



**REPUBLIC OF TURKEY PRIME MINISTRY**  
Investment Support and Promotion Agency of Turkey

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**TURKISH ENVIRONMENTAL  
TECHNOLOGIES & RENEWABLE ENERGY  
INDUSTRY REPORT**

AUGUST 2010



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## 1. Executive Summary

Environmental concerns are becoming a priority issue in Turkey mainly due to economic growth as a result of the increased energy demand, industrialization and urbanization of Turkey. Local firms are seeking foreign partnerships to undertake larger projects and the regulations have been modified to favor investments. Environmental companies engaged in consultancy, engineering or equipment aspects of hazardous/medical waste treatment are likely to be very active in Turkey in the near future. Waste-to-energy projects have been initiated in order to generate alternative energy at some landfills in Turkey. Development of municipal water/wastewater treatment is developing faster than the other areas of the sector.

Turkey hosts significant direct investment opportunities in environmental technologies, as well as in advanced conventional energy generation and renewable energy. Foreign consultancy or equipment manufacturers are likely to find major business opportunities in this area.

Total environmental expenditures in Turkey were USD 9.9 billion in 2008. The majority of the expenditure was municipality expenditures corresponding to 78.2 percent of the total, whereas the private companies' environmental expenditures were 9 percent of the total amounting to USD 872 million<sup>1</sup>.

Since the amendment of the Environment Law no. 2872 in 2006, the municipalities have been further required to build and establish waste management centers and protocols. The last five-year period, which was seen as a progress phase, experienced a significant growth in waste management and recycling efforts. According to the Environment Law, as an incentive to reduce and prevent industrial pollution, the government plans to offer significant support and incentives to industrial plants if they set up their own waste treatment facilities.

In 2008, in order to have a more organized waste management policy and speed up the investment process, a "Solid Waste Action Plan" was approved by the Ministry of Environment and Forestry. In accordance with the action plan, the number of waste management centers and the municipalities' efforts are expected to increase.

The decreasing oil, natural gas and hard coal resources together with the pollution that is caused by these primary energy resources are leading the world to search for alternative energy sources. Turkey has significant potential for solar, geothermal and wind energy but still has not taken sufficient steps towards utilizing these potential.

Currently, the largest share of the installed capacity in Turkey is still attributable to thermal power plants. As of the end of 2008, 66 percent of the total installed capacity consists of thermal power plants, 33 percent of hydro power plants, 0.1 percent of geothermal and 0.9 percent of wind power plants<sup>2</sup>. Although there is currently a low level of non-thermal installed capacity, there is an environment conducive to renewable investments due to substantial renewable energy resources and recent developments in renewable legislation and liberalization in the electricity market. There are numerous projects undergoing license approvals mainly for HEPPs and WPPs. 77 percent of the total number of new licenses (176) granted to the private sector in the year 2009 was for the construction of new HEPPs<sup>3</sup>. As of September 2009, there are a total of 105 WPP given and approved licenses, with a capacity of 4,237 MW. There are 727 licenses awaits evaluation, corresponding to 31,957 MW<sup>3</sup>.

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<sup>1</sup> TUIK (Turkish Statistical Institute), <http://www.tuik.gov.tr>

<sup>2</sup> TEIAS (Turkish Electricity Transmission Company), <http://www.teias.gov.tr>

<sup>3</sup> EPDK (Energy Market Regulatory Authority), <http://www.epdk.gov.tr>



The installed hydroelectricity capacity of the 213 HEPPs (14.3 GW) corresponds to c.36 percent of the country's technical hydroelectricity potential of 44.2 GW<sup>4</sup>. The electricity generated from the hydroelectricity plants amounted to 36 TWh in 2009.

The contribution of other renewable sources to Turkey's total electricity supply is small, only c. 0.2 percent, in Turkey's total electricity generation. On the other hand, there is an additional renewable capacity of 0.4 GW, waiting for license approval from EPDK as of September 2009<sup>3</sup>. Clearly, Turkey is considered to have a large amount of wind, geothermal, and solar power potential, which have made the sector attractive in terms of M&A activity in the last couple of years.

## 2. Sector Overview

### 2.1 Global Sector

During the past decade, it became evident that the global use of fossil fuels was causing irreparable damage to the environment by warming up the planet, raising the sea level and the extermination of species. One important consequence was the formation of a global consciousness where many countries and companies are searching for ways to use fossil fuels in "cleaner" forms with "greener" production processes and make better use of alternative energy sources.

On the other hand, global demand for energy is rising rapidly. It is predicted that by the year 2050, global population will reach 10 billion people, who will obviously need food, water, and energy. Yet even today, around two billion people in the world do not have access to or cannot afford electricity and clean water.

During the recent economic downturn, many oil and gas companies focused on implementing cash preservation strategies. Now, together with an economic recovery in many countries, meeting the increasing energy demand by using such "green" technologies is a big challenge, but also a great economic opportunity for the industry to create predominantly green economies.

#### 2.1.1 Pollution Control, Waste Management and Recycling

Air and marine pollution, land and water contamination, waste management and recycling have been the main issues in the environmental technologies sector. In the last decade, the sector grew to include other areas, such as carbon emissions, energy management, carbon capture and storage as well as carbon finance.

The global market size of the sector was USD 5,361 billion as of 2008-2009 period, including the renewable energy segment. The United States and China are the leading countries which form almost one third of the global market followed by Japan.<sup>5</sup>

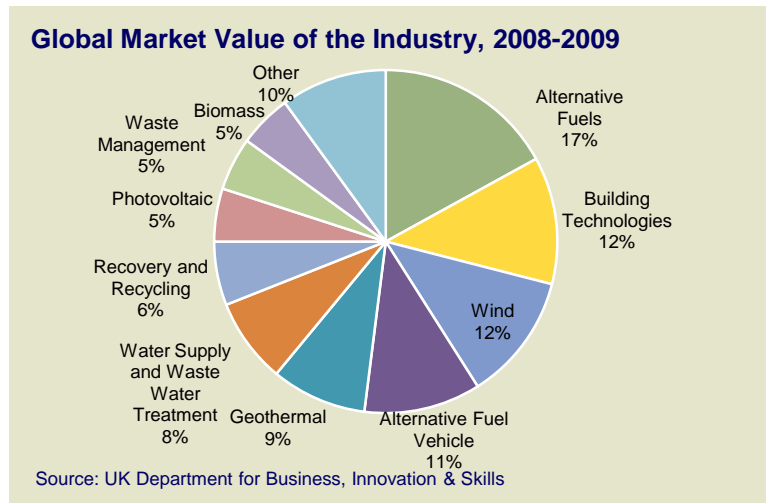
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<sup>4</sup> ETKB (Ministry of Energy and Natural Resources, May 2009), <http://www.enerji.gov.tr>

<sup>5</sup> UK Department for Business, Innovation & Skills, March 2010



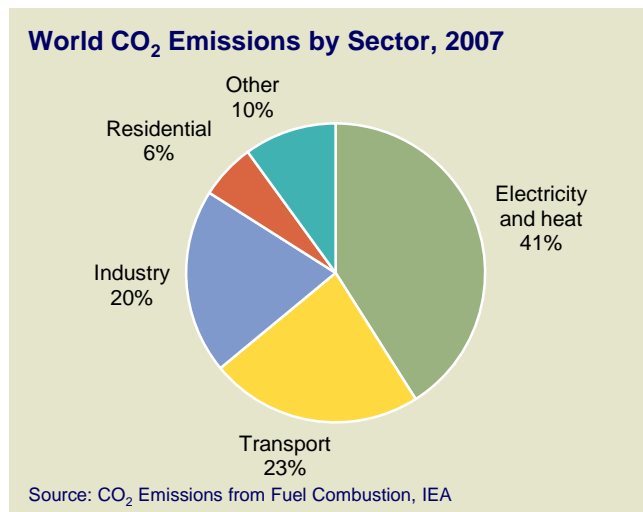
Figure 1 - Sector Share of the Global Market Size



Increasing trade of manufactured products and a rise in the share of coal in world energy consumption have caused global levels of carbon-dioxide (CO<sub>2</sub>) emissions to rise rapidly over the last decade. Global CO<sub>2</sub> emissions have increased by 30 percent since the signing of the Framework Convention on Climate Change (UNFCCC) in 1992. Moreover, the CO<sub>2</sub> emission level has increased by 99 percent between 1971 and 2009; with an average growth rate of 2 percent per year. This level is expected to triple by the end of the century.<sup>6</sup>

The largest share in the global CO<sub>2</sub> emission corresponds to the electricity and heat sector with 41 percent of the total. The transportation sector is second in terms of CO<sub>2</sub> emissions with 23 percent of the total.<sup>7</sup>

Figure 2 - World CO<sub>2</sub> Emission by Sector, 2007



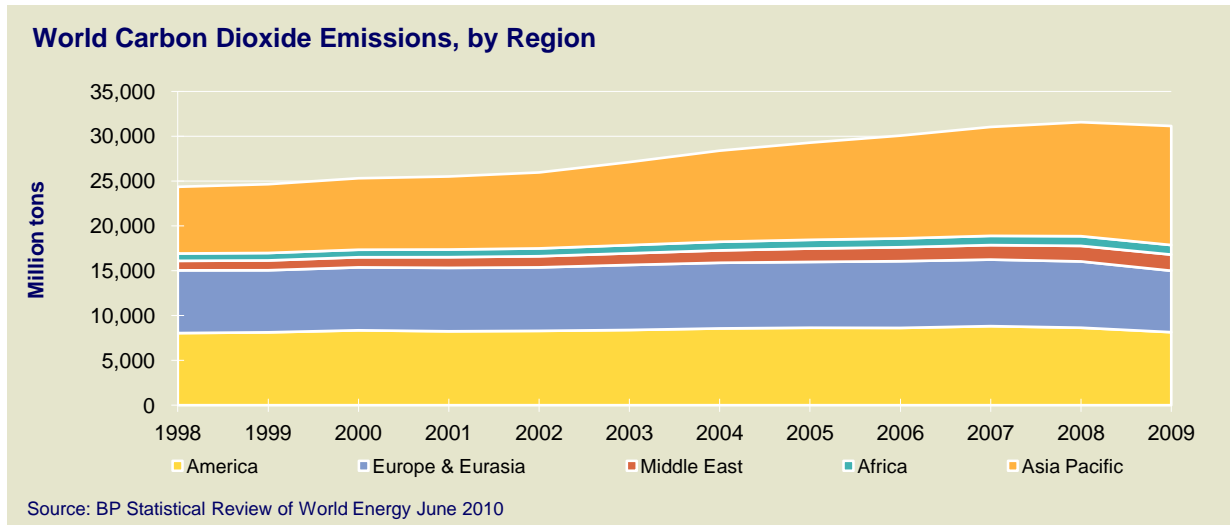
In terms of regions, CO<sub>2</sub> emissions in the Asia Pacific region have substantially increased during the last decade, as observed in the figure below.

<sup>6</sup> Economist Intelligence Unit, World Energy Outlook, September 4<sup>th</sup>, 2009

<sup>7</sup> IEA (International Energy Agency)



Figure 3 - World CO<sub>2</sub> Emissions, by Region



Current incentives to reduce CO<sub>2</sub> emissions include carbon trading, taxes on carbon or energy and government regulations, including efficiency requirements for appliances. Carbon trading is beginning to be acknowledged as the preferred way to enforce CO<sub>2</sub> emission regulations.

The US and Western European countries such as Norway, Denmark, Ireland, Switzerland, and Luxembourg are the leading countries in terms of waste generation. A country's municipal waste generation is directly proportional to its urbanization rate, its GDP per capita and to the habitants' lifestyles.

The municipal waste covers household waste, waste from office buildings, institutions, businesses, street sweepings, litter content, and other similar waste items.

In 2007, the quantity of municipal waste generated in the OECD area has risen to 623 million tons<sup>8</sup>. On the other hand, the growth rate in recent years has been lower than private final consumption expenditure and GDP.

Figure 4- Municipal Waste Generation per capita



The global demand for water is estimated to have increased more than twice as fast as population growth over the last century. In the 1960s and 1970s, water consumption in most OECD countries rose due to demand in the agriculture and energy sectors.

<sup>8</sup> OECD Factbook 2010



However, since the 1980s, more efficient irrigation techniques, the decline of water-intensive industries and cleaner production technologies have allowed countries to cap their water consumption levels.<sup>8</sup>

Figure 5 - Water Abstractions per capita



### 2.1.2 Renewable Energy

The renewable energy segment has the second largest share within the Environmental Technologies sector. Renewable energy is a diverse and long-term option in today's global energy supply. Their benefit in reducing greenhouse gases and other pollutants is valuable as well as their effect in reducing dependence on limited fossil sources. The downside of renewable energy seems to be its high cost, but costs are continuing to decline, which makes renewable energy very accessible in some countries.

Renewable energy sources play a far more significant role in global energy production in 2009 than a decade ago.

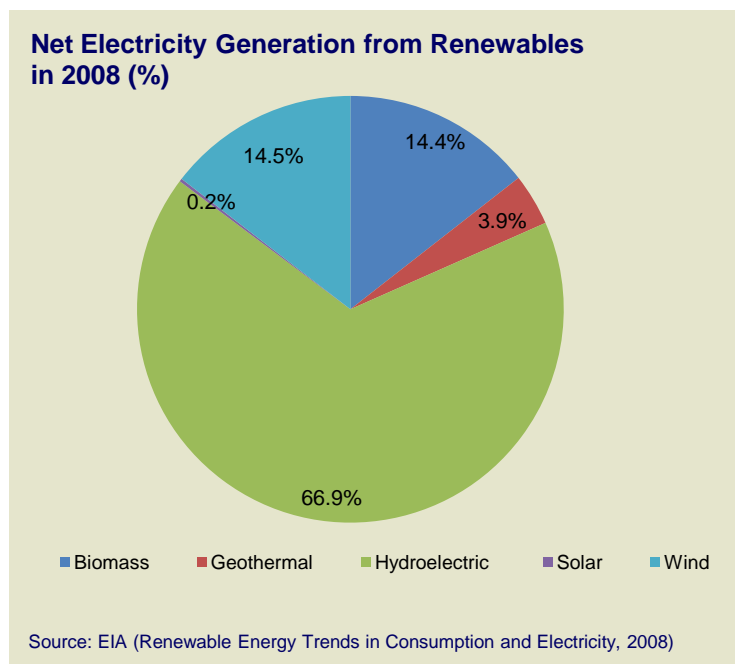
Hydroelectric energy is the most important renewable energy source, providing 6.4 percent of global energy consumption in 2008<sup>9</sup>. The world's biggest hydroelectric producers are China, Brazil and Canada forming 39 percent of the total. China accounts for 15 percent followed by Brazil and Canada each accounting for 12 percent.<sup>10</sup>

<sup>9</sup> OECD Factbook 2009

<sup>10</sup> International Energy Agency, Key World Statistics, 2009



Figure 6 - Net Electricity Generation from Renewable Energy Sources



Other renewable energy sources mainly include wind, solar, and geothermal energy.

Photovoltaic solar energy demand experienced a significant growth by 20 percent and reached 7.3 GW in 2009. Demand by European countries, Germany, Italy and Czech Republic being the main markets, accounted for 5.60 GW, constituting 77 percent of world demand. The global photovoltaic energy revenue amounted to USD 38.5 billion in 2009<sup>11</sup>.

Globally, wind energy follows hydroelectric energy as the second highest consumed renewable energy, although not by a small margin. Wind energy is very attractive to most countries, mainly due to the environmental benefits it provides. Additional to the CO<sub>2</sub> benefit of wind power, emissions of pollutants such as oxides of sulphur and nitrogen are also avoided by using wind energy.

Between 2000 and 2009, global wind energy capacity rose with a CAGR of 27.4 percent, from 18 GW to 159 GW. The USA, China, and Germany are the leading markets in 2009 in wind energy production, together accounting for 55 percent of wind energy production in 2008. Wind energy produced by China increased significantly by 113 percent in 2009 compared to 2008.<sup>12</sup>

<sup>11</sup> Solarbuzz website, <http://www.solarbuzz.com>

<sup>12</sup> World Wind Energy Association, World Wind Energy Report, 2009





Figure 7 - World Wind Energy: Total Installed Capacity



Source: World Wind Energy Association

The United Nations Climate Change Conference in Copenhagen in December 2009 will effect both renewable and alternative energy sectors going into 2010. The conference is expected to set the terms for beyond 2012 when the Kyoto Protocol runs out. The Kyoto Protocol entered into force on February 16, 2005, and set binding targets for 37 industrialized countries and the European Community for reducing greenhouse gas emissions of an average of 5 percent against 1990 levels over the five-year period 2008-2012. To date, 184 parties have ratified the protocol.

**2.1.3 Energy Efficiency**

Energy efficiency broadly means the reduction in energy used. Constraints on energy supplies have made energy efficiency an important topic in both developed and developing countries. In developing countries the concern on energy efficiency is mainly driven by avoiding high energy import costs, reducing requirements for high energy investments and improving energy supply usage and access. Developed countries are more concerned about pollution and reduction of greenhouse gas emissions.



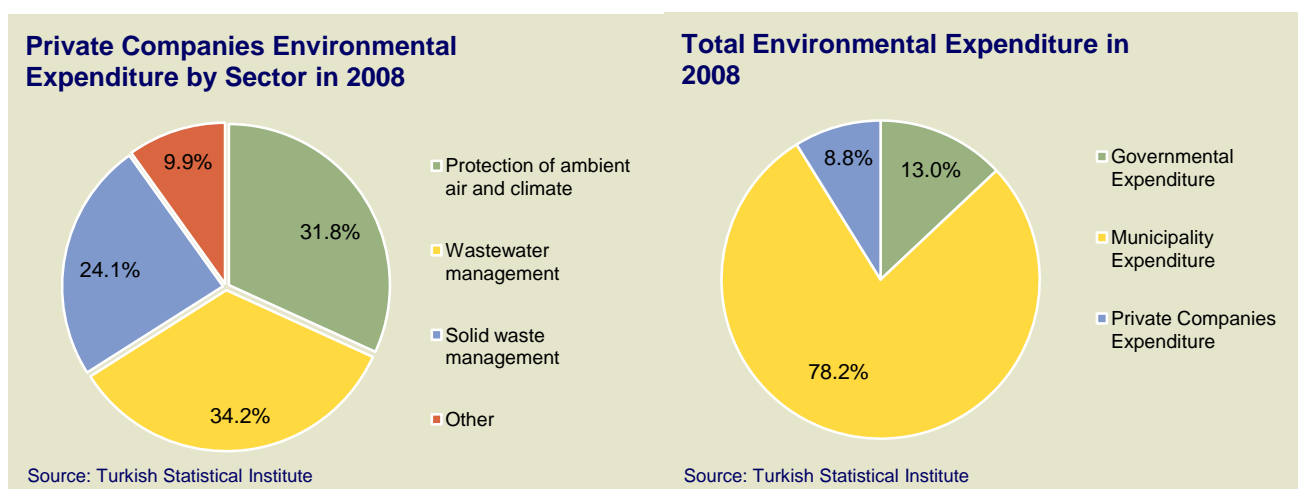
## 2.2 Domestic Sector

### 2.2.1 Pollution Control, Waste Management and Recycling

Economic growth in Turkey has caused an increase in energy demand, industrialization and urbanization, raising concerns about environmental issues. These environmental concerns are forcing Turkey to establish effective water, waste and air pollution control management.

Total environmental expenditure in Turkey was USD 9.9 billion in 2008. The majority of environmental expenditures consist of municipality expenditures corresponding to 78.2 percent of the total, whereas the environmental expenditures of private companies were 9 percent of the total amounting to USD 872 million.<sup>13</sup>

Figure 8 - Environmental Expenditures of Private Companies & Total Expenditures (%)



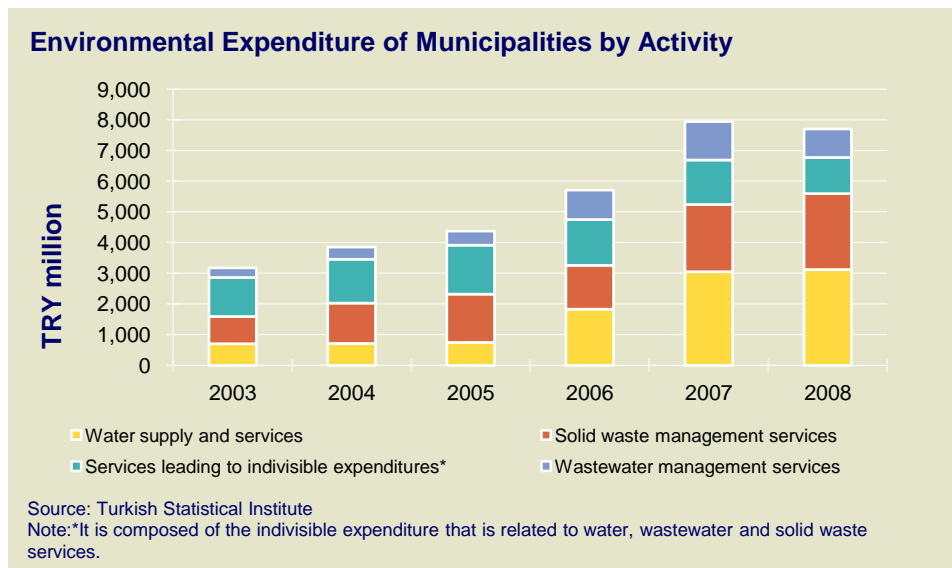
Turkey's attempt to become a full-fledged European Union member is creating a positive environment for foreign investment. Regulations in the sector are being modified to favor foreign investments, resulting in foreign investors partnering with local businesses in waste management solutions.

The environmental technologies market also benefits from new arrangements in local regulations. Since the change in the article of Environment Law numbered 2872 in 2006, municipalities have been further required to build and establish waste management facilities and protocols. The last five-year period has experienced a steep increase in waste management and recycling efforts. As an incentive to reduce and prevent industrial pollution, the government offers industrial plants a reduction up to 59 percent of their electricity bills if they set up their own waste treatment facilities, in accordance with the above-mentioned Environment Law article.

<sup>13</sup> TUIK (Turkish Statistical Institute), <http://www.tuik.gov.tr>



Figure 9 - Expenditures of Municipalities



Furthermore, the Ministry of Environment and Forestry proposed a “Solid Waste Action Plan” in order to organize waste management policies and aid in sustaining the sector’s growth in 2008. In this report, the Ministry aimed at drawing up a clear plan for the 2008-2012 period. With the action plan, the number of waste management facilities reached 108, the number of municipalities participating reached 1,128 and the number of people that these facilities cover rose to 50 million. The number of people that these facilities cover is expected to reach 57 million by 2012.<sup>14</sup>

In order for Turkey to reach regulatory compliance with EU environmental requirements, the EHCIP (Environmental Heavy Cost Investment Planning) Project funded by the EU was established in January 2004. This project aims to provide funds to the Ministry of Environment and Forestry to increase capacity for a high level of environmental protection.

As seen elsewhere in the world, industrialization and urbanization, reinforced by economic growth, have increased the need for environmental goods and services in Turkey. As a result, waste management, water supply and air pollution control have become areas with an ever growing demand and opportunities for investment.

**Waste Management**

Currently Turkey's waste management infrastructure is not sufficient to cover the country's needs; an annual amount of 30 million tons of waste is produced.<sup>14</sup> The majority of this waste is stored in municipal waste storage facilities and landfills. Existing landfills and waste energy plants are insufficient in number. Izaydas, which owned the first facilities for waste management, is the major waste energy plant in the country. Although several facilities have been established by large municipalities in recent years, the number of waste energy plants is still insufficient and should be further developed in the future. Therefore, expertise for managing and constructing landfills and waste energy plants is needed in order to manage the current levels of waste production. Supply of waste handling equipment, technologies for treatment, collection, separation and handling are also areas with extensive development opportunities and therefore offer investment options in the country.

In the entire environmental expenditures of all the governmental institutions in 2008, water management and wastewater management expenditures take up some 63 percent.

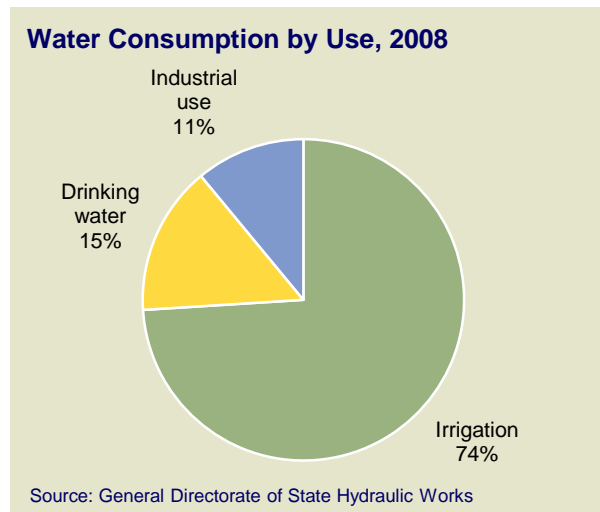
<sup>14</sup> Cevre ve Orman Bakanligi (Ministry of Environment and Forestry), Waste Action Plan (2008-2012)

Comparison of environmental expenditures by sectors yields that wastewater management expenditure in manufacturing industry accounted for 96 percent of total wastewater management expenditure and 81.2 percent of total solid waste management in 2008<sup>15</sup>.

**Water Supply and Management**

Population growth in Turkey from 2000 to 2009 from an estimated 65.7 million people to 72.6 million (CAGR of 1.1 percent) resulted in an increasing demand for drinking and irrigation water supply. As of 2009, usable water supply per capita is approximately 1,650 m<sup>3</sup>, which classifies Turkey as a country facing water shortage.<sup>16</sup> Irrigation is the primary need for water consumption, accounting for 74 percent of the total in 2008, followed by drinking water at 15 percent and industrial use at 11 percent.

**Figure 10 - Water Consumption by Use, 2008**



Current water supply and management facilities in Turkey are insufficient to meet the demand of the population, and this imbalance is likely to increase further in the future as freshwater reserves are expected to decline. Only 40.2 percent of the population is serviced by water treatment plants<sup>17</sup>. The necessary construction of new plants and renewal of existing ones represent significant investment opportunities in the country.

**Air Pollution Control**

Industrial CO<sub>2</sub> emissions, household heating and carbon emissions from vehicles are the three main sources of air pollution in Turkey. Currently, air pollution is monitored by 116 stations. The measurement results obtained from the stations are evaluated in environmental laboratories and hourly averages are published on the air quality monitoring network web site<sup>18</sup>. Main obstacles in sustaining an acceptable level of air pollution are highlighted as follows<sup>19</sup>.

<sup>15</sup> TUIK (Turkish Statistical Institute), <http://www.tuik.gov.tr>

<sup>16</sup> DSI (The General Directorate of State Hydraulic Works), Annual Report, 2009

<sup>17</sup> DSI (The General Directorate of State Hydraulic Works), Turkey Water Report, 2009

<sup>18</sup> Cevre ve Orman Bakanligi (Ministry of Environment and Forestry)

[<http://www.havaizleme.gov.tr/Default.htm>]

<sup>19</sup> Cevre ve Orman Bakanligi (Ministry of Environment and Forestry), Turkish Environment Status Report, 2007



- ✓ Low cost – low quality coal usage in household heating
- ✓ Inefficient use of energy in industrial production
- ✓ Lack of emissions controls in thermal power plants

As Turkey's air quality needs to develop, there will be long term opportunities for providers of air quality control testing stations, with resulting requirements for emission control devices, electronic displays, and monitoring devices.

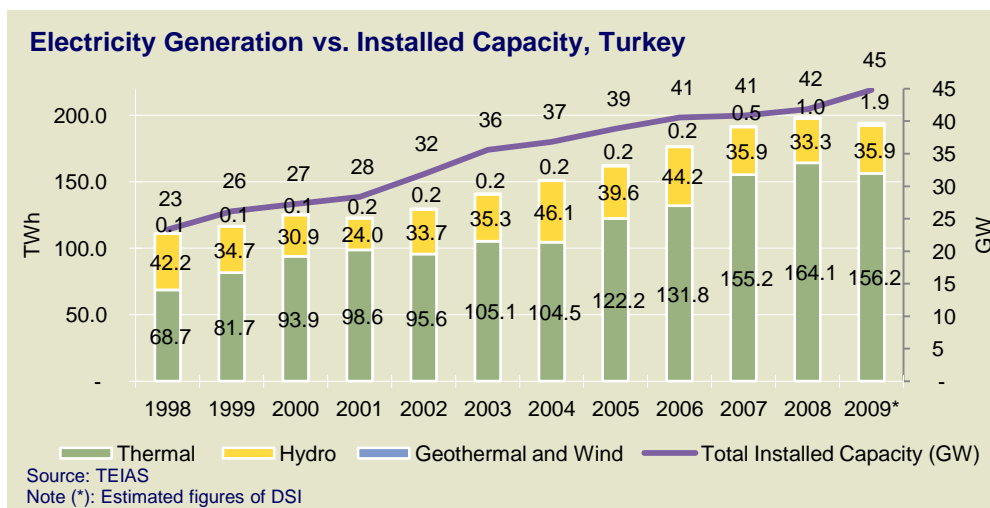
### 2.2.2 Renewable Energy

Alternative energy sources are becoming more and more desirable in the world as pollution has become a global threat and the primary energy sources such as oil, natural gas and coal are decreasing in supply. The renewable market in Turkey is still at an infant stage with the majority of electrical generation capacity still coming from thermal plants (66 percent of total installed capacity as of 2008). Hydro power plants contribute 33 percent, and the remaining 1 percent is from geothermal (0.1 percent) and wind (0.9 percent) sources as of end 2008.

Recent developments in Turkey such as the liberalization of the electricity market and improvements in the renewable legislations have opened the door for growth and investment opportunities in renewable energy sources. These developments coupled with the country's naturally endowed potential for solar, geothermal and wind energy resources, create a vast potential in this market.

In May 2005, the Law on Utilization of Renewable Energy Resources for Electricity Production No. 5346 was enacted for the decentralization of the renewable energy sector in Turkey. The law aims to increase renewable energy resources' utilization and generate low cost, secure, and high quality electricity. Large HEPPs in terms of installed capacity are excluded from the law. The law enacts feed-in tariffs determined by EPDK for power plants in operation for less than 10 years. However, the tariffs for every energy resource are to be determined whereas diversification may be necessary and there is also a need for efficient tax and investment incentives. The Ministry of Energy and Natural Resources has prepared a draft report to be presented to the Parliament in the first half of 2010, however, review of the law had not yet been achieved when the Parliament closed for vacation on July 23, 2010. Despite the delay in the incentives, there is a considerable interest from investors in the renewable energy sector.

Figure 11 - Electricity Generation vs. Installed Capacity

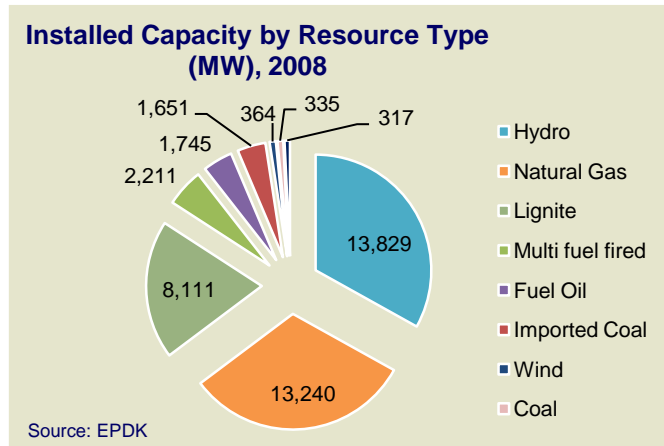


As of 2008, total electricity installed capacity is 41,802.6 MW in Turkey. 33 percent of total installed capacity corresponds to hydroelectricity, 32 percent to natural gas, 24 percent to coal, and the remaining 11 percent to other resources.



The installed capacities by resource type are presented below:

Figure 12 - Installed Capacity by Resource Type



**Hydroelectric Energy**

The installed hydroelectricity capacity of the 213 HEPPs (14.3 GW) corresponds to approximately 36 percent of the country’s technical hydroelectricity potential of 44.2 GW. The electricity generated from the hydroelectric power plants amounted to 36 TWh in 2009<sup>20</sup>.

77 percent of the total number of new licenses granted to the private sector in 2009 was for construction of new HEPPs. The majority of the HEPPs are owned and operated by the state. The rest is divided among BOT and TORs and the private sector players. In practice, licenses are usually granted for 49 years.

Major HEPPs with power capacities higher than 100MW are presented below:

<sup>20</sup> DSI (The General Directorate of State Hydraulic Works), Annual Report, 2009

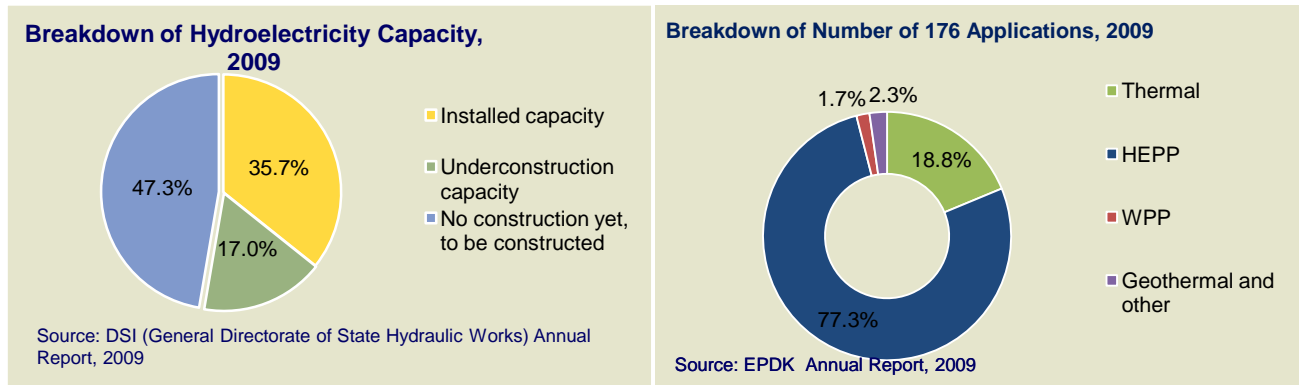


Figure 13 - Major HEPPs in Turkey

Major HEPPs in Turkey					
Dam Name	River	Place	Completion Date	Power (MW)	Installed Capacity (GWh)
Atatürk	Fırat	Şanlıurfa	1992	2,400	8,900
Karakaya	Fırat	Diyarbakır	1987	1,800	7,354
Keban	Fırat	Elazığ	1975	1,330	6,000
Birecik	Fırat	Şanlıurfa	2000	672	2,518
Berke	Ceyhan	K.Maraş	2001	510	1,672
Altınkaya	Kızılırmak	Samsun	1988	700	1,632
Oymapınar	Manavgat	Antalya	1984	540	1,620
Hasan Uğurlu	Yeşilirmak	Samsun	1981	500	1,217
Borçka	Çoruh	Artvin	2007	300	1,039
Sır	Ceyhan	K.Maraş	1991	284	725
Karkamış	Fırat	Maraş	1999	180	652
Çatalan	Seyhan	Adana	1996	169	596
Aslantaş	Ceyhan	Adana	1984	138	569
Gökçekaya	Sakarya	Eskişehir	1972	278	562
Gezende	Ermenek	İçel	1990	159	528
Menzelet	Ceyhan	K.Maraş	1989	124	515
Batman	Batman	Batman	2004	198	483
Muratlı	Çoruh	Artvin	2005	115	444
Yamula	Kızılırmak	Kayseri	2005	100	422
Özlüce	Peri	Bingöl	1998	170	413
Sarıyar	Sakarya	Ankara	1956	160	400
Hırfanlı	Kızılırmak	Kırşehir	1959	128	400
Kılıçkaya	Kelkit	Sivas	1989	124	332
Dicle	Dicle	Diyarbakır	1997	110	298

Source: General Directorate of State Hydraulic Works website (<http://www.dsi.gov.tr>)

Figure 14 - Hydroelectricity Capacity & 2009 License Applications



**Wind**

Turkey presents an attractive geography for wind energy investments. The Aegean and Marmara regions are the most attractive regions for wind energy power generation. The installed capacity of wind energy is 363.7 MW in 2008<sup>21</sup> and the total wind energy potential is estimated at 131,756 MW.<sup>22</sup>

TEIAS projections for 2009-2018 include 4 different scenarios; with higher-lower capacity and higher-lower demand. According to the high capacity scenario of TEIAS, installed capacity of wind energy is expected to reach 1,012 MW by 2011 with a projected electricity generation of 3,176 GWh continuing to increase to 3,663 GWh in 2012<sup>23</sup>.

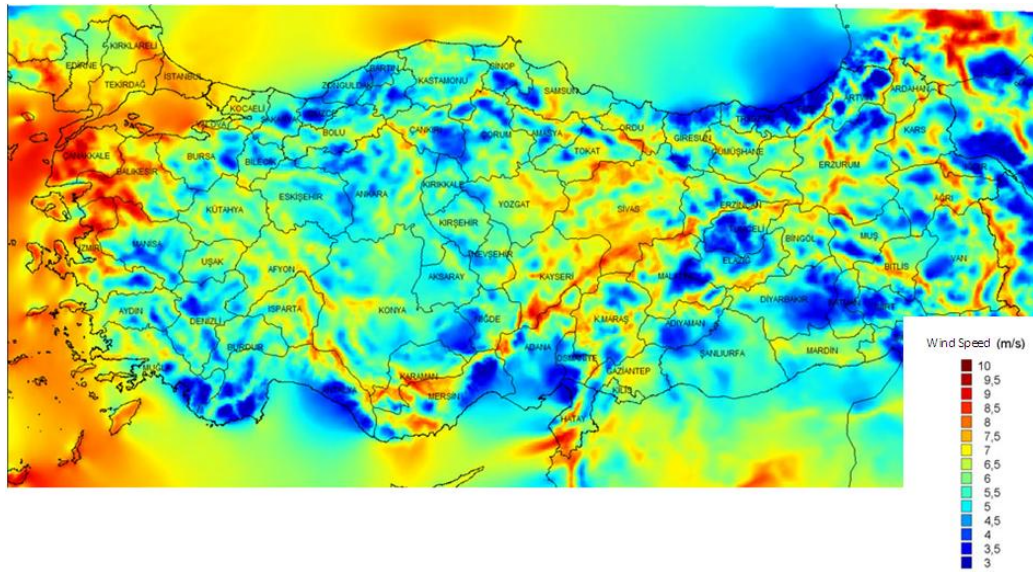
<sup>21</sup> TEIAS (Electricity Transmission Company), <http://www.teias.gov.tr>

<sup>22</sup> Enerji ve Tabii Kaynaklar Bakanlığı (Ministry of Energy and Natural Resources), <http://www.enerji.gov.tr>

<sup>23</sup> TEIAS (Turkish Electricity Transmission Company), Turkish Electricity Energy 10 Year Forecast



Figure 15 - Potential Wind Energy- Above 100m Average Height in Turkey

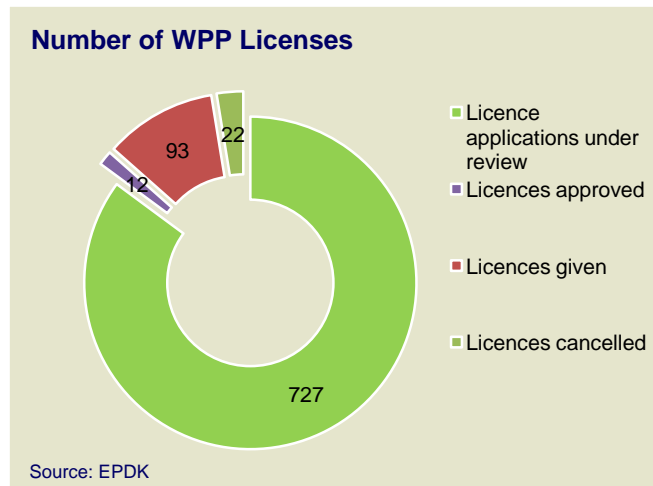


Source: TUREB

There has been a significant amount of interest in wind-based generation which has resulted in 1,118 license applications for a total of 86GW capacity since 2002. This high level of enthusiasm has further caused multiple applications for overlapping locations and capacities exceeding the supported limits. On November 1<sup>st</sup> 2007 alone, there were 725 such license applications amounting to a total capacity of 71.4 GW. Given the supported grid capacity of 7 GW according to TEIAS, the license applications need to undergo a technical review to decide on the feasibility of non-overlapping applications and for the overlapping license applications which have passed the technical reviews, TEIAS will make its decision through a tender bidding where the highest bidder will be granted the license for a WPP.

As of September 2009, there are a total of 105 WPP given and approved licenses, with a capacity of 4,237 MW. There are 727 licenses awaiting review, corresponding to 31,957 MW<sup>24</sup>.

Figure 16 - Number of WPP Licenses



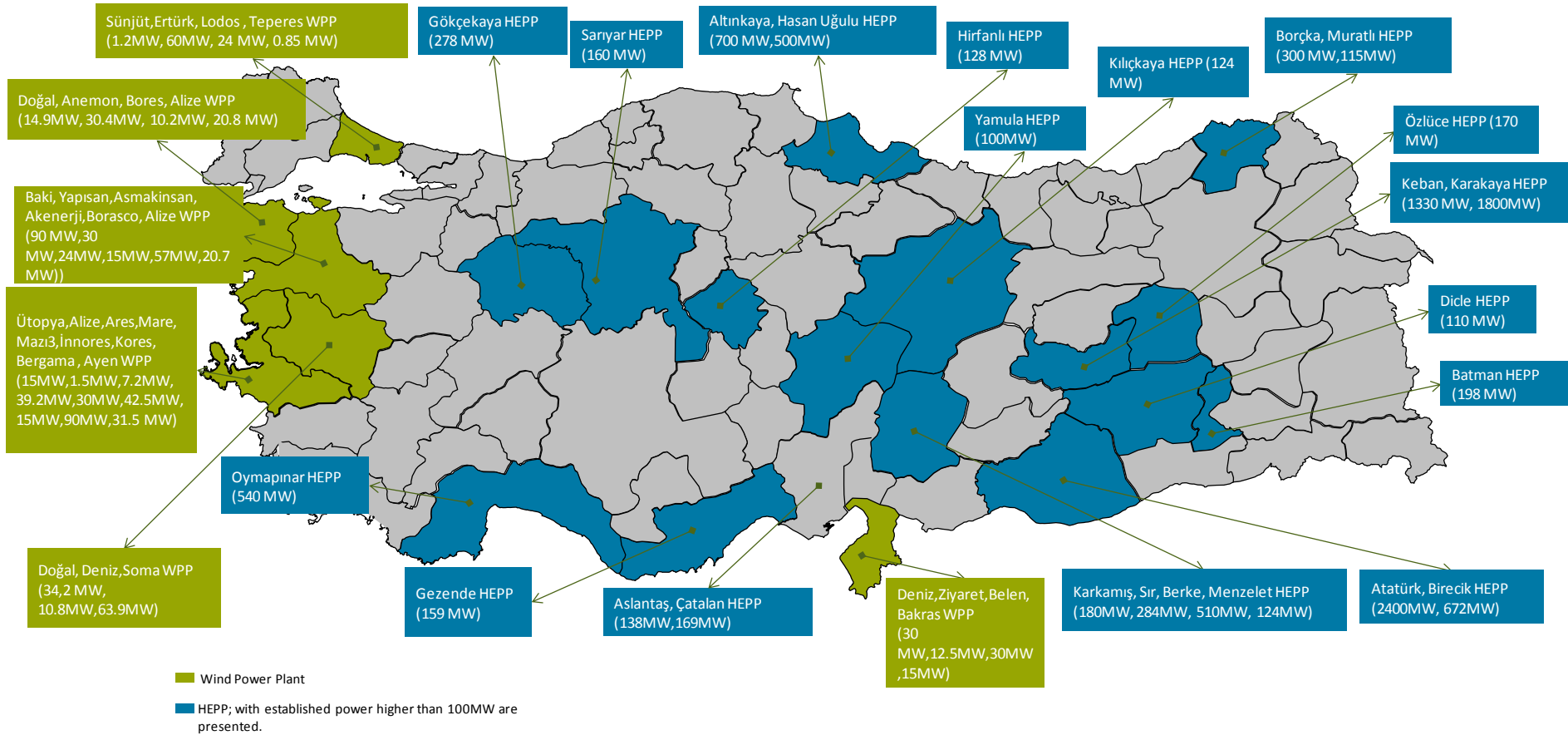
<sup>24</sup> EPDK (Energy Market Regulatory Authority), <http://www.epdk.gov.tr>





The locations of major HEPPs and WPPs in Turkey are presented in the following map:

Figure 17- WPPs and HEPPS (>100 MW) in Turkey



Source: EPDK

### Geothermal

Turkey ranks 5<sup>th</sup> for the potential of geothermal resources and 7<sup>th</sup> for the utilization of these resources in the world. However, only 3 percent of the total potential (31,500 MW) is in use<sup>25</sup>. Two-thirds of the country's geothermal resources are located in the Aegean region<sup>26</sup>.

Figure 18- Geothermal Plants



Source: EPDK website

Out of the licenses granted by EPDK in 2008, only one was for a geothermal plant, of 15 MW. Lack of technical expertise can be one of the main reasons for the low exploitation of geothermal resources in Turkey.

The exploration, development, ownership rights and economic use of geothermal resources are regulated by the Geothermal Resources and Mineral Waters Law No. 5686, enacted in 2007. Licensing and feed-in tariff issues, on the other hand, fall within the scope of the Electricity Market Law and Renewables Law.

### Solar

Solar energy is mainly utilized as flat plate solar collectors for domestic hot water production despite the huge potential for electricity generation in Turkey. The photovoltaic generation application is insignificant: currently, the total photovoltaic generation capacity in Turkey is 5 MW<sup>27</sup>. Photovoltaic energy is used for signaling purposes and in rural areas such as the watch towers of the Ministry of Environment and Forestry, light houses and lighting of highways.<sup>28</sup>

<sup>25</sup> EPDK (Energy Market Regulatory Authority), <http://www.epdk.gov.tr>

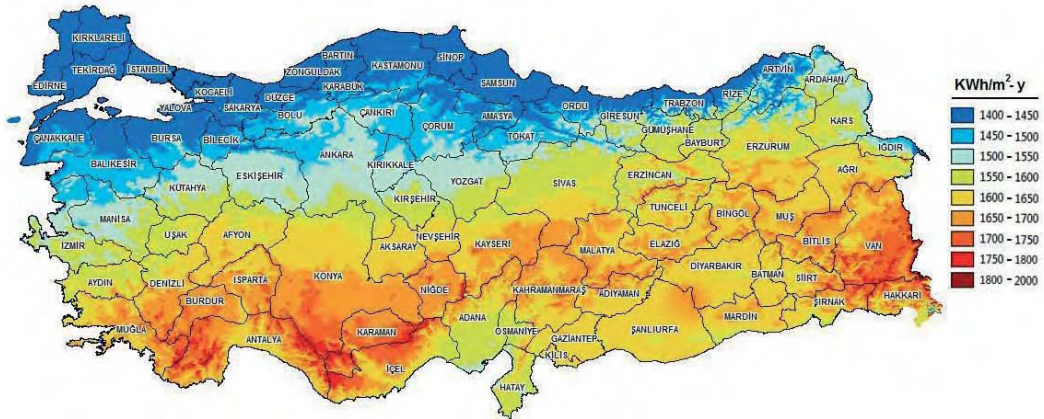
<sup>26</sup> IGEME (Export Promotion Center), Renewable Energies and Technologies Report, <http://www.igeme.org.tr>

<sup>27</sup> IEA, PVPS Annual Report 2009

<sup>28</sup> EIE (General Directorate of Electrical Power Resources Survey and Development Administration), <http://www.eie.gov.tr>



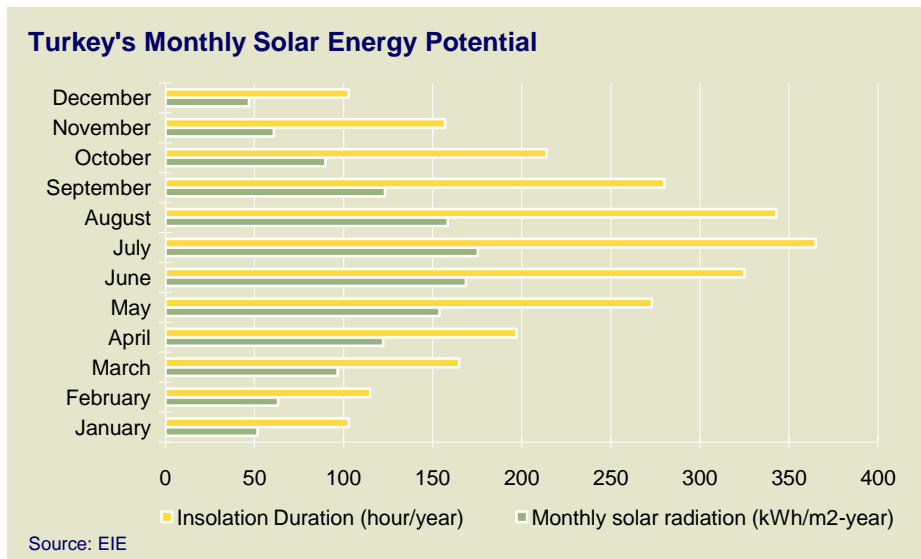
Figure 19– Solar Map of Turkey



Source: IEA, PVPS Annual Report 2008

Turkey's annual average insolation duration is estimated as 2,640 hours (7.2 hours/day) and the average annual solar radiation is 1,311 kWh/m<sup>2</sup>-year (3.6 kWh/m<sup>2</sup> per day) by EIE. Total solar energy production was 420 thousand TOE in 2007.

Figure 20- Monthly Solar Energy Potential



Source: EIE

### 2.2.3 Energy Efficiency

Turkey is projected to reach an energy-saving potential of 15 percent in the transportation sector, 20 percent in the manufacturing sector and 30 percent in the building industry. The Ministry of Energy and Natural Resources aims to reduce energy imports and wasted energy, use energy effectively, relieve the burden of energy costs on the economy and improve efficiency in the use of energy sources<sup>29</sup>.

In April 2007, the Law on Energy Efficiency No. 5627 was enacted with energy efficiency objectives in line with the Ministry's objectives as stated above.

<sup>29</sup> ETKB (Ministry of Energy and Natural Resources), <http://www.enerji.gov.tr>

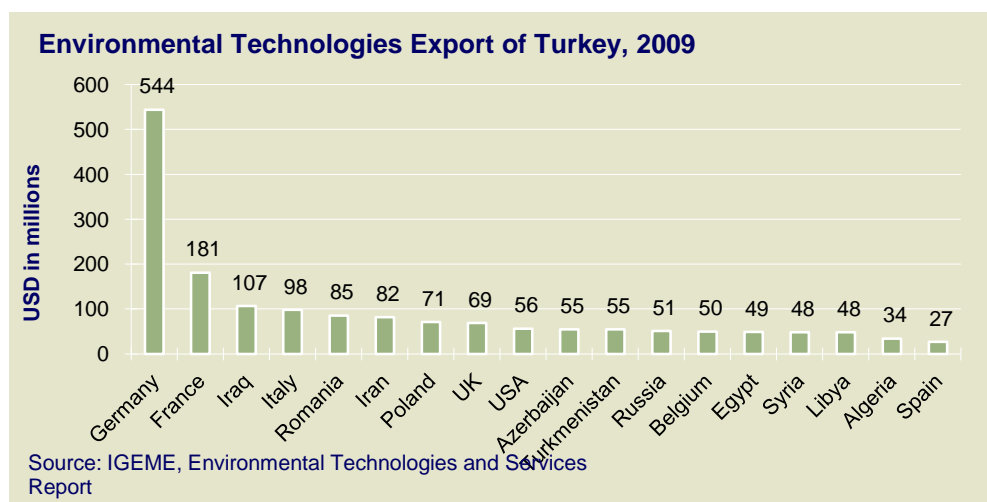


With this law, 20 percent of total energy costs will be covered with the contract signed between industrial companies and EIE. The industrial companies are to guarantee reducing their energy usage by a minimum 10 percent within three years. (Renewable energy is not included).

### 2.2.4 Foreign Trade

Turkey exports environmental technologies abroad to countries such as Germany, France, Italy and UK. Germany is the leading country for Turkish exports of environmental technologies with USD 544 million in 2009<sup>30</sup>.

Figure 21- Environmental Technologies Export of Turkey, 2009



## 2.3 Sector Outlook

### 2.3.1 Pollution Control, Waste Management and Recycling

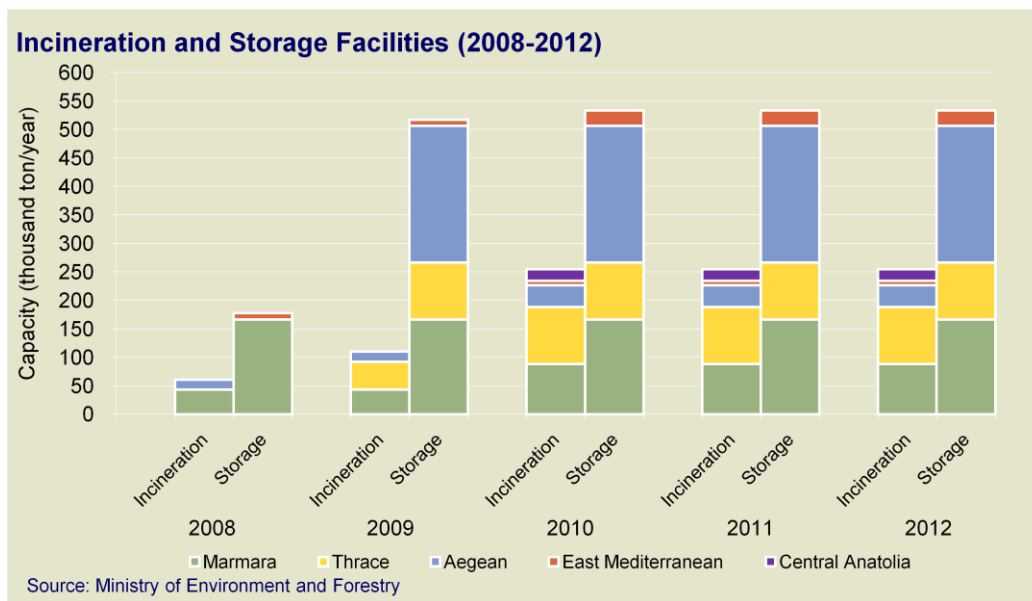
The high demand for waste treatment facilities has led to the creation of 5 hazardous waste zones which will have their own central storage facilities and incinerators. This strategy is expected to treat one million tons of hazardous waste per year. The investment required for waste management treatment expected to be made between 2010 and 2012 is approximately € 1,201 million<sup>31</sup>. The following figure presents the storage and incineration facilities planned to be built in the five regions between 2008-2012 by the Ministry of Environment and Forestry by taking into consideration the growth of industrialization. It is observed that the Aegean and Marmara, including Thrace, have the greatest potential for planned facilities.

<sup>30</sup> IGEME (Export Promotion Center of Turkey), Environmental Technologies and Services Report, 2009

<sup>31</sup> Çevre ve Orman Bakanlığı (Ministry of Environment and Forestry), Waste Action Plan (2008-2012)



Figure 22- Incineration and Storage Facilities Planned to Be Built between 2008 - 2012



Various companies producing waste are also trying to find solutions for waste treatment. For example Petkim, which is the largest petrochemicals producer in Turkey, is planning to build a new facility to manage its own waste and environmental companies engaged in hazardous/medical waste treatment are also expected to be very active in Turkey.

One of the reasons for the low level of waste treatment in Turkey is the lack of landfills, storage for solid waste and solid waste handling equipment. The construction of landfills and storages is expected to start in the coming years.

Municipal water and wastewater treatment is the most emphasized area among others. Proper wastewater treatment is still low in Turkey and there still are small cities without any treatment facility. Although current public spending is low, there is a large potential for development due to scarce treatment facilities.

Clean air policy is another improvement area which Turkey is working towards. Public spending is low for air pollution as well as for other environmental areas.

### 2.3.2 Renewable Energy

According to IEA, the ratio of global renewable energy to total energy consumption is expected to increase by 53 percent in 2020. This indicates massive potential in the hydroelectric and other renewable energy market.

Turkey has significant wind, geothermal, and solar power potential. The high growth in electricity demand coupled with constraints on the supply side also signals high potential in the renewable energy market in Turkey.

Electricity generation in Turkey is currently largely based on coal, gas, oil and hydro. Gas provides about 48.6 percent of generated electricity, with coal accounting for some 28.3 percent<sup>32</sup>. Hydroelectric power generation is expected to significantly increase its market share by 2014 whereas the share of oil has been declining<sup>33</sup>.

<sup>32</sup> TEIAS (Turkish Electricity Transmission Company), <http://www.teias.gov.tr>

<sup>33</sup> BMI forecast (Business Monitor International)



Figure 23- Turkey's Non Thermal Power Forecast

Turkey's Non-Thermal Power, 2009-2014						
	2009e	2010f	2011f	2012f	2013f	2014f
Electricity generation, tw h <sup>1</sup>	185	192	201	211	220	230
Primary energy demand, mn toe	98	101	107	112	117	121
Hydro power generation, tw h <sup>2</sup>	35.0	39.0	40.0	42.0	43.0	45.0
% electricity generation <sup>1</sup>	17.8%	20.3%	19.9%	19.9%	19.5%	19.6%
Renew able energy generation, tw h <sup>1</sup>	1.0	1.3	1.5	1.8	1.9	2.1
% electricity generation <sup>1</sup>	0.5%	0.7%	0.7%	0.9%	0.9%	0.9%

Source: <sup>1</sup> BMI, <sup>2</sup> BP Statistical Review of World Energy, June 2009  
 Note: e/f: BMI estimate/forecast.

Turkey currently has 213 HEPPs with an installed capacity of 14.3GW<sup>34</sup>. According to the BMI forecasts and BP Statistical Review of World Energy Report, hydro-electric generation is expected to grow with a CAGR of 6.5 percent and renewable energy generation with a CAGR of 20 percent between 2009 and 2014, which are both above the 5.6 percent CAGR seen in electricity generation.

According to TEIAS forecasts, total installed capacity is expected to grow from 48,817 MW to 71,273 MW between 2010 and 2015 with a CAGR of 6.5 percent. Renewable energy is expected to form 37 percent of the total installed capacity and to remain stable in future years whereas currently renewable energy corresponds to 34 percent of the total.

Figure 24 - Long-term Electricity Forecast in Turkey

Long-term Electricity Capacity Forecast in Turkey			
Plant Type	Installed Capacity (MW)		
	2010	2015	2020
Thermal	30,583	45,603	62,273
Renew able	18,234	25,670	34,076
<b>Total capacity</b>	<b>48,817</b>	<b>71,273</b>	<b>96,349</b>

Source: General Directorate of State Hydraulic Works (DSİ), 2009 Annual Report

<sup>34</sup> DSI (The General Directorate of State Hydraulic Works), Annual Report, 2009



## 2.4 SWOT Analysis

### S

#### Strengths

- Suitable geography with various natural resources
- Turkey is among the first five countries in terms of geothermal resources
- The solar energy potential of Turkey is higher than the combined potential of several European countries
- According to the DSI Annual Report 2009, Turkey has 213 HEPPs with an installed capacity of 14.3GW
- The Turkish electricity market represents one of the most promising markets in Europe with respect to growth potential in the coming years

### W

#### Weaknesses

- Significant need for foreign environmental expertise in Turkey as most Turkish firms within the environmental technologies sector lack the capabilities to handle large environmental projects
- Lower efficiency in energy utilization compared to Europe
- Lack of financial resources of local entrepreneurs.

### O

#### Opportunities

- High potential of resources for the use of new renewable energy technologies (particularly boron and thorium resources)
- As a result of economic growth, industrialization and urbanization, the demand for EGS in Turkey is increasing, particularly in the waste management, water supply and management, and air pollution control sub-sectors.
- Turkey has started to focus on renewable energy, in an effort to decrease energy imports
- Tremendous investment opportunities in renewables market

### T

#### Threats

- Being import dependent on HEPP and WPP equipment
- Renewable energy resources are mainly state owned both in Turkey and globally
- Delay in the liberalization process and the private sector investments





## 2.5 Investment Opportunities

There is an encouraging investment climate for environmental technologies and the renewable energy sector in Turkey. There are significant investment opportunities in hazardous waste and solid waste management, water and waste water treatment and in renewable energy. Current opportunities in waste management and water supply concerns a relatively large market with a broad range of activities whereas the opportunities in environmental consultancy concern a smaller market.

There are also other opportunities in air pollution control, marine pollution control, carbon capture and storage, and carbon finance. These segments are expected to expand and offer attractive investment opportunities to investors in the future.

The Turkish renewable energy sector has been one of the most attractive sectors in terms of M&A activity in the last couple of years. Many utility industry giants have entered Turkey and there are numerous local entrepreneurs who have obtained renewable licenses but are looking for international partnerships.

The Turkish government is in the course of privatization of the distribution companies as a step towards full liberalization of the energy market. Privatization of electricity production companies has accelerated during 2010. 52 hydro-electric power plants' tenders were established under 19 groups of which 18 have been finalized with a total deal amount of USD 439.9 million.

The following major transactions demonstrate the increasing interest from international investors in the Turkish market since 2005.

Figure 25- M&A Transactions by Foreign Investors in the EGS and Renewable Energy Sector

M&A Transactions by Foreign Investors in the EGS and Renewable Energy Sector						
Acquirer	Origin	Target	Date	Stake	Deal Value (USD million)	
Energo - PRO as	Czech Republic	Aralık HPP / Hamzalı HPP / Resadiye Cascade	Apr-10	100.0%	407.0	
Not Disclosed	Turkey	ABK Elektrik Üretim AS	Apr-10	ND	ND	
Enerco Group	Turkey	Essentium Grupo	Jan-10	ND	ND	
Statkraft	Norway	Yeşil Enerji	Jun-09	95.0%	118.9	
EnBW	Germany	Borusan Enerji	Mar-09	50.0%	ND	
EDF Energies Nouvelles	France	Polat Enerji	Dec-08	50.0%	ND	
CEZ	Czech Republic	Akenerji	Oct-08	37.4%	302.6	
Cogentrix Energy (Goldman Sachs)	USA	Taşyapı Enerji	Jul-08	50.0%	ND	
Italgas	Italy	Bares Elektrik	Jul-08	100.0%	50.2	
Verbund	Austria	Enerjisa	Mar-07	50.0%	326.6	
Berggruen Holding	USA	BND Elektrik	Dec-06	66.7%	0.7	
United Development Company	Qatar	Türk Millenya	Jun-06	60.0%	ND	
Sumitomo Corporation	Japan	Birecik Dam and HEPP	May-05	31.0%	40.7	

N/D: Not Disclosed  
Source: Deloitte



## 2.6 Sector Establishments and Institutions

Establishments and Institutions	Code	Description	Website
Ministry of Environment and Forestry	MoEF	MoEF is responsible for environmental legislation and policy in Turkey.	<a href="http://www.cevreorman.gov.tr">http://www.cevreorman.gov.tr</a>
Ministry of Energy and Natural Resources	MENR	MENR is responsible for energy legislation and policy in Turkey.	<a href="http://www.enerji.gov.tr">http://www.enerji.gov.tr</a>
Energy Markets Regulatory Authority	EPDK	EPDK is responsible for licensing new energy projects, including renewables.	<a href="http://www.epdk.gov.tr">http://www.epdk.gov.tr</a>
Central Finance and Contracting Unit	CFCU	CFCU is responsible for implementing EU funded projects.	<a href="http://www.cfcu.gov.tr">http://www.cfcu.gov.tr</a>
General Directorate of State Hydraulic Works	DSI	DSI is the primary executive state agency responsible for overall water resources planning, managing, execution and operation.	<a href="http://www.dsi.gov.tr">http://www.dsi.gov.tr</a>
İller Bank	İB	Bank has the objective of supporting the Government's sustainable environmental services in selected municipalities.	<a href="http://www.ilbank.gov.tr">http://www.ilbank.gov.tr</a>
Turkish Electricity Transmission Company	TEİAŞ	TEİAŞ, being a state owned enterprise under the Decree Law No:233 and within the framework of the existing legislation and Articles of Association, has been acting in compliance with the new market structure depending upon the transmission licence obtained from Electricity Market Regulatory Authority (EMRA) on 13 March 2003.	<a href="http://www.teias.gov.tr">www.teias.gov.tr</a>
Electricity Generation Co.Inc.	EUAS	The state-owned company EUAS has taken up the responsibility of power plants which are not transferred to private companies. Additionally, it carries on as being sole owner of power plants whose operating rights have been transferred to private companies. In terms of supply security and other reasons, provided that approved by authorized entities, this company is going to build new power plants and operate them. This company (EUAS) has also taken up the responsibility of the operation of the hydraulic power plants constructed by Directorate-General of State Hydraulic Works (DSI).	<a href="http://www.euas.gov.tr">www.euas.gov.tr</a>
Turkish Electricity Distribution A.Ş.	TEDAS	TEDAS distributes and sells electricity to users in Turkey.	<a href="http://www.tedas.gov.tr">www.tedas.gov.tr</a>
Türkiye Elektrik Ticaret ve Taahhüt A.Ş.	TETAS	According to deregulation works in energy sector in 2001, Turkish Electricity Generation & Transmission (Teas) has been divided into three separate entities as Turkish Electricity-Transmission Company (TEİAŞ), Electricity Generation Company (EUAS) and Turkish Electricity Trading and Contracting Company (TETAS) on 01.10.2001. TETAS is founded to operate as the only wholesale of electricity which is the first electricity wholesaler public company.	<a href="http://www.tetas.gov.tr">http://www.tetas.gov.tr</a>
General Directorate of Electrical Power Resources Survey and Development Administration	EİE	Electrical Power Resources Survey and Development Administration ( EİE ) founded on June 24, 1935 under law No. 2819 EİE, being governed by the provisions of private law and administrated in accordance with commercial methods, having the status of a juridical person and being bound to the Ministry of Energy and Natural Resources, carrying out engineering service with opportunity of production of electrical energy is an investor public organisation.	<a href="http://www.eie.gov.tr">http://www.eie.gov.tr</a>
Environment Protection and Packing Wastes Utilization Foundation	CEVKO	CEVKO aims to protect environment, develop on-going recycling system for social development and contribution to economy.	<a href="http://www.cevko.org.tr">http://www.cevko.org.tr</a>



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## 2.8 Abbreviations

BMI	Business Monitor International
BOT	Build-Operate-Transfer
CAGR	Compound Annual Growth Rate
CCGT	Combined cycle gas turbine
DisCo	Distribution Company
DSI	The General Directorate of State Hydraulic Works
EIE	General Directorate of Electrical Power Resources Survey & Development Administration (Elektrik Isleri Etud Idaresi Genel Mudurlugu)
EIU	Economist Intelligence Unit
EGS	Environmental Goods & Services
EMEA	Europe, Middle-East and Africa
EPDK	Energy Markets Regulatory Authority
EUAS	Electricity Generation Co.Inc.
GDP	Gross Domestic Product
HEPP	Hydro Electricity Power Plant
WPP	Wind Power Plant
IEA	International Energy Agency
IGEME	Export Promotion Center (Ihracati Gelistirme Etud Merkezi)
MEF	Ministry of Environment and Forestry
MENR	Ministry of Energy and Natural Resources
OPEC	Organization of the Petroleum Exporting Countries
PED	Primary energy demand
PVPS	Photovoltaic Power Systems Programme
US	United States
USD	US Dollars
TEIAS	Turkish Electricity Transmission Company
TEAS	Turkish Electricity Generation and Distribution Co.Inc.
TOE	Ton Oil Equivalent
TOR	Transfer of Operating Rights
TUIK	Turkish Statistical Institute (Turkiye Istatistik Kurumu)
TUREB	Turkish Wind Energy Association (Turkiye Ruzgar Enerjisi Birligi)

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