

# Goldman Energy Case Study Qantas Trigeneration Project



Figure 1 MWM D4000 engine

## Summary:

Goldman Energy together with GridX designed, installed and operated a 12MW Cogeneration plant for Qantas at Sydney Airport, Mascot.

Throughout 2014 Goldman Energy worked alongside GridX and Qantas to produce the plant that supplies 12MW of electricity, 12MW of heating and 22MW of chilled water.

As well as being the principle contractors involved with the design, construction, and installation and commissioning, Goldman Energy were also the leading engineering consultant. This Turnkey project shows the capabilities of both Goldman Energy and Trigeneration technology.

## Overview:

The Trigeneration facility now supports:

1. The QANTAS head office with over 50,000m<sup>2</sup> of workspace
2. The Qantas Jetbase (maintenance and repair workshops)
3. The new Terminal 3 (opened in August 2013).

4. The Qantas catering facility (creates the meals for all of Qantas' flights)

Phase 1 was to supply power, heating and cooling to the Jetbase and the Catering facility. This was increased to include the Head Office building in 2014.

Phase 2 saw an expansion of this facility to include electricity, heating and cooling to the Terminal 3 building.

## Qantas benefits:

The energy costs for Qantas, coupled with the high costs for greenhouse gas emissions saw them look to Trigeneration to reduce their outgoings.

Qantas are included in the:

1. FTSE4Good Index
2. Dow Jones Sustainability Index (DJSI)
3. Carbon Disclosure Project

And have been awarded the Eco-Aviation Award in 2013 and the Banksia Environmental Award in 2012

These sustainability criteria, recognized as key performance indicators by Qantas, meant that

identifying opportunities to reduce their carbon footprint was a high priority for the airline.

### The Solution:

Trigeneration was seen as a solution to the energy requirements of the site.

Our team at Goldman Energy designed and installed, and now maintain and monitor the state of the art facility including:

- 4 MWM Gas Engines
- 6 World Energy Absorption chillers
- 3 Carrier Electrical chillers
- Pumps
- Civil construction of the plant room
- Control valves
- Cooling towers
- Urea storage
- Comap High tech monitoring equipment
- Selective Catalytic reducers
- Integration into Qantas' High Voltage Power system



Figure 2 Qantas Jetbase Plant room

### Cogeneration Units:

Goldman Energy installed two MWM D4000KW engines and two MWM D1600KW engines. These were packaged by TEDOM. TEDOM are our technology partners providing high quality and high efficiency Cogeneration systems.

Utilising engines from MWM, these engines were installed with the TEDOM control system from ComAp including and full integration into the Qantas BMS System.

Advantages of the QUANTO Units include

- Increased electrical efficiency
- Good accessibility to individual parts of the system
- Simple and fast servicing
- Reliable operation
- Low emission from Exhaust gas
- Operation with a lean mixture of gas or a three way catalytic converter

**Table 1 Performance characteristics of selected MWM engines**

Performance							
Unit		D4000			D1600		
Rated Electrical Output	KW	4300			1560		
Maximum Heat Output	KW	4580			1576		
Load	%	<b>50</b>	<b>75</b>	<b>100</b>	<b>50</b>	<b>75</b>	<b>100</b>
Heat Output	kW	2713	3628	4580	935	1276	1626
Fuel input	kW	5473	7617	9812	1937	2769	3605
Electrical Efficiency	%	39.3	42.3	43.8	38.8	41	42.1
Heat Efficiency	%	49.6	47.6	46.7	48.3	46.1	45.1
Total Efficiency	%	88.9	90	90.5	87.1	87.1	87.2
Generator							
Cos $\phi$		0.8			0.8		
Efficiency in the working point	%	97.8			97.4		
Frequency	Hz	50			50		
Engine							
Arrangement of Cylinders		V 16			V 16		
Bore x Stroke	mm	260/320			170/195		
Displacement	dm <sup>3</sup>	272			70.8		
Compression ratio		12:1			13.5:1		
Speed	Rpm	1000			1500		
Oil consumption, normal / max	g/kWh	0.3			0.2		
Max. engine power	kW	4395			1602		
Unit Dimensions and Weights							
		Engine - Generator			Engine - Container		
Length / width / height	mm	9360 / 2685 / 3385			14800 / 3150 / 3000		
Service weight	Kg	53675			45200		
<b>*All Values are per engine</b>							

### Absorption Chillers:

Three World Energy absorption chillers were installed in each of the two facilities. Both sites utilise two double effect exhaust driven absorption chillers and one single effect hot water driven absorption chiller. By managing all six absorption chillers we are able to supply the Qantas base with their chilled water requirements.

**Table 2 Performance Characteristics of selected Absorption Chillers**

Unit	CHP100H	HVAR-L825H	CHP032H	HVAR-L470H
Quantity	2	1	2	1
Cooling Capacity (KW)	3310	2646	1127	1290
Heating fluid	Exhaust Gas	Jacket Water	Exhaust Gas	Jacket Water
Chilled water temp in / out (°C)	12 / 6			
Condenser water temp in / out (°C)	29.5 / 36			
Hot water temp in / out (°C)	NA	90 / 78	NA	90 / 75
Exhaust Gas temp in / out (°C)	448 / 115	NA	425 / 115	NA
Dimension L/W/H (mm)	6,657 / 3,535 / 3176	6246 / 2303 / 3867	4742 / 2349 / 2137	5540 / 1830 / 3222
Weight (ton)	41.1	31.8	11.8	19.4

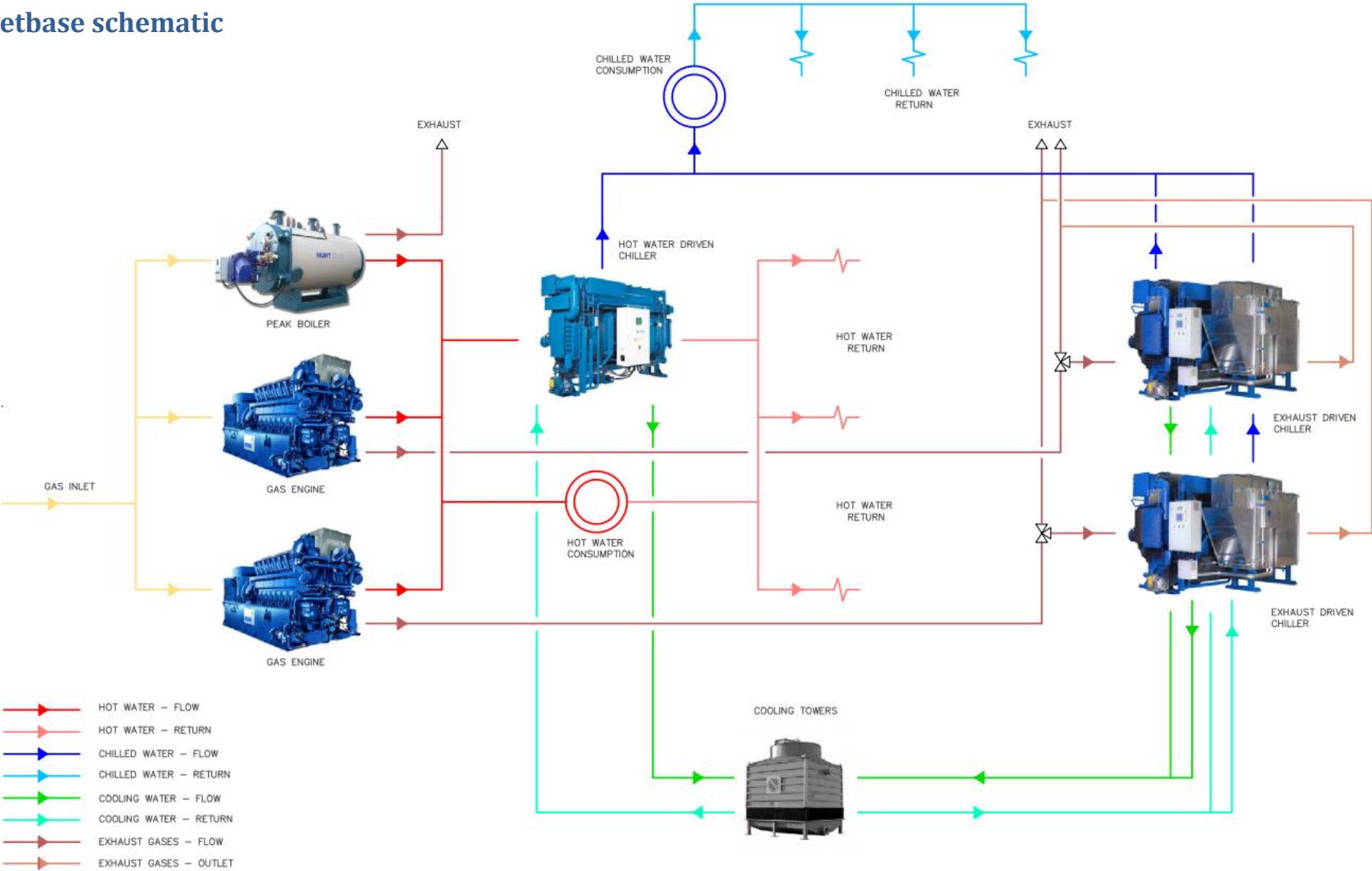
## Electric Chillers

To provide the high amounts of chilled water required, two 19XRV7777564MDH5B electric chillers were installed from Carrier. These also enable chilled water to be produced with the Generators are not running due to economic or maintenance reasons.

**Table 3 Performance characteristics of selected Electric Chillers**

Output Type	Full Load	Part Load	Part Load
Percent Load	100	50	10
Chiller Capacity (KW)	4000	2000	400
Chiller Input (kW)	644	270	124
Chiller COP	6.2	7.4	3.2
Chilled water temp in / out (°C)	12 / 6	8.99 / 6	6.6 / 6
Condenser water temp in / out (°C)	29.5 / 35	18.33 / 21.04	18.33 / 18.98
Operating weight (ton)		21048	

# Qantas Jetbase schematic



- HOT WATER - FLOW
- ← HOT WATER - RETURN
- CHILLED WATER - FLOW
- ← CHILLED WATER - RETURN
- COOLING WATER - FLOW
- ← COOLING WATER - RETURN
- EXHAUST GASES - FLOW
- EXHAUST GASES - OUTLET



## ComAp

As part of the TEDOM Trigeration packages, Goldman Energy utilised ComAp technology in the control and integration system. The GenSet control allows excellent optimisation and visibility of the units from a central plant room. ComAp programming is a vital part of every Trigeration system and enables the operators and Original equipment suppliers to remotely monitor the system. The ComAp offering also allows control of other plant equipment without purchasing additional hardware. With 4 ports for inputs and outputs, and the option for modularising the system, the whole plant can be run from a single control panel.

The ComAp inteli-pro	InteliSys <sup>NI</sup> BaseBox	InteliVision 8
<ul style="list-style-type: none"> <li>• Excellent reverse current protection</li> <li>• Proved majority of DNSPs in Australia</li> <li>• Highly flexible interconnection/mains decoupling protective relay with extensive protective functions</li> <li>• Dynamic grid support</li> <li>• QU protection (directional reactive power under-voltage protection)</li> <li>• Certified according to IEC 60255, VDE 0126-1-1 and BDEW</li> <li>• Applicable for requirements of G59/3, G10, G83 and IEEE1547 and VDE-AR-N 4105</li> <li>• Possibility to enable the appropriate functions required by your utility</li> <li>• Detailed history log fully records the nature of mains disturbances including brown-outs</li> <li>• Watchdog reporting provides increased reliability of the installation</li> <li>• Advanced on-line communication notifies immediately of changes in the mains-connection</li> <li>• InteliPro features a new Pole Slip protection. Click to find out more about Pole Slip</li> </ul>	<ul style="list-style-type: none"> <li>• Gen-set controller for single or multiple generating sets operating in standby or parallel modes</li> <li>• Support of cogeneration (CHP) and other complex applications</li> <li>• To be used in conjunction with detachable colour display InteliVision 8 or monochromatic display IS-Display</li> <li>• Support of engines with ECU</li> <li>• Many communication options – easy remote supervising and servicing</li> <li>• Gen-set performance log for easy problem tracing</li> <li>• Automatic synchronizing and power control (via speed governor or ECU)</li> <li>• Baseload, Import / Export, TempByPower, Peak shaving, Voltage and PF control (AVR)</li> <li>• Generator measurement, Mains measurement</li> <li>• Inputs and outputs configurable for various customer needs</li> <li>• Controller redundancy</li> <li>• Event-based history (up to 1000 records) with customer-selectable list of stored values; RTC; statistic values</li> <li>• Integrated PLC programmable functions</li> </ul>	<ul style="list-style-type: none"> <li>• 8" Colour Detachable Display Unit with a resolution of 800 x 600 pixels</li> <li>• PLUG and PLAY</li> <li>• Complete access to all control and monitoring functions</li> <li>• More information in less time with Fast and intuitive navigation</li> <li>• TRENDS monitoring screen with USB flash disk file Storage</li> <li>• Easy Drag &amp; Drop screen configuration in graphical editor</li> <li>• ADAPTIVE and COLOUR alarm list</li> <li>• Binary signal activation – S/R button / toggle button / pulse generator</li> <li>• Configurable soft keys buttons: Fast skip to any screen</li> <li>• Large history screen</li> <li>• Support of Tier 4 icons</li> <li>• Communication connections via RS232/485 and CAN bus</li> <li>• Same cut profile as IS-Display (single replacement of monochrome displays)</li> <li>• Mounting screw available at the rear face of InteliVision 8 to mount a compatible controller</li> <li>• Direct connection to the controller (converters are not needed)</li> </ul>



Alongside these controllers, Goldman installed a number of InteliMonitors. InteliMonitor is Windows 2000 /XP /Vista /Win7 /Win8 compatible software which provides the following main functions:

- Online monitoring of a controller or site
- Fully customizable SCADA diagram
- Browsing of all measured and computed values
- Browsing of controller history records
- Adjusting set points
- Receiving active calls
- PLC Monitor, great PLC monitoring tool is a part of InteliMonitor

**InteliMonitor can be connected to the controller or site:**

- Directly using a serial cable
- Remotely via modems
- Remotely via Internet (Ethernet)
- Remotely via ComAp AirGate
- Offline

