Happy Camp Biomass Supply & Feasibility Update Meeting

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THE BECK GROUP

The Beck Group

- Forest products planning and consulting services
- More than 40 years in business; based in Portland, OR
- Services:
  - Feasibility studies
  - Small diameter tree utilization
  - Raw material supply & demand
  - Merger/acquisition due diligence
  - Mill benchmarking
  - Mass timber
  - Expert witness
  - Capital project planning

Biomass Utilization Feasibility Study Objectives

1. Raw Material - Identify other/existing biomass users (if any) and know the net amount available per year, its characteristics, cost, etc.

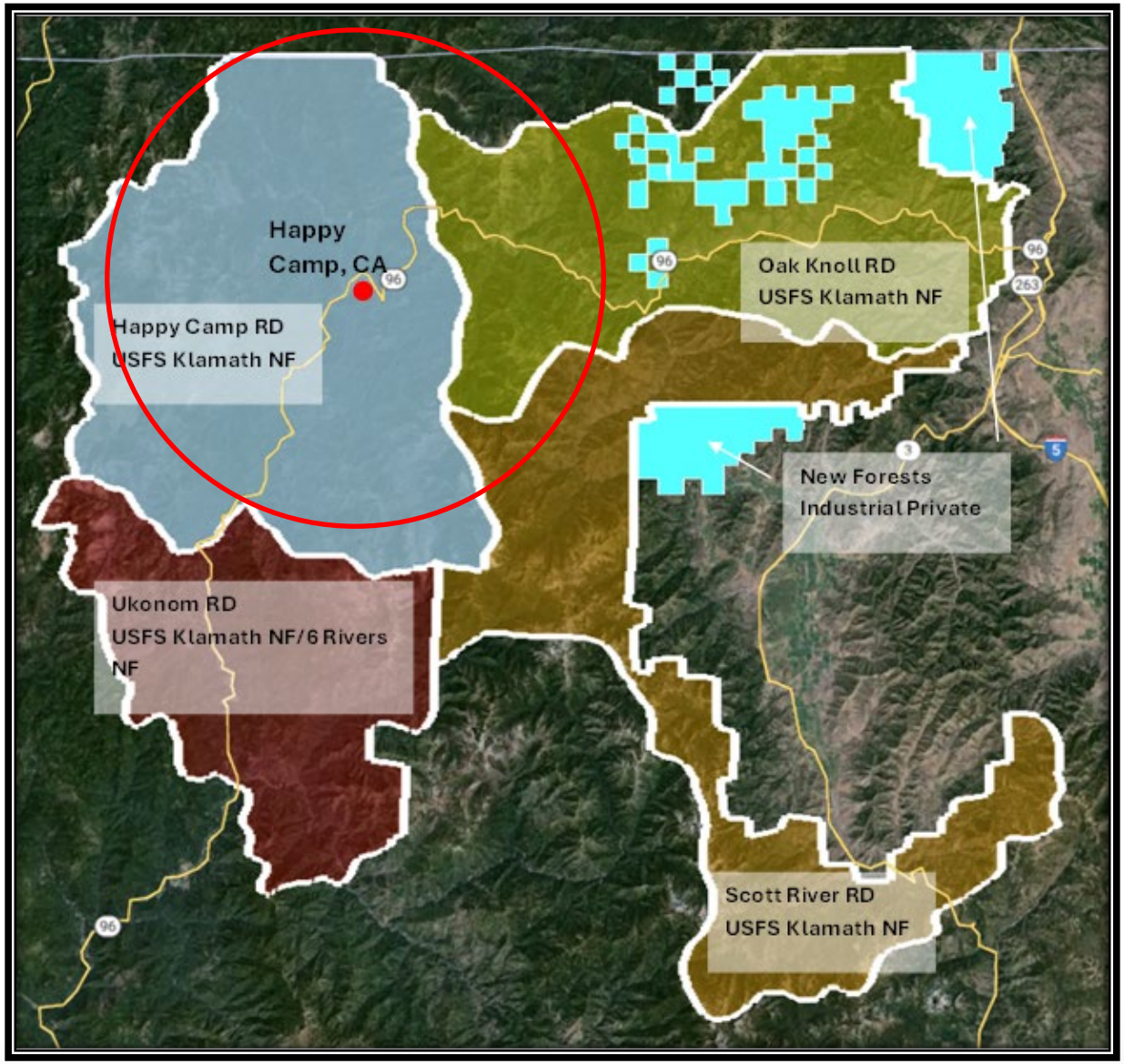
2. What kind of biomass business?
   - Develop screening criteria
   - Use a business screening process to identify business type

3. Evaluate the likelihood of successfully developing a biomass utilization business
   - Technical – are there technical barriers?
   - Financial – can the business be profitable?
   - Economic – what are economic impacts?

Defining the Happy Camp Supply Area

15-mile Radius Supply Circle Centered on Happy Camp, California

Supply Study:
Happy Camp Region



Timberland Ownership

***Timberland Ownership in 15-mile Radius of Happy Camp (Acres)**

County/ State	National Forest	Other Federal	State and Local	Private	Total	% of Total
Del Norte County, CA	6,580	0	0	0	52,125	2.3%
Siskiyou County, CA	274,727	0	0	186	625,146	97.0%
Josephine County, OR	1,929	0	0	0	212,194	0.7%
Total Acres	283,285	0	0	186	283,422	100.0%
% of Total	99.9%	0.0%	0.0%	0.1%	100.0%	

***Timberland is land that can grow at least 20 cubic feet/acre/year and that has not been excluded from harvesting (i.e., does not include National Parks, Wilderness, etc.)**

Terminology

Board Feet

- **1 board foot of lumber = 1” x 12” x 12”**
- **Board Feet (log scale) = estimated board feet of lumber that can be produced from a log**
- **A log 32’ long and 12” in diameter at the small end scales at 140 board feet**
- **Board feet of logs adds up quickly, so the industry convention is to refer to them in units of 1,000s, or MBF**
- **A truckload of logs will contain about 3,500 to 4,000 board feet**

Bone Dry Ton

- **A volume of wood that weighs 2,000 pounds at zero percent moisture content**
- **If trees are live (green) when harvested, their weight is usually about 50% water**
- **Therefore, a rule of thumb is that the bone dry weight is ½ of the green weight.**
- **For example, 1 truckload of logs usually weighs about 25 green tons and 12.5 bone dry tons**
- **We used a conversion of 3.5 bone dry tons per MBF**

Standing Timber Volume

Standing Timber Volume in 15 Mile Radius Supply Area by Species (BDT in millions)

	Douglas-fir	Pond. Pine	True Fir	Sugar Pine	Incense Cedar	Other Sftwd.	Tan Oak	Other Hdwd.	Total
% of Total	64%	2%	20%	3%	2%	1%	2%	6%	100%
Tons	2.37	0.07	0.76	0.13	0.06	0.02	0.08	0.21	3.72

Volume Harvested

Historical Timber Annual Harvest Levels in Siskiyou County (2017 to 2022 MBF/Year)

Year	Private & Tribal	State	Forest Service	Other Public	Total
2018	180,756	0	66,954	0	247,709
2019	163,973	0	46,669	0	210,642
2020	136,201	0	31,251	0	167,452
2021	166,424	0	36,564	0	202,988
2022	126,246	0	47,336	0	173,581
20 Year Annual Average	**155,234**	**0**	**55,331**	**15**	**210,579**
15-mile Radius			**19,618**		

Volume Harvested

Species Percentage of Harvested Volume

Douglas-fir	Ponderosa & Jeffrey pine	True fir	Oak	Total
62%	17%	20%	1%	100%

Diameter Percentage of Harvested Volume

Diameter at Breast Height	0"-7"	8"-12"	13"-19"	20"+	Total
Percentage	4%	22%	49%	25%	100%

Volume Harvested

Summary of Annual Sawtimber and Biomass Supply in the Happy Camp Region & *Potential from Pre-Commercial Thinning (BDT/Year)

Source Type	MMBF per Year	Total BDT per Year	Available Portion (BDT/Year)
Baseline Sawtimber	19.6	68,600	10,500
Logging Slash	n/a	9,300	6,000
Topwood	2.9	10,300	10,300
Historical Total	**22.5**	**88,200**	**26,800**
*Pre-commercial thinning		13,000	13,000
Potential Total	**26.2**	**101,200**	**39,800**

Costs Associated with Harvest

The total cost of removing biomass varies by operation type, tons per acre, tree size, slope, and time to travel to facilities.

Summary of Estimated Delivered Cost Ranges by Material Type ($/BDT)

Sawlogs from Sawtimber Trees			Sawlogs from Hazard Trees			Topwood in Log Form			Small Diameter Trees in Log Form			Topwood in Chip Form			Small Diameter Trees in Chip Form		
Low	Hi	Avg	Low	Hi	Avg	Low	Hi	Avg	Low	Hi	Avg	Low	Hi	Avg	Low	Hi	Avg
35	115	75	35	105	70	25	65	45	80	180	130	38	72	55	78	172	125

Summary of Key Supply Related Points

- Nearly 40,000 BDT/year of biomass and/or sawlogs could be available to a business in Happy Camp
- Roughly 25% of it is large diameter sawlogs, 60% is small diameter biomass, and 15% is logging slash
- Delivered costs are expected to range $35 and $180 per BDT depending on type of material
- That is enough annual volume to support a manufacturing operation in Happy Camp
- Virtually 100% of the timberland in the 15-mile radius supply area is USFS managed, therefore the USFS will be a key partner:
  - Explore opportunities for securing longer-term supply through contracting mechanisms
    - Stewardship, Good Neighbor Authority, etc.
  - Explore opportunities for collaboration with Karuk Tribe, MKWC, WKRP

What Kind of Biomass Business for Happy Camp?

Energy-Related	Traditional and/or Engineered Wood Products	Other Miscellaneous Products
Biomass Combined Heat & Power	Lumber (Small, Specialty Sawmill)	Animal Bedding
Bundled Firewood	Oriented Strandboard (OSB)	Bark/Compost/Mulch
Densified Fuel Bricks/Logs	Posts & Poles	Biochar
Liquid Biofuels	Woodstraw	Essential Oils
Wood Pellets	Wood Wool Cement	Wood Fiber Insulation

Technology Screening Tool

Criteria Type	Max Score	Criteria
Timing	6	The business/technology can be constructed and operational within 18 to 24 months of receiving financing.
Timing	6	The business/technology has a high likelihood of successfully obtaining required permits, licenses, etc., and these can be obtained within 18 to 24 months of receiving financing.
Timing	6	The business/technology can utilize an existing site to help speed the development process and lower development costs.
Raw Material	6	The business/technology will utilize otherwise unused raw materials (i.e., there is limited competition with existing users, or it is or complementary to existing users).
Raw Material	10	Raw material security: Alternate source raw material (e.g., mill residuals) is not available to competitors at substantially lower cost.
Raw Material	6	The business/technology, in a single location, is scaled or can be expanded to utilize the amount of raw material harvestable in the supply region.
Raw Material	6	The business/technology does not require utilization of a specific tree species.
Economics	14	The business/technology economic structure is such that it can operate profitably (during most of an economic cycle) at the delivered raw material costs identified in the supply study.
Economics	4	The business/technology is such that the capital costs relative to revenues and operating costs mean the developer can reasonably expect to have a 10-year or less payback period.
Economics	14	The business/technology must be able to demonstrate that there is a defined and supportable market segment for the product, with potential demand from multiple customers.
Proven Technology	16	The business/technology proposed must have been successfully demonstrated in a commercial setting, at commercial scale, with similar raw material mix, for at least two years.
Proven Technology	6	The business/technology equipment vendors must be able to offer commercial warranties as to performance, environmental compliance, and completion, and must be able to bond such warranty through commercial sources.
Grand Total	100	

Technology Screening Tool - Results

Biomass Utilization Technology	Screening Score
Lumber (Small, Specialty Sawmill)	92
Wood Wool Cement	88
Bundled Firewood	87
Posts & Poles	81
Densified Fuel Bricks/Logs	70
Animal Bedding	70
Oriented Strandboard (OSB)	69
Bark/Compost/Mulch	64
Woodstraw	61
Wood Pellets	58
Biomass Combined Heat & Power	53
Wood Fiber Insulation	53
Essential Oils	52
Biochar	42
Liquid Biofuels	29

Biomass Power

Biomass fuel > Boiler > Steam > Turbine > Power > Grid

Poor Economics

- 40,000 BDT of biomass ~ 5 MW of capacity
- 8,000hours/Year x 5 MW = 40,000 MWH/year of power produced
- Current renewable power market values $45/MWH to $50/MWH
- At those rates, annual power revenue = $1.8 to $2.0 million
- Additional ~$500,000 for RECs and steam sales
- Total of $2.5 million in revenue/year
- 5 MW plant Cap Ex ~$35 million
- 1 MWH produced = 1 BDT of fuel consumed
- If fuel costs > $50/BDT delivered the project is already underwater without accounting for other costs (labor, supplies, R&M, etc.) & amortization of loans

Other Issues

- Potentially higher than normal Cap Ex to interconnect
- Need for licensed boiler operators (difficult in some remote towns)

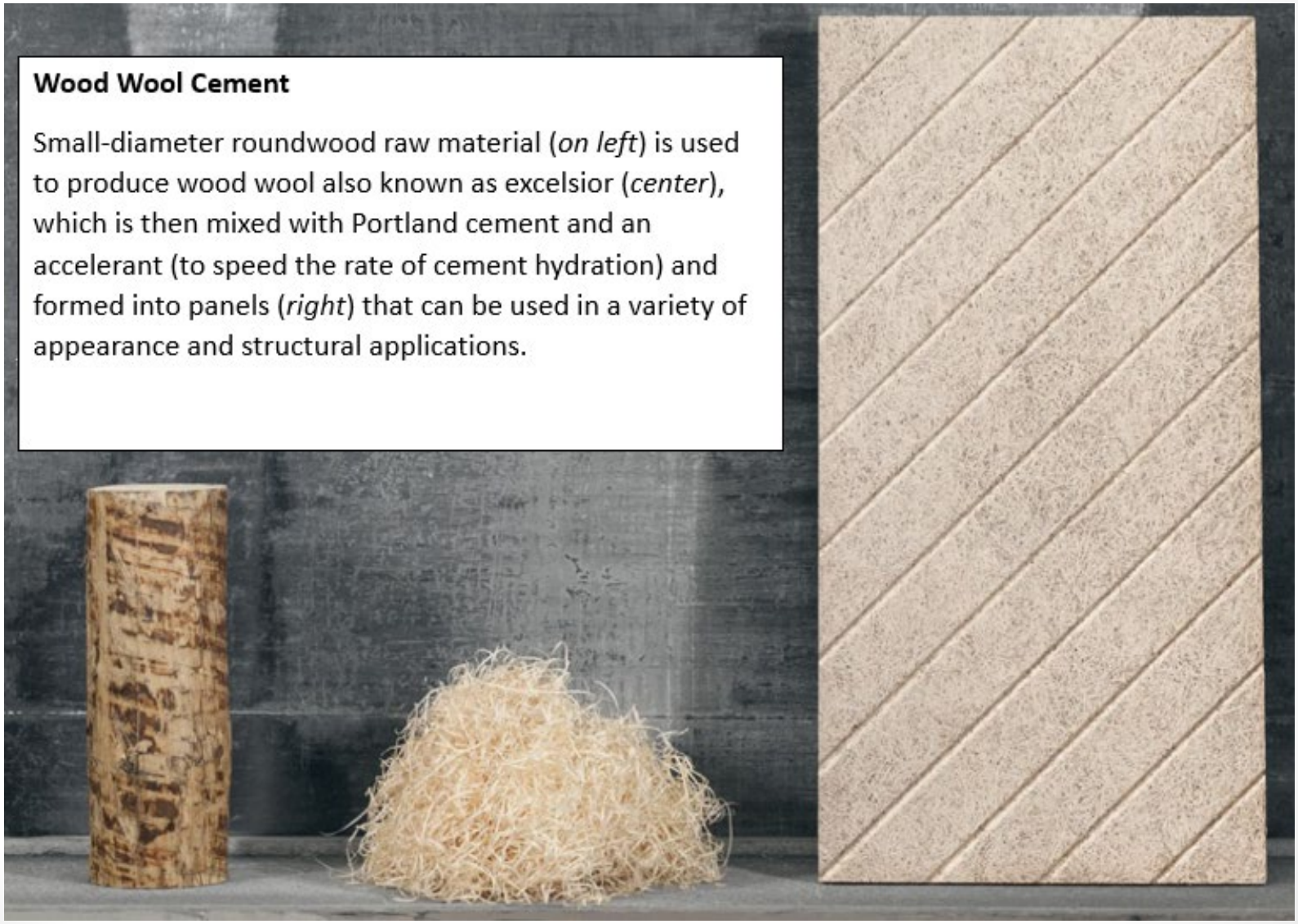
Biochar

- Biochar is used as a soil amendment, but little solid information available about the value landowners are willing to pay or size of the market
- Instead, revenue model for manufacturer is built on monetizing carbon credits per ton of biochar applied
- Credits can only be claimed after application is documented
- Other manufacturers produce biochar as a byproduct (Biomass One, White City, OR)
- Therefore, economics very unfavorable for an entity that must generate a revenue stream to cover all manufacturing costs

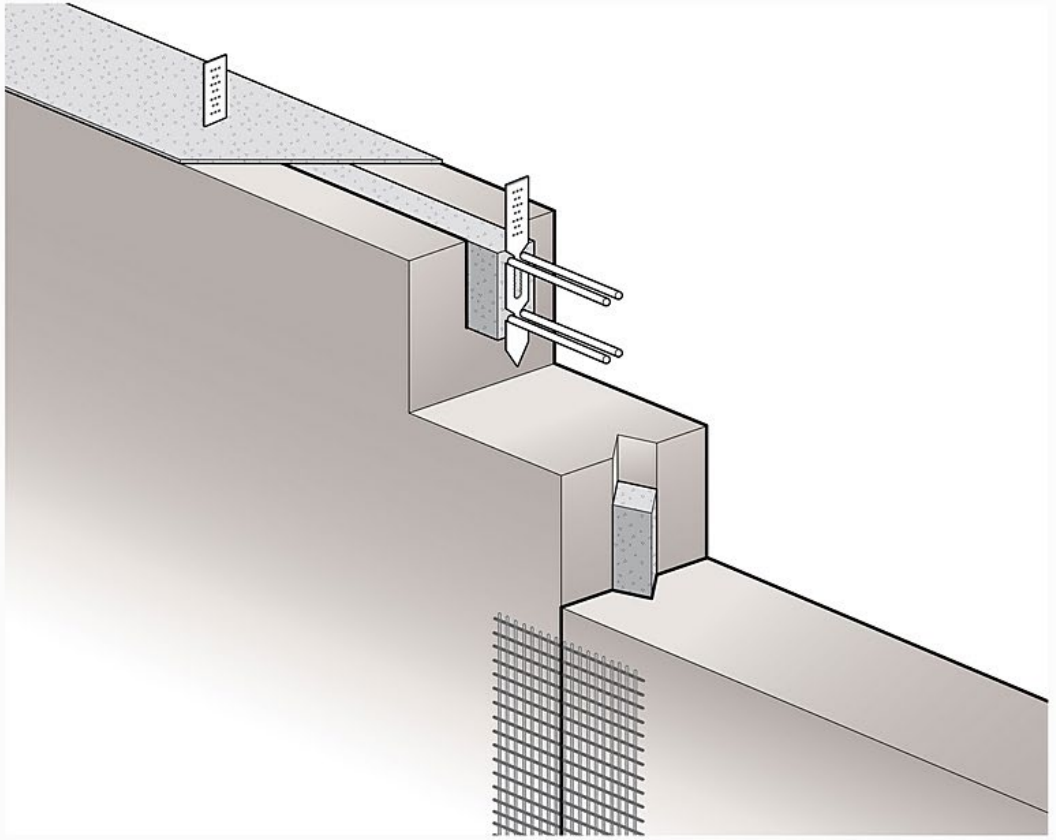
Small, Specialty Sawmill

- Limited market for large diameter logs in Happy Camp region, so log supply is available
- Small scale mill cannot not be competitive manufacturing commodity products (stud & dimension lumber) because per unit costs are too high
- Can make high value products:
  - Special sizes (large beams)
  - Extra long lengths
  - Special products
  - Less common species

Wood Wool Cement



Wood Wool Cement: Large Wall Element



- **Fast building construction**
- **Carbon negative if low energy intensity cement is used**
- **Excellent thermal and acoustical properties**
- **Mold/fungus resistant**
- **Highly fire resistant**

Wood Wool Cement:
Large Wall Element Finished Home

Wood Wool Cement: Considerations

- Large Wall Elements have been used in Europe for decades and are now approved for use in buildings in Arizona and approval is pending in Portland, OR
- Eltomation (Netherlands) offers a turn-key wood wool cement plant
  - ~$40 million Capital Expense
  - Consumes 12,500 BDT/Year
  - Produces about 4.2 million cubic feet of product/year
  - Requires about 35 hourly staff and ~5 salaried manager, sales, etc.
- That scale is likely too large for Happy Camp
- However, Single Widget (Portland Startup) is evaluating/planning a small-scale, low CapEx system that could produce enough material for about 20 homes per year to provide local, sustainable, fire-resistant housing. Single Widget is interested in Happy Camp as place to start pilot scale operation
- Grant support likely for planning/developing pilot plant
- Opportunity to ramp up after Pilot Scale level of:
  - Proving concept
  - Proving market

Next Steps

1. **Complete feasibility analysis:**
   - **Small, specialty sawmill**
   - **Pilot scale wood wool cement**

2. **Finalize written report:**
   - **Supply study**
   - **Technology screening**
   - **Feasibility analysis**
   - **Conclusions & recommended next steps**

Questions/Discussion