

Collegiate Wind Competition 2017-2018

Market Team B1

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HR2: BLADES AND SITING

- **Structural and performance analysis of blades.**
 - Lower C_p than expected. Higher TSR than expected.
 - Model does not account for pitch regulated systems.
 - Average power output ~ 3.65 MW.
- **Siting**
 - **Wind Resource:** 15.7 - 16.8 mph average wind speed.
 - **Turbine Selection:** 3 - 4.8 MW off the shelf.
 - **# Turbines:** 20 - 33 turbines for 100 MW power plant output.

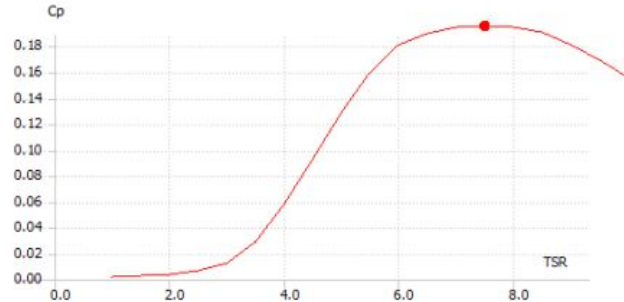


Figure 2: C_p vs TSR



Figure 3: Site Location

HR2: V2G and Design FEA

- **V2G Simulink Model modified to match our population**
 - 1000 Electric Cars- 40MW Storage (1000X40kW)
 - Consumption and Energy Storage
 - 150MW Residential Load (About 200,000 homes)
 - Usage profile with most the load in morning and evening
 - 100MW Wind farm
 - Nominal Wind Speed of 13.2 m/s
 - Wind Speed from 0-25m/s
 - Scopes Show the System is usable
 - Coal and Diesel Power plants still in use

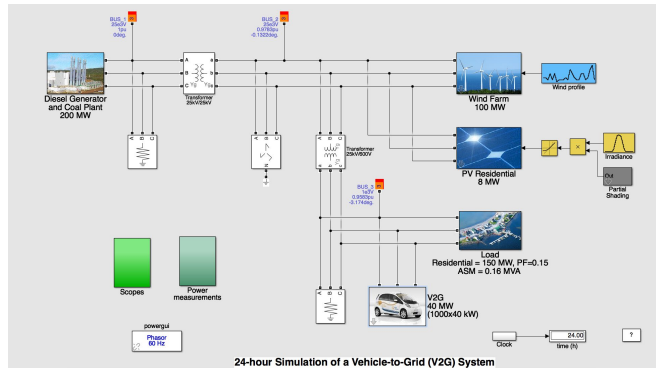


Figure 5: Modified V2G Model

- **Conceptual Design of 3.5 MW Wind Turbine Finalized with FEA**
 - 1.5 meter tower deflection at 25 m/s where braking is initiated
 - Max stress of 152.3 MPa at base (Yield=500 Mpa)



Figure 6: Final Design

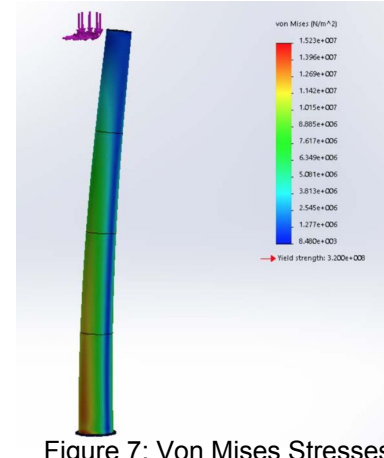


Figure 7: Von Mises Stresses

HR2: Mitchell

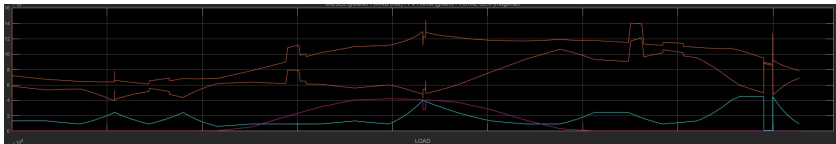


Figure 3: Results of V2G Grid Example

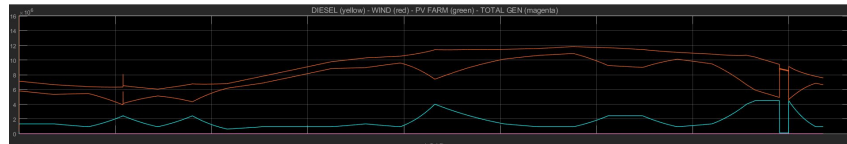


Figure 4: Adjusted Grid Example

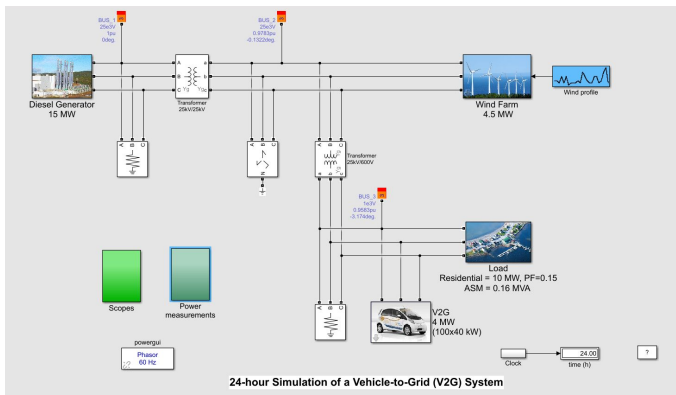


Figure 5: V2G Grid Example

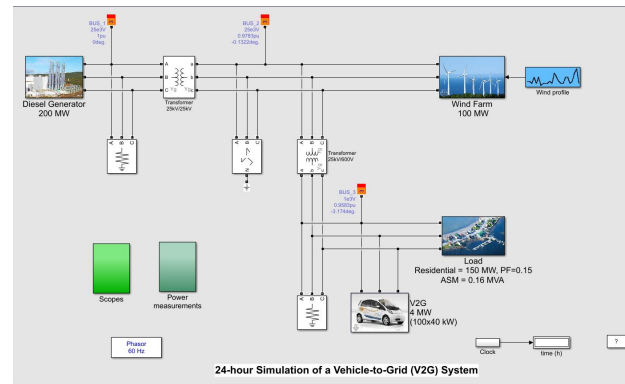


Figure 7: Adjusted Grid Simulation

HR2: System Advisory Model and Siting

- **System Advisory Model**

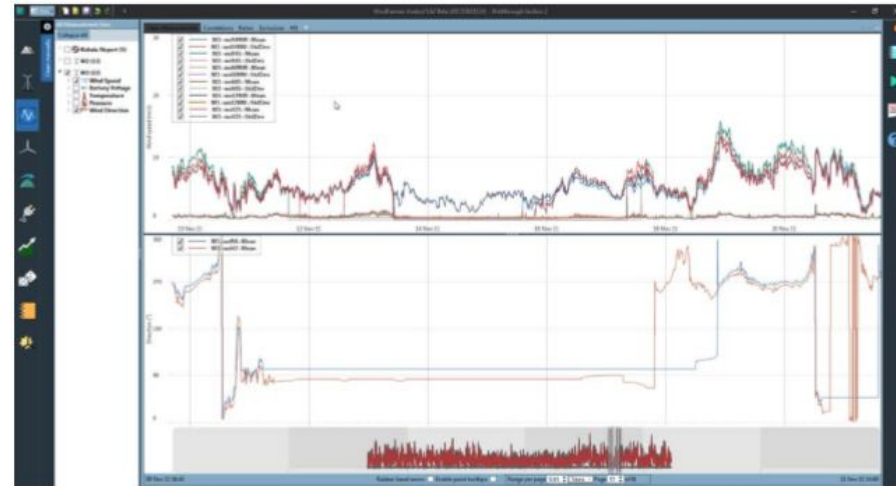
- Analysis created using business model, in order to create financial figures.

Table 1: User Defined Turbine Inputs	
Rated Output:	3500 kW
Rotor Diameter:	140 m
Maximum Cp:	0.20
Maximum Tip Speed:	80 m/s
Maximum Tip Speed Ratio:	7.8
Cut-In Wind Speed:	4 m/s
Cut-Out Wind Speed:	25 m/s
Drivetrain Design:	Direct Drive
Blade Design:	Advanced Design
Tower Design:	Advanced Design

- **Siting Challenge**

- Obtained wind resource data for planned area.
- WindFarmer Analyst Tutorials
- Meeting with Coconino County Community Development Advisory Group

Table 2: SAM Outputs	
Annual Energy Production (Year 1)	320,223,776 kWh
Capacity Factor (Year 1)	37.3%
Levelized Cost of Energy	6.62 cents per kWh



HR2: Windfarmer Theory and County Meeting

Windfamer Theory important points:

- Input Files
- Energy Calculations
 - Net Yield calculations
 - Modeling Losses as efficiencies
- Wake Models
 - Modified PARK
 - Eddy Viscosity
- Turbulence Estimations
 - Can be designed around IEC standards
- MCP methods
 - Least Squares method
 - PCA method

County Meeting Important Points:

- Windfarms and Met towers are processed as Conditional Use Permits (CUP's)
- The most important aspects to consider in this county are the environmental and visual aspects of the wind farm.
 - Game and Fish
 - Photo-sims
 - Neighbor outreach
 - Motion sensor lights