An Overview of the Wind Power Project Development Process and Siting Considerations

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The 6 Key Elements of a Successful Wind Project

• Wind – 1 mph difference is make or break
• Land – need willing landowners
• Permits – wildlife and NIMBY issues
• Transmission (capacity and proximity)
• Buyer (Power Purchase Agreement)
• Financing – need all 5 above to get it
6 Key Elements

• Need **ALL** 6 elements to build a project
• The lack of any **one** kills a project
• Unlike natural gas, coal or nuclear power plants, we can not transport our “fuel” (wind) to a desirable location – we have to go to where the resource is
• Rate of return is set by capital markets- it is not a question of “how much can we make?” but rather, “can this project get built?”
The sequence of evaluating each element varies by site, but often the order is:

- Wind – evaluate the resource
- Land – are landowners interested?
- Permits – initial review of permitting issues
- Transmission – capacity; cost
- Buyer – general market; specific buyer(s)
- Financing – based on all of the above
• At early stages of a project, confidentiality is a very real business issue for us
  – Agencies subject to FOIA/state sunshine laws
  – Fierce competition for best sites and land
  – Until you know you plan to proceed with developing a site, don’t want to waste scarce time and resources debating potential impact questions

• Cause of great deal of miscommunication and mistrust between developers and wildlife agencies/advocates.

• The closer to actually applying for permits, developer should be willing to discuss details
Key Siting Considerations

- **Wind** - is the most absolute requirement –
  - Energy is function of cube of wind speed
  - Avg. wind speeds of 16-19 mph in most areas
  - At higher altitudes, air density drops - requires a higher wind speed for same output
  - Depends on region’s market price for power
  - No mitigation for low wind speed!
Viability is very sensitive to wind speed.

Price versus wind:
- $110
- $82
- $64
- $51
- $41
- $34

Net capacity factor (%):
- 0
- 20
- 40
- 60
- 80
- 100

PPA price ($/MWh):
- 0
- 20
- 40
- 60
- 80
- 100
- 120

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Key Siting Considerations

• **Land** - Owners must be willing-
  – Can’t build without land.
  – Need large, contiguous parcels.
  – Compatible land uses - e.g. ranching, dry land (un-irrigated) agriculture, open space
  – Developers do **not** have power of eminent domain.
Key Siting Considerations

- **Transmission**
  - Typically connect to 115/230/345 kV lines
  - Must have capacity available
  - Feeder lines typically < 5 - 10 miles
  - Ability to finance feeder lines, upgrades depends on project size and economics. Bigger projects with better winds can afford longer feeder lines and more upgrades
  - Long feeder lines may be difficult and expensive to acquire and permit
Key Siting Considerations

- **Market** - Must have a buyer for power
  - Most, but not all, areas of the country have growing need for power
  - RPS and other policies drive demand
  - This typically dictates the region more than the individual site (i.e. ND vs. NY)
  - Closely related to transmission – who owns the lines, where do they go, etc.
Key Siting Considerations

• Permits and Environmental:
  – Wildlife impacts is typically the top issue
  – But- many issues and stakeholders to address—potentially conflicting interests to reconcile (e.g. wildlife, NIMBY, archeological)
  – Different agencies and advocates have different agendas and concerns
  – Developer has to strike a balance among all
Wind Project Siting Challenges/Hurdles

- Wind Industry
- Public
- Utilities/RPS
- Affected Land Owners
- Environmental Organizations
- Tribes

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Developers
Federal, State, Local Agencies

Indian Lands
Military
T&E Species
Wetlands
Noise
Visual
Radio Interference
Wilderness, Parks, Refuges, etc.
Avian/Bat
Cultural/Tribal Resources
Unwilling Landowners
Community/Political Sentiment
Constructability
Proximity to Load
Transmission
Buyer/PPA
Wind
What Else is Required?

- Site must be accessible – must be able to deliver and erect turbines over 400’ tall
- Need adequate level ground around each turbine site – crane pads, laydown areas
- Need adequate spacing between rows of turbines – 1/3 to ½ mile
Wind Energy Facilities and Construction Sequence
Project Facilities

- **Access Roads** – Gravel roads linking wind turbine strings to existing roads.

- **Electrical Collection System** – Cables that electrically connect wind turbines to the project substation.

- **Project Substation** – Steps up project generation to interconnection voltage.

- **Operations & Maintenance Building** – Houses central office, computer systems for facility operations, equipment storage and maintenance areas.
• Roads
• Foundation
• Wind Turbine Generator
  – Tower
  – Setting the generator
  – Rotor assembly
• Electrical Collector System
Road Construction

Grading
• Prepare road for construction

Drainage
• Install culverts, fords at drainage areas
Install Base Material:

- Place geo-fabric or Geo-Grid on top of compacted 16 to 20 foot wide road sub-grade.
- Place 6 to 8 inches of gravel over road surface.
- Finish road profile slightly above natural grade with a 2% crown in the center to promote drainage.
- Construct shoulders with a maximum of 2% side slope for crane travel (reclaimed after construction).
Tower Pier Foundation with Spreadfooter

- Footing: 50-80 ft diameter, 4ft depth with taper.
- Pier: 16-20 ft diameter, 3ft height.
- Apron: Compacted area over footing diameter with 6 in rock surface.

Construction:

- Excavation depth to ~8ft and +50ft base elevation.
- Mud Mat – 2 to 4 inches lean concrete.
- Rebar cage and anchor bolts cage.
- Concrete (5000 psi) formed and poured in two lifts.
- Backfill with native soil
Tower Erection

• The 80-meter turbine tower is composed of four cylindrical steel sections.

• The four tower sections are typically unloaded adjacent to each wind turbine foundation to minimize handling of these heavy steel components.

• Each tower section weighs between 35 and 50 tons.
• The lower tower section is set first. A flange on the bottom of this 15’ diameter section allows it to be bolted to the top of the foundation pedestal.

• After the tower sections are set, the nacelle is raised and bolted to the top of the tower.

• A 2 megawatt class turbine nacelle weighs over 100 tons.
Tower Erection

- The rotor assembly is erected last.
- The rotor consists of three blades and a hub that mount on the front of the nacelle.
- Typically, the blades and hub are assembled on the ground and then raised as a single unit, called the rotor, and attached to the nacelle.
Collector Cable Construction
Collector Substation
Collector Substation
O&M Building
Mounting the FAA Light

Bracket Assembly Schedule (Top->Down):
- FAA Light
- Bolts, Nuts, Washers – Light to Bracket
- Bracket
- Sikaflex Bed
- Bolts, Washers – Bracket to Nacelle

Installation Notes:

Preferred Mounting Location

Mounting Locations

Sikaflex plugs (to be removed)