Renewable Wind Energy in Vermont: A Site Suitability Analysis

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EOS 104 Geological Applications of GIS

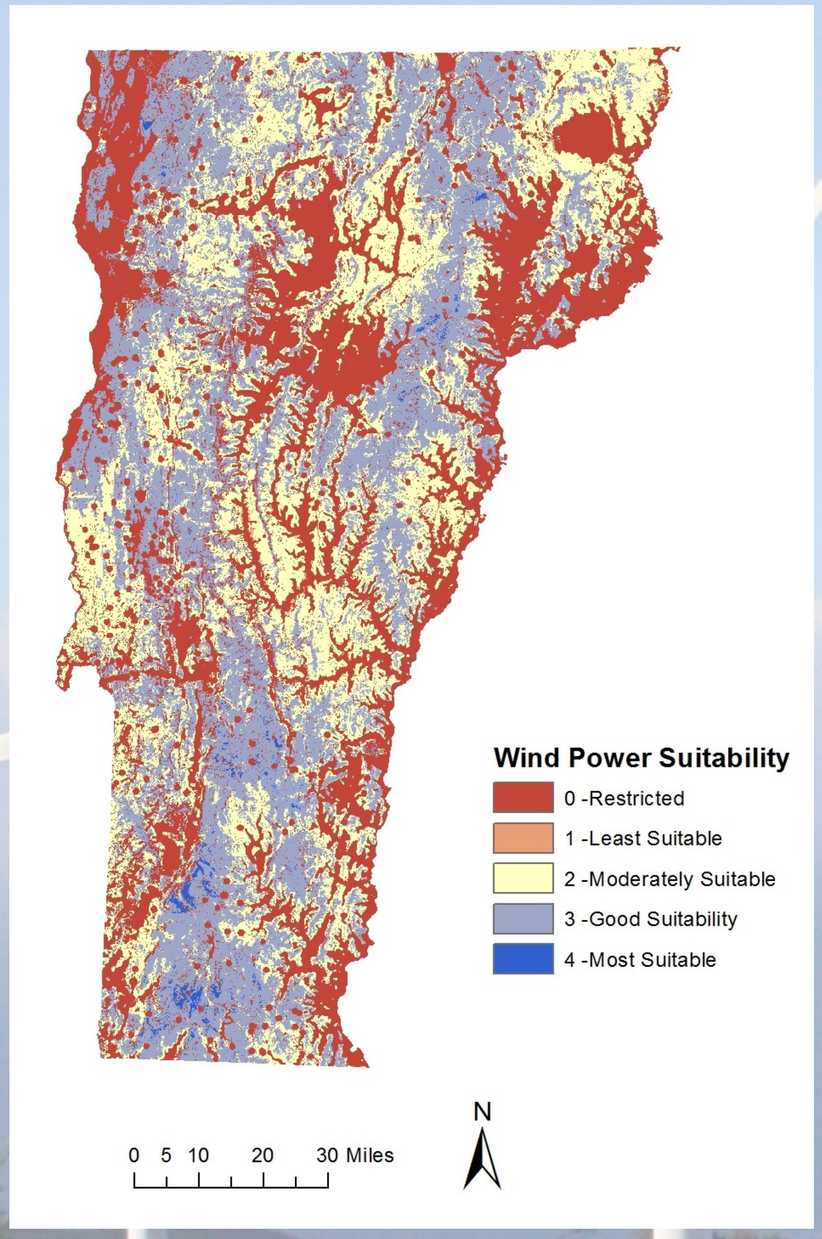
Introduction:

In a world filled with an ever-increasing amount of environmental pollution and energy waste, we must make the inevitable shift towards clean, renewable energy. One of the main renewable energy sources today is wind power, which is becoming an increasingly efficient and popular choice for environmentally-aware businesses and individuals looking to reduce their carbon footprint. In this project I perform a GIS analysis to determine which areas and locations in the state of Vermont might be most suitable to effectively harness wind power.

Methods:

The main method I chose to complete this study was a weighted analysis which incorporated and ranked seven different factors pertaining to wind power site construction and suitability. These seven factors were: **Mean wind speeds, land cover, slope of the terrain,** as well as proximity towards **dense population, historical sites, major roads and transmission lines.** Once all data for these seven factors was collected and weighed relative to their importance, they were then input into the overlay analysis tool which combined them to generate a final map. This map represents a model of the state of Vermont ranked into 5 suitability classes, ranging from areas that are completely restricted to areas determined to be the most suitable for wind power site construction.

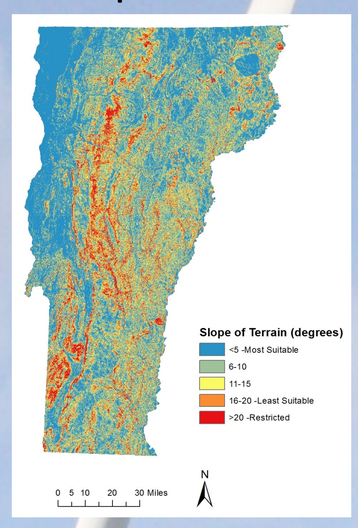
Site Suitability Map



Results:

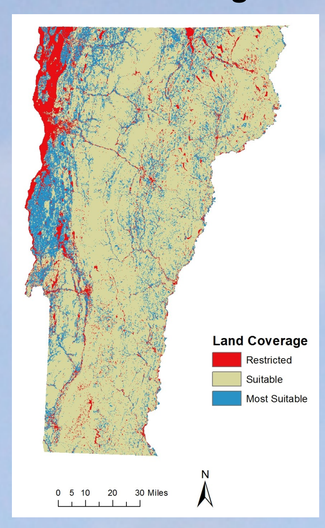
The results from my map show that there is a good amount of land in proportion to the state that is not only feasible, but well suited to construct wind power. That being said, there is also another good proportion of the state that the model deemed unsuitable to consider the construction of wind energy. The areas of the map that are displayed in red are considered restricted and would fall in this latter category. However, all other locations are at least feasible for wind power, and small areas in the southern and northwest portions of the state are deemed by the model to have high suitability preference for wind energy. If there were any plans by either the Vermont state government or businesses/individuals nearby these “hotspots” to either switch to or further their use of renewable energy, they should consider wind power, possibly over other alternatives.

Slope of Terrain



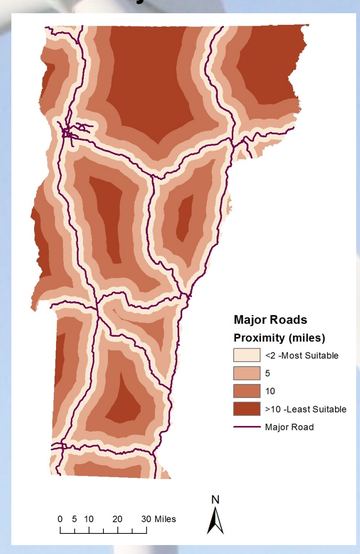
Having a suitable slope degree is integral for wind power construction, which both requires and favors horizontal foundations so as not to increase construction costs. It was weighted at 15% of the total analysis.

Land Coverage



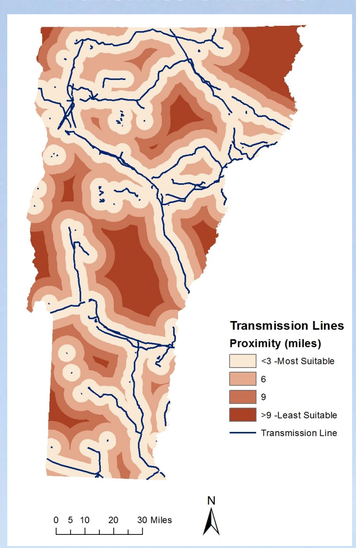
The land coverage data was compiled and then reclassified into 3 different values: Restricted, Suitable, and Most Suitable. Open water, wetland and developed areas were restricted, forests were suitable, and herbaceous land such as pastures, grass and croplands were grouped as most suitable. The total percentage it had in the analysis was 5%.

Major Roads



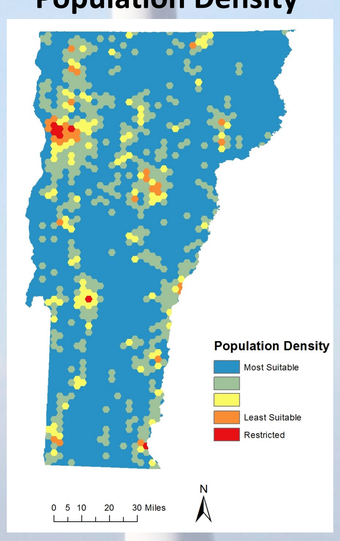
Roads are important in wind turbine construction since much of the material is extremely large and difficult to transport, so the closer you are to a major road or highway, the better chance you have of decreasing construction costs. This factor was weighted at 10% of the total analysis.

Transmission Lines



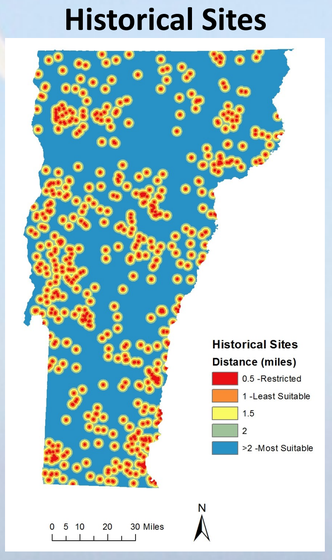
Much like major roads, the closer your site is to a transmission, or power line the better. This allows for the overall energy output to be much more efficient as well as decreasing the potential costs of building new power lines. This got 20% of the analysis weight.

Population Density



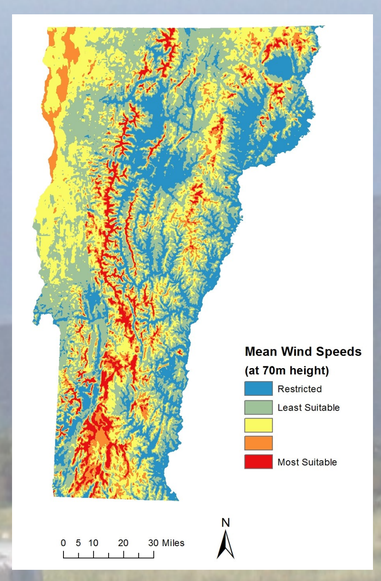
Although the benefits of renewable wind energy far outweigh the costs, there have been reports of potential health/ stress related problems from people living in too close of a proximity to a turbine site. Because of this we want to try our best to avoid large or dense populations of people living nearby a site. This was weighted at 10%.

Historical Sites



A relatively small factor in the grand scheme, historical sites are still important to try and avoid since they are both nostalgic and serene parts of the environment, especially to long-time residents of the area. Any area within a half a mile of a historical site was restricted and the rest of the values were weighted at 5%.

Mean Wind Speeds



This factor received the highest weighting (35%) due to the obvious fact that high wind speeds are essential in order to effectively generate the turbine propellers and ultimately collect energy. Many of the red areas you see on the site suitability map are due to restricted areas of wind speeds below the minimum requirement for consideration.

Conclusion:

Although there were seven factors used in this analysis, there are still others that can be taken into consideration when determining where to construct a wind power site, such as land ownership or endangered species habitats. One of the main limitations to doing a weighted overlay analysis is that the ultimate percentages chosen as weights for each of the factors is subjective. Although there were many hours put into research to decide both the usage of and weights for each of these factors, there may always be a more objective classification or weighting system out there to decide what is most suitable, or what is more important/significant for the analysis.

Map Projection Used: NAD_1983_StatePlane_Vermont_FIPS_4400

Sources: https://geodata.tufts.edu/ , http://geodata.vermont.gov/