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Biogas, a low-tech fuel with a big payoff

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No wastes: The fermentation of pig and cattle manure generates organic fertiliser and biogas (for electricity generation). This biogas plant about 150km south of Santiago, Chile, generates up to 4MW of electricity for the farm's own use. — Photos by AFP

Whether at household operations or at industrial facilities, a centuries-old

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technology is increasingly being used to extract energy from crop waste, kitchen scraps and sewage.

IN villages across China, tens of millions of families use farm and household waste to make clean cooking fuel in backyard fermenters. Germany generates as much electricity as two nuclear power plants with the gas produced by decaying plant matter and animal slurry. Near San Francisco, a landfill extracts enough energy from its stewing garbage to power 300 trucks on their daily runs.

Around the world, both household-run operations and industrial-scale facilities are using centuries-old technology to extract a fuel known as biogas from crop waste, manure, kitchen scraps and even sewage. Proponents cite the multiple benefits of harnessing biogas, such as reducing emissions of the powerful climate-warming gas methane, cutting waste streams and saving the lungs of those in poor countries who would otherwise burn wood or other smoky fuels indoors. After biogas is extracted from organic material, a rich fertiliser remains.

“It’s essentially the lowest technology on the planet, but it really works well. It’s very inexpensive. Long term, it is going to come, and it’s going to be big,” said Chris Somerville, director of the Energy Biosciences Institute at the University of California, Berkeley.

Historians say the Assyrians may have used biogas to heat bath water, and Marco Polo noted in the 13th century that the Chinese extracted energy from covered sewage pots. Gas from sewage treatment powered some English streetlights in the 1890s.

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In this biogas plant about 180km south of Santiago, Chile, pig and cattle manure is decomposed in a digester to produce biogas (a mix of methane and carbon dioxide) that is then used to generate enough electricity to supply 2,500 homes.

Clean and cheap

When organic matter – anything from kitchen scraps and farm cuttings to sewage and manure – decays with no oxygen present, either in nature or under controlled conditions in a sealed tank, it ferments, emitting methane and carbon dioxide. That mixture, if released, is a potent contributor to climate change. But if it is burned instead, it creates energy, just like natural gas.

In recent years, significant growth in biogas use has come mainly in countries where governments, seeking new clean energy sources and other benefits (like a reliable, domestic supply of gas) have offered financial incentives and logistical support. With Germany and China, both major biogas users, now pulling back or refocusing efforts, though, continued expansion is not a sure thing.

Germany, a world biogas leader, encouraged the fuel's greater use as part of a huge national effort to shift to renewable energy. Since 2000, the government has offered guaranteed payments to facilities feeding clean power, from biogas and other sources, into electricity grids. Now, nearly 8,000 biogas plants process specially grown crops, animal slurry, and agricultural plant waste, combusting the resulting gas to generate electricity, and also capturing and distributing heat.

Some purify the gas into biomethane, which has the same chemical make-up as natural

gas, and pump it into gas distribution grids, to be used by households or at filling stations for vehicles equipped to run on compressed natural gas. Revenue from that energy production has become a steady income source for many farmers.

Burning gas of any kind for power is useful as the country seeks to increase the share of electricity provided by solar and wind, whose unpredictability can be a problem. Gas-fired plants “are able to start and stop their production when there is demand for electricity,” said Manuel Maciejczyk, a general manager of the 4,800-member German Biogas Association. Officials are encouraging biogas producers to expand storage and increase power capacity so they will be better able to shoulder that backup role, he said. Biogas now provides 4.6% of Germany’s electricity, Maciejczyk said. In August, though, the government, struggling with rising electricity costs, modified the rules governing the sector and cut the rate guaranteed to larger producers, moves that Maciejczyk said would hit the industry hard.

Biogas: how it works



Commercial biogas plants

China, scrambling to meet exploding energy demand, relies on biogas for about 10% of its total natural gas use, said Xia Zuzhang, an energy access specialist for the Asian Development Bank. Beijing started promoting the use of basic, backyard biogas production for rural families in the 1930s, said Xia, author of a report on Chinese biogas published by the International Institute for Environment and Development in London. Officials saw the sealed tanks, known as digesters, as a way to improve sanitation, provide energy to rural dwellers and reduce breathing problems caused by burning wood and dung indoors.

For households with a farm animal or two, the combination of manure, human waste and plant material is enough to create a steady supply of clean-burning cooking gas, usually via a pipe that runs directly into the kitchen. More than 42 million Chinese households currently have such set-ups, Xia said. But officials have slowed efforts to add more home-based digesters, as rural residents have migrated to cities, electrification has reached almost everywhere and village markets sell alternative fuels

like propane, he said. Now China is more focused on bringing biogas production to the industrial-scale cattle, pig and chicken farms whose effluent waste poisons land and rivers.

Nepal, Vietnam, Bangladesh and Cambodia make more limited use of small-scale digesters, as do African countries including Tanzania, Burkina Faso, Uganda and Kenya, Xia said. Feedstocks can include farm waste like the husks left over after rice is milled.

Biogas from waste

The United States is also exploring the use of biogas, though natural gas prices depressed by the shale gas boom make it harder for the fuel to compete on cost. In Brooklyn, the Newtown Creek Wastewater Treatment Plant mixes food waste with sludge to generate biogas, and it plans to start purifying the fuel so it can be pumped into New York's natural gas grid. National Grid, the company managing the purification facility, says it will be ready in 2016 and could provide enough gas to heat 5,200 homes.

National Grid, which supplies natural gas for New York, Rhode Island, Massachusetts and New Hampshire, said that with US\$7bil (RM22.4bil) in infrastructure investment, biogas could supply a quarter of those states' natural gas demand, excluding that used by power plants. Doing so would have the same climate benefit as taking three million cars off the road, the company said.

Landfills, where decaying garbage emits methane, are another source. More than 600 American landfills capture that pollutant and use it to produce energy, the Environmental Protection Agency reports. At the Altamont Landfill, east of San Francisco, for example, the gas is converted into a liquid that fuels 300 garbage trucks. Dairy farms are also big methane emitters, and therefore a major potential biogas contributor. There is talk in the United States of creating a network of natural gas filling stations for trucks, infrastructure that could easily be used for biogas as well. – International New York Times

How to make a Bio-gas Digester



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