Multifamily ZNE from Coast to Coast

Survey of Issues and Examples

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Agenda

- Introductions
- What is a ZNE Building?
- Issues and Examples
  - Renewables
  - Site/Source Energy
  - Modeled/Performance
  - Time Valuation
  - Cost
  - Emissions
- Considerations for Future of ZNE

What is a ZNE Building?

US Army Net Zero Hierarchy

- Definition of ZNE identifies priorities
- Key Issues
  - Permissibility of fossil fuels
  - Geographic boundaries of renewables
  - Comparison of energy generated to grid resources

ZNE Rating Systems

Energy Comparison	Geographic Boundary	Organization
All electric building, kWh vs kWh	At least 80% met with on-site renewables, credits or utility green power limited to 20%	• Architecture 2030 Challenge • US Conference of Mayors • NYC One City: Built to Last • AIA 2030 Commitment
All electric building, kWh vs kWh	On-Site	• International Living Future Institute, Net Zero Energy Building Certification
All electric building, Time Dependent Valuation	On-Site	• Passivhaus Institute, Passive House Premium
All electric building, Time Dependent Valuation	Mostly on-site renewables, balance is grid power	• Passivhaus Institute, Passive House Plus*
Site Energy	On-Site	• ASHRAE's Building Energy Quotient (Asset or Operational)- Zero Net Energy • NESEA Zero Net Energy Building Award
Time Dependent Valuation	On-Site	• California's Building Energy Efficiency Standards
Source Energy	On-Site	• US GSA Net Zero Energy Building Task Group draft definition, Net Zero Energy Building • US DOE draft definition, Zero Energy Building
Source Energy	Community	• US DOE draft definition, Zero Energy Campus • US DOE draft definition, Zero Energy Portfolio • US DOE draft definition, Zero Energy Community
Source Energy	Max on-site, remainder off site	• US GSA Net Zero Energy Building Task Group draft definition, Off-site-NZEB
Source Energy	Max on-site, remainder grid power	• US GSA Net Zero Energy Building Task Group draft definition, REC-NZEB

Renewables

- On-Site
  - Roof/façade
- On-property
  - Parking lot-mounted PV/Backyard wind turbine
- Imported
  - Wood chips/waste vegetable oil/biodiesel/biogas
- Off-site purchased
  - RECs

Renewables: Cottages at Cypress

- Located in Fort Bragg, CA (northern coast)
- All-electric, 130% PV-powered
- Tenants received $160-200 refund
- Hybrid-metering to address shading

Project provided by Redwood Energy

Renewables: El Jardin de Selene

- Located in the Bronx
- 82,000 SF, 84 units
- 11 kW PV system offsets common area lighting, heating, and cooling

Project provided by Steven Winter Associates

Site/Source Energy

Energy Type	U.S. Ratio
Electricity (Grid Purchase)	3.14
Electricity (on-Site Solar or Wind Installation)	1.00
Natural Gas	1.05
Fuel Oil (1,2,4,5,6,Diesel, Kerosene)	1.01
Propane & Liquid Propane	1.01
Steam	1.20
Hot Water	1.20
Chilled Water	1.00
Wood	1.00
Coal/Coke	1.00
Other	1.00

EPA Portfolio Manager Site to Source Ratios by Fuel

- **Site:** Building's metered energy use = RE generated
  - Easy to calculate
  - Constant / Building owner-controlled
- **Source:** Building's grid energy use = RE generated
  - Takes into account grid losses and power plant fuel mix

Site/Source Energy: Ethan Terrace

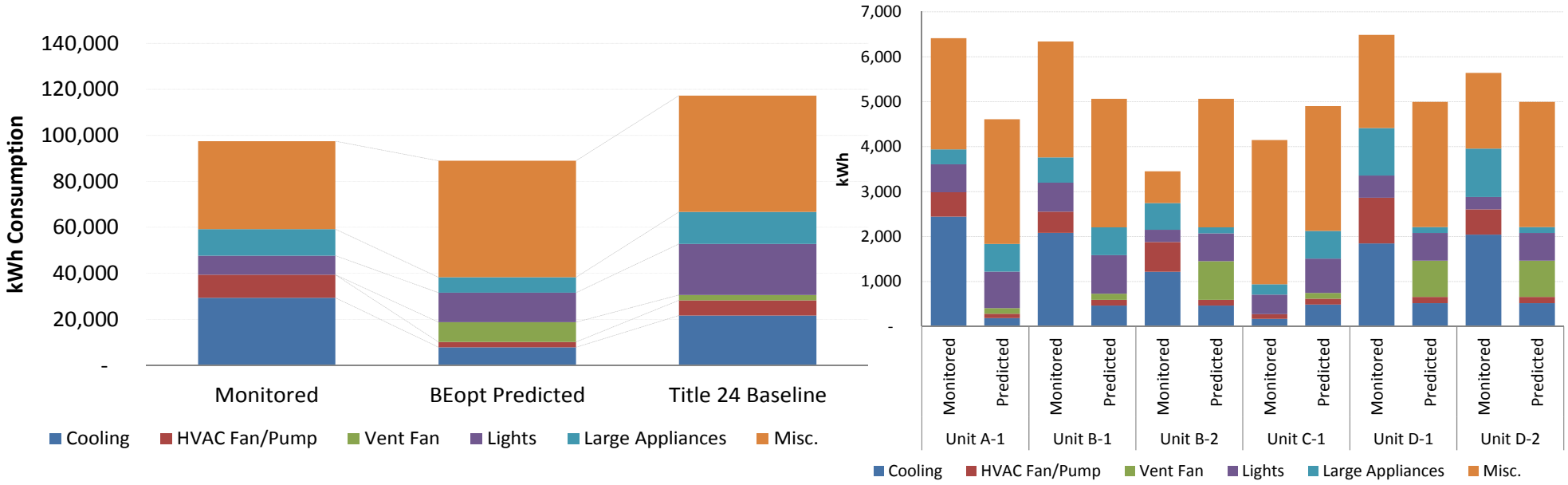
- Existing Complex
- MLK Partners aimed to eliminate DHW gas bill
  - Solar hot water insufficient
  - Switched gas boiler to heat pump tanks offset with PV
- CA site/source calculation calculated mini-splits as greater benefit than DHW fuel switch

Project provided by Redwood Energy

Modeled/Performance

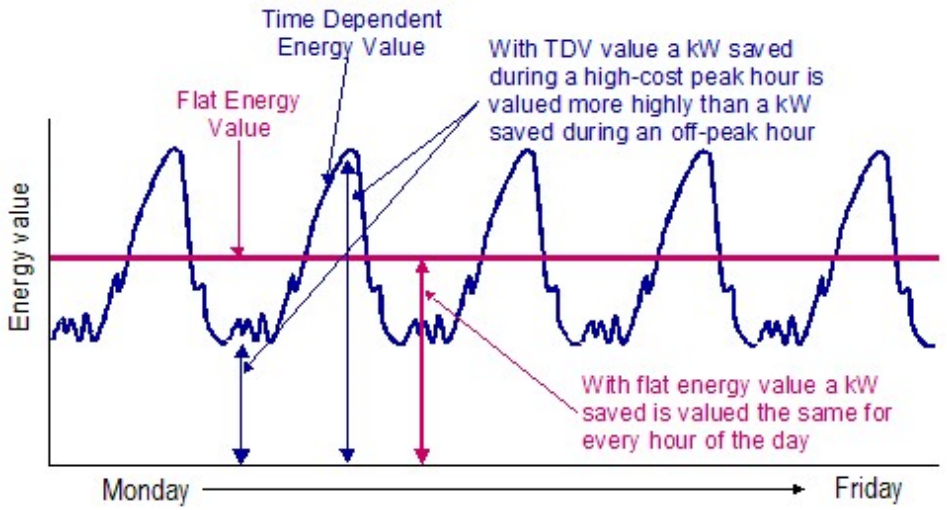
- Energy models are never 100% accurate
- Performance-based metrics take into account behavior, equipment performance/failure, maintenance over time, etc.
- Modeled metric can incentivize designing based on software "quirks"
- Modeled is constant and easy to calculate

Modeled/Performance: La Valentina



Time Valuation

- Time-dependent value of energy (TDV) is economic metric from California
  - Energy is worth less on clear mild day with lots of sun and wind and worth more on hot evening
- Time-dependent value of energy generated must equal time-dependent value of energy used
- Requires modeling hourly energy use and generation for a full year



Time Valuation: Heritage Square

Project provided by Redwood Energy

- New construction
- Central heat pump water heating
- All-electric
- PV meets 60% of demand
- Not considered very efficient by Title 24 as it is compared to TDV of gas heated building

Cost

- Cost of energy generated = cost of energy consumed
- Market-based option
- May not result in zero carbon emissions
- Dependent on rate structures
- No built-in mechanism for grid maintenance

Cost: netZero Village and Tilley Ladder

- Technical and financial support from NYSERDA's Low-Rise Residential New Construction Program as well as NY-Sun
- Demonstrations of potential approaches for ZNE-ready buildings
- Tilley Ladder is a historic gut rehab with a CHP installation
- Owner using "all in" rental model to resolve split incentive

Emissions

CO2 Equivalents		
Fuel Type	**Unit**	**Lbs. CO_2e per Unit**
Electricity	kWh	0.83200
Natural Gas	kBtu	0.11638
All Types of Fuel Oil	kBtu	0.15966
Propane	kBtu	0.13830
Diesel	Gallon	22.38400
Gasoline	Gallon	19.56400

- Using this metric directly connects ZNE buildings to climate change
- Difficult to calculate
- ZNE becomes more difficult over time

Emissions: Beach Green North

- New construction in Rockaways
- 101 units
- Passive House
- Close to zero emissions
- Full storm water retention

Project provided by Blue Stone

Considerations for Future

- Definitions
  - Cost and TDV do not focus on reducing greenhouse gas emissions or improving resiliency
- Renewables
  - High-rise multifamily buildings struggle to comply with any ZNE definition that requires renewable to be on-site or on-property. Heating climates will likely need to allow imported renewable for heating requirements (also, improved resiliency)
  - Off-site renewables are less costly and easier for adoption, do not result in zero emission buildings

Framework for ZNE Definitions

Rank	Strategy	Effect
A+	Annual building energy use = Annual onsite renewable energy production	ZNE site
A	Maximize energy efficiency + on site renewables + purchase of grid level renewables/credits = 0 annual energy use	ZNE grid
B	Maximize energy efficiency	ZNE ready
C+	Above-average energy efficiency	On the path to ZNE
C	Average energy efficiency	

Thank you!

Any questions?

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