BLACK ART

A little-known technology could help clean the oil sands

By Darren Campbell

AT THE 2011 WORLD HEAVY OIL CONGRESS, Dr. Robert Skinner, senior vice-president of Statoil Canada Ltd, outlined the environmental challenges facing an industry that keeps getting heavier. "We're either reversing geology or we're accelerating geology," he told a crowd at Edmonton's Shaw Conference Centre last March. "It's going to take a lot of energy, and not just energy, but human ingenuity, water, and manpower. That is the footprint of difficult oil."

Difficult oil is certainly an apt description for the oil sands. For decades, bright individuals and the organizations they worked for labored long and hard to find an economical way to extract black goo from the sand in the Fort McMurray region and turn it into black gold. There were many failures.

But slowly and surely, progress was made and by the late 1990s a convergence of higher oil prices and better extraction practises made the oil sands a viable business, so much so that Alberta's 170 billion barrels of reserves – most of it oil sands – gained international attention as a resource to be reckoned with.

However, as production challenges have been overcome, the environmental challenges have proven much more difficult to solve. Toxic tailings ponds continue to grow, and now measure 170 square kilometers in size. The mining operations that scrape the sand from the surface leave behind landscapes that resemble the moon's surface. And then there is the issue of the emissions generated in the extraction and production of the oil sands. The Canadian Association of Petroleum Producers says the sector was responsible for 6.5 per cent of Canada's greenhouse gas (GHG) emissions in 2010, and with production from the oil sands expected to grow from 1.5- to 4.5-million barrels per day between 2010 and 2035, according to the International Energy Agency, its carbon footprint isn't going down.

This reality has cast Canada as the villain in the global debate over how to curb emissions and reduce the effects of climate change on the planet. In that context, a little-known technology has emerged as a potential tool in the fight to solve these vexing challenges: biochar. >>

IT TURNS OUT THAT CHARCOAL CAN do more than cook a steak. Biochar is, after all, fine-grained charcoal, and by adding it to the soil it can store carbon safely for hundreds or even thousands of years. It can also boost soil fertility, which can accelerate the time it takes to reclaim abandoned mine sites.

So how does it work? Nature offsets carbon by absorbing carbon dioxide ($C0_2$) from the atmosphere and incorporating that into plant matter using solar energy. But the carbon is only stored for as long as the plant is alive. Once the plant dies, it decomposes and the $C0_2$ is released back into the atmosphere.

The beauty of biochar is it converts biomass that would have either decomposed or been burned and release $C0_2$ into the atmosphere, and turns it into charcoal. The charcoal – or biochar – stores half of the carbon that would have gone into the atmosphere (the other half is released during the conversion process). The end result is less $C0_2$ is emitted than would have occurred if the biomass had been left alone.

That's an attractive concept for a sector that's come under increasing scrutiny for the part it's playing in the growth of Canada's GHGs. But it's not just the negative press that is bothersome. Emitting carbon is costly. In 2007, the Alberta government put a price of $15 per tonne on carbon, over and above a 100,000 tonne cap. That price, while not nearly as high as some would like, provides oil and gas companies with an incentive to cut down the GHGs they emit.

Subodh Gupta is determined to prove biochar can be a solution to this problem. While the Alberta government and companies pour billons of dollars into advancing carbon capture and sequestration projects, Gupta, Cenovus Energy Inc.'s technology advancement advisor, is leading a pilot project that is trying to turn garbage into biochar.

There is a lot riding on the endeavor. Cenovus, like other oil sands producers, is in growth mode. In 2012 it plans to spend $3.4 billion, a 23 per cent increase from 2011. Of that $3.4 billion, $2 billion is earmarked for oil sands production. The firm has also set a goal of producing 500,000 barrels per day of net oil by 2021 (it plans to pump out an average of 163,000 barrels per day in 2012). To reach that goal, the company will emit a lot of GHGs at a time when much of the world is seeking to drastically cut emissions.

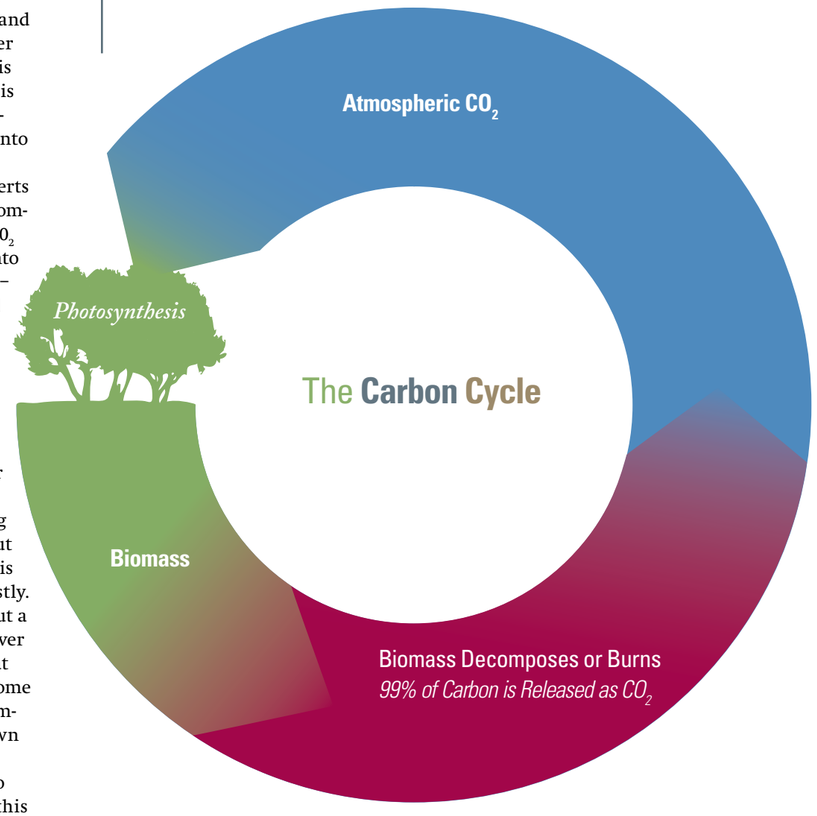
Gupta hopes his work can play a role in combating rising emissions from industrial activity. Cenovus isn't using wood or biomass as the feedstock to create biochar. Instead it's using landfill waste. Gupta says up to 85 per cent of landfill waste is typically a byproduct of plants, forests, and other carbon matter. "Anything that contains carbon can be converted into charcoal," he says.

The benefits of using waste as biochar feedstock are threefold for Cenovus. First, it can get the waste for free, while procuring wood so it can be turned into biochar can be costly. Secondly, it would take waste out of landfills. Thirdly, by preventing the waste from decomposing, which gives off methane, Cenovus would be offsetting some of the emissions it is creating through its oil and gas operations.

Gupta says the pilot project his company is running involves installing equipment to process waste at one of its work camps at the Foster Creek steam assisted gravity drainage project 75 kilometers northwest of Cold Lake, >>

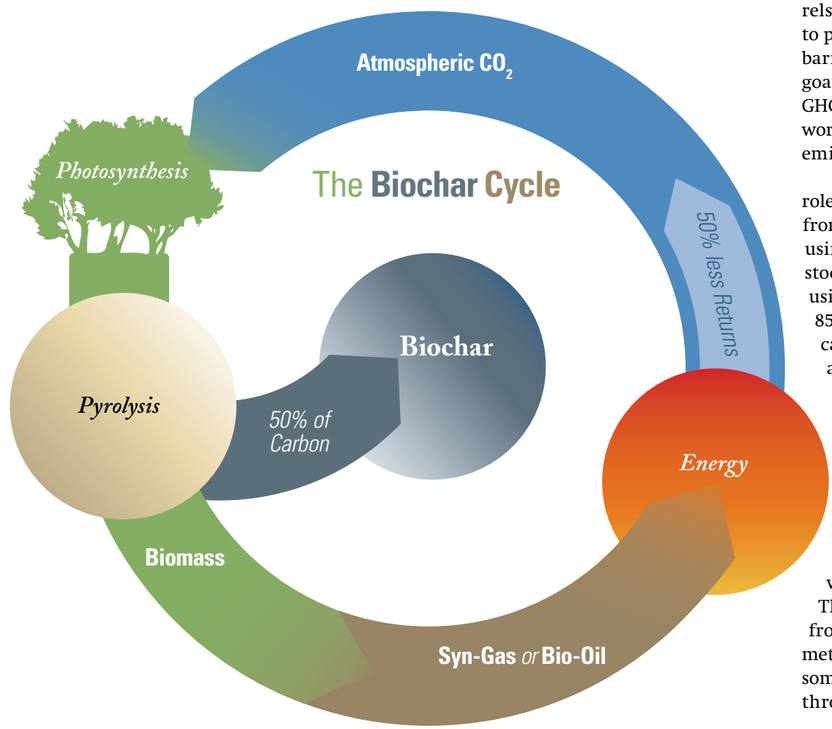
Nature *Calls*

Biochar is not a complicated technology. It builds on what nature already does. In the carbon cycle (left), green plants remove $C0_2$ from the atmosphere through photosynthesis and convert it to biomass. Almost all of the carbon is returned to the atmosphere when plants die or decay. And if it is burned, it is returned immediately. >>



100,000 Trees fall daily in Colorado and southern Wyoming due to the mountain pine beetle epidemic, creating a $C0_2$ liability of 175,000 tonnes each day

>> In the biochar cycle, plants remove $C0_2$ from the atmosphere and convert it to biomass. But through intense heating of the biomass (pyrolysis), syngas, bio-oil and biochar is produced. Half of the carbon is then sequestered as biochar. The other half returns to the atmosphere when the syngas and bio-oil are burned as fuel.



0.25 gigatons Of carbon could be stored annually by 2030 using biochar according to the International Biochar Initiative

800 Celsius The temperature sometimes required to heat biomass and convert it to biochar

Alberta. Foster Creek currently produces 120,000 barrels per day of oil.

But whereas the technology to take wood, heat it at 300 degrees Celsius without oxygen and turn it into biochar has been available for years, converting waste to biochar has not. What Gupta's team is tasked with is developing equipment that can convert that waste to biochar at a large enough scale to offset some of the company's carbon footprint.

"Carbon emissions are a big problem. Our industry and bitumen production is energy intensive and we use fossil fuels to recover it," Gupta says. "One way or the other we have to find ways to be less energy intensive and less carbon intensive. Once this gains the status of being a viable process, others will be drawn in. It will be taken up by a multitude of sectors. Hopefully it will be taken up by municipalities the world over."

But biochar's promise is not just relegated to the sphere of GHG emissions. It also has the potential to aid in the reclamation of oil sands sites.

AS OF 2009, JUST 104 OF MORE THAN 60,000 HECTARES disturbed by oil sands operations have been certified as reclaimed.

Companies are spending millions, and in some cases billions, to devise strategies to reclaim the land. One example: Alberta Innovates is working with Suncor Energy Inc. to evaluate the potential for seeding tailings sand with native perennial plants, and stabilizing the tailings sand with vegetation before carrying out further reclamation work. Biochar could be another technology in the oil sands reclamation tool kit.

The opportunity has caught the attention of Morgan Williams. The president and CEO of Colorado-based Biochar Solutions Inc. has become a leading North American biochar advocate; the firm set up a Canadian subsidiary – Biochar Solutions Canada Ltd. – in Drayton Valley, Alberta, late last year.

In this case, the black material isn't used to turn biomass into a solid structure that stores carbon, but is instead put in the ground to revegetate land. But Williams warns that the soil at each site has different problems that require different types of biochar products. One size does not fit all. Biochar Solutions is in the business of developing these products.

Williams insists that biochar isn't some far-fetched concept. Some hard rock mining sites in the United States that Biochar Solutions has worked on, for instance, have seen a 340 per cent increase in vegetative cover during the first season of use.

But he understands there is skepticism out there among oil and gas companies about how effective biochar could be in reducing emissions and aiding in land reclamation. "They've had people come to them forever telling them about some technology that's better or more efficient and can do everything," Williams says. "But I think there is immense opportunity ... to engineer specific carbon negative materials that will address the reclamation problems in Alberta."

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Yet for all its apparent benefits, it isn't hard to find naysayers. A November 2011 report issued by Biofuelwatch – a United Kingdom-based organization that opposes the use of bioenergy for industrial uses – raised a number of concerns regarding biochar's effectiveness in reducing carbon emissions and reclaiming land.

Among the red flags mentioned in the report, entitled *Biochar: A Critical Review of Science and Policy*, is that field testing of the technology is lacking. Biochar doesn't always remain stable for long periods of time, the report said, which calls into question claims that it can store carbon for hundreds or thousands of years. The scale required to produce enough of the material to make a meaningful impact would also require converting large swaths of land to grow biochar feedstock. The report concludes that, "making biochar economically viable is unlikely without massive subsidies, which so far have not materialized, but future potential exists, and vigilance is needed."

Back at Cenovus, that vigilance is not lacking. Gupta says his project team is perhaps a year or a year-and-a-half away from proving its camp waste-to-biochar technology works. If that is accomplished, it's on to bigger and better things for Gupta's project, and perhaps biochar technology. "This will not solve all the world's emission problems," Gupta says. "But it's a legitimate baby step in convincing others that this is a viable way to offset carbon emissions." AO