by Karla Zubrycki

From Waste to Resource

Using drain and land maintenance waste for bioenergy and compost

With the development of Canada-wide carbon pricing, we can expect an increased demand for low-carbon energy sources. At the same time, there is a public expectation to keep our waterways clean, including preventing algal blooms from nutrients such as phosphorus and nitrogen – a problem common not only in many of Canada's lakes, but also in stormwater and wastewater retention ponds.

The City of Winnipeg is using an approach that addresses both of these concerns. By turning unused materials from land maintenance activities into biomass fuel pellets and compost, it is creating bioenergy for space heating, reducing nutrients released into waterways, and improving urban habitat. These actions reflect a growing trend in Manitoba, where smaller communities and rural municipalities (RMs) are also looking at land maintenance in a new light.

Pellets of Power

Rodney Penner, city naturalist with Winnipeg's public works department, began to see the potential for bioenergy from local plant materials when the city's new developments started to include naturalized areas around stormwater retention ponds. The areas were planted with native prairie grasses that historically would have been naturally maintained by wildfires, which controlled dead plant materials, released nutrients into the soil, and stimulated prairie renewal. Similarly, numerous brownfield areas in the city, such as decommissioned landfills, were turned back into prairie. Penner says that since starting even controlled fires near urban developments can be unwelcome, other management methods had to be considered, particularly mowing.

"Mowing opened up the opportunity for bioenergy. We realized we could turn a waste product into something worthwhile," says Penner. The pilot site for this idea became the city-owned Living Prairie Museum, where a pellet stove was installed to heat the building.

To make pellets, the city partnered with the Winnipeg-based International Institute for Sustainable Development (IISD), which for 10 years has been researching ways to turn locally-harvested plant materials into value-added products, including bioenergy. Dr. Richard Grosshans, senior research scientist at IISD, says perennial plants – such as grasses and the abundant wetland plant, cattail – provide advantages over traditional bioenergy fuels, such as wood. "Their energy value is comparable to or better than wood pellets, and you get additional benefits such as capturing nutrients in harvested materials and providing habitat for species that need prairie or wetlands."

A five-hectare restored prairie in Winnipeg was harvested; and, in order to produce an ideal mix, the grasses were blended with cattail harvested from RMs outside of the city and wood residues from local manufacturing to produce what Grosshans calls "premium pellets." Last winter, these pellets were able to heat the entire museum, even on the coldest of Winnipeg days.

Part of the "premium" built into these pellets is their ability to displace coal as a fuel source. While the Living Prairie Museum does not burn coal, and Winnipeg buildings are generally heated by hydro-electricity or natural gas, pellets are being used to replace coal in several rural locations, including three Hutterite colonies. Biomass can directly replace coal in some heating systems – no major modifications required. Grosshans says that while some biomass users were at first skeptical of pellets that were not 100 percent wood, the mixed-source pellets won them over. "They all loved it and wanted more."

While the Living Prairie Museum only uses about two tonnes of pellets each year, larger biomass burners can heat entire building complexes, requiring many more tonnes. One of the larger biomass users in Manitoba is Providence University College, in the community of Otterburne, which can use about 300 tonnes of biomass per year to heat the campus. In greenhouse gas (GHG) reduction terms, amounts like this add up. Burning 300 tonnes of biomass represents a CO_2 reduction of roughly 618 tonnes compared to the equivalent amount of heat from lignite coal. That's equivalent to taking 135 cars off the road for a year. The Hutterite colonies burn more than 1,000 tonnes per year, representing the equivalent of each taking 460 cars off the road.

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Composting Cattail

When he learned about the bioenergy initiative, Travis Stephenson, a technologist with Winnipeg's water and waste department, remarked that waste plant materials could also be composted. Stephenson oversees the removal of vegetation from 25 kilometres of city drains every year in order to improve water flow. This activity produces large amounts of plant materials, mostly cattail, which for years were sent to the city's landfill.

The construction of the city's nine-hectare composting facility in 2013 presented the opportunity to divert these materials to better use. "We thought we could improve our environmental footprint by looking at ways to compost," he says.

To test the idea, the city composted 59 tonnes of cattail last year, only a small portion of what was actually removed. Becky Raddatz, environmental planner with the city, calls the experiment a success. Laboratory test results of the composted cattail showed that the finished compost was similar to that from composted leaf and yard waste. It appeared fit for unrestricted use according to compost quality guidelines from the Canadian Council of Ministers of the Environment.

The composted cattail is now being put to use as part of the cap for the finished landfill, a move that also saves the city money, as they don't have to buy as much soil from landscaping companies – meaning that compost has both environmental and economic value. "When you're throwing your organics away, you're throwing away value. When you compost, you're producing something that has value," says Raddatz.

Another benefit of harvesting the cattail is that the nutrients are not released into waterways. Had the cattail been left in the drains, it would have released nutrients from its leaves when it decomposed. Grosshans says cattail "are like sponges" for nutrients and contain up to two kilograms of phosphorus and 10 kilograms of nitrogen per tonne.

Stephenson points out that capturing these nutrients will not only benefit the city's waterways, but also those downstream, such as Lake Winnipeg. "By cutting and removing vegetation from the drains, we're capturing and removing excess nutrients from the system before they reach the receiving bodies of water. I assume that this will gradually reduce the nutrients available in the watershed, which should improve water quality over time and help reduce problem vegetation such as algae," he says. Indeed, estimates show that the 2015 experiment captured 60 kilograms of phosphorus and 300 kilograms of nitrogen.

As an additional environmental bonus, diverting cattail from landfill also reduces the city's GHG emissions. Cattail that goes to landfill might decompose without oxygen, a process that releases the potent GHG, methane. The city turns its compost rows, thereby allowing oxygen in. The 2015 compost test resulted in a GHG reduction of almost 14 tonnes. Stephenson says those amounts are likely to grow in future years, as the city is planning to compost much more of its harvested cattail in 2016.

He also suggests that other cities can quite easily adopt a similar method, particularly if they're already removing vegetation. "If you're already doing drain maintenance, it's fairly easy to slightly modify your approach," he says.

A Rural Revolution in Ditch Management

Outside of Winnipeg, RMs are also looking at ways to add value to their ditch management. Rick Wilson, a councillor for the RM of Springfield, located east of Winnipeg, says controlling cattail growth in the RM's more than 1,600 kilometres of roadside drains is not optional. Without management, significant flooding happens.

"I've seen drains where cattail reduces the flow to a trickle. It's like trying to get water to flow in a sink that has a hair clog," he explains. If that water can't flow downstream, it floods farmers' fields.

Common practice in Manitoban RMs is to leave the cattail in the ditch after it is cut. However, Wilson points out, "that doesn't do us much good. The dead plants can end up clogging culverts." Instead, the RM is hoping to collect the materials and sell it to the province's growing number of bioenergy users. With a ban on the use of coal for space heating coming into effect in Manitoba in 2017, biomass demand is outpacing availability, creating an opportunity for those with biomass to sell.

With so much "waste" plant materials in RMs throughout Manitoba, Wilson believes there is potential to produce more than just bioenergy. "I'm thinking into the future and I see the possibility to make biochar from cattail," he says. Biochar is a form of charcoal made from plant materials that is used to improve soil quality and that can also store carbon to fight climate change.

Grosshans says that not only can cattail produce biochar, but that the Winnipeg-based Composites Innovation Centre is also exploring how cattail and other waste materials, such as agricultural residues, can be turned into high-value products such as building materials, furniture, and electric vehicle bodies. These renewable "biofibres" are lower weight and less energy intensive than traditional materials, such as plastics. "With a large agricultural sector and lots of land to maintain, Manitoba (and Canada as a whole) has a lot of potential to find better and more cost effective ways of dealing with plant waste," he says. "What these municipalities are showing is that they can improve the environment – capturing nutrients and fighting climate change – while also producing products that have actual economic value." *MW*

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