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Hydropower and Future Environmental Policies

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Abstract

Hydropower energy is a renewable, sustainable and clean energy in the other alternative energy sources. Moreover, it does not deprive future generations in terms of raw materials, or burdening them with pollutants or waste. Hydroelectric power plants utilize the basic national and renewable resource of the country. Although the initial investment cost of hydropower seems relatively high, the projects have the lowest production costs and do not depend on foreign capital and support, when considering environmental pollution and long-term economic evaluation. Hydropower is available in a broad range of project scales and types. Projects can be designed to suit particular needs and specific site conditions. As hydropower does not consume or pollute the water it uses to generate power, it leaves this vital resource available for other uses.

Keywords: *Hydropower; Renewable Energy; Energy Utilization; environmental Policy, Turkey*

Introduction

The hydropower industry is closely linked to both water management and renewable energy production, and so has a unique role to play in contributing to sustainable development in a world where billions of people lack access to safe drinking water and adequate energy supplies. On the other hand, approximately 1.6 billion people have no access to electricity and about 1.1 billion are without adequate water supply. However, resources for hydropower development are widely spread around the world. Potential exists in about 150 countries and about 70% of the economically feasible potential remains to be developed-mostly in developing countries where the needs are most urgent [1, 2, 3-6].

Some countries such as Turkey has dynamic economic development and rapid population growth. It also has macro-economic, and especially monetary, instability. The net effect of these factors is that Turkey's energy demand has grown rapidly almost every year and is expected to continue growing, but the investment necessary to cover the growing demand has not been forthcoming at the desired pace. On the other hand, meeting energy demand is of high importance in Turkey. But exploiting the country's large energy efficiency potential is also vital.

Air pollution is a significant problem and, as the government's projections show, carbon emissions could rise sharply if current trends continue [1, 2, 7-9].

On the other hand, as would be expected, the rapid expansion of energy production and consumption has brought with it a wide range of environmental issues at the local, regional and global levels. With respect to global environmental issues, Turkey's carbon dioxide (CO2) emissions have grown along with its energy consumption. States have played a leading role in protecting the environment by reducing emissions of greenhouse gases (GHGs). In this regard, renewable energy resources appear to be the one of the most efficient and effective solutions for clean and sustainable energy development in Turkey.

Turkey's geographical location has several advantages for extensive use of most of these renewable energy sources. In this reason, in the coming decades, global environmental issues could significantly affect patterns of energy use in Turkey.

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Future energy policy: Focus on Turkey

Based on the demand forecast from MAED, total final energy consumption grows at an average rate of 5.9% per year from 65.5 mtoe (2000) to 273.5 mtoe (2025). Average annual growth rates vary by sector, with industry having the highest rate at 7.6%, followed by the transportation sector with 5.0%. Between, 2000–2025, industrial consumption increases from 23.9 to 148.9 mtoe increasing its share from 36 to 54%. On the other hand, in terms of final energy by fuel, hard coal/coke increase their share slightly from 13–18%, lignite holds steady at 6%, electricity grows from 17–24%, oil products decline from 42–29% and natural gas increases from 7–17% between 2000 and 2025. The model also projects fuel mixes for each of the consumer groups or demand sectors [10, 11].

Total natural gas consumption is projected to increase at an annual rate of 9.6% from 15.0 to 169.4 billion m^3 (bcm) over 2000–2025. Power sector gas demand is one of the main drivers for this projected growth and will account for 112.8 bcm or 67% of total gas consumption in 2025. Industrial demand is the fastest growing market segment with gas expanding from 2.5–38.4 bcm during 2000–2025 and eventually accounting for 23% of total gas consumption. New capacity additions are projected to total about 108 GW by 2025. WASP results indicate that the majority of the load growth is met with natural gas-fired generation. By 2025, gas-fired units represent 67% (93 GW) of the installed generating capacity and account for 77% of total generation [10, 11].

Primary energy supply is projected to increase from 64.5 mtoe (1995) to 332.0 mtoe (2025). Crude oil imports remain constant at 33.0 mtoe after 2004 when the domestic refineries are forecast to run into their processing capacity, resulting in a drop in crude oil share from 44% to 10% of total supplies. Once the refining capacity is reached, net imports of refined products quickly grow from 2.6 to 52.3 mtoe (2000–2025), accounting for about 16% of total supplies by 2025. Natural gas quickly increases its share from 10% (6.3 mtoe) in 1995 to 42% (139.8 mtoe) of total supplies in 2025. Although renewables double over 2000–2025, their share decreases from 14% in 2000 to 7% in 2025 [6, 10-14].

Future Energy Policies in Turkey

Turkey is an energy importing country; more than half of the energy requirement has been supplied by imports. Oil has the biggest share in total primary energy consumption. Due to the diversification efforts of energy sources, use of natural gas that was newly introduced into Turkish economy, has been growing rapidly.

Turkey has large reserves of coal, particularly of lignite. The proven lignite reserves are 8.0 billion tons (Table 1).
The estimated total possible reserves are 30 billion tons. Turkey, with its young population and growing energy demand per person, its fast growing urbanization, and its economic development, has been one of the fast growing power markets of the world for the last two decades (Figures 1 and 2).

It is expected that the demand for electric energy in Turkey will be 300 billion kWh by the year 2010 and 580 billion kWh by the year 2020. Turkey's electric energy demand is growing about 6-8% yearly due to fast economic growing [14-21].

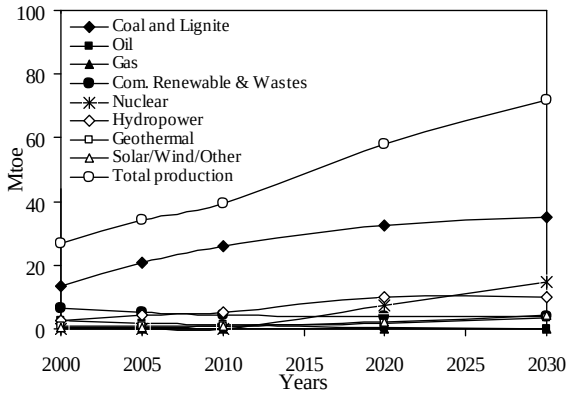

Figure 1. Turkey's Primary Energy Production During 2000-2030 [22]

Table 1 Primary Energy Reserves in the Last Decade in Turkey

Energy sources	Proven	Probable	Possible	Total
Hard coal (Million ton)	428	456	245	1129
Lignite (Million ton)				
Elbistan	3 357			3 357
Others	3 982	626	110	4 718
Total	7 339	626	110	8 075
Asphaltite	45	29	8	82
Bitumes	555	1 086		1 641
Hydropower				
GWh/yr	126			126
	109			109
MW/yr	35 539			35 539
Petroleum (Million ton)	39			39
Natural gas (Billion m^3)	10.2			10.2
Nuclear sources (ton)				
Uranium	9 129			9 129
Thorium	380 000			380 000
Geothermal (MW/yr)				
Electricity	200		4 300	4 500
Thermal	2 250		28 850	31 100
Solar energy				
Electricity				8.8
Heat				26.4

Source: [21]

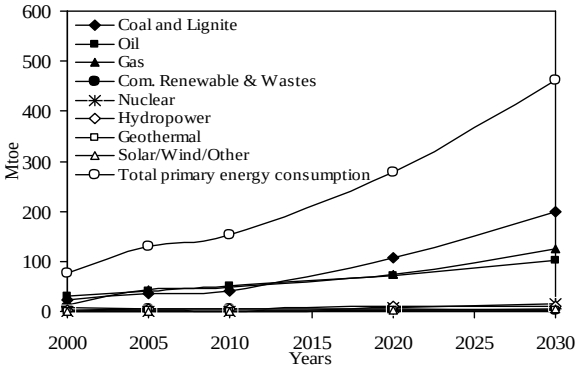

Figure 2. Turkey's Primary Energy Consumption Forecast 2000-2030 [22]

Target of Energy Policies

The main aim of the energy policies is to meet the energy needs of increasing population and growing economy in a continuous, qualified and secure manner through primarily private sector investments in a competitive and transparent free market environment. In this context, it is the main target to supply the required energy timely, uninterrupted and at minimum costs while making energy supply planning [16].

The privatization process for the power generation assets and distribution companies would continue as per Electric Energy Sector Reform and Privatization Strategy Paper with an aim for contributing to formation of a competitive market and minimum-cost electricity system rather than revenue generation alone. Due not to be incurred new and extra burdens by the public sector, privatizations should be done carefully. Privatizations would be realized under such a rationale that private entrepreneurship is encouraged to take place in the electricity sector also after the privatizations.

Along with privatization, a system which is more efficient and effective and operates completely as per market rules is aimed at. In this scope, it is expected that a significant decrease in the distribution loss/theft rate which is highly above the world averages, an increase in the billing rate and an improvement in collection would be achieved [1, 15, 16, 19, 21].

A suitable environment will be established, with legislative regulations if necessary, in order for the private sector to fill the gap that will arise as a result of the withdrawal of the state from the sector, in a timely manner and to expedite the start of the new production investments in line with supply and demand projections [17]. Thus, emphasis will be given to privatization of the existing facilities in order to prevent the burden of new investments on the state. The state will be adequately equipped in a way to closely monitor the supply security within the framework of its regulatory and supervisory role and to take measures [18, 19, 21].

Renewable Energy Supply in Turkey

Renewable energy supply in Turkey is dominated by hydropower and biomass, but environmental and scarcity-of-supply concerns have led to a decline in biomass use, mainly for residential heating. As a result, the composition of renewable energy supply has changed and wind power is beginning to claim market share. As a contributor of air pollution and deforestation, the share of biomass in the renewable energy share is expected to decrease with the expansion of other renewable energy sources. Table 2 shows renewable energy supply and projections for future in Turkey [17, 19, 21].

Table 2 Renewable Energy Supply in Turkey

Renewable energy sources	2000	2005	2010	2015	2020
Primary energy supply					
Hydropower (ktoe)	2 656	4 067	4 903	7 060	9 419
Geothermal, solar and wind (ktoe)	978	1 683	2 896	4 242	6 397
Biomass and waste (ktoe)	6 457	5 325	4 416	4 001	3 925
Renewable energy production (ktoe)	10 091	11 074	12 215	15 303	19 741
Share of total domestic production (%)	38	48	33	29	30
Share of TPES (%)	12	12	10	9	9
Generation					
Hydropower (GWh)	30 879	47 287	57 009	82 095	109 524
Geothermal, solar and wind (GWh)	109	490	5 274	7 020	8 766
Renewable energy generation (GWh)	30 988	47 777	62 283	89 115	118 290
Share of total generation (%)	25	29	26	25	25
Total final consumption					
Geothermal, solar and wind (ktoe)	910	1 385	2 145	3 341	5 346
Biomass and waste (ktoe)	6 457	5 325	4 416	4 001	3 925
Renewable total consumption (ktoe)	7 367	6 710	6 561	7 342	9 271
Share of total final consumption (%)	12	10	7	6	6

Source: [17, 21]

Turkey is to be the recipient of a US$ 202 million renewable energy loan provided by the World Bank to be disbursed as loans via financial intermediaries to interested investors in building renewable energy sourced electricity generation.

These loans are expected to finance 30-40% of associated capital costs.

The aim of the Renewable Energy Program is to increase privately-owned and operated power generation from renewable sources within a market-based framework, which is being implemented in accordance with the Electricity Market Law and the Electricity Sector Reform Strategy [23]. This program will assist the Directorate of the Ministry of Energy and Natural Resources (MENR) in the preparation of a renewable energy law, as well as to define the required changes and modifications related to legislation such as the Electricity Market Law to better accommodate greater private sector involvement [19, 21].

As an Alternative Renewable Energy, Hydropower in Turkey

The hydropower industry is closely linked to both water management and renewable energy production, and so has a unique role to play in contributing to sustainable development in a world where billions of people lack access to safe drinking water and adequate energy supplies. On the other hand, approximately 1.6 billion people have no access to electricity and about 1.1 billion are without adequate water supply. However, resources for hydropower development are widely spread around the world. Potential exists in about 150 countries and about 70% of the economically feasible potential remains to be developed-mostly in developing countries where the needs are most urgent [1, 2, 3-6].

Hydropower is available in a broad range of project scales and types. Projects can be designed to suit particular needs and specific site conditions. As hydropower does not consume or pollute the water it uses to generate power, it leaves this vital resource available for other uses. At the same time, the revenues generated through electricity sales can finance other infrastructure essential for human welfare. This can include drinking water supply systems, irrigation schemes for food production, infrastructures enhancing navigation, recreational facilities and ecotourism.

The total gross hydropower potential and total energy production capacity of Turkey are nearly 50 GW and 112 TWh/yr, respectively and about 30% of the total gross potential may be economically exploitable. At present, only about 35 % of the total hydroelectric power potential is in operation [24]. The national development plan aims to harvest all of the hydroelectric potential by 2010. The contribution of small hydroelectric plants to total electricity generation is estimated to be % 5-10 [25, 26]. On the other hand, the Southeastern Anatolia Project (GAP) is one of the largest power generating, irrigation, and development projects of its kind in the world, covering 3.0 million ha of agricultural land [27]. This is over 10 % of the cultivable land in Turkey; the land to be irrigated is more than half of the presently irrigated are in Turkey. The GAP project on the Euphrates and Tıgris Rivers encompasses 22 dams and 19 hydroelectric power plants. Once completed, 27 billion kWh of electricity will be generated and irrigating 1.7 million hectares [20, 24, 27-29].

Conclusions

There is no single solution to the world's quest for more, cleaner energy and effective water management. Energy and water for sustainable development depend not only on supply choices, but also on how these choices are implemented. It requires the creation of a level playing field among available energy options and global water governance involving all stakeholders in a participatory decision-making process. In adopting their own sustainability guidelines, the members of the International Hydropower Association are committed to developing and operating their projects, in collaboration with all stakeholders, in a way that is environmentally friendly, socially responsible and economically efficient so that hydropower projects can make a major contribution to achieving sustainable energy and resource development.

Hydropower energy is a renewable, sustainable and clean energy in the other alternative energy sources. Moreover, it does not deprive future generations in terms of raw materials, or burdening them with pollutants or waste. Hydroelectric power plants utilize the basic national and renewable resource of the country. Although the initial investment cost of hydropower seems relatively high, the projects have the lowest production costs and do not depend on foreign capital and support, when considering environmental pollution and long-term economic evaluation.

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