Northwest Power and Conservation Council

January 29, 2009

MEMORANDUM

TO: **Power Committee**

FROM: Jeff King, Senior Resource Analyst

SUBJECT: Assessment of biomass generating resource potential

Aggressive renewable portfolio standards and greenhouse gas control policies have increased the demand for sources of renewable or low-carbon energy. Energy from various biomass fuels is one such source. Biomass fuels break out into two broad categories: renewable organic residuals from non-energy economic sectors, and biomass grown expressly for its energy value. The former have greater near-term promise in the Northwest. The best-adapted rapidly growing high energy potential crop in the Northwest, hybrid poplar, has greater value for fiber than energy. The residual fuels are diverse, including mill residues, logging slash, forest management residues, urban wood waste, methane from wastewater treatment digesters, methane from landfill decomposition, methane from animal waste treatment and various agricultural residues. More controversial, but still renewable biomass are the renewable organics contained in municipal solid waste and in spent pulping (black) liquor. Unutilized region-wide electricity generation potential of these materials ranges from tens of megawatts to in excess of a thousand megawatts.

Conventionally, solid biomass fuels are converted into electric power using direct-fired steam-electric plants. These often serve cogeneration loads, improving economics. Wastewater treatment, landfill gas and animal manure energy recovery usually employ reciprocating engine-generators. Numerous advanced technologies have been proposed but the conventional technologies continue to predominate. Most forms of biomass generation operate continuously and can provide sustained peaking capacity. Many help resolve waste disposal issues. High cost is the principal downside of most biomass generation. Reliability of fuel supply and fuel transportation cost can be an issue for operations dependent upon forest products. Air quality and fuel transportation impacts may be of concern.

Staff will describe the potential availability, estimated cost of energy and issues associated with development of the principal biomass resources. Presentation materials will be provided prior to the meeting.

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Sixth Northwest Conservation & Electric Power Plan

Woody Biomass Resource Assessment

Jeff King
Northwest Power and Conservation Council
Power Committee
Portland, OR
February 10, 2009

Woody biomass fuels

Residue fuels:

- Biogenic MSW
  - Urban wood residues
  - Unrecycled paper & cardboard
  - Food waste
  - Construction & demolition debris
- Orchard prunings, other woody agricultural residues
- Mill residues
- Logging slash
- Unmerchantable residue from forest management operations

Energy crops

- Hybrid poplar/cottonwood plantations in the Northwest
- Higher value as fiber for foreseeable future

Woody biomass energy resource issues I

Mature technology

Well-established in the Northwest

- Long association with the forest products industry
- Boom in '80's, retirements in '90s, some post-2000 development
- 335 MW operating capacity in PNW (some co-fired w/NG or FO)

Generally acknowledged to be CO2-neutral over time

Can solve waste disposal problems

Some cogeneration applications

Sustained peaking capacity value

Could use for load-following, though not customary

Woody biomass energy resource issues II

Has been cost-effective only at low fuel costs

Fuel supply issues:

- Competing uses for fuel (landscaping, animal husbandry, etc.)
- Securing reliable fuel supply for independent plants has been difficult
- Mill & logging residue availability sensitive to economic cycles
- Forest product sector cogeneration value sensitive to economic cycles
- Sustained fire risk management has been difficult to implement on public forest lands
- Forest management subsidy or capped price may be needed to ensure steady and economic supply of non-merchantable forest thinnings.

Not perceived as "green" as non-thermal renewable resources

Lower PTC than wind ($10/MWh) (mature technology)

Woody biomass residue fuels

Sources:

- Unused logging slash
- Unused mill residues
- Forest thinning residues
  - Fire risk reduction
  - Pre-commercial thinning
- Biogenic fraction of MSW

Availability based on estimates published in Jan 2006 by the Western Governor's Association

Forest thinning residue assumptions:

- Plausible thinning of commercial timberland w/stand replacement fire risk at a rate sustainable for 20 years.
- Additional timberland will have developed into the at-risk category following 20 years
- Limited to land w/50% merchantable thinning products.

Estimated fuel cost ($/MMBtu, delivered)

Data (scarce, no central exchange!)

California Energy Commission, 2006	$2.50
Reported PNW marginal, forest thinning, 2008	$3.20
Reported PNW annual average fuel supply, 2008	$1.80 - $2.10
Sierra Nevada Conservancy, demonstration forest thinning project, 2008	$3.40

Proposed $3.00

- Marginal sources will be forest thinning residues.
- Sierra Nevada Conservancy demonstration project is representative, well-documented, consistent with reported PNW forest thinning costs.
- Some fraction of lower cost supply (mill residues, orchard trimmings, etc.) will reduce average cost slightly.

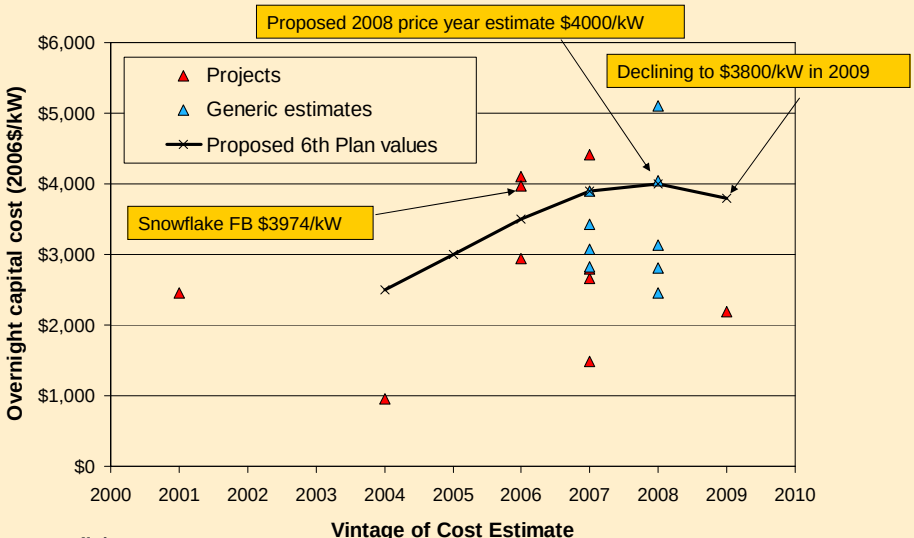
Reference plant

25 MW fluid-bed steam-electric plant

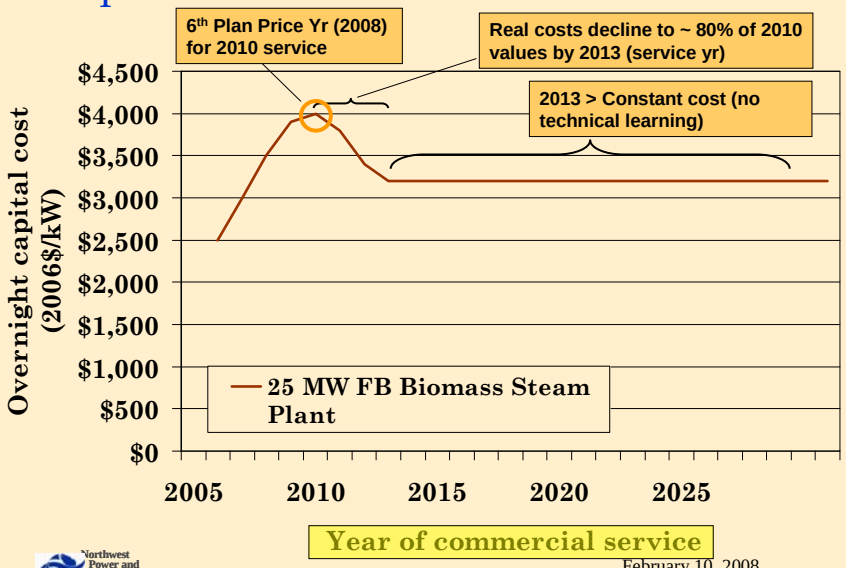
- Widely-used, mature technology
- Fuel flexibility
- Improved carbon burn (higher thermal efficiency)
- Lower emissions off furnace
- Small size, lower voltage interconnection facilitates siting near fuel sources - results in lower fuel transportation cost
- Cogeneration potential (at somewhat greater cost)

Little evidence of commercial adoption of advanced technology (bio-gasification)

Capital cost estimates: Woody biomass plants



Capital cost forecast



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Woody biomass power plant assumptions

	Fluid-bed Steam-electri	
Net capacity (MW)	25	
Heat Rate (Btu/kWh)	15,500	22% thermal efficiency
Availability (%)	90%	CF, well-managed plant 80%
Overnight capital ($/kW)	$4000	2008 price year
Fixed O&M ($/kW/yr)	$180	2008 price year
Variable O&M ($/MWh)	$3.70	2008 price year
Preconstruction		lection > Financing
Preparation		major foundations
Committed construction	12 mo	Major equipment > service
Earliest new PNW unit	Jan 2014	Jan 2010 site selection

Very wide range of possible cost $2000 - $5000 (size, use of salvaged equipment, air quality controls, etc.)

High capacity factor requires reliable fuel supply at competitive cost

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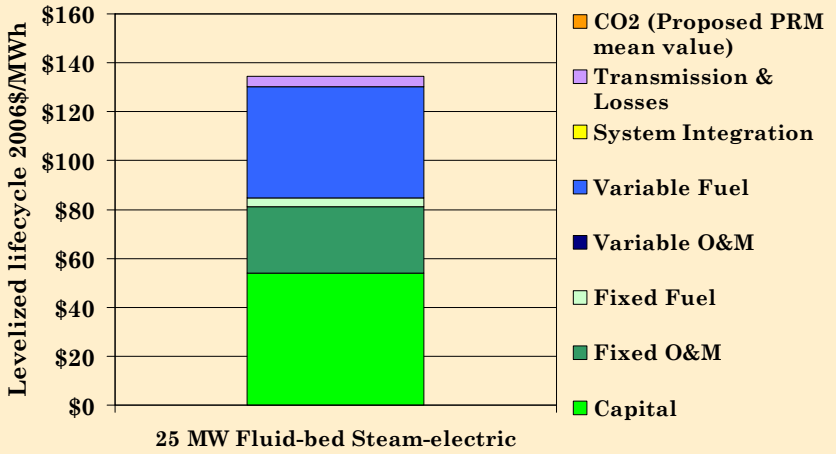
Woody biomass generation cost elements ca: 2020

IOU financing
2020 service
80% CF
No incentives



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Woody biomass: Availability

Assumptions: Heat value - 8700 Btu/lb
Excess fuel supply ratio - 2.5
Plant heat rate - 15500 But/kWh
Plant capacity factor - 80%

	Forestry[1] (MMODT)	Biogenic[1] MSW (MMODT)	Total (MMODT)	Total (Tbtu/yr)	Practical Potential (TBtu/yr)	Energy (aMW)	Capacity (MW)
ID	2.05	0.43	2.47	43.0	17.2	127	158
MT	1.83	0.50	2.33	40.6	16.2	119	149
OR	1.51	1.65	3.16	55.0	22.0	162	203
WA	1.54	3.47	5.01	87.2	34.9	257	321
Total						**665**	**831**

1) Western Governor's Association. *Biomass Task Force Report: Supply Addendum*. January 2006. Exhibit 1-1

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Discretionary woody biomass resource under current planning assumptions

Available energy from woody biomass	**665 aMW**
Assumed biomass fraction of RPS by 2029:	
Montana	6
Oregon	170
Washington	134
Total RPS	**310 aMW**
Discretionary energy from woody biomass	**355 aMW**

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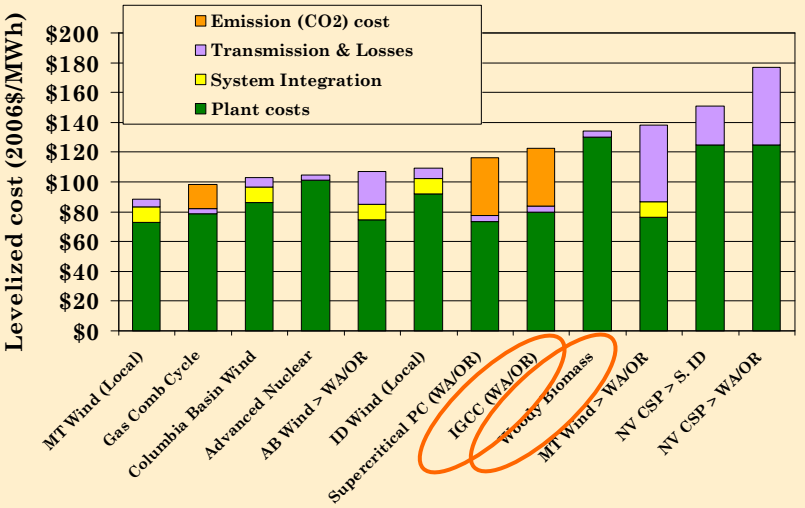
Resource comparison Early 2020s

Transmission cost & losses to point of LSE wholesale delivery
No federal investment or production tax credits
Baseload operation (CC, Nuc, SCPC 85%; IGCC, Bio - 80%)
Medium NG and coal price forecast (Draft 6th Plan)
Proposed Draft 6th Plan CO2 price.



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Possible action items

Comprehensive assessment of woody biomass resource potential in the Northwest (similar to CEC Biomass Resource Assessment in California, April 2005).

Work to establish policy and programs to provide reliable and sustainable supplies of forest thinning residues from public timberlands.

Demonstration woody biomass power project using forest thinning residues as primary fuel supply.