ZNE SCHOOL RETROFIT WEBINARS

Prop 39 ZNE School Retrofit Pilot Case Studies

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Presenters:

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Two in-person workshops and four on-line webinars in 2018 have been set to highlight the benefits of high performance schools and approaches to achieve ZNE in new and existing schools. These trainings will use real-world examples, including those currently underway in the Proposition 39 ZNE Pilot Program, to offer critical insight into the costs, design and construction approaches, and operational needs to successfully achieve ZNE in schools through whole building retrofits. This webinar highlighting two Prop 39 ZNE Retrofit case studies shared lessons learned and worked to expand knowledge of the opportunities and challenges to ZNE school design, retrofit and operations.

These events comprise the 2018 Proposition 39 ZNE Pilot Training Series and are brought to you by California's Investor-Owned Utilities.

Due to the inspiring and detailed stories we heard on our webinar we were unable to take questions publically during the presentation. We were asked by several participants the questions below and believe those in attendance and those who view the webinar at a later date will benefit from seeing the answers. Our esteemed panelists were Alexis Karolides (AK below) a Principal at Point Energy Innovations and Dave Houghton (DH below) Owner of Avila Partners. You are welcome to contact them if you have any remaining questions about these projects or other ZNE projects they are working on. RL is Reilly Loveland from New Building Institute.

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To find out more about our other webinars and trainings please visit:
https://newbuildings.org/proposition-39-trainings/

Follow Up Questions:

1. **What is the best AC sources for school? Traditional furnace, heat pump, tankless water heater or geothermal? Than PV.**

   DH: The answer depends on climate, fuel sources, fuel costs, existing equipment, and a few other things. Here in our area, we have small furnaces and little or no a/c. Renovations are now including air conditioning, usually with VRF systems (multiple indoor units connected to an outdoor condensing unit, often on the roof). You have to consider maintenance, potential for vandalism, and noise—Alexis pointed out the importance of that one.

   AK: not sure what's meant by "AC sources." Did they mean HVAC sources? This depends on climate (e.g. do you need both heating and cooling and how much?) and other design factors. But some general notes about these technologies are: tankless water heaters would be for domestic hot water (see discussion on DHW below—do you need to heat the lavatory water at all? If so, tankless might be a viable option). Geo-exchange systems (ground source heat pumps) have high upfront costs (for drilling) and might make sense if you have both high heating and high cooling loads; otherwise air source heat pumps (ASHPs) will be more cost effective than GSHPs.

2. **Will radiant flooring be suitable for school?**

   DH: Possible but unlikely, unless you are in a very cold climate. Radiant floors are not good for light or transient loads like we have here. They are more expensive and react more slowly than air-based systems, and very difficult to retrofit.

   AK: We are designing a new school building at the Nueva School campus in the south bay area, with radiant heating in the floors, and HRV units for ventilation in the classrooms. For a few select areas of the school that require cooling, we are using VRF, but otherwise, it is heating only due to the mild climate and good envelope design. So yes, radiant can be appropriate for a school. However, it is an expensive system and if you also need cooling, there are less expensive and simpler alternatives (radiant cooling might require ceiling panels). For a retrofit, radiant floors would be very involved and costly to do—I'm assuming you were referring to a new school.

3. **Will HRV (heat recovery ventilation) system suitable to school as well?**

   DH: Absolutely. HRVs are a common solution to school ventilation challenges. Fresh air really helps students, and is required by codes and standards. An HRV system (aka DOAS—dedicated outdoor air system) is a positive way to ensure your students get to breathe good air.

   AK: Yes, it is a good option, as noted above. You could combine it with a heat pump for heating and cooling; you could have the HRV be on occupancy control so it only runs when needed. Note, however, that for a retrofit in CA, if you are doing any building/structural changes, you trigger DSA (Dept of State Architect) review and significant cost, so for instance, we looked into

a mini-split heat pump plus HRV for the modular classrooms and it was prohibitively costly compared to simply replacing the existing loud, inefficient Bard heat pump with a new, efficient, quiet Bard unit and no HRV (the new Bard unit was considered like-for-like replacement, requiring no new holes in the wall.

4. **What specific LED fixtures were used for retrofit? Kits or full on fixtures?**

DH: At LOMS we used Lithonia 2BLT fixtures with the nLight wireless controls. This is a brand-new fixture that is available in several lumen packages. We were somewhat overlit with existing fixtures so were able to reduce the quantities. At the elementary schools we are doing the line-voltage tube retrofits. The product being used there is the Forest T8 LED.

AK: all of our projects just replaced the lamps in the existing fixtures because 1. Fixtures & labor to replace fixtures are much costlier, 2. Fixture replacement triggers Title 24 code requirements, including dimming controls, which are even costlier, and 3. We got most (but not all) of the savings by just replacing the lamps, so it was hard to justify the fixtures from a Savings to Investment perspective.)

5. **Did you use Type A, B or C LED tubes?**

DH: The Forest product is a Type B—line voltage. The ballast is removed and the fixture is rewired. You need to make sure maintenance staff never tries to put a fluorescent tube back in the sockets!

AK: A has an internal driver and can be installed directly, B also has an internal driver but the sockets are wired directly to line voltage, and C has a remote driver; we used A, because B and C would have been a "Fixture modification in place," triggering Title 24 upgrades

6. **Did you consider HPWHs? Was fuel switching an option? Did you consider white roofs?**

DH: The LOMS project was a joint effort between the electric and gas utilities. Fuel switching was not considered.

AK:
HPWHS:
A) In our Community College project, we did substitute a HPWH for a boiler for space heating (VAV reheat), and this reduced the building's EUI (Energy Use Intensity) by a significant amount (about 3-4 kBtu/sf-yr compared to the gas boiler base case). Note that the boiler needed to be replaced, otherwise replacing a perfectly good gas boiler would not have penciled out.
B) For domestic hot water (DHW) schools without big kitchens use so little DHW (lavatories only—no one showers at school anymore) that it did not make sense to upgrade the DHW system. In our community college retrofit we actually eliminated the domestic water heating altogether. This has been shown to be just as sanitary, and the hot water was not reaching the

tap in time anyway. In cases where the hot water is currently reaching the tap, or where the city water is very cold, I will say from anecdotal experience that removing the DHW is not popular.

Fuel Switching:
A note on fuel switching. Fuel switching from gas to electric is dis-incentivized in CA by the focus on Source Energy (or time-dependent-value, TDV). It takes three units of fossil fuel to create one unit of electricity so if you switch from burning gas directly on site to using electricity, it is considered three times as energy intensive, when accounted at the source. A heat pump must therefore have a coefficient of performance greater than COP 3 (one unit of electricity to produce three units of heating) to overcome this Source Energy disincentive for switching to electricity.

White roofs: are an excellent retrofit for buildings that require cooling; there is an LBNL study that found up to 40% cooling savings potential, as I recall. For the schools in our program, two of them did not use any significant cooling and the one that did have cooling (a community college building) already had a white roof.

7. **How much electricity do projectors use?**

DH: Good question. We inquired about that but discovered that most classrooms are getting converted to big-screen displays. Those use 100-250W depending on model and size. Our firm has actually been testing the latest displays in support of the ENERGY STAR program, which is keeping up with the advances in technology.

AK: I found an article on the web here that states that a projector's power use is dependent on the wattage of the bulb and ranges from 150 watts to 800 watts per hour, but 300 watts per hour is common. By comparison, a 19-inch LED TV uses as little as 15 watts per hour, while a 54 inch LED TV uses 66-120 watts per hour. You can find lampless projectors that use lasers and LEDs as the light source and have electricity usage rates similar to large LED TVs!

8. **How many schools (# and %) are getting the ZNE retrofit?**

RL: 12 schools are currently getting the ZNE retrofit through Prop 39. Ten of these are K-12 and the remaining two are community colleges. Additionally, 100% of State Special Schools, 98% of County Offices of Education, 98% of Public School Districts and 66% of Charter schools in the state have received some funding through the Prop 39 program that is not the pilot. These funds are for energy efficiency upgrades from a small to large scale.