

# How Can Wind Turbines Be An Efficient & Sustainable Source Of Energy?



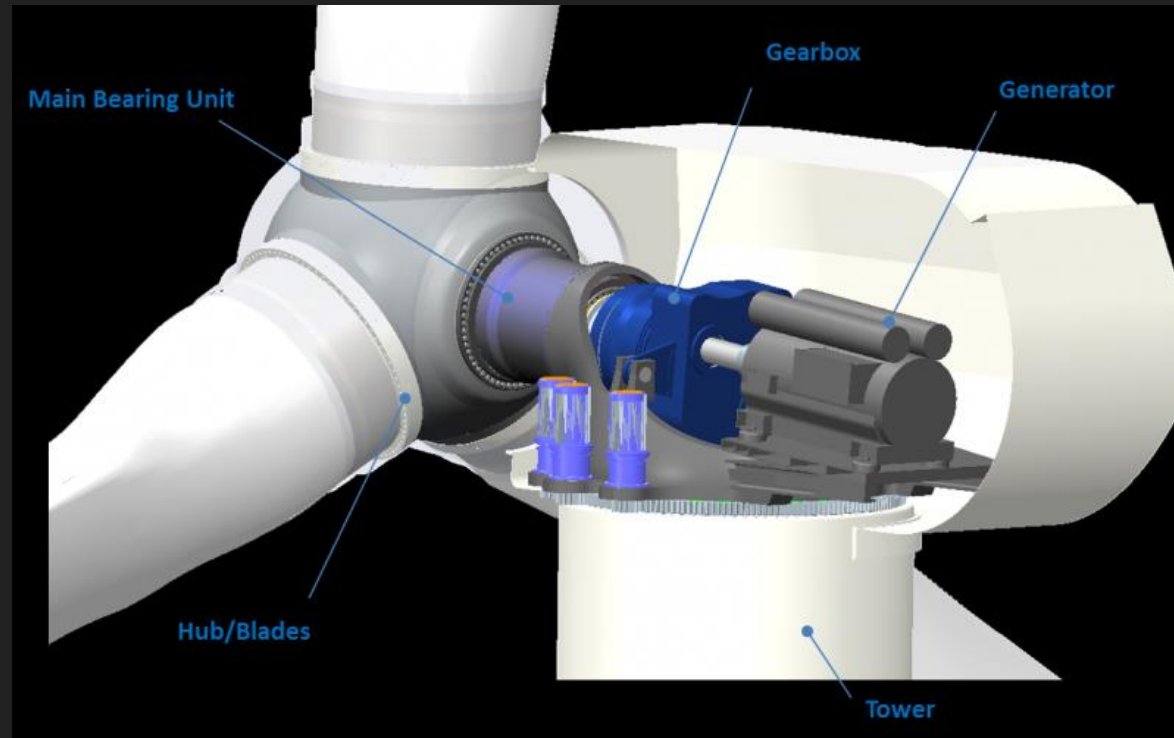
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# The Situation

- Today, we are mainly operating on finite sources of energy
- Conventional energy sources, like fossil fuels, will run out one day, so we'll need to find an alternative source of renewable energy to power our cities and facilities
- Wind is essentially an infinite source of energy, and has the ability to distribute a great amount of power. However, the technology is still relatively new
- How can we make wind turbines operate more efficiently?

# How It Works

- Wind turbine components:
- Rotors
- Drivetrain
- Gearbox
- Driveshaft
- Generator
- Control System



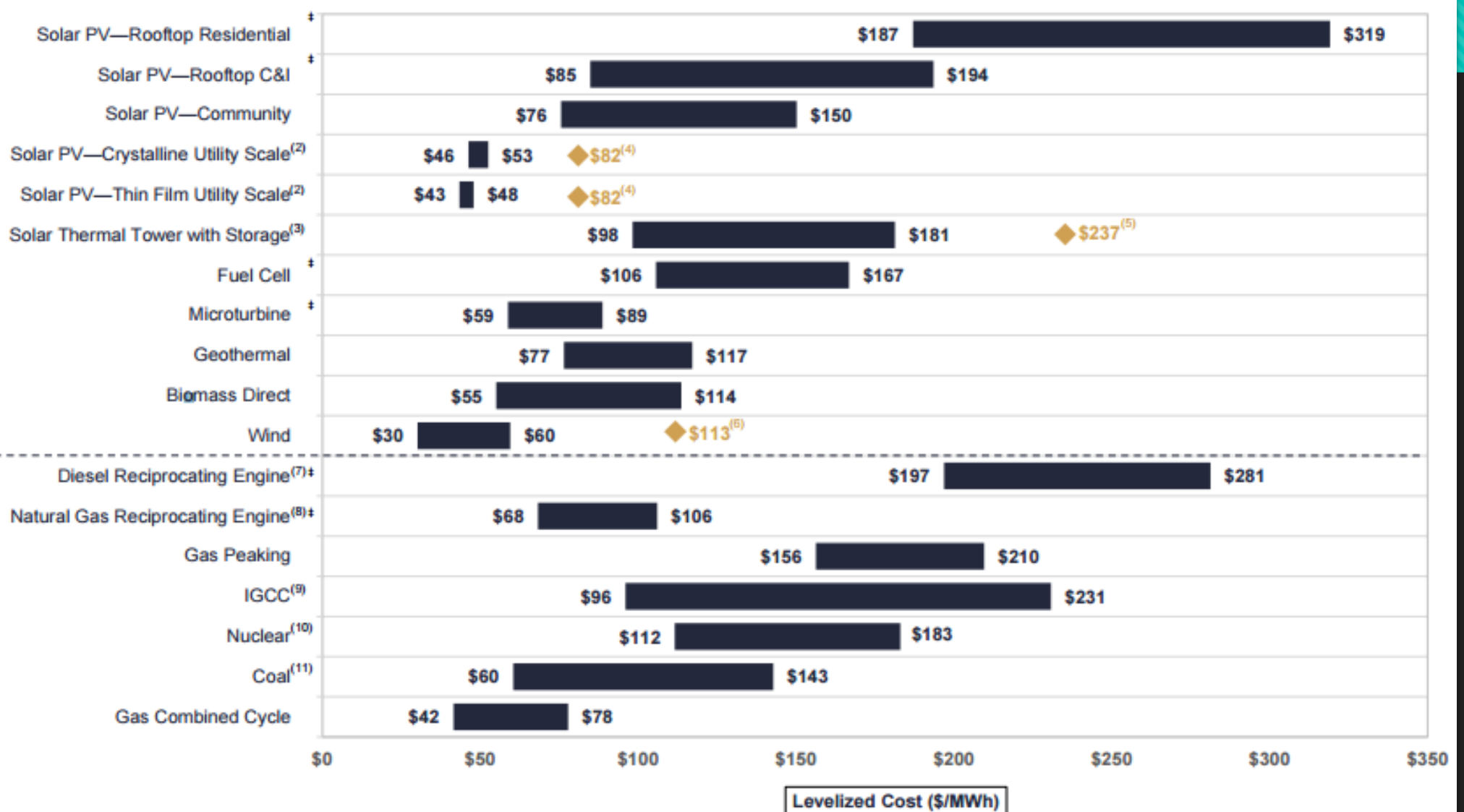
# How It Works

- The kinetic energy from the wind is made by the rotation of the rotors
- This energy enters the driveshaft, where it is converted to mechanical power
- The drivetrain consists of the gearbox and generator. The gearbox increases the rotation speed from the rotors in order to drive the generator
- The generator converts the mechanical power from the driveshaft into electrical power
- A control system collects operational data from the turbine in order to ensure it is working properly
- Depending on the size of the turbine, it can produce anywhere from 50 kW to 10 MW

# The Cost

Alternative Energy <sup>(1)</sup>

Conventional



# The Cost

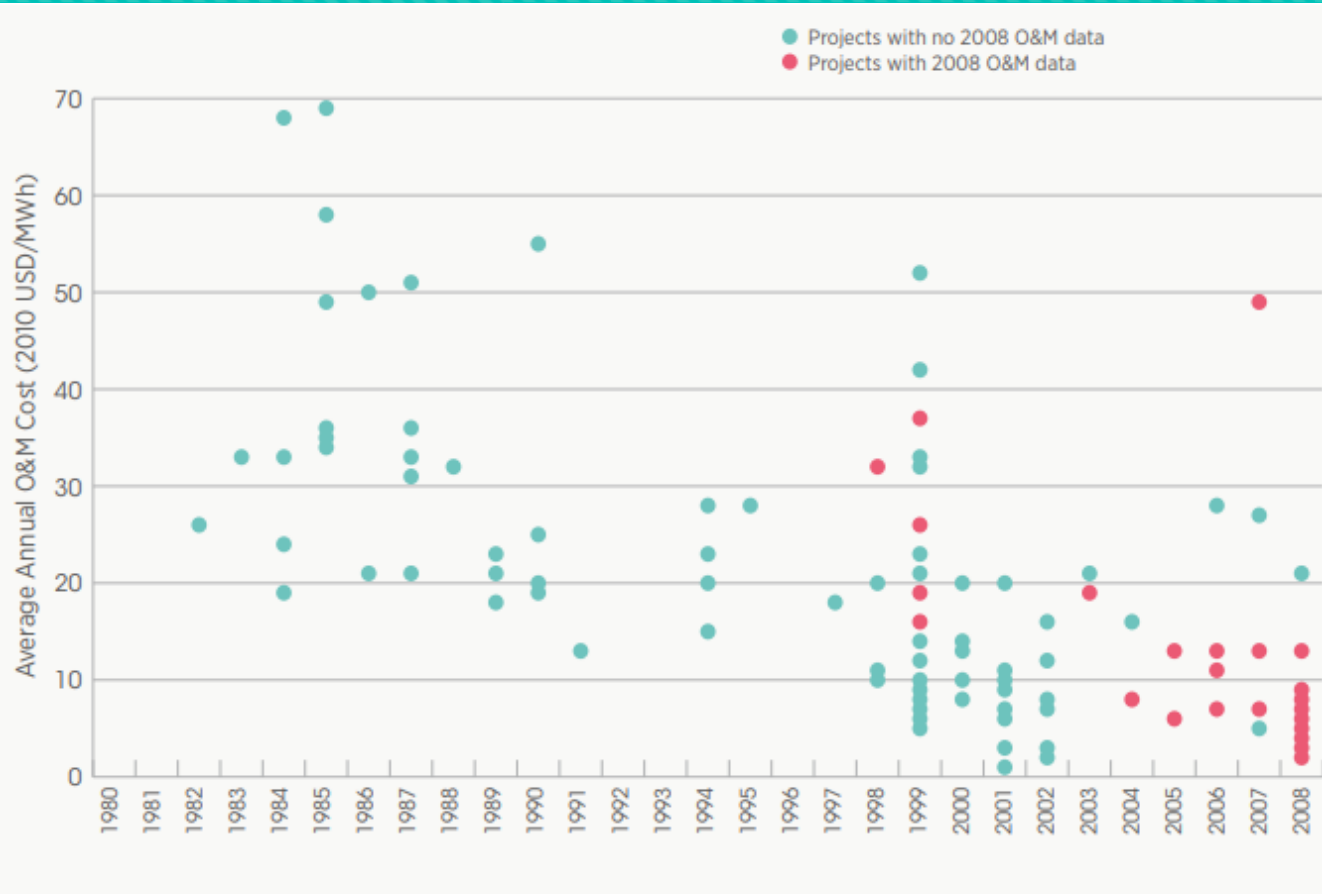


FIGURE 4.7: O&M COSTS FOR WIND POWER PROJECTS IN THE UNITED STATES, 1980 TO 2008



# The Implementation

- In Reno, Nevada, turbines are installed on city owned buildings
- These are being used to power various city facilities
- The city is saving \$12,000 a year in energy costs



# The Implementation

- Moving towards more renewable energy usage is a goal for Denmark
- Denmark produced almost 44% of the country's electricity consumption in 2017 from just wind turbines





# Is Wind Energy Sustainable?

- There is no fuel cost for wind energy
- Wind is natural, so it is essentially an infinite source of energy
- Because of this, wind energy is one of the most sustainable energy sources based on cost



# Is Wind Energy Efficient?

- Looking at the cases of Reno & Denmark, wind energy can be very efficient in providing power in many parts of the world
- Some drawbacks, however, include the space that wind turbines require to be installed, & the electricity needed to power entire cities
- In Reno, the wind turbines are installed on top of the city, which accounts for saving a lot of space, even though they aren't widely used yet
- Denmark showed us how it is possible to have a massive power output just from wind turbines, so it is theoretically possible to do so in other parts of the world

# Can We Use Wind Turbines As A Conventional Energy Source?

- The technology is still young, & there are many problems that still prevent us from using wind as a widespread method of generating electricity
- That being said, we are being given examples in practice that show us what the future could look like
- There have been many breakthroughs in the use of wind energy over the last decade through research & real world applications, & if we see the trend continue, wind energy can advance to the point where it is a widespread conventional energy source

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