



## TURKEY

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### INTRODUCTION AND BACKGROUND

Energy production in Turkey is mainly based on imported fossil fuel. Both limiting greenhouse gas emissions in energy production for struggling climate change and ensuring energy supply security for sustainable development are serious priorities. The performance of these priorities is closely related to increasing clean energy production and efficiency in the use of energy. Increasing clean energy supplies will be possible, mainly by expanding energy production through the use of renewable energy sources such as water, wind, sun, and geothermal. Turkey has a significant amount of renewable energy sources, especially hydraulic, wind, solar, geothermal, and biomass. The potential for renewable energy resources is in second place after coal. In Turkey, hydroelectric and biomass have the most important share of renewable energy production. The shares of wind and solar energies is very small, yet increases in these are expected in the future. With regards to energy resources and policies, Turkey assumes an active role for resources diversification. Hydrogen technologies are expected to take place an important place in country's future energy portfolio.

### UPDATE ON MEMBER'S ENERGY FRAMEWORK

#### UPDATE ON RELEVANT POLICIES

With regard to supply security, necessary legal and institutional infrastructure has been established in order to encourage electrical energy generated from renewable energy resources so as to diversify resources. This situation has a strong impact on development of renewable energy. Studies have kept going to improve the supportive environment.

Transition to a low carbon economy and clean production processes in industry will be promoted and informative activities regarding this subject will be focused on. For this purpose, moving the industry to production zones enabling them to produce with organized infrastructure facilities will be encouraged and the greenhouse gas emissions will be controlled, monitored and reported. Eco-efficiency programs which comply with clean production by dealing with sustainable development, economic growth and environmental performance will be implemented throughout the country.

#### UPDATE OVERVIEW ON RELEVANT PROGRAMS AND PROJECTS

##### Funding

Various initiatives have been taken under TÜBİTAK's lead to ensure the results of R&D activities create economic value and meet the needs of the private sector. They have mostly been conducted within the Turkish Research Area Program (TARAL). The aim of TARAL is to improve cooperation opportunities among all institutions which carry out R&D activities and demand the results of these activities. In this context, the "Academic and

### STATISTICS

#### Population

The population of Turkey is 74,724,269 on December 31, 2011

#### Territory

780 000 km<sup>2</sup>

#### Capital

ANKARA

#### GDP/capita

13,119 TL – 10,067 USD (2009)

#### Average Annual GDP Growth

2010 – %14.4 – TL

2010 - %17.6 - USD

#### Primary Energy Structure

##### Production

Total Production 32.493  
MillionTEP 2010

Type	% of total imports
<i>Fossil Fuels</i>	
<i>87.310 MTEP</i>	<i>% 99.887</i>
<b>Sub-Type</b>	<b>% of sub-total</b>
<i>Coal</i>	
<i>15.921 MTEP</i>	<i>18.235%</i>
<i>Natural Gas</i>	
<i>36.566 MTEP</i>	<i>41.881%</i>
<i>Petroleum</i>	
<i>34.823 MTEP</i>	<i>39.884%</i>
<i>Electricity</i>	
<i>0.098 MTEP</i>	<i>%0.113</i>



## Electricity

### Production

211207 GWh (2010)

Type	% of total production
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Fossil Fuels 155828 GWh	73.780%
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Sub-Type	% of sub-total
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Coal 55504 GWh	35.619%
Natural Gas 98144 GWh	62.982%
Petroleum 2180 GWh	1.399%

Renewables 54711 GWh	25.904%
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Sub-Type	% of sub-total
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Hydro 51795 GWh	94.670%
Wind 2916 GWh	5.330%
Solar 0 GWh	0%
Biofuel 0 GWh	0%
Geothermal 668 GWh	0.316%

### Imports

0.098 MTEP

### Exports

0.165 MTEP

### Total Demand/ Consumption

Consumption = 2347 kWh/  
person (2010)

Practical R&D Support,” “Public R&D Support,” “Industry R&D Support,” “Defense and Space R&D Support,” “Improvement of Science and Technology Awareness,” and the “Training and Development of Scientists” projects have been conducted successfully since 2005.

### Highlights of Progress

The National Science, Technology and Innovation Strategy-UBTYS (2011–2016) is in preparation by TÜBİTAK. The vision is “to contribute to new knowledge and develop innovative technologies to improve the quality of life by transforming the former into products, processes, and services for the benefit of the country and humanity.” Energy takes place under need oriented approaches as one of the three main areas.

## HYDROGEN R,D&D SPECIFICS

### PROGRAMS, PROJECTS, INITIATIVES IN BRIEF

According to the Industrial Strategy Document of Republic of Turkey Ministry of Industry and Trade as determined for a period of 2011–2014, studies for products based on alternative energy sources to be used in the industry, and improvement of their technical infrastructure and their transformation into commercial products will be carried out.

Within this framework, the Ministry of Industry and Trade will cooperate with the Scientific and Technological Research Council of Turkey, Universities and Public Sector, and provide support to projects for commercialization of production of hydrogen fuel cells for automotive industry and/or for power portable electronic equipment such as mobile phones, computers, etc., as well as for fuel cell based system optimization. Actions will be taken to develop technical capacity regarding hydrogen energy technologies, fuel cell applications, and industrial applications for the purpose of improving products based on alternative energy resources and supporting technological infrastructure and related R&D activities in Turkey and in the region.

Moreover, MSc, and PhD studies on hydrogen technologies are ongoing at universities. In 2011, 23 theses have been completed. The main subjects were the followings:

- Hydrogen use in lean burn spark ignition engines
- Electrochemical hydrogen storage
- Sorption enhanced ethanol reforming for hydrogen production
- H<sub>2</sub> production via microbial electrolysis
- Photofermentative hydrogen production
- Phototrophic hydrogen production
- Direct synthesis of hydrogen storage alloys
- Mg-Ti powder for hydrogen storage
- Design of metal hydride reactor for hydrogen storage
- Hydrogen production in immobilized bioreactors
- Geothermal energy use in hydrogen production and liquefaction
- Porous silicon based hydrogen cell
- H<sub>2</sub> production from lignocellulosic wet biomasses by supercritical water gasification
- Ammonia borane for chemical hydrogen storage
- Production of metal borohydride for hydrogen storage

- H<sub>2</sub> production from animal and processed milk waste
- H<sub>2</sub> storage tanks and computer aided modeling
- H<sub>2</sub> storage in carbon nanotubes
- Exergoeconomic analysis and life cycle assesment of biomass based hydrogen production
- H<sub>2</sub> production from olive pomace by supercritical water gasification
- H<sub>2</sub> production by supercritical water gasification of glucose and galactose
- H<sub>2</sub> as supplementary fuel in otto engines
- H<sub>2</sub> production from sorghum by aqueous phase reforming process

Every year, TÜBİTAK organizes competitions, called HIDROMOBİL and FORMULA G, in order to stimulate the use of hydrogen and solar technologies at industrial level, increase the awareness of hydrogen and renewable energy among the young researchers, and power the human resources on alternative technologies. This year, competitions were held on July 16–17th, 2011 at İzmir. The competition forces students to design better vehicles in terms of durability and aerodynamics.



## Imports

87.409 MTEP - 2010

Type	% of total imports
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Fossil Fuels	87.310 MTEP	% 99.887
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## Sub-Type

Sub-Type	% of sub-total	
Coal	15.921 MTEP	18.235%
Natural Gas	36.566 MTEP	41.881%
Petroleum	34.823 MTEP	39.884%

Renewables	54711 MTEP	25.904%
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## Exports

8.009 MTEP - 2010

Type	% of total imports
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Fossil Fuels	7.844 MTEP	% 97.939
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## Sub-Type

Sub-Type	% of sub-total	
Coal	0 MTEP	0.000%
Natural Gas	0.594 MTEP	7.573%
Petroleum	7.250 MTEP	92.427%

Electricity	0.165 MTEP	%2.060
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Figure I. Photos from the HIDROMOBİL and Formula G Competitions

**Consumption**

83.372 MTEP - 2010

<b>Type</b>	<b>% of total imports</b>
Fossil Fuels	
65.524 MTEP	78.592%

<b>Sub-Type</b>	<b>% of sub-total</b>
Coal	
23.837 MTEP	36.379%
Natural Gas	
27.667 MTEP	21.397%
Petroleum	
14.020 MTEP	42.224%

Renewables	
0.444 MTEP	0.532%
Hydro	
0.000 MTEP	0.000%
Wind	
0.000 MTEP	0.000%
Solar	
0.432 MTEP	97.297%
Biyofuel	
0.012 MTEP	2.703%

Jeothermal	
2.612 MTEP	3.133
Electricity	
14.79	17.741%

**REFERENCES**[www.tubitak.gov.tr](http://www.tubitak.gov.tr)[www.mam.gov.tr](http://www.mam.gov.tr)**OTHER IMPORTANT WEBSITES**<http://www.sanayi.gov.tr/><http://www.enerji.gov.tr/>**CONTACT INFORMATION**[Alper.sarioglan@mam.gov.tr](mailto:Alper.sarioglan@mam.gov.tr)[Asli.kaytaz@mam.gov.tr](mailto:Asli.kaytaz@mam.gov.tr)