Latent Building Energy Waste for Dummies

“Knowledge is power, it will improve your income and provide security for your family.”

The biggest latent energy waste is; No Accountability

No one talks about accountability or holding someone accountable for their energy usage. But it is **necessary**, **feasible and cost justified with today’s technology,** to hold every occupant and control systems operator accountable for their energy usage.

Every person that sits at a desk should know how much energy dollars it costs for the air diffuser to condition their area, how much it costs in energy dollars for their lighting and the plug loads in energy dollars that they are responsible for.


Turn it all off when unoccupied

Building control operators are constantly being requested to reduce the energy consumption. The main concern for the control operators is to maintain a comfort level to the occupants. They have no feedback on if they made the right energy-saving adjustment or if they cleaned the cooling tower, how much that will save in energy dollars.

They get no satisfaction or recognition if they save energy because there is no way of documenting their efforts.

I think you got the point we need data for the operators and owners to expose our profits and losses.

“What gets measured, gets managed”

Vampire Power Waste

I research the industry daily and while back I was surprised to learn about plug loads, something I never thought about and didn’t think there was an opportunity for savings.

These loads pose different challenges than central energy loads.

“The Department of Energy (DOE) reports that plug loads are rising at roughly twice the rate of total building energy use. By 2030 they will increase some 49% while other building loads will increase only 24%. The projection is based on increases in the number of plug-in devices and their energy intensity. Plug loads currently represent 33% of commercial building energy use. In the quest for whole building energy efficiency, Facility Managers cannot ignore plug loads, which account for a growing share of commercial building consumption.”

Paying electric bills for stuff you aren't using. If they're plugged in, your computers, peripherals, and electronics are eating up energy when you think they're off--and in no small amount, either.

Quote GSA

"To understand a facility's plug loads and develop effective energy management strategies, managers must first obtain accurate energy use data. Proper metering is the key to getting this data. Use the data to calculate the average load during work and non-work hours. Strategies to reduce plug loads can save about $0.17 - $0.23 per square foot for an office building. This translates into savings of roughly $40,000 - $60,000 over five years for a facility of 50,000 square feet. Metering plug loads is a necessary first step to realizing these savings."

Scheduling

There is an old, established energy conservation sequence it's called. Turn it off!

I told the owner that he would receive X amount ROI by installing DDC zone controls. Replacing the pneumatic system with all electric DDC controls. (500 zones) The owner received rebates and we were on our way. We installed a perfect control system. On to the next job.

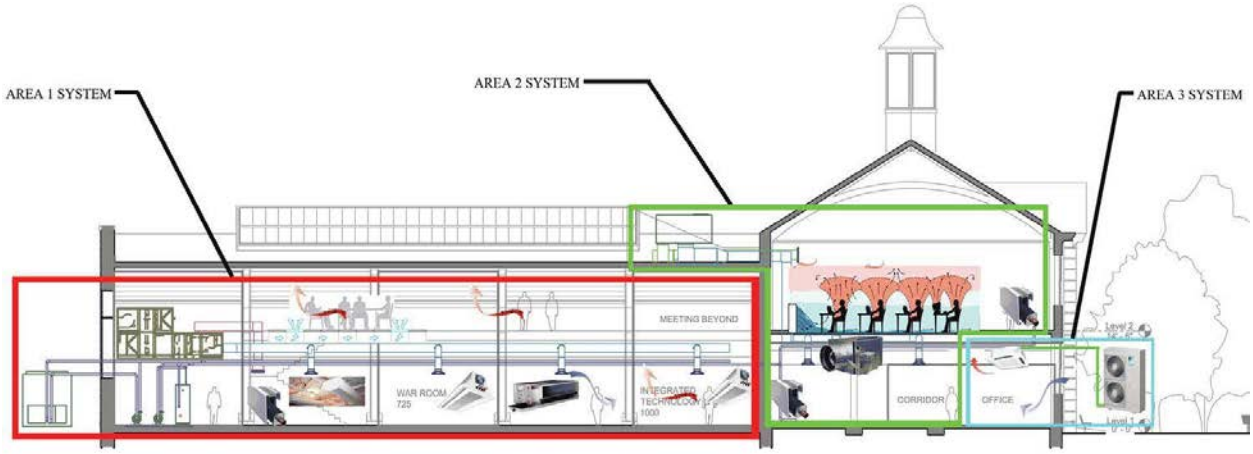
A year or so later I contacted the building owner and he was extremely mad and said my energy savings projections was Bull Shit!

The problem was that the system operator did not customize the schedules of the various zones. He started all zones at 4-5 am in the morning and shut down everything at 6 pm in the evening. No vacation schedules, but he did have holidays. This building was multi use, some people come in at 6 AM and leave it 3 PM or 9 AM and leave at 6 PM. It took me two weeks to customize majority of the schedules. The control system operator promised to complete the scheduling.

I came back a couple years later only to find out that they were back to the whole building zone schedules was at 4-5 am in the morning and shut down everything at 6 pm in the evening. Again! I never received a referral from the owner.

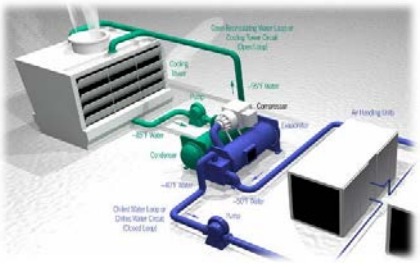
This is nationwide problem with large control systems. It's just too time-consuming to get the proper schedule information from the occupants. Proper scheduling could save the nation billions a year.

There is a simple technology available to automate this procedure and save billions!



Supply air settings

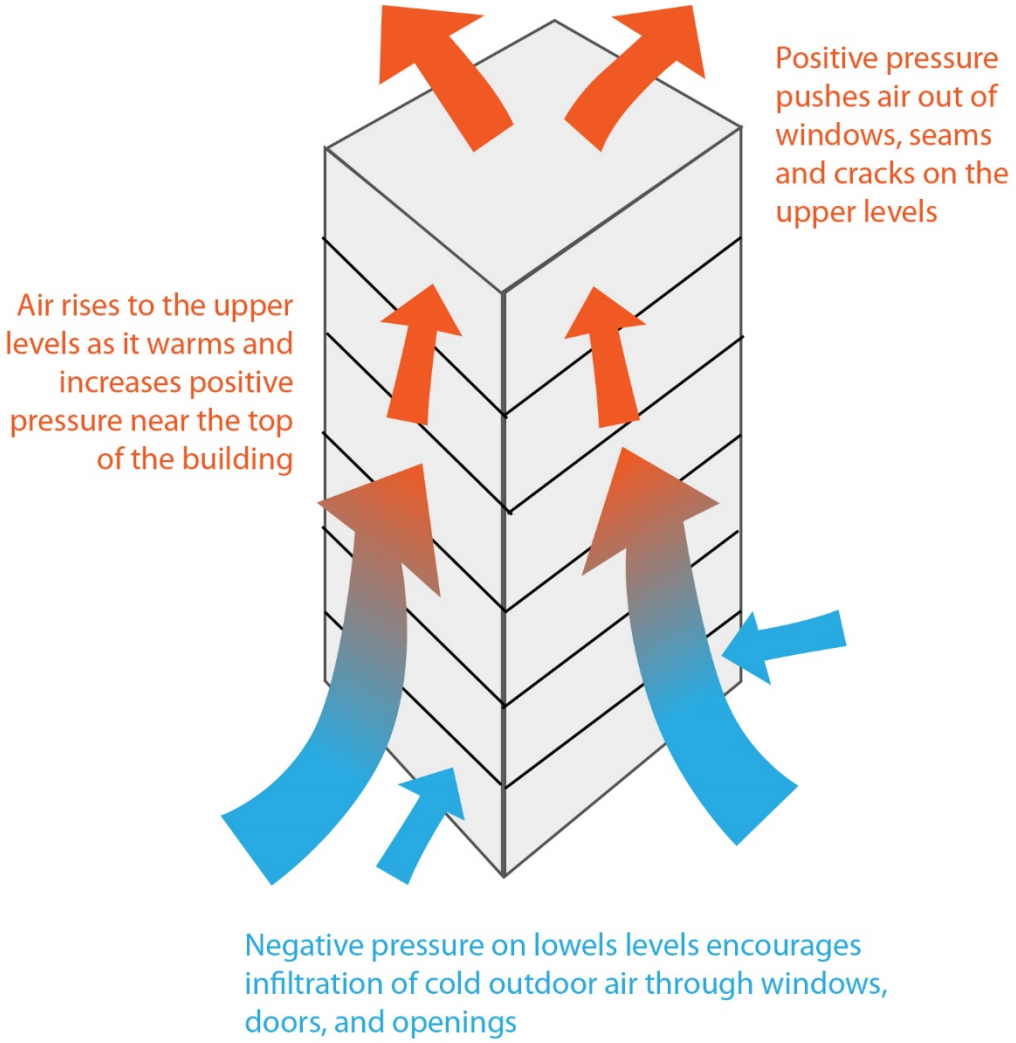
A typical sequence is when the return air reaches the set point it energizes the cooling. A warm complaint comes in and the control system operator sets return air set point lower. There could be several problems. A large meeting that morning or a problem with the zone that was later fixed. But the lower set point of the return air **never gets changed back higher to conserve**. Instead of investigating the problem the easy fix is to drop the temperature. Not only does this waste energy it's hard on the mechanical cooling equipment running in low load conditions. This is typical problem with heating setpoints also. There are economical solutions with diagnostic analytics and automatically changing parameters to maintain comfort and energy conservation.



Building Pressurization

This is a major problem in small and larger commercial facilities. In high-rises facilities they call it the stack effect. Building pressurization should be maintained at .05 inches of positive pressure.

HOW DOES STACK EFFECT WORK?



I was referred to a building because they were having extremely high energy bills. The first thing I noticed was that the doors were blowing open. Common sense; if you're blowing your conditioned air out, warm outside air is coming in via the HVAC system.

Negative pressure is worse because it's introducing unfiltered outside air directly affecting the temperature of the occupants. What comes in must go out and again were blowing our conditioned air out through the HVAC exhaust system.

The major problems are nonfunctioning controls and/or adjustments. Another thing that I've found is that there is a standard sequence in industry called fan tracking. The exhaust fan tracks the speed of the supply fan. **This does not work** because it doesn't

take in an important factor of the outside air economizer system. **There's only one way to control building static pressure** that is to measure the building pressure appropriately and control the speed of the exhaust fans independently of the supply fans speed.

Air balance

The bookkeeper is pissed off! Technician comes in and she says, cold air is dumping out of that air diffuser and I'm freezing. Shut the damn air off or turn it down. The technician goes straight up into the ceiling and adjusts the manual balancing damper to a minimum now she is happy, and the technician runs off to solve other issues.

The real problem is the boss has the thermostat in his corner office and is getting a sun load that the bookkeeper wasn't receiving. (An equal load conditions) The boss comes back to his office, now he is mad and says he can't hear because the air is coming out so fast. The technician goes up into the ceiling and dampens down his damper.

You ever hear the complaint when it's cold outside it's cold in here, when it's hot outside it's hot in here? **The above is a major problem throughout the industry.** And were wasting fan energy trying to push air through a restricted ductwork system. Is there a cost justified solution to this problem? Think about it, do some research you may be surprised.

Leaky ductwork

Leaky ductwork is a problem with a lot of systems but is more prevalent with the VAV system. (Variable Air Volume) This system is found in commercial facilities 40,000 square-foot and up. Very popular. The ductwork is usually designed to hold 1 inch of static pressure to the VAV zone. The supply fan varies the flow of air to accommodate the change in pressures as the VAV zones opens and closes their dampers throughout the system.

After the first control malfunction or miss adjustment, the fan speeds up to 100%. *(System operator: I can fix this temperature problem, I will turn the fan speed up to 100%)* When the majority of the VAV zone dampers shut the air dampers down the main ductwork is over pressurized causing air leaks throughout the system.

I've been in thousands of buildings and I can't emphasize enough that I often find it's cooler in the ceiling that it is in the condition space. I could safely say that **this problem goes unreported because of the difficulty of locating the leaks.** Majority of commercial buildings (specially built in the 80s) are wasting considerable amount of energy because of leaky ductwork. There is such a simple solution.

Economizers

I design the controls for the Transamerica Building

I was very proud of the project I did as a young man and several years later I returned to the facility and they gave me a tour of the mechanical system. It was a pleasant 54° summer day in San Francisco and when I looked up at the huge control panel I noticed that all six economizer systems were supplying 68° to 65° mixed air. I questioned building engineers and they said that's how it was designed. I asked if I could look because usually if it's 54° outside the supply air from the economizers should be 56 to 57. ° (heat of compression from the fan will raise the temperature 1 to 3°) I immediately checked for leaks and tight close off the return air dampers which is the usual problem. They were perfect. There had to be something, I looked for unfinished holes etc. in all six mechanical rooms. Nothing.

I went away shaking my head and frustrated that I couldn't find the problem. As I was leaving I looked up and saw that the exhaust outlet was right next to the outside air inlet and this wasn't obvious inside the mechanical room. I went back and recommended that they install a thick Plexiglas divider between the inlets and outlets. We knew the cost of the Plexiglas dividers, but I couldn't give them an **100% accurate** cost of the energy savings. With technology today, that **can be done accurately** and economically. The cost/BTU/Time? With the above outside air temperature conditions this building could've operated almost all day without starting the huge chiller.

Two pumps running at the same time?

As a young engineer I knew that typically facilities would have two pumps and they would alternate running (lead lag sequence) and switch over in emergencies. Engineers, design the systems to operate with one pump in operation. (I'm referring to chill water and condenser water for cooling tower systems.) In the 70s I was in a 11-story office building and all 4 pumps were operating at the same time. I asked the building engineer why he had the backup pumps running and he said they been running like that since he started working there 10 years ago. I did the math and found that running 2 pumps unnecessarily was $16,000 a year wasted energy and $160,000 in the 10 years he that he worked there. Through the years from being in thousands of buildings I would say that over 50% of the time they had all the pumps running in the facilities that I inspected. I guess the reasoning is; more the better. Again, knowing the cost to operate equipment could save billions of dollars. (Inexpensive wireless amperage sensors?)

The bad apple zone issue

Example: this zone that has twice the computer stations or the VAV zone is sized too small or not functioning properly. The complaint of being too warm is relayed to the controls system operator. He resets the supply air temperature lower and/or increases the fan air pressure. Zones that do not have high load conditions are now throttling the VAV airflow down to the minimum causing temperature and airflow stratification issues throughout the condition space. Indoor air quality and comfort are suffering along with increased energy waste. If the system is not operating correctly it's wasting energy. If the occupants are uncomfortable it's usually indicative of an energy wasting facility. Knowing the cost of the fan operation or the cost of chiller system. (Amperage, temperature difference, flow = BTU's/Cost/Time.) If the operator knew the cost of his adjustments and settings, they would make better choices.

Operator's lack of HVAC knowledge

What would happen if you let a grandma drive a racecar? She would drive slow and never win a race. It's the same thing with an inexperienced control systems operator. Turns into a major energy waste.

Sometimes, the control systems are so complicated that even experienced HVAC personnel can barely maintain temperatures and that's with them wasting hours of time and money monitoring and adjusting conditions daily.

Quote: "If it needs a manual, it's already broken." Control systems can be designed to monitor and operate simply, but it does cost additional money.

Leaks in pneumatic tubing etc.

(Approximately 40/50 million pneumatic thermostats in the nation)

I was asked to provide a quotation for enlarging the return air duct work system in office building in Silicon Valley. The projected cost was about $180,000. I noticed that the huge supply fan was running at full speed and the supply air temperature was below design conditions. They just were not getting enough air to the far side of the facility, so the consulting engineer designed a larger return air duct system to improve the airflow.

It just didn't seem right to me, so I inspected the system and found that the pneumatic control air pressure was too low at the far end of the facility.

The pneumatic dampers were not opening the cooling enough to allow the air to condition this end of the building. So, by fixing the simple air leak I was able to reduce energy consumption significantly and save the facility $180,000 in repairs. Again, with technology today there is a simple cost justified diagnostic solution.

Zoning design problems

There are two zoning issues; whole building and interior/exterior zones.

Whole building zoning in a VAV system should at least consider one HVAC system for the **east** side of the building, one HVAC system for the **west** side and one HVAC system for the **core** of the building. Quality buildings also have additional HVAC systems for the **perimeter** of the facility. Each HVAC system could in theory be crudely controlled by one thermostat. Well now you know how it should be controlled but

unfortunately there is a great deal of facilities that are not designed to high quality standards. **Quality designs costs.** 

Poor comfort equals excessive energy use.

Each thermostatically controlled zone should have equal load conditions, too simple it down that means exterior window zones should not be intermixed with interior zones. Again, high energy use is usually associated with poor comfort conditions. To redo the ductwork or add HVAC systems to the existing building is a tremendous cost. There is an economical solution to correct poor engineered systems with modern technology.

Summary

This is just a fraction of the energy waste in the commercial, residential and industrial industries in our nation. With almost 50 years in energy-saving business I could write a book about the thousands of energy wasting situations.

The most obvious energy waste is that we do not turn off HVAC, lighting and plug loads when they're not required or when unoccupied for commercial buildings. If we did 100 billion dollars a year savings in the nation? In the world $???? Billions. It's such a waste and it's so simple to just turn off. **After reading this information there is a quiz.**

How many of the above items have cost justified solutions that could save the nation and the world billions of dollars per year. I'm going to give you a hint. Look at www.ecWizard.net if you're studious you will see all the solutions to the above energy wasting issues.

As an inventor you must think about the big three. Does it solve a problem? Is it unique? Is it cost justified?

https://www.ecwizard.net/about