

A high-efficiency incinerator at Cenovus Energy's terminal near Edmonton destroys all noxious hydrocarbon emissions as tank cars are loaded with crude oil.



TARGET ON METHANE

Governments have imposed ambitious targets to stop the emission of methane, a potent greenhouse gas, from oil and gas operations. What will it take to meet them?

By Mark Lowey



Decades before climate change became an environmental crisis, Canada's petroleum industry disposed of then-unmarketable natural gas, or methane, simply by burning it. In Alberta's Turner Valley oilfield in the 1920s, large gas flares would light up the sky. Near the flares, grass stayed green year-round, migratory birds wintered in the warmth and, in the light, housing construction for oilfield workers continued well into the night. The book *The Great Oil Age* quotes a visiting British reporter describing the scene: "Seeing it you can imagine what Dante's inferno is like...a rushing torrent of flame, shooting 40 feet high...a ruddy glow to be seen for 50 miles... the titanic monster glowering from the depths of Hades."

Flaring of methane (CH_4) by the petroleum industry is much more regulated today, although there are still health and environmental concerns about the practice. The industry's biggest problem now is the venting of unburned CH_4 from oilfield facilities and equipment, along with so-called fugitive emissions or leaks. Methane is known to be a potent greenhouse gas, contributing to global warming and climate change. In light of this, Alberta, where most of the methane from Canada's oil and gas industry is emitted, has set a target to reduce the sector's CH_4 emissions by 45 percent by 2025. Ottawa, along with the United States and Mexico, has similar targets. University scientists, technology providers and environmental groups — even the petroleum industry — say the targets are achievable using existing technologies that range from \$2 gaskets and solar-powered pumps to refrigeration units and waste gas incinerators. Maurice

Dusseault, professor of engineering geology at the University of Waterloo, says that meeting the 2025 target won't impose financial hardship on petroleum companies. "The target is absolutely doable with off-the-shelf technology," Dusseault says.

Why focus on CH_4 ? Global Warming Potential (GWP) is a measure of the amount of heat one kilogram of a specified greenhouse gas (GHG) in the atmosphere can trap over a certain period, relative to the same mass of carbon dioxide (CO_2) emitted at the same time. CH_4 is a potent GHG that lasts for 12 years in the atmosphere — shorter than CO_2 — which lasts up to 95 years, according to the Fifth Assessment Report of the UN's Intergovernmental Panel on Climate Change. CH_4 , however, is more efficient at trapping solar radiation than CO_2 . The 20-year GWP of methane is 86, so one kilogram of CH_4 will trap 86 times more heat than a kilogram of CO_2 over two decades.

Some companies have already embraced CH_4 mitigation on a voluntary basis. Chemical engineer Audrey Mascarenhas, president and CEO of Calgary-based Questor Technology, says her company uses high-efficiency mobile and permanent gas incinerators that destroy CH_4 , along with noxious and toxic hydrocarbon gases like benzene, toluene and xylenes. "It's not just about greenhouse gas emissions. There are benefits around air quality and quality of life," Mascarenhas says. "Focusing on methane is one of the easiest ways to really have an impact on reducing greenhouse gas emissions."

Toronto-based Berg Chilling Systems has found another solution to escaping methane. President Don Berggren says his company uses a mobile refrigeration technology developed with Montana partner



*Audrey Mascarenhas,
CEO of Questor Technology.*

GTUIT that eliminates the need for flaring. Instead of burning off the gas stream, the technology captures, compresses and cools the gas to about -40 C , which separates out valuable liquid hydrocarbons — including propane, butane and hexane — which can be transported by tanker truck and sold. At the same time, the process leaves a dry, conditioned gas that can be used onsite for power generation or put in a pipeline and sold as natural gas. Given the environmental and health concerns about flaring, Berggren says, "there really isn't a good reason to flare" except whenever a large oilfield facility has an operational upset or an emergency situation.

The petroleum industry is the single biggest industrial emitter of methane, accounting for 43 percent of Canada's total CH_4 emissions, or 46 million tonnes (Mt) CO_2 equivalent (CO_2e), according to 2013 data from Environment and Climate Change Canada. In Alberta, the oil and gas industry accounts for 70 percent, or



31.4 Mt CO_{2e}, of the province's total methane emissions, Alberta Environment reported in 2014. Venting and leaks from oilfield compressors, dehydrator units, pneumatic devices, storage tanks, valves and pumps account for 94 percent of the CH₄ of industry emissions, with the remaining six percent from flaring or other sources. As well, across Western Canada, small amounts of CH₄ are leaking out of wellbores from tens of thousands of active and abandoned oil and gas wells. Globally, an estimated five trillion cubic feet of gas is flared every year, according to the World Bank, which has an initiative to end global flaring by 2030. "The vast majority of emissions can be addressed simply by reducing the amount that's vented and leaked," says Mark Brownstein, vice-president, climate and energy, at the US-based Environmental Defense Fund.

The petroleum industry still uses flaring to burn solution gas (natural gas found along with oil in geological reservoirs) and to test and produce oil and gas. Companies are allowed to flare solution gas when not enough gas is found to make it economic to collect and sell as natural gas. However, Mark Taylor, vice-president of the Alberta Energy Regulator's (AER) climate policy assurance team, points out the agency

is recognized by the World Bank as an international leader in conserving solution gas and reducing flaring by more than 63 percent and venting emissions by more than 39 percent over the past two decades. Nevertheless, due to greater oil and gas production, the combined volume of flared and vented solution gas in Alberta increased 2.3 percent in 2014 from the previous year, to 920 million cubic metres, according to AER. In British Columbia, flaring levels also rose — by 22 percent in 2014 from the previous year to about 236 million cubic metres — mainly due to increased exploratory drilling and well testing, states the BC Oil and Gas Commission.

Flaring remains an option for the industry to manage methane emissions because it converts the CH₄ to CO₂, a much less potent greenhouse gas over the short term.

The black smoke that accompanies flaring is caused by the incomplete combustion of gas, releasing methane, other hydrocarbons and particulates.

A mobile, skid-mounted Berg-GTUIT refrigeration unit operating in North Dakota's Bakken shale oilfield.





A Berg-GTUIT mobile refrigeration unit captures natural gas and separates out the valuable liquid hydrocarbons in North Dakota's Bakken shale oilfield.

But despite improvements in flaring regulations, “flares are not 100 percent efficient. There’s still methane being emitted by these flares,” Dusseault says. There are also health concerns about the substances emitted by flares, including potentially toxic hydrocarbons and harmful particulates. However, no technology exists to directly measure all the substances coming from a flare, says Matthew Johnson, Canada Research Chair and professor of mechanical and aerospace engineering at Carleton University.

What about the cost to industry of cutting oil and gas industry methane emissions by 45 percent by 2025? Canadian Association of Petroleum Producers (CAPP) spokesperson Chelsie Klassen says government will need to provide some financial incentives

to national companies so that the additional cost of reducing emissions doesn’t make them less competitive than those in other jurisdictions not subject to the regulations. A 2015 study by research firm ICF International, commissioned by the Environmental Defense Fund, found the cost to Canada’s petroleum industry would amount to \$2.76 per tonne of methane CO_{2e} reduced, for a net annualized cost of \$74.5 million per year. This includes the value to companies of the recovered gas. Berg Chilling Systems’ technology, for example, recovers not only the methane but the valuable hydrocarbons in the gas stream, which petroleum companies can sell.

In Colorado, a state analysis estimated that new regulations to reduce CH_4



emissions cost companies, which sell the gas they capture, about 0.4 percent of their annual revenues. Some argue that simple prevention is even cheaper. Mike Shorts, president of Ontario-based Triangle Fluid Controls, which makes a range of gaskets to stop fugitive emissions, says tackling the problem involves “the proper use and deployment of existing technology. The cost is not prohibitive.”

The Alberta Energy Regulator is working with a multi-stakeholder group to develop the “most effective and efficient” regulations and cost-effective technology options for the petroleum industry to reduce methane emissions, Taylor says. The provincial government offers the industry carbon offsets as an incentive for voluntary

action between now and 2020 and has made available \$40 million to support development of technologies for CH₄ detection, quantification or reduction of emissions. As an example of what can be accomplished, ConocoPhillips Canada voluntarily reduced 98,000 tonnes of CO_{2e} per year over five years, using 10 methane-reducing technologies, including more efficient pneumatic controllers (which use gas pressure to control valves and other mechanical devices) and solar-powered (instead of gas-driven) chemical-injection pumps. “Regardless of how far the industry takes it on a voluntary basis between now and 2020, there are going to be solid regulations in place that ensure by 2025 we see that 45 percent reduction,” Taylor says.

The BC government has committed to reduce methane emissions by 45 percent from oil and gas infrastructure built before 2015. However, if the province’s liquefied natural gas (LNG) industry produces 24 million tonnes of LNG per year (which is just over half of BC’s targeted volume of LNG for export), the added infrastructure will emit 21 million tonnes of GHGs per year, according to a report by the Calgary-based Pembina Institute, a non-governmental policy and research organization. A study, released in late November by the Canadian Energy Research Institute (CERI), states, “significant residual effects related to greenhouse gas emissions” have been identified for seven out of 18 proposed natural gas pipeline and LNG projects that have undergone government environmental assessments. The Canadian Environmental Assessment Agency found that one project alone — the Pacific NorthWest LNG terminal near Prince Rupert and associated upstream natural gas development — will emit 11.4 million tonnes (Mt) of CO_{2e} per year.

Responding by email, David Karn, senior public affairs officer at the BC Ministry of Environment, says the province’s LNG facilities “will be the cleanest in the world.” Toward this goal, the government has set a “global standard” for GHG intensity of 0.16 tonnes of CO_{2e} emitted per tonne of

LNG produced. However, LNG companies will have the option to buy carbon offsets and pay into a technology fund rather than reduce emissions at their facilities. The government also offers a reduced “eDrive” electricity rate, which critics call a subsidy, of about \$60 per megawatt-hour versus the original rate of \$83 per MWh for LNG developers that use hydro-generated electricity rather than natural gas to operate the liquefaction process. This process cools natural gas to a temperature of -160 C, which shrinks the volume of the gas by about 600 times, enabling the LNG to be transported economically by ocean tanker over long distances.

Despite those measures, more than 90 international experts on climate change, in a letter last May, called on the federal government to reject the Pacific NorthWest LNG project. They noted that the ongoing freeze in BC’s carbon tax and exemptions in carbon-tax coverage for non-combustion sources, “such as methane venting and leakage, fundamentally undermine the province’s ability to encourage reductions in GHG emissions from the project and associated extraction activities.” Ottawa approved the project this past September, with a condition that direct GHGs from the project be capped at a maximum 4.3 Mt of CO_{2e} per year.

The federal government, to meet its 45 percent methane-reduction target by 2025, is working on new regulations that will start coming into force in 2018. But looming over Canada’s good intentions is United States president-elect Donald Trump, who has vowed to dismantle federal initiatives aimed at curbing global warming, which he called a “hoax.” The American Petroleum Institute says it will be “pursuing aggressively” a rollback of methane regulations. But Mascarenhas from Questor Technology says regardless of what the US does, Albertans and all Canadians deserve to breathe clean air, unpolluted by methane and other hydrocarbons. “I think we’ve got an opportunity here to really meet these targets, make Alberta a stronger place and diversify our economy and help our oil and gas industry make this transition.” **accn**