DOCKETED	
Docket Number:	18-IEPR-09
Project Title:	Decarbonizing Buildings
TN #:	223951
Document Title:	Scott Shell Comments Need to develop low cost pathways to reach CA GHG goals
Description:	N/A
Filer:	System
Organization:	Scott Shell
Submitter Role:	Public
Submission Date:	6/26/2018 2:37:39 PM
Docketed Date:	6/26/2018

Comment Received From: Scott Shell
Submitted On: 6/26/2018
Docket Number: 18-IEPR-09

Need to develop low cost pathways to reach CA GHG goals

Our architectural firm has designed over a dozen all electric buildings in the past decade. Ten years ago commercial scale heat pumps were less common and more expensive, but some of our clients were deeply committed to meeting AB32 GHG reduction goals and so paid the premium. In recent years we have seen a significant shift and we have now completed a handful of all electric projects using heat pumps that were less expensive than mixed fuel designs. In one project the school could have saved $75,000 (the premium for the gas service if it were not required for the science labs). These were all institutional projects which had to meet their budgets and where the General contractor and sub-contractors could propose cost saving value engineering options. We offered to switch to a gas boiler and they said it didn't save any cost. We were wondering if this applied only to our practice, or if others were seeing the same thing, so we met with seven of the leading mechanical firms in California to get their take. See the attached document for their comments. In general they confirmed there is a clear move to all electric buildings, and it is cost effective both on first cost and on operational cost.
Many of our clients are very interested in reducing their GHG emissions, and in addressing climate change in a cost effective manner. Our office is convinced that electrification of buildings is a cost effective pathway, and that it is the only technology that is ready to start scaling up to the challenge. Installing new gas infrastructure in our communities and buildings that will have to be removed and replaced to reach California's 2050 goals is a much more costly pathway for Californians. I urge California to continue to lead the country on forward thinking cost effective planning for the future.

Additional submitted attachment is included below.

Are We Ready for All-Electric Buildings?

Scott Shell FAIA LEED® AP BD+C CERTIFIED PASSIVE HOUSE DESIGNER
Principal, EHDD

At EHDD, we have been pushing the boundary of low energy building design for more than 15 years. When the U.S. withdrew from the Paris Climate Agreement last year, we decided to take a closer look to see if our building design strategies could reduce carbon emissions at a scale commensurate with the climate challenge.

First, we calculated the carbon emissions for some of our buildings, and were pleased to see how much cleaner our electric grid was than just a few years ago. As California advances toward its 50% renewable energy goal by 2030, electricity will keep getting cleaner and cleaner.

We have made great strides in cleaning up our power grid, but what about our buildings? Most buildings in California still use natural gas for space and water heating.

We've completed more than a dozen all-electric zero energy (NZE) buildings with rooftop solar. But are we ready to shift all of our buildings to all-electric, and rely on the cleaner grid for low carbon power? We decided to ask a handful of our top mechanical engineering partners if the building industry is ready for this shift. Their response was generally Yes, we can now design all electric buildings that are competitive with natural gas in most of our projects.

Ted Tiffany & Steve Guttmann, Guttmann & Blaevoet Consulting Engineers
Eric Solrain, Integral Group
Kent Peterson, P2S Engineering
Peter Rumsey, Point Energy Innovations
Sean Armstrong, Redwood Energy
Meg Waltner, Alisdair McGregor, Raphael Sperry, ARUP
Hormoz Janssens, Interface Engineering

Is the industry ready to shift to all electric buildings today?

Integral: Generally, yes. Integral currently has dozens of all electric buildings recently complete, in construction, and in design. A big sea change in recent years. A lot of momentum in Multi-family residential and general commercial projects moving to electric.
Arup: Electrification is something that we are looking at for many projects today – both at the individual building and city master plan scale.
It is also an issue that we are looking at in our internally funded research: Arup just identified electrification as a key trend for our global strategic research planning and we are also starting a detailed research project to create design guidelines for electrification, which will build on earlier research laying out a blueprint for fossil-fuel free designs by 2020.
Interface: Almost all our projects are all electric, even one in Minnesota where we are using air source heat pumps for a large facility. I have only been using gas systems where required by the client.
Point Energy Innovation: Heat pumps and electric heating have already made significant inroads in California. We are seeing a lot of developers use electric heating with high levels of insulation in apartments that don't need cooling. Developers are using VRF systems on small to medium sized commercial buildings. Production home builders have been using central heat pump heating and cooling units for many years.

G&B: For most building types and sizes, there is no technical reason preventing the industry from shifting to all-electric buildings.We are seeing a surge in the use of larger heat pumps for generating hot water systems. A client has to be motivated to make the change from a high carbon source (such as natural gas) to an electric based system, because the cost of gas is relatively cheap right now.
P2S: New buildings are much easier to get to all electric because you can do an integrated design. Residential buildings are easy, and medium size non-res, say up to 100,000 sf are straightforward. Existing buildings can present challenges, and large complex projects have their challenges as well.
Redwood Energy: FEIA shows continued growth in all electric construction since 1994, and today one in four new homes in the United States is built all electric. Developers have been choosing all electric construction because it cost less to build and that trend has been going on for 24 years now. New construction is easy to go electric both technically and financially--the construction cost savings justify going all-electric.

Are there project types or sizes that are more challenging?

Redwood Energy: Yes, low-power homes like trailer homes, small apartments and old houses have a relatively small list of products to choose from that will fit their limited power supply without requiring a new breaker panel and potentially a service upgrade for more power.
G&B: Labs and Hospitals are a challenge due to the high outside air loads, demands for sterilization, high hot water loads, all that need higher content fuels like natural gas. Not impossible, but challenging.
Interface: Most project types work just fine. We are doing 500,000 gsf all electric office for Microsoft, with major savings using heat pumps vs a central plant.

All Electric projects:

Interface:


Santana Row Lot 11


Sacred Heart School

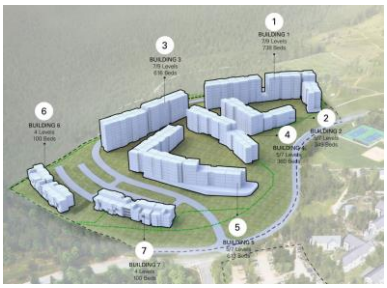

Chatam University Dining


Chatam University Housing

American Geophysical Union

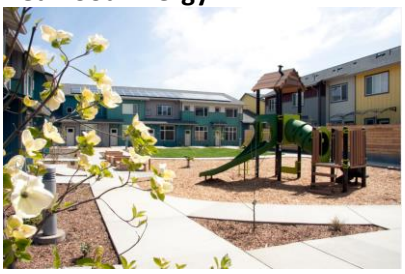
White Hill Campus, Ross Valley USD

Bay Meadows



UC Santa Cruz West Housing

Redwood Energy:



Church Hill Townhouses, Fortuna

Affirmed Housing, Carson

Danco, Eureka

Danco, Arcata

Arcata Bay Crossing

Cloverdale Family Apartments

Integral:

1700 Webster

Integrated Genomics Lab, LBNL

SFO Consolidated Admin Facility

EHDD:

Exploratorium
Photo by Bruce Damonte

Packard Foundation
Photo by Jeremy Bittermann

Boulder Commons
Coburn Partners

Marin Country Day School
EHDD

Lick Wilmerding High School
EHDD

Mark Day School
EHDD

ARUP: Example projects that have considered or gone all electric included:

- All-electric micro-unit 16-story residential project in Hawaii on track for LEED Platinum
- Northern CA courthouse -- all electric VRF design

- MarketZero – near zero retrofit of a San Francisco Whole Foods considered electrification (including DC distribution) as a strategy. Final design electrified rotisserie ovens which were major natural gas end-use.
- University central plant replacement with all electric to minimize GHG emissions (study)
- All-electric master plan for international 2-million-person city with carbon neutrality goals
- Decarbonization strategies for existing municipal buildings in SF
- High rise student housing project in Southern California -- Looked closely at electric vs gas on a high rise student housing project. Ultimately went with heat pump for spacing heating and grey water heat recovery and solar thermal supplemented by gas boilers for water heating.

How does the construction cost compare?

P2S: Electric is cost competitive on most new work, in that we can design to meet a client's typical budget using good integrated design.

Integral: It depends on what you are comparing it to. If comparing to a high-performance design (LEED gold, better than Title 24) then electric is cheaper. If comparing to moderate performance, electric is cost neutral. If comparing to most basic design, there will be a small cost premium. There are significant code changes in California energy code in 2019 that will make electric even more cost competitive.

Point Energy Innovation: Generally as a hot water system for domestic or heating is in the neighborhood of 10% to 20% more expensive with the prices coming down. Title 24 used to discourage electric heating of all types and is now more neutral on the issue. See this analysis for University of California: **https://www.ucop.edu/sustainability/_files/Carbon%20Neutral%20New%20Building%20Cost%20Study%20FinalReport.pdf**

Redwood Energy: It is between $2,500 and $5,000 of savings for the developer per residence not plumb gas.

G&B: A significant issue is whether or not gas service can be eliminated on the site, and the cost savings for eliminating this utility

Interface: Electric is almost always less expensive or cost neutral. Very rarely is it more expensive. Often it is our value engineering option. The exception is geothermal systems where the cost of the excavation and tubing makes is much less economical.

We do lots of detailed cost analysis with developers to find the most cost effective solution. For example, at Bay Meadows our all electric design for 1 million sf of development was significantly less expensive than a traditional rooftop package unit + boiler + reheat system.

Arup: Gas piping is much more labor intensive, so more expensive than running wires, especially in California.

As your electric uses grow, the code lets you assume a higher diversity factor which we've found in some projects actually leads to downsizing of the electric system, reducing its first cost.

If all electric you save on gas service to building, offsetting other costs.

How does the life cycle cost compare?

Arup: The low cost of gas and comparatively high price of electricity can hurt cost-effectiveness. The cost of gas and electricity varies a lot by where you are, and some large users such as SFO or Campuses sometimes have much lower rates. Oregon and Washington have cheap electricity.

G&B: Lower LCC's in most cases are reported if time of use cost management practices are enabled. In the UCOP report almost all cases showed lower LCC's with all-electric buildings.

P2S: It depends on what you are comparing it to, but for most projects it has lower cost lifecycle cost. However, a large gas co-gen plant produces very low cost energy, but has poor carbon performance.

What percentage of your work is currently all electric?

Interface: almost all our work is electric
G&B: +/-25% of our work is all electric, and this is trending upwards.
ARUP: We are looking at it much more often, but it is still not that common in our building types.
Redwood Energy: 90%
Integral: Very common

Can we eliminate gas service to these buildings?

Redwood Energy: Absolutely, and is a huge favor to the Builder to reduce costs and dangers, and it is a huge favor to society which pays disproportionately for upkeep of gas lines compared to electric lines, and of course the whole planet desperately needs us to stop burning fossil fuels.
ARUP: Often in large buildings there is a restaurant or some other small specialty use that requires gas. Service can be downsized.
G&B: In most cases yes.
Integral: Usually yes.

Other thoughts or recommendations?

Integral: All electric takes up significantly less space and that space can be used for other things. At 1700 Webster the gas option filled the roof with equipment, while the electric option freed up enough space for a nice deck and pool!
Getting gas service to the equipment, and a flue out through the building can be challenging problems. Getting make-up air to gas boilers can be challenging.
There have been good advances in heat pump choices in recent years. Aermec and Climacool make excellent equipment, that can heat and cool simultaneously with robust controls.
Huge climate benefits to shifting from gas to electric. London is completely redoing it's 10 year old decarbonization plan which was drafted when they had a dirty electric grid. Their grid is much cleaner now so they are quickly revising the plan to promote electrification.
Arup: Eliminating a boiler flue is a big deal, routing those up and out a tall building are challenging. Likewise fresh air requirements for boiler rooms can be challenging to meet. Heat pumps give you more flexibility in where they are located.
Significant safety benefit by eliminating gas. Water heaters pulling loose from gas connection is a major source of fires after earthquakes. A $500 automatic shut off valve isn't needed if you don't have gas.
Many buildings we are designing now will not be open till 2022 or later, we need to anticipate the future. The grid will be even cleaner, codes will be tighter
Interface: The space requirements are much smaller, instead of having two to three separate systems for space heating, cooling, and hot water, we can do it with a single heat pump system and it only needs half as much space. That space can be used for other things or the building made smaller for more savings.
Maintenance is less than most conventional systems because you have one system rather than multiple systems to maintain. Maintenance is just like an air-conditioning system, it's the same thing in reverse, and you eliminate the boiler.
A huge benefit for heat pumps is reducing water use. Using an air source heat pump for cooling rather than a cooling tower has large water savings. In addition, electric power plants consume 42% of the water used in the US, by using heat pumps paired with PV on your building, you can self-consume that electricity dramatically reducing water use from the power plant.
PV + heat pump is a very effective combination. Even better add SunDrum solar thermal collector to back of PVs to pre-heat domestic hot water.

The heat pump industry has come a long way in last ten years, and equipment costs have come down. Many more manufacturers, better trained mechanics, larger market share, and controls greatly improved. 10 years ago, efficiency was poor in cold climates. When it got below 45 degrees, and the heat pumps switched to electric resistance heating. Now they are efficient down to 20 degrees, so they are good solutions in many more climates.

G&B: See UC Report on Strategies for Decarbonization.
https://www.nceas.ucsb.edu/files/research/projects/UC-TomKat-Replacing-Natural-Gas-Report_2018.pdf