



Deploying a District Geothermal System to Equitably Decarbonize a Low-Income Neighborhood in Ann Arbor

City of Ann Arbor, IMEG, Community Action Network,
U.A. Local 190, and the residents of the Bryant
Neighborhood

Equitably Decarbonizing

Neighborhood Decarbonization

Holistic application of solar and geothermal (potentially using existing natural gas lines), beneficial electrification, efficiency, and energy storage to achieve 262 carbon neutral, low-income, primarily BIPOC households in a Justice40 neighborhood - saving residents money, improving indoor health and comfort, and addressing the climate crisis.



DEI and Justice

Framed firmly in procedural, distributional, structural, transgenerational, and transformational equity and justice, this project is co-designing solutions that center the realities, needs, and aspirations of a Justice40 neighborhood



Schools & Education

Support thermal load decarbonization in public school, improving comfort, providing educational opportunities and hands on exposure to sustainability..



Visionary

Nested as part of a large program to create the nation's first fully decarbonized existing low-income neighborhood and doing that in a way that centers residents needs, desires, and aspirations.



Removing Energy Burden

Creation of pathways to help increase inter-generational wealth building, lower day to day living expenses, and stabilize neighborhoods.



Collaboration

Working with private industry, utilities, local governments, residents, nonprofits, trade representatives and educational institutions to create a shared strategy for district geothermal.



Sustainable and Replicable

Harnessing momentum to scale up and replicate the project at the local, regional, and national levels. Commitment to sharing lessons learned, promising practices, and pathways to success with peers across the U.S.



Workforce Development & Resilience

Collaborating with trades to recruit more BIPOC and women while also working with businesses to create and retain high-road, green energy jobs. Development of a shared strategy for building the workforce of the future.



the
Bryant
Neighborhood

Why the Bryant Neighborhood?



- Frontline community with historic under-investment
 - Over 50% POC
 - 75% low-income
 - Ave energy costs \$1,300-\$1,800/yr.
 - 1/3 classified as "energy cost burdened"
- Community Action Network (CAN) neighborhood center actively engaged in neighborhood and partnering with A²ZERO
- Leadership from within the community
- 262 homes built in 1950's, half owner-occupied and half rental



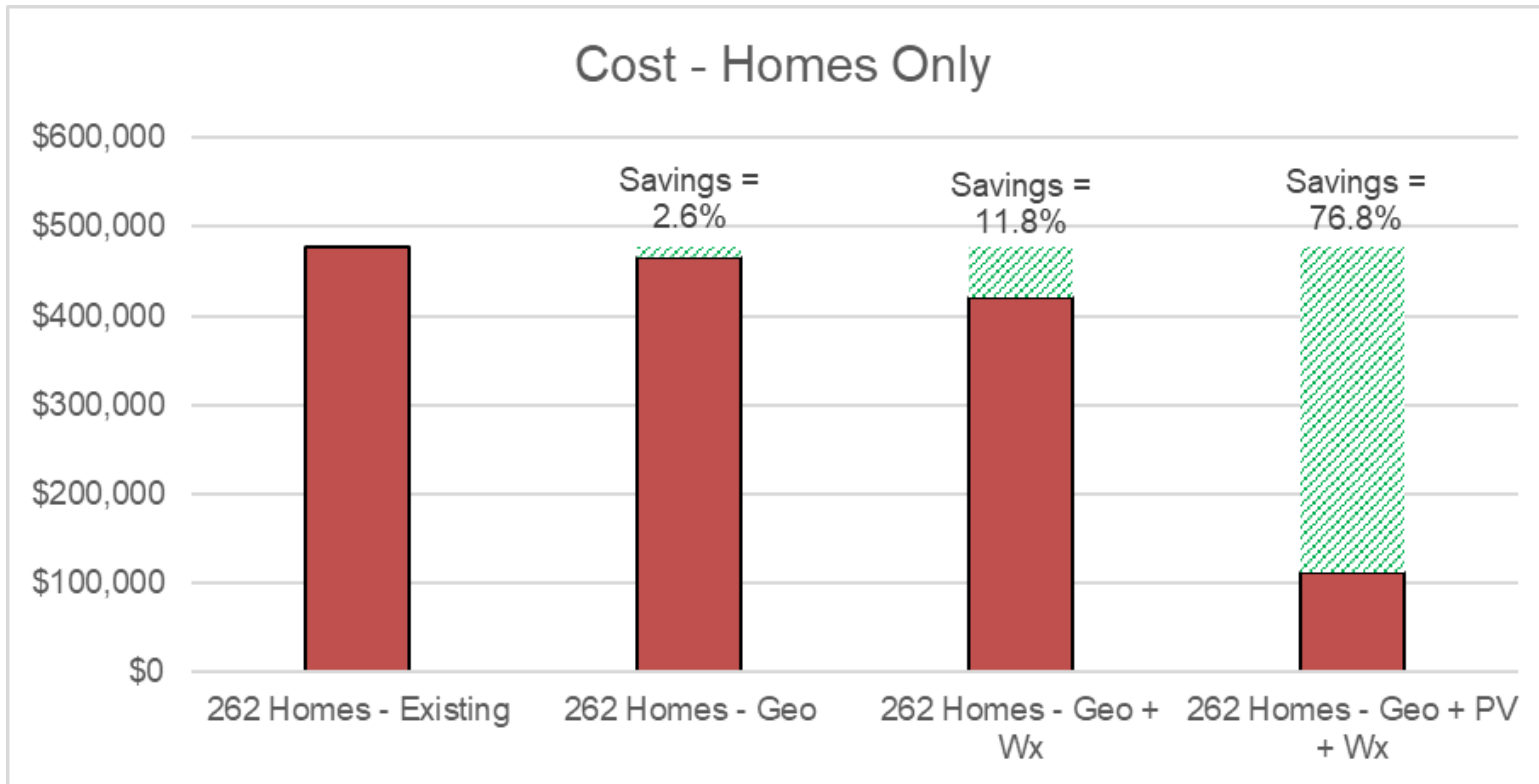
Existing Work



Engagement



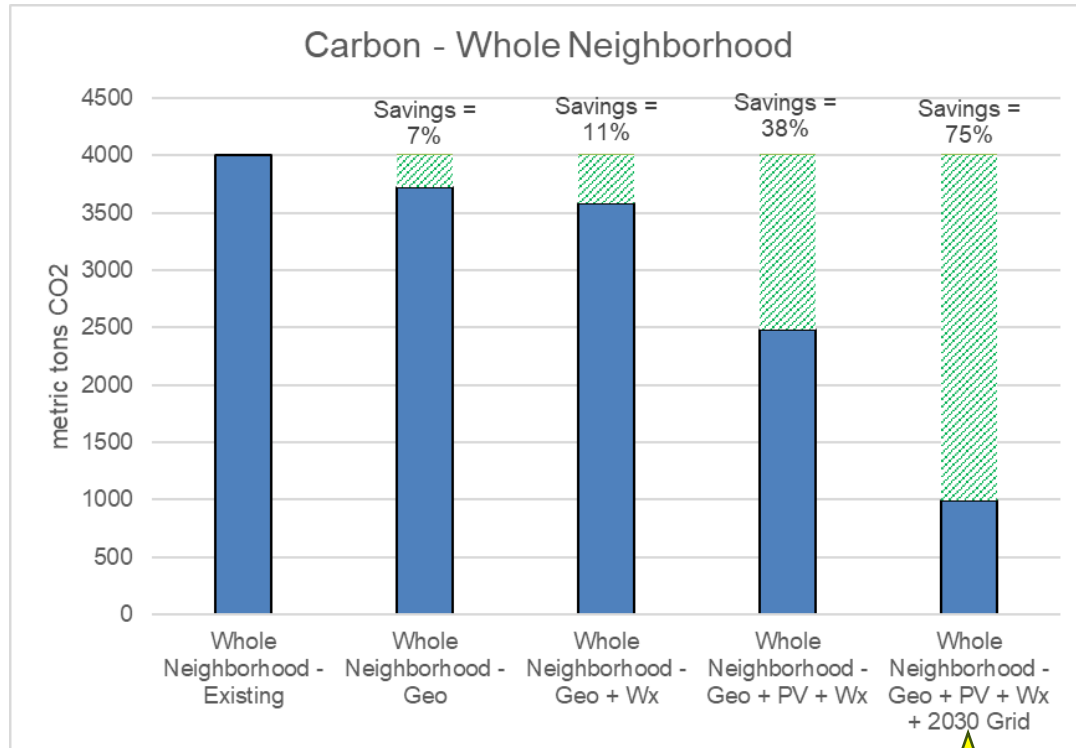
Residents' Energy Cost



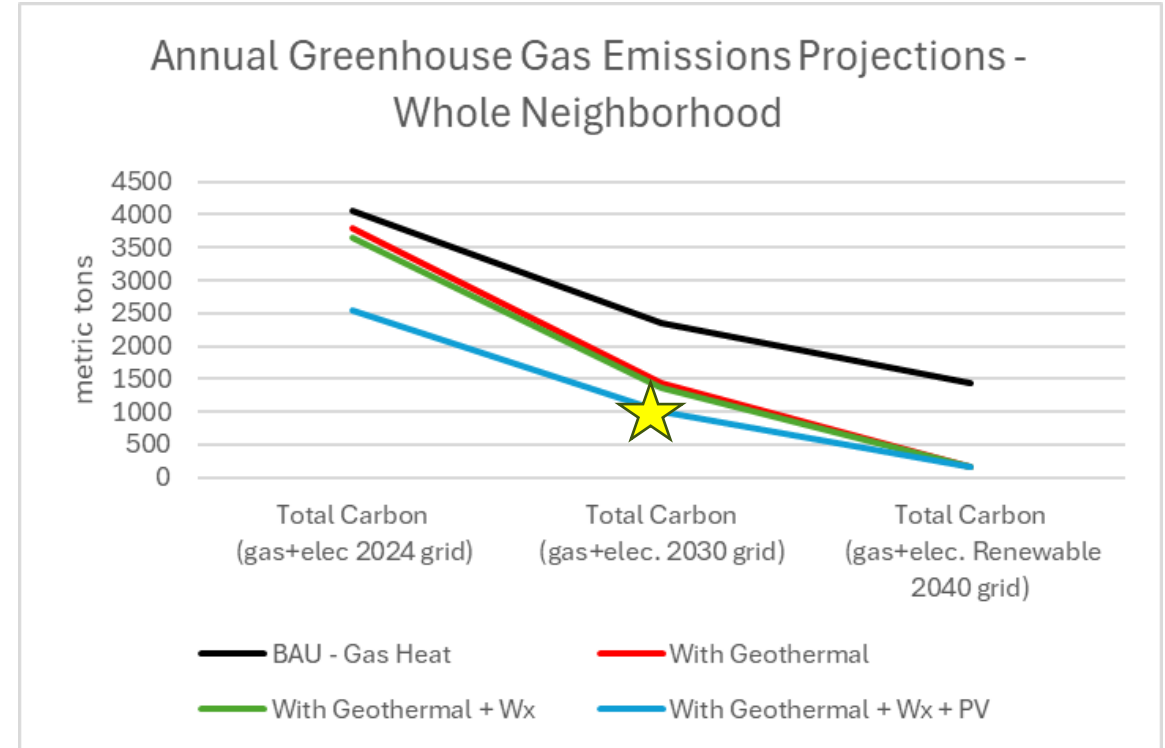
Residents are expected to see a 2.6% savings with the sole transition to geothermal.

With stacking of energy efficiency measures, with solar and geothermal, the proposed design can lower resident's utility bills by nearly 77%.

Greenhouse Gas Emissions

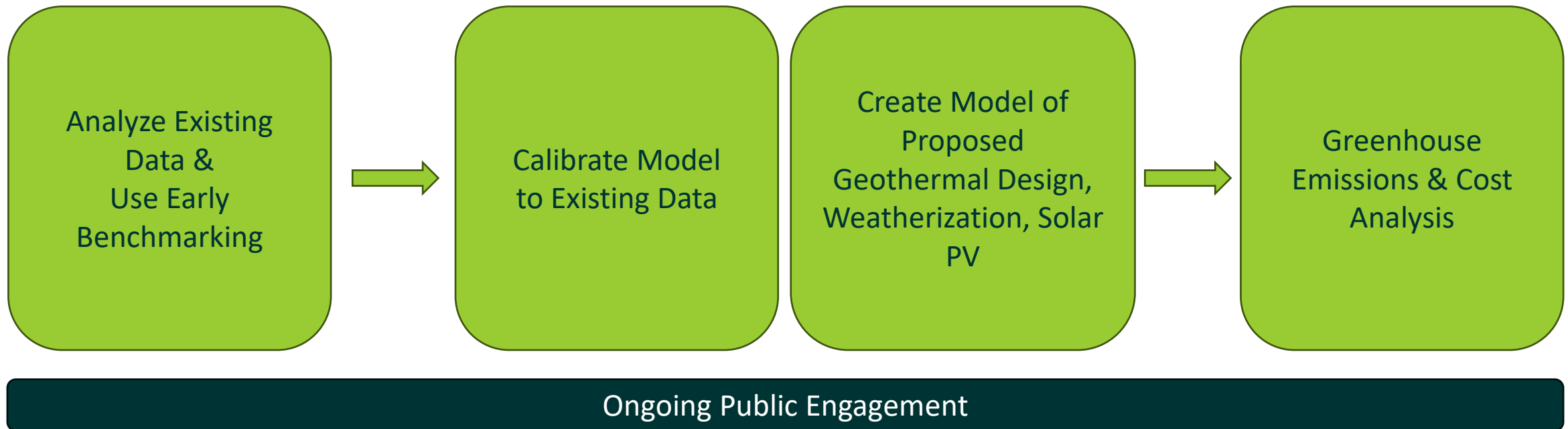


With current (2024) GHG emission rates, the full system (geothermal + weatherization + PV) achieves 38% greenhouse gas reduction.

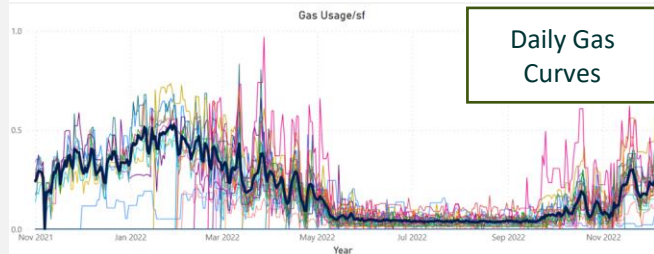
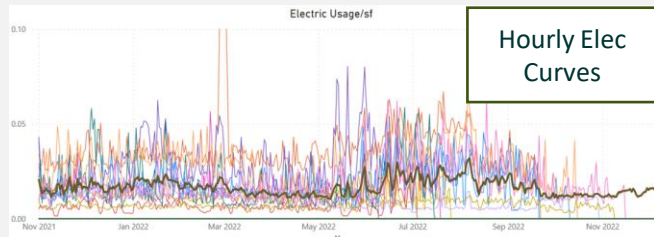
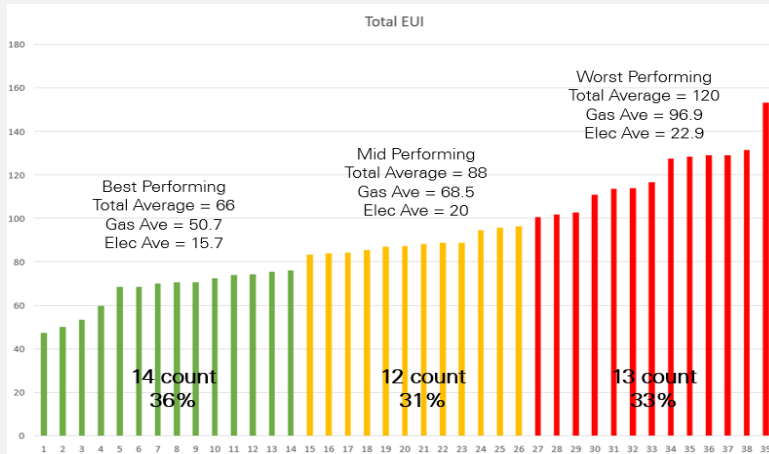


With 2030 GHG emission rates, the system (geothermal + weatherization + PV) achieves 75% reduction and only continues to decrease as additional state and local policies come online.

Analysis Approach



Existing Data

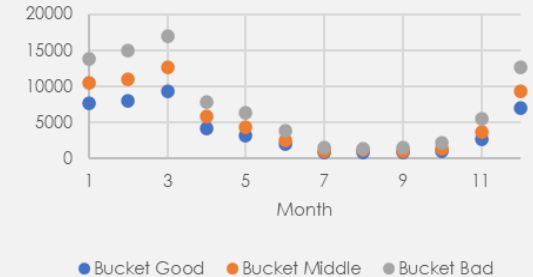
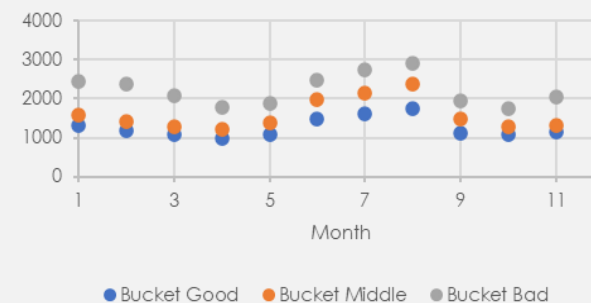
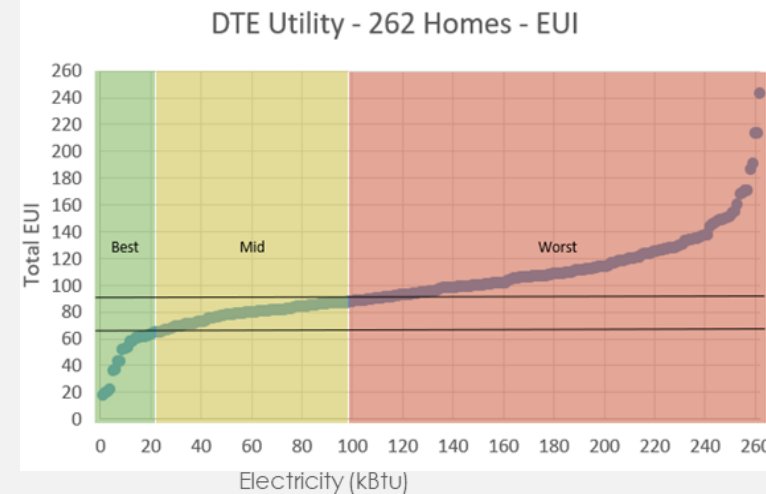


Energy Audits (40 homes)

- The energy audit provided annual gas and electric consumption for 40 homes.
- Based on their total consumption, these homes were **evenly** split into 3 buckets
 - Best, Middle, and Worst Performing
 - There are 12-14 homes per bucket
- The averages for gas and electric EUI were taken to create target EUIs for the energy model.

- Hourly electric consumption and daily gas consumption was displayed using Power Bi
- The curve profile set a general template for the energy model to align with

DTE - Utility Data (262 homes)



- The utility provided the monthly gas and electric usage for all 262 homes
- To determine the number of homes within each bucket, the total EUI of all 262 homes were evaluated and split accordingly

Best (45-66 EUI)
26 Homes (10%)

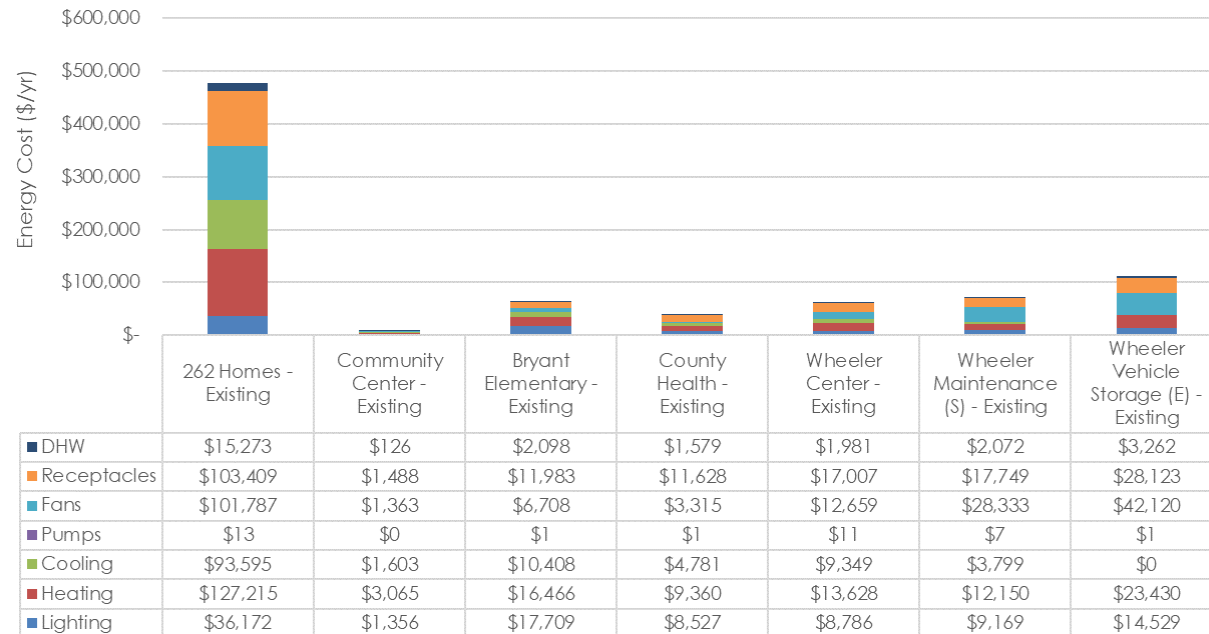
Middle (66-88 EUI)
79 Homes (30%)

Worst (88 + EUI)
158 Homes (60%)

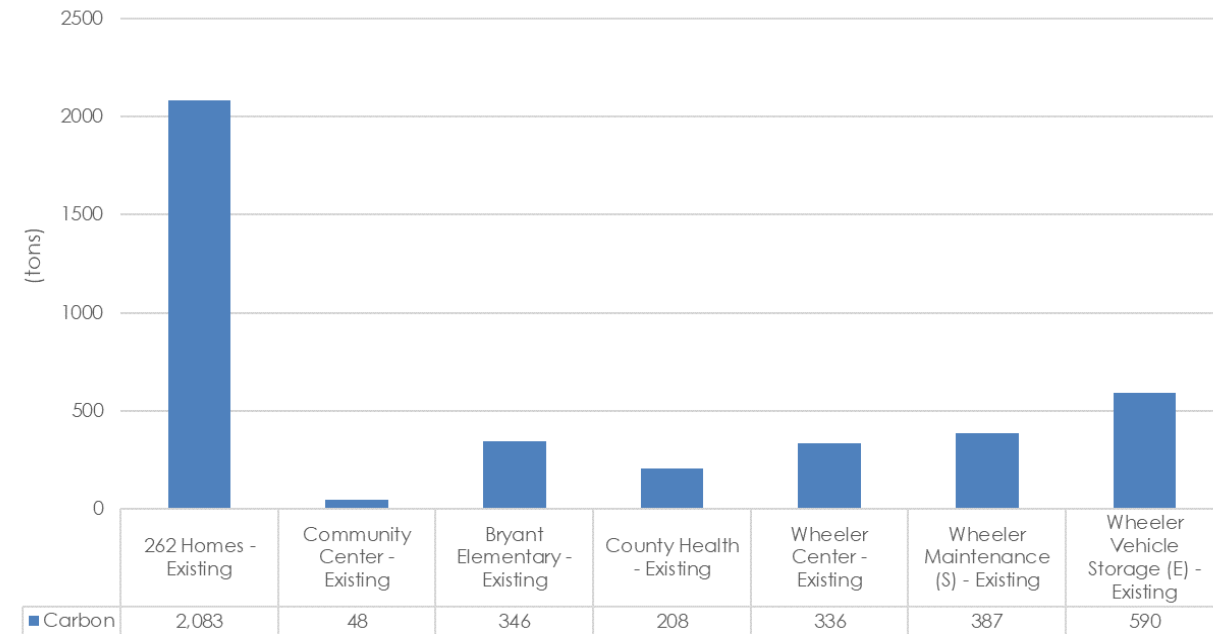
Existing Conditions



Energy Cost Breakdown



Carbon Emissions

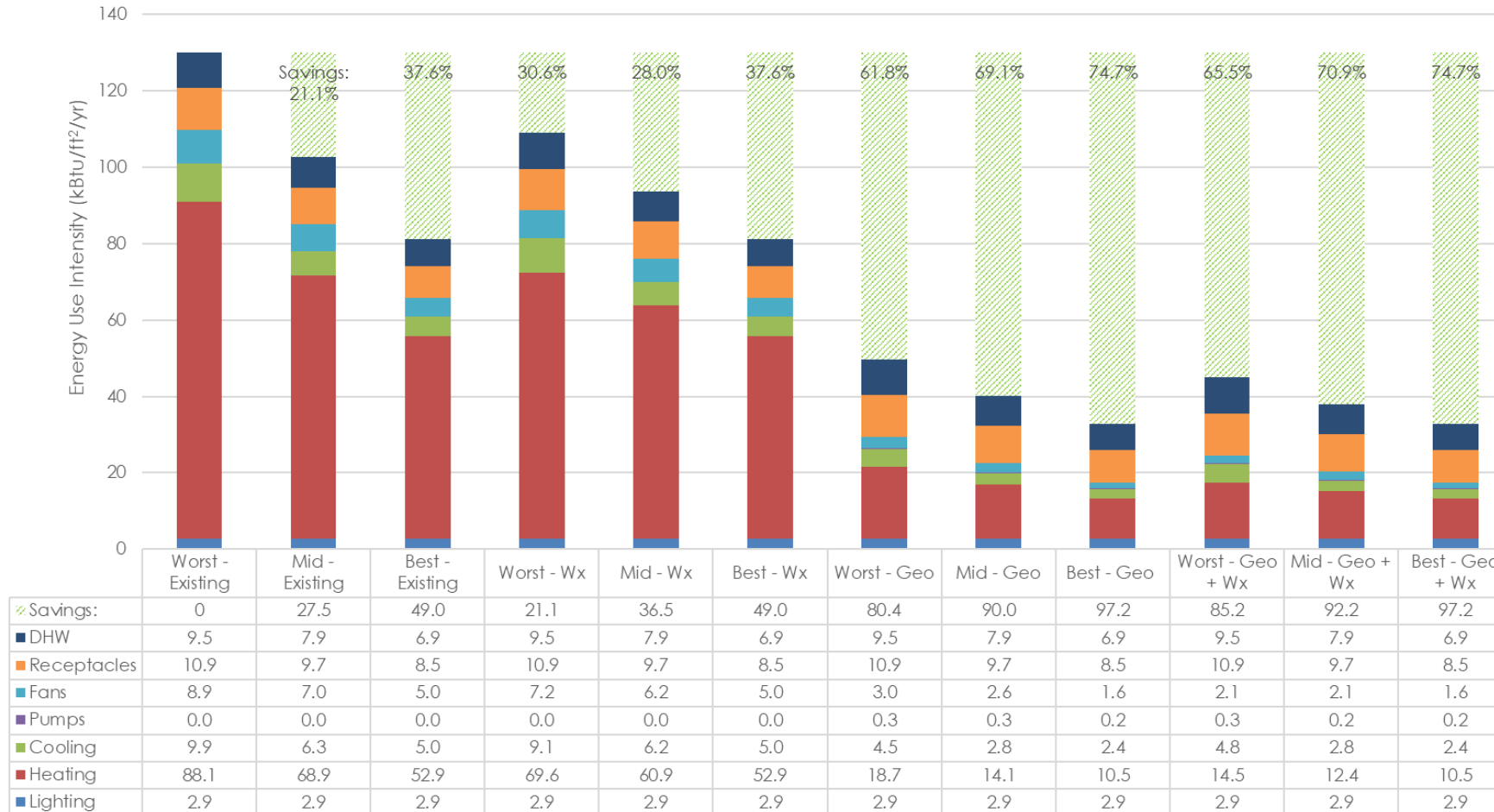


Looking at the entire neighborhood, the 262 households make up much of the overall energy usage and associated costs, as well as the local GHG emissions. As such, residential homes were the main focus of decarbonization throughout the project.

Home Energy Use



Energy End Use Breakdown



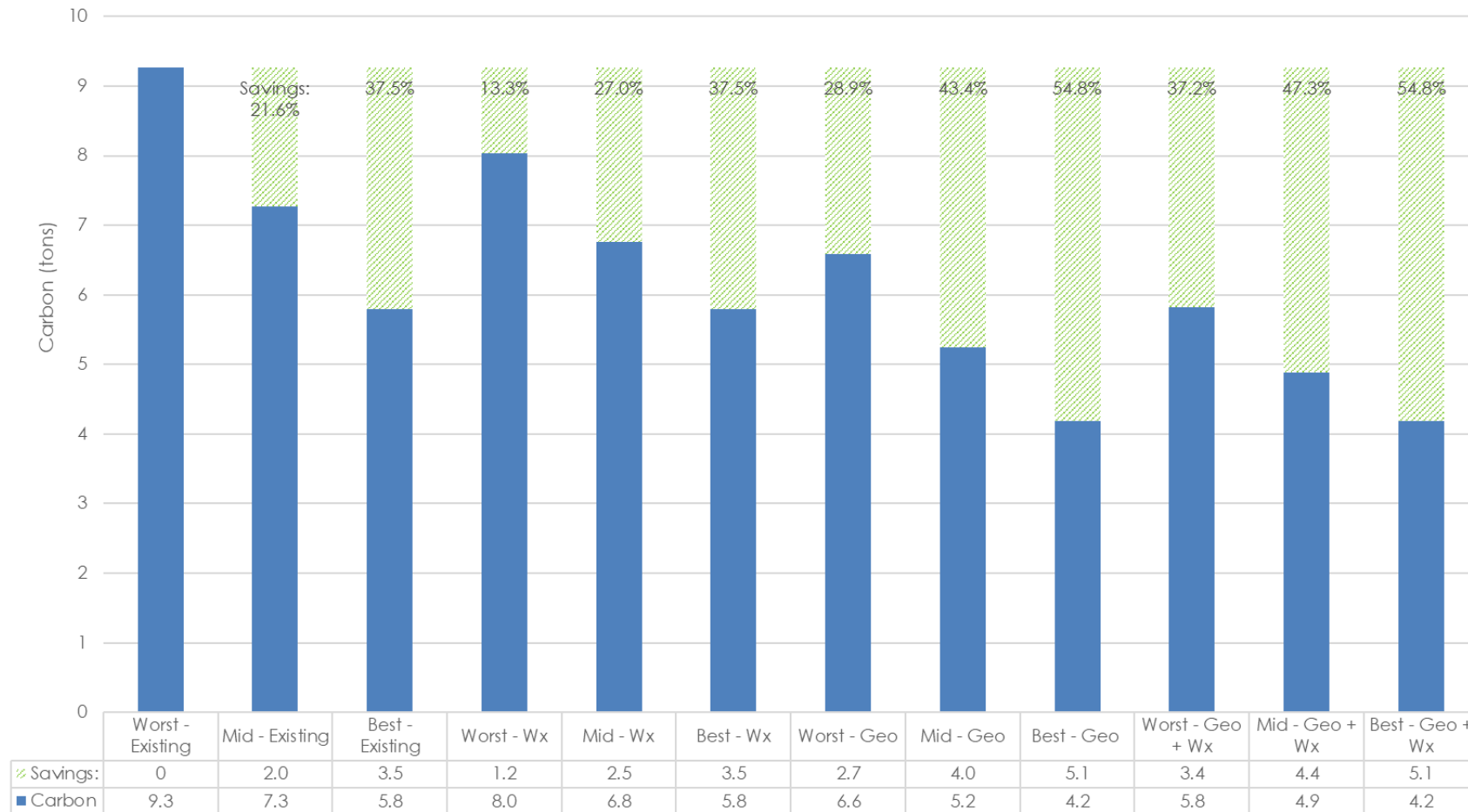
Weatherization was applied to each of the energy performance buckets, showing a maximum potential of 30% energy use savings in a single home.

The addition of geothermal significantly increases the energy use savings, especially for heating and cooling.

Home Energy Carbon



Carbon Breakdown



Similarly, greenhouse reductions within one home are significant with weatherization and geothermal.

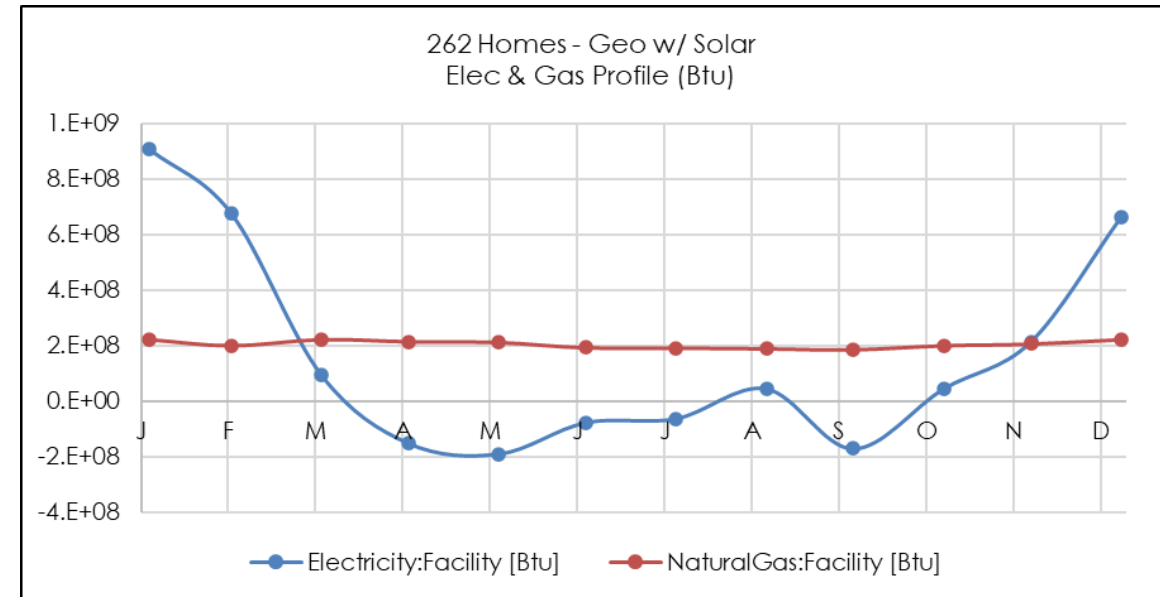
Rooftop Solar PV



Annual Solar Production Potential = 1680 MWh

The neighborhood has plans and funding for a mass buildout of solar on the roofs of households in the neighborhood.

With the addition of all the solar and the switch to geothermal, the homes will be providing the local grid with clean energy during the summer months while simultaneously lowering residents' monthly utility bills.



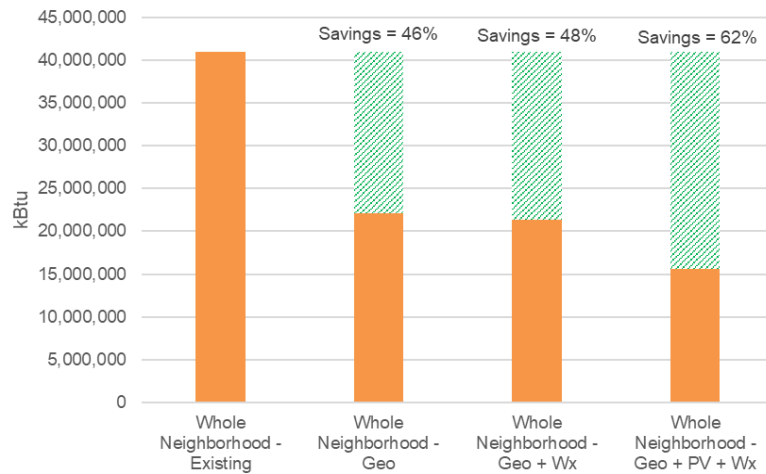
System/Plant	Energy Cost		Energy Consumption		CO2	
	(\$/yr)	% Savings	(kBtu/sf/yr)	% Savings	(metric tons)	% Savings
262 Homes – Existing	\$477,465	-	111	-	2,083	-
262 Homes – Geo	\$464,223	2.8%	46	58.1%	1,607	22.9%
262 Homes - Geo + Solar (Net Metered)	\$134,271	71.9%	20	81.7%	511	75.4%
262 Homes - Geo + Solar (Utility Buyback)	\$155,070	67.5%	20	81.7%	511	75.4%

Residents could likely see a 68-72% energy cost reduction with solar and geothermal, assuming the current utility rate structure.

Final Neighborhood Design



Energy Consumption - Whole Neighborhood



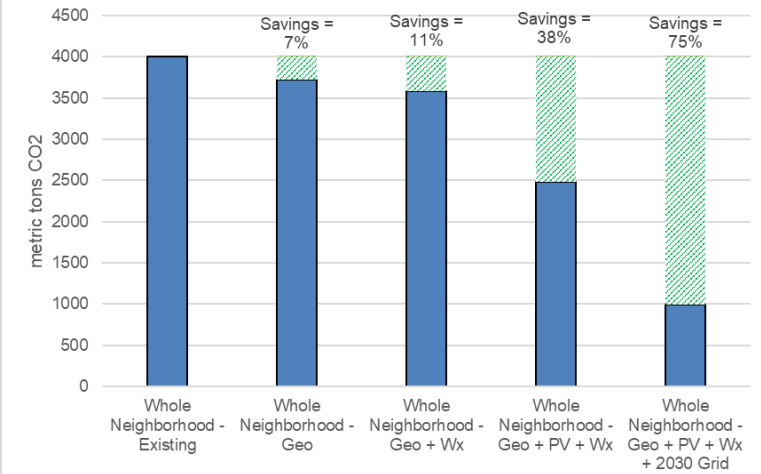
The final neighborhood design achieves a
62%
reduction in energy consumption

Cost - Whole Neighborhood



The final neighborhood design achieves a
37%
reduction in energy cost

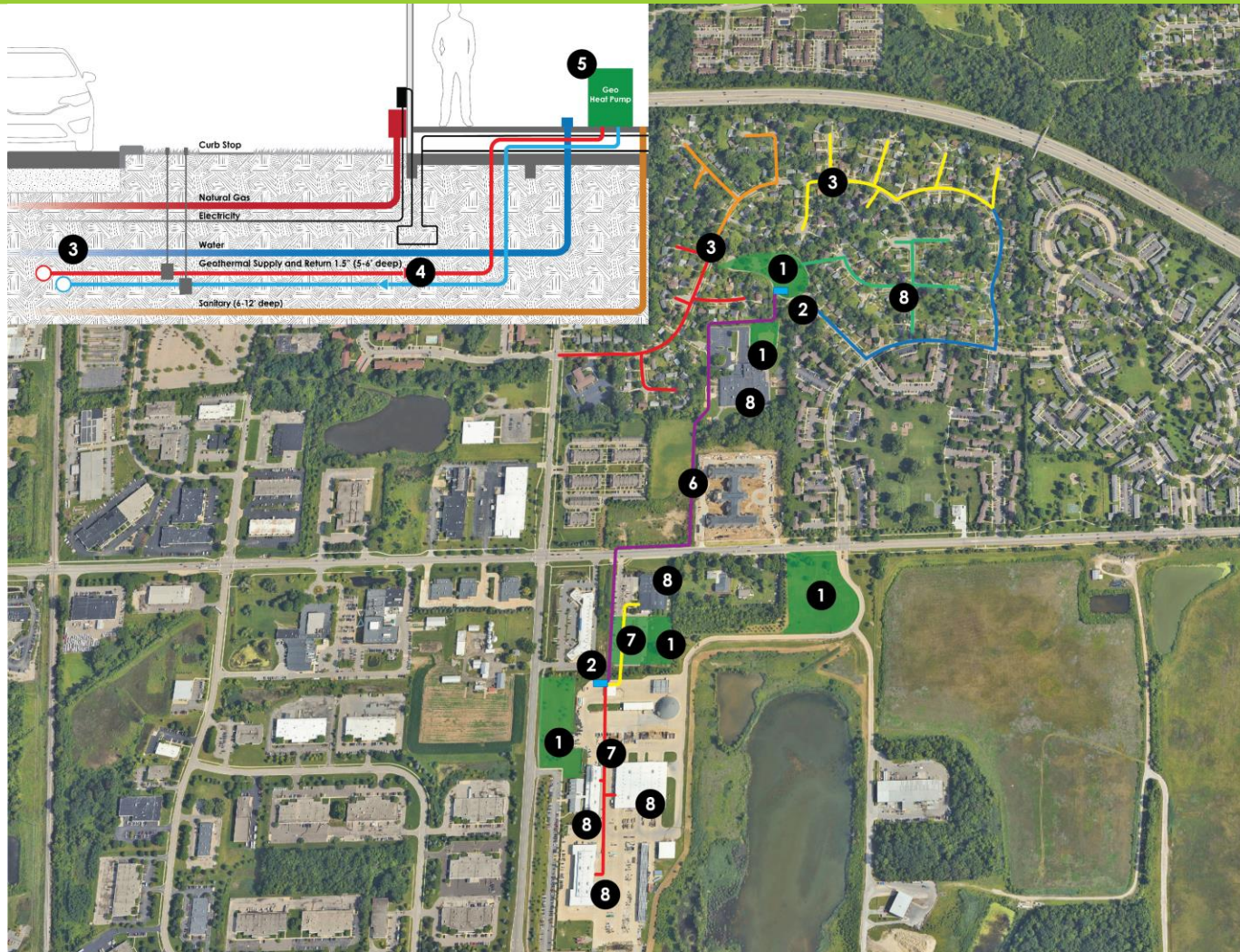
Carbon - Whole Neighborhood



The final neighborhood design achieves a
75%
reduction in GHG emissions by 2030

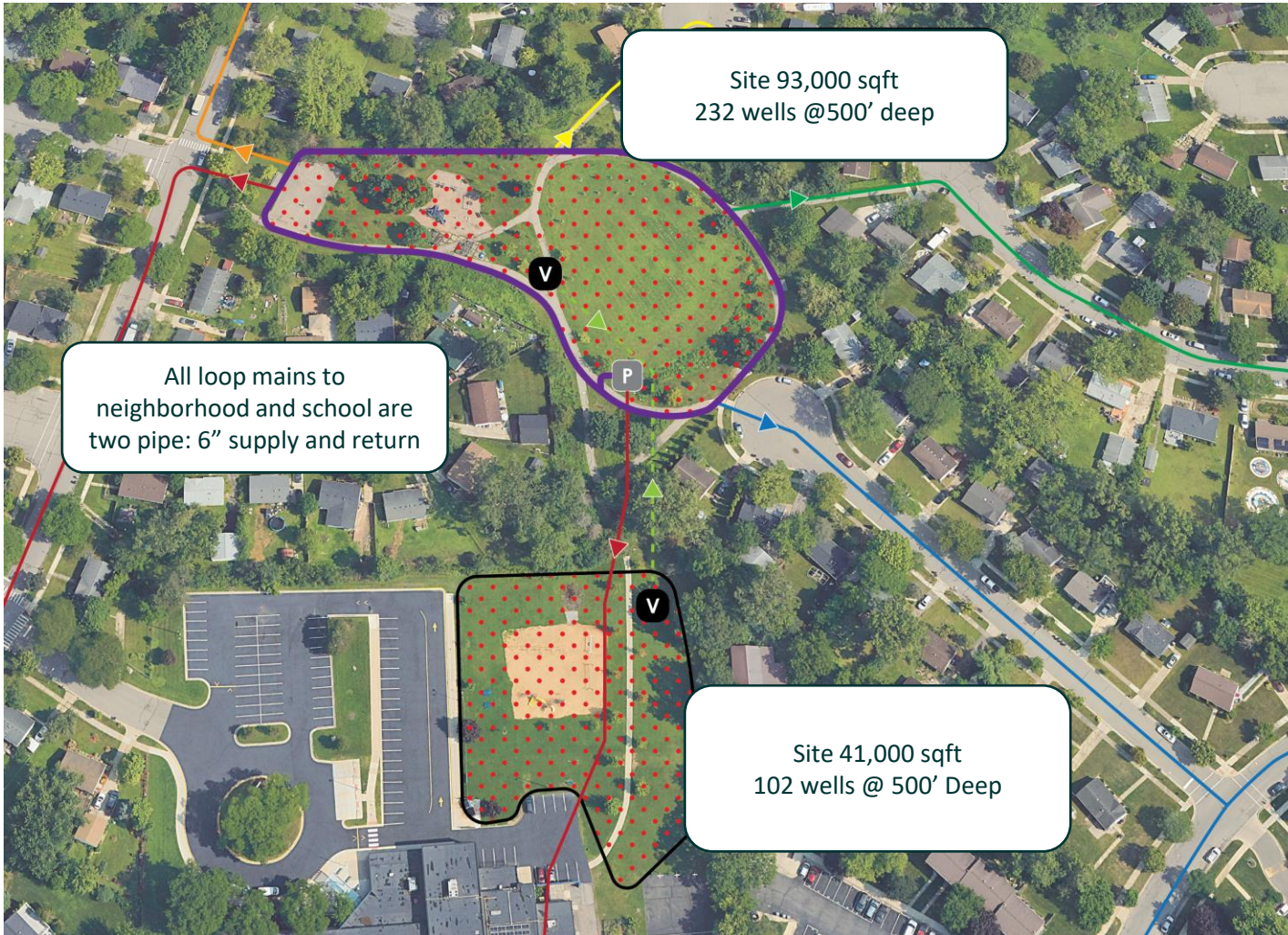
Residents specifically achieve a
77%
reduction in energy cost

Neighborhood Design



- 1 GeoThermal Field
- 2 Pump House
- 3 Neighborhood Distribution
- 4 Easement to Home
- 5 Residential Heat Pump
- 6 North to South Loop Connection
- 7 Commercial Building Distribution
- 8 Commercial Building Equipment

Geothermal Fields



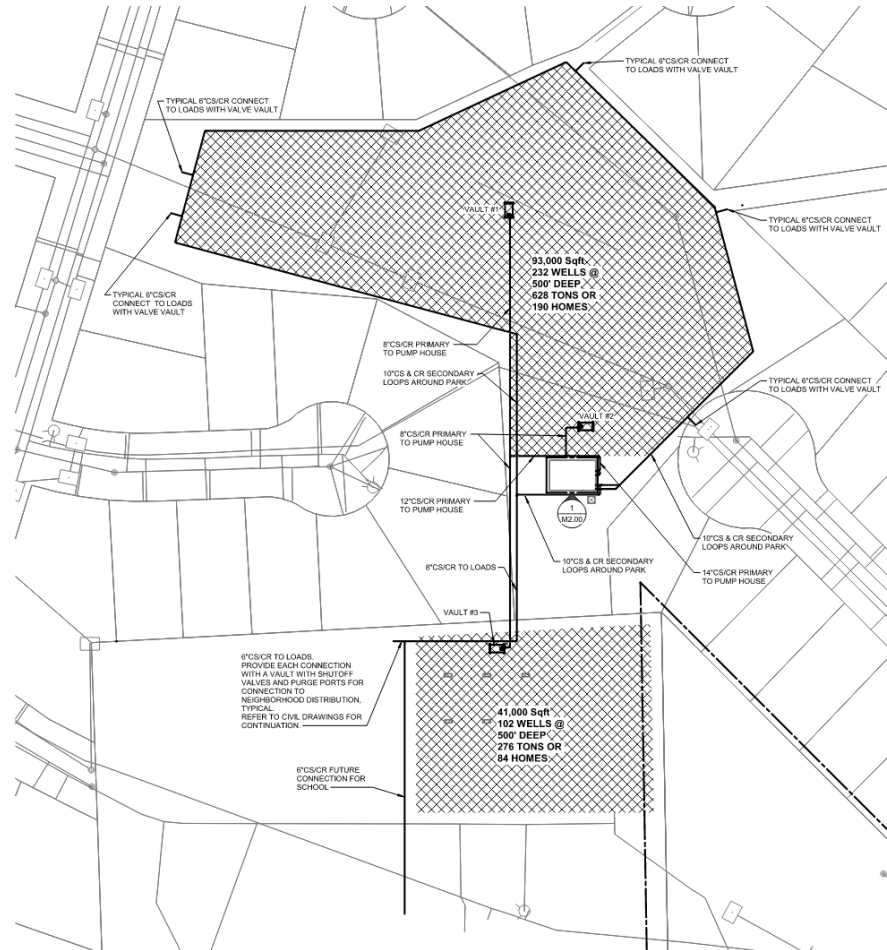
Geo field vault (Location TBD)



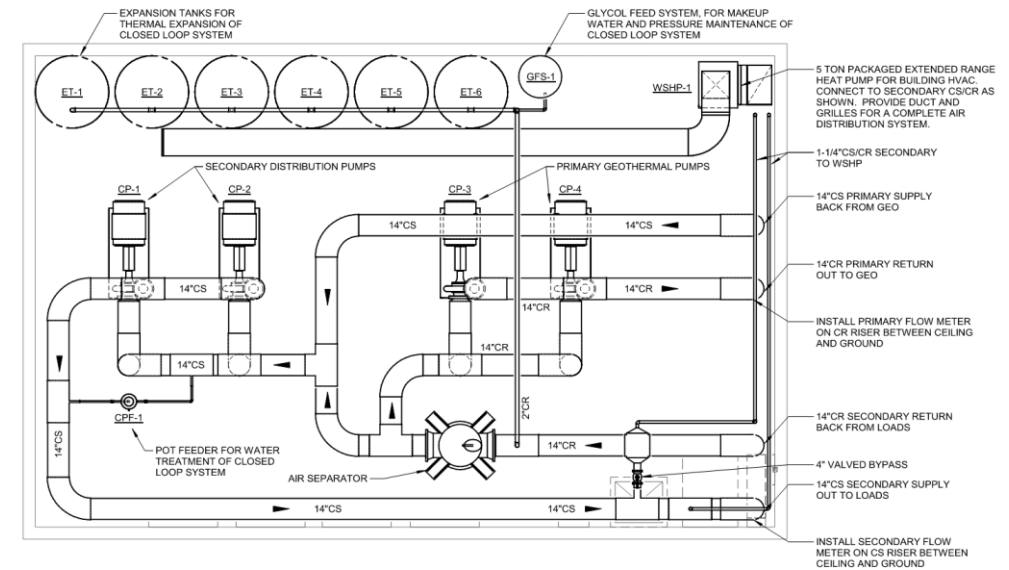
Pump House (Location TBD)
3 Loop Pumps @ 50 HP each +
3 Field Pumps @ 30 HP each +
Supplemental Equipment

--- Geothermal main

Base: Closed Loop



1 GEOTHERMAL SITE PLAN - MECHANICAL
1" = 50'-0"



1 GEOTHERMAL PUMP HOUSE PLAN - MECHANICAL
1/4" = 1'-0"

Alternate – Open Loop



Pros

More stable supply temperature

Fewer wells

Less surface disruption

Reduce time drilling on site

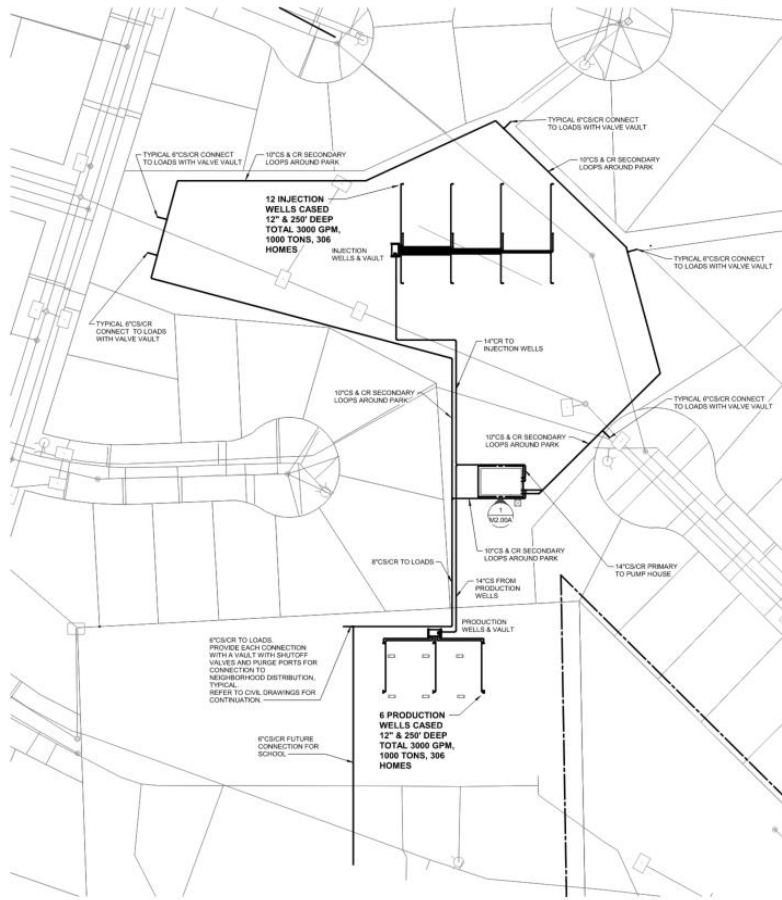
Lower cost

Cons

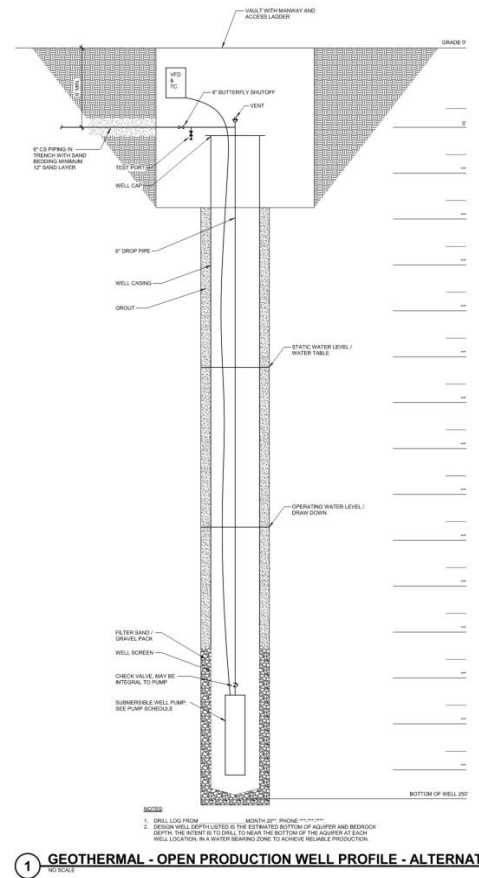
Maintenance for water filtration

Re-injection well monitoring

Less familiar for permitting (but is allowed)

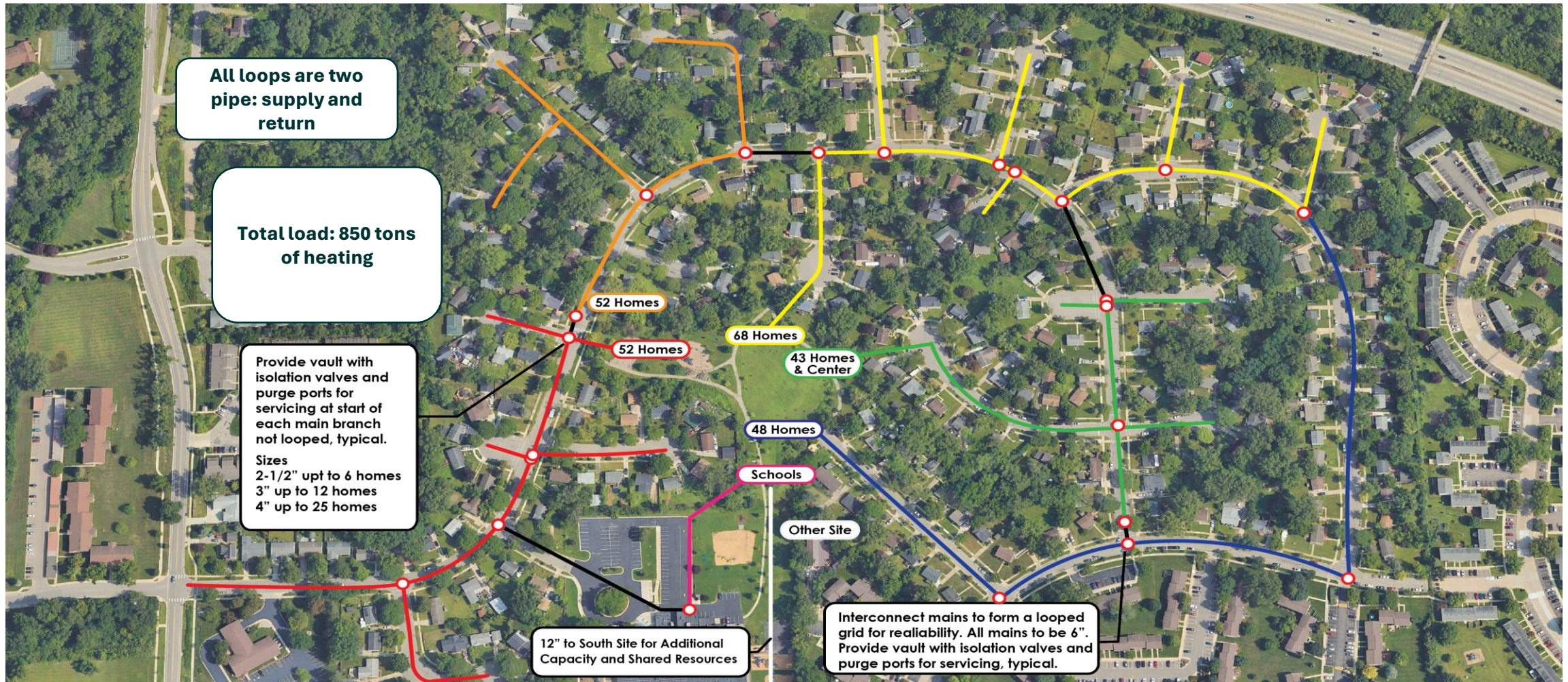


1 GEOTHERMAL SITE PLAN - MECHANICAL ALTERNATE
1" = 50'-0"

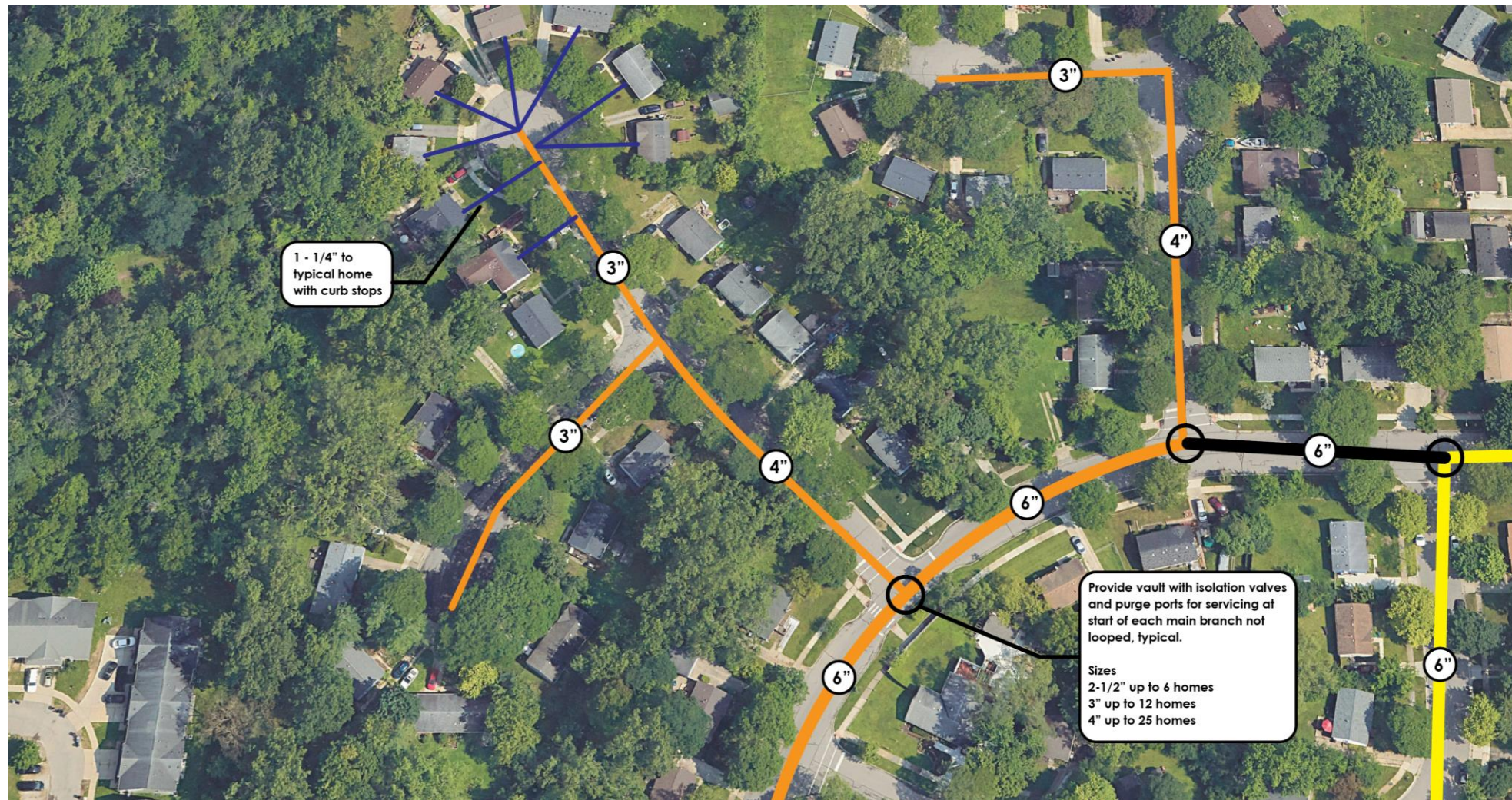


1 GEOTHERMAL - OPEN PRODUCTION WELL PROFILE - ALTERNATE
NO SCALE

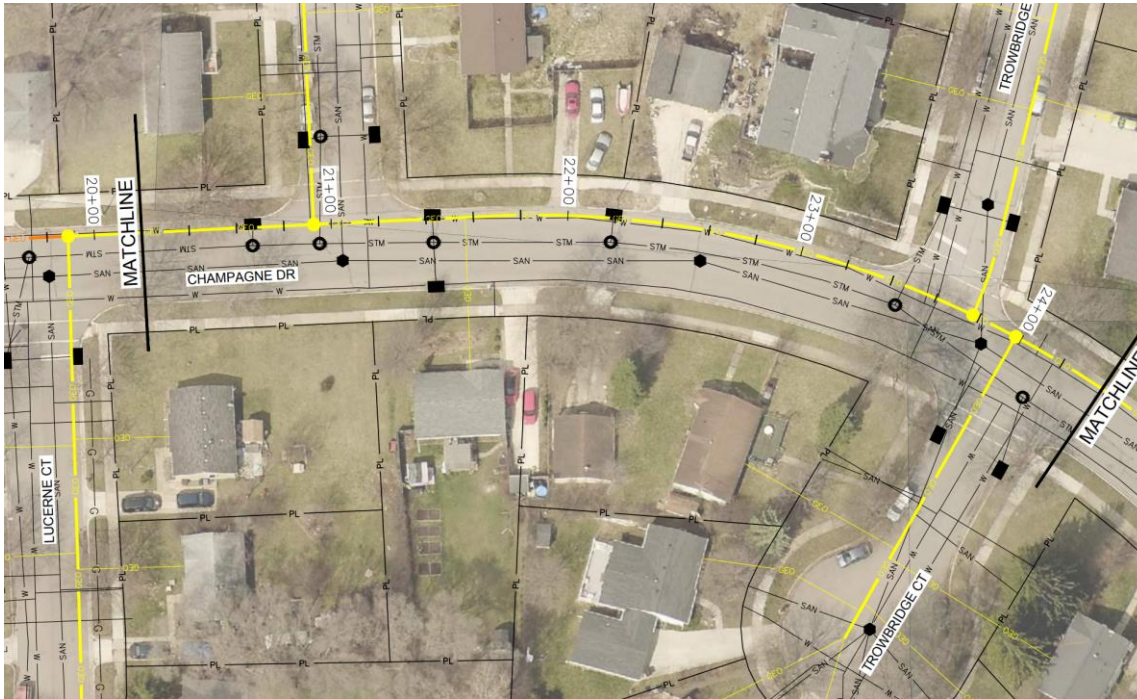
Utility Distribution



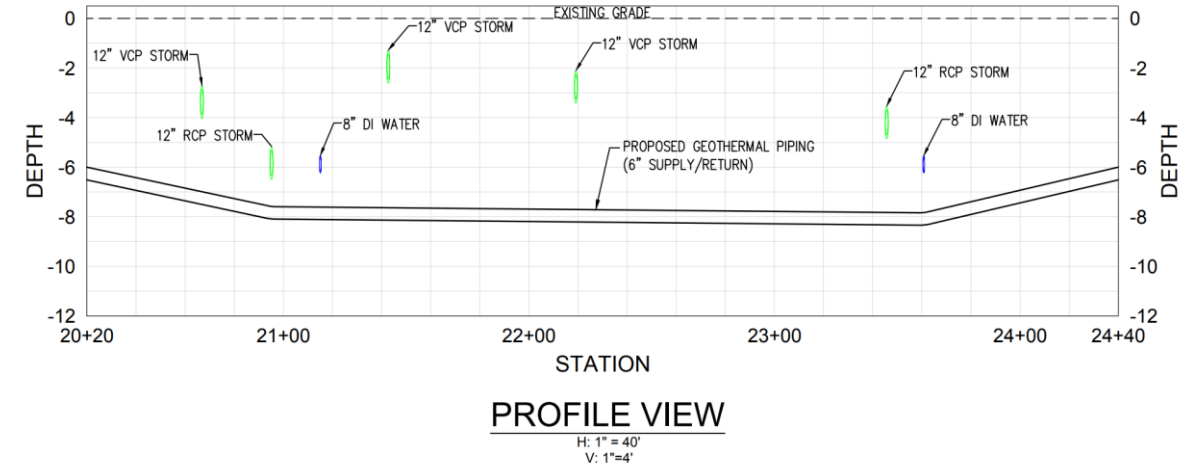
Typical Cul de Sac



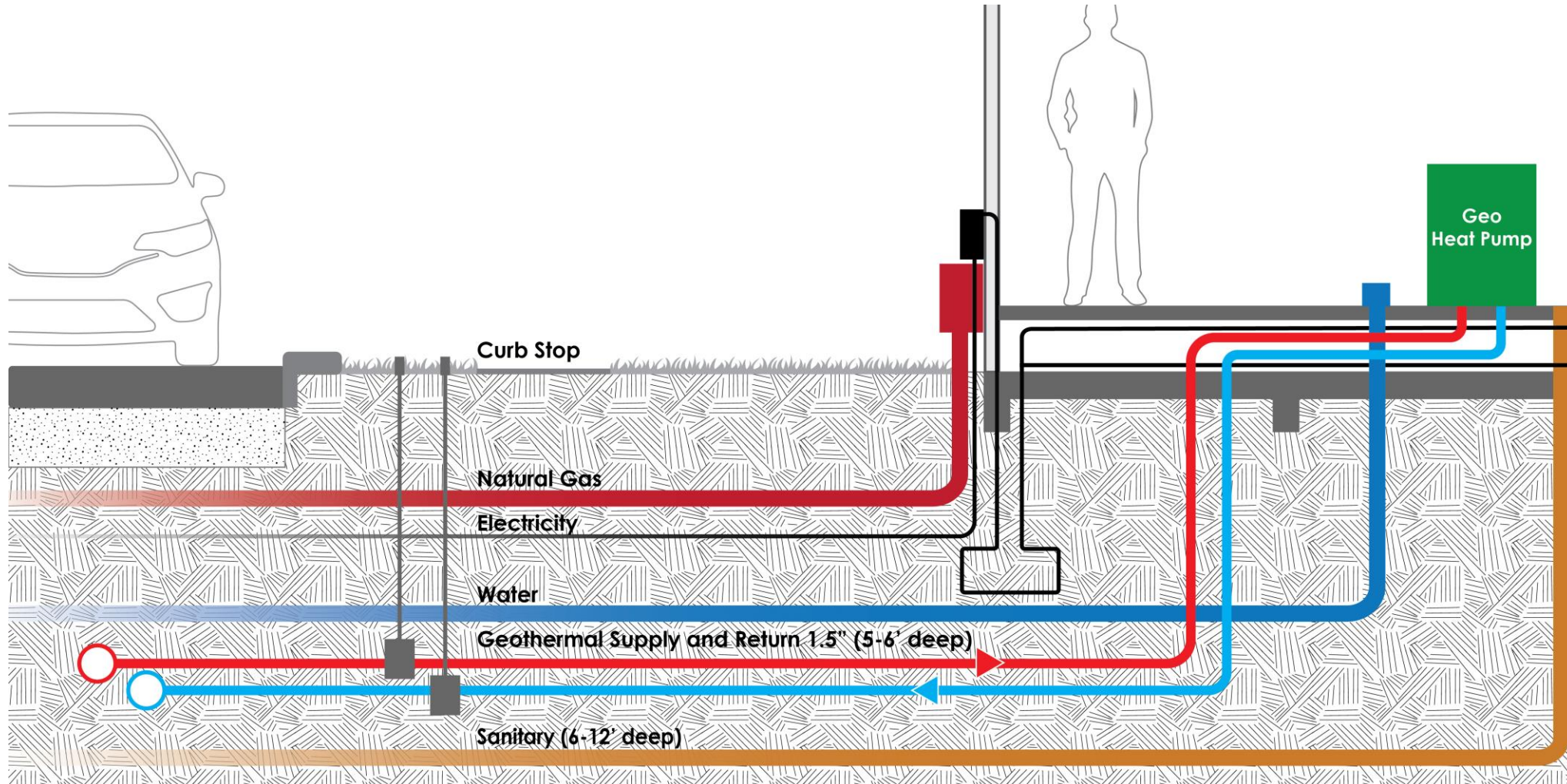
Utility detail



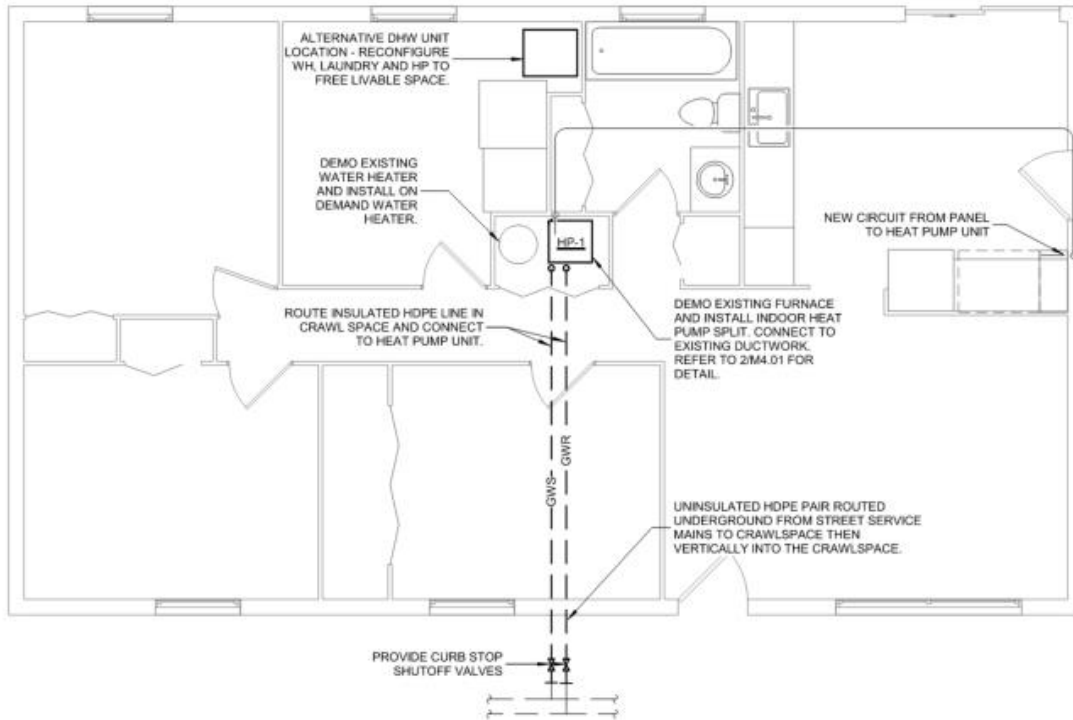
Plan View



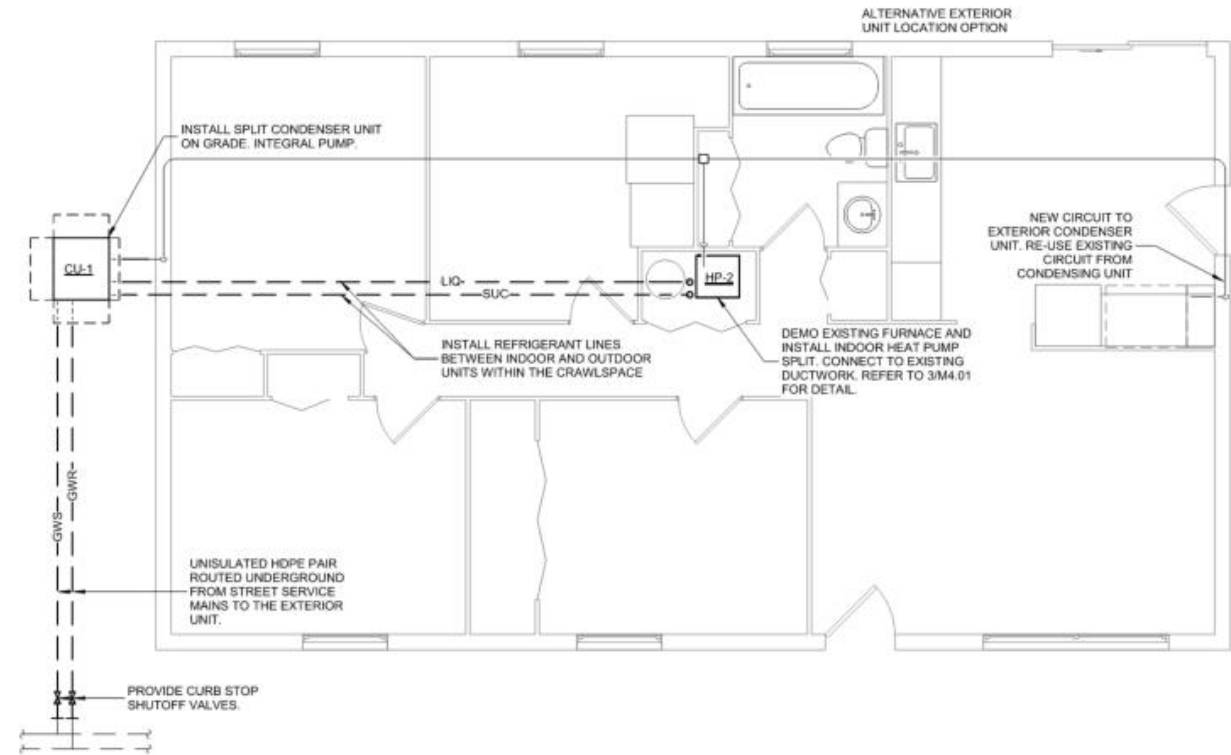
Service to the Residences



Residential Heat Pumps



1 TYPICAL HOME OPTION 1 - HEAT PUMP IN HOME
1/4" = 1'-0"



2 TYPICAL HOME OPTION 2 - SPLIT HEAT PUMP
1/4" = 1'-0"

Assessing the Workforce



Ann Arbor Bryant Geothermal Project Workforce Development Roundtable Discussion

What: Roundtable discussions to explore existing capacity, needs, and opportunities related to creating the skilled workforce needed to support large-scale geothermal deployment as well as implement other decarbonization initiatives. Your input is extremely valuable so please make every effort to attend!

When: Thursday, January 25th & Thursday, February 1st @ 6:30 pm

Where: Meetings will take place via Zoom.

You can click on the link below and automatically be connected.

Thursday, January 25th @ 6:30pm

<https://us02web.zoom.us/j/86387230990?pwd=VUc4cVhlcjRNMmpFTkdPV1VsTFZ2dz09>

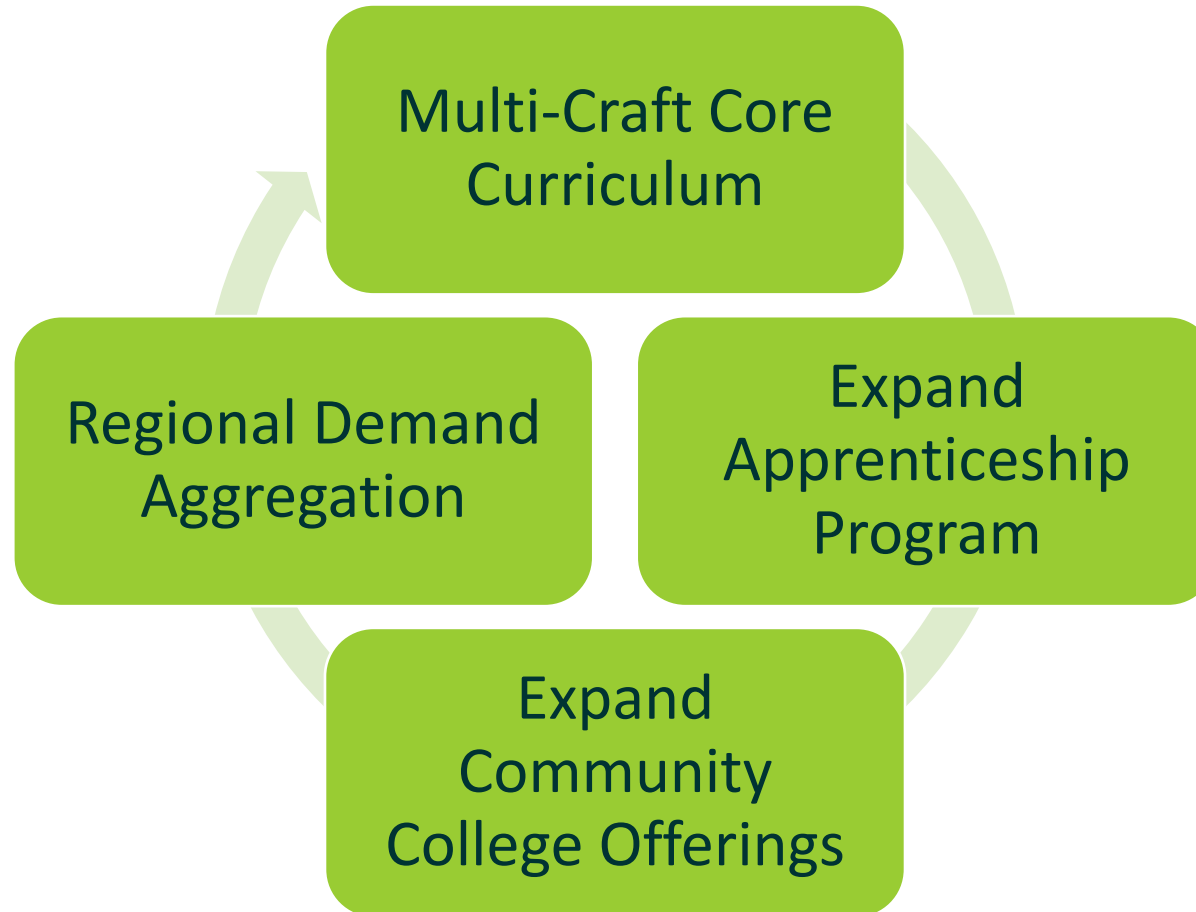
Thursday, February 1st @ 6:30pm

<https://us02web.zoom.us/j/89229663876?pwd=RkZnS1BGdFdYRlZpMUUpU2g5Rk83dz09>

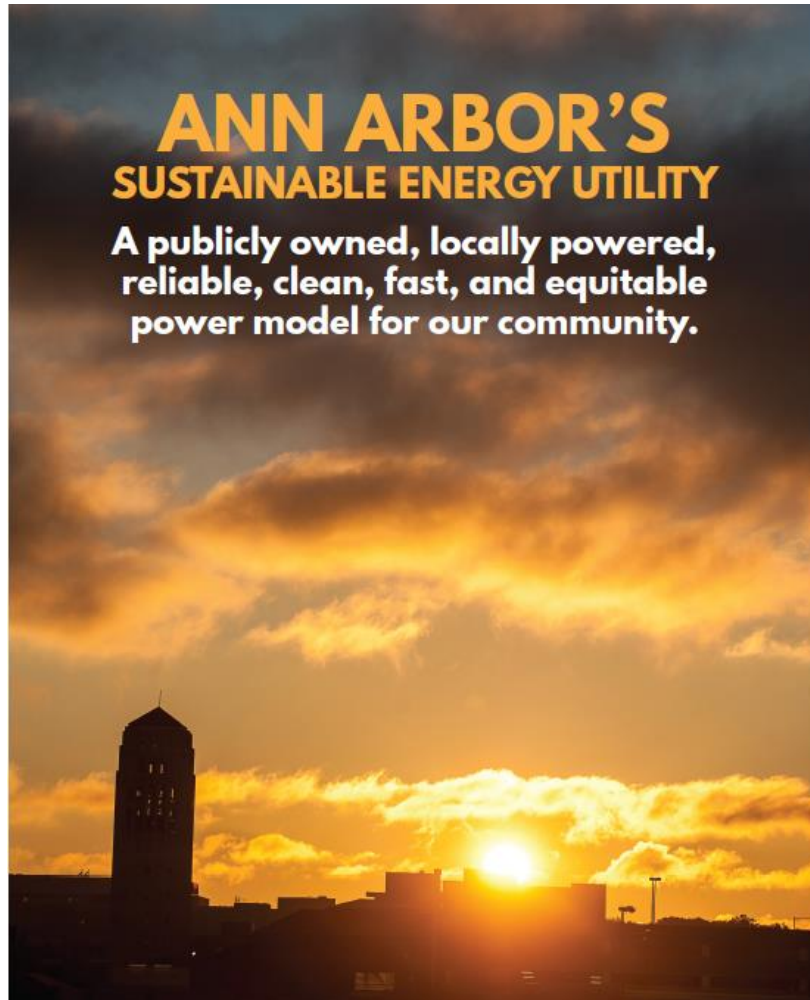
This discussion is part of a grant from the U.S. Department of Energy where UA 190, the City of Ann Arbor, and other partners are designing a district geothermal system while establishing a framework for advancing local, family-sustaining jobs.



Workforce Plan



Deployment



DTE

Simple Budget



Costs

Geothermal Field

Geo field (park)	\$ 4,750,000
Geo field (school)	\$ -
Site clearing, traffic control, and restoration	\$ 550,000
Piping from vaults to pump house	\$ 50,000
Final Design and CA for geothermal field	\$ 250,000

Pump House + Equipment + Glycol (full system sizing)

Building + mech equipment	\$ 1,537,500
---------------------------	--------------

Neighborhood Distribution (yellow + green loops) – 111 Homes

See distribution breakdown sheet	\$ 10,261,050
----------------------------------	---------------

Residential Homes – 111 Homes

Install heat pump, connect to stubbed piping	\$ 2,220,000
--	--------------

Workforce Development

Implementation of workforce development strategy	\$ 560,000
--	------------

Community Engagement

Ongoing community engagement	\$ 150,000
------------------------------	------------

Staffing and Utility Operation

Staffing costs (project management, coordination, billing)	\$ 1,016,428
--	--------------

Total

Total Costs	\$ 21,344,978
-------------	---------------

Financing

Sources

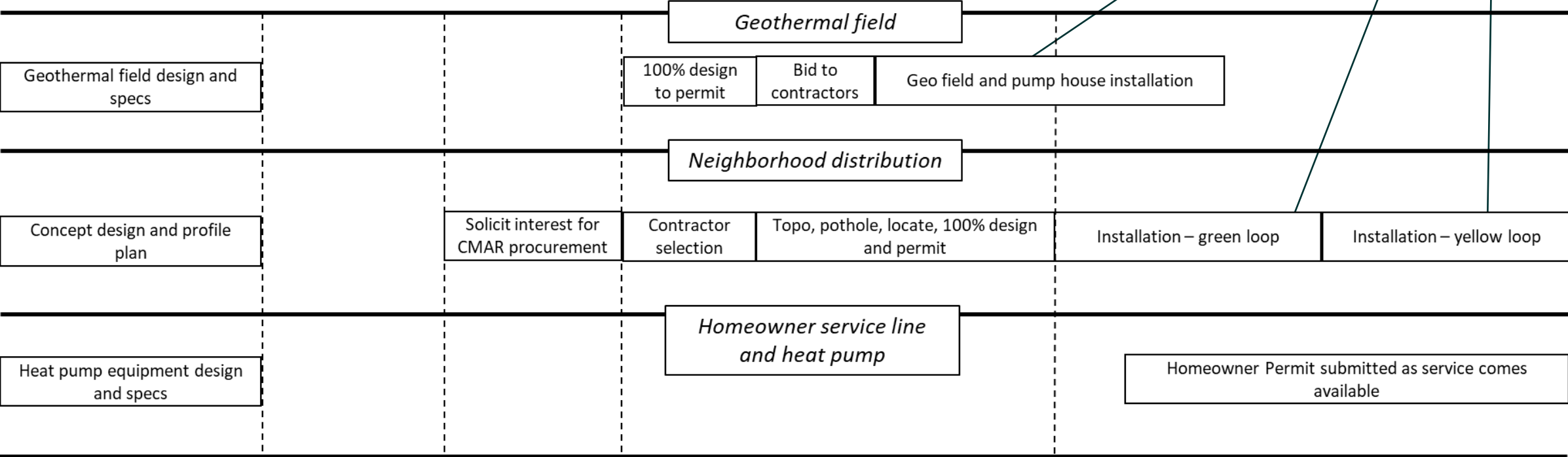
Federal Tax Incentive (30%)	\$ 6,403,493
DOE Grant	\$ 10,000,000
Cost Share	\$ (3,596,507)
Total	\$ 21,344,978

Proposed Tasks for BP 2



1. Prepare ownership materials
2. Finalize designs and permitting
3. Implement workforce development initiatives identified in Budget Period 1
4. Ongoing and sustained community engagement
5. Competitive bidding for drilling and loop construction
6. System construction
7. Commissioning, operation, and ongoing maintenance

Implementation Timeline



Budget Period 1 submittal
09/2024

DOE Notice of Award
12/2024

DOE Notice to Proceed
03/2025

10/2025

09/2027

Continuing Engagement



ANN ARBOR PUBLIC SCHOOLS
LEAD. CARE. INSPIRE.



Thank You!

