

EXECUTIVE SUMMARY

This work attempts to provide the most financially responsible and technically accurate guidance possible to the building owner of a Class A Office building in the Chelsea neighborhood of Manhattan. We felt that the given information was extremely helpful yet not enough on its own to provide sound technical advice to our client. This analytical package deploys several alternative calculation methods to recommend or oppose a variety of Energy Conservation Measures (ECMs). These methods include Time of Use (TOU) energy cost estimates, Net Present Value (NPV) and Capital Investment financial analysis, alternative financing techniques (rebates, incentives, leasing structures) and market forecasting. As a result, we believe we have compiled a remarkable package of recommendations that will not only make financial, implementable and technical sense for the building owner but will also enhance the overall building value and tenant happiness.

CHALLENGE

Different stakeholders throughout the office building have different concerns regarding the implementation of the energy efficiency measures presented in the energy audit. The family trust that owns the building is concerned about costs, payback, construction interfering with the building's operations and any effect these improvements will have on the building's tenants. The retail tenants have expressed no desire in LEED and any interference into their spaces may affect their sales. These tenants also pay a fixed fee for the electricity so any savings that will come from a more efficient building would not lower their bottom line. On the other hand, the law firm leases 65% of the building and has expressed interest in LEED. Their lease expires shortly and their electric costs are passed through to them, meaning an efficient building will lower their monthly expenses.

METHODOLOGY

Building Calibration

The primary driving factors for our methodology are realism and analytical accuracy; keeping consistent with cost amounts, energy amounts and building scale were of the utmost importance. Our approach assumes that the building square footage (300,000), the site Energy Use Intensity (104 kBtu/sf-yr) and the end-use distributions (30% lighting, 19.5% steam boiler heating, etc.) from the competition package are all correct. Consequently, we found the total energy from the Energy Consumption By End Use chart be underestimated by 70% and as such adjusted these estimates by a multiplier of 3.39 for consistency. Once all of our baseline energy figures were consistent with a 300,000 SF building with an Energy Use Intensity of 104, we were able to calculate Time of Use (TOU) multipliers by end-use. Because ConEd charges different rates for using energy at different times of the day, TOU values are critical to understanding realistic cost implications of ECMs (rather than the blanketed \$.12 per kWh and \$1.25 per therm used in the energy audit). For example, though lighting and cooling both use electricity, cost of kWh per kBtu for each of these should be different because they have different daily usage profiles. Using eQUEST – the whole building energy modeling software – we were able to calibrate an energy model to the baseline energy figures mentioned above with a margin of error of less than five percent. eQUEST then allowed us to input custom TOU figures based on ConEd's actual billing

rates, which in turn allowed us to extrapolate TOU multipliers by end-use. The ECMs in Table A include both simple savings and annual TOU savings for comparison.

Financial Assumptions and Decision Criteria

To properly appeal to the family trust, we need to justify our final recommendations as financially beneficial. We examined the proposed and alternative ECMs over a 10-year period and found the net present value (NPV) using a 6.13% discount rate, the current capitalization rate in the NYC metro area.ⁱ An ECM with a positive NPV will be a better allocation of the owner's capital than making further real estate investments in New York City.

Similarly, the effects of obtaining LEED certification and changes to the rent structure were looked at conservatively, but in a way that would benefit the owner following the capital investment to upgrade the building's efficiency. While reports have been issued that suggest that LEED-certified buildings command a premium due to the cachet LEED brings to a building, we feel that the most appropriate way to justify an investment in LEED certification is with financial justification. To that effect, the USGBC reports that tenants in existing buildings that pursue LEED-EB certification will pay a 3% rent premium,ⁱⁱ but that only the law firm, which has an interest in LEED, will pay the rent premium.

Financially, we set out to capture the greatest return on investment for the building owner, utilizing available rebates and looking at the long-term increase in building value that the owner can capture if he proceeds with the ECMs we are recommending.

ENERGY CONSERVATION MEASURES

Amendments to Energy Audit

In addition to providing more realistic TOU cost savings for the 19 identified ECMs, the calibrated eQUEST model allowed us to evaluate supplementary ECMs with a high degree of confidence. Total energy savings, peak energy reductions, cost savings and EnergyStar ratings were also calculated using the calibrated model. Below are some of the key amendments made to the existing list of ECMs.

Thermal Energy Storage

A nine tank thermal energy storage system will help reduce peak cooling demand by nearly 3 MW throughout the year. Though the first cost for installing this system will be very expensive, a substantial NYSERDA rebate totaling 1.2M makes this ECM a great financial investment. ICE storage systems from CALMAC are readily available in Manhattan and easy to install; maintenance is minimal and cheap in comparison to a traditional chiller system

Hot Water Boiler

The existing hot water boiler ECM listed in the energy audit is not a cost effective ECM in either financial model: simple payback or NPV. We are recommending that this not be pursued or as a more cost-effective solution to consider indirect water heating, which is also more reliable and relatively maintenance free.

LED Retrofit

The energy audit figures show LED costs to be about \$100/fixture, where we found them to be more in the range of \$50/fixture. Of the total lighting, 83% are said to be incandescent lamps which we are proposing to replace with LED lamps, this reduces our overall installed watts/SF by more than half. Again this ECM is eligible for rebates from NYSERDA at \$.16/kWh saved, making this investment very worth-while.

Enhanced Daylighting

In an office environment – where lighting is almost always one of the largest energy costs – enhancing daylighting almost seems like a no-brainer. However, before actualizing electrical energy savings due to enhanced daylighting with technologies like interior light shelves, photosensors must be installed. At about \$100 per sensor, locating photosensors on the South, East and West facing lighting circuits of the building saves about \$50,000/year (before switching to LEDs and assuming 50% adjacency shading). This makes the simple payback less than a year and another sound investment.

Water Fixture Upgrades

The research into upgrading the water fixtures in the bathrooms and showers in the fitness center was initiated by the significant LEED credits that we could obtain for reducing water usage in the building. Additionally, the water rates have increased substantially in New York City over the last several years,ⁱⁱⁱ and we felt there was an opportunity for the owner to save money by making these upgrades to the building. Using a conservative annual increase of 3% in water rates, upgrading the bathroom fixtures has a payback period of 5 years.

Excluded ECMs

Through these methods (TOU savings, NPV, and a calibrated eQUEST model), we were able to evaluate many other ECMs that didn't make financial sense (Table A). Other ECMs that we analyzed but not recommend include: rooftop photovoltaics, a green roof, a green wall, a cool roof, exterior insulation & finish system (EIFS) and elevator upgrades. As a result of our analysis, we are also recommending that owner not consider CFL retrofits, nor the hot water boiler.

Available Rebates and Financing

There are various state and local utility rebates for reducing energy usage in existing facilities. The two main rebate sources are ConEd, the local utility, and NYSERDA, the New York State Energy Research and Development Authority. Rebates from these programs cannot be combined, but the NYSERDA does not provide rebates for steam usage.

For the electric-savings ECMs, we used the NYSERDA rebates due to their very favorable rebates for existing buildings that implement demand response systems. Our ICE Storage System qualifies us for this rebate, so even though the return on this specific measure has a negative net present value and 12-year payback period, it is a worthwhile investment. Demand response rebates are limited to 75% of the total project cost or a combination of \$.16/kWh saved and

\$600/kW for energy storage systems.^{iv} We would not be eligible for the additional \$200/kW for the demand response system. The total energy savings and rebate overview is shown below in Figure 1.

Table 1- NYSERDA Rebate Summary

		NYSERDA Rebate	Usage Rebate	Maximum Rebate
kWh Saved by ECMs	1,843,000	\$0.16/kWh	\$2,291,680	\$648,362
kW saved by Energy Storage	3,328	\$600/kW		
Total Cost of Electricity-Saving ECMs	\$864,482			
		TOTAL REBATE	\$648,362	

Proposed Leasing Structure

Currently, the retail tenants and law firm have different lease structures. The only opportunity to alter the terms of the leases is when tenants renew. Since we do not know the exact location of the building, we are assuming that current base rents are fair market value amounts. Both tenants are paying variations of modified gross leases. In order to reap the full benefits of the energy overhaul in the building, we propose switching the leases to a full service gross lease. While the owner will be able to see a larger profit margin on each tenant's rent due to a reduction in energy costs greater than 25%. With this leasing structure tenants will get a locked in rental rate without having to worry about escalations in the utility portion of their monthly bill.

LEED-EB Determination

LEED-EB Point Allocations

The majority of our points came from several credits- Alternative Transportation Credit (SSc4), Optimize Energy Efficiency Performance (EAcl) and Indoor Plumbing Fixture and Fitting Efficiency (WWc2). By showing that more than 75% of the buildings' occupants do not commute to work in a single-occupancy vehicle, we are able to get the maximum number of points in this category. In Manhattan, more than 88% of employees commute to work by some other method. We earned 14 points ENERGYSTAR by reaching a score of 88 for the building as discussed earlier in this paper. Lastly, by upgrading the water fixtures and obtaining water savings of over 80%, we are able to gain 5 credits as well as a regional priority credit for this measure.

Our other credits come either as a result of ECMs we are implementing, the fact that the building has undergone an energy audit or as a result to changes in the building management program that come at a minimal cost (such as green cleaning measures). We obtained enough credits to qualify for a LEED-Silver rating. Our LEED Checklist is attached in Appendix Table B.

Financial Reasoning in Obtaining LEED Certification

The costs for the LEED points we earned is covered under our determination of which ECMs to implement. Besides the costs to apply and obtain LEED certification, we see no additional costs to obtaining LEED. With the law firm paying a 3% rent premium for LEED (discussed earlier),

in 2015 the law firm will pay roughly \$2.50/sf more than their current lease. If their first year alone were to be discounted to a present value, their rental increase would result in nearly \$350,000, more than enough to pay for estimated LEED registration costs of \$50,000.

Additionally, many studies have shown that LEED-certified buildings increase dramatically in their value. We have not taken this increase into account since specific geographic information is unknown and the real estate market has seen a tumultuous few years, throwing into doubt the validity of some of this research.

Final ECM Recommendations & Phasing Schedule

	Energy Conservation Measure	Install Duration (Weekend days)	Contact
Cost ECMs	Replace OA Temperature/Humidity Sensor	2	Building Energy Management
	Insulate Hot Water Pipes	2	Gil-Bar Industries
	Timer On DHW Circulator Pump	2	Building Energy Management
	Optimal Start Stop Control	2	Building Energy Management
	Hot Water Temp. From 125F° to 120F°	1	Building Energy Management
	Fitness Center Occupancy Lighting Sensor	5	International Lights Incn/ Tirschwell & Co.
	Hot Water Heater Schedule Modification	1	Building Energy Management
	Occupancy Sensors in Rooms	5	Building Energy Management
	Turn Off Extra Lighting in Stairwell	1	Building Energy Management
	Modifications to Use Air Side Economizer	3	Building Energy Management
Capital Cost ECMs	Replace Filters w/ Higher Efficiency Models	4	Grainger Industrial Supply
	Supply Air Temp. Reset on Return/OA	1	Building Energy Management
	Enable Auto. Chilled Water Temp. Reset	1	Building Energy Management
	Replace CHW/CW Motors w/ Efficient Models	10	Grainger Industrial Supply
	VFD on CHW Pump and Variable Bypass	10	Grainger Industrial Supply
Additional	Thermal Energy Storage System	10 (winter)	Calmac Inc.
	Daylight Sensor Controlled Dimming	2	Building Energy Management
	Full Incandescent LED Replacement	20	International Lights Inc / Tirschwell & Co., Inc.
	Water Fixture Upgrades	15	Building Energy Management

FINANCIAL OVERVIEW OF CAPITAL INVESTMENT

Appendix Table C shows the value of the building before and after the implementation of ECMs. We have used a baseline vacancy rate of 2.7%.^vThe current electric surcharge amounts are adjusted for the alterations we made due to the results of our baseline building simulation. From the tables in the appendix, we have shown that the value of the building has increased by nearly \$10 million, roughly 4.2% in value after ECMs. This increase is as a result of turning the leases into gross leases and before any adjustments in the law firm's rental rates are accounted for.

CONCLUSIONS

The ECMs proposed by the Energy audit resulted in annualized estimated savings of \$37,653 with a simple payback period of 5.3 years. After detailed analysis, including rebates from various government bodies, a capital investment of \$1,265,143 would payback in less than a year (or in 2.45 years without rebates).

APPENDICES

Table A – Appendix A Revised

Energy Conservation Measure	Cost (\$)	Savings (kWh)	Savings (Therms)	Savings (\$/Year)	Simple Payback (Years)	Saving (\$/kWh/Year)	TOU Savings (\$/Year)	TOU Simple Payback (Years)	Maintenance (\$)	Other Cap. Cost. Year	Rebates	Net Present Value (NPV)	Recommended (Y/N)
Replace OA Temperature/Humidity Sensor	\$550	56,639	0	\$6,798	0.1	193,269	\$6,776	0.1	\$25	\$550	6	\$2,483.0	Y
Insulate Hot Water Pipes	\$80	508	28	\$96	0.8	4,333	\$21	3.8	\$0	\$0	-	884	Y
Timer On DHW Circulator Pump	\$150	2,440	0	\$294	0.5	8,236	\$56	2.7	\$0	\$0	-	293.2	Y
Optimal Start Stop Control	\$900	37,323	233	\$2,270	0.4	150,657	\$2,263	0.4	\$0	\$0	-	1,700.6	Y
H/W Water Temp. From 125°F to 120°F	\$10	0	24	\$25	0.4	2,400	\$5	2.1	\$0	\$0	-	21.7	Y
Fitness Center Occupancy Lighting Sensor	\$500	5,766	0	\$693	0.7	19,675	\$1,103	0.5	\$300	\$0	-	7,437.9	Y
H/W Water Heater Schedule Modification	\$0	0	31	\$32	0.0	3,100	\$6	0.0	\$0	\$0	-	48.2	Y
Occupancy Sensors in Rooms	\$40	2,323	0	\$304	0.1	8,609	\$484	0.1	\$20	\$0	-	3631.0	Y
Turn Off Extra Lighting in Stairwell	\$0	7,446	0	\$995	0.0	25,408	\$1,425	0.0	\$0	\$0	-	11,273.6	Y
Modifications to Use Air Side Economizer	\$0	68,253	0	\$819	0.0	232,200	\$816	0.0	\$0	\$0	-	6,459.1	Y
Replace Filters w/ Higher Efficiency Models	\$3,300	11,086	0	\$2,612	1.3	37,829	\$5,750	0.6	\$0	0	-	4,020.8	Y
Retrofit Lighting in Elevators to LED	\$1,800	6,377	0	\$767	2.3	21,760	\$1,221	1.5	\$0	\$0	-	7861.3	Y
Supply Air Temp. Reset on Return/OA	\$8,200	3,800	3,129	\$4,482	1.8	335,867	\$4,477	1.8	\$0	\$0	-	2,726.7	Y
Retrofit Lighting in Lobbies to CFL	\$6,480	16,617	0	\$1,995	3.2	56,702	\$3,176	2.0	\$0	\$0	-	1,866.5	Y
Enable Auto. Chilled Water Temp. Reset	\$2,400	29,386	0	\$3,550	0.7	100,356	\$6,179	0.4	\$0	\$0	-	46,488.0	Y
Replace CHW/CW Motors w/ Efficient Models	\$3,800	1,627	0	\$435	8.7	5,352	\$434	8.8	\$0	\$0	-	-369.3	Y
Fitness Center Lighting Retrofit (LED)	\$1,800	880	0	\$161	11.8	2,832	\$256	7.4	\$0	\$0	-	128.0	N
Steam Boiler to HW Boiler	\$156,000	0	6,200	\$9,349	16.7	620,000	\$2,365	59.6	\$0	\$0	-	\$15,000	N
VFD on CHW Pump and Variable Bypass	\$11,500	17,204	0	\$2,666	5.6	58,705	\$3,596	3.2	\$0	\$0	-	1,695.0	Y
Fitness Center Lighting Retrofit (CFL)	\$133	415	0	\$50	2.7	1,416	\$79	1.7	\$0	\$0	-	484.3	Y
Thermal Energy Storage System	\$300,000	763,121	0	-	-	2,603,998	\$24,500	12.2	\$0	\$500	every 2 years	-108073.1	Y
Elevator Efficiency Upgrade	\$360,000	13,074	0	-	-	44,612	\$3,335	108.0	\$0	\$0	-	-333613.3	N
Daylight Sensor Controlled Dimming	\$5,000	319,150	-1,900	-	-	899,036	\$81,404	0.1	\$200	\$0	-	63740.4	Y
Interior Light Shades (w/ Daylight Sensors)	\$45,000	36,298	-228	-	-	107,884	\$9,768	4.6	\$0	\$0	-	3,224.8	Y
Full Incandescent LED Replacement	\$778,500	1,092,800	-7,500	-	-	2,978,961	\$286,738	3.1	\$0	\$0	-	1,389,977.0	Y
Rooftop PV (64 kW)	\$256,000	78,488	0	-	-	267,654	\$10,371	24.7	\$1,000	\$0	-	-18,849.3	N
Rooftop PV (32 kW, 50% Shading)	\$128,000	39,219	0	-	-	133,827	\$5,186	24.7	\$500	\$0	-	-9094.6	N
Cool Roof	\$25,000	500	-100	-	-	-8,294	\$149	167.8	\$0	\$0	-	-2382.0	N
Green Roof	\$175,000	1,175	-235	-	-	-19,481	\$550	499.8	\$4,800	\$0	-	-2102.0	N
Water Fixture Upgrades	\$159,430	-	-	-	-	-	\$34,686	4.6	\$0	\$0	-	1,4634.9	Y
Total non-Water Utility Upgrades	\$1,265,143	1,988,000	-15,800			\$2,263,652	\$520,000	0.61				940,983.8	

Cost CEMS

Capital Cost CEMS

Additional CEMS

Table C.1 – Building Value

Vacancy Rate	2.70%				
Cap Rate	6.13%				
			Electric w/	Pass-Thru	
Tenant	Sq Ft	\$/sf	Surcharge	Expenses	Total Rent
Law Firm	195000	\$75.00	\$3.54	\$3.42	\$15,983,139
A	15000	\$65.00	\$4.75		\$1,046,250
B	15000	\$63.50	\$5.20		\$1,030,500
C	21000	\$66.50	\$5.00		\$1,501,500
D	24000	\$73.00	\$5.45		\$1,882,800
E	30000	\$73.00	\$5.20		\$2,346,000
TOTAL	300000				\$23,790,189
			Rent w/ vacancy		\$23,147,854
Operating Expenses					
Utilities		\$1,955,000			
Property Tax*	10.15%	\$3,974,508			
Mgmt Fee	3%	\$694,436			
Insurance	0.5%	\$2,289,469			
Misc. (non pass-thru)	(\$.50/sf)	\$150,000			
Water		\$50,000			
Sum Expenses		\$9,113,412			
NOI		\$14,034,442			
Bldg Value		\$228,946,851			

*The property tax is assessed as 10.15% of Fair Market Value. In 2010, the average assessed value for Class A office buildings in Manhattan was \$290/sf. We are using that value to determine the overall fair market value of the building.

Table C.2

Vacancy Rate	2.16%	(LEED buildings on average have	
Cap Rate	6.13%	20% lower vacancy)	
Tenant	Sq Ft	\$/sf	Total Rent
Law Firm	195000	\$82.00	\$15,990,000
A	15000	\$69.75	\$1,046,250
B	15000	\$68.70	\$1,030,500
C	21000	\$71.50	\$1,501,500
D	24000	\$78.45	\$1,882,800
E	30000	\$78.20	\$2,346,000
TOTAL	300000		\$23,797,050
		Rent w/ vacancy	\$23,283,034
Operating Expenses			
Utilities		\$1,434,660	
Property Tax	10.15%	\$3,974,508	
Mgmt Fee	3%	\$698,491	
Insurance	0.5%	\$2,385,046	
Misc. (non pass-thru)	(\$.50/sf)	\$150,000	
Water		\$20,000	
Sum Expenses		\$8,662,705	
NOI		\$14,620,329	
Bldg Value		\$238,504,554	

ⁱ<http://www.rcanalytics.com/Public/data.aspx>

ⁱⁱ<http://www.ucei.berkeley.edu/PDF/seminar20090130.pdf>, page 28

ⁱⁱⁱhttp://www.nyc.gov/html/nycwaterboard/html/rate_schedule/index.shtml

^{iv}<http://www.nysersda.ny.gov/Page-Sections/Commercial-and-Industrial/Programs/Existing-Facilities-Program/Performance-Based-Incentives.aspx>

^v<http://www.nyc-officespace-leader.com/chelsea>