

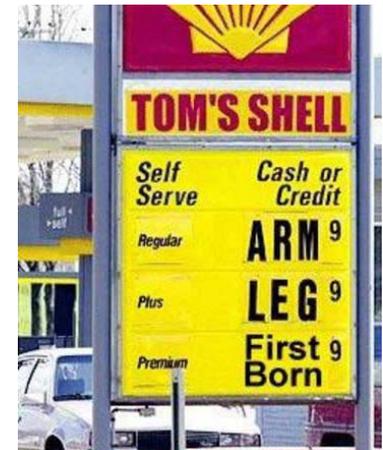
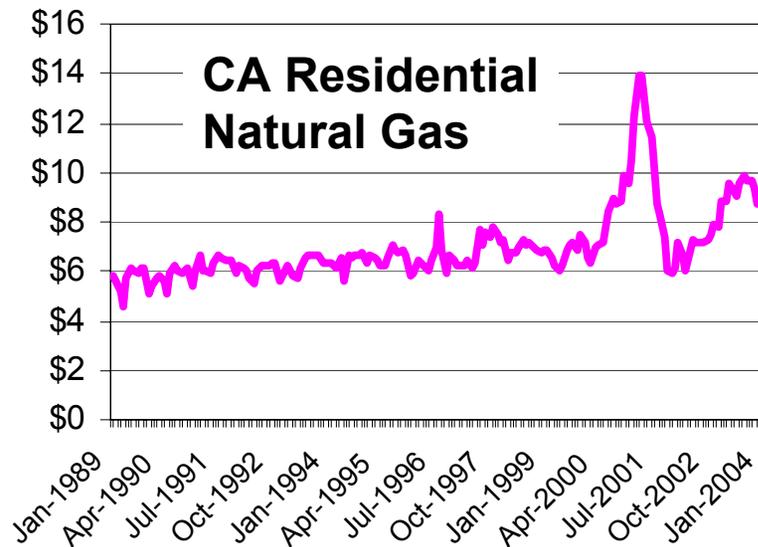
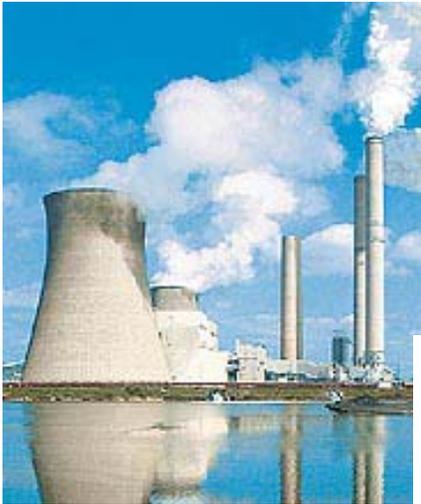
# Renewable Distributed Generation with Small Wind

**Mike Bergey**  
Bergey Windpower Co.  
AWEA Small Wind  
Turbine Committee  
June 8, 2004



# People Want Energy Alternatives

**Coal is too dirty, natural gas is too volatile, nuclear is too dangerous, and consumers feel trapped**

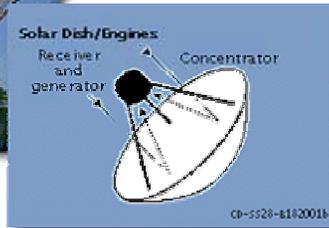




“Please give me something that will lower my electric bills, will help the environment, and that I can afford”



Photo credit: Warren Grenz



**Solar-Thermal**



**Small Wind**

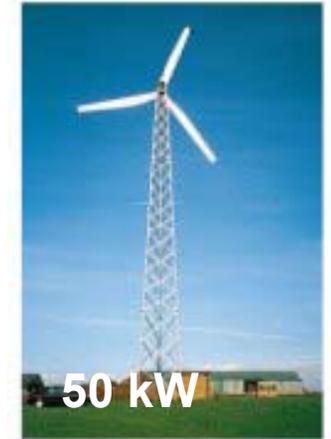


**Solar-PV**



# Modern Small Wind Turbines: Not Your Grandfather's Wincharger

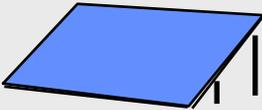
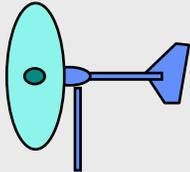
- ❖ **Definition: Under 100 kW**
- ❖ **Aerospace Technology**
- ❖ **Sophisticated, but Simple**
- ❖ **American Companies are the Market and Technology Leaders**



(Not to scale)

# Clean Distributed Generation

## Renewables for Homes, Farms, and Businesses

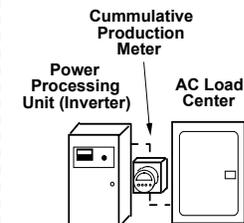
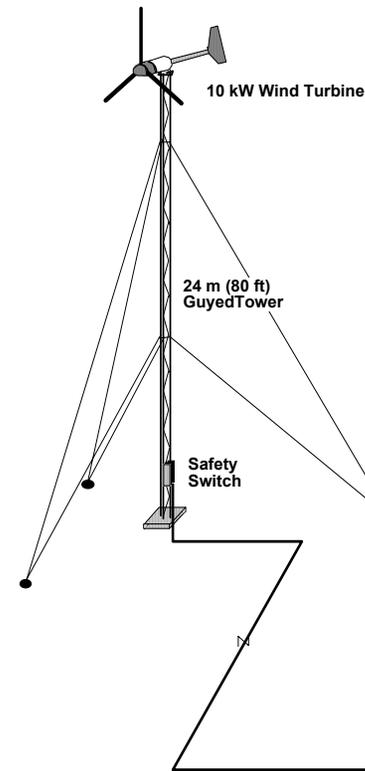
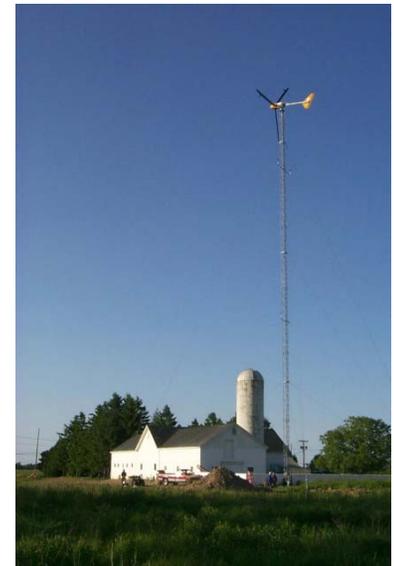
Status of the Technologies	 Photovoltaics	 Solar Thermal	 Small Wind
Status	Commercial	Demo	Commercial
Installed Cost	\$ 9 / Watt	\$ 15 / Watt	\$ 5 / Watt
Payback Period	25 Years	30+ Years	15 Years
Cost Potential	\$ 4 in 2010	?	\$ 2 in 2010
Typical Site	Suburban	Southwest	Rural
Available Resources	Fair - Good	Poor - Good	Poor - Great

**Small wind has a good shot at affordability**

# Rural Residential Wind

## TYPICAL HOME SYSTEM

- ❖ 10 kW (22 ft. Rotor Diameter)
- ❖ Rural Site, 1 Acre or More
- ❖ Connected to House Wiring
- ❖ Produces ~ 12,000 kWh per Year
- ❖ Excess Power Sold to Utility under Net Metering
- ❖ Offsets ~ 7 Tons of CO<sub>2</sub> per Year
- ❖ Cost: ~ \$45,000 - \$60,000



# 10 kW Bergey Excel-S

## America's Leading Residential Wind Turbine

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- ◆ Over 900 Installed
- ◆ ~ 75% World Market Share, 5 – 15 kW Size Range
- ◆ Only Direct Grid Intertie Turbine in CEC Program
- ◆ GridTek 10 Inverter built in Livermore, California
- ◆ New Rotor for 2004 ... better performance in low wind areas



# Typical Customer ... Today

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- ❖ 1 acre of property or more
- ❖ \$100 / month electric bill or more
- ❖ DOE Class 3 wind resource or better (over 30% of the “inhabited” U.S.)
- ❖ State subsidy program



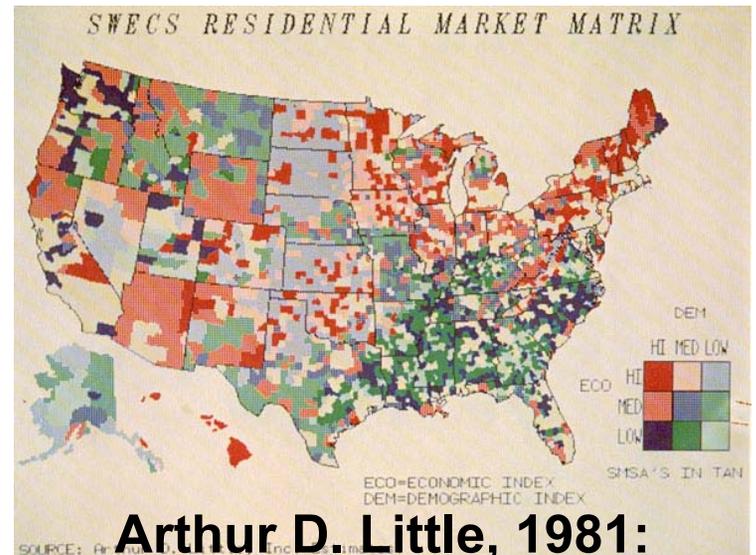
# Typical Customer ... Tomorrow?

- ❖ Single family dwelling
- ❖ Any size electric bill
- ❖ DOE Class 2 wind resource or better (over 50% of the “inhabited” U.S.)
- ❖ No or minimal subsidy
- ❖ Monthly payment for wind system ~ equal to utility bill savings



# U.S. Market Potential: **It's Big!**

- ❖ Residential Electricity Consumption Exceeds Either Commercial or Industrial (35% of U.S. Sales in 1998)
- ❖ 20.6 Million Homes have 1 Acre or More
- ❖ 30.4 Million Homes have 1/2 Acre or More
- ❖ 4.6 Million Commercial Buildings
- ❖ Estimated 50%+ are in Class 2 Winds or better



**Market  
Potential:**

**4 - 8 Million  
Units by 2020**

The U.S. Small Wind Turbine Industry

# ROAD MAP

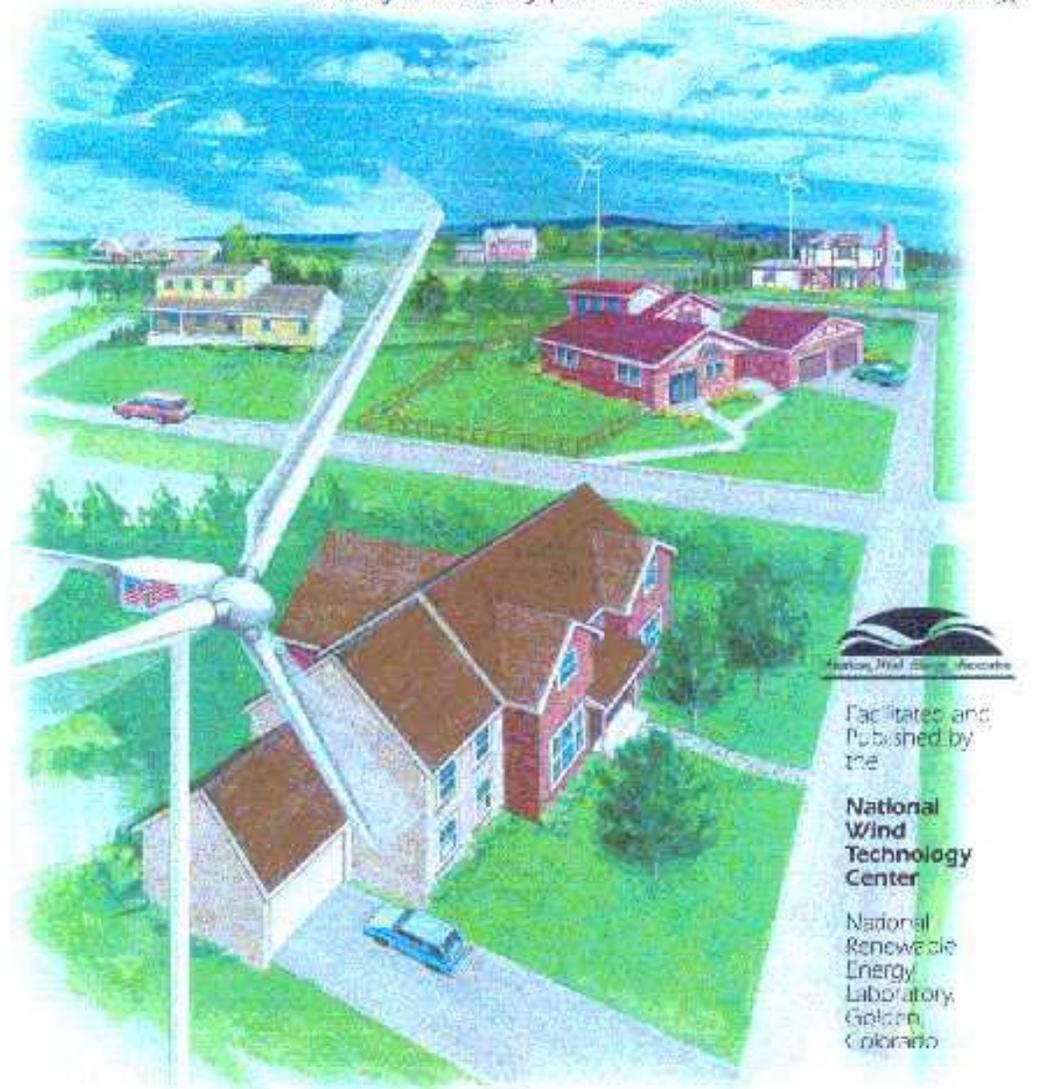
A 20-year industry plan for small wind turbine technology

## Strategic Plan For Small Wind Turbine Technology

American Wind  
Energy Association  
& US-DOE  
2002

Available On-line:

[http://www.awea.org/smallwind/  
documents/31958.pdf](http://www.awea.org/smallwind/documents/31958.pdf)



# 2003 World Markets

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- ❖ Large Wind\*: \$7.5 billion
- ❖ Photovoltaics\*: \$4.7 billion
- ❖ Fuel Cell\*: \$700 million
- ❖ Small Wind: ~ \$50 million

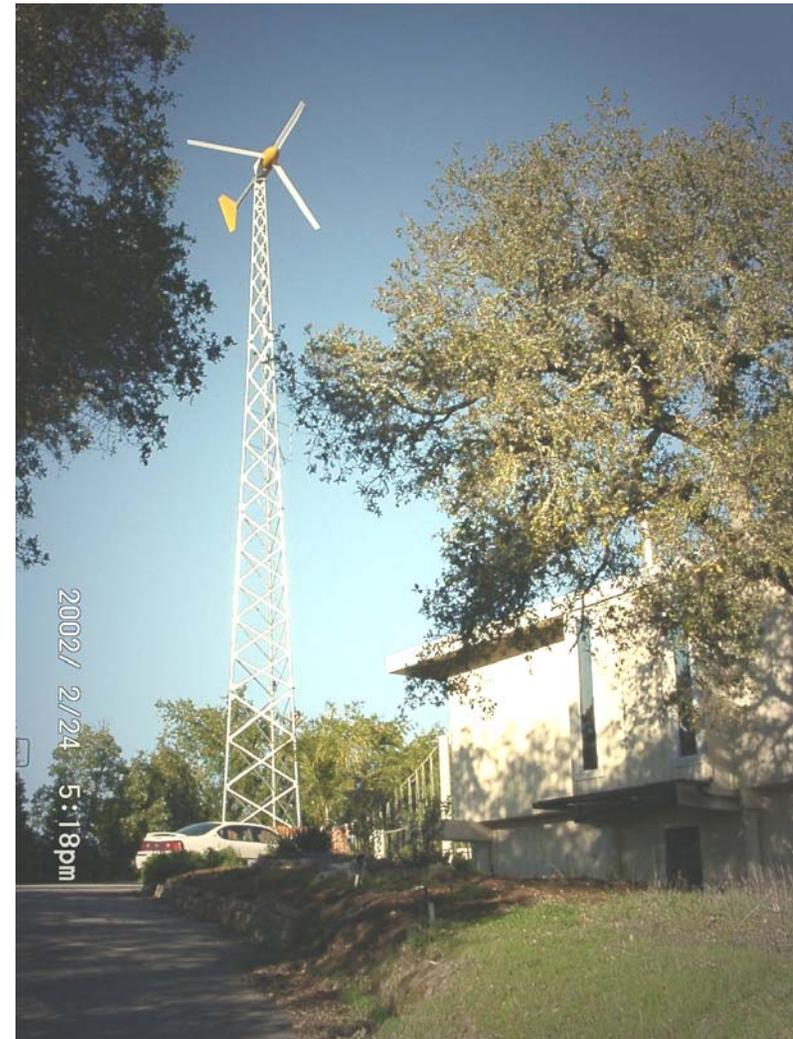


\* Source: Clean Edge

# Barriers to the Market

## Why Aren't There More Small Turbines

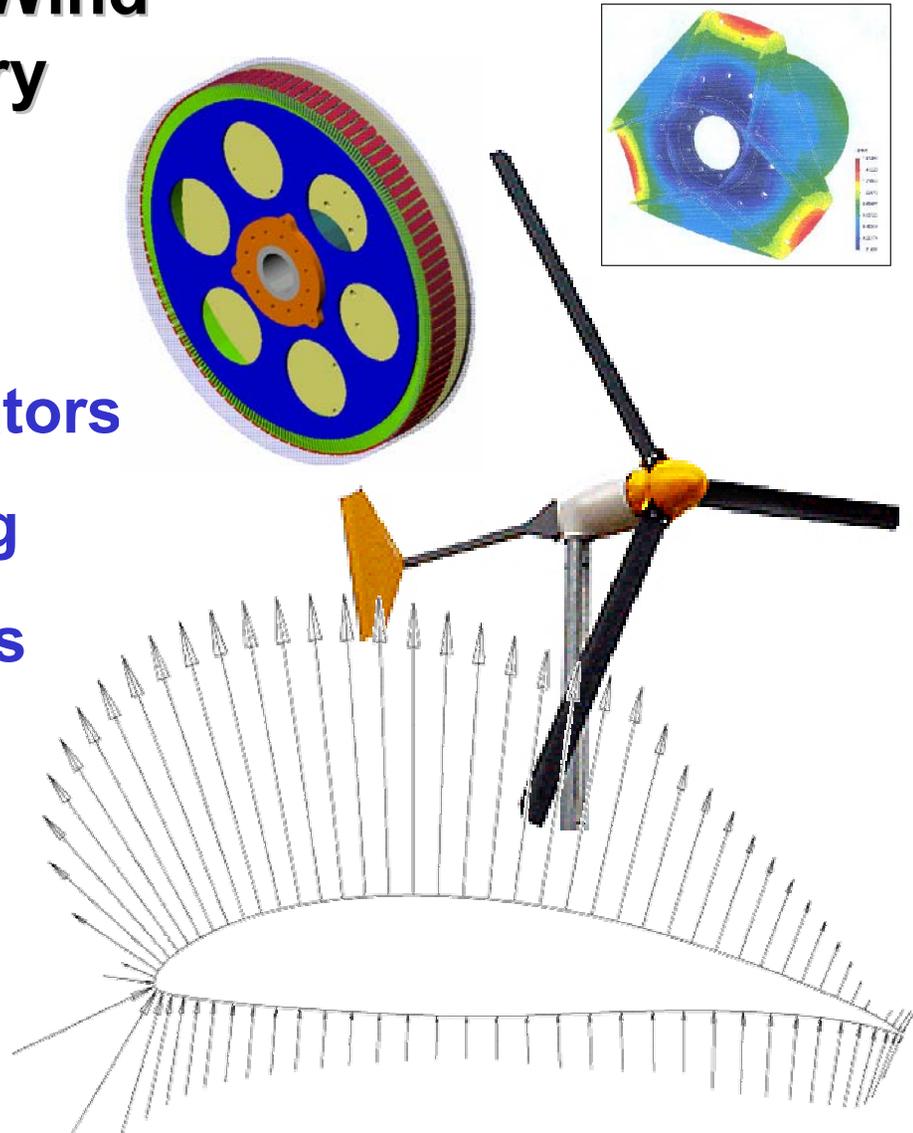
- ❖ **Equipment Costs too Much!** (Low Production Volumes & Shortage of Subsidies)
- ❖ **Zoning / Permits: 35' Height Restrictions in Residential Zones**



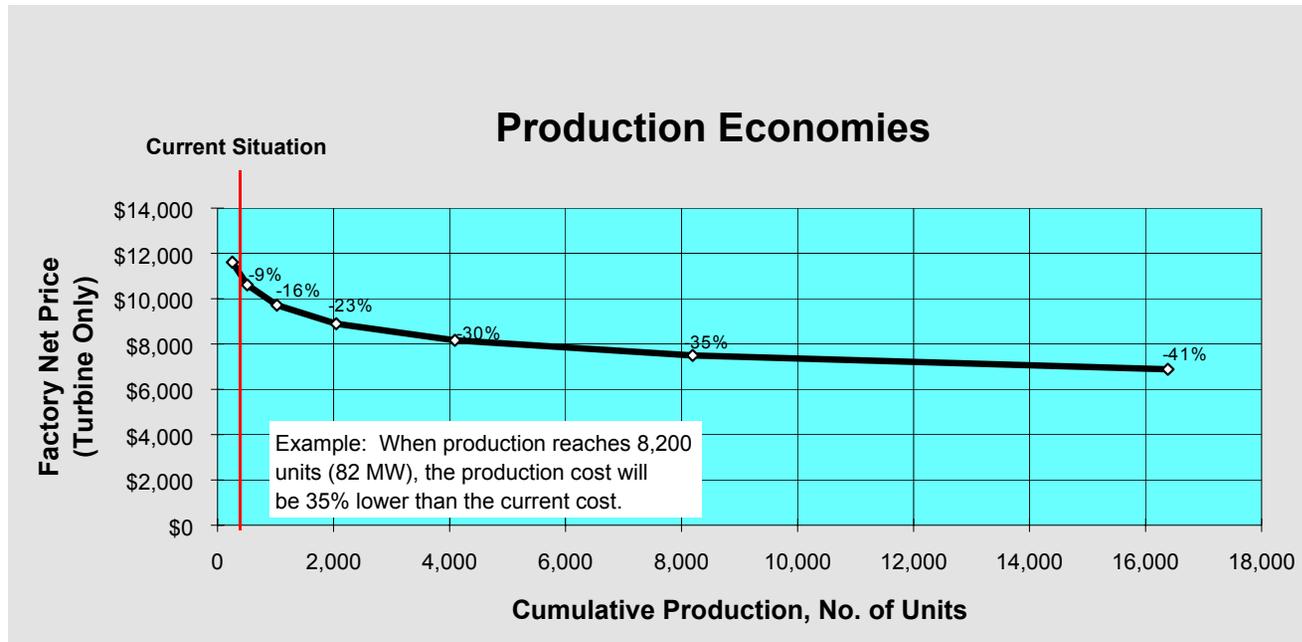
# New Technology is Lowering Costs

## US-DOE Advanced Small Wind Turbine Program + Industry Funded R&D

- ❖ Advanced Airfoils
- ❖ “Super-Magnet” Generators
- ❖ Low Cost Manufacturing
- ❖ Smart Power Electronics
- ❖ Stealth: Very Low Noise



# Volume Production will Drive Costs Down Significantly



**Small Wind as a New-Age Home Appliance ...**  
**“ a ceiling fan on steroids ”**



# Small Wind in California



# Typical California 10 kW System Costs



Item	Description	Price
1	EXCEL-S Wind Turbine	\$16,150
2	GridTek 10 Inverter	\$8,600
3	100 ft. Guyed-Lattice Tower	\$7,800
4	Tower Wiring Kit	\$1,000
5	Shipping & Delivery	\$1,600
6	Foundations	\$2,500
7	Wire Run (250 ft)	\$1,750
8	Electrical Contractor	\$1,375
9	Turbine Set-Up (Inc. Crane)	\$1,500
10	Misc. Costs	\$500
11	Building Permit	\$2,500
12	Sales Tax (7.75%)	\$2,600
<b>Total:</b>		<b>\$47,875</b>

**Guyed Lattice Towers  
~ 2/3 of CA Market**

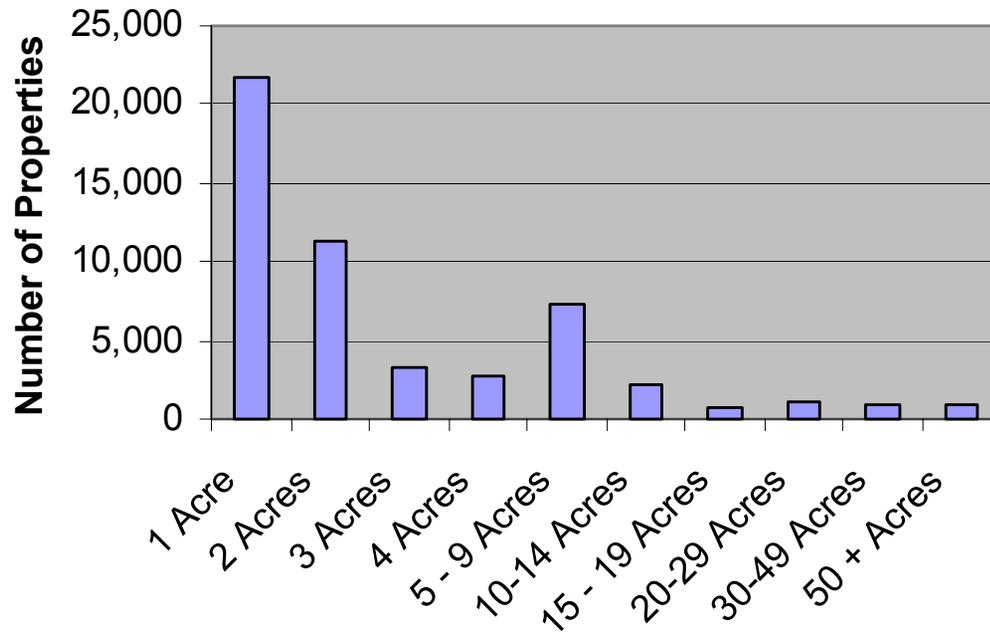
**Self-Supporting Towers  
~ 1/3 of CA Market**



Item	Description	Price
1	EXCEL-S Wind Turbine	\$16,150
2	GridTek 10 Inverter	\$8,600
3	100 ft. Self-Supporting Tower	\$12,490
4	Tower Wiring Kit	\$1,000
5	Shipping & Delivery	\$2,000
6	Foundations	\$7,600
7	Wire Run (250 ft)	\$1,750
8	Electrical Contractor	\$1,375
9	Turbine Set-Up (Inc. Crane)	\$2,100
10	Misc. Costs	\$500
11	Building Permit	\$2,500
12	Sales Tax (7.75%)	\$2,964
<b>Total:</b>		<b>\$59,029</b>

# California Small Wind Potential

- ❖ 24 million acres, 24% of California, has Class 2 wind resources or better
- ❖ 1.8 million acres are prime for small wind development (Class 3+, non-urban, not protected, mild slope)
- ❖ Top 200 zip codes for small wind potential have 52,000 properties of 1 acre or larger ... ~ 400 MW



# Prime Small Wind Market Areas

Solano County

Antelope Valley  
Hesperia Area



## California Wind Resources Wind Speed at 30 m



GOVERNOR - GRAY DAVIS

CALIFORNIA ENERGY COMMISSION

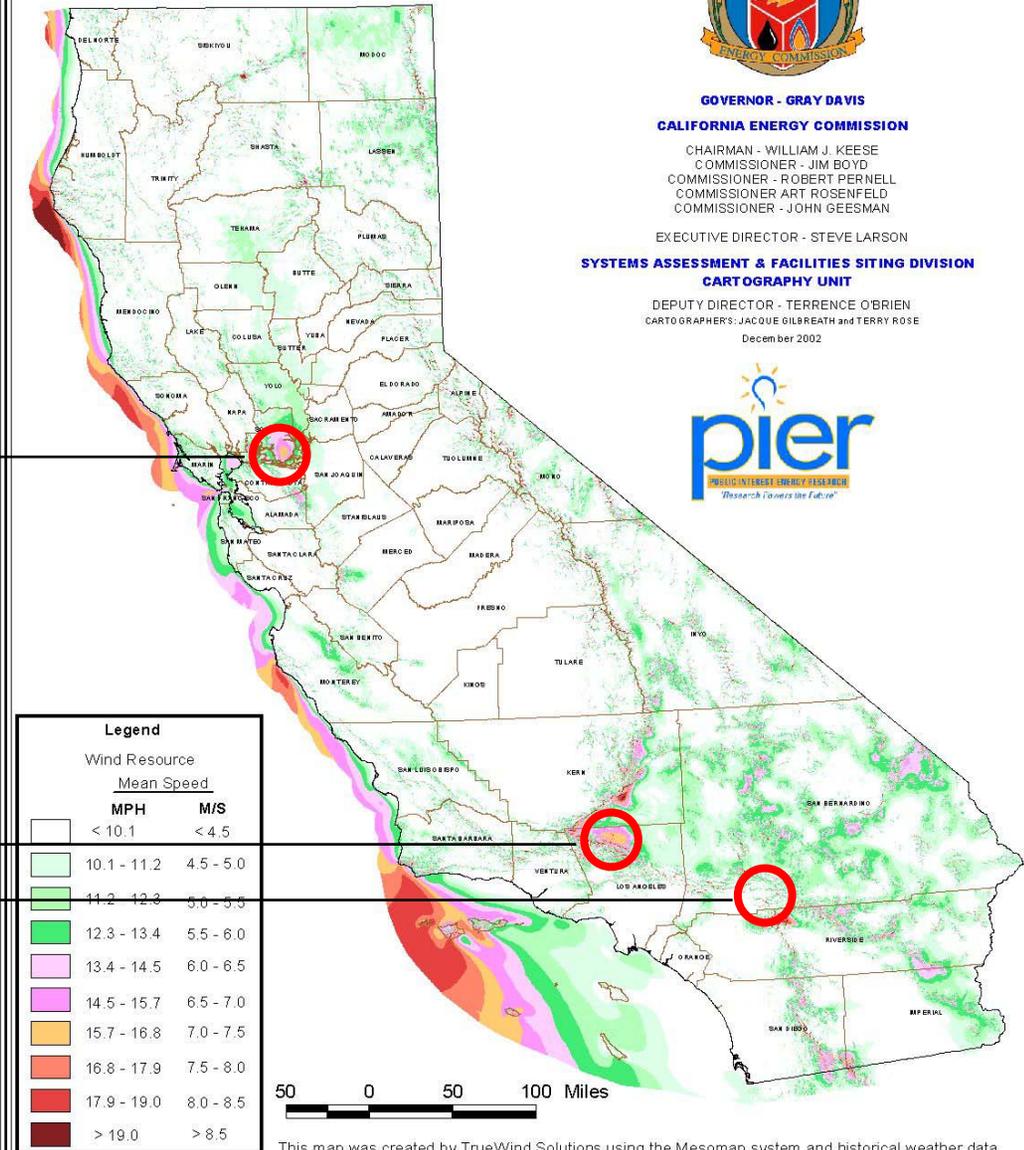
CHAIRMAN - WILLIAM J. KEESE  
COMMISSIONER - JIM BOYD  
COMMISSIONER - ROBERT PERNELLS  
COMMISSIONER - ART ROSENFELD  
COMMISSIONER - JOHN GEESMAN

EXECUTIVE DIRECTOR - STEVE LARSON

SYSTEMS ASSESSMENT & FACILITIES SITING DIVISION  
CARTOGRAPHY UNIT

DEPUTY DIRECTOR - TERENCE O'BRIEN  
CARTOGRAPHERS: JACQUE GILBREATH and TERRY ROSE

December 2002



This map was created by TrueWind Solutions using the Mesomap system and historical weather data.

# Hesperia Market Area

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- ❖ ~ 45 10 kW wind turbine within 10 mile radius
- ❖ Relaxed permitting requirements in San Bernardino Co.
- ❖ Market tipping point achieved in 2004 after 3 years



# Hesperia Market Area

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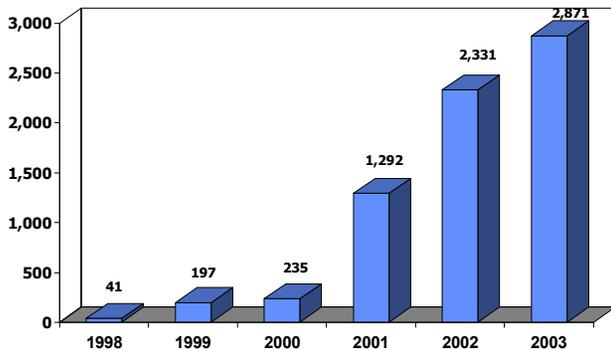
**Neighboring 10 kW  
Turbines**

**“5 – Pack”  
Shipment**



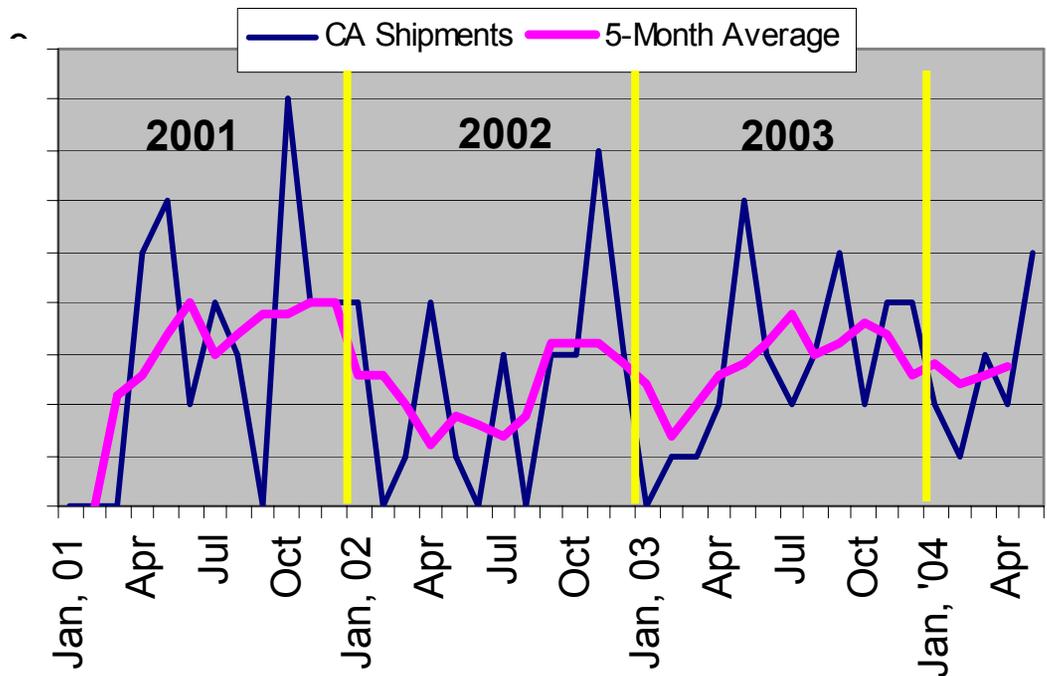
# Unlike Solar, Small Wind Sales Didn't Take Off in 2001 ... Due to Zoning Barriers

## Photovoltaics



## Small Wind

Shipments of 10 kW Bergey Turbines to California



# Los Angeles Co. – Antelope Valley

**~80 Quotes /  
Reservations  
in 12 months**

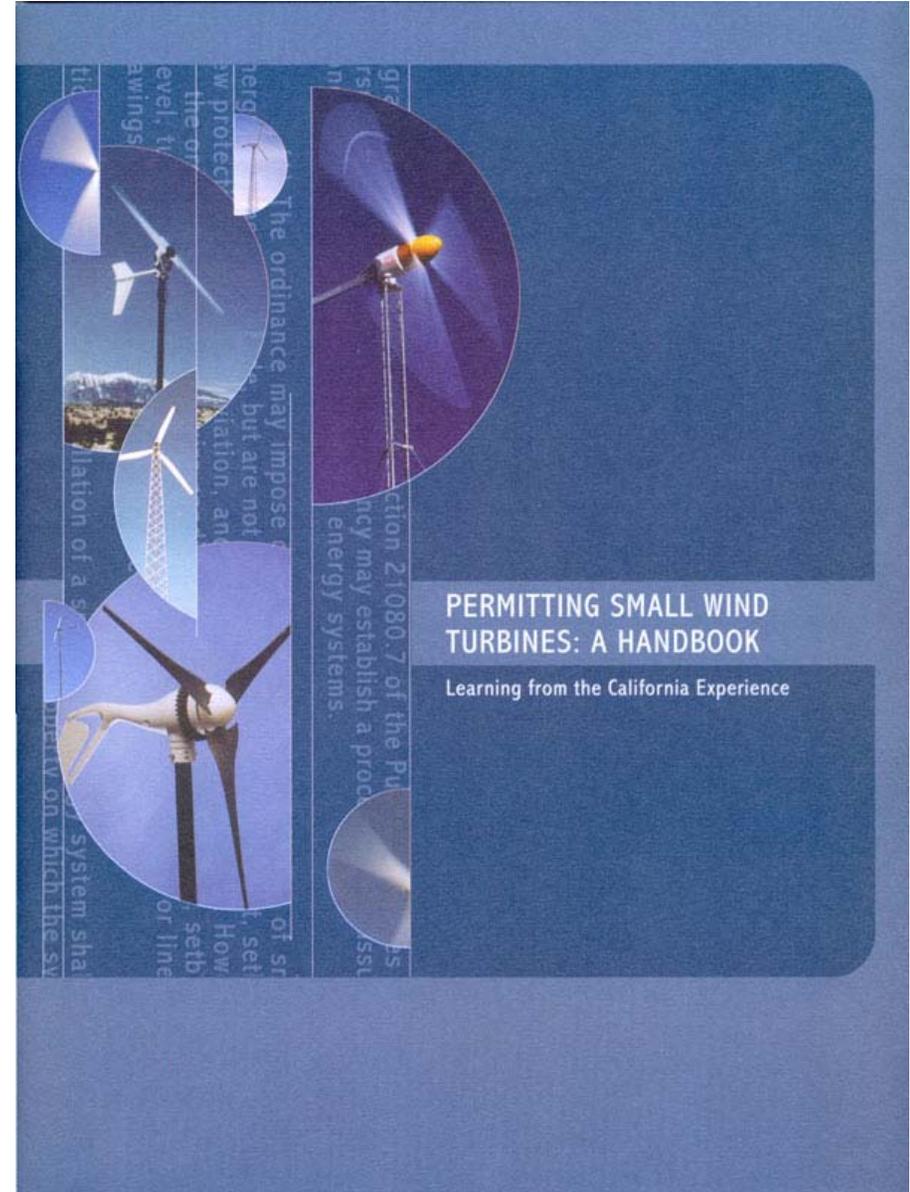
**6 Permits in  
12 months**

GENERAL STANDARD	QUANTITY/QUALITY
Minimum parcel size	½ acre*
Maximum tower height	-35 feet for lot < 1 acre in size* -65 feet for lot 1-1.99 acres in size* -85 feet for lot 2 or more acres in size*
Min distance between facility, and property line or roadway	Total height of facility, including the vertical extent of the blades, generator and wind measuring devices*
Placement of facilities	-Not permitted within easements or on property lines* -Safe clearance from structures and trees*
Colors	Muted and compatible*
Climbing apparatus	Lowest extent at least 12 ft above ground*
Signs	Only one sign permitted—max. 18 in. wide and 12 in. high—for owner and manufacturer identification only*
Parking	No displacement of existing parking spaces*
Maintenance	Must be maintained in operable and safe condition*
Removal	Must be removed within 6 months of non-operation or permit expiration*
Blade lower extension	May not extend to within 20 ft of ground
Generator Control Mechanisms	Must include manual and automatic speed controls
Safety wires	To be installed on any guy wires.
Noise	May not exceed 60 dba SEL as measured at nearest wall of closest occupied residence.*
Visual effects	-May not "silhouette" above any "major ridgeline" as seen from mapped highway, Scenic Highway, or significant residential area (See Part 15 of Chapt.22.52 for definition of "major ridgeline") -Facility to be at least 100 horizontal feet from, and top of facility to be at least 25 vertical feet below top of, adjacent major ridgeline (includes highest extent of the WECS-N blades), or less than 100 horizontal feet* -Subject to conditions if located within viewshed of a mapped highway or Scenic Highway -Conform to policies of Local Coastal Plan* -May not obstruct views of ocean from residence or highway* -Generated power must be used for on-site consumption, and no revenue or utility payment credit may be received for excess power generated
Flight Safety	-Acquire flight agencies' approvals through zoning permits* -Safety lights to FAA standards for all facilities 50 feet or more in height* -Safety lights may be required for shorter facilities*

\*Also applies to Temporary Meteorological Towers (Temp Met Towers)



# CEC is Helping



# Taking Small Wind to the Next Level in California

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- ❖ **Leverage off new/enhanced rebate programs in VT, NY, and NJ; smaller programs in MT, WI, OH, VA**
- ❖ **Revisit the ERP rebate levels and terms to restore market stimulus**
- ❖ **Extend and upgrade AB 1207 permitting legislation**
- ❖ **Address small wind property tax issue**

# Q 1: Coordinate state and local programs?

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- ❖ Promote permissive permitting through incentives and advocacy
- ❖ Promote property tax exemptions
- ❖ Concentrate on inland Southern California, where high growth is expected

## Q 2: Is the ERP cost reduction model effective?

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- ❖ Model is quite good, but small wind subsidies were reigned in too early ... we didn't get over the cost hump
- ❖ Wind took a bigger reduction than solar in 2003 and the \$0.20/W biannual decline hits wind twice as hard due to its lower basis
- ❖ We have proposed a short term increase in the wind rebates that would quadruple sales and lower installed prices ~ 17% over two years, at a marginal ERP cost of ~ \$4-5 million
- ❖ If ERP funds are exhausted in the months ahead, the manufacturers will survive, but most of the dealers will not – the local support infrastructure will dissolve

## Q 3: ERP/Japan model or German model?

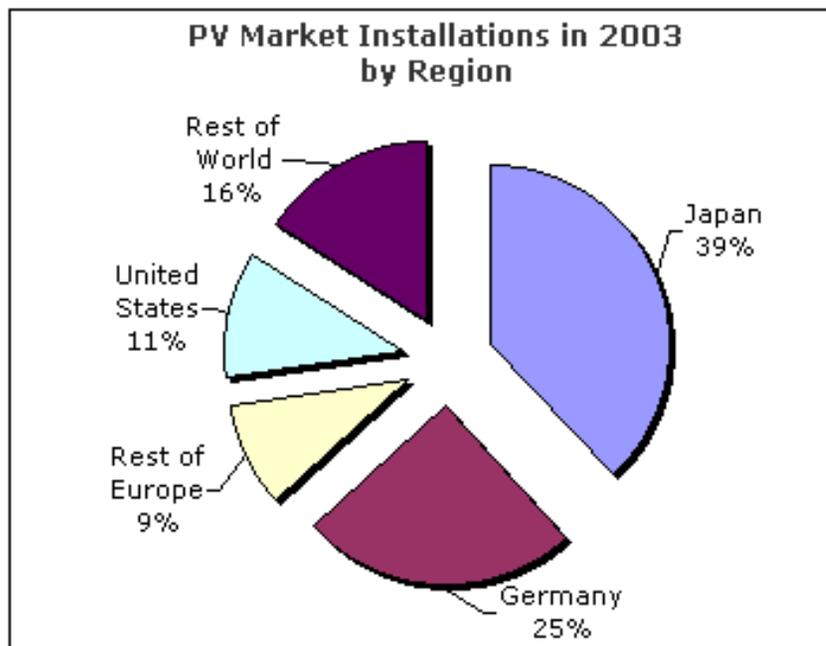
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- ❖ Performance-based subsidies that pay out over a number of years will probably need a coordinated financing program to be effective
- ❖ Why change horses midstream?

## Q 4: Lessons from Japan and Germany?

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- ❖ It is unfortunate when the U.S. federal government isn't in the game
- ❖ Strong local markets begat strong manufacturers and job creation



**Japan Mfg Share: 49%**  
**U.S. Mfg Share: 12%**

## Q 5: Net metering, CRS, tax credits?

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- ❖ Net metering is a 2<sup>nd</sup> or 3<sup>rd</sup> tier incentive and shouldn't be given a priority over rebates, tax credits, tax exemptions, etc.
- ❖ CRS exemption could be temporary, but should cover the probable payback period
- ❖ Though not as flexible and immediate as rebates, people love tax credits ... extension of state credit would definitely help
- ❖ Federal credit likely to be capped at \$2,000

## Q 6: Fostering solar systems on new homes?

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- ❖ Why not solar and wind? Allowing more consumer choice.
- ❖ Could combine mandated financing availability and structuring with modest buydown that provides monthly cash flow balancing (utility savings pays mortgage increment)
- ❖ European model: cooperatively owned, remotely sited, large scale renewables (mostly wind) with proportionate energy production credited to co-owners home utility bill.
- ❖ Don't forget existing homes