

Introduction to Wind Power

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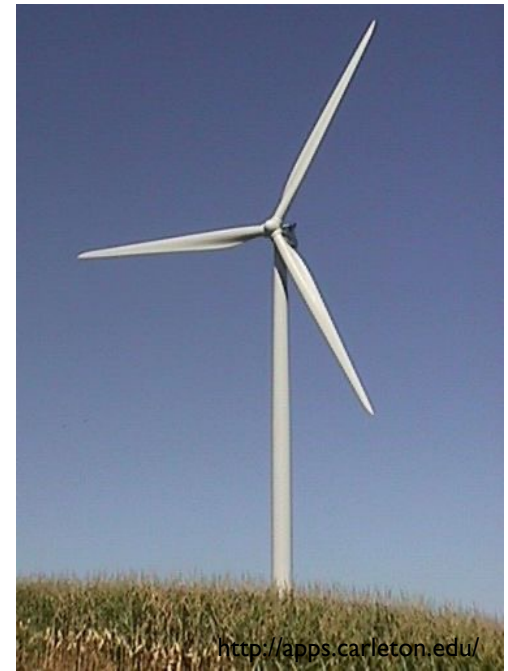
Wilkes University

For EGY 105



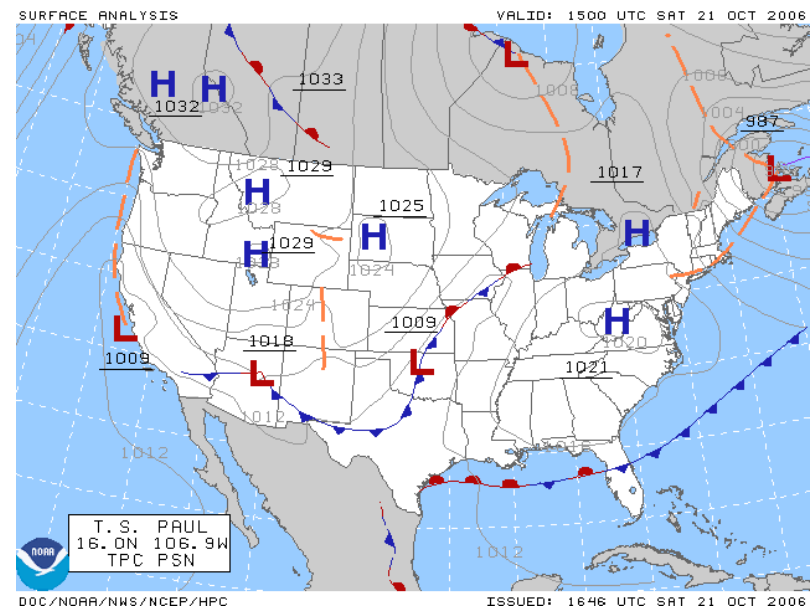
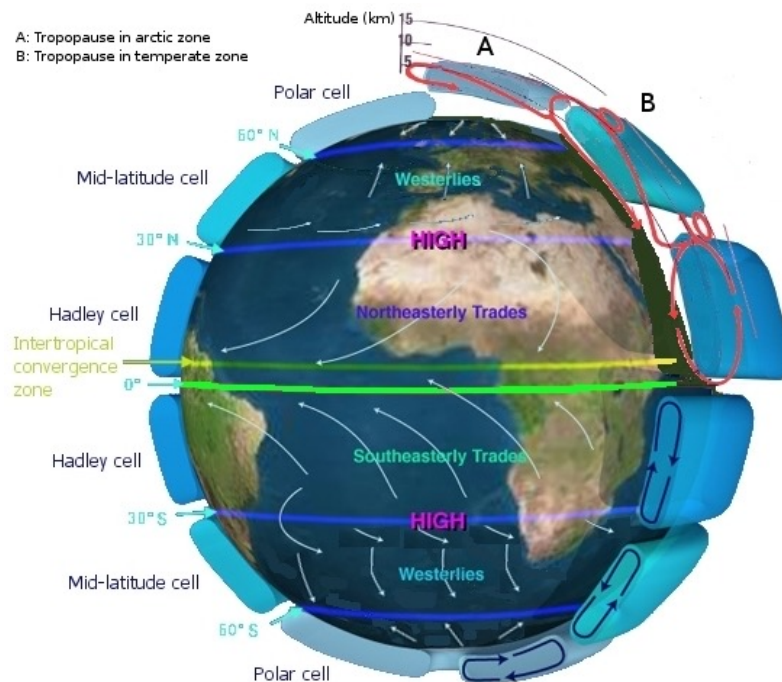
What is wind power?

- Conversion of wind energy to useful form
 - Mechanical energy
 - Transportation
 - Electricity

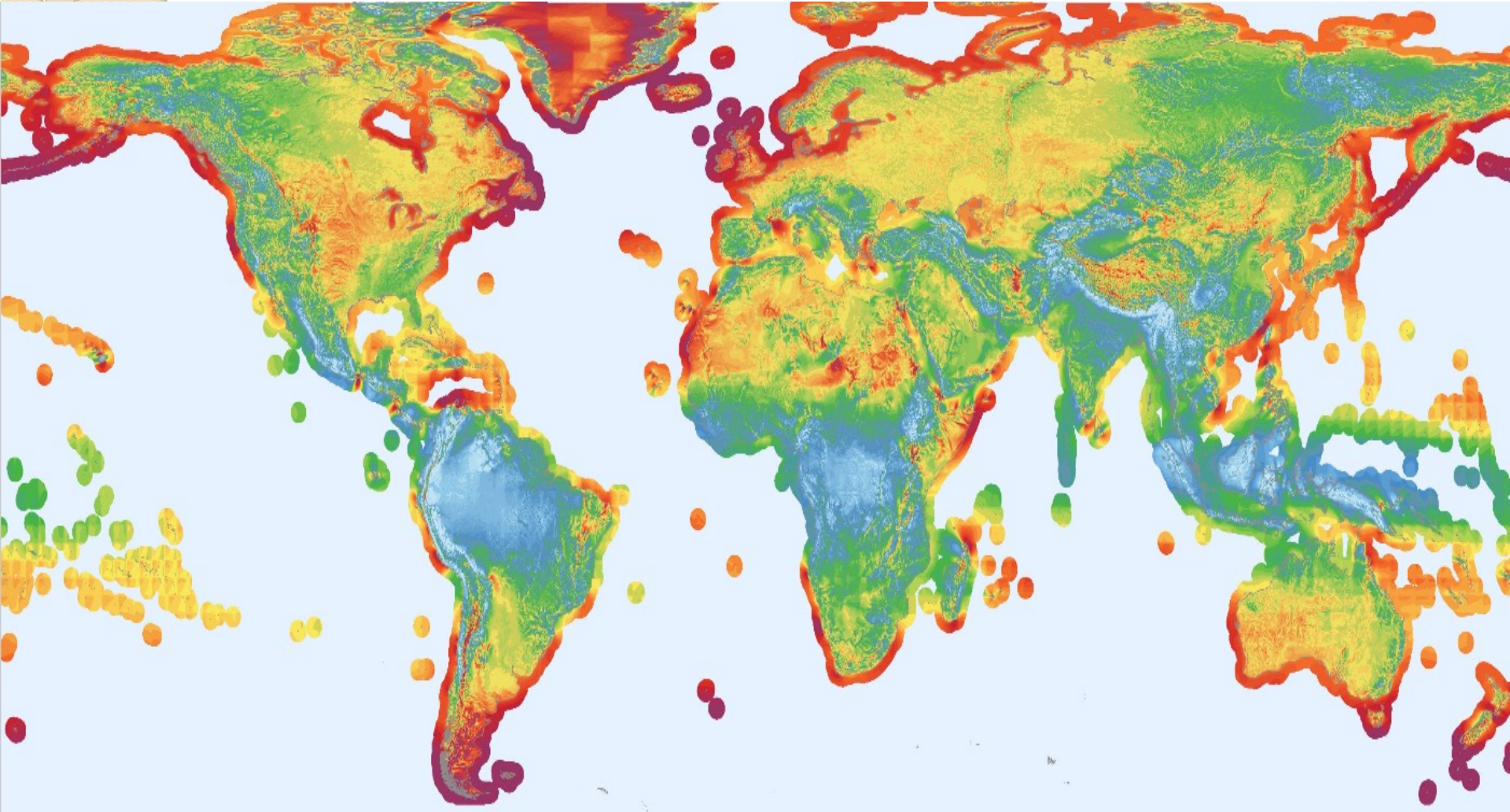


Why does wind blow?

- Uneven heating of earth's atmosphere
- Large-scale cells
- Air pressure differences



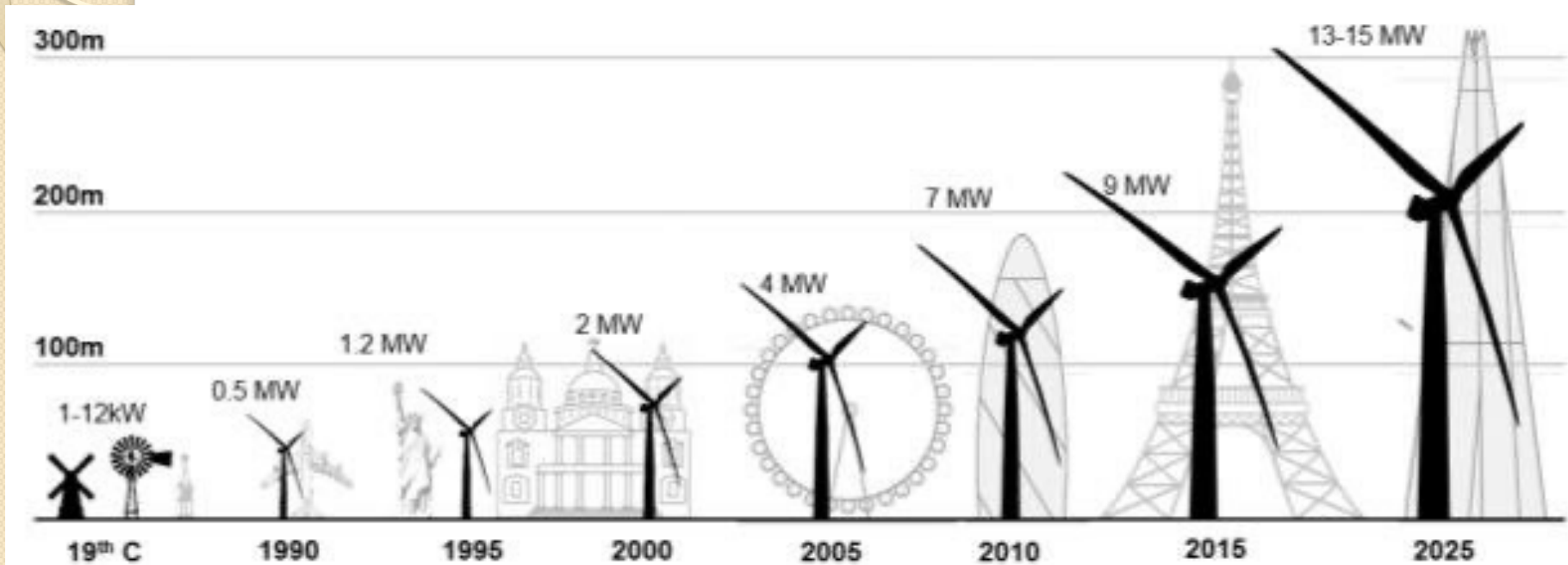
Where is wind available?



Modern wind power uses turbines in arrays called windfarms

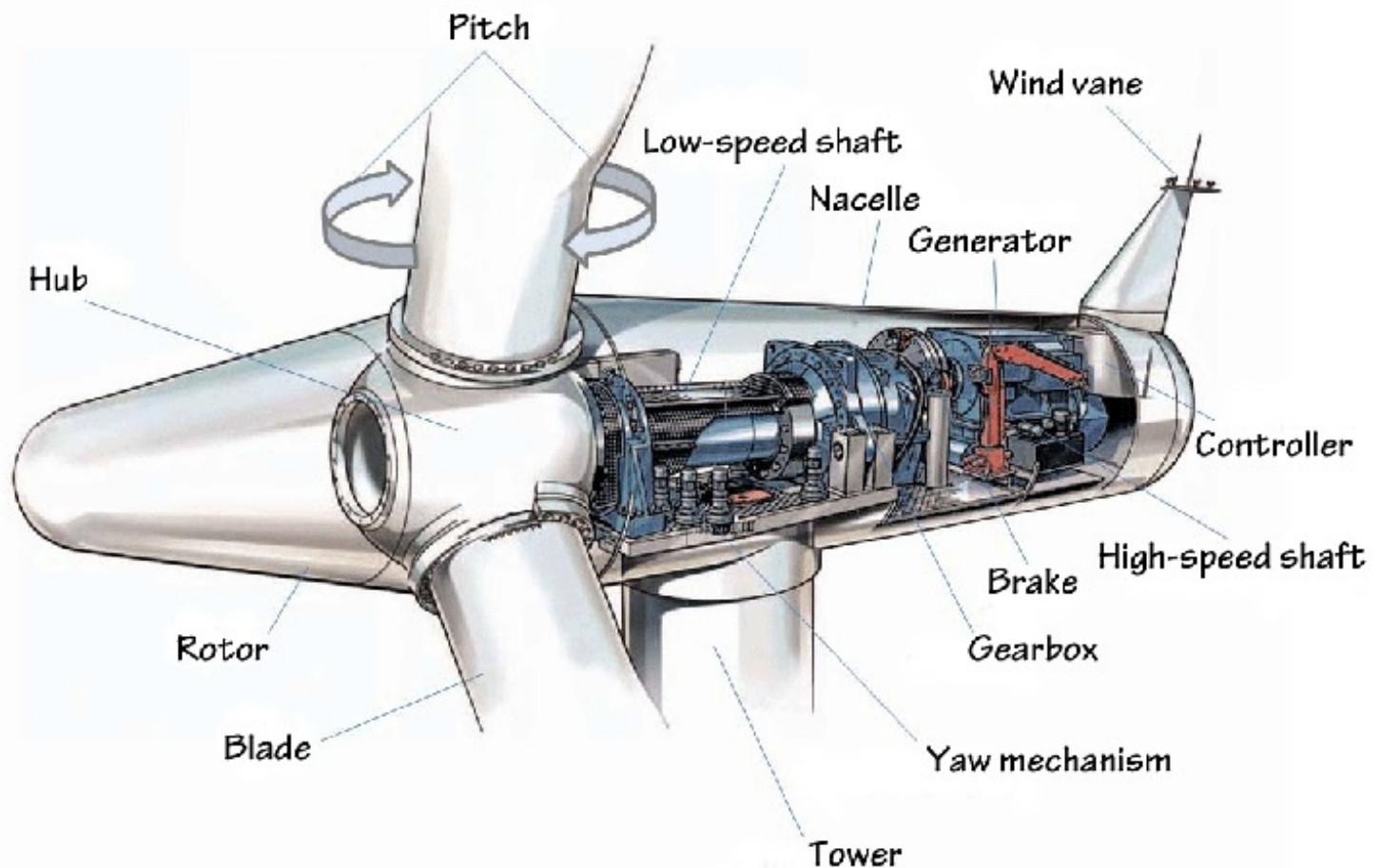


Wind turbines are evolving



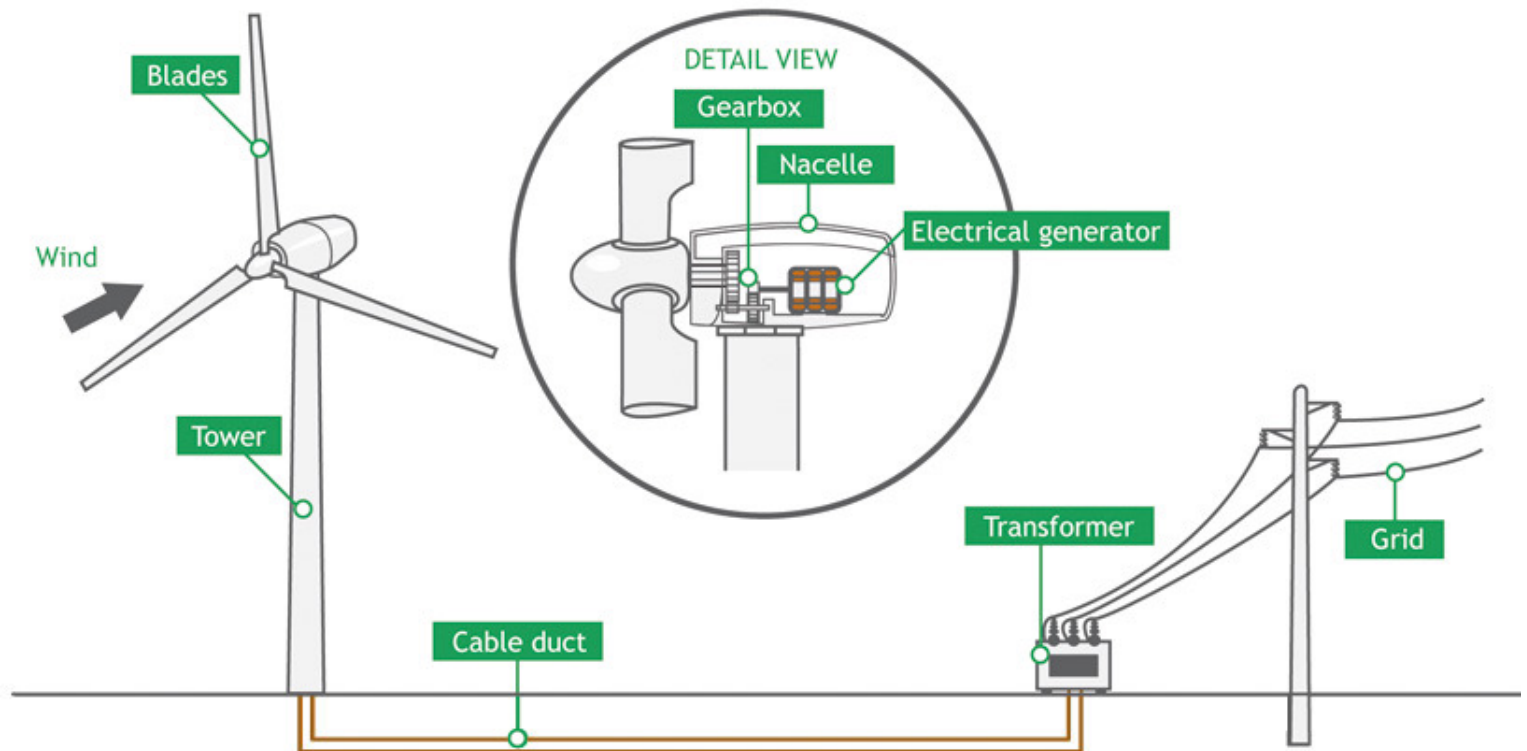
https://www.researchgate.net/publication/335812782_Input_of_advanced_geotechnical_modelling_to_the_design_of_offshore_wind_turbine_foundations/figures?lo=1

Wind turbine nacelle

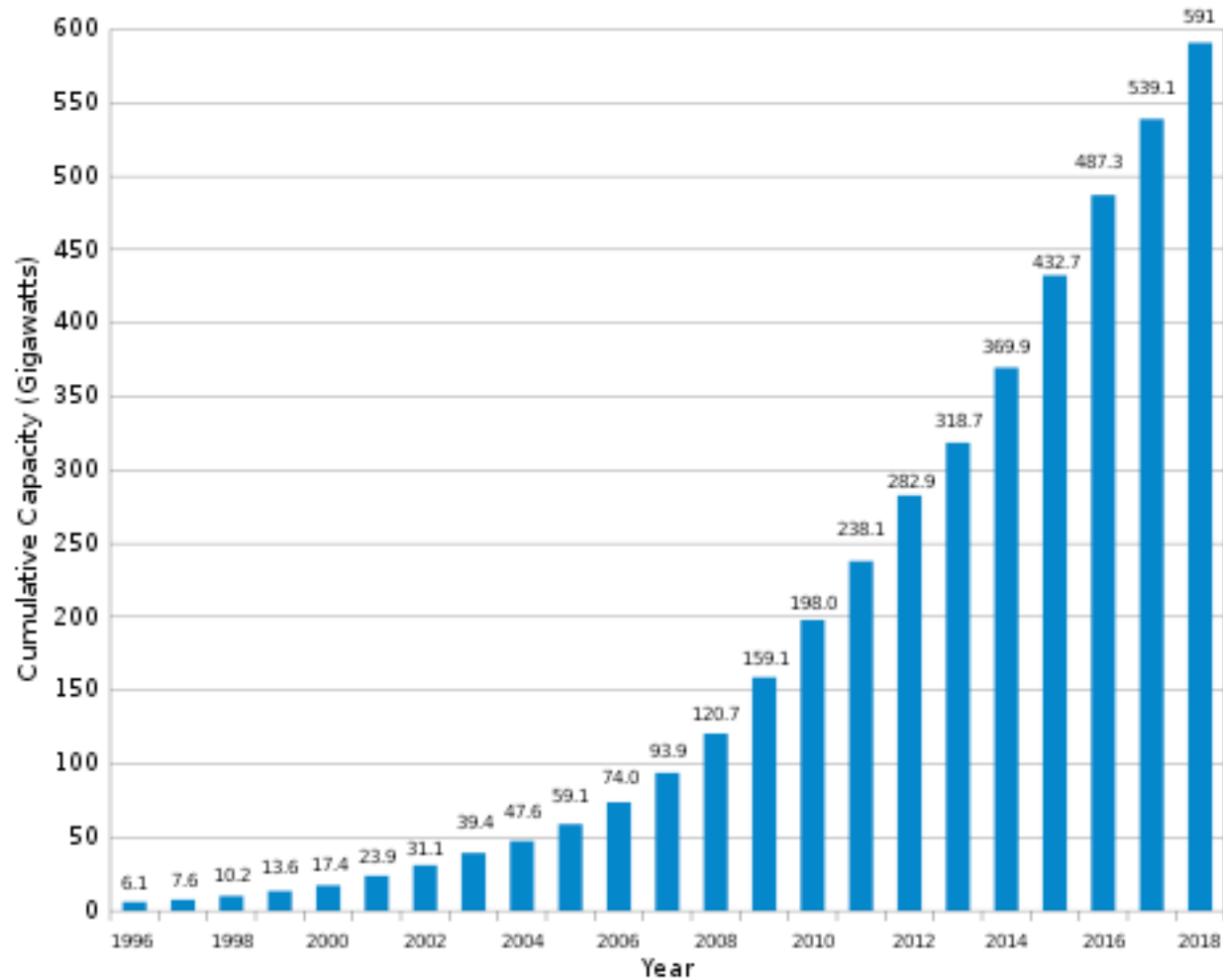


SOURCE: Center on Globalization, Governance, and Competitiveness, Duke University

Connecting to grid

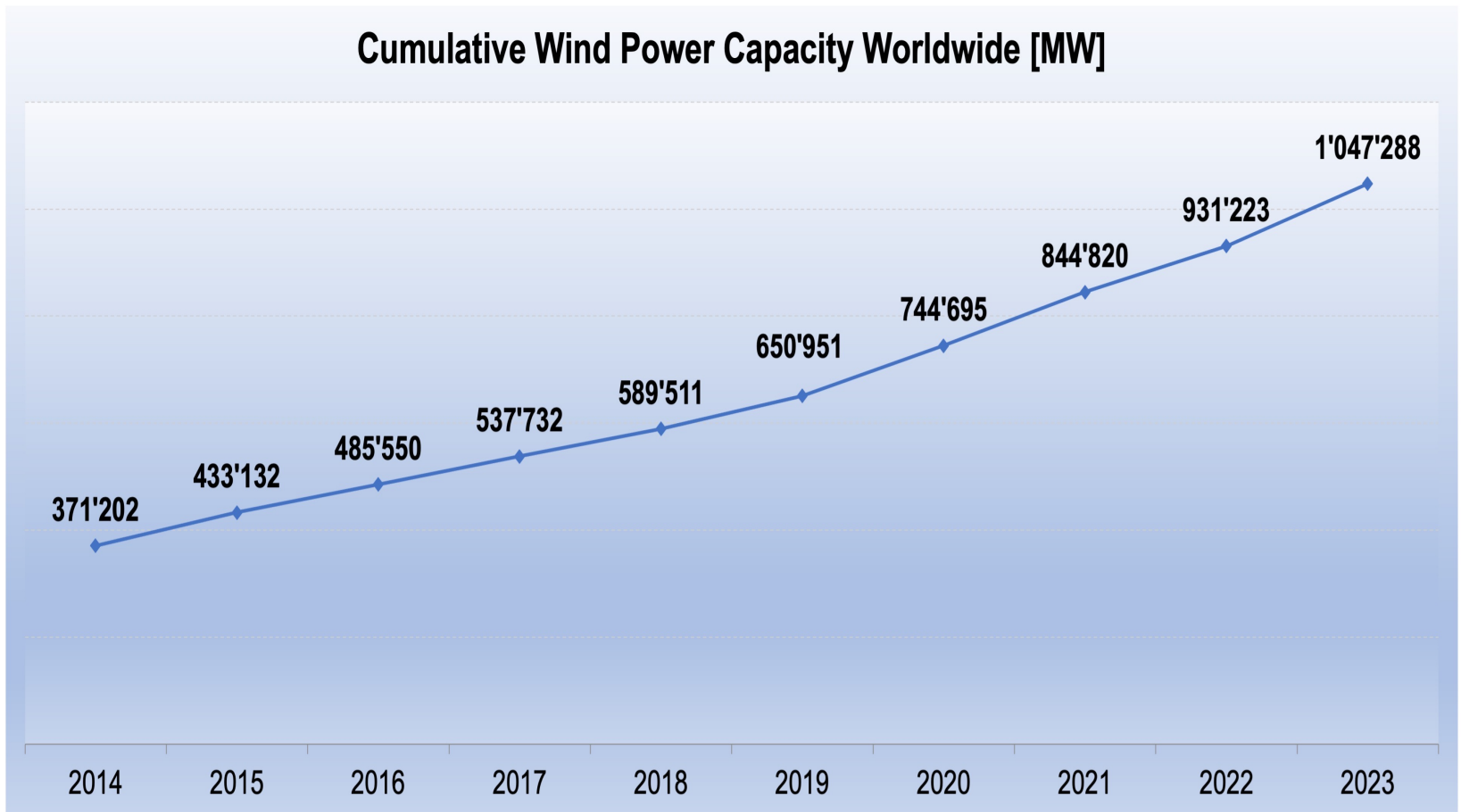


Global windpower capacity



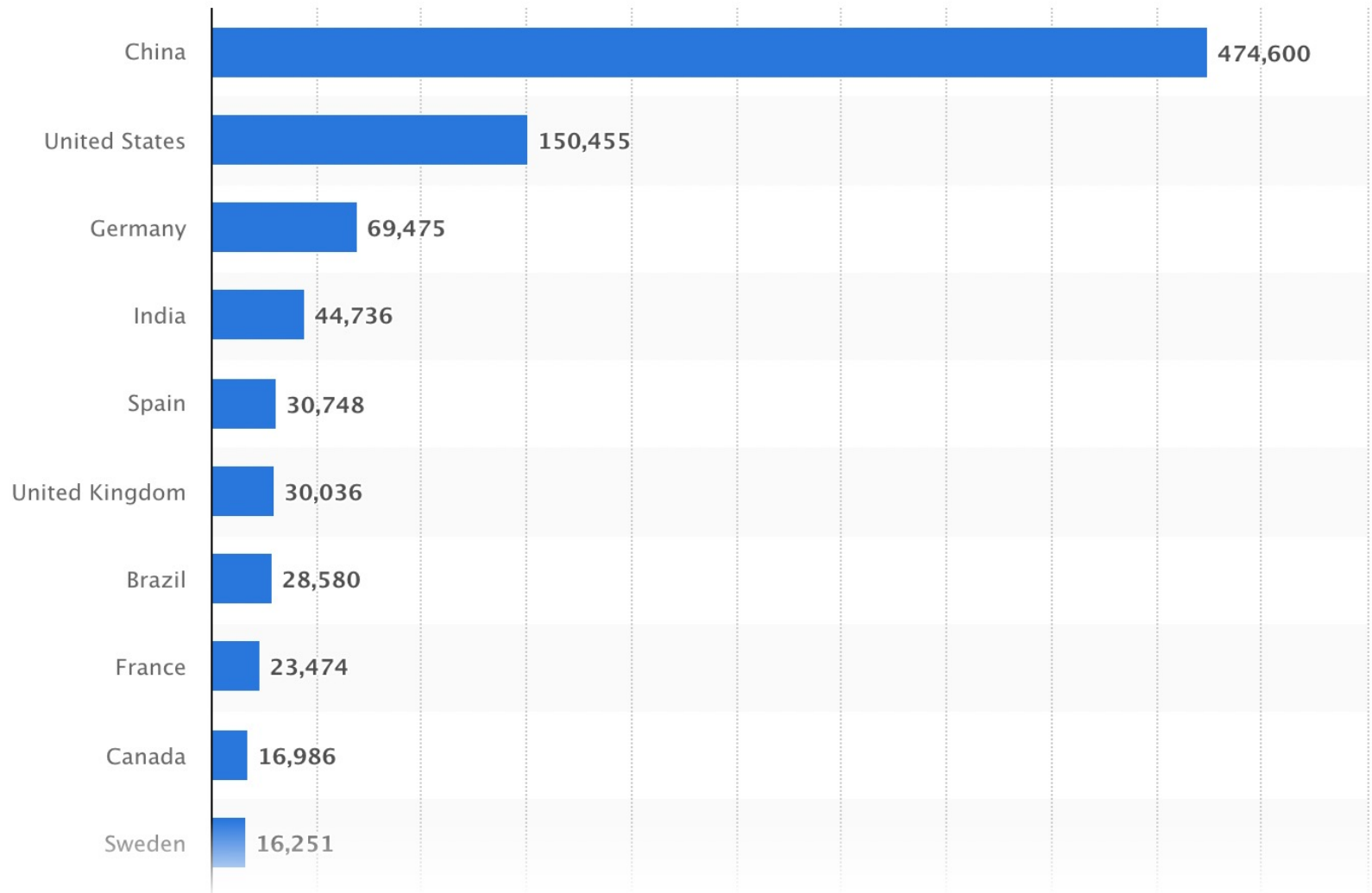
https://en.wikipedia.org/wiki/Wind_power_by_country

More recent data

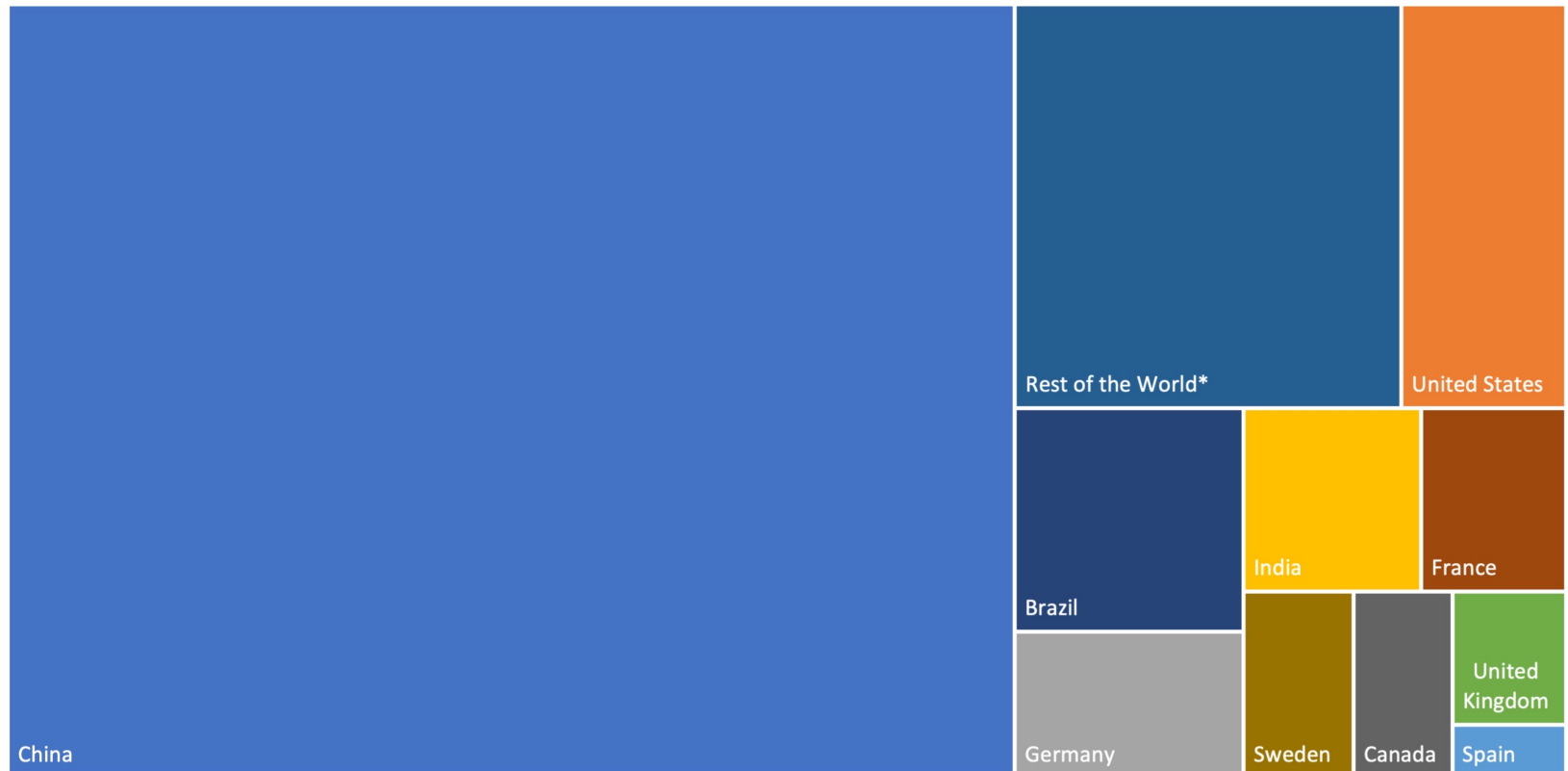


<https://www.indea.org/AnnualReport2023>

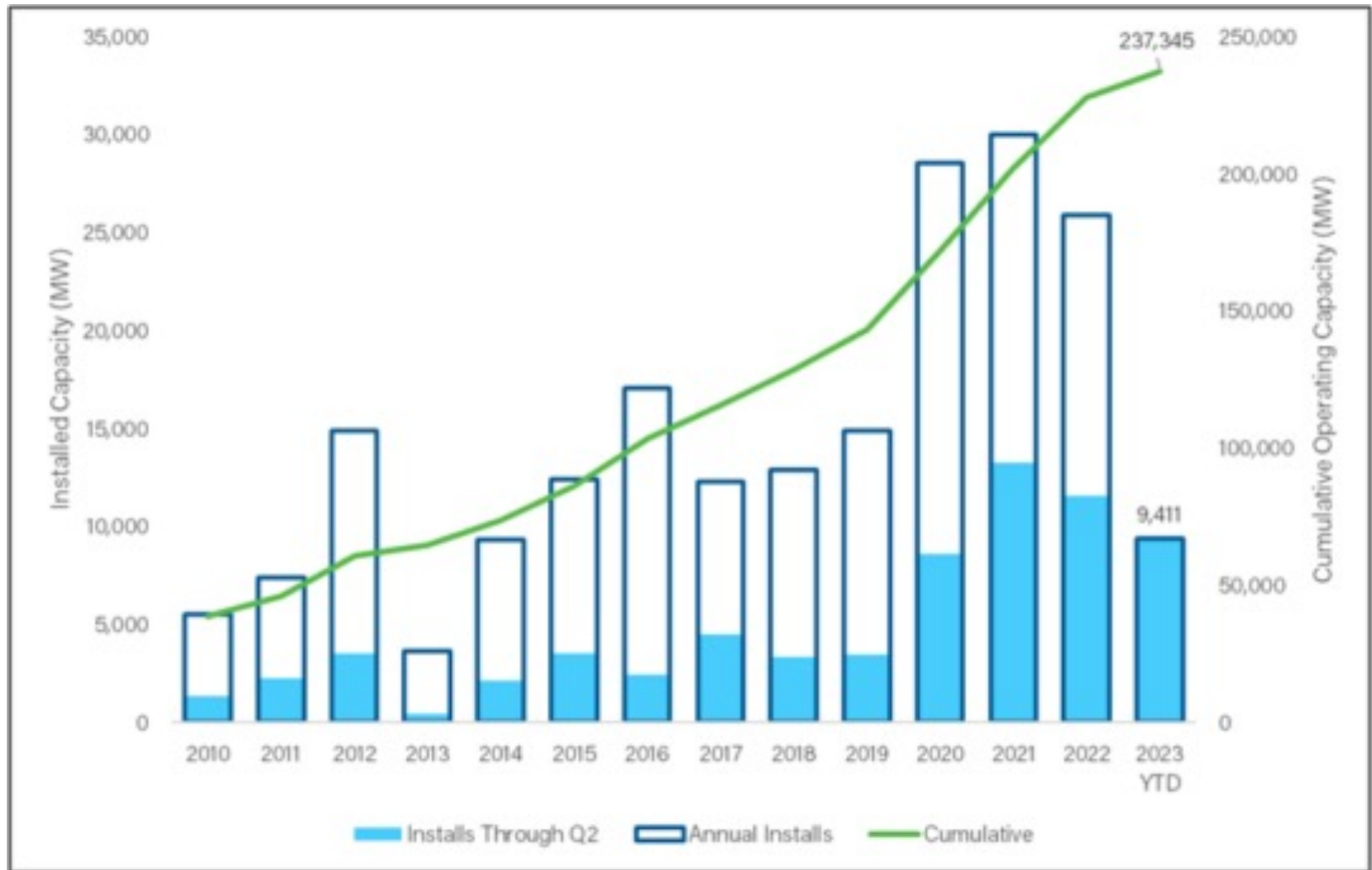
Global wind power capacity, 2022



Global installations - 2023



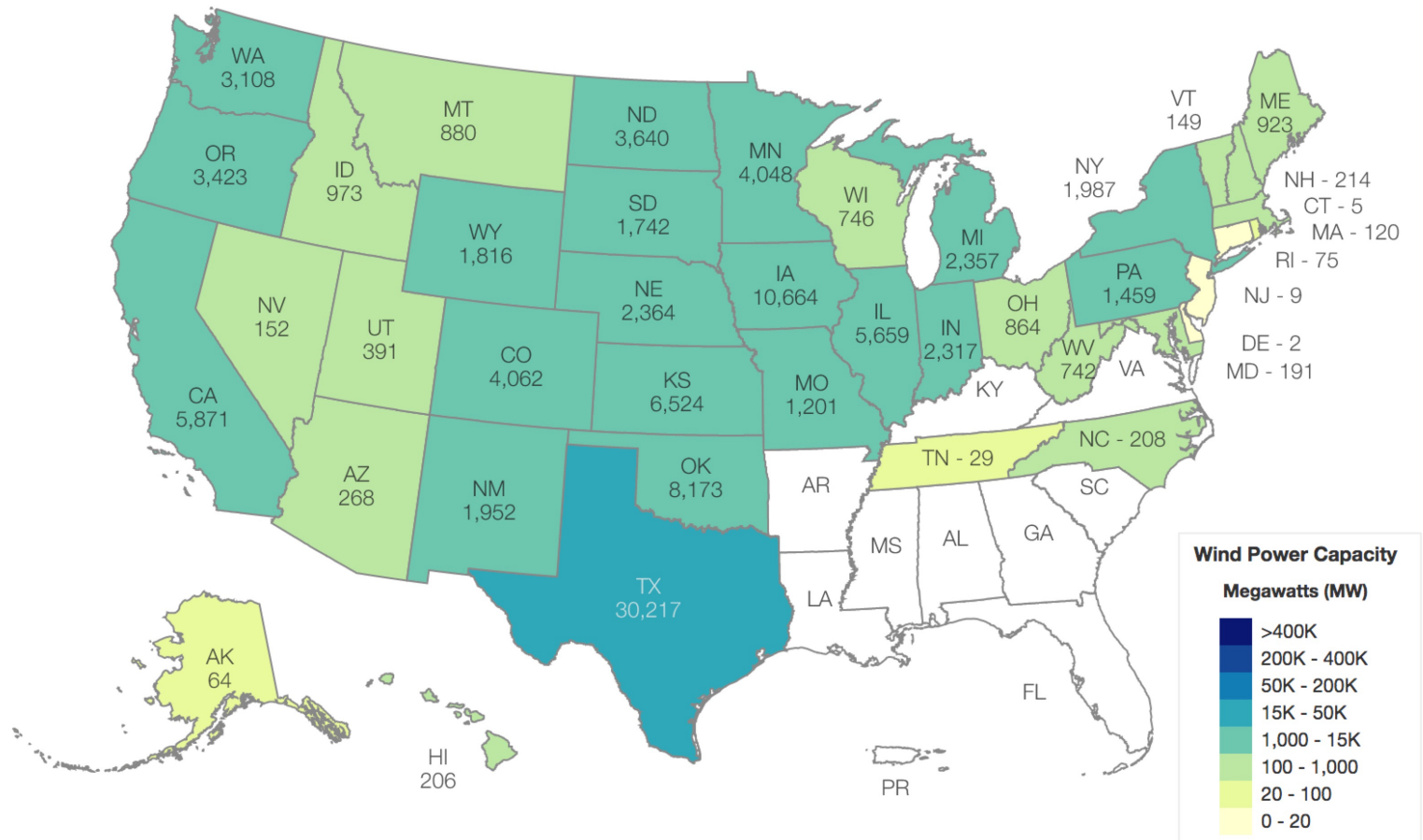
U.S. wind installation and capacity.



<https://www.evwind.es/2023/08/03/2023-sees-the-highest-second-quarter-on-record-for-us-wind-power-and-solar-installations/93226>

U.S. wind capacity by state

Q2 2020 Installed Wind Power Capacity (MW)



<https://windexchange.energy.gov/maps-data/321>

Wind Power in Pennsylvania:

Where is the wind?



6.6 - 6.9 mph
12.2 - 14.3 mph

6.9 - 7.2 mph
14.3 - 16.5 mph

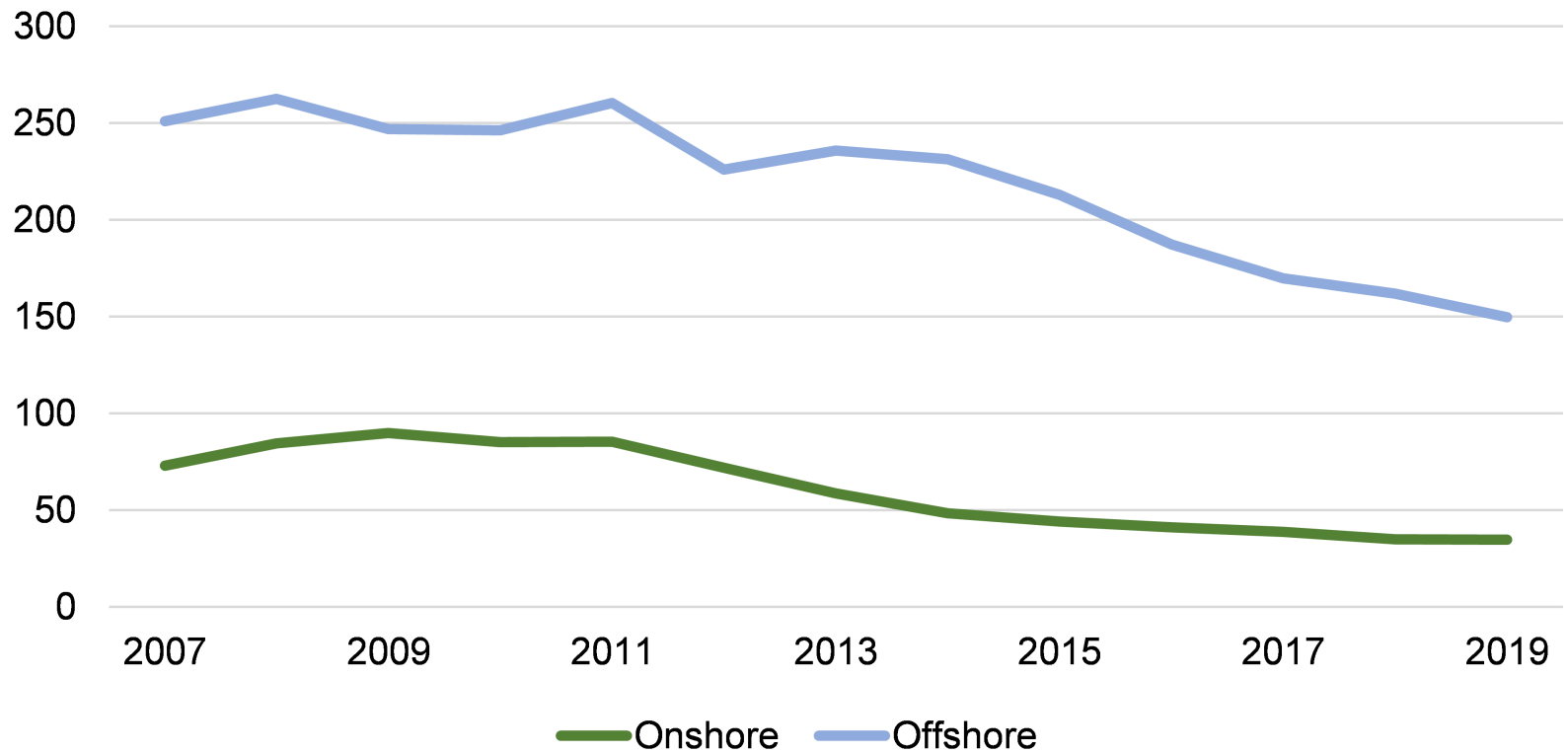


Where are the windfarms?

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- Doncasters Fastener Systems**
Altra Industrial Motion
- Ellwood Group, Inc.**
- Hodge Foundry**
- Sperian Fall Protection**
- Windurance**
- PPG Industries**
- Magnetek**
- Emerson Swan**
- HICO America**
- ABB Inc.**
- Gamesa Technology Corporation, Inc.**
- Gamesa Technology Corporation, Inc.**
- Phoenix Contact USA**
- Harrington Hoists and Crane**
- Vacon Inc.**
- SKF USA Inc.**
- McClarin Plastics, Inc.**
- Tioga**
- Bradford**
- Susquehanna**
- Wayne**
- Lockport**
- Wilmington**
- Luzerne**
- Monroe**
- Carbon**
- Lehigh**
- Santa Clara**
- Lebanon**
- Berks**
- Montgomery**
- Bucks**
- ITW Wind Group**
- Fenner Precision**
- McGraw Hill**
- Simkar LLC-Energy Lighting Group**
- FARO Technologies**
- Torco Industrial Bolting Tools**
- HYDAC TECHNOLOGY CORP.**
- Sapa Extrusions**

Wind costs have declined

Levelized cost of energy (2019\$/MWh)



<https://emp.lbl.gov/news/are-we-underestimating-potential-wind>

Benefits of wind power

- No emissions of carbon into atmosphere
- No radioactive waste
- Sustainable
- Energy is free – only cost is construction of windfarm and some maintenance



Employment in wind industry

- 120,000 (According to American Wind Energy Association)
- Professions include:
 - Designing, building, maintaining turbines
 - Assessing and purchasing land
 - Assessing wildlife impacts
 - Support services to scientific and technical staff

Concerns about wind energy

- Intermittent source of power
- Habitat fragmentation
- Bird and bat mortality
- Aesthetic concerns
- Fires
- Ice throw
- Wind turbine syndrome



<http://news.softpedia.com/>



<https://sites.google.com/site/montvill>
ewind/pictures/birds-wildlife



<http://irjci.blogspot.com/>



Some people oppose wind power



<https://stopthesethings.com/2016/04/20/want-hate-filled-communities-then-just-add-wind-farms/>

Wind turbine designs are evolving



<http://www.popularmechanics.com/science/energy/solar-wind/432433>

And Finally...

