E3T Energy Efficiency Emerging Technologies

Washington State University Extension Energy Program

Bonneville Power Administration

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EMERGING TECHNOLOGIES SHOWCASE WEBINAR:

HIGH PERFORMANCE COMMERCIAL BUILDINGS #2:

- HIGH PERFORMANCE ELEVATORS
- NATURAL VENTILATION FOR NIGHTTIME COOLING
- MECHANICAL VENTILATION FOR NIGHTTIME COOLING

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Shanti Pless, Senior Engineer, National Renewable Energy Laboratory (NREL)
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April 24, 2014
Question and Answer Session

High Performance Elevators
Sameer Kwatra, (ACEEE)

Q: How 'emerging' is this technology? What is the current rate of uptake without incentives?

A: I do not have the exact figures on the uptake rate but the technology (all the technologies that were discussed) has been around for at least 10 years. It is estimated that more than 70% of the current systems are still hydraulic. Doing a rough calculation over the last 10 to 15 years including new construction, the technology penetration has been around 20 to 25% over 15 years. It is still emerging, not high penetration, but true and commercially available.

Q: In new construction, is cost less due to less building square footage required or because of no machine room?

A: I don't break out new construction versus old. However I can hypothesize the overall project cost comparing new construction employing hydraulic-geared elevators versus gearless permanent magnet (PM) systems. A factor in the overall cost would indeed be requiring no machine room. Machine rooms require their own HVAC because there is a lot of heat dissipation. Those energy costs are saved with gearless systems. Even the number of elevators required might be less if there are destination dispatch or other controlled mechanic systems. So if you put those together then the overall project costs would be lower, although I do not have a break out of the cost of upgrade versus new construction.

Q: Most of BPA's territory is in the rural part of the Northwest, off of the I-5 corridor. How are the savings in low rise, 2 to 5 story buildings?

A: Low rise buildings, because they do not require high-speed elevators, more often do not have a very, strong need to go in for advanced sophisticated systems. Almost all of them will have hydraulic systems. So the potential savings are still considerable. One case study suggests a 40% savings at the lower end.

More important factors when considering those as candidates for program intervention or for upgrades is first if they are meeting the code requirements. All elevators are required to have a backup, they should not stall on the users, and as I mentioned modern codes require lighting and ventilation. So if they are complying that's one.

A second factor is if the elevator is functioning properly. So there could be multiple reasons why they should be targeted, including non-energy benefits. I would not place that case solely on the total energy savings but it's good that there are multiple factors. Just to reiterate that the savings from the case studies that I've seen for low-rise buildings are still around 40%, so that's a significant.

[Participant Comment] Hydraulic elevators are mainly used in low-rise two to eight story buildings, not mid-rise or high-rise as they tend to have DC traction motor drive. Above seven or eight stories it's all rope lifts.

Q: Does the savings analysis include regeneration as a feature of the elevator upgrade?

A: No, it does not. That's additional savings in energy that are in effect, a reutilization of savings. They have not been factored in.

Q: Would it be a fair bit cheaper and easier to focus this technology on new buildings and not try to do as much of it through retrofits?

A: The largest opportunity is for retrofits because that's where most of the conventional hydraulics motors are. I would not focus on that. But yes, it would definitely be an easier decision for new construction.

Q: Except for cost (payback), are there any other major reasons for low penetration rate?

A: I'm hypothesizing because I've not done research into this, but one thing is that elevators are generally long lived, especially for low rise buildings. People don't see a reason to upgrade unless there's something wrong with the system. So mainly it's cost and lack of awareness of these technologies which could be elevated to a large extent through intervention.

Q: Is there a natural point in the lifecycle of elevators where it would make sense for a utility program to intervene?

A: When a building is naturally undergoing a renovation or retrofit for other systems, it would make sense to intervene and upgrade the elevators. Secondly, it could be an upgrade is necessary to comply with the latest codes. The third is when there's a breakdown or malfunctioning in the existing system. I can't pinpoint the age of when to upgrade an elevator – it depends.

Q: BPA typically pays incentives as high as $0.20 per first year's energy savings. That might be a little higher than Xcel's rebate, but not a lot higher. Will a rebate that's less than 10% of project cost have much impact?

A: Although the program rebate would not be the major determinant for cost effectiveness for elevator upgrades, in combination with O & M savings that accrue, as well as other non-energy benefits, it could be a significant factor in nudging people toward more efficient systems. It could influence the decision to go for a higher efficiency system rather than be the sole determinant.

Q: Are the standby loads significantly different between hoist and hydraulic?

A: I don't have a measure or percentage, but I would consider there are a number of things such as lighting, ventilation, and music, and also things like motors for opening and closing doors. All of these are significant idle loads that can be reduced in more efficient operations.

Natural Ventilation for Nighttime Cooling Q&A

Shanti Pless, NREL
Bill Livingood, NREL

Q: I have heard that in the U.S., large interior temperature swings are allowed for pure natural ventilation. A few years ago, U.S. code did not allow large interior swings in commercial buildings when any mechanical ventilation is used to supplement natural ventilation. Is that information still true or has the code been updated?

A: [Shanti Pless, NREL] I think the question is about the active comfort model in ASHRAE 55 which suggests that if you give occupants control over their own comfort, they are generally more okay with higher temperature swings. That is to say that when you give occupants control over, for example, natural ventilation with operable windows, they are more likely to be okay with larger temperature swings in their space.

I think that has to do with the controllability of occupants over their comfort. This wouldn't necessarily give occupants any more or less control over their comfort. I don't believe that ASHRAE 55 requirements for indoor air comfort have necessarily relaxed the temperature requirements for these types of systems. I can say that if you are able to communicate to your occupants that it's going to be a hot day and it's a little cold in the morning, in general they are okay with being a little cold knowing that it will be a hot day outside. But don't want people complaining about being too cold in the morning and using space heaters and extra heat to make up for that. That's my understanding at least of that.

Q: The mechanical cooling started out with a house example but the rest of the discussion was about an office building. So the $3,500 cost is given if for a SFR (single-family residence) that is a stretch.

A: [Shanti Pless, NREL] So the question is "Are these single-family residential cost numbers?" There are probably more commercial building cost numbers with existing economizers.

Q: Are there specific products designed to convert fresh air ventilation systems to night ventilation cooling for smaller RTU's (rooftop units) not controlled by DDC (direct digital control)?

A: [Shanti Pless, NREL] That's a good question. The enabling technology here is the economizer control. There are plenty of small rooftops that do not have a central DDC controller that do have a local economizer controller. In those cases, these cost numbers are representative of what it would take to modify a control system in a small rooftop that already has an existing economizer control. However, knowing that lots of economizers are broken, in reality on these systems, and no one necessarily checks

them, you may also have to pay for fixing the economizer damper linkage. That is probably more of a real number then some of these conceptual numbers but that's what we've seen at least in how to implement this.

[Bill Livingood, NREL] I was just going to mention that BPA has investigated modification kits, let's call them, for RTU's to add variable speed capability but that also enables some economizer functionality in addition some advanced controls capability. Those kits are out there and it's another pathway to pursue.

Q: How would systems be operated differently to optimize energy savings versus demand reduction?

A: if you're looking for demand reduction, you turn on your air conditioner at night, run your chilled water system or DX cooling at night for more pre-cooling when your economizer mode isn't necessarily sufficient for nighttime pre-cool. You're sacrificing nighttime energy use, you're not just using an AC at night. You might use energy savings, but you could potentially shift your cooling load. A lot of the research has been on this – running the AC at night, not necessarily the economizer, to get the benefit of peak demand savings rather than energy savings.

Q: Which method of nighttime purge do you think will offer more savings? Mechanical ventilation because it can pre-cool the building better with fans, or natural ventilation because of the lack of fan power?

A: if you have an open floor plan where the natural ventilation is intended to reach all your square footage and you have sufficient window area to do so, the natural ventilation would probably save more energy. That being said, if you have to move air with fans to get it through the total square footage of the building, then the mechanical economizer system would be preferred and probably save more energy over the whole building.

Something to factor in is how many buildings in the PNW have those architectural features in place now, when you look at it from a savings in the PNW potential.

Q: How do we distinguish the HVAC (heating, ventilation, and air conditioning) option for nighttime ventilation from the technologies under review by the HVAC TAG? Are we talking about mass, etc?

A: When we started talking about natural nighttime ventilation cooling, we started talking about economizers, and there was excitement about that. We said, wait a minute, this is natural, there shouldn't be any economizers, but at that point there was enough interest in mechanical nightime flush as an added opportunity because nearly all commercial buildings in NW have economizers so it was worth continuing on, even though it does overlap with HVAC TAG. Also, that TAG is past, a few years ago, and not active.

Mechanical Ventilation for Nighttime Cooling Q&A
Shanti Pless, NREL
Bill Livingood, NREL

(No time for question/answer)