

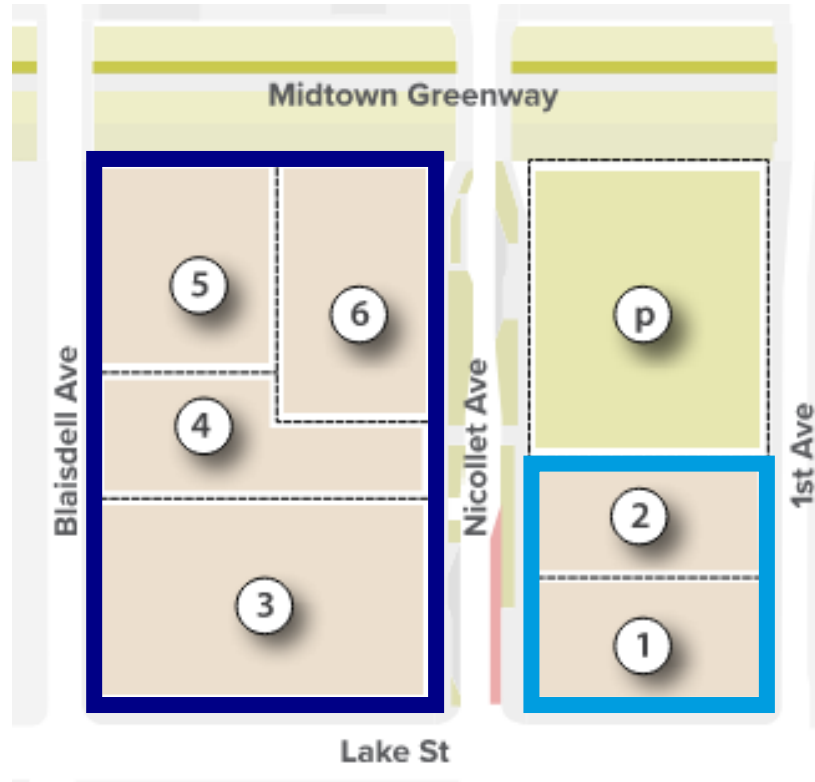
# New Nicollet Geothermal Site Feasibility Study

December 11, 2025

# Background

- Salas O'Brien is under contract with the City of Minneapolis Health Department to conduct this analysis and provide consulting services. Additional data, analysis, and consulting from Salas O'Brien may be provided by the City to the selected developer.
- This report provides a technical analysis of the energy use, energy costs, GHG emissions, and capital costs of Darcy Solutions-type submerged closed loop heat exchanger (SCLHE) geothermal systems and other HVAC options for the New Nicollet project.
- This analysis builds upon the RFP's Attachment 9 (Darcy Solutions Geothermal Viability Report) and Attachment 10 (Description of tax credits, grants, rebates, and financing tools for clean energy).

# Study Scope



- Phase 1 – Part of study
- Later Phases – Not part of study

Parcel	1	2	3	4*	5*	6*	p**	total
Subsidized Rental Units	70 units	60 units	53 units		65 units	36 units		284 units
Market Rate Rental Units			180 units			144 units		324 units
Subsidized Ownership Units				21 units				21 units
Stories	5	4	4-7	3	4	4-6		
Gross Square Feet	100,000 gsf	85,000 gsf	295,000 sf	42,000 gsf	65,000 gsf	185,000		772,000 gsf
Building Footprint	30,000 sf	30,000 sf	65,000 sf	16,800 (800 each)	16,500 sf	30,000 sf		
Parcel Size	33,000 sf / .75 acres	33,000 sf / .75 acre	75,000 sf / 1.72 acres	40,000 sf / .9 acres	38,000 sf / .85 acres	45,000 sf / 1 acre	70,000 sf / 1.6 acres	
FAR	3.0	2.5	3.9	1.05	1.7	4.1		
Retail	8,000 sf (retail)		25,000 sf (grocery) 5,000 sf (retail)			2,000 sf (retail)		40,000 sf
Parking	85 (below grade) 50 (enclosed at-grade)	85 (below grade) 30 (enclosed at-grade)	185 (below grade) 85 (at-grade enclosed)	21 (at-grade enclosed)	100 (below grade)	128 (below grade)		583 (below grade) 186 (at-grade enclosed)
Community Use		13,000 sf						13,000 sf
Public Park							70,000 sf	

# Traditional PTAC Heating and Cooling Systems Examined

	PTAC - Gas	PTAC - Elec
General HVAC Description	Separate heating and cooling units in each space with central ventilation.	Separate heating and cooling units in each space with central ventilation.
Heating	Natural Gas	Electric Resistance
Cooling	DX	DX
Domestic Hot Water	Electric	Electric
Ventilation	Central DOAS w/ ERV at 60% effectiveness	Central DOAS w/ ERV at 60% effectiveness
Heat Rejection	Outside Air	Outside Air
Heat Source	Natural Gas	Electricity

DX = Direct Expansion

HVAC = Heating, Ventilation, and Air Conditioning

DOAS = Dedicated Outdoor Air System PTAC = Packaged Terminal Air Conditioning unit

ERV = Energy Recovery Ventilator

# No- and Low-Gas High Efficiency Heating and Cooling Systems Examined

	ASHPs	Darcy Well – Full	Darcy Well – Partial Gas
General HVAC Description	Separate air-to-air heat pumps (AAHPs) serving each space with central ventilation.	Separate water-to-air heat pumps (WAHPs) serving each space with central ventilation.	Separate water-to-air heat pumps (WAHPs) serving each space with central ventilation.
Heating	Air source AAHPs	Ground source WAHPs	Ground source WAHPs
Cooling	Air source AAHPs	Ground source WAHPs	Ground source WAHPs
Domestic Hot Water	Air source AWHPs	Ground source WWHPs	Ground source WWHPs
Ventilation	Central DOAS w/ ERV at 60% effectiveness	Central DOAS w/ ERV at 60% effectiveness	Central DOAS w/ ERV at 60% effectiveness
Heat Rejection	Outside air	Darcy wells	Darcy wells
Heat Source	Outside air	Darcy wells	Darcy wells / Gas boiler

ASHP = Air Source Heat Pump  
 AAHP = Air-to-Air Heat Pump  
 AWHP = Air-to-Water Heat Pump

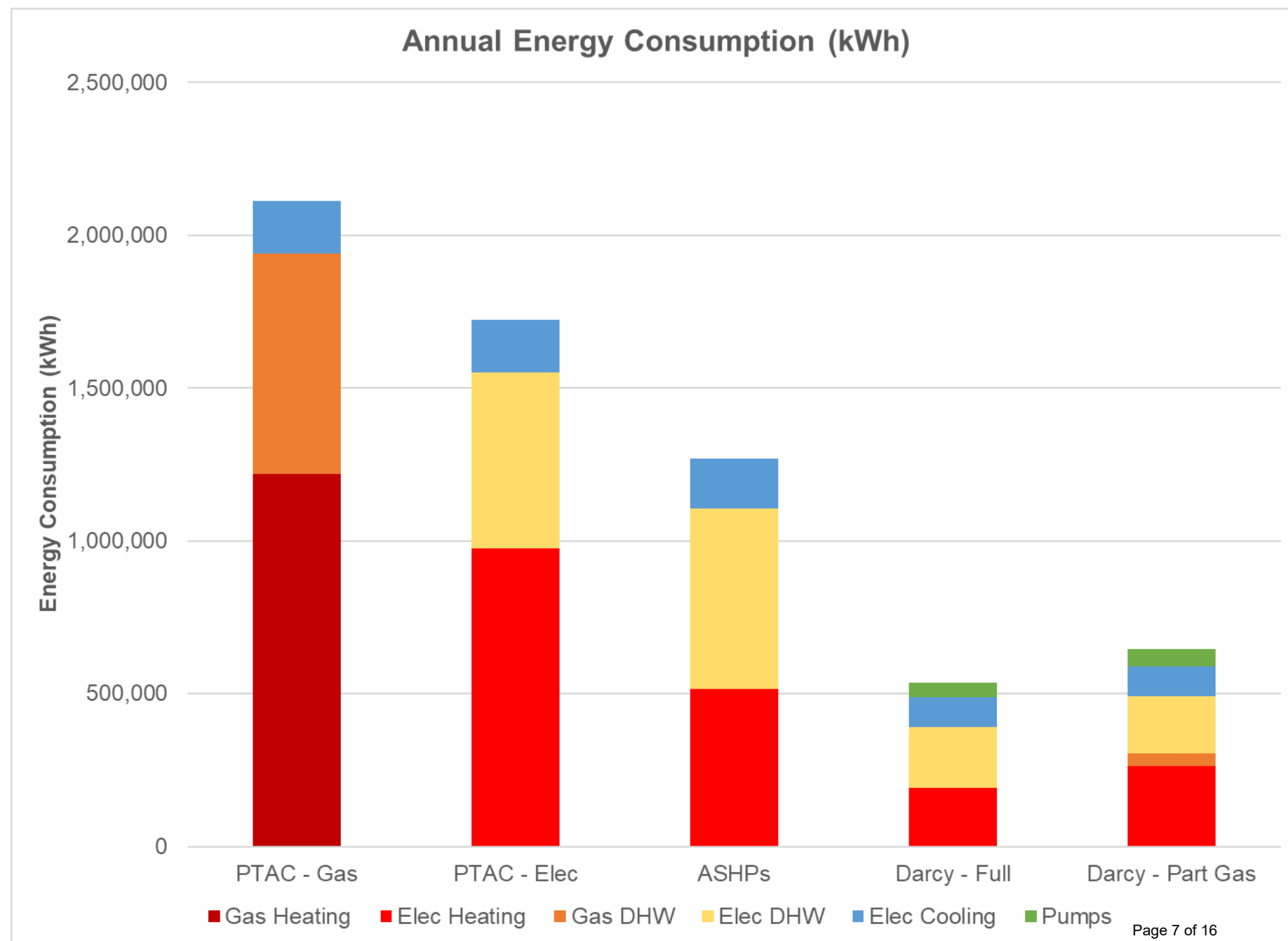
WAHP = Water-to-Air Heat Pump  
 WWHP = Water-to-Water Heat Pump



# Darcy Well Analysis

- Based on a thermal load calculation of the proposed building sizes and programming, two Darcy Solutions-type wells are needed to fully meet all heating and cooling needs of Parcel 1 and 2.
- One well can cover a majority of Parcel 1 and 2 heating and cooling needs.
  - A boiler would be needed to supplement about 2% of annual heating and 46% of peak heating.
- See Exhibit 9 for Darcy well capacity and characteristics.
- MN Department of Health mandates wells must be accessible for service, and therefore not located under buildings.
  - Space is available for well placement along the perimeters of and between Parcel 1 and 2. A minimum of 100 feet of spacing is required between wells.

# Results – Annual Energy Consumption



# Results – Annual Energy Consumption

	PTAC - Gas	PTAC - Elec	ASHPs	Darcy – Full	Darcy – Partial Gas
	kWh	kWh	kWh	kWh	kWh
Gas Heating*	1,219,691	0	0	0	0
Elec Heating	0	975,753	514,712	192,385	261,894
Gas DHW*	719,972	0	0	0	42,170
Elec DHW	0	575,977	592,145	198,613	186,980
Cooling	171,981	171,285	163,123	97,198	97,198
Pumping	0	0	0	48,791	57,628
<b>Total</b>	<b>2,111,644</b>	<b>1,723,015</b>	<b>1,269,980</b>	<b>536,987</b>	<b>645,870</b>
Savings	-	388,629	841,663	1,574,657	1,465,774
Savings	-	18%	40%	75%	69%
EUI (kBtu/SF)	36.1	29.5	21.7	9.2	11.0

- \*PTAC-Gas and Darcy Partial – Gas have natural gas as a heating and DHW heat source, but this consumption was converted to kWh for comparison purposes.
- Savings are calculated from PTAC – Gas results.
- EUI = Energy Use Intensity. This metric has units of kBtu/SF is used to represent annual building energy consumption divided by total building square footage.

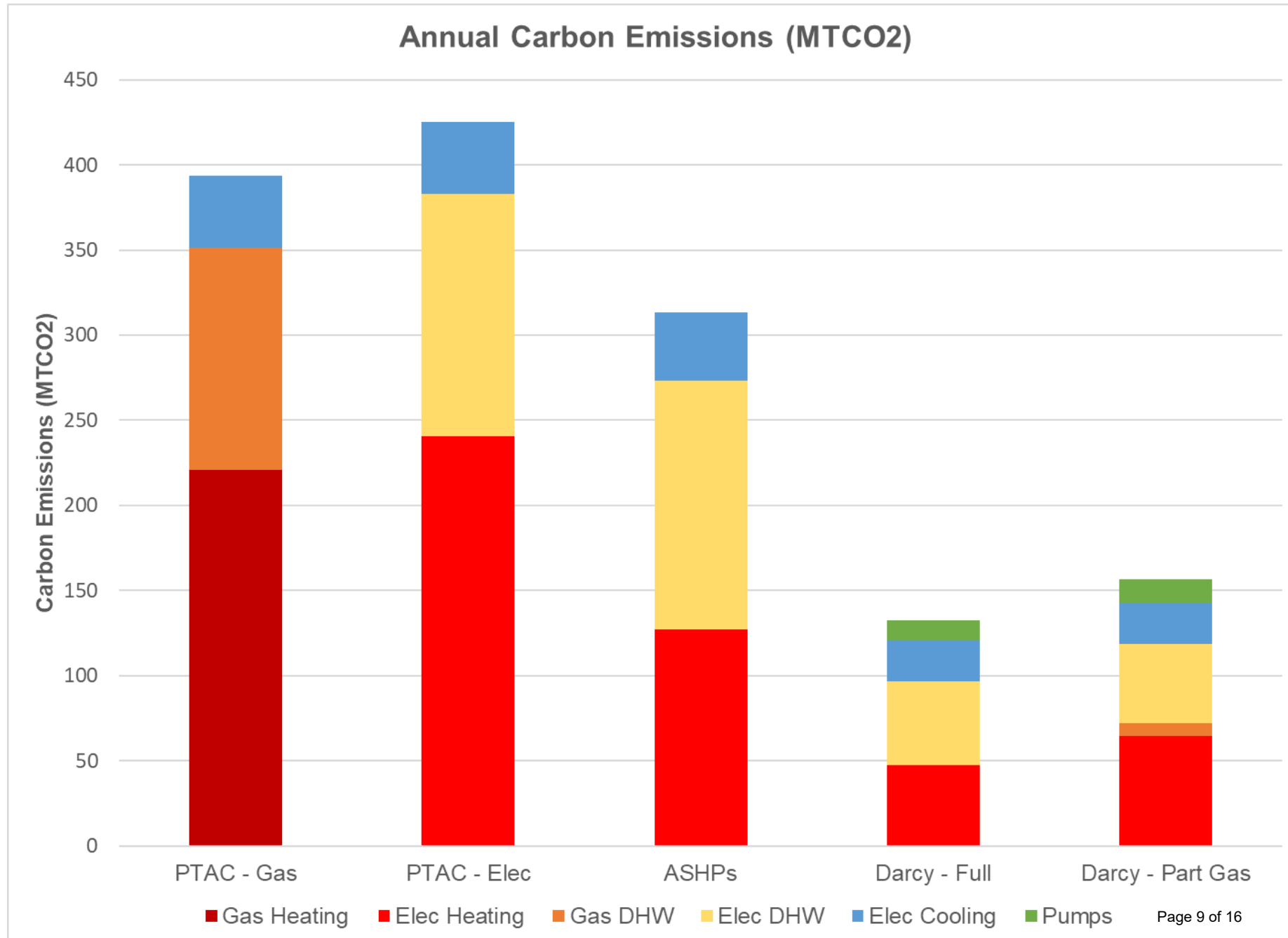




# Results – Annual Carbon Emissions (Present)

MTCO2 = Metric tons CO2

Last updated 12/11/2025



# Results Annual Carbon Emissions (Present)

2023 Electricity carbon emission factor: 543 lbs CO<sub>2</sub>/MWh = 0.07234 kg CO<sub>2</sub>/kBtu  
 Source: [https://www.xcelenergy.com/staticfiles/xcel-responsive/Company/Sustainability%20Report/2023\\_Xcel\\_Energy\\_Carbon\\_Intensities\\_Info\\_Sheet.pdf](https://www.xcelenergy.com/staticfiles/xcel-responsive/Company/Sustainability%20Report/2023_Xcel_Energy_Carbon_Intensities_Info_Sheet.pdf)

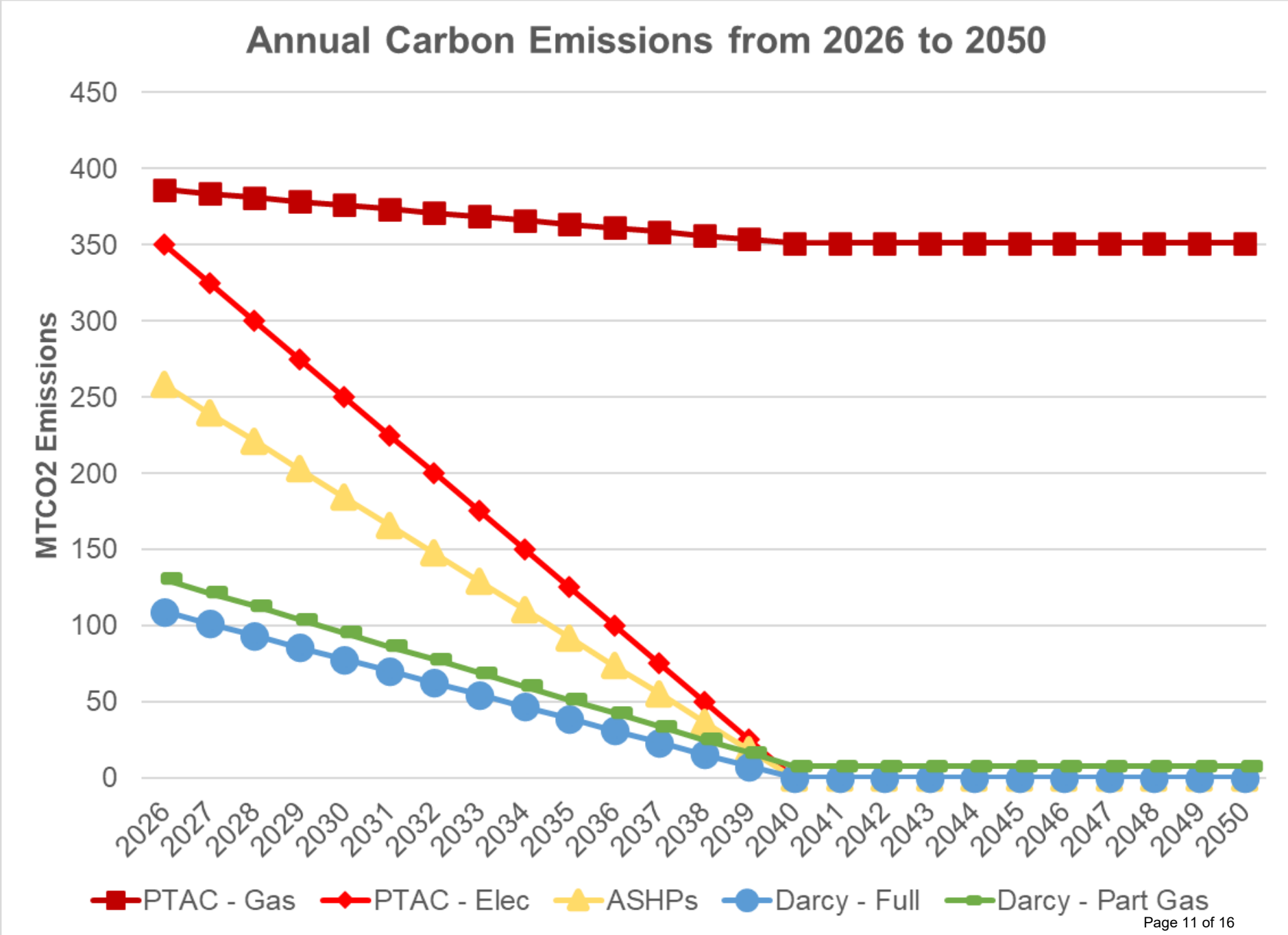
2025 Natural gas carbon emission factor: 11.7 lbs CO<sub>2</sub>/therm = 0.05306 kg CO<sub>2</sub>/kBtu  
 Source: <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

	PTAC - Gas	PTAC - Elec	ASHPs	Darcy – Full	Darcy – Partial Gas
	MTCO <sub>2</sub>	MTCO <sub>2</sub>	MTCO <sub>2</sub>	MTCO <sub>2</sub>	MTCO <sub>2</sub>
Gas Heating	221	0	0	0	0
Elec Heating	0	241	127	47	65
Gas DHW	130	0	0	0	8
Elec DHW	0	142	146	49	46
Cooling	42	42	40	24	24
Pumping	0	0	0	12	14
<b>Total</b>	<b>394</b>	<b>425</b>	<b>313</b>	<b>133</b>	<b>157</b>
Savings	-	-32	80	261	237
Savings	-	-8%	20%	66%	60%



# Results – Annual Carbon Emissions (Through 2050)

Note: Electricity emissions factor is assumed to decrease linearly year-over-year until reaching 0 in 2040, as required by MN law. Natural gas emissions were assumed to remain constant.



# Results – 25 Year Cumulative Carbon Emissions

	PTAC - Gas	PTAC - Elec	ASHPs	Darcy – Full	Darcy – Partial Gas
	MTCO2	MTCO2	MTCO2	MTCO2	MTCO2
Electricity	262	2,627	1,936	819	920
Gas	8,779	0	0	0	191
<b>Total</b>	<b>9,041</b>	<b>2,627</b>	<b>1,936</b>	<b>819</b>	<b>1,111</b>
Savings	-	6,415	7,105	8,223	7,930
Savings	-	71%	79%	91%	88%

- ▶ MTCO2 = Metric tons CO2
- ▶ Electricity emissions factor is assumed to decrease linearly year-over-year until reaching 0 in 2040, as required by MN law. Natural gas emissions were assumed to remain constant.
- ▶ Savings are calculated from PTAC – Gas results.



# Utility Rates Used by HVAC Option

	Elec Rate 1	Elec Rate 2	Gas Rate
PTAC – Gas	X		X
PTAC – Elec		X	
ASHPs		X	
Darcy – Full		X	
Darcy – Partial Gas	X		X

- Electric rates are inclusive of all energy charges and taxes except monthly connection fees.
- No cost escalator is applied in this analysis.

## Electricity Rate 1 – [Standard Residential](#)

- \$0.217/kWh (June-Sept)
- \$0.214/kWh (Oct-May)**
- Electricity Demand Cost = None (Residential rates assumed)
- Source: Minneapolis resident electric utility bill

## Electricity Rate 2 – [Electric Space Heating](#)

- \$0.217/kWh (June-Sept)
- \$0.149/kWh (Oct-May)**
- Electricity Demand Cost = None (Residential rates assumed)
- Source: Minneapolis resident electric utility bill.  
Costs reduced by \$0.065/kWh from Rate 1 per Xcel electric space heating rate reduction.

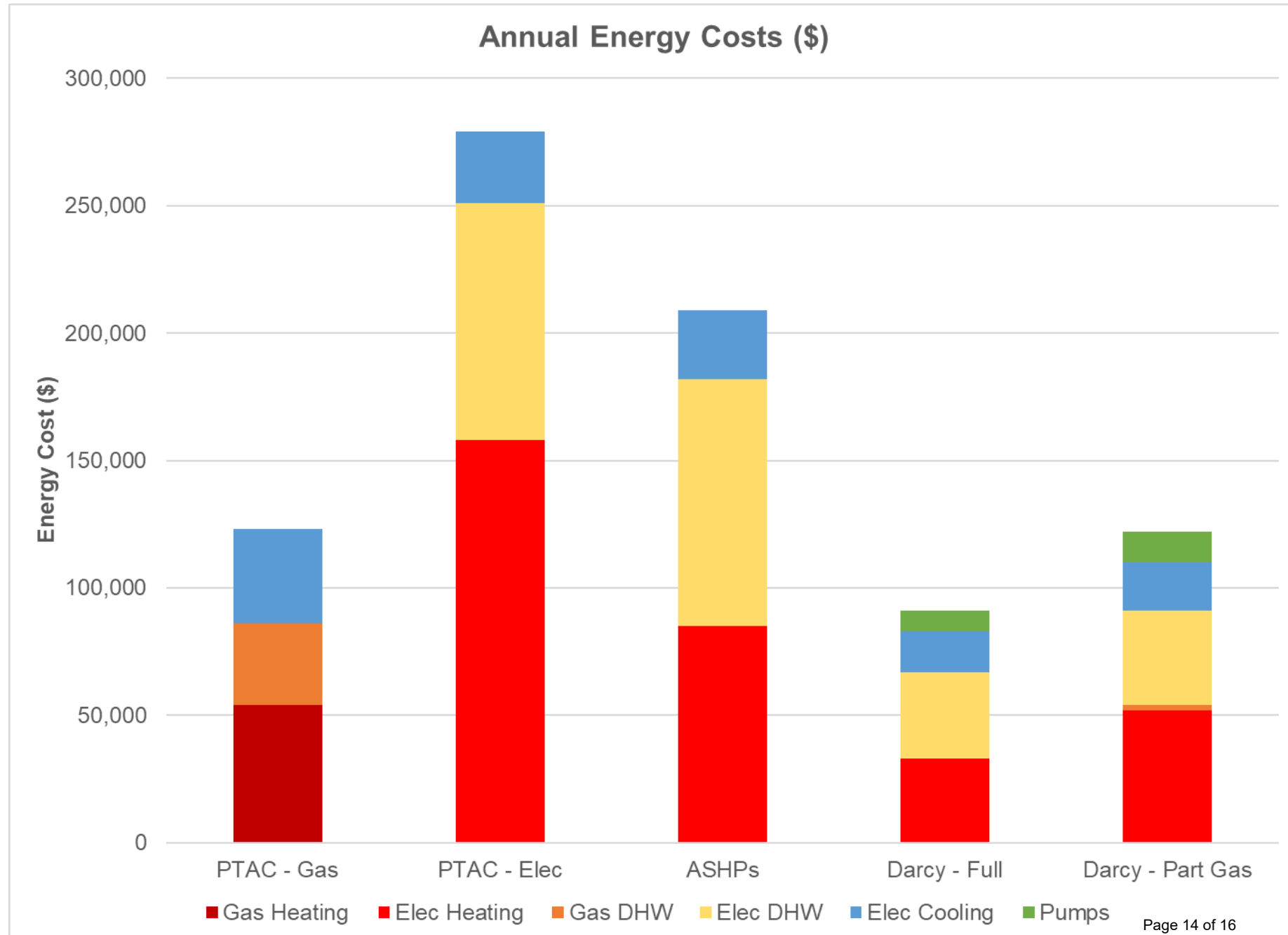
## Natural Gas Rate

- \$1.276/therm (Apr-Oct)
- \$1.297/therm (Nov-Mar)
- Source: Minneapolis resident natural gas bill

# Results – Annual Energy Costs

Note: This slide shows annual energy costs for each scenario assuming all-electric scenarios use Electricity Rate 2 and other scenarios use Electricity Rate 1. See Slide 13 for energy cost rates.

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# Results – Annual Energy Costs

	PTAC - Gas	PTAC - Elec	ASHPs	Darcy – Full	Darcy – Partial Gas
	\$	\$	\$	\$	\$
Gas Heating	54,000	0	0	0	0
Elec Heating	0	158,000	85,000	33,000	52,000
Gas DHW	32,000	0	0	0	2,000
Elec DHW	0	93,000	97,000	34,000	37,000
Cooling	37,000	28,000	27,000	16,000	19,000
Pumping	0	0	0	8,000	12,000
<b>Total</b>	<b>123,000</b>	<b>279,000</b>	<b>209,000</b>	<b>91,000</b>	<b>122,000</b>
Savings	-	-156,000	-86,000	32,000	1,000
Savings	-	-127%	-70%	26%	1%

- ▲ Savings are calculated from PTAC – Gas results.
- ▲ This is an estimate for the first year of operation and no energy cost escalators have been applied.
- ▲ This slide shows annual energy costs for each scenario assuming all-electric scenarios use Electricity Rate 2 and other scenarios use Electricity Rate 1.
- ▲ See Slide 13 for energy cost rates.



# Results – Preliminary Capital Expenditure (CAPEX)

	PTAC - Gas	PTAC - Elec	ASHPs	Darcy – Full	Darcy – Partial Gas
	\$	\$	\$	\$	\$
In-Room Units	\$3,990,000	\$4,990,000	\$6,490,000	\$6,980,000	\$6,980,000
Geothermal Equipment	\$0	\$0	\$0	\$2,080,000	\$1,040,000
Boiler	\$0	\$0	\$0	\$0	\$110,000
<b>CAPEX</b>	<b>\$3,990,000</b>	<b>\$4,990,000</b>	<b>\$6,490,000</b>	<b>\$9,060,000</b>	<b>\$8,130,000</b>
30% ITC Tax Credit	\$0	\$0	\$0	-\$2,718,000	-\$2,439,000
40% ITC Tax Credit	\$0	\$0	\$0	-\$3,624,000	-\$3,252,000
50% ITC Tax Credit	\$0	\$0	\$0	-\$4,530,000	-\$4,065,000

- These are Class 5 equipment CAPEX values, meaning actual project CAPEX could be -50% or +100% from the listed values.
- Engineering design, soft costs, construction and overhead, and any other additional fees were not included.
- Refer to New Nicollet Phase 1 RFP Attachment 10 (Description of tax credits, grants, rebates, and financing tools for clean energy) for further discussion on investment tax credit (ITC) levels and other possible incentives.