



# ENE 101: Introduction to Energy Engineering



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**October 2017**



# Week 4: Energy Engineering Discipline



# Energy Engineering

- ❑ **Energy engineering** or **energy systems engineering** is a broad field of engineering dealing with *energy efficiency, energy services, facility management, plant engineering, environmental compliance and alternative energy technologies*.
- ❑ Energy engineering is one of the more recent engineering disciplines to emerge. Energy engineering combines knowledge from the fields of physics, math, and chemistry with economic and environmental engineering practices.
- ❑ Prepares the student to tackle the complex energy-related problems faced by society.



# Energy Engineering

Energy engineers apply their skills to increase efficiency and further develop renewable sources of energy.

The main job of energy engineers is to find the most efficient and sustainable ways to operate buildings and manufacturing processes.

Energy engineers audit the use of energy in those processes and suggest ways to improve the systems. This means suggesting ***advanced lighting, better insulation, more efficient heating and cooling properties of buildings.***



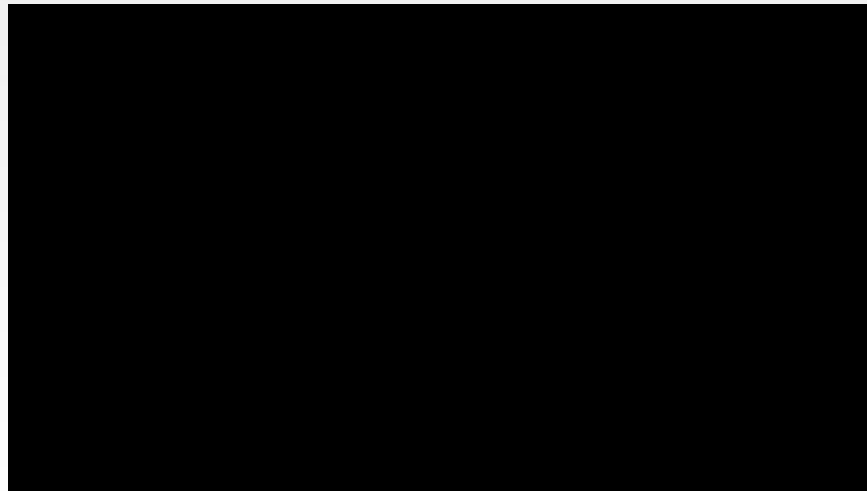
# Job Opportunities

**Job Opportunities:** There are many job opportunities for students who major in Energy Engineering, especially in **green energy**. Companies are hiring Energy Engineers, Clean Energy Specialists, Energy Conservation Engineers, Energy Efficiency Engineers, Energy Systems Engineers, Solar Energy Specialists, etc.

Employment fields will include Renewable Energy, Photovoltaic Engineering, Waste Management and Recycling, Oil and Gas Production, Fuels Engineering, Energy Systems, Energy Generation, Energy Storage, Energy Transmission, and Energy Consumption, etc. both domestic and global. Some of these jobs may not require a master's or Ph.D.



# Energy Engineering



- [https://www.youtube.com/watch?v=z\\_LYFfVQHyo](https://www.youtube.com/watch?v=z_LYFfVQHyo)



# Energy Engineering Courses

1. Sınıf / 1. Yarıyıl							
Dersin Kodu	Dersin Adı	Türü	Kuramsal	Uygulama	Toplam saat	Ulusal	AKTS
CHM 101	General Chemistry I (Genel Kimya I)	Z	3	2	5	4	6
PHY 121	Physics I (Fizik I)	Z	3	2	5	4	6
MTH 101	Calculus I (Matematik I)	Z	4	2	6	5	7
CHM 103	General Chemistry Lab. (Genel Kimya Lab.)	Z	0	4	4	2	3
ENE 101	Introduction to Energy Engineering (Enerji Mühendisliğine Giriş)	Z	1	0	1	1	2
ENE 103	Technical Drawing (Teknik Resim)	Z	1	2	3	2	3
OUL 101	Orientation to University Life (Üniversite Yaşamına Uyum)	Z	0	0	0	0	0
TUR 101	Turkish I (Türk Dili I)	Z	2	0	2	2	1
HIS 101	Atatürk Principles and History of Revolution I (Atatürk İlkeleri ve İnkılapları Tarihi I)	Z	2	0	2	2	1
ENG 101	Development of Reading and Writing Skills in English I (İngilizce Okuma ve Yazma Becerisinin Geliştirilmesi I)	Z	2	0	2	2	1
<b>Toplam</b>					<b>30</b>	<b>24</b>	<b>30</b>



# Energy Engineering Courses

## 1. Sınıf / 2. Yarıyıl

Dersin Kodu	Dersin Adı	Türü	Kuramsal	Uygulama	Toplam saat	Ulusal	AKTS
CHM 102	General Chemistry II (Genel Kimya II)	Z	2	2	4	3	5
PHY 122	Physics II (Fizik II)	Z	3	2	5	4	6
MTH 102	Calculus II (Matematik II)	Z	4	2	6	5	7
ENE 102	Computer Programming (Bilgisayar Programlama)	Z	3	2	5	4	5
PHY 172	General Physics Lab. (Genel Fizik Lab.)	Z	0	4	4	2	4
TUR 102	Turkish II (Türk Dili II)	Z	2	0	2	2	1
HIS 102	Atatürk Principles and History of Revolution II (Atatürk İlkeleri ve İnkılapları Tarihi II)	Z	2	0	2	2	1
ENG 102	Development of Reading and Writing Skills in English II (İngilizce Okuma ve Yazma Becerisinin Geliştirilmesi II)	Z	2	0	2	2	1
<b>Toplam</b>					<b>30</b>	<b>24</b>	<b>30</b>





## 2. Sınıf /

Dersin Kodu	Dersin Adı	Türü
ENE 201	Materials Science (Malzeme Bilimi)	Z
STA 231	Probability & Statistics (Olasılık ve İstatistik)	Z
ENE 205	Material and Energy Balances (Kütle ve Enerji Denklikleri)	Z
ENE 203	Circuit Analysis (Devre Analizi)	Z
MTH 211	Differential Equations (Diferansiyel Denklemler)	Z
ENG 201	Advanced Reading and Communication Techniques in English I (İngilizcede İleri Okuma ve İletişim Teknikleri I)	Z
ART xxx	Fine Arts (Güzel Sanatlar)	S

## 2. S

Dersin Kodu	Dersin Adı
ENE 202	Engineering Thermodynamics I (Mühendislik Termodinamiği I)
ENE 204	Energy and Environment (Enerji ve Çevre)
ENE 206	Fluid Mechanics (Akışkanlar Mekaniği)
ENE 208	Mechanics (Mekanik)
ENE 210	Numerical Analysis (Nümerik Analiz)
ENG 202	Advanced Reading and Communication Techniques in English II (İngilizcede İleri Okuma ve İletişim Teknikleri II)
ENS xxx	Social Electives (Sosyal Seçmeli)

## 3. S

Dersin Kodu	Dersin Adı
ENE 303	Engineering Thermodynamics II (Mühendislik Termodinamiği II)
ENE 301	Energy Conversion Processes I (Enerji Dönüşüm Prosesleri I)
ENE 305	Heat & Mass Transfer (Isı & Kütle Aktarımı)
ENE 307	Electric Power Systems (Elektirik Güç Sistemleri)
ENE 309	Engineering Economy (Mühendislik Ekonomisi)
ENE xxx	Electives (Bölüm Seçmeli Dersleri)

## 3.

Dersin Kodu	Dersin Adı
ENE 304	Materials in Energy Technologies (Enerji Teknolojileri Malzemeleri)
ENE 302	Energy Conversion Processes II (Enerji Dönüşüm Prosesleri II)
ENE 306	Sustainable Energy (Sürdürülebilir Enerji)
ENE 308	Management in Energy Engineering (Enerji Mühendisliğinde Yönetim)
ENE 310	Engineering Lab. I (Mühendislik Lab. I)
ENE xxx	Electives (Bölüm Seçmeli Dersleri)

## 4. S

Dersin Kodu	Dersin Adı
ENE 401	Energy Design Project I (Enerji Tasarım Projesi I)
ENE 403	Control System Analysis (Kontrol Sistem Analizi)
ENE 411	Engineering Lab. II (Mühendislik Lab. II)
ENE 499	Summer Practice (Staj)
ENE xxx	Electives (Bölüm Seçmeli Dersleri)
ENE xxx	Electives (Bölüm Seçmeli Dersleri)

Dersin Kodu	Dersin Adı
ENE 402	Energy Design Project II (Enerji Tasarım Projesi II)
ENE 404	Graduation Project (Bitirme Projesi)
ENE xxx	Electives (Bölüm Seçmeli Dersleri)
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# Qualifications

To become an energy engineer you need to have an **engineering or scientific-related degree**. Relevant subjects include:

- earth sciences;
- electrical, mechanical or chemical engineering;
- environmental engineering;
- environmental science and management;
- mining or petroleum engineering;
- renewable or sustainable energy.



# Turkey in Energy Sector

Turkey's ambitious vision for 2023, envisages especially interesting targets for the renewable part of the energy sector. These targets include:

34,000 MW capacity of hydro power plants;  
20,000 MW capacity of wind power plants;  
Minimum 5000 MW of solar power plants;  
Minimum 1000 MWe geothermal energy; and  
1000 MWe installed capacity for Biomass energy.

Turkey's primary target was even then to **increase share of renewable energy resources** for electricity generation at least to 30 percent by year 2023.



# Where stands Turkey now?

As of end of August 2015, Turkey has **71,858 MW** electricity generations installed capacity. **23,643 MW** of total installed capacity consists of generating facilities utilizing hydraulic resources,

**4053 MW** of total installed capacity consists of generating facilities utilizing **wind energy resources**,

**524 MW** of total installed capacity consists of generating facilities utilizing **geothermal energy resources**,

**317 MW** of total installed capacity consists of generating facilities utilizing **biomass energy resources** and waste heat, and

**155 MW** of total installed capacity consists of generating facilities utilizing **solar energy resources**.



# Where stands Turkey now?

As end of January 2015, generating facilities utilizing renewable energy resources constitutes 41% of total installed capacity.

As end of year 2013, electricity consumption is approximately 246.356 GWh and approximately 28% of this consumption is fulfilled by renewable energy resources. Approximate contribution of renewable energy resources group is 68,980 GWh which is formed by 86% hydraulic resources (59,420 GWh), 11% wind resources (7,557 GWh), 2% geothermal resources (1,363 GWh) and rest is biomass resources (1,171 GWh).



# Turkey's potential

- According to various resources Turkey has following minimum technical renewable energy potentials;
  - 160,000 GWh/year economic hydraulic capacity
  - 48,000 MW/year wind energy capacity
  - 1,500 kWh/m<sup>2</sup>-year average global solar radiation
  - 31,500 MWt geothermal capacity
  - 8.6 MTOE biomass potential
  - 1.5-2 MTOE biogas potential



# Hydropower

- *'Target 2023 → 34,000 MW capacity of hydro power plants'*
- Hydroelectricity power stations are well known due to their environmentally friendly and carrying low potential risk. Hydroelectricity power stations take also the role of insurance in energy prices, have a long lifespan, low operating costs, and are not dependent on imports.



# Hydropower

- Turkey has a theoretical hydroelectricity potential of 1% of theoretical potential of the world, while its economic potential is 16% of the economic potential of Europe.
- The hydraulic resources of Turkey holds the most important position in the renewable energy potential of 433 billion kWh, while the technically usable potential is 216 kWh, and the economic hydroelectricity potential is 140 billion kWh/year.
- As of the end of 2013, 41% of the potential was in operation, and 27% was in the process of being built. Turkey continues to take steps towards developing the investment environment based on competition within the electricity generation sector, which has been opened up to the private sector, 560 licenses had been obtained as of January 2013 (a total capacity of 12.515 MW) in order to build hydroelectricity plants (HES).
- As of the end of 2013, there were 467 HES plants, with a total installed capacity of 22.289 MW. This is the equivalent of 34,8% of the total potential. In 2013, 24,8% of our electricity output came from hydraulics.

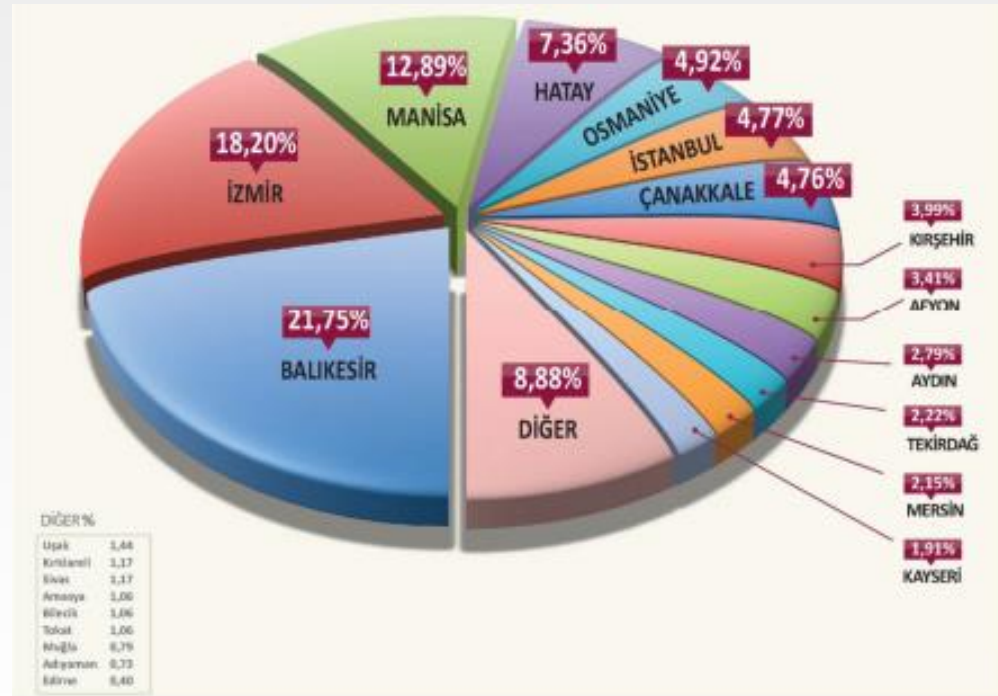




# Wind energy

'Target 2023 → 20,000 MW capacity of wind power plants'

the cities according to installed capacity for operational wind power plants (%)

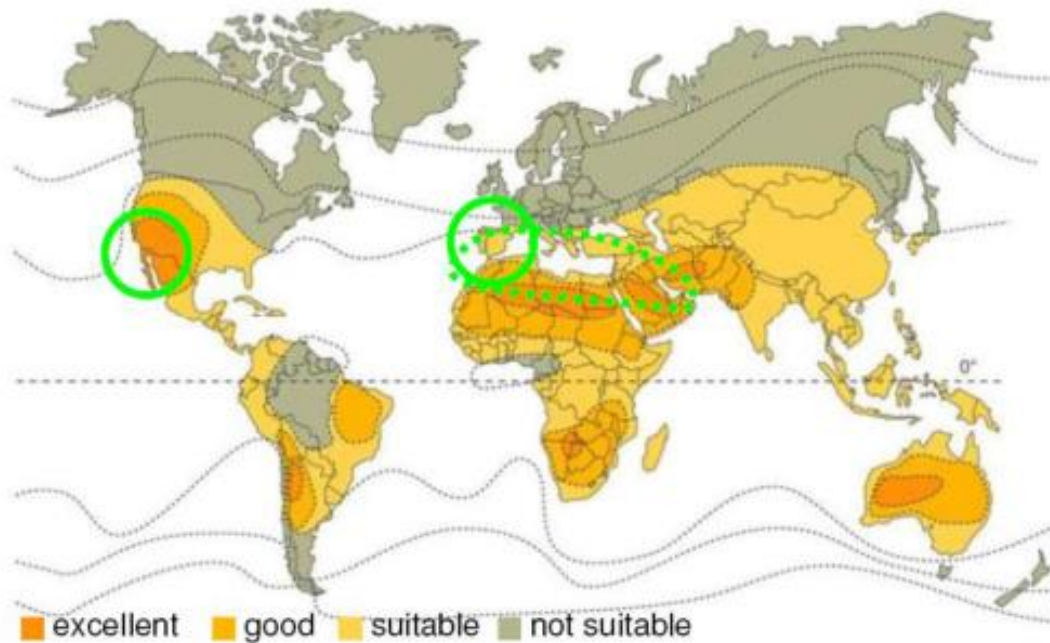


source: TWEA

<sup>2</sup> Please note: Wind energy potential (annual average wind speed > 7 m/s), 50 m a.g.l. / Calculated for the places located at altitudes of lower than 1500 m.



# Solar Energy



Source: YEGM

Turkey is very lucky to possess a high solar energy potential, in terms of its geographical location.

it has been determined that the total annual insolation time is 2.737 hours (a total of 7.5 hours per day), and the total solar energy derived per year is 1.527 kWh/m<sup>2</sup> per year (total 4,2 kWh/m<sup>2</sup> per day)

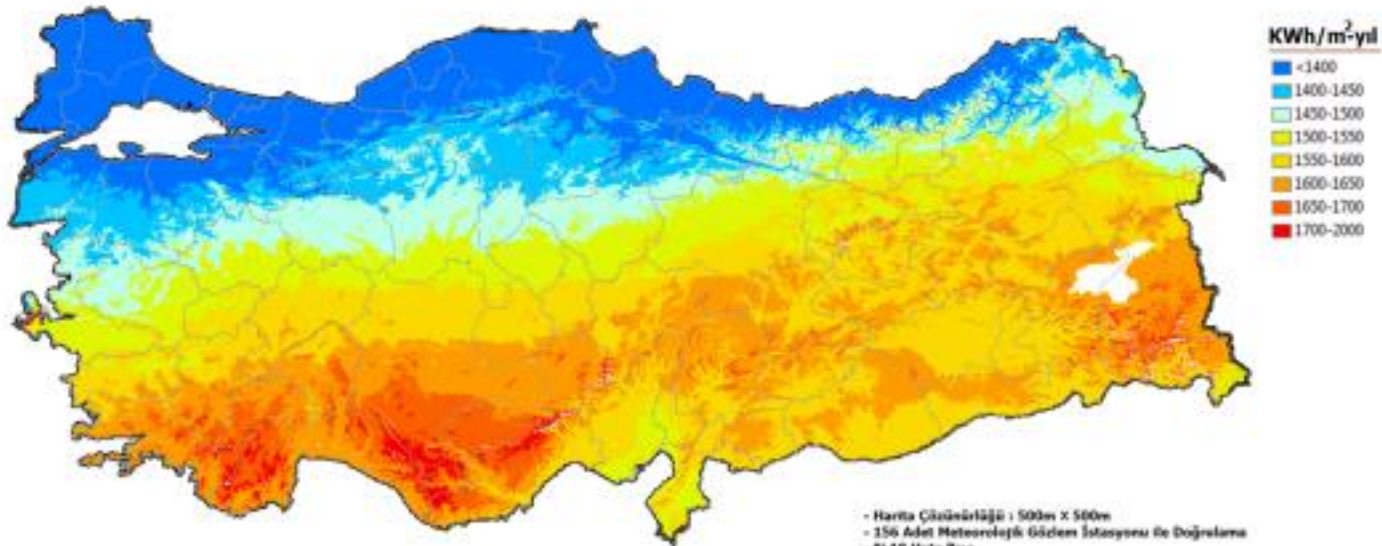
Source: Solar Millennium AG, Erlangen



# Solar Energy

'Target 2023  $\Rightarrow$  minimum 5000 MW of solar power plants'

In the picture below, you will see the average Global Solar Radiation of Turkey: 1,500 kWh/m<sup>2</sup>-year





# Geothermal Energy

- Geothermal energy includes all types of direct or indirect benefit derived from geothermal sources.
- Low temperature (20-70 C) fields are used for heating in particular, as well as in industry, for the production of chemicals.
- Medium temperature (70-150 C) and high temperature (above 150 C) fields can be used for the generation of electricity as well as in heating applications, in an integrated manner, subject to the re-injection conditions.
- The top 5 countries in geothermal heat and hot springs applications are China, the USA, Sweden, Turkey and Japan.



# Geothermal Energy

- 'Target 2023 → 1000 MWe geothermal energy
- As Turkey is situated on the Alps – Himalaya's belt, it is a country with quite a high geothermal potential. In theory, the geothermal capacity of Turkey is 31.500 MW.
- 79% of the areas with a potential, are situated in Western Anatolia, 8,5% in Central Anatolia, 7,5% in the Marmara Region, 4,5% in Eastern Anatolia and 0,5% in the other regions. 94% of the geothermal resources are low and medium heat, and suitable for direct applications (heating, thermal tourism, the output of minerals, etc.), while 6% are suitable for indirect applications (the generation of electricity energy).



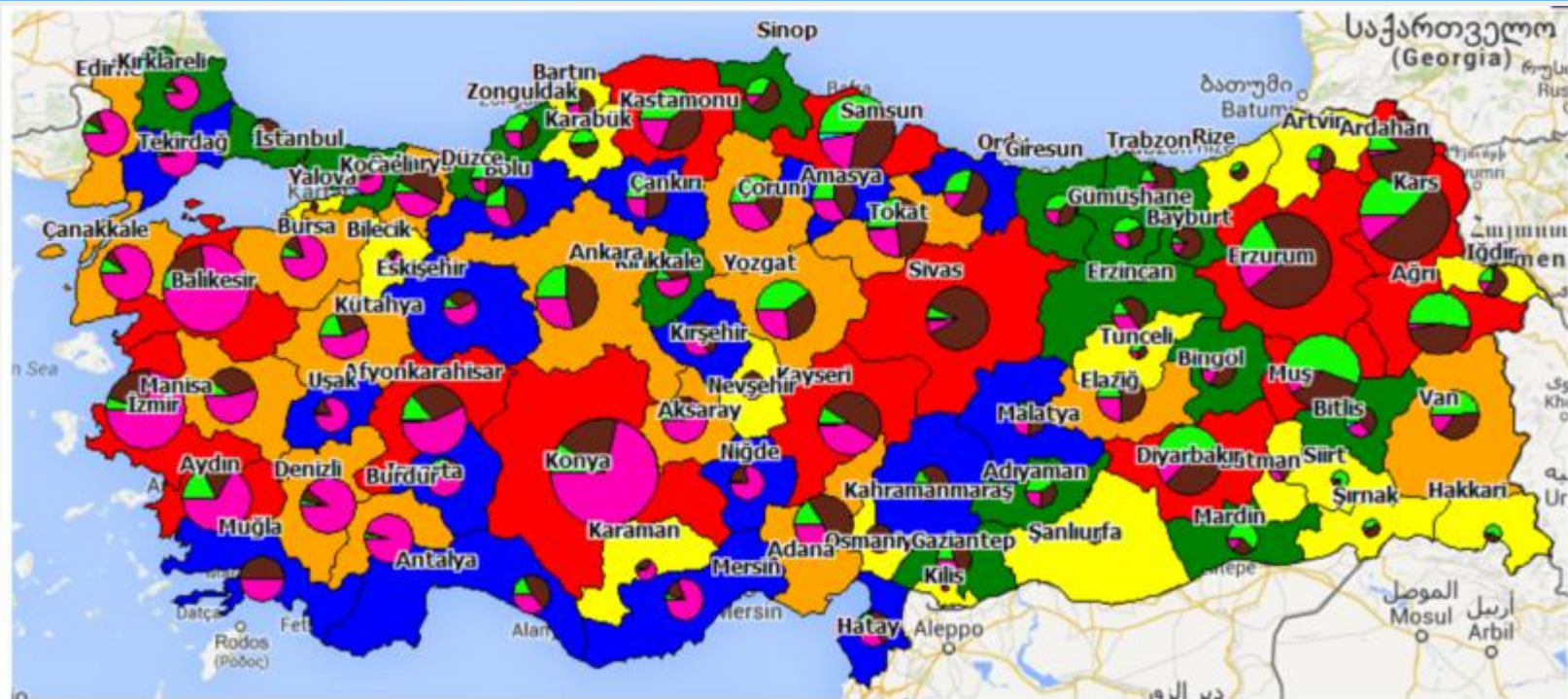


# Biomass Energy

- *Target 2023 → 1000 MWe installed capacity*
- Biodiesel is obtained from agricultural plants, and converts CO<sub>2</sub> by photosynthesis, ensuring the carbon cycle. Therefore, it does not have any impact of increasing the greenhouse effect.
- The total consumption of fuels in Turkey is 22 million tons. 3 million tons of this is petrol. In contrast to this the installed capacity for biodiesel in Turkey is 160 thousand tons.



# Biomass potential of Turkey



Source: YEGM





# References

- Renewable Energy Turkey, October 2015. Prepared by Derya Kaplan.  
(<https://www.rvo.nl/sites/default/files/2015/10/Renewable%20Energy%20Turkey.pdf>)
- <https://en.0wikipedia.org/https://en.0wikipedia.org/index.php?q=aHR0cHM6Ly9lbi53aWtpcGVkaWEub3JnL3dpa2kvRW5lcmd5X2VuZ2luZWVyaW5n>
- <http://engineeringscience.berkeley.edu/energy-engineering/>



TEŞEKKÜRLER

