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SECONDARY MARKETS FOR POST-CONSUMER FOUNDATION WOOD

Executive Summary

In 2020, the [Mattress Recycling Council](#) (MRC)'s contracted recyclers extracted and recycled 5,096 tons of wood from discarded box springs (also known as foundations). The wood today composes more than 16% of the material recycled in MRC's California program.

MRC anticipates in coming years that there will be a decrease in capacity at mulch, biomass and other secondary end markets (markets). Maintaining these markets, or finding new ones, is therefore especially important to maintaining the program's recycling rate.

MRC in this study has explored alternative wood markets without great success. The most promising new market was particle board; however, a pilot test proved that the test sample which was still contaminated with metal staples could not be used. MRC may rerun the test in 2022 if a cleaner foundation wood feedstock is sourced.

In addition to the particle board industry, the study explored using the foundation wood in the manufacturing of medium density fiberboard, wood pellets, fire logs, pallets, animal bedding and oriented strand board.

One alternative suggested in the study is that California recyclers maybe able to diversify their markets and reduce transportation costs if they invest in shredders.

Background: The Need for New Secondary Markets

In 2016, California Governor Brown signed [SB 1383](#), requiring jurisdictions to reduce organics disposal to 50% of 2014 baseline levels by 2020. This reduction increases to 75% by 2025.

In 2020, CalRecycle estimated there will be an 8 million ton gap between the capacity to handle these organics, which includes foundation wood, and the expected volume hitting the system. It found that 18 million tons of organics must be diverted to compost, anaerobic digestion or chip-and-grind facilities to meet SB 1383 goals in 2025; however, only 10 million tons of capacity currently exists statewide. Of concern for MRC's contracted recyclers, the chip-and-grind facilities needed to process foundation wood processing has some excess capacity with 3.5 million tons of capacity while 3.3 million tons of material is expected to be generated.

While California procurement policies require state agencies to consume an increasing amount of post-consumer material, it is likely that supply will exceed demand for chipped post-consumer foundation wood in the future.

Table 1. Estimated Composting, Anaerobic Digestion, and Chip-and-Grind Capacity in 2025 (Million Tons)

Technology	Estimated Capacity 2025	Estimated Needed Capacity 2025	Difference
Compost	5.3	9.6	-4.3
Anaerobic Digestion	1	2.7	-1.7
Co-Digestion	0.12	2.4	-2.3
Chipping and Grinding	3.5	3.3	0.2
Totals	9.9	18	-8.1

According to the [California Energy Commission](#) and the [California Biomass Energy Alliance](#), biomass capacity has been steadily decreasing in the state. In 2021, there were 23 solid fuel biomass electric generating facilities with 7.3 million tons of annual feedstock capacity.

In 2020, 4.5 million tons of material was sent to biomass according to SB 498 annual reporting. This is a decrease of 48% from 2015.

Biomass accounted for 1,613 tons of the program’s recycled wood total. While adequate mulch and biomass markets currently exist, MRC anticipates these markets becoming more competitive in coming years.

Additional End Markets for Foundation Wood

MRC has explored new secondary applications for foundation wood including:

Particle Board and Medium Density Fiberboard (MDF)

Particle board and MDF were identified as feasible markets for post-consumer foundation wood because it is not contaminated with plastic, stain, varnish or paint. Eco-Mobilier, tasked with collecting and recycling used mattresses and furniture in France, also identified [particle board](#) and MDF as viable markets. These applications can tolerate up to 20% post-consumer material in end products and they prefer soft pine which is used to make foundations. Foundation wood is also a low-cost and dry feedstock.

Two building product certifications could bolster demand for post-consumer wood products:

1. [Eco-Certified Composite](#) certification is possible for manufacturers using 75% post-industrial wood fiber (fiber), or 50% post-industrial fiber with a minimum of 5% post-consumer fiber.
2. The [Forest Stewardship Council](#) certification requires between 70 and 85% post-consumer fiber. A challenge for mattress recyclers is that post-consumer fiber supply exceeds demand and therefore these certified product manufacturers do not offer a strong financial incentive for post-consumer wood feedstock.

Foundation wood must be pre-shredded for acceptance at a particle board or MDF facility. At time of this report, California manufacturers were paying \$40 to \$85 per ton for clean, dry material chipped into a two-inch minus shred with less than 1% metal contamination as metal can damage processing equipment. The particle board application is more tolerant of metal contamination than MDF, however, metal contamination must be short in length, such as nails or staples.

[Timber Products](#) is located in Sutter Creek, Calif., and is the only particleboard and MDF manufacturer in the state of California. At time of this report, its daily capacity is 40 truckloads, or 160,000 tons per year. There are typically no minimum tonnage requirements. Specifications for these products are:

1. **MDF:** Accepts 1.5-inch shredded post-consumer wood that is untreated and metal free. Pays between \$45 and \$30 per ton of material depending on feedstock quality.
2. **Particle Board:** Accepts 1.5-inch minus shredded post-consumer wood that is untreated and metal free. Pays \$50 per ton, reduced to \$25 per ton if further processing is required.

Timber Products recommends [Zanker Recycling](#) in Sacramento, Calif., or [Sierra Wood Shavings](#) in French Camp, Calif., to pre-process foundation wood before it arrives at their manufacturing facility in Sutter Creek. Zanker Recycling's capacity is at least 1,000 tons annually and charges about \$40 per ton for grinding to 1.5-inch including magnetic separation of ferrous metal.

In December 2021, Timber Products accepted a 48-yard test load of shredded foundation wood in an open-top walking floor trailer from one of MRC's recyclers. The wood was shredded to 2 inches plus, but unfortunately contained long (12-18 inches) pieces of foundation metal. Timber Products rejected the load due to metal contamination.

In 2022, MRC may conduct another particle board pilot project if a cleaner wood feedstock is sourced or produced with further processing.

Purchasing a shredder may be a worthwhile investment for mattress recyclers looking to develop new markets and reduce transportation costs. New shredders suitable for foundation wood range from \$325,000 and \$800,000, however, used wood shredders can start at under \$100,000.

Wood Pellets and Fire Logs

MRC spoke with several wood markets experts that recommended pursuing wood fuel pellets as a technically optimal end-use application because they are made from soft, kiln-dried wood that is not painted or varnished. Wood pellets are manufactured using die presses which compress the material into cylinders about 6 millimeters in diameter and 25 millimeters in length. The ideal feedstock is 3 to 5 millimeters and is screened for contamination prior to manufacturing.

While many wood pellet manufacturers claim their feedstock is from recycled sources, further research indicates the material is often post-industrial wood waste from sawmills. Most domestic wood pellet manufacturers are based in the Southeast United States and ship their product to Europe and Asia for energy production in the industrial, commercial and residential sectors.

CalRecycle, the state agency that oversees implementation of California solid waste policy, has determined that wood pellets would qualify as “recycling” provided they are used in a certified biomass facility or for home heating and not in a waste-to-energy application.

[Mallard Creek](#) in Rocklin, Calif., accepts post-consumer wood material pre-processed to 4-inch minus and would consider a 20-ton test load under a pilot project. Its main concerns are feedstock contamination and BTU value. This facility accepts a 50-ton minimum of material per order. Wood pellet experts noted that manufacturers typically pay \$20 to \$30 per ton for quality pre-shredded wood feedstock.

A significant financial investment is required to set up a pelletization plant. There are several well-known equipment vendors and [startup collateral](#) typically describes plant cost per desired tons per hour, potential markets, and equipment details. [Mechanical presses](#) can also create a round or square briquette used for fuel and heating similar to wood pellets. Briquetting requires feedstock have 8-12% moisture content and particle size of 16mm or less for best results. Assuming a briquetting machine runs two shifts at 8 hours per shift 300 days per year, the total cost can be up to \$36 per ton for a medium-sized machine.

Industry experts also recommended that MRC pursue fire log manufacturers, as foundation wood could be an ideal feedstock; however, no fire log manufacturers are in California and transporting wood out of state may be cost prohibitive.

Pallets

MRC also explored pallets as a market for foundation wood; however, this market is very price competitive and an unlikely end use. Manufacturers produce pallets in several standard sizes and require structurally sound lumber in specific dimensions. Potential buyers are sensitive to nail defects and species of wood to maintain the integrity of the finished product.

An alternative market could be plastic composite pallet manufacturers. These manufacturers produce artificial lumber using wood flour mixed with post-consumer plastics. It would cost \$50 per ton to grind the material into a wood flour. Adding transportation costs, it would be economically infeasible, therefore MRC would only recommend recyclers explore composite manufacturers nearby. Michigan-based manufacturer SaN Plastics, LLC, would consider licensing its technology or running a trial.

MRC identified seven California-based pallet manufacturers using post-consumer wood or plastic:

1. [Century Pallets](#), Lynwood
2. [Oakland Pallet](#), San Lorenzo
3. [Valley Pallet](#), Salinas
4. [United Pallets](#), Modesto
5. [A&I Pallets](#), Los Angeles
6. [American Pallet Inc.](#), Oakdale
7. [BR Pallet](#), Compton

Animal Bedding

Animal bedding is commonly made from cedar, pine or other white softwood processed into quarter-sized shavings (also called flakes) or fines. Manufacturers will require that all metal be removed and prefer a feedstock that has between 10 and 12 percent moisture content. Processing costs are estimated at \$50 per ton. Foundations are typically kiln dried to 18 percent moisture content and moisture may rise or fall depending on the climate where usage occurs.

The product is sold in bulk quantities for equine and dairy farm applications or in bags for smaller buyers. The animal bedding market is relatively stable while wood supply is variable, therefore animal bedding manufacturers may pay or charge a per ton rate for feedstock depending on market conditions. Manufacturers include [Lignetics](#) in Colorado and [American Wood Fibers](#) with two Northern California locations.

Oriented Strand Board (OSB)

OSB is a type of engineered wood that is manufactured by compressing layers of wood flakes with adhesives into specific orientations to create structural rigidity. It is used in construction and is primarily made from recently harvested aspen popular, southern yellow pine and mixed hardwoods.

Experts quickly encouraged MRC to first explore other markets because OSB manufacturing is highly intolerant of metal contamination and the process requires a high moisture-content material to mitigate dust.

Summary: MRC Pilot Studies

MRC has tested the suitability of foundation wood in a particle board application, based on known product specifications required as well as projected economics for Northern California mattress recyclers. The pilot showed that the only particle board manufacturer in California is intolerant of feedstock with excessive metal contamination. MRC may rerun this pilot in 2022.

MRC may also explore a pilot study to evaluate the technical feasibility of shredded foundation wood in wood pellets given the suitability of the feedstock and CalRecycle's approval of this application as recycling.

MRC also suggests that each recycling facility undertake a cost analysis of purchasing equipment to reduce the size and bulk of foundation wood to reduce transportation costs and improve marketability for new products. Shredding equipment made for multiple applications including pocket coil processing may add additional value.

Potential Pilot Study Partners and Other Sources

CalRecycle's "Analysis of the Progress Toward SB 1383 Organic Waste Reduction Goals"

Particle Board and Medium Density Fiberboard (MDF)

CalRecycle, local assistance and market development branch

Julie Trueblood, environmental program manager

Julie.trueblood@calrecycle.ca.gov

916-341-6535 (o), 916-765-9848 (c)

Composite Panel Association

<https://www.compositepanel.org/products/product-locator.html>

Forest Plywood, La Mirada, Calif.

Manufacturer and distributor of composites

<https://forestplywood.com/product/medium-density-fiberboard-mdf/>

714-523-1721

JFS Enterprises, mobile shredder

559-960-6791

Roseburg, Roseburg, Ore.

Manufacturer of particle board and MDF

<https://www.roseburg.com/ProductGroup/roseburg-mdf/>

John Holte, wood procurement manager

541-679-2759

Stockton Wood Shavings, Stockton, Calif.

Foundation wood processor

Sheri Luiz, general manager

sheri-luiz@mulchstock.com

209-982-0552

Timber Products, Sutter Creek, Calif.

Manufacturer of particle board and MDF

<https://www.timberproducts.com/about/manufacturing/sutter-creek-california>

Chris Nelson, procurement manager

Chnelson@timberproducts.com

209-223-1690 ext 8

Zanker Recycling, Sacramento, Calif.

Foundation wood processor

Abel Periera, operations

abel@zankerrecycling.com

408-786-8383

Wood Pellets and Fire Logs

Bear Mountain Lignetics, multiple Oregon locations
Wood pellet and animal bedding products (sawmill sourced)
<https://lignetics.com/pages/bear-mountain-forest-products>
800-544-3834

Biomass Magazine
<http://biomassmagazine.com/plants/listplants/pellet/US/>

Forest Energy, Mendocino, Calif., and Show Low, Ariz.
Virgin material wood pellet producer, recently opened new plant using sawmill wood by-product
<https://forestenergy.com/>
800-246-3192

Mallard Creek, Rocklin, Calif.
Producer of wood fuel pellets
<https://mallardcreekinc.com/fuel-pellets/scott@mallardcreekinc.com>
916-645-1681

Pellet Fuels Institute
<https://www.pelletheat.org/>

Pellet Producers in the U.S.
<http://biomassmagazine.com/plants/listplants/pellet/US/page:1/sort:state/direction:asc>

U.S. Environmental Protection Agency
Waste Reduction Model (WARM) used to assess the energy requirements and greenhouse gas emissions from various processing methods by material type.

US Industrial Pellet Association
<https://theusipa.org/>

Vecoplan: pellet producing equipment
<https://www.vecoplanmidwest.com/wp-content/uploads/2016/06/Pellet-Mill-Startup-Paged.pdf>

Pallets

Atlas Wood Products, San Diego, Calif.
Recycler and refurbisher of wood pallets
<http://atlaswp.com/>
atlaswp@sbcglobal.net
619-710-8922

Chep
California-based pallet manufacturer
866-261-2437
Garcia's Wood Works, Fontana, Calif.
Recycler of wood pallets
<http://www.garciaswoodworks.com/>
1-833-472-5538

SaN Pallets,
Michigan-based pallet manufacturer
Rick Sofia, owner
rsafia@sanpallets.com
937-271-5308

Tolko, Canada
Remanufacturer of wood waste into crates and bins
<https://tolko.com/tolko-products/remanufacturing/>
CorporateCommunications@tolko.com
250-550-2512