

Nuclear Energy: An Alternative Energy Source For Turkey

İskender Akkurt
Süleyman Demirel University
Science and Arts Faculty Physics Department Isparta-Turkey
iskender@fef.sdu.edu.tr

Hakan Akyıldırım
Süleyman Demirel University
Science and Arts Faculty Physics Department Isparta-Turkey

Betül Mavi
Süleyman Demirel University
Science and Arts Faculty Physics Department Isparta-Turkey

Murat Öztürk
Suleyman Demirel University,
Hydrogen Technology Res. and Application Center, Isparta, Turkey

Nuri Özek
Süleyman Demirel University
Science and Arts Faculty Physics Department Isparta-Turkey

Abstract: Energy consumption is an important parameter to show the development level of a country. Thus the total energy consumption per capita (in 2005) is 1778 (unit is kilograms of oil equivalent (kgoe) per person) for world average, 4720 for developed countries and 975.9 for developing countries. On the other hand it is 1185.9 for Turkey. Although there are many different energy sources for many different countries depending on the geological and geographical conditions, Nuclear energy is one of the most commonly used alternative energy source in especially developed countries. The first large-scale nuclear power plant opened in England, in 1956 and nowadays about 16% of the world's energy needs has been produced from Nuclear power plants where huge amounts of energy from small amounts of fuel can be obtained without any pollution by burning fossil fuels. This rate is about 24% for developed countries. In conventional nuclear power plant the energy is generated using Uranium (^{235}U) fuel. In a typical sample of natural uranium, most of the weight (99.27%) consists of atoms of ^{238}U and about 0.72% of the weight consists of atoms of ^{235}U . This requires enrichment of the ^{235}U in the sample which is expensive and high technology. On the other hand recently new generation nuclear power plant based on the proton accelerator so-called Accelerator Driven System (ADS) has been proposed. Establishing nuclear power plant will lead to be transferred nuclear technology to Turkey and it will be possible to be used it in other fields.

Keywords: Energy, nuclear power plant, Turkey, nuclear technology.

Introduction

As a scientific term, energy describes the amount of work performed by a force, an attribute of objects and systems that is subject to a conservation law (Kittel vd., 1973:134). Different forms of energy such as kinetic, potential, thermal, gravitational, sound, light, elastic, and electromagnetic energy are available. All living organism needs energy to continue their life. Especially radiation from the Sun in the case of green plants is necessary to be fed. For this purposes from the beginning of life people have always been searching new types of energy sources as the population has increased sharply. Energy consumption of a country is an important parameter to show the development level. Thus the total energy consumption per capita (in 2005) is 1778 (unit is kilograms of oil equivalent (kgoe) per person) for world average, 4720 for developed countries and 975.9 for developing countries. On the other hand it is 1185.9 for Turkey. The world population and related electricity demand as a function of year is shown in Fig.1. It can be seen from this figure that the world population

increases fast according to world average of 2%. It seems that at the end of this century population and related energy demand will almost be equal (Omer, 2008).

Energy Sources

Energy sources are not used directly in daily life and also in industry. Those of energies are used in electricity generation and most of the electricity power plants use turbines to generate electricity and here it is important to turn turbines. Although some types of turbines can be driven by wind or falling water, most of them are driven by a steam which can be obtained by boiling water using different types of energy. This is scheduled in Fig.2. For this purposes it is important to find new energy source. Before construction power plant where different types of energies are used to generate steam, there are some parameters to be considered. Because energy power station have to be considered plays an increasingly vital role in national security of any country. Those parameters

- Economical efficient
- Foreign dependence
- Environmental effect
- Resources potential
- Efficiency

With those of parameters any country should decide which types of energy sources, will be detailed below, suitable to be used to generate electricity.

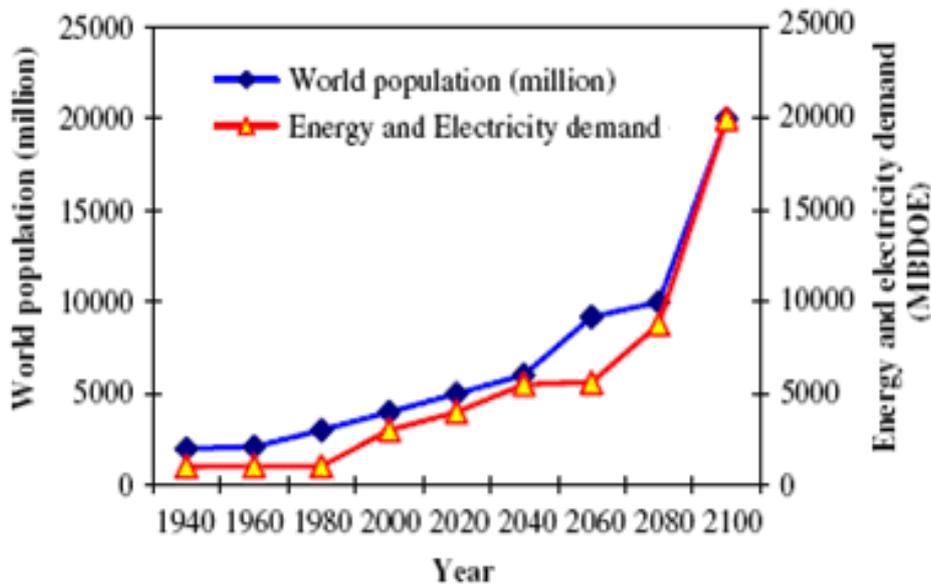


Figure 1. World population and electricity demand as a function of year (Omer, 2008).

Nuclear Energy

Nuclear energy is obtained from the fission of heavy nuclei such as uranium, plutonium or thorium and also from the fusion of hydrogen into helium. When an heavy nuclei is splitted an energy is released due to the loosing of some part of nuclear mass. The conversion of nuclear mass to energy is described by Einstein as

$$\Delta E = \Delta m \cdot c^2$$

where ΔE is the energy release, Δm is mass defect and c is the speed of light (Kaplan, 1965:178-180). The first large-scale nuclear power plant opened in England, in 1956 and nowadays about 16% of the world's energy needs has been produced from Nuclear power plants where huge amounts of energy from small amounts of fuel can be obtained without any pollution by burning fossil fuels. This rate is about 24% for developed countries. In conventional nuclear power plant the energy is generated using Uranium (^{235}U) fuel. In a typical sample of natural uranium, most of the weight (99.27%) consists of atoms of ^{238}U and about 0.72% of the weight consists of atoms of ^{235}U . This requires enrichment of the ^{235}U in the sample which is expensive and also heart of this high technology.

The Nuclear energy is used to generate steam is used to drive turbines as described previous section. For this purposes an extra section called “reactor” should be built. Nuclear reactor basically controls chain reactions (fission) to release heat desired rate. Although there are many different types of nuclear reactor types, most commonly used types are namely Advanced Gas-Cooled Reactor (AGR), boiling-water reactors (BWRs), and pressurized-water reactors (PWRs) and liquid metal fast breeder reactors (LMFBR), high temperature gas cooled reactors (HTGR). On the other hand recently new generation nuclear power plant based on the proton accelerator so-called Accelerator Driven System (ADS) has been proposed.

As the energy is an important for developing country such as Turkey, it is vital to spread out energy sources to generate electricity. It can be concluded that the nuclear energy is an important energy sources for any country not just for generating electricity also to transfer nuclear technology which can be used a variety of different fields.

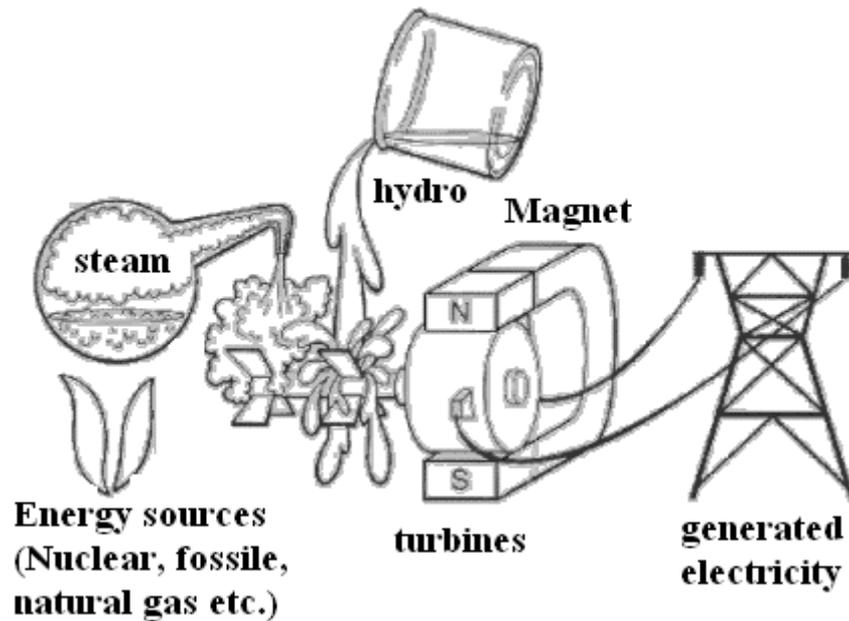


Figure 2. Schematic view of electricity generation.

References

Kaplan, I., (1965), Nuclear Physics, Çev. Nusret Kürkçüoğlu, Berksoy Matbaası, İstanbul.

Kittel, C., Knight, W.D., Ruderman, M.A., (1973), Mechanics Vol 1, New York.

Omer, A.M. “Energy, Environment And Sustainable Development” Renewable and sustainable energy reviews 12(2008)2265