Small Wind Farm Research at

MSU

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Dr. Vincent Winstead

Graduate Student: Ms. Priti Sood

Topics

• Applied Small Wind Project

• Wind Farm Modeling

• Simulation Efforts

• On-going Studies

Motivation

From: [www.windpoweringamerica.gov](http://www.windpoweringamerica.gov/)

Motivation

• 2025 Energy Initiative

– 25% electrical energy via

renewables by 2025

– How to get there?

• Minnesota is number 4 in installed wind in the U.S.

• What about residential

installations?

From: [www.windpoweringamerica.gov](http://www.windpoweringamerica.gov/) From: [www.windpoweringamerica.gov](http://www.windpoweringamerica.gov/)

Project Scope

• Small (Residential Scale) Wind Installations

using commercially available systems

• Questions to answer: What are…

– Costs associated with purchase, installation

– Electrical code issues

– Maintenance requirements

– Performance capability vs. manufacturer data

• *Can the typically consumer benefit?*

Self-Imposed Constraints

• Roughly 2-3kW rated output

• U.S. manufacturer or distributor

• Some VAWTs (Vertical Axis) and some HAWTs

(Horizontal Axis)

PacWind – Delta I

Decision Process

Southwest Windpower – Skystream 3.7

Urban Green Energy - SAWT 3kW

Southwest Windpower – Whisper 500

WindMax 2kW (similar)

Southwest Windpower – Skystream 3.7

Urban Green Energy - SAWT 3kW

Abundant Renewable Energy – ARE 110

- PacWind becomes WePOWER

- WePOWER also markets SAWT turbines

Helixwind S322

Southwest Windpower – Skystream 3.7

Urban Green Energy - SAWT 3kW

Abundant Renewable Energy – ARE 110

- Abundant Renewable Energy becomes XZERES Wind

Specifications

• SAWT 3kW – 3.3kW

rated

• ARE 110 – 2.5kW rated

• Skystream 3.7 – 1.9kW

rated (later 2.4kW)

• Helixwind S322 – 2.5kW

• Battery charging

– 48VDC pack

– Internal or

external rectifier

– Charge controller

– Grid isolated

– Diversion load

Configuration

*Southwest Windpower Skystream 3.7*

**18%** average MN

household demand

*UGE SAWT 3kW*

**3.3%** average MN

household demand

Results

Power law

Modeling

• Modeling efforts based on manufacturer power curve,

tower height, wind direction/speed and wake effect

Simulations

• Results of wind sensor data and Monte Carlo based turbine placement

Simulations

• Steepest descent algorithm driven by multi-criteria cost function

Next Steps

• Applied projects

– Helixwind S322 power converter

– Advanced power data acquisition (smart grid

capable)

• Simulation studies

– Convergence proofs

– Terrain/obstacle incorporation

Questions?