



# WhisperGen

## The Quiet Little Revolutionary

Turning an invention from the early 1800s into a 21st-century electricity and hot water supply solution is helping to power a Christchurch high-tech engineering company onto the world stage. **RICHARD WORRALL** reports on a potentially huge export income earner.

**WHISPER TECH LIMITED** of Christchurch has developed what it calls a "Personal Power Station", based on the Stirling engine, a concept first developed more than 180 years ago by the Reverend Robert Stirling. The WhisperGen is a highly efficient and environmentally friendly means of generating electricity and heating water for applications as diverse as yachts, mobile homes, houses remote from main electricity supplies, refrigerated trucks and even passenger trains.

While the range of potential applications is vast, the company is concentrating at present on the household and boating markets. "Virtually every day people come to us with possible new applications, but we have decided that with limited resources it is better to concentrate on bringing the product onto selected high-value niche markets first," says Whisper Tech Limited's managing director David Moriarty.

### Beginnings

The WhisperGen story began back in 1989 when Don Clucas began a PhD research project, working with Professor John Raine in the Department of Mechanical Engineering at Canterbury University to develop a Stirling cycle battery charger for yachts. The device quickly evolved into a fully

fledged personal power station, which showed so much promise that Professor Raine, Dr Clucas and the University of Canterbury established a company in 1993 to commercialise the concept. The new venture EcoTech Limited was formed with the help of seed funding from Southpower (now Orion Limited).

The company's name was changed to Whisper Tech Limited in 1995 when Southpower made a further substantial investment into the fledgling company. By this stage Whisper Tech shareholders had grown to include SouthPower, the University of Canterbury, Professor Raine, Dr Clucas, and Bruce Boehm who ran the Master of Engineering Management programme at University of Canterbury and had assisted with the company start-up. These shareholders have since been joined by Meridian Energy.

Between 1995 and 1997 further refinement and development of the engine and the control electronics and software took place. This was followed by intensive field trials in yachts and remote dwellings. Commercial sales began in the last quarter of 1999, and in the year to 31 March 2002 the company expects to manufacture 400 units. The target retail

price per unit is from \$US2500 to \$3000 each depending on the particular variant.

Staff numbers have ballooned from just three when the company was founded to 53 today. Further growth in staff numbers is expected next year as production volumes accelerate. Roughly half the staff, including about a dozen University of Canterbury School of Engineering graduates, are engaged in ongoing research and development.

### The Stirling engine

At the heart of the Stirling engine concept is the use of the properties of gas to effect piston movement. Put simply, the engine generates power by moving a mass of nitrogen gas from a hot place (inside the top of each cylinder) to a cold place (the lower portion of the cylinder) and back again. Each time the gas is heated and cooled the piston is pushed up and down inside the cylinder. The gas is pressurised inside the cylinder once during manufacture.

Compared with conventional internal combustion engines the Stirling engine offers a number of advantages, says Dr Clucas. "There are no valves or valve gear in the engine as the gas is simply moved by the piston motion. In addition, the gas is heated by a continuous flame, unlike the intermittent explosive combustion of an automotive engine."

He says the end result is a very quiet, clean and reliable engine capable of operating without oil or oil changes, using a variety of energy sources including natural gas, kerosene, biogas and diesel. A further bonus is that the process of cooling the gas produces a continuous stream of hot water that can be used for space or water heating.

### The wobble yoke

As the Stirling engine is a broad engineering principal rather than specific design, much initial research went into identifying the right configuration. Eventually a four-cylinder double-acting configuration was chosen as it is compact and permits easy heat exchange and very smooth operation.

The motion of the pistons drives an electric generator via a patented engine crank, known as a wobble yoke, designed by Dr Clucas. This device consists of two rocking beams mounted on top of each other at right angles and connected to the pistons. The rocking beams in turn are connected to two nutating bearings on the crankshaft.

He says the wobble yoke was by far the best option for harnessing the piston motion, as it has the most reliable bearings and therefore the best motion. Harnessing power directly from the pistons was not an option, as this would have required the use of complicated and expensive linear alternators.

The wobble yoke, together with the advent of durable high temperature heat-exchange materials and polymer-based piston seals, has unlocked the potential of the Stirling engine. These factors combined allow, for the first time, the efficient and reliable conversion of linear piston motion to

rotating motion to run a conventional electricity generator.

While technical breakthroughs in other fields have helped greatly, the achievements of the small team of Christchurch engineers headed by Dr Clucas should not be belittled. They have succeeded on a relatively tiny budget where many multinationals – the likes of General Motors, Ford and Philips – failed, despite spending literally billions of dollars trying to commercialise the Stirling engine from the mid-1930s.

Another reason for Whisper Tech Limited's success has been their market-led approach, according to Dr Clucas. "The first thing we did was to identify markets that suited the characteristics of the Stirling engine, rather than just looking for a technical breakthrough for its own sake."

AC and DC versions of the WhisperGen are being manufactured. The DC version is designed for power generation

**They have succeeded on a relatively tiny budget where many multinationals – the likes of General Motors, Ford and Philips – failed.**

in remote areas where the cost of connection to mains electricity supply is prohibitive, and for mobile applications such as generation on board yachts. DC models store electricity in batteries. It is converted to AC power for running appliances via an inverter; using a battery/inverter combination, power can be supplied 24 hours a day to



## ENERGY

connected electrical loads without the user having to start an engine generator system.

The first production models of the DC version were exported to Western Europe in 2000. According to Mr Moriarty, this market was chosen because it is a high-price, price-insensitive market and thus offers higher and more reliable profit margins. Initially the DC model is being targeted at wealthy boat owners. The WhisperGen competes against standby diesel generators and systems using the main propulsion engine as a primary energy source. Given the WhisperGen's advantages in size, quietness, reliability and running costs over conventional on-board electricity sources, he says the market potential is very large. "Boat owners are early adopters of new technology as they like to be seen to have something that other boats owners may not have on their vessels."

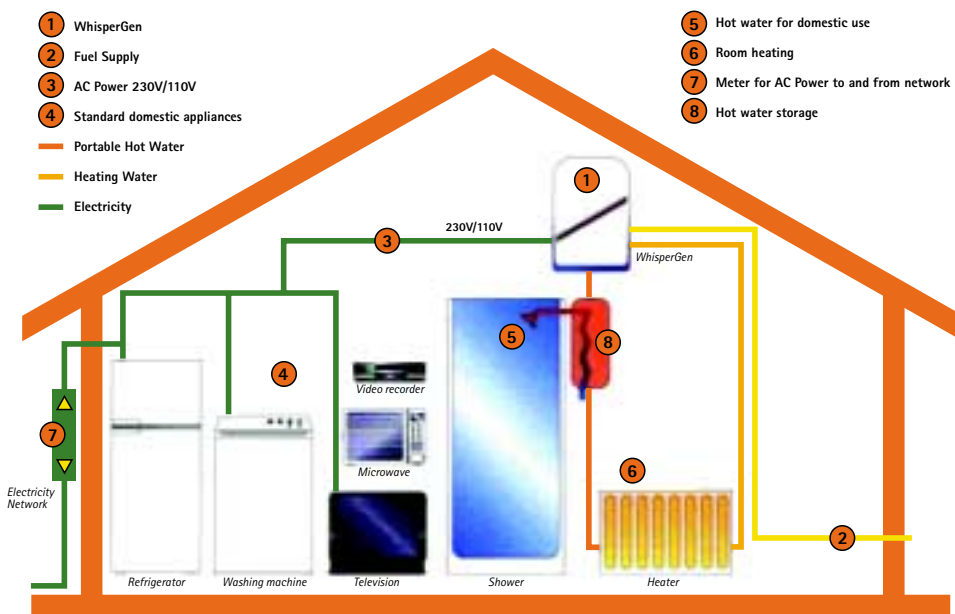
### AC/DC

Across the globe in Japan Whisper Tech Limited is targeting the domestic home-buyer market with its DC WhisperGen model. The units are proving increasingly popular in houses remote from mains electricity, and also with people who want to be independent of outside sources of electricity. Another Japanese market niche WhisperTech Limited hopes to make inroads into is the network of 70,000 so-called "safe homes" spread throughout the country to provide havens for residents during natural disasters. "At present these houses are equipped with diesel generator sets, but authorities are concerned about the safety of storing diesel in these houses. Installing WhisperGen units would solve this problem as they can run on natural gas or LPG," says Mr Moriarty.

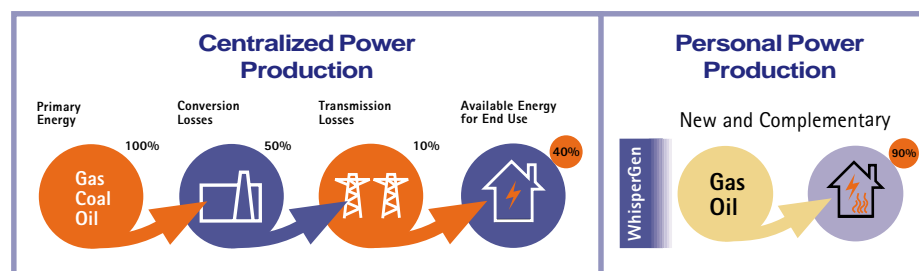
The residential market is also shaping up to become a major market in Europe for the AC version as a result of a 1997 approach to Whisper Tech Limited by Gasunie, the state-owned gas importer and distributor in the Netherlands. Gasunie wanted a gas-powered combined heating and electricity generating system. The resulting unit is called a micro combined heat and power system.

The AC units feature the same core engine as the DC version but rather than generating electricity for running household appliances it replaces the household boilers that supply the hot water and space heating requirements in most European homes. Although the heat is generated by fossil fuels rather than electricity, Mr Moriarty says that with much of Europe's electricity generated by coal-fired power stations, WhisperGen units are far better for the environment.

"Using fossil fuels to generate electricity at large power stations is only about 40 percent efficient, on top of which another 8 to 10 percent of electricity is lost during transmission. The WhisperGen is more than 90 percent efficient when it comes to energy conversion."



WhisperGen MCHP System – Urban Home Power Station



Mr Moriarty says the huge advantage to consumers is that the WhisperGen unit not only provides a far more cost-effective means of heating water but as a by-product it generates electricity at a low cost, and this is fed directly into the house's switchboard. Such co-generation is ideally suited to winter conditions when demand for heat and electricity is highest. "Based on the average price and demand for electricity in Netherlands, buyers can expect to recover the capital cost of their WhisperGen units in just three to four years," he says.

### Potential

The potential market for the AC units can be measured in the millions per annum, according to Mr Moriarty, who says at least four million household boilers are replaced each year across Europe.

A number of units have completed field trials in Europe and these will be joined by a further 22 units installed throughout the United Kingdom for trials over the 2001/02 northern winter. These are being carried out in conjunction with a major UK energy company. Full commercial release of the AC units is expected in 2003.

Whisper Tech Limited's biggest headache is likely to be keeping up with demand, as the company's Christchurch factory is capable of producing only 2000 units per annum. While the company is likely to move to a bigger factory next year to boost output, it is likely that much of the manufacturing will be carried out overseas using strategic partners.

Richard Worrall is a Christchurch-based freelance journalist.