U.S. Department of Energy
Energy Efficiency and Renewable Energy

federal energy management program

Case Study of Energy Project
GGNRA Park Headquarters
2002 – 2006

Fort Mason Building 201

Fort Mason Historic District

San Francisco, California

Background on FM201

BUILT:
1902
Masonry
12500 SF

ADDITIONS:
1918, 1939 and 1944
Wood Frame
Increasing to 36,000 SF

USE:
Initially a Post Hospital
Converted to office uses
early in its history.

Building Location - (E) Mech System

East Wing - Has an existing historic functional hot water radiator system consisting of a furnace (circa 1950), piping and cast iron radiators.

West Wing, floors 1 and 2 - Existing heating system is an electric resistance heating system.

West Wing, 3rd floor - Modern HVAC system using roof-mounted equipment and interior ducting.

View of 1930s-era boiler

Background on NREL Project

- Objective was to determine where energy efficiency improvements could be made, and to select improvements based on a life cycle cost analysis.
- A second objective was to determine whether on-site cogeneration would be economically and environmentally sound.
- First step in the energy analysis was an energy audit of building operation, operating schedules, types of lighting, mechanical equipment, potential for construction effects (no interruption of occupancy), and occupant comfort.

Figure 12: Building 201 Electric Consumption

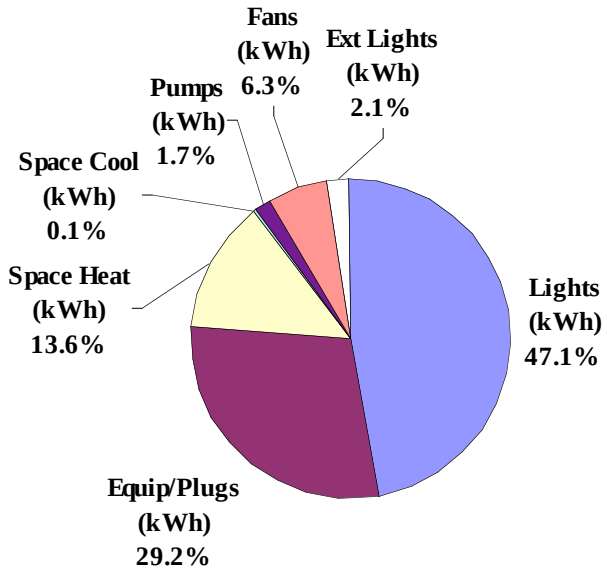


Table 10: Installed Cost and Simple Payback for each Recommended ECM

Gas

DOE-2 Simulations	Total Energy Savings kWh	Total Savings Therms	Building Demand Reduction kW	Total Installed Cost $	Total Energy Savings $	Simple Payback Years
Base	-	-	-	-	-	-
ECM-1: Wall Insulation	16,358	903	11.8	$29,095	$2,559	11.4
ECM-2: Floor Insulation	14,171	1,468	4.3	$6,773	$2,617	2.6
ECM-3: Attic Insulation	1,777	840	2.0	$7,500	$670	11.2
ECM-4: Window Caulking	19,363	2,387	20.6	$10,243	$3,815	2.7
ECM-5: Hydronic Expansion	46,198	(2,963)	30.9	$64,905	$4,216	15.4
ECM-6: Lighting Retrofit	61,584	(919)	10.4	$104,400	$7,505	13.9
ECM-7: Boiler Upgrade	3,921	3,035	0.0	$5,605	$2,146	2.6
ECM-8: Combination of ECM's	130,612	5,140	59.0	$228,520	$19,527	11.7

Initial Analysis of Cogen

- *Best configuration: One microturbine installed and use of thermal heat storage*
- Uses the waste heat by storing it in a hot water thermal storage tank. The exhaust from the microturbine could charge the water tank and store the hot water until needed the following day as dictated by the thermal load. The maximum amount of stored energy required is 1.1 MMBtu, which could be stored by a hot water tank of roughly 500 gallons of capacity. This option increases the annual savings in 200 MMBtu, which represents $1,220 per year.

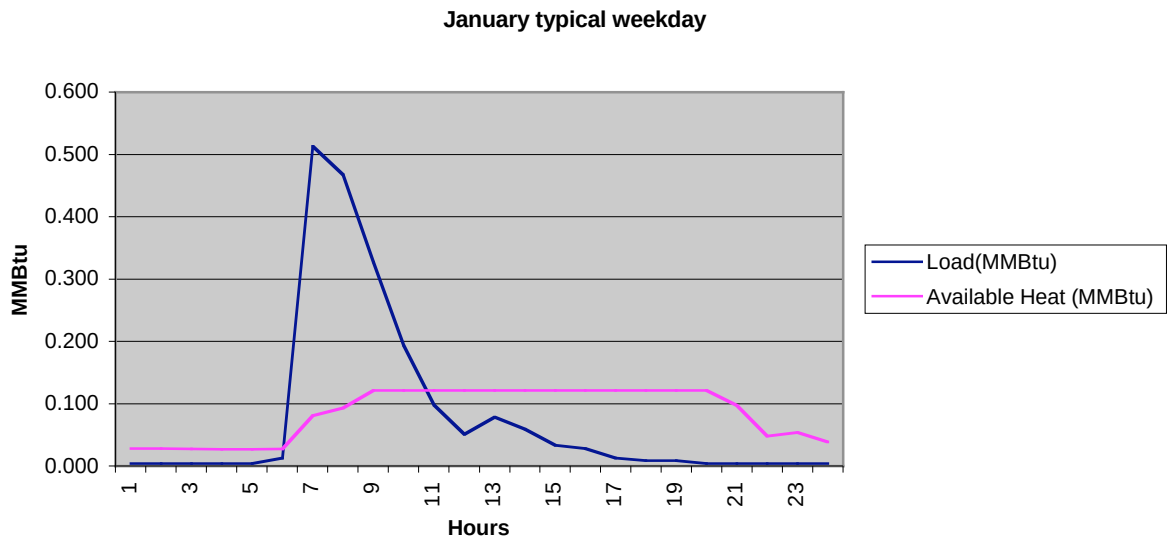


Figure 18. Electric and Gas Load Profiles for Building 201

Note asynchronization between the daily electric and thermal load profiles, which is reconciled by use of the hot water storage tank.

Fuller Analysis of Cogen

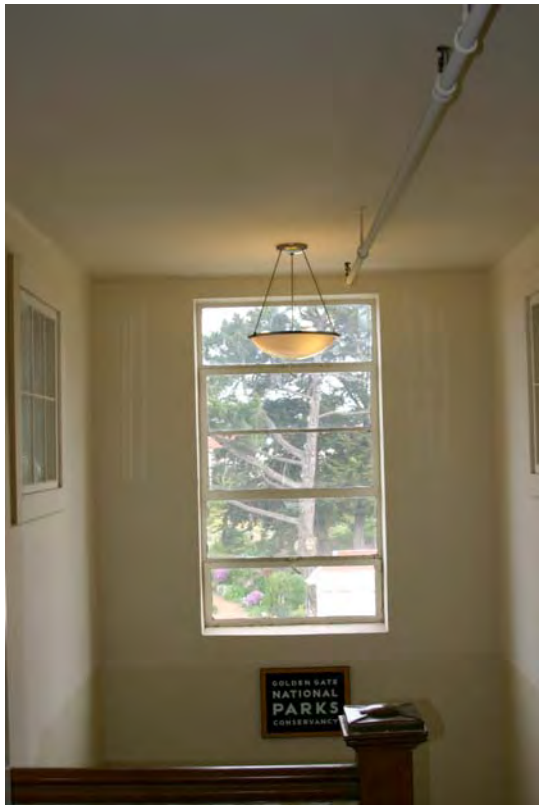
- Issues with exterior installation: noise and exhaust.
- Issues with construction cost for interior location; head height, construction access route, future seismic improvement of the building, etc.
- Complexity of the existing mechanical system resulting in added work to the distribution system in order to use the heat gathered by the Cogen system.
- Variance with most efficient program for Cogen systems.

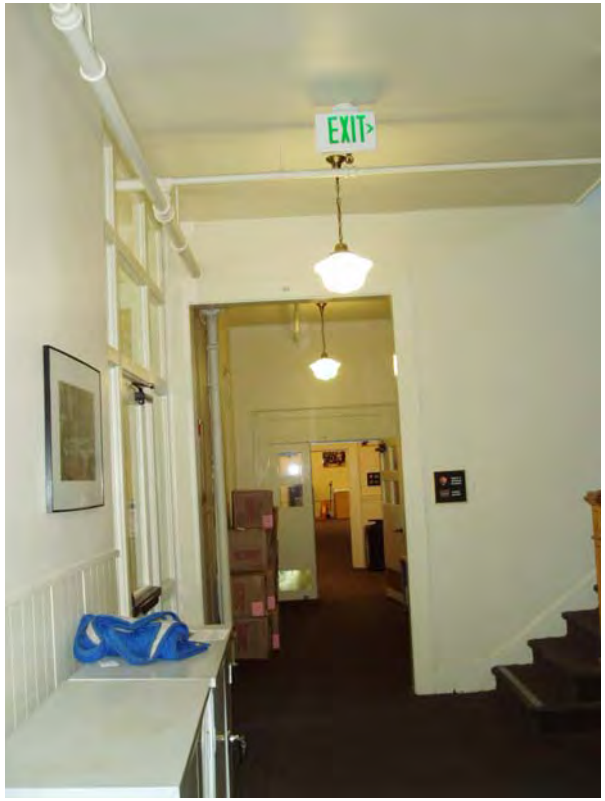
Implemented Program: Interior Ventilation & Lighting Improvements

- Project Construction Cost: $560,000
- Mech: Disabled (e) ductwork was rebuilt to provide code-complying air changes at interior spaces without access to windows. This reversed an unintended consequence of poorly informed facility management.
- Elect: Office and Meeting Room interior lighting replaced with new contemporary compatible 4-foot suspended fluorescent fixtures.
- Elect: Primary historic hall and stair lighting replaced with new period-replica energy efficient light fixtures, based on historic evidence.
- Elect: Multiple generations of early modern light fixtures removed.
- Results: Safety conditions improved by incorporation of modern battery pack back-up lighting systems.
- Results: Light quality and indoor air quality was enhanced.
- Results: Energy efficiency improvements realized through at 50% reduction in wattage used for lighting.

Lighting Before/After

Lighting Before/After





Wrap-up

- An effective improvement strategy was selected and implemented.
- Substantial effort expended by staff and contractors to evaluate the Cogen concept, which was ultimately abandoned in part due to unfavorable changes in the local utility energy buy-back rules.
- Ultimately, the project goals were limited by the dollars available for implementation.
- Mechanical system improvements were deferred due to issues of cost and complexity. For example, extension of the radiator system to the entire building would have cost in the range of $700,000 and
- Removal of inefficient light fixtures left some areas of the building inadequately heated. As an interim remedy, electric tempering coils were inserted at air intake ducts providing ventilation to interior rooms.
- AE team compliance with modern code standards would have resulted in overlighting of interior corridors: project was modified during construction to reduce fixtures in these areas with a favorable overall result.

Participants

- Andy Walker, NREL
- Jim Kren, GGNRA Project Manager
- Architectural Energy Corp, Energy Modeling
- RMH Group, Mechanical Engineers