



Idaho National Laboratory

# DOD Wind Integration

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**Idaho National Laboratory**

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# Renewable Energy Program at INL

- **Who are we?**
- **Why am I here?**
- **Regional Resource Assessment**
- **Military lands can support large wind farms**
- **Focus Areas**
  - **Renewable Energy Assessments**
  - **Increased integration**
  - **Demonstration Projects**
    - **Wind, Solar, Hybrid, Geothermal, and others**
  - **Anemometer Programs**
  - **Wind Radar Interaction**
  - **DOD renewable installations**



# Goals for Today!

- Why Wind
- Understand your resource
- Know your alternates
- Integration
- Know and overcome issues
  - Mission
  - Radar
  - Training, etc
- Windy Bases, some examples
- ***Your Goals?***

# Why Wind?

- **With the rising cost of energy the military is turning towards alternative energy sources to reduce the dependency on fossil fuels.**
- **Executive orders are aggressive and drive wind as lowest cost and quickest to market.**
- **The Military complex has both the need and opportunity to efficiently transition itself from fossil to energy alternatives.**
- **Forward base and remote operations have greatest savings potential (both in lives and funds).**
- **Quick to build once permitting is complete.**

# Key Elements

- **Maximizing energy security within the military**
- **Discussing the use alternate fuels within the military**
- **Examine critical technical barriers**
- **Evaluating key strategies for successful integrating renewable Energy**
- **Choosing the best energy alternatives for individual military needs**

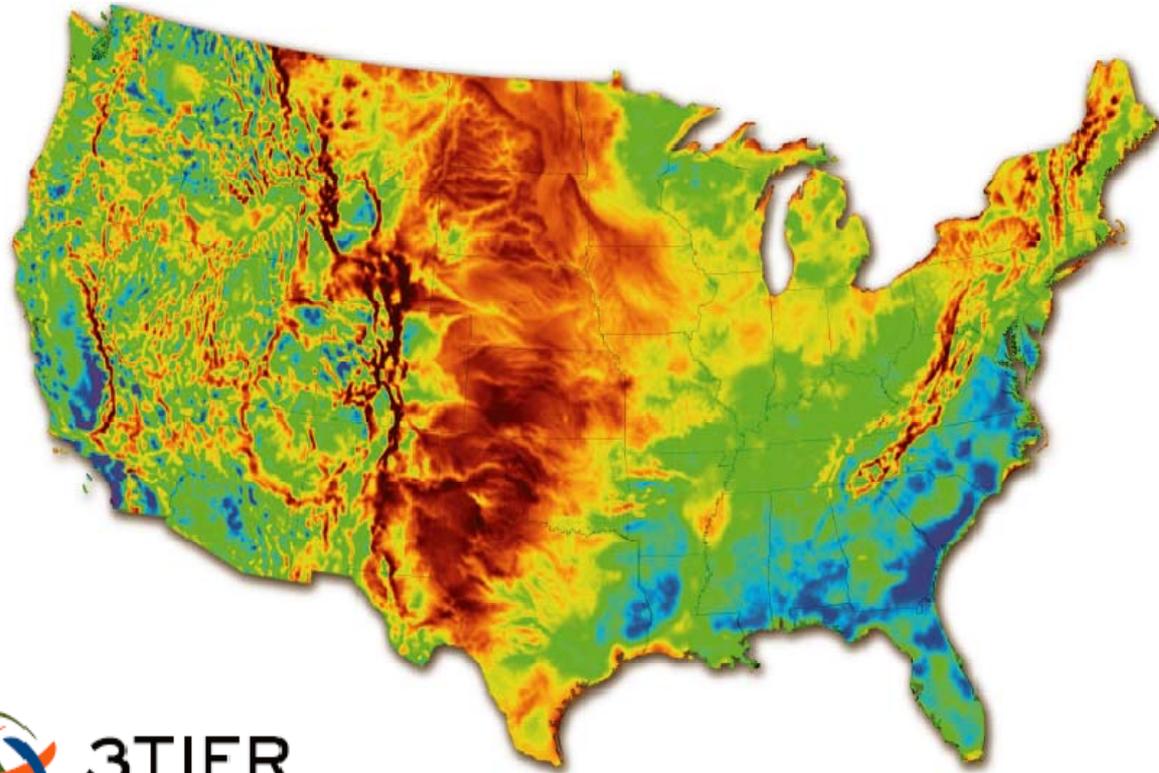
# Maximizing Energy Security

- **Reduce Fossil Fuel Dependence**
- **The high cost of logistics**
  - **In Dollars**
  - **And People!**
- **Even Small changes impact these issues significantly**

# Know Your Resource

- You **MUST** have a good understanding of your wind
- How?
  - Anemometer
    - Development grade Anemometer
    - Prospector towers
  - Local wind farms
  - Modeling
  - High Resolution State Maps
- Analyze and document
- Assess different technologies

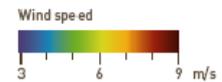
# Wind Resources – An Example



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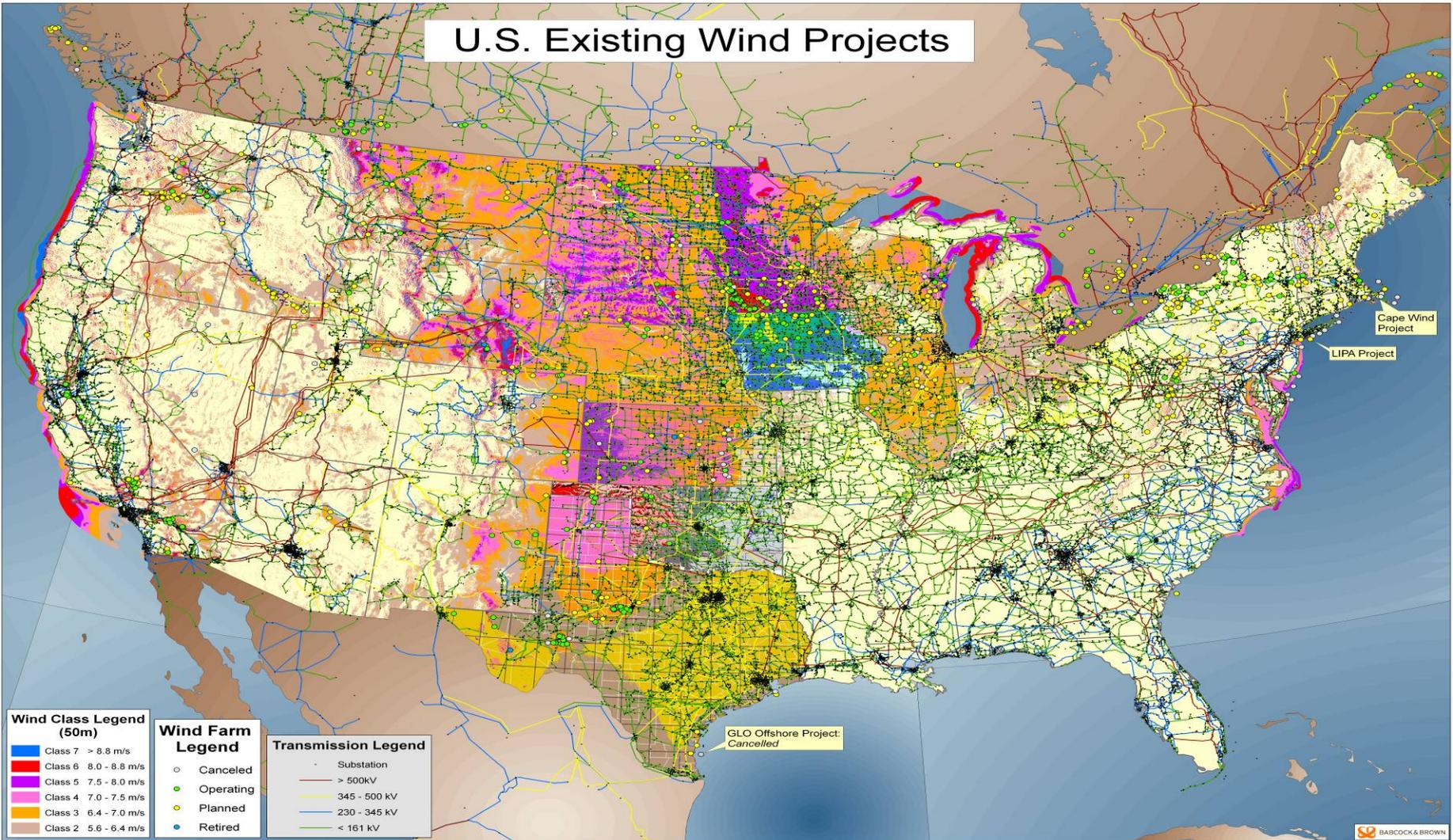
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5km Wind Map at 80m

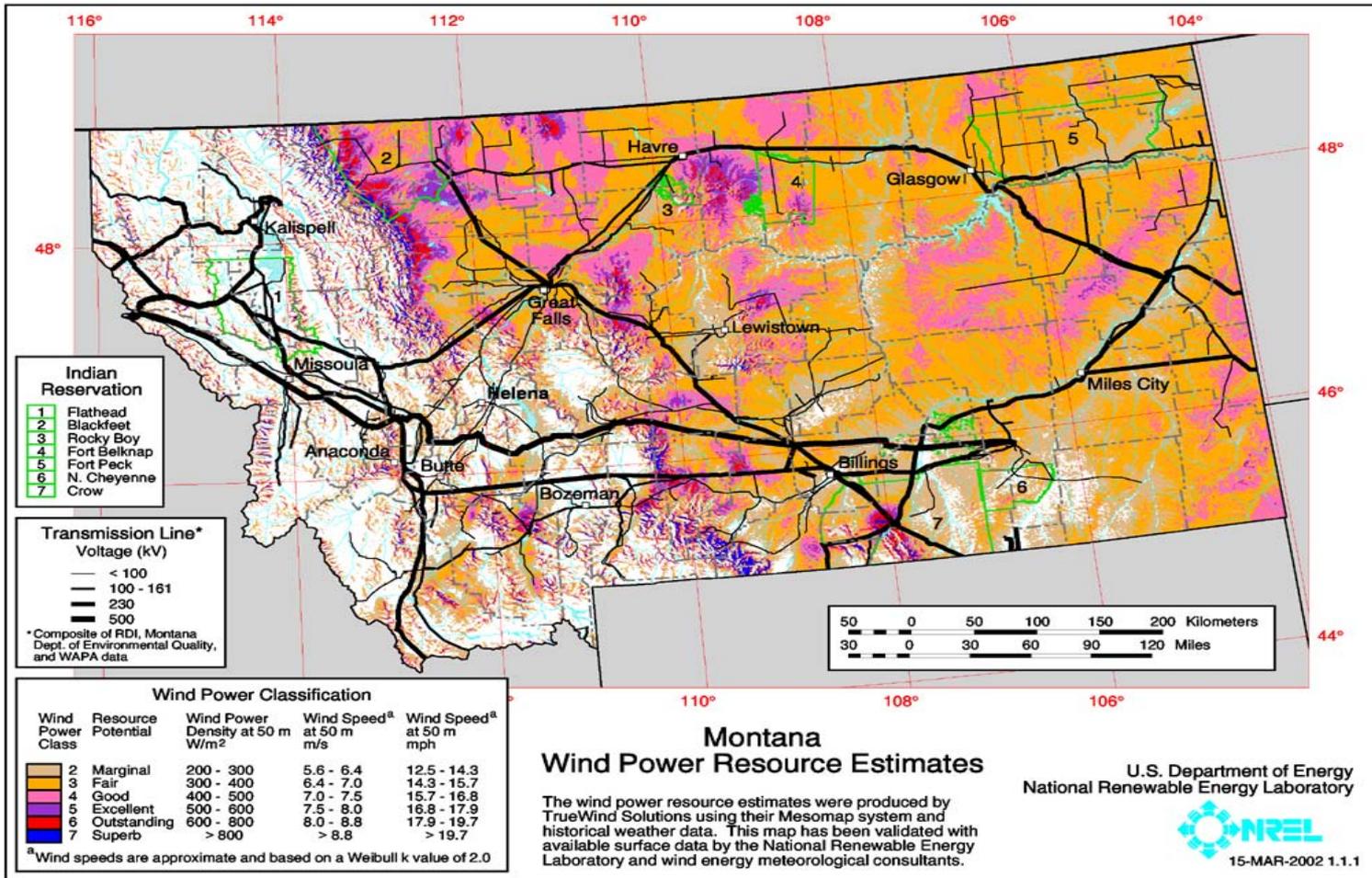


# POTENTIAL

## U.S. Existing Wind Projects



# Montana Wind





# Data Analysis Considerations

- **There are many factors to address in data analysis**
  - **Quality of data (any icing, etc.)**
  - **Is correlation with other sites possible**
  - **Elevation**
  - **Weather/temperature**
  - **Scaling to different heights (wind shear, turbulence)**
  - **Turbine sizes/types/manufacturers being considered**
  - **Where does the majority of the wind come from**

# Look like a windy area, What about your site?



# Another windy area



# Anemometer tower installation





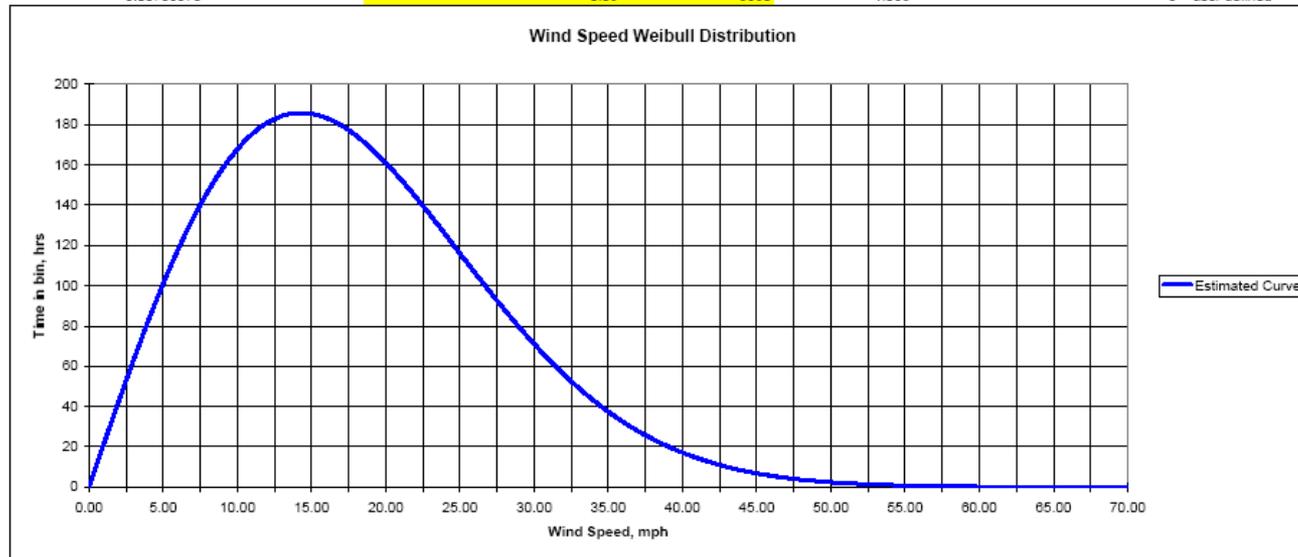
# Know your Resource

## Quality Wind Data is Important

- Your analysis should be based on collected data
- People's perception of "windy" is not good enough for a wind power project
- Difference between wind "prospecting" and development
- Collect initial data from multiple sources (i.e. talk to people, look for existing data, look at wind maps, use own experience, etc.)
- Look at lay of the land, prevailing wind direction, vegetation (flagged trees, etc.)
- Decide what type of wind data tower will work best for what you are planning (10 to 50 meters, number & type of instruments, cost, permits, etc.)

# An Example of INL Analysis Tools

shape alpha =	2	hours	scale beta (metric) =	Enter number to choose power curve:	1 = GE 1.5MW, 70.5m rotor, 1.225kg/m <sup>3</sup>
scale beta =	20.21324748	8760.00	9.035872812	6	2 = GE 1.5MW, 70.5m rotor, 1.12kg/m <sup>3</sup>
Enter Mean, in mph	Anemometer height, m	Total Gross Energy Production	Capacity factor		3 = GE 1.5MW, 70.5m rotor, 1.02kg/m <sup>3</sup>
15.40	30	5334345.649	40.5962%		4 = GE 1.5MW, 77m rotor, 1.225kg/m <sup>3</sup>
Scaled Mean, in mph	Scaled hub height, m	Estimated Wind Shear	Site Elevation (in feet)	Calculated Air Density average [kg/m <sup>3</sup> ], based on elevation	5 = GE 1.5MW, 77m rotor, 1.12kg/m <sup>3</sup>
17.91352417	80	0.09	5390	1.036	6 = GE 1.5MW, 77m rotor, 1.02kg/m <sup>3</sup>
Scaled Mean, in m/s					7 = user defined
8.00783376					8 = user defined



# Know Your Alternatives

- Big Wind?
- Small Wind?
- Virtual Wind?



# Wind Energy Comes in Different “Sizes”



**Small ( $\leq 10$  kW)**

Homes

Farms

Remote Applications

(e.g. water pumping,  
telecom sites,  
icemaking)



**Intermediate (10-250 kW)**

Cabin Power, Farm Power

Village Power, Hybrid Systems



**Large (250 kW – 3+ MW)**

Wind Farms

Utility Centric



## **Skyline Skystream 3.7**

### **INL's Teaming with Teachers Program**

**Why not use these at every windy DOD school?**

# The SkyStream 3.7, Why not at Windy Guard Stations



# Virtual Wind

- **What is Virtual Wind**
  - It is **NOT** a simulation
- **Rather, it is the generation of wind at the resource area and used by the base where you work and train**
- **Why Virtual?**
  - **State Regulations limit systems based on point of coupling and metering points**
  - **Separations into two systems introduces multiple contracts or restrictions**
- **Accept that virtual systems may make sense and are worth implementing**
- **But, accept that it may take additional effort or challenge the paradigms**

# Know and Overcome Issues

- **Issues**
  - **Mission**
  - **Wind Radar Interaction**
  - **Training Missions**
  - **Others**

# Mission

- **What is the mission?**
  - **Specific and open discussions recommended early in the process**
- **Is it compatible with wind energy?**
- **Examples of what may raise questions.**
  - **Low flights, Helicopter & UAV and ?**
  - **Ground Systems**
  - **Test and evaluate radar systems**
  - **Training pilots**
  - **Developing new weapons and flight systems**
- **Compatible with small or big wind**

# Wind Radar Interaction, Fact or Fiction?

## Overview

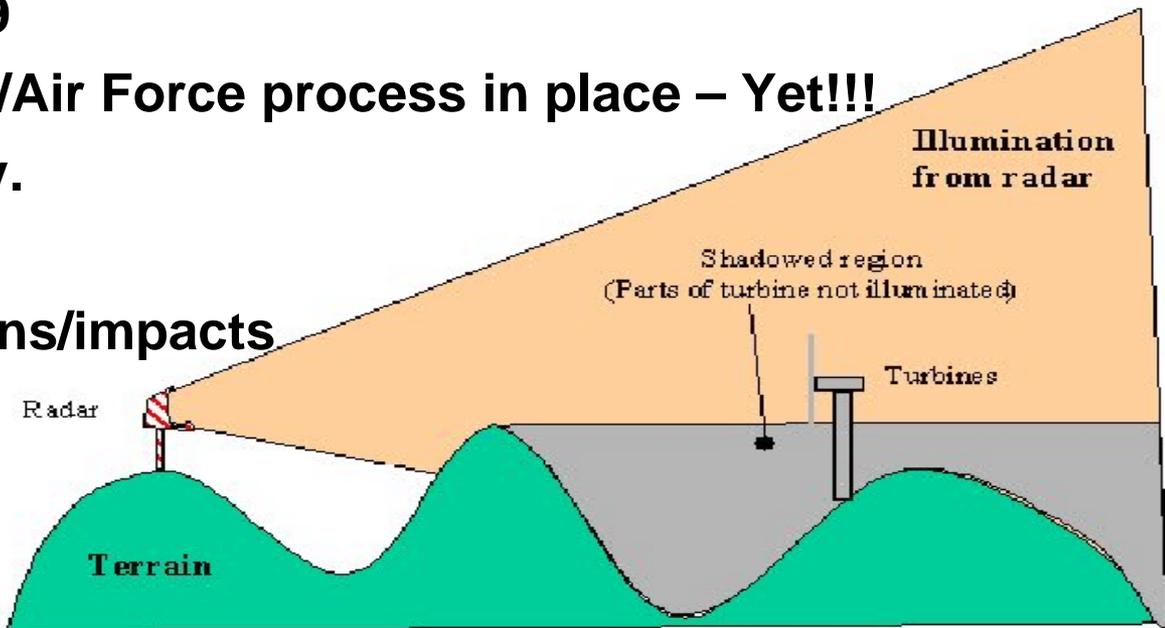
- Interference
  - What Kind
  - Direct or Doppler
  - Passive or Active
  - Shadows and Ghosts
  - Mission Impact
- Significance
- Mitigation



10/20/1998

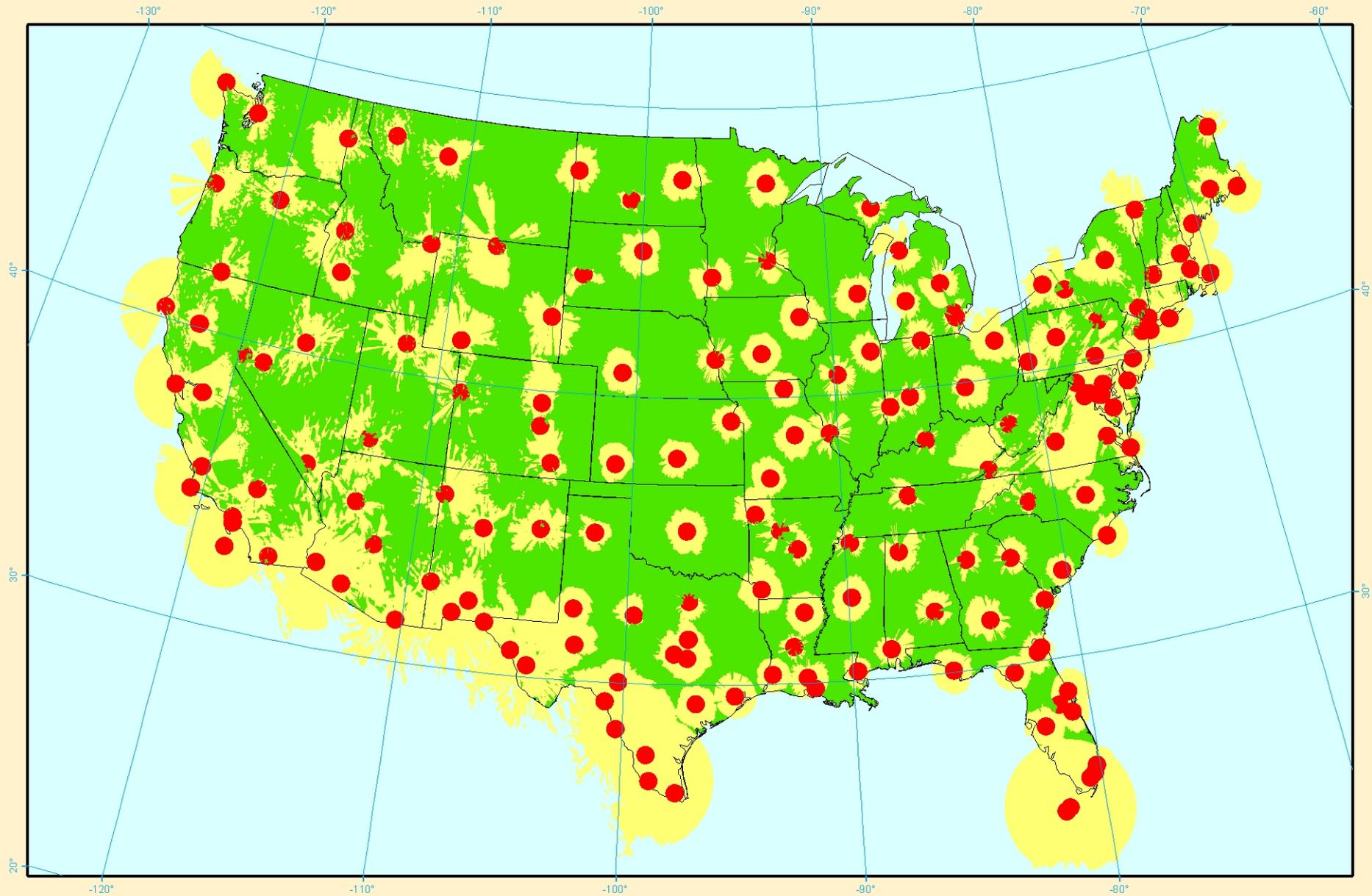
# Ongoing Activities, cont.

- Wind Radar – The next obstacle
- Mission and Radar system impacts - a valid concern
  - NTS project cancelled due to mission impact
  - Multiple radar interference impacts on UK projects
  - FAA has concerns when close to their radar systems
  - IEA hosted wind radar conference March, 2005 and November of 2009
  - No standard DOD/Air Force process in place – Yet!!!
- If in doubt, start early.
- Key guidance
  - Determine missions/impacts
  - Articulate
  - Quantify



# Wind Radar Interaction





**Legend**

- Potential Build Region
- Build Region
- Clipped\_20nmiBuffer

# United States Obstruction Build Map

Prepared by the 84th Rades  
Evaluation Squadron (ACC)  
Hill AFB, Utah  
06 February 2007



Source: ESRI Data & Maps CD  
Created in ArcGIS 9 using ArcMap



# Training Missions

- **DOD has many training missions**
  - **Examples where training missions may impact wind**
    - **Air training environments such as MOA's**
    - **Air borne weapons development and training**
    - **Ground based training**
    - **Helicopter training**
    - **Night operations**
  - **Start early and involve impacted agencies early**
    - **Avoid last minute impacts**

# Integration?

- **Identify Barriers?**
- **Integrate into base or portable systems**
  - **Do your homework**
  - **What is required?**
  - **What size?**
  - **What mitigations are needed?**
  - **Funding availability?**
  - **Environmental or other considerations?**

# Barriers

- **Durability**
- **Performance**
- **Cost (both infrastructure and operational costs)**
- **Maintainable?**
- **Portability (transportable?)**
- **Storage**
- **Breaking down paradigms**
  - **Change makes people uncomfortable**
  - **Logistics a challenge**
  - **Look at all of the alternative energy options**
  - **Assess real mission needs**

# Wind Energy Environmental Impacts

- **NEPA Process**
- **Air Emissions (None!)**
- **Avian Issues**
- **Visual Impact**
- **Noise**
- **Electromagnetic Interference**
- **Land Use**
- **Flora and Fauna**
- **Safety**

# Integration

- **Key renewable energy integration strategies;**
  - **Know your mission**
  - **Obtain local management support**
  - **Assess your resources**
  - **Run the numbers**
    - **Is it economical**
    - **Other costs**
    - **Know the escalation (future energy cost)**
    - **What kind of financing?**
    - **What is the Payoff?**

# Integration

- **Key renewable energy integration strategies cont;**
  - **Determine what procurement method will be used**
    - **This will also determine what kind of money you will use?**
    - **Milcon? ECIP? Operating Budget? Third Party? EUL?**

## **Design**

- **Either infrastructure and vehicles or power infrastructure**
- **Pick the right team that is willing to look outside the box and has the expertise to perform**
- **Use the design process to get local participation**
- **Permitting and/or power purchase?**

# Choosing What is Best for Your Needs

- **Know your options**
  - **Accept that change is OK**
  - **Determine what will best suit your needs**
    - **Both short term and long term**
    - **Remember that renewables have long term pricing, conventional is subject to the world market and inflation**
    - **What is your value on carbon management**
- **Get management buy in**
- **Make a plan and execute**
- **Enjoy the fruit of your efforts for years to come**
- **Small is OK**

# Windy Bases

- **A brief discussion on Wind follows**
- **Shows typical issues and questions that are and will be raised**
- **Illustrates some projects in progress or on line**
- **Wind is not the only system that works, It is just shown here to illustrate the issues.**

# Wind Power and DOD

- DOD is the single largest energy user in the USA
- This presents opportunity
- Executive Order 13123 requires energy efficiency and establishing renewable energy Goals
- The new requirements of the energy bill!
- Can they co-exist, wind turbines and the DOD?
  - Yes they can
  - They are, in remote locations
  - Now in Wyoming
    - FE Warren AFB
    - 2 Vestas 660 kW turbines
    - Gamesa 2.0 MW
  - Navy using Turbines in
    - Guantanamo Bay
    - San Clemente



# ECIP Activities

- **An active energy conservation and investment program (ECIP)**
- **Ongoing or completed projects**
  - Ascension Phase 1
  - Ascension Solar System
  - Ascension Phase 2
  - Grassmere Solar System
  - FE Warren Phase 1 & 2
  - Multiple Small Systems
- **Potential Sites**
  - Alaska Sites (Under construction)
  - Guam
  - Hawaii/Kaena Point
  - Ft Huachuca
  - Tooele (under construction)
  - Marine Reserve Bases
  - More to come



# Ongoing Activities

- **DOD renewable energy assessment report completed March, 2005**
  - **Included wind data collection**
  - **Identified potential wind resources on or near DOD facilities**
  - **Identified green energy procurement strategies**
  - **Identified a need for renewable energy on bases to enhance national security and reduce energy costs**
  - **Assessed all renewable energy systems, including wind**
  - **Provides an awareness, and a plan for future activities**
  - **Available on DOD web site**

# Is Wind Energy Practical?

- If you have a good wind resource
- If you have adequate acreage
- Will your local zoning ordinances or neighborhood covenants allow wind turbines?
- Can create long term revenue, taxes, and local jobs
- If there is easy access to electrical power lines for installations
- A long term investment!
- Remember, wind can easily integrate with energy storage to firm power
- If the mission can co-exist

# *Remote Challenges - Examples*



- Remote shipping
- Restricted shipping schedules
- Pier restrictions
- Limited Supplies
- Limited crane reach
  - Very short towers
- Limited access

# ***F E Warren AFB – Another Success***



- 2 MW Gamesa
- 2 x 660 kW Vestas turbines
- Averaging 1100 kW an hour
- High Wind Speeds
- Restricted airspace
- Base power 2500-3000 kW
- Low cost Power
- 38-40% capacity factor
- 5-10% penetration, with no measurable impact

# LESSONS LEARNED

- Perform resource assessments
- Know your mission, mitigate impact
- Partner at the beginning
- Performance based specifications
- Control system integration crucial
- Plan and model loads up front
- Teamwork and communication is key

# Summary

- **Your opportunities are boundless**
- **Know your resource**
- **Be willing to look outside the box**
- **Be willing to embrace change**
- **Work the Integration issues**
- **Do the engineering before you ask for funds**
- **What you put in now will provide 20+ years of fixed price low emissions supply**
- **Move forward, they can be win-win for all (cost, environment, future local grown power, etc)**
- **Most of all – Have fun doing what you think is right**

# Before



## Wind – DOD A Great Synergy



# Questions?

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<http://energy.inel.gov/powersystems/wind/>

# After