

Energy Conservation as a Renewable Resource

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Renewable Energy Resources

- Have traditionally been thought of as:

- Solar
- Wind
- Biomass



- These sources do not have a finite supply (like fossil fuels) and generally are carbon neutral

Parallels to the Recycling Movement

- Traditional recycling has focused on a sequence of actions:
 - Reduce,
 - Reuse, then
 - Recycle
- We should employ the same ideals for energy.



Energy Hierarchy

- We propose the following:
 - Reduce
 - Recover, then use
 - Renewables
- In this way, we address the issues of carbon pollution and economics.

REDUCE

RECOVER

RENEWABLES

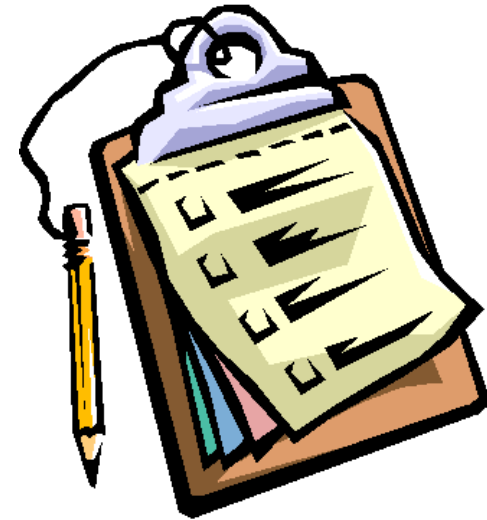


Energy Reduction (Conservation)

- This is the best way to reduce carbon, since it's better to not produce the energy, if you don't need it.
 - Some experts have termed energy savings “NEGA-Watts”
- The challenge with energy conservation is that it:
 - Requires engineering expertise to determine savings
 - Installing new lights, changing operating conditions is not as visible as installing panels on the lawn or wind turbines, but can be far more cost effective.

Energy Reduction (Conservation)

- There are many types of recommendations we can make, depending on the system:
 - Lighting
 - Compressed Air
 - HVAC
 - Boilers and Steam
 - Utility Billing



Lighting



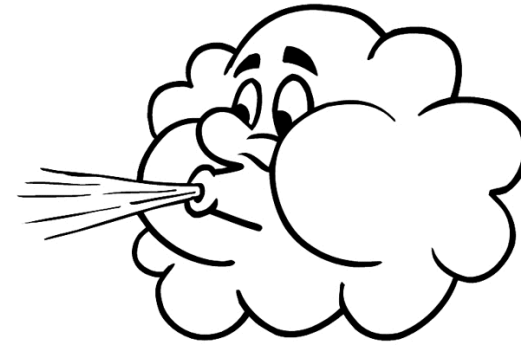
- Lighting recommendations are straight forward to implement, though it can be pricey.
 - LED lighting is where everyone is going
 - Example 1: Replace a 400 W metal halide (455 W) with a 125 – 175 watt LED, depending on ceiling height.
 - Example 2: Replace a four lamp T12 fixture (160 W) or 4 lamp T8 (110 W) with a 40 Watt LED drop in fixture
- Occupancy sensors and photocells are easy.

Lighting

- Paybacks depend greatly on hours of use.
 - One shift operations may have trouble paying things back in a few years
 - Three shift and 24/7 operations may have paybacks of less than 3 years
- Don't forget utility rebate programs from Duke Energy!
 - These can provide significant buy down
 - Not generally economical to stay opted in though, unless you take advantage of rebates for lighting, compressed air, and HVAC units in a short period.

Compressed Air

- Compressed air is often considered a third utility
- It is VERY inefficient to generate and not very well understood.
- Efficiency focuses on operating equipment properly and reducing inappropriate uses of air.



Compressed Air

- Reduce the pressure of the air to the minimum
 - Often 100-105 psig is adequate, do some trials to find your minimum
 - What piece of equipment is the bottleneck and how can we fix this?
- Operate the correct compressors for the job
 - Screw compressors are very inefficient when not fully loaded.
 - At 70% of load, a modulating compressor still uses 91% full power
 - Can you shut off compressors at night/weekends?
 - Do you need a system master control for multiple compressors?
 - Does a VFD compressor make sense?

Compressed Air

- Repair Compressed Air Leaks Frequently
 - Remember the unit will unload!
- Look at Engineered Nozzles for Blow Off Applications
- Recover Heat from the Compressor
 - Recover heat from air compressors, and other process equipment that reject heat for process/space heat

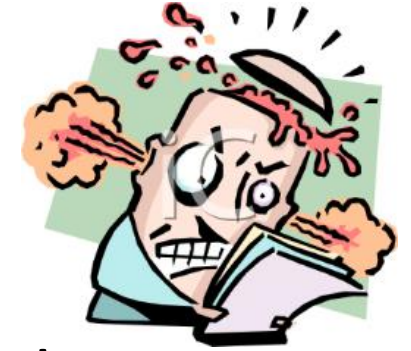


HVAC



- HVAC is a little tougher to work with because the units are typically very expensive and upgrading for energy savings alone is not practical
 - Upgrade roof-top units to higher SEER values when they are replaced. The incremental cost of a higher SEER unit can pay for itself.
 - Raise setpoint temperatures in the summer, particularly when the space is not occupied. New programmable thermostats can be set to lower temperatures an hour before occupancy. Careful with heat pumps!!
 - Utilize water cooled chillers. They are more efficient (0.6 vs 1.0 kW/ton), but require a cooling tower and maintenance. Not suggested for small systems.

Boilers and Steam Systems



- Steam is a great way to move heat around at moderate temperatures. Boilers are fairly efficient and less costly to operate than electric heat.
- Boiler Measures:
 - **Install a stack thermometer and a make-up water flow meter**
 - Tune the boiler annually to reduce excess air. Oxygen trim controls are recommended for boilers >600 hp that operate continuously
 - Recover heat from boiler blowdown. Blowdown losses can be several percent of the fuel fired. Flash low pressure steam for the DA tank or use to preheat boiler make-up water

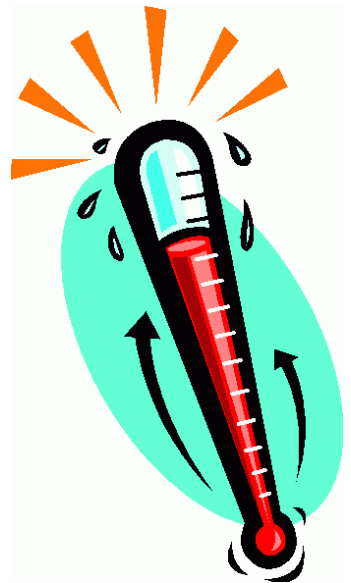
Boilers and Steam Systems

- Boiler Measures (continued):

- Lower steam pressure ← be careful of carrying out liquid
- Lower stack temperature with an economizer. The stack temperature should be 75-100F above the steam temperature at high fire, otherwise the boiler is dirty or poorly designed.

Lower the stack temperature with an economizer to around 300F if the boiler is large (say >600 hp) and used year round.

~35-40F change in stack temperature = 1% in efficiency



Boilers and Steam Systems

- **Steam System Measures:**

- Test and repair steam traps. About 5% of traps fail in a year and some facilities waste >40% of their steam in bad traps. Weekly observe the vents from the condensate receivers around the plant (often on the roof). If the steam is a lazy plume, the traps are OK. If it jets out, one or more traps are bad.
- Repair insulation. Easy one to overlook. Use 3-Eplus (download for free at: pipeinsulation.org) to compute the savings.
- Repair steam leaks. It's a safety issue. Need I say more??

Utility Bills



- Make sure you are on the correct rate schedule:
 - Plants that operate 1 shift to 12 hrs per day, 5 days per week are typically best served on standard rates – Rate I or SGS/MGS
 - Plants that operate 3 shifts or 7 days per week are usually better served with a Time of Use Rate – OPT-TOU, LGS-TOU.
- Opt Out of the REPS Charge
 - This is a part of the standard rate and you are opted in (paying) unless you see a REPS credit at the bottom of your bill.
 - Often, this is several tenths of a cent per kWh.
100,000 kWh/month might cost several thousand dollars per year.

Renewable Energy

- Once we've reduced our demand for energy, now we are ready to produce the energy we do need using renewable resources.
- Wind power in Central NC is essentially worthless
- Solar is possible, but without the NC Tax Credit, the paybacks are in the 10+ year range.
 - A 1 kW solar panel will produce about 5 kWh per day and cost \$3,000 to install.

Renewable Energy

- Intermittency is still a problem with many renewable technologies.
 - The sun is up only a certain number of hours and weather can affect.
 - Interconnection can also be expensive.
 - Difference between 2 kW of solar vs. 2 kW of energy conservation....



Our Work

- Our program does energy conservation assessments for manufacturers and institutions through gov't funding.
 - The one day surveys are FREE.
 - We involve engineering students to collect data, analyze potential measures, and calculate savings – under my supervision.
 - We provide a written technical report with a rough implementation cost and simple payback.



Questions

- Thank you for inviting me.

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