Engineering
Architecture
Environmental

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October 31, 2009

Reinhard Gsellmeier, P.E.
Monroe County Department of Environmental Services
7100 City Place
50 West Main Street
Rochester, New York 14614

Re: Monroe County Crime Lab – LEED Summary Report
Construction Document Phase

Dear Mr. Gsellmeier:

In compliance with the Monroe County's Green Building Policy, dated August 14, 2007 and the Green Building Project Implementation Guide, dated July 2, 2008, this letter is to summarize the process and decisions made for the Monroe County Crime Lab project's pursuit of the Leadership in Energy & Environmental Design (LEED) Platinum Certification through the construction document phase.

The Monroe County Public Safety Laboratory - Crime Lab serves an eight county area (Monroe, Genesee, Livingston, Ontario, Seneca, Wayne, Wyoming, Yates). The laboratory provides analytical and physical examination of a wide variety of material to be used as evidence in criminal cases, including all controlled drugs seized in the region. Testing and analysis done by the lab is divided in to the following areas: Biology, Criminalistics, Drug and Chemistry, Firearms, and Fire Debris. Today the lab is cramped into a 19,000-square-foot building that dates from 1963. The new crime lab will be four stories tall and 45,000 square feet. It will be at the southeast corner of Plymouth Avenue and Broad Street next to the Civic Center Complex, in what is now a parking lot. The design maintains parking, adds a secure garage and a driveway meant to improve traffic flow. School Alley, which runs parallel to Fitzhugh Street and South Plymouth Avenue, will be abandoned and added to the site.

In June 2007, Monroe County Executive Maggie Brooks announced that every county building project will pursue an environmentally friendly design in accordance with the rating system known as the Leadership in Energy and Environmental Design (LEED) developed by the U.S. Green Building Council (USGBC). The LEED Green Building Rating System™ encourages sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. LEED certification is a third-party validation of a building's performance. LEED certified projects blend environmental, economic, and occupant-oriented performance. They cost less to operate and maintain; are energy and water efficient, and are healthier and safer for occupants, demonstrating the values of the organizations that own and occupy them.

Monroe County is pursuing certification under the LEED for New Construction V2.2 rating system. The LEED Green Building Rating System™ is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings' performance. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.

Following is a brief description and benefits of the categories and LEED measures that will be incorporated into the project.

Sustainable Sites

The LEED Sustainable Sites credits for New Construction, promote responsible, innovative, and practical site design strategies that are sensitive to plants, wildlife, and water and air quality. These credits also mitigate some of the negative effects buildings have on the local and regional environment.

Selecting and Developing the Site Wisely

Credit 1 - Site Selection
Credit 3 - Brownfield Redevelopment
Buildings affect ecosystems in a variety of ways. Development of a greenfield, or previously undeveloped site, consumes land, compromises existing wildlife habitat, and exacerbates local and regional erosion . This project site selected was a previously developed site and somewhat environmentally damaged that will be remediated. This reduces pressure on undeveloped land since the site has already been disturbed, damage to the environment is limited and sensitive land areas can be preserved. In addition, the remediation / restoration of the site will enhance the health of the surrounding community.

Reducing Emissions Associated with Transportation

Credit 2 - Development Density
Credit 4.1 - Alternative Transportation – Public Transportation Access
Credit 4.2 - Alternative Transportation – Bicycle Storage & Changing Rooms
Credit 4.3 - Alternative Transportation – Low Emitting and Fuel Efficient Vehicles
Environmental concerns related to buildings include vehicle emissions and the need for vehicle infrastructure as building occupants travel to and from the site. Emissions contribute to climate change, smog, acid rain, and other air quality problems. Parking areas, roadways, and building surfaces increase stormwater runoff and contribute to the urban heat island effect. The urban project site chosen is will provide the building occupants pedestrian access to a variety of services located within a half mile of the building. To further promote reduction of emissions, the project is providing occupants with bicycle racks, changing facilities, preferred parking for low emitting and fuel efficient vehicles, and access to mass transit to encourage use of alternative forms of transportation. Promoting mass transit reduces the energy required for transportation as well as the space needed for parking lots,

Managing Stormwater Runoff

Credit 6.1 - Stormwater Management – Quality Control
Credit 6.2 - Stormwater Management – Quantity Control
As areas are developed and urbanized, surface permeability is reduced, which in turn increases the runoff transported via pipes and sewers to streams, rivers, lakes, bays, and oceans. Also this increased the need for addition infrastructure and taxes local governments. Impervious surfaces on the site may cause stormwater runoff that harms water quality, aquatic life, and recreation opportunities in receiving waters. Runoff also accelerates the flow rate of waterways, increasing erosion, altering aquatic habitat, and causing erosion downstream. This project has implemented effective strategies such as pervious concrete pavement to control, reduce, and treat stormwater runoff before it leaves the project site and recharge local aquifers; rain gardens which also reduce and treat stormwater runoff, in addition to enhancing sidewalk appeal; rainwater harvesting which also reduces the amount of stormwater runoff, and lessens the demand on the municipal water supply.

Reducing the Heat Island Effect

Credit 7.1 - Heat Island Effect – Roof
Credit 7.2 - Heat Island Effect – Non Roof
The use of dark, nonreflective surfaces for parking areas, roofs, walkways, and other surfaces contribute to the heat island effect. These surfaces absorb incoming solar radiation and radiate that

heat to the surrounding areas, increasing the ambient temperature. In addition this increase raises the building's external and internal temperature, requiring more energy for cooling in the summer months. The project is incorporating a white roof, and light colored concrete surfaces around the building to minimize the heat island affect create by the building on the local community. In addition, the installation of reflective surfaces and vegetation, the project will benefit in reduced cooling energy.

Eliminating Light Pollution

Credit 8 - Light Pollution Reduction
Poorly designed exterior lighting may add to nighttime light pollution, which can interfere with nocturnal ecology, reduce observation of night skies, cause roadway glare, and hurt relationships with neighbors by causing light trespass. This project has employed strategies, such as full cut off luminaries, flagpole downlighting that reduce light pollution that causes less disruption to birds' migratory patterns and also reduce infrastructure costs and energy use over the life of the building.

Water Efficiency

The Water Efficiency prerequisites and credits address environmental concerns relating to building water use and disposal and promote the following measures:

Reducing Indoor Potable Water Consumption
Credit 2 - Innovative Wastewater Technologies
Exemplary Performance – over 40% water use reduction
The project has employed measures to reduce indoor potable water consumption such as:

- water-efficient fixtures – toilets, faucets, showers
- electronic controls
- rainwater harvesting

Lowering potable water use for toilets, showerheads, faucets, and other fixtures will reduce the total amount withdrawn from natural water bodies. Savings associated with water efficiency result in reduced energy costs, by reducing the amount of water that must be treated, heated, cooled, and distributed.

Practicing Water-Efficient Landscaping
Credit 1.1, 1.2 - Water Efficient Landscaping
The project team has selected native plants for the building site to foster a self-sustaining landscape that will require minimal supplemental water. Native plants require less water for irrigation and tend to require less fertilizer and pesticides, avoiding water quality degradation and other negative environmental impacts.

Energy Performance

The energy performance of a building depends on its design. Its massing and orientation, materials, construction methods, building envelope, and water efficiency as well as the heating, ventilating, and air-conditioning (HVAC) and lighting systems determine how efficiently the building uses energy. The project team implemented an integrated whole building approach to optimize energy efficiency. Collaboration among all team members, from the beginning of the project was implemented to design the building systems.

Tracking Building Energy Performance—Designing, Commissioning, Monitoring

Prerequisite 1 - Fundamental Commissiong
Credit 1 - Optimize Energy Efficiency
Credit 3 - Enhanced Commissioning
Projects that achieve any level of LEED certification must at a minimum perform better than the average building. This building is projected to perform over 32% better than a New York State Energy Conservation Construction Code building. A summary of the design features that will reduce energy requirements are:

- High-efficiency air-cooled chiller.
- High-efficiency natural gas-fired condensing boilers.
- Variable flow/speed chilled and hot water pumping systems.
- Exhaust air energy recovery on laboratory supply and exhaust system.
- Laboratory occupancy sensor reset of exhaust and supply airflow requirements.
- Enthalpy economizer controls for AHU-1.
- Improved levels of building envelope insulation over the prescriptive requirements of ASHRAE Standard 90.1-2004.
- High-performance/reduced SHGC window glazing.
- EnergyStar® compliant high albedo roof.
- High-efficiency lighting and controls with lighting power density lower than the maximum ASHRAE Standard 90.1-2004 prescriptive limit.
- Automatic daylighting controls.
- Premium-efficiency motors that meet NYSERDA minimum prescriptive requirements.

As the building was designed to operate at a high performance level, commissioning was integrated to ensure that what will be constructed meets the design intent and will be operating efficiently. Commissioning began with the development of the owner's project requirements, followed by additional steps that included creation of a formal commissioning plan, and will employ verification of equipment installation. In addition, Enhanced commissioning which includes additional tasks, such as design and contractor submittal reviews, creation of a formal systems manual, verification of staff training, and a follow-up review before the warranty period ends will also be employed. Commissioning optimizes energy and water efficiency by ensuring that systems are operating as intended, thereby reducing the environmental impacts associated with energy and water usage. Additionally, commissioning can help ensure that indoor environmental quality is properly maintained. Properly executed commissioning can substantially reduce costs for maintenance, repairs, and resource consumption, and higher indoor environmental quality can enhance occupants' productivity. Monitoring the performance of building systems has also been considered by establishing a measurement and verification plan based on the best practices developed by the International Performance Measurement and Verification Protocol (IPMVP). The plan must cover at least one year of Post-construction occupancy. This will ensure the long-term performance of the building's energy systems.

Managing Refrigerants to Eliminate CFCs

Prerequisite 3 -Fundamental Refrigerant Management
Credit 4 Enhanced Refrigerant Management

The release of chlorofluorocarbons (CFCs) from refrigeration equipment destroys ozone molecules in the stratosphere through a catalytic process and harms the Earth's natural shield from incoming ultraviolet radiation. CFCs in the stratosphere also absorb infrared radiation and create chlorine, a potent greenhouse gas. Care has been taken to incorporate equipment in the project that contains no CFC's.

Using Renewable Energy

Credit 2.1 - Renewable Energy – 2.5%
Credit 6 - Green Power
The project team had two opportunities to integrate renewable energy strategies into the project: using on-site renewable energy systems and buying off-site green power. The project integrated 2.5% of the building's annual energy cost into on-site electrical (photovoltaic,) power. An additional credit will be received for purchasing 35% of the buildings' predicted electricity usage from off-site renewable green power by contracting for a purchase of renewable energy certificates (REC's) from a wind energy supplier. Energy generation from renewable sources—such as solar, wind,—avoids air and water pollution and other environmental consequences associated with producing and consuming fossil and nuclear fuels. Renewable energy minimizes acid rain, smog, climate change, and human health problems resulting from air contaminants.

Materials & Resources

Building operations generate a large amount of waste on a daily basis. Meeting the LEED Materials and Resources credits can reduce the quantity of waste while improving the building environment through responsible waste management and materials selection. The credits in this section focus on 2 main issues: the environmental impact of materials brought into the project building and the minimization of landfill and incinerator disposal for materials that leave the project building.

Construction Waste

Credit 2.1 & 2.2 Construction Waste Management – 50% , 75%
Construction and demolition wastes constitute about 40% of the total solid waste stream in the United States. These credits address the extent to which waste material leaving the site is diverted from landfills. The percentage represents the amount diverted through recycling and salvage divided by the total waste generated. The project team has incorporated waste reduction strategies into the project specifications to divert 75% of the waste generated during construction from landfills. Types of waste to be diverted are: wood (palettes, plywood, OSB), concrete, ashaplt, granite curbs & walks, concrete masonry units, metals, drywall, insulation, carpet, glass, plastics, paper, and cardboard.

Recycling

Prerequiste 1 - Storage & Collection of Recyclables
Credit 4.1, 4.2 - Recycled Content – 20%, 30%
Exemplary Performance – Materials with recycled content over 40%
Materials selection plays a significant role in sustainable building operations. During the life cycle of a material, its extraction, processing, transportation, use, and disposal can have negative health and environmental consequences, polluting water and air, destroying native habitats, and depleting natural resources. Environmentally responsible procurement policies can significantly reduce these impacts. The project team has incorporated the purchase of products for over 40% of the cost of building materials containing post and pre-consumer recycled content. This selection expands markets for recycled materials, slows the consumption of raw materials, and reduces the amount of waste entering landfills. Materials incorporated with recycled content include: steel, glass, non-structural metal framing, drywall, concrete, lockers, acoustic ceiling tile, ceramic tile, hardware, aluminum entrance and storefronts, metal doors and frames, roofing, flashing and column covers, to name a few. To further facilitate the reduction of waste generated by the building occupants, the project team has integrated accessible areas on each floor dedicated to the collection and storage of non-hazardous materials for recycling, including paper, corrugated cardboard, glass, plastics and metals.

Material Selections

Credit 5.1, 5.2 Regional Materials – 10%, 20%
Credit 6 Rapidly Renewable Materials
Credit 7 Certified Wood
The project team considered the relative environmental, social and health benefits of available material choices when specifying materials for the project. Thirty percent of the cost of building materials were specified as regional – materials from local sources (extracted, harvested and manufactured within 500 miles of the project site) that will support the local economy while reducing transportation impacts. These materials consist of: cast in place concrete, concrete reinforcement, thermal insulation, steel deck and joists, concrete masonry units and calcium silicate masonry units, and fireproofing to name a few. Two and a half percent of the costs of materials were specified as rapidly renewable (materials made from plants that are typically harvested within a ten-year cycle or shorter). This strategy reduces the use and depletion of finite raw materials and long-cycle renewable materials by replacing them with rapidly renewable materials. These materials consist of: agrifiber doors, acoustical ceiling tile. Linoleum sheet flooring, resilient tile flooring, broadloom carpet and linen wall coverings. The project team also

incorporated the use of third-party certified wood for 50% of the wood products permanently incorporated into the building to improve the stewardship of forests and related ecosystems.

Indoor Environmental Quality

This credit category addresses environmental concerns relating to indoor environmental quality; occupants' health, safety, and comfort; energy consumption; air change effectiveness; and air contaminant management. The following are strategies for addressing these concerns and improving indoor environmental quality:

Improving Ventilation

Credit 1 - Outdoor Air Delivery Monitoring
Credit 2 - Increased Ventilation
Actions that affect employee attendance and productivity will affect an organization's bottom line. The project team has specified building systems that will provide a high level of indoor air quality. Increased ventilation in buildings may require additional energy use, but the need for additional energy has been be mitigated by using heat-recovery ventilation and/or economizing strategies. The indoor air quality design also takes advantage of regional climate characteristics to reduce energy costs, such as, using exhaust air to heat or cool the incoming air to significantly reduce energy use and operating costs. Demand controlled ventilation is also incorporated to reduce energy use in multi-occupant spaces.

Managing Air Contaminants

Prerequisite 1 - Environmental Tobacco & Smoke Control
Credit 3.1 - Construction Indoor Air Quality – During Construction
Credit 3.2 - Construction Indoor Air Quality – Before Occupancy
Credit 4.1 - Low Emitting Materials –Adhesives & Sealants
Credit 4.2 - Low Emitting Materials – Paints & Coatings
Credit 4.3 - Low Emitting Materials – Composite Wood & Agrifiber Products
Credit 4.4 - Low Emitting Materials – Carpet Systems
Credit 5 - Indoor Chemical & Pollutant Source Control
Protecting indoor environments from contaminants is essential for maintaining a healthy space for building occupants. Several indoor air contaminants should be reduced to optimize tenants' comfort and health. There are 3 basic contaminants:
Environmental tobacco smoke (ETS), or secondhand smoke, is both the smoke given off by ignited tobacco products and the smoke exhaled by smokers. Smoking will be prohibited in the building and 25 feet from any building entrance. Carbon dioxide (CO_2) concentrations will be measured to determine and maintain adequate outdoor air ventilation rates in buildings. CO_2 concentrations are an indicator of air change effectiveness. Elevated levels suggest inadequate ventilation and possible buildup of indoor air pollutants. CO_2 levels will be measured to validate indications that ventilation rates need to be adjusted. Particulate matter in the air degrades the indoor environment. Airborne particles in indoor environments include lint, dirt, carpet fibers, dust, dust mites, mold, bacteria, pollen, and animal dander. These particles can exacerbate respiratory problems such as allergies, asthma, emphysema, and chronic lung disease. Air filtration incorporated into the building systems will reduce the exposure of building occupants to these airborne contaminants by uing high-efficiency filters. Measures have been incorporated into the specification to Protect air handling systems during construction and flushing the building before occupancy further reduce the potential for problems to arise once the building is occupied. Preventing indoor environmental quality problems is generally much more effective and less expensive than identifying and solving them after they occur. The project team has specified materials that release fewer and less harmful chemical compounds. Adhesives, paints, carpets, composite wood products with low levels of potentially irritating off-gassing will reduce occupants' exposure and harm. Appropriate scheduling of deliveries and sequencing of construction activities has been incorporated to reduce material exposure to moisture and absorption of off-gassed contaminants.
The project team worked with building occupants to assess their needs to help improve building efficiencies. They provided individual lighting controls and area thermostats to improve occupants'

comfort and productivity and save energy. Individual controls enable occupants to set light levels appropriate to tasks, time of day, personal preferences, and individual variations in visual acuity.

Innovation in Design

The purpose of this category is to recognize projects for innovative building features and sustainable building knowledge. The project team will incorporate a display into the building façade educating the community about the sustainable design features in the building. The County will also prepare a case study and broadcast it on their website for the same purpose. The County will also devise and implement a green housekeeping program for the building, using environmentally friendly chemicals for cleaning and maintaining the indoor work environment.

The following appendices include

1. Appendix A: Life cycle cost analyses calculated for the project
2. Appendix B: LEED scorecard summarizing each LEED measure and identifying the added consultant design fees, added construction costs and life cycle savings for the measure.
3. Appendix C: NYSERDA Technical Assistance Report

If you should have any questions or require additional information, please do not hesitate to contact myself or Tammy Schickler.

Respectfully Submitted,

Mark Kukuvka, AIA
Project Manager

Tammy Schickler, LEED AP
Principal
Sustainable Performance Consulting, Inc.

Appendix A:

Life Cycle Cost Analysis
- Geothermal
- Photovoltaic
- Solar Tube
- Pervious Pavement

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LIFE CYCLE COST EVALUATION

Project Name:	Monroe County Crime Lab	
Project Number:	050246	
Calculated by:	Brian Danker	Date: 11/4/2008

Base System:	Building without geothermal system - boilers and chiller used to provide the building heating and cooling.
Evaluated System:	Building with geothermal system - a well field, piping, heat pumps to provide the building heating and cooling.
Description:	Geothermal wells with 160 well feet per ton, wells spaced 20' apart and 90 wells total.

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	3	%
Natural Gas:	3	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$492,000	
Annual Maintenance Cost:	$0		$0	
Expected Life:	30	years	30	years
System Replacement % to Initial:	50	%	25	%
Annual Energy Usage:				
Electric:	806,948	kWH/year	775,523	kWH/year
Natural Gas:	24,205	Therm/year	13,516	Therm/year
Total Net Present Cost:	$2,090,543		$2,333,304	

Evaluated System Simple Payback: 31.9 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.
4. The maintenance costs are very similar between the base and geothermal systems so is left at $0.
5. The energy usage is from the energy model performed by SAIC as part of the NYSERDA work.
6. Refer to the attached information for cost backup.

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Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	6	%
Natural Gas:	6	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$492,000	
Annual Maintenance Cost:	$0		$0	
Expected Life:	30	years	30	years
System Replacement % to Initial:	50	%	25	%
Annual Energy Usage:				
Electric:	806,948	kWH/year	775,523	kWH/year
Natural Gas:	24,205	Therm/year	13,516	Therm/year
Total Net Present Cost:	$3,043,681		$3,150,890	

Evaluated System Simple Payback: 31.9 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
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3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.
4. The maintenance costs are very similar between the base and geothermal systems so is left at $0.
5. The energy usage is from the energy model performed by SAIC as part of the NYSERDA work.
6. Refer to the attached information for cost backup.

GEOTHERMAL - PRELIMINARY ANALYSIS

Initial Assumptions

- 160 to 200 well feet per ton
- Wells spaced 20 feet apart for optimum heat transfer
- Drilling Costs $12 - $15 per bore foot for well/pipe/cirout
- 180 Ton building load
- NYSERDA Reabate: $600/Ton capped @ $200K.

Well Field Costs

- Low: (90 Wells) (320 ft.) ($12/bore ft.) = $345,600
- High: (90 Wells) (400 ft.) ($15/bore ft.) = $540,000

Use $450,000 for the average.

Project Budget

• Well Field Cost:	$450,000
• Manhole & Horizontal Piping:	$75,000
• HVAC System Premium ($,500,000 @ 5% Premium):	$75,000
	$600,000
• NYSERDA Rebate; (180 Tons) ($600/Ton)	<$108,000>
	$492,000

Operational Cost Savings

• DA #1:	VAV w/ Glycol Heat Recovery (HR)	$115,687/yr
• DA #2:	Geothermal w/ Glycol HR	$96,484/yr
• DA #3:	VAV w/ Enthalpy HR	$108,530/yr
• DA #4:	Geothermal w/ Enthalpy HR	$93,096/yr

Simple Payback

- $492,000/yr ÷ $15,434/yr = 31.8 years

Roberts Wesleyan College

- 50 wells @ 344 ft. = 17,200 bore feet
- Building 43,000 SF @ 106 Tons (162 bore feet per Ton)

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LIFE CYCLE COST EVALUATION

Project Name:	Monroe County Crime Lab	
Project Number:	050246	
Calculated by:	Brian Danker	Date: 10/22/2008
Base System:	Building without PV system.	
Evaluated System:	Building with PV system.	
Description:	PV system is 20kW and no NYSERDA $.	

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	6	%
Natural Gas:	6	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$180,000	
Annual Maintenance Cost:	$0		$200	
Expected Life:		years	25	years
System Replacement % to Initial:	100	%	75	%
Annual Energy Usage:				
Electric:	20,000	kWH/year	0	kWH/year
Natural Gas:		Therm/year	0	Therm/year
Total Net Present Cost:	$56,089		$247,964	

Evaluated System Simple Payback: 90.1 yrs

Calculation Information:

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3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.
4. The first cost ($9kW) and yearly generation capability was obtained from Rochester Solar Technologies.

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Project Number:	050246	
Calculated by:	Brian Danker	Date: 10/22/2008
Base System:	Building without PV system.	
Evaluated System:	Building with PV system.	
Description:	PV system is 20kW and $90,000 from NYSERDA.	

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	3	%
Natural Gas:	3	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$90,000	
Annual Maintenance Cost:	$0		$200	
Expected Life:		years	25	years
System Replacement % to Initial:	100	%	75	%
Annual Energy Usage:				
Electric:	20,000	kWH/year	0	kWH/year
Natural Gas:		Therm/year	0	Therm/year
Total Net Present Cost:	$38,525		$126,787	
Evaluated System Simple Payback:			45.1 yrs	

Calculation Information:

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Phone: 518.533.2171, Fax: 518.533.2177

LIFE CYCLE COST EVALUATION

Project Name:	Monroe County Crime Lab		
Project Number:	050246		
Calculated by:	Brian Danker	Date:	10/22/2008
Base System:	Building without PV system.		
Evaluated System:	Building with PV system.		
Description:	PV system is 20kW and $90,000 from NYSERDA.		

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	6	%
Natural Gas:	6	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$90,000	
Annual Maintenance Cost:	$0		$200	
Expected Life:		years	25	years
System Replacement % to Initial:	100	%	75	%
Annual Energy Usage:				
Electric:	20,000	kWH/year	0	kWH/year
Natural Gas:		Therm/year	0	Therm/year
Total Net Present Cost:	$56,089		$126,787	

Evaluated System Simple Payback: 45.1 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.
4. The first cost ($9kW) and yearly generation capability was obtained from Rochester Solar Technologies.

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LIFE CYCLE COST EVALUATION

Project Name: Monroe County Crime Lab
Project Number: 050246
Calculated by: Brian Danker   Date: 10/22/2008

Base System: Building without PV system.

Evaluated System: Building with PV system.

Description: PV system is 20kW and no NYSERDA $.

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	3	%
Natural Gas:	3	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$180,000	
Annual Maintenance Cost:	$0		$200	
Expected Life:		years	25	years
System Replacement % to Initial:	100	%	75	%
Annual Energy Usage:				
Electric:	20,000	kWH/year	0	kWH/year
Natural Gas:		Therm/year	0	Therm/year
Total Net Present Cost:	$38,525		$247,964	

Evaluated System Simple Payback: 90.1 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.
4. The first cost ($9kW) and yearly generation capability was obtained from Rochester Solar Technologies.

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LIFE CYCLE COST EVALUATION

Project Name:	Monroe County - Crime Lab	
Project Number:	50246	
Calculated by:	Ron Mead	Date: 10/22/2008
Base System:	Building without solar collection vacuum tube system.	
Evaluated System:	Building with solar collection vacuum tube system.	
Description:	Solar collection system with 126 panels (Sunmaxx 30) to supplement the building heating system and for adsorber supply for cooling.	

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	3	%
Natural Gas:	3	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$920,600	
Annual Maintenance Cost:	$0		$5,000	
Expected Life:	30	years	25	years
System Replacement % to Initial:	100	%	25	%
Annual Energy Usage:				
Electric:	36,562	kWH/year	0	kWH/year
Natural Gas:	9,240	Therm/year	0	Therm/year
Total Net Present Cost:	$275,107		$1,167,127	

Evaluated System Simple Payback: 64.8 yrs

Calculation Information:
1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.

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LIFE CYCLE COST EVALUATION

Project Name:	Monroe County - Crime Lab	
Project Number:	50246	
Calculated by:	Ron Mead	Date: 10/22/2008
Base System:	Building without solar collection vacuum tube system.	
Evaluated System:	Building with solar collection vacuum tube system.	
Description:	Solar collection system with 126 panels (Sunmaxx 30) to supplement the building heating system and for adsorber supply for cooling.	

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	6	%
Natural Gas:	6	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$920,600	
Annual Maintenance Cost:	$0		$5,000	
Expected Life:	30	years	25	years
System Replacement % to Initial:	100	%	25	%
Annual Energy Usage:				
Electric:	36,562	kWH/year	0	kWH/year
Natural Gas:	9,240	Therm/year	0	Therm/year
Total Net Present Cost:	$400,537		$1,167,127	

Evaluated System Simple Payback: 64.8 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.

M/E ENGINEERING, P.C.	**COST ESTIMATE**	
Mechanical/Electrical Engineering Consultants	PROJECT NAME: MONROE COUNTY CRIME LAB	
	M/E REFERENCE:	DATE: 10/6/2008
150 NORTH CHESTNUT STREET	DIVISION:	BY: RCM
ROCHESTER, NY 14604		APPROVED BY:

ITEM	DESCRIPTION	QTY.	UNIT	UNIT COST	TOTAL UNIT COST	TOTAL ITEM COST
A.	SOLAR COLLECTOR					
	Material	126	EA	$1,500.00	$189,000.00	$189,000.00
	Labor	126	EA	$600.00	$75,600.00	$75,600.00
B.	DRY COOLER					
	Material	1	EA	$32,000.00	$32,000.00	$32,000.00
	Labor	40	Hours	$65.00	$2,600.00	$2,600.00
C.	STORAGE TANK (2 @ 8000 Gal.)	2	EA	$13,200.00	$26,400.00	$26,400.00
D.	PIPE, VALVES & FITTINGS	LS			$65,000.00	$65,000.00
E.	PUMP, AIR SEPARATORS, HEAT EXCHANGER	LS			$50,000.00	$50,000.00
F.	INSULATION - PIPE, TANK, FITTINGS	LS			$60,000.00	$60,000.00
G.	CONTROLS	LS				$15,000.00
H.	RIGGINGS	LS				$15,000.00
I.	TEST START-UP & BALANCING	LS				$75,000.00
						$605,600.00
					10% Contingency	**$53,000.00**
	TOTAL COST - Heating Only					**$658,600.00**
A	ABSORPTION CHILLER (60 TON)					
	Material	1	EA	$140,000.00	$140,000.00	$140,000.00
	Labor	1	EA	$16,000.00	$16,000.00	$16,000.00
B.	PIPE, VALVES AND FITTINGS	LS				$30,000.00
C.	PUMPS, AIR SEPARATRS, HEAT EXCHANGERS	LS				$20,000.00
D.	INSULATION	LS				$15,000.00
E.	CONTROLS	LS				$10,000.00
F.	RIGGING	LS				$3,500.00
G.	TEST, START-UP & BALANCING	LS				$3,500.00
						$238,000.00
					10% Contingency	**$24,000.00**
	TOTAL COST - Additional cost for cooling					**$262,000.00**

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LIFE CYCLE COST EVALUATION

Project Name:	Monroe County - Crime Lab
Project Number:	50246
Calculated by:	Ron Mead — Date: 10/22/2008
Base System:	Building without solar collection vacuum tube system.
Evaluated System:	Building with solar collection vacuum tube system.
Description:	Solar collection system with 126 panels (Sunmaxx 30) to supplement the building heating system only.

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	3	%
Natural Gas:	3	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$658,600	
Annual Maintenance Cost:	$0		$5,000	
Expected Life:	30	years	25	years
System Replacement % to Initial:	100	%	25	%
Annual Energy Usage:				
Electric:	0	kWH/year	0	kWH/year
Natural Gas:	9,240	Therm/year	0	Therm/year
Total Net Present Cost:	$204,681		$874,873	

Evaluated System Simple Payback: 62.5 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.

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LIFE CYCLE COST EVALUATION

Project Name:	Monroe County - Crime Lab	
Project Number:	50246	
Calculated by:	Ron Mead	Date: 10/22/2008

Base System: Building without solar collection vacuum tube system.

Evaluated System: Building with solar collection vacuum tube system.

Description: Solar collection system with 126 panels (Sunmaxx 30) to supplement the building heating system only.

Assumptions:

Inflation Rate:	3	%
Maintainance Inflation Rate:	6	%
Discount Rate:	6.5	%
Energy Inflation Rate		
Electric:	6	%
Natural Gas:	6	%
Energy Usage Annual Increase:	0	%
Evaluation Duration (years):	30	yr
Energy Costs:		
Electricity:	$0.10	/kWH
Natural Gas:	$1.15	/Therm

System Information:

	Base System		Evaluated System	
First Time Capital Cost:	$0		$658,600	
Annual Maintenance Cost:	$0		$5,000	
Expected Life:	30	years	25	years
System Replacement % to Initial:	100	%	25	%
Annual Energy Usage:				
Electric:	0	kWH/year	0	kWH/year
Natural Gas:	9,240	Therm/year	0	Therm/year
Total Net Present Cost:	$298,001		$874,873	

Evaluated System Simple Payback: 62.5 yrs

Calculation Information:

1. The inflation rate is used for calculating the replacement costs. The average CPI since 2001 is 2.96.
2. The discount rate is the rate of return that could be earned on an investment in the financial markets with similar risk.
3. The energy inflation rate can be any anticipated by the owner. The government Energy Information Administration estimates the natural gas costs to raise an average of 0.3% and the electrical costs to decrease an average of 0.2% until 2030 in todays cost. We recommend at least matching the inflation rate.

SOLAR VACUUM TUBE SYSTEM

Basis of Design

- Sunmaxx 30 - 30 tubes per panel (nominal 9' x 7' array)

- Based on Roof Area: 9 rows @ 14 panels per row = 126 panels

- Solar day BTU output (4hr average)

  Low: 518 BTU/Sq.Ft./Solar Day

  High: 823 BTU/Sq.Ft./Solar Day

- Recommended Storage: (128 gal/panel) (126 panels) = 16,128 Gallons

- Daily Solar Gain:

  Low: (518 BTU / SF - Day) (51 SF / Panel) (126 Panels) = 3,328,668 BTU/Day

  High: (823 BTU / SF - Day) (51 SF / Panel) (126 Panels) = 5,288,598 BTU/Day

- Use: 4,400,000 BTU/Day Average

- 30 Ton adsorption chiller uses - 676,000 BTU/hr

Heating Savings

(7 Months / YR) (30 Days / Month) (4.4M BTU) ÷ (100,000 BTU / Therm) (.90% EFF) $1.10/Therm

= $11,293/yr

Cooling Savings:

- Adsorption Chiller: 4,4000,000 BTU/Day / 676,000 BTU/Hr = 6.5 Hr/Day @ 30 Ton Load

- Air Cooled Chiller: 30 Tons @ 1.25 kW/Ton = 37.5kW

- (5 Months / (YR)) (30 Day / (Month)) (37.5 kW / (HR)) (6.5 Hrs. / (Day)) ($.10 / (KWH)) = $3,656/yr

Conclusion

• Cost of Solar Collectors for Heating:	$590,000
• Annual Heating Savings:	$12,000/yr
• Simple Payback:	49 Years
• Cost of Upgrades for Cooling:	$260,000
• Annual Cooling Savings:	$4,000/yr
• Simple Payback:	65 Years

Quick Check (Heating Only)

• Cornell Warren Hall heating: $0.32 / SF / yr savings
@ 45,000 SF x $0.32/yr = $14,400/yr

LARSEN ENGINEERS

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Rochester, NY 14623
585-272-7310
585-272-0159 (fax)

07-3-6083

Revised November 6, 2008

LIFE CYCLE COST EVALUATION

Monroe County Crime Lab

Description:

Asphalt Pavement including detention and drainage versus Porous Concrete Pavement

The area proposed for porous concrete is 10,400 square feet (ft^2) The actual NYSDEC stormwater permit required area is 6,535 ft^2.

To have a valid present worth comparison, the two alternatives need to have the same life. To accomplish this comparison, 60 years is the lowest common multiple of expected life for these alternates.

In comparing the two alternates, both surfaces allow traffic to access parking and subsequently leave. Only porous concrete is also able to meet the stormwater quality and quantity requirements of the NYSDEC. The asphalt surface would add to the imperviousness of the site and require additional stormwater quantity storage. The cost of detention, including design and contingencies (150 feet of 30" detention chambers, 5 inlets and 100 feet of 12" pipe) is $56,150.

LEED points are able to be secured with the porous concrete pavement for stormwater quality, quantity and heat island effects. Asphalt would not satisfy any of the LEED points.

Assumptions:

General:

Inflation rate : 6.5%
Maintenance inflation rate: 6.5%

Asphalt:

Cost $3.00/$ft^2$ plus $56,150 site piping including design & contingency
Life 20 years
Maintenance Add 1-inch top after 10 years, at $1.50/$ft^2$;
Vacuum sweep 3 times per year, at $200/year

Porous Concrete:

Cost $8.93/$ft^2$

Life 15 years
Maintenance Vacuum sweep 3 times per year, at $200/year
Water hosing once per year, at $100/year

Compound Interest Factors:

6.5% (P/F)

Year	Value
10	0.5327
15	0.3888
20	0.2838
30	0.1512
40	0.0805
45	0.0588
50	0.0429

6.5% (P/A) 60 years ---- Value 15.033.

Asphalt Present Worth = $87,350 + ($200 X 15.033) + ($87,350 X (0.2838 + 0.0805)) + ($15,600 X (0.5327 +0.1512 + 0.0429))

Porous Concrete Present Worth = $92,872 + ($300 X 15.033) + ($92,872 X (0.3888 + 0.1512 + 0.0588))

Comparison:

Material	**Asphalt**	**Porous Concrete**
Capital cost - 10,400 ft^2	$31,200 plus $56,150	$92,872
Annual maintenance cost	$200	$300
Expected Life years	20	15
Re-top after 10 years	$15,600	
Present worth – 60 year life	$133,500	$153,000

While values are presented, to be a truly valid comparison, the value of the LEED credits would need to be factored into the analysis

Appendix B:

LEED Scorecard

Monroe County Crime Lab

9/1/2009

LEED Platinum Scorecard

Credit Category	LEED Credits in pursuit		Points	LEED Total Premium	LEED Design & Doc Premium	LEED Construct Premium	Annual Savings	Simple Payback (Years)
			LEED Platinum (52-69 Points)					
SS	Prereq 1	**Construction Activity Pollution Prevention**	p	$140	$140	$0	$0	0
SS	Credit 1	**Site Selection**	1	$140	$140	$0	$0	0
SS	Credit 2	**Development Density & Community Connectivity**	1	$640	$640	$0	$0	0
SS	Credit 3	**Brownfield Redevelopment**	1	$1,280	$1,280	$0	$0	0
SS	Credit 4.1	**Alternative Transportation**, Public Transportation Access	1	$320	$320	$0	$0	0
SS	Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1	$1,270	$320	$950	$0	0
SS	Credit 4.3	**Alternative Transportation**,Low-Emitting and Fuel-Efficient Vehicles	1	$1,320	$320	$1,000	$0	0
SS	Credit 4.4	**Alternative Transportation**, Parking Capacity	1	$950	$600	$350	$0	0
SS	Credit 6.1	**Stormwater Design,** Quantity Control	1	$56,049	$2,330	$53,719	$0	0
SS	Credit 6.2	**Stormwater Design,** Quality Control	1	$700	$700	$0	$0	0
SS	Credit 7.1	**Heat Island Effect,** Non-Roof	1	$385	$385	$0	$0	0
SS	Credit 7.2	**Heat Island Effect,** Roof	1	$13,370	$1,600	$11,770	$100	134
SS	Credit 8	**Light Pollution Reduction**	1	$1,200	$1,200	$0	$100	12
WE	Credit 1.1 & 1.2	**Water Efficient Landscaping,**No Potable Water Use	2	$630	$630	$0	$0	0
WE	Credit 2	**Innovative Wastewater Technologies**	1	$50,500	$6,500	$44,000	($17)	0
WE	Credit 3.1 & 3.2	**Water Use Reduction**, 20% & 30% Reductions	2	$3,500	$3,500	$0	$108	32
EA	Prereq 1	**Fundamental Cx of the Building Energy Systems**	p	$160	$160	$0	$0	0
EA	Prereq 2	**Minimum Energy Performance**	p	$1,500	$1,500	$0	$0	0
EA	Prereq 3	**Fundamental Refrigerant Management**	p	$1,000	$1,000	$0	$0	0
EA	Credit 1	**Optimize Energy Performance**	8	$178,812	$45,564	$133,248	$25,864	7
EA	Credit 2.1	**On-Site Renewable Energy** (PV System; see Footnote 1)	1	$207,900	$8,000	$199,900	$3,687	56
EA	Credit 3	**Enhanced Commissioning**	1	$21,410	$160	$21,250	$1,000	21
EA	Credit 4	**Enhanced Refrigerant Management**	1	$1,000	$1,000	$0	$0	0
EA	Credit 5	**Measurement & Verification**	1	$75,974	$4,500	$71,474	$0	0
EA	Credit 6	**Green Power**	1	$4,850	$250	$4,600	$0	0
MR	Prereq 1	**Storage & Collection of Recyclables**	p	$2,450	$1,450	$1,000	$0	0
MR	Credit 2.1 & 2.2	**Construction Waste Management**, Divert 50%/ 75% from Disposal	2	$81,645	$6,700	$74,945	$0	0
MR	Credit 4.1 & 4.2	**Recycled Content**, 10%, 20% (post-consumer + ½ pre-consumer)	2	$7,200	$7,200	$0	$0	0
MR	Credit 5.1	**Regional Materials**, 10%, 20% Extracted, Processed & Mfg. Regionally	2	$6,100	$6,100	$0	$0	0
MR	Credit 6	**Rapidly Renewable Materials**	1	$35,700	$5,200	$30,500	$0	0
MR	Credit 7	**Certified Wood**	1	$4,600	$1,800	$2,800	$0	0
IEQ	Prereq 1	**Minimum IAQ Performance**	p	$1,500	$1,500	$0	$0	0
IEQ	Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	p	$660	$360	$300	$0	0
IEQ	Credit 1	**Outdoor Air Delivery Monitoring**	1	$27,200	$2,000	$25,200	$0	0
IEQ	Credit 2	**Increased Ventilation**	1	$35,700	$4,000	$31,700	$0	0
IEQ	Credit 3.1	**Construction IAQ Management Plan**, During Construction	1	$15,000	$3,000	$12,000	$0	0
IEQ	Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1	$21,700	$1,000	$20,700	$0	0
IEQ	Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1	$2,600	$2,600	$0	$0	0
IEQ	Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1	$2,600	$2,600	$0	$0	0
IEQ	Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1	$600	$600	$0	$0	0
IEQ	Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1	$1,600	$1,600	$0	$0	0
IEQ	Credit 5	**Indoor Chemical & Pollutant Source Control**	1	$3,100	$3,100	$0	$0	0
IEQ	Credit 6.1	**Controllability of Systems**, Lighting	1	$1,500	$1,500	$0	$0	0
IEQ	Credit 6.2	**Controllability of Systems**, Thermal Comfort	1	$20,200	$1,500	$18,700	$0	0
IEQ	Credit 7.1	**Thermal Comfort**, Design	1	$1,500	$1,500	$0	$0	0
IEQ	Credit 7.2	**Thermal Comfort**, Verification	1	$4,400	$4,400	$0	$0	0
ID	Credit 1.1	**Innovation in Design**: Green Houskeeping	1	$5,000	$5,000	$0	$0	0
ID	Credit 1.2	**Innovation in Design**: Education	1	$12,800	$7,800	$5,000	$0	0
ID	Credit 1.3	**Innovation in Design**: Exemplary Performance - Recycled Content	1	$400	$400	$0	$0	0
ID	Credit 1.4	**Innovation in Design**: Exemp. Perform. - Water Efficency	1	$1,900	$1,900	$0	$0	0
ID	Credit 2	**LEED® Accredited Professional**	1	$23,410	$23,410	$0	$0	0
		TOTALS:	56	***$946,065***	***$180,959***	***$765,106***	***$30,842***	***31***

Footnotes:

1. Price reflect actual bid values; Assumes NYSERDA incentive of $108,000 ($3/watt).

Appendix C:

NYSERDA Technical Assistance Report

October 2009

TECHNICAL ASSISTANCE STUDY IN SUPPORT OF NEW CONSTRUCTION PROGRAM

completed by

SAIC - *CONTRACT #10128-07*

for

Monroe County
Public Safety Laboratory
Rochester, New York

Project Number: NCP8142

Science Applications International Corporation
6390 Fly Road
East Syracuse, New York

New York State
Energy Research and Development Authority

NOTICE

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SECTION 1 - EXECUTIVE SUMMARY

OVERVIEW

The New York State Energy Research and Development Authority (NYSERDA) is offering financial incentives to qualified customers who implement electric energy efficiency measures in new construction or major renovation projects that exceed standard practice. The NYSERDA New Construction Program can offset a portion of the incremental first-cost associated with the selection and installation of qualifying measures.

Science Applications International Corporation (SAIC) completed an evaluation of energy efficiency opportunities on behalf of Monroe County for a new Public Safety Laboratory building located in Rochester, New York. The County is planning to construct a new 45,000 gross square foot, 4-story building to house crime laboratories and offices. The first floor will include an unconditioned garage, laboratory support space, storage and mechanical equipment rooms. The second and third floors will have offices on the west side of the building and labs on the east side. Laboratory space also exists on the east side of the fourth floor, with mechanical equipment space occupying the west side.

The project has been registered with the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED®) program under LEED-NC Version 2.2. Consequently, the design team is incorporating features into the building that meet the criteria for a rating from the USGBC using the LEED® Rating System. A LEED Gold rating is being targeted by the Owner and design team.

The building will be constructed with levels of insulation and glazing performance characteristics that exceed the prescriptive requirements of the Energy Conservation Construction Code of New York State (ECCC) and ASHRAE Standard 90.1-2004 – *Energy Standard for Buildings Except Low-Rise Residential Buildings*. SAIC evaluated insulation and window glazing options during design development to help the Owner and design team select the most appropriate options.

Two central station variable air volume (VAV) air handling units will be provided for the building. One unit will serve the laboratory side of the building, while the second will serve the offices and support space. The laboratory unit will supply 100% outside air to the laboratories. The supply fan will be fitted with a variable frequency drive to vary the amount of air delivered to the building in response to a duct static pressure control. An enthalpy wheel selected for zero percent cross contamination is specified to transfer energy between building exhaust and outdoor air streams to preheat or precool make-up air.

Chilled water will be produced by a nominal 178-ton high-efficiency air-cooled rotary screw chiller. Hot water will be generated for space heating and domestic hot water by three (3) 900 MBH output natural gas-fired condensing boilers. The boilers will generate domestic hot water through a plate-and-frame heat exchanger. Variable speed pumping systems will be provided for hot and chilled water loops.

A building automation system (BAS) will provide monitoring, direct digital control (DDC), and central management of the HVAC systems. Control enhancements specified for the project include a dual enthalpy economizer on the office air handling unit and discriminator controls to reset discharge air temperature setpoints on the VAV systems. Lighting occupancy sensors will be used to index through the BAS occupancy status in laboratory spaces. When occupancy is not detected for 20 minutes, the room/lab shall reset to unoccupied status and its corresponding airflow requirement. The system will return to occupied airflow requirements immediately upon detection of space occupancy.

The lighting system is designed for power densities significantly lower than the maximum allowed by ASHRAE 90.1-2004. Automatic daylight stepped control of fluorescent fixtures will be implemented in perimeter labs and offices while on/off control of fixtures will be utilized in the conference room, lounge, library and break room.

In September 2008, SAIC developed preliminary building energy simulation models of the proposed building with two HVAC system options: the basis of design central chilled and hot water plant with variable air volume (VAV) air handling units and alternative geothermal heat pump (GHP) system. Based on the results of this analysis, the Owner selected the VAV system with central chilled and hot water plant.

After the HVAC system type was selected, SAIC provided preliminary modeling results (e.g., predicted energy and utility cost savings, and estimated NYSERDA incentive) on individual energy efficiency measures (EEMs) and various design alternatives to the design team and Owner during the design development and construction document phases so that final design decisions could be made. The measures evaluated by SAIC included reduced lighting power densities, daylighting control, building insulation and glazing improvements, alternative chillers and boilers, occupancy sensor reset of laboratory exhaust and supply airflow requirements, and exhaust air energy recovery. This report reflects the final building design shown on the June 12, 2009 Contract Documents, along with Addenda provided by the design team.

A summary of the design features that will reduce energy requirements follows.

- High-efficiency air-cooled chiller.
- High-efficiency natural gas-fired condensing boilers[1].
- Variable flow/speed chilled and hot water pumping systems.
- Exhaust air energy recovery on laboratory supply and exhaust system.
- Laboratory occupancy sensor reset of exhaust and supply airflow requirements.
- Enthalpy economizer controls for AHU-1.
- Improved levels of building envelope insulation over the prescriptive requirements of ASHRAE Standard 90.1-2004.
- High-performance/reduced SHGC window glazing.
- EnergyStar® compliant high albedo roof.
- High-efficiency lighting and controls with lighting power density lower than the maximum ASHRAE Standard 90.1-2004 prescriptive limit.
- Automatic daylighting controls.
- Premium-efficiency motors that meet NYSERDA minimum prescriptive requirements.

The proposed building was evaluated for potential financial incentives through the NYSERDA New Construction Program (NCP) using the Whole Building Design approach. An eQUEST/DOE-2.2 building energy simulation model was developed for the building with all energy efficiency measures (EEMs) implemented. A baseline model was then developed that just meets the prescriptive requirements of ASHRAE Standard 90.1-2004 following the Appendix G Performance Rating Method (PRM). These two models were compared to determine the incentive for the project based on annual energy and summer peak demand savings.

SAIC used the same models to determine the number of rating points available from LEED *Energy and Atmosphere Credit 1 (EAc1) – Optimize Energy Performance.* The LEED® *Option 1 – Whole Building*

[1] While natural gas efficiency measures are not eligible for incentives, they do impact the owner's operating costs and the building's total energy improvement required to identify the appropriate New Construction Program incentive tier.

Energy Simulation compliance path was followed. Graphic representations of the eQUEST building model are shown below (Figures 1-1 through 1-6).

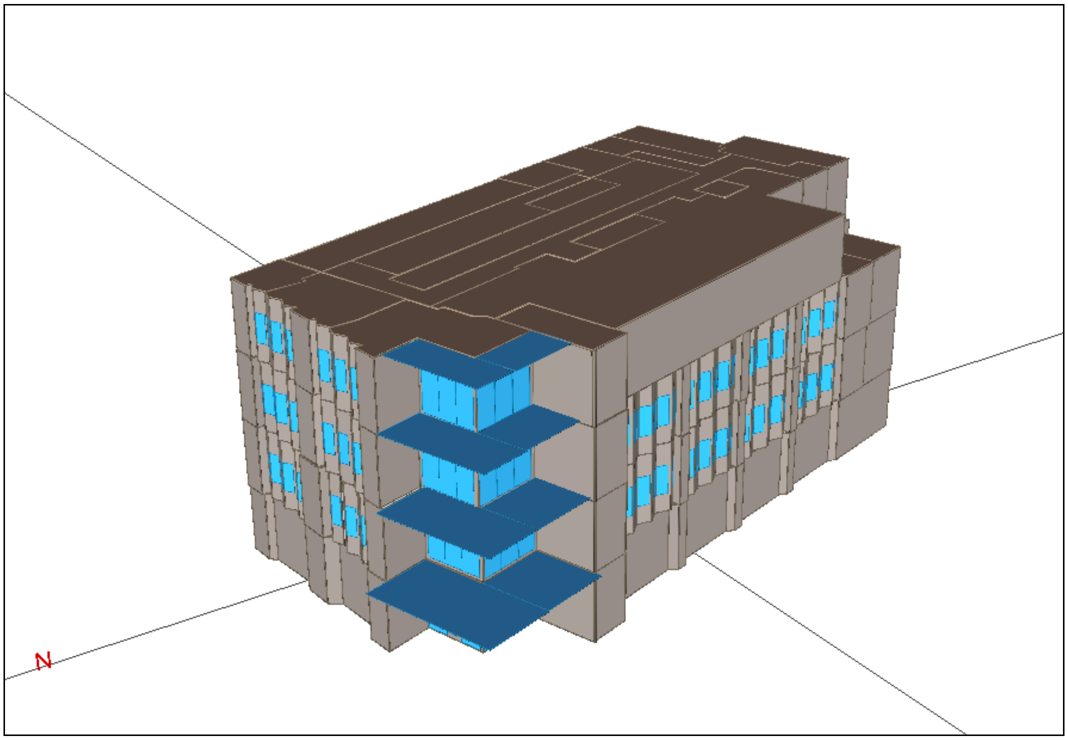

Figure 1-1: 3-D eQuest View

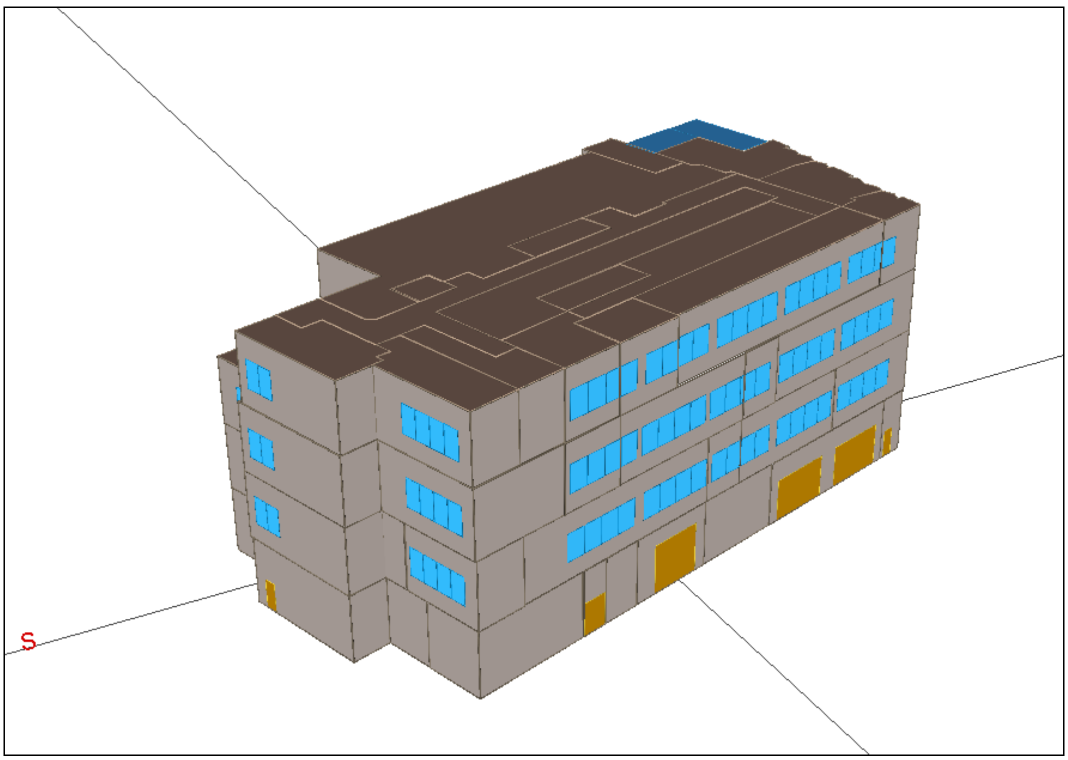

Figure 1-2: 3-D eQuest View

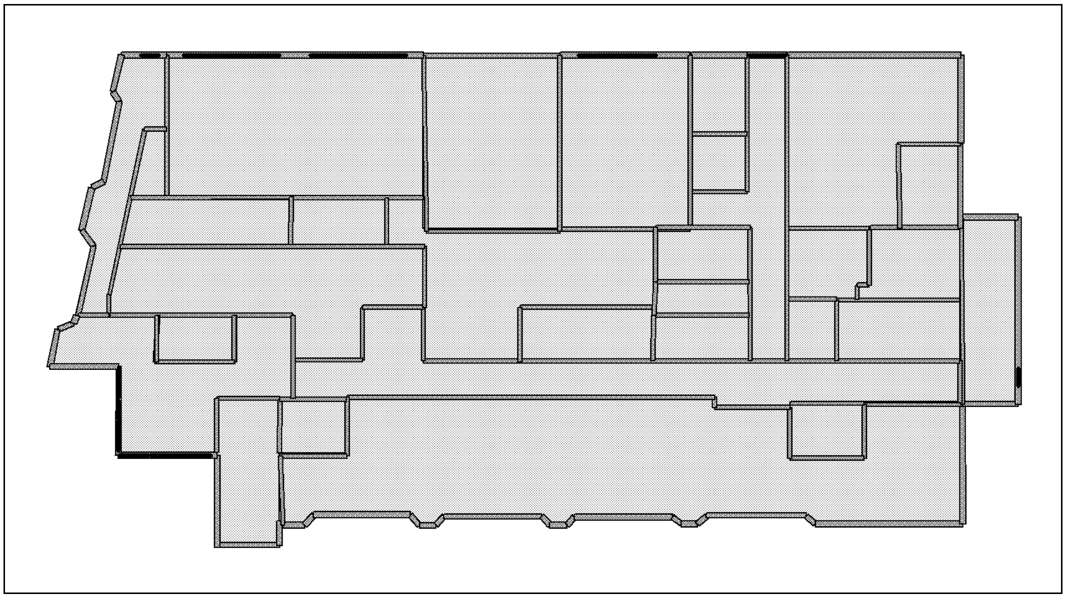

Figure 1-3: First Floor Zoning

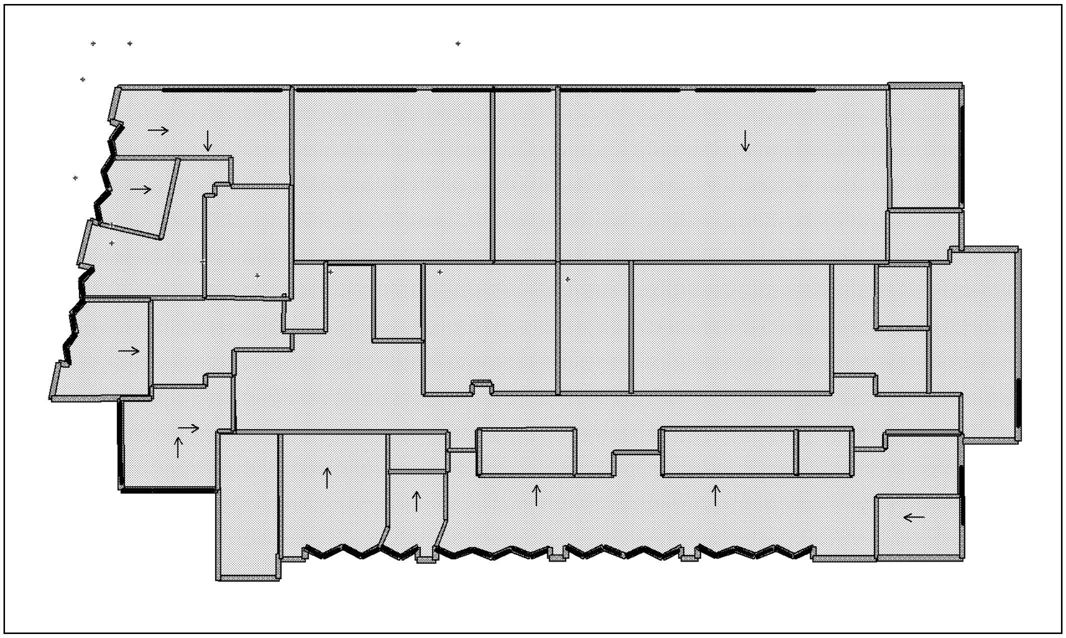

Figure 1-4: Second Floor Zoning

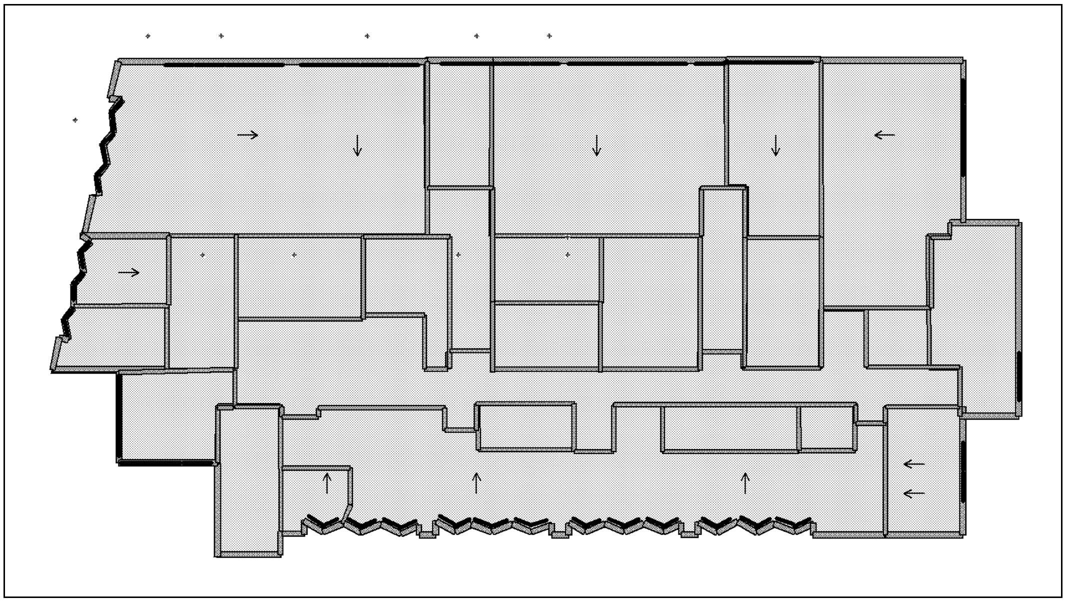

Figure 1-5: Third Floor Zoning

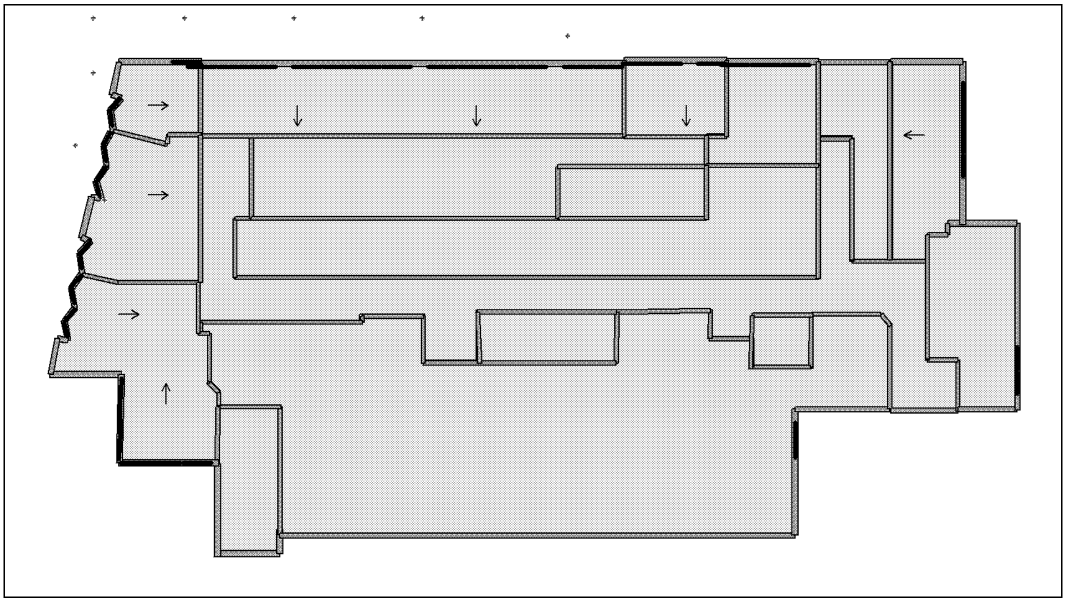

Figure 1-6: Fourth Floor Zoning

The project was evaluated by SAIC based on design documents and information provided by LaBella Associates, the architect, and M/E Engineering, the MEP design engineer. Appendix A contains a list of contact names, addresses, and telephone numbers for the project participants.

METHODOLOGY

The baseline and design buildings were modeled in eQUEST (version 3.6/DOE-2.2 release 44e4), a DOE-2.2 based hourly building energy simulation program developed by James J. Hirsch & Associates. This program applies state-of-the-art features that allow a modeler to enter key characteristics for the building shell, mechanical and electrical systems, along with characteristic operating strategies and schedules. The interactions between all of the different building loads, systems and plants are then simulated in hourly time intervals using typical or long-term average weather data for the location to provide a detailed account of energy consumption and demand.

For a whole building design approach, an energy simulation model is developed for the building with all energy efficiency measures under consideration implemented. These may include higher levels of building envelope insulation than required by code, high-performance glazing, energy-efficient lighting designs, and high-efficiency HVAC equipment. A baseline model is then developed that that just meets the prescriptive and mandatory requirements of ASHRAE 90.1-2004 following the Appendix G Performance Rating Method (PRM). These two models are compared so the incentive for the project can be determined based on annual energy and summer peak demand savings.

RESULTS

Table 1-1 summarizes annual energy and peak demand savings for the proposed building design, along with the recommended incentive for the entire project and each individual measure. Energy savings and incentives for each individual measure were estimated by comparing the design model with all measures installed in the building to a baseline case with all measures implemented except for the one measure being evaluated. This approach provides interactive savings for the individual measures and, therefore, the best estimate of actual savings and incentive for each measure. The sum of the individual measure savings will not equal the savings determined from the comparison of the design model with all measures implemented and the baseline model with no measures. Individual measure results shown in Table 1-1 reflect ASHRAE 90.1-2004 baseline requirements.

Table 1-1: Whole Building Design Approach Analysis Results

EEM	Project/Measure Description	Annual Energy Reduction (kWh)	Summer Peak Demand Reduction (kW)	Winter Peak Demand Reduction (kW)	Annual Natural Gas Savings (Therms)	Annual Electric Energy Cost Savings	Annual Natural Gas Cost Savings	Total Annual Energy Cost Savings	Percent Energy Cost Improvement over ASHRAE Standard 90.1	Estimated Incremental Cost	Simple Payback Period (years)	Incentive	Customer Effective Payback Period (years)
ALL	***Design Package - Compared to ASHRAE 90.1-2004 Baseline***	***91,338***	***122***	***5***	***57,656***	***$9,134***	***$66,305***	***$75,439***	***34.0%***	***$228,070***	***3.02***	***$87,071***	***1.87***
1	Envelope Insulation (Exterior Walls and Roof)	4,435	0	0	1,483	$443	$1,706	$2,149	1.5%	$41,324	19.23	$1,084	18.72
2	High Performance Window Glazing	7,057	3	0	1,786	$705	$2,054	$2,759	1.9%	$19,272	6.99	$2,924	5.93
3	High Efficiency Lighting and Occupancy Sensor Controls	28,067	5	8	374	$2,806	$430	$3,236	2.2%	$34,270	10.59	$8,638	7.92
4	Daylight Harvesting Controls	17,013	7	0	-378	$1,701	-$434	$1,267	0.9%	$11,100	8.76	$7,637	2.73
5	High-Efficiency Air-Cooled Screw Chiller	15,832	15	0	0	$1,583	$0	$1,583	1.1%	$19,720	12.46	$11,661	5.09
6	Exhaust Air Energy Recovery and Occupancy Sensor Reset	67,821	58	23	30,591	$6,782	$35,181	$41,963	28.7%	$91,900	2.19	$46,644	1.08
7	Variable-Speed Pumping	10,214	1	1	-164	$1,021	-$188	$833	0.6%	$8,595	10.32	$2,573	7.23
8	Enthalpy Economizer Control	334	9	0	18	$33	$21	$54	0.0%	$705	13.05	$5,181	0.00
9	Premium Efficiency Motors	2,066	1	0	-15	$206	-$16	$190	0.1%	$1,184	6.23	$728	2.40

Based on the results of the whole building analysis, the County is eligible for a performance incentive of ***$87,071*** if all of the measures listed above are implemented. This incentive reduces the simple payback period for the project from 3.02 to 1.87 years assuming a total incremental cost of $228,070 for all of the energy efficiency measures. The proposed building provides 34.0% annual energy cost savings relative to the baseline building.

If LEED® certification is achieved and 5 or more points are obtained from LEED *Energy and Atmosphere Credit 1 (EAc1) – Optimize Energy Performance*, the capital cost incentive will be increased by 25% or ***$21,768***. The applicant is also eligible for a ***$7,500*** LEED incentive if the project becomes LEED®

certified and a minimum of 3 points is achieved under the same credit. The project is expected to receive eight (8) rating points for the credit (see below).

The applicant design team (i.e., architect or engineer of record) is eligible for an incentive of ***$14,613*** based on the percent energy cost improvement over the energy code for the proposed building design. For projects that exceed the energy code by 23.1%, an incentive of $120/kW summer demand saved is available up to a maximum of $20,000.

Building commissioning is required by NYSERDA if the incentive award is over $100,000. To help offset the cost of commissioning, NYSERDA will increase the performance-based incentive by 10% up to a maximum of $50,000. For LEED certified projects, NYSERDA will increase the incentive by another 10% (for a total of 20%) to offset costs of LEED Enhanced Commissioning. For this project, a commissioning subsidy of ***$17,414*** is expected. Therefore, the total NYSERDA incentive available to the applicant is ***$148,365***.

Energy savings from the proposed building design would, if fully implemented, provide societal benefits in the form of reduced emissions from power generating plants including nitrogen oxides (NO_x), sulfur oxides (SO_x), and carbon dioxide (CO_2). The energy savings predicted for the project would result in the following annual reduction in emissions:

- 714 pounds of nitrogen oxides (NO_x)
- 274 pounds of sulfur oxides (SO_x)
- 387 tons of carbon dioxide (CO_2)

These savings are equivalent to removing 77 cars from the road.

Summary of NYSERDA Incentives:

The following table summarizes financial incentives available from NYSERDA for the project. NYSERDA will issue an incentive check to the County for the energy efficiency measures after construction is completed and the measures are inspected to verify program compliance. A second check will be issued by NYSERDA for incentives related to LEED certification after certification is obtained.

Incentive Component	Incentive
Whole Building Design	$87,071
LEED® Green Building Bonus (25%)	$21,768
Applicant LEED® Incentive	$7,500
Applicant Design Team Incentive	$14,613
Building Commissioning Services (20%)	$17,414
Total Incentive Upon LEED® Certification	***$148,365***

COMMISSIONING

NYSERDA encourages commissioning (Cx) in all of its projects, and requires it on all projects receiving incentive awards over $100,000. The building is being commissioned to meet the requirements of LEED® *Energy and Atmosphere Prerequisite 1 – Fundamental Commissioning of the Building Energy Systems* and *Credit 3 – Enhanced Commissioning*. The six LEED requirements outlined in LEED-NC Version 2.2 Reference Guide for *EAp1* are:

1. Designate an individual as the Commissioning Authority (CA) to lead, review and oversee the completion of the commissioning process activities.
2. The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CA shall review these documents for clarity and completeness. The Owner and design team shall be responsible for updates to their respective documents.
3. Develop and incorporate commissioning requirements into the construction documents.
4. Develop and implement a commissioning plan.
5. Verify the installation and performance of the systems to be commissioned.
6. Complete a summary commissioning report.

LEED *EAc3 – Enhanced Commissioning* has six requirements in addition to the Fundamental Commissioning prerequisite:

1. Prior to the start of the construction documents phase, designate an independent Commissioning Authority (CA) to lead, review, and oversee the completion of all commissioning process activities.
2. The CA shall conduct, at a minimum, one commissioning design review of the Owner's Project Requirements (OPR), Basis of Design (BOD), and design documents prior to mid-construction documents phase and back-check the review comments in the subsequent design submission.
3. The CA shall review contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD. This review shall be concurrent with the A/E reviews and submitted to the design team and the Owner.
4. Develop a systems manual that provides future operating staff the information needed to understand and optimally operate the commissioned systems.
5. Verify that the requirements for training operating personnel and building occupants are completed.
6. Assure the involvement of the CA in reviewing building operation within 10 months after substantial completion with O&M staff and occupants. Include plan for resolution of outstanding commissioning-related issues.

NYSERDA will provide an additional 10% to the capital cost incentive to cover the cost of required commissioning of projects that are not LEED or NY-CHPS certified buildings. For buildings that do achieve LEED or NY-CHPS certification, NYSERDA will provide an additional 20% to the capital cost incentive to cover the cost of enhanced commissioning if LEED EAc3 (Enhanced Commissioning) is achieved. Applicants may have required Cx services provided by a contractor of their choice. Commissioning service providers must meet minimum criteria, and follow procedures and reporting requirements established by NYSERDA.

LEED® ENERGY AND ATMOSPHERE CREDIT 1 – OPTIMIZE ENERGY PERFORMANCE

The design team has incorporated features into the building that meet the criteria for a rating from the United States Green Building Council (USGBC) using the LEED® (Leadership in Energy and Environmental Design) Rating System. To assist in this effort, SAIC developed eQUEST/DOE-2.2 models of the proposed and baseline buildings to determine the number of additional rating points available from LEED *Energy and Atmosphere Credit 1 (EAc1) – Optimize Energy Performance.* The LEED® *Option 1 – Whole Building Energy Simulation* compliance path was followed. This approach uses the Building Performance Rating Method (PRM) outlined in Appendix G of ASHRAE 90.1-2004. Section 3 presents the results of this analysis. ***Based on this analysis, the design building provides 35.7% energy cost savings relative to the baseline building. This results in eight (8) LEED rating points for the credit.*** The number of points awarded for the credit is subject to USGBC review of the credit submission.

REPORT CONTENT

Section 2 of this report presents the analysis methodology. Section 3 addresses the whole building analysis including a description of the building design and the baseline comparison, energy analysis, incremental construction cost, and incentive calculation. Section 3 also evaluates the building's potential to receive additional rating points from LEED *Energy and Atmosphere Credit 1 – Optimize Energy Performance.* The appendices of this report contain DOE-2.2 output reports, energy analysis spreadsheets, construction cost estimates, NYSERDA worksheets for the whole building design application, and supporting documentation for the LEED analysis.

SECTION 2 – ANALYSIS METHODOLOGY

The baseline and design buildings were modeled in eQUEST (version 3.61, DOE-2.2 release 44e4), a DOE-2.2 based hourly building energy simulation program developed by James J. Hirsch & Associates. This program applies state-of-the-art features that allow a modeler to enter key characteristics for the building shell, mechanical and electrical systems, along with characteristic operating strategies and schedules. The interactions between all of the different building loads, systems and plants are then simulated in hourly time intervals using typical or long-term average weather data for the location to provide a detailed account of energy consumption and demand. All simulations used Rochester TMY2 (Typical Meteorological Year) weather data, which represents typical year conditions.

The LOADS analysis program of DOE-2.2 calculates peak loads and hourly space loads imposed by ambient weather conditions and internal occupancy, lighting and equipment, as well as by variations in the size, location, orientation, construction, and materials for walls, roofs, and windows. The HVAC program simulates the operation of secondary Heating, Ventilating, and Air Conditioning (HVAC) components including fans, coils and economizers that are operated according to various user-defined temperature schedules as well as primary HVAC equipment such as boilers, chillers, and cooling towers. Utility rate structures are modeled in the ECONOMICS program to calculate building energy costs.

Architectural drawings provided to SAIC were used to obtain dimensional information and construction characteristics on the building. Thermal zones were established primarily based on building exposure, common space type, and the actual HVAC zones indicated on the drawings. Design ratings for the HVAC systems were obtained from the design drawings, specifications and manufacturer's performance data.

Installed lighting loads were calculated by SAIC from reflected ceiling plans and fixture specifications provided by the design team. Plug loads were based on the electrical equipment that would be expected in each space (e.g., office equipment, computers, copiers, etc.). This information was used to estimate installed lighting and equipment power for the model. Typical occupancy levels and schedules were obtained from the owner. The program models input energy to lighting and electrical equipment and also calculates heat generated by these systems and building occupants; the resulting loads are imposed on the building's HVAC systems.

SAIC developed eQUEST building energy simulation models of the proposed (i.e., design) and baseline buildings to estimate energy and demand savings and financial incentives available from the New Construction Program and to determine the number of rating points available from LEED *Energy and Atmosphere Credit 1 (EAc1) – Optimize Energy Performance.* The LEED® *Option 1 – Whole Building Energy Simulation* compliance path was followed. This approach uses the Building Performance Rating Method (PRM) outlined in Appendix G of ASHRAE 90.1-2004. Addendum *a* to the Standard was followed, which eliminates the requirement to distribute glazing in horizontal bands for the baseline building.

Utility costs were predicted by eQUEST based on cost data provided by the County. According to the County, the average cost of energy is $0.10/kWh and $1.15/Therm for electricity and natural gas, respectively.

The incentive level for whole building projects depends on the percent energy cost savings of the proposed design relative to the baseline building design. Only electrical energy and summer on-peak demand savings can be considered for the incentive calculation. The following table presents the unit incentive for each tier.

Incentives are capped at 60% of the incremental cost for the project (or 75% for LEED certified buildings) . The maximum capital cost incentive is $750,000 per building project, with a single measure incentive cap of $200,000.

Table 2-1: NYSERDA New Construction Program Whole Building Design Incentives for PON 1222

Percent Above Code	Energy ($/kWh)	Summer On-Peak Demand ($/kW)	Winter On-Peak Demand ($/kW)
3% to 8%	$0.18/kWh	$470/kW	$0/kW
8.1% to 13%	$0.19/kWh	$490/kW	$0/kW
13.1% to 18%	$0.20/kWh	$510/kW	$0/kW
18.1% to 23%	$0.21/kWh	$530/kW	$0/kW
Over 23%	$0.22/kWh	$550/kW	$0/kW

Construction cost estimates were developed by SAIC. The cost estimates were based on cost data provided by the design and construction teams (if available), vendor quotes, previous projects evaluated by SAIC for the New Construction Program and material costs, labor costs, overhead and profit taken from current R.S. Means Electrical, Mechanical and Construction Cost Data (31st Annual Edition, 2008).

SECTION 3 – WHOLE BUILDING DESIGN ANALYSIS

Proposed Project and Baseline Description: The proposed project includes the following energy efficiency measures. These measures are not required by code or considered standard design practice for the building.

- High-efficiency air-cooled chiller.
- High-efficiency natural gas-fired condensing boilers.
- Variable flow/speed chilled and hot water pumping systems.
- Exhaust air energy recovery on laboratory supply and exhaust system.
- Laboratory occupancy sensor reset of exhaust and supply airflow requirements.
- Enthalpy economizer controls for AHU-1.
- Improved levels of building envelope insulation over the prescriptive requirements of ASHRAE Standard 90.1-2004.
- High-performance/reduced SHGC window glazing.
- EnergyStar® compliant high albedo roof.
- High-efficiency lighting and controls with lighting power density lower than the maximum ASHRAE Standard 90.1-2004 prescriptive limit.
- Automatic daylighting controls.
- Premium-efficiency motors that meet NYSERDA minimum prescriptive requirements.

Table 3-1 compares construction and efficiency characteristics of the baseline and design buildings simulated by the eQUEST models developed for this study. The baseline column lists the minimum prescriptive requirements of ASHRAE 90.1-2004 for the building envelope, lighting, and HVAC systems. The source of data for the baseline code model is also presented in the table. Design parameters are based on information shown on drawings and provided to SAIC by the project team.

Table 3-1: Comparison of Baseline and Design Building Characteristics – NYSERDA NCP and LEED EAc1 Analysis (Climate Zone 5A)

Parameter	Baseline Building	Design Building	Baseline Source/Notes
Building Loads (~18% Glazed Area)			
Exterior Wall Insulation			
Metal Framed Walls	R-13 cavity R-3.8 continuous U-0.084 max. assembly	R-13 cavity R-10 continuous U-0.054 for assembly	ASHRAE 90.1-2004 Table 5.5-5 Steel-Framed Walls (see Note 1)
Concrete Masonry Unit Walls (south stairwell)	R-13 cavity R-3.8 continuous U-0.084 max. assembly	R-5 continuous U-0.118 for assembly	
Metal Framed Walls (Semi-exterior exposure, interior parking garage walls)	R-13 cavity U-0.124 max. assembly	R-13 cavity R-10 continuous U-0.054 for assembly	
Roof Insulation			
Insulation Above Deck	R-15 continuous U-0.063 max assembly	R-28.8 continuous (average 4.5" polyisocyanurate; R-6.4 per inch) U-0.034 for assembly	ASHRAE 90.1-2004 Table 5.5-5 (see Note 1)
Window Glazing			ASHRAE 90.1-2004 Tables 5.5-5 and G3.1.5(c) and (f) (see Note 1)
Assembly U-factor	0.57	0.29 center of glass and 0.327 calculated assembly	
Assembly SHGC	0.39	0.38	
High Albedo Roof			LEED-NC Version 2.2 Reference Guide (pg. 180) and ASHRAE 90.1-2004 Table G3.1 (see Note 2)
Initial Solar Reflectance	0.30	>=0.75	
3-year Aged Solar Reflectance	NA	0.45	
Infrared Emittance	NA	>=0.90	
Slab-on-Grade	F-0.730	F-0.60	ASHRAE 90.1-2004 Table 5.5-5 (see Note 1)
Opaque Doors			ASHRAE 90.1-2004 Table 5.5-5 (see Note 1)
Swinging	U-0.700	U-0.071 (R-14)	
Non-Swinging	U-1.450	U-0.160 (R-6) U-0.820 (uninsulated for parking garage)	

Parameter	Baseline Building	Design Building	Baseline Source/Notes
Interior Lighting (Entire Building)			
Power Density	1.120 W/ft^2	0.953 W/ft^2	
Power Allowance	50,596 Watts	43,089 Watts	
Daylighting Controls	No	Yes (Perimeter Labs, Perimeter Offices, Conference Room, Lounge, Library and Break Room)	ASHRAE 90.1-2004 Table 9.6.1 (see Note 3)
Occupancy Sensor Controls	As per ASHRAE 90.1-2004, no credit taken as per Table G3.1.	As per ASHRAE 90.1-2004 plus offices, lab/exam rooms, corridors and storage areas. Overall LPD equals 0.877 W/ft^2 with 10% power adjustment applied to zones where occupancy sensors are not required.	
Task Lighting	Same as Design	1.85 kW	
Plug Load (Entire Building)	Same as Design	0.94 W/ft^2	Note 4
Refrigeration Load	Same as Design	42 kW (5,256 EFLH)	Note 4
Vertical Transportation	Same as Design	57 kW (2,054 EFLH)	Note 4
Exterior Lighting	6.23 kW	3.45 kW	Note 5
HVAC and Service Water Heating			
HVAC System Type	Packaged VAV w/reheat with DX cooling and fossil fuel boiler (System 5; Packaged VAV w/Reheat)	VAV systems with fan VFDs for AHU-1 and AHU-2. AHU-2 is a 100% outdoor air unit for the laboratory spaces and contains an enthalpy wheel energy recovery unit. Hot water unit heaters for mechanical rooms and stairwells (modeled as identical to baseline system as per PRM).	ASHRAE 90.1-2004 Table G3.1.1A and G3.1.1B (see Note 6)
Baseline Packaged VAV Cooling Efficiency	< 5.4 tons: 12.0 SEER 5.4-11.3 tons: 10.1 EER 11.3-20 tons: 9.5 EER 20-63.3 tons: 9.3 EER > 63.3 tons: 9.0 EER	NA NA NA NA NA	ASHRAE 90.1-2004 Tables 6.8.1.A and 6.8.1E
Exhaust Air Energy Recovery	No Energy Recovery in Baseline Model	Enthalpy wheel on AHU-2.	ASHRAE 90.1-2004 Section G3.1.2.10 (see Note 6)

Parameter	Baseline Building	Design Building	Baseline Source/Notes
Chiller Plant	No Chiller Plant in Baseline Model	One (1) 177.5-ton Air-Cooled Electric Screw Chiller rated at 1.122 kW/ton at job conditions (12°F delta-T across evaporator) and 0.828 kW/ton IPLV	ASHRAE 90.1-2004 Section G3.1.3.7
Primary Chilled Water Pump Flow Control	No Chilled Water Loop in Baseline Model	Variable Flow/Speed	ASHRAE 90.1-2004 Section G3.1.3.10
Boiler Plant	Two (2) equally-sized Natural Draft, Natural Gas-Fired Boilers with 80% thermal efficiency.	Three (3) 900 MBH Natural Gas-Fired Condensing Boilers with 88% thermal efficiency at full-load.	ASHRAE 90.1-2004 Section G3.1.3.2
Hot Water Pump Flow Control	Primary, Constant Speed, Riding the Pump Curve (19 W/GPM)	Variable Flow/Speed	ASHRAE 90.1-2004 Section G3.1.3.5
Service Water Heating	Natural Gas-Fired Domestic Hot Water Heater with 80% Thermal Efficiency.	Flat Plate Heat Exchanger served by Hot Water Loop.	ASHRAE 90.1-2004 Table 7.8
DDC Enhancements			ASHRAE 90.1-2004 Section G3.1.2.6, Section G3.1.2.5 (see Note 7)
Airside Economizer	Dry-Bulb (70°F limit)	Dual Enthalpy (AHU-1)	
Demand Controlled Ventilation (DCV)	No	No	
Discharge Air Temperature Reset	Yes	Yes	
Hot Water Temperature Reset	Yes	Yes	
Chilled Water Temperature Reset	NA	Yes	
Laboratory Occupancy Sensor Reset	No	Yes	
Motors	EPACT 92	NEMA Premium	ASHRAE 90.1-2004 Table 10.8

Notes:

1. Baseline performance characteristics are dependent on percentage of window and glazed door area on above-grade walls. Listed insulation R-values do not account for thermal bridge effects, but baseline and design models derate cavity insulation R-values as appropriate. Performance Rating Method requires light weight construction (e.g., steel frame exterior walls, insulation above metal roof deck, etc.) for the baseline building model regardless of design building construction.
2. New roofs with a surface reflectance greater than 0.70 and an emissivity greater than 0.75 (high albedo) are modeled with an aged reflectance of 0.45. The baseline roof is modeled with a reflectance of 0.3. See Table G3.1 of ASHRAE 90.1-2004.
3. Average design lighting power density calculated from sum-total of all spaces. ASHRAE 90.1 space-by-space method was used to determine baseline lighting power allowance. Used 1.5 W/ft^2 for Electrical/Mechanical, 1.4 W/ft^2 for Laboratory, 1.3 W/ft^2 for Lobby, 1.1 W/ft^2 for Office (Enclosed or Open), 0.9 W/ft^2 for Restroom/Break Room, 0.8 W/ft^2 for Active Storage, 0.7 W/ft^2 for Automotive – Service/Repair, 0.6 W/ft^2 for Active Stairs, 0.5 W/ft^2 for Corridor, and 0.2 W/ft^2 Parking Garage. Occupancy sensor controls required for classrooms, conference/meeting rooms, and lunch/break rooms. Ten (10) percent power reduction applied to zones in design building model where occupancy sensors are not required as per ASHRAE 90.1-2004 Table G3.2.
4. Miscellaneous electric (plug) loads based on survey of building owner to estimate number of personal computers, office equipment, etc. in each DOE-2.2 zone. Also modeled elevators identically in baseline and design building models (estimated 57 kW total input power based on one 40 hp and one 50 hp motors). Refrigeration equipment load based on estimated electrical usage provided by the design team and modeled identically in design and baseline.
5. Baseline exterior lighting power was established and coordinated with LEED Sustainable Sites Credit 8: Light Pollution Reduction.
6. Energy recovery is required on individual fan systems that have both a design capacity of 5,000 CFM or greater and have a minimum outside air supply of 70% of the supply air volume. The energy recovery system, when required, must have at

least 50% recovery effectiveness. According to Section G3.1.2.10, energy recovery is required for the baseline for areas served by laboratory system AHU-2, however a Credit Interpretation Ruling issued by the USGBC specifies that credit can be taken for energy recovery if the designed system has the ability to reduce total airflows by at least 50% (http://www.usgbc.org/LEED/Credit/CIRDetails.aspx?CIID=1819). Therefore, energy recovery is not modeled in the baseline.

7. Air-side economizers are required for baseline packaged VAV w/reheat (System 5) as per Section G3.1.2.6 and Table G3.1.2.6B.

One (1) 177.5-ton air-cooled rotary screw chiller will provide cooling capacity to the building. The basis of design is Trane RTAC series rated at 1.122 kW/ton full-load (10.7 EER) and 0.828 kW/ton IPLV (14.5 EER) at job conditions of 45° leaving chilled water temperature and 57°F entering chilled water temperature.

Three (3) 900 MBH output high efficiency natural gas-fired condensing boilers provide space and domestic hot water heating capacity. The basis of design is Hydrotherm KN-10 with 88% thermal efficiency at full-load. The boilers will generate domestic hot water through a plate-and-frame heat exchanger (HX-1).

A variable primary flow chilled water pumping system is specified. Pump speed/flow will be controlled by variable frequency drives (VFDs) in response to a differential pressure control. Each 10-hp pump is rated for 340 GPM at 55 feet of head. Only one pump operates at a time; the second pump provides standby service.

The building heating hot water pumping system consists of variable speed pumps HWP-1 and -2, each rated for 180 GPM at 45 feet of head (5-hp), and west and east constant speed radiation pumps HWP-4 and -5 rated for 20 GPM at 30 feet of head (0.5-hp). Variable speed pump HWP-3 (30 GPM at 15 feet of head; 0.5-hp) circulates hot water from the boiler loop through domestic hot water heat exchanger HX-1. The domestic hot water loop will include a fractional horsepower recirculation pump.

Fume hoods and bio-safety cabinets will be utilized in the laboratories. A variable air volume (VAV) laboratory supply and exhaust system will be provided. Space temperature and supply/exhaust air volume will be controlled through VAV terminal boxes as well as air valves on the exhaust of each fume hood and general exhaust.

Two central station variable air volume (VAV) air handling units will be provided for the building. One unit will serve the laboratory side of the building (designated as AHU-2), while the second will serve the offices and support space (AHU-1). The laboratory unit will supply 100% outside air to the laboratories. The supply fan will be fitted with a variable frequency drive to vary the amount of air delivered to the building in response to a duct static pressure control.

All of the laboratory exhaust systems will be ducted into a common header. Two 19,000 CFM variable speed/variable flow exhaust fans (designated as EF-6 and -7) will be controlled to maintain exhaust system static pressure as well as stack discharge velocity within an acceptable range. AHU-2 includes an enthalpy wheel that transfers energy between building exhaust and outdoor air streams to preheat or precool make-up air. The wheel was selected for zero percent cross contamination.

A flat plate heat exchanger is specified for exhaust air heat recovery in the PCR Amplification Lab. This system consists of make-up air fan EF-4 (1,500 CFM) and packaged heat recovery unit HR-1. Outside air is drawn through the heat exchanger by EF-4 before being delivered to the AHU-2 outside air intake. Energy is transferred between the laboratory exhaust air stream (on laboratory exhaust fans EF-6 and -7) and the outdoor air brought into the building by EF-4. A dedicated exhaust system is specified for the firing range (EF-3).

The office and support area VAV system will include terminal boxes with hot water reheat coils and a traditional duct static pressure control scheme to provide fan speed modulation through variable frequency drives.

Table 3-2 summarizes design ratings for the building's two major air handling systems. The values shown in the table were obtained from design drawings and vendor submittals.

Table 3-2: Air Handling Unit Design Ratings

I.D.	Service	Type[1]	Supply Fan Characteristics		Minimum OA CFM	Return/Exhaust Fan Characteristics		Heating Coil Capacity (MBH)	Cooling Coil Total Capacity (MBH)[2]	Cooling Coil Sensible Capacity (MBH)	Energy Recovery
			CFM	HP		CFM	HP				
AHU-1	Offices and Support	VAV	20,000	40	2,500	18,000	5	282	822	562	None
AHU-2	Laboratory	VAV	40,000	40	40,000	40,000	50	1,485	1,872	1,331	Enthalpy Wheel

A building automation system (BAS) will provide monitoring, direct digital control (DDC), and central management of the HVAC systems. Several control enhancements are specified including a dual enthalpy economizer on AHU-1 and discriminator controls to reset duct discharge temperature setpoints on the VAV systems. Lighting occupancy sensors will be used to index through the BAS occupancy status in laboratory spaces. When occupancy is not detected for 20 minutes, the room/lab shall reset to unoccupied status and its corresponding airflow requirement. The system will return to occupied airflow requirements immediately upon detection of space occupancy.

The building will be constructed with levels of insulation and glazing performance characteristics that exceed the minimum prescriptive requirements of the Energy Conservation Construction Code of New York State (ECCC) and ASHRAE Standard 90.1-2004 – *Energy Standard for Buildings Except Low-Rise Residential Buildings* (see Table 3-1). For example, a typical exterior wall consists of a masonry finish backed by 2-inches of continuous extruded polystyrene (nominal R-10), six inch metal studs, and nominal R-13 polyicynene spray foam between the studs. This compares to minimum R-3.8 continuous and R-13 cavity insulation as per ASHRAE Standard 90.1-2004 in Climate Zone 5A. Energy simulation models prepared by SAIC consider effective thermal resistance from thermal bridging through the metal studs. The continuous layer of rigid insulation serves as a thermal break at the studs.

The proposed PVC roofing membrane will be highly reflective with a minimum emissivity of 0.90. The Energy Star compliant membrane is intended to reduce the heat island effect and lower cooling energy requirements. The building design calls for an average of 4.5 inches of polyisocyanurate roof deck insulation. Assuming an aged thermal resistance of R-6.4 per inch, the total average R-value for the roof insulation is R-28.8.

High-performance glazing will be provided. The final design calls for low-E glazing (Guardian SunGuard basis of design). The 0.29 U-factor and 0.38 SHGC (center of glass) listed in the specifications for this glass type exceed the minimum requirements of the energy code and ASHRAE 90.1-2004. Glazing with reduced solar heat gain coefficient (SHGC) lowers space cooling loads and energy requirements, while reduced U-factors primarily lower heating energy requirements.

The lighting system is designed for an overall power density (LPD) that is lower than the maximum limit specified by the ASHRAE 90.1-2004 space-by-space method. The lighting power density for the entire building is approximately 0.953 Watts per square foot. This compares to a maximum allowable lighting power density of 1.120 W/ft^2 following the space-by-space method of ASHRAE 90.1-2004. Automatic daylight stepped control of fluorescent fixtures will be implemented in perimeter labs and offices while on/off control of fixtures will be utilized in the conference room, lounge, library and break room.

Baseline HVAC System Description: Tables G3.1.1A and G3.1.1B of ASHRAE 90.1-2004 define the appropriate baseline HVAC system type. For this project the baseline system is packaged variable air volume with reheat (VAV w/reheat) with DX cooling and fossil fuel boiler (System 5). There is no chilled water plant for the baseline building as the baseline system uses direct expansion cooling. As required by the PRM, all areas of the design building that will *not* be mechanically cooled were modeled with a DX cooling system that matches the baseline building system. In both cases, the same cooling system type and efficiency (equal to ASHRAE 90.1-2004 minimum efficiency) were modeled.

Building Energy Analysis: SAIC developed eQUEST building energy simulation models of the proposed (i.e., design) and baseline buildings to estimate energy and demand savings and financial incentives available from the New Construction Program and to determine the number of rating points available from LEED *Energy and Atmosphere Credit 1 (EAc1) – Optimize Energy Performance*. The LEED® *Option 1 – Whole Building Energy Simulation* compliance path was followed. This approach uses the Building Performance Rating Method (PRM) outlined in Appendix G of ASHRAE 90.1-2004. Addendum *a* to the Standard was followed, which eliminates the requirement to distribute glazing in horizontal bands for the baseline building. Also, Addendum *ac* was followed, which specifies an alternate method for calculating baseline fan brake horsepower and input power.

The PRM calls for four baseline model calculations; one for the building oriented as designed and three others with the building rotated 90°, 180° and 270° from the actual orientation. Annual energy and utility costs for the final baseline building are calculated as the average of the simulation results for the four orientations. The baseline and design building models include all energy end uses for the site, including regulated (e.g., interior and exterior lighting, space heating and cooling, pumps, fans, service water heating, snow melt system) and non-regulated (e.g., elevators, refrigeration, kitchen equipment and receptacle loads).

As required by the LEED EAc1 Energy Modeling Protocol (EMP), the non-regulated (process) energy use for both buildings is the same and has been scheduled such that the energy cost for the process loads is at least 25% of the total energy cost for the baseline building. The EMP requires the default process energy use unless a detailed accounting of process loads is presented. The estimated process energy cost for this project is 25.2% of the baseline building energy cost. In order to achieve the default process energy consumption (kWh), the estimated power (kW) for the process loads was maintained (so that HVAC equipment capacity would not be affected) while operating hours were extended.

In accordance with ASHRAE 90.1-2004 Appendix G, heating and cooling capacities of the baseline HVAC systems were oversized 25% and 15%, respectively, compared to eQUEST autosized loads. Baseline design air flow rates are based on a supply-air-to-room-air temperature difference of 20°F (Section G3.1.2.8). Baseline fan brake horsepower and input power were calculated by following the equations in Addendum *ac* to the Standard with credits for a fully-ducted return, return airflow control device, and MERV 13 filter (AHU-2 only).

Based on anticipated building usage, the office air handling system (AHU-1) is expected to operate weekdays from 6 a.m. to 7 p.m. with minimal operation on weekends and holidays. The laboratory air handling system (AHU-2, EF-6 and EF-7) will operate continuously.

Table 3-3 compares annual energy use and demand predicted by DOE-2.2 for the major end-uses in the building for the baseline and design buildings evaluated for the NYSERDA New Construction Program. As noted above, the baseline building results are the average of the four simulation run orientations.

Table 3-3: Comparison of Building Energy Use and Demand for Baseline and Design Building Models – NYSERDA NCP Analysis

	Units	*Baseline Building*	*Design Building*	*Savings*
Maximum Summer Demand	kW	432.5	310.7	121.8
Minimum Winter Demand	kW	192.0	186.5	5.5
Area Lights	kWh	136,796	93,058	43,738
Task Lights	kWh	17,292	17,292	0
Miscellaneous Equipment	kWh	315,187	315,187	0
Space Heating	kWh	0	1,999	(1,999)
Space Heating	Therms	89,431	31,821	57,610
Space Cooling	kWh	199,597	142,492	57,105
Pumps and Miscellaneous	kWh	28,879	27,919	960
Vent Fans	kWh	233,111	253,304	(20,193)
Exterior Lighting	kWh	26,284	14,556	11,728
Domestic Hot Water	Therms	404	356	48
Total Electricity	kWh	1,184,904	1,093,566	91,338
Total Natural Gas	Therms	89,834	32,178	57,656
Total Electric Cost @ $0.10/kWh	dollars	$118,491	$109,357	$9,134
Total Natural Gas Cost @ $1.15/therm	dollars	$103,309	$37,004	$66,305
Total Utility Cost	dollars	$221,800	$146,361	$75,439
Percent Energy Cost Savings				***34.0%***

Appendix B also includes selected DOE-2.2 output reports for the LEED EAc1 baseline and design building models. These reports present annual energy use for each building end-use (reports PS-E, BEPS and BEPU) as well as economic reports that summarize utility costs for both cases (reports ES-D and ES-E). Based on this analysis, the design building provides 34.0% energy cost savings relative to the baseline building.

Table 3-4 compares annual energy use and demand predicted by DOE-2.2 for the major end-uses in the building for the baseline and design buildings evaluated for the LEED EAc1 Analysis, including the operation of the PV Solar system (which is not included in the NYSERDA NCP results presented earlier).

Table 3-4: Comparison of Building Energy Use and Demand for Baseline and Design Building Models – LEED EAc1 Analysis

Performance Rating Method Compliance Report							
Performance and Rating Table Energy Summary by End Use			EAc1 Points 8 EAc2 Points 1				
			Proposed Building		**Baseline Building**		**Savings**
End Use	**Energy Type**	**Units**	**Energy**	**Peak**	**Energy**	**Peak**	**(%)**
Area Lights	Electricity	kWh	93,058	29.2	136,796	44.9	32%
Task Lights	Electricity	kWh	17,292	5.1	17,292	5.1	0%
Miscellaneous Equip	Electricity	kWh	315,187	38.9	315,187	38.9	0%
Space Heating	Electricity	kWh	1,999	0.9	-	-	-
Space Heating	Natural Gas	Therm	31,821	16.0	89,431	46.9	64%
Space Cooling	Electricity	kWh	142,492	136.9	199,597	247.7	29%
Pumps & Misc	Electricity	kWh	27,919	7.0	28,879	4.5	3%
Fans - Interior	Electricity	kWh	253,304	54.8	233,111	56.9	-9%
Refrigeration	Electricity	kWh	227,760	26.0	227,760	26.0	0%
Service Water Heating	Natural Gas	Therm	356	0.2	404	0.2	12%
Exterior Usage	Electricity	kWh	14,556	3.5	26,284	6.2	45%
Total Building Consumption		**MMBtu**	**6,950**		**13,028**		**47%**

		Proposed Building		**Baseline Building**		**Percentage Improvement**	
Type		**Energy Use**	**Energy Cost**	**Energy Use**	**Energy Cost**	**Energy (%)**	**Cost (%)**
Nonrenewable (Regulated & Unregulated)							
Electricity	MMBtu	3,732	$ 109,357	4,044	$ 118,491	7.7%	7.7%
Natural Gas	MMBtu	3,218	$ 37,004	8,983	$ 103,309	64.2%	64.2%
Steam or Hot Water	MMBtu	-	$ -	-	$ -	-	-
Chilled Water	MMBtu	-	$ -	-	$ -	-	-
Other	MMBtu	-	$ -	-	$ -	-	-
Total Nonrenewable	MMBtu	6,950	$ 146,361	13,027	$ 221,800	46.7%	34.0%
		Proposed Building		**Baseline Building**		**Percentage Improvement**	
Exceptional Calculation Method Savings (savings indicated as negative)		**Energy Use (MMBtu)**	**Energy Cost**	**Energy Use (MMBtu)**	**Energy Cost**	**Energy (%)**	**Cost (%)**
Site-Generated Renewable (REC)		(126)	$ (3,687)			1.0%	1.7%
Site-Recovered						-	-
Exceptional Calculation #1 Savings						-	-
Exceptional Calculation #2 Savings						-	-
Exceptional Calculation #3 Savings						-	-
Total including Exceptional Calculations		6,824	$ 142,674	13,027	$ 221,800	47.6%	35.7%
Percentage Improvement = 100 x (1 - (Proposed Building Performance / Baseline Building Performance))							**35.7%**
Percent Renewable = REC / (Proposed Building Performance + REC)							**2.52%**

Based on this analysis, the design building provides 35.7% energy cost savings relative to the baseline building and 2.52% site-generated renewable energy. This results in eight (8) LEED rating points for EAc1 and one (1) LEED rating point for EAc2. The number of points awarded is subject to USGBC review of the credit submissions. SAIC completed the LEED Online submittal template for the credit and prepared a separate report to document the results of the LEED EAc1 analysis.

The eQUEST simulations are in compliance with the requirements of ASHRAE 90.1-2004 Appendix G for simulation discrepancies between the baseline and design models. According to Section G3.1.2.2 of the standard, the unmet load hours reported by the simulation output for both the baseline and design runs may not exceed 300 hours per year (of the 8,760 hours simulated). Further, unmet load hours for the proposed building design may not exceed the unmet load hours for the baseline building design by more than 50 hours per year. This requirement is intended as a final check that adjustments made to the baseline HVAC system sizing was done correctly (and in accordance with the Standard) so that the baseline system loading characteristics are similar to the design system.

Incremental Cost: The estimated incremental cost for the proposed building design relative to the baseline building is $228,070 (see Appendix C). This includes all of the upgrades listed in Table 3-1.

Summary of Annual Electric Energy and Demand Savings and Recommended Incentive: The following table summarizes electric energy and demand savings for the project, total energy cost savings, the recommended performance-based NYSERDA incentive, and resulting simple payback period when the design building is compared to the ASHRAE 90.1-2004 Appendix G Performance Rating Method baseline. Section 1 of this report presents additional incentives available to the applicant and design team if LEED certification for the building is achieved.

Energy Savings (kWh)	91,338
Peak Summer Demand Savings (kW)	121.8
Peak Winter Demand Savings (kW)	5.5
Natural Gas Savings (Therms)	57,656
Total Annual Cost Savings	$75,439
Customer Effective Payback with Incentive (years)	1.87
NYSERDA Whole Building Design Incentive	***$87,071***

Appendix A

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Project Contact List

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Appendix B

eQUEST/DOE-2.2 Output Reports for Baseline and Design Building Models

LEED Baseline Building

DESIGN BUILDING

Appendix C

Estimated Incremental Construction Costs

Appendix D

NYSERDA New Construction Program Worksheets