NARA Integrated Biorefinery (IBR) Fact Sheet

What is an Integrated Biorefinery?

A high-capacity plant that takes woody biomass from raw slash or other woody residuals all the way to biojet fuel.

Integrated Biorefinery Requirements

Other Infrastructure

This includes existing utilities; fermentation and separation tanks; pretreatment vats; storage, blending and distribution infrastructure. NARA examined both operating and moth-balled facilities with existing infrastructure to identify potential siting locations for biofuels facilities. Utilizing existing infrastructure can be an important way to reduce capital expenditures. Sulfite and Kraft mills are the best match for a wood-based biofuels plant.

Biomass Cost

The costs associated with handling and processing raw forest residuals and C&D waste. Costs vary based on accessibility of feedstock and proximity to processing site. However, based on NARA economic analysis, biomass costs can be upwards of one-third of the operating expenditure for a wood to biofuels plant. Estimated biomass availability in the NARA region (WA, OR, ID & MT) range from 0 to over 400,000 Bone Dry Tons (BDT) available annually.

Labor Cost

Average county-level wages estimates. County level data in the NARA region showed a variation of average labor costs ranging from $32,029 to $52,000. The more complicated the processing, the greater the labor costs.

Electricity Rates

The cost per kilowatt hour. In the NARA region, county-level electricity rates vary from 3 to 6 cents a kilowatt hour. Many of the processing steps are energy intensive, thus electricity rates can impact annual operating expenses.

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NARA is led by Washington State University and supported by the Agriculture and Food Research Initiative Competitive Grant no. 2011-68005-30416 from the USDA National Institute of Food and Agriculture.

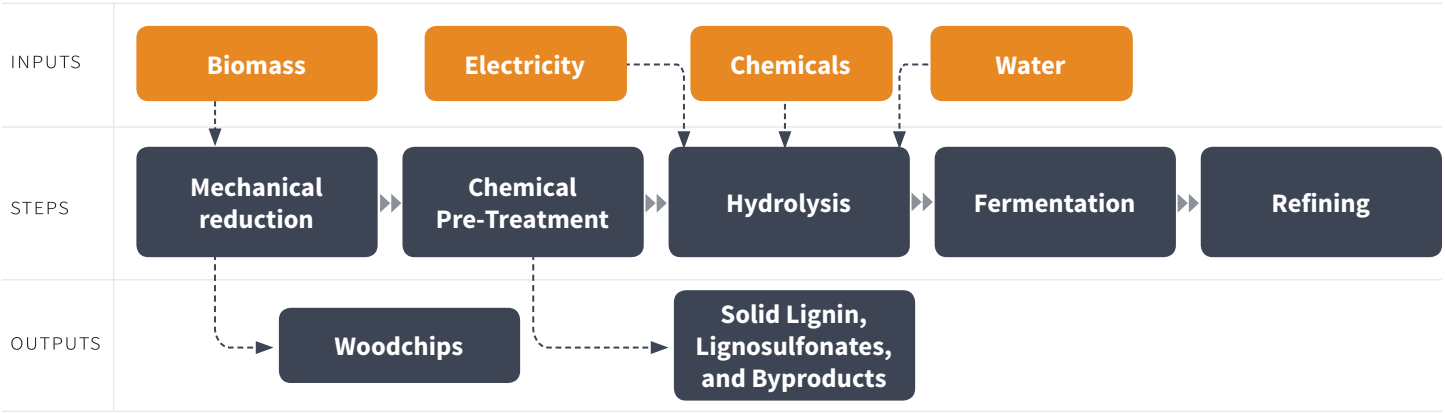
Integrated Biorefinery Siting

An IBR can take biomass from raw slash or other woody residuals, all the way to isobutanol, and to biojet fuel, if refining is available onsite. The IBR includes the following major handling and processing stages: A) Seasonal and surge storage for raw biomass; B) Mechanical feedstock size reduction, i.e., grinding or chipping; C) Chemical and thermal pretreatment to further break down the biomass into its cellulose, hemicellulose, and lignin constituents; D) Enzymatic hydrolysis to separate cellulose and hemicellulose into their 5- and 6-carbon sugars; E) Fermentation of sugars to produce isobutyl alcohol (IBA); F) Extraction of IBA, likely simultaneous with fermentation; and G) Oligomerization of IBA to produce the final isoparafinic kerosene fuel. An IBR would operate most economically by receiving feedstocks directly from nearby forests, as well as chips or pellets from solids depots, and sugar syrup from liquids depots.

The selection criteria for IBR siting are:

- **Biomass Availability**
- **Existing Site Acreage**
- **Rail Access**
- **Barge Access**
- **Aviation Facilities**
- **Cost of Living Index**
- **Electricity Rates**
- **Labor Force**
- **Boiler/Energy Plant**
- **Hydrolysis/ Fermentation Capability**
- **Kraft/Bisulfite (Pretreatment Capability)**
- **Wastewater Treatment**

What does an Integrated Biorefinery do?



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