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Distributed Wind Energy

Why Distributed Wind?

- Rapid deployment
- Proven Technology
- Demand-side (core competency)
- Economically compelling
- Low Risk

- Part of the solution

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Small Wind Turbines Are Different

- Utility-Scale Wind Power
  600 - 1,800 kW wind turbines
  - Installed on wind farms, 10 – 300 MW
  - Professional maintenance crews
  - 13 mph (6 m/s) average wind speed
- Small Wind Power
  300 W - 100 kW wind turbines
  - Installed at individual homes, farms, businesses, schools, etc.
  - On the “customer side” of the meter, or off the utility grid entirely
  - High reliability, low maintenance
  - 9 mph (4 m/s) average wind speed

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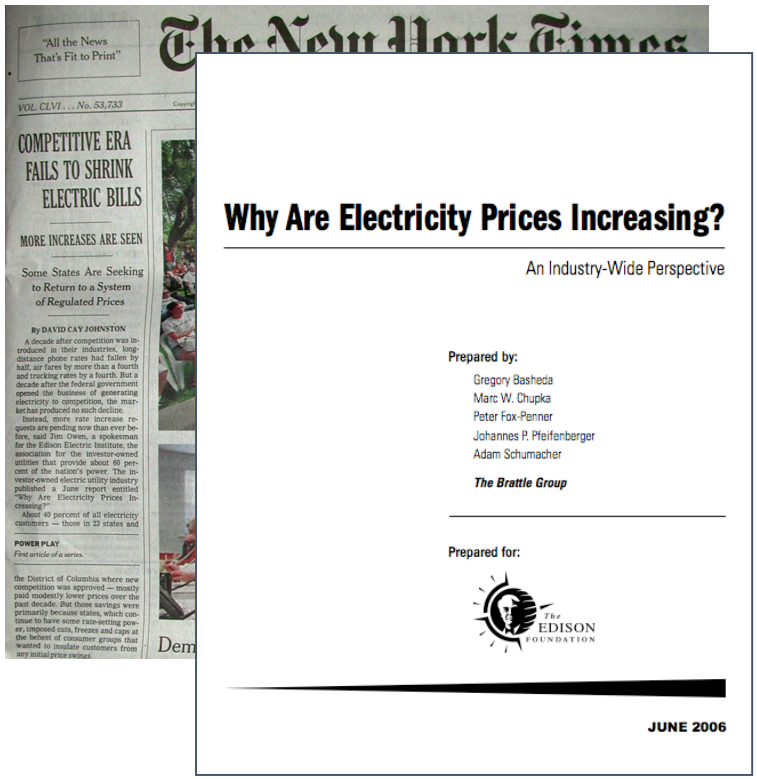
Economic Drivers for Distributed Wind

Energy and finance sectors agree electricity costs will rise



"All the News That's Fit to Print"

The New York Times

VOL. CLVI . . . No. 53,733

COMPETITIVE ERA FAILS TO SHRINK ELECTRIC BILLS

MORE INCREASES ARE SEEN

Some States Are Seeking to Return to a System of Regulated Prices

By DAVID CAY JOHNSTON

A decade after competition was introduced in their industries, long-distance phone rates had fallen by half, air fares by more than a fourth and trucking rates by a fourth. But a decade after the federal government opened the business of generating electricity to competition, the market has produced no such decline.

Instead, more rate increase requests are pending now than ever before, said Jim Owen, a spokesman for the Edison Electric Institute, the association for the investor-owned utilities that provide about 60 percent of the nation's power. The investor-owned electric utility industry published a June report entitled "Why Are Electricity Prices Increasing?"

About 40 percent of all electricity customers — those in 23 states and the District of Columbia where new competition was approved — mostly paid modestly lower prices over the past decade. But those savings were primarily because states, which continue to have some rate-setting power, imposed cuts, freezes and caps at the behest of consumer groups that wanted to insulate customers from any initial price swings.

POWER PLAY

First article of a series.

Why Are Electricity Prices Increasing?

An Industry-Wide Perspective

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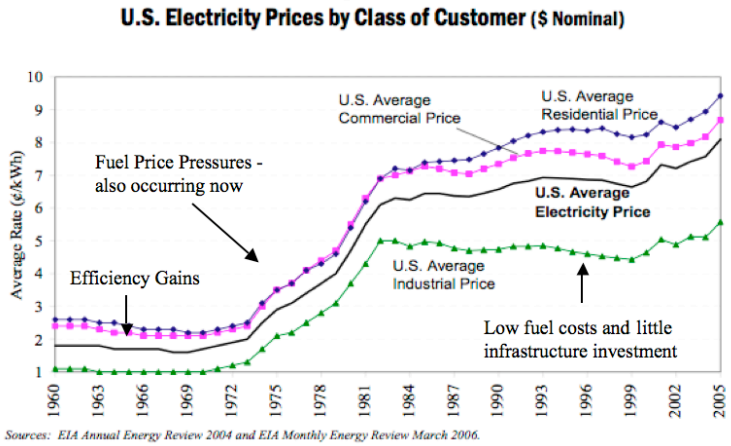
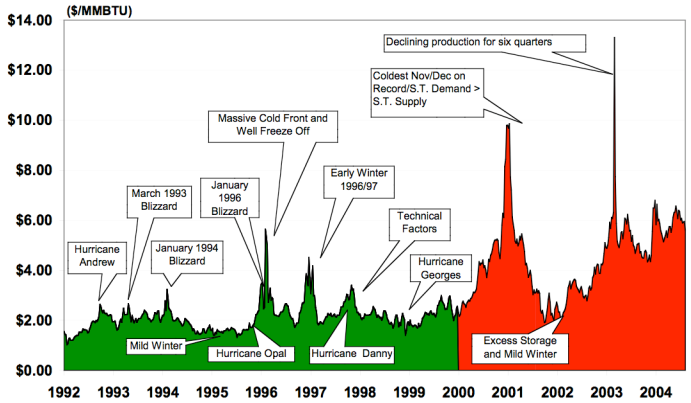
Prepared for:

The EDISON FOUNDATION

JUNE 2006



Sources: EIA Annual Energy Review 2004 and EIA Monthly Energy Review March 2006.



Source: NGW and EVA, Inc.

March 06' Lehman Brothers

"Infrastructure investments and high fuel costs spell rate shock, demand destruction and regulatory risk for traditional utilities. The projected 10 percent annual increases through the next four years could pain consumers, pressure politicians and harden regulators…"

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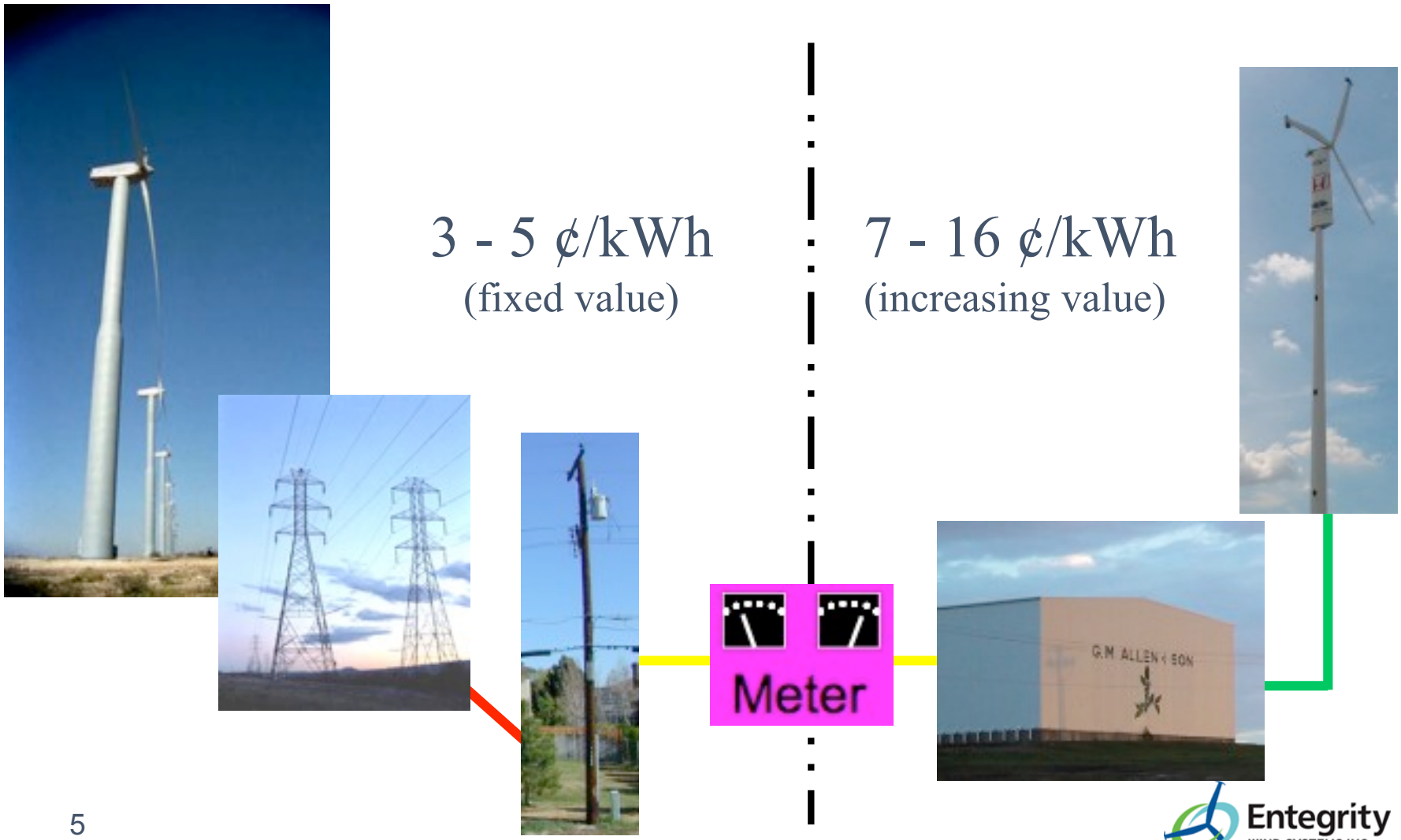
Valuing Distributed Wind



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Typical Distributed Wind Development Process

1. Assess electricity consumption, cost, and utility tariff
2. Become more energy efficient → reduce consumption
3. Estimate or measure wind resource
4. Select turbine sizes (models) and tower height
    1. Choose scale
    2. May be a combination of sizes
        1. Permaculture?
5. Investigate incentives & economics
6. Get zoning approval

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Typical Distributed Wind Development Process

7. Complete a utility interconnection agreement
8. Obtain building & electrical permits
9. Order turbine and tower
10. Install the turbine
11. Commission the turbine
12. Perform periodic inspections & maintenance

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Distributed Wind Development Process

- Iterative Process
  - General siting exercise
  - Assumptions

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Step 1

- Choose a location
- Improve understanding of interplay of
  - Wind Resource
  - Grid proximity
  - Setbacks

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Small Wind Resource Assessment

- On-site resource measurement
  - Expensive
  - Correlation to long-term data sets is non-trivial
  - Uncertainty of resource can be lower than the uncertainty of the cost of energy (volatile)
  - Smaller scale/lower risk

- Desktop Resource Assessment with Good Micrositing can yield high-confidence performance estimates

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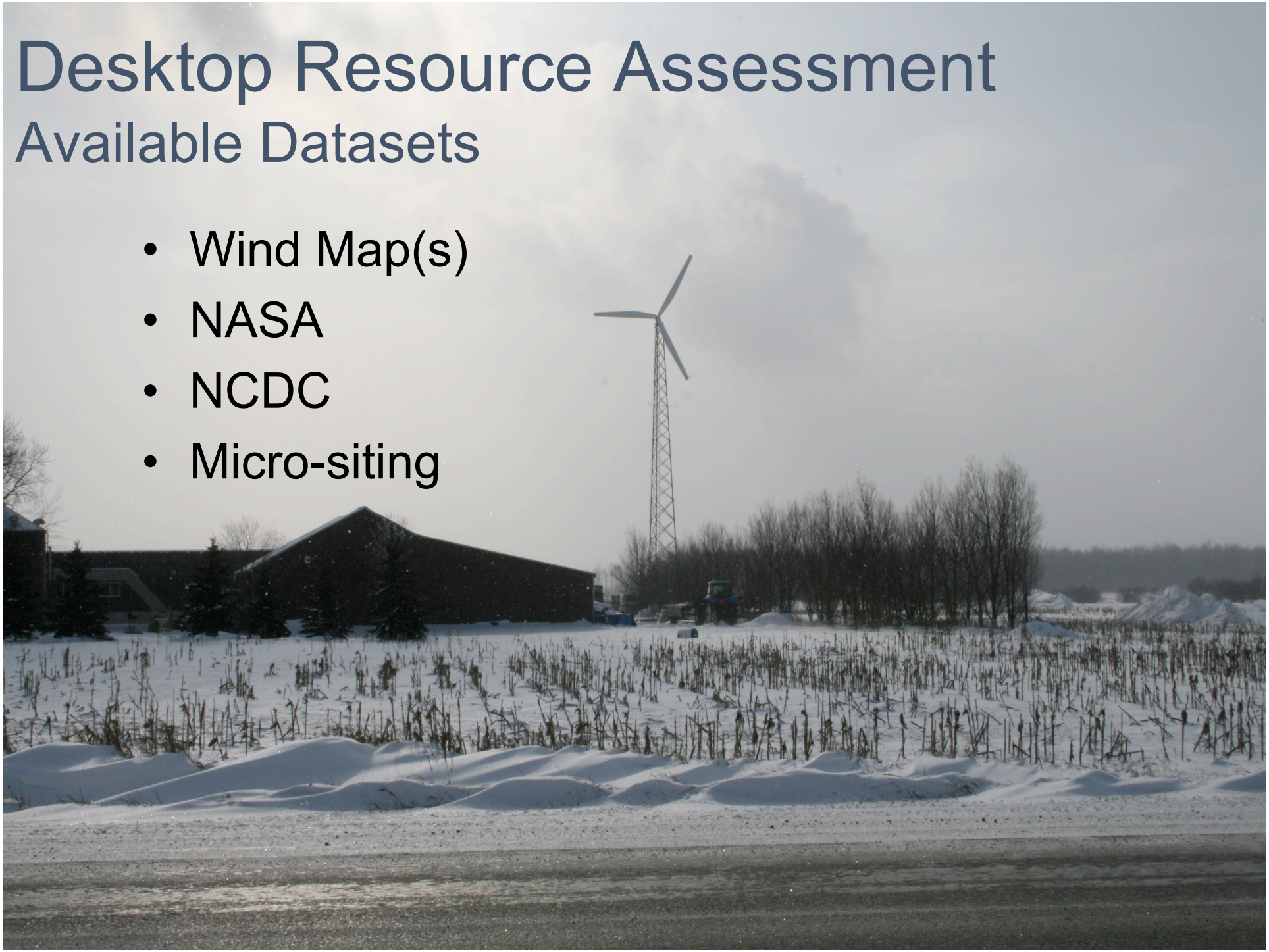
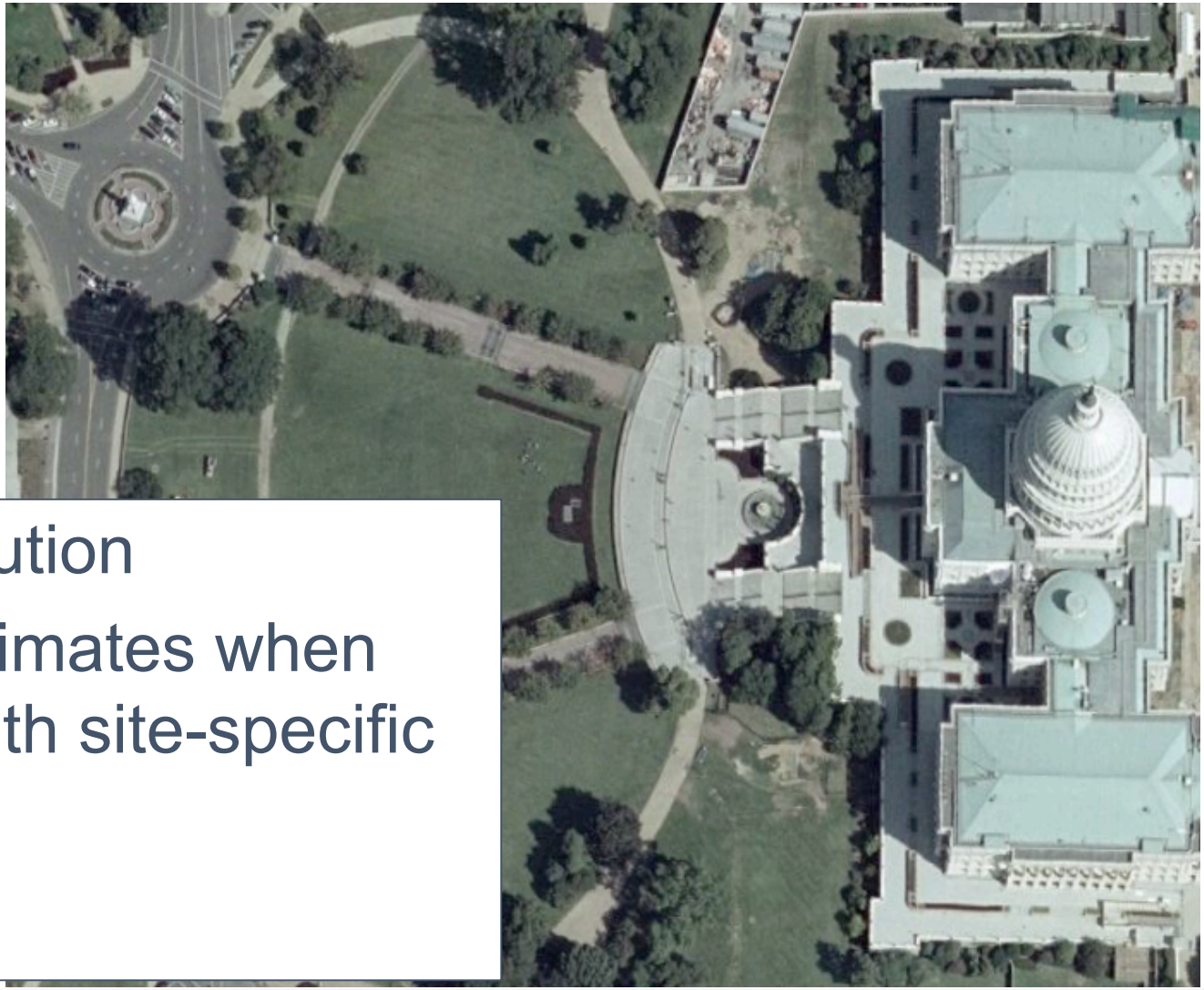
Desktop Resource Assessment

Available Datasets

- Wind Map(s)
- NASA
- NCDC
- Micro-siting



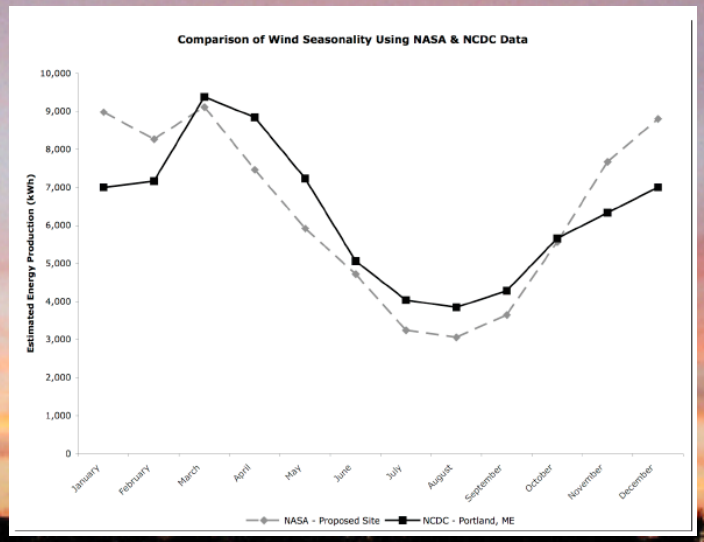
Wind Maps – NREL, AWS Truewind



- 200m Resolution
- Effective estimates when combined with site-specific information

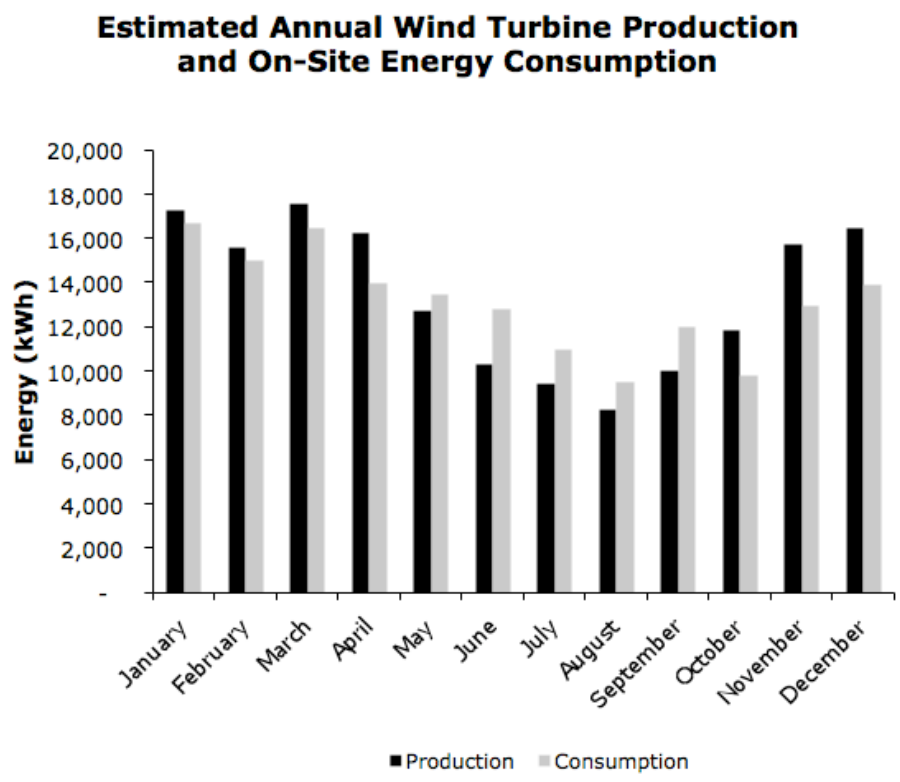
Beyond the Basics

- Correlate Sources
- Evaluate Seasonality
- Site-specific considerations



Seasonality

- Helps evaluate net monthly excess power generated
- Policy interactions



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Shade Rose Calculations

Wind Energy in per cent of Wind Energy Without Obstacle

m height

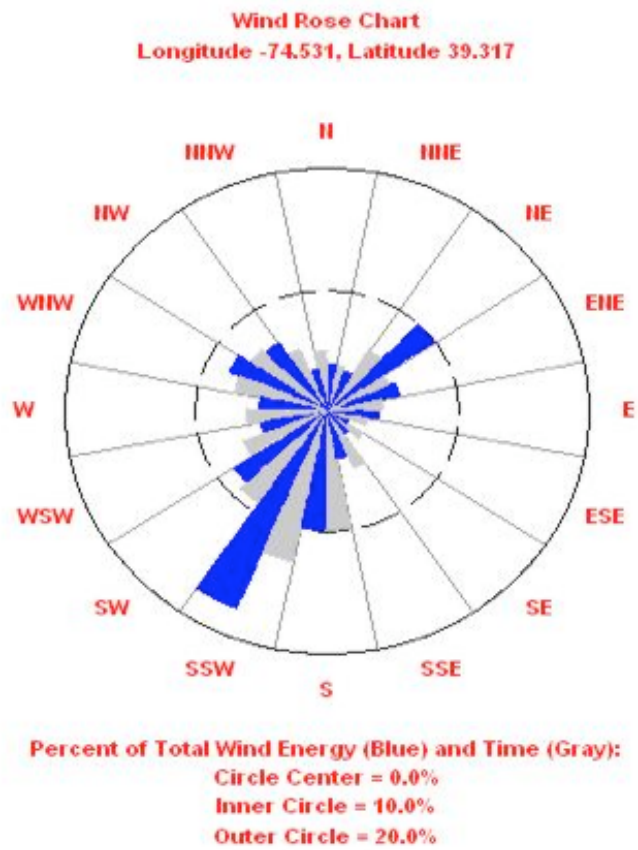
75	100	100	100	100	100	100	100	100	100	99	99	99	99	99	99	99	99	98	98	98	98
73	100	100	100	100	100	100	100	100	99	99	99	99	99	99	98	98	98	98	98	98	98
70	100	100	100	100	100	100	100	99	99	99	99	98	98	98	98	98	98	98	98	98	98
68	100	100	100	100	100	100	99	99	99	98	98	98	98	98	97	97	97	97	97	97	97
65	100	100	100	100	100	100	99	99	98	98	98	97	97	97	97	97	97	97	97	97	97
63	100	100	100	100	100	99	99	98	98	97	97	97	96	96	96	96	96	96	96	96	96
60	100	100	100	100	99	99	98	98	97	96	96	96	96	95	95	95	95	95	95	95	95
58	100	100	100	100	99	98	98	97	96	95	95	95	95	94	94	94	94	94	95	95	95
55	100	100	100	99	99	98	97	96	95	94	94	93	93	93	93	93	93	94	94	94	94
53	100	100	100	99	98	97	95	94	93	92	92	92	92	92	92	92	92	93	93	93	93
50	100	100	100	98	97	95	93	92	91	90	90	90	90	90	91	91	91	91	92	92	92
48	100	100	99	97	95	93	91	89	88	88	88	88	88	88	89	89	90	90	91	91	91
45	100	100	98	96	93	90	88	86	85	85	85	85	86	87	87	88	88	89	89	90	90
43	100	99	97	93	90	86	84	82	81	81	82	83	84	84	85	86	87	87	88	89	89
40	100	99	95	90	85	82	79	78	77	77	79	80	81	82	83	84	85	86	87	88	88
38	100	98	91	85	79	76	74	72	72	73	75	76	78	80	81	82	83	85	86	86	87
35	100	95	86	78	72	69	67	67	67	68	71	73	75	77	79	80	82	83	84	85	86
33	99	91	78	69	63	61	60	60	61	64	67	70	72	74	77	78	80	82	83	84	85
30	98	83	67	57	53	52	52	53	55	59	63	66	69	72	75	77	79	80	82	83	85
28	96	71	53	45	42	43	44	47	50	54	59	63	67	70	73	75	77	79	81	83	84
25	89	53	36	31	31	34	37	40	44	50	55	60	64	68	71	74	76	78	80	82	84
23	74	31	20	19	22	26	31	35	40	46	52	58	62	66	70	73	76	78	80	82	83
20	47	11	8	10	14	19	25	30	36	43	50	56	61	65	69	72	75	78	80	82	83
18	14	1	1	4	8	14	20	27	33	41	48	55	60	65	69	73	76	78	80	82	84
15				1	5	11	18	25	32	40	48	55	61	66	70	73	76	79	81	83	85
13					3	10	17	25	33	42	50	57	63	68	72	75	78	80	83	84	86
10					3	10	19	28	36	45	54	60	66	71	75	78	80	83	85	86	88
8					5	15	25	34	43	52	60	66	71	75	79	82	84	86	87	89	90
5				3	13	26	37	47	55	62	69	74	78	82	84	87	88	90	91	92	93
3			5	21	37	50	60	67	73	78	82	86	88	90	91	93	94	94	95	96	96
	21	43	64	86	107	129	150	171	193	214	236	257	279	300	321	343	364	386	407	429	450 m

= Obstacle height 20 m = Hub height 50 m

Roughness length = 0.055; Porosity = 0; Obstacle width = 60 m

Note: Vertical and horizontal scales are different. Horizontal scale shows distance from obstacle.

© 1998, 2003 Danish Wind Industry Association



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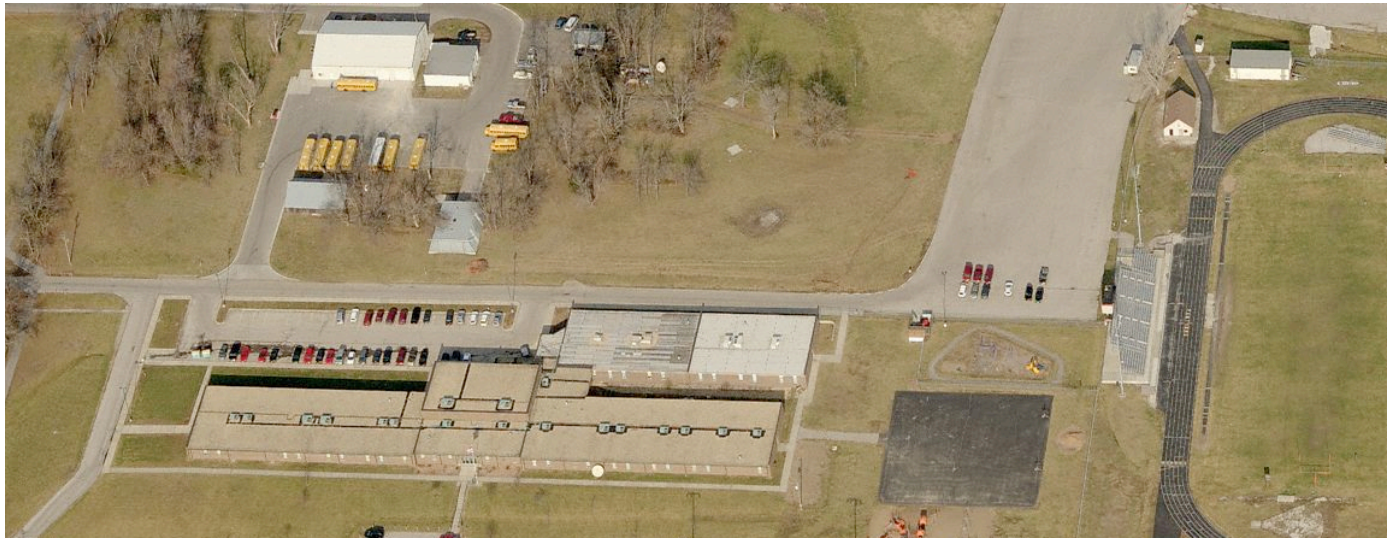
.055m roughness length

.3m roughness length



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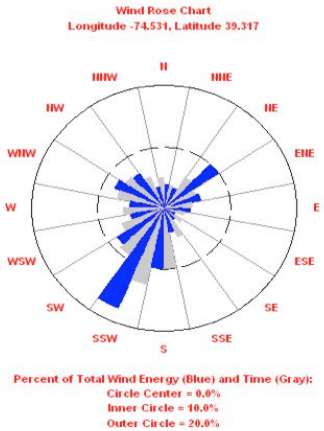
Wind Micrositing



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Grid Interconnection and Setbacks

- Grid costs
  - $10 - $20 per foot plus transformers
- Setbacks
  - Scale dependent
    - Residential scale - 50’ and up
    - Commercial scale - 400’ and up
  - Background noise dependent

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Steps 2+

- Adjust scale/location/strategy
- Conduct soil studies (as appropriate)
- Develop foundation design
- Develop electrical design
- Procure fixed/firm bids
- Develop final pro-forma

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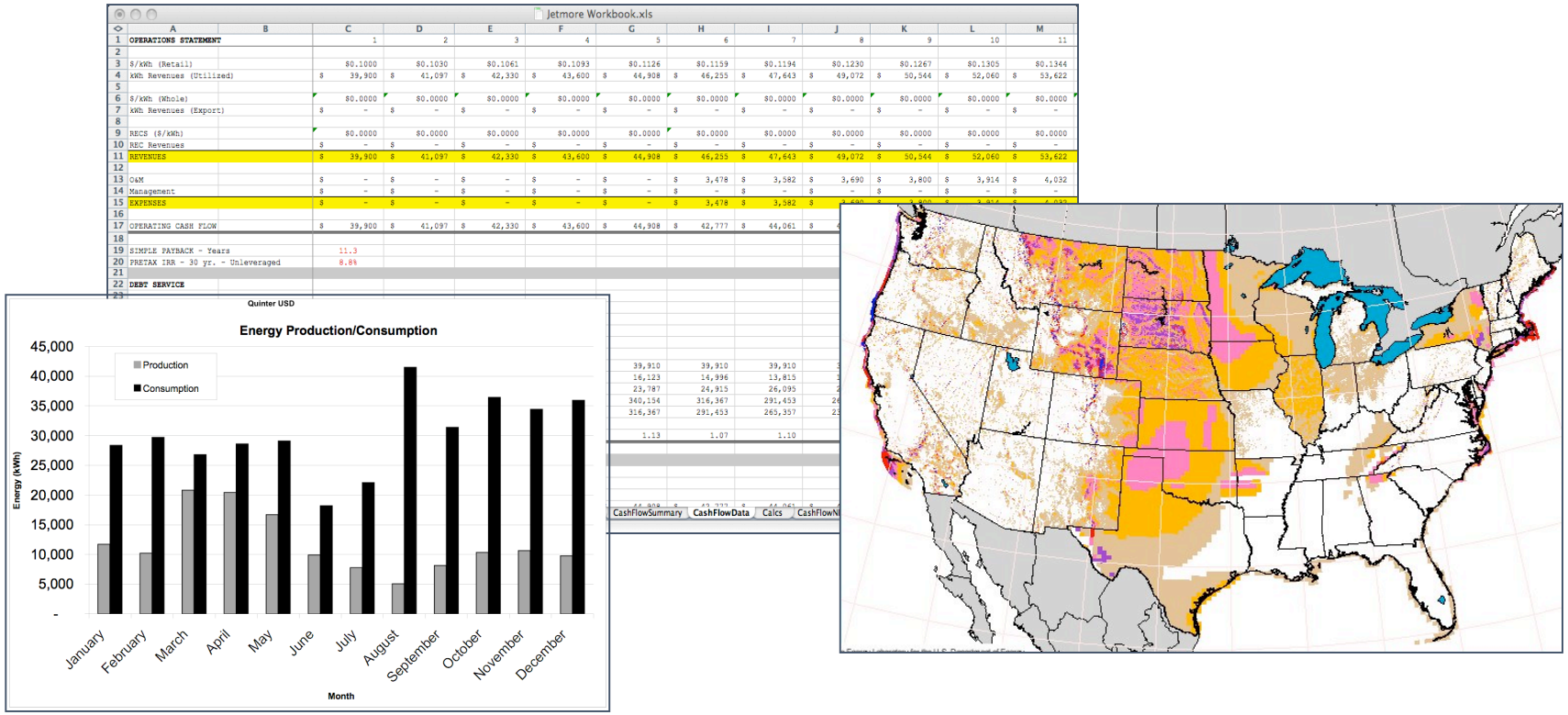
Developing the Case for Small Wind



- Analysts use computer modeling, energy consumption, financial and site information to produce an economic analysis
- http://navigator.awstruewind.com/
- http://firstlook.3tiergroup.com/

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Ingredients for Success

- Critical
  - Experienced Development Team
  - Wind Resource
  - Moderate to High Cost of Energy
  - Load Match
  - Appropriate Site
  - Utilities That Cooperate
- Helpful
  - Green Energy Markets
  - Policy
  - Corporate, Institutional, Community Values

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Frequently Asked Questions - Siting

- Radio/TV Interference: Not a problem with today's fiberglass or wood blades (no metal blades!)
  - Can affect line-of-site/paired antennas
- Noise:
  - < 30 mph, soft "swoosh" sound
  - > 30 mph, some can get either "flutter" or a "helicopter" sound
  - Noise test reports on the Web: http://www.nrel.gov/docs/fy04osti/34662.pdf
- Impact on Birds: Bird kills are rare, use common sense in siting turbines
- FAA Regulations:
  - Proximity to local airport versus tower height
  - Investigate if within ~3 miles

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Maintenance, Warranty, and Lifetime

- "Low Maintenance" not "No Maintenance"
  - Periodically inspect mechanical and electrical connections, check for corrosion, check guy wire tension, inspect/replace leading-edge tape, etc.
  - Beyond 10 years: blade or bearing replacement may be needed
- Warranties
  - 2-5 years, coverage of materials and workmanship
- Lifetimes of 15 to 30 years with regular maintenance

"A wind turbine will see as many operating hours in <u>one year</u> as an automobile will see in 200,000 miles!"

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New Technology Questions

- What is the performance?
  - Power curve or annual energy output
  - System performance (power to the grid)
- Was this performance measured in a field test?
  - Not estimated, not from wind tunnel or truck testing
- Has this performance been independently verified?
- Is it labeled for compliance with UL 1741?
  - For safe interconnection to the utility grid
- Is it compliant with an IEC design/safety standard?
- Who can provide parts and service?
- What is the warranty?
- Where has it been demonstrated?
- Is price estimated, or based on real manufacturing experience?

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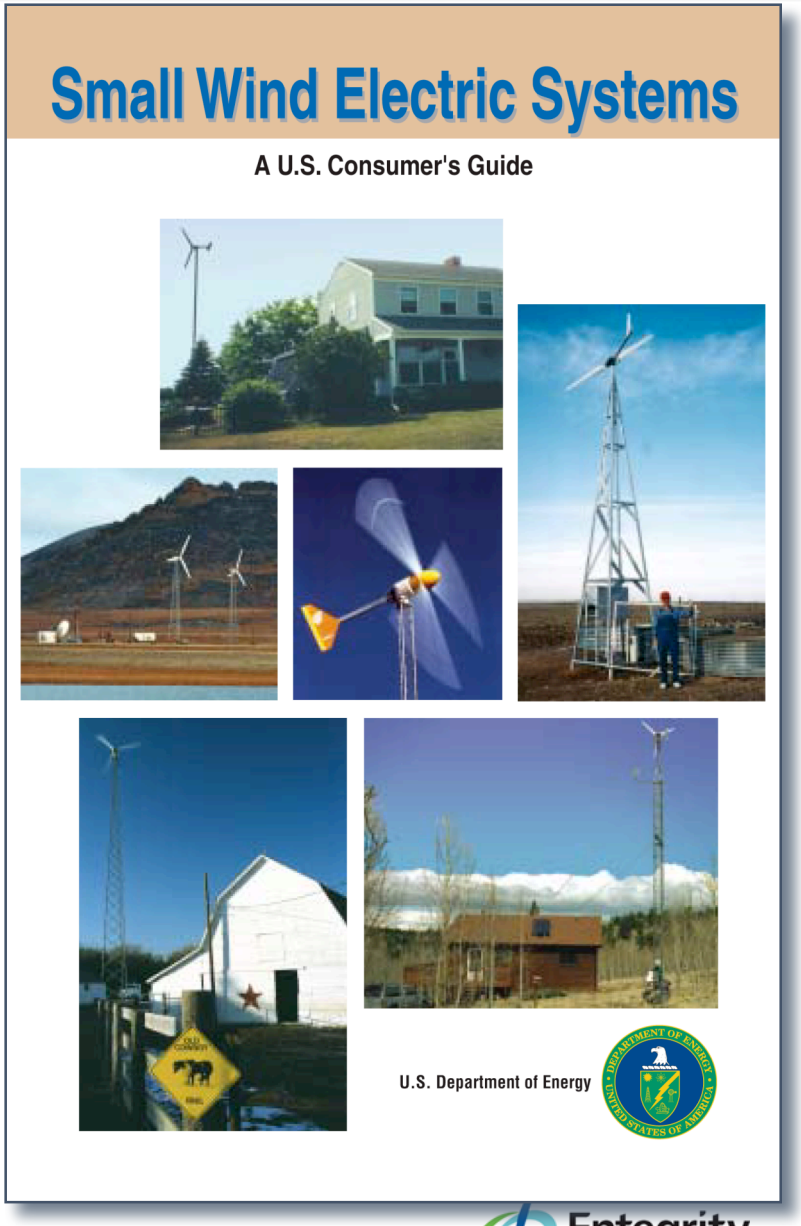
More information

National Renewable Energy Laboratory:
www.windpoweringamerica.gov

American Wind Energy Association:
www.awea.org



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