Collegiate Wind Competition 2017-2018

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COLLEGIATE WIND COMPETITION
U.S. DEPARTMENT OF ENERGY

Project Description

The U.S. Department of Energy Collegiate Wind Competition challenges interdisciplinary teams of undergraduate students from a variety of programs to offer a unique solution to a complex wind energy project using the three multi-faceted elements; **Develop and Deliver a Business Plan, Build and Test a Wind Turbine, and Plan a Wind Project**, providing each student with real-world experience as they prepare to enter the wind industry workforce.

Objectives

- 100 MW Wind Power Plant.
- Maximize energy production.
- Balance environmental and community impact.

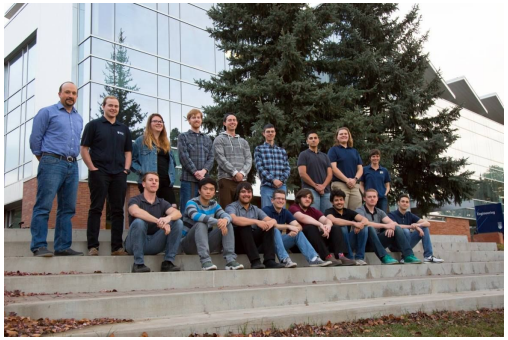

Figure 1: CWC Engineering Team

Figure 2: CWC Engineering and Business Team

Site Selection Criteria

- Wind Resource
- Landowners
- Access to transmission
- Transportation access
- Terrain
- Vegetation
- Environmental impact
- Community impact

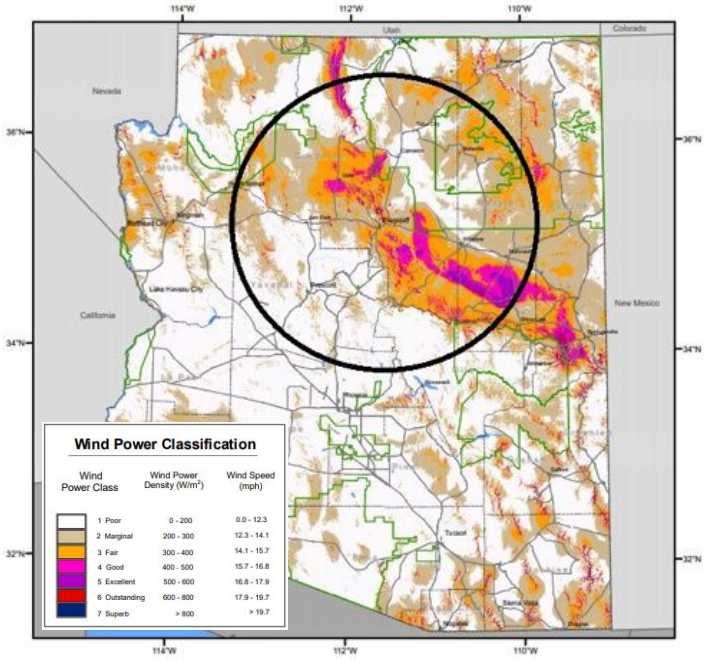

Figure 3: AZ Wind Resource at 100m [1]

Site Comparison

Table 1: Site Comparison

	Gray Mountain	Mormon Lake	Willaha
Pros:	• 7.0-7.5 m/s avg. wind speeds. • Transmission lines within five miles of site. • Low density of vegetation. • Relatively flat terrain. • Located within two miles of a major highway	• 7.0-8.4 m/s avg. wind speeds. • Transmission lines within two miles of site.	• 7.0-7.5 m/s avg. wind speeds. • Transmission lines within five miles. • Less than five miles from major highway. • Relatively flat terrain.
Cons:	• State and privately owned land within site. • Site boundary near National Forest, and Tribal Lands.	• High density of vegetation. • Site located within Coconino National Forest. • Known eagle migration area. • Major recreational area	• Site boundary near National Forest. • Site located within close proximity to Grand Canyon National Park.

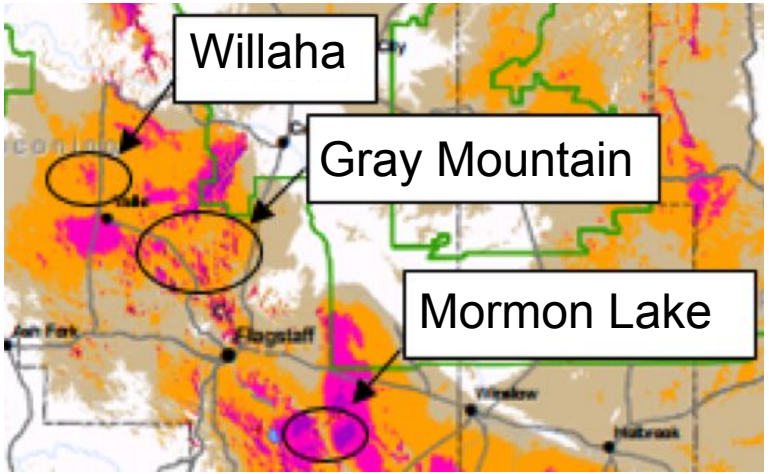

Figure 4: Sites Considered

Proposed Site

- Gray Mountain 33 miles from NAU.
- Approximately 60,000 acres.
  - Final footprint will decrease
- Private and State Owned.
  - Babbitt Ranches
- ~ 2.2 miles from 180.
- ~ 9.3 miles from 89.
- ~ 13.1 miles from Valle.
- ~ 1.0 mile from all other major boundaries, including Kaibab and Coconino National Forest, as well as the Navajo Nation.

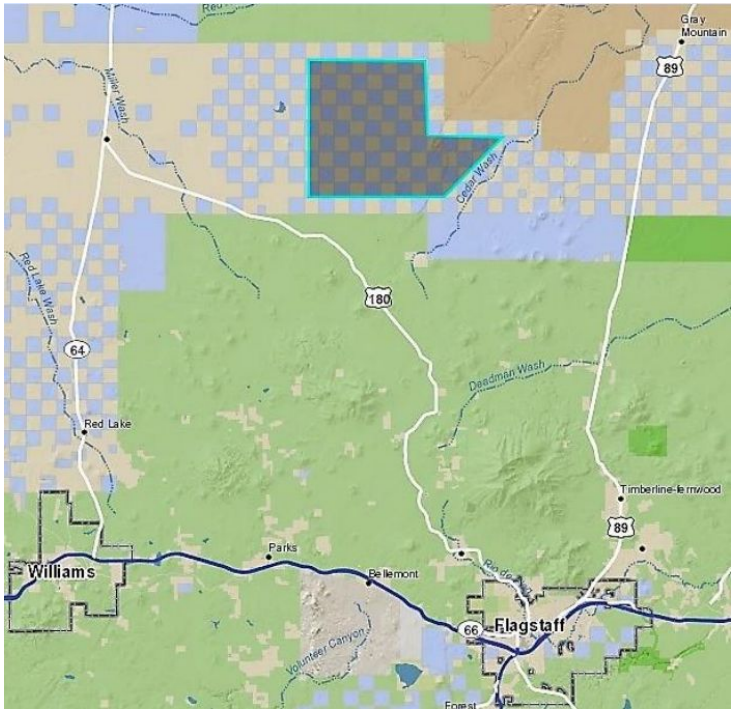

Figure 5: Proposed Site Boundary [2]

Wind Resource Assessment

- Data acquired through NAU Anemometer Loan Program.
- 3 Meteorological Tower modeled in Windfarmer Analyst.
- Average Wind Speeds of 7.3 m/s.

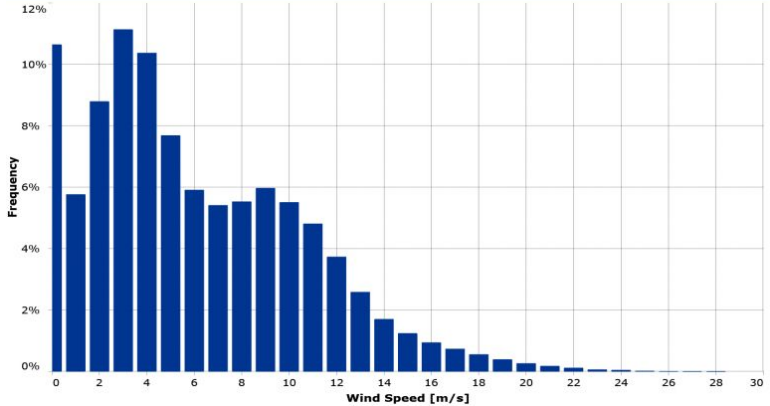

Figure 6: Weibull Distribution of Wind Resource

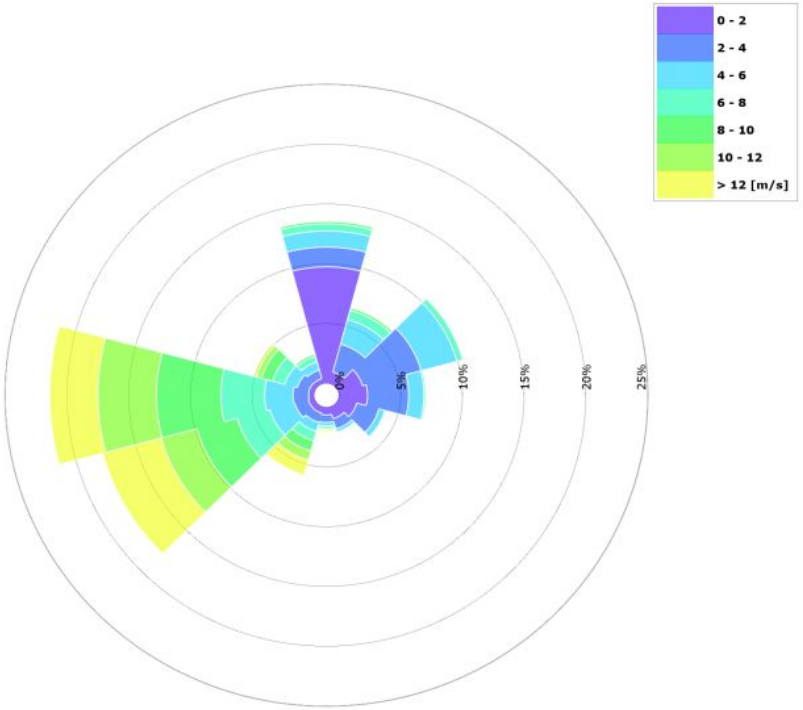

Figure 7: Wind Speed and Direction Frequency Distribution

Turbine Selection

- IEC Wind Class: IIIB
- Hub height: 110 m

Table 2: Turbine Comparison

Manufacturer	Model Number	Rated Power (MW)	Rotor Diameter (m)	
Vestas	V150-4.2 MW	4	150	[3]
GE	3.6-137	3.6	137	[4]
Ming Yang	MySE 3.0-135	3	135	[5]

Infrastructure Considerations

- Access to transmission lines
  - Sites falls within 500 kV transmission line path.
- Transportation
  - Primary road established from highway to site.
  - Mitigate road construction.
- Relatively flat terrain.
  - Reduces impact to land during construction.

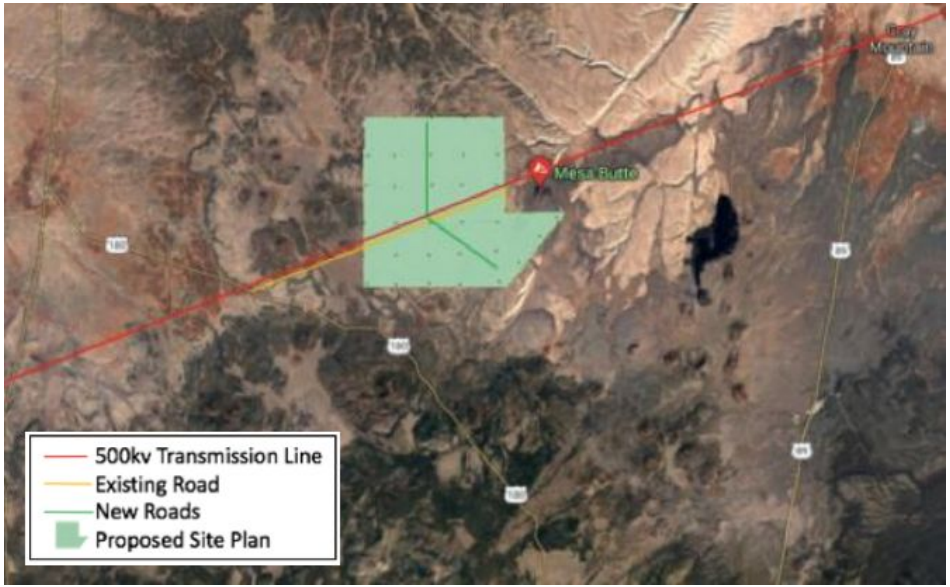

Figure 8: Transmission Layout

Community Outreach

- Series of meeting conducted with Coconino County Planning Board.
  - A preliminary Conditional Use Permit Application was drafted.
  - Meetings helped to better understand the scope of a project this size, and what is a priority when developing.
- A meeting with the private landowner was conducted.
  - Landowner stressed that the team would have to make best use of data gathered from site development.
  - Babbitt Ranch has previously used developer data to construct a Golden Eagle Sanctuary, and monitor other important species on the ranches.
  - Getting landowners involved in the process as early as possible will make for a more mutually beneficial project.

Environmental Impacts

- Vegetation
  - Noxious weed mitigation
  - Restore affected areas with native seeds
- Floodplains
  - Coconino County GIS and FEMA Flood Insurance Maps
  - Site is outside of all floodplains
- Wildlife Protection
  - In accordance with Arizona Game and Fish Department:
    - Preliminary wildlife screenings within 3 mile radius
    - Pronghorn and Golden Eagle habitats and prey paths
    - All turbines set at least 2 miles away
    - Incidental Take Permit from US Game and Fish Service
    - Select on-site staff trained to handle and transport raptors
  - Additional Conservation Efforts:
    - Team analyzing 30 years of data from SWCA Environmental Consultants
    - Sharing outcomes with SWCA and Babbitt Ranch

Community Impact

- Recreation
  - Slight decrease in hunting during construction.
- Visual
  - Aircraft Detection Lighting System to be used in order to minimize light pollution.
  - Shadow Flicker mitigated by distance.
- Noise
  - Mitigated by distance.
- Transportation
  - Increase in local traffic during construction.

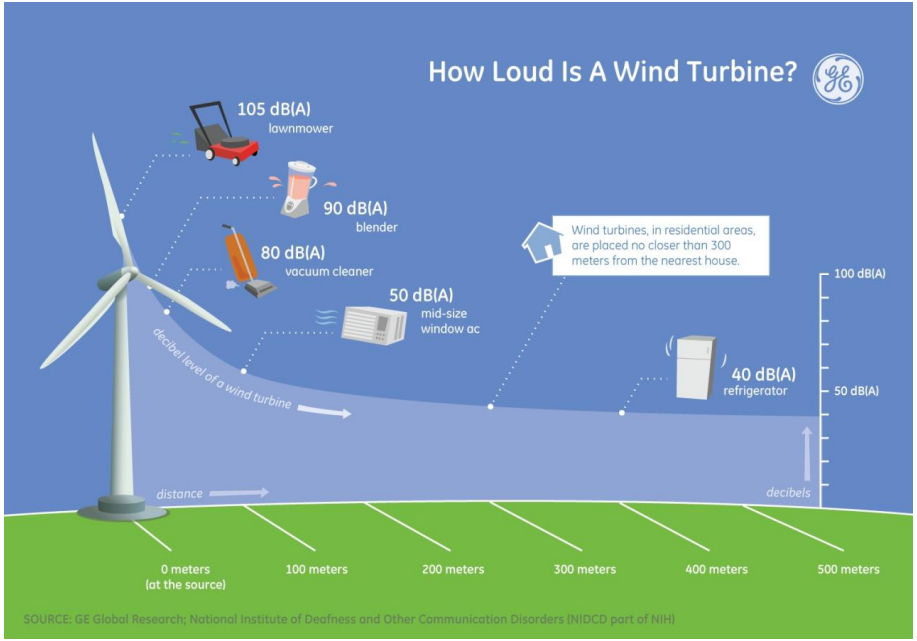

Figure 9: GE Wind Farm Sound Chart [6]

Figure 10: PhotoSim of Sitting Area

Figure 11: PhotoSim of Sitting Area

Economic Impact

- Short-term:
  - Increase in local employment
  - Boost in economy from construction-related expenditures
  - Economic benefits for Valle
- Long Term:
  - Boost in economy from operation-related expenditure
    Increased tax revenue
- Housing prices in the area should not be directly affected.

Questions?

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References

[1] Northern Arizona University, State of Arizona Average Annual Wind Resource 328 ft (100m). 2005.

[2] Ruiz, A. (n.d.). Coconino Parcel Viewer. Flagstaff, Arizona: Coconino County GIS.

[3]"V150-4.2 MW™", Vestas, 2018. [Online]. Available: https://www.vestas.com/en/products/turbines/v150-4_2_mw#!technical-specifications. [Accessed: 16- Apr- 2018]

[4]"GE's 3MW Platform", GE Renewable Energy, 2017. [Online]. Available: https://www.gerenewableenergy.com/content/dam/gepower-renewables/global/en_US/downloads/brochures/wind-onshore-3mw-wind-turbine-platform-gea32208b-r1.pdf. [Accessed: 17- Apr- 2018].

[5]"MySE 2.5/3.0 MW Hybrid Drive WTG", MyWind, 2018. [Online]. Available: http://www.mywind.com.cn/upfile/File/2017/MySE3.0.pdf. [Accessed: 16- Apr- 2018].