National Indian Gaming Association 2005

Certification: Energy Management for Cost Savings

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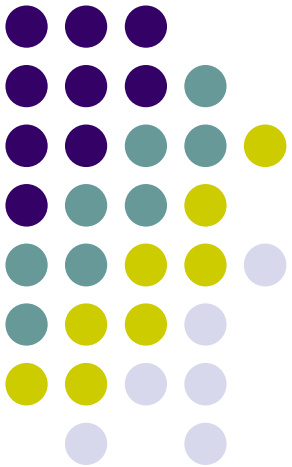
On behalf of
CERT

Wild Horse Casino in Umatilla Country, Oregon

Dancing Eagle Casino in Laguna Country, New Mexico

Casino First Principle

Maintain an environment that is as conducive to gaming as possible



Special features of casinos

- Open for business 24/7
- Virtually ***constant*** and large lighting load
- Virtually ***constant*** and large machine load
- Larger cooling than heating load in most climate zones
- Variable people load

--Therefore ***variable*** smoke, moisture, CO_2, cooking, drinking loads

- No windows
- No clocks
- Serious security made as unobvious as practical
- Distinct areas for the public versus the staff

HVAC issues at Wildhorse

- Gamblers smoke, so it's important to move plenty of ventilation air through the gaming areas. Requires lots of fan power plus heating and (especially) cooling energy
- The trick is to recover energy from the waste air stream without cross pollution from smoky air
- Wild horse system for energy recovery is probably only 30% efficient; should be >80%--major control issues
- Difficulties in meeting loads on hot days and cold nights
- Should zone non-smoking casino areas to ensure good indoor air quality with less fan power

Chillers at Wildhorse

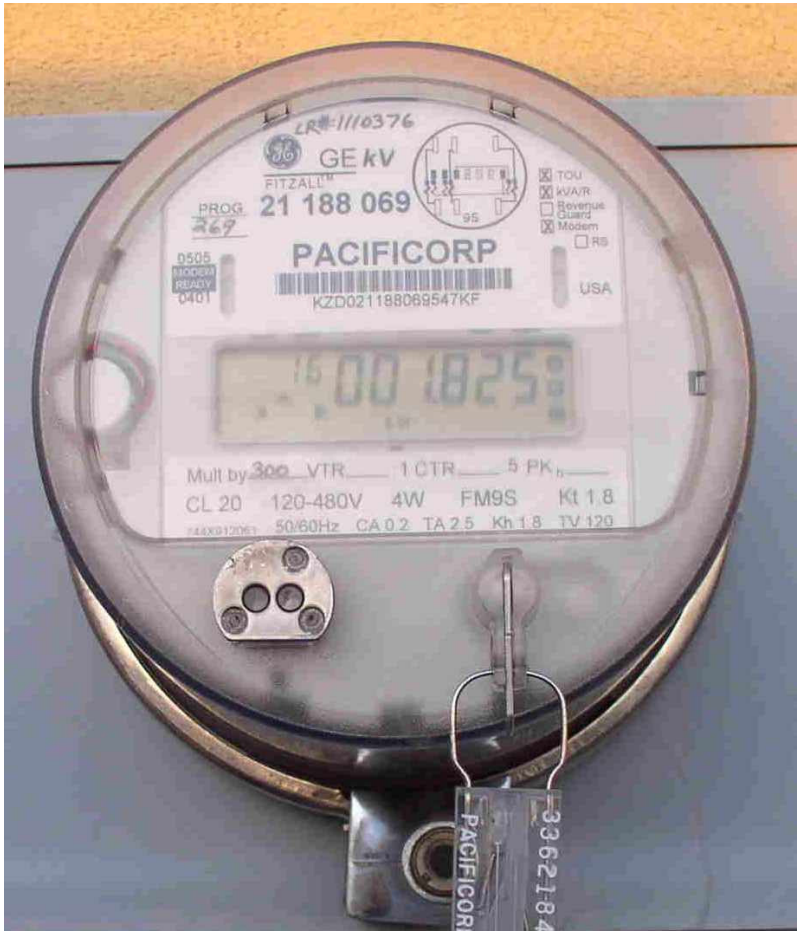
- Casino uses two Trane 60 ton units, one 50 ton unit
- Units use 1.1 kW per ton of cooling delivered, COP of 3.2, EER of 10.9
- Modern evap cooler units use only 0.5 kW per ton of cooling delivered
- Climate in Pendleton has low humidity, good conditions for excellent evaporative chillers

Slot machines

- Modern card-style slot machine measured at 180 watts of demand, power factor of 0.82
- 500 slots have a demand of 90 kW, an A/C load of 26 tons, adding another 28 kW of demand
- Over a year, 500 slots consume 780 MWh of electrical energy plus cooling of as much as 245 MWh/yr, an energy cost of $50,000/yr @ $0.05/kWh
- Energy efficient, attractive slot machines can be designed—and should be! (Including a smoke sucker inlet to the HVAC would help as well.)

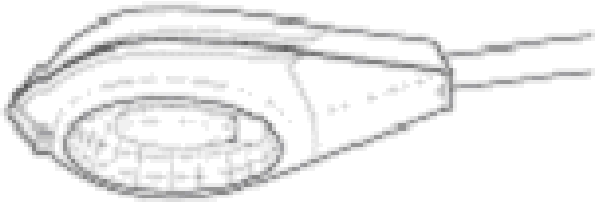
Lighting

- There is a great deal of incandescent lighting in the casino that could be replaced with functionally equivalent, attractive CFLs
- Incandescents have to be replaced often, disrupting gambling. They use four times as much energy per unit of light produced, so load up the A/C system, wasting even more
- Since lights on 24/7, paybacks in well less than a year

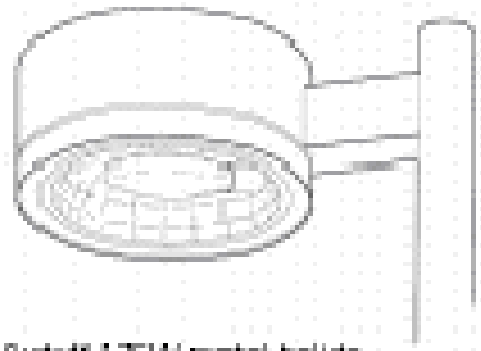


Parking lot lighting has large potential savings

- Efficient **parking lot lighting fixtures** can reduce the energy use on the site without compromising safety or illumination
- “Hockey puck” fixtures, which use 175-watt metal halide bulbs, require fewer poles, cut down on light pollution, have better color rendering, and use 70% less electricity than “cobra head” fixtures using 250-watt high-pressure sodium bulbs.
- Use daylighting sensors to turn off parking lot lights during the day

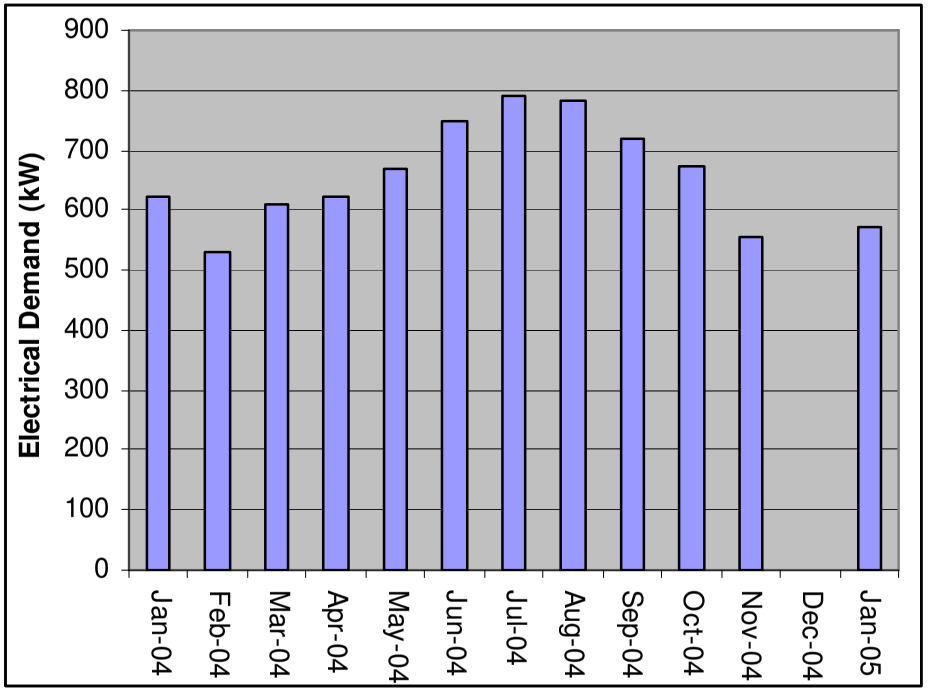


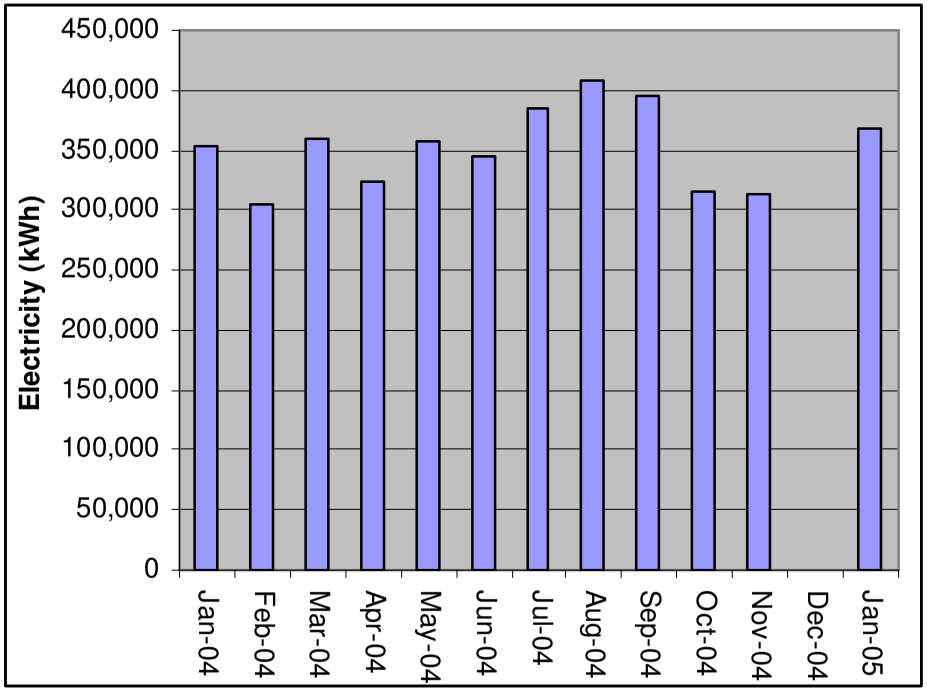
Cutoff 250W high-pressure sodium luminaire on 30-foot pole



Cutoff 175W metal halide luminaire on 30-foot pole

Electric bills: demand on the left; energy on the right

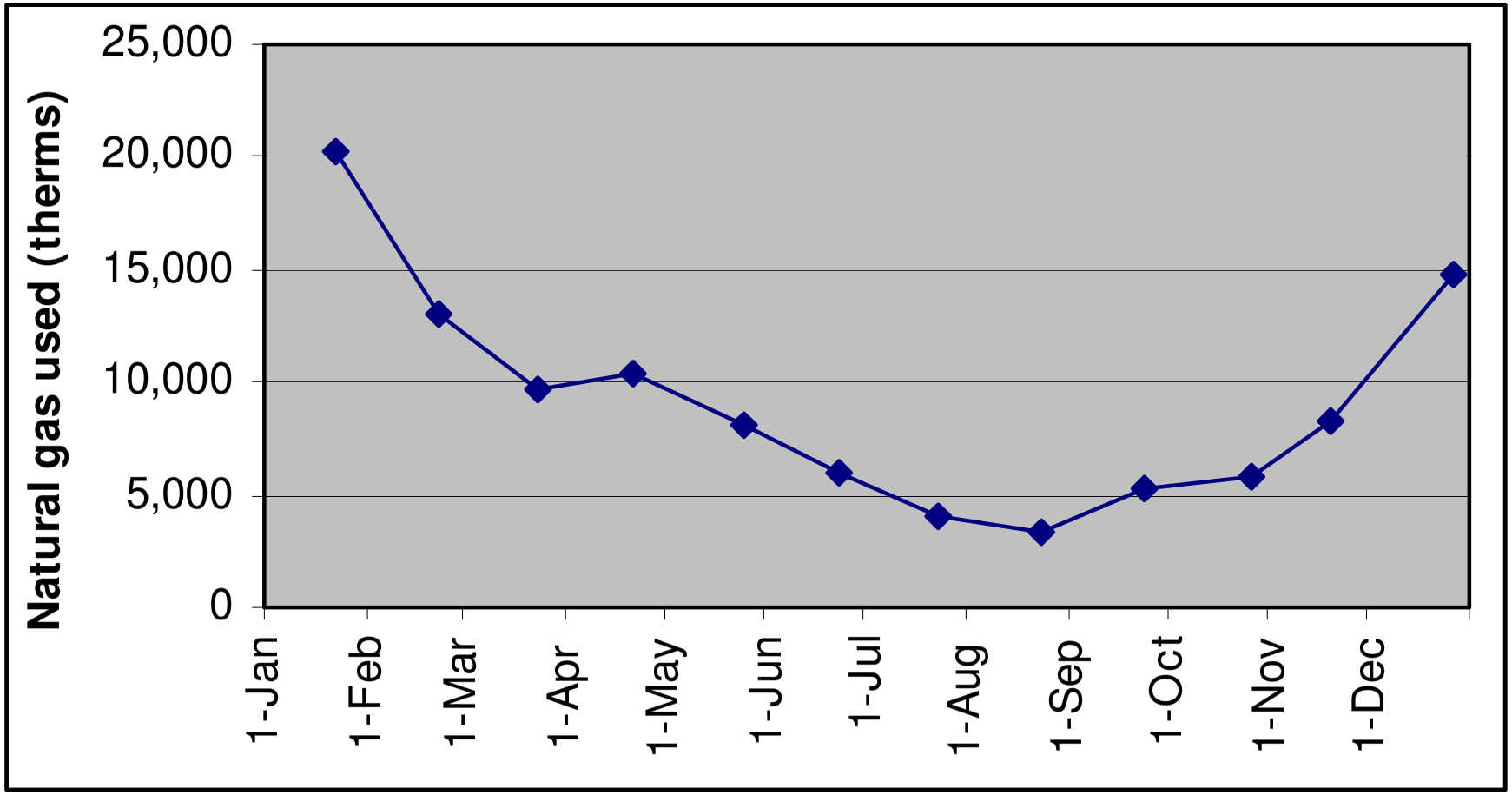




Peak shaving with back up generator

- Back up is used very infrequently
- Should be run from time to time to ensure functionality
- Could help in shaving peaks
- To measure is to manage; peak load should be followed carefully

Gas consumption follows the heating season



Carnot effect:

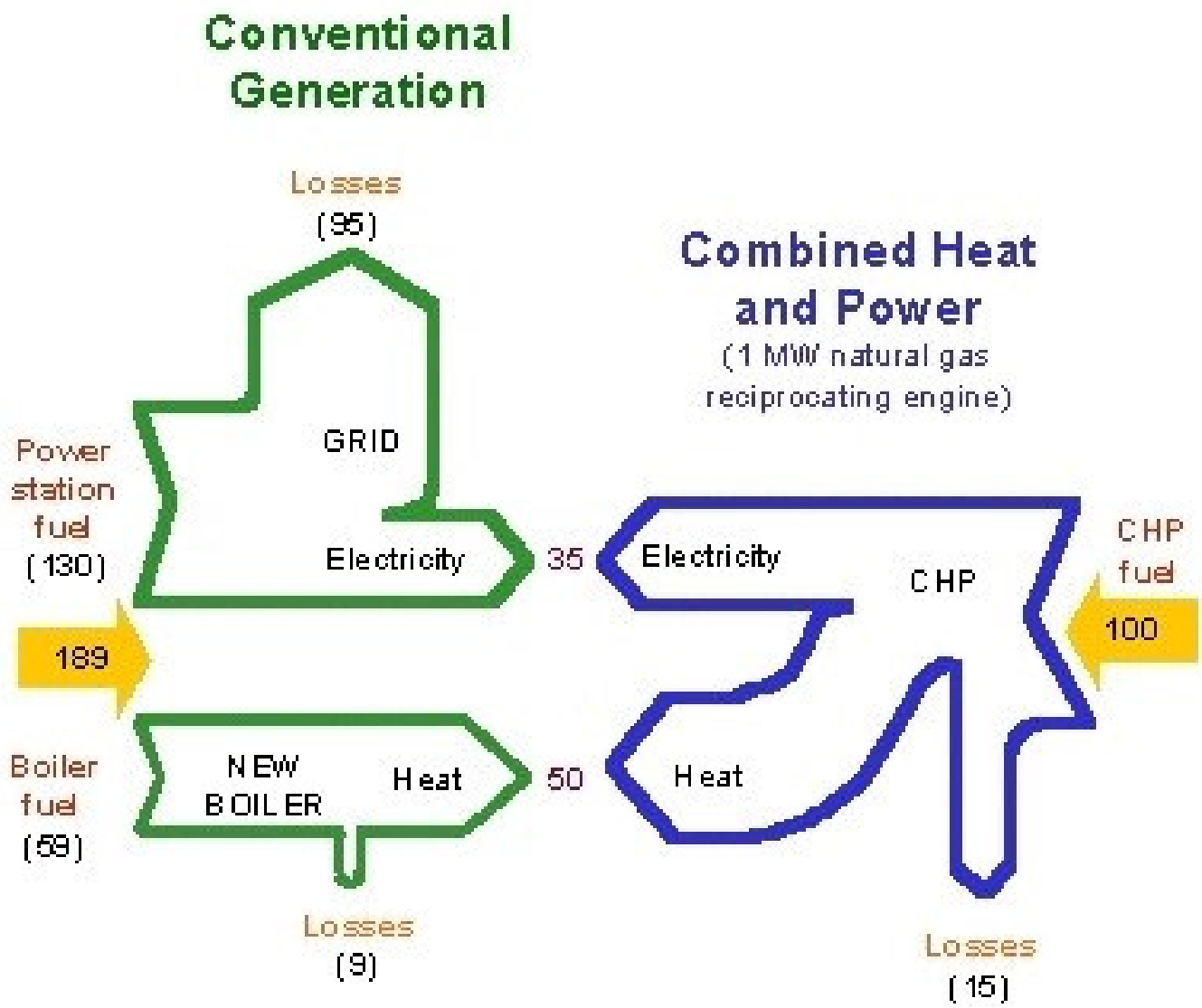
$Q_{out} = Q_{in}[(T_{in}-T_{out})/T_{in}]$, where Q is quantity of energy and T is absolute temperature

- A fundamental physical limitation applicable to all heat engines
- Practical effect is that the efficiency of electricity generated by heat engines < 40%
- So 60% of input energy is converted to heat instead of mechanical energy to yield electrical energy
- In the case of large power plants, this heat is routinely lost
- CHP captures this heat and puts it to use.

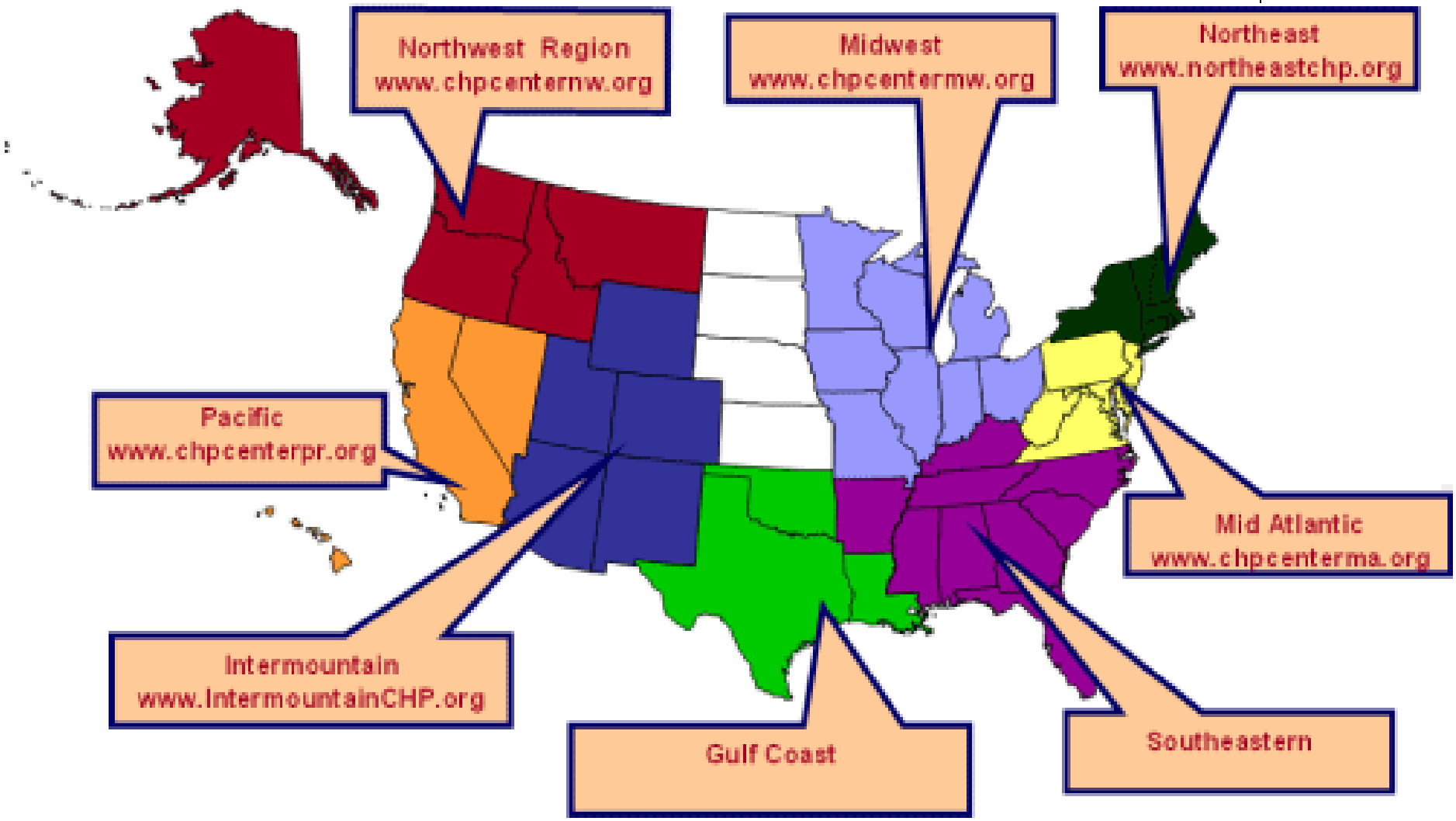
Combined Heat and Power

- Most central power plants lose the thermal energy associated with Carnot losses, but local CHP systems put the thermal losses to good use, thereby improving the overall system efficiency of generating electricity by a factor of 2 or more
- Heat from the generation process in a CHP system can be used to produce space heating, DHW, or through an absorption process, space cooling
- A close-to-constant load is the key to making CHP economics work, exactly the circumstance of casinos. A good source of low-cost natural gas is also critical.

Conventional versus CHP energy flow



Regional Application CHP Centers



Energy First Principle

If you can’t measure it

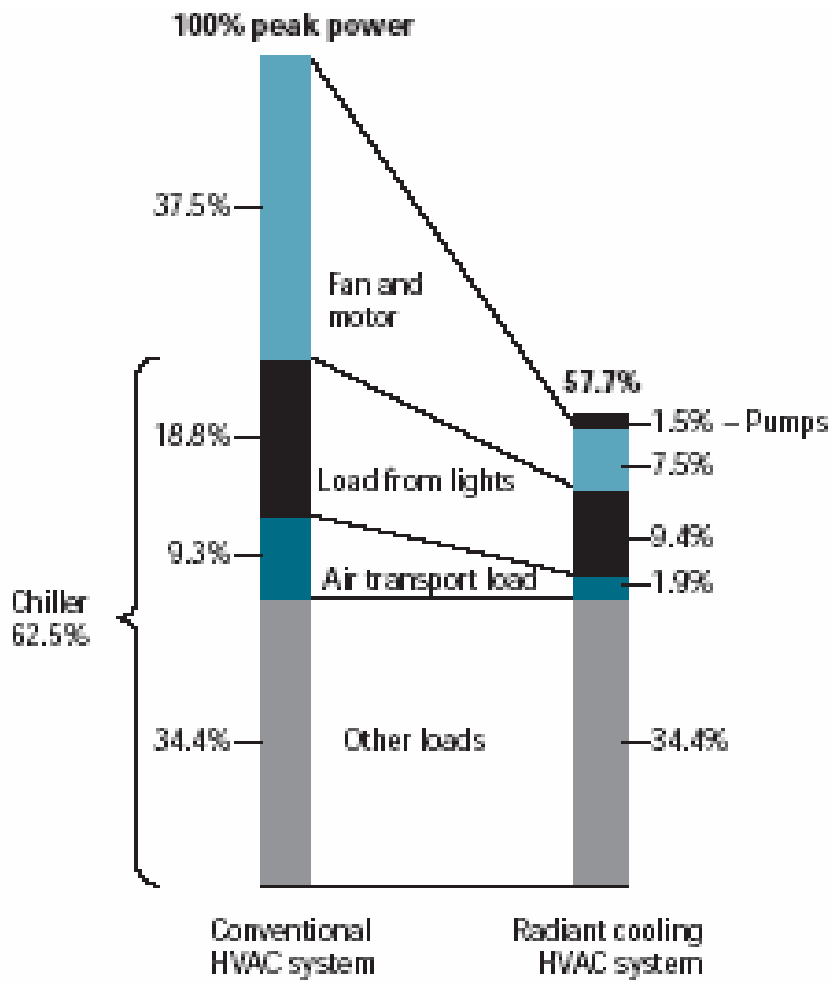
you can’t manage it

Designing new casinos to work better with much less energy waste: a modest proposal!

- Most existing casinos have HVAC systems that combine the space conditioning function with the ventilation function
- Therefore, they use enormous amounts of air, necessitating large ducts, large fan power that wastes energy but nonetheless does a pretty poor job in maintaining good IAQ in smoking areas
- Need to separate the space conditioning function from the ventilation function

Radiant heating and cooling

- Inefficient fans and fan motors replaced by small, efficient motors that move warm or chilled water to where it's needed
- Radiant surfaces built into floors, walls, ceilings, and slot areas
- Small temp differences consistent with very efficient heating and cooling



A lesson from Jon Air

- The picture shows an approach to dealing with odors that's instructive
- Instead of having a bathroom fan in the ceiling, where odors cross the nose on the way out, the exhaust air inlet is inches away from the source. A very small fan (15 cfm) does an excellent job.
- Occupancy sensor saves energy by turning on fan only when needed
- The concept should work with tobacco smoke as well

Ventilation

- Exhaust air taken from as close to source of smoke as possible—bars, cabinets below slot machines, etc, before it has had a chance to fully mix
- Local sensors of tobacco smoke vary local dampers from 10% to 100% as a direct function of smoke sensed
- Sensors at the main plenum monitor tobacco smoke, CO_2, and humidity, using data to set speed of exhaust and make-up air fans
- Heat recovery preconditions make-up air with exhaust air without polluting it. Other conditioning of make-up air usually not necessary except when humidity high or weather is very cold
- Clean, filtered supply air is inserted high and mixed well
- Building zoned to separate smoking from non-smoking areas

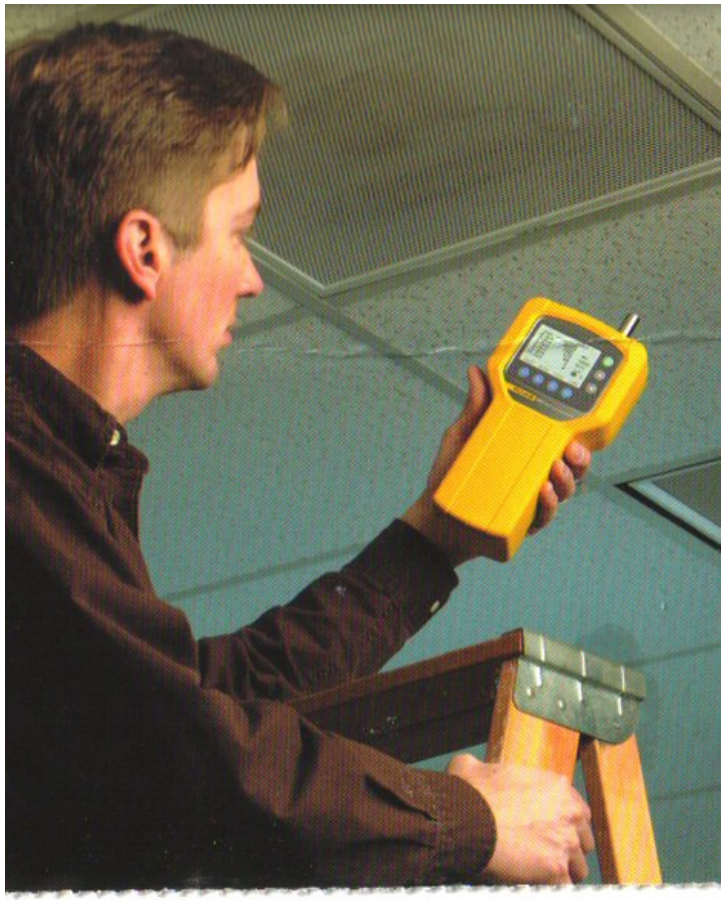
Other advantages

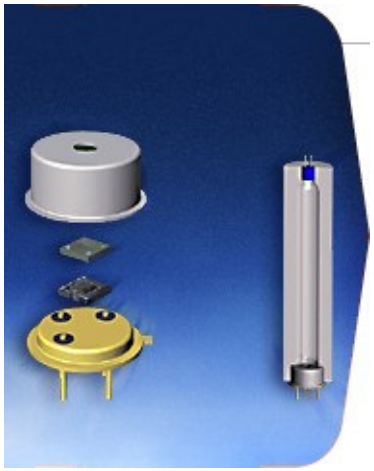
- Condensing boilers with large set-back ratios have greater efficiency at lower temps, > 95%
- Cooling water temp can also be higher, so high efficiency
- Cooling-tower-based cooling can avoid compressor use under most conditions, saves energy and demand costs
- May be consistent with CHP system with absorption cooling; need careful modeling to pencil out economics
- Overall fan power is much less, yet IAQ is high since sensors and controls are smart, many small exhaust inlets close to source
- Radiant cooling widespread in Germany, produces excellent comfort at modest energy cost and lower front end costs as well.

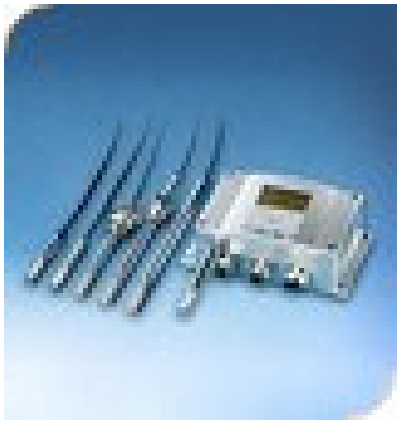
Details important

- There is need for research and design work on bars, cabinets that have slots on top. Integrate labyrinth of cooling coils (simple and cheap) as well as exhaust inlets, micro-plenum, sensor and damper
- Set up facility for continuous commissioning
- Monitor what needs monitoring, have capability of measuring performance and adjusting it quickly
- Smart thermostat control of radiant heating and cooling system that projects needs based on anticipated weather and occupancy

Electronic sensors of CO_2, humidity, tobacco smoke







Resources

See www.energydesignresources.com

Site sponsored by major utilities in California, material is first rate

Includes case studies, design guides, design briefs, and software free for downloading

See design briefs on radiant cooling, variable air volume systems, chiller efficiency, economizers, indoor air quality, smart buildings, and more

And a tip of the hat to Jon Air, www.jon-air.com

Feedback's welcome!

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