Plug and Play The Oil Game

by Michael Chomitsch

Dr. Bruce McGee (Electrical '80), MEng Electrical '84, PhD Electrical '98)

"Basically, you plug it in and get oil," Dr. Bruce McGee (Electrical '80), MEng Electrical '84, PhD Electrical '98) jokes.

Heat bitumen-rich oil sands with electricity and remove the oil from it. This idea mesmerized McGee from the moment his professor Dr. Fred Vermeulen (Electrical '60, PhD Electrical '66) gave a presentation on his research in 1980.

McGee saw the huge potential in the idea pioneered by two of his professors, Vermeulen and Dr. Steve Chute, at the University of Alberta in the 1970s.

"It was technology I believed in then and still do," McGee says.

"I felt committed to doing something with it."

That he has, though there were many who doubted anything would come of it. McGee had faith and persevered, driven by his firm belief in the technology.

He took Vermeulen and Chute's approach and made it better. He brought it from the classroom to the field, in one of the most successful technology transfers to happen at the U of A.

McGee, who has a diverse engineering background, solved an electro-thermal dilemma that had plagued practitioners for years: the finite length electrode problem. Essentially, McGee discovered how to efficiently transfer heat between electrodes, making that single, mesmerizing idea feasible.

McGee's life's work has culminated in his patented Electro-Thermal Dynamic Stripping Process (ET-DSP™). ET-DSP basically passes electrical current between electrodes placed in soil, heating the oil in bitumen-rich deposits to allow it to be pumped out.

The process has several remarkable features. Oil can be recovered from deposits very quickly—75 to 80 percent of oil can be

ET-DSP™ in the field.

recovered in one year. It is environmentally friendly; small wells are drilled for electrodes and pumps while the rest of the land is disturbed as minimally as possible. It is scalable—as more oil is recovered, more wells can be drilled and more capital generated. Finally, the costs for electricity are inexpensive when compared to more conventional methods of oil extraction, such as surface mining.

No other oil extraction/recovery process can boast such quick, cost-effective returns with such minimal environmental impact. While McGee patented the process three years ago, he's only now drawing his first drops of oil from the bitumen-rich Athabasca Oil Sands.

McGee and E-T Energy, the company he formed in 2004 to apply ET-DSP in the oilfield, are currently conducting a field test at a one-hectare test site approximately four kilometres north of Fort McMurray. If the technology works, E-T Energy can begin to develop the approximately 1.25 billion barrels of oil in place on its oil sand leases.

In a stroke of good fortune, the one thing ET-DSP needs the most—power—is supplied by a power line that runs right through the test site.

"The stars couldn't line up better," McGee says with a smile.

ET-DSP's potential is even more remarkable. According to McGee, nearly two-thirds of the estimated 2.5 trillion barrels of oil in the oil sands is either too shallow to be reached by conventional drilling methods or too deep to be extracted via steam injection. The alternative is an in-situ process like ET-DSP.

In other words, if McGee's claims are correct, E-T Energy has a possible niche market of 1.66 trillion barrels of oil—enough oil to sustain the world's current needs for 55 years.

Despite this phenomenal forecast, McGee had trouble convincing oil industry companies to test ET-DSP on their leases. Generally conservative by nature, the oil industry didn't leap to support new technology such as his. But McGee wasn't fazed.

"If they didn't do it, I would. I know this process will work," he declares.

So, he formed E-T Energy. A friend, who is now a partner in the company (McGee retains 38 percent ownership), had some influence in the oil industry, and helped line up some investors. However, they needed $12 million to start the field test. McGee took his pitch to potential investors in New York City, Boston, Toronto, and Calgary.

"The hardest part was letting go of the technology to the investment community," McGee admits.

"But by doing it right, you can get the best people in the world working with you."

In the end, he raised the money he needed. His lifelong work was about to take its next giant step.

Some of the major oil industry players from Canada, the U.S., and Europe are now investors, and even partners, in ET-Energy. In addition, the Alberta Government helped fund the project with a $675,000 grant.

Once the results of the field test are evaluated, McGee will seek additional investment to go commercial.

Regardless of the outcome of the field test, E-T Energy is already poised to make its mark. With an estimated 1.25 billion barrels of oil in reserve in the 14.5 sections of land it owns, the company is currently the largest junior oil company in the Athabasca Oil Sands.

McGee has faith in ET-DSP and believes the field test will be successful.

"I know it will work. I've seen it work and I've built a company around it."

As it turns out, he actually built two. Somewhat ironically, it was the work of the other company he founded, McMillan-McGee Corporation (McC^2), that helped make believers out of the investors. McGee established McC^2 in 1995, while working on his PhD. McC^2 first used ET-DSP to reclaim contaminated sites.

"The principles are the same regardless of what ET-DSP is used for," says McGee.

A cross-section of an electrode.

"You heat the soil and the chemicals will vaporize. They can then be collected and extracted from the soil. Oil gets hot and it flows easier. It's the same process, but the end-product is usable."

Environmentalists were the first to

embrace the technology, applying it to environmental problems.

"During the first ten years, we were cleaning soils in urban areas where we couldn't disturb the infrastructure," McGee says.

"Focussing on the environmental aspect of the process became more and more important over time. It is really gratifying to clean up a site, to make harmful soil clean."

The expected recovery rate of oil using ET-DSP—between 75 to 80 percent—demonstrates McGee's commitment to the environment.

"The timeline (for oil recovery) is very short," McGee points out.

"When you compare environmental disturbance to the benefit, it's almost negligible."

His goal is to recover oil in the first year of a project and begin environmental reclamation in the second.

McC²'s work proved to be a huge advantage for E-T Energy. It proved ET-DSP works.

"Some of our biggest environmental clients were oil companies. They examined McC² and were confident that E-T Energy could create wealth."

McC² is very successful in its own right. ET-DSP is currently deployed on $150 million in contracted environmental projects, and there are plans to increase that to $200 million next year. Its customers include the U.S. Department of Energy, the U.S. Environmental Protection Agency, the U.S. Department of Defence, and large companies such as TOTAL, Esso, and Shell. McC² has offices in Florida and California.

Despite McC² success, McGee's sights were always set on using ET-DSP in the oil sands.

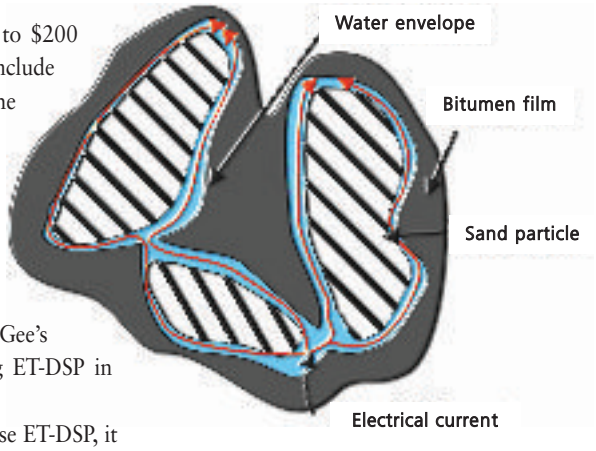
Given that both companies use ET-DSP, it should come as no surprise that they work seamlessly together. They share a brand new office and manufacturing facility in Calgary.

ET-DSP involves high-level calculations, and it takes a multi-disciplinary engineering team to make it all work. The staff of 20 includes environmental, electrical, power, chemical, and petroleum engineers. Any blue-collar work required is contracted out.

McC² manufactures all the circuits used in the process and monitors the projects in real time over the Internet. Clients are leased power supply units, sold electrodes, and receive engineering consulting services as part of their contract.

McGee works hard, averaging 70- to 80-hour workweeks. He currently spends nearly three quarters of that time on E-T Energy, but he expects to focus entirely on the company when things really get rolling.

"We're up for the challenge. We'll make it work; there's no doubt about that."



The extraction process.

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Electro-thermal Dynamic Stripping Process

At the basic level, ET-DSP™ places electrodes in a bitumen-rich oil sands formation and passes an electrical current between the electrodes. Additionally, water is injected into the electrodes to transfer the heat rapidly into the oil sands. This heats and displaces the oil so that it flows easily in the reservoir and can then be extracted at production wells using surface pumps.

In actuality, it is a phenomenally complex multi-disciplinary feat of engineering. It involves applied electromagnetic fields, non-linear physics, mass and heat transfer coupled to the electro-thermal processes.

In a target volume of soil, electrode wells are drilled in a dense grid. This maximizes efficiency in heating, which occurs as electrical current is passed between the electrodes. They can be stacked and drilled to reach a maximum depth of 300 m.

The bitumen has half the heat capacity of water, which means, as McGee points out, "We heat with the most efficient thing we can use—the oil!"

When oil gets hot, it flows better and is easier to extract, which is done via small surface pumps on the surface. Indeed, multiple extraction points are a key component to ET-DSP's effectiveness.

Other key features of ET-DSP include:

- Quick return on investment—Oil recovery begins within 30 to 60 days of start-up. This creates a revenue cycle, where, as more oil is recovered, more electrodes can be drilled, more pumps can be used, more oil can be recovered. A "pay as you go" economic model is quickly established.
- Water conservation—ET-DSP uses only one barrel of water to recover one barrel of oil—far less that other oil recovery methods. The issue of water usage in the oilfield is becoming an increasing concern for the Alberta Government, which has hinted it may start charging for water usage in the province.
- Energy efficiency—Electricity is actually a by-product of the waste heat of refining, so, exclaims McGee, "We're producing energy without adding one molecule of greenhouse gases into the environment." (He admits that, while electricity is an expensive form of energy, the ET-DSP process is so thermally efficient that its use more than offsets the cost of the electricity.)
- Minimal environmental impact—Oil is recovered in one year and the only environmental impact is the number of wells and pumps that need to be drilled. Environmental recovery, using methods proven by the forestry industry, can begin in the second year of operation.
- Year-round operation – ET-DSP can be conducted 365 days per year.