Xcel Energy®

PARTNERS IN ENERGY
An Xcel Energy Community Collaboration

An Energy Action Plan

Technical Advisory Report for the

National Western Center Capital Build Program

October 2017

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Executive Summary

The National Western Center (NWC) is a 250-acre, long-term redevelopment and expansion of the National Western Stock Show site by the City and County of Denver (City), Western Stock Show Association (WSSA) and Colorado State University (CSU), Denver Museum of Nature and Science and History Colorado (NWC Partners). It is one of the largest urban infill projects in the country. The NWC will physically transform north Denver and create tremendous regional economic benefits as it seeks to create *"the global destination for agricultural heritage and innovation."*

The NWC Master Plan identified nine guiding principles for the NWC, including "Embrace an Ethic of Regeneration" and "Engage the River and Nature." Captured in the Master Plan's Regeneration and Sustainability Framework, the NWC Partners have expressed a desire to create a zero energy district (ZED) and carbon neutral future at the NWC. The City, in its role as manager of the NWC Capital Build Program,[1] has a singular opportunity to lay a strong foundation during the Capital Build for sustained success of the NWC's energy future. Long term operations, maintenance and programming of the campus will be the responsibility of the NWC Authority (Authority), which will be established in early 2018. Once established, many critical decisions about campus-wide energy systems will rest with the Authority.

To help frame and pursue these aspirations, CCD engaged with Xcel Energy through its Partners in Energy offering. Partners in Energy is a six-month facilitated planning process culminating in the creation of an Energy Action Plan Technical Advisory Report (Report), followed by ongoing implementation support. For NWC, the facilitated planning process included an energy model used to help gain data-driven insights to the interactions between energy, cost and greenhouse gas (GHG) emissions for the redevelopment and to assist stakeholders in recommending performance targets to achieve NWC goals. The energy model was built on results of past and concurrent studies, using historical energy consumption data from the site along with Capital Build Program assumptions such as future buildings, construction year, phase and square footage, to create an energy forecast by year and phase through build-out.

Concurrently with this effort the NWC Capital Build Program management team developed a Capital Build Performance Management Framework with specific goals in the areas of energy, water, the natural environment, and waste. The Capital Build Performance Management Framework necessarily takes into consideration Capital Build scope and budget constraints. This EAP Report is organized to align with and inform that Framework and also extend beyond the many constraints of the Capital Build to identify future opportunities for implementing campus-wide energy goals. As such, the targets and strategies in this Report – such as those related to achieving a zero energy district and carbon neutrality – extend beyond the Capital Build Performance Management Framework to include targets and strategies that could be achievable if additional partners and resources are identified.

Through Partners in Energy, Xcel Energy and the NWC Partners relied on local energy advisors such as the National Renewable Energy Lab (NREL) and CSU to guide this approach. Offering many creative ideas and strategies, NWC Partners and energy advisors consistently challenged the City, Xcel Energy and the NWC Capital Build program to:

[1] Throughout this EAP Report, Capital Build Program refers to Phases 1 and 2 of the redevelopment, which includes all land acquisition, site remediation and horizontal development across 250-acres and 1,500,000 sf of new facilities.

- Maximize what can delivered through the Capital Build program
- Maximize what can be *enabled* through the Capital Build program and achieved through partnerships with the NWC Authority and/or private sector partners

Summary of Key Findings

The table below summarizes the projected energy, carbon, and economic differences after completion of Phase 1 and 2 Capital Build between three scenarios analyzed:

- **Scenario 1: LEED Gold v4** - Focuses solely on energy efficiency and the amount of annual energy use reduced from adopting LEED Gold energy use targets in addition to energy code standards.
- **Scenario 2: Zero Energy District but Not Carbon Neutral -** Achieves zero energy performance with the tradeoff of selling the renewable energy credits (RECs) associated with the two variations of solar arrays to lower the cost of zero energy improvements.
- **Scenario 3: Zero Energy District and Carbon Neutral -** Like Scenario 2, this scenario also achieves zero energy performance but it looks at the implications of retaining all RECs.

Table 1: Summary of Scenarios Analyzed after completion of capital build program (Phases 1 and 2)

Summary of Results after Phase 1 & 2			
	LEED Gold v4	Zero Energy District but Not Carbon Neutral	Zero Energy District and Carbon Neutral
Percent towards Carbon Neutral	26%	55%	92%
Percent towards Zero Energy	27%	93%	93%
Estimated Incremental Cost*	$2,800,000	$9,200,000	$9,200,000
Estimated Annual Cost Savings	$140,000	$533,000	$533,000
Incentives	$920,000	$4,650,000	$4,000,000

**The cost assumptions and scenarios developed in this report are preliminary and meant mainly to inform performance management targets*

Based on energy modeling, scenario analysis and stakeholder input, key findings in this Report include:

1. Because NWC facilities will be built using improved building and energy codes and will achieve a minimum of LEED Gold certification (modeled as 27% reduction over code), the NWC campus (which is four times larger than the current Stock Show Complex) will only double electric use and require a 35% increase in natural gas use compared to current energy use.

2. Building to even more aggressive energy efficiency (Best-in-Class) standards could result in less than a 10% increase in energy use compared with the Stock Show Complex's current energy use today (despite the new NWC campus being four times larger).

3. Since LEED is a points-based rating system with options for achieving certification at the individual building level and on a campus level, it is recommended that the NWC develop a program-level LEED strategy coordinating energy, water, and waste targets within the Capital Build performance management framework.

4. The NWC site has a unique opportunity to implement sewer heat recovery (SHR) as a potential strategy toward a zero energy district. Thermal energy from the nearby Delgany Interceptor could supply 55% of campus energy use based on current information. It would also be a highly innovative and catalyzing project supporting multiple goals across the program.

5. Achieving a zero (or positive) energy district and net carbon neutrality on the site are both technically feasible. This Report considers several potential strategies for utilizing renewable energy resources at the NWC to achieve this aspirational goal. Also, on-site energy generation would serve both resiliency purposes as well as educational purposes. Since many of these strategies would require long-term partnership agreements that extend beyond the Capital Build, the City will need to work closely with the NWC Authority on implementation.

6. Financial feasibility of creating a zero energy district and achieving carbon neutrality will likely depend on the following, at a minimum:
   - Achieving high energy efficiency (such as LEED Gold certification) through the Capital Build
   - Financial incentives from Xcel Energy
   - Identifying one or more private sector partners, such as a district energy partner
   - Tapping the ingenuity of NWC partners, such as Colorado State University's energy technology research and development capabilities
   - Coordination with and potential financial contribution from Metro Wastewater, should Sewer Heat Recovery be implemented

NWC Energy Targets

Based on these findings, two sets of energy targets have been identified - one that aligns with the Performance Management Framework, or LEED Gold v4 standard for the Capital Build Program, and a more aspirational, or preferred, set of targets that could become achievable through a partnership between the NWC Authority and a district energy partner to share both resources and risk.

LEED Gold v4 Targets:

- Buildings perform 27% below ASHRAE 90.1-2013[2]
- 5% of total building energy use supplied through on-site renewable energy[3]
- All buildings address solar ready requirements

Zero Energy District Targets:

- Campus-wide zero energy district on annual basis
- Carbon neutral campus on a net annual basis
- Zero emissions from fleet
- At least one pilot project per program phase

Due to the high visibility of the National Western Center campus and "blank slate" of campus infrastructure, the NWC Partners, Authority and Xcel Energy have an unparalleled opportunity to demonstrate global energy leadership and to educate over 2 million visitors annually about energy innovation. Being an energy

[2] Equivalent to a 35% reduction from ASHRAE 90.1-2010 or 14 of possible 18 LEED points under EAc2: Optimize Energy Performance.

[3] Equivalent to 3 of possible 3 LEED points under EAc5: Renewable Energy Production

leader adds tremendous value to the campus – both in operational cost savings and in reputation - and will help the NWC, its partners and tenants compete in a global marketplace.

Introduction

The National Western Center (NWC) is a 250-acre, long-term redevelopment and expansion of the National Western Stock Show site. It is the largest urban infill project in the country and one of Denver's most transformational and unique redevelopments. Current partners – including the City and County of Denver, Colorado State University, State of Colorado, Western Stock Show Association, Denver Museum of Nature and Science, History Colorado, Denver Water, National Renewable Energy Lab (NREL), and our emerging partner Metro Wastewater Reclamation District – are working together to transform the site into a year-round campus estimated to attract over two million visitors per year. A comprehensive master planning effort for the site identified nine guiding principles for the NWC, including "Embrace an Ethic of Regeneration" and "Engage the River and Nature." NWC has translated these guiding principles into the Capital Build Performance Management Framework with specific targets in the areas of energy, water, the natural environment, and waste. Achievement of these targets will follow a stepped approach of compliance pathways based on City requirements and public commitments as top priorities. NWC Partners will also work with the NWC Authority on achieving long-term aspirational outcomes for the campus.

The NWC Master Plan identified various energy goals, which the Capital Build Team worked with NWC Partners to distill into the following eight desired outcomes:

(1) Minimize energy demand of campus during each phase of build-out.
(2) Maximize installed renewable energy generation
(3) Determine and enable appropriate energy system(s) for thermal, electric and transportation energy requirements, taking a holistic and integrated view.
(4) Serve as a platform for clean energy technology innovation.
(5) Incorporate educational and interpretive programs that showcase clean energy innovations and practices.
(6) Site and buildings operate to maximize energy efficiency performance with low maintenance liability.
(7) Visitor education to increase awareness of clean energy innovations and practices.
(8) Site and building adaptability for new systems.

Xcel Energy is the electric utility serving the NWC. In the summer of 2014, Xcel Energy launched Partners in Energy to support communities in developing and implementing energy action plans that supplement existing sustainability plans, strategies, and tools. Xcel Energy and City and County of Denver signed a Memorandum of Understanding (MOU) in March 2017 outlining the City's participation in Partners in Energy and respective roles of the City and Xcel Energy. One of the deliverables of this agreement is this Energy Action Plan. This plan contains information and recommendations derived from a series of planning workshops, data collection and modeling efforts that included various NWC decision-makers and energy advisors, facilitated by an energy project management team committed to vetting and implementing plan strategies.

Xcel Energy will work with NWC to coordinate support for implementing the plan and will develop a MOU that outlines specific support Xcel Energy will provide to help NWC deploy its strategies and achieve its targets and goals. Partners in Energy is a two-year collaboration with Xcel Energy to develop and implement the plan.

NWC Performance Management Framework Recommendations

To incorporate the energy goal into the overall NWC development program and develop a common framework for articulating performance, a matrix outlining recommendations for specific goal elements was prepared. Desired outcomes, strategies, targets, and performance indicators were defined to meet minimum program requirements as well as more aspirational desired outcomes. In addition, lifecycle operations and maintenance considerations were considered to ensure that design requirements would position the buildings for ongoing high performance. Many of the terms below are defined in the Glossary on page 16.

Goal: Achieve Zero (or Positive) Energy

Desired Outcome	Strategy	Target	Measure (Performance Indicator)
Minimize energy demand of campus each phase of build-out.	Prioritize passive building design considerations for heating, cooling, and daylighting. Establish building design standards and a sub-metering strategy for high energy performance. Develop LEED Gold strategy emphasizing energy efficiency and renewable energy points, while balancing water, and waste points to incorporate into design, procurement and construction standards.	Buildings perform 27% below ASHRAE 90.1-2013.	Modeled EUI for each building compared to available benchmarks. % modeled reduction of energy use for buildings as compared to an ASHRAE 90.1 2013 Baseline. Xcel Energy EDA energy savings estimates - program totals. Energy forecast for the NWC campus at build-out compared to business as usual.
Maximize installed renewable energy generation.	Enable performance-based financing/procurement strategies for bundling efficiency and renewable energy, tapping O&M savings to address incremental capital costs above baseline. Enable the procurement of renewable energy from offsite sources. All buildings and open spaces to define solar ready requirements.	5% of total building energy use supplied through on-site renewable energy. All buildings address solar ready requirements.	% of total campus energy use supplied by on-site generation. % of total campus energy use supplied by off-site generation.
Maximize campus connections for alternative modes of transportation like biking, walking and public transit	Promotion of electric vehicles.	50% multi-modal goal by 2030.	Mode share of trips.
Determine and enable appropriate energy system(s) for thermal, electric and transportation energy requirements, taking a holistic and integrated view.	Optimize heating and cooling options based on ROI, carbon, zero energy impacts. Optimize centralized versus distributed energy system	Campus scale zero energy on annual basis. Carbon neutral campus on a net annual basis. Zero emissions from fleet operations.	% of total campus energy use supplied by on-site renewable energy generation. Annual forecasted GHG emissions from campus operations.

Desired Outcome	Strategy	Target	Measure (Performance Indicator)
	configurations and link to metering configuration. Explore district energy and micro-grid solutions for enhanced. resiliency, reliability, low-carbon power options. Establish innovative partnerships and energy system owner/operator models. Explore fleet electrification, enable public charging stations and parking policies to encourage electric vehicles.		Use formula from DOE NZE campus guidelines, modified to include fleet. Net cost of delivered energy. Building level load control. Hours of operation for critical functions in case of grid loss (resiliency/reliability).
Serve as a platform for clean energy technology innovation.	Technology pilot projects.	At least one pilot project per program phase.	Pilot project metrics (energy, cost, carbon).
Site and buildings operate to maximize energy efficiency performance with low maintenance liability.	Incorporate O&M staff in design charrettes and review to ensure energy efficiency and ease of operations are aligned. O&M training, education, and robust handover on energy systems.	95-100 target Energy Star score for standard operations for eligible building types, comparable EUI target for non-eligible buildings. 100 target Energy Star score at peak operations.	Schedule and perform proper preventative asset management tasks for facilities and building systems. Actual vs. target energy usage. Energy Star score. Trainings, materials. Charrette attendance.
Maximized use of alternative modes of transportation like biking, walking and public transit.	Dedicated O&M staff and budget for promoting alternative transportation to and within the campus.	35% of trips to and within campus use non-Single Occupancy Vehicle transportation mode.	Mode share of trips to and within campus.
Visitor education.	Communications strategy for visitor education.	15% increase in visitor awareness.	Awareness levels per annual survey at NWSS.
Site and building adaptability for new systems.	Explore feasibility for adaptable technologies and strategies.	Integrate all strategies with supportive business case into baseline conditions or long-term campus capital improvements plan.	Progress and milestone completion against target.

By achieving these outcomes, the NWC will capture a host of additional benefits, both directly and indirectly, that will enable greater overall project success. Some of these benefits include:

- Reduced ongoing operations and maintenance costs, and lifecycle costs in general.
- Synergies with other environmental goals that enable increased resource conservation.

- Leadership actions leading to opportunities to showcase, educate, and learn from advanced technologies, which are enabled by the capital infrastructure design.
- Attracting innovation partners to explore demonstration projects.
- Increased flexibility to accommodate future opportunities and design solutions.
- Public education and demonstration of leadership through highly visible technologies.

NWC Energy Strategy

Defining the Zero Energy Goal

The National Western Center Campus has a long-term aspiration to meet the U.S. Department of Energy's definition of a Zero Energy District to shape its strategies. A Zero Energy District is "an energy-efficient campus where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy." This definition also applies to campuses, portfolios, and communities. Ultimately the mix of on and off-site renewable energy will depend on site opportunities and constraints, financial feasibility and future partnerships.

Participants in the Partners in Energy planning process were asked to consider ways in which the Capital Build Program could directly deliver viable solutions toward the zero energy goal, as well ways it could contribute to or enable these efforts with other key stakeholders who can contribute their resources and expertise.

Energy Planning Process

NWC including the City and County of Denver (CCD), Colorado State University (CSU), and the Western Stock Show Association (WSAA), plus Xcel Energy, the National Renewable Energy Lab (NREL), and Metro Wastewater (Metro), have committed considerable resources toward the planning, analysis and systems for this Energy Action Plan. Representatives from these partners participated in the Partners in Energy process. Table 2 below lists participants in the Partners in Energy workshops and their role.

Table 2. Contributors

ReNEWW Working Group	Energy Advisors (* also on energy modeling working group)	Partners in Energy Project Management Team
• Eric Anderson, CH2M • Barb Frommell, NWCO • Jocelyn Hittle, CSU • Gretchen Hollrah, NWCO • Kye Holtan-Brown, WSSA • Sonrisa Lucero, City and County of Denver • Sam Stevens, CH2M (Lead) • Paul Schmiechen, City and County of Denver	• Jessica Brody, CAO • Gina Carnahan, Xcel Energy • Greg Fisher, Denver Water • Jeff Lyng, CSU • Jim McQuarrie, Metro Wastewater Reclamation District • Josie Plaut, CSU • Shanti Pless, NREL* • Ben Polly, NREL* • Scott Prisco, Denver Community Planning & Development • Jason Quinn, CSU* • Kirk Scheitler, Xcel Energy • Eric Shafran, NWCO • Tyler Smith, Xcel Energy • Bryan Wilson, CSU*	• Judy Dorsey, Brendle Group (Lead)* • Becky Fedak, Brendle Group* • Barb Frommell, NWCO • Tami Gunderzik, Xcel Energy • Jocelyn Hittle, CSU • Kye Holtan-Brown, WSSA • Conor Merrigan, Brendle Group • Lindsey Ritter, CH2M • Sam Stevens, CH2M

Two three-hour workshops were held in Spring 2017 to gather ideas, discuss and refine the strategies contained in this Energy Action Plan. These energy-specific efforts are part of a larger regeneration strategy within the redevelopment efforts. Members from the three groups listed in Table 2 were present at the two workshops. The agenda for each workshop can be found in Appendix A. In addition to the workshops, the energy modeling working group met twice during the Spring of 2017 to review current data and create energy modeling scenarios that help informed the workshop discussions. The Project Management and Energy Modeling Working Group members examined the baseline energy data, forecasted energy use at each phase of build-out, and then developed recommended strategies and scenarios for pursuing NZE within the NWC performance management framework for the capital build program.

There are both opportunities and challenges to pursuing zero energy at the National Western Center Complex. Among the opportunities are:

- Space for on-site generation and storage
- Potential sewer heat recovery (SHR)
- Modernizing infrastructure and more stringent building codes
- CSU expertise
- NREL expertise
- Xcel Energy as an early partner
- CCD policy drivers
- Regeneration Framework and related studies

Some challenges to achieving NZE include:

- NWC phasing
- Sewer heat owned by Metro; may be generated offsite
- NZE strategies and technologies are not built into NWC cost model

In addition, some aspects of the site are both opportunities and challenges, such as it being low density development and the fact that the load profile will be shifting from a January peak to more of a year-round load.

Based on these opportunities and challenges, potential energy reduction and energy generation strategies were analyzed to determine incremental and comparative outcomes on an energy consumption, cost-benefit and greenhouse gas emissions basis. The following strategies were analyzed to inform this plan:

- **New Construction Energy Efficiency** – As part of the forecasting analysis three different energy forecasts were created based on three different standards of building efficiency: (1) Code-built (ASHRAE 90.1-2013), (2) LEED Gold certification, and (3) Best-in-Class construction. The difference in energy use between the baseline forecast and the proposed forecast represents the energy efficiency strategies that are part of this analysis.
- **Sewer Heat Recovery** – The Delgany Interceptors located on the National Western Center's campus have the potential to provide thermal energy to the campus buildings through sewer heat recovery to reduce the demand on heating and cooling equipment.
- **Rooftop Solar** – This strategy considers the potential for roof-mounted photovoltaic (PV) systems on new buildings. When installing solar arrays the owner can sell the renewable energy credits (RECs) associated with the array to the utility in exchange for rebates to lower the cost of installation and maintenance. By selling the arrays' RECs, the owner cannot claim the associated carbon emissions reduction in their GHG inventory. Both options, keeping or selling RECs, were considered in this analysis.
- **Solar Gardens** – A solar garden refers to installing ground mounted PV arrays in large clusters around the campus or off-site. Like rooftop solar, the owner of a ground mounted system could decide to keep or sell the associated RECs and both options were considered as part of the analysis. For off-site solar gardens, the NWC campus would purchase shares to offset energy and potentially carbon depending on the arrangement with the solar garden developer.
- **Additional Strategies** – Several additional strategies were proposed for implementation on the NWC campus as part of the two workshops and additional meetings with stakeholder groups. Although these strategies are not included in the current energy analysis, they are listed below to provide inspiration as the planning process continues and the design process begins. Another consideration with each of these technologies is the ability for them to be introduced as small proof of concept demonstrations, which could be used as an educational/research opportunity for Stock Show attendees.
    - **District Energy with Central Utility Plant (CUP) –** Multi-building campuses or districts often use a CUP to provide heating and cooling to a group of individual buildings instead of investing in individual heating and cooling equipment for each unit. A CUP building typically includes chillers and cooling towers to provide cooling; boilers to provide heating; and various pumps to circulate water to the equipment and to the buildings. However, newer technologies such as ground source heat pumps or solar thermal heating, described below, could also be

incorporated. District energy works best when buildings are very close to one another to cut down on the cost of installing and maintaining transmission pipes.

- **Combined Heat and Power (CHP) –** A typical power plant or backup generator creates waste heat as a byproduct of power generation. A CHP plant similarly generates electricity. However, it is designed to make use of excess heat on-site which can be used for space and water heating as well as space cooling if paired with absorption chillers. Since the CHP plant is able to generate useful heat and electricity, it has a higher efficiency than grid-based power generation sources. Also, since it operates separately from the grid, it provides resiliency by allowing the NWC to reliably generate electricity independent of the grid's status.
- **Biomass** – Biomass is an alternative heating or electrical generation technology that is often used to replace natural gas heating equipment. Biomass heating or electrical generation is a carbon neutral option that is advantageous when the user has access to enough biomass; i.e. organic material such as wood waste, animal manure, etc.
- **Solar Thermal Heating** – In addition to using solar energy for electricity generation from photovoltaic technology solar arrays are also used to capture the sun's radiant energy for heating and storing domestic hot water in place of traditional electrical or natural gas heaters. Specifically, the Wash Rack buildings that are part of the Stock Yards could be a good application for this technology.
- **Wind** – On-site wind generation was brought up during the first workshop as an additional energy generation technology that should be considered. However, the low wind quality on-site does not justify the expense. However, a small wind turbine could be installed to demonstrate how the technology could be used by event attendees' farms, ranches, and homes. Additionally, off-site wind could be an option depending on the final adopted renewable energy strategy, although it would not fit into the DOE's definition of zero energy.
- **Ground Source Heat Pumps (GSHP)** – Ground source heat pumps are an alternative to traditional heating and cooling equipment like the sewer heat recovery strategy. The difference is that sewer heat recovery would use the Delgany Interceptors as a heat sink during cooling periods and a heat source during heating months whereas GSHP employs a series of horizontal or vertical wells to use the ground as a heat sink/source.
- **Energy Storage (**e.g. battery) – Energy storage is a technology such as batteries, flywheels, or thermal storage that allows a building to store energy produced at one time and use it at another time. This is beneficial when on-site generation equipment, such as a solar array or wind turbine, is producing more electricity than the entity can use or when grid-supplied electricity prices are low. Both cases save the entity money from reduced electricity charges.

The preliminary results from analyzing the above strategies indicated that there are multiple pathways to achieve NZE for this site at build-out, but with different financial and environmental implications. To help understand the interrelationship between energy, GHG emissions, and cost three different scenarios were modeled:

- **Scenario 1: LEED Gold v4** - Focuses solely on energy efficiency and the amount of annual energy use reduced from adopting LEED Gold energy use targets in addition to energy code standards.

- **Scenario 2: Zero Energy District but Not Carbon Neutral -** Achieves zero energy performance with the tradeoff of selling the renewable energy credits (RECs) associated with the two variations of solar arrays to lower the cost of zero energy improvements.
- **Scenario 3: Zero Energy District and Carbon Neutral -** Like Scenario 2, this scenario also achieves zero energy performance but it looks at the implications of retaining all RECs.

Note that the work of this planning exercise was not to select a scenario. Rather, the scenarios were used to inform and understand the interactions between strategies, goals, and targets to inform the performance management framework.

Energy Scenario Analysis Findings

Analysis for each scenario utilized the energy efficiency and renewable energy generation strategies listed above. The different strategies were combined within each scenario and contribute to the zero energy goal. Strategies were analyzed on a yearly basis through build-out based on program phasing, taking into account three considerations: incremental cost, GHG emissions and energy balance. Please refer to the cost-benefit analysis detailed in Table 3 and Table 4. Below is a list of key findings and assumptions from the energy analysis.

- Zero energy and net carbon neutrality are both technically feasible given the availability of energy efficiency and renewable energy technologies modeled relative to campus energy use.
- By itself, the LEED Gold baseline requirement substantially reduces energy use for the NWC compared with simply following the building code. Despite more than quadrupling the square footage of the site at build-out, improving energy codes and the goal of achieving LEED Gold (modeled as 27% reduction over code) will only double electric use and require a 35% increase in natural gas use compared to current energy use.
- Since LEED is a points-based system with options for achieving certification both at the campus level and at the individual building level, it will be important during future program management efforts to develop a program-level LEED strategy coordinating energy, water, and waste targets within the capital build performance management framework.
- Sewer heat recovery (SHR) could be a major strategy toward achieving zero energy, accounting for 55% of the zero energy goal. It would be a highly innovative and catalyzing project supporting multiple goals across the program. Incremental costs relative to baseline heating and cooling systems are still to be determined, therefore, it was not included in the cost-benefit analysis.
- If SHR is not pursued as part of the capital build, other options would be needed to fill the 55% energy gap to achieve zero energy. This would come from either additional energy efficiency to best-in-class or similar scale renewable energy-based heating and cooling system such as ground source heat pumps and an increase in the amount of solar installed.
- Currently, as modeled, in Figure 5 and Figure 6 the solar wedge in the diagram represents 4 MW of installed rooftop solar, whereas total rooftop potential at build-out is roughly estimated between 6-8 MW. Therefore, it would be possible to replace the gap left by now implementing SHR with solar alone, but there would be cost implications.
- While the exact design or delivery model for these strategies is not yet known, estimates on future utility savings were determined along with potential utility incentives to support these strategies.

- First costs to implement the strategies were also estimated as very preliminary estimates of incremental costs compared to inaction, on a rough comparative basis to inform the overall scenarios analysis and performance framework recommendations[4].

Table 3 and Table 4 summarize the energy, carbon, and economic differences between the three scenarios analyzed after Phase 1 and 2 and after build-out. Of note, the two energy and emissions percent reductions between capital build (i.e., Phases 1 and 2) and full build-out are very close. This is due to a combination of the comparatively long timeline for Phases 1 and 2 and the contribution of existing buildings in the near-term that will be demolished before build-out. Additional modeling results are provided in Appendix C.

Table 3. Summary of Results after the completion of Phase 1 and 2

Summary of Results after Phase 1 & 2			
	LEED Gold v4	Zero Energy District but Not Carbon Neutral	Zero Energy District and Carbon Neutral
Percent towards Carbon Neutral	26%	55%	92%
Percent towards Zero Energy	27%	93%	93%
Estimated Incremental Cost*	$2,800,000	$9,200,000	$9,200,000
Estimated Annual Cost Savings	$140,000	$533,000	$533,000
Incentives	$920,000	$4,650,000	$4,000,000

Table 4. Summary of Results at Build-out

Summary of Results at Build-out			
	LEED Gold v4	Zero Energy District but Not Carbon Neutral	Zero Energy District and Carbon Neutral
Percent towards Carbon Neutral	27%	55%	100%
Percent towards Zero Energy	27%	100%	100%
Estimated Incremental Cost*	$5,500,000	$16,330,000	$16,330,000
Estimated Annual Cost Savings	$390,000	$942,000	$942,000
Incentives	$1,400,000	$9,200,000	$6,100,000
Payback	15 years	12 years	15 years

**The cost assumptions and scenarios developed in this report are preliminary and meant mainly to inform performance management targets*

Energy Strategy Implementation

As shown in the Energy Performance Management Framework recommendations, targets and their measures arrange from achieving compliance requirements to a more aspirational threshold that will enable the redevelopment to be positioned as Best-in-Class. The framework recommendations are also positioned

[4] Zero Energy District incremental costs assumed to be 10% and LEED Gold 5%; Source: New Buildings Institute. Getting to Zero 2012 Status Update: First Look at the Costs and Features of Zero Energy Commercial Buildings. Vancouver, WA: New Buildings Institute, 2012

to enable successful ongoing operations and maintenance to continue to perform and anticipate future changes to the site.

During the next phase of Partners in Energy, Xcel Energy can help with implementation of these recommendations where it is valuable and supportive of the capital build program. For example, Xcel Energy can:

- Put together a coordinated one-stop plan for accessing Xcel Energy rebates and other financial and technical assistance services presented during the planning process at relevant milestones in the program.
- Support participation in the energy savings programs and renewable energy generating programs that best support the strategy goal such as:
    - Using new construction programs, a suite of renewable energy programs, and continuing to be willing to explore innovative options will ensure that the National Western Center is best positioned to meet the goal.
        - The primary new construction program to be utilized will be the Energy Design Assistance Program, which can lock in incentives as soon as initial kick-off meetings are held for specific building designs. This will allow custom building modeling and rebates based on the energy improvement from the City and County of Denver's current energy codes as the baseline.
    - The suite of renewable energy programs has been presented, and will be coordinated with the project delivery teams to ensure that the programs with the greatest benefit are utilized at the time of need, which will likely result in several different options being deployed on site.
- Collaborate with the City and/or Authority to seek a third-party energy partner that can help achieve campus energy goals through build-out of NWC renewable energy

Though the flexibility for innovative programs is limited as a regulated utility, Xcel Energy will continue to work within those guidelines to identify opportunities and ensure that the Project Management team is well-informed about the mechanisms to intervene should they desire to ask regulators for greater opportunities at the National Western Center or more broadly in terms of innovative programs for future regulatory filings.

In addition to the specific Xcel Energy assistance offered through this Energy Action Plan, a number of additional strategies have been identified for the National Western Center that will include interactions with Xcel Energy but rely more heavily on other partners in the development. These are captured in the Performance Management Framework and will be integrated into the delivery of the project goals at each phase. By describing performance requirements and allowing contractors and designers the flexibility to achieve them, the project will enable creative and innovative solutions not currently envisioned or imagined. The opportunities to highlight community uses can lead to new opportunities to help the surrounding community become more resilient in the face of a variety of future challenges. Overall, by serving as an example and demonstration of energy leadership, the National Western Center will help shape a new paradigm of what development can look like and how that development can contribute to the wider community.

Appendix A: Workshop Agendas

Workshop 1: April 18, 2017, 9:00 a.m. – 12:00 p.m.

Agenda

1. **Block 1: Introductions and Workshop Framing (20 mins)**
2. **Block 2: Exploring NZE Vision, Definitions and Targets (60 mins)**
    a. Discussion/Q&A: Workshop Briefing Materials
    b. Survey and discussion: Framing questions for shaping NZE definition
    c. Small group exercise – advisory model
3. **Working Break: Block 2 Prioritization (20 mins)**
4. **Block 3: Exploring NZE Strategies (60 mins)**
    a. Large Group Discussion
    b. Small Group Exercise – technical advisor model
    c. Report Out and Direction to Modeling team
5. **Block 4: Decision-Making and Next Steps (20 mins)**
    a. Introduction to Energy Action Plan deliverable – to inform energy portion of the Regeneration Management Plan (10 mins)
    b. Recap on today's decisions (10 mins)
    c. Action Items and Next Steps toward Workshop 2 (10 mins)

Workshop 2: June 5, 2017, 1:00 – 4:00 p.m.

Agenda

1. **Block 1: Workshop Objectives and Progress Updates (40 mins)**
    a. Workshop objectives and agenda overview
    b. NWC program updates and Workshop 1 recap
    c. Introduction to the draft Energy Performance Management Framework
2. **Block 2: Ways for Xcel Energy to Support NWC's Energy Strategy (40 mins)**
    a. Overview of Xcel Energy offerings for NWC
    b. Case Study: Panasonic battery storage
    c. Energy Design Assistance Incentives
    d. Discussion/ Q&A
3. **Block 3: Refining the Energy Performance Management Framework (80 mins)**
    a. How modeling results inform the current draft
    b. Small Group Exercise – technical advisor model ***(including Break)***
    c. Report Out and Direction to Planning Team
4. **Block 4: Decision-Making and Next Steps? (20 mins)**
    a. Recap on today's decisions
    b. Action Items and Next Steps

Appendix B: Glossary of Terms

ASHRAE 90.1: International standard that provides minimum requirements for energy efficient building design.

Carbon Neutral: Achieving net zero carbon emissions.

Demand Side Management (DSM): modification of consumer demand for energy through various methods, including education and financial incentives. DSM aims to encourage consumers to decrease energy consumption, especially during peak hours or to shift time of energy use to off-peak periods, such as nighttime and weekend.

Department of Energy (DOE): An agency of the US government focused on energy policy and safety.

Energy Action Plan: a written plan that includes an integrated approach to all aspects of energy management and efficiency. This includes both short- and long-term goals, strategies, and metrics to track performance.

Energy Design Assistance (EDA): A free, Xcel Energy comprehensive approach to energy and cost savings for businesses considering new construction or major renovation projects.

Energy Use Intensity (EUI): Energy use per square foot per year; an expression of a building's energy use as a function of its size or other characteristics.

Goals: the results toward which efforts and actions are directed. There can be a number of objectives and goals outlined in order to successfully implement a plan.

Ground Source Heat Pump (GHSP): Ground source heat pump systems provide heating and cooling capacity to a building or plant using the earth's temperature differential. During the winter the ground is used as a heat source and in the summer it is used as a heat sink.

Kilowatt-hour (kWh): a unit of electricity consumption

Leadership in Energy and Environmental Design (LEED): A rating system of the US Green Building Council that measures the environmental and energy performance of buildings. Certification levels include certified, silver, gold, and platinum.

Megawatt-hour (MWh): a unit of electricity consumption equivalent to 1,000 kWh.

Net Positive: Generating more energy than is consumed.

Zero Energy Building (ZEB): An energy-efficient building where, on a source energy basis, the actual annual delivered energy is less than or equal to the on-site renewable exported energy. This definition also applies to campuses, portfolios, and communities.

Operations and Maintenance (O&M): A spectrum of services that involve the care and upkeep of equipment or a facility.

Premise: a unique identifier for the location of electricity or natural gas service. In most cases, it is a facility location. There can be multiple premises per building, and multiple premises per individual debtor.

Recommissioning: An energy efficiency service focused on identifying ways that existing building systems can be tuned-up to run as efficiently as possible.

Renewable Energy Credits (RECs): Also known as renewable energy certificates, are energy commodities that are non-tangible and represent that a set amount of electricity from a renewable energy resource has been directed into the electrical grid.

Return on Investment (ROI): The benefit that comes from an investment. A high ROI is desirable because it means that the costs from an investment are quickly recovered by financial benefits. In the context of energy efficiency and generation it means that a technology saves more in operating costs than it cost to install it.

Sewer Heat Recovery (SHR): Sewer heat recovery is a process of using the embodied heat in wastewater to provide heating and cooling to a building or plant. During the winter the system uses the wastewater heat to help meet the heating demand of a building or campus using a heat exchanger. In the summer time heat is rejected to the wastewater to help meet the cooling demand.

Therm: a unit of natural gas consumption.

Appendix C: Energy Modeling Assumptions and Results

A spreadsheet-based energy model was created as a resource for the facilitation process of this plan to help advisors and stakeholders establish an energy and emissions forecast, for use during goal setting and strategy development. The energy analysis was a collaborative effort between Brendle Group, Colorado State University, and the National Renewable Energy Lab (NREL).

The first phase of work by the modeling team was to establish a forecast to estimate energy use for each building as the redevelopment process began. This was done at three different levels, the first was the least aggressive forecast and its assumptions were based on the City of Denver's current energy code, ASHRAE 90.1-2013, which is referred to as the Code-Based Forecast. ASHRAE 90.1-2013 outlines the minimum requirements for energy use for a new commercial building. Since several of the buildings that are planned for the NWC are unique the modeling team did its best to estimate energy use based on published standards and on the annual energy use of the current NWC building stock. Existing energy benchmarks were de-rated to account for adherence to stricter energy code requirements.

The second forecast was done for LEED Gold to align with the city's Executive Order 123 which requires all new municipal buildings to achieve LEED Gold certification. This requires more aggressive energy savings below the established energy code. Since LEED's requirements allow for flexibility there is not a specific energy savings percentage that is required for LEED Gold certification. Therefore, four new buildings that achieved LEED Gold certification under the most recent version of the LEED program were used to establish anticipated savings.

The third forecast was created to show Best-in-Class performance which was established based on the assumption that the campus would have a combined energy use intensity (EUI) of 21 kBtu/ft^2. This target was established based on published literature that stated that zero or ultra-low energy buildings had an average EUI of 21 kBtu/ft^2.[5] Table 5 gives the energy targets under each forecast for each building that will be part of the new campus.

[5] https://www.nwga.org/wp-content/uploads/2016/03/Jim-Edelson-New-Buildings-Institute-commerical-net-zero.pdf

Table 5. Building Level Energy Targets

Building Name	Square Footage	Phase	Operational Year	Building Description	Baseline Assumption (Current Facility or Model Simulation)	Energy Use Intensity (kBtu/ft²)			Footnote
						Code-Built	LEED Gold[6]	Best-in-Class	
Stock Yards	871,200	Phase 1	2020	Outdoor Multi-Use Space	Current Facility - Stock Yards	0.1	0.1	0.1	7, 8, 9
Stock Yards Events Center	35,100	Phase 1	2020	Arena Complex	Current Facility - Stock Yards Auction Arena	41.4	30.0	19.4	6, 7, 8
CSU Water Resources Center	150,000	Phase 1	2021	Educational/Research Facility & Denver Water Testing	Model Simulation - Secondary Education Building	46.3	33.6	21.8	7, 8, 10
TOD Parking Structure	325,000	Phase 1	2021	Enclosed Parking Garage	Current Facility - CSU South College Parking Garage	2.6	2.6	2.6	11, 12
Livestock Center	376,790	Phase 2	2023	Arena Complex & Barns	Current Facility - Events Center	40.1	29.1	18.8	6, 7, 8
Equestrian Center	469,064	Phase 2	2023	Arena Complex & Barns	Current Facility - Events Center	40.1	29.1	18.8	6, 7, 8
CSU Equine Sports Medicine Clinic	78,600	Phase 2	2023	Equine Medical Clinic	Model Simulation - Hospital Building	123.6	89.7	58.0	7, 8, 9
Livestock Exchange Building/Flex Space	54,000	TBD	TBD	Office Space	Livestock Exchange Building	-	-	-	
NWSS Maintenance Facility	44,000	Phase 2	2023	Maintenance Facility	Current Facility - Etna Building	34.4	25.0	16.2	6, 7, 8
Renovate 1909 Arena	106,000	Phase 3	2024	Arena Complex	Current Facility - Events Center	40.1	29.1	18.8	6, 7, 8
Trade Show/Exposition Hall	460,000	Phase 4	2026	Multi-Use/Exhibit Space	Current Facility - Stadium Arena Complex	37.8	27.5	17.8	6, 7, 8
Parking under Expo Hall	270,000	Phase 4	2026	Enclosed Parking Garage	Current Facility - CSU South College Parking Garage	2.6	2.6	2.6	10, 11
New Arena	295,700	Phase 5	2026	Arena Complex	Current Facility - Events Center	40.1	29.1	18.8	6, 7, 8
CSU Center	155,735	Phase 6	2026	Educational Facility	Model Simulation - Secondary Education Building	46.3	33.6	21.8	7, 8, 9
Parking Structure for CSU Center	162,000	Phase 6	2026	Enclosed Parking Garage	Current Facility - CSU South College Parking Garage	2.6	2.6	2.6	10, 11

[6] Per executive order 123, all new City building projects (new construction and major renovation) over 5,000 square feet that are funded after March 11, 2013, must achieve LEED Gold Certification, with the goal of achieving LEED Platinum, where economically feasible.

[7] Code-built EUIs were calculated by applying a 43% savings to the current buildings' EUI, to meet ASHRAE 90.1-2013 requirements. Source: https://www.nwga.org/wp-content/uploads/2016/03/Jim-Edelson-New-Buildings-Institute-commerical-net-zero.pdf

[8] LEED Gold EUIs are estimated from existing LEED v4 Gold Certified projects

[9] Best in Class EUIs were calculated by targeting to have a combined campus EUI goal of 21 kBtu/ft² to align with the average EUI of a Zero Energy Building, excluding parking garages and the Stock Yards. Source: https://www.nwga.org/wp-content/uploads/2016/03/Jim-Edelson-New-Buildings-Institute-commerical-net-zero.pdf

[10] Source of Code Built EUI: https://www.energycodes.gov/sites/default/files/documents/2015_IECC_Commercial_Analysis.pdf

[11] Source of Code Built EUI: https://www.fm.colostate.edu/energycaponline/

[12] The EUIs of the three parking garages and Stock yards do not change based on scenario

Using the three forecasts outlined above,

Table 6 was created and presented during Workshop 1. The results show that even with a significant growth in total building square footage building to the Best-in-Class forecast would result in a net reduction in overall energy use and emissions footprint. The incremental cost associated with both LEED Gold and Best-in-Class building standards was also estimated to provide an initial look at the financial requirements of upgrading. Figure 1 through Figure 3 compare the three forecasts with respect to electricity, natural gas and total energy across phases.

Current and Forecasted Energy Picture

Table 6. Square Footage, Energy Use and Greenhouse Gas (GHG) Emissions Today and at Build-Out

		Today	Redeveloped (In 2026)		
			Code-Built	LEED Gold	Best-in-Class
Square Footage		700,000	3,000,000		
Electricity/Natural Gas Split		40%/60%	TBD		
Electricity	kWh	5,100,000	13,000,000	10,000,000	7,000,000
	Cost	$459,000	$1,200,000	$890,000	$610,000
Natural Gas	Therms	300,000	560,000	410,000	270,000
	Cost	$150,000	$280,000	$200,000	$130,000
Greenhouse Gas Emissions		5,400	9,300	6,800	4,600
GHG Split (Electricity/Natural Gas)		72%/28%	TBD		
Incremental Cost[13]		-	-	$5,500,000	$11,000,000

[13] Incremental cost for projects that achieve zero energy ranges from 0-10%. We assumed that Best in Class approach would result in a 10% incremental cost and LEED Gold would result in a 5% incremental cost. Source: NBI. Getting to Zero 2012 Status Update: First Look at the Costs and Features of Zero Energy Commercial Buildings. Vancouver, WA: New Buildings Institute, 2012. Accessed May 2017: http://newbuildings.org/sites/default/files/GettingtoZeroReport_0.pdf.

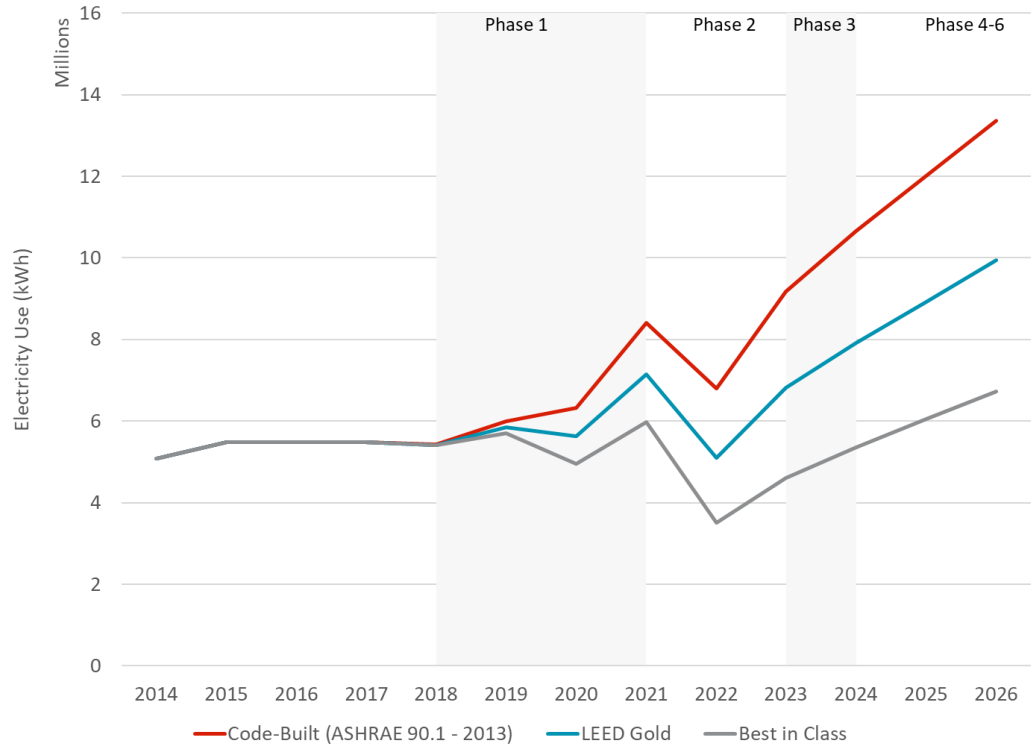

Figure 1. Electricity Forecast through Phase 6: Code Built, LEED Gold, Best-in-Class EUI Scenarios

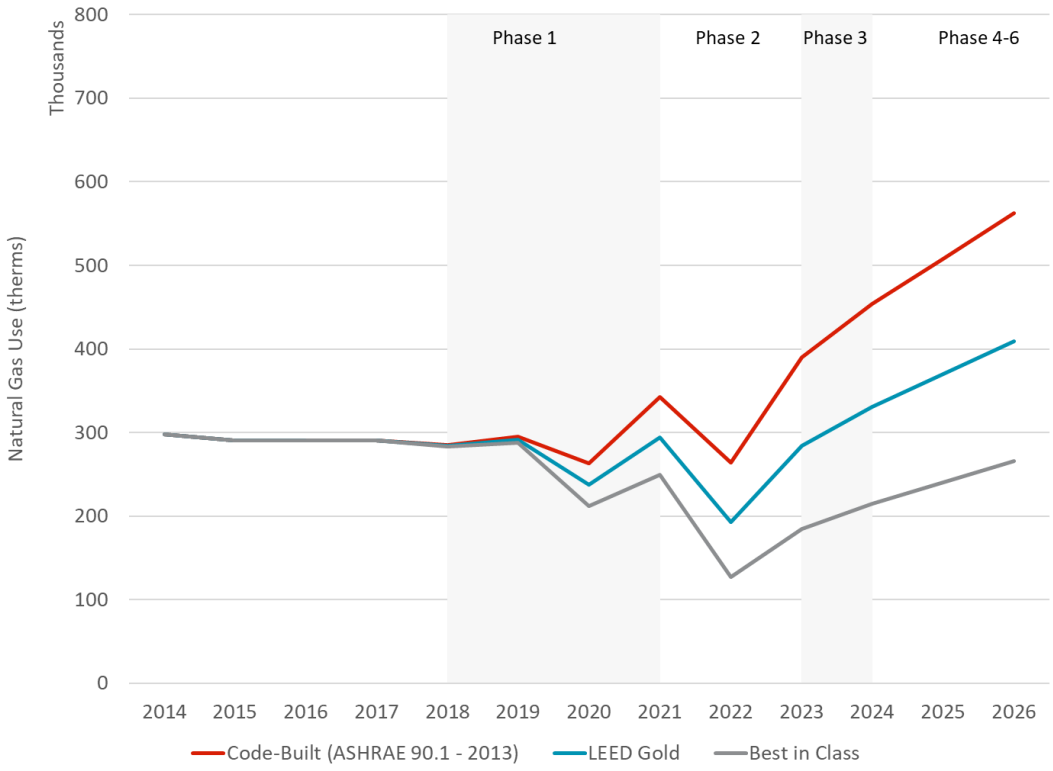

Figure 2. Natural Gas Forecast through Phase 6: Code Built, LEED Gold, Best-in-Class EUI Scenarios

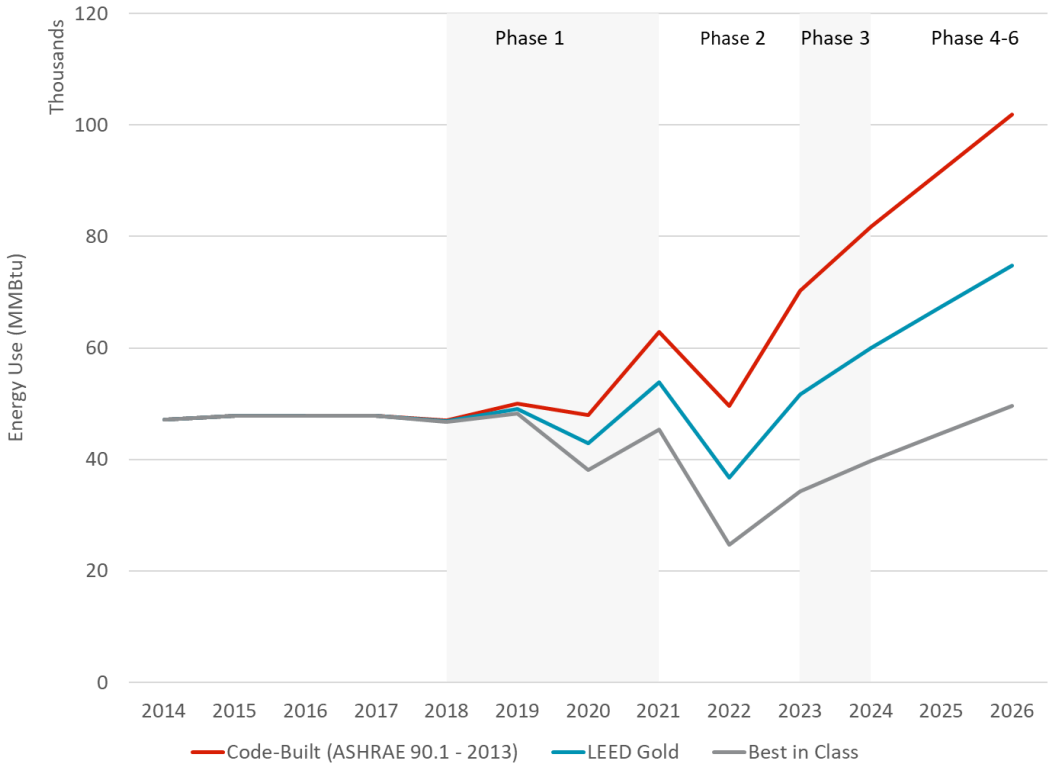

Figure 3. Total Energy Forecast through Phase 6: Code Built, LEED Gold, Best-in-Class EUI Scenario

Once the three forecasts were developed and presented, stakeholders began to identify potential energy reduction and energy generation strategies during the second half of the first workshop. A list and description of these strategies can be found under the Energy Planning Process section of this plan. After this exercise was completed, the modeling team analyzed the strategies based on the available information for the NWC campus. Three scenarios were also developed based on the list of strategies to show the tradeoffs between energy and emissions reduction and cost. These three scenarios are: (1) LEED GOLD v4, (2) Zero Energy District but not Carbon Neutral, and (3) Zero Energy District and Carbon Neutral. The scenarios were established based on stakeholder feedback and the preliminary goals for the campus of zero energy and aligning with the City's 80% emission reduction goal.

The LEED Gold v4 Scenario focused solely on the New Construction Energy Efficiency strategy, and its results show the estimated energy and emissions reductions that would take place from adopting LEED Gold efficiency standards. The results of which, in addition to the other two scenarios, can be found in Table 7 after Phase 1 and 2 completion and Table 8 after full build-out. As both tables show, incentives are available for this project through Xcel Energy's Energy Design Assistance program which provides incentives for energy efficiency efforts during new construction. The results (shown as percentages) reflect the reduction in annual energy use and emission compared to the Code-Built Forecast and due to the City's Executive Order, these savings represent what NWC is already committed to pursuing. However, an incremental cost is still applied to show simple payback for this scenario.

Table 7. Summary of Scenarios after Phase 1 and 2

Summary of Results after Phase 1 & 2						
#	Strategy	Annual Emissions Reduction in 2023 (MTCO2e)	Annual Energy Reduction in 2023 (MMBtu)	Estimated Incremental Cost*	Annual Cost Savings	Incentives
LEED Gold v4						
1	LEED Gold Energy Efficiency	1,900	19,000	$2,800,000	$140,000	$920,000
Total		26% of Forecasted Inventory	27% of Forecasted Inventory			
Zero Energy District but Not Carbon Neutral						
1	Best in Class Energy Efficiency	1,800	17,000	$2,800,000	$130,000	$1,500,000
2	Sewer Heat Recovery	970	18,000	TBD	$83,000	$2,500,000
3	Solar Gardens – No RECs	0	0	$0	$0	$0
4	Rooftop Solar - No RECs	0	13,000	$6,400,000	$320,000	$650,000
Total		**2,770**	**48,000**	**$9,200,000**	**$533,000**	**$4,650,000**
		55% of Forecasted Inventory	93% of Forecasted Inventory			
Zero Energy District and Carbon Neutral						
1	Best in Class Energy Efficiency	1,800	17,000	$2,800,000	$130,000	$1,500,000
2	Sewer Heat Recovery	970	18,000	TBD	$83,000	$2,500,000
3	Solar Gardens – with RECs	0	0	$0	$0	$0
4	Rooftop Solar – with RECs	2200	13,000	$6,400,000	$320,000	$0
Total		**4,970**	**48,000**	**$9,200,000**	**$533,000**	**$4,000,000**
		92% of Forecasted Inventory	93% of Forecasted Inventory			

The second scenario is for the NWC campus to pursue Zero Energy District but not carbon neutrality. The basis of this strategy uses the LEED Gold energy forecast as a baseline and incorporates two energy reduction strategies and two energy generation strategies. The energy reduction strategies are: New Construction Energy Efficiency to achieve the Best-in-Class energy forecast and Sewer Heat Recovery to reduce the campus' heating and cooling load. The two energy generation strategies are both photovoltaic solar options, ground-mounted Solar Gardens and Rooftop Solar.

The difference between this scenario and the third scenario, Zero Energy District and Carbon Neutrality, is that all of the renewable energy credits (RECs) are sold to Xcel Energy on an annual basis to reduce capital and operational costs. However, selling the campus' RECs means that it would not be able to take credit for the emissions reduction of the solar arrays and therefore the campus would not achieve carbon neutrality.

The third scenario, Zero Energy District and Carbon Neutrality, includes the same underlying assumptions as the second scenario except as the title indicates all RECs stay with the campus which results in a longer payback, with the benefit of being able to claim carbon neutrality at build-out.

Table 8. Summary of Scenarios after Build-out

Summary of Results at Build-out						
#	Strategy	Annual Emissions Reduction in 2031 (MTCO2e)	Annual Energy Reduction in 2031 (MMBtu)	Estimated Incremental Cost*	Annual Cost Savings	Incentives
LEED Gold v4						
1	LEED Gold Energy Efficiency	2,500	27,000	$5,500,000	$390,000	$1,400,000
Total		27% of Forecasted Inventory	27% of Forecasted Inventory	Blended Payback: 15 years		
Zero Energy District but Not Carbon Neutral						
1	Best in Class Energy Efficiency	2,300	25,000	$5,500,000	$360,000	$2,300,000
2	Sewer Heat Recovery	1,500	27,000	TBD	$110,000	$3,800,000
3	Solar Gardens – No RECs	0	2,700	$930,000	$62,000	$300,000
4	Rooftop Solar - No RECs	0	20,000	$9,900,000	$410,000	$2,800,000
Total		**3,800**	**74,700**	**$16,330,000**	**$942,000**	**$9,200,000**
		55% of Forecasted Inventory	100% of Forecasted Inventory	Blended Payback: 12 years		
Zero Energy District and Carbon Neutral						
1	Best in Class Energy Efficiency	2,300	25,000	$5,500,000	$360,000	$2,300,000
2	Sewer Heat Recovery	1,500	27,000	TBD	$110,000	$3,800,000
3	Solar Gardens – with RECs	380	2,700	$930,000	$62,000	$0
4	Rooftop Solar – with RECs	2,800	20,000	$9,900,000	$410,000	$0
Total		**6,980**	**74,700**	**$16,330,000**	**$942,000**	**$6,100,000**
		100% of Forecasted Inventory	100% of Forecasted Inventory	Blended Payback: 15 years		

Figure 4 through Figure 9 show the energy and emissions forecasts like the forecasts before but with wedges to represent the impacts of each strategy as they are implemented.

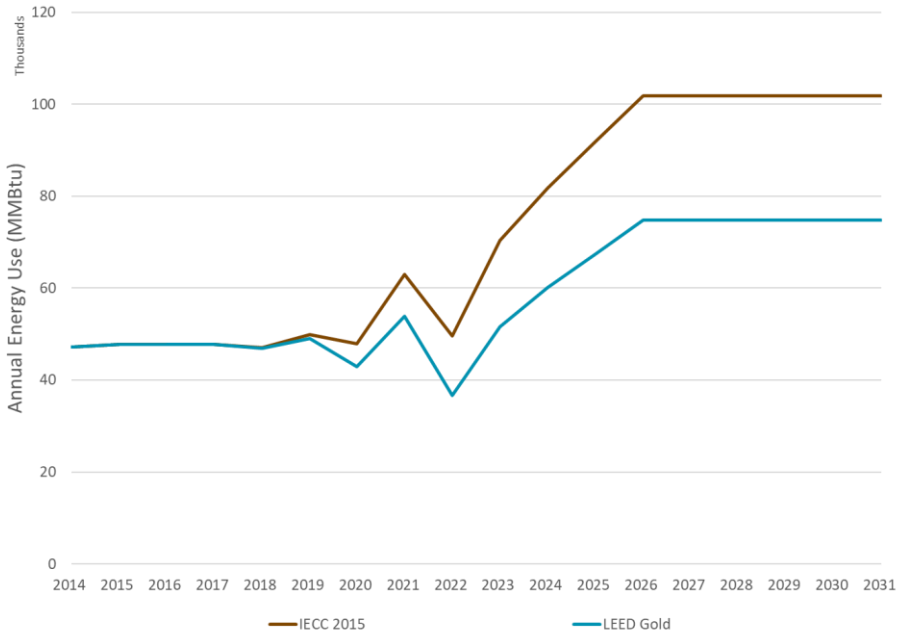

Figure 4. LEED Gold v4 Scenario Energy Forecast with Energy Efficiency Contributions

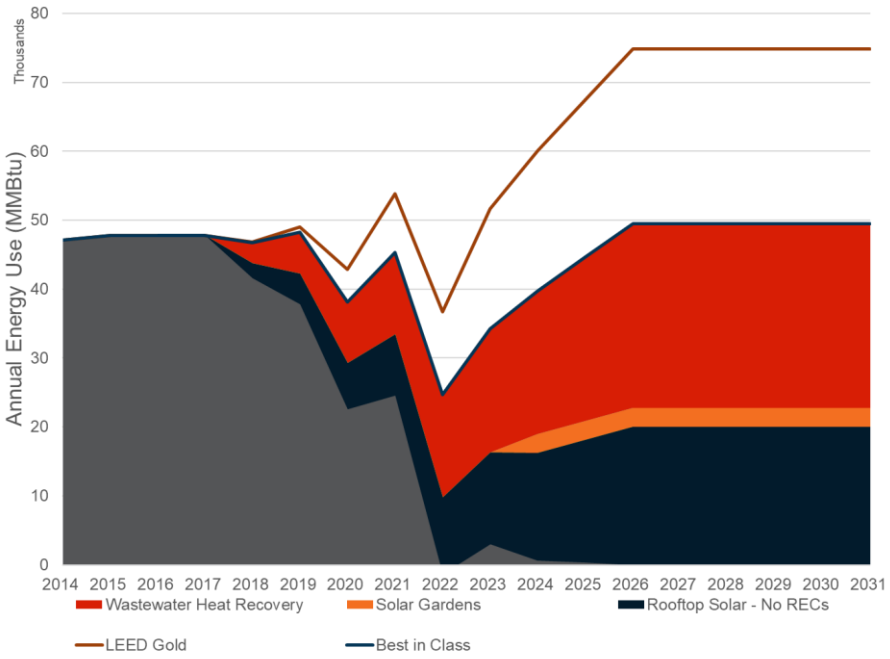

Figure 5. Zero Energy District but not Carbon Neutral Energy Forecast with Scenario Contributions

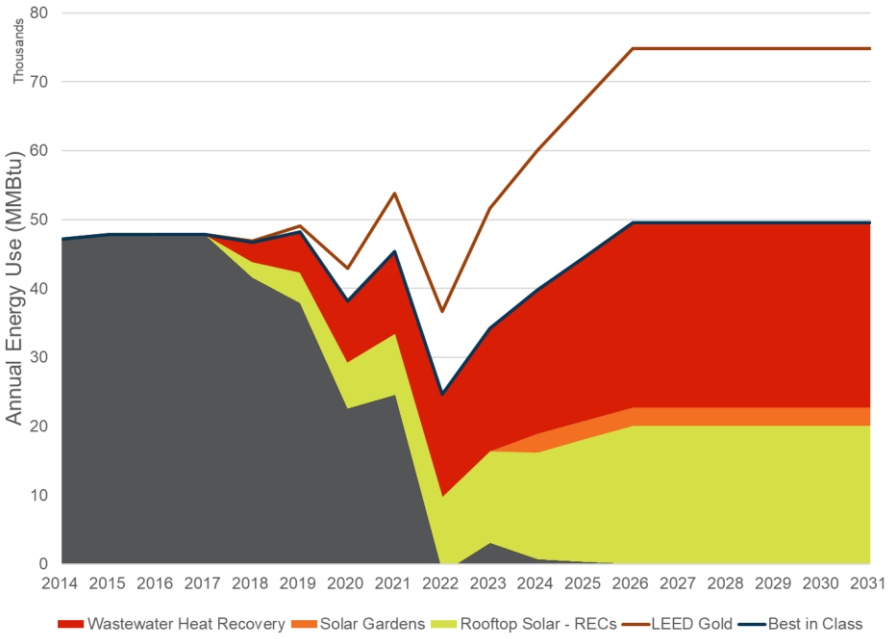

Figure 6. Zero Energy District and Carbon Neutral Energy Forecast with Scenario Contributions

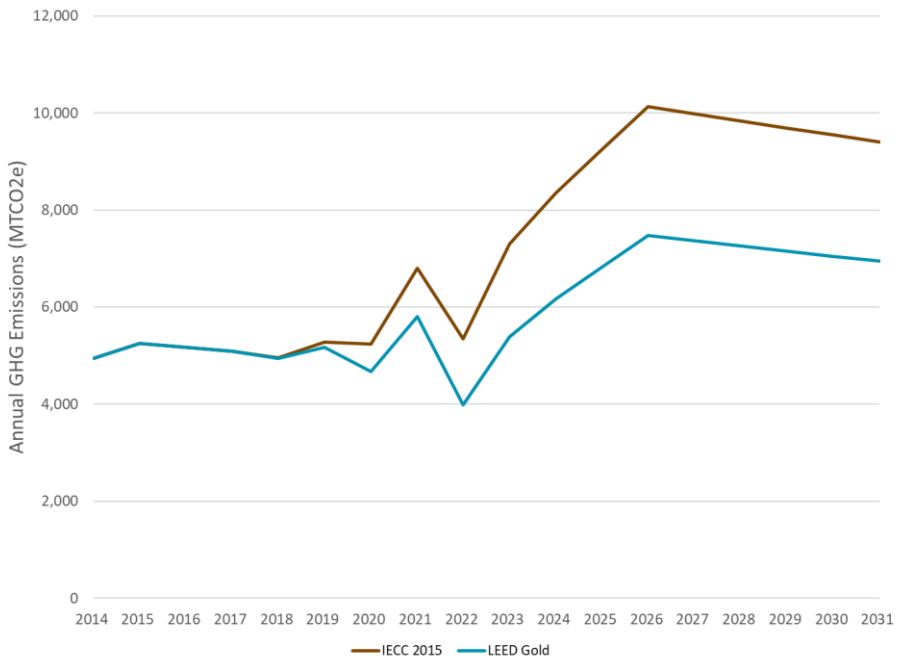

Figure 7. LEED Gold v4 Scenario Emissions Forecast with Energy Efficiency Contributions.

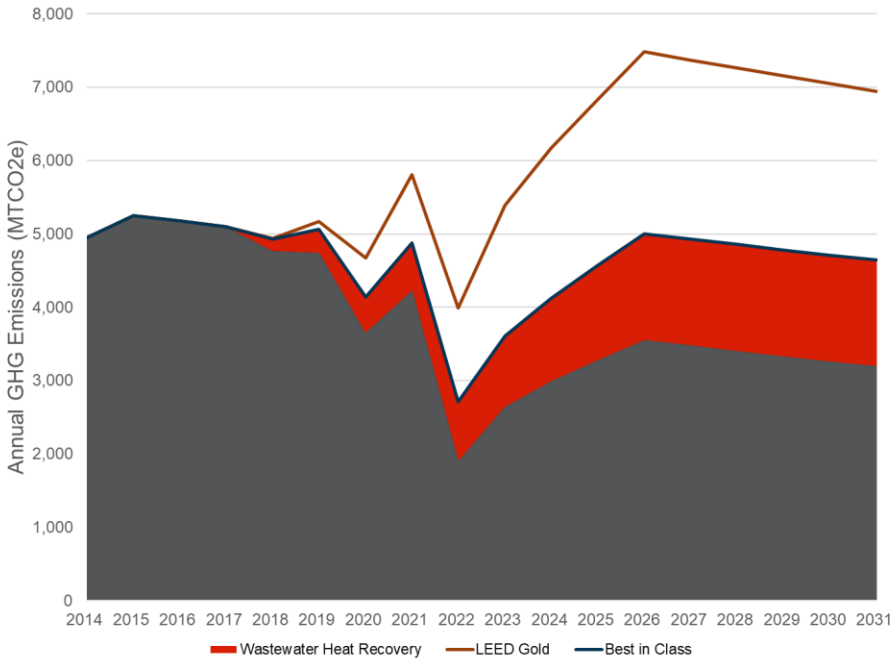

Figure 8. Zero Energy District but not Carbon Neutral Emissions Forecast with Scenario Contributions

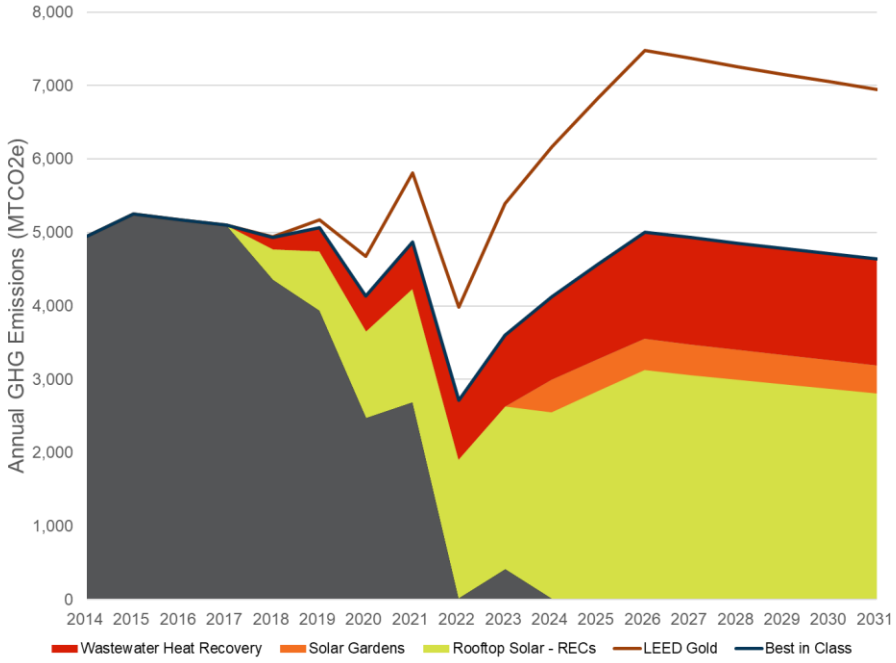

Figure 9. Zero Energy District and Carbon Neutral Emissions Forecast with Scenario Contributions