

ZERO NET ENERGY AFFORDABLE HOUSING IN CALIFORNIA

By SEAN ARMSTRONG of
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PROJECT MANAGER SEAN ARMSTRONG

- Founded Redwood Energy in 2011 to provide consulting for Zero Net Energy design in low-income housing
- Project Manager for 6 years with affordable housing developers that innovated multifamily ZNE
- Co-directed an off-grid demonstration house with solar, wind, biodiesel and human power at HSU, volunteer since 1995
- Second generation farmer specializing in grass-fed Kunekune pigs



ENERGY ANALYST MICHAEL WINKLER



- **Current Mayor** of the City of Arcata, 8 years on the Planning Commission
- CABEC and CalCERTS **Certified Energy Analyst, HERS Rater and LEED Green Rater**
- B.S. in Environmental Resources Engineering and Physics, Phi Beta Kappa
- Technical Lead for the world's first cell phone system
- Hydrogen Fuel Cell Engineer





WHAT IS MEANT BY “ZERO NET ENERGY?”



First Update to the

Climate Change Scoping Plan

BUILDING ON THE FRAMEWORK

PURSUANT TO AB 32

*THE CALIFORNIA GLOBAL WARMING
SOLUTIONS ACT OF 2006*

- AB 32 necessitates “Zero Net Carbon” buildings to get 80% below 1990 GHG emissions. ZNE is a proxy for ZNC.
- Zero Net Energy residences produce 100% of energy used on-site each year with on-site renewables.
- No on-site combustion of fossil fuels is part of the international definitions of ZNE, and used in President Obama’s Energy Initiatives of 2009 and 2013 to direct Federal Agencies to begin implementing ZNE into all Federal buildings



ZERO NET ENERGY HOUSING OUTSIDE OF CALIFORNIA



PIS 2011: KAUPUNI
VILLAGE, Oahu—19
ZNE affordable houses
for Hawaiian natives



PIS 2011: ZHOMES,
Seattle, WA—First ZNE
multifamily in America.
10 ZNE market rate
townhomes.

ZERO NET ENERGY ON THE NORTH COAST



PIS 2012: PLAZA POINT, Arcata—29 senior apartments in mixed use downtown building. Danco Communities



PIS 2014: COTTAGES AT CYPRESS, Fort Bragg. With 24 ZNE houses, it is now the largest ZNE single family housing development in the USA. Danco Communities

ZERO NET ENERGY IN THE CENTRAL AND COASTAL VALLEY



PIS 2015: SPRING
LAKE, Woodland—
62 farmworker
apartments. Mutual
Housing California

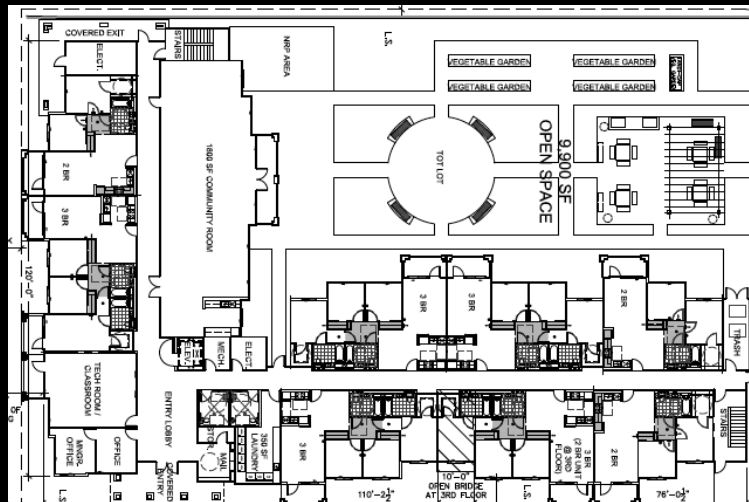


PIS 2014: KING
STATION, King
City—56 family and
senior apartments.
Pacific Communities

ZERO NET ENERGY IN WINE COUNTRY



PIS 2015: CALISTOGA
APTS, Calistoga—48
farmworker apartments.
Corporation for Better
Housing



PIS 2016: CLOVERDALE
APTS, Cloverdale—32
farmworker apartments.
Corporation for Better
Housing

ZERO NET ENERGY IN SOUTHERN CALIFORNIA



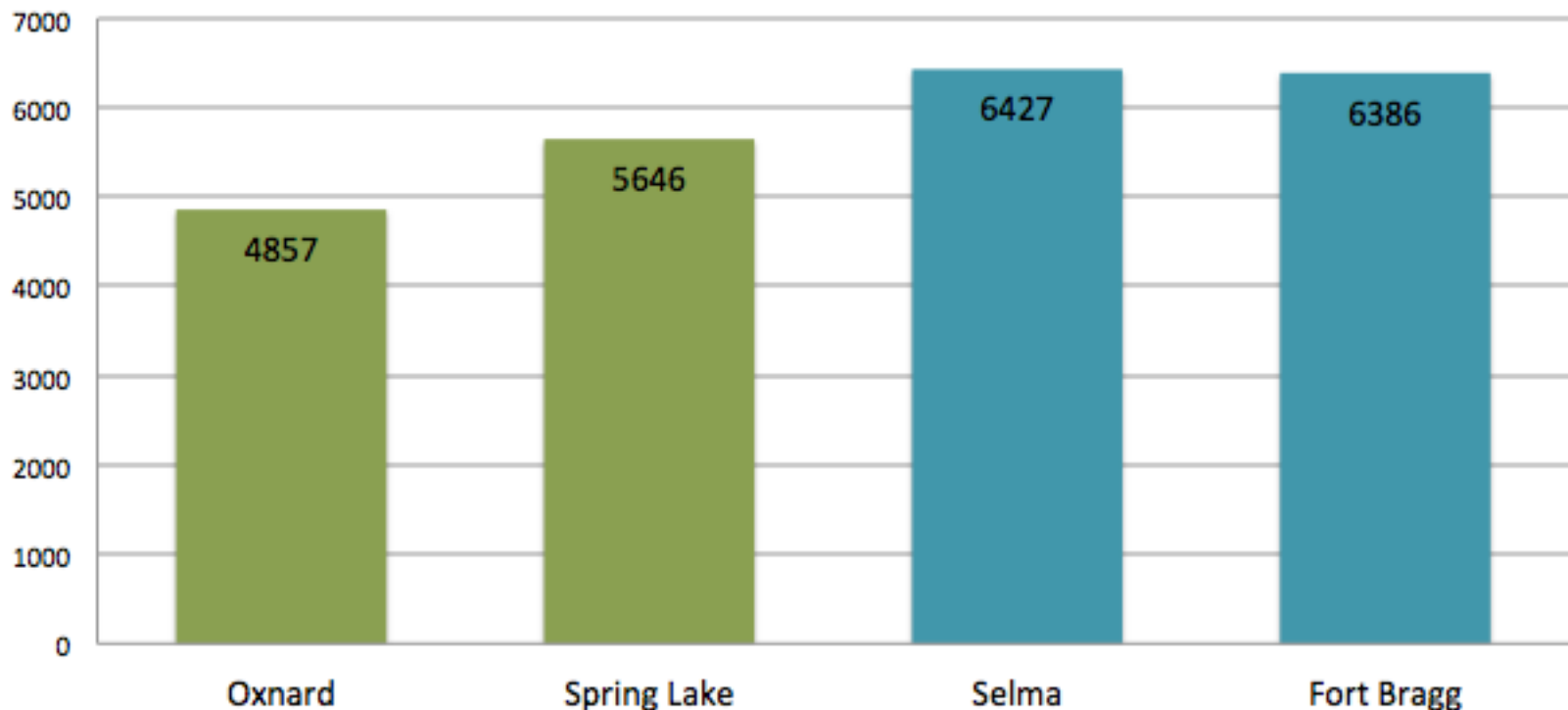
PIS 2014: COLONIAL
HOUSE, Oxnard—44
farmworker apartments.
Pacific Communities



PIS 2015: RIO VISTA,
San Ysidro—160 family
apartments with a ZN-
Electric retrofit, could
not afford fuel switching
costs. Standard Property

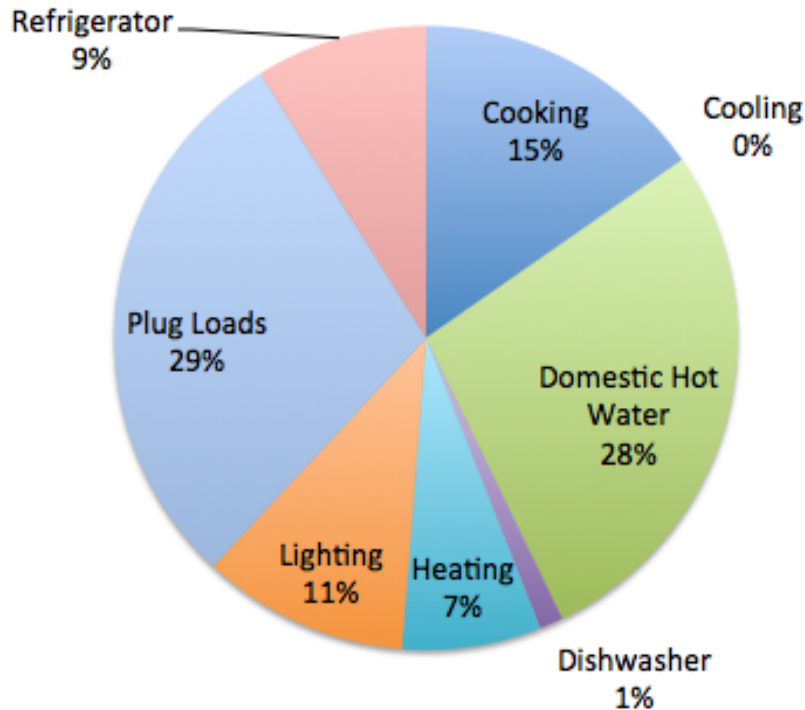
COMPARING HOUSING TYPES AND CLIMATES

**A Comparison of Energy Use in Two Bedroom ZNE Apartments
vs. Single Family Houses: ~12% More Energy Use for Climate and
~12% for Envelope**

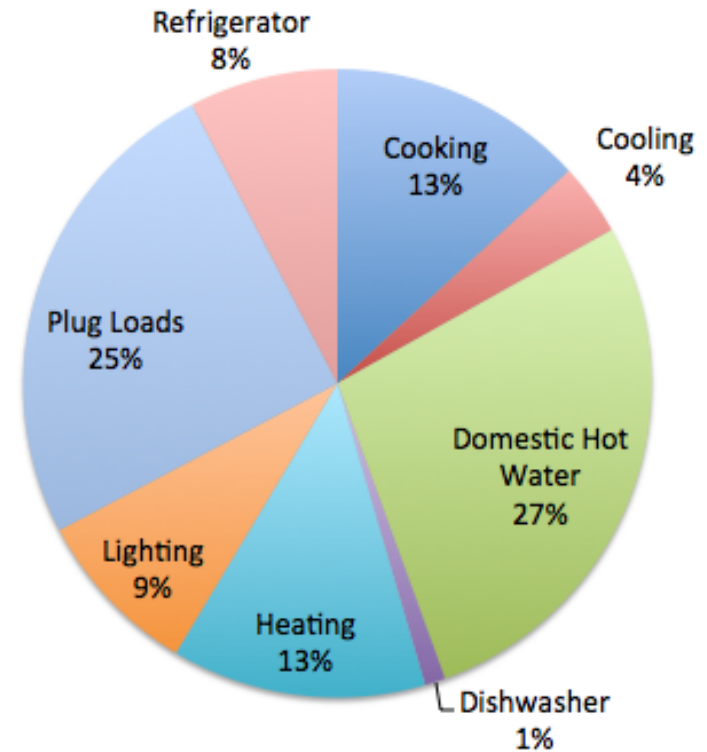


THE SOCAL COAST VS. THE CENTRAL VALLEY: HVAC IS A SMALL IMPACT TO ZNE GOALS

Oxnard Energy Use: 4857 kWh/year



Spring Lake Energy Use: 5646 kWh/year



TECH: SOLAR ELECTRIC POWER



- Solar array credited Tenants and Owners
- Tenants' solar can be directly credited (LADWP) or “virtually” billed (PG&E, SDG&E, etc.)
- Up to 80% co-funding with State rebates, plus 30% Fed tax credits and accelerated depreciation



Direct Billing:
Micro-inverters

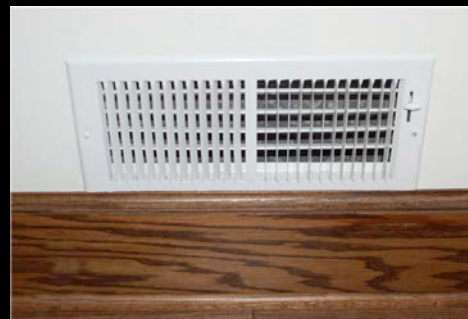


Virtual Net Metering:
1-4 Inverters

TECH: HEATING AND SPACE COOLING



- Individual Units vs Central Systems
- Air Conditioners now work as Heat Pumps
- Chillers now work as Heat Pumps
- Ducted is standard, ductless used in some small apartments



TECH: DOMESTIC HOT WATER



- Individual Units vs Central Systems
- Air conditioners can heat water
- Commercial Chillers now work as Central DHW Heat Pumps
- Solar Hot Water can make the system more efficient



PLUG LOADS



- In ZNE apartments tenants are given daily energy budgets. Educational monitors help tenants learn to live efficiently
- Home Office and Entertainment are 80% of Plug Loads
- Requiring Energy Star cable boxes, as other appliances are required to be E.S., would be a significant improvement in CTCAC housing

LIGHTING AND KITCHEN APPLIANCES



- LED bulbs and Energy Star appliances cost no more than fluorescent bulbs and less efficient appliances, but use $\frac{1}{3}$ to $\frac{1}{2}$ less electricity.



QUALITY CONTROL INSPECTIONS



- HVAC systems are frequently inappropriately installed (fans, air conditioning fluid, duct work, etc.) and are brought into Code compliance with specialized quality control inspection



- HERS inspections save solar construction costs in CTCAC buildings

QUESTIONS?

