

UNIVERSITY OF MINNESOTA

**EXTENSION**

# **Trends In Energy Use: Renewable Energy Today and Tomorrow**

Dean Current, Program Director,

Center for Integrated Natural Resource and Agricultural Management

Fueling the Future:

The Role of Woody and Agriculture Biomass for Energy Workshop

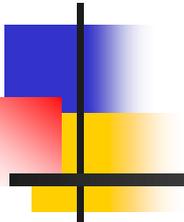
March 19, 2009

Morris

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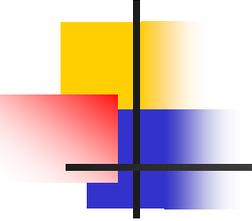
# Trends in Energy Use: Renewable Energy Today and Tomorrow

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Dean Current, Program Director,  
Center for Integrated Natural Resource and Agricultural Management (CINRAM)  
Dept. of Forest Resources  
University of Minnesota

## **Fueling the Future:**

**The role and use of woody and agriculture biomass for energy workshop  
March 19, 2009 (Thursday) – USDA-ARS, Morris, MN**



# Content

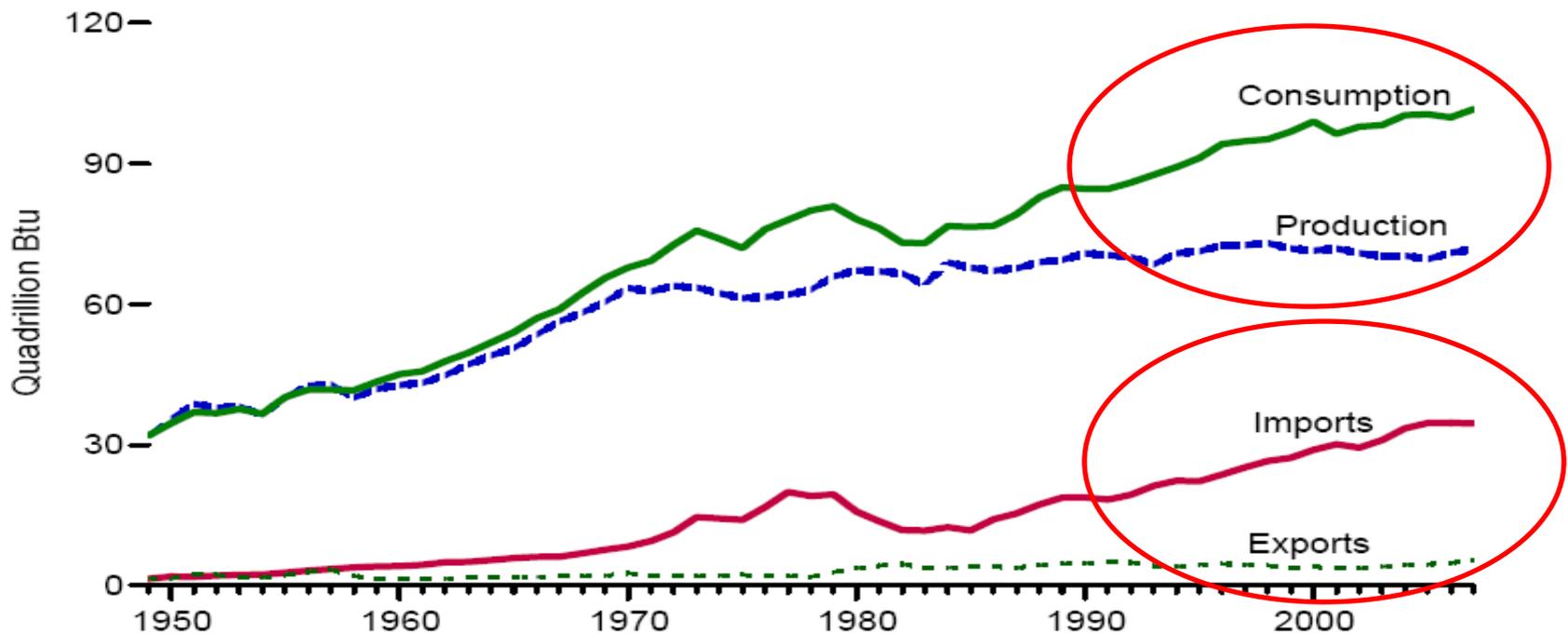
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- Past and future trends in energy and renewable energy use
- Opportunities created by interest in renewable energy from biomass
- Options for biomass production
- Issues and constraints

# Energy Production and Consumption 1949-2007

Figure 1.1 Primary Energy Overview

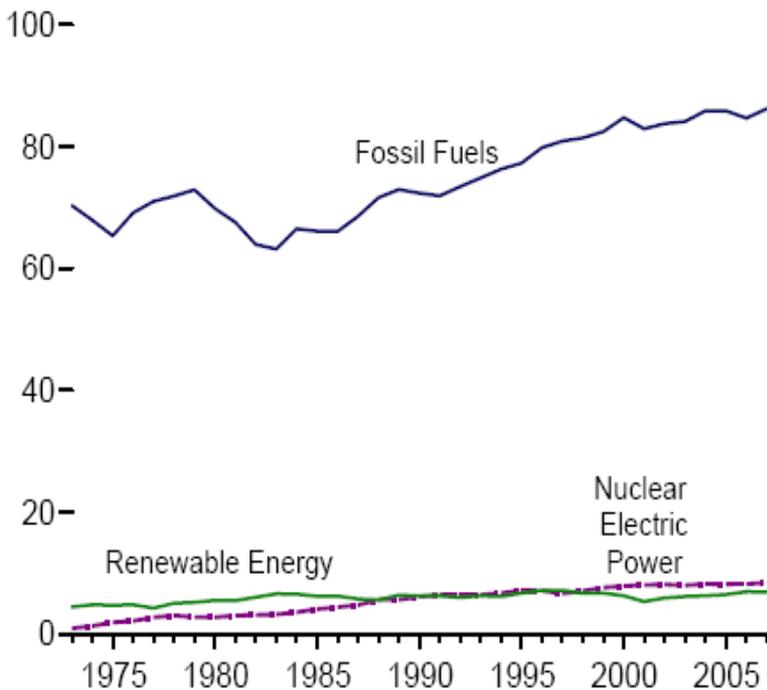
Overview, 1949-2007



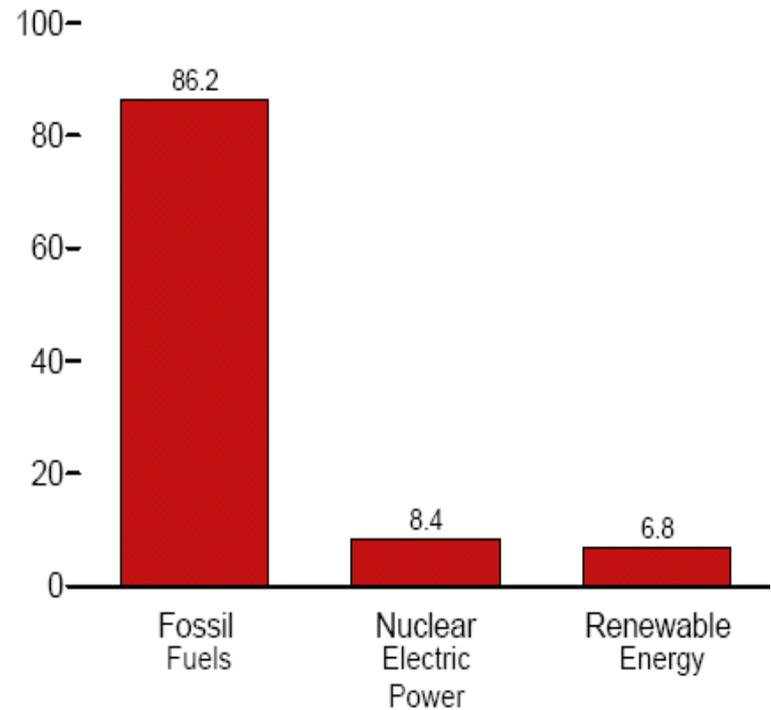
Source: Energy Information Administration – Annual Energy Review –2007

# Role of Renewables - present

Compared With Other Resources, 1973-2007



Compared With Other Resources, 2007

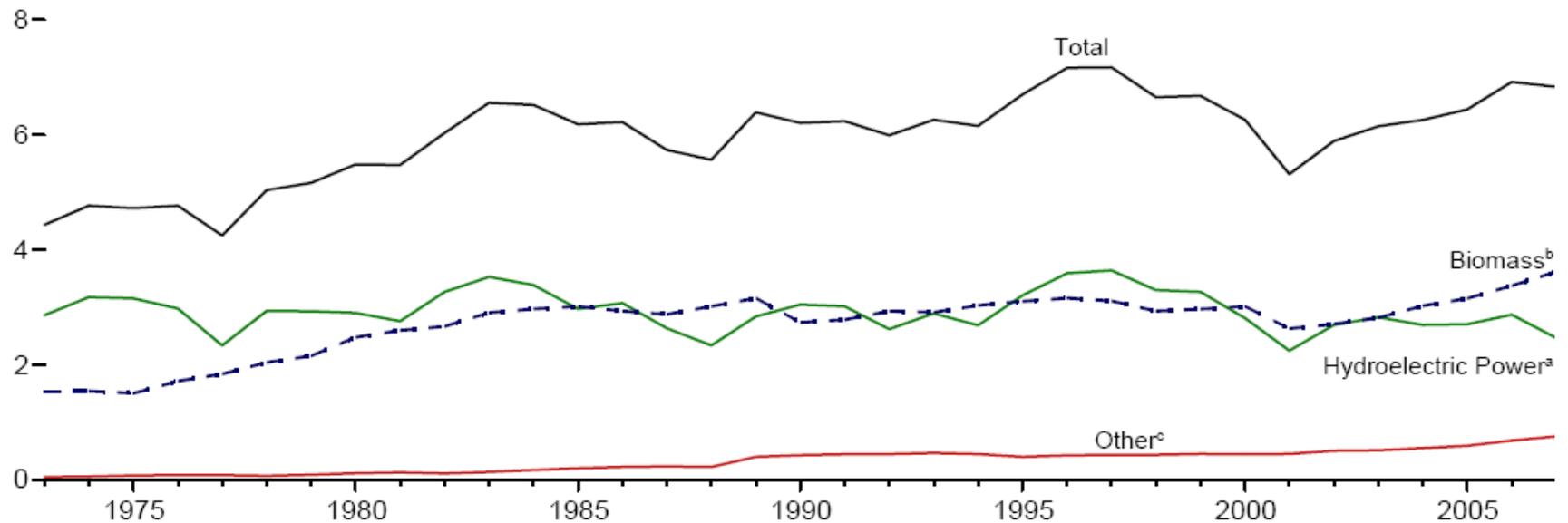


Source: Energy Information Administration – Monthly Energy Review – Jan. 2009

# Renewable Energy Consumption 1973-2007

**Figure 10.1 Renewable Energy Consumption**  
(Quadrillion Btu)

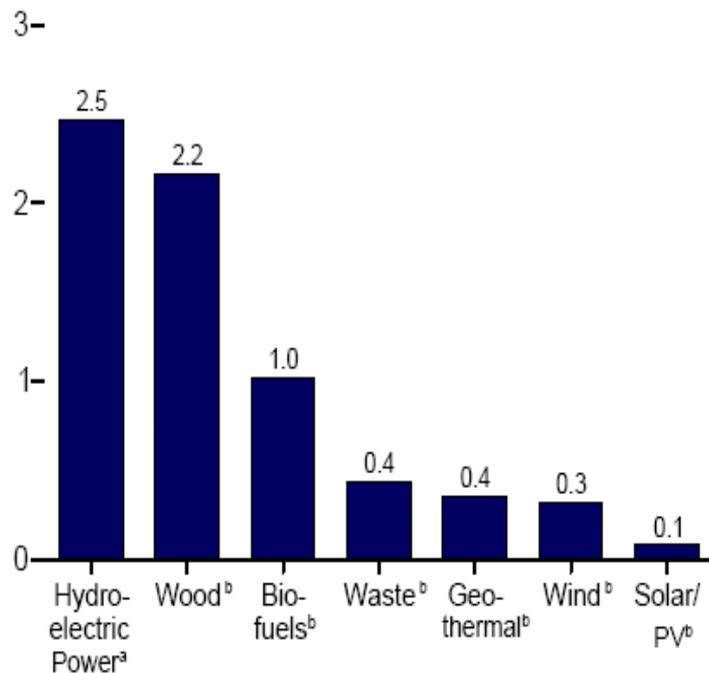
Total and Major Sources, 1973-2007



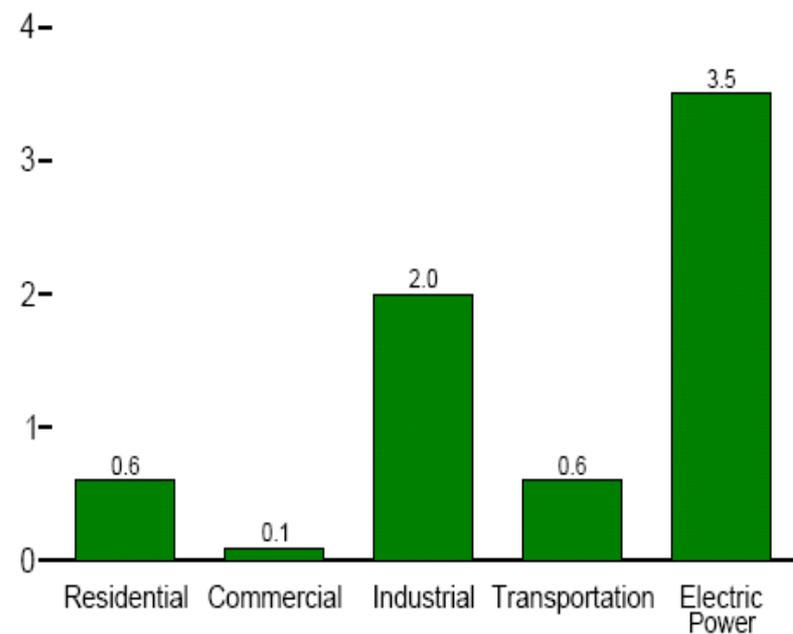
Source: Energy Information Administration – Monthly Energy Review – Jan. 2009

# Renewable Energy-Source and Sector

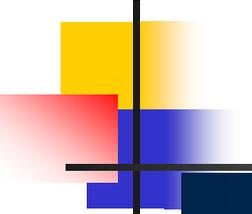
By Source, 2007



By Sector, 2007



Source: Energy Information Administration – Monthly Energy Review – Jan. 2009

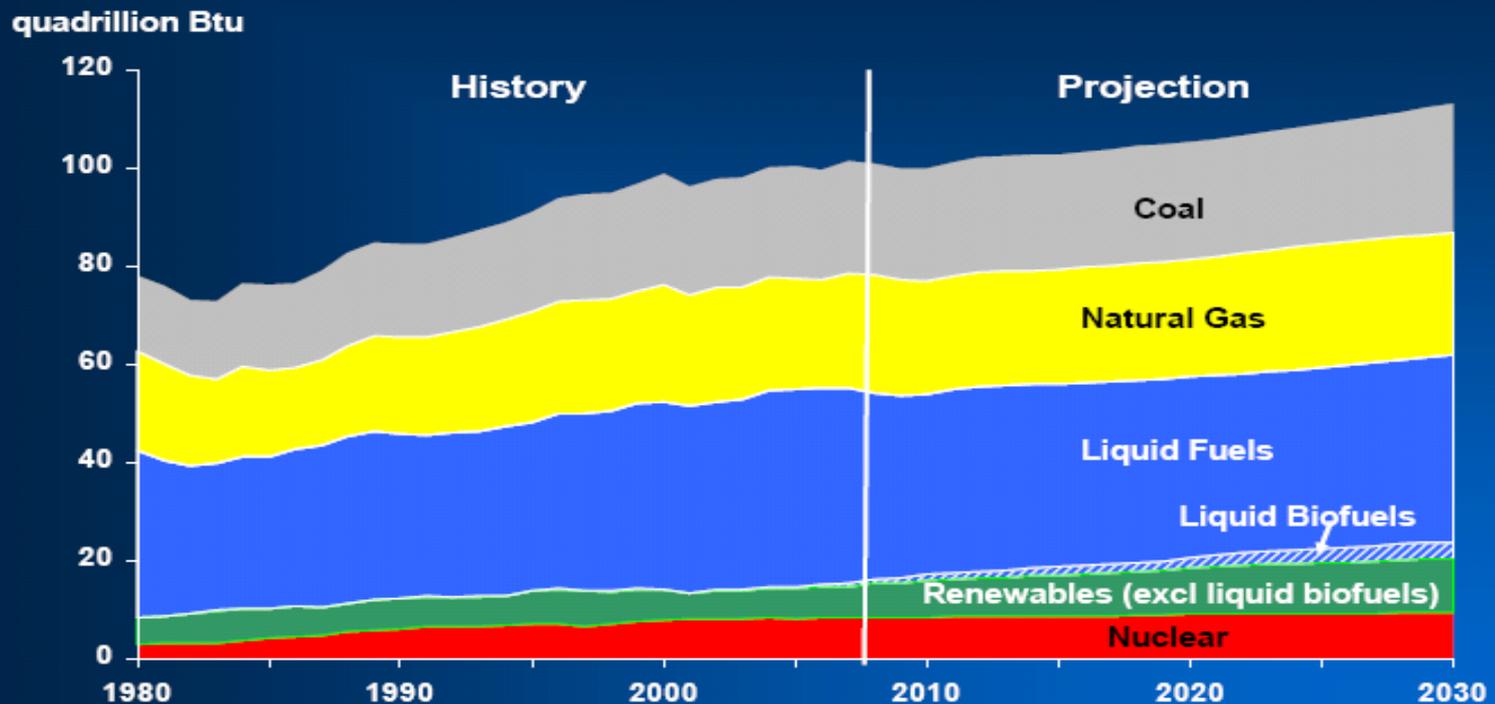


# So what does the future hold? - Projections from EIA

- Long-term economic growth averages about 2.5 percent per year between 2007 and 2030
- World crude oil prices recover from a near-term decline and reach \$130 per barrel (in 2007 dollars) by 2030
- A robust domestic natural gas resource base allows for a steady expansion of production given projected growth in demand and prices
- Recently-enacted policies and concerns over greenhouse gas (GHG) emissions, combined with high energy prices, moderate projected growth in energy consumption and emissions

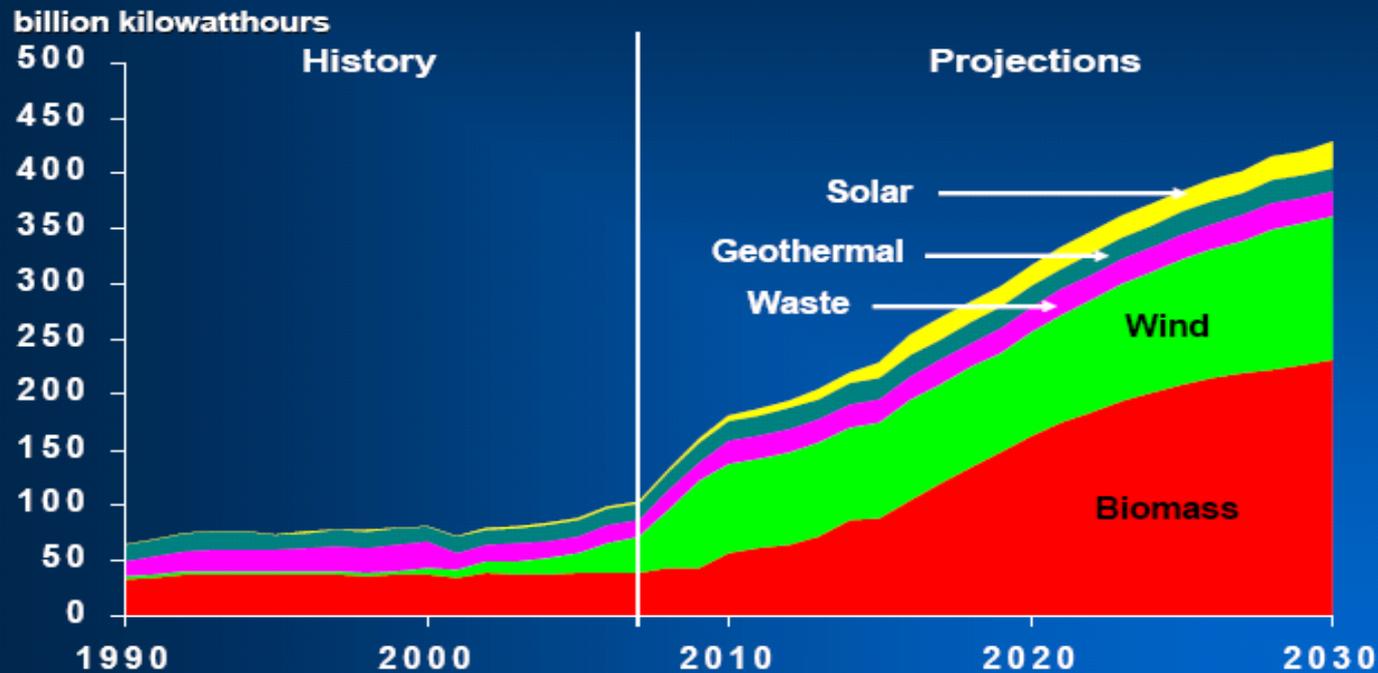
# Use of Renewables will grow

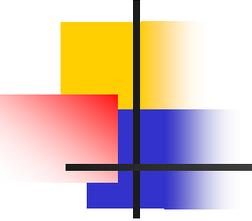
**Non-fossil energy use grows rapidly, but fossil fuels still provide 79 percent of total energy use in 2030**



# Biomass will be an important component

**Nonhydropower renewable power meets 33% of total generation growth between 2007 and 2030**



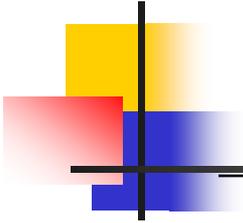


# Economic stimulus bill

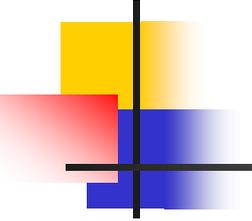
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- \$16.8 billion for the DOE Office of Energy Efficiency and Renewable Energy (EERE).
- Ten-fold increase over 2008

# Potential demand for biomass



<b>Energy Facility</b>	<b>Location</b>
<b>Rock Tenn</b>	Saint Paul, MN
<b>Laurentian Energy Authority</b>	Virginia, MN
<b>Minnesota Power</b>	Grand Rapids, MN
<b>FibroMin (Ag residue and wood)</b>	Benson, MN
<b>District Energy</b>	Saint Paul, MN
<b>Little Falls Ethanol Cooperative</b>	Little Falls, MN
<b>Rahr Malting – KODA Energy</b>	Shakopee, MN



# Renewable Energy

## - Biomass Opportunities

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- Dedicated herbaceous crops - grasses
  - Switchgrass, Miscanthus, Native prairie
- Corn/cellulosic ethanol
- Crop and woody harvest residues\*
- Dedicated woody crops
- Brushlands
- Fuel and fiber integrated forest management

# Dedicated energy crops

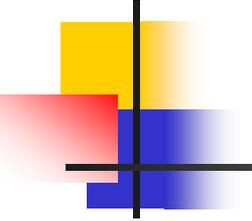
- Hybrid poplar or willow
- 3-6 year rotation
- Economics improving but still marginal
- Payments for environmental services could improve economics (CO<sub>2</sub>, water)



Self-propelled forage harvester  
(Claas)

Photo: Forest Research

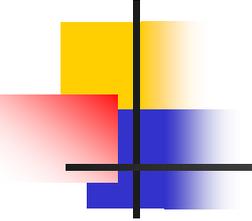




# Thinning

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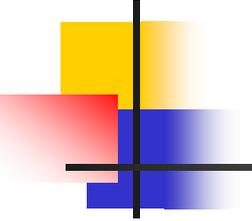
- Due to costs of pre-commercial thinnings, thinning does not take place
- Thinning has the potential to increase productivity of stands 50% or more
- Thinning could provide important source of biomass and productivity enhancement
- Est. 4.5 dry tons/acre at age 10 and 23.5 at age 30 aspen (Demchik, 2006)



# Logging Residue

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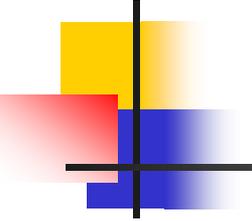
- 10-19 Green tons/acre depending upon cover type (est. \$15-25/ton at plant)
- Would probably have to leave up to 30% on site



# Integrated, intensive forest management

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- Include biomass generation throughout management cycle
  - Optimize biomass and forest product production
  - Healthier, more resistant forest
  - Improved forest productivity for a number of benefits
  - Under guidelines that ensure environmental protection and services
  - Increased employment opportunities



# Hazardous fuel removal

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- Forest Service pays up to \$575/acre currently for hazardous fuel removal
- 14,000 acres on the Superior National Forest in 2007
- 7-10 green tons/acre
- By harvesting hazardous fuel for biomass energy use, costs of treatment could be reduced
- Little work has been done on this

# Brushland harvest

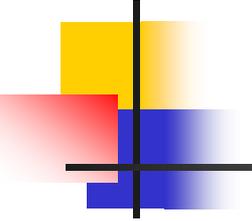
- Brush currently sheared, piled and often burned for wildlife habitat management
- Brush could be harvested and sold
- Density of brush important to economics
- Estimated 12-17 dry tons/acre on well stocked sites (Berguson, 1997)



# Bio-baler



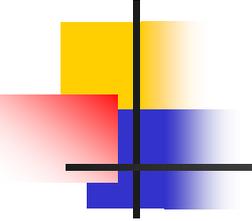
Photos courtesy of Philippe Savoie – Agriculture and Agri-Food Canada



# Concerns

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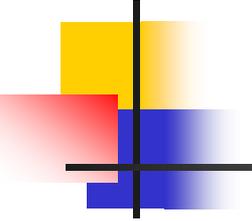
- Food vs. fuel
- Deforestation in other parts of the world linked to renewable production
- Sustainable production
- Energy balance
- GHG emissions



# Environmental concerns

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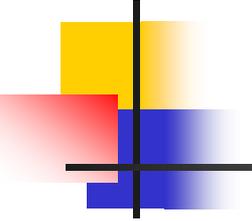
- Over harvest of forest lands
- Depletion of nutrients when removing greater amount of material
- Sustainable Biodiesel Alliance – BMP's
- Brushland and slash harvest principles
  - Research background provided by UMN
  - Guidelines prepared by DNR and MN Forest Resources Council



# Environmental benefits

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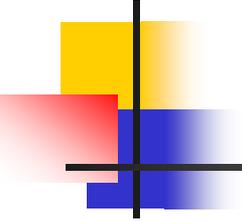
- Targeting environmentally sensitive areas with perennial crops
- Healthier, more productive forest
- More resilient ecosystems
- Carbon credits - Minnesota Terrestrial Carbon Project



# Issues:

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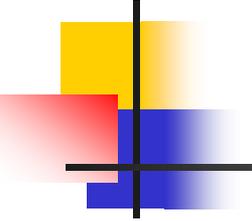
- Many of the biomass related activities are new to land managers
- Production issues
  - How much biomass is available from ag lands and forests (thinnings and harvest residue)
  - How can we economically harvest and transport biomass as an energy source
  - What kind of productivity improvements are possible and what is their value



# Issues:

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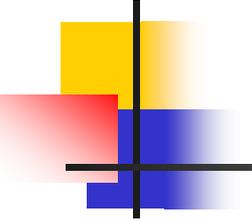
- Logistics:
  - New machinery needs
  - Transportation issues
  - Densification
  - Handling smaller material
- Products
  - Chemicals/Bio-oil
  - Chips
  - Pellets



# Issues:

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- Ecological services
  - Carbon payments
  - Sustainable management
  - Maintaining forest areas
- Economics
  - Profitability of different options
  - Initial investment needs for new activities
  - Economic/community development

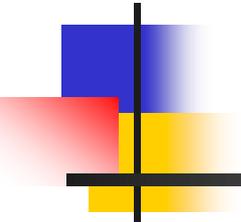


# Summary

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- Renewable energy provides opportunities in the Ag and Forest sectors, but
- much work to be done to make the opportunities a reality

# Questions?



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## **For additional information contact:**

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