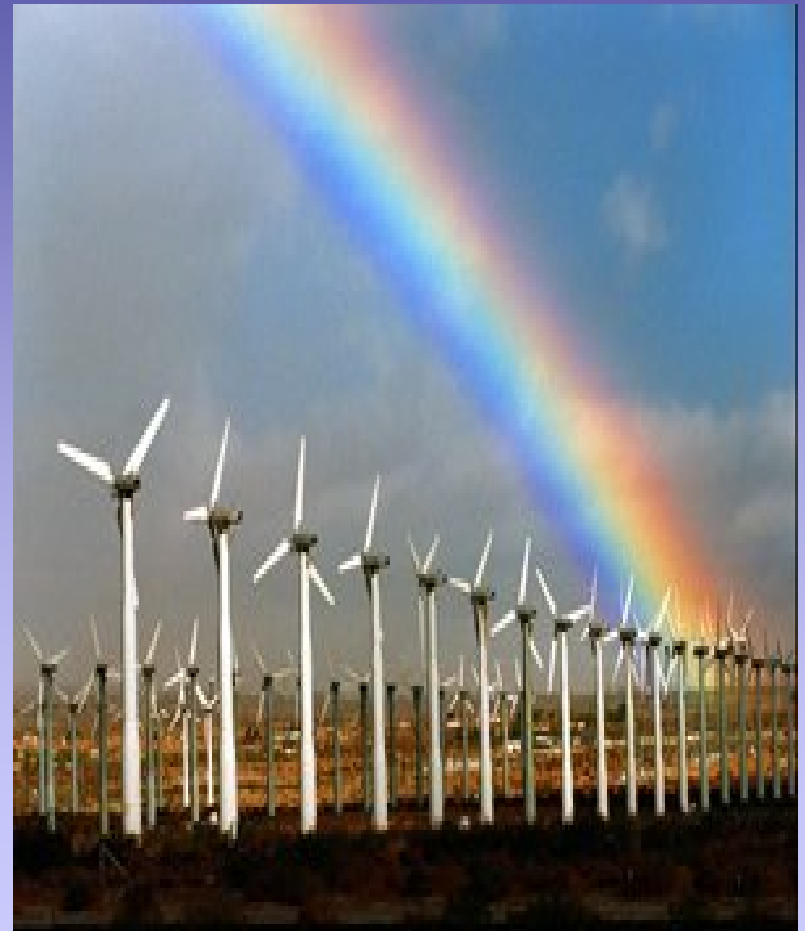


Small Wind 101: An Overview of Small-Scale Wind Electric Systems



*Affordable,
Clean Energy
for Homes, Farms
& Businesses*



Why Wind?

- Gain energy independence
- Ease demand on the power grid



- Reduce vulnerability to volatile utility prices
- Reduce air pollution from fossil electricity sources

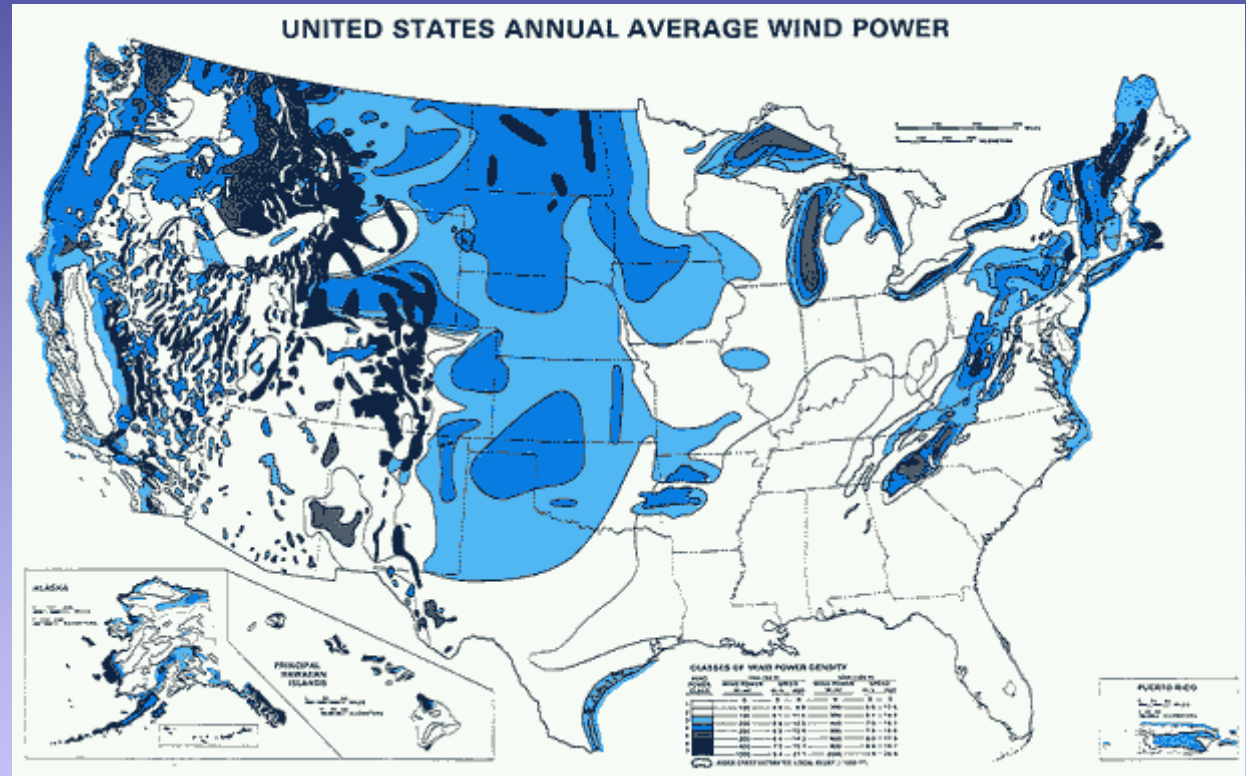


A Valuable, Widely-Available Resource

Small Wind Energy Systems

Value of Power =
6-18¢ / kWh

Installed cost of \$2-\$3/Watt is 1/3 to 1/2 that of solar technologies



How Small Wind Turbines Work

Wind Turbine
(400 W-100 kW)

**Guyed or
Tilt-Up Tower**
(60-120 ft)

**Safety
Switch**

**Basic Parts of a Small
Wind Electric System**

Rotor

Generator/
alternator

Tail

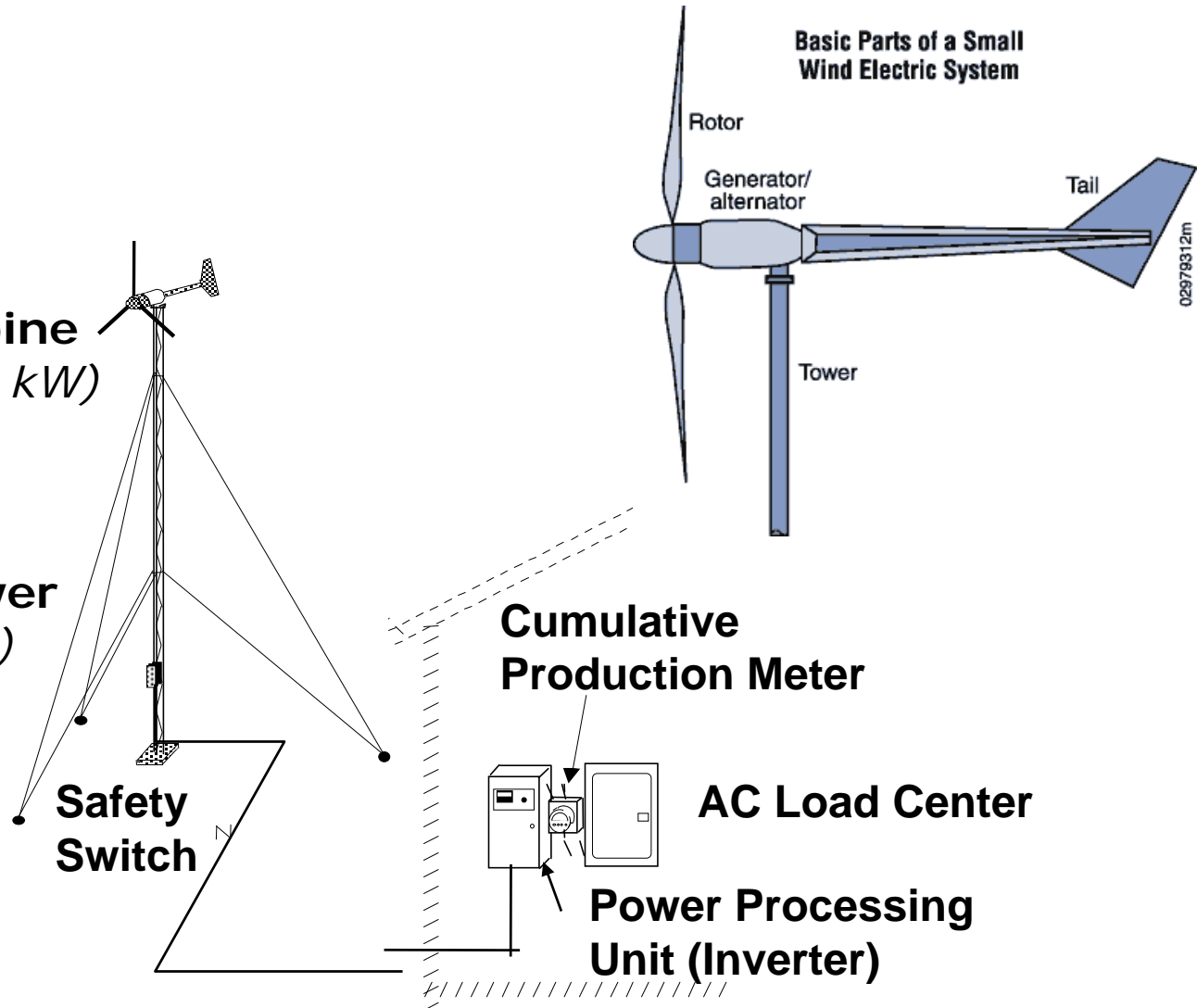
Tower

02879312m

**Cumulative
Production Meter**

AC Load Center

**Power Processing
Unit (Inverter)**



Typical Applications

Farms, Homes, Businesses

Off-Grid Water Pumping with Wind



- Supplies water for 120 head of cattle
- 1 kW, 9-ft rotor, 30-ft tower
- Produces ~ 2,000 kWh/yr
- Offsets ~ 1.5 tons CO₂/yr
- Costs ~ \$4,000 installed

Supplementing Grid Power



- Connected to utility grid through house/farm wiring
- 3 kW, 15-ft rotor, 23-ft tower*
- Produces ~ 5,000 kWh/yr
- Offsets ~ 3.8 tons CO₂/yr
- Costs ~ \$10,000

** due to zoning restrictions
(not recommended)*

Typical Applications

Farms, Homes, Businesses

Offsetting All Utility Power



- “Net metering” utility power
- 10 kW, 23-ft rotor diameter, 100-ft tower
- Produces ~ 15,000 kWh/yr
- Offsets ~ 14 tons CO₂/yr
- Costs ~ \$35,000

Selling Power Back to Utility



- Excess power sold to utility
- 50 kW, 49-ft rotor, 90-ft tower
- Produces ~ 120,000 kWh/yr
- Offsets ~ 91 tons CO₂/yr
- Costs ~ \$150,000

Frequently-Asked Questions

- Will the noise bother my neighbors?
- What about visual impact?
- Do wind turbines kill birds?
- Will it interfere with TV/radio reception?
- Can wind supply power during an outage?
- What happens during a tornado?



The blades "furrow or rotate" into the wind during extreme winds

Factors to Consider



- Good wind resource: Class 2 or better
- Home or business located on 1 acre or more of land
- Average monthly electricity bills \geq \$100 for 10 kW system, \geq \$50 for 5 kW system
- Zoning restrictions, economic incentives

Options: On or Off the Grid?

Stand-Alone System



- Batteries to store excess power
- Charge controller
- Inverter (DC to AC)
- Back-up power source for complete energy independence

Grid-Connected System



- Inverter (DC to AC)
- Annual wind speed ≥ 10 mph (4.5 m/s)
- Customer motivated by high utility prices, self sufficiency, or environmental concerns

Net-metering for Grid-Connected Systems

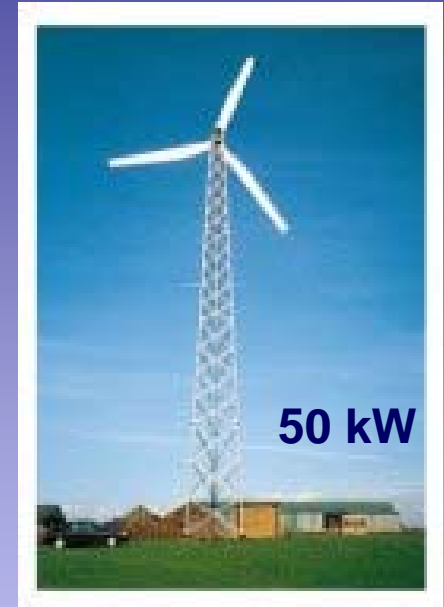
- “Bank” excess energy with the local utility
- Meter spins backward; customer receives full retail value for each kWh produced
- Net excess generation (NEG) credited monthly or annually



Modern Small Wind Turbines

High Tech, High Reliability, Low Maintenance

- Small turbines range from 20 W to 100 kW
- Only 3-4 moving parts means very low maintenance
- 20- to 40-year design life
- Proven technology – 150,000 installed; over a billion operational hours
- American companies are the market and technology leaders
- Substantial cost-reduction potential



(Not to scale)

Historic Barriers to Small Wind Energy Systems

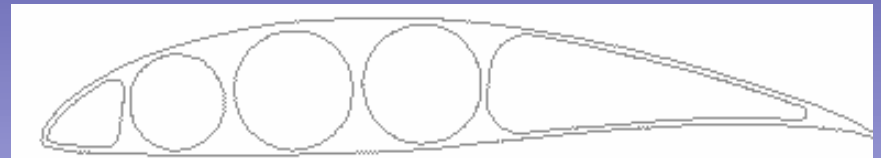
- **Economics:** Low production volume & historical lack of public funding = high costs
- **Small wind upstaged by large-scale projects and other technologies**
- **Zoning / Permits:** 35-ft height restriction in residential zones, noise, NIMBY attitudes
- **Onerous interconnection requirements**
- **Low public awareness**



New Technology is Lowering Costs

U.S. DOE's Advanced Small Wind Turbine Program + industry-funded R&D

- Advanced airfoils
- "Super-magnet" generators
- Low cost manufacturing
- Smart power electronics
- Very tall towers
- "Stealth" low noise & visual impact



Programs and Policies to Nurture the Rural Residential Market

- Buy-down, rebate or grant programs
- State production tax credits
- Sales and property tax exemptions



- Net metering, with annual “banking” period
- Reasonable interconnection standards
- Model zoning ordinances

Sources for Further Information on Small Wind

- **American Wind Energy Association**
Washington, DC 202-383-2500
www.awea.org/smallwind.html
- **U.S. DOE National Wind Technology Center**
Boulder, CO Clearinghouse: 800-363-3732
www.nrel.gov/wind/smalltur.html
www.eren.doe.gov/erec/factsheets/wind.html
www.eren.doe.gov/power/consumer/
- **Home Power Magazine**
Ashland, OR 800-707-6585
www.homepower.com
- **Broadband Specialists, Inc.**
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