CARBON EMISSIONS REDUCTION REPORT FOR
UNIVERSITY OF MINNESOTA BUILDINGS

DRAFT

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Andrew Edwins
David Grandall
Luke Hollenkamp
Patrick Santelli
Amy Scheller

Final Project for
PA5721: Energy and Environmental Policy
EXECUTIVE SUMMARY

ISSUE DEFINITION

Why should we care?

AMERICAN COLLEGE & UNIVERSITY PRESIDENTS’ CLIMATE COMMITMENT

Green Building Policy

Greenhouse Gas Emissions Inventory

HISTORICAL CONTEXT

CURRENT UNIVERSITY POLICIES

In July of 2004 the University of Minnesota Board of Regents adopted the “Sustainability and Energy Efficiency” Policy. (Explain more? This policy consists of 5 guiding principles...) Although this policy doesn’t address carbon directly, it states that the University “shall undertake a process to increase energy efficiency, reduce dependence on non-renewable energy, and encourage the development of energy alternatives through research and innovation” and requires that each campus set sustainability targets in the area of buildings, infrastructure and operations.¹

The Facilities Management’s Energy Management group is tasked with managing the University’s energy budget. Its $90 million annual budget supports the electricity and steam infrastructure that providing lighting, heating, and cooling to the Twin Cities Campus. To address the Regents’ policy, Energy Management has set a goal of reducing total energy consumption by 1.5% (of what year’s usage?) by the end of FY09 and by 5% of FY10.²

The University furthered its sustainability commitment by joining the Chicago Climate Exchange (CCX) in 2004. By joining the voluntary program, the University has made legally binding commitments to meet greenhouse gas emission reduction targets. (further explained in section 1-b-ii)

The University is making incremental progress toward its goals of reduced energy consumption and greenhouse gas emissions. In its annual report, Facilities Management reported that the

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Twin Cities campus lowered its total carbon footprint by 5.7 percent since 2002.\textsuperscript{3} This reduction occurred despite an increase in the total campus square footage. Figure 1 shows the actual CO\textsubscript{2} emissions due to both electrical and steam systems.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{university_of_minnesota_co2_levels.png}
\caption{Twin Cities Campus CO\textsubscript{2} Emissions (Only Due to Buildings, Not Other Carbon Emitting Activities... Cut Out Of: HTTP://WWW.FACM.UMN.EDU/SITES/FM_NEWS/PDFS/FM_YEARINREVIEW_WEB.PDF )}
\end{figure}

The reduction in energy use is attributable to a number of projects and programs over the last several years. (Include some, but not all of these...)

- The Southeast Steam Plant was retrofitted to burn biomass fuels such as oat hulls in addition to natural gas. The plant started burning oat hulls in 2006 resulting in fuel cost savings and reductions of greenhouse gas emissions. Last year, 3.8\% of the steam was generated by oat hulls, moving toward the goal of 5\%.\textsuperscript{4}

- With funding from the Minnesota State Legislature, a Central Chiller Plant was constructed on the St Paul campus, reducing CO\textsubscript{2} emissions by 3,300 metric tons annually.\textsuperscript{5}

- The University participates in Xcel Energy’s Energy Design Assistance to assist in implementing energy efficient strategies on new construction and major renovation projects on campus.


\textsuperscript{4} Malmquist, Jerome, October 13, 2008.

A formal building recommissioning program was adopted in 2004. Outside consultants were hired to examine the heating, cooling and control systems to identify opportunities for efficiency improvements.

Lighting retrofits... One such project replaced bulbs with LED lights, reducing energy consumption by 92,242 kilowatt hours per year and reducing carbon dioxide emissions by 76 metric tons per year.

Consolidation of compressed air systems.

According to the director of Energy Management, Jerome Malmquist, building profiles are used to help detect facilities with high energy use to target for energy efficiency projects. They have a $6 million dollar evolving fund for such projects. They seek to spend $1 million each year on projects expected to have a five year or less payoff period. Projects that have been funded this way include:

- Lighting upgrades – replacing T12 florescent bulbs with T8 and now T5 bulbs. T5 lamps use about 34% less energy than the T12s. Also LED lighting in hallways and exit signs (2 year payback)
- Variable frequency drives (on what? DG: Air handling systems)
- Digital controls (DG: DDC)
- Heat recovery systems
- (also some of the above list might have been funded this way...)

One challenge toward increased energy efficiency mentioned by Malmquist is the increased energy needs of today’s buildings. A remodel of Walter Library resulted in the energy use increasing 4 fold due to the shift from print to electronic media.

Other items to consider including in this section:

- Future plans include “Elements of the plan include: detailed reviews for energy reduction opportunities in capital projects; optimizing building room and equipment schedules; re-commissioning existing university buildings; increasing awareness and encouraging behavioral changes for energy usage on campus.”

- The public face of the sustainability efforts is the “Sustainability and U” campaign with a web presence at http://www.uservices.umn.edu/sustainableU/ although the primary point of the website seems to be to collect marketing blurbs about the initiatives without much emphasis on results and outcomes at this point.
In January of 2008, President Bruininks signed the American College and University Presidents Climate Commitment. Through this commitment, the University will complete a greenhouse gas inventory by January 2009 and will complete an action plan toward climate neutrality by January 2010. (Need more on this here or was complete explanation in section 1-a-i?)

CHICAGO CLIMATE EXCHANGE (CCX)

Phase I & II

PREVIOUS REPORT

PROBLEM ANALYSIS

MODEL

Steam Consumption Model

The steam consumption model uses steam data from Facilities Management for each building in each of the last ten fiscal years. It should be noted that several buildings in the data set contained no steam consumption data. The total consumption was figured for each fiscal year. Heating degree data from the Minnesota Climatology Working Group was used to normalize the steam consumption for the effects of variations in winter temperatures—the effects of weather have been removed from the data. The result is shown in figure XXX.

![Steam Use: Twin Cities Campus 1998-2008](image)

FIGURE XX: TC STEAM USE, WEATHER NORMALIZED
A linear regression was performed to create a model for future years, and it is also shown in figure XXX. The regression is not particularly strong with an R-squared of only 0.64, so the model can only predict general trends. We also have limited data on the projected steam consumption of new buildings for the next four years. Data points for 2009-2012 were extrapolated using the model, and the projected new buildings were added to these data points. The result is shown in figure XXXX.

![Twin Cities Campus Steam Use Projections: 1998-2012 with Growth](image)

**FIGURE 3: TC STEAM USE PROJECTIONS, WITH GROWTH**

The graph shows the result for 2009-2012 if the University stopped all efforts in energy savings. The 1998-2008 data has both energy savings and growth built in. If growth were removed from the graph, the slope of the regression would be even more negative. If the growth and energy savings rates continued, we would expect the original savings rate to continue.

**Carbon emissions from steam**

We do not currently have fuel mix data from years other than 2008. Because of this, we calculated the carbon emissions for 2008, and also used the baseline data from FM and the Patterson report. The report also contained the CO2 emissions data for 2003-2006. Figure XXXXX shows the CO2 emissions from steam from 2003 to 2012 along with the allowances for those years according to CCX. Also, the data for 2009-2012 assumes conservation continues at the current rate, using the regression shown in figure 1.
Electric Consumption Model

Similar to the steam consumption model, we summed the electric usage for all buildings for each fiscal year. This data was plotted, and a regression line plotted. The regression was then used to project into the future for years 2009-2012. This is shown in figure XXXXX.
Twin Cities Campus Electric Usage

\[ y = 8.9236x + 17530 \]
\[ R^2 = 0.8936 \]

FIGURE 5: TC ELECTRIC USAGE, YEARS 2000-2012 PREDICTED FROM REGRESSION

The R-squared value of 0.89 means the regression represents the data fairly well. We do not have data for future buildings' electric usage, so the best model we can create simply extrapolates the model into the future.

Carbon emissions from electricity

The CCX assigns a value of 0.83 metric tons of CO2 per MWh of electricity, since the University consumes electricity produced in the Mid-Continent Area Power Pool (MAPP). With this data, we can convert the electric usage data to CO2 emissions. This is shown in figure XXXXX
**CO2 Emissions from Electricity**

![Graph showing CO2 emissions from electricity from 1996 to 2014.](image)

**FIGURE 6: CO2 EMISSIONS FROM ELECTRICITY, YEARS 2009-2012 PROJECTED**

**EMISSIONS WEDGES**

The concept of stabilization wedges has been developed as a tool to guide the use of existing technologies and conservation options in the pursuit of GHG emission reductions. Wedges represent different techniques that, when taken together, lead to a practical reduction in emissions to current levels; also to subsequent levels below current.

Wedges can be applied to the University's commitment of GHG reductions through the CCX market. When electricity and steam emissions are ultimately combined together, it will be necessary for the university to take definite action to reduce energy usage. By providing a list of emission reduction options, as represented by wedges, choices can be made based upon the cost effectiveness and difficulty of each option.
RECOMMENDED POLICIES

NEW CONSTRUCTION STANDARDS

Rating Systems—LEED and B3

Instituted and managed by the United States Green Building Council (USGBC), LEED (Leadership in Energy and Environmental Design) is a rating system designed to measure a buildings impacts, or lack thereof, on the environment. LEED is currently the most extensively used green rating system in the United States with some XXXXX projects certified, or in design and construction. XXXXX of these are in Minnesota, and XXXXX are directly affiliated with the University and its operations. LEED Certification is awarded based on a points system. There are a total of 69 points available under LEED, with the four different ratings breaking down as follows:

- LEED Certified 26-32 points
- LEED Silver 33-38 points (Applicable for PCC)
- LEED Gold 39-51 points (Applicable for PCC)
- LEED Platinum 52-69 points (Applicable for PCC)

These points are awarded based on a building’s compliance in set areas in six different categories. Points are not relative; therefore achieving one point is Sustainable Site does not correlate with the same reductions in Materials and Resources. Points are distributed as follows:

- Sustainable Sites (SS) 14 possible points
- Water Efficiency (WE) 5 possible points
- Energy and Atmosphere (EA) 17 possible points
- Materials and Resources (MR) 13 possible points
- Indoor Environmental Quality (EQ) 15 possible points
- Innovation and design process (ID) 5 possible points

One of the accepted methods of meeting the Presidents climate commitment is by, “Establish[ing] a policy that all new campus construction will be built to at least the U.S. Green

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Building Council’s LEED Silver standard or equivalent.”

Being that the presidents climate commitment is specifically aimed at an 80% reduction in GHG emissions, establishing a building policy of LEED Silver or higher posses a problem. It is possible to achieve the 33 points necessary to earn a silver rating while including minimal energy efficiency measures.

This does not mean that meeting LEED Silver or higher is fruitless. However it requires that any policy based on LEED that will have tangible results in actually reducing GHG emissions must specifically address credits that deal with energy consumption in the building. Table 1 is a list of theses credits and which ought to be mandatory, and which will provide additional GHG reductions. It is important to note here that many of these credits address the daily operations of a building, not just the idealized consumption.

<table>
<thead>
<tr>
<th>Lead Chapter</th>
<th>Credit</th>
<th>Title</th>
<th>Potential Points</th>
<th>Mandatory</th>
<th>Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Sites</td>
<td>SS 7.2</td>
<td>Urban Heat Island Effect</td>
<td>Low (13)</td>
<td>High (24)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Energy and Atmosphere

<table>
<thead>
<tr>
<th>Prerequisite 1</th>
<th>Fundamental Commissioning of the Buildings Energy Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prerequisite 2</td>
<td>Minimum Energy Performance</td>
</tr>
<tr>
<td>Prerequisite 3</td>
<td>Fundamental Refrigerant Management</td>
</tr>
<tr>
<td>EA 1</td>
<td>Optimize Energy Performance</td>
</tr>
<tr>
<td>EA 2</td>
<td>On-Site Renewable Energy</td>
</tr>
<tr>
<td>EA 3</td>
<td>Enhanced Commissioning</td>
</tr>
<tr>
<td>EA 4</td>
<td>Enhanced Refrigerant Management</td>
</tr>
<tr>
<td>EA 5</td>
<td>Measurement &amp; Verification</td>
</tr>
<tr>
<td>EA 6</td>
<td>Green Power</td>
</tr>
</tbody>
</table>

7 Presidents Climate Commitment, Section 2(a).
The rationale for each of these points is as follows. The following credits pertain to the energy consumption of a building and the measures that meeting these credits requires would reduce the buildings demand. For example, credit EA 1 is a general energy reduction credit for a baseline energy consumption model. 5 points represents a 24.5% reduction in energy use, whereas achieving the full 10 points represents a reduction of 42%, for new construction. This is energy, and it does not specify where this reduction comes from (mechanical systems, lighting, plug loads, etc.). However, the other credits outlined address how to achieve this reduction based on both reducing demand (daylighting) and being sure that the building is operating at its maximum efficiency (enhanced commissioning). SS 7.2 is an Urban Heat Island reduction which mandates a high albedo (reflective) or vegetated (green) roof. Both of these roofing types reduce the amount of heat energy that a building has to exhaust, thereby making the buildings cooling system work less saving energy. How much this reduction is in real terms is highly dependent on a number of variables—area of coverage, reflectance of roofing material, depth of green roof, etc.

The PCC states LEED Silver or comparable, and in Minnesota, any building that receives public money is subject to the Minnesota Sustainable Building Guidelines (B3—Buildings, Benchmarks and Beyond). Differing from LEED, B3 is a performance based system where evaluations are made base on how well a building performs in a certain area, rather than if it meets a standard or not as is the case with LEED. For example B3 attempts to take into account issues as varied as life-cycle costing, environmental impacts and social impacts of a building. B3 is unique to Minnesota and managed by the Center for Sustainable Building Research and the University of Minnesota. Although B3 operates in a slightly different way than LEED and has different ways

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of interpreting data, there are many commonalities, and many times they are used simultaneously. This overlap for energy specific credits is shown in Table 2.

<table>
<thead>
<tr>
<th>B3 Chapter</th>
<th>Credit</th>
<th>Title</th>
<th>LEED Cross reference</th>
<th>Potential Points</th>
<th>LEED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy and Atmosphere</td>
<td>E.1</td>
<td>Reduce Energy Use by at least 30%</td>
<td>EA Prerq1, C 1.1-1.5</td>
<td>low (6)</td>
<td>low (20)</td>
</tr>
<tr>
<td></td>
<td>E.2</td>
<td>Efficient Equipment and Appliances</td>
<td></td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>E.3</td>
<td>Evaluate Renewable and Distributed Energy Generation</td>
<td></td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>E.4</td>
<td>Atmospheric Protection</td>
<td>EA Prerq 3, C 4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>E.5</td>
<td>Outcome Documentation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Indoor Environmental Quality | I.7 | Thermal Comfort | EQ C 7.1 | 1 | 1 |
| I.8 | Daylight | EQ C 8.1 | 0 | 1 |
| I.9 | Quality Lighting | | | |
| I.10 | View Space and Window Access | EQ C 8.2 | 0 | 1 |
| I.12 | Effective Acoustics & Positive Soundscapes | | | |
| I.13 | Personal Control of IEQ Conditions & Impacts | EQ C 6.1, 6.2 | 0 | 2 |
| I.15 | Outcome Documentation | | | |

**TABLE 1: SUMMARY OF B3 CREDITS, AND THEIR LEED EQUIVALENTS.**

As tables 1 and 2 show, there are many commonalities in meeting each rating systems requirements. What needs to be taken into account is how many points, in the case of LEED, or credits, in the case of B3, each action will yield. In other words, each of these points comes with a different economic and social cost regarding construction. Research is hard to come by that attempts to quantify these costs, however, it is more than fair to assume since most all of these have to do with the overall efficiency of the buildings operation, any investment would be recovered within a reasonable (3-10 year) time period.

There is no doubt that these systems fall outside of the standard operating procedure for designing a building; however, the use of tools such as these is becoming more and more common, especially on institutional projects. It is important to note that economically each may have some costs associated with their implementation, but that meeting LEED is optional, whereas meeting B3 would be required. However, the extra costs, documentation, and
administration that occurs to meet LEED certification at any level come with the benefit that LEED has become the industry standard in the United States, and any rating of LEED Silver, Gold, or Platinum is recognizable across the country as an action towards a more sustainable future. One study of two municipal projects in Seattle found that meeting LEED Silver resulted in a net benefit for the city, despite increased upfront costs.\textsuperscript{10} These gains were due largely to reduced operating costs due to more efficient mechanical systems, and commissioning.

Possible Graphs:

+If all new buildings had a 24.5% energy use reduction

+If all new buildings had a 40% energy use reduction

**Commissioning of New Construction and Retro-commissioning of Existing Buildings**

Commissioning is a process that evaluates how well the systems of a building are functioning, and diagnosis problems to be sure that they are running as efficiently as possible, for LEED basic commissioning is a prerequisite, and advanced commissioning can earn one points towards LEED certification. B3 also requires commissioning. Although usually adding expense to the upfront cost of a project, commissioning and the program, system, and operational changes that follow its analysis are usually implemented based on a defined payback period. In other words, it is a procedure that is intended to save money in the long term by confirming that all systems are operating at maximum efficiency, and not wasting energy, and therefore money.

A study of the commissioning process of Yale’s new Biomedical laboratory found that through the process of commissioning a total savings of 568,809 kwh of electricity would be saved in the first year of operation alone which the authors state amounts to $60,000 annual energy savings.\textsuperscript{11} Tso et al. found in a survey of 20 commissioning projects in the Pacific Northwest that on average these projects had a payback of 5.6 years when considering direct costs, but


\textsuperscript{11} Bjorklund, Abbe, Daryl Fournier, David Collins, and Reyhan Lerimer, *Case Study: Commissioning of a New 450,000 sf Biomedical Laboratory Research Building at Yale School of Medicine*, 11\textsuperscript{th} National Conference on Building Commissioning, May 2003. p. 8-9.
4.4 years when indirect costs such as worker comfort and efficiency were taken into account.\textsuperscript{12} The average savings for all buildings was 114,131 kWh of electricity and 4,125 therms of natural gas per year at a savings of $11,394.\textsuperscript{13} On a per square foot basis these savings were: 1.18 kWh of electricity, 0.04 therms of natural gas, and $0.12 for the twenty buildings studied.\textsuperscript{14}

What the authors also show is that there is a distinct difference between the commissioning of new construction and retro-commissioning of an existing building. They determined that the commissioning of new buildings would result in savings of 106,395 kWh, 2,806 therms and $9,836 annually with a direct payback of 7.2 years, and an indirect payback of 5.6 years.\textsuperscript{15} Retro-commissioning (which will be discussed in detail in the next section) had a direct payback of 3.9 years and an indirect of 3.2. What is to be gleaned from this is not that new building commissioning is less effective, but rather that retro-commissioning has much greater benefits.

Possible Graphs:

+Long term cost savings of commissioning on buildings

+Long term energy savings of commissioned buildings

Retro-Commissioning is nearly identical in process to commissioning except that it takes place after a building has been constructed and occupied for some time. Retro-commissioning usually takes place in a building where a severe problem is noticed, and is rarely (CHECK THE U'S POLICIES TO BE SURE) part of an operations and maintenance protocol. Retro-commissioning has many benefits to the operations of a building and its demand for energy. Tso et al. show in

\textsuperscript{12} Tso, Bing, Lisa Skumatz, and John Jennings, \textit{The Cost-Effectiveness of Commissioning Public Buildings in the Pacific Northwest}, 11\textsuperscript{th} National Conference on Building Commissioning, May 2003.

\textsuperscript{13} Ibid, Table 3, p. 10.

\textsuperscript{14} Ibid, Table 3, p. 10.

\textsuperscript{15} Ibid, Table 3, p. 10.
their study referenced in the previous section that retro-commissioning has greater savings than the commissioning of commissioning new construction. Their study shows an average savings across 8 buildings of 125,734 kWh 6,104 therms, and $13,730, or 1.26 kWh of electricity 0.06 therms of natural gas, and $0.14 per square foot at an average cost of $53,833 or $0.54 per square foot yielding a payback of 3.9 years.\textsuperscript{16} A survey by the authors of this report of trade literature from the California Commissioning Collaborative showed a slightly higher cost per square foot at $0.75 with a payback of 3 years.\textsuperscript{17}

A policy that includes a systematic retro-commissioning of all buildings in a cyclic fashion over a long time period (25-30 years) would not only save the university money, it would drastically reduce the amount of GHG emissions from existing buildings by a significant amount. This would entail buildings be put on a schedule of when they would be retro-commissioned for the first time, and then how long it would be until their next "check-up." Using conservative numbers of 1 kWh of retro-commissioned savings on 25% of the Universities existing built square footage would yield a reduction of XXXXX tons of CO2 from electric power.\textsuperscript{18} These are savings that could be expected in 6 years if 5% of the universities total square footage is retro-commissioned per year.

Possible Graphs:

+Reduction of 1 kWh per square foot of 10, 20, 25, 30, 40, 50, etc% of built square footage of existing buildings.

+Cost savings of an example retro-commissioned building over 25 years

\textsuperscript{16} ibid, Table 3, p. 10.

\textsuperscript{17} I can put this table in an appendix in the final draft if we want.

\textsuperscript{18} Based on current Minnesota electric grid mix (2005) of 62% coal, 5% natural gas, 3% petroleum, 24% nuclear, 1% hydro, and 5% renewables. From US DoE
ENERGY STAR

Energy Star is a building rating system sponsored and administered by the US Environmental Protection Agency and the US Department of Energy. A numerical score from 1 to 100 is assigned to a particular building based upon the energy consumption of that facility compared to a survey of its peers. A score of 50 indicates that a building is consuming energy at the same level as the mean building in the survey. A score of 75 or above qualifies the building as an ENERGY STAR, indicating that it is within the top 25% of building in the country in energy performance. Additionally, an ENERGY STAR consumes on average 35% less energy and generates one-third less carbon dioxide than a typical similar building.

In addition to offering a rating system for a variety of building use types, the program also provides valuable guidance on how higher education organizations can increase the energy efficiency of their facilities. ENERGY STAR-labeled appliances are recommended to reduce electrical plug load. A particular application of energy star branding is a model dormitory room outfitted with low-consumption devices and sub-metering to assess performance. An example of this program is the showcased Dorm Room at Tulane University. By installing Energy Star rated lighting, office equipment, and home electronics, the three sophomores residing in the two-bedroom suite estimated they would save $130 over the course of the school year in electricity costs. If every one of the 1,708 dorm rooms were similarly outfitted, Tulane would save more than $200,000 and over 968,000 pounds of CO2 annually.

Encouraging the use of Energy Star products and design of Energy Star buildings is effective in theory, but also has been shown to have a quantifiable and statistically significant impact. According to recent studies by the New Building Institute and the CoStar Group, ENERGY STAR labeled buildings use an average of 40% less energy than average buildings, emitting approximately 35% less carbon. This is an ever larger impact than LEED certified buildings, which use 25-30% less energy than non-certified buildings.

RETROCOMMISSIONING

For existing facilities, an average energy savings of 15% can be expected; yielding a payback time of .7 years. The median upfront cost of purchasing commissioning services is $0.27/ft².

COMMISSIONING

For new facilities, an average energy savings is difficult to quantify since a hypothetical (un-built) building does not exist to benchmark against. However, it can be estimated that a payback time of 4.8 years and a median upfront cost of purchasing commissioning services of $1.00/ft² can be expected.
RENEWABLE ENERGY

Opportunities exist for the University to reduce grid energy usage and reduce subsequent GHGs by the utilization of on-site and off-site. ADD MORE RESEARCH.

CONCLUSION

WORKS CITED

APENDICES (IF ANY)
1. Final Report (20-25 Pages)
   a. Definition of Issue
      i. American College & University Presidents Climate Commitment
         1. **GREEN BUILDING POLICY:** Establish a policy that all new campus
            construction will be built to at least the U.S. Green Building Council’s
            LEED Silver standard or equivalent.
         2. Greenhouse Gas Emissions Inventory
   b. Historical Context
      i. Current University Policies
         1. Action Plan by January 2010
         2. Greenhouse Gas inventory by January 2009
      ii. Chicago CCX
          1. Phase I
          2. Phase II
      iii. Previous Report
   c. Problem Analysis
      i. Meeting CCX Goals
      ii. Effects of Business As Usual
      iii. Wedges
          1. Background
          2. U of M application
   d. Recommended Policies
      i. New Construction Standards
         1. LEED
            a. Meet or exceed Silver rating
b. Encouraged to certify, though not required.

c. Commissioning credit
   i. Required
   ii. Extra

d. Energy Efficiency Credits
   i. Levels

2. EnergyStar for Higher Education

3. B3
   ii. Building Retrocommissioning
   iii. Renewable Energy
      1. On-Site

e. Conclusion

f. Resources

2. Policy Brief (2-4 Pages)

3. Presentation
Hi all,

Lots of interesting material here, but some focus of organisation is necessary to make your report clear. I liked your calculations but I had a hard time seeing how they were linked to any larger policy recommendations.

It seems there are three points:
1. How E & I buildings relate today
2. What other institutions do for it
3. Policies for retrofitting in new builds

- tools
- resources
- reporting requirements, etc.

Understanding the share of emissions could be reduced for the greenest buildings. I think I links to other aspects of sustainability.

Looking forward to seeing the final report.

Wen

[Signature]