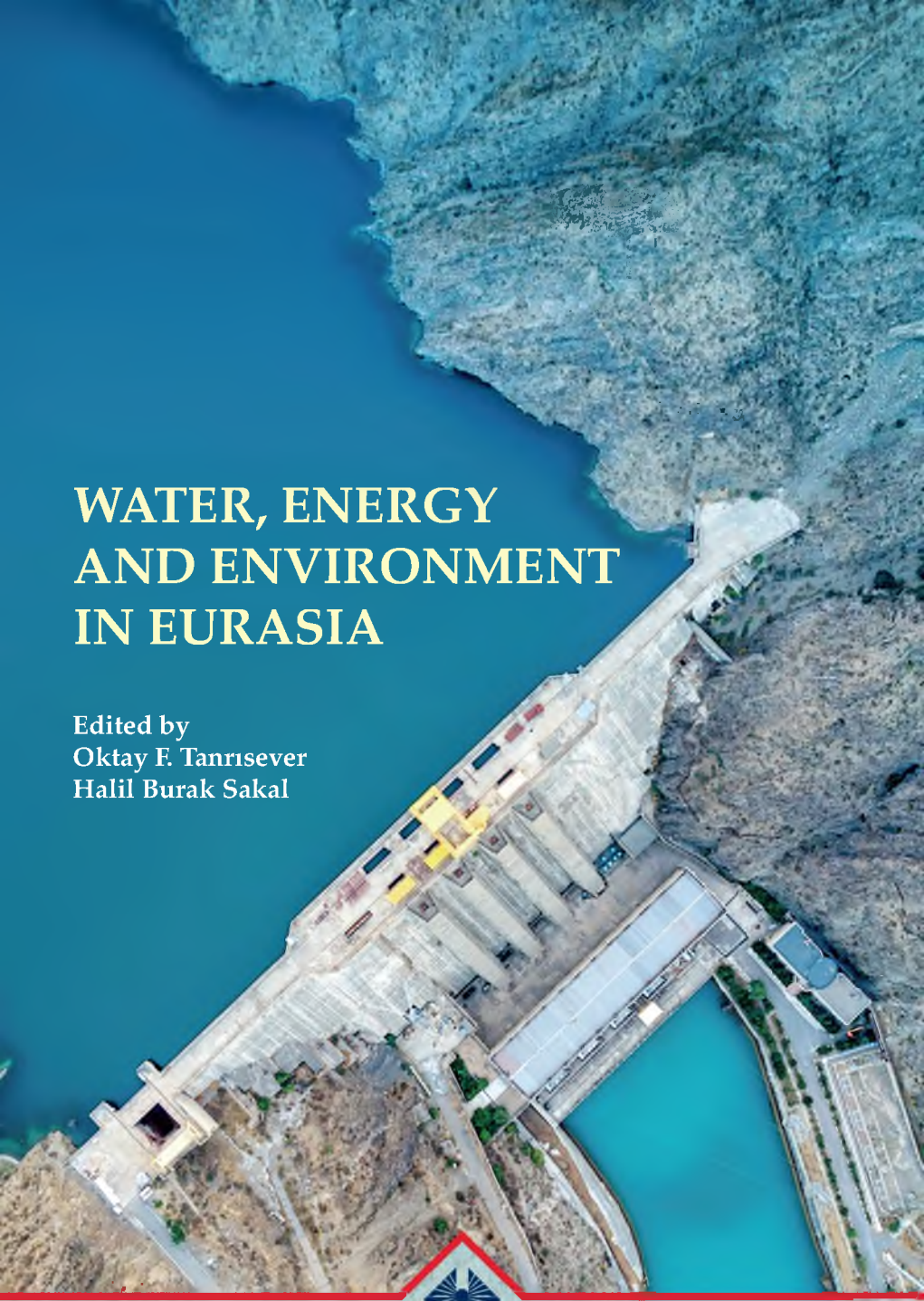
WATER, ENERGY AND ENVIRONMENT IN EURASIA

Edited by
Oktay F. Tanrısever
Halil Burak Sakal



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Introduction

Hydropower was by far the largest source of renewable electricity in Turkey in 2019. In addition to supplying energy, hydropower offers many other important services to the power grid, and helps to maintain system stability and security of supply by providing frequency regulation, voltage support, contingency reserves, and load following and black start service. Hydropower also plays an increasingly important role in grid-scale energy storage, balancing the services provided by such intermittent renewables as wind and solar power, and water management services through its reservoirs, including flood control, water supply, irrigation and transport. In this chapter we address the use of water for the generation of electricity in Turkey, including its background and the current situation, with due consideration of political and economic policies, as well as its development and the criticisms of the environmentalist block.

The aim of this chapter is to provide the reader with insight into the economic model used for the exploitation of water for the generation of electricity in Turkey, from its earliest beginnings to the present time. In the first part, we detail the water situation in Turkey and its place in the world, while the second part will address the energy profile. The third and

fourth sections will detail the background of hydropower generation in Turkey, and the fifth part will focus on the liberal period, when new promotional models facilitated the realization of the economically viable exploitation of water potential. In the final part, the environmental critics towards rough use of hydropower will be tackled.

Turkey's water potential

Turkey is located primarily in the sub-tropical zone between the humid mid-latitude zone and the dry/hot tropical zone. As a result of its spanning of different geographic regions and climatic zones, from the Mediterranean to continental regimes (Sariş et al., 2010), Turkey experiences varying levels of precipitation, averaging 643mm/m^2/year, corresponding to 501 billion m^3 of water (General Directorate of State Hydraulic Works, 2020). It has 25 river basins, including two that are trans-boundary, the largest being the Tigris and Euphrates rivers that empty into the Persian Gulf, and the Araks River Basin, emptying into the Caspian Sea. However, the annual gross amount of water reserves in Turkey has recently been approximately 1,500 m^3 per capita. Falling within the 3,000–1,000 m^3 range, according to internationally recognized criteria, Turkey is considered a water-poor country, and the picture is worsening due to the rising demand for domestic use, the increasing population, climate change, and the pollution of water reservoirs and flows.

As Table 1 shows, Turkey possesses 1.07 percent of the gross, 1.54 percent of the technical and 1.84 percent of the economically utilizable hydropower potential in the world, and 16 percent of the European economic hydropower potential (T.C. Enerji ve Tabii Kaynaklar Bakanlığı, n.d.)

Table 1. World Hydropower Potential

Region	Gross HP Potential (GWh/year)	Technical HP Potential (GWh/year)	Tech.& Econ. HP Potential (GWh/year)
Africa	4,000,000	1,665,000	1,000,000
Asia	19,000,000	6,800,000	3,600,00
Australia and Oceania	600,000	270,000	105,000
Europa	3,150,000	1,225,000	800,000
N.& Central America	6,000,000	1,500,000	1,100,000
South America	7,400,000	2,600,000	2,300,000
World	40,150,000	14,060,000	8,905,000
Turkey	433,000	216,000	127,820
Turkey/World (%)	**1.07**	**1.54**	**1,84**

Source: Gökdemir et al., 2012.

According to Table 1, Turkey possesses 127,820 GWh/year of economically viable water sources that require the building of 55,000 MW of total installed capacity. This figure, which was 27,000 MW in the 1980s, is subject to increase as the price of electricity increases in the future. By 2020, Turkey has developed 28,494 MW of installed hydropower capacity, and utilizes 51.2 percent of its economic water potential. As of January 2020, installed hydropower capacity accounted for 32 percent of the total installed capacity (91,252 MW). According to the Turkish Energy Exchange report, as of November 2019, 4,492,312 MWh of electricity i.e. 19 percent of the total electricity generation, was produced from hydropower in Turkey (EXIST, 2020).

Figure 1 shows that of the total global installed hydropower capacity of 4,200 TWh in 2018, China ranks first, followed by Brazil, while Turkey occupies sixth place with 28,000 MWh of installed capacity, after Norway.

Energy profile of Turkey in 2019

As an emerging regional economic power, Turkey has recorded the fastest growth in electricity demand among the OECD member countries, with an annual growth rate of 5.5 percent since 2002. Figure 1 shows annual growth in demand for electricity from 2008 to 2018. The main characteristic of Turkey's energy usage is its dependency on imported primary energy sources and its electricity generation from fossil fuels. Turkey, in line with its national strategies and international developments, has been taking the necessary steps to decrease its dependency and to diversify its resources.

Turkey's primary energy resources are coal, natural gas, hydropower, wind and other sources. It consumed 157.7 Mtoe in 2017 – marking a 9.5 percent increase from the previous year, and accounted for 1.2 percent of the global primary energy consumption (BP, 2018). The same report stated a share of renewable energy of 12 percent and a share of hydropower of 8.4 percent. Annual primary energy consumption has almost quintupled between 1990 and 2018, reaching 303 TWh (IEA, n.d.).

The share of renewable resources in electricity generation was 26 percent and the share of hydropower was 20 percent in 2018 (TEİAŞ, n.d.-b).

Table 2. Distribution of Installed Capacity in Turkey by Primary Energy Resource in Nov. 2019

Resource	MW	Percentage
Natural Gas	25,928	28
Dams	20,643	23
Hard Coal and Lignite	10,912	12
Imported Coal	8,967	10
Run of River	7,851	9
Wind	7,554	8
Others	9,398	10
Total	**91,252**	**100**

Source: EXIST, 2020.

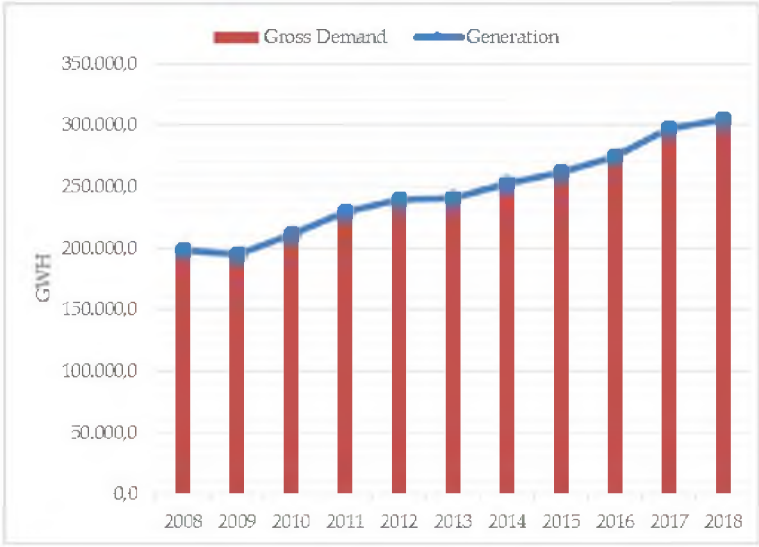

Figure 1. Annual Increase in Gross Electricity Generation and Demand in Turkey (2008-2018).

Table 3. Distribution of Electricity Generation in Turkey by Primary Energy Resource in 2018

Resource	Electricity Generated GWh	Percentage
Natural Gas	92,482.8	30.34
Imported Coal	62,988.5	20.67
Hydropower	59,938,3	19.66
Hard Coal and Lignite	50,260,1	16.49
Wind	19,949,2	6.54
Others	19,182,1	7.22
Total	**304,801.9**	**100**

Source: TEİAŞ, n.d.-b.

Table 4. The Distribution of Electricity Generation in Turkey by Electricity Utilities in 2019

Name of Electricity Utilities	Installed Capacity MW
Independent Power Plants	61,866
State owned Power Plants (EUAS)	19,552
BOT[1]	150
ToOR[2]	3,447
Unlicensed PP's	6,206
Total	**91,252**

Source: EXIST, 2020.

Table 5. Key Statistics of Turkey in 2018

	Total Energy Production Mtoe	Total Primary Energy Supply Mtoe	Electricity Final Consumption TWh
	41	146	303
Increase from 1990 (%)	64	186.27	506

Source: IEA, 2016.

Background to the development of hydropower in Turkey

The Hittites in Anatolia built the first known dam structure some 1300 years ago, and the dams built by the Ottomans are still in the service of the people of İstanbul. The first dams to be built after the foundation of the Republic of Turkey were the Çubuk I and Çubuk II Dams near Ankara, which were solely for the supply of drinking water. The first hydropower unit was a dynamo of 2 kW capacity, connected to a watermill that was later developed into a small HPP dam producing 60 kW, built in 1902 during the Ottoman Period on the Berdan River in Tarsus, southern Turkey (İbiş, 2018; Özdemir, 2016). Up until the

1 Build-Operate-Transfer. See footnote 5 in this Chapter.

2 Transfer of Operating Rights. See footnote 3 in this Chapter.

1930s, it was mainly foreign entrepreneurs, and a few local entrepreneurs and cooperatives who were involved in electricity generation activities in the Republican period. The great recession of 1929 saw most of these enterprises going bankrupt, and the government, which had already adopted a statist economic development model in response to the recession, appropriated all foreign electricity utilities (Özdemir, 2016).

İller Bankası, a state-owned financial institution, was established in 1933 to aid local government in electricity generation, after which, Etibank, a state economic enterprise, was established in 1935 to carry out all electricity generation and distribution works, and all power plant and transmission line construction. Lastly, the Electrical Power Survey and Development Institute (EİE) was established to carry out potential assessment studies related to water. In November 18, 1937, Prime Minister Celal Bayar announced in his first Government Program that the utilization of hydropower was their target, referring to it as white coal, and stated that the EİE would be conducting surveys of the Sakarya River, the waters of the Adana and Kayseri provinces, the Aegean region rivers, and the Euphrates, Tigris and Kızılırmak Rivers (Yurtoğlu, 2018).

The private Antalya Electricity Company, which would later become the Kepez Electricity Company, founded in 1925 (Ünsal, 2020), and the Kayseri and its Vicinities Electricity Company (KCETAŞ, n.d.), founded in 1926, survived the appropriations, and their concessions were renewed by the Democratic Party government after 1950. The generation of electricity in those years relied mainly on thermal energy sources, and was criticized as being the cause of foreign exchange losses during this period.

Table 6. Electricity Generation by Primary Energy Sources in 1938

	Million kWh	%
Hard Coal	232	82.3
Lignite	2	0.7
Fuel Oil	28	10.0
Other fuels	2	0.8
Hydropower	17.5	6.2
TOTAL	**281.5**	**100.0**

Source: Çavdar, 1984, p. 692.

Table 7. Electricity Generation by Primary Energy Sources in 1950

	Million kWh	%
Hard Coal	540.307	68.48
Lignite	137.047	17.37
Fuel Oil	81.533	10.33
Hydropower	29.982	3.8
TOTAL	**789.5**	**100**

Source: Çavdar, 1984.

Installed hydroelectric power capacity was 18 MW in 1950, accounting for only 4.4 percent of total installed capacity. At the end of World War II, when the multiparty system was established, Turkey witnessed dramatic economic change. The Democratic Party (DP), which came to power in 1950, launched numerous development projects including the building of large dams, making use of the financial support provided under the US Marshall Plan. Besides the institutions mentioned above, the General Directorate of State Hydraulic Works (DSİ) was established to build and operate all types of dams and irrigation systems and to manage all of Turkey's water potentials in 1953. In this period, under the DP government, the construction of

the large Seyhan (built in 1956, 54 MW), Sarıyar (1956, 160 MW), Kemer (1958, 48 MW), Hirfanlı (1959, 128 MW) and Demirköprü (1960, 69 MW) HPPs was completed, and ground was broken for other large dam projects. As these large dams entered into operation, the share of installed hydropower capacity increased from 18 MW in 1950 to 431 MW in 1960, in other words, accounting for 35.6 percent of the total 1,272.4 MW total installed capacity, up from 4.4 percent in 1950.

Table 8. Hydropower Installed Capacity Development

Year	HEP (MW)	Percentage of total Installed Capacity	Percentage of HEP Generated	Total Installed Capacity (MW)
1950	18	4.4	3.8	180
1955	38.1	6.22	5.6	611
1960	411	32.3	35.6	1,272.4

Source: TEİAŞ, n.d-a.

At the time of the multi-party system, the building of large dams was seen as a great achievement and they were seen as monuments of national pride, and would emerge as one of the main themes of the political competition among political leaders of the period.

After the Military coup of 1960, Turkey entered an era of planned economic development, for which the State Planning Organization (SPO) was established in 1961, as prescribed in the new Constitution. The First Five Year Development Plan prepared by the SPO in 1963 (Tekeli, 1984) prioritized the full utilization of the hydropower potential of the country and the increased use of electrical energy in every realm in Turkey. During the first years of the plan, 280.4 MW hydropower capacity and 630 MW of thermal power capacity were added to the existing total installed capacity (Çavdar, 1984). As an institutional outcome of the first plan, the Ministry of Energy

and Natural Resources (MENR) was established in 1964, and the DSİ was attached to it. The initial program put forward by Süleyman Demirel's government (1965–1969) was the first of its kind, stating clearly the government's hydropower priority. The politicians and technocrats of that era were enthusiastic about the conquest over water power. The late Süleyman Demirel, who had a civil engineering background and was the first General Director of the DSİ, held the posts of Prime Minister on seven occasions (10.5 years from 1964 to 1993) and the 9th President of the Republic (between 1993–2000), and was the greatest proponent of the conquest of the power of water. He was known as "the Father" by his supporters, but also "the King of Large Dams". In his memoirs, President Demirel recalled his emotions upon paying a visit to the Hoover Dam in Nevada, USA as a young engineer, and pledged to build dams upon his return to Turkey in 1949 (Demirel & Turgut, 2005).

The Turkish Electricity Authority (TEK) – a state-owned economic enterprise – was established in 1970 for the generation, transmission and distribution of electricity, integrating the operation of all electricity-related activities, and the roles of Etibank, İller Bankası, the municipalities and other official institutions in the electricity field were subsequently phased out. The DSİ was made responsible for building dams and HPPs, while TEK was given the responsibility for the operation of the HPPs (Gökdemir et al., 2012). The construction of the large dams of Keban (1975, 1,330 MW), Oymapınar (1984, 540 MW), Karakaya (1987, 1,800 MW), Altınkaya (1988, 700 MW) and Atatürk (1992, 2,400 MW) led this period to be known as the Golden Age of hydropower energy in Turkey.

Table 9. Hydropower Installed Capacity Development 1965–1984

Year	HEP (MW)	Percentage out of total Installed Capacity	Percentage of HEP Generated	Total Installed Capacity (MW)
1965	505.1	33.8	44	1,490.5
1970	725.4	48	35.1	1,509.5
1975	1,779.6	42.5	37.8	4,186.7
1980	2,130.8	41.6	48.7	5,118.5
1984	3,874.8	45.8	43.8	8,461.6

Source: TEİAŞ, n.d-a.

Quest for new economic models for energy in Turkey

Up until 1984, with the exception of the privately operated electricity distribution regions of Çukurova, Antalya and Kayseri, the state had realized all electricity-related activities. In line with the global economic trends and the enactment of a new constitution in 1982 following the 1980 military coup, the government adopted a neo-liberal economic policy involving the downsizing of the government, and the privatization of state assets began. The government hoped to recover after the oil crises of the 1970s and global economic crises of the 1980s, which had culminated in rapid urbanization and a population increase, and ushered in a new liberal development initiative in Turkey. More investments were needed to improve the infrastructure and to meet the energy demands of the emerging economy, however, the government lacked the necessary funds, and so both foreign and Turkish private-sector investments were encouraged and incentivized as a solution to the predicament. Market-oriented policies for renewables started in 1984 with third-party financing, and exemptions on excise and sales tax. Several laws were enacted to attract foreign and Turkish private sector investors to build and operate hydro and thermal power plants. (Erdogdu, 2011) Law No. 3096, which ended the monopoly of TEK, was enacted in 1984, and several

approaches, including those involving the private sector, were introduced, such as privatization, ToOR[3] and BO[4] models in the energy sector. Law no: 3996 enacted in 1994 introduced the BOT[5] model, which aimed at the realization of such large-scale projects as energy plants, highways, airports, seaports, telecoms etc., while Law No. 4047, enacted in 1994, provided further incentives, including long-term purchasing and price level State Treasury guarantees for BOT projects. In the hydropower energy sector, this period was marked by the opening of the large dams of Oymapınar (1984), Karakaya (1987), Altınkaya (1988) and Atatürk (1992) by Turgut Özal, the two-time Prime Minister from 1983 to 1989 and the eighth President of the Republic between 1989–1993.

The fierce political competition between Özal and Demirel – as two center-rightist politicians – focused primarily on the realization of major hydropower projects. Public awareness of the development of water potential was high at the time because of the many debates of the political leaders. In 1993, as part of the structural reforms, the TEK Company was divided into two separate state economic enterprises for privatization purposes, creating TEDAŞ, as the distribution company, and TEAŞ, as the generation and transmission company. Unfortunately, the applied BOT, BO and ToOR models did not produce the expected results, and therefore a fragile balance of power persisted during this period. The failure of the models was attributed to poor planning, the lack of coordination

3 Transfer of Operating Rights (ToOR): The transfer of public service enterprises from the public to the private sector under certain conditions for a certain period, and the exchange of a certain transfer price.

4 Build-Own (BO) is a form of project financing in which a private entity receives a concession from the private or public sector to finance, design, construct, own and operate the facility detailed in the contract.

5 Build-Operate-Transfer (BOT) is a form of project financing in which a private entity receives a concession from the private or public sector to finance, design, construct and operate the facility detailed in the concession contract.

and a common understanding among the government authorities and the Judiciary, and also the complicated legal framework. In addition, the long-term purchase agreements, which deviated from the liberal understanding, placed a heavy burden on public funds through take-or-pay contracts. The BOT and BO financial incentives schemes ended in 2000, with only 4,800 MW of hydro and thermal power plant capacity being built in the 17 years following 1984.

Table 10. Hydropower Installed Capacity Development

Year	HEP (MW)	Percentage out of total Installed Capacity	Percentage of HEP Generated	Total Installed Capacity (MW)
1985	3,874.8	42.5	35	9,121.6
1990	6,764.3	41.4	40	16,317.6
1995	9,862.8	47	41	20,954.3
2000	11,175.2	41	24	27,264.1

Source: TEİAŞ, n.d-a.

Another development witnessed during this period was the rise of eco-political opposition towards the prevailing energy policies, which argued against the dependency on imported fossil fuels, the use of more thermal sources and the disregard of Turkey's renewable energy sources. The opposition groups were also against the privatization of state assets and the liberalization of the energy markets, and these criticisms would soon become the *modus vivendi* of opposition parties, environmentalists, chambers of engineers and mainstream media, energy circles in the government and private-sector, as well as public opinion in Turkey, especially in the 2000s.

Liberal period: From 2001 to the present

A new era in the energy markets began in the 2000s. The economic crisis in 2001 compelled the government at the time to

make some major legal and structural reforms, opting to liberalize the electricity sector and accelerate privatization. At the outset, the main aim was to unbundle and liberalize electricity market activities, to privatize state-owned enterprises and to establish a competitive market, but as the Turkish economy started to grow rapidly, policymakers became increasingly concerned about the security of the country's electricity supply. Therefore a new financial model was put in place within the framework of the Electricity Market Law No. 4628, enacted in 2001 (Erdogdu, 2011), and the Energy Markets Regulatory Authority (EMRA) was founded. This structural adjustment was aimed at limiting the government's involvement in energy sector, including the hydropower, to licensing of the market players, adapting regulations and monitoring of the markets by an independent authority (EMRA). The new model adopted by the Law in line with the European Union acquis stipulated the use of incentives to achieve the green energy targets, to reduce carbon emissions and to promote renewable energy sources.

The first key development for hydropower under the new law was the issuance of By-Law regulating the Water Usage Agreement in 2003 introduced incentives, defined the application procedure for HPP projects, and set the functions of provincial institutions and EMRA. Right after that, the DSİ and EİE announced project portfolios via the Internet to be realized by the private sector under the licensing procedure of EMRA. During this period, existing 20 intergovernmental bilateral HPP projects totaling 5,837 MW and 1 BOT project of 90 MW were also included among the announced projects to be applied for by the private sector. Law No. 4628 also divided the TEAŞ Company, into TEİAŞ, as the system operator and the transmission company; EÜAŞ, as the generation company, and the TETAŞ, as the trading company. All HPPs (12,995 MW

total) that had been built so far and operated by the DSİ were transferred to EÜAŞ. Though, this transfer did not include the high dams of Atatürk, Keban and Karakaya on the transboundary Euphrates River, that is to ensure frequency regulation in electricity (Yılmaz, 2018). In addition to this exemption, the DSİ was assigned the task of constructing four large dam projects of total 2,095 MW capacity that were assumed to be beyond the financial capacity of the private sector. The privatization ToOR for 49 years of HPPs under the EUAŞ umbrella was started, as stipulated by the Law.

The By-Law regulating Water Usage Right Agreement issued in 2003 as secondary legislation of the Law No.4646 stipulates that every HPP project holder should sign an agreement with the DSİ, which has since then, become an expert institution in water management in Turkey. Moreover, the By-Law stipulates that the DSİ may grant a "water usage right" certificate to HPP projects. In the event of multiple applications for the same project, the By-Law also stipulates that the DSİ is to conduct a public tender, and then to inform EMRA of the winners for licensing. The water usage agreement states the volume of water flow and calls for the monitoring of the impact of HPP on the river to protect natural life.

Another milestone development in hydropower usage was the enactment of Renewable Energy Resources Law (RER) No: 5346 dated May 2005, that provided a support system, that is, feed-in tariff (FIT) for electricity generation from renewable energy sources. The RER Law No: 5346 envisioned the FIT with upper and lower limits for a maximum of 10 years of operation, being 5.0 and 5.5-euro cents per kWh, respectively. However, the law failed to attract more investors, after which, the Law No. 5346 was elaborated upon and amended by the Law No. 6094 in 2011 (Gözen, 2015). New law introduced the

operation of the Renewable Support Mechanism (YEKDEM) which began on December 1, 2011. The YEKDEM mechanism provides FIT for hydropower with a lower limit of US$7.3 and an upper limit of US9.6 cent/kWh. The FITs provided by the Law no: 5346 were considered insufficient because the FIT was lower than the per kW electricity price realized in the spot electricity market. The effect of the new law could be seen immediately increase in the number of HPP license applications to EMRA, with 1,024 project applications with an installed capacity of 6500 MW were made by the private sector in a short period of time. In addition, Another Law No. 5784 which was enacted in July 2008, exempted RER projects up to 1,00 kW from the need to obtain a license to generate electricity from renewable energy sources also accelerated the utilization of hydropower potential. The aim of the Law No. 5784 was to promote real or legal persons to invest on generating their own electricity needs. Under this law, the government also provides guaranty to buy any excess electricity from these non-licensed power plants. During this period we witnessed an increase in the construction of mini and micro-hydropower plants (Erdogdu, 2011).

YEKDEM support mechanism introduced and integrated day-ahead market in 2011. Under the new mechanism, which was unique to Turkey, renewable-based electricity was sold on the day ahead market in EXIT which also incentivized the realization of hydropower potential of Turkey.

Table 11. Installed Capacity Development

Year	HEP (MW)	Percentage out of total Installed Capacity	Percentage of HP generated	Total Installed Capacity
2001	11,672.9	44	19	28,332.8
2005	12,906.1	33.2	24.6	38,843.5
2010	15,831.2	32	24.6	49,524.1
2015	25,867.8	35.4	25.6	73,147.6
2017	27,273.1	32.7	19.6	85,200,0
2018	28,111.6	31.7	19.9	88,550.8
2019 Nov.	28,494.0	31.9	20	91,252.0

Source: TEİAŞ, n.d.-a.

As can be seen from Table 11, Turkey was able to install 15,587.9 MW hydropower capacity from 2005 to 2019, amounting to almost 1,113.4 MW per year on average under the new legal and economic model. The impact of the new incentive model could also be seen in the number of HPPs established, as detailed in Table 12, and in the total installed capacity benefiting from the feed-in tariffs, presented in Table 13.

Table 12. Breakdown of the Number of HPPs as of March 2019

Status	Number of HPPs	Capacity (MW)
Operational	659	28,391.4
Under Construction	33	1,739.0
Licensed	84	2,342.0
Pre-licensed	150	4,969.0
Under Consideration	5	110
Total	**931**	**37,394**

Table 13. HPPs Operating under the Renewable Support Mechanism

Run of River	6,330 MW
Reservoir	6,373 MW
Total	21,290 MW

Source: YEKDEM.

Table 14 shows that the pace of the realization of water potential under the new schema increased Turkey's share of the world's total installed capacity.

Table 14. Hydropower Capacity Development in Turkey Vis-à-vis the World

Year	World (MW)	Turkey (MW)	TR/World (%)
2008	960,584	13,829	1.08
2017	1,270,496	27,313.1	2.149

When the percentage of utilization of the total economic water potential is taken into account, especially in the last two decades this development was a considerable success for Turkey, yet Turkey has another potential to be realized for the next years.

Table 15. Utilization of Total Economically Viable HP Potential in Turkey in 2019

HPPs	MW	Percentage
Utilized	28,494	51.80
Economical Potential	55,000	100

According to the Renewable Energy Strategy document, Turkey plans to reach 34,000 MW Hydropower capacity by 2023 (T.C. Enerji ve Tabii Kaynaklar Bakanlığı, n.d.).

Issues with hydropower generation

Hydropower generation plants, and primarily the dams constructed for the hydropower plants, have raised some social and environmental concerns. The environmental implications are different from those of fossil fuels, with the main concerns being related to the impact on the land and water ecosystem associated with the construction and operation of hydro dams. These concerns include the effects of changing river flows on ecosystem regimes, the flooding of extensive land areas, necessitating the relocation of residents and a loss of agricultural land, silt deposition and the impact on certain sensitive species (Erdogdu, 2011). Furthermore, all human interventions into natural life, the course of rivers and their diversions can have a considerable impact on the flora and fauna of the ecosystem and human life.

Increase in the number of the construction of HPPs during past two decades in Turkey with the sole purpose of utilizing the natural resources and profit maximization, while ignoring the impacts of these human activities on river basins, has led the environmental degradation and public contentment. Private entrepreneurs, primarily those operating river-type HPPs, sought the rapid realization of their projects, and disregarded the lengthy hydrological, technical and scientific procedures (Gökdemir et al., 2012). Their hasty and rash style actions were tolerated by the Government authorities who prioritizes energy supply security to the environment. The rough approach to construction on the site and their appropriation of lands have led to environmental degradation of and tension with those living in the vicinity of HPPs. Moreover, the diversion of watercourses, thus reducing the availability of water for the streams and agricultural activities in nearby fields further exacerbated the social and environmental problems. The total installed capacity of such run-of-the-river type HPPs is

almost half of the total hydropower capacity, while the cost to the environment and social life of the areas in focus is said to be high. This can be attributed to the fact that the government considers energy security to be the highest priority, and has thus tended to neglect the adverse effects of hydropower projects (Gökdemir et al., 2012).

Conclusion

To conclude, this chapter demonstrates the importance of hydropower for Turkey's overall energy and environment policies. In fact, hydropower provides cheap, clean and environment-friendly form of electricity compared to other forms of electricity produced from fossil fuels. The chapter also highlights the significance of hydropower in Turkey's overall socio-economic modernization strategy. This turned the construction of large dams into one of the focal points of the political agenda and a target of the economic development plans, being considered a remedy to the increasing demand for electricity resulting from rapid industrialization and urbanization.

On the other hand, Turkey is not a water-rich country. Actually, the per capita freshwater stocks of Turkey continue to decline due to climate change, while the use of water has increased over the years. To achieve its ultimate desire to become an economically and socially modern country, Turkey adopted several development programs and established a number of state entities in order to increase Turkey's energy production, including its hydropower capacity. More recently, Turkey adopted new regulations to encourage the construction of hydropower plants stirring up tensions between the local people and environmentalists on one side and entrepreneurs and official bodies on the other in the 2000s.

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