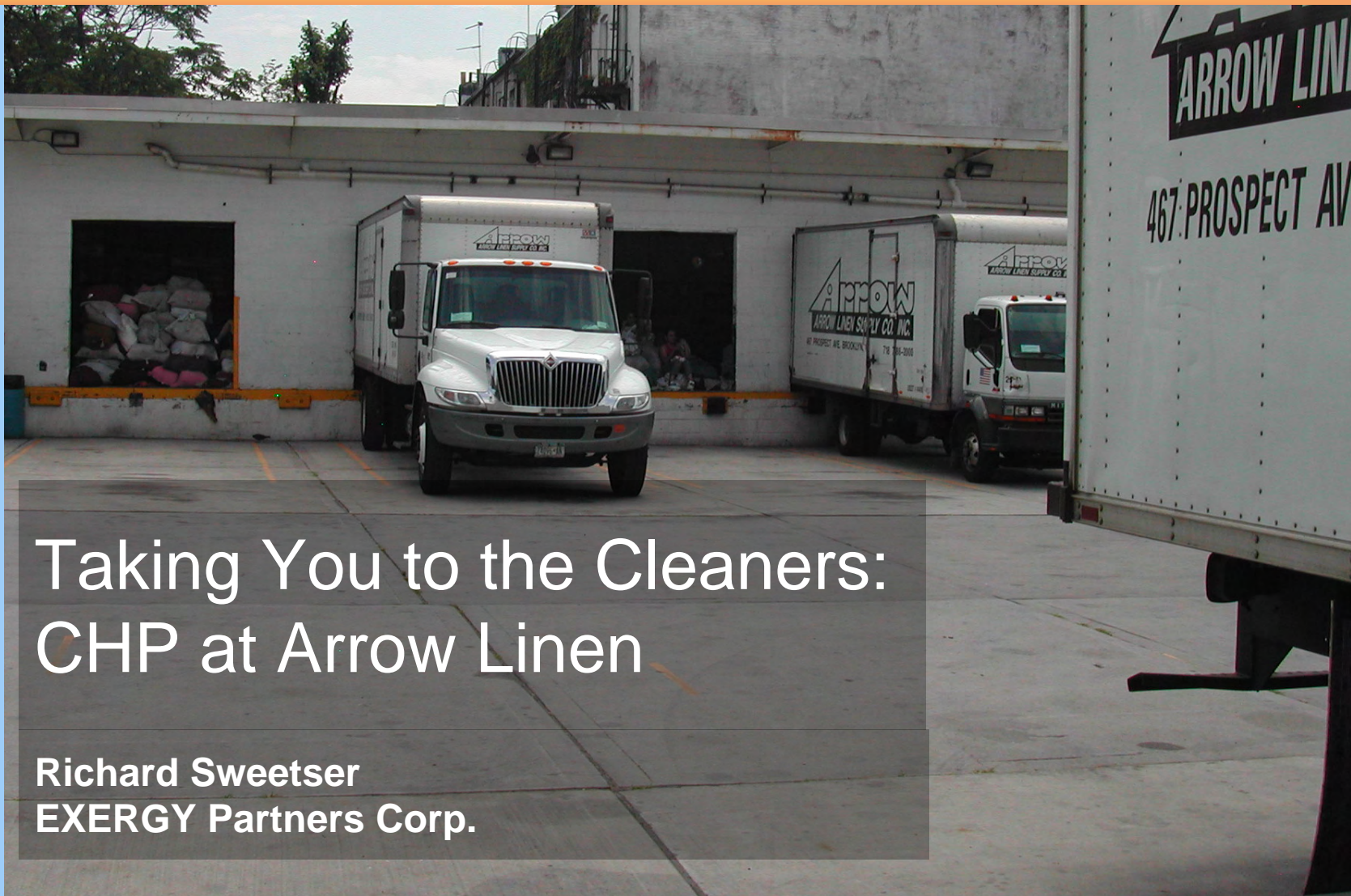




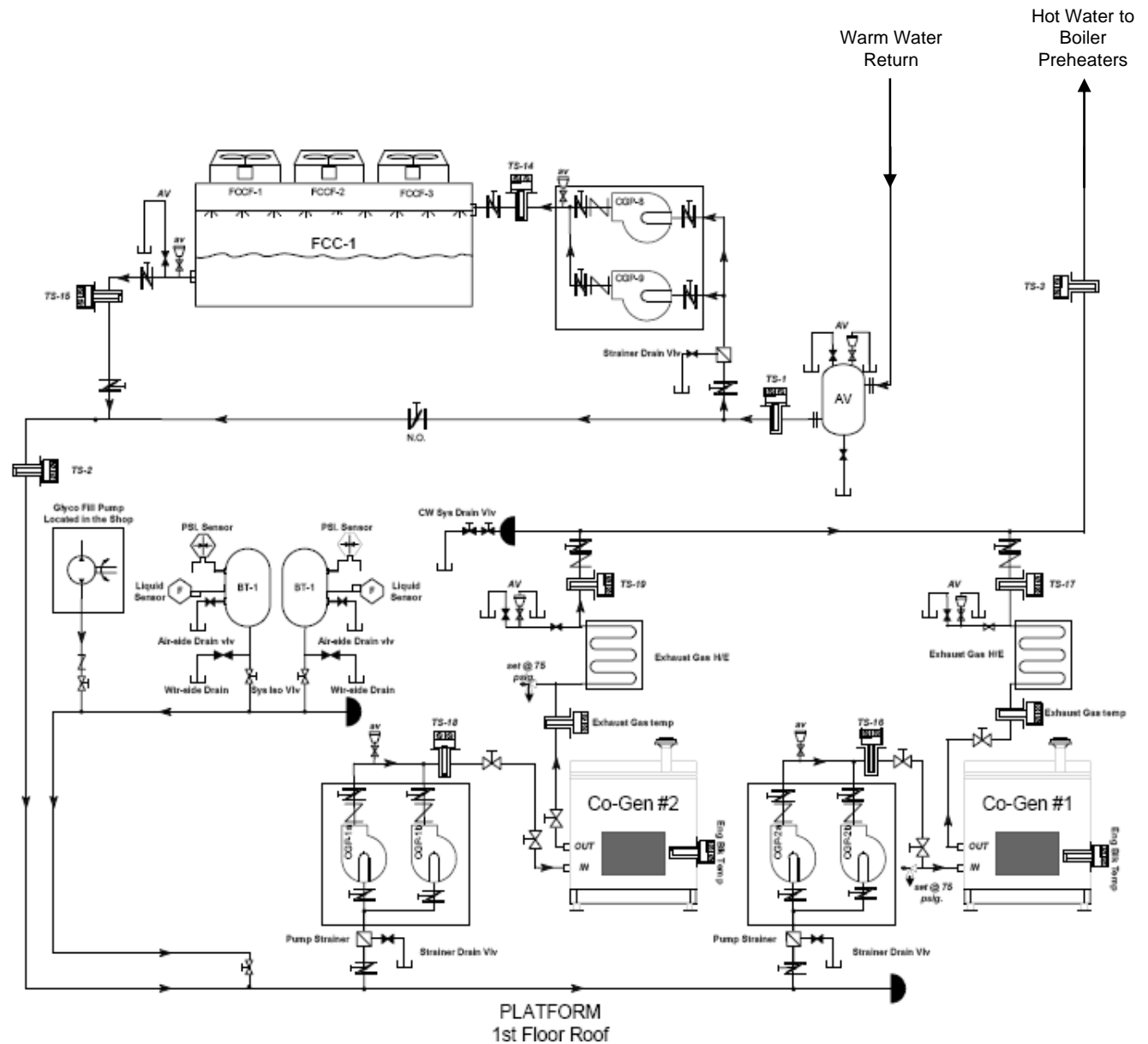
Body Shop:
Building
Strategies



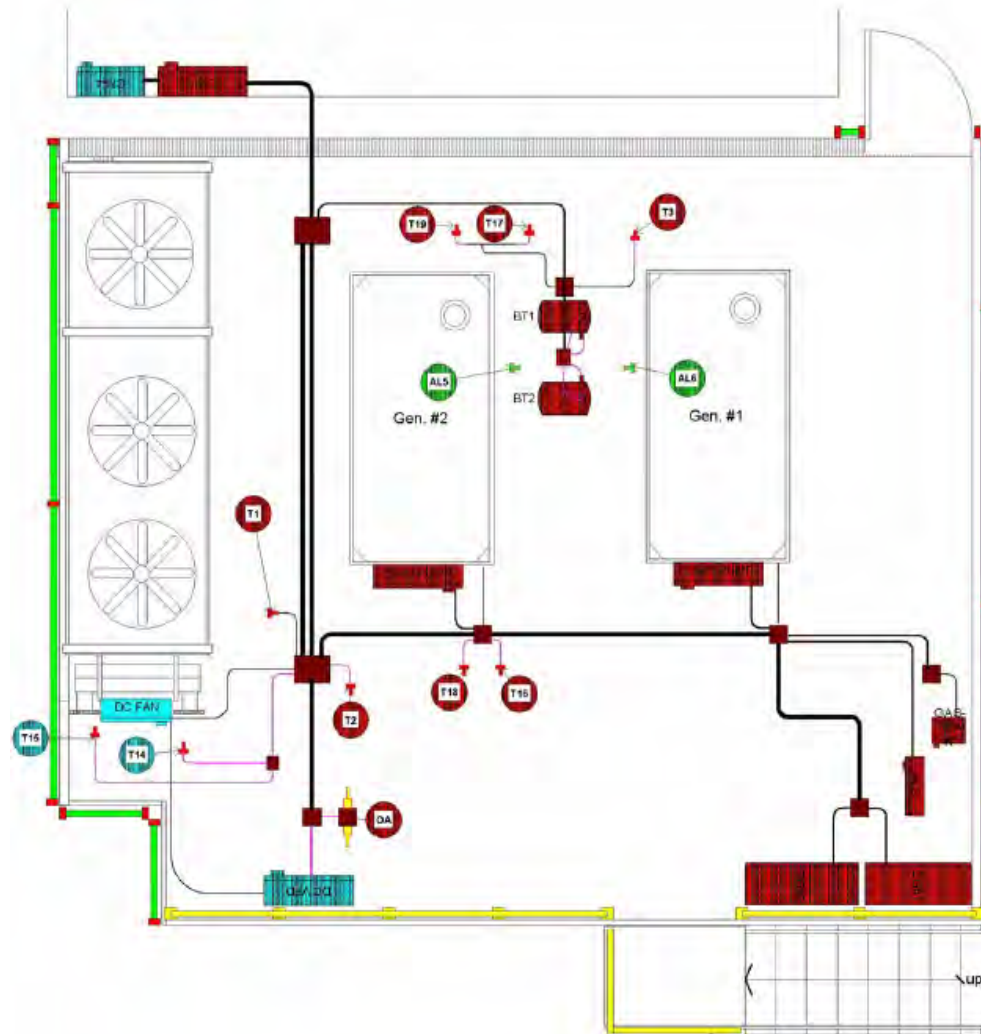
Taking You to the Cleaners: CHP at Arrow Linen

Richard Sweetser
EXERGY Partners Corp.

The CHP System Schematic



CHP System Layout



The CHP Installation

Parallel induction plant using two (2) 150 kW generators. Engine jacket water and exhaust waste heat are recovered and used for pre-heating boiler make up water and domestic hot water.



**Mechanical Platform. 2-150 kW
Generators and Fluid cooler**



**Full CHP Plant on Mechanical Platform
located on the roof of the facility**



Structural Design



Urban Good Neighbor



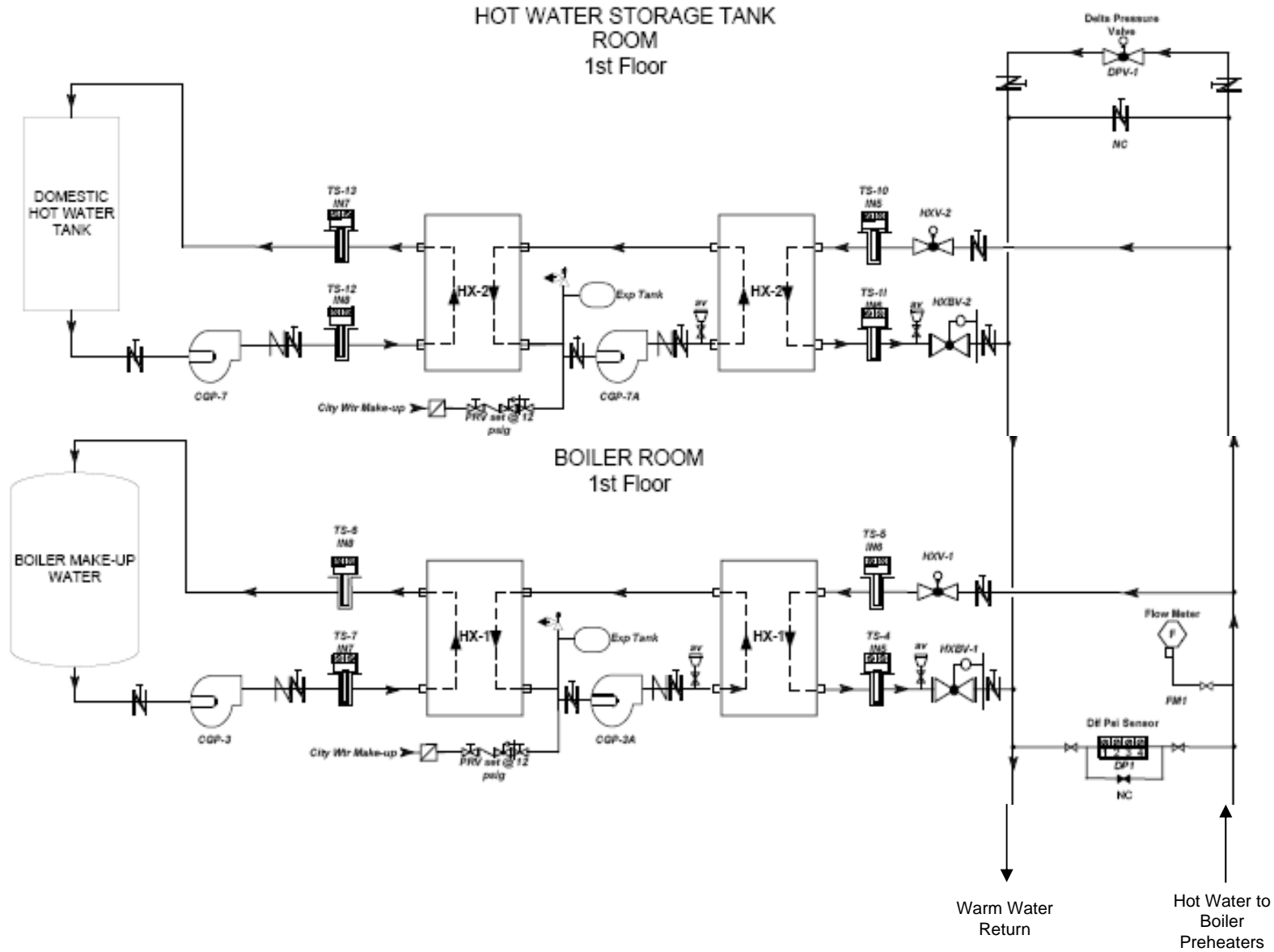
Sound Level
68.7 dBA



CHP Plant

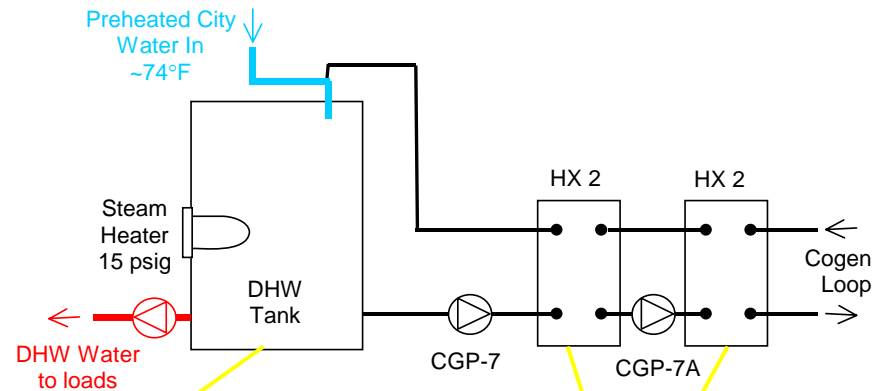


The Thermal Loop System Design



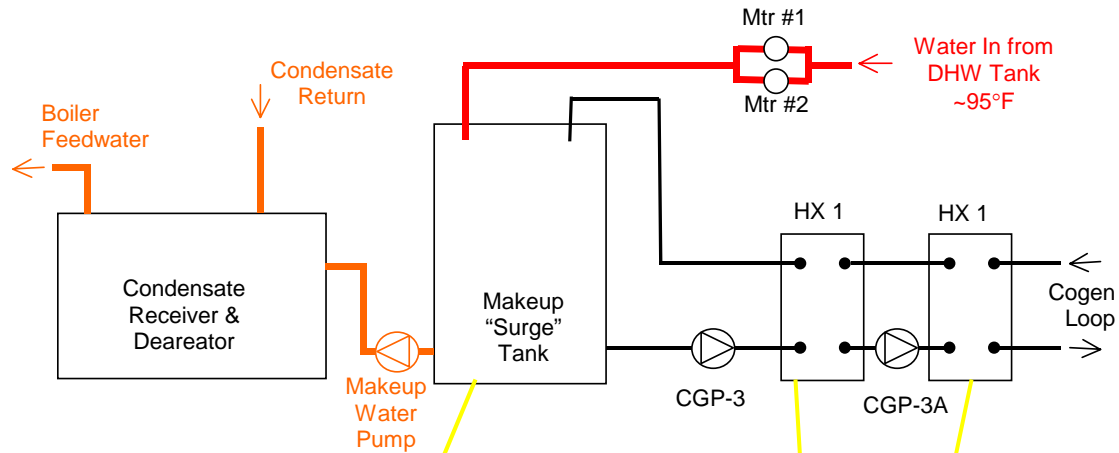
DHW System Thermal Loop

DHW tank is heated by a recirculation loop that pulls from the bottom of the tank and returns heated water at the top of the tank (along with incoming city water). Hot water from the DHW tank is provided as makeup water to the boiler system. The total DHW/boiler load is typically 100,000 gallons per day.



Boiler System Thermal Loop

Heat from the cogen loop is added by recirculating water from the makeup or "Surge" tank.



Real-time Data



<table border="1"> <tr><td>CHP % of Bldg Power</td><td>82.2 Pct</td></tr> <tr><td>CHP Heat Utilization</td><td>100.0 Pct</td></tr> <tr><td>Site CHP Efficiency</td><td>Pct</td></tr> <tr><td>Site Elect. Efficiency</td><td>64.2 Pct</td></tr> <tr><td>Total Site Power</td><td>329.7 kW</td></tr> <tr><td>Cogen Power</td><td>275.1 kW</td></tr> <tr><td>Cogen Unit #1 Status</td><td>ON Run Status</td></tr> <tr><td></td><td>Auto Auto Status</td></tr> <tr><td></td><td>OK EStp Status</td></tr> <tr><td>Cogen Unit #2 Status</td><td>ON Run Status</td></tr> <tr><td></td><td>Auto Auto Status</td></tr> <tr><td></td><td>OK EStp Status</td></tr> <tr><td>Cogen Unit #1 Block</td><td>183.3 Deg F</td></tr> <tr><td>Cogen Unit #2 Block</td><td>182.6 Deg F</td></tr> <tr><td>Cogen 1 Exhaust Gas</td><td>1104.1 Deg F</td></tr> <tr><td>Cogen 2 Exhaust Gas</td><td>1155.0 Deg F</td></tr> </table>	CHP % of Bldg Power	82.2 Pct	CHP Heat Utilization	100.0 Pct	Site CHP Efficiency	Pct	Site Elect. Efficiency	64.2 Pct	Total Site Power	329.7 kW	Cogen Power	275.1 kW	Cogen Unit #1 Status	ON Run Status		Auto Auto Status		OK EStp Status	Cogen Unit #2 Status	ON Run Status		Auto Auto Status		OK EStp Status	Cogen Unit #1 Block	183.3 Deg F	Cogen Unit #2 Block	182.6 Deg F	Cogen 1 Exhaust Gas	1104.1 Deg F	Cogen 2 Exhaust Gas	1155.0 Deg F	<table border="1"> <tr><td>Site Overview</td><td>Electrical Detail</td><td>Cogen Loop Detail</td><td>Blr/DHW Wtr Detail</td></tr> <tr><td>Total Site Heat Usage</td><td>Cogen Heat Recovery</td><td>Sound Level</td><td>Site Altitude</td></tr> <tr><td>1703.4 kBTU/Hr</td><td>1703.4 kBTU/Hr</td><td>68.7 dBA</td><td>560 Ft</td></tr> </table>	Site Overview	Electrical Detail	Cogen Loop Detail	Blr/DHW Wtr Detail	Total Site Heat Usage	Cogen Heat Recovery	Sound Level	Site Altitude	1703.4 kBTU/Hr	1703.4 kBTU/Hr	68.7 dBA	560 Ft	<table border="1"> <tr><td>Site Connection</td><td>OK</td></tr> <tr><td>Last Data Update</td><td>10:20 on 1/19/2005</td></tr> <tr><td>Ambient Temp</td><td>32.4 Deg F</td></tr> <tr><td>Ambient Humidity</td><td>75.8 Pct</td></tr> <tr><td>Dom Hot Wtr to Tank</td><td>108.7 Deg F</td></tr> <tr><td>Dom Hot Wtr fr Tank</td><td>88.9 Deg F</td></tr> <tr><td>Boiler Data</td><td>249.9 Stm, KPPH</td></tr> <tr><td></td><td>199.9 Stm, PSIG</td></tr> <tr><td></td><td>9.9 O2, Pct</td></tr> <tr><td>Boiler Water to Tank</td><td>118.1 Deg F</td></tr> <tr><td>Boiler Water fr Tank</td><td>115.8 Deg F</td></tr> <tr><td>Waste Water Data</td><td>139.1 Sup, Deg F</td></tr> <tr><td></td><td>109.9 Ret, Deg F</td></tr> <tr><td></td><td>11.0 pH</td></tr> <tr><td>City Water Data</td><td>0.0 GPM</td></tr> <tr><td></td><td>40.5 Sup, Deg F</td></tr> <tr><td></td><td>65.7 Ret, Deg F</td></tr> </table>	Site Connection	OK	Last Data Update	10:20 on 1/19/2005	Ambient Temp	32.4 Deg F	Ambient Humidity	75.8 Pct	Dom Hot Wtr to Tank	108.7 Deg F	Dom Hot Wtr fr Tank	88.9 Deg F	Boiler Data	249.9 Stm, KPPH		199.9 Stm, PSIG		9.9 O2, Pct	Boiler Water to Tank	118.1 Deg F	Boiler Water fr Tank	115.8 Deg F	Waste Water Data	139.1 Sup, Deg F		109.9 Ret, Deg F		11.0 pH	City Water Data	0.0 GPM		40.5 Sup, Deg F		65.7 Ret, Deg F
CHP % of Bldg Power	82.2 Pct																																																																															
CHP Heat Utilization	100.0 Pct																																																																															
Site CHP Efficiency	Pct																																																																															
Site Elect. Efficiency	64.2 Pct																																																																															
Total Site Power	329.7 kW																																																																															
Cogen Power	275.1 kW																																																																															
Cogen Unit #1 Status	ON Run Status																																																																															
	Auto Auto Status																																																																															
	OK EStp Status																																																																															
Cogen Unit #2 Status	ON Run Status																																																																															
	Auto Auto Status																																																																															
	OK EStp Status																																																																															
Cogen Unit #1 Block	183.3 Deg F																																																																															
Cogen Unit #2 Block	182.6 Deg F																																																																															
Cogen 1 Exhaust Gas	1104.1 Deg F																																																																															
Cogen 2 Exhaust Gas	1155.0 Deg F																																																																															
Site Overview	Electrical Detail	Cogen Loop Detail	Blr/DHW Wtr Detail																																																																													
Total Site Heat Usage	Cogen Heat Recovery	Sound Level	Site Altitude																																																																													
1703.4 kBTU/Hr	1703.4 kBTU/Hr	68.7 dBA	560 Ft																																																																													
Site Connection	OK																																																																															
Last Data Update	10:20 on 1/19/2005																																																																															
Ambient Temp	32.4 Deg F																																																																															
Ambient Humidity	75.8 Pct																																																																															
Dom Hot Wtr to Tank	108.7 Deg F																																																																															
Dom Hot Wtr fr Tank	88.9 Deg F																																																																															
Boiler Data	249.9 Stm, KPPH																																																																															
	199.9 Stm, PSIG																																																																															
	9.9 O2, Pct																																																																															
Boiler Water to Tank	118.1 Deg F																																																																															
Boiler Water fr Tank	115.8 Deg F																																																																															
Waste Water Data	139.1 Sup, Deg F																																																																															
	109.9 Ret, Deg F																																																																															
	11.0 pH																																																																															
City Water Data	0.0 GPM																																																																															
	40.5 Sup, Deg F																																																																															
	65.7 Ret, Deg F																																																																															
<p align="center">Arrow Linen Supply - Commercial IC Engine Site</p> <p>Qty. 2, 150-IC IC Engines 150 kW Electric 210 kW_e Heat Recovery</p> <p>Natural Gas Supply</p> <p>Facility Loads</p> <p>DHW Heat Exch</p> <p>Domestic Hot Water Tank</p> <p>Boiler Water Heat Exch</p> <p>Boiler Makeup Water Tank</p> <p>Dump Cooler (FCC-1)</p>																																																																																
<table border="1"> <tr><td>Gas Flow. (30M Avg)</td><td>27.7 CFM</td></tr> <tr><td>Gas Use (Cur. Day)</td><td>10700.0 CF</td></tr> </table>	Gas Flow. (30M Avg)	27.7 CFM	Gas Use (Cur. Day)	10700.0 CF	<table border="1"> <tr><td>Common Cogen Wtr</td><td>104.0 GPM</td></tr> <tr><td></td><td>197.2 Deg F, Sup</td></tr> <tr><td></td><td>160.2 Deg F, Ret</td></tr> </table>	Common Cogen Wtr	104.0 GPM		197.2 Deg F, Sup		160.2 Deg F, Ret	<table border="1"> <tr><td>Dump Cooler Intake</td><td>17.5 Deg F</td></tr> <tr><td>Dump Clr Discharge</td><td>75.9 Deg F</td></tr> </table>	Dump Cooler Intake	17.5 Deg F	Dump Clr Discharge	75.9 Deg F	<table border="1"> <tr><td>Dump Clr Heat Reject.</td><td>0.0 kBTU/Hr</td></tr> <tr><td>City Water Make-up</td><td>OFF</td></tr> </table>	Dump Clr Heat Reject.	0.0 kBTU/Hr	City Water Make-up	OFF																																																											
Gas Flow. (30M Avg)	27.7 CFM																																																																															
Gas Use (Cur. Day)	10700.0 CF																																																																															
Common Cogen Wtr	104.0 GPM																																																																															
	197.2 Deg F, Sup																																																																															
	160.2 Deg F, Ret																																																																															
Dump Cooler Intake	17.5 Deg F																																																																															
Dump Clr Discharge	75.9 Deg F																																																																															
Dump Clr Heat Reject.	0.0 kBTU/Hr																																																																															
City Water Make-up	OFF																																																																															

Real-time Data



CHP % of Bldg Power	84.7 Pct
CHP Heat Utilization	100.0 Pct
Site CHP Efficiency	Pct
Site Elect. Efficiency	64.2 Pct
Cogen Unit #1 Status	ON
TE1 Wtr to Cogen 1	159.9 Deg F
TE2 Wtr fr Cogen 1	197.4 Deg F
Cogen Pump 1A	ON
Cogen Pump 1B	OFF
Cogen Unit 2 Status	ON
TE3 Wtr to Cogen 2	159.7 Deg F
TE4 Wtr fr Cogen 2	196.0 Deg F
Cogen Pump 2A	ON
Cogen Pump 2B	OFF

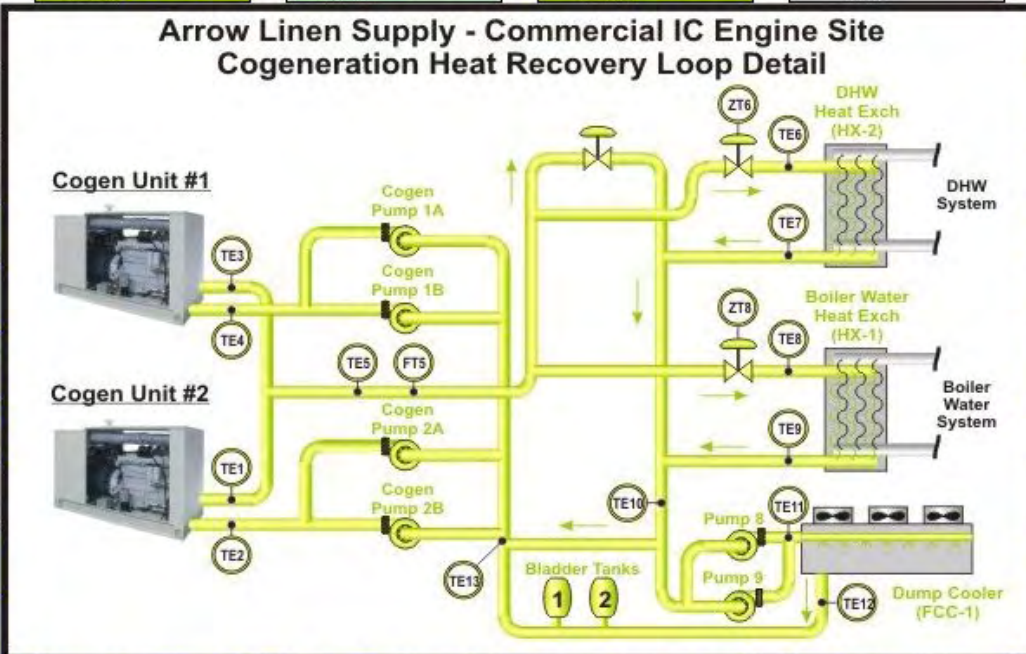
Site Overview	
Total Site Heat Usage	1803.3 kBTU/Hr

Electrical Detail	
Cogen Heat Recovery	1803.3 kBTU/Hr

Cogen Loop Detail	
FT5 Cogen Flow	104.4 GPM

Blr/DHW Wtr Detail	
Site Altitude	560 Ft

Site Connection	OK
Last Data Update	10:21 on 1/19/2005



ZT6 Wtr to DHW Vlv	100.0 Pct
TE6 Wtr to DHW HX	197.5 Deg F
TE7 Wtr fr DHW HX	103.7 Deg F
ZT8 Wtr to Blr Vlv	29.0 Pct
TE8 Wtr to Blr HX	119.9 Deg F
TE9 Wtr fr Blr HX	196.1 Deg F
Dump Clr Heat Rej.	0.0 kBTU/Hr
Dump Cooler Fan	OK
Dump Cooler Fans	OFF Fan #1 OFF Fan #2 OFF Fan #3
Dump Cooler Pump 8	0.0 Pct
Dump Cooler Pump 9	0.0 Pct

Cogen Loop (Deg F)	197.2 TE5-Sup
	154.6 TE10-Ret
	159.6 TE13-Dump

Bladder Tank 1	OK
Bladder Tank 1 Pres	11.7 PSIG

Bladder Tank 2	OK
Bladder Tank 2 Pres	11.5 PSIG

TE11 Dump Clr In	17.5 Deg F
TE12 Dump Clr Out	75.9 Deg F

Real-time Data



CHP % of Bldg Power	79.0 Pct
CHP Heat Utilization	100.0 Pct
Site CHP Efficiency	Pct
Site Elect. Efficiency	57.7 Pct

Cogen Wtr to DHW HX	194.0 Deg F
Cogen Wtr fr DHW HX	106.6 Deg F

Cogen Wtr to Blr HX	119.9 Deg F
Cogen Wtr fr Blr HX	196.1 Deg F

Common Cogen Wtr	101.3 GPM
	193.2 Sup, Deg F
	161.7 Ret, Deg F

Site Overview

Electrical Detail

Cogen Loop Detail

Blr/DHW Wtr Detail

Site Connection
OK

Last Data Update
10:22 on 1/19/2005

Ambient Temp
31.6 Deg F

Ambient Humidity
75.1 Pct

DHW Water to Tank
114.9 Deg F

DHW Water fr Tank
95.2 Deg F

DHW Wtr Pump 7
ON

DHW Wtr Pump 7
Auto

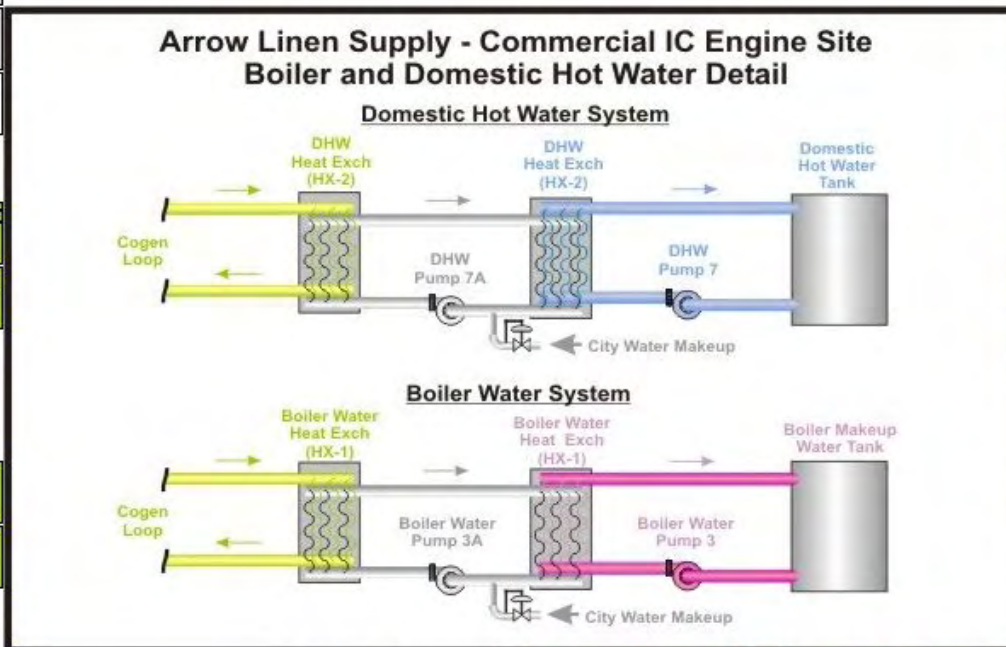
DHW Wtr Pump 7A
ON

DHW Wtr Pump 7A
Auto

City Water Make-up
OFF

City Water
0.0 GPM

40.5 Sup, Deg F
65.7 Ret, Deg F



Boiler Wtr Pump 3A	ON
Boiler Wtr Pump 3A	Auto

Boiler Wtr Pump 3	ON
Boiler Wtr Pump 3	Auto

Boiler Wtr to Tank	121.0 Deg F
Boiler Wtr fr Tank	118.5 Deg F

Real-time Data



CHP % of Bldg Power	92.2 Pct
CHP Heat Utilization	100.0 Pct
Site CHP Efficiency	Pct
Site Elect. Efficiency	49.1 Pct

Site Overview

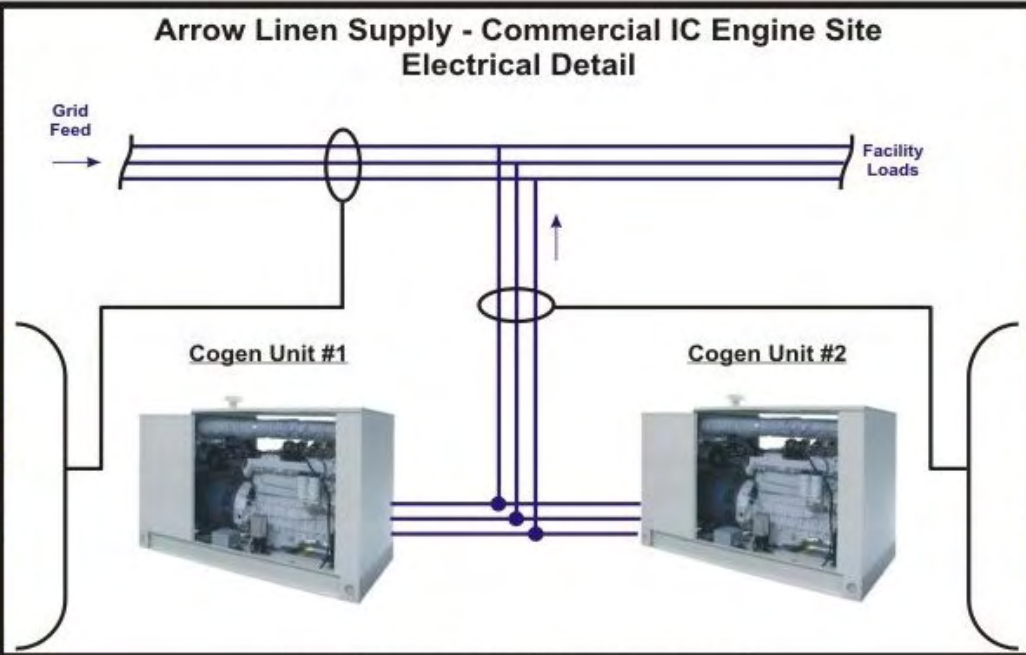
Electrical Detail

Cogen Loop Detail

Blr/DHW/Wtr Detail

Site Connection	OK
Last Data Update	10:29 on 1/19/2005
Ambient Temp	31.3 Deg F
Ambient Humidity	75.1 Pct
Total Site Power	319.5 kW
Bldg Pwr (Cur. Day)	2181.5 kWh

Power from Grid	38.4 kW
Grid Power (Cur. Day)	535.8 kWh
React. Pwr frm Grid	395.2 VAr
Grid Voltage	120.4 Phase A
	120.7 Phase B
	120.6 Phase C



Total Cogen Power	281.1 kW
Cogen Pwr (Cur. Day)	1642.6 kWh
Cogen Reactive Pwr	179.3 VAr
Cogen Voltage	271.2 Phase A
	272.9 Phase B
	275.1 Phase C

Cogen Unit #1 Status	ON Run Status
	Auto Auto Status
	OK EStp Status

Cogen Unit #2 Status	ON Run Status
	Auto Auto Status
	OK EStp Status

Performance

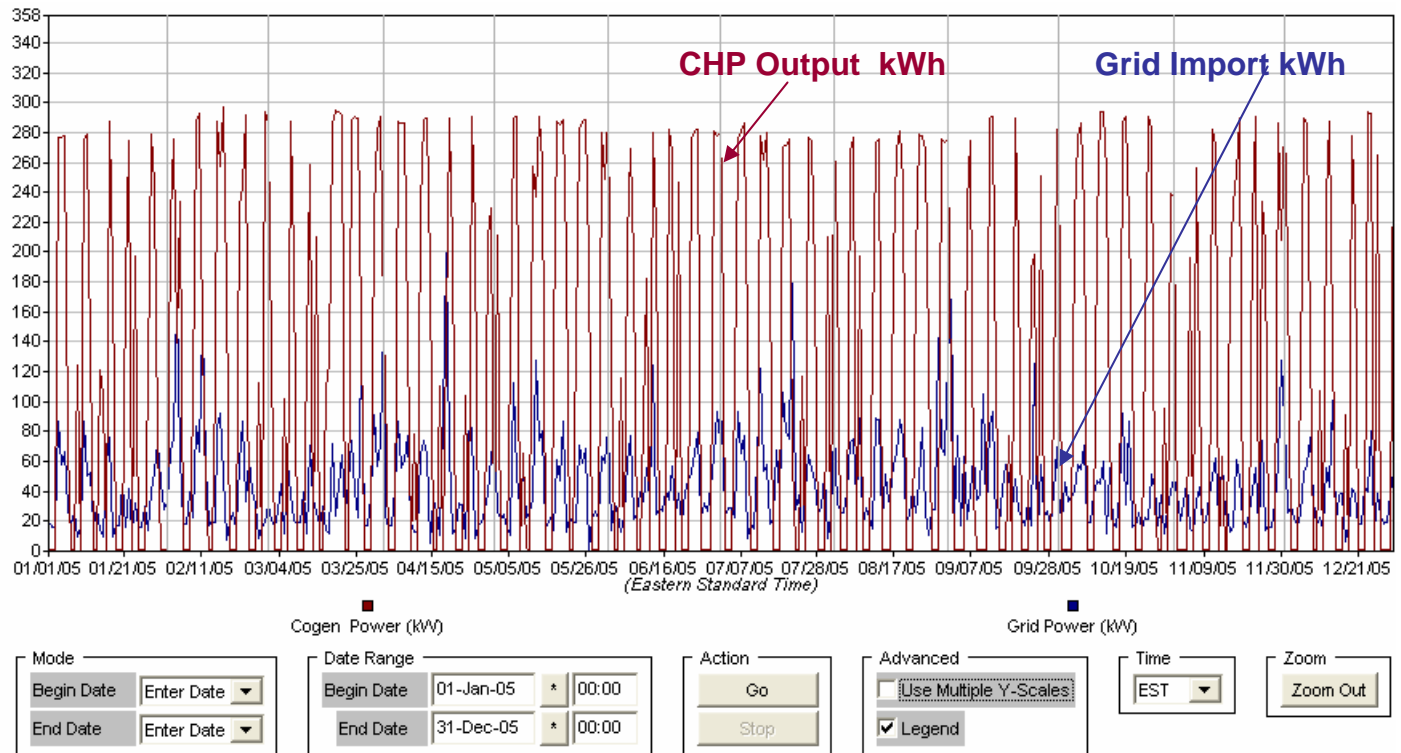
GENERATOR RUNTIME, GAS USE AND HEAT RECOVERY SUMMARY

Arrow Linen

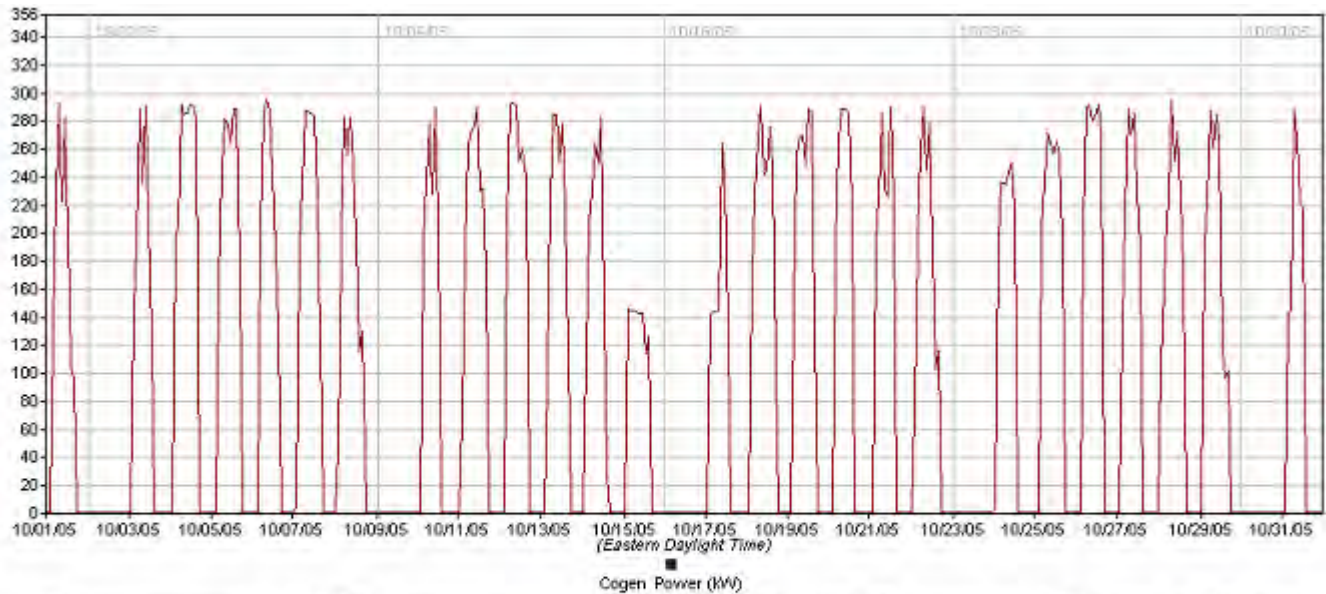
03/01/05 to 12/31/05

Date	Good Data (%)	Total Generator Runtime (hrs)	Total Facility Gas Use (cu ft)	Total Generator Gas Use (cu ft)	Total Useful Heat Recovery (MBtu)	Total Unused Heat Recovery (MBtu)	Percent Useful Heat Recovery (%)
Mar 2005	91.01	356.00	n/a	775367.19	138162.11	14.14	99.99
Apr 2005	96.58	360.25	n/a	962304.69	127024.03	10.85	99.99
May 2005	93.40	360.00	n/a	988712.69	130109.78	3.49	100.00
Jun 2005	99.88	400.00	n/a	1084502.00	144909.92	5.46	100.00
Jul 2005	99.83	370.50	n/a	1037196.40	137413.00	4.91	100.00
Aug 2005	96.61	376.25	n/a	1017190.90	107201.62	6.53	99.99
Sep 2005	99.69	331.25	n/a	896484.81	98411.55	235.88	99.76
Oct 2005	99.65	349.75	n/a	912783.13	121609.68	62.72	99.95
Nov 2005	99.81	332.75	n/a	914079.88	123832.55	5.65	100.00
Dec 2005	99.85	361.25	n/a	989680.44	128944.19	5.55	100.00
Total	97.61	3598.00	n/a	9578302.00	1257618.40	355.19	99.97

Measuring Performance - CHP & Grid kWh vs Time (2005)



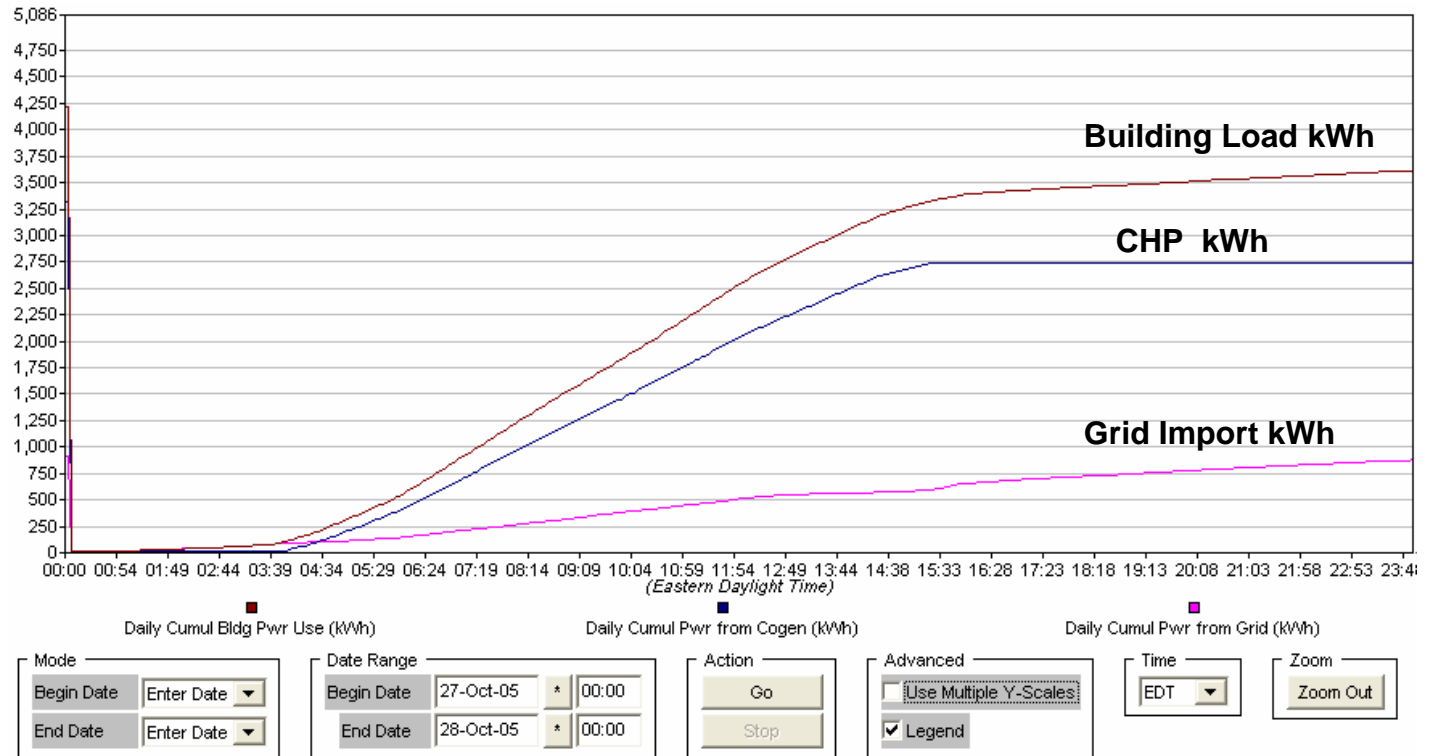
Measuring Performance – CHP Power Output kW vs Time (October, 2005)



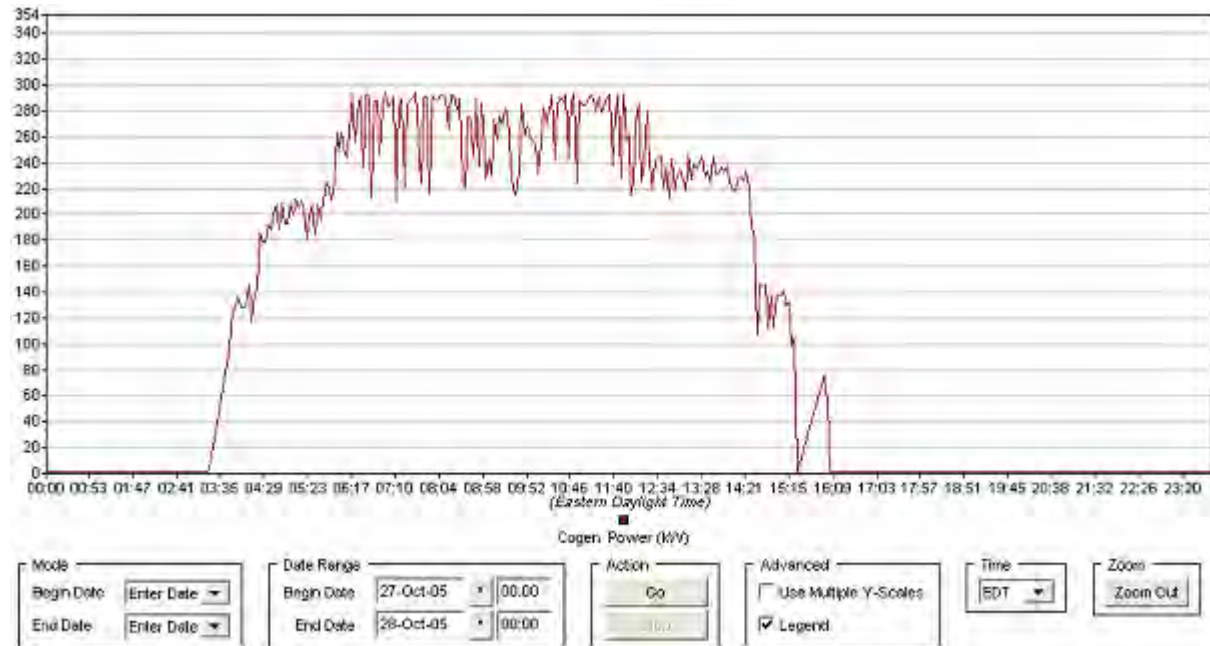
Cogen Power (kW)

Mode	Date Range	Action	Advanced	Time	Zoom
Begin Date: <input type="text" value="Enter Date"/>	Begin Date: 01-Oct-05 00:00	<input type="button" value="Go"/>	<input type="checkbox"/> Use Multiple Y-Scales	EDT	<input type="button" value="Zoom Out"/>
End Date: <input type="text" value="Enter Date"/>	End Date: 01-Nov-05 00:00	<input type="button" value="Stop"/>	<input checked="" type="checkbox"/> Legend		

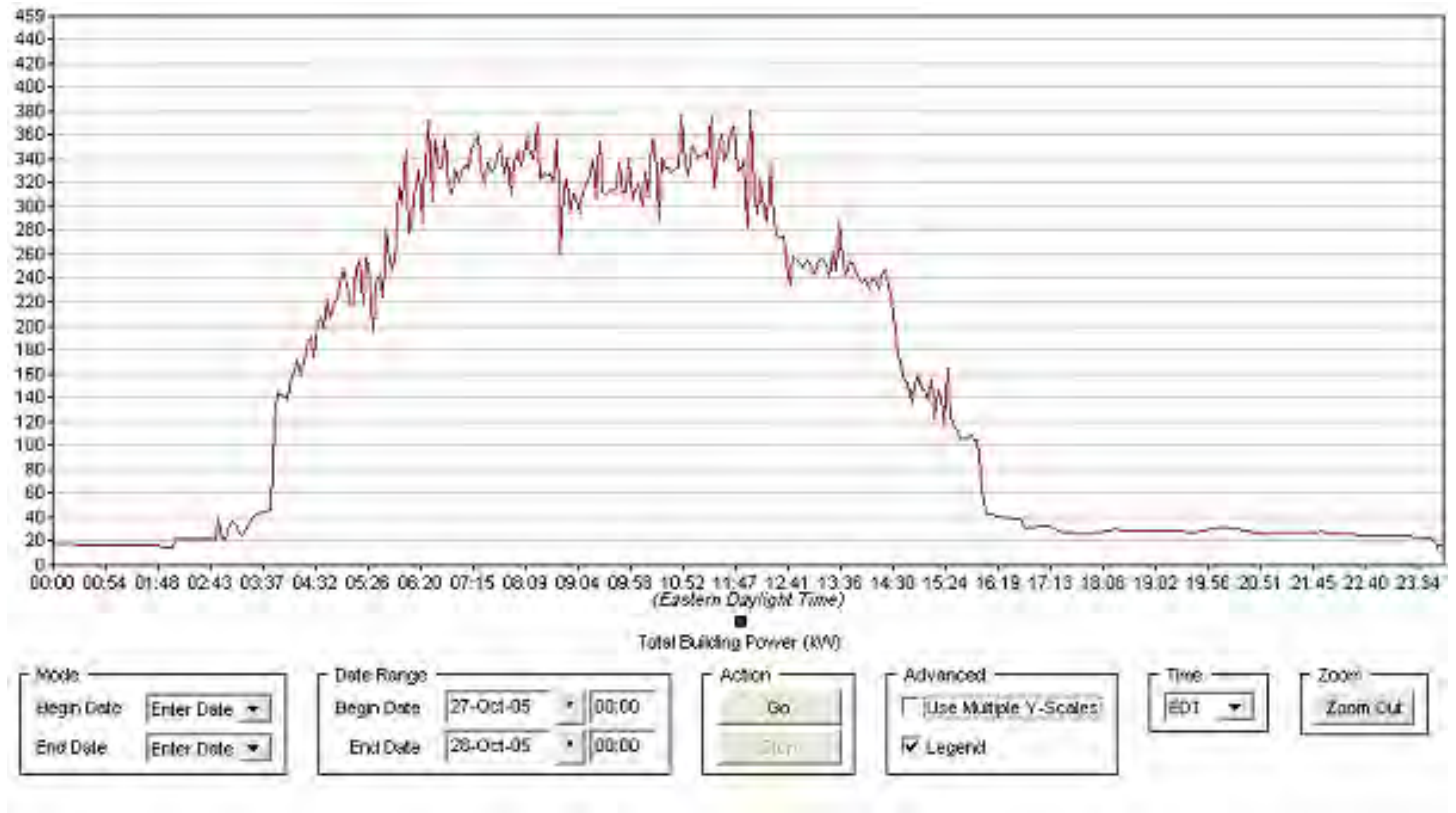
Measuring Performance - Total Building, CHP & Grid kWh vs Time (October 28, 2005)



Measuring Performance – CHP Power Output kW vs Time (October 28, 2005)



Measuring Performance - Total Building kW vs Time (October 28, 2005)



Laundering Money

For the month of October, fuel use, power generated (adjusted for parasitics) and useful thermal energy is:

October 2005 Operating Parameters	
Net Power Generated (kWh):	78,324
Fuel Consumed (MBtu):	912,700
Useful Thermal Energy (MBtu):	490,700

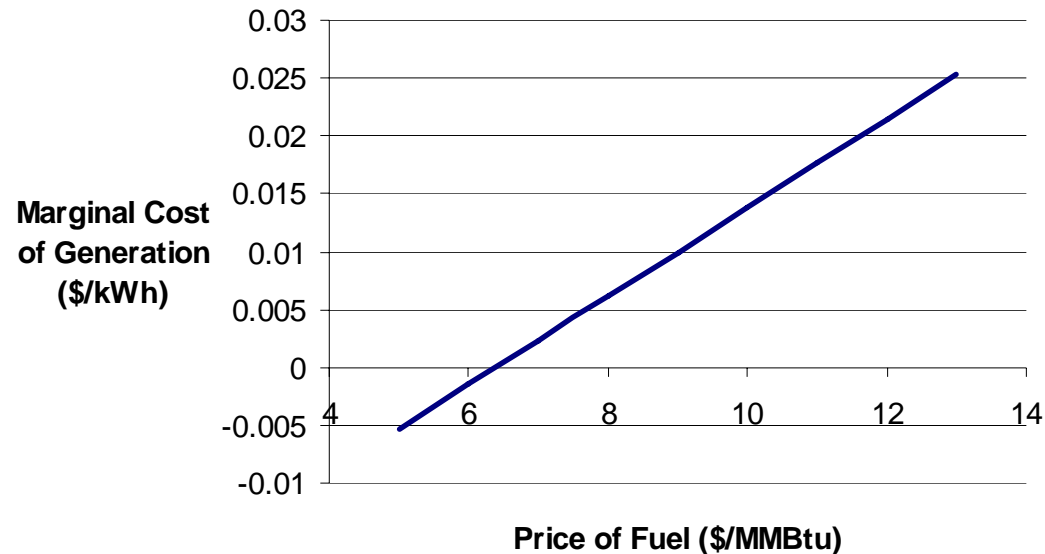


Laundering Money

Marginal Cost of CHP System (¢/kWh) =

Cost of Engine Fuel – (Cost of Useful Thermal Energy/.8)
Cost of Net Power Output

+ 2 ¢/kWh – 4.4 ¢/kWh



Laundering Money

The laundry is paying around \$11 to \$12/MMBtu for natural gas and that their avoided electric rate is around 14 ¢/kWh. Based on the results from the calculated marginal energy curve the energy savings revenue stream from the CHP system at Arrow Linen.

Annual Estimate Generation:	940,000 kWh
Annual Energy Cost Savings:	\$122,800/Year



A photograph of a factory floor featuring a row of industrial machines. The machines are primarily blue with large, circular, silver-colored metal doors. The machine in the foreground has a control panel with a digital display and various buttons. A green metal cart is positioned in front of the first machine. The background shows a typical industrial environment with pipes, ducts, and a brick wall.

Questions

For more information: www.exergypartners.com