Wind Power on the Big Island of Hawai'i

Tufts

Data Sources: Hawaii GIS, USGS

CEE 194: Intro to GIS, Summer 2010

Projected Coordinates: NAD 1983, UTM Zone 4N

Introduction

Currently, the state of Hawai'i uses imported fossil fuels to meet 90% of its energy needs. In 2008, Governor Linda Lingle signed the Hawai'i Clean Energy Initiative, presenting the goal to meet 70% of the state energy needs with renewable, efficient sources of alternative energy by the year 2030.

The Hawaiian islands are home to a unique and fragile ecosystem that developed over 70,000 years of isolation. For the sake of the many endangered endemic species, as well the agricultural community and the longevity of the prominent tourist economy, Hawai'i must invest in multiple alternative energy programs quickly.

This project explores possible sites for wind farms on the Big Island of Hawai'i. This island was chosen because it is the largest and youngest island of the archipelago and it has the greatest area with high wind energy of any of the eight main islands.

GIS is a necessary tool to combine the multivariate data layers that each play a key role in evaluating the options for locations for the next wind farm.

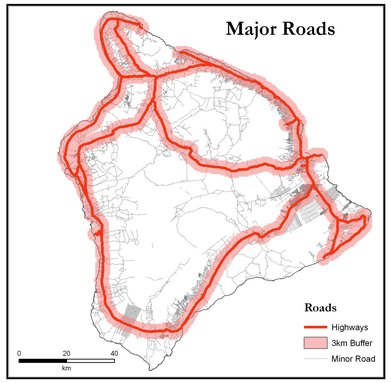
There is already a wind farm on the southern tip of the Big Island, with 14 1.5-megawatt turbines.

Where should the next farm go?

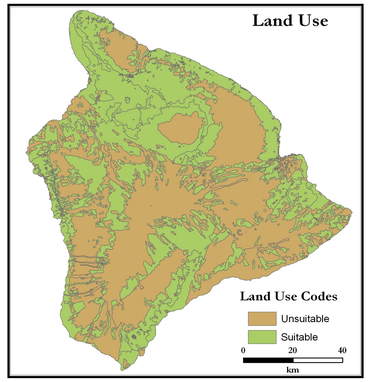
Methods:

Six factors were chosen for consideration in the analysis process. Each factor answers a question about the practicality or efficiency of a potential wind farm in any given location on the island. This project analyzed the 6 factors in three stages. 1) Datalayers were obtained from the Hawaii GIS Database. 2) The values of the datalayers were reclassified according to the suitability of that value to a wind turbine project.

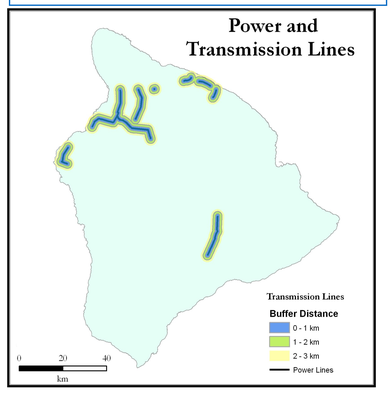
3) The reclassified datalayers were assigned weights based on their relevance to the overall question and then combined using a raster calculator to show the overall best locations for wind farms on the Big Island.



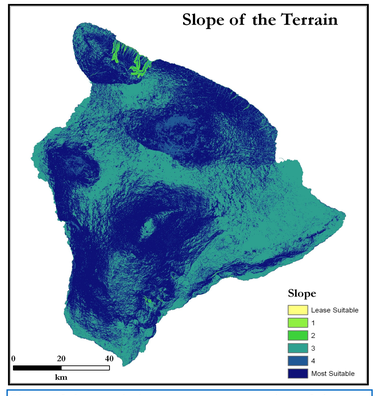
Roads: Wind turbines are a resource and not a destination. Building new roads can increase the project cost by **50%.**



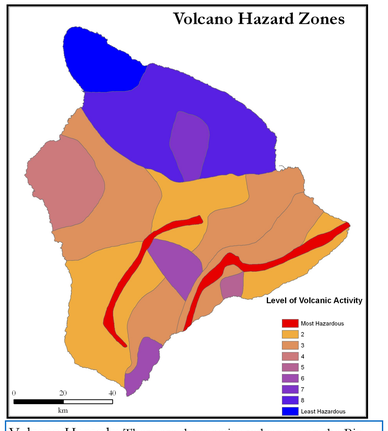
Land Use: Some areas are not conducive to wind farms. Here, rangeland and agricultural land are considered suitable.



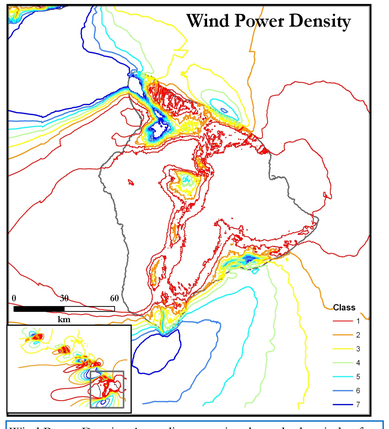
Power and Transmission Lines: The faster the energy can reach the people, the better the wind farm.



Slope: If the terrain is too steep, construction of the turbines would be impossible. However, a slight slope adds to the wind speed and power density.



Volcano Hazards: There are three active volcanoes on the Big Island, one of which (Kilauea) has been erupting since 1983.



Wind Power Density: According to national standards, winds of class 4 or higher (measured in w/m^2)are appropriate for turbines.

Reclassified Values

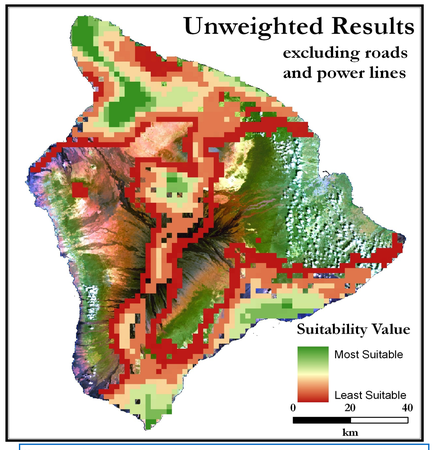
WIND POWER		SLOPE		Volcanic Hazard		Land Use	
w/m2	Class*	Percentage	Value	Zone	Value	Usage	Value
<200	1	14.8	2	1	0	Urban	0
200-300	2	14.8 – 24	5	2	1	Agriculture	1
300-400	3	24 – 63	4	3	2	Rangeland	1
400-500	4	63 – 135	3	4	3	Forest	0
500-600	5	135 - 766	1	5	4	Wetland	0
600-800	6			6	5	Barren	0
>800	7			7	6	Tundra	0
				8	7	Ice/Snow	0

Results

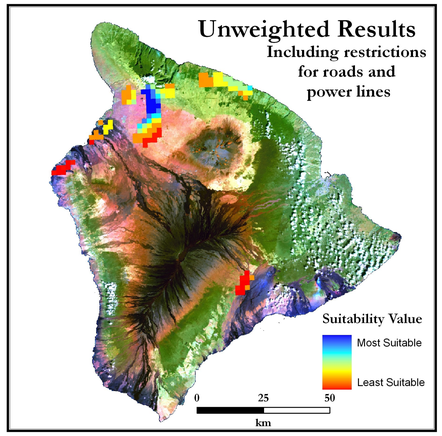
Two of the layers in this evaluation were especially constrictive: the roads and power lines. If we were to look at potential sites on the island based on access to these power lines, there would be very few locations to consider.. It is possible that not all of the existing power lines were mapped on the datalayer, which could lead to misinterpretations. To provide a more hopeful picture, the results of the weighted calculations are presented without the layers of roads and power lines.

Conclusion

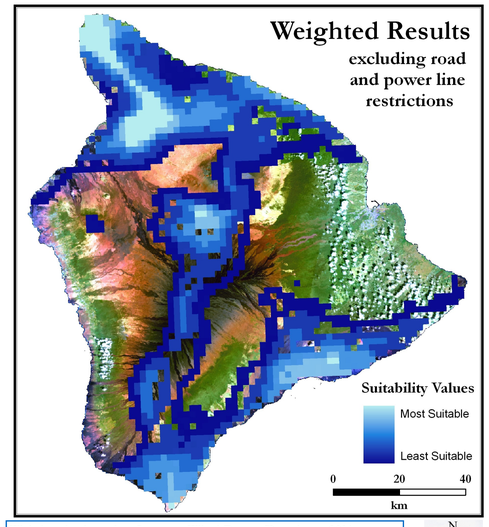
The best place to consider building a wind farm is the northern most area of the Big Island—Kohala Point. Hawaii should also consider expanding its infrastructure of power lines to open up more options for sustainable development in all types of alternative energy.



Results when each layer is given equal importance. Excluding roads and power lines.



If we consider the currently mapped power lines as restrictive, then very few areas of the island are suitable for development.



Weights Assigned to Layers: Wind Power Density = 30%

Slope = 30%, Land Use = 20% and Volcanic Hazard = 20%

N