

# GENERATING X

PRODUCING HIGH-QUALITY DRINKING WATER AND CONVERTING WASTEWATER INTO A CLEAN HARBOUR DISCHARGE ARE TWO PROCESSES THAT TAKE A LOT OF ENERGY. BUT THOSE PROCESSES ALSO RELEASE ENERGY, WHICH WATERCARE CAPTURES TO REDUCE COSTS FOR CUSTOMERS AND TO BRING ENVIRONMENTAL BENEFITS FOR THE AUCKLAND REGION. IAN PARKES REPORTS ON WATERCARE'S PLANS TO GENERATE MORE ELECTRICITY AS A BY-PRODUCT OF THE COMPANY'S CORE BUSINESS. PHOTOGRAPHY BY RACHEL ALFORD.

Watercare generates power in two ways: using biogas produced by microbes breaking down waste in the wastewater treatment process and from water-driven turbines installed at two of the region's drinking water dams. In the immediate future, Watercare plans increased electricity production from biogas and hydro sources.

## GASSING UP

The biogas produced at the wastewater treatment plant is piped to four turbo-charged, 16-cylinder gas engines. The engines, installed in 2001 as part of the wastewater treatment plant upgrade, replaced three engines that were based on older technology.

The new-generation Austrian-built engines produce more power from the available gas, require less downtime, and the lean-burn technology in the new engines results in much cleaner emissions.

With a generating output of 1.7 megawatts each, the four engines can produce a total output of 6.8 megawatts. That would have been more than enough power to meet the needs of the old wastewater treatment plant. But the newly-upgraded plant is both more sophisticated and a bigger consumer of electricity – the plant consumes three times the electricity as the old plant. See *Energised* page 6.

At present, the biogas that is pumped off the wastewater treatment process is sufficient to power 2.5 engines. Natural gas has to be added to the biogas to run a third engine at optimum load.

Until recently, the natural gas supplement was playing another vital role. Biogas like that produced at Mangere includes hydrogen sulphide gas and siloxane, both of which are

substances that have a corrosive effect on engines. Diluting the biogas with natural gas has kept that corrosive effect in check and allowed the engines to operate within the manufacturer's guidelines.

However, Watercare recognised that removing hydrogen sulphide and siloxane from the biogas would significantly reduce maintenance costs and downtime on the engines and reduce the quantity of natural gas that has to be burnt in the engines.

Consequently, midway through 2003, Watercare installed mixed media filters (the filters use activated carbon and iron sponge, see page 11) to remove the siloxane and hydrogen sulphide from the biogas. The filters will extend the life of cylinder liners, piston rings, spark plugs, and lubricants nearly three-fold and further improve exhaust emissions from the engines.

The fitting of the filters has allowed Watercare to cut its natural gas consumption at Mangere to a third of what it was.

See illustration, page 12, of biogas-powered electricity generation.

## SOUNDING OUT MORE BIOGAS

Wastewater planning engineer Graham Barker says further enhancements to biogas production are under consideration. A new process called sludge cell lysis promises to produce more gas. The process uses ultrasound to break down cell walls in the sludge, aiding decomposition and simultaneously releasing more biogas.

Cell lysis would have another environmental benefit in further reducing the mass of biosolids to be disposed of at the end of the wastewater treatment process.

Watercare is currently evaluating cell lysis,

which is installed in just a few plants around the world.

Graham says that laboratory tests of cell lysis are showing increased gas production of between 30 and 60 per cent. At 60 per cent more biogas, that would be enough to operate all four engines on full output and sufficient to take biogas-powered electricity generation to more than 80 per cent of the plant's demand. Indeed, wastewater operations manager Erle Robinson says that eventually it might be possible to run a fifth engine with cell lysis installed at Mangere.

A 60 per cent increase in biogas yield would mean Watercare would use at least 20,000,000 kW/h less electricity from the national grid per year at Mangere, enough electricity to power almost 1,700 New Zealand homes per annum.

## USING MORE HYDRO-GENERATION

New Zealand is unusual in the developed world in that a large proportion – about 70 per cent – of the country's power comes from hydro and geothermal sources.

These abundant sources of power – literally fuelled from the skies in the case of hydro – means that for years New Zealand has enjoyed some of the cheapest power in the developed world. However, as the country's energy demand continues to grow, and as the Maui gas field runs down, the cost of filling the energy gap means the price of power is sure to rise.

Which makes Watercare's own hydro-generation schemes all the more important. They are on a much smaller scale than national hydro-generation power stations, but the economics of power generation is changing, making small co-generation plants such as those run by Watercare increasingly viable.

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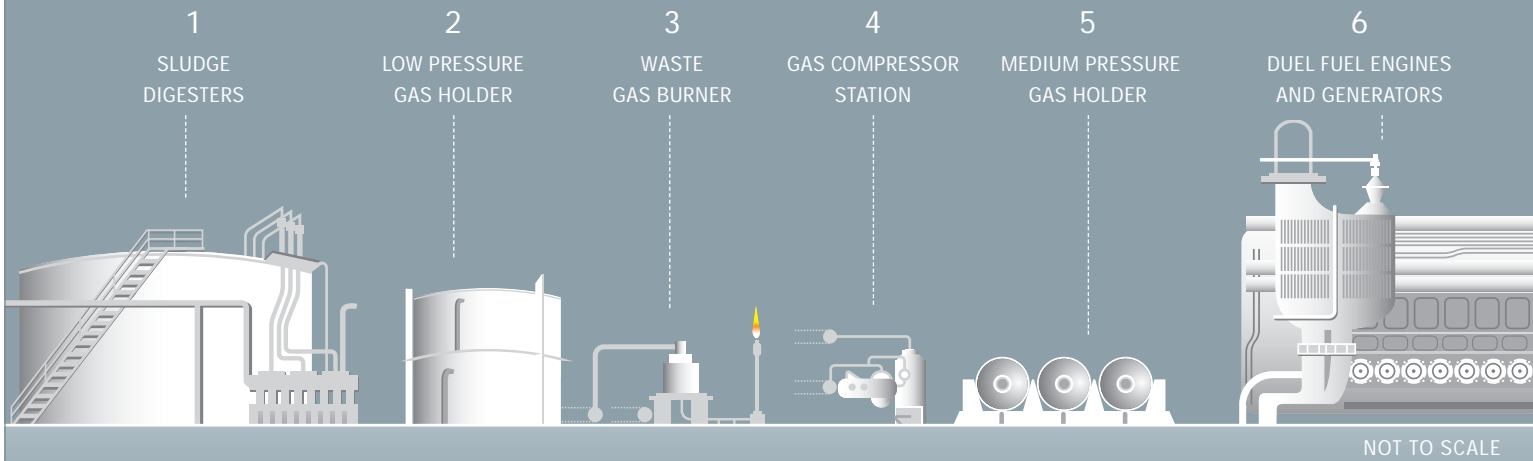


POWER GRAINS: ACTIVATED CARBON GRAINS (PICTURED ABOVE) ARE USED AS THE FILTERING MEDIA TO EXTRACT SILOXANE FROM THE BIOGAS AT THE MANGERE WASTEWATER TREATMENT PLANT. EXTRACTING SILOXANE AND HYDROGEN SULPHIDE MAKES THE BIOGAS EASIER TO USE IN THE GENERATORS AT THE PLANT. CURRENTLY, THE BIOGAS-POWERED GENERATORS SUPPLY JUST OVER HALF OF THE WASTEWATER TREATMENT PLANT'S ELECTRICITY. EVENTUALLY THEY COULD SUPPLY MORE THAN 80 PER CENT OF THE POWER FOR THE TREATMENT PLANT.

# GASSED UP:

HOW WATERCARE GENERATES POWER FROM BIOGAS AT THE MANGERE WASTEWATER TREATMENT PLANT

ILLUSTRATION  
BY ELECTRIC ART



## 1. SLUDGE DIGESTERS:

As part of the wastewater treatment process, sludge is extracted from the wastewater stream. The sludge is circulated and heated to 37 degrees (C) in the digesters, activating bacteria which break down the organic material in the sludge. One of the by-products of this process is biogas. The sludge is taken away for further treatment and, ultimately, disposed of as biosolids. Meanwhile, the biogas is drawn off at low pressure.

## 2. LOW PRESSURE GAS HOLDER:

Low pressure biogas is stored here.

## 3. WASTE GAS BURNER:

Watercare aims to use all of the biogas that it draws off the wastewater treatment process. However, on occasions, when some of the gas is surplus, it is flared and burnt.

## 4. GAS COMPRESSOR STATION:

Like any gas that is going to be burnt, biogas has to be compressed before it goes into the engines. The gas is taken up to about 70 kPa, before it is transported to filters that remove siloxane and hydrogen sulphide from the biogas.

## 5. MEDIUM PRESSURE GAS HOLDER:

Medium pressure biogas is stored here.

## 6. DUAL FUEL ENGINES AND GENERATORS:

The biogas – which has been compressed and filtered – is fed to the engines, blended with natural gas where necessary to provide enough fuel to run three engines. The engines generate electricity which is used to run the wastewater treatment plant. Currently, the engines supply just over half of the plant's electricity requirements.



CLOCKWISE FROM UPPER LEFT: IRON SPONGE IS LOADED INTO THE HYDROGEN SULPHIDE FILTER AT THE MANGERE WASTEWATER TREATMENT PLANT. THE IRON SPONGE EXTRACTS HYDROGEN SULPHIDE TO MAKE THE BIOGAS EASIER TO USE IN THE BIOGAS-POWERED GENERATORS AT THE PLANT. BELOW: INSIDE THE FILTER BEFORE THE IRON SPONGE IS LOADED: THE BIOGAS ENTERS THE FILTER AND PASSES THROUGH THE IRON SPONGE BEFORE GOING INTO THE GENERATORS, WHERE IT IS BURNT TO GENERATE ELECTRICITY. LOWER LEFT: THE IRON SPONGE IS LOADED VIA A LOADING PORT ON THE TOP OF THE FILTER. THESE PICTURES WERE TAKEN WHEN THE FILTERS WERE INSTALLED AT MANGERE IN THE EARLY SPRING.



SPECIAL FEATURE