DEMAND-SIDE ENERGY MANAGEMENT AT THE UNIVERSITY OF VIRGINIA

By Paul Crumpler[1] PE

INTRODUCTION

The following text offers a view of the Energy Management Program at the University of Virginia (UVa), located in Charlottesville, Virginia. UVa has a very successful history of conserving energy and improving efficiency in central energy systems such as chilled water loops and steam production and distribution. More recently, the UVa Energy Management Program has intensified efforts on demand-side energy conservation opportunities. Demand-side conservation opportunities exist at most college campuses; improvements in efficiency in buildings (demand side) can significantly reduce energy consumption and cost. The keys to an effective demand-side energy management program are shown in the graphic. This basic, continuous improvement cycle of PLAN-DO-CHECK-ACT was coined by Deming, and is the basis of energy management at UVa.

Past and ongoing successful efforts at UVa have paid huge dividends. They include elimination of many aging stand-alone chillers and boilers by connecting buildings to central plants. Avoided energy use and cost has saved at least $10,000,000 annually. Demand-side improvements include lighting upgrades made in all buildings by replacing older T-12 fluorescent fixtures with T-8 tubes with electronic ballasts. Occupancy sensors were also added to thousands of lighting circuits. A major supply-side improvement was investing in four large electric substations to combine hundreds of electricity accounts into four, thus reducing cost and improving reliability.

UVa has hundreds of buildings with approximately 14 million square feet of enclosed building space. Building uses and types include a large teaching hospital, research buildings, animal care areas, laboratory, classroom, athletic, and student housing ranging in age from more than 200 years to new construction. Energy and utility use vary just as greatly as their ages and uses. Regardless of how efficient a building is designed to be, it operates only as efficiently as it is allowed to be by building occupants and managers.

BACKGROUND: JUSTIFYING DEMAND-SIDE ENERGY MANAGEMENT

Large college campuses offer a goldmine of opportunities to reduce energy and utility use. For this article, the term energy is intended to include all primary and secondary utilities such as electricity, natural gas, water, steam, chilled water, and hot water. The strategy generally employed in large institutional settings is supply-side management. Supply-side energy management focuses energy conservation resources on large central systems that supply energy to buildings that use energy on the demand-side; small improvements in efficiency can result in large energy and dollar savings. Many supply-side upgrades also require large sums of money to implement significant design and construction. Demand-side energy management is often overlooked for many reasons.

Demand-side energy management is defined as reducing the overall energy use on the user, building, or customer end of the energy cycle. A simple demand-side energy management project might be replacing incandescent light bulbs with compact fluorescent bulbs. Changing one bulb saves energy and money, but not significant amounts unless repeated on a larger scale such as at a whole building or university, or a city. Maintaining the improvement must be considered as well; as the compact fluorescent bulbs burn out, they must be replaced with similar or better bulbs to sustain the improvement. A simple project like this done on a very large scale increases in complexity, includes a large number of people, and

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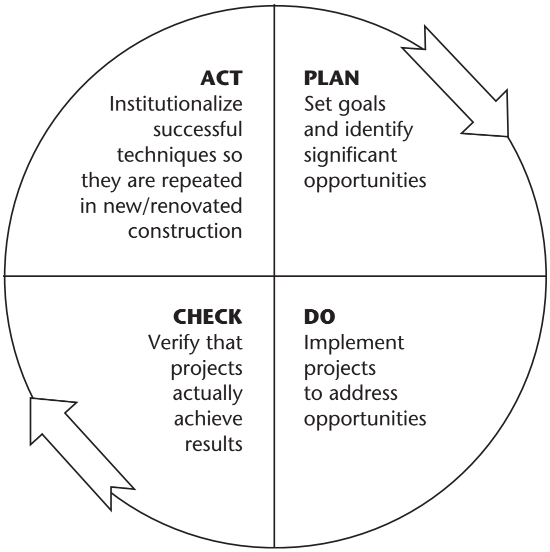


involves difficult to manage aspects such as human behavior (likes, dislikes, and preconceived opinions) and market forces of price and availability. This represents some of the challenges of demand-side management: a large number of "simple" projects that increase in complexity as they are implemented on a large scale.

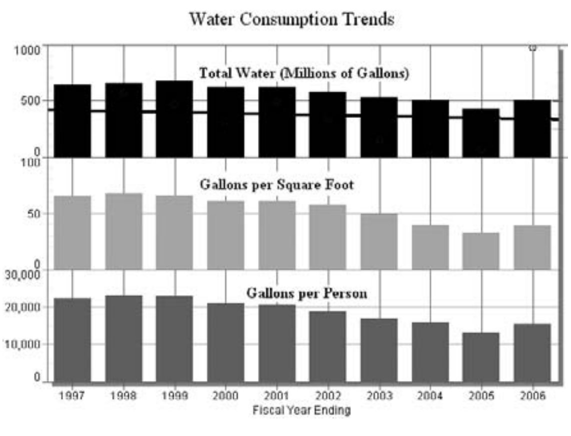
Demand-side management energy conservation opportunities are, however, equally as significant as supply-side opportunities. Experience has shown that demand-side energy conservation opportunities can result in saving 10% to 30% or more in existing buildings. Projects as simple as recalibrating HVAC temperature and humidity sensors, implementing night setback conditions, and adding occupancy and daylight sensors for lighting control will typically significantly reduce energy consumption. Conserving energy on the demand-side has the added benefit of reducing the need to add to existing infrastructure. Implementing methods to reduce chilled water and steam use in buildings saves energy and money, but may also avoid or reduce the need to add new chillers or boilers.

Demand-side management, in many ways, is more complex than supply-side; large numbers of buildings means that a large number of highly varied projects and programs may be needed to make significant reductions in energy use. Additionally, there is a prevailing attitude that serious energy conservation can only be achieved on the supply-side. This attitude is heard daily when listening to news and political commentary where developing new sources of energy is the primary topic of discussion. One of the key challenges is how to focus limited energy management program resources so that they are efficiently applied to significant opportunities and do not become bogged down in hundreds of small projects.

BASIC BUILDING BLOCKS OF DEMAND-SIDE ENERGY MANAGEMENT

Two very key elements of demand-side energy management at UVa were the addition of a **metering program** and implementation of a **Building Automation System (BAS).** Utility meters were added to nearly 100% of the buildings for electricity, water, chilled water, hot water, and steam. Many buildings were also connected to the BAS where air handlers and building zones are controlled and monitored at a central location through a computer interface. Many of the meters are also connected to the BAS providing real-time usage data. Metering and subsequent data collection with long-term trending has allowed UVa to benchmark and identify buildings that have higher than expected energy consumption. Often high or variable energy consumption can be traced to particular control issues or equipment failures, which can be quickly diagnosed through the BAS. An example of the benefit of metering is demonstrated in water use reduction at UVa (Figure 1). Water use at UVa has decreased significantly over the past 7 years,

FIGURE 1. Water consumption at UVa.



and much of this success can be directly attributed to metering. Metering and review has helped to quickly identify leaks which are then repaired. Additionally, projects to reduce water consumption, such as using low flow sink, shower, and toilet fixtures, could be verified through metering and comparing before and after consumption

Demand-side energy management in large institutional settings cannot target the most significant opportunities without a metering program in place. The success of reducing water use at UVa demonstrates this fact. Without metering, leaks or other problems could exist for years without detection. UVa also specifically adds water meters to cooling towers, chilled water makeup, and boilers where simple failures of a float valve may result in a large waste of water and energy. Even in small facilities, submetering of equipment that consumes water is recommended. An example was seen in a commercial printing operation where a chilled water makeup valve (a float valve very similar to a toilet shutoff valve) failed to open resulting in the loss of $30,000 of water, and additional loss of energy by having to chill water from incoming temperature to 40°F. The problem was discovered visually during an energy audit. Metering would likely have identified a problem much sooner. The establishment of a metering program is a necessary prerequisite in large institutions that want to reduce energy and water consumption. While not an absolute requirement, a BAS is a very useful tool in diagnosing problems that may be very difficult to find otherwise.

DEMAND-SIDE OPPORTUNITIES AT UVA

In the past two years, the Energy Management Program at UVa has expanded efforts on demand-side energy management. A steam trap management program has been implemented to reduce steam loss in traps located inside buildings and distribution lines. Efforts have been made to eliminate incandescent lighting in decorative and general lighting fixtures. Additionally, a new lighting project is exploring using 28-watt T-8 fluorescent tubes to replace the nearly 400,000 32-watt T-8 tubes used in buildings at UVa. Each of these projects is estimated to save between $50,000 and $500,000 annually in energy cost. A potentially greater opportunity exists in maximizing HVAC system performance in buildings through optimizing the sequence of operation and using the BAS to better self-diagnose operating problems. Heating and cooling consume more than 60% of the total energy and 25% of the total water used at UVa.

OPTIMIZATION OF HVAC SEQUENCE OF OPERATION

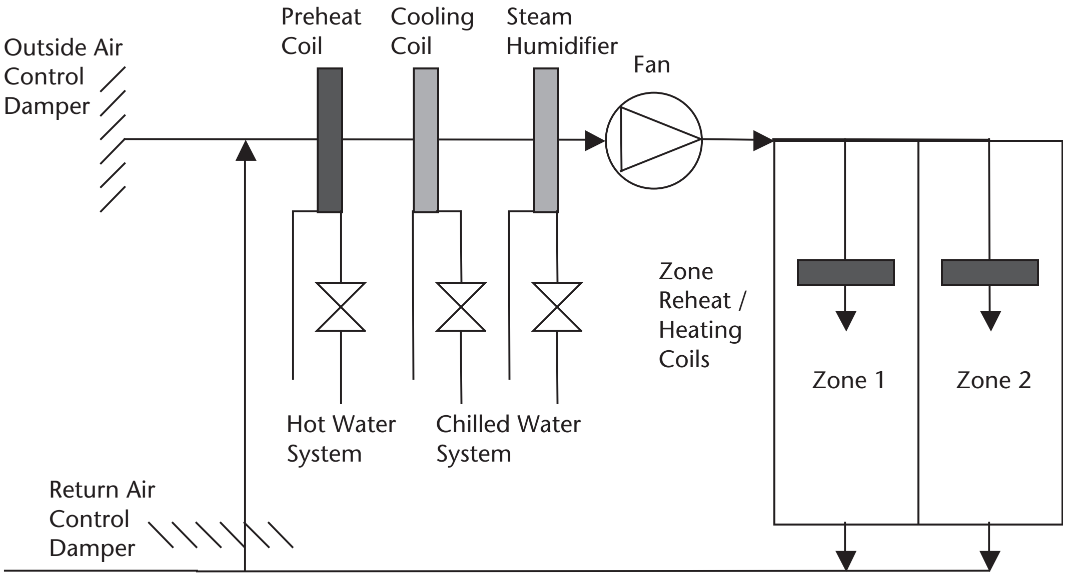
Buildings at UVa are typically heated with steam or hot water generated at our main steam plant. Cooling is provided by chilled water from one of the several chilled water loops. Many of the buildings have constant volume air conditioning systems such as patient care and laboratory buildings with heavy exhaust requirements. A typical constant volume air handler schematic is provided in Figure 2.

Air is conditioned and blown to various parts of the building and zones. A mixture of outside air and return air is drawn through a preheating coil, a cooling coil, humidifier nozzle, and a supply air fan before being delivered to individual zones. Each zone typically has a heating coil to provide temperature control by reheat. There are many variations to this design. Some buildings have the preheat coil located so as to only heat outside air. Some have an additional heating coil either before or after the cooling coil. Humidifiers are often located before either the heating or cooling coil. Some buildings have 100% outside air and return no air to the air handler from the building; this is typical of laboratory and medical research buildings. The location of the supply air fan, and possibly return air fans, vary as well.

In larger buildings with high internal heat loads, air temperature leaving the cooling coil is typically fixed at 55°F summer and winter. This provides simple control, since humidity levels in the zones will usually not exceed 60% relative humidity if the zone is maintained at 72°F. Outside air and return air dampers are used to modulate the amount of outside air brought into the building. When occupied, a fixed volume of air is brought into the building to prevent CO_2 and internally generated pollutants from building up in the atmosphere.

Preheating is done for two reasons. One is to prevent damage to the building in case of very low outside air temperatures. Cold outside air can cause water-filled coils to freeze and break. The second reason is to boost air temperature to the air handler dis-

FIGURE 2. Constant volume air system.



charge set-point when it is colder outside than discharge air set-point.

Problems typically encountered in constant volume systems include:

- Excessive Preheat Resulting in Simultaneous Preheating and Cooling
- Unnecessary Dehumidifying and Reheating
- Excessive Air Flow
- Unnecessary Humidification
- Maintaining Conditions when Buildings are Not Occupied

These opportunities to improve certainly exist at UVa. Experience has shown that they typically exist in many other institutional settings as well. This is based on the author's experience in conducting energy audits at large facilities across the United States.

OPTIMIZING SEQUENCE OF OPERATION—SIMULTANEOUS PREHEATING AND COOLING

Temperature control on preheat coils is often very inaccurate. This is especially true if heating is done with steam. High steam temperatures and control valves with poor ability to modulate steam flow often results in very high preheat temperature. Steam preheat coils with face and bypass dampers represent an improvement, but can still have problems with higher than necessary temperatures. Logically, if air entering the air handler is preheated to 55°F, then no cooling should be necessary for either latent or sensible heat. However, if the entering air is heated to a temperature greater than 55°F, the cooling-coil chilled water valve will typically open and cool the air back down to 55°F. Inaccuracies in the ability of the control valves to modulate air temperature, inaccuracies in temperature sensors, and excessive preheating set point temperature very often result in preheating and recooling. This represents a very large waste of energy. Also, heating control valves that have failed partially or fully open allowing hot water or steam to flow through the heating coil uncontrolled, result in excessive preheating and recooling.

These problems are not as simple to diagnose as might appear on the surface. If the preheating coil is providing excessively hot air, the cooling coil can typically compensate and lower the supply air temperature back to 55°F. The building and occupants may be perfectly comfortable. The first place that excessive preheat may be noticed is in the utility bills where excessive heating is done in warmer months. The only way to diagnose the problem is to compare leaving air temperatures which can be done manually or automatically within the BAS.

Surveying air handlers at UVa indicated that excessive preheating problems of some type existed in as many as 20% of the air handler systems. This is certainly a problem not confined only at UVa. The author has observed the exact same problem in air handler controls at every institution (university campuses, military bases, and hotels) visited while conducting energy audits. Some of the worst offenders were in buildings with 100% outside air which was being continually preheated even in warm summer months due to a valve failure, sensor failure, or logic errors in system programming.

At UVa, preheating is now typically controlled based on outside air temperature. If outside air temperature is greater than 50°F, preheating is locked out through the BAS. This generally solves the problems associated with excessive preheating when it is warm outside. To minimize the effect of temperature sensor inaccuracy causing excessive preheating and recooling, preheat temperature set point is set several degrees lower than the supply air temperature (55°F) to prevent overheating.

Alternatively, the cooling water control valve can sometimes be locked out when preheating to prevent simultaneous heating and cooling. High temperature alarms have been set in some air handlers through the BAS. Alarms help detect excessive preheat problems, but are especially good at detecting valve failure causing preheat to take place constantly. These simple changes have reduced energy use significantly at UVa.

An example of cost savings associated with excessive preheating follows (Figure 3). A constant volume 100% outside air handler supplying 30,000 CFM is used in the example. This type of system is common to older medical research buildings. Preheat discharge temperature was originally set to be the same as the discharge air temperature of 55°F. Inability of the steam control valve to control precise temperature caused the preheat coil to heat to an average of 65°F. The cooling coil valve then compensated to recool the air back to 55°F. For this example, 3000 hours per year is used as the operating time of the preheat coil which is consistent with weather data for the number of annual hours when the temperature is less than 50°F. Correcting this problem will save approximately 1,800 MMBtus and $21,600 annually in one air handler.

More extreme cases of preheating when unnecessary were discovered. Preheat valves were staying open far beyond when preheating was necessary. This example is also in medical research building with 100% outside air. Incoming air was being heated to

Heating Energy Saved

= 30,000 CFM × (0.07 lbm/Ft^3) × 60 Minutes/hour × 3,000 hours/year × 0.24 Btu/F-lbm x (65°F – 55°F)
= 900 MMBtu annually

Heat Cost Savings

= 900 MMBtu/year × $14/MMBtu
= $12,600 annually

Cooling Energy Saved

= 30,000 CFM × (0.07 lbm/Ft^3) × 60 Minutes/hour × 3,000 hours/year × 0.24 Btu/F-lbm × (65°F – 55°F)
= 900 MMBtu annually

Cooling Cost Savings

= 900 MMBtu/year × $14/MMBtu
= $9,000 annually

Total Energy Savings = 1,800 MMBtu annually

Total Cost Savings = $21,600 annually

FIGURE 3. Energy savings estimation in preheat reduction.

approximately 20°F above outside air temperature creating a continuous artificial cooling load on the building due to a controls failure. If faults of this nature are allowed to continue without detection, the result will be excessive energy use and cost of more than 10,000 MMBtu and $100,000 annually in a 30,000 CFM system. This points out the necessity of monitoring large air handlers and insuring that they are working properly.

Simultaneous heating and cooling can also occur in packaged Freon-based air conditioners with gas or electric heat. An example of this was discovered recently at a military base. A natural gas control valve was stuck open on a medium-sized roof top package air conditioning unit. Heat was constantly supplied to the air, increasing the cooling load, which prevented the compressor from ever cycling off. In this case, more than $50,000 would be wasted annually if not corrected. However, the building occupants remained comfortable. This problem was noticed through metering data which indicated the building was using excessive natural gas and electricity.

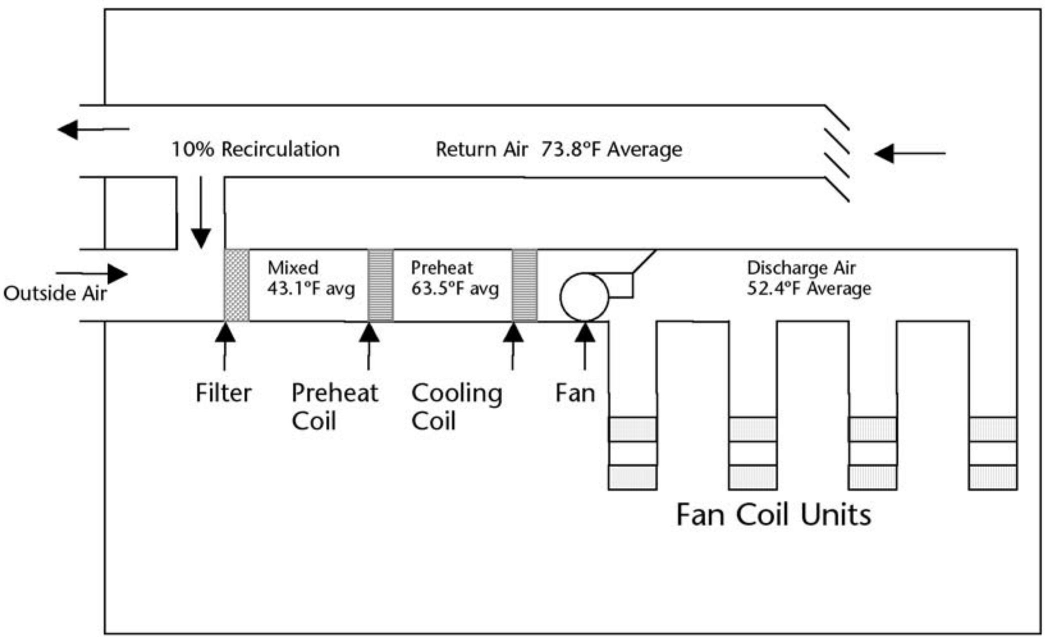
The Chemical Engineering building was traditionally the largest energy user per square foot at UVa. The primary problem identified through review of BAS data was excessive preheat followed by recooling (Figure 4). During one 67-hour period monitored, the average incoming air temperature was 43.1°F. Preheating brought the air to 63.5°F. Recooling reduced the average discharge air temperature to 52.4°F. It was estimated that preheating was only necessary for 3 hours of this period. Three changes were made to minimize excessive preheating and cooling. Preheating is enabled only if the outside air temperature is below 45°F. Secondly, temperature sensors were calibrated so that more accurate readings and better control could be achieved.

The energy savings from these relatively modest changes was very significant. Figure 5 shows actual metered data for chilled water, electricity, and steam usage from fiscal year 2003 to 2006. Overall energy use decreased by 34%.

DEHUMIDIFYING WHEN NOT NECESSARY

A fixed air supply temperature of 55°F works well when dehumidifying is necessary. In the warm summer months, from May through September, dehumidifying in central Virginia is necessary roughly 70% of the time. Dehumidifying outside of this time range is necessary perhaps 15% of the time.

FIGURE 4. Chemical engineering schematic.



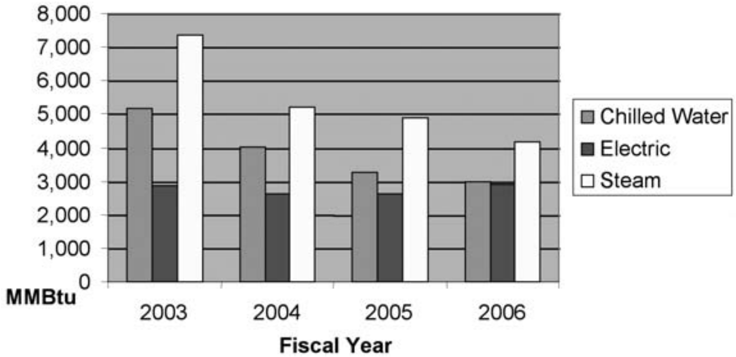


FIGURE 5. Chemical engineering energy use by type.

Dehumidifying when not necessary is comparable to heating when not necessary. Dehumidifying is done by decreasing the air temperature to below the dew point causing water to drop out of the air stream. When air is cooled to a fixed supply air temperature of 55°F, this only provides dehumidification if the mixture of return air and outside air has a dew point of greater than 55°F. If the dew point is less than 55°F, cooling to this point only removes sensible heat from the air and no moisture. If reheating is taking place in the building zones to compensate for low temperature and the dew point of the mixed air is greater than 55°F, then an opportunity exists to save energy by resetting the supply air temperature to a level greater than 55°F to reduce the amount of reheat necessary.

A logical temperature reset can be designed into the building automation system to minimize the amount of excess dehumidification and reheat taking place. This can be done by designing the control program to calculate the dew point in the mixed air stream; a humidity and temperature sensor is necessary, usually located in the mixed air portion of the duct. If the dew point is below 55°F, the temperature of the supply air can be increased as long as zone cooling needs are met. For example, the program can determine if zone heating is taking place by polling reheat valves and coils located in the fan coil boxes in the building zones. If heating is taking place, then the supply air temperature can be increased perhaps 1°F or 2°F incrementally. This process will continue until the heating valves close or until one zone temperature rises above its set point. If this happens, the supply air temperature can be decreased incrementally. This can be a constantly changing process, but can reduce the amount of chilled and hot water used to maintain conditions in a building. Care should be taken so that the control system does not become unstable, such as if temperatures of supply air are rapidly increasing then decreasing. This process is currently being implemented in one classroom building and one food service facility at UVa, and will be implemented in other buildings to the maximum extent possible.

An example of possible energy savings is provided in Figure 6. Supply air temperature in this example is initially fixed at 55°F and supplied to zones maintained at 72°F. If supply air temperature can be increased to 60°F for three thousand hours during the colder winter months when dehumidification is unnecessary, energy savings will be significant at more than $10,000 per year. Even if the temperature reset is only 1°F, the savings will be more than $2,000 annually.

REDUCING AIR FLOW

Reheating can also be reduced by applying variable air volume systems to buildings. Schematically, this is shown in Figure 7. A variable speed fan is installed in place of the constant volume fan. The fan speed is controlled by a duct pressure sensor. Air volume to the zones is controlled by dampers in the Variable Air Volume boxes in the zones. These dampers are typically controlled by zone temperature. If the zone temperature is higher than set point, the damper opens further and allows more cool air to enter. The variable speed drive fan increases in speed to maintain the duct pressure. If the zone becomes too cold, then the VAV box damper closes until it reaches its minimum setting, which is often (but not necessar-

Heating Energy Saved

= 30,000 CFM × (0.07 lbm/Ft^3) × 60 Minutes/hour × 3,000 hours/year × 0.24 Btu/F-lbm × (60°F – 55° F)
= 450 MMBtu annually

Heat Cost Savings

= 450 MMBtu/year × $14/MMBtu
= $6,300 annually

Cooling Energy Saved

= 30,000 CFM × 0.07 lbm/Ft^3 × 60 Minutes/hour × 3,000 hours/year × 0.24 Btu/F-lbm × ((72°F – 55°F) – (72°F – 60°F))
= 450 MMBtu annually

Cooling Cost Savings

= 450 MMBtu/year × $10/MMBtu
= $4,500 annually

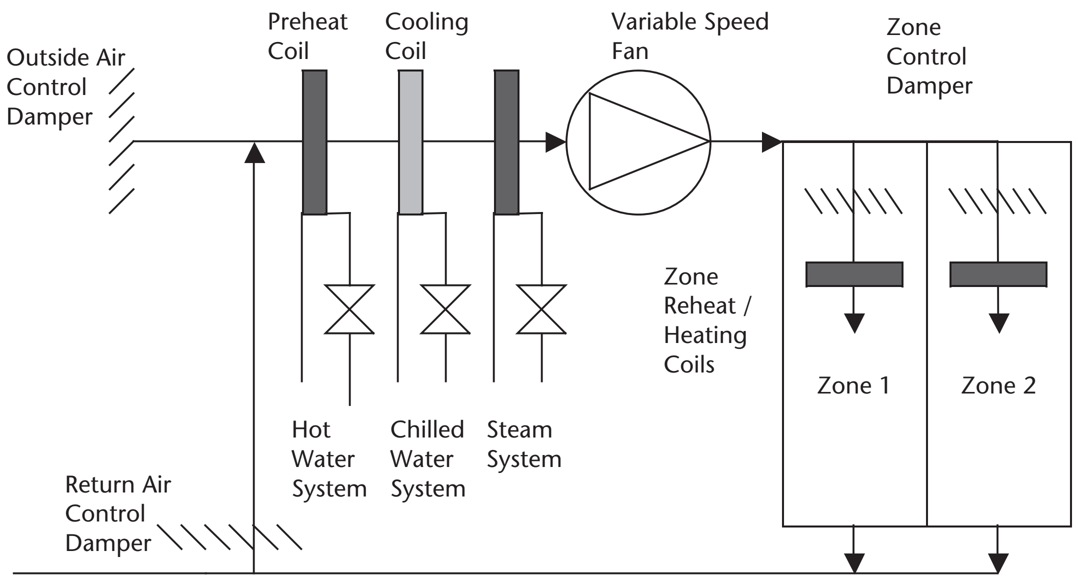
Total Energy Savings = 900 MMBtu annually

Total Cost Savings = $10,800 annually

FIGURE 6. Energy savings through temperature reset.

ily) based on the amount of fresh air needed to supply air to the zone when occupied. The VAV boxes are fitted with a reheat coil that supplies heat if minimal air requirements of the zone still cause the temperature of the zone to be too cold. If reheating is occurring during minimum flow, a logical temperature reset can be used to increase supply temperature and reduce the need to reheat. Savings will be comparable to a constant volume system. However, the best method for reducing energy use in a well operating VAV system is to decrease the minimum VAV box supply air setting.

FIGURE 7. Variable air volume schematic.



To minimize reheat and fan energy use, verify that the VAV box minimum setting is as low as it can be. VAV box minimum flow settings are often arbitrarily set at 50% to 75% of the maximum flow. Design conditions may require that the VAV minimum air volume setting can be 20% to 40% during occupied times. When unoccupied, the amount of fresh outside air required is 0%. Reducing the minimal air supply setting in a VAV will save cooling energy, heating energy, and fan energy. An office may be only occupied 30% or less of the total hours in a year; unoccupied settings for 70% of the year may provide large savings. Savings can be further increased by allowing the zone temperature to drift above or below set-point during unoccupied hours.

Reducing air flow not only saves cooling or heating energy, it also reduces fan horsepower considerably. Note that a fan operating at 100% of its rated speed consumes 100% of its rated power, while operating at 70% will consume 34% of its rated power. Small decreases in air flow and fan speed will save significant amounts of electricity.

An example of energy saving by reducing VAV box flow settings follows. An air handling unit supplies a maximum of 5,000 CFM of cool air at 55°F to three VAV boxes that feed into two offices and one small meeting room. Outside air is supplied at 20% of flow. Each office receives a maximum of 1,000 CFM and the meeting room the remaining 3,000 CFM. The minimum air flow setting on the VAV boxes are 66% of the maximum flow. When each VAV box is supplying minimal air, a total of 3,300 CFM is supplied requiring significant reheat especially at night when the building is unoccupied. For each room, outside air requirements are 100 CFM in each office and 300 CFM in the meeting room when the rooms are at expected occupancy. When the VAV boxes are set at 66% minimum and supplying 20% outside air, the offices are receiving 132 CFM each, and the meeting room is receiving 396 CFM. Instead of setting the minimum flow to be 66%, it could be decreased to 50%. Assuming that the fan consumes 1.5 HP at full speed, power requirements decrease from 0.4 HP at 66% to 0.2 HP at 50%.

A further improvement is the addition of a CO_2 sensor in the return air from the zones. Adding a CO_2 sensor allows the control system to determine how much outside air is needed based on actual occupancy. On nights and weekends, a CO_2 sensor may allow the VAV box to completely shut down for extended periods of time saving heating, cooling, and electricity.

In constant volume systems, it is also possible to reduce airflow either by adding variable speed drives or by slowing fan speeds mechanically.

A combination of the techniques discussed above was used in the University Chapel. The Chapel is a more than 100-year-old stone structure that is used primarily for weddings and similar events. It is a historic structure; preservation of wood surfaces through humidity control is one of the primary reasons for air conditioning in addition to comfort. This building was originally fitted with a constant volume air handler sized to handle the cooling load during a hot summer day when the building was fully occupied. This condition almost never existed. Air was supplied at 55°F. Reheating was taking place almost 100% of the time.

A variable frequency drive was added to the 10 HP fan motor. Supply air is maintained at 55°F as long as the temperature of the Chapel is above set point. The fan VFD controls supply air to maintain set point. Reheating is only used if the minimum setting of the VFD causes the temperature to decrease below set point while the humidity level is above set point. Otherwise, the heating and cooling valves are programmed to not be open simultaneously. Figure 8 shows metered energy savings. Medium temperature hot water is also supplied for heating, but this is not currently metered for this building. Metered energy savings indicate a 33% reduction compared to 2003 usage. The project was completed at the beginning of FY 2006.

SEQUENCE OF OPERATION: HUMIDIFYING WHEN UNNECESSARY

Many air handlers at UVa are also fitted with steam humidifiers. Steam at approximately 5 psi is directly injected into the air stream inside an air handler with the goal of increasing humidity if sensors indicate that excessively dry conditions exist inside the building. Humidification is generally needed in the dry winter months when air temperatures remain below 50°F.

During summer months, especially when dehumidification is necessary, rehumidifying air is almost

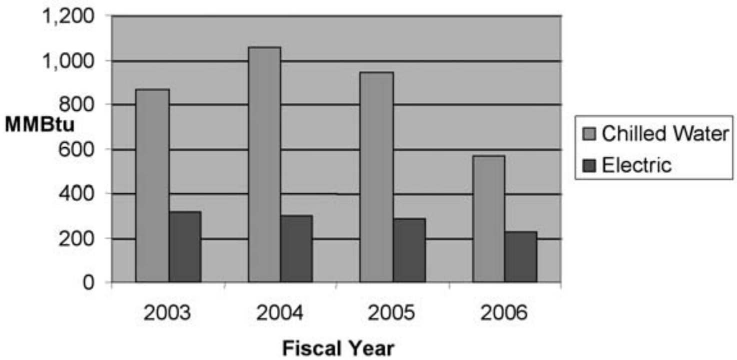


FIGURE 8. University Chapel energy use by type.

never necessary. During summer months, it is generally possible to disable humidifiers. This process can be automated by preventing humidifiers from opening if the outside air temperature is greater than 55°F. During winter months, excessive humidification can also be caused by faulty humidity sensors located in zones or ducts.

When humidifier nozzles are located immediately upstream of cooling coils, it is often advisable to disable humidification if the cooling coils are providing cooling. In this case, warm steam is sprayed directly onto the cold cooling coil causing water to condense onto the coil, raising the surface temperature of the coil and causing increased use of chilled water. The net result is increased heat use to generate steam, increased chilled water use, and no or little net increase in humidity.

SEQUENCE OF OPERATION: MAINTAINING CONDITIONS WHEN BUILDINGS ARE UNOCCUPIED

Another major opportunity at UVa is to avoid maintaining tight environmental controls when buildings are not occupied. Night setback has long been known as an excellent method of reducing heating and cooling costs, but it has remained an underutilized method. The major reason that night-setback is not universally used in university and institutional settings is that people use their offices outside of normal business hours. Even if this is infrequent, an incident of a hot or cold office can result in complaints. Maintenance personnel then have to respond or explain why.

In a university setting, offices, dorms, food service, and athletic facilities all present extended periods when they are unoccupied. A typical office may be unoccupied 70% of the time, but it is occupied almost daily. Some areas may not be used for months, such as a food service area that is heavily used during the normal academic year, but not at all during the summer.

SUCCESSFUL EXAMPLE OF "UNOCCUPIED SETBACK" IN A DINING HALL

A recently built food service facility at UVa was shut down for the summer while the majority of students were away. During this period, the allowable space temperature was allowed to be as high as 85°F, but still controlled for humidity. In this three story building, the top two levels were placed on summer setback, while the bottom level remained in an occupied mode to support office staff. For the period of June and July 2006, electricity use dropped to 42% of the amount of energy used in the previous summer. Chilled water used dropped to 33% of the amount used during the previous summer. Steam use also decreased substantially to 57%. During the prior summer, the building was in the final stages of commissioning following construction, and was not serving meals to students. Much of the savings are directly related to allowing the building to be less conditioned during the summer.

SUSTAINING IMPROVEMENT

Significant opportunities are identified through metering and submetering utilities. Projects are implemented to address the most significant savings opportunities. Success or failure of projects can be verified through comparing energy use before and after a project using metering. However, improvements cannot be sustained without institutionalizing improvements. Institutionalizing means that once a successful project or technique is developed, rules are imposed so that the technique will be used on all future construction, renovation, and maintenance projects. At UVa, this is done by adding the successful technique to the design guidelines or through issuing directives. Examples at UVa include the requirement that all utility service is to be metered, all new construction should be connected to central chilled water or steam systems, and that only energy efficient electric motors are used. Improvement is sustained further by evaluating energy use at least annually and setting departmental goals.

More specific information on energy use and conservation efforts at UVa can be found by visiting http://utilities.fm.virginia.edu/publications/anrpt.htm. Overall success of this program is demonstrated by long term improvements. Overall energy cost savings and avoided cost is estimated to be more than $10,000,000 annually, which has been sustained since the mid-1990s.