National Perspectives on Small Wind

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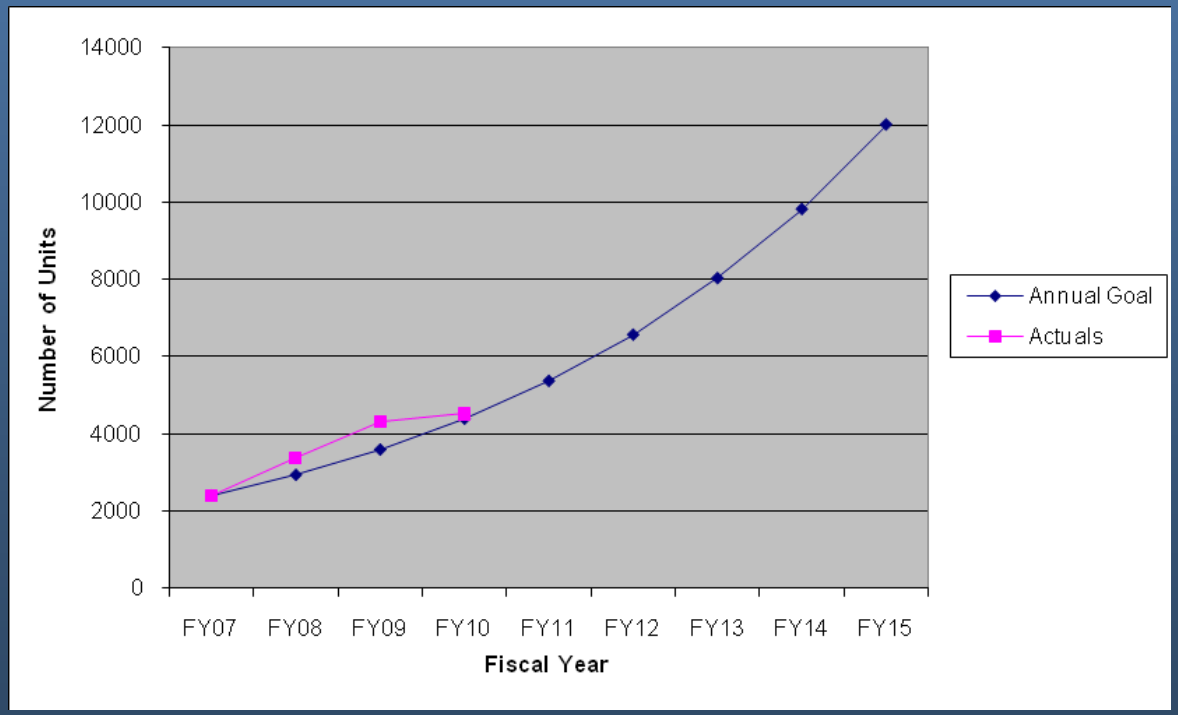
Presentation Outline

- Actuals in small wind market
- Wind resource variability
- Micro-siting
- Summary of PtP of different states in region
  - Summary of different state incentives, what works and what doesn't
- Small Wind Certification (60 kW and less)
- Installer Certification (100 kW and less)
- Other sources of information

Deployed Distributed Wind Turbines

- ✓ All turbines from 1 kW to 1MW, on- and off-grid
- ✓ All types of hardware: HAWT, VAWT, BWT, etc.
- ✓ All turbines noted in the 2010 AWEA Small Wind Turbine Global Market Study - new turbines 1 kW to 100 kW



Year	Actuals
FY07	2401
FY08	3376
FY09	4321
FY10	4520
FY11	
FY12	
FY13	
FY14	
FY15	

http://www.awea.org/_cs_upload/learnabout/smallwind/4420_1.pdf

Calculation of Wind Power

- Power in the wind = $\frac{1}{2} \rho A V^3$
  - Effect of wind speed, V
  - Effect of rotor diameter on swept area, A
  - Effect of elevation and temperature on air density, ρ

Capacity Factor

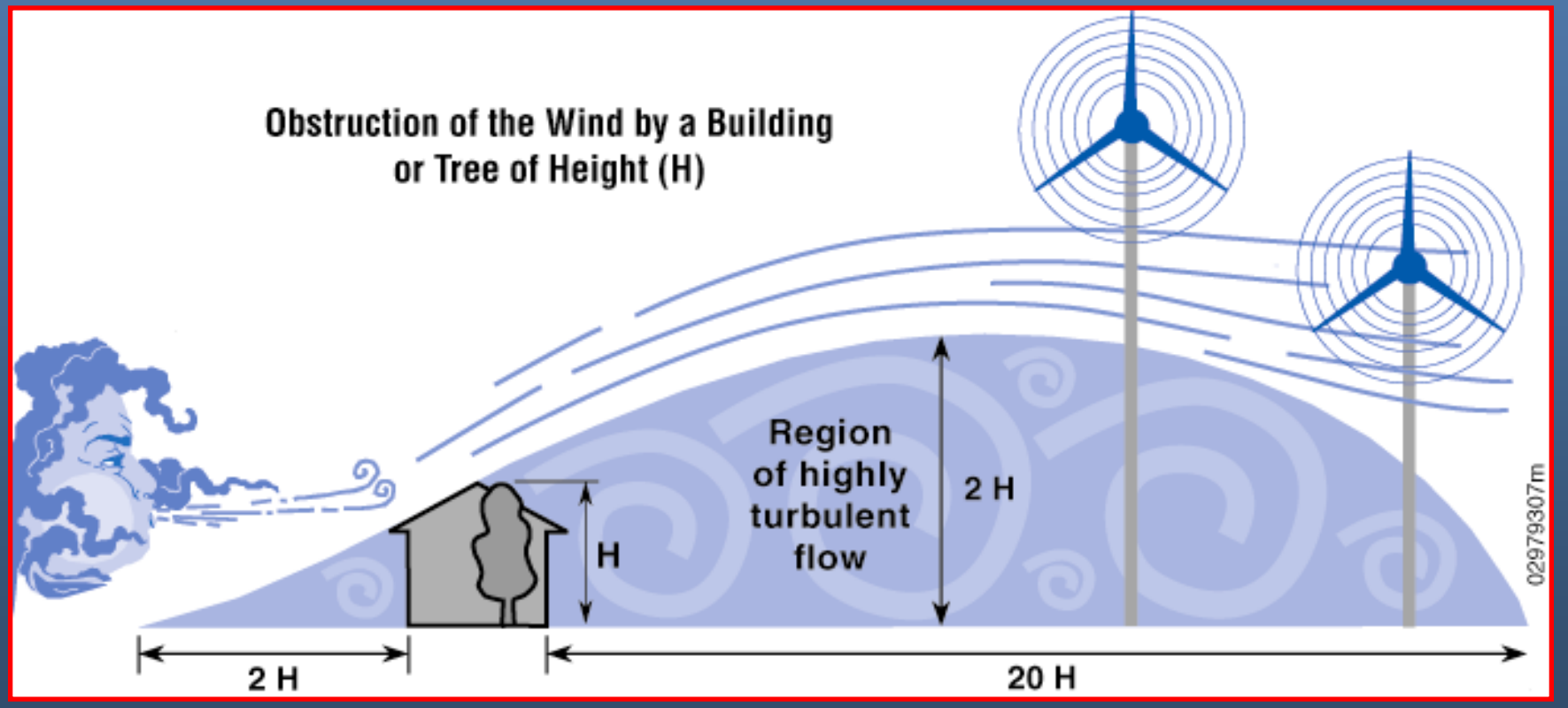
Capacity Factor =
kWh produced per year/(P_{rated} * 8760 hours/year)

- P_{rated} – rated power of the wind turbine
  - Small Wind Turbines have wide variation
- Used to judge the site more than the turbine
- Can be evaluated across any period of time
  - Yearly, monthly or weekly
- Capacity Factor – typically ranges from 10 – 40%
  - Small wind 9-22%
  - Distributed wind 15-30%
  - Windfarm 28-42%

Availability

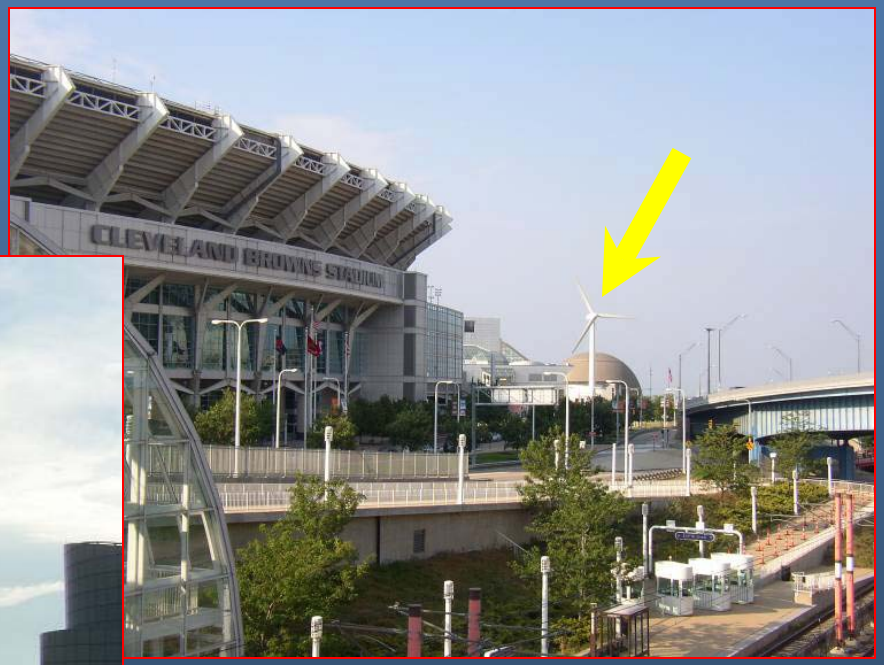
- Is expressed in a fraction (98%)
  - [total number of hours in a period *(when the wind is high enough for the turbine to produce energy)* – number of downtime hours]/total number of hours x 100%
- Reasons for less than 100% availability
  - Scheduled maintenance and inspection
  - Line outages
  - Delays for parts or equipment
  - Public relations (tours)
  - Delays in responding to faults
  - Etc.

Importance of “Micro-Siting”



4.4% capacity factor in first year of operation

(July 2007)

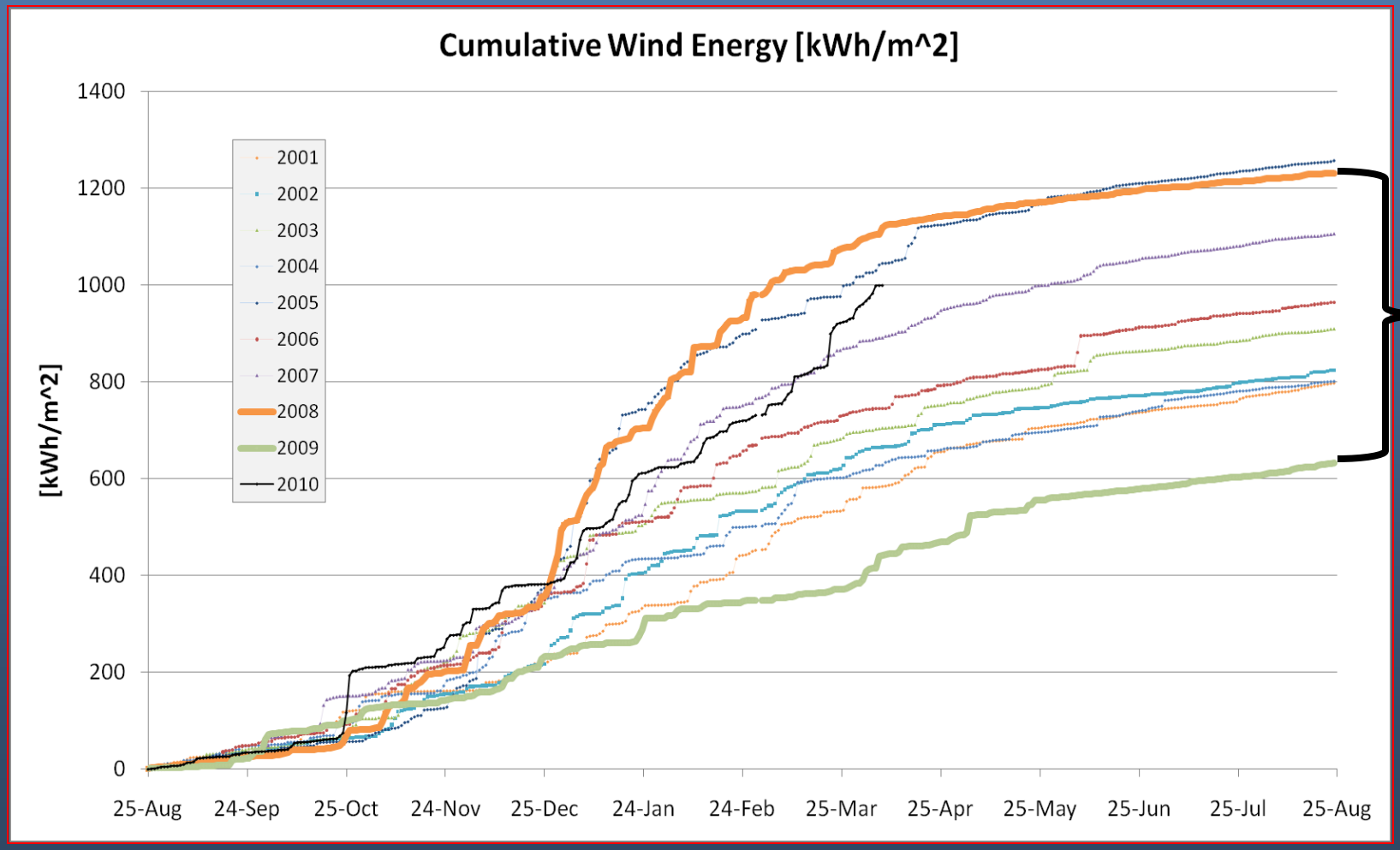


Estimated 7% capacity factor in first 5 months of operation

(December, 2006 – April, 2007)

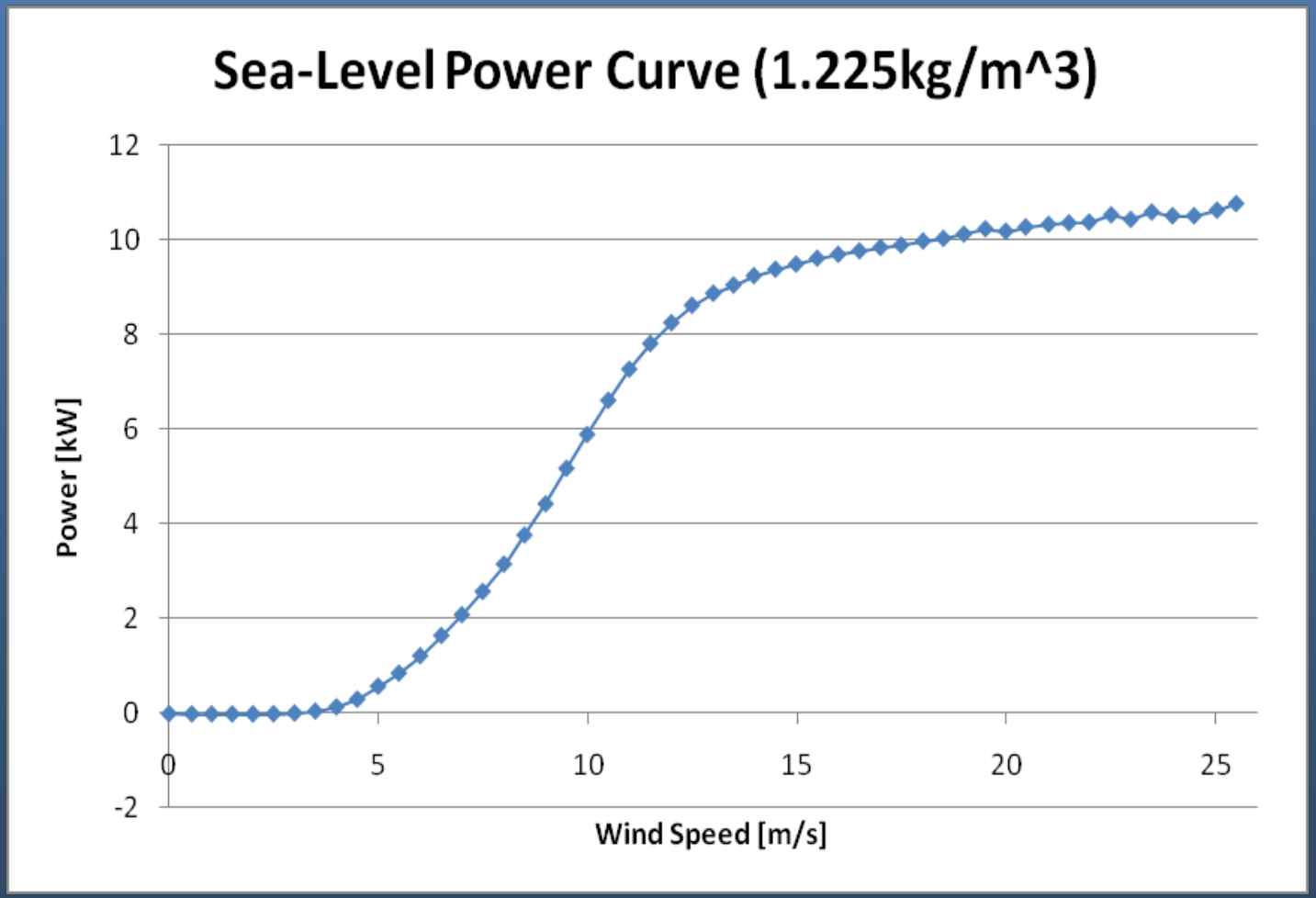
NWTC site

Difference in energy resource NWTC – Boulder, CO

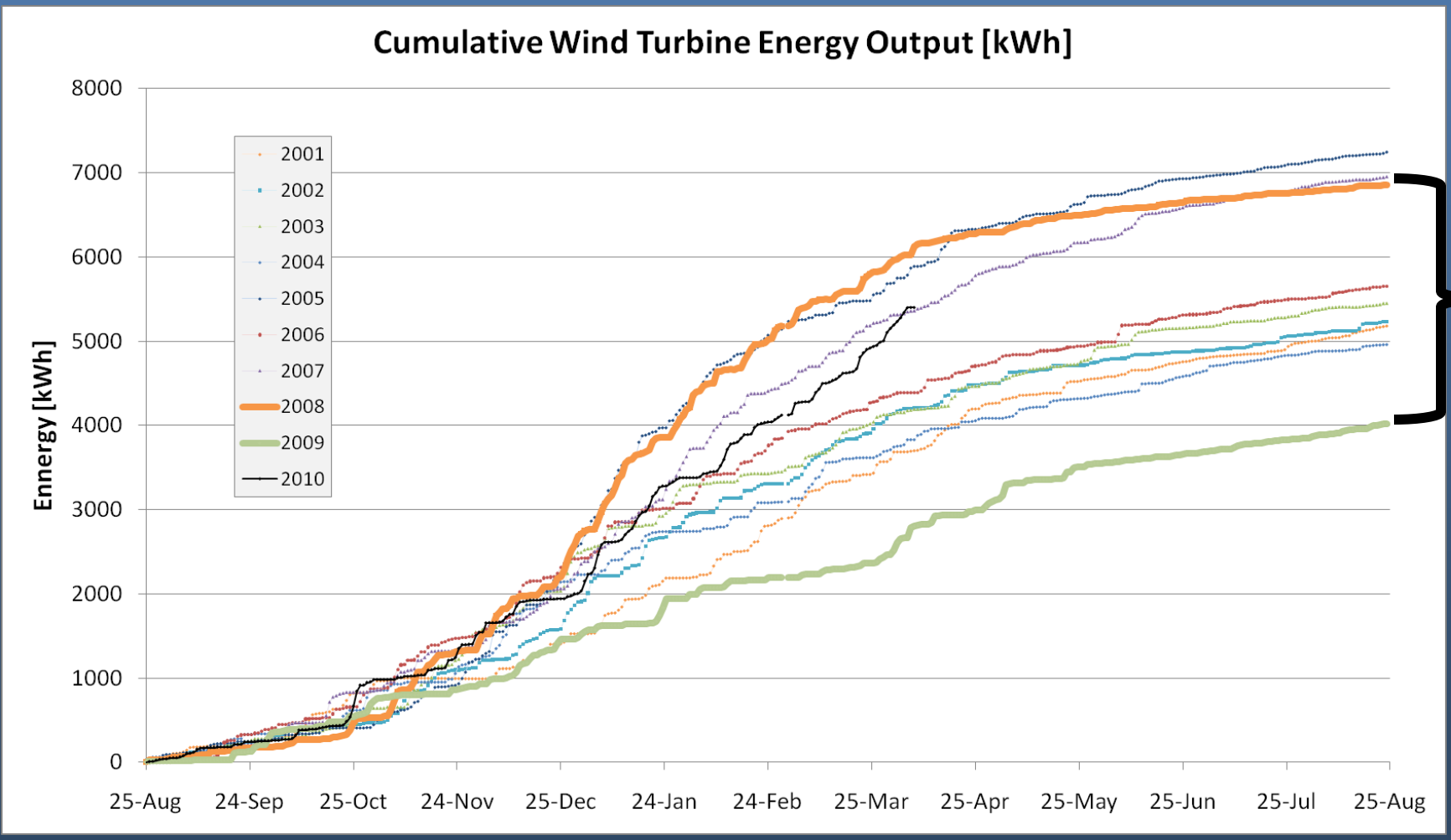


49% Δ

10 kW turbine power curve



Energy Production difference between 2008 and 2009



DSIRE™

Database of State Incentives for Renewables & Efficiency

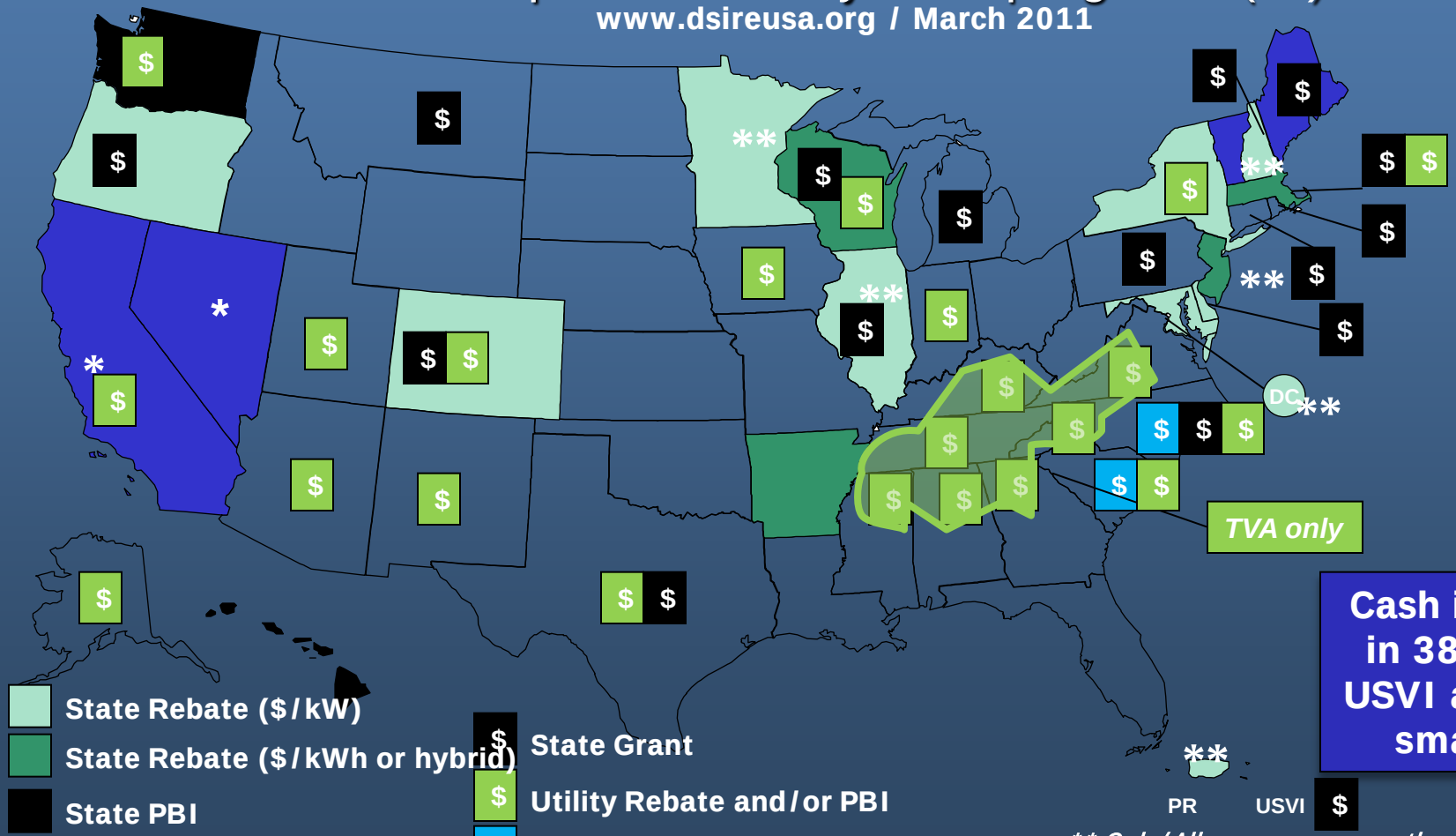
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

IREC Interstate Renewable Energy Council

North Carolina Solar Center

State PBIs, Rebates and Grants + Utility Rebates and incentives + Non-profit REC buy-back programs (all) for small wind

www.dsireusa.org / March 2011



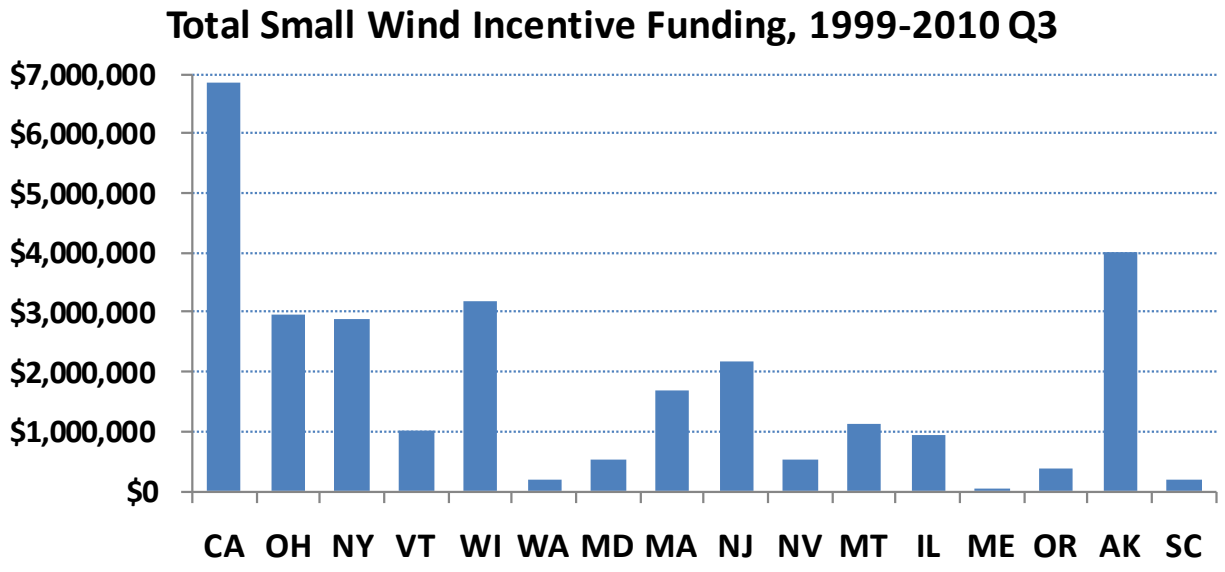
Cash incentives in 38 states + USVI and DC for small wind

- State Rebate ($/kW)
- State Rebate ($/kWh or hybrid)
- State PBI
- State Rebate and PBI
- State Grant
- Utility Rebate and/or PBI
- Not-for-profit REC buying program

** Only/All programs currently out of funding

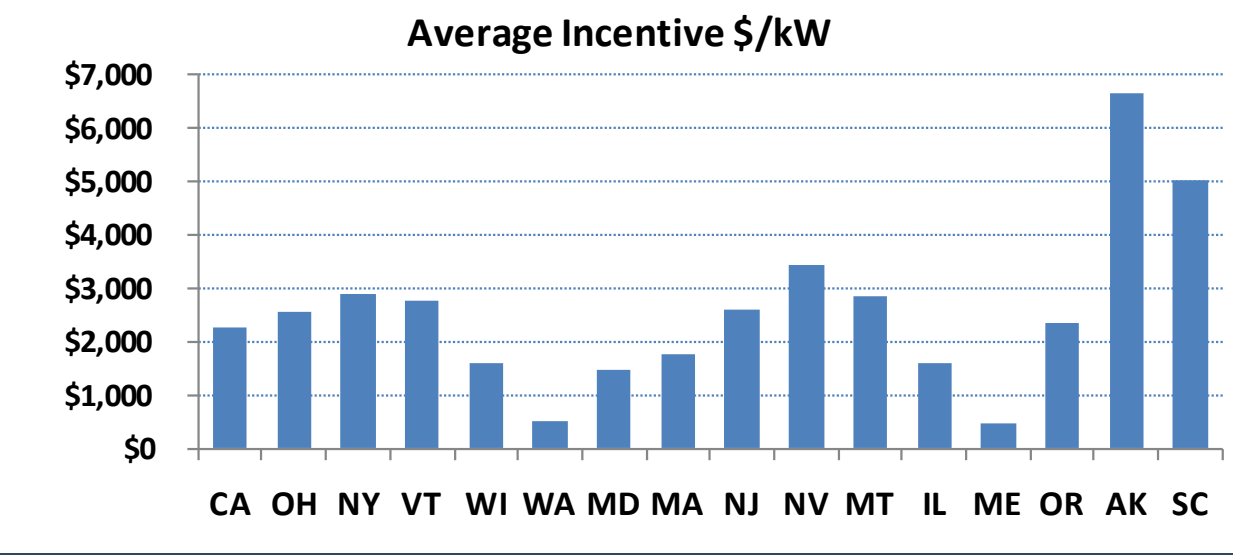
* At least one program currently out of funding

Small Wind Installed with State Cash Incentives



Average funding:
$22,000/unit

Range
$2,100-
$670,000/unit



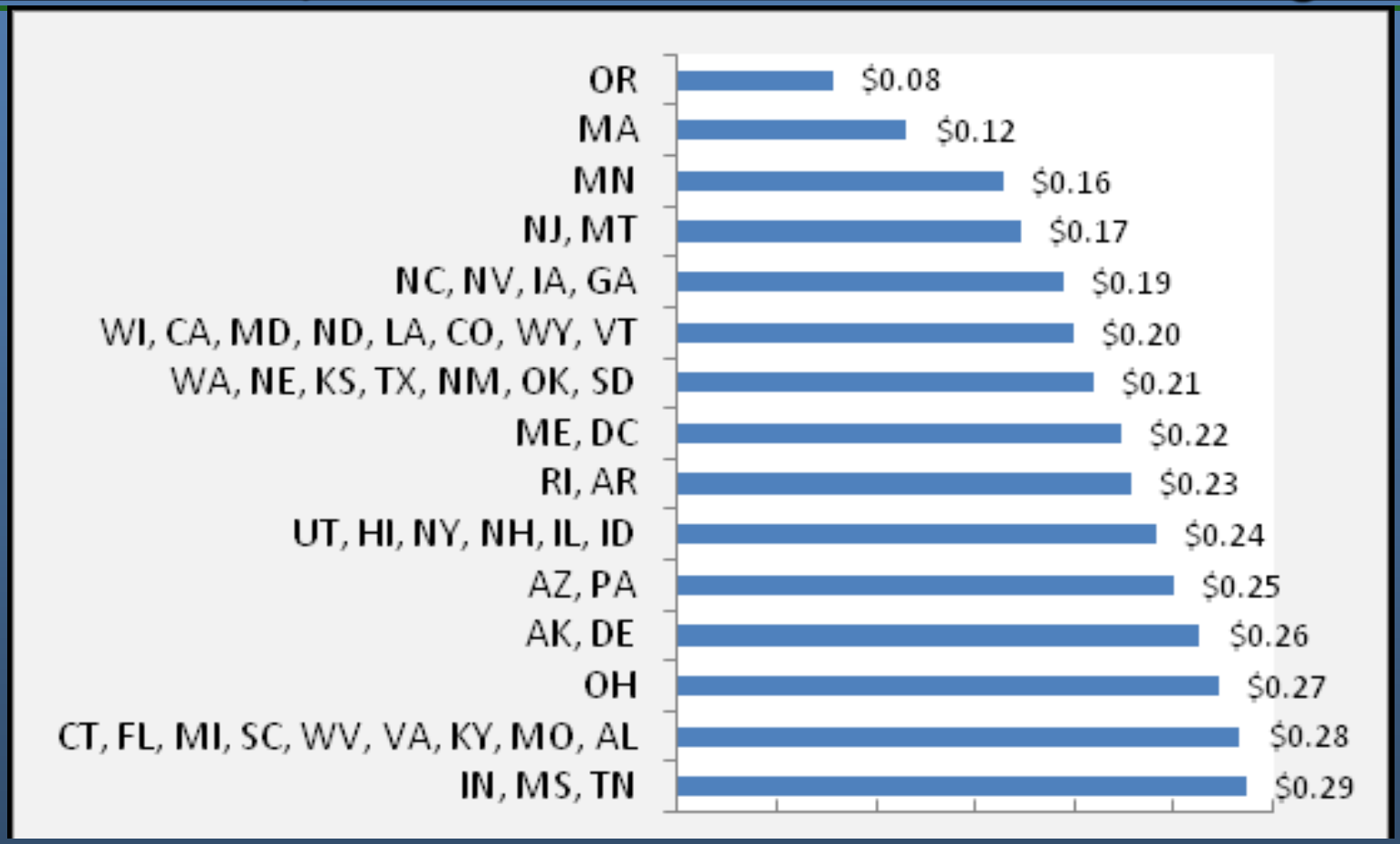
Average $2.40/Watt

In order of
total units funded

Source: EFO & IREC

State Ranking – COE

Residential, Non-Taxed & Commercial Sectors Averaged

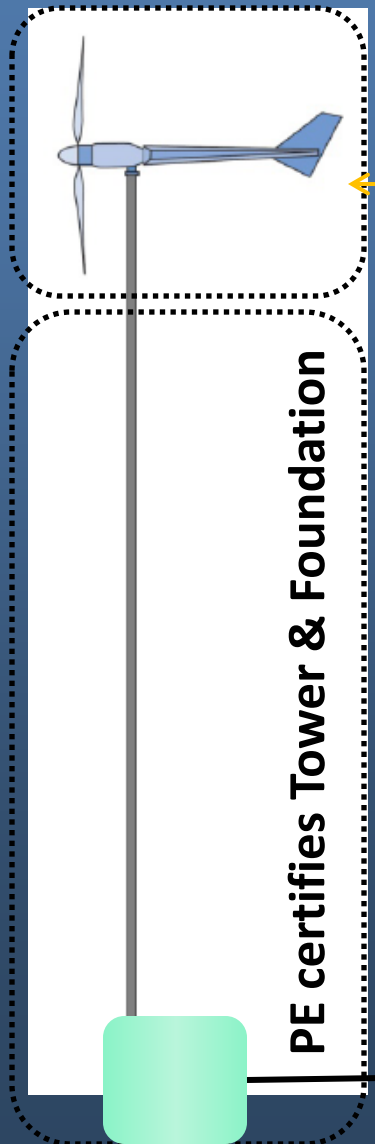


Average COE results of base case scenarios, current policies and incentives

www.eformativeoptions.com/dwpolicytool

Sign up to receive project announcements

SWCC and NRTLs certify Mechanical Strength, Durability, Function & Performance of Turbine System (excludes tower only) to AWEA standard

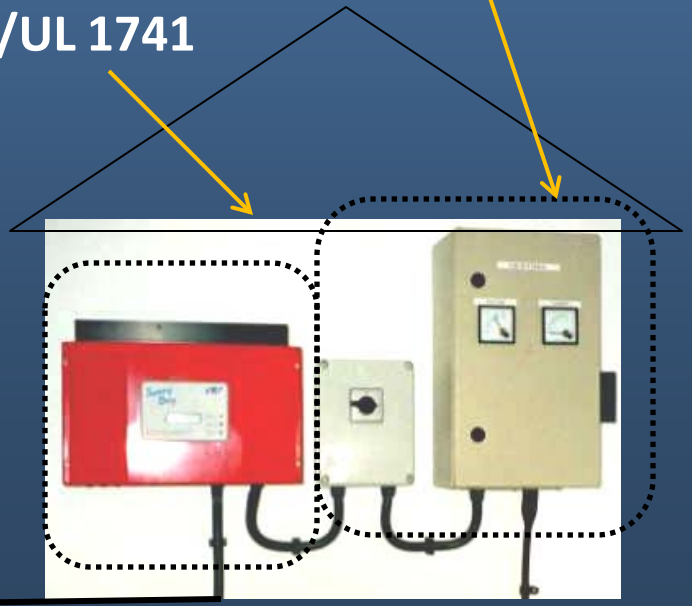


PE certifies Tower & Foundation

NRTLs **will** certify Electrical Safety of Turbine & Controller (*new UL Standards in development*)

NRTLs certify Inverter to IEEE 1547/UL 1741

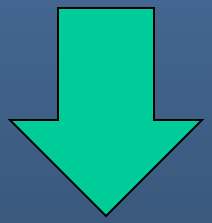
NABCEP certifies the Installer



Wired per NEC *(new article 694 in 2011)*

Various Certification Standards

- International Electrotechnical Commission (IEC) 61400 series
  - -2 Design Requirements for Small Wind Turbines
  - -11 Acoustics
  - -12-1 Power Performance



- American Wind Energy Association (AWEA – national)
  - **Small Wind Turbine Performance and Safety Standard** **9.1 – 2009**
    - **Parts of IEC -2, -11, -12-1**
- British Wind Energy Association (BWEA – national)
  - **Small Wind Turbine Performance and Safety Standard**
    - **Parts of IEC -2, -11, -12-1**
    - **-11 Acoustics reporting is different**

Micro-generation Certification Scheme

http://www.microgenerationcertification.org/mcs-consumer/product-search.php?searchProductTypeID=1623

	Product Name	Manufacturer	Product Type	Product Models	Certification No	
	Evance...	Evance Wind Turbines Limited	Wind Turbine	R9000...	MCS WT0039/01	More Info
	Evoco...	Evoco Energy Limited	Wind Turbine	Evoco 10...	MCS WT0054/01	More Info
	Gaia-Wind 133-11kw...	Gaia-Wind Ltd	Wind Turbine	GW 133-11kw...	TUV 0002	More Info
	Proven Energy P35...	Proven Energy	Wind Turbine	P35...	TUV 0001	More Info
	Proven Energy P35-2...	Proven Energy	Wind Turbine	P35-2...	TUV 0003	More Info
	Skystream 3.7...	Southwest Windpower, Inc.	Wind Turbine	Skystream 3.7...	MCS WT0043/01	More Info
	Skystream Marine 3.7...	Southwest Windpower, Inc.	Wind Turbine	Skystream Marine 3.7...	MCS WT0043/02	More Info
	Xzeres -442SR Wind Genrator...	Xzeres Wind Corp	Wind Turbine	Xzeres-442SR Wind Generator...	BBA0071	More Info

SWCC Certification Label

- SWCC Rated Annual Energy
  - (@ one-year average wind speed of 11.2 mph - may change)
- SWCC Rated Sound Level
  - (level not exceeded 95% of time with average wind speed of 11.2 mph)
- SWCC Rated Power
  - (@24.6 mph)
- Meets Safety and Durability Requirements

SWCC Certification Process Summary

1. Notice of Intent to Submit an Application
2. Certification Agreement
   (Turbines listed as Application Pending)
3. Field Testing and design analysis performed
   (~ min 6 months, typically one year to complete)
4. Test reports submitted with Certification Application
5. Technical review
6. Certification Decision
7. Granted; Info added to website

SWCC Certification Applications Pending

American Zephyr Corporation	Airdolphin GTO
Bergey Windpower Co.	Bergey 5kW & Bergey Excel-S
BRI Energy Solutions, Ltd	Vbine 10-05
Endurance Wind Power Inc.	Endurance S-343
Enertech, Inc.	Enertech E13
Evance Wind Turbines Ltd.	Evance R9000
Eveready Diversified Products	Kestrel e400i 3kW 250V & 48Vdc
Evoco Energy	Evoco 10kW
Polaris America LLC	P15-50
Potencia Industrial S.A.	10kW Hummingbird
Renewegy, LLC	Renewegy VP-20
Seaforth Energy	AOC 15-50
Southwest Windpower	Skystream 3.7
Taisei Techno Co.	TTK-10kW
Talk, Inc.	Suelflow 100
Urban Green Energy	UGE-1k and UGE-4k
UrWind	UrWind O_2
Ventera Energy Corporation	Ventera VT10
Windspire Energy	Windspire – 800040
Xzeres Wind Corporation	ARE442

NABCEP Certified Small Wind Installers™

- Congratulations to the first

- **Dale Leroux**
- **Erika Weliczko**
- **Joseph DiFrancisco**
- **Lane Young**
- **Mick Sagrillo**
- **Owen Hyland**
- **Roy Rakobitsch**
- **Timothy Olsen**

Best practices of state-led policies

- Need to help remove the first costs to move market
- Change to existing NJ policy would further delay
- Need long-term policies to grow an industry
- Equity with solar incentive programs
  - Ratchet up from 60% to 70%
- If concerned about wind resource quality, set up anemometer loan program

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?

For More Information

- Wind Powering America – www.windpoweringamerica.gov
- American Wind Energy Association – www.awea.org
- Community Wind - Windustry - www.windustry.org
- Incentives – www.dsireusa.org
- Small Wind Certification Council
- www.smallwindcertification.org
- North American Board of Certified Energy Practioners – www.nabcep.org
- Home Power Magazine www.homepower.com