wfec western farmers electric cooperative

WFEC Blue Canyon Project

Western Farmers Electric Cooperative

Oklahoma Co-ops Lead the Way

- First to sign a PPA for Wind
- Partner w/Zilkha Renewable
- 15 miles north of Lawton
- 45 Turbines
- 74.25 MW

WindWorks Oklahoma's Wind Power

Touchstone Energy® The power of human connections

wfec western farmers electric cooperative

✓ Innova

Windmills to Wind Turbines

WHY WERE OKLAHOMA COOPS THE FIRST?

✓ Environmentally Conscious

Wind is renewable – lowest cost renewable next to hydro power

Wind generation produces no air emissions

Wind is safe – to people and to wildlife

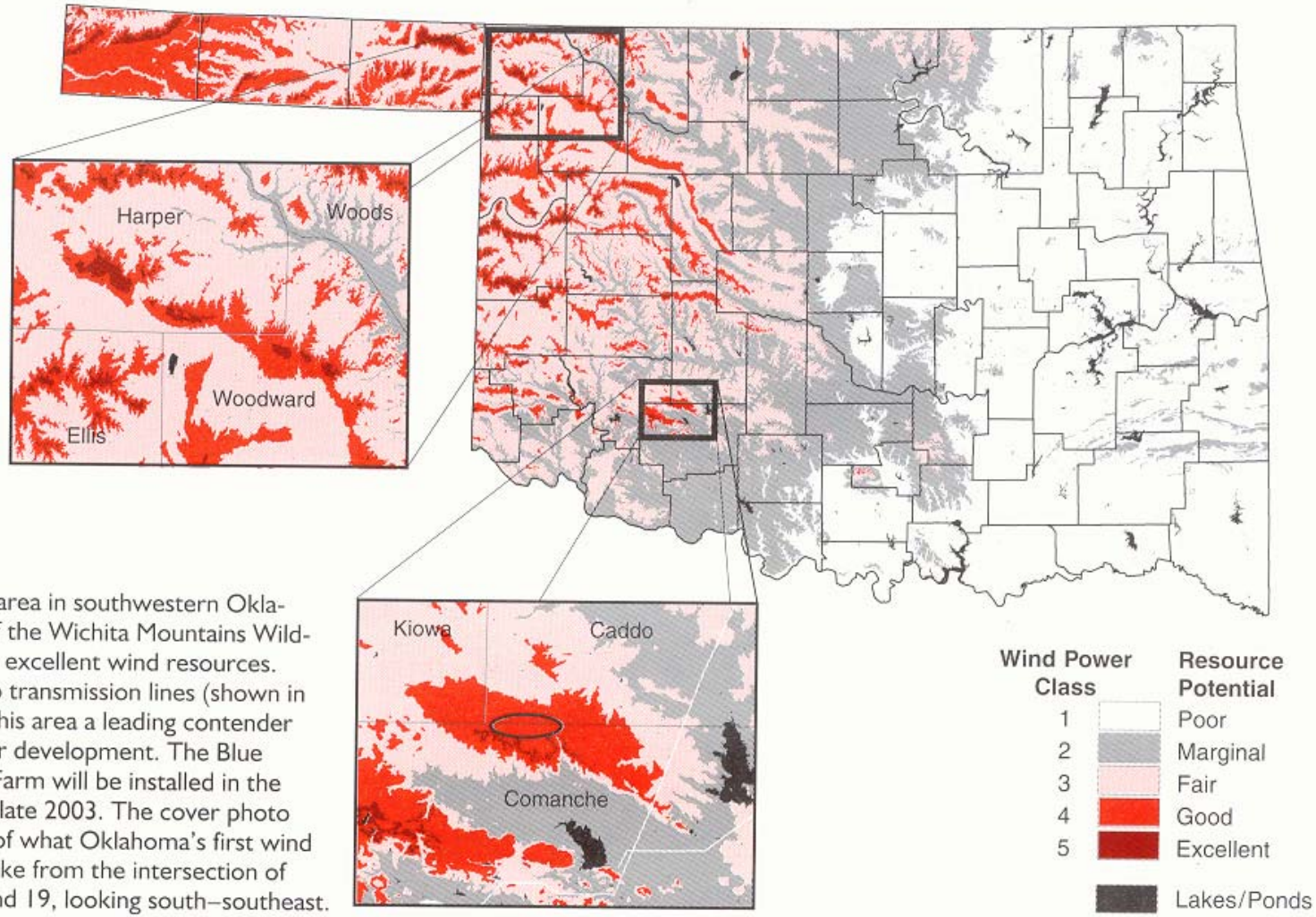
Turbines can be located on land that can also be used for farming

Benefits to our Member/Owners & to Oklahoma

- ✓ Land owner leases and royalties
- ✓ Property taxes of $3 - $5 million of the life of the project
- ✓ 100 or more jobs during wind farm construction
- ✓ Up to 50 jobs for transmission construction
- ✓ 6 or 7 ongoing operations & maintenance jobs
- ✓ Use of a native, natural, abundant, and renewable Oklahoma resource

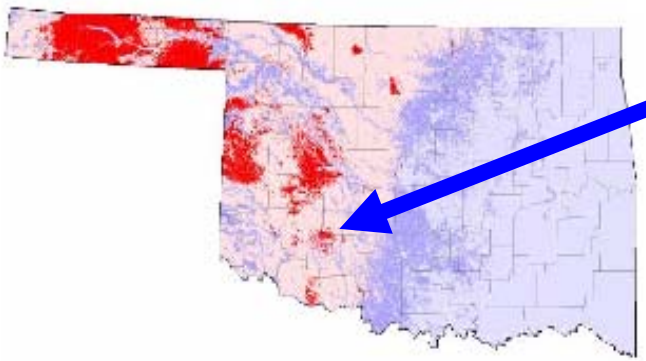
Why Did We Select This Site for Blue Canyon Wind Farm?

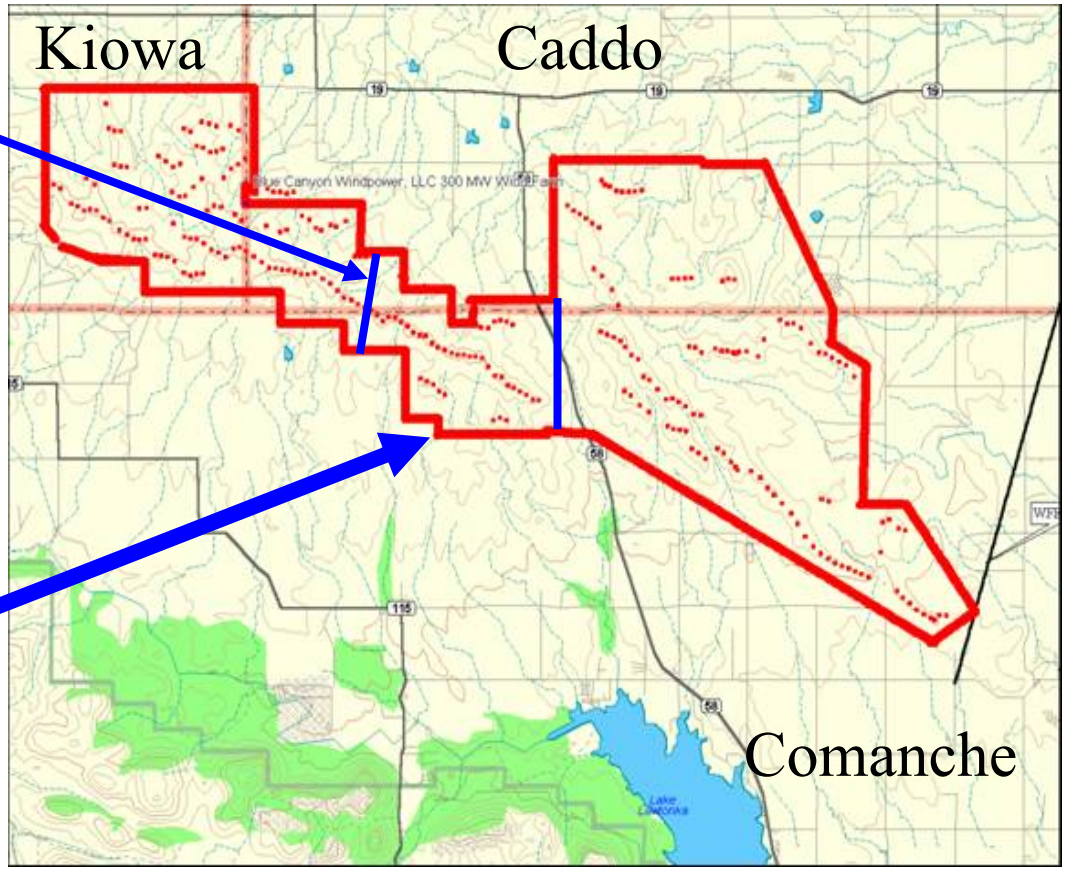
Northwest Oklahoma is a prime region for utility-scale wind farms. Oklahoma Municipal Power Authority has plans to buy electricity from a wind farm to be developed north of Woodward by the end of 2003.



The Slick Hills area in southwestern Oklahoma (north of the Wichita Mountains Wildlife Refuge) has excellent wind resources. Good access to transmission lines (shown in white) makes this area a leading contender for wind-power development. The Blue Canyon Wind Farm will be installed in the circled area by late 2003. The cover photo is a simulation of what Oklahoma's first wind farm will look like from the intersection of Highways 58 and 19, looking south–southeast.

74.25 MW Blue Canyon Wind Power Phase I





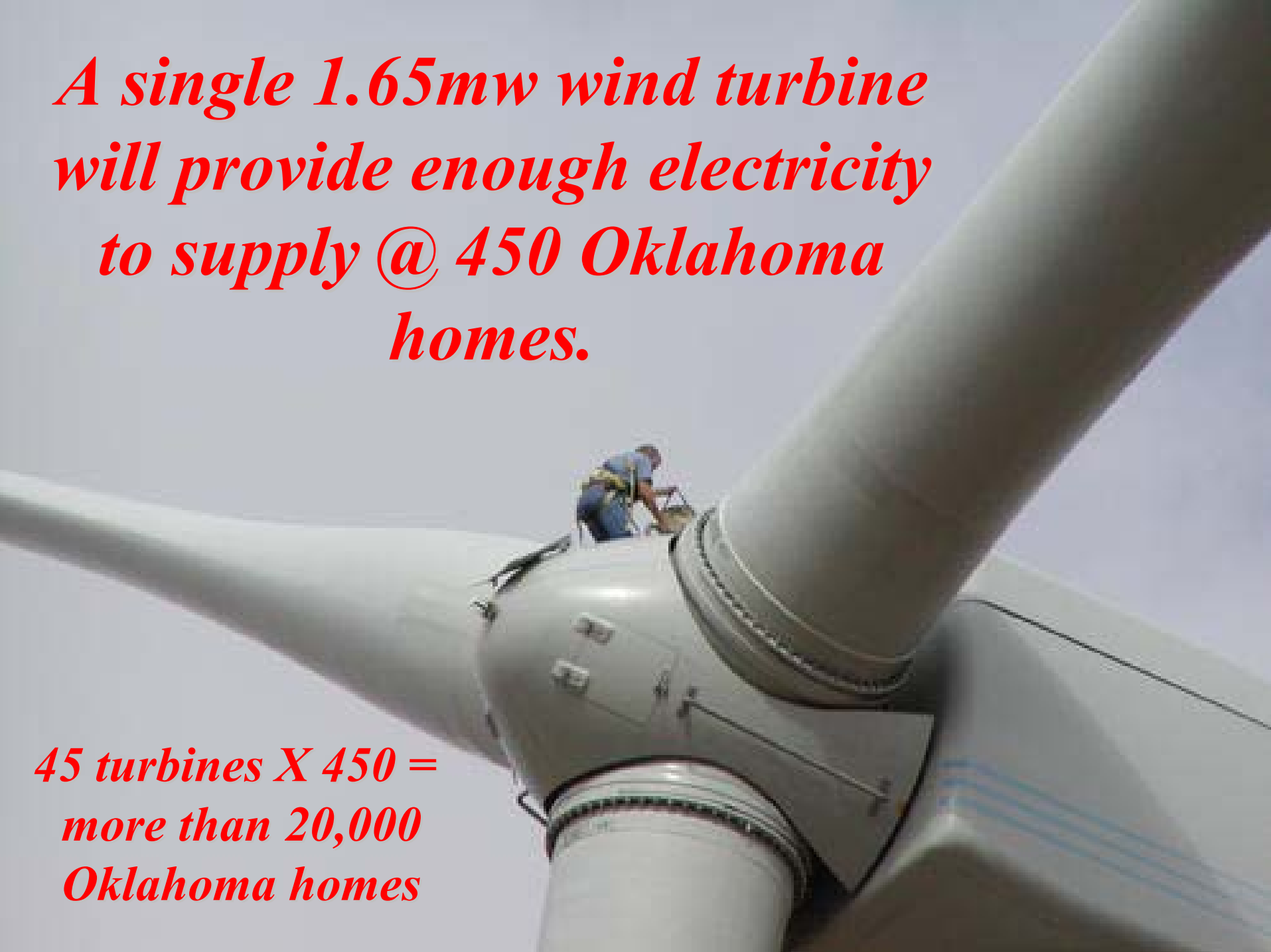
Location of the Blue Canyon Wind Farm

Computer simulated photographs of Blue Canyon I

Picture of Blue Canyon Wind Farm taken on 12/4/03

Blue Canyon Construction Schedule

- **Transmission Line**
  - ✓ 24 miles – 138Kv
  - ✓ Completed in October-ahead of schedule
  - ✓ Longest line exclusively for wind energy
- **45 Wind Turbines**
  - ✓ 1.65 Mw each
  - ✓ Began receiving test power on Sunday, November 2, 2003


A single 1.65mw wind turbine will provide enough electricity to supply @ 450 Oklahoma homes.
45 turbines X 450 = more than 20,000 Oklahoma homes

Wind Works for Our Cooperatives

- **Adds Diversity to Fuel Blend**
  - **24% Gas**
  - **10% Purchased**
  - **5% Wind**
  - **52% Coal**
  - **9% Hydro**
- ***Approximately 14% Renewable***

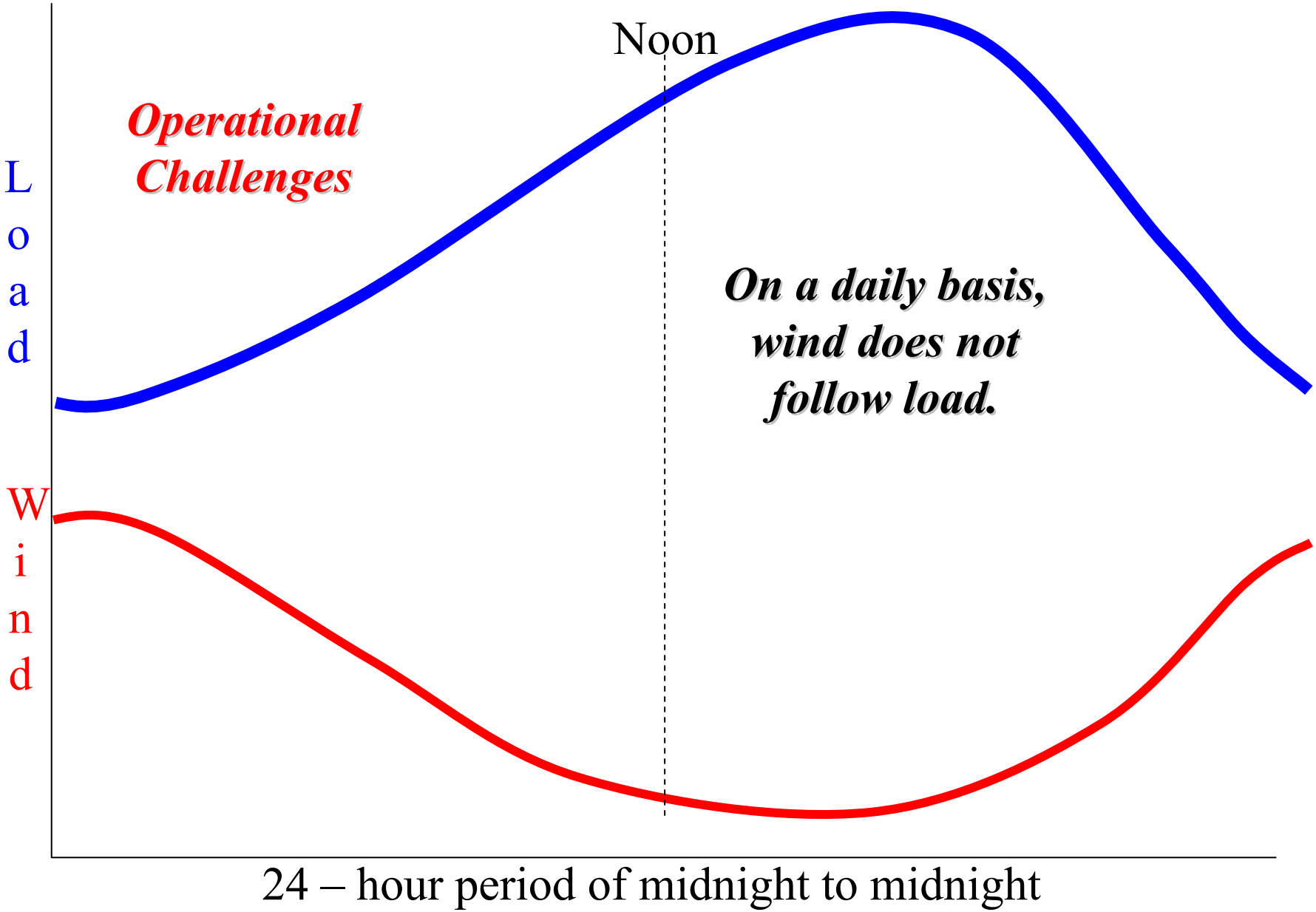
WindWorks Oklahoma's Wind Power

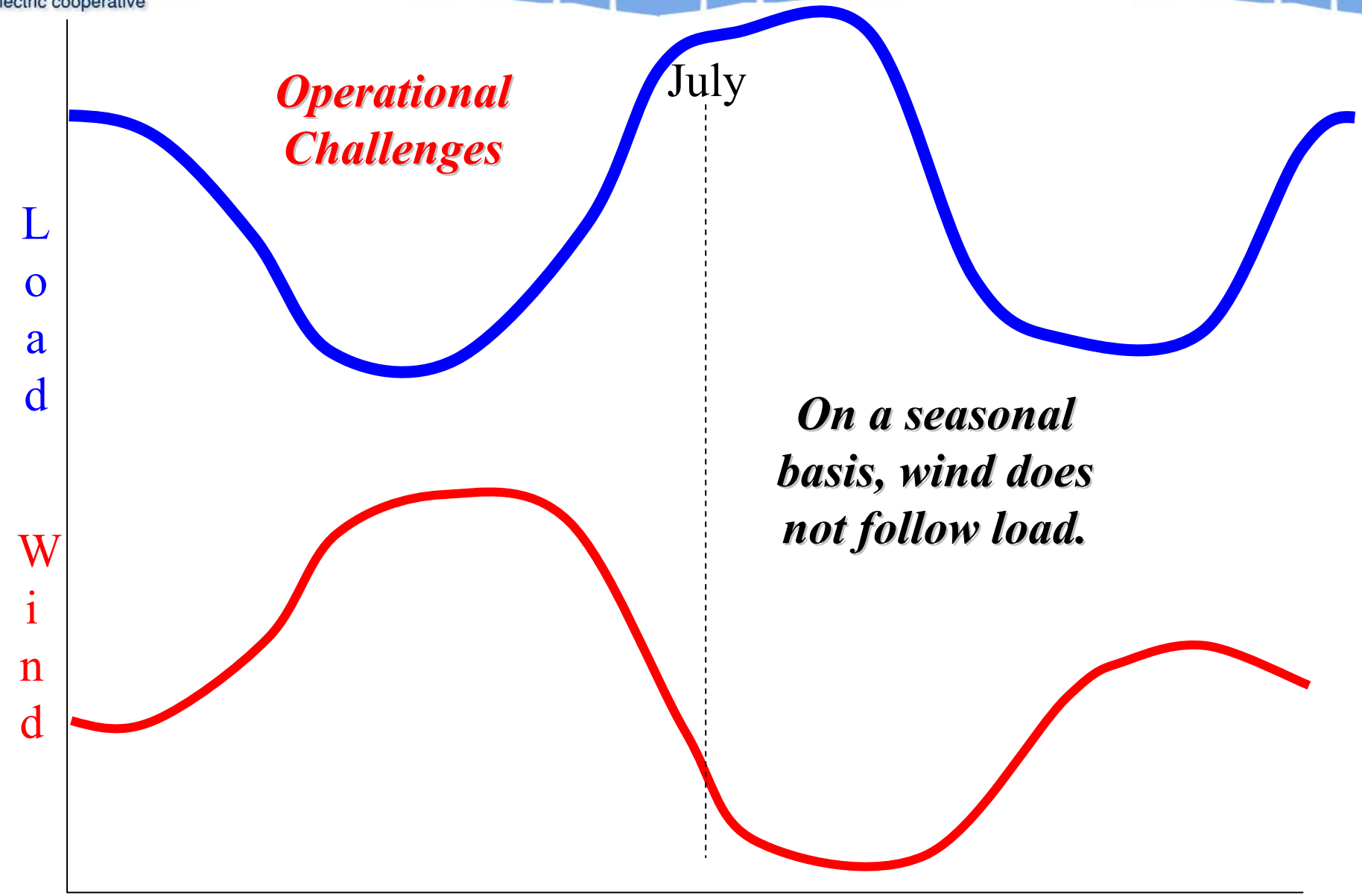
Touchstone Energy® The power of human connections

One of every Seven kwh sold by WFEC member-owners will be from a renewable source.

Operational and Efficiency Issues

- Wind does not “look like” conventional generation.
- Variability of production.
- Limited “on/off” control of production.
- Regulation of Wind generation.

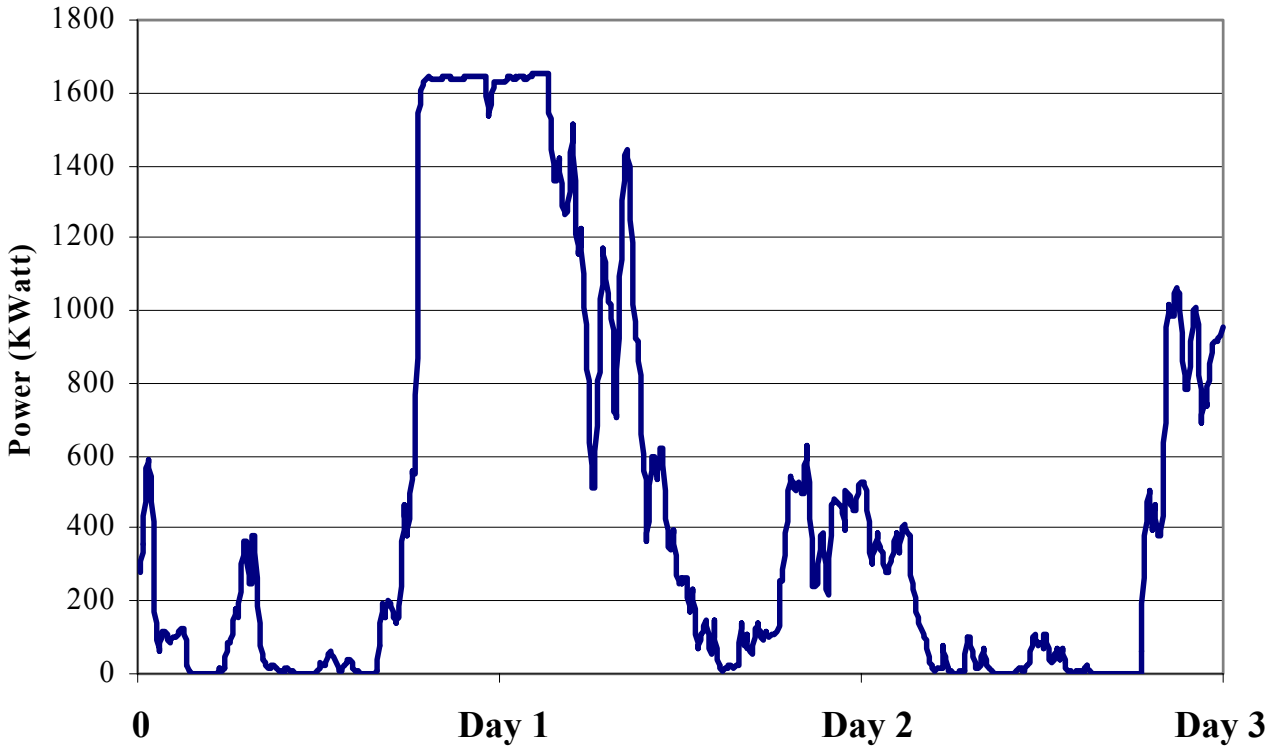

Noon
Operational Challenges
Load
Wind
On a daily basis, wind does not follow load.
24 – hour period of midnight to midnight



One year – from January 1 to December 31

A Typical Wind Generation Output

Every 10 minute period for 3 days



Wind Generation is Uncertain.

Integration Costs

1. Costs associated with forecast inaccuracy
   - Buffalo Ridge Project Study (Electrotek)
     - 30% - 50% forecasting error = $0.995 to $1.436
     - Based on WFEC's generation portfolio we believe our costs are approximately $1.40
2. Cost of additional load following reserves
   - Simulated data suggests 9 MW requirement
   - WFEC estimate = $1.98/mwh
3. Cost of intra-hour load following
   - Electrotek study suggests $0.41/mwh
   - WFEC estimates our costs are similar
4. Additional cost for regulating reserves
   - Minimal additional cost

WFEC Estimated Integration Costs = $3.39 to $3.83/mwh

TOWER FOUNDATION
21’ X 21’ X 17’ Deep
30 concrete trucks

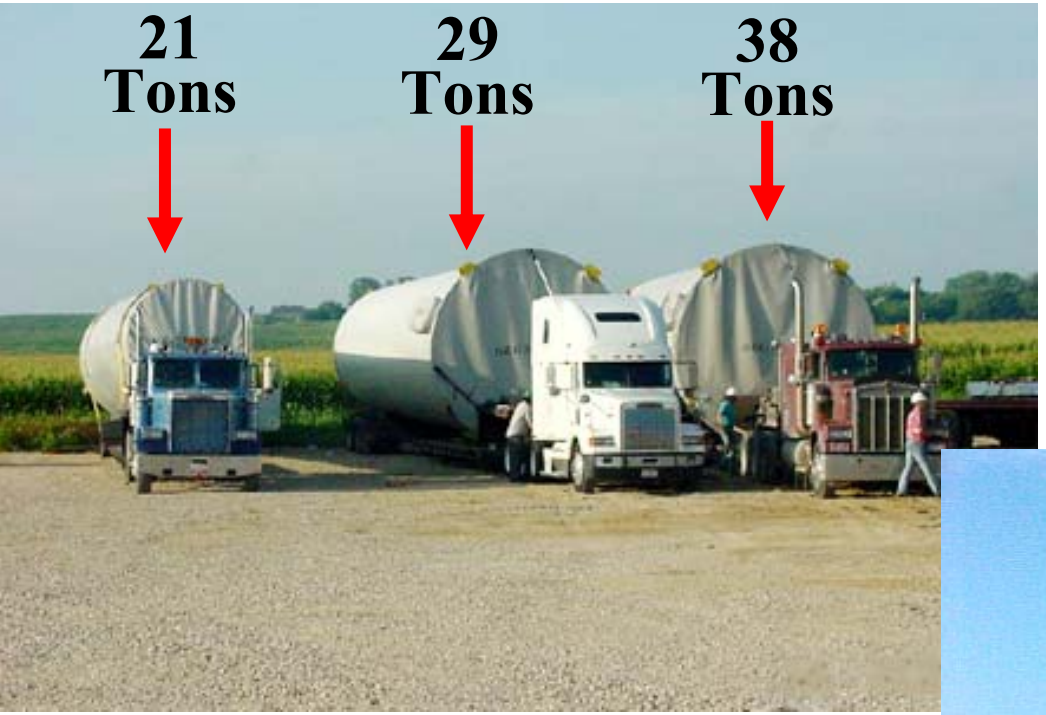
Foundation Construction

Anchor bolts and rebar wraps tied

Foundation prepared for pour

TOWER FOUNDATION
21’ X 21’ X 17’ Deep
30 concrete trucks

Tower Erection



Towers arrive at site

(3 sections per tower)

Towers off-loaded

Tower Base

Tower Base Erection

Tower base section rigged for upending

Tower base section upended

Tower Erection

Towers bases set

Tower top sections erected

Rotor Erection

Rotor erected

Rotor secured to nacelle

Underground Electrical

Underground cables connect between the turbines (typically 30-48” deep)

Transformer at the base of each turbine – steps up voltage for transmission to substation

Interconnect & Substation

Interconnect to main grid lines

Completed substation

(requires 1-2 acres)

NACELLE

1.65 Megawatts

Weight is @ 63.5 Tons

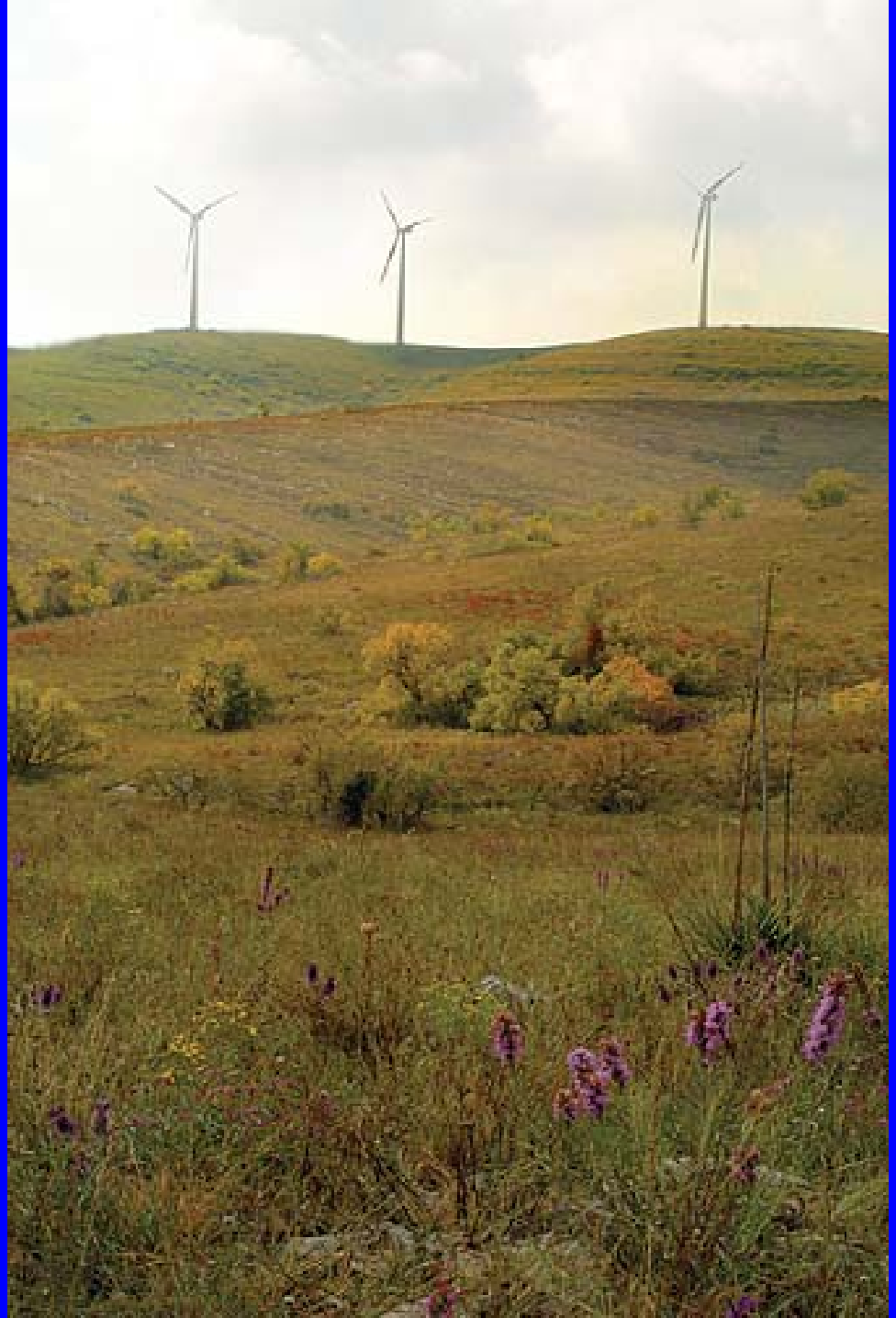
Turbine Blade
115 feet long
6 tons
T93
PARKING

Rotor Hub

Full size pickup next to blades

Turbine Blades – Construction lay down yard

TURNER



16 – 20 RPM

6 MPH

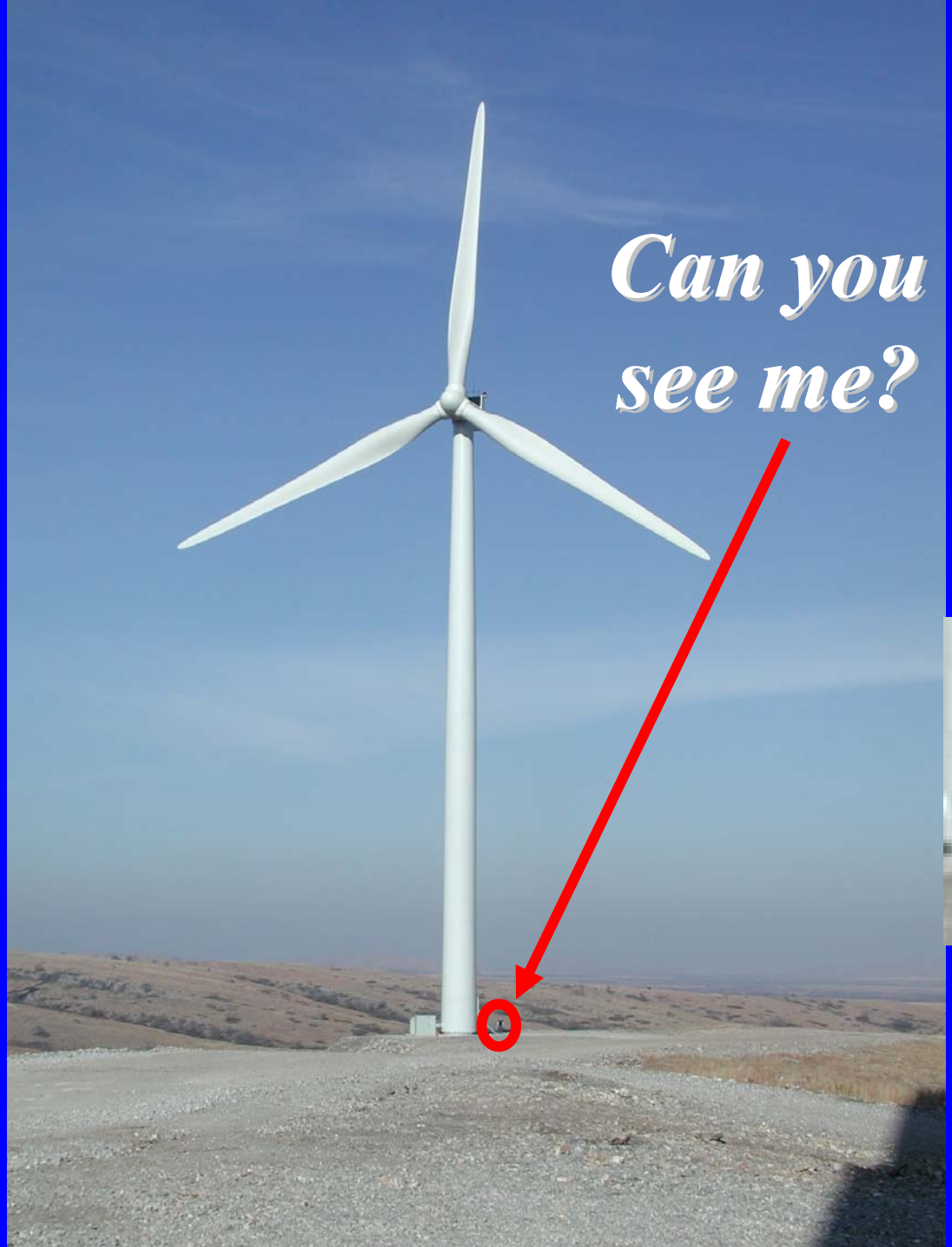
Blade tip travels at 150 MPH

Size of Turbines

- Turbine Footprint is small
- Rotors on larger machines: bigger than Boeing 747
- Lowest ground clearance is about 100 ft.

Can you see the one ton Truck?

Can you
see the man?


Can you
see me?

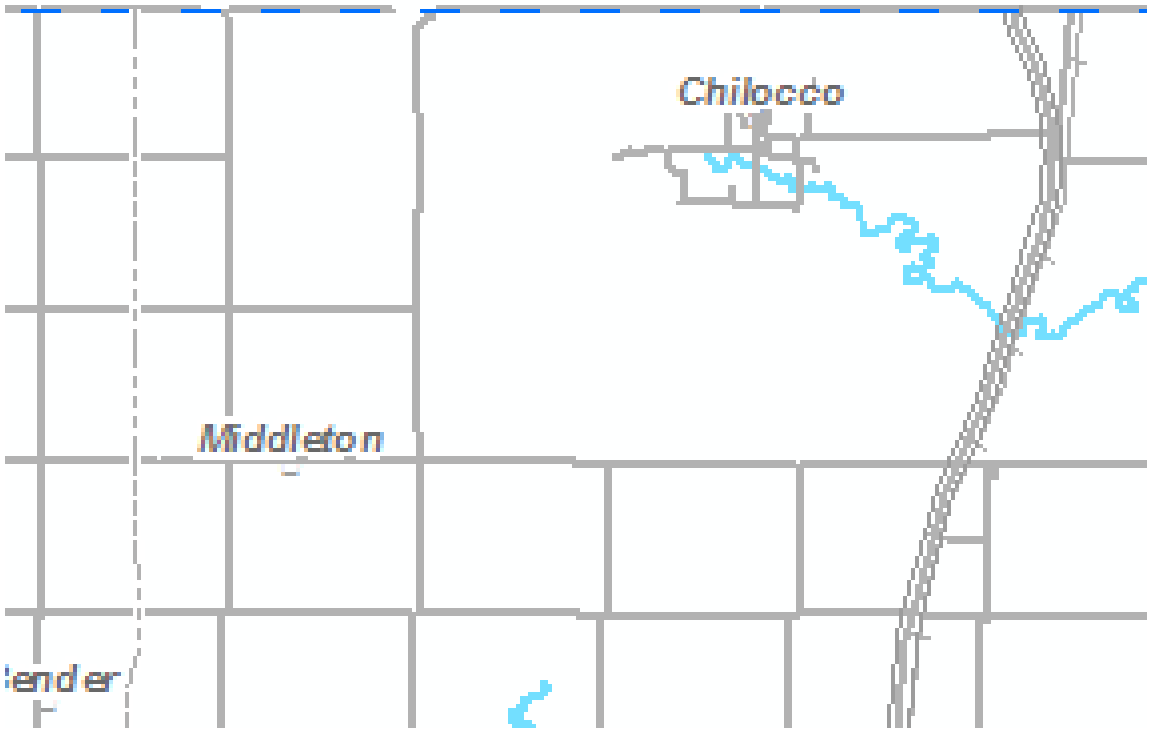
Can you
see the man?

BELEIVE IT

OR NOT!

Oklahoma Co-ops' First Wind Power

Proposed Chilocco Project



Proposed Chilocco Project

SPP Interconnection Process

- SPP performs studies
  - Feasibility – Power Flow
  - System Impact – Powerflow, Stability, Short Circuit
  - Facilities – Cost estimates of facilities Upgrade

- SPP transmission Service Process
  - Aggregate Study Process
    - Performed every four months (three times per year)
    - Groups all service requested together and designs upgrades to meet all service requirements – NERC standards for contingencies and voltage, etc.
    - Develops an list of projects required and spreads the cost of upgrades to all users.

Chilocco Project

- Once you know the total cost and wind performance, estimate the cost/kwh, federal and state credits, green credits, etc to determine an energy sales price.
- Work with your utility power your loads?