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KYOTO and What It Means for the Forest Sector

Given the huge amount of press and political commentary surrounding the global warming issue, it is easy to lose sight of what it might mean in the long run for the forest sector. You have probably read comments from sceptics that some of the science connecting fossil fuels with global warming is questionable, and that economic projections have exaggerated future needs for fossil fuels. You may have read dire warnings from Kyoto enthusiasts that if we don't act now, the ice will melt, the sea level will rise and more tsunamis will strike; just where and when all this will happen may seem a bit sketchy, but it certainly sounds scary. Maybe you have read Michael Crichton's latest novel "State of Fear" in which he highlights how things can go off the rails when politicians start talking science.

By Mike Bradley and Andy Garner

All this chatter sells a lot of paper, but does it matter any more? The Kyoto protocol on climate change, for all its flaws, came into force as an international treaty on February 16th 2005. This commits signatory countries to cut Green House Gas (GHG) emissions, which generally means they must burn less fossil fuel.

One of the consequences of Kyoto is that there are new opportunities for the forest sector in the form of green energy from wood waste. The CO2 released when wood (or any biomass) is burnt is not counted as GHG because wood is a renewable fuel. Wood burning is often referred to as 'carbon-neutral' and is not blamed for global warming. Growing more trees recaptures the CO2, forming more biomass and refreshing the atmosphere with oxygen.

In our post-Kyoto world, wood-derived energy is preferred over fossil energy. This has the immediate and practical consequence that wood will command a premium from customers who want to displace fossil fuels to avoid paying carbon taxes or credits.

Aside from the Kyoto advantages, there is also a more fundamental sustainability argument for using wood that has recently been detailed in the climatology literature. The conversion of sunshine to biomass, compared to the conversion of sunshine through to fossil fuels like oil or gas is not only quicker by millions of years, but is more efficient by about five thousand times. Put in another way, compared to burning oil or gas, burning wood is thousands of times less wasteful of the earth's primary source of energy, sunlight. This is such a big difference that we need to see it in a broader context.

A global sustainability picture for fuels

Fossil fuels are a form of ancient biomass that has been buried and transformed over millions of years into coal, oil or gas. Coal was once referred to as 'buried sunshine' to highlight the fact that solar energy created the original biomass from which the coal is made. Much of the coal we use today is thought to have originated from peat-swamp forests, where accumulated peat and trees were buried and transformed under pressure into coal. Oil and gas have a different origin. They come mostly from marine organisms called phytoplankton, which accumulate in marine sediments and are transformed into oil or gas deposits.

In a paper recently published in the scientific journal Climatic Change (Vol 61 p31 2003) titled "Burning Buried Sunshine: Human Consumption of Ancient Solar Energy", Jeffrey Dukes of the Carnegie Institute in Stanford, California has calculated just how much solar energy was needed to create the fossil fuels we consume worldwide in a typical year. He calculates that an almost incredible 400 years of global biomass growth was needed to create the fossil fuel burned worldwide in 1997. Put in another way, 100 tonnes of ancient biomass was needed to make that gallon of gas you used to get to work today.

Dukes also calculates the life cycle efficiency of generating electricity from solar energy using biomass, coal, oil and gas. He shows that a million watts of solar energy produced sufficient coal to generate about 1000 watts of electricity, but only enough oil or gas to generate a miniscule one watt of electricity. This is because oil and gas deposits are just the residual drops left over from oceans full of biomass. On the same basis, regular, unfossilized biomass, in the form of trees for example, would generate about 5000 watts of electricity. And we don't have to wait millions of years for it.

Fossil fuel burning: Why we do it and where does wood fit in?

Fossil fuel first came into use during the Industrial Revolution in 18th century Europe, when there were no longer enough trees to sustain iron making. Coal filled the need for an abundant highly calorific fuel, eventually finding huge success in the 20th century as a primary fuel for electricity production worldwide, a role that continues today. Open pit mining, efficient rail and sea transportation, as well as modern flue gas clean up have made this the favoured low cost fuel for electric power in countries like Germany, Japan and the U.S. The U.S. alone is estimated to have a 250-year supply of coal remaining.

Once oil was discovered in sufficient quantities, it came to prominence in the last century as a remarkably low cost fuel: it can be pumped straight out of the ground into tankers and refineries. With the advent of the automobile, it became the dominant mobile fuel. As for the current reserves, it is anticipated that conventional oil supplies will start to decline in ten years time, and less conventional sources in deep waters, or heavy oil and oil sands will be increasingly needed.

Natural gas, which came into its own in the second half of the 20th century, has the great advantage of being easy to clean up near the wellhead. Recently, compression and

refrigeration technology has been established so that it can now be transported around the world as a commodity in the form of liquid natural gas (LNG). Another advantage is that burning natural gas produces less GHG than other fossil fuels i.e. 50 kg CO2/GJ for gas versus 74 kg CO2/GJ for oil and 82-94 kg CO2/GJ for coal, making it much more sought after in recent years for its lower GHG's. Though estimates vary, some suggest that upwards of 250 years of natural gas remain to be exploited.

These three fossil fuels are the dominant sources of primary energy consumed in the world today. They are successful because they have been relatively cheap to collect and profitable to sell. It is unrealistic to imagine that wood-waste, or any other form of biomass can take over from fossil as a major primary fuel source in the foreseeable future: the logistics of collection and transport, and hence the underlying costs mean that they will be able to compete only in special applications or favourable locations.

None the less, it is anticipated that there will be a global expansion in the use of wood-waste for fuel. This will be on a small scale relative to fossil fuel, but it represents a big opportunity for the forest sector.

What does this mean for the Canadian forest sector?

Now that the Kyoto accord has come into effect, energy generation from renewable sources like biomass has assumed much greater importance. The Federal budget delivered on February 23rd included several measures relating specifically to biomass: electricity generation from renewable energy will now attract a one-cent per kilowatt hour subsidy, and an increase in capital cost allowance from 30% to 50%. There is also a Clean Air Fund for government to purchase domestic and international GHG offset credits.

Despite the fact that Kyoto is international law, today there are no regulations in place in Canada requiring GHG emission reduction. Ironically, wood pellets are already being shipped from British Columbia to European customers who buy them for $160/BDt to displace fossil. The EU has seen fit to enact a renewable portfolio standard that requires member nations to meet renewable energy targets. It is more likely that such wood will be used locally in the future as new Canadian measures to reduce GHG emissions take effect.

One topic that is often part of GHG discussions is fast-grown plantation forestry. This kind of forestry is being done in Alberta for example, where marginal farmland is planted with hybrid poplar. Such projects may be eligible for one-time carbon credits when first established if they are recognized as afforestation, i.e. reforestation of land previously cleared for agriculture. When the trees are harvested, the portion burnt as biomass can gain additional carbon credits if used to displace fossil fuel.

Now that some of the financial incentives have been quantified, we could see a significant amount of marginal farmland in Canada converted to fast-grown plantations. BC energy consultant Brian McCloy sees it this way: "This is an important opportunity

for Canada given the millions of hectares of transition forests in Canada that were harvested decades ago to produce pasture lands. Not only will such forests provide a significant carbon sink, they will also provide a future source of low cost fibre."

Kyoto also provides for the creation of so-called "managed forest sinks." Canada has to decide by 2006 if it will take advantage of this opportunity. This decision will hinge on whether Canada's managed forests are deemed to be a net source or sink. Modelling work previously indicated Canadian forests were a slight net sink. However, the recent pine-beetle infestation in British Columbia has now affected 70,000 km2 of forest, an area the size of New Brunswick, much of it inaccessible by road. Brian McCloy suggests that this outbreak alone could, "tip the scales and effectively make Canadian forests a net source during the 2008-2012 Kyoto reporting period." It is unclear how much extra biomass might be available for fuel since the economics of removing standing timber simply for fuel production have been typically marginal, at best.

Technologies and applications for biomass fuels

Wood waste can be used in a variety of ways at different scales to supply energy. One small-scale example is when wood waste is burnt as a fuel to heat hot water for commercial greenhouse operations. On a larger scale, boilers can be heated to make low-pressure process steam or high-pressure steam for co-generation, also known as Combined Heat and Power (CHP) (electricity from turbines plus steam for heating). The wood burning can be done with conventional power boilers often with moving grates to handle the ash, or in more sophisticated fluid bed boilers where flue gas particulate capture is less complicated. Co-firing wood with fossil fuels like coal is done in Nordic countries, attracting carbon-credits for the biomass fraction.

Wood waste can also be gasified into synthetic gas called 'syn gas' which is then burnt for process heat in a plywood plant, or burnt in a kraft mill limekiln. Transforming wood into bio-oil by fast pyrolysis has been the subject of ongoing research projects for some time in Canada: success here might allow solid wood operations to go off fossil fuel. Finally, ethanol can be made by fermenting wood residue and may yet reach commercial viability in Canada.

In the chemical pulp mill, black liquor gasification techniques are being developed, with the world's first full scale commercially operational plant now running at a Canadian soda mill, the Norampac corrugating medium mill at Trenton, Ontario. Behind any discussion of gasification is always the long-term possibility of using the gas to produce hydrogen for use in fuel cells, although this will take some time to come to fruition.

Canadian Kyoto commitments and how biomass can contribute

Canada is now committed to reduce annual GHG emissions by 250 Mt of CO2, of which 55 Mt of CO2 is needed from industry. It has been estimated by the Canadian Bioenergy Association that enough surplus wood waste is available to offset 6.7 Mt of CO2 by displacing fossil fuel, principally fossil fuel that would otherwise be used for electricity

generation. The Canadian pulp and paper sector is already the largest industrial operator of co-generation facilities, with 45 plants producing 1500MW of electric power as well as process steam from wood waste. The largest independent biomass power plant in North America is in Williams Lake BC at 60 MW, and a new 48 MW co-gen plant is currently in start-up at Canfor's Prince George pulp and paper complex .

In 2003 FPAC signed a Memorandum of Understanding with the Federal Government to reduce GHG emissions by an additional 1.4 Mt of CO2, the first such commitment by any Canadian industrial sector. This comes on top of a spectacular 12-year period where the Canadian pulp and paper industry cut total GHG emissions by almost 28%, a period in which total production increased by 30% (fig 2).

FPAC is well positioned to help develop the technical and infrastructure needs for GHG emissions initiatives, with very active Climate Change and Energy Committees. The committees are providing input for the development of an internationally compatible Canadian GHG Emissions Trading system. There is also active support for GHG inventory protocols, EcoLogoM certification of biomass cogeneration plants and tradable Renewable Energy Certificates, all part of the infrastructure and regulatory framework needed for Kyoto initiatives.

Summary

Now that the Kyoto protocol on climate change has come into force as international law, there are new opportunities for the Canadian forest sector with increased demand for waste wood as an attractive, renewable and carbon-neutral alternative to fossil fuels. Recent calculations published in climatology literature have shown that the conversion of solar radiation to electricity is about 5000 times more efficient by burning biomass than it is by burning oil, and more than five times more efficient than burning coal. Greenhouse gas and long-term sustainability arguments appear to favour wood waste as a highly attractive niche-market alternative to fossil fuels.

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