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Advanced **Hardwood Biofuels** Northwest

Biomass Supply Chains

An overview of concepts and considerations for biofuel

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Feedstock



Conversion



Sustainability



Education



Extension



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Outline

- Definitions
- Overview of biofuel supply chain
- Cost drivers
- Strategies for reducing costs
- Considerations for suppliers

Supply chain defined

The sequence of processes involved in the production and distribution of a commodity

Not only logistics and processing (technical)

- Business relationships (chain of custody)
- Infrastructure
- Regional policy/regulations

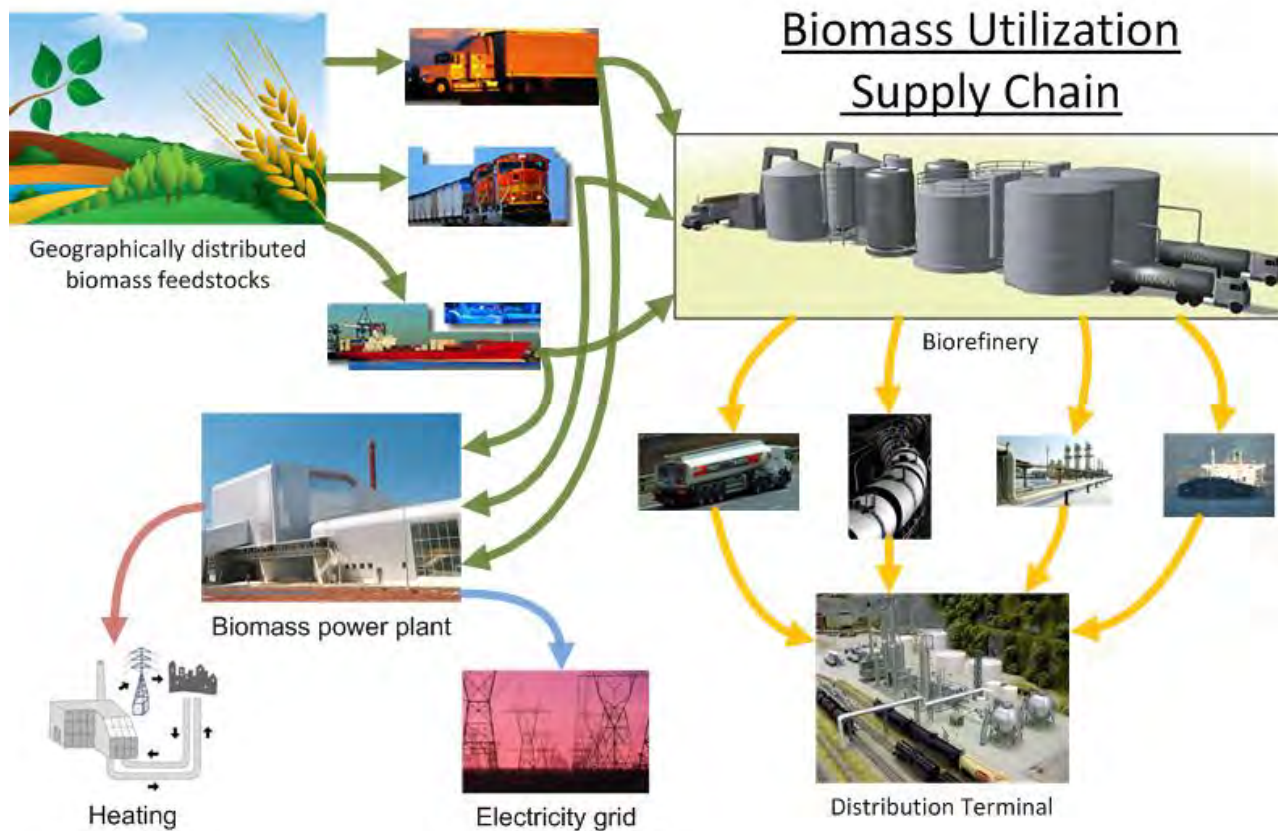


Supply chains in emerging and mature industries

- Emerging industries (eg Biofuels)
 - guaranteed supply locally
 - regional spot market
 - fractured chain of custody
- Mature industries (eg: liquid petroleum fuels)
 - commodity market transactions
 - vertical integration



Biofuel supply chain



Biomass sources

Forest biomass



Agricultural residues



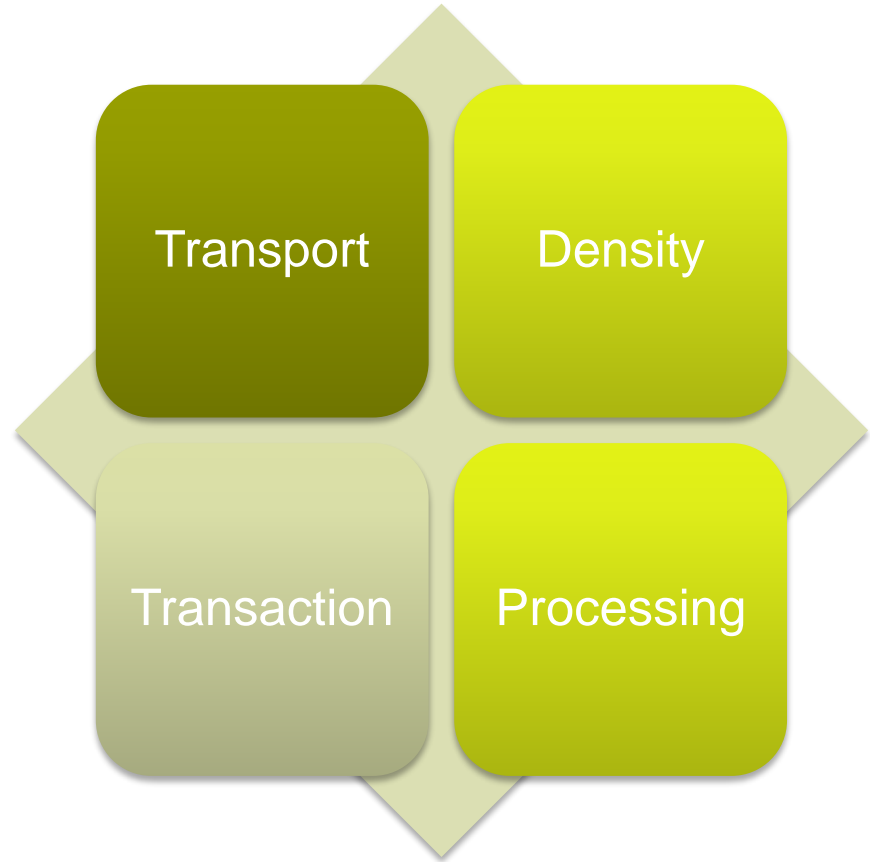
Waste streams



Energy crops

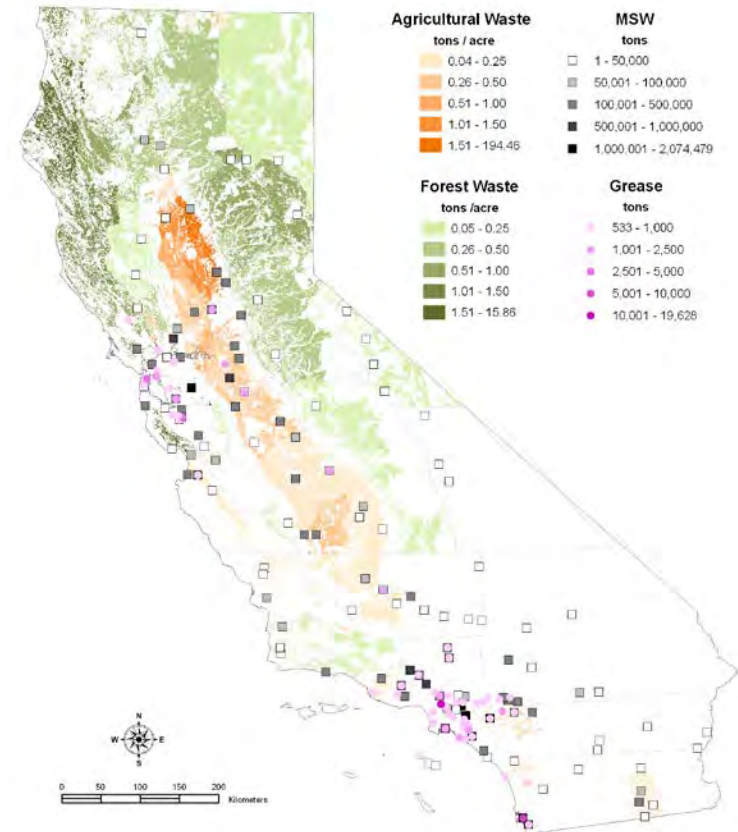


Cost drivers in biomass supply chains



Transportation

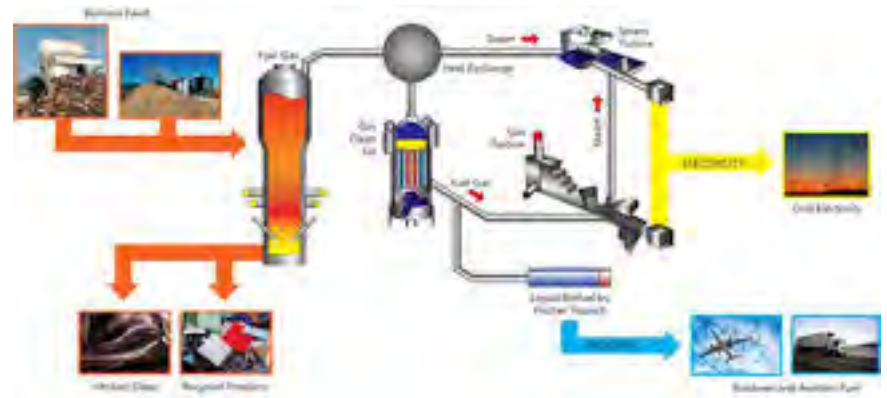
- Distributed resource
- Low bulk density
 - Handling
 - Unit transport cost



Product value

- Conversion processes dictate product market/value
 - Energy Density
 - Piece size, moisture content, constituents

How Cellulosic Ethanol is Made



Transaction costs

- Bilateral supply contracts
- Multiple business entities in chain of custody
- Contingency costs
 - How is supply maintained if contract does not perform?

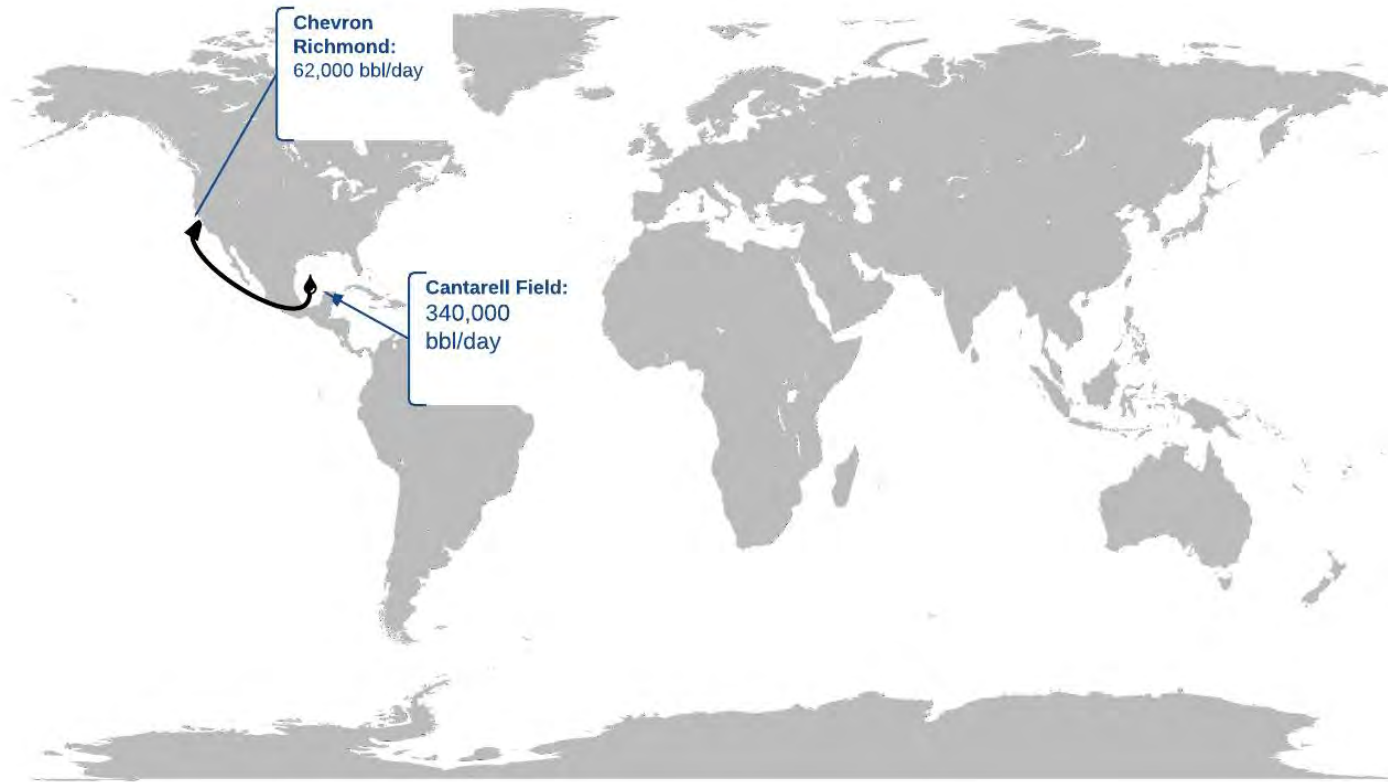


Fossil energy and Bioenergy: Key supply chain differences

- Mass energy density
 - **Coal:** 26-33 MJ/kg
 - **Crude oil:** 44 MJ/kg
 - **Wood:** 16 MJ/kg
- Bulk energy density
 - **Coal:** 21000 MJ/m³
 - **Crude Oil:** 37400 MJ/m³
 - **Dry wood chips:** 3000 MJ/m³



Geographic density: Fossil



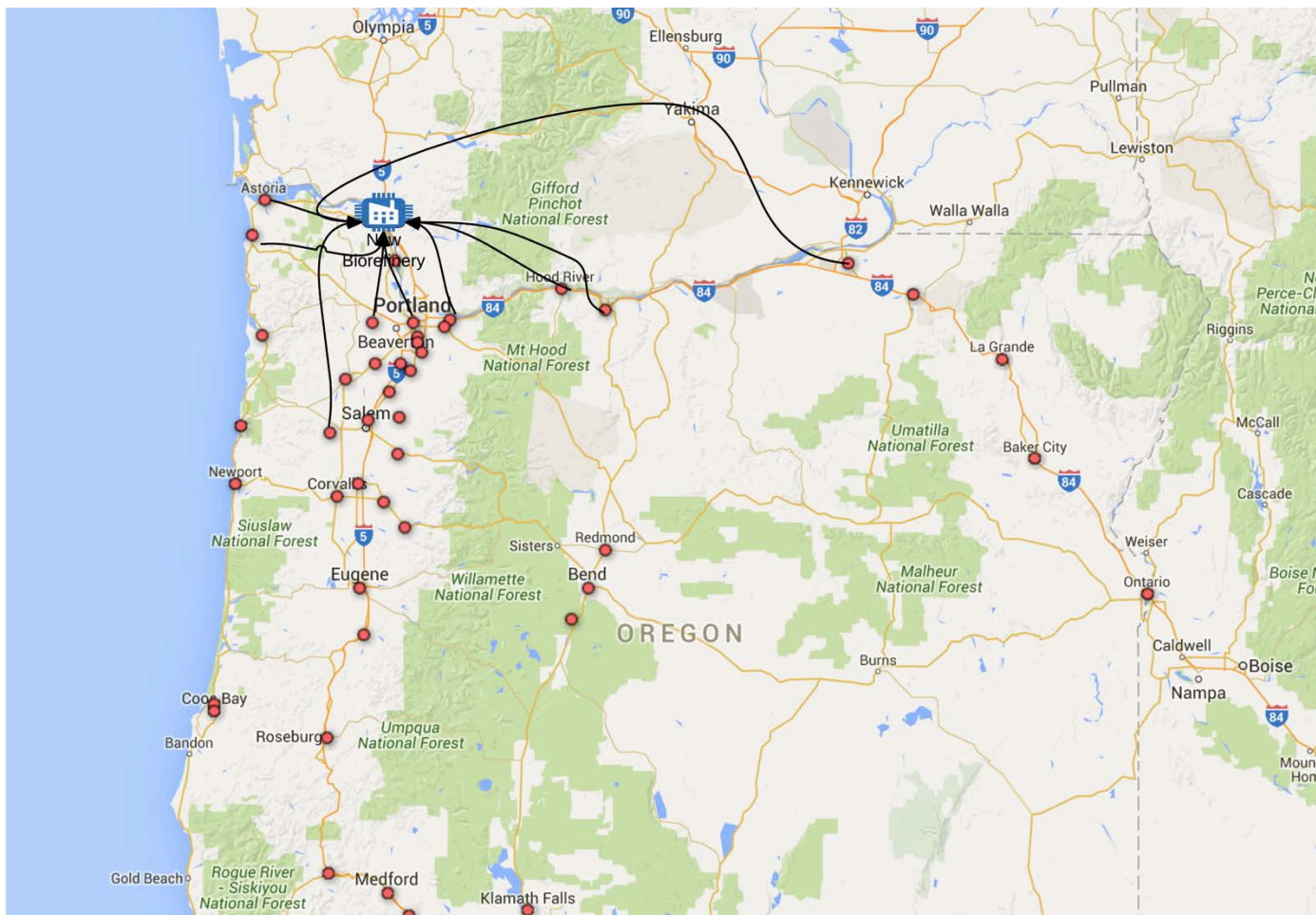
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Geographic density: Biomass



Supply chains compared

Scenario:

80 ac wastewater remediation plantations

1.9 M bbl Crude (crude shipment capacity)

\$150/dry ton clean chips

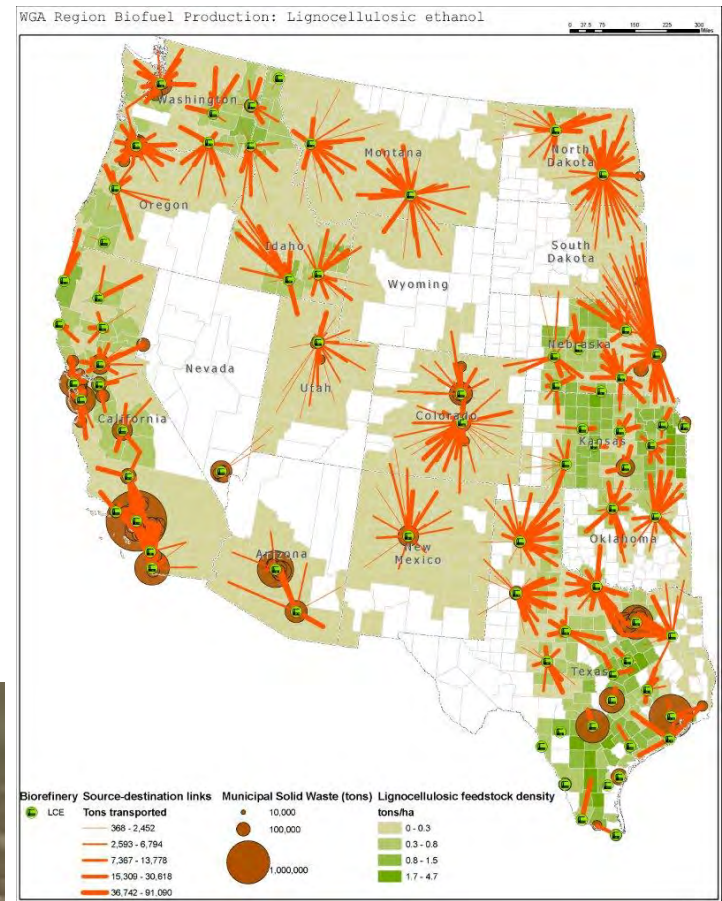
| | Biofuels | Fossil fuels |
|-------------------------|-----------------|--------------|
| Suppliers | 400 | 1 |
| Raw material cost \$/MJ | \$.004 | \$33 |
| Raw material cost \$/m3 | \$1.5 | \$315 |
| Competing land use | Ag, residential | none |
| Geographic reach | 150 miles (?) | Global |



Tools for improving cost profile of delivered biomass

Fixed infrastructure,
spot/contract markets

- Add Value
 - Energy/bulk densification
 - Distributed pre-treatment
- Reduce transport
 - Facility siting



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Supply optimization

Facility siting

- Balance transport cost on equivalent unit basis between supply and distribution

Transport

- Backhaul (no empty trucks)
- Bulk
- Reduce handing



Key considerations for biomass suppliers

- Know your customer specifications
 - Piece size
 - Moisture content
 - Quality (clean chip, pellet, hog fuel)
 - Ash content
- Reduce handling
 - Continuous processing (i.e. hot load chip vans)
 - Fell and bunch logs, harvest/process simultaneously with energy plantations
- Increase bulk density
 - Any way you can: chip vans tend to be volume, not weight limited. (bumper strips, etc.)



Thanks

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<http://ucanr.edu/sites/WoodyBiomass/>



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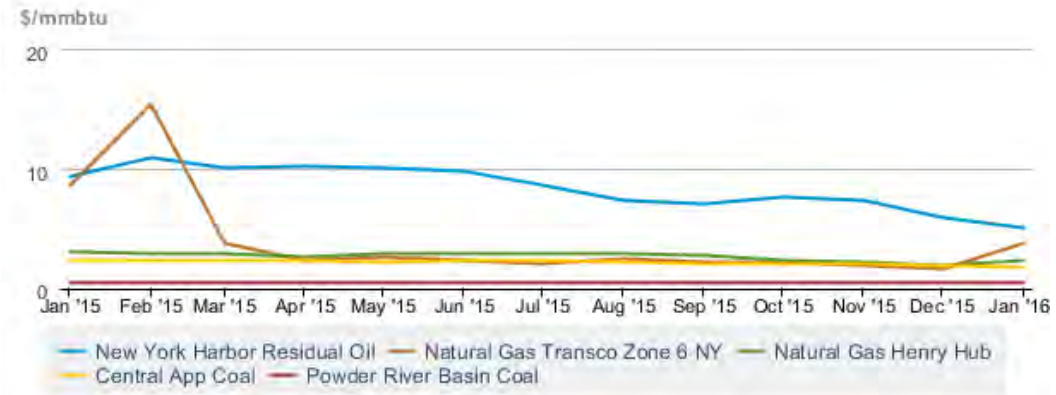
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Supply chains for energy products

Average fossil fuel spot prices (\$/mmbtu), January 2015 – January 2016



Source: U.S. Energy Information Administration derived from Bloomberg Energy