Biomass Power:
Strengths, Weaknesses, Opportunities, & Challenges

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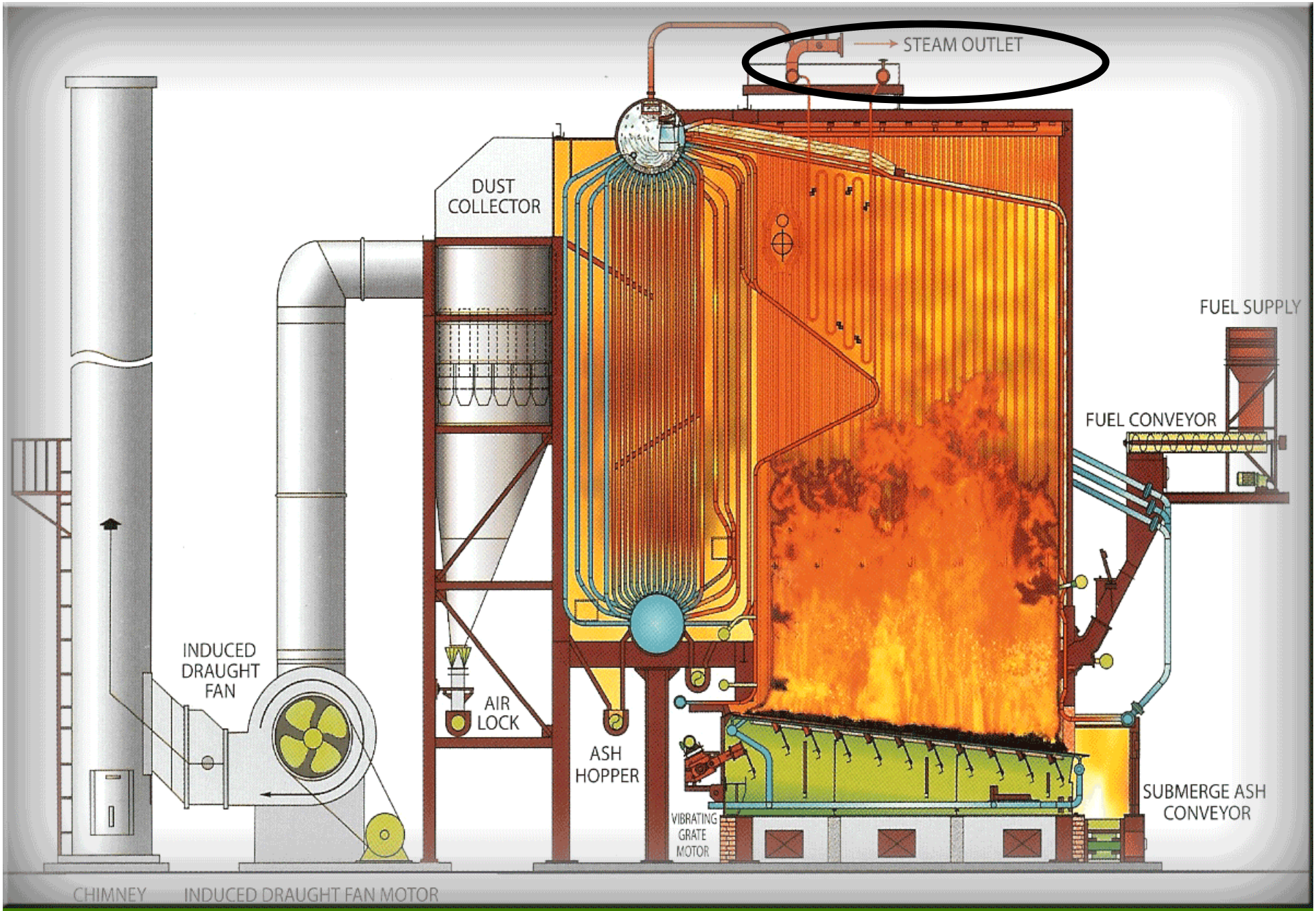
The Beck Group

- **Planning, consulting and benchmarking services for the Forest Products Industry**
- **5 full-time consultants on staff**
- **Sawmill Planning & Design**
  - Collins Companies Hardwood Sawmill, Boardman, OR
- **More than 30 North American benchmarking studies completed over the past 10 years**
  - Softwood and Hardwood lumber
  - Particleboard and MDF
  - OSB and Plywood
- **Biomass Power**
  - Fuel Supply
  - Feasibility

Benchmarking Report

Western Stud Mills (2004, 13 Mills)

Statistic	Mill A	Mill B	Mill C	Survey Average	Range
Annual Production (MMBM)	**50**	**125**	**225**	**71**	**53-219**
Production/Manhour (bm/mh)	**715**	**544**	**518**	**496**	**383-715**
Employees (hourly)	**30**	**117**	**203**	**120**	**30-203**
Total Conversion Cost ($/MBM)	**95**	**80**	**123**	**103**	**75-140**
Net Sales Average ($/MBM)	**313**	**283**	**316**	**288**	**268-316**
Lumber Recovery (MBM/MBF) Westside Log Scale	**2.46**	**2.51**	**2.44**	**2.55**	**2.26-2.80**



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What is Biomass Power?

Why Biomass Power?

- **Renewable**
  - Carbon neutral → climate change
  - Energy Independence
- **Forest Health**
  - Strengthened demand for small diameter trees
  - Utilization of logging slash & mill residues
- **Rural Economic Development**
  - Direct employment
  - In-direct jobs

Biomass Feasibility

Fuel Supply	**Mill residues, logging slash, urban wood, roundwood**
Power Market	**What is renewable power worth?**
Capital Cost	**Cost for equipment, construction, engineering, permitting, etc.**
Operating Cost	**Fuel, Labor, Maintenance, Ash disposal, etc.**
Incentives	**Local, State, & Federal (grants, tax credits, financing, etc.)**
Regulatory	**Permits for air, water, building, etc.**
Financial Analysis	**Pro forma income statement and return on investment analysis**

Case 1: Cogen at Oregon Sawmill

Sawmill	**Produces Green DF lumber**
January 1, 2011	**Lumber used in California buildings must be 19% MC or less before enclosure**
How to Respond:	**Do nothing – look for other lumber markets**
	Purchase a boiler and dry kilns
	Purchase a boiler, Turbine Generator, and Dry Kilns

Case 1: Fuel Supply

Fuel Source	Volume (Bone Dry Tons)	Delivered Cost ($/Bone Dry Ton)	Cumulative Value ($/Bone Dry Ton)
Mill Residues			
Pulp Chips	40,200	63.60	n/a
Hog Fuel	20,500	29.30	n/a
Sawdust	7,400	27.50	n/a
Shavings	4,500	26.90	n/a
Subtotal Mill Residues (exc. pulp chips)	32,400	28.55	n/a
Logging Slash			
10 mile haul distance	3,000	40.00	40.00
20 mile haul distance	27,000	44.00	43.64
30 mile haul distance	44,000	47.00	45.96
40 mile haul distance	72,000	50.00	48.29
Total Logging Slash	146,000		48.29
Grand Total (All Fuel Sources)	178,400	44.70	n/a

Case 1: Capital Cost

Capital Cost Item	Cost ($ 000s)
Equipment and Construction Costs	26,500
Project Management/Permitting/Engineering	500
Site Prep/Roads/Fencing	400
Working Capital	500
Utility Interconnection	600
Fuel Receiving/Processing	2,000
Contingency	1,525
Total Capital Costs:	**32,025**
Less: Discounts	9,127
Net Capital Costs	**22,898**

5 MW plant; 60,000 pound per hour boiler;
$6.4 million/MW capital cost

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Case 1: Pro Forma

YEAR 1 PRO FORMA

- Assumes $33.07/BDT average fuel cost; 47,400 BDT/year
- 100% Equity
- Power sales value of $98.40/MWH
- Steam sales value of $11.30 per thousand pounds

FINANCIAL ANALYSIS

- $1.2 TO $1.8 million in net cash flow after Year 1
- 5.4 percent internal rate of return
- $528,000 NPV 5% discount rate; 20 years

Revenue/Expense Line Item	($ 000s)
Electric Sales	3,051
Steam Sales	908
Green Tag Sales	1,080
TOTAL REVENUES:	**5,039**
O&M	1,679
Fuel	1,568
Ash Disposal	34
EXPENSES:	**3,281**
OPERATING INCOME:	**1,758**
– Interest	0
– Depreciation	1,373
PRETAX INCOME:	**385**
+ Depreciation	1,373
PRETAX CASH FLOW	**1,758**
+/- Taxes/Credits/Grants	(5,621)
NET CASH FLOW	**7,379**

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Case 1: Conclusions

- **Project is feasible in terms of:**
  - Interconnection
  - Air & water permit
  - Water supply
  - Fuel Supply
- **Constraints on feasibility**
  - Small plant size → high capital cost per MW
  - Relatively high fuel costs
  - Rate of return is too low to attract a private investor

Case 2: Stand Alone in SW U.S.

Pinyon Juniper Forests

- Wildlife habitat
- Fire Hazard
- Treatment costs $100 to > $1,000 per acre

How to Respond?

- Biomass Power

Case 2: Fuel Supply

Distance Increment (Miles from Center Point)	Phase I (BDTs)	Phase II (BDTs)	Phase III (BDTs)	Total within Zone (BDTs)	Cumulative (BDTs)
0 to 10	22,300	87,200	147,100	256,600	256,600
11 to 20	80,600	313,100	531,100	924,800	1,181,400
21 to 30	215,800	837,900	1,422,100	2,475,800	3,657,200
31 to 40	130,200	506,400	858,100	1,494,700	5,151,900
41 to 50	24,900	96,900	164,400	286,200	5,438,100
Total	473,800	1,841,500	3,122,800	5,438,100	n/a

Case 2: Fuel Cost

Cost Category	Phase I Cost Estimate ($/BDT)	Phase II Cost Estimate ($/BDT)	Phase III Cost Estimate ($/BDT)
Felling and Bunching	78.75	49.38	24.52
Skidding	33.24	20.84	12.16
Chipping	13.41	13.41	13.41
Transport	7.50 to 33.00	7.50 to 33.00	7.50 to 33.00
Total	133 to 158	91 to 117	58 to 83

Case 2: Capital Cost

Capital Cost Item	Cost ($ 000s)
Equipment and Construction Costs	37,500
Project Management/Permitting/Engineering	400
Site Prep/Roads/Fencing	400
Working Capital	850
Utility Interconnection	800
Fuel Receiving/Processing	3,000
Interest During Construction & Issuance Costs	3,378
Total Capital Costs:	47,547
Capital Cost per MW	4,755

10 MW plant; 90,000 pound per hour boiler;
67,300 BDT of fuel per year; $6.4 million/MW capital cost

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Case 2: Pro Forma

YEAR 1 PRO FORMA

- **Set model to return the fuel price that provides a 15 percent rate of return on equity**
- **30% Equity; 70% Debt**
- **Power sales value of $95/MWH**

FINANCIAL ANALYSIS

- **Project requires a $27.00 per bone dry ton price**
- **Projected delivered cost of fuel is $96.30/bone dry ton**
- **Project would lose $4.71 million per year (67,300 BDT/year x $70/BDT)**

Revenue/Expense Line Item	($ 000s)
Electric Sales	7,790
Steam Sales	0
TOTAL REVENUES:	**7,790**
O&M	2,768
Fuel	1,845
Ash Disposal	24
EXPENSES:	**4,638**
OPERATING INCOME:	**3,152**
– Interest	1,331
– Depreciation	2,377
PRETAX INCOME:	**(557)**
+ Depreciation	2,377
– Loan Principal	(1,118)
PRETAX CASH FLOW	**703**
+/- Taxes/Credits/Grants	(2,469)
NET CASH FLOW	**3,172**

Case 2: Conclusions

- **Project is feasible in terms of:**
  - Interconnection
  - Air & water permit
  - Fuel supply & BLM willing to commit to long term stewardship contracts
- **Constraints on feasibility**
  - Limited water supply: 180 gallons per minute needed for cooling; used a dry cooled design
  - Radial transmission system → limited outbound transmission capacity
  - High fuel cost

Summary

- **Strengths/Opportunities**
  - Diversify sawmill revenue stream
  - Cogen → dry lumber and produce power
  - Proven technology
  - Job creation
  - Incentive programs
- **Weaknesses/Challenges**
  - Significant capital investment; need strong financing
  - Fuel sourced directly from the forest (slash & roundwood) is expensive and most mill residues are already being used
  - Incentive programs
  - All conditions need to be “right” for feasibility (fuel, power value, interconnection/transmission, water, permits, etc.)