Passive House Multifamily - MN CARD Grant

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Keywords: Passive House, energy efficiency, construction cost, market potential

This research is funded by the MN Department of Commerce CARD program and has 3 main objectives. 1) Determine the feasibility, cost effectiveness, and energy/carbon savings potential of Passive House certification for multifamily buildings in Minnesota using modeling and existing monitoring data from recently completed, regional examples. 2) Use surveys and market studies to understand the drivers and barriers related to multifamily Passive House adoption in Minnesota and identify the most promising market segments for CIPs to target. 3) Provide guidance on how best to structure CIPs targeted at multifamily Passive House construction to maximize awarded energy savings and market uptake.

Funders: Minnesota Department of Commerce.

3 buildings scales

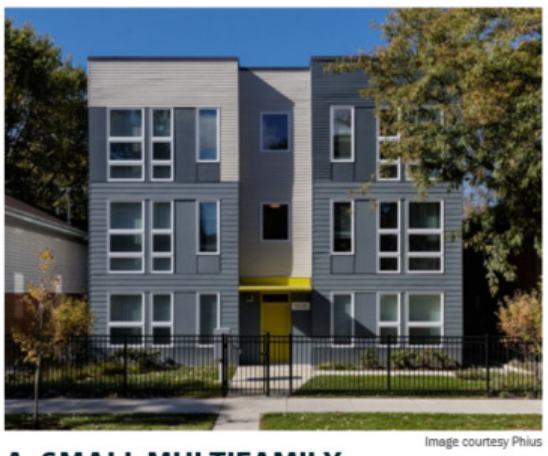


Image courtesy Phius

A. SMALL MULTIFAMILY
TIERRA LINDA

Envelope Area	14,107
iCFA	8,596
Dwelling Units	6
Bedrooms	18

Image courtesy Precipitate

B. MEDIUM MULTIFAMILY
SOLSTICE APARTMENTS

Envelope Area	21,103
iCFA	17,880
Dwelling Units	23
Bedrooms	23

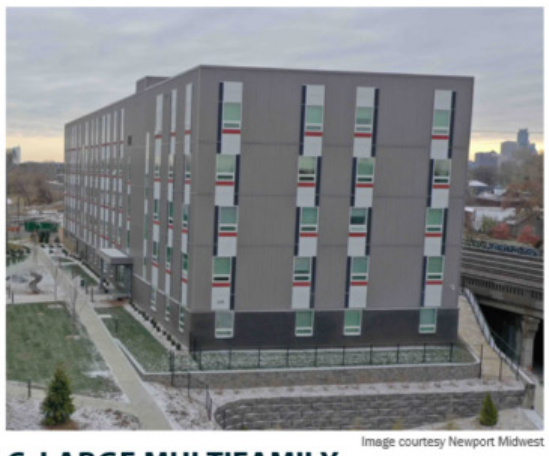


Image courtesy Newport Midwest

C. LARGE MULTIFAMILY
HOOK & LADDER

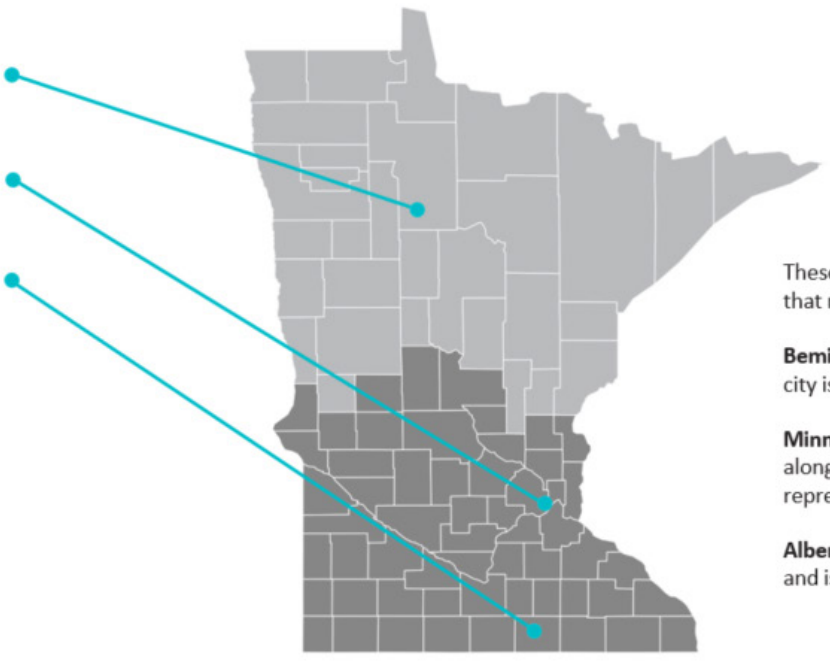
Envelope Area	56,200
iCFA	53,167
Dwelling Units	59
Bedrooms	97

3 climates

7 NORTH
BEMIDJI MUNICIPAL AIRPORT

6A CENTRAL
Minneapolis - St. Paul Intl Airport

6A SOUTH
Albert Lea (AWOS)



These cities were chosen to study three, different regions that represent a good cross-section of Minnesota.

Bemidji in the north, is located in climate zone 7, and the city is surrounded by lakes and forestland.

Minneapolis and St. Paul are located in climate zone 6A along the Mississippi River and network of lakes, and it represents the largest city of the three examples.

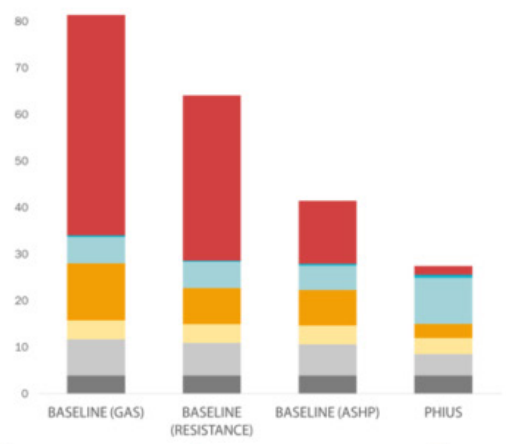
Albert Lea in the south, is located in the climate zone 6A, and is located between lakes and farmland.

model assumptions for medium multifamily

	BASELINE COMMERCIAL CODE ASHRAE 90.1 2019 W/MN AMENDMENTS			PASSIVE HOUSE
	GAS	ELECTRIC RESISTANCE	ELECTRIC ASHP	PHIUS+ 2021
Roof	R30 Zone6, R35 Zone7			PERFORMANCE BASED (VARIES)
(whole wall) Wall	R20 + 3.8ci			
Slab	R7.9 (slab on grade w/48" R25)			
Windows	U-0.43/0.37 (operable), U-0.36/0.29 (fixed) site & summer shading 0.75, no interior blinds			
Doors	Uw-0.77 (R1.3)			
Air Sealing	0.31 cfm/SF @50 Pa (3 ACH50)			.06 cfm/SF @50 Pa
Heating	80 AFUE Gas Furnace	All-in-One Elec Heating & AC	Air Source Heat Pump COP 3.4 @ 47f / 2.2 @ 17F	Air to Air Heat Pump 20,000 BTU/h Heating COP 3.17 @ 47F / 2.47@ 17F
Cooling	Electric AC 13 SEER / 11.38 EER		Air Source Heat Pump 14 SEER / 12.25 EER	Air to Air Heat Pump 18,000 BTU/h 20 SEER
Ventilation	Balanced, No Recovery 1 W/cfm Fan Efficiency			Energy Recovery Ventilator SRE 1 / LRE 0 / 1.5 W/cfm
DHW	Standard Natural Gas 0.69 Ef R3.3 Pipe Insulation	Electric 0.92 UEF R3.3 Pipe Insulation		Electric Heat Pump 4.07 UEF 72 ga. tank
Lighting & Power	75% LED, Utility Baseline Appliances			100% LED, Median Energy Star Apps.
Thermal Bridging	Not Included in Baseline Models			

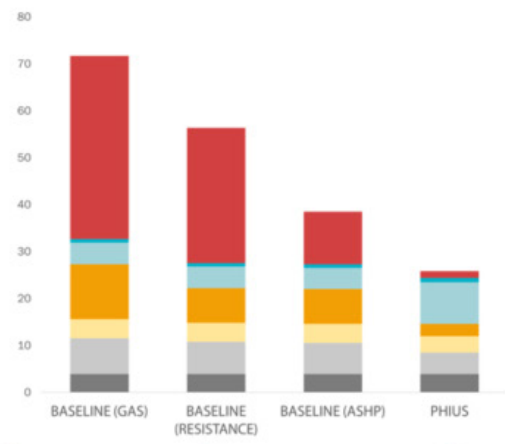
annual site energy use comparison | medium multifamily

BEMIDJI (7A)
66% - 34% savings



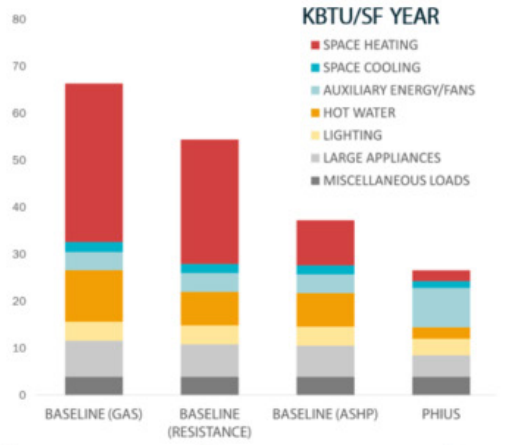
Wall	R24	R34
Roof	R35	R38
Slab	R0.42	R10
Wdws	U0.32	U0.16
Doors	U0.77	U0.29
Solar PV		2,000 kWh/y

MINNEAPOLIS ST PAUL (6A)
64% - 33% savings



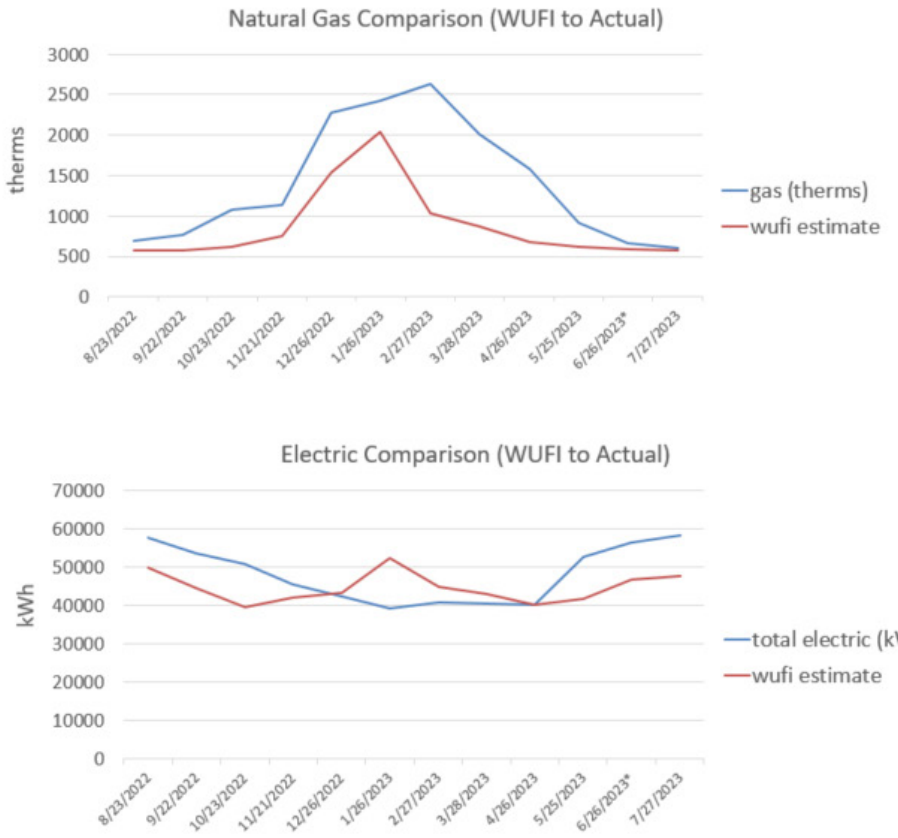
Wall	R24	R34
Roof	R30	R38
Slab	R0.42	R10
Wdws	U0.32	U0.16
Doors	U0.77	U0.29
Solar PV		none

ALBERT LEA (6A)
60% - 29% savings



Wall	R24	R34
Roof	R30	R38
Slab	R0.42	R10
Wdws	U0.32	U0.16
Doors	U0.77	U0.29
Solar PV		2,500 kWh/y

modeled to actual consumption - verdant



WUFI EUI (with parking garage):
23.5 kBTU/sf/yr

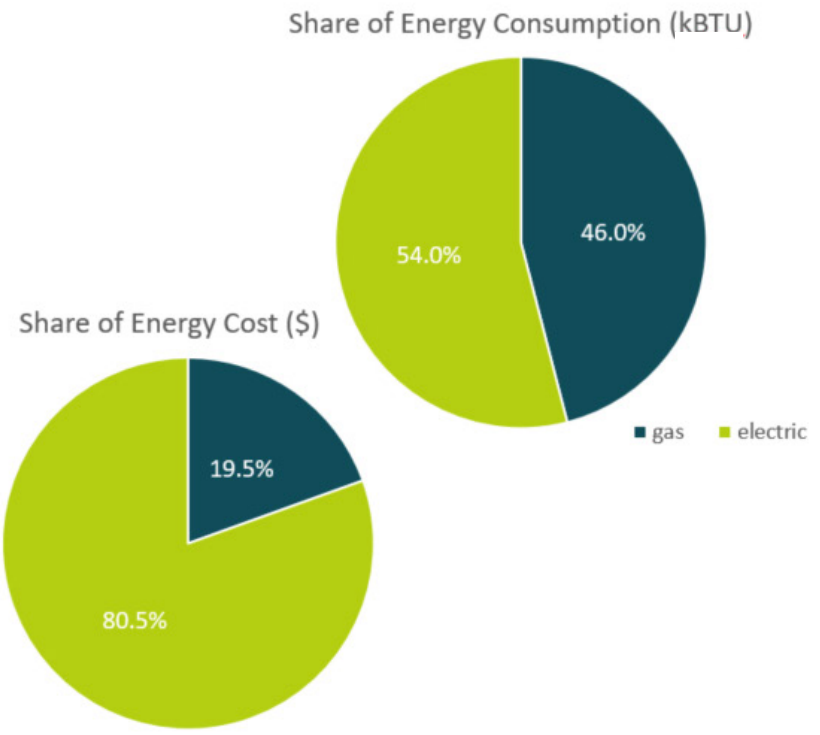
Measured EUI (with parking garage):
29.6 kBTU/sf/yr

80% Modeled vs. Actual
(Measured data is most recent 12 months, but has not been weather-normalized yet)

utility bills - verdant

yearly total = $98,980

Since gas is a cheaper energy source and PH buildings mostly save gas, we can't expect 50% energy cost savings to match the 50% reduction in energy consumption.



construction costs – minnesota projects

Project	Location	# Units	Floor Area (gross)	Construction Cost	Cost year	Cost/sf	Cost/unit	Incremental	Incremental above…
Hook & Ladder	Minneapolis, MN	59	73,000	$ 10,350,360	2017	$ 142	$ 175,430	13.0%	Energy Star
Verdant	Saint Paul, MN	82	123,137	$ 19,456,650	2021	$ 158	$ 237,276	12.0%	Green Communities
Hillcrest Village	Northfield, MN	17	17,674	$ 4,069,500	2022	$ 230	$ 239,382	7.0%	Standard construction
Solstice	Minneapolis, MN	23	18,960	$ 6,138,000	2023	$ 324	$ 266,870	7.5%	Energy Star

incremental construction costs

Typical incremental cost in MN: 7-13%, MN average 10%