

# Net Zero Multifamily Cost and Energy Optimization

NESEA BuildingEnergy Boston  
March 14<sup>th</sup>, 2019

Jesse Schwartzberg, RA: Black Mountain Architecture  
Dave Bruns: Bruns Realty Group, LLC

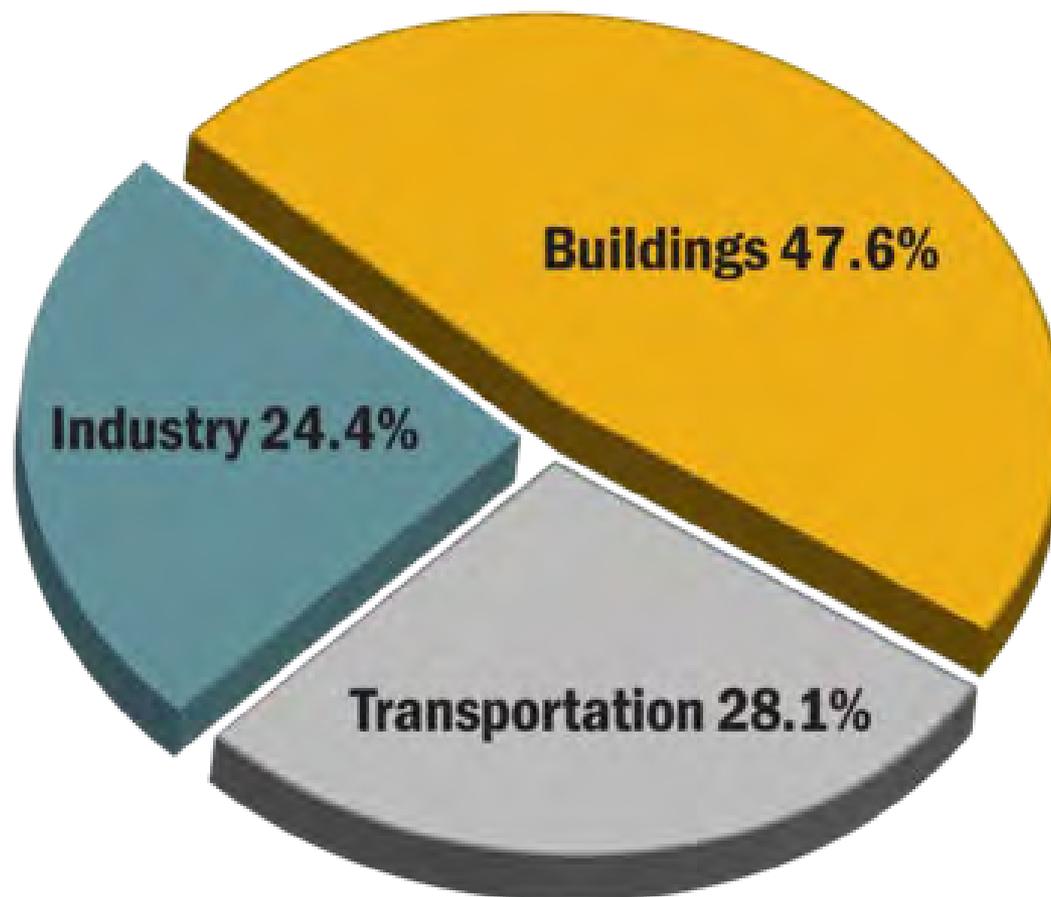


**BLACK MOUNTAIN**  
ARCHITECTURE



**SOLARA**  
ECOLUXURY LIVING

# The Market



## U.S. Energy Consumption by Sector

Data Source: U.S. Energy Information Administration (2012).

# The Market

## A Nation Of Renters

REALINVESTMENTADVICE.COM

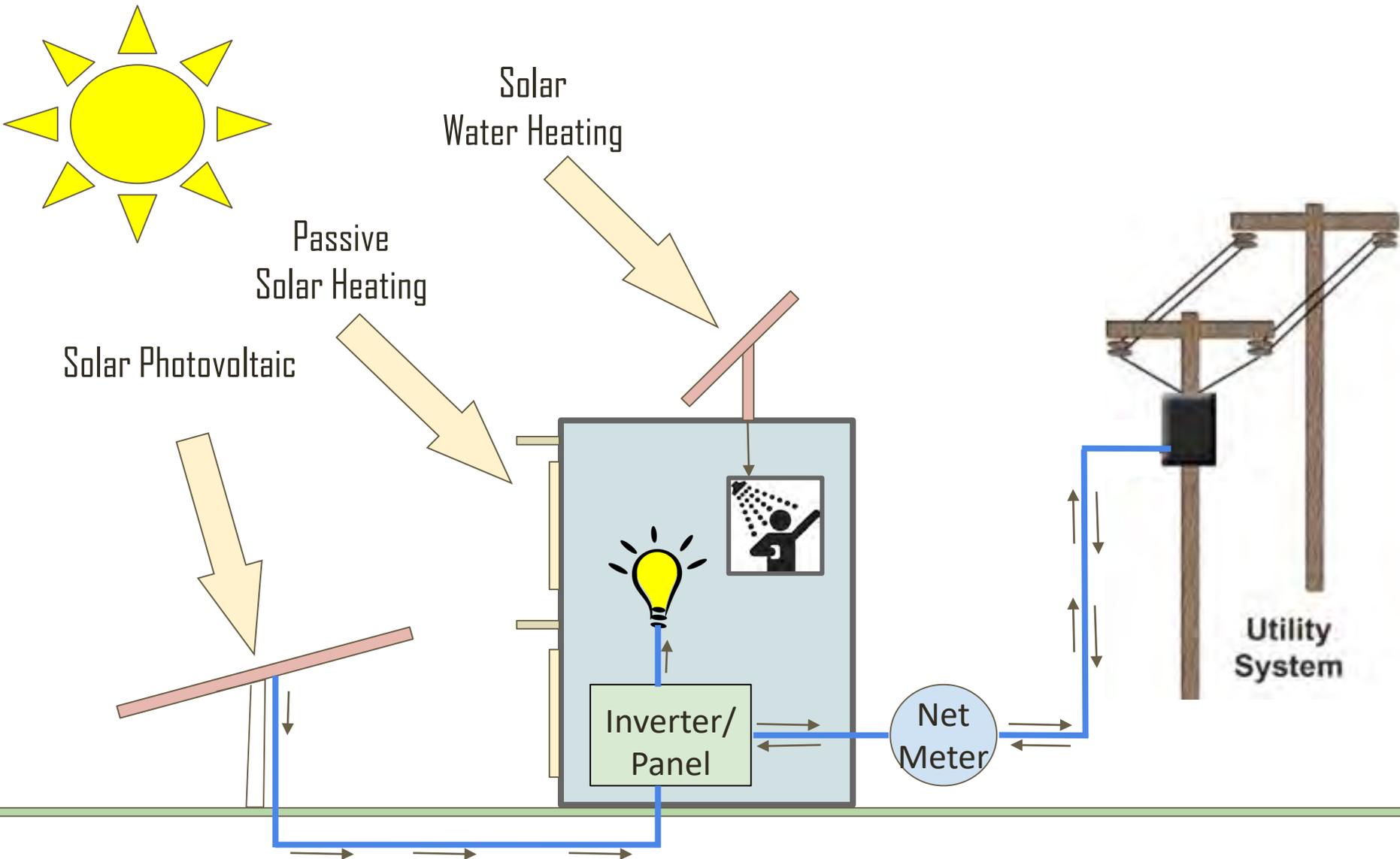


# The Goals

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- Profitable
- Bankable
- Marketable
- Reproducible

# The Net Zero Concept



# Project #1: NetZero Village



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# Project #1: NetZero Village



# Project #1: NetZero Village



# The Results: Cost

## Conventional Wood Frame

- \$80,000 per unit
- \$85+/- per SF



## Net Zero Village

- \$100,000 per unit
- \$100+/- per SF



# The Results: Energy

## 2016-2017: Buildings 1-6 (72 units)

	Actual	Predicted	Deviation	kWh/Unit
Consumed:	371,386 kWh	338,364 kWh	10%	5,158 kWh
Produced:	430,617 kWh	475,200 kWh	-9%	5,981 kWh
Net:	59,231 kWh (+16%)	-	-	823 kWh

## 2018-2019: Buildings 1-11 (132 units)

	Actual	Predicted	Deviation	kWh/Unit
Consumed:	821,621 kWh	620,334 kWh	32%	6,224 kWh
Produced:	754,010 kWh	871,200 kWh	-13%	5,712 kWh
Net:	-67,611 kWh (-8%)	-	-	-512 kWh



**BLACK MOUNTAIN**  
ARCHITECTURE



INVITATION TO ATTEND

**BUILDING ENERGY**  
2002

The conference and trade show for renewable energy and green building professionals

**Tufts University**  
Medford, MA  
March 20-23, 2002

Organized by  
**NESEA**

Title Sponsor: **Massachusetts TECHNOLOGY Collaborative RENEWABLE ENERGY TRUST**

Hosted by: **Tufts Climate Initiative**

# Next 30 Minutes:

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- **Integrated Design Process**
- **Team Members/ Roles**
- **Key Building Systems, Specifications, and Details**
- **Modeling Tools Used to Inform Decisions**
- **Window Specification Example**
- **Heat Pump Specification Example**

# Dave's Question:

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Is it less expensive to reach our net zero goal by installing 3" of Closed Cell Spray Foam instead of 2" or by purchasing additional PV?

-David Bruns

# Team's Goals in Response to Dave's Question:



- Make Informed Decisions
- Spend construction \$ in areas of highest value to Net Zero Goal
- Stop spending with diminishing returns
- Analyze every building component through the lens on \$ and kWh

# The Integrated Design Process: Weekly Meetings



# The Developer



**Dave Bruns**

**Bruns Realty Group, LLC**

- Vision
- Rental Property Experience
- Integrity
- Compassion
- Trust

# The Builder

## Ballston-Mourningkill Associates

Rob Hofmann



- Multifamily Experience
- Eager to Learn
- Lean and Efficient
- Laser focus on costs

Eric Carlson



# The Architects

## Harris Sanders Architects

Owen Neitzel



- Multifamily Experience
- Code Knowledge
- Market Knowledge
- Open to Integrated Design Process

Daniel Sanders



# Black Mountain Architecture: Jesse Schwartzberg



- Energy Architect
- Integrated Design Process Leader
- Building Science Knowledge

### Collaborators



Kate Stephenson



Dylan Lamar

# The HERS Rater



**Tom Vitale**

**En-Tech Associates, Inc.**

- Energy Star Rater
- Problem Solver
- Multifamily Experience
- Building Science Knowledge

# The DHW Designer and Contractor



**Peter Skinner**

**E2G Solar**

- Solar Thermal Guru
- Understands how to best capture the sun's energy
- Passion for Solar DHW

# Key Building Specifications

- Designed for local Albany tradespeople
- Easy to Build
- Easy to Bid



# Key Building Specifications: Roof



- TPO
- 4" Polyiso
- OSB
- 2 ½" Closed Cell Spray Foam
- R-38 Assembly

# Key Building Specifications: Walls

- ½" Polyiso ZIP-R Sheathing
- 2x6 Wood Stud
- 3 ½" Closed Cell Spray Foam
- GWB
- R-25 Assembly



# Key Building Specifications: Walls



# Key Building Specifications: Windows



- Single Hung Vinyl
- Double Pane
- 180/i89 Glass
- SHGC = .52
- Condensation Resistance = .46
- U-value = .24
- R-value = 4

# Key Building Specifications: Exterior Sun Shades

- PVC
- Off-the-Shelf Fence Parts
- Custom Fabricated
- \$250 per shade



# Key Building Specifications: Foundation/Slab



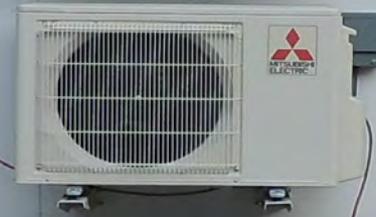
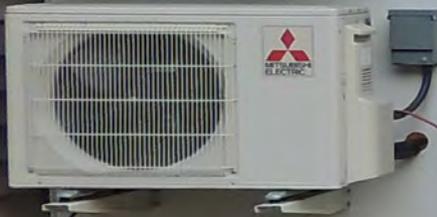
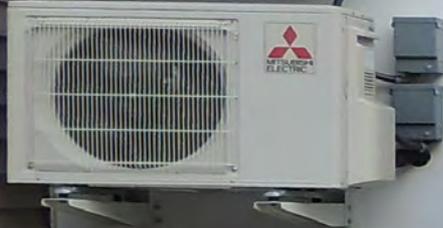
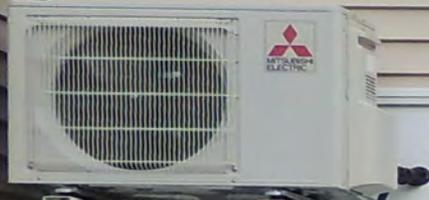
- 4" Concrete
- 6-mil poly
- 8" Compacted Earth
- 2" XPS Foam
- Undisturbed Earth

# Key Building Specifications: Foundation/Slab



# Key Building Specifications: Mechanicals

- Air Source Heat Pumps
- Low temperature
- 1-Ton units
- One indoor unit per apartment
- One outdoor unit per apartment
- One unit per common area



# Key Building Specifications: Mechanicals



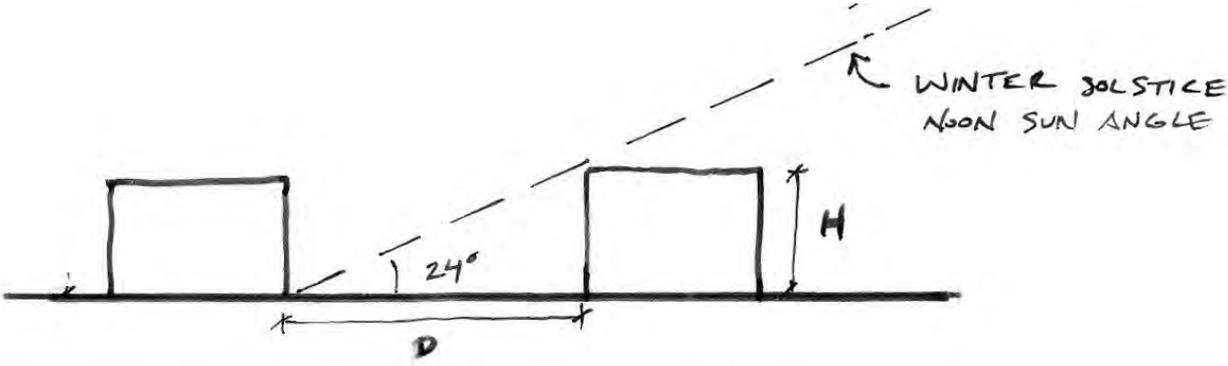
- 70% Assumed Sensible Recovery Efficiency (HVI)

# Key Building Specifications: Active Solar

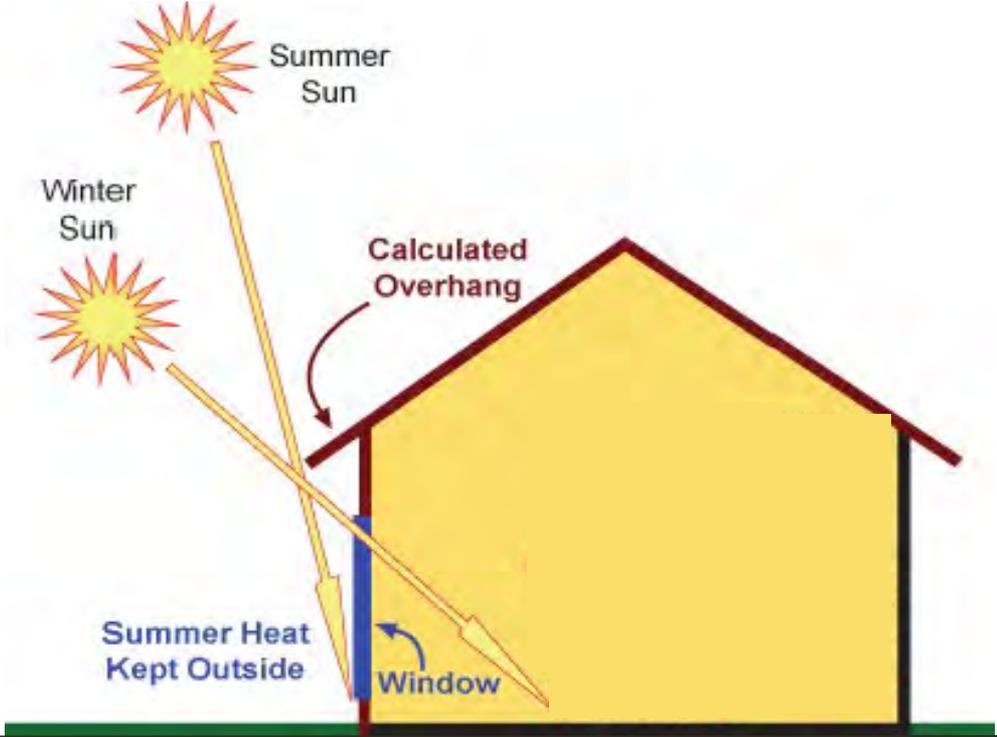


- 66 KW system per building
- Located on carports
- 79,200 kwh predicted annual generation
- Predicted EUI: 15.2

# Key Building Specifications: Passive Solar

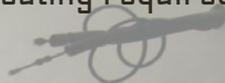


- E-W Orientation
- South-facing Windows
- Solar Pathfinder Study



# Key Building Specifications: Passive Solar

- Sun's heat + Tight envelope = Minimal heating required during construction



# Key Building Specifications: Solar Thermal/DHW

- 78% of DHW Need
- NYSERDA Incentives
- Critical to Net Zero

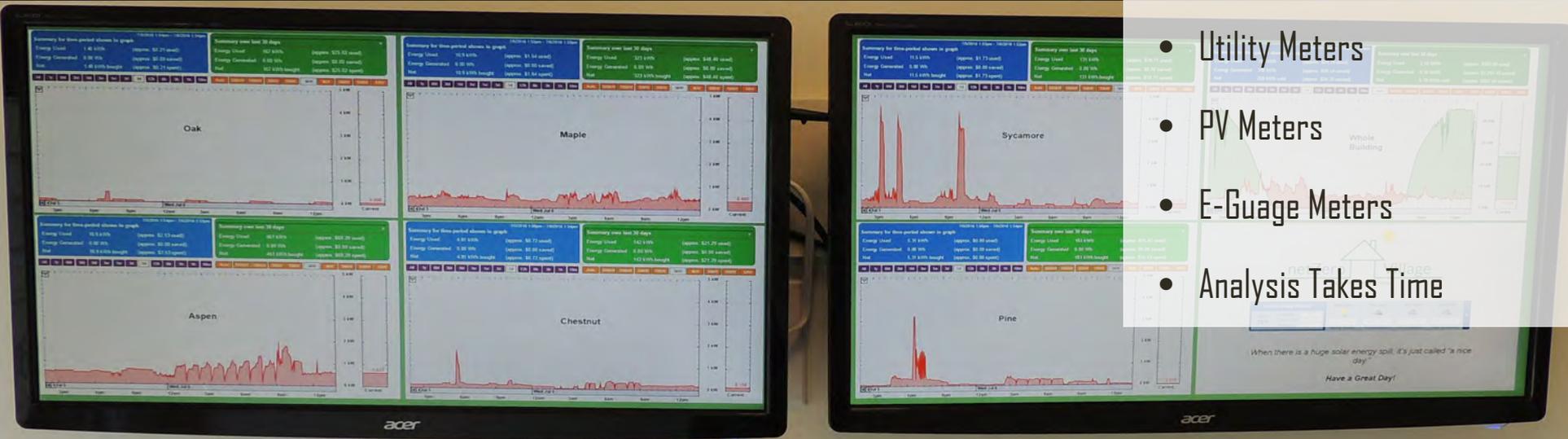


# Key Building Specifications: Airtightness

- Initial Fog Test
- Pre GWB Test
- Pre Occupation Test
- .6 ACH50 (Actual)



# Key Building Specifications: Monitoring



# How Did We Answer Dave's Question?: Energy Modeling

- Good
- Better
- Best



PHPP

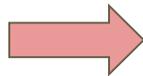
Passive House Planning Package

Version 9 (2015) © Passive House Institute

# Energy & Cost Value Engineering: Windows

Base	Good	Better	Best
Guardian 63/31, 2-pane, Lo-e	Windows: Cardinal 180, 2-pane, Lo-e, Argon Doors: Anderson	Guardian 75/68, 3-pane, Lo-e, Air	Trosch, 3-pane, Lo-e, Argon
U-cog = 0.29 SHGC = 0.31	Windows: U-cog = 0.26 SHGC = 0.65 Doors: U-cog = 0.32 SHGC = 0.35	U-cog = 0.18 SHGC = 0.54	U-cog = 0.09 SHGC = 0.50
8097	(2476)	(3783)	(7022)

\$



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10,573 kwh  
Saved

1,307 kwh  
Additional  
Saved

3,239 kwh  
Additional  
Saved

# Energy & Cost Value Engineering: Windows

<b>PARADIGM WINDOW AND GLAZING OPTIONS</b>				
<b>SINGLE HUNG DOUBLE GLAZING 3/4"IGU w/ Argon</b>		<b>U-value</b>	<b>SHGC</b>	<b>CR</b>
	180	0.28	0.52	0.61
	180/ i89	0.24	0.52	0.46
	270	0.27	0.28	0.62
<b>SINGLE HUNG TRIPLE GLAZING 3/4" IGU w/ Argon</b>		<b>U-value</b>	<b>SHGC</b>	<b>CR</b>
	180/CLR/ 180	0.25	0.47	0.63
	180/CLR/ i89	0.25	0.48	0.47
	270/CLR/ 270	0.24	0.26	0.66
<b>CASEMENT TRIPLE GLAZED W/ 1" IGU w/ Argon</b>		<b>U-value</b>	<b>SHGC</b>	<b>CR</b>
	180/CLR/ 180	0.21	0.38	0.68
	270/CLR/ 270	0.21	0.22	0.68
	270	0.26	0.23	0.61
	180	0.26	0.42	0.63

# Energy & Cost Value Engineering: Heat Pumps



# Energy Modeling/Value Engineering: Heat Pumps



# Lessons Learned: NetZero Village

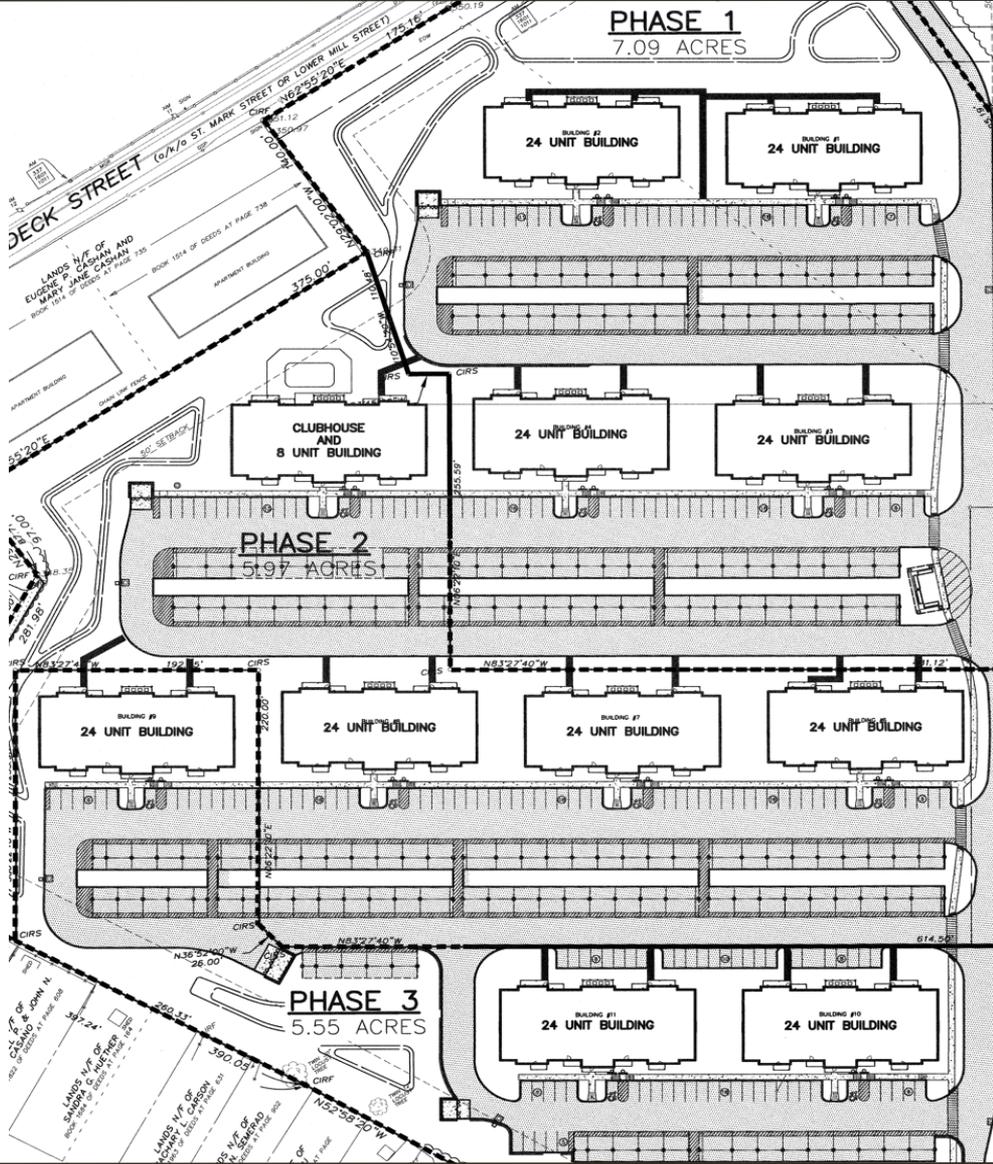


- Shared Responsibility
- Personal Dedication

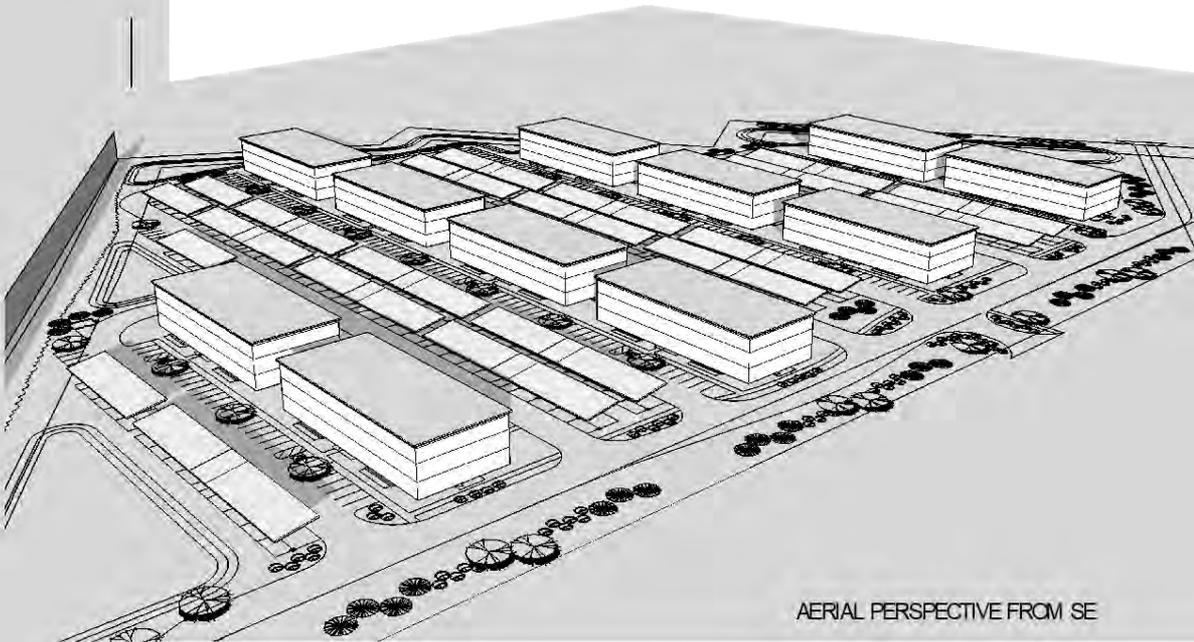
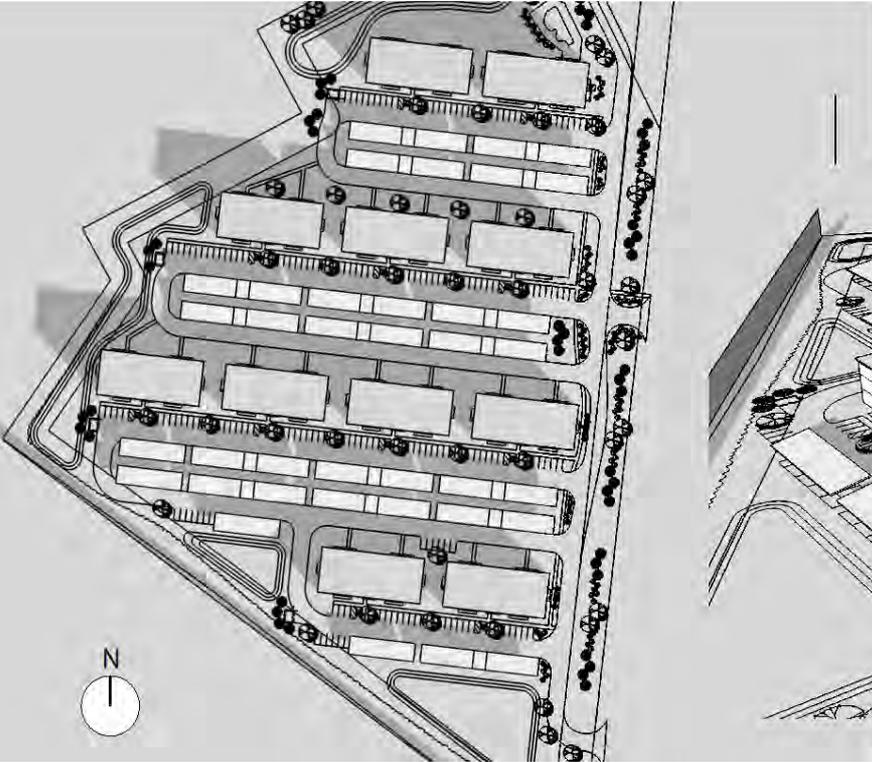
# Project#2: Solara



# Project #2: Solara



# Project #2: Solara



AERIAL PERSPECTIVE FROM SE

# Project #2: Solara

- Elevators
- Double-loaded corridor
- Switch from HRV to ERV
- Switch from ½" polyiso to 1" (ZIP-R)
- Heat pump hot water
- Heat pump dryers
- "Smart and Holistic" master building controls
- Hot water recirculation loop
- Dehumidification plan
- Eave detail



# Project #2: Solara



# Project #2: Solara



# Project #2: Solara



# Project #2: Solara



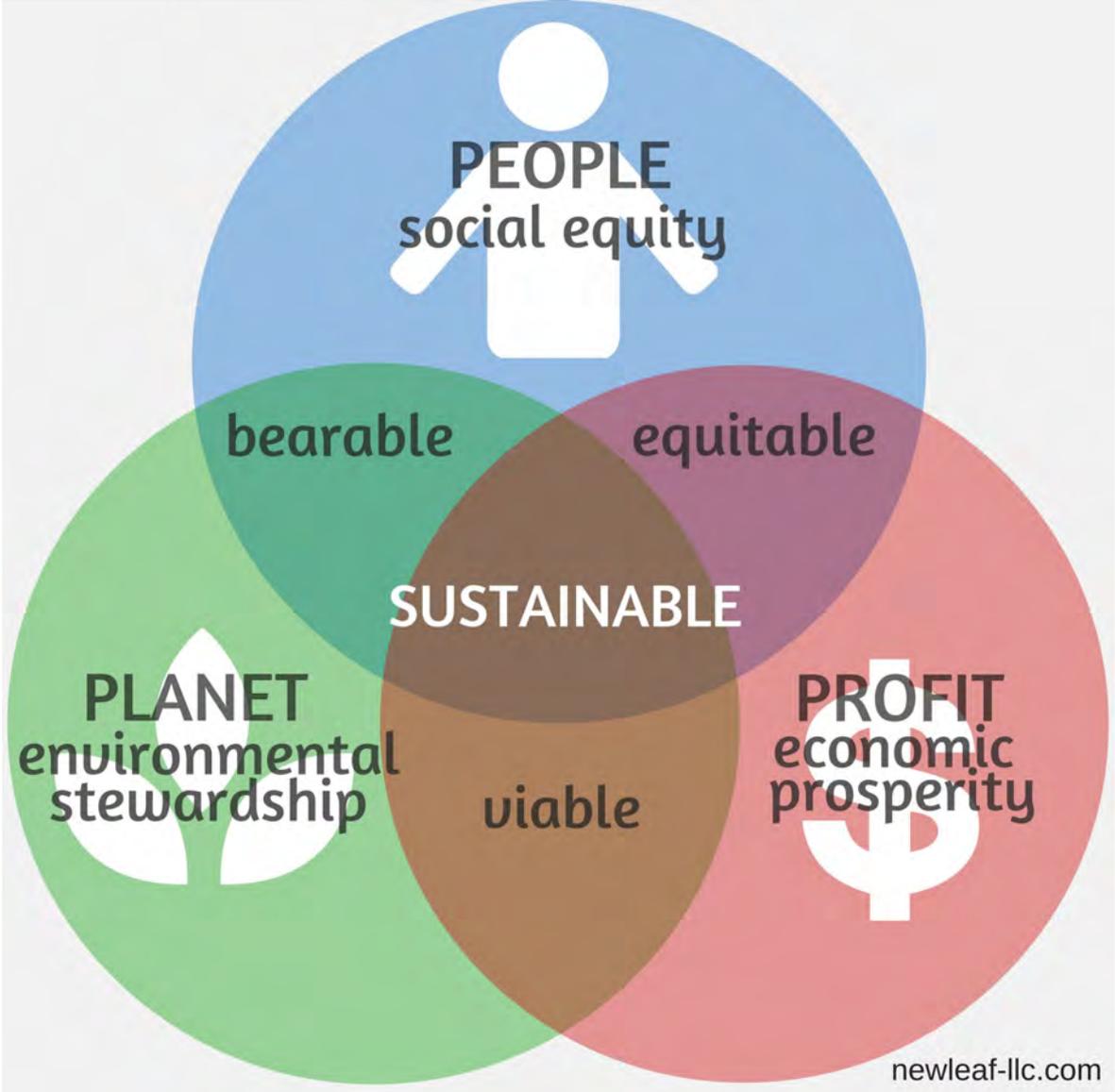
# Reproducible Goal Achieved!



# Who's Watching the Project?



# You can do this too!



# QUESTIONS

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