INL/EXP-24-79666-Revision-0

Unseen Winds: Harnessing High-Altitude Winds in the Southeast USA

August 2024

Carlos Alonso Castillo-Guzman

Changing the World's Energy Future

Idaho National Laboratory

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Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

Final Edge of Poster

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Revolutionizing the Energy Landscape with High-Altitude Winds

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Airborne Wind Energy Technologies

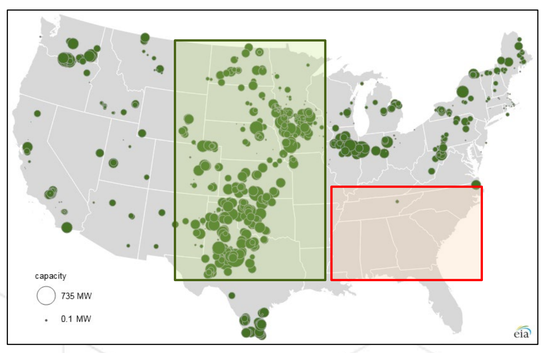
- Airborne wind technologies include **kite-based systems**, **drone-based systems with turbines**, and **glider-based systems**, all of which capture **high-altitude** wind energy and send it to the ground through tethers.
- Impact of **distributed wind adoption**: enhanced local **resiliency**, domestic **energy** production, and **climate** impact mitigation

Altaeros Energies' BAT floats 1,000 to 2,000 feet high to harness stronger winds (MIT News)

A Makani hard-winged drone equipped with wind turbines (X DEVELOPMENT LLC, Yale Environment 360)

Wind Energy Extraction in the USA

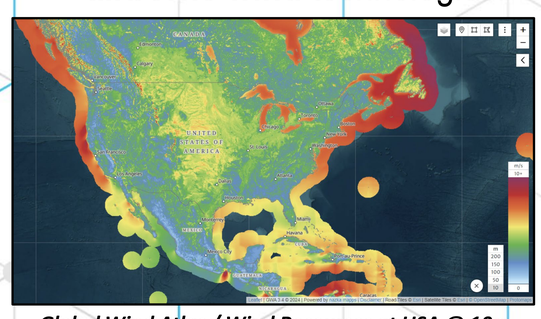
- The vast majority of wind energy production is in the **central USA**, utilizing **traditional wind turbines** that harness strong wind speeds **below 100 meters**.
- The **southeastern USA** lacks wind energy extraction due to **lower wind speeds** at heights **below 100 meters**, making traditional turbines **ineffective**.



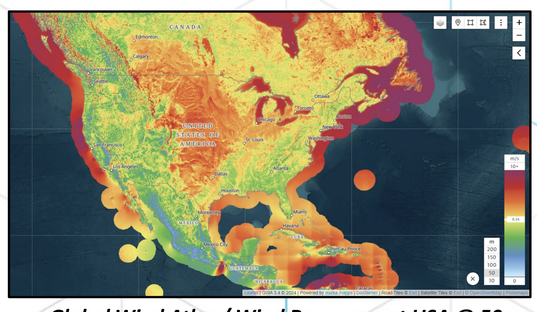
Distribution of Wind Power Plants in the Lower 48 States (as of December 2016, U.S. Energy Information Administration)

Open Market in the Southeastern USA

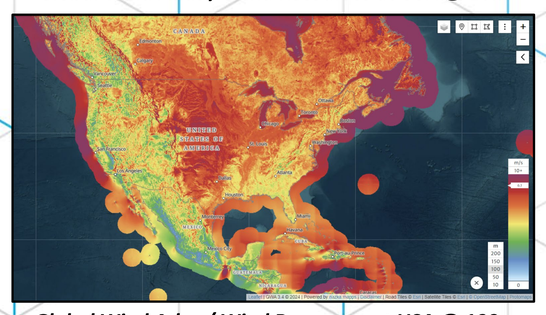
- The **southeastern** USA has untapped **high-altitude** wind resources of 8 to 9 meters per second at **150 meters** and higher, **suitable** for **airborne wind** technologies.



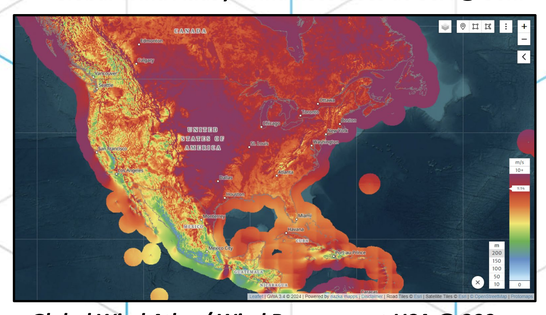
Global Wind Atlas / Wind Recourses at USA @ 10m



Global Wind Atlas / Wind Recourses at USA @ 50m



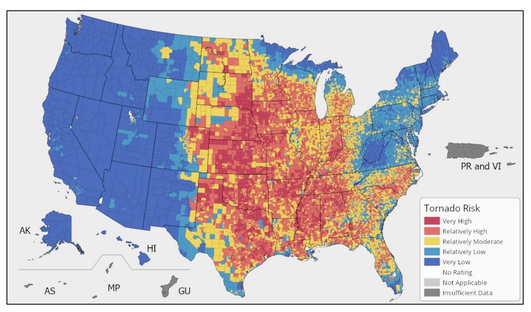
Global Wind Atlas / Wind Recourses at USA @ 100m



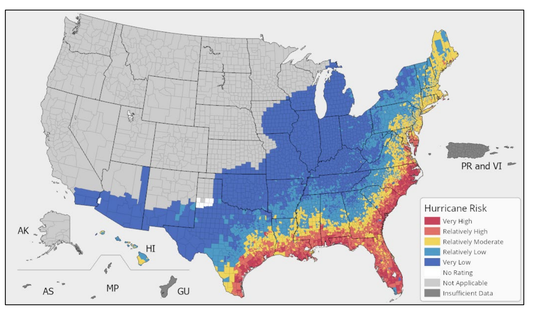
Global Wind Atlas / Wind Recourses at USA @ 200m

Approach

- Target Cities: High **electricity** costs, **carbon-based** energy, low **population**, and **high tornado/hurricane** risk.
- Why Risky Areas?: Airborne wind tech is adaptable and can be quickly relocated during storms.



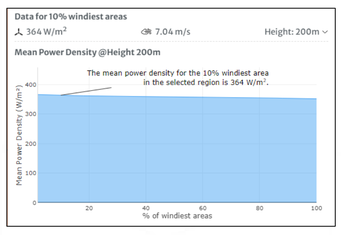
Tornados | National Risk Index



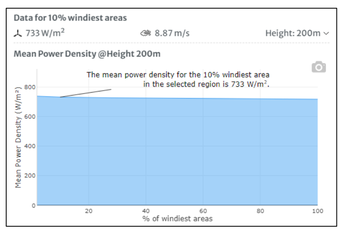
Hurricane | National Risk Index

Results

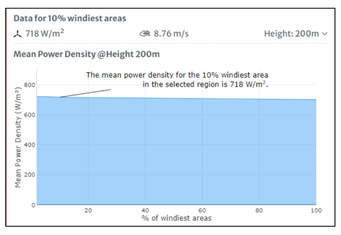
- Top Locations: After our analysis, **Noma**, FL, **Elkton**, KY, and **Guthrie**, KY ranked highest.
- Testing AWS on these sites will boost U.S. adoption and refine the platform.



Mean Power Density @ 200m of Noma, FL



Mean Power Density @ 200m of Elkton, KY



Mean Power Density @ 200m of Guthrie, KY

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