

SUSTAINABLY UTILIZING THE WHOLE ACRE



Biomass 2011: Replacing the Whole Barrel
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Linda A. Beltz Ph.D., NPDP
Director, Technology Partnerships
Weyerhaeuser

AGENDA

- **Context - *Background to Weyerhaeuser***
- **Generating Plentiful Biomass – *New Sources***
- **Sustainability – *The Foundation***
- **Utilizing All of the Biomass – *Underutilized Lignin***
- **Conclusions**



WEYERHAEUSER: FOREST PRODUCTS LEADERSHIP

FOUNDED:	1900
2010 REVENUES:	\$6.6 Billion
FORTUNE 500 RANK:	147
NUMBER OF EMPLOYEES:	15,000 in 10 countries
TECHNOLOGY STAFF:	300 scientists / engineers
FORESTLAND OWNED OR MANAGED:	21.6 million acres
HOME OFFICES:	Federal Way, WA
OPERATIONAL EXPERIENCE:	Australia, Brazil, Canada, China, France, Indonesia, Ireland, Japan, Malaysia, Mexico, New Zealand, Philippines, Uruguay, USA
SALES AND SUPPORT:	Worldwide (> 60 Countries)



HOW WE DELIVER THE VISION

Performance: We delight our customers and generate top-quartile returns. We hold ourselves accountable.

People: We attract diverse, high-performing talent. Our employees are engaged and proud advocates for our company. We invest in our people and communities.

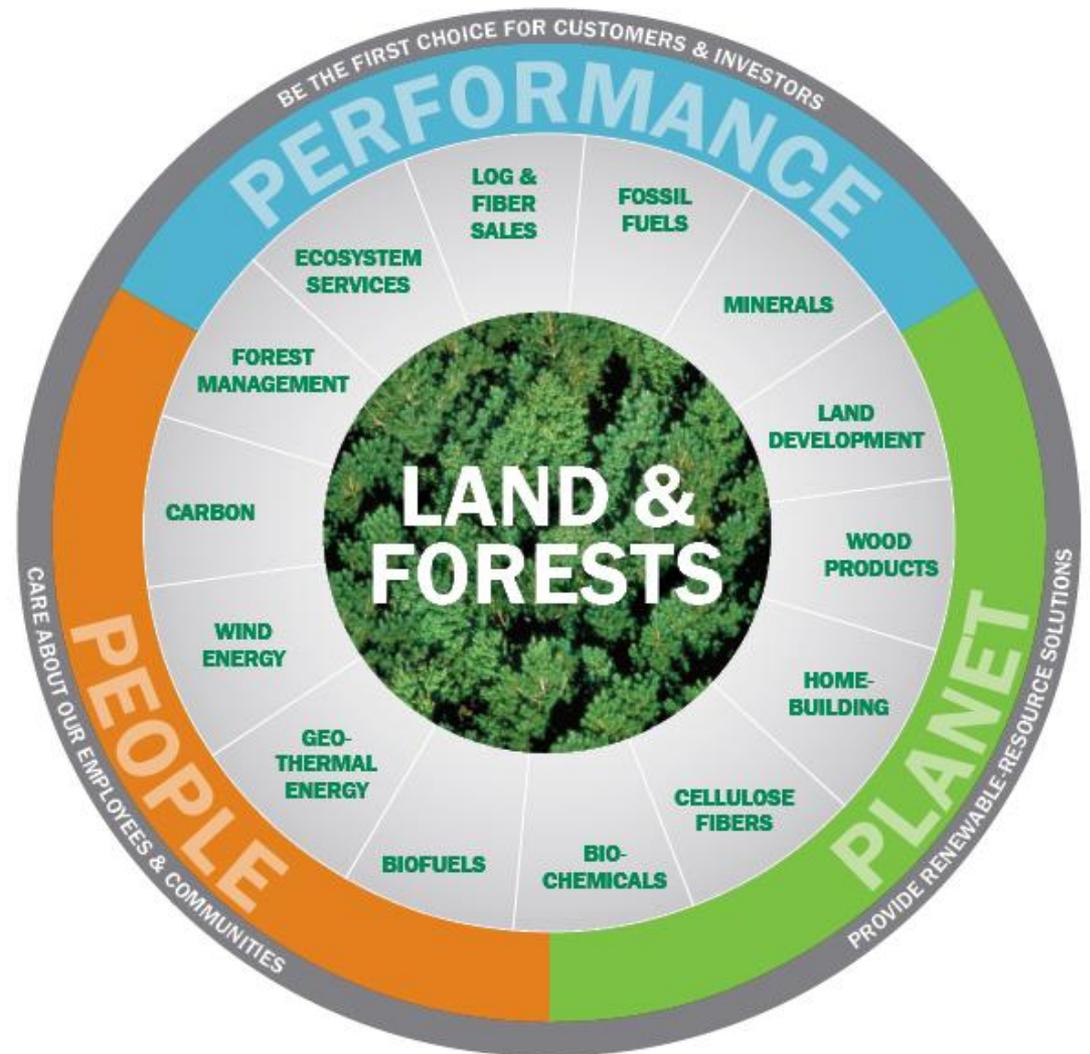
Planet: We conserve natural resources. We address society's needs with sustainable, innovative solutions.

WHAT SUCCESS LOOKS LIKE

Safely Make Money: We deliver superior sustainable solutions that provide shelter, create green energy, and make lives more comfortable.

Focused Growth: We grow with our customers, forge partnerships, explore new business models, and take advantage of market opportunities.

Satisfied Stakeholders: Our investors, customers, employees, and communities know we are a company that delivers sustainable results.



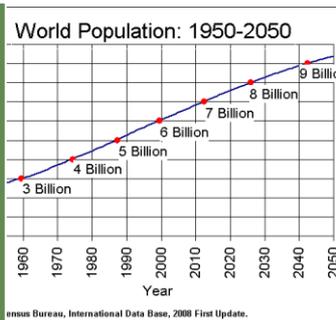
SUSTAINABLE SOLUTIONS AND PRODUCTS

- Timberlands – Sustainable, scale production of timber & biomass
- Weyerhaeuser Solutions – Bringing sustainable solutions to clients
- iLevel – Products for green building and energy efficiency
- WRECO – Regional builders providing products to meet the emerging trends in home building
- Cellulose Fibers – Sustainable products for convenience in global markets



THE NEXT PROFITABLE USES FOR FOREST RESOURCES?

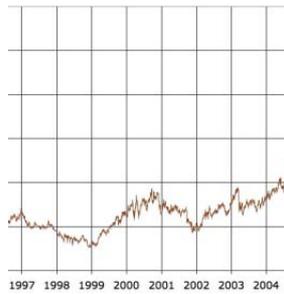
WHAT'S NEEDED?



WHAT DO WE BRING?

- Forestry
- Biomass logistics/
handling
- Scale processing/
conversion

Oil Prices, 1994-March 2008
(NYMEX Light Sweet/WTI)



Sustainable energy and materials that enhance our quality of life



CATCHLIGHT ENERGY VALUE CHAIN: FOREST TO FUEL

END-TO-END VALUE CHAIN SOLUTION

- Leverages the strengths of two natural resource leaders



**Weyerhaeuser
Feedstocks
at Scale**

**Catchlight
Energy
Conversion
Technology**

**Chevron
High Quality
Fuel
to Customers**

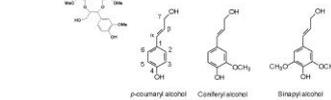


RANGE OF OPPORTUNITIES IN BIOPRODUCTS AND BIOFUELS

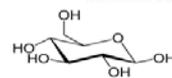
Value Chain



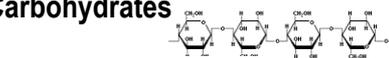
Lignin & Lignin Fractions



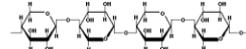
Sugars



Carbohydrates



Extractives

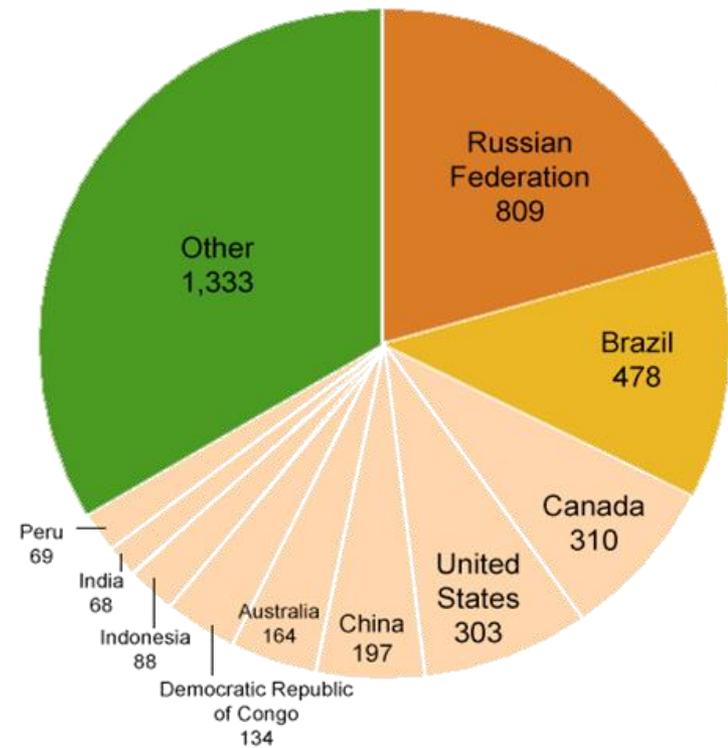


FORESTS ARE GLOBALLY ABUNDANT

- Forests are 30% of world land area (84% publicly owned)
- Forest area is unevenly distributed globally
- Over half of remaining available arable land is in Africa and South America
- Environmental policies increasingly limit natural forest harvest
- Planted forests account for an estimated 35% of global industrial wood production
 - Expected to be 50% by 2025

World Forest Area

(3,850 million hectares)



GENERATING PLENTIFUL BIOMASS

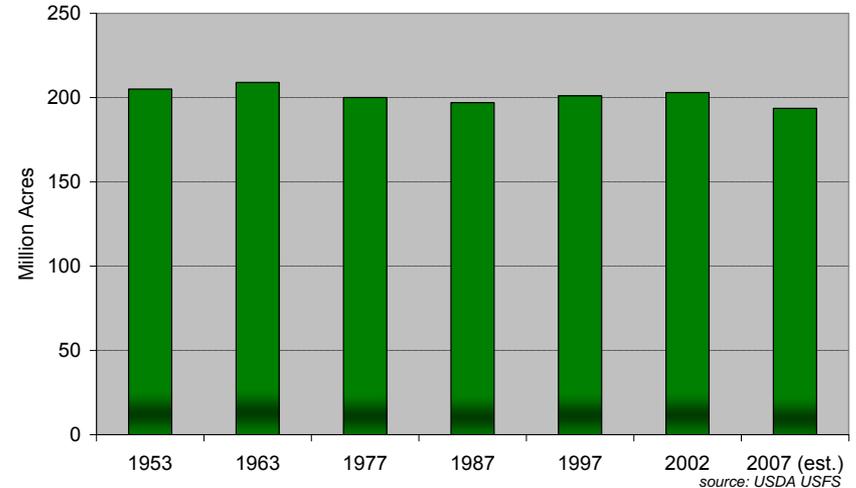
- **Forest management & improvements in silviculture**
- **Multi-use acre**
- **Harvest residuals & improvement in biomass harvesting technology**
- **New crops – innovative ways to integrate biomass cultivation with forest management**
- **Sustainable practices**



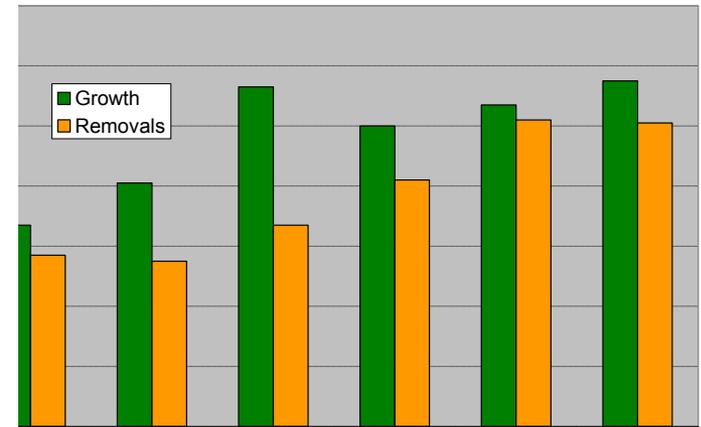
US SOUTH: MORE VOLUME FROM FOREST MANAGEMENT

- Timber land base has been stable.
- Investments in forest management have resulted in a significant increase in volume growth over the same time period

US South Timberland Area



US South Growth versus Removals

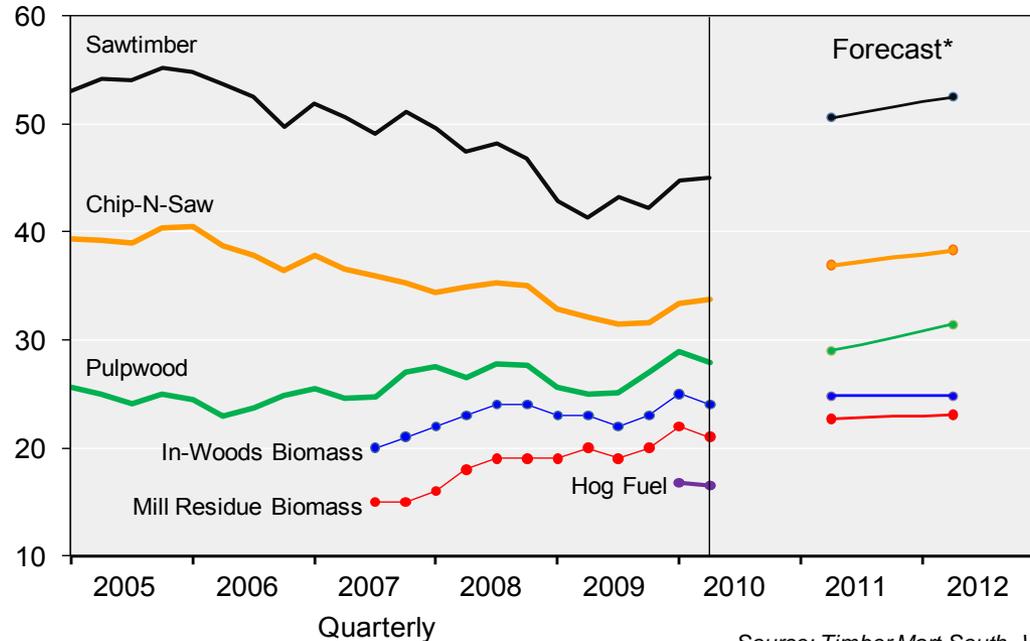


FOREST RESOURCES PROVIDE FOR MULTIPLE USES

South Central Biomass Prices vs.
Delivered Southern Average Prices

\$/Green Ton Delivered

Forest Product Pricing, U.S. South



QTLP60D

Source: Timber Mart-South, Wood Biomass Market Report, *RISI, *FEA

- Value is tied to end use
- Lumber, panels and pulp add highest value - reflected in higher raw material prices
- Pulp and paper mill purchasing power can be 3x current pricing
- Value added products like bio chemicals and products are well positioned
- Competitiveness of power and biofuel manufacturers may depend on subsidies
- Reliance on subsidies for economic viability creates long-term project risk



BIOMASS & HARVEST RESIDUALS – ARE THEY....



Clean Enough?	WY delivers residuals today with ash content < 1% and low alkali content
Consistent Enough?	Harvest residuals and intercrops from plantation forests are very consistent; understory can be used in thermochemical pathways
Scalable?	Approximately 2/3 of our available biomass is the forest residuals component. Production is tied to economic activity in two separate forest product sectors (paper, wood products)
Flexible Enough?	Forest residuals can be processed and conditioned in the woods and/or at the receiving facility to manipulate particle size and moisture content
Environmentally Sustainable?	Initial research results indicate forest ecosystems continue to thrive when forest residuals are removed

Technology improvements and cost reduction provide more and cleaner biomass for use in chemicals & fuels processes



INTERCROPPING OF DEDICATED ENERGY CROPS

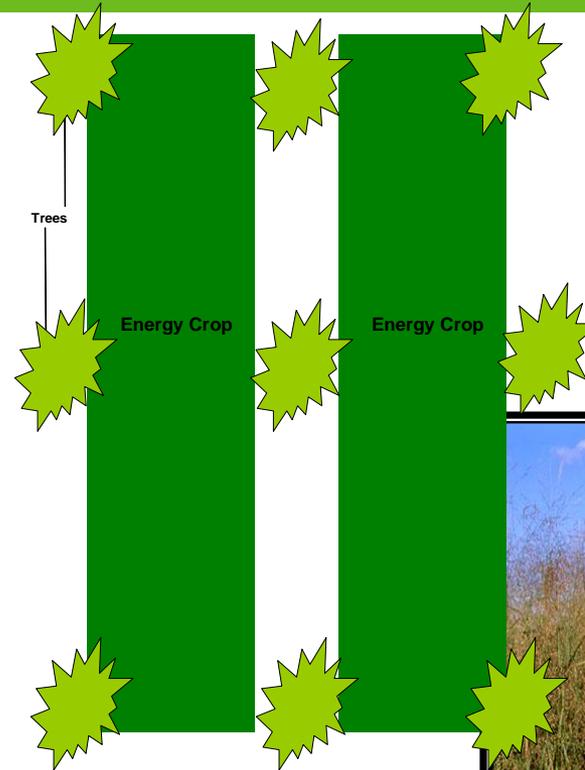
Innovative way to more fully utilize the forest landscape to provide more biomass

How this works

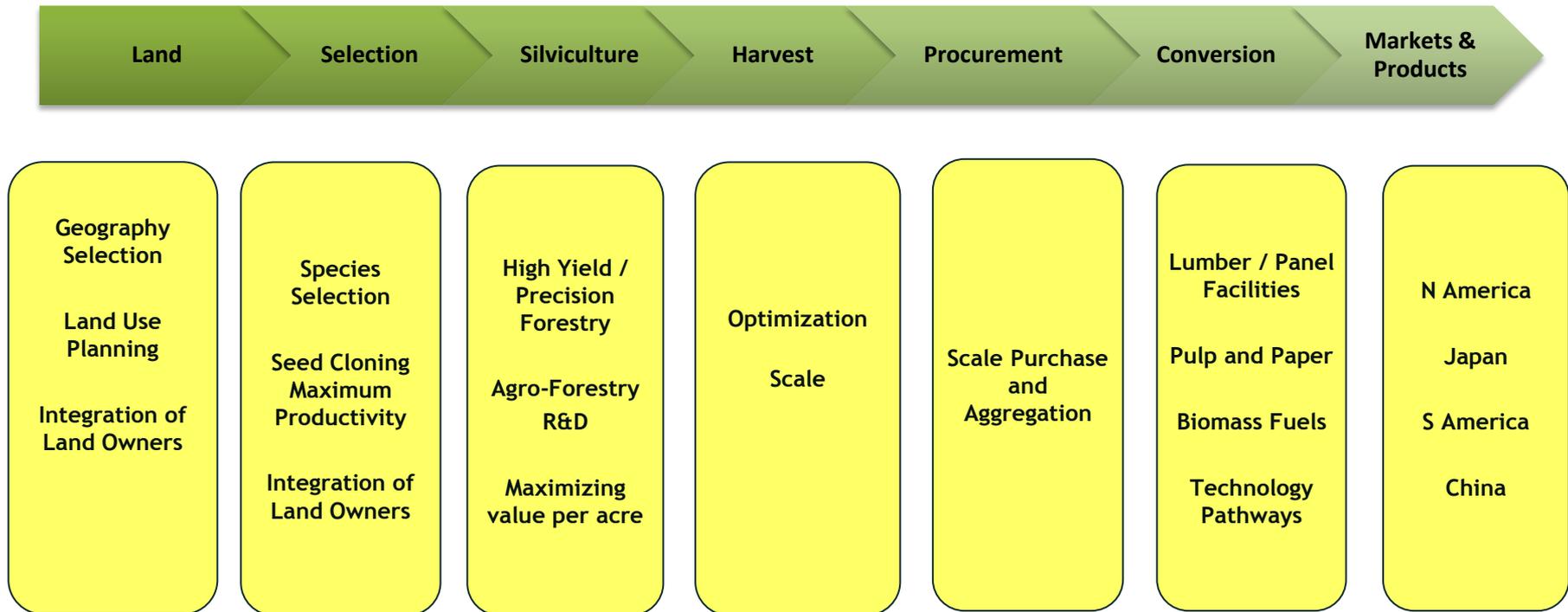
- Grow strips of pine trees and an energy crop
- Perennial energy crop harvested annually for a number of years
- Trees managed for wood products and fiber.

Catchlight Energy is conducting Research & Development on:

- Various methods of growing energy crops (switchgrass and miscanthus)
- Practical application of intercropping and the impact on the environment and sustainable production – soil productivity, water, bio-diversity, carbon sequestration and LCA.



SUSTAINABILITY IS THE FOUNDATION



Sustainability Platform

Certification / market reputation
Environmental research & technology
Social issue risk management

Public policy / Regulatory Risk Management
Chain of Custody
Partnering with NGOs - sustainability research



SUSTAINABILITY RESEARCH

What is forest ecosystem response to biomass removal?

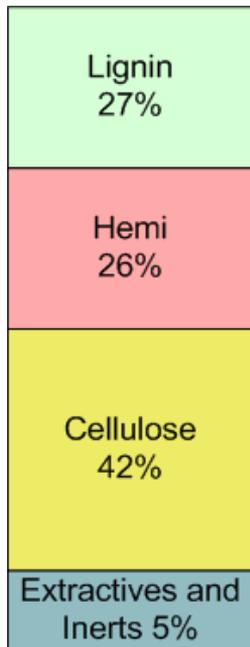
- **WY has 10 research sites across U.S. and South America; baseline for some sites goes back to 1970**
- **Conducting long-term, large-scale study of soil carbon, water flow and quality, vegetation, animal biodiversity**
- **Collaborators include: Mississippi State University, Virginia Tech, NCASI, USFS and many others**
- **Initial results indicate that forest ecosystems maintain broad diversity but longer term data needed**



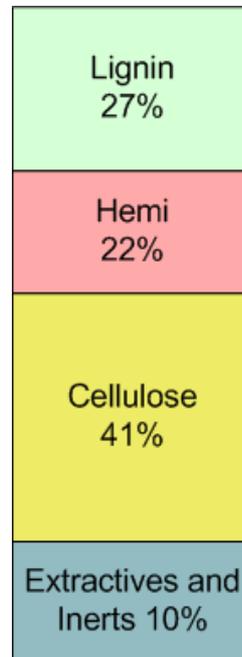
NOT ALL WOODY & HERBACEOUS BIOMASS IS CREATED EQUAL



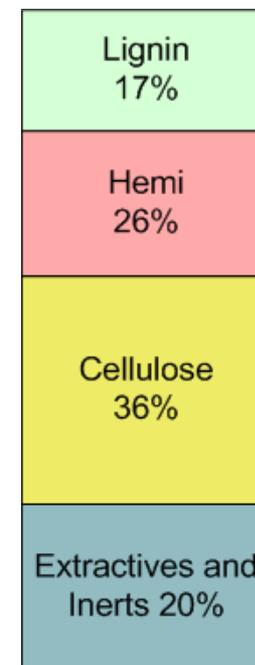
Softwood



Hardwood

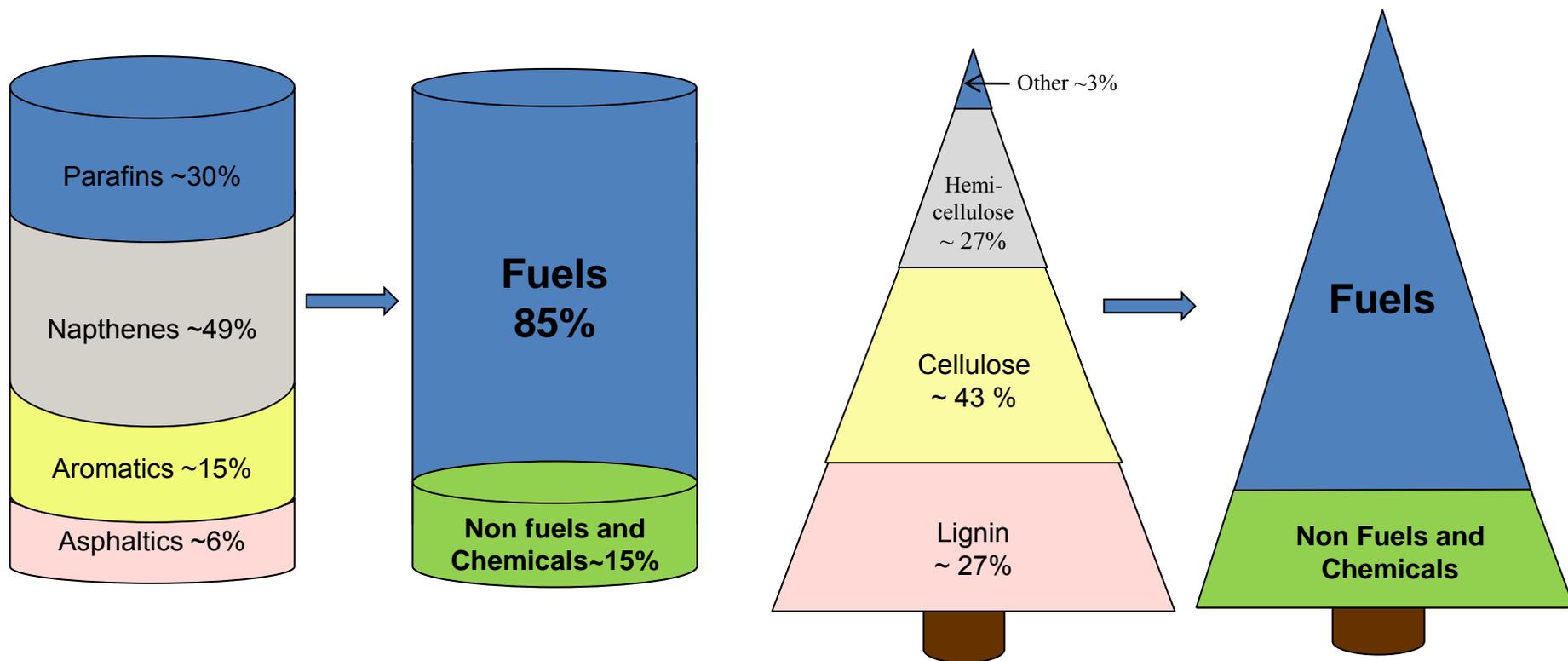


Grass, Bagasse

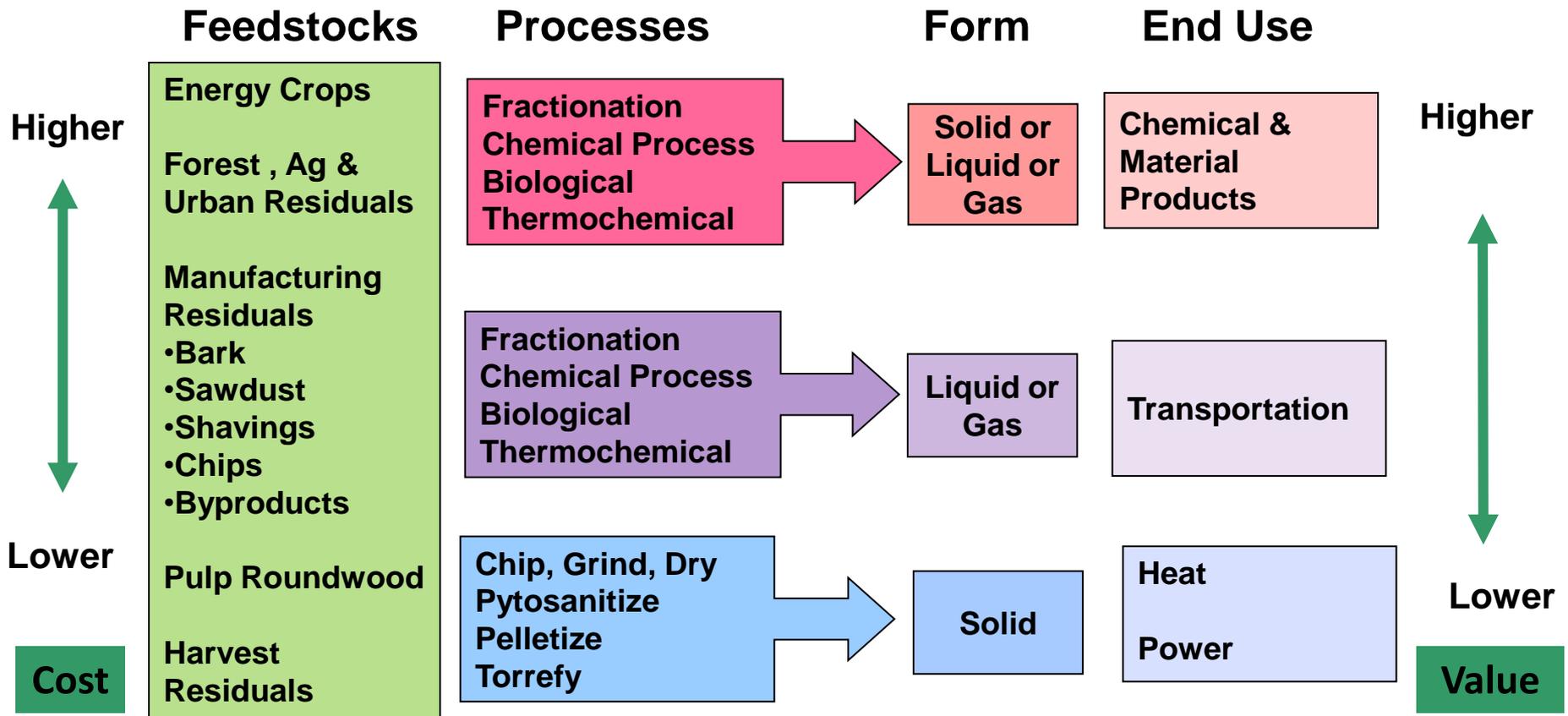


ECONOMICS ARE DRIVEN BY FULL BIOMASS UTILIZATION

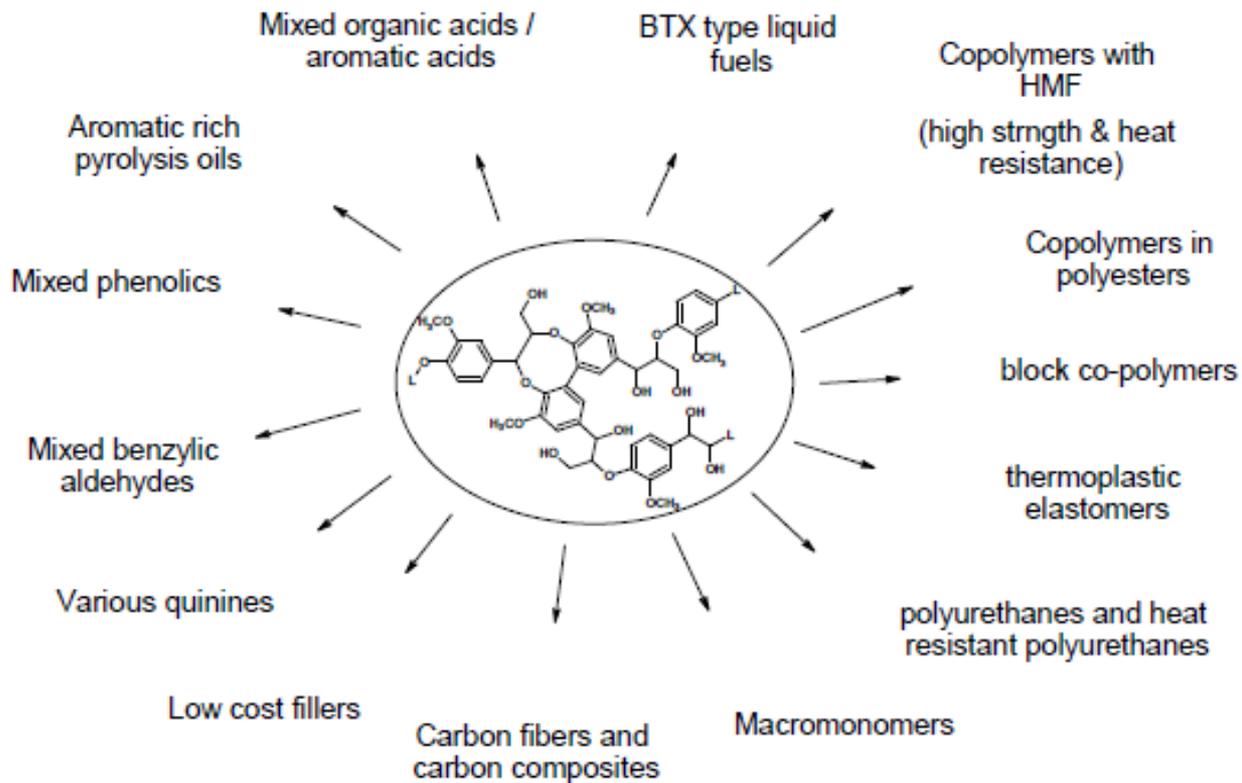
“Just as petroleum refineries don’t make money solely from fuels, a biorefinery won’t either. High value co-products will help enable financially attractive biorefineries.”



FEEDSTOCKS AND CONVERSION



NEW PRODUCT OPPORTUNITIES FROM LIGNIN¹



¹ Top Value-Added Chemicals from Biomass Volume II—Results of Screening for Potential Candidates from Biorefinery Lignin
Holladay, Bozell, White, Johnson - Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830 PNNL



VALUATION OF CURRENT LIGNIN MARKETS

Lignin use	\$/Lb
Boiler Fuel	0.05-0.20
Lower value-added products	0.25-0.40
- Fillers	↕
- Asphalt additives	
- Animal feed additives	
Higher value-added products	0.50-0.75
- Dispersing agents	↕
- Resins	
- Specialty chemicals	
- Carbon fibers	
	0.85-2.00

Using lignin in higher value applications helps overall economics for biofuel production.



CONCLUSIONS

- **Multi-use acre provides the most economical biomass for multiple end uses**
- **Forest management & improvements in silviculture are important for generating more and new forms of biomass**
- **Robust, integrated conversion processes that use a variety of feedstocks and fully utilize the biomass will compete the most effectively**
- **Sustainable practices, with vetted research, are the foundation for long-term biomass supply**



THANK YOU!



BEST IN CLASS
environmental and
social performance
STOREBRAND SRI



**SUSTAINABLE
FORESTRY
INITIATIVE**

