

The Cost Effectiveness of Building Electrification

Comments from Bay Area Architects & Engineers

August 21, 2019

Scott Shell, FAIA, Principal

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Casa Adelante, 2060 Folsom, San Francisco



Maceo May Veterans Apartments, Treasure Island



Balboa Upper Yard Family Apts, San Francisco

Malcolm Harris, Principal

MITHŪN

We have a number of all-electric multifamily housing projects. I'm a huge, huge fan of this change to all-electric multifamily housing. It is better in every way, a great simplification of the system. Less expensive, higher performance, less maintenance, more sustainable.

It is a major cost saving move that pays for a lot of other upgrades.

At Maceo May we saw big savings from eliminating gas fired hydronic heating, the gas connection, and the solar thermal required by T24.

The savings paid for continuous exterior insulation, energy recovery ventilators (eliminating Z-ducts), electric resistance heat, and PVs. With these upgrades we are beating Title 24 by 20%, getting more Green Points, and lower GHGs on a grid that's getting cleaner.

The occupants get better indoor air quality benefits from the energy recovery ventilators.



Hunters Point Shipyard Block 52, San Francisco



Hunters Point Shipyard Block 54, San Francisco



681 Florida, San Francisco

Malcolm Harris, Principal

MITHUN

Overall the system is just much simpler—there is just one energy system—electrical, rather than two.

The gas fired boiler & hydronic systems are very problematic at every step from design to construction to maintenance. During construction there are often leaks. Commissioning is a constant challenge, and there are lots of tenant complaints in first few months. Operations is challenging as maintenance staff are not equipped to operate the digital BMS system.

Casa Adelante 127 residential Units, 9 stories, under construction. Developers: TNDC/CCDC, Architect: Mithun & YA Studio.

Maceo May 105 residential units, in permitting. Chinatown Community Development Center, Swords to Plowshares.

Balboa Upper Yard Family Apts 120 residential units, in design development. Developer Mission Housing Development & Related California.

Hunters Point Shipyard Block 52 136 residential units total, Design Development. Developer McCormack, Baron, Salazar.

Hunters Point Shipyard Block 54 136 residential units total, Design Development. Developer McCormack, Baron, Salazar.

681 Florida 136 residential units total, In Design Development. Developers: TNDC & MEDA



Santana Row Lot 11



UC Davis Webster Hall Replacement



American Geophysical Union

Hormoz Janssens, Principal



Almost all our projects are all-electric, I have only been using gas systems where required by the client.

Electric is almost always less expensive or cost neutral. Very rarely is it more expensive. Often it is our value engineering option.

Most project types work just fine. We are doing a 500,000 sf all electric office for Microsoft, with major cost savings using heat pumps vs a central plant.

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.



UC Santa Cruz Student Housing West



270 Brannan, San Francisco



Chatam University Dining Commons

Hormoz Janssens, Principal



The space requirements are smaller for all-electric, 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, 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 just one system. 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.

We've done several all electric commercial food service projects that have been very successful. The Chef's quite skeptical at the beginning, but now say they will never go back to cooking on gas.



UC Santa Cruz Student Housing West



UC Irvine Student Housing West, Developer ACC



UC Riverside Dundee Residence Hall, Developer ACC

David Phillips, Associate Vice President for Energy & Sustainability UC Office of the President



The University of California has committed to carbon neutrality by 2025. We are prioritizing all-electric new buildings (required starting June 2019), and then electrifying existing buildings & systems over time.

Our studies show that all electric mechanical equipment capital costs are comparable for academic & lab buildings, and the costs are lower for residential buildings. Twenty year life cycle costs are comparable for Academic and labs buildings, and lower for residential buildings.

UC has many all-electric housing projects, office buildings, and laboratories now in place and many more in design.

UC's carbon neutrality strategies are pragmatic: don't allow growth to increase carbon emissions; and then transition *existing* buildings and systems off fossil fuels over time.

Decarbonizing Your Campus thru Electrification, SCUP 2019



Exploratorium, San Francisco



Packard Foundation, Los Altos



Marin Country Day School, Corte Madera

Scott Shell, Principal



We have completed a dozen or so all electric buildings. 10-15 years ago it was not common in California, and we saw some cost premium on those early projects.

In the last 5-7 years all-electric has become much more common on our projects which are primarily commercial and educational. It is now generally cost neutral or less expensive. There are more manufacturers providing equipment, and the subcontractors are more familiar with installing it.

Last year we had an all-electric project go to bid and the total cost came back higher than expected. In an attempt to reduce cost, we asked the mechanical contractors to price a standard gas heating system instead. They came back with no cost savings between gas and all electric, so the client decided to stay with the preferred all-electric option.



Mark Day School, San Rafael



Boulder Commons



Lick Wilmerding High School, San Francisco

Scott Shell, Principal



When the University of California, one of our largest clients, decided to prohibit gas in new projects that really got our attention. It now seems irresponsible to recommend gas to our clients who may then have to retrofit them before that equipment reaches the end of its life in order to meet their carbon goals or local mandates to decarbonize. We don't want to be saddling our clients with stranded assets.

Last year I interviewed seven leading mechanical engineers that we work with asking if the building industry is ready to go all electric. They agreed that the vast majority of buildings can go all-electric, and the cost is competitive with a few exceptions.

Most of our all electric projects also include PVs, it is LESS expensive for our clients to get their electricity from PV than from their utility. With a power purchase agreement there is no out of pocket cost. Some clients decided to fund the PVs themselves since it provides a favorable financial return. Ten years ago solar was seen as an expensive solution for projects with big budgets. It is amazing to see how quickly that has flipped.





Cascade Apartments, Seattle



4700 Brooklyn Ave NE, Seattle

Shawn Oram, Principal



Ecotope has completed 26 central heat pump water heating projects since 2008, mostly 100-500 unit projects. Partial list:

Mid Rise | 50-400 dwelling units

- Stream - 134 units - (2) 10T Colmac Air-Source HP in below-grade parking
- Sunset Electric - 92 units - Colmac in below-grade parking
- Stackhouse - 120 units - Colmac in underground parking deck
- Augusta Apartments - 224 units - Colmac in below-grade parking
- Batik Apartments - 195 units - Colmac in underground parking deck
- Yesler 3 - 227 - Colmac in underground parking deck
- Jackson Apartments - 526 units - Colmac in underground parking deck
- Colina Apartments - 131 units, Sanden - Decentralized
- The Vale Apartments - 134 units - Versati 2, Multi-Pass
- Waterfront Place - 137/135 units - Versati 2, Multi-Pass
- Hopeworks - 67 units, Sanden CO2 Stacks

High Rise | 200-450 dwelling units

- 4700 Brooklyn - 284 units - Colmac with VRF Temp Maintenance
- Cascade - 430 units - Colmac with VRF Temp Maintenance
- 1200 45th - 245 units - In Design



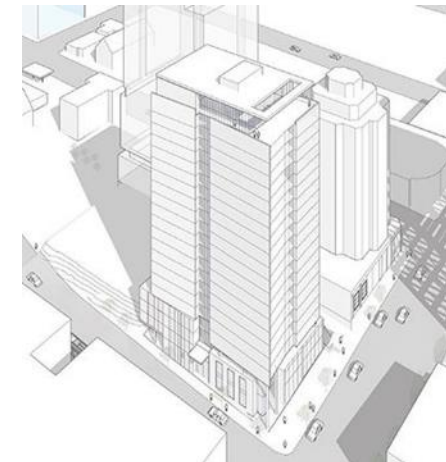
Batik Apartments, Seattle



Jackson Apartments, Seattle



August Apartments, Seattle



1200 NE 45th, Seattle



Coliseum Place, Oakland



Altamira Family Apartments, Sonoma

Peter Waller, Principal



We have several current all-electric multi-family projects. In our experience it has been indispensable to have a knowledgeable energy/Title 24 consultant on the team to help guide both analysis and design.

It is critical to share information about best practices and lessons learned. By sharing best practices we can reduce mistakes.

We work with both non-profit and for-profit housing developers that own and operate lots of buildings. It is important to make sure everyone is aware of the potential challenges that come with new technology.

The life span of the current generation of heat pump water heaters may be less than the traditional gas fired boilers, depending on operating conditions. We expect the life span will increase as the market becomes deeper and more sophisticated, but we try to be open about this reality with our clients. With that in mind provide access for maintenance and future replacement down the road.



Quetzal Gardens, San Jose



Valley Glen, Dixon



Plaza Point, Arcata

Sean Armstrong, Redwood Energy

Redwood Energy

Foremost Zero Net Energy Specialists in Multifamily Housing

All-electric construction consistently reduces construction costs and ongoing utility bills.

It saves between \$2,500 and \$5,000 per residence for the developer to not plumb gas. When infrastructure and appliance costs are added up, a recent study done by Rocky Mountain Institute found a median increased cost of \$8,800 more per house for gas infrastructure, piping, purchasing appliances and venting

Only education is preventing developers from profiting from the technological innovations available in the all-electric domain.

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 technically and financially and because the construction cost savings justify going all-electric.



Cloverdale, Corporation for Better Housing



Colonial House Apartments, Oxnard



Atascadero, Corporation for Better Housing

Sean Armstrong, Redwood Energy

Redwood Energy

Foremost Zero Net Energy Specialists in Multifamily Housing

New construction is easy technically and financially and because the construction cost savings justify going all-electric.

Because an all-electric building can achieve higher mechanical system efficiency than a gas burning building, it is lower cost for developers building all-electric to comply with the Title 24 Energy Code. We documented this in our report A Zero Emissions All-Electric Multi-family Construction Guide, see the graphic on page 7.

<https://fossilfreebuildings.org/ElectricMFGuide.pdf>



152 N. 3rd, San Jose



The Tidelands Housing, San Francisco

Peter Rumsey, Principal



There are great examples of all electric buildings for virtually every building type that are cost effective. It is very easy for our firm to design these systems, we are very familiar with them.

For Multifamily projects we are seeing a lot of developers use electric heating with high levels of insulation in apartments that don't need cooling.

All electric air-cooled VRF heat pumps are very common on multifamily projects up to ten stories where cooling is needed; this is very cost effective.

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. And we are seeing a surge in the use of larger heat pumps for generating hot water systems. Central hot water systems can have a cost premium, but it is very small as a percentage of the building cost.



Pier 70, Building 12



The Exploratorium, San Francisco

Peter Rumsey, Principal



Large 20 story multifamily high-rise require a water source heat pump and that equipment still has a cost premium.

Cooking remains a hard sell in many cases, a lot of people are very skeptical of giving up gas. Technically this isn't a problem, the experts at the Food Service Technology Center in San Ramon say an electric fryer provides better and more even heat than gas. Induction ranges are excellent.

The market for all electric buildings and heat pumps has been making significant inroads in California, and this had gotten the attention of manufacturers. General Contractors and mechanical subcontractors are getting more familiar with this approach as well.

Title 24 used to discourage electric heating of all types and is now more neutral on the issue. I understand that future versions of title 24 are going to be more encouraging of some types of electric heating.



Alexander Valley Medical Center



Goldman School of Public Policy + Housing



SMUD Office & Operations Building, Sacramento

Ted Tiffany, Principal



We have designed quite a few all electric buildings. The Goldman School of Public Policy is as designed all-electric and construction cost compared favorably to gas. This also allowed for individually metered apartments so tenants paid their own utility bills.

The UCOP did a robust cost analysis of various building types and in almost all cases it found lower life cycle costs with all-electric buildings. It is important to manage TOU rates. First cost savings are partly dependent on if you can eliminate the gas service, which in most cases you can; if you do this generally makes the construction cost less than mixed fuel buildings.

[https://www.ucop.edu/sustainability/ files/Carbon%20Neutral%20New%20Building%20Cost%20Study%20FinalReport.pdf](https://www.ucop.edu/sustainability/files/Carbon%20Neutral%20New%20Building%20Cost%20Study%20FinalReport.pdf)



Albany High School



Silver Oak Winery



Sonoma Clean Power

Ted Tiffany, Principal



For most building types and sizes, there is no technical reason preventing the industry from shifting to all-electric buildings.

Laboratories and Hospitals can be more of a challenge as all electric due to the high outside air loads, demands for sterilization, and high hot water loads. They are possible, but more challenging.



J. Craig Venter Institute Lab, San Diego



SFO Consolidated Admin Facility



Integrated Genomics Lab, LBNL

Eric Solrain, Principal



Integral currently has dozens of all-electric buildings recently complete, in construction, and in design. There has been a big sea change in recent years towards all-electric. Around 50% of our work is currently electric.

There is lot of momentum in Multi-family Residential and in Commercial projects moving to electric systems.

Comparing the construction cost of all-electric to gas depends on what you are comparing it to. If comparing to a high-performance design such as LEED Gold then all-electric is cheaper. If comparing to moderate performance building then all-electric is cost neutral. If comparing to the most basic design, there may be a small cost premium.

There are some significant code changes in California energy code in 2019 that will make all electric even more cost competitive, especially for multifamily.



435 Indio, Sunnyvale



415 Mathilda, Sunnyvale



380 N. Pastoria, Mountain View

Eric Solrain, Principal



All electric has several big advantages:

- Electric equipment 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 heat pump option had much less equipment so they were able to put a nice deck and pool on the roof.
- Getting gas service to the equipment, and a flue out through the building can be challenging problems and cost money. Getting make-up air to gas boilers can be challenging.
- For large multi-family projects heat-pump dryers avoid all the problems associate with venting.
- 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.
- There are 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.



Edwina Benner, Sunnyvale



Stoddard Housing, Napa



Casa Adelante, San Francisco

Nick Young



In multifamily buildings with individual heating and hot water systems for each unit it's a no-brainer to go all-electric, from a cost, modeling, technology, and code compliance perspective. **All-electric should be the standard design for these projects.**

For Multifamily buildings with central domestic hot water there are also excellent options using electric heat pumps. We are seeing these projects go with Sanden, Colmac, and Nyle heat pumps.

A significant challenge is that Title 24 doesn't have a modeling pathway for central hot water systems. The CEC is working on fixing this, targeting the 2019 code cycle.

Our all-electric multi-family projects include: Edwina Benner Plaza in Sunnyvale, 2437 Eagle Ave in Alameda, St Paul's Commons in Walnut Creek, Stoddard Housing in Napa, Casa Adelante in San Francisco, and Maceo May in San Francisco.