

# UTILIZING CALIFORNIA TREE MORTALITY

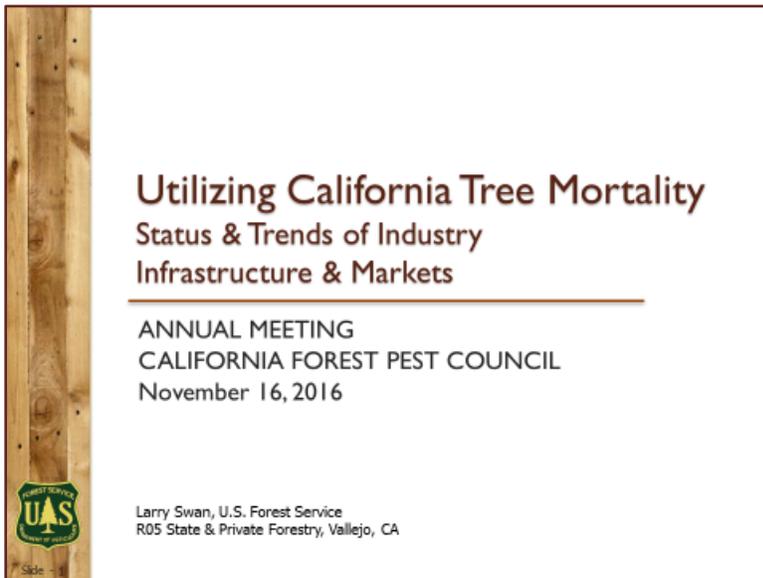
Status & Trends of Industry Infrastructure and Markets

CFPC Annual Meeting, UC Davis

November 16, 2016

Larry Swan, U.S. Forest Service

## SLIDE 1, TITLE



**Utilizing California Tree Mortality**  
Status & Trends of Industry  
Infrastructure & Markets

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ANNUAL MEETING  
CALIFORNIA FOREST PEST COUNCIL  
November 16, 2016

Larry Swan, U.S. Forest Service  
R05 State & Private Forestry, Vallejo, CA



Slide 1

## SLIDE 2, OUTLINE



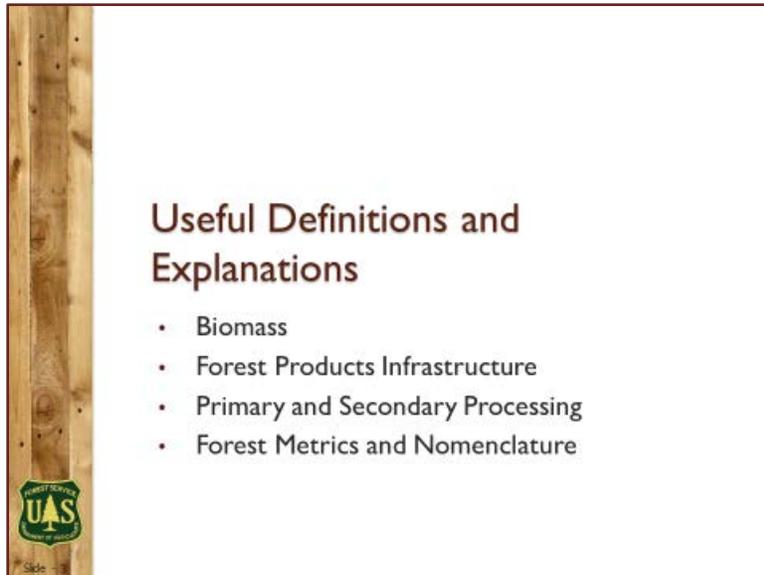
**Outline**

- Current Status, California Primary Processing Industry Infrastructure
- Current Status, Central & Southern Sierra Primary Processing Industry Infrastructure
- Status & Trends, Central & Southern Sierra Log & Fiber Markets
- Infrastructure Trends, Central & Southern Sierra Industry Infrastructure
- Other Utilization Pathways, Old and New



Slide 2

## SLIDE 3, USEFUL DEFINITIONS AND EXPLANATIONS



### Notes for Slide 3

**Biomass** - The term biomass refers to structural and non-structural carbohydrates and other compounds produced through photosynthesis consisting of plant materials and agricultural, industrial, and municipal wastes and residues. The components of biomass include cellulose, hemicelluloses, lignin, lipids, proteins, simple sugars, starches, water, hydrocarbons, ash and other compounds (unattributed citation).

**Forest Biomass** – Byproducts or residuals from forest management and wood processing. Forest biomass directly from the woods is usually either ground or chipped into smaller particles. Wood processing waste includes hog fuel (general term that includes bark), chips, sawdust and shavings.

**Ag Biomass** – For the purpose of this presentation, agricultural biomass includes prunings, orchard removals, and food processing residuals, such as shells, pits and hulls. Manure, corn stover, pomace (i.e. seeds, stems and skins left over from making wine) and other “wet” material are not usually included in this definition for conventional biomass energy plants in California (i.e. does not include biodigesters).

**Urban Biomass** – Urban biomass includes green waste (tends to be higher moisture content), construction and demolition debris, pruning and tree removals, and pallets/dunnage. Urban biomass normally requires additional sorting to remove contaminants, such as plastic, metal, and treated wood.

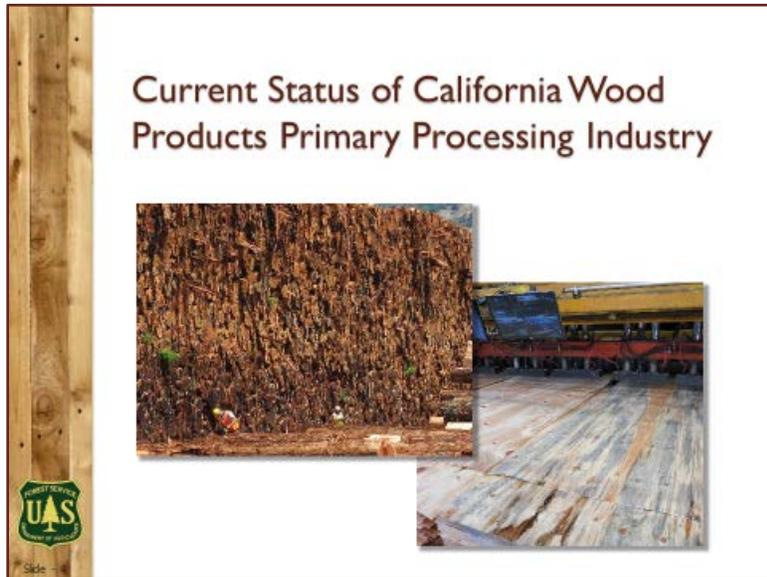
**Forest Products Infrastructure** – Includes management, harvest, transportation, processing, marketing, distribution, and related specialized skills and support, such as financial/insurance services and equipment/supplies vendors, for logs, residuals, and finished products.

**Primary vs Secondary Processing** - 1° processing refers to conversion of logs to lumber, chips, posts/poles, mulch, shavings, pellets (pellet furnish is rarely made from logs in the Western U.S.), particle board (the one California particle board plant is attempting to make some of its furnish from logs), and other products. 2° processing refers to further processing and adding value to 1° products, like pallets and dunnage, I-beams, roof trusses, millwork (e.g. windows, doors and flooring), furniture, cabinets etc.

**Forest Metrics and Nomenclature** - Forest and wood products measurements are sometimes referred by outsiders as a professional “black box”. One example of why metrics and nomenclature are important is when board feet (i.e. “bd ft” or “BF”) are discussed: Standing timber (cruising), logs (scaling) or lumber (board foot tally, nominal).

The same is true for moisture content: Is it “dry basis” (usually for lumber, veneer, and millwork; i.e. the difference between initial mass – oven dry mass/oven dry mass) or “wet basis” (usually for chipped or ground wood; i.e. difference between initial mass and oven dry mass/initial mass. [Note: “Oven dry” or “bone dry” weight is obtained by following ASTM protocol.]

#### **SLIDE 4, CURRENT STATUS OF CALIFORNIA WOOD PRODUCTS PROCESSING INDUSTRY**



#### **Notes for Slide 4**

##### **Photo Credits**

Photo 1, Log Deck, Redwood Empire, Cloverdale (L. Swan, USFS, 7/2016)

Photo 2, Blue Stain Veneer, Roseburg Forest Products, Weed (L. Swan, USFS, 8/2016)

**SLIDE 5, TABLE, CALIFORNIA WOOD PRODUCTS PRIMARY PROCESSING INFRASTRUCTURE**



## California Wood Products Primary Processing Infrastructure (11/2016)

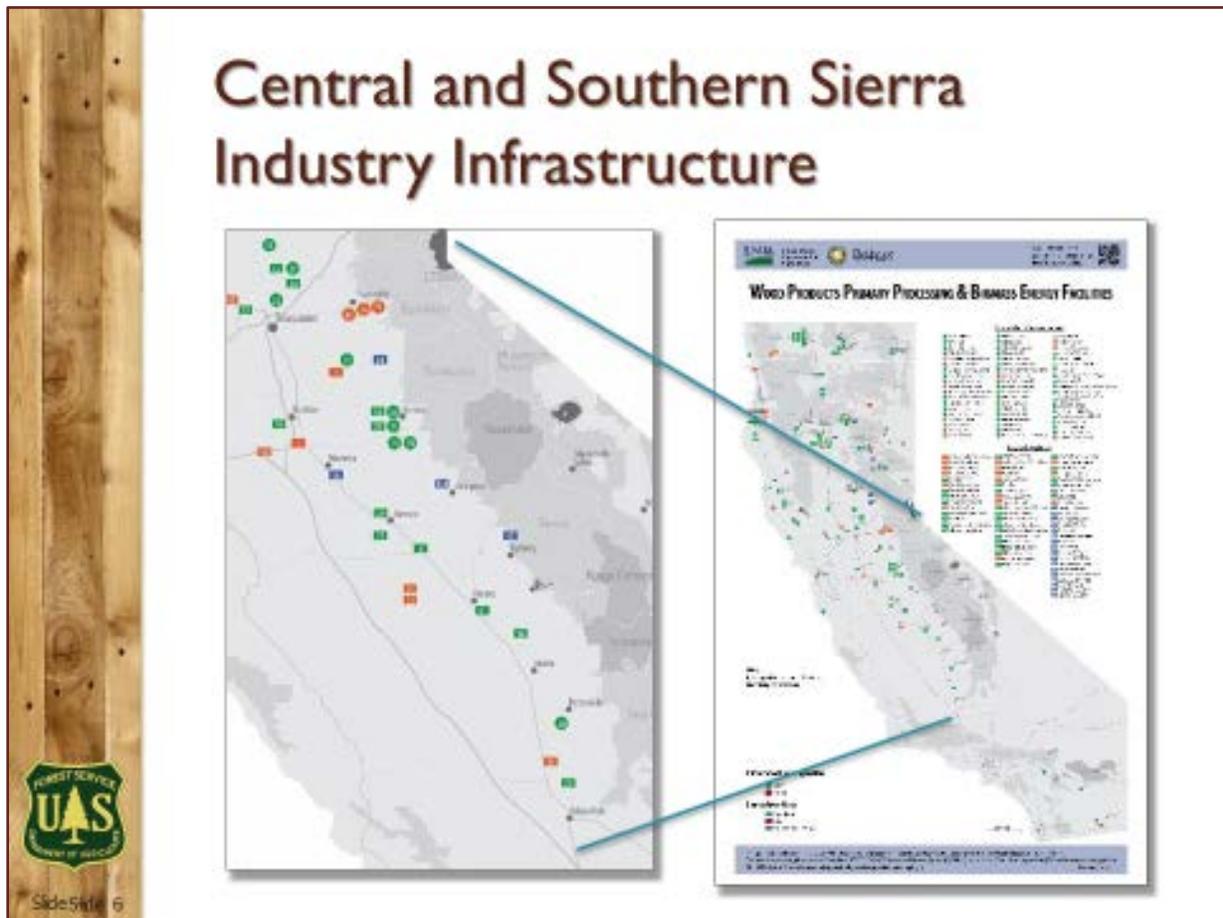
Geographic Area	Sawmills	Veneer Plants	Post & Pole	Whole Log Shavings Mill	Total
Central & North Coast	11	0	0	0	11
Northern Calif.	9	2	2	0	13
Central & Southern Sierras	4	0	0	1	5
Southern CA	1	0	0	0	1
<b>Total</b>	25	2	2	1	30



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**Notes for Slide 5**

**Observations for Central and Southern Sierra** – Statewide processing capacity is not ideally located for current tree mortality volume. Central and Southern Sierra sawmills include SPI Lincoln (large and small log mills in one complex), SPI Sonora Standard (large log mill), SPI Chinese Camp (small log mill), and Sierra Forest Products (Terra Bella) (large and small log mill) (actual total primary breakdown systems = 6).



**Notes for Slide 6**

**Statewide Map** – Statewide map is updated quarterly. There is also an interactive electronic version which includes biomass power and primary wood products processing plants, major utility company service areas, and other layers. Background data set is maintained in cooperative effort between UC Berkeley Biomass Center and Forest Service, State & Private Forestry. Hardcopy map version is maintained by Forest Service. Link to UC Berkeley Interactive Map: [http://ucanr.edu/sites/WoodyBiomass/Technical\\_Assistance/California\\_Biomass\\_Power\\_Plants/](http://ucanr.edu/sites/WoodyBiomass/Technical_Assistance/California_Biomass_Power_Plants/)

## SLIDE 7, CALIFORNIA FOREST RESIDUALS INFRASTRUCTURE



### Notes for Slide 7

#### Photo Credits

Photo 1: Sawdust, Sycan Forest Products, Dairy, OR (L. Swan, USFS, 1992)

Photo 2: Forest thinning operation, chipper and forwarder, unknown location and photographer.

**Forest Biomass** - For the purpose of this presentation, forest biomass is residuals from forest management and wood processing. Forest biomass directly from the woods is usually either ground or chipped into smaller particles. Processing waste includes hogfuel (includes bark), clean chips, sawdust and shavings.

**Disposition of Harvest** - In 2012, out of the 421 million cubic feet (MMCF) harvested from public and private lands, 229 MMCF (54%) was used to generate biomass energy (steam or electricity), 115 MMCF was converted to lumber (27%, also includes lumber shrinkage of 5% of total volume harvested), 42 MMCF (10%) was used for animal bedding and mulch products, 17 MMCF (4%) was used for veneer, posts/poles and firewood, and an equal amount, 17 MMCF (4%), was used for particle board and MDF. Reference: *California Forest Products Industry and Timber Harvest, 2012* (McIver et al. 2015).

**Disposition of Processing Residuals** - A robust wood processing byproducts market is critical to the health of wood processing plants. For example, about 50% of the log processed at a sawmill comes out as lumber and the remainder is residuals, including bark, clean chips, shavings, and sawdust. If mills cannot economically dispose of their residuals, they become non-competitive and are closed.

**Forest Service Biomass Example** - In California, National Forest System lands produce about 381,000 BDT of biomass, with about 75% coming from saw log processing (285,750 BDT) and the remainder in-woods biomass (95,250 BDT).



## California Forest Residuals Infrastructure (11/2016)

Geographic Area	Co-Gen Power Plants	Majority Forest Fuel Power Plants	Composite Panel (particle bd)	Bark & Chip Mulch Plants	Shavings Pkg. Plant	Densified Fuel Plants	Mulch & Soil Amends.	Plants With Rail Sidings With Bulk Loading
Central & North Coast	1	1	0	0	0	0	2+	(?)
Northern Calif.	6	2	0	2	1	1 (?)	(?)	5
Central & Southern Sierras	2	1	1	1	0	1	(?)	2
Southern CA	0	0	0	0	0	0	2+	1
<b>Total</b>	<b>9</b>	<b>4</b>	<b>1</b>	<b>3</b>	<b>1</b>	<b>2(?)</b>	<b>4+</b>	<b>8+</b>

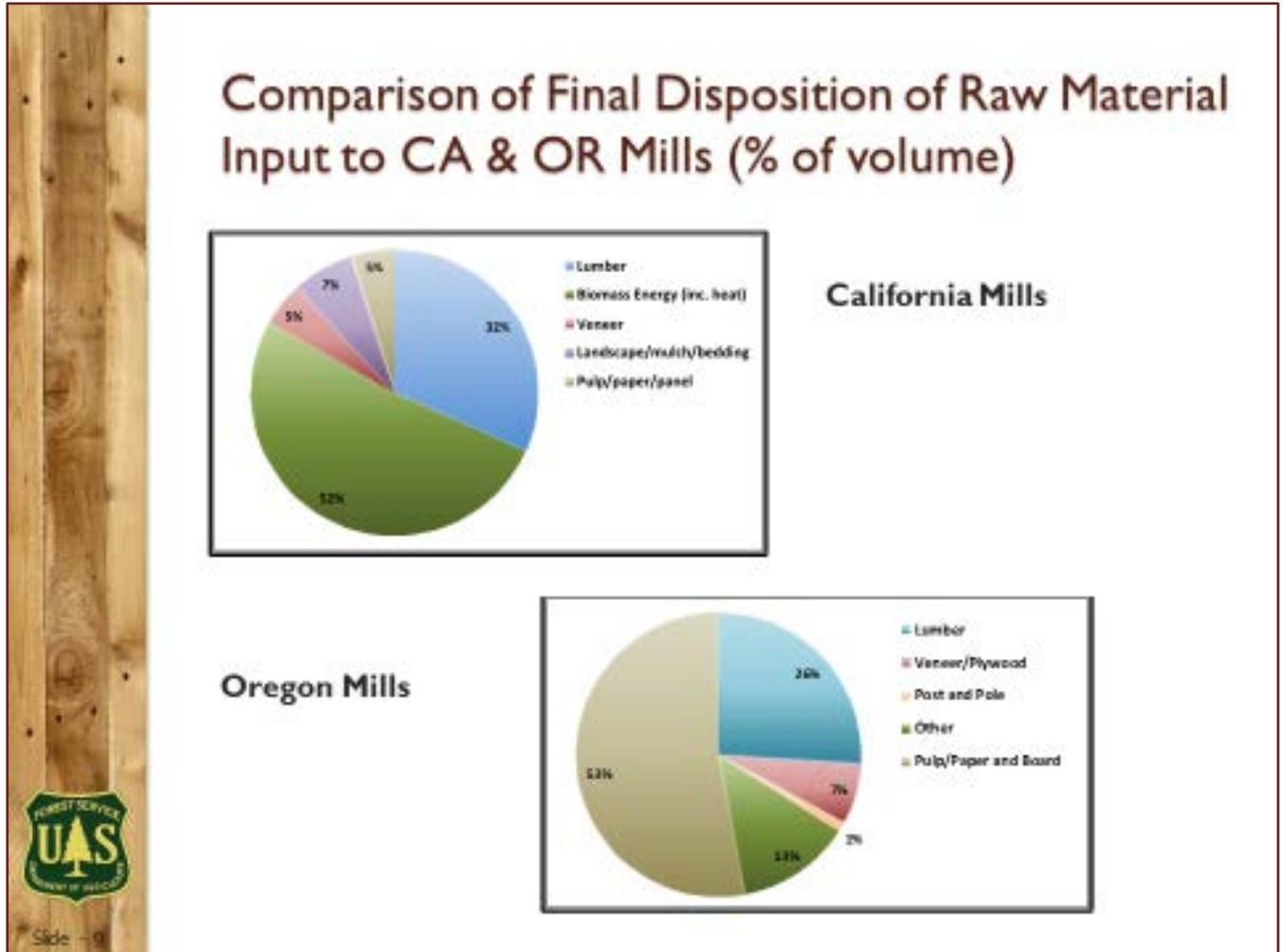
Slide - 8

**Notes for Slide 8**

**Statewide Observations** – There are no pulp/paper plants remaining in California, so clean chips have to be shipped out-of-state or used for hog fuel or mulch. Pulp/paper chip market is currently poor throughout the PNW and clean chips in California are being burnt for hog fuel or put into mulch markets. There is no significant densified fuel production or related product lines (e.g. animal bedding and BBQ pellets) in California, and no current significant bulk or container export of clean paper chips.

**Observations for Central and Southern Sierra** – The only composite panel plant in California is located in the Central Sierra (i.e. particle board, Martell). There are significant bark, clean chip, and ground mulch and soil amendment markets because of orchard nursery operations in Southern San Joaquin and proximity to S. California. Also only whole log shavings mill in California is located in this area, one of three on the West Coast (others are in Redmond and Cascade Locks, OR).

**SLIDE 9, GRAPHIC, COMPARISON OF FINAL DISPOSITION OF RAW MATERIAL INPUT TO CALIFORNIA & OREGON MILLS**



**Notes for Slide 9**

**Graphic Credit**

Pie Charts were excerpted from *An Assessment of Wood Business Innovation Opportunities and Markets, Phase 1, Interim Report* (completed by The Beck Group for the National Forest Foundation, with funding from the USDA Forest Service, Pacific Southwest Region), see <https://www.nationalforests.org/who-we-are/regional-offices/california-program/california-assessment-of-wood-business>.

**California** - Nearly three quarters of the raw material (i.e. logs) that is further processed in California goes into sawmills. However, sawmills convert less than half of that material into lumber, with much of the balance going into biomass energy, landscape/mulch/bedding, and the panel industry. Note that there is no remaining pulp and paper industry in California, but to allow for time series comparisons in the data there is still a “pulp/paper/panel category”.

**Oregon** - Unlike California, the “Pulp/Paper and Board” category [i.e. composite panels] accounts for the highest proportion of fiber disposition in Oregon. Also note that the “Other” category in Oregon includes biomass energy and is only 13 percent of the fiber disposition in Oregon.

## SLIDE 10, STATUS AND TRENDS OF CENTRAL AND SOUTHERN SIERRA LOG MARKETS



### Notes for Slide 10

#### Photo Credits

Photo 1, Siskiyou Complex, Oregon (L. Swan, 7/2008)

Photo 2, Blue Stain Pine Lumber, SPI Sonora Standard (L. Swan, 7/2016)

**Log Market** – With the exception of the North Coast, the log market in California has been dominated by fire salvage and insect/disease logs, especially in the Central and Southern Sierra, for at least the last 3 years and for the last 2 years there has been a huge increase in drought/bark beetle mortality. SPI Lincoln noted that they have been cutting fire salvage for the last 3 yrs as has the SPI Sonora-area mills and Sierra Forest Products. SPI Sonora-area mills and Sierra Forest Products also have been cutting primarily drought/bark beetle mortality the last 1.5 yrs.

**Log Market, Species Changes** – Mills from Sonora south are seeing a heavy increase in pine because of drought/bark beetle mortality - up to 80% of species mix, which is close to double normal green volume of some mills.

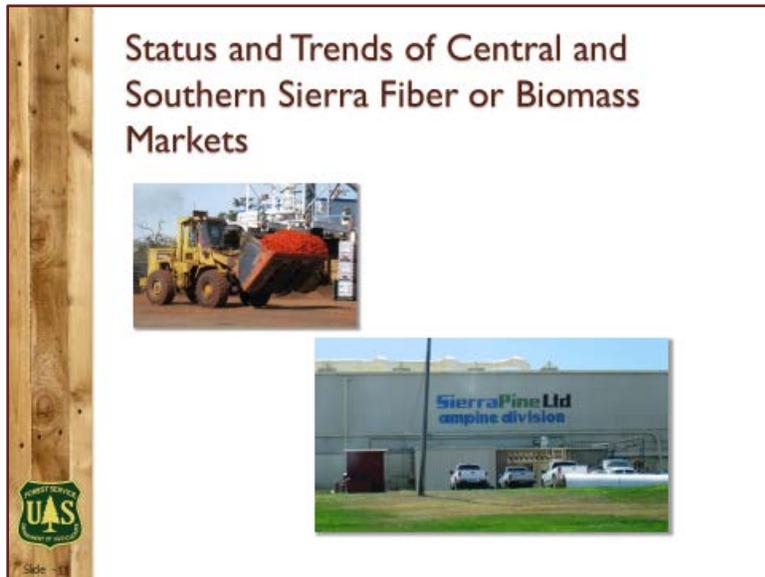
**Log Quality Changes** – Drought/bark beetle logs showing blue stain while still have green needles. Logs are drier, which creates issues with cracking and checking. These are considered serious saw log defects when scaled, which greatly reduce non-defect volumes and value. Insect holes are also showing up quicker, which affects log and lumber quality and prices.

**Export Log Market** – Export log market is more active than in many years in Central and Southern Sierra. This is somewhat unusual because of general Chinese log market downturn and reduction in West Coast log exports in general. One size estimate for the particular Chinese log market where most logs are going from the Central and Southern Sierra is up to 200 MMBF/yr in size. Probably will hit 80-90 MMBF this year from the two main exporters. Log quality is becoming a serious issue though. According to one source, started summer 2016 with 2-3% log defect, but by early fall was at 40% defect, which means cannot accept those logs because paid on net scale, not gross scale (serious defects, such as cracking, can apparently open up over a weekend). Have tried end coating and water, but did not make enough difference. Federal log export waiver also being discussed.

**Scenario 1** – Using mid-2016 Aerial Detection Survey data, the Forest Service estimated about 3.7 million dead trees were critical to be removed from high hazard zones. Assuming about 1.23

BDT/tree, this equals about 4.5 million BDT. Assuming about 6.5 GT/MBF and 2 GT/BDT, this equals approximately 1.4 billion bd ft (log scale). Most of this volume is in the Southern Sierra at this point. Assuming this volume can be marketed for up to 3 years (which is becoming increasingly debatable), then 1.4 billion BF/3 years = 467 MMBF/yr. To process 467 MMBF/yr would require doubling the combined capacity of SPI Lincoln, SPI Sonora Standard/Chinese Station and Sierra Forest Products (467 MMBF/235 MMBF), even if transportation costs were ignored.

## SLIDE 11, STATUS AND TRENDS OF CENTRAL AND SOUTHERN SIERRA FIBER OR BIOMASS MARKETS



### Notes for Slide 11

#### Photo Credits

Photo 1, SPI Bark Mulch Plant, Jamestown (L. Swan, 7/2015)

Photo 2, Sierra Pine Particle Board Plant, Martell (L. Swan, 7/2015)

**Fiber Quality Changes** – Wood fiber quality will probably decline significantly within 5-7 yrs. Certain niche markets will not accept blue stain fiber, such as Japanese fuel pellet exports and large animal bedding (e.g. race horse) (in both cases, blue stain is seen as mold).

**Fiber Market Exports** – Have not seen any upturn, although businesses continue to check out potential. Domestic market is poor (e.g. pulp/paper).

**Bark** – Bark mulch continues to be most valuable fiber market.

**Biomass Power Industry** – N. California has better cost structure, and less competition from ag and urban. Southern San Joaquin has had least appealing cost structure, and more competition from ag and urban.

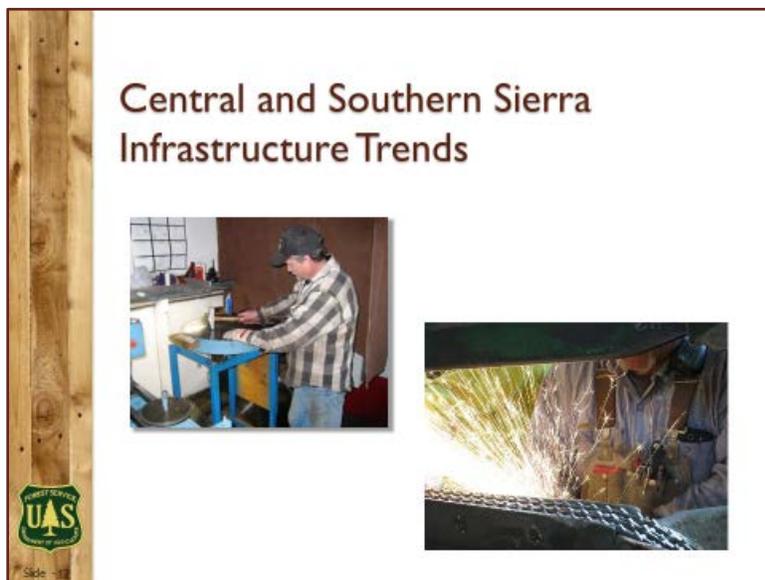
**BioRAM 1 and 2** – Governor's Emergency Proclamation for 50 MW/yr of biomass power (BioRAM 1) (Bioenergy Renewable Auction Mechanism) and SB 859 with 125 MW/yr of biomass energy (BioRAM 2) makes things more interesting. The utilization requirement for forest biomass is about 140 MW/yr (in-woods and processing residuals). Without these interventions, would have seen at least 198 MW/yr of biomass power contracts expire since June, 2016, of which at least 2-3 are

closest to the main tree mortality volumes in the Central and Southern Sierra. Will not know results until probably early December.

**BioMAT** – The Bioenergy Market Adjustment Tariff (BioMAT) program implements SB 1152 for small biomass power plants (<3 MW to the grid). It describes the mechanism by which the PPA price for electricity increases using an auction process. Projects are just now gaining some momentum. One facility has broken ground (North Fork, 1 MW) and expect another couple within 12 months. About 10 facilities are in development or planning (estimated 20 MW total or about 160,000 BDT potential consumption of biomass).

**Scenario 2** - Assuming that minimal saw logs will be salvaged from tree mortality after the next year or two, then the “critical” 4.5 million BDT (mid-2016 estimate) that needs to be removed from high hazard zones will probably have to go to fiber markets, such as biomass power. Assuming conservatively 5 yrs of adequate fiber quality, this would be about 900,000 BDT/yr, most of which is currently in the central and southern Sierra. This amount of fiber would require about 5 plants the size of Pacific Ultrapower (Chinese Station) or Rio Bravo Fresno to consume, assuming forest mortality is their only fuel source and there is sufficient funds to subsidize removals. Realistically about \$60 – \$70 million per year is needed to make this happen, assuming government agencies find funding for project planning, prep and implementation.

## SLIDE 12, CENTRAL AND SOUTHERN SIERRA INFRASTRUCTURE TRENDS



### Notes for Slide 12

#### Photo Credits

Hammering Out Circular Saw, Malheur Lbr., John Day, OR (L. Swan, USFS, 11/2015)

Millwright Grinding, Fruit Growers Supply, Yreka, CA (L. Swan, USFS, 3/2016)

**Processing Infrastructure** – No major changes in sawmill capacity is projected, but everyone would prefer less blue stain pine, and a larger percentage of fir and cedar. The Forest Service has contacted a variety of industry players within and outside of California, but industry and investor appetite is minimal for large quantities of blue stain pine.

**Residuals Infrastructure** – Biggest changes could be because of SB 859 and keeping open several biomass power plants open that were projected to close. It will be very challenging though, to supply even medium-size biomass power plants with the required 80% forest fuel.

**Transportation** – Key issue is availability of log trucks when needed. In part has to do with Tier 4 emissions control technology and new equipment purchase costs.

**Specialized Skills and Knowledge** – Have been running into faller shortage – utility power line hazard tree removal contractors offer higher wages. In general, most mills have open entry-level positions that are difficult to keep filled. Sierra Forest Products runs an extended “1 shift” and does not foresee adding a shift, in part due to shortage of supervision and skill positions, such as millwrights and electricians.

**Capacity Increase, BioMAT and Other Projects** – Expect to see 2-3 BioMAT projects developed in Central and Southern Sierra over the next 3-4 years, and possibly other miscellaneous projects, such as additional whole log shavings and mulch/soil capacity. In total, this might add about 156,000 GT of fiber consumption capacity or about 24 MMBF equivalent. Critical aspect for economic success will be co-located businesses.

### SLIDE 13, WHAT MORE COULD WE BE DOING?



#### Notes for Slide 13

**Firewood** - The U.S. Forest Service in California estimates that in 2015 about 107,000 tons of firewood (12% MC) were cut and transported from National Forests. The most volume came from five National Forests: Lassen NF (19,089 tons), Shasta-Trinity NFs (15,361 tons), Plumas NF (13,584 tons), Klamath NF (13,387 tons), and Inyo NF (7,290 tons).

\*Conversion used was average 28 lbs/cf @ 12% MC air-dried (PP and JP). Did not include adjustment for hardwoods.

**Industrial Compost Examples** – Enclosed facility owned and operated by Inland Empire Regional Composting Authority, Rancho Cucamonga, consumes about 60,000 tons/yr of wood waste. Outdoor facility owned and operated by Synagro, Taft, consumes up to 100,000 tons/yr of wood waste.

**Specialty Mulch Markets** – Includes playgrounds and pathways. Also niche market for biofilters, which are primarily used in California to reduce odor. Specs are tight. Customers are mainly wastewater treatment facilities and composting facilities that utilize biosolids. There are artificial substitutes, but these are more costly, however, they do not have to be replaced as often. The biofilter at the Inland Empire Regional Composting Authority, Rancho Cucamonga, is probably the largest one on the West Coast (about 32,700 cu yds or 8,000 gt).

**Post & Poles** – Currently 2 manufacturers in California, SPI Anderson Pole Plant (utility grade pole) and Blue Lk. Round Stock (Anderson). California probably has largest post/pole mkt. in Western U.S. because of trellising systems used for some crops in the Central Valley and elsewhere.

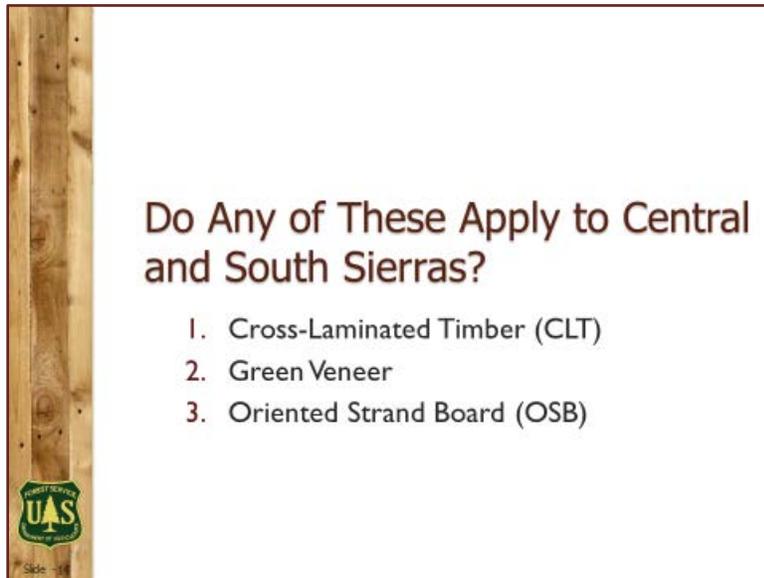
**Animal Bedding, Whole Log Shavings Plant** - The only whole log shavings plant in California is California Wood Shavings (American Wood Fiber), Jamestown, CA. There are two whole log shavings manufacturers in Oregon, one in Redmond and the other co-located at the Bear Mountain Forest Products pellet plant in Cascade Locks. Historically, the animal bedding market on the West Coast has been served by sawmill residues (shavings), however, as the number of mills decreased, demand for shavings grew with the increasing population. A whole log shavings plant with 2 modern shavings machines can utilize over 21,000 gt/yr of logs. American Wood Fiber also runs a bagging plant in Marysville using sawmill residues.

**Densified Wood Products** – Aware only of Mallard Creek (Sacramento), which uses remanufacturing residue. Also understand from an industry source that Siskiyou Forest Products (Anderson) may make or have made fire logs (unconfirmed). Fire brick feasibility study in the Sonora area was completed a few years ago by Andrew Haden (OR). California is an attractive market for residential fuel pellet manufactures and there continue to be on-going discussions at various locations.

**Semi-Stationary Sawmill** – One experienced semi-stationary sawmill operator estimates he can cut about 1 TL of logs per day with his current band mill operation (about 5 MBF log scale/TL). He also said he produces 1,100 – 1,200 BF lumber scale/hr. Assuming a 6 hr day this means about 7 MBF lumber production/day. Most mobile mills in California are probably on the coast, from Santa Cruz north to Eureka. The one operator thinks California might be in the top 3-5 states in terms of the number of small, portable mills, with NY, GA and TN ahead, with perhaps 1,500 – 2,000.

**Impact Example, 1 Band Mill, Experienced Operator** – Assume 5 MBF log scale consumption /day, 208 production days, 1 shift:  $208 \text{ production days/yr} * 5 \text{ MBF/day} = 1,000 \text{ MBF/yr}$  (1.0 MMBF). Assume 15 MBF/ac tree mortality:  $1,000 \text{ MBF/yr} * 1 \text{ ac/15 MBF} = 67 \text{ ac/yr}$ .

## SLIDE 14, DO ANY OF THESE APPLY TO CENTRAL AND SOUTH SIERRA?



### Notes for Slide 14

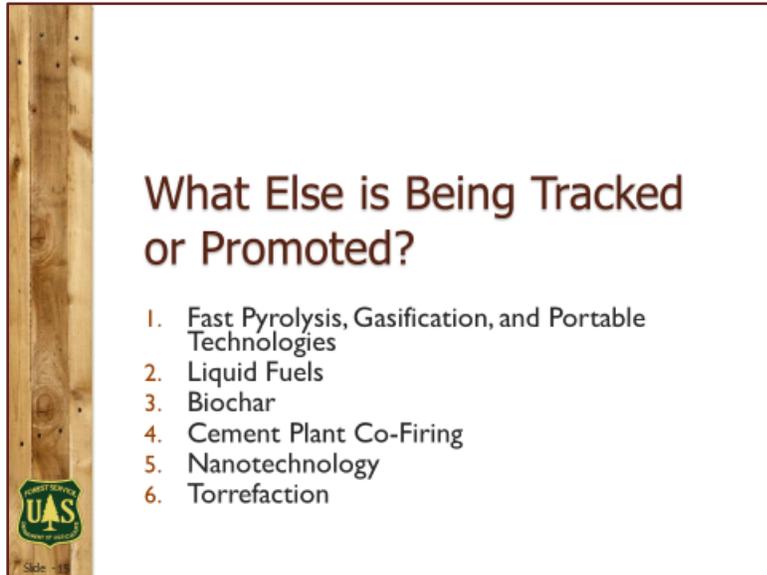
**Forest Service-Funded California Wood Products Industry Assessment** - Special funding from the Forest Service was obtained to perform an assessment of current deployed technology and industry in California, and what might be deployed in the near future to increase the pace and scale of ecosystem restoration treatments. Reports (2) are posted on the National Forest Foundation web site (<https://www.nationalforests.org/who-we-are/regional-offices/california-program>) and UC Berkeley Biomass Center web site (<http://ucanr.edu/sites/WoodyBiomass/>, see the Library tab).

**Cross-Laminated Timber (CLT)** – Cross laminated timber (CLT) is an engineered wood product made of alternating layers of dimensional lumber. The development of a CLT market will be the first new use of dimensional lumber in many years. The CLT slabs can be used for such things as well drilling pads and bridge decking without modification. CLT can also be used in buildings, where if properly engineered and designed, can be installed much quicker than standard building techniques allow (cost savings). CLT is used more in Europe than the U.S. At this point, there are only four plants in N America, 2 in Canada and 2 in the U.S. Two CLT plants in Western U.S. are: D.R. Johnson, Riddle, OR, and SmartLAM, Columbia Falls, MT. Architects indicate the key factor holding back the market is lack of supply. Uncertain how much blue stain pine lumber can be used.

**Veneer Plants** – Two existing veneer plants in N. California, Timber Products (Yreka) and Roseburg (Weed). None further south because of species preference (DF), appropriate supply, and proximity to Southern Oregon plywood and laminated veneer lumber (LVL) manufacturing base. However, can use blue stain pine and some insect holes in plywood interior core layers.

**Oriented Strand Board (OSB)** – OSB is a structural panel that has wide use in buildings and industrial applications. Initial investigations by The Beck Group indicated closest OSB suppliers for CA, which is the Western U.S. largest market, are about 1,000 miles away in British Columbia and Texas. Initial feasibility study indicated that an OSB plant would require about \$166 million capital investment and require 670,000 GT/yr, and might affect up to 27,000 ac of forestland annually. It is assumed the OSB plant would pay about \$23.5 million annually for raw material. Forest Service provided grant funds to conduct more detailed due diligence with interested company for a N. CA location. All investigations are taking place in Anderson area because of fiber requirements and potential access to sawmill residuals (if switch from chipping heads to stranding heads).

## SLIDE 15, WHAT ELSE IS BEING TRACKED OR PROMOTED?



### Notes for Slide 15

**Gasification (partial air)** – Not new, but not well proven commercially in U.S. at the scale needed for BioMAT projects. However, there is high interest and commitments from many BioMAT projects.

**Fast Pyrolysis (no air) and Liquid Fuels** – Liquid fuel examples include biooil, cellulosic ethanol, butanol, and with further refining, jet fuel, diesel and naphtha (Red Rock Biofuel example, 140,000 bdt and 15 million gallons of liquid products). No large scale commercial facilities yet operating in U.S.

**Portable Technologies** – Several demo. units for fast pyrolysis and gasification technologies have made inquiries about locations to operate over the last 3-4 years, but potential host responses have been restrained.

**Liquid Fuels** – Red Rock BioFuels LLC (Lakeview, OR) has obtained necessary permits, but construction not yet started. Red Rock BioFuels is planning to make diesel, jet fuel, and naphtha (140,000 BDT/yr input and 15 million gallons/yr of liquid products output). If successful, this would be the first large scale wood cellulose to liquid fuel commercial facility in the U.S. (there have been previous attempts, such as KiOR, MS)

**Biochar** – BioChar is a popular topic lately. BioChar is a char that is made for a specific purpose, usually related to soil and crop production enhancement, but also for other products, such as where activated charcoal is currently used (e.g. filtration). Most of the small biomass power plants proposed in California will use gasification, which can produce higher quality char than a larger biomass power plant that uses conventional technology. It is hoped by many of the groups developing small-scale biomass power plants (i.e. BioMAT projects) that markets will develop sufficiently to allow them to generate revenue from the char they will produce and would otherwise have to find other ways and means to dispose.

The UC Davis Soil and Environmental Chemistry Lab maintains a Biochar Database with over 1,000 samples. They report “explosive growth” in research between 2006 – present. Their analysis indicates that feedstock and pyrolysis temp. are very important. Common fallacy is short-term observations are extrapolated to indicate long-term benefits. “No clear predictive performance

factors". California now has statewide biochar research steering committee and recently passed AB 2511 to help establish consistent quality standards.

**Cement Plant Co-Firing** – California has at least 6-7 cement plants, mostly in S. California. At least three cement plants in S. California utilize or are set-up to utilize some wood waste. If one of the larger ones, such as CEMEX, decided on a goal of 25% wood instead of coal, this would require about 160,000 BDT/yr (equivalent to about a 20 MW biomass power plant). Unknown when or how much increasing GHG emissions restrictions will apply.

**Nanotechnology** – One sheet of paper is about 100,000 nanometers. Basically produce either crystals and fibrils through hydrolysis (former) or grinding (latter). Testing in progress on actual forest biomass to determine best pathways – previously used bleached white pulp. Worldwide race to find commercial applications, but very few yet. The Forest Service Forest Products Lab (FPL) is very engaged and there is a project in progress utilizing forest processing residuals from Yreka, California. Potential to see a cement/nanotechnology bridge deck application next summer in Siskiyou County (2017). Other applications being tested include fruit coating, structural insulated panels and polylactic acid (biodegradable thermoplastic, similar to polypropylene).

**Torrefaction** – The Forest Service is partner with U.S. Endowment in Oregon Torrefaction LLC, which is producing torrefied material for a test burn at the Pacific Power & Light coal plant in Boardman, OR. Need 8,000 tons for the test burn. It will be challenging to obtain this amount given status of production technology.

## SLIDE 16, CONCLUSIONS



### Conclusion

- **Volumes** - At this point no one has any plausible economic solutions to utilize tree mortality volumes, even in Tier I High Hazard Zones.
- **Log Quality** - Saw log quality has already significantly deteriorated. Need to remove quickly to obtain any value.
- **Biomass** - Biomass options are not revenue positive, but will have longer time period in which to work.
- **Partnerships** - USFS will stay engaged with state, private, community, and non-profit partners, and keep door open to new technologies and opportunities.

Slide 16



## Contact Information

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