



Carlos Tamayo showing the concrete digester at the back of his house.
Photos: Martin Egbert

Relieving (energy) poverty with biogas

Biogas plants are much in demand in Cuba: they ensure that waste from pig-farming is disposed of in an environmentally friendly manner, and help rural families to cut energy costs and earn additional income. However, there are many hurdles still to be overcome before this “green” fuel can supply the country’s energy on a large scale.

When Carlos Tamayo goes out collecting in his neighbourhood of the village of Cuatro Caminos, he probably won’t be rattling his collecting tin. “I collect dung for my biogas digester”, explains the pastor of La Trinidad episcopal church and laughs. The grey concrete digester is no bigger than a refuse bin and stands under a guava tree behind his house, covered by a tin sheet and a few stones. Inside, pig manure ferments to produce methane, which is forced through a narrow pipe directly into the kitchen, where it supplies a two-burner stove. Here the pastor’s wife cooks for at least five people every day. She used to use an electric hotplate. “The biogas cuts our electricity bill by half, that’s to say roughly the equivalent of five euros.” That is a quarter of what a doctor or a teacher earns in a month.

■ Profiting financially and environmentally

Wages are low and prices high on the Caribbean island, which is why hardly any Cubans can live on their official salary. Carlos Tamayo also needs

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to supplement his pastor’s salary, so has other jobs besides the profession he was called into. For a while, for example, he kept ten to fifteen pigs, to sell and for his own consumption, and their waste ran the digester. “But I’m out and about too often to keep pigs.” So now he collects pig manure three times a week from members of his “flock”.

With Tamayo’s help, fifteen smallholders in the village have been able to install small digesters as well. They took courses to learn about building and operating the plants, and the church gave them small loans to enable them to pay for building materials and labour. In the mainly agricultural province of Matanzas there are a large number of small-scale pig breeders. “That is an environmental problem too, as most of them dispose of the untreated waste in ditches”, explains Pastor Carlos Tamayo. That pollutes the soil and groundwater – and is unpleasant for people.

The church-based aid organisation Centro Cristiano de Reflexión y Diálogo-Cuba (CCRD-C) has been promoting biogas since the start of the economic crisis in the early 1990s. This period, known as the *Período especial*, was triggered by the collapse of the Soviet Union. Cuba lost its market for the sugar produced on

most of its arable land – as well as its supplier of subsidised manufactured goods, oil and fertiliser. To make matters worse, America expanded its economic embargo. The island suffered acute shortages, especially of energy. Oil deliveries from Venezuela, drilling for Cuban crude oil and national energy-saving programmes have now alleviated the extreme supply problems. For example, nine million low-energy light bulbs have been distributed to Cuban households and low-interest loans made available for purchasing energy-efficient refrigerators, hobs and electric fans. Furthermore, the government has decentralised supply in order to relieve the strain on the dilapidated old power stations. Power cuts and blackouts do still occur, admittedly, but to a far lesser extent than in the 1990s, when outages lasted up to sixteen hours a day.

■ Demand can scarcely be met

“We can kill two birds with one stone with biogas”, says Rita Morris, director of CCRD-C. “We can improve the lives of rural people and reduce the environmental damage caused by pig manure.” The organisation receives support from Berlin Mission and the European Union, amongst others. There are 300 digesters in the mainly agricultural province of Matanzas

alone that have been installed with the aid of CCRD-C. "Each digester is used by three families on average", explains Rita Morris. There is a great deal of interest among farmers in the province, she says, because they see how much their lives will improve if they can produce their own methane. "At the moment we have around a hundred people on the waiting list for a micro-digester." However, the organisation has neither the money nor the capacity to fulfil all these requests.

■ The versatility of biogas

The CCRD-C also operates two biogas plants of its own. This saves the organisation around sixty euros a month, which it previously had to spend on propane gas. On the aid organisation's 36-hectare fruit and vegetable farm close to the small coastal town of Cárdenas, methane is used not only to prepare meals for the twenty or so employees: in a kitchen on the outskirts of the farm two women preserve cabbage, mangoes, papaya, cucumbers and green tomatoes to sell. In this way they keep the farm's wide range of produce in supply even out of season, providing local people with affordable healthy food. Used plastic bottles are collected from hotels, restaurants and private houses for this. The women cut them open and then wash them in hot water to sterilise them. Then they fill them with cooked food in vinegar, hold them in

a clamp and seal them using a metal rod, which they have first heated on the stove. Methane is used in almost all stages of the work.

A growing number of independent farmers in Cuba are also investing in biogas plants – without the aid of organisations like the CCRD-C. Joel Matienso has been operating his, which ferments manure from 300 pigs, since 2012. The waste flows straight from the sties along concrete channels into the 42-cubic metre fermentation tank at the edge of his farm in Sancti Spíritus province. "I built the digester myself", his voice hoarse as he shouts above the noise of his pigs and the chaff cutter, which his two employees are using to chop cassava. He had help from other farmers with previous experience. Four families live and cook at the farm, making sixteen people altogether. Besides Joel Matienso and his wife and two children, this includes one of his three brothers, who helps him in the business, and the brother's family. "We use methane to cook broken rice to feed the piglets, too."

In this way Matienso saves the equivalent of 240 euros a year. In Cuba that is more than the annual salary of a university professor, a doctor or a construction engineer – Joel Matienso's actual profession. Thanks to his pig-breeding he was able to give up his job five years ago. Since then the family has prospered. There is a

new air-conditioning system and a new television set in the house, and a red motorbike is parked outside – a 1989 MZ that, despite its ripe old age, costs the equivalent of 8,000 euros. Private transport is a luxury in Cuba. The investment of the equivalent of 1,700 euros for materials and labour to build the biogas plant was modest by comparison. "I shall have recouped that in no time", says the 49-year-old farmer, and trudges off in his white wellingtons towards the cropland to show how effective the digester residues are as fertiliser. Sugar cane and cassava for the pigs flourish over an area of half a hectare, as do guavas, avocados, bananas, limes, coconuts and a host of other crops for the family growing in another field. This self-sufficiency farming is extremely important in Cuba, owing to continuing supply shortages. Private farmers often have virtually no access to expensive fertiliser and pesticides; both are sold almost exclusively through state-owned businesses. That is why many farmers effectively farm organically, without necessarily being certified.

■ Requirements for pig-fattening units

A lot of Cuba's pig farmers work closely with the state-owned Empresa porcina, from whom they buy piglets, feedstuffs and veterinary services and to whom in return they sell their pigs. Since 2015 these farms have had to



The digester residues are often used as fertilisers.
Photos: Martin Egbert



A worker feeding the pigs on Joel Matienso's pig farm. The farmer also uses methane to cook broken rice to feed the piglets.

provide evidence of a biogas plant when signing their contracts, which always last for six months. Moreover, since the beginning of 2016 all units keeping twenty or more pigs have had to ferment their dung in digesters. That is why, of the 1,200 pig-fattening units in Sancti Spíritus province, almost four hundred have their own biogas plants.

However, the boom also owes much to the expertise at the University of Sancti Spíritus. Research into this fuel has been taking place in this small town in central Cuba for many years. "There is great potential in Cuba", says Osvaldo Romero Romero of the University of Sancti Spíritus, currently visiting professor at the Technische Universität Berlin. To date 1,818 digesters altogether are in operation across the island, according to the energy ministry's official figures. Volumes range from ten to more than two hundred cubic metres. As well as these there is a not inconsiderable number of unrecorded digesters. However, there is potential for many more yet, Osvaldo Romero Romero believes. "Seven thousand plants could be run just on pig manure, and another 1,700 if cow dung is used as well." Five hundred plants could ferment the residues from sugar refineries, jam factories, distilleries, abattoirs and coffee processors.

■ Renewables must be expanded

Cuba produces only 4.3 per cent of its electricity from renewable sources, of which by far the greatest proportion comes from biomass. Almost half of Cuba's power stations burn crude oil, over sixty per cent of which has to be imported, as do the other fossil fuels, diesel and gas, that are used to generate electricity. This is to change under proposals from the national commission for the development of renewable energies set up by Raúl Castro. The proportion of biomass, hydropower, and solar and wind energy is to rise to 24 per cent by 2020. Biogas generation is not included in this plan as a source of electricity, but as a source of fuel and organic fertiliser. However,



On CCRD-C's fruit and vegetable farm, women preserve cabbage, mangoes, papaya, cucumber and green tomatoes, providing local people with affordable food out of season.

a national programme for the development of biogas, which envisages electricity generation from methane, is currently being drafted at the University of Sancti Spíritus on behalf of the commission. "Biogas could provide seven to ten per cent of the electricity used in Cuba, and in Sancti Spíritus province it could even be more than twenty per cent", estimates Osvaldo Romero Romero. As yet, however, there are neither the technical skills nor the funds needed to import foreign biogas systems to realise this potential.

■ Cooperation with German plant construction companies

Archea New Energy from Oldendorf in Hesse wants to change that through a collaboration with the University of Sancti Spíritus. "Cuba is very interested in green energy", says Saskia Louwen, a project engineer for biogas plant construction with the company. She sees the potential for electric capacity from biogas plants as at least 500 megawatts. The company initially plans to build a pilot plant generating 250 kilowatts at a rice farm, to promote the use of biogas in this way. At the same time the highly qualified scientists at the university could gain practical experience in the field.

The question of a suitable substrate is as yet unresolved, as Cuba lacks the

resources for growing energy crops. Of the more than six million hectares of arable land, almost one million are lying fallow. However, this Caribbean island must prioritise growth in food production and feedstuffs in order to reduce imports. On the basis of a doctoral thesis there, Archea worked at the University of Sancti Spíritus to develop the idea of using the waste from rice-drying. The husks, broken grains and stalk residues can be mixed with manure from a neighbouring pig farm, and the methane from the digester used to drive a combined heat and power plant. The rice farmer could use the heat and electricity generated himself, for example for drying the rice. That is important, because feed-in is difficult in Cuba's overloaded grid. However, there are many other stumbling blocks: "Every bag of cement that you need has to be planned for a year in advance", is how Saskia Louwen describes the shortages and problems of a centrally controlled economy. Then there is the bureaucracy. And which business model is suitable? In a recent development foreign companies have been able to set up their own subsidiaries outside joint ventures, although they are not for instance allowed to recruit their own staff, but must select them from the skilled workers referred by the state. "Nevertheless, we are determined to be involved in biogas in Cuba", says Saskia Louwen.