What is wind energy? Advantages and disadvantages

The basic principle of wind energy is simple. A series of sails or blades mounted around a rotor catch the wind and translate its kinetic energy into rotational energy. Traditional windmills use that rotational energy to grind grain or pump water. But in modern wind turbines, it turns a generator that creates electricity.

Illustration by Hilary Allison on Treehugger

How do wind turbines work?

Wind turbines work on a simple principle: instead of using electricity to make wind—like a fan—wind turbines use wind to make electricity. The wind turns the propeller-like blades of a turbine around a rotor, which spins a generator, which creates electricity. This can then be used on-site, delivered to transmission lines, or stored in a battery for later use.

Wind energy types

Photo by inakiantonana on Getty Images

Utility Scale Wind Energy

Utility scale wind energy involves wind turbines that range in size from one hundred kilowatts to megawatts. The electricity is delivered to the power grid and then distributed to end users by electric utilities or power system operators. They are similar in scope to a coal-fired or natural gas power plant, which they sometimes replace or supplement.

Offshore Wind Energy

These projects, placed in coastal waters, tend to be utility-scale sized. Wind energy projects often appear in these areas because wind usually blows more

consistently and strongly in offshore areas than on land. Hence, they can generate tremendous power for larger cities or regions.

Small Scale or Distributed Wind Energy

This type of wind energy is the opposite of the examples above. These are smaller wind turbines usually used to meet a specific site or local area's energy demands. Sometimes, these turbines connect to larger energy distribution grids, and other times they are completely separate. You will often see these smaller installations in residences, where they might provide some or most of a home's needs, depending on the weather. Medium-sized versions often appear at industrial or community sites, where they tend to combine with renewable energy systems (such as solar power, geothermal, or other energy sources).


Photo by monap on Getty Images

Advantages of wind energy

Wind energy offers many advantages, which explains why it is one of the fastest-growing energy sources in the world. There are several reasons why it makes a useful source of renewable energy.

It is sustainable

Wind comes from the Sun's heat unevenly heating the atmosphere. This uneven heating is the result of Earth's rotation, and the differences between its surfaces. Hence, it can be considered a form of solar energy. Hence, as long as the sun shines and the wind blows, we can harness energy and use it to power our grids.

It is a clean fuel source

Wind energy does not pollute the air, unlike fossil fuels. Many coal or natural gas power plants emit particulate matter, nitrogen oxides, and sulphur dioxide – causing human health problems and economic damage. Fossil fuels often cause acid rain, smog, and greenhouse gases. Wind turbines, in contrast, do not produce emissions.

Wind is a proven technology

Many places rely on wind power to meet their needs. In Australia, for instance, wind supplied 35.9 per cent of the country's clean energy and 9.9 per cent of their overall electricity between 2019 and 2020. This makes it Australia's largest source of renewable power.

Wind creates jobs

The Australian Bureau of Statistics found that in Australia, full-time (or equivalent) jobs in the wind energy sector increased by 60% between 2017-18 and 2018-19. Much of this growth came through the increasing frequency of wind farm projects in Victoria.

Wind turbines can be built on existing farms or ranches

This greatly benefits rural economies, which have many of the best wind sites. These can be built on farms, as farmers and ranchers can keep working the land. This is because wind turbines use only a fraction of the land compared to other uses. In one example, wind power plant owners make regular payments to landowners for the use of the land, providing them with additional income.

Wind energy is cost-effective

Wind energy is a cheap source of electricity, reaching as low as 2 cents per kilowatt-hour. This energy can also be sold at fixed prices over a long time (e.g. 20+ years), as materials don't change in price (unlike fossil fuels). This reduces the price uncertainty that fuel costs add to traditional sources of energy. Also, this fuel source is free.

Disadvantages of wind energy

Wind may be a free and unlimited fuel with so much potential, but it faces some challenges. However, research aims to address these.

Wind power must still compete with conventional generation sources on a cost basis

Though the cost of wind power fell dramatically in the past decade, wind projects must be able to compete economically with the lowest-cost source of electricity for people to use them. Also, some locations may not be windy enough to be cost-competitive.

Good land-based wind sites tend to be in remote locations, far from electricity consumers

Transmission lines are vital to bring electricity from wind farms to the cities and urban areas which consume much of the power. This can be costly, as wind farms need to be in areas with strong winds to be practical. Many of these lie far away from population centres.

Wind resource development might not be the most profitable use of the land

Land suitable for wind-turbine installation must compete with alternative uses for the land. Other uses may be more valuable than electricity generation.

Wind turbines might cause noise and aesthetic pollution

Though wind power plants have relatively few impacts on the environment compared to conventional power plants, concerns exist over turbine blade noises, and their visual impacts on landscapes.

Wind plants can impact local wildlife

Spinning turbine blades have killed birds and other flying creatures. However, technological developments and building wind farms outside of nesting areas have greatly reduced this issue.

Despite these efforts, all power projects (not only wind) can alter habitats where they are built. This can harm biodiversity, as certain species may not be able to

engage with spaces as much as before.

Solar and wind energy harnessed on a rooftop. Photo by dja65 on iStock

7 fun facts about wind energy

1. **Wind power is not new**.
   Humans have been using wind energy for millennia. As early as 5000 B.C., our ancestors sailed boats along the Nile River. By 200 B.C., windmills in Persia and the Middle East were used to grind grain, and the idea of using wind for food production eventually spread around the world. In the late 1800s, wind turbines were first used to generate electricity.

2. **Wind turbines look simple, but they are actually very complex**.
   In fact, a single wind turbine has around 8,000 different parts.

3. **Wind turbines can stand taller than the Sydney Opera House**.
   One of the tallest wind turbines in Australia stands at around 180 meters tall. The Sydney Opera House stands at 65 meters tall.

4. **Wind turbines are getting bigger**.
   The higher the better, in terms of reaching the fastest moving winds. That is why Albany Grasmere Wind Farm, a Bright Energy Investments joint venture, is in such a great spot sitting 80 meters above the Southern Ocean.

5. **The world's biggest wind turbine was made by Chinese wind-energy hardware maker MingYang Smart Energy.**
   It is 242 meters tall with blades that are 118 meters long that, when in motion, would cover a total of 46,000 square meters of area. To put that into perspective, that is larger than six soccer fields.

6. **Wind could power the world.**
   Every 24 hours, wind generates enough kinetic energy to produce roughly 35 times more electricity than humanity uses each day. And unlike coal or oil, this resource is totally renewed each day.

7. **You could take a ride on a wind turbine**.
   When it opens, you will need to visit the world's first sustainable theme park. Dutch renewable energy company Qurrent unveiled plans back in 2015. However, there are no progress updates or predicted completion dates as of yet.

Which is better, wind energy or solar?

There are benefits to both solar and wind energy, both being much greener than traditional fossil fuel power. Solar panels tend to be cheaper, more compact, and more widely accepted in urban and suburban environments. They also generate power more reliably, as they can absorb light on cloudy days while turbines only spin when it's windy.

However,, wind power is the more efficient and environmentally-friendly option. Turbines can harness 50% of kinetic energy from wind whereas today's photovoltaic panels harness only 15% to 20% of solar energy from the sun. A single U.S. home, for example, would need only one five-kilowatt turbine to fully power it, compared to 20 solar panels.

Modern wind turbines have made wind energy one of the most efficient and inexpensive sources of electricity in many places. Wind turbines already provide essential energy for communities around the world. As Abraham Lincoln once said, "...the wind is an untamed, and unharnessed force." With continued improvements in wind forecasting, electrical grid infrastructure, and energy storage, wind power might blow away all our energy problems.

A world run on 100% renewable energy is possible. Being free from fossil fuels leads to a thriving economy, planet, and people worldwide. We can progress to 100% renewable energy by working together.

Everyone can help limit climate change. From the way we travel, to the products we use and the food we eat, we can make a difference. You could start with changing your home's source of energy to renewables. Ask your utility company if your home energy comes from oil, coal or gas. If possible, see if you can switch to renewable sources such as wind or solar. Or install wind turbines or solar panels on your roof to generate energy for your home.

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