© Copyright Statement

FUEL EFFICIENCY & GREENHOUSE GAS REDUCTION STUDY AT GRANNY SMITH MINESITE FOR PLACER (GRANNY SMITH) PTY LTD

June, 1999

Prepared by:

Fuel Technology Pty Ltd
6a Nairn Street
FREMANTLE WA 6160
(PO Box 1271)

Tel: (08) 9335 6899
Fax: (08) 9430 5403
E-mail fueltech@nettrek.com.au

ACN 063 561 151

C O N T E N T S

Appendix

EXECUTIVE SUMMARY

The FTC Combustion Catalysts manufactured and marketed by Fuel Technology Pty Ltd have proven in laboratory and field trials to reduce fuel consumption in the range 3% to 8% under comparable load conditions and to also substantially reduce carbon emissions.

Following meetings with Placer (Granny Smith) Pty Ltd's Environment Engineer, Nathan Russell, it was agreed that a fuel efficiency and greenhouse gas reduction emission study should be conducted at the power generation plant. The trial to employ four engines, two to remain untreated for control comparison and two to have their fuel supply treated with the FTC-3 Combustion Catalyst.

Two engineering standard test procedures were employed in the test program, namely:-

1. Specific Fuel Consumption tests (SFC)
2. Exhaust Emission Carbon Balance tests AS2077-1982 (CB)

The net efficiency gain (reduction in fuel consumption) measured by the two test methods was **3.5%/3.6%**. The efficiency gain measured by the Specific Fuel Consumption test translates to an annual reduction in CO_2 emissions of 2498 tonnes.

INTRODUCTION

Baseline (untreated) fuel efficiency tests were conducted on four Caterpillar 3612 alternator sets, Nos 1, 3, 4 and 6 during the week commencing 12th April, 1999 employing the SFC test procedure. Carbon Balance untreated fuel tests were conducted on 20th April, 1999.

Fuel Technology Pty Ltd supplied, on loan, an air operated FTC catalyst metering system which was calibrated and commissioned following completion of the baseline tests. This unit injected catalyst into the fuel supply to the two treated fuel test engines, Nos 4 and 6. Engine Nos. 1 and 3 continued to operate on untreated fuel.

Treated tests on Units 4 and 6 and control tests on Units 1 and 3 employing the SFC test procedure were conducted during the week commencing 25th May, 1999 and by the CB test procedure on 8th June, 1999.

For all tests the engine load was set at 2.4 MW.

TEST METHODS

The Specific Fuel Consumption (SFC) test procedure employed in this efficiency study measures the absolute amount of fuel consumed against work performed by the engine over time at a constant load. From this raw data the engine's efficiency can be calculated.

This evaluation of FTC involves a series of back to back untreated (baseline) and treated fuel tests conducted approximately one month apart.

A pair of calibrated MacNaught M-10 flow transducers were used to measure fuel supplied to the engine and also fuel returning from the engine from which the net volume of fuel consumed over a ten-minute time interval can be calculated.

The flow transducers are fitted with thermocouple probes which enable measurement of fuel temperature at each transducer.

From the fuel temperature the density at that temperature is calculated. A sample of fuel was taken for laboratory analysis and the density determined at 15°C. Copies of the laboratory reports are included in the *Appendix*.

Volumetric fuel flows are corrected for density and temperature and reported in mass (kg) of fuel.

A Microvip MK II energy analyser was used to measure the alternator's electrical output parameters namely:-

KWatt	kVArh	Ampere	kWh
Volt	Hours	Hz	LmA
PD Med	MVAr		

The hard copy printouts of these parameters are also included in the *Appendix*.

The Carbon Balance Measurement (CB) is a procedure whereby the mass of carbon in the exhaust is calculated as a measure of the fuel being burned. The elements measured in this test include the exhaust gas composition, its temperature and the gas flow rate calculated from the pressure and exhaust stack cross sectional area. Whilst this is an engineering standard test (AS2077-1982) in field testing we are unable to comply with the procedure in relation to employing a chassis dynamometer. However, in the case of power generation the alternator substitutes as a mechanism to apply a constant load.

TEST RESULTS

1. Fuel Efficiency

A summary of the fuel efficiency results achieved in this test program are detailed in the following tables.

Table 1 details the results achieved in the SFC test program comparing the tests with the control units Nos. 1 and 3 with the FTC treated units Nos. 4 and 6. The results are represented graphically in Graphs 1, 2, 3 and 4.

TABLE 1
Specific Fuel Consumption Test Results

(A) Control Group

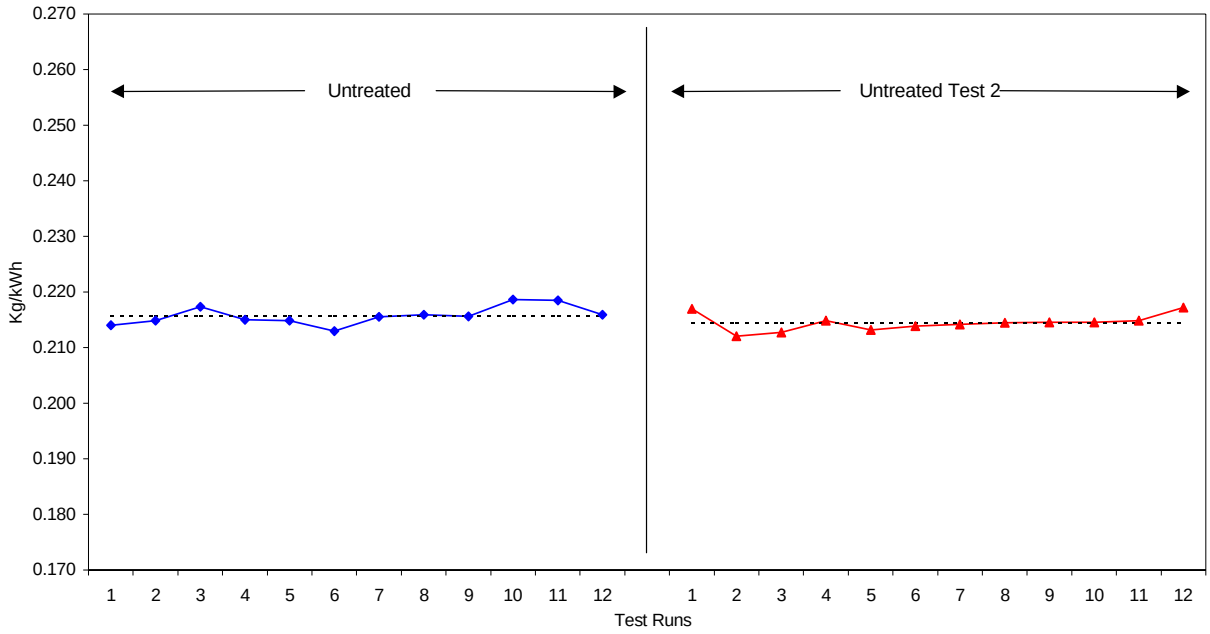
Unit No.	Baseline 14/4/99 Kg/kWh	Retest 28/5/99 Kg/kWh	Variation
1	0.2158	0.2145	- 0.6%
3	0.2120	0.2107	- 0.6%
AVERAGE	**0.2139**	**0.2126**	**- 0.6%**

(B) Treated Group

Unit No.	Baseline 14/4/99 Kg/kWh	Treated 28/5/99 Kg/kWh	Variation
4	0.2110	0.2044	- 3.1%
6	0.2164	0.2053	- 5.1%
AVERAGE	**0.2137**	**0.2048**	**- 4.2%**

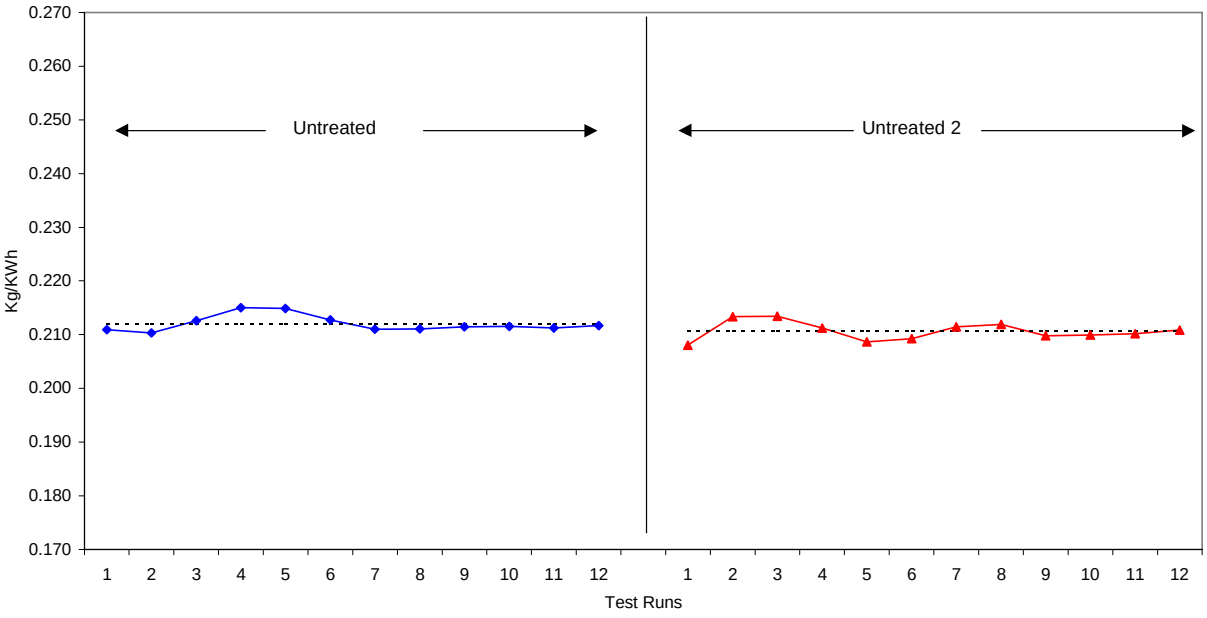
GRAPH NO. 1

Granny Smith Power Station
Genset # 1 2.4 MW

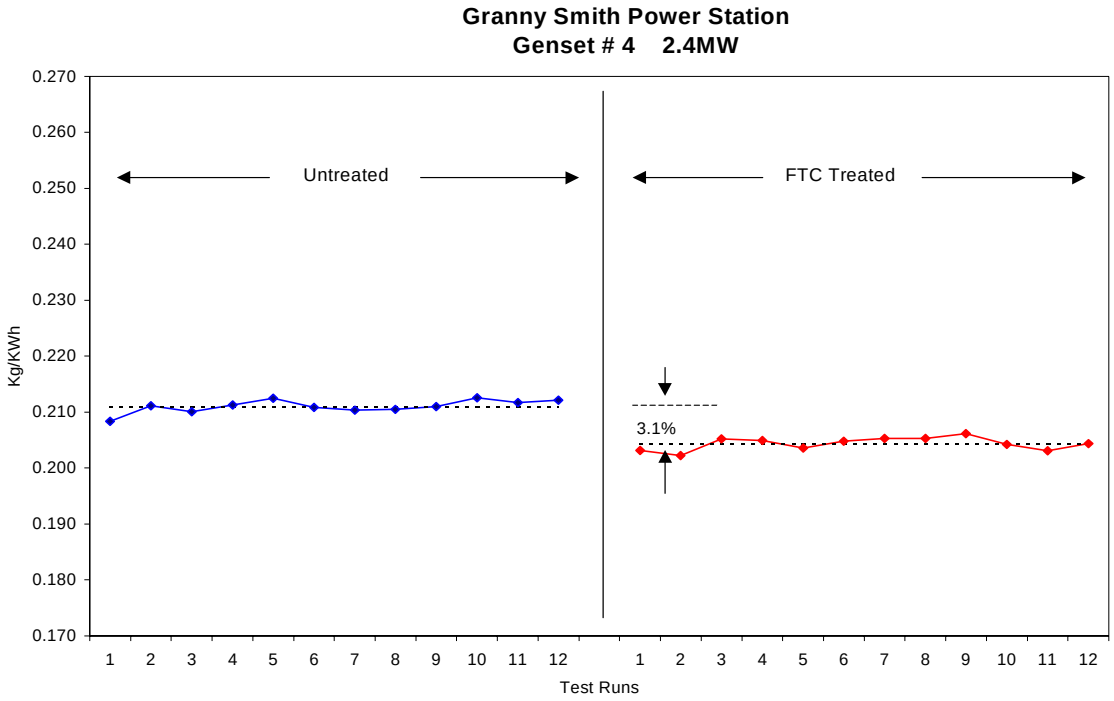


GRAPH NO. 2

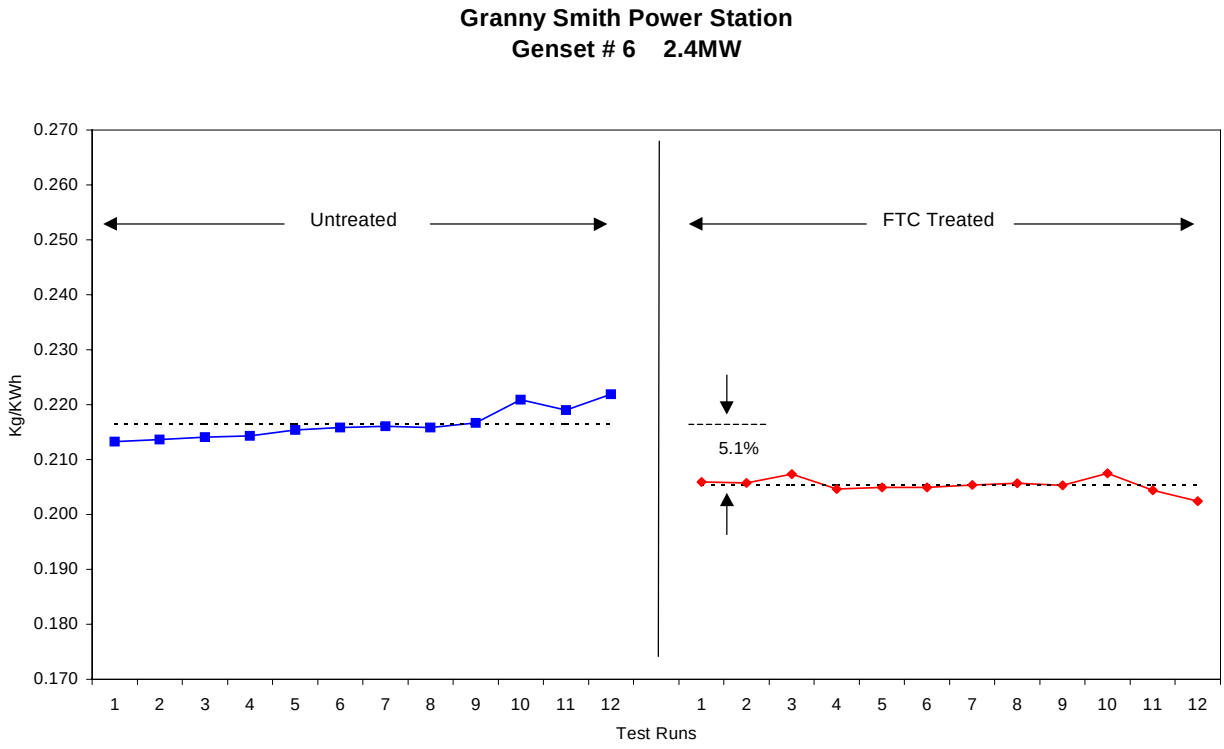
Granny Smith Power Station
Genset # 3 2.4 MW



GRAPH NO. 3



GRAPH NO. 4



The efficiency gain of 0.6% recorded by the untreated test engines is probably a result of climatic conditions and/or repeatability of the test method. The net efficiency gain resulting to fuel treatment with the FTC-3 Catalyst is (4.2% - 0.6%) **3.6%**. The computer printouts of the results are contained in the *Appendix* as are the raw data sheets.

Table 2 provides results achieved in the CB test program comparing results of control engines Nos. 1 and 3 with FTC-3 Catalyst treated engines Nos. 4 and 6.

TABLE 2
Carbon Balance Fuel Consumption Test Results

(A) Control Group

Unit No.	Baseline 20/4/99 Carbon Flow Rate	Retest 8/6/99 g/s	Variation
1 L	63.436	63.448	
1 R	63.695	63.886	
TOTAL g/s	**127.131**	**127.334**	**+ 0.2%**
3 L	62.298	62.196	
3 R	63.591	63.295	
TOTAL g/s	**125.889**	**125.491**	**- 0.3%**
AVERAGE # 1 & 3	**126.510**	**126.413**	**- 0.1%**

(B) Treated Group

Unit No.	Baseline 20/4/99 Carbon Flow Rate	Treated 8/6/99 g/s	Variation
4 L	59.818	58.053	
4 R	62.727	60.797	
TOTAL g/s	**122.545**	**118.850**	**- 3.1%**
6 L	56.533	54.269	
6 R	57.017	54.560	
TOTAL g/s	**113.550**	**108.829**	**- 4.2%**
AVERAGE # 4 & 6	**118.048**	**113.839**	**- 3.6%**

The CB test procedure provides confirmation that addition of FTC-3 Catalyst to the fuel supply of Unit Nos. 4 and 6 has resulted in a reduction in carbon flow (fuel consumption) of **3.5%**, eg (3.6 – 0.1%). The computer printouts of results and raw data sheets are contained in the *Appendix*.

A Bosch smoke test is also undertaken during conduct of the CB test and the results are shown in Table 3. Significant reductions in smoke particulates are not generally measured after only one month's running on FTC treated fuel. Three or more months running on treated fuel is usually required before major reductions in particulates are measured.

TABLE 3
Bosch Smoke Measurements

(A) Control Group

Unit No.	Baseline 20/4/99	Retest 8/6/99	Variation
1 L	0.3	0.3	
1 R	0.3	0.3	
AVERAGE	**0.3**	**0.3**	**N/C**
3 L	0.5	0.6	
3 R	0.4	0.5	
AVERAGE	**0.45**	**0.55**	**+ 22 %**
AVERAGE # 1 & 3	**0.375**	**0.425**	**+ 13 %**

(B) Treated Group

Unit No.	Baseline 20/4/99	Treated 8/6/99	Variation
4 L	0.4	0.5	
4 R	0.4	0.3	
AVERAGE	**0.4**	**0.4**	**N/C**
6 L	0.5	0.5	
6 R	0.4	0.3	
AVERAGE	**0.45**	**0.4**	**- 11 %**
AVERAGE # 4 & 6	**0.425**	**0.4**	**- 6 %**

The Bosch Scale reads from 0.1 (very clean) to 0.9 (very dirty).

The FTC treated engines are showing a positive average trend of reduced particulate emissions whilst the control group show an increase in particulate output. The results, whilst indicating a positive reduction for the engines running on treated fuel are encouraging, it is too early in the treatment program to indicate any significant change. The Bosch smoke patches are contained in the *Appendix*.

2. Greenhouse Gas Reduction

A gross reduction of 3.6% of the current estimated annual fuel consumption of 24,000 KL translates to a 2498 tonnes per annum reduction in CO_2 emissions based on the formula outlined in Worksheet 1 of the "Electricity Supply Business Greenhouse Change Workbook". Our estimate is based on the following calculations:-

	(24000 KL x 38.6 x 74.9) ÷ 1000	=	69,387.4 tonnes CO_2 per annum
- 3.6%	(23136 KL x 38.6 x 74.9) ÷ 1000	=	66,889.4 tonnes CO_2 per annum

CO_2 reduction by application FTC-3
69,387.4 – 66,889.4 = 2498 tonnes

CONCLUSION

These carefully controlled engineering standard test procedures conducted on Caterpillar 3612 generator sets Nos 1, 3, 4 and 6 provide clear evidence of reduced fuel consumption for the test engines Nos. 4 and 6 compared to the control engines Nos. 1 and 3 in the range **3.5% - 3.6%**.

The correlation between the two test procedures is very good and provides strong confidence in the accuracy of the test procedures.

A fuel efficiency gain of 3.6% as measured by the Specific Fuel Consumption test method if applied to the total fuel currently consumed by the power generation plant will result in a 2498 tonnes per annum reduction in CO_2 emissions.

Additional to the fuel economy benefits measured is a reduction in greenhouse gas emissions due to more complete combustion of the fuel. Further, the more complete combustion will translate to significant reduction over time in engine maintenance costs.

Appendix “C”

Bosch Smoke Filter Samples

SPECIFIC FUEL CONSUMPTION GENSET TRIAL

Customer: Granny Smith
Genset No: 1
Date: 14/04/1999
Load: 2.4MW

Make & Model: Caterpillar 3612
Engine Hrs: 53784
Amb; Temp; Start ^{o} C: 29.4
Amb; Temp; Finish ^{o} C: 31.5

Fuel Sample	Density	Temp Deg C
	0.8465	20
Corrected	0.850	15

UNTREATED

Run No,	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp (C) In	Fuel Temp (C) Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	1155		2.894														
	1205	10	2.988	394.80	2369	470.33	371.92	98.41	0.2493	31.0	38.5	0.839	0.833	394.47	309.96	84.51	0.2141
2	1210		3.035														
	1220	10	3.129	394.80	2369	470.11	371.31	98.80	0.2503	31.3	38.9	0.839	0.833	394.19	309.38	84.81	0.2148
3	1225		3.176														
	1235	10	3.269	390.60	2344	469.72	371.04	98.68	0.2526	31.5	39.7	0.838	0.833	393.81	308.93	84.89	0.2173
4	1240		3.316														
	1250	10	3.410	394.80	2369	469.77	370.93	98.84	0.2504	31.8	39.5	0.838	0.833	393.76	308.87	84.89	0.2150
5	1255		3.457														
	1305	10	3.551	394.80	2369	469.49	370.71	98.78	0.2502	32.0	39.8	0.838	0.833	393.43	308.62	84.82	0.2148
6	1310		3.597														
	1320	10	3.692	399.00	2394	469.38	370.27	99.11	0.2484	32.2	39.6	0.838	0.833	393.29	308.32	84.97	0.2130
7	1325		3.738														
	1335	10	3.832	394.80	2369	469.44	370.16	99.28	0.2515	32.4	39.7	0.838	0.833	393.30	308.20	85.10	0.2156
8	1340		3.879														
	1350	10	3.973	394.80	2369	469.72	370.27	99.45	0.2519	32.7	40.3	0.838	0.832	393.39	308.14	85.25	0.2159
9	1355		4.020														
	1405	10	4.114	394.80	2369	469.33	370.05	99.28	0.2515	32.7	40.3	0.838	0.832	393.06	307.96	85.11	0.2156
10	1410		4.161														
	1420	10	4.254	390.60	2344	469.66	369.99	99.67	0.2552	32.8	40.1	0.838	0.832	393.34	307.94	85.40	0.2186
11	1425		4.301														
	1435	10	4.394	390.60	2344	469.33	369.61	99.72	0.2553	33.1	40.1	0.837	0.832	392.97	307.63	85.34	0.2185
12	1440		4.441														
	1450	10	4.535	394.80	2369	469.27	369.67	99.60	0.2523	33.2	40.2	0.837	0.832	392.87	307.64	85.23	0.2159
Mean				394	2365			99.14	0.2516	32.2	39.7					85.026	0.2158
Std Dev				2.424871	14.54923			0.4311	0.0021							0.2604	0.0017
C.V				0.6%	0.6%			0.4%	0.8%							0.3%	0.8%

Genset No: 1
Date: 28/05/1999
Load: 2.4MW

Engine Hrs: 54630
Amb; Temp; Start ^{o} C: 17.4
Amb; Temp; Finish ^{o} C: 20.5

Fuel Sample	Density	Temp Deg C
	0.8438	20
Corrected	0.847	15

UNTREATED 2

Run No	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp In	Fuel Temp Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	840		14.293														
	850	10	14.385	386.40	2318	461.49	365.60	95.89	0.2482	22.3	34.1	0.842	0.834	388.67	304.84	83.83	0.2170
2	855		14.432														
	905	10	14.526	394.80	2369	460.33	364.56	95.77	0.2426	22.5	34.5	0.842	0.834	387.60	303.90	83.70	0.2120
3	910		14.572														
	920	10	14.666	394.80	2369	459.99	363.79	96.20	0.2437	22.6	34.2	0.842	0.834	387.31	303.33	83.98	0.2127
4	925		14.713														
	935	10	14.806	390.60	2344	459.66	363.51	96.15	0.2462	22.8	34.5	0.842	0.834	386.94	303.02	83.92	0.2148
5	940		14.853														
	950	10	14.947	394.80	2369	459.55	363.07	96.48	0.2444	23.1	34.7	0.842	0.833	386.76	302.58	84.17	0.2132
6	955		14.994														
	1005	10	15.088	394.80	2369	459.88	363.07	96.81	0.2452	23.3	34.9	0.842	0.833	386.99	302.55	84.44	0.2139
7	1010		15.134														
	1020	10	15.228	394.80	2369	459.33	362.58	96.75	0.2451	23.6	35.8	0.841	0.833	386.43	301.88	84.55	0.2142
8	1025		15.275														
	1035	10	15.369	394.80	2369	459.27	362.36	96.91	0.2455	23.9	36.1	0.841	0.832	386.29	301.63	84.66	0.2144
9	1040		15.42														
	1050	10	15.509	394.80	2369	459.44	362.36	97.08	0.2459	24.1	36.1	0.841	0.832	386.34	301.63	84.71	0.2146
10	1055		15.56														
	1105	10	15.650	394.80	2369	458.83	361.75	97.08	0.2459	24.5	36.7	0.841	0.832	385.69	300.98	84.72	0.2146
11	1110		15.70														
	1120	10	15.790	394.80	2369	458.72	361.42	97.30	0.2465	24.7	36.6	0.841	0.832	385.55	300.74	84.82	0.2148
12	1125		15.84														
	1135	10	15.930	390.60	2344	458.61	361.04	97.57	0.2498	25.0	36.1	0.840	0.832	385.37	300.53	84.84	0.2172
Mean				393	2360			96.67	0.2457	23.5	35.4					84.363	0.2145
Std Dev				2.735624	16.41374			0.5699	0.0019							0.4170	0.0015
C.V				0.7%	0.7%			0.6%	0.8%							0.5%	0.7%

% CHANGE:	kWh	Avg Load		Litres Consumed	Fuel (Lt) Per kWh				Fuel (kg) Consumed	Fuel (kg) Per kWh
Treated-Baseline										
Baseline	-0.18%	-0.18%		-2.49%	-2.32%	-27%	-11%		-0.78%	**-0.6%**

SPECIFIC FUEL CONSUMPTION GENSET TRIAL

Customer: Granny Smith
Genset No: 3
Date: 14/04/1999
Load: 2.4MW

Make & Model: Caterpillar 3612
Engine Hrs: 55467
Amb; Temp; Start ^{o} C: 19.5
Amb; Temp; Finish ^{o} C: 24.6

Fuel Sample	Density	Temp Deg C
	0.8465	20
Corrected	0.850	15

UNTREATED

Run No,	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp (C) In	Fuel Temp (C) Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	637		0.331														
	647	10	0.426	399.0	2394	454.38	355.71	98.67	0.2473	28.5	33.5	0.841	0.837	381.91	297.73	84.18	0.2110
2	707		0.615														
	717	10	0.710	399.0	2394	456.33	358.24	98.09	0.2458	27.9	33.6	0.841	0.837	383.73	299.81	83.92	0.2103
3	722		0.758														
	732	10	0.852	394.8	2369	457.27	359.23	98.04	0.2483	27.5	33.3	0.841	0.837	384.66	300.71	83.94	0.2126
4	737		0.900														
	747	10	0.993	390.6	2344	458.66	360.82	97.84	0.2505	27.2	33.8	0.841	0.837	385.92	301.93	83.98	0.2150
5	752		1.042														
	802	10	1.135	390.6	2344	459.44	361.86	97.58	0.2498	27.1	34.2	0.842	0.837	386.62	302.70	83.92	0.2149
6	807		1.183														
	817	10	1.277	394.8	2369	459.44	361.86	97.58	0.2472	27.0	34.3	0.842	0.836	386.66	302.66	84.01	0.2128
7	822		1.325														
	832	10	1.420	399.0	2394	459.66	361.92	97.74	0.2450	27.1	34.8	0.842	0.836	386.80	302.60	84.20	0.2110
8	837		1.467														
	847	10	1.562	399.0	2394	459.38	361.59	97.79	0.2451	27.3	34.9	0.841	0.836	386.52	302.29	84.23	0.2111
9	852		1.609														
	902	10	1.704	399.0	2394	459.38	361.59	97.79	0.2451	27.4	35.6	0.841	0.836	386.48	302.11	84.37	0.2114
10	907		1.751														
	917	10	1.846	399.0	2394	459.22	361.37	97.85	0.2452	27.6	35.8	0.841	0.835	386.25	301.85	84.40	0.2115
11	922		1.893														
	932	10	1.988	399.0	2394	459.22	361.53	97.69	0.2448	27.9	36.3	0.841	0.835	386.16	301.88	84.28	0.2112
12	937		2.035														
	947	10	2.130	399.0	2394	459.16	361.42	97.74	0.2450	28.0	36.8	0.841	0.835	386.11	301.64	84.47	0.2117
Mean				397	2381			97.87	0.2466	27.5	34.7					84.158	0.2120
Std Dev				3.350441	20.10265			0.2963	0.0020							0.1984	0.0015
C.V				0.8%	0.8%			0.3%	0.8%							0.2%	0.7%

Genset No: 3
Date: 27/05/1999
Load: 2.4MW

Engine Hrs: 55943
Amb; Temp; Start ^{o} C: 22.2
Amb; Temp; Finish ^{o} C: 20.8

Fuel Sample	Density	Temp Deg C
	0.8438	20
Corrected	0.847	15

UNTREATED 2

Run No	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp In	Fuel Temp Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	1455		12.417														
	1505	10	12.512	399.00	2394	455.11	358.29	96.82	0.2427	27.9	35.3	0.838	0.833	381.47	298.46	83.02	0.2081
2	1510		12.559														
	1520	10	12.652	390.60	2344	455.33	358.29	97.04	0.2484	27.7	35.4	0.838	0.833	381.75	298.42	83.33	0.2133
3	1525		12.701														
	1535	10	12.794	390.60	2344	454.83	357.74	97.09	0.2486	27.9	35.8	0.838	0.833	381.24	297.85	83.38	0.2135
4	1540		12.841														
	1550	10	12.935	394.80	2369	454.38	357.08	97.30	0.2465	28.1	35.4	0.838	0.833	380.82	297.41	83.40	0.2113
5	1555		12.982														
	1605	10	13.077	399.00	2394	453.88	356.37	97.51	0.2444	28.4	34.6	0.838	0.834	380.31	297.03	83.27	0.2087
6	1610		13.124														
	1620	10	13.219	399.00	2394	453.72	356.20	97.52	0.2444	28.6	35.8	0.838	0.833	380.08	296.57	83.51	0.2093
7	1625		13.266														
	1635	10	13.360	394.80	2369	453.33	355.71	97.62	0.2473	28.9	35.8	0.838	0.833	379.66	296.16	83.50	0.2115
8	1640		13.408														
	1650	10	13.502	394.80	2369	453.16	355.21	97.95	0.2481	29.0	35.5	0.837	0.833	379.48	295.82	83.66	0.2119
9	1655		13.55														
	1705	10	13.644	399.00	2394	452.72	354.72	98.00	0.2456	29.2	35.9	0.837	0.833	379.06	295.34	83.72	0.2098
10	1710		13.69														
	1720	10	13.786	399.00	2394	452.33	354.28	98.05	0.2457	29.2	35.8	0.837	0.833	378.74	294.97	83.76	0.2099
11	1725		13.83														
	1735	10	13.927	394.80	2369	452.27	355.10	97.17	0.2461	29.3	35.8	0.837	0.833	378.64	295.66	82.98	0.2102
12	1740		13.97														
	1750	10	14.066	386.40	2318	452.49	357.14	95.35	0.2468	29.4	35.9	0.837	0.833	378.82	297.35	81.47	0.2108
Mean				395	2371			97.29	0.2462	28.6	35.6					83.251	0.2107
Std Dev				4.184061	25.10436			0.7279	0.0018							0.6122	0.0017
C.V				1.1%	1.1%			0.7%	0.7%							0.7%	0.8%

% CHANGE:	kWh	Avg Load		Litres Consumed	Fuel (Lt) Per kWh			Fuel (kg) Consumed	Fuel (kg) Per kWh
Treated-Baseline									
Baseline	-0.44%	-0.44%		-0.59%	-0.16%	3.96%		-1.08%	**-0.6%**

SPECIFIC FUEL CONSUMPTION GENSET TRIAL

Customer: Granny Smith
Genset No: 4
Date: 14/04/1999
Load: 2.4MW

Make & Model: Caterpillar 3612
Engine Hrs: 52236
Amb; Temp; Start ^{o} C: 18.4
Amb; Temp; Finish ^{o} C: 22.3

Fuel Sample	Density	Temp Deg C
	0.8465	20
Corrected	0.850	15

UNTREATED

Run No,	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp (C) In	Fuel Temp (C) Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	611		4.796														
	621	10	4.891	399.00	2394	414.94	317.52	97.42	0.2442	25.8	30.6	0.842	0.839	349.55	266.40	83.15	0.2084
2	626		4.939														
	636	10	5.033	394.80	2369	414.94	317.14	97.80	0.2477	25.7	29.9	0.843	0.840	349.59	266.24	83.35	0.2111
3	641		5.080														
	651	10	5.175	399.00	2394	414.66	316.42	98.24	0.2462	25.7	30.3	0.843	0.839	349.35	265.54	83.81	0.2101
4	656		5.222														
	706	10	5.317	399.00	2394	414.83	316.09	98.74	0.2475	25.7	30.6	0.843	0.839	349.49	265.20	84.29	0.2113
5	711		5.364														
	721	10	5.457	390.60	2344	414.27	317.19	97.08	0.2485	25.6	30.9	0.843	0.839	349.06	266.06	83.00	0.2125
6	726		5.504														
	736	10	5.598	394.80	2369	413.94	316.48	97.46	0.2469	25.7	30.8	0.843	0.839	348.74	265.50	83.25	0.2109
7	741		5.645														
	751	10	5.740	399.00	2394	414.22	316.09	98.13	0.2459	25.8	31.5	0.842	0.838	348.94	265.01	83.93	0.2103
8	756		5.787														
	806	10	5.882	399.00	2394	413.66	315.65	98.01	0.2456	25.7	32.1	0.843	0.838	348.51	264.51	83.99	0.2105
9	811		5.929														
	821	10	6.023	394.80	2369	413.72	316.59	97.13	0.2460	25.7	32.2	0.843	0.838	348.56	265.27	83.29	0.2110
10	831		6.117														
	841	10	6.211	394.80	2369	413.83	316.04	97.79	0.2477	25.9	32.9	0.842	0.837	348.57	264.65	83.92	0.2126
11	846		6.258														
	856	10	6.353	399.00	2394	414.05	315.60	98.45	0.2467	26.1	33.1	0.842	0.837	348.71	264.25	84.46	0.2117
12	911		6.494														
	921	10	6.588	394.80	2369	414.38	316.86	97.52	0.2470	26.2	33.5	0.842	0.837	348.95	265.21	83.74	0.2121
Mean				397	2379			97.81	0.2467	25.8	31.5					83.682	0.2110
Std Dev				2.807943	16.84766			0.5184	0.0012							0.4686	0.0012
C.V				0.7%	0.7%			0.5%	0.5%							0.6%	0.6%

Genset No: 4
Date: 27/05/1999
Load: 2.4MW

Engine Hrs: 53024
Amb; Temp; Start ^{o} C: 18
Amb; Temp; Finish ^{o} C: 22.3

Fuel Sample	Density	Temp Deg C
	0.8438	20
Corrected	0.847	15

TREATED

Run No	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp In	Fuel Temp Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	730		10.071														
	740	10	10.167	403.20	2419	443.22	349.01	94.21	0.2337	20.2	30.1	0.844	0.837	373.94	292.02	81.93	0.2032
2	745		10.214														
	755	10	10.310	403.20	2419	443.05	349.23	93.82	0.2327	20.5	30.2	0.844	0.837	373.71	292.17	81.55	0.2022
3	915		10.675														
	925	10	10.770	399.00	2394	443.27	348.95	94.32	0.2364	21.6	31.3	0.843	0.836	373.54	291.65	81.89	0.2052
4	930		10.816														
	940	10	10.911	399.00	2394	443.49	349.28	94.21	0.2361	21.9	31.6	0.843	0.836	373.64	291.86	81.78	0.2050
5	1145		11.047														
	1155	10	11.143	403.20	2419	443.38	348.68	94.70	0.2349	22.8	32.5	0.842	0.835	373.24	291.15	82.09	0.2036
6	1200		11.191														
	1210	10	11.287	403.20	2419	443.61	348.35	95.26	0.2363	23.0	32.7	0.842	0.835	373.39	290.80	82.58	0.2048
7	1215		11.335														
	1225	10	11.430	399.00	2394	443.11	348.62	94.49	0.2368	23.3	33.0	0.842	0.835	372.88	290.96	81.92	0.2053
8	1230		11.476														
	1240	10	11.571	399.00	2394	443.71	349.12	94.59	0.2371	23.4	32.9	0.841	0.835	373.34	291.41	81.93	0.2053
9	1245		11.62														
	1255	10	11.714	399.00	2394	443.55	348.73	94.82	0.2376	23.6	33.6	0.841	0.834	373.16	290.91	82.25	0.2061
10	1300		11.76														
	1310	10	11.858	403.20	2419	443.05	347.36	95.69	0.2373	23.8	31.4	0.841	0.836	372.65	290.29	82.36	0.2043
11	1315		11.91														
	1325	10	12.003	407.40	2444	443.11	347.25	95.86	0.2353	23.9	32.4	0.841	0.835	372.70	289.95	82.75	0.2031
12	1330		12.05														
	1340	10	12.145	399.00	2394	442.77	348.40	94.37	0.2365	24.2	33.1	0.841	0.835	372.28	290.74	81.54	0.2044
Mean				401	2409			94.70	0.2359	22.7	32.1					82.047	0.2044
Std Dev				2.807943	16.84766			0.6192	0.0015							0.3770	0.0011
C.V				0.7%	0.7%			0.7%	0.6%							0.5%	0.6%

% CHANGE:	kWh	Avg Load		Litres Consumed	Fuel (Lt) Per kWh				Fuel (kg) Consumed	Fuel (kg) Per kWh
Treated-Baseline										
Baseline	1.24%	1.24%		-3.19%	-4.4%	-12%	2%		-1.95%	**-3.1%**

SPECIFIC FUEL CONSUMPTION GENSET TRIAL

Customer: Granny Smith
Genset No: 6
Date: 15/04/1999
Load: 2.4MW

Make & Model: Caterpillar 3612
Engine Hrs: 48059
Amb; Temp; Start ^{o} C: 24.6
Amb; Temp; Finish ^{o} C: 26.8

Fuel Sample	Density	Temp Deg C
	0.8465	20
Corrected	0.850	15

UNTREATED

Run No,	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp (C) In	Fuel Temp (C) Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	1120		6.886														
	1130	10	6.981	399.00	2394	426.55	327.41	99.14	0.2485	28.0	35.4	0.841	0.836	358.69	273.58	85.10	0.2133
2	1135		7.028														
	1145	10	7.123	399.00	2394	426.61	327.14	99.47	0.2493	28.3	35.2	0.841	0.836	358.65	273.42	85.23	0.2136
3	1150		7.170														
	1200	10	7.265	399.00	2394	426.22	326.53	99.69	0.2498	28.5	35.6	0.841	0.836	358.24	272.82	85.42	0.2141
4	1205		7.312														
	1215	10	7.407	399.00	2394	426.27	326.53	99.74	0.2500	28.8	36.2	0.840	0.835	358.19	272.69	85.51	0.2143
5	1220		7.454														
	1230	10	7.549	399.00	2394	426.33	326.15	100.18	0.2511	29.0	36.6	0.840	0.835	358.20	272.27	85.93	0.2154
6	1235		7.597														
	1245	10	7.692	399.00	2394	426.66	326.09	100.57	0.2521	29.0	36.0	0.840	0.835	358.48	272.35	86.13	0.2159
7	1250		7.739														
	1300	10	7.834	399.00	2394	426.33	325.54	100.79	0.2526	29.3	36.1	0.840	0.835	358.07	271.86	86.22	0.2161
8	1305		7.882														
	1315	10	7.977	399.00	2394	426.27	325.60	100.67	0.2523	29.6	36.6	0.840	0.835	357.94	271.81	86.13	0.2159
9	1320		8.024														
	1330	10	8.119	399.00	2394	426.11	325.27	100.84	0.2527	29.9	37.7	0.840	0.834	357.72	271.28	86.44	0.2167
10	1335		8.167														
	1345	10	8.260	390.60	2344	426.11	325.21	100.90	0.2583	29.9	36.8	0.840	0.835	357.72	271.42	86.30	0.2209
11	1350		8.309														
	1400	10	8.403	394.80	2369	425.83	324.83	101.00	0.2558	30.2	37.5	0.839	0.834	357.40	270.94	86.46	0.2190
12	1405		8.452														
	1415	10	8.545	390.60	2344	425.88	324.50	101.38	0.2595	30.3	37.3	0.839	0.834	357.40	270.73	86.67	0.2219
Mean				397	2384			100.36	0.2527	29.2	36.4					85.961	0.2164
Std Dev				3.330438	19.98263			0.7034	0.0035							0.5211	0.0028
C.V				0.8%	0.8%			0.7%	1.4%							0.6%	1.3%

Genset No: 6
Date: 26/05/1999
Load: 2.4MW

Engine Hrs: 48921
Amb; Temp; Start ^{o} C: 19.4
Amb; Temp; Finish ^{o} C: 20.3

Fuel Sample	Density	Temp Deg C
	0.8438	20
Corrected	0.847	15

TREATED

Run No	Time Start	Period Mins	kWh Meter	kWh 4200	Avg Load kW	Fuel (Lt) In	Fuel (Lt) Out	Litres Consumed	Fuel (Lt) Per kWh	Fuel Temp In	Fuel Temp Out	Density In	Density Out	Fuel (kg) In	Fuel (kg) Out	Fuel (kg) Consumed	Fuel (kg) Per kWh
1	1430		7.775														
	1440	10	7.870	399.00	2394	462.49	367.30	95.19	0.2386	22.4	30.0	0.842	0.837	389.46	307.32	82.14	0.2059
2	1445		7.917														
	1455	10	8.012	399.00	2394	464.33	369.28	95.05	0.2382	22.5	30.5	0.842	0.836	390.97	308.87	82.10	0.2058
3	1500		8.060														
	1510	10	8.154	394.80	2369	465.38	370.65	94.73	0.2399	22.4	30.4	0.842	0.837	391.90	310.05	81.85	0.2073
4	1515		8.202														
	1525	10	8.297	399.00	2394	466.44	372.03	94.41	0.2366	22.3	30.4	0.842	0.837	392.84	311.20	81.63	0.2046
5	1530		8.344														
	1540	10	8.439	399.00	2394	467.16	372.80	94.36	0.2365	22.1	30.7	0.842	0.836	393.49	311.74	81.75	0.2049
6	1545		8.487														
	1555	10	8.582	399.00	2394	466.94	372.14	94.80	0.2376	21.8	29.1	0.843	0.837	393.40	311.63	81.77	0.2049
7	1600		8.629														
	1610	10	8.724	399.00	2394	466.61	371.75	94.86	0.2377	21.6	29.2	0.843	0.837	393.21	311.27	81.95	0.2054
8	1615		8.772														
	1625	10	8.867	399.00	2394	466.44	371.53	94.91	0.2379	21.4	29.3	0.843	0.837	393.12	311.04	82.07	0.2057
9	1630		8.91														
	1640	10	9.009	399.00	2394	465.27	370.65	94.62	0.2371	21.2	29.4	0.843	0.837	392.22	310.31	81.91	0.2053
10	1645		9.057														
	1655	10	9.151	394.80	2369	465.83	371.36	94.47	0.2393	21.3	30.1	0.843	0.837	392.65	310.72	81.93	0.2075
11	1700		9.20														
	1710	10	9.293	399.00	2394	464.22	369.83	94.39	0.2366	21.4	29.0	0.843	0.837	391.24	309.70	81.55	0.2044
12	1715		9.340														
	1725	10	9.436	403.20	2419	464.44	370.05	94.39	0.2341	21.4	29.3	0.843	0.837	391.43	309.81	81.62	0.2024
Mean				399	2392			94.68	0.2375	21.8	29.8					81.857	0.2053
Std Dev				2.1627	12.9762			0.2845	0.0015							0.1958	0.0013
C.V				0.5%	0.5%			0.3%	0.6%							0.2%	0.6%

% CHANGE: Treated-Baseline / Baseline	kWh	Avg Load		Litres Consumed	Fuel (Lt) Per kWh				Fuel (kg) Consumed	Fuel (kg) Per kWh
	0.35%	0.35%		-5.66%	-6%	-25%	-18%		-4.78%	**-5.1%**