

Workshop on Renewable Energy

Oct 12, 2006

Sponsors:

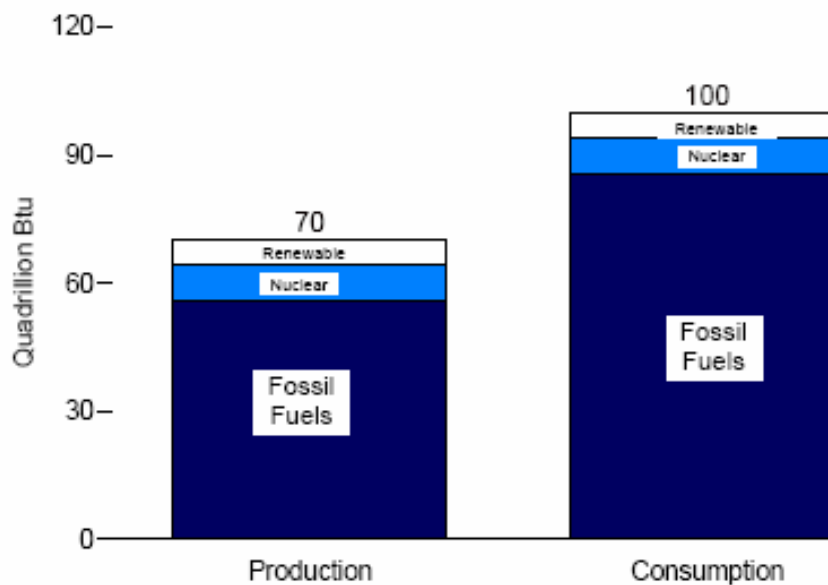
- XCEL Energy
- National Science Foundation
- Department of ECE, UMN
- UM Center for Electric Energy (UMCEE)
- IEEE Twin Cities Power Engineering Society

- Wind Workshop 2003
- Wind Workshop 2004
- Renewable Energy Workshop 2005

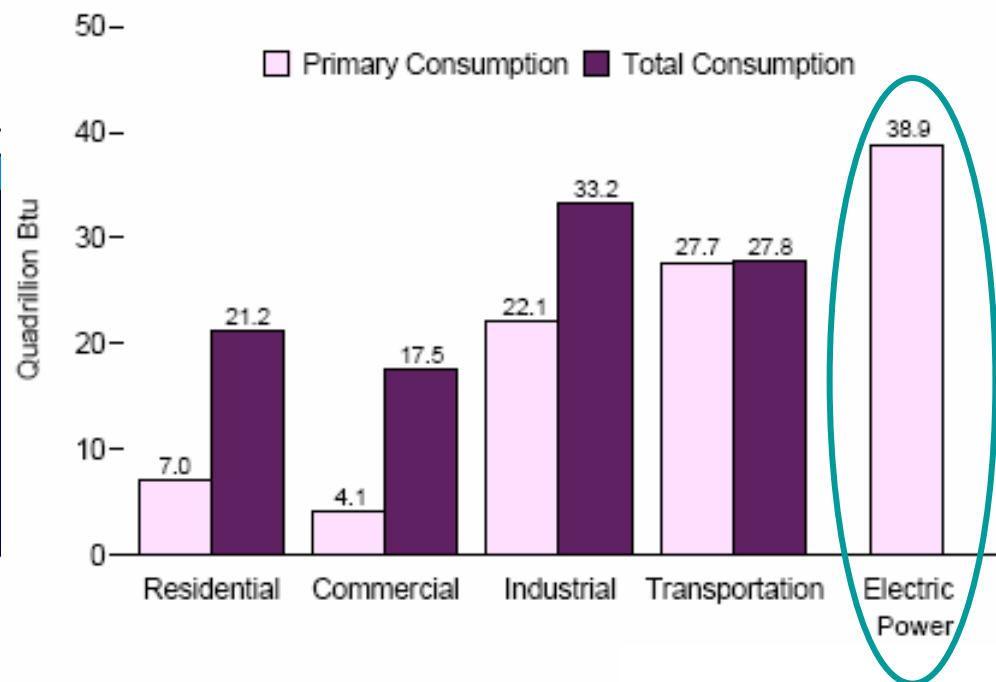
OBJECTIVES of 2006 Workshop:

- Discuss renewable energy prospects in MN
- Describe our research results + Posters
- Bring renewable energy curriculum into K-12

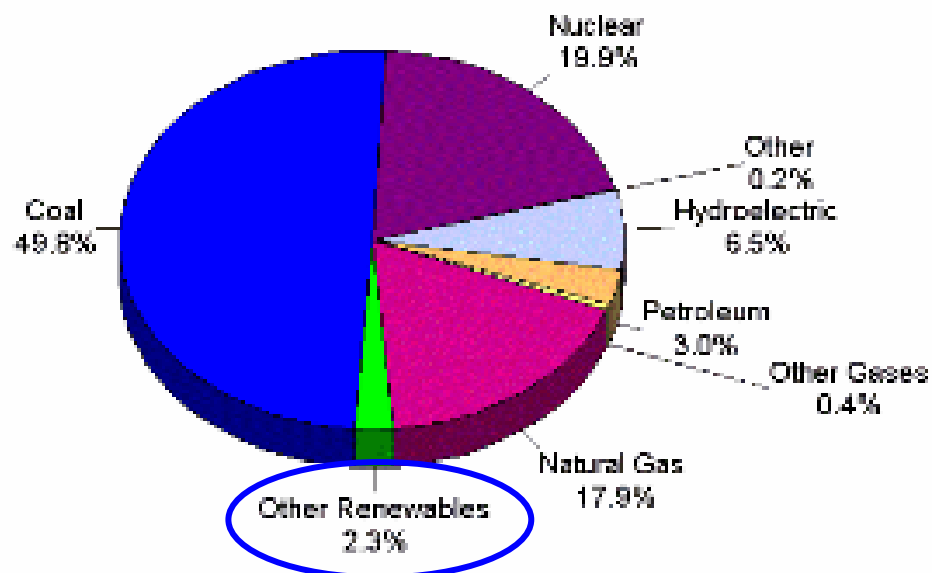
Production and Consumption, 2004



Primary and Total Consumption by Sector, 2004



Electric Power Generation by Fuel Type (2004)



United States - Wind Resource Map

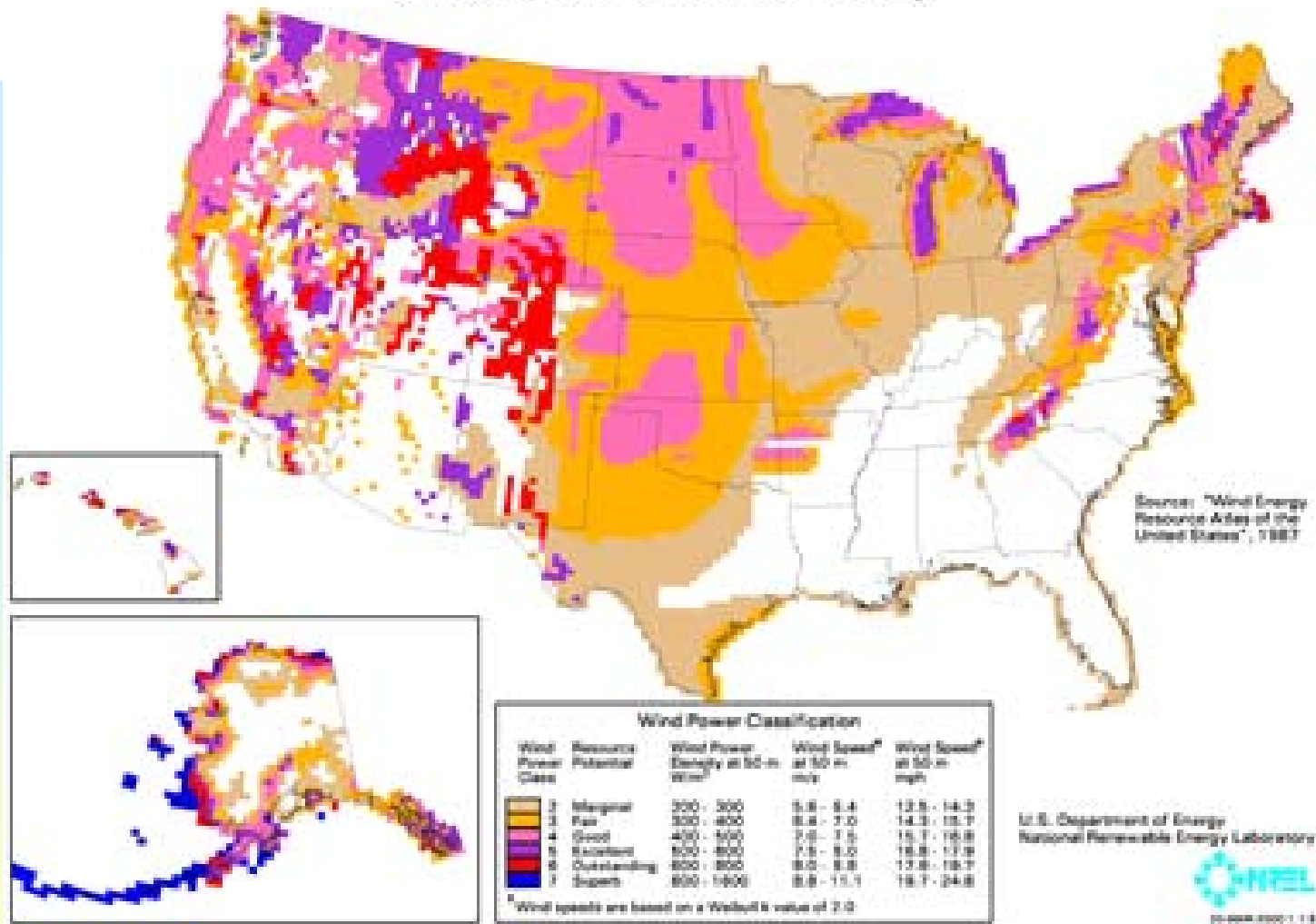


Fig 2 Wind resources in the U.S. [NREL, 7]

AGENDA:

Welcome and Introduction

- Steve Crouch, Michelle Swanson, Ned Mohan

Renewable Energy Overview: (Bruce Wollenberg)

- Tom Overbye, Terje Gjengedal, Glen Skarbakka

Wind Energy: (Bill Robbins)

- John Dunlop, Terry Grove

Research in Renewable Energy at ECE

- Ned Mohan

Hydrogen and Fuel Cells: (Paul Imbertson)

- Lanny Schmidt, Brad Palmer

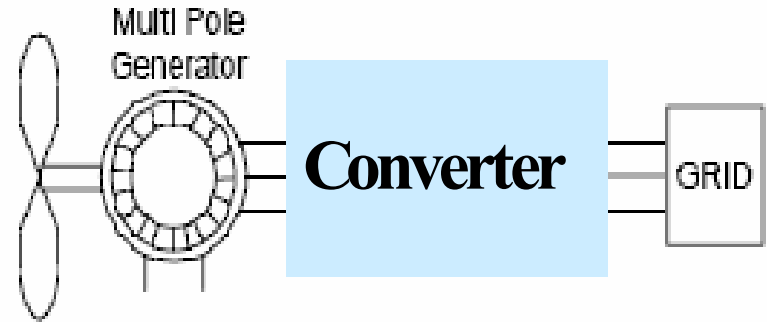
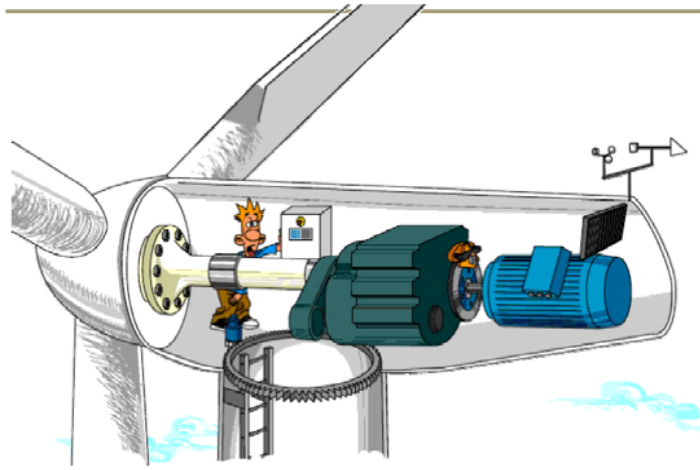
Bringing Renewable Energy & Conservation Curriculum into K-12 Courses

- Sustainable Architecture: Virajita Singh, John Carmody
- Group Discussion: Mike Maas and Steve Pullar

Posters

- **Storing Excess Wind Energy in a Flywheels**
- **Highly Simplified Control of Matrix Converters**
- **A Multi-Port DC Converter**
- **Tripling the Efficiencies of Fan Motors**
- **Wind-Generated Electricity Using Flexible Piezoelectric Materials**
- **Series Compensation for Wind Turbines**

Generator Control that is Ideal for Windmills



- Increases available voltage and Power to 150%
 - Generator could be 1/3rd smaller
- Bearing currents are eliminated
- Slot insulation reduced by a factor 1.73
- Higher efficiency (?)
- Power Factor on the Utility-side is controllable
- Increased Reliability due to Capacitor Elimination
- SiC Ready