

How to Green Your HVAC System

My “Insider” Tools to Achieve
Low CarbonFootprintGreen,
High Energy Star Rating Buildings

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“Show Me the Money” on Energy Savings

Energy Savings Increases a Buildings Value

1. Energy Savings increases a Building's Value 10-14 Times depending on the capitalization rate.

After energy savings equipment pays back their investment, the building's value increases by **10-14 Times** that annual energy savings.

Example: New energy savings equipment costs **\$100,000**.

It saves **\$50,000** per year.

The First **Two** Years pay back the investment.

In Year **Three**, the building increases in value by **\$500,000** with an **8%** cap rate ($\$50,000 \times 10$) or **\$700,000** for a **6%** cap rate (Class A Building)

Energy Savings Balance Sheet

<u>Year</u>	<u>Energy Equipment</u>	<u>Energy Savings(10%)</u>	<u>Building Increase</u>	<u>Total Profit</u>
1	- \$100,000 Cost	\$50,000		
2	-\$50,000 Cost	\$55,000	\$70,000 + \$5,000 =	\$75,000
3	0	\$60,100	\$841,400 + \$65,100 =	\$906,500
4	0	\$66,110	\$925,540 + \$131,210 =	\$1,056,750
5	0	\$72,721	\$1,018,094 + \$203,930 =	\$1,222,024
6	0	\$79,931	\$1,119,903 + \$283,861 =	\$2,950,059
7	0	\$87,924	\$1,230,936 + \$371,785 =	\$1,575,721
8	0	\$96,716	\$1,354,024 + \$468,501 =	\$1,822,525
9	0	\$106,387	\$1,489,418 + \$574,888 =	\$2,064,306
10	0	\$117,025	\$1,638,350 + \$691,913 =	\$2,330,263

Energy Savings decreases net operating income and makes everyone look great

2. Energy Savings can have a:
 - a. Fast Payback,
 - b. Positive ROI during the life of the building
 - c. Reduction in net operating income

These numbers will make any CFO Very Happy :

- ▶ A \$100,000 investment had a two year payback.
- ▶ It then generated \$906,500 of profit in year 3
- ▶ A total profit of \$2,330,263 profit by year 10.

The “New” World of Building Operations

High Performance “Green” Building Engineers need to:

- a. Correctly Program and Operate Computer Energy Management Systems tied into the HVAC system.
- b. Match Outside Air Intake with the number of Building Occupants versus just a set Outside Air rate.
- c. Coordinate Staged Cooling Tower start-ups.
- d. Perform Aggressive New Preventative Maintenance Schedules.
- e. Maintain Energy Recovery Equipment.
- f. Maintain Ultraviolet Lights to keep Cooling coils and Drainpans Sterile and free of Bacteria and Mold.
- g. Maintain Oxygen Ion Systems to Neutralize VOCs.
- h. Operate off peak thermal storage.

So where can additional savings come from?

Your HVAC systems!

- 40-50%+ of your building's energy costs are from HVAC.
- The most expensive cost in an HVAC system is heating or cooling Outside Ventilation Air.
- The prime areas of HVAC energy savings is fine tuning the Ventilation System and Air Conditioning components like the cooling coils.

Pop Quiz #1

How did the Original Mechanical Engineer design your Building's HVAC system?

Yes No

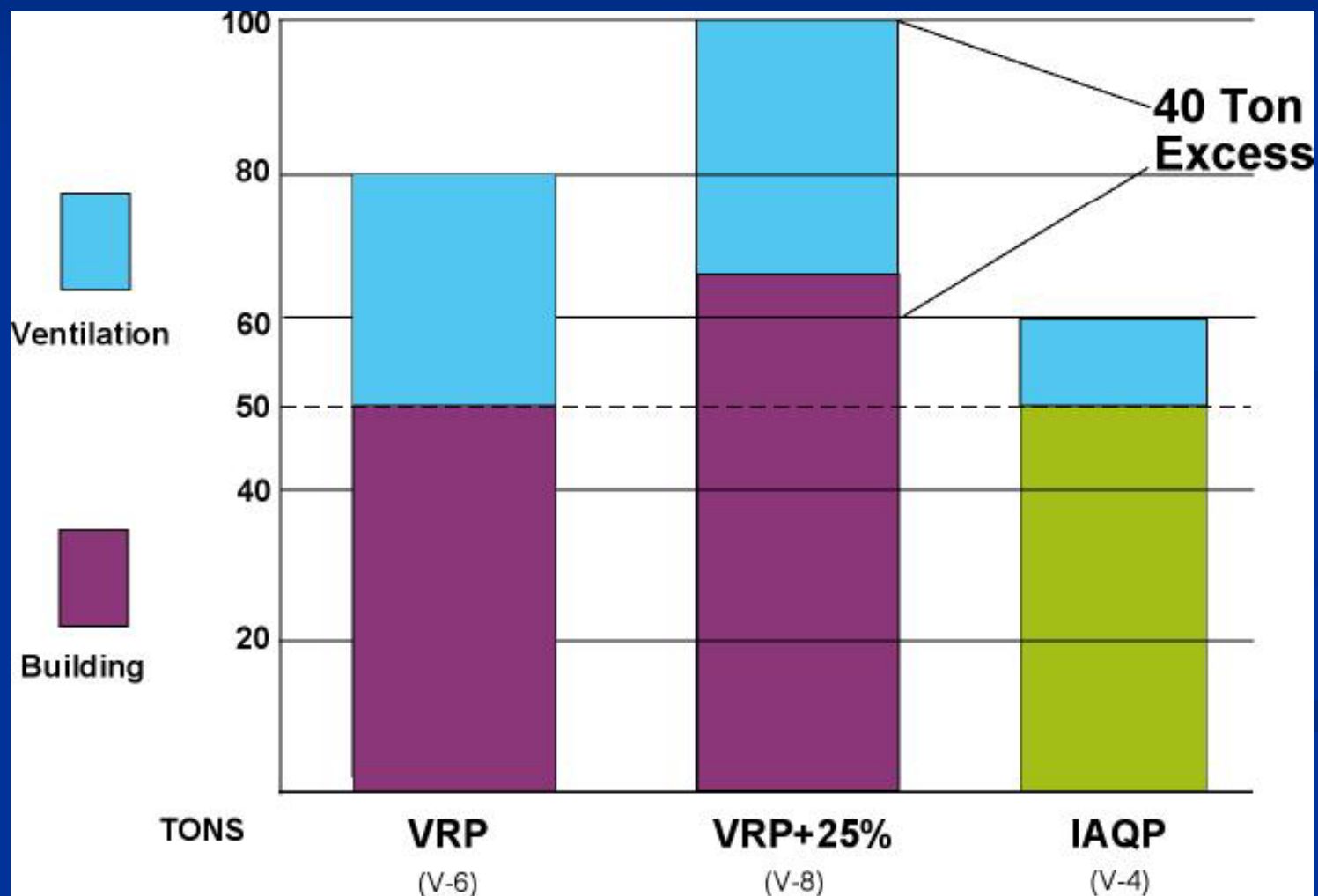
- He matched the amount of outside air required to the actual number of building occupants.
- He calculated the correct size and then added an additional 25% on as a fudge factor.

Insider Tip: Commercial HVAC systems are Overdesigned Energy Hogs

ASHRAE 62.1 Ventilation Rate Procedure (VRP)

- 99% of Mechanical Engineers calculate the required Outside air using a default setting based on square footage. They may (or may not) guess on how many people will eventually occupy the building.
- When Energy was cheaper, over designing an HVAC system wasn't really a major problem because success was just keeping tenants cool & warm.
- HVAC design engineers overdesigned projects by 25% so when equipment got run down from little real preventative maintenance, the building would still stay cool. But: "There is no free lunch."

Engineers Over-Size HVAC Systems for Outside Air and Future System Degradation



Oversized HVAC Systems are Very Inefficient

- Having an oversized HVAC system is like driving a car and never getting into fourth gear much less into energy-efficient overdrive. Your mileage/efficiency must suffer.
- “Rightsized” HVAC systems are perfectly tuned to the building volume, occupants and the climate zone.
- Rightsized tuned HVAC systems can be 30% more efficient than oversized guesstimated systems.

“Greening” HVAC Systems is the Key to Energy Savings & Energy Star Ratings

1. Ventilation Rates are Too High. (-\$\$)
2. So Your Heating & Air Conditioning Units are too big. (-\$\$)
3. Your Air Conditioner Coils are Mold Infested blocking their ability to transfer cooling Btu's to the air. (-\$\$)
4. Your Cooling Tower tubes are coated with scale making them more inefficient in removing heat. (-\$\$)
5. The pumps and motors are either full on or off, making them inefficient. (-\$\$)
6. You have no thermal storage, so at peak loads you have no choice but to run your chiller at full blast. (-\$\$)
7. Your chiller water reservoir has a 20-30% heat loss efficiency , which wastes even more energy. (-\$\$)

Pop Quiz #2

1. Why do Buildings bring in Outside Air (OA)? _____

2. What is Displacement Ventilation? _____

3. What are Human Bioeffluents? _____

Outside Air. ASHRAE. 2006 IMC.

Outdoor Air Ventilation Rules & Options Have Changed.

Mechanical Engineers have two choices: The 2006-7 IMC & ASHRAE 62.1 Ventilation codes allow either:

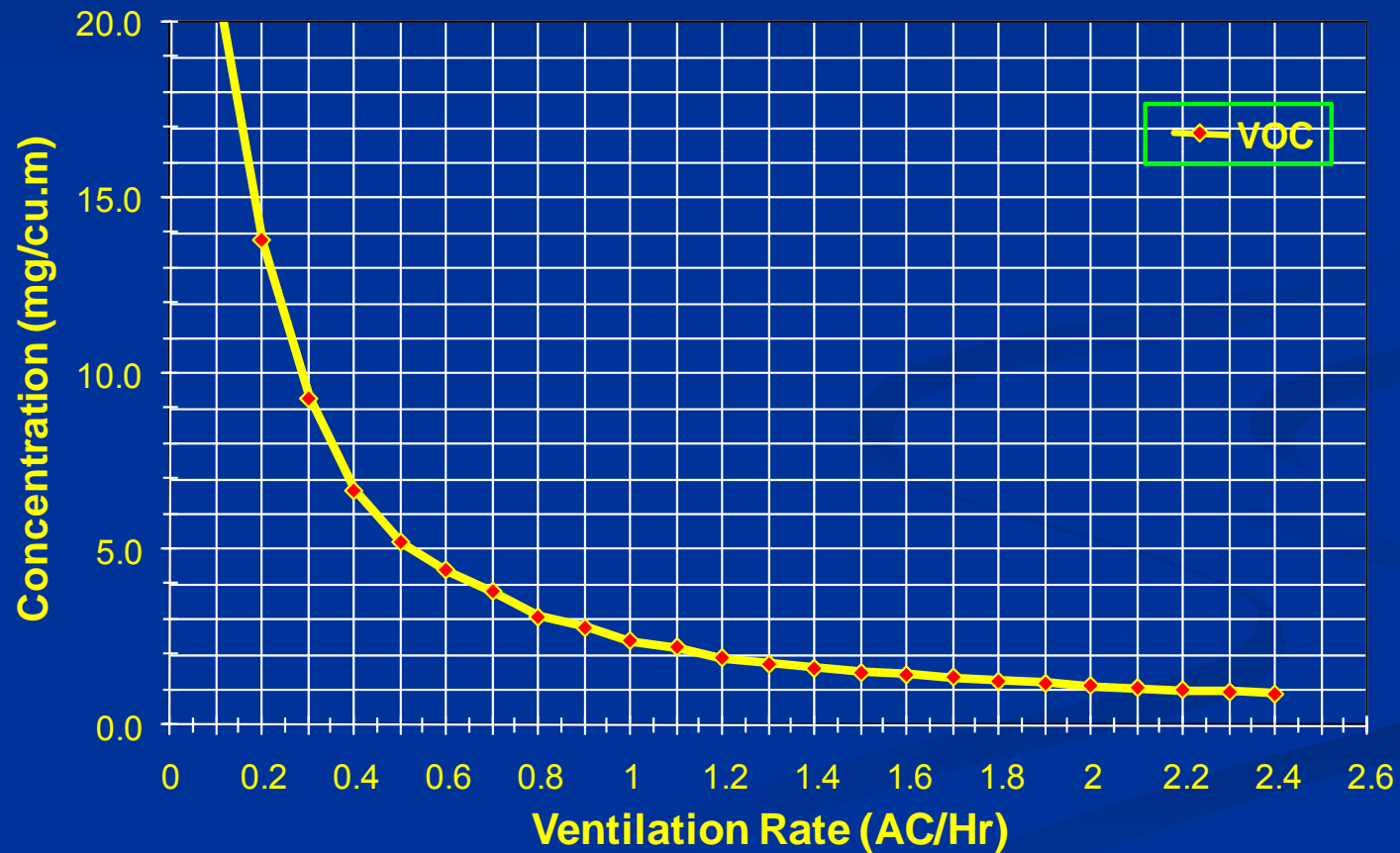
1. **VRP**= 20 CFM per PERSON OR
2. **IAQP**= 5 CFM (as long as a VOC purification system **sufficiently** cleans the air).

The difference between 20 & 5 CFM is a whopping **15 CFM**.

The energy saving of reducing **15 CFM** of ventilation air can be as much as **25%** of your **HVAC Energy Bill**.

Outside Air alone can't effectively remove all the VOC's

Ventilation for VOC Control



Indoor Air Quality improvements of Less Outside Air brought Indoors:

1. Dramatically Reduces outdoor Ozone flooding indoor air.
2. Drastically Reduces airborne bacteria & mold spores levels.
3. Prevents overly dry air winter from drying out occupants airways which makes them sicker.
4. In winter, Higher humidity air reduces airborne virus levels because viruses' moisture makes them weigh more and fall to the ground. Drier winter air causes the viruses' moisture to evaporate and since they weigh less, they'll stay airborne for longer periods of time.

Financial implications of Less Outside Air:

1. Reduces Peak Energy Demand Loads and Up-Charges
2. Can Allow HVAC equipment do be:
 - a. converted to using thermal storage
 - b. downsized and upgraded for higher efficiency.
3. This can save as much as 10-30% on HVAC Costs.
4. Significantly reduces costs to dehumidify humid air in summer and humidify dry air in winter.

How to Lower Outside Air Intake Volumes: Perform an ASHRAE 62.1-2007 Ventilation Audit.

This will provide you with the information to fine tune your Building's Ventilation Volumes with the following information:

1. Maximum Required Outdoor Air Intake Volume.
2. Minimum Allowable Outdoor Air Intake Volume with VOC Air Purification systems.

62.1 IAQP & VRP Modeling Software

- *Uses The Indoor Air Quality Procedure*
- *Accurately Predicts Contaminant Concentrations v. Acceptable Limits*
- *Provides Cost Effective Alternatives (Outdoor Air + Air Contaminant Removal)*
- *Reduces First Cost and Operating Costs*
- *Provides Documentation*

Cooling Coil Inefficiency

1. “Cleaning” “Dirty” coils rarely is successful from an energy point of view
2. Deep sterilizing clean coils have shown significant energy savings and
3. Up to 20-30% energy efficiency increases
4. Indoor air Quality improvements-Tulsa

Green Low CarbonFootprint Energy Star Buildings

- Every Energy Dollar Saved = Increased Profits by Reduced Operating Income
- Energy Savings Profit = 10X Revenue Required to Produce that same profit (Assuming 10% net Profit)
- Energy Savings = 10-14 times that Savings in Increased Building Value
- Every Kilowatt/Therm saved= reduced global warming
- Lower Powerplant Energy Output = Less Toxic Mercury, Ozone and Sulfur Dioxide in Outdoor air
- Lower Outdoor Air Pollutants= Less Indoor Toxic Pollutants

Healthy Low Carbon Footprint Green Buildings:

- 1. Save Energy**
- 2. Reduce Global Warming**
- 3. Increase Building Value**
- 4. Improve Net Operating Income**

Homework Assignment

1. Your Building's Outside Air (OA)_____
2. Your Building's OA Per Person_____
3. Your Building's Total Exhaust Air (EA) _____
4. Is your Building's OA or EA is modulated by occupancy_____
5. What is the Minimum OA Your Building Could bring by
according to ASHRAE Standard 62.1-2007 and the 2007
International Mechanical Code_____

(ALL Above Values in C.F.M.)

Homework Assignment Details

1. Calculate Your Building's Outside Air.

- a. Using a hot-wire precision Anemometer, calculate your building's intake airflow in feet per minute.
- b. Calculate the area of your intake vent.
- c. Using those calculations find your intake's air volume in cubic feet per minute.
- d. Use an oversized airflow hood

2. Calculate Your Building's Exhaust Air.

- a. Using a hot-wire precision Anemometer, calculate your building's exhaust airflow in feet per minute.
- b. Calculate the area of your intake vent.
- c. Using those calculations find your exhaust's air volume in cubic feet per minute.
- d. Use an oversized airflow hood