

7 AFFORDABLE AND  
CLEAN ENERGY



# Goal 7: Affordable and Clean Energy

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## Overview

Affordable clean energy

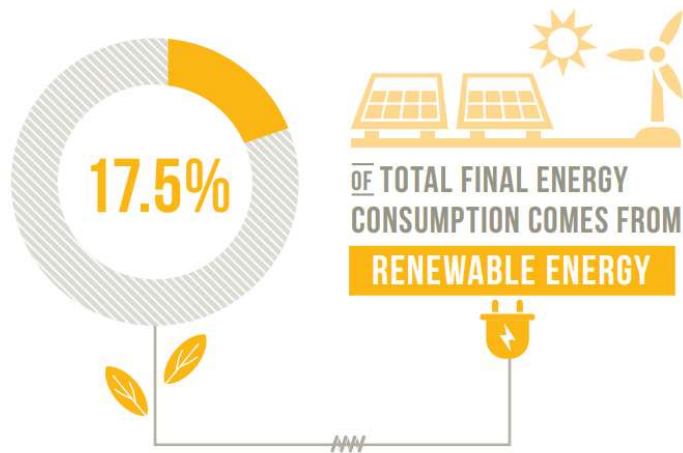
Renewable Energy

Efficiency

<https://www.un.org/sustainabledevelopment/energy/>



## Facts



13% of the global population still lacks access to modern electricity.

Energy is the dominant contributor to climate change, accounting for around 60 percent of total global greenhouse gas emissions.

Indoor air pollution from using combustible fuels for household energy caused 4.3 million deaths in 2012, with women and girls accounting for 6 out of every 10 of these.

<https://www.un.org/sustainabledevelopment/energy/>



## 7.1

### Target

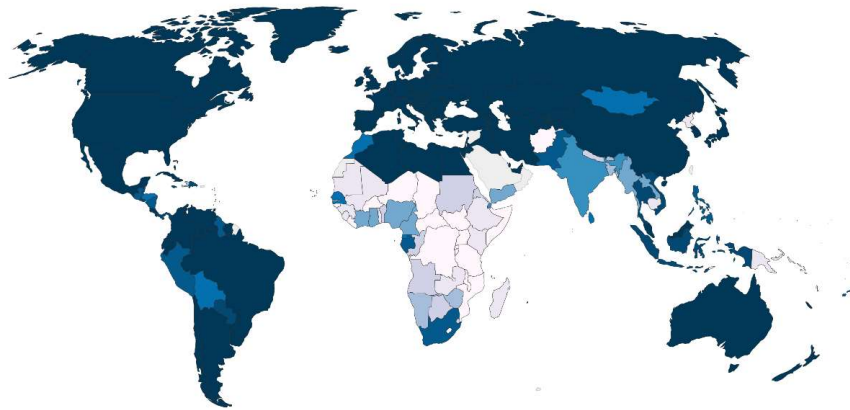
- By 2030, ensure **universal access** to affordable, reliable and **modern energy** services

### Indicators

- Proportion of population with **access to electricity**
- Proportion of population with primary reliance on **clean fuels** and technology

### Share of the population with access to electricity, 2000

Data represents electricity access at the household level, that is, people who have electricity in their home. It comprises electricity sold commercially, both on-grid and off-grid. Countries considered as "developed" by the UN, and classified as high income are assumed to have an electrification rate of 100% from the first year the country entered the category.

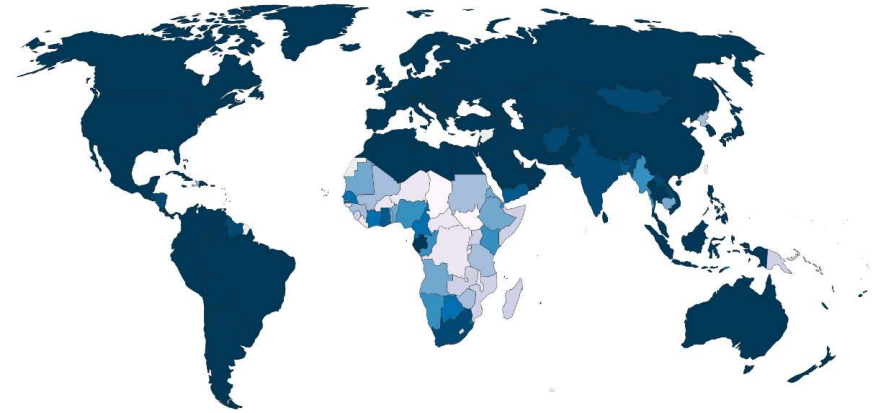


Source: The World Bank

OurWorldInData.org/energy-production-and-changing-energy-sources/ • CC BY

### Share of the population with access to electricity, 2016

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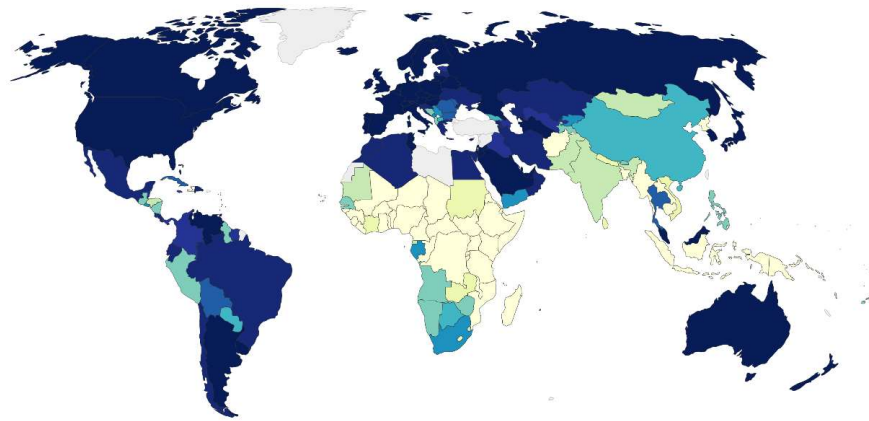
Source: The World Bank

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Increases in South America, Sub-Saharan Africa, and South East Asia. Some areas in Africa still not being reached however.

## Access to clean fuels and technologies for cooking, 2000

Share of the total population with access to clean fuels and technologies for cooking. Access to clean fuels or technologies such as clean cookstoves reduce exposure to indoor air pollutants, a leading cause of death in low-income households.

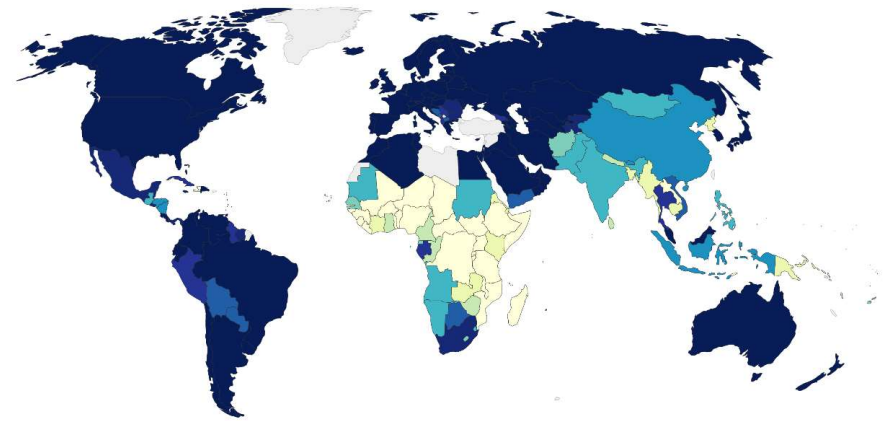


Source: World Bank

[OurWorldInData.org/indoor-air-pollution/](http://OurWorldInData.org/indoor-air-pollution/) • CC BY

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Sub-Saharan Africa suffering the most from 2000 to 2016

South-east Asia has had improvement from ranges of 20-30% to 50-60%



## 7.2

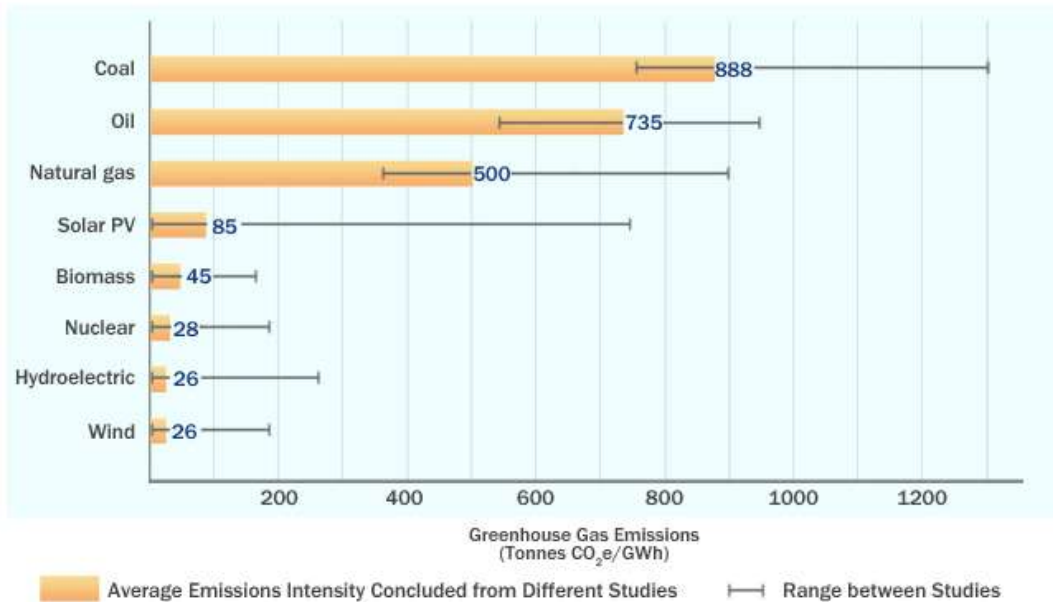
### Target

- By 2030, increase substantially the share of **renewable energy** in the global energy mix

### Indicators

- **Renewable energy share** in the total final energy consumption

<https://sustainabledevelopment.un.org/sdg7>



Source: Comparison of Life Cycle Greenhouse Gas Emissions of Various Electricity Generation Sources (July 2011), World Nuclear Association

\*\* Life cycle emissions cover the direct emissions come from electricity generation and indirect emissions from other upstream activities such as fuel mining, transportation and processing.

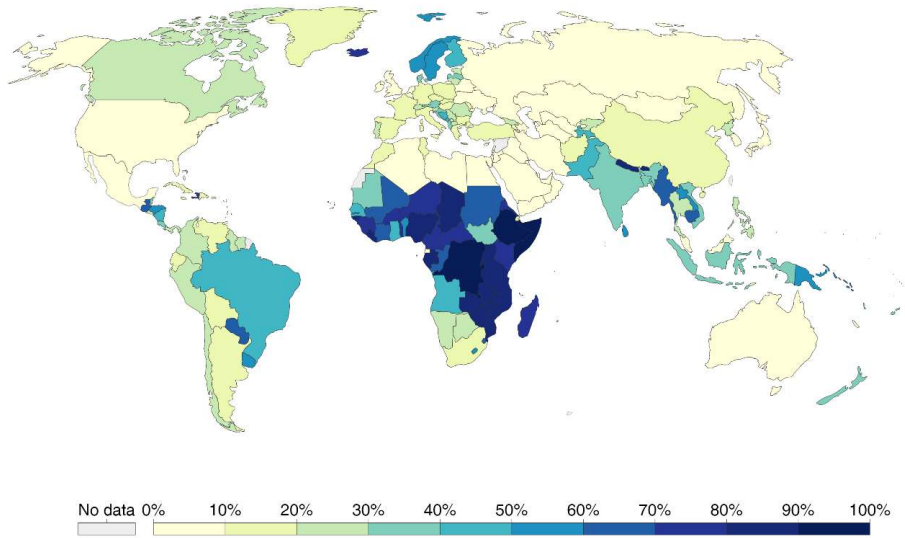
The CO<sub>2</sub> impact of the different sources of energy

Renewable is when we don't use a limited resource

Natural gas emits less carbon dioxide than a coal plant, but methane leaks during extraction and use and is 34 times stronger than CO<sub>2</sub> at trapping heat



**Renewable energy consumption (% of total final energy consumption), 2015**  
 Renewable energy (inclusive of solar, wind, geothermal, hydropower, bioenergy and marine sources) as a share of final (not primary) energy consumption.

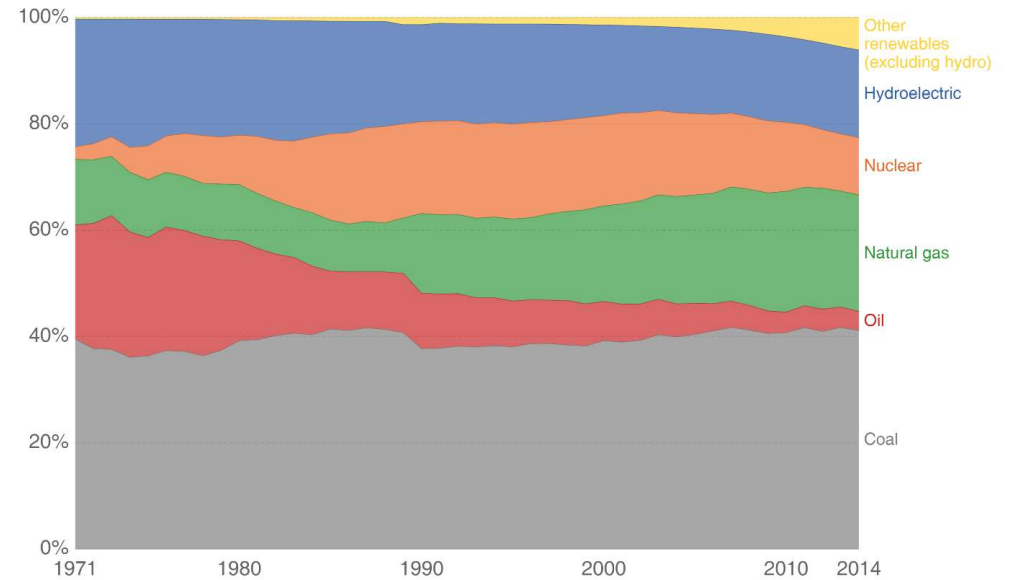


Source: World Bank

### Electricity share by fuel source, World



Electricity production (measured as the percentage of total electricity production) by source (coal, oil, gas, nuclear, hydroelectric power and other renewables). Other renewables in this definition includes biomass, wind, solar, geothermal, and marine power.



Source: International Energy Agency (IEA) via The World Bank

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The world on average from 1990 to 2015 has been at 18% renewable energy. Developed countries are contributing the most to coal and gas energy.



## Target

- By 2030, double the global rate of improvement in **energy efficiency**

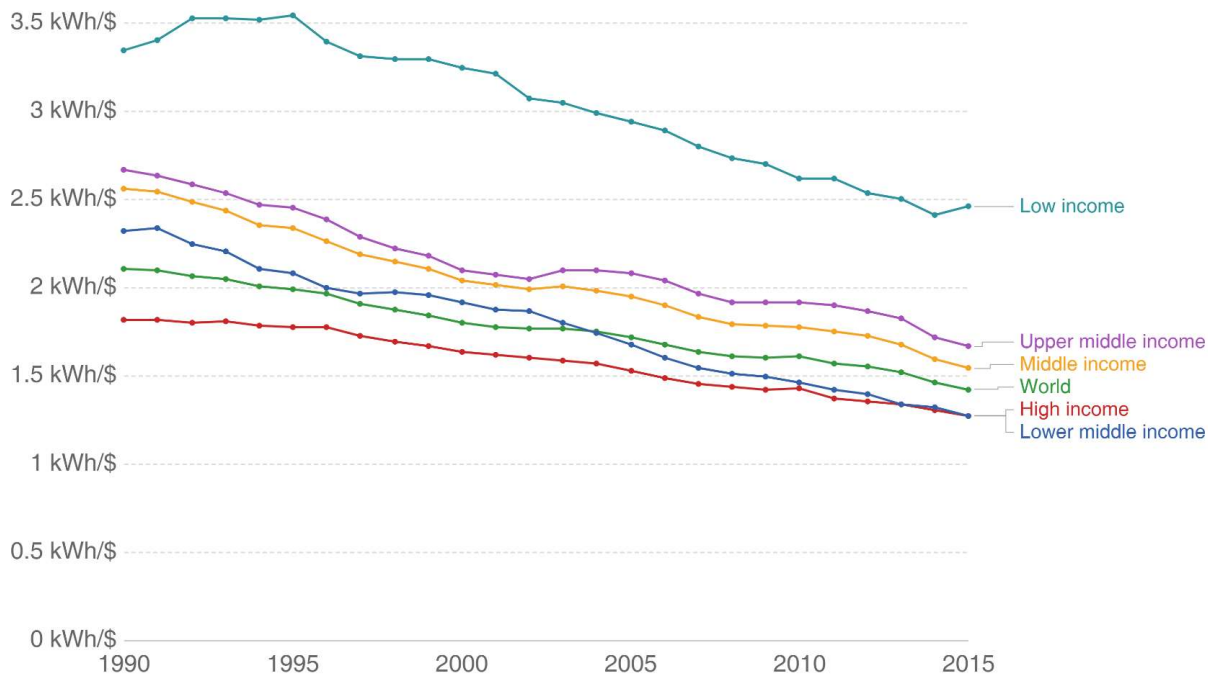
## Indicators

- Energy intensity measured in terms of **primary energy and GDP**

## Energy intensity of economies

Energy intensity level of primary energy is the ratio between energy supply and gross domestic product measured at purchasing power parity. Energy intensity is an indication of how much energy is used to produce one unit of economic output. Lower ratio indicates that less energy is used to produce one unit of output.

Our World  
in Data



Source: World Bank, Sustainable Energy for All (SE4ALL)

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Quantity of kilowatt-hours produced per international-\$ of gross domestic product

The decrease shows more efficiency since 1990

World average change from about 2.5 kWh/\$ to 1.5 kWh/\$



## 7.A

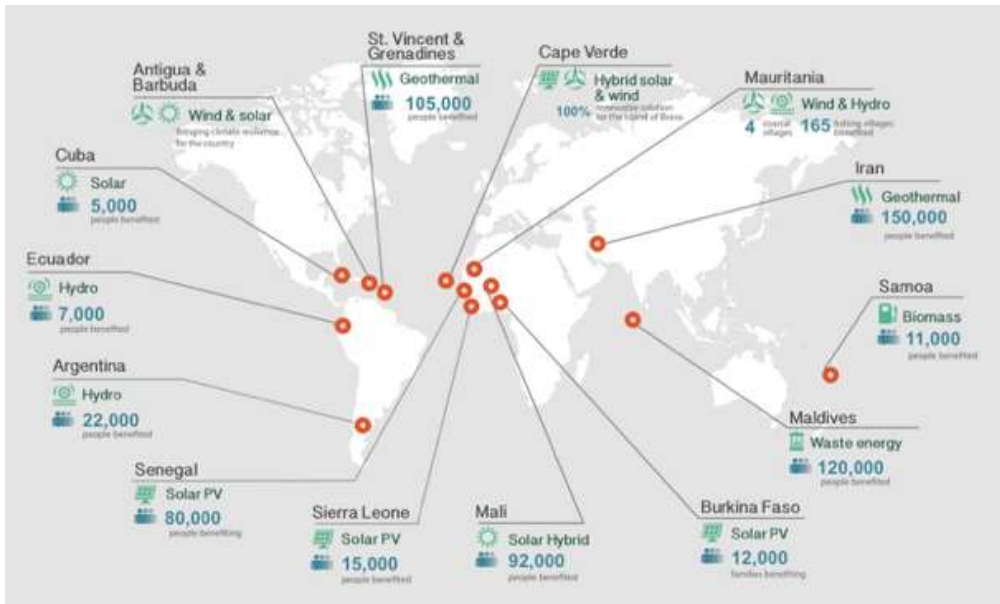
### Target

- By 2030, enhance international cooperation to facilitate access to **clean energy research and technology**, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology

### Indicators

- International **financial flows to developing countries** in support of clean energy research and development and renewable energy production, including in hybrid systems

<https://sustainabledevelopment.un.org/sdg7>



International Renewable Energy Agency (IRENA) and the Abu Dhabi Fund for Development (ADFD) invested \$350 million to developing nations to capitalize on renewable energy.

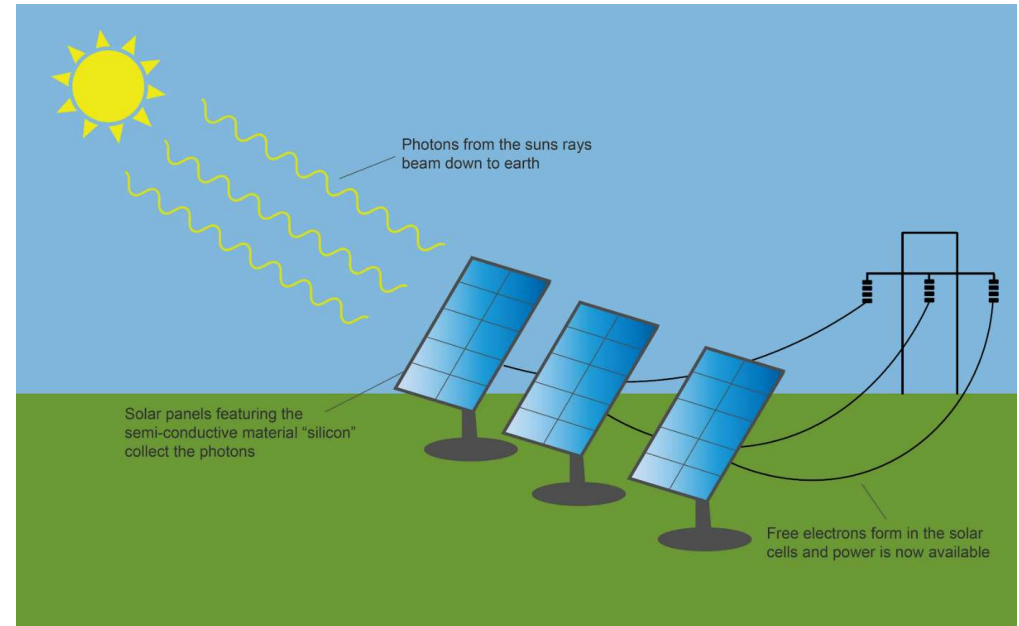
<https://www.renewableenergyworld.com/2016/11/30/irena-announces-funding-round-for-renewables-in-developing-nations/>

# Solar

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# Mechanics

Two layers of semiconductor material commonly composed of silicon crystals  
Breakthrough is using optical furnaces for the silicon panels, which reduce the energy needed to create them



## Location

### **Solar Farms- Massive expanses of solar arrays**

“Seven southwestern states have the technical potential and land area to site enough CSP (Concentrating solar-thermal power) to supply more than four times the current U.S. annual electricity demand.”

### **Home Installation- Solar panels on roofs to supplement traditional energy**

Companies have popped up that cover costs of installing panels if they share the profit from the energy.





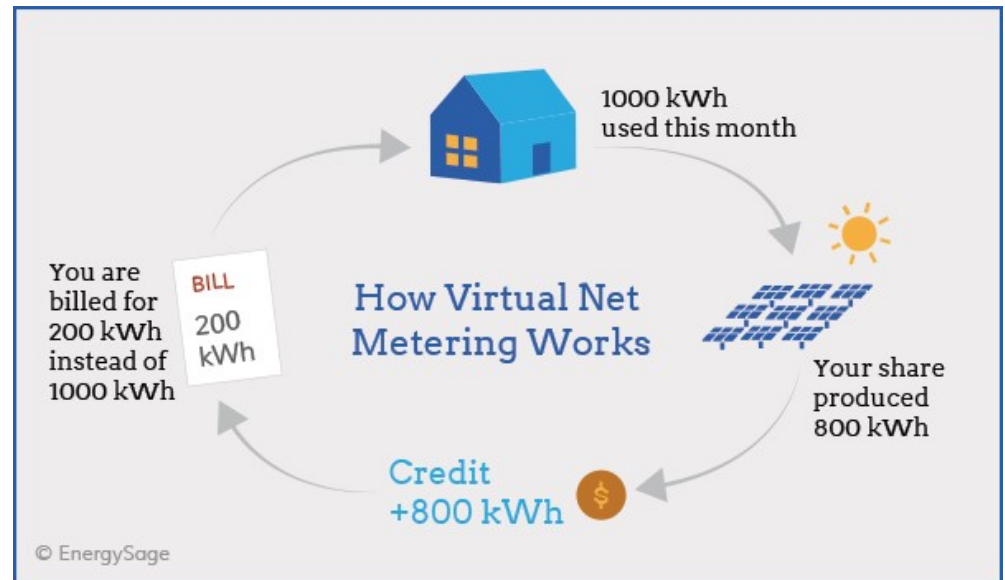
# Financial

Net Metering- For home use, the practice of adding power to the grid from roof panels, subtracting from the total power use of the home

Essentially operating as a mini power plant

First case was someone hooked up to grid without asking, now questions of regulation and policy are in the air

Farms costs and benefits vary but cost of panels have decreased significantly in last few decades



## Negatives

Panels have about a 25 year lifespan, currently not good plans for waste

Sent to other countries to take them apart for reuse, but can release toxic substances

Landfill

Opportunities for innovation

For farms, many times habitats are disrupted or displaced. Even in deserts some wildlife has to be moved

**Despite this, still much less waste and impact on environment than other energies**



# Wind

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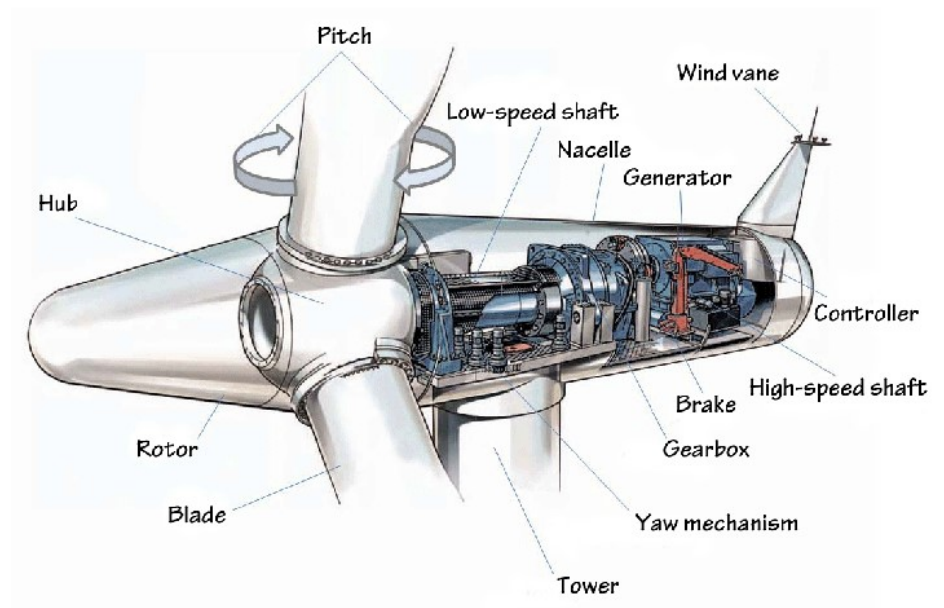
## Mechanics

Wind turns the propeller blades

Spins the generator

Creates electricity or used for mechanical tasks in the past

**Diagram 2. The major components of a wind turbine**

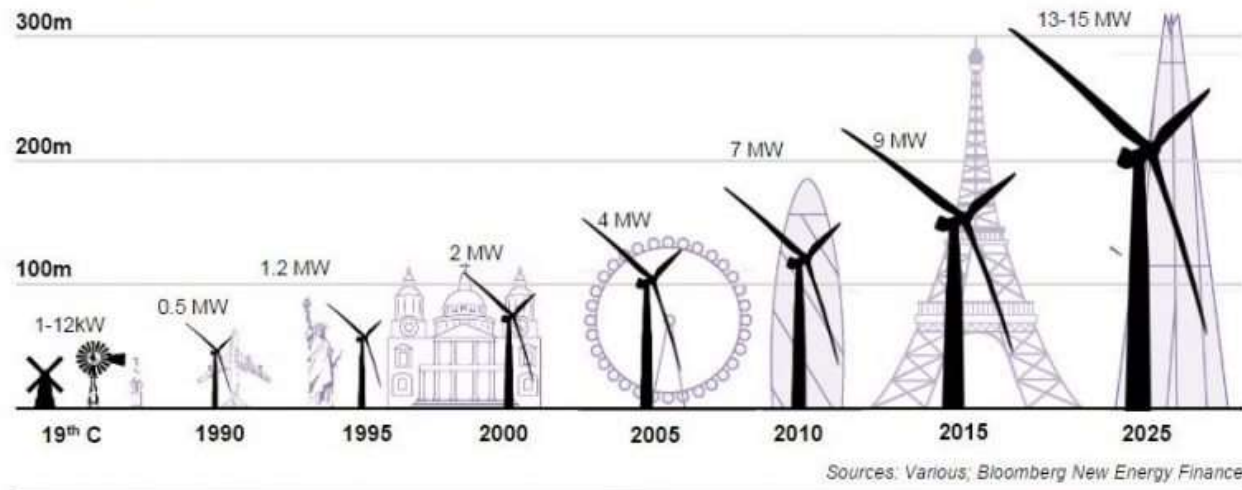


SOURCE: Center on Globalization, Governance, and Competitiveness, Duke University

# Size

Blades average 184 feet long and 290 feet tall  
Exponentially more energy as they get bigger

## Evolution of wind turbine heights and output



## Location

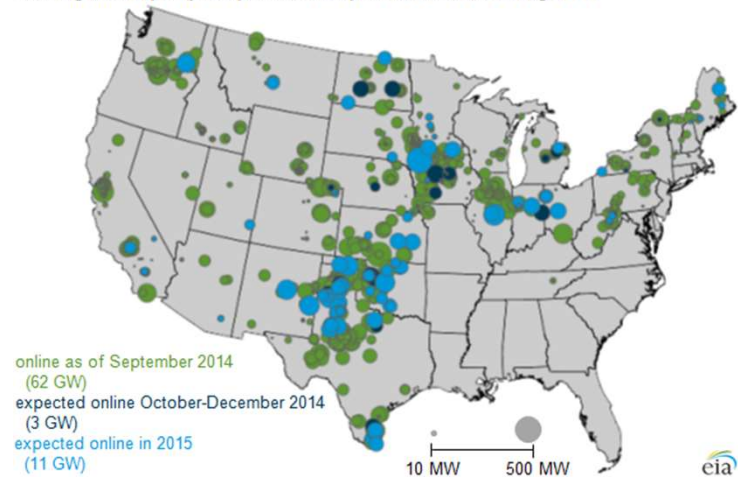
Some are offshore-> Can be located closer to cities

Many in remote locations-> Need long power cables to connect to populated areas

Currently supplies more than 30% of energy in Kansas, Iowa, and Oklahoma



Existing wind capacity and planned wind plant installations through 2015



## Negatives

- Can disrupt habitats with the noise
- Can cause deaths of large endangered birds of prey
- Research has gone into preventing this
- Using radar and turning off turbines
- Painted bright colors
- Lights
- Vertical Axis Turbines



# Liquid Batteries

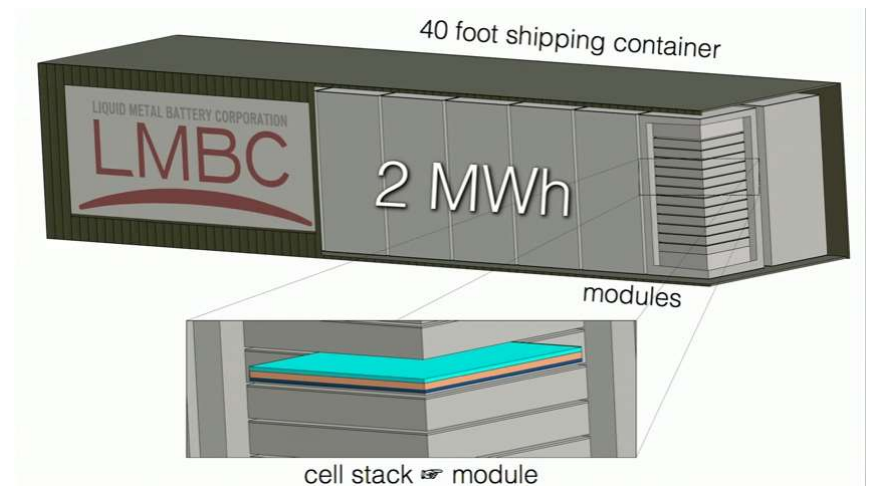
Created to solve the problem that energy isn't being produced by wind or solar sources all the time, is intermittent.

Made of sodium and nickel chloride

Originally thought of in 1968 but it needed a thin membrane, and they thought only a brittle ceramic material would work.

Now made a specially coated metal mesh

Cheap, abundant materials. Little degradation





# Wave Energy

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Renewable energy that can be easily predicted.

Can have an effect on the marine ecosystem.  
With lots of noise, disturb the sea floor.

Can also disturb private and commercial vessels

Isn't as productive in rough weather



# Ted Talks

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Cost and benefit of renewable energy

<https://www.youtube.com/watch?v=N-yALPEpV4w>