Low-tech Solutions:

Simple & Effective Basics of Minimization

NW Wind Energy and Wildlife Workshop
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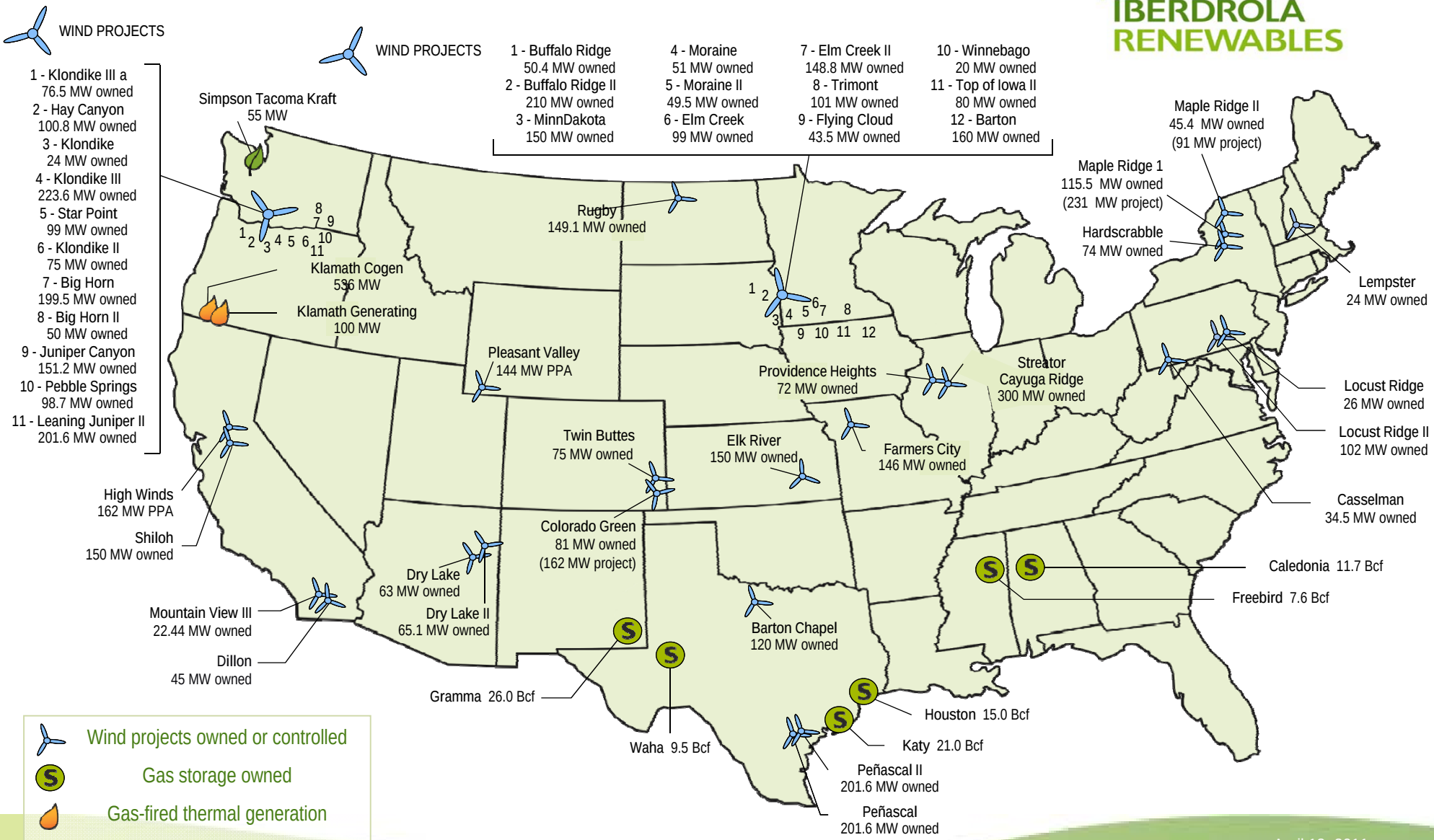
Agenda

- Our Environmental Standards
- Wind 101: Key Elements of Wind Energy Development
- Low-tech solutions
  - Fatal Flaw Review and Macrositing
  - Early agency consultation
  - Pre-construction surveys
  - Permitting/Mitigation Planning
  - Micrositing
  - Training/Compliance
  - Post-construction Follow-up
  - Collaborative Studies
- Lessons Learned

US Asset Portfolio



Development of the Avian and Bat Protection Policy

- Drafted over 1/2008 to 10/2008 period
- Began with “translation” of ABPP guidelines
- Internal team included development, operations, asset management, EHS, and legal
- USFWS review team included Ecological Services, Law Enforcement, and field staff
- Adopted the policy in October 2008
- Expect to update once USFWS Guidelines are revised; then revisit regularly

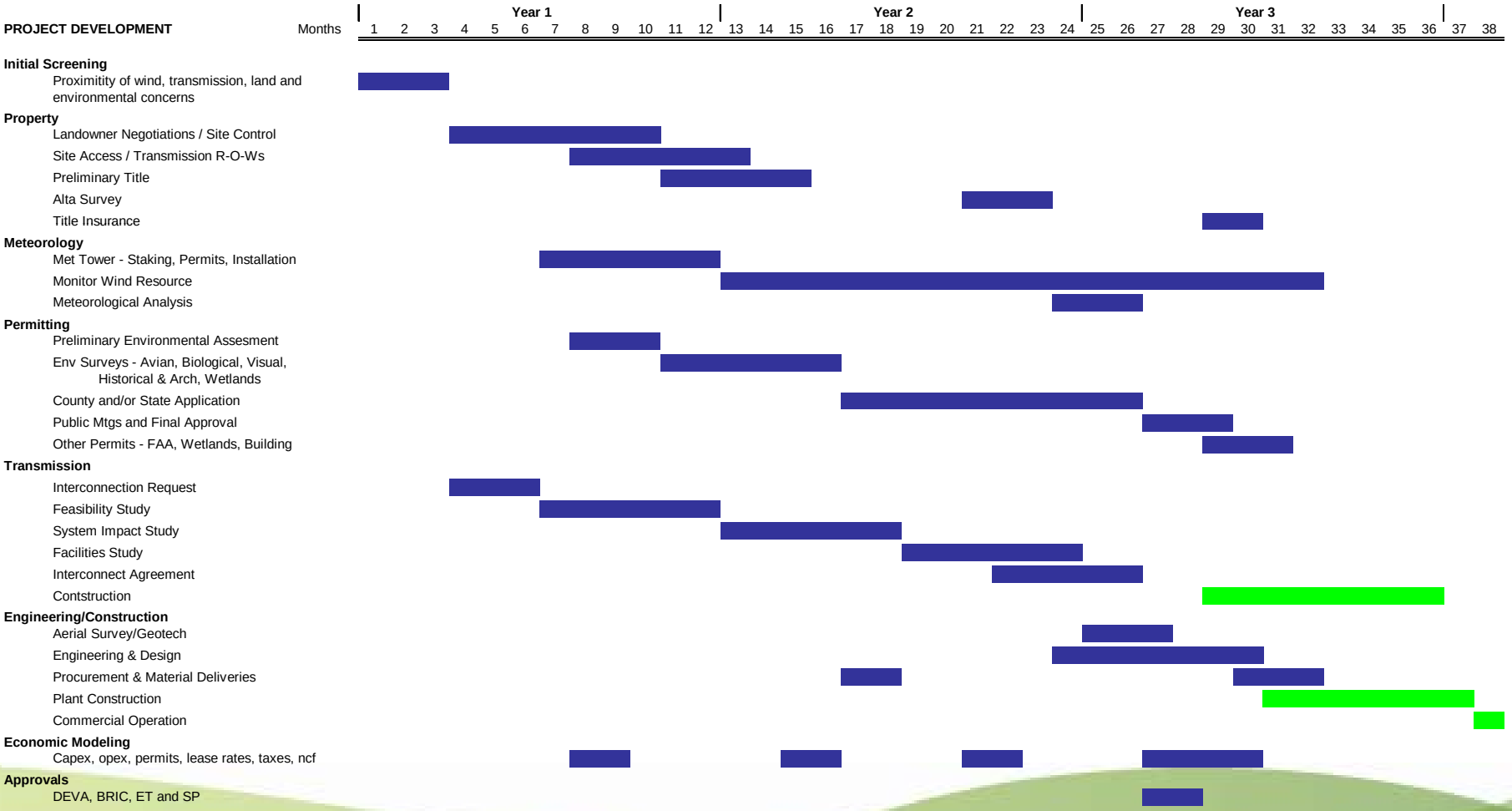
Environmental Leader – Thinking of the Long-Term

- Industry representative to USFWS Federal Advisory Committee
- Founding member of Bats and Wind Energy Cooperative
- Site volunteer for BWEC and BCI research
- Founding member of American Wind and Wildlife Institute
- First wind industry Avian and Bat Protection Policy
- First wind industry member of APLIC

Key Elements of Wind Energy Development

- Market
- Wind
- Transmission Access (capacity, cost, ability to deliver to customer)
- Land – community interest and constructability
- Minimal Environmental Impacts and Permitting issues
- Financing – need 5 above to get funding either from investors or company board

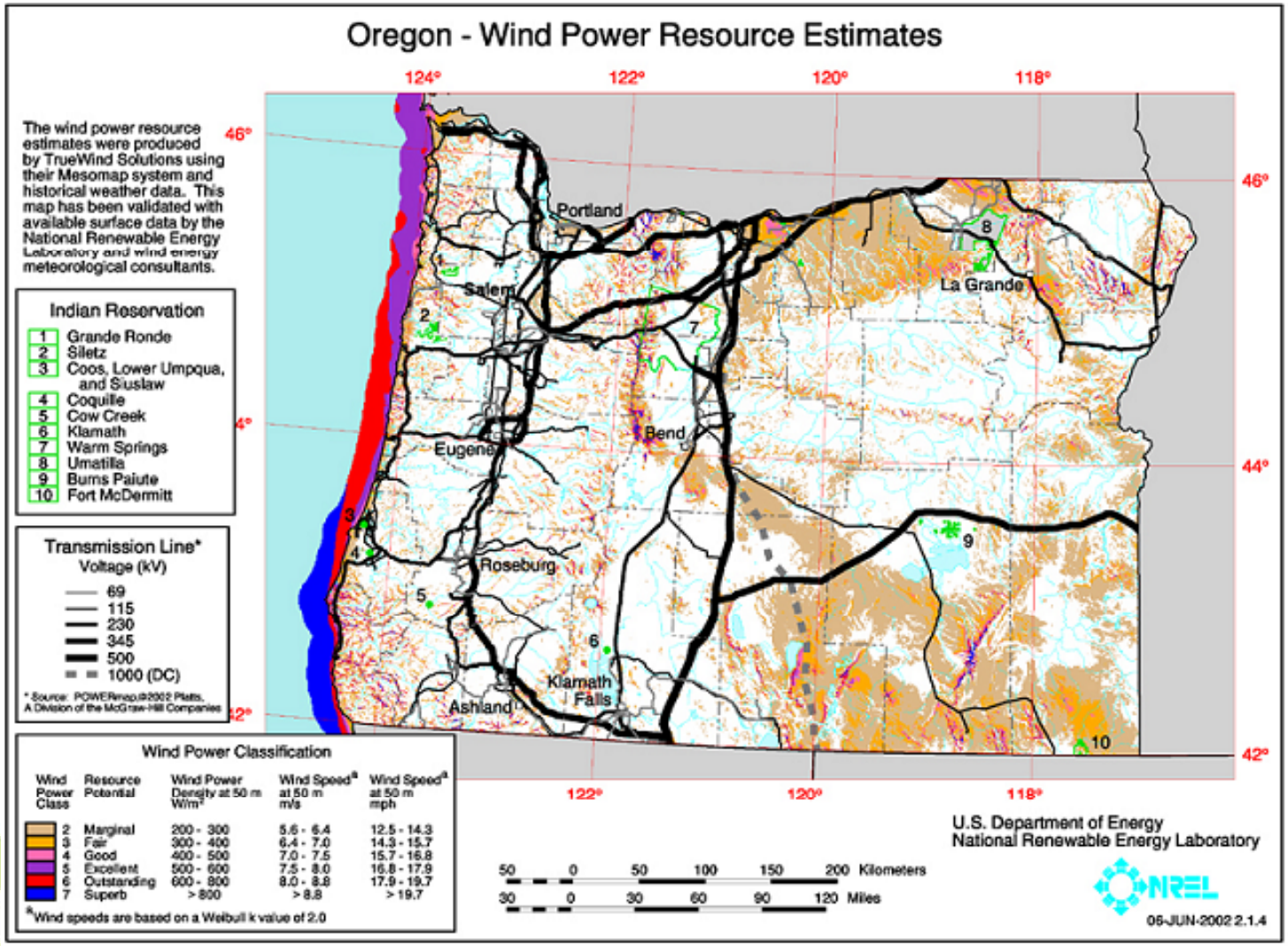
Development Process



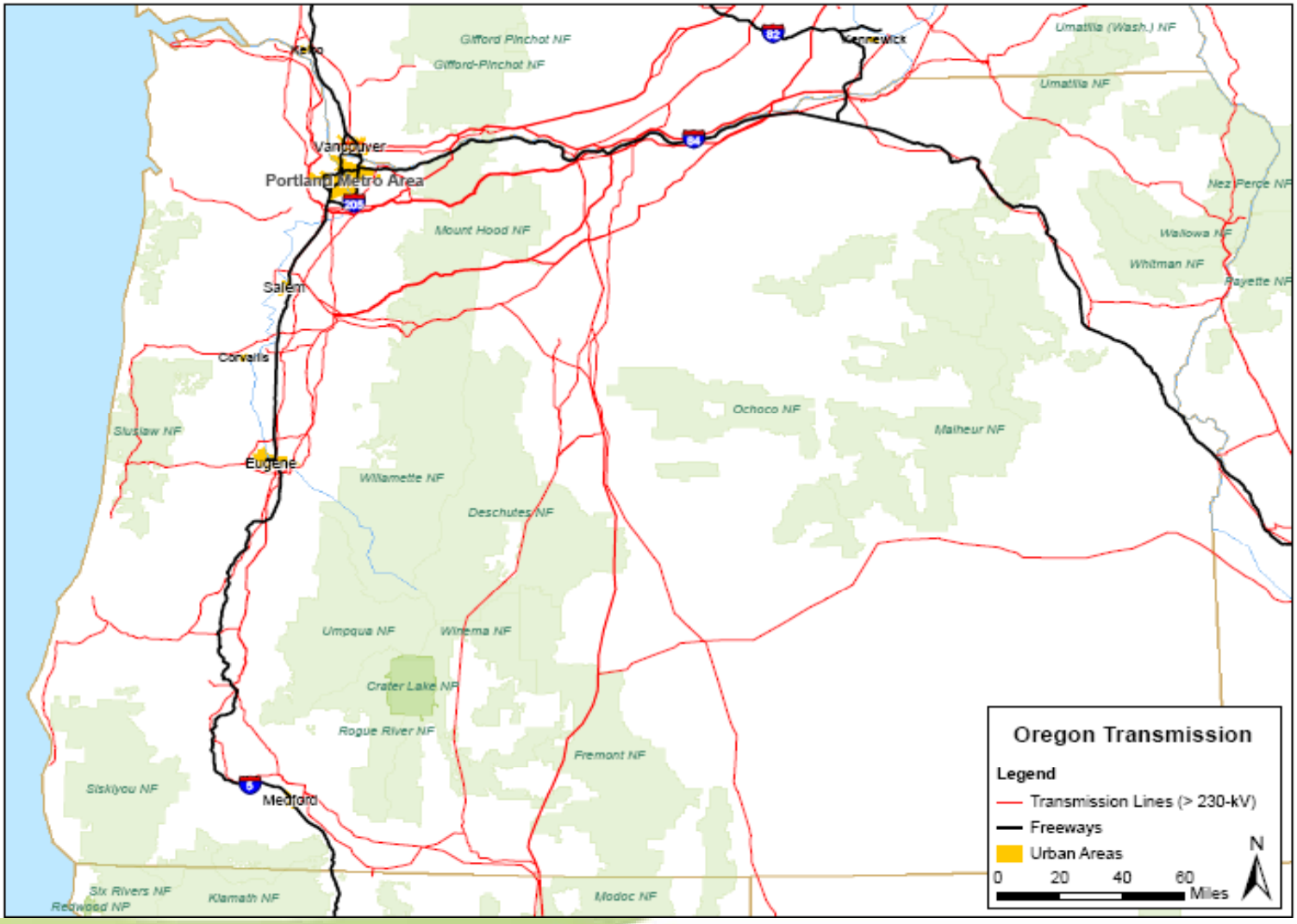
Market

- **Must have a buyer for power**
  - Customer need/interest drives development
  - Load, State RPS and other policies drive demand
  - Most projects in Pacific Northwest are owned by a utility (for ex Biglow Canyon is owned by PGE) or sell their power under a Power Purchase Agreement (for ex, Klondike III/IIIA is sold to EWEB, BPA, PSE and PG&E)
  - Without a long term buyer, most developers are not willing to invest the capital costs to purchase turbines or start construction

Best Wind Resources



Transmission Access



Landowner Interest

- Discuss Project With Land Owners
- Evaluate site for constructability
- Negotiate and Finalize Leases
- Negotiate and Finalize Easements
- Gather Landowner Input on Project (O&M building, substation, Micrositing of Turbines, Roads, Collectors, Transmission Lines, Laydown Areas)
- Estimate construction costs

Participating landowners at Klondike II Project

Low Tech Solutions to Avoiding and Minimizing Environmental Impacts

- Fatal Flaw Review and Macrositing
- Early agency consultation
- Pre-construction surveys
- Permitting/Mitigation Planning
- Micrositing
- Training/Compliance
- Post-construction Follow-up
- Collaborative Studies

Fatal Flaw Review and Macrositing

- Fatal Flaw Review
  - Review land use, habitat types, sensitive species, proximity to parks, TNC areas, IBAs, etc.
  - Review regulatory requirements and scope out potential issues with resource agencies and permitting authorities
- Chose sites with fewer environmental issues and other five key elements to development - and community support
- Stakeholders and stakeholders/agencies often have conflicting interests. Other areas of concern to stakeholders: minimizing impacts to farm land (i.e. Goal 3/Dept of Ag), visibility of project (i.e. Goal 5), sound, archeological resources (i.e. Oregon Trail), etc.

Early and Continual Agency Consultation

- Maintain open communication with resource agencies and stakeholders
  - Understand priority resource areas
  - Discuss big picture development plans without sharing confidential project info subject to FOIA
- Use agency approved survey protocols and consult with agencies regarding potential additional studies for unique site specific characteristics
- Conduct a Site Visit
- Continue to consult with agencies throughout process (permitting, construction and operations)

Pre-Construction Surveys

Set objectives

- Predict potential impacts
- Identify ways to avoid, minimize and mitigate impacts
- Assess risk (low, medium, high)

Collect Quantitative Data

- Information Review
- Wildlife Habitat Mapping
- Avian and Bat Use Study
- Raptor Nest Surveys
- Multi-species pedestrian surveys
- Wetland/stream delineations

Permitting/Mitigation Planning

Submit a thorough permit application

- Agency input
- Known impacts from operating projects
- Pre-construction survey results
- Impact Assessment

Engage stakeholders throughout permitting process

- Develop ways to avoid and minimize impacts
- Develop restoration, habitat mitigation and wildlife monitoring plans with stakeholder involvement

Critical Issues When Developing Mitigation

Certainty in Operational Costs

- **Mitigation for Temporary and Permanent Impacts to Habitat**
  - Agencies concerned with viability of restoration of desert environments. Developers need certainty in terms of mitigation requirements and costs.
  - ODFW habitat mitigation policy requires no net loss of valuable native habitat.
  - Oregon Guidelines encourage development on land already used for cropland and recommend avoiding Category 1 and 2 habitats, and minimizing and mitigating for impacts to Category 3, 4 and 5 native habitat.

Critical Issues When Developing Mitigation

Certainty in Operational Costs, con't.

- **Mitigation for Avian/Bat Impacts**
  - Moving, altering or curtailing turbines post-construction adds uncertainty and risk to project. Tax equity investors are wary of these uncertainties.
  - IRI and others are currently conducting experiments to test effectiveness of curtailment for reducing bat mortality in locations in the Northeastern US where bat mortality has raised concerns.
  - Anticipated costs for habitat and wildlife mitigation are included in project capital and operational expenditure budgets prior to construction and disclosed to financial partners.
  - Un-anticipated costs during operation are in excess of allocated budgets and affect financial partners.

Micrositing

- Identify Constraints
  - Setbacks (from other projects, roads, houses, pipelines, beam paths, etc)
  - Sensitive environmental resources (wetlands, cultural/archeological sites, sensitive species)
- Revise Layout
  - Microsite layout to avoid constraints and minimize habitat and wildlife impacts.

Importance of Micrositing

Micrositing Corridors - Flexibility in Final Project Design

- Allows developer flexibility to continually fine tune the layout based on turbine type, up to date meteorological data, and sensitive areas
  - For example, with overhead (OH) vs. underground (UG) collector lines. Majority will be UG, but developer needs flexibility to place OH for following reasons:
    - Steep terrain where the use of backhoes and trenching machines infeasible or unsafe
    - Streams/wetlands where OH line avoids or minimizes environmental impacts
    - Soil with low thermal conductivity preventing adequate heat dissipation from the conductor, and rocky conditions that significantly increase trenching costs
- Defines the range of possible wind facility impacts and demonstrates that in all potential configurations, the facility will meet applicable regulatory standards
- Allows agencies to evaluate “worst-case” project impacts (for ex, Agencies review max # miles of UG and OH)

Training/Compliance

- Develop protection measures
  - Constraints mapping/training
  - Flagging
  - Construction monitoring
- Education
  - Conduct several trainings before and during construction with construction teams to review permit conditions, constraints, sensitive wildlife and other environmental concerns.
- Follow-up
  - Restore areas temporarily disturbed during construction with native vegetation.

Post-construction Follow-up

- Conduct post-construction site visits with agencies
- Revegetation Plan - Restore areas temporarily disturbed during construction with native vegetation
- Habitat Mitigation Plan - Set up a conservation easement in native habitat to offset impacts to wildlife habitat.
- Wildlife Mitigation and Monitoring Plan – Conduct formal avian and bat fatality and wildlife monitoring
- Train operations staff to monitor site for avian and bat fatalities and respond to injured birds and bats.
- Maintain open communication with agencies.

Collaborative Studies

- Initiated sage grouse radio-collaring study with Horizon in WY; continuing GPC study in KS
- Two years of curtailment studies at Casselman, PA, as a tool to reduce bat mortality
- Two years of ultrasound bat deterrence field trials, at Locust Ridge, PA
- Other bat risk assessment studies in CA, PA, and WVA
- Experimental use of Merlin radar and curtailment to minimize risks to migratory birds on S. Texas coast
- Providing pre- and post-construction monitoring data to American Wind Wildlife Institute to facilitate development of Research Information System

Activities in OR

- Participated in OR and WA Task Forces to develop Wind Power Siting Guidelines
- Participating in Eagle Foundation, statewide golden eagle population survey
- Initiated County-wide Technical Advisory Committee in Gilliam County
- Coordinating with other developers on fatality monitoring
- Initiating bi-state mid-Columbia raptor nest study with ODFW, WDFW, Horizon, Invenergy, and PacifiCorp
- Conserving and enhancing native habitat for habitat mitigation sites
- Grassland nesting birds: pre- and post-construction monitoring of curlews to look at potential displacement
- WGS: pre and post-construction monitoring of to track population levels

Lessons Learned

- Open communication results in less surprises/hidden costs and more trust
- Pre-construction surveys enable developers to identify sensitive areas projects and avoid impacts through micrositing
- Fatality studies from existing wind facilities provide useful information about level of fatalities at macro-scale
- Avian Risk Assessment and avian use survey provide useful information on species composition and general relative level of avian risk compared to other sites.
- Collaborative studies help answer tough questions - about improving methods/metrics, cumulative impacts, displacement, sensitive species

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 collection substation.
- Project Collection Substation –Steps up voltage to interconnection level.
- Operations & Maintenance Building – Houses central office, computer systems for facility operations, equipment storage and maintenance areas.

Construction Sequence

- Construct Roads & Work Areas
- Excavate & Pour Foundations
- Install Wind Turbines
  - Erect Tower Sections
  - Set Nacelle
  - Assemble and Set Rotor
  - Connect Electrical Systems
- Install Electrical Collector System

Roads: Grading and Drainage

- Prepare road for construction
- Install culverts, fords at drainage areas

Roads: 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).

Foundation: Tower Pier 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 4-6 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
  - Backfilled with native soil

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Tower Erection

- The 80-meter turbine tower is composed of three to five cylindrical steel sections.
- The tower sections are typically unloaded adjacent to each wind turbine foundation to minimize handling of these heavy steel components.
- Each tower section typically weighs between 35 and 70 tons.

Tower Erection

- 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 90 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

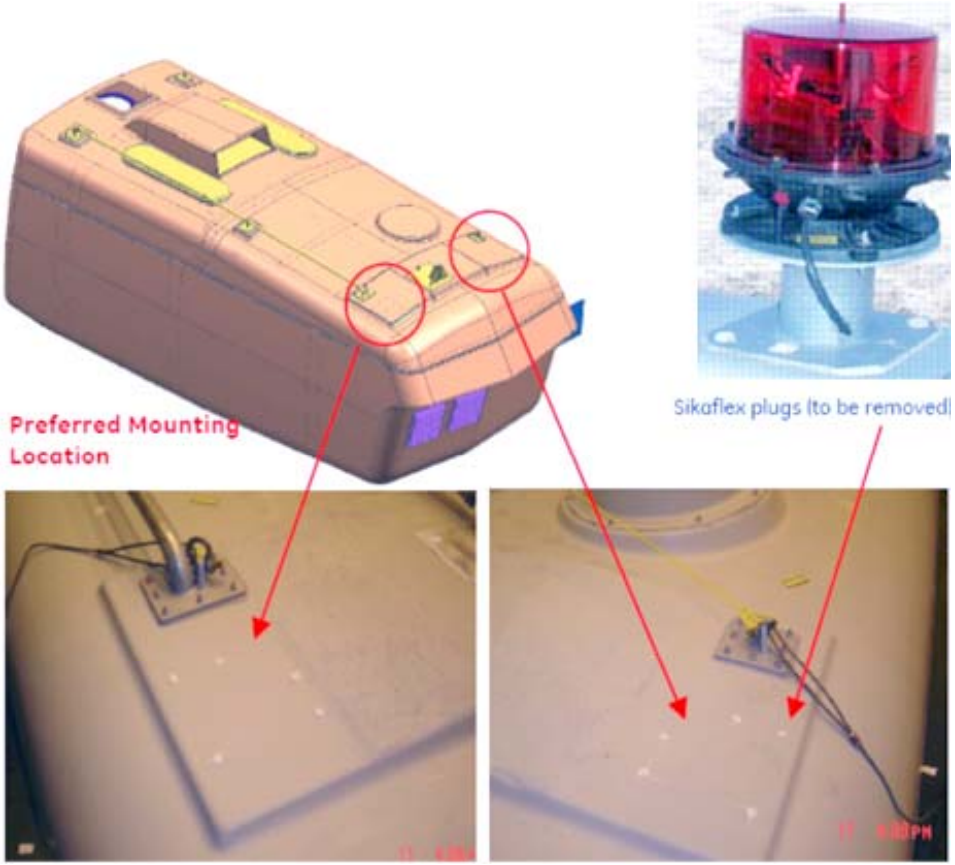
Collector Substation

Collector Substation Transformer

O&M Building

FAA Lights

- Red, synchronized flashing lights on ends of turbine strings and approximately every ½ mile
- Standard turbine finish serves as daylight marking—no day-time lighting needed



Thank You!

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