

Draft Briefing Paper on Black Liquor: Main Points for Policymakers

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In Spring of 2005, Energy Trust of Oregon commissioned preliminary market research into the status of black liquor in Oregon as an energy resource, in order to understand its potential role in our renewable energy programs. This research did not consider the threshold question of whether black liquor qualifies as a renewable resource legally eligible for Energy Trust funding. This draft paper summarizes the conclusions and findings of that preliminary research.

Draft conclusions

Oregon pulp-and-paper mills could increase the amount of electric power generated from spent pulping (i.e., “black”) liquor. If such projects were deemed eligible for Energy Trust funding, it is unclear what above-market costs, if any, might be associated with them.

Such projects would present a difficult contractual challenge for Energy Trust, as they would probably mingle renewable and fossil fuels as market conditions allowed, making it difficult to predict or ascertain actual eligible generation.

In addition, black liquor combustion currently provides mills with industrial process steam. Mills typically use other on-site wood residues, augmented as necessary by purchased wood residues and fossil fuels to meet process steam loads. Many mills also serve a substantial portion of their electricity load from these fuels, using cogeneration. More efficient use of black liquor for steam production and electricity generation may result in a net global reduction in fossil fuel consumption. Depending on the nature of the efficiency improvements, the net reduction may or may not occur within the plant boundary.

For this and other reasons, Energy Trust would need to consider proposed black liquor generation projects in light of the project’s impact on the site’s overall economics, energy efficiency, environmental effects and fuel choices.

Summary of draft findings

- Oregon’s **six largest pulp-and-paper facilities** employ about 10,000 residents and contribute nearly \$1 billion to the gross state product.
- The U.S. pulp-and-paper sector, including Oregon facilities, have **struggled** in recent years to compete against foreign producers, which have enjoyed better access to trees, faster-growing trees, a strong dollar and increasingly modern facilities. The challenging operating environment has resulted in reduced financial performance; mergers and acquisitions; and decreased capital investment, which

- is now less than depreciation. The weakened dollar may somewhat offset these factors, and improve the economic competitiveness of U.S. facilities.
- The six or seven (depending on how the Springfield site is counted) largest pulp-and-paper facilities in Oregon use the Kraft (or sulfate) pulping process to separate the wood fibers used in papermaking from lignin and other wood solids. This process produces **large quantities of spent pulping liquor** – i.e., “black” liquor – as a byproduct.
 - To avoid having to dispose of the corrosive black liquor, to recover valuable pulping chemicals for re-use, and to capture the black liquor’s stored chemical energy, these Oregon mills follow standard industry practice by **burning it in Tomlinson recovery boilers**, and directing the resulting steam to on-site uses.
 - Currently, Oregon’s black liquor is **fully utilized** as an energy resource, with none stored or treated by means other than steam-producing recovery boilers.
 - Although increasingly stringent **environmental regulations** have shaped the pulp-and-paper sector’s activities in recent decades, and absorbed a moderate fraction of its capital investment, they do not drive the use of black liquor as an energy resource. Rather, this practice is motivated by the economics of chemical recovery and steam production.
 - In three Oregon facilities, all of the steam produced by black liquor combustion is used for **industrial processes**. These facilities present opportunities for addition of cogeneration potential.
 - Three or four (depending on classification of Springfield) of the Oregon facilities have **electric power generating capacity**. The generators receive mingled steam from a) black liquor recovery boilers, and b) power boilers fueled interchangeably by wood residue, natural gas, fuel oil or coal, as market conditions dictate. In one case, steam is also produced from a heat recovery boiler on a natural gas turbine.
 - The total installed steam generating capacity is reported to be 157 MW, of which 145 MW are reported in service and 12 MW idle. Facilities report neither the annual generation nor the annual fuel composition for this capacity. We therefore do not know the **megawatt-hours attributable to black liquor fuel**.*

* We can approximate by assuming that the active steam turbines operate at a capacity factor of 80% and that the black liquor fraction of the fuel is the national average of 40%. This suggests that something on the order of 46 average megawatts (~400,000 MWh) are generated annually from black liquor combustion.

- While the Kraft process presently has no economically viable alternative, it does offer **significant potential for economic improvement**, in particular via increased energy efficiency and power generation. Mills can increase power generation by:
 - Substitution of black liquor **gasification** for Tomlinson boilers, which makes black liquor suitable for combustion in conventional cogeneration equipment.
 - Gasification is **capital intensive and new to the Northwest**. A key advantage is that it allows direct recovery of pulping chemicals without the lime kilns used with standard Tomlinson boilers. For that reason, gasification makes best economic sense for greenfield mills that have not invested in a lime kiln, or for mills whose lime kiln requires replacement.
 - Installation of **new power generation** (i.e., cogeneration) at the facilities where none currently exists.
 - Pulp-and-paper mills would likely require that such installations permit **fuel flexibility** – i.e., the option to switch among several fossil and renewable fuels as market conditions permit.
 - Most or all of the Oregon mills that do not currently generate power appear to have **considered and rejected cogeneration** projects using natural gas-fired turbine-generators in the past. Reasons may include restricted access to capital, more attractive investment opportunities or rising natural gas prices.
 - Incremental **upgrades** to any of the elements of the black liquor recovery and power generation process.
 - A key opportunity may be to **replace older recovery boilers** with recent-vintage, higher-efficiency models, leading to increased electricity generation.
 - Energy Trust would consider improvements that reduced energy consumption at the mill site as “energy efficiency.” However, increased efficiency of the black liquor conversion process, resulting in **more kWh per unit of eligible renewable fuel input**, would be considered “renewable energy.”
 - The type and quantity of fuel saved, the environmental effects and the economics would vary, depending upon the specific upgrade.

Analytic Issues for Assessing Black Liquor Projects

Assuming that black liquor projects qualified for Energy Trust incentives, **evaluation of a black liquor generation project** at a pulp-and-paper facility would have to address, in addition to the standard analysis, at least the following questions:

1. Are project costs increased or offset by any **operational effects**, including improved or reduced efficiency of the chemical recovery process, and altered plant operations and maintenance costs?
2. What is the resulting **shift in fuel consumption**, within the plant boundary and globally, and what are the associated environmental and economic impacts?
3. How should Energy Trust appropriately treat a project that **switched among several renewable and non-renewable fuels** throughout its operating life?
4. Is there a way to value the role of such projects, if any, in **conserving natural gas**, given that Energy Trust is not currently funded to undertake industrial gas efficiency?