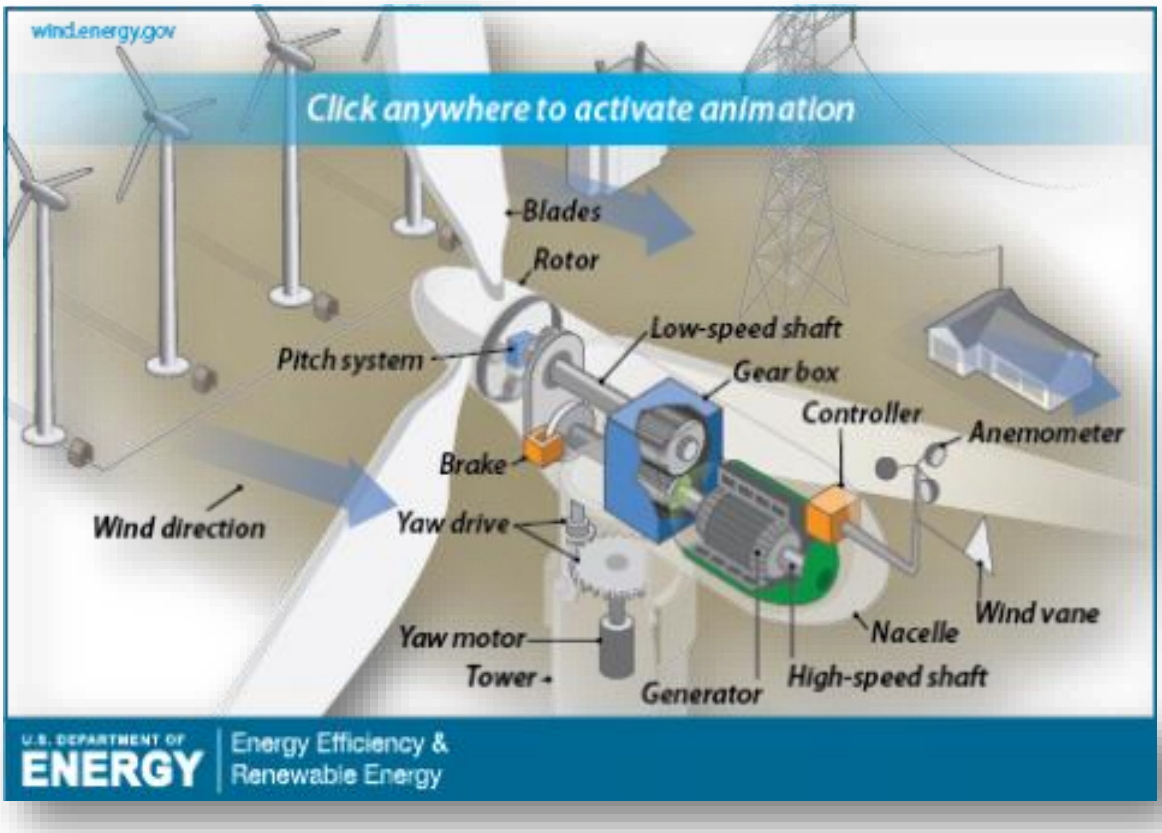
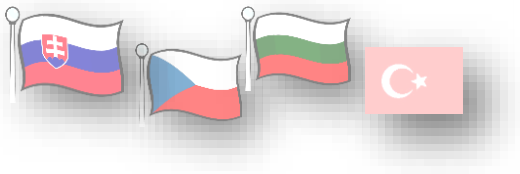
WIND POWER PLANTS

HOW DOES WIND POWER PLANT WORK?

So how do wind turbines make electricity? Simply stated, a wind turbine works the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns the blades, which spin a shaft, which connects to a generator and makes electricity. Wind is a form of solar energy and is a result of the uneven heating of the atmosphere by the sun, the irregularities of the earth's surface, and the rotation of the earth.

The terms wind energy or wind power describe the process by which the wind is used to generate mechanical power or electricity. Wind turbines convert the kinetic energy in the wind into mechanical power. This mechanical power can be used for specific tasks (such as grinding grain or pumping water) or a generator can convert this mechanical power into electricity.





PARTS OF WIND TURBINE

Anemometer: Measures the wind speed and transmits wind speed data to the controller.

Blades: Lifts and rotates when wind is blown over them, causing the rotor to spin. Most turbines have either two or three blades.

Brake: Stops the rotor mechanically, electrically, or hydraulically, in emergencies.

Controller: Starts up the machine at wind speeds of about 8 to 16 miles per hour (mph) and shuts off the machine at about 55 mph. Turbines do not operate at wind speeds above about 55 mph because they may be damaged by the high winds.

Gear box: Connects the low-speed shaft to the high-speed shaft and increases the rotational speeds from about 30-60 rotations per minute (rpm), to about 1,000-1,800 rpm; this is the rotational speed required by most generators to produce electricity. The gear box is a costly (and heavy) part of the wind turbine and engineers are exploring "direct-drive" generators that operate at lower rotational speeds and don't need gear boxes.

Generator: Produces 60-cycle AC electricity; it is usually an off-the-shelf induction generator.

High-speed shaft: Drives the generator.

Low-speed shaft: Turns the low-speed shaft at about 30-60 rpm.

Nacelle: Sits atop the tower and contains the gear box, low- and high-speed shafts, generator, controller, and brake. Some nacelles are large enough for a helicopter to land on.

Pitch: Turns (or pitches) blades out of the wind to control the rotor speed, and to keep the rotor from turning in winds that are too high or too low to produce electricity.

Rotor: Blades and hub together form the rotor.

Tower: Made from tubular steel (shown here), concrete, or steel lattice. Supports the structure of the turbine. Because wind speed increases with height, taller towers enable turbines to capture more energy and generate more electricity.

Wind direction: Determines the design of the turbine. Upwind turbines—like the one shown here—face into the wind while downwind turbines face away.

Wind vane: Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.

Yaw drive: Orients upwind turbines to keep them facing the wind when the direction changes. Downwind turbines don't require a yaw drive because the wind manually blows the rotor away from it.

Yaw motor: Powers the yaw drive.

TYPES OF WIND TURBINES

Modern wind turbines fall into two basic groups: the horizontal-axis variety, as shown in the photo to the far right, and the vertical-axis design, like the eggbeater-style Darrieus model pictured to the immediate right, named after its French inventor. Horizontal-axis wind turbines typically either have two or three blades. These three-bladed wind turbines are operated "upwind," with the blades facing into the wind.

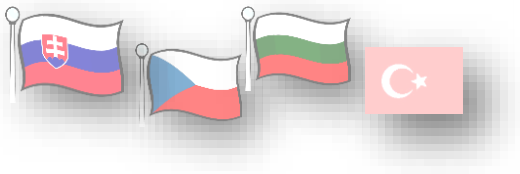
SIZES OF WIND TURBINES

Utility-scale turbines range in size from 100 kilowatts to as large as several megawatts. Larger wind turbines are more cost effective and are grouped together into wind farms, which provide bulk power to the electrical grid.

Single small turbines, below 100 kilowatts, are used for homes, telecommunications dishes, or water pumping. Small turbines are sometimes used in connection with diesel generators, batteries, and photovoltaic systems. These systems are called hybrid wind systems and are typically used in remote, off-grid locations, where a connection to the utility grid is not available.

ENERGY 101: WIND TURBINES VIDEO

This video explains the basics of how wind turbines operate to produce clean power from an abundant, renewable resource—the wind.



HOW DOES WIND ENERGY WORK – HOW MUCH ELECTRICITY CAN A TURBINE PRODUCE?

Electricity output depends on a number of variables including location (how much wind there is), turbine size and style, and rotar diameter.

Wind turbines have a rated capacity – how much electricity they will produce at optimal wind speeds. A 2kW rated wind turbine will produce 2 kWh of electricity for every hour it's exposed to optimal wind.

Generally, residential wind turbines are designed to function with wind speeds between 11 and 15 meters per second larger turbines are often positioned in high wind-exposure locations, so are designed to function at higher wind speeds – thus producing more electricity.

Because of the intermittent nature of wind, general guidelines are that wind turbines will output between 10-40% of their rated capacity.

A realistic estimate of how much electricity a wind turbine would produce can be calculated using the average wind speed and hours for your location and turbine model specifications. You can calculate this yourself, or a local dealer will have all the measurements.

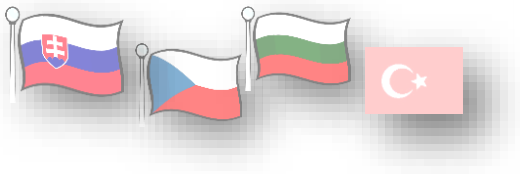
In summing up, wind is a low cost, low maintenance energy production method. Wind energy works by harnessing natural wind movements, capturing it as kinetic energy through turbine blades, then converting the kinetic energy into electricity through an electromagnetic generator at the top of the turbine.

ADVANTAGES AND DISADVANTAGES OF WIND ENERGY

ADVANTAGES OF WIND POWER PLANTS

Wind energy offers many advantages, which explains why it's one of the fastest-growing energy sources in the world. Research efforts are aimed at addressing the challenges to greater use of wind energy.

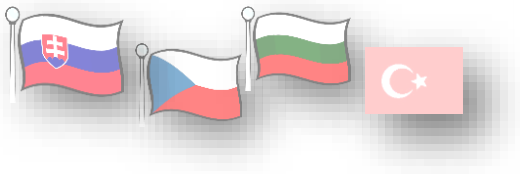
- ✓ **It's a clean fuel source.** Wind energy doesn't pollute the air like power plants that rely on combustion of fossil fuels, such as coal or natural gas. Wind turbines don't produce atmospheric emissions that cause acid rain or greenhouse gasses. Once the wind turbine is built the energy it produces does not cause green house gases or other pollutants



- ✓ **Wind energy is a domestic source of energy.** The nation's wind supply is abundant: over the past 10 years, cumulative wind power capacity in the United States increased an average of 30% per year, outpacing the 28% growth rate in worldwide capacity.
- ✓ **It's sustainable**. Wind is actually a form of solar energy; winds are caused by the heating of the atmosphere by the sun, the rotation of the earth, and the earth's surface irregularities. For as long as the sun shines and the wind blows, the energy produced can be harnessed to send power across the grid.
- ✓ **Wind power is cost effective.** It is one of the lowest-priced renewable energy technologies available today, costing between four and six cents per kilowatt-hour, depending upon the wind resource and project financing of the particular project.
- ✓ **Wind turbines can be built on existing farms or ranches.** This greatly benefits the economy in rural areas, where most of the best wind sites are found. Farmers and ranchers can continue to work the land because the wind turbines use only a fraction of the land. Wind power plant owners make rent payments to the farmer or rancher for the use of the land providing landowners with additional income. This is especially the case in agricultural areas as farming can still continue.
- ✓ **It creates jobs**. In 2014, the wind sector invested more than $8 billion of private capital in the U.S. economy to build projects and employed more than 73,000 workers. According to the *Wind Vision Report*, wind has the potential to support over 600,000 jobs in manufacturing, installation, maintenance, and supporting services by 2050.
- ✓ The wind is free and with modern technology it can be captured efficiently.
- ✓ Remote areas that are not connected to the electricity power grid can use wind turbines to produce their own supply.
- ✓ Wind turbines have a role to play in both the developed and third world.
- ✓ Wind turbines are available in a range of sizes which means a vast range of people and businesses can use them. Single households to small towns and villages can make good use of range of wind turbines available today

DISADVANTAGES OF WIND POWER PLANTS

- ✓ **Wind power must still compete with conventional generation sources on a cost basis.** Depending on how energetic a wind site is, the wind farm may or may not be cost



competitive. Even though the cost of wind power has decreased dramatically in the past 10 years, the technology requires a higher initial investment than fossil-fueled generators.

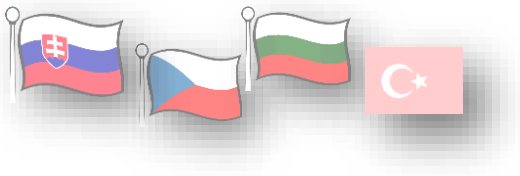
- ✓ **Good wind sites are often located in remote locations, far from cities where the electricity is needed.** Transmission lines must be built to bring the electricity from the wind farm to the city.
- ✓ **Wind resource development may not be the most profitable use of the land.** Land suitable for wind turbine installation must compete with alternative uses for the land, which may be more highly valued than electricity generation.
- ✓ **Turbines may cause noise and aesthetic pollution.** Although wind power plants have relatively little impact on the environment compared to other conventional power plants, there is some concern over the noise produced by the rotor blades, aesthetic (visual) impacts. Each one can generate the same level of noise as a family car travelling at 70 mph Many people see large wind turbines as unsightly structures and not pleasant or interesting to look at. They disfigure the countryside and are generally ugly.
- ✓ **The turbine blades may damage local wildlife.** Sometimes birds have been killed by flying into the rotors.
- ✓ The strength of the wind is not constant and it varies from zero to storm force. This means that wind turbines do not produce the same amount of electricity all the time. There will be times when they produce no electricity at all.
- ✓ Many people feel that the countryside should be left untouched, without these large structures being built. The landscape should left in its natural form for everyone to enjoy.
- ✓ When wind turbines are being manufactured some pollution is produced. Therefore wind power does produce some pollution.

ENVIRONMENTAL ISSUES

Wind energy development environmental concerns include, noise, visual impacts, and avian and bat mortality.

Although wind power plants have relatively little impact on the environment compared to fossil fuel power plants, concerns have been raised over the noise produced by the rotor blades, visual impacts, and deaths of birds and bats that fly into the rotors (avian/bat mortality).

Noise



Like all mechanical systems, wind turbines produce some noise when they operate. Most of the turbine noise is masked by the sound of the wind itself, and the turbines run only when the wind blows. In recent years, engineers have made design changes to reduce the noise from wind turbines. Early model turbines are generally noisier than most new and larger models. As wind turbines have become more efficient, more of the wind is converted into rotational torque and less into acoustic noise. Additionally, proper siting and insulating materials can be used to minimize noise impacts.

Visual Impacts

Because they must generally be sited in exposed places, wind turbines are often highly visible; however, being visible is not necessarily the same as being intrusive. Aesthetic issues are by their nature highly subjective. Proper siting decisions can help to avoid any aesthetic impacts to the landscape. One strategy being used to partially offset visual impacts is to site fewer turbines in any one location by using multiple locations and by using today's larger and more efficient models of wind turbines.

Avian /Bat Mortality

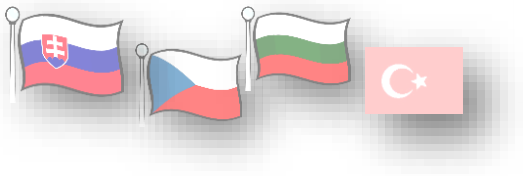
Bird and bat deaths are one of the most controversial biological issues related to wind turbines. The deaths of birds and bats at wind farm sites have raised concerns by fish and wildlife agencies and conservation groups. On the other hand, several large wind facilities have operated for years with only minor impacts on these animals.

To try to address this issue, the wind industry and government agencies have sponsored research into collisions, relevant bird and bat behavior, mitigation measures, and appropriate study design protocols. In addition, project developers are required to collect data through monitoring efforts at existing and proposed wind energy sites. Careful site selection is needed to minimize fatalities and in some cases additional research may be needed to address bird and bat impact issues.

While structures such as smokestacks, lighthouses, tall buildings, and radio and television towers have also been associated with bird and bat kills, bird and bat mortality is a serious concern for the wind industry.

Other Concerns

Unlike most other generation technologies, wind turbines do not use combustion to generate electricity, and hence don't produce air emissions. The only potentially toxic or hazardous materials are relatively small amounts of lubricating oils and hydraulic and insulating fluids. Therefore, contamination of surface or ground water or soils is highly unlikely. The primary



health and safety considerations are related to blade movement and the presence of industrial equipment in areas potentially accessible to the public. An additional concern associated with wind turbines is potential interference with radar and telecommunication facilities. And like all electrical generating facilities, wind generators produce electric and magnetic fields.

WIND POWER PLANTS IN TURKEY

With its growing economy, Turkey is one of the fastest growing energy markets in the world. Electricity demand in Turkey has doubled the economic growth rate in the last 2-3 decades. Turkey is the second fastest growing country after China in terms of natural gas and electricity demand.

Despite the increasing energy demand, Turkey is dependent on foreign energy sources due to its limited natural gas and oil reserves. Turkey currently imports 98% of its total natural gas demand and 92% of the total oil demand. Turkey's total energy dependence on foreign sources is more than 70%.

The current account deficit is one of the main problems of Turkish economy. Energy import need of Turkey is the main reason of the current account deficit. Turkey's current account deficit was $64.66 billion in 2013.

Development of internal energy sources is the main goal in Turkey's energy strategy due to high energy dependence and high import bill.

Turkey's energy strategy particularly focuses on renewable energy sources. Hydropower is the biggest renewable energy source in Turkey, and according to TEİAŞ hydropower covers 34.1% of Turkey's total installed capacity.

Wind power is the second largest renewable energy source after hydropower. Share of wind power in Turkey will make 5.2% of total installed capacity at the end of January 2015.
Wind Energy due to its geographic location, Turkey is under the influence of different pressure systems. In winter, the Island High Pressure system expands its impact area to southern latitudes of Turkey, causing strong, gusting winds from the north and especially north eastern directions. Anatolia, especially the western side, is under the influence of western and north western winds. In summer, Turkey is influenced by the Azores High Pressure center, causing constant winds from the north, especially in the western regions of Turkey. The strong gradient of the Azores High Pressure center and the Basra Low Pressure center in the east creates

gusting north eastern winds in the eastern region. Southern, as well as eastern regions are generally under the impact of winds from the south and south-eastern direction.

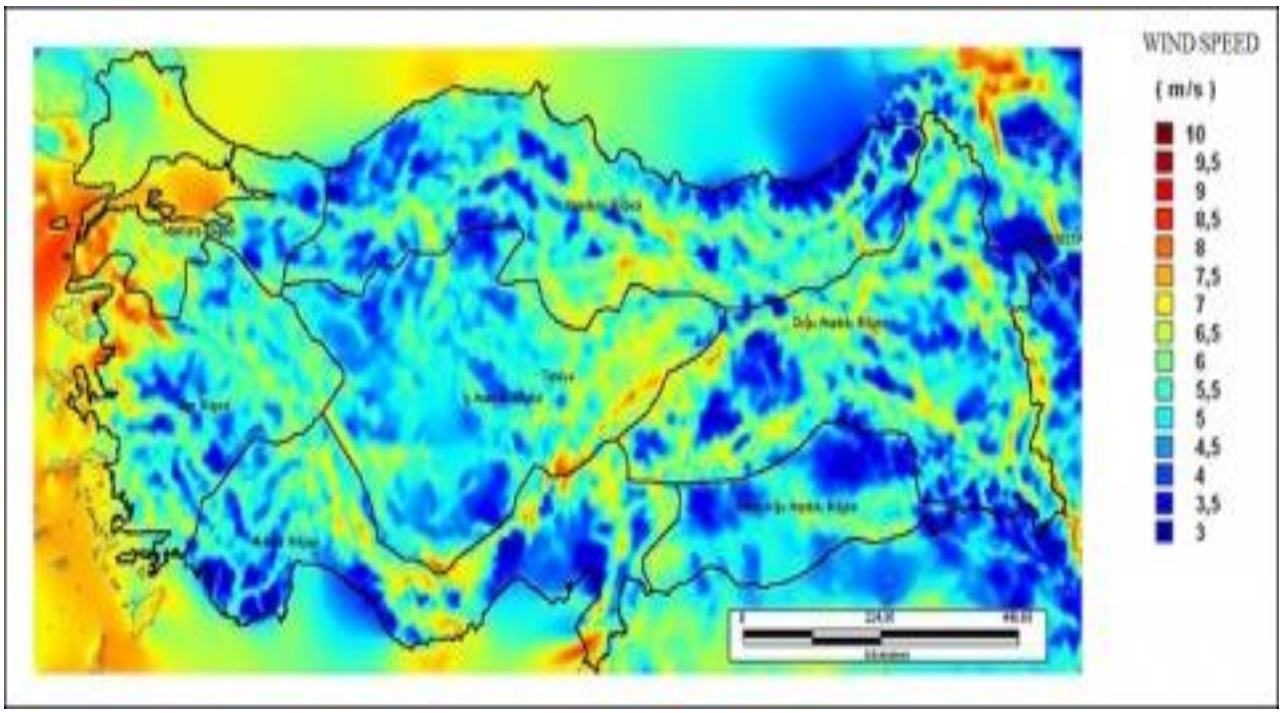


***Figure 1*:** Scattering of average wind speed at 50 m high in Turkey.

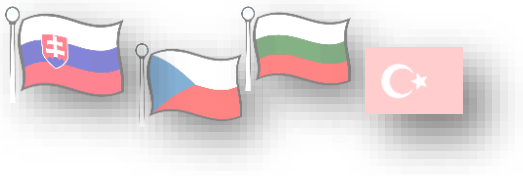
The reason for the distribution can be understood by looking at Figure 1, which shows the wind speed and the associated wind power at 50 m. The main wind potentials are located at the coastlines of the Marmara and Aegean regions, as well the coast of the Black sea region. Just these three (3) regions contain about 74% of the technical potential.

Power intensity in 50 m of elevation above ground, which is significant to establish turbines, in places with 4-5 m/s of average annual wind speed at 50 m of elevation above ground mostly exceed annual average of 500 w/m^2. Estimated figures resulting from the researcher conducted in the field, technical wind energy potential of Turkey, established power, and average efficiencies are available in Table 1. In this table, the land of Turkey has been classified by means of wind energy resource degree. It can be seen from this table that approximately 37% of the land of Turkey has capacity above medium.

Table 1: *Areal distribution of wind speed, power and potential energy amount in Turkey.*

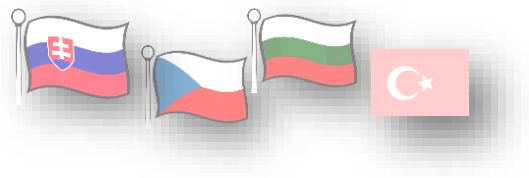
Wind source degree	Wind class	Wind power at 50 m. (W/m^2)	Wind speed at 50 m. (m/s)	Overall area (km^2)	Windy land (%)	Potential capacity (MW)
Medium	3	300–400	6.8–7.5	16781.39	2.27	83906.96
Good	4	400–500	7.5–8.1	5851.87	0.79	29259.36
Perfect	5	500–600	8.1–8.6	2598.86	0.35	12994.32
Perfect	6	600–800	8.6–9.5	1079.98	0.15	5399.92
Perfect	7	>800	>9.5	39.17	0.01	195.84
Total				26351.28	3.57	131756.40

First small-scale application to generate electrical energy in Turkey was started with a plant that has 55 kW installed power in Izmir-Çeşme in the Aegean region in 1986. The first power plant in large-scale was also installed in 1998, Çeşme-Germiyan with 1.74 MW capacity. In 1998, the ARES wind farm was built in Çeşme-Alaçatı and included 12 × 600 kW wind turbines.

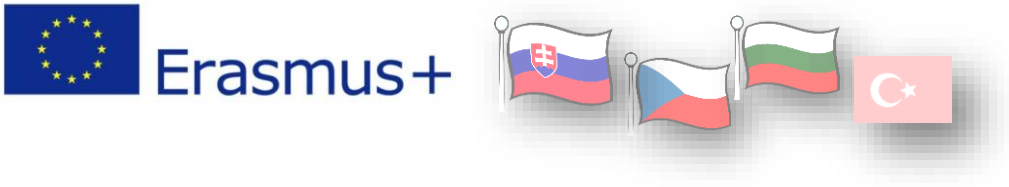


Wind Energy Power Stations Active in Turkey (January 2015)

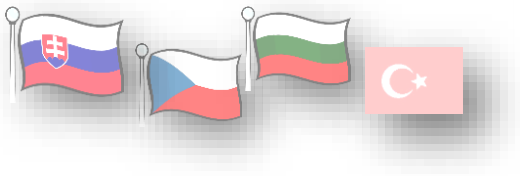
İŞLETMEDEKİ RÜZGAR ENERJİSİ SANTRALLERİ							
WIND POWER PLANTS UNDER OPERATİON							
FİRMA ADI	**PROJE ADI**	**KURULU GÜÇ (MW)**	**İL**	**TÜRBİN ÜRETİCİSİ**	**TÜRBİN MODELİ**	**TÜRBİN GÜCÜ**	**İŞLETMEYE GİRİŞ TARİHİ**
COMPANY NAME	PROJECT NAME	INSTALLED CAPACITY (MW)	CITY	TURBINE MANUTACTURERS	TURBINE MODEL	TURBINE POWER	COMMERCEMENT OG OPERATION
Ayen En.A.Ş.	Akbük RES	31,5	Aydın	SUZLON	S 88	2,1 MW	2009
Akhisar Rüz.En.El.Ür.San.Ltd.Şti	AKRES	45	Manisa	NORDEX	N90	2,5 MW	2000
Aksu Temiz En.Ür.San. ve Tic.A.Ş.	Aksu RES	72	Kayseri	VESTAS	V100-2.0	2 MW	2012
Tan Elektrik Ür.A.Ş.	Aliağa RES	9,6	İzmir	NORDEX	N117	2,4 MW	2014
Baktepe En.A.Ş.	Amasya RES	40	Amasya	NORDEX	N100	2,5 MW	2008
Ares Alaçatı Rüs.En.San.Tic.A.Ş.	ARES	7,2	İzmir	VESTAS	V44-600	600 KW	1998
Aksa Enerji Ür.A.Ş.	Atik Belen RES	18	Hatay	GAMESA	G90	2 MW	2014
Ayres Ayvacık El.Ür.Sant.Ltd.Şti	AyRES	5	Çanakkale	VESTAS	V90-1.80	1,8 MW	2011
Ak En.El.Ür.A.Ş.	Ayyıldız RES	15	Balıkesir	VESTAS	V90-1.3	3 MW	2009
Borusan EnBW	Balabanlı RES	50,6	Tekirdağ	SIEMENS	SWT-2.3-108	2,3 MW	2014
Bares El.Ür.A.Ş.	Balıkesir RES	143	Balıkesir	GE	GE2.73-103	2,75 MW	2012
Yapısan El.Ür.A.Ş.	Bandırma RES	30	Balıkesir	GE	GE1.5se	1,5 MW	2006
Borasco En. Ve Kim.San.Tic.A.Ş.	Bandırma RES	60	Balıkesir	VESTAS	V90-3.0	3 MW	2009/2010
Bandırma En. ve El.Ür.Tic.A.Ş.	Bandırma RES ext-1	26,4	Balıkesir	VESTAS	V112-3.3	3,3MW	2014
Yapısan El.Ür.A.Ş.	Bandırma RES ext	5	Balıkesir	NORDEX	N90	2,5 MW	2012
As Makinsan En.El.Ür.San.Tic.A.Ş.	Bandırma-3 RES	25	Balıkesir	NORDEX	N90	2,5 MW	2008
Belen El.Ür.A.Ş.	Belen RES	48	Hatay	VESTAS	V90-3.0	3 MW	2099/2010/2012
Bergama RES En.Ür.A.Ş.	Bergama RES	90	İzmir	NORDEX	N90	2,5 MW	2007
Bores Bozcaada Rüs.En.San.Tic.A.Ş.	Bozcaada RES	10,2	Çanakkale	ENERCON	E-40	0,6 MW	2000
Kardemir Haddecilik San.Tic.Ltd.Şti	Bozyaka RES	12,5	İzmir	NORDEX	N100	2,55 MW	2012
Integreen Yenilenebilir Enerji Sistemleri A.Ş.	BURES	0,9	İstanbul	ENERCON	E-44	0,9 MW	2014
Doğal En.El.Ür.A.Ş.	Burgaz RES	14,9	Çanakkale	ENERCON	E-48/E-44	0,8MW / 0,9MW	20117
Alize En.El.Ür.A.Ş.	Çamsaki RES	20,8	Çanakkale	ENERCON	E-82/E-48	2 MW / 0,8 MW	2009
BORA Rüz.El.Ür.San. Ve Tic.A.Ş.	Çanta RES	47,5	İstanbul	NORDEX	N100	2,5 MW	2013/2014
Sanko Rüz.En.San. Ve Tic.A.Ş.	Çatalca RES	60	İstanbul	VESTAS	V90-3.0	3 MW	2008



Alize En.El.Ür.A.Ş.	Çataltepe RES	16	Balıkesir	ENERCON	E-82/E-48	2 MW	2010
Alize En.El.Ür.A.Ş.	Çeşma RES	1,5	İzmir	ENERCON	E-40	0,5 MW	1998
Enerjisa En.Ür.A.Ş.	Dağpazarı RES	39	Mersin	SIEMENS	SWT-3.0-101	3,0 MW	2011
Dares Datça Rüz.En.Sant.San. Ve Tic.A.Ş.	Dares Datça RES	29,6	Muğla	ENERCON	E-48/E-44	0,8MW / 0,9MW	2008
Olgu En.Ür.Tic.A.Ş.	Dinar RES	115	Afyon	SIEMENS	SWT-2.3-108	2,3 MW	2013
Ütopya En.Ür.San.Tic.A.Ş.	Düzova RES	51,5	İzmir	GE	GE2.5-100	2,5 MW	2009/2010/2012/2013
Edincik Enerji El.Ür.A.Ş.	Edincik RES	30	Balıkesir	NORDEX	N100	2,5 MW	2013
Boreas En.Ür.San. Ve Tic.Ltd.Şti	Enez RES	15	Edirne	NORDEX	N90	2,5 MW	2008
Geres Enerji Ür.Tic.A.Ş.	GERES	27,5	Manisa	NORDEX	N90	2,5 MW	2014
Al-Yel El.Ür.A.Ş.	Geycek RES	150	Kırşehir	ENERCON	E-82/E-48	2MW / 3MW	2013/2014
Garet En.Ür. Ve Tic.A.Ş.	GokRES	35,75	Manisa	GE	GE2.75-103	2,75 MW	2014
Rotor El.Ür.A.Ş.	Gökçedağ RES	135	Osmaniye	GE	GE2.5-100	2,5 MW	2009/2010
Manres El.Ür.A.Ş.	Günaydın RES	12,5	Balıkesir	GE	GE2.5-100	2,5 MW	2012
Manres El.Ür.A.Ş.	Günaydın RES ext	8,25	Balıkesir	GE	GE2.75-100	2,75 MW	2014
Eksim Enerji Ür.A.Ş.	Hasanbeyli RES	50	Osmaniye	NORDEX	N100	2,5 MW	2014
Tamyeli Enerji Üretim A.Ş.	İncesu RES	13,2	Afyon	VESTAS	V112-303	3,3 MW	2014
Anemon El.Er.Ür.A.Ş.	İntepe RES	35	Çanakkale	ENERCON	E-48/E-82	0,8MW / 2,3MW	2007/2014
Kangal Elektrik Üretim A.Ş.	Kangal RES	44	Sivas	VESTAS	V100-2.0	2,0 MW	2014
Kapıdağ Rüz.En.Sant.El.Ür.San. ve Tic.A.Ş.	Kapıdağı RES	24	Balıkesir	VESTAS	V80-2.0	2,0 MW	2013
Kapıdağ Rüz.En.Sant.El.Ür.San. ve Tic.A.Ş.	Kapıdağı RES	4	Balıkesir	VESTAS	V80-2.0	2,0 MW	2014
Lodos Er.Ür.A.Ş.	Karaburun RES	120	İzmir	ENERCON	E-82	2MW / 3 MW	2013
Garet En.Ür. Ve Tic.A.Ş.	Karadağı RES	10	İzmir	GE	GE2.5-100	2,5 MW	2012
Aysu En.Sar. Ve Tic.A.Ş.	Karadere RES	15	Kırklareli	GE	GE1.6-100	1,6 MW	2014
Deniz El.Ür.Ltd.Şti	Karakurt RES	10,8	Manisa	VESTAS	V90-1.80	1,8 MW	2007
Briza El.Ür.A.Ş.	Kavaklı RES	52	Balıkesir	VESTAS	V112-3.3	3,3 MW	2014
Alize En.El.Ür.A.Ş.	Keltepe RES	23	Balıkesir	ENERCON	E-44/E-70	0,9MW/ 2,3 MW	2009/2014
Lodos Er.Ür.A.Ş.	Kemerburgaz RES	24	İstanbul	ENERCON	E-82	2 MW	2008
Alenka Enerji Ür. ve Yat. Ltd.Şti.	Kıyıköy RES	28	Kırklareli	GAMESA	G90-G97	2,0 MW	2014
Kores Kocadağ Rüz.En.Sant.Ür.A.Ş.	KORES	17,5	İzmir	NORDEX	N90	2,5 MW	2012
Ayen En.A.Ş.	Korkmaz RES	25,2	İzmir	SUZLON	S 88	2,5 MW	2014
Doğal En.El.Ür.A.Ş.	Kozbeyli RES	32,2	İzmir	ENERCON	E-70	2,3 MW	2012/2013
Alize En.El.Ür.A.Ş.	Kuyucak RES	25,6	Manisa	ENERCON	E-70/E-44	2 MW / 0,9 MW	2010
Kıroba El.Ür.A.Ş.	Madranbaba RES	19,5	Aydın	GAMESA	G90	2,0 W	20123
Enerjisa En.Ür.A.Ş.	Mahmudiye RES	29,9	Çanakkale	SIEMENS	ST-2.3-101	2,3 MW	2010
Mare Manastır Rüz.El.San.Tic.A.Ş.	Mare Manastır RES	39,2	İzmir	ENERCON	E-48/E-44	0,8 MW / 0,9 MW	20116/2007



Mazı-3 Rüz.En.Sant.El.Ür.A.Ş.	Mazı-3 RES	30	İzmir	NORDEX	N90	2,5 MW	2011
Akdeniz El.Ür.A.Ş.	Mersin Mut Extension	9	Mersin	VESTAS	V90-3.0	3 MW	2013
Akdeniz El.Ür.A.Ş.	Mersin Mut RES	33	Mersin	VESTAS	V90-3.0	3 MW	2010
Can Enerji Ent.El.Ür.A.Ş.	Metristepe RES	40	Bilecik	NORDEX	N100	2,5 MW	2011
Ayen En.A.Ş.	Mordoğan RES	31,5	İzmir	SUZLON	S 88	2,1 MW	2014
R.K. RES El.Ür.San. Ve Tic.Ltd.Şti	Paşalimanı RES	0,8	Balıkesir	ENERCON	E-53	0,8 MW	2013
Pitane Elektrik Ür.Ltd.Şti	Pitane RES	4,8	İzmir	NORDEX	N117	2,4 MW	2014
Poyraz En.El.Ür.A.Ş.	Poyraz RES	54,9	Balıkesir	ENERCON	E-82	2 MW	2012/2013
Öres El.Ür.A.Ş.	Salman RES	27,5	İzmir	GE	GE2.75-100	2,78 MW	2014
Doğal En.El.Ür.A.Ş.	Samurlu RES	34,5	İzmir	ENERCON	E-70	2,3 MW	2012/2013
Saray Dök.Mad.Ak.San.Tic.A.Ş.	Saray RES	4	Tekirdağ	ENERCON	E-82	2 MW	2012
Garet En.Ür. Ve Tic.A.Ş.	SaRES	24,75	Çanakkale	GE	GE2.75-100	2,75 MW	2010/2011
Alize En.El.Ür.A.Ş.	Sarıkaya RES	28,8	Tekirdağ	ENERCON	E-82/E-70/E-48	2MW / 0,8 MW	2009
Doğal En.El.Ür.A.Ş.	Sayalar RES	54,2	Manisa	ENERCON	E-82/E-70/E-44	2 MW / 0,9 MW	2008/2013
Deniz El.Ür.Ltd.Şti	Sebenoba RES	34	Hatay	VESTAS	V80-2.0	2 MW	2011
Ealos Rüz.En.Ür.A.Ş.	Senkoy RES	36	Hatay	ALSTOM	ECO100/ECO110	3 MW	2012/2013
Doruk En.Ür.San.Tic.A.Ş.	Seyitali RES	30	İzmir	ENERCON	E-70	2 MW	2011
Silivri Enerji Ür.A.Ş.	Silivri RES	45	İstanbul	NORDEX	N100	2,5 MW	2014
Tektuğ En.Ür.A.Ş.	Sincik RES	27,5	Adıyaman	NORDEX	N100	2,5 MW	2013
Soma En.El.Ür.A.Ş.	Soma RES	196,1	Manisa	ENERCON	E-70/E-44	2 MW / 0,9 MW	2011/2012/2014
Bilgin Rüz.Sant.En.Ür.A.Ş.	Soma RES	90	Manisa	NORDEX	N90	2,5 MW	2007
ABK En.Ür.San. Ve Tic.A.Ş.	Söke-Çatalbük RES	30	Aydın	GAMESA	G90	2,0 MW	2010
Sunjüt Suni Jüt San.Tic.A.Ş.	Sunjüt RES	1,2	İstanbul	ENERCON	E-40	0,6 MW	2006
Alentek En.A.Ş.	Susurluk RES	60	Balıkesir	NORDEX	N100/N90	2,5 W	2012
Çanres El.Ür.A.Ş.	Şadıllı RES	38,5	Çanakkale	GE	GE2.75-100	2,75 MW	2014
Galata Wind En.Ltd.Şti	ŞahRES	93	Balıkesir	VESTAS	V90-3.0	3,0 MW	2011
Galata Wind En.Ltd.Şti	ŞahRES Extension	12	Balıkesir	VESTAS	V90-3.0	3,0 MW	2013
Baki El.Ür.Ltd.Şti	Şamlı RES	113,4	Balıkesir	VESTAS	V90-3.0	3,0 MW	2088/2010
Yeni Belen Enerji Elektrik Üretim	Şenbük RES	27	Hatay	VESTAS	V112-3.3	3,0 MW	2013
Bakras Enerji Elektrik Ür. Ve Tic. A.Ş.	Şenbük RES	15	Hatay	VESTAS	V90-3.0	3,0 MW	2010
Bakras Enerji Elektrik Ür. Ve Tic. A.Ş.	Şenbük RES Extension	23	Hatay	VESTAS	V112-3.3	3,3 MW	2014
Teperes El.Ür.A.Ş.	TepeRES	0,85	İstanbul	VESTAS	V52-850	850 KW	2006
Pem En.A.Ş.	Tokat RES	40	Tokat	NORDEX	N100	2,5 MW	2010/2011
Sabaş El.Ür.A.Ş.	Turguttepe RES	24	Aydın	VESTAS	V90-2.0	2,0 MW	2010
Elfa Elektrik Üretim A.Ş.	Umurlar RES	10	Balıkesir	VESTAS	V100-2.0	2,0 MW	2014
Amaz RES Rüzgar En.El.Ür.	Uşak RES	54	Uşak	SINOVEL	SL1500/90	1,5 MW	2013
Innores El.Ür.A.Ş.	Yuntdağ RES	57,5	İzmir	NORDEX	N90	2,5 MW	2011



Innores El.Ür.A.Ş.	Yuntdağ RES Ext	2,5	İzmir	NORDEX	N100	2,5 MW	2014
Zeytineli RES El.Ür.A.Ş.	Zeytineli RES	50	İzmir	NORDEX	N100/90	2,5 MW	2013
Ziyaret RES El.Ür.San.Tic.A.Ş.	Ziyaret RES	65	Hatay	GE	GR2.5-100	2,5 MW	2010/2011/2013
Ziyaret RES El.Ür.San.Tic.A.Ş.	Ziyaret RES Ext	11	Hatay	GE	GE2.75-100	2,75 MW	2014
		3.762,10					

WIND ENERGY ECONOMICS

The economics of wind power plants is influenced by a number of factors. These include the quality of the wind resource, technology efficiency and reliability, the availability of long-term power contracts, and the ability to forecast at least several hours ahead. By far the most significant factors that contribute to wind energy value are related to the wind resource and the characteristics of the grid and the evolving market rules. As additional wind capacity is developed, these variables will be quantified more precisely. It can be said that wind energy is as economically usable as other common energy sources

CONCLUSION AND SUGGESTIONS

Under global climate change conditions, all countries have trended towards renewable energy sources to reduce carbon dioxide emissions into the atmosphere. Wind energy is the most suitable energy source among renewable sources because wind energy has great potential throughout the world, including Turkey, and it is sustainable and does not pollute the environment. So, it has become crucial for electricity production. In general, potential wind energy areas in Turkey lie in northern and the north-western parts, at locations along the Aegean Sea and Marmara Sea coast. Aegean, Marmara, East-Mediterranean, and South East Anatolia regions of Turkey are generally seen as promising of higher wind power potential compared to other part of Turkey. The installed wind capacity of Turkey is approximately 14% of Turkey's total economical wind potential. However this rate will be increased after installing the licensed projects.

It may be stated that the existing wind energy power stations and the ones that are currently being built in Turkey are sympathized by the public due to their potential contribution to the solution of the energy problem perhaps partly because of their yet limited amount. However, depending on the size and increasing number of wind energy power stations, it is controversial whether this optimism will continue or not in the future considering the fact

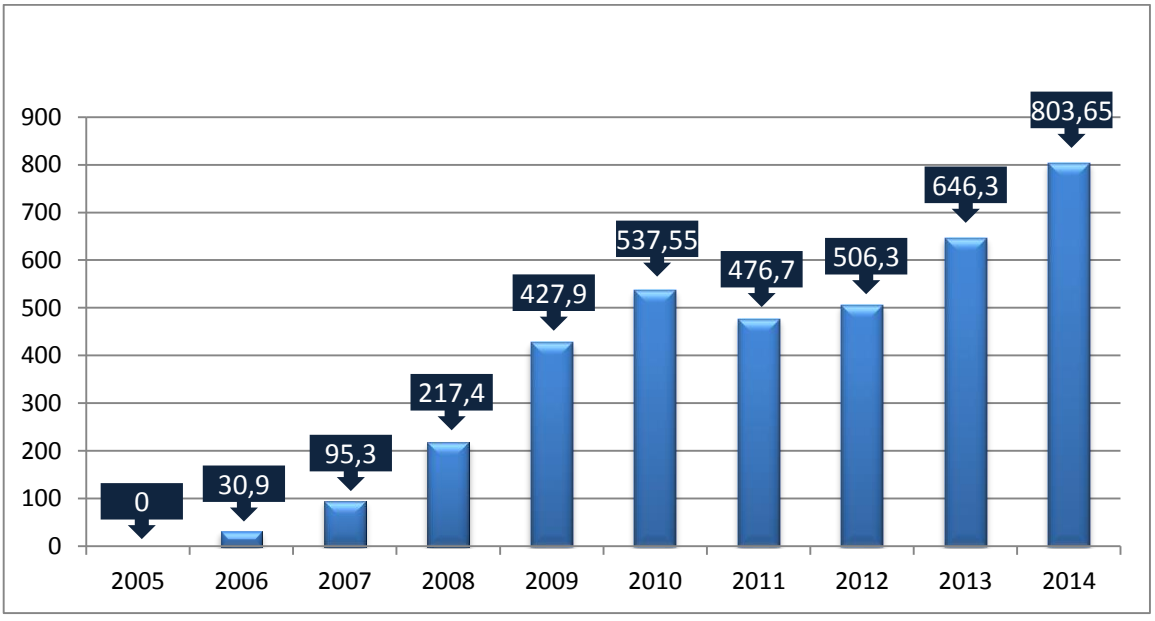
that wind energy power stations are partly in conflict with especially agriculture and tourism sectors. The fact that wind energy power stations established in our country are present in coasts with intense tourism activity may lead to problems between energy production and tourism activities in time in terms of the land use. It is possible to overcome such problems only with the help of long term development plans showing regard to country requirements and social benefit in both sectors.

All in all, Turkey is facing serious challenges in satisfying its growing energy demand. To fuel a rapidly growing economy, the country's electricity consumption is increasing by an average of 8-9% every year, and significant investments are needed in generation, transmission, and distribution facilities to balance the power system's supply and demand. Finally, Turkey is an energy-importing country. In order to be less dependent on other countries, Turkey needs to use its sustainable sources. From this point of view, wind power is a very attractive choice, since it is economical, sustainable, environment friendly, and a familiar energy source in Turkey.

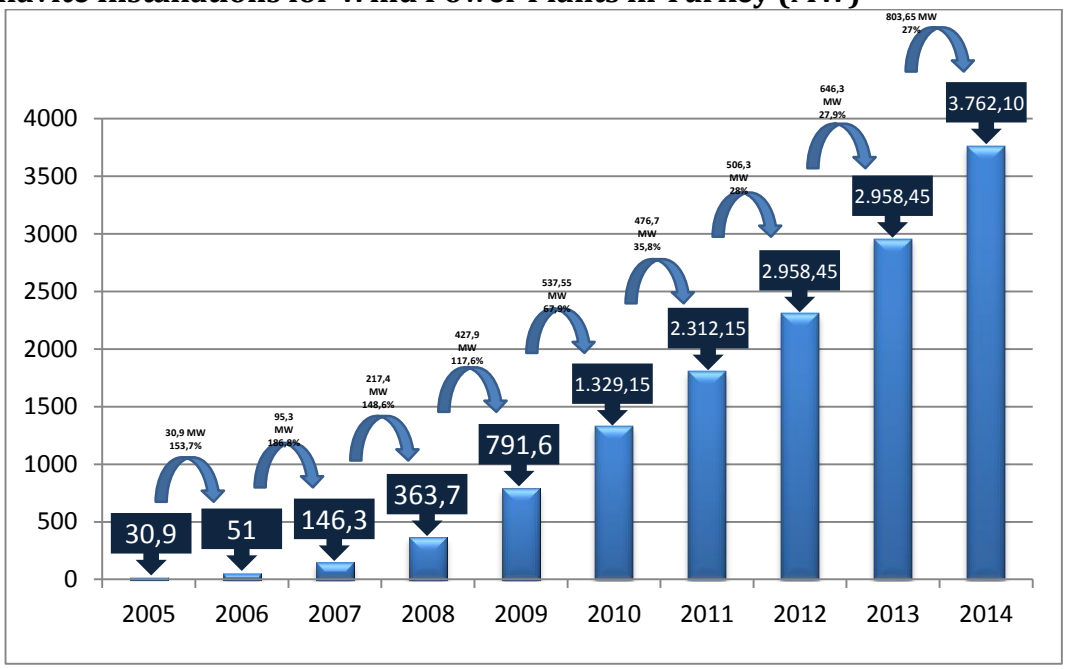
TURKISH WIND ENERGY STATISTICS REPORT JANUARY 2015

The Development of Turkey's Wind Energy Investments

Annual Installations for Wind Power Plants in Turkey (MW)



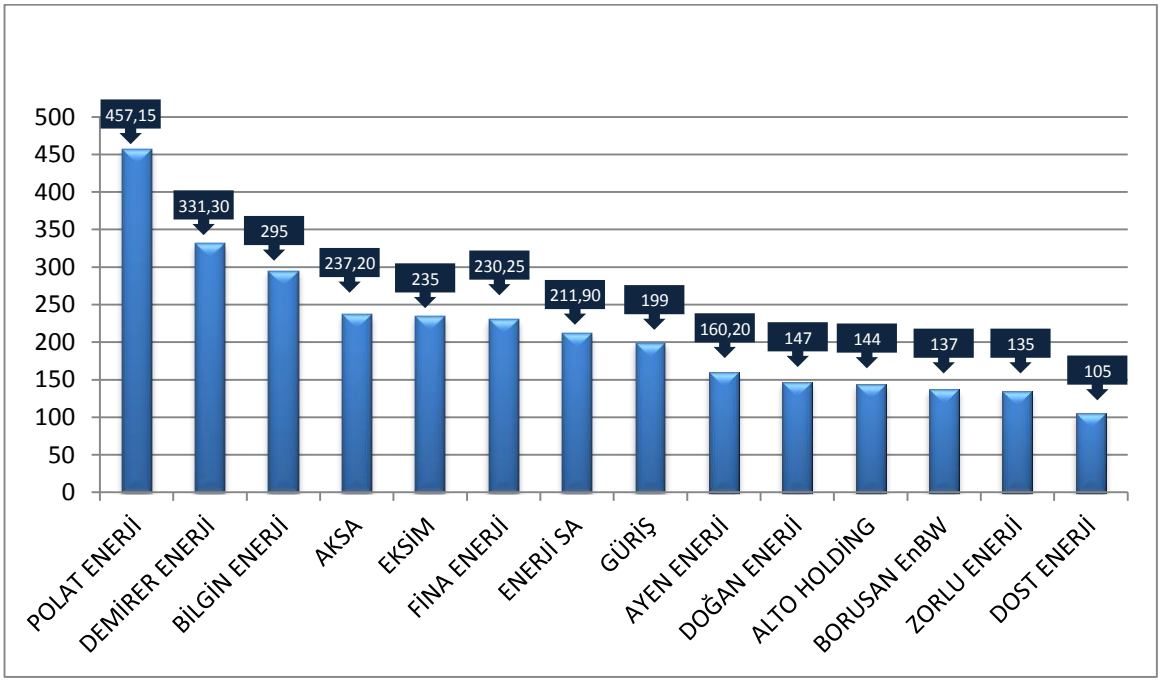
Cummulavite Installations for Wind Power Plants in Turkey (MW)



YEARS

Investors According to Operational WPPs

Inventors according to ınstalled Capacity for Operational Wind Power Plants(MW)

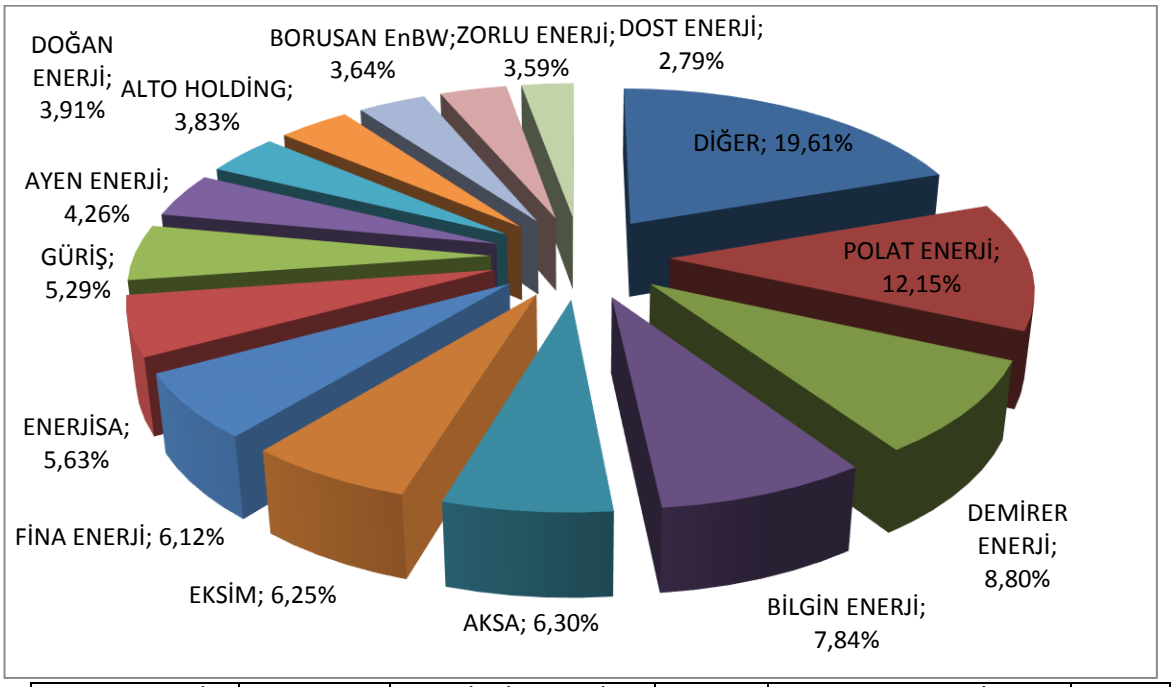


INVESTORS

AKSA: AyRES,Kapıdağ RES, Karakurt RES, Sebenoba RES, Şamlı RES, Kapıdağ RES, Kıyıköy RES, Atik Belen RES /ALTO HOLDİNG: Karaburun RES, Kemerburgaz RES
/AYTEN Enerji: Akbük RES, Korkmaz RES, Aksu RES / BİLGİN Enerji: Bandırma RES,Bandırma RES Ext.,Bergama RES, Mazı-3 RES, Soma RES,Zeytineli RES/ BORUSAN EnBW: Balabanlı RES, Bandırma RES, Bandırma RES Ext-1/DEMİRER Enerji:Bozcaada RES, Çamseki RES, Çataltepe RES,Çeşme RES,Dares Datça

RES,Keltepe RES,Kuyucak RES, Mare Manastır RES, Sarıkaya RES, İntepe RES,Burgaz RES,Kozbeyli RES,Poyraz RES,Samurlu RES,Sayalarlar RES,Seyitalı RES/ DOĞAN ENERJİ: Mersin Mut RES, Mersin Mut RES,Şah RES, Şah RES Ext./ DOST ENERJİ : GERES, KORES, Yuntdağ RES, Yuntdağ RES Ext./EKSİM: Amasya RES, Hasanbeyli RES, Silivri RES, Susurluk RES, Tokat RES/ ENERJİ SA:Balıkkesir RES, Dağpazarı RES, Mahmudiye RES/ FİNA ENERJİ: Düzova RES, Günaydın RES,Karadere RES,Salman RES,Ziyaret RES,Ziyater RES Ext., Şadıllı RES, Günaydın RES Ext./ GAMA Enerji: Karadağ RES, SaRES,GokRES/ GÜRİŞ: Belen RES, Dinar RES, Senkoy RES/ POLAT Enerji: Burgaz RES, Kozbeyli RES, Poyraz RES, Samurlu RES, Sayalar RES, Seyitalı RES, Geycek RES, Soma RES
Installed capacity is distributed by the share ratio which is accepted as %50 for partner.

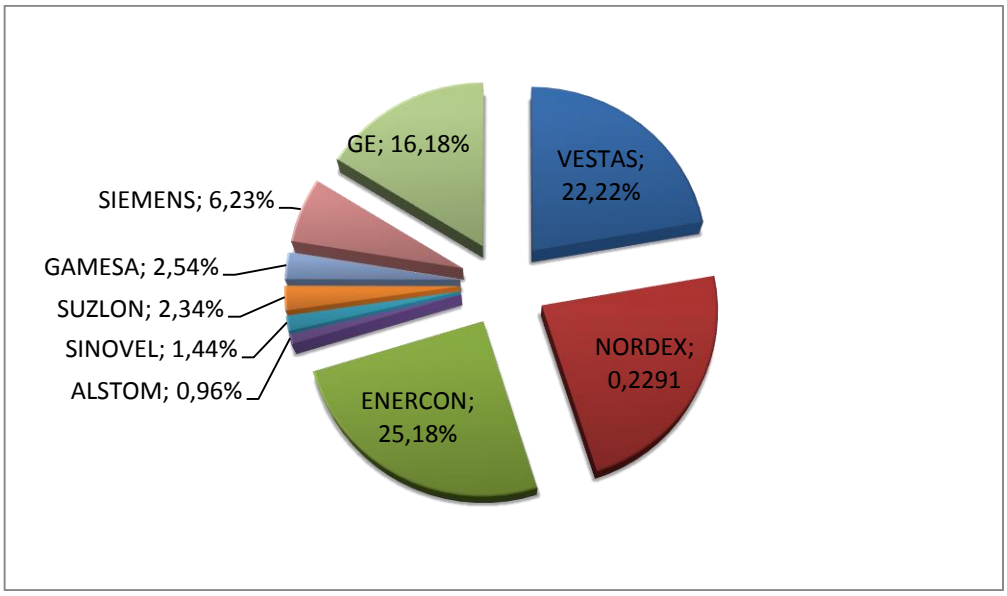
Investors According to Installed Capacity for Operational Wind Power Plants(%)



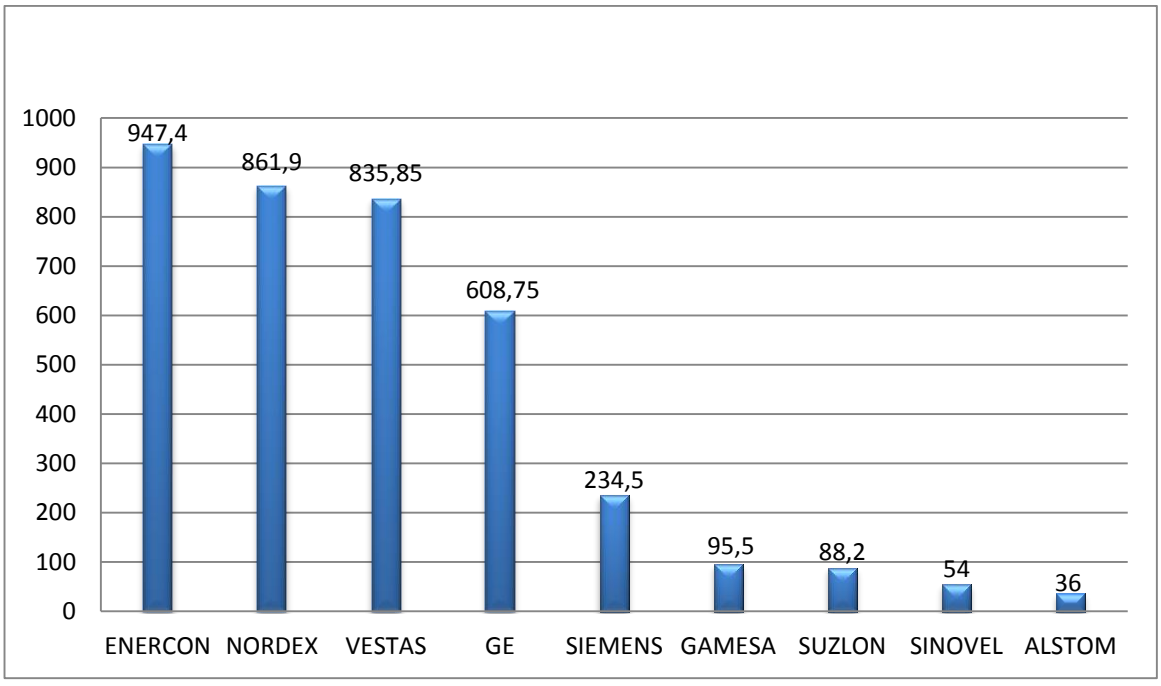
GAMA ENERJİ	1,87	EDİNCİK ENERJİ	0,80	ELFA ELEKTRİK	0,27
SANKO	1,59	TEKTUĞ ELEKTRİK	0,73	AKÇA ELEKTRİK	0,26
BEREKET ENERJİ	1,44	AS MAKİNSAN	0,66	ADO ENERJİ	0,26
ERCİYES ÇELİK BORU AŞ	1,38	SABAŞ	0,64	ARES	0,19
TEFİROM	1,37	KIROBA ELEKTRİK	0,52	BIÇAKÇILAR ELEKTRİK	0,13
BOYDAK HOLDİNG	1,26	AKENERJİ	0,40	SARAY DÖK.MAD.AK.SAN.TUR.AŞ	0,11
BEST A.Ş.	1,20	ENER HOLDİNG	0,40	SUNJÜT	0,03
ECE-TUR	1,17	ZAF GRUP	0,36	INTEGREEN	0,02
CAN ENERJİ	1,06	AKİŞ	0,35	ERTÜRK	0,02
ABK ENERJİ	0,80	KARDEMİR	0,33	TELKO ENERJİ	0,02

Turbine Manufacturers According to Operational WPPs

Turbine Manufacturers according to Installed Capacity for Operational Wind Power Plants (%)

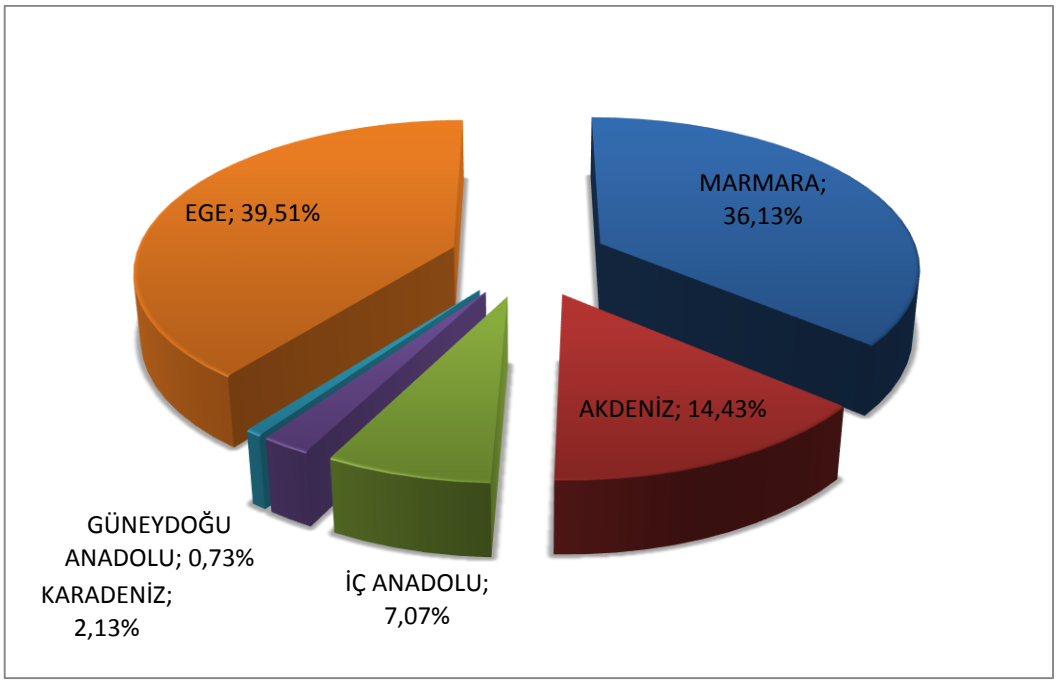


Turbine Manufacturers According to Installed Capacity for Operational Wind Power Plants (MW)

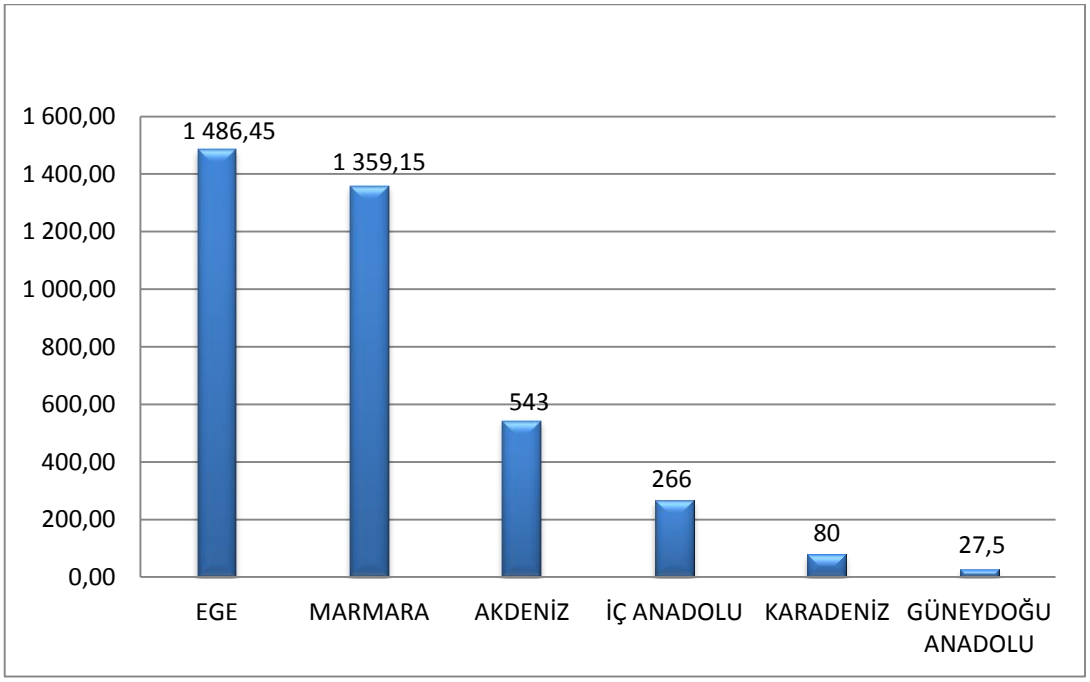


Regions According to Operational WPPs

Regions according to Installed Capacity for Operational Wind Power Plants (%)

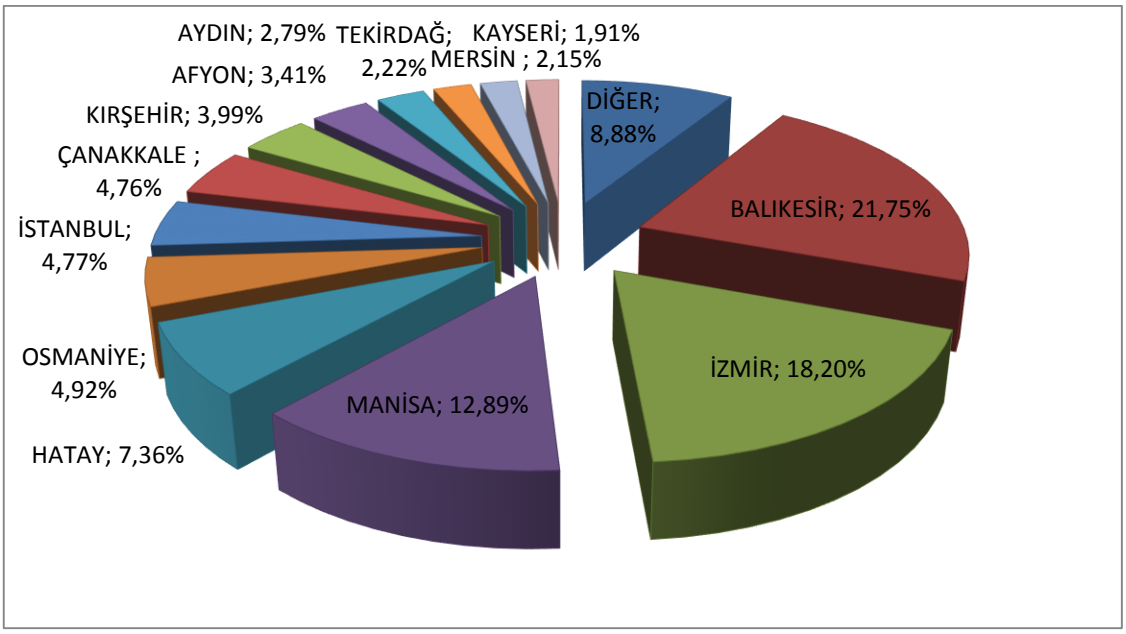


Regions According to Installed Capacity for Operational Wind Power Plants (MW)



Cities According to Operational WPPs

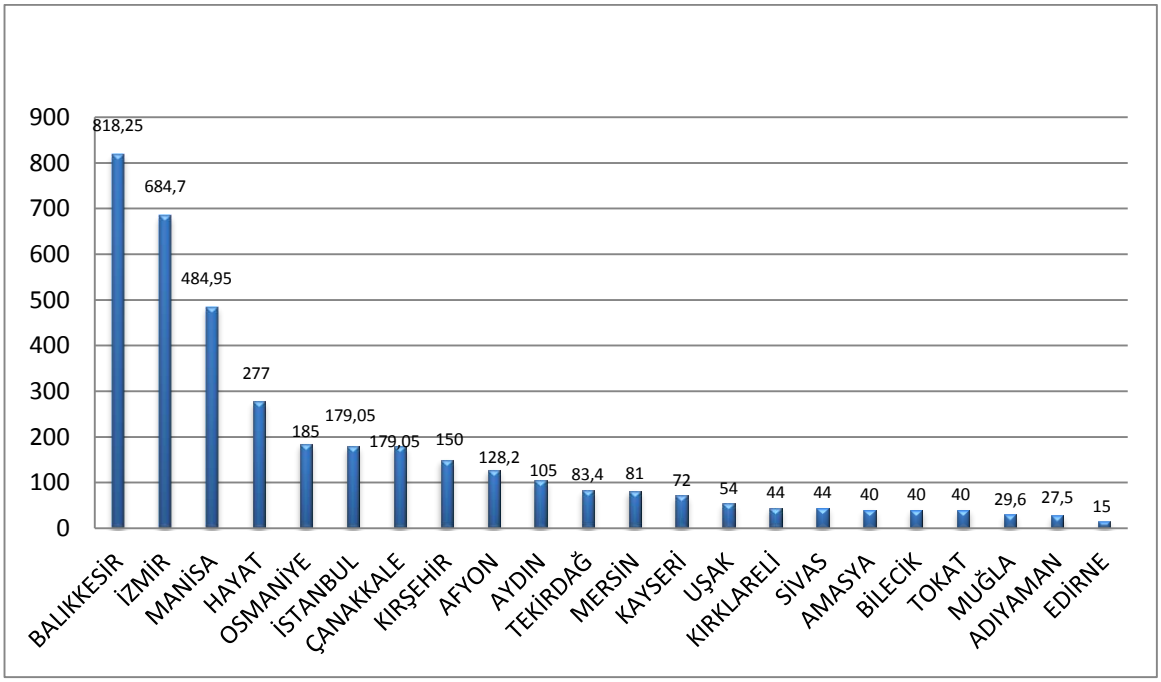
Cities according to Installed Capacity for Operational Wind Power Plants (%)



DİĞER %

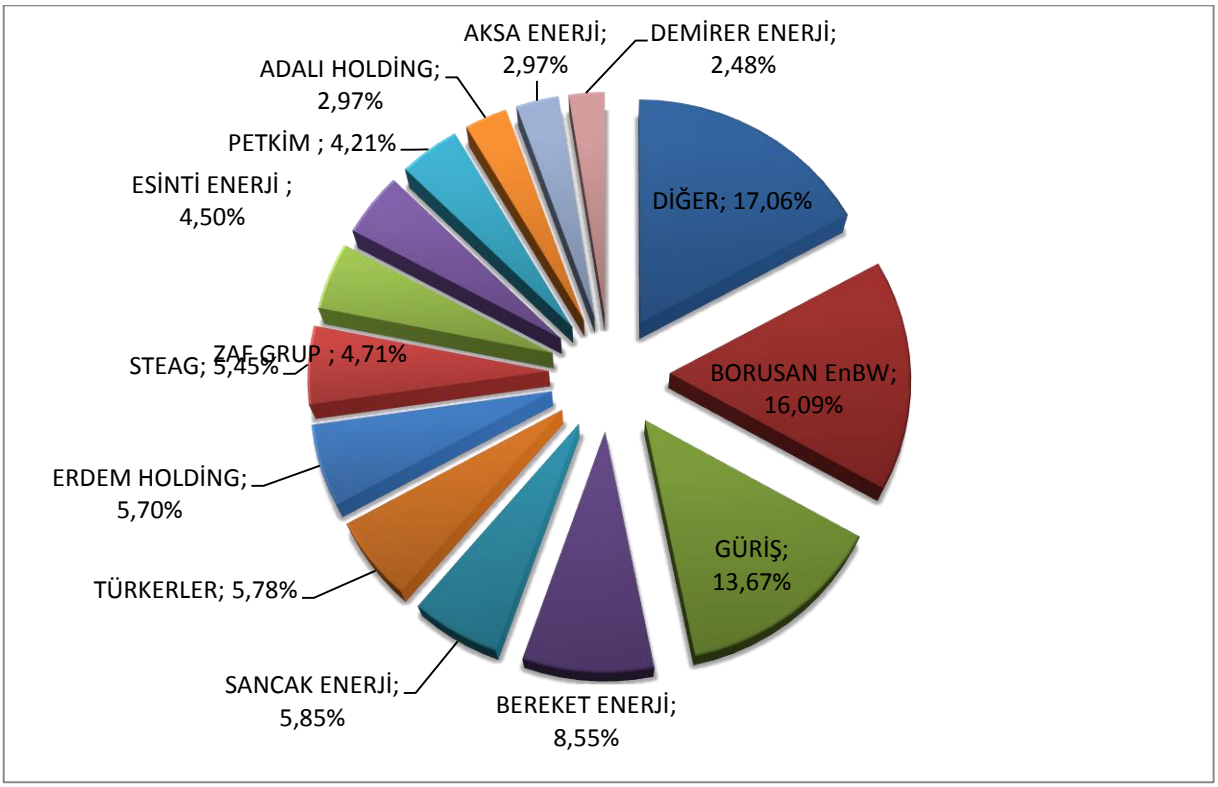
UŞAK	1,44
KIRKLARELİ	1,17
SİVAS	1,17
AMASYA	1,06
BİLECİK	1,06
TOKAT	1,06
MUĞLA	0,79
ADIYAMAN	0,73
EDİRNE	0,40

Cities according to Installed Capacity for Operational Wind Power Plants (MW)



Investors According to WPPs Under Construction

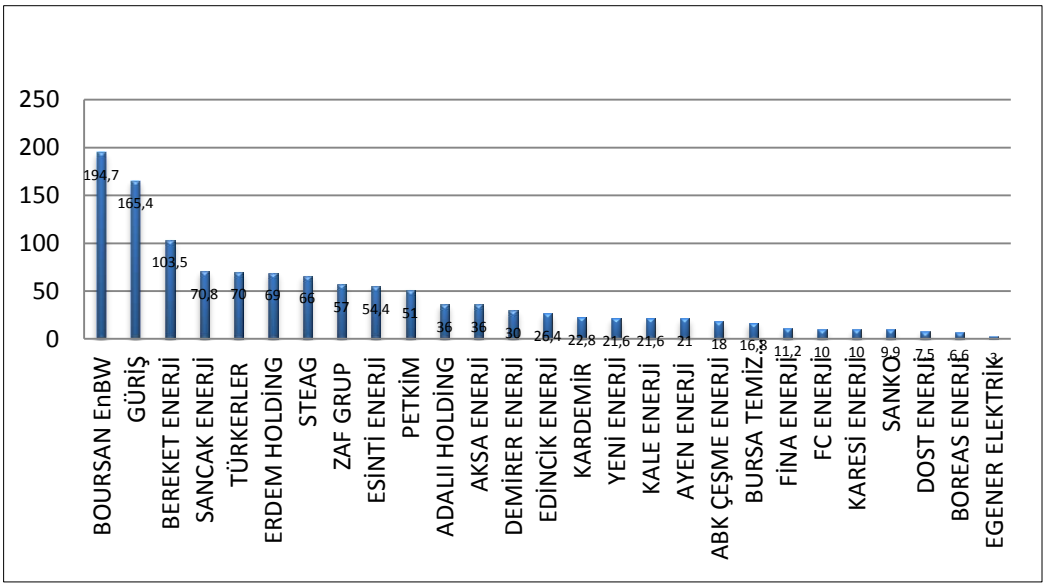
Investors according to Capacity for Wind Power Plants Under Construction (%)



DİĞER %

EDİNCİK ENERJİ	2,18
KARDEMİR	1,88
YENİ ENERJİ	1,78
KALE ENERJİ	1,78
AYEN ENERJİ	1,73
ABK ÇEŞME ENERJİ	1,49
BURSA TEMİZ ENERJİ	1,39
FİNA ENERJİ	0,93
FC ENERJİ	0,83
KARESİ ENERJİ	0,83
SANKO	0,82
DOST ENERJİ	0,62
BOREAS ENERJİ	0,55
EGENER ENERJİ	0,25

Investors According to Capacity for Wind Power Plants Under Construction (MW)



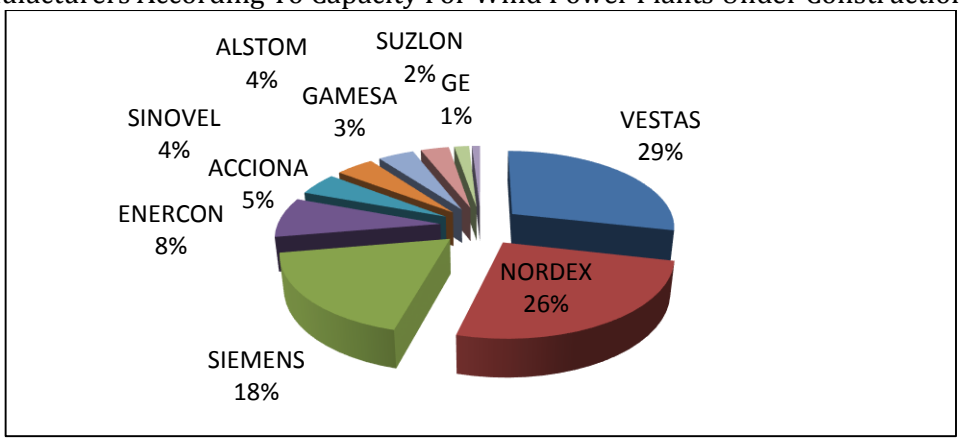
INVESTORS

AKSA:SEBENOBA RES Ext.,ATİK BELEN RES/BEREKET ENERJİ:SOKE RES, YALOVA RES,/BORUSAN EnBW: BANDIRMA RES Ext-2,FUAT RES, HARMANLIK RES, KORU RES,MUT RES/ERDEM HOLDİNG:BAĞARASI RES, ÖDEMİŞ RES/ GÜRİŞ: ZELİHA RES, KANİJE RES, FATMA RES/KARDEMİR: BOZKAYA RES Ext., OVARES /SANCAK ENERJİ: URLA RES, YAHYALI RES/TÜRKERLER ENERJİ: PAMUKOVA RES, GEVYE RES

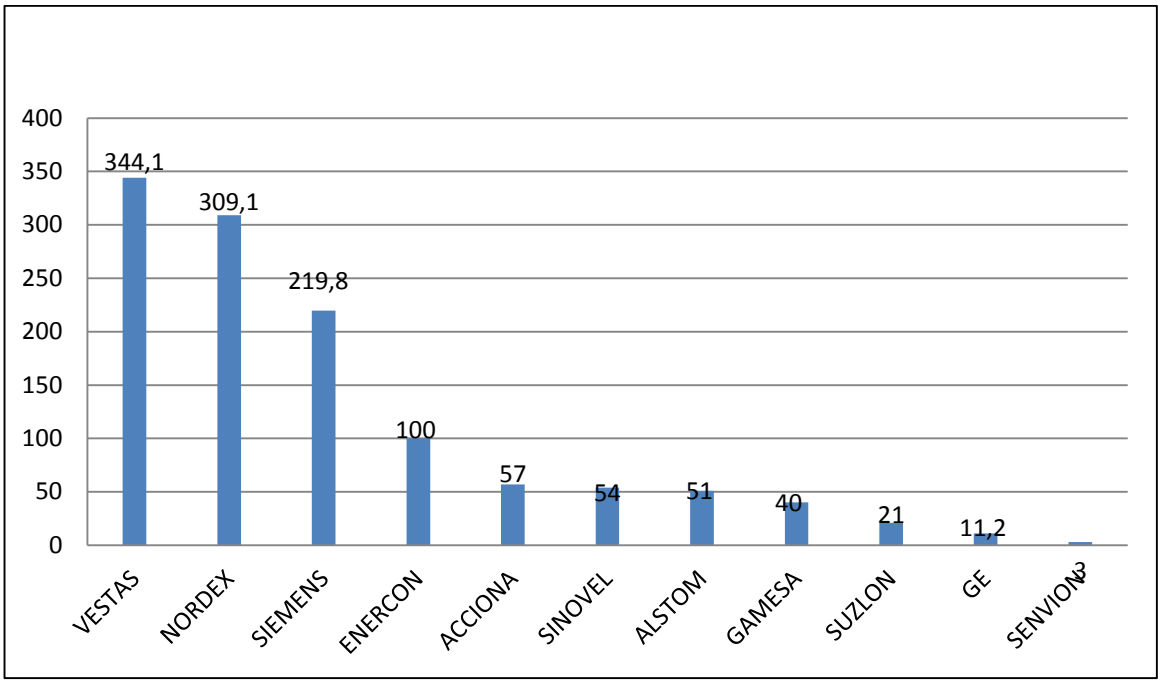
Installed capacity is ditrubes by the share ratio which is accepted as %50 for partner

Turbine Monfactureers According To Wpps Under Construction

Turbine Manufacturers According To Capacity For Wind Power Plants Under Construction (%)



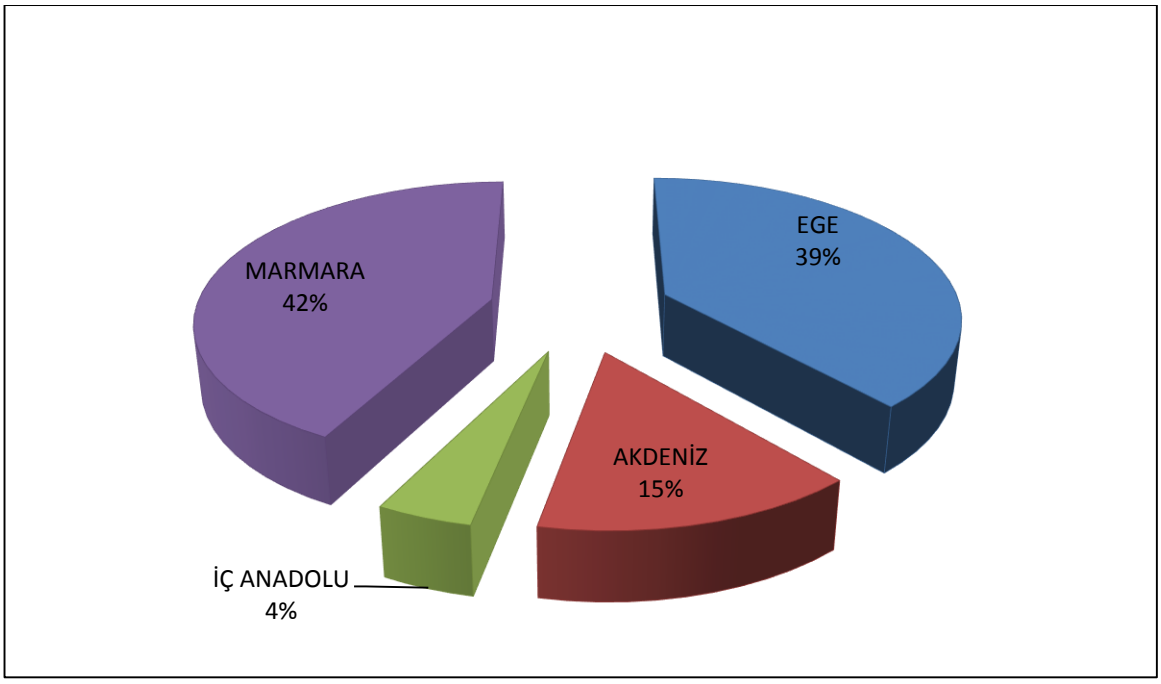
Turbine Manufacturers according to Capacity for Wind Power Plants Under Construction (MW)



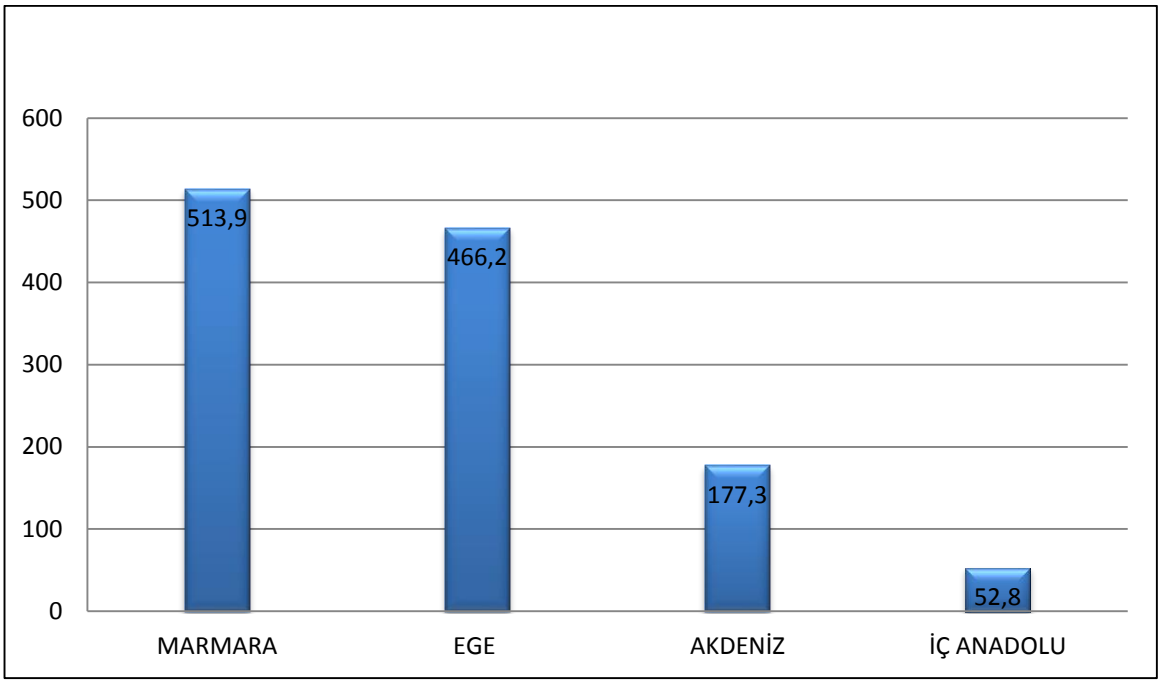
TURBINE MANUFACTURERS

Regions According to WPPs Under Construction

Regions according to Installed Capacity for Wind Power Plants Under Construction (%)



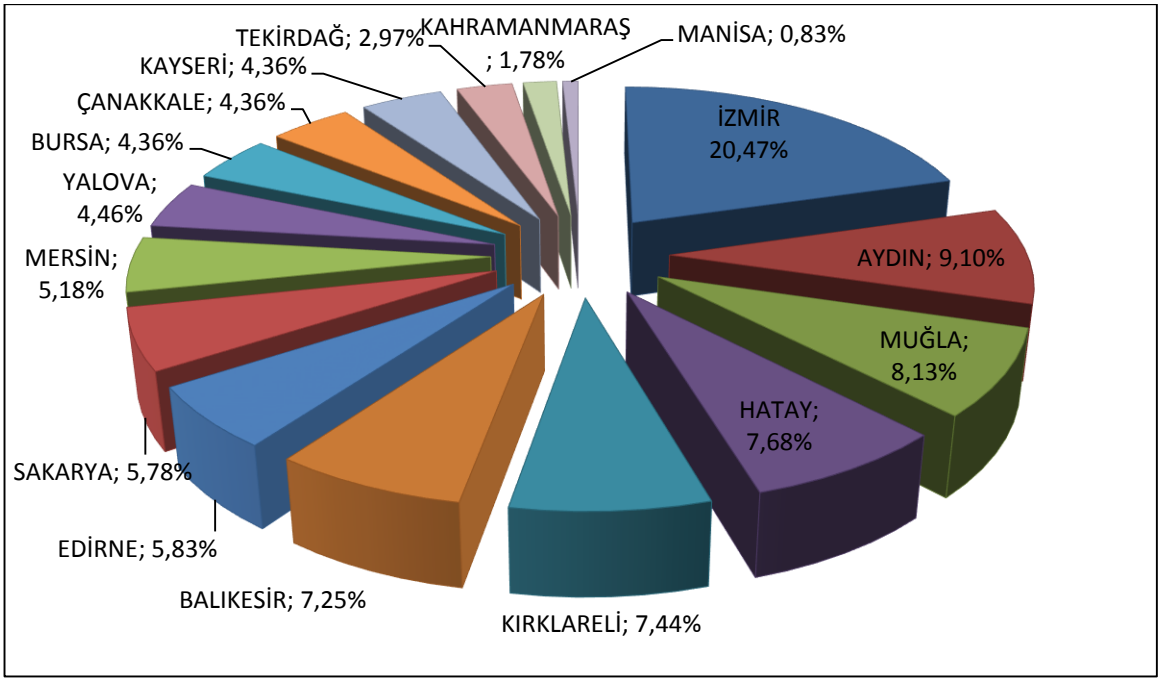
Regions According To Installed Capacity For Wind Power Plants Under Constructions (MW)



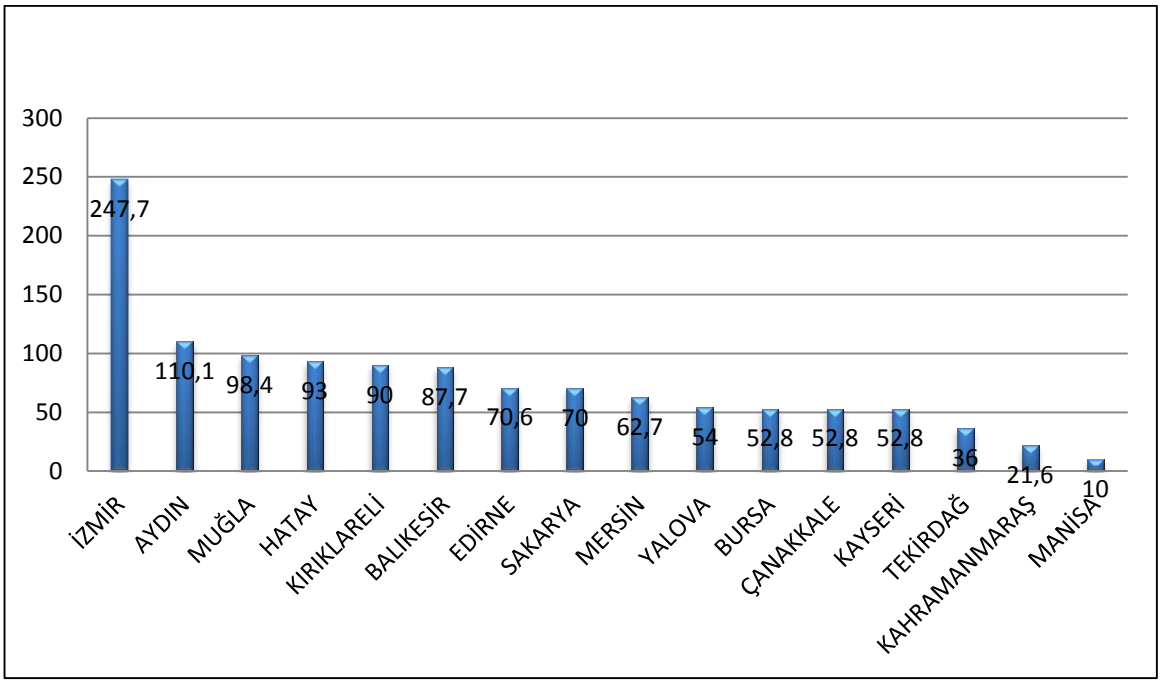
REGIONS

Cities According to WPPs Under Construction

Cities according to Installed Capacity for Wind Power Plants Under Construction (%)

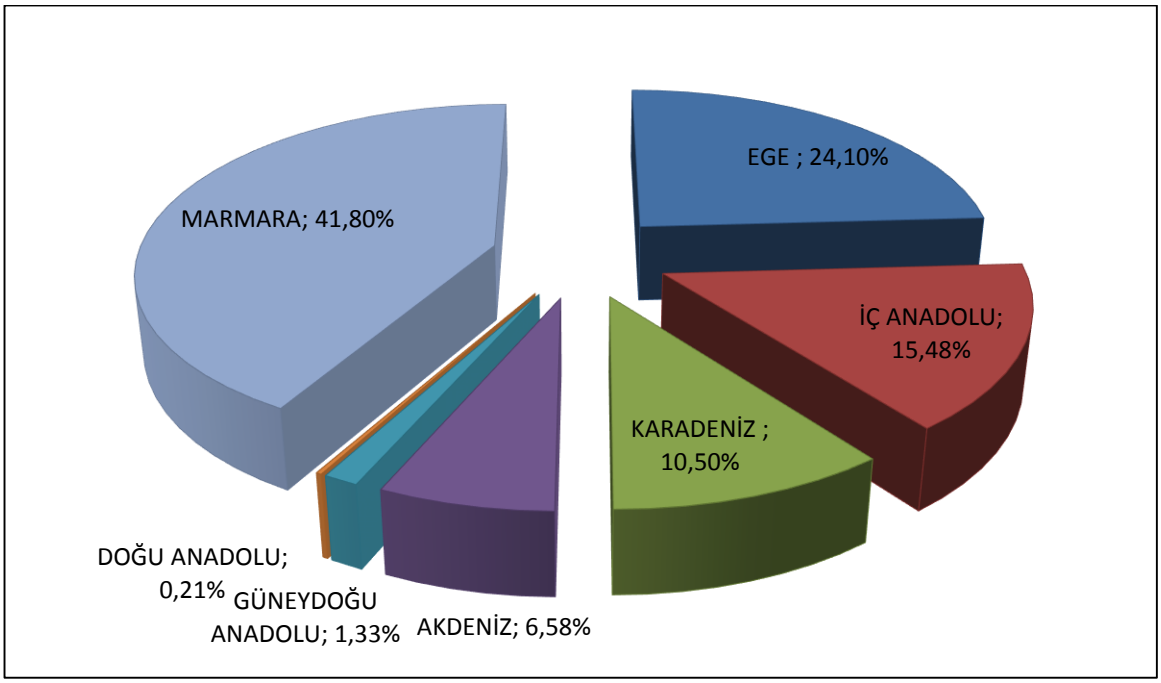


Cities according to Capacity for Wind Power Plants Under Construction (MW)

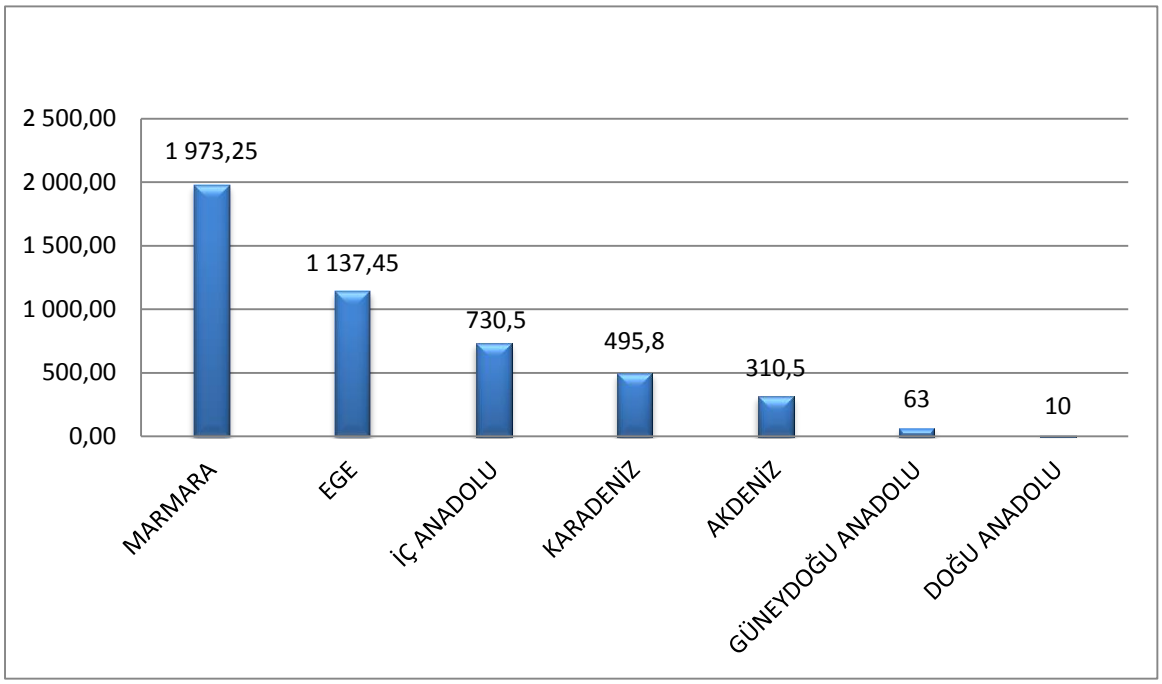


Regions According to Licensed WPPs

Regions according to Installed Capacity for Licensed Wind Power Plants (%)

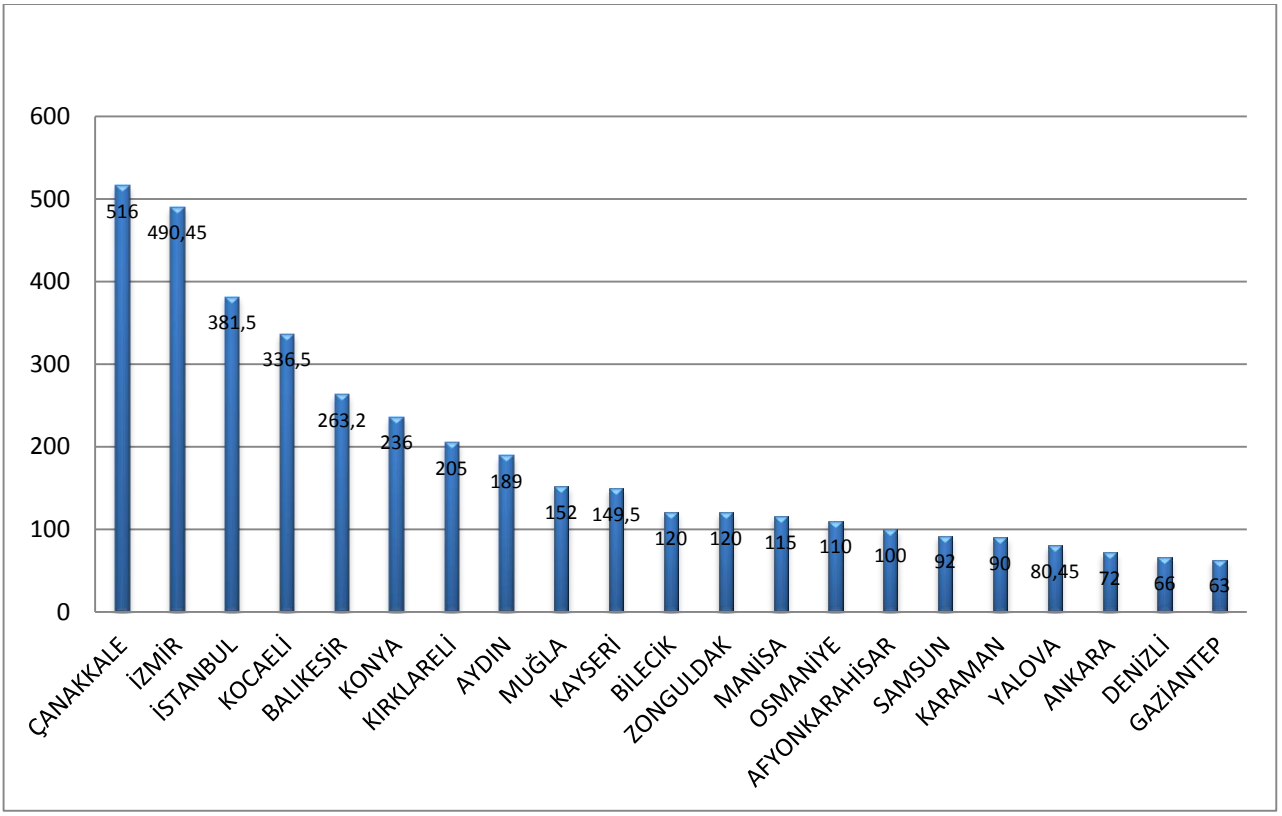


Regions According To Intsalled Capacity for Licensed Wind Power Piant (MW)



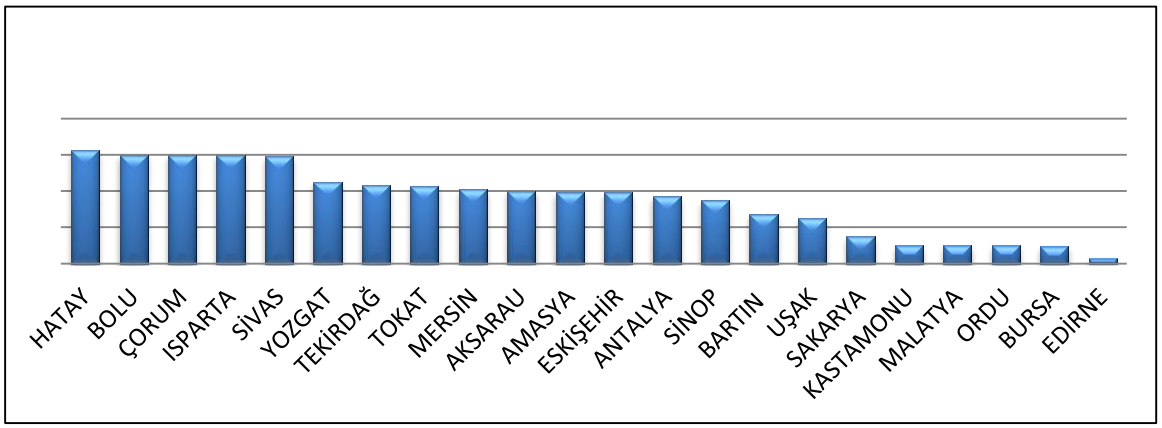
Regions

Cities According to WPPs Under Construction



CITIES

Cities According To Intsalled Capacity for Licensed Wind Power Piant (MW)



TEST ABOUT WIND ENERGY

1-Which one is one of the advantages of wind energy?

a. Turbines may cause noise and aesthetic pollution

b. The turbine blades may damage local wildlife.

c. The strength of the wind is not constant and it varies from zero to storm force.

d. Wind power is cost effective. It is one of the lowest-priced renewable energy technologies available today.

2-Which one is false about wind power plant?

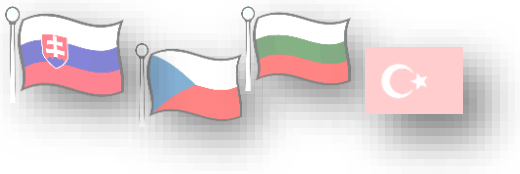
a. It's a clean fuel source. Wind energy doesn't pollute the air like power plants that rely on combustion of fossil fuels, such as coal or natural gas.

b. There are two types of wind turbines.

c. Good wind sites are often located in cities where the electricity is needed. So building transmission electric lines is easy and cheap.

d. A wind turbine works the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity.

3-When was the first wind turbine established in Turkey?



a. in 1986

b. in 1975

c. in 2001

d. İn 1989

4-Which one is false about Turkey's wind energy?

a. İzmir Alaçatı is the first wind turbıne of Turkey.

b. The number of wind turbınes which is located in Mediterrian region is the highest compared to other regions of Turkey.

c. Turkey has an important potential in terms of energy production out of wind power.

d. There is a significant increase in the development of Turkey's energy investment.

5-Which one is true about wind energy?

a. The impact of wind turbines on wildlife, most notably on birds and bats, has been widely document and studied.

b. Turkey does not have an important wind energy potential.

c. There is water impact associated with the operation of wind turbines.

d. Once the wind turbine is built the energy it produces causes green house gases or other pollutants

Answer Key:

1-d

2-c

3-a

4-b

5-a

Selfassessment:(Correct answers)

Evaluating your needs:

If you did well on the test (5), but you still want to brush up on your skills, try studying the material on your own.

If you feel that you need guidance with studying, take part in a science course. This can be an efficient way to further your education. Pay attention to your teacher and keep the SLANT rules.

If you scored within 2-3, don't forget the math, physics, and calculator skills because you'll need them right away.

If you scored within 0-1, If you don't know how to solve simple equations or work confidently with negative numbers and decimals, get these skills first. Study much more at home and keep the SLANT rule at school!!!