

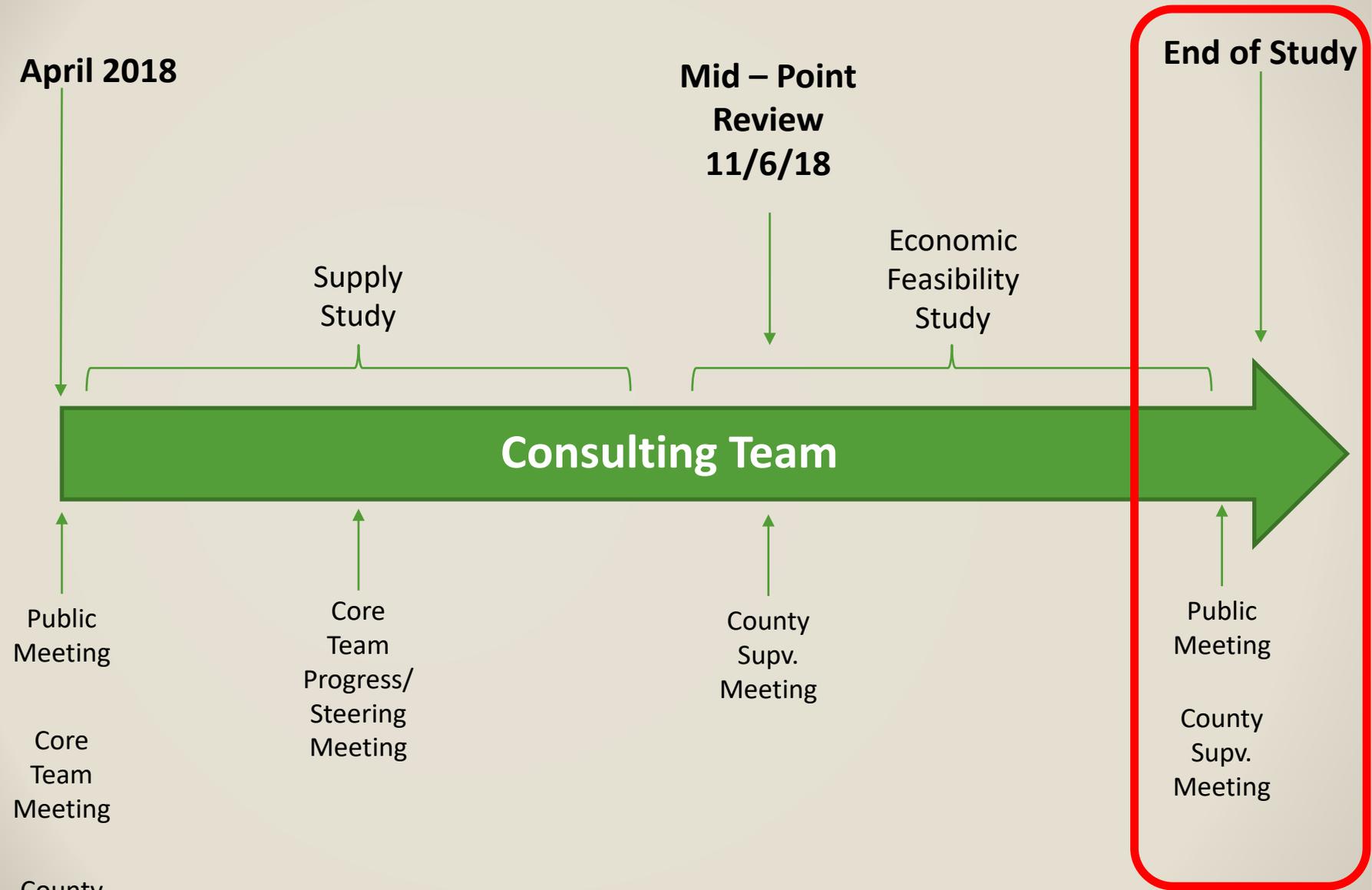


Biomass Utilization Facility (BUF) Feasibility Studies

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Final Study Report
Sonora, California
February 12, 2019

BUF Study: Work Plan



BUF Supply Study: Results

- Annual Biomass Supply Volume (BDT = bone dry tons)

Biomass Feedstock Type	Potentially Available	Practically Available	Already Being Utilized					Net Available
	BDT	BDT	Use Type: Biomass Fuel (BDT Logs and Chips)	Use Type: Mulch & Compost (BDT Logs and Chips)	Use Type: Animal Bedding (BDT Logs only)	Use Type: Particle-Board (BDT Logs & Chips)	Use Type: Other (BDT from all Sources)	BDT
Forest Derived Feedstocks	279,659	170,592	105,000	9,000	16,800	4,500	2,000	33,292
Non-Forest Derived: Mill Residues	124,740	124,740	30,294	5,346	0	30,640	53,460	5,000
Non-Forest Derived: Ag/Orchard	167,854	167,854	153,000	0	0	0	12,500	2,354
Non-Forest Derived: Urban	69,522	45,163	15,000	20,000	0	0	8,000	2,163
Total	641,775	508,349	303,294	34,346	16,800	35,140	75,960	42,809

BUF Supply Study: Results

- Delivered Biomass Cost (\$/BDT)

Fuel Type	Feedstock Supply Area Zone	Landowner Type	Annual Volume (BDT)	Avg. Del. Cost (\$/BDT)
Community-Based/Utility Programs	Zone 1	Private	1,830	\$ 25.04
Community-Based/Utility Programs	Zone 2	Private	2,745	\$ 29.86
Standing Dead Trees Removed with Harvest	Zone 1	Public	3,362	\$ 44.86
Standing Dead Trees Removed with Harvest	Zone 1	Private	1,399	\$ 44.86
Standing Dead Trees Removed with Harvest	Zone 2	Public	2,751	\$ 53.09
Standing Dead Trees Removed with Harvest	Zone 2	Private	4,196	\$ 53.09
Harvest Residuals: Top Piles, Burn Piles	Zone 1	Public	7,146	\$ 56.77
Harvest Residuals: Top Piles, Burn Piles	Zone 1	Private	8,813	\$ 56.77
Harvest Residuals: Top Piles, Burn Piles	Zone 2	Public	5,847	\$ 66.40
Harvest Residuals: Top Piles, Burn Piles	Zone 2	Private	26,438	\$ 66.40
Standing Dead Trees > 20" DBH within 100' of roads	Zone 1	Public	2,202	\$ 72.33
Standing Dead Trees > 20" DBH within 100' of roads	Zone 1	Private	5,509	\$ 72.33
Pre-commercial & Plantation Thinning	Zone 1	Public	1,938	\$ 72.75
Pre-commercial & Plantation Thinning	Zone 1	Private	806	\$ 72.75
Standing Dead Trees > 20" DBH 101 to 1000' of roads	Zone 1	Public	3,987	\$ 73.04
Standing Dead Trees > 20" DBH 101 to 1000' of roads	Zone 1	Private	10,065	\$ 73.04
Standing Dead Trees > 20" DBH within 100' of roads	Zone 2	Public	17,817	\$ 80.14
Standing Dead Trees > 20" DBH within 100' of roads	Zone 2	Private	7,012	\$ 80.14
Standing Dead Trees > 20" DBH 101 to 1000' of roads	Zone 2	Public	32,259	\$ 80.86
Standing Dead Trees > 20" DBH 101 to 1000' of roads	Zone 2	Private	12,810	\$ 80.86
Pre-commercial & Plantation Thinning	Zone 2	Public	2,720	\$ 82.35
Pre-commercial & Plantation Thinning	Zone 2	Private	8,940	\$ 82.35
Total			170,592	

Supply Study: Results

- Two Wildcards:

- **Pacific Ultrapower Chinese Station**

- Currently operating under a BioRAM contract
- Contract offers relatively high price for power, but specifies use of high % of biomass from T1 and T2 HHZ zones
- Hard to meet contract fuel source/usage specs, although SB 901 provisions will make it easier
- Plant may “opt out” of contract
- 105,000 BDT/year swing volume
- Implications for fuel supply/cost in the region

- **Dead Trees**

- Usually not considered in supply studies
- Included in this case because of large volume
- Conservative approach to estimating dead tree supply:
 - Adjusted for rate/timing of die-off
 - Only considered large trees
- Likely difficult to secure financing if business(es) is heavily reliant on dead trees as supply source

BUF Feasibility Study: Business Screen

- Screened ~ 40 business types
 - Fatal flaw screens:
 - Compete with existing user
 - Too long to develop
 - Economic: Lower cost raw material available elsewhere to others; Poor financials (low product value; high CapEx; high OpEx; long payback period; etc.)
 - Other screens:
 - Scale
 - Start-up time
 - Proven technology
 - Economics
 - Markets (size & sales values)
 - Operating costs
 - Capital costs
 - Utilize wide range of material (size, species, live/dead, etc.)
 - Permitting/regulatory

BUF Feasibility Study: Businesses

- Five Businesses Identified

1. Small-scale biomass power (BioMAT)
2. Small scale sawmill
3. Post & pole manufacturing
4. Firewood bundling
5. Biomass fuel grinding

- Key Considerations

- Co-locating = shared labor, management, lease, etc.
- Site: need about 7.5 to 10 acres
 - Camage Avenue, Tuolumne County Wood Sort Yard, Others?
 - Needs electrical substation ~5 MW
 - Wastewater discharge
 - Needs water ~60 gpm for cooling
 - Access ~6,000 trucks/year



BUF Feasibility Study: Results

Business Type	Annual Raw Material Needed (BDT)	# of Direct Jobs	Cap Ex (\$ 000)	Annual EBITDA (\$ 000)	Annual EBIT (\$ 000)	Simple Payback Pre-Tax (Years)	Annual Return Pre-Tax (%)	EBIT/BDT (\$/BDT)	Raw Mat. Del. Price (\$/BDT)	Break-even Deliv. Raw Mat. Price (\$/BDT)
Small Sawmill	25,000	13	9,670	1,126	158	8.6	11.6	6	65	71
Post & Pole	14,056	2	1,150	239	124	4.8	20.8	9	80	89
Bundled Firewood	3,800	6	389	76	38	5.1	19.5	10	65	75
Power Plant	27,189*	10	33,800	2,177	762	15.5	6.4	28	34	62
Shared Labor		15								
Total	49,379	46	45,009	3,618	1,082	12.5	8.0	22	56	78

*27,189 BDT total annual raw material requirement, of which 6,523 BDT would come from external (i.e., non co-located) sources

BUF Feasibility Study: BioMAT Cogen

- Small Scale Biomass Power
 - BioMAT program
 - 20 year contract to sell power at \$199.72/MWH
 - Need to use biomass fuel from specified sources (HHZ &/or Sustainable Forest Management)
 - Modeled as selling 3 MW, but could possibly sell 5 MW at that price
 - Considered 4 Scenarios: different combinations of size & technology
 - 3 MW standalone gasification/internal combustion
 - 3 MW standalone boiler steam/turbine
 - 5 MW cogeneration boiler steam/turbine; selling 3 MW to utility and supplying steam/power to co-located businesses
 - 5 MW cogeneration boiler steam/turbine; selling up to 5 MW to utility and supplying steam to co-located businesses

BUF Feasibility Study: BioMAT Cogen

- Gasification Technology

- Fuel needs to be dry and uniformly sized
- No experience using mixed forest fuel (i.e., fuel that is not dry and not uniformly sized)
- Screening of forest produced fuel to achieve sizing would likely only yield 50% (i.e., substantially increases fuel cost)
- Has benefit of Biochar as saleable by-product
 - Unknown markets for Biochar (market size? product value?)
 - Additional biochar comes at cost of reduced fuel efficiency
- Uncertain financial modeling because no proven plants using forest waste
- Unknown requirements regarding pollution control equipment

BUF Feasibility Study: Summary

- Study provides a pathway to BUF development
- Co-locating to share costs and resources is key concept
- Five economically viable biomass utilizing businesses identified
- The four co-located businesses would utilize nearly 50,000 BDT of biomass annually
- Provide nearly 50 direct jobs and create an estimated 100 to 150 indirect and induced jobs
- Next steps

Questions?