



# **Vertical Axis Wind Turbines (VAWT)** **“Small Wind” Energy**

Black Swan



Presented to Energy Huntsville, July 20, 2012  
**Wind Power Systems, LLC**



# Did You Know?

Wind's long-term *theoretical* potential is much greater than current annual world energy consumption.

The most comprehensive study to date found the potential of wind power on land and near-shore to be over five times the world's current energy use and 40 times the current electricity use.





# Wind Power Systems



# Early History of Wind Turbines

**Wind Power was Used in Persia as early as 200 BC and Later Introduced into the Roman Empire by 250 AD.**

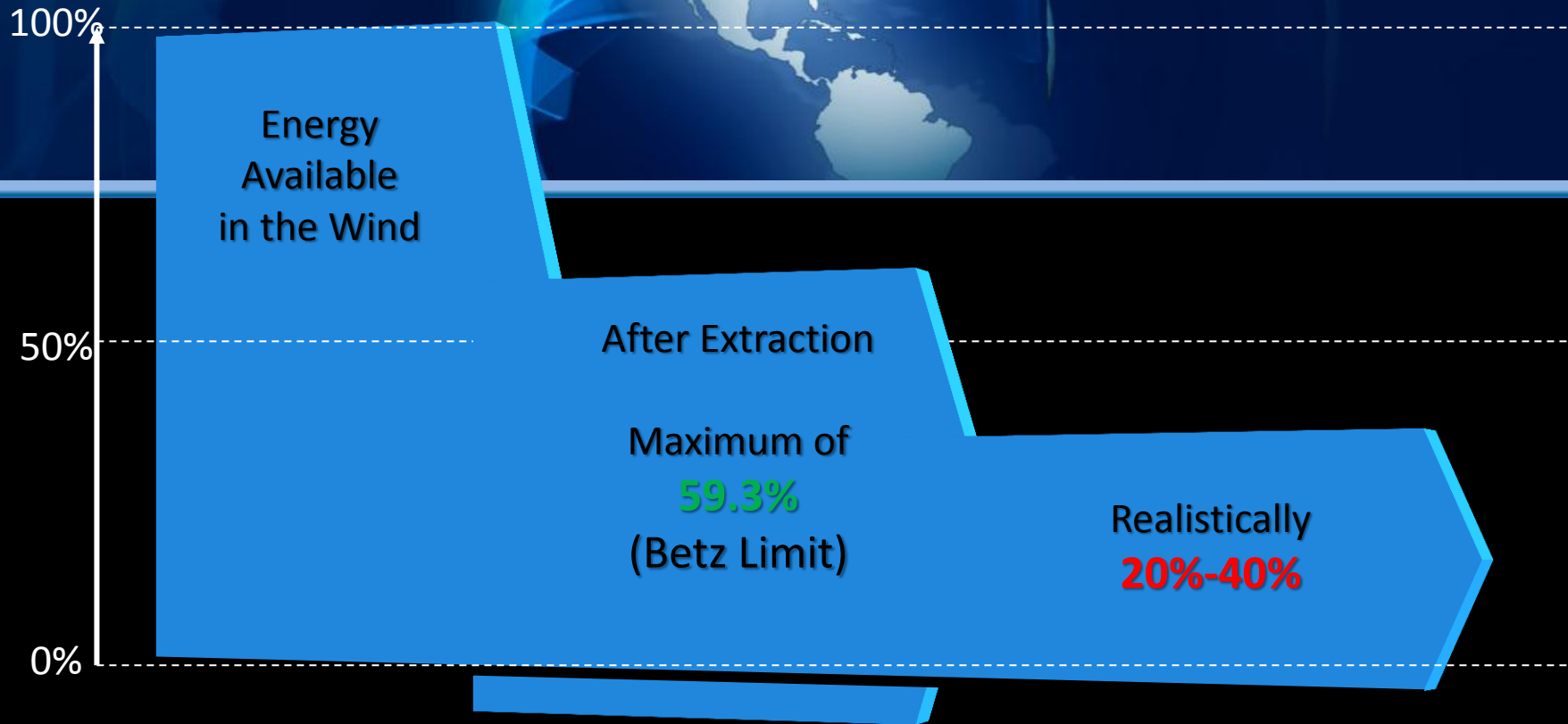
**The first practical windmills were built in Afghanistan during the Mid-7th century.**

**These were vertical axle windmills, which had long vertical drive shafts with rectangle shaped blades. Made of six to twelve sails covered in reed matting or cloth material, these windmills were used to grind corn and draw up water, and were used in the grist milling and sugarcane industries.**

**By the 14th century Dutch windmills were in use to drain areas of the Rhine River delta.**



# Useable Power in the Wind



# 2011 U.S. Small Wind Turbine Market Report

## 2012 “Small Wind” Energy Prospects


Source: AWEA 2011 U.S. Small Wind Turbine Market Report

In general, the industry expects a rebound and increased 2012 sales as the economy improves, state incentive programs are refreshed and certified turbines are installed as U.S. certification programs progress.

Competition from low-cost PV will continue to be a challenge.

Export markets — including European and Canadian FITs, telecom and diesel-electric applications — will continue to be important.



A photograph of a baseball field with green grass and white dirt base paths. The number '3' is painted on the grass in the infield.

# Alabama - Energy Tax Credit Wind/Solar Rebates and Incentives

The Tennessee Valley Authority along with affiliated utility companies grant a power generation incentive for homeowners and commercial businesses that utilize renewable energy systems.

Qualifying systems: biomass, small hydropower, solar panel installation and wind power.

Incentive amount is dependent upon the type of system. For solar systems, customers will receive a premium rate of \$0.12/kWh on top of the standard retail rate. All other renewable energies are offered \$0.03/kWh plus retail rates .

New subscribers will receive a \$1,000 bonus for joining that can be put toward installation costs of a given system.

There is currently no maximum incentive for this program.

Reimbursement is represented in the form of credit on the participant's monthly electric bill.

Systems must be greater than 500 watts and no larger than 999 kilowatts to participate.

# **“Small Wind” Energy Innovations**

# **HAWT**

## **Horizontal Axis Wind Turbine**

**Horizontal-axis wind turbines (HAWT’s) have the main rotor shaft and electrical generator at the top of a tower and are pointed into the wind.**

**Small turbines are pointed by a simple wind vane while large turbines generally use a wind sensor coupled with a servo motor.**

**Most have a gearbox which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive a generator.**





# “Small Wind” Energy Innovations

## VAWT

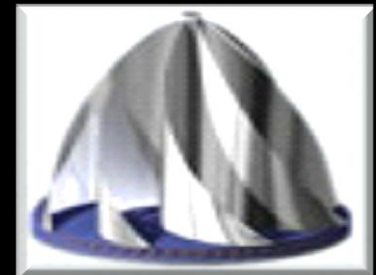
Vertical Axis Wind Turbine



Vertical-axis wind turbines (VAWT's) have the main rotor shaft running vertically.



Key advantages of this arrangement are that the generator and/or gearbox can be placed at the bottom, near the ground, so the tower doesn't need to support it and that the turbine doesn't need to be pointed into the wind.





### Advantages Compared Horizontal Turbines

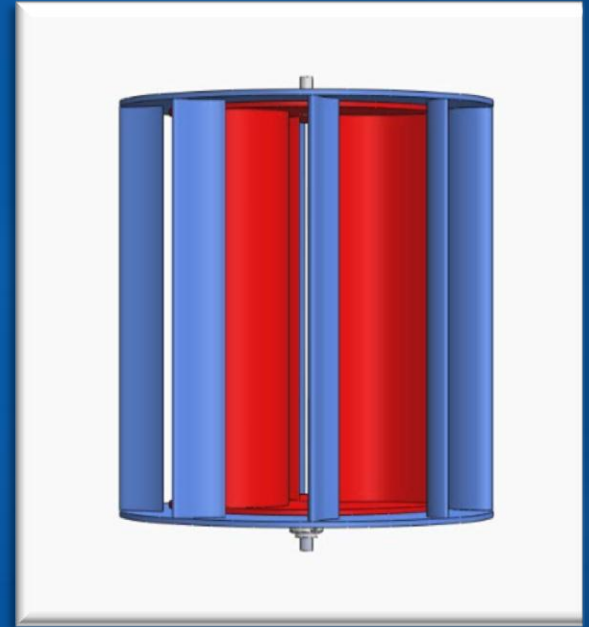
- Can accept changes of wind direction with no problem.
- Generator can be on the ground for more easy access, rather than high up in the air.
- Generally begin rotating at lower speeds.
- Are more quiet.
- Lower susceptibility to cross-winds.

### Disadvantages Compared to Horizontal Turbines

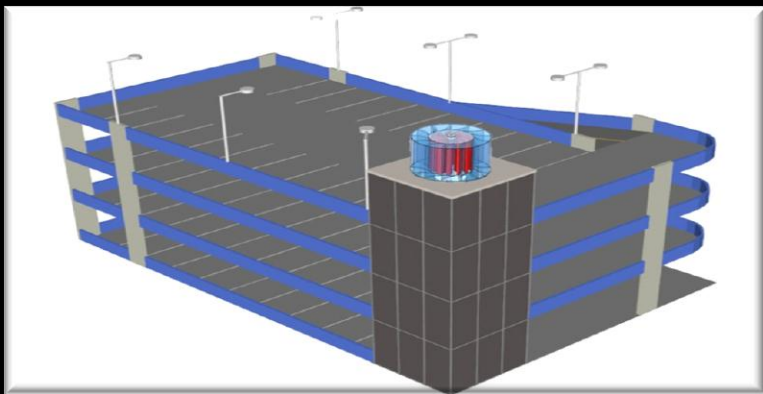
- Complicated in structure.
- Wind energy efficiency is typically lower.
- Cost is generally higher.

# Wind Power Systems

## Black Swan



# Commercial, Residential, Governmental, Military, & Emergency Apps



# Multiple kW Output Configurations, Rugged, with Easy Deployment and Dependable Results



# Mobile Installation Options for Forward Operations, Remote Power & Emergency Use



Photo Shopped Images

# Telescopic Mast/Pole Mounting/Easy Assembly

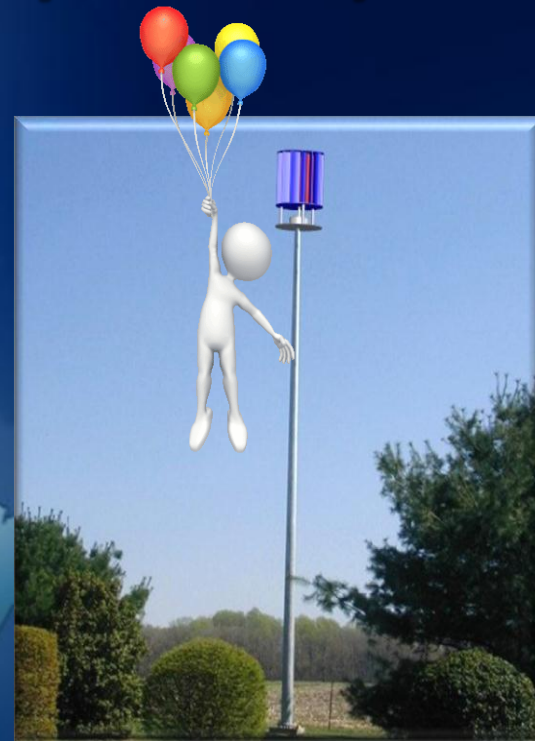


Photo Shopped Images

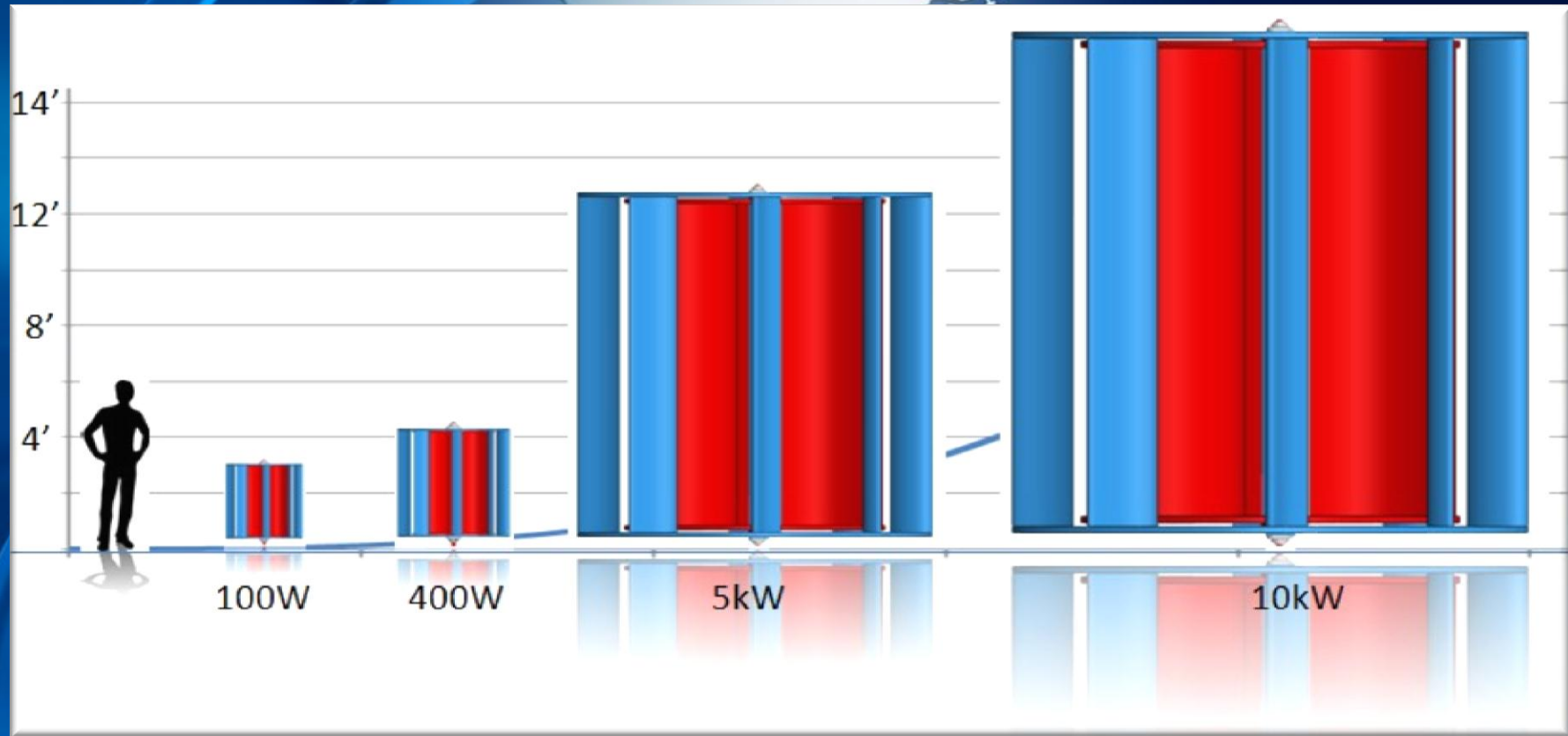
# Residential “Small Wind” Power Systems

CSP Wind Energy Installations/400W Black Swan Turbines





# Wind Turbines ...Size & Physics Matter





# WPS Gen.4 Black Swan Vertical Axis WIND Turbine

## Characteristics

# of Stator Blades	8
# of Rotor Blades	3
Characteristic Cut-in Wind Speed	8 mph (3.5 m/s)
Cut-out speed	N/A
Rotor Speed	<400 RPM
Blade Material	Profiled Aluminum Sheets
Rated Power Output	See below



## WPS Gen-4 Series

Rated Power Output @ 28mph	200W	400W	5kW	10kW	20kW
Cut-in Wind Speed	8 mph (3.5 m/s)				
Overall Diameter	2.5 ft. (0.75m)	3.5 ft. (1.1m)	12.3 ft. (3.8m)	17.5 ft. (5.3m)	24.7 ft. (7.53m)
Height	2.5 ft. (0.75m)	3.5 ft. (1.1m)	12.3 ft. (3.8m)	17.5 ft. (5.3m)	24.7 ft. (7.53m)
Total Weight	54lbm (25kg)	78lbm (35kg)	533lbm (242kg)	1,003lbm (455kg)	1,928lbm (875kg)

# A Position of Power...

# THANK YOU

