

Rural Alaska



Biogas could bring new energy to rural Alaska

Jill Burke | Jan 17, 2011



Students at a small high school in Alaska are giving new meaning to the "new energy" mantra coined by onetime Gov. Sarah Palin. But instead of looking to extract oil and gas reserves, as pitched by Palin, scientists in the Last Frontier are pioneering advances in an alternate method of gas collection -- the creation and harvest of methane -- and Cordova teenagers are leading the way.

Cows burp it, their dung piles emit it and [melting permafrost](#) in Alaska and elsewhere is releasing once-trapped reserves of methane gas that are now escaping as land shifts and melts. Methane, a greenhouse gas that traps heat at rates much higher than carbon dioxide, is the byproduct of bacteria that create the gas as they dine on dying plants and other waste.

In findings released last year, University of Alaska scientist Dr. Katey Walter-Anthony discovered that the methane bubbling out of [Alaska's flaming arctic lakes](#) is created by a cold-loving bacteria hard at work. [Urban planner T.H. Culhane](#), who builds waste-eating contraptions called

biodigesters to improve the lives of people living in urban slums and rural villages across the globe, thought Walter-Anthony's discovery could help his mission by improving the efficiency of the small-scale biodigesters he teaches others to make using commonly available supplies. Their partnership, facilitated by [National Geographic's Emerging Explorers](#) program, has resulted in an experiment, now in its second year, at Cordova High School, looking at whether Alaska's cold-loving bacteria, called psychrophiles, can expand the temperature range at which traditional biodigesters -- typically used in more temperate regions of the earth -- operate.

Culhane believes the technology will work in rural Alaska. With plenty of fish waste, wood, food scraps and other organic materials available, the raw materials are in place. All that's needed is the motivation.

"The dream of doing this in an Alaska community is if the money is there we can do it. The bacteria will do the job. It's really about plumbing and insulation," he said. "We are trying to build an artificial cow. A cow made out of plastic that you can set inside your house and which doesn't smell and that eats all of your waste and produces your energy and fertilizer."

The science class of a lifetime

When Cordova High School's chemistry and science club students were first offered a shot at participating in Culhane and Walter-Anthony's research, teacher Adam Low said they were seriously charged up. "It wasn't just 'yeah,' but 'Hell yeah, let's do this!'" he said.

The work would be tedious and at times unglamorous. Not only would they need to build six digesters, they would need to feed and partially drain them daily and record and analyze the data. Grinding up mass quantities of leftover school lunches to make meals for bacteria isn't exactly a teenager's dream job. Low was thrilled that his students were willing to take it on: "The payoff is that you really could change the world. You get to do a [real science project](#) without a known outcome and work with experts."

Under Culhane and UAF researcher Laurel McFadden's guidance, the students assembled and began monitoring the digesters during the 2009-2010 school year. Lake mud from Fairbanks and manure were used as starter, and soon the students were testing their own homegrown brew of microbes combined with water and ground-up food. They filled large plastic cubes with Alaska's lake bacteria, warm-weather bacteria (found in animal guts and feces) and blends of both and tested the methane-making potential of each cocktail at different temperatures.

"We were blown away that within three days we had flaming methane coming out of them," Low recounted as senior Craig Bailer, who has created his own independent class studying biogas, took daily measurements on a recent school day.

Phase two of the project is to do something useful with the gas, like cook or run a generator, which involves a whole new level of experiment. "One of our current science projects is what can we do to collect the gas to not create an explosives issue," Low said. "You don't want bags of biogas sitting around a high school."

Plans are underway to clean and compress the gas in propane tanks. But the students have also purchased a tractor tire inner tube. Inner tubes hold the gas well, gas flow is easy to measure from them and they are simple containers from which to pump the gas to an engine. Young scientists on the cable TV show ["Mythbusters"](#) once captured methane in an inner tube and used it to power a lawnmower. Low is convinced his students can do it, too.

Biogas at work

The digesters at Cordova High School aren't producing the same generous amounts of methane they might in a warmer climate. But that's not the goal. The Alaska experiment is testing how the various bacteria or bacteria blends perform at about 60 degrees and 75 degrees Fahrenheit -- certainly not cold for Alaska, but chilly compared to other climates around the world, especially those in developing countries. Bacteria, which love warmer temperatures, shut down if it gets too cold.

In warmer climates, 275-gallon digesters can produce about two hours of usable gas that can be burned to cook food or power a refrigerator. At Cordova High School, similarly-sized digesters are only producing about 20 minutes of usable flame.

"By themselves at the temperatures we are talking about, they are not going to produce commercial quantities of gas. No organism can metabolize at the rate human beings want to operate machinery," Culhane said. "We are trying to build a system for low-income people in developing countries and extend it into areas where it is cold."

Biodigesters in impoverished mountain regions tend not to do well, because when they fail as the temperatures drop, people give up on them and will resort to cutting trees for heat and fuel -- a problem because it degrades the environment and animal habitats. Conceivably, Alaska could begin exporting its cold-weather bacteria to

enhance the productivity of digesters beyond its borders. But it may be a stretch, for a number of reasons.

Culhane recently offered to import psychrophiles as part of a good will mission to Africa, believing they would be of use in the construction of Hutu-Tutsi reconciliation villages. The villages are intended to be entirely sustainable, and Culhane thought improved, cold-weather-capable biodigesters would fit in well.

But the project's organizer wanted a completely homegrown effort, which meant looking for a place to collect locally instead of bringing the cold weather bacteria in from somewhere else. Culhane is now looking at expeditions to other cold and glacial regions in search of psychrophiles, which are found throughout the world in cold climates.

The effort will carry him to the Himalayas and to Mount Kilimanjaro, and to the "Mountains of the Moon" on the equator near Rwanda, where the Nile river originates amid ice and snow.

Larger-scale digesters can be found in places like Germany and Stockholm, where governments help facilitate the collection of waste on a wide scale for processing in grain-silo sized containers, from which the generated gas powers homes and fuels cars and buses. Some communities, like Stockholm, even have homes with built-in food grinders that feed the large digesters directly.

In Culhane's ideal world, communities would have no waste and would harmoniously incorporate "all of the wildlife, including the microbial wildlife."

An energetic academic on an impassioned quest for a better society, Culhane isn't a kooky, unrealistic dreamer. In fact, just as Palin is reported to be [traveling to Israel](#) this spring on an international mission, so too will Culhane. The U.S. State Department, in cooperation with Palestine and Israel, is paying his way to the region next month to install biodigesters and teach others how to do it. The large-scale effort is meant to help reduce the amount of waste that's making its way into the environment there, including the Jordan River. During the four-village tour he will distribute manuals on how to make community and household digesters, available in English, Arabic and Hebrew.

"U.S. tax dollars are going to help bring some sort of energy sensibility to the region," he said of the upcoming trip in an interview from his home in Germany.

What about rural Alaska?

Large scale biodigesters -- ones fed by and which in turn feed fuel to the community -- aren't inexpensive. The ones just down the road in his German neighborhood are in the range of \$1.3 million each, Culhane said.

"Can it be done in an Alaskan village? Absolutely," he said. "When will Alaska do it? When someone who has that kind of capital says 'let's do it.'"

Communities in rural Alaska -- remote, spread out, often roadless and with limited jobs -- would certainly benefit from cheaper forms of energy.

While Alaskans appreciate the innovation Culhane is striving for, some are skeptical money is the only barrier to making biodigesters more commonplace.

"I'm not saying it's impossible, but there are difficulties," said Dave Messier of the Yukon River Inter-Tribal Watershed Council, who says a number of emerging technologies -- from wind, solar and hydro power to biomass projects -- have promise. "But when you start to get down to the human interactions, that's where it begins to get difficult."

It can be tough to find local people to run power plants, let alone oversee new technologies, and people who are reliable and active in the community tend to be really busy already, Messier said.

Plus, encouraging people to change personal habits could be another hurdle altogether. It's one thing to bring power to families living without it in third world villages, he said, but when you already have electricity or heat "it's a little different than going from (the mindset that) it's easier to throw the scraps in the trash or give them to the dog when (people) already have power and all (they) have to do is flip a switch."

Even Culhane, who believes biodigesters could be effectively put to use in Alaska's villages, admits there are limits. Could they help people "live a lifestyle that is better than subsistence? Definitely yes," he said. "To lead a lifestyle that uses snowmobiles and big screen TVs? Probably not. I don't think society can live with the inefficiencies we have."

Contact Jill Burke at [jill\(at\)alaskadispatch.com](mailto:jill(at)alaskadispatch.com).

Read more of the Dispatch

- *Is Sarah Palin at the center of the GOP's universe?*
- *'Nyuk, nyuk, nyuk', Gulf spill companies talk to Congress*
- *A sit-down with Shell's Alaska boss*
- *Fairbanks doctors sue tribal group over unpaid bills*
- *Beaten but not defeated, Murkowski and Walker consider carrying on*