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Hydropower Capacity of Turkey and Actual Investments

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Abstract: Turkey's energy consumption is continuously increasing with industry and the population growth. As production quantities can not afford consumption, it is a country that imports energy intensively. In energy production, hydraulic energy has a large share. Turkey hydroelectric potential covers the theoretical potential about 1% in the world and about 16% of European potential. At of the end of 2017, hydraulic power plants cover 35% of the total installed capacity. The fact that energy strategies makes hydraulic energy investments attractive every day because it is not dependent on the external conditions. As the environment friendly, renewable, productive and operating costs are low, it is leading the country's energy policy. In this study, Turkey's potential hydroelectric capacity, installed capacity, the distribution of the plants by region and the actual investments are discussed.

Key words: Turkey, Hydraulic energy, Hydraulic power plants, Energy strategies

Introduction

Hydroelectric power plants(HPP) convert the power of flowing water into electricity. The amount of energy in the flowing water determines the flow or drop rate of the water. Water flowing in a large river carries a large amount of energy. Or when water is reduced from a very high point, a high amount of energy is obtained. In both ways, the water that is taken into the ducts or pipes flows into turbines, allowing turbines with arms like propeller to turn to produce electricity. Turbines depend on generators and convert mechanical energy into electrical energy. Hydroelectric power plants; it is the most important renewable energy source in terms of obtaining energy from water, creating no greenhouse gas emissions, building with local facilities, long technical life and lack of fuel costs, low operating maintenance costs, creating employment opportunities, revitalizing economic and social structure in rural areas.

In a variety of energy sources, hydroelectric power plants are preferred because they are environmentally friendly and bear low potential risks. Hydroelectric power plants; environmentally friendly, clean, renewable, high efficient, non-fuel costs, long life, operation costs are not dependent on very low output. Turkey's theoretical hydroelectric potential is 1% of the world's theoretical potential and 16% of the European economic potential. The potential of the hydroelectric potential of our country is 433 billion kWh of theoretical hydroelectric potential, which can be technically evaluated 216 billion kWh and 140 billion kWh of economic hydroelectric potential. In 2017, 58.2 billion kWh of electricity was produced from hydroelectric sources. By the end of June 2018, the total installed power of 636 Hepp with 27.912 MW installed in the enterprise corresponds to 32% of the installed power of Turkey(WEB1,2018).

Population growth, urbanization and industrialization in the world, increasing trade opportunities as a result of globalization, demand for natural resources and energy is increasing steadily.Turkey's electricity consumption reached 230 billion kWh by the end of 2011 and is projected to be around 450 billion kWh in 2023.

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Hydroelectric Power Plants

The potential energy of a system is the sum of its kinetic energy and potential energy. This means that the energy of a system is converted into mechanical energy by means of a number of mechanisms. The kinetic energy of an object is the sum of its kinetic energy and its potential energy. This energy is called "hydroelectric energy". Hydroelectric power plants, known as "HPP", are plants that produce hydroelectric energy. Naturally or artificially, the water gained a certain height is transmitted to turbines at lower levels than it is. The water that hits the turbine wheels at the lower level is rotating the turbine shaft. Accordingly, generator works and electricity is produced. The above-mentioned mechanisms are found in dams. The hydroelectric power plants are called the whole of the facilities where these systems are located(Figure 1).

Figure 1. Hydroelectric power plant(WEB2,2018)

Hydroelectric power plants can be classified as traditional hydroelectric power plants and pumped storage hydroelectric power plants.

According To Storage Structures:
- Stored (reservoir) HPP
- River type(regulator) HPP

According To Head:
- Low-head HPP(H<10m)
- Medium-head HPP(h= 10-50 m)
- High-head HPP(h>50 m)

According To The Installed Power:
- Very small (micro) capacity(<100 kW)
- Small(mini) capacity(100-1000 kW)
- Medium capacity(1000-10000 kW)
- Large capacity(>10000 kW)

The hydroelectric power plant consists mainly of water holding structure, water intake structure, transmission channel, steel pipes, snail, turbine, generator, transformers, switchboard and auxiliary equipment (Figure 2).

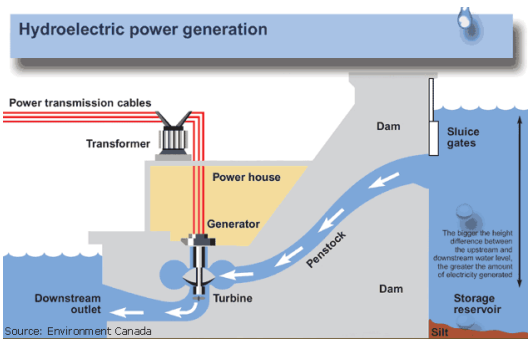

Figure 2. Schematic view of hydroelectric power plant(WEB3,2018)

Construction of dam before the construction of many work, dam preparation and installation costs of facilities is one of the biggest disadvantages on behalf of these plants. In other words, the investment cost of the power plant and dam is very high. Moreover, as a result of dozens of studies, there is a risk that the power plant or dam will not be established, there is a risk of wasting money. Apart from the economic dimension of the business, a much worse effect of these power plants is that they harm the natural environment and environment. This is also the basis of the mass protests and the head lifts to the HPP. Hydroelectric power plants damage natural and wild life, but also natural resources. In addition, the destruction of regional cultures and historical monuments in that geography, and the negative impact on the quality of the water consumed are the disadvantages of the HPP. It should also be noted that many trees are cut for these facilities.

The points that can be considered as advantages about hydroelectric power plants, it can be said that the raw material cost required after the investment cost is less expensive because water is used. At the same time, air pollution is not a very big problem. In addition to all these, the environment where the hems are located can meet the water needs, prevent floods and floods, create a softening climate, because of the presence of the power plant can provide convenience in transportation, agricultural lands can contribute to irrigation in the form of a number of states can be said. Turkey's growing demand for energy and its dependence on foreign energy is a reality. In recent years, there has been a great trend towards hydroelectric energy in Turkey in order to meet this increasing demand and to reduce dependence on foreign markets. The most efficient way to utilize hydraulic energy is to reduce dependence on external energy, as well as to mobilize clean energy resources(Ürker and Çobanoğlu,2012).

In Turkey, the theoretical hydroelectric potential is 433 billion kWh,the technically feasible potential is 216 billion kWh and the economic hydroelectric energy is 140 billion kWh/year(WEB2,2018). 37% of the Turkish hydraulic energy potential is in operation, 15% (including projects carried out by private enterprises) is in construction. Total installed power of 597 hydroelectric power plants in Turkey is 26.694 MW(WEB4,2018). The main hydroelectric power plants installed in Turkey are shown in Figure 3.

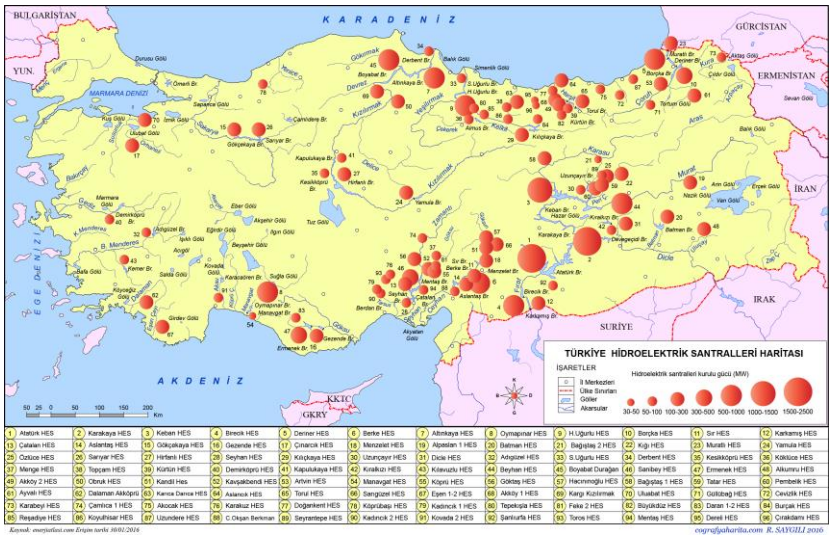

Figure 3. Main hydroelectric power plants established in Turkey(WEB5,2018)

Turkey's theoretical hydroelectric potential is 433 billion kWh, technically usable hydroelectric potential is 216 billion kWh. However, Turkey's potential for hydroelectric potential is 158 billion kWh/year, which can be made with existing investments both economically and socially. The projects and plans to be developed are expected to be 180 billion kWh. As of the end of 2016, it has increased to this level. Because the potential of hydroelectric can be made varies according to years. As the energy generation of hydroelectric power plants, the installed power of 26.819 MW is 12.380 MW, 46.2% of which is composed of hydroelectric power plants constructed and developed by State Hydraulic Works(DSI). Hydroelectric potential,which was first started in 1956, reached 66 hydroelectric plants as of 2016(Yaman and Haşıl,2018). As of the end of 2016, potential status of hydroelectric power plants is shown in Table 1. The hydroelectric power plants that are currently in operation and are planned to be constructed in Turkey are shown in Table 2.

Table 1. Hydroelectric power plant potential in Turkey(DSI,2016)

Situation	**HPP(unit)**	**Total Capacity(MW)**	**Annual Production(GWh/year)**	**Rate(%)**
Operating	596	26.819	93.653	59
Under construction	83	5.424	16.508	10
Planning	639	15.330	48.383	31
Total	1318	45.573	158.544	100

Table 2. Installed power and Project capacities of hydroelectric power plants(DSI,2016)

Situation	**Power(MWe)**	**Rate(%)**
Operating	27.212	62.2
Under costruction	6.138	14.1
Production licenced	3.181	7.3
Pre-licenced	3.938	9
Planning	2.993	6.9
Total	43.682	100

Turkey's gross hydraulic potential is 430 billion kWh/year, its technical potential is 215 billion kWh/year and its economically usable hydraulic potential is 125 billion kWh/year. The installed power capacity of 125 hydroelectric power plants (HPP) is 11.600 MW and the annual average energy production potential is 42 billion kWh. These figures show that only 34% of the technical and economic valuables hydroelectric potential has been developed in our country. According to the high demand scenario in the 10-year production capacity projection of Turkey (2009-2014) prepared by TEIAS, the installed power capacity in our country has been projected to be increased to 45.011 MW in 2010 and 56.382 MW in 2018. In the same period, hydroelectric installed power capacity was projected to be increased to 14.886 MW in 2010 and 21.077 MW in 2018. This requires the addition of an average hydraulic power capacity of 750 MW to the existing system every year. It is impossible to carry out this program, which requires an investment of approximately 1.2 billion dollars per year, with the exception of electricity transmission lines, by means of the DSI, whose annual energy investment budget is fixed at the level of $ 750.000 (WEB6,2018).

Results and Conclusions

In Turkey, the theoretical hydroelectric potential is 433 billion kWh, and the technically evaluated hydroelectric potential is 216 billion kWh, while the potential developed as economic, social and environmental potential is 158 billion kWh/year. It is estimated that it will reach 180 billion kWh/year with new projects that can be developed following completion of master plans. Turkey's technically evaluated hydroelectric potential is 1.5% of the world's theoretical potential and 17.6% of the European potential. Although our country is the second country with the greatest potential after Russia in Europe with this potential, it is not in a good position in terms of the growth rate of this potential.

The US developed 86% of its technical hydroelectric potential, 78% of Japan, 72% of Norway, 56% of Canada and 37.3% of Turkey. In 2020, the International Energy Agency (IEA) predicted that the share of hydroelectric and other renewable energy sources in world energy consumption would increase by 53% compared to today, and it is interpreted as the evaluation of hydropower potential in every power. Within the framework of the European Union strategies,the European Union (EU) has enacted legal regulations to increase its share of renewable energy in internal gross energy consumption to 20% by 2020. Energy efficiency studies aimed to reduce Turkey's energy intensity (energy consumed per national income) by at least 20% compared to 2011 by 2023(WEB7,2018).

Energy efficiency policies, on the one hand, are directly related to the sustainability of economic growth and social development goals. And on the other hand, due to the key role played in reducing total greenhouse gas emissions, are among the areas that need to be dealt with with sensitively. While using water to meet basic human needs, such as drinking and using, and producing electricity, it is also important to restructure and implement it within an understanding that guarantees the continuity of ecosystem services and the protection of freshwater species and habitats.

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