energy building is. 16.6% of the youth mentioned that they had no idea about it.

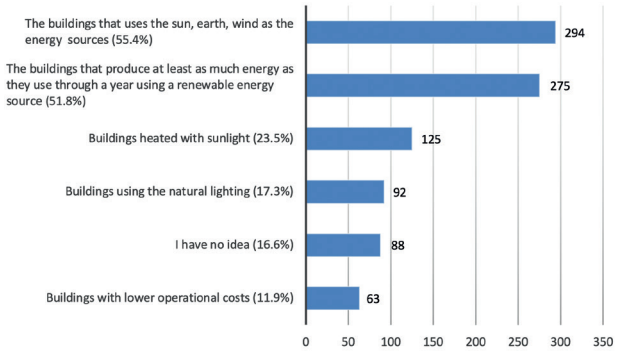

Figure 23. Answers to the question "What do you think a zero-energy building might be?"

As shown in Figure 24, 89% of students have not participated in any workshops, awareness campaigns or seminars on the "zero-energy building". This answer is actually one of the first indicators that educational materials, seminars and dissemination activities that are among the project's target outcomes will meet an important need.

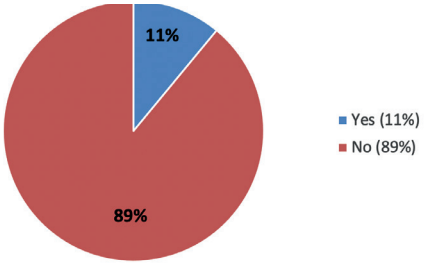

Figure 24. Answers to the question "Have you attended any workshops, awareness campaigns or seminars related to the zero-energy building?"

Similarly, nearly 90% of the youth have said they have never seen a zero-energy building before.

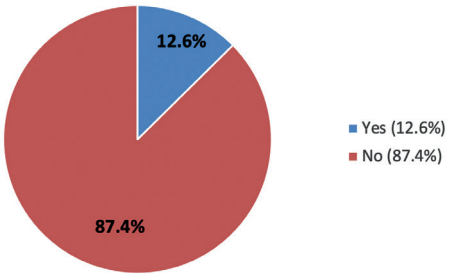

Figure 25. Answers to the question "Have you ever seen a real zero-energy building?"

As shown in Figure 26, the answers to the question "what benefits do you think there are in increasing the number of zero-energy buildings in your country?" demonstrated that the youth have poor awareness and are not able to prefer any option.

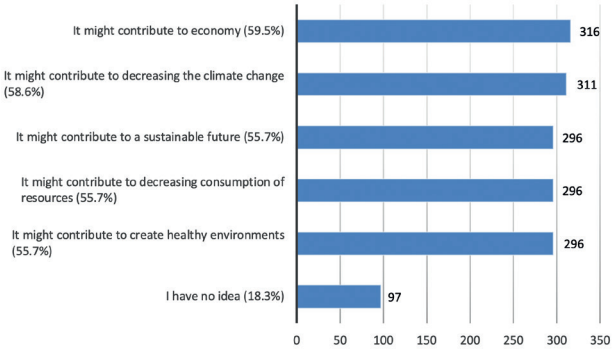

Figure 26. Answers to the question "What benefits do you think there are in increasing the number of zero-energy buildings in your country?

4.3. Survey results including opinions of industry representatives

Within the scope of the EU Project, which is coordinated by Gazi University, a survey consisting of multiple-choice questions was designed as a "google documents[6]" form and delivered to industry employees by e-mail on a voluntary basis in order to get the opinions and suggestions of industry representatives on "the energy efficiency of buildings and zero-energy buildings". The survey was kept open for 25 days between 4 May and 29 May 2019 and the results were collected. In this part of the national report, evaluations of the responses of 206 sector employees surveyed from 48 different provinces are presented.

Demographic information was obtained in the first part of the survey. According to the survey results of 207 people in total, it was determined that 44.9% of the participants were female and 55.1% were male (Figure 1); 44.4% were between 30-39 years of age, 26.1% were between 40-49, 17.4% were between 18-29, 8.7% are between 50-59, and 3.4% were over 60 years old (Figure 2).

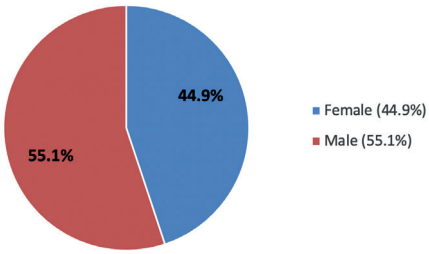

Figure 1. Gender of the survey participants

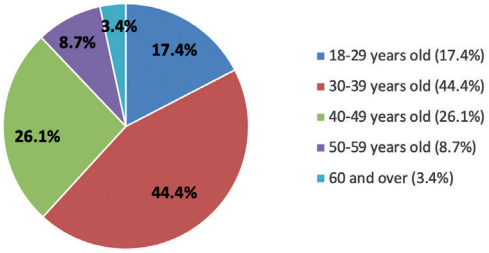

Figure 2. Age distribution of the survey participants

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As the educational status, it was determined that 39.6% were undergraduate, 38.2% with master's degrees, 21.2% with doctoral degrees, and 1% were associate degree graduates (Figure 3). Professional groups were 44% engineers, 32% architects, 4% urban planners, 3% technicians, 5% academicians, 4% civil servants and the remaining 8% were sales manager, expert, mathematician, foreign trade and real estate development and management, biologist, lawyer and real estate specialist each equal or lower than 1%. In the profession-based distribution of 207 participants working in the public sector, private sector, associations and universities, it was determined that 67 people were architects, 91 were engineers, 10 were academics, 9 were city planners, 6 were technicians, and 7 civil servants, while the remaining 17 were the employees of the sectors in the "others" group (Figure 4).

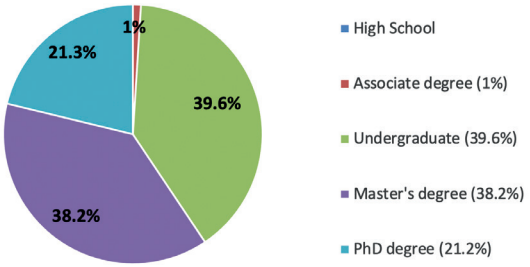

Figure 3. Educational status of the survey participants

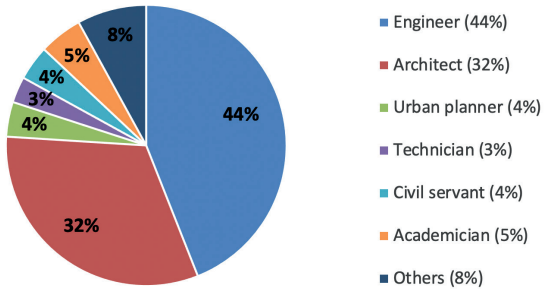

Figure 4. Professions of the survey participants

As a response to what extent the energy efficiency was considered in existing buildings in Turkey, 48.3% of the participants answered as inadequate, 35.7% responded as quite inadequate, 14.5% as neither adequate nor inadequate, and 1.4% as adequate. In context of the results, it was detected that the majority of the participants as much as 84%, who were within the sector, responded that the level of consideration and implementation of energy efficiency was inadequate or quite inadequate, and 14.6% did not have a clear idea about the inadequacy (Figure 5).

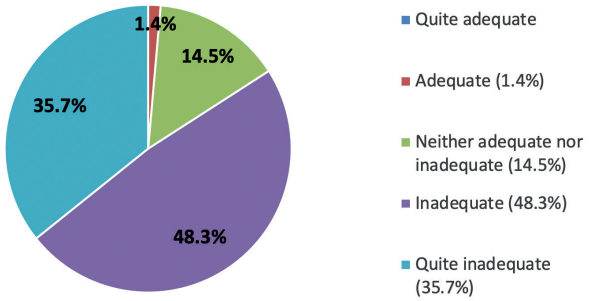

Figure 5. Answers to the question "To what extent do you think energy efficiency is considered in existing buildings in Turkey?"

Base on the answers regarding the consideration level of energy efficiency in the new building design in Turkey, 38.6% mentioned that it was neither adequate nor inadequate, 38.2% preferred inadequate, 12.6% quite inadequate, and 10.6% opted for adequate. According to the result, it is observed that more than 1/3 of the experts in the sector do not have sufficient knowledge about the subject. Those who think that energy efficiency is not taken into account in the new building designs had the highest proportion with *inadequate* and *quite inadequate* answers. The proportion of those who saw *adequate* remained very low. Taking into account expert opinions, it was concluded that the parameters of energy efficiency were not included in the new building design processes on a country basis (Figure 6).

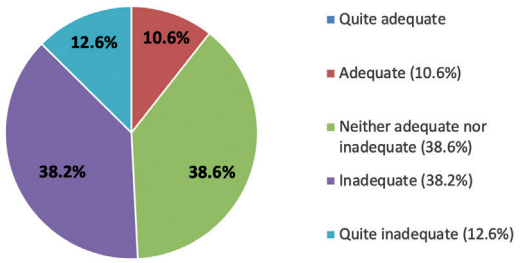

Figure 6. "To what extent do you think energy efficiency is taken into account in the design of new buildings in Turkey?"

The participants were asked to rate (between 0 and 5) the environmental effects emerging from disregarding the energy efficiency such as global warming, ozone layer depletion, increase emission of CO_2, formation of acid rains, oxygen depression in waters, human poisoning, ecological poisoning, consumption of natural resources, the formation of photochemical oxides, air-water-soil pollution and the extinction of plant-animal species. About the rating of global warming 44 people rated as 5, 28 people 4, 32 people 3, 65 people 2, 32 people

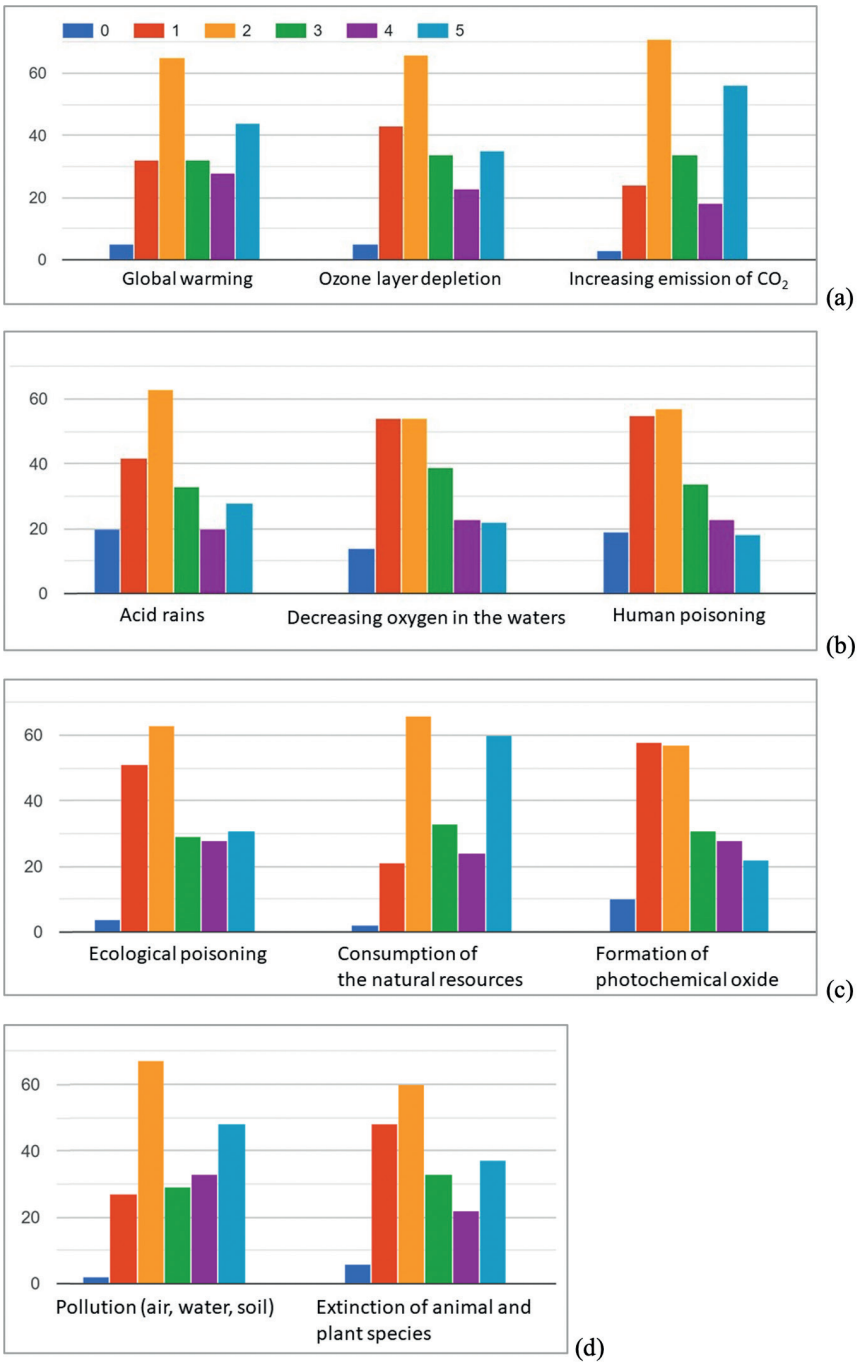

Figure 7. Answers to the question "Rate the environmental impacts caused by the disregard of energy efficiency in buildings?"

1, and 5 people 0 answers. 49.51% (102 people) of the participants stated that it was below the average (Below-average levels are 0-1-2 and above-average levels are 3-4-5) and the largest share remained at "2". Among the participants, 50.49% (104 people) responded as "3 or more". In the answers given about its effect on the ozone layer depletion, 35 people rated as 5, 23 people 4, 34 people 3, 66 people 2, 43 people 1, and 5 people 1. Based on this result, 55.34% (114 people) of the participants rated below-average and 44.66% (92 people) rated above-average answers. In responses to increasing CO_2 emissions, 56 people said 5, 18 people 4, 34 people 3, 71 people 2, 24 people 1 and 3 people rated as 0. It was observed that 47.57% of the participants (98 people) rated below-average, and 52.43% of them (108 people) remained above-average. In terms of acid rains, 5 was rated by 28 people, 4 was rated by 20 people, 3 by 33 people, 2 by 63 people, 1 by 42, and 0 by 20 people. Of the participants, 60.68% (125 people) rated below-average and 39.32% (81 people) rated above-average impact levels. The issue of oxygen depletion in waters was rated by 22 people as 5, 4 by 23 people, 3 by 39 people, 2 by 54 people, 1 by 54 people, and 0 by 14 people. 59.22% (122 people) of the participants rated below-average and 40.78% (84 people) rated above-average. The issue of human poisoning was rated by 18 people as 5, 4 by 23 people, 3 by 34 people, 2 by 57, 1 by 55, and 0 by 19 people. 63.59% (131 people) of the participants rated below-average and 36.41% (75 people) made above-average evaluations. Ecological poisoning was rated by 31 people as 5, 4 by 28 people, 3 by 29 people and 2 by 63 people, 1 by 51 people, and 0 by 4 people. Among the respondents, 57.28% (118 people) rated below-average and 42.72% (88 people) rated above-average. The issue about consumption of natural resources was rated by 60 people as 5, 24 by 4, 3 by 33 people, 2 by 66, 1 by 21, and 0 by 2 people. 43.2% (89 people) of the participants rated below-average and 56.8% (117 people) rated above-average impact levels. The issue of photochemical oxide formation was rated as 5 by 22 people, 4 by 28 people, 3 by 31 people, 2 by 57 people, 1 by 58 people, and 0 by 10 people. Among the participants, 39.3% (81 people) rated below-average and 42.72% (125 people) rated above-average impact level. The issue of pollution such as air, water, soil, etc. was rated as 5 by 48 people, 4 by 33 people, 3 by 29 people, 2 by 67 people, 1 by 27 people, and 0 by 2 people. It was found that 53.4% (110 people) had below-average opinions and 46.6% (96 people) had above-average opinions. The issue of the extinction of plant and animal species was rated as 5 by 37 people, 4 by 22 people, 3 by 33 people, 2 by 60 people, 1 by 48 people, and 0 by 6 people. The opinions of 55.34% of the participants were below-average and those of 44.66% (92 people) were above-average (Figure 7).

The results obtained from the opinions of the participants are presented in Table 1. According to the data obtained, it was concluded that the employees of the sector did not reach the level of awareness about the environmental impacts caused by disregarding the energy efficiency.

Table 1. Numerical data of participant opinions on environmental impacts caused by disregarding the energy efficiency

Impacts of Energy Efficiency	Number and rated of participants			
	Above-average		Below-average	
	People	%	People	%
Global warming	104	50,49	102	49,51
Ozone layer depletion	92	44,66	114	55,34
Increasing CO_2 emission	108	52.43	98	47,57
Acid rains	81	39,32	125	60,68
Decreasing level of oxygen in the waters	84	40,78	122	59,22
Human poisoning	75	36,41	131	63,59
Ecological poisoning	88	42,72	118	57,28
Consumption of natural resources	117	56,8	89	43,2
Formation of photochemical oxide	125	42,72	81	39,3
Pollution (Air, water, soil etc.)	96	46,6	110	53,4
Extinction of animal and plant species	92	44,66	114	55,34

Data on three areas were collected in the question to determine the efforts concerning energy-efficient building design within the sector:

1. Concerning the Design Parameters, the existence of certain efforts in the sector was examined such as topography-compatible building design, solar-compatible building design, climate-friendly building form design, prevailing wind-compatible building design, climate-appropriate building envelope design, and climate-friendly landscape design. Concerning the *topography-compatible building design*, 107 participants (51.94%) responded as YES while 99 participants (48.06%) responding as NO; 95 participants (46.12%) answered as YES concerning *solar-compatible building design* while 111 participants (53.88%) as NO; 92 participants (44.66%) answered as YES for *climate-friendly building form design* while 114 participants (55.34%) responded as NO; 78 participants (37.86%) responded as YES while 128 participants were NO concerning the *prevailing wind-compatible* building design; concerning the *climate-appropriate building envelope design* 90 participants (43.69%) answered as YES while 116 participants (56.31%) responding as NO, and concerning the *climate-friendly landscape design*, 95 participants (46.12%) responded as YES, while 111 participants (53.88%) answering as NO. Within the framework of the data obtained, the rate of consideration of energy-efficient design parameters in designs remained approximately 51% or less. The highest rated parameter was *topography-compatible building design* with a rate of 51.94%, while the lowest rated parameter was 37.86%, *prevailing wind-compatible building design* (Figure 8).

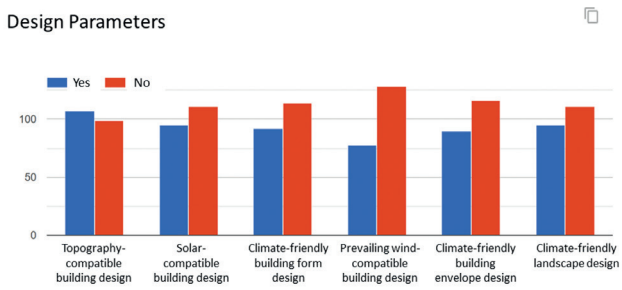

Figure 8. Answers to the question "Which efforts exist in your sector about the design parameters concerning energy-efficient building design?"

2. Concerning active systems, the existence of certain systems in the sector was examined such as solar cells, wind turbines, heat or water source geothermal heat pumps, biogas systems, waste management and heat recovery systems, and building automation systems. Examining the responses, it was determined that 66 participants (32.03%) said YES for the use of solar cells, while 140 (70.87%) of them answered as NO; in terms of wind turbines, 42 participants (20.39%) mentioned YES, and 164 participants (71.61%) preferred NO; concerning water source geothermal heat pumps, 50 participants (24.27%) answered YES, while 156 participants (75.73%) responded as NO; as per the heat source geothermal heat pumps, 40 participants (19.42%) responded as YES, and 166 participants (80.58%) NO; concerning the biogas systems, 25 participants (12.14%) mentioned YES, while 181 (87.86%) responded NO; for the waste management and heat recovery systems, 83 participants (40.29%) sad YES, and 123 participants (59.71%) preferred NO; as per the building automation system, 115 participants (55.83%) answered YES, and 91 of them (44.17%) responded as NO (Figure 9). According to the answers given, the presence of active systems in the sector, excluding building automation systems, remained below 40% and it was concluded that their use was not widespread. Only building automation systems were preferred with a rate of 55.83%, slightly above the average.

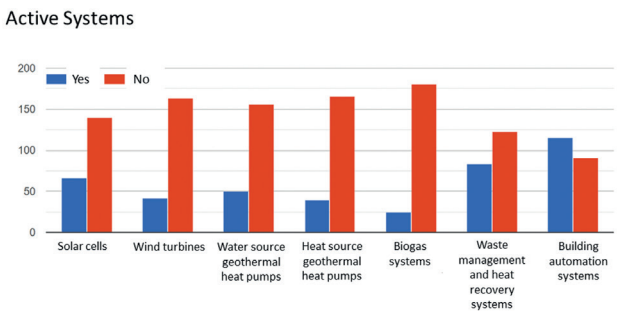

Figure 9. Answers to the question "Which efforts exist in your sector about the active systems concerning energy-efficient building design?"

3. Concerning passive systems, the existence of certain systems in the sector was examined such as metal walls, solar walls, solar chambers, heat, light, and sound insulated windows, double-layered facades, shading elements, labyrinth systems, venturi chimneys, solar chimneys, heliostats and anidolic ceilings. It was determined that 40 participants (19.42%) answered as YES concerning the metal walls and 166 participants (80.58%) responded as NO; 28 participants (13.59%) preferred YES concerning the solar walls, while 178 (86.41%) responded as NO; 21 participants (10.19%) answered as YES concerning the solar chambers and 185 of them (89.81%) preferred NO; 156 participants (75.73%) said YES for the heat, light, and sound insulated windows, and 50 participants (24.27%) said NO; 116 participants (56.31%) preferred YES option for the double-layered facades, while 90 of them (43.69%) answered NO; 111 participants (53.88%) responded as YES for the shading elements, and 95 of them (46.12%) preferred NO; 24 participants (11.65%) said YES for the labyrinth systems, and 182 participants (88.35%) said NO; 24 participants (11.65%) answered YES for the venturi chimneys, while 182 participants (88.35%) responded as NO; 19 participants (9.22%) preferred the YES option about solar chimneys, while 187 participants (90.78%) mentioned as NO; 10 participants (4.85%) answered as YES for the heliostats, and 196 of them (95.15%) responded as NO; 8 participants (3.88%) answered as YES for the anidolic ceilings, and 198 participants (96.12%) gave no answers (Figure 10). According to the results, the use of heat, light and sound insulated windows among the passive systems is the most common in the sector with a rate of 75.73%. Then comes the use of double-layered facades (56.31%) and shading elements (53.88%). Other systems, with values between 19-3%, are almost unable to find any place in the sector.

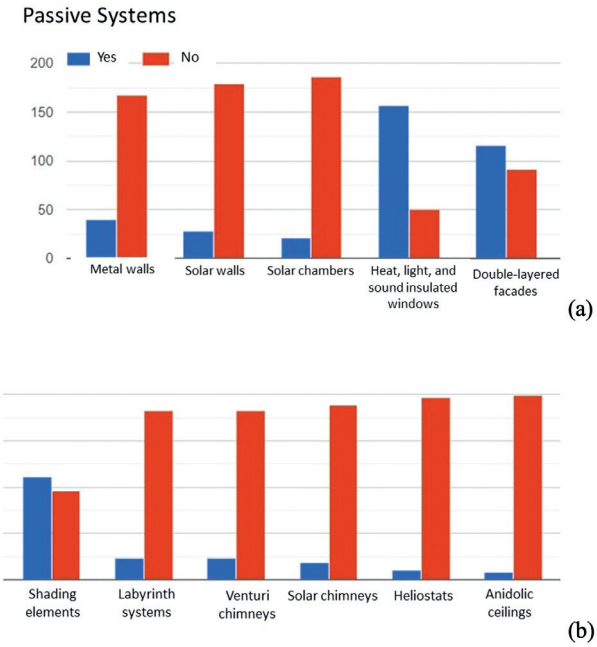

Figure 10. Answers to the question "Which efforts exist in your sector about the passive systems concerning energy-efficient building design?"

In the next step, the opinions of industry employees regarding the relationship between energy-efficient building design and the effective and sustainable use of country resources were examined. 76.8% of the participants (159 people) rated as "5", which expresses the highest relationship. 16.9% (35 people) of the participants rated as "4", 5.3% (11 people) rated as "3", and the remaining 1% participants rated as "1" and "2" (Figure 11). The answers indicate that the relationship is very strong.

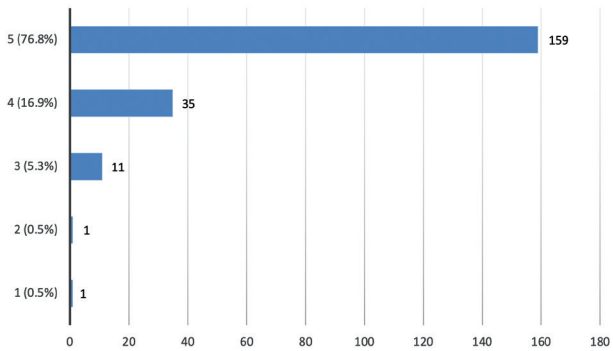

Figure 11. Impact of energy-efficient building design on efficient and sustainable use of country resources

Upon the question whether energy-efficient building design approaches (design parameters / active systems / passive systems) are important when buying real estate, 171 participants (83.1%) responded as YES, 23 of them (11.1%) answered as NO, and 12 people (5.8%) opted for "I don't know" (Figure 12). If the answer from this query was YES, it was questioned which of the active systems, passive systems, and energy efficient design approaches have an impact on the economic value of real estate. Of the 172 people who responded as YES, 127 answered the second step of the survey. The results are given in Table 2. According to the results, although there was a high-level awareness about taking into consideration the energy-enabled systems, it was concluded that there was not enough information about the systems.

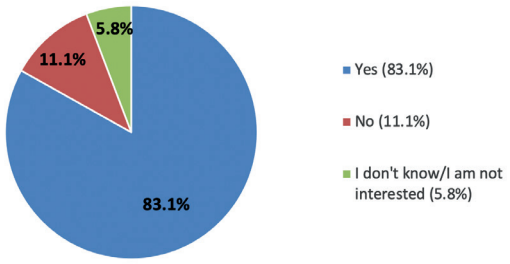

Figure 12. Answers to the question about the importance of energy-efficient building design approaches when buying real estate

Table 2. Answers of the participants about the energy efficient design approaches which are effective on the economic value of the real estate

Energy-efficient building design approaches	Number of people	%
Both active and passive systems	44	34,65
Active systems	11	8,66
Heat insulation	15	11,81
Passive systems	8	6,3
Photovoltaic panels	8	6,3
Wastewater recycling systems	8	6,3
Heat pump	3	2,36
Solid waste management	3	2,36
Solar chimney	2	1,57
Wind turbine	1	0,79
Building direction	1	0,79

Upon the question whether there were appropriate legislation and functioning for the promotion of energy efficiency in buildings in real estate purchase and sale, 185 people (89.8%) answered NO and 21 (10.2%) answered YES (Figure 13).

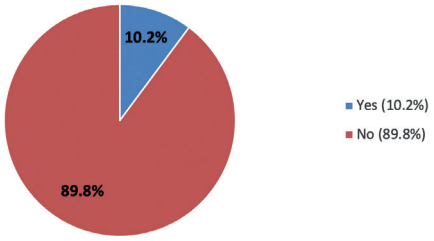

Figure 13. Answers to the question "Is there appropriate legislation and functioning for the promotion of energy efficiency in buildings in the purchase and sale of real estate?"

Only 17 people answered the question of the existence of appropriate legislation and functioning for the promotion of energy efficiency in buildings during real estate purchase and sale. Among these 17 people, who accepted the existence of this promotion, 5 stated that the legislation and regulations, 5 responded that the *energy performance certificate practice, and 4 stated that the heat insulation methods* were appropriate legislation and functioning for the promotion of energy efficiency. Of the remaining 3 people, 1 person mentioned that she/he did not know, 1 person said that there was not enough legislation, and 1 person just accepted its existence, however, could not give further details. Taking into account the content of the answers received from only 17 of the 206 survey participants, it was concluded that the level of knowledge on the subject was insufficient even within the sector closely related to the subject.

Upon the question about the adequacy of the country's legislation on energy efficiency, it was determined that 10 of the participants responded as *adequate*, 80 people as *inadequate*, 6 people mentioned that the energy was not handled in the environmental integrity within the legislation, 25 people stated that it was inadequately handled in the legislation and/or it had contradictions, 10 people mentioned that the users were not sufficiently informed about the legislation, 13

people said that state supervisions were inadequate, 14 people mentioned about the inadequacy about the promotions and support by the state, 27 people mentioned that inadequacy in the implementation and outputs cannot be covered, and 7 people expressed that it cannot be implemented due to high costs. 13 people answered that they did not have enough information.

Upon the question whether the operational costs in buildings will be reduced by the implementation of energy-efficient building design approaches (design parameters / active systems / passive systems), 194 people (94.2%) among 206 participants answered as YES, 4 people (1.9%) responded as NO, and 8 people (3.9%) as *I am not familiar with the issue* (Figure 14). 1 person did not answer this question.

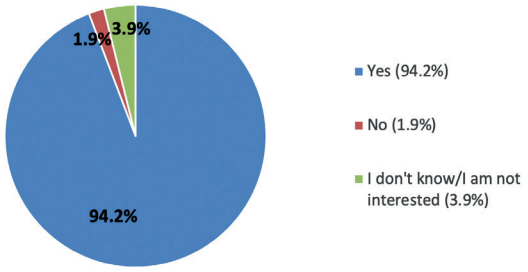

Figure 14. The opinions of the participants whether the operating costs will be reduced in buildings by implementing energy-efficient building design approaches

According to the answers given to the question whether an energy-efficient building design would increase the cost of investment, 42.2% (87 people) of respondents answered that there would be an increase as much as 25-50%, while 35.9% (74 people) of the participants estimated that there would be an increase only as much as 0-25%, and 12.6% (26 people) stated this ratio as 50-75%, ultimately 2.9% (6 people) reported their ideas as 75-100%. 6.3% (13 people) declared that they had no idea (Figure 15).

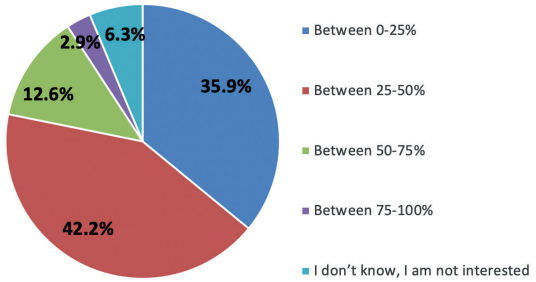

Figure 15. Answers to the question "Do you think that an energy-efficient building design will increase the cost of investment?"

In the step in which the availability of energy-efficient buildings in Turkey was questioned, 108 people (52.4%) answered as YES, 78 (37.9%) as NO, and 20 people (9.7%) responded that they did not know (Figure 16).

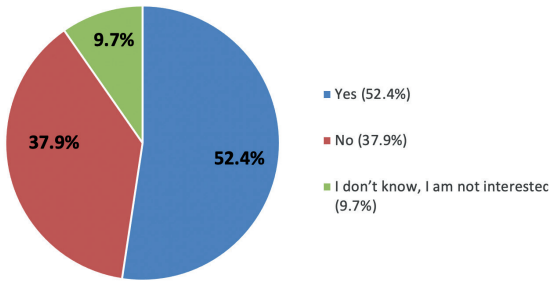

Figure 16. Answers to the question "Do you think energy-efficient buildings are being designed in Turkey?"

In this step, the participants, who answered as NO to the questions, were asked for their views on the reasons why energy-efficient building design approaches were not implemented and it was stated that more than one multiple options offered to them could be marked. 77 of the participants (38%) did not reply to this step and did not mention any opinion. Of the 130 who answered, 48.5% (63 people) said that zoning legislation was not appropriate, 76.9% (100 people) mentioned that the designers were lacking in knowledge and experience, 62.3% (81 people) defended that there were insufficient number of technical staff in practice, 74.6% (97 people) stated that the actors in the construction sector were lacking in knowledge and experience, 77.7% (101 people) reported that the

public demand for energy-efficient building design was insufficient, 78.5% (102 people) stated that the initial investment costs were high, and 44.6% (58 people) emphasized the lack of qualified staff in the operational process (Figure 17).

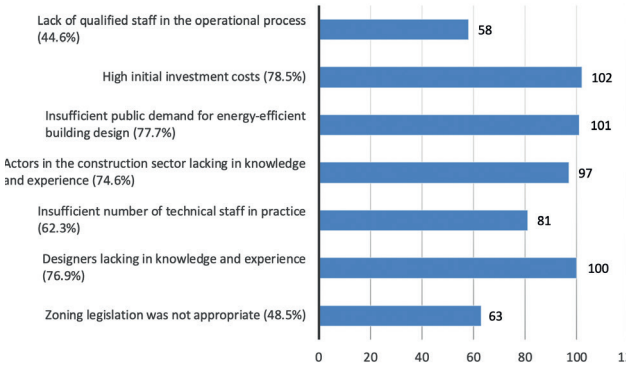

Figure 17. Views of the participants on the reasons why energy-efficient building design approaches were not implemented

According to the answers obtained in the step questioning the areas, in which the institutions of the survey participants are serving, concerning the energy efficiency, 13 of the participants stated to be working in legislation area, 31 mentioned to be in the education area, 76 in the practice of design and construction processes, 3 people in consulting area, 14 people in the control area, 8 people in trade area, and 61 people declared that they were working out-of-area.

The objectives of the participants in terms of energy efficiency in their institutions were answered as *awareness/dissemination* by 25 people, *increasing practices* by 11 people, *reducing energy* usage density by 19 people, increasing the consumption of natural resources by 13 people, *increasing energy efficient designs* by 31 people, *increasing energy efficiency* by 18 people, and *improving waste management* by 9 people. 80 people declared that they did not have any effective objectives.

When their objectives for zero-energy buildings were questioned, 126 people declared that they had no targets on the subject. 33 people answered that their objective was *awareness/dissemination*, 8 people responded as *increasing practices*, 3 people *as reducing energy usage density*, 10 people stated *increasing the use of natural resources*, 17 people responded as *improving design methods*, and 5 people stated that their objective *was increasing energy efficiency*.

CONCLUSION AND SUGGESTIONS

KA2 Strategic Partnerships "From Zero To Hero: Wise Energy Use Volunteering Scheme for Youngster" EU Project, which will be developed under the coordination of Gazi University, aims at "increasing the knowledge and awareness of the youth, who will build the future, about energy-efficient environments" in cooperation with partners from the universities in Turkey, Italy, Spain, and Netherlands, non-governmental organizations and private sector.

For this purpose, in this project, where four intellectual outputs will be prepared, initially the "national reports" were created, which reveal the energy, energy efficiency, and energy policies of each country, and which, at the same time, analyze the survey results measuring the awareness/knowledge levels of the target audience. As can be seen in the report concerning Turkey, our country ranks lower in the world list in terms of energy consumption, while it is one of the fastest growing countries in terms of energy consumption. Although domestic production in energy has increased, Turkey's rate of meeting energy demand with domestic resources decreases since the energy demand increases with a higher rate, and ultimately, the energy gap emerges. Until now, the only solution to close this energy gap has been seen as making new energy investments, especially in the last 20-25 years, investment has always been considered as seeking imported resources and fossil fuels (oil, natural gas, imported coal, etc.).

Moreover, the built environments, which consume the vast majority of energy, have reached to a great extent in a short period of time. According to building inventory of the Turkish Statistical Institute, the number of buildings increased from 4.3 million (in 1984) to 7.7 million (in 2000) with an increase of 78%, and it increased by 129% to 8.35 million (in 2008). By the end of 2016, the total number of buildings reached to 9.57

million. It is estimated that the energy consumption of the construction sector in our country, which is 28.3 MTEP (Million Tons of Equivalent Petroleum) in 2008, will reach 47.5 MTEP in 2020.

Considering that the TS 825 Standard has been implemented as of 2000, it will be possible to mention that the majority of the buildings in Turkey are insufficient in terms of energy conservation. Similarly, considering that there are no comprehensive measures in terms of energy efficiency in existing buildings, there is a high potential in the building sector to achieve high gains concerning efficiency. Most of the energy consumed in the buildings is spent on heating, cooling, and air-conditioning spaces to provide the comfort of the users. It is required to improve the structures, and within the bounds of possibility, to establish systems that support the use of sustainable energy sources in order to reduce the energy needs.

Particularly with the projects developed in Europe to ensure energy efficiency, concepts such as heat insulation, designs without heat bridges, high efficiency window, heat recovery air-conditioning and energy efficiency with active systems are standardized and energy savings up to 90% are achieved in the existing buildings that have been renewed.

In terms of reducing energy usage density and foreign-dependent energy requirements in Turkey, it is observed that there is a significant potential in designing energy-efficient new structures, and energy-efficient renewal of the existing structures by using renewable energy resources.

It is of critical importance for the young people, who will produce or demand built environments in the near future, to see the "whole picture" and have an idea of their details, in short, to raise their awareness about "built environments and energy". While creating our project, we were expecting that the young people would develop energy-oriented approaches in their habits, expectations, and preferences within the buildings and all built environments in which they live, and in line with their increasing awareness levels, they would tend to question, evaluate, and produce solutions to energy efficiency in their personal developments and/or career plans. A survey was conducted to determine the awareness levels of the youth about environmental problems, climate change, energy, energy in the built environments, energy-efficient building design, and zero-energy buildings as well as to measure their learning desires. Similarly, another survey was administered to the experts of the field and industry representatives to determine the existing technical knowledge and conceptual framework.

The survey, which was administered to learn the opinions, knowledge and tendency levels of the youth about these issues, confirmed our expectations. While the vast majority of the youth were aware of the relationship between "energy-environmental pollution and climate change", we realized that they wanted to learn more about these issues. Based on the results of the same survey, we realized that the youth had difficulty in comprehending the "built environments-energy" relationship, they were not aware of the active role of the buildings in this regard, and they oversimplified the renewable energy-building relationship down to obtaining hot water through solar panels.

Consequently, in the project in which four intellectual outputs will be prepared in line with these objectives, initially the "national reports" were created, which reveal the energy, energy efficiency, and energy policies of each country, and which, at the same time, analyze the survey results measuring the awareness/knowledge levels of the target audience. The second intellectual output focuses on preparing training modules that can be accessed through social media, where young people spend a lot of time, and subsequently, to the quizzes where they can test themselves. The third intellectual output requires the preparation of training cards that would be developed by methods other than widespread training methods and to improve the levels of knowledge and interest step-by-step. The fourth intellectual output aims at preparing the e-learning website and videos based on the zero-energy buildings.