Rising Tides: Avoiding the Surge

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Research Idea

The research basis for this study was centered on a theoretical migration away from the eastern United States driven by climate change. If coastal communities are forced to move inland, where would be the most optimal area within the United States for long-term, environmentally conscious lifestyles? In a general analysis of renewable energy maps in the United States (wind, solar, and geothermal), the state of Wyoming (WY) has proven to be a prime candidate for this study. Once the decision was made to focus on WY, a primary research goal was developed: **to find a suitable area within the state of Wyoming with the highest potential for renewable energy infrastructure.**

Objective

The objective of this study was **to find a single polygon in Wyoming** that exhibits the highest number of positive qualities. These qualities were determined by prior research: **low cost, high efficiency, close proximity.**

Data Sources

The data sets acquired for this study were given by the following sources: the National Renewable Energy Laboratory (NREL), Environmental Systems Research Institute (ESRI), National Oceanic and Atmospheric Administration (NOAA), United States Geological Survey (USGS), Garmin, and the United States National Park Service (NPS).

The data was not available for public download and therefore the raster sets used in this study were first digitized by hand using the edit tool within ArcMap (ESRI). The solar data's pixels were of a lower resolution, and the polygon method was used **(figure 1.1)**. For the wind raster, the data had higher resolution and the freehand technique was used **(figure 1.2).** In both cases, the polygons were digitized for varying degrees of intensity, and then converted to raster sets for further analysis. The geothermal points were reclassified using the Euclidean distance tool in ArcMap **(figure 1.3).**

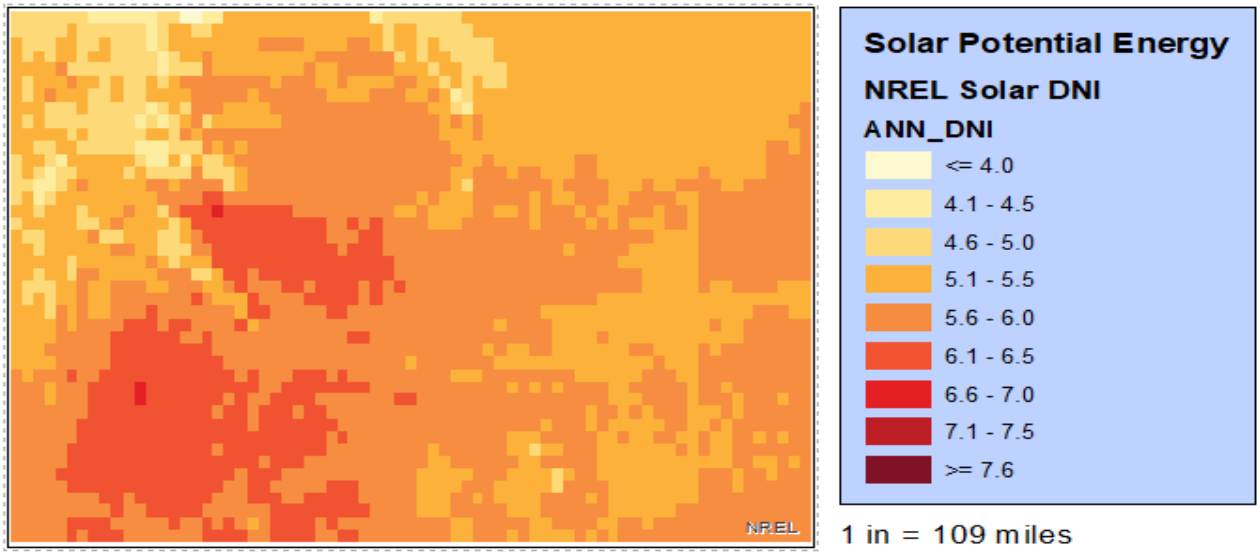

Figure 1.1: The solar data set for the state of Wyoming. Solar potential energy is measured in direct normal irradiance (DNI).

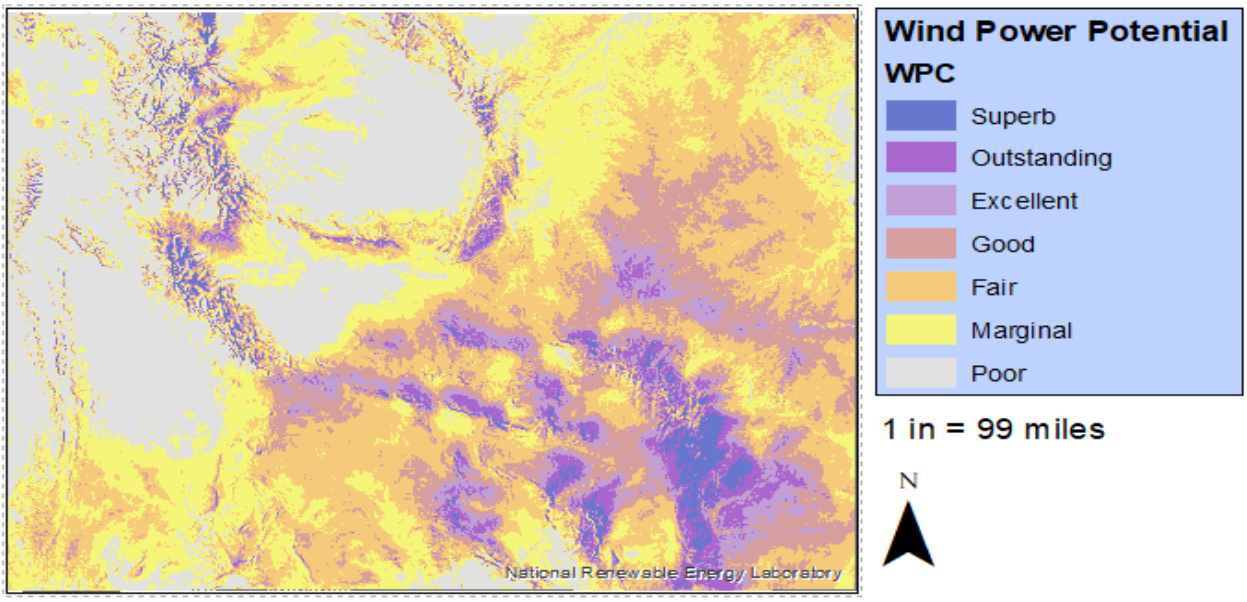

Figure 1.2: The wind data set for the state of Wyoming. Wind energy is measured in strength of wind (mph).

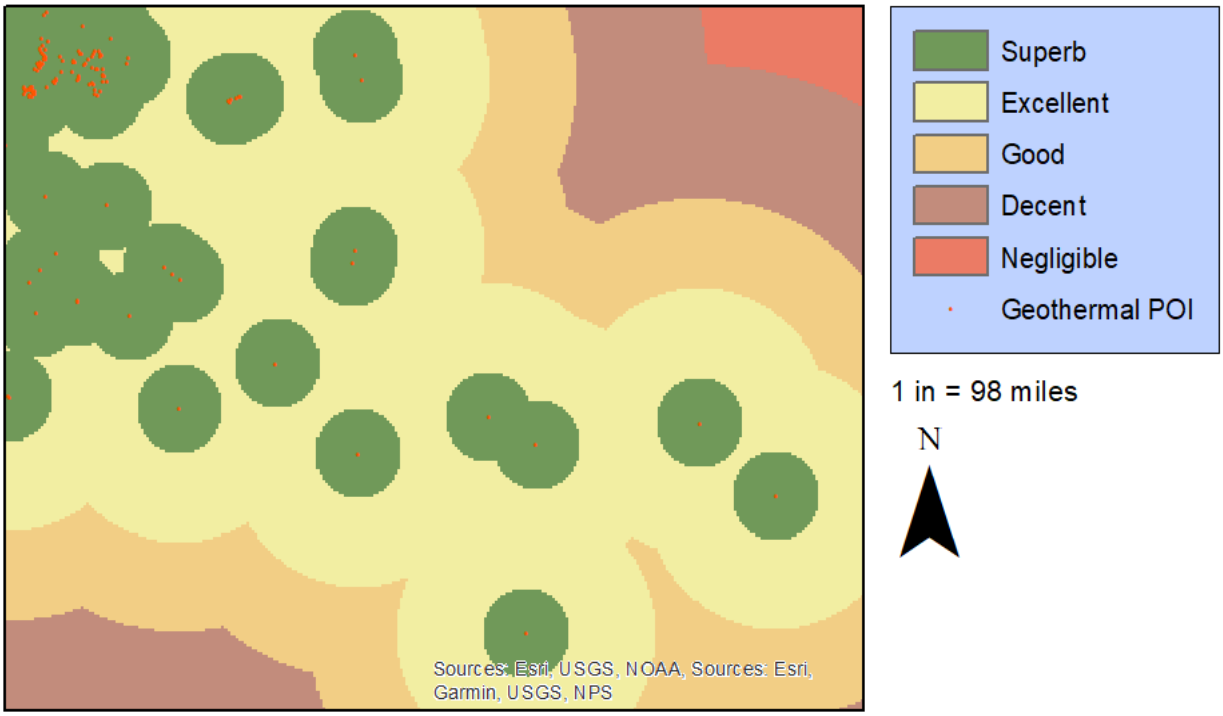

Figure 1.3: The geothermal data set for the state of Wyoming. Distance from the points of interest (POIs) is used to classify the data for further analysis.

Methodology

The goal of this study is to find the optimal area for sustainable development using a number of different criteria based on energy sources. Once all the datum is in raster form, they will be reclassified to hold values based on supporting parameters. After the reclassification, a weighted overlay will be applied to highlight suitable areas for development. The tool **weighted overlay** is the fundamental aspect of this study. By weighting the variables differently, the study can highlight various parameters such as cost, efficiency, and applicability. Once these areas are found, the **con** tool will be used to display the optimal area within the suitable areas (areas of value 8 and above). The **majority filter** tool will then be applied to refine the areas in question, resulting in the research goal of the study: polygons exhibiting the greatest number of positive attributes within the scope of this study. The general model for the methodology is provided in **figure 2.1** and the different methods of weighting the data sets can be found in **tables 2.1-2.3.**

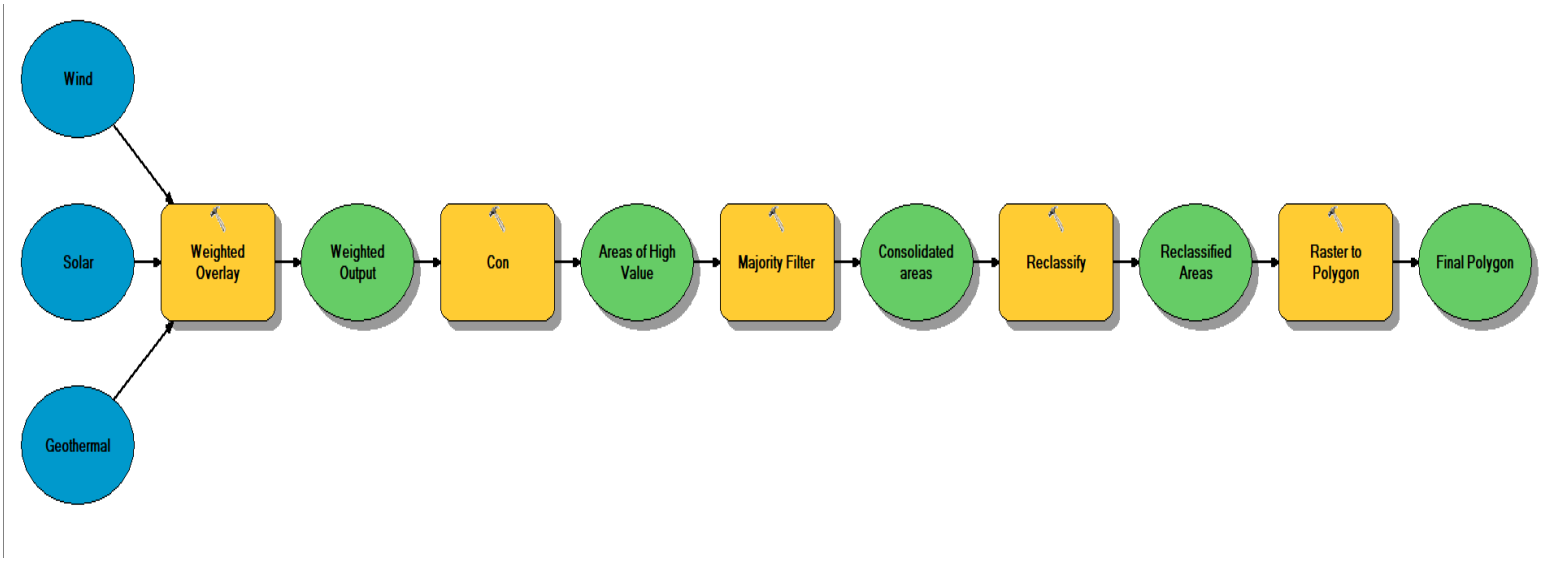

Figure 2.1: The model used to complete this study. The tool which was altered for various parameters (dependent variable) was the weighted overlay tool.

Table 2.1: Weight classifications based on cost values.

Energy Type	Cost ($/MWhr)	Weighted Overlay Value
Solar	51	42
Wind	46	48
Geothermal	77	10

Table 2.2: Weight classifications based on efficiency values.

Energy Type	Efficiency (%)	Weighted Overlay Value
Solar	207	4
Wind	1,164	64
Geothermal	514	32

Table 2.3: Weight classifications based on applicability values.

Energy Type	Applicability (%)	Weighted Overlay Value
Solar	49	49
Wind	50	50
Geothermal	1	1

Results

The final result of this study was a **polygon in the center-northwest section of Wyoming (figure 3.1).** The polygon exhibited the parameters of low cost, high efficiency, and highest applicability (proximity and quantity of energy sources).

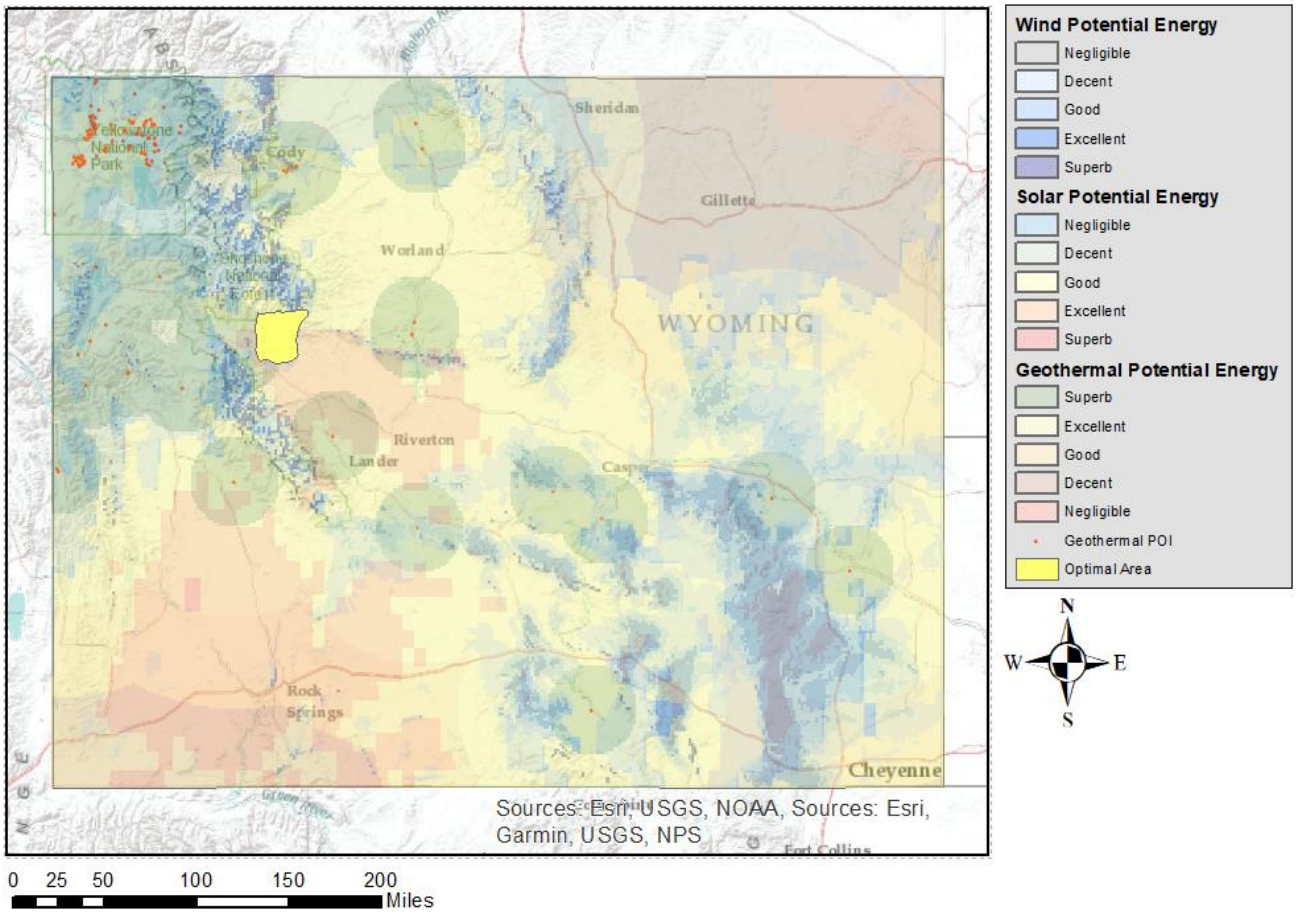

Figure 3.1: The optimal area for renewable energy sources in Wyoming (yellow polygon).

Additionally, the polygons based on the applicability of an energy source can be found in **figure 3.2.** To reiterate, the applicability of an energy source is essentially a measure of how cheap, accessible, and efficient an energy source is for a given area.

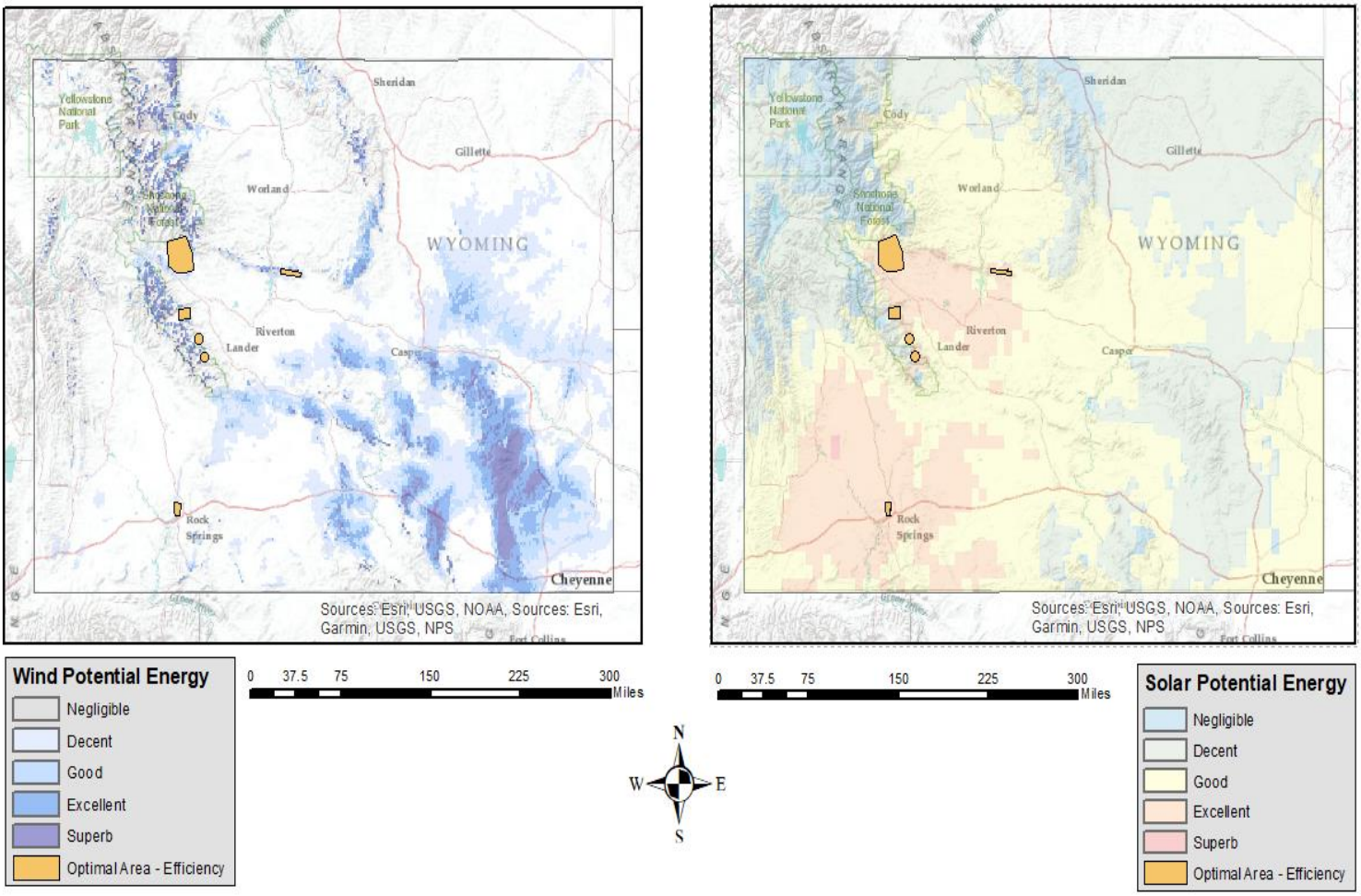

Figure 3.2: Polygons showing the optimal area of renewable resources in Wyoming based on applicability (orange). Also shown are the wind (left) and solar raster sets (right).

Discussion

Error in this study resides in the **digitization of the raster sets**. While the digitized raster sets were fairly accurate, they were not perfect. Additionally, **the pixel size** for the data wasn't as precise as possible. In a further study, the methodology would run with more precise data drawn by direct remote sensing sources.

In regard to the limitations of this study, there are many parameters omitted from consideration. A large portion of Wyoming is covered in **protected areas** (national parks, native American reservations, etc.). These protected areas aren't available for state-funded building and should be addressed in a further study. Additionally, a population map, digital elevation model (DEM), and hydrological parameters were left out of the study for simplicity. These parameters, if included, would offer a more defined and accurate optimal area.