Maine Forest Biorefinery Research Initative and Green Chemistry: Opportunities for Bioproducts

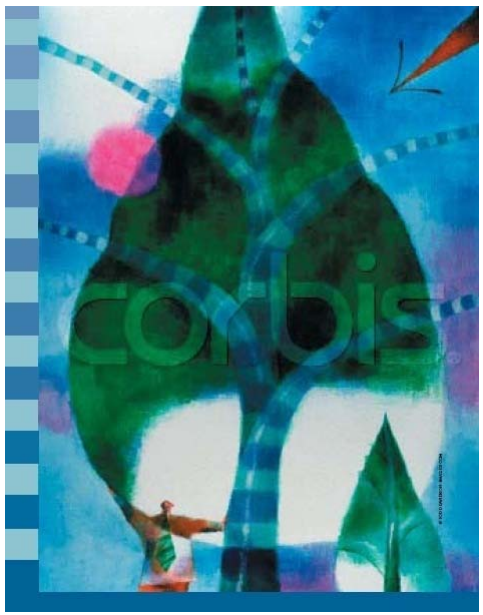
Northeast Sun Grant Regional Feedstock Summit

November 11-13, 2007

Jonathan Rubin

Three Opportunities

- Potatoes-to-Plastics
- Forestry Biorefinery Research Initiative
- Forestry credits under RGGI



FBRI
FOREST BIOPRODUCTS
RESEARCH INITIATIVE

Discovering
a Sustainable Bio-Economy

Potatoes-to-Plastics

Team

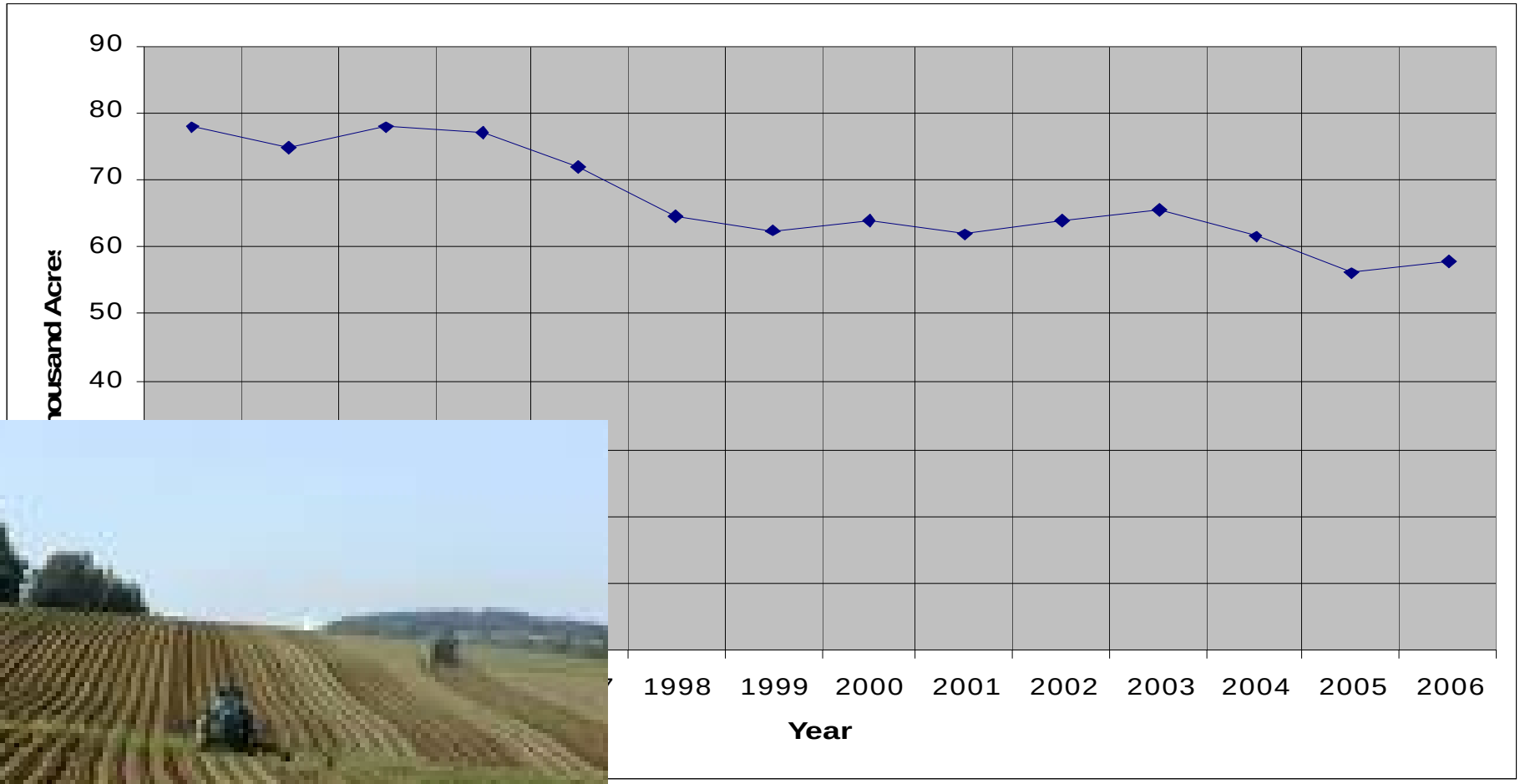
- Kate Dickerson, MCS Policy Center
- Maine Technology Institute
- Alliance for a Clean & Healthy Maine
- Green Harvest Technologies
- InterfaceFABRIC
- Maine Potato Board
- University of Maine
- University of Massachusetts, Lowell

Report: http://www.umaine.edu/mcsc/reports/potatoesRpt.pdf

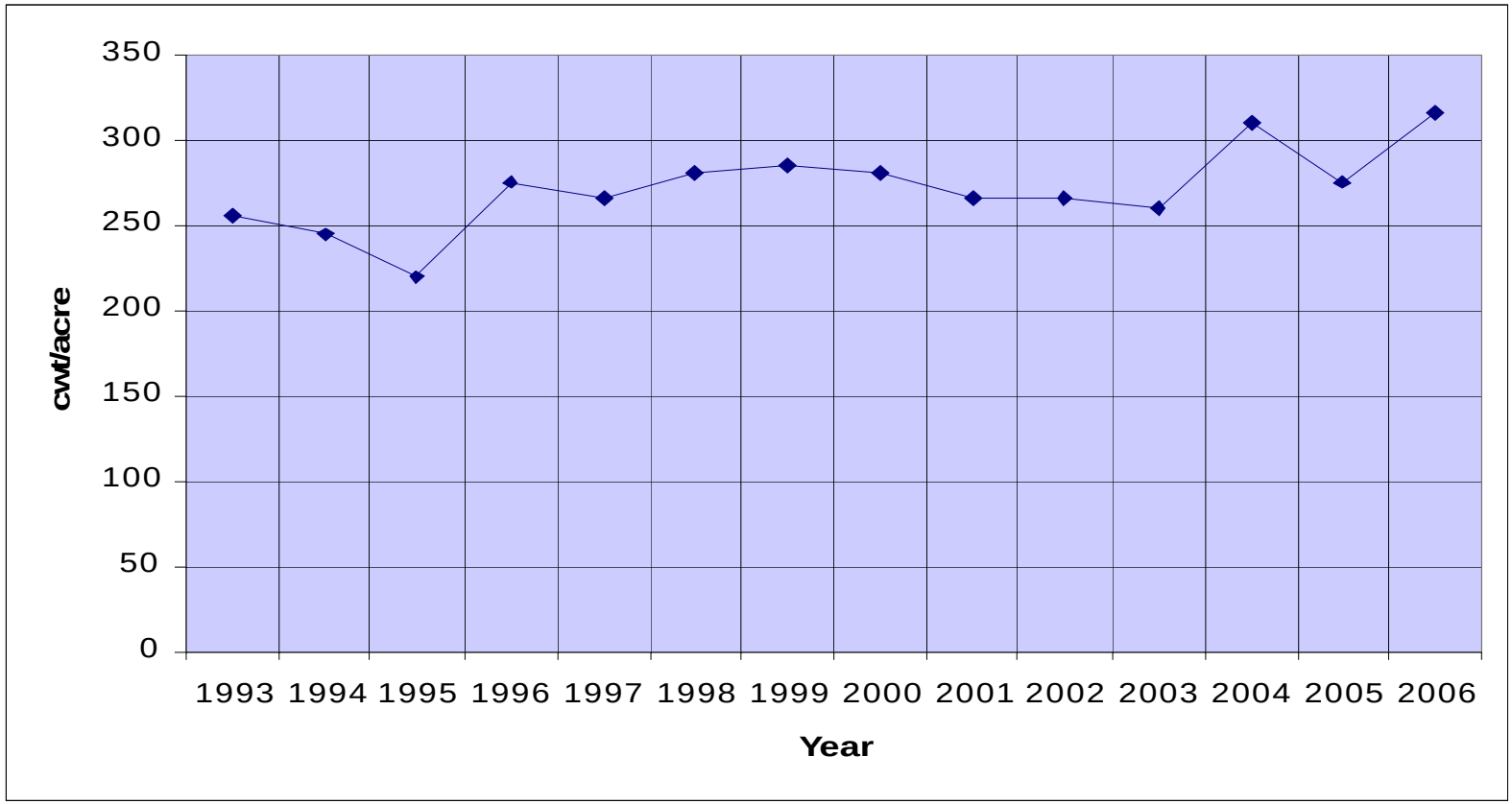
Why?

- Petroleum displacement
- Less toxic
- Economic development

All Purpose Potatoes Harvested in Maine, 1993-2006



Maine Potato Yield
hundred weight/acre, 1993-2006



InterfaceFABRIC: 13M lbs of PLA/yr

PLA Available from Potatoes	
Potato Yield	27,100 lbs potatoes/acre
Percentage of starch in Russet Burbank and Shepody potatoes	14.8 %
Potato starch	4,011 lbs/acre
PLA from Starch (1:0.65)	2,607 lbs/acre
Additional acres for potatoes (in 3-year rotation)	6,667 acres
PLA yield with new acreage	**17,380,133 lbs**

InterfaceFABRIC:13M lbs of PLA/yr

PLA Available from Potato Wastes		
Potato Harvest		67,000 acres
Yield		27,100 lbs of potatoes/acre
Waste Percentage availability	lbs starch available	lbs of PLA
If 10% of production culls and smalls (waste potatoes)	26,872,360	17,467,034
If 50% of production is for fries and 30% waste occurs (potato waste)	40,308,540	26,200,551

Cost Estimates

- Estimated annual operating costs of a small capacity PLA facility using corn: $26.6 M/yr
- At such a facility, PLA can be produced at a price of *$1.20/lb*
- Using potatoes rather than corn brings an additional cost of $0.06 per pound of fresh potatoes. Total PLA production cost: *$1.26/lb*

Summary of Findings

- Potential to produce PLA from potato starch will not be limited by the ability of potato growers to provide a viable crop.
- Cost to growers will not be prohibitive for such a project; return will be similar to that for food stock potatoes.
- No current table-ready or processing potatoes need to be taken out of the supply chain.
- The needed increase in the amount of acres planted and harvested can be implemented within one planting season to provide the starch.
- Potato varieties currently grown, in particular the Russet Burbank and/or Shepody potatoes, can be used as the source of starch for PLA manufacturing.

Next Steps: Build Industry-University Research Cluster

- R&D of specific performance characteristics required
  - Fiber for textile manufacturing
  - Bottles and containers for food consumption
  - Resins for composite building products
- Conduct the research to determine the location and technical specifications for a PLA facility in Maine
- Examine the potential contribution of waste potatoes and processed starch to support a PLA facility
- Examine potential for new more cost effective and environmentally sustainable potato varieties which can be grown specifically for the PLA market
- Market research for products and product characteristic

FBRI

FOREST BIOPRODUCTS RESEARCH INITIATIVE

Discovering

a Sustainable Bio-Economy

NSF EPSCoR

1865 THE UNIVERSITY OF MAINE

FBRI's Core Research

From the forest floor to the factory floor, researchers, students, and project partners' goals are to:

Promote

Forest Health for a Stable Bio-Economy

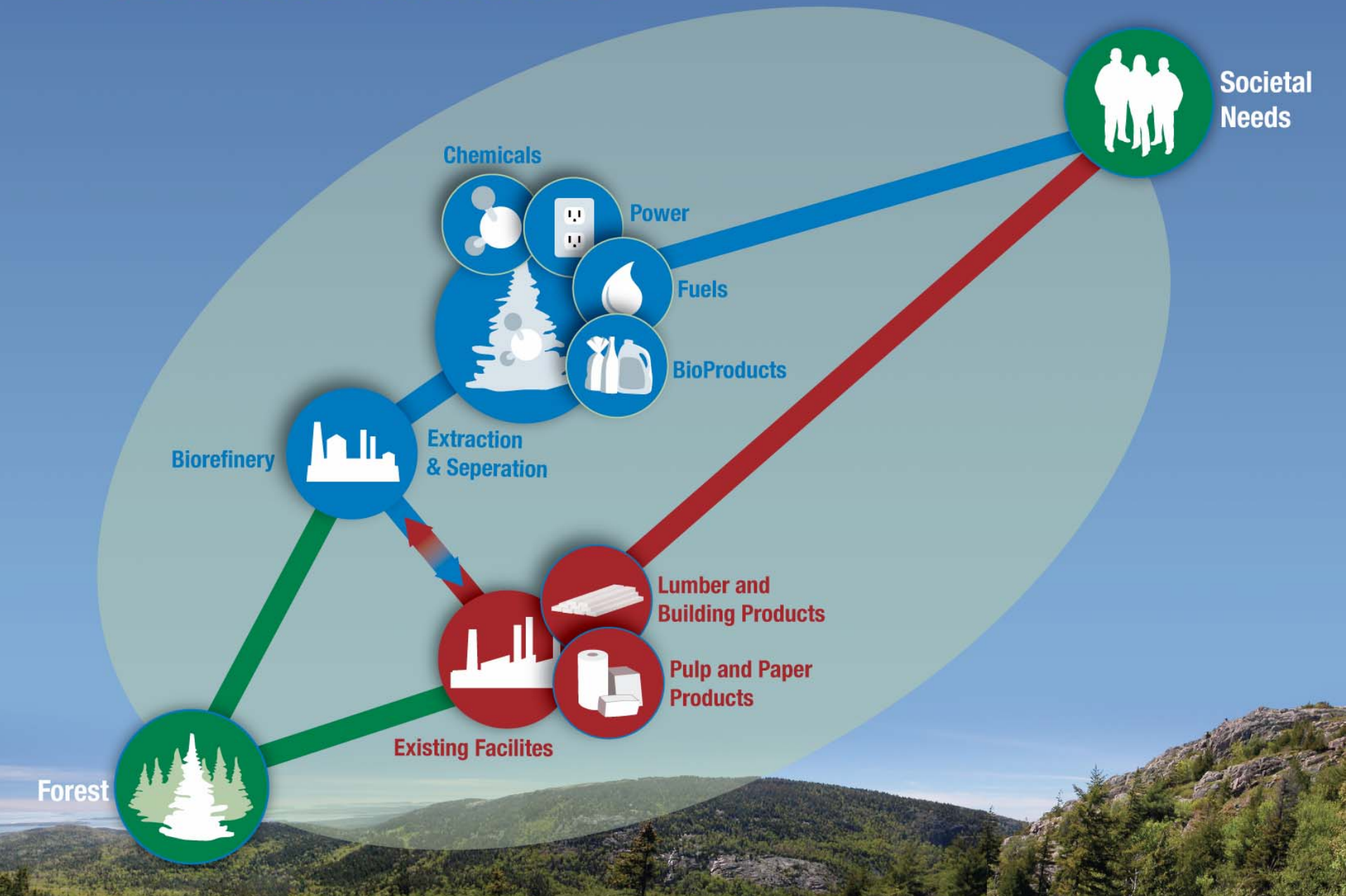
Understand

and Separate Wood Components

Create

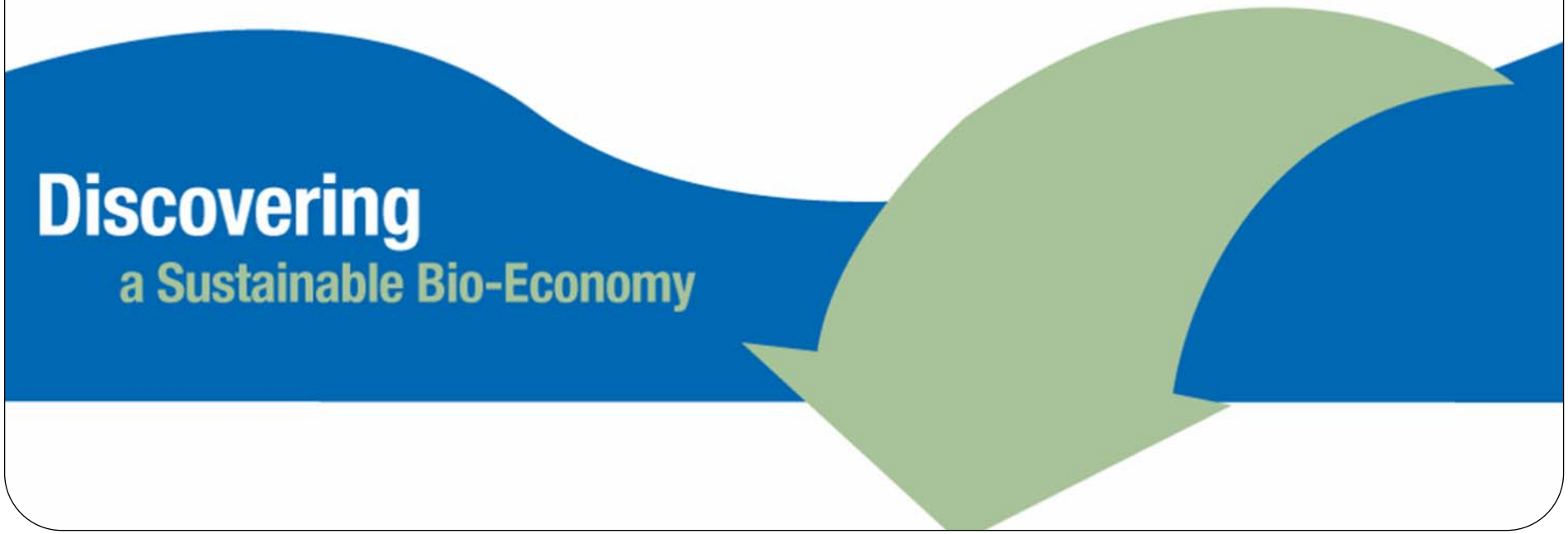
and Commercialize New Bioproducts

FOREST BIOPRODUCTS RESEARCH INITIATIVE

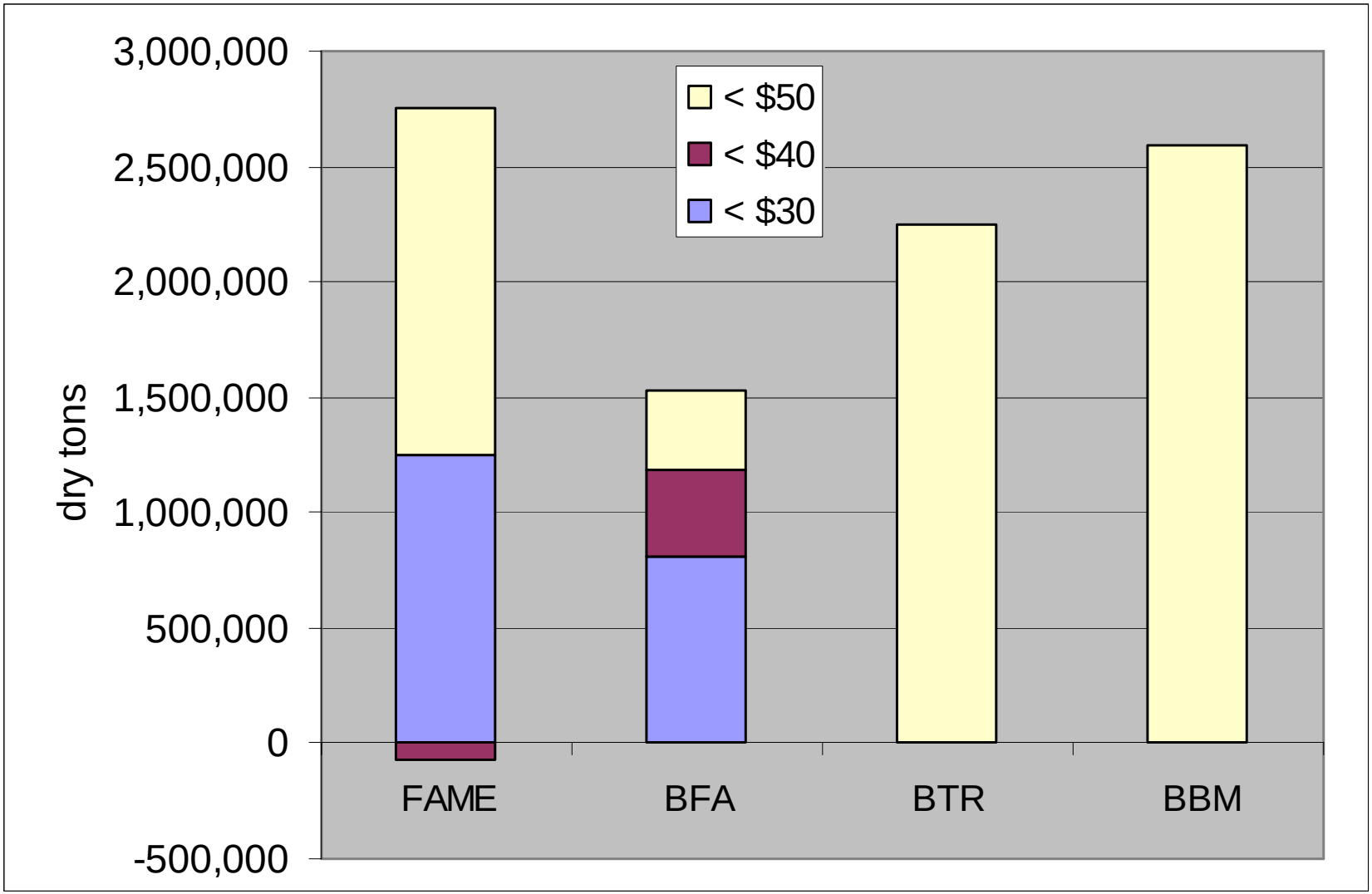


FBRI's CORE RESEARCH AREAS

- **Promote Forest Health for a Sustainable Bio-Economy**
- **Understand and Separate Wood Components**
- **Create and Commercialize New Bioproducts**



Maine Forest Residue Estimates



Forest Capacity for Fuel Production

- **Forest residues**
  - Ethanol could replace 32% of Maine gasoline
  - Fischer-Tropsch diesel could replace 76% of Maine's petro-diesel
- Roundwood & residues
  - 100% of Maine transportation fuels
  - 13% of New England's gasoline consumption
- Modified Billion Tons methodology and better, more recent data
  - Refined estimates on the way

Sustainable Annual Harvests

Report available: http://www.umaine.edu/mcsc/reports/Biomass_and_Biofuels_in_ME.pdf

Woody Biomass Availability After Harvesting

- Determine additional biomass availability after traditional harvests and through pre-commercial thinning
- Evaluate the potential impact of additional biomass removals on future stand conditions
- Approach
  - Post-harvest stand conditions measured to determine amount of woody biomass available using current harvest methods
  - Assess amount of biomass available from precommercial thinning
  - Project future stand conditions in to determine the long-term impact of biomass harvests on future stand conditions.

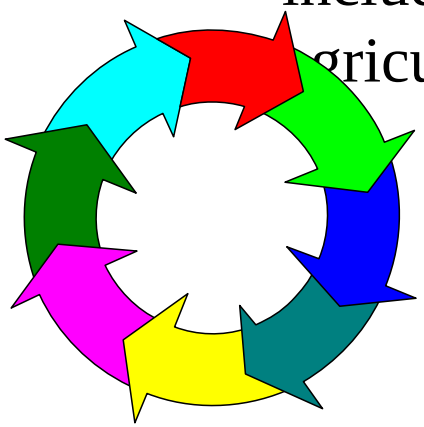
FBRI's CORE RESEARCH AREAS

Promote Forest Health for a Sustainable Bio-Economy

- Public perceptions emerging forest bioproducts industry
  - Determine potential social challenges of a forest bioproducts economy
  - Quantify social acceptability using social network maps of the forestry community
- What is the market for eco-branded ethanol and diesel?
  - Can we use regional marketing to differentiate our fuel from corn-based ethanol?
  - What fuel/community forestry aspects will consumers pay a premium for?

Life Cycle Analysis of Forest Bioproducts

- Advance the practice of LCA in application to bio-products
  - Use LCA to help advance sustainable bio-product design and evaluation
  - Develop and demonstrate new methods for LCI, including linkages to forest and economic modeling
  - Develop and demonstrate new methods for LCIA, including addressing land use impacts of forestry and agriculture



FBRI's CORE RESEARCH AREAS

Understand and Separate Wood Components

- How do we change the wood to make paper products as well as bioproducts?
- How will using different portions of a tree affect the amount, quality, and cost to produce bioproducts?
- Can advanced scientific tools explore the molecular structure of woody materials, allowing us to develop new processes and bioproducts?
- Can cellulose nanofibers be used to improve coatings and plastics?

FBRI's CORE RESEARCH AREAS

Create and Commercialize New Bioproducts

- What biological processes can be used to efficiently convert wood to desired bioproducts?
- Can we develop a process to produce biopolymers that when combined with natural fibers replace petroleum products?
- How do we design a flexible production system to easily make different bioproducts depending on market opportunities?

Regional Greenhouse Gase Initiative (RGGI)

- Regional Cap-and-Trade
  - Maine, New Hampshire, Vermont, Connecticut, New Jersey, New York, Delaware, Massachusetts, Rhode Island

"The Regional Greenhouse Gas Initiative," *Environment*, 49(2) 2007

New Market Opportunity: Offsets

- Capturing methane gas
  - Landfills
  - Agriculture
- Capturing sulfur hexafluoride (SF6)
- **Afforestation**
- Improving “end use” efficiency
  - E.g., Home heating and hot water, etc.
- Reducing methane emissions from natural gas transmission and distribution.
- **Other** offset agreed to by RGGI states

Offset prices of between **$8 and $10** per tCO2e is approximately equivalent to current CRP rates of $44 per acre in the RGGI region (The Sampson Group, Inc, 2004)