Monitoring: 2010 Edition

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Outline for presentation:

Site Assessment → Turbine Testing → Deployment → Incentives

Site Assessment

Site Assessment (is not happening)

- Hardware available and more cost effective than ever
- Why not?
  - Still expensive
  - Delays sales process
  - Not required for incentives

Site Assessment (is happening)

- Large wind
  - Still seeing MET towers at wind farms under construction
- Educational
- New installers & new geography

Turbine Testing

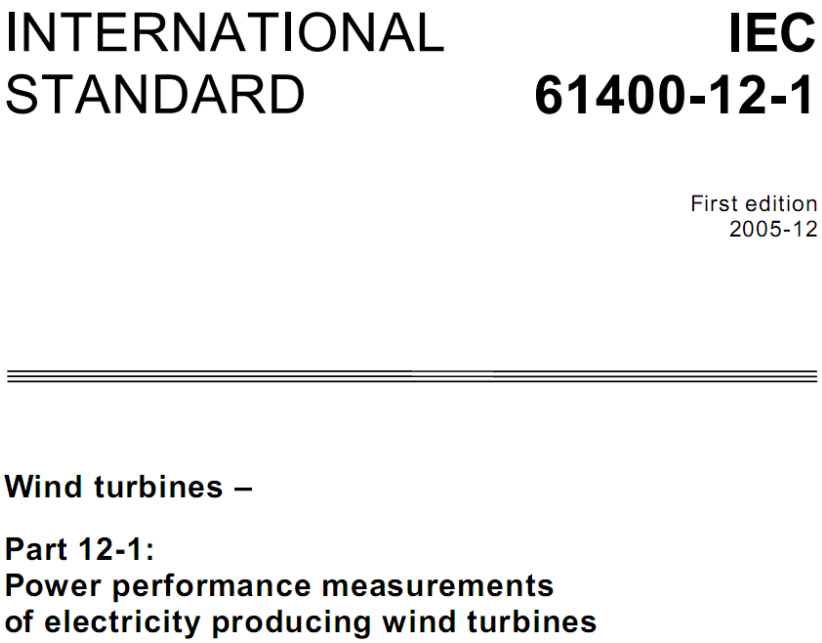
(It is HORIZONTAL AXIS!)

Sales
(are happening)

- (responsible) industry is pushing towards verified and performing turbines
  - Small Wind Certification Council (SWCC) requiring testing to AWEA standards

Manufacturer Testing (pre SWCC)

- Excellent
  - Test with lab to IEC 61400-12 standards


INTERNATIONAL STANDARD

IEC 61400-12-1

First edition
2005-12

Wind turbines –

Part 12-1:
Power performance measurements
of electricity producing wind turbines

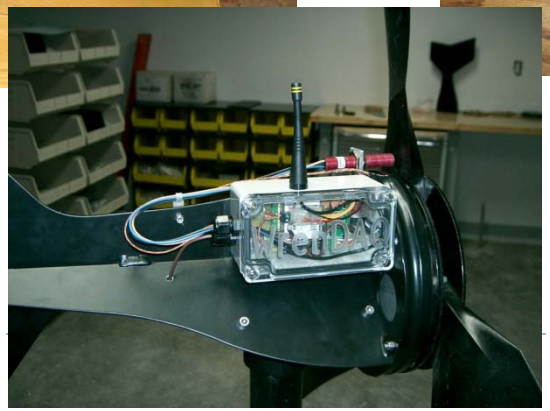
- Very expensive for small wind
- Many $$$ of labor and equipment
- Accredited laboratory required
- Hundreds of pages and thousands of dollars for the standards

National Renewable Energy Lab

- Has developed techniques for IEC testing, but does not want to provide it as a commercial service

Manufacturer Testing (pre SWCC)

- Good
  - Data and test driven design
  - Extensive field testing with manufacturer or customer supplied monitoring

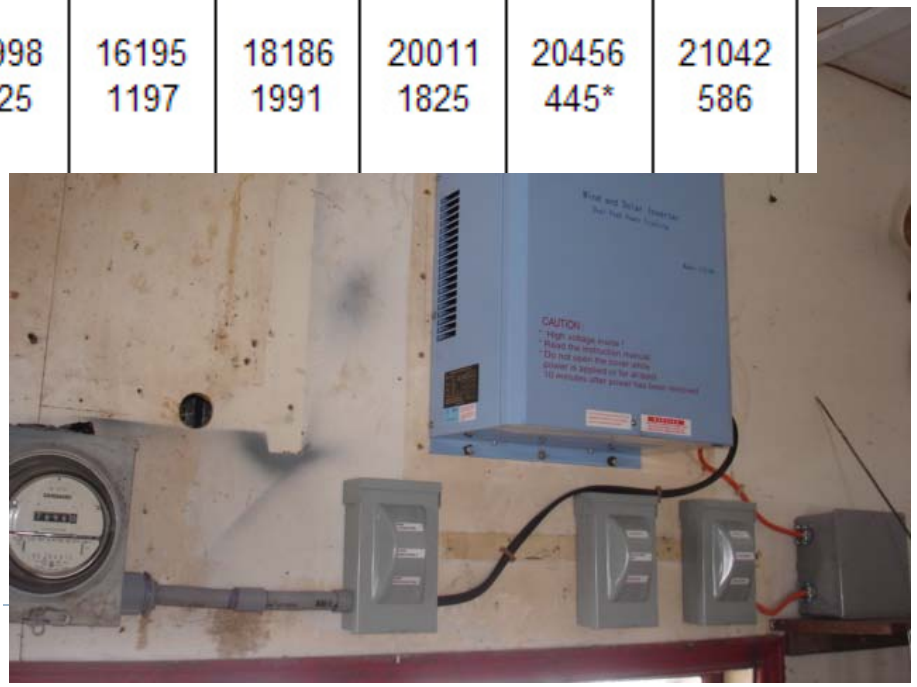


Manufacturer Testing (pre SWCC)

- Bad, but better than nothing
  - KWH meters on turbine output
  - No wind data

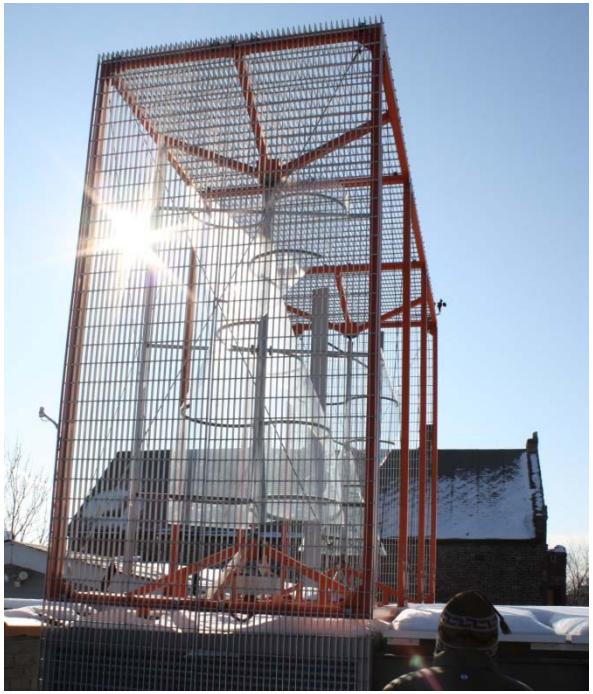
	Jan1	Jan	Feb	Mar	Apr	May	June	July
Reading	1672	2860	3788	4774	6237	7497	8391	9053
Mo-kwh		1188	928	1040	1463	1260	894	662
Reading	12650	13873	14998	16195	18186	20011	20456	21042
Mo-kwh		1223	1125	1197	1991	1825	445*	586

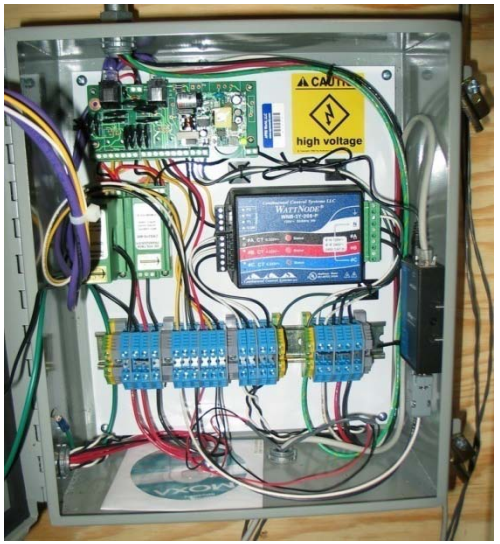
: 785kwh/month



Manufacturer Testing (pre SWCC)

- UGLY
  - Ship it and let the customer see if it works





- (end user spent thousands to monitor their turbines that have produced $0)

Small Wind Certification Council

- Data driven testing process
- Designed and relatively affordable for small wind
- Testing of:
  - Power Performance
  - Acoustic
  - Duration
- Design Verification of:
  - Safety and function
  - Structure

AWEA / SWCC Testing (continued)

- Power performance
  - Power, voltage, current versus standardized wind conditions
- Acoustic
  - Rated sound level, changes in sound
- Duration
  - Vibration, hours of operation, hours of power production, turbulence, power degradation

Manufacturer Testing Requirements (for SWCC / AWEA)

- Characterized test site with full range of wind conditions
- Calibrated equipment
- Documented processes
- Accredited laboratory and/or review by SWCC for proper operation and correct data

Deployment

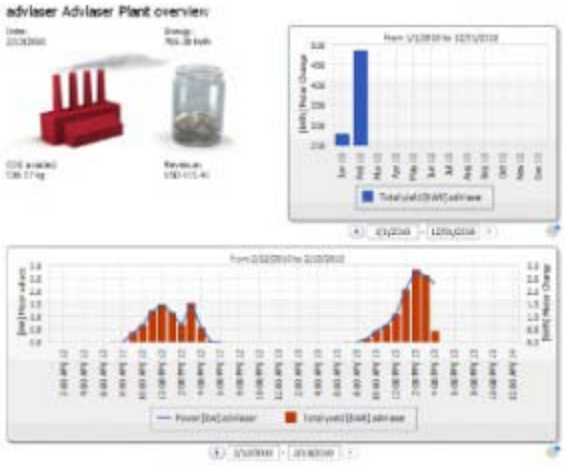
Remote Monitoring from the turbine manufacturers

Picking on our conference sponsors:

	Bergey	Xzeres	SW WP	Endurance	WTI	Fortis
Mentioned On MFG web:	No	No	Barely	Yes!	No (just announced)	Barely
Availability:	Partner	Inverter Supplier	No	Direct	Direct	Inverter Supplier
Price (MSRP):	$650	$600		$0	?	$600
Anemometer:	+ $$$	+ $$$	No	$0	?	+ $$$
Web Monitoring:	Yes Automatic	$$$ + hardware + configuration	No	Yes	Yes Automatic	$$$ + hardware + configuration

Manufacturer Examples

Xzeres and Fortis using SMA inverters using SUNNY WEBBOX:



Bergey:

Data Date:	2010-06-16 10:06:25 (CDT) Report received 2 seconds ago.
PowerSyncII Inverter	
Status:	RUNNING
Power:	2,107 watts
Energy:	35 KWH over last 24 hours 564 KWH since monitoring started (2010-06-04) 2,499 KWH on inverter
AC:	244 VAC @ 60 Hz
DC:	100 VDC @ 20 amps

(Now) (Diagnostics) (Fault Log)

System State Frequency

This table shows the percentages of time the inverter spen

N Occurances	State Code	State Description
98,117 (96.8%)	9	RUNNING
2,950 (2.9%)	5	WAITING FOR WIND
152 (0.2%)	4	STOP
58 (0.1%)	7	AC_RUNNING
26 (0.0%)	6	AC_RUN_INIT
8 (0.0%)	11	FAULT
101,311 total		

Date (UTC)	Fault Code	Fault Description	Action
2010-06-07 20:08:43	8000	AC UNDER FREQ: The frequency of the utility grid voltage went out of range. The upper range threshold was crossed	Surrounding Data: (TXT) (CSV)
2010-06-07 20:08:53	8000	AC UNDER FREQ: The frequency of the utility grid voltage went out of range. The upper range threshold was crossed	Surrounding Data: (TXT) (CSV)
2010-06-07 20:45:08	2280	AC UNDER VOLT: The AC line voltage has dropped below its minimum threshold	Surrounding Data: (TXT) (CSV)
2010-06-07 20:45:11	2280	AC UNDER VOLT: The AC line voltage has dropped below its minimum threshold	Surrounding Data: (TXT) (CSV)
2010-06-08 03:55:22	8000	AC UNDER FREQ: The frequency of the utility grid voltage went out of range. The upper range threshold was crossed	Surrounding Data: (TXT) (CSV)
2010-06-08 03:55:32	8000	AC UNDER FREQ: The frequency of the utility grid voltage went out of range. The upper range threshold was crossed	Surrounding Data: (TXT) (CSV)
2010-06-08 04:20:17	8000	AC UNDER FREQ: The frequency of the utility grid voltage went out of range. The upper range threshold was crossed	Surrounding Data: (TXT) (CSV)
2010-06-08 04:20:27	8000	AC UNDER FREQ: The frequency of the utility grid voltage went out of range. The upper range threshold was crossed	Surrounding Data: (TXT) (CSV)

WTI and Endurance:

???

Remote Monitoring from third parties

Pros

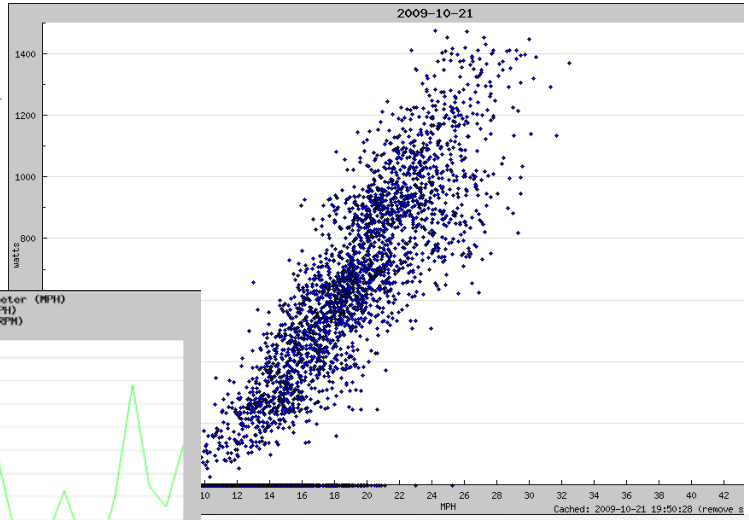
- Available for *anything*
- Accurate (for $$$)
- Flexible
- May be customizable

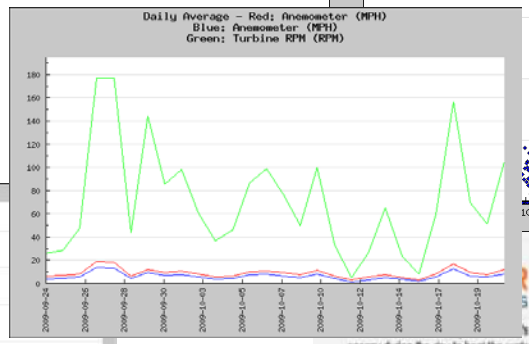
Cons

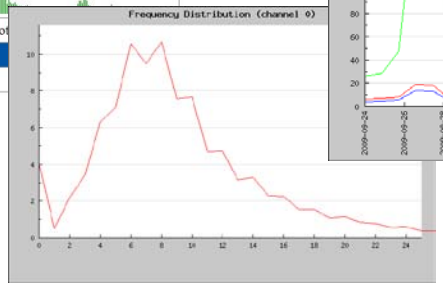
- Expensive
- Time consuming to install
- Complex
- May not be reliable
- Often custom
- Lead time

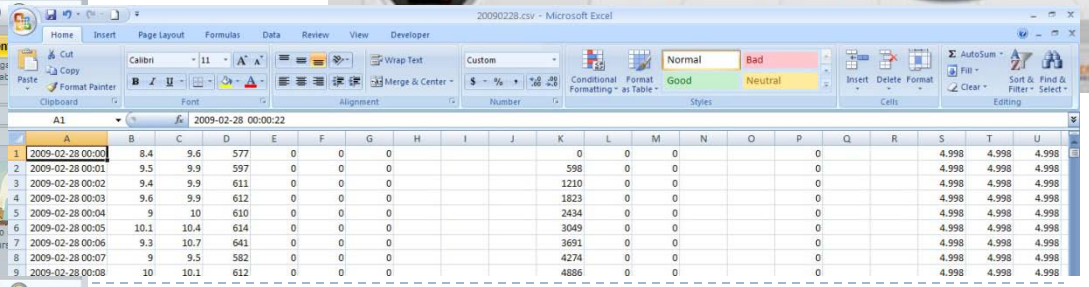
Third Party Examples

Report Date:	43 seconds ago 2010-06-16 11:01:28 EDT
Weather Conditions	**Last 24 Hours**
Wind Speed (now) - top:	6.4 MPH gusting to 9.2 MPH
Wind Speed (now) - bottom:	3.9 MPH gusting to 6.1 MPH
Wind Direction (now):	155°
Temperature:	64.4°F
Relative Humidity:	59.9%
Bergey Excel Conditions	**Last 24 Hours**
Power Output (now):	293 watts
Energy (lifetime):	257.5 KWH net, 257.5 KWH positive to
Data Export	
Text / CSV / Spreadsheet:	by Date Range



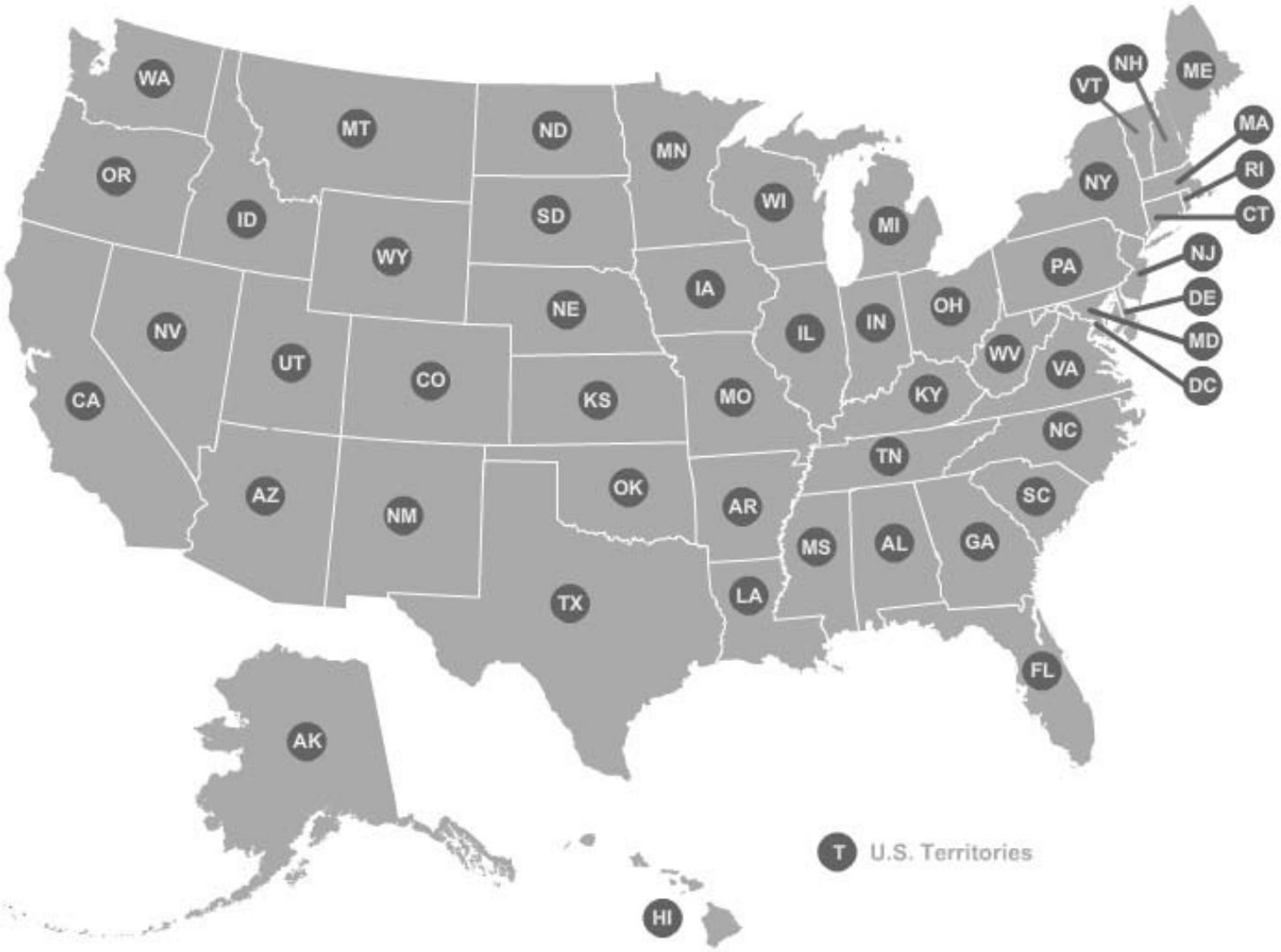






	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	2009-02-28 00:00	8.4	9.6	577	0	0	0				0	0	0			0			4.998	4.998	4.998
2	2009-02-28 00:01	9.5	9.9	597	0	0	0				598	0	0			0			4.998	4.998	4.998
3	2009-02-28 00:02	9.4	9.9	611	0	0	0				1210	0	0			0			4.998	4.998	4.998
4	2009-02-28 00:03	9.6	9.9	612	0	0	0				1823	0	0			0			4.998	4.998	4.998
5	2009-02-28 00:04	9	10	610	0	0	0				2434	0	0			0			4.998	4.998	4.998
6	2009-02-28 00:05	10.1	10.4	614	0	0	0				3049	0	0			0			4.998	4.998	4.998
7	2009-02-28 00:06	9.3	10.7	641	0	0	0				3691	0	0			0			4.998	4.998	4.998
8	2009-02-28 00:07	9	9.5	582	0	0	0				4274	0	0			0			4.998	4.998	4.998
9	2009-02-28 00:08	10	10.1	612	0	0	0				4886	0	0			0			4.998	4.998	4.998

Incentives



Map from DSIREusa.org

State Incentives

Financial Incentives for Renewable Energy

From DSIRE (June 2010): Federal = ☐ State = ▮ Utility = ▮ Local = ▮ Non-Profit = ▮

State	Personal Tax	Corporate Tax	Sales Tax	Property Tax	Rebates	Grants	Loans	Industry Support	Bonds	Production Incentives
Totals	42	42	39	64	339	68	165	37	3	0

- Site assessment monitoring typically not required
- Some incentives require performance monitoring
- Little or no production incentives

Incentive Performance Monitoring

- Many states with small wind incentives require wind speed and production data hardware to be installed
  - Collection of data is often sporadic and not well defined

- Massachusetts Clean Energy Center incentives require:
  - Two anemometers and a wind vane
  - Temperature
  - Power measurement
  - And prefer automatic reporting of 1 minute or faster data

Production Incentives

- Question: *Why no production incentives?*

My Thoughts

- Industry is maturing and is certifying turbines
- Let's make sure they stay working in the field
- Let's incentivize those that do work