Indoor Air Quality, Are We Getting the Most from Our IDAQ Investments

Tuesday February 13th, 2024
3:10 pm to 4:00 pm Aloeswood Room

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2024 Midwest Facility Masters Conference
February 13-14 • Exhibits on February 13 • Wisconsin Dells

Agenda

- Post COVID Chatter
- What Are The Key Opportunities
- Systems Being Installed
- What Are The Challenges
- What Is The Research Starting to Tell Us
- What Was Old Is New Again
- Energy Consumption vs Costs
- Questions and Answers

What Are You Hearing and Doing

What Are The Key Opportunities

CLEAN THE MECHANICAL SYSTEMS

- Filter Changes
- Ductwork Cleaning
- Outdoor Air Louvers
- Walls and Roof Around Intakes
- Mechanical Rooms
- Louvers and Ceilings

CODE AND OTHER

- Eliminate Fire Walls
- Address Moisture Issues
  - Roof – Walls - Foundations
- Replace Mechanical Systems

Staffing / Equipment

- Staff Training
  - Cleaning/Controls/Hazards
- Communications
- What Can't a Machine Do

OPERATIONAL PRACTICES

- Window/Vent Coordination
- Air Flushing
- Increase Amount of Outside Air

CLEANING PRACTICES

- Avoid Using Chemicals
  - Cleaning/Activities
- Vacume and Dust Often
- Pay Special Attention to
  - Corners and Under Objects
- Avoid Using Plastics

The EPA tells us there are three basic strategies to improve indoor air quality:
Source Control - Improve Ventilation - Consider Air Cleaners

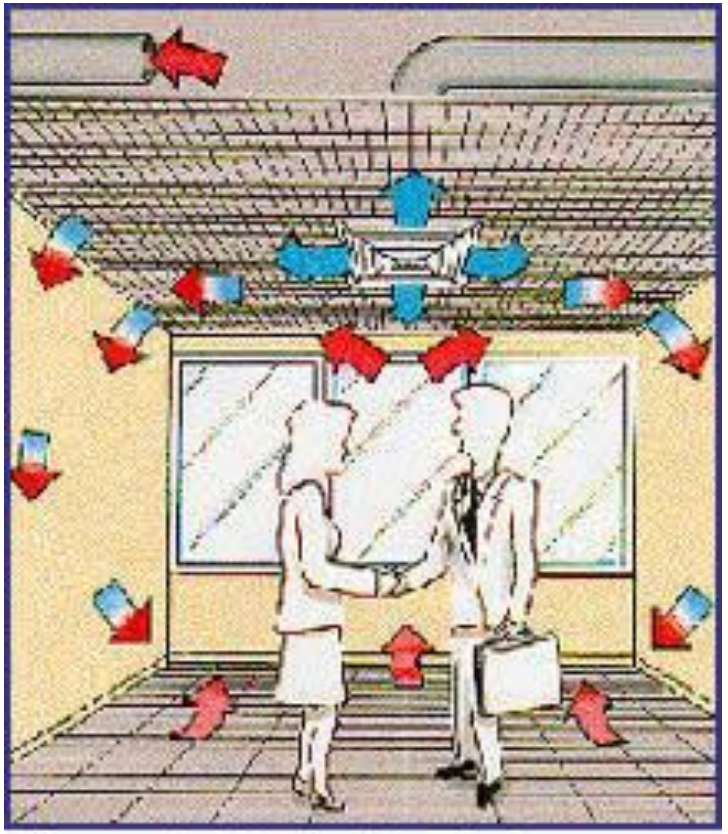
What Are The Systems Being Installed

Mechanical Systems are the most critical component regarding occupant comfort and Indoor Air Quality.

Mixed Variable Air Volume (VAV) Systems have been the most common systems in schools due to its fast design effort, low installation costs and simple operations.

Supply Air (blue arrows considered fresh air) and Return Air (red arrows considered foul air) diffusers are both located on the ceiling. Fans push the supply air from the ceiling to the floor.

With these types of systems, the higher the ceiling, the harder the fans need to work to push the fresh air to the breathable zone. And typically, the higher the ceiling, the more diffusers are required to more evenly distribute the air over a larger area.



http://www.iklimnet.com

What Are The Systems Being Installed

- **Air Purifiers**

  An air purifier or air cleaner is a device which is typically free standing which removes contaminates from the air to improve indoor air quality.

- **HVAC In-Line Bipolar Ionizers**

  An ionizer is a device which releases a negative ion into the air which attach to particles causing them to clump. The larger clumps can then be caught in filters or fall to the “ground”. The by product is the production of ozone.

- **Inline or Room Ultra-Violet (UV) Lights**

  UV light is a type of electromagnetic radiation which can be used to disinfect and sterilize surfaces.

- **Filtration Systems**

  The higher the MERV number, the denser the filter material and that will help catch smaller particles.

- **Dehumidification**

  The reduction of relative humidity which can help improve the environment necessary for growing molds and other harmful contaminates.

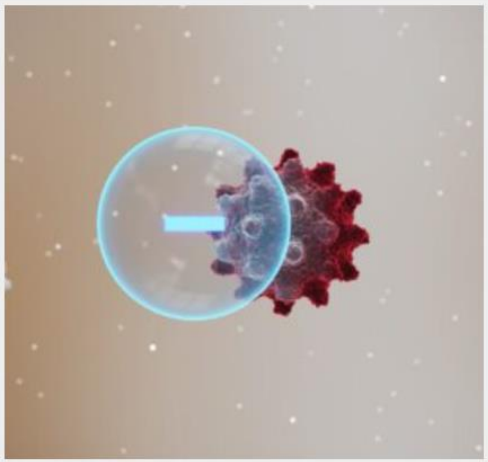


Photo courtesy of globalplasmasolutions.com

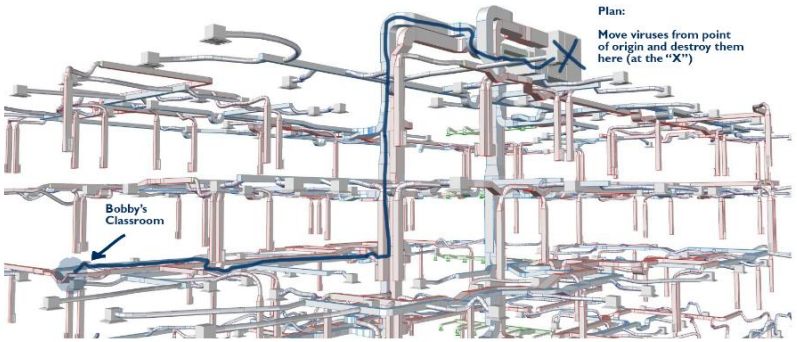
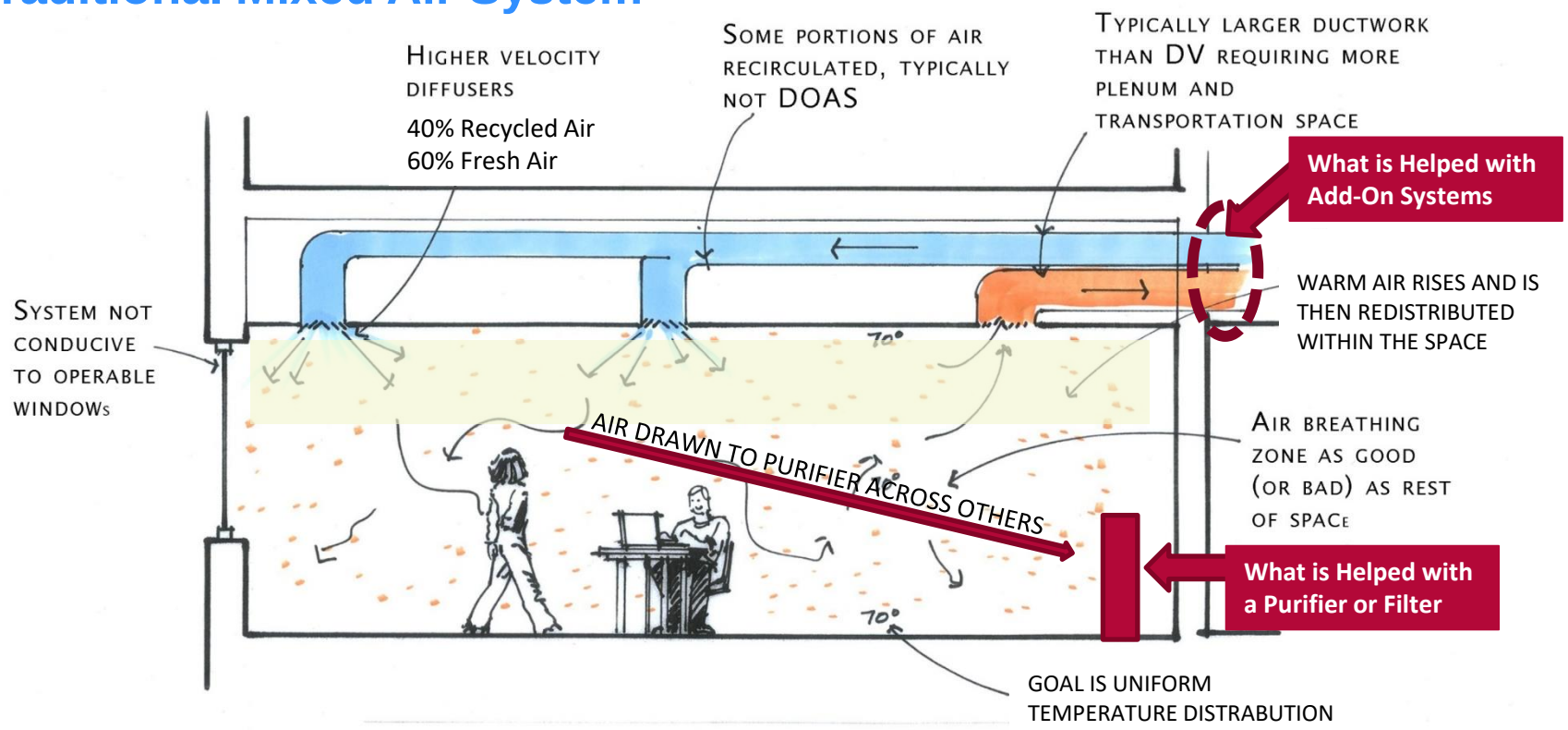


Image by My Engineering Notes

What Are The Potential Risks Of Systems

Traditional Mixed Air System



Background Noise Levels and Mixing of Air

- Mixed Air Systems will mix 30% to 55% of the return room air (recycled existing room air). Other systems can incorporate 100% outside air without mixing airborne germs/particulates.
- If systems are added to the duct stream or in the room, what are the challenges, risks and the benefits?
- Perceptions are most people's reality.

What Are The Risks Of All Of These Systems

- **Air Purifiers**

  These devices work with one of the other technologies. The challenge is cross contamination in rooms with large numbers of occupants.

- **HVAC In-Line Bipolar Ionizers**

  The effectiveness of some of these systems are being challenged in court. They are ineffective against orders, asthma and the produced ozone causes throat irritation, shortness of breath, and possibly chest pain.

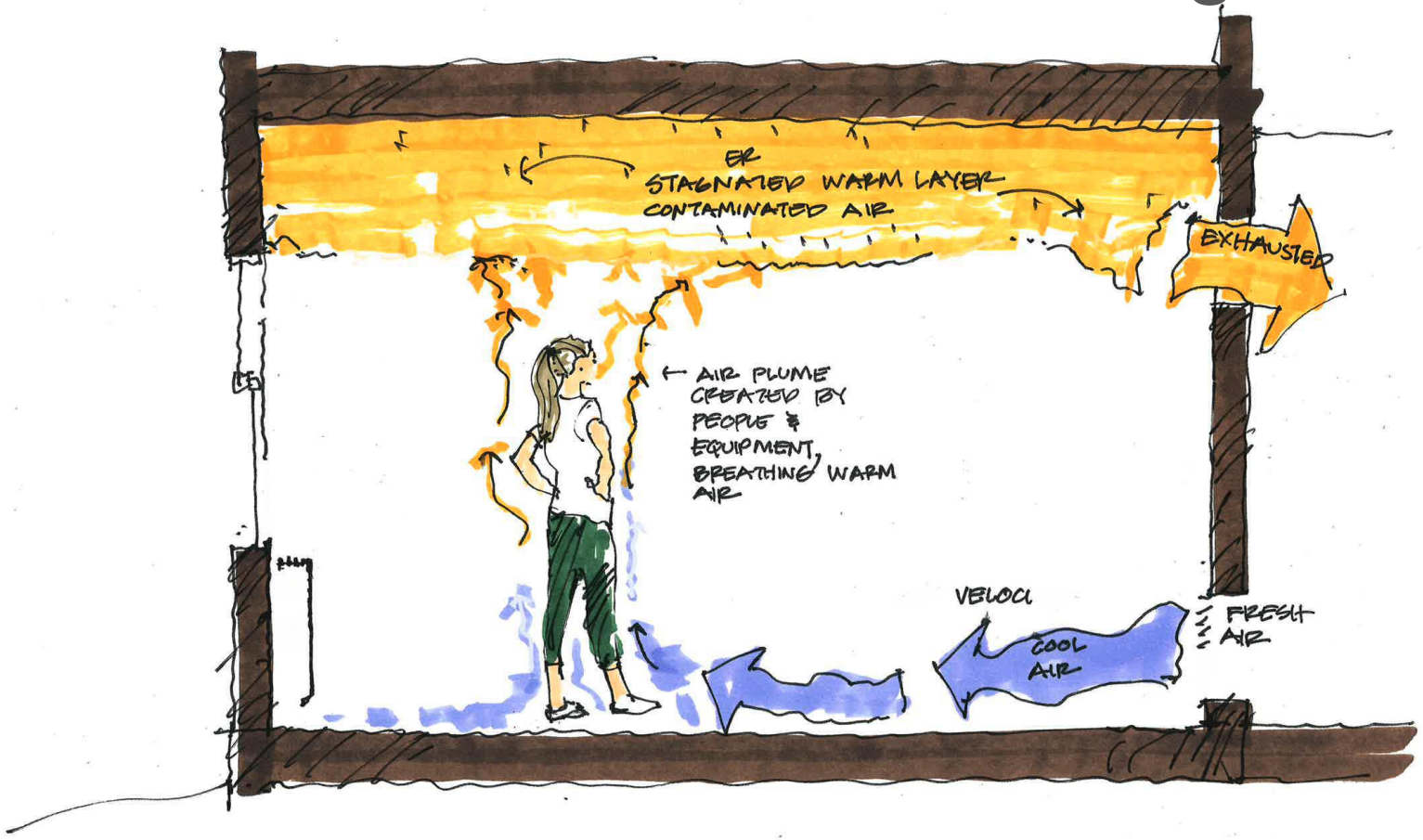
- **Inline or Room Ultra-Violet (UV) Lights**

  Direct exposure for humans is never safe. UVA and UVB rays are dangerous to the skin and UVC is damaging to the eyes.

- **Filtration Systems**

  The higher the MERV number the less energy efficient the system and potentially hazardous the waste.

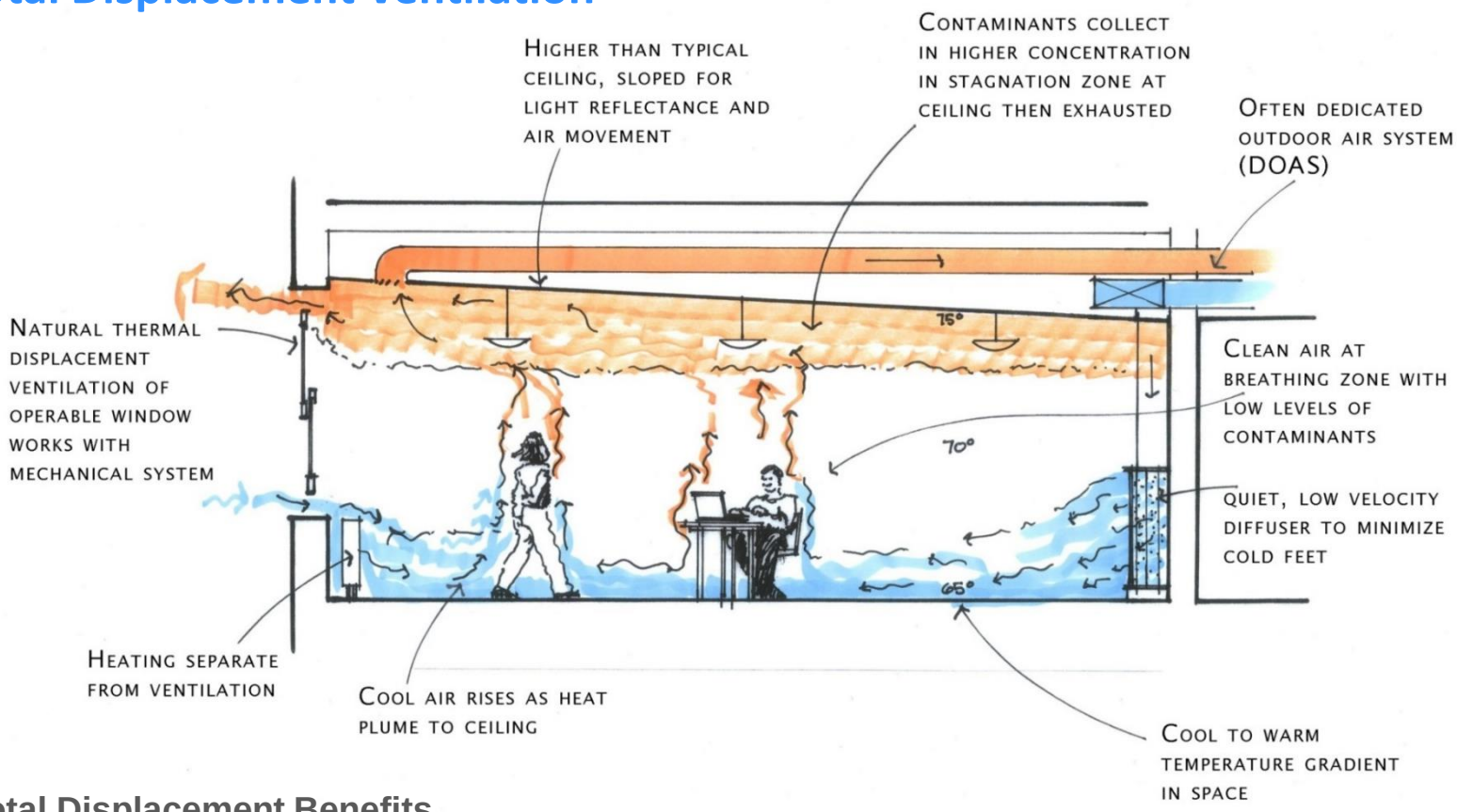
What Was Old Is New Again



Displacement Ventilation with Radiant Heating have been used since the late 1800s and are among the healthiest of systems installed. Supply Air is delivered at a lower temperature at the floor and rises as it warms. Return Air (stagnant air) is removed from the space at the ceiling.

What Are The Systems Being Installed

Total Displacement Ventilation



Total Displacement Benefits

A hybrid displacement system is part of our healthy buildings research efforts. The system incorporates 100% outside air. This system has proven to reduce the number of sick days, improved learning/test scores, and improve overall occupant comfort.

Comparisons To Other Systems

- **Background Noise Levels**

  The typical VAV system generates an average of 40 dB of background noise due primarily from fans pushing air from the ceiling to the floor. The Displacement and Conditioned Air Systems are generating and average of 30db (less than half) the background noise levels. This can be a dramatic impact on teaching and learning.

- **Energy Efficiency**

  The Conditioned Air System is the most efficient system due to size reduction/elimination of fans and reduced chiller sizes compared to the other systems. It is generally 30% - 35% more efficient that the VAV system and 5% - 10% more efficient than the typical Displacement system.

- **Construction Costs**

  There are variables regarding the various systems designs, primarily the cooling strategies and the method of providing heating. Displacement was long thought to be more expensive than the VAV systems. However, with the refinements of the Conditioned Air system, this systems has now proven to be equal to or less than the VAV systems.

- **Losses Due to Sick Days**

  The number of days lost due to airborne contaminates is far less to the Condition Air system. It is 4 to 6 days better than typical displacement systems and 18 to 20 days better than the VAV systems. This is primarily due to the mixing of outside air with the return air in a mixing system.

Other Benefits Of Displaced Conditioned Air

- **Reduced Maintenance Costs**

  Because there are fewer fans and components, there is less to clean and maintain.

- **Smaller Duct Sizes**

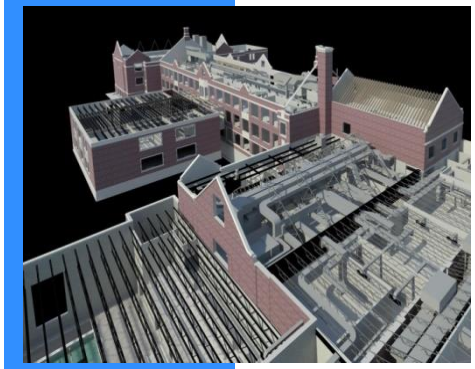
  When renovating buildings, there is often a smaller distance between the ceiling and roof structure to place ductwork and other building components. The Conditioned Air System allows for ceilings to be higher and therefore is visually pleasing for renovation projects.

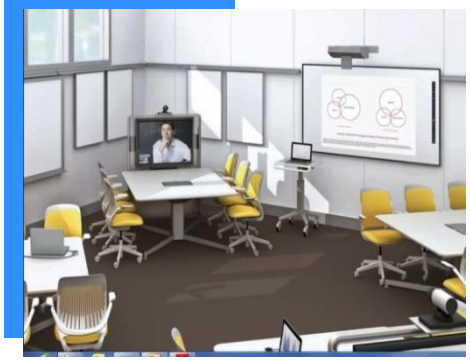
- **Filtration Systems**

  The higher the MERV number, the less efficient the mechanical system are due to the work effort required by fans to push air through the systems. In a post pandemic world, the recommendation is to use a MERV 13 final filter (what is also being used for face masks). The conditioned air system has always used MERV 13 however the other systems have typically been designed with MERV 10 or less. Simply adding a MERV 13 filter to the other systems will decrease energy efficiency, increase background air noise and maintenance costs.

- **Dehumidification vs. Air Conditioning**

  With conditioned air, the system is designed to efficiently reduce the relative humidity rather than rely on the expensive processes of reducing the temperature. Based on the building type, system design and the building density/exposure; the building the design for “occupancy comfort” is maintainable to the low 90’s external air temperature.





Strategies to Achieve Energy Reductions, But There's More?

- Requirements to include strategies to reduce consumption in a COMPREHENSIVE FACILITIES PLAN(S).
- Complete RETROCOMMISSIONING or RECOMMISSIONING to help with staff training and identifying potential building and system improvements/replacement.
- Make energy savings potential a factor in considering CAPITAL PROJECTS or changes in space function.
- Building project REPAIR AND REPLACEMENT is prioritized based on guaranteed energy savings and funds available, thereby freeing up money for other potential projects.
- Energy consumption was made a factor in more aggressively pursuing building/system RIGHTSIZING.
- Compile USER GROUP DATA. Use their comments to guide your goals and let them know how they impacted the process

Three Areas of Energy Management

Energy-efficient operations

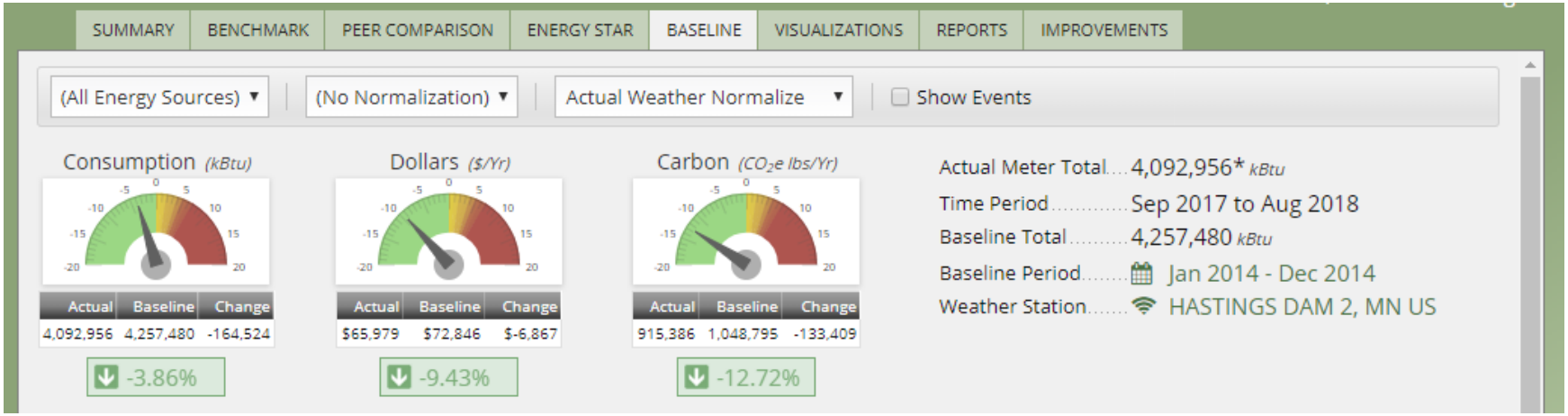
Savings Potential: 7% to 17%

Building and systems improvements

Savings Potential: 5% to 20%

Beyond the meter: understanding the rate structure

Savings Potential: 1% to 3%



Managing the Costs and Consumption

Xcel Energy®

MAILING ADDRESS	ACCOUNT NUMBER
ISD 277 SCHOOL DISTRICT ATTN: BUSINESS SERVICES 5901 SUNNYFIELD RD E MOUND MN 55364-8250	51-6795009-8
	STATEMENT NUMBER: 530672653 / STATEMENT DATE: 01/10/2017

METER READING INFORMATION

METER 17956112 - Multiplier x 300 — Read Dates: 11/22/16 - 12/27/16 (35 Days)

DESCRIPTION	CURRENT READING	PREVIOUS READING	MEASURED USAGE	BILLED USAGE
Firm Demand	Actual			250 kW
Interrupt Demand	Actual			157 kW
Demand	Actual			407 kW
Billable Demand				407 kW
Power Factor Demand	91.66%			

ELECTRICITY CHARGES — **RATE: Peak Controlled Service**

DESCRIPTION	USAGE UNITS	RATE	CHARGE
Basic Service Chg			$55.00
Energy Charge	160617 kWh	$0.032010	$5,141.35
Fuel Cost Charge	160617 kWh	$0.024360	$3,912.59
Firm Demand Winter	250 kW	$9.960000	$2,490.00
Controllable Demnd	157 kW	$8.210000	$1,288.97
Affordability Chrg			$2.79
Resource Adjustment			$861.20
Interim Rate Adj			$695.59
Total			**$14,447.49**

Predetermined Demand Level 250

Premises Total **$5,007.10**

$9,440

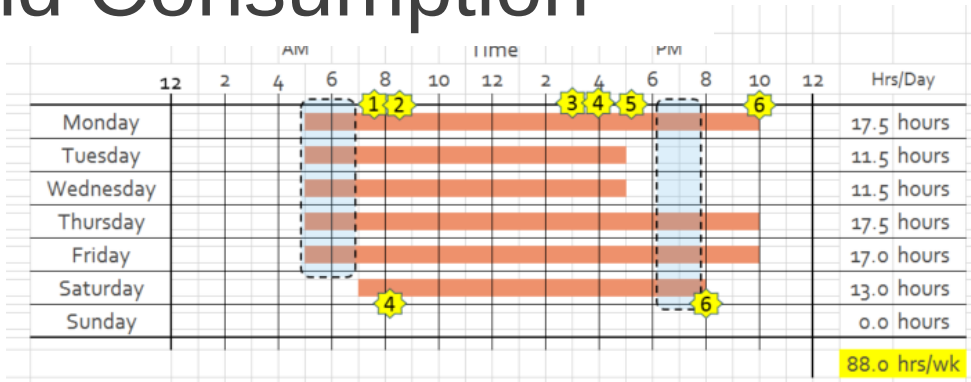
DAILY AVERAGES	Last Year	This Year
Temperature	32° F	24° F
Electricity kWh	4321.0	13492.6
Electricity Cost	$1,589.53	$1,327.52

Xcel Energy Invoice
Strategic Goal Review

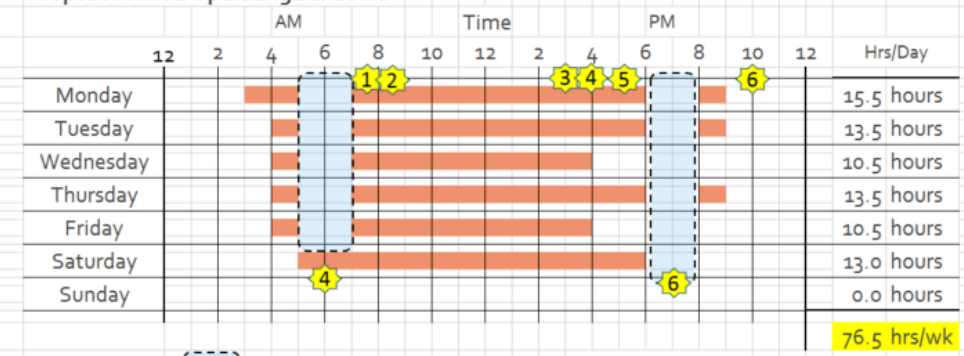
Highlights of January 2017 Invoice:

Page	Building	Program	Demand Level	Last Year Daily Average	This Year Daily Average	Savings
3	Hilltop Elementary	Peak Controlled	50	228.29	129.45	98.84
4	Mound Westonka HS*	Peak Controlled	250	1,589.53	1,327.52	262.01
11	Grandview MS	Peak Controlled	50	316.61	149.42	167.19
19	Shirley Hill Elementary	Peak Controlled	50	188.89	94.08	94.81

*Credit applied to MWHS invoice in the amount of $9,440.39.



Proposed AHU2 Operating Schedule



Symbol Key: Peak Demand Charges; AHU Operating

1 Staff and Students Arrive
2 Classes Begin
3 Classes End
4 Activities Begin
5 Classroom Staff Depart
6 Activities End

Considerations

A. How long can we suspend system operation and maintain occupant comfort during occupied hours
B. Can schedules be adjusted to avoid peak demand charges (PDC)
C. Can avoiding PDC also reduce the hours of operation
D. Can temperatures be reduced during Activities (athletics) and still maintain occupant comfort
E. Is it cost effective to continue night set-back schedules
F. Are the AHUs zoned to reflect operational needs and schedules
G. Understand the costs ($) vs. consumption (kbtu) values

Questions & Answers

Indoor Air Quality, are We getting the Most from our IDAQ Investments

Call or Email Anytime!

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