



Small-Scale Wind Energy

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Our Wind Cooperative, Montana
Photo credit: Spark Northwest



One size doesn't fit all

Small



CBD Ranch, Klickitat

www.sparknorthwest.org

Medium



Cascade Community Wind

Large

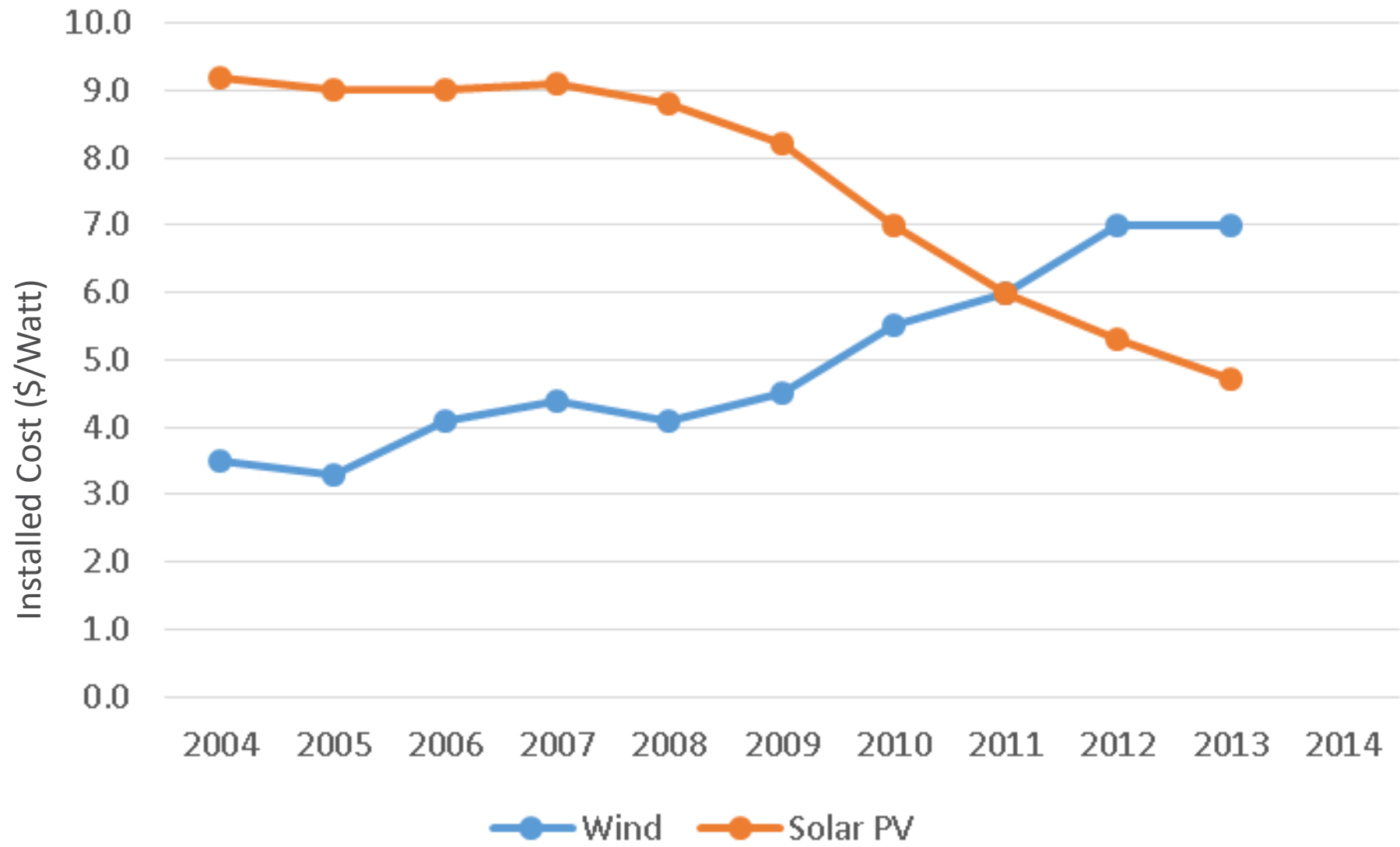


Puget Sound Energy

9/9/2019



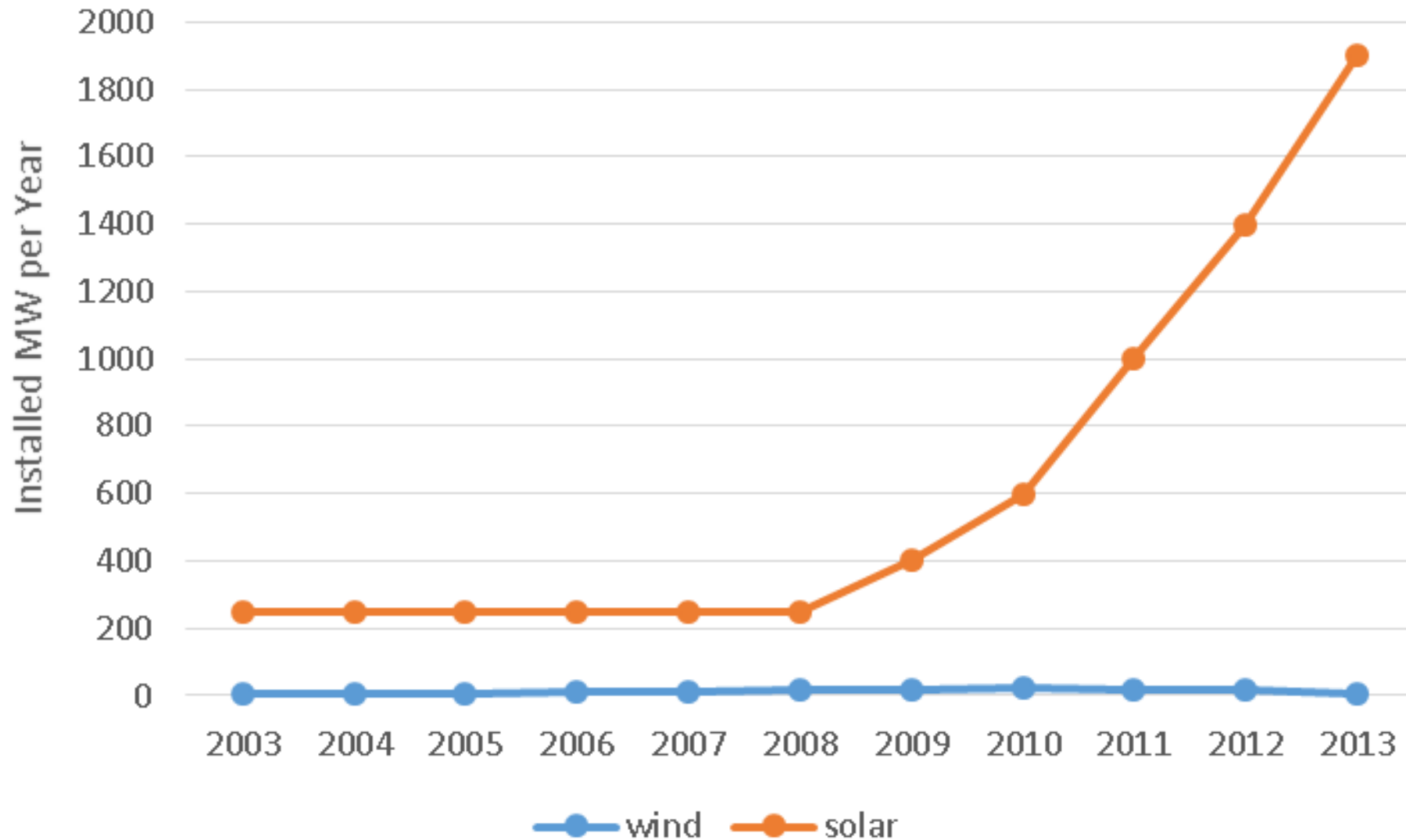
Installed Cost of Distributed Generation in US



Wind data : Bloomberg New Energy Finance "2015 Factbook: Sustainable Energy in America"

Solar data source: LBNL "Tracking the Sun VII", systems up to 10 kW in size.

Installed Distributed Generation in US



Data source: Bloomberg New Energy Finance "2015 Factbook: Sustainable Energy in America"


Wind data includes only turbines 100 kW or less. Solar data includes only "small-scale" solar.

Buyer Beware: Equipment Certification



Small Wind Certification Council
Certified Small Wind Turbine

Manufacturer/Model
Sample Windpower Company
SWT, 240V, 60Hz



CERTIFIED
SMALL WIND TURBINE
SWCC-XX-XX

Rated Annual Energy
 Estimated annual energy production assuming an annual average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution and 100% availability. Actual production will vary depending on site conditions.

12,345
 kWh/year

Rated Sound Level
 The sound level that will not be exceeded 95% of the time, assuming an average wind speed of 5 m/s (11.2 mph), a Rayleigh wind speed distribution, 100% availability, and an observer location 60 m (~ 200 ft.) from the rotor center.

55
 dB(A)

Rated Power
 The wind turbine power output at 11 m/s (24.6 mph) at standard sea-level conditions.

9.5
 kW

Certified to be in Conformance with:
AWEA 9.1 - 2009

For a summary report visit www.smallwindcertification.org



Built-Environment Report Summary for WINDEXchange

Heidi Tinnesand, Ian Baring-Gould, Jason
Fields, Robert Preus, & Frank Oteri

September 28, 2016



Case Studies



Pearson Square Court (NY)

Photo from UGE



Twelve West (OR)

*Photo from Flickr
4852149002*



Boston Museum of
Science (MA)

*Photo from Boston Museum
of Science, NREL 18006*



Detroit Metro Airport (OH)

*Photo from Wayne County
Airport Authority*



Brooklyn Navy Yard (NY)

Photo from Flickr 2874788682

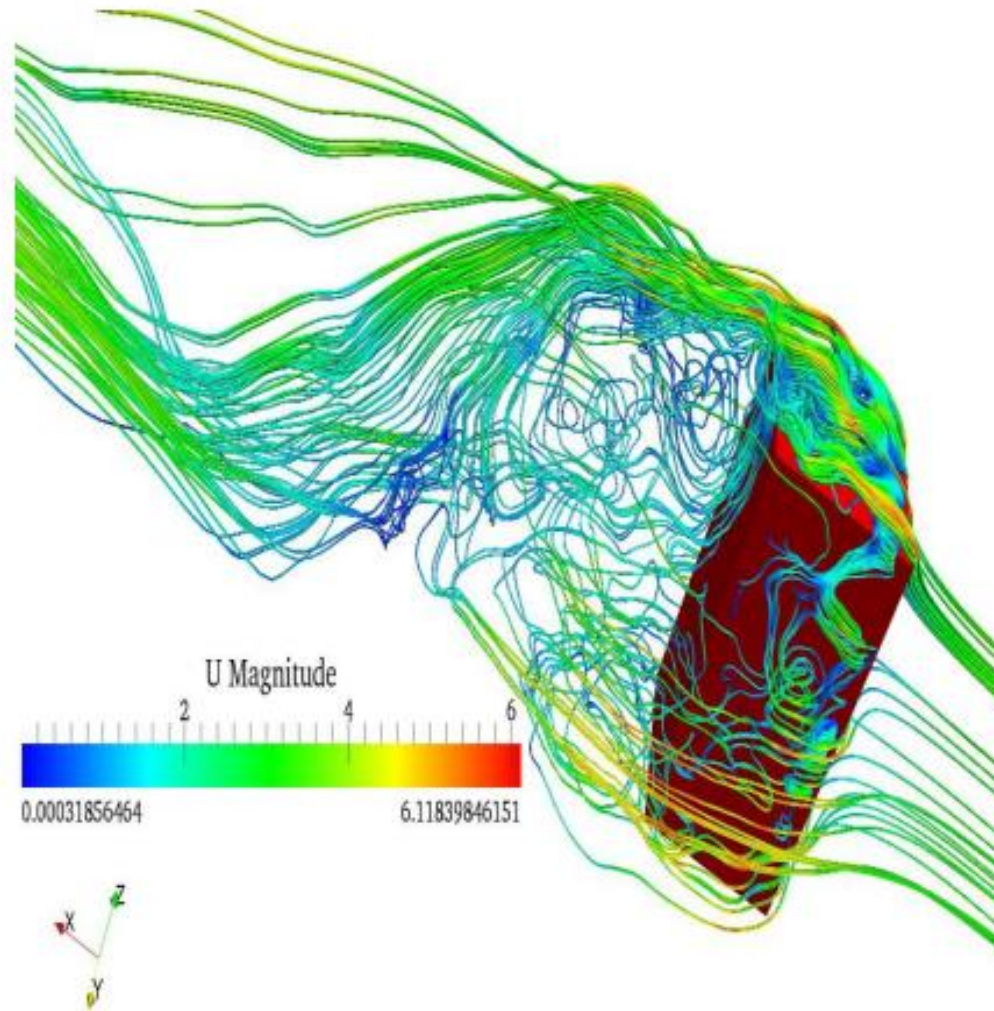


NASA Building 12 (TX)

Photo by Dave Jager, NREL

Lessons Learned: Project Performance

- When compared with actual production, BEWT project performance is often over-estimated.
None of the case study projects met their energy production estimates.
- Consolidation of small turbine manufacturers is common and can lead to loss of warranty and difficulty in service parts availability.
- Current national and international standards do not reflect wind conditions often seen in the built environment.



CFD simulation of flow around building. Image from Francisco Toja

Twelve West: Estimated vs. Actual Energy

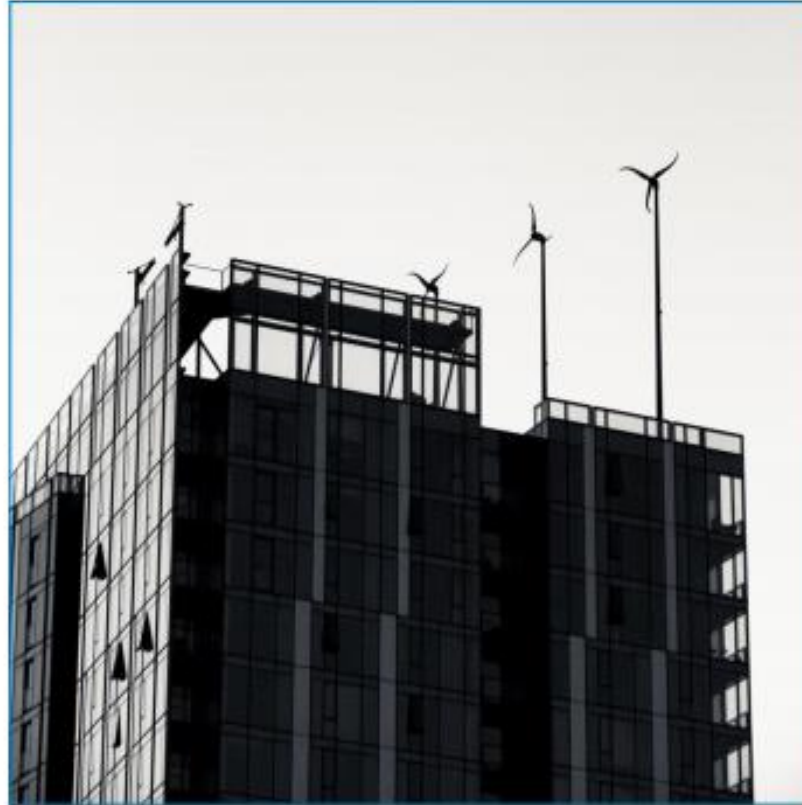
Estimated production:

- ~9,000 kWh/year
- 11% CF
- LCOE: \$2.846/kWh

Actual production:

- ~5,500 kWh/year
- 7% CF
- LCOE: \$4.657/kWh

Average Portland retail rate: \$0.1256/kWh.
BEWT power is 37 times more expensive.



Twelve West wind turbine installation in Portland, OR. Photo from Flickr 4852149002

Key Conclusions - Outcomes/Risks

- The team could not find an example of a BEWT project for which the energy production met pre-construction estimates.
Measured CF range: <1% to 7%
- BEWTs are often shut down or removed early due to vibration, noise, or reliability issues.
- BEWT OEMs often fail, voiding warranties and reducing spare parts supply.
- Project costs are often higher than expected.



NASA Building 12, Phase 1. Photo from Jason Fields, National Renewable Energy Laboratory