

Overcoming Barriers

Expanding the Market for Small Wind Energy Systems



- **Small Wind 102: Economics**
Making the numbers work
- **Small Wind 103:**
Siting Issues
***Addressing permit requirements,
height restrictions, and
environmental concerns***
- **Small Wind 104: Grid
Interconnection**
***Reaching an agreement
with your utility***

Overcoming Barriers

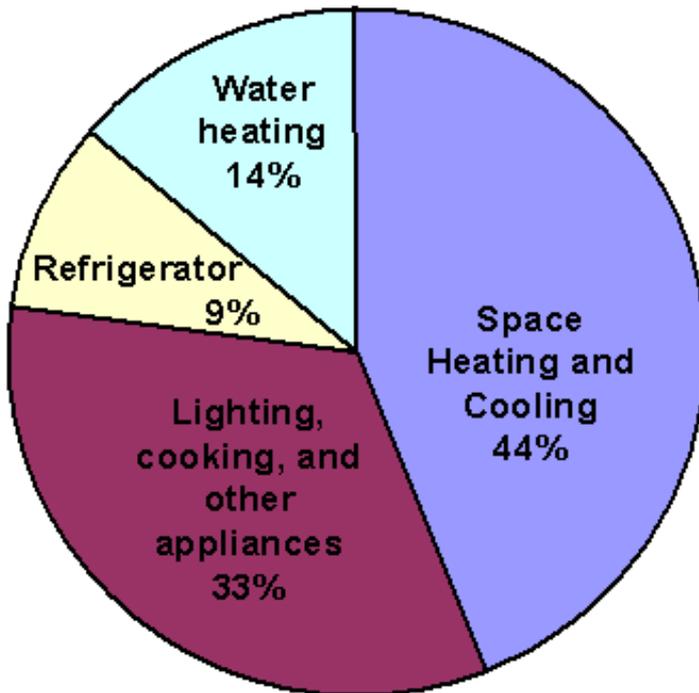
Small Wind 102: Economics *Making the numbers work*



Before You Buy

Economics will depend on system chosen, local wind resource, electricity costs, and how you use your wind system

Average Home Energy Use



Evaluate energy efficiency options first!

Approach investment as you would any other major purchase – do your homework

Installation Costs



- **Estimate \$2-4/installed watt for typical system**
- **Smaller systems require smaller initial outlay, but cost more per watt**
- **Taller towers cost more, but usually reduce the payback period**

A 4-10 kW system can meet the needs of a typical home

Customers paying 12 cents/kWh or more for electricity with average wind speeds of 10 mph or more can expect a payback period of 8-16 years

Factors Affecting Payback

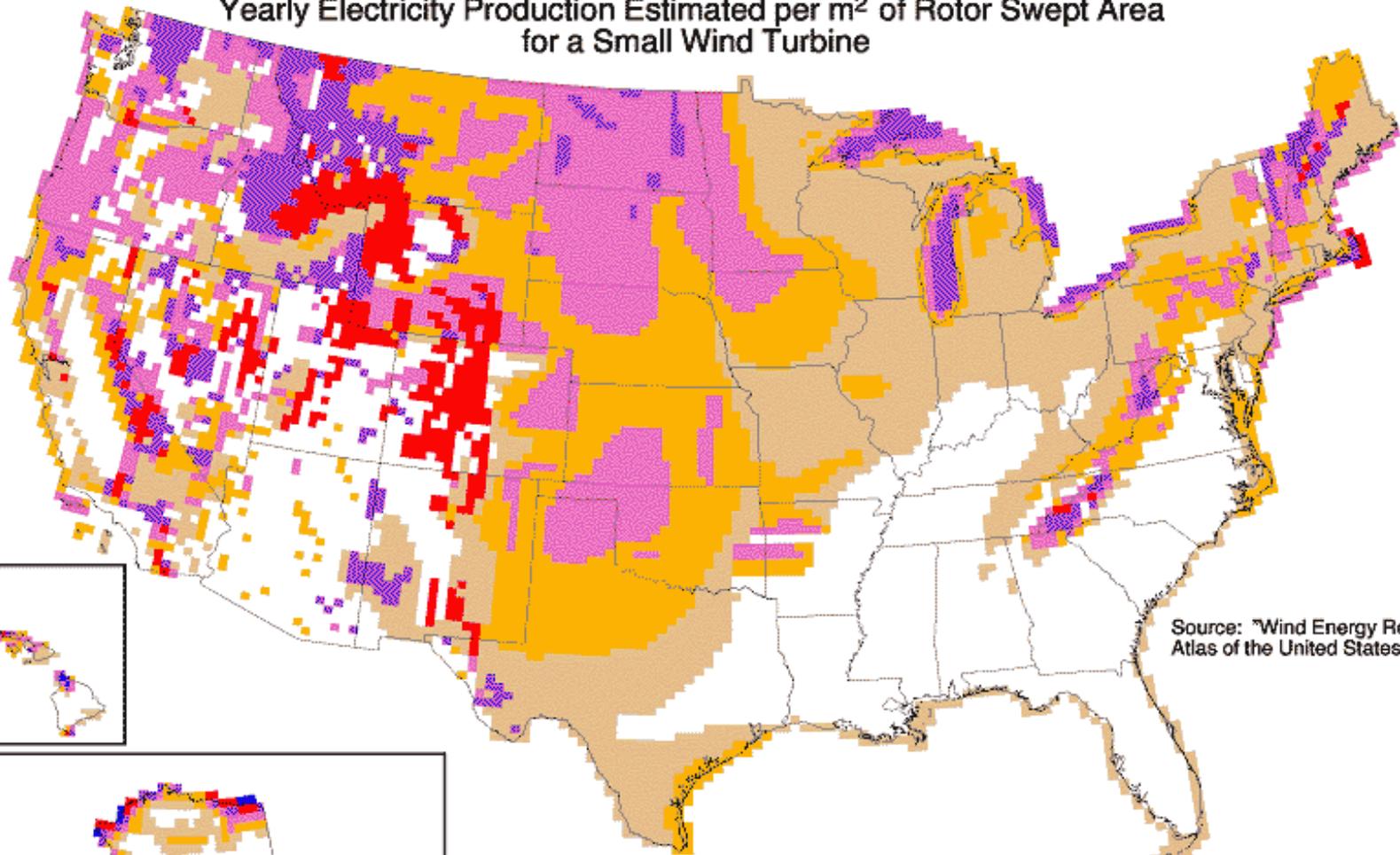
- Type, size and configuration of system
- Wind resource
- Local cost of electricity
- How wind system is used
- Rebates available, if any



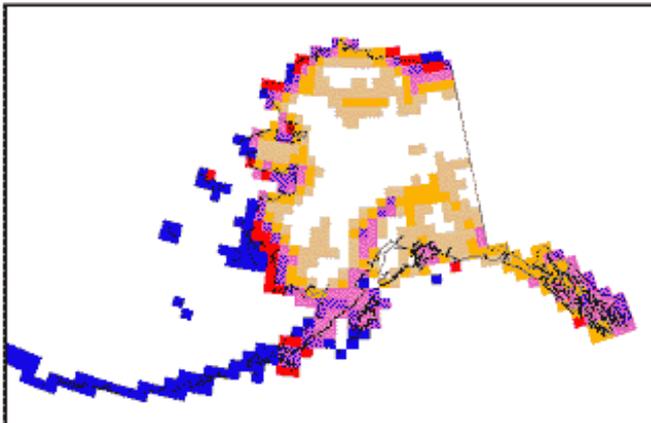
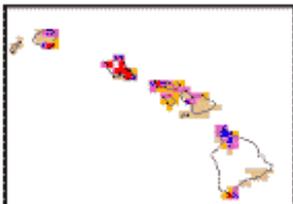
If you can participate in a California-type 50% buy-down program, have net metering and average annual winds of at least 15 mph (6.7 m/s), your system can pay for itself in about 6 years

United States - Wind Resource Map

Yearly Electricity Production Estimated per m² of Rotor Swept Area for a Small Wind Turbine



Source: "Wind Energy Resource Atlas of the United States", 1987



Small Wind Turbine Productivity Estimates*

Wind Power Class	Productivity per m ² of swept area** (kWh/year)	Wind Power Density at 33 ft (10 m) (W/m ²)	Wind Speed at 33 ft (10 m) (mph)	Wind Speed at 33 ft (10 m) (m/s)
1	< 350	<100	< 9.8	< 4.4
2	350 - 500	100 - 150	9.8 - 11.5	4.4 - 5.1
3	500 - 610	150 - 200	11.5 - 12.5	5.1 - 5.6
4	610 - 690	200 - 250	12.5 - 13.4	5.6 - 6.0
5	690 - 770	250 - 300	13.4 - 14.3	6.0 - 6.4
6	770 - 880	300 - 400	14.3 - 15.7	6.4 - 7.0
7	880 - 1170	400 - 1000	15.7 - 21.1	7.0 - 9.4

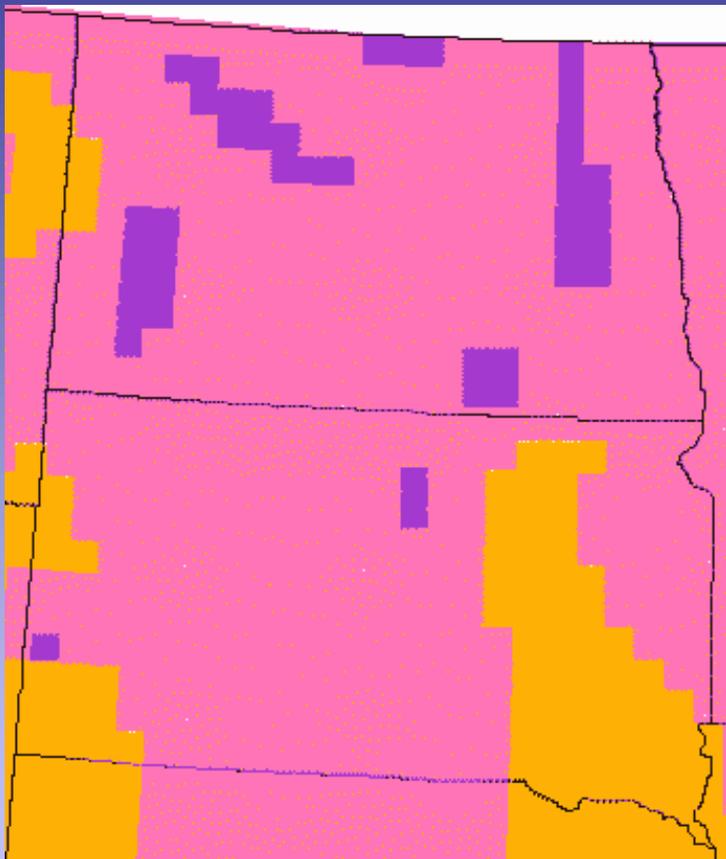
* Estimates are based on different models and sizes of wind turbines assuming a tower height of 80 ft (24 m).

** For systems of different sizes, multiply the estimated productivity by the total swept area of the turbine.

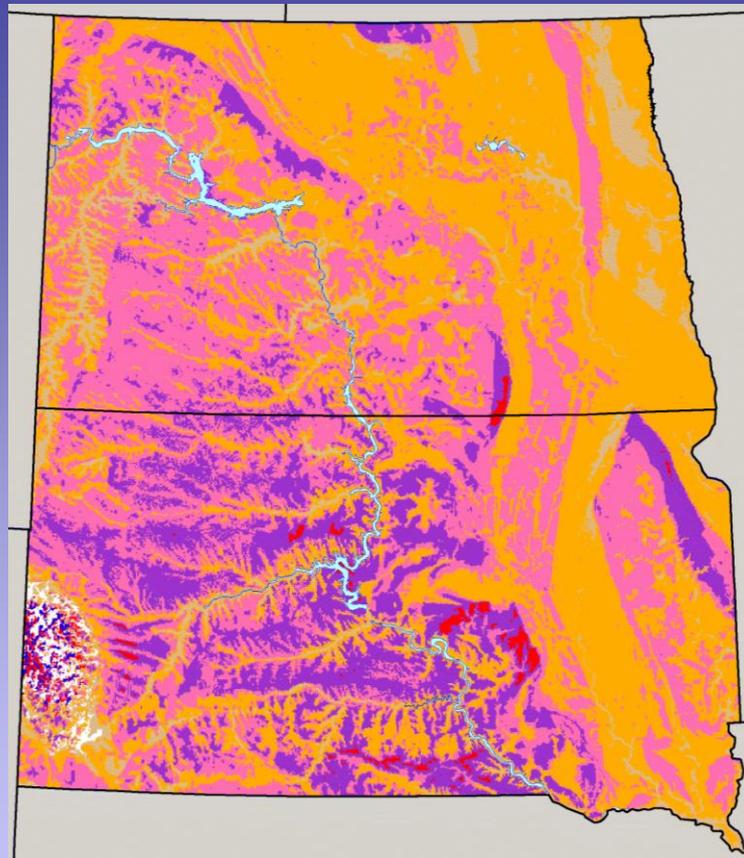
U.S. Department of Energy
National Renewable Energy Laboratory



New GIS Modeling Techniques Can Provide Substantially More Wind Resource Information



1987
U.S. Wind Atlas
North & South Dakota



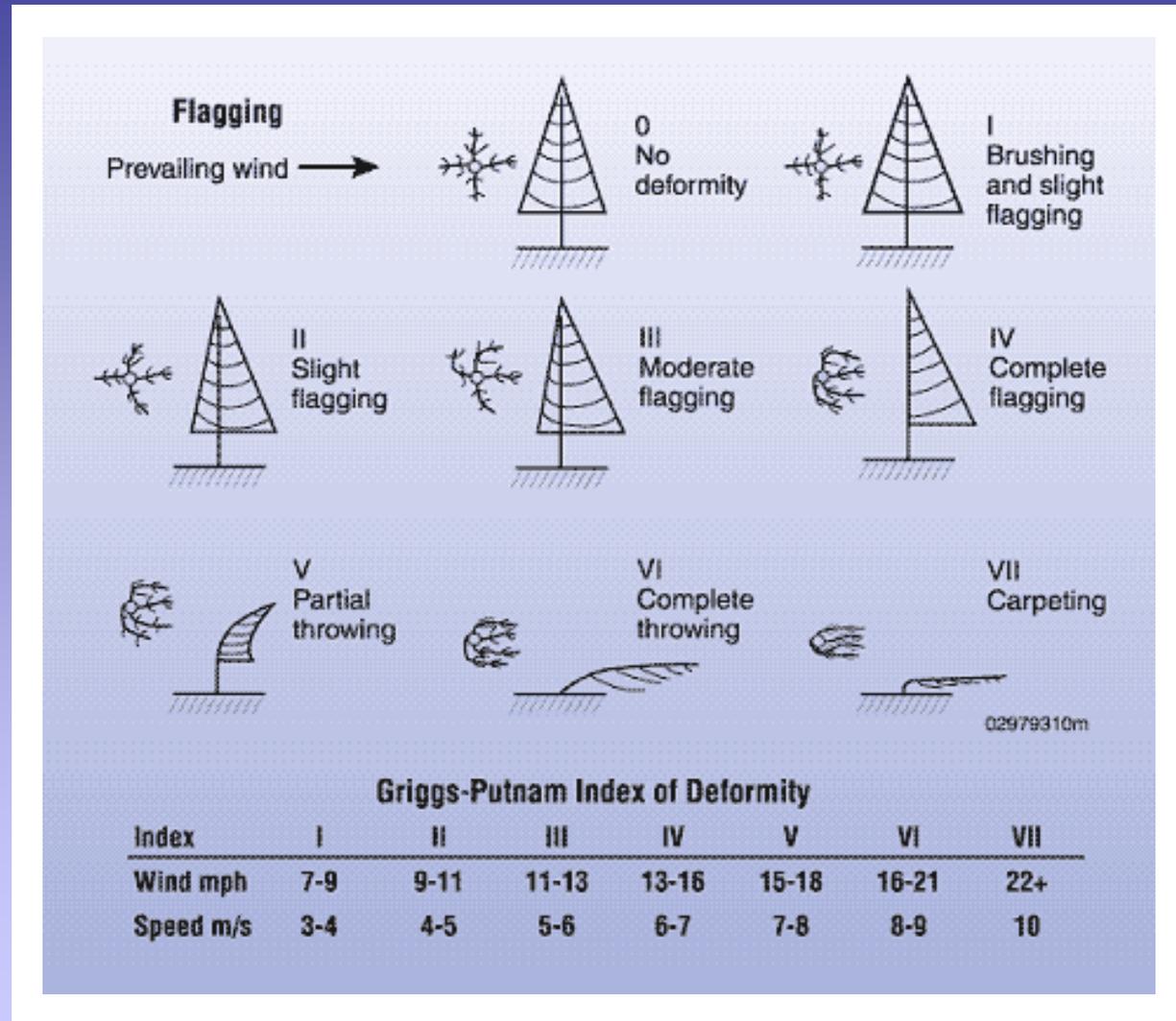
2000
High-Resolution
(1-km²) Wind Map

Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m ²	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

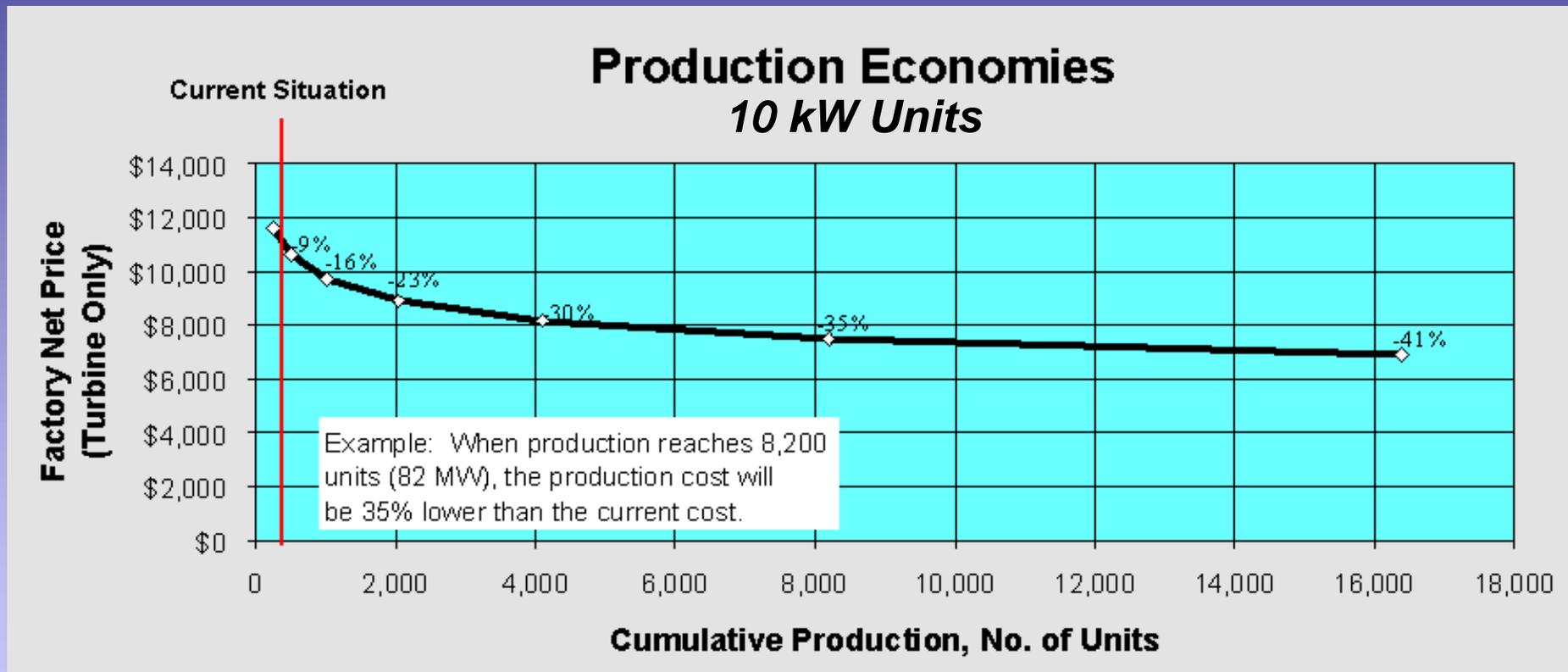
Indirect Estimates of Wind Resource

- Review wind maps
- Obtain airport data
- Visually observe site vegetation



See "A Siting Handbook for Small Wind Energy Conversion Systems," 800-553-6847 or www.ntis.gov/ordering.gov

Production & Technology Improvements Bringing Down Costs



Costs for small wind turbines are projected to decrease to \$1.50 / kW by 2010

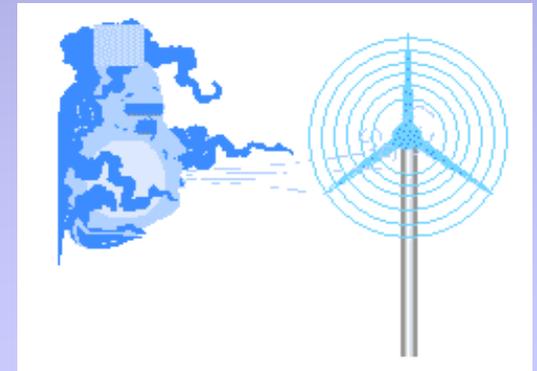
Programs and Policies that Support Small Wind

- **Rebates or grant programs (10 states)**
- **Personal or corporate tax incentives (14 states)**
- **Sales tax exemptions (10 states)**
- **Property tax exemptions (18 states)**
- **Loan funds (15 states)**
- **Net metering policies (33 states)**
- **PURPA (federal)**



For More Information on Small Wind Economics...

- **Bergey Payback Calculator**
www.bergey.com/Channels/1F2.htm
- **Wind Resource Atlas of the United States**
<http://rredc.nrel.gov/wind/pubs/atlas/>
- **Database of State Incentives
for Renewable Energy**
www.dsireusa.org



Overcoming Barriers

Small Wind 103: Siting Issues

Addressing permit requirements, height restrictions, & environmental concerns



Potential Obstacles

Legal issues

- City, town, or county ordinances restricting height or requiring minimum setbacks
- Building codes and covenants

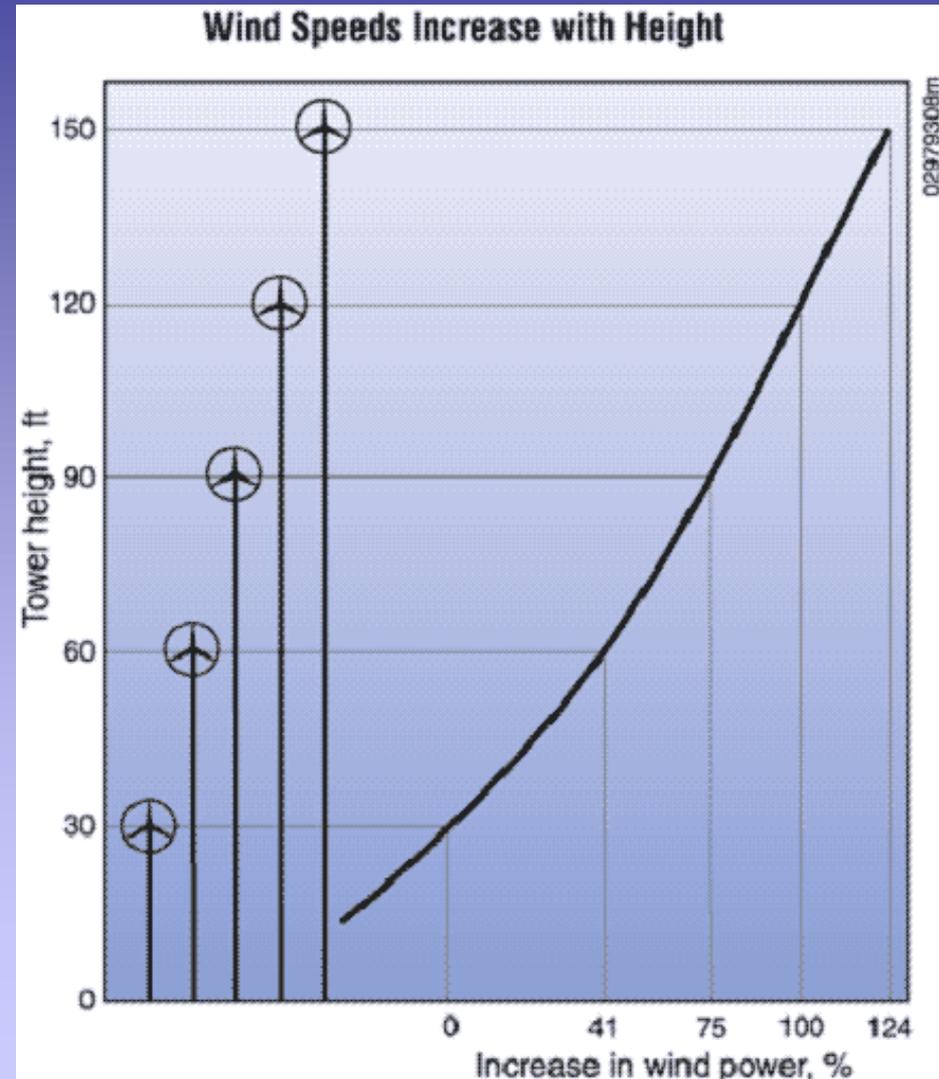
Environmental Issues

- Neighbors' concerns (*visual impact, noise*)
- Potential physical obstacles (*growing trees, planned construction*)



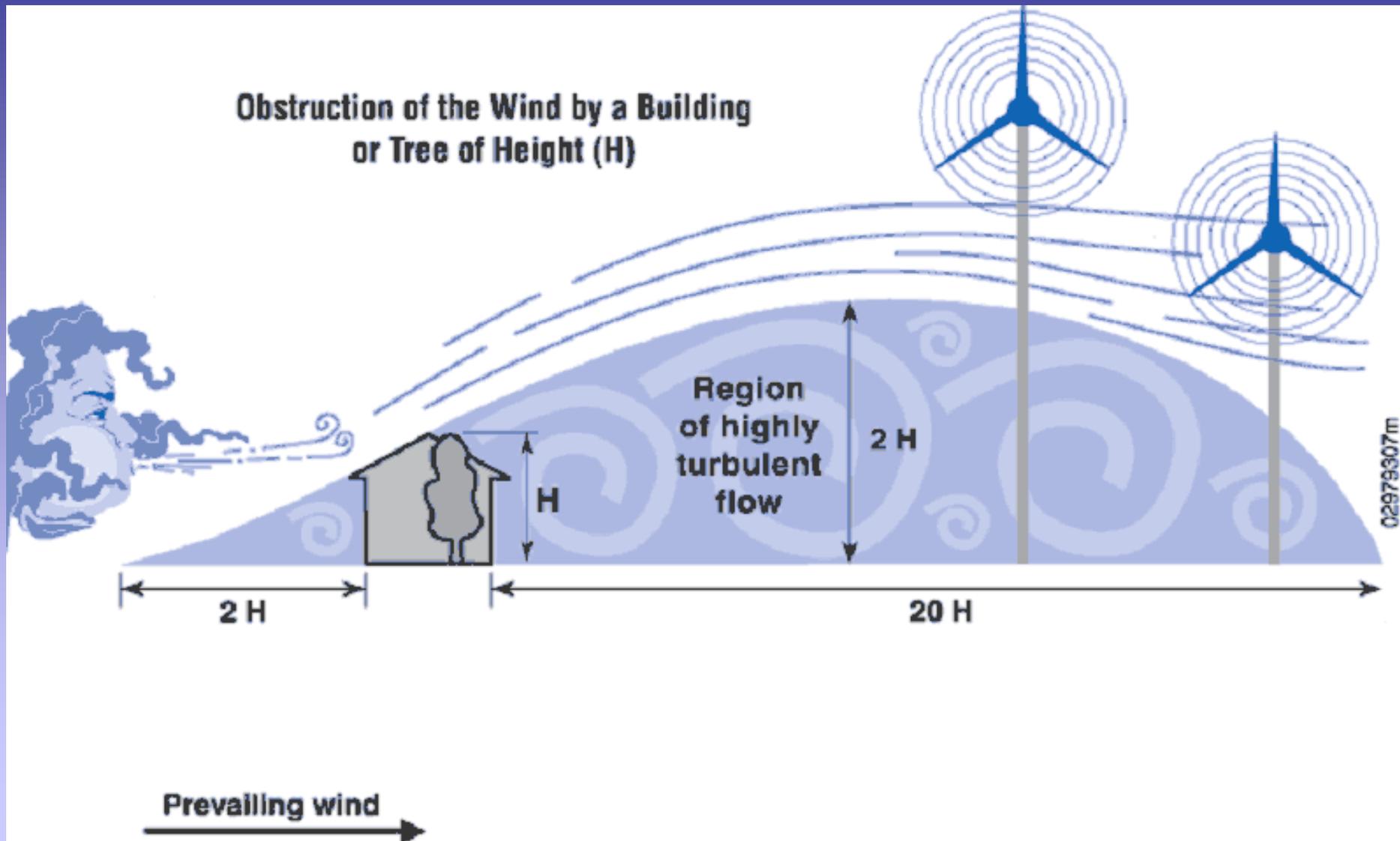
Tower Height Matters

- ◆ Wind speed increases with height
- ◆ Small increases in wind speed result in large increases in power
- ◆ Tall towers often needed for clearance above obstacles (*turbulence*)
- ◆ May require a variance or a special use permit



Height or Distance Needed

Obstruction of the Wind by a Building or Tree of Height (H)



Noise & Visual Impact

Improved designs have made machines much quieter

- **Comparable to central AC unit**
- **Noise levels fall sharply with distance**

1 acre is a good rule-of-thumb minimum property size for a small wind installation capable of powering the whole house



Objections are less likely in a rural setting

- **Spinning blades perceived as useful**
- **Talk to neighbors before seeking permit**

Raising Awareness Increases Acceptance

- **Emphasize the positive – *quiet, safe, renewable, non-polluting source of energy***
- **Supply objective data – *expected decibel level, photographs of the equipment***
- **Ask your city/county planners to designate small turbines a “permitted” use to allow 80- to 120-foot towers – *35-foot limits often date back to early 1900s***

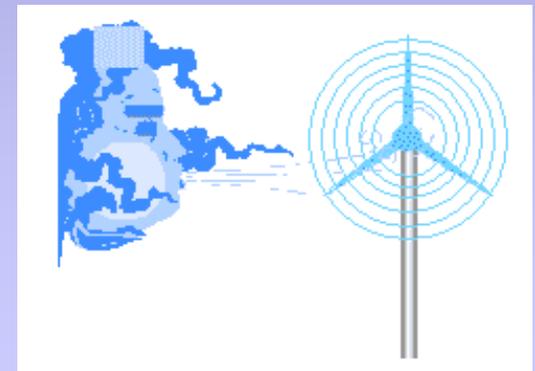


For More Information on Zoning Issues...

- **Legal and Safety Issues – U.S. DOE Small Wind System Installation Reference Brief**
www.eren.doe.gov/consumerinfo/refbriefs/ja2.html

- **AWEA Advice from an Expert**
www.awea.org/faq/sagrillo

- *Trials and Tribulations*
- *Keeping Hearings Under Control*
- *Zoning Obstacles*
- *Perceptions/Local Concerns*



Overcoming Barriers

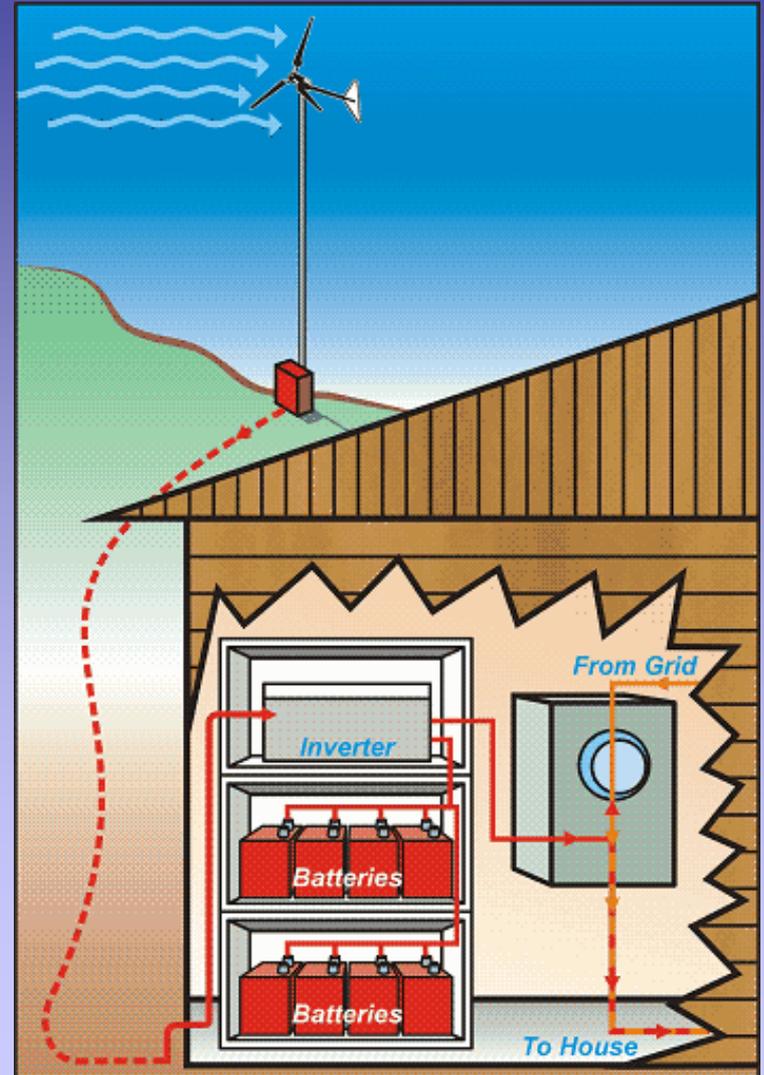
Small Wind 104: Grid Interconnection

*Reaching an
agreement
with your utility*



Connecting to the Grid

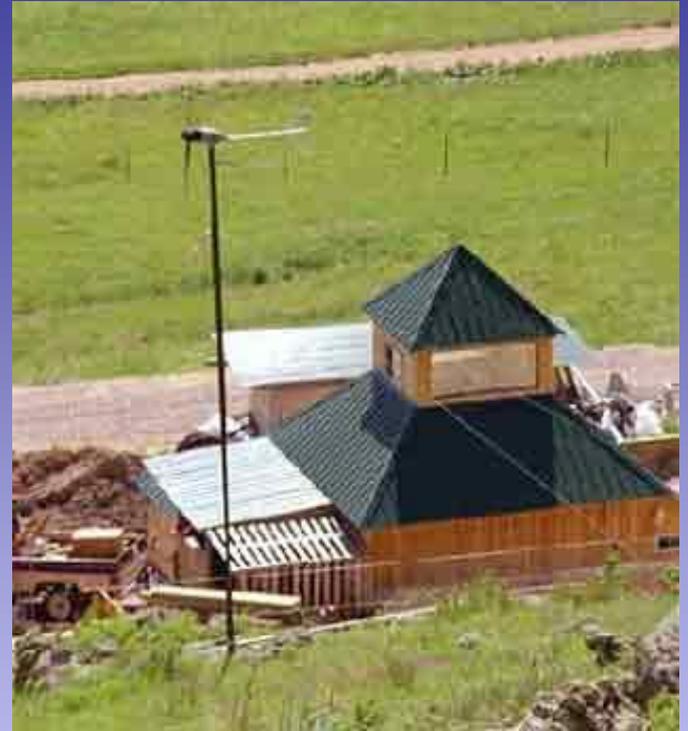
- PURPA requires utilities to connect with and purchase power from small wind systems
- Reduce consumption of utility-supplied electricity
- Utility acts as a big "battery bank"
- Contact individual utility before connecting to its lines



Interconnection Requirements

Safety Issues

- Must meet electrical codes
- Must stop supplying power to grid during power outages



Power Quality Issues

- Must synchronize with grid
- Must match utility power's voltage, frequency and quality

Standard Requirements and Contracts

California net metering law
*Limits utility requirements
to certification of national
safety and power quality
standards (UL 1741; IEEE
929-2000, 519, and P1547)*

Utility standard contracts
*Tariffs to expedite
contracting and
interconnection*



Insurance Requirements

Some utilities require small wind turbine owners to maintain liability insurance of \$1 million or more

Policy Responses

- **Eight states prohibit utilities from imposing insurance requirements for qualified systems**
- **Five other states limit required coverage amounts to levels consistent with commercial and residential insurance policies**



In >20 years, there has never been a small wind system related liability claim

Other Requirements

Utilities may want to be indemnified for liabilities that may arise from operation of a customer's generating facility

Policy Responses

- **Indemnity provisions should not favor the utility, but should be fair to both parties**
- **Federal law prohibits utilities from assessing discriminatory charges to customers who have their own generation facilities**



Other charges may include metering, interconnection, or standby fees

For More Information on Interconnection...



“Connecting a Small-Scale Renewable Energy System to an Electric Transmission System” U.S. Department of Energy Reference Brief (bibliography) 800-DOE-EREC www.eren.doe.gov/consumerinfo/refbriefs/ja7.html

“Connecting to the Grid” Interstate Renewable Energy Council www.irecusa.org

