National Renewable Energy Laboratory

Small Wind Technology and Applications

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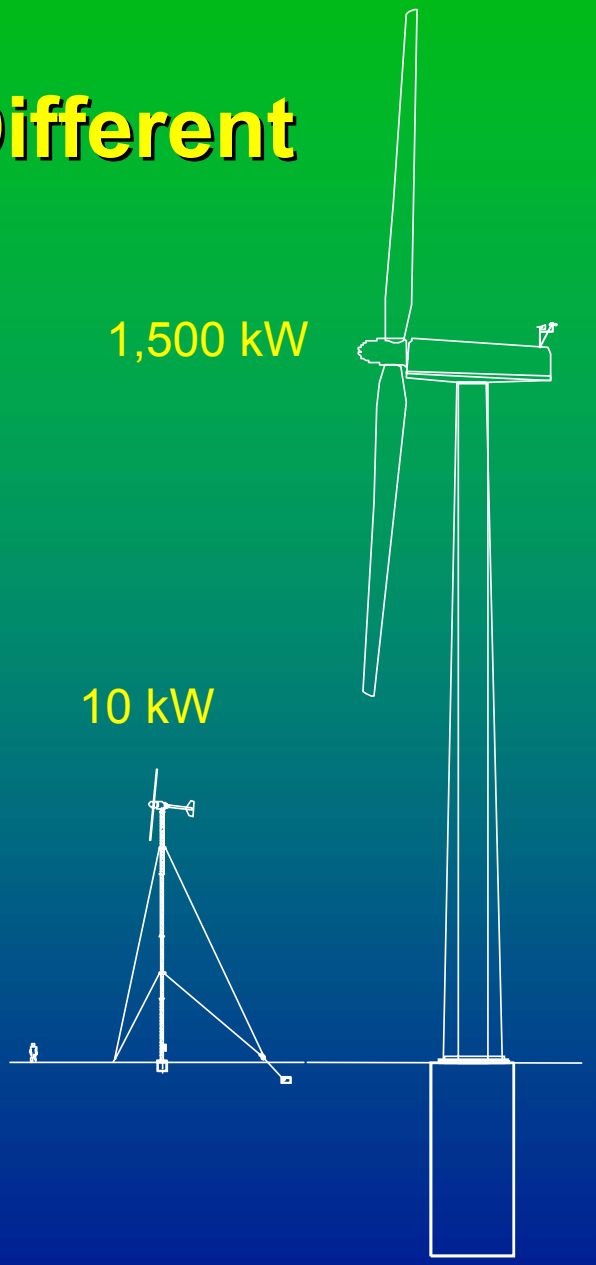
Operated for the U.S. Department of Energy by Midwest Research Institute • Battelle • Bechtel

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
  - Classes 5 and 6 (> 6 m/s average)
- Distributed Wind Power
  300 W - 600 kW wind turbines
  - Installed at individual homes, farms, businesses, schools, etc.
  - On the “customer side” of the meter
  - High reliability, low maintenance
  - Classes 2 and 3 (5 m/s average)



Frequently Asked Questions (I)

- Lightning: Effectively avoided with proper grounding and use of surge suppressors

- Ice Shedding: Blades with ice don't work! Ice typically accumulates at the base of the tower.
- Severe Storms: Can be a problem, some turbines have survived hurricanes and tornados
- Hail Damage: Have not heard of problems

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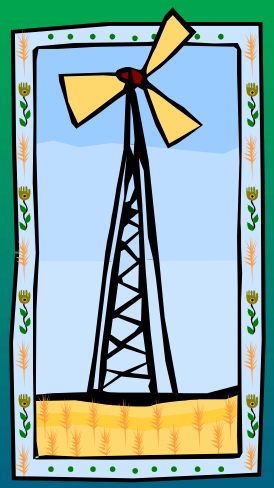
Frequently Asked Questions (II)

- Radio/TV Interference: Not a problem with today's fiberglass or wood blades (no metal blades!)
- Noise:
  - Below 30 mph, soft "swoosh" sound
  - Above 30 mph, can get either:
    - Loud buzzing from blade "flutter"
    - "Wop/wop" sound like a helicopter if furled



- Impact on Birds: Bird kills are rare, use common sense in siting turbines

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Frequently Asked Questions (III)

- Homeowners Insurance: Coverage for a damaged wind turbine varies, consult your insurer
- Property Taxes: Increased property value? Some states provide temporary or permanent exemptions
- FAA Regulations:
  - Proximity to local airport versus tower height
  - Investigate if within ~3 miles
- Zoning: Towers > 30–35 ft may require a "special use review" by the local zoning authority
  - Few problems in rural areas
  - May be difficult/impossible to get for urban/suburban areas

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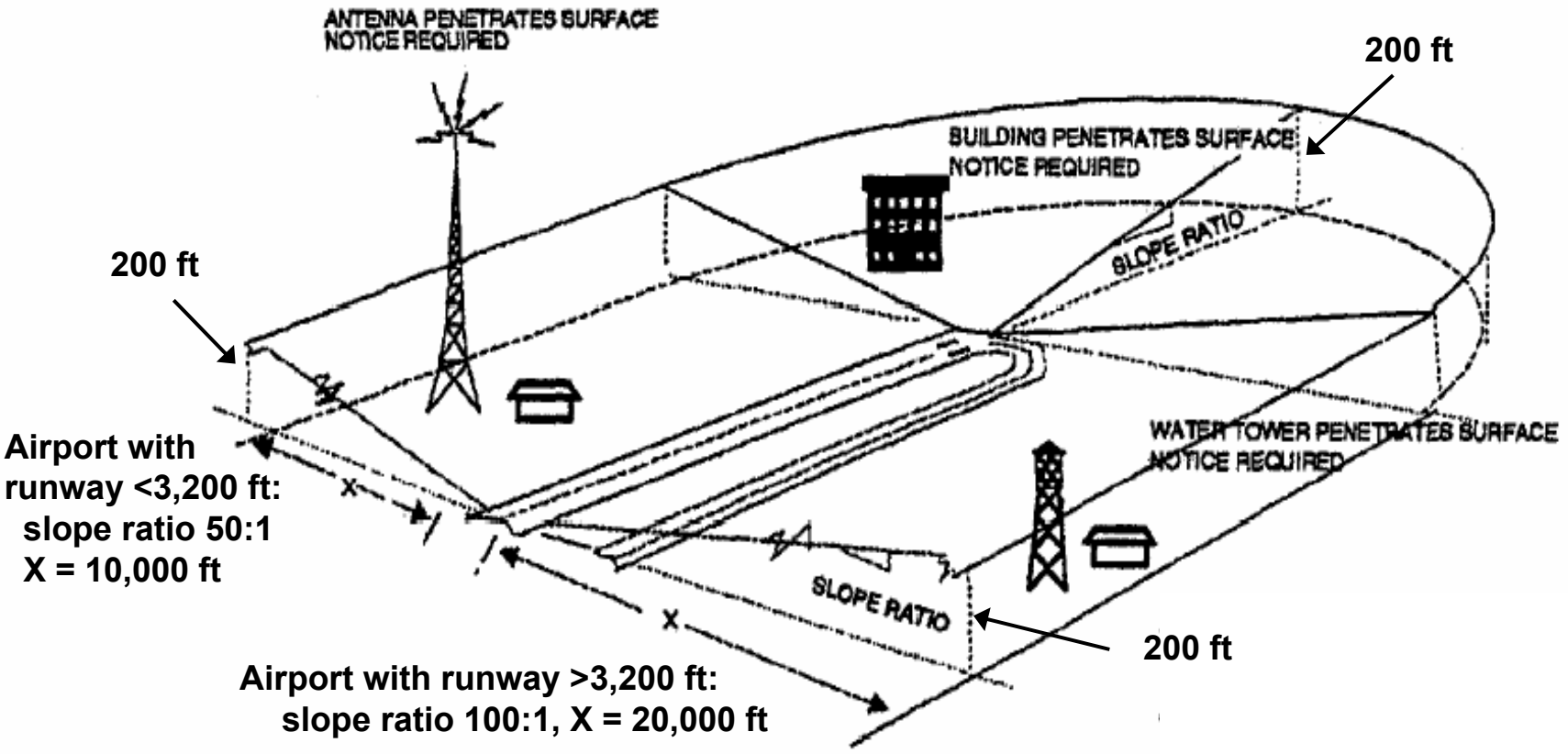
Guidance on Structures Near Airports

from: FAA Advisory Circular AC 70/7460-2K



Wind Turbine Installed Cost
Example 1

Updated: 4-Nov-04

Bergey Excel-S (10 kW)			High Cost	Low Cost
Wind turbine & inverter		$24,750	$24,750	$24,750
Tower (100 ft guyed)		$7,800	$25,100	$6,200
Tower Wiring Kit		$860	$1,070	$860
Shipping		$1,500	$2,000	$1,000
Installation		$8,000	$10,000	$2,000
Permits/Fees		$500	$3,500	$0
Sales Tax:	5.0%	$2,171	9.3%	0.0%
Total		$45,581	$72,272	$34,810

Wind Turbine Installed Cost

Example 2

Updated: 4-Nov-04

Southwest Windpower Whisper 100 (900 W)		High Cost	Low Cost
Wind turbine & Controller	$2,045	$2,045	$2,045
Tower (80 guyed)	$2,220	$2,220	$690
Inverter	$1,000	$2,500	$500
Battery and Containment	$300	$800	$200
Shipping	$200	$400	$150
Installation	$1,200	$2,500	$0
Permits/Fees	$200	$500	$0
Sales Tax: 5.0%	$358	9.3%	0.0%
Total	$7,523	$11,706	$3,585

Case Study: On-Grid Farm

- Southwestern Kansas
- Utility bill reduction
- Bergey Windpower Excel turbine, 10 kW, 23-ft rotor, 100-ft tower
- Electricity production ~21,000 kWh/year
- Utility bill savings ~$2,800/year
- Installed in early 1983, ~$20,000
- Received federal tax credit
- Maintenance costs, $50/year
- One lightning strike, one blade was replaced

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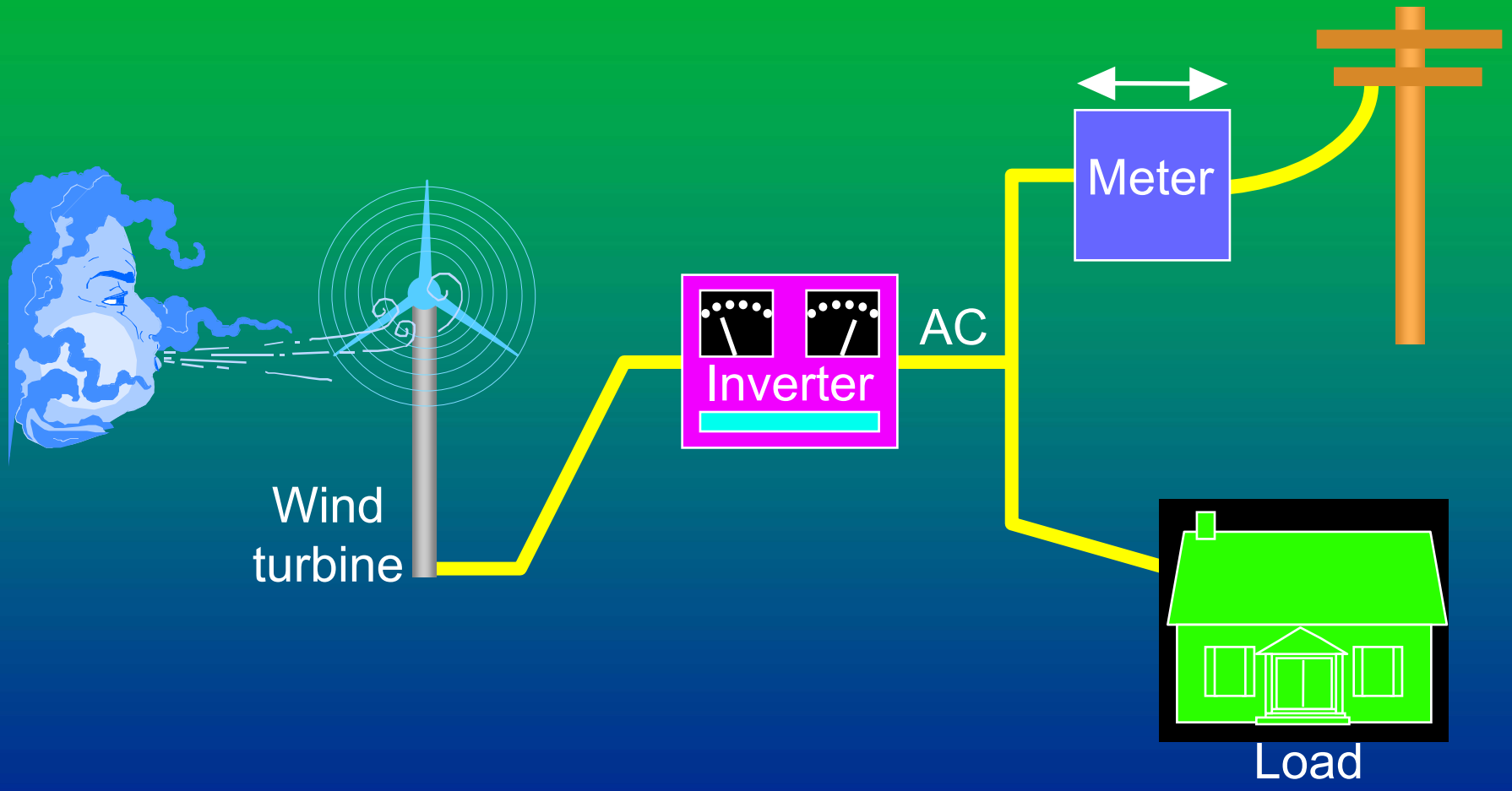
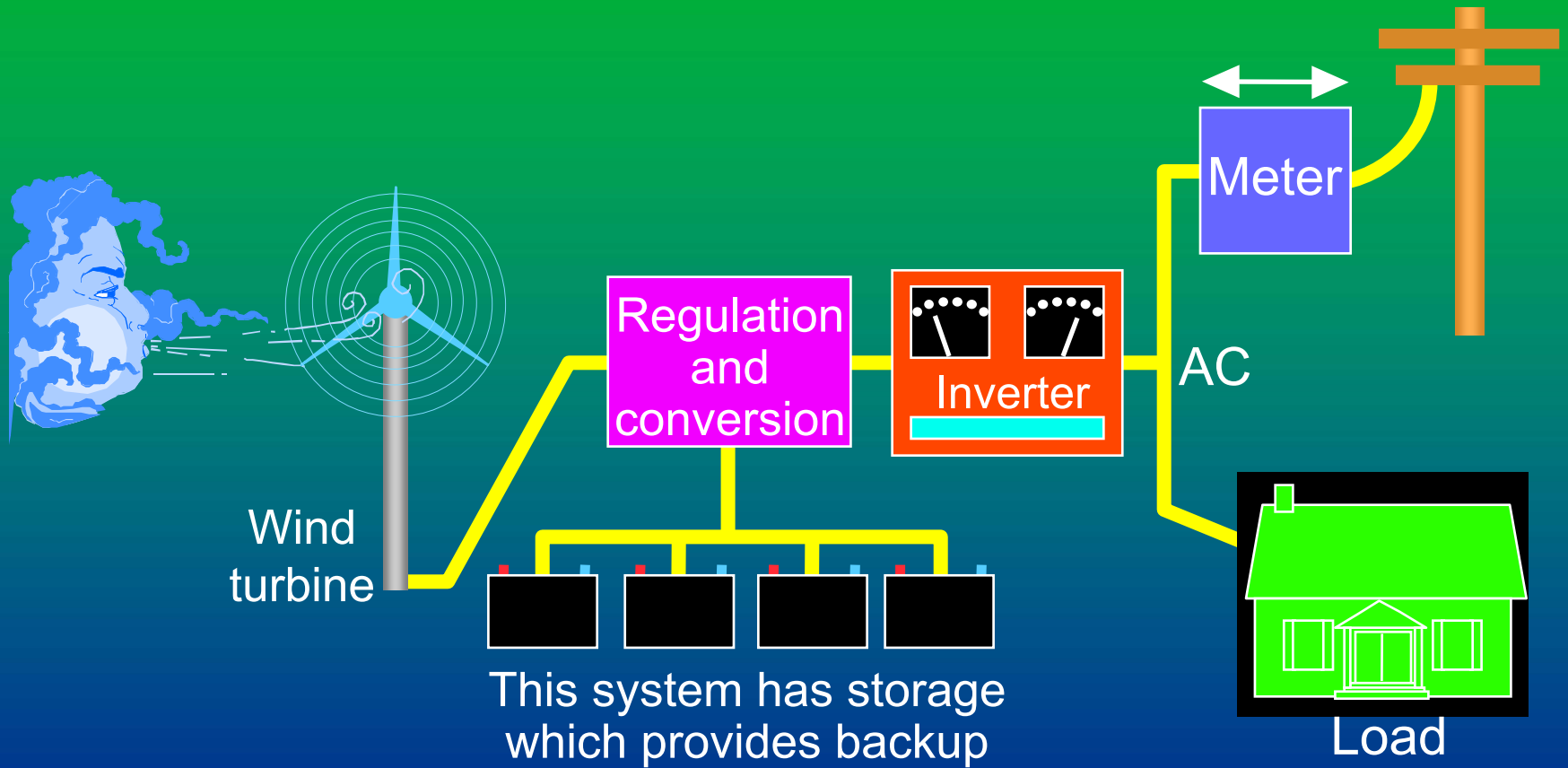
On-Grid Wind System without Storage



On-Grid Wind System with Storage

(uninterruptible power)



Case Study: On-Grid Home

- Morrison, Illinois
- Utility bill reduction
- Jacobs 26-17.5 wind turbine, 17.5 kW, 26-ft rotor, 120-ft tower
- Electricity production ~15,600 kWh/year
- Installed cost $15,986 (wind turbine only)
- Installed in 1994

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Case Study: On-Grid Home

- Tehachapi, California
- Net metering for utility bill reduction
- Bergey Excel wind turbine, 23-ft rotor, 10 kW
- Total installed cost was $34,122 in October 1999
- California buy down program, $16,871 cash rebate
- Estimated payback: 8 years

Case Study: On-Grid Farm

- Webster, New York
- Utility bill reduction
- Bergey Excel wind turbine, 10 kW

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Will Wind Energy Work For Me?

- Good wind resource?
- Minimum 1 to 2 acres of land?
- Local zoning rules/process or neighborhood covenants that allow wind turbines on at least 60 to 80-ft towers?
- Comfortable with long-term investments?
- Concerned about rising electricity prices in the future?
- Concerned about the environmental impacts of electric power generation?
- A desire to be more self-sufficient?

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Steps to Implement a Small Wind Project

- Wind Resource
- Wind Turbine Dealer
  - Choose model and tower height, estimate performance, determine price
- Grants / Buy-Down / Tax Credit
- Zoning / Building Permit
- Utility Interconnection Agreement
- Installation

Small Wind Can Work For You!

Home

Business

Farm