

# BUSH TECH BRIEF # 7

## Feasibility of gas and dual fuel



### Background

Recently CAT investigated the feasibility of using an emerging technology, the gas micro-turbine. We also looked at the use of gas and dual fuel (gas & diesel) generators to power remote communities and meet their energy needs.

Many remote communities still do not have a reliable and cost effective source of electricity. And, importantly, using the most efficient fuels and machines for generating electricity will reduce greenhouse emissions.

### What we found

Aided by field visits, we identified advantages and disadvantages with all types of power generation.

On visits to Standley Bore, Al Yuen, Hamilton Downs Youth Camp and Stanley Chasm, we asked residents a few questions about their power systems. These were:

- How much does it cost to run?
- How much did it cost to install it?
- How much does it cost to do maintenance?
- What problems do you have with their current system?
- Are you happy with your system?
- Are your power needs being met?
- Is maintenance an issue with your unit?
- How reliable is your power?
- What do you want?

### Problems revealed

After sourcing this information from communities, many problems were revealed:

- The costly use of gas to power a small community where no other power supply was available.
- Communities are not making use of the diesel fuel rebate for off-road use (38.143 c/litre)
- Gas distributors are not able to supply large quantities of gas to remote communities cost effectively
- Technical knowledge of gas/ dual fuel/ microturbines is minimal in remote areas
- The cost of maintenance is very high and done irregularly, which results in reduced life of systems
- Gas service and warranty contracts are sometimes misunderstood, leading to uneconomical arrangements
- There are situations where gas was cheap upon installation of equipment but after a few years the cost per litre increased to become dearer than diesel
- Training is not appropriate or adequate for maintenance staff and residents.

Other insights from our investigation were:

- The better you maintain equipment the more reliable it becomes and the longer it lasts
- Large LPG fuel storage tanks (bulk storage) reduce the number of times gas suppliers need to fill up; however it is difficult for remote communities to get access to this service. Most gas suppliers will travel only on sealed roads.

### Safety when using gas

Gas (LPG) is designed to be transported and used in pressure vessels and lines at all times. So if you smell gas leaking, turn it off immediately and call in a qualified person to repair the damage. A leak can easily lead to an accident. Leaks also waste gas and it can be a long drive to get another full cylinder.



DIESEL GENERATOR — STILL THE CHEAPEST.

LPG CONTAINERS NEED TESTING EVERY TEN YEARS.



### Bulk storage for domestic use?

Bulk storage of gas is difficult as suppliers do not find it profitable to deliver gas to remote areas. Gas suppliers would prefer to fill bulk tanks four or more times a year to make it profitable. They would like to deliver a full truckload of LPG but this far exceeds the gas consumption of small to medium communities. If communities decide to install bulk storage of gas, it is worth thinking about purchasing the container rather than leasing it, as this may be cheaper. This way, communities can negotiate with the gas suppliers a reasonable price and may only need the container to be filled once a year. Note that if you buy a bulk storage container, this will need to be tested every ten years. Reticulation of gas to houses may need gas meters at each house to determine the usage and detect any leaks.

After investigating the pros and cons of bulk storage, it was found that domestic gas for cooking, heating and hot water is best obtained by using a 45kg cylinder beside the house. A 45kg cylinder may be refilled or exchanged easily and then transported by community transport rather than relying on gas distributors for delivery. This also means that each house is accountable for its own gas consumption. Households could keep two cylinders and use an automatic change-over valve so that an empty cylinder can be taken to town on your next trip, but the household is not left without gas in the mean time.

### Comparing the cost of gas and diesel

The table overleaf compares the costs of power generation for different fuels. The figures are based on several 30kVA generators powered by diesel, gas, and dual fuel as well as diesel and gas microturbines. The table includes initial costs, installation costs, servicing costs and fuel costs at Alice Springs. The basis for comparing costs of different modes of power generation is the total cost per year. This shows that the cheapest way to generate power in a remote area is with a diesel generator, if you receive the diesel fuel rebate. If gas were to be competitive with this option, it would have to be available at around 40 cents per litre, which is virtually unheard of in remote areas.



# BUSH TECH BRIEF # 7

## Feasibility of gas and dual fuel (continued)

Cheapest option for power generation

Financial illustration of different fuels in engines for power generation based on about 30kW capacity if located in Alice Springs.

Mode of power generation	L/hour	Price of fuel cent/L	\$/hour	Annual cost of fuel \$ /year	Suggested number services per year	Service intervals (hours)	Initial costs of equipment	Average service costs/year	1/5 of purchase price	Total cost/year
Diesel generator	10.3	104	\$10.71	\$93,819	35	250	\$20,000	\$10,280	\$4,000	\$108,099
Diesel generator with rebate	10.3	65.85	\$6.78	\$59,415	35	250	\$20,000	\$10,280	\$4,000	\$73,695
LPG Gas generator	17.5	55	\$9.62	\$84,271	22	400	\$30,000	\$6,960	\$6,000	\$97,231
Dual fuel 20% lpg generator	8.2/3.5lpg	104/55	\$10.40	\$91,454	35	250	\$30,000	\$10,280	\$6,000	\$107,734
Gas Micro-turbine	17.4	55	\$9.57	\$83,833	1	8000	\$115,000	\$1,520	\$23,000	\$108,353
Diesel micro-turbine with rebate	12.5	64.85	\$8.11	\$71,010	1	8000	\$115,000	\$1,520	\$23,000	\$95,530
Bio-diesel micro-turbine	10.3	?	?	?	1	8000	\$115,000	\$1,520	23,000	?
Reduced cost gas in a generator	17.4	<b>39.8</b>	\$6.93	\$60,735	22	400	\$30,000	\$6,960	\$6,000	\$73,695

- Using 1/5 of the purchase price over five years.
- Costs are based at Alice Springs; i.e. no travel or installation costs are included.
- All figures are based on 100% load continuous operation.
- Services are based on 250 hours for diesel and 400 hours for gas.
- 250hrs service cost =- 2 hours labour @\$60+\$100 parts =\$220
- 600hr service cost =-2.5 hours labour @\$60 + \$150 parts=\$300

- 1000hr service cost =-3 hours labour @\$60 + \$200 parts=\$380
- 4000hr service cost =10 hours labour @\$60 + \$1000 parts=\$1600
- Servicing of micro-turbines is \$430 per 8000 hours and \$3157 per 16000 hours

Maximum price of gas to be competitive

### Micro-turbines

Gas micro-turbines are very new on the market in the United States and, with the low Australian dollar, are over priced for their use in remote sites here. The micro-turbines can be run on many different forms of fuel. They do have potential to be run on diesel and, with the off-road rebate, this will be the best option in time. Co-generation, using the heat from the exhaust gases has the potential to heat areas in winter, cool in summer or make hot water. Bio-diesel is the most environmentally-friendly fuel and also has the potential to be produced cheaper than rebate diesel. One problem for micro-turbines in the Australian desert could be high ambient temperatures and this would need to be closely monitored.

### Using gas in standard generator sets

Some LPG installations were installed when LPG was much cheaper than it is today. Unfortunately, some communities have continued to run gas gen-sets at a very high cost. One community runs their generator for about 14 hours a day (no power at night), but uses \$50,000 per year in LPG to power about seven houses. Knowledge and technical experience of these complicated pieces of equipment is hard to find in remote areas. Dual fuel was another option investigated. This involves using a combination of LPG (20%) and diesel fuel (80%) in a diesel generator. This doesn't seem to have any real benefit but only complicates the technology further. Cost savings are negligible or nil.

### Maintenance

It was very obvious that regular maintenance by people who know the machine is the best way to ensure a good reliable machine. In communities where experienced people conducted

regular maintenance, the machine was good and reliable, even if was way oversized for the community. But if servicing was neglected or faults not reported the reliability was poor.

### Conclusion

Although gas is cheaper by the litre, you require a larger quantity to power a generator. With the diesel rebate for off-road use it's still cheaper to use diesel. Micro-turbines will be the next generation for for small-scale power provision in remote areas, especially once their reduced service requirements become apparent. Unfortunately we have to wait about ten years for these. We may need to obtain technicians from interstate initially to service the micro-turbines with their complicated technology.

Our investigation revealed that bio-diesel could significantly reduce costs if it could be produced more cheaply than the diesel currently being sold. Bio-diesel also is the most environmentally-friendly option; that is, the CO<sub>2</sub> emissions in the lifecycle of bio-diesel are much less than for LPG or diesel.

Whatever technology and fuel you use, the key to reliable equipment is having trained staff who can service the machinery at agreed intervals.

### References

- Capstone model 330 micro-turbine product data sheet
- Aquatec maxcon, Ipswich Qld, Garth Lee
- Perry Brothers Power Generation, Alice Springs
- Western Diesel, Alice Springs
- Allight Pty Ltd, Lansdale WA
- Philip Calais and Ralph Sim, Murdoch University, Perth.

Compiled by John Pickels, Rio Tinto Fellow at CAT Alice Springs