Rice Creek Commons

Clean Energy Analysis

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Acknowledgements

Ever-Green Energy (Ever-Green) and LHB would like to express their gratitude to the City of Arden Hills, Ramsey County, the Energy Advisory Committee (EAC), and the Joint Development Authority (JDA) for their assistance in the development of this Rice Creek Commons Green Energy Plan.

About Report Author Ever-Green Energy and LHB

Ever-Green led the development of this Rice Creek Commons Green Energy Plan. The team at Ever-Green takes pride in being one of the country's premier district energy system experts, with decades of experience in developing, operating, and managing community energy systems. Ever-Green's unique combination of technical expertise, business acumen, and operations experience has helped communities, colleges and universities, health care campuses, and government organizations advance the study, development, and operation of community energy systems. The Ever-Green team applies its depth of knowledge through every step of a system's development and implementation, finding sustainable solutions that are reliable and financially viable to secure a community's energy future.

Ever-Green partnered with LHB due to their ability to bring complementary expertise in energy, carbon, and sustainability planning to Ever-Green's expertise in energy system development. LHB's Climate Solutions team leverages the LHB-developed Regional Indicators Initiative for scenario planning and greenhouse gas (GHG) reduction tracking on projects such as climate action plans, carbon-free community planning, net-zero building planning, GHG inventories, and development of sustainability guidelines for the built environment. LHB always looks forward to thinking beyond established practices to create innovative pathways to a more sustainable and regenerative future. Contributors to this project included: Becky Alexander, Rick Carter, Maureen Colburn, Matt Gruber, and David Williams.

Executive Summary

About Rice Creek Commons

Rice Creek Commons is a 427-acre brownfield redevelopment in Arden Hills, Minnesota. The site was formerly known as the Twin Cities Army Ammunition Plant (TCAAP). It will be a mixed-use development and is divided into five neighborhoods. The development will include a variety of residential options, such as multi-family residential, single-family residential, townhomes, and senior housing, as well as commercial, retail, big-box retail, and light industrial spaces. At the time of this analysis, the planned buildout of the development will occur over four years, with the conceptual phasing taking place between 2027 and 2030.

Project Partners

The Joint Development Authority (JDA) Board — which consists of two members from Arden Hills City Council, two members from the Ramsey County Board of Commissioners, and one appointed resident from Arden Hills — and City of Arden Hills and Ramsey County staff are working together to determine next steps for the development of Rice Creek Commons.

This group of partners established the need for a report to assess the feasibility of implementing goals within the JDA's Green Energy Vision for Rice Creek Commons (RCC): carbon neutrality, clean energy, climate resiliency, equity, and innovation.

Study Scope and Process

Ever-Green Energy, with support from LHB, conducted a comprehensive energy analysis, evaluated greenhouse gas (GHG) reduction strategies, developed sustainability design guidelines, and selected a suitable certification program.

By quantifying the potential GHG reductions, analyzing various clean energy scenarios, and encompassing a community-wide approach, the report aims to identify effective strategies to achieve Rice Creek Common's sustainability goals. Additionally, it explores potential funding sources and opportunities to support the implementation of these initiatives.

High-Performance Buildings

An analysis comparing the community's energy use under a code baseline scenario versus a high-performance building scenario demonstrated that high-performance buildings would result in a 62% reduction in the community's total building energy use. Since the high-performance buildings are all-electric, they also have the potential to use carbon-free energy sources to a greater extent than the baseline buildings.

Energy Modeling

Heating and cooling needs were analyzed for each of the five neighborhoods in the planned development. Three all-electric scenarios were compared to a baseline scenario, which assumed buildings were constructed to current building codes and utilized natural gas for heating. Two scenarios looked at options for a district energy system. The third scenario proposed a decentralized solution, where each building has its own geothermal system.

The modeling indicates that an all-electric, carbon-free development is feasible at Rice Creek Commons by developing high-performance buildings and using geothermal ground source systems for heating and cooling with either district energy or a decentralized system. The remaining renewable energy needs could be met by a combination of on-site solar and purchasing renewable energy from Xcel Energy. By taking these steps and going all-electric, Rice Creek Commons could reduce GHG emissions from heating and cooling by up to 98% over 30-years compared to the baseline.

Next Steps

Implementation of the strategies described in this document will involve deep collaboration between the JDA, developers, and other project partners. As a first step, the JDA could adopt a policy that the Rice Creek Commons development be all-electric and carbon-free. This policy would provide guidance for the project team and developers while still allowing flexibility to determine specific technologies and strategies to meet this requirement.

The project team will continue to work with developers to understand the costs and financial incentives associated with green energy and sustainability measures. In particular, the project team will engage with developers to compare district energy and decentralized geothermal systems to determine the best path forward for the project. The project team will finalize Sustainability Design Guidelines for JDA approval and implementation and also begin the LEED for Communities certification process.

Rice Creek Commons Clean Energy Analysis

1. Introduction

The purpose of this report is to assess the feasibility of achieving the Rice Creek Commons (RCC) Energy Vision:

Rice Creek Commons will be a vibrant and unique, climate-forward development that aligns with the goals outlined in the State of Minnesota's Climate Action Framework: carbon neutrality, clean energy, climate resiliency, equity and innovation. Rice Creek Commons will attract investment and partnership that will create sustainable benefits for the community.

Guiding Principles

- Develop a resilient community for energy and other utilities using clean energy technologies, reducing consumption, and reusing local resources onsite.
- Implement infrastructure solutions that are flexible and scalable over 50 years, including developing the site to be adaptable to future technological needs.

- Deliver a model of efficient energy and water usage that minimizes Rice Creek Commons' impact on the environment.

- Create an economically competitive and attractive environment for developers and businesses to create a vibrant community with multi-modal transportation options.

To achieve this, a comprehensive energy analysis was conducted, greenhouse gas (GHG) reduction strategies were evaluated, sustainability design guidelines were developed, and a certification program was selected. By quantifying the potential GHG reductions, analyzing various clean energy scenarios, and fostering a community-wide approach, the report aims to identify effective strategies to achieve RCC's sustainability goals. Additionally, it explores potential funding sources and opportunities to support the implementation of these initiatives.

2. Development Definition

Located in Arden Hills, Minnesota, the 427-acre brownfield site, formerly known as the Twin Cities Army Ammunition Plant (TCAAP), is now being developed as RCC. This mixed-use development is divided into five neighborhoods: Town Center, Creek Neighborhood, Hill Neighborhood, Southwest Neighborhood, and Outlot A as shown in Figure 1. The analysis in this report is based on the development concepts provided by developer in March 2024.

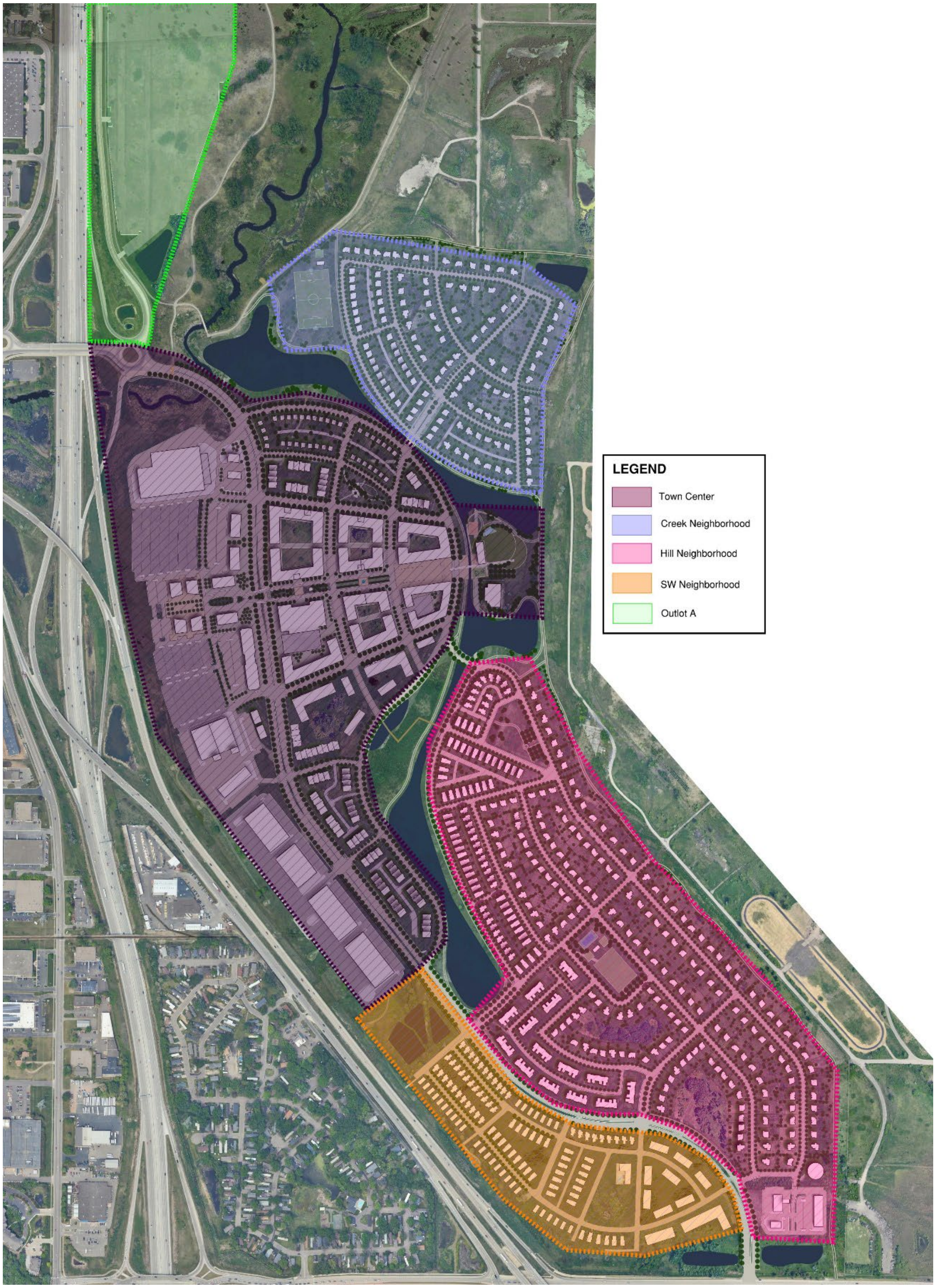

Figure 1. Rice Creek Commons Conceptual Site Plan

The development includes a variety of residential options, such as multi-family residential, single-family residential, townhomes, and senior housing, as well as commercial, retail, big-box retail, and light industrial spaces. The buildout of the development is planned to occur over four years, with the conceptual phasing taking place between 2027 and 2030.

		2027	2028	2029	2030	Total
Town Center	GSF	495,750	531,000	635,000	914,450	2,576,200
Hill Neighborhood	GSF	358,977	552,401	0	0	911,378
Creek Neighborhood	GSF	0	0	0	384,508	384,508
SW Neighborhood	GSF	693,450	5,000	0	0	698,450
Outlot A	GSF	425,940	0	0	0	425,940
Total	GSF	1,974,117	1,088,401	635,000	1,298,958	4,996,476

Table 1. Conceptual development building gross square feet (GSF) by year.

3. Building Strategies and Energy Use

While all new buildings at RCC are required by law to meet Minnesota's Energy Code, there is potential for beyond-code building design measures that can significantly reduce energy use, energy costs, and GHG emissions. This analysis compares the community's energy use under a code baseline scenario versus a high-performance building scenario.

3.1 Baseline Buildings

Baseline building energy use was estimated for each building type and size using IES VE energy modeling software. Buildings are assumed to:

- Meet ASHRAE 90.1-2019, which is the basis for Minnesota's current commercial energy code[1]
- Use a combination of electricity and utility gas
- Use typical HVAC systems, such as packaged terminal air conditioners for residential buildings and variable air volume systems for commercial buildings

[1] Although Minnesota's residential and commercial energy codes will become incrementally more stringent over the next decade (M.S. 326B.106), this is not expected to have a major impact on the near-term construction at Rice Creek Commons and was not incorporated into the energy models.

3.2 High-Performance Buildings

High-performance building energy use was also estimated using IES VE energy modeling software for each building type and size. While these models used the same geometry and occupancy schedules as the baseline buildings, the high-performance buildings are assumed to:

- Be all-electric (use no natural gas)
- Have high-performance envelopes and lighting, exceeding code requirements
- Use highly efficient HVAC systems, including heat pumps that are connected to a district energy system

3.3 Results of Building Strategies

Using these parameters, the high-performance buildings are predicted to use 36%-72% less energy than the baseline buildings (Table 2). The building energy use intensity (EUI) and percentage reduction vary based on building type, with offices on the lower end of the range and light industrial on the upper end. This equates to a 62% reduction in the community's total building energy use (all RCC buildings blended). Because the high-performance buildings are all-electric – in comparison to the baseline buildings where nearly three-quarters of energy use is utility gas (Figure 2) – they also have the potential to use carbon-free energy sources.

	Building EUI	Community EUI
Baseline Buildings	44-103	63
High-Performance Buildings	18-32	24
% Reduction	36%-72%	62%

Table 2. Building energy use intensity (EUI) comparison in kBtu/sf-year

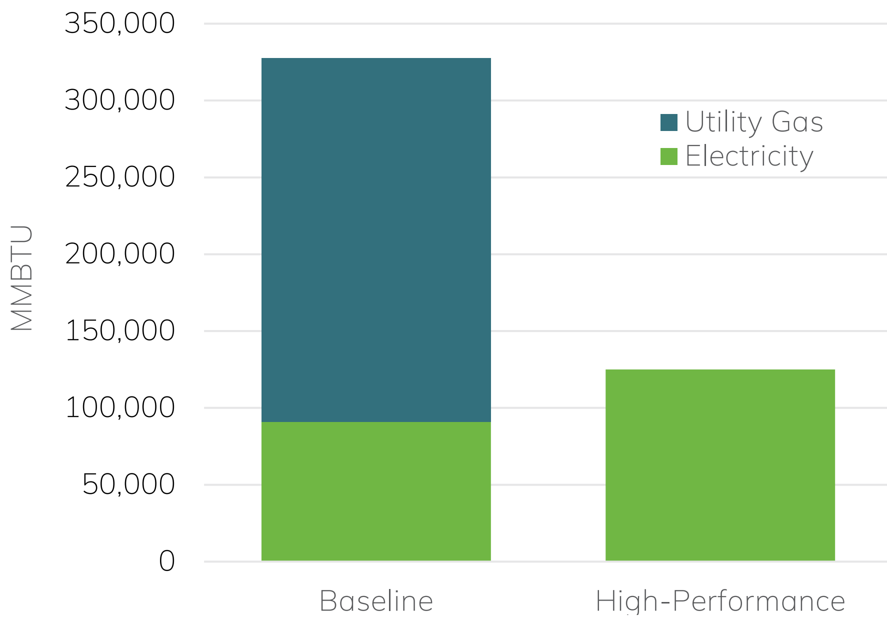

Figure 2. Community-wide building energy use comparison

3.4 Development Energy Use

To model the development, RCC was split into five neighborhoods: Town Center, Creek Neighborhood, Hill Neighborhood, Southwest Neighborhood, and Outlot A. The Town Center contains a mix of uses, including light industrial, commercial (including a potential big box store), multi-family housing, single-family housing, townhomes, and senior housing. The Creek, Hill, and Southwest Neighborhoods are primarily single-family homes and townhomes. Outlot A is zoned for light industrial. The neighborhoods are displayed in Figure 1.

Table 3 lists the heating and cooling energy and load values for each neighborhood. These values represent the cumulative heating and cooling demand from the high-performance building standard from Section 3: Building Strategies on a tepid water district energy loop. Notably, the Town Center has the highest building density among the five neighborhoods, accounting for over half of the total building square footage in RCC, with nearly 2.6 million gross square feet (GSF) of building area.

	Building GSF	Heating/DHW MMBtu	Heating/DHW MMBtu/hr	Cooling Ton-hrs	Cooling Tons
Town Center	2,576,200	35,000	28.1	2,424,000	2,880
Hill	911,378	12,000	7.6	863,000	820
Creek	384,508	5,000	3.1	343,000	340
SW Neighborhood	698,450	11,000	7.0	617,000	610
Outlot A	425,940	7,000	8.3	313,000	900
Total	4,996,476	70,000	54.0	4,560,000	5,550

Table 3. RCC building square footage, heating energy and load, and cooling energy and load by neighborhood.

The heating and cooling energy consumption and peak load will be phased according to the current development schedule. The full buildout of the development is planned for 2030, at which time a majority of buildings will be constructed and occupied. In the initial year of development, 2027, approximately 40% of the total development is expected to be completed, contributing a significant portion of the total heating and cooling energy and load in the early years. Should the development timeline be accelerated or extended the conclusions in this analysis would remain the same. A district energy system, which requires significant infrastructure and upfront costs, can benefit from this early concentration of development. The development building area, heating demand and energy, and cooling demand and energy are summarized by year in Table 4.

		2027	2028	2029	2030	Total
Building Area	GSF	1,974,117	1,088,401	635,000	1,298,958	4,996,476
Heating & DHW Demand	MMBtu/hr	23.3	10.8	6.2	13.7	54.0
Heating & DHW Energy	MMBtu	29,000	17,000	9,000	15,000	70,000
Cooling Demand	Tons	2,320	990	560	1,680	5,550
Cooling Energy	Ton-hrs	1,770,000	1,080,000	480,000	1,230,000	4,560,000

Table 4. Development building area, energy, and loads by year.

4. District Energy System

A district energy system includes three primary components: building connections, thermal energy sources, and a tepid water distribution system. An underground, closed-loop distribution network circulates clean water throughout the community at a constant temperature. Water-source heat pumps, installed in each building, extract heat from the water loop for heating and reject heat into the loop for cooling. The system's flexibility, reliability, and efficiency are enhanced by the ability to utilize multiple energy source solutions to maintain the water loop's temperature, enabling the selection of the most cost-effective and efficient options.

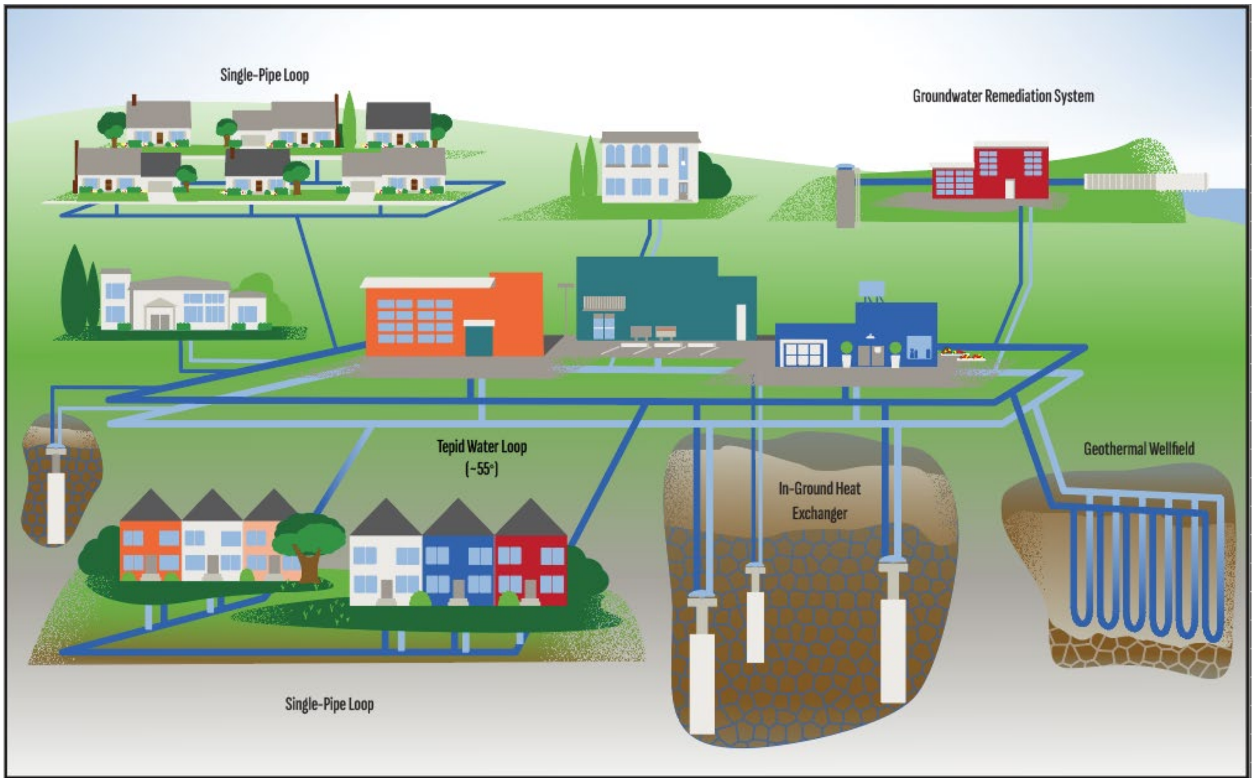

Figure 3. RCC district energy concept

4.1 Building Connections

In a district energy system, each building connects individually to the tepid water loop that runs through the community. Each connection typically includes service piping, service isolation valves, fittings, control valves, strainers, energy meters, and potentially heat exchangers. While heat exchangers are not necessarily required for single-family and townhome connections, they are recommended for multifamily and commercial buildings. These buildings may have internal water loops, and heat exchangers would isolate the district loop from the building's internal loop.

The Rice Creek Commons development includes over 640 buildings (including single-family houses). Connecting all these buildings to the district energy system would cost approximately $4.1 million. If the system were scaled down to serve only the Town Center, which includes 99 buildings, the estimated connection costs would be approximately $1 million.

The primary focus is on electrifying building heating and cooling demands through the use of water source heat pumps in the buildings. Water source heat pumps offer a sustainable, reliable, and often cost-effective energy solution for communities, reducing reliance on fossil fuels and mitigating GHG emissions. The estimated cost for the in-building heat pump equipment is $113.5 million.

4.2 Thermal Energy Solutions

The district energy system allows for a combination of serval energy sources, and this analysis seeks to determine the most cost-effective and energy efficient options to serve the Rice Creek Commons community. Several energy sources were analyzed, including connection to the TCAAP groundwater remediation system (TGRS), closed-loop geothermal wellfields, in-ground heat exchangers, and aquifer thermal energy storage (ATES). All of these technologies could potentially interact with the groundwater on-site in various ways. Despite restrictions on groundwater extraction due to contamination, the Amended Environmental Covenant and Easement for the property specifically permits technologies that do not withdraw water, such as geothermal heat exchangers.

4.2.1. GROUNDWATER REMEDIATION SYSTEM

The RCC development site houses the TCAAP Groundwater Remediation System (TGRS) that continuously extracts 1,750 gallons per minute (GPM) of water for treatment (as of 2024). This water is treated before being discharged into a nearby quarry, as shown in Figure 4. The system's consistent water flow makes it a potential source to facilitate heat exchange for a tepid water loop. The treated water would not directly flow within the tepid water loop, the loop itself would be a closed system containing only clean water from the development's water supply. At its current rate of extraction, the TGRS could potentially provide approximately 9 MMBtu/hr or 730 tons of heating and cooling capacity. This represents 13% of the total site cooling load and 30% of the site heating load on the district energy system.

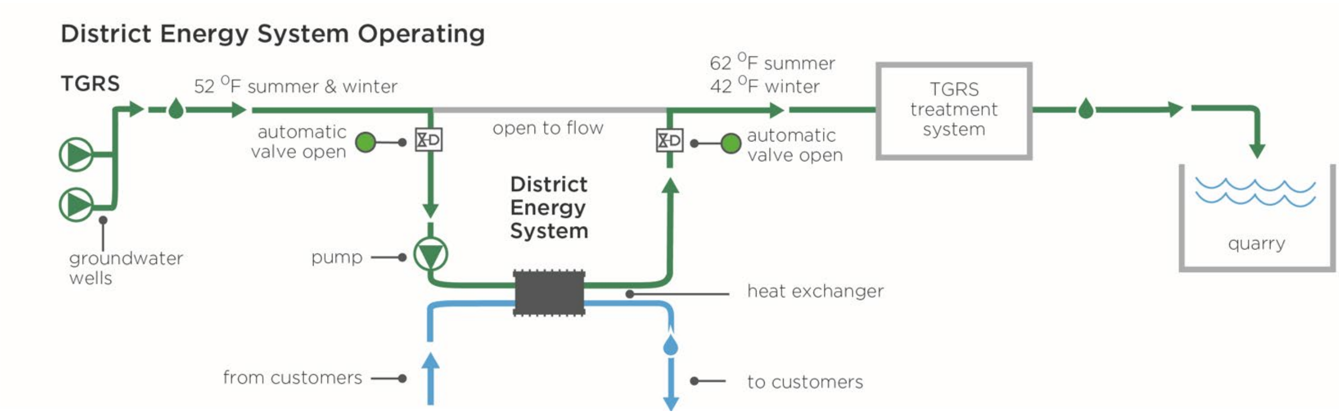

Figure 4. District energy connection to the ground water remediation system.

With much of the necessary infrastructure already in place, this presents a low-cost opportunity for energy capture and extraction. The TGRS connection would require adding heat exchangers, pumps, and controls to the treatment building. The estimated cost to connect to a district system is $1.75 million (projected 2027 dollars), which equates to approximately $200,000 per MMBtu/hr or $2,400 per ton of cooling capacity. This analysis did not cover the regulatory approvals necessary for use of the TGRS, which is owned by the US Army.

4.2.2. CLOSED-LOOP GEOTHERMAL WELLFIELDS

Closed-loop geothermal wellfields coupled with a tepid water district energy system utilize the stable ground temperature (approximately 55°F) for heating and cooling. A network of closed-loop wells is drilled into the ground to circulate water, which acts as a heat transfer fluid. This water would circulate through a closed-loop system, transferring heat to or from the ground as needed. In winter, the ground's warmth is extracted and distributed to buildings via the tepid water district energy system network. Conversely, in summer, heat is transferred from buildings to the ground for cooling.

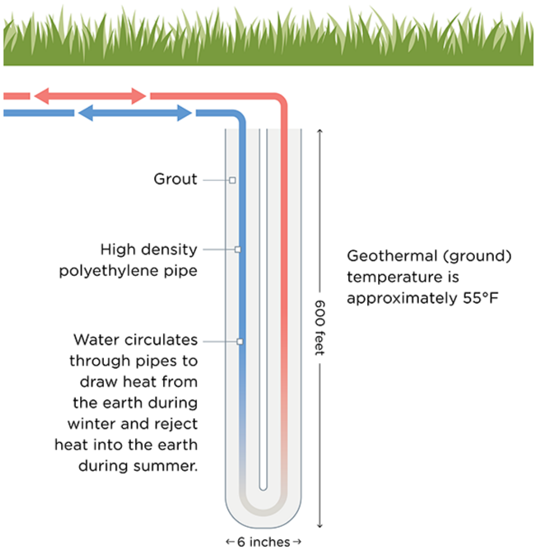

Figure 5. Closed-loop geothermal well

Geothermal wellfields can be installed beneath parking lots, athletic fields, and most green spaces. The wells are fully concealed, allowing uninterrupted use of the surface area above. Each well typically costs around $30,000, but costs can vary significantly depending on soil conditions and well depth. Each well can produce 1 to 3 tons of cooling or heating capacity. At an average capacity of 2 tons per well, the cost for geothermal is $15,000 per ton, or approximately $1.25 million per MMBtu/hr. To serve the entire RCC development, approximately 2,850 wells would be required, occupying 27.5 acres of land for geothermal wellfields, at a total estimated cost of $86 million. Figure 6 illustrates potential locations for well fields (shown in orange), which when combined, would exceed the high-performance building heating and cooling demand for RCC.

The district energy system allows the wellfields to be split up and installed in various locations along the distribution loop. This provides system redundancy and can allow for reduced distribution pipe sizes. A district energy network may require 20% to 30% less wells when compared to each building installing their own wells, due to system load diversity.

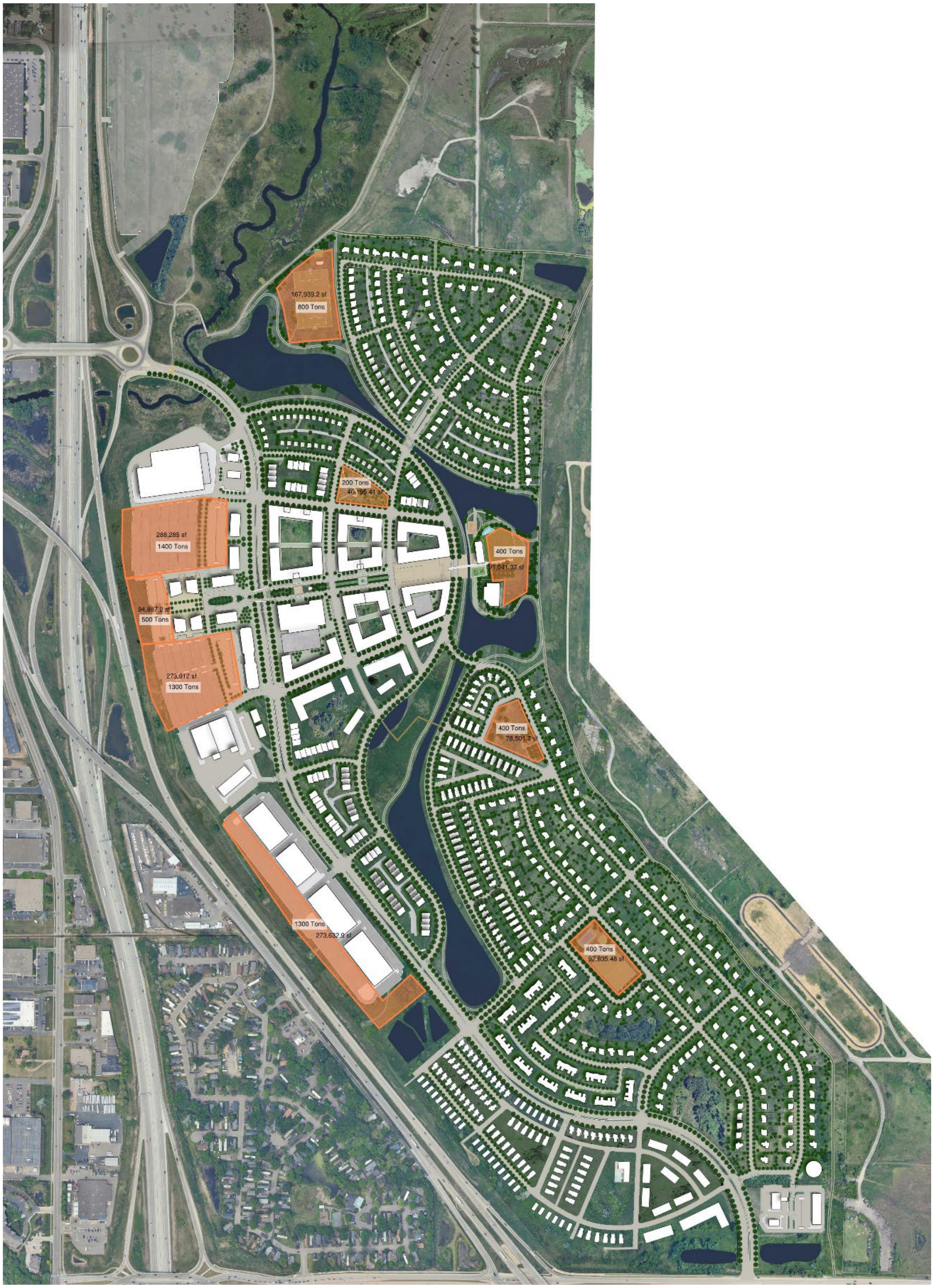

Figure 6. RCC conceptual locations for geothermal wellfields

4.2.3. GEOTHERMAL EXCHANGE WITH IN-GROUND HEAT EXCHANGERS

In-ground heat exchangers are a groundwater-based solution for heating and cooling buildings. The in-ground heat exchanger taps into the thermal capacity of groundwater and takes advantage of consistent groundwater temperatures. These systems provide significantly more energy per unit of space compared to traditional closed-loop geothermal wellfields. The system utilizes a heat exchanger and pump installed in a standard, purpose-built well. The groundwater remains underground, while the district energy system circulates potable water, in a closed loop, through the underground heat exchanger. This design ensures that groundwater remains undisturbed, mitigating any potential impacts on TGRS and the groundwater remediation efforts.

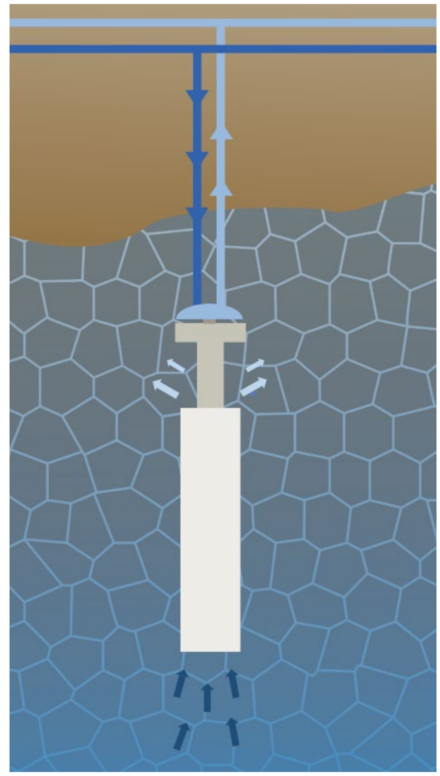

Figure 7. In-ground heat exchanger style heat transfer

The number of in-ground heat exchangers can be scaled to meet specific heating and cooling demands; each well has a potential capacity of 600+ MBH (50 tons) of heating and 100 tons of cooling. This approach reduces the geothermal system's footprint by 95%, making it ideal for space-constrained sites, minimizing disruption, installation time, and construction costs. Each in-ground heat exchanger is estimated to cost $500,000, which equates to $5,000 per ton of cooling and $830,000 per MMBtu/hr of heating. The in-ground heat exchangers do not need to be installed in a central location or close to one another. They can be spread out along the district energy system distribution network, increasing system resiliency, redundancy, and potentially reducing the distribution system pipe diameter size.

4.2.4. AQUIFER THERMAL ENERGY STORAGE

Aquifer thermal energy storage (ATES) is another ground source-based technology that uses the thermal properties of underground water-bearing rock formations to store and retrieve thermal energy for heating and cooling applications. ATES relies on a series of wells and piping systems that can move heat between buildings and the local aquifer. The process works by pumping water from the aquifer to a heat exchanger, where heat is either extracted or rejected to the aquifer water. The aquifer water is then returned to the aquifer through another well. In the summer, cool water is pumped from the aquifer to cool buildings, while in the winter, warmer water is pumped to provide heating. This system allows for efficient use of energy as the temperature of the aquifer remains relatively constant over the course of a year. The ATES process for a typical year is shown in Figure 8.

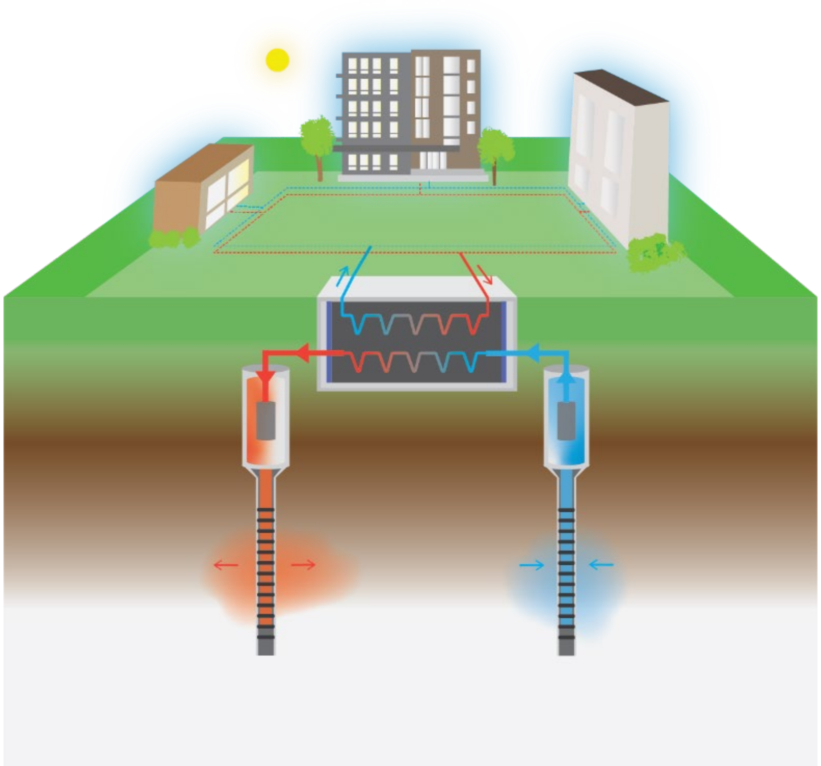

Figure 8. Aquifer thermal energy storage process during the cooling season.

ATES is generally more cost-effective than traditional closed-loop geothermal wells or in-ground heat exchangers, with estimated costs of $6,000 per ton of cooling and $500,000 per MMBtu/hr for heating. While ATES presents a potential energy resource for RCC, the potential negative impacts on the operation of the groundwater remediation system were deemed too risky and this technology was not modeled as a viable option.

4.2.5. PRODUCTION SUMMARY

RCC is well suited for a district energy system that incorporates multiple geothermal and ground source energy solutions. This system could combine the groundwater remediation system (TGRS) with another ground-source technology, both connected to a district energy network. This approach offers source and loop redundancy, as well as opportunities for future expansion and increased capacity.

		TGRS	In-Ground HE	Geothermal Wellfields
Cost per Ton of Cooling	$/Ton	$2,420	$5,000	$15,000
Cost per MMBtu/hr of Heating	$/MMBtu/hr	$200,000	$830,000	$1,250,000

Table 5. Estimated probable cost per unit of production capacity

Integrating heat transfer with the groundwater remediation process offers the lowest installation cost per unit of energy, it could reduce the RCC district energy production source cost by over $7 million. The groundwater remediation system would eliminate the requirement for 10 in-ground heat exchangers or 365 geothermal wells (approximately 3.5 acres of wellfield). However, there is sufficient capacity for district energy from other solutions if it is not possible to use the TGRS. Assuming the next available lowest-cost energy solution is the in-ground heat exchangers, the impact on the total cost for production capacity is shown in Table 6.

		Without TGRS Connection	With TGRS Connection
RCC Full District Energy	MM$	$48.9	$41.7
Town Center District Energy	MM$	$26.0	$19.4

Table 6. Cost comparison of the district energy system using the groundwater remediation system to the energy system or not

4.3. District Energy System Distribution

The community-wide district energy distribution system would operate as a tepid water loop, enabling buildings to both reject and extract heat. This system would be closed-loop and comprise supply and return piping in the Town Center and Outlot A and single-pipe loops in the residential neighborhoods. The water in this closed-loop tepid water system will originally come from the city water system, not the aquifer. Constructed of high-density polyethylene (HDPE), the distribution piping is estimated to range in diameter from 2 to 16 inches, except for service laterals. To serve every building on the RCC site a conceptual pipe route is shown in Figure 9, the route includes over 45,000 trench feet (8.5 miles) of piping.

The estimated cost to install the piping network is $34.3 million. One strategy to reduce distribution costs involves implementing a single-loop main pipe instead of the traditional supply and return mains. Each building connection would require a supply and return service pipe equipped with a pump to circulate water. The water would be drawn from the main loop, passed through a heat pump, and then returned to the loop. This single-pipe loop approach was assumed for the residential neighborhoods, which reduces installation costs. However, during periods of high demand, the loop may trend warmer or colder for buildings located on the far end of the loop, slightly impacting their equipment efficiency.

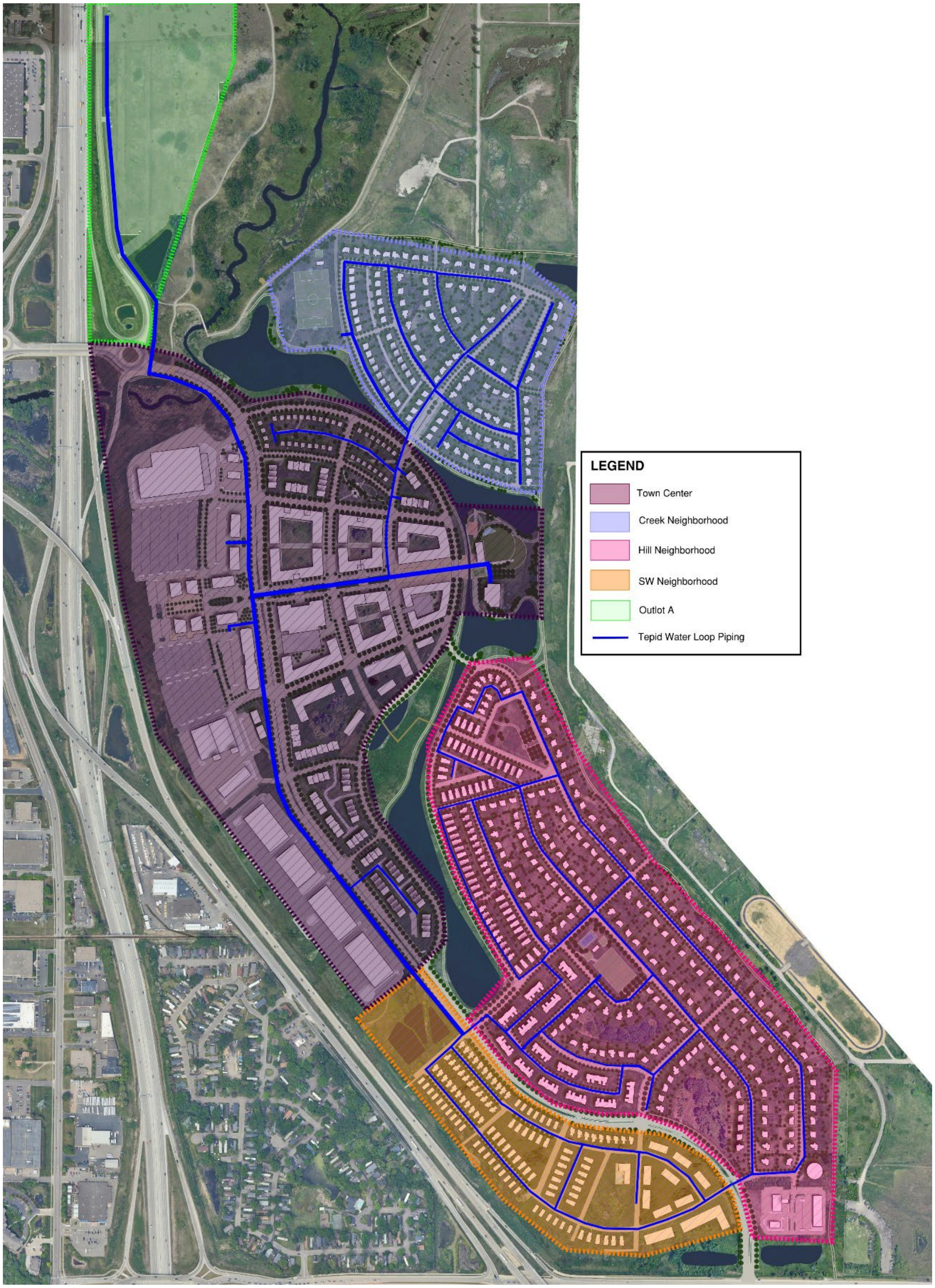

Figure 9. Proposed distribution mains.

Another scenario considered limiting the district energy system to the Town Center, shown in purple in Figure 9. This is the area of RCC with the highest building density. This reduces the required trench length from approximately 45,000 feet to just over 10,000 feet. As a result, the estimated total distribution cost decreases to approximately $9.5 million.

5. Energy Modeling Scenarios

Ever-Green and LHB developed energy models for different scenarios and analyzed them for GHG emissions and life cycle cost over 30 years. These models provide insight into the advantages and disadvantages of different energy supply options for Rice Creek Commons.

5.1 Scenario Comparison

5.1.1. BUSINESS-AS-USUAL

In a business-as-usual scenario, all buildings within RCC adhere to the current Minnesota Energy Code (ASHRAE 90.1-2019) and are based on the baseline set in Section 3: Building Strategies. Both natural gas and electricity serve these buildings, with Xcel Energy as the sole electricity provider. Gas-fired heating systems, including forced air furnaces, rooftop units, and air handling units, are assumed to be in place.

5.1.2. SCENARIO 1: DISTRICT ENERGY – ENTIRE DEVELOPMENT

This scenario involves high-performance buildings, as set in Section 3: Building Strategies, that are entirely electric. These buildings are integrated into a district energy network, including all single-family homes and townhomes. Water-to-water heat pumps or water source variable refrigerant flow (VRF) systems would provide heating and cooling to buildings.

5.1.3. SCENARIO 2: DISTRICT ENERGY – TOWN CENTER

Similar to Scenario 1: District Energy – Entire Development, this scenario includes high-performance buildings, as set in Section 3: Building Strategies, that are entirely electric. However, this scenario concentrates on a district energy network in the Town Center, which is the densest area of the site and would serve multi-family housing, senior living, light industrial, and commercial spaces in the Town Center. Water-source heat pumps or water-source VRF systems would provide heating and cooling for the Town Center buildings. The single-family homes and townhomes on the rest of the site would not be served by district energy, and are assumed to use geothermal wellfields at each individual building site with water-source heat pumps or variable refrigerant flow (VRF) systems.

5.1.4. SCENARIO 3: DECENTRALIZED GEOTHERMAL

Scenario 3 does not have a district energy system. Instead, each building has its own electric heating and cooling equipment. The scenario assumes the same high-performance electric buildings as Scenario 1 and 2. Heating and cooling would be provided at each individual building site by geothermal ground source with water-source heat pumps or variable refrigerant flow (VRF) systems.

While there is sufficient land area to accommodate geothermal wellfields connected to a district energy system, the district energy system can leverage large green spaces, playing fields, and parking lots to meet energy demand. In practice, a playing field with an underlying wellfield on the north end of RCC could serve buildings on the south end. However, without a district energy system, individual buildings, especially in high-density areas, might not have enough land to meet their heating and cooling energy demands. This could be mitigated using technologies like in-ground heat exchangers.

5.1.5. OTHER SCENARIOS CONSIDERED

The following scenarios were also modeled but are not included in this analysis.

- Decentralized air source heat pumps or VRF systems. This scenario may require additional equipment, increased capacities due to potential derating in colder temperatures, and cold climate-specific components. Electric strip heating might also be necessary for peak loads. This scenario may not be technically feasible for all building operations. Condenser units could occupy roof space that could otherwise be used for solar PV. This scenario is not included in the analysis due to feedback from the developer that if a decentralized system were selected, a decentralized geothermal (Scenario 3) would be preferred.

- Decentralized electric resistance heat. This scenario is unlikely due to the high electrical demand and associated energy costs, therefore it is not included in this analysis

5.2. Heating and Cooling GHG Emissions

By state statute, Minnesota's electric grid is planned to be carbon-free by 2040.[2] Until then, the GHG calculations are based on Xcel Energy's Integrated Resource Plan. By implementing all-electric heating and constructing high-performance buildings at RCC, emissions from heating and cooling systems would be reduced by over 90%. With a district energy system or decentralized geothermal water source systems, the reduction could be up to 98%. The 30-year cumulative GHG emissions are summarized in Figure 10. Heating and cooling energy could become carbon-free prior to 2040 by utilizing on-site solar PV or purchasing renewable energy through Xcel Energy or other providers.

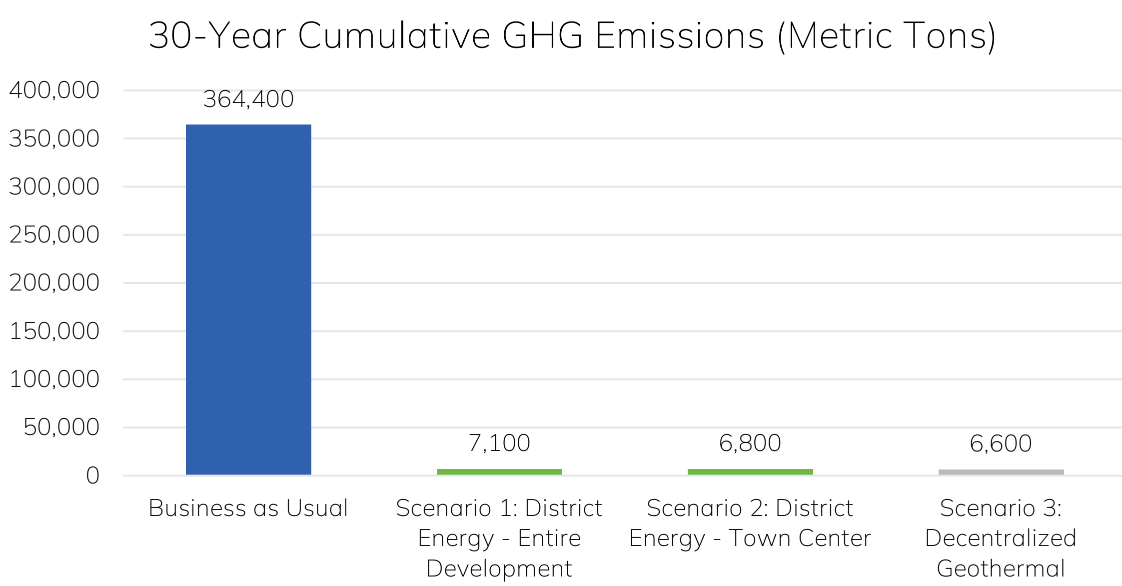

Figure 10. 30-Year cumulative heating and cooling GHG emissions

[2] Minn.Stat. 216b.1691 (2023)

5.3 Energy Model & Life Cycle Cost analysis

The life cycle analysis considered equipment efficiencies, energy rates, and the capital and operating costs associated with the proposed energy systems.

5.3.1 CAPITAL COST

The estimated capital costs for each scenario are summarized in Table 7.

		Scenario 1: District Energy - Entire Development	Scenario 2: District Energy - Town Center	Scenario 3: Decentralized Geothermal
Distribution Network	MM$	$34.3	$9.5	$0.0
Building Connections	MM$	$117.6	$117.6	$117.6
Energy Source/Sink	MM$	$41.7	$66.3	$99.6
Total	MM$	$193.6	$193.5	$217.2
Total with IRA Reductions	MM$	$161.6	$139.8	$130.3

Table 7. Probable estimated capital cost for heating and cooling RCC buildings

By leveraging the Inflation Reduction Act (IRA), a 40% reduction in the capital costs for the district energy distribution system, thermal sources, and building connections was assumed. The in-building equipment costs, such as water-source heat pumps and VRF systems, were assumed to be the same for each scenario. However, the IRA deduction does not apply to in-building equipment for buildings connected to the district energy system. The IRA impacted the total capital cost for each scenario as follows:

- Scenario 1 – With IRA funding, the total capital cost decreased by $32 million.
- Scenario 2 - This scenario includes decentralized systems outside the Town Center. The decentralized geothermal well costs were estimated at $46.9 million, and the district energy thermal source was estimated at $19.4 million, totaling $66.3 million. The IRA was also applied to the decentralized systems, including the in-building equipment, decreasing the total capital cost by $53.6 million.
- Scenario 3 - This is the most capital-intensive scenario, but more of the IRA funding can be applied to in-building systems. This reduced the total estimated capital cost from $217.2 million down to $130.3 million, a reduction of $86.9 million.

If the IRA were applied to in-building equipment for district energy connections, the total cost for Scenarios 1 and 2 would be $116 million for each scenario. This would reduce the total capital cost to be lower than Scenario 3 by approximately $14 million. Further research is necessary to determine the IRA's applicability in this context.

5.3.2. OPERATING COSTS

Operating costs consist of electricity consumption for water-source heat pump and VRF system, pumps, and well pumps. Additionally, the district energy system requires a management and maintenance allowance. Capital costs are not included in the operational costs.

In 2030, the first year of full buildout, the estimated operational cost under a business-as-usual scenario is $2.6 million. Scenarios 1, 2, and 3 have estimated cost savings of $0.7 million, $0.8 million, and $1 million, respectively, compared to business as usual, as summarized in Table 8. This results in an estimated operational cost savings ranging from 27% to 38% depending on the scenario.

		Scenario 1: District Energy - Entire Development	Scenario 2: District Energy - Town Center	Scenario 3: Decentralized Geothermal
Green Energy Operational Cost	(MM$)	$1.9	$1.8	$1.6
Operational Cost Savings	(MM$)	$0.7	$0.8	$1.0
Operational Cost Savings	%	27%	31%	38%

Table 8. Estimated operational costs in the year 2030.

The 2030 operational cost trend continues throughout the 30-year life-cycle cost analysis. A comparison of the cumulative operational costs from 2027 to 2050 is illustrated in Figure 11.

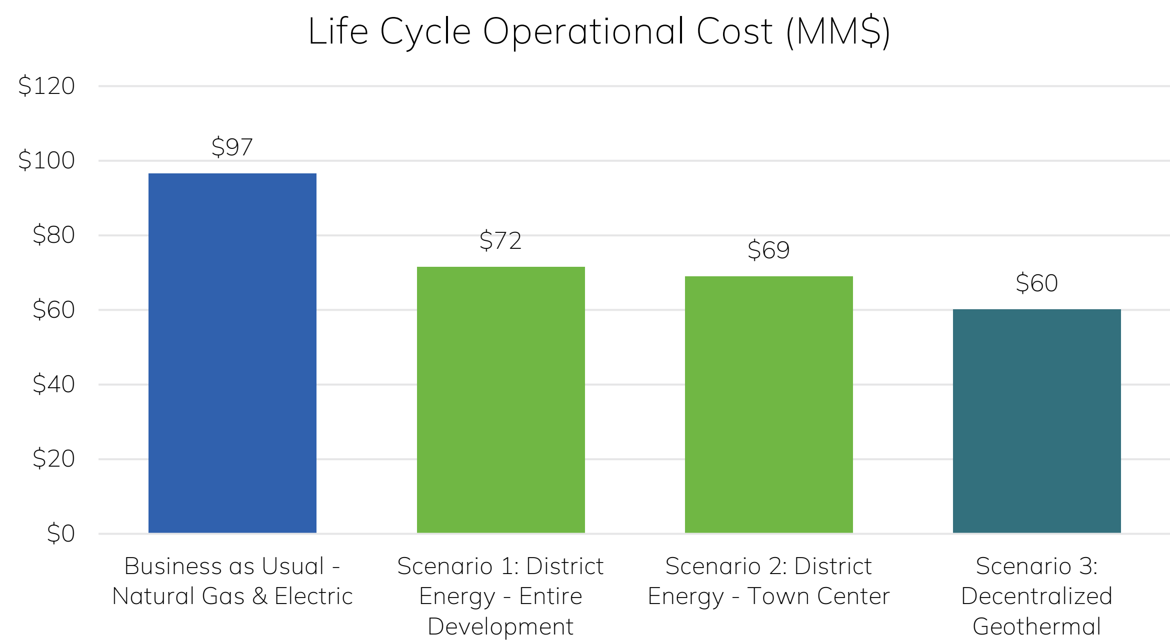

Figure 11. 30-year life cycle operational cost comparison

5.3.3. NET PRESENT VALUE

A net present value (NPV) analysis was conducted based on a 30-year life cycle cost analysis from 2027 through 2057. The analysis, summarized in Figure 12, included capital costs and operational costs. Scenario 3, decentralized geothermal, has the lowest net present value, making it the most financially advantageous investment over the 30-year period. This is primarily attributed to the IRA funding being applied to the in-building equipment. Scenario 1, district energy for the entire RCC development, has the highest net present value as it incurs the full cost of in-building equipment.

To assess the impact of in-building equipment costs when the IRA reduction is not applied to district energy connections, an additional model was completed with the IRA also applied to the district energy in-building equipment costs. This reversed the outcome presented in Figure 12. Scenario 1, which initially had the highest net present value, now has the lowest at $134 million, a reduction of $41 million. Conversely, Scenario 3, previously the least costly, now has the highest NPV at $148 million. As illustrated in Figure 12, the blue bars represent the scenarios where the IRA is not applied to the in-building equipment for district energy system connections, while the green line represents the results with the IRA applied to the in-building equipment for all scenarios.

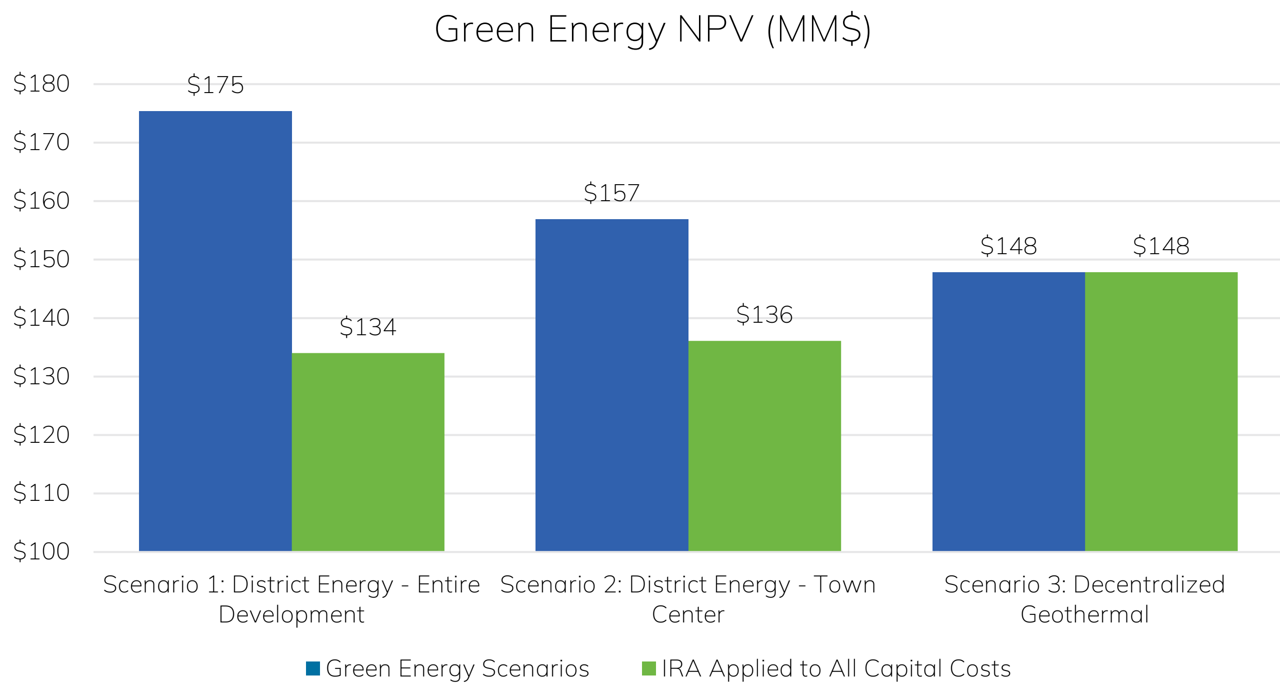

Figure 12. Impact of IRA funding on in-building equipment: NPV comparison for green energy scenarios with and without IRA support for district energy connection in-building equipment.

5.3.4. ENERGY AND LCCA MODELING SUMMARY

The energy model and life-cycle analysis evaluated three scenarios: District Energy – Entire Development, District Energy – Town Center, and Decentralized Geothermal. These scenarios were compared against each other and the baseline (business as usual) to assess the potential benefits and drawbacks of different energy strategies.

Prior to applying the IRA funding reduction, the decentralized geothermal scenario had the highest capital cost. However, with IRA funding applied to all heating and cooling equipment in the decentralized buildings, it becomes the most cost-effective option, with the lowest capital cost to implement and the lowest cost per metric ton of carbon avoided. This scenario also provides the lowest projected operating costs, resulting in the lowest NPV among all scenarios. The results of the energy model and life-cycle cost analysis for each scenario are summarized in Table 9.

		Scenario 1: District Energy – Entire Development	Scenario 2: District Energy – Town Center	Scenario 3: Decentralized Geothermal
Capital Cost (With Reductions)	(MM$)	$162	$140	$130
Green Energy NPV	(MM$)	$175	$157	$148
2030 Operational Cost Savings	(MM$)	$0.7	$0.8	$1.0
Life Cycle Operational Cost Savings	(MM$)	$25.0	$27.6	$36.3
Life Cycle GHG Savings	(tons)	357,000	358,000	358,000
Capital $ per Ton CO2 Avoided	($)	$453	$391	$364

Table 9. Life cycle cost analysis results.

The analysis assumes that IRA funding does not apply to the in-building equipment costs for buildings connected to a district energy system. However, if IRA funding were applied to in-building costs in all three scenarios, the results would be reversed. Scenario 1 would become the lowest-cost option, with the lowest net present value (NPV) and lowest cost per metric ton of carbon avoided.

6. Renewable Electrical Energy Strategies

Multiple renewable energy strategies are available to serve the needs of Rice Creek Commons, including both on- and off-site options, as described below.

6.1. Xcel Energy's Planned Energy Mix

In 2023, 42% of the energy used to generate the electricity sold by Xcel came from renewable energy sources.[3] Including nuclear power, 64% of the energy was from carbon-free sources.[4] Xcel plans for these percentages to continue increasing (Table 10), and by 2040, Minnesota law requires all electricity sold in the state to be from carbon-free sources.[5,6] Because of this rapid decarbonization, any grid electricity used at RCC will have a relatively low carbon footprint over the life of the buildings.

[3] Xcel Energy, Certified Renewable Percentage for Minnesota, 2023. To avoid allocating renewable energy attributes to multiple entities, this percentage only includes sources where the renewable energy certificates (RECs) were retired on behalf of all customers. Additional renewable energy was generated through programs like Windsource, where the customers receive the RECs.
[4] Xcel Energy, Generating Power: Energy Mix Breakdown (Upper Midwest), accessed September 20, 2024.
[5] Xcel Energy, 2024-2040 Upper Midwest Integrated Resource Plan, filed February 1st, 2024.
[6] M.S. 216b.1691

	2023	2030	2040
Renewable	42%	64%	75%
Carbon-Free	64%	80%+	100%

Table 10. Xcel Energy's planned grid mix [7,8]

6.2 On-Site Solar

Decarbonizing the electric grid can be supported by distributed on-site generation in developments like RCC, with rooftops and parking lots hosting solar photovoltaic (PV) systems. Based on the building assumptions used for this analysis, the rooftops at Rice Creek Commons are estimated to be able to host 27 MW of solar PV, which would meet 84% of the community's estimated annual electricity use under the Scenario 2: District Energy – Town Center (Table 11). About half of this generation is from commercial, industrial, institutional, and multifamily buildings, while the other half is from townhomes and single-family homes. Because of their geometry and energy loads, multifamily buildings are typically only able to produce a portion (around 40%) of their annual electricity use, while other building types are typically able to generate more electricity than they use each year.

The amount of on-site solar could be further increased with the use of solar over parking lots and/or other ground-mounted systems. To qualify as a net-zero energy community, RCC would need to generate as much energy as it uses on an annual basis. Installing solar panels over parking lots would help realize this goal.

	Generation Capacity (MW)	Annual Generation (MWh)	% of Electricity Use
Rooftop Solar Potential: All Buildings	27.1	31,900	84%
Commercial, industrial, institutional, multifamily	13.8	15,900	42%
Townhomes, single-family homes	13.3	16,000	42%

Table 11. Rooftop solar potential

Opportunities for on-site solar should be evaluated with consideration to:

- Grid connection and capacity: Solar PV systems can be set up to primarily serve the building's own consumption but can also sell excess energy to the grid. Sites anticipating large amounts of excess generation should coordinate early with the electric utility to ensure the local grid has the capacity to accept this electricity.

[7] Xcel Energy, NSP Renewable Generation Forecasted 2024-2040, provided to LHB upon request, based on the Preferred Plan in the 2024-2040 Integrated Resource Plan filed February 1, 2024.
[8] Xcel Energy, 2024-2040 Upper Midwest Integrated Resource Plan, filed February 1st, 2024.

- Costs/Incentives: There are many programs that can reduce the life-cycle costs of on-site solar, including grant funding, low-interest green loans, property-assessed financing, tax credits, and generation incentives. Eligibility for these programs and the level of benefits may depend on variables like location, building type, income level, system size, domestic content, and prevailing wage.

- Resilience: Buildings with critical loads will want to consider how on-site solar can support maintained functionality when grid power is unavailable. This typically requires battery storage and specialized equipment to cut the system off from the grid during these periods.

Additionally, the following information should be used to determine how to account for on-site solar when calculating greenhouse gas emissions or making statements about renewable energy. While there is overlap between these two types of accounting, there are important nuances that differentiate them.

- Renewable energy statements: Making claims about renewable energy use requires owning the renewable energy attributes of the energy used, tracked via renewable energy certificates (RECs). If a building owner sells the RECs associated with their on-site solar system – for example, by participating in an incentive program like Xcel's Solar*Rewards – that renewable energy use cannot be credited to the building or community. In this case, the community could state they generate renewable electricity but could not claim that a certain percentage of their electricity use is from renewable sources.

- Carbon accounting: Any renewable electricity that is generated and used directly on-site ("behind the meter") can be counted as carbon-free building energy use. However, carbon-free electricity sold to the grid is accounted for within the grid's carbon emission rate, meaning that it cannot also be claimed by the building.

6.3. Utility Green Tariff

Another option for the community to support renewable energy development is for building owners to subscribe to a utility green tariff through Xcel Energy. These are currently available through the Renewable*Connect program, which supports new wind and solar projects in Minnesota. Customers pay a small premium on their electric bills, purchasing renewable energy certificates (RECs) in 100 kWh blocks at $1.50 per block. They also receive fuel cost credits for the subscribed energy. This typically balances out to $6 to $8 per month of added electricity costs for a residential customer.[9]

To be fully carbon-free, all electricity purchases for the community must include bundled RECs, such as those purchased through a utility green tariff.

6.4. Other Renewable Energy Options

While the topics described above are some of the most common ways to incorporate renewable energy sources into new developments, additional opportunities may include:

- Other on-site renewables – such as wind or solar thermal

- Other off-site renewables – such as community solar, power purchase agreements, renewable energy investment funds, direct access to wholesale renewables market, and unbundled RECs

[9] Xcel Energy, Renewable*Connect Flex Information Sheet: Minnesota, 2023.

- Using biogas or green hydrogen to address hard-to-electrify loads

Each of these options has varied implications for carbon accounting and REC ownership and different levels of value regarding resilience, environmental justice, and additionality (making an impact that would not have happened otherwise).

7. Opportunities and Considerations

7.1. Xcel Geothermal Pilot

Xcel Energy is seeking innovative pilot projects to reduce their natural gas system emissions. A key focus is a ground source geothermal heat pump pilot project, up to 500 tons, to serve a multi-use development. Pending approval of the Natural Gas Innovation Act (NGIA), Xcel will initiate a siting analysis to identify potential pilot locations. Comprehensive feasibility studies will then evaluate environmental and construction challenges, load diversity, geothermal wellfield size, and drilling accessibility to select the optimal site. NGIA approval is expected by late 2024, with a potential pilot location identified by mid-2025. Rice Creek Commons appears to align well with the focus of this pilot, and the project team is tracking this potential opportunity.

A challenge is the NGIA flat energy rate for buildings that are part of the pilot, which means those customers would pay much lower energy bills than other buildings. To mitigate energy costs disparities and maximize the pilot project's compatibility with the goals of Rice Creek Commons, connecting the affordable housing buildings to the pilot is a potential solution. Another option would be for the Xcel pilot to feed into a broader district energy network serving RCC. This would eliminate the rate disparity concern and would make Xcel's energy available to all district energy system customers at RCC.

7.2. Potential Funding Sources

The analysis included Inflation Reduction Act (IRA) funds, which reduce applicable capital costs by 40%. These funds are available in the form of rebates for eligible capital costs. The Minnesota Climate Innovation Finance Authority (MNCIFA) could potentially provide bridge funding for upfront costs before the rebates come in. While the IRA is currently the major funding reduction available, additional funding sources could become accessible before construction is scheduled for 2027.

8. Emission Analysis

Once the community is fully developed in 2030, Scenarios 1, 2, and 3 are estimated to generate less annual carbon dioxide (CO_2) emissions than the Business-as-Usual Scenario. Specifically, Scenario 1: District Energy – Entire Development is estimated to generate 83% less annual carbon dioxide (CO_2) emissions than the Business-as-Usual Scenario, Scenario 2: District Energy – Town Center is estimated to generate 82% less annual carbon dioxide emissions than the Business-as-Usual scenario, and Scenario 3: Decentralized Geothermal is estimated to generate 79% less carbon dioxide emissions than the Business-as-Usual scenario. These savings come from eliminating fossil fuel use, constructing high-performance buildings, and using an alternate energy system (the technologies modeled in Scenarios 1, 2, and 3).

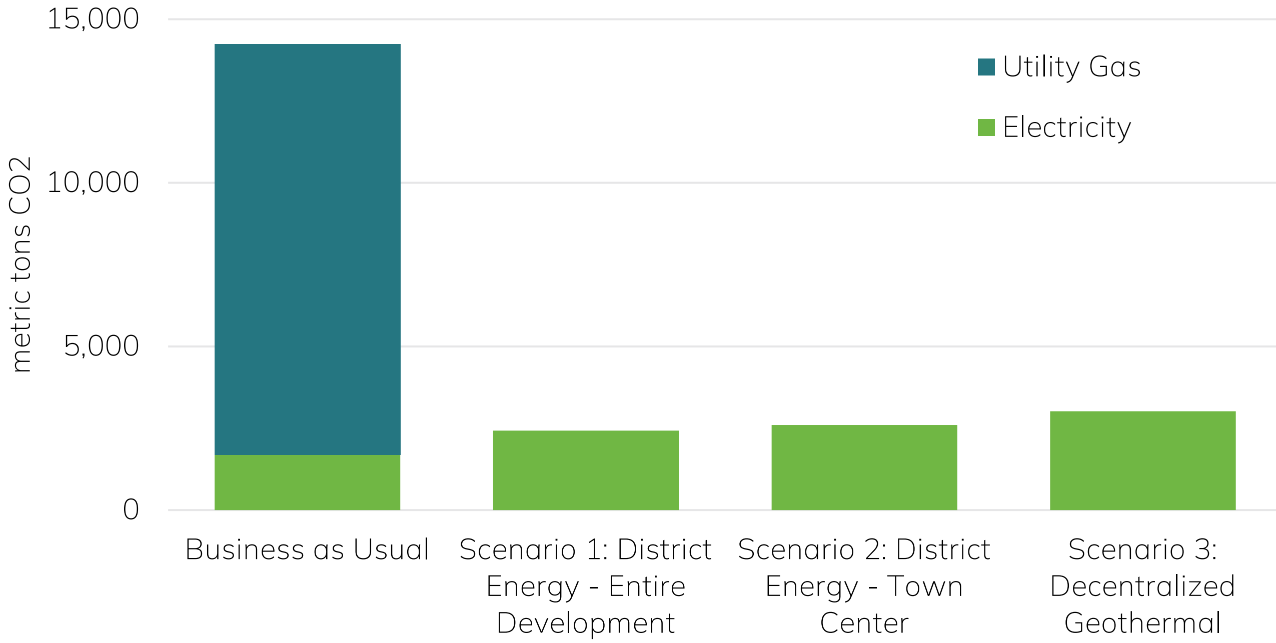

Figure 13. Community-wide emissions from buildings in 2030

In the near term, the community's carbon footprint could be further reduced or eliminated by using carbon-free electricity sources – such as on-site solar and/or utility green tariffs, as described in Section 6: Renewable Electrical Energy Strategies. Since all of Minnesota's electricity must be carbon-free by 2040, an all-electric community should have no carbon emissions from building energy use after that year.

9. Draft Sustainability Design Guidelines

The development of sustainability design guidelines (Appendix I) for RCC supports the JDA's vision to create a climate-forward development by providing a set of rigorous requirements for the developers of buildings/parcels within the community to follow. These guidelines will support the RCC energy vision through requirements for third party rating certifications, building energy efficiency and electrification, on-site renewable energy generation, connection to district energy, embodied carbon reduction, support for electric vehicle infrastructure, and tracking of performance metrics. Although a final version of the guidelines was outside the scope of this project, a comprehensive draft of this team's recommendations was developed and is ready for further discussion with stakeholders.

The following key requirements are included in the draft:

- Each building and tenant improvement to achieve LEED BD+C New Construction certification at the silver level or above.
- All buildings and tenant improvements shall achieve 50% better energy efficiency than the MN Energy Code, certification from the DOE's Zero Energy Ready Home program, or Phius CORE certification as a Passive House.
- All buildings shall be all-electric and shall not use any fossil fuels.

- All buildings shall install photovoltaic systems that maximize on-site energy production.
- All buildings shall connect to the district energy system if this system is available to them.
- All buildings shall conduct a whole building life-cycle assessment and achieve at least a 10% reduction in global warming potential.
- Rigorous requirements for electric vehicle infrastructure.
- All owners shall report building energy consumption and other key energy and water metrics.
- Outline of administration and waiver processes.

10. Selection of Certification Program

In order to support the energy vision and guiding principles of the RCC community, as well as inform the methodology used to establish RCC's greenhouse gas baseline, LHB recommended LEED for Communities as a community-wide certification program. LEED for Communities is a data-driven, comprehensive third-party system that addresses transportation, water, energy, natural systems, greenhouse gas reduction, materials/resources, and quality of life.

To inform this selection, LHB's Project Team analyzed two third-party rating system options. These options were to a) require a rating system for the whole community or b) require sustainability design guidelines for individual buildings. LHB identified LEED Cities and Communities: Plan and Design, as well as LEED for Neighborhood Development, as specific rating systems that could be required for the entire RCC community. LEED for Building Design and Construction (BD+C), the DOE Zero Energy Ready Home Program, and LEED Campus were identified by LHB as potential sustainable design guideline frameworks for individual buildings (where LEED Campus is an approach to certification, rather than a rating system). For each of these options, the pros/cons, central areas of impact, and anticipated fee were considered.

LEED for Communities was chosen for further evaluation because of its focus on public access to green space, green travel priorities, and ambitious strategies for pushing health/wellbeing, which align with some of RCC's key goals. LHB analyzed the feasibility of achieving LEED for Communities Gold or Platinum certification, which are ambitious targets meant to "push" the project beyond where it would be without a rating system. The LEED for Communities Scorecard was used to identify areas of required and optional credit. Strategies required by LEED for Communities include ecosystem assessment, public access to green spaces, integrated water management, social infrastructure, and an organics collections service. The initial feasibility analysis indicates that pursuing Platinum certification is a reasonable goal. The timeline from LEED for Communities registration to precertification to certification was estimated to be around 2 years, and ballpark fees for the JDA were estimated to be around $250,000.

After determining the feasibility of LEED for Communities, LHB reviewed the system's pros/cons with the Energy Advisory Committee (EAC). Some of the largest pros of LEED for Communities are its reliability and ability to "push" the project if Gold or Platinum is pursued. Some of the cons of LEED for Communities are its high input needs: the program takes a lot of time, effort, and monetary expenses. Based on these discussions, LHB proposed a recommendation for pursuing LEED for Communities to the EAC and the JDA, who approved the decision to pursue LEED for Communities certification for the community as a whole. Further discussion will be needed to confirm the pathway for certification of individual buildings.

11. Concerns and Mitigation

Though many of the green energy and sustainability strategies analyzed are becoming industry standard, some of the recommendations may go above and beyond the typical business-as-usual for development. As such, there may be some questions about the technical and financial feasibility of the measures described above. Based on Ever-Green Energy and LHB's analysis and professional experience, they believe these concerns can be mitigated. The project team is committed to collaborating with project partners to implement these ambitious strategies.

- The high-performance buildings would be constructed to a significantly higher energy standard than the current building code. This might result in increased capital costs to construct these buildings. To mitigate these cost increases, as well as reducing the operational cost of energy for occupants, the following rebates and funding sources may be available:
    - Inflation Reduction Act (IRA)
        - Investment Tax Credits (ITC) for clean energy solutions including solar and geothermal: this program enables tax-exempt organizations to receive a direct play credit for 6-70% of the system cost depending on several factors. For this project, a 40-50% credit is a feasible estimate.
        - Home Energy Rebates (HOMES & HEAR): incentives for energy efficient equipment and appliances may be available up to $14,000 per unit, however, this program has not yet launched and details are still in development.
        - 45L Tax Credit: this program provides federal tax credits for builders of energy efficient single or multifamily homes. Credits range from $2500-5000 per single family home or $500-$5000 per dwelling unit. The maximum credit of $5000 for single family homes and $5000 per dwelling unit (in a multifamily building) is based on achieving DOE Zero Energy Ready Home program and prevailing wage requirements.
        - 179D Energy Efficient Buildings Tax Deduction: the IRA enhanced this tax deduction to enable the designer of tax exempt-owned buildings to deduct up to $5.00 per square foot for energy efficient building projects.
    - Xcel Energy rebates
- Green Bank Loans (MNCIFA)
- Ground-Source Energy Systems Interaction with Contaminated Groundwater: The amended and restated deed for the site that restricts certain uses of the groundwater on the site explicitly allows for the use of geothermal energy for the development.
- Land Area Available for Decentralized Geothermal Wells: Decentralized geothermal (Scenario 3) is shown as the most economical scenario, but its implementation may present challenges. Individual buildings, especially in high-density areas, might lack sufficient land for geothermal wells to meet

their heating and cooling energy demands. While in-ground heat exchangers could be considered as an alternative, developer feedback indicated a preference for geothermal wellfields. District energy uses land more efficiently and would not have this issue.

- Inflation Reduction Act (IRA) rebates defray capital costs more for a decentralized system (Scenario 3) than with district energy (Scenarios 1 and 2). The project team is researching whether there are other ways to structure a system to mitigate this issue.

12. Next Steps

The findings in this report demonstrate that an all-electric, carbon-free development is both technically and financially feasible at Rice Creek Commons. This is possible by implementing a combination of strategies: reducing energy use through high-performance building standards and providing clean energy from sources such as geothermal ground source and onsite solar.

Implementation of the strategies described in this document will involve deep collaboration between the JDA, developers, and other project partners. As a first step, the JDA could adopt a policy that the Rice Creek Commons development be all-electric and carbon-free. This would mean that the development would be served be renewable energy sources, and no natural gas infrastructure would be built onsite. This policy would provide guidance for the project team and developers while still allowing flexibility to determine specific technologies and strategies to meet this requirement.

The project team will:

- Work with project partners to finalize Sustainability Design Guidelines for JDA approval and implementation.
- Begin LEED for Communities certification process.
- Engage developers to continue to understand cost implications of green energy and sustainability measures and incentives to offset costs.
- Engage developers to compare district energy and decentralized geothermal energy systems.
    - If a district energy system is determined to be the best path forward, the project team will work with the JDA to determine the preferred organizational structure and financing strategy.

RICE CREEK COMMONS SUSTAINABILITY DESIGN GUIDELINES

Last Revised: September 19, 2024

1.1 Purpose. The purpose of these Sustainability Design Guidelines (SDL) is to advance the TCAAP Joint Development Authority's (JDA's) mission to advance sustainable development and to reduce energy use and CO2 emissions to mitigate the effects of climate change at the Rice Creek Commons development. Each building and parcel in the Development shall comply with the SDL. Alternative strategies that show demonstrable and quantifiable progress towards these goals may be considered alternative compliance to the requirements below and potentially approved as a waiver as provided in the recorded Covenants.

1.2 LEED Certification. The JDA is pursuing Leadership in Energy and Environmental Design (LEED) v4.1 for Communities: Plan + Design certification for the Development and plans to submit for pre-certification at the platinum level. Each building and tenant improvement shall achieve LEED BD+C New Construction certification at the silver level or above using the newest version available at the time of registration. The LEED boundary for each improved parcel of land within the Development shall be the same as the boundary of that parcel. Other systems will be considered for one- to four-unit residential buildings, including the DOE's Zero Energy Ready Home (ZERH) program and Phius' Passive House standards.

1.3 Building Decarbonization.

1.3.1 Energy Efficiency. All buildings and tenant improvements shall achieve: 50% better energy efficiency than the applicable Minnesota Energy Code, certification from the DOE's Zero Energy Ready Home (ZERH) program, or Phius CORE certification as a Passive House.

1.3.2 Electrification. Except as otherwise expressly provided herein, all buildings shall be all-electric and shall not use any fossil fuels. Use of fossil fuels can only be incorporated with the prior written consent of the JDA and must be restricted to systems or devices for which an equivalent all-electric system or design is unavailable, impractical, or is determined to present an equity gap, as reasonably determined by JDA. All buildings using any fossil fuels must offset an equivalent amount of carbon emissions each year.

1.3.3 Renewable Energy. All buildings in the Development must install photovoltaic (PV) systems that either:

1.3.3.1 generate, on an annual basis, enough electricity to meet one hundred twenty percent (120%) of the site's anticipated energy use; or

1.3.3.2 include a rooftop array with a rated capacity of not less than 10.75 watts per gross square foot of roof area and a covered parking array for all parking lots containing twenty or more parking spaces – including the top level of multi-level parking structures – with a rated capacity of not less than 7.5 watts per gross square foot of parking area.

All panels used in PV systems must be rated as Tier 1 panels and qualify under the Inflation Reduction Act for the Investment Tax Credit. Any renewable energy credits generated from PV systems in the Development shall be credited to the Development as a whole. Projects that do not generate enough energy, on an annual basis, to meet one hundred percent of their energy use must purchase green power for the remainder.

1.3.4 District Energy. For heating and cooling, all buildings shall connect to the District Energy System if a District Energy System is available to them..

1.3.5 Embodied Carbon. Except as otherwise expressly provided herein, all buildings shall conduct a whole building life-cycle assessment and achieve at least a 10% reduction in global warming potential, using the calculation methods established in LEED BD+C: New Construction. This Section does not apply to single family homes or tenant improvements within commercial buildings.

1.4 Electric Vehicle Infrastructure. The Development shall include infrastructure to support electric vehicles (EV) – as defined by the International Building Code – as follows:

1.4.1 For non-residential parcels where four or more vehicle parking spaces are provided, not less than 4% of the total number of parking spaces or not less than 8% of designated employee-only parking spaces shall be EV ready spaces or EVSE spaces. Not less than 30% of the total number of parking spaces shall be EV capable spaces, EV ready spaces, or EVSE spaces.

1.4.2 For residential parcels, not less than 20% of the total number of parking spaces shall be EV ready spaces or EVSE spaces. Not less than 75% of the total number of parking spaces shall be EV capable spaces, EV ready spaces, or EVSE spaces.

1.5 Reporting. On an annual basis, all owners shall report monthly whole-building energy consumption, on-site energy generation, electrical demand, and water use to Energy Star Portfolio Manager and ensure this information is accessible to the JDA. Owners shall provide other building data upon the reasonable request of JDA.

DOCUMENTATION OF SUSTAINABILITY GUIDELINES

The Joint Development Authority (JDA) design review should be concurrent and streamlined with all City of Arden Hills review processes.

Documentation of the Sustainability Requirements

- Proof of registration with LEED.
- Checklist of the planned LEED credits to be achieved.
- Within one year of building occupancy, provide documentation reporting the LEED certification level and credits achieved.

Energy efficient design and operations

- All buildings and tenant improvements: energy model report showing achievement of 50% better efficiency than the applicable Minnesota Energy Code, certification from the DOE’s Zero Energy Ready Home (ZERH) program, or Phius CORE certification as a Passive House.

Electrification

- Mechanical plans documenting that buildings are all-electric.
- If granted an exception to use gas service, documentation showing offset of an equivalent amount of carbon emissions from offsite sources.

Renewable energy

- PV system specifications showing that panels meet requirements of Section 2.3.3.

- PV system sizing documentation indicating that system will generate enough electricity to meet requirements of Section 2.3.3.

District energy

- Mechanical plans documenting that buildings will be connected to a District Energy System for heating and cooling, if provided by Declarant, its affiliates, or other unrelated third parties.

Embodied carbon

- All buildings (except tenant improvements and detached single family residential) shall provide documentation for LEED MR Credit: Reduce Embodied Carbon indicating achievement of at least 2 points.

Electric vehicle infrastructure

- For each parking area, provide a site plan indicating the total number of parking spaces and number achieving the EV infrastructure requirements of Section 2.4.

Reporting

- Upon building occupancy, set up Energy Star Portfolio Manager to enable sharing with the Declarant.
- Annually, report monthly whole-building energy consumption, on-site energy generation, electrical demand, and water use to Energy Star Portfolio Manager.

Documentation

- Use the provided Sustainability Guidelines Documentation Package in support of these requirements.

Appendix II – LEED for Communities Recommendation Presentation Slide Deck

Agenda

Objective: EAC understands how their goals can be supported by adopting a green rating system for the whole community, for individual buildings, or both, and establish a process for finalizing the decision.

DISCUSS:

- Review goals discussed at 5/2 meeting
- Rating system evaluation process
- LEED for Communities overview
- Sustainability Design Guidelines overview
- Next steps

LHB

EVER-GREEN ENERGY

Energy Vision

Rice Creek Commons will be a vibrant and unique, climate-forward development that aligns with the goals outlined in the State of Minnesota's Climate Action Framework: **carbon neutrality, clean energy, climate resiliency, equity and innovation**. Rice Creek Commons will attract investment and partnership that will create sustainable benefits for the community.

GUIDING PRINCIPLES

- Develop a **resilient community for energy and other utilities** using **clean energy technologies**, **reducing consumption**, and **reusing local resources onsite**.
- Implement infrastructure solutions that are flexible and scalable over 50 years, including developing the site to be adaptable to future technological needs.
- Deliver a model of **efficient energy and water usage** that minimizes Rice Creek Commons' impact on the environment.
- Create an economically competitive and attractive environment for developers and businesses to create a vibrant community with multi-modal transportation options.

LHB

EVER-GREEN ENERGY

Goal Review

RICE CREEK COMMONS…

- Is **walkable and sustainable** within itself.
- Achieves **ambitious goals without pricing itself out of the market**.
- Is the **model for communities** across the U.S.
- **Inspires others.**
- Demonstrates trying to **go as far as possible.**
- Is **financially viable** for the City/County.

LHB

EVER-GREEN ENERGY

Pathways in Support of Energy Vision

Require a rating system for the whole community	and/or	Require sustainability design guidelines
• LEED for Communities: Plan and Design		• LEED for Building Design + Construction v5 for commercial buildings & apartments • Zero Energy Ready Homes (ZERH) for single family & townhomes • Guidelines to address high priority goals

LHB

EVER-GREEN ENERGY

Rating System Evaluation Process

Task: selection of certification program

- The Project Team is proposing analysis of two options to help inform selection of a third-party rating system that will guide the community to achieving ambitious sustainability goals.
- LHB will review the feasibility of achieving points in "LEED for Communities: Plan and Design" and "LEED for Neighborhood Development: Plan," and will assist the JDA in identifying next steps toward certification.
- A decision on the certification system will help inform the methodology used to establish the GHG baseline.
- Documentation toward LEED certification is outside the timeline and budget of this project.

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Rating System Options

LEED Cities and Communities: Plan and Design

- For use in planning stage of a new community
- Data-driven, comprehensive system addressing natural systems, transportation, water, energy, GHG reduction, materials, resources, quality of life

LEED for Neighborhood Development

- For use in planning stage of a new neighborhood
- Focus on site selection, sustainable neighborhood design, green infrastructure/buildings

LEED for Building Design and Construction (BD+C)

- For use during building design and construction of a new building, certified post-occupancy
- Versions for specific buildings types such as residential, retail, warehouses are available

DOE Zero Energy Ready Home Program

- For use during design and construction of residential buildings, certified post-occupancy
- Focus on energy and GHG emissions reduction

LEED Campus

- Note that this is an approach to certification, not a rating system
- Used to certify multiple buildings on a single site that are pursuing LEED commercial rating systems

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Typical LEED Process

1. Owner hires consultant to guide project through certification process
2. Owner pays registration fee
3. Consultant works with team to select credits to pursue
4. Team produces documentation for prerequisites and selected credits with guidance from consultant
5. Owner pays certification fee and consultant submits for third-party review
6. GBCI provides review comments and team responds with additional documentation
7. GBCI grants certification

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LEED for Communities Specifics

- LEED for Communities precertification option
  - Enables marketing as "precertified" in advance of final certification
- Feasible timeline
  - 1 year from registration to precertification
  - 1 year from precertification to certification
- Ballpark fees (JDA)
  - Recommended consultant - SIG: approx. $113,000
  - USGBC/GBCI: approx. $50,000 (based on size)

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LEED for Communities Scorecard

Y	?	N			
5	0	0	**Integrative Process**		5
Y			Prereq	Integrative Planning and Design Process	Required
5	0	0	Credit	Green Building Policy and Incentives	5
5	8	0	**Natural Systems and Ecology**		13
Y			Prereq	Ecosystem Assessment	Required
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	Green Spaces	Required
0	5	0	Credit	Natural Resources Conservation and Restoration	5
2	0	0	Credit	Light Pollution Reduction	2
3	3	0	Credit	Resilience Planning	6
4	7	7	**Transportation and Land Use**		18
0	2	4	Credit	Compact, Mixed Use and Transit Oriented Development	6
1	3	0	Credit	Walkability and Bikeability	4
0	0	2	Credit	Access to Quality Transit	2
2	0	0	Credit	Clean Transportation	2
0	2	0	Credit	Mobility Management	2
1	0	1	Credit	Priority Sites	2
7	5	0	**Water Efficiency**		12
Y			Prereq	Integrated Water Management	Required
Y			Prereq	Water Access and Quality	Required
5	0	0	Credit	Stormwater Management	5
0	5	0	Credit	Wastewater Management	5
2	0	0	Credit	Smart Water Systems	2

Y	?	N			
31	0	0	**Energy and Greenhouse Gas Emissions**		31
Y			Prereq	Power Access, Reliability and Resiliency	Required
19	0	0	Prereq	Energy and Greenhouse Gas Emissions Management	19
4	0	0	Credit	Energy Efficiency	4
6	0	0	Credit	Renewable Energy	6
2	0	0	Credit	Grid Harmonization	2
5	4	2	**Materials and Resources**		11
Y			Prereq	Construction and Demolition Waste Management	Required
Y			Prereq	Solid Waste Management	Required
0	2	0	Credit	Organic Waste Treatment	2
5	0	0	Credit	Recycling Infrastructure	5
0	2	0	Credit	Responsible Sourcing	2
0	0	2	Credit	Smart Waste Management Systems	2
8	0	2	**Quality of Life**		10
Y			Prereq	Demographic Assessment	Required
Y			Prereq	Social Infrastructure	Required
0	0	2	Credit	Affordable Housing	2
6	0	0	Credit	Public Health and Wellbeing	6
2	0	0	Credit	Emergency Management and Response	2
0	6	0	**Innovation**		6
0	6	0	Credit	Innovation	6
0	4	0	**Regional Priority**		4
0	4	0	Credit	Regional Priority	4
65	34	11	**TOTAL**	Possible Points:	110

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

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LEED for Communities Pros/Cons

Pros:

- Provides a third-party certification to ensure requirements are met
- Gives the project a recognizable label for promotional use
- Helps guide sustainability decision-making
- Enables project to make a verified claim about GHG emissions
- Can be used to push the project beyond where it would be without a rating system

Cons:

- Large expense for JDA
- Takes a lot of time and effort
- May not push the project
  - Where it doesn't align with plans already in place
  - Unless Gold or Platinum is pursued

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How LEED for Communities Helps Push Sustainability

Requirements for:

- Providing public access to green space/wetlands
- Including an organics collections service

Optional points for:

- Certifying buildings to LEED
- Reducing light pollution
- Including pedestrian and bike infrastructure
- Employing strategies to reduce travel by individual car
- Designing to reduce GHG emissions
- Including on-site renewable energy generation
- Participating in utility demand-response programs
- Designing paving with recycled content
- Employing outdoor air quality monitoring and other health/wellbeing strategies

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Sustainable Design Guidelines

Sustainable Design Guidelines may be used **in addition to or in lieu of LEED** for Communities to address:

- Building certification requirements
- Energy efficient design and operations
- Electrification
- Renewable energy
- District energy
- Embodied carbon
- EV infrastructure
- Waste management
- Other

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Sustainable Design Guidelines Pros/Cons

Pros:

- Helps guide sustainability decision-making
- Tailored to specific project goals
- Less time/effort than LEED for Communities
- LEED/ZERH certification fees paid by developer, not JDA
- Can be used to push the project beyond where it would be without guidelines

Cons:

- No overall certification label
- Requires administration

LEED BD+C v5

LEED v5 has three central areas of impact:

- Decarbonization
- Quality of life
- Ecological conservation and restoration

Opening for registration in early 2025.

DOE Zero Energy Ready Home Program (ZERH)

A ZERH is a high-performance home that is so energy efficient, a renewable energy system could offset most or all the home's annual energy use.

Requirements:

1. **A home must meet all requirements of the applicable program version, based on building type.**
   - ❖Townhomes can participate in either single family or multifamily programs
   - ❖Single family with permit after 1/1/24 - Single Family Version 2, Rev. 1
   - ❖Multifamily with permit after 1/1/25 - Multifamily Version 2
2. **The builder/developer must be registered as a ZERH program partner**
   - ❖Requires free registration and watching a 40-minute online training
3. **The project must be certified by an approved third-party verifier**

ZERO
ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

DOE Zero Energy Ready Home Program (ZERH)

Funding:

45L tax credit is $5,000 for single family homes, and $5,000 per dwelling unit
- ❖Need to meet prevailing wage requirements
- ❖Offered from 12/31/22-1/1/33

Next Steps

Decide on an approach to certification and sustainable design guidelines.

- Who is deciding?
- What is the timeline?
- How will the decision be documented?

LEED v4.1 Cities and Communities: Plan and Design Cities

Project Checklist

Project Name:
Project ID
Date:

Y	?	N			
5	0	0	**Integrative Process**		**5**
Y			Prereq	Integrative Planning and Design Process	Required
5	0	0	Credit	Green Building Policy and Incentives	5
5	8	0	**Natural Systems and Ecology**		**13**
Y			Prereq	Ecosystem Assessment	Required
Y			Prereq	Construction Activity Pollution Prevention	Required
Y			Prereq	Green Spaces	Required
0	5	0	Credit	Natural Resources Conservation and Restoration - Rice Creek?	5
2	0	0	Credit	Light Pollution Reduction	2
3	3	0	Credit	Resilience Planning	6
4	8	6	**Transportation and Land Use**		**18**
0	2	4	Credit	Compact, Mixed Use and Transit Oriented Development	6
1	3	0	Credit	Walkability and Bikeability	4
0	0	2	Credit	Access to Quality Transit	2
2	0	0	Credit	Clean Transportation	2
0	2	0	Credit	Mobility Management	2
1	1	0	Credit	Priority Sites - ask about definition of infill	2
7	2	3	**Water Efficiency**		**12**
Y			Prereq	Integrated Water Management	Required
Y			Prereq	Water Access and Quality	Required
5	0	0	Credit	Stormwater Management	5
0	2	3	Credit	Wastewater Management	5
2	0	0	Credit	Smart Water Systems	2

Y	?	N			
29	2	0	**Energy and Greenhouse Gas Emissions**		**31**
Y			Prereq	Power Access, Reliability and Resiliency	Required
18	1	0	Prereq	Energy and Greenhouse Gas Emissions Management	19
4	0	0	Credit	Energy Efficiency	4
6	0	0	Credit	Renewable Energy	6
1	1	0	Credit	Grid Harmonization	2
5	4	2	**Materials and Resources**		**11**
Y			Prereq	Construction and Demolition Waste Management	Required
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5	0	0	Credit	Recycling Infrastructure	5
0	2	0	Credit	Responsible Sourcing	2
0	0	2	Credit	Smart Waste Management Systems	2
4	4	2	**Quality of Life**		**10**
Y			Prereq	Demographic Assessment	Required
Y			Prereq	Social Infrastructure	Required
0	0	2	Credit	Affordable Housing	2
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2	0	0	Credit	Emergency Management and Response	2
3	3	0	**Innovation**		**6**
3	3	0	Credit	Innovation	6
2	2	0	**Regional Priority**		**4**
2	2	0	Credit	Regional Priority	4
64	33	13	**TOTAL**	Possible Points:	**110**

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

Attempted Points **110**

Appendix IV – Lifecycle Cost Analysis Assumptions

Life Cycle Cost Analysis Assumptions	Unit	Value	Notes
Energy and Demand Rates			
Summer Electricity Rate	$/kWh	$0.171	https://www.xcelenergy.com/company/rates_and_regulations/rates/rate_books
Winter Electricity Rate	$/kWh	$0.151	https://www.xcelenergy.com/company/rates_and_regulations/rates/rate_books
Natural Gas	$/MMBtu	$7.00	Xcel's Residential 12 Month average Rate
Water	$/kgals	$4.97	
Sewer	$/kgals	$6.91	
Funding Opportunities			
Inflation Reduction Act (IRA)	% of Capital	40%	Toggle.
Grants	$	$0	Toggle.
Rates			
Discount Rate	%	6.5%	
Cost of Capital - Developer	%	7.0%	
Cost of Capital - District Energy	%	6.5%	
Capitalized Interest Period (Years)	%	1	
Payment Periods	%	30	
Inflation Rate	%	2.9%	https://pages.nist.gov/eerc/
Natural Gas	%	2.0%	https://pages.nist.gov/eerc/ (Commercial, 25 years)
Electricity	%	1.9%	https://pages.nist.gov/eerc/ (Commercial, 25 years)
Water/Sewer	%	2.9%	
Equipment Efficiency			
Forced Air Furnace Eff	%	86%	ASHRAE 90.1 Minimum is 80%
Forced Air A/C Eff	(kWe/Ton)	1.2	ASHRAE 90.1 Minimum is 13 EER, however assumed seasonal COP of 3
Magic-Pak Furnace Eff	%	86%	ASHRAE 90.1 Minimum is 80%

Magic-Pak A/C Eff	(kWe/Ton)	1.2	ASHRAE 90.1 Minimum is 13 EER, however assumed seasonal COP of 3
RTU Burner Eff	%	86%	ASHRAE 90.1 Minimum is 80%
RTU A/C Eff	(kWe/Ton)	1.4	ASHRAE 90.1 Minimum is 12.3 EER, however assumed seasonal COP of 2.5
DHW Electric Eff.	%	99%	Electric water heater
All Electric Heating Eff.	COP	2.00	Air-source heat pumps, ASHRAE Minimum 6.7 HSPF2
All Electric Cooling Eff.	(kWe/Ton)	1.2	ASHRAE 90.1 Minimum is 13 EER, however assumed seasonal COP of 3
Energy Modeling Software - Gas Burner Eff.	%	86%	From LHB Modeling Software
Energy Modeling Software - Gas DHW Eff.	%	95%	From LHB Modeling Software
Energy Modeling Software - Heating COP	COP	4.2	From LHB Modeling Software
Energy Modeling Software - Cooling COP	COP	3.5	From LHB Modeling Software
WS Heat Pump Cooling - Ground Source	EER	27	https://www.waterfurnace.com/literature/5series/OMW5-0016W.pdf
WS Heat Pump Cooling - Ground Source	COP	3.50	Annual Assumption, overridden to match LHB modeled values
WS Heat Pump Cooling - Ground Source	kW/ton	0.44	Annual Assumption
WS Heat Pump Heating - Ground Source	COP	4.20	https://www.waterfurnace.com/literature/5series/OMW5-0016W.pdf
Operation and Maintenance			
District Energy System			
Base Annual Management Fee	$	$150,000	
District Energy System	% of Capital	0.10%	Also applies to site based geothermal.
GHG Emission Rates			
Natural Gas	CO2 lb/MMBtu	117	
Electric Utility (2023)	CO2 lb/MWh	575	https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Sustainability%20Report/2023_Xcel_Energy_Carbon_Intensities_Info_Sheet.pdf

Water and Sewer	CO_2 lb/kgal	0.85	Not Used
LCCA Toggles			
Include Ground Water Remediation Connection	(Y/N)	Y	
Include In-Building Costs	(Y/N)	Y	Cost of heat pumps, VRF, and HVAC systems
Include Inflation Reduction Act	(Y/N)	Y	District energy system and decentralized geo (included in-building for decentralized geo)
Include Inflation Reduction Act for DES Buildings	(Y/N)	N	Apply IRA funding to district system in-building equipment (Heat Pumps, VRF, etc.)
Include Grant Funding	(Y/N)	N	