Advanced Hardwood Biofuels Northwest -
Laying the foundation for a PNW biofuels and bio based chemicals industry

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USDA United States Department of Agriculture
National Institute of Food and Agriculture

Overview of AHB

Pacific Northwest Grown
Short Rotation
Hybrid poplars

Cellulosic Ethanol,
Biochemicals, and Drop-in
Replacement
Transportation Fuels

Talk outline


Education


Feedstock


Conversion


Sustainability


Extension

Policy support is needed!

Education

For successful development of PNW bioenergy and related industries, we must:

RURAL

- Educate students, their families and their communities about bioenergy
- Provide them with the skills to operate the new technologies
- Give them the tools to innovate and solve future energy problems.

Bioenergy education pipeline

- Family and Community Programming
- Pre-College Programs
- Bioenergy College Transition Program

OSU Bioenergy Education: SMILE, graduate students

- Community and Technical College Workforce Development

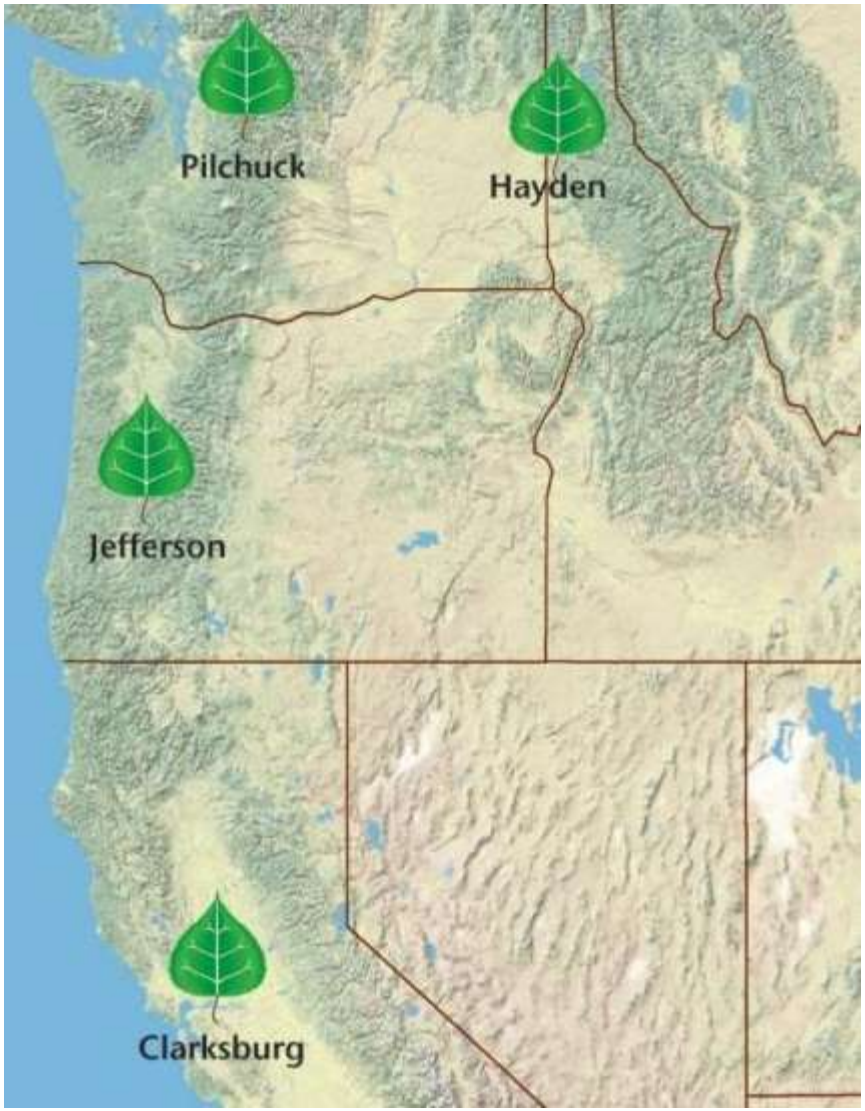
Walla Walla Community College

- Undergraduate Bioenergy Education
- Graduate-level Programs

OSU Bioenergy Education: staff and graduate students

Hybrid poplar demonstration farms

- Four farms, 50 to 100 acres each.
- Alluvial plains and Cascade range piedmont sites
- Sea level to 2300 feet elevation
- Level terrain up to 10% slope
- 18 to 45 inches precipitation
- Clay, clay loams, silty loams

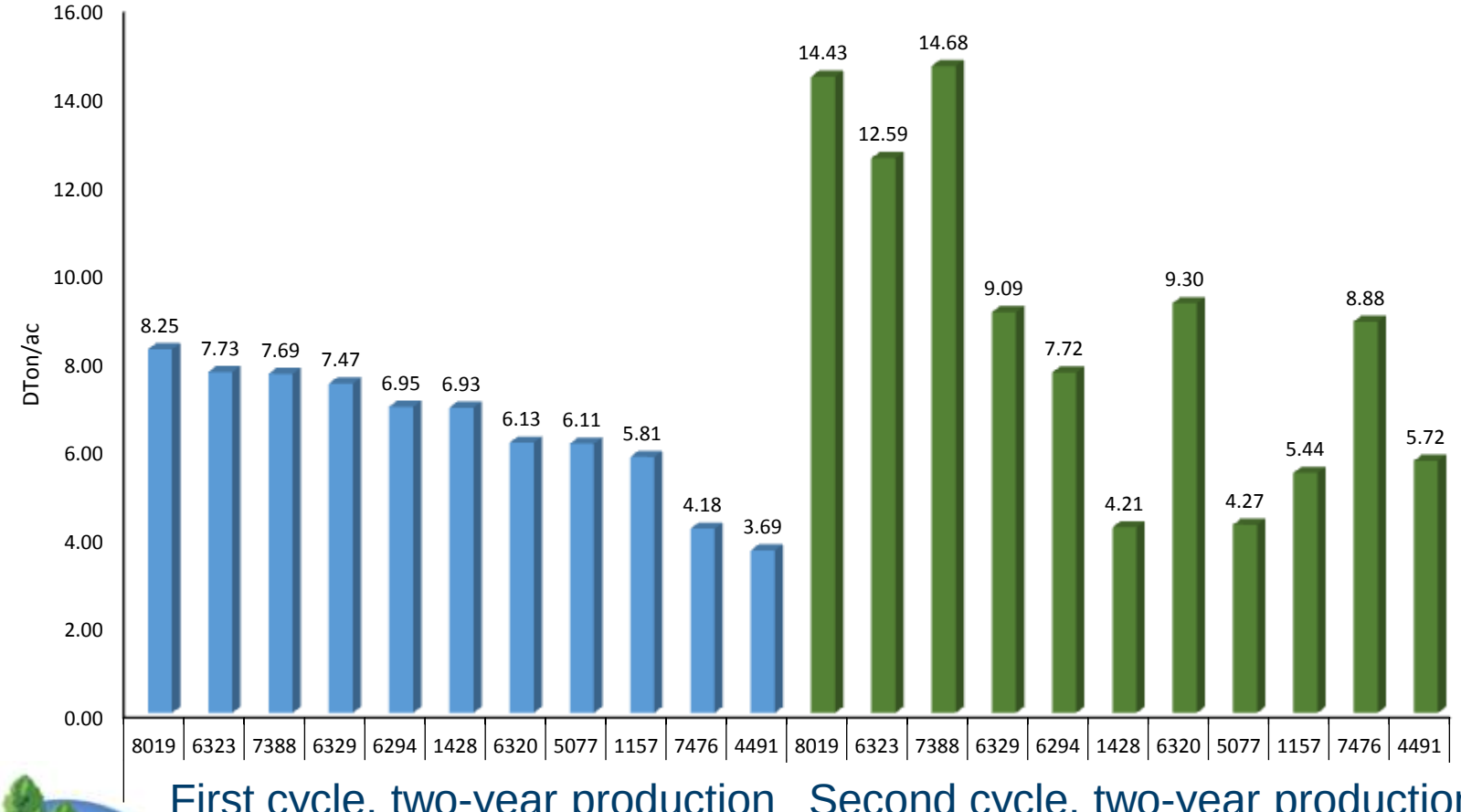


Bioenergy silviculture

Demonstration Farms: Harvest Schedule

Site – Planting Year	First Harvest from Planting	Second Harvest from Coppicing	Restoration
Jefferson - 2012	2013 (2 years)	2016 (3 years)	2017
Hayden - 2012	2013 (2 years)	2016 (3 years)	2017
Clarksburg - 2013	2014 (2 years)	2017 (3 years)	2018
Pilchuck - 2013	2014 (2 years)	2017 (3 years)	2018

Biomass Production

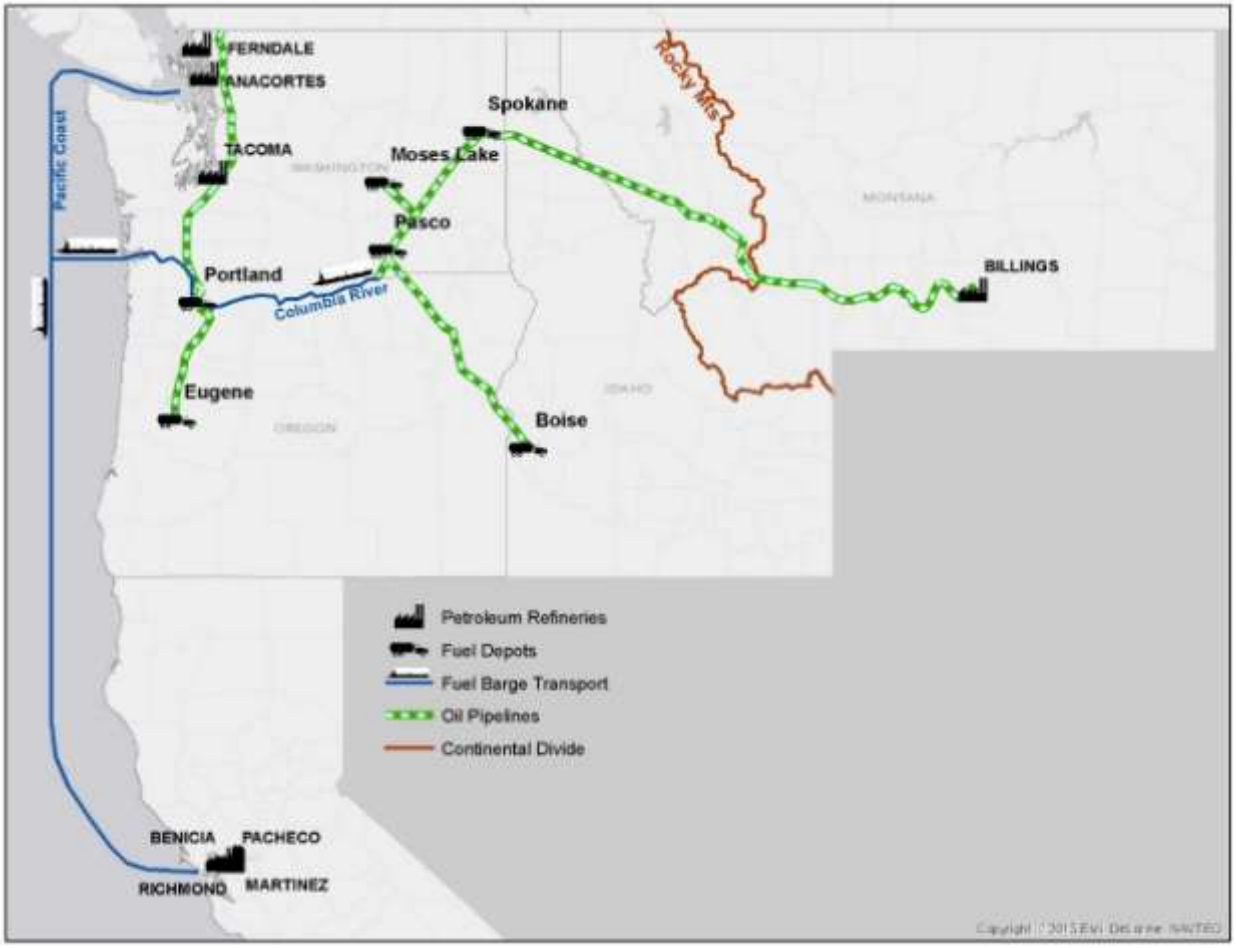


Feedstock Production: Summary

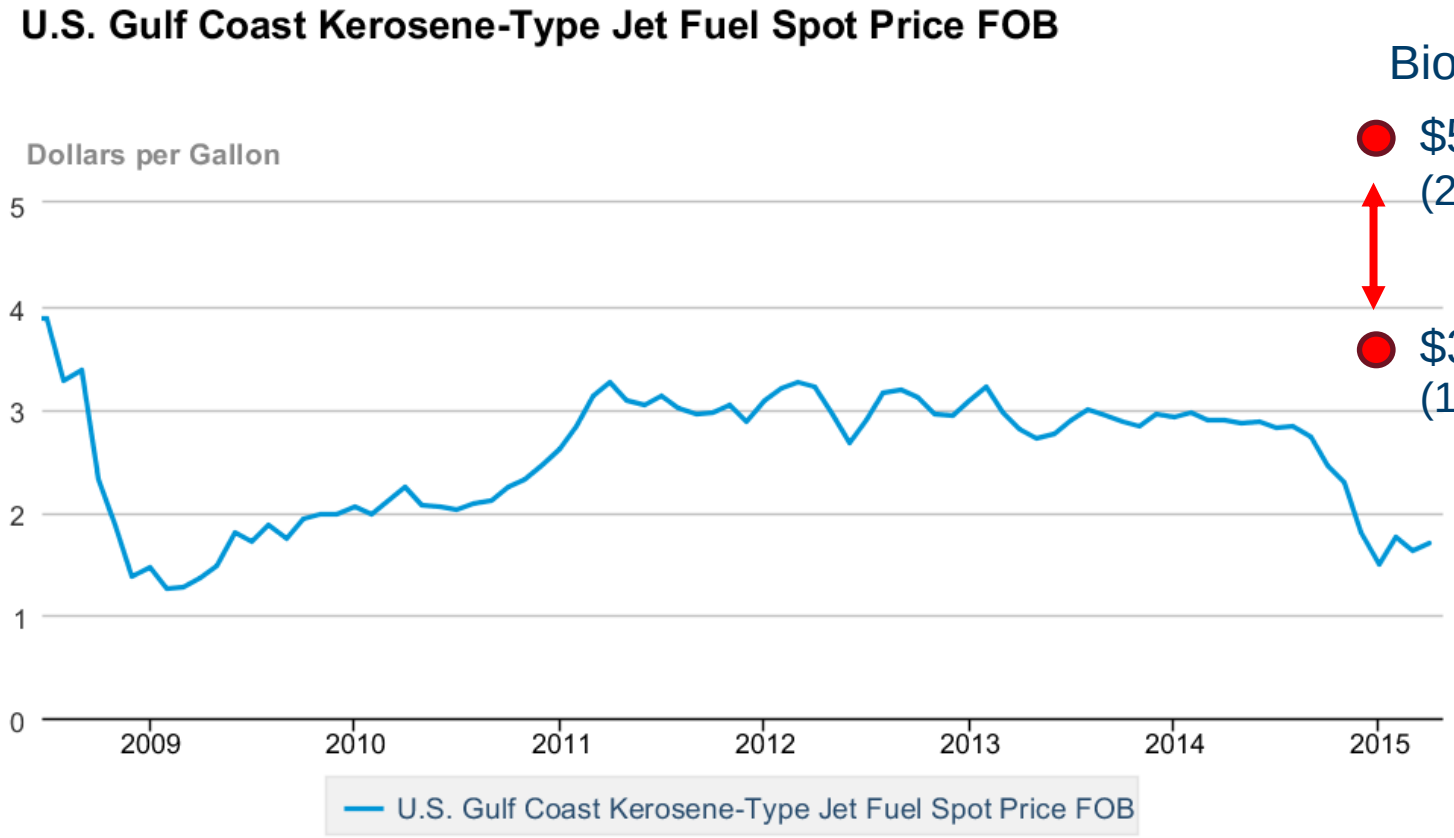
- Preliminary rates of biomass production achieved across a diversity of sites
- Production metrics and economics becoming clearer; harvest system works well and engineering improvements identified.
- Impacts of cropping system on soil and air resources and wildlife being studied.
- Financial analyses are developing to support investments into bioenergy farms.

Conversion

Pacific Northwest fuel distribution network:



Renewable fuels business is tough



Bio-jet*

$5.78
(25 Mil gal year)

$3.44
(100 Mil gal year)

THOMSON REUTERS

*7% discount rate and $80 per dry ton feedstock

Conversion pathway produces multiple products:

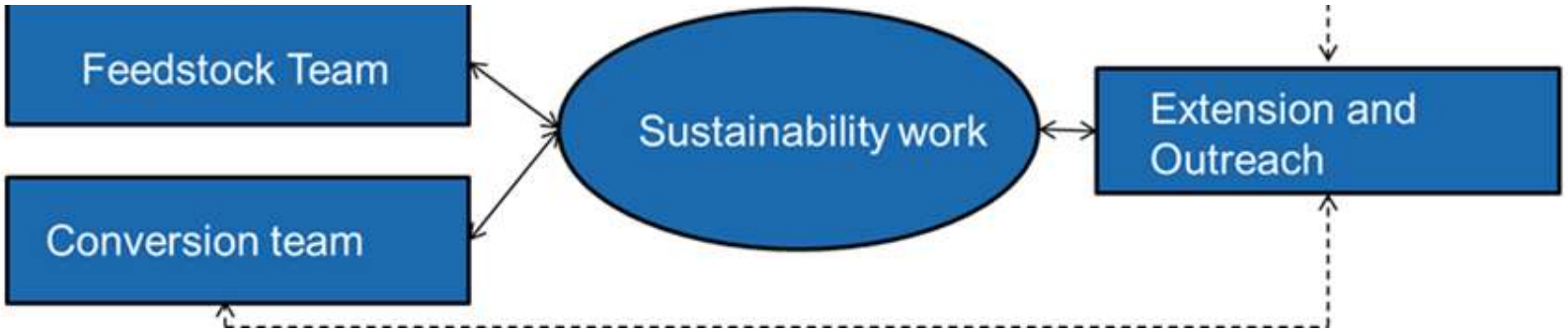
Acetic Acid
Ethyl Acetate
Ethanol
Ethylene
Drop-in Fuels

Moving to Commercialization

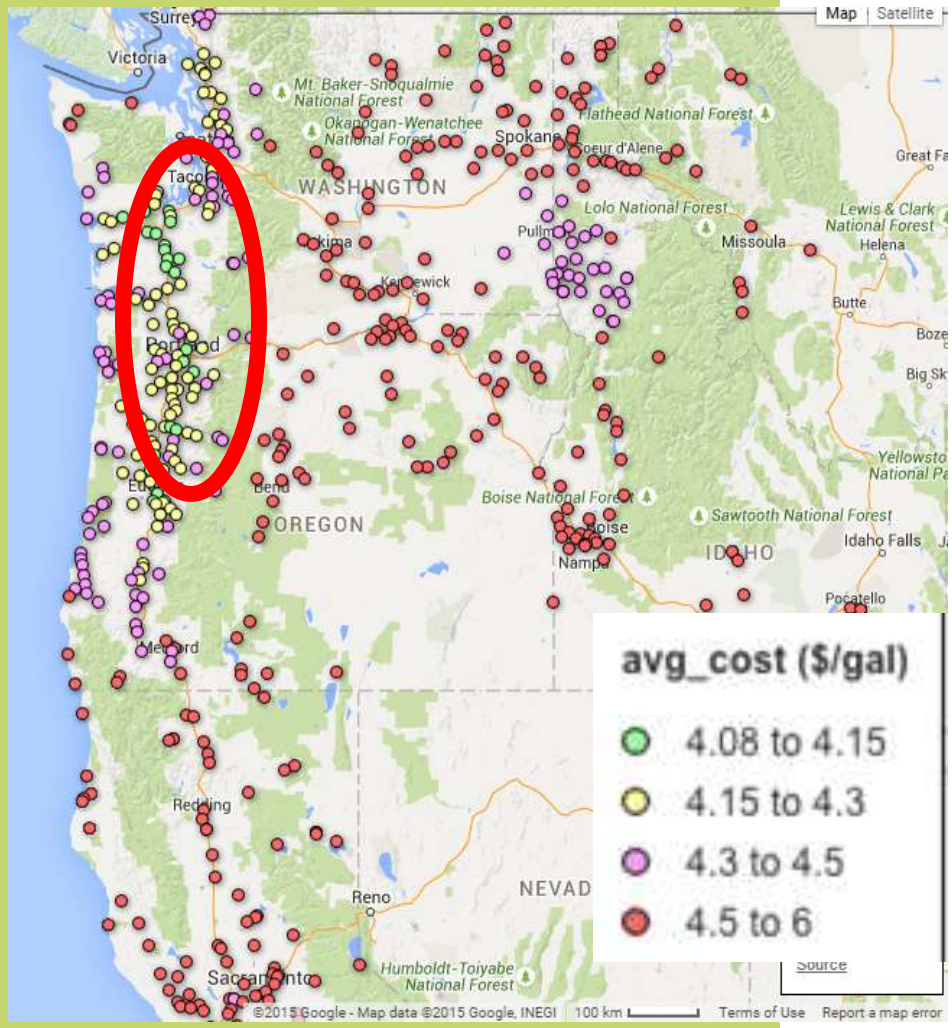
- First Commercial Plant; Boardman, Oregon
- Front End Engineering Underway
- Working on feedstock logistics:
- Mixed products:
  - Ethanol
  - Acetic Acid
  - Lignin

AHB Sustainability Objectives

- Quantify overall benefits and impacts of large scale biomass based enterprises
- Produce tools and databases to facilitate establishment of hybrid poplar based biofuel and biobased product industries in PNW region.

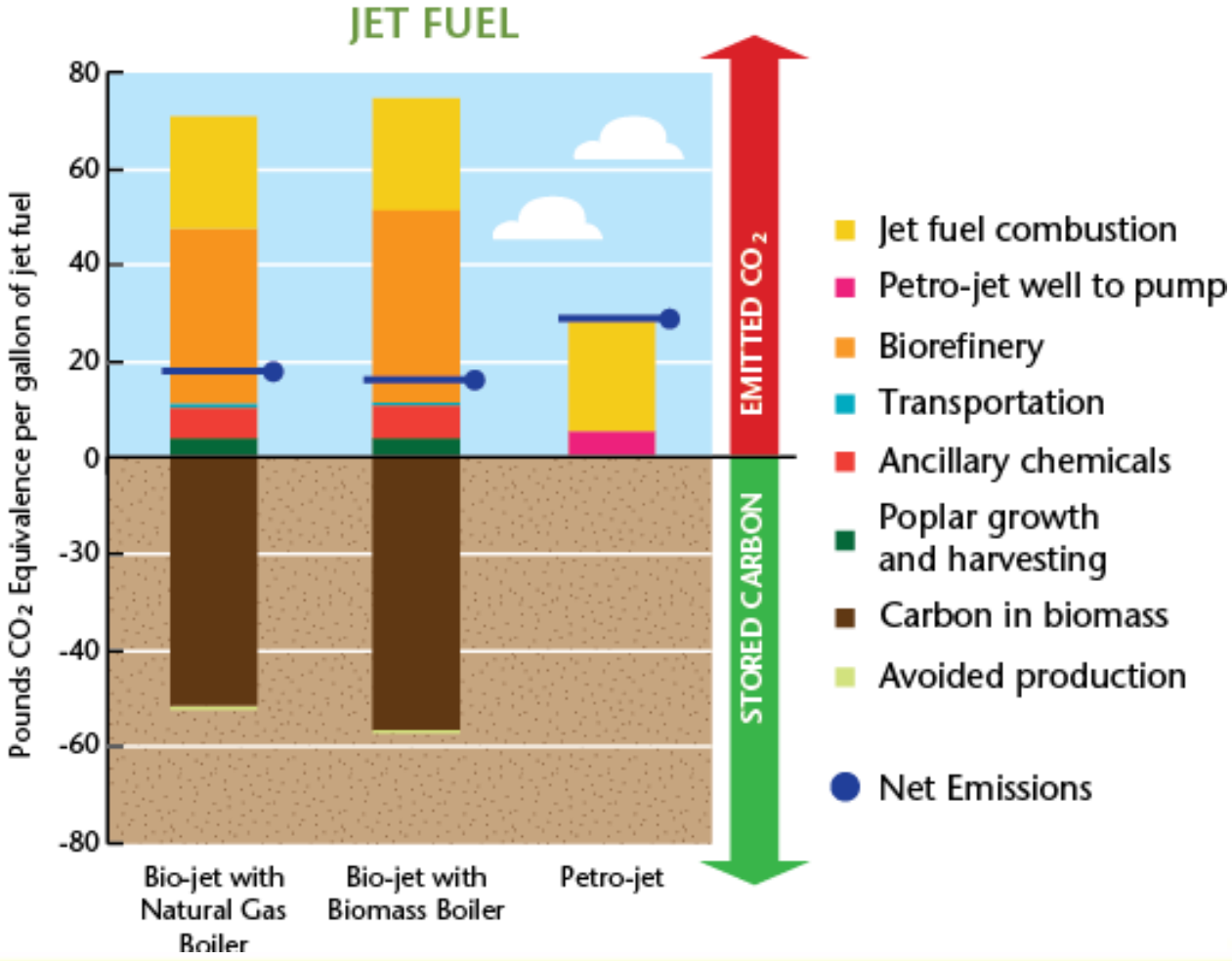


Analysis of jet fuel biorefineries

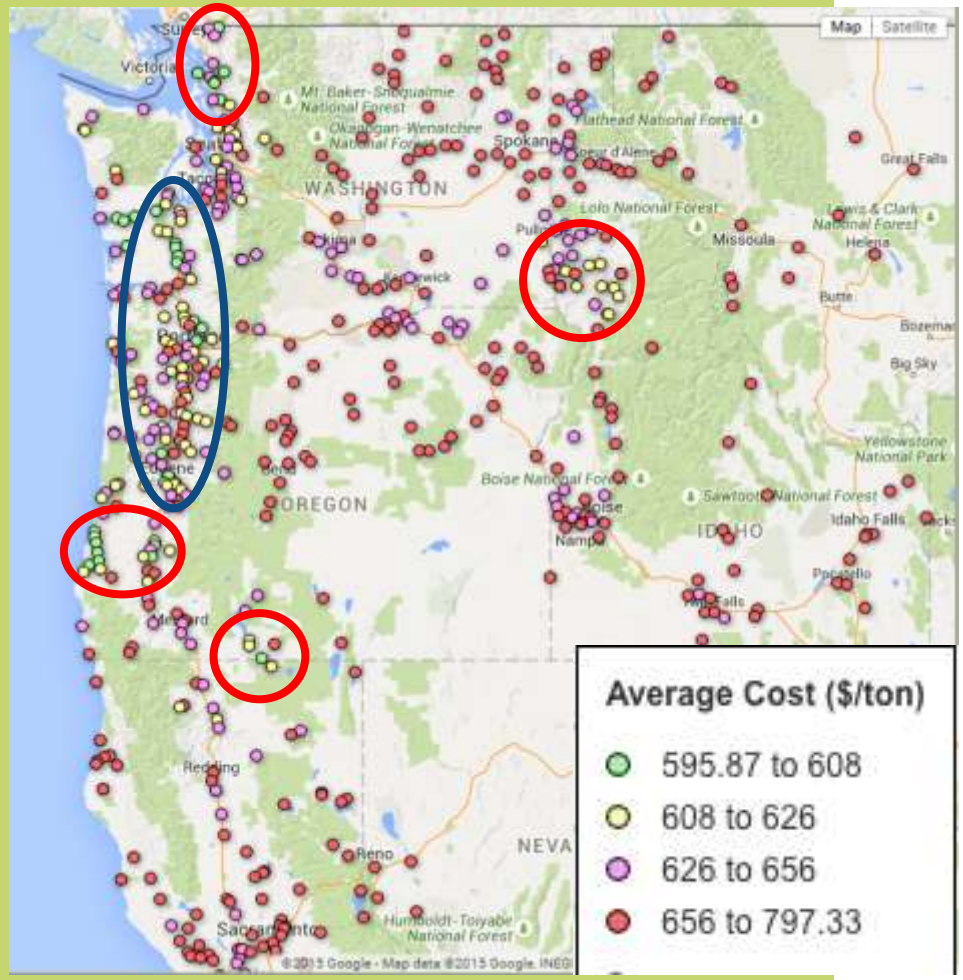


- Best sites in western WA and OR
- Most sites have costs >$4.5/gal
- Challenges in aggregating enough low cost poplar

Life cycle analysis jet fuel



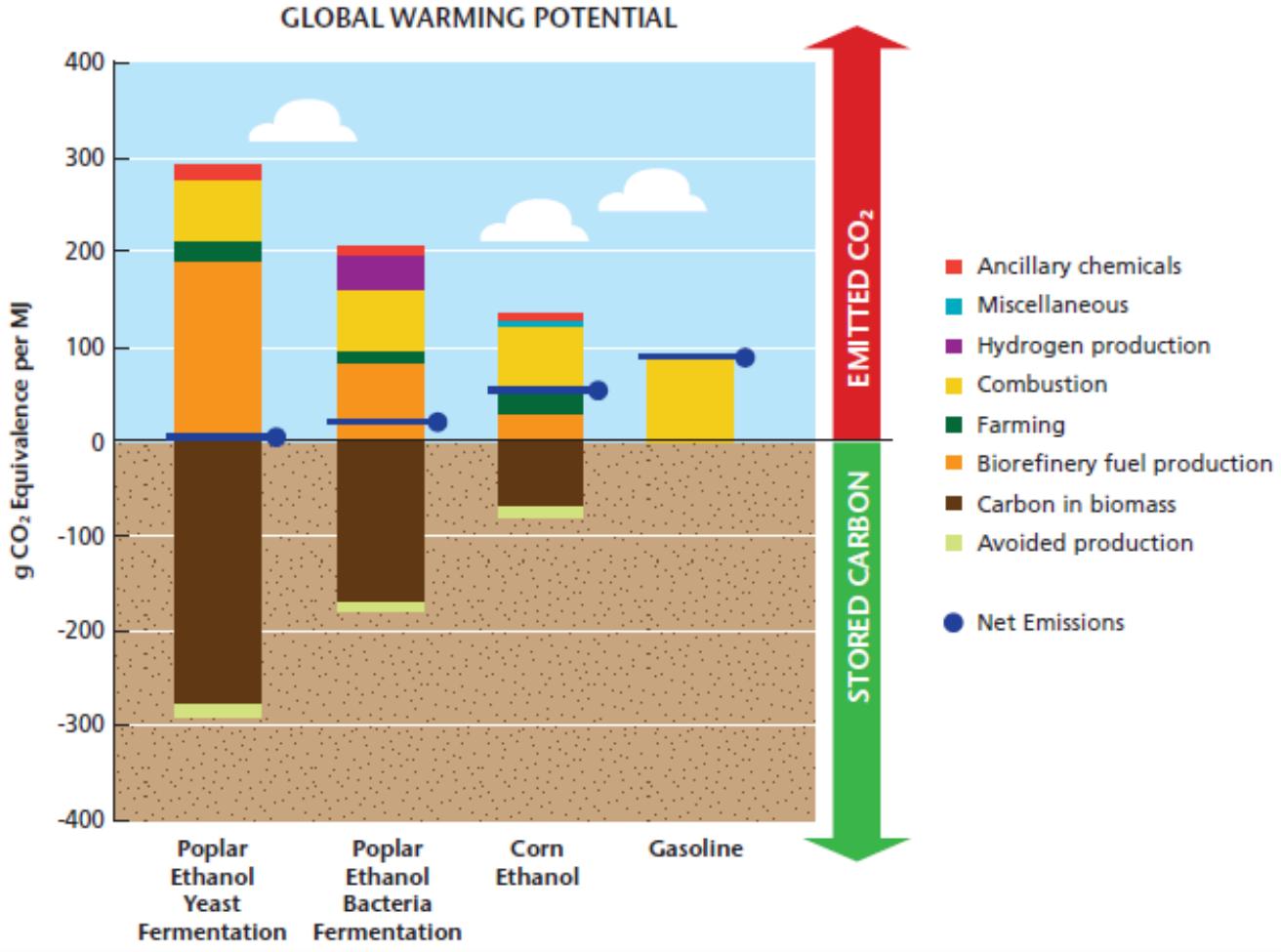
Analysis of acetic acid biorefineries



- Larger set of good sites
- Production costs of $600/ton - $650/ton

~$500-$550/ton with novel recovery process!!

Life cycle analysis ethanol



Extension: Getting Stakeholders Involved

2015 Field tours

- Jefferson, OR
  - September 15, 2015
- More in 2016

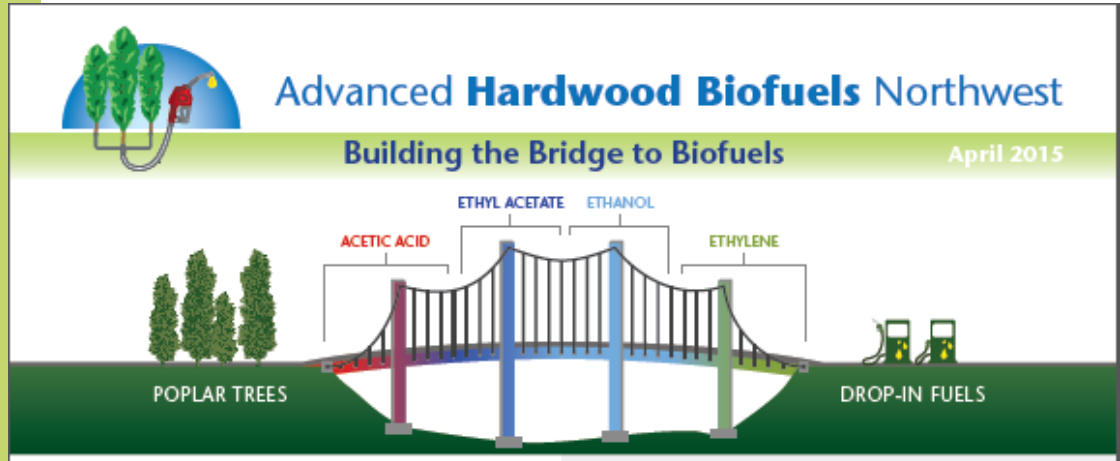
Policy Makers

AHB - NARA Quarterly Briefing Papers

For policy makers through

William D. Ruckelshaus Center

Joint UW and WSU effort



ABOUT THE BRIDGE

Advanced Hardwood Biofuels Northwest (AHB), a consortium of university and industry partners, is developing renewable biofuels and bio-based chemicals from fast growing poplar trees.

Along the conversion pathway from poplar wood chips to drop-in fuels such as gasoline, diesel, and jet fuel, intermediate chemicals are produced. Each of these chemicals builds off of the previous, forming a metaphorical "bridge to biofuels." Acetic acid, ethyl acetate, ethanol, and ethylene (all building blocks of hydrocarbon fuels) can be sold on their own or can continue in the conversion pathway to become drop-in biofuels.

This "bridge to biofuels" allows biorefineries to scale up production as the market grows. Facilities can start with acetic acid or ethanol then add on additional units eventually producing drop-in biofuels.

The volatility of fuel prices creates a large financial risk for biorefineries. Chemicals, on the other hand, tend to have more stable prices and higher economic returns than fuels. By co-producing biochemicals and biofuels, the biorefineries are more resilient and can compete better in the marketplace.

ACETIC ACID

Acetic acid is the foundation of the conversion process. It is used to make de-icing salts, wood glue, and synthetic fabrics. Most acetic acid is currently made from petroleum. Our industry partner, Zeachem, has technology to produce acetic acid with excellent process yields and has plans to manufacture this important commodity chemical at its biorefinery in Boardman, OR. Unit operations can then be added downstream of acetic acid production to manufacture other high value chemicals and drop-in fuels.

ETHYL ACETATE

Ethyl acetate is an environmentally friendly solvent used to remove nail polish, and decaffeinate coffee and tea.

ETHANOL

Cellulosic ethanol is the simplest biofuel to make. It has a lower life cycle carbon intensity and requires much less fossil fuel to produce than corn ethanol. Cellulosic ethanol will be the other product initially manufactured by ZeaChem in Boardman, OR.

ETHYLENE

The last section of the biofuels bridge is ethylene gas, which is a versatile chemical that is the backbone of the plastics we use every day.

DROP-IN FUEL

Finally, ethylene gas molecules are linked together in short chains to build the larger hydrocarbon molecules required for fuels. In this way, drop-in biofuels virtually identical to petroleum derived gasoline, diesel fuel, and jet fuel can be made.

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USDA United States Department of Agriculture National Institute of Food and Agriculture

hardwoodbiofuels.org

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Poplar and Wastewater Management

- Meeting March 2015
- Hungry for AHB assistance
- Many rural communities
- Over 1000 acres
- Only 2% of municipalities are growing poplar
- Workshop October 15, 2015

Overlap with good biorefinery locations

Over 1200 acres of poplar!

Poplar at the Biocycle Farm

Spring Poplar/Willow Forum

National Working Forum: Managing Poplar and Willow for Environmental Benefits and the Renewable Fuels Industry

- Portland, OR April 11-13, 2016
- Bring stakeholders together
  - Researchers
  - Growers
  - Industry
  - Environmental professionals
  - USDA, DOE, EPA, and NOAA
- Develop action items

NEWBio

IBSS
Southeastern Partnership for
Integrated Biomass Supply Systems

Conclusions

- Poplar is an excellent feedstock for production of renewable fuels and chemicals
- Commercialization of a biorefinery using mixed feedstocks including poplar is forthcoming
- Production of fuels and chemicals from poplar feedstock is sustainable and provides substantial rural economic benefits
- Extension and education programs are reaching a wide audience – educating key stakeholders and future leaders.

Policy support is needed for the development of a bioenergy and renewable product industry in the PNW

The AHB project is supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30407 from the USDA National Institute of Food and Agriculture

Questions.....