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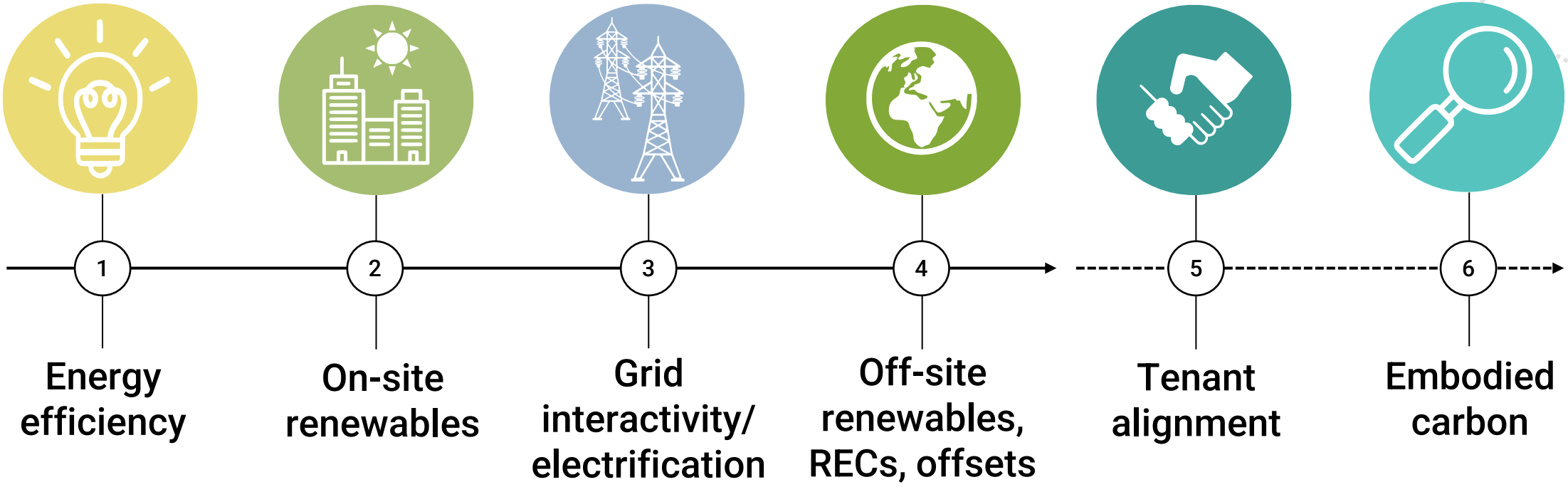
Pumping Up Sustainability:
Embracing Heat Pumps in Commercial Real Estate

SEPTEMBER 20TH, 2024

ULI Net Zero Mission Priority

Decarbonizing the real estate sector and accelerating our progress to net zero

Defining Net Zero



A net zero building portfolio is highly efficient and fully powered by on-site and off-site renewable energy sources and offsets

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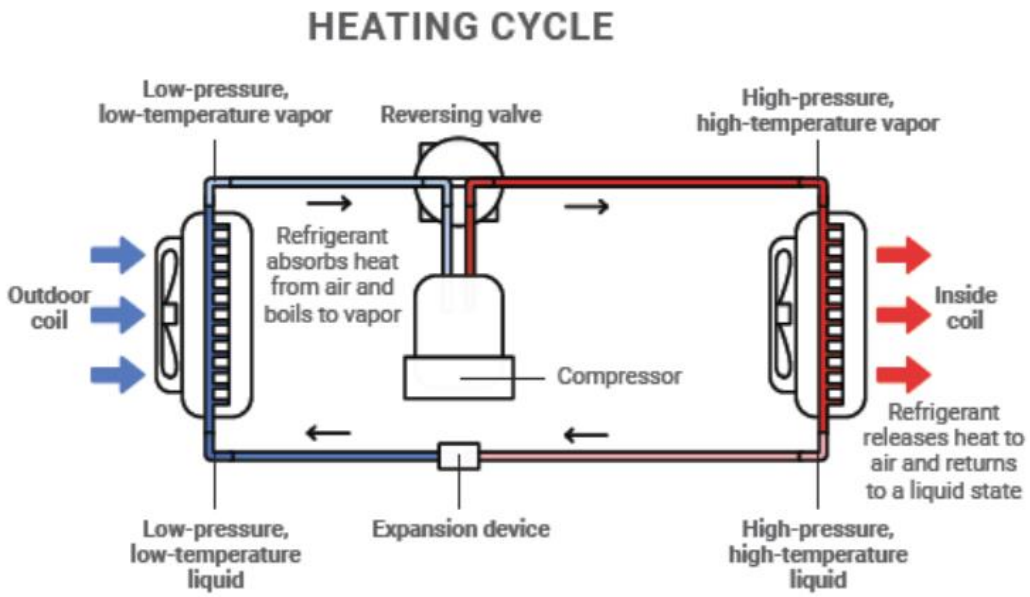
Panelists

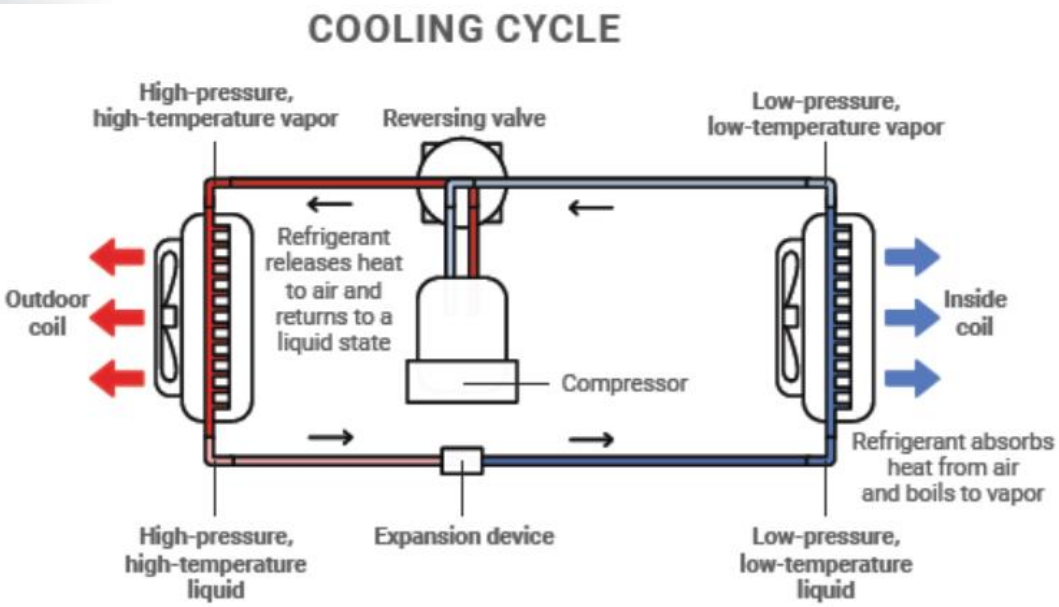
Jonathan Arnold
Principal
Arnold Development

Laura Humphrey
Senior Director of Energy and Sustainability
L+M Development Partners

Stet Sanborn, VP
Director of Climate Impact
SmithGroup

How do heat pumps work?





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Myths Around Heat Pumps in Commercial Developments

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MYTHS AROUND HEAT PUMPS IN COMMERCIAL DEVELOPMENTS

Myth 1: Heat pumps are not cost-effective, and my utility bill will go up by switching to heat pumps.

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Arnold Development Group

Energy Efficient - Transit Oriented - Mixed-Income

ad ARNOLD DEVELOPMENT

Second and Delaware

276 Unit Passive House Development

55,000 SF Courtyard and Rooftop Gardens

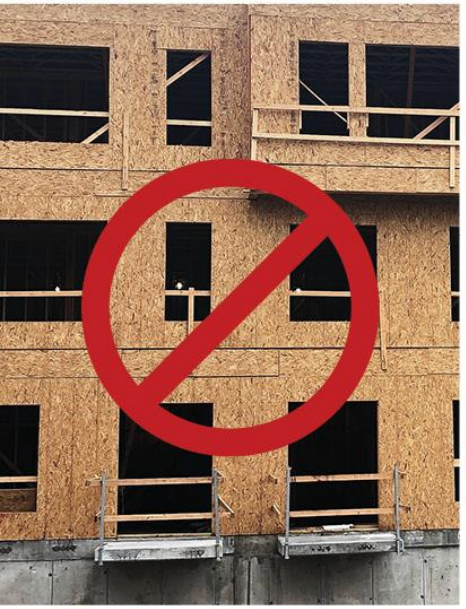
Winner of NAA Best New Community Award

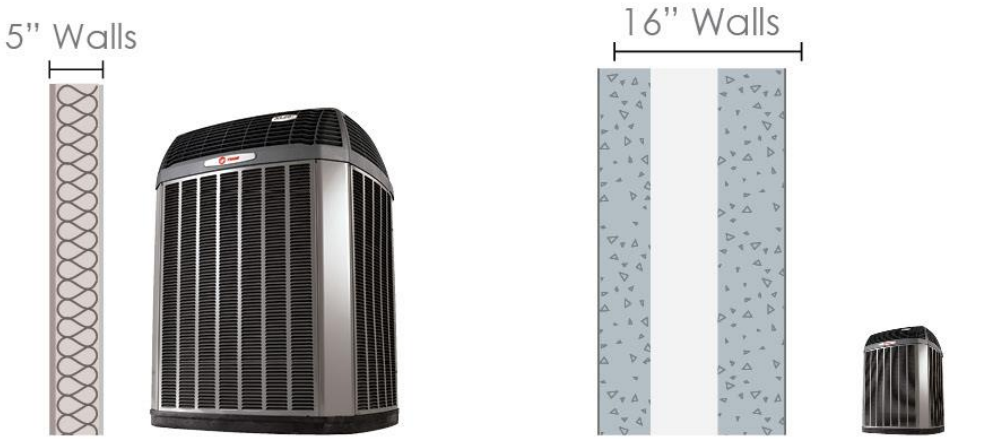
NAA EXCELLENCE AWARDS 2022

WINNER

Closing the Financing Gap with Sustainable Design

The "Lowest First Cost" approach makes that gap worse. Energy efficient, resilient buildings have lower operating costs and qualify for lower cost capital, resulting in a smaller financing gap.





$197.43 per month → **$73.39** per month

Code Based Buildings — **Passive House Buildings**

1. Reduce Utility and Insurance Expenses
2. Access Lower Cost Capital
   - GHGRF (1-2%)
   - TIFIA (4%)
   - Tax Credits (LIHTC and ITC)

-29 +44 = 15

Passive House: Cost Effective Energy Efficiency

The projects in the pipeline will be built to the Passive House standard, which results in 60-90% reduction in energy consumption.

Code Based Building

Building Size 277,512 SF

Site Energy **40,703,695** kBtu/yr

Passive House Building (KC Prototype)

Building Size 321,096 SF

Site Energy **7,581,734** kBtu/yr ← **84% less energy per square foot**

Heat Pump Plus Geothermal

When a heat pump is combined with a geothermal heating and cooling system the entire HVAC system goes into the basis of calculating the tax credits.

		Market Rate		Low to Moderate Income	
		Cost Per Unit	*Cost Per Foot*	*Cost Per Unit*	*Cost Per Foot*
Geothermal Wells		20,404	17.00	20,404	17.00
Heat Pump		14,300	11.92	14,300	11.92
Total Mechanical Cost		**34,704**	**28.92**	**34,704**	**28.92**
ITC Base Credit	30%	(10,411.31)	-8.68	(10,411.31)	(8.68)
ITC American Content Boost	10%	(3,470.44)	-2.89	(3,470.44)	(2.89)
LIHTC (4% @$0.85)	40%	N/A	N/A	(11,799.49)	(9.83)
45L Tax Credit		(1,000.00)	-0.83	(1,000.00)	(0.83)
DOE Rebate Heat Pumps		(4,000.00)	-3.33	(8,000.00)	(6.67)
Total Cost After Incentives		**15,823**	**13.19**	**23**	**0.02**

Capitalizing on Energy and Operational Savings

We include a market rate utlity cost to each unit's rent, which allows the energy savings to finance the cost of the energy efficient features.

Conventional Stick			*Passive House / Concrete*		*DELTA*
Concrete	40		Concrete	85	45
Wood	24		Wood	1	(23)
Insulation	1		Insulation	3	2
Windows	4		Windows	8	4
Floor	5		Floor	2	(2)
Drywall	10		Drywall	8	(2)
Exterior	13		Exterior	10	(3)
Mechanical	8		Mechanical	13	5
Green Roof	-		Green Roof	4	4
Other Costs	88		Other Costs	88	-
GC Fees	30		GC Fees	30	-
Total	**223**		**Total**	**252**	**29**

113%

Increased Cost	**$ 9,387,084**	$	29
Energy Savings	410,796		
Insurance Savings	215,368		
Reduced Painting Costs	41,400		
Garden Plot Rentals	14,040		
Rooftop Event Rentals	96,000		
Total Additional NOI	777,604		
Cap Rate	5.50%		
Added Value	14,138,248	$	44
Net Increase in Value	**4,751,164**	**$**	**15**

Electricity Savings

Median Market Utility / Mo	PH Utilities / Mo		Savings / Mo	Mos / Yr	Savings / Unit Per Year	Savings Per Year	Cap Rate	Value of Savings	Value Per SF	Cost of Improvements	Net Increase in Value
197.43	73.39		124.03	12	1,488	410,796	5.50%	$ 7,469,012	**$ 23.26**	$ (9,387,084)	**$ (1,918,073)**

-29 +44 = 15

MYTHS AROUND HEAT PUMPS IN COMMERCIAL DEVELOPMENTS

Myth 2: Heat pumps are not a viable option for properties in cold climates

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MATCHING ALL-ELECTRIC SYSTEMS TO BUILDING TYPES

SIMPLE REPLACEMENTS – IN COLD CLIMATES SMALL OFFICES, SCHOOLS, ETC

Heat Pump Rooftop Package Units

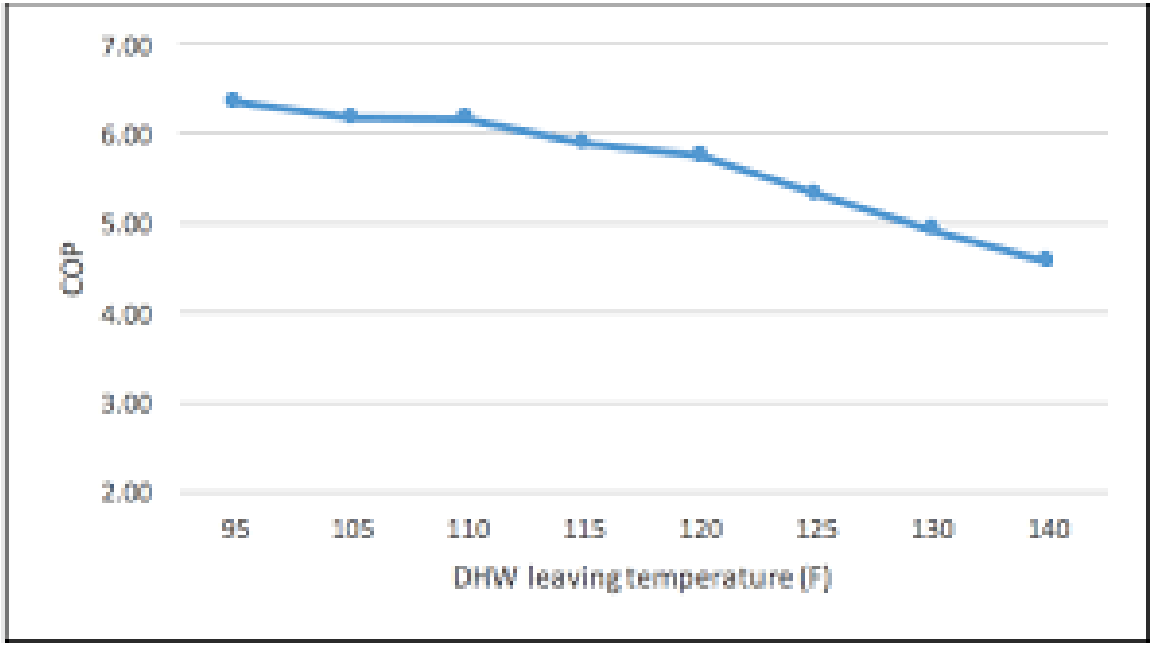
VRF

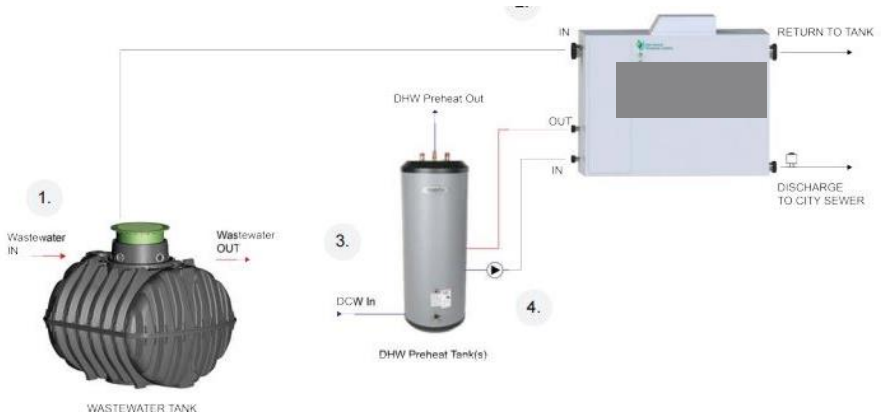
Considerations & Strategies:

- Integrated HRV/ERV
- Select for Correct OAT
- Minimize Electric Resistance Heating

COLD CLIMATE HEAT PUMPS → SANITARY WASTE ENERGY EXCHANGE

DOMESTIC HOT WATER: THE POWER OF POOP





COLD CLIMATE HEAT PUMP → GROUND SOURCE!

OPTIMIZE THE EQUIPMENT

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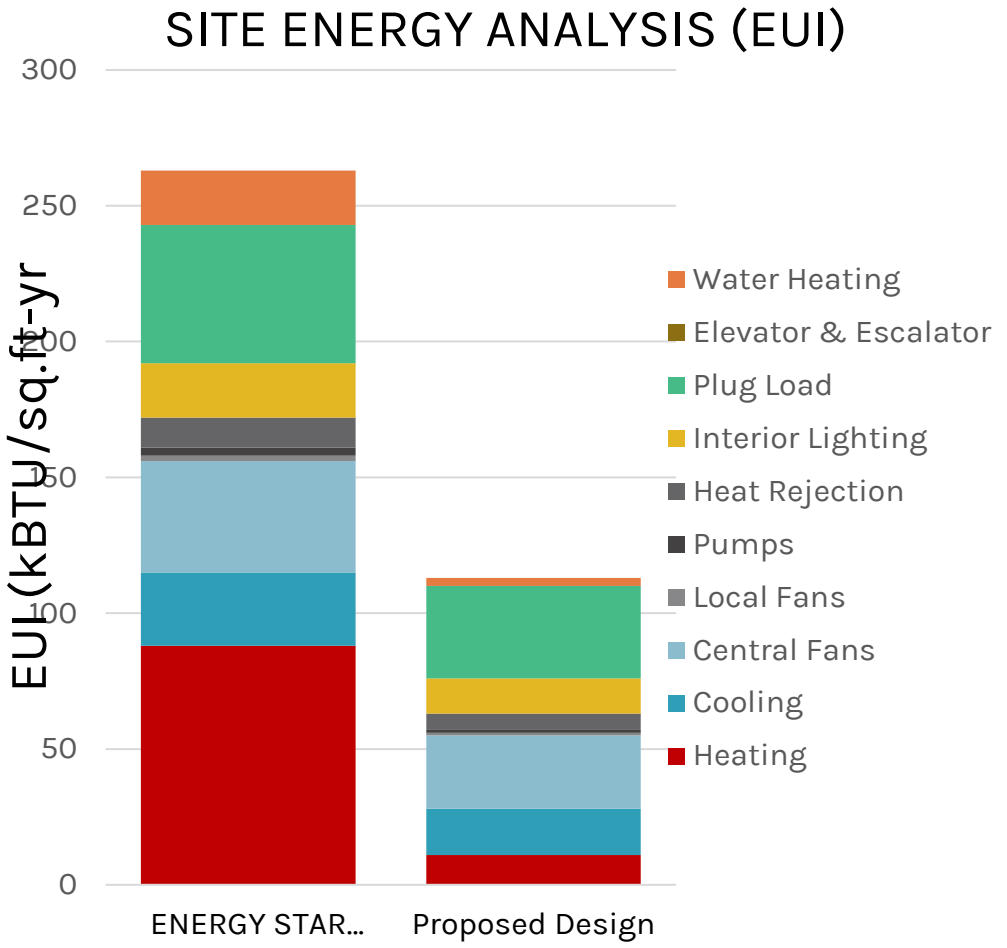
OPTIMIZE THE EQUIPMENT



MYTHS AROUND HEAT PUMPS IN COMMERCIAL DEVELOPMENTS

Myth 4: Heat pumps are only for single-family homes or small commercial and don’t work for mid-rise, high-rise, or industrial properties.

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Myth 4: Community Scale Heat Pumps

Alafia, Brooklyn

Highlights

- Community-scale, multi-phase development across 28 acres
- >2.2 million SF
  - 2,400 affordable and supportive housing units
  - 15K SF healthcare clinic
- All buildings will have individual geothermal systems for all thermal loads

MATCHING ALL-ELECTRIC SYSTEMS TO BUILDING TYPES

MEDIUM OFFICE AND SIMILAR VAV/REHEAT SYSTEMS

Heat Pump AHU's, ASHP-HR

VRF

Considerations & Strategies:

- Consider Heat Recovery Heat Pump Integrated with AHU & Reheat Loop
- Integrated HRV/ERV

MATCHING ALL-ELECTRIC SYSTEMS TO BUILDING TYPES

CENTRAL CHILLER / BOILERS WITH HYDRONIC SYSTEMS

6, 4 and 2-pipe ASHP's

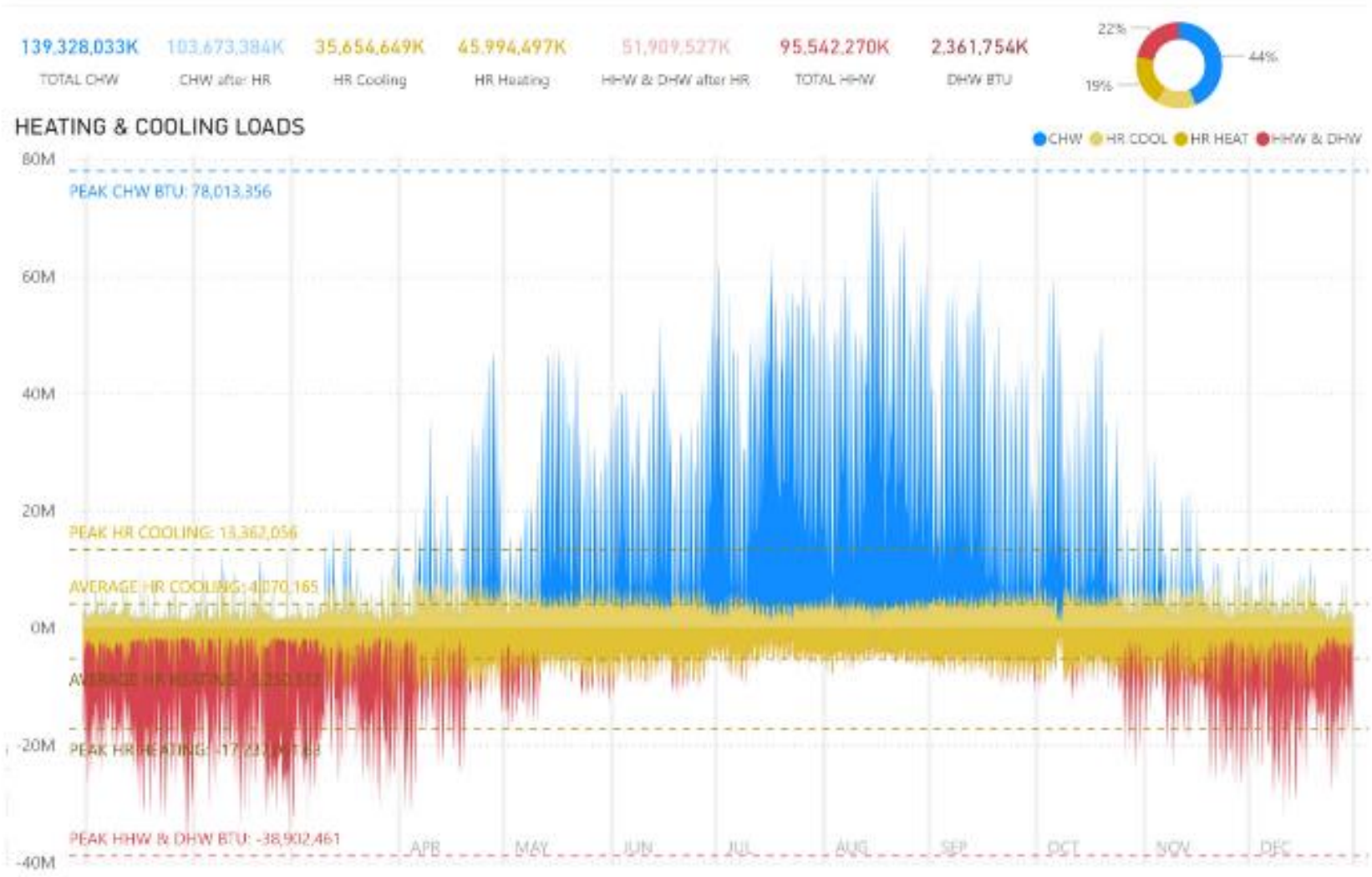
Heat Recovery Chillers

Considerations & Strategies:

- Maximize Heat Recovery
- Consider adding Thermal Energy Storage to increase Heat Recovery Potential
- Consider adding TES for shifting heating load into daytime hours
- Footprint will be challenging
- Consider Augmenting with Ground-Source Heat Exchange
- Can be challenging to maintain consistent Delta T

MATCHING ALL-ELECTRIC SYSTEMS TO BUILDING TYPES

CENTRAL CHILLER / BOILERS WITH HYDRONIC SYSTEMS



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- Myth 5: Heat pumps can only be implemented in new construction, not in retrofits.

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MYTHS AROUND HEAT PUMPS IN COMMERCIAL DEVELOPMENTS

- Myth 7: There is only one type of heat pump

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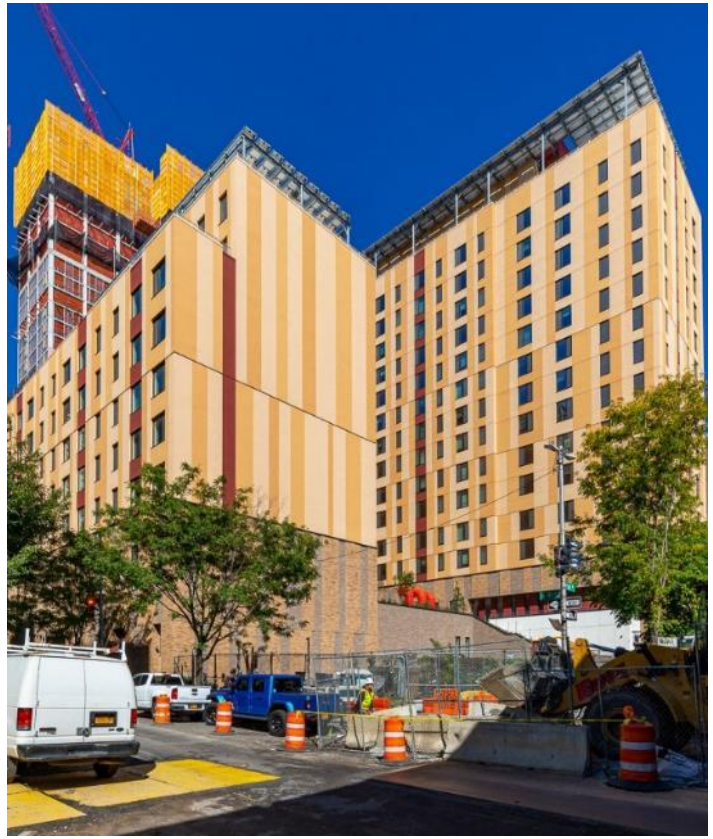
Myth 7: Heat Pumps in New Construction

L+M has used heat pumps in large multifamily construction since 2018



Clockwise from the top left: Beach Green II – geothermal, Sendero Verde - VRF, Marcus Garvey Extension, geothermal

Myth 7: Heat Pumps in New Construction

L+M is starting to apply heat pumps in building renovations, even when residents are in place

Harlem River NYCHA PACT Renovation

Packaged Terminal Heat Pumps (PTHPs) in each unit

Myth 7: Heat Pumps in Existing Buildings

L+M is starting to apply heat pumps in building renovations, even when residents are in place

Harlem River NYCHA PACT Renovation

Packaged Terminal Heat Pumps (PTHPs) in each unit

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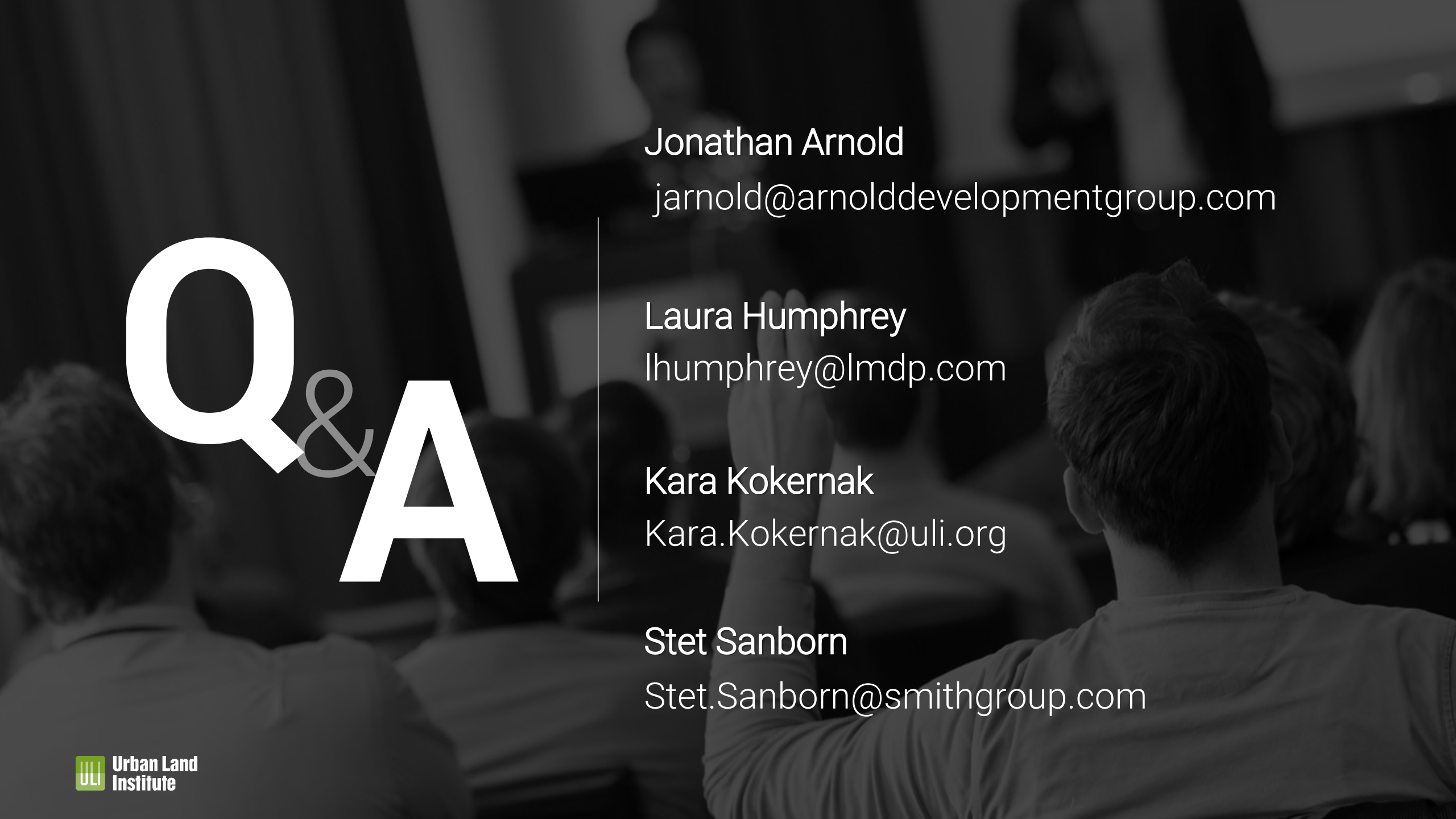

Jonathan Arnold
jarnold@arnolddevelopmentgroup.com

Laura Humphrey
lhumphrey@lmdp.com

Kara Kokernak
Kara.Kokernak@uli.org

Stet Sanborn
Stet.Sanborn@smithgroup.com

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