Save the trees, and the music stands:
*An Energy Evaluation of Bernhard Music Center and Chapin Hall*

*By Sophia Vargas*
INTRODUCTION
Located on the north side of campus, Chapin Hall and Bernhard Music Center provide a performance, rehearsal and academic center for music at Williams College. While Chapin Hall was built in 1910 primarily as a 1100 seat concert hall, Bernhard was designed in 1978 to host musical education as well as performance. Together, this complex includes 25 practice rooms, technology and recording studios, Presser Choral Hall, Brooks-Rogers Recital Hall and Shainman Rehearsal Hall. The building is officially open from 7am to 1am during the week, and beyond these hours, access is restricted to those with swipe access.¹

Along with these uses, many pianos are permanently housed in the building and there are lockers available for instrument storage. Not only does this building have to sustain comfortable conditions for students and faculty, but it also has to maintain the integrity of the delicate instruments throughout the building. Thus there are very stringent temperature and humidity requirements that the whole building must adhere to throughout the year. The department requests a constant temperature of about 72 degrees, and humidity levels of 44% in the winter and around 50% in the summer.² Even though Bernhard was built 68 years after Chapin hall, both buildings have had many upgrades within their structures, equipment and air quality regulation systems in order to better sustain these demands.³

The steam plant, located south of the Currier quad, central chiller, located under the 62 center parking lot, and onsite humidifier are responsible for maintaining these temperature and air quality regulations. These sources then are coordinated by AHU or air handling units within the building that are controlled

Figure 1: Air flow control
by facilities. Even though all of these settings can only be changed at facilities, there are air flow controls in the building that provide a few degrees of variation by room.

Considering the daily energy use of this building, the air composition and temperature regulation systems are always running at some baseline amount. The rest of the electricity use and fluctuation depends on daily student and faculty traffic. Since the facilities are responsible for the first part and the efficiency of this system depends on the technology itself, this paper will focus on analyzing monthly and daily electricity use in order to develop a plan that will encourage the building users to be more efficient and conscious about their plug loads and electricity bill.

Figure 2: Windowless downstairs hallways, practice rooms and lockers

The first structural difficulty within this building is there are very few windows once you leave the front lobby. Thus, when people are using any of the rooms in Bernhard or Chapin, minimally, the lights in the hallway and the occupied room will be on. Since there is no natural light, except in Chapin hall itself, many lights are left on for at least the entire time the building
is ‘open’. Thus I suspect that much of the daily variation pattern is influenced by how much of the building is ‘in use’ and thus how many lights are turned on at any given time. To investigate this claim, let’s consider the electricity metering form Chapin Hall/Bernhard complex over the last year.

**DATA:**

![Figure 3](image)

*Figure 3: This graph provides a monthly electricity use trends for Chapin Hall and Bernhard.*

<table>
<thead>
<tr>
<th>Monthly totals</th>
<th>Total Electricity in kWh</th>
<th>Average kWh per day</th>
<th>Cost $1.1/kWh</th>
<th>Emissions .41 kg/kWh (unit in kg eCO2/unit)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/8 – 3/7 2010</td>
<td>28809</td>
<td>1029</td>
<td>$3169</td>
<td>11812</td>
</tr>
<tr>
<td>3/7 – 4/5 2010</td>
<td>22034</td>
<td>760</td>
<td>$2424</td>
<td>9034</td>
</tr>
<tr>
<td>4/6 – 5/3 2010</td>
<td>29022</td>
<td>1036</td>
<td>$3192</td>
<td>11899</td>
</tr>
</tbody>
</table>

**Table 1:** This first chart generally introduces the recent monthly electricity bill, cost and emissions of the Bernhard/Chapin complex.
During the shut down this winter between 12/23/09 and 1/2/10, campus buildings that were not in use were closed and everything that was not needed for the time was shut down. The college saw a reduction in heating costs, electricity usage and emissions. While most buildings had their temperatures reduced, as explained before, Bernhard and Chapin hall’s temperature and humidity levels had to remain consistent. Even though this building may not have decreased its energy cost as much as some of the others, this data set provides a reasonable baseline of electricity use for the building. This baseline would include the function of AHU systems in the building at optimal levels, as there would be no disturbance caused by building users, and it would still be subject to changes in weather conditions.

![Winter Shutdown Daily Average](image)

**Figure 4:** Demonstrates the electricity use fluctuation that is inherent to the weather conditions in Williamstown.
From this point on, these variations can be disregarded and the baseline electricity values can be derived by the average of the daily averages which is calculated to be 398 kWh; for graphing purposes, about 17 kW consumed per hour. With this baseline, we can compare day to day values:

**Figure 5a & 5b:** 1 day in February and 1 week in February with baseline
These examples of daily use provide a first look into the trends of these buildings. However, how do we account for larger than average spikes on the grid? On April 29th, 2010 the electricity meters indicated the hourly data points recorded spikes of 100 kW, when other data suggested normal daily spikes around 70-80 kW. From Table 1, the average daily kWh consumed for April was 1030 and on April 29th, the daily total was 1468 kWh.
RESULTS/DISCUSSION:

Given these data sets, we can begin to understand general patterns of electricity use in the Bernhard and Chapin complex. Figure 3 affirms that in the less active summer months, less electricity is used. However, in general, we seem to be using 5000 kWh more electricity this April, compared to last year. Due to lack of information I can propose that either the building has been slightly busier than last year, or perhaps the students have become more forgetful.

Most days, the larger rooms in Bernhard and Chapin are reserved throughout the day for classes and rehearsals, and Chapin hall is mostly used for midweek music concerts and large ensemble rehearsals and performances, such as Symphonic winds, Berkshire symphony, and the percussion ensemble.  

![Figure 8: Calendar for Presser Choral Hall. Note that this schedule does not include classes](image)

Comparing weekdays to weekends, (Figures 6a and 6b), as one might expect the weekends generally consume less electricity. Not only did the weekdays have higher spike
values, those two days together consumed 2277 kWh and the weekend only 1938 kWh. It can be concluded that these building are pretty active all day, every day.

Looking at Figures 5 and 6, the electricity metering confirms that the building is mostly inactive between the hours of 1 am and 7 am, and perhaps a little longer on weekends. Using our baseline value derived from the data set for figure 4, Figures 5a and 5b demonstrate that in hours of low activity, daily values approach this value, but seldom actually reach it. This may be accounted for by the ‘baseline’ AHU system electricity use, as it would increase while the building was open for public use. People walking in and outside, breathing out CO₂, and opening windows may increase the activities of the AHU as they seek to maintain certain chemical levels as well as temperature levels within the building. From my personal experience, I know that after 1 am, the remaining stragglers mostly occupy the library, practice rooms, or the technology lab. With the exception of the large rehearsal halls, all of the studios, classrooms and lobby lights are turned off. However, where the students are working the lights remain on. Because the technology lab is frequently used at night, the computers in there are rarely turned off, even though not all of them are in use at this time. Thus the AHU system, continuing plug loads and constant lighting compounds and creates a higher baseline than during the shutdown.
Recalling Figure 7, the data and the calendar alone do not explain why April 29th used so much more energy than the sounding days. The most intense hours were between 2pm and 11pm. During this time, the record confirms Berkshire Symphony set up and had rehearsal in Chapin. None of the other calendars reveal any unusual activity. It also appears that the same thing happens the previous and following days according to the calendar. As someone who was in the music building at this time, I can confirm that there were an excessive of people in the building. I propose that this energy spike was the result of many additional individual student and professional musicians practicing – with all of the downstairs lights turned on – in addition to normal classes, rehearsals and activity. There were 3 concerts that occurred the following day: my recital at 4:15pm, Berkshire Symphony orchestra at 8pm, and an Octet concert at 10pm. So this event provides an example where the building was being used way above its average levels,
and the energy use confirms it. Mostly, the building electricity use is pretty predictable, save nights when everyone is doing some last minute practicing.

CONCLUSIONS:

While the topic of the heating/cooling systems have not been the focus of this paper, it is still important to remember the large energy bill associated with these systems. For the most part, since there aren’t very many windows or doors, there isn’t too much that can be done about the AHU baseline except wait for the next upgrade. Since the users of Bernhard and Chapin have very little impact on these values, the largest human impact is the lighting. According to Don Clark, almost all of the lights in these buildings are incandescent. I spoke with Professor Keckley as well and he mentioned that as a musician, he prefers the existing quality of the lights for the concert halls, as the visibility of the music and ensemble members are just as important as the visual quality for the audience members, as would also be the case for any performance. However, this doesn’t mean that other lights in the building can’t be upgraded. It is helpful to have strong light in the practice rooms, but the hallway lighting is less important – as long as it is on! Another simple suggestion would be to set the computers to fully shut off after 1am if they have been idle for a while, mimicking what they have already done in the other computer labs around campus.

For the most part, the lights that are left on in the building for most of the night are located in the main hallway downstairs. This could be accounted for by the fact that no one wants to turn off the hallway lights when people are still in the building for safety reasons, but then sometimes they get left on. According to campus security, when they walk through the building at 1am to lock particular spaces, they will turn off some of the lights, but only if there
are no students. When the practice room lights are left on, mostly the person who is using it returns eventually to continue practicing or put things away. However, since the technology room is only accessible by swipe access, if the last person forgets to turn off the light, than the remaining people in the building may not be able to turn those off at all, or the computers in the room. Perhaps, along with the practice rooms, this room’s electricity consumption could be decreased by motion sensor lights. According to David Keckley, they are already in most of the faculty offices.

According to amazon.com, consumer priced motion sensors are around $20 a piece. For 25 practice rooms plus the technology lab, the price would be less than $500 for the equipment, assuming there is a bulk discount. Using $200 per hour service fees, 26 fixtures each taking 30 minutes, we can roughly estimate this transition cost would be: $200/60 minutes = $13 * 260 = $2600. Including the cost of the fixtures, perhaps the whole operation will cost around $3000. On average, the normal baseline electricity use during night hours is around 30 kW, while this value during the winter shut down was 17 kW per hour. So for 6 hours, (1 am to 7 am), the building used 181 kWh while during winter shut down it used approximately 102 kWh. Thus if we could reduce the consumption in this 6 hour period by half this difference, (40 kWh) after 1 year, we would have saved: $365*40*.11 = $1606. Thus we can conclude that our investment will be paid back in under 2 years.

Considering another method, if the buildings hours were reduced, I don’t think it would have too much of an impact on the energy bill since the building temperature has be maintained throughout the night. Thus the AHU systems will remain active, and individuals with swipe access will continue to use it all times in the evening. It may be helpful to perhaps remind students to turn off the hall lights when they are the last to leave the building. However, it is
sometimes difficult to know if you are the last person left in the building, and for safety reasons no one wants to turn the hallway lights out until everyone else has gone. Once again, if the last person doesn’t have swipe access to the building, they cannot return to fix their mistake. Thus I believe that the best solution would be to address student behavior in this area and to consider the possibility of simple technological adjustments that I have proposed.
REFERENCES:

(Note: All of the pictures that are not referenced were taken by me on May 10th, 2010 in the evening)

1. “Bernhard Music Center” from Facilities descriptions taken from the music website:  
   http://music.williams.edu/node/371

2. Interview with Don Clark, Utilities Program Manager, 2pm on May 7th in his office at  
   Facilities headquarters

3. Williams College Property Book: Maintained by Williams College Facilities  
   http://facilities.williams.edu/property-information/property-book/

4. All of the electricity data is originally taken from:  

5. “The Great Shutdown of 09” from Sustainability at Williams, January 2009, Last visited  
   January 20th, 2009  
   http://blogs.williams.edu/sustainability/2009/01/20/the-great-shutdown-of-09/

6. Chapin Calendar: Maintained by Jenny Dewar (updated daily)  
   http://www.google.com/calendar/embed?src=5tk0lg767s2rg8b6b3pthf23ls%40group.calendar.google.com&ctz=America%2FNew_York&pvttk=18239b0e96387d20e267e53693d928d1&gsessionid=71NuvqLFFV1puFjMC9Y9zQ

7. Presser Calendar: Maintained by Jenny Dewar (updated daily)  
   http://www.google.com/calendar/embed?src=5disrucmfsa4evth7aj4e4yav0%40group.calendar.google.com&ctz=America/New_York&pvttk=24eadbc30b15477906da59d604802d81

8. Interview with David Kechley, Chair and Professor of Music, 5:30pm on May 14th in  
   Bernhard lobby

9. Brief Interview with Peter Mazzacco, Campus Safety and Security Officer, 2:45pm on  
   May 18th at Hopkins

10. Motion sensor prices on Amazon.com: last visited May 18, 2010  
    http://www.amazon.com/SmartHome-Motion-Sensing-Light-Switch  
    PIR617M/dp/B00032ATV0-

11. Motion censor cost analysis: Last updated January 2009  