HIGH ELECTRICAL EFFICIENCY MICROTURBINE ENGINE DRIVEN NATURAL GAS COGENERATION

AS APPLIED TO

MULTI-FAMILY BUILDINGS

Submitted by:

DSM Engineering Associates, PC
Energy Management & Research Associates
Ingersoll-Rand Power Systems
10 West 66th Street Corporation

APPLICATION OF THE INGERSOLL-RAND MICROTURBINE CHP EQUIPMENT

AT

10 WEST 66TH STREET

A HIGH RISE, ELECTRICALLY HEATED RESIDENTIAL COOPERATIVE APARTMENT BUILDING IN NEW YORK CITY

THE BUILDING IS LOCATED JUST A FEW YARDS FROM CENTRAL PARK WEST AND IS ONLY A BLOCK FROM LINCOLN CENTER

PROJECT DESCRIPTION

- For this project we chose to demonstrate the effectiveness of the highest efficiency Microturbine currently on the market, a unit manufactured by Ingersoll Rand Corporation, in a 256 unit high rise, electrically heated and cooled multi-family residential cooperative building in mid-town Manhattan. The recovered heat is to be utilized to provide heating of domestic water (DHW) for the building. To improve the potential for full, continuous recovery of the 70 kW in demand savings for the building a typical, low cost RP standby generator with an automatic transfer switch will be provided to activate and connect to isolated loads in the building whenever the microturbine unit is off line.

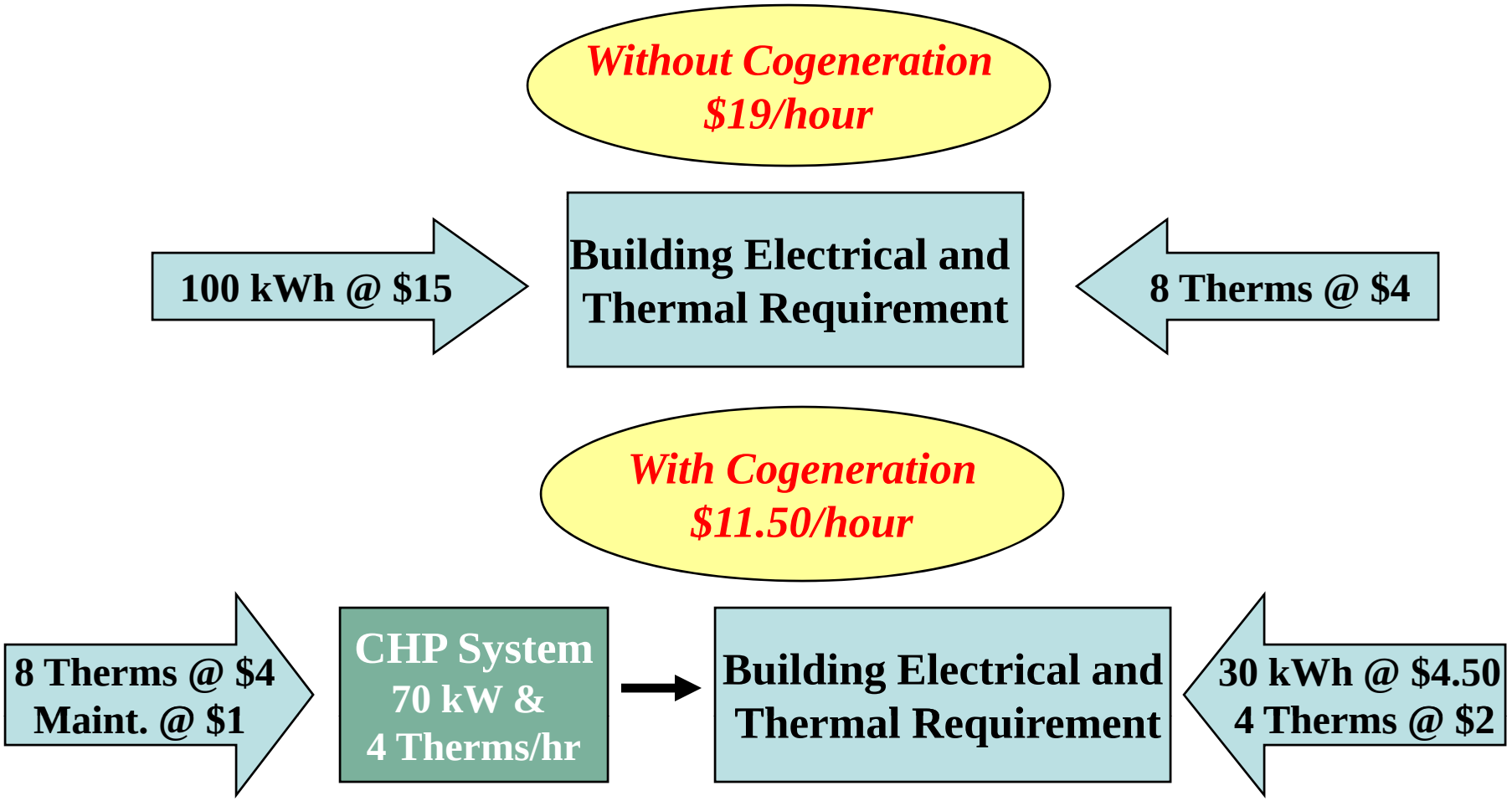
CHP ECONOMIC CONSIDERATIONS

- **As with any energy conservation project, the two most significant issues are dollars saved periodically and first cost. The amount of savings, for a CHP project, is a function of the following factors:**

- **Electric Rates for Energy and Demand**
- **Available Hours of Operation**
- **Demand Savings Achieved**
- **Fuel Cost**
- **Heat Recovered**
- **Maintenance Cost**

ILLUSTRATION OF TYPICAL SAVINGS WITH CHP

- **Cogeneration provides production of two or more forms of energy from a single fuel powered device.**



WHY USE CHP AT 10 WEST 66TH STREET?

- During the past 30 years many large residential buildings in NY State were encouraged (both by utilities looking to sell electricity and builders looking for lower cost construction) to be constructed with electric heating and cooling systems.

- Heating often comprises electric baseboard or packaged terminal air conditioners with electric heat or, at best, packaged terminal heat pumps with electric heat. These buildings have lower electric rate tariffs, for all their electricity, than fuel-heated equivalent structures.

- While the lower costs tend to discourage the application of electrical energy savings it doesn't alleviate the fact that these buildings consume far more energy, at the source, than their fuel heated counterparts.

10 West 66th Street is a typical example of an electrically heated and cooled residential building. They have been active for many years in trying to control energy costs by innovative conservation projects.

WHY MICROTURBINES?

- Over the past several years small turbomachinery driven generators have been under development. This Turbogenerator concept when fully developed appears to offer an advancement in the state of the art for small cogeneration and on-site power generation. Eventually, if the equipment cost factors quoted by the manufacturers, (equivalent to or lower than RP engines of the same capacity) prove to be correct and the maintenance in the field correlates to the predictions made by analyses, (considerably longer cycles between maintenance periods than those for RP engines) the ROI's could improve sufficiently to excite even more interest in CHP and considerably expand the market.

THE INGERSOLL- RAND 70LM MICROTURBINE

UNIT DIMENSIONS:
87.4” HIGH
42.6” WIDE
71.2” LONG
WEIGHT:
4100 lb.
SOUND LEVEL:
78 dBa @ 1 METER

INGERSOLL RAND POWERWORKS Model 70 kWe Microturbine Package.

Natural Gas Microturbine with Induction Type Electric Generator

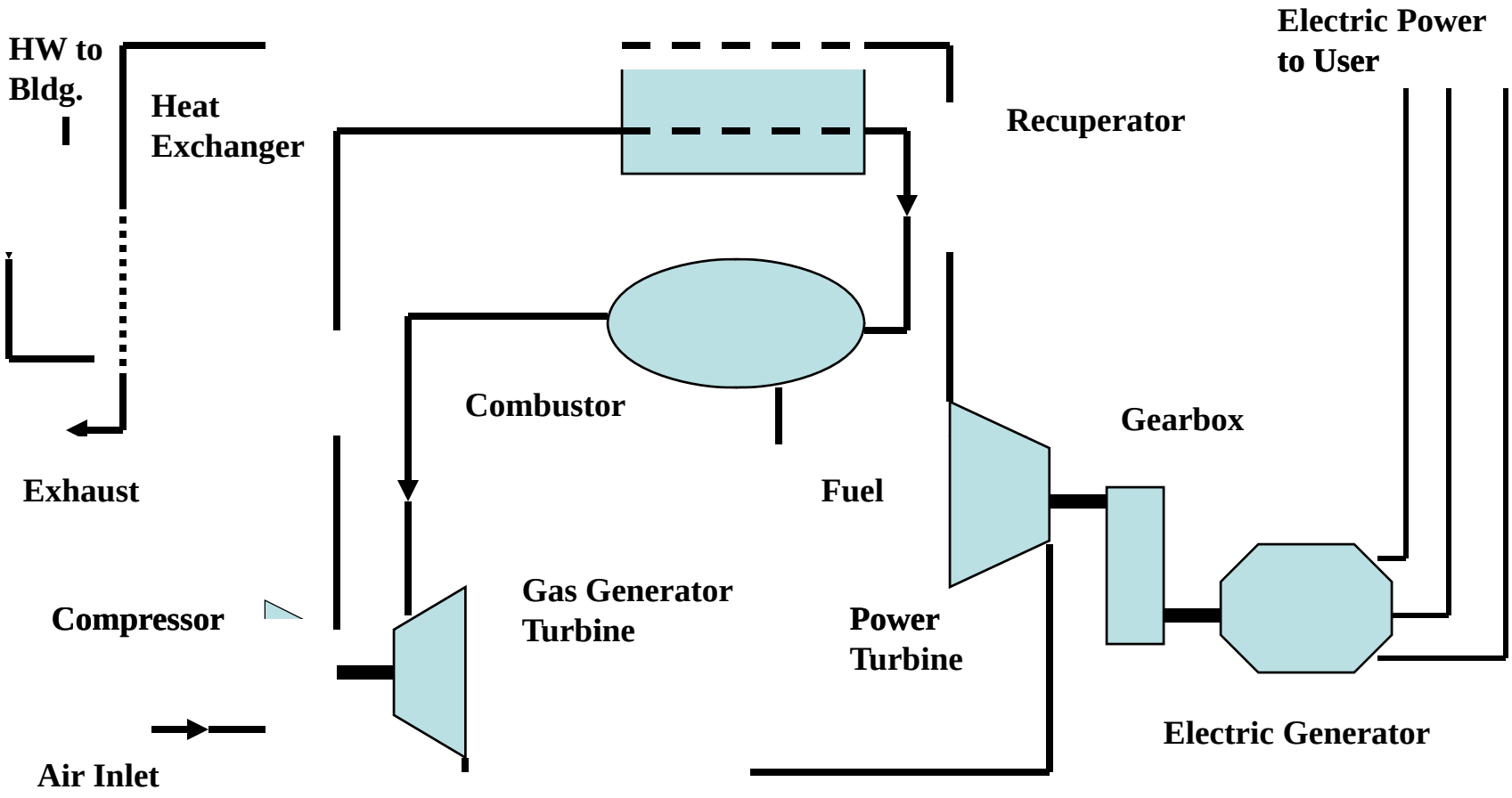
Fuel input of 7.96 Therms/Hr. provides 70 kW + 400,000 BTUH

Production cost, without installation is $75,000 and includes:

- ***a natural gas (or oil or other fuels) Microturbine engine running at 38000 RPM***
- ***engine speed and throttle controls to maintain electrical generation at 70 kW***
- ***440/480 volt, 3 phase 60 Hz, 3600 RPM Induction Generator***
- ***Gearbox to connect to generator, electrical switchgear and electronic controller***
- ***Recuperative heat exchanger to boost electrical efficiency to 30% (HHV)***
- ***Heat exchangers to extract heat from engine oil cooler and exhaust***
- ***Natural gas hermetic pressure booster compressor***

INGERSOLL RAND MICROTURBINE – BETA MODEL

THE INGERSOLL-RAND MICROTURBINE POWER CYCLE



RELATIVE ECONOMICS, MICROTURBINE AND RP ENGINE CHP EQUIPMENT

- ***MICROTURBINE***
- ELECTRIC SAVINGS $52,000
- THERMAL SAVINGS $16,500
- FUEL COSTS $33,250
- MAINTENANCE $ 6,000
- EQUIPMENT COST $122,500
- SIMPLE PAYBACK 4.2 YRS

- ***RECIPROCATING PISTON***
- ELECTRIC SAVINGS $47,500
- THERMAL SAVINGS $15,000
- FUEL COSTS $29,750
- MAINTENANCE $10,500
- EQUIPMENT COST $122,500
- SIMPLE PAYBACK 5.5 YRS

Based on Electric Cost of $0.09/kWh; No Demand Savings; Fuel Cost of $0.50/Therm; 85% Availability for RP Engines, 95% for Microturbines; Maintenance Costs of $0.02/kWh for RP Engines, $0.01 for Microturbines

RELATIVE ECONOMICS WITH THE ADDITION OF A STANDBY GENERATOR

- ***MICROTURBINE***
- ELECTRIC SAVINGS $52,000
- THERMAL SAVINGS $16,500
- DEMAND SAVINGS $21,000
- FUEL COSTS $33,250
- MAINTENANCE $ 6,000

- EQUIPMENT COST $165,000

- SIMPLE PAYBACK 3.3 YRS

- ***RECIPROCATING PISTON***
- ELECTRIC SAVINGS $47,500
- THERMAL SAVINGS $15,000
- DEMAND SAVINGS $21,000
- FUEL COSTS $29,750
- MAINTENANCE $10,500

- EQUIPMENT COST $165,000

- SIMPLE PAYBACK 3.8 YRS

Based on Electric Cost of $0.09/kWh; 100% Demand Savings @ $25/kW;
Fuel Cost of $0.50/Therm; 85% Availability for RP Engines, 95% for Microturbines;
Maintenance Costs of $0.02/kWh for RP Engines, $0.01 for Microturbines