



Alternative & Renewable Energy Sources

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Agenda

- Introduction
 - Clean Tech and Alternative Energy
- Alternative energy market update
- Key alternative energy segments and risks
 - Wind
 - Solar
 - Ethanol
- Q&A

What is Clean Tech?

Clean Technology = Products & Services focused on efficient and sustainable use of resources, principally focused on:

- Alternative energy generation and management
- Product life cycle management
- Manufacturing processes including the supply chain
- Efficient management of property and buildings

Worldwide Trends in Clean Tech

Development and deployment in three regions: Asia, Europe, and North America

Asia:

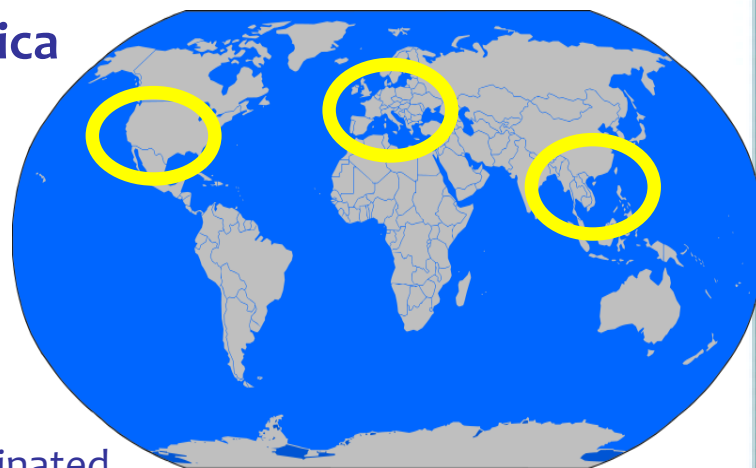
- Manufacturing capacity ramping up
- Supplier to other parts of the world
- Focus on solar and wind technologies

Europe:

- Largest alternative energy installed base dominated by wind and solar
- Focus on micro-generation
- Smart buildings/appliances/energy efficiency

North America

- Focus on solar, wind, and smart grid
- Next clean tech areas of development: alternative fuels, hybrid, and electric transport
- Micro-generation and material development



Sources:
State Technology Spending: Governing State and Local Sourcebook
HIT Summary Data: Corptech, Gartner Group

Top Three Clean Tech Segments by 2017: Wind, Solar, & Smart Grid Technologies

Clean Tech Segments and Technology Examples:

- **Alternative Energy Production and Storage**
 - Wind, Solar, Tidal
 - Ethanol, Bio Fuels, Geothermal
 - Carbon Capture & Other Storage
 - Grid Stability Software
 - Advanced Batteries
- **Materials**
 - Nanotech
 - Thermal fibers
- **Transportation**
 - Hybrid Vehicles, Smart Logistics Software
 - Fuel Efficiency
- **Service Providers**
 - Smart Grid Technologies
 - Consultants
 - Communications
 - Control Systems
 - Construction
- **Manufacturing and Industrial**
 - Building Systems
 - Sensors
 - Lighting Systems
- **Water & Waste Water**
 - Ultra Filtration
 - Desalination Equipment

Alternative Energy Market Update

- Renewable energy accounted for approximately half of the new electric capacity added in 2011 globally.
- Renewables deliver about 25% of global electric supply.
- By early 2011 at least 119 countries had some type of renewable energy policy at the national level.
- China leads several indicators of market growth: top wind turbine and solar thermal installer and top hydropower producer.
- Total investment in renewable energy reached \$211B in 2010, up from \$160B in 2009.

Renewable Energy Leaders

Renewable Power Capacity	Wind Power	Biomass Power	Geothermal Power	Solar PV
China	China	USA	USA	Germany
USA	USA	Brazil	Philippines	Spain
Canada	Germany	Germany	Indonesia	Japan
Brazil	Spain	China	Mexico	Italy
Germany	India	Sweedden	Italy	USA

Macro Challenges

- 100 year old power grid and infrastructure
- Renewable energy is more expensive
- Distribution and renewable energy not local to each other
- Sometimes little to no standards
- Servicing challenges
- Evolving supply chain headaches
- Regulatory approvals
 - Renewable energy “chicken and egg”
 - Unintended consequences – (e.g. Marcellus Shale)

Alternative Energy Basic Overview

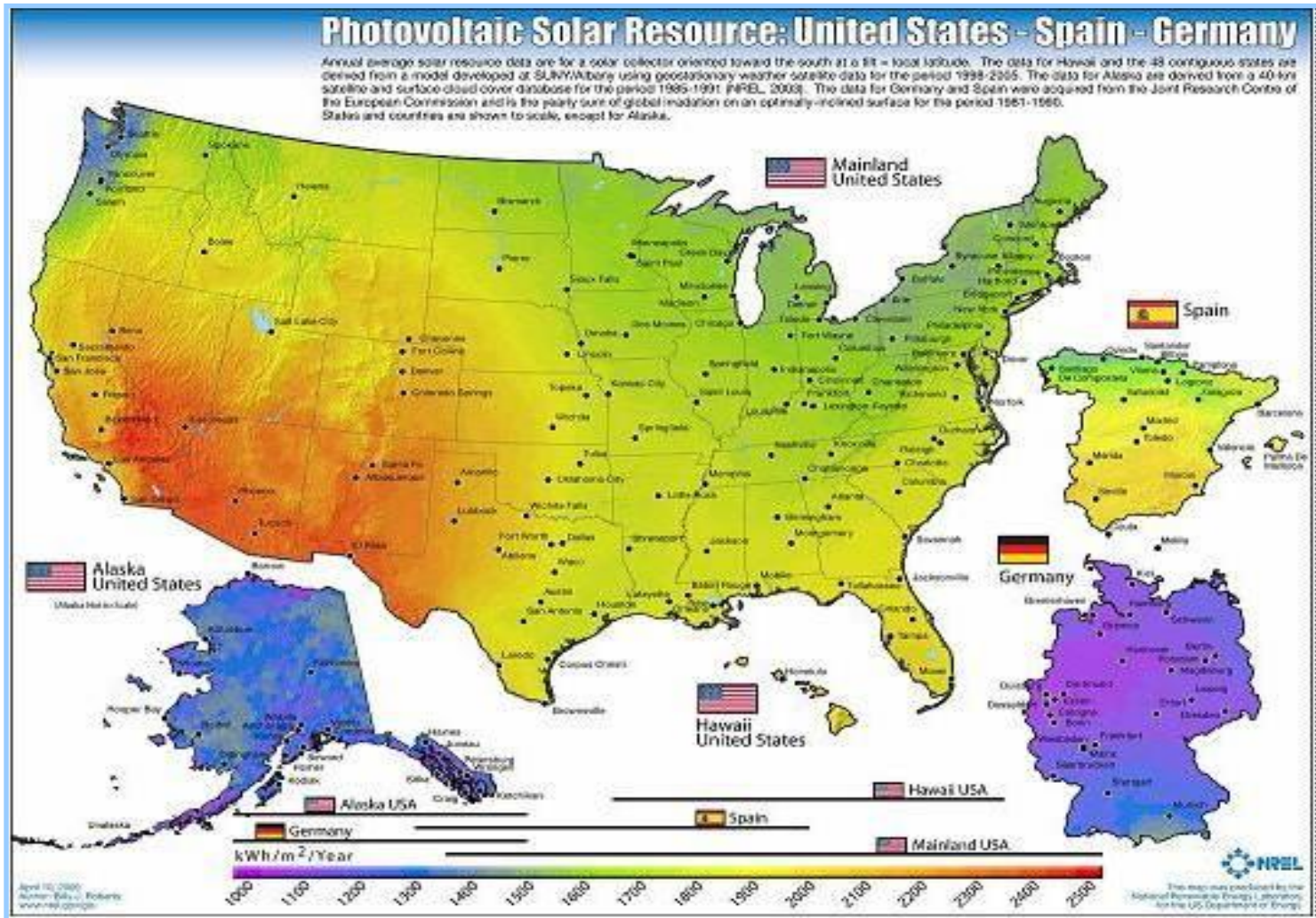
- Key Segments
 - Solar
 - Wind
 - Biomass & Biofuels

Solar Energy



Florida Gulf Coast University 16 acre 2-megawatt installation

Solar Energy Capacity



Solar Energy Types

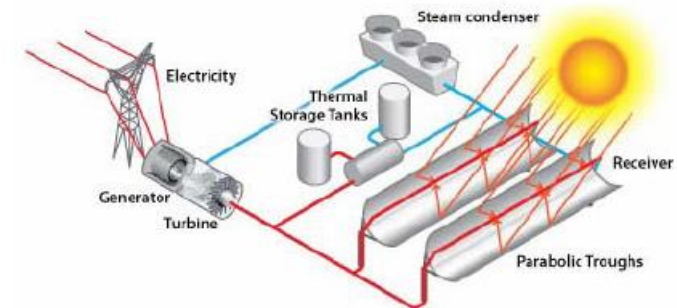
- Photo Voltaic (PV)

- Uses a chemical reaction to produce power
 - Chemicals force an electron flow when exposed to light.
- Can be placed anywhere



- Thermal

- Direct capture of heat
 - Rooftop water heaters, etc
- Indirect Capture of heat, make steam, turn a turbine
 - Power generation
- Limited use due to the land use vs efficiency needs



How Does PV Solar Work?



Types of PV Solar Panels

- Mono & poly crystalline silicon
- Thin Film
 - Amorphous & CIGS thin film
 - CdTe
 - Nanotechnology thin film
- Which is better?



Mono-Crystalline
Silicon



Poly-Crystalline
Silicon



Flexible Amorphous
Thin Film



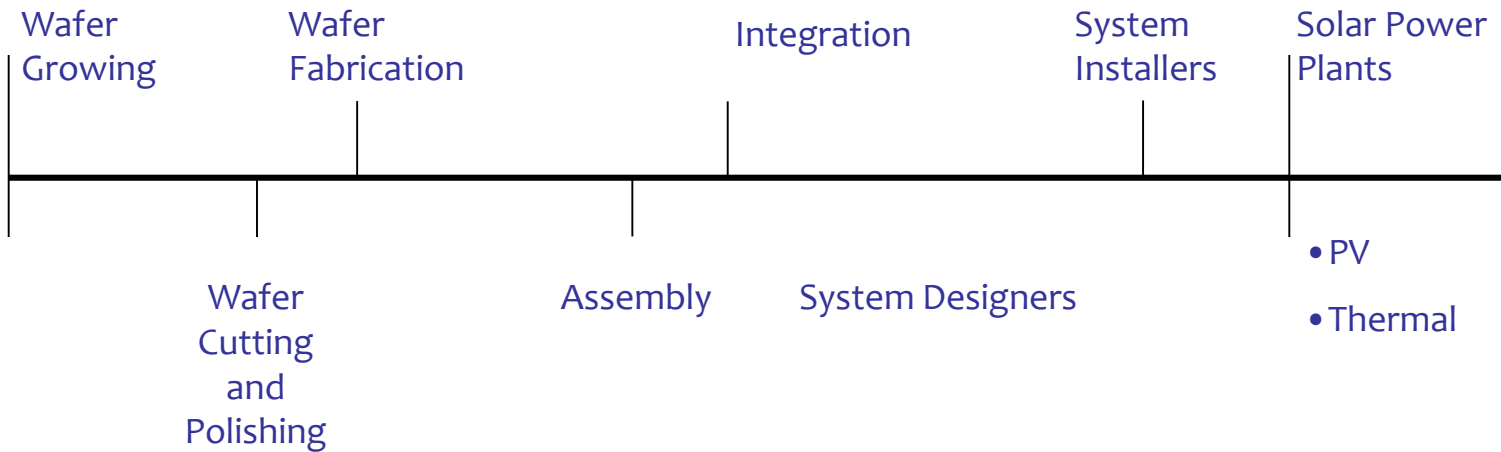
CIGS Thin
Film

Solar Continuum PV Perspective

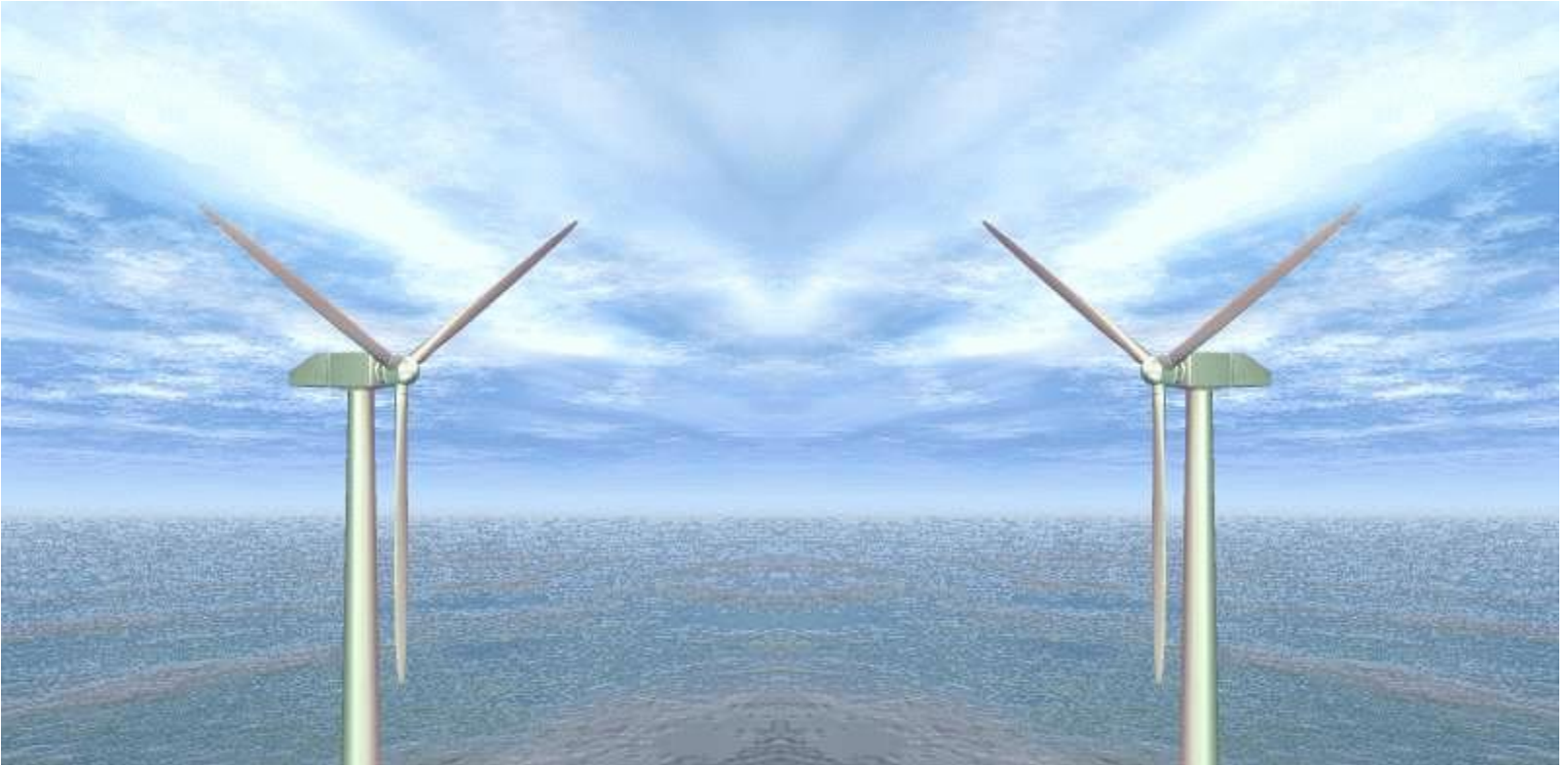
Solar Operations

Raw Materials “Upstream”

Finished Products “Downstream”



Wind Energy



Wind Energy Fast Facts

- Capacity installed worldwide: 194,000 MW – Up 22% over 2009
- Capacity installed U.S.: 40,180 MW (end of 2010) – Up 15% over 2009¹
- An estimated 70.8 billion kilowatt-hours (kWh) Wind Generated
- Top 5 states in wind energy installed (end of 2010)
 - 1. Texas: 10,085 MW
 - 2. Iowa: 3,675 MW
 - 3. California: 3,177 MW
 - 4. Minnesota: 2,192 MW
 - 5. Oregon & Washington: 2,104 MW
- US Potential: Estimated at 36,920 billion kWh annually (Source: NREL)
- One megawatt (MW) of wind: powers 250-300 homes
- Over 200 manufacturing facilities on line in the U.S.

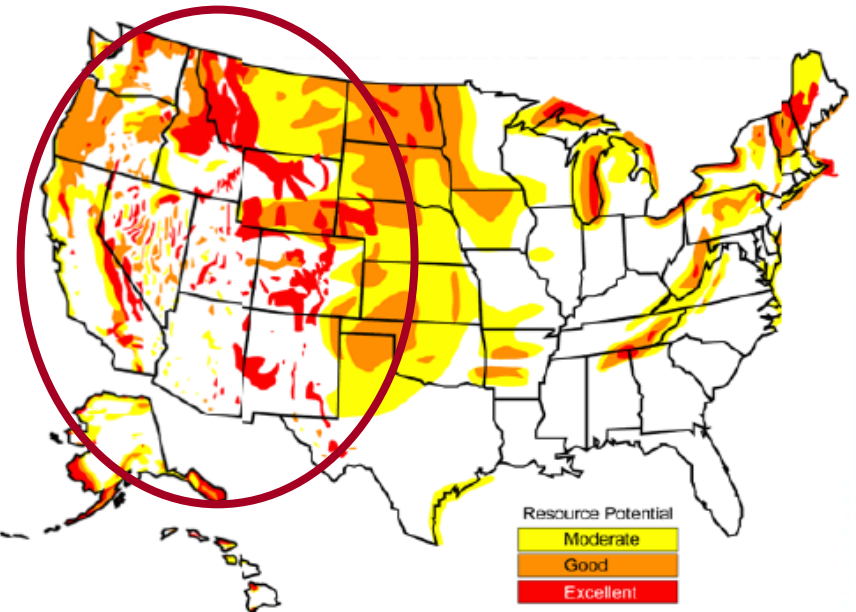
¹ Source for data is AWEA unless otherwise indicated

Wind Energy Potential

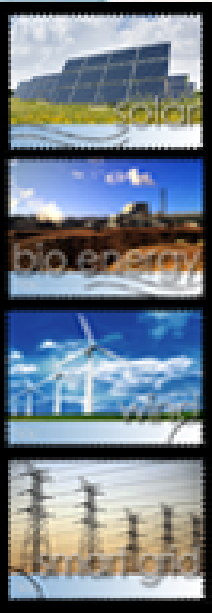
THE TOP TWENTY STATES for wind energy potential, as measured by annual energy potential in the billions of kWhs, factoring in environmental and land use exclusions for wind class of 3 and higher.

1	North Dakota	1,210	11	Colorado	481
2	Texas	1,190	12	New Mexico	435
3	Kansas	1,070	13	Idaho	73
4	South Dakota	1,030	14	Michigan	65
5	Montana	1,020	15	New York	62
6	Nebraska	868	16	Illinois	61
7	Wyoming	747	17	California	59
8	Oklahoma	725	18	Wisconsin	58
9	Minnesota	657	19	Maine	56
10	Iowa	551	20	Missouri	52

Source: *An Assessment of the Available Windy Land Area and Wind Energy Potential in the Contiguous United States*, Pacific Northwest Laboratory, 1991.



Onshore Wind – Micro Generation



Logan International Airport supplements electricity and Innovation through 20 small onsite wind turbines

Components to a Wind Turbine

Turbine Components

There are over 8000 components in a turbine, including:

Towers:

Towers
Ladders
Lifts

Rotor:

Hub
Nose Cone
Blades
- Composites
- Blade Core
Pitch Mechanisms
Drives
Brakes
Rotary Union

Nacelle:

Nacelle Cover
Nacelle Base
Heat exchanger
Controllers
Generator
Power Electronics
Lubricants
Filtration
Insulation
Gearbox
Pump
Drivetrain
Ceramics
Shaft

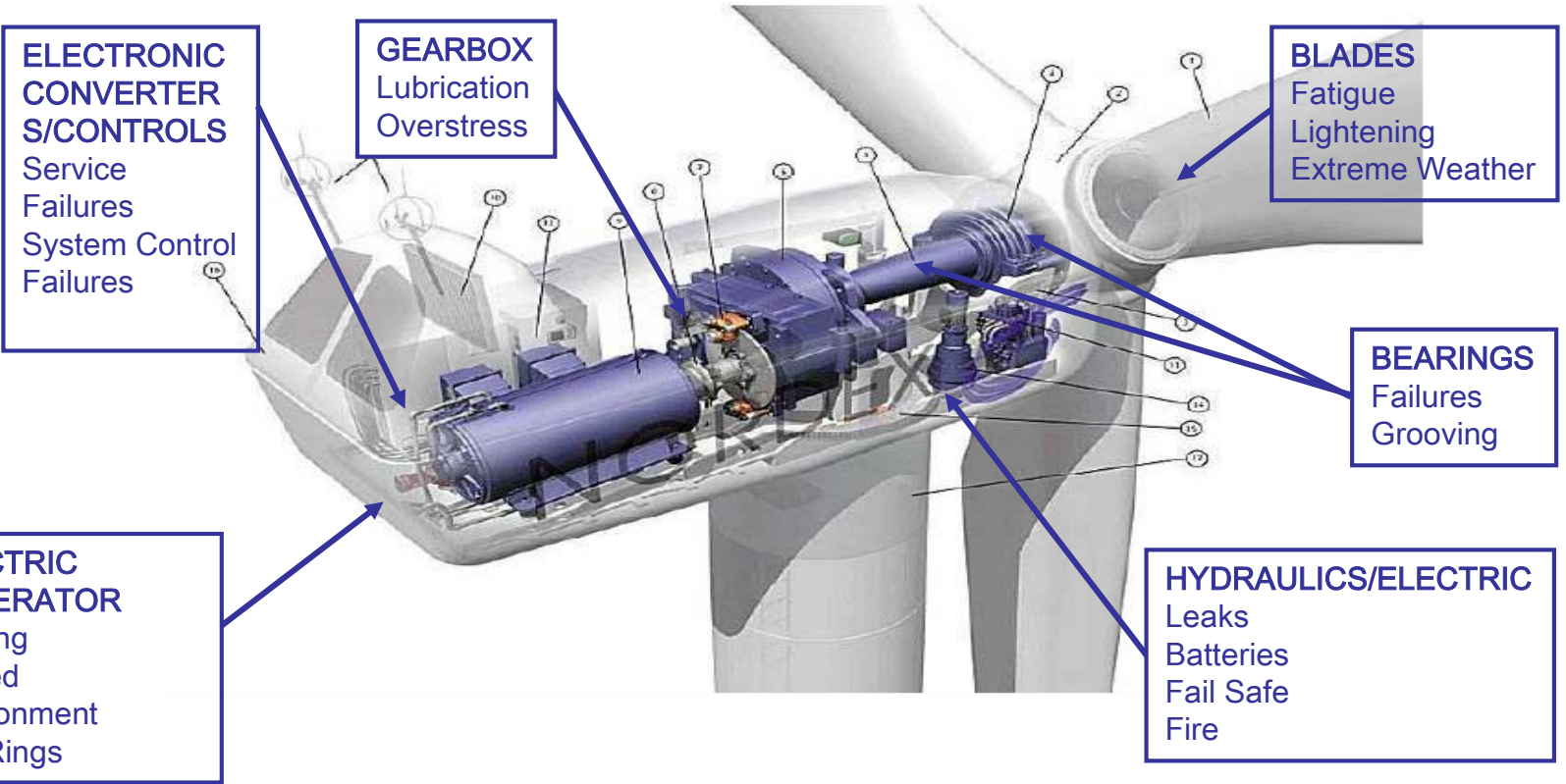
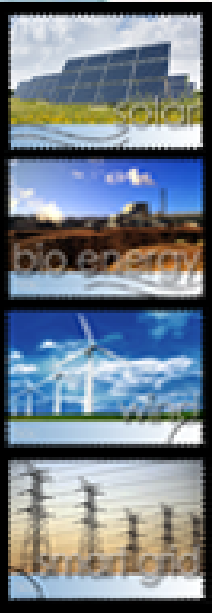
Foundation:

Rebar
Concrete
Casings

Other:

Transformers
Bolts/Fasteners
Wire
Paints and Coatings
Lighting
Lightning Protection
Steel Working/Machining
Communication Devices
Control and Condition Monitoring Equipment
Electrical Interface and Electrical Connection
Batteries
Bearings
Brakes

How it works and what can happen?



The following list names the labelled elements in the diagram.

- | | | |
|------------------------|--------------------------|----------------------|
| 1. Rotor Blade, | 7. Mechanical Disc Brake | 13. Hydraulic System |
| 2. Rotor Hub | 8. Generator Coupling | 14. Yaw Drive Motor |
| 3. Turbine Frame | 9. Generator | 15. Yaw Ring Bearing |
| 4. Main Rotor Bearing, | 10. Cooling Radiator | 16. Nacelle Cover |
| 5. Rotor Shaft | 11. Wind Instruments | 17. Tower |
| 6. Gearbox | 12. Controller | |

Source: Auswind

Inside of the Nacelle

How do I get out?



The Kaboom Factor

- Mechanical breakdowns are common
 - Lack of inspections
 - 30 minutes to climb
- Broken blades create missiles
- Collapse and structural failure
- A lack of inspections breeds potential problems
- NIMBY
 - Ice throws
 - Blade flicker
 - Noise



Insurance Industry Response

Property –

- Machinery Breakdown – Evolution of the technology
- Fire and other perils – Protection considerations/realities
- Contingent Business Income – Domestic and foreign suppliers, worldwide supply chain

Products Liability –

- Components, what is considered a “critical” component
- Supply chain – It’s a global issue

Premises Liability –

- Attractive nuisance
- Construction and operational risks

Insurance Industry Response

Workers Comp -

- Multiple risks
- Remote locations
- Construction
- Installation
- Maintenance

Commercial Auto -

- Service/maintenance fleets
- Heavy hauling exposure – In house vs. subcontracted

Errors and Omissions -

- How risk adverse is your carrier with new/prototypical technology?
- Financial loss suffered by utility due to turbines not producing electricity
- Delay and delivery is big exposure for wind energy market

Insurance Industry Response

Warranty -

- Pre-mature product failure
- Compare and contrast against other clean tech segments

Environmental – Internal and external forces

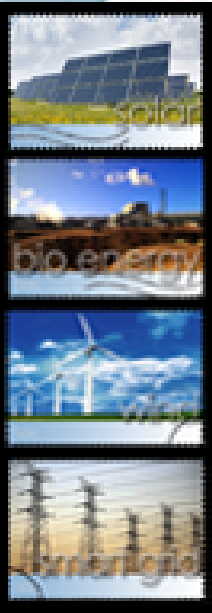
- Onsite pre-existing and new conditions clean-up insurance
- Non-owned disposal site insurance
- 3rd party transportation clean-up insurance
- Many utilities and lenders require environmental insurances

Biofuels and Biomass



NASCAR changes fuel formula for 2011 season to use 15% corn ethanol (E-15) in their race cars

Biofuels & Biomass



Types of Biomass



Wood fuel



Rubbish



Alcohol fuels



Crops



Landfill gas

The Kaboom Factor

- Ethanol plants are flammable liquids distilleries
- Biofuels are chemical plants
- Gasification biomass power plants can become a bomb
- Ethanol has to be trucked to final destination
- Do idle plants mean vacant building exposures?
- Fire and explosion protection must be excellent
- Engineering, construction, operation and maintenance requires highly qualified and experienced people

Insurance Industry Response

Property –

- Pilot, demonstration and production plants, anticipate correct limits?
- Multiple exposures=multiple perils
- Machinery breakdown challenges
- Business Income
 - Onsite BI
 - CBI from lack of feedstock

Products Liability –

- “Bad product” damage to end use transportation
- Distillers Dried Grains, what liabilities exist?

Premises Liability -

- Chemical plant considerations – Public exposure?
- Rail sidings
- Truckers – Load-in, load out
- Security
- Contractors on premises

Insurance Industry Response

Worker's Comp –

- Expect severe exposures
- Training and safety programs

Commercial Auto –

- Flammable liquids transportation

Environmental – Options for?

- Onsite pre-existing and new conditions clean-up insurance
- Non-owned disposal site insurance
- 3rd party transportation clean-up insurance

Other Clean Tech Considerations

- Dynamic business plans and changing operations
- Off-shore wind production
- Contracting Exposures
 - Installation
 - Testing and warranty
- Proper Controls – “Kaboom” factor
- Emerging hazards
 - Nanotechnology
 - Lithium-ion batteries
 - Green building material construction defect

Resources

- American Wind Energy Association
<http://www.awea.org/>
- Solar Electric Power Association
<http://www.solarelectricpower.org/>
- Database of State Incentives for Renewables & Efficiency
<http://www.dsireusa.org/>
<http://www.mass.gov/energy/rps>
- National Renewable Energy Laboratory
<http://www.nrel.gov/>

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Questions?

