The background of the slide is a photograph of a rural landscape. In the foreground, there are rolling hills covered in green and yellow grass. In the middle ground, a small farm is visible, featuring a blue barn, a smaller blue building, and a white water tower. The sky is a clear, solid blue.

# **Triple Bottom Line Thinking:**

## **The Wind Energy Experience On A Small Farm**

### **Winter Intersession**

**Rathbone Hall - Engineering Complex**

**Kansas State University**

**Manhattan, Kansas**

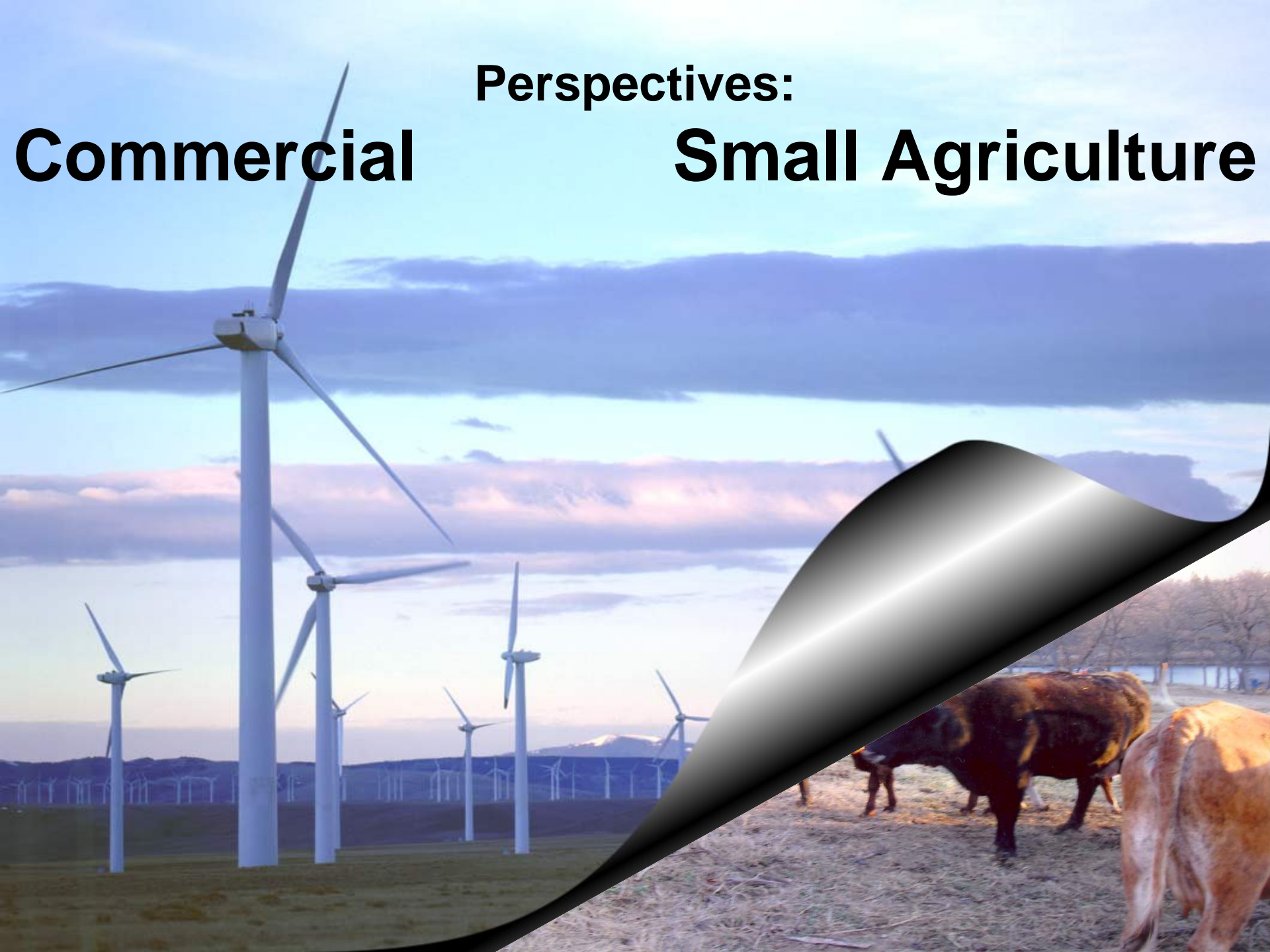
**January 9, 2008**



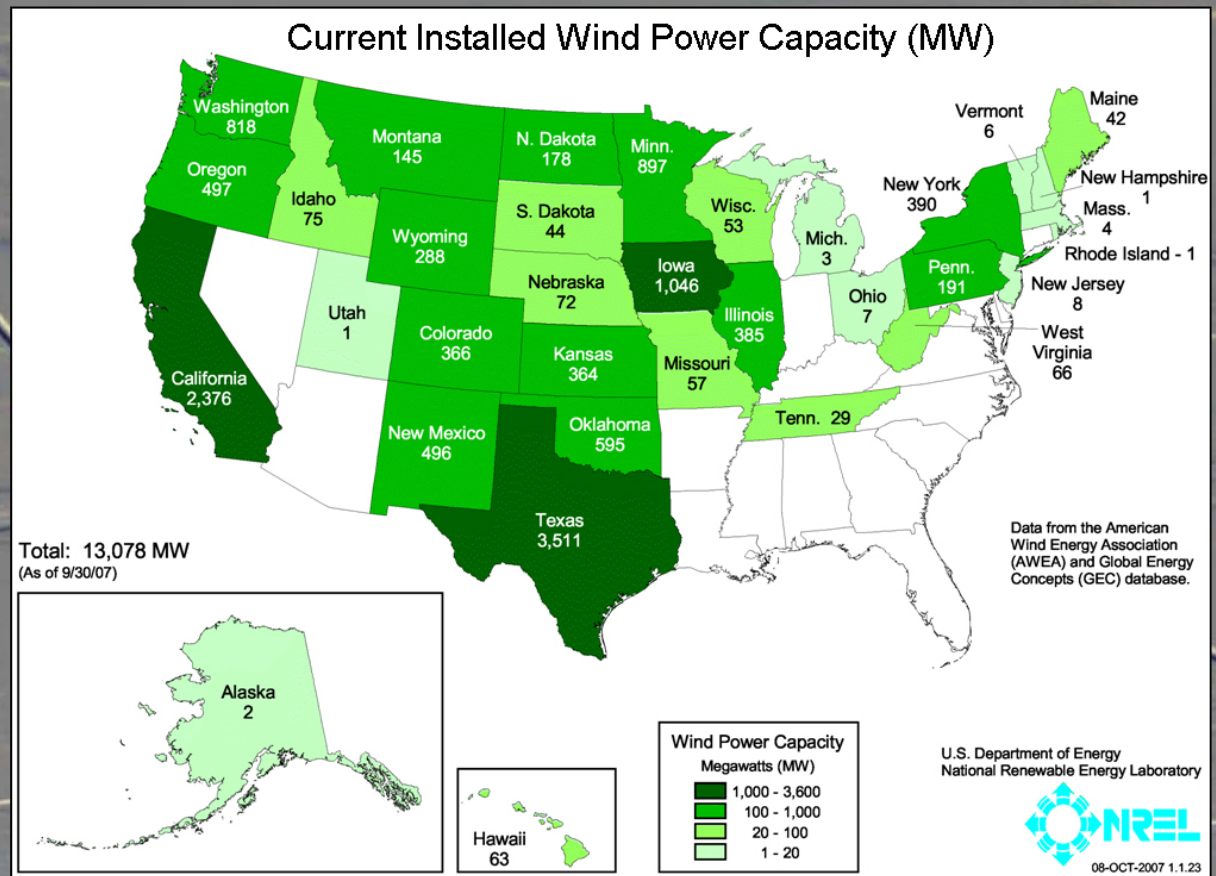
**Commercial**

**Perspectives:**

**Small Agriculture**



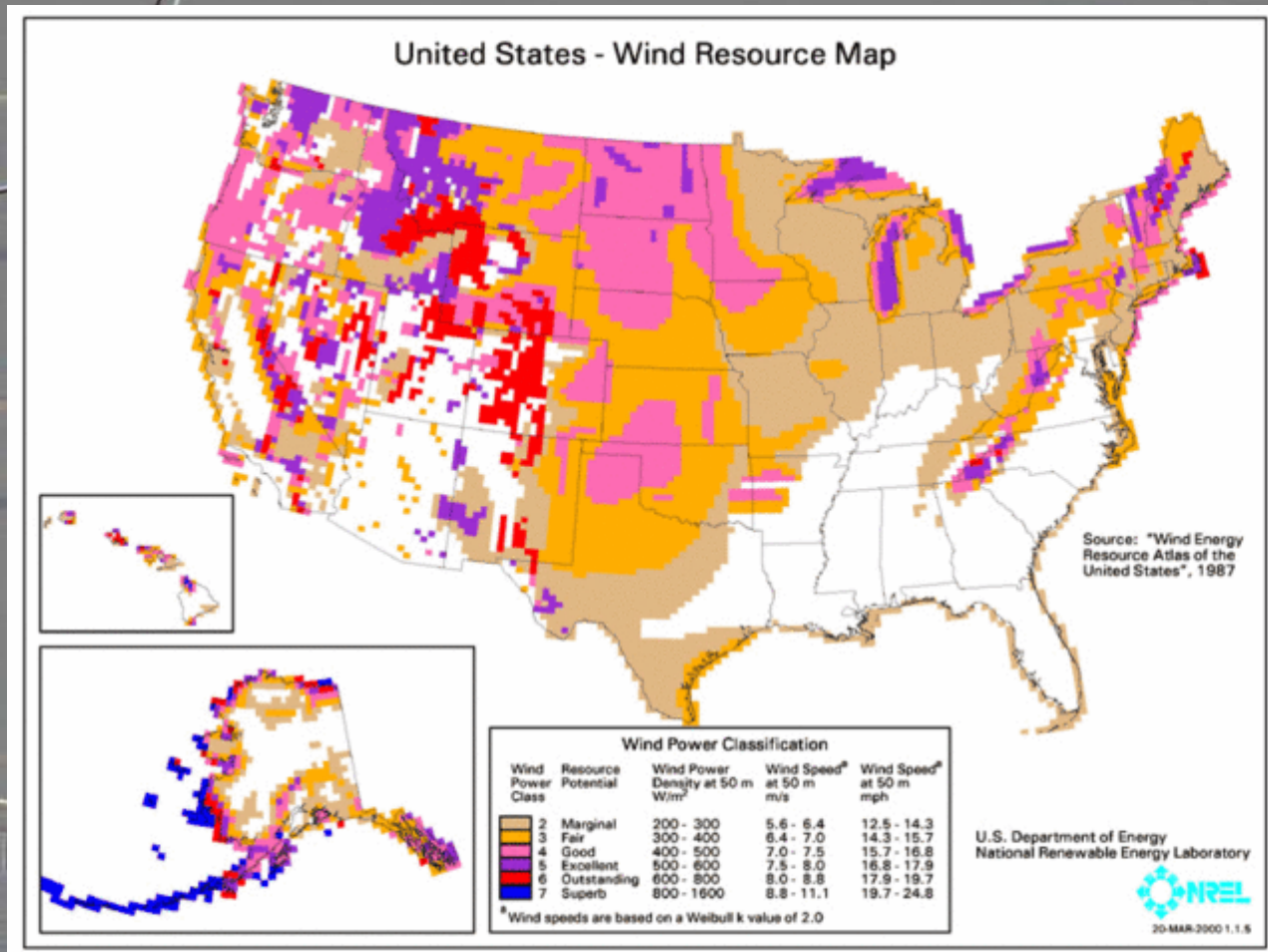
# Wind Energy In The Heartland



From NREL 2007

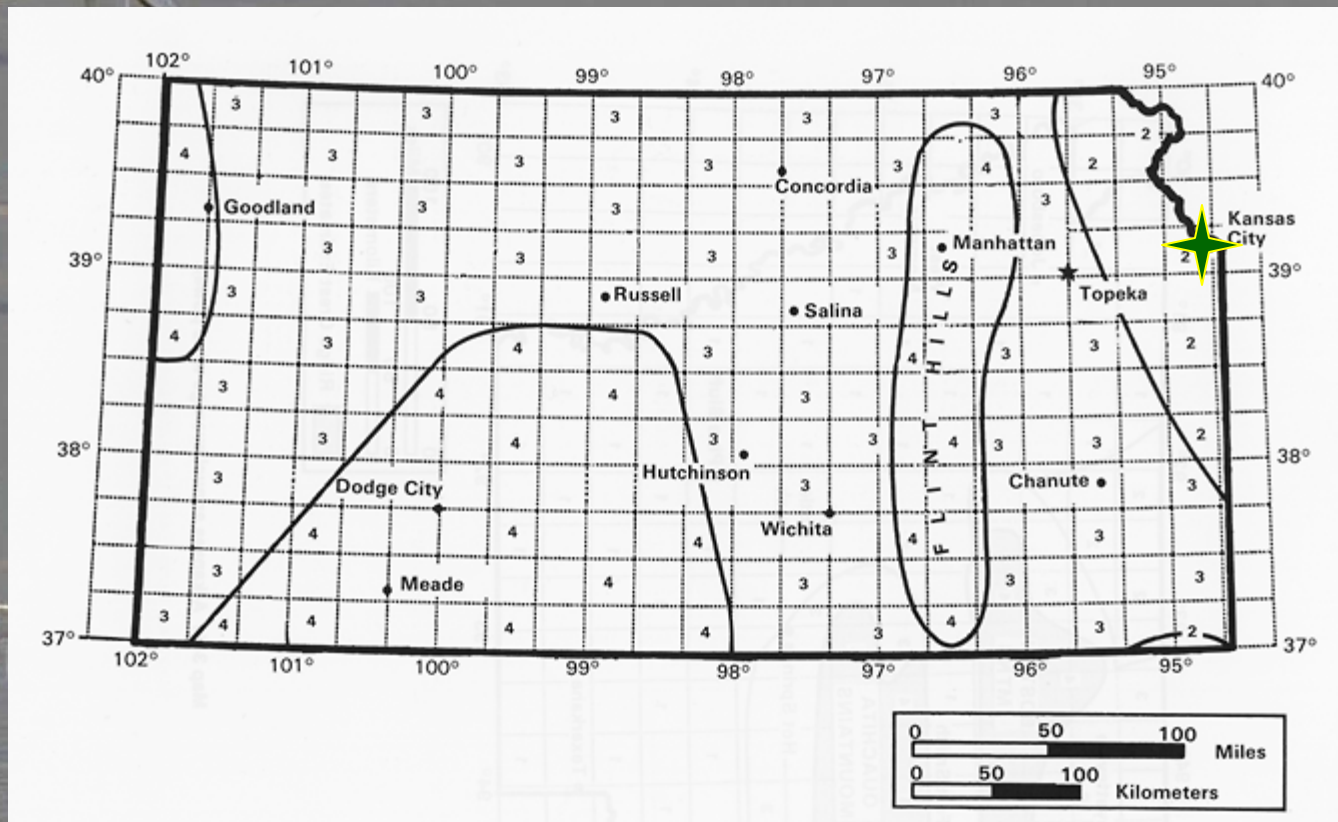


# Kansas ... fair to good resources



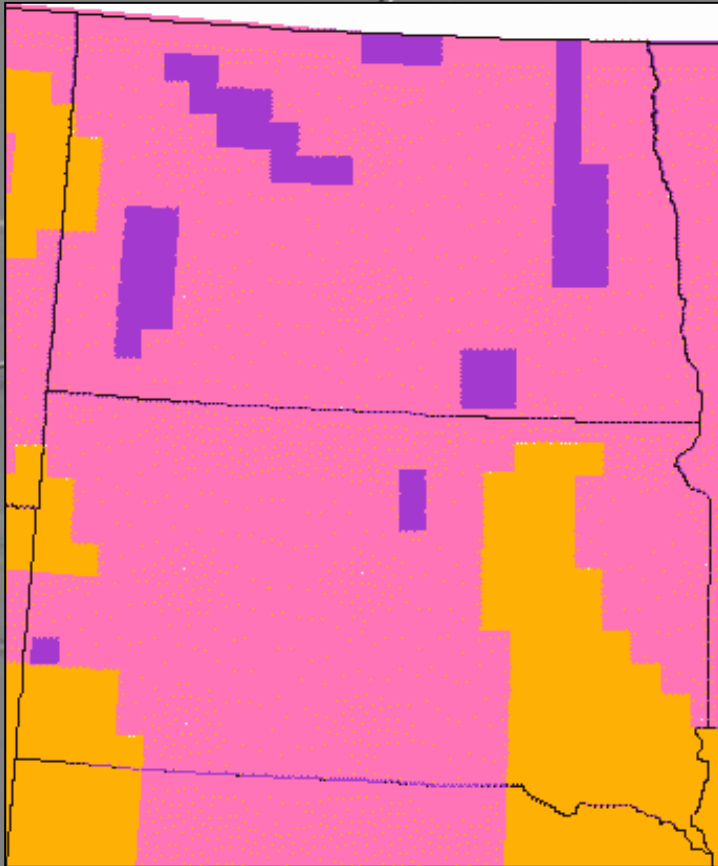
# Kansas Wind Resources

Well Suited To Small Turbines

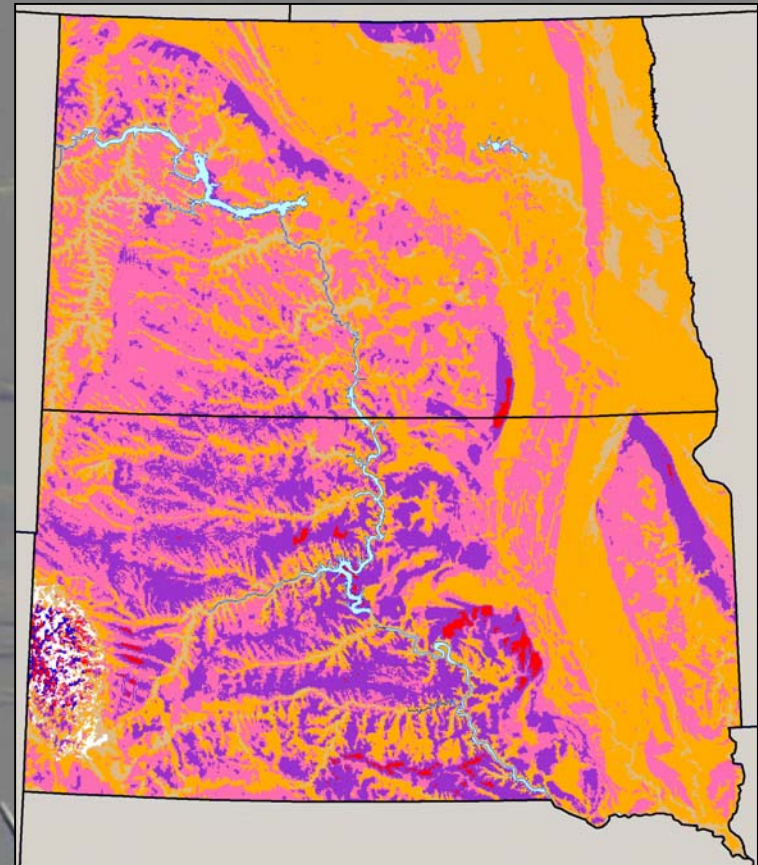




# Improved modeling of local wind resources



**1987**  
**U.S. Wind Atlas**  
**North & South Dakota**

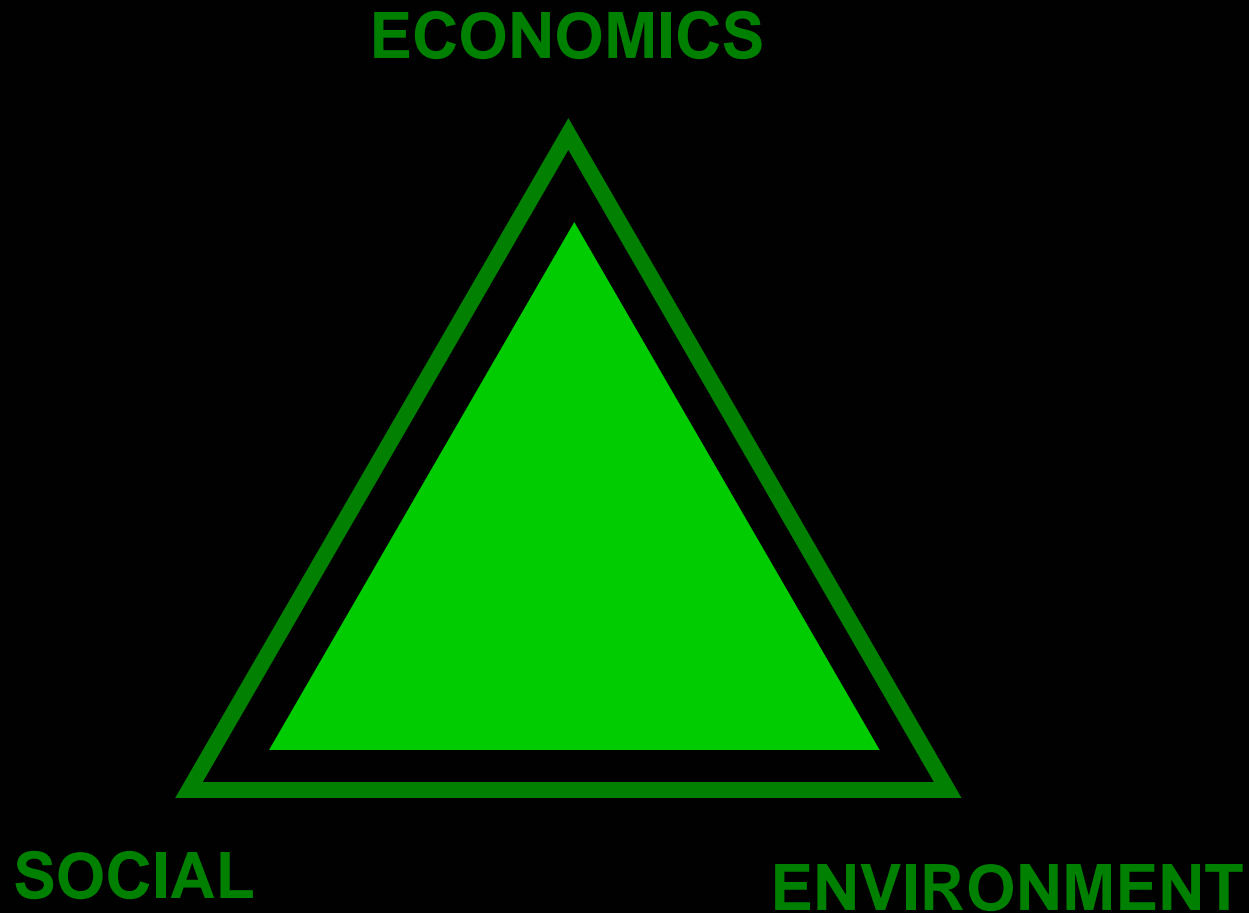


**2000**  
**High-Resolution**  
**(1-km<sup>2</sup>) Wind Map**

Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m <sup>2</sup>	Wind Speed* at 50 m m/s	Wind Speed* at 50 m mph
2	Marginal	200 - 300	5.6 - 6.4	12.5 - 14.3
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

\*Wind speeds are based on a Weibull k value of 2.0

# Triple Bottom Line Thinking: Commercial Wind Farms






## ECONOMICS

“ Building a wind farm is not cheap. On average, wind power development costs around \$1 million per megawatt (MW) of generating capacity installed. To take advantage of economies of scale, wind power facilities should be in excess of 20 MW. Assuming the average wind turbine is rated at 750 kilowatts (kW) in capacity, this means the installation of at least 26 turbines and an initial investment of \$20 million dollars. “

**From American Wind Energy Association factsheet *10 Steps in Building a Wind Farm***




**DSIRE**

[NC Solar Center](#)
[IREC](#)
[Contacts](#)
[About Us](#)
[NCSU](#)

**Federal Incentives for Renewables and Efficiency**

Note: Only selected federal incentives are provided. See [What federal incentives does DSIRE track](#) for more information.

[See All Summaries](#)

**Incentives**  
[Incentives List](#)  
[DSIRE Home](#)

**Financial Incentives**

**Corporate Deduction**

- [Energy Efficient Commercial Buildings Tax Deduction](#)

**Corporate Depreciation**

- [Modified Accelerated Cost-Recovery System \(MACRS\)](#)

**Corporate Exemption**

- [Residential Energy Conservation Subsidy Exclusion \(Corporate\)](#)

**Corporate Tax Credit**

- [Business Energy Tax Credit](#)
- [Energy Efficient Appliance Tax Credit for Manufacturers](#)
- [New Energy-Efficient Home Tax Credit for Builders](#)
- [Renewable Electricity Production Tax Credit \(PTC\)](#)

**Federal Grant Program**

- [Tribal Energy Program Grant](#)
- [USDA Renewable Energy Systems and Energy Efficiency Improvements Program](#)

**Federal Loan Program**

- [Clean Renewable Energy Bonds \(CREBs\)](#)
- [Energy Efficient Mortgage](#)
- [USDA Renewable Energy Systems and Energy Efficiency Improvements Program](#)

**Personal Exemption**

- [Residential Energy Conservation Subsidy Exclusion \(Personal\)](#)

**Personal Tax Credit**

- [Residential Solar and Fuel Cell Tax Credit](#)

**Production Incentive**

- [Renewable Energy Production Incentive \(REPI\)](#)

# ECONOMICS

- Corporate/Commercial renewable energy incentives apply to wind energy
- Examples;
  - Renewable Electricity Production Tax Credit
    - \$0.02/KWh, 10 years
  - Renewable Energy Production Incentive
    - \$0.015/KWh (1993, indexed for inflation) for 10 years
  - Modified Accelerated Cost-Recovery System
    - 5 year property for wind energy microturbines

# Improved Production Technology & Methods



- ◆ Better, more efficient turbines & blades
- ◆ Expedited construction methods
- ◆ Improving storage, transmission and inter-connect capabilities



- ◆ **Low social impacts compared to other production & industry**

- ◆ Less industrialized production on Brownfield (urban) reconstruction sites is healthier
- ◆ Integrates already with existing community infrastructures
  - ◆ “Electricity is electricity”
- ◆ Existing land use is relatively unchanged and unrestricted
- ◆ Few legacy issues to the community if some day removed

- ◆ **Commercial siting & permitting considerations**

- ◆ Archaeological and cultural studies
- ◆ Visual aesthetics and viewshed analyses
- ◆ Noise modeling and monitoring
  - ◆ Infrasound studies
- ◆ Shadow analysis
- ◆ Flicker analysis

**SOCIAL**

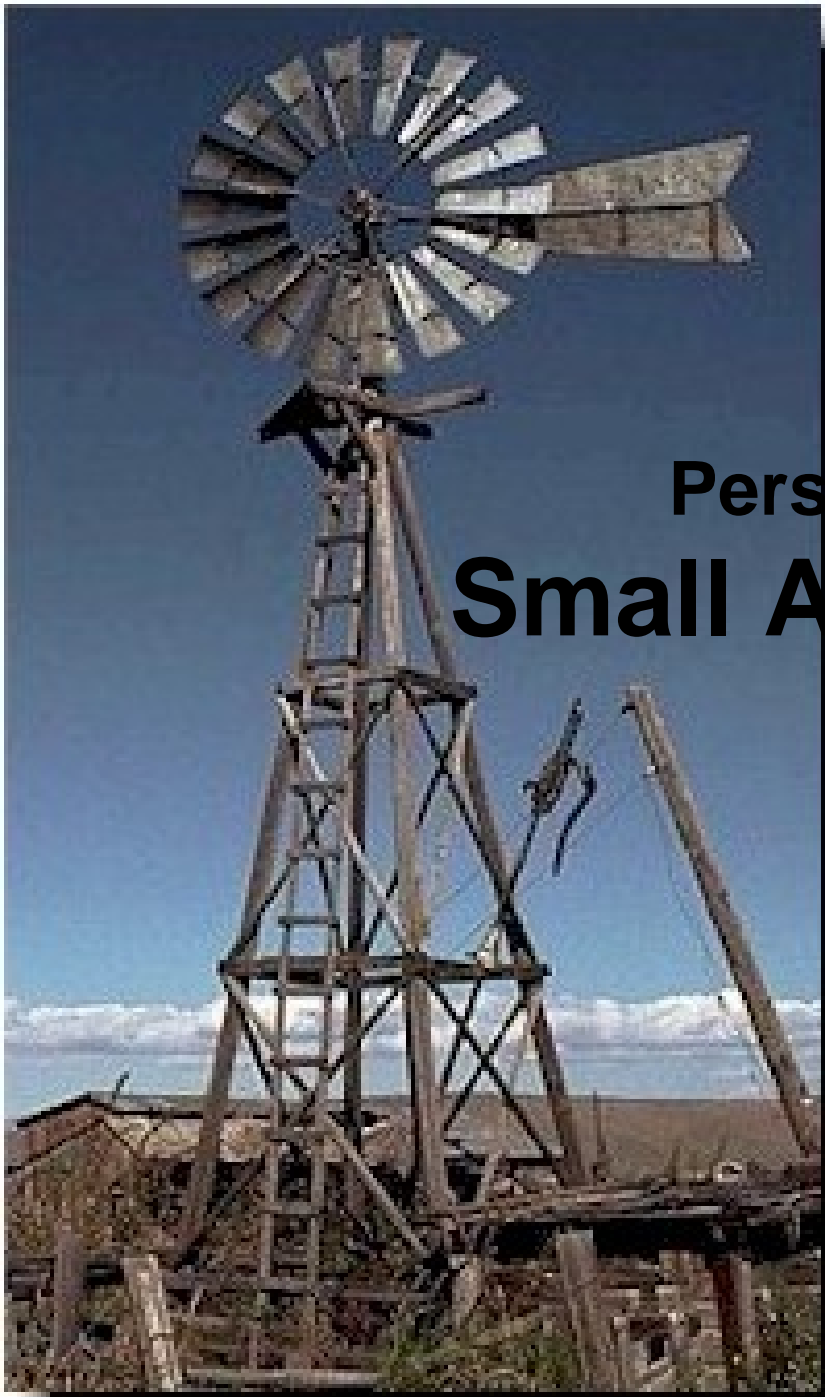


# ENVIRONMENT

- ◆ Although commercial wind energy is considered inherently 'green', wind farms are not without influence on the environment
- ◆ Builders must consider temporary construction and sustained operation impacts
- ◆ **Wildlife issues at permitting**
  - ◆ Avian species studies
  - ◆ Endangered and protected species and critical habitat disruption
    - ◆ KS prairie chicken
  - ◆ Bat species, collision and mortality studies
- ◆ **Physical environment**
  - ◆ Wetlands surveys and protection
  - ◆ Flood plain determinations
  - ◆ Storm water pollution prevention controls during construction







**Perspective:**  
**Small Agriculture**



It's  
Not New To  
Farmers

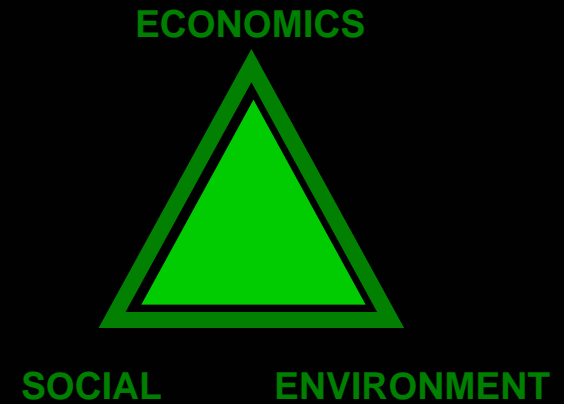
# Triple Bottom Line Thinking and One Farmer's Perspective

- ♦ Terry Lipp, Lipp Properties
  - ♦ 18 acre farm
    - ♦ Cattle and orchard
  - ♦ Edwardsville, Kansas
  - ♦ Farmer, Businessman,  
Geotechnical  
Engineering Technician
- ♦ The Vision in 2005
  - ♦ Convert farm buildings  
and farmhouse fully to  
alternative energy
  - ♦ Selected wind energy



# Why'd I Pick Wind Energy?

- ♦ **Economically, a viable system with reasonable operating histories to provide research information**
  - ♦ Reasonable payback, can resell surplus back to the grid at 150% of offset cost of utility power
  - ♦ Eligible for USDA renewable energy grant to defray 25% of costs.
  - ♦ Can resell power back to grid at 150% of offset cost of traditional power
- ♦ **Socially, low to no impact on farm operations**
  - ♦ Agricultural self sufficiency to farmhome and outbuildings in power outages.
  - ♦ Normal farm-related construction activities needed, able to self-build
  - ♦ Able to service/maintenance systems with farm operations
- ♦ **Environmentally, low impact to environment**



# Getting Started



- ◆ 2005
  - ◆ Personal research
  - ◆ Attended Kansas renewable energy seminars
- ◆ 2006
  - ◆ Found renewable energy grants by USDA
  - ◆ One of the very first in state of Kansas to apply with USDA for small wind
  - ◆ Hired assistance to help complete the USDA grant application

“The United States Department of Agriculture is providing up to \$22.8 million in grant funding to agricultural producers and small rural business owners interested in improving their energy efficiency or investing in renewable resource technology. The nationwide program, set up as part of the Farm Security and Rural Investment Act of 2002, is available to businesses in populations of 50,000 or less and to farmers and ranchers. “

2008 USDA Website



# Planning

## Other Processes



- ◆ **Special use permit process with local officials addressing tower over 40 feet high**
  - ◆ Address neighbor concerns of turbine noise
- ◆ **Notices of Construction for U.S. Department of Transportation, Federal Aviation Administration**
- ◆ **Kansas City Power & Light connection issues**
  - ◆ Offered \$0.02/kW, selling power to house @ ~\$0.07
    - ◆ Can't calculate 150% of utility offset cost because KCPL does not know cost
  - ◆ No net metering assistance in planning
- ◆ **Form RD 1940-20 Request for Environmental Information**
  - ◆ Demonstration that tower located in a cattle feedlot and pasture not significant



# Planning

## The USDA Grant Process



- ◆ USDA grant application March 2006
  - ◆ Sole proprietorship, rural small business
- ◆ USDA 2-page response May 2006
  - ◆ Dated May 1, 2006
  - ◆ Required 13 Forms and 4 significant modifications
  - ◆ Response required by May 12, 2006



# Planning

## Project Financing

ECONOMICS

- ◆ ~\$82,000 Project Estimate
  - ◆ \$1,000 Legal
  - ◆ \$7,000 Technical Services
    - ◆ \$5,000 Engineering
    - ◆ \$2,000 Inspections
  - ◆ ~\$66,000 Construction
    - ◆ \$63,500 Construction
    - ◆ \$2,500 Direct Expenses
  - ◆ \$8,000 Contingency Fees



### Reality Checks

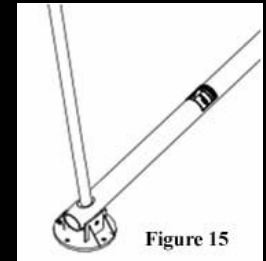
- ✓ USDA denies upfront expenses to prepare information for grant
- ✓ Will not allow self build, can rent farm equipment to contractor ...
- ✓ Will not allow power to be used for house ... small business grant

# Planning

## Technology Selection

- ◆ Industry has improved small turbine technology – higher reliability, lower maintenance
  - ◆ Small turbines range from 20 W to 100 kW
  - ◆ 3-4 moving parts means low maintenance
  - ◆ 20- to 40-year design life
  - ◆ Proven technology – 150,000 installed; over a billion operational hours

## ECONOMICS



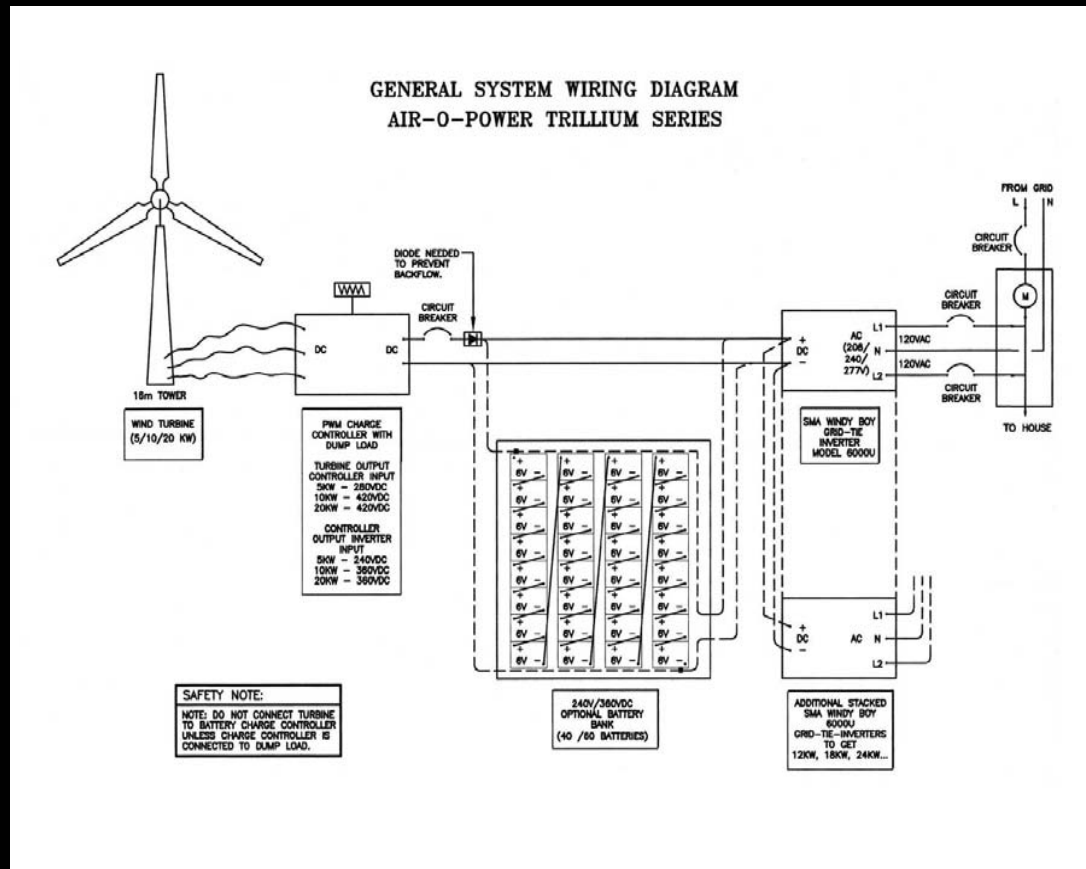
### My Project

- ◆ Considered one 10KW turbine, but selected two 5KW turbines
  - ◆ Maximum 8KW output each
  - ◆ Always have one operating
  - ◆ Air-O-Power Trillium Series
- ◆ Turbine output increases with height, went to 80-foot tower
- ◆ Tilt up tower bases
  - ◆ No crane installation
  - ◆ Lower in tornado conditions



# Planning & Reality

## Electrical

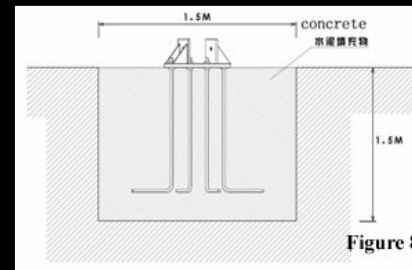
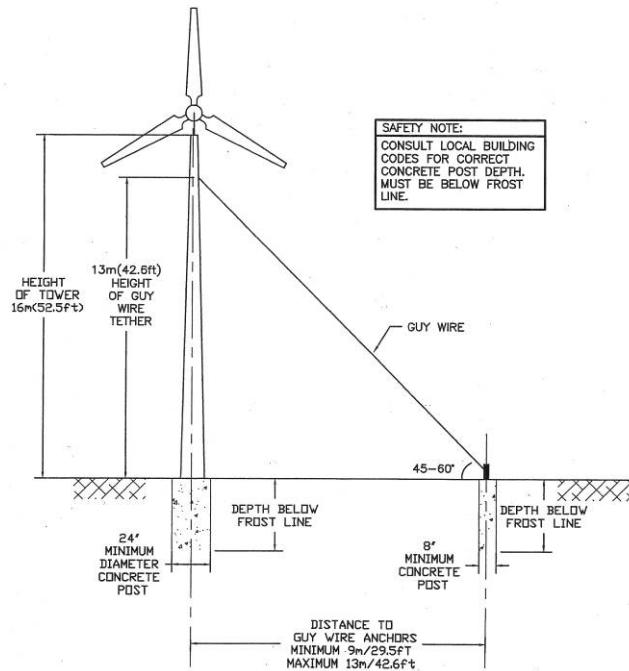


# Planning & Reality

## Foundation Engineering

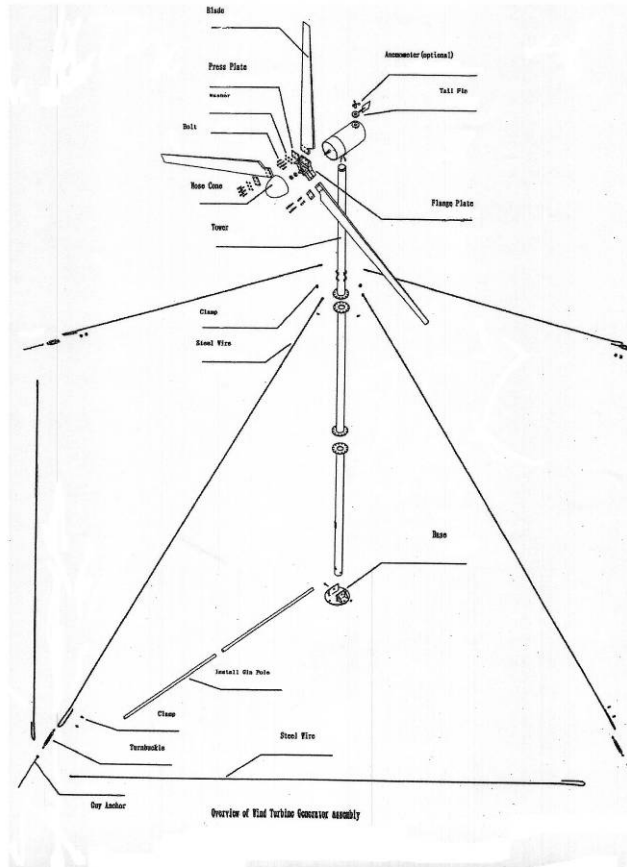


### TOWER CONCRETE REQUIREMENTS AIR-0-POWER 16m TOWERS



# Planning & Reality

## Engineering

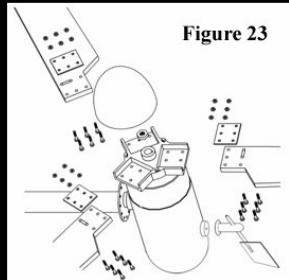




# Planning & Reality

## Construction

ECONOMICS

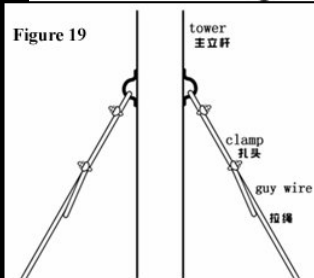


tower  
主立杆

guy wire  
拉绳

gin pole  
辅助立杆

Figure 19



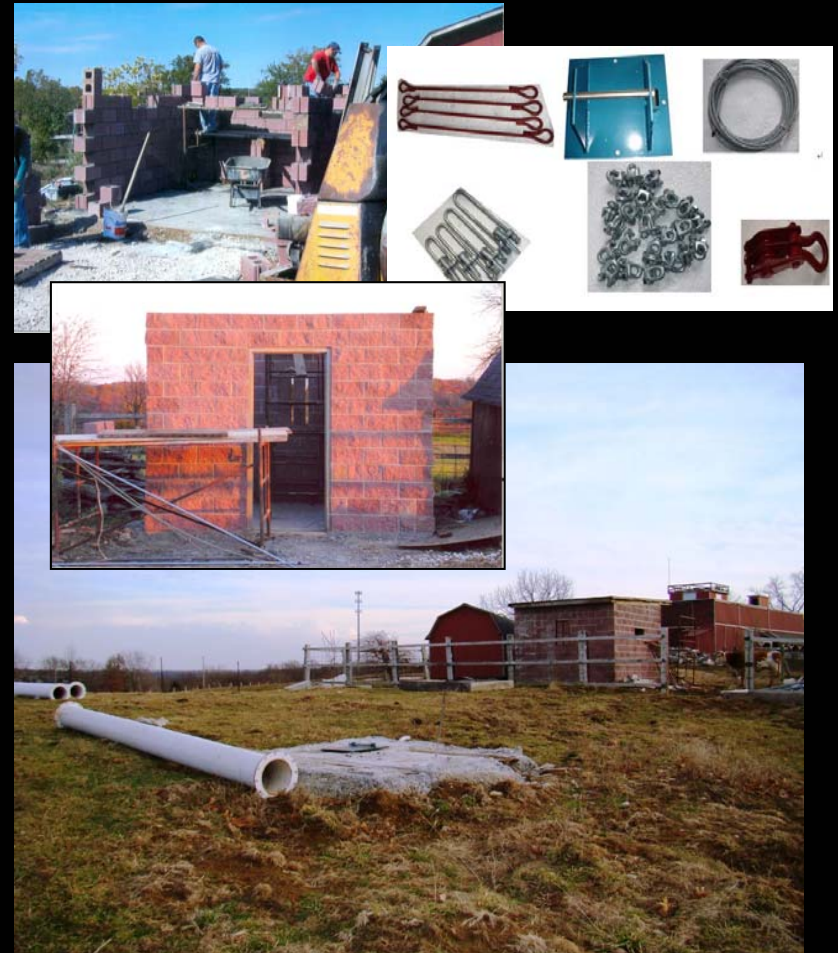
7.0m

7.0m

4.0M

4.0M

4.0M





# 5 Greatest Hurdles

Many of these since addressed by USDA as part of my experience

- ◆ **The extensive USDA application process for a small farming operation with a small renewable energy construction project**
  - ◆ Essentially no different than if constructing two large wind turbines
- ◆ **Grant approval process**
- ◆ **Ineligible expenses not covered by 25%**
- ◆ **Equipment vendor problems**
  - ◆ Poor communication, changed swivel base without discussion
  - ◆ Lack of manufacturing documentation required by USDA
    - ◆ Addition studies
- ◆ **Grid connection headaches with KCPL**
  - ◆ Not prepared for a rural/agricultural small power producer
  - ◆ Lack of coordination, communication and support before actual connection

# Terracon

Delivering Success for Clients and Employees



**A CESAS Member**

# Thank You

**Dave Koch**  
**Senior Principal / Corporate Sector Leader**  
**Renewable Energy & Brownfield Services**  
**dekoch@terracon.com**  
**800.593.7777**

**Terry Lipp**  
**Owner / Operator**  
**Lipp Properties**  
**Edwardsville, KS**