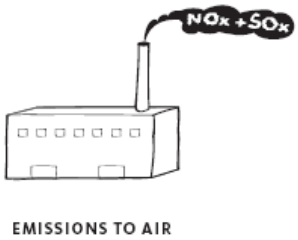
ENVIRONMENTAL FOOTPRINT COMPARISON TOOL

A tool for understanding environmental decisions related to the pulp and paper industry



EFFECTS OF DECREASED GREENHOUSE GAS EMISSIONS ON EMISSIONS TO AIR

Emissions from Energy Use in Manufacturing

There are two primary ways that energy-related emissions can be reduced: a) changing to less greenhouse gas-intensive fuels, and b) increasing energy efficiency so less fuel and purchased electricity is needed.

Reducing greenhouse gas emissions by changing fuels can have significant effects on SO_2, NO_x, and particulate emissions. The fossil fuels that tend to have the highest sulfur contents (coal and fuel oil) are also the most greenhouse gas intensive. Therefore, switching from these fuels to natural gas or biomass would be expected to reduce SO_2 emissions. Some general information on the greenhouse gas intensity and SO_2 emissions associated with different fuels is shown in Table G1.

Table G1. Representative Fuel Sulfur and Nitrogen Content and GHG Emission Factor

Fuel	Nitrogen, %	Sulfur, %[a]	GHG Emissions[b] kg CO_2 eq./GJ (HHV)
Natural Gas	Insignificant	Insignificant	50.54
Residual Oil	0.1 to 1.0	0.3 to 3.0	73.77
Coal	0.5 to 2.0	0.4 to 4.0	90.32
Bark and Wood Residue	0.1 to 0.4	0.2 or less	1.84

[a] USEPA 1998.
[b] IPCC 2006.

The effects of fuel selection on NO_x emissions are more complex because NO_x emissions are affected not only by fuel type but also by the combustion conditions. Though a significant portion of the fuel nitrogen can be converted to NO_x during combustion, the amount of nitrogen available in the fuel is relatively small compared with the amount of nitrogen available for conversion in the combustion air. Peak combustion temperatures influence the magnitude of that conversion. More information on the factors that affect NO_x emissions is available under the SOx and NOx Tab of the navigation menu in this Tool.

Reducing greenhouse gas emissions by selecting low GHG-intensity fuels can affect particulate emissions, with the effect ranging from strong co-benefits to strong trade-offs. Although in general, solid fuels are associated with higher particulate emissions than liquid and gaseous fuels, the emissions are also highly dependent on the type and efficiency of the device used to control particulate emissions. In the U.S., the two solid fuels used most by the industry, coal and wood-derived biomass fuels, are at the opposite end of the range of greenhouse gas emission factors. Therefore, fuel switching from coal to biomass, which would greatly reduce greenhouse gas emissions, may not significantly affect particulate emissions. Switching from coal to natural gas would accomplish reductions in both particulate emissions and greenhouse gases. And at the other end of the spectrum, switching from natural gas to solid biomass would significantly reduce greenhouse gas emissions, but in all likelihood, significantly increase particulate emissions.

Where greenhouse gas emissions are reduced by reducing energy consumption, emissions of SO_2, NO_x, and particulates will usually also decline, reflecting the reduction in fuel consumption.

Few wood products mills use coal or oil. SO_x emissions are very low at most wood products plants as the only source of sulfur is the small amount of sulfur in wood. NO_x emissions can be significant and, as

discussed previously, are a function of both nitrogen from fuel and nitrogen from the atmosphere. Wood products mills that use urea-formaldehyde resins (primarily particleboard and MDF mills) generate higher NO_x emissions than mills using other resins, as urea is a nitrogen rich compound.

References

Intergovernmental Panel on Climate Change (IPCC). 2006. Stationary combustion. Chapter 2 in *Energy*. Volume 2 in 2006 IPCC guidelines for national greenhouse gas inventories. http://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

United States Environmental Protection Agency (USEPA). 1998. Chapter 1, Sections 1.1 to 1.6. External combustion sources. In *Compilation of air pollutant emission factors, Volume 1: Stationary point and area sources.* Research Triangle Park, NC: U. S. Environmental Protection Agency, Office of Air Quality Planning and Standards.