Wind Energy

Sustainably Powering the Future

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Agenda

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Wind Energy Industry Overview

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Investment Analysis

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Recommendations & Conclusion

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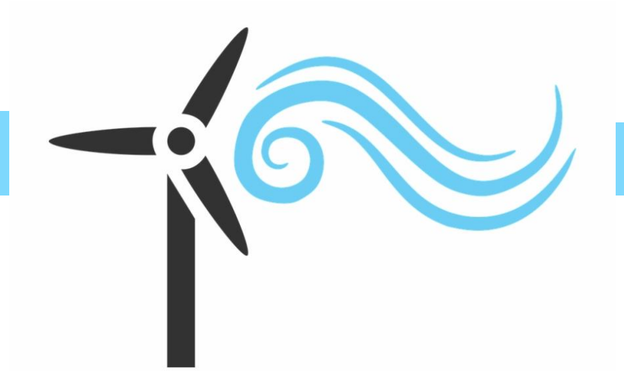
Industry Overview



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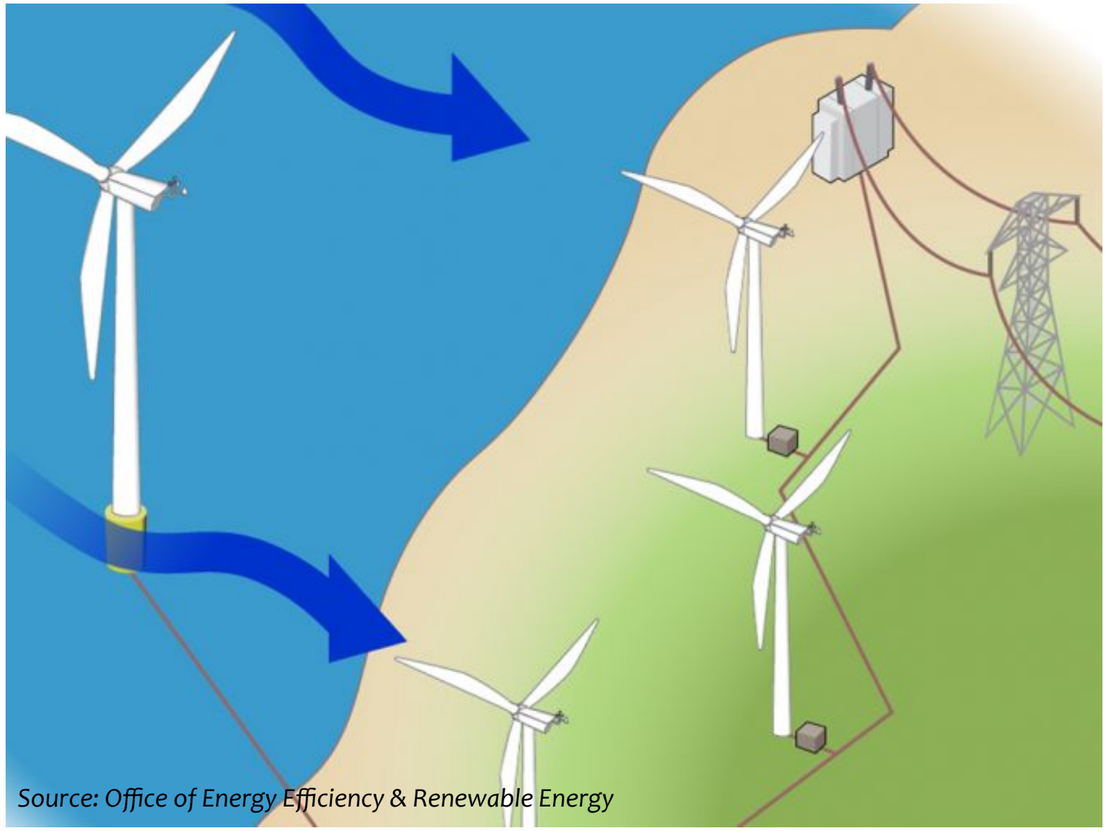
Quick Facts on Wind Energy

- Wind turbines convert the wind's kinetic energy to **electricity without emissions**
  - ↪ In 2020 U.S., wind capacity avoided an estimated 319 million metric tons of **CO2 emissions**

- **Types** of Wind Turbines
  (1) Horizontal Axis Turbines
  (2) Vertical Axis Turbines

- Turbine **Locations**
  (1) Land - can range in size from 100 kW to several MW
  (2) Offshore - tend to be massive > Statue of Liberty
  (3) Distributed - tend to be small and produce <100kW

- Commercially **Viable Wind Speeds >= 6.5 m/s**



Source: Office of Energy Efficiency & Renewable Energy

Source: Center for Sustainable Systems, University of Michigan. 2021. "Wind Energy Factsheet." Pub. No. CSS07-09.

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Global Energy Market

	Market Share	Consumption	R Capacity
Total	**100.0%**	**163,709 TWh** +0.9% CAGR	**3,063 GW** +879 GW '17
Wind	**3.0%** +9.0% CAGR	**4,872 TWh** +9.9% CAGR	**825 GW** +311 GW '17
Hydro	**6.8%** -0.3% CAGR	**11,183 TWh** +0.6% vs LY	**1,230 GW** +79 GW '17

Source: Our World BP Statistical Review of World Energy
R Capacity Source: International Renewable Energy Agency (IRENA) (2022) Renewable Capacity Statistics 2022
Note that the above CAGR figures are based on 2017-2021 in order to neutralize volatility from individual years and the impact of COVID in 2020

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U.S. Energy Market

	Market Share	Consumption	R Capacity
Total	**100.0%**	**25,594 TWh** Flat CAGR	**325 GW** +95 GW '17
Wind	**3.9%** +7.9% CAGR	**1,004 TWh** +8.0% CAGR	**133 GW** +45 GW '17
Hydro	**2.6%** -3.1% CAGR	**674 TWh** -3.1% vs LY	**80 GW** -4 GW '17

Source: Our World BP Statistical Review of World Energy
R Capacity Source: International Renewable Energy Agency (IRENA) (2022) Renewable Capacity Statistics 2022
Note that the above CAGR figures are based on 2017-2021 in order to neutralize volatility from individual years and the impact of COVID in 2020

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Costs

Turbine Size	Yearly Revenue	35% Capacity	50% Capacity	65% Capacity	100% Capacity	Until Paid Off
1 Megawatt	$0.02 per kWh = $20/hour x 24 hours x 365 days	$61,320	$87,600	$113,800	$175,200	14 Years
2.5 Megawatts	$0.02 per kWh = $50/hour x 24 hours x 365 days	$153,300	$219,000	$284,700	$438,000	11,8 Years
4 Megawatts	$0.02 per kWh = $80/hour x 24 hours x 365 days	$245,280	$350,400	$455,520	$700,800	11,4 Years

Source: https://climatebiz.com/commercial-wind-turbine-cost/

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Government Regulations & Incentives

- **Regulations**
  - Solar and Wind Energy Rule for use of **public lands and federal waters**
  - **Local Ordinances** exist at the regional level (county, township, municipality)
- **Production Tax Credit (PTC)**
  - Provides a **1-3 cent¢/kWh** benefit for the first 10 years of a wind energy facility's operation for projects started by December 31, 2021
  - Extended through 2024 due to the Inflation Reduction Act (IRA)
- **Alternative Incentive Credit (ATC)**
  - Provides a credit for **12%–30%** of investment costs at the start of the project.
  - Additionally, Congress established a **30% ITC for any offshore wind project** that begins construction by December 31, 2025 or began construction before January 1, 2017

Source: WINDExchange is a resource of the U.S. Department of Energy's Wind Energy Technologies Office.

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Environmental Impacts

Land Use

- Wind facilities can be **constructed on "brownfields"**, which are known as **abandoned or underused industrial land**, reducing concerns about land use
- Of the total area of the wind facility, the turbines occupy a small portion due to spacing requirements (5-10 rotor diameters apart)
- The remainder of the land often serves a productive secondary purpose such as **livestock grazing** & **agriculture**

Wildlife

- The **impact of wind turbines on birds and bats** has been widely studied, and it has been concluded that the overall impact **does not pose a threat to species population**
- The U.S. Fish and Wildlife Service has played a crucial role in reducing the impact on wildlife by holding advisory meetings with representatives from the industry, state and tribal governments, and non-profit organizations and giving recommendations on appropriate wind farm sites

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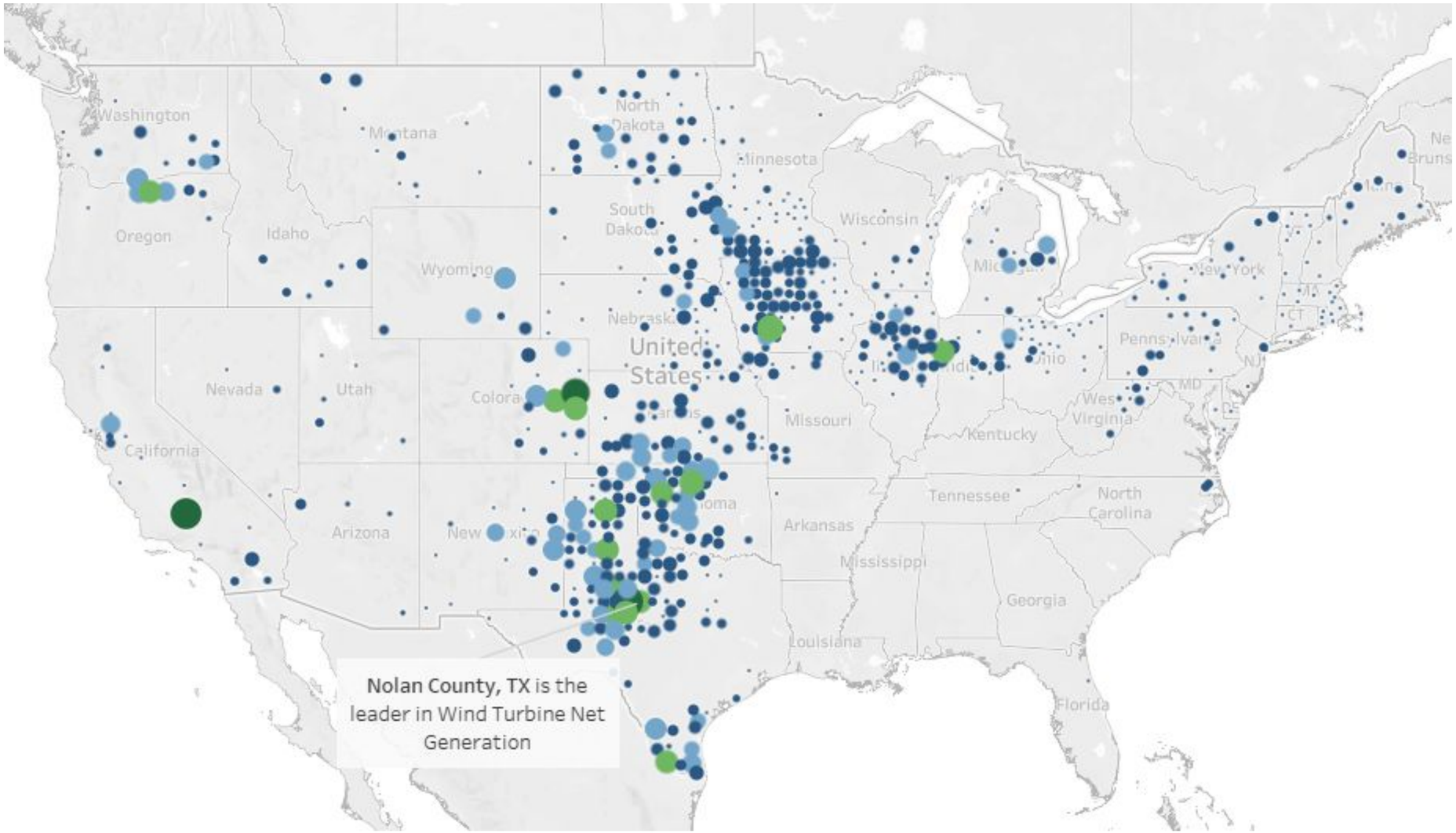
Wind Turbine Locations



** This map exclusively represents turbine locations in the Continental United States*

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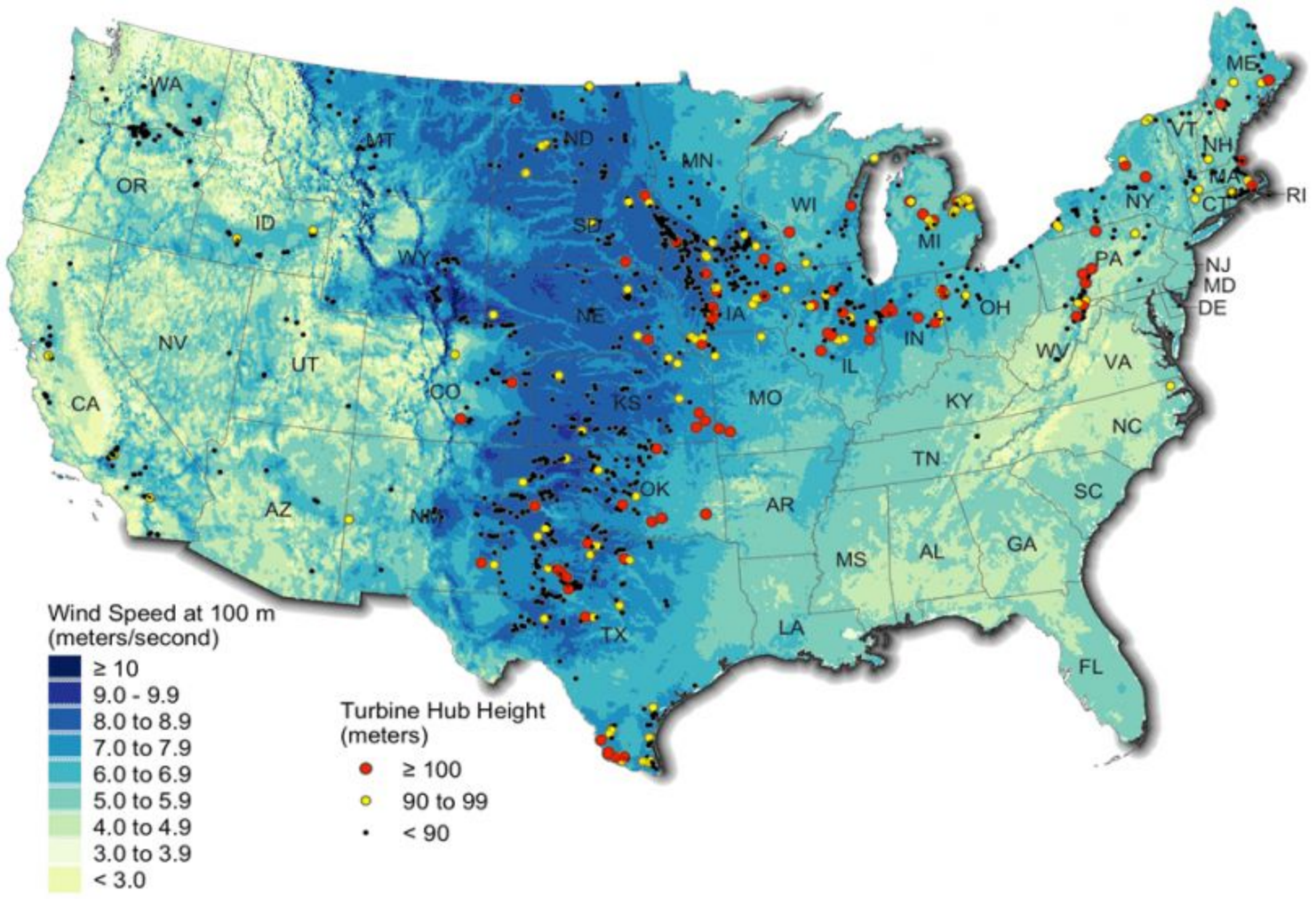
Wind Speed Trends

In order for Wind Turbine facilities to be considered **profitable**, wind speeds are required to be **6.5 m/s or greater**

Regions in **dark blue** indicate the greatest wind speeds, and are mostly located in the **Central United States** as of 2022

Wind Turbine facilities are primarily located in **sparsely populated counties**, with the top 5 located in:

- Kit Carson Co, CO - Pop: 7K
- Guthrie Co. IA - Pop: 11K
- Garfield Co. OK - Pop: 62K
- Nolan Co. TX - Pop: 14K
- Scurry Co. TX - Pop. 17K



Location of tall-tower turbine installations from the Land-Based Wind Market Report: 2022 Edition.

* *Population figures as of the 2022 Census Data*

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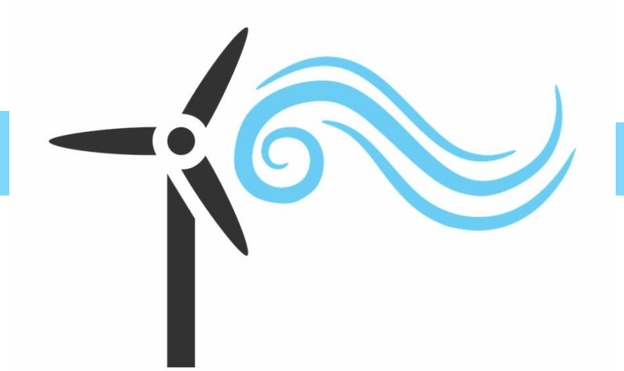
Investment Analysis



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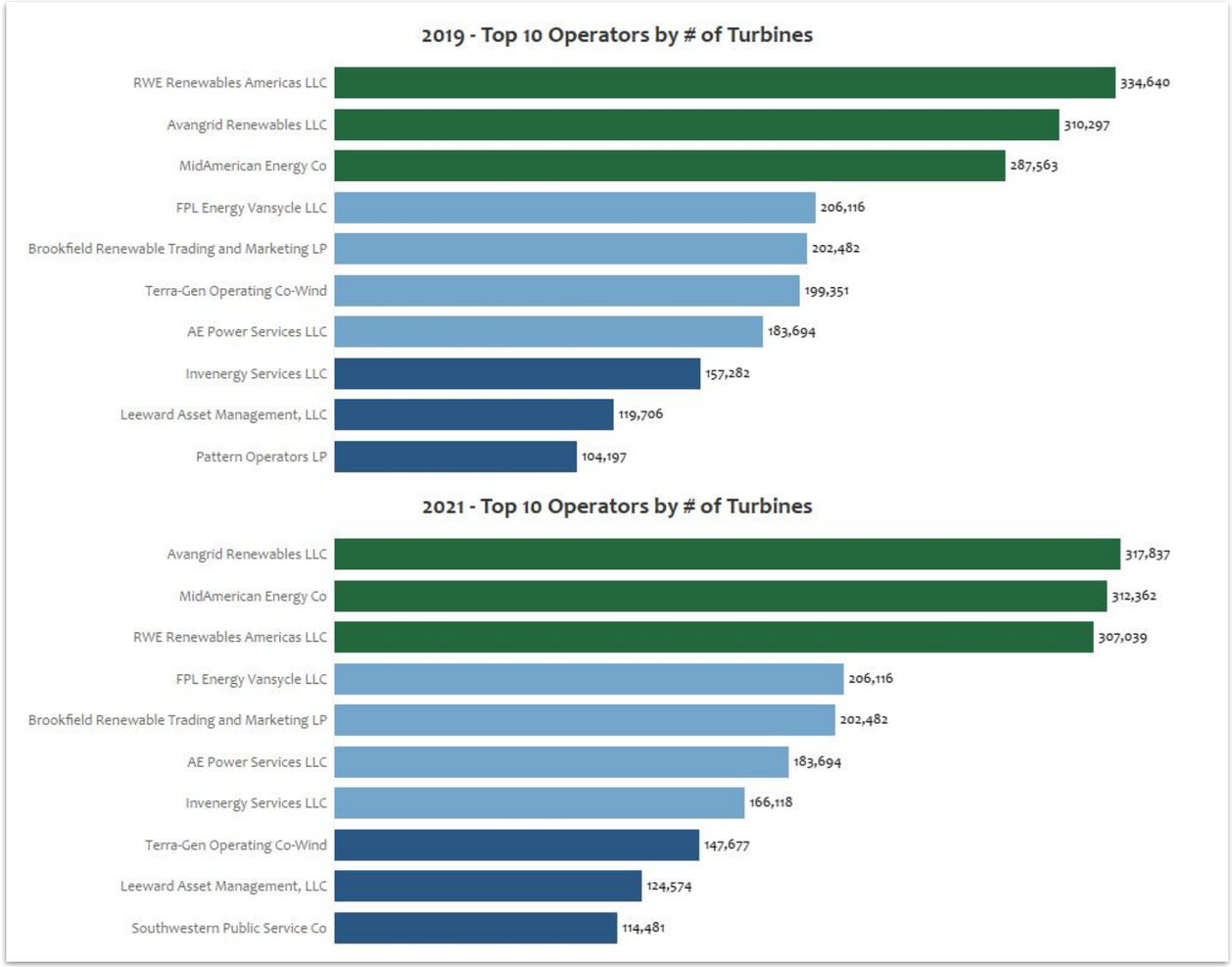
Turbines by Operator

- Data was provided by U.S. Wind Turbine Database and U.S. Energy Information Administration (2019 and 2021).

- Due to COVID-19 shutdowns and disrupted supply chains affecting operational flow, 2020 data has been excluded from the analysis.[1]

- **Top 3 operators by growth:**
  - ↪ MidAmerican Energy Co **+8.6%**
  - ↪ Invenergy Services LLC **+5.7%**
  - ↪ Avangrid Renewables **+2.4%**



1. *https://www.nsenergybusiness.com/features/the-impact-of-covid-19-on-wind-power-supply-chains/*

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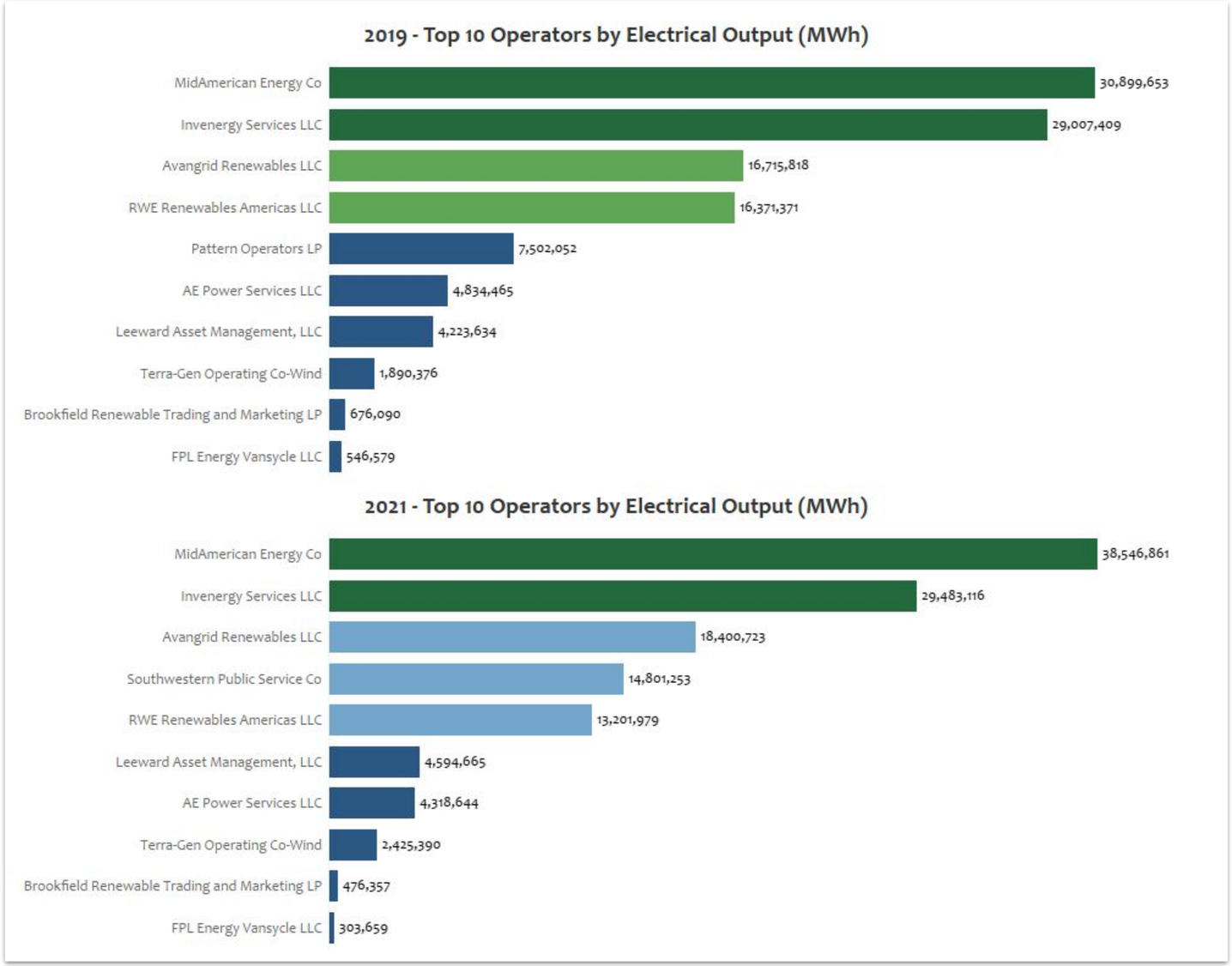
Net Generation

- **Top 3 operators by growth:**
  - ↪ MidAmerican Energy Co **+24.8%**
  - ↪ Avangrid Renewables LLC **+10.1%**
  - ↪ Invenergy Services LLC **+1.6%**

- 62% of MidAmerican Energy Co's generation capacity is wind.[1]

- Vast majority of Avangrid Renewables LLC is wind energy.[2]

- ~60% of Invenergy Services LLC is wind.[3]



1. https://www.midamericanenergy.com/energy-mix
2. https://www.avangridrenewables.com/wps/portal/aren/ourbusiness/
3. https://invenergy.com/what-we-do/invenergy-services

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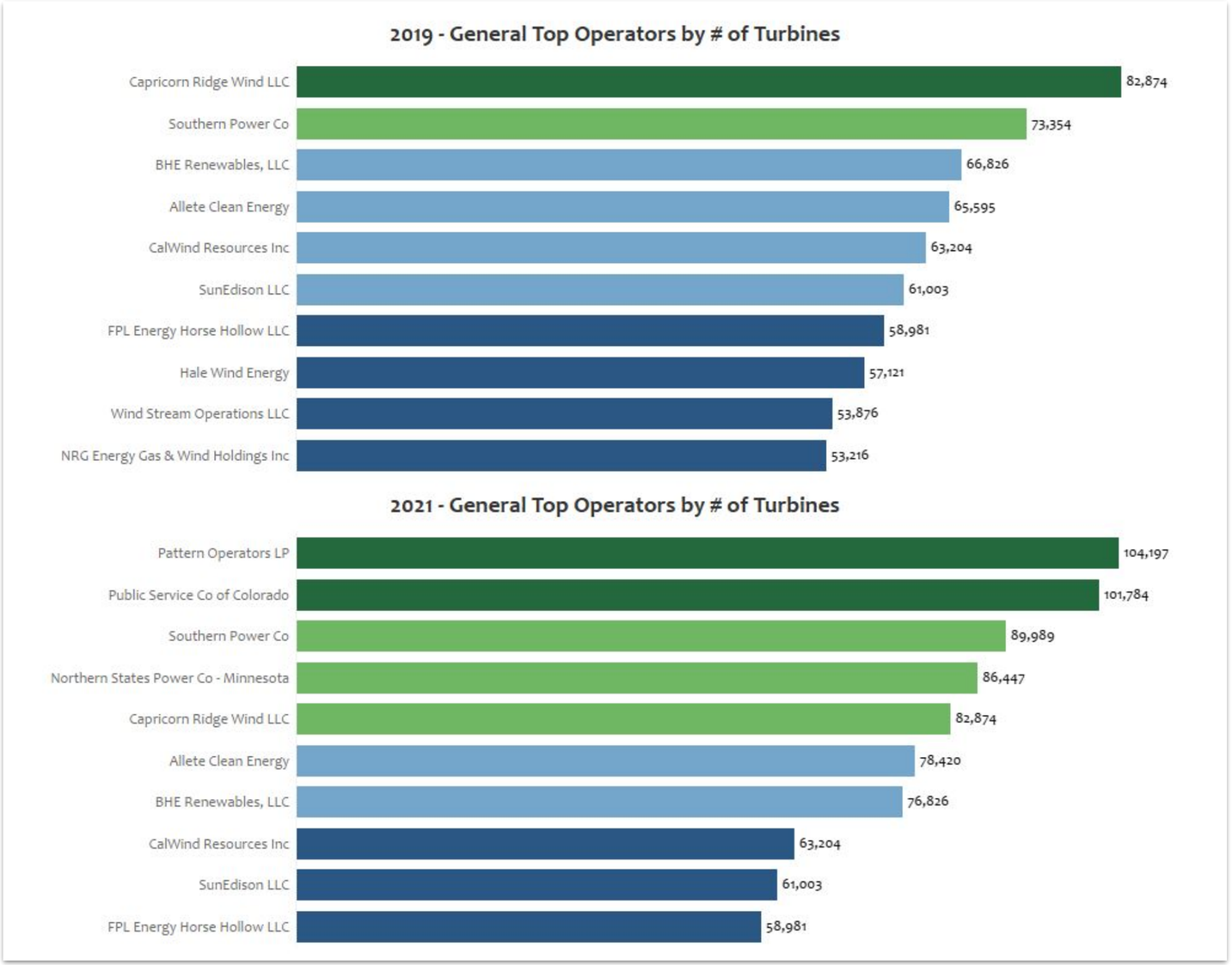
Operator Growth

- **Top 3 operators by growth:**
  - ↪ Southern Power Co **+22.7%**
  - ↪ Allete Clean Energy **+19.6%**
  - ↪ BHE Renewables, LLC **+15.0%**

- Noteworthy: Public Service Co of Colorado and Northern States Power Co - Minnesota are subsidiaries of XCel Energy.[1, 2]
  - ↪ Public Service Co of Colorado **+104.4%**
  - ↪ Northern States Power Co - Minnesota **+72.9%**



1. *https://findenergy.com/providers/public-service-company-of-colorado/*
2. *https://findenergy.com/providers/northern-states-power-company/*

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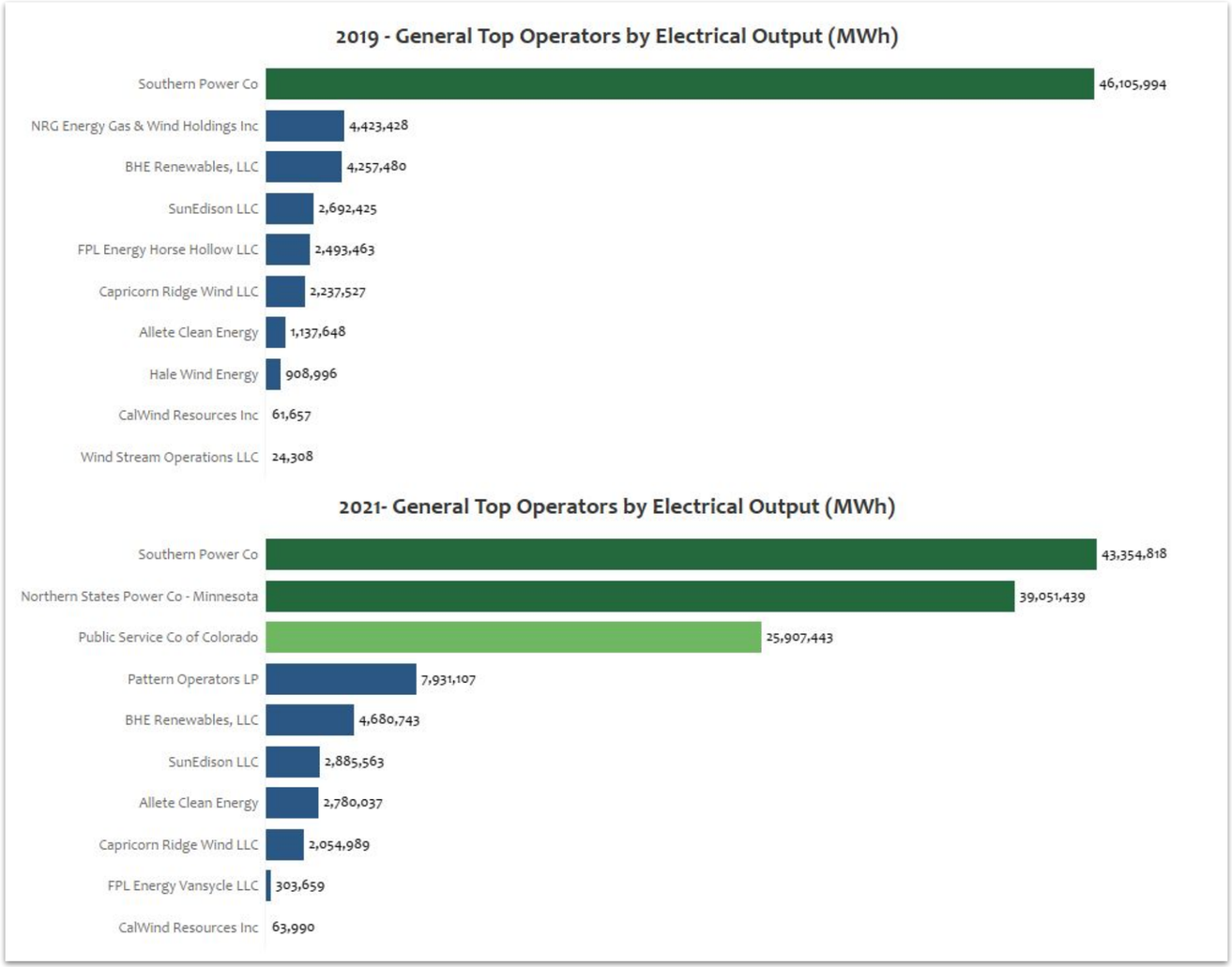
Operator Production

- **Top 3 operators by growth:**
  - ↪ Allete Clean Energy **+144.4%**
  - ↪ BHE Renewables, LLC **+9.9%**
  - ↪ SunEdison LLC **+7.2%**

- Both subsidiaries of Xcel Energy produced less power from 2019 to 2021:
  - ↪ Public Service Co of Colorado **-2.1%**
  - ↪ Northern States Power Co - Minnesota **-2.2%**

- Allete Clean Energy produces only wind energy.[1]

- ~55% of BHE Renewables, LLC energy is wind.[2]



1. https://alletecleanenergy.com/OurCompany
2. https://www.bherenewables.com/projects

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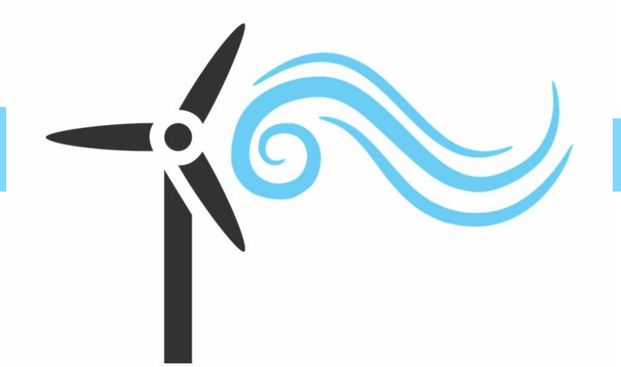
Recommendations & Conclusion



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Investment Recommendations

Conservative

1. MidAmerican Energy Co:
   - Operator Turbine Growth **+8.6%**
   - Net Generation growth **+24.8%**
   - **62% of MidAmerican Energy Co's generation capacity is wind.**

2. Avangrid Renewables:
   - Operator Turbine Growth **+2.4%**
   - Net Generation growth **+10.1%**
   - Vast majority of Avangrid Renewables LLC is wind energy.

3. Invenergy Services LLC:
   - Operator Turbine Growth **+5.7%**
   - Net Generation growth **+1.6%**
   - ~60% of Invenergy Services LLC is wind.

Aggressive

1. Allete Clean Energy:
   - Turbines by operator growth **+19.6%**
   - Net Generation growth **+144.4%**
   - Allete Clean Energy produces only wind energy.

2. BHE Renewables, LLC:
   - Turbines by operator growth **+15.0%**
   - Net Generation growth **+9.9%**
   - ~55% of BHE Renewables, LLC energy is wind.

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Thank You

On behalf of the entire **MCK** CONSULTANTS team, we thank you for selecting our firm in guiding you towards your investment goals.

Please feel free to ask any & all questions regarding today's analysis & investment recommendations.

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