Variable Frequency Drive HVAC Applications

40 Hp high bay air handler.  
Cooling Tower Pump VFD: Since the small chiller only needs 900 gpm and the existing pump supplies 2000 gpm, a VFD was far more efficient than a throttle valve (see previous slide).

30 Hp high bay air handler.

AHU’s: Original owner of Bldg. needed 100% OA for the manufacturing space. New owner did not need that so VFDs were used to throttle these drives down significantly. This also allowed for dehumidification control (by moving the air very slow and lowering the chill water temperature) and reduced load on the chiller and boiler.
Reheat Reduction using variable airflow

Original Line-up (simplified with no exhaust): Air moved at max CFM across the cooling coil that had 42F chilled water going through it. This dropped the temperature. This colder air was then passed across a reheat coil that had 180F water going through it. This brought the air to a normal discharge temperature of 55F – 65F.

New De-humidification line-up (simplified with no exhaust): Air moved at min CFM across the cooling coil that had 42F - 47F chilled water going through it. This drops the temperature significantly, condensing more water therefore reducing humidity. The need for reheat is reduced or eliminated. The reduced airflow helps keep the space from getting too cold, but a little reheat may be required if that occurs. As you can see the low discharge air temperature means the supply air duct definitely has to be insulated.
Eliminating reheat required the high bay ductwork to be insulated because the discharge air temp would drop and sweating could occur. This was an $18,000 investment with a payback of about 1 month!
Natural gas consumption has been the largest success of our energy management efforts. Overall Results:

- Dekatherms reduced by **87.8%**
- Cost reduced **$239,728** for a cost reduction of **89.2%**
• Electronic Timers should be installed on electric water heaters.
• Many facilities have water heaters that are grossly oversized
• NG should be used if available (Far less expensive to heat with than electric resistance)
• Tankless NG systems are ideal for low or variable occupancy applications
• Heat Pump water heaters are good for hot kitchens
When water heaters are turned off, their associated recirculation pumps need to be turned off also. If not, they will cause the piping system to act as a large radiator, removing heat from the hot water tank, causing the water heater to use more energy on start-up (to reach set point). This energy loss is in addition to the energy use to operate the pump.
Vending Misers

- Shuts down the compressor and lights when people are not in the area
- Can have a payback of less than one year
- Simple to install requiring little technical skills
- Sometimes soda vendor will supply for free
- Soda still stays cold
Many opportunities for vending and cooler misers
Many drink coolers have very bad seal leaks.

A vendor supplies these coolers to this golf resort, but the resort still has to pay the utility bill! These are basically operating with the door left open.
Refrigerated Water Fountains

Use of a programmable receptacle can reduce water fountain power use by 30%
The hood should overhang 6” over the cooking equipment. Either the equipment needs pushed back a little more or extensions need installed on the hood.
Dishwasher sanitizing heaters, such as these two 36 kW models, can consume up to 30% of a restaurant's total power use. Should consider a NG unit or a chemical dishwasher.
Dishwasher exhaust is on when dishwasher is not operating. Best fix is an interlock.
Idle time needs to be reduced whenever possible.

Pilot lights should be shut off whenever possible.
Assume 1,250 BTUs for commercial pilot. This is a two-fold savings: natural gas or propane to fuel the pilot and the electricity saved by not having to remove the heat with the HVAC system. A 4 burner stove (they are usually larger) would require 10 tons of cooling a day to remove the heat from the pilots!
Example of a plastic curtain that would work well in the walk-in coolers and freezers.

Walk-Ins

No curtains
Lighting Opportunities

Most painless energy project! Replace incandescent exit signs with LED signs. About a 6 month payback and no complaints!

500 T12 lights on at 0100 in the morning in a large library
Many times hallways are over-illuminated. Rarely should a 4 bulb fixture be used in a hallway. The Illuminating Engineering Society of North America (IESNA) maintains that 10-20 fc is adequate for hallways and aisles. These were 50 fc or higher.
Reduced Lighting Plan on the cheap

This is an inexpensive way to secure lighting that does not have switches. This example is for high bay lighting (uses much more energy than office lighting). The breakers we labeled and security was trained to turn them off when they are not needed. This reduced the off-shift load by 35 – 50 KW with no capital required, just labeling and a procedure. The lifespan of the breakers was investigated and it was found that they should last over 11 years if they are cycled twice a day.
This hi bay was converted from 250w HPS to T8 fluorescent. 32 fixtures were replaced with 16 4’s and 16 6’s. This reduced wattage by 3,242 watts and HVAC by 1902 tons. This project was done in conjunction with installing switches that allowed for all but 6 lights to be off when the space was not in use. This allowed for a 1.4 yr payback and allowed for a much better work environment. The 5000K lighting made reading prints and assembly work much easier than the yellowish HPS.

It helps to sell a lighting retrofit if switches can be added in. Also, do not forget to calculate the HVAC savings, which can be substantial. New lighting can be “brighter” but the foot candle readings may be lower; be more concerned about the reception of the lighting.
### Existing Fixtures

<table>
<thead>
<tr>
<th>T12-4</th>
<th>190</th>
<th>192</th>
<th>85,363</th>
<th>$10,244</th>
</tr>
</thead>
<tbody>
<tr>
<td>T12-2</td>
<td>5</td>
<td>96</td>
<td>1,123</td>
<td>$135</td>
</tr>
<tr>
<td>T8-4</td>
<td>42</td>
<td>113</td>
<td>11,070</td>
<td>$1,218</td>
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<tr>
<td>400 watt MH</td>
<td>16</td>
<td>464</td>
<td>13,363</td>
<td>$1,791</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>110,920</strong></td>
<td><strong>$13,387</strong></td>
</tr>
</tbody>
</table>

### Proposed new fixtures

| T8-2 | 190 | 56  | 25,040 | $33.92 | $4.08 |
| T8-2 | 5   | 56  | 655    | $10.00 | $28.00 |
| T8-2 | 42  | 56  | 5,504  | $14.16 | $23.84 |
| T8-6 | 16  | 221 | 6,359  | $60.80 | $164.20 |

### Savings

| T8-2 | 66,358 | $7,631 | $1,916 | 0.25 |
| T8-6 | 7,004  | $939   | $2,627 | 2.80 |
| **Total** | **73,362** | **$8,070** | **$4,544** |

**Combined Payback (in years): 0.56**

This spreadsheet is a very handy tool in obtaining buy-in for lighting projects. Be sure to research any available rebates: they can be very lucrative.
Prescriptive Rebate Measures

- Offered on a per-unit basis. Examples:
  - Lighting
  - HVAC
  - Refrigeration