Barriers to Biomass Feedstock

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California Department of Forestry and Fire Protection

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Categories of Barriers

- Reliable Supply
  - Gross Biomass Forest Stocks
  - Technically Available Forest Stocks
- Permitting
  - Wood
  - Water
  - Other (Social License)
- Harvesting and Transportation
  - Cost
  - Equipment Needs
  - Efficiency
  - Research and Development

Reliable Supply of Forest Biomass

- Numerous estimates made by a variety of groups.
  - Vary in assumptions to reach estimates
  - Based of different geographic scales (state-regional-national)
  - Most start with Forest Inventory Analysis data

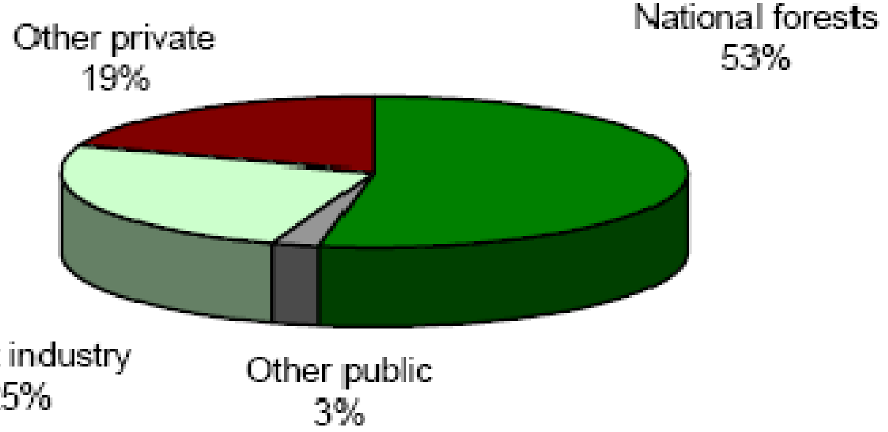
- California Biomass Collaborative, March 2008 estimate is conservative: (14.3 mm BDT/yr.)
  - Excludes Forest Reserves
  - Excludes Stream Management Zones
  - Excludes National Forest Lands with > 35% slopes
  - Excludes Private and other Public Lands with > 30% slopes

- Forestry is 32% of the Gross available biomass of 83 mm BDT/ yr. and 43% of the technically available biomass of 33 mm BDT/yr.

Timberland Base

Resource Area	Total private	Forest industry	Other private	Total public	USFS	Other public	Total
North Coast	2,738	1,402	1,336	675	535	140	3,413
North Interior	2,276	1,717	559	3,669	3,519	150	5,945
Sacramento	1,663	911	752	2,635	2,556	79	4,298
San Joaquin/Southern	515	146	369	2,173	2,120	53	2,688
Central Coast	245	22	223	62	55	7	307
California	7,437	4,198	3,239	9,214	8,785	429	16,651

Source: compiled by FRAP from Waddell and Bassett, 1996, 1997



Source: compiled by FRAP from Waddell and Bassett, 1996, 1997

California Biomass Collaborative, March 2008
An Assessment of Biomass Resources in California, 2007

Table S.1. Resources and generation potentials from biomass in California, 2007

Category	Units	Agriculture	Forestry	Municipal Wastes	Dedicated Crops	Total
Gross Resource	Million BDT/y	20.6	27	36	0	83
Technical Resource	Million BDT/y	8.6	14.3	9.6	0	33
Gross Electrical Capacity	MWe	1960	3580	3940	0	9,480
Technical Electrical Capacity	MWe	891	1907	1027	0	3,820
Gross Electrical Energy	TWh	15	27	29	0	70
Technical Electrical Energy	TWh	7	14	8	0	28
Existing and Planned Capacity	MWe	136	262	570	0	968
Existing and Planned Energy	TWh	1	2.0	4.2	0	7
Technical Capacity Net of Existing and Planned	MWe	755	1644	457	0	2857
Technical Energy Net of Existing and Planned	TWh	6	12	3	0	21

Forest Biomass Components

- Logging Slash – 8 mm BDT/yr.
- Forest Thinning – 7.6 mm BDT/yr.
- Mill Residue – 6 mm BDT/yr.
- Chaparral – 5 mm BDT/yr.

Forest Resources of the United States: W. Brad Smith; et.al.; 2005,

Table 38—Biomass on timberland in the United States by region, sub region, State, and tree component, 2002

Region, subregion, and State	All biomass	Live trees: All live	Live trees: Boles	Live trees: Tops	Live trees: Saplings	Sound dead
	Million dry tons					
Pacific Southwest:						
California	1,330	1,328	864	415	49	2
Hawaii	4	4	4	0	0	0
Total	1,334	1,332	868	415	49	2
Pacific Coast total:	5,064	4,951	3,391	1,356	204	113

Barriers to Reliable Supply

- Barriers –
  - Long – term sales contracts.
  - Approximately 53% (8.7 mil acs.) of the timberland land base is in USFS lands and availability is necessary .
- What Can be Done?
  - Federal policy needs to accommodate long-term sales contracts for biomass supply.

Permitting

Primary Permit – Timber Harvest Plan

Four Year History - Timber Harvesting Plans - Number/ Acres				
Year	No. Approved	No. Acres	Avg. Acs./Plan	
2008	355	139,365	393	
2007	403	133,876	322	
2006	416	128,312	308	
2005	485	126,957	262	
Emergency Notices/ Exemptions Submitted by Year				
Year	Exemptions	Emergencies		
2008	2,149	324		
2007	2,504	91		
2006	2,598	74		
2005	2,877	122		

Other Required Permits –

-Stream Alteration Agreements with Dept. Fish and Game

-Waste Discharge Permits – Regional Water Quality

-State and Federal Endangered Species Compliance

-Section 404 Permit – Corps of Engineers

-Local Use Permits – Eg. Road Ordinances

Permitting

- What is the Cost of a THP?
  - Average Plan Size - ~ 400 acres
  - Average Cost/ Plan - ~ $40,000
  - Range of THP cost is from $20K to $60K with extreme highs above $100K.
  - Biomass removed per acre ranges from 5 to 13 tons with an average of around 7 tons per acre.
  - Cost of permitting per ton removed is approximately
    - THP Cost / avg. acres. / tons per acre $40,000 / 400ac / 7 t/ac = $14.30/ton Permit cost
- Regulations for timber harvesting create an additional cost of compliance in the range of $10 – 15 / acre (BoF rough estimate)
- THP Cost does not include the cost to the landowner of the inspection program/ compliance during harvest.
- Public concern can add to cost during and following THP process through communication and litigation.

Permitting

- What Can be Done –
  - Public Education on Biomass benefits
    - Reduces conflict for permit approval and post approval litigation
  - Create lower cost permits for lower impact operations.
    - Board of Forestry and Fire Protection has created exemptions for fuel hazard reduction projects (similar to building standard approach)
    - Board is working on revision to Modified THP which has restricted harvesting standards, but reduced permit costs.
  - Continue to work to maximize regulatory efficiency –
    - Lead Agency process creates information necessary for approval of other permits.

Before Treatment

After Treatment

Biomass Harvesting/Transportation Costs

TABLE 1. — Comparison of five mechanized fuel reduction treatments.

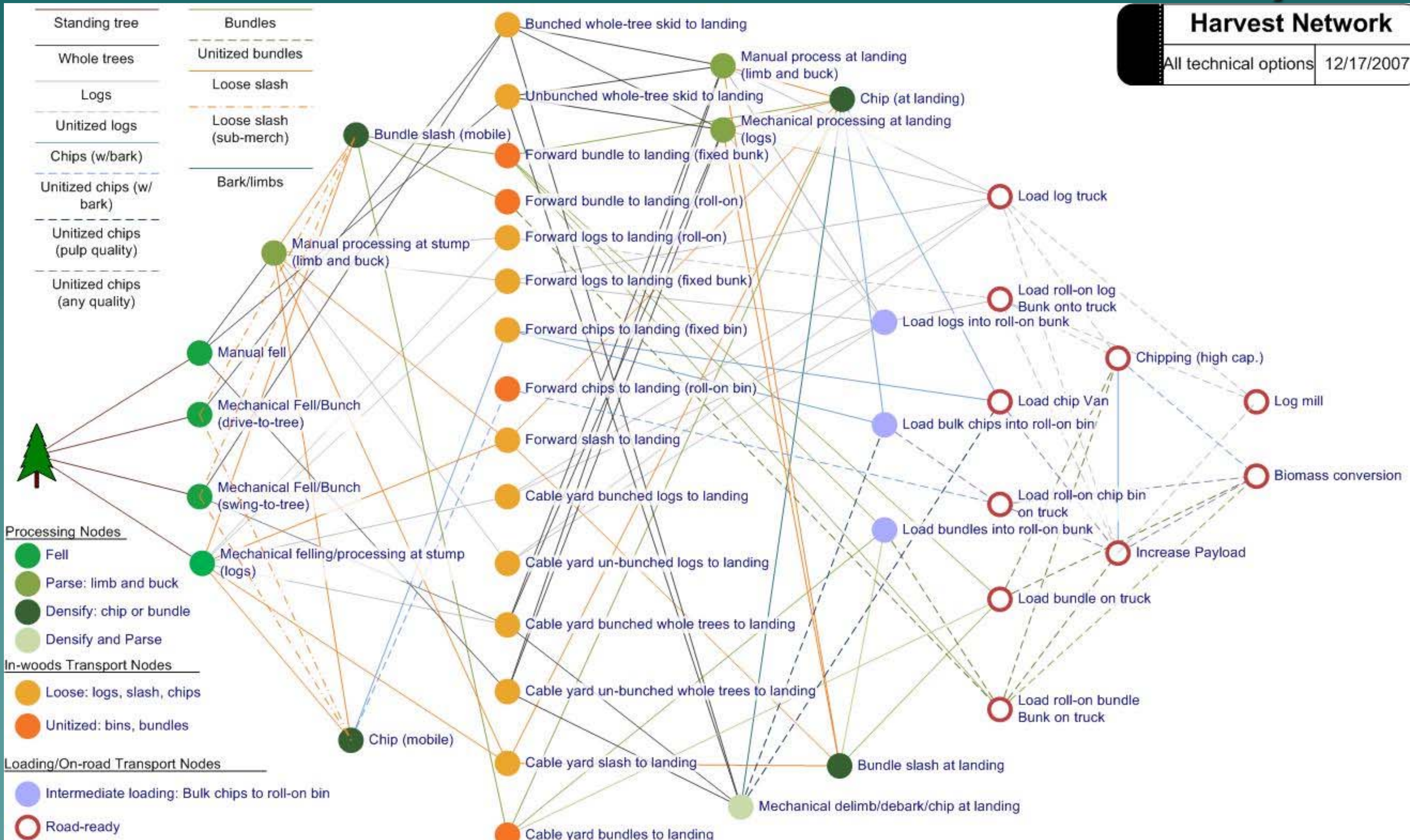
System	Reference	Treatment Location	Productivity (tons/SMH)	Cut-n-haul cost ($/ton)
Harvester/small yarder	Brown and Kellogg (1996)	OR	7.00	42.44
Harvester/small yarder	Drews et al. (2001)	OR	5.40	79.93
Small-scale harvester/forwarder	Rummer and Klepac (2002)	WY	2.88	40.94
Harvester/forwarder	Drews et al. (2001)	OR	8.10	45.73
Harvester/forwarder/chipper	Bolding (2002)	AL	5.82	37.06
Average			5.84	49.22

Forest Fuels Reduction: Current Methods and Future Possibilities, M. Chad Bolding et.al. ; Proc. 26th Annual Council on Forest Engineering Meeting; Bar Harbor, ME.; 2003

CBC Equipment Review by Bruce Hartsough , 2008

- Looked at the array of equipment available for forest biomass harvesting
- Estimated costs per unit of harvesting and transportation/ different scenarios
- What can be done to improve these cost factors?

Possible Harvest Process Steps



Equipment, Past & Present

- Comminution
- Densification
- Extraction (primary transport)
- Felling
- Loading
- Processing
- Transport

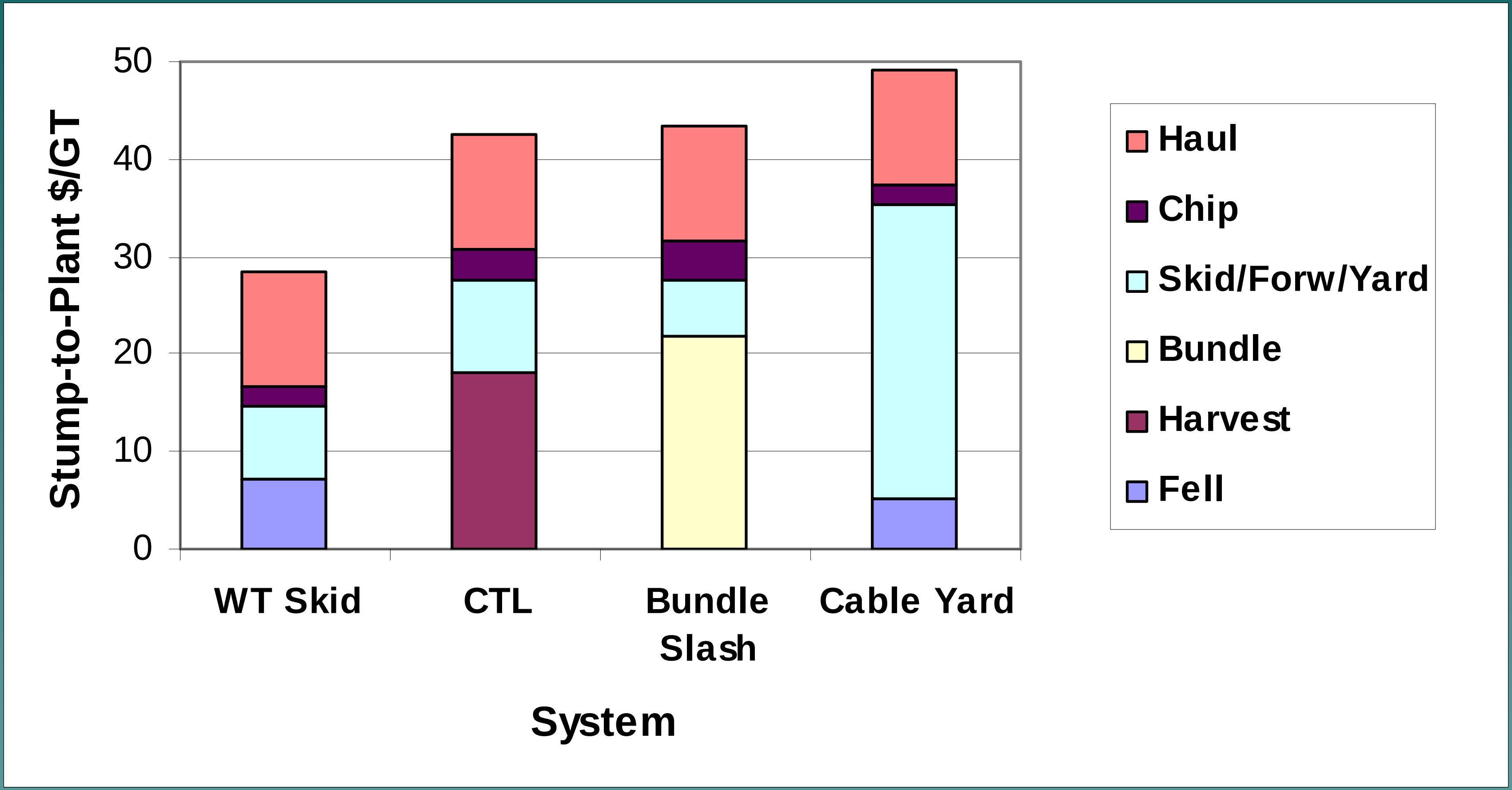
Productivity & Cost

- Productivity
  - Based on results of empirical studies where available
  - Simulated where necessary
  - Covered a range of tree sizes: 4-10” dbh
  - Slopes as relevant for specific equipment: 10, 30, 60%
- Hourly cost
  - Used standard machine-rate approach
- Base Case Scenarios were used to provide cost estimates

Figure 8. Yarder-processor.
Source: McMass Industries

Figure 10. Harwarder.
Source: Pinox Oy

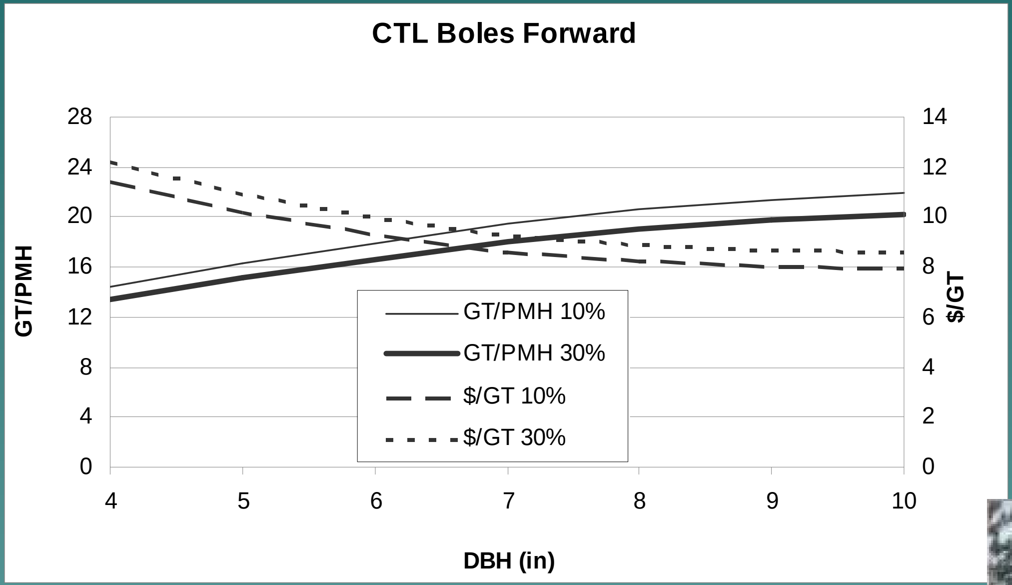
Base Case Woods to Landing Systems



- Removals: 45 GT/ac (190-7" trees/ac)
- 500' skid, 30% slope (60% for cable), 50-mi haul
- Results of $30-50/GT including $12/GT transportation

Scenario Example

- Ground Based – Cut to Length - Forwarder



What Can Be Done?

- Some Recommendations – http://biomass.ucdavis.edu/
  - Harvesting on gentle slopes is more efficient with mechanized whole tree systems (feller-buncher, skidder, chipper) and provides less cost per ton to the landing
  - Existing clambunk skidders or a conventional skidder with a large grapple appear to have potential for increasing the size of skidded payloads and decreasing skidding costs.
  - Consider chunking. Chunkers require less energy per ton to comminute than do chippers, so they could be applicable if the downstream users can utilize material larger than standard chips.
  - Partially dry trees and residues prior to comminution and transport. Post-felling air-drying is the least expensive method of reducing transportation costs.
  - Continue development of roll on/ roll off bins and stinger van trailers

What Can Be Done ? (cont/d)

- Research and Development –
  - Develop automated felling and bunching equipment – Allows operator to focus on tree retention and removal.
  - Develop a continuous-travel feller buncher – Reduces cost per ton but is a challenge where selective harvest is to be used.
  - Increase strip width. For a given production rate, increasing the width of the strip within which a machine can acquire reduces the required travel speed.
  - Develop a combination feller-buncher-yarder to combine the advantages of bunching and of tethering the felling equipment on steep terrain.
  - A yarder-chipper, or a yarder-loader feeding a separate chipper, would provide the same advantage for a system producing comminuted energy feedstock rather than roundwood.
  - Train operators. Simulators such as the Simlog products for CTL systems help new operators come up to speed more rapidly while eliminating much of the downtime caused by inexperienced personnel.

No Silver Bullet

- Bruce Hartsough – There are interesting concepts out there for cost reduction, however, costs will still be high for harvesting and transportation. To get the reduction additional research will need to be done. No magic answers.
- With proper equipment selection, planning, and training operation costs can be lowered in the range of a 10 to 20%.
- Research, Development, and Demonstration is needed for the varied terrain and forest condition in California (not the Southeast)

The End

- Equipment Examples -