MARKIM HALL

ENERGY & ATMOSPHERE CATEGORY

LEED FOR NEW CONSTRUCTION V2.2

14	Energy & Atmosphere	Possible Points:	17

Y	Prereq 1	Fundamental Commissioning of the Building Energy Systems	
Y	Prereq 2	Minimum Energy Performance	
Y	Prereq 3	Fundamental Refrigerant Management	1
1	Credit 1.1	Optimize Energy Performance, 10.5% New / 3.5% Existing	1
1	Credit 1.2	Optimize Energy Performance, 14% New / 7% Existing	1
1	Credit 1.3	Optimize Energy Performance, 17.5% New / 10.5% Existing	1
1	Credit 1.4	Optimize Energy Performance, 21% New / 14% Existing	1
1	Credit 1.5	Optimize Energy Performance, 24.5% New / 17.5% Existing	1
1	Credit 1.6	Optimize Energy Performance, 28% New / 21% Existing	1
1	Credit 1.7	Optimize Energy Performance, 31.5% New / 24.5% Existing	1
1	Credit 1.8	Optimize Energy Performance, 35% New / 28% Existing	1
1	Credit 1.9	Optimize Energy Performance, 38.5% New / 31.5% Existing	1
1	Credit 1.10	Optimize Energy Performance, 42% New / 35% Existing	1
	Credit 2.1	Renewable Energy, 2.5%	1
	Credit 2.2	Renewable Energy, 7.5%	1
	Credit 2.3	Renewable Energy, 12.5%	1
1	Credit 3	Enhanced Commissioning	1
1	Credit 4	Enhanced Refrigerant Management	1
1	Credit 5	Measurement & Verification	1
1	Credit 6	Green Power	1

ENERGY & ATMOPSHERE PREREQUISITE 1: FUNDAMENTAL COMMISSION OF THE BUILDING ENERGY SYSTEMS

REQUIRED

Intent

Verify that the building's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents.

Benefits of Commissioning

Benefits of commissioning include reduced energy use, lower operating costs, reduced contractor callbacks, better building documentation, improved occupant productivity, and verification that the systems perform in accordance with the owner's project requirements.

Requirements

The following commissioning process activities shall be completed by the commissioning team, in accordance with the LEED for New Construction 2.2 Reference Guide.

1) Designate an individual as the Commissioning Authority (CxA) to lead, review and oversee the completion of the commissioning process activities.

a) The CxA shall have documented commissioning authority experience in at least two building projects.

b) The individual serving as the CxA shall be independent of the project's design and construction management, though they may be employees of the firms providing those services. The CxA may be a qualified employee or consultant of the Owner.

c) The CxA shall report results, findings and recommendations directly to the Owner.

d) For projects smaller than 50,000 gross square feet, the CxA may include qualified persons on the design or construction teams who have the required experience.

2) The Owner shall document the Owner's Project Requirements (OPR). The design team shall develop the Basis of Design (BOD). The CxA 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.

Commissioned Systems

Commissioning process activities shall be completed for the following energy-related systems, at a minimum:

❑ Heating, ventilating, air conditioning, and refrigeration (HVAC&R) systems (mechanical and passive) and associated controls

❑ Lighting and daylighting controls

❑ Domestic hot water systems

❑ Renewable energy systems (wind, solar etc.)

Potential Technologies & Strategies
Owners are encouraged to seek out qualified individuals to lead the commissioning process. Qualified individuals are identified as those who possess a high level of experience in the following areas:

❑ Energy systems design, installation and operation

❑ Commissioning planning and process management

❑ Hands-on field experience with energy systems performance, interaction, start-up, balancing, testing, troubleshooting, operation, and maintenance procedures

❑ Energy systems automation control knowledge

Owners are encouraged to consider including water-using systems, building envelope systems, and other systems in the scope of the commissioning plan as appropriate. The building envelope is an important component of a facility which impacts energy consumption, occupant comfort and indoor air quality. While it is not required to be commissioned by LEED, an owner can receive significant financial savings and reduced risk of poor indoor air quality by including building envelope commissioning.
The LEED for New Construction 2.2 Reference Guide provides guidance on the rigor expected for this prerequisite for the following:

❑ Owner's project requirements

❑ Basis of design

❑ Commissioning plan

❑ Commissioning specification

❑ Performance verification documentation

❑ Commissioning report

CREDIT COMPLIANCE
All requirements for commissioning of the building were met. The complete commissioning scope of work and report can be found in the digital appendix.

ENERGY & ATMOPSHERE PREREQUISITE 2: MINIMUM ENERGY PERFORMANCE

REQUIRED

Intent

Establish the minimum level of energy efficiency for the proposed building and systems.

Requirements

Design the building project to comply with both—

❑ the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) of ASHRAE/IESNA Standard 90.1-2004 (without amendments); and

❑ the prescriptive requirements (Sections 5.5, 6.5, 7.5 and 9.5) or performance requirements (Section 11) of ASHRAE/IESNA Standard 90.1-2004 (without amendments).

Potential Technologies & Strategies

Design the building envelope, HVAC, lighting, and other systems to maximize energy performance. The ASHRAE 90.1-2004 User's Manual contains worksheets that can be used to document compliance with this prerequisite. For projects pursuing points under EA Credit 1, the computer simulation model may be used to confirm satisfaction of this prerequisite.

If a local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy standard process for commercial energy code determination, then it may be used to satisfy this prerequisite in lieu of ASHRAE 90.1-2004. Details on the DOE process for commercial energy code determination can be found at www.energycodes.gov/implement/determinations_com.stm.

CREDIT COMPLIANCE

The project complies with all minimum energy performance requirements.

ENERGY & ATMOPSHERE PREREQUISITE 3: FUNDAMENTAL REFRIGERANT MANAGEMENT

REQUIRED

Intent
Reduce ozone depletion.

Requirements
Zero use of CFC-based refrigerants in new base building HVAC&R systems. When reusing existing base building HVAC equipment, complete a comprehensive CFC phase-out conversion prior to project completion. Phase-out plans extending beyond the project completion date will be considered on their merits.

Potential Technologies & Strategies
When reusing existing HVAC systems, conduct an inventory to identify equipment that uses CFC refrigerants and provide a replacement schedule for these refrigerants. For new buildings, specify new HVAC equipment in the base building that uses no CFC refrigerants.

CREDIT COMPLIANCE
The new IGC Building is served from a central campus chilled water plant. This plant contains a series of water cooled Chillers utilizing HCFC-123 as their refrigerant. No CFC refrigerants are in use.

ENERGY & ATMOPSHERE CREDIT 1: OPTIMIZE ENERGY PERFORMANCE (1-10 POINTS)

10 POINTS

Intent

Achieve increasing levels of energy performance above the baseline in the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Requirements

Select one of the four compliance path options described below. Project teams documenting achievement using any of these options are assumed to be in compliance with EA Prerequisite 2.
NOTE: LEED for New Construction projects registered after June 26th, 2007 are required to achieve at least two (2) points under EAc1.

OPTION 1 — WHOLE BUILDING ENERGY SIMULATION (1–10 Points)
Demonstrate a percentage improvement in the proposed building performance rating compared to the baseline building performance rating per ASHRAE/IESNA Standard 90.1-2004 by a whole building project simulation using the Building Performance Rating Method in Appendix G of the Standard. The minimum energy cost savings percentage for each point threshold is as follows:

New Buildings	Existing Building	Renovations Points
10.5%	3.5%	1
14%	7%	2
17.5%	10.5%	3
21%	14%	4
24.5%	17.5%	5
28%	21%	6
31.5%	24.5%	7
35%	28%	8
38.5%	31.5%	9
42%	25%	10

** Note: Only projects registered prior to June 26, 2007 may pursue 1 point under EAc1.*

Appendix G of Standard 90.1-2004 requires that the energy analysis done for the Building Performance Rating Method include ALL of the energy costs within and associated with the building project. To achieve points using this credit, the proposed design—

❑ must comply with the mandatory provisions (Sections 5.4, 6.4, 7.4, 8.4, 9.4 and 10.4) in Standard 90.1-2004;

❑ must include all the energy costs within and associated with the building project; and

❑ must be compared against a baseline building that complies with Appendix G to Standard 90.1-2004. The default process energy cost is 25% of the total energy cost for the baseline building. For buildings where the process energy cost is less than 25% of the baseline building energy cost, the LEED submittal must include supporting documentation substantiating that process energy inputs are appropriate.

For the purpose of this analysis, process energy is considered to include, but is not limited to, office and general miscellaneous equipment, computers, elevators and escalators, kitchen cooking and refrigeration, laundry washing and drying, lighting exempt from the lighting power allowance (e.g., lighting integral to medical equipment) and other (e.g., waterfall pumps). Regulated (non-process) energy includes lighting (such as for the interior, parking garage, surface parking, façade, or building

grounds, except as noted above), HVAC (such as for space heating, space cooling, fans, pumps, toilet exhaust, parking garage ventilation, kitchen hood exhaust, etc.), and service water heating for domestic or space heating purposes.

For EA Credit 1, process loads shall be identical for both the baseline building performance rating and for the proposed building performance rating. However, project teams may follow the Exceptional Calculation Method (ASHRAE 90.1-2004 G2.5) to document measures that reduce process loads. Documentation of process load energy savings shall include a list of the assumptions made for both the base and proposed design, and theoretical or empirical information supporting these assumptions.

OR

OPTION 2 — PRESCRIPTIVE COMPLIANCE PATH: ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004 (4 Points)

Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide for Small Office Buildings 2004. The following restrictions apply:

❑ Buildings must be under 20,000 square feet.

❑ Buildings must be office occupancy.

❑ Project teams must fully comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located.

OR

OPTION 3 — PRESCRIPTIVE COMPLIANCE PATH: Advanced Buildings™ Core Performance™ Guide (2-5 Points)

Comply with the prescriptive measures identified in the Advanced Buildings™ Core Performance™ Guide developed by the New Buildings Institute. The following restrictions apply:

❑ Buildings must be under 100,000 square feet.

❑ Buildings may NOT be health care, warehouse or laboratory projects.

❑ Project teams must fully comply with Sections One, Design Process Strategies, and Two, Core Performance Requirements.

Minimum points achieved under Option 3 (2-3 points):

❑ Three (3) points are available for all office, school, public assembly, and retail projects under 100,000 square feet that comply with Sections One and Two of the Core Performance Guide.

❑ Two (2) points are available for all other project types under 100,000 square feet (except health care, warehouse, or laboratory projects) that implement the basic requirements of the Core Performance Guide Additional points available under Option 3 (up to 2 additional points):

❑ Up to two (2) additional points are available to projects that implement performance strategies listed in Section Three, Enhanced Performance. For every three strategies implemented from this section, one point is available.

❑ Any strategies applicable to the project may be implemented except:

- 3.1-Cool Roofs
- 3.8-Night Venting
- 3.13-Additional Commissioning

These strategies are addressed by different aspects of the LEED program and are not eligible for additional points under EA Credit 1.

OR

OPTION 4 — PRESCRIPTIVE COMPLIANCE PATH: Advanced Buildings Benchmark™ Basic Criteria and Prescriptive Measures (1 Point)

Note: projects registered after June 26, 2007 may not use this option.

Comply with the Basic Criteria and Prescriptive Measures of the Advanced Buildings Benchmark™ Version 1.1 with the exception of the following sections: 1.7 Monitoring and Trend-logging, 1.11 Indoor Air Quality, and 1.14 Networked Computer Monitor Control. The following restrictions apply:

❑ Project teams must fully comply with all applicable criteria as established in Advanced Buildings Benchmark for the climate zone in which the building is located.

Potential Technologies & Strategies
Design the building envelope and systems to maximize energy performance. Use a computer simulation model to assess the energy performance and identify the most cost-effective energy efficiency measures. Quantify energy performance as compared to a baseline building.
If a local code has demonstrated quantitative and textual equivalence following, at a minimum, the U.S. Department of Energy standard process for commercial energy code determination, then the results of that analysis may be used to correlate local code performance with ASHRAE 90.1-2004. Details on the DOE process for commercial energy code determination can be found at www.energycodes.gov/implement/determinations_com.stm.

CREDIT COMPLIANCE
The USGBC required two energy simulations to be run comparing a baseline building to the proposed design. The first, Step 1, used utilities from the campus central plant. The second, Step 2, was modeled according to the Performance Rating Method, ASHRAE 90.1-2004 Appendix G for the baseline building and 'virtual' chiller and boiler plants for the proposed building. Using the Step 1 model, 56% of energy and 53.3% in cost was saved when compared to the baseline.

Step 1 – The building was modeled using purchased campus chilled water (CHW) and heating hot water (HHW) from the central plant. The campus does not charge users for utilites but the following prices were used for modeling puposes and were based on annual average costs. Utility prices used for purchased HHW are $9.41/MB and 0.7-KW/ton or $0.052/ton-hr or $4.33/MB for CHW.

General Information:
Principle Heating Source: Fossil Fuel
Quantity of Stories: 4
Weather File: Minneapolis MN TMY2
Climate Zone: 6A
Energy Code Used: ASHRAE 90.1-2004 Appendix G
New Construction Percent: 100
Energy Star Target Finder Score: 98

Space summary:

Building Use (Occupancy Type)	Conditioned Area (sf)	Unconditioned Area (sf)	Total Area (sf)
IGC Court	850		850
Enclosed Offices	3,593		3,593
Mechanical/Electrical		1,441	1,441
Restrooms	622		622
Stairwells	1,959		1,959
Open Office/Hallway	5,428		5,428
Storage	2,549		2,549
Total	15,001	1,441,	16,442

Advisory Messages (from simulation output files):

	Proposed Building	Baseline Building	Difference
Num. of Hours Heating Loads not Met	243	193	50
Numb. of Hours Cooling Loads not Met	0	0	0
Number of Warning Messages	0	0	0
Number of Error Messages	0	0	0
Number of Defaults Overridden	0	0	0

Comparison of Proposed Design Versus Baseline Design:

Model Input Parameter	Proposed Design Input	Baseline Design Input
Exterior Wall Construction	R-34, 6" HD SPF	Steel Framed, U=0.058 (R-17.24)
Roof Construction	R-50, Minimum	Insulation entirely above deck
Floor/Slab Construction	R-30	Unheated, F-0.73
Window-to-Gross Wall Ratio	19%	19%
Fenestration Type	Triple Low-e w/Argon, except double on S.	Fixed, double Low-e (std properties)
Fenestration U-factor	Double=0.3, Triple=0.2	0.57
Fenestration SHGC-south	Double=0.33	0.49
Fenestration SHGC-non-south	Triple=0.29	0.39
Fenestration Visual Light transmittance	Double=0.7, Triple=0.56	0.9
Shading Devices	Overhangs on select windows on south face	None
Interior Lighting Power Density (W/sf)	0.8	1.2
Daylighting Controls	Yes, continuous daylight dimming	None
Other Lighting Control Credits	None	None
Exterior Lighting Power (kW)	0	0

Model Input Parameter	Proposed Design Input	Baseline Design Input
Process Lighting (kW)	0	0
Receptacle Equipment Power Density (W/sf)	0.65	0.65
Primary HVAC System Type	Dedicated outdoor air ventilation system with radian ceiling panels for heating and cooling	Table G3.1.1B System #7- Packaged rooftop variable air volume CHW cooling with HW reheat
Fan supply, exhaust or return flowrate	4,250 CFM SA and EA	14,420 CFM SA, 10,4855 CFM RA
Fan Power	1.55 KW each SA and EA	90.1=13.8 KW SA, 10.0 KW RA
Economizer Control	70F dry bulb	70F dry bulb high limit shutoff
Demand Control Ventilation	No	No
Unitary Equipment Cooling Efficiency	N/A	N/A
Unitary Equipment Heating Efficiency	N/A	N/A
Chiller Parameters	Step 1, purchased CHW from campus system	Step 1, purchased CHW from campus system
Chilled Water Loop & Pump Parameters	44-556 F	44-56 F
Boiler Parameters	Step 1, purchased steam from campus system with HW converter	Step 1, purchased steam from campus system with HW converter
Hot Water Loop & Pump Parameters	180-130F	180-130F
Cooling Tower Parameters	N/A	N/A
Condenser Water Loop & Pump Parameters	N/A	N/A

Energy Type Summary:

Energy Type	Utility Rate Description	Units of Energy	Units of Demand
Electricity	Xcel rate A-14 General Service	kWh	Kw
Purchased Chilled Water	CHW from Campus Plant	MBtu	MBH
Purchased Steam	LP Steam from Campus Plant	MBtu	MBH
Natural Gas	Xcel rate #118 Large	Therms	MBH

Performance Rating:

End Use	Proposed Design Energy Type	Proposed Design Units	Proposed Building Results	Baseline Building Units	Baseline Building Results	Percent Savings
Interior Lighting	Electricity	Energy Use (kWh)	25,923	Energy Use (kWh)	51,480	49.6%
Exterior Lighting	Electricity	Energy Use (kWh)	0	Energy Use (kWh)	0	0%
Space Heating	Purchased Steam	Energy Use (MBtu)	385	Energy Use (MBtu)	987.3	61%
Space Cooling	Purchased Chilled Water	Energy Use (MBtu)	106	Energy Use (MBtu)	229.8	53.9%
Pumps	Electricity	Energy Use (kWh)	1,206	Energy Use (kWh)	11,494.5	89.5%
Heat Rejection	Electricity	Energy Use (kWh)	0	Energy Use (kWh)	0	0%
Fans-Interior	Electricity	Energy Use (kWh)	12,485	Energy Use (kWh)	31,255	60.1%
Service Water Heating	Electricity	Energy Use (kWh)	10,735	Energy Use (kWh)	10,735	0%
Receptacle Equipment (Process Energy)	Electricity	Energy Use (kWh)	16,018	Energy Use (kWh)	16,018	0%
Energy Totals	**Total Annual Energy Use (MBtu/yr)**		**717**		**1,630**	**56%**
	Annual Process Energy (MBtu/yr)		**55**		**55**	**0%**

Energy Cost and Consumption by Energy Type:

	Proposed Design		Baseline Design		Percent Savings	
Energy Type	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
Electricity	66,367 kWh	$4,932	120,982 kWh	$8,989	45.1%	45.1%
Purchased Chilled Water	106 MBtu	$458	229 MBtu	$995	53.7%	54%
Purchased Steam	385 MBtu	$3,619	987 MBtu	$9,289	61%	61%
Natural Gas	0 therms		0 therms	0	0%	0%
Total	**717 (MBtu/yr)**	**$9,009**	**1,630 (MBtu/yr)**	**$19,273**	**56%**	**53.3%**

Energy Units:
1 kBtu = 1,000 Btu 1 MBtu = 1,000 kBtu
1 kWh = 3.412 kBtu 1 MWh = 3,412 kBtu
1 therm = 100 kBtu 1 ton hr = 12 kBtu

Step 2- The baseline building was modeling according to ASHRAE 90.1 using two gas-fired HHW boiler and a packaged DX VAV system and billed under local electric and firm gas rates. The proposed building was modeled using CHW and HHW from 'virtual' dedicated chiller and boiler plants that reflect the operating efficiencies and losses described above, and billed under local electric and firm gas rates.

General Information:

Principle Heating Source: Fossil Fuel
Quantity of Stories: 4
Weather File: Minneapolis MN TMY2
Climate Zone: 6A
Energy Code Used: ASHRAE 90.1-2004 Appendix G
New Construction Percent: 100
Energy Star Target Finder Score: 98

Space summary:

Building Use (Occupancy Type)	Conditioned Area (sf)	Unconditioned Area (sf)	Total Area (sf)
IGC Court	850		850
Enclosed Offices	3,593		3,593
Mechanical/Electrical		1,441	1,441
Restrooms	622		622
Stairwells	1,959		1,959
Open Office/Hallway	5,428		5,428
Storage	2,549		2,549
Total	15,001	1,441	16,442

Advisory Messages (from simulation output files):

	Proposed Building	Baseline Building	Difference
Num. of Hours Heating Loads not Met	243	193	50
Numb. of Hours Cooling Loads not Met	0	0	0
Number of Warning Messages	3	2	1
Number of Error Messages	0	0	0
Number of Defaults Overridden	0	0	0

Comparison of Proposed Design Versus Baseline Design:

Model Input Parameter	Proposed Design Input	Baseline Design Input
Exterior Wall Construction	R-34, 6" HD SPF	Steel Framed, U=0.058 (R-17.24)
Roof Construction	R-50, Minimum	Insulation entirely above deck
Floor/Slab Construction	R-30	Unheated, F-0.73
Window-to-Gross Wall Ratio	19%	19%
Fenestration Type	Triple Low-e w/Argon, except double on S.	Fixed, double Low-e (std properties)
Fenestration U-factor	Double=0.3, Triple=0.2	0.57
Fenestration SHGC-south	Double=0.33	0.49
Fenestration SHGC-non-south	Triple=0.29	0.39
Fenestration Visual Light Transmittance	Double=0.7, Triple=0.56	0.9
Shading Devices	Overhangs on select windows on south face	None
Interior Lighting Power Density (W/sf)	0.8	1.2
Daylighting Controls	Yes, continuous daylight dimming	None
Other Lighting Control Credits	None	None
Exterior Lighting Power (kW)	0	0
Process Lighting (kW)	0	0
Receptacle Equipment Power Density (W/sf)	0.65	0.65
Primary HVAC System Type	Dedicated outdoor air ventilation system with radian ceiling panels for heating and cooling	Table G3.1.1B System #7-Packaged rooftop variable air volume CHW cooling with HW reheat
Fan Supply Volume	3,820 CFM	14,420 CFM
Fan Power (SA,EA or RA)	1.5, 1.5-kW	13.8, 10.0-kW
Economizer Control	65F dry bulb	70F dry bulb high limit shutoff
Demand Control Ventilation	No	No
Unitary Equipment Cooling Efficiency	N/A	9.3-EER from Table 6.8.1-A
Unitary Equipment Heating Efficiency	N/A	N/A
Virtual Chiller Parameters	0.67 –KW/T average at campus chiller plant	N/A-Packaged DX Cooling
Chilled Water Loop & Pump Parameters	USGBC default 5% distribution loss	N/A
Boiler Parameters	USGBC default 70% boiler plant efficiency	Two 90% gas-fired HHW boilers
Hot Water Loop & Pump Parameters	USGBC default 15% distribution loss	50-degree delta-T system
Cooling Tower Parameters	N/A	N/A

Model Input Parameter	Proposed Design Input	Baseline Design Input
Condenser Water Loop & Pump	N/A	N/A

Energy Type Summary:

Energy Type	Utility Rate Description	Units of Energy	Units of Demand
Electricity	Xcel rate A-14 General Service	kWh	Kw
Natural Gas	Xcel Firm rate #118 Large	Therms	MBH

Performance Rating:

End Use	Proposed Design Energy Type	Proposed Design Units	Proposed Building Results	Baseline Building Units	Baseline Building Results	Percent Savings
Interior Lighting	Electricity	Energy Use (kWh)	25,923	Energy Use (kWh)	51,480	49.6%
Exterior Lighting	Electricity	Energy Use (kWh)	0	Energy Use (kWh)	0	0%
Space Heating	Purchased Steam	Energy Use (MBtu)	6,382	Energy Use (MBtu)	13,949	54.2%
Space Cooling	Purchased Chilled Water	Energy Use (MBtu)	6,449	Energy Use (MBtu)	29,992.8	78.5%
Pumps	Electricity	Energy Use (kWh)	1,210	Energy Use (kWh)	4,427.3	72.7%
Heat Rejection	Electricity	Energy Use (kWh)	0	Energy Use (kWh)	0	0%
Fans-Interior	Electricity	Energy Use (kWh)	16,458	Energy Use (kWh)	31,848.5	48.3%
Service Water Heating	Electricity	Energy Use (kWh)	10,735	Energy Use (kWh)	10,735	0%
Receptacle Equipment (Process Energy)	Electricity	Energy Use (kWh)	16,018	Energy Use (kWh)	16,018	0%
Energy Totals	**Total Annual Energy Use (MBtu/yr)**		**900**		**1,888**	**52.3%**
	Annual Process Energy (MBtu/yr)		**55**		**55**	**0%**

Energy Cost and Consumption by Energy Type:

	Proposed Design		Baseline Design		Percent Savings	
Energy Type	Energy Use	Cost	Energy Use	Cost	Energy Use	Cost
Electricity	76,793 kWh	$5,083	144,500 kWh	$9,333	46.9%	45.5%
Natural Gas	6,382 therms	$6,564	13,949 therms	$13,837	54.2%	52.6%
Total	**900 (MBtu/yr)**	**$11,647**	**1,888(MBtu/yr)**	**$23,170**	**52.3%**	**49.7%**

Energy Units:
1 kBtu = 1,000 Btu 1 MBtu = 1,000 kBtu
1 kWh = 3.412 kBtu 1 MWh = 3,412 kBtu
1 therm = 100 kBtu 1 ton hr = 12 kBtu

The building saved 56% in energy use and 53.3% in cost over the baseline.

The Basis of Design Docuptement for MEP Systems and the eQuest energy simulation output can be found in the appendix.

ENERGY & ATMOPSHERE CREDIT 3: ENHANCED COMMISSIONING

1 POINT

Intent

Begin the commissioning process early during the design process and execute additional activities after systems performance verification is completed.

Requirements

Implement, or have a contract in place to implement, the following additional commissioning process activities in addition to the requirements of EA Prerequisite 1 and in accordance with the LEED for New Construction 2.2 Reference Guide:

1. Prior to the start of the construction documents phase, designate an independent Commissioning Authority (CxA) to lead, review, and oversee the completion of all commissioning process activities. The CxA shall, at a minimum, perform Tasks 2, 3 and 6. Other team members may perform Tasks 4 and 5

    a. The CxA shall have documented commissioning authority experience in at least two building projects.
    b. The individual serving as the CxA shall be—
        i. independent of the work of design and construction;
        ii. not an employee of the design firm, though they may be contracted through them;
        iii. not an employee of, or contracted through, a contractor or construction manager holding construction contracts; and
        iv. (can be) a qualified employee or consultant of the Owner.
    c. The CxA shall report results, findings and recommendations directly to the Owner.
    d. This requirement has no deviation for project size.

2. The CxA 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 CxA shall review contractor submittals applicable to systems being commissioned for compliance with the OPR and BOD. This review shall be concurrent with 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 by the CxA in reviewing building operation within 10 months after substantial completion with O&M staff and occupants. Include a plan for resolution of outstanding commissioning related issues.

Potential Technologies & Strategies

Although it is preferable that the CxA be contracted by the Owner, for the enhanced commissioning credit, the CxA may also be contracted through the design firms or construction management firms not holding construction contracts. The LEED for New Construction 2.2 Reference Guide provides detailed guidance on the rigor expected for following process activities:

- ❑ Commissioning design review
- ❑ Commissioning submittal review

❑ Systems manual

CREDIT COMPLIANCE

The commissioning agent met all the requirements. The scope of work and final commissioning report can be found in the appendix under Energy and Atmosphere Prerequisite 1.

ENERGY & ATMOPSHERE CREDIT 4: ENHANCED REFRIGERANT MANAGEMENT

1 POINT

Intent

Reduce ozone depletion and support early compliance with the Montreal Protocol while minimizing direct contributions to global warming.

Requirements

OPTION 1

Do not use refrigerants.

OR

OPTION 2

Select refrigerants and HVAC&R that minimize or eliminate the emission of compounds that contribute to ozone depletion and global warming. The base building HVAC&R equipment shall comply with the following formula, which sets a maximum threshold for the combined contributions to ozone depletion and global warming potential:

$$LCGWP + LCODP \times 105 \leq 100$$

Where:

$LCODP = [ODPr \times (Lr \times Life + Mr) \times Rc]/Life$

$LCGWP = [GWPr \times (Lr \times Life + Mr) \times Rc]/Life$

LCODP: Lifecycle Ozone Depletion Potential (lbCFC11/Ton-Year)

LCGWP: Lifecycle Direct Global Warming Potential (lbCO2/Ton-Year)

GWPr: Global Warming Potential of Refrigerant (0 to 12,000 lbCO2/lbr)

ODPr: Ozone Depletion Potential of Refrigerant (0 to 0.2 lbCFC11/lbr)

Lr: Refrigerant Leakage Rate (0.5% to 2.0%; default of 2% unless otherwise demonstrated)

Mr: End-of-life Refrigerant Loss (2% to 10%; default of 10% unless otherwise demonstrated)

Rc: Refrigerant Charge (0.5 to 5.0 lbs of refrigerant per ton of cooling capacity)

Life: Equipment Life (10 years; default based on equipment type, unless otherwise d emonstrated)

For multiple types of equipment, a weighted average of all base building level HVAC&R equipment shall be applied using the following formula:

$$[\ \Sigma\ (LCGWP + LCODP \times 105) \times Qunit\ ]\ /\ Qtotal \leq 100$$

Where:

Qunit = Cooling capacity of an individual HVAC or refrigeration unit (Tons)

Qtotal = Total cooling capacity of all HVAC or refrigeration

Small HVAC units (defined as containing less than 0.5 lbs of refrigerant), and other equipment such as standard refrigerators, small water coolers, and any other cooling equipment that contains less than 0.5 lbs of refrigerant, are not considered part of the “base building” system and are not subject to the requirements of this credit.

AND

Do not install fire suppression systems that contain ozone-depleting substances (CFCs, HCFCs or Halons).

Potential Technologies & Strategies

Design and operate the facility without mechanical cooling and refrigeration equipment. Where mechanical cooling is used, utilize base building HVAC and refrigeration systems for the refrigeration cycle that minimize direct impact on ozone depletion and global warming. Select HVAC&R equipment with reduced refrigerant charge and increased equipment life. Maintain equipment to prevent leakage of refrigerant to the atmosphere. Utilize fire suppression systems that do not contain HCFCs or Halons.

CREDIT COMPLIANCE

Refrigerant Impact Calculation:

	HBAC&R Equipment Type	
	Centrifugal Chiller	Centrifugal Chiller
#	1	3
Q (tons)	650	860
Refrigerant	R-123	R-123
GWPr	76	76
ODPr	0.02	0.02
RC (lb/ton)	2.31	1.86
Life (yrs)	23	23
Lr (%)	2	2
Mr (%)	10	10
LCGWP	4.3	3.4
LCODP x 10^5	1,125	90.6
Refrigerant Impact Per Ton	116.8	94
Refrigerant Impact Total	75,895	242,561

Credit Narrative

The new building is served with Chilled Water from The Macalester College central campus plant. This plant contains 4 water cooled chillers utilizing HCFC-123 as their refrigerant. This equipment has been newly installed and the expected leakage rate from the Equipment Manufacturer's literature is assumed to be less than the 2% used in the table calculation above. The expected rate is in the order of 0.5% which would change the above calculation to show a Total Refrigerant Impact per Ton of 37.9. In either case (2% or 0.5% leakage) this plant complies with the requirements of this credit.

ENERGY & ATMOPSHERE CREDIT 5: MEASUREMENT & VERIFICATION

1 POINT

Intent

Provide for the ongoing accountability of building energy consumption over time.

Requirements

❑ Develop and implement a Measurement & Verification (M&V) Plan consistent with Option D: Calibrated Simulation (Savings Estimation Method 2), or Option B: Energy Conservation Measure Isolation, as specified in the *International Performance Measurement & Verification Protocol (IPMVP) Volume III: Concepts and Options for Determining Energy Savings in New Construction, April, 2003*.

❑ The M&V period shall cover a period of no less than one year of post-construction occupancy.

Potential Technologies & Strategies

Develop an M&V Plan to evaluate building and/or energy system performance. Characterize the building and/or energy systems through energy simulation or engineering analysis. Install the necessary metering equipment to measure energy use. Track performance by comparing predicted performance to actual performance, broken down by component or system as appropriate. Evaluate energy efficiency by comparing actual performance to baseline performance.

While the IPMVP describes specific actions for verifying savings associated with energy conservation measures (ECMs) and strategies, this LEED credit expands upon typical IPMVP M&V objectives. M&V activities should not necessarily be confined to energy systems where ECMs or energy conservation strategies have been implemented. The IPMVP provides guidance on M&V strategies and their appropriate applications for various situations. These strategies should be used in conjunction with monitoring and trend logging of significant energy systems to provide for the ongoing accountability of building energy performance.

CREDIT COMPLIANCE

The project followed Option D: Calibrated Simulation (savings Estimation Method 2). The following tables are taken from the Measurement and Verification Plan. The entire plan can be found in the appendix.

Table A-1 Macalester College - IGC

BUILDING AS DESIGNED - Anticipated Results (from Energy Model)

Electrical Usage - metered at Building

Units (kWh x 000)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Hot Water Usage	1.07	1.15	1.02	1.05	1.20	0.59	0.66	0.94	0.65	0.84	0.95	0.63	**10.75**
Fans	1.59	1.43	1.53	1.35	1.22	1.05	0.77	0.35	0.17	0.53	0.95	1.54	**12.48**
Pumps	0.13	0.11	0.13	0.12	0.14	0.13	0.10	0.06	0.04	0.05	0.08	0.12	**1.21**
Misc Equipment (plugs)	1.44	1.48	1.31	1.36	1.70	0.90	1.11	1.70	1.17	1.44	1.50	0.91	**16.02**
Lighting	2.47	2.47	2.12	2.15	2.57	1.38	1.68	2.58	1.85	2.38	2.62	1.64	**25.91**
TOTAL	**6.70**	**6.64**	**6.11**	**6.03**	**6.83**	**4.05**	**4.32**	**5.63**	**3.88**	**5.24**	**6.10**	**4.84**	**66.37**

Cooling Energy (purchased CHW from Campus Plant, Metered at Building)

Units (MBTU)

Cooling Energy	0	0	0	0.874	11.325	19.428	26.469	31.572	12.96	1.326	0	0	**103.954**

Heating Energy (purchased HW/steam from Central Plant, Metered at Building)

Units (MBTU)

Heating Energy	74.1	60.7	58.2	41.5	20.2	6.3	3.7	2.5	2	11.7	34.4	69.4	**384.7**

Table A-2 Macalester College - IGC

BASELINE BUILDING - Minimum Code Complaint (From Energy Model)

Electrical Usage - metered at Building

Units (kWh x 000)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	TOTAL
Hot Water Usage	1.07	1.15	1.02	1.04	1.20	0.58	0.66	0.94	0.65	0.84	0.95	0.63	**10.73**
Fans	3.73	3.13	3.32	3.20	3.16	2.68	2.10	1.60	0.96	1.75	2.55	3.38	**31.56**
Pumps	1.30	1.15	1.24	1.17	1.15	1.01	0.80	0.59	0.34	0.64	0.96	1.24	**11.59**
Misc Equipment (plugs)	1.44	1.48	1.31	1.36	1.70	0.90	1.11	1.70	1.17	1.44	1.50	0.91	**16.02**
Lighting	4.62	4.76	4.20	4.39	5.47	2.90	3.56	5.47	3.75	4.62	4.81	2.92	**51.47**
TOTAL	**12.16**	**11.67**	**11.09**	**11.16**	**12.68**	**8.07**	**8.23**	**10.30**	**6.87**	**9.29**	**10.77**	**9.08**	**121.37**

Cooling Energy (purchased CHW from Campus Plant, Metered at Building)

Units (MBTU)

Cooling Energy	2	2	2	5	28	50	64	59	12	4	2	2	**232**

Heating Energy (purchased HW/steam from Central Plant, Metered at Building)

Units (MBTU)

Heating Energy	237	180	130	59	19	4	4	3	3	34	102	207	**982**

ENERGY & ATMOPSHERE CREDIT 6: GREEN POWER

1 POINT

Intent

Encourage the development and use of grid-source, renewable energy technologies on a net zero pollution basis.

Requirements

Provide at least 35% of the building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. Renewable sources are as defined by the Center for Resource Solutions (CRS) Green-e products certification requirements.

DETERMINE THE BASELINE ELECTRICITY USE
Use the annual electricity consumption from the results of EA Credit 1.
OR
Use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use.

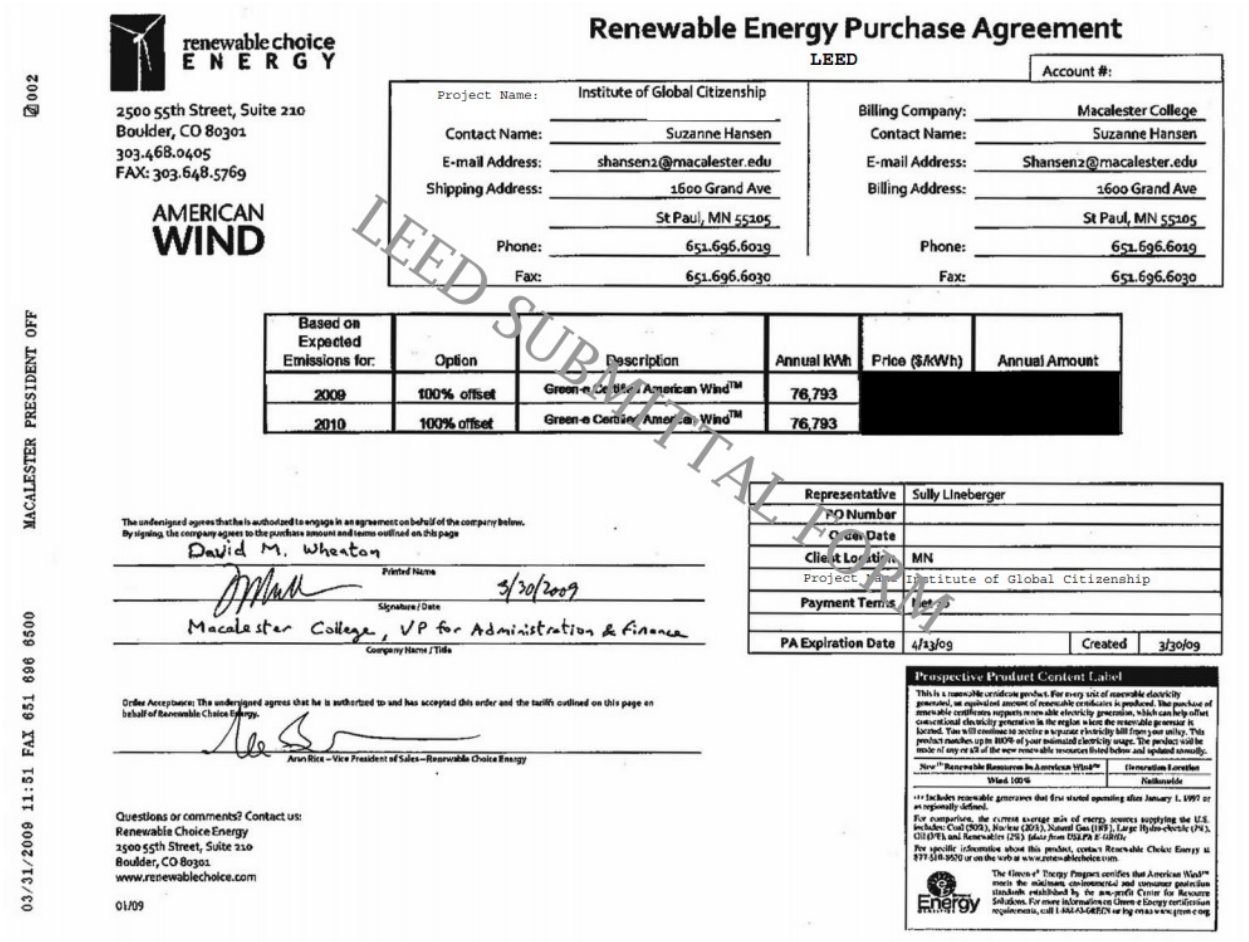
Potential Technologies & Strategies

Determine the energy needs of the building and investigate opportunities to engage in a green power contract. Green power is derived from solar, wind, geothermal, biomass or low-impact hydro sources. Visit www.green-e.org for details about the Green-e program. The power product purchased to comply with credit requirements need not be Green-e certified. Other sources of green power are eligible if they satisfy the Green-e program's technical requirements. Renewable energy certificates (RECs), tradable renewable certificates (TRCs), green tags and other forms of green power that comply with Green-e's technical requirements can be used to document compliance with EA Credit 6 requirements.

CREDIT COMPLIANCE

Based on the design energy cost from Energy & Atmosphere Credit 1, the total annual electric energy usage is 66,367 kWh. Macalester College entered a two year contract for green energy from Renewable Choice Energy to offset 100% of both the projected electricity and heat for the building.

The electricity use offset with a renewable energy credit (REC), clean source energy. In this case, wind energy was requested. All of the RECs are Green E certified. The heat is offset with Choice Carbon. The funds will be used by the Upper Rock Islands Co Landfill in Illinois and are certified by the American Carbon Registry.



renewable choice ENERGY

2500 55th Street, Suite 210
Boulder, CO 80301
303.468.0405
FAX: 303.648.5769

AMERICAN WIND

Renewable Energy Purchase Agreement

LEED

Account #:

Project Name:	Institute of Global Citizenship		
Contact Name:	Suzanne Hansen	Billing Company:	Macalester College
E-mail Address:	shansen2@macalester.edu	Contact Name:	Suzanne Hansen
Shipping Address:	1600 Grand Ave	E-mail Address:	Shansen2@macalester.edu
	St Paul, MN 55105	Billing Address:	1600 Grand Ave
Phone:	651.696.6019		St Paul, MN 55105
Fax:	651.696.6030	Phone:	651.696.6019
		Fax:	651.696.6030

LEED SUBMITTAL FORM

Based on Expected Emissions for:	Option	Description	Annual kWh	Price ($/kWh)	Annual Amount
2009	100% offset	Green-e Certified American Wind™	76,793	[redacted]	
2010	100% offset	Green-e Certified American Wind™	76,793		

Representative	Sully Lineberger
PO Number	
Order Date	
Client Location	MN
Project Name	Institute of Global Citizenship
Payment Terms	Net 30
PA Expiration Date	4/13/09
Created	3/30/09

The undersigned agrees that he is authorized to engage in an agreement on behalf of the company below. By signing, the company agrees to the purchase amount and terms outlined on this page

David M. Wheaton
Printed Name

3/30/2009
Signature / Date

Macalester College, VP for Administration & Finance
Company Name / Title

Order Acceptance: The undersigned agrees that he is authorized to and has accepted this order and the tariffs outlined on this page on behalf of Renewable Choice Energy.

Ann Rice – Vice President of Sales – Renewable Choice Energy

Questions or comments? Contact us:
Renewable Choice Energy
2500 55th Street, Suite 210
Boulder, CO 80301
www.renewablechoice.com

01/09

Prospective Product Content Label

This is a renewable certificate product. For every unit of renewable electricity generated, an equivalent amount of renewable certificates is produced. The purchase of renewable certificates supports renewable electricity generation, which can help offset conventional electricity generation in the region where the renewable generator is located. You will continue to receive a separate electricity bill from your utility. This product matches up to 100% of your estimated electricity usage. The product will be made of any or all of the new renewable resources listed below and updated annually.

New™ Renewable Resources in American Wind™	Generation Location
Wind 100%	Nationwide

††† Includes renewable generators that first started operating after January 1, 1997 or as regionally defined.

For comparison, the current average mix of energy sources supplying the U.S. includes: Coal (50%), Nuclear (20%), Natural Gas (18%), Large Hydro-electric (7%), Oil (3%), and Renewables (2%). (data from DOE/EIA-0384).

For specific information about this product, contact Renewable Choice Energy at 877.510.9510 or on the web at www.renewablechoice.com.

Energy

The Green-e® Energy Program certifies that American Wind™ meets the minimum environmental and consumer protection standards established by the non-profit Center for Resource Solutions. For more information on Green-e Energy certification requirements, call 1-888-63-GREEN or log on to www.green-e.org.

002
MACALESTER PRESIDENT OFF
03/31/2009 11:51 FAX 651 696 6500

The Emissions Impact Report and proposal for purchasing renewable energy from Renewable Choice Energy can be found in the appendix.