The Role and Importance of Energy Efficiency for Sustainable Development of the Countries

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Abstract. Energy, which is needed for every aspect of life, plays a key role for the development of the countries. Countries need to use energy efficiently to be advantageous in the global competition and ensure the sustainable development. Countries using the energy efficiently succeed economically and have leading the field in the competition. The purpose of this study is to put forward to the role and importance of energy efficiency for the sustainable development of the countries. In this study, energy efficiency has been examined conceptually considering the studies in the literature and the role and importance of energy efficiency has been emphasized for the sustainable development of the countries.

Keywords: Energy · Efficiency · Sustainable development

1 Introduction

Energy has been an important element for human development and economic growth. Providing sufficient and affordable energy is required to increase human welfare and living standards. Energy should be considered as an important factor in terms of economic development; since the energy is used as an input in most of the production processes. Energy consumption increases in parallel with economic growth and development. In this way, energy need should be met sufficiently and economically.

In the last 50 years, there have been important developments. Living standards have increased and people have been living longer and healthier. Science and technology increased welfare of society considerably. Energy resources of Middle East, which are abundant and cheap, have especially contributed to these developments. Sufficient global energy resources have importance both for the world and the countries individually in terms of sustainable development, running of the economy and welfare of the society. Thus, consistent use of energy is going to be possible and the energy will be secured [6].

Industrialised countries have been using the energy more efficiently since 1973. Following the oil shock of the 1970s, these countries have made policies to increase energy efficiency in all the sectors of their economies. These policies have contributed to the decrease in the energy intensity. In addition to that, most of the industrialised

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countries have intensified their energy efficiency works as a part of their own strategies in order to decrease their greenhouse gas emissions [5].

In the second part of this study, energy efficiency has been discussed conceptually. In the third part, the role and importance of energy efficiency in the sustainable development have been explained. In the conclusion part, the study has been overviewed.

2 Conceptual Framework of Energy Efficiency

Energy is one of the primary elements which are needed for social and economic development. Energy is a means to achieve the goals such as health, high level of living standards, sustainable economy and a clean environment [7].

Energy resources of the countries are one of the main factors indicating their development and leadership position in the rivalry. Therefore, efficient use of energy becomes more of an issue for the countries. Energy efficiency is identified as the efficiency scaling the relation between energy inputs and outputs by means of comparison [2].

Patterson [15] explained that energy efficiency means obtaining the same product and service using less energy. Galvin [3] identified energy efficiency with the help of monetary and physical indicators. According to Galvin [3], the ratio between energy input and energy output as monetary value is considered as monetary indicators. Energy input per gross domestic product is an example of this. The ratio between energy input and physical output states physical indicators. Amount of aluminium that is produced or how many kilometres you drive your car in the highway is an example of physical indicators.

Ganda and Ngwakwe [4] states that energy efficiency means the policies, technologies and strategies to solve the problems of residential, commercial and national energy use reducing the financial cost and minimizing greenhouse gas emission which causes global warming.

During the oil shock of 1973, measuring the energy efficiency has been an important part of the energy strategy, especially for those lacking energy. With sharp increase in the world oil prices, many countries have been aware of the need for the understanding of the methods for efficient energy consumption and increasing the energy efficiency. As from late 1980s, because of the increasing worries about the fact that fossil fuels cause global warming, improving the energy efficiency in order to reduce greenhouse gas emission has been an important issue for the countries [1].

Countries need to follow various policies on the basis of sector in order to improve their energy efficiencies. Policies of some sector are as follow [12]:

- New buildings can be 70% more efficient using insulated windows, modern gas furnaces and more efficient air conditioners. It is possible to save energy with the help of localized heating, heat pumps and solar energy. With advanced lighting system, it is possible to save cost at a rate between 30 and 60%.
- When it comes to residences, there have been improvements in fridges, water heaters and dish washers. It is possible to make energy savings with the technological improvements in this field.

- Energy demand in the industry and CO_2 emission can be halted improving the efficiencies of engines, pumps and boilers and heating systems, energy recovery in the process of production, recycling the material that is used and using the materials more efficiently.
- In the transportation sector, efficiency of the gasoline-powered and diesel-powered vehicles can be improved with turbine turbocharger, fuel injection, improved electronic methods, more compact engines, hybrid cars and advanced diesel engines.

3 Ensuring Sustainable Development for the Countries via Using Energy Efficiently

Sustainable development, according to the definition of United Nations World Commission on Environment and Development in 1987, has been stated as meeting the needs of today's society not jeopardizing the needs of the future generations [17]. Sustainable development is a general term which identifies the development of countries considering economic, social and environmental factors. Efficient energy use has some economic, social and environmental aspects. Therefore, energy efficiency has an important role for ensuring sustainable development.

It is a need for the sustainable developments of the countries to obtain the energy resources easily and at a reasonable cost in the long term. To ensure sustainable development, countries need to use energy with maximum benefit and minimum environmental damage [16].

Energy need has been increased worldwide with high population growth rate, technological developments and increasing living standards. Limited reserves and increasing prices of the fossil resources have leaded the countries to take measures in order to protect themselves from a possible energy crisis. Energy sector provides input for the other sectors of the economy. For this reason, stable and consistent energy policy is a must for sustainable development [9].

Because of the worries about high energy prices, global warming and sustainable development, energy efficiency has been an important of the energy strategy in many countries. Increasing the energy efficiency is the cheapest, fastest and the most environmental-friendly way of meeting an important part of energy need. Improved energy efficiency reduces the need for investment in the energy demand [12].

Increasing the energy sufficiency is important from various policy perspectives. Saving from the energy obtained from the fossil fuels is an important target for the countries to prevent the running out of fossil fuels in the near future. Improvement of the energy efficiency is also going to increase energy security of the countries. Especially, reduction of the energy use is a must to prevent the worsening of the environmental quality. Minimizing the costs is another aim to ensure energy efficiency. In terms of cost efficiency, it is important to reduce energy use in the period of high energy prices and use other inputs instead of energy at the same time [10].

Energy is crucial for the countries to ensure their sustainable development. Some of the policy measures to support sustainable development are as follows [6, 8, 11]:

- Increasing the energy efficiency in the industry, construction and transportation sectors,
- Reducing the use less efficient coal-fired power plants and forbidding their constructions,
- Increasing the investment to the renewable energy,
- Phasing out the subventions in the consumption of the fossil fuels,
- Reducing the methane emission in the production of oil and gas,
- Distributing sufficient and reasonable priced energy resources to the regions where there is no energy service,
- Encouraging energy efficiency,
- Providing widely use of advance energy technologies,
- Placing importance on activities of research and development on improving new and advanced energy technologies,
- Encouraging the use environment friendly energy resources such as renewable energy resources,
- Empowering the regulations on energy,
- Reflecting the environmental cost of energy use and consumption to the energy, prices as much as it is possible and necessary,
- Contribution of the free and open trade to the energy market and security,
- Ability of the energy systems to response to the urgent situations in quick and flexible way,
- Improving international cooperation and connections.

If today's demographic, economic, social and technological trends aren't strong and balanced by new government policies, there are significant difficulties in the long-term sustainability of the global energy system. Developments in energy saving in OECD countries accelerated with increases in energy prices in the 1970s [11]. OECD countries have taken an important step in energy conservation and environmental issues with the policies they apply in the energy field. Energy policies for OECD countries may differ [13].

Energy efficiency policies in Turkey increase energy security to benefit from growing economy and reduce greenhouse gas emissions. Turkey has established a comprehensive, strategic and legal framework to promote energy efficiency. The energy efficiency law in Turkey has a wide coverage area, including related regulations. These areas include: increasing and supporting energy efficiency, setting up energy efficiency consulting companies, establishing energy management systems, promoting energy efficiency investments, increasing energy efficiency in transport and buildings, preventing the sale of inefficient devices and raising awareness.

Luxembourg implemented energy performance regulations in 2008 for residential buildings and in 2011 for non-residential buildings. These regulations establish a methodology to calculate energy performance of buildings, to determine minimum energy requirements for new buildings, extensions and renewed elements of existing buildings. Luxembourg is promoting the energy efficiency of buildings with the introduction of energy performance certificates.

New Zealand's "Smart Warming Program" aims to increase the number of hot, dry and energy-efficient homes to protect patient health and prevent loss of productivity.

The first "New Zealand Energy Strategy" and the second 5-year "New Zealand Energy Efficiency and Conservation Strategy" were published in October 2007. However, after the National Party government was elected in 2008, both of these documents were audited. The purpose of doing this is to present a clearer link between energy policies and economic growth.

The program of energy saving targets for energy suppliers is a central component of Ireland's energy efficiency policy. The first "National Energy Efficiency Action Plan" identified potential energy saving programs targeting energy suppliers in 2009.

The "Green Deal" initiated in the United Kingdom in January 2013 is the program of the British government to help increase energy efficiency in homes and businesses. This program saves on energy bills and makes improvements on the cost side possible. "Electricity Market Reform" is the most important and radical change for the UK electricity market. This reform includes regulations that make low carbon production investments attractive and provide safe, affordable electricity supply for the UK.

Norway supports the increase of oil production in order to achieve long-term goals in energy field. It also uses oil and gas in a profitable way, the management of energy resources is based on comprehensive knowledge and facts, and the energy management framework is designed to be sensitive to health, safety and environmental issues.

USA is consistently publishing the "Climate Action Plan" to reduce national and international greenhouse gas emissions. There are three main pillars of this plan: to reduce carbon pollution in USA, to prepare USA for the effects of climate change, and to pioneer the international struggle to combat global climate change and prepare for the effects of climate change. The plan is designed to reduce emissions by 17% below the 2005 level by 2020. In addition, USA regularly updates national and international reports.

Sweden is working to build a vehicle fleet that does not use fossil fuels until 2030, and the energy is taxed at a high rate. The Swedish tax system supports the purchase of environmentally friendly vehicles through tax exemption during the first 5 years. This incentive is reinforced by an extra subsidy for "super environmentally friendly" cars that emit less than 50 g of CO_2 per kilometer of hybrid and electric vehicles. To promote alternative fuels in Sweden, high-mix renewable fuel mixture into gasoline and motor is subject to full tax exemption.

Canada is defeating procedures to regulate projects for the development of natural resources. In 1997, Canada created a building law that sets new buildings and sets a minimum level for energy performance in their design. "The Canadian National Energy Law for Buildings", which assessed the minimum energy performance level of buildings over three floors in 2011, entered into force. This law covers heating, ventilation, air conditioning, water heating, lighting, electric power motor systems and equipments for buildings.

Japan is working to improve energy efficiency through its energy efficient economy. The Japanese government has laid down the law on the rational use of energy in May 2013. The first step in this regulation is to improve the thermal insulation performance of homes and buildings. In this context, the use of energy-saving isolators and windows is helping to reduce the energy consumption associated with air conditioning and water heating. In the second step of the scheme, the introduction of technologies such as smart meters, energy management systems and accumulators are encouraged to reduce energy demand.

Italy is eyeing the natural gas market mechanisms and infrastructure to keep rising gas prices under control. In Italy, research projects based on the system approach of interest to the national electricity system and applied research are being developed. These activities aim to improve the performance of the system in terms of economy, security and environment and to renew.

In South Korea, in 2008, the government enacted the "Basic Energy Law" in the formulation and implementation of a national energy plan for every 5 years for a period of 20 years. The goals of each plan are to: to promote the direction of future energy policies, to identify medium and long-term strategies for safe energy sources, to expand infrastructure to provide domestic energy, and to rationalize the use of energy for the development of the national economy.

France intends to bring innovative energy projects to the market with its research programs. Since 2010, the French Agency for Environment and Energy Management has been responsible for investment programs for low carbon vehicles, intelligent network projects, supporting the testing of renewable energies and green chemistry in real conditions and demonstration premises. These programs are new tools designed to support innovative green projects.

In agreement with the government in line with a framework established by Denmark, energy organizations are helping to provide cost-effective energy savings throughout the economy. In 2020, 50% of electricity consumption from wind power is one of Denmark's energy policy objectives. Renewable energy conversion by 2050 is the long-term goal of Denmark's full conversion.

The use of hydropower as a renewable energy source is crucial for Austria's electricity generation. The use of hydroelectric power in Austria contributes to the provision of energy security and to the independence of electricity supply. With about 70% of the electricity generated from renewable energy sources, Austria is the country with the highest share in the European Union.

Approximately 80% of Australia's total energy consumption is generated by the industry. The Government's "Energy Efficiency Opportunities Program" aims to make the industry more energy efficient. The participating enterprises in this program receive financial assistance of approximately 800 million Australian dollars per year.

The Czech Republic is updating its energy strategy, especially considering the declining production of lignite. The Czech Republic's energy policy aims to facilitate the transformation of the Czech energy sector in order to produce sufficient electricity and cost effectively meet the high supply standards.

In 2008, the government approved an "Energy Efficiency Action Plan" aimed at reducing the use of fossil fuels by 20% by 2020 and growing electricity demand by 5% between 2010 and 2020 in Switzerland. In addition, the Swiss government finances R&D at energy efficiency and promotes professional energy efficiency training as well as consultancy.

In Portugal, the "Energy Efficiency Program in Public Administration" is intended to encourage efficiency in the public sector's energy use, which is mandatory for the central government and is optional for municipalities. Portugal improves the security of natural gas supply with major investments (including the construction of a new interconnection pipeline with Spain, increased underground storage capacity at Carriço, and expansion of capacity at the Sines LNG Terminal).

Energy security is one of the main features of the Polish energy policy. An important aspect of Poland's energy security policy is the diversification of fuel and technology. The government supports the development of clean technologies and the production of coal-based liquid and gaseous fuels. Poland is striving to reduce its energy dependence on Russia and diversify its energy sources. Poland is focused on maximizing the use of existing domestic energy resources.

Spain supplies a large amount of electricity from renewable sources. Until 2020, about 40% of the electricity consumed in Spain will be from renewable sources. In the first half of 2013, about 48% of the electricity demand was supplied from renewable sources.

Germany is increasing its knowledge and awareness in this area by issuing annual reports on energy politics. Germany's energy targets include reducing greenhouse gas emissions by 40% by 2020, at least 80% by 2050, and reducing primary energy consumption by 20% by 2020 and 50% by 2050. In Germany, the share of renewable energy sources in energy consumption will increase by 30% by 2030 and by 60% by 2050.

According to the OECD [12], if governments fail to implement their policy in the framework between the present and 2030, the following situations will be the case:

- Energy consumption will increase by 53%,
- CO_2 emissions related to energy will increase by 55%,
- The poor peoples of the world will continue to lack access to electricity, modern cooking and heating services.

4 Conclusions

Considering that energy is a limited resource, it is important for countries to use the minimum level and to obtain maximum economic output from the energy used. When this process takes place, minimizing the harm to the people and the environment is also considered as a matter to be paid attention to. Increasing energy efficiency for countries leads to reduced environmental pollution and increased competition.

Today, the local, regional and global negative effects of the traditional energy production and consumption technologies on the people, environment and natural resources have come to a serious state. In order to ensure the sustainable development and protect natural balance, it is vital to provide energy from consistent, safe, cheap, clean, good quality and domestic energy resources and use it efficiently [14].

It is important to monitor eco-friendly energy efficiency policies for the economic development and progress of countries. Sustainable economic development based on energy efficiency should form the basis of energy policies of countries. If countries increase their economic activities by improving their environmental performance, they can reach a good level of energy efficiency. As long as the balance between economic growth and energy consumption is balanced, the energy efficiency of countries will increase.

Energy efficiency has become important for the countries to provide sustainable development. Especially for reducing CO_2 emission and effects of the climate change, energy efficiency has a key role for the energy efficiency.

Countries should know that they will not be able to succeed in rivalry and sustainable development without being aware of the comprehending the efficient use of energy. This study casts light upon the future studies in the field of energy efficiency for the countries to ensure sustainable development explaining the role of energy efficiency.

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