Manufacturing, materials, and resource challenges

- **Materials**
  - Demand for steel will increase significantly
  - Improved availability of critical materials needed: fiberglass, resins and permanent magnets could be a constraint

- **Manufacturing**
  - The 20% Wind Scenario would require a 20% annual growth in installations for nearly a decade and then require maintaining that installation level through 2030

- **Education and workforce**
  - The decreasing availability of a qualified work force continues to be a challenge
Major challenges and opportunities in raw materials and components include:

- Increasing demand for core materials, including carbon fiber
- Increasing costs of resins and adhesives
- Introducing aluminum and lightweight composites
- Simplifying nacelle machinery, which may reduce raw material costs and increase reliability
- Continuing to use glass fiber-reinforced plastic (GRP) in blades; using carbon fiber could reduce weight and cost
- Increasing the need for magnetic materials (such as rare-earth permanent magnets) in permanent magnet generators
Manufacturing capacity would need to ramp up to support an installation increase from 3 GW per year in 2006 to over 16 GW per year by 2018.

Source: AWEA, 2008
Over 500,000 total jobs would be supported by the wind industry.

Approx. 180,000 jobs supported directly by the wind industry in operations, construction, and manufacturing.
The decreasing availability of a qualified work force continues to be a challenge.

As of January 2009, 85,000 workers are employed in the wind industry*

Increased educational opportunities for engineers and technicians are being offered, but more are needed.

Sample Career Opportunities:
- Electrical Engineers
- Electricians
- Industrial Machinery Mechanics
- Welders and Metal Fabricators
- Electrical Equipment Assemblers
- Construction Equipment Operators
- Installation Helpers
- Laborers
- Construction Managers

Projected percentage of 22-year-olds with bachelor degree in science and engineering through 2050

Chart Source: National Science and Technology Council, 2000
* Source: AWEA, 2009
Paths forward

Materials
- Opportunities exist for introducing aluminum or lightweight composites
- The use of carbon fiber might help reduce weight and cost

Manufacturing
- Stable and consistent policies will encourage investment in manufacturing capacity
- Timely manufacturing expansion needed is feasible: historical precedents with other major products (e.g. defense equipment, automobiles)

Education and workforce
- More support from industry, trade organizations, and various level of government could foster university programs that prepare the work force for careers in wind and renewable energy technology