REV.01

GLUMAC

King County Library System

Climate Action Plan

Prepared For
King County Library System

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A special thanks to all community members that participated in the community engagement for the project. Your feedback was valuable and utilized to inform the final Climate Action Plan.

African Community Housing and Development

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EXECUTIVE SUMMARY

INTRODUCTION

PROJECT BACKGROUND

With the support of a grant from the National Endowment for Humanities (NEH), the King County Library System (KCLS) hired Glumac and Site Story to help develop their first Climate Action Plan (CAP). Building upon KCLS' long-term sustainability goals and commitment to environmental stewardship, the CAP will act as a roadmap to help KCLS respond to climate change, reduce its carbon footprint, and support healthy communities.

The plan articulates the status of the library system in terms of sustainable building design, energy, water, site, the KCLS fleet, and community resilience. Then, it provides short-term and long-term recommendations for the library system to work towards a more sustainable future for their community. The plan also offers information on potential funding opportunities and partnerships to help the library system find opportunities to implement the recommended measures.

Figure 1. Renton Library, one of the KCLS libraries analyzed

COMMUNITY ENGAGEMENT

While Glumac led the technical analysis and strategic recommendations for the CAP, Site Story advised the team on outreach and inclusion strategies for the overall project. It was determined that the best investment in the project's first year was to conduct a series of events with the KCLS' most impacted communities. All the events were structured as listening sessions with prompts to gauge key concerns, challenges, and opportunities with the community. The first series was two Climate and Ecological Justice Leader Roundtables focused on the voices of experts in the field of climate change, including community-based organizations, energy specialists, diversity and inclusion experts, policymakers, and social service providers. The second series included four Pop-Up activity tables at various King County Library and existing community events. The Pop-Ups served as both informal polling opportunities and a chance to have an open dialogue with community members at large.

The input from KCLS' community engagement is summarized in the report and influenced the recommendations within the CAP. KCLS' Strategic Framework seeks to reflect its commitment to public service by enhancing lives, forging connections, and strengthening communities, so it is essential that the CAP helps support this mission.

SITE VISITS & OBSERVATIONS

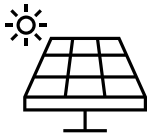
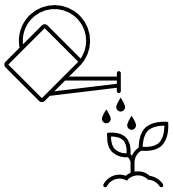
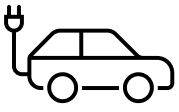
Glumac conducted a series of site visits to assess the KCLS facilities' current conditions and gain stakeholder feedback from facilities managers and onsite technicians. The consultant team visited sites with the highest electrical and natural gas usage, unique design features, and high-efficiency sustainability systems to ensure that the feedback was comprehensive and that trends across the system could be identified. Common themes across libraries included interest in reducing Greenhouse Gas (GHG) emissions, augmenting energy resilience, implementing additional renewable energy projects, and fostering community engagement with climate action.

SUMMARY OF FINDINGS

To support the KCLS community and reduce emissions, it is recommended that action be taken in the summarized categories shown in Table 1. The body of the report provides more detail on each specific strategy category, with each category receiving its own section of detailed recommendations, scope of implementation, and benefits.

Table 1. KCLS Summary of Findings

Strategies	Goals	Projects	Impacts
 **Sustainable Building Standard**	Standardize sustainability requirements across KCLS projects	• Create a Sustainable Building Standard for all new construction and major renovation projects	Reduce KCLS' overall impact on the natural environment and improve health and well-being of occupants
 **Retrocommissioning and Controls**	Maximize the efficiency of the existing Heating, Ventilation, and Air Conditioning (HVAC) systems	• Fine-tune building HVAC controls for optimal operation • Install plug load controls to make sure computers aren't using excess energy	Reduce **Scope 1** and **Scope 2** emissions by **353** metric tons CO_2e
 **Lighting Upgrades**	Reduce total energy usage at libraries	• Upgrade lighting to high efficiency systems • Install smart controls to limit unnecessary lighting usage	Reduce **Scope 2** emissions by up to **978** metric tons CO_2e

Strategies	Goals	Projects	Impacts
 **Renewable Energy**	Increase onsite renewable energy generation	• Install Photovoltaic (PV) systems at libraries with open roof areas or parking lots	Reduce **Scope 2** emissions by up to **45** metric tons CO_2e **per library**
 **Efficiency Upgrades**	Reduce total energy and emissions from KCLS buildings	• Upgrade HVAC systems to more efficient alternatives	Reduce **Scope 1** and **Scope 2** emissions by **137** metric tons CO_2e
 **Building Electrification**	Eliminate onsite natural gas combustion	• Transition to electric heating for hot water and space heating • Replace fossil fuel backup power generators with batteries	Reduce **Scope 1** emissions by **413** metric tons CO_2e
 **Irrigation Controls**	Reduce KCLS water use	• Transition to weather-based irrigation controls	Reduce total **water use** by up to **28%**
 **Low-Flow Fixtures**	Reduce KCLS water use	• Install low-flow aerators for lavatory faucets • Transition to low-flow and low-flush water fixtures	Reduce total **water use**
 **Site Strategies**	Protect and restore habitat, promote biodiversity and reduce exposure to harmful chemicals	• Utilize native and adapted plant species • Promote healthy soil • Utilize organic fertilizers	Supports local, healthy **ecosystems**
 **Electric Vehicles & Infrastructure**	Eliminate emissions from KCLS' vehicle fleet	• Transition to electric vehicle fleet • Install electric vehicle charging infrastructure to support the fleet	Reduce **Scope 1** emissions by **434** metric tons CO_2e

Strategies	Goals	Projects	Impacts
 **Climate Change Resources & Education**	Educate and provide resources about climate change to the community	• Showcase climate change resources at each library • Green Ambassadors Program • Partner with Community Based Organizations and local Climate & Ecological Justice Leaders	Help create future climate leaders in KCLS' communities
 **Resilience Hubs**	Serve the community during extreme weather events	• Create community resilience hubs	KCLS resilience hubs are a place of refuge for community members impacted by climate change

KCLS FACILITIES & FLEET

SUSTAINABLE BUILDING DESIGN

BACKGROUND

KCLS has taken steps to ensure that sustainable building design has been considered during the new construction and renovation of libraries for the past 20 years. Although it has been too costly to implement LEED certification (a globally recognized rating system that demonstrates a building's commitment to sustainability) across all new buildings and renovations, two libraries - Duvall and Burien - have received this distinction. Traditionally, the following five green building measures were targeted during new construction and renovation projects: site planning, water conservation, energy savings, recycled materials, and air quality of the interior environment.

Examples of sustainable design features within KCLS libraries include:

- Implementation of Building Management Systems that help save energy
- LED lighting that saves energy
- Daylighting that saves energy and creates a healthy indoor environment
- Interior finishes with low levels of Volatile Organic Compounds (VOCs) which improve indoor air quality
- Furniture with recycled content
- Low flow plumbing fixtures to conserve water
- Rain gardens that help reduce pollution, flooding, and increase biodiversity on site
- Green roof to help lower cooling demands and manage stormwater
- Efficient mechanical systems including ground source heat pumps, radiant heating, and heat recovery

Figure 2. Federal Way Library Green Design Features

PROJECT APPROACH

Methodology

Sustainable building design measures are currently being implemented within KCLS new construction and renovation projects as a best practice. Although KCLS does not currently adhere to an official green building standard, it is recommended that a sustainable building standard be developed for future new construction and major renovation projects to maintain best practices in line with other peer libraries around the country.

SUSTAINABLE BUILDING STANDARD

Short-Term Recommendations

It is recommended that KCLS create a Green Building Standard for all new construction, major renovation, and other minor projects. The standard should include requirements on certification pathways as well as specific requirements tied to energy, water, waste, materials, and human health. Creating this standard will help ensure that all projects are pursuing sustainable design features that are in line with KCLS goals. It will also streamline the process for potential sustainability certifications.

Emissions Impact

The GHG emission reduction benefits from the creation of a Sustainable Building Standard will vary based upon the stringency of the created standard as well as the number of planned new construction and renovation projects.

Responsible Parties

- Planning, Design, and Construction – ensure the standard addresses KCLS sustainability goals and vision and has a tiered structure based on the project type and size.
- Maintenance & Operations – ensure the Sustainable Building Standard is in line with maintenance policies and procedures. Possibly, update current policies and procedures to be more in line with sustainability goals.
- Consultant – guide the KCLS team in the creation of the Sustainable Building Standard based upon industry best practices.

Financial Impacts

Cost to create the standard is estimated to be $100k.

Key Enabling Actions

- Create a Sustainability Standards team and utilize the CAP to prioritize sustainability goals.
- Incorporate requirements into procurement process and documents for all upcoming new building and renovation projects.

ENERGY

SUMMARY

Methodology

The primary goal of the energy analysis was to identify the most impactful, cost-effective energy and carbon-reducing strategies that KCLS can begin implementing in the short and long term. This was accomplished by analyzing each library's existing energy performance via evaluating utility bills, constructing energy models, and conducting in-person audits at select facilities. These baseline performances highlighted areas that represented opportunities for significant improvement. A more detailed methodology is provided below, but ultimately, the energy analysis successfully identified the priority order of actions that KCLS should implement to reduce its utility bills and carbon emissions.

Results and Recommendations

The analysis found that KCLS could significantly reduce its carbon footprint through the recommended actions described in the energy strategy section. Table 2 shows KCLS's current energy and emissions performance before any upgrades.

By implementing all possible energy efficiency, electrification, and renewable energy upgrades, KCLS could reduce its emissions by up to 49.9% annually. This assumes the detailed scope of projects laid out in the energy strategy subsections, and that KCLS installs, on average, a 50 kW PV array per library throughout the entire system.

Regarding implementation cost, the study ordered each recommended project category relative to its cost-effectiveness. That is, retrocommissioning (RCx) and controls on plug loads (automatic systems that turn off appliances plugged into wall outlets when not in use) will reduce the most emissions per dollar spent on upgrades, followed by lighting upgrades, followed by PV arrays, and in a similar pattern through all recommended strategies.

Table 2. Summary of King County Library System-wide totals before recommended upgrades

Metric	Portfolio-Wide Total	Equivalent To
Greenhouse Gas Emissions	**8,500,000 lbs** of CO2e emissions per year	Driving **1,120 cars** for a full year[1]
Electrical Energy	**9,800,000 kWh** of electricity used per year	Powering **1,235 typical Washington homes** for a year[2]
Natural Gas	**109,000 Therms** of natural gas used per year	Heating **158 typical Washington homes** for a full winter[3]
Total Buildings	55 buildings accounting for **990,000 total square feet**	Over **17 football fields** of indoor library space

Finally, while outside the scope of this study, it should be noted that all buildings in the portfolio over 20,000 SF will need to comply with the Washington State Clean Buildings Performance Standard (CBPS) within the next 2-6 years. The CBPS provides energy efficiency performance targets that existing buildings must meet to show compliance. If the recommended actions in this report are followed, most of the buildings in the portfolio are anticipated to achieve compliance; however, the CBPS provides further justification for implementing the following energy efficiency actions. More information on the standard can be found at the Department of Commerce's website: CBPS Document Library – Washington State Department of Commerce.

[1] Greenhouse Gas Emissions from a Typical Passenger Vehicle | US EPA

[2] Electricity use in homes - U.S. Energy Information Administration (EIA)

[3] Residential Consumption of Natural Gas (Summary)

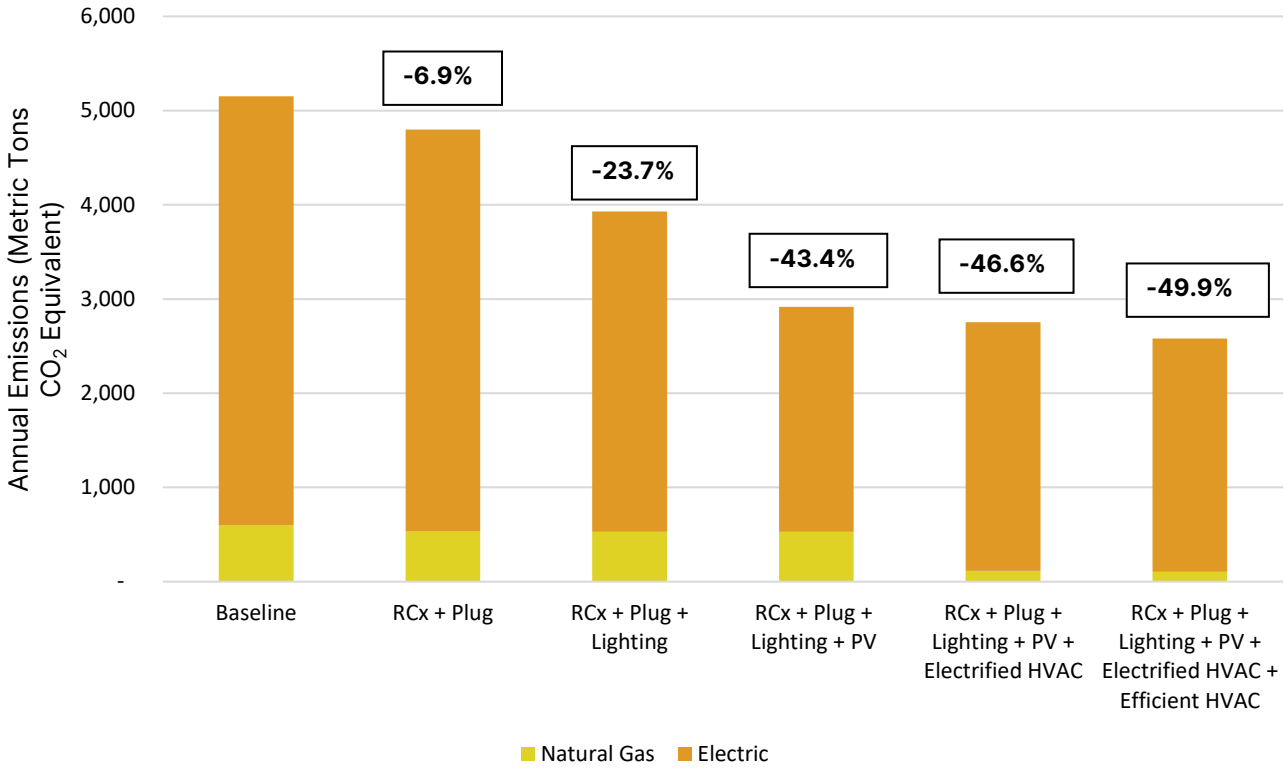


Figure 3. Summary of possible emissions reductions against Baseline per recommended action

The following charts in Figure 4, Figure 5, and Figure 6 highlight how the library system is currently using energy and generating emissions and, therefore, where priority areas for upgrades could be.

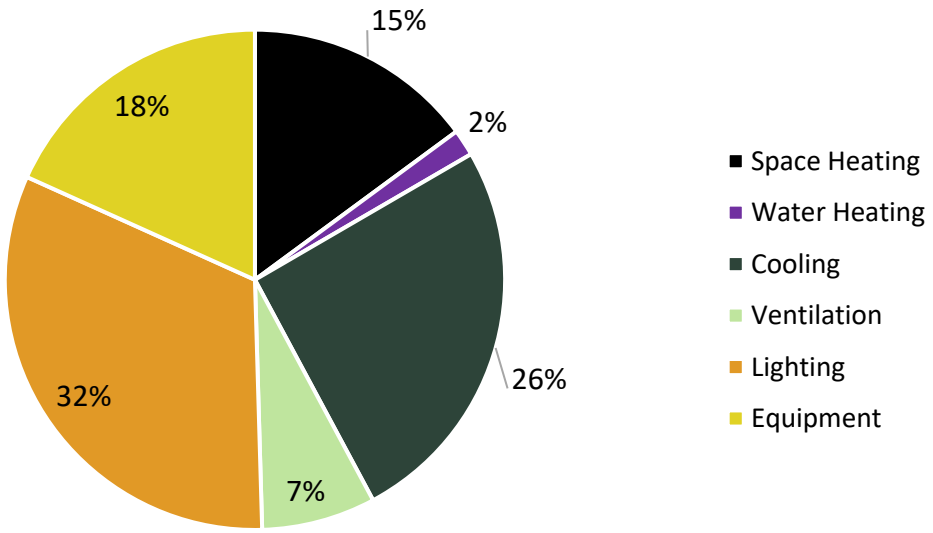


Figure 4. KCLS Portfolio-Wide Energy Usage is shown as each Category's Percentage of the Total Usage

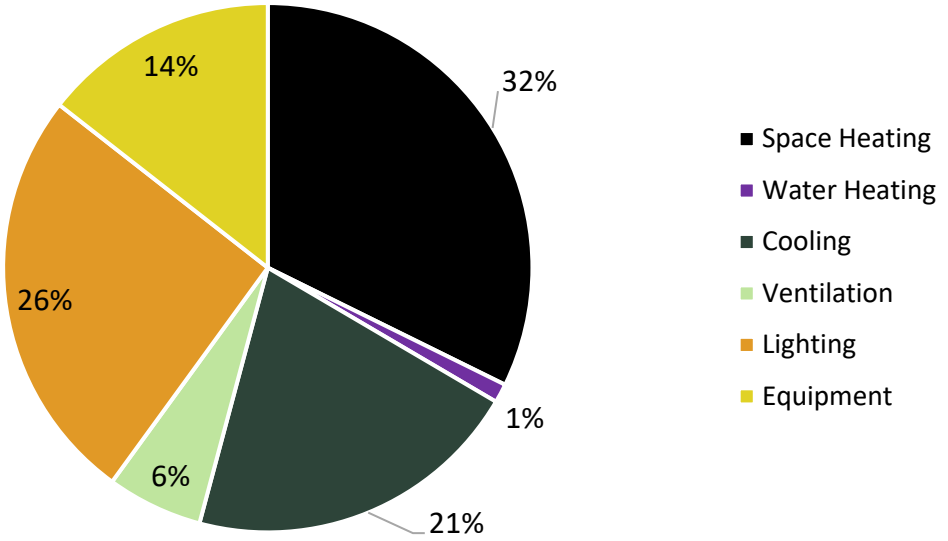


Figure 5. KCLS Portfolio-Wide Emissions is shown as each Category's Percentage Contribution to Total Emissions

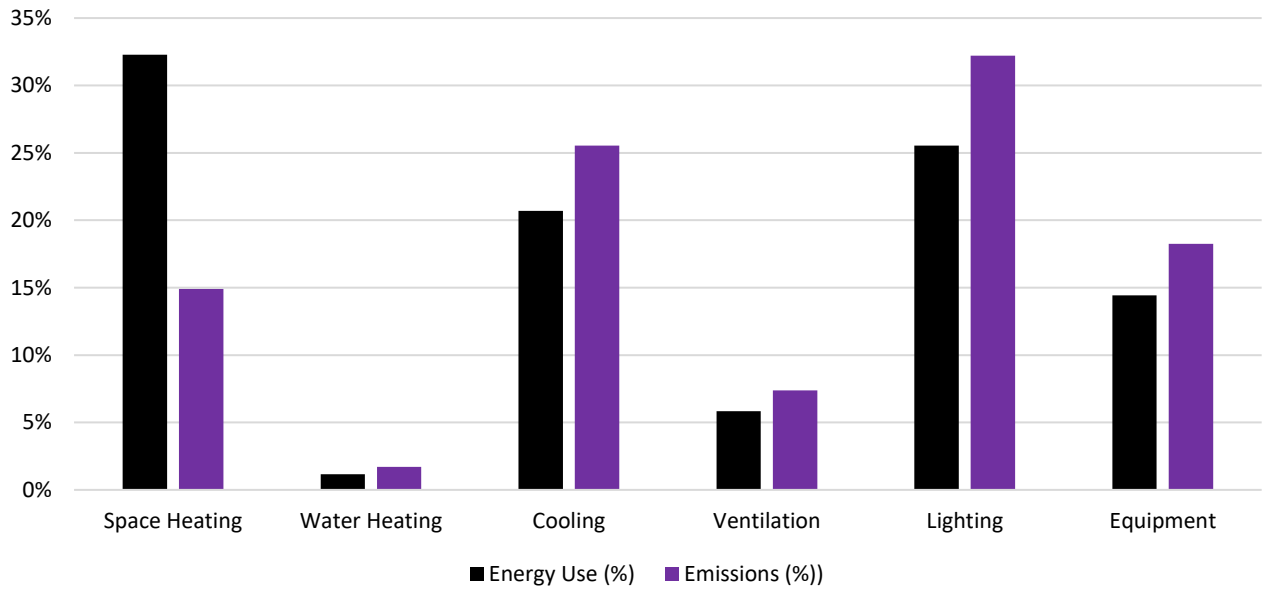


Figure 6. Each Category of Energy Consumption shown as a percent of total usage versus associated emissions

The analysis of the existing libraries highlighted which buildings used the most electricity and natural gas, both on a per-square-foot and total usage basis. The top five buildings in each category shown in Figure 7, Figure 8, Figure 9, and Figure 10 represent priority libraries that should be focused on first when planning the order of upgrade projects.

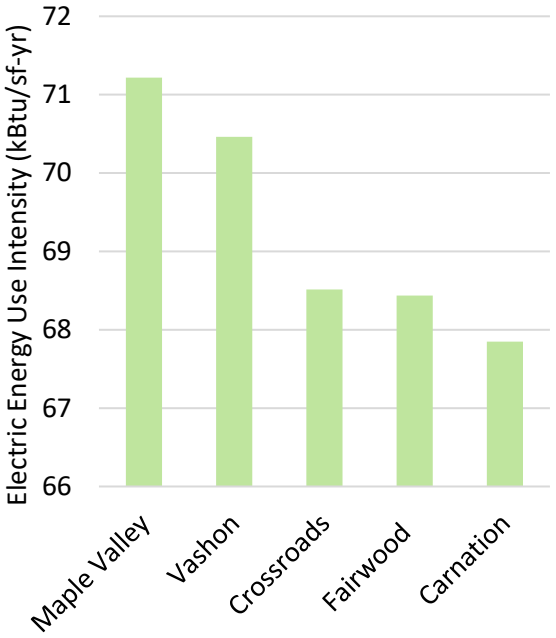


Figure 7. Highest electrical use per square foot

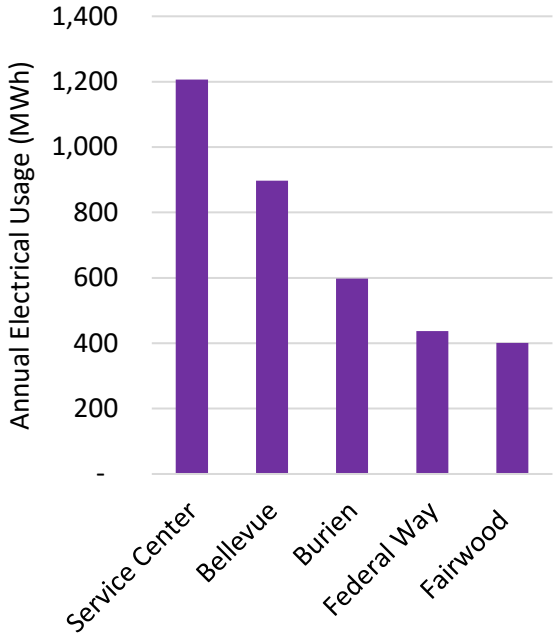


Figure 8. Highest total electrical use per building

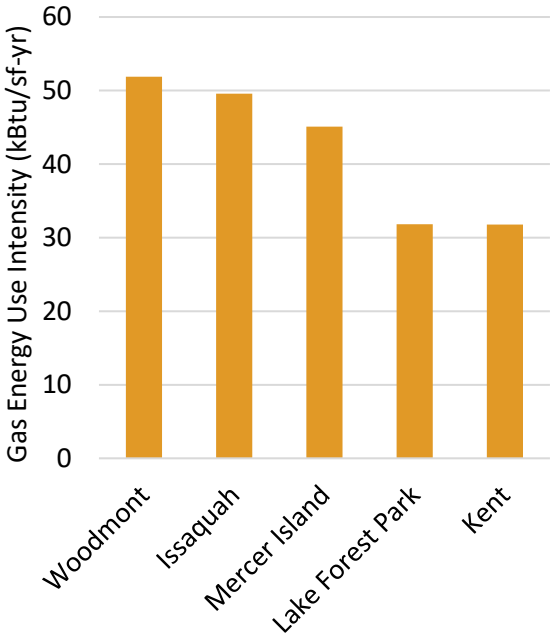


Figure 9. Highest natural gas use per square foot

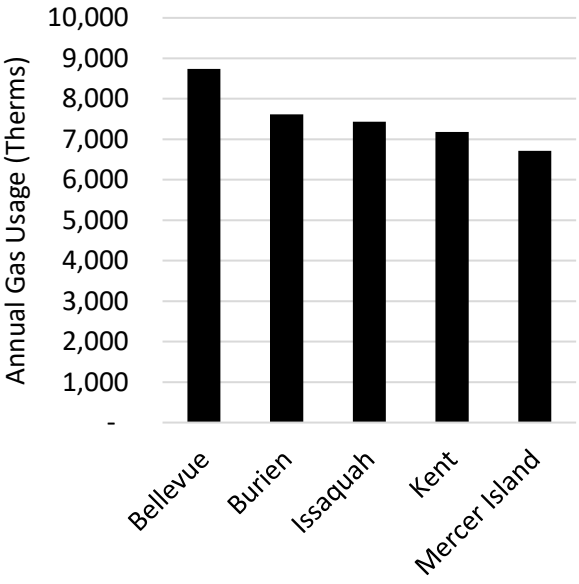


Figure 10. Highest total natural gas per building

PROJECT APPROACH

Energy Methodology

The approach for the energy analysis was divided into multiple phases and followed the steps shown in the figure below. The final step, Energy Project Prioritization, directly informed the results in the following energy subsections,

which are listed in priority order, where retrocommissioning should be implemented soonest and HVAC electrification can be completed over a longer timescale.

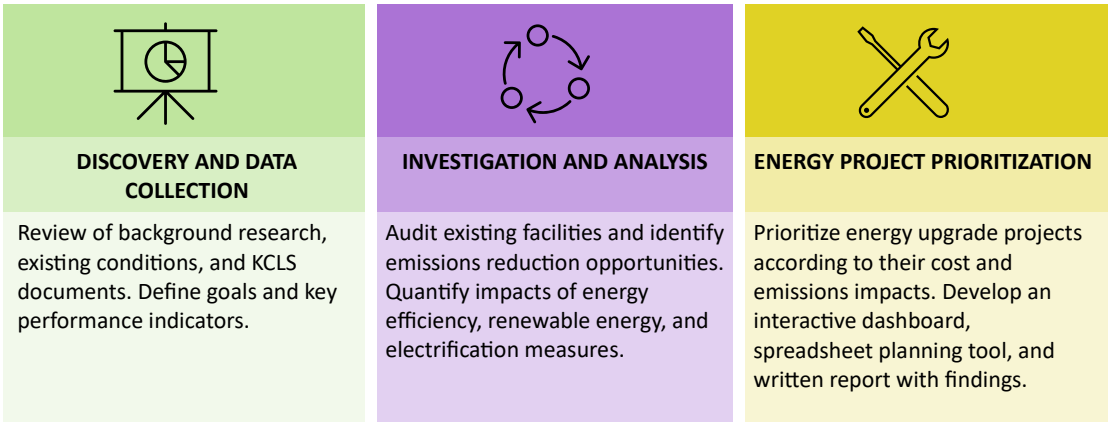


Figure 11: Summary of Steps in the Energy Analysis Methodology

Discovery and Data Collection: The first phase involved meeting with the KCLS CAP committee and external stakeholders, setting goals, and requesting and compiling documents. This phase familiarized the project team with the existing conditions and is the first step in finding where the most impactful energy and sustainability upgrade opportunities are.

Investigation and Analysis Phase: The second portion of the analysis involved analyzing the portfolio of existing buildings and past utility bills to develop a performance baseline. This helps indicate how the library system is currently performing, can be used to compare against peer institutions, and highlights areas of opportunity for significant improvements.

For example, Figure 6 shows that the top areas contributing to emissions are lighting, cooling, space heating, and water heating. These areas will have the most significant impact on reducing energy consumption and emissions and will be prioritized in the recommendations. Additionally, this helped the project team identify which libraries should be investigated in person during the onsite energy audits phase of analysis and what systems they should focus on evaluating.

Energy Project Prioritization: The analysis ranked the project types evaluated in the previous phase in order of most impactful and ease of implementation. The CAP focuses on five project types for energy: retrocommissioning and controls, lighting, on-site renewable energy, HVAC efficiency upgrades, and HVAC electrification. The strategic recommendations below include a summary of each strategy and **are listed in priority order**. Additionally, each section has a short and long-term recommendation for implementation to assist with a planning process for the foreseeable future.

RETROCOMMISSIONING AND CONTROLS

Short-Term Recommendations

Retrocommissioning (RCx) identifies and corrects operational deficiencies and optimizes building controls and sequences of operation. This Energy Efficiency Measure (EEM) results in potential savings of **7-10**% of overall building energy use with very low implementation costs. Retrocommissioning can also be transitioned into "continuous commissioning," where building operation is monitored via Building Automation Systems or other sensors, and issues can be proactively identified and resolved. Fine-tuning HVAC systems, building controls, and operating sequences reduces heating, cooling, ventilation, and pumping energy.

A. Adding "Plug-Load Controls", which are automatic systems for major energy-using appliances plugged into wall sockets used by the library. This could include printers, banks of computers, and equipment in creative spaces. The controls will limit energy consumption and ensure the systems aren't being used during unoccupied hours.

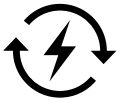
B. Anticipated to reduce total natural gas usage by **10.9%** and electricity usage by **5.6%.**

Long-Term Recommendations

In the long term, KCLS should consider a formal retrocommissioning program with reoccurring inspection dates. This would include recommended intervals for repeating the process (such as every 5 to 10 years for priority buildings) and ensuring facilities operate as intended.

Summary of Findings

Table 3. Emissions, energy, and cost savings achieved for portfolio-wide retrocommissioning

Climate Action Target	Portfolio-Wide EEM Implementation Impact
 **GHG Emissions**	**Eliminate 353 metric tons of CO_2 equivalent emissions**
 **Energy Efficiency**	**Reduce annual electrical energy usage by 721,000 kWh and natural gas usage by 12,000 therms**
 **Balancing Cost**	**Save $83,000 annually on electrical utility costs and $8,000 on annual natural gas costs**
 **Number of Applicable Buildings**	**53 of 55 libraries and parking facilities suitable for upgrade**

Emissions and Energy Impact

Pursuing these energy efficiency measures will significantly reduce KCLS's overall carbon emissions. Together, fine tuning the HVAC controls and setpoints in every library will **draw down annual carbon emissions by nearly 286 tons**. Implementing these EEMs in every library will **eliminate 7.3% in total energy consumption**.

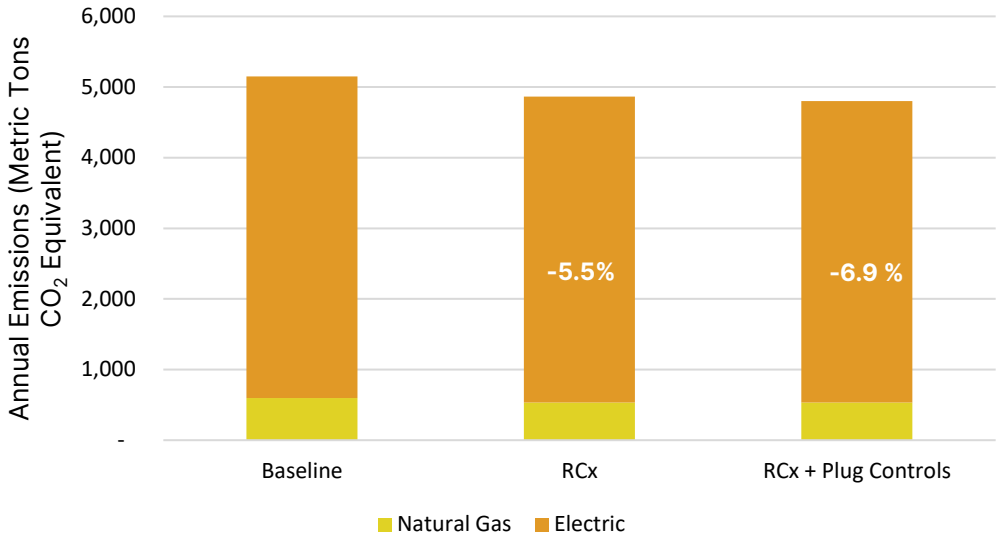


Figure 12. Potential emissions benefits from Retrocommissioning and Plug Load Controls

In the short and long term, retrocommissioning should occur regularly and will continue to be a low-cost, moderately impactful EEM. As increasing amounts of modern HVAC and building operations systems are installed, ensuring they operate correctly and have efficient sequences of operations programmed will become even more critical.

Responsible Parties

- Planning, Design, and Construction – Incorporate a regular retrocommissioning program with recurring activities every 5-10 years.
- Maintenance & Operations – Follow the recommendations and operations protocol established by the retrocommissioning agent.

Financial Impacts

Retrocommissioning is typically one of the most cost-effective energy efficiency measures for building owners. This strategy's costs include conducting retrocommissioning studies and implementing low-cost corrective action, such as reprogramming controls to turn off and on at different times, and tuning fans and pumps to operate at specific speeds. Since there are usually little to no physical hardware upgrades required to successfully retrocommission a building, the implementation costs are relatively cheap. The range of implementation costs per square foot is due to economies of scale for different-sized buildings. A larger library with a higher square footage but a similar amount of Mechanical, Electrical, and Plumbing systems will likely cost roughly the same total amount to retrocommission as a smaller library but therefore have a lower price per square foot.

Table 4. Electric cost savings assuming full implementation of retrocommissioning and plug load controls

Savings Category		Annual Savings ($/year)
Retrocommissioning	Electric Utility Savings	$65,000
	Gas Utility Savings	$8,000
Plug Load Controls	Electric Utility Savings	$17,000
	Gas Utility Savings	$0
Total Cost Savings		**$91,000**
Implementation Cost ($/Square Foot)		**$0.75-1.25**

Key Enabling Actions

- Develop a recurring schedule for an ongoing retrocommissioning program.
- Partner with a retrocommissioning vendor.
- Identify suitable plug loads that would benefit from an automated controls system and implement the systems accordingly.

LIGHTING

Short-Term Recommendations

Presently, lighting accounts for **23%** of KCLS's total energy usage. To advance KCLS's commitment to mitigating climate change via improvements in energy efficiency, several lighting strategies offer avenues to reduce operational energy usage. In the short-term, prioritizing LED fixture retrofitting and installation can achieve a majority of the potential lighting energy and emissions savings, representing the most cost-effective avenue for improving KCLS's operational lighting strategies.

The following energy efficiency measures (EEMs) may be applied across nearly all libraries in the KCLS portfolio:

A. LED Lighting – Retrofit existing lighting fixtures with LED sources or install new LED fixtures. Depending on the existing systems in place, upgraded lighting fixtures can save **40-60%** of lighting electricity use.

B. Smart Controls – Implement intelligent lighting controls to increase lighting flexibility and automatically turn on/off or dim lights to match a building's lighting needs. These advanced controls can reduce lighting energy consumption by up to **10%** depending on the use of a space.

1. Occupancy Sensors – Install occupancy sensors to control lighting based on the presence or absence of people in library spaces. Occupancy sensors are most effective in areas that frequently switch from occupied to non-occupied. Typical spaces that benefit from occupancy sensors are bathrooms, enclosed conference rooms, and smaller office or support spaces.
2. Daylight Sensors – Install daylight sensors to automatically dim or brighten lighting based on the available daylight entering library spaces. These should be installed in the large, open common areas where most of the libraries typically have significant window areas to let in sunlight. Daylight controls are most effective in areas that receive sufficient sunlight to illuminate the space with lighting fixtures.

Long-Term Recommendations

In the long-term, KCLS should update their design standards to include LED fixtures as the new standard for lighting systems and ensure this requirement is included in the recommended Sustainable Building Standard development. Ensuring that LEDs are continued to be used and supported (via maintenance and buildings operations staff) will ensure efficient, cheap, and low emissions lighting systems.

Summary of Findings

Table 5. Emissions, energy, and cost savings achieved for portfolio-wide installation of LED lighting

Climate Action Target	Portfolio-Wide EEM Implementation Impact
 **GHG Emissions**	**Eliminate 978 metric tons of CO_2 equivalent emissions**

Electrical Energy Efficiency	**Reduce annual electrical energy usage by 2,194,000 kWh**
Balancing Cost	**Save $230,000 annually on electrical utility costs**
Number of Applicable Buildings	**53 of 55 buildings and parking facilities suitable for upgrade**

Emissions & Energy Impact

Pursuing these energy efficiency measures will significantly reduce KCLS's overall carbon emissions. Together, upgrading lighting fixtures to LED and installing smart controls in every library will **draw down annual carbon emissions by nearly 945 tons**, equivalent to the yearly energy use of 113 homes.

Implementing these lighting EEMs in every library will **eliminate 75% of lighting energy** presently used in KCLS operations—equivalent to **17% reduction in total energy consumption**. These measures will lead to an average reduction in energy use intensity (EUI) of 8.6 kBtu per square foot per year in every library, corresponding to an average **15% decrease in EUI values.**

Table 6. Potential energy savings assuming full implementation of lighting EEMs

	LED & Smart Controls
Baseline Electrical Energy Use (kWh)	11,750,000
Post EEM Electrical Energy Use (kWh)	9,737,000
Electrical Energy Reduction (kWh)	**2,013,000**

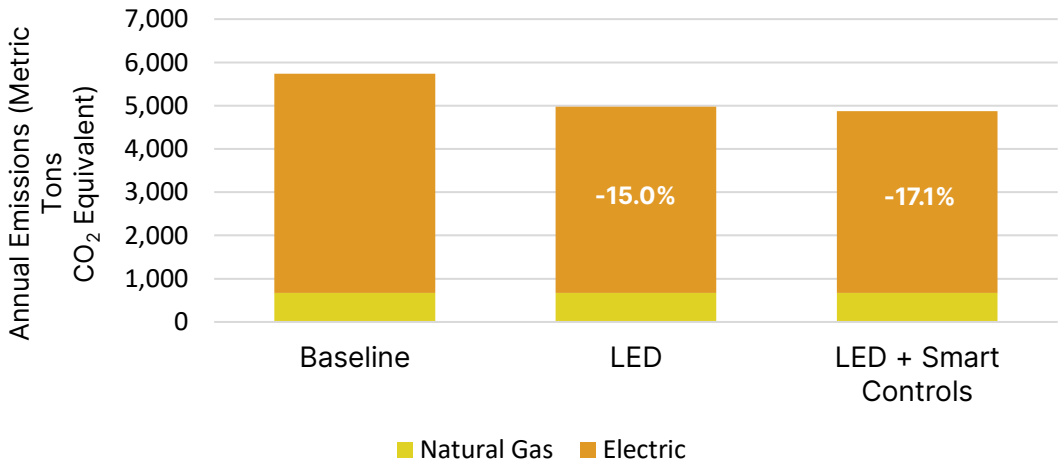


Figure 13. Potential emissions benefits from LED and smart control lighting

In the short-term, prioritizing LED fixture retrofitting and installation can achieve a majority of the potential lighting energy and emissions savings, representing the most cost-effective avenue for improving KCLS's operational lighting strategies.

Responsible Parties

- Planning, Design, and Construction – Incorporate smart-control LED lighting fixtures into new construction and major renovation RFP process.
- Building Services – Revise Design & Construction standards to reflect current KCLS practices.
- Energy Management – Provide verification of performance of new projects.
- Maintenance & Operations – Provide feedback on operational effectiveness of new buildings.

Financial Impacts

Transitioning to smart-control LED lighting fixtures in all libraries will save KCLS 17% of its current electric utility costs each year, opening up funding for other climate action strategies. The implementation of LED fixtures and smart controls is usually a cost-effective EEM. The cost estimate in the below table assume KCLS can use retrofit kits and account for contractor installation costs.

Table 7. Electric cost savings assuming full implementation of lighting EEMs

	LED & Smart Controls
Baseline Annual Lighting Costs	$1,233,000
Post EEM Annual Lighting Costs	$1,022,000
Annual Electric Cost Savings	**$211,000**
Retrofit Kits Implementation Cost ($/Square Foot)	**$5.00-6.00**

Key Enabling Actions

- Develop a schedule for lighting upgrades for the buildings with the highest energy use and complete by 2035.
- Implement EEMs as funding permits.
- Verify savings of completed projects.

ON-SITE RENEWABLE ENERGY

Short-Term Recommendations

KCLS should aim to implement as much on-site renewable energy as feasible in a cost-effective manner. Several buildings present opportunities for installation of photovoltaic (PV) systems. The following criteria may be used to evaluate the sites:

- Building with a large amount of roof or available parking area
- Flat or low-sloped roofs
- South-facing exposure (if low-sloped)

In the short term, KCLS should conduct feasibility studies to identify suitable candidates for implementation. Additionally, prioritizing large installations can reduce the installed cost per kW of capacity, maximizing cost-effectiveness.

In addition to these geographic considerations, when implementing additional renewable sources, KCLS should also consider the ability of a library to use the generated energy and the ability to connect to the local Puget Sound Energy (PSE) or Seattle City Light (SCL) infrastructure, enabling the return of excess energy to the grid.

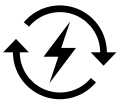
Long-Term Recommendations

Once multiple libraries have been identified as promising candidates for onsite renewable energy systems, KCLS should begin engaging vendors for system installation. This will include beginning a capital expense plan that includes budgeting for installing future systems and searching out rebates and incentives to offset system installation costs.

Additionally, it should be noted that Washington State Energy Code (WSEC) mandates that new construction buildings must have a minimum amount of onsite renewable energy systems. This should be accounted for in all future capital expense plans when evaluating possible new libraries.

Summary of Findings

Table 8. Summary of implementing onsite renewable energy systems.

Climate Action Target	EEM Implementation Impact
 **GHG Emissions**	**Eliminate 45 metric tons of CO_2 equivalent emissions for every 100 kW PV**
 **Electrical Energy Efficiency**	**Produce 113,200 kWh electrical energy annually for every 100 kW PV**
 **Balancing Cost**	**Save $12,830 annually on electrical utility costs for every 100 kW PV installation**

Emissions & Energy Impact

Representative PV systems were modeled to evaluate potential reduction in GHG emissions (Table 9). Buildings serviced by Puget Sound Energy (PSE) represent the greatest opportunity for emissions reduction. For example, a 50-kW array installed on a PSE-served building can offset nearly 22 tons of carbon emissions annually, equivalent to removing over 5 gasoline-powered vehicles from the road for a year.

Table 9. PV System GHG Emissions Reduction Potential

Proposed Total Array Size (kW)	Annual Electricity Produced (kWh)	Carbon Emissions Offset (ton CO_2)	
		Puget Sound Energy	Seattle City Light
25	28,200	11.1	0.3
50	56,900	22.4	0.5
100	113,200	44.6	1.0
200	226,100	89.1	2.0

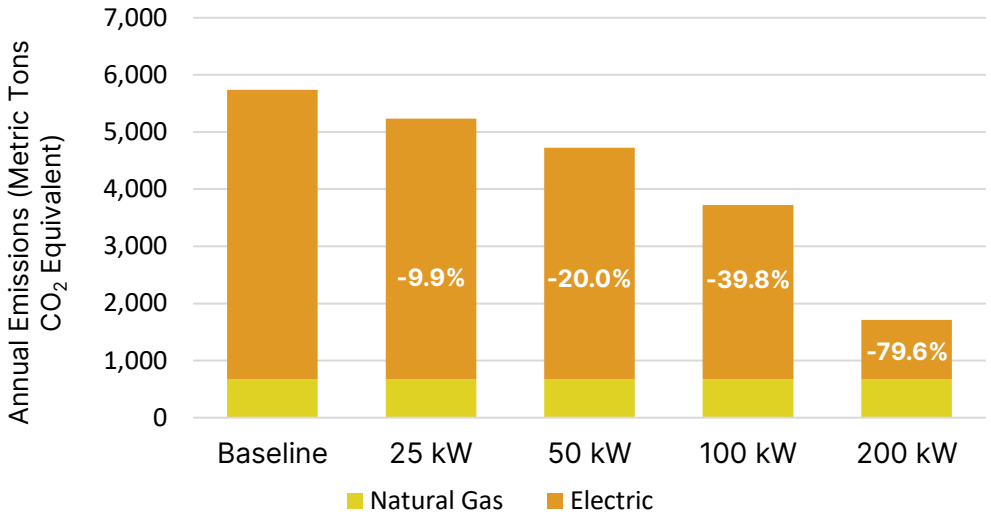


Figure 14. Potential emissions benefits from on-site solar photovoltaics

Responsible Parties

- Planning, Design, and Construction – Integrate on-site renewables into all new building and major renovation projects and ensure its inclusion in the Sustainable Building Standard.
- Procurement – Continue to develop Request for Proposals (RFPs) for PV systems.
- Energy Management – Verify performance of installed arrays.

Financial Impacts

Given current federal rebates and potential operational cost savings, the initial capital investment for PV installation can be recouped within a few decades.

Table 10. Life Cycle Cost Assessment for representative 100 kW PV installation

	On-Site Renewable Energy	
	Rooftop	Carport
Total Current Capital Cost	$0	
Total Strategy Capital Cost*	$227,500	$297,500
Annual Operating Cost Savings	$12,830	
Simple Pay Back	18 Years	23 Years

**Capital Cost calculations account for current federal rebates offered through the Inflation Reduction Act (IRA)*

Funding & Financing Options

Financing options for this strategy include internal KCLS funds, green bonds, grants and subsidies, and appropriations. Additionally, a range of federal and state incentives aim to make renewable projects more financially viable and enhance energy infrastructure from the local to national level.

To supplement a grant received from the National Endowment for the Humanities (NEH) and corresponding match to be made by the KCLS Foundation, Smart Grid Grants and U.S. Department of Energy Solar Energy Technologies Office (SETO) offer further funding opportunities for solar PV installation, transmission system capacity expansion, and other related initiatives. These opportunities also encourage collaborations among community organizations, universities, industry, federal, state, and local governments, and non-government agencies.

Several programs offered by the Washington State Department of Commerce, including the Solar Grant Program and Energy Efficiency Grant Program, provide funding to install solar PV and a range of energy saving projects at existing public-owned facilities. Leveraging KCLS's status as a publicly owned entity and its commitment to local patrons and programs will allow the library system to pursue optimal funding opportunities to advance community development via expansion of on-site solar capabilities.

Key Enabling Actions

- Guided by individual building energy demands and available roof and/or parking area, identify priority sites for PV installations.
- Develop a timeline for future deployment over the next 20-30 years.
- Include a requirement for on-site PV in all new building and major renovation projects and the Sustainable Building Standard.

HVAC EFFICIENCY UPGRADES

Short Term Recommendations

Presently, the space heating, cooling, and ventilation systems at KCLS account for roughly 60% of total energy consumption and 50% of total emissions. These represent the major energy uses associated with the HVAC systems at the libraries and represent opportunities to reduce energy usage and emissions. However, HVAC system upgrades typically have a very high cost and should be timed to occur when the system reaches the end of its expected useful life, when it needs to be replaced anyway. In the short term, the possible actions include:

A. Air Flush – Reducing or eliminating the strategy of night-time air flushes at specific buildings will reduce the amount of outside air that needs to be heated or cooled. This could reduce KCLS' **total gas usage by 0.4%** and the **total electricity by about 0.1%**. While these savings numbers are relatively small, there are essentially no costs associated with implementing this upgrade, and it could produce immediate benefits.

Long Term Recommendations

In the longer term, KCLS could consider the following upgrades, which represent more expensive upgrades but have much higher impacts on reducing utility bill cost, energy usage, and emissions. If these upgrades are timed to align with when the HVAC systems need to be replaced anyway, the price increase will be marginal. Additionally, these upgrades will possibly be required for compliance with upcoming energy efficiency performance mandates as described in the Clean Buildings Performance Standard (CBPS). In the long term, the possible actions include:

B. Chiller Replacement—When the 3 currently operating chillers are due for replacement, replace the existing chillers with newer, high-performance models. This could reduce **total system electricity by 0.8%** and save roughly **$10,500 on annual utility bills.**

C. Constant Air Volume (CAV) to Variable Air Volume (VAV) Air Handler Unit (AHU) Conversion – Upgrade the AHUs that currently operate at constant volume and cannot adjust the speed at which their fans run to variable volume. This allows the AHUs to vary how much air is needed at any time and will save on heating, cooling, and ventilation energy, accounting for an **8.6% reduction in total system energy usage**, saving around **$122,500 per year.**

Summary of Findings

Table 11. Emissions, energy, and cost savings achieved for portfolio-wide installation of HVAC efficiency measures

Climate Action Target	Portfolio-Wide EEM Implementation Impact
CO_2 **GHG Emissions**	**Eliminate 133 metric tons of CO_2 equivalent emissions**

Energy Efficiency	**Reduce annual electrical energy usage by 422,000 kWh and annual gas usage by 18,000 therms**
Balancing Cost	**Save $60,000 annually on gas and electricity utility costs**
Number of Applicable Buildings	**7 buildings suitable for air flush, 3 buildings suitable for chiller upgrade, 43 buildings suitable for CAV to VAV conversion**

Emissions & Energy Impact

Pursuing these energy efficiency measures will significantly reduce KCLS's overall carbon emissions. Together, this EEM will **draw down annual carbon emissions by roughly 133 tons**, equivalent to the yearly energy use of 14 homes.

Implementing these HVAC efficiency EEMs in every library will **eliminate 16% of total gas and 4% of electricity usage** presently used in KCLS operations—equivalent to a **7.5% reduction in total energy consumption**. These measures will lead to an average energy use intensity (EUI) reduction of 3.3 kBtu per square foot per year in every library.

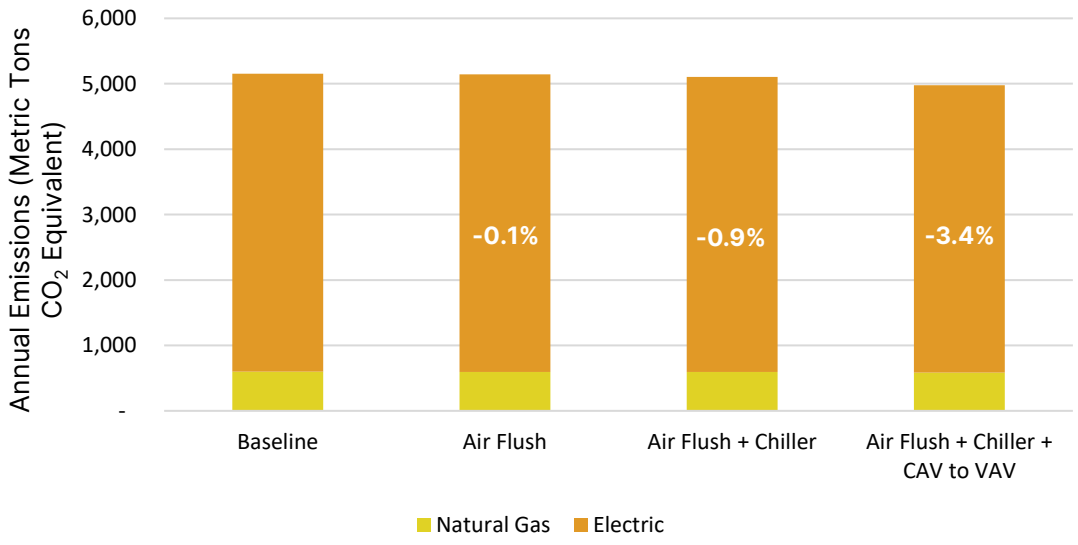


Figure 15. Potential emissions benefits from all HVAC efficiency upgrades

Responsible Parties

- Planning, Design, and Construction — Use the provided Building Database to identify buildings with constant air volume AHUs and older chillers that are eligible for upgrade.
- Building Operations – Review operating schedules and confirm if night-time air flush is required for health-safety concerns or if it could be reduced.

Financial Impacts

HVAC efficiency upgrades are costly to implement but produce significant cost savings. The Air Flush cost is assumed to require just the hourly rate of roughly 4-8 hours of a KCLS internal facility manager. The Chiller upgrade and CAV to VAV AHU conversions are more expensive, and the price includes the materials and installation cost of each.

Table 12. Electric cost savings assuming full implementation of HVAC Efficiency Upgrades

Savings Category		Annual Savings ($/year)
Nighttime Air Flush	Electric Utility Savings	$900
	Gas Utility Savings	$350
Chiller Upgrade	Electric Utility Savings	$10,500
	Gas Utility Savings	$0
CAV to VAV AHU Conversion	Electric Utility Savings	$37,000
	Gas Utility Savings	$11,500
Total Cost Savings		**$60,250**
Nighttime Air Flush Implementation Cost		**4-8 hours of facility manager hourly rate**
Chiller Upgrade Implementation Cost		**$10-15,000/ton of cooling capacity**
CAV to VAV AHU Implementation Cost		**$20-35/SF of served area**

Key Enabling Actions

- Plan and budget capital expenses to allow for upgrades over the next 10-15 years.
- Implement EEMs as funding permits.
- Verify savings of completed projects.

HVAC ELECTRIFICATION

Short Term Recommendations

The electrification of existing fossil fuel building systems includes replacing natural gas boilers, rooftop units, and hot water heaters with alternative electric systems. This action will significantly reduce Scope 1 GHG emissions at KCLS and could be paired with increasing use of renewable energy to maximize its impact. In the short term, KCLS should prioritize the following actions:

A. Identify the buildings with natural gas heating systems that are suitable for upgrade and create a phased upgrade plan based on each system's recommended replacement date.

B. Evaluate each recommended building's electrical infrastructure and ensure there is adequate capacity to add an electric heating system.

Long Term Recommendations

After the preliminary, short-term actions have been taken, KCLS can work on the actual system implementation by working on the following actions:

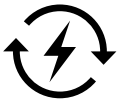
C. Replace existing natural gas boilers used to create hot water to heat rooms within the library with air-to-water heat pumps (AWHPs). AWHPs run using electricity and are 2-4 times more efficient than a typical gas hot water boiler. This will drastically reduce emissions and energy consumption.

D. Replace existing natural gas rooftop units (RTUs) with air-to-water heat pumps (AWHPs). RTUs burn natural gas to heat air and warm the library. AWHPs run using electricity and are 2-4 times more efficient than a typical gas RTU. This will drastically reduce emissions and energy consumption.

E. Replace existing natural gas furnaces with electric split system heating units. Furnaces burn natural gas to heat air and warm the library. Split systems run using electricity and are up to 3 times more efficient than a typical gas furnace. This will drastically reduce emissions and energy consumption.

Summary of Findings

Table 13. Emissions, energy, and cost savings achieved for portfolio-wide electrification of HVAC equipment

Climate Action Target	Portfolio-Wide EEM Implementation Impact
 **GHG Emissions**	**Eliminate 162 metric tons of CO_2 equivalent emissions**
 **Energy Efficiency**	**Transitions to a roughly 3x as efficient heating source**
 **Reducing Onsite Emissions**	**Eliminates 70% of total natural gas usage**
 **Number of Applicable Buildings**	**17 of 55 buildings and parking facilities suitable for upgrade**

Emissions & Energy Impact

Using natural gas as a heating source significantly contributes to KCLS's emissions. Switching from natural gas to electricity as a heating source would nearly entirely remove onsite emissions. The electricity would still produce some offsite emissions, but due to the highly efficient heating systems, the new emissions associated with electricity would be much smaller than the amount of avoided emissions associated with natural gas.

Overall, this combination of electrification measures would reduce gas emissions by 414 metric tons of CO2 per year and increase electrical emissions by 251 metric tons per year for **an annual net reduction of 162 metric tons of CO2.**

Implementing these EEMs in every library will **eliminate 55% of heating energy** presently used in KCLS operations—equivalent to **11% reduction in total energy consumption**.

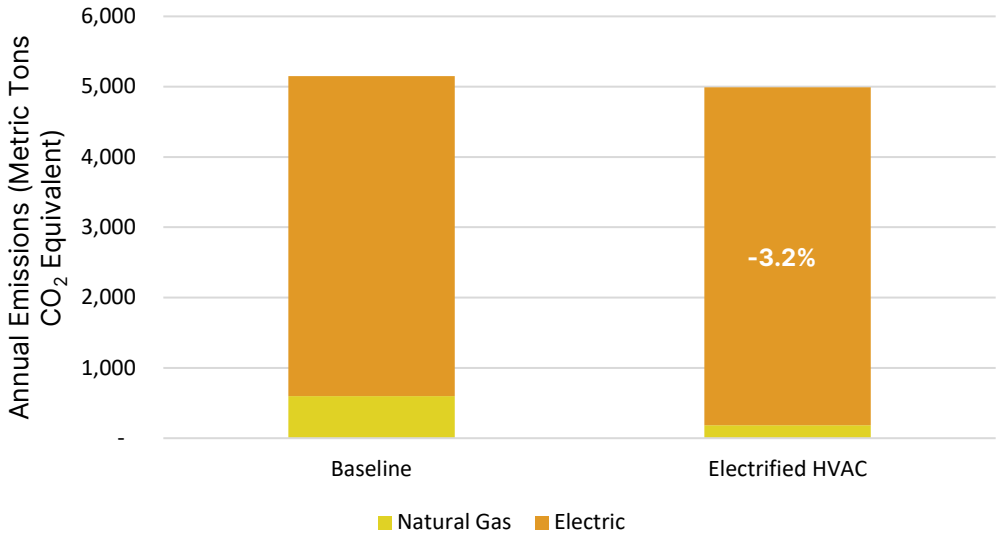


Figure 16. Potential emissions benefits from electrifying all HVAC systems

In the short term, prioritizing electrification upgrades can be a costly but effective upgrade. However, removing Scope 1 (onsite) building emissions entirely is a highly impactful sustainability upgrade and should be implemented where budget and timing allow.

In the long-term, it is recommended to prioritize replacing heating systems with electrified alternatives when natural gas boilers, RTUs, and furnaces reach the end of their expected life cycle. This makes the upgrade to high-efficiency electric heating systems only marginally more expensive as the replacement project will be occurring regardless.

Responsible Parties

- Planning, Design, and Construction – Utilize the provided Building Database to identify buildings with natural gas heating systems that are eligible for upgrade. Review electrical infrastructure drawings, possibly retain electrical engineering services as needed to conduct electrification feasibility studies.
- Building Services – Identify the age of all existing natural gas heating systems and create a timeline for updates.
- Procurement – Begin budgeting/creating a capital expense plan that includes phased electrification upgrades over the next 15-20 years.

Financial Impacts

Transitioning to electrified heating systems has two financial impacts. It drastically reduces natural gas utility costs as it will no longer be the primary heating fuel source. It also increases electricity costs as more systems will rely on electricity as a heating source. While electric heating systems are much more efficient and use less total energy overall, natural gas is much cheaper per unit of energy. This means the total difference in utility bills is relatively close to even, although the strategy will significantly reduce total energy usage and emissions.

Table 14. Electric cost savings assuming full implementation of lighting EEMs

Savings Category		Annual Savings ($/year)
Boilers to Heat Pumps	Electric Utility Savings	($46,000)
	Gas Utility Savings	$30,000
Gas RTU to Heat Pumps	Electric Utility Savings	($9,000)
	Gas Utility Savings	$5,500

Furnaces to Heat Pumps	Electric Utility Savings	($27,000)
	Gas Utility Savings	$15,500
Total Cost Savings		**($32,000)**
Typical Electrification Implementation Cost		**$400-600/MBH of Heating Capacity**

Key Enabling Actions

- Utilize the provided Building Database tool to identify which buildings are suitable for upgrades.
- Create a phased upgrade plan to switch to electrified alternatives when existing systems meet the end of their useful life.
- Conduct detailed engineering feasibility studies to ensure that each building's existing electrical infrastructure can support an increased electrical demand associated with new electric heating systems.

WATER

BACKGROUND

KCLS is a major user of water, with an estimated usage of 20 million gallons per year. Presently, based upon the available water bills, irrigation water is accounting for approximately 70% of KCLS' annual water usage, so any initial upgrades to the water systems should first focus in on reducing irrigation water use.

IRRIGATION CONTROLS

Short-Term Recommendations

To both decrease KCLS' water consumption and save money on utilities, it is recommended that WaterSense labeled weather-based and network-connected irrigation controls be installed within all facilities that do not currently utilize them. Decreasing the amount of irrigation water consumed will have the largest impact on water savings across the KCLS portfolio as well as the highest return on investment. Replacing a standard clock-based controller with a weather-based controller can reduce water use by 15-40%.[4] The water savings is contingent on several local factors and the controller and features selected. If possible, installing a weather-based controller with a soil moisture sensor will likely lead to the largest amount of water savings.

[4] Water-Efficient Technology Opportunity: Advanced Irrigation Controls | Department of Energy

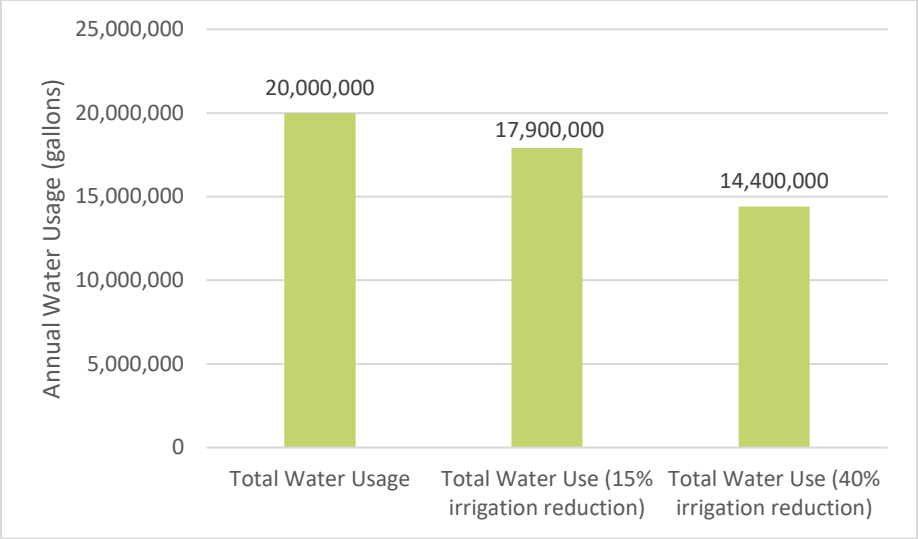


Figure 17. Potential total water savings with weather-based irrigation controls

Summary of Findings

Table 15. Emissions, energy, and cost savings achieved for upgrading irrigation controls

Climate Action Target	Portfolio-Wide EEM Implementation Impact
CO_2 **GHG Emissions**	**Small impact**
Energy Efficiency	**Minimal energy savings due to decreased pumping demand**
Reducing Onsite Water Use	**Reduces KCLS total water use by up to 28%**
Number of Applicable Buildings	**43 of 55 buildings and parking facilities may be suitable for upgrade**

Emissions and Energy Impact

Reducing KCLS' total water use will have a small impact to KCLS' emissions, primarily due to the decreased pumping energy needed.

Responsible Parties

- Maintenance & Operations – Perform an inventory at KCLS facilities to identify current controls at each location.
- Building Services – Create a timeline for updates based upon the inventory assessment.

- Procurement – Begin budgeting/creating a capital expense plan that includes upgrades to irrigation controls.

Financial Impacts

The water savings and cost of the irrigation controls are contingent on the controller and features selected as well as the number of irrigation zones on each site.

Table 16. Irrigation Control Cost Estimate & Savings

Irrigation Controls	
Typical Implementation Cost	$1,000 per zone with ongoing monthly fees
Estimated Annual Operating Cost Savings[5]	$3400-$9000

Key Enabling Actions

- Perform an inventory at KCLS facilities to identify the current irrigation controls at each location.
- Replace current system with weather-based irrigation controls.

LOW-FLOW FIXTURES

Short-Term Recommendations

Replacing existing lavatory faucet aerators with low-flow aerators is a cost-effective way to reduce KCLS' water consumption. It is recommended that any faucet with a flow rate of 1.5 gallons per minute or greater be replaced with a low-flow aerator.

Long-Term Recommendations

To both decrease KCLS' water consumption and save money on utilities, it is recommended that water fixtures be updated to low-flow or low-flush fixtures whenever fixtures need to be replaced. All new construction should also incorporate low flow fixtures utilizing industry best practices. These best practices should also be incorporated into the Sustainable Building Standard. Recommended maximum flow and flush rates in gallons per minute (GPM) and gallons per flush (GPF) for typical fixtures are shown below in Table 17.

Table 17. Recommended Low Flow Fixture Rates

Fixture	Recommended Max Flow (GPM/GPF)
Water Closets	1.28 GPF
Urinals	0.125 GPF
Lavatories	0.35 GPM
Showers	1.5 GPM
Breakroom Sinks	1.0 GPM

[5] Assuming $1.60/kgal

Emissions and Energy Impact

Water heating only accounts for 2% of all of KCLS' portfolio-level energy usage, so reducing KCLS' total water use will have a minimal impact to KCLS' total emissions.

Responsible Parties

- Maintenance & Operations – Identify flow rates of current lavatory faucets and install low-flow aerators as necessary.
- Planning, Design, and Construction – Ensure that fixture maximum flows are incorporated into the Sustainable Building Standard.

Financial Impacts

Low-flow aerators are cost-efficient, simple to install, and have a short payback. There is also a minimal cost premium for low flow and flush fixtures, and these are only recommended for new construction projects or to replace faulty fixtures.

Key Enabling Actions

- Identify lavatory faucet aerators to update.
- Standardize low-flow and flush fixtures for all new construction and renovation projects which include plumbing upgrades and include requirements in the Sustainable Building Standard.

SITE STRATEGIES

BACKGROUND

As best practice some site-specific measures are recommended for adoption into KCLS' operations. These recommendations will help protect and restore habitat, promote biodiversity, and reduce exposure to harmful chemicals. It is also recommended that site specific strategies be included within the Sustainable Building Standard and that updates are made to any existing site-specific criteria in any current operational policies and procedures.

SITE

Short-Term Recommendations

A. Vegetation:

1. Utilize native and/or adapted plant species wherever possible in new landscaping projects.
2. Consider the inclusion of local pollinator plants.

B. Healthy Soil:

1. Consider the inclusion of a wood-chip mulch depth of 2-4 inches in all planted areas to reduce the need for herbicides.
2. Test or manually evaluate soils before treating to avoid unnecessary or excess treatment.

C. Fertilizers:

1. Utilize organic slow-release fertilizers and ensure products are registered with the Washington Department of Agriculture, which ensures the product meets allowable metal content.
2. Do not apply fertilizers or pesticides before forecasted significant rainfall.
3. Consider natural alternatives to fertilizers such as locally sourced compost.

4. Schedule manual weed removal to reduce the need for herbicides.

Responsible Parties

- Building Services – Update any existing landscaping policies to include best practice recommendations.
- Procurement – Perform a simple cost-benefit analysis to determine which best practice measures should be prioritized.

Financial Impacts

There are expected to be cost premiums for implementing the soil and organic fertilizer measures. A simple cost-benefit analysis should be performed to determine which measures should be prioritized.

Key Enabling Actions

- Standardize site criteria for all landscape projects and include site specific requirements in the Sustainable Building Standard.

KCLS FLEET

SUMMARY

KCLS has approximately 57 vehicles in their fleet which is made up of vehicles that serve the library facilities and programs. Most of the vehicles utilize unleaded gasoline or diesel, and 5 vehicles are hybrid. In 2023, KCLS spent $100,532.83 on fuel and the fleet traveled approximately 430,000 miles. KCLS vehicles utilized approximately 17,800 gallons of unleaded gasoline over the course of the year and 4,000 gallons of diesel. The estimated annual emissions associated with the KCLS fleet is shown in Figure 18.

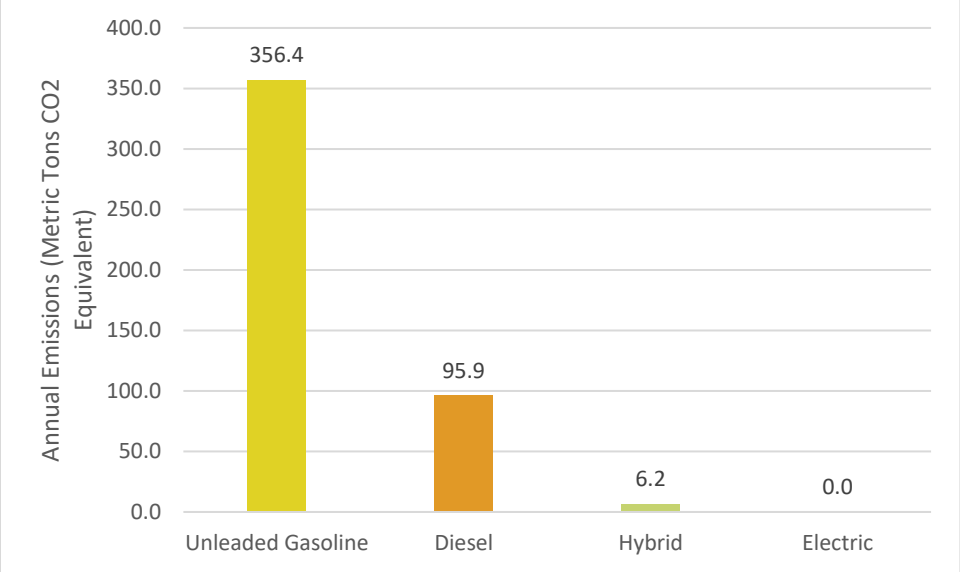


Figure 18. Estimated KCLS Fleet Annual Emissions

Currently, KCLS does not have the electric vehicle charging infrastructure at their facilities to support moving to a purely electric fleet. Recommendations regarding the steps toward facility upgrades and electrification of the fleet are included in the strategy section.

ELECTRIC VEHICLES & INFRASTRUCTURE UPGRADES

Short Term Recommendations

As fleet vehicles need to be replaced at the end of their lifespan, it is recommended that the gasoline and diesel-powered vehicles be replaced with hybrid electric vehicles which utilize both a gasoline engine and an electric motor to achieve improved fuel efficiency and reduced emissions. As the libraries are upgraded to include electric vehicle charging infrastructure, it is recommended that KCLS transition into purchasing fully electric vehicles. Switching to hybrid and electric vehicles will significantly reduce KCLS' Scope 1 GHG emissions. In the short-term, KCLS should prioritize the following actions:

A. Identify the vehicles that will need to be replaced and create a phased upgrade plan to move the fleet to hybrid and electric powered vehicles.

B. In tandem with the HVAC electrification measure, evaluate each building's current electrical infrastructure and verify if there is adequate capacity to add electric vehicle charging infrastructure to the facility.

C. Identify available funding opportunities.

Long Term Recommendations

After the preliminary, short-term actions have been taken, KCLS can work on the electric vehicle charging infrastructure implementation by working on the following actions:

D. Install electric vehicle charging infrastructure at KCLS locations per the phased upgrade plan.

Summary of Findings

Table 18. Emissions, energy, and cost savings achieved for fleet electrification

Climate Action Target	Portfolio-Wide Implementation Impact
CO_2 **GHG Emissions**	**Eliminate 334 (hybrid) to 434 (electric) metric tons of CO_2 equivalent emissions**
Energy Impact	**Increase annual electrical energy usage by up to 147,800 kWh**
Reducing Annual Cost	**Eliminates up to 100% of gasoline and diesel usage. Cost per mile decreases by up to 80%.**
Number of Applicable Vehicles	**52 vehicles in the fleet currently utilize gasoline or diesel**

Emissions and Energy Impact

Using gasoline and diesel-powered vehicles contributes significantly to KCLS' emissions. Transitioning the KCLS fleet to hybrid and eventually all-electric will have the largest impact to Scope 1 emissions reductions. There will be an increase in Scope 2 emissions associated with the energy use from on-site electric vehicle charging.

Overall, the transition of the KCLS fleet to all-electric will eliminate the Scope 1 emissions associated with the fleet. The scope 2 electrical emissions associated with on-site charging of the electric vehicles will increase by 24 metric tons of CO2 year. This results in an **annual net reduction of 434 metric tons of CO2**.

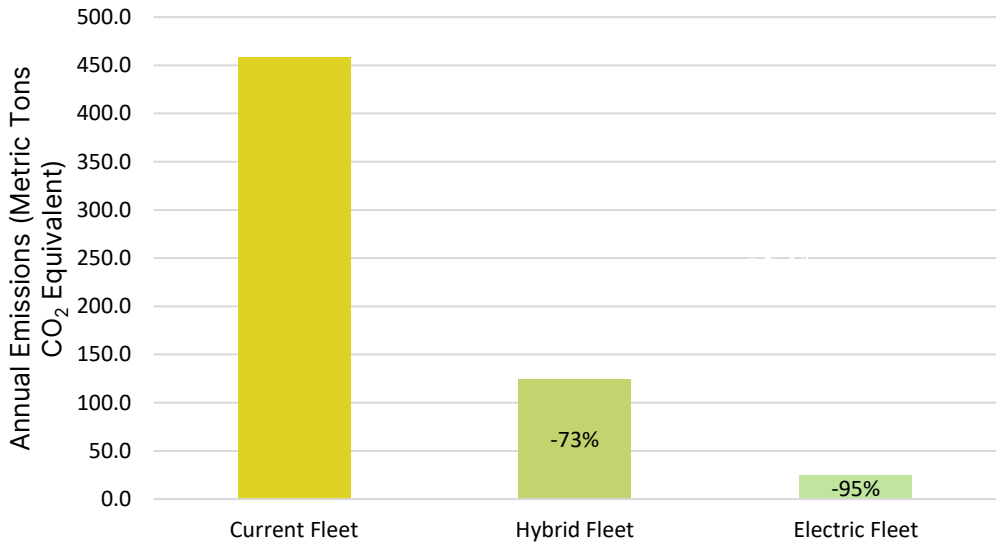


Figure 19. Potential emissions benefits from electrifying the fleet[6]

Responsible Parties

- Building Services – Identify the vehicles that will need to be replaced and create a phased upgrade plan to move the fleet to hybrid and eventually all electric vehicles.
- Procurement – Begin budgeting/creating a capital expense plan that includes phased electrification upgrades to accommodate Electric Vehicle charging capacity over the next 10-15 years.

Financial Impacts

Transitioning to hybrid and electric vehicles will drastically reduce the annual cost for the fleet by utilizing electricity instead of unleaded gasoline or diesel. However, the cost to install the electric vehicle charging infrastructure, especially if an electrical capacity upgrade is required, can be significant. It is recommended that KCLS identify funding opportunities to reduce the cost of switching the fleet to all-electric.

Table 19. Cost savings for fully electrifying the KCLS fleet

Savings Category		Annual Savings ($/year)
Gas/Diesel to Electric	Fuel Cost Savings	$100,000
	Electric Utility Savings	($21,000)
Total Cost Savings		**$79,000**

[6] Alternative Fuels Data Center: Emissions from Electric Vehicles

Table 20. Electric Vehicle Implementation Cost

Implementation Cost	Estimated Cost
Electric Vehicle Premium vs Gas-Powered	**$6,000**[7]
Electric Vehicle Chargers (no new electrical service required)	**$15-20k per charger**
Electric Vehicle Chargers (electrical capacity upgrade required)	**$45k per charger**

Funding & Financing Options

Financing options for this strategy include internal KCLS funds, green bonds, grants and subsidies. Additionally, a range of federal and state incentives aim to make fleet electrification projects more financially viable from the local to the national level.

Seattle City Light [8]offers rebates for the installation of EV chargers that can be up to 50% of the total project cost. Puget Sound Energy [9]offers incentives that include different ownership models for installing electric vehicle supply equipment with the PSE-owned turnkey service option in which PSE will take care of planning, design, installation, and maintenance of the equipment.

The Inflation Reduction Act also offers several provisions to increase EV adoption, including tax credit for the purchase of electric vehicles as well as the electric vehicle charging infrastructure. Funding mechanisms for fleet electrification are constantly evolving and it is recommended that KCLS leverage its status as a publicly owned entity and its commitment to local community to pursue additional funding opportunities as they become available.

Key Enabling Actions

- Create a phased upgrade plan to switch to an electric fleet.
- In tandem with the HVAC electrification study, conduct a detailed engineering feasibility study to ensure that each building's electrical infrastructure can support the increased electrical demand associated with both the electric fleet charging and HVAC upgrades.

[7] How Much Are Electric Cars? - Kelley Blue Book

[8] Fleet Electrification Program - City Light | seattle.gov

[9] PSE | Fleet Electrification

COMMUNITY RESILIENCE

COMMUNITY ENGAGEMENT & FEEDBACK

ROUNDTABLES

In September 2024, KCLS hosted two Climate and Ecological Justice Leader Roundtables to begin the process of creating meaningful connections with communities most impacted by systemic inequities. KCLS invited climate and ecological justice leaders from regional community-based organizations and from public agencies to highlight the interconnectedness of climate change and how it impacts quality of life. The roundtables were designed to help KCLS learn what climate change impacts the participants are encountering in their communities and to identify potential local-based solutions to help support the communities.

KCLS aimed to identify how the library system could best poise itself as a partner to climate-change solutions while beginning to compile a list of both existing and needed resources within King County. This work will be conducted with an eye to equity and accessibility for the most impacted in the county. Two key principles were instrumental in the outreach approach and in the messaging:

- KCLS is striving to humanize climate change, and
- Together, we can do more.

These outreach efforts were made with a people-centered approach that centered participants lived and professional experience and ensured Environmental Social Justice (ESJ) practices that immerse ESJ principles in all engagement work. The roundtables helped serve as a catalyst to move the vision forward in a realistic and grounded way.

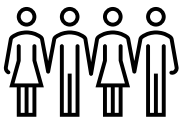
To reach a broad audience, two Climate and Ecological Justice Leader Roundtable events were offered, one a midday virtual option, and the other an evening in-person event near one of the King County Library locations and multiple transportation options. These sessions were designed to stimulate conversations and gather input around the pending issues of climate change and resilience, discussing how ESJ leaders see their communities being impacted, and brainstorming how KCLS can be most valuable in supporting the communities.

Figure 20. Climate and Ecological Justice Leader Roundtable

By taking the time to connect and listen to the representatives of the broader community, KCLS can create a more responsive and dynamic "living" toolkit that can be shared as new and unprecedented issues that will negatively impact human health, and the environment are encountered.

The roundtable groups discussed three key topics: Health Impacts, Affordable Energy & Housing Impacts, and Extreme Weather Impacts. The prompts and summary of the community input is summarized in Table 21, Table 22, and Table 23 below.

Table 21. KCLS Roundtable - Health Impacts

How does climate change impact the health and wellness of the communities that you serve?	
Impact Category	**Community Input**
 **Community Impacts**	• Needs vary – community and resources are often overwhelmed • Lack of research and data available for individuals and communities to deal with the climate change impacts that they are experiencing • Need access to grant support for small community groups and individuals
 **Health Impacts**	• Climate change exacerbates disparities • Health conditions may lead to missed work and impact income • Mental health impacts • People with pre-existing conditions are most vulnerable
 **Extreme Heat**	• Need to increase the quality of the built environment (dwelling units) to protect people/communities from extreme heat • Heat island is worse in low-income communities • Lack of trees and parks in most impacted communities
 **Air Quality**	• Wildfire smoke exposure is an annual occurrence • More people seeking health clinics due to air quality issues • Lack of access / affordability of electric vehicles impacts the air quality
 **Water**	• Concerns over water quality • Increased exposure to hazardous materials when dealing with flooding • Salmon run declines – they are both culturally important and a local keystone species

How does climate change impact the health and wellness of the communities that you serve?	
Impact Category	**Community Input**
 **Economics**	• Increased cost to be prepared for climate change impacts (clothing, heating, cooling, water, power, food) • School and work closures lead to missed work and impacts on wages

Table 22. KCLS Roundtable - Housing & Energy Impacts

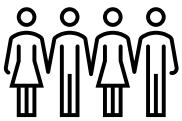
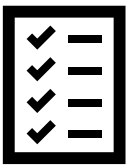
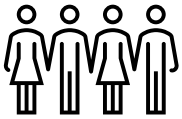
How does climate change impact access to affordable housing and energy?	
Impact Category	**Community Input**
 **Community Resources**	• Need resources on how to save money in the face of climate change • Programs and benefits are available but there are barriers that prevent participation from the most impacted community members • Need case studies and examples of how rebates and incentives have been effectively communicated and implemented within communities • Lack of information easily available on tenant rights (language barriers)
 **New Housing**	• Programs and codes for increasing resilience and weatherization are mostly focused on new construction • New developments that are climate resilient are tied to displacement of communities and gentrification – this is a huge fear in BIPOC communities
 **Existing Housing**	• Affordable housing tends to be older building stock with minimal weatherization • Clean energy systems are not easily available for low-income community members • Renovations are costly and cause rents to increase, displacing renters
 **Energy**	• Clean energy systems are not as available for low-income community members • Utility programs are ineffective and lack both information on how to participate and advocacy to encourage participation • Electric vehicles are not accessible to the general population • Rural locations have longer and more frequent power outages

Table 23. KCLS Roundtable - Extreme Weather Impacts

How have extreme weather events and/or the threat of these events impacted your community?	
Impact Category	**Community Input**
 **Planning**	• Why are we responding to these events during the crisis? We need to think and plan ahead • We need to develop a solution to support the community in both the short and long-term
 **Economics**	• People lose wages when they cannot safely get to work due to extreme weather
 **Community**	• The Pacific Northwest is anticipated to be a climate refugee destination – people that take refuge here are losing their sense of community and having to restart • We need to connect resources with the people that need them most • Increase people to people connections to share information
 **Extreme Weather**	• Sea level rise and flooding issues are becoming more frequent • Extreme heat, snow and ice events, and flooding are increasing in frequency • Air quality issues occur yearly due to forest fires

POP-UP EVENTS

The community outreach events that were part of the KCLS CAP were held in the fall of 2024 in conjunction with other local community events to help expand the depth of community participation. Locations were chosen based on KCLS' 2022 Community Demographic Analysis report (prepared by Berk and Associates as part of KCLS' 2021-22 Organizational DEI Assessment), which examines and details the racial, geographic, linguistic, age, and economic diversity of KCLS' service area. Using KCLS's demographic research, the Pop-Up events were centered on the most impacted communities in South King County and included pop-ups in Auburn, Kent, Renton, and Skyway.

Pop-Up participants were invited to share concerns through an interactive conversation where they posted stickers on a board that asked the following question: How does climate change impact you? Within the board was a series of nine prompts which included:

School Cancelled (childcare needs change/work conflicts/income loss)

Power Outage (food spoils/stores closed/can't run medical equipment)

Personal Transportation Issues (flooded or blocked roads/electric vehicle charging unavailable)

Public Transportation Issues (routes canceled or re-routed/uncertain schedules)

Safety Issues (walkways and roads are unsafe)

Human Health (poor air quality in extreme temperatures & wildfires/existing health issues worsen)

Cost of Living Increases (anticipate higher utility bills)

Access to Resources (How to get help?)

Other Issues (Participants asked to write down their concerns)

The cumulative results from the climate change impact activity at the four Pop-Up events is shown in Figure 21 below.

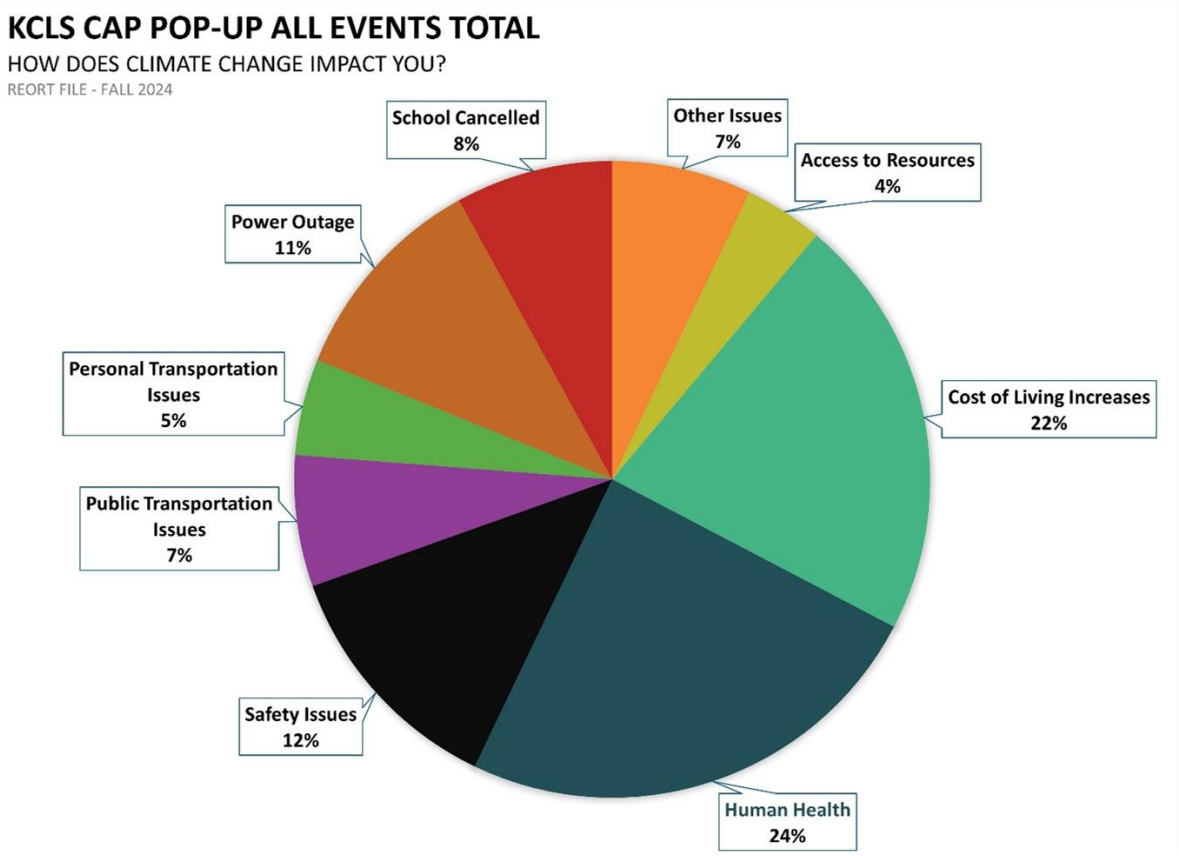


Figure 21. KCLS Pop-Up Event - Climate Change Impact

RESILIENCE

SUMMARY

Climate change is expected to increase the frequency and intensity of extreme weather events and natural disasters in King County. What were once considered exceptional and isolated events are now more common than ever, expanding beyond historical boundaries and challenging the resilience of the KCLS system. Other impacts such as

rising temperatures, sea level rise, and decreasing snowpack are developing gradually over time because of the evolving climate conditions.

Some KCLS community members are more vulnerable to the impacts of climate change. Per the EPA (Climate Change and the Health of Socially Vulnerable People | US EPA), socially vulnerable groups include communities of color, low-income groups, immigrants, and those with limited English proficiency. These communities are often more impacted due to the disproportionate amount of climate risks occurring where they live. Often the infrastructure is aging, the homes that they live in do not have appropriate weatherization measures for the evolving climate, and they often have a greater rate of existing medical conditions, which can be worsened by climate change impacts.

In November 2024, King County experienced a bomb cyclone that swept through western Washington and left almost half a million people without power and caused property damage throughout the county, including two of the vans in the KCLS Library 2Go! Fleet shown in Figure 22 below. Although KCLS had to close a few locations due to power outages and fallen trees in the parking lots, the libraries that remained open became essential shelters for the local community members who needed warmth and access to the internet. This demonstrates what a valuable resource the libraries are for the community by serving as a place of refuge and connection during a natural disaster.

Figure 22. KCLS closed during the bomb cyclone (left), KCLS libraries served as shelters during the resulting power outages (middle), KCLS Library2Go! vans were totaled during the bomb cyclone

The climate hazards listed in Table 24**Error! Reference source not found.** have been identified as those most threatening to the KCLS community and infrastructure.

Table 24. Top King County Climate Hazards

Climate Hazard	Probability	Risk Impact to KCLS Community
Extreme heat	**Highly Likely**	• More very hot days above 90°F • Increased risk of heat-related illnesses and death • Increasing water temperatures impact to biodiversity • Damage to local crops

 **Extreme Weather**	**Highly Likely**	• Increased extreme weather events • Physical harm to humans • Damage to community infrastructure • Disruption to operations
 **Wildfires**	**Likely**	• Poor air quality • Increased risk of smoke-related health issues • Damage to community infrastructure • Physical harm to humans
 **Flooding**	**Likely**	• Sea level rise and extreme weather will contribute to coastal and river flooding • Damage to community infrastructure • Increased risk of erosion and landslides • Disruption to operations
 **Decreased Snowpack**	**Likely**	• Reduced water storage for summer drinking water • Reduced water for irrigation of crops • Impact to power generation at dams

CLIMATE CHANGE RESOURCES & EDUCATION

Short Term Recommendations

1. Showcase a collection of climate change resources, classes, trainings, and support services for the community. Allocate an area in each library as a "green section" to share resources on energy conservation, composting, climate change, resilience, etc. This could include a space for storytelling where community members can share and read about the great climate change and sustainability work that is already happening in the KCLS community.
2. Develop a Green Ambassador Program and assign an interested staff member in each library to serve as a "Green Ambassador". Their role should include providing support and resources to library patrons on available climate specific programming and information on KCLS' Climate Action Plan.
3. Partner with Community Based Organizations, such as Spark NW, to support the rollout of an Energy Ambassadors program. This program could include an array of offerings such as trainings in energy topics, support, and advocacy to community members on available incentive programs, roundtables on climate specific issues, the development of climate resilience curriculum, etc. It is anticipated that the Community Based Organizations will work closely with the KCLS Green Ambassador Program to roll-out energy specific programming to the libraries.
4. Climate Leader Panels – Partner with local climate and ecological justice leaders to create educational panel events in support of educating the local community.

Responsible Parties

- Planning & Procurement – Work with Library "Green Ambassadors" to provide programming and resources for each library.
- KCLS Librarians – Interested librarians to serve as "Green Ambassadors."

Key Enabling Actions

- Developing programming and purchase resources to support the library "green sections" and "Green Ambassador" programs.
- Continue to grow and expand upon partnerships with local community-based organizations and climate and ecological justice leaders to co-create programming and educational events.

RESILIENCE HUBS

The libraries already serve as a place of refuge for members of the community that are unhoused and for others seeking shelter or resources during extreme weather events. Based upon feedback from the community, KCLS libraries have the opportunity to partner with King County and other Community Based Organizations to expand the network of resilience hubs within the communities that KCLS serves.

Short Term Recommendations

A. Identify partners, such as King County or other Community Based Organizations, to work with in the co-development of KCLS resilience hubs.

B. Identify KCLS library locations that will be designated as resilience hubs, focusing on the most vulnerable areas of the KCLS community that lack access to existing resilience hubs.

C. Once libraries have been identified as promising candidates to become resilience hubs, the KCLS team should begin by working to identify the regional climate hazards that affect the specific selected libraries. By knowing what the most likely climate hazards are at a library level, it will be easier to prioritize the most impactful upgrades that directly mitigate specific hazards. Below is a non-exhaustive list of resources that KCLS can use for this identification process.

Additionally, the table includes a link to the EPA's Environmental Justice Screening and Mapping (EJScreen) Tool. This tool can be used at a very granular level to identify issues affecting various communities disproportionately and, therefore, prioritize their upgrades to assist the most impacted communities. Example screenshots from EJScreen and the Climate Mapping for Resilience and Adaptation (CMRA) tool are shown below.

Table 25. Summary of hazard identification resources

Database Name	Description
Environmental Justice Screening and Mapping (EJScreen) Tool, Located at: https://ejscreen.epa.gov/mapper/	This is a website created by the Environmental Protection Agency that shows granular threats to human health, with a specific focus on air quality concerns. Additional layers can be used to place land areas into percentile risk categories for flooding, wildfires, sea level rise, and historical floodplain proximity. This tool's granular data is valuable for evaluating a specific college campus location.
Climate Mapping for Resilience and Adaptation (CMRA) Tool, Located at: https://resilience.climate.gov/	This is a federally funded website that tracks live climate hazards, such as wildfire events, drought, extreme heat, and inland and coastal flooding. Users can aim at their specific region and see current hazards, as well as projected future changes under lower and higher emissions scenarios. The tool is less granular than the EJScreen tool but has robust forecasting capabilities.

Weathershift Database, Located at: https://weathershift.com/	The WeatherShift tool uses data from global climate change modeling to produce weather files "morphed" for changing climate conditions. These files contain hourly values of key weather variables for a typical year and are intended to be used for simulating building energy requirements for future years.

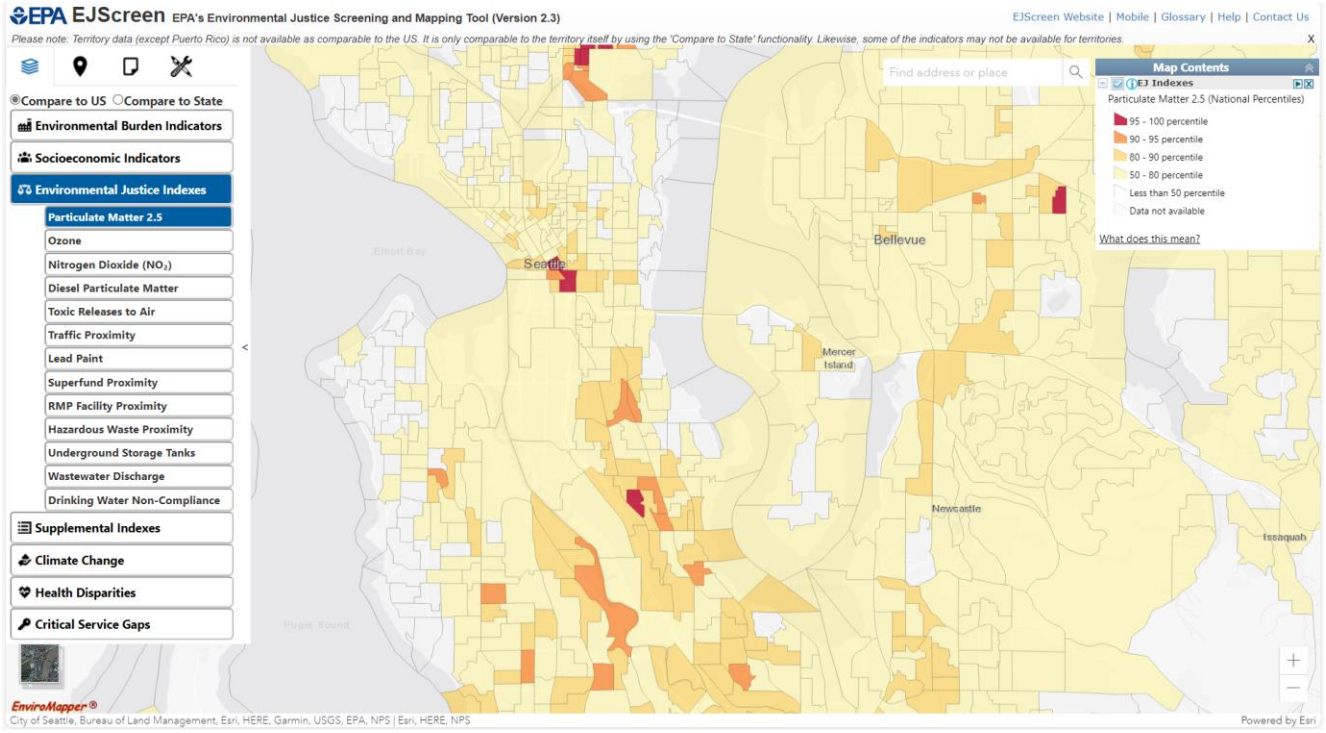


Figure 23. Example screenshot showing the particulate matter risk index for census tracts in and near King County using the EJScreen tool

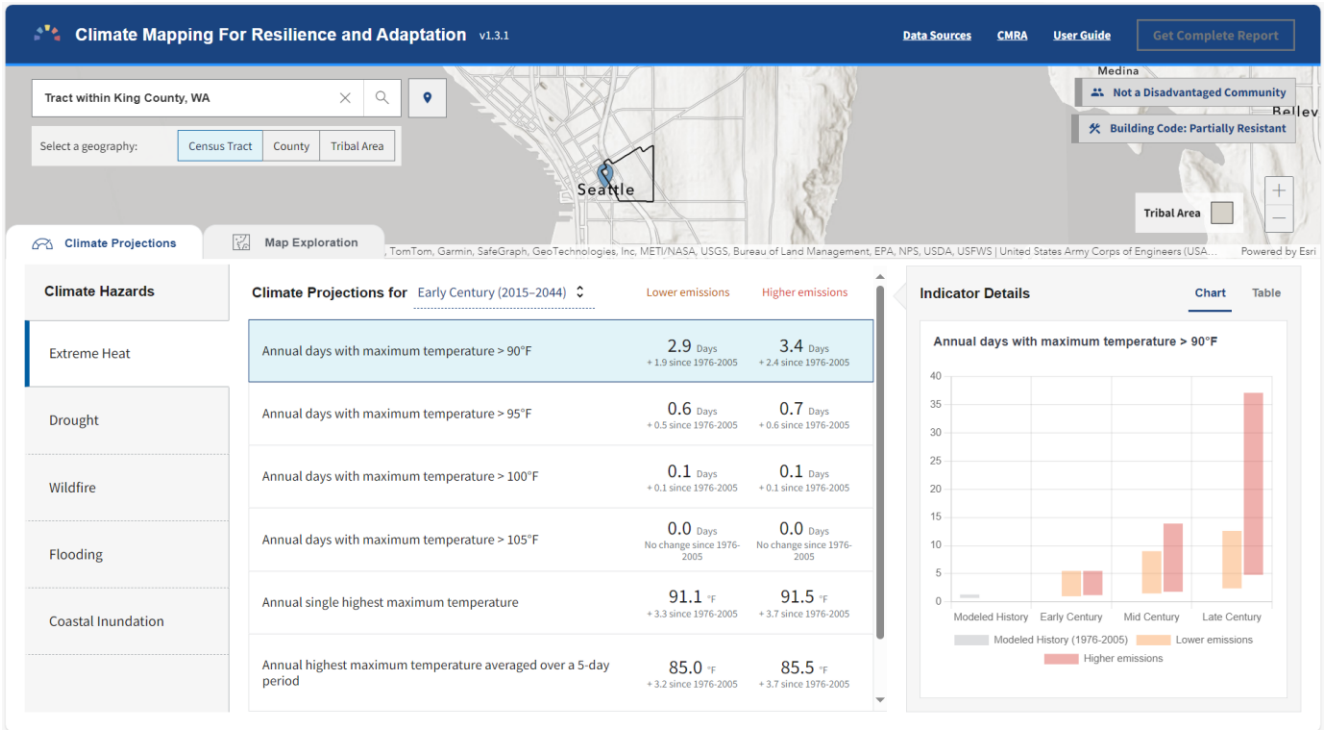


Figure 24. Example screenshot of the extreme heat risks facing downtown Seattle using the CMRA tool

Long Term Recommendations

Once libraries have been identified as future resilience hubs and library-specific hazards have been identified, the next step is to begin selecting mitigation strategies that can help protect the libraries against the identified hazards. This will include beginning a capital expense plan that includes budgeting for installing future systems and searching out rebates and incentives to offset system installation costs. To assist in this effort, very high-level preliminary costing estimates show the cost to implement each strategy at one library. Table 26 breaks down the costing estimates into ranges, as the exact cost will vary per library based on site constraints and the existing conditions at each library. These cost ranges are used in

D. Table 27 to show each recommended resilience strategy's category, scope, and rough cost.

Table 26: Resilience Strategies Costing Estimates per Library

Cost Range Designation	Implementation Cost
$	$0-250,000
$$	$250,000-1,000,000
$$$	$1,000,000+

Table 27. Potential Resilience Strategies for Library Resilience Hubs

Strategy Name	Category	Description of Scope	Cost Estimate
Backup Power Generation Capabilities	Power	Evaluate the installation of building-level backup power generators or battery energy storage systems at each critical library. Ensure the generators are	**$$$**

		sized appropriately based on the electrical demand of the critical building.	
Energy Demand Study	Power	Conduct a study to evaluate future growth in electrical demand at resilience hubs. Verify that the study considers higher demand for electrical cooling during summer months in future years. Use the study results to determine if the existing electrical system can handle future growth, such as electrifying heating systems, adding EV chargers, and supplying cooling during increasingly hotter summer months.	**$**
Future Thermal Demand Study	Heating and Cooling	Conduct a study to ensure that current HVAC systems can meet peak heating and cooling demand during increasingly hotter summer months and worsening winter storms. Consider upsizing existing HVAC systems when it is time for replacement.	**$**
Redundant HVAC Systems	Heating and Cooling	Investigate if resilience hubs have backup HVAC systems that can either heat or cool the space in case one of the primary HVAC systems fails.	**$$$**
HVAC Systems on Backup Power	Heating and Cooling	Ensure that the HVAC systems at resilience hubs have a source of backup power and can continue to operate during an outage. If the backup power source is limited in capacity, consider backing up only the HVAC equipment and some emergency lighting systems rather than the entire building.	**$$**
Multiple Internet Service Providers	Internet/ Data	Procure internet service from at least two different providers to have an alternate source of network connectivity in case a provider briefly experiences an outage in operations.	**$**
Co-locate Servers	Internet/ Data	Consider a backup, alternate location for an additional set of critical servers. While other strategies increase instantaneous network connectivity capabilities, having an additional set of servers will support the campus retaining its saved data in the case that one server room experiences damage or failure.	**$**
Emergency Repair Prioritization (Contracted Maintenance)	Coordination/ Planning	Coordinate an emergency supply contract with the utility provider to identify KCLS as a high-priority customer during outages. This could possibly include an agreement that the resilience hubs are prioritized when evaluating repair logistics.	**$**
Cross-Training/Redundancy in Maintenance Expertise	Coordination/ Planning	Provide additional training between maintenance staff personnel to ensure there is redundancy in expertise when evaluating difficult repairs.	**$**
Community Emergency Response Plan	Coordination/ Planning	Create and circulate a plan highlighting each community's closest resilience hub and making it clear that libraries can be places of refuge during climate hazards.	**$**

Responsible Parties

- Planning, Design, and Construction – Outreach to King County and other Community Based Organizations to find partners for the creation of resilience hubs. Identification of hazards and mitigation strategies.
- Procurement – Begin budgeting/creating a capital expense plan that includes phased mitigation strategy upgrades over the next 5-20 years.

Financial Impacts

Financing options for this strategy include partnering with King County and other organizations to support funding for the creation of resilience hubs. A range of federal and state incentives can help make these projects more financially viable. The cost of transitioning the selected libraries into resilience hubs is dependent on the mitigation strategies selected for each library location.

Key Enabling Actions

- Identify partners for the co-development of the resilience hubs and potential funding mechanisms.
- Perform a climate hazard assessment for selected libraries.
- Identify hazard mitigation strategies to support the resilience hubs.

GLOSSARY

Carbon footprint: Measure of the amount of carbon dioxide and other carbon compounds emitted due to the consumption of fossil fuels.

Clean Buildings Performance Standard (CBPS): A Washington State standard with the objective to lower cost and pollution from fossil fuel consumption in Washington's existing buildings.

Electrification: The conversion of fossil fuel-based energy to electric based energy.

Energy Efficiency Measure: Strategies that decrease the consumption of energy.

Energy Resilience: The ability for the energy system to withstand and recover from major disruptions in the energy supply that can be caused from power outages, natural disasters, etc.

Greenhouse Gas (GHG) Emissions: Gases that have been released into the earth's atmosphere that trap heat and contribute to global warming.

HVAC System: Heating, Ventilation, and Air Conditioning System. A system that controls the temperature, humidity and air quality of a space.

PV System: Photovoltaic System is also known as a solar power system, and it uses panels to convert sunlight into electricity.

Plug Load: Energy used by products that are powered by means of an ordinary AC (alternating current) plug.

Resilience Hub: Community serving facilities that can help support the community and provide resources during natural hazard events.

Retrocommissioning (RCx): A process for optimizing the performance of existing buildings that involves a comprehensive evaluation of a building's systems and their components. The goal of RCx is to identify areas of improvement in the building's operation to make it more efficient, improve occupant comfort and reduce operating costs.

Scope 1 Emissions: Direct GHG emissions that occur from sources that are controlled or owned by an organization. For KCLS, this correlates to any natural gas systems within their buildings, refrigerants, and fuel use from the KCLS vehicle fleet

Scope 2 Emissions: Indirect GHG emissions that occur when an organization purchases and uses electricity, steam, heating, or cooling. For KCLS, this refers to the purchased electricity used to run their buildings.

Weatherization: Process of improving and protecting a building and its interior from the natural elements.