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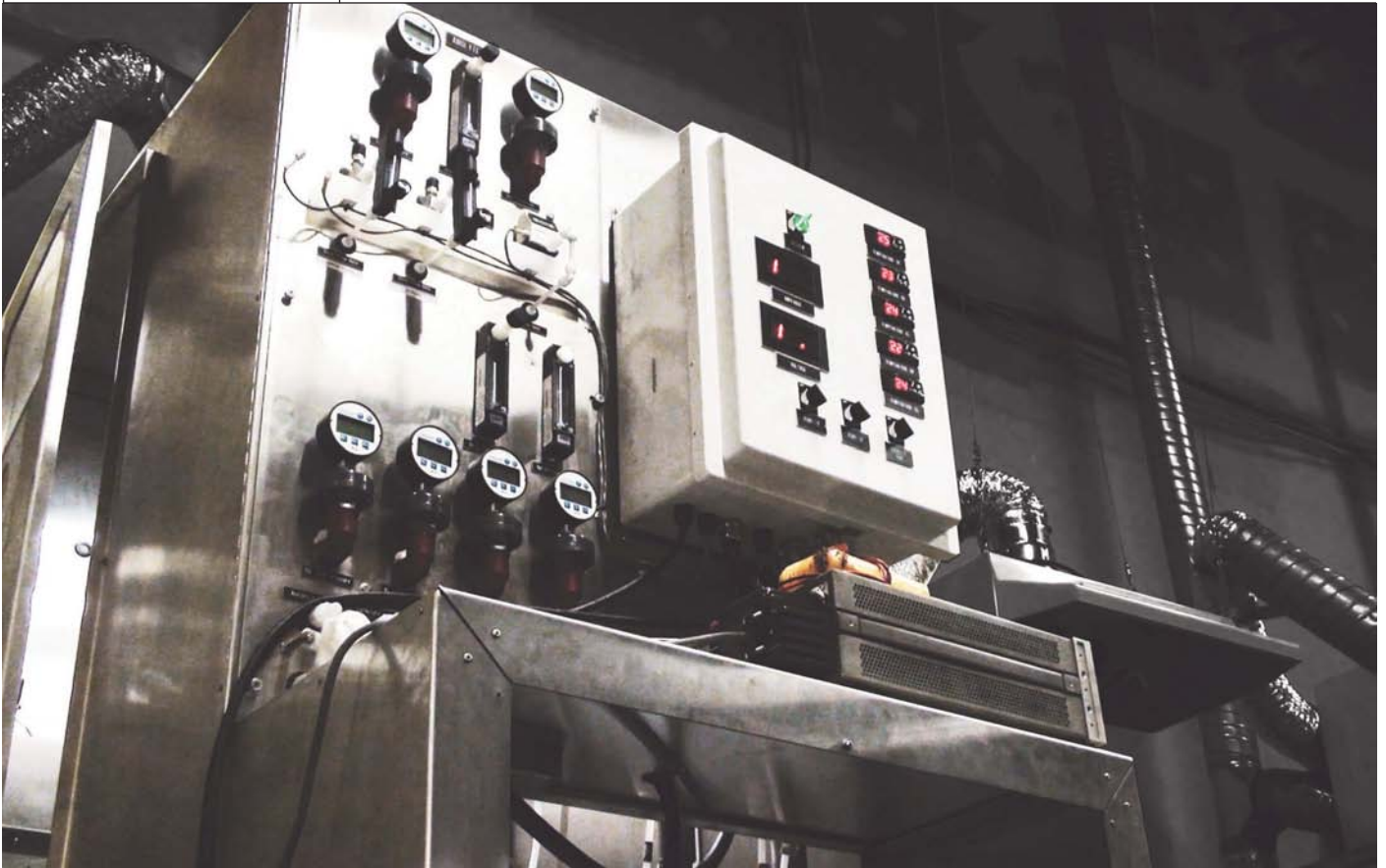
## Mantra Venture Group explores new ways to reduce carbon emissions.

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**Plus:** Peregrine Diamonds has high hopes for an island diamond mine in Nunavut, Canada.

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Mantra Venture Group is developing new technologies to capture and recycle environmentally harmful carbon emissions created by industrial plants.

# CLEAN ENERGY CRUSADE

VANCOUVER'S MANTRA VENTURE GROUP OFFERS AN ALTERNATIVE TO CARBON SEQUESTRATION BY CAPITALIZING ON CO<sub>2</sub> AS A RECYCLABLE FEEDSTOCK.

## COMPANY PROFILE

Mantra Venture Group

[www.mantraenergy.com](http://www.mantraenergy.com)

HQ: Vancouver, British Columbia

Employees: 12

Specialty: Carbon recycling and other clean energy systems

Larry Kristof, founder and CEO:

"This emerging technology is something that is not only green, but is going to help the economy."

The energy industry is a powerful and lucrative business, but not without its drawbacks. For years, energy companies around the world have faced the dilemma as to what to do with the 27 billion metric tons of carbon dioxide (CO<sub>2</sub>) emitted into the atmosphere annually from the burning of fossil fuels. Despite a worldwide push to reduce global warming, energy-related CO<sub>2</sub> emissions are projected to reach 43 billion metric tons per year by 2030 – a 60 percent increase within two decades.

The International Energy Agency (IEA) has hailed carbon capture and storage (CCS) – the process of capturing CO<sub>2</sub> and storing it in deep geological formations, in the ocean or as mineral carbonates – as a viable solution in dealing with CO<sub>2</sub> emissions. Governments in Europe, Australia, Asia, Canada and the United States have demonstrated a tremendous interest in this technology. In fact, U.S. Secretary of Energy Steven Chu announced in May that \$2.4 billion from the American Recovery and Reinvestment Act would be spent on accelerating the commercial deployment of CCS.

However, questions have been raised as to whether the long-term storage of CO<sub>2</sub> would create human or ecosystem-related risks. Moreover, CCS remains an unproven, expensive idea that will not reach commercial availability for another 10 to 20 years. Despite an enthusiastic endorsement from most governments

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worldwide, there has yet to be a country that has developed the legal and regulatory framework necessary to effectively govern the use of this process, although the IEA projects it will have 10 demonstration plants operating globally by 2015.

The fact remains that no full-scale CCS project is operational as of yet. Schwarze Pumpe in northern Germany is the most advanced CCS project with €1 billion invested, all the parts tested, and now halted because of local legal opposition. Scientists continue to research other CO<sub>2</sub> management methods.

When Vancouver-based Mantra Venture Group discovered a process could not only recycle carbon, but transform it into a marketable commodity, the company took notice.

“The market is open for innovation,” founder and CEO Larry Kristof declares. “It is likely that governments will soon authorize carbon recycling from industrial plants, and there needs to be a cost-effective way to implement it.”

He says Mantra’s patent-pending technology is poised to do just that.

### A New Solution

Between 2001 and 2006, Prof. Colin Oloman developed a technology in the University of British Columbia’s Clean Energy Research Center called the electroreduction of carbon dioxide (ERC), which is a form of carbon recycling.

The process uses electricity to combine carbon dioxide and water to create a number of valuable chemicals including formic acid and formate – oxalic acid and methanol are two of the future possibilities. Formic acid and formate have multiple applications, Kristof says, that range from preserving animal feed to finishing leather.

Looking for prospects in the clean energy market, Kristof founded Mantra in early 2007. By the end of the year, the company acquired rights to the ERC process from Oloman.

“Mantra took a risk on something like this in 2007, when it wasn’t even a topic of discussion,” he admits, explaining that this occurred at a time when the world was convinced that carbon sequestration or CCS was the future.


“But CCS has its problems,” he says. “As a society, we are looking at pumping captured CO<sub>2</sub> in megaton amounts down into the ground – I definitely see a concern. Many people are waking up to that concern. CCS was proposed as the entire answer,

the way to reduce CO<sub>2</sub>, but at the same time, a growing number of individuals are uncomfortable with the proposed projects.

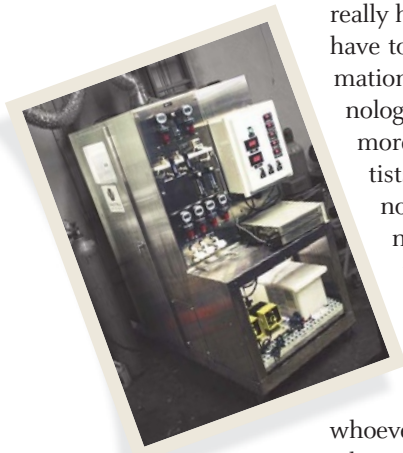
“As of the last six months, we’ve seen projects being halted by the community, such as in Europe, and by the government, such as India, and the U.S. Environmental Protection Agency has asked how CO<sub>2</sub> being injected underground could potentially have an effect on the supply of clean water,” Kristof adds. “CCS is no longer the clear, simple answer that it was. These problems have paved the road for our technology that finds another way to deal with CO<sub>2</sub>. Rather than burying the problem, we convert CO<sub>2</sub> into chemicals with added value; the result is a positive return rather than a huge cost.”

### Education Required

Now, Kristof says, Mantra holds the alternative to CCS: carbon recycling. But, “It’s something you

 Mantra Venture Group Vice President of Technology John Russell stands in front of the ERC bench scale reactor, which recycles carbon emissions created by industrial plants.





really have to educate people about,” he notes. “You have to spend a lot of time giving them the information and leading them to understand our technology. We’ve seen more attraction to ERC and more media attention due to the fact that scientists and informed members of the public are now saying CCS may not be the answer. Yet, no end of money is available for CCS, while we have an alternative technology that has few or no problems, and can be past demonstration and ready for industrial use within two years.”

Rather than trying to explain ERC to whoever would listen, Mantra has chosen who it educates. One of the entities the company has chosen to focus on is the Canadian government.

“We have raised our own capital since our inception, but the company has had encouragement and help from the federal government,” Kristof says. “Almost all of our funding has gone into our development program – the recent phase was five months long – and we made a lot of progress. Our approach and our focus have been working.”

**+** ERC combines carbon with water to create numerous useful chemicals, including formic acid, formate and potentially methanol.



### Forming Partnerships

In addition, Mantra has attracted the attention of 3M, a multinational conglomerate that is known for its innovations. Recognized as a leader in research and development, 3M produces thousands of products for dozens of diverse markets. With \$25 billion in sales, 3M employs 75,000 people worldwide and has operations in more than 60 countries.

The company’s core strength is applying its more than 40 distinct technology platforms – often in combination – to a wide array of a customer needs.

At the end of October, Mantra announced that it would undertake a project with 3M to evaluate the suitability of certain parts and materials proposed by the corporation to be included in the ERC equipment. It also will investigate a new approach to CO<sub>2</sub> capture. The parties will share the cost of the project equally.

Kristof says Mantra welcomes 3M to its development process. “3M has the skills and experience which should allow us to reach our goal of a commercial process faster and with less risk,” he states. “It is probable that the project will allow us to incorporate into ERC some key, high-tech parts manufactured by 3M. In addition, the CO<sub>2</sub> capture process shows promise.”

### Additional Technologies

ERC is Mantra’s flagship technology, but in the three years since the company was established, it has attracted two additional clean energy technologies: the mixed reactive fuel cell (MRFC) and the biometals recovery system (BRS), which it is negotiating.

MRFC – also developed by Oloman at the University of British Columbia – was licensed by Mantra in early September.

“This technology proposes a cost-effective fuel cell that can operate with different types of fuel such as sodium formate, potentially methanol and, of course, hydrogen,” Kristof says. “It has advantages over the standard fuel cell.”

Unlike typical fuel cells that require a proton exchange membrane to separate the fuel from the oxidant within the cell, MRFC is based on an innovative technology that mixes the fuel with the oxidant and eliminates the need for the expensive, yet fragile, membrane, he explains.

As a bonus, MRFC is a complementary technology to ERC since it utilizes one of the products of that process: sodium formate.

### A Bright Future

Mantra’s direction for the future is to move ERC, MRFC and BRS from “the bench scale to demon-

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stration mode,” Kristof says.

“I think all three of them hold a lot of value. We’ve been in business for the better part of three years, and we’ve been a public company for two years. We’ve looked at a lot of opportunities in technologies and projects.

“We’ve done a lot of due diligence where we wanted to put our money down and focus the company’s direction, and these technologies are expected to have a high return.

“We’re putting these technologies into demonstration projects supported by both the industry and government,” he continues.

“Right now, we’re more focused on developing the core partnerships and the core contributors to this technology. We’re aligning ourselves in collaboration with the proper expertise to bring this towards commercialization.”

Kristof could not have picked a better time to form a clean energy venture capital group.

“I think we all understand that now that we live in a green economy, we have to adapt to the world we live in today, accept how it’s changing and look to the future of energy production,” he states.

“This emerging technology is something that is not only green, but is going to help the economy. Given where the world is heading, job creation is definitely going to be in renewables and in alternative fuels. If you look at what happened to the auto-


mobile market in Detroit, now they’re building windmills. We see them changing their direction, and it’s exciting.”

### Crediting the Pioneer

Kristof credits Oloman for being a scientist greatly ahead of his time. He says Oloman has given the company the foundation for its future success.

“He is the inventor, the pioneer and the visionary,” Kristof says. “This began in 2001 – how many of us were talking climate change in 2001? I was driving a Hummer. I saw his vision and took advantage of this opportunity.

“He still remains solidly involved with the company – someone both our management team and our advisory people hold very dear. Mantra can’t take credit for the initial vision – that has to be handed to the inventor. But, we certainly get a pat on the back for taking it to the next level.” ■

 Prof. Colin Oloman (pictured below) created ERC at the University of British Columbia’s Clean Energy Research Center. He still maintains close ties with Mantra today, Kristof says.

### Advantages of ERC Technology

- The process is driven by electric energy that can be taken from an electric power grid supplied by hydro, wind, solar, tidal or nuclear energy (all renewable).
- Medium reaction rate allows for commercial, viable CO<sub>2</sub> processing times.
- Medium CO<sub>2</sub> space velocity gives the ability to treat comparatively large volumes of CO<sub>2</sub>.
- High product selectivity for formate and formic acid - up to 90 percent.
- Low-operating temperature (20 C to 80 C) and pressure (below 1 MPa or magnitude of pressure).
- Hydrogen is not required as a feed reactant, but is already present in water used in the process.
- ERC byproducts represent useful and financially profitable sources of income.
- ERC pilot projects can be executed on any scale, whereas sequestration can only be performed on a very large scale, leading to exorbitant research and development expenditures.

