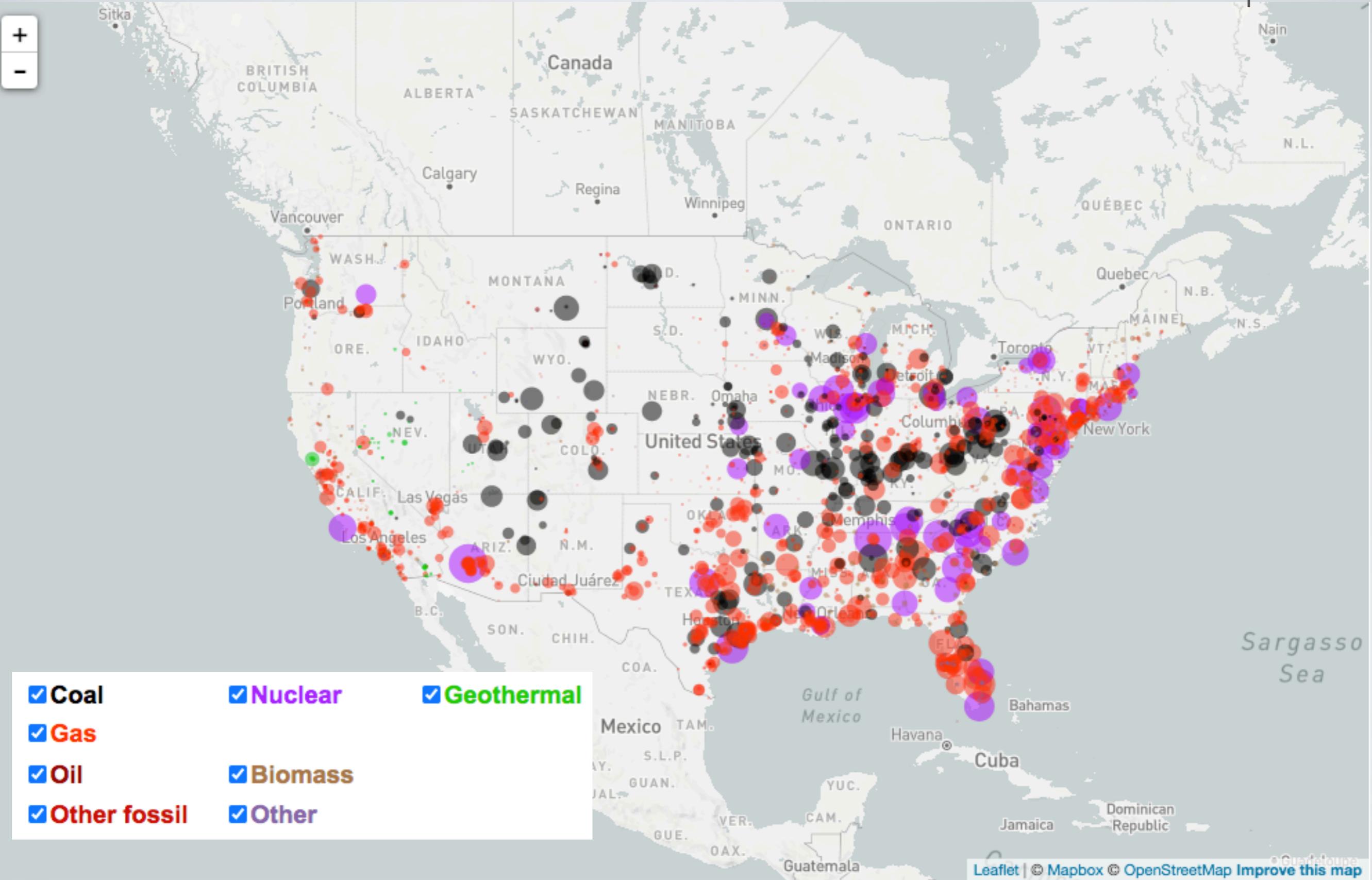


# Big Kinetic

# Overview

# Thermal-kinetic-electrical plants

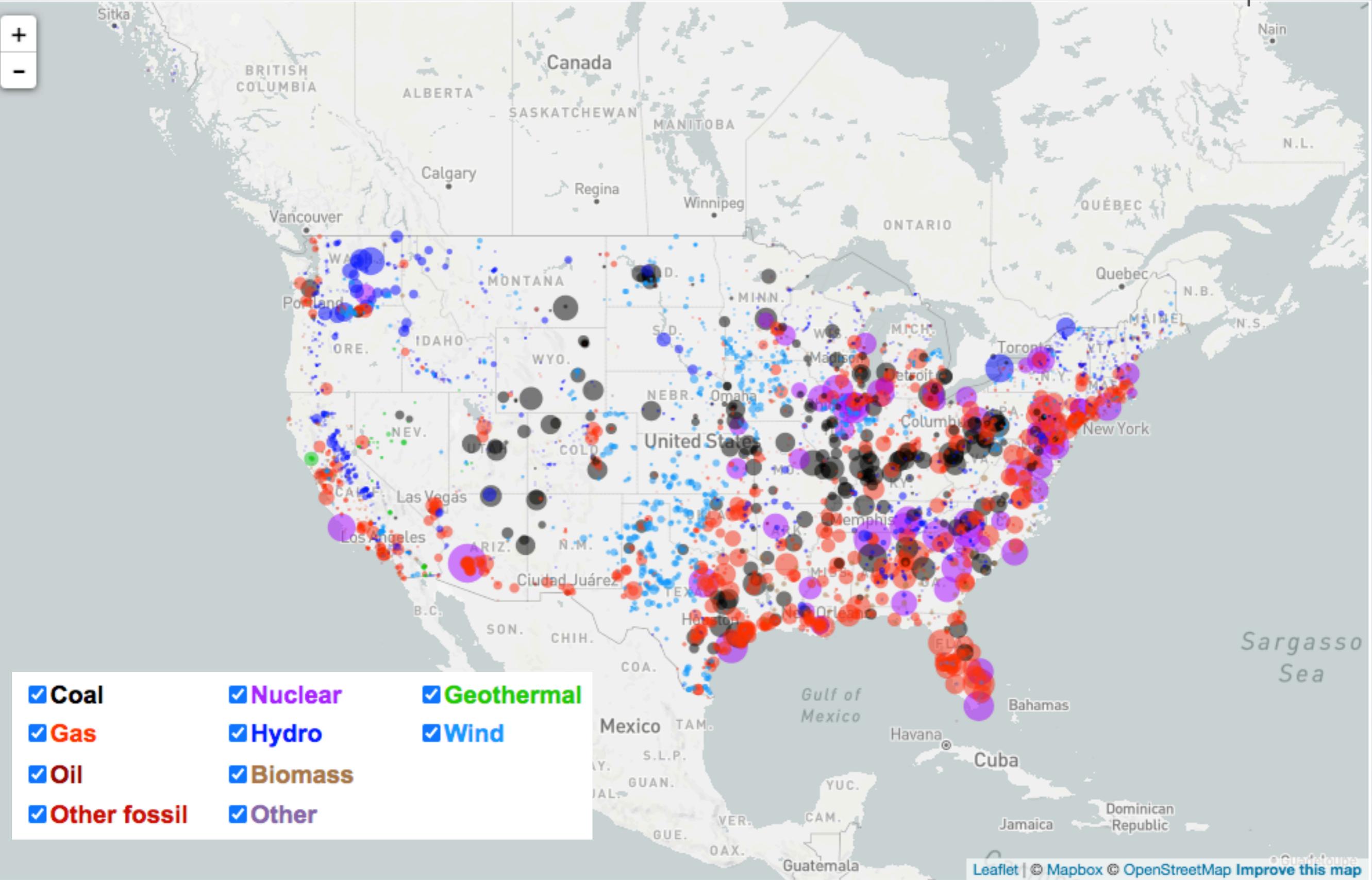


2019

Really awesome map of US electrical generation: <https://physics.weber.edu/schroeder/energy/PowerPlantsMap.html>

# Overview

# All kinetic-electrical plants

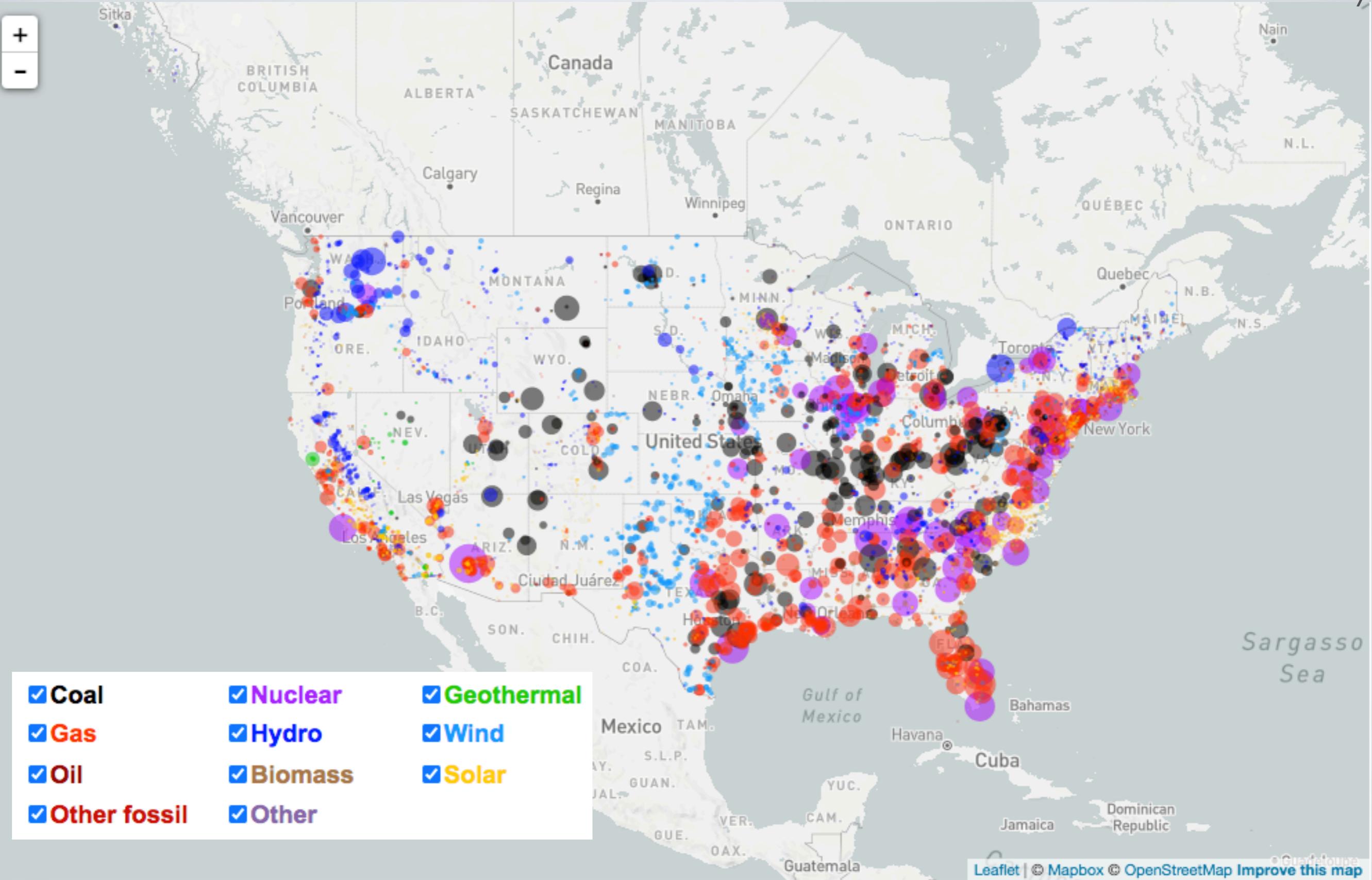


2019

Really awesome map of US electrical generation: <https://physics.weber.edu/schroeder/energy/PowerPlantsMap.html>

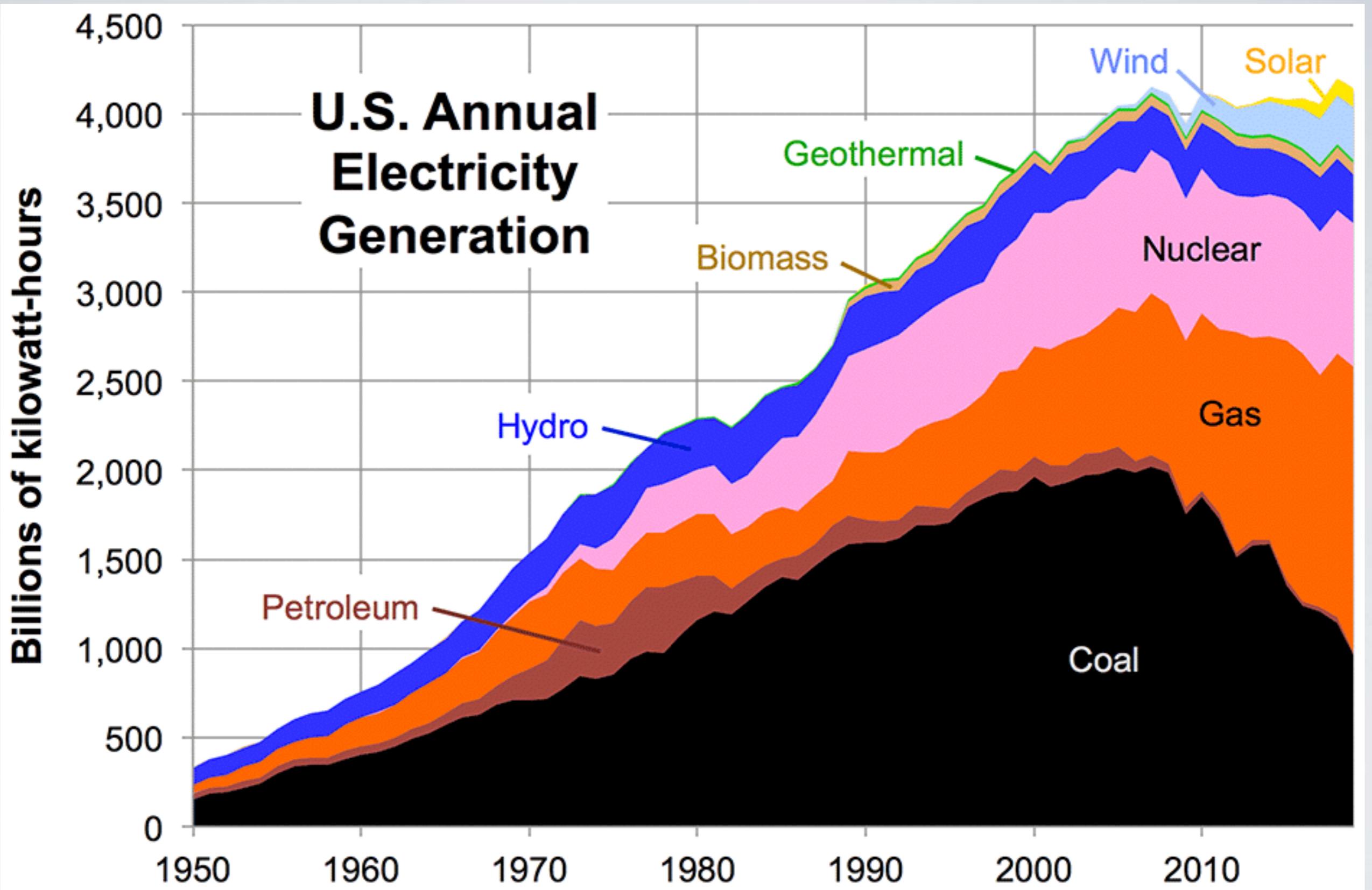
# Overview

All electricity

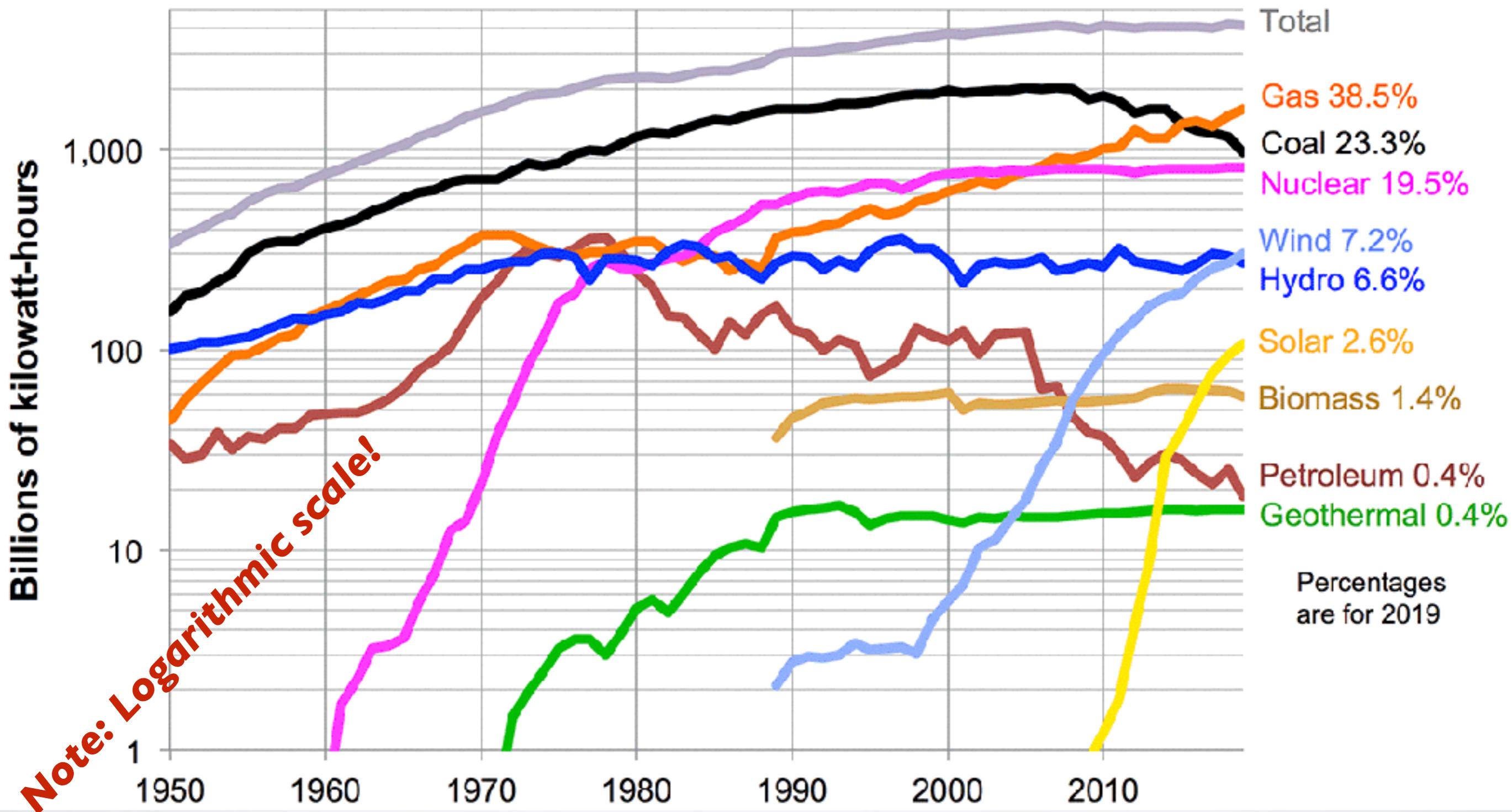


2019

Really awesome map of US electrical generation: <https://physics.weber.edu/schroeder/energy/PowerPlantsMap.html>

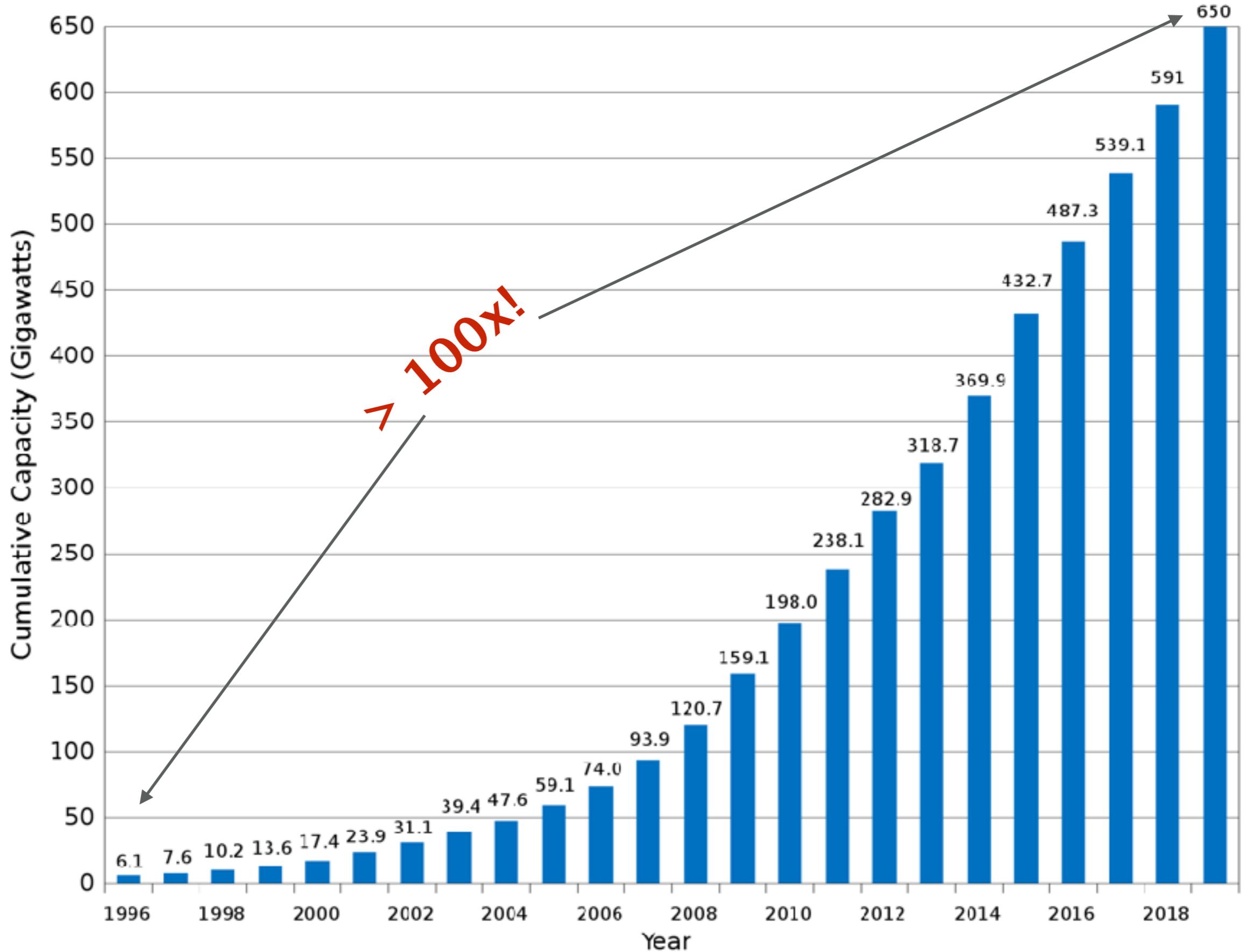


# U.S. Annual Electricity Generation

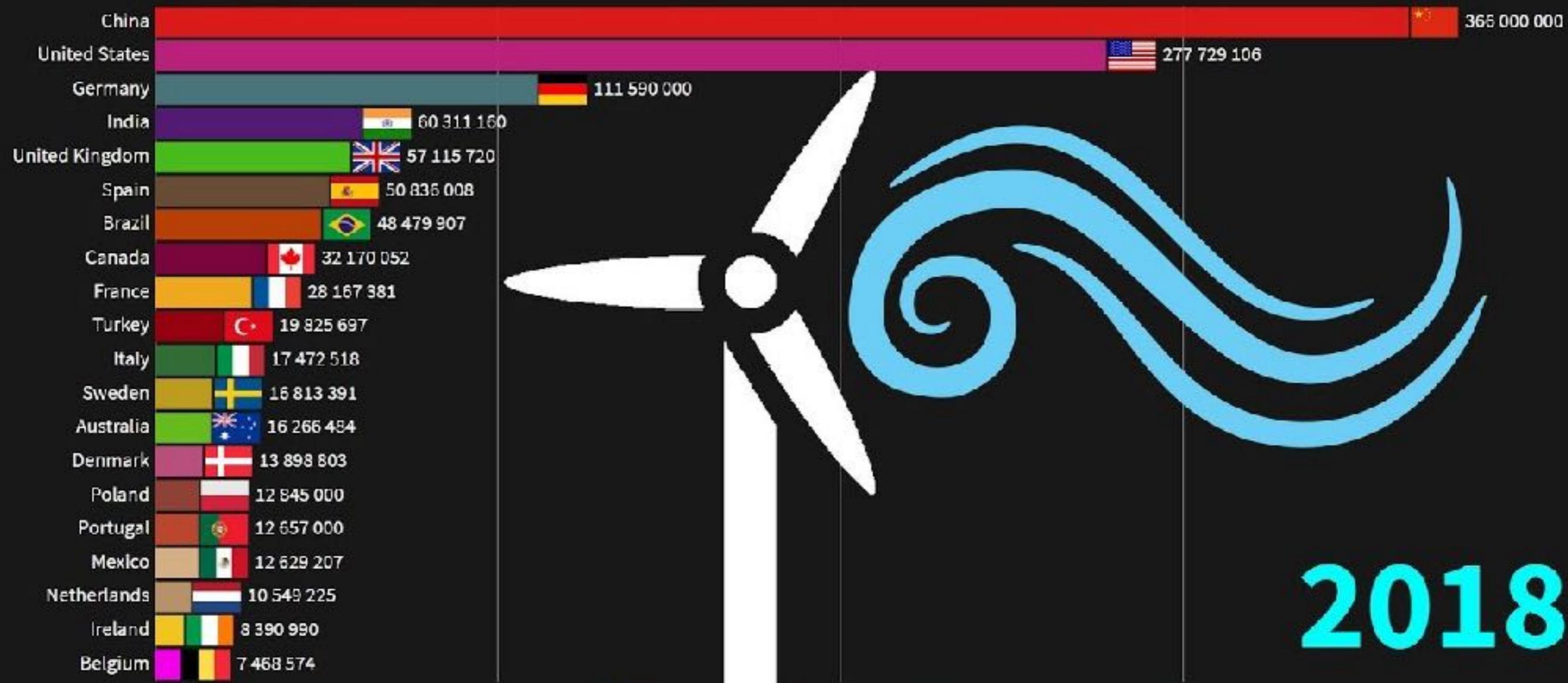


# Global: How much?

## Global Wind Power Cumulative Capacity (Data: GWEC)



# Highest Wind Energy Producing Countries

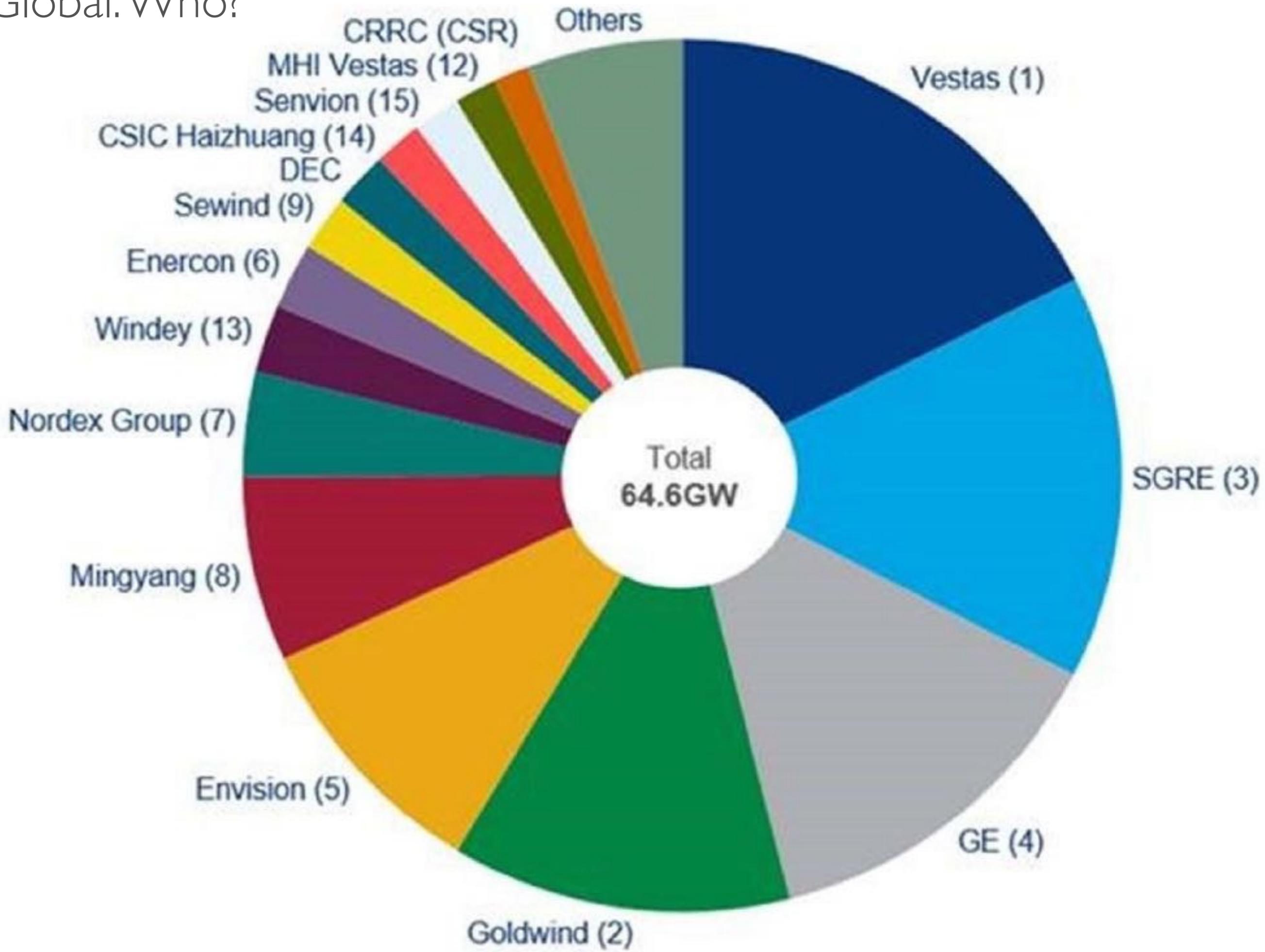


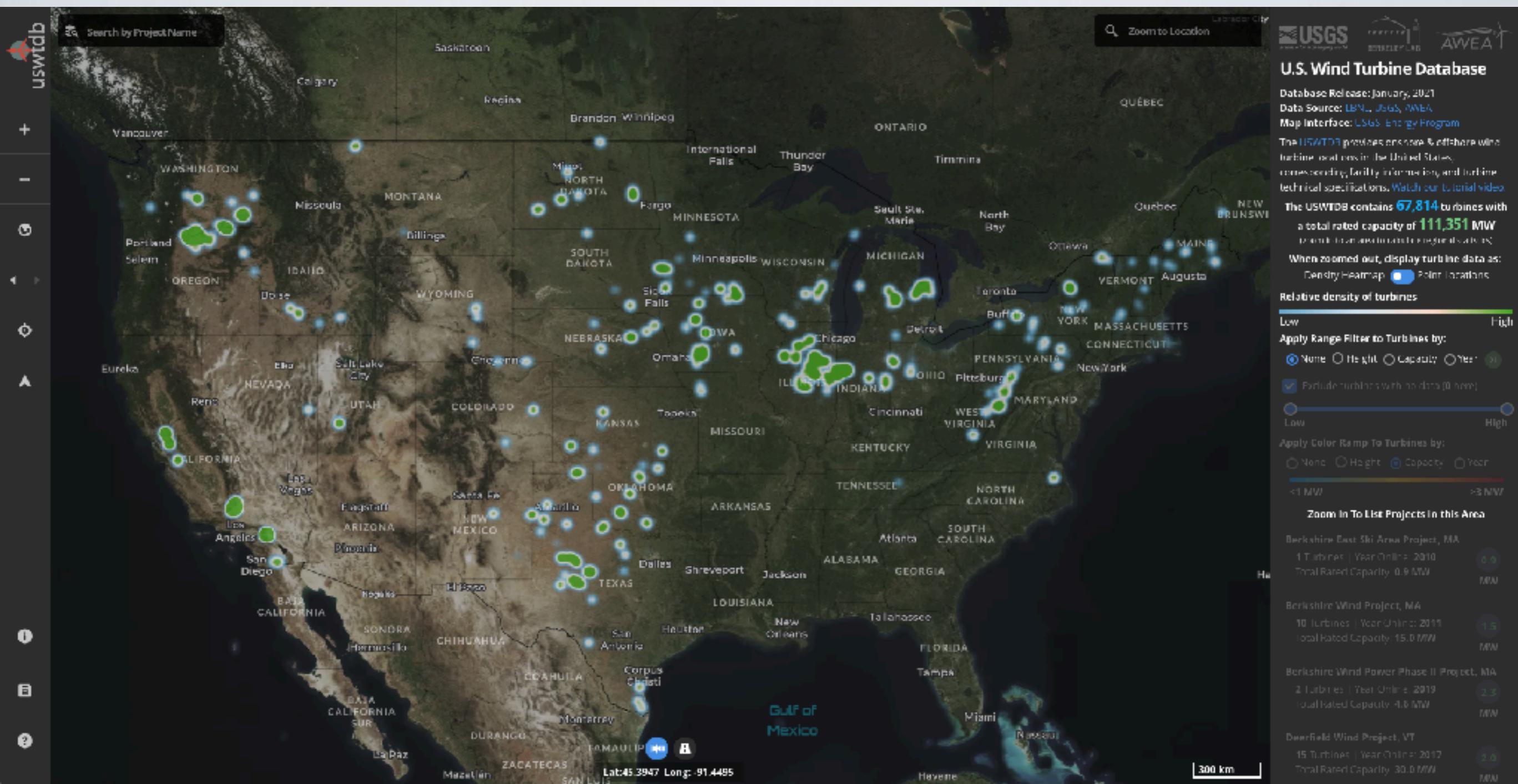
2018

World Total: 1 269 953 375

\*Production in Megawatt hour per year

# Global: Who?





Another very cool map for wind in the US: <https://eerscmap.usgs.gov/uswtodb/>

# Axis

**“Vertical”** (Perpendicular to wind)

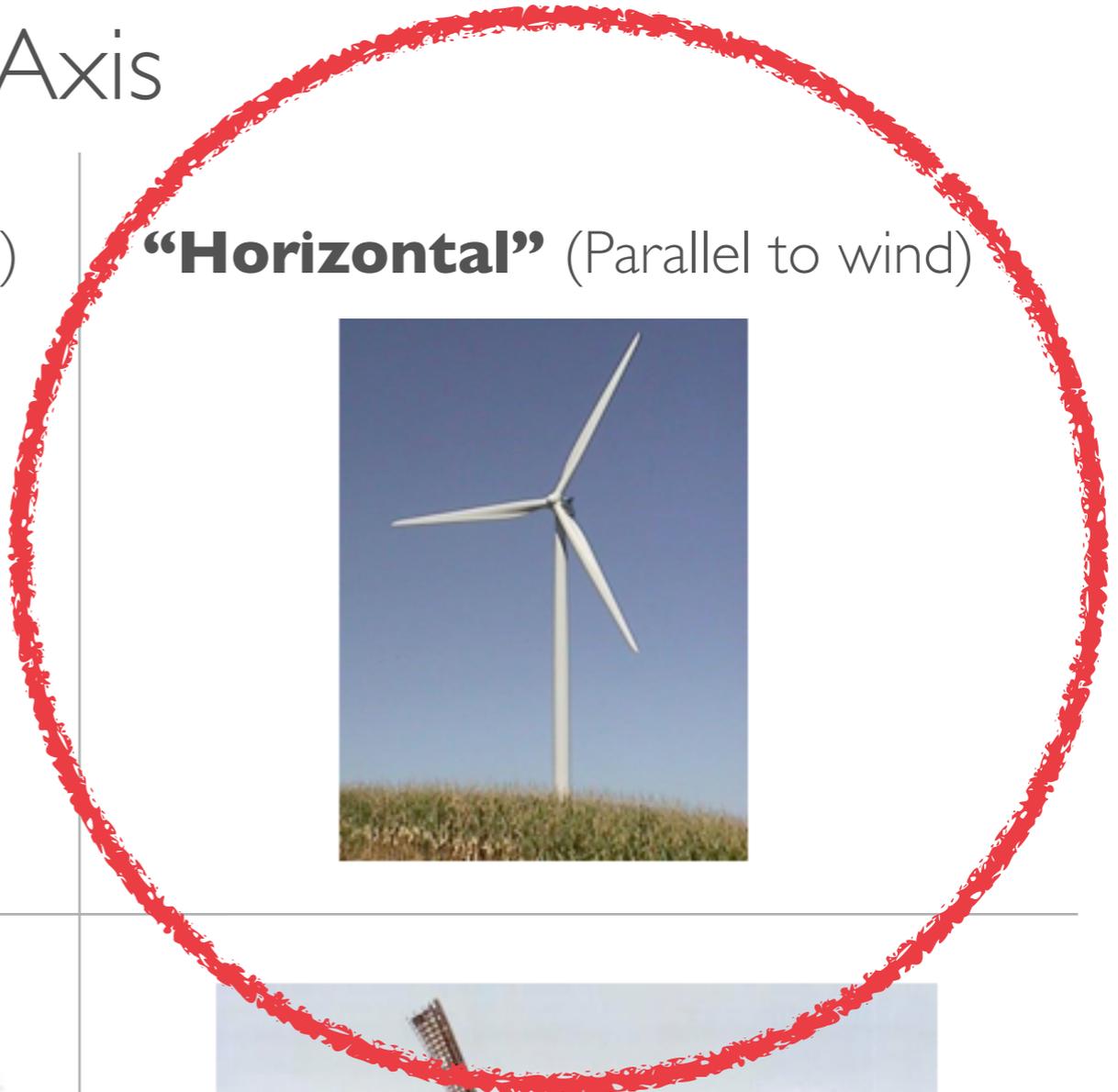
**“Horizontal”** (Parallel to wind)

Blade Type

**Lift**



**Drag**





2.3 MW



~ 2MW typical turbine size



2.3 MW



x 11,500\*

\*200 watt output

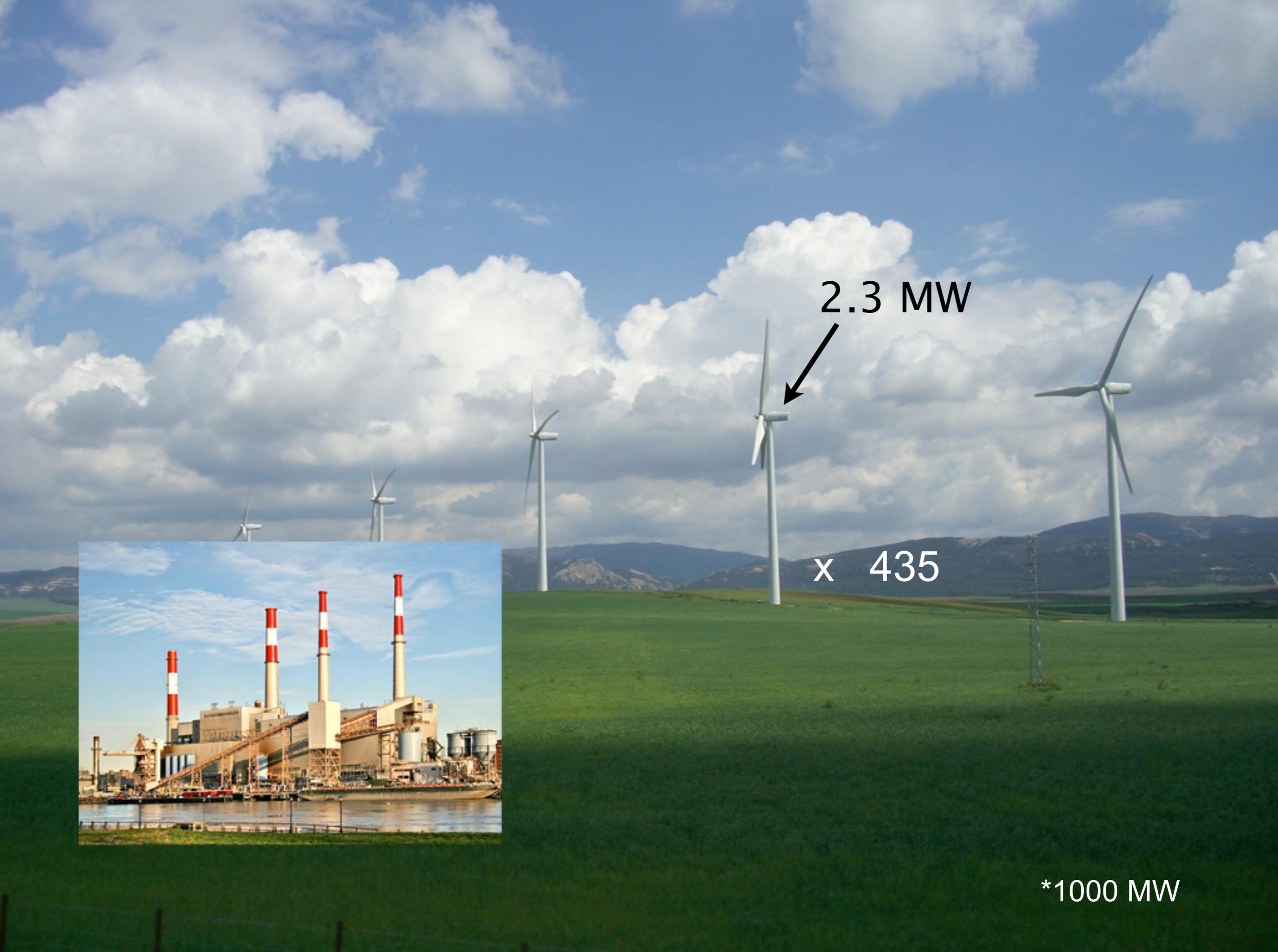
2.3 MW



x 22\*



\*140 hp output



2.3 MW

x 435

\*1000 MW





<http://www.juwisolar.com/>

## 2.2 MW solar installation for Mars Corp, Hackettstown, NJ



Google Earth

**Three factors** in wind turbine design:

Swept area, and thus power, increases with ***square*** of radius ( $\pi r^2$ ) **Bigger is better**

Kinetic energy increases with ***square*** of velocity ( $1/2 mv^2$ ) **Faster is better**

**Capacity factor** - effective portion of “***nameplate capacity***” delivered in real world conditions

**Consistent is better**

# Bigger is better

Brooklyn Wind  
Turbine

Vestas V27  
225 kW

572 m<sup>2</sup>  
swept area

13.5m  
blade length

31m tall

Project  
West Wind

Siemens 2.3  
2.3 MW

5,026 m<sup>2</sup>  
swept area

40m blade  
length

67m tall

Mahinerangi

Vestas V90  
3 MW

6,082 m<sup>2</sup>  
swept area

44m blade  
length

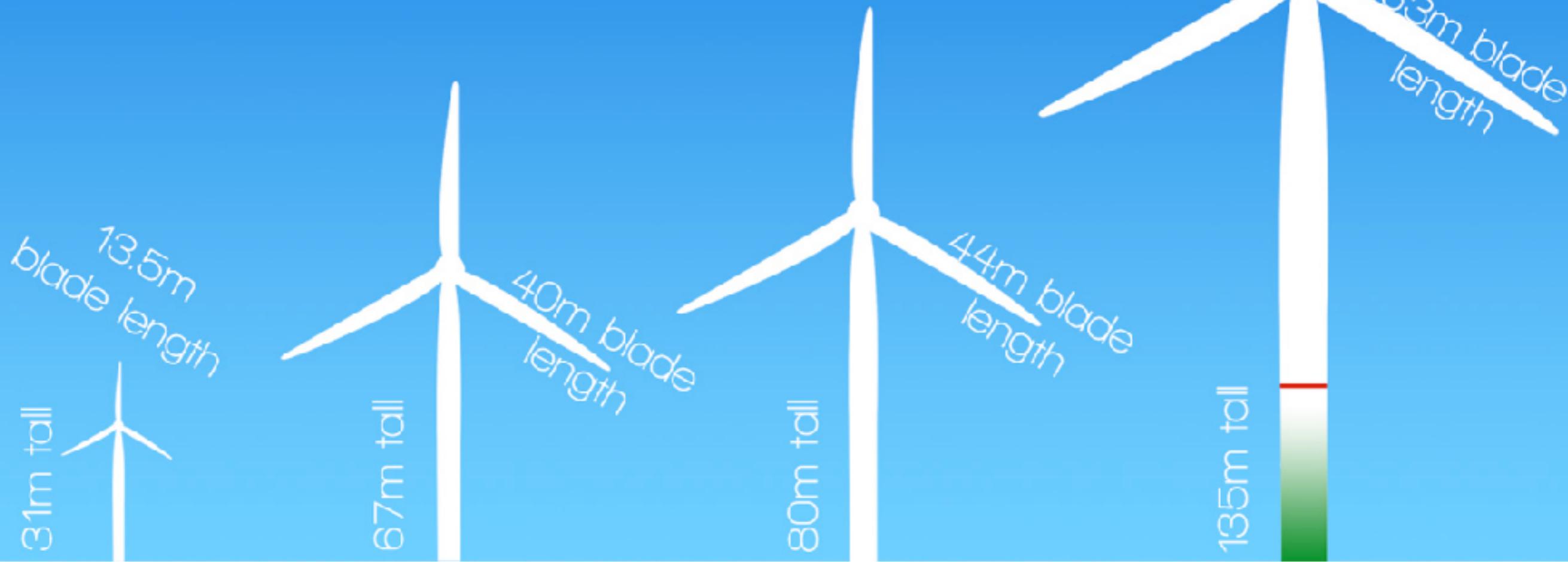
80m tall

Enercon E126  
7.58 MW

12,469 m<sup>2</sup>  
swept area

63m blade  
length

135m tall





“Ninety individual blades, each of them 128 feet long and weighing 77,000 pounds, were offloaded from the Chinese freighter ‘Gong Yin 1’ at the port and are now being loaded onto railcars. The blades were manufactured by Vestas Wind Systems, a Danish company, and are bound for a terminal in Manly, Iowa, that handles wind turbine components. The blades are composed of carbon and glass fiber.”



An 83.5-m-long blade made by Denmark's SSP Technology in transit to Scotland in 2013. It was called the longest blade in the world at the time.

<http://www.globalconstructionreview.com>



With the largest wind turbine blade more than 200 ft long, moving wind blades from the factory floor to the project site can require up to eight hauls using multiple transportation modes. The Aeroscraft can pick up wind blades from the factory floor and deliver them directly to locations without infrastructure.

<http://aeroscraft.com>

**Art Break**



Patrick Marold "Windmill Project" 2001-ongoing

<https://www.patrickmarold.com/>



Jason Bruges “Wind to Light” 2007



Smallest Vini Wind Turbines Generator LED Teaching Tools Sample Model  
★★★★★ 4.7 - 36 Reviews 100 orders

**US \$4.75** ~~US \$5.92~~ -17%

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Jason Bruges "Wind to Light" 2007

# Strandbeest-Theo Jansen



# THEO JANSEN STRANDBEEST

Plateforme 10, Lausanne  
Auditorium, Musée cantonal  
des Beaux-Arts (MCBA)  
1<sup>er</sup> juillet - 3 août 2025

PRÉSENTÉ PAR  
**AUDEMARS PIGUET**  
CONTEMPORARY



AUDEMARS PIGUET  
*Le Temps*

PREMIER  
AUDEMARS PIGUET



MCBA  
muda  
PHOTO  
ELYSEE

SIEGE OF GORAŽĐE  
BOSNIAN WAR  
1992-1995



SIEGE OF GORAŽĐE  
BOSNIAN WAR  
1992-1995



SIEGE OF GORAŽDE  
BOSNIAN WAR  
1992-1995



# SIEGE OF GORAŽĐE BOSNIAN WAR 1992-1995



This is an example of an improvised power plant



We quickly made the first mills from 500 watts to 2 kilowatts.

# SIEGE OF GORAŽĐE BOSNIAN WAR 1992-1995



We quickly made the first mills from 500 watts to 2 kilowatts.



Under the main city bridge, there were maybe 30 or 50.

Daan Roosegaarde  
WINDVOGEL

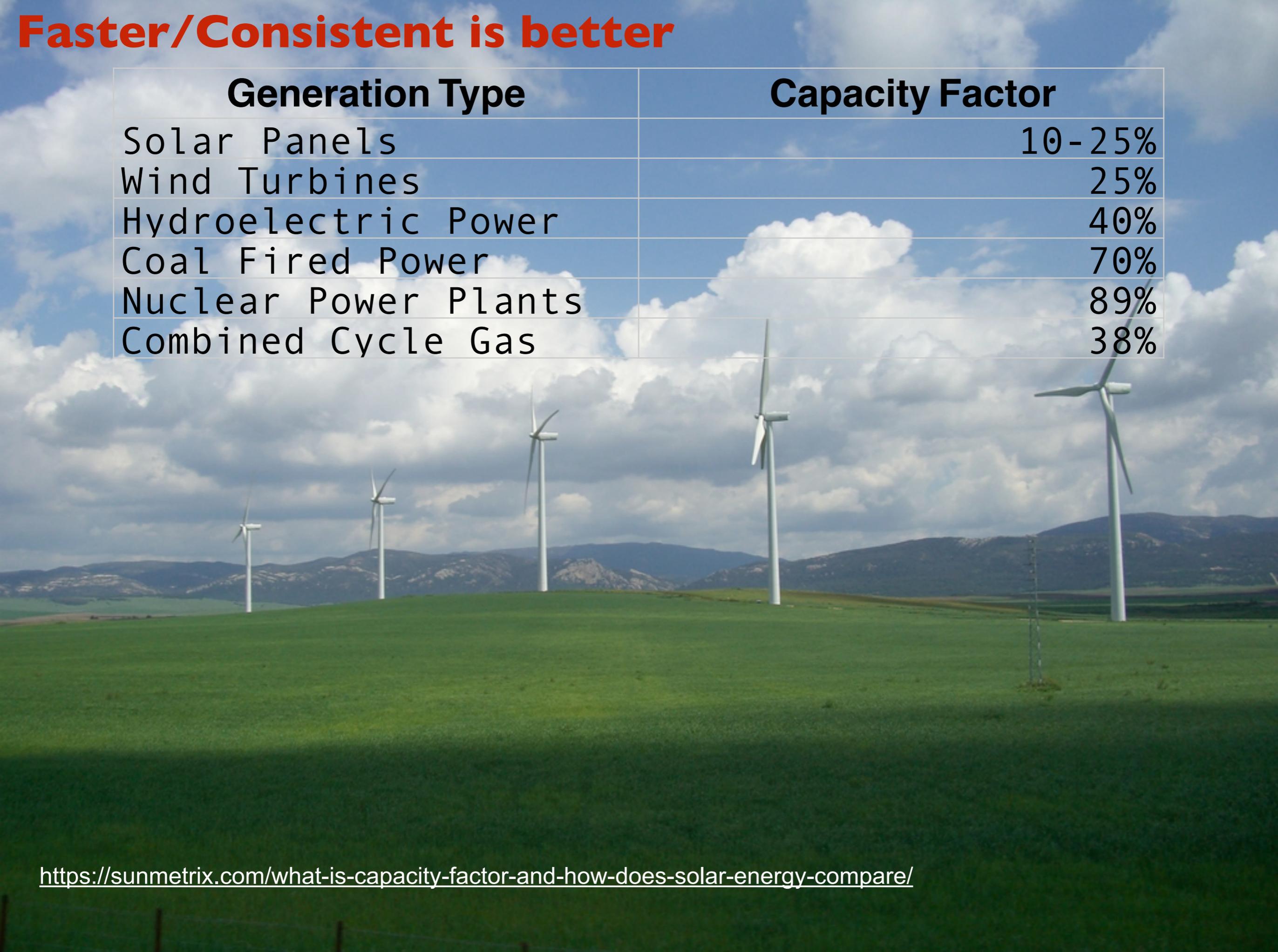




**Art Break**

# Faster/Consistent is better

Generation Type	Capacity Factor
Solar Panels	10 - 25%
Wind Turbines	25%
Hydroelectric Power	40%
Coal Fired Power	70%
Nuclear Power Plants	89%
Combined Cycle Gas	38%



# Faster/Consistent is better

Capacity factor: 20 - 40%

$2.3 \text{ MW} \times 365 \text{ days} \times 30\% = 6 \text{ GWh}$





Offshore wind



Vestas V164/V174  
9.5MW record in 2017

Vestas V236  
15MW, 236m diameter, 2022

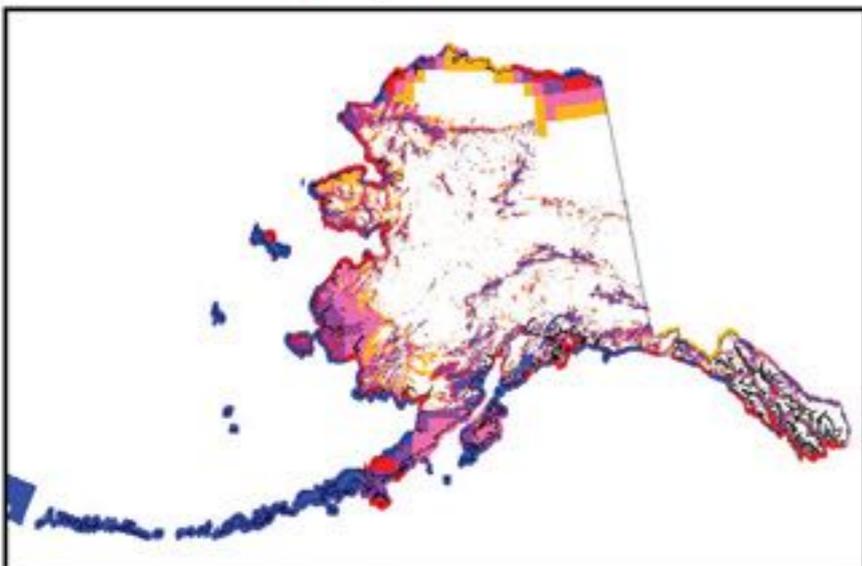
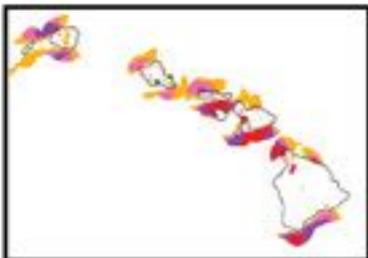
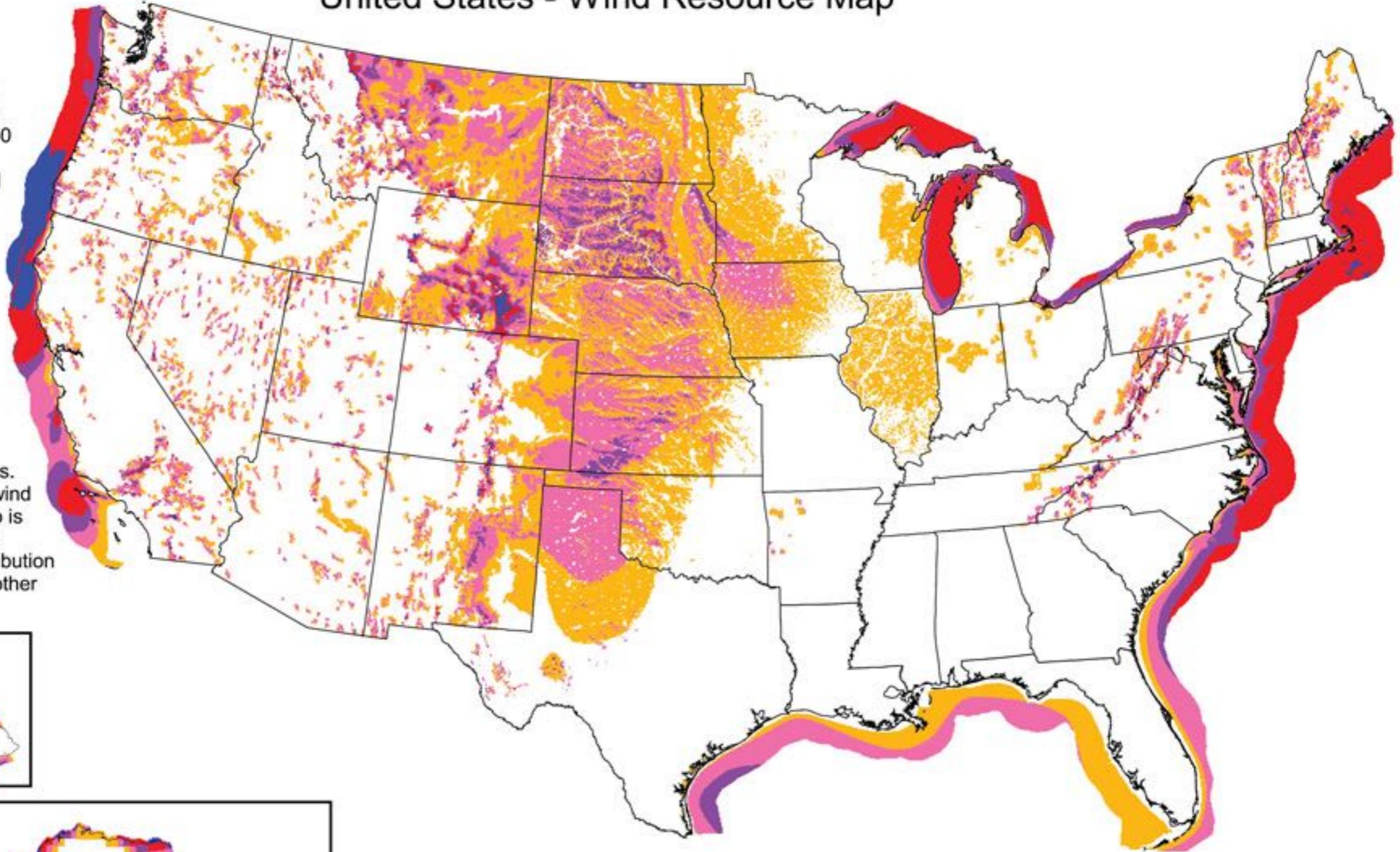


2025: Dongfang 26MW,  
310m diameter



# United States - Wind Resource Map

This map shows the annual average wind power estimates at 50 meters above the surface of the United States. It is a combination of high resolution and low resolution datasets produced by NREL and other organizations. The data was screened to eliminate areas unlikely to be developed onshore due to land use or environmental issues. In many states, the wind resource on this map is visually enhanced to better show the distribution on ridge crests and other features.



Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m <sup>2</sup>	Wind Speed <sup>a</sup> at 50 m m/s	Wind Speed <sup>a</sup> at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

<sup>a</sup> Wind speeds are based on a Weibull k value of 2.0



U.S. Department of Energy  
National Renewable Energy Laboratory

# United States - Wind Resource Map

This map shows the annual average wind power estimates at 50 meters above the surface of the United States. It is a

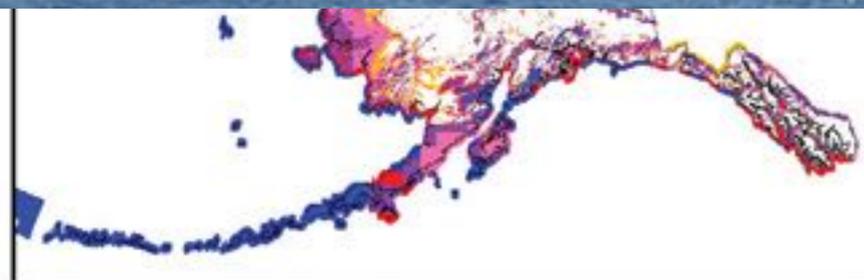
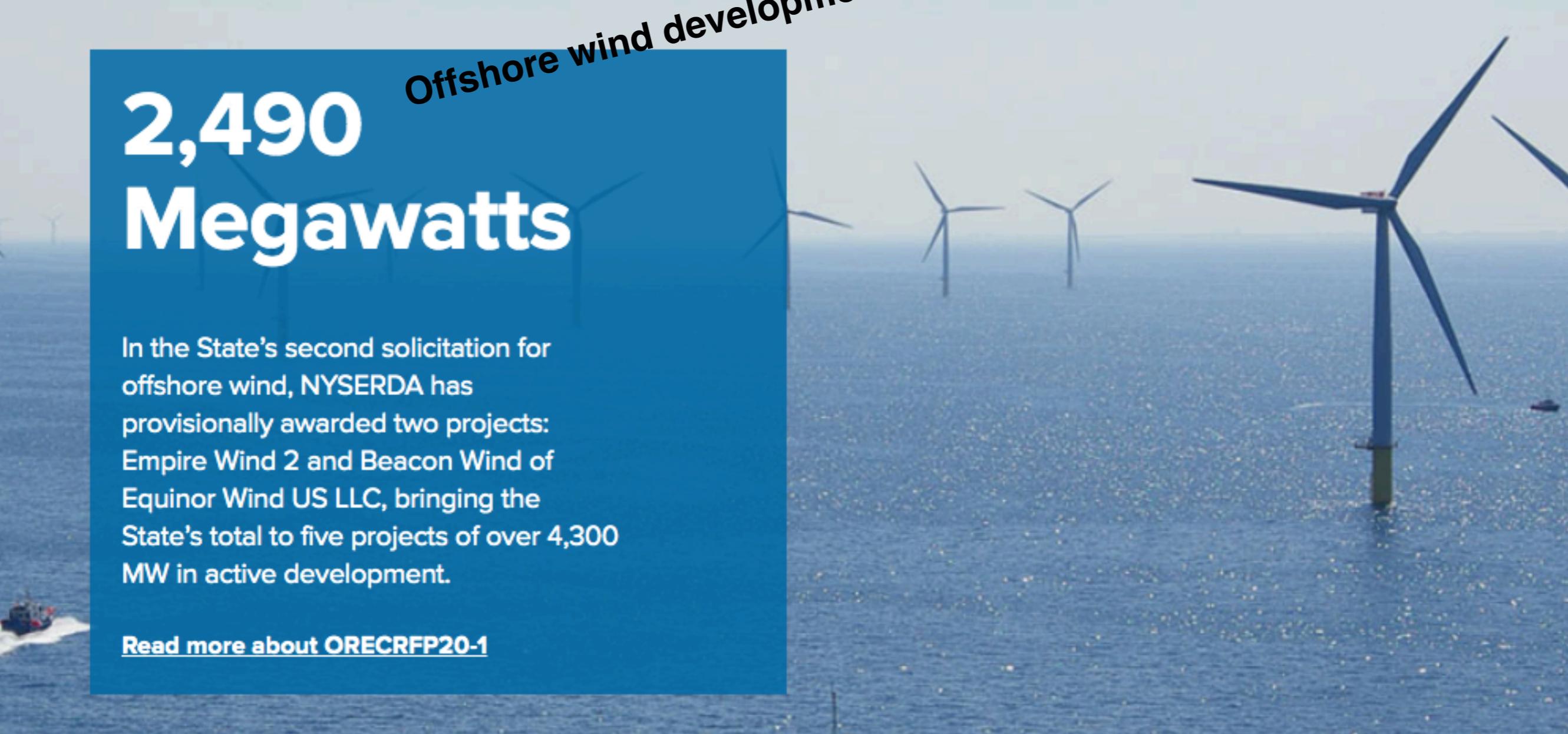


**Offshore wind development happening in NY, now**

## 2,490 Megawatts

In the State's second solicitation for offshore wind, NYSERDA has provisionally awarded two projects: Empire Wind 2 and Beacon Wind of Equinor Wind US LLC, bringing the State's total to five projects of over 4,300 MW in active development.

[Read more about ORECRFP20-1](#)



Class		W/m <sup>2</sup>	m/s	mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

<sup>a</sup> Wind speeds are based on a Weibull k value of 2.0

# Judge Hands Trump a Fifth Loss in His Effort to Halt Offshore Wind Projects

The court ruled that construction can restart on a wind farm off the coast of New York State. The Trump administration had ordered work to stop in December.

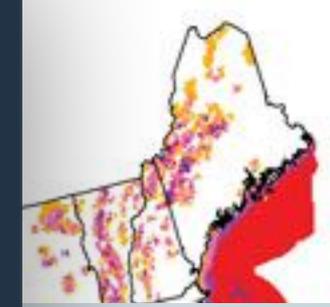
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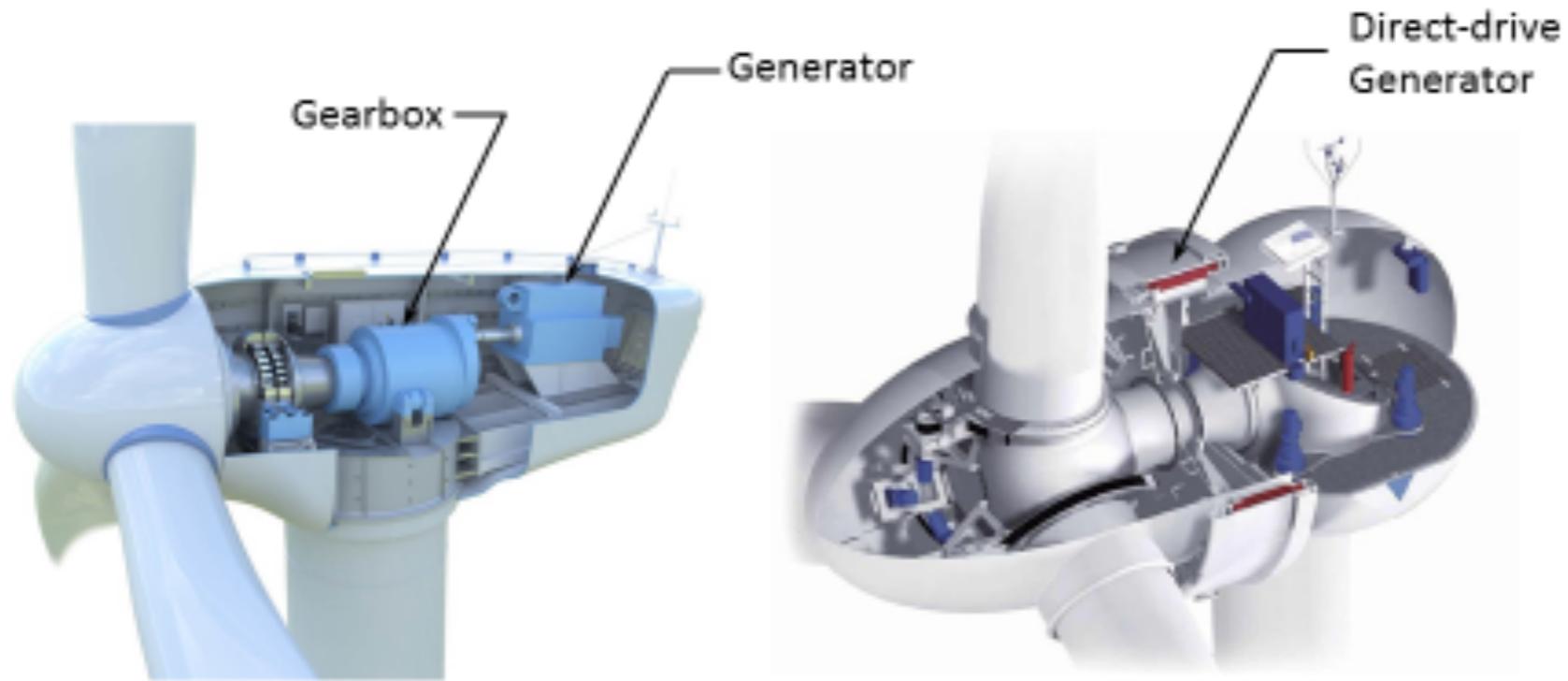
393



~~RIP (?) 2024???~~



# “Traditional” and “direct-drive” turbines



Like a gear motor

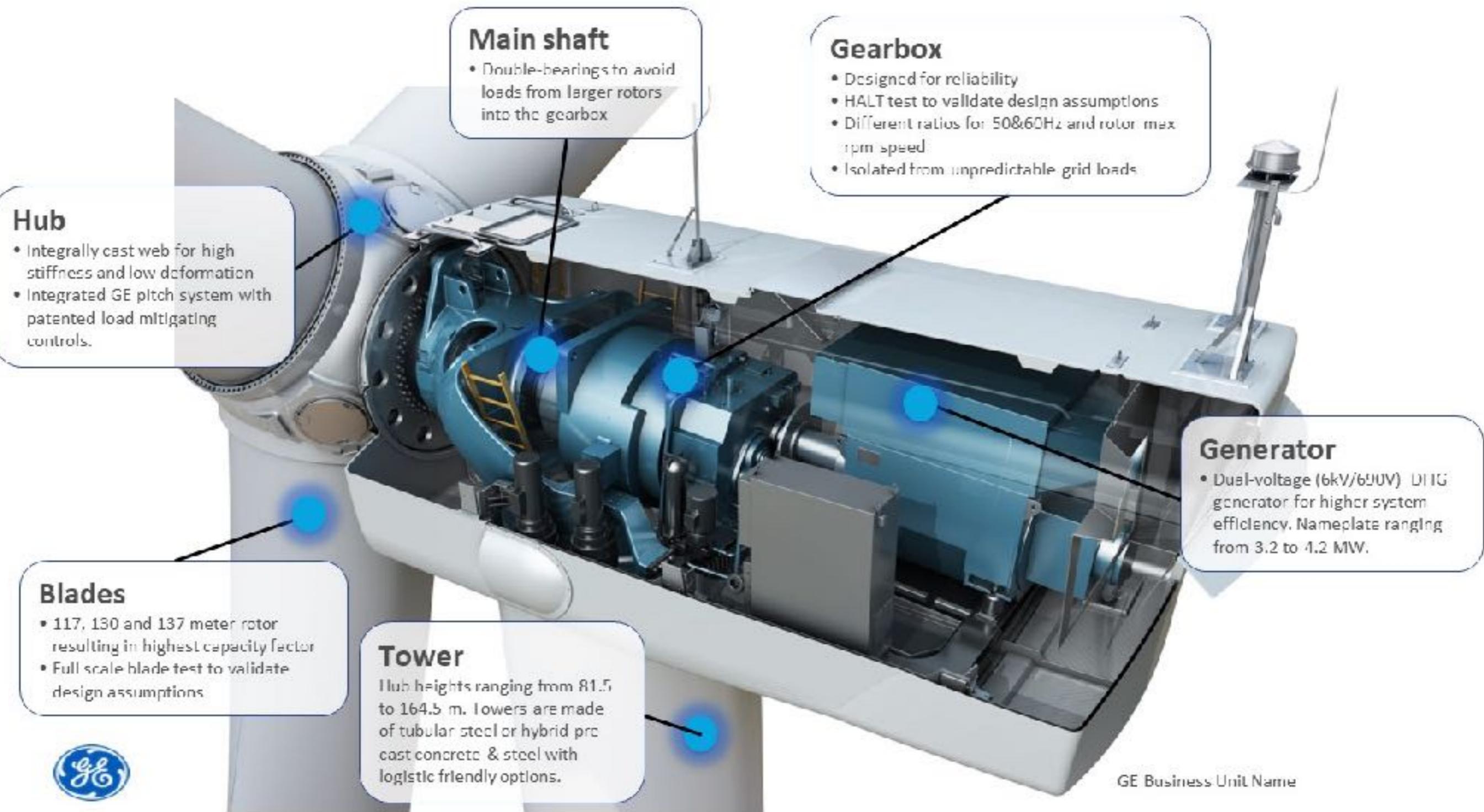
Like a stepper

NREL's graphics aren't great...

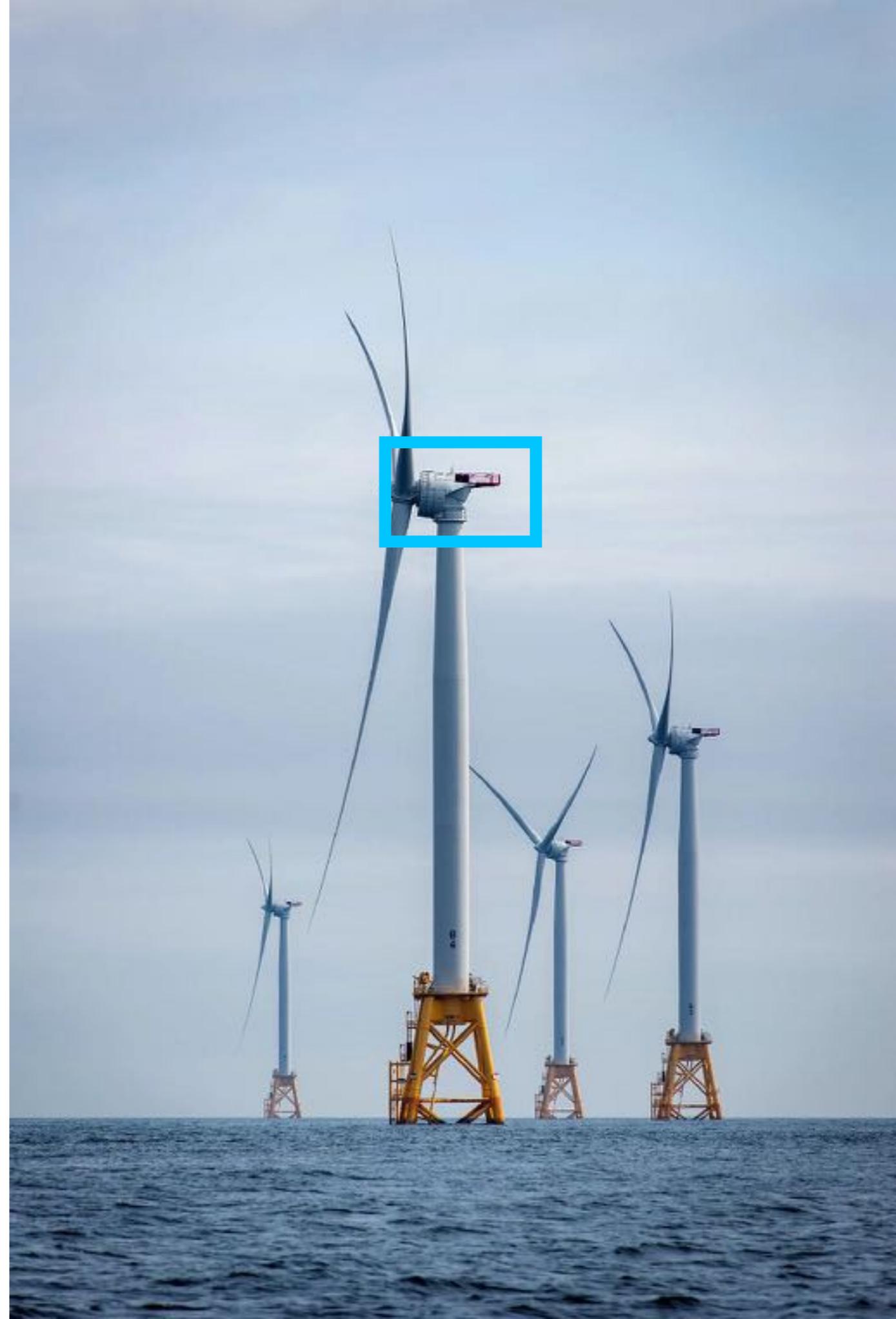
“Traditional” turbine with gearbox and generator



# “Traditional” turbine with gearbox and generator



“Direct drive” - note tiny nacelle



“Direct drive” - note tiny nacelle

GE Renewable Energy

# Haliade\* 150-6MW Offshore Wind Turbine

## Generator

In charge of generating the electricity, the direct-drive permanent magnet generator has fewer rotating parts, which increases reliability, maximizes availability and reduces maintenance costs.

## Hub

Supports the rotor blades and houses their pitch assembly. It is designed to provide easy access.

## Rotor Bearings

Directly transfer the unwanted load on the rotor towards main structure, bypassing the drive train.

## Pitch

Controls the blade angle optimizing the area exposed to the wind, the rotation speed to ultimately increase the yield.

## Helipad

A helicopter winching area allows for quick access in case of emergency at sea.

## Elastic Coupling

Key element of the Pure Torque\* system, includes a patented coupling system that avoid undesired load towards the generator.

## Main Frame & Tower

Made of cast steel, the frame supports the rotor and transfers the loads to the tower.



## Innovative, reliable, efficient

- The new generation 6 MW direct drive offshore wind turbine
- Suitable for all offshore conditions, delivering renewable energy at competitive cost to 5,000 households

\*Trademark of General Electric Company

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www.petzl.com

# Big Hero 6



# Makani 2006 – 2020 (patents opensourced)



<https://x.company/projects/makani/>

Makani M30 30kW  
prototype airborne turbine

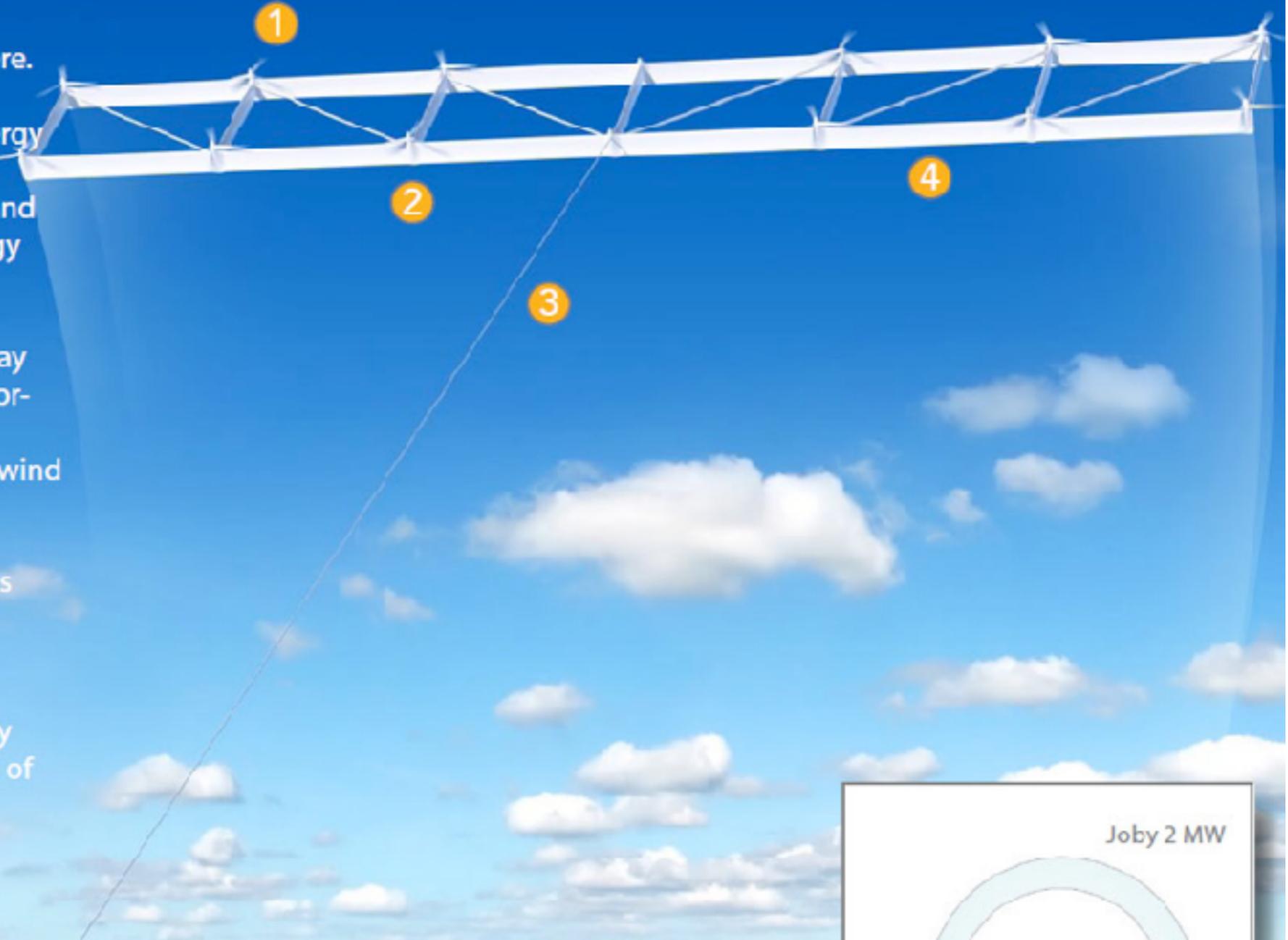
# Airborne Wind Turbines

Joby RIP 2012

Joby Energy is developing airborne wind turbines which will operate in the upper boundary layer and the upper troposphere.

While knowledge of the tremendous energy in high-altitude wind is not new, recent advances in power electronics, sensors, and control systems now make our technology practical.

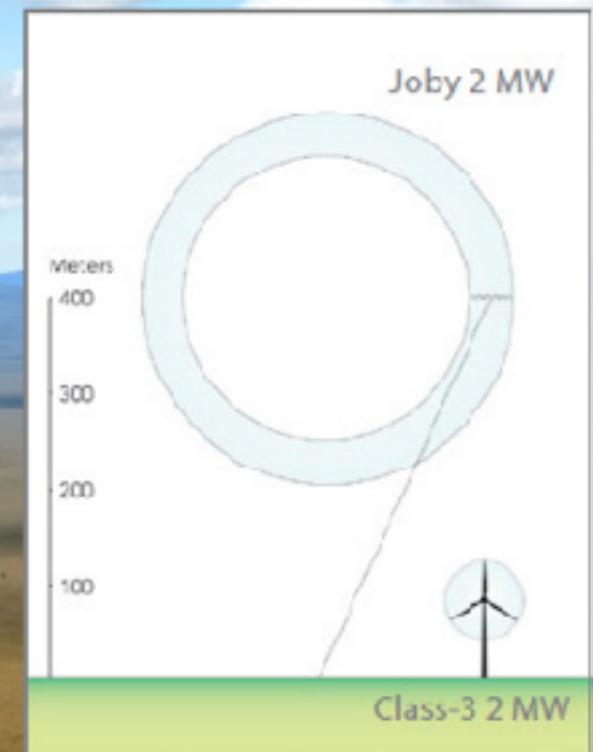
Our multi-wing structure supports an array of turbines. The turbines connect to motor-generators which produce thrust during takeoff and generate power during crosswind flight. Orientation in flight is maintained by an advanced computer system that drives aerodynamic surfaces on the wings and differentially controls rotor speeds. A reinforced composite tether transmits electricity and moors the system to the ground. The high redundancy of the array configuration can handle multiple points of failure and remain airborne.



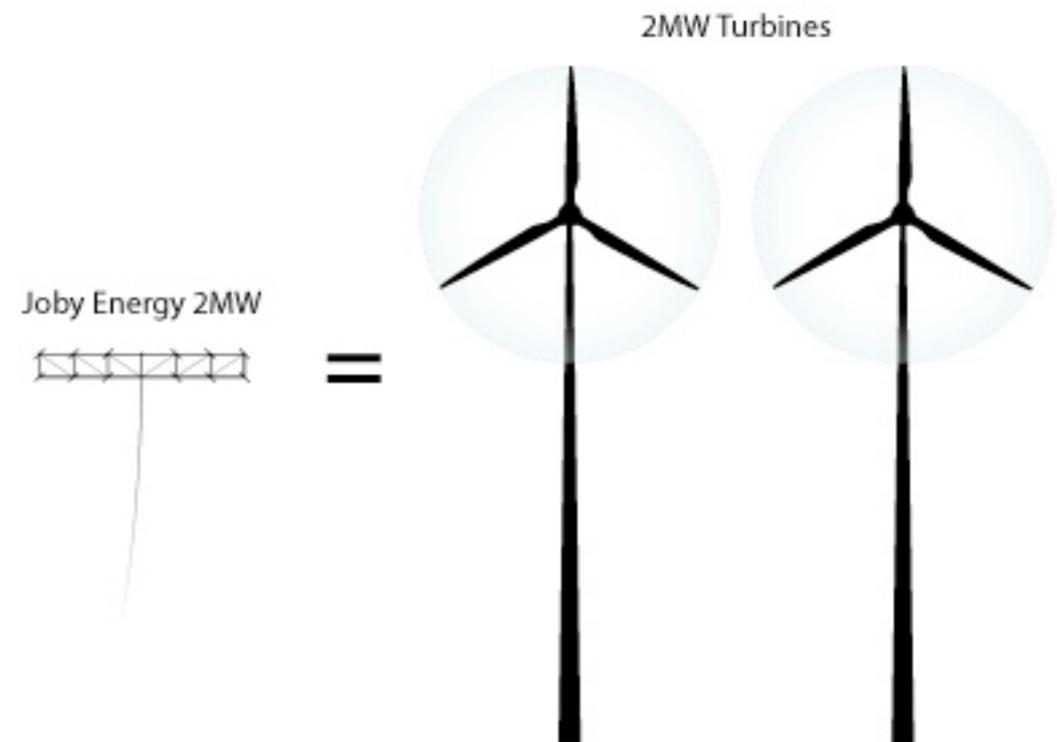
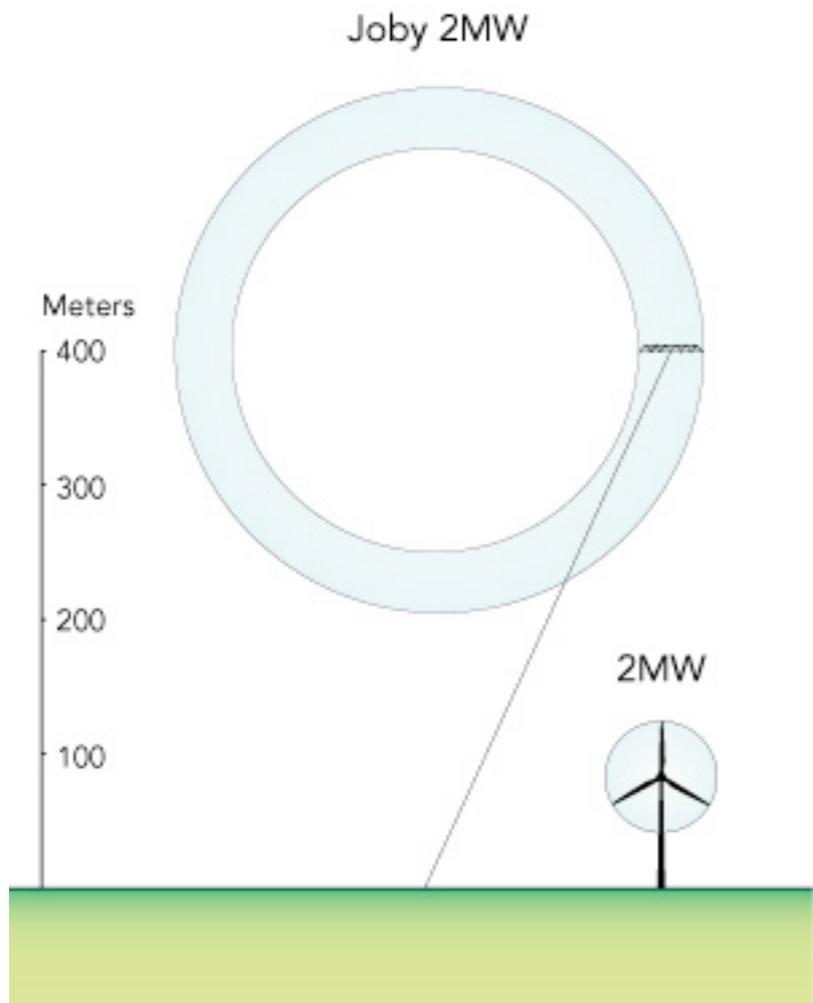
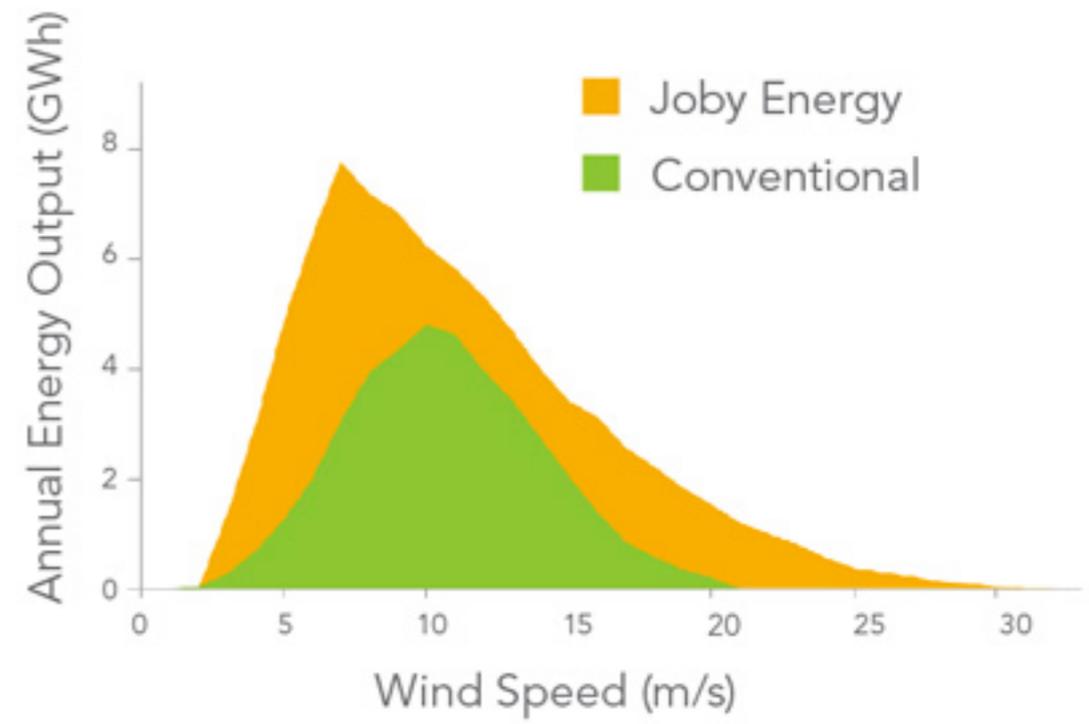
## How It Operates

For launch, the turbines are supplied with power to enable vertical take-off. Upon reaching operating altitude, the system uses the power of the wind to fly cross-wind in a circular path. The high cross-wind speeds result in the turbines spinning the generators at high speeds, eliminating the need for gearboxes and increasing efficiency. The energy is transferred to the ground through the electrical tether. During occasional periods of low wind the turbines are powered to land the system safely.

Joby turbine



Joby turbine data  
(predicted)



# WILL THIS TAKE OFF?



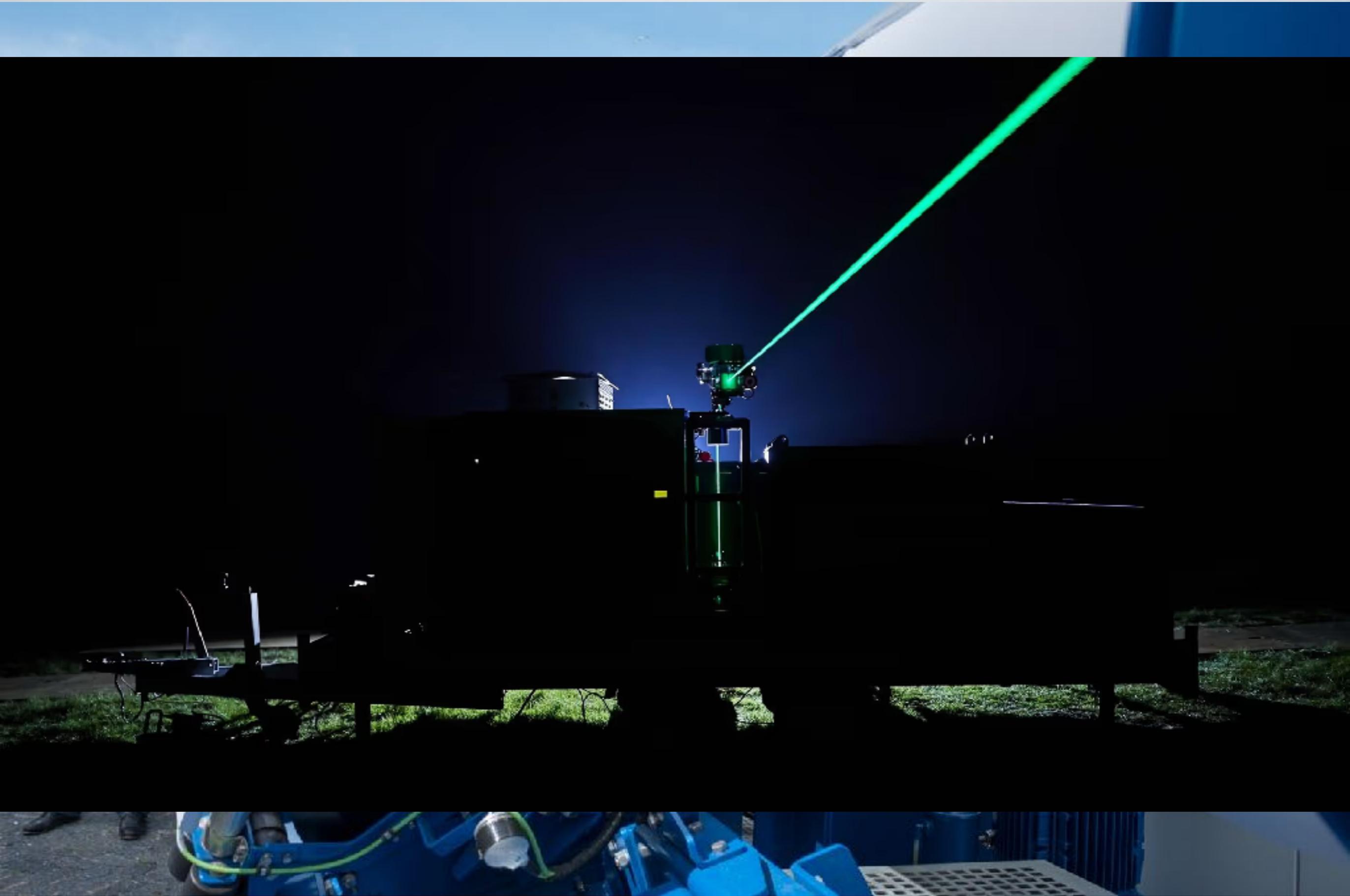
Engineering with  
**ROSIE**

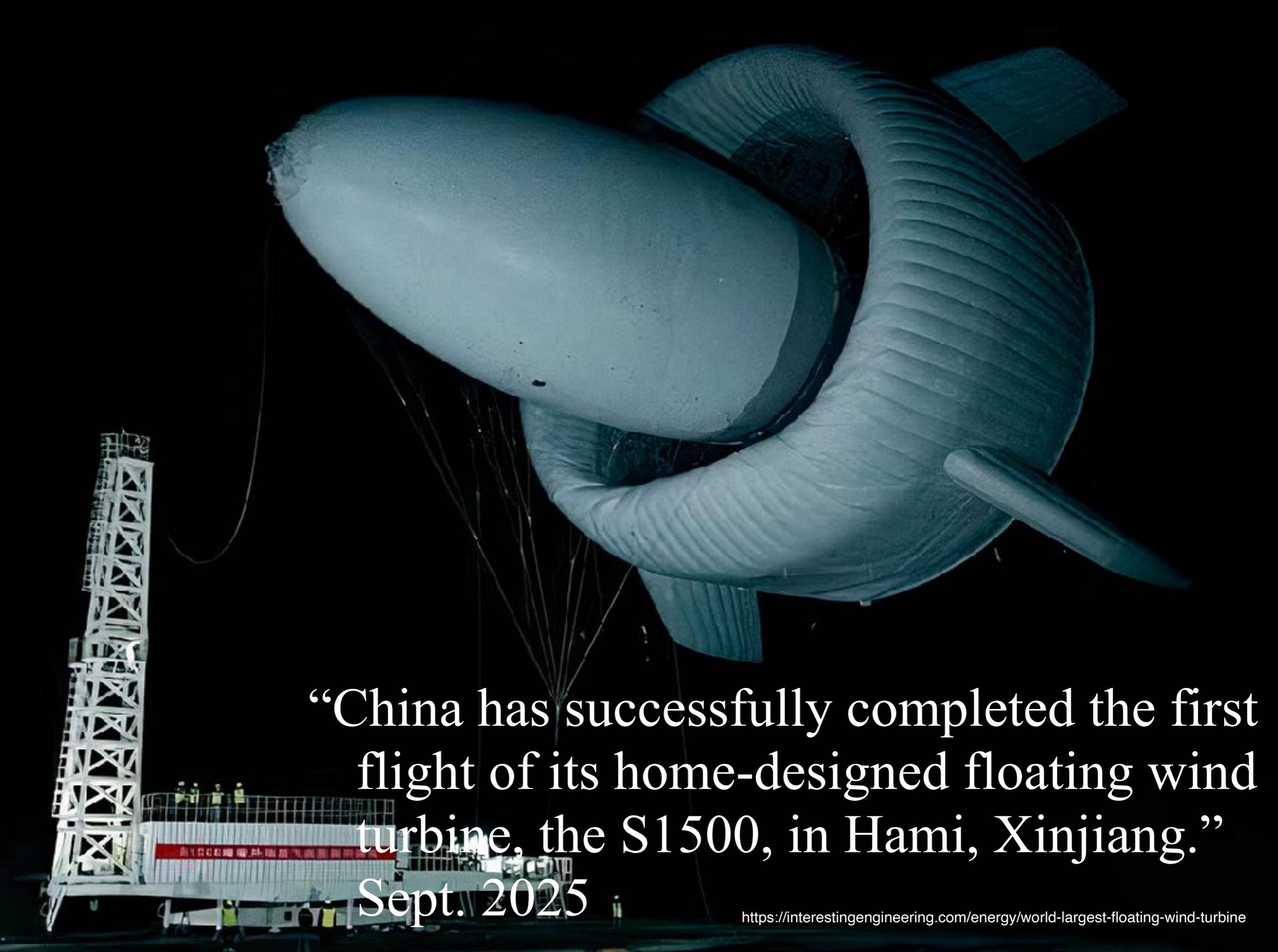
Great recent overview of “airborne wind”: <https://www.youtube.com/watch?v=UfpW-MKhjuY&t=1s>



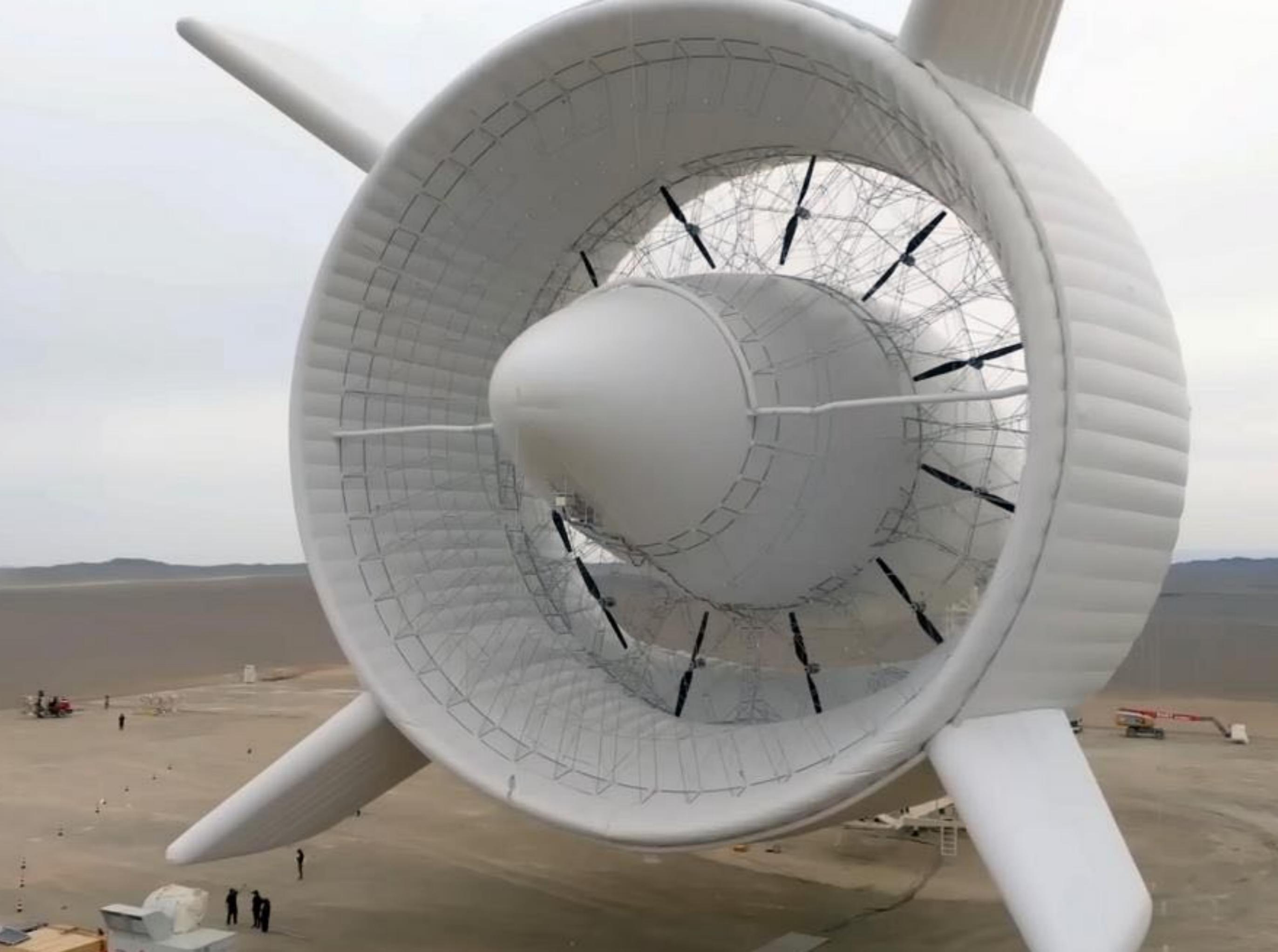


DROMEC



A large, white, cylindrical floating wind turbine component is being hoisted by a crane at night. The component is suspended by several thick cables. In the background, a tall, white lattice crane structure is visible. The scene is illuminated by artificial lights, creating a high-contrast, blue-tinted atmosphere.

“China has successfully completed the first flight of its home-designed floating wind turbine, the S1500, in Hami, Xinjiang.”  
Sept. 2025







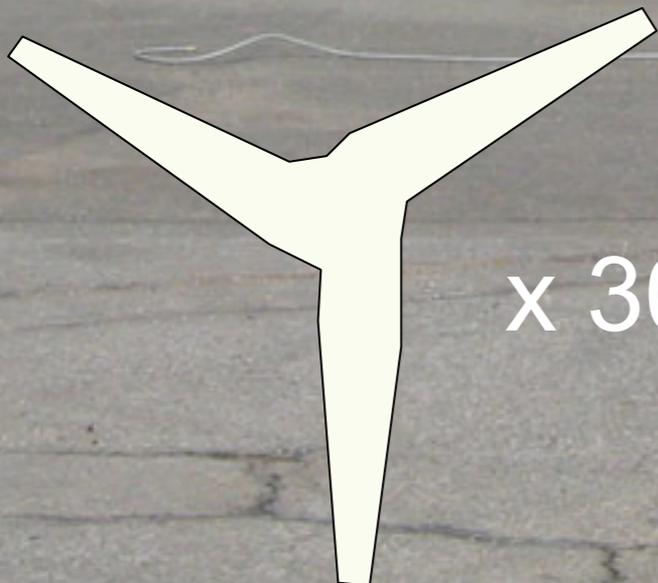
- Phase 1 (2002 – 2006): Prototype Testing
- Phase 2 (2006 – 2009): Demonstration
- Phase 3 (Current): MW-Scale Build-Out

Verdant Power East River turbines

## Verdant Power East River turbines



- Phase 1 (2002 – 2006): Prototype Testing
- Phase 2 (2006 – 2009): Demonstration
- Phase 3 (Current): MW-Scale Build-Out
- “Gen5” turbine (~2017)
- **October 2020: three tidal power turbines form the Roosevelt Island Tidal Energy (RITE) Project site in the East River, the first U.S. licensed tidal power project.**



x 30 = 1 MW

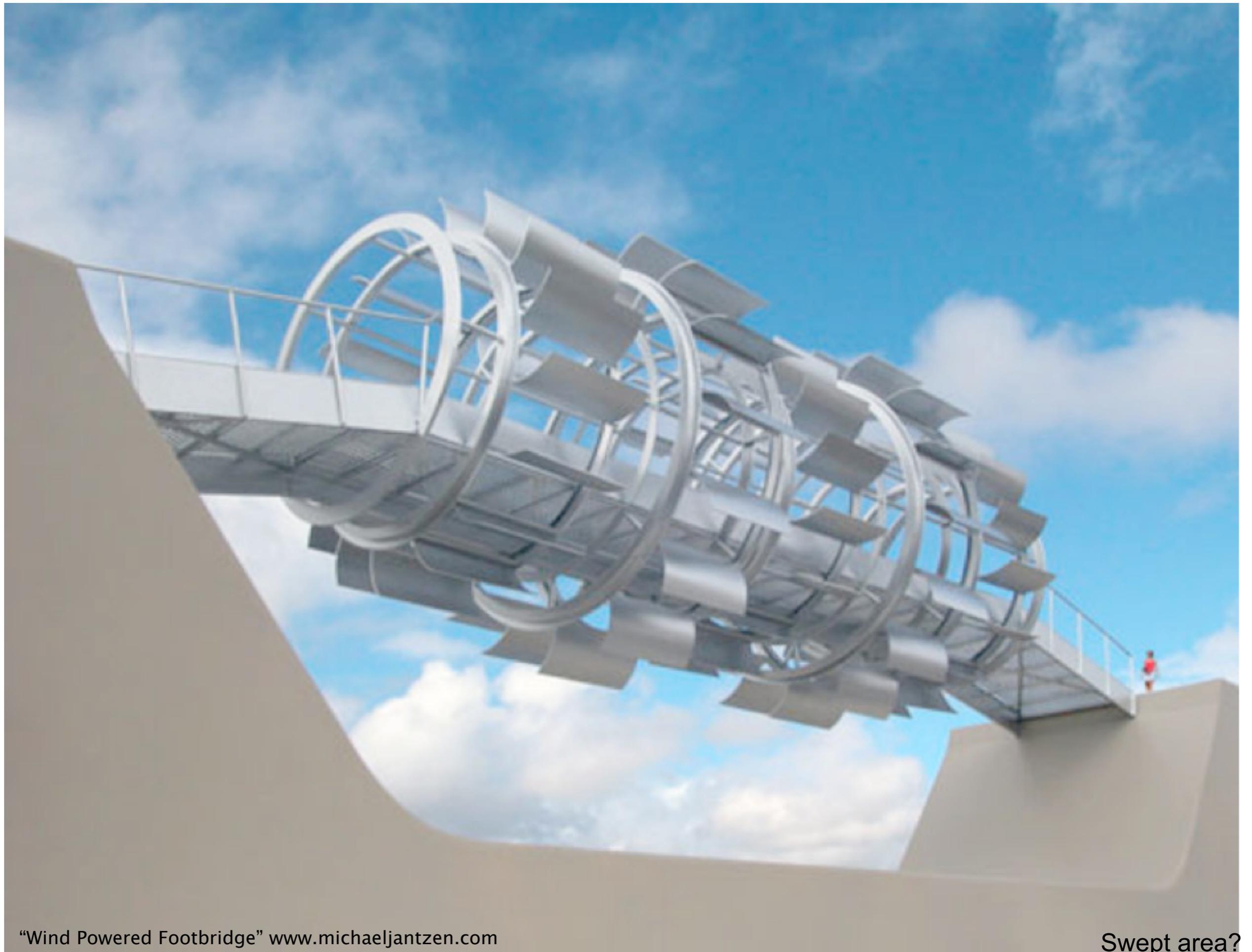
Verdant Power East River turbines



Source of wind?



Source of wind?



“Wind Powered Footbridge” [www.michaeljantzen.com](http://www.michaeljantzen.com)

Swept area?