Revealing the Real Onshore Potential: A Socio-Technical Wind Atlas for the U.S.

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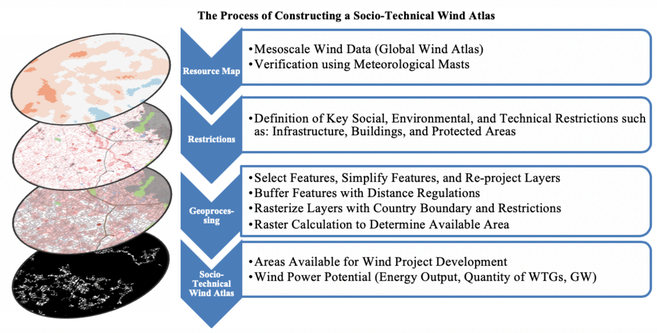
Background

- The continuous development of onshore wind farms is an important feature of the U.S. transition towards an energy system powered by distributed renewables.
- This study simulates each state's potential for future onshore wind turbine installations.
- The study visualizes, via maps, all the national and regional socio-technical restrictions and regulations for wind project development using spatial analysis conducted through GIS.

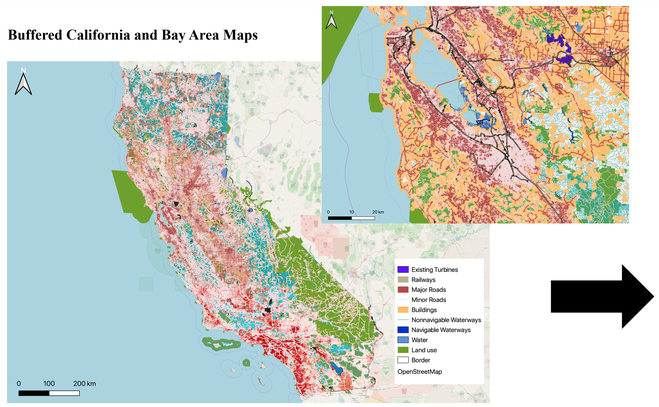
Objectives

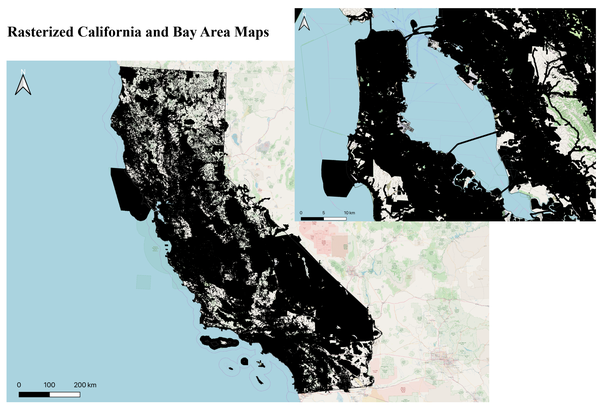
- The U.S.-wide socio-technical wind atlas is the first of its kind, where the emphasis is on the restrictions and regulations for wind farm deployment, not solely on the wind resource itself.
- The methodological approach and application of open source data allows this study to be replicated for any country, which is why this will be developed into a global planning tool, reducing resources spent for greenfield development, increasing certainty in investment profiles, and assisting in national and international wind project planning.

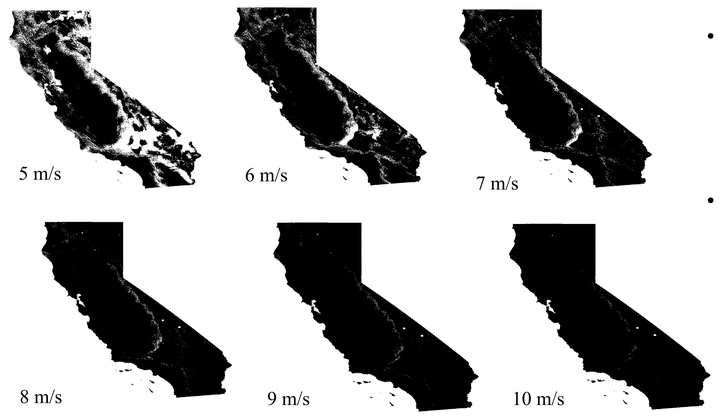
Methods & Process



- Restrictions were categorized into three main groups: Infrastructure, Buildings, and Protected areas.
- The restricted areas and associated shapefile layers were processed using QGIS.
- The geoprocessing algorithms *Buffer, Re-Project, and Rasterize* were run to process these layers.
- As an additional step, the Buildings layer was buffered according to urban or rural land use type.







- The maps above show the process of transforming the buffered data into rasterized areas. The land covered in black represents restrictions to wind farm development, while the leftover land is still available.
- The figure to the left shows the progression of diminishing available land areas when higher annual average wind speed thresholds are applied, ranging from 5 m/s to 10 m/s at 100 m hub height.

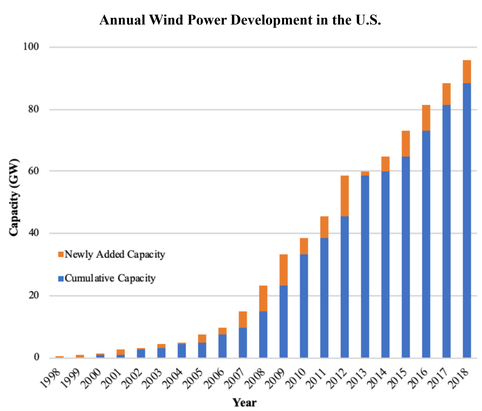
Conclusions

- This study offers a more rigorous, granular, multi-dimensional, and feasible assessment of the vast potential of future onshore wind project development in the U.S.
- This socio-technical wind atlas informs U.S. policymakers on the need for subsidies in states with available areas and low wind speeds, as well as collaboration opportunities and grid integrations.
- The individual high-resolution state maps will furthermore assist with the planning of future renewable energy systems, as states and regions will know where to invest more in wind, along with PV in the case of poor availability for wind project development.
- Examining the wind atlas, it becomes clear that wind turbine manufacturers are forced to innovate on solutions for areas with wind speeds below 6 m/s, as the spacing of such are enormous.

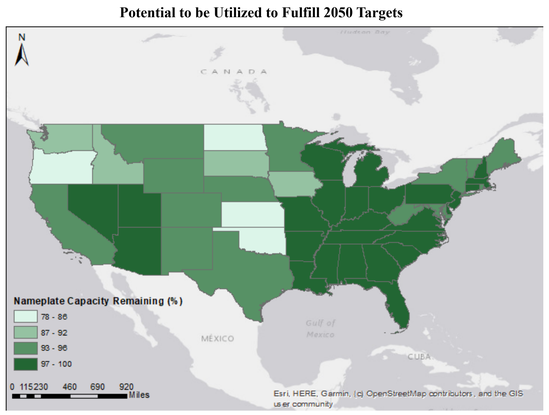
Next Steps

- Using mapped restrictions to quantify the land area leftover for wind farm development.
- Combining infrastructural and natural restrictions with economic wind potential to reveal the potential installed wind capacity.
- Comparing power density potential in different states.
- Conducting a similar analysis for offshore wind.

Results



- The U.S. wind energy industry has experienced tremendous growth in the past decade (309% growth over the past 10 years).
- Repowering of existing capacity with more efficient turbines will reduce the amount of capacity needed to meet electricity demand in a period when total U.S. electricity demand growth is relatively flat.



- The U.S. has sufficient wind energy resources to meet and significantly exceed existing 2050 targets set by previous studies (The Solutions Project).
- The percentage of remaining nameplate capacity that can be installed represents the progress toward wind energy targets alone, ranging from 0.7-70% of total state energy demand.

References

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