Wood Energy and the Role of Government Policy

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Massive Energy From Wood –Wishful Thinking?

3 Realities that Limit Impact on Forestry

1. **Economics favor agricultural wastes and agro-forestry.** Land-use change will become an issue.
2. **Forest residues have higher valued use.** Subsidies will face increasing pressure.
3. **Mandates & subsidies are the only driver.**

Key BioEnergy Drivers

- Energy Security
  - pushes policy toward domestically produced transportation fuels
- Increasing Oil Prices
  - pushes policy toward cheaper liquid fuel alternatives
- GHG Reduction
  - pushes policy toward lowest cost mitigation projects

Policy so far has been driven more by energy security than the other 2.

Energy Security Premium

Driven by:

- Conflicts in Middle East
- OPEC policy
  - History is to react aggressively to decreases in demand
- Energy conservation
- Political will for subsidies
- Unintended consequences

Is Wood Energy Cost Competitive?

- Wiltsee (2000)
  - Review of 20 operating power plants
  - Wood prohibitively expensive in all cases
- Kumar et al. (2003)
  - Looked at straw, forests & logging residues
  - Biomass not competitive w/o subsidy
- Yemshakov & McKenney (2008)
  - Fast growing poplar in Canada
  - No cases competitive with coal at $5 / ton CO2
- Schneider and McCarl (2003)
  - Wood Energy not feasible until CO2 = $40 / tonne

Current Government Policies

- Production Mandates
  - 36 Billion gallons per yr mandate
  - subsidies increase if mandates are not met
- Grants
  - $500 million per year 2008 - 2015 to start new cellulosic ethanol plants
- Subsidies
  - $0.51 per gallon blender's credit (decrease to $0.45)
  - $0.10 per gallon small producer's subsidy
  - $1.01 per gallon cellulosic ethanol producer's subsidy
- Duties
  - $0.54 per gallon import duty on Brazilian ethanol
  - Production costs lower in Brazil, sugarcane more efficient

Lessons Learned

- Subsidies have not yet created a viable industry
- Controversy about the actual greenhouse gas effect of ethanol
- Many unintended consequences uncovered as the industry is scaled up to have a national impact
- Result is that ethanol has lost its luster on Capitol Hill and in Europe

Case Study - Don Roberts

- 5,000 BDMT / day biorefinery
- If harvest is 2 BDMT / acre, circle is 58 Miles
- If Harvest is 10 BDMT / acre circle is 22 miles (avg haul distance is 30 miles)
- **Key to success is dedicated agroforestry, with high yields to keep transportation cost down.**

These factors do not favor existing forests & residues.

Available Forest Biomass (Billion Ton Report)

- Industrial Wastes (159 Million Tons)
  - 95% already used (57% for energy)
- Fuel wood (35 Million Tons)
  - Already used for energy
- Fuel treatments (60 Million Tons)
  - Very costly, long supply lines, most in dry or remote areas
- Logging residues (41 Million Tons)
  - Very costly, has environmental considerations, but possible
- Urban wastes (36 Million Tons)
  - Possible, much goes to landfills

Bottom Line - About 2.5 billion gallons of ethanol could be produced from surplus.

Likely Feedstocks of the Future

Warm Climates

- Switchgrass
- Miscanthus

These grow on marginal croplands with high biomass density, and have low nutrient and water needs.

Colder Climates

- Poplar
- Eucalyptus

Genomic Traits:

* Fast Growth
* Branching habit
* Cell wall chemistry
* Branch habit

Source: Rubin, E. Genomics of cellulosic biofuels. *Nature*

Possible Unintended Consequences

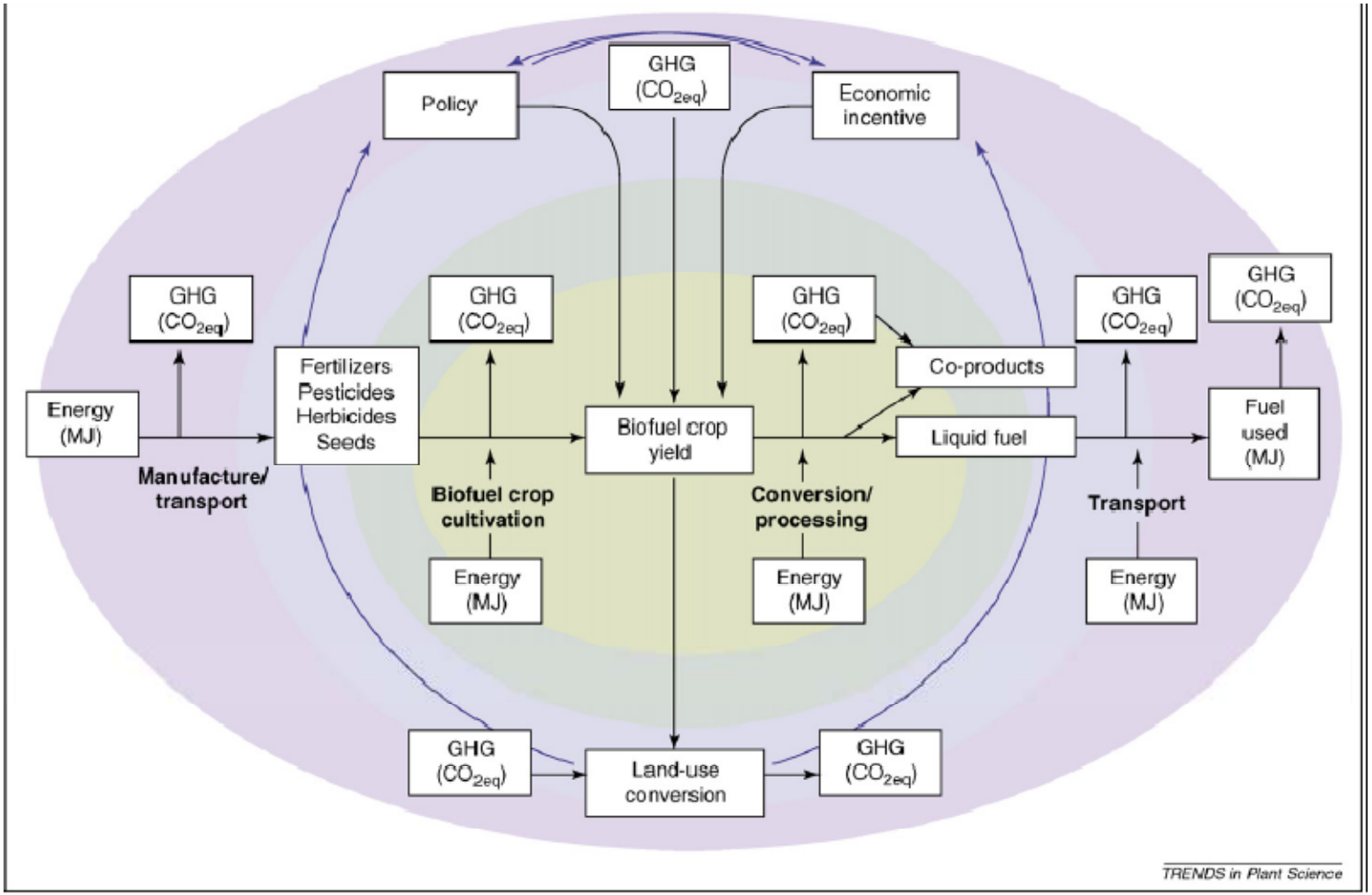
- Energy subsidies drive conventional product manufacturers south (leakage)
  - Sawdust in BC now goes to wood pellets
- Carbon debt due to land use change (additionality)
  - Can take decades to gain back emissions from LUC
- Loss of conservation reserve lands and rangelands to fuel production


OIL BARREL VS. PORK BARREL : SAME DIFFERENCE?
BAD CO2!
NOT THE SAME DIFFERENCE!
GOOD CO2!
HYDROCARBON BYPRODUCT SO PASSE!
FROM "CLEAN" COAL - SO CHIC!
OIL
US CONGRESS
ADM
ETHANOL
GREENER GREENHOUSE GASES!
ADM

Big Changes are Afoot

- EU Directive 37 requires full carbon effects of land use change to be considered (2008)
- California Low Carbon Fuel Standard requires land use change to be considered in GHG emission calculations (2009)

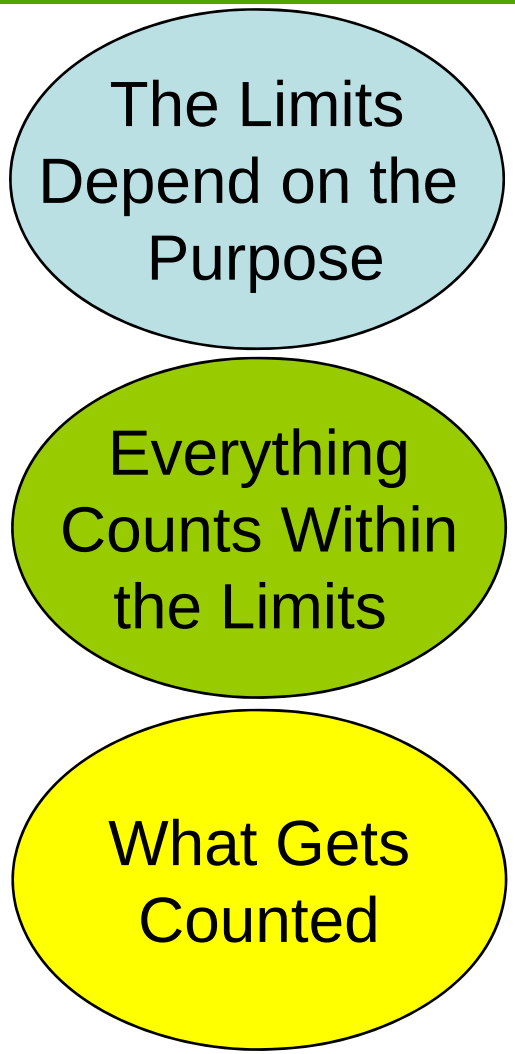
Life-Cycle of Biological Energy Materials



Davis et al. (2009) Life Cycle analysis and the ecology of biofuels.

Life Cycle Analysis Framework

- System Boundary
  - Spatial
  - Temporal
  - Production chain
- Inventory
  - Required inputs
  - Outputs
- Functional Units
  - Net energy (NEV)
  - GHG Flux
  - Mitigation Cost?



Measuring Net Energy

- Not all energy is the same
  - Liquid fuels: energy security consequence. Higher value?
  - Electricity: Storage Issues
- Fuel Energy Ratio
  - Energy produced / Fossil fuel energy consumed
  - If FER < 1, project loses energy
- In published studies FER ranges from 5.6 to 0.44 depending on LCA assumptions (Davis et al. 2009)

Scales of Life-Cycle Analysis

- Processing Scale
  - Harvest, transport, processing, transport, use
- Stand Level Scale
  - Considers crop cultivation from bare ground
  - Includes agrucultural inputs
- Landscape level scale
  - Considers magnitude of project
  - Includes emissions from land use change

Why Landscape Scale LCA?

- Large energy projects require massive amounts of feedstock
- Land conversion must be *scheduled* to provide sustainable supply
- Transportation costs & emissions depend on available land base
- Time is *project-based* not *stand-based*

Recent News in Biofuels

- 8 Nations Warn EU over Biofuel Barriers
  - Measures to protect land use change discriminate against developing countries
  - Huge potential for sugarcane biofuels in tropical areas
- EPA asked *not to release* results of life cycle analysis on carbon emissions
  - At issue is emissions due to land use change
- VeraSun Declares Bankruptcy
  - High feedstock costs, volatile prices, dropping demand

Why Cellulosic Ethanol?

- Corn ethanol production capped at 15 billion gallons in 2015.
- 21 billion gallons must come from "*advanced biofuels*" defined as "renewable fuel other than ethanol derived from corn starch…"

Questions:

- Is the subsidy enough to meet the mandates?
- Will the political will remain in new administration & congress?
- What are the implications for forestry?

The Rush to Cellulosic Ethanol

The promise of ethanol!

- Ecosystem restoration
- Utilize beetle killed salvage wood
- Provide rural employment
- Make fuel treatments economically feasible
- Provide viable markets for “smallwood”
- Reduce CO_2 emissions
- Bring forestry back to national prominence

Competitiveness Issues

US Dept of Energy Study

- 3 Breakthroughs Needed
  - Biomass cost dropped to $30 per ton
  - Yield increased by 50% to 90 gallons per ton
  - Enzyme costs lowered by a factor of 8 to $0.05 per gallon
- What is likely to happen
  - Agricultural wastes utilized first
  - Genetic breeding for specialized energy crops tailored to a particular enzyme or process
  - High yield marginal agricultural lands used to reduce supply costs

These factors have specific implications for how forestry will contribute.

Opportunity Cost Issues

- Cost of cellulosic ethanol relative to sugar cane ethanol
  - Will import duty need to be increased?
  - Southern hemisphere production could meet mandates
- Value of biomass for ethanol relative to other uses
  - Pulp industry pays 3 times this amount for biomass
  - Wood Pellets market strong and growing due to carbon taxes in Europe and high heating oil costs
- Transportation costs a significant factor
  - Economy of scale demands large plants and big supply zones

Lessons From Current Investment

- Iogen has 1st demonstration plant
  - Process perfected for wheat straw
  - Canadian govt awarded $500 million for Sask. Plant
- US DOE funded 6 new plants (March 2008)
  - 5 of the 6 plants will process agricultural & landfill wastes
  - Range fuels syn-gas plant intended to process wood residues

What Could Make Wood Energy Competitive?

- Carbon prices in excess of $50 / ton
  - Life cycle impacts critical
  - Cap and trade system with teeth
- Wood combustion emissions excluded from cap
  - Less likely with LUC effects
- Government subsidies
- Available land for energy plantations
  - Existing forests have carbon debt implications

Land availability is a critical issue.

Competing Priorities

- Energy security
- Protection of biodiversity on conservation reserve lands
- Protecting & enhancing carbon storage in forests
- Food production
- Water conservation

Start Up Problems

- Start up of major energy plant could require massive land use changeover
- Energy plant must be located where raw material is plentiful, close, cheap and sustainable
- Land conservation issues could be a major driver
- Conversion will cause carbon flux that must be counted

Land Use Planning – Balancing Competing Issues

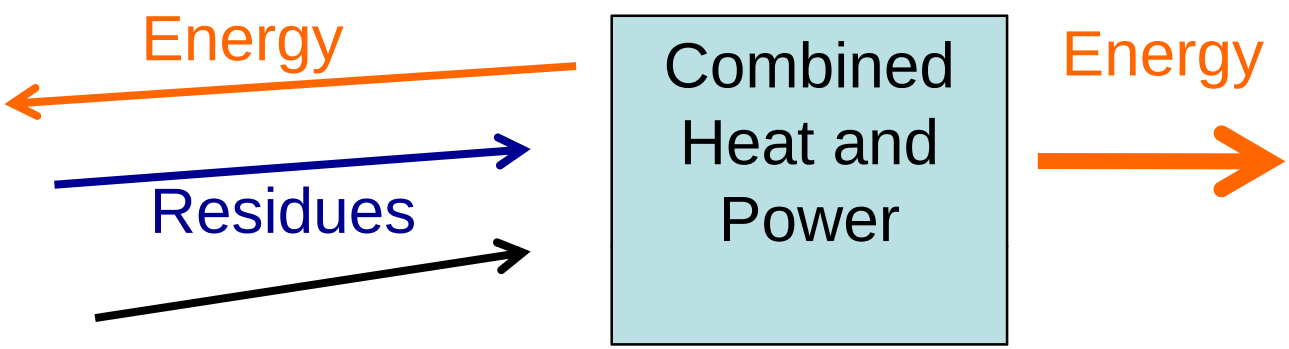
- Joint production function
  - Traditional timber
  - Net energy production
  - Total carbon flux
  - Other ecosystem services
- Land conversion to energy plantation
- Reactions to various government policies
- Fire and disturbances
- Building climate change resilience
- Protected area strategy

Planning Approaches

- Agent Based Simulation
  - Collection of agents that react to policy environment
  - Will agents' behavior maximize policy goals
  - Study the benefits and unintended consequences
  - Landscape evolves as cellular structure
  - No central planning
- Optimization Approach
  - Mixed integer programming problem
  - Use sensitivity analysis with different carbon values & policies
  - Constraints & spatial restrictions drive costs
  - Assumes central planning

Facility Location Issues

- Manufacturing Cluster Approach
  - Solid Wood
  - Secondary
  - Pulp
  - Chemicals
  - Energy wood

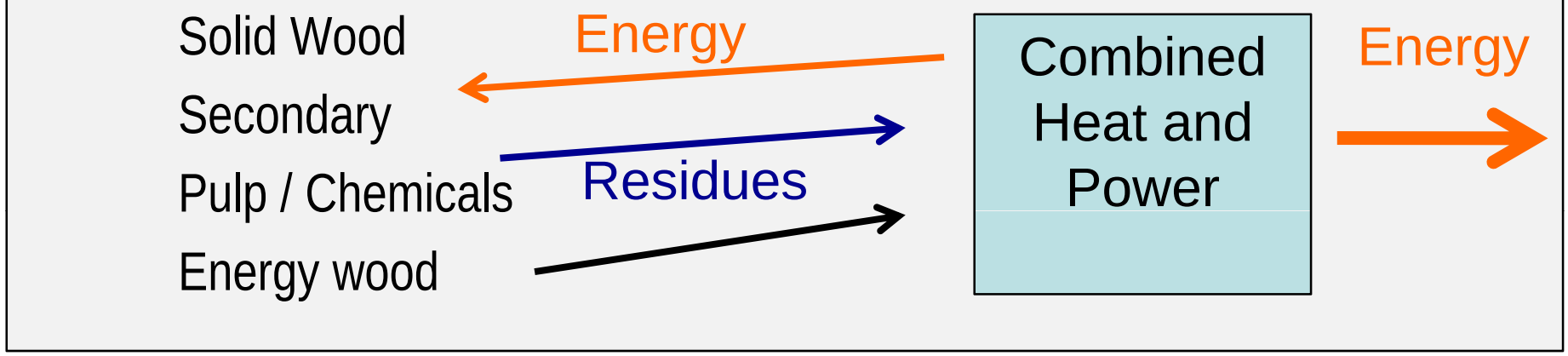


- Dedicated
  - Pulp / Chemical mill complex
  - Dedicated energy plantation

Ethanol
Biodiesel
Chemicals

Facility Location Options

- Manufacturing Cluster Approach



- Dedicated

Pulp / Chemical mill complex

Dedicated energy plantation

Agro-forestry or Perennials

Ethanol
Biodiesel
Chemicals

Discussion