ATTAINMENT TECHNOLOGIES, L.L.C.

EMISSION SOLUTIONS FOR TODAY

NYSERDA

June, 2004

Smart Energy Management Drivers

Old Drivers	+	New Drivers	=	Future
◆ Conservation		◆ Emissions		
		◆ Efficiency		◆ **Smart Grid** (automation; controls, demand response)
		◆ Security		
◆ Cost Savings		◆ Shrinking Supplies		
		◆ Congestion Management		
		◆ Innovative Rates		◆ **Efficiency Gains** (increased load factors)
		◆ T&D Deferment		
◆ Reliability		◆ Demand Response		
		◆ National Policy		◆ **Clear Skies** (emissions trading)
		◆ Technology		
		◆ Automation		***Risk Management!***
		◆ Rate Increases		
		◆ Liability		

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GreenGuard Retrofit System

- **Exhaust Gas Recirculation allows the use of higher Compression Ratio**
  - **No Excess Oxygen**
  - **Higher Power Output**
  - **Lower Fuel Consumption**
- **Exhaust Gas Recirculation Slows Combustion**
- **NSCR Technology**
  - **Proven Technology (Automotive)**
  - **High Conversion Rates for ALL Relative Emissions**
- **No Reagent necessary to lower emissions**
  - **No installation cost for Urea tank and delivery system**
  - **No operation cost for consumables (Urea, distilled water)**
  - **No danger of Ammonia Slip**

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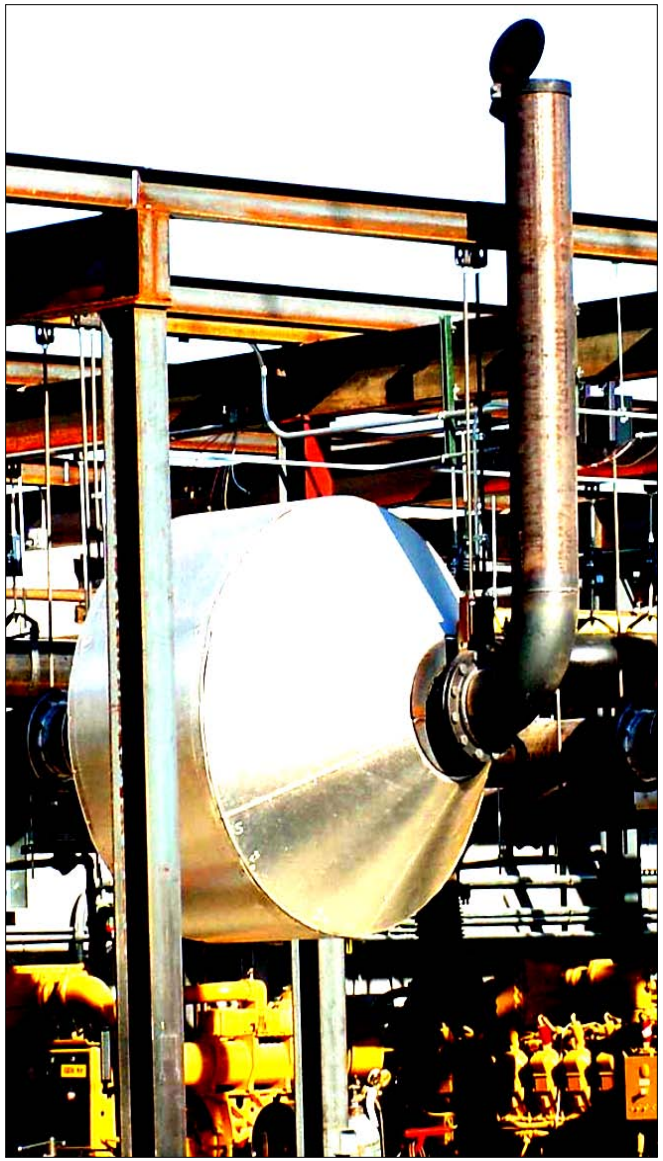
Project One: Power Generation Project

Mesa, AZ; 2001 – 2002

Two power stations, each 6.8 MW

- **Total Value: $7 M**
- **16 Caterpillar 3516 Natural Gas Generator Sets**
- **First 8 Units installed and operational in 31 days**
- **All 16 Units overhauled in 16 weeks**
- **Engine modifications and development of aftertreatment system for extreme low emissions (0.3 g/bhp-hr NOx and CO) – Guaranteed; actual results lower.**
- **Patent application for low emission technology**
- **The *GreenGuard* allows project owner to operate engines year-round in a baseloaded mode.**



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Patent & Official Test Results

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Christopher R. LeLeux and Gerald Fischer
Filed: Concurrently herewith
Serial No.:
For: "High Efficiency, Reduced Emissions Internal Combustion Engine System, Especially Suitable for Gaseous Fuels"
Docket No.: 612.001

Attention: Box Patent Application
Assistant Commissioner for Patents
Washington, D.C. 20231

OIPE JC139 OCT 3 1 2002 PATENT & TRADEMARK OFFICE

FILING RECEIPT

Date of Deposit _____

The package contains the following: Transmittal Letter, U.S. Patent Application and Abstra (19 pages total), 3 Sheets of Drawings, Declaration and Power of Attorney, Verified Stateme Claiming Small Entity - Independent Inventors, Information Disclosure Statement, PTO Form 1449 Prior Art, a check in the amount of $415, and a stamped postcard.

Maricopa County
Environmental Services Department
Technical Services Unit
1001 North Central Avenue, Suite 301
Phoenix, Arizona 85004

December 5

Attn: Kathy Houed

Emissions	NOx	CO	Formalde-hyde
[g/bhp-hr]	0.051	0.230	0.010
[ppm @15% O2]	3.9	28.3	0.97
conversion efficiency [%]	> 99%	> 97%	

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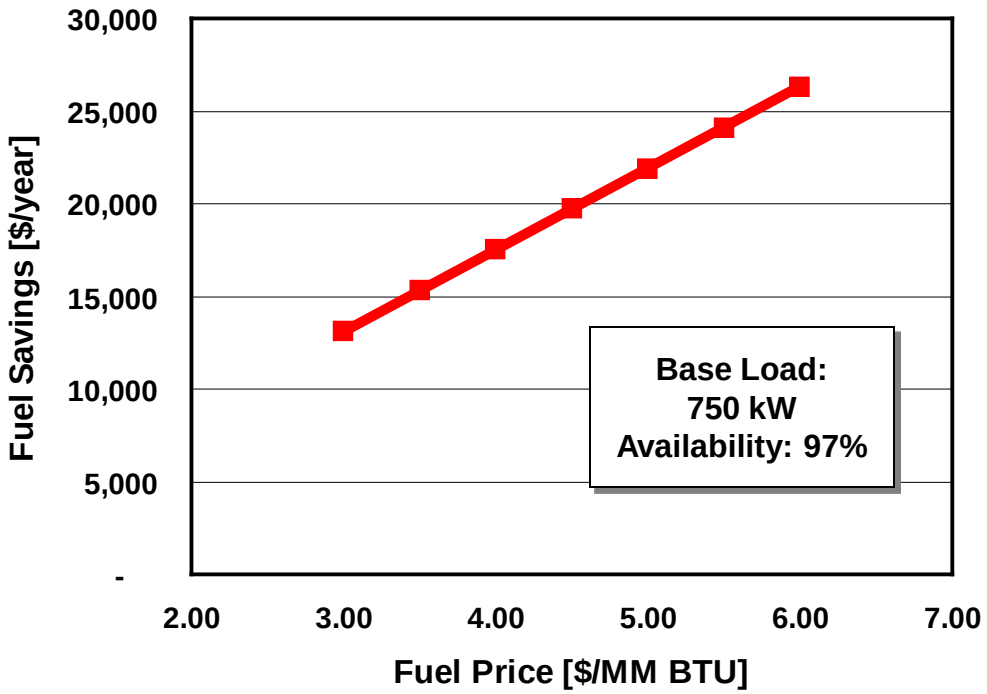
Fuel Savings

- Exhaust Gas Recirculation allows the use of higher Compression Ratio
- Higher Power Output
- Lower Fuel Consumption

	Caterpillar 3516 130 LE	Caterpillar 3516 130 TA
Compression Ratio [-]	11:1	9:1
Generator Output [kW]	820	750
Engine Power [bhp]	1150	1050
Fuel Consumption @ full load [BTU/bhp-hr] LHV	7011	7506

Based on 905 BTU/scf LHV



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Rio All-Suites Hotel & Casino

Las Vegas, NV

- 4.9 MW, sized for thermal load
- 6 Caterpillar 3516 Natural Gas Gen-Sets
- Operational May, 2004
- CO Non-attainment area
- Projected savings, $6,000 per day
- Payback less than 3 years
- Establishes new BACT in Clark County

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Emissions Test Results*

Test Data Averages (Normalized to 15% Oxygen)							
Location	Engine Power Output (kW)	NO_x (ppm)	NO_x (lbs/mwh)	NO_x (g/bhp-hr)	CO (ppm)	CO (lbs/mwh)	CO (g/bhp-hr)
After Catalyst	800	2.4	0.098	0.033	3.3	0.134	0.046
	600	2.3	0.093	0.032	3.6	0.146	0.05
	400	2.4	0.098	0.033	2.8	0.114	0.039
Before Catalyst	400	584.6	23.759	8.075	998.7	40.588	13.795
	800	N/A			N/A		

*** As tested by the Gas Technology Institute (GTI). Final report issued March, 2004.**

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New York City Emissions Reduction Credit Example

Potential to Emit Calculation

Annual run time	8760
Capacity	820
Conversion of kw to bhp	1.407
Conversion of gram to pou	454
Conversion of pound to toı	2000

Units	KW	HP	g/bhp-hr	grams/year	Lbs/year	Tons/year	
1	820	1153.74	9	90,960,862	200,354	100.18	currently permitted
1	820	1153.74	**1.5**	15,160,144	33,392	16.70	new rule
1	820	1153.74	0.5	5,053,381	11,131	5.57	**11.13**
1	820	1153.74	0.3	2,958,077	6,516	3.26	**13.44**

Potential ERCs in tons for Nox at 0.5 grams.	11.13
Market Value of ERCs for Nox/ton (2003 avg. NYC Severe Non-attainment area	**$9,000**
Cost of Conversion and Emissions technology per engine*	$135,000
Aggregate Value of ERCs for Nox at 0.5 grams.	$100,170
Difference between conversion cost and ERC value	$34,830
Cost in $/ton of Nox reduced	$1,426.88

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NYC Energy Task Force

Engine Type	NOx (g/hp-hr)	NOx (lbs/mwh)	w/EGR (g/hp-hr)	w/EGR (g/hp-hr)	Proposed NY Rule^	Proposed NY Rule**	Proposed NY Rule^^
Diesel < 600 hp	14.06	41.54	7.03	4.22	0.544	5.438	9.0
Diesel > 600 hp	10.86	32.16	5.43	3.26	0.544	5.438	9.0
			50%	70%			16.0 lbs/mwh

Engine Size	Total Engines	Capacity (MW)
25-50 kW	26	1
50-100 kW	123	8
100-250 kW	426	70
250-500 kW	509	178
500-750 kW	389	229
750-1000 kW	328	277
1000-1500 kW	319	346
1500+ kW	116	211
Total	**2,236**	**1,320**

^ Spark-ignited engines

** Emergency Compression Engines installed prior to 1/1/09

^^ Existing Non-Emergency Diesel-fired engines

What if . . .

Summary of NYC Distributed Resources Potential 2003-2008

Category*	High Case		w/*GreenGuard*	w/Diesel EGR	Total
Peak Load Management	127		150	300	577
Energy Efficiency	868	***Plus***	0	0	868
Clean On-Site Generation	343		250	500	1,093
Total	**1,338**		**400**	**800**	**2,538**

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