Engine Driven Combined Heat and Power: Arrow Linen Supply

Bruce Hedman
ICF International

December 2, 2008

Power-Gen International

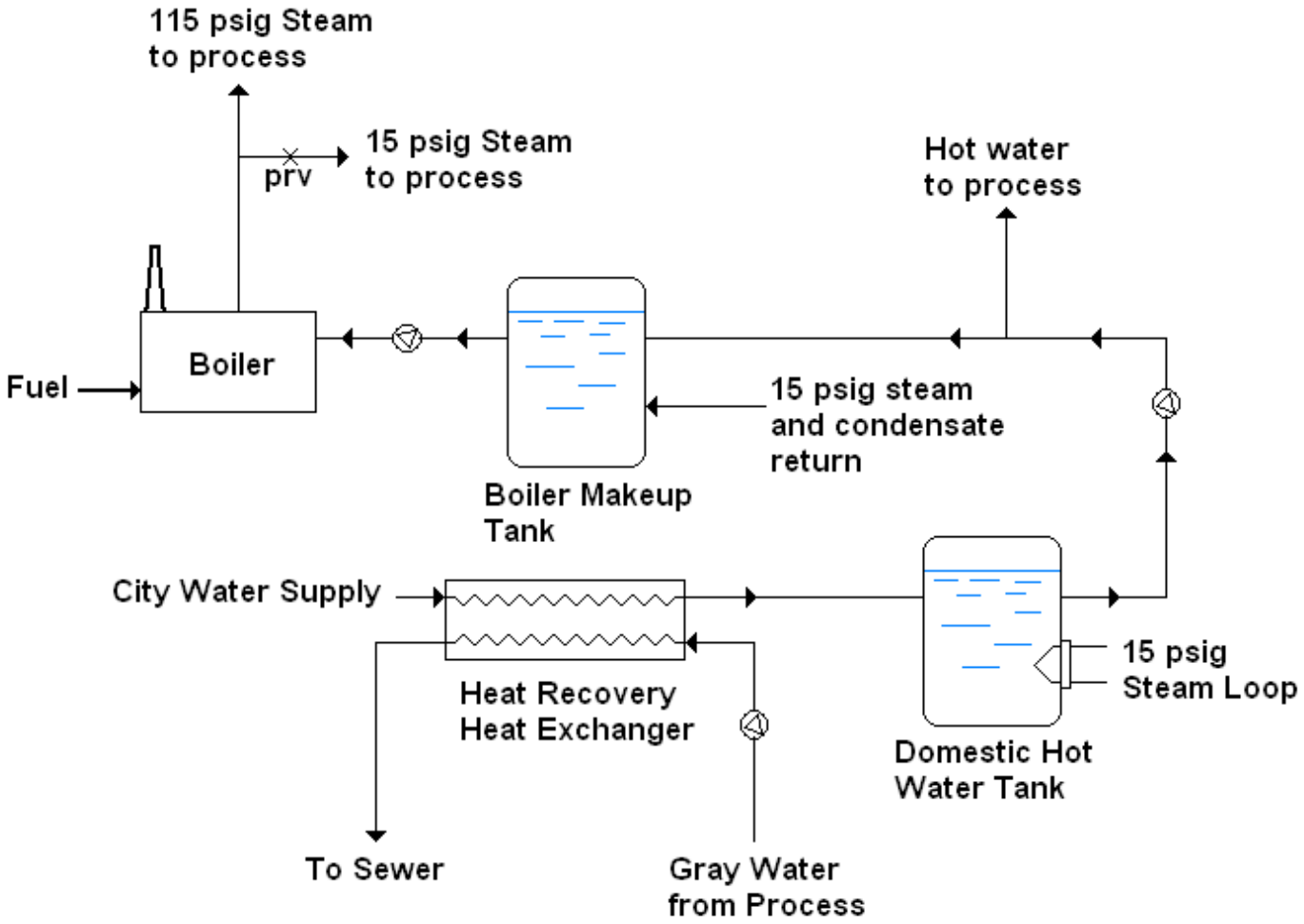
Arrow Linen CHP Demonstration

- Original installations supported by NYSERDA
- Data monitoring and analysis supported by DOE
- Team consisted of Oak Ridge National Lab, Energy Solution Center and ICF International

Arrow Linen Supply, Brooklyn, New York

- Laundry service for restaurants in New York area
- Operates 6 days per week 4:00 am to 4:00 pm
- Annual energy bills:
  - $235,000 Electricity
  - $670,000 Natural Gas
- Peak demand = 370 kW
- Average demand = 260 kW

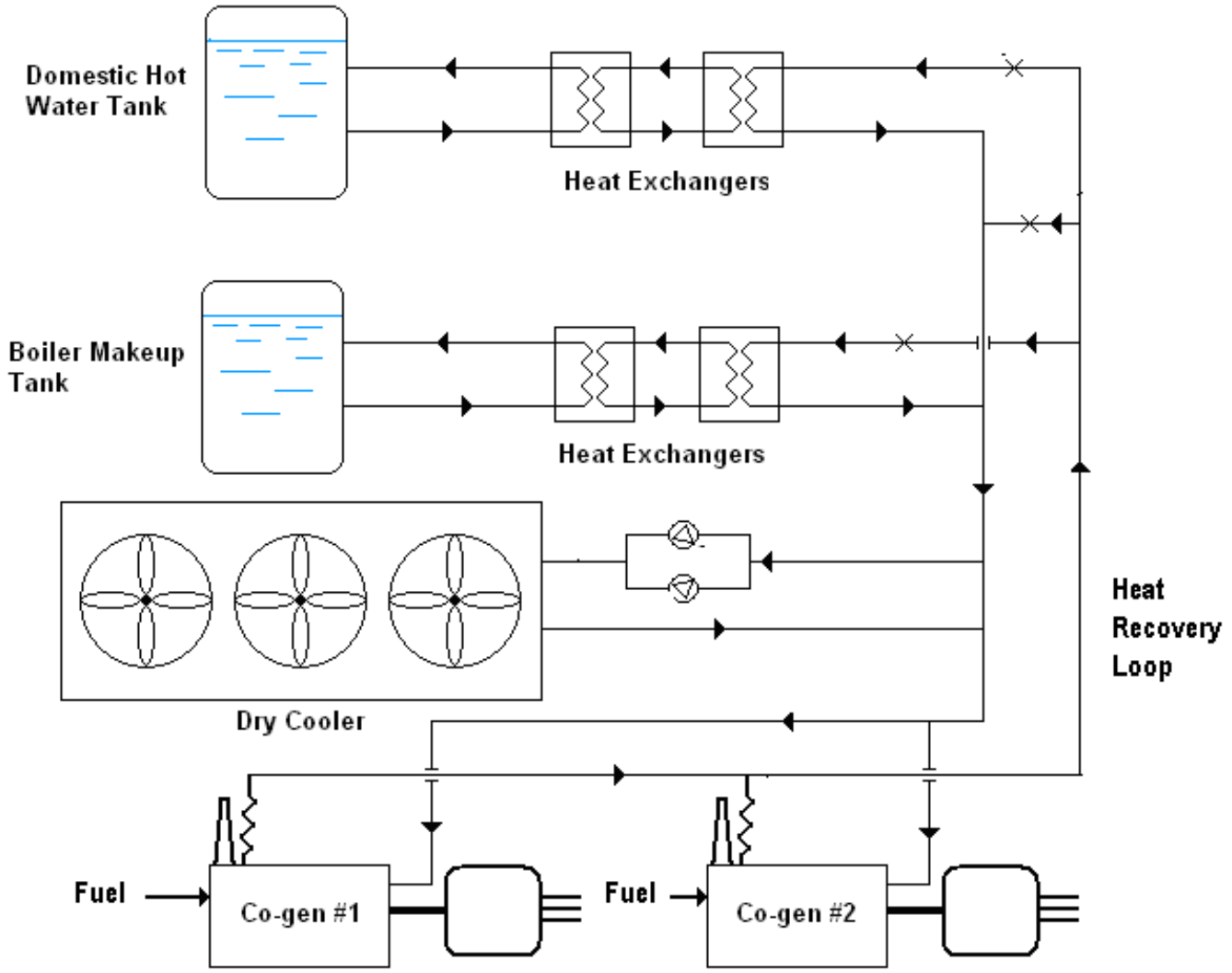
Existing Thermal System



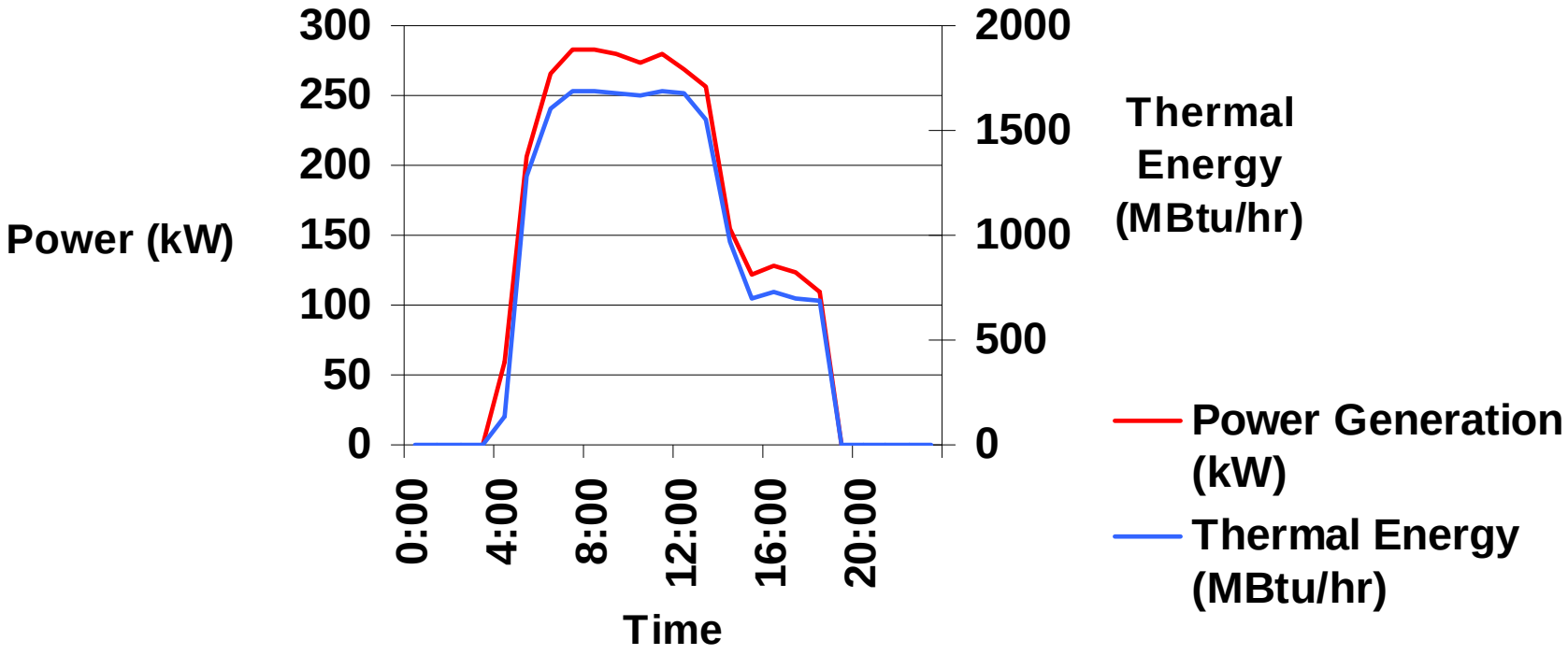
Arrow Linen Supply CHP System

- Two 150 kW Coast Intelligen reciprocating engine packages
- Rich-burn Mann engines
- Induction generators
- Net power output = 284 kW
- Thermal recovery = 1.44 MMBtu/hr
- Fuel consumption = 3.10 MMBtu/hr
- Electric load following

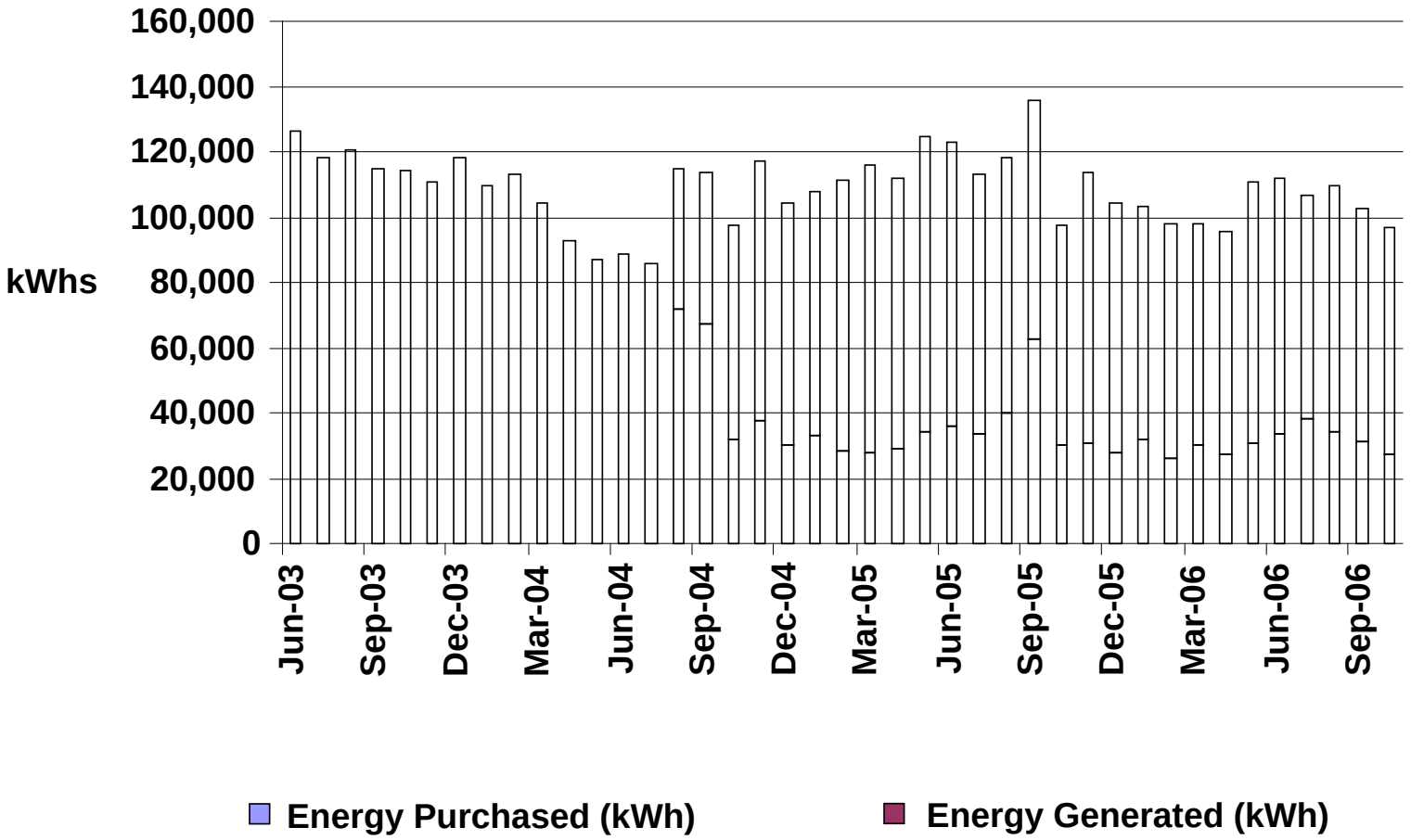
CHP System Schematic



Daily CHP Load Profile



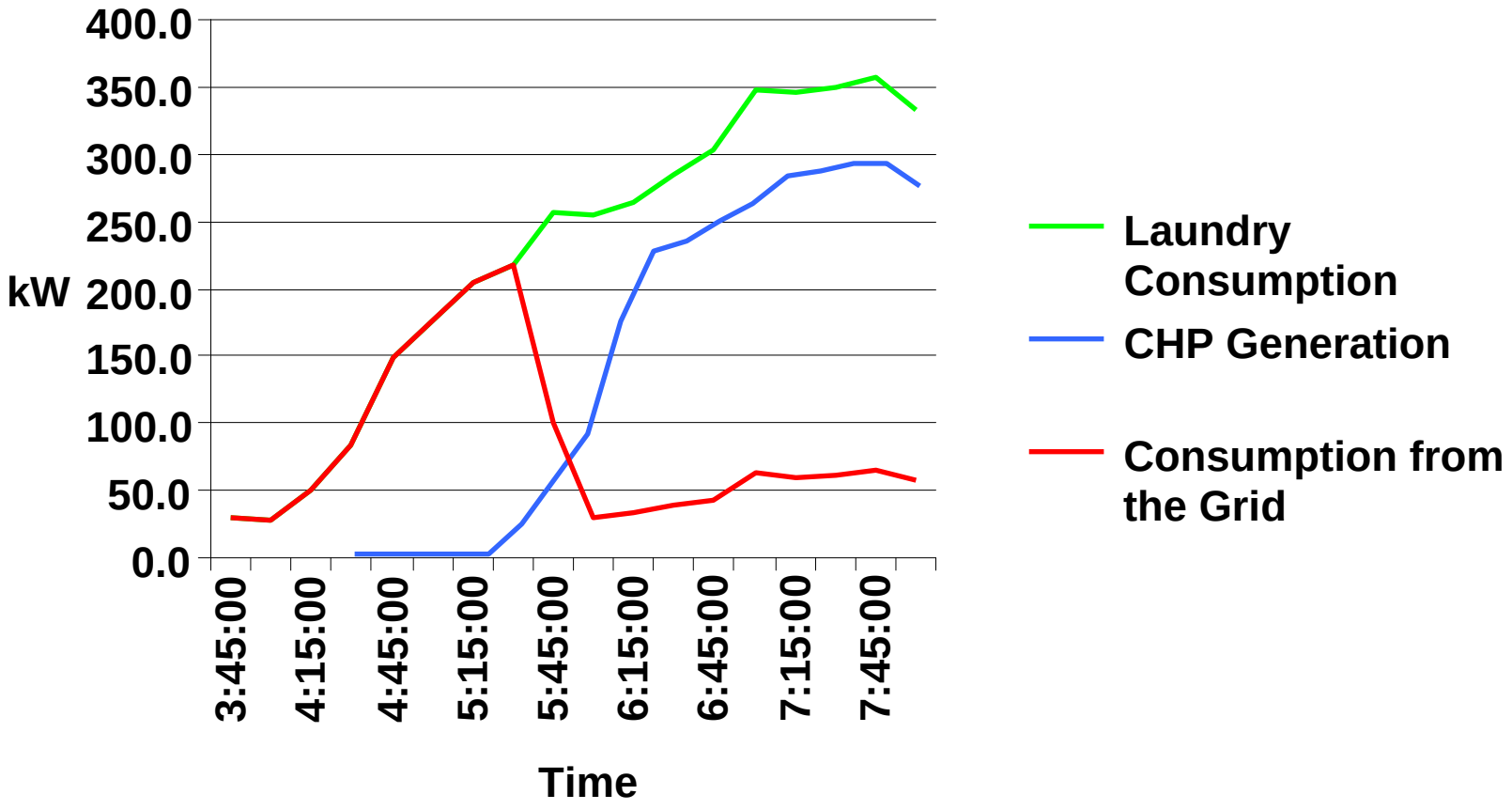
Monthly Power Consumption



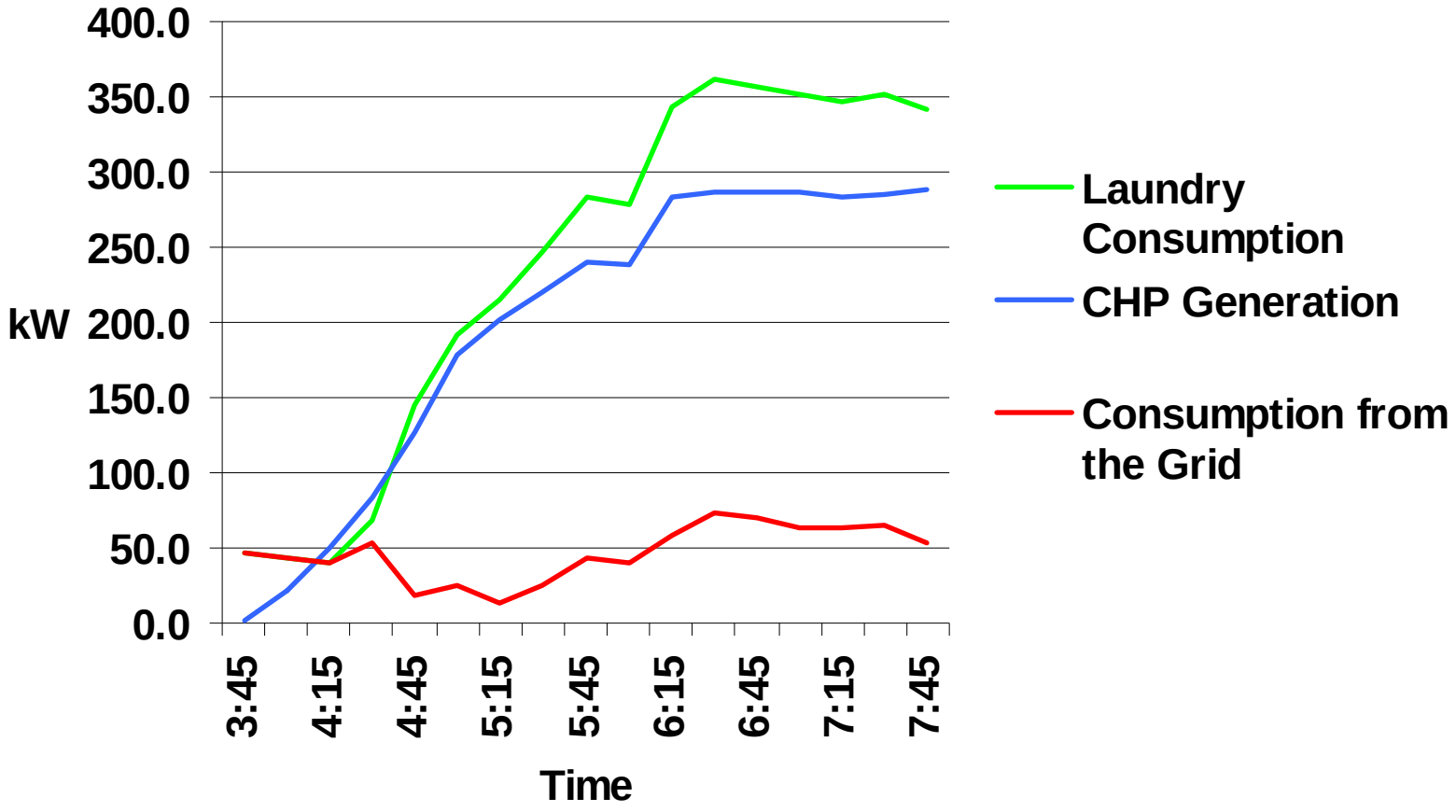
CHP System Operating Parameters

	Design	Average
Gross Generator Output, kW	300	206
Net Generator Output, kW	284	195
System Electrical Efficiency, %	31.3%	26.2%
Fuel Consumption, MMBtu/hr	3.10	2.54
Thermal Energy Recovered, MMBtu/hr	1.44	1.28
Power-to-Heat Ratio	0.67	0.52
Overall CHP Efficiency	77.7%	76.4%

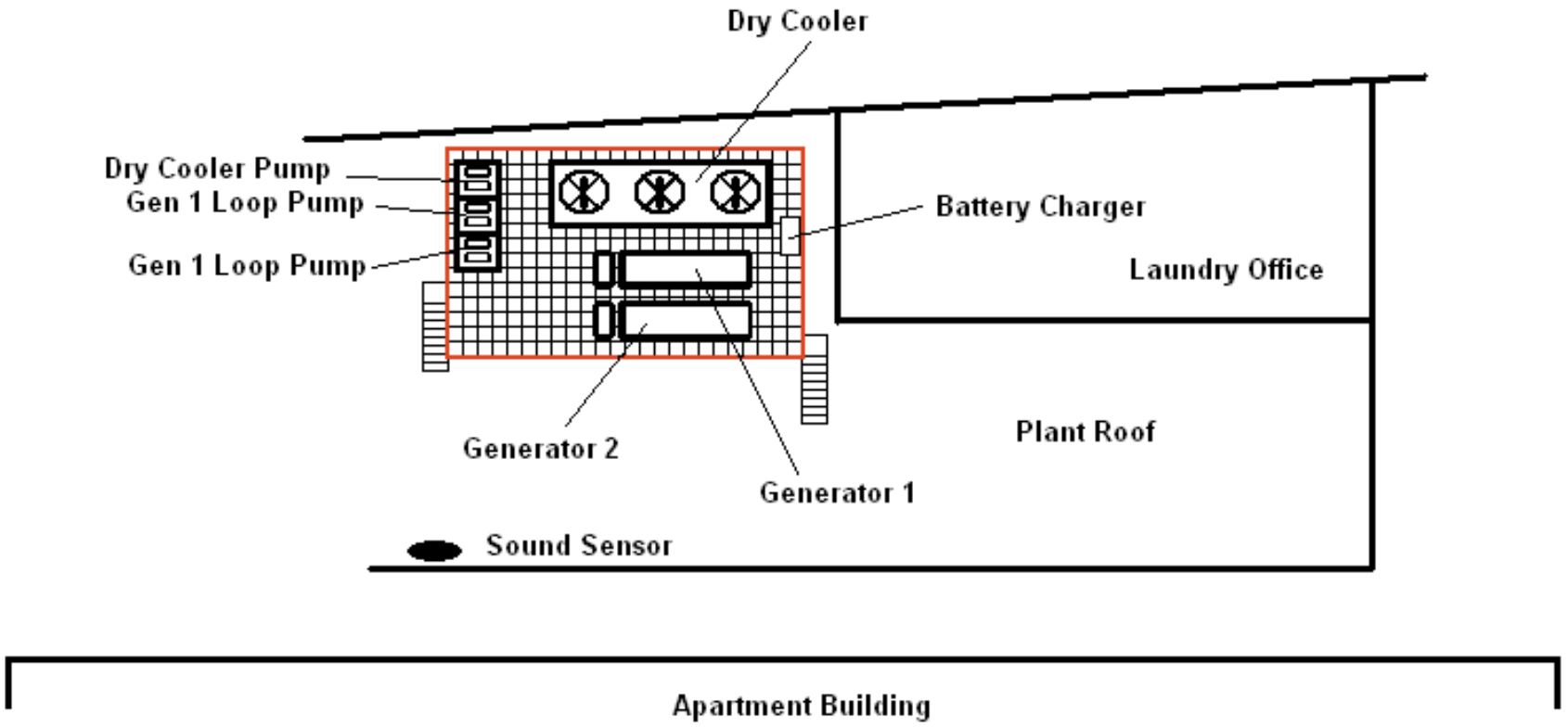
Delayed Start Sets High Billing Demand



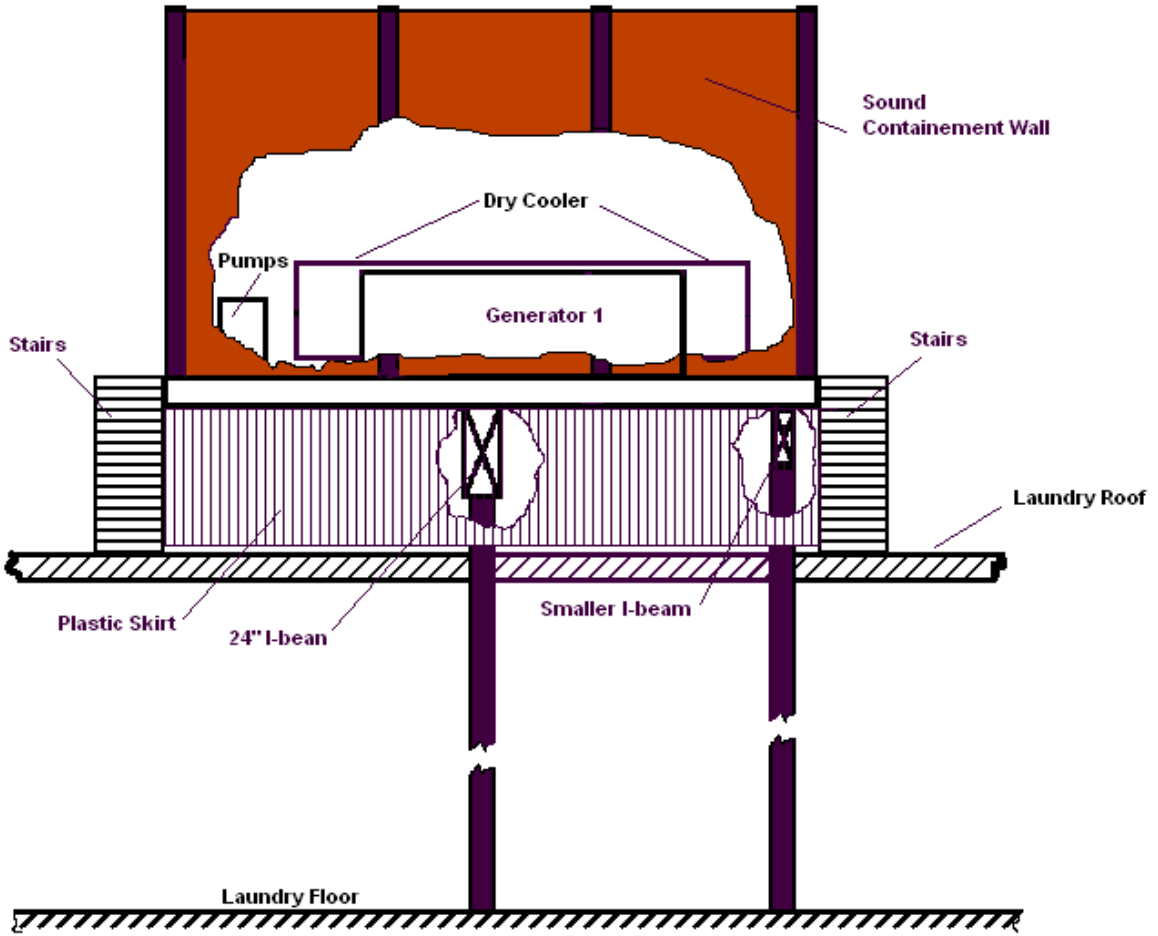
Daily Profile After Control Correction



CHP System Siting



CHP System Support Platform



CHP System on Roof

Total Installed Costs

Item	Cost
Generators, equipment installation	$508,000
Electrical	$320,000
Professional fees	$73,000
Miscellaneous construction costs	$120,000
Total installed costs	$1,021,000
Total installed costs, $/kW	$3,403
Non-typical costs	$316,000
Typical installed costs, $/kW	$2,350

12 Month Energy Profile

	W/O CHP November 2005 thru October 2006 (Calculated)	With CHP November 2005 thru October 2006 (Actual)
CHP System Average Electric Output, kW	n/a	197
Facility's Peak Demand, kW	378	378
Average Monthly Grid Demand, kW	257	60
Average Monthly Peak Demand Reduction, kW	n/a	120
Purchased power, kWh	1,250,658	369,200
CHP Generated Power, kWh	n/a	881,458
CHP Thermal Recovery, MMBtu/yr	n/a	5,780
Boiler Fuel, MMBtu/yr	47,899	40,675
CHP Fuel, MMBtu/yr	n/a	11,501

Operating Cost Savings

	W/O CHP November 2005 thru October 2006 (Calculated)	With CHP November 2005 thru October 2006 (Actual)
Fuel Costs		
CHP Natural Gas Cost	n/a	$127,507
Boiler Natural Gas Cost	$667,497	$567,670
Total Fuel Cost	*$667,497*	*$695,177*
Electricity Costs		
Electricity Commodity Cost	$182,131	$53,665
Electric Demand Cost	$49,806	$34,018
Miscellaneous Billing Charges	0	($12,710)
Total Purchased Electricity Cost	*$231,947*	*$74,973*
Incremental CHP O&M (based on $0.015/kWh)	*n/a*	*$13,222*
Total Costs	**$899,444**	**$783,372**
Annual Savings	n/a	$116,073

Simple Payback

	Costs
Total Installed Costs, $	$1,021,000
Total Installed Costs, $/kW	$3,403
Operating Savings (no incentives), $	$116,073
Simple Payback (no incentives), years	*8.8*
NYSERDA Capital Cost Incentive, $	$417,831
Net Installed Costs, $	$603,169
NYC Production Incentive, $/year	$47,726
Net Operating Savings (w/incentives), $	$163,799
Simple Payback (w/incentives), years	*3.7*

Success Factors

- Designer/Installer had experience with the equipment and with working in New York City
- System is designed to be highly efficient
- Full service maintenance contract
  - System has 98.9% operating availability
- Aggressively pursued incentives
- Internal champion

Energy and CO2 Impacts

Annual Emissions Analysis					
	CHP System	Displaced Electricity Production	Displaced Thermal Production	Emissions/Fuel Reduction	Percent Reduction
NOx (tons/year)	0.20	0.89	0.36	1.06	84%
SO2 (tons/year)	0.00	3.16	0.00	3.16	100%
CO2 (tons/year)	672	818	423	569	46%
Carbon (metric tons/year)	166	202	105	141	46%
Fuel Consumption (MMBtu/year)	11,484	10,347	7,231	6,094	35%
Equivalent Acres of Pine and Fir Forests				117	
Equivalent Passenger Vehicles				94	

This CHP project will reduce emissions of Carbon Dioxide (CO2) by 569 tons per year

This is equal to 141 metric tons of carbon equivalent (MTCE) per year

This reduction is equal to the annual carbon stored by 117 acres of pine and fir forests

OR

This reduction is equal to the carbon emissions of 94 passenger vehicles per year

Questions?

- Bruce Hedman
  ICF International
  Arlington, VA
  703-373-6632
  bhedman@icfi.com