

# Efficient Use of Materials and Waste Minimization

In manufacturing our products, we utilize each and every input to the greatest possible degree. By integrating flow loops into critical stages of the manufacturing process, we can capture and re-use excess material, and we further minimize waste to landfill by recycling anything we can't re-use.

## 1. Natural Synergies

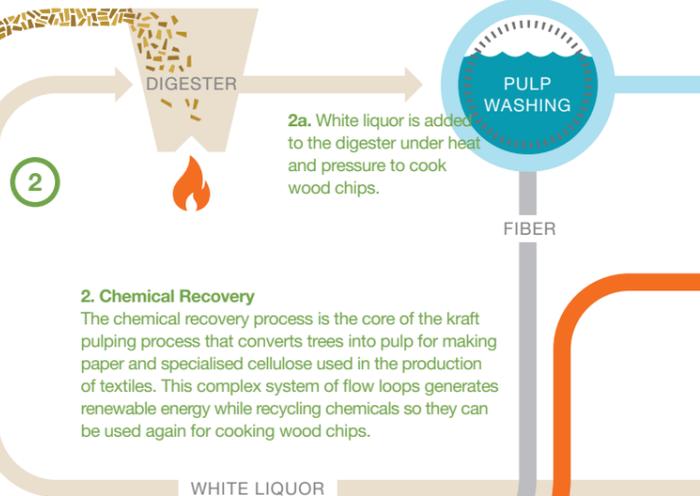
The forest products industry seeks out natural synergies to put wood to its most efficient use. For example, a saw mill will typically yield 50-60 percent of wood as timber, roughly 30 percent as chips and the remainder as shavings, sawdust and bark. Shavings and sawdust are further processed to make structural panels (e.g., medium-density fiberboard) and the paper industry utilizes chips as a fiber source and bark for biomass fuel.



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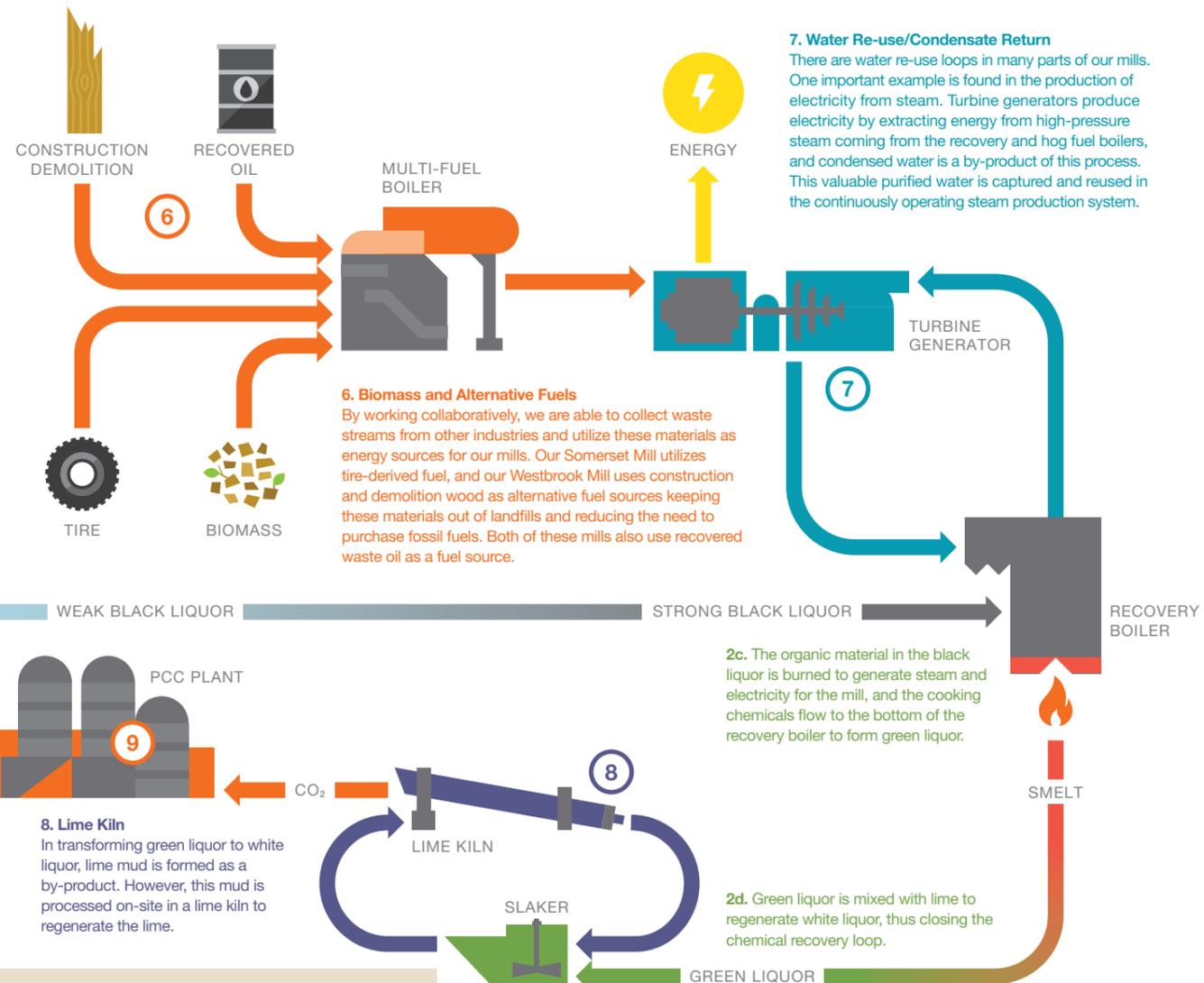
## 2. Chemical Recovery

The chemical recovery process is the core of the kraft pulping process that converts trees into pulp for making paper and specialised cellulose used in the production of textiles. This complex system of flow loops generates renewable energy while recycling chemicals so they can be used again for cooking wood chips.



2b. The dissolved organic materials (lignin and hemicelluloses) are washed out of the pulp along with the cooking chemicals, creating black liquor.

2a. White liquor is added to the digester under heat and pressure to cook wood chips.



## 6. Biomass and Alternative Fuels

By working collaboratively, we are able to collect waste streams from other industries and utilize these materials as energy sources for our mills. Our Somerset Mill utilizes tire-derived fuel, and our Westbrook Mill uses construction and demolition wood as alternative fuel sources keeping these materials out of landfills and reducing the need to purchase fossil fuels. Both of these mills also use recovered waste oil as a fuel source.

7. Water Re-use/Condensate Return  
There are water re-use loops in many parts of our mills. One important example is found in the production of electricity from steam. Turbine generators produce electricity by extracting energy from high-pressure steam coming from the recovery and hog fuel boilers, and condensed water is a by-product of this process. This valuable purified water is captured and reused in the continuously operating steam production system.

2c. The organic material in the black liquor is burned to generate steam and electricity for the mill, and the cooking chemicals flow to the bottom of the recovery boiler to form green liquor.

2d. Green liquor is mixed with lime to regenerate white liquor, thus closing the chemical recovery loop.

## 9. PCC Plant

PCC is a primary ingredient in making coated papers. Both our Somerset and Cloquet mills have PCC generating plants on site. These plants, located adjacent to our pulp mills, draw CO<sub>2</sub> out of the flue gas from the lime kiln and use it to form this specialty pigment. Binding the CO<sub>2</sub> with calcium in the PCC plant captures this greenhouse gas, reducing our GHG emissions.

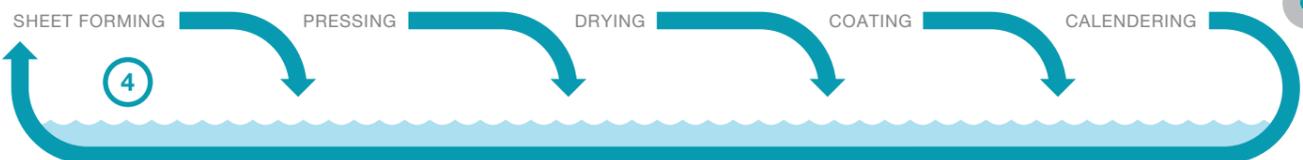
## 10. Benefitting from our products

Our Cloquet and Somerset mills have identified local partners that can utilize some of our mill by-products as a soil amendment, providing nutrients and pH adjustment to their land. These materials are offered at no cost and provide significant benefit to local farmers while reducing our contribution to landfills. Dirt washed off logs at our Cloquet Mill is used as an underlayment for road building.

## 3. Precipitated Calcium Carbonate (PCC)

PCC is made on-site and used as filler in both the fibrous center layer and coatings applied to the surfaces of paper. This useful pigment imparts the optical properties of brightness, whiteness and opacity to paper. And, when blended in paper coatings with other pigments, PCC provides improved surface smoothness and uniform ink holdout due to the ability to control particle size and shape during the precipitation process.

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## 4. Broke Systems

Paper machines occasionally face upsets that break the continuous web of paper being produced. Collection systems capture and recycle the broken paper so that no material goes to waste. This internally recycled "broke," which is captured in two flow loops, does not count toward recycled content claims. "Off-machine broke" consisting of edge trim paper is collected and re-pulped. "On-machine broke" is collected by large tanks located beneath the machine. The broke tanks have rotors that re-pulp/mix the collected material for recycling into the stock at the wet end of the machine. 100 percent of this on-machine generated broke is re-used to make paper.

## 5. Coating Reclaim

Our mills manufacture various grades of coated paper on the same equipment, each with uniquely designed coating formulations. In the past, leftover coating material from one grade would be diverted to the waste treatment plant during a grade changeover. Now, all three of our mills have coating reclaim systems that capture leftover material, allowing it to be re-used.



## 11. Other Materials

A wide array of materials is recovered, reused and recycled at each of our mills, including pallets, drums, light bulbs, e-waste, batteries, cardboard, scrap metal, asphalt, packaging materials and more. In 2014, our Cloquet Mill partnered with PHASE, a local non-profit, and recycled over 180,000 lbs of materials that had previously been burned on site as fuel. When possible, used equipment is sold for refurbishing.

## 12. Beyond Our Mill Gates

Paper and paperboard are recovered for re-use at very high rates compared to other valuable materials such as plastics and metals. Our coated papers can and should be recycled. Sappi is a strong advocate for recycling and waste minimization of all valuable material types, and we encourage our customers, suppliers and community partners to promote recycling and to themselves recycle as much, as often and as responsibly as they can.

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