



100 MW Wind Power Plant in West Texas

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Introduction

Renewable energy demand in Texas has grown significantly, driven by climate change and economic factors.

- Yearly renewable generation rose from 12% (2015) to 34% (2025) of total state power
- Texas leads the nation in wind energy, generating 40,556 MW in 2022 (21.94% of state production)
- Most wind farms are concentrated in the panhandle and central Texas
- Wind energy is non-dispatchable, meaning it depends on weather, unlike fossil fuel or nuclear plants

This study evaluates the feasibility of a 100 MW wind power plant near El Paso, TX, proposing a 40-turbine plant which would be capable of powering up to 75,000 homes. It focuses on technical performance calculated using average hourly regional weather data.

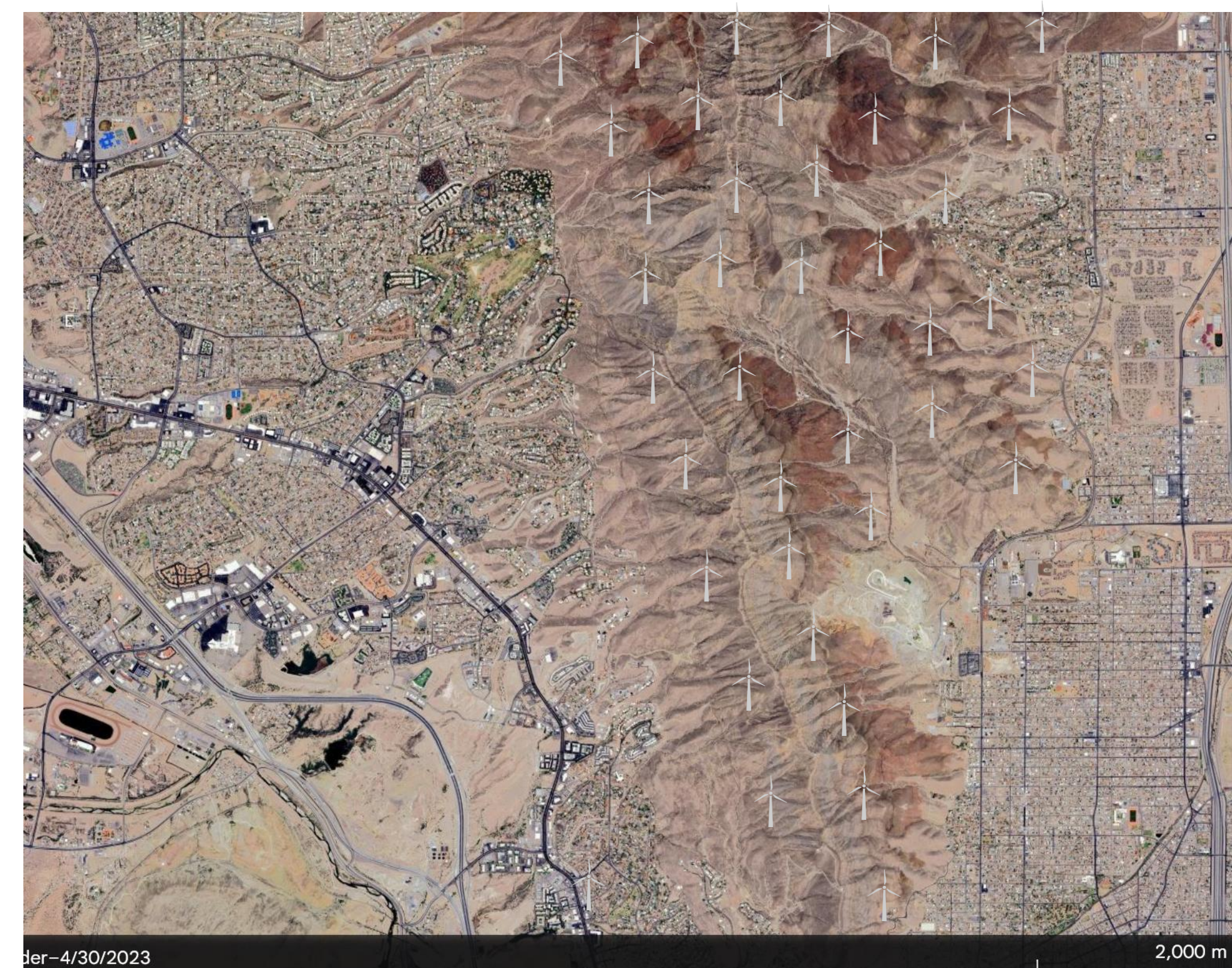
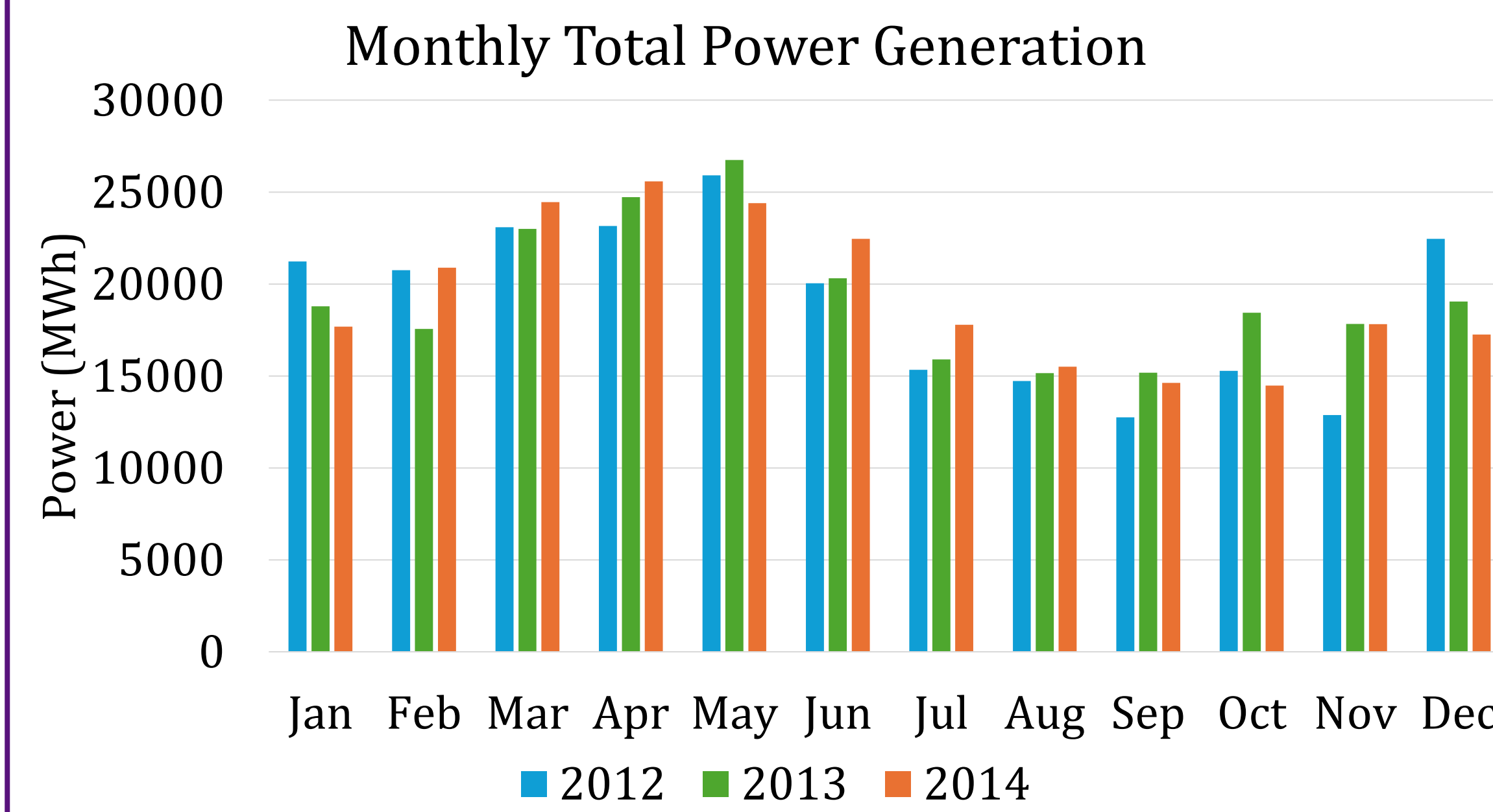
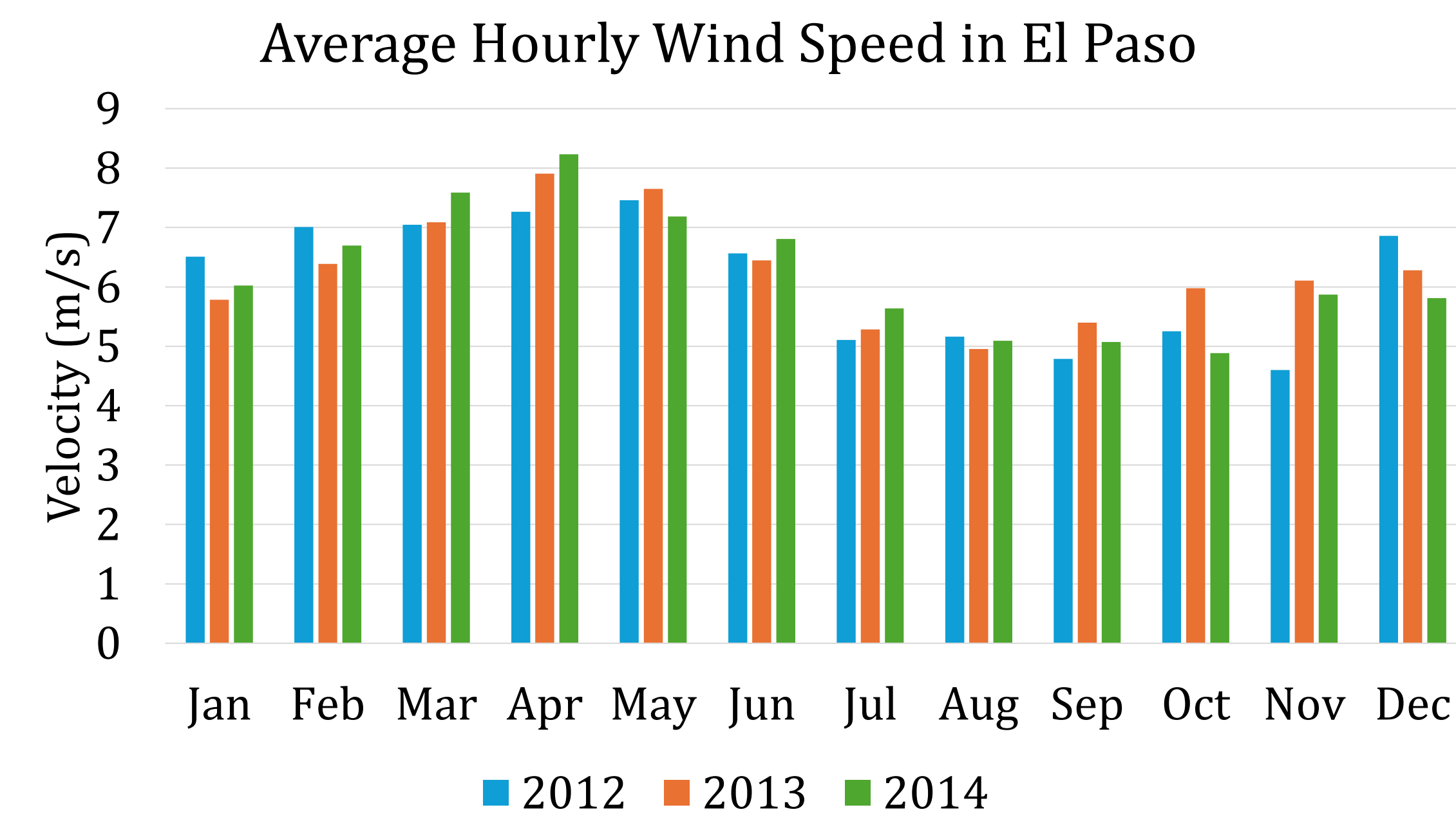
Methodology

Wind resource and turbine data were gathered and analyzed to estimate the plant's average power output.

- Wind data was sourced from the Wind Resource Database (WRDB) at the National Laboratory of the Rockies, using coordinates northeast of El Paso based on geographic constraints
- The GE 2.8 MW turbine was selected due to its widespread use in U.S. wind farms
- Average power per turbine was calculated in Excel using air density, rotor swept area, and wind velocity (Equation 1) for 2012, 2013, and 2014
- Actual output is lower than nameplate capacity, and is only ~20-40% of the nameplate capacity due to efficiency losses and inconsistent wind patterns

Equation 1: $\dot{W}_{av} = \frac{1}{2} V^2 \dot{m} = \frac{1}{2} A \rho V^3 = \frac{\pi}{8} D^2 \rho V^3$

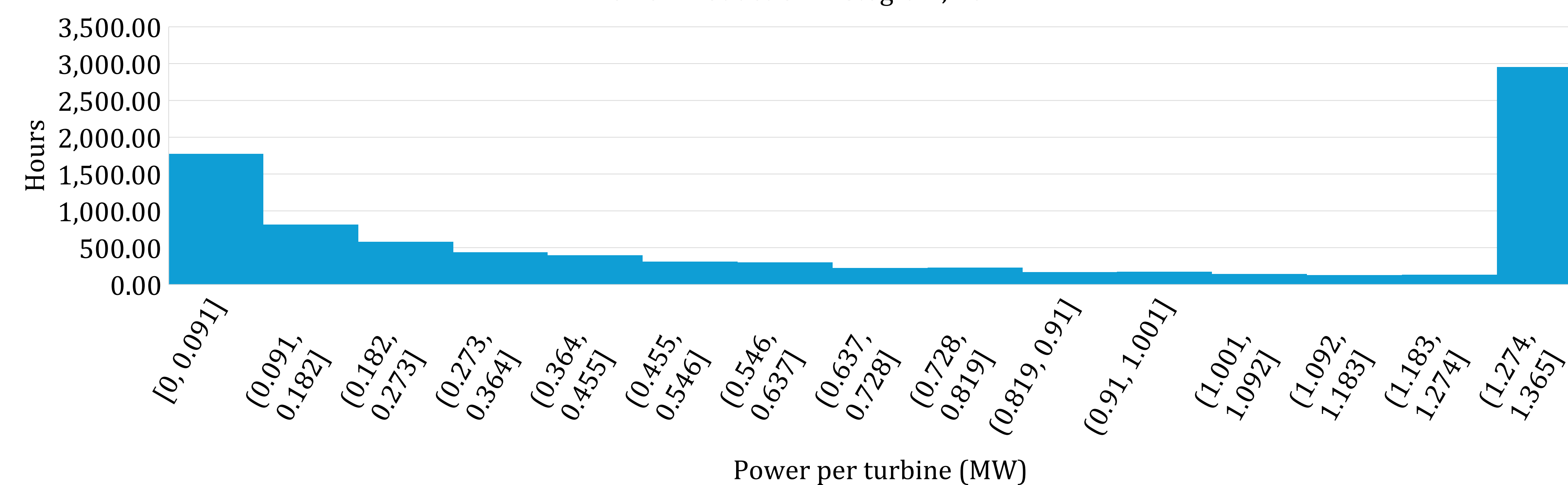
Results



Key Takeaways:

- Average hourly wind speeds in El Paso remain below the GE turbine's rated velocity of 8 m/s for most of the year, so rated power output is rarely achieved.
- Monthly power generation closely tracks average wind speed. Spring months, particularly April and May, produced the highest output due to elevated wind speeds.
- A total of 40 windmills were used to achieve a nameplate capacity of 112 MW.
- The plant's average hourly power output for 2014 was 26.6 MW, yielding a capacity factor of 23.75%.
- This would be able to support 20,000 to 24,000 households year-round, and close to 45,000 at peak output.
- According to the 2014 yearly histogram, peak power in the farm would only be achieved for about 3000 hours or 33% of the year. For about 20% of the year, no power was produced at all.
- The proposed mountainous location was chosen as the area of study but would likely not be used due to the topography and protected status of the range.

Power Production Histogram, 2014



Conclusions

This study finds that a 100 MW wind power plant northeast of El Paso is technically feasible, though its performance would be limited by the climate in the area. The calculated capacity factor of 23.75% falls below the 30–40% typical of comparable U.S. wind farms (4), which is primarily caused by El Paso's low average wind speeds.

- Mountainous terrain at the proposed site would add significant construction costs, requiring favorable financing or policy incentives to offset this
- Despite these limitations, a 24% capacity factor remains commercially viable. The plant could power up to 45,000 homes and extend wind generation into a region currently underserved by Texas' existing wind infrastructure
- With statewide renewable demand continuing to rise, this project could be a meaningful opportunity to expand Texas' wind system and bring clean, independent energy to the greater El Paso area

References

1. Center for Sustainable Systems. "Wind Energy Factsheet." *University of Michigan*, 2023, css.umich.edu/publications/factsheets/energy/wind-energy-factsheet.
2. Michaelides, Efstathios E. *Energy, the Environment, and Sustainability*. CRC Press, 2018. Mechanical and Aerospace Engineering Series, vol. 1.
3. Texas Comptroller of Public Accounts. "Wind Energy in Texas: A 2023 Snapshot." 2023, comptroller.texas.gov/economy/economic-data/energy/2023/wind-snap.php.
4. "Texas Renewable Energy Share Climbs to 29%, Led by Solar and Wind Growth." *The Gilmer Mirror*, 25 Feb. 2026, www.gilmermirror.com/2026/02/25/texas-renewable-energy-share-climbs-to-29-led-by-solar-and-wind-growth/.

