Sustainable Biofuels and Bioproducts from our Forests: Meeting the Challenge

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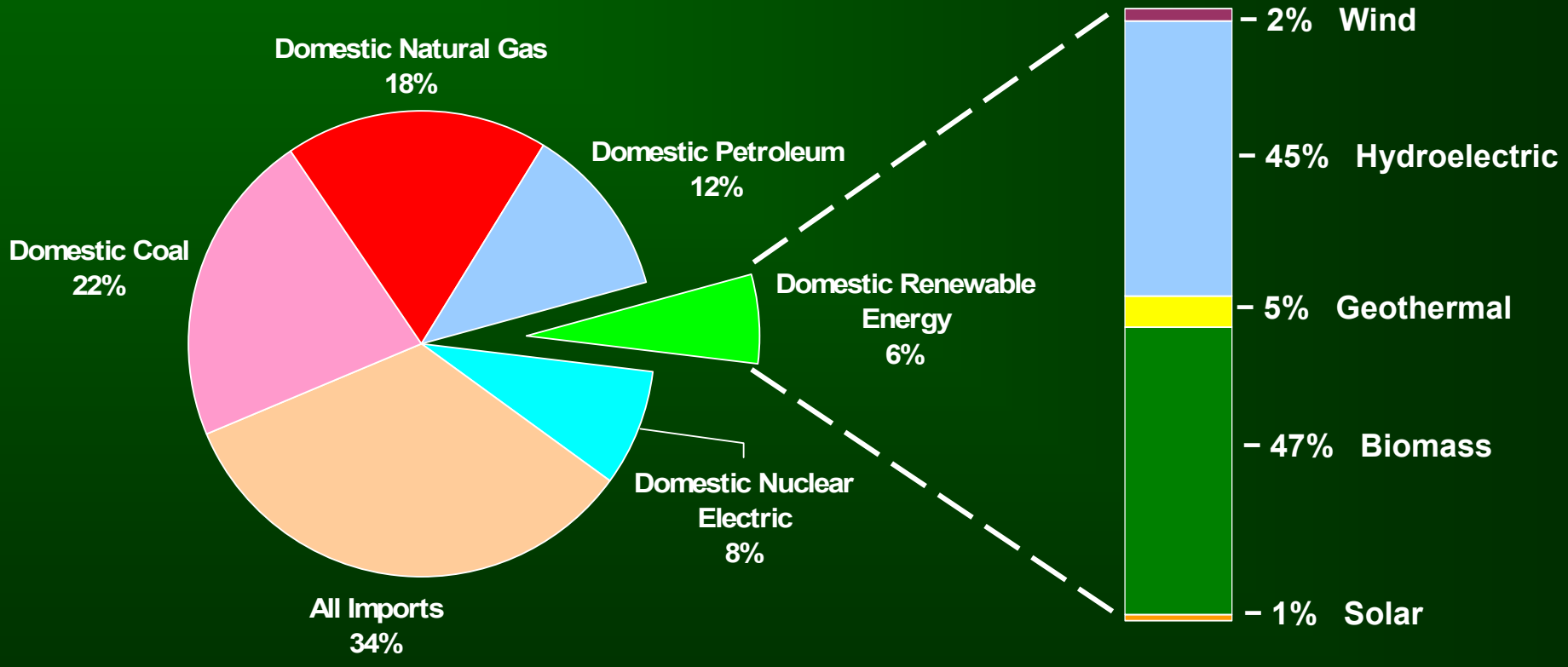
U.S. Energy Consumption Overview 2004

Domestic Energy Consumption = 99.7 Quadrillion Btu

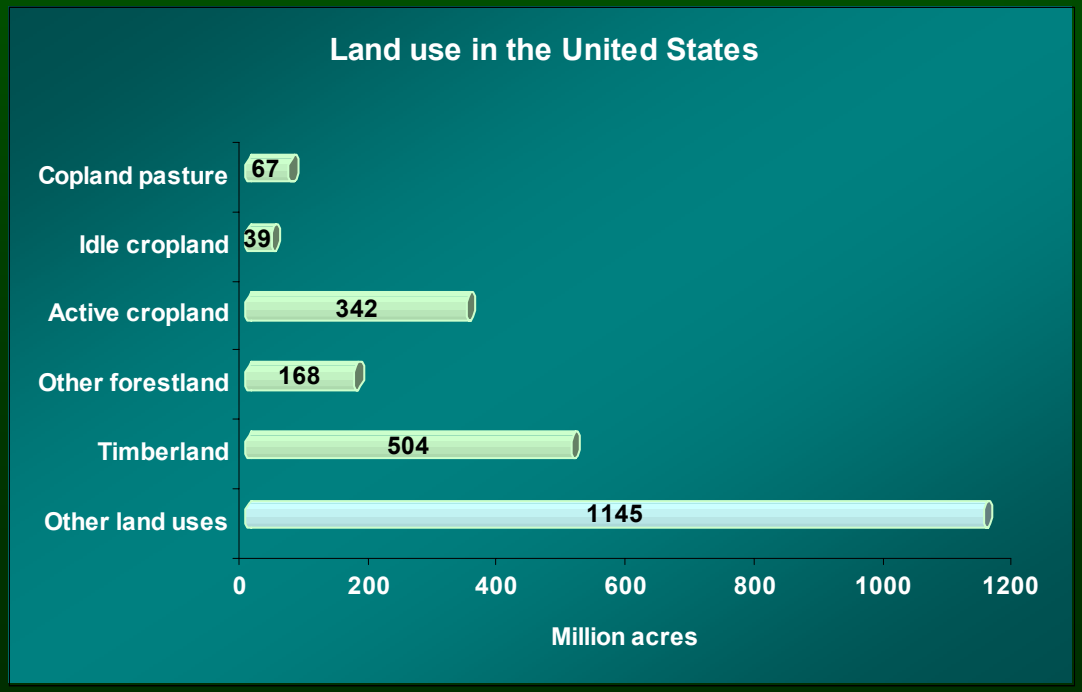


★ 70% of biomass is wood based

Source: EIA

The Biomass Feedstock Resource Base

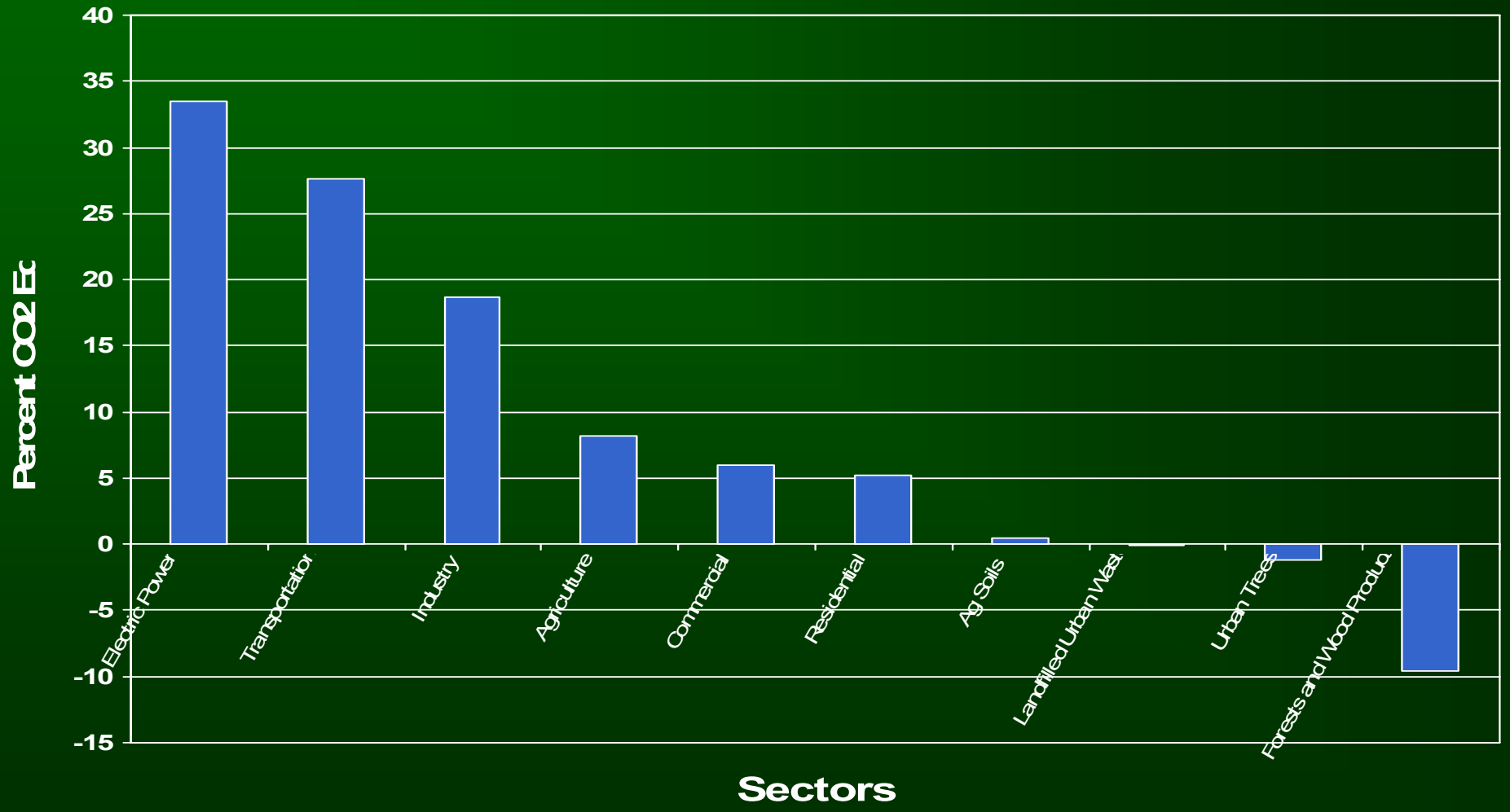
- About one-half of the land in the contiguous U.S.
  - Forestland resources -- 504 million acres of timberland, 91 million acres of other forestland
  - Agricultural resources -- 342 million acres cropland, 39 million acres idle cropland, 68 million acres cropland pasture



Forest resources

- Logging residues and other removals
  - Traditional logging activities
  - Cultural operations on timberlands
- Forest thinnings (fuel treatments)
  - Timberland
  - Other forestland
- Industry processing residues
  - Primary wood processing mill wastes
  - Secondary wood processing mill wastes
- Urban wood wastes
- Fuelwood
- Pulping liquors (black liquor)
- Conventional Forestry
- Short Rotation Woody Crops

Percent Total US GHG Annual Emissions by Sector (2005)



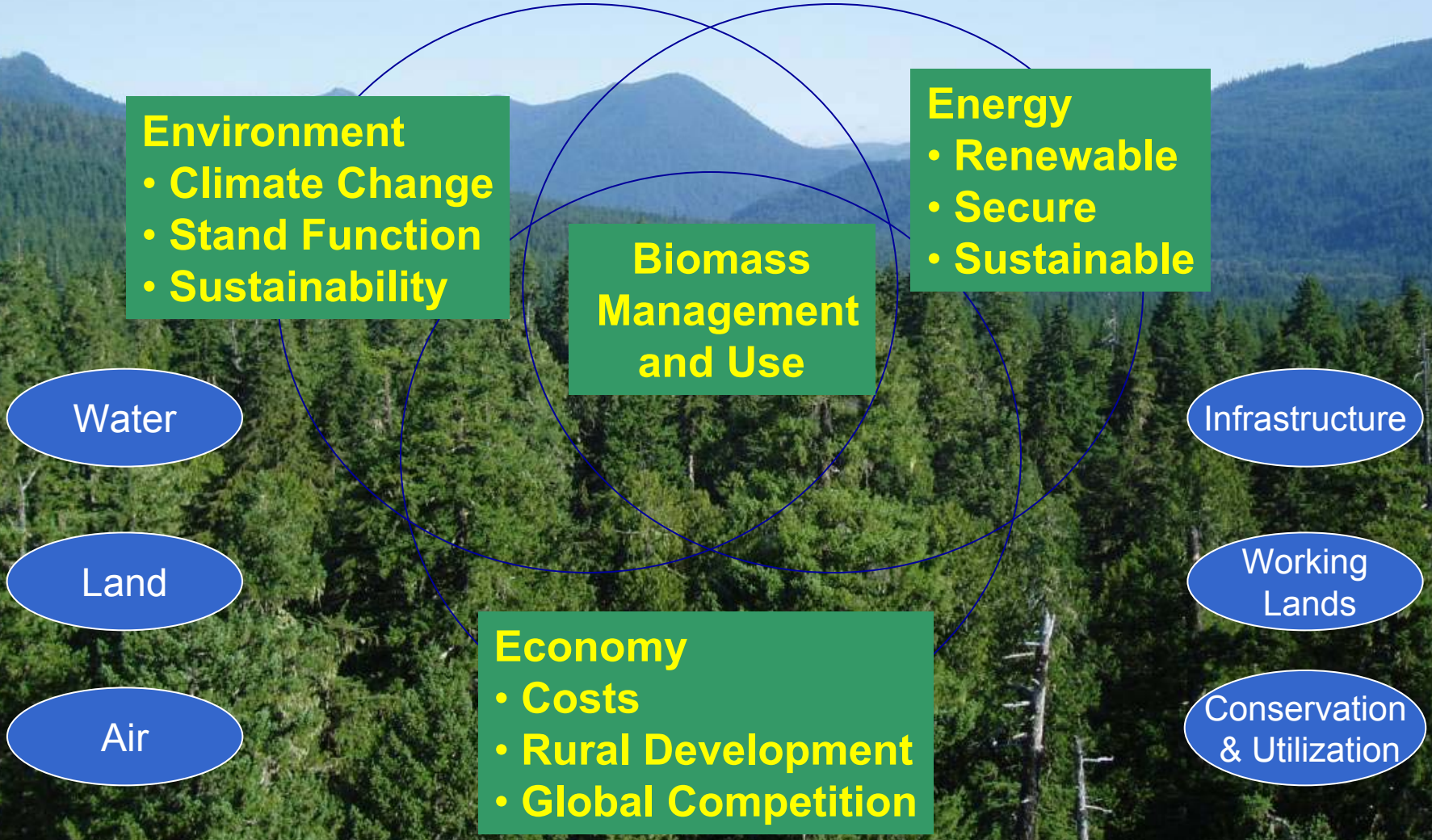
Note: Negative numbers denote sequestration; forests, trees and wood products sequester 11% US GHG emissions annually

Source: http://www.epa.gov/climatechange/emissions/downloads06/07ES.pdf

Forests: A Strategic Asset

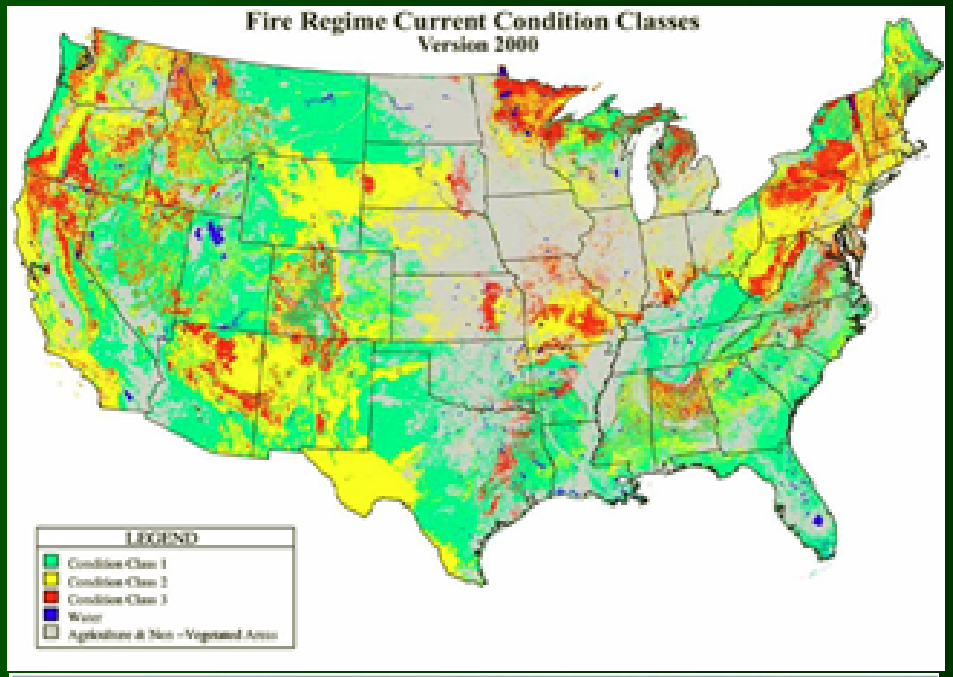
- Energy security
- Environmental quality
- Economic opportunity

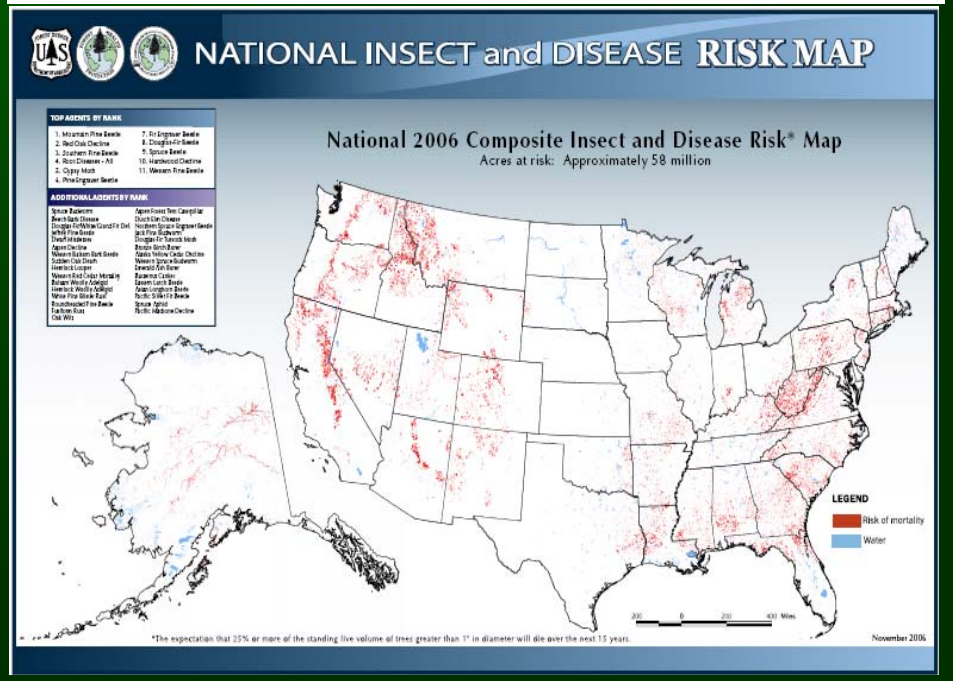
Natural Resource Management



Points to Ponder

- Large volumes of biomass
  - Fire risks
  - Declining health
  - Reduction of services
  - Many forms and shapes
  - Can produce even more
- Declining infrastructure
  - Industry decline
  - Offshore investments and imports
  - Worker (capacity) shortage
  - Reduced investments
- Markets and barriers
  - Cyclic booms and busts
  - No markets
  - Higher costs
  - Very distributive





The Opportunity & Potential

Feedstock

- Forest Residues
- Hazardous Fuel Treatments
- Short Rotation Woody Crops
- Wood Waste
- Conventional Forestry
- Mill Wastes & Residues

Conversion

- Manufacturing
- Co-firing
- Combustion
- Gasification
- Hydrolysis
- Digestion
- Pyrolysis
- Extraction
- Separation

Uses

Fuels:
- Ethanol
- Other Liquid Fuels
- Hydrogen

Electricity and Heat

Biobased Products
- Composites
- Specialty Products
- New Products
- Chemicals
- Traditional Products

Desired Resource Outcome

- Forest systems
  - Healthy
  - Productive
  - Supply goods, services, and values

We will expect forests to produce

- Wood
- Water
- Non-wood products
- Recreational opportunities
- Habitats
- Climate change mitigation
- Energy

So we must

- Manage through changing conditions
  - Environmental
  - Economic
  - Supply & demand
  - Global economy
- Continue to supply goods, services, and values
- Including energy

Challenge

- NOT merely
  - Sustaining existing systems
  - Restoring selected systems

- IS ALSO
  - Enhance capacity of systems to meet future resource needs
  - Managing systems to provide for increasing levels of a variety of benefits

Woody Biomass

- Derived from any and all parts of trees
  - Bole, limbs, tops, roots, foliage
- Insect-, disease-, or fire- damaged or killed
- Purpose-grown wood for energy
- Conventional forestry
- Pre- and post consumer paper and wood products
- Pulping liquors

Considerations

- Resource availability, sources, production and management, feedstock supply components
- Harvesting and operations technologies, in-forest pre-processing technologies, transportation
- Conversion technologies, feedstock characteristic needs, conversion efficiencies, costs
- Integrated management systems
- Information, data, decision tools
- Development/deployment of biomass energy facilities

Challenges

- Provide quantities of wood needed for energy
  - Increase the supply of renewable and alternative fuels to 35 billion gallons by 2017[1]
  - RFS 36 Bgal biofuels/year by 2022 with 20 Bgal non-corn[2]
  - Replace 15% of current US gasoline consumption with ethanol from wood – ~21 billion gallons of gasoline annually[3]
- Maintain & enhance forest health and productivity
  - Ensure conservation & sustainable delivery of wood products and other benefits
  - Avoid/mitigate potential negative impacts
  - Capitalize on benefits working forests provide in the landscape
- Reduce Costs & increase efficiency
  - Feedstock production & management
  - Harvest, collection & delivery
  - Conversion processes
- Reduce Investor Risk

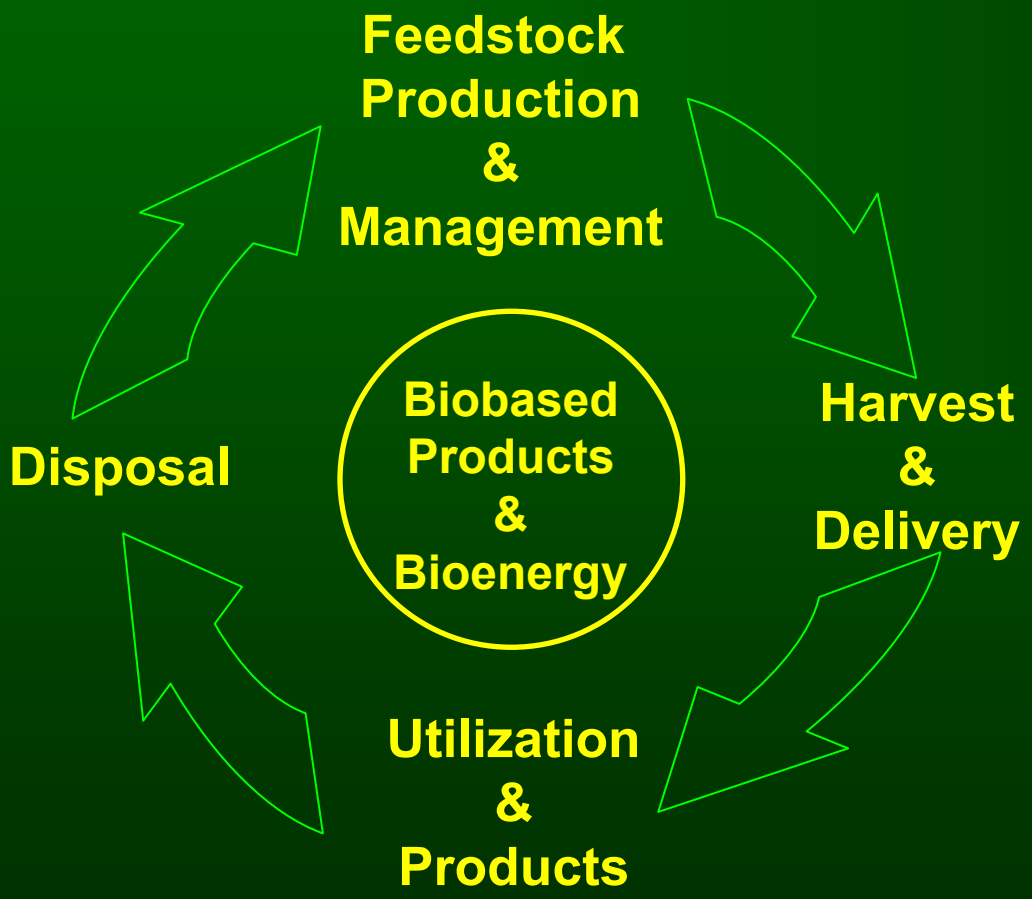
[1] 2007 State of the Union Address
[2] EISA 2007 (Energy Independence and Security Act of 2007)
[3] FS Chief Gail Kimbell, 9/7/07

Some Critical Information In Hand

- Resource Assessments
  - Billion Ton Report
  - Resources Planning Act Assessments
  - Regional Assessments
  - FIA
- Life Cycle Analyses
  - CORRIM
- Soil Productivity
  - National Long Term Soil Productivity Study
  - Soil carbon syntheses
  - Whole-tree logging and harvest impact studies
- Water quality
  - Best Management Practices (42 states)
- Habitat and biodiversity studies
- Forest Certification Programs

* Items listed as examples – not exhaustive

Integrated Biobased Products And Bioenergy Approach



- Research & Development
- Synthesis
- Development of
  - options
  - strategies
  - systems
  - practices

For sustainable goods, services, & values

Critical Research

- Management and utilization systems for forest biomass and residues, forest health and fuels reduction treatments, and production forests
- Science and technology for woody cropping systems at multiple operational scales
- Management and land use systems for specific functions (designed forest systems)

Critical Research (cont)

- More efficient, light-on-the-land harvest, collection, and transportation systems
- Highly productive feedstocks with improved water- and nutrient-use efficiencies
- Efficient technologies for wood conversion to biofuels and bioproducts
- Life cycle analysis of integrated systems

. . . Sustainability

IEA BIOENERGY

- **TASK 31: Biomass Production for Energy from Sustainable Forestry**
  - 8 Countries: USA, Canada, United Kingdom, Finland, Sweden, Denmark, Norway, Germany, Netherlands
  - Two State-of-the Science books from Tasks A6 and 31

TASK 31

Richardson et al. 2002. Bioenergy from Sustainable Forestry: Guiding Principles and Practices.

TASK A6

Dyck et al. 1994. Impacts of Forest Harvesting on Long-Term Site Productivity.

http://www.ieabioenergytask31.org/

IEA BIOENERGY

- **TASK 30: Short Rotation Crops for Bioenergy Systems**
  - 5 Countries: Brazil, Canada, Australia, New Zealand, Sweden, United Kingdom, USA

http://www.shortrotationcrops.org/

SHORT ROTATION CROPS INTERNATIONAL CONFERENCE: BIOFUELS, BIOENERGY, AND BIOPRODUCTS FROM SUSTAINABLE AGRICULTURAL AND FOREST CROPS

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