TECHNICAL GUIDE
1.0

Gasification momentum builds in New Zealand

After a long period on the sidelines, gasification is attracting new interest. For businesses with ready access to a good source of wood fuel — and increasingly other forms of biomass — it could be a very attractive way of producing low-cost and low-emission heat and electricity. This article overviews the technology and shares the experience of the 'advance guard' driving this technology forward in New Zealand.

Gasification vs conventional burning

There are already a number of organisations around New Zealand producing heat and generating electricity from wood fuels and other biomass. These systems work by completely combusting the wood fuel.

Gasification works differently. By starving the process of oxygen, the fuel is only partially combusted. This creates 'producer gas'; a mixture of carbon monoxide, hydrogen and methane. This gas can be cooled, filtered and then burned directly for heat or, once it's been scrubbed of particles and tars, used to fuel a gas engine to generate electricity.

Char generated through the gasification process.

Basic designs

There are several designs of gasification boiler — two of the most common are the updraft and downdraft gasifiers.

In an updraft design, fuel moves slowly down through the reactor, turning into char with air passing upwards through the fuel bed. The producer gas is taken from the top of the reactor and contains volatiles like tars. The char at the bottom of the reactor is normally burnt to a white ash.

In a downdraft design, air moves down through the fuel. The gas exits at higher temperatures — energy that is often recovered to pre-heat incoming fuel. After the gas is produced it passes though the hot test part of the reactor, at the bottom of the fuel bed. This helps clean the gas by breaking down the tars. A char is produced, which is an activated carbon, and is useful as a medium in filters.

The key to making the most of these systems is to have a dry fuel source, that is consistent in size.

Generation applications

Producer gas from gasification can be used for cogeneration or combined cycle generation.

With cogeneration, electricity is generated and the residual heat is also utilised. This option is particularly valuable for businesses like timber mills, which typically use large amounts of electricity and also require heat for their drying kilns.

With combined cycle generation, the producer gas is first used to fuel a gas turbine generating electricity. The residual heat is then used to generate steam for a steam turbine. This greatly increases the amount of electricity a given amount of wood fuel or biomass can generate, potentially making it a more cost effective option for larger businesses or power generators.

Growing NZ expertise

The technology has a long history — in the 1800s coal was gasified for town gas, and gasification was used widely to combat fuel shortages in World War Two. It is well established in some countries but is still in its infancy here.

Interest is growing however, and there are now at least three businesses in New Zealand offering expertise in the technology — Alternative Energy Solutions (AES), Windsor Engineering Group and Page Macrae Engineering. All three companies are at various stages of adoption.

AES and the Ankur range

AES is the New Zealand agent for the Ankur range of biomass gasifiers.

Ankur's gasifiers are the downdraft type and are available with a wide range of capacities. They're designed for wood fuels and various types of biomass including corn cobs and bagasse (sugar cane residue).

Ankur is selling its gasifiers successfully in Germany, Italy, Russia, Vietnam, Sri Lanka and other countries. Many of the installations are in small manufacturing businesses that are off their national grid.

> "It's fair to say that the fuels in the countries Ankur serves generally have a lower moisture content than in New Zealand, eliminating or reducing the need to dry fuel." Gavin Hedley, AES.

A test gasifier set up AES.

One of the issues that needs to be clarified for New Zealand businesses is fuel quality.

"It's fair to say that the fuels in the countries Ankur serves generally have a lower moisture content than in New Zealand, eliminating or reducing the need to dry fuel. Also, the countries buying these systems produce less energy from renewable sources and tend to have green tariffs or other green investment incentives," says AES co-founder, Gavin Hedley.

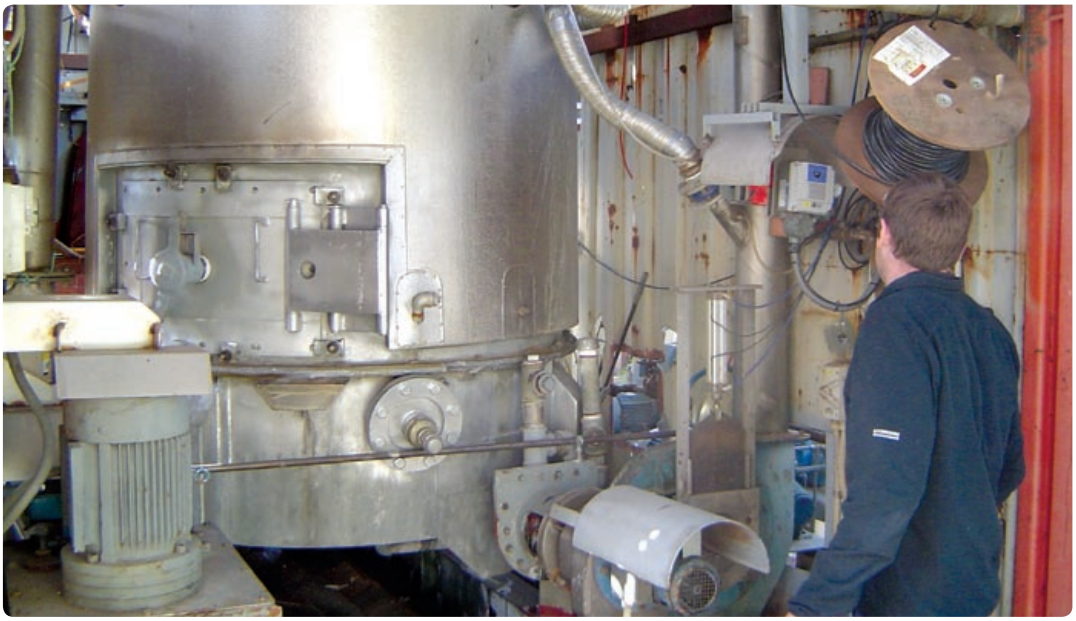
The higher moisture content in New Zealand is something that can be managed, and Windsor Engineering Group are one company experimenting with mixing fuels for optimum performance.

Windsor signs up to Agder Biocom

Windsor Engineering Group is certainly optimistic about the prospects of gasification technology. It has recently signed up to represent the Agder Biocom range of bioenergy heat plants in both New Zealand and Australia.

"We see a gap in the market for small scale (1-5 MW) combustion plants that have low emissions and burn cleanly without needing extensive filtration at the end of the process," says Managing Director Maurice Davies.

"Most of the heat plants currently available don't burn cleanly and require filtration or wet scrubbers to comply with air emission regulations, which are only getting tougher. We feel the best way to deal with that is to use a cleaner burning technology at the front of the process."



The gasifier run by Page Macrae.

We'll also look at the other fuels this process can use, including dried sewage sludge and even combinations of biomass and lignite coal.

Maurice agrees that there is some uncertainty in the market about what fuels can be used.

"From our research, a gasifier requires consistency of fuel with optimum moisture content for an efficient and stable combustion process.

"New Zealand's wood tends to have a higher moisture content than in Norway, where this particular technology originates. The trick will be with the blending of the fuel, for example blending green chip wood with dry shavings or with sawdust or bark.

"If the moisture of the main fuel is variable, then it's simply a matter of being more flexible with the blending."

Windsor will be setting up a 1 MW gasification R&D facility that will experiment with different fuels.

"Not just wood residue. We'll also look at the other fuels this process can use, including dried sewage sludge and even combinations of biomass and lignite coal.

"Once we have the results we feel positive that the business case for many organisations will be quite good."

Page Macrae supplies plywood factory

Page Macrae Engineering also has a lot of experience with gasification. It started experimenting almost 10 years ago and for several years managed a trial 3 MW gasification plant at a local Carter Holt Harvey-owned plywood factory.

"We realised that to get solid operational data, we needed to be running a system with a good and measurable load for extended periods," recalls Chief Engineer Hans Burgraff. "We came to an agreement with the plywood factory that we'd do the installation if they would give us the fuel and we would split the savings 50/50. They ended up getting steam at a heavily reduced rate."

Once the system bedded in, it was providing 95% 'availability'. "It was chugging along nicely providing the base load. At one point, we ran it two months, 24/7 non stop. We only shut it down then to check it out — but there was no indication that we couldn't have kept running it for another six months or more."

Hans acknowledges a fair bit of experimentation was needed in the early stages.

"The biggest issue getting started was figuring out what's going on, what we can do and what we can't. But that was just research, and once we got it sorted it was PLC-controlled and pretty much self-sufficient. It's just a matter of allowing for that bedding in process."

Hans points out a big advantage is the reduced emissions.

"In many areas you find wood fired boilers have to meet an emission limit of around 250 mg/m^3 of particulates in their exhaust gas from the stacks. They can usually achieve that with good cyclones or dust capture, but sometimes they need bag houses or precipitators. But the limits are constantly being pushed down and we've had a lot of guys coming to us and saying we're going to be in trouble.

"We did a number of emissions tests and the highest figure we came up with was 40 mg/m^3 — that's likely to be comfortably within any consent in New Zealand for many years, without all the expense of the extra equipment.

"Another big advantage is in maintenance. Boiler grates work at very high temperatures and even if they're water cooled they eventually need replacing. Gasifiers are relatively compact, so the grate is smaller and cheaper to replace.

"There are all sorts of practical advantages that should really put gasification ahead of traditional systems."

An opportunity to be grasped

Increasingly, gasification looks a very neat solution to the twin pressures of ever-rising fuel costs and increasingly tougher emissions standards. The technology is well proven offshore, and there is now a growing knowledge base developing here, including engineers with hands-on experience with our local fuels. It's an exciting technology that has the potential to help businesses better utilise forest residue. For more information about these projects please contact us directly.

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EECA enables organisations to increase their domestic and international competitiveness by adopting energy efficiency and renewable energy practices.

We work with businesses to identify the opportunities for energy management that are available to them and help them develop energy management action plans to make the most of these opportunities.

Good energy management has many benefits for businesses, including lower costs, increased productivity, reduced greenhouse gas emissions and a positive effect on the brand.

We have a particular interest in:

- encouraging new or under-used technology that can make processes more efficient
- projects that reduce greenhouse gas emissions, and
- developing the wood fuel industry.

For more information contact The Energy Efficiency and Conservation Authority:

EECA HEAD OFFICE:
PO Box 388, Wellington, (04) 470 2200

EECA AUCKLAND:
PO Box 37444, Parnell, Auckland, (09) 377 5328

EECA CHRISTCHURCH:
PO Box 13983, Christchurch, (03) 353 9280

www.eecabusiness.govt.nz

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