The Utility Wind Integration Group (UWIG)

- *A Positive Force*
- *For Responsible Wind Energy Development*

- Introduction and Overview

Adopted for
Wind Power Management class
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A New Cash Crop

1979: 40 cents/kWh

- Increased Turbine Size
- R&D Advances
- Manufacturing Improvements

2000: 4 - 6 cents/kWh

2004: 3 - 5 cents/kWh

NSP 107 MW Lake Benton wind farm
4 cents/kWh (unsubsidized)

Source: NREL

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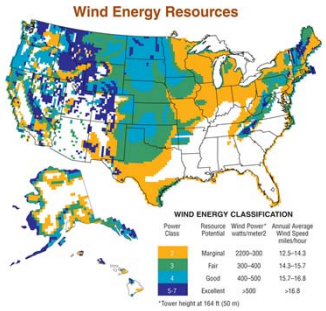
An All American Resource

Rank	State
1	North Dakota
2	Texas
3	Kansas
4	South Dakota
5	Montana
6	Nebraska
7	Wyoming
8	Oklahoma
9	Minnesota
10	Iowa
11	Colorado
12	New Mexico
13	Idaho
14	Michigan
15	New York
16	Illinois
17	California



Source: AWEA

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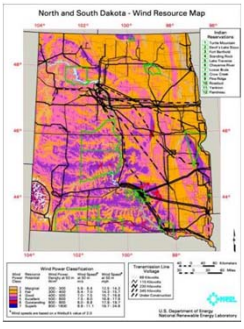
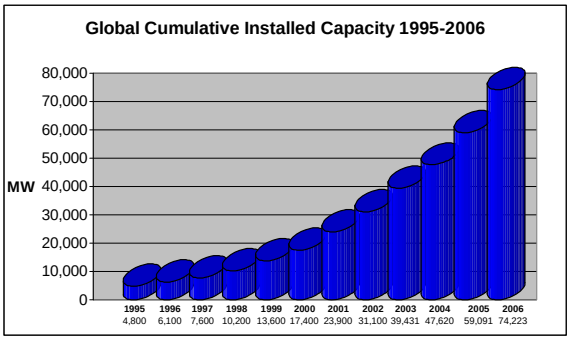
Wind Resource Mapping

- Identifies most promising areas for wind energy development
- Employs geographic information system technology to create layers of key information
- Used by state energy planners, Indian tribes, and developers
- Approach changing from empirical to numerical modeling techniques
- Forecasting, resource assessment and site specific inflow quantification methods are likely to converge into a single approach

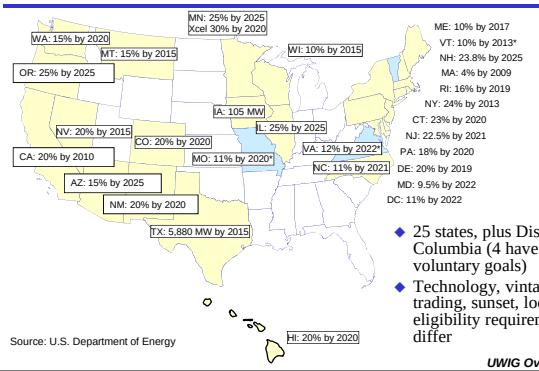


Taking Off Worldwide



Source: Global Wind Energy Council

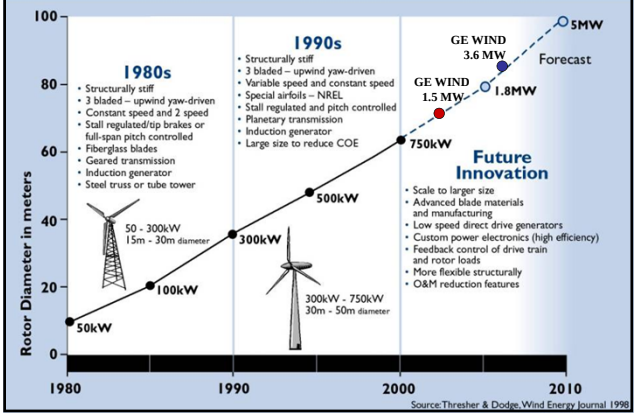
State Renewable Portfolio Standard (RPS)



Source: U.S. Department of Energy

- 25 states, plus District of Columbia (4 have voluntary goals)
- Technology, vintage, credit trading, sunset, location eligibility requirements differ

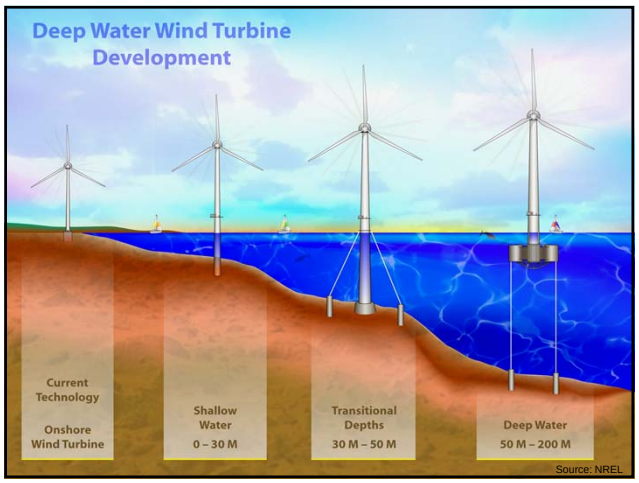
The Evolution of Commercial U.S. Wind Technology



Source:Thresher & Dodge,Wind Energy Journal 1998

Economic Development

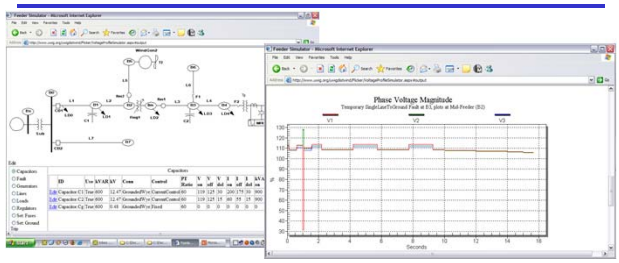
- Typical income from land leased for agricultural use:
  - $150 - $200 per acre
- Typical profits from wind:
  - Typically 25-40 acres per turbine
  - 4 turbines per acre of land taken out of production
  - Royalties of $2,000 per machine
  - Income of $8,000 per acre of land taken out of production
- Wind farming is looking good!



Perceived Market Barriers

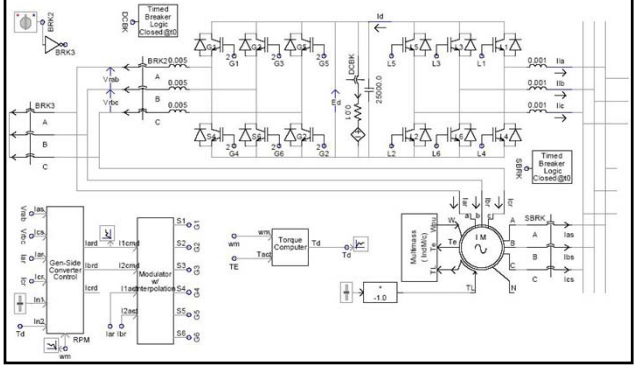
- Siting
  - Avian/bat mortality
  - Noise
  - Aesthetics
- Transmission constraints
- Energy cost
- Financing
- Variable output
  - Large system impacts (transmission level)
  - Small system impacts (distribution level)

Distributed Wind Analytical Tools



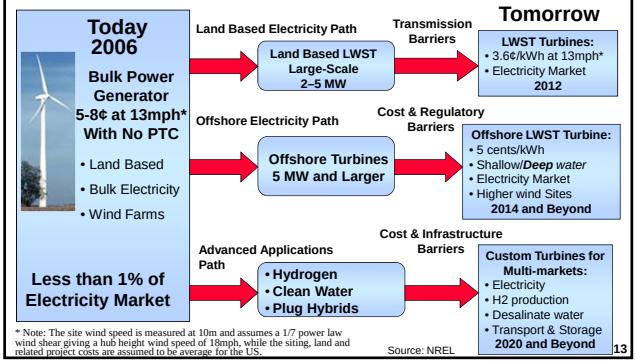
- Development effort resulted in analytical applets, application guides, case studies, and monitoring of distributed wind sites
- Complete details can be found at http://www.uwig.org/distwind/default.htm

Wind Turbine Models



Wind Energy Markets – A Future Vision

LWST = Low Wind Speed Technology



* Note: The site wind speed is measured at 10m and assumes a 1/7 power law wind shear giving a hub height wind speed of 18mph, while the siting, land and related project costs are assumed to be average for the US.

Source: NREL

For More Information

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