

The Role of Energy Efficiency in Sustainable Development: Turkey Assessment

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Summary

Energy, which constitutes an integral part of daily life, is needed more and more every day with the increase in living standards, increasing population and industrialization. The increase in the need for energy along many problems such as price increases, deviations in competition, diminishing resources, deterioration in budget and current account balance, and foreign dependency, as well as deterioration in the ecological balance. The increasing need for energy and the resulting problems affect the economy, the environment and social life, in other words, every stage of sustainable development in a positive and/or negative way. The aim of this study is to reveal the importance of energy efficiency in sustainable development in Turkey within the scope of the literature review and to present measures that will protect not only current generations but also future generations. For this purpose, the study firstly includes what has been done and what needs to be done for energy efficiency on a general basis, and then tries to reveal what needs to be done in distribution, transportation, lighting and industry, especially in awareness-raising, in order to ensure sustainable development in Turkey. The importance of the subject increases due to the fact that energy efficiency is a serious step in the protection of the world.

Keywords: Energy Efficiency, Energy Saving, Sustainable-knows Development, Turkey

The Role of Energy Efficiency on Sustainable Development: Evaluation of Turkey

Abstract

Energy forms an indispensable part of daily life and increased levels of its requirement are seen due to higher levels of life standards, growing population and industrialization. The increase of energy need brings together several adverse effects such as; environmental degradation, price increases, diversion of competition, decrease of resources and de-

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pendency to foreign resources. These overall problems also affect every element of sustainable development like the economy, environment and social life.

This study aims to put forward the significance of energy efficiency over sustainable development in the realm of Turkey by using literature review methods. The study also stresses policies that will help protect not only the current generations but also future generations as well. Therefore the study discusses what has been done and what should have been done so far about energy efficiency in general and then Turkey case with respect to what should be done in the areas of transportation, lightening and industry. The significance of the subject comes from the ideal that energy efficiency serves for world's protection for the next generations to a great extent.

Keywords: *Energy Efficiency, Energy Saving, Sustainable Development, Turkey*

1. INTRODUCTION

The need for energy is increasing day by day due to the provision of fuel for heating, lighting, transportation and other vehicles. This increase is due to both necessity and pleasure and entertainment. Since this increasing need leads to more energy use, also leads to the rapid depletion of resources, degradation of the environment, and foreign dependence of countries in terms of energy. In addition, it causes many negativities such as causing energy-related competition problems for businesses and creating a significant burden on the family and national budget.

The increasing need for energy and the problems caused by it raise the question of whether social welfare can be increased without reducing the quantity and quality of energy consumed. Undoubtedly, if we do not change the way of production and consumption, it is obvious that we will not be able to leave a livable world for future generations. Because the ecological balance is deteriorating, energy prices are increasing, income distribution damaged, and fossil resources that provide energy are decreasing day by day.

For these reasons, energy efficiency is a sine qua non for sustainable development. Because any positive or negative development related to energy affects the human and environmental factors that constitute the focal point of sustainable development. Therefore, increasing efficiency in production and consumption rather than producing and consuming more will provide positive economic, social and environmental contributions.

The aim of this study is to reveal the importance of energy efficiency and saving in terms of ensuring sustainable development within the scope of the literature review, to include the studies carried out in some countries in this direction, and to provide solutions on what can be done in Turkey and why it should be done.

to propose solutions to the energy crisis. Energy efficiency and conservation is primarily a matter of raising awareness, and the steps to support this are of a nature that will contribute to sustainable development.

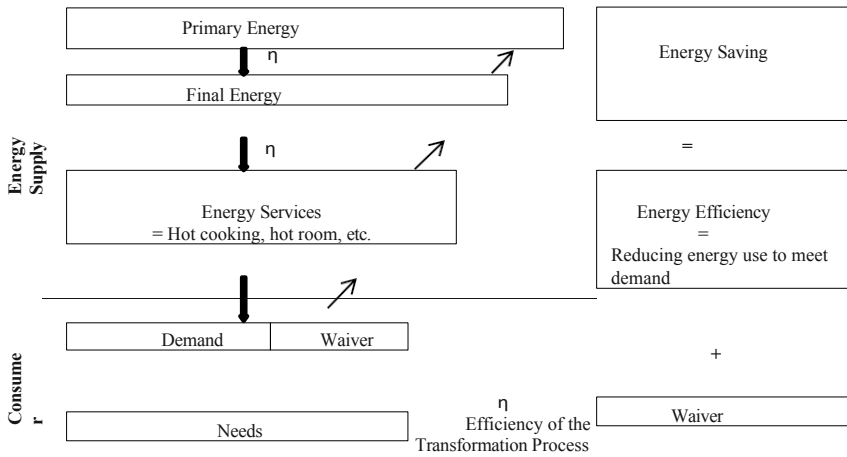
2. EFFICIENCY

The word energy originates from the Greek *energeia*, which is defined as "the force that acts" ¹. The Turkish Language Association (TDK) defines it as "the power that exists in matter and appears in the form of heat and light, power". Efficiency is defined as "the state of being efficient, efficiency, fertility"². Energy efficiency first and foremost means producing more goods and services with less energy use (coal, gas, electricity, etc.) without compromising comfort conditions³ and shows a development towards energy saving through the use of new technologies⁴. Because energy efficiency is about reducing the energy used per unit of service or product quantity without a reduction in production, quality, performance and most importantly social welfare⁵. This means reducing energy consumption in buildings, transportation, industry, lighting without reducing the standard of living, quality and quantity of service or production⁶. However, energy saving refers to a reduction in the amount of energy used at each stage as a result of measures taken by energy users⁷.

- 1 Sebastian Bolay, et al., *Faktenpapier Energieeffizienz 2014, Stand/Trends/Forderung*, (Berlin/Brüssel: Deutscher Industrie- und Handelskammertag-DIHK-, August 2014), p. 5.
- 2 Türk Dil Kurumu (TDK), "Enerji", T.C. Başbakanlık Atatürk Kültür, Dil ve Tarih Yüksek Kurumu, Güncel Türkçe Sözlük, http://www.tdk.gov.tr/index.php?option=com_gts&arama=gts&guid=TDK.GTS.571b4382117ff7.33179028, (Date of Access: April 23, 2016).
- 3 Frank Büchner, Udo Niehage and Maria Reinisch, *Zukunft gemeinsam gestalten Erfolgsfaktor Energieeffizienz Der Schlüssel zu Wettbewerbsfähigkeit und Innovation* (Herausgeber), Management Summary, (Berlin und München: 2014 Siemens AG), p. 3.
- 4 Association of Heat, Water, Sound and Fire Insulators (İZODER), *Energy Efficiency in Buildings Strategies and What Needs to be Done in Turkey 2010-2023 Insulation Planning Report* Istanbul: İZODER, June 2010, p. 4.
- 5 Sermin Onaygil, *The Place of Lighting in Energy Efficiency Studies*, Turkish National Committee on Lighting, June 23, 2011, p. 3.
- 6 Republic of Turkey Ministry of Energy and Natural Resources (MENR), *Enerjini Boşa Harcama-Enerji Verimliliği*, Republic of Turkey Ministry of Energy and Natural Resources General Directorate of Electrical Power Resources Survey and Development Administration, s. 1, <http://ordu.tarim.gov.tr/unye/Belgeler/SLOGANLAR/enerji%20verimlilikilililigi%20kitabi%20.pdf> (Accessed January 23, 2016).
- 7 Onaygil, *Energy Efficiency...*, p. 3.

The relationship between energy saving and energy efficiency, as shown in Figure 1, refers to a process that encompasses primary and final energy and energy services. Here, energy efficiency is a broader concept that includes energy conservation, where energy conservation entails the sacrifice of energy used, while energy efficiency refers to the reduction of energy use to meet demand without reducing the quality and quantity of production.

Figure 1: Energy Saving and Energy Efficiency



Source: Pehnt, Energieeffizienz..., p. 4.

The ever-increasing need for energy makes both energy efficiency and energy saving a necessity. This necessity increases even more due to the increasing energy demand, the rapid depletion of energy resources, the damage to the environment during the production, transmission and consumption of energy, and the foreign dependence of many countries in energy use. In addition, the fact that the energy bill occupies an important place in both family and country budgets, and that energy has become an important tool used by countries to ensure their competitive advantage, increases the need for energy saving and efficiency day by day⁸⁹.

8 MENR, *Wasting Your Energy...*, p. 1.

9 Kubilay Kavak, 'Dünya ve Türkiye'de Enerji Verimliliği ve Türk Sanayiinde Enerji Verimliliğinin İncelenmesi', Devlet Planlama Teşkilatı (DPT), İktisadi Sektörler ve Koordinasyon Genel Müdürlüğü, DPT Publication No: 2689, (Expertise Thesis, ISBN 975-19-3782-5 -Print Edition-, September 2005), p. 5.

Ensuring energy efficiency at a point where energy is so prominent requires that the studies to be carried out in the field of energy production, transmission and consumption should be handled as a whole. In other words, regulations should be made in the entire production, transmission and consumption process. This means less cost and more energy production with less primary resources. In other words, it means doing more work with the same amount of energy or doing the same amount of work using less energy¹⁰.

3. DEVELOPMENT

Sustainability, which comes from the Latin word "sustinere", refers to the state of sustainability of a situation or process for an indefinite period of time^{11,12}. In Turkish, it is a concept used for "being continuous, , " and is mostly used in conjunction with concepts that directly depend on human will and actions¹³.

Development, on the other hand, is a concept that is mostly considered in economic terms. However, it also includes social and environmental factors. What is meant by *economic development* is the production of goods and services to meet the unlimited demands of people by creating an advanced economic system and an increase in welfare and happiness in society. *Social development* refers to improvement of social welfare through improvements in education, health, culture, urbanization and infrastructure. *Environmental development* refers to the establishment of an environmentally sustainable system that includes the protection of atmospheric balance, bio-logical diversity and other ecosystem functions that are not classified as economic resources¹⁴.

Sustainable development generally aims to enable the present generation to meet its own needs without jeopardizing the needs of future generations.

10 Kavak, *In the World and Turkey...*, pp. 1-2.

11 Veli Alpagut Yavuz, 'Sustainability Concept and Sustainable Production Strategies for Businesses', Mustafa Kemal University Journal of Institute of Social Sciences, Volume7, Issue: 14, 2010, p. 64.

12 Turan Ergün and Nesrin Çobanoğlu, 'Sustainable Development and Environmental Ethics', Ankara University Journal of Institute of Social Sciences, 3(1), 2012, p. 99.

13 Urungu Akgül, 'Sustainable Development: The Action Area of Applied Anthropology', Ankara University Faculty of Language and History Geography Anthropology Journal, Issue 24, 2010, p. 135.

14 Jonathan M. Harris, 'Basic Principles of Sustainable Development', Tufts University USA, Global Development and Environment Institute Working Paper: 000-04, 2000, 'Basic Principles of Sustainable Development' (Translated by Emine Özmete), p. 6, <http://www.sdergi.hacettepe.edu.tr/makaleler/EmineOzmet2eviri.pdf>, (Accessed: 15.Şubat 2016).

¹⁵. In fact, it seeks to answer the question of how the needs of the present generation can be satisfied without jeopardizing or taking away the chances of future generations¹⁶. It refers to an economically, socially and environmentally integrated understanding of development that repairs the damage caused to resources in the past while meeting today's needs, conserves the carrying capacity of the environment, preserves and develops the renewable essence of resources and transfers them to the future¹⁷. Therefore, the concept reflects a future-oriented management approach. This requires a sound ecological, social and economic structure. It is not possible to have one without the other¹⁸. Sustainable development represents a process of change, not adaptation to a fixed state¹⁹. For this reason, there is no single agreed definition that everyone can accept. The challenge with sustainable development is that it requires the close integration and collaboration of many levels. Ultimately, sustainable development is a global justice issue. The goal is to optimize limited global resources and the world's environmental capacity to provide a decent life for present and future generations ²⁰.

Sustainable development was first articulated as a concept in the report "Limits to Growth" published by the Club of Rome in 1972. In 1987, its conceptual framework was established for the first time in the Brundtland Commission report ²¹. Sustainable development, as defined by the report, refers to *"a development that meets the needs of the present generation without jeopardizing the chances of future generations under continuous development"*. The reference point for discussions on sustainable development is the carrying capacity or sustainability of natural ecosystems under the threat of massive global environmental destruction. The destruction of the ecosystem is irreversible without a change in the human perspective. At the global and local level, there are many expressions to describe this over-exploitation and environmental degradation.

15 Tracey Strange and Anne Bayley, 'Sustainable Development: Linking Economy, Society, environment', OECD Insights, 2008, p. 24.

16 Jürgen Kreller, 'Nachhaltige Entwicklung in einem Entwicklungsland -Das Fallbeispiel Costa Rica während der Regierung Figueres (1994-1998)', Trier, 2000, p. 15.

17 Tülay Selici, Zafer Utlu and Nadir İlten, Environmental Impacts of Energy Use and its Evaluation in terms of Sustainable Development, p. 2, nuis/Enerji-Kullanimi-Cevresel-Etkiler-Surdurulebilir-Enerji.005 428. pdf (Access Date 01 January 2016).

18 Bayerisches Landesamt für Umwelt, Nachhaltigkeit als Leitbild: Global denken-lokal handeln, Bayerisches Landesamt für Umwelt, Augsburg, August 2014, p. 1.

19 Strange and Bayley, *Sustainable Development...*, p. 30.

20 Uwe Schneidewind, 'Nachhaltige Entwicklung - wo stehen wir?', Nachhaltige Entwicklung, Deutsche Unesco-Kommission e.V., Magazin der Deutschen UNESCO-Kommission, Nr. 2, 2011, s. 7.

21 Akgül, *Sustainable Development...*, p. 136.

also exist. These include species die-off, loss of soil fertility, desertification, climate change, sea level rise, the ozone hole, tropical rainforest clearing, water pollution and many more ²².

4. THE ROLE OF ENERGY EFFICIENCY IN SUSTAINABLE DEVELOPMENT IN THE WORLD

The resources offered by nature and the environment are being damaged and depleted day by day as a result of human activities. In order for nature to renew itself, humans need to provide it with opportunities to renew itself. For this reason, sustainability is becoming more and more important every day ²³. Energy is an important element at the center of sustainable development. However, today millions of people suffer from energy poverty. Lack of energy, or too little access to energy, creates difficulties in cooking, lighting, heating, cooling or the use of information and communication technologies. This impairs quality of life, health, educational opportunities, income opportunities and hinders the economic development of countries ²⁴. However, for a long time, the role of energy in sustainable development has been evaluated only in terms of how energy can be delivered safely to consumers. The relationship between energy and development has also been considered in this narrow axis. However, the fact that fossil fuels such as coal, oil and natural gas, which constitute a significant portion of energy resources, are gradually decreasing, as well as the environmental problems that arise during their production, distribution and use, have the question of how these energy resources can be used both rationally and economically. This has led to the inclusion of the concept of energy efficiency in studies on sustainable development ²⁵.

As can be seen, there is a strong relationship between energy efficiency and the environment. Each improvement in energy efficiency leads to a reduction in energy losses, which in turn reduces energy output per unit and energy input per unit of operation, thereby reducing pollution generation. In addition, energy sources and technologies that incorporate the life cycle minimize environmental impacts at the most important stages of the life cycle.

22 Kreller, *Nachhaltige Entwicklung...*, pp. 15-16.

23 Kavak, *In the World and Turkey...*, p. 65.

24 Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, *Nachhaltige Energie für Entwicklung*, 'Die Deutsche Entwicklungszusammenarbeit im Energiesektor', (BMZ Informationsbroschüre 1/2014), p. 7.

25 Kavak, *In the World and Turkey...*, p. 1.

and offers opportunities for improved efficiency²⁶. This is because the efficient use of energy is, as stated, a prerequisite for sustainable development. There is a need for efficient energy use not only because of the scarcity of resources and the rising prices of fossil energy fuels, but also because of the protection of the environment and climate²⁷. In addition, energy use has a great significance in the economic process. Because almost every production activity is associated with energy consumption²⁸.

The oil crises and the subsequent rise in energy prices as a result of these crises have also played a role in the importance of energy. This situation led especially Western industrialized countries and Japan to develop and implement the first energy efficiency strategies (with a focus on residential heating) in the 1970s²⁹. In the 1980s, with the increasing need for energy, the concept of energy efficiency became a sine qua non of development policies and began to find widespread application³⁰. For example, as of 2016, Germany is one of the pioneers of energy efficiency in Europe. However, even this is not considered sufficient for Germany, and it is being discussed how the country can further increase its pace in this regard. This is because if energy efficiency is increased by at least 2.1% per year, Germany will only be able to meet its environmental target by 2050. However, since 1990, the average energy efficiency has averaged approx. 1.8%. In 1990, the agreed target for 2020 is 40% less carbon dioxide (CO₂) emission, and for 2050 80% less. Primary energy consumption is also expected to decline by 2020 compared to 2008, by about 20% by 2050 and 50% by 2050. In renewable energy, it is stated that Germany is on the right track and that savings of up to 60% of gross energy consumption can be achieved by 2050. Therefore, it was emphasized that Germany is already on the path to a sustainable future³¹.

26 Selici, Utlu and Ilten *Energy Use*, p3.

27 Dieter Posch, 'Eine Veröffentlichung im Rahmen der Schriftenreihe der Aktionslinie Hessen-Umwelttech des Hessischen Ministeriums für Wirtschaft', Praxisleitfaden Energieeffizienz in der Produktion (Herausgeber: Carsten Ott), Verkehr und Landesentwicklung, Mai 2009, p. 1.

28 Statistisches Bundesamt, 'Nachhaltige Entwicklung in Deutschland Indikatorenbericht 2014', (Wiesbaden: Statistisches Bundesamt, Juni 2014), p. 6.

29 Co-funded by the Intelligent Energy Europe Programme of the European Union, 'Energy Efficiency Trends and Policies in the Household and Tertiary Sectors', (An Analysis Based on the ODYSSEE and MURE Databases, June 2015), p. 16.

30 Kavak, *In the World and Turkey...*, p. 45.

31 Siemens AG, 'Zukunft gemeinsam gestalten Erfolgsfaktor Energieeffizienz Der Schlüssel zu Wettbewerbsfähigkeit und Innovation (Herausgeber)', (Berlin und München: 2014 Siemens AG), pp. 6-8.

In the energy efficiency strategy prepared for the UK, it is stated under the title of "mission" that the benefits of energy efficiency can be as follows⁽³²⁾;

- Accelerating growth and creating jobs in the economy,
- in fuel bills of households and businesses,
- Creating a more sustainable and secure energy system,
- Achieving an effective cost benefit climate change targets,
- Reducing energy imports.

Energy efficiency will also reduce dependence on fossil fuels with high political risk and will also improve the financial balance with the decrease in energy costs (İZODER, 2010: 4)⁽³³⁾. The UK Secretary of State for Energy and Climate Change has described energy efficiency as the heart of the low-profit bon- bon economy. He stated that by reducing energy use and waste, energy bills can be reduced, the energy system can be made more sustainable and greenhouse gas emissions can be reduced³⁴. United Nations Secretary-General Ban Ki-moon stated that "sustainable energy is not only necessary but also essential for everyone. Because it combines development, social inclusion and environmental protection as a common issue". The social, environmental and economic aspects of sustainable development are presented in more detail in Table 1.

32 Department of Energy & Climate Change, 'The Energy Efficiency Strategy: The Energy Efficiency Opportunity in the UK', Energy Efficiency Deployment Office Department of Energy and Climate Change, London, November 2012.

33 İZODER*Energy in Buildings*, p4.

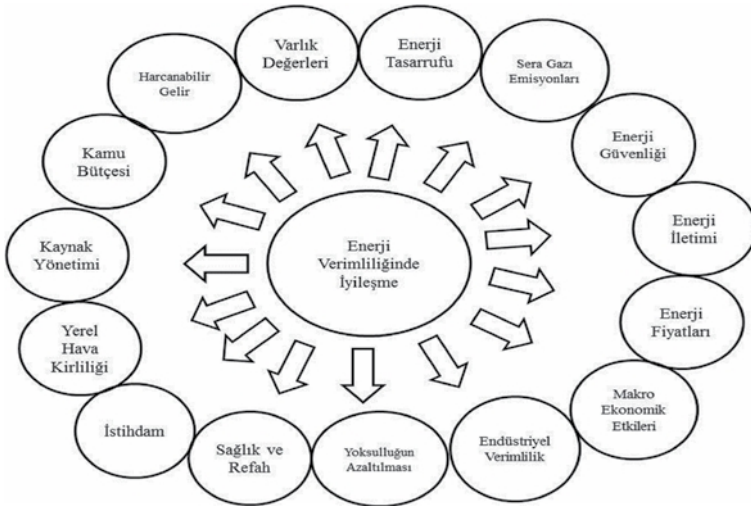
34 Edward Davey, 'Ministeial Foreword', Department of Energy & Climate Change, The Energy Efficiency Strategy: The Energy Efficiency Oppurtunity in the UK, Energy Efficiency Deployment Office Department of Energy and Climate Change, London, November 2012, p. i.

Table 1: Sustainable Development

Social Equality	Economic Efficiency	Environmental Responsibility
<ul style="list-style-type: none"> • Living Conditions • Equal Opportunity • Social Cohesion • International Solidarity • Human Capital Protection 	<ul style="list-style-type: none"> • Economic Growth • Efficiency and Competitiveness • Flexibility and Stability • Production/Consumption • Employment • International Trade 	<ul style="list-style-type: none"> • Consumption of Resources • Materials and Waste • Risks • Rate of Change • Natural and Cultural View

Source: SFSO, *Measuring Sustainable...*, p. 5.

seen in Table 1, energy efficiency affects almost every aspect of sustainable development. This makes it a sine qua non for sustainable development. For this reason, the European Union (EU) has created a plan for energy efficiency that envisages a 20% reduction in energy consumption by 2020 within the scope of the "Energy Efficiency Action Plan". Thanks to this plan, competitiveness will increase, 780 million tons of CO₂ emissions will be prevented by 2020, and 100 billion euros will be saved annually. In other words, industry, the environment, consumers, economic growth and unemployment will be positively affected ³⁵. Improvements in energy efficiency have many co-benefits. To give them in detail, they are as shown in Figure 2.

Figure 2: Various Benefits of Energy Efficiency

Source: IEA, *Capturing the Multiple Benefits...*, p. 20.

³⁵ İZODER *Energy in Buildings*, p6.

As can be seen in Figure 2, energy efficiency has many different gains in various areas such as greenhouse gas emissions, energy security, public budget, employment, industrial productivity, health and welfare. Meanwhile, energy consumption in the world is increasing day by day. This increase has been around 45% since the 1980s. By 2030, the projected increase is more than 70% ³⁶. The International Energy Agency different scenarios for 2040. For the world primary energy demand of 13.5 billion tons of oil equivalent, there are three different increase scenarios of 45%, 35% and 12%. The amount of energy used for electricity generation is also projected to increase by 70% by 2040, or 2% per year. In addition, the projected increase in primary energy consumption in industry is 81%, which accounts for 50% of the world primary energy growth rate³⁷. These increases in energy consumption affect all aspects of sustainable development such as living conditions, equality of opportunity, international solidarity, economic growth, productivity, competition, employment, production-consumption, natural and cultural appearance. Therefore, energy efficiency is an inevitable reality for sustainability in the world. This fact brings with it the necessity of taking various measures. These measures include legal regulations, institutional structure, investment, technology (production, energy consuming devices) and awareness raising activities ³⁸.

According to data from the International Energy Agency, between 2015 and 2040, \$68.2 trillion ^{39*} is projected to be invested in the energy sector globally. Of this, \$21.8 trillion is expected to be invested in the energy efficiency sector, \$19.7 trillion in the electricity sector, \$15.4 trillion in the oil sector and \$9.9 trillion in the coal sector⁴⁰. The projected investments for energy infrastructure between 2015 and 2040 by source are as shown in Chart 1.

36 Schneider Electric, 'Energy Efficiency Solution Catalog', EECAT201101TR/01/2011, p. 9, <http://www.schneider-electric.com.tr/documents/solutions/EV-cozum-EECAT201101TR.pdf> (Accessed February 21, 2016).

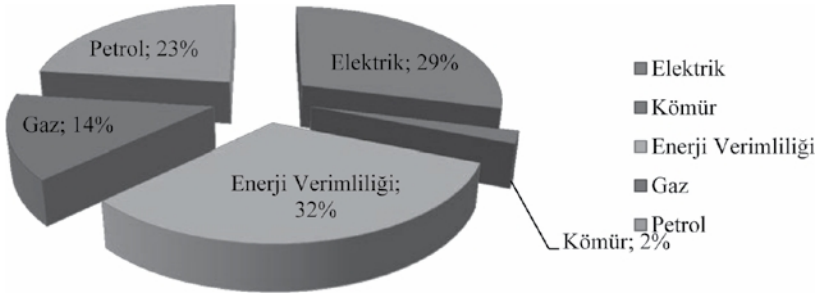
37 Republic of Turkey Ministry of Energy and Natural Resources (MENR), 'World and Country Energy and Natural Resources Outlook', Presidency of Strategy Development, Issue 11, January 01, 2016, pp. 9-10.

38 Onaygil, *Energy Efficiency...*, p. 3.

39 The United States of America (US) dollar is used throughout the study.

40 MENR, *The World and Our Country...*, p. 13.

Chart 1: Projected Investments in Energy Supply Infrastructure by Source between 2015 and 2040 under the New Policies Scenario



Source: MENR, *The World and Our Country...*, p. 13.

The regulations for the 2040 energy efficiency target should include economic, legal and social developments as well as technical trends and regulations for market operators⁴¹. Therefore, decision-makers in energy efficiency decision-making should pay attention to the following when establishing the main objectives of future policies⁴²:

- *Raising Awareness on Energy Efficiency:* In measurements, awareness is raised in the consumption habits of consumers and energy consumption is increased.

It is stated that a reduction of up to 10% can be achieved ⁴³. In many developed countries (except Japan, because they only heat one room), increasing prosperity has led to increased energy consumption because it provides greater comfort and leads to the use of more household appliances. However, even a small change in behavior can increase or decrease energy consumption. For example, it is stated a 3 degree increase in indoor temperature in 10 years in the UK caused a 20% increase in the energy consumed for heating ⁽⁴⁴⁾.

- *Implement Energy Management Programs:* Maintaining an energy management program corresponds to a 1-2% reduction in total energy expenditures and a 10-40% reduction in consumption, excluding capital expenditures

41 Adrian Bründel, et al., 'Branchenmonitor Energieeffizienz 2015', Deutsche Unternehmensinitiative Energieeffizienz e.V. (DENEFF), Berlin, April 2015, p. 5.

42 Schneider Electric, *Energy Efficiency...*, p. 11.

43 Schneider Electric *Energy Efficiency...*, p. 30.

44 World Business Council for Sustainable Development (WBCSD), *Energy Efficiency in Buildings for Transformation in Energy Consumption*, Corporate Solutions a Sustainable World, Istanbul: SKD Turkey June 2009, p. 28.

⁴⁵. This puts energy management programs in an important position in energy use.

- *Limiting Final Energy Consumption for All Sectors:* At a point where energy efficiency is so important, there are many things that can be done to increase efficiency in distribution, street, park, garden lighting, transportation, buildings and industry.

- o *Energy Efficiency in Distribution:* Regulations in energy distribution (electricity, natural gas, etc.) can contribute to energy efficiency. This contribution can be enhanced through legislative changes, by ensuring that energy efficiency programs are made available to users, and by encouraging energy companies in the production and distribution sectors to invest in energy efficiency instead of new energy investments. It can also be further enhanced by the regular use of the most appropriate technologies in new investments and periodic maintenance of transmission and distribution lines ⁴⁶.

Loss and leakage rates in the distribution system are particularly high in the electricity sector. In 2009, this figure was 4% in Germany and Japan, 5% in the USA and 14.5% in Turkey⁴⁷. While technical losses are inevitable in Turkey, it is stated that preventing illegal use poses a management problem⁴⁸. This shows that even the arrangements to be made in the transmission and distribution phase will be an important step in energy efficiency.

- o *Energy Efficiency in Lighting:* Achieving the same level of illuminance without reducing the quality of lighting in the areas intended to be illuminated will ensure both efficiency and savings in lighting. In this way, not only will the required amount of light be sent to the areas intended to be illuminated and the required areas will be illuminated, but it will also be possible to provide sufficient lighting with less energy consumption. In a typical commercial enterprise, lighting alone accounts for 40% of electricity consumption.

⁴⁵ Schneider Electric, *Energy Efficiency...*, p. 19.

⁴⁶ TMMOB Chamber of Electrical Engineers, *Energy Efficiency Report*, Ankara: Chamber of Electrical Engineers, EMO Publication No: GY/2012/3, 2012, pp. 32-33.

⁴⁷ TMMOB Chamber of Electrical Engineers, *Energy Efficiency Report*, p. 38.

⁴⁸ TMMOB EMO İzmir Branch Energy Commission, "Problems in Urban Distribution Networks and Suggestions for a Better Distribution System", TMMOB 2nd City Symposium, (İzmir: 28-30 November 2013), p. 86.

can create energy efficiency and savings ⁴⁹. There are many measures to ensure energy efficiency and savings in lighting. These include many methods such as making more use of daylight, using energy efficient lamps, not illuminating unused areas, periodic maintenance of lighting equipment, efficient use of light output, lighting with timers, photocells or proximity sensors, color selection of the space, using table lamps while working, choosing methods that will illuminate the optimal area in road, building, corridor lighting, and replacing lamps with reduced efficiency⁵⁰.

- o *Energy Efficiency in Transportation*: The 1973 oil crisis increased the search for energy efficiency and savings in the USA, EU countries and Japan. One of these searches has been the development of alternative freight and passenger transportation systems (such as railways, maritime routes) that are more advantageous than highways through research and development (R&D) studies in the field of transportation ⁵¹. Apart from this, there is no doubt that arrangements can be made to increase efficiency for each of the transportation methods. These include many points such as increasing the scarce efficiency in road transportation, arranging urban transportation and connection points in the most effective way, providing time adjustments that will ensure energy efficiency in lighting systems, changing the habits of citizens in transportation⁵².
- o *Energy Efficiency in Buildings*: Energy consumption in the world is approximately 40% of primary energy consumption is in buildings⁵³. In Europe, buildings are the largest consumers of primary energy consumption with 40% ⁵⁴. Buildings are also where about 80% of human life takes place.

49 Schneider Electric, *Energy Efficiency...*, p. 8.

50 Canan Perdahcı and Uğur Hanlı, Efficient Lighting Methods, 3E Electrotech, March 2010, pp. 323-324, <http://www.3eelectrotech.com.tr/arsiv/yazi/verimli-aydynlatma-yontemleri>, (Date of Access: March 20, 2016).

51 Energy Efficiency Association, Transportation, p. 1, <http://www.enver.org.tr/tr/icerik/ulasim/15>, (Date of Access: 06 February 2016).

52 TMMOB Chamber of Electrical Engineers, *Energy Efficiency Report*, p. 19.

53 Matthias Hensel, "Energieeffiziente Gebäude" Energieeffizienz bei Gebäuden - Zentraler Baustein einer modernen Energie- und Klimapolitik, Energieeffiziente Gebäude BDI initiativ, BDI-Publikations-Nr.: 0013, October 2014, Industrie-Förderung GmbH, Berlin, s. 15.

54 Holger Lösch, "Energieeffiziente Gebäude" Energieeffizienz bei Gebäuden - Zentraler Baustein einer modernen Energie- und Klimapolitik, Energieeffiziente Gebäude BDI initiativ, BDI-Publikations-Nr.: 0013, October 2014, Industrie-Förderung GmbH, Berlin, p. 8.

spaces. Therefore, they should not only be energy efficient, but also offer the highest quality of work and life ⁵⁵. It is possible to reduce energy consumption in buildings with lower costs and higher returns than in other sectors.

Energy efficiency is also crucial for achieving the International Atomic Energy Agency's 2050 target of reducing the planet's carbon footprint by 77% (or 48 gi- gatonnes). In the World Business Council for Sustainable Development's study on energy efficiency in buildings, it was stated that the carbon footprint based on energy consumption could be reduced by 40% by investing 150 billion dollars annually in energy efficiency in buildings in the US, EU, China, Japan, India, Brazil, which account for 70% of the world's total Gross Domestic Product (GDP). According to the discounted payback period method, it is also stated that the investments will be returned to the building owners in 5 years, energy will be reduced by 12% and a total savings of more than 50% will be created ⁽⁵⁶⁾.

Domestic dwellings consume about 20% of the total energy consumed in the US. Within the scope of the "Building America" research program, the projection for 2020 is to save up to 30% of this energy use. The plan for this is to meet at least 30% of the energy demand in buildings from renewable sources by realizing maximum energy savings by making improvements in the building envelope and ensuring mechanical installation compatibility ⁵⁷. In the USA, within the scope of the American Recovery and Reconstruction Movement, 5 billion dollars were allocated for investments for building envelope improvement works and 6,500 dollars per dwelling was contributed to be used for energy efficiency purposes. In addition, effective between 01.01.2009 and 21.12.2010, an upper limit tax deduction of 1,500 dollars was introduced for investments made by consumers, including building insulation⁵⁸.

The estimated electricity consumption of buildings in the EU-28 in 2012 was 55% and total final energy consumption was around 40%. Buildings are the largest end-use, followed transport (32%), industry (26%) and agriculture (2%). Estonia, Latvia

55 Hensel, *Energieeffiziente Gebäude...*, p. 15.

56 WBCSD, *Energy Consumption...*, pp. 3-5.

57 İZODER *Energy in Buildings*, p7.

58 İZODER *Energy in Buildings*, p9.

and Hungary, the final energy consumption in buildings over 45%. At EU level, 2/3 of the buildings' consumption is in residential buildings⁵⁹. In addition, for example, in Germany, although about 10% of the existing buildings are non-residential buildings, it is stated that more than 1/3 of the total housing sector's energy needs are used by these buildings⁶⁰.

- o *Energy Efficiency in Industry*: Energy efficiency is among the main long-term goals of countries as it provides competitive advantage in terms of energy security as well as environmental quality. The fact that industry has a significant share in final energy consumption undoubtedly brings energy efficiency in the industrial sector to the forefront. One advantage of the industrial sector is that it allows energy efficiency to be realized at a lower cost compared to other sectors. This investment can pay for itself in about 3 years⁶¹.

According to the World Bank, if energy efficiency can be achieved in the industrial sector, this will save 22% in steel enterprises and 28% in cement enterprises, which will have a negative impact on enterprises in the short term, but will positively affect both enterprises and the national economy thanks to the savings to be achieved in the long term⁶².

- *Setting and Monitoring Realistic Energy Efficiency Targets Based on Measurements*: Realistic measurement of energy consumption enables accurate targets for energy efficiency to be set and monitored. For example, understanding how the building works and uncovering potential opportunities, or accurately measuring energy consumption in elevators will allow comparing the consumption of existing systems, labeling in terms of energy consumption, estimating annual consumption. At the simplest level, realistic measurement of the energy performance of the elevator system will be a criterion that will enable contractors, architects, planners and installation companies to determine more advantageous systems in the energy efficiency evaluation of the building⁶³. Or measurement in cooling systems (pressure

59 Co-funded by the Intelligent Energy Europe Programme of the European Union, *Energy Efficiency Trends...*, p. 16.

60 Lösch, *Energieeffiziente Gebäude...*, p. 9.

61 Konya Chamber of Commerce (KTO), 'Energy Efficiency in Industry', p. 5-6, http://www.kto.org.tr/d/file/enerji_verim_rapor.pdf, (Date of Access: February 11, 2016).

62 Koç University, *Energy Efficiency Map and Targets in Turkey*, p. 29, http://www.enver.org.tr/UserFiles/Article/90_dfee6d-4004-4165-99c0-5642a4e90ed0.pdf, (February 11, 2016).

63 H. Tarık Duru, 'Analysis of Energy Consumption in Elevator Systems', p. 1. <http://www.emo.org.tr/ekler/86adcf5918a920dek.pdf>, (Access Date: 15 April 2016).

continuous measurement of various parameters such as temperature, current, power coefficient), fault analysis, fault monitoring, and detection of maintenance requirements will play an important role in terms of energy efficiency⁶⁴.

- *Renewable Energy Sources and Technologies to be applied for this purpose:* Energy efficiency and renewable energy are fundamental building blocks of the future energy system. They can increase prosperity, as shown by the evaluation indicators of current research projects. Both the increase in energy efficiency and the expansion of renewable energy can increase Gross Domestic Product (GDP) and create additional jobs. The energy transition can go beyond its purely economic outlook, and can increase welfare through positive side effects. It can also significantly reduce the negative side effects of the old energy system, such as climate change or public health risks. On the other hand, it also increases energy security⁶⁵. Energy efficiency measures therefore often lead to a classic win-win situation. For example, implementing energy efficiency in companies not only makes businesses better, but also protects the environment and climate by reducing emissions during resource consumption⁶⁶.

- *Emissions Trading and Opening Markets by Providing Incentives to Reduce Demand:* The EU Emissions Trading System involves Member States limiting greenhouse gases in an economically efficient way. Within the scope of the Emissions Trading System, there are more than 10,000 facilities in the energy and industrial sectors, which account for half of EU CO₂ emissions and 40% of greenhouse gas emissions⁶⁷. The EU Emissions Trading System is the first international emissions trading system, adopted by Directive 2003/87/EC and put into practice in 2005. The system is based on four main principles. These include the following mechanisms⁶⁸:

64 İsa Kadir, Hüseyin Bulgurcu and Murat Adaköy, 'Importance of Measurement and Evaluation in Cooling Systems in terms of Energy Efficiency', Tesisat Magazine, Issue: 187, August 2011, p. 1.

65 Ulrike Lehr and Christian Lud, 'Volkswirtschaftliche Effekte der Energiewende: Erneuerbare Energien und Energieeffizienz', Gesellschaft für Wirtschaftliche Strukturfor- chung GmbH, (Osnabrück, Heidelberg, 2012), p. 9.

66 Julika Wei and Siegmard Otto, 'Aktiv werden für Energieeffizienz - Ein Leitfaden für Betriebsräte und Beschäftigte Institut für Ökologische Wirtschaftsforschung (IÖW)(Berlin: Hans Böckler Stiftung, November 2011), p. 6.

67 İsmet Munlaloğlu and R. Barış Canpolat, 'European Union Emission Trading System (EU ETS) Revision', p.1, [www.enofis.com.tr/yayinlar/Avrupa%20Birligi%20Emisyon%20Ticaret%20Sistemi%20\(EU%20ETS\)%20Revizyonu.pdf](http://www.enofis.com.tr/yayinlar/Avrupa%20Birligi%20Emisyon%20Ticaret%20Sistemi%20(EU%20ETS)%20Revizyonu.pdf), (Date of Access: April 15, 2016).

68 İlge Kılıncım, The Latest Situation in the European Union Emissions Trading System - Aviation SectorIKV Evaluation Note 53 2012 pp 1-3 http://ikv.org.tr/images/upload/data/files/degerlendirme_notu_-_53.pdf, (Date of Access: April 10, 2016).

- o Cap-and-market system (free emission allowances are granted to installations within the country. However, maximum emission allowances are granted for high CO₂ emitting plants).
- o Requiring participation from relevant sectors (typically including high CO₂ emitting facilities such as power plants, large combustion plants, oil refineries, coke ovens, iron and steel and cement plants).
- o Strong compliance framework.
- o Mechanisms such as "Emissions Trading", "Clean Development Mechanism" and "Joint Enforcement" to support national arrangements under the Kyoto Protocol.

There are many practices that can be taken and done for energy efficiency, and if these are done together and in harmony, it will be more possible to achieve the desired goals.

5. THE ROLE OF IN SUSTAINABLE DEVELOPMENT TURKEY

Turkey is a rapidly developing country with an ever-increasing need for energy to sustain its rapid development. This requirement further increases both the existing energy demand and consumption. While energy consumption increases by 4-5% each year, electricity consumption accounts for approximately 7-8%⁶⁹ of this increase. The approximate increase in electricity consumption is twice the world average. Per capita equivalent oil consumption (primary energy) is about 1.5 tons. ¾ of the equivalent oil consumption is imported. This means an annual energy import of approximately 500 dollars for each individual in Turkey. In other words, Turkey is significantly dependent on imported energy ⁷⁰. For Turkey, which is import-dependent in energy, energy efficiency is becoming indispensable as it plays a key role in minimizing the economic, social and environmental costs of energy production, transmission and consumption⁷¹.

69 In the 2014 annual report, it was stated as 6-7%. See Ministry of Energy and Natural Resources (MENR), 2014 Annual Report, Ankara: Ministry of Energy and Natural , February 2015, p. 68.

70 Heinrich Böll Stiftung Association, 'Energy Efficiency Awareness Brochure', (Istanbul: Art-press, September 2008), p. 11.

71 Republic of Turkey Ministry of Development, 'Energy Security and Efficiency', Tenth Development Plan (2014-2018), Ankara: Republic of Turkey Ministry of Development Special Specialization Commission Report 2014, p. xiii1.

5.1. Regulations for Energy Efficiency in Turkey

While energy management in the industrial sector in Turkey was carried out voluntarily between 1995 and 2007, it has become a compulsory practice in the industrial, building and service sectors since 2007 with the enactment of the Energy Efficiency Law ⁷². The distribution of energy consumption by sectors in Turkey is as shown in Table 2.

Table 2: Energy Consumption and Saving Potential by Main Sectors

Sector	Share in Total Consumption	Savings Potential
Industry	%39	%20-25
Buildings	%30	%30-50
Transportation	521	%15-20
Agriculture	%5	-
Non-Energy	%5	-

Source: Özyurt and Karabalık, *Energy Efficiency...*, p. 32.

Primary energy intensity in Turkey from 2008 to 2014

8% reduction. The Energy Efficiency Strategy Document, which entered into force in February 2012, aims to reduce energy intensity by 20% by 2023⁷³.

mentioned, the beginning of energy efficiency policies in Turkey can be traced back to the Energy Efficiency Law No. 5627, which was implemented on May 2, 2007. This law covers many issues including the effective implementation, monitoring and coordination of energy efficiency, administrative structure, authorization, duties and responsibilities, public education and awareness raising, support mechanisms for renewable energy sources, and fines to be imposed on those who do not fulfill the legal requirements. Numerous regulations and communiqués have also been issued to regulate many of the issues mentioned here⁷⁴. These are Transportation (June-2008), Heat Stakeholders (April-2008), Energy Efficiency (October-2008), Small and Medium Enterprises Support (October-2008), Energy Efficiency in Buildings (December-2008)⁽⁷⁵⁾. In addition, the Energy Efficiency Strategy entered into force in 2012⁷⁶.

72 Republic of Turkey Ministry of Energy and Natural Resources (MENR), '2015 Annual Report', Ankara: Republic of Turkey Ministry of Energy and Natural Resources, February 2016, p. 39.

73 MENR, *2015 Annual Report*, pp. 37-38.

74 World Energy Council Turkish National Committee, 'Energy Efficiency Legislation' (as of May 2013), Provincial Energy Efficiency, Ankara, 2013, pp. 4-7.

75 Onaygil, *Energy Efficiency...*, p. 7.

76 World Energy Council Turkish National Committee, *Energy Efficiency Legislation*, p. 3.

In order to achieve the target of reducing energy intensity, efficiency improvement, rehabilitation and modernization works have been initiated in existing public power generation plants by using new technologies. Within the scope of efficiency-enhancing projects, with the "Regulation on Increasing Efficiency in the Use of Energy Resources and Energy" published on October 27, 2011, projects that do not exceed TL 1,000,000, excluding value-added tax, in projects aimed at increasing energy efficiency in the existing systems of industrial enterprises were included in the scope of support at a maximum of 30% of their cost. Within the scope of supporting voluntary agreements, the average energy intensity of industrial enterprises in the last 5 years was taken as reference energy intensities. Those who fulfill their commitment by committing to reduce their reference energy intensity by at least 10% on average within 3 years after the agreement were provided with a support of 20% of the energy expenses of the agreement year (not exceeding 200,000 TL). Within the scope of energy manager training programs, courses to develop energy efficiency awareness and culture were organized. "Energy Efficiency Week" activities are organized every year in the second week of January. In addition to national studies, important steps have been taken by participating in multinational projects such as European Energy Network Membership and Cooperation, Industrial Energy Efficiency Improvement Project, Energy Efficiency Improvement Project in Buildings ⁽⁷⁷⁾.

In the 2015-2019 strategic plan of the Ministry of Energy and Natural Resources (MENR), 8 strategic themes and 16 objectives have been identified to achieve these goals. These strategies include energy supply security, energy efficiency and energy saving, good governance and stakeholder interaction, regional and international effectiveness, technology, R&D and innovation, improvement of investment environment, raw material supply security, efficient and effective raw material utilization ⁽⁷⁸⁾.

5.2. Policies that can be implemented for Energy Efficiency in Turkey

Policies to be implemented for energy efficiency in Turkey can be grouped under the headings of distribution, lighting, transportation, buildings and industry.

77 MENR, *2015 Annual Report*, pp. 37-39.

78 MENR, *2015 Annual Report*, p. 26.

5.2.1. Policies on energy distribution

What is meant to be expressed by the amount of loss and leakage is the difference between the amount of energy entering the system and the amount of energy accrued to consumers in the distribution system (total from lines, transformers, meters and illegal use of electricity)⁷⁹. In Turkey, a significant portion of energy losses and leakages is only due to the loss of electrical energy. The rate of loss and leakage in electricity consumption is approximately 12%. The fact that electrical energy must be consumed as soon as it is generated, i.e. it cannot be stored, also plays a role in this process. When problems arising from transmission and distribution are added this, loss and leakage become inevitable. This is because imbalances caused by line breaks, breaker tripping, phase-ground short circuits and phase-phase short circuits due to voltage drops and rises cause both labor loss and financial loss to end-users. Attempts to distribute energy without on-site generation also increase losses and leakages. It is stated that only 7-8% of transmission and distribution losses can be prevented with on-site generation⁸⁰. Table 3 shows the electric energy loss rates in Turkey and the EU.

Table 3: Electricity Loss Rates in Turkey and the EU (%)

Years	2002	2003	2004	2005	2006	2007	2008	2009
AB	7,3	7,2	6,9	7,0	7,2	6,9	6,8	7,1
Turkey	25,2	22,0	18,6	17,7	16,5	14,8	16,9	17,8

Source: Rumeli, *Electric Energy...*, p. 317.

The rates of loss and theft in electricity in Table 3 vary according to regions. As stated in the decision dated 16.10.2010 and numbered 2932, this rate is very high at 60% in the Dicle distribution region, while the same rate is around 7% in the Uludağ distribution region⁸¹. According to the statistics of the Turkish Electricity Distribution Corporation, while the target for losses and leakages was 15% in 2011, the rate 18%. This is an extra

⁷⁹ Electricity Market Law (No. 4628), 'Announcement on Loss and Leakage Charges', [www.omurokur.com/pdf/elektrik piyasasi/kkbedeli hk.pdf](http://www.omurokur.com/pdf/elektrik_piyasasi/kkbedeli hk.pdf), (Date of Access: February 02, 2016).

⁸⁰ M. Emin Meral, Ahmet Teke and Mehmet Tümay, 'Energy in Electrical Facilities', Journal of Uludag University Engineering-Mimarlık Faculty, Volume: 14, Issue: 1, 2009, s. 31-33.

⁸¹ Beşir Fatih Doğan, 'Whether the Collection of Loss-Leakage and Meter Reading Fees from Consumers in the Electricity Market is Lawful and Whether it falls within the Jurisdiction of the Consumer Problems Arbitration Committee', Energy, Market and Regulation, Vol. 2, 2011, p. 77.

3 million 650 thousand megawatt hours of electricity consumed⁸². It was stated that the Energy Market Regulatory Authority's increase in the target loss and theft rates in 2014 would lead to the collection of unjustifiably higher loss and theft charges from household users. For 2015, this rate is estimated to be 1 billion 654 million TL (based on the fact that households use approximately 1/5 of Turkey's consumption). When subscriber groups such as industrial and commercial households are added to these figures, it is stated that it will go even higher⁸³. The point criticized here is that the reflection of loss and leakage rates to consumers through prices will prevent companies from seeking solutions to problems.

In Turkey, it is also necessary to distinguish between loss and leakage rates. Because the situation arising as a result of the internal resistance of transformers and cables in transmission lines is defined as loss, and this rate is not expected to be zero, but between 4-7% is considered ideal. Therefore, while Turkey's loss rate of 5-7% is not far from the world average, there is a problem with the leakage rate. Leakage the electricity taken without using the demand. While the average leakage rate in Turkey is stated as 7% + 16% = 23%, it is stated that this rate increases to 7% + 40% = 47% in some places. It is calculated that solving this loss and leakage problem will result in savings equivalent to 3 nuclear power plants⁸⁴.

82 Banu Salman and Kahraman Yapıcı , 'Kayıp ve Kaçakak Hedefleri Tepetaklak', Elektrik Mühendisliği, Issue 453, April 2015, p. 38.

83 Banu Salman and Kahraman Yapıcı , *Loss and Leakage...*, pp. 40-41.

84 Nükleer Teknoloji Bilgi Platformu, 'Elektrikte Kayıp ve Kaçakak', <http://www.nukte.org/kayipkacakmeselesi>, (Date of Access: February 20, 2016).

Table 4: Electricity Consumption and Grid Losses and Leakages in Organization for Economic Cooperation and Development (OECD) Countries

Countries	KiloWatt Hour (kWh)/person	Consumption Billion kWh	Missing %	Fugitive %	Total Lost-Leakage %
Turkey	1.479	103	7	16	23
Mexico	1.722	173	7	11	18
Hungary	3.281	33	7	6	13
Poland	2.825	108	7	6	13
New Zealand	8.779	35	7	5	12
Ireland	5.609	22	7	2	9
Czech Republic	5.255	54	7	2	9
Spain	5.250	213	6	3	9
Norway	24.068	109	7	1	8
Greece	4.435	49	7	1	8
France	6.848	419	7	0	7
America	12.558	3.610	6	0	6
Korea	6.209	296	6	0	6
Iceland	26.466	8	5	0	5
Austria	6.964	56	5	0	5
Belgium	7.784	80	4	0	4
Netherlands	6.441	104	4	0	4
Germany	6.235	514	4	0	4
Finland	15.480	86	3	0	3
Luxembourg	12.600	6	3	0	3

Source: Nükte, *Lost Electricity...*, p. 1

As can be seen in Table 4, although loss and leakage rates exist in many countries, Turkey has the highest rate. What is important here is to minimize and reduce these loss and leakage rates to reasonable levels.

5.2.2. Policies for enlightenment

Lighting also has an important place in energy efficiency studies. Because 25% of the total electricity generated in Turkey is used for lighting, which is the largest source of energy consumption after heating and cooling systems. Lighting, International Lighting

As defined by the Commission, it is "the application of light to ensure that the environment and the object can be properly seen". At a point where lighting and energy are so important, energy efficiency comes into play. For example, it is possible to provide the work of a 100 Watt lamp with a 20 Watt efficient lamp. For this reason, high efficiency lamps should be preferred for energy efficiency, and unused lamps should be turned off when leaving the environment. Maximum use should be made of daylight, maintenance and cleaning of lighting fixtures should be done regularly, the light output of the lamp should be utilized at the highest level, timers, photocells proximity sensors should be used, importance should be given to space paint, efficient products should be used in street and road lighting, and lamps with reduced light output should be replaced on time ⁸⁵.

5.2.3. Policies for the transportation sector

In Turkey, ¼ of energy consumption is in the transportation sector. In the transportation sector, 95% of passenger transportation and 91% of freight transportation is carried out by road. Bus passenger transportation consumes 155 calories/person-kilometer and freight transportation (by truck) consumes 921 calories/person-kilometer of energy. Petroleum products account for more than 99% of energy consumption in this sector. However, in the EU rail transportation, the ratio of lines is close to 100% and the average electrified line ratio in all EU countries is close to 50% (20.14% in Turkey). Compared to rail and maritime transportation in Turkey, the power requirement per unit km of road transportation is quite high. This situation makes the transportation sector quite inefficient compared to many countries in the world and harms the environment. In a study conducted in Germany on energy consumption, it was stated that railways, highways and airways consume 1 unit, 3 units and 5.2 units of energy, respectively, in passenger and freight transportation. Therefore, the transportation sector needs to be reorganized in terms of both consumption and environment ⁸⁶.

Energy efficiency in the transportation sector requires the regulation of many factors. For energy efficiency in transportation, it is necessary to move towards efficient modes of transportation (between rail, maritime, road and air), to prefer vehicles that burn less fuel, to pay attention to the use of cleaner fuels, to increase efficiency standards in vehicles and to encourage consumers to choose vehicles with low emissions.

85 Perdahçı and Hanlı, *Efficient Lighting...*, pp. 323-325.

86 Energy Efficiency Association, *Transportation*, p. 1.

in many ways, such as redirecting the railroad system⁸⁷. One of the recommendations of the Chamber of Mechanical Engineers is to prioritize rail transportation in national policy and to implement rail systems for both urban and intercity transportation⁸⁸.

In Turkey, the share of CO₂ emissions from the transportation sector in total emissions is 18%. This ratio is lower than the EU and OECD countries (30%). The reason for this is the low share of transportation in total emissions due to the low number and length of trips and low mobility in Turkey⁸⁹. However, it is possible to reduce these emissions even further.

As a result of a study on CO₂ emissions in Turkey between 1990 and 2004, it was stated that the withdrawal of approximately 320,000 old vehicles from traffic through tax reductions between 2003 and 2004 resulted in an 8.7% decrease in average CO₂ emissions per km per vehicle between 1990 and 2004, and 4.9% decrease only in 2003-2004⁹⁰⁹¹.

5.2.4. Policies for the building sector

Insulation and low energy consumption equipment, which are among the "passive energy efficiency" measures for energy efficiency in buildings, are necessary for the energy future, but not sufficient alone. What is important here is the net energy consumption of the building, which is the difference between the energy produced and consumed. Therefore, what needs to be done is not only to reduce the energy consumption of buildings, but also to ensure that they become energy producers⁹².

Another point that should not be ignored within the scope of low energy consumption in buildings is electrical household products. The ever-increasing variety and number of electrical household products increases the frequency of their use. This increase increases the electrical energy consumed by an average family as a result of the use of electrical household appliances to around 6 thousand kWh per year.

87 MENR, *The World and Our Country...*, p. 3.

88 Chamber of Mechanical Engineers, *Transportation Sector...*, p. 32.

89 Ela Balık-Sutcliffe, Transportation Sector Current Situation Assessment Report, Development of Turkey's Climate Change National Action Plan Project, Draft, September 2010, p. 4.

90 Balık-Sutcliffe, *Transportation Sector...*, p. 12.

91 United Nations Development Program (UNDP), 'Turkey's First National Communication on Climate Change' (Editor: Günay Apak, Bahar Ubay), Ankara: Ministry of Environment and Forestry, General Directorate of Environmental Management January 2007 p69.

92 Schneider Electric, *Energy Efficiency...*, p. 9.

is. In other words, approximately 80% of the energy used in homes is realized by electrical appliances⁹³. This increases the need for the conscious use of energy efficient products.

5.2.5. Policies for the industrial sector

In a report, it was stated that in 2007, the industrial sector accounted for approximately 39% of total final energy consumption in Turkey, making it the largest energy consumer in the sector. The industrial sector has an annual energy saving potential of around \$3 billion, about 8 million tons of oil equivalent, or about 25%. In the industrial sector, energy accounts for between 20% and 50% of the total production cost (the iron and steel sector accounts for the largest share with 22%, followed by cement, glass, ceramics, bricks with 19%)⁹⁴. The actions to be taken to increase energy efficiency in industry are very diverse and some of them are as follows⁹⁵;

- Realization of effective thermal insulation in used furnace, hot water and similar lines,
- Use of energy efficient steam boilers, appropriate fuel systems and combustion systems,
- Introducing high efficiency air conditioning systems, especially in the textile sector,
- Ensuring the recovery of waste heat,
- Utilization of energy efficient grinding systems (in stone, soil, ore, cement, etc.), modification of transport systems.

6. CONCLUSION

The ever-increasing population and the development in social life increase the need for energy in a wide range of areas from heavy industry to transportation, from buildings to individual consumption. The increase in energy production is primarily driven by industry.

93 Mustafa Mutlu, Ömer Kaynaklı and Muhsin Kılıç, 'Investigation of Energy Labeling of Electrical Household Appliances', p. 2 http://www.mmo.org.tr/resimler/dosy_ekler/728306c33e38495_ek.pdf?tipi (Date of Access 27 August 2015).

94 Worldbank (2011), *Harnessing the Potential for Energy Savings in Turkey*, January 2011, p. 13-17 <http://siteresources.worldbank.org/TURKEYEXTN/Resources/361711-1294661147811/TurkeyEE-tr.pdf>, (Accessed February 11, 2016).

95 KTO, *Energy in Industry...*, pp. 5-6.

It raises the standard of living by increasing the quality and quantity of services or production in many areas such as housing, lighting and transportation. In addition to these contributions to human life, energy also has many negative impacts, such as an increase in greenhouse gas emissions, problems in energy security, deficits in the public budget, deterioration in income opportunity, rise in prices, deterioration in human health and loss of environmental welfare.

These positive and negative repercussions of energy use affect economic and social life, especially human and the environment. This brings the concepts of sustainable energy and development to the agenda and puts sustainable energy at the center of sustainable development. Because sustainable development involves meeting the needs of present generations while not jeopardizing future generations. In fact, it expresses an understanding that repairs the damages that resources have suffered in the past, considers the carrying capacity of the environment, protects and develops the renewable properties of resources and passes them on to the future.

At a point where sustainable development is so important, energy efficiency refers to the reduction of energy used per unit of service or quantity of production with less coal, oil, natural gas, nuclear energy, without a reduction in production, quality, performance and social welfare. Therefore, energy efficiency is a sine qua non for sustainable development. The importance of energy efficiency increases as it creates a win-win situation for both producers, consumers and the environment.

Many countries have set targets in their energy policies for efficient consumption of energy, raising social awareness, transition to renewable energy systems and reducing carbon emissions in the world. In this field, the search for energy efficiency and savings continues to increase day by day in many countries, especially in the USA, EU countries and Japan (since 1970). For example, R&D studies in the field of transportation, the development of alternative freight and passenger transportation systems such as rail and sea routes, which are more advantageous than highways, allocating budgets for investments for improvements in the building envelope, introducing tax reductions for investments per dwelling and investments made by consumers, including building insulation, and establishing an international emission trading system are only a small part of the search for energy efficiency.

Turkey, which wants to grow and develop, more and more energy every day, and this increase increases external dependency.

is. Energy expenditures also constitute an important part of the foreign trade deficit. The increase in energy use also brings environmental problems in its wake. This contradictory relationship between growth and the environment inevitably leads to the need for energy efficiency in Turkey as in many other countries. In the long run, energy efficiency is a necessity for Turkey to transition to a low-carbon economy, reduce dependence on imports of gasoline and natural gas, which are expensive and limited resources, create a sustainable and secure energy system, and reduce environmental costs.

Turkey has started to take important steps by making many legal regulations on energy efficiency. However, energy efficiency a joint effort involving the harmony of many different variables. First of all, the fact that companies do not feel the need to seek to reduce loss and leakage due to reasons arising from pricing creates a management problem. Measures should be taken to solve this problem. In addition, alternative transportation systems such as railways and sea routes be introduced instead of road transportation. Incentives and subsidies should pave the way for the use of environmentally friendly vehicles that consume less fuel in road transportation, insulation in buildings should be given the necessary importance to ensure that there are no buildings without insulation, and the use of energy efficient products in electrical household appliances used in homes should be increased. In lighting, daylight should be utilized more; timers, appropriate space paint, and energy-efficient products should be used; and many problems such as waste heat reuse, efficient air conditioning systems, and effective thermal insulation should be solved in industry. Individual and social awareness for a better future is the sine qua non condition for solving problems.

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