

Energy Security & National Defense

Shepard's Flat Wind Farm

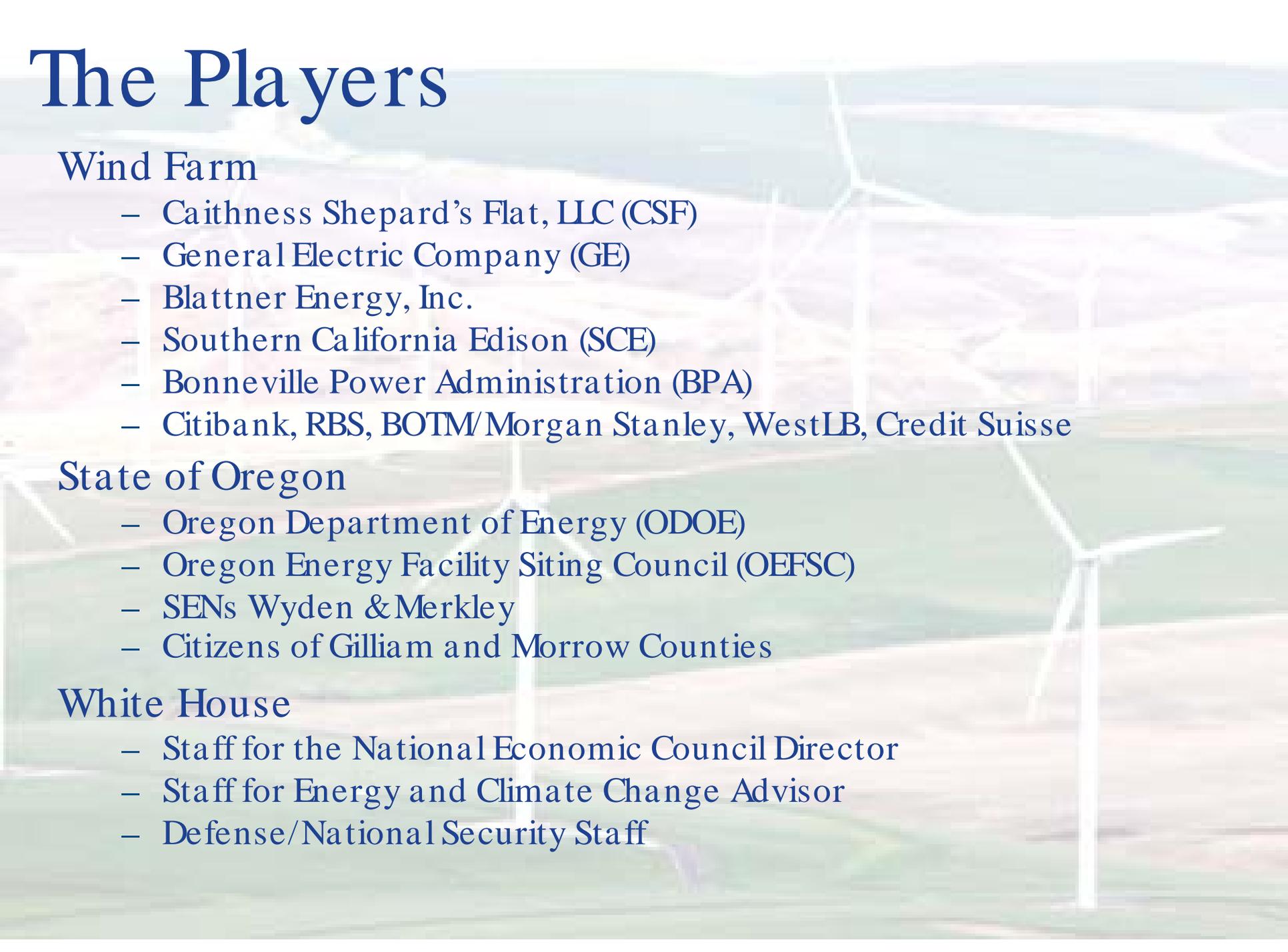
Chip Cotton
GE Global Research
Program Manager – Energy R&D
GovEnergy 2010



imagination at work



The Players



Wind Farm

- Caithness Shepard's Flat, LLC (CSF)
- General Electric Company (GE)
- Blattner Energy, Inc.
- Southern California Edison (SCE)
- Bonneville Power Administration (BPA)
- Citibank, RBS, BOTM/Morgan Stanley, WestLB, Credit Suisse

State of Oregon

- Oregon Department of Energy (ODOE)
- Oregon Energy Facility Siting Council (OEFSC)
- SENs Wyden & Merkley
- Citizens of Gilliam and Morrow Counties

White House

- Staff for the National Economic Council Director
- Staff for Energy and Climate Change Advisor
- Defense/National Security Staff

The Players

Department of Defense

- Deputy Under Secretary of Defense (Installations & Environment)
- NORTHCOM/NORAD
- Whidbey Island NAS (Boardman Bombing Range)
- Mountain Home Air Force Base
- 84th Radar Evaluation Squadron (84th RADES)

Department of Transportation

- General Counsel
- Federal Aviation Administration (Air Traffic Organization/General Counsel)

Massachusetts Institute of Technology

- Lincoln Labs

American Wind Energy Association

Wind Turbine/Radar Interaction

National Defense Authorization Act For Fiscal Year 2006 required a “Report on Effects of Windmill Farms on Military Readiness”

Wind Turbines

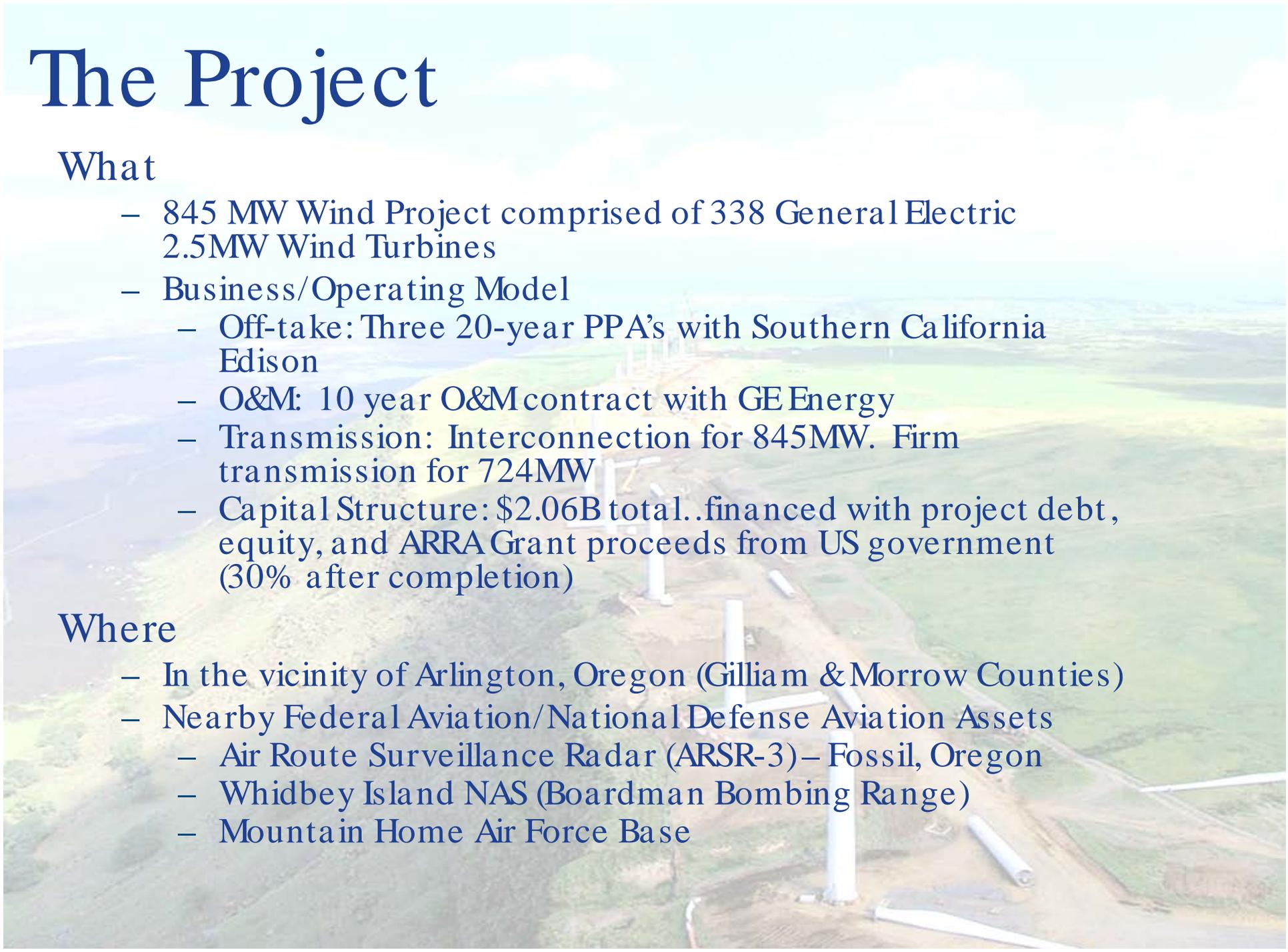
- Tower
 - Height – taller tower impacts LOS at greater distance
 - Stationary reflector/no Doppler – no impact on Moving Target Identification/Detection
- Nacelle
 - Rotation - rates tend to be relatively low ...appear to the radar as a virtually stationary object even when rotating
 - Materials – weight is a big factor ...many composites are partially transparent to RF energy
- Blade
 - Angle of Attack – computer controlled to maximize power production w/i relatively narrow rotation rate range
 - Radar Cross Section – substantial ...combined with rotation leads to appearance of a moving target

Radars

- Clutter
 - Earth’s surface, any man-made objects on the earth’s surface, and weather effects such as rain or hail can cause clutter

One Conclusion: “...Existing processes to include engagement with local and regional planning boards and development approval authorities should be employed to mitigate such potential impacts.”

The Project



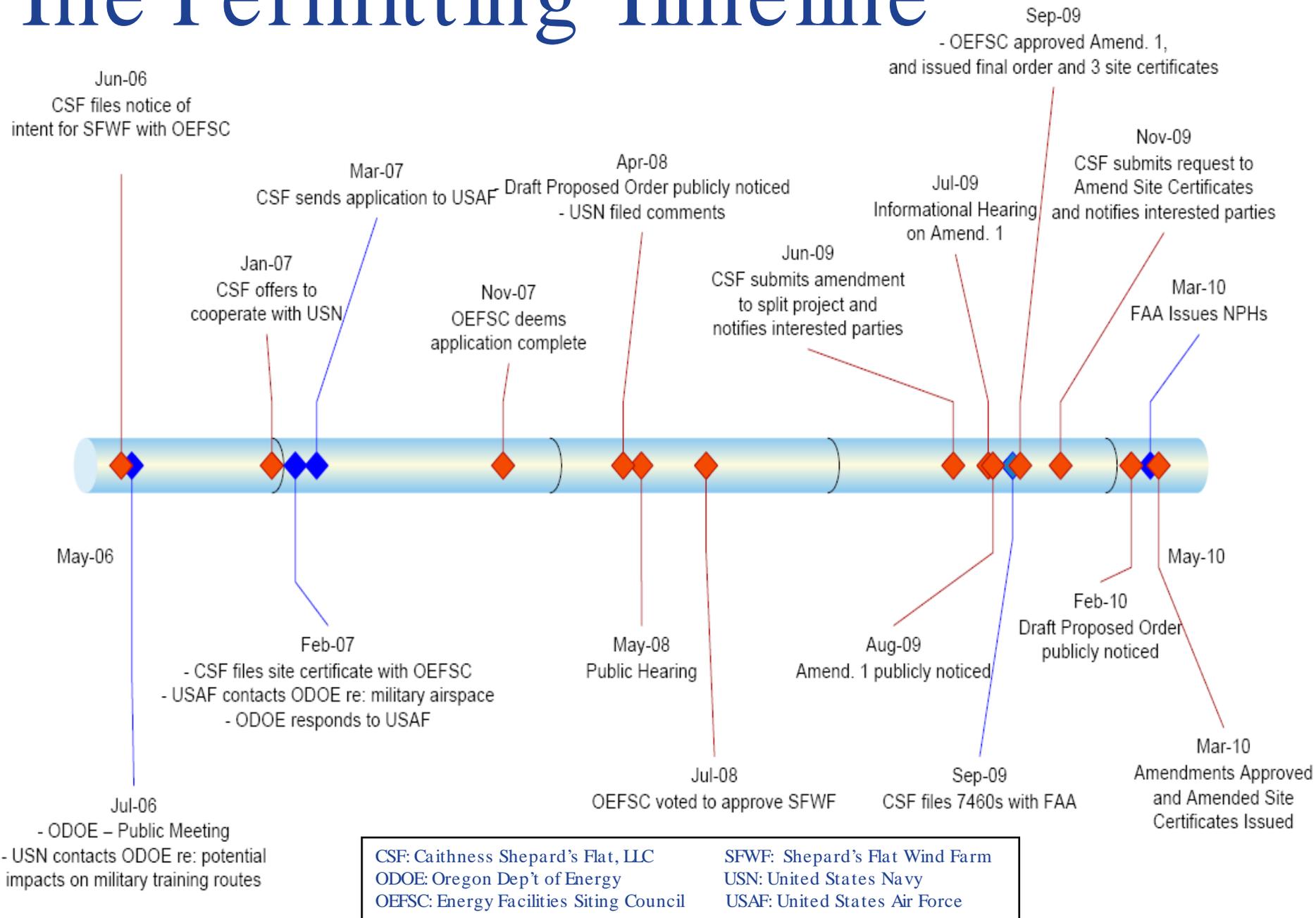
What

- 845 MW Wind Project comprised of 338 General Electric 2.5MW Wind Turbines
- Business/Operating Model
 - Off-take: Three 20-year PPA's with Southern California Edison
 - O&M: 10 year O&M contract with GE Energy
 - Transmission: Interconnection for 845MW. Firm transmission for 724MW
 - Capital Structure: \$2.06B total..financed with project debt, equity, and ARRA Grant proceeds from US government (30% after completion)

Where

- In the vicinity of Arlington, Oregon (Gilliam & Morrow Counties)
- Nearby Federal Aviation/National Defense Aviation Assets
 - Air Route Surveillance Radar (ARSR-3)– Fossil, Oregon
 - Whidbey Island NAS (Boardman Bombing Range)
 - Mountain Home Air Force Base

The Permitting Timeline



No Hazard Determination

9/18/09 - Caithness filed applications for FAA Determinations of No Hazard

- Approximately 1,800 wind turbines already exist or have been proposed in the vicinity of the Shepard's Flat project

Mid-November '09 – Caithness receives input from FAA staff indicating no significant objections were filed by FAA Technical Operations and the U.S. Navy..however, they were awaiting feedback from the Air Force

Late January '10 - FAA staff received a “general” objection from the Air Force and requested specific information to support the objection by 12 February

3/1-2/10 - FAA issued Notices of Presumed Hazard for all 349 turbine sites which stated that “any height exceeding 0 feet above ground level . . . will result in a substantial adverse effect.”

- 60 day response timeline to the Notices, however the deadline may be extended if efforts are underway to resolve the issue
- CSF project technical team believes mitigation measures may be available, but lacked key information to make an accurate assessment of scope and costs of potential mitigations

- North Hurlburt Wind Turbines: White Paint/Synchronized Red Lights
- North Hurlburt Wind Turbines: White Paint/Synchronized Red Lights
- South Hurlburt Wind Turbines: White Paint
- South Hurlburt Wind Turbines: White Paint/Synchronized Red Lights
- Horseshoe Bend Wind Turbines: White Paint
- Horseshoe Bend Wind Turbines: White Paint/Synchronized Red Lights



No Hazard Determination

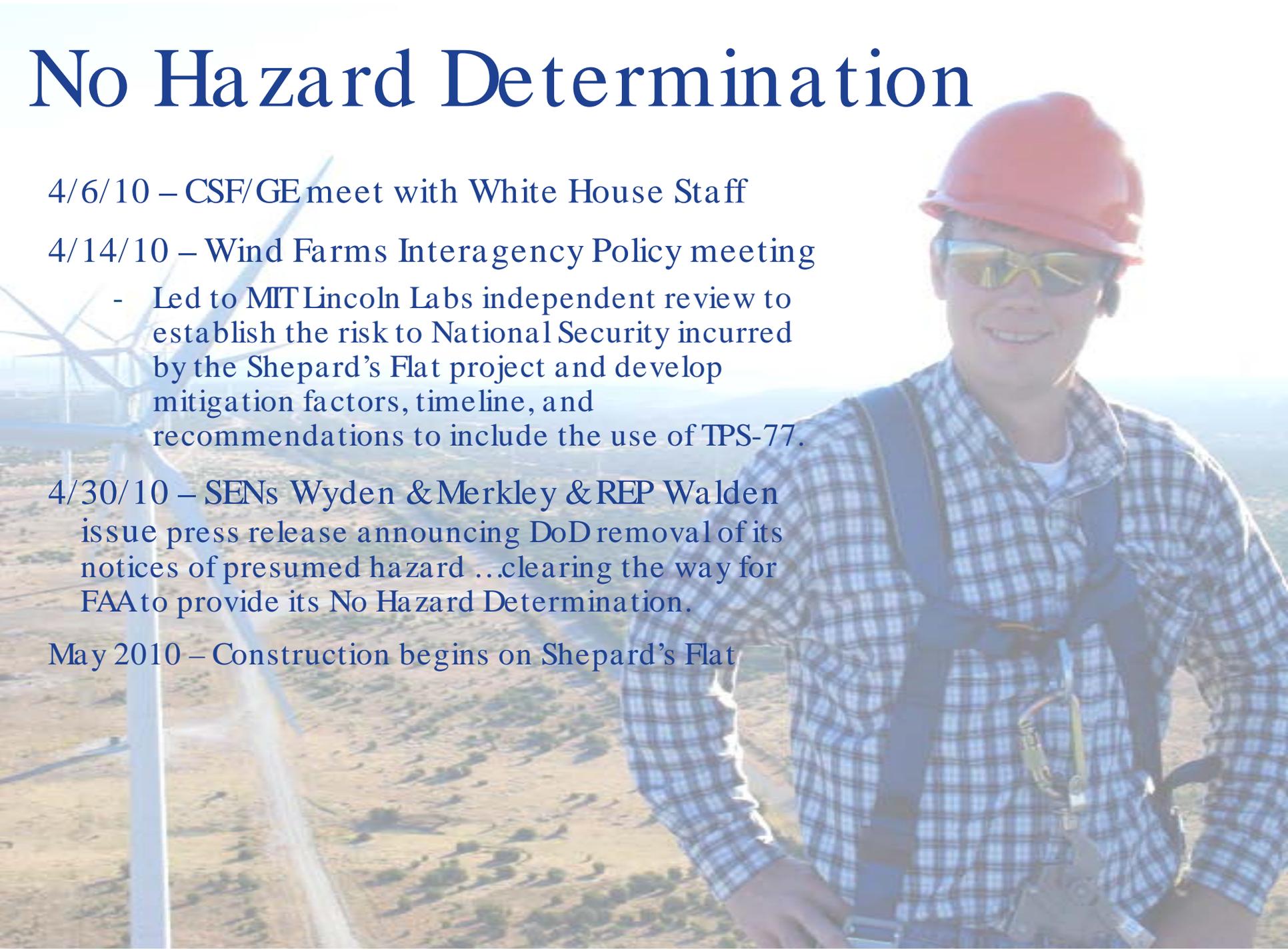
NORAD/USAF Objections:

- Increased Screening - limited to the height of the wind turbine towers and extend approximately 2.5 to 17.7 NM behind the structures
- Increased Search False Targets - existing wind turbines within the area were producing approximately 6 to 12 false targets per scan
- Decreased Sensitivity - Primary impact to receiver sensitivity will be directly over the wind turbines depending on several factors to include aircraft location relative to the wind turbines, fluctuations in flight level or direction, and wind turbine orientation and blade speed, all of which vary over time
- Mitigation Options - No minimum height that will put these wind turbines outside RLS at their current locations ..no overlapping radar coverage in this area to supplement the limited low level coverage loss from the Fossil radar

3/25/10 – CSF/GE met with DUSD(I&E) who directed her staff to engage in mitigation discussions but remained skeptical that acceptable mitigation solution could be found given timing challenge

3/31/10 - Initial National Security Council meeting involving White House staff, Air Force, and NORAD officers

No Hazard Determination



4/6/10 – CSF/GE meet with White House Staff

4/14/10 – Wind Farms Interagency Policy meeting

- Led to MIT Lincoln Labs independent review to establish the risk to National Security incurred by the Shepard's Flat project and develop mitigation factors, timeline, and recommendations to include the use of TPS-77.

4/30/10 – SENs Wyden & Merkley & REP Walden issue press release announcing DoD removal of its notices of presumed hazard ...clearing the way for FAA to provide its No Hazard Determination.

May 2010 – Construction begins on Shepard's Flat

MIT Lincoln Labs Study¹

Methodology

- Construction of predictive performance models leveraging earlier FAA radar and AFRL wind farm modeling efforts
- Validation using on-site field measurements with general aviation aircraft

Findings

- Clutter: manifests itself as false alarms/targets) and is only partially mitigated by the ARSR-3 native clutter filtering capability
 - Existing 1801 wind turbines within LOS of the radar occupy approximately 2.5% of the total terrain visible to the radar (false targets generated was approximately 10-20% of the total produced by the radar)

Mitigations

- Number of false targets can be reduced by proper adjustment of the radar settings as part of the planned September 2010 optimization
- False target count further reduced by modifications
 - Auxiliary processor resulting in an adaptive clutter map
 - Planned 2014 Service Life Extension Program (SLEP) of the ARSR-3 will replace transmitter & receiver parts with solid-state components

Other Case Studies

DRACONIAN GATES

Purpose: assess effects of wind farms on air defense radar performance

Background: conducted by Royal Danish Air Force 11-18 SEP 2008

Equipment: ac - T1A, T17, F16; radar – TPS77, RAC3D; turbines – Vestas V80

Results: TPS77 achieved high PD against all targets even in very close proximity to the wind farm..RAC 3D outputs could not be processed

Fallago Rig Wind Farm

Background: 48 turbines, 144 MW, on-shore, Scottish border area

Radar Mitigation Scheme:

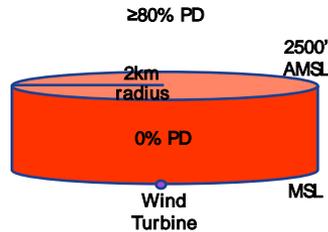
- 1) Integration of air traffic control radar into RAF Leuchars Watchman air control & surveillance radar
- 2) Developer undertaking a further mitigation scheme to achieve the Aviation Specification
- 3) Developer financial responsibility to MoD in event developer does not satisfy the Aviation Specification..put towards the MoD's radar mitigation scheme.
- 4) Developer purchase bond or other security to guarantee #3

Select European Policies



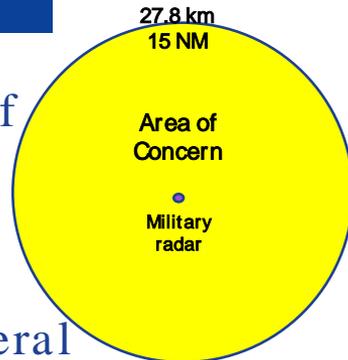
MoD Aviation Specification:

- a horizontal plane at 2,500ft AMSL
- a horizontal plane at MSL
- a vertical elevation, formed by a 2km radius around each turbine

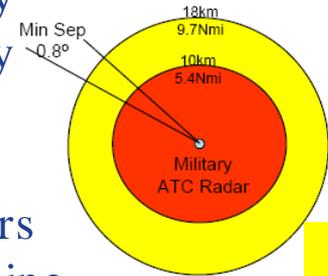


Plans for wind turbines within 15NM (27.8km) of military radars must be submitted to RNLAf

- Shadowing by wind turbines and more general concerns of impacts of wind turbines on radars.



'Protection Zone' of 10km (5.4NM) around all military ATC radars is protected by law. An 'Area Of Interest' defined as a region 18km (9.7NM) from the ATC radars – Shadowing by wind turbine towers a major concern.

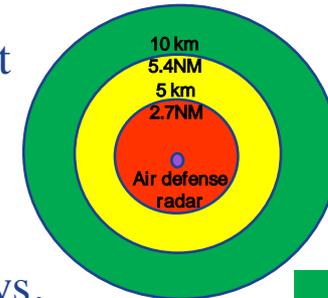


Area of Interest
Protection Zone



Proposed wind turbines evaluated by local authorities (Mayor, District Governor) in consultation with Austrian Ministry of Defense

- EMI of radars, radio relays, & HFDFs and obstacles to low flying routes



No Objections
Conditional
Protected

Challenges/Recommendations

Ability to predict site specific wind farm/radar interaction effects

- Multiple radar systems - varying signal and data processing capabilities
- Multiple wind turbine manufacturers - varying performance parameters
- Multiple missions – radars and military facilities
- Varying geographic, weather, previous wind projects, existing air traffic
- Cumulative effects of overall distribution & density of wind farms
- ❖ Research, Development, Modeling & Simulation

Lack of policy

- Deliberate consideration of trade space between energy national security policies
- ❖ Establish acceptable & fair standards

Poor coordination/process

- Land use authority/zoning – State/Local authorities
- NHD process is one size fits all/FIFO – no discrimination for complexity / impact to national objectives
- ❖ Early & often interaction between all stakeholders