Print and Paper The Facts

Much of the energy used for papermaking is renewable and the carbon footprint is surprisingly low

Like many major manufacturing operations, papermaking is an energy-intensive endeavor. However, roughly two-thirds of the energy used by North American pulp and paper mills is self-generated using renewable, carbon-neutral biomass in combined heat and power (CHP) systems. In fact, the forest products industry produces and uses more renewable energy than any other industrial sector. [1]

A look across the life cycle of paper shows that its carbon footprint can be divided into three basic elements: greenhouse gas emissions, carbon sequestration and avoided emissions. Each of these elements is influenced by important characteristics that make paper's carbon footprint smaller than might be expected: it's made from a renewable resource that stores carbon, it's manufactured using mostly renewable energy and it's recyclable.

Greenhouse Gas Emissions

- A carbon footprint is the amount of carbon dioxide and other greenhouse gases that a person, organization, event or product causes to be released to the atmosphere, either directly or indirectly, during its life. For paper products, this life includes everything from harvesting trees through the manufacturing process to use and disposal or recycling.
- The global print and paper industry accounts for only 1% of global carbon dioxide emissions.[1]
- At pulp and paper mills, the emission rate expressed in tons of carbon dioxide equivalents per ton of production has been reduced by 55.8 % since 1972, 23.1% since 2000, and 3.9% compared to 2010.[2]
- In Canada, a changing energy mix and greater energy efficiency are clearly reducing energy use and greenhouse gas emissions in the forest sector. The forest sector's substantial cut in fossil fuel use between 2000 and 2011 has helped reduce direct emissions by 50% and total energy use by 30%.[3]
- The major proportion of carbon dioxide generated during the life cycle of paper comes from combustion of fossil fuels during production. In a study of four paper grades (office paper, catalog, telephone directory and magazine), the largest portion of the carbon footprint came from the production stage (44-67%) and the smallest portion from transportation (1-2%). [4]
- The end of life stage (disposing of paper in landfill sites and its subsequent breakdown producing methane, a potent greenhouse gas) accounted for 19-38% of the total carbon footprint. Increasing the recovery of office paper and catalogues had the potential to reduce the carbon footprint of these paper grades by 15-25%. By eliminating these products from landfill and using them instead as a source of biomass for energy production further reduced their global warming impact. [5]

Carbon Sequestration

- Forests provide an important ecosystem service in the form of carbon sequestration – the uptake and storage of carbon in forests and wood products. Carbon dioxide is removed from the atmosphere by trees and stored for a period before being returned to the atmosphere. The sequestered carbon is stored not only in trees but also in forest products [including paper] for periods ranging from days to centuries. Growing trees also release oxygen into the atmosphere, thereby supporting life on our planet.[6]
- Terrestrial ecosystems store about 2100 Gt C in living organisms, litter and soil organic matter, which is almost three times that currently present in the atmosphere. Boreal and temperate forests store about 700 Gt and tropical forests another 500 Gt.[7]
- The net GHG balance of managed forest land in Canada amounted to removals of 162 million tonnes of CO_2 Eq. from the atmosphere in 2013. This estimate includes net emissions and removals of CO2, as well as N2O, CO and CH4 emissions from slash burning and wildfires.[8]
- In the long term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber or energy from the forest, will generate the largest sustained [climate change] mitigation benefit.[9]
- In the U.S. alone, carbon stocks on private timberland are increasing by more than 240 million tons of CO_2 equivalents per year. It appears that about one-quarter of private timberland is managed to produce wood for the forest products industry, suggesting that 60 million tons of forest carbon sequestration can be directly attributed to the U.S. forest products industry[10]
- "At a global level, the greenhouse gas emissions from the forest products industry value chain are largely offset by sequestration in forests and forest products." "The carbon removed from the forest by the paper and forest products industry represents only about 0.5% of the carbon that is

Print and Paper The Facts

recycled between the forest and the atmosphere annually, and less than 0.03% of the carbon stored in the world's forests." [11]

Avoided Emissions

- Paper and paperboard recovery at about 43 million tons resulted in a reduction of 149 million metric tons of carbon dioxide equivalent emissions in 2013. This is equivalent to removing 31 million cars from the road in one year. [12]
- There is a vital difference between energy production from fossil fuels and from biomass. Burning fossil fuels releases carbon dioxide that has been locked up for millions of years [introducing "new" carbon to the atmosphere]. By contrast, burning biomass simply returns to the atmosphere the carbon dioxide that was absorbed as the trees grew and there is no net release of carbon dioxide (carbon neutral) if the cycle of growth and harvest is sustained.[13]
- It is the carbon from fossil fuels that is primarily responsible for the increases in atmospheric carbon dioxide that have occurred in the last 100 years.[14] Historically, it is estimated that since 1850 just under 500 Gt of carbon may have been released into the atmosphere in total as a result of human actions, and around three quarters of this is through fossil fuel use. [15]
- The Intergovernmental Panel on Climate Change (IPCC) estimates that forest biomass-derived energy could reduce global emissions by between 400 million and 4.4 billion tonnes of CO_2 equivalent per year.[16]
- Paper and wood products mills use biomass residuals [waste wood] from their manufacturing operations to produce bioenergy that provides significant carbon reducing benefits to the environment. This use of forest residuals for energy in the U.S. provides enormous greenhouse gas benefits by avoiding the emission of about 181 million metric tons of CO_2 Eq. This is equivalent to removing about 35 million cars from the road. [17]
- The forest products industry efficiently uses biomass residuals through combined heat and power (CHP) systems. This diverts material from landfills where it would decompose and release greenhouse gases.[18]
- In the CHP process, exhaust steam from electricity-generating turbines is used to dry wood and paper and to heat production processes or buildings before being condensed and recycled back to steam generation boilers. The use of CHP results in efficiencies in the range of 50 to 80% at forest products plants, in comparison to non-CHP electrical stations, such as utilities, with typical efficiencies around 33%. In 2012, 96% of the electricity the industry generated was through CHP. The forest products industry produced 30% of CHP electricity generated by manufacturing facilities in the U.S. [19]
- On average, about 66% of the energy used at AF&PA member pulp and paper mills is generated from carbon-neutral biomass. In fact, forest and paper products facilities accounted for 62% of the renewable biomass energy consumed by all manufacturing facilities in all sectors. Fifty-nine percent of the electricity used by members was self-generated. Indeed, 42% of members' mills self-generated more than half of their power, and 23% sold excess power back to the grid, much of it renewable as well.[20]
- Since 1990, U.S. pulp and paper mill purchased energy (from fossil fuels) use per ton of production has been reduced by 25%.[21]
- The Canadian forest industry's substantial cut in fossil fuel use between 2000 and 2012 has helped reduce direct emissions by 56% and total energy use by 30%. Some of this decline can be attributed to the contraction of the forest industry between 2005 and 2009. A large part of it, however, is a result of changing energy usage and increases in the self-generation of power from waste products. [22]
- In Canada, 98% of wood residue is now being used for either energy generation or composting. More than 66% of mills' wastewater sediment is being used for either energy generation, composting or land application. [23]

1 ECOFYS, 2013
2 AF&PA, 2014
3 Natural Resources Canada, 2014
4 AF&PA, 2011
5 AF&PA, 2011
6 AF&PA, 2014
7 UNEP, 2009
8 Environment Canada, 2015
9 International Panel on Climate Change (IPCC), 2007
10 NCASI, 2007
11 World Business Council for Sustainable Development and NCASI, 2007
12 EPA. 2015
13 Biomass Energy Centre, 2011
14 IPCC, 2007
15 UNEP, 2009
16 FAO, 2010
17 AF&PA, 2015
18 AF&PA, 2015
19 AF&PA, 2014
20 AF&PA, 2014
21 AF&PA, 2015
22 Natural Resources Canada, 2015
23 Forest Products Association of Canada, 2014