

Türkiye'nin Sıfır Enerjili Bina Tarihine Dünya Bağlamında Genel Bir Bakış

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Özet

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Küresel topluluk, enerji verimliliğinin önemini giderek daha fazla kabul etmekte ve Türkiye bu eğilime ayak uydurarak sürdürülebilir enerji uygulamaları alanında takdire değer adımlar atmaktadır. Ülke, yenilenebilir enerji kaynaklarını kullanmak ve yaymak için bir yolculuğa çıkarken, aynı zamanda binalarda enerji kullanımını optimize etmeyi hedefleyen iddialı enerji verimliliği girişimlerini de başlatmıştır.

Sürekli değişen bu manzarada, sürdürülebilir enerji tüketimi taahhüdü katlanarak artmıştır. Türkiye'de ve dünya çapındaki araştırmacılar ve politikacılar, enerji tüketim modellerini ve değerli enerji kaynaklarını koruma yöntemlerini araştıran çalışmaları özveriyle araştırmaktadırlar. Bu çabanın önemi, çevreyi korumak ve ekolojik dengeyi desteklemek için güçlü bir araç sunduğundan, ekonomi alanlarının çok ötesine uzanmaktadır. Dünya, enerjinin ortaya çıkardığı çok yönlü zorluklarla boğuşurken, verimli enerji kullanımı arayışı, gelişen ve sürdürülebilir bir geleceğin ayrılmaz bir parçası olarak ortaya çıkmaktadır. Küresel topluluk, en son araştırmaları, yenilikçi teknolojileri ve ilerici politikaları birleştirerek, gezegenin doğal kaynaklarını gelecek nesiller için korurken ekonomik büyümeyi desteklemek için enerji tasarrufu potansiyelinden yararlanabilir.

A General Overview of Turkey's Zero-Energy Building History in the World Context

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Abstract

Throughout history, the significance of energy has remained unwavering, holding its position as one of the most critical global issues. While in the past, discussions on energy conservation primarily centered around large-scale industrial settings, today's discourse has shifted towards individual energy expenditures, particularly in residential contexts. The evolution of this subject is evident in the transformation of keywords employed in research, progressing from "energy consumption" and "energy saving" to more specialized terms such as "low energy building," "almost zero energy building," and "net-zero energy building."

Globally, there has been a notable emphasis on energy efficiency, and Turkey has followed suit, making remarkable strides in this domain. The country has not only embraced the utilization and dissemination of renewable energy sources but has also initiated various energy efficiency projects focused on optimizing energy consumption in buildings.

The ongoing research and implementation of sustainable energy practices, both on a global scale and within Turkey, hold the promise of not only bolstering economic growth but also ensuring environmental sustainability. As the world continues to grapple with energy challenges, the pursuit of efficient energy use stands as a driving force in securing a prosperous and ecologically balanced future.

Keywords: Energy crisis, energy consumption, zero energy building, zero build.

1.Introduction

The energy crisis refers to a period when the world faced a shortage of energy resources, particularly oil, and experienced significant price increases and economic challenges. The energy crisis began in the early 1970s and continued through the 1980s [1]. The crisis was triggered by a combination of

factors, including political instability in oil-producing countries, the increased demand for oil in developed nations, and the decision by the Organization of the Petroleum Exporting Countries (OPEC) to limit oil production and raise prices [2]. In 1973, OPEC declared an oil embargo on countries that supported Israel in the Yom Kippur

War, leading to a significant increase in oil prices and shortages in many countries. This event, coupled with continued political instability in the Middle East and the growing demand for oil in developing nations, contributed to the energy crisis [2, 3]. Governments and industry responded to the crisis by promoting energy conservation, exploring alternative energy sources such as nuclear and renewable energy, and increasing domestic oil production. While the crisis subsided in the 1980s, its effects were felt for years to come, and it remains an important moment in the history of energy policy and global economics [1, 4-6].

Global energy conservation efforts began in the 1970s in response to the energy crisis, which included political instability in oil-producing countries and an increase in oil demand in countries that have developed the one of the earliest and most visible efforts to promote energy conservation was the "Energy Crisis" campaign launched in the US in 1973. It included measures such as reducing speed limits on highways, encouraging carpooling, and encouraging people to save energy at home by reducing thermostats and the use of energy efficient devices [7, 8]. Other countries have launched similar campaigns to promote energy conservation, including Japan, Germany, France, and other European countries. Governments have begun offering tax incentives and subsidies to businesses and individuals who have invested in energy-efficient technologies, such as insulation, efficient lighting, and solar panels. Over time, the focus on energy conservation has expanded to include building codes and standards that require new buildings to be energy efficient, energy efficient appliances and vehicles, and energy renewables such as wind and solar. These efforts aim to promote economic growth and energy security by reducing energy

consumption and greenhouse gas emissions [9, 10].

It is known that most of the total energy in the world is consumed in industry, construction, and transportation sectors [11]. Heating, cooling, and lighting used in buildings constitute a large part of the energy consumed. Electricity is mostly used for lighting and cooling, and both fossil fuels and electrical energy are used together for heating [12, 13]. Since more than 30% of the total energy consumed is used in buildings, zero construction can provide great support for increasing energy efficiency, minimizing the use of fossil fuels and using more efficient and clean energy, as it also focuses on renewable energy sources [14].

In all this summarized historical process, energy maintains its currency as one of the most important issues of today as it was in the past. In the past, saving measures were discussed on the consumption of energy in large business areas, but today individual consumption in residences is discussed. While in the past there were studies within the framework of keywords such as "energy consumption, energy saving", this subject has evolved into keywords such as "low energy building, almost zero energy building, net zero energy building" in its historical course. For this reason, the general purpose of this article is to shed light on the current situation in the world today, and to briefly discuss the level of Turkey within the framework of these developments in the world.

2. Consumption Rates of Energy Types in the World

The proportional data of energy consumption varies by country and region. Consumption rates of energy types based on countries around the world may differ due to geographical locations of countries, local

resources they have, economic power and many other reasons. However, according to the current 2020 data of the International Energy Agency, an average global distribution is as follows [15]:

- Oil: 33.2%
- Coal: 26.6%
- Natural gas: 22.8%
- Renewables (including hydropower): 11.7%
- Nuclear: 4.4%
- Other (including biofuels and waste): 1.3%

These figures represent the shares of global primary energy consumption by fuel type. It's worth noting that the mix of energy sources used to generate electricity may differ from the mix of primary energy sources due to differences in the efficiency of energy conversion and the availability of different fuels in different regions. The use of renewable energy sources has been growing in recent years, and their share of global primary energy consumption is expected to continue to increase in the coming decades as the world transitions to a lower-carbon energy system [16].

In addition to these consumption rates based on countries in the world, it would be useful to specify the sectoral distribution rates of energy in countries in general. The current data presented by the International Energy Agency in 2019 on this subject can be listed as follows [17]:

- Industry: 37%
- Transportation: 32%
- Buildings: 17%
- Electricity and heat production: 10%
- Other (including agriculture, fishing, and non-specified): 4%

Manufacturing is the most energy-intensive sector, including energy-intensive manufacturing processes such as metal fabrication and chemical manufacturing.

Transportation is the second largest sector, which includes fuel consumption in all types of vehicles from cars, trucks, trains, airplanes, and ships. Construction represents the third largest sector, that includes the energy consumption of heating, cooling, and lighting equipment in residential, commercial, and institutional buildings. Electric heat production refers to the energy consumption of electricity and district heating, which is a method of distributing heat from a central location to multiple rooms the "other" section includes the energy consumption of non-industrial activities such as farming, fishing, and unspecified areas. It should be noted that the areas of energy efficiency can vary greatly among countries and regions depending on factors such as budget, climate, and demographics.

In today's scientific world, studies are carried out on energy consumption in buildings, which take priority in energy consumption by leveling up. In this context, when the distribution of energy expenditures in buildings is evaluated according to the data of the International Energy Agency, the following results are obtained [15]:

- Space heating: 49%
- Electricity for appliances and lighting: 27%
- Water heating: 9%
- Cooling: 8%
- Cooking: 4%
- Other (including ventilation and refrigeration): 3%

In dwellings located in cold climates, space heating typically consumes the most energy. The second-largest energy-consuming category is heating water for domestic use. Cooking represents a small section, and the usage of electricity to operate the products which include air conditioners, pumps, and different utilities. It must be noted that energy consumption in buildings can range

significantly between typology and locations, relying on factors along with building age, insulation stage, HVAC (heating, ventilation, and air conditioning) performance, occupancy, and local climate. Improving energy efficiency in buildings may be achieved with proper insulation, an efficient HVAC, and appliances [18].

3. Steps Taken within the Framework of Today's Goals and Emerging New Definitions

There are many things that individuals, organizations, and governments are doing to prevent energy consumption and promote energy conservation. Within the framework of the important sources examined, the prominent ones can be listed as follows [19]:

1. Improving energy efficiency: Energy efficiency improvements can be made in homes, buildings, and industrial processes by using energy-efficient technologies, such as LED lighting, energy-efficient appliances, and insulation. Improving the energy efficiency of buildings can be particularly effective, as buildings account for a significant portion of global energy consumption.
2. Promoting renewable energy: Renewable energy sources, such as wind, solar, and hydropower, are becoming increasingly competitive with fossil fuels in terms of cost and performance. Governments and private organizations are promoting the adoption of renewable energy through policies, such as feed-in tariffs, tax incentives, and renewable energy mandates.
3. Encouraging behavior change: Changing individual behavior can also help to reduce energy consumption. This can include simple actions such as turning off lights and unplugging electronics when not in use, as well as more significant changes such as reducing car usage and shifting to public transportation or electric vehicles.

4. Developing new technologies: Research and development efforts are focused on developing new, more efficient technologies for energy generation, storage, and distribution, such as advanced batteries and smart grids.

5. Implementing policy measures: Governments can implement policy measures to encourage energy conservation and promote the adoption of renewable energy sources, such as carbon pricing, emissions regulations, and energy efficiency standards for buildings and appliances.

Overall, there is a wide range of activities underway to reduce energy consumption and promote a shift to cleaner, more sustainable energy sources [20,21]. These efforts will be critical in reducing greenhouse gas emissions and addressing the global climate crisis [22, 23].

Below are definitions of new concepts being discussed today in the context of low energy, passive power generation and energy efficiency around the world.

1. Energy Efficient Building: An energy efficient building is a building designed to use less energy than a conventional building while providing greater comfort to its occupants. Low-energy buildings often achieve energy savings through a combination of energy efficient buildings, high-efficiency HVAC systems and the use of renewable energy sources [18].
2. Nearly/Almost-Zero Energy Building (N/A-ZEB): a zero-energy building is a building with very high energy performance and uses a very small amount of energy from external sources. The energy consumption should be close to zero or minimum and energy requirement should be covered by renewable energy produced in or near the site [24].
3. Net Zero Energy Building (NZEB): A net zero energy building is a building that produces the energy it uses in a year.

Energy-efficient buildings typically achieve this through a combination of energy-efficient building designs, efficient HVAC systems and on-site renewable energy sources such as solar or wind power [24]. It should be noted that definitions of these concepts may vary depending on the country or region. [1, 25].

4. The Latest Status of Zero Energy Building Studies in the World and in Turkey

Energy-efficient construction is becoming more widespread globally. Building codes and standards are being updated to encourage energy efficiency and the use of renewable energy sources. However, the acceptance of these practices varies by region. In 2010, low-energy housing was still a small portion of the total housing available. Energy efficient construction is gaining momentum and becoming more common, especially in some European countries. Today in Europe, more than 2,000 buildings certified zero-energy by 2019. The number of low-energy and zero-energy buildings in the United States is also increasing, but only in percentage terms a few percent are still new buildings. Globally, the energy-efficient construction market is expected to grow exponentially in the coming years, driven by factors such as rising energy costs, growing concerns about climate change, and building codes and standards adoption of more severe forms results [25, 26]. It should be noted that achieving an uncertain energy state can be difficult and may require a significant upfront investment. However, longer-term benefits could include lower energy costs, improved resident comfort and reduced greenhouse gas emissions [27, 28].

There are many laws, regulations, directives, and standards that have been put in place to support the goals of reducing energy

consumption and promoting zero energy buildings. Here are some examples of these measures:

1. **Building codes:** Many countries have building codes that require minimum energy efficiency standards for new construction and major renovations. For example, the International Energy Conservation Code (IECC) in the United States sets minimum standards for energy efficiency in buildings.
2. **Energy performance standards:** Some countries have energy performance standards that require buildings to meet specific energy consumption targets. For example, in the European Union, nearly zero energy building (nZEB) standards have been introduced for new construction and major renovations.
3. **Renewable energy incentives:** Governments around the world offer incentives, such as tax credits or subsidies, to encourage the adoption of renewable energy technologies, such as solar panels or wind turbines.
4. **Energy labeling schemes:** Energy labeling schemes provide information to consumers about the energy efficiency of products, such as appliances or HVAC systems. Labels, such as the Energy Star label in the United States or the EU energy label, provide information about the energy consumption and efficiency of products.
5. **Green building certifications:** Green building certifications, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method), provide a framework for evaluating the sustainability and energy efficiency of buildings [29].
6. **Emissions regulations:** Some countries have emissions regulations that limit the amount of greenhouse gases that can be emitted from buildings. For example, in California, the Title 24 Energy Efficiency

Standards require buildings to meet specific energy efficiency and emissions standards.

The aim of these measures is generally to promote energy efficiency and the adoption of renewable energy sources and support the transition to a low-carbon economy [30,31]. Turkey has set ambitious goals for reducing energy consumption and promoting zero energy buildings. In 2017, Turkey launched the "Energy Efficiency in Buildings" project, which aims to improve energy efficiency in buildings and reduce greenhouse gas emissions. The project focuses on a range of measures, including energy audits, retrofits, and the use of renewable energy sources. The Turkish government has also introduced building codes and regulations aimed at promoting energy efficiency, including requirements for thermal insulation and efficient lighting systems. In addition, Turkey has implemented an Energy Performance Certificate (EPC) system, which provides information to consumers about the energy efficiency of buildings. Despite these efforts, progress towards zero energy building targets has been slow. According to a 2019 report by the International Energy Agency (IEA), Turkey has a small number of nearly zero energy buildings, and the adoption of energy-efficient building practices remained low. One challenge is that the upfront costs of energy-efficient building design and renewable energy technologies can be high, which can make them less accessible to developers and building owners. In addition, there is still a lack of awareness and understanding of the benefits of energy-efficient buildings among the public. However, Turkey has set a goal of reducing its energy consumption by 14% by 2023, and energy efficiency has identified as a key area for achieving this goal. With continued government support and public awareness efforts, it is possible

that Turkey can make progress towards its energy efficiency and zero energy building targets in the coming years [32,33].

5. "ZeroBuild" as One of the Most Important Awareness Studies in Turkey

The ZeroBuild Summit is an annual event that has been held in Turkey for the past four years. The summit is focused on promoting sustainable and energy-efficient building practices, with a particular emphasis on zero energy buildings. The event brings together a wide range of stakeholders, including architects, engineers, policymakers, and building owners, to share knowledge and best practices for designing, constructing, and operating energy-efficient buildings. The summit features keynote speeches, panel discussions, and workshops on topics such as building materials, energy-efficient design, renewable energy systems, and financing for energy-efficient buildings. The ZeroBuild Summit is organized by the Sustainable Production and Consumption Association (SPCA), a non-governmental organization that aims to promote sustainable development and resource efficiency in Turkey. The event is also supported by several government agencies, academic institutions, and private sector organizations. The summit has grown in popularity over the past few years, reflecting a growing interest in energy-efficient building practices in Turkey. By bringing together experts and stakeholders from different sectors, the summit helps to facilitate knowledge-sharing and collaboration, and it serves as a platform for promoting sustainable building practices in Turkey and beyond [34].

6. Conclusion

The energy crisis that started in the 1970s has been an important issue worldwide from past to present. This crisis has triggered attention and savings in energy

consumption, as well as efforts towards alternative energy sources. Industry, transportation, and buildings are accepted as three sectors of energy consumption in the world. The measures taken on energy consumption from the past to the present, together with the incentives of the governments and technological developments, have increased the use of energy efficiency and renewable energy in these sectors. While in the past general terms such as "energy consumption, energy saving and renewable energy" were emphasized to draw attention to the energy issue, today the importance of individual energy expenditures in residences is emphasized and concepts such as low-energy buildings and zero-energy buildings became popular. Parallel to these improvements in the world, it is seen that Turkey has also made progress in regard of energy efficiency. In addition to the use and dissemination of renewable energy sources, also initiated energy efficiency projects in buildings. The continuation of studies on energy consumption and sustainable use of energy resources throughout the world and of course in Turkey will both support economic growth and ensure environmental sustainability.

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