

An Update on Wind Energy Research at Marshall University



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October 19, 2010

Photo courtesy of Dave Saville



DOE Research

Market Impact Issues:

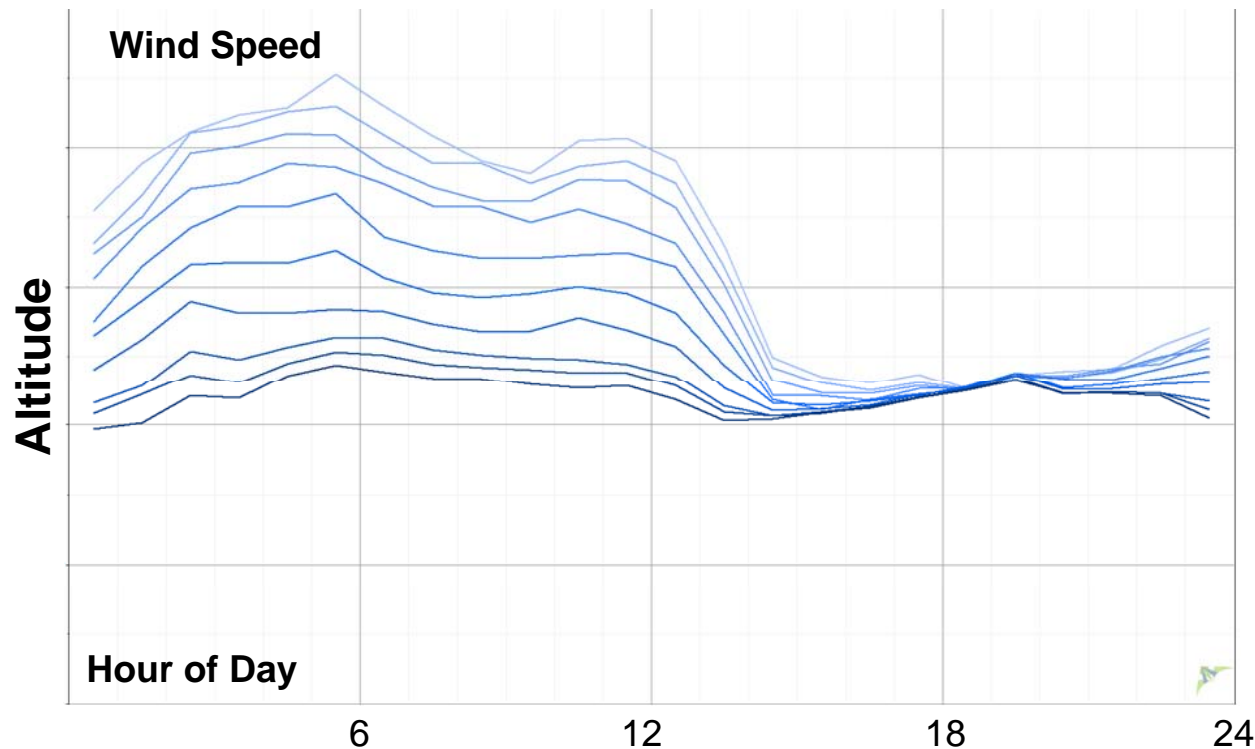
- Recommendations to efficiently integrate large quantities of wind generation, focusing on our region
- Siting Requirements – Are state policies affecting the rate of development? (WA & OR vs. PA & WV)
- Property Values – Can we say whether or how they are affected.
- Assess wind speeds on surface-mined land in WV (with MU CEGAS)



Wind and Wind Behavior in PJM

- Wind is about 2% of installed MW
- Wind levels have not impacted the need for reserves, yet

A Common Diurnal Wind Trend



2009 Capacity

| PJM State | Nameplate MW |
|-----------|--------------|
| DE | 2 |
| IL | 1,608 |
| IN | 649 |
| NJ | 9 |
| OH | 7 |
| PA | 680 |
| WV | 330 |
| Total | 3,286 |

- High-speed wind patterns are opposite of human electricity demand

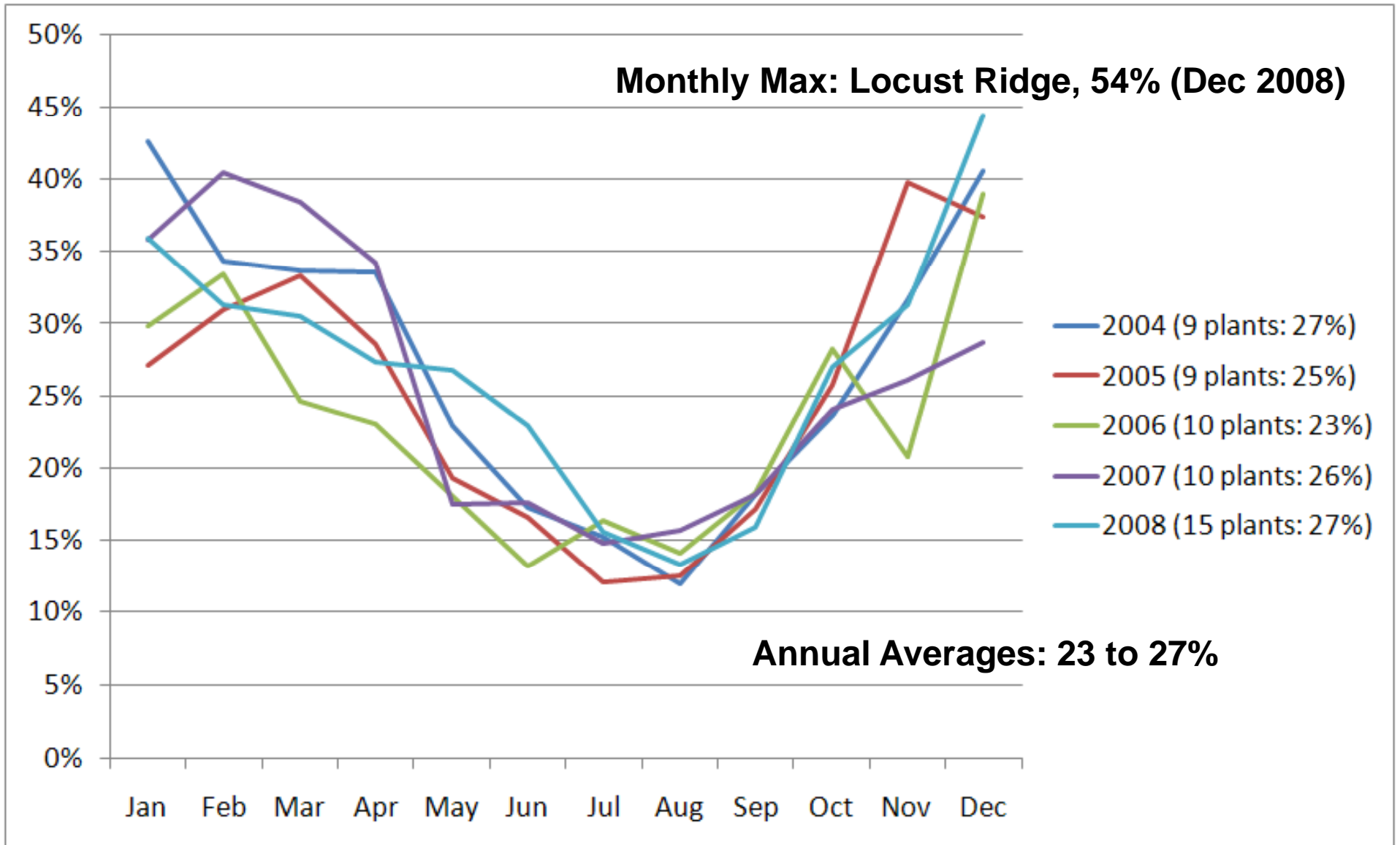


Fri Oct 15 and Sun Oct 17, 2010

| Time | PJM Load (MW) | Wind Output (MW) | Wind as % of Load |
|--------------------------------|---------------|------------------|-------------------|
| Friday October 15, 2010 | | | |
| 2:23 am | 56,709 | 3,110 | 5.5% |
| 7:53 am | 74,304 | 2,446 | 3.3% |
| 12:20 pm | 75,717 | 1,131 | 1.5% |
| 4:40 pm | 72,653 | 1,154 | 1.5% |
| | | | |
| Sunday October 17, 2010 | | | |
| 9:40 am | 64,288 | 1,286 | 2.0% |
| 1:40 pm | 64,625 | 741 | 1.1% |
| 5:40 pm | 66,035 | 579 | 0.9% |
| 9:40 pm | 67,820 | 977 | 1.4% |
| 1:40 am | 54,322 | 787 | 1.4% |



Wind Generation Trends (PA, WV & NY) - Actual Capacity Factors





General Recommendations to Maximize System Efficiency at Wind Grows

 **Doing?**

- 1) Wind forecasting and integration of that information. ✓
- 2) Consolidation of balancing areas ✓
- 3) Use intra-hour markets (flexibility) ✓
- 4) Create supplementary markets with services or protocols to ramp supply up or down. ✓
- 5) Expand markets for demand response. ✓
- 6) Develop more energy storage. ✓
- 7) Expand transmission. ✓

Efficient integration is technically feasible according to many, including: USDOE, Carnegie-Mellon, NERC



What is PJM Doing to Integrate Wind?



- Gives wind capacity credit (at 13%)
- Allows wind to be a capacity resource by choice
- Allows wind farms to submit negative offers
- Have eliminated penalties for generation differing from schedule
- Developing a **Wind Farm Communication Model Strawman** to manage wind in real-time (outage data, curtailment ability, meteorological data)
- Are developing **light load planning criteria** from a reliability perspective – some contention, market for curtailment?
- **Energy Resource Curtailment Initiative** – for resources that aren't capacity resources. If no CIR, eco min = 0 MW.
- A **PJM Wind Integration Study** will be completed in 2012
- Will probably adopt any NERC recommendations from the IVGTF (e.g. use of EUE - Expected Unserved Energy - instead of LOLP/LOLE)



Initial Integration Questions

- What is the impact of wind plant generation on fossil plant fuel input? **It varies. Average daily coal MW displaced in PJM is between 240 and 370 MW (max in shoulder hours); average natural gas is 30 to 90 MW (max in peak hours).**
- How much can/do fossil plants ramp down/up when the wind blows/stops blowing? **It varies. STs less, GTs more. Large-scale wind ramping is fairly slow.**
- How much additional system reserves are required to balance wind capacity on the system? **None in PJM (yet). It is not necessary to install a MW of coal for every MW of wind.**
- How is PJM different from Texas? **Can easily assign costs of new transmission to load.**



Details for Report

- Situation in WA with Bonneville Power Authority
 - As of October 2009, wind reserve needs surpassed reserve needs for load in BPA. Solution protocol: wind curtailment when under-generation by wind causes a reserve to be over deployed (curtail to schedule)
 - In March 2010, wind was **50%** of load served by BPA.
- NERC Final Report recommendations
- Summary of unique recommendations from other ISOs, power pools, public service commissions, etc.



Aspects of State-Imposed Siting

Large differences by state and within states:

One-stop shopping with a central authority: can simplify the process (in VA have to get more than 3 permits)

Local wind ordinances: can promote (guidelines for acceptance) or restrict (height restrictions);

Length of time to review a permit (state-run processes can be quicker than local)

Formal land-use guidelines at the local level: absence of guidelines and zoning can lead to high levels of installations (Somerset County); some basic criteria such as distance setbacks can reduce uncertainty

The state-level differences apply to all energy facility siting.

Local involvement is just as important.

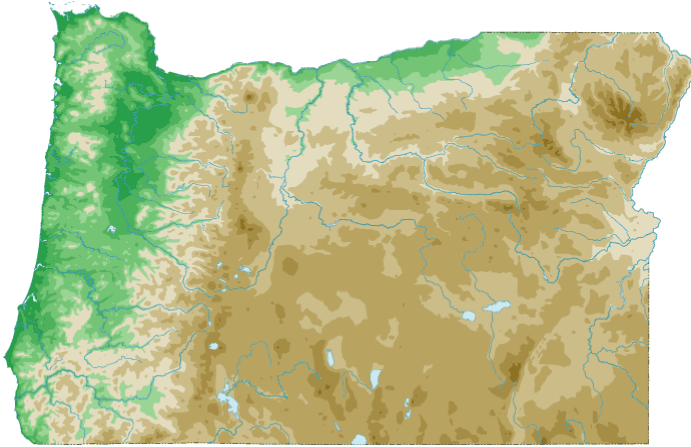


Siting Requirements

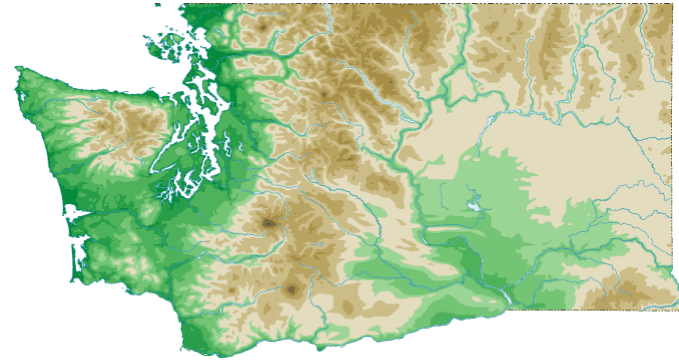
- Is there a State Authority for Wind Siting? Can it preempt local decisions? **It varies by state, but it doesn't appear to be a primary driver of installations.**
- Are there formal land use guidelines at the local level? Must get a local approval? **Usually not, but local approval is very important.**
- How complicated is the application process? **Even states with a “simplified” approach have fairly complex requirements.**
- Does conditional permit approval cause delays? **Maybe**
- Is the “simplified” approach used by WA & OR better? **Maybe, but it probably doesn't impact the level of installations.**
- Is Appalachia different? – **Goodness, yes.**



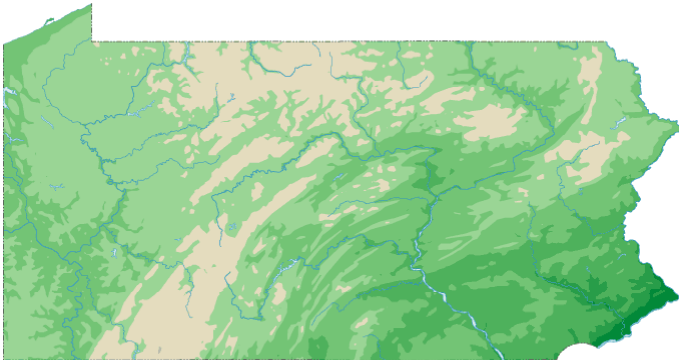
Comparisons



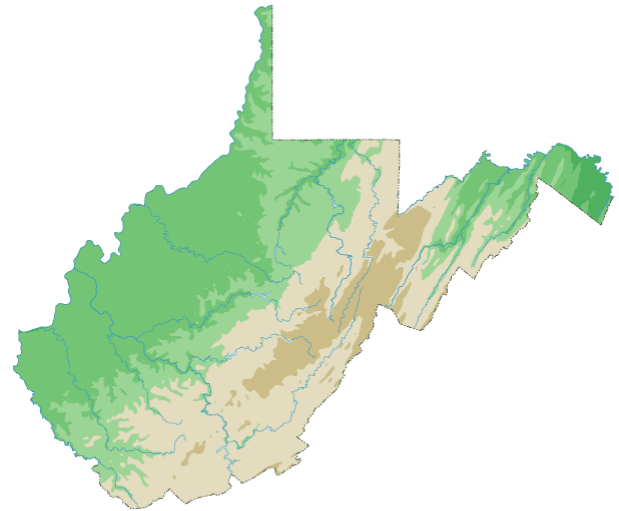
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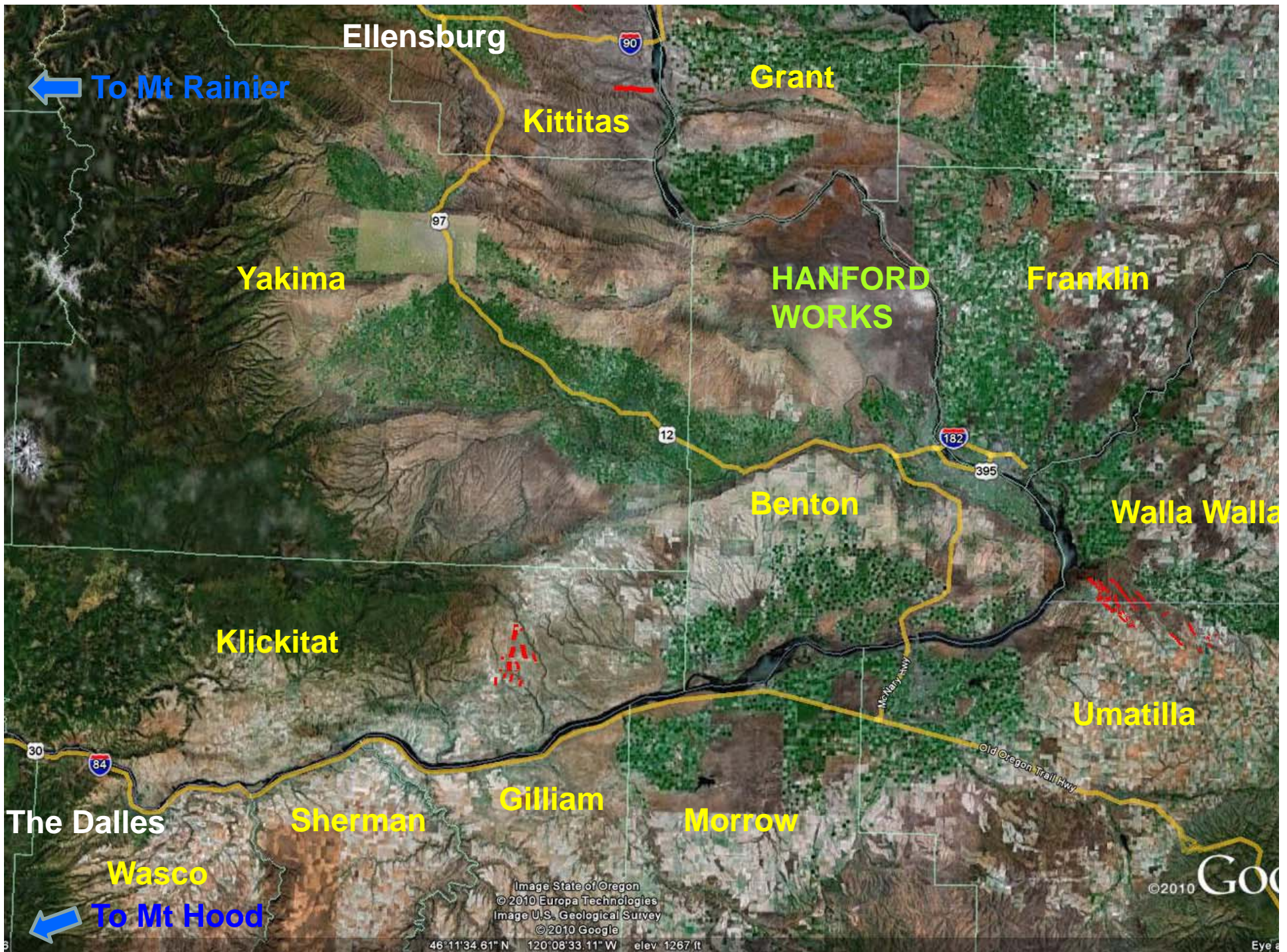


VS.



&





Ellensburg

Grant

Kittitas

Yakima

HANFORD
WORKS

Franklin

Benton

Walla Walla

Klickitat

Umatilla

The Dalles

Sherman

Gilliam

Morrow

Wasco

To Mt Hood

Image State of Oregon
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46°11'34.61" N 120°08'33.11" W elev 1267 ft

Eye a



Another Angle

| State | Actual MW (2009) | Potential Installed MW | Windy Land Area (km ²) | Available Windy Land Area | Actual as % of Potential | KW/ sq mi | KW/ km ² windy area |
|---------------|------------------|------------------------|------------------------------------|---------------------------|--------------------------|-----------|--------------------------------|
| Washington | 1,849 | 18,479 | 11,933 | 2.1% | 10.0% | 28 | 155 |
| Oregon | 1,758 | 27,100 | 17,110 | 2.2% | 6.5% | 18 | 103 |
| New York | 1,274 | 25,781 | 17,706 | 4.1% | 4.9% | 27 | 72 |
| Pennsylvania | 748 | 3,307 | 2,124 | 0.6% | 22.6% | 17 | 352 |
| West Virginia | 330 | 1,883 | 1,495 | 0.6% | 17.5% | 14 | 221 |
| Maine | 175 | 11,251 | 6,027 | 2.7% | 1.6% | 6 | 29 |

AWS TrueWind and NREL for potential capacity and windy land area.

- 78% of windy area in West Virginia is excluded
- Potential power is assumed to be 5 MW/km² but could be higher on a WV ridgetop



LBNL Property Value Study Data

| Area | # WTGs | Total # Homes Sold in Area | # Sold w/in 1 Mile of a WTG | # Sold 1-3 Miles | % w/in 3 Miles | % of WTGs in Study | % of Sold Homes in Study | # of Sold Homes with a Substantial or Extreme View | # of Sold Homes with a Minor or Moderate View |
|--------------|--------|----------------------------|-----------------------------|------------------|----------------|--------------------|--------------------------|--|---|
| IA/IL/WI | 515 | 2044 | 43 | 620 | 32% | 38% | 27% | 26 | 179 |
| PA/NY | 104 | 2201 | 61 | 387 | 20% | 8% | 30% | 13 | 197 |
| TX/OK | 144 | 2424 | 21 | 992 | 42% | 11% | 32% | 24 | 181 |
| WA/OR | 582 | 790 | 0 | 20 | 3% | 43% | 11% | 0 | 110 |
| Total | 1345 | 7459 | 125 | 2019 | | | | 63 | 667 |

PA/NY region had the smallest # of turbines in study but the greatest # of homes sold with a view of a turbine.

WV/OR region had the largest # of turbines in study but the fewest # of homes sold with a view of a turbine.



Social Differences

- Elected Officials: Maria Cantwell (D-WA) along with Susan Collins (R-ME) sponsored the Carbon Limits and Energy for America's Renewal (CLEAR) Act - upstream carbon cap
- RPS with no alternative provisions
- Utility organization and history of support for wind research in Oregon
- ...
- “Contextual factors are the existing natural resource, economic, environmental, and social conditions that set the stage for renewable energy development.” – NREL study



Property Values

- Still a paucity of data to describe the scene within one or two miles of turbines; can't expect either positive or negative impact.
- Can't promise that no negative impact will occur.
- Logical to assume that if a negative impact occurs it is more likely with closer proximity (viewshed or sound).
- Ben Hoen/Ryan Wiser study final.
 - No pervasive evidence of consistent negative impacts, even within one mile of turbines, but only 125 transactions analyzed in 9 states (61 of 125 in PA/NY).
 - Sound evidence that no negative impacts occur in aggregate within a 4-mile radius.
- U.K. studies by Sims/Dent useful (proximity based) – found that existing stigmas complicate analysis



Property Values II

- Evidence from High-Voltage transmission lines (HVTLs) shows view and proximity matter, but value diminution is not a systematic trend and is often temporary (up to 10 years)
 - Properties that may be more affected: custom homes, those in “scenic” areas, homes next to poorly maintained properties, those with a good view of tower/turbine, non-participating properties, properties sold after facility announcement but before actual construction
- Impact on viewshed can be minimized with careful micro-siting

Next Step:

- Summary document to the Council - “FINDINGS ON THE IMPACT OF WIND TURBINES ON RESIDENTIAL PROPERTY VALUES: A Reference Guide as of 2010”



THANK YOU