City of Tacoma
WASHINGTON

McKinstry
For The Life Of Your Building

Municipal Facilities Decarbonization Study (MFDS) - Final

July 28, 2023

FOR THE LIFE OF YOUR BUILDING

July 21st, 2023

Perry Spring, Resource Conservation Manager
City of Tacoma, Environmental Services Department
326 East D Street
Tacoma, WA 98421

Re: City of Tacoma – Decarbonization Study

Dear Mr. Spring,

Thank you again for the opportunity to partner with the City of Tacoma for your Decarbonization Study. We recognize that the City of Tacoma is a national leader on this front, and an impactful example of how to align setting goals and taking action to best serve your community. We hope that the findings of this study will continue to assist with prioritization and the implementation of projects in line with your carbon reduction goals.

COLLABORATIVE APPROACH: Multiple sources of information were reviewed as part of the study to obtain a full picture of the facilities' current state. The City of Tacoma's staff were instrumental in assisting with compiling this data and provided their time for interviews and evaluations. Thanks to their efforts, we were able to assess the eight locations identified and collaborate with city staff on best approach to reach the desired end state. Without the staff's support, this comprehensive look would not have been possible.

STUDY TAKE-AWAYS: The study findings of this report outline and provide strategic guidance for recommended projects to decarbonize facilities in the City of Tacoma's portfolio. This includes coordination of asset management, capital project planning, and deferred maintenance needs. Our hope is that these measures can be extrapolated and act as a catalyst for implementation of decarbonization city-wide. They create an efficient opportunity to address both the city's needs as well as reaching the city's longer-term goals.

RECOMMENDATIONS: The City of Tacoma's adopted Decarbonization Resolution 40776 and 2030 Climate Action Plan both outline optimistic goals for the future. To reach these milestones, it is important to understand a realistic timeline and steps needed to get there. Selecting and starting with a pilot project would be a great place to initiate momentum and set the City up for success. We recommend that this study be used to target upcoming work and act as the basis for a plan to achieve the desired 2030 state.

Study results are a great first step towards taking action. Understanding your current state allows you to see the gap between where you are, and where you need to be. Creating a pathway for reduction in our industry's carbon footprint is something McKinstry is passionate about and we look forward to the ways we can continue to support you on this front. We would love the opportunity to work together with the City of Tacoma to realize these goals and follow-up with the implementation of impactful carbon reduction measures.

Sincerely,

Shelby Sawyers | Account Executive

509.551.3053 | ShelbyS@mckinstry.com

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Project Contacts

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Abbreviations

Study Abbreviations

Abbreviation	Definition
AHU	Air Handling Unit
AWHP	Air to Water Heat Pump
BAS	Building Automation System
BESS	Battery Energy Storage System
CBECS	Commercial Building Energy Consumption Survey
CBPS	Clean Building Performance Standard (WA State Building Energy Efficiency Benchmarking program, WAC 194-50))
CCA	Climate Commitment Act (WA State Cap-and-invest program, WAC 173-446)
CEI	Carbon Emissions Intensity (lbs CO2e/ft2 = pounds of carbon dioxide equivalent emitted per square foot)
CHW	Chilled Water
City	City of Tacoma (See also COT)
CMP	Cooling Master Plan
CO2	Carbon Dioxide (as a refrigerant)
CO2e	Carbon Dioxide Equivalent (as a greenhouse gas)
COT	City of Tacoma (See also City)
dT or DeltaT	Temperature Difference
EBCx	Existing Building Commissioning
ECM	Not Used (See FIM)
EEM	Not Used (See FIM)
ESCO	Energy Services Company (McKinstry Essention LLC)
ESPM	Energy Star Portfolio Manager
EUI	Energy Use Intensity (kBTU/SF/yr of site energy) (see also WNEUI)
EUIt	EUI Target, as required by Clean Building Performance Standard
EVSE	Electric Vehicle Supply Equipment
FCA	Facility Condition Assessment
FIM	Facility Improvement Measure
GC	General Contractor
GFA	Gross Floor Area
GWP	Global Warming Potential (of a refrigerant)
GSHP	Ground Source Heat Pump
HHW	Heating Hot Water
HPWH	Heat Pump Water Heater
HVAC	Heating Ventilation Air Conditioning
IRA	Inflation Reduction Act

Abbreviations

Abbreviation	Definition
ITC	Investment Tax Credit
kVA	Kilovolt-Ampere
kW	Kilowatt
kWh	Kilowatt-Hour
kWp	Kilowatt Peak
LED	Light Emitting Diode
McKinstry	McKinstry Essention LLC
MFDS	Municipal Facilities Decarbonization Study
MT	Metric Ton (1000 kg, 2205 lbs.)
NG	Fossil Natural Gas
ODP	Ozone Depletion Potential (of a refrigerant)
PV	Photovoltaics
RCx	Retro Commissioning
ROM	Rough-Order-of-Magnitude
RTU	Rooftop Unit
SCC	Social Cost of Carbon
SCL	Seattle City Light
SEC	Seattle Energy Code
SHGF	Solar Heat Gain Factor (how well glazing reflects heat from direct sunlight) See also VLT
SHW	Service Hot Water
SNAP	Significant New Alternatives Policy (Federal Phaseout of HFC Refrigerants)
TAB	Testing, Adjusting, and Balancing
UMP	Utility Master Plan
VLT	Visible Light Transmittance (how much visible light glazing lets through) See also SHGF
VRF	Variable Refrigerant Flow
VRV	Variable Refrigerant Volume (aka VRF)
WNEUI	Weather Normalized EUI (from ESPM)
WSEC	Washington State Energy Code
WWHP	Water to Water Heat Pump
ZOT	Zero-Over-Time

Assumptions

Study Assumptions

Item	Assumption	Notes
Active Energy Management	Not in report	This is recommended but not included in the report since this report is focused on capital projects.
Base Case Cost	• 09.01 Lighting / Lighting Controls (35%) • 01.01 Convert to electric Heat Pump Heating (70%) • 12.01 Convert to Heat Pump Domestic Hot Water (70%) • 15.01 Convert Gas Cooking to Electric (70%) • 13.01 Envelope Air Sealing (0%) • 13.02 Envelope Upgrades (70%) • 03.01 Duct Sealing (25%) • 10.01 Install Rooftop Solar PV + BESS (0%) • 18.01 Water Conservation (35%) • 05.01 Low-No Cost Measures and Building Automation System (BAS) (35%)	For FIMs that fully replace or extend the life of existing systems, we're assuming the base case cost is like-for-like without improving efficiency and without decarbonizing (as contrasting with Pre-ROM Budget which is the cost to replace existing systems with decarbonized systems)
Building Operating Shifts Normalization Factor	1.0	For Clean Building Performance Standard level 2 audit form.
Carbon Neutral Design Specifications	TBD	This report didn't include helping COT to develop a standard design specification. It's assumed that any projects executed from this study will follow COT's design specification document. McKinstry can assist COT with developing this document as a separate effort.
Audits for Clean Building Performance Standard (CBPS)	Excluded	This report is a level 2 audit but didn't include CBPS required site visits or Life Cycle Cost Analysis. If COT determines that any of these 9 buildings won't follow the WNEUI <= EUIt path, additional auditing will be needed.

Assumptions

Item	Assumption	Notes
Construction Cost Escalation	To be added by COT.	Costs shown are based on current labor, material, and equipment pricing. Recommend that COT use this resource when escalating to future years for capital budgeting. https://www.mortenson.com/cost-index/seattle
Electric Kitchen Equipment TPU Rebates		https://www.mytpu.org/wp-content/uploads/Commercial_Foodservice_Rebate_Application_Nov_2020.pdf
Electric Utility Rebates	• Lighting $0.17 per annual kWh saved Up to 60% of the total project cost • Non-HVAC $0.23 per annual kilowatt hour saved up to 70% of the total project cost • HVAC - $0.30 per annual kWh saved up to 70% of the total project cost • Solar PV - $0 • Low/no Cost Measures - $0	https://www.mytpu.org/wp-content/uploads/Comm_Guide_3517_RD4.pdf
Electric Vehicle Charging	Excluded	
Electricity Emissions Factor	0.010 MT CO2e/MWh (0.00293 MT CO2e / MMBTU)	Source: https://www.commerce.wa.gov/wp-content/uploads/2022/04/Utility-GHG-Emissions-Report-2020.xlsx

Assumptions

Item	Assumption	Notes
Embodied Carbon	Excluded except as noted to the right.	Quantifying embodied carbon related to the FIMs is beyond the scope of this study. However, the two strategies were employed to limit embodied carbon: 1. Specified the lowest available GWP refrigerants for each FIM and recommended reselecting equipment prior to implementation as manufacturers expand their offerings. 2. FIMs assume that COT will continue to renew their existing facilities (i.e. adaptive reuse / real-estate repositioning) for the long-term rather than demolishing/ building new. This is the single most impactful embodied carbon reduction strategy recommended.
Facility Improvement Measure (FIM) Interactive Effects	FIMs modeled sequentially in the order noted to the right to avoid double counting savings.	1. 13.01 Envelope Air Sealing 2. 01.01 Convert to Heat Pump Heating 3. 09.01 Lighting / Lighting Controls 4. 12.01 Convert to Heat Pump Domestic Hot Water 5. 15.01 Convert Gas Cooking to Electric 6. 13.02 Envelope Upgrades 7. 03.01 Duct Sealing 8. 10.01 Install Rooftop Solar PV + BESS 9. 18.01 Water Conservation 10. 05.01 Low-No Cost Measures and BAS 11. 23.01 Other End of Life and Needs Based Items Not Captured by or Necessary for Other FIMs

Assumptions

Item	Assumption	Notes
Gas Cooking Efficiency	Per Energy Star	Conventional cooking tops typically employ gas or resistance heating elements to transfer energy with efficiencies of approximately **32%** and newer style "induction cooktops" are more efficient: about **84%.** A standard electric oven has a cooking efficiency of about 12%, according to the LBNL study, while a self-cleaning electric oven, which has more insulation in the oven case, has a cooking efficiency of about **14%**. By comparison, standard gas ovens have cooking efficiencies of about 6% and self-cleaning models **7%**.
Ground Source Heat Pumps	Excluded for this study.	The scope documents and pricing in this study assume air-source heat pumps. Ground source may be feasible for some of the buildings, and recommendation to include open and closed-loop ground source evaluation in the IGA phase. Based on the 30% IRA ITC Direct Pay option, the cost for ground source (if the site is conducive) will be similar to the cost for air source.
Long Term Planning	Excluded	COT will adjust years in the planning tool provided.
Metering for CBPS	Excluded	This report doesn't include adding meters. COT may need to add metering for Clean Building Performance Standard (CBPS) compliance. McKinstry can assist COT with developing this FIM as a separate effort.

Assumptions

Item	Assumption	Notes
Natural Gas Emissions Factor	53.06 kg CO2e / MMBTU (0.0531 MT CO2e / MMBTU)	Source: 2022 ICLEI – Local Governments for Sustainability: a global network working with more than 2,500 local and regional governments committed to sustainable urban development. This source was selected to maintain consistency with the City's Greenhouse Gas (GHG) Inventories and Climate Action Plan (CAP) progress report. https://icleiusa.org/wp-content/uploads/2022/09/U.S.-Community-Protocol-DASH_-Greenhouse-Gas-Emissions-Profile.pdf This in turns references EPA Hub: https://www.epa.gov/system/files/documents/2022-04/ghg_emission_factors_hub.pdf
Natural Gas Utility Rebates	$0 assumed since eliminating.	
Net Cost	The average of the low and high pre-ROM budget minus Potential Incentives and minus the average of the low and high base case cost.	=(AVERAGE([@[Pre-ROM Budget Low]],[@[Pre-ROM Budget High]])-AVERAGE([@[Base Case Cost Low]],[@[Base Case Cost High]])-[@[Potential Incentives]]
Other Grants and Incentives	Not included in this study except for the solar WA Sales Tax exemption and the solar IRA (ITC direct pay base incentive.) Other grants/incentives will be investigated when each FIM is closer to implementation (i.e., at the IGA phase)	IRA, WA Commerce, etc.

Assumptions

Item	Assumption	Notes
Pre-ROM Budget	Preliminary Rough Order of Magnitude Budget for the Decarbonization Facility Upgrades Recommended in this Report (as contrasted with Base Case Cost which is the cost for like-for-like upgrades of systems when they reach end of life)	The budgets created as part of this study utilized a mix of pricing methods to capture the variability of the systems and the buildings that could be repeatable across the 9 buildings included in the study. For some of the systems McKinstry has historical square foot pricing, and for others install estimates were developed on a per unit basis. This study did not assume procurement methodologies and schedules, but all budgets include equipment purchase, contractor install, design, overhead and profit, management, general conditions (includes site supervision), and contingency. The budgets do not include escalation or TPU charges (if any) for electrical service upgrades which can range from $250,000 to $750,000 each. A high-level budget of this nature, using square foot budgets and estimates includes a large number of assumptions. A collaborative approach with the City and the design team will be able to determine what opportunities are available to streamline the scope of work to maintain and possibly improve project budgets.
Quarterly or Annual Updates to FIMs	Excluded	We can propose if requested by COT.
Return on Investment (ROI)	Simple ROI is 1 divided by the Simple Payback. Simple payback is the net cost divided by the annual savings.	The Excel Formula is =([@[Annual Utility Savings]]+[@[Annual Social Cost of Carbon Savings]])/[@[Net Cost]]
Social Cost of Carbon	$90.99/MT CO2e	WA State Department of Commerce CBPS Form F (updated Feb 22, 2023) adjusted to 2024 Implementation Form F: Life Cycle Analysis (LCCA) Tool

Assumptions

Item	Assumption	Notes
Square Footage Used	From Energy Star Portfolio Manager (ESPM)	Portfolio Manager
TPU Fee for Service Upsize	Excluded (see notes from TPU)	TPU Feeder(s)/Transformer(s) may be, required for some buildings when converting to electric heating, DHW, and cooking. Any alteration to the service requires an electrical permit. The Electrical Inspector is the "last line of defense" for upgrades and sends them to New Services if they have not already been there. Most Engineering and Electrical Contractors know they need to talk to Engineering if they are increasing loads significantly. Upgrades to transformers are paid for by the developer prior to being installed. Up to 500kVA there is a charge for the labor to install, 500kVA to 2500kVA there is a charge for the transformer and install labor. Each is based on an engineering estimate. The transformer is sized based on the loading information provided by the customer. If they provide information that is not correct, we reserve the right to "right size" the transformer (it is always smaller, rare that a service draws what they plan on). The only place TPU will subsidize a transformer upgrade is in the residential area. If a customer is making a change that is "normal residential load", like changing from oil/gas to electric heat.
Utility and Maintenance Cost Escalation	To be added by COT.	TPU will be the best source of electricity cost escalation. EIA is a good source of information on gas cost escalation. IFMA and BOMA provide maintenance escalation predictions.

Assumptions

Item	Assumption	Notes
Water Utility Rebates	$0.42 per billing unit (100 cubic feet or 748 gallons) of water saved up to 50% of the total project cost	https://www.mytpu.org/wp-content/uploads/cii-procedures.pdf
Wildfire Smoke	MERV 13 and controls sequence	Any new HVAC equipment installed with be equipped with MERV 13 filtration. Control sequences to reduce outside air will also be employed for any controls upgrades.

City of Tacoma Municipal Facilities Decarbonization Study (MFDS) – Report Summary

EXECUTIVE SUMMARY

The Municipal Facilities Decarbonization Study Report (MFDS Report) is intended to provide strategic guidance on projects that decarbonize City's commercial buildings toward meeting Climate Action Plan goals of 30% emission reduction by 2030 and carbon neutrality by 2050. The City's baseline emissions for all City facilities in 2019 was 2,559 MT CO2e; emissions need to be reduced by 768 MT CO2e to meet 2030 target.

This MFDS Report is the result of an analysis called for in Decarbonization Resolution 40776. Staff evaluated the City's 100 plus building portfolio and selected 8 sites with 9 buildings to be representative of both City's facilities with highest carbon pollution emissions from energy use, and key buildings representative of distinctive space types. In the 2019 baseline year, these 9 buildings accounted for 37% municipal facility emissions and 46% of the commercial building emissions (non-industrial).

The City's consultant McKinstry conducted the Municipal Facility Decarbonization Study (the Study) in collaboration with City staff. City's Sustainability Office assembled a Project Team to support the consultant in milestone progress. MFDS Study involved key City staff from the City's 5 facility management workgroups, as well as staff from capital project delivery and budgeting.

21 of the City's buildings will need to comply with the WA State Clean Buildings Performance Standard (CBPS) and 5 of these are analyzed in the Study. The proposed decarbonization solutions in this report can serve as a guide to obtain compliance for 20% of City buildings needing to comply with the CBPS.

The City's carbon emissions from commercial buildings are heavily weighted to natural gas use; natural gas from PSE is 9 times more carbon intensive than the clean electricity from Tacoma Power. Eight of the 9 Study buildings use natural gas for space heating / water heating.

The results of this study include:

- Clean Buildings Performance Standard table for the 21 City buildings with over 20,000 of Gross Floor Area; the table includes:
  - Preliminary analysis of target Energy Use Intensity versus actual building performance in 2019 baseline year for each building, and
  - Buildings eligible for early adoption incentives
- A series of Facility Improvement Measures (FIM) specific to each of the 9 Study buildings,
- Return On Investment for each FIM derived from energy savings, net cost after incentives, and the social cost of carbon,
- Aggregation of measures to complete by 2030 to meet 30% reduction CAP target, with balance of measures to complete by 2050 towards overall carbon neutrality of City facilities,
- Estimate low and high investment budgets for these measures; both as energy reduction decarbonization measures and comparative business-as-usual maintenance and replacement, and

- Acknowledgement that the City's industrial sites contribute an outsized portion of its total facilities emissions; the decarbonization of them will entail strategies quite different from the commercial FIMs proposed for the 9 Study buildings.

For the 9 Study buildings, the required estimate investment range is $35.5 million to $76 million by 2050 in present day dollars. This investment is $20 million to $45 million above the business-as-usual base case.

For the City's full commercial facility portfolio, the required investment estimate range is $204.3 million to $437.8 million by 2050 in present day dollars. This investment is $118.5 million to $319.3 million above business-as-usual base case.

Table 1 of this MFDS Report includes a preliminary estimate of investment to meet the 2030 emission targets, and the 2050 carbon neutrality goal. Implementation of all FIMs by themselves is projected to reduce City facility emissions by 94%. The remaining 6% is from present-day carbon intensity of utility electricity. Based on compliance with the WA Clean Energy Transformation Act of 2019, all electric utilities in the State generate emission free electricity by 2045.

The use of this Report's analysis and findings will guide City staff in proposing facility specific investments that align sequentially with other facility management priorities. These proposed investments will be incorporated into the City's 6-year Capital Facility Plan and the biennial budgets. City staff, including the Sustainability Office, will pursue grant awards, utility incentives, and other financial mechanisms to reduce initial capital project costs.

Table 1: Investment estimate to achieve carbon neutrality by 2050

Investment[1, 5]	9 MFD Study Buildings[4]			**All City Buildings[4]**		
Investment Period (Year)	2023-2030	2031-2050	2023-2050	2023-2030	2031-2050	2023-2050
FIM Decarbonization $	21M	35M	56M	122M	199M	321M
Base Case investment $	9M	14M	23M	50M	81M	131M
Net Investment Premium[2,3]	**12M**	**20M**	**32M**	**83M**	**136M**	**219M**

1. These are Rough-Order-of-Magnitudes estimates; ROM budgets require analysis beyond range of this study. FIM Pre-ROM investment estimate may range is from 70% to 150% of estimates shown here.
2. Investment premium is the difference between Decarbonization and Base Case pre-ROM
3. Net Investment Premium does not take into account possible incentive savings (utility, state, federal)
4. Ratio for 2030 vs 2050 investments based on Total Cost of Ownership Calculator for each of 9 MFD Study Buildings, such that 2030 investment achieves 30% reduction in emissions from 2019 baseline. FIM porportions are 38% by 2030 plus 62% by 2050. Same porportions are applied for base case investments and all City building' total investment.

City of Tacoma Municipal Facilities Decarbonization Study (MFDS) – Report Summary

BACKGROUND AND OWNER'S OBJECTIVES

McKinstry was contracted by the City of Tacoma to develop a report that will provide strategic guidance for Facility Improvement Measures (FIMs) to decarbonize the occupied facilities in City's owned / operated property portfolio with high annual Greenhouse Gas Emissions (GHG) relative to other facilities in the City's portfolio. The goal is to provide specific decarbonization strategies and associated budget estimates for the evaluated facilities. The City will also be able to use the report as a template for completing analyses for other similar facilities in the City's owned / operated portfolio. This work supports the City's goal of net zero emission for its building portfolio by 2050.

Objectives

- Satisfy directive in Council adopted Decarbonization Resolution 40776
- Support Carbon Neutrality Strategy for municipal operations within 2030 Tacoma Climate Action Plan
- Propose Strategic investments toward meeting municipal operation emission targets.
- Coordinate decarbonization strategies with asset management, capital project planning, and deferred maintenance needs.
- Provide resources that support leveraging of project funding through both internal City sources, and successful City-led applications to relevant external grant sources.
- Support implementation of policy goals adopted by Council within Climate Emergency Resolution 40509, Green Building Resolution 38249, Life-Cycle Assessment Resolution 38248.

INDUSTRIAL FACILITIES' IMPACT ON CITY'S FACILITIES EMISSIONS

The Central Treatment Plant (CTP) and Asphalt Plant are the City's 2 biggest energy users and have an outsized impact on total municipal facility emissions. Two other industrial facilities account for only 1% of the facility emissions annually (Northeast Wastewater Treatment Plant and the 14 non-commercial structures in the Tacoma Recovery and Transfer Center campus).

For 2019 base year, Industrial facilities accounted for 512 MT CO2e or 20% of all COT facilities emissions. In 2 of the next 3 years, industrial facility emissions have increased significantly, account for 55% of Municipal facilities emission in 2022. By comparison, the 9 commercial Study buildings together comprised 37% of 2019 emissions and 42% of 2022 emissions.

City will not meet municipal facility emission reduction goal of 30% by 2030 without finding ways to decarbonize industrial sites. Industrial facility energy use is driven primarily by process loads rather than the space conditioning loads that largely shape commercial building energy use. Industrial decarbonization involve process specific strategies and technology.

City of Tacoma Municipal Facilities Decarbonization Study (MFDS) – Report Summary

The Central Treatment Plant (CTP) has been participating for over 10 years in an industrial Strategic Energy Management (SEM) through Bonneville Power Administration's regional Energy Smart Industrial program. As this program is funded by electrical utilities, the SEM operational and maintenance actions have been focused on electrical savings and progress has been significant.

However, to reach the 30% reductions in industrial emissions by 2030, reducing use of fossil fuel natural gas use must be the focus. There are electrical and renewable thermal energy technology available but a significant cost premium. The rate at which these technologies become more cost effective through commercialization will be key to the City's ability to decarbonize its industrial facilities.

2022 Building Energy and Emissions Summary

Building Type	# Bldgs	GFA in sf	*Percent of All Bldgs*	Energy MMBTU	Energy as % of All Bldgs	Electric MTCO2e	Nat Gas MTCO2e	Total MTCO2e	*Emissins as % of All Bldgs*
Industrial	49	288,839	***9%***	118,208	44%	184	2,943	3,126	***55%***
Commercial	95	3,066,392	*91%*	148,059	56%	309	2,267	2,576	*45%*
All	144	3,355,231	*100%*	266,267	100%	492	5,210	5,702	*100%*
MFDS Buildings + 2	11	795,513	*24%*	46,648	18%	82	989	1,071	*19%*
As % of Commercial Buildings		26%		32%		27%	44%	42%	

MFDS building + 2 includes the 3 buildings of the Theater Complex: Pantages+Jones+TOTS

BUILDINGS AND SCOPE INCLUDED IN THIS STUDY

Note that the study scope references 8 buildings, but this report splits the Tacoma Municipal Building complex into two buildings since they do not share systems or meters. For the Pantages Theater Complex, Facility Improvement Measures (FIMs) are included for the adjacent Jones Building which shares both energy meters and systems. GFA square footage and energy use for Theater on the Square (TOTS) are included as it shares a common nat

natural gas meter. Identifying FIMs for TOTS is outside of the MFDS scope.

Building	Sq Ft
Tacoma Municipal Building	207,020
Tacoma Municipal Building North	41,400
Fire Station 08	17,400
Police Headquarters	73,000
Tacoma Convention Center	227,449
Pantages Theater complex	90,508
Tacoma Solid Waste Admin and Shop	34,232
Tacoma Main Library	95,727
Lighthouse Senior Center	8,777
Total	**795,513**

The scope of this study included the specific tasks outlined below:

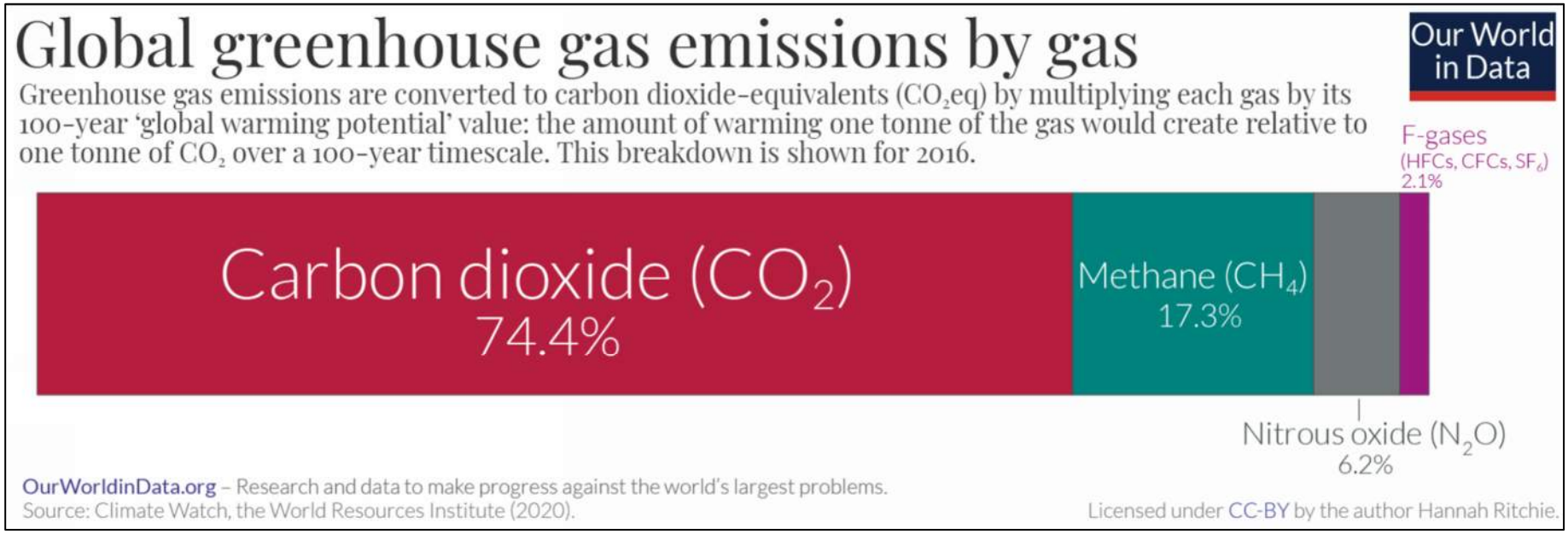
- Assessment of facilities - For each of the selected City owned facilities, conduct both building ASHRAE Level II audits, and assessment of the property that addresses back up power and renewable energy potential for site level carbon neutrality analysis. Complete assessment of each facility and its site.
- Evaluate Retrofit Opportunities - Evaluate feasibility at each facility for deep energy retrofitting, decarbonization fuel switching, and onsite renewable power systems. Evaluate alternative strategies and appropriateness of currently available technology.
- Decarbonization Recommendations and Budget Estimates - Develop a Report that includes recommended decarbonization strategies and provide project cost estimates for each facility.

At the end of this summary section, extrapolated costs are provided, based on the entire square footage of the City's owned property portfolio to assist with budget planning at the City level.

GREENHOUSE GAS (GHG) EMISSIONS

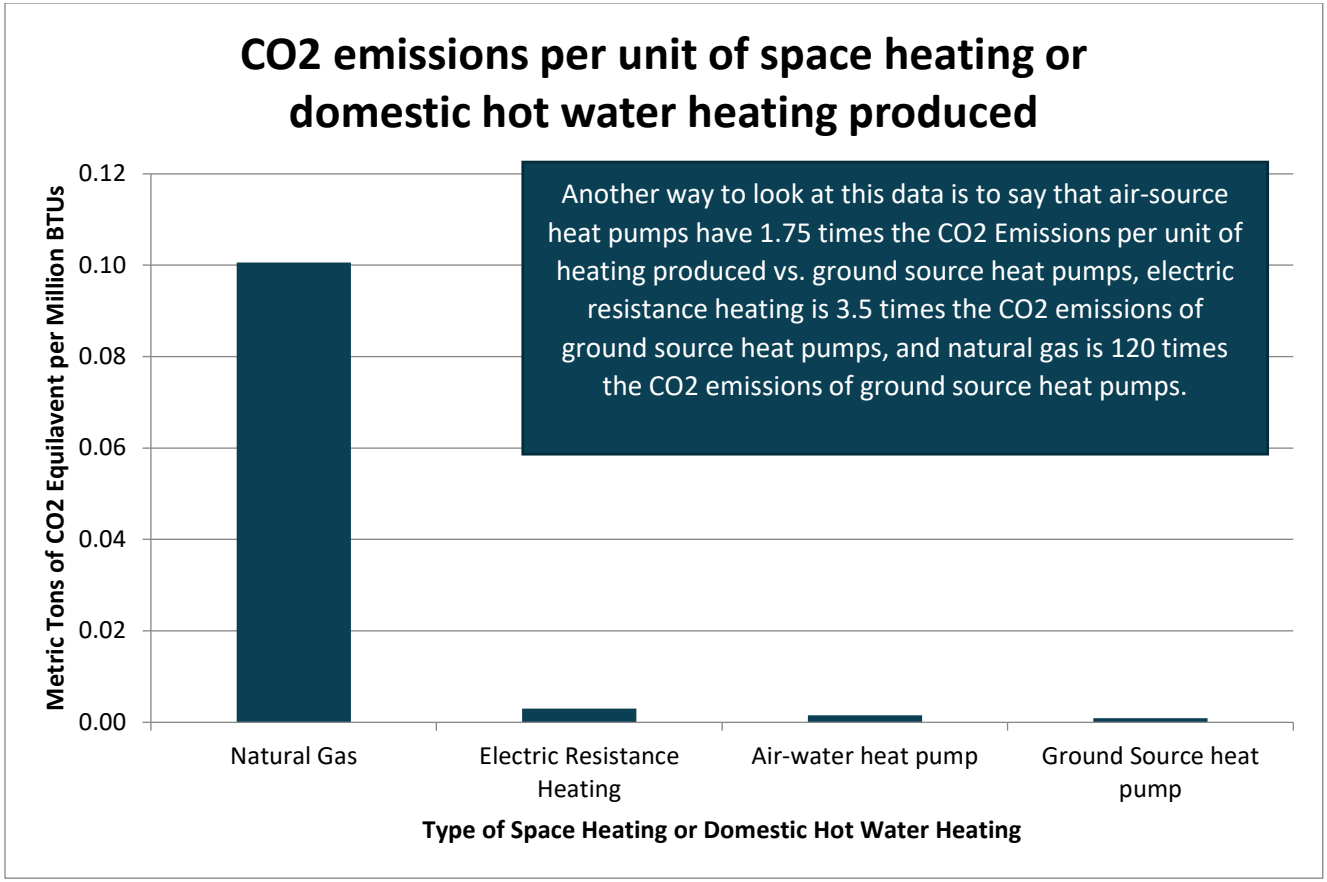
In the context of these buildings and this study, decarbonization is the removal of natural gas (on-site combustion) emissions from the operations of the facility. Natural gas is typically combusted for heat in building heating systems, domestic hot water heaters, and/or kitchen cooking systems. The Carbon Dioxide Equivalent (CO_2e) emissions from natural gas are a product of the combustion process, the CO_2e impact of methane leakage (since methane is a potent greenhouse gas,) and other emissions as shown below as worldwide averages, not specific to the City of Tacoma. Source: Climate Watch, the

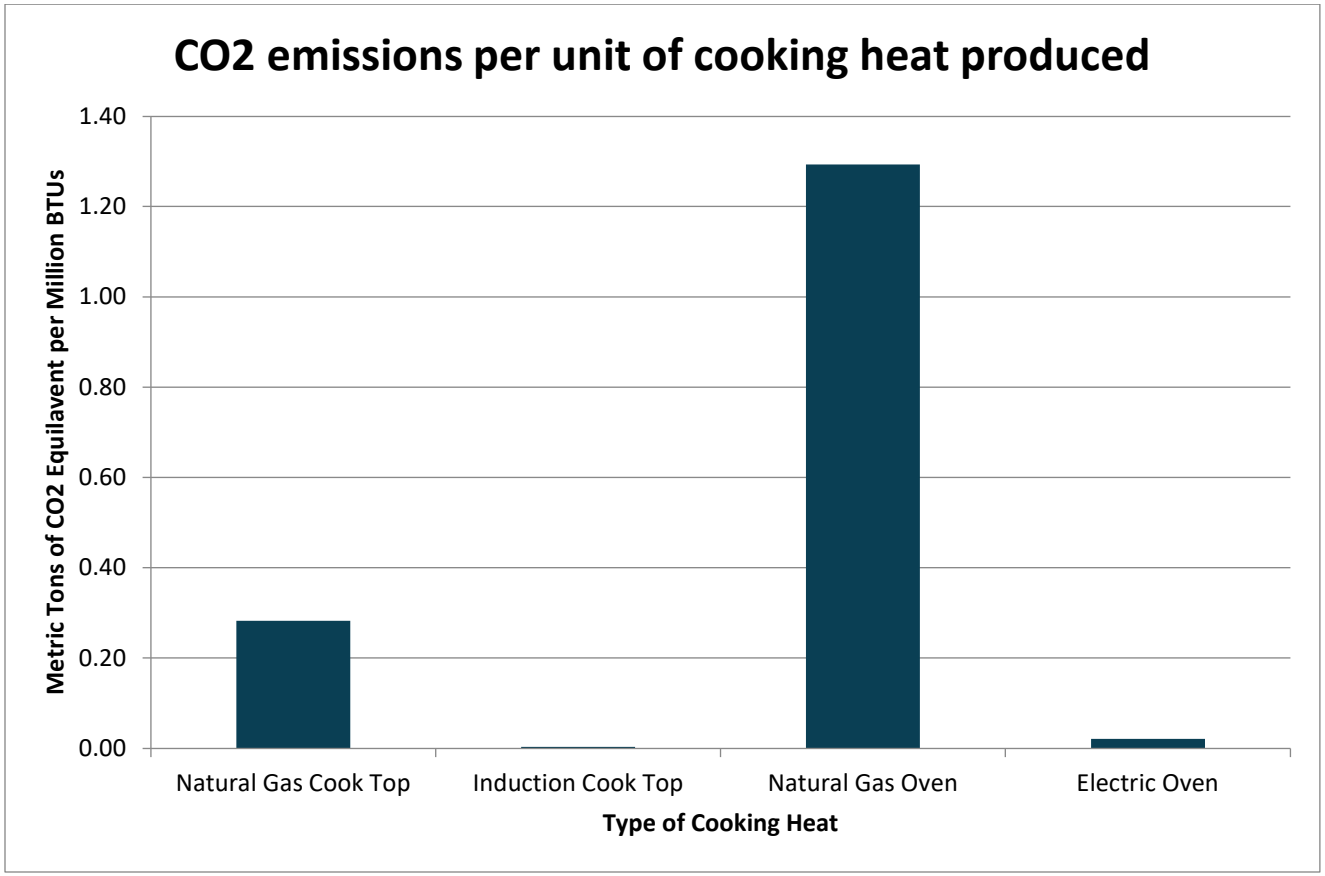
World Resources Institute (2020.)



Social Cost of Carbon is an important fiscal metric in facility decarbonization analysis. According to the Columbia Climate School (RENEE CHO |APRIL 1, 2021,) "The social cost of carbon (SCC) is used to estimate in dollars all economic damage that would result from emitting one ton of carbon dioxide into the atmosphere. It indicates how much it is worth to us today to avoid the damage that is projected for the future. The assumptions section of this report shows that $90.99/MT CO2e is used; this is the value shown in the WA State Department of Commerce Clean Building Performance Standard (CBPS) Form F (updated Feb 22, 2023) adjusted to 2024 Implementation. The reason this value was selected is because the Early Adopter Incentive Program (EAIP) of the CBPS mandates the use of this form when applying for incentives.

For electricity usage, carbon emissions are linked to the origination source of the electricity. When electricity is generated with hydropower or other renewable energy sources, the carbon emissions are extremely low for the electricity consumed. This is the case for the electricity used in the Tacoma Public Utilities power production. The charts below show the impact for converting space heating, domestic hot water (DHW) heating, and cooking from natural gas to electricity. Although electric resistance has low CO2e intensity vs. natural gas, it is inefficient and should only be used in cases where converting to heat pump technology is not feasible. A chart for fleet electrification may be similar, but such studies are beyond the scope of this contract.


CO2 emissions per unit of space heating or domestic hot water heating produced
Another way to look at this data is to say that air-source heat pumps have 1.75 times the CO2 Emissions per unit of heating produced vs. ground source heat pumps, electric resistance heating is 3.5 times the CO2 emissions of ground source heat pumps, and natural gas is 120 times the CO2 emissions of ground source heat pumps.
Metric Tons of CO2 Equilavent per Million BTUs
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Natural Gas
Electric Resistance Heating
Air-water heat pump
Ground Source heat pump
Type of Space Heating or Domestic Hot Water Heating


CO2 emissions per unit of cooking heat produced
Metric Tons of CO2 Equilavent per Million BTUs
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Natural Gas Cook Top
Induction Cook Top
Natural Gas Oven
Electric Oven
Type of Cooking Heat

STANDARD APPROACH TO BUILDING CHARACTERISTICS REPORTING

Data provided by the City and in the City's Energy Star Portfolio Manager account used to populate the WA Department of Commerce "Form D" fields in the U.S. Department of Energy's audit tool for consistency and to facilitate future grant and incentive applications.

COST ESTIMATING APPROACH

The budgets created as part of this study utilized a mix of pricing methods to capture the variability of the systems and the buildings that could be repeatable across the 9 buildings included in the study. For some of the systems McKinstry has historical square foot pricing, and for others install estimates were developed on a per unit basis.

This study did not assume procurement methodologies and schedules, but all budgets include equipment purchase, contractor install, design, overhead and profit, management, general conditions (includes site supervision), and contingency. The budgets do not include escalation or TPU charges (if any) for electrical service upgrades which can range from $250,000 to $750,000 each.

A high-level budget of this nature, using square foot budgets and estimates includes a large number of assumptions. A collaborative approach with the City and the design team will be able to determine what opportunities are available to streamline the scope of work to maintain and improve project budgets.

UTILITY SAVINGS ESTIMATING APPROACH

McKinstry's 8760 hourly modeling tool utilized to create a baseline model for each building based on each building's characteristics. This tool is named 8760 because that is the number of hours there are in a year, and it calculates the energy use for each hour. This is a true 8760 hourly calculation that uses TMY3 (Typical Meteorological Year 3) data sets published by the National Renewable Energy Laboratory (NREL.) McKinstry's 8760 Calculation has been created to be flexible so it can quickly and accurately model a wide variety of energy conservation measures. McKinstry's 8760

Calculation accounts for internal heat gains, building insulation values, infiltration, solar loads, night setback and outside air damper minimum shut down and air-side economizer operation, reheat systems such as VAV, fuel type, heating and cooling efficiency, and fan energy. Baseline model then fine-tuned to achieve a good fit to the monthly utility billing data for gas and electric. The modeling tool generates annual gas and electric usage for each end use.

Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

A high-level energy calculation of this nature, using end use savings includes a large number of assumptions. A collaborative approach with the City and the design team will be able to determine what opportunities are available to enhance the scope of work to maintain and improve the utility savings.

Solar FIM utility savings was calculated using software from HelioScope.

HelioScope

Water FIM utility savings was calculated by Hydrametrics.

HydraMetrics
investing in the intelligent use of water

Envelope air sealing savings was calculated by iStar.

I-STAR
ENERGY SOLUTIONS

PAST, CURRENT, AND PLANNED ESCO PROJECTS FOR THE CITY OF TACOMA

- Wastewater Treatment Plant – Gas Re-injection Project, Included HVAC upgrades at Buildings E and F.
- Tacoma Dome LED Lighting Upgrade – Arena Lighting and Exterior Lighting
- Rialto Theater Roof Repair – HVAC Upgrade(pending)
- Convention Center – Chiller Rebuild, Lighting Upgrades, DDC Optimization
- Main Library is applying for Solar + Storage planning grant with McKinstry.
- Solid Waste Admin Bldgs - HVaC services with McKinstry

SUPPORTING DOCUMENTATION PROVIDED BY COT

THERE ARE 16.7 GB (7081 FILES AND FOLDERS) OF SUPPORTING FILES LOCATED HERE: Municipal Facilities Decarbonization Study Rather than duplicating those items in this report, please refer to the link. This report repeats specific information from the files where relevant to the Level 2 Audit Tool and FIM analysis.

FACILITY IMPROVEMENT MEASURES (FIMS)

GENERAL APPROACH

To provide FIMs that are widely applicable to all COT facilities (not just the 9 facilities in this study,) 10 standard FIMs were developed that each tackle a logical project scope and can be standardized across the COT facility portfolio.

1. 09.01 Lighting / Lighting Controls
2. 01.01 Convert to Heat Pump Heating (electricity)
3. 12.01 Convert to Heat Pump Domestic Hot Water (electricity)
4. 15.01 Convert Gas Cooking to Electric
5. 13.01 Envelope Air Sealing and Mech. Insulation
6. 13.02 Envelope Upgrades
7. 03.01 Duct Sealing
8. 10.01 Install Rooftop Solar Photovoltaic (PV) + Battery Energy Storage System (BESS)
9. 18.01 Water Conservation
10. 05.01 Low-No Cost Measures and Building Automation System (BAS)

09.01 LIGHTING / LIGHTING CONTROLS

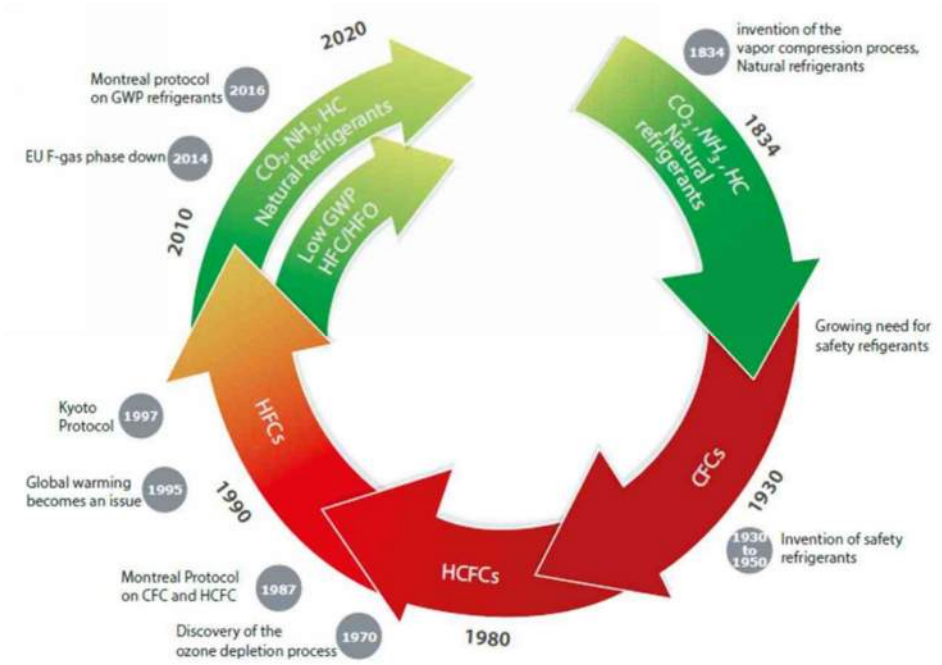
Existing Conditions: Many buildings in the MFDS have T-8, HID, and other non-LED lighting. Some facilities have poor or non-existent lighting controls.

Proposed Upgrades Related to the Overall Facilities in this Study: Retrofit existing troffers and/or T-8 lighting to flat panel door kits. Convert all remaining interior and exterior lighting to LED. Upgrade lighting control panels as needed. Provide standalone motion and daylighting control where appropriate. Upgrade exterior and parking to LED and provide photocell or astronomical timeclock dimming if not already equipped.

01.01 CONVERT TO HEAT PUMP HEATING

Existing Conditions: Most facilities in the MFDS have gas heating. TMB is electric resistance. TMBN is mostly electric resistance except for some supplemental natural gas fired rooftop units that were recommended and installed by McKinstry prior to the transformative shift in the HVAC industry towards heat pump heating predicated by the climate change crisis and improvements in heat pump technology.

Proposed Upgrades Related to the Overall Facilities in this Study: Replace outdated equipment. Install: electric air-water heat pumps, Variable Refrigerant Flow (VRF) electric heat pumps, and/or split Direct Expansion (DX) systems. Estimated costs are based on the lowest currently available Global Warming Potential (GWP) refrigerant for each type of equipment. This report recommends reevaluating the basis of design for each system prior to implementation since the market is adapting rapidly to regulations and building owner demand for lower GWP refrigerants. In general, “natural refrigerants” will reduce the negative environmental impact of refrigerants. Among natural refrigerants, CO2 is still not available for space heating applications, and some manufacturers are coming out with propane and ammonia space heating products – propane and ammonia pose health and safety risks if not applied properly, but the overall environmental impact is lower than synthetic refrigerants. None of the cost estimates in this report are based on equipment that uses propane or ammonia since manufacturers have not widely released these products as of the date of this report.



12.01 CONVERT TO HEAT PUMP DOMESTIC HOT WATER

Existing Conditions: CO2 is widely available as a refrigerant now for domestic hot water (DHW) heat pumps. For this study, split systems that receive heat from the outdoors were specified. In some cases, a packaged system will make sense if the water heater is in a space with adequate air volume exchange to prevent overcooling.

Proposed Upgrades Related to the Overall Facilities in this Study: Replace natural gas boilers or electric resistance water heaters with split system CO2 refrigerant electric heat pump water heaters or packaged heat pump water heaters. For very small DHW heaters, it is recommended to leave existing electric resistance units in place.

15.01 CONVERT GAS COOKING TO ELECTRIC

Existing Conditions: Natural gas kitchen equipment. In addition to the climate impact of natural gas, burning natural gas inside occupied spaces additional heat gain in the kitchen.

Proposed Upgrades Related to the Overall Facilities in this Study: Convert gas equipment to electric as needed.

13.01 ENVELOPE AIR SEALING AND MECH. INSULATION

Existing Conditions: Air sealing the building envelope is a key step in improving the energy efficiency. It can help reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades Related to the Overall Facilities in this Study: Provide: spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking.

13.02 ENVELOPE UPGRADES

Existing Conditions: Certain parts of the buildings may experience uncomfortable temperature levels.

Proposed Upgrades Related to the Overall Facilities in this Study: Upgrade single pane glazing to very low U-factor, spectrally selective (low solar heat gain factor (SHGF) with high visible light transmission (VLT)) glazing and/or add exterior horizontal shading devices to south facing glazing or vertical exterior shading devices to east/west facing glazing as needed.

03.01 DUCT SEALING

Existing Conditions: Case studies conducted by Aeroseal show that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades Related to the Overall Facilities in this Study: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks, and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. McKinstry has implemented Aeroseal on past projects (including municipal buildings and hospitals,) and have not had complaints of odor from occupants – product is installed when the building is unoccupied, ideally at the start of a weekend. Within a couple of days of application, the resultant material hardens and becomes inert. Aeroseal uses an emulsion of water and vinyl acetates that are stable, non-toxic, and non-flammable.

10.01 INSTALL ROOFTOP SOLAR PV + BESS

Existing Conditions: None of the buildings in the MFDS (or any other City owned facilities) are equipped with renewable energy except for a solar domestic hot water (DHW) system at the Solid Waste Admin building and solar PV at the City's Envirohouse.

Proposed Upgrades Related to the Overall Facilities in this Study: Install a fixed-tilt solar PV system on the roof of the building if there is adequate space. Interconnect to the grid and set-up for net metering with the utility. Install a behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

18.01 WATER CONSERVATION

Existing Conditions: Buildings of this vintage typically have: 1.6 gallons per flush (GPF) toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gallons per minute (gpm) lavatory aerators, but McKinstry has found from past projects that most flushometers are not optimized to provide maximum performance and minimum (GPF.)

Proposed Upgrades Related to the Overall Facilities in this Study: Provide: new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, and low flow kitchen spray heads. Upgrade and commission/tune flushometers and tank toilet kits. This study excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

05.01 LOW-NO COST MEASURES AND BAS

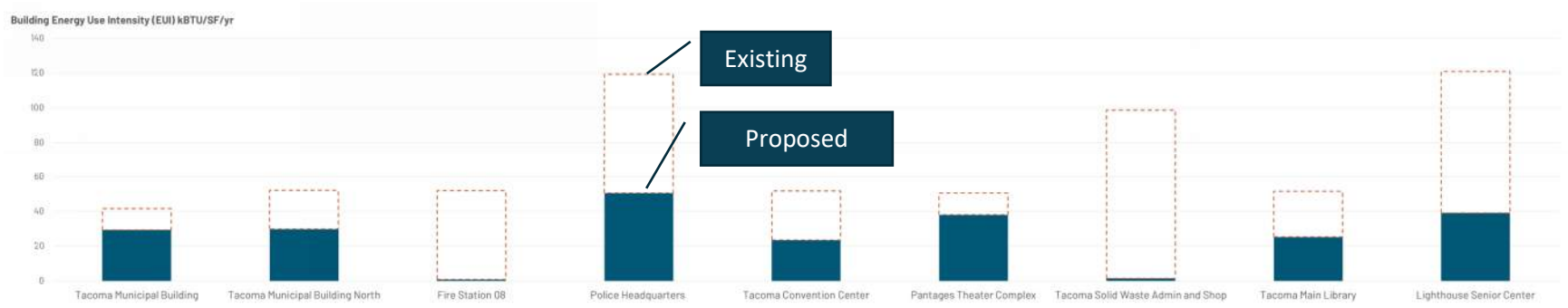
Existing Conditions: For buildings with high energy use (even after the other FIMs are modeled) we included Existing Building Commissioning (EBCx.)

Proposed Upgrades Related to the Overall Facilities in this Study: Provide EBCx. The pricing shown in this study report includes an allowance for small repairs and adding select Building Automation System (BAS) points such as CO2 sensors and motion sensors where recommended.

SUMMARY RESULTS

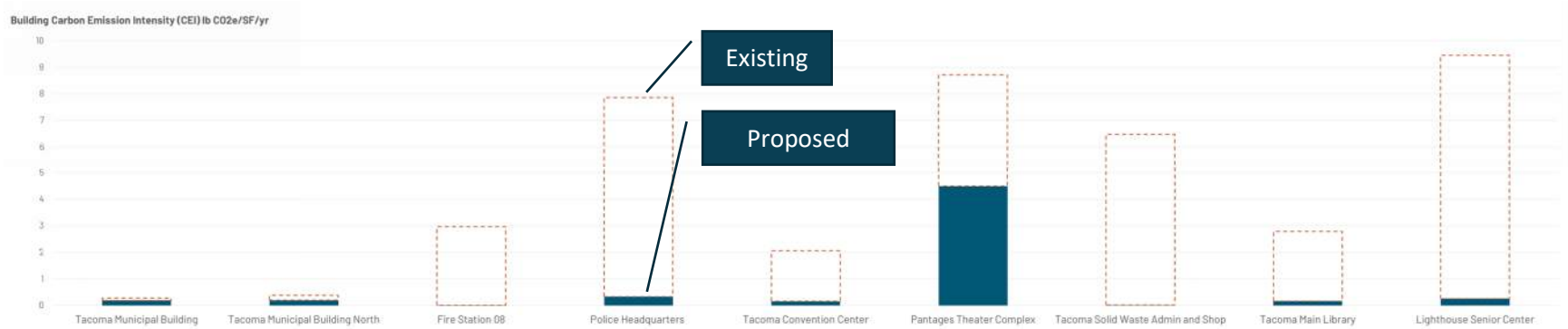
The following charts summarize the energy impact, carbon impact, and cost if 100% of the FIMs are implemented. For a FIM-by-FIM summary table and supporting details for each FIM, refer to section 4.

PRE AND POST EUI



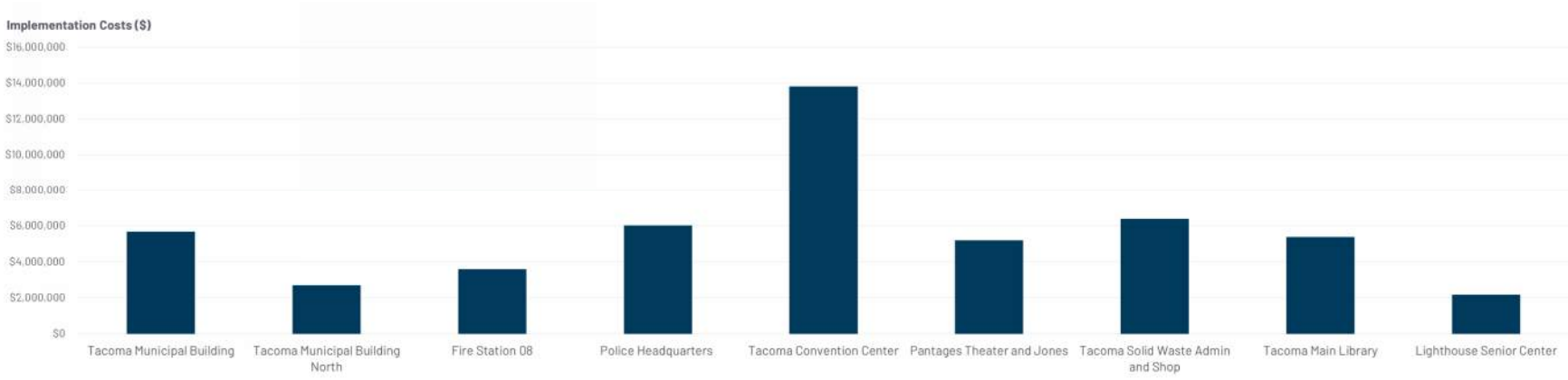
PRE AND POST CARBON

Note that these nine sites represent **17%** of the overall CO2e emissions from COT owned facilities based on 2022 data provided by COT. Also note that the Pantages Theater Complex Carbon Reduction Percentage is less than the other buildings because Theater on the Square (TOTS) shares metering but was not part of this study for decarbonization upgrades.



City of Tacoma Municipal Facilities Decarbonization Study (MFDS) – Report Summary

IMPLEMENTATION COST OF MFDS 9 FACILITIES



IMPLEMENTATION COST OF MFDS 9 FACILITIES (LOW TO HIGH RANGE)

$ 35,500,000	$ 76,000,000

IMPLEMENTATION COST EXTRAPOLATED ACCROSS ALL CITY OF TACOMA OWNED FACILITIES

Refer to the Assumptions Section for an Explanation of the Base Case Cost Methodology (The cost of upgrading end of life systems without decarbonizing.)

	70% of Pre-ROM Estimate	150% of Pre-ROM Estimate		
Facility	**Pre-ROM Budget Low**	**Pre-ROM Budget High**	**Base Case Cost Low**	**Base Case Cost High**
Extrapolate COT Wide All Blds	$ 204,250,000	$ 437,750,000	$ 85,750,000	$ 176,750,000
Extrapolate COT Wide Elec Blds	$ 93,750,000	$ 201,000,000	$ 39,500,000	$ 81,250,000
Extrapolate COT Wide Gas Blds	$ 110,500,000	$ 236,750,000	$ 46,500,000	$ 95,500,000
Total Selected MFDS Gas Blds. ▶	$ 29,750,000	$ 63,750,000	$ 12,500,000	$ 25,750,000
Total All MFDS ▶	$ 35,500,000	$ 76,000,000	$ 14,500,000	$ 31,250,000

City of Tacoma Municipal Facilities Decarbonization Study (MFDS) – Report Summary

Table: Investments for 9 Study buildings to achieve carbon neutrality by 2050

Municipal Facility Decarbonization Study		2023 - 2030			2031 - 2050			2023 - 2050 Totals	
Building Name	Dept.	Investment (Low-to-High Average)	CO2e Savings (MT/yr)	Net Cost / Annual MT CO2e Saved	Investment (Average)	CO2e Savings (MT/yr)	Net Cost / Annual MT CO2e Saved	Investment (Average)	CO2e Savings (MT/yr)
Fire Station 08	PW	$311,687	8.4	$36,908	$1,572,073	14.9	$105,221	$1,883,760	23.4
Lighthouse Senior Center	PW	$331,531	31.2	$10,635	$880,610	5.5	$161,541	$1,212,141	36.6
Pantages Theater Complex	TVE	$378,962	17.1	$22,159	$1,546,500	125.2	$12,351	$1,925,462	142.3
Police Headquarters	PW	$490,006	43.0	$11,408	$2,329,317	206.5	$11,278	$2,819,323	249.5
Tacoma Convention Center	TVE	$1,454,498	38.2	$38,040	$6,084,880	159.3	$38,205	$7,539,378	197.5
Tacoma Main Library	TPL	$1,290,143	106.7	$12,088	$1,544,159	7.2	$215,563	$2,834,302	113.9
Tacoma Municipal Building	PW	$2,235,368	7.0	$318,099	$801,384	0.4	$1,800,304	$3,036,752	7.5
Tacoma Municipal Building North	PW	$534,753	1.0	$513,622	$559,060	2.5	$227,135	$1,093,813	3.5
Tacoma Solid Waste Admin and Shop	ES	$2,794,654	30.8	$90,595	$724,875	69.6	$10,418	$3,519,529	100.4
Totals: 9 Study Buildings		$9,821,602	**284**	$34,637	$16,042,857	**591**	$27,142	$25,864,459	**875**

1. Investment by 2030 achieve 30% emissions from 2019 Baseline for 9 buildings is 934 MT CO2e. Investments by 2050 result in 94% reduction. Remainder through Utility electricity decarbonization.
2. Net Cost = Average Pre-ROM Budget - (Average Base Cost + Utility Incentives). Does not include savings from grants (state, federal)
3. Dollars and emissins shown here derived from McKinstry's Total Cost of Ownership workbook, aggregated from calculatons for each building's FIMs

The City of Tacoma operates on a biennial budget cycle. The Office of Management & Budget (OMB) centers on budget development and monitoring, six-year financial forecasting, and the Capital Facilities Program.

The current 2023 – 2024 Biennial Budget was adopted by City Council on November 22, 2022.Unlike the operating budget, the Capital Budget establishes long-term expenditure authority. The Capital Budget is derived from Capital Facilities Program, a six-year planning and financial document. CFP is a prioritization of capital improvements the City intends to build in the next six years and a plan for how to pay for these improvements. Currently adopted version, 2023 -2028 Capital Facilities Program, will be updated for the 2025 – 2026 Biennial Budget.

Most of the recommended Facility Improvement Measures (FIMs) in this report will be proposed through the CFP process. The CFP process involves multiple entities within the organization. Facilities departments and stakeholders develop project proposals with evaluation criteria includes city goals and sustainability policies. The Planning Commission ensures alignment with the Comprehensive Plan and guides project prioritization. The City Manager and their designees propose allocation of available funding, balancing a variety of input sources. Ultimately the Council approves the Biennial Budget and the associated CFP.

This work supports the City's Climate Action Plan goals of reducing GHG emissions of its municipal facilities; 30% by 2030, and carbon neutrality by 2050.

City of Tacoma Decarbonization
Environmental Impact Calculator

The values shown on this sheet assume that all MFDS Facility Improvement Measures are Implemented

Total	**Load Factor to Use**		
TPU Commerce 2020	**Select Factor**	**0.00293**	**MT CO2e / MMBTU (Electricity Emissions Factor)**

Amount Each Utility Type Will Be Reduced Per Year

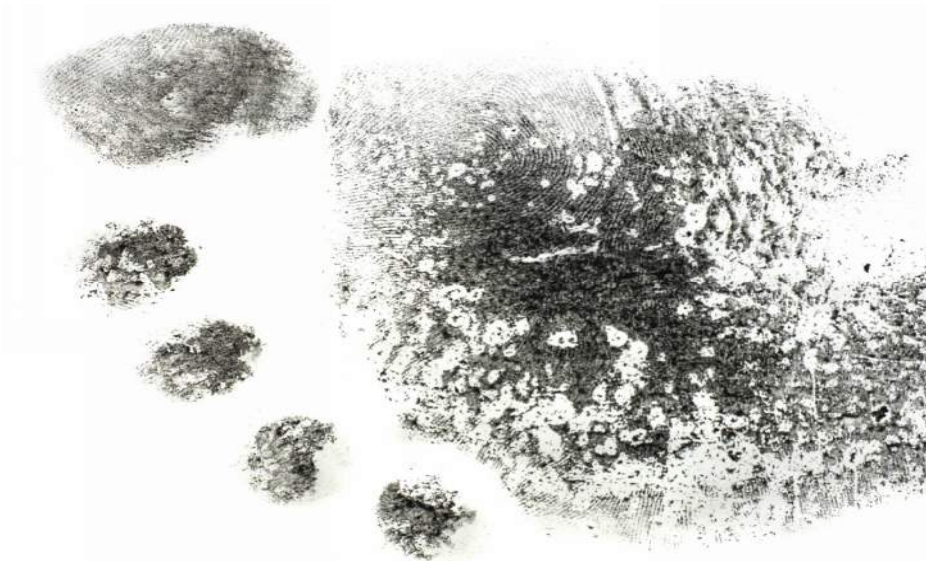
Electricity						
8,894	**MMBTU**	=	**57,460**	**lbs CO_2**	**26.1**	**Metric Tonnes CO_2**
Natural Gas						
146,447	**Therms**	=	**1,713,431**	**lbs CO_2**	**777.2**	**Metric Tonnes CO_2**
Steam						
0	**Mlbs**	=	**0**	**lbs CO_2**	**0.0**	**Metric Tonnes CO_2**
Fuel Oil						
0	**Gallons**	=	**0**	**lbs CO_2**	**0.0**	**Metric Tonnes CO_2**
Propane						
0	**Gallons**	=	**0**	**lbs CO_2**	**0.0**	**Metric Tonnes CO_2**
	Total Reduction	=	**1,770,891**	**lbs CO_2**	**803.3**	**Metric Tonnes CO_2**

This Annual Emissions Reduction Is Equivalent To The Following:

154	Number of Vehicles Removed From Roads (Avg Size); or
3,001,511	Number of Miles Not Driven Per Year (Avg Size); or
122,979	Number of 13.5 Watt Light bulbs Not Energized; or
77	Number of Avg Sized Houses Removed From Power Grid; or
220	Acres of Trees Planted; or
827,519	Pounds of Coal Not Burned Per Year

Other Emissions Factors

Natural Gas (ASHRAE Std. 189-2017 Table 7.5.2):	**19.96**	**lbs CO2 / Therm**
Steam (Seattle Steam):	**195.364**	**lbs CO2 / Mlbs**
Fuel Oil:	**22.384**	**lbs CO2 / gal**
Propane:	**12.5**	**lbs CO2 / gal**
Conversion:	**2204.62**	**lbs CO2 / Metric Tonnes CO2**



Equivalents Conversions

Car Emmissions: 11,470 lbs CO_2 / car / yr
Tree Carbon Sequestation: 8,066 lbs CO_2 / acre / yr
Vehicle Mileage Emmissions: 0.59 lbs CO_2 / mile
13.5 W Light Bulb Emmissions: 14.4 lbs CO_2 / Light Bulb / yr
Tree Carbon Sequestation: 8,066 lbs CO_2 / acre / yr
Coal Emmisions: 2.14 lbs CO_2 / pound Coal
Houses Removed: 22,880 lbs CO_2 / house

Sources:

* Energy Information Agency (EIA)
* Environmental Protection Agency (EPA)
* ENERGY STAR
* eGRID 2020 (If eGrid Subregion or Local Utilities Chosen)
* NWPCC Report dated June 13, 2008 (If WADES Factor Chosen)

City of Tacoma MFDS – Preliminary Electrical Capacity Analysis

Summary

Since this report contains Facility Improvement Measures that would convert natural gas loads into electrical loads (01.01 Convert to Heat Pump Heating, 12.01 Convert to Heat Pump Domestic Hot Water, 15.01 Convert Gas Cooking to Electric) and since the City of Tacoma is interested in adding electrical vehicle supply equipment (EVSE) capacity, McKinstry evaluated 12 months of electrical billing demand, electrical one-line diagrams, and proposed electrical load additions to get a preliminary determination if electrical capacity is adequate. A detailed analysis and 30-day metering will be required during the Investment Grade Audit (IGA) phase to confirm these preliminary results.

Table Overview

The following is an explanation of each column in the electrical analysis table that follows this write-up:

- **Peak Winter kW:** This is highest winter kW based on Tacoma Public Utilities (TPU) provided data.
- **Peak Summer kW:** This is highest summer kW based on Tacoma Public Utilities (TPU) provided data.
- **Load Added to Electrical Service**: [BTUH of space heating required (rule of thumb of 20 BTU per SF) + BTUH of DHW heating required (rule of thumb per SF and building type)] / 3,412 BTU/kW / 2 (heat pump coefficient of performance) + kW of kitchen equipment
    - DHW BTUH Rule of Thumb:

Property Name	DHW BTUH/SF
Police Headquarters	1.245
Tacoma Convention Center	0.54
Pantages Theater	0.75
Solid Waste Admin Building	1.0
Tacoma Main Library	0.11
Lighthouse Senior Center	1.6
Fire Station 08	1.9

- **Peak Demand x 1.25:** Peak Summer (kW) x 1.25
    - Note that the 1.25 factor is a requirement of the National Electrical Code (NEC) Section 220.87.
- **Estimated New Load**: Load Added to Electrical Service (kW) + Peak Demand x 1.25 (kW)

- **Electrical Service Size**: Electrical Service Size (Amps) x 0.832 x 80%
  - The electrical service size was determined based on as-built drawing review of the electrical one-line diagrams.
  - Note that these are NEC required factors.
- **Electrical Service Voltage:** determined based on as-built drawing review of the electrical one-line diagrams
- **Electrical Service Capacity:** determined based on as-built drawing review of the electrical one-line diagrams
  - Note that 80% is an NEC required factor.
- **EVSE Available Capacity**: Electrical Service Capacity (kW) – Estimated New Load (kW)
  - This column shows the capacity that will be left over after the 3 decarbonization FIMs are implemented. This capacity could be used for Electric Vehicle Supply Equipment (EVSE.)

Conclusion

Based on this analysis, the electrical capacity is sufficient for the proposed building electrification. As part of an investment grade audit, we still require a detailed electrical engineering analysis as well as 30-day metering. This statement only pertains to the buildings included in the study and not to all buildings within the COT facilities portfolio.

Property Name	Peak Winter kW	Peak Summer kW	Load Added to Electrical Service (Space Heating, DHW, and Kitchen) kW	Peak Demand x 1.25 (NEC 220.87) kW	Estimated New Load kW	Electrical Service Size (A)	Electrical Service Voltage	Electrical Service Capacity (at 80% rating of Main) kW	Electric Vehicle Supply Equipment (EVSE) Available Capacity kW
Tacoma Municipal Building	1006	723	622	1258	**1880**	N/A	N/A	Not evaluated due to building already being fully electric.	N/A
Tacoma Municipal Building North	173	232	126	290	**416**	4000	208	**1152**	**736**
Police Headquarters	240	256	227	320	**547**	1600	480	**1065**	**518**
Fire Station 08	44	40	56	55	**111**	600	208	**173**	**62**
Tacoma Convention Center	664	776	629	970	**1599**	N/A	N/A	4 electrical services; total capacity is adequate for heat pumps and electric cooking - specific design to be determined during the IGA	N/A
Pantages Theater (TVE)	60	130	108	163	**270**	2000	208	**576**	**306**
SWM Admin Building	104	146	105	183	**288**	1000	480	**665**	**377**
Tacoma Main Library	199	252	282	315	**597**	2500	208	**720**	**123**
Lighthouse Senior Center	45	35	28	56	**84**	600	120/240	**115**	**31**

Notes:

1. Although this preliminary analysis of existing peak billing demand, proposed load additions, and existing electrical one-line diagram capacity shows what all 9 of the MFDS buildings can support electrification of heating, DHW, and cooking without upgrading the main switchboards, an Investment Grade Audit (with 30-day metering of the main service and branch loads will be required to confirm capacity).

2. Electric Utilities are not bound by the National Electrical Code, so it's possible that the TPU service size will be smaller than the building switchboard capacity. Refer to the assumptions document for TPU procedures and costs to perform studies and up-sizing if necessary. These studies would occur during the Investment Grade Audit phase and would be paid directly by COT to TPU.

Facility Improvement Measure (FIM) Impact and Decision Matrix

Project	City of Tacoma Decarbonization
Scenario	COT MFDS

Totals (based on filter)

$ 14,614,250	$ 31,313,625	$ 35,430,000	$ 75,915,000	$ 222,252	$ 412,753	23,539	$ 73,129	$ 6,833,545	803.7		
See Assumptions Section		70% of Pre-ROM Budget	150% of Pre-ROM Budget	70% of ROM Savings	130% of ROM Savings				Green is Lowest	Green is Highest	Green is Lowest

Database ID	FIM Name	Dept.	Facility	Remaining Life Notes	Remaining life, overdue, 1-5, 6-10, etc.	Base Case Cost Low	Base Case Cost High	Pre-ROM Budget Low	Pre-ROM Budget High	Annual Utility Savings Low	Annual Utility Savings High	Annual Energy MMBTU Savings	Annual Social Cost of Carbon Savings	Potential Incentives	Net Cost / Annual MMBTU Saved	Annual CO2e Savings (MT)	Net Cost / Annual MT CO2e Saved	Implementation Year (COT Entered) DEADLINE
50431	09.01 Lighting / Lighting Controls	PW	Fire Station 08	Lamps and ballasts are 20 years old.	Overdue	$ 21,875	$ 46,375	$ 62,500	$ 132,500	$ 1,851	$ 3,437	136	$ 36	$ 6,763	$ 417	0.4	$ 142,304	2030
50440	01.01 Convert to Heat Pump Heating	PW	Fire Station 08	20 year old DX and gas radiant equipment is at the end of their expected life.	1-5	$ 635,250	$ 1,359,750	$ 907,500	$ 1,942,500	$ 1,971	$ 3,661	177	$ 1,237	$ -	$ 2,412	13.6	$ 31,442	2050
50449	12.01 Convert to Heat Pump Domestic Hot Water	PW	Fire Station 08	20 year old gas Domestic Hot Water (DHW) is at the end of its expected life.	1-5	$ 115,500	$ 246,750	$ 165,000	$ 352,500	$ 434	$ 806	39	$ 272	$ -	$ 1,990	3.0	$ 25,937	2030
50458	15.01 Convert Gas Cooking to Electric	PW	Fire Station 08	20 year old gas appliances are at the end of their expected life.	1-5	$ 98,000	$ 210,000	$ 140,000	$ 300,000	$ 363	$ 675	36	$ 280	$ -	$ 1,854	3.1	$ 21,429	2030
50467	13.01 Envelope Air Sealing	PW	Fire Station 08	N/A	N/A			$ 17,500	$ 40,000	$ 491	$ 911	37	$ 178	$ 2,483	$ 713	2.0	$ 13,429	2030
50503	03.01 Duct Sealing	PW	Fire Station 08	N/A	N/A	$ 17,500	$ 37,500	$ 70,000	$ 150,000	$ 86	$ 159	6	$ 2	$ 553	$ 13,026	0.0	$ 4,444,631	2030
50512	10.01 Solar PV and Storage	PW	Fire Station 08	N/A	N/A			$ 1,145,000	$ 2,452,500	$ 5,155	$ 9,573	459	$ 122	$ 654,177	$ 2,495	1.3	$ 851,439	2050
50540	18.01 Water Conservation	PW	Fire Station 08	Flushometers, aerators, shower heads are near the end of their expected life.	1-5	$ 875	$ 2,625	$ 2,500	$ 7,500	$ 229	$ 425	0	$ -	$ 13		0.0		2030
50437	09.01 Lighting / Lighting Controls	PW	Lighthouse Senior Center	Lamps and ballasts are at the end of their expected life.	Overdue	$ 19,250	$ 41,125	$ 55,000	$ 117,500	$ 459	$ 852	38	$ 10	$ 1,879	$ 1,437	0.1	$ 490,186	2030
50446	01.01 Convert to Heat Pump Heating	PW	Lighthouse Senior Center	The 1985 Birchfield steam boiler and piping are well beyond the end of their expected life.	Overdue	$ 229,250	$ 490,000	$ 327,500	$ 700,000	$ 2,451	$ 4,553	328	$ 2,291	$ -	$ 470	25.2	$ 6,122	2030
50455	12.01 Convert to Heat Pump Domestic Hot Water	PW	Lighthouse Senior Center	The gas domestic hot water heater (FCA indicated roughly 2015 installation date) is mid-way through its expected life.	6-10	$ 117,250	$ 252,000	$ 167,500	$ 360,000	$ 550	$ 1,021	74	$ 514	$ -	$ 1,074	5.6	$ 14,007	2030
50464	15.01 Convert Gas Cooking to Electric	PW	Lighthouse Senior Center	The drawings indicate 1986. If the oven/range hasn't been replaced since then, it's well beyond the end of its expected life.	Overdue	$ 49,000	$ 105,000	$ 70,000	$ 150,000	$ 281	$ 521	41	$ 322	$ -	$ 806	3.5	$ 9,314	2050
50473	13.01 Envelope Air Sealing	PW	Lighthouse Senior Center	N/A	N/A			$ 7,500	$ 17,500	$ 258	$ 479	29	$ 139	$ 1,943	$ 366	1.5	$ 6,899	2050
50518	10.01 Solar PV and Storage	PW	Lighthouse Senior Center	N/A	N/A			$ 837,500	$ 1,792,500	$ 1,449	$ 2,691	129	$ 34	$ 477,948	$ 6,493	0.4	$ 2,215,303	2050
50546	18.01 Water Conservation	PW	Lighthouse Senior Center	Flushometers, aerators, shower heads are beyond the end of their expected life.	Overdue	$ 1,750	$ 4,375	$ 5,000	$ 12,500	$ 372	$ 691	0	$ -	$ 22		0.0		2030
50555	05.01 Low-No Cost Measures and Building Automation System (BAS)	PW	Lighthouse Senior Center	N/A	N/A	$ 14,875	$ 32,375	$ 42,500	$ 92,500	$ 982	$ 1,824	81	$ 22	$ 5,443	$ 476	0.2	$ 162,392	2030
50434	09.01 Lighting / Lighting Controls	TVE	Pantages Theater complex	Lamps and ballasts are at the end of their expected life.	Overdue	$ 35,875	$ 76,125	$ 102,500	$ 217,500	$ 1,568	$ 2,912	128	$ 34	$ 6,371	$ 763	0.4	$ 260,494	2030
50443	01.01 Convert to Heat Pump Heating	TVE	Pantages Theater complex	The boilers were installed in 2008 and are near the end of their useful life.	1-5	$ 2,296,000	$ 4,921,000	$ 3,280,000	$ 7,030,000	$ 5,174	$ 9,609	816	$ 5,697	$ -	$ 1,895	62.6	$ 24,702	2050
50470	13.01 Envelope Air Sealing	TVE	Pantages Theater complex	N/A	N/A			$ 25,000	$ 55,000	$ 1,189	$ 2,209	157	$ 757	$ 10,558	$ 188	8.3	$ 3,540	2030
50506	03.01 Duct Sealing	TVE	Pantages Theater complex	N/A	N/A	$ 52,500	$ 111,875	$ 210,000	$ 447,500	$ 388	$ 721	32	$ 8	$ 2,784	$ 7,699	0.1	$ 2,627,056	2030
50543	18.01 Water Conservation	TVE	Pantages Theater complex	Flushometers, aerators, shower heads are beyond the end of their expected life.	Overdue	$ 6,125	$ 14,000	$ 17,500	$ 40,000	$ 279	$ 518	0	$ -	$ 16		0.0		2030
50432	09.01 Lighting / Lighting Controls	PW	Police Headquarters	Lamps and ballasts are 15 years old.	Overdue	$ 107,625	$ 230,125	$ 307,500	$ 657,500	$ 8,754	$ 16,257	766	$ 204	$ 38,159	$ 360	2.2	$ 122,723	2030
50441	01.01 Convert to Heat Pump Heating	PW	Police Headquarters	Based on their 24/7/365 operation, these boilers have exceeded their expected life.	Overdue	$ 1,246,000	$ 2,670,500	$ 1,780,000	$ 3,815,000	$ 17,208	$ 31,959	2,678	$ 18,694	$ -	$ 313	205.5	$ 4,085	2050
50450	12.01 Convert to Heat Pump Domestic Hot Water	PW	Police Headquarters	These DHW heaters are 15 years old and are near the end of their expected life.	1-5	$ 176,750	$ 379,750	$ 252,500	$ 542,500	$ 2,485	$ 4,615	387	$ 2,699	$ -	$ 308	29.7	$ 4,020	2030
50468	13.01 Envelope Air Sealing	PW	Police Headquarters	N/A	N/A			$ 30,000	$ 62,500	$ 1,323	$ 2,456	172	$ 830	$ 11,583	$ 202	9.1	$ 3,800	2030
50495	13.02 Envelope Upgrades	PW	Police Headquarters	N/A	N/A	$ 381,500	$ 817,250	$ 545,000	$ 1,167,500	$ 829	$ 1,539	73	$ 19	$ 4,889	$ 3,474	0.2	$ 1,185,488	2050
50504	03.01 Duct Sealing	PW	Police Headquarters	N/A	N/A	$ 76,875	$ 164,375	$ 307,500	$ 657,500	$ 1,288	$ 2,392	113	$ 30	$ 9,906	$ 3,124	0.3	$ 1,065,878	2050

Facility Improvement Measure (FIM) Impact and Decision Matrix

Project	City of Tacoma Decarbonization
Scenario	COT MFDS

Totals (based on filter)

$ 14,614,250	$ 31,313,625	$ 35,430,000	$ 75,915,000	$ 222,252	$ 412,753	23,539	$ 73,129	$ 6,833,545	803.7
See Assumptions Section		70% of Pre-ROM Budget	150% of Pre-ROM Budget	70% of ROM Savings	130% of ROM Savings				Green is Highest

Green is Lowest — Green is Lowest

Database ID	FIM Name	Dept.	Facility	Remaining Life Notes	Remaining life, overdue, 1-5, 6-10, etc.	Base Case Cost Low	Base Case Cost High	Pre-ROM Budget Low	Pre-ROM Budget High	Annual Utility Savings Low	Annual Utility Savings High	Annual Energy MMBTU Savings	Annual Social Cost of Carbon Savings	Potential Incentives	Net Cost / Annual MMBTU Saved	Annual CO2e Savings (MT)	Net Cost / Annual MT CO2e Saved	Implementation Year (COT Entered) DEADLINE
50513	10.01 Solar PV and Storage	PW	Police Headquarters	N/A	N/A			$ 885,000	$ 1,900,000	$ 2,099	$ 3,899	187	$ 50	$ 506,388	$ 4,744	0.5	$ 1,618,588	2050
50541	18.01 Water Conservation	PW	Police Headquarters	Flushometers, aerators, shower heads are near the end of their expected life.	1-5	$ 10,500	$ 22,750	$ 30,000	$ 65,000	$ 1,495	$ 2,777	0	$ -	$ 88		0.0		2030
50550	05.01 Low-No Cost Measures and Building Automation System (BAS)	PW	Police Headquarters	N/A	N/A	$ 25,375	$ 54,250	$ 72,500	$ 155,000	$ 7,478	$ 13,888	654	$ 174	$ 44,102	$ 46	1.9	$ 15,559	2030
50433	09.01 Lighting / Lighting Controls	TVE	Tacoma Convention Center	Lamps and ballasts are 20 years old.	Overdue	$ 98,875	$ 211,750	$ 282,500	$ 605,000	$ 5,720	$ 10,623	584	$ 156	$ 29,098	$ 444	1.7	$ 151,515	2050
50442	01.01 Convert to Heat Pump Heating	TVE	Tacoma Convention Center	At 20 years old, cast-iron sectional boilers are 2/3 of the way through their useful life.	11-15	$ 2,282,000	$ 4,889,500	$ 3,260,000	$ 6,985,000	$ 10,203	$ 18,948	1,731	$ 12,080	$ -	$ 888	132.8	$ 11,575	2050
50451	12.01 Convert to Heat Pump Domestic Hot Water	TVE	Tacoma Convention Center	At 20 years old, this style of domestic hot water heating is at the end of its expected life.	1-5	$ 180,250	$ 386,750	$ 257,500	$ 552,500	$ 1,543	$ 2,865	262	$ 1,827	$ -	$ 464	20.1	$ 6,052	2030
50460	15.01 Convert Gas Cooking to Electric	TVE	Tacoma Convention Center	The kitchen equipment is 20 years old which is the end of its expected life.	1-5	$ 491,750	$ 1,053,500	$ 702,500	$ 1,505,000	$ 1,115	$ 2,070	206	$ 1,623	$ -	$ 1,607	17.8	$ 18,567	2050
50469	13.01 Envelope Air Sealing	TVE	Tacoma Convention Center	N/A	N/A			$ 40,000	$ 85,000	$ 2,021	$ 3,754	286	$ 1,383	$ 19,293	$ 151	15.2	$ 2,843	2030
50505	03.01 Duct Sealing	TVE	Tacoma Convention Center	N/A	N/A	$ 256,875	$ 550,625	$ 1,027,500	$ 2,202,500	$ 1,652	$ 3,068	169	$ 45	$ 14,829	$ 7,094	0.5	$ 2,420,429	2030
50514	10.01 Solar PV and Storage	TVE	Tacoma Convention Center	N/A	N/A			$ 3,957,500	$ 8,480,000	$ 26,684	$ 49,557	2,374	$ 633	$ 2,261,085	$ 1,667	7.0	$ 568,722	2050
50542	18.01 Water Conservation	TVE	Tacoma Convention Center	Flushometers, aerators, shower heads are beyond the end of their expected life.	Overdue	$ 15,750	$ 35,000	$ 45,000	$ 100,000	$ 3,813	$ 7,081	0	$ -	$ 224		0.0		2030
50551	05.01 Low-No Cost Measures and Building Automation System (BAS)	TVE	Tacoma Convention Center	N/A	N/A	$ 35,000	$ 76,125	$ 100,000	$ 217,500	$ 8,241	$ 15,305	841	$ 224	$ 56,718	$ 55	2.5	$ 18,844	2030
50436	09.01 Lighting / Lighting Controls	TPL	Tacoma Main Library	Lamps and ballasts are 20 years old.	Overdue	$ 154,875	$ 331,625	$ 442,500	$ 947,500	$ 4,063	$ 7,545	454	$ 121	$ 22,607	$ 946	1.3	$ 322,705	2030
50445	01.01 Convert to Heat Pump Heating	TPL	Tacoma Main Library	At 36 years old, this equpment is beyond its expected life.	Overdue	$ 1,279,250	$ 2,738,750	$ 1,827,500	$ 3,912,500	$ 6,881	$ 12,779	1,374	$ 9,591	$ -	$ 627	105.4	$ 8,169	2030
50472	13.01 Envelope Air Sealing	TPL	Tacoma Main Library	N/A	N/A			$ 15,000	$ 30,000	$ 616	$ 1,143	103	$ 496	$ 6,916	$ 152	5.4	$ 2,860	2050
50508	03.01 Duct Sealing	TPL	Tacoma Main Library	N/A	N/A	$ 73,125	$ 156,250	$ 292,500	$ 625,000	$ 564	$ 1,048	63	$ 17	$ 5,543	$ 5,370	0.2	$ 1,832,090	2050
50517	10.01 Solar PV and Storage	TPL	Tacoma Main Library	N/A	N/A			$ 1,180,000	$ 2,527,500	$ 5,869	$ 10,899	522	$ 139	$ 674,235	$ 2,259	1.5	$ 770,678	2050
50545	18.01 Water Conservation	TPL	Tacoma Main Library	Flushometers, aerators, shower heads are beyond the end of their expected life.	Overdue	$ 3,500	$ 7,875	$ 10,000	$ 22,500	$ 365	$ 678	0	$ -	$ 21		0.0		2050
50429	09.01 Lighting / Lighting Controls	PW	Tacoma Municipal Building	Lamps and ballasts are 20 years old.	Overdue	$ 238,000	$ 510,125	$ 680,000	$ 1,457,500	$ 8,115	$ 15,071	804	$ 214	$ 40,045	$ 814	2.4	$ 277,907	2030
50438	01.01 Convert to Heat Pump Heating	PW	Tacoma Municipal Building	The electric boiler is at the end of its expected life but could gain added years if supplemented with a heat pump.	1-5	$ 990,500	$ 2,122,750	$ 1,415,000	$ 3,032,500	$ 15,247	$ 28,316	1,510	$ 403	$ 132,778	$ 354	4.4	$ 120,731	2030
50465	13.01 Envelope Air Sealing	PW	Tacoma Municipal Building	N/A	N/A			$ 15,000	$ 35,000	$ 876	$ 1,628	87	$ 23	$ 5,851	$ 221	0.3	$ 75,275	2050
50501	03.01 Duct Sealing	PW	Tacoma Municipal Building	N/A	N/A	$ 223,750	$ 478,750	$ 895,000	$ 1,915,000	$ 846	$ 1,572	84	$ 22	$ 7,371	$ 12,481	0.2	$ 4,258,658	2030
50510	10.01 Solar PV and Storage	PW	Tacoma Municipal Building	N/A	N/A			$ 737,500	$ 1,580,000	$ 731	$ 1,358	65	$ 17	$ 421,539	$ 11,327	0.2	$ 3,864,803	2050
50538	18.01 Water Conservation	PW	Tacoma Municipal Building	Flushometers, aerators, shower heads are beyond the end of their expected life.	Overdue	$ 15,750	$ 33,250	$ 45,000	$ 95,000	$ 8,105	$ 15,052	0	$ -	$ 476		0.0		2050
50430	09.01 Lighting / Lighting Controls	PW	Tacoma Municipal Building North	Lamps and ballasts are 29 years old.	Overdue	$ 59,500	$ 127,750	$ 170,000	$ 365,000	$ 2,485	$ 4,615	280	$ 75	$ 13,970	$ 570	0.8	$ 194,593	2030
50439	01.01 Convert to Heat Pump Heating	PW	Tacoma Municipal Building North		Overdue	$ 875,000	$ 1,876,000	$ 1,250,000	$ 2,680,000	$ 4,186	$ 7,774	476	$ 199	$ 40,493	$ 1,152	2.2	$ 250,467	2050
50448	12.01 Convert to Heat Pump Domestic Hot Water	PW	Tacoma Municipal Building North	The 30-year old DHW heaters are beyond their expected life.	Overdue	$ 134,750	$ 287,000	$ 192,500	$ 410,000	$ 153	$ 285	17	$ 5	$ 1,166	$ 5,156	0.1	$ 1,759,333	2030

Facility Improvement Measure (FIM) Impact and Decision Matrix

Project	City of Tacoma Decarbonization
Scenario	COT MFDS

Totals (based on filter)

$ 14,614,250	$ 31,313,625	$ 35,430,000	$ 75,915,000	$ 222,252	$ 412,753	23,539	$ 73,129	$ 6,833,545	803.7
	See Assumptions Section	70% of Pre-ROM Budget	150% of Pre-ROM Budget	70% of ROM Savings	130% of ROM Savings				Green is Lowest	Green is Highest	Green is Lowest

Database ID	FIM Name	Dept.	Facility	Remaining Life Notes	Remaining life, overdue, 1-5, 6-10, etc.	Base Case Cost Low	Base Case Cost High	Pre-ROM Budget Low	Pre-ROM Budget High	Annual Utility Savings Low	Annual Utility Savings High	Annual Energy MMBTU Savings	Annual Social Cost of Carbon Savings	Potential Incentives	Net Cost / Annual MMBTU Saved	Annual CO2e Savings (MT)	Net Cost / Annual MT CO2e Saved	Implementation Year (COT Entered) DEADLINE
50466	13.01 Envelope Air Sealing	PW	Tacoma Municipal Building North	N/A	N/A			$ 10,000	$ 22,500	$ 815	$ 1,513	92	$ 25	$ 6,197	$ 109	0.3	$ 37,312	2050
50502	03.01 Duct Sealing	PW	Tacoma Municipal Building North	N/A	N/A	$ 56,875	$ 121,250	$ 227,500	$ 485,000	$ 510	$ 947	58	$ 15	$ 5,061	$ 4,554	0.2	$ 1,553,893	2030
50539	18.01 Water Conservation	PW	Tacoma Municipal Building North	Flushometers, aerators, shower heads are beyond the end of their expected life.	Overdue	$ 7,875	$ 17,500	$ 22,500	$ 50,000	$ 866	$ 1,607	0	$ -	$ 51		0.0		2030
50435	09.01 Lighting / Lighting Controls	ES	Tacoma Solid Waste Admin and Shop	The lamps and ballasts are 12 years old and are near the end of their expected life.	1-5	$ 52,500	$ 112,000	$ 150,000	$ 320,000	$ 4,683	$ 8,698	305	$ 81	$ 15,201	$ 451	0.9	$ 153,824	2030
50444	01.01 Convert to Heat Pump Heating	ES	Tacoma Solid Waste Admin and Shop	At 13 years old, (2010) this equpment is 2/3 through its expected life.	6-10	$ 1,076,250	$ 2,306,500	$ 1,537,500	$ 3,295,000	$ 4,021	$ 7,467	907	$ 6,331	$ -	$ 799	69.6	$ 10,418	2050
50453	12.01 Convert to Heat Pump Domestic Hot Water	ES	Tacoma Solid Waste Admin and Shop	At 13 years old, (2010) this equpment is 2/3 through its expected life.	6-10	$ 201,250	$ 432,250	$ 287,500	$ 617,500	$ 832	$ 1,546	188	$ 1,311	$ -	$ 723	14.4	$ 9,424	2030
50471	13.01 Envelope Air Sealing	ES	Tacoma Solid Waste Admin and Shop	N/A	N/A			$ 25,000	$ 50,000	$ 1,048	$ 1,946	197	$ 954	$ 13,304	$ 123	10.5	$ 2,309	2030
50507	03.01 Duct Sealing	ES	Tacoma Solid Waste Admin and Shop	N/A	N/A	$ 56,250	$ 120,625	$ 225,000	$ 482,500	$ 289	$ 536	19	$ 5	$ 1,653	$ 14,020	0.1	$ 4,783,764	2030
50516	10.01 Solar PV and Storage	ES	Tacoma Solid Waste Admin and Shop	N/A	N/A			$ 2,182,500	$ 4,677,500	$ 18,454	$ 34,271	1,642	$ 438	$ 1,247,074	$ 1,329	4.8	$ 453,607	2030
50544	18.01 Water Conservation	ES	Tacoma Solid Waste Admin and Shop	Flushometers, aerators, shower heads are near the end of their expected life.	1-5	$ 1,750	$ 3,500	$ 5,000	$ 10,000	$ 644	$ 1,196	0	$ -	$ 38		0.0		2030
50553	05.01 Low-No Cost Measures and Building Automation System (BAS)	ES	Tacoma Solid Waste Admin and Shop	N/A	N/A	$ 17,500	$ 36,750	$ 50,000	$ 105,000	$ 1,056	$ 1,961	69	$ 18	$ 4,638	$ 665	0.2	$ 226,829	2030

PW	Overdue	$ 3,005,625	$ 6,439,125	$ 4,967,500	$ 10,642,500
PW	1-5	$ 2,027,375	$ 4,344,375	$ 2,912,500	$ 6,242,500
PW	6-10	$ 117,250	$ 252,000	$ 167,500	$ 360,000
PW	11-15	$ -	$ -	$ -	$ -
PW	N/A	$ 796,750	$ 1,705,750	$ 5,845,000	$ 12,525,000
PW	Total	$ 5,947,000	$ 12,741,250	$ 13,892,500	$ 29,770,000
TVE	Overdue	$ 156,625	$ 336,875	$ 447,500	$ 962,500
TVE	1-5	$ 2,968,000	$ 6,361,250	$ 4,240,000	$ 9,087,500
TVE	6-10	$ -	$ -	$ -	$ -
TVE	11-15	$ 2,282,000	$ 4,889,500	$ 3,260,000	$ 6,985,000
TVE	N/A	$ 344,375	$ 738,625	$ 5,360,000	$ 11,487,500
TVE	Total	$ 5,751,000	$ 12,326,250	$ 13,307,500	$ 28,522,500
ES	Overdue	$ -	$ -	$ -	$ -
ES	1-5	$ 54,250	$ 115,500	$ 155,000	$ 330,000
ES	6-10	$ 1,277,500	$ 2,738,750	$ 1,825,000	$ 3,912,500
ES	11-15	$ -	$ -	$ -	$ -
ES	N/A	$ 73,750	$ 157,375	$ 2,482,500	$ 5,315,000
ES	Total	$ 1,405,500	$ 3,011,625	$ 4,462,500	$ 9,557,500
TPL	Overdue	$ 1,437,625	$ 3,078,250	$ 2,280,000	$ 4,882,500
TPL	1-5	$ -	$ -	$ -	$ -
TPL	6-10	$ -	$ -	$ -	$ -
TPL	11-15	$ -	$ -	$ -	$ -
TPL	N/A	$ 73,125	$ 156,250	$ 1,487,500	$ 3,182,500
TPL	Total	$ 1,510,750	$ 3,234,500	$ 3,767,500	$ 8,065,000
	Grand Total	$ 14,614,250	$ 31,313,625	$ 35,430,000	$ 75,915,000

Table 3.1 - Energy Savings Summary

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Date	7/20/2023

A negative eleciticity value below reflects new energy and associated costs that previously were natural gas.
In most cases the net result is a reduction in annual energy costs.

			Electricity		Natural Gas		Water		Sewer		Total
Facility Improvement Measures	Facility	Net Effective Multiplier	kWh	kWh ($)	Therm	Therm ($)	CCF	CCF ($)	CCF	CCF ($)	($)
09.01 Lighting / Lighting Controls	Fire Station 08	100.0%	39,782	$2,644	0	$0	0	$0	0	$0	$2,644
01.01 Convert to Heat Pump Heating	Fire Station 08	100.0%	-24,448	-$2,145	2,607	$4,961	0	$0	0	$0	$2,816
12.01 Convert to Heat Pump Domestic Hot Water	Fire Station 08	100.0%	-5,381	-$472	574	$1,092	0	$0	0	$0	$620
15.01 Convert Gas Cooking to Electric	Fire Station 08	100.0%	-6,951	-$610	593	$1,129	0	$0	0	$0	$519
13.01 Envelope Air Sealing	Fire Station 08	100.0%	0	$0	368	$701	0	$0	0	$0	$701
03.01 Duct Sealing	Fire Station 08	100.0%	1,844	$123	0	$0	0	$0	0	$0	$123
10.01 Solar PV and Storage	Fire Station 08	100.0%	134,428	$7,364	0	$0	0	$0	0	$0	$7,364
18.01 Water Conservation	Fire Station 08	100.0%	0	$0	0	$0	32	$76	32	$251	$327
09.01 Lighting / Lighting Controls	Lighthouse Senior Center	100.0%	11,054	$655	0	$0	0	$0	0	$0	$655
01.01 Convert to Heat Pump Heating	Lighthouse Senior Center	100.0%	-45,264	-$2,667	4,827	$6,169	0	$0	0	$0	$3,502
12.01 Convert to Heat Pump Domestic Hot Water	Lighthouse Senior Center	100.0%	-10,158	-$599	1,083	$1,384	0	$0	0	$0	$786
15.01 Convert Gas Cooking to Electric	Lighthouse Senior Center	100.0%	-7,995	-$471	682	$872	0	$0	0	$0	$401
13.01 Envelope Air Sealing	Lighthouse Senior Center	100.0%	0	$0	288	$368	0	$0	0	$0	$368
10.01 Solar PV and Storage	Lighthouse Senior Center	100.0%	37,785	$2,070	0	$0	0	$0	0	$0	$2,070
18.01 Water Conservation	Lighthouse Senior Center	100.0%	0	$0	0	$0	52	$124	52	$408	$531
05.01 Low-No Cost Measures and BAS	Lighthouse Senior Center	100.0%	23,666	$1,403	0	$0	0	$0	0	$0	$1,403
09.01 Lighting / Lighting Controls	Pantages Theater complex	100.0%	37,478	$2,240	0	$0	0	$0	0	$0	$2,240
01.01 Convert to Heat Pump Heating	Pantages Theater complex	100.0%	-112,563	-$5,630	12,002	$13,021	0	$0	0	$0	$7,391

Table 3.1 - Energy Savings Summary

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Date	7/20/2023

A negative eleciticity value below reflects new energy and associated costs that previously were natural gas.
In most cases the net result is a reduction in annual energy costs.

			Electricity		Natural Gas		Water		Sewer		Total
Facility Improvement Measures	Facility	Net Effective Multiplier	kWh	kWh ($)	Therm	Therm ($)	CCF	CCF ($)	CCF	CCF ($)	($)
13.01 Envelope Air Sealing	Pantages Theater complex	100.0%	0	$0	1,566	$1,699	0	$0	0	$0	$1,699
03.01 Duct Sealing	Pantages Theater complex	100.0%	9,280	$555	0	$0	0	$0	0	$0	$555
18.01 Water Conservation	Pantages Theater complex	100.0%	0	$0	0	$0	39	$93	39	$306	$399
09.01 Lighting / Lighting Controls	Police Headquarters	100.0%	224,462	$12,506	0	$0	0	$0	0	$0	$12,506
01.01 Convert to Heat Pump Heating	Police Headquarters	100.0%	-369,394	-$18,725	39,387	$43,309	0	$0	0	$0	$24,584
12.01 Convert to Heat Pump Domestic Hot Water	Police Headquarters	100.0%	-53,338	-$2,704	5,688	$6,254	0	$0	0	$0	$3,550
13.01 Envelope Air Sealing	Police Headquarters	100.0%	0	$0	1,718	$1,889	0	$0	0	$0	$1,889
13.02 Envelope Upgrades	Police Headquarters	100.0%	21,256	$1,184	0	$0	0	$0	0	$0	$1,184
03.01 Duct Sealing	Police Headquarters	100.0%	33,021	$1,840	0	$0	0	$0	0	$0	$1,840
10.01 Solar PV and Storage	Police Headquarters	100.0%	54,746	$2,999	0	$0	0	$0	0	$0	$2,999
18.01 Water Conservation	Police Headquarters	100.0%	0	$0	0	$0	209	$497	209	$1,639	$2,136
05.01 Low-No Cost Measures and BAS	Police Headquarters	100.0%	191,750	$10,683	0	$0	0	$0	0	$0	$10,683
09.01 Lighting / Lighting Controls	Tacoma Convention Center	100.0%	171,164	$8,172	0	$0	0	$0	0	$0	$8,172
01.01 Convert to Heat Pump Heating	Tacoma Convention Center	100.0%	-238,715	-$11,103	25,452	$25,678	0	$0	0	$0	$14,576
12.01 Convert to Heat Pump Domestic Hot Water	Tacoma Convention Center	100.0%	-36,101	-$1,679	3,849	$3,883	0	$0	0	$0	$2,204

Table 3.1 - Energy Savings Summary

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Date	7/20/2023

A negative eleciticity value below reflects new energy and associated costs that previously were natural gas.
In most cases the net result is a reduction in annual energy costs.

			Electricity		Natural Gas		Water		Sewer		Total
Facility Improvement Measures	Facility	Net Effective Multiplier	kWh	kWh ($)	Therm	Therm ($)	CCF	CCF ($)	CCF	CCF ($)	($)
15.01 Convert Gas Cooking to Electric	Tacoma Convention Center	100.0%	-40,266	-$1,873	3,434	$3,465	0	$0	0	$0	$1,592
13.01 Envelope Air Sealing	Tacoma Convention Center	100.0%	0	$0	2,862	$2,887	0	$0	0	$0	$2,887
03.01 Duct Sealing	Tacoma Convention Center	100.0%	49,430	$2,360	0	$0	0	$0	0	$0	$2,360
10.01 Solar PV and Storage	Tacoma Convention Center	100.0%	695,887	$38,121	0	$0	0	$0	0	$0	$38,121
18.01 Water Conservation	Tacoma Convention Center	100.0%	0	$0	0	$0	533	$1,268	533	$4,179	$5,447
05.01 Low-No Cost Measures and BAS	Tacoma Convention Center	100.0%	246,601	$11,773	0	$0	0	$0	0	$0	$11,773
09.01 Lighting / Lighting Controls	Tacoma Main Library	100.0%	132,983	$5,804	0	$0	0	$0	0	$0	$5,804
01.01 Convert to Heat Pump Heating	Tacoma Main Library	100.0%	-189,519	-$7,488	20,207	$17,318	0	$0	0	$0	$9,830
13.01 Envelope Air Sealing	Tacoma Main Library	100.0%	0	$0	1,026	$879	0	$0	0	$0	$879
03.01 Duct Sealing	Tacoma Main Library	100.0%	18,477	$806	0	$0	0	$0	0	$0	$806
10.01 Solar PV and Storage	Tacoma Main Library	100.0%	153,049	$8,384	0	$0	0	$0	0	$0	$8,384
18.01 Water Conservation	Tacoma Main Library	100.0%	0	$0	0	$0	51	$121	51	$400	$521
09.01 Lighting / Lighting Controls	Tacoma Municipal Building	100.0%	235,561	$11,593	0	$0	0	$0	0	$0	$11,593
01.01 Convert to Heat Pump Heating	Tacoma Municipal Building	100.0%	442,594	$21,782	0	$0	0	$0	0	$0	$21,782
13.01 Envelope Air Sealing	Tacoma Municipal Building	100.0%	25,439	$1,252	0	$0	0	$0	0	$0	$1,252
03.01 Duct Sealing	Tacoma Municipal Building	100.0%	24,571	$1,209	0	$0	0	$0	0	$0	$1,209
10.01 Solar PV and Storage	Tacoma Municipal Building	100.0%	19,075	$1,045	0	$0	0	$0	0	$0	$1,045
18.01 Water Conservation	Tacoma Municipal Building	100.0%	0	$0	0	$0	1,133	$2,695	1,133	$8,883	$11,578
09.01 Lighting / Lighting Controls	Tacoma Municipal Building North	100.0%	82,174	$3,550	0	$0	0	$0	0	$0	$3,550
01.01 Convert to Heat Pump Heating	Tacoma Municipal Building North	100.0%	134,976	$5,831	159	$149	0	$0	0	$0	$5,980

Table 3.1 - Energy Savings Summary

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Date	7/20/2023

A negative eleciticity value below reflects new energy and associated costs that previously were natural gas.
In most cases the net result is a reduction in annual energy costs.

			Electricity		Natural Gas		Water		Sewer		Total
Facility Improvement Measures	Facility	Net Effective Multiplier	kWh	kWh ($)	Therm	Therm ($)	CCF	CCF ($)	CCF	CCF ($)	($)
12.01 Convert to Heat Pump Domestic Hot Water	Tacoma Municipal Building North	100.0%	5,071	$219	0	$0	0	$0	0	$0	$219
13.01 Envelope Air Sealing	Tacoma Municipal Building North	100.0%	26,943	$1,164	0	$0	0	$0	0	$0	$1,164
03.01 Duct Sealing	Tacoma Municipal Building North	100.0%	16,869	$729	0	$0	0	$0	0	$0	$729
18.01 Water Conservation	Tacoma Municipal Building North	100.0%	0	$0	0	$0	121	$288	121	$949	$1,237
09.01 Lighting / Lighting Controls	Tacoma Solid Waste Admin and Shop	100.0%	89,420	$6,691	0	$0	0	$0	0	$0	$6,691
01.01 Convert to Heat Pump Heating	Tacoma Solid Waste Admin and Shop	100.0%	-125,101	-$4,375	13,339	$10,119	0	$0	0	$0	$5,744
12.01 Convert to Heat Pump Domestic Hot Water	Tacoma Solid Waste Admin and Shop	100.0%	-25,900	-$906	2,762	$2,095	0	$0	0	$0	$1,189
13.01 Envelope Air Sealing	Tacoma Solid Waste Admin and Shop	100.0%	0	$0	1,974	$1,497	0	$0	0	$0	$1,497
03.01 Duct Sealing	Tacoma Solid Waste Admin and Shop	100.0%	5,512	$412	0	$0	0	$0	0	$0	$412
10.01 Solar PV and Storage	Tacoma Solid Waste Admin and Shop	100.0%	481,237	$26,362	0	$0	0	$0	0	$0	$26,362
18.01 Water Conservation	Tacoma Solid Waste Admin and Shop	100.0%	0	$0	0	$0	90	$214	90	$706	$920
05.01 Low-No Cost Measures and BAS	Tacoma Solid Waste Admin and Shop	100.0%	20,164	$1,509	0	$0	0	$0	0	$0	$1,509
		Totals	**2,606,655**	**$143,588**	**146,447**	**$150,820**	**2,260**	**$5,377**	**2,260**	**$17,718**	**$317,503**

Table 3.3 - Base Utility Rates

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Date	7/21/2023

Building_Name	Utility_Provider	Rate_Name	Utility_Type	Dollars_Per_Unit	Units	Published_Date_Effective
Fire Station 08	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Lighthouse Senior Center	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Pantages Theater complex	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Police Headquarters	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Tacoma Convention Center	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Tacoma Main Library	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Tacoma Municipal Building	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Tacoma Municipal Building North	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Tacoma Solid Waste Admin and Shop	City of Tacoma, Washington (Utility Company)	Commercial General Service - Inside City	Water	$2.379000	CCF	1/1/2022
Fire Station 08	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Lighthouse Senior Center	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Pantages Theater complex	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Police Headquarters	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Tacoma Convention Center	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Tacoma Main Library	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Tacoma Municipal Building	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Tacoma Municipal Building North	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Tacoma Solid Waste Admin and Shop	City of Tacoma, Washington (Utility Company)	Commercial Wastewater - Category 1	Sewer	$7.840000	CCF	1/1/2023
Fire Station 08	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Lighthouse Senior Center	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Pantages Theater complex	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Police Headquarters	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Tacoma Convention Center	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Tacoma Main Library	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Tacoma Municipal Building	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Tacoma Municipal Building North	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Tacoma Solid Waste Admin and Shop	Puget Sound Energy (PSE)	Schedule 31 - Commercial General Service	Natural Gas	$1.188260	Therms	1/7/2023
Fire Station 08	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Lighthouse Senior Center	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Pantages Theater complex	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Police Headquarters	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Tacoma Convention Center	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Tacoma Main Library	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Tacoma Municipal Building	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Tacoma Municipal Building North	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023
Tacoma Solid Waste Admin and Shop	Tacoma Public Utilities (TPU)	Schedule G - General Service (energy)	Electricity	$0.054780	kWh	4/1/2023

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50431	Fire Station 08

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: The lighting hasn't been upgraded since the 2003 original construction.

Proposed Upgrades: Upgrade T-8 lighting with flat panel kits. The square footage is 17,400.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	39,782	$2,644
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,644**

Pre-ROM Financials

	Low	High	Notes
First Cost	$62,500	$132,500	
Base Case Cost	$21,875	$46,375	
Annual Utility Savings	$1,851	$3,437	
Carbon Savings (MT CO2e)	0.4	0.4	
Annual Social Cost of Carbon	$36	$36	
Potential Incentives	$6,763	$6,763	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50440	Fire Station 08

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: There are five existing natural gas furnaces paired with cooling only DX cooling split systems. The apparatus bays have natural gas radiant tube heaters.

Proposed Upgrades: Demo five existing indoor DX cooling coils and outdoor condensing units, and replace with with 5 DX indoor heat pump coils, 5 outdoor heat pump units, and new line sets. We evaluated an alternate to serve the 5 DX coils via shared VRF heat pump (with heat recovery) outdoor units rather than via 5 separate outdoor units, and it resulted in a similar cost. Demo the 5 gas duct heaters. Demo 5 high-bay gas radiant heaters and replace with a single 25 ton (10,000 CFM) packaged RTU heat pump. Include a small amount of supply air distribution ductwork and high bay diffusers. Include low wall return. Demo UH-1 (qty. 2) in the basement storage area and replace with a single 4-ton ductless split wall cassette heat pump.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-24,448	($2,145)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	2,607	$4,961
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,816**

Pre-ROM Financials

	Low	High	Notes
First Cost	$907,500	$1,942,500	
Base Case Cost	$635,250	$1,359,750	
Annual Utility Savings	$1,971	$3,661	
Carbon Savings (MT CO2e)	13.6	13.6	
Annual Social Cost of Carbon	$1,237	$1,237	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50449	Fire Station 08

FIM Description 12.01 Convert to Heat Pump Domestic Hot Water

Existing Conditions: There is an existing 100 gal, 200 MBH natural gas fired DHW heater.

Proposed Upgrades: Demo the DHW Heater and replace with a split system CO2 refrigerant heat pump water heater. 285 gal, 60 MBH to reduce electrical load, vs. the existing 100 gal, 200 MBH gas heater. https://www.eco2waterheater.com/product-info

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-5,381	($472)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	574	$1,092
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$620**

Pre-ROM Financials

	Low	High	Notes
First Cost	$165,000	$352,500	
Base Case Cost	$115,500	$246,750	
Annual Utility Savings	$434	$806	
Carbon Savings (MT CO2e)	3.0	3.0	
Annual Social Cost of Carbon	$272	$272	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50458	Fire Station 08

FIM Description	15.01 Convert Gas Cooking to Electric

Existing Conditions: Natural Gas Kitchen Equipment consists of an Oven/Range and a Gas BBQ

Proposed Upgrades: Replace all gas cooking equipment with electric equivalent equipment.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-6,951	($610)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	593	$1,129
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$519**

Pre-ROM Financials

	Low	High	Notes
First Cost	$140,000	$300,000	
Base Case Cost	$98,000	$210,000	
Annual Utility Savings	$363	$675	
Carbon Savings (MT CO2e)	3.1	3.1	
Annual Social Cost of Carbon	$280	$280	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50467	Fire Station 08

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Architectural drawings are saved in the SOW folder. The square footage is 8,777.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	368	$701
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$701**

Pre-ROM Financials

	Low	High	Notes
First Cost	$17,500	$40,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$491	$911	
Carbon Savings (MT CO2e)	2.0	2.0	
Annual Social Cost of Carbon	$178	$178	
Potential Incentives	$2,483	$2,483	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50503	Fire Station 08

FIM Description	03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings are in the SOW folder. The square footage is 17,400.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	1,844	$123
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$123**

Pre-ROM Financials

	Low	High	Notes
First Cost	$70,000	$150,000	
Base Case Cost	$17,500	$37,500	
Annual Utility Savings	$86	$159	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$2	$2	
Potential Incentives	$553	$553	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50512	Fire Station 08

FIM Description	10.01 Solar PV and Storage

Existing Conditions: Current building equipment does not include renewable energy.

Proposed Upgrades: Install a 134 kW-DC / 100 kW-AC, flush-mount solar PV system on the East and West roofs of the building. Interconnect to the grid and set-up for net metering with the utility. Install a 125 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	134,428	$7,364
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$7,364**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,145,000	$2,452,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$5,155	$9,573	
Carbon Savings (MT CO2e)	1.3	1.3	
Annual Social Cost of Carbon	$122	$122	
Potential Incentives	$654,177	$654,177	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50540	Fire Station 08

FIM Description 18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	32	$76
Sewer	CCF	32	$251
Total			**$327**

Pre-ROM Financials

	Low	High	Notes
First Cost	$2,500	$7,500	
Base Case Cost	$875	$2,625	
Annual Utility Savings	$229	$425	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$13	$13	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50437	Lighthouse Senior Center

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: The FCA and COT interview indicate aging T-8 throughout with no lighting controls and exterior not upgraded.

Proposed Upgrades: Retrofit the existing troffers to flat panel LED. Provide standalone motion and daylighting control where appropriate. Upgrade exterior and parking to LED and provide photocell or astronomical timeclock dimming. Square footage: 5,650 basement plus 5,650 main level.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	11,054	$655
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$655**

Pre-ROM Financials

	Low	High	Notes
First Cost	$55,000	$117,500	
Base Case Cost	$19,250	$41,125	
Annual Utility Savings	$459	$852	
Carbon Savings (MT CO2e)	0.1	0.1	
Annual Social Cost of Carbon	$10	$10	
Potential Incentives	$1,879	$1,879	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50446	Lighthouse Senior Center

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: Most of the building is served by heat pumps, but there are still some areas on the lower level that are served by steam convectors served by a natural gas fired (1985, originally fuel oil fired) Birchfield low pressure (15 psig) steam boiler operating at 5 psig supplying original steam distribution piping.

Proposed Upgrades: Install a VRF system or ductless split system heat pumps for the lower floor (wall cassettes) for any spaces that don't already have heat pump fan coil units.

Leave existing steam piping and radiators on this floor (abandon in place.) Demo the boiler to free up much needed storage space for the senior center.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-45,264	($2,667)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	4,827	$6,169
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$3,502**

Pre-ROM Financials

	Low	High	Notes
First Cost	$327,500	$700,000	
Base Case Cost	$229,250	$490,000	
Annual Utility Savings	$2,451	$4,553	
Carbon Savings (MT CO2e)	25.2	25.2	
Annual Social Cost of Carbon	$2,291	$2,291	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50455	Lighthouse Senior Center

FIM Description	12.01 Convert to Heat Pump Domestic Hot Water

Proposed Upgrades: There is a 'newer' (as of 2018 FCA) A.O. Smith 100-gal, 198 MBH natural gas fired water heater. There is also a point-of-use electric DHW heater at stage toilet room.

Proposed Upgrades: Demo and replace the gas DHW Heater with a split system CO2 refrigerant heat pump water. Leave point-of-use electric DHW heater at stage toilet room. New DHW heat to be 285 gal, 60 MBH to reduce electrical load. https://www.eco2waterheater.com/product-info

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-10,158	($599)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	1,083	$1,384
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$786**

Pre-ROM Financials

	Low	High	Notes
First Cost	$167,500	$360,000	
Base Case Cost	$117,250	$252,000	
Annual Utility Savings	$550	$1,021	
Carbon Savings (MT CO2e)	5.6	5.6	
Annual Social Cost of Carbon	$514	$514	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50464	Lighthouse Senior Center

FIM Description	15.01 Convert Gas Cooking to Electric

Existing Conditions: Natural Gas Kitchen Equipment consists of an Oven/Range.

Proposed Upgrades: Replace all gas cooking equipment with electric equivalent equipment.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-7,995	($471)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	682	$872
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$401**

Pre-ROM Financials

	Low	High	Notes
First Cost	$70,000	$150,000	
Base Case Cost	$49,000	$105,000	
Annual Utility Savings	$281	$521	
Carbon Savings (MT CO2e)	3.5	3.5	
Annual Social Cost of Carbon	$322	$322	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50473	Lighthouse Senior Center

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Floor plans are saved in the SOW folder. McK area takeoff in SOW folder = 5,650 basement plus 5,650 main level.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	288	$368
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$368**

Pre-ROM Financials

	Low	High	Notes
First Cost	$7,500	$17,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$258	$479	
Carbon Savings (MT CO2e)	1.5	1.5	
Annual Social Cost of Carbon	$139	$139	
Potential Incentives	$1,943	$1,943	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50518	Lighthouse Senior Center

FIM Description 10.01 Solar PV and Storage

Existing Conditions: Current building equipment does not include renewable energy.

Proposed Upgrades: Install a 38 kW-DC / 25 kW-AC, flush-mount solar PV system on the East and West roofs of the building. Interconnect to the grid and set-up for net metering with the utility. Install a 125 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	37,785	$2,070
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,070**

Pre-ROM Financials

	Low	High	Notes
First Cost	$837,500	$1,792,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$1,449	$2,691	
Carbon Savings (MT CO2e)	0.4	0.4	
Annual Social Cost of Carbon	$34	$34	
Potential Incentives	$477,948	$477,948	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50546	Lighthouse Senior Center

FIM Description	18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	52	$124
Sewer	CCF	52	$408
Total			**$531**

Pre-ROM Financials

	Low	High	Notes
First Cost	$5,000	$12,500	
Base Case Cost	$1,750	$4,375	
Annual Utility Savings	$372	$691	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$22	$22	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50555	Lighthouse Senior Center

FIM Description	05.01 Low-No Cost Measures and BAS

Existing Conditions: For buildings with high energy use, we included Existing Building Commissioning (EBCx.)

Proposed Upgrades: Provide EBCx and BAS (assume steam traps, if any, will go away)

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	23,666	$1,403
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,403**

Pre-ROM Financials

	Low	High	Notes
First Cost	$42,500	$92,500	
Base Case Cost	$14,875	$32,375	
Annual Utility Savings	$982	$1,824	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$22	$22	
Potential Incentives	$5,443	$5,443	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	21-Jul-23

FIM Number	50434	Pantages Theater complex

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: The lighting hasn't been upgraded except for the lobby area. Per COT interviews, the interior (including the stage lighting) and exterior are not LED. Controls are unknown so assume no controls.

Proposed Upgrades: Upgrade T-8 lighting with flat panel kits. The square footage is 12,458 Office + 11,500 Theater Stage +11,500 Finished Basement. Upgrade exterior lighting to LED.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	37,478	$2,240
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,240**

Pre-ROM Financials

	Low	High	Notes
First Cost	$102,500	$217,500	
Base Case Cost	$35,875	$76,125	
Annual Utility Savings	$1,568	$2,912	
Carbon Savings (MT CO2e)	0.4	0.4	
Annual Social Cost of Carbon	$34	$34	
Potential Incentives	$6,371	$6,371	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	21-Jul-23

FIM Number	50443	Pantages Theater complex

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: There are two boilers in the sub basement. One is a steam boiler (B2) serving Jones, and one is a HW boiler (B1) serving Pantages. Note that B1 currently has no redundancy and is a single point of failure for the Pantages Theater and B2 is a single point of failure for the Jones office building. The Jones steam pipe, condensate pipe, and steam traps leak and are in need of replacement, but replacement would be costly and not provide needed cooling to the Jones office building.

Proposed Upgrades: Install 700,000 BTUH of Transom low GWP refrigerant air-water heat pumps on the roof. Route 6" piping through the boiler flue pathway to the sub-basement. Demo B1 (the HW boiler) in the sub-basement. For Jones, install a new Variable Refrigerant Flow System. This measure will decommission the steam system and will provide efficient heating and cooling to this space.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-112,563	($5,630)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	12,002	$13,021
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$7,391**

Pre-ROM Financials

	Low	High	Notes
First Cost	$3,280,000	$7,030,000	
Base Case Cost	$2,296,000	$4,921,000	
Annual Utility Savings	$5,174	$9,609	
Carbon Savings (MT CO2e)	62.6	62.6	
Annual Social Cost of Carbon	$5,697	$5,697	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	21-Jul-23

FIM Number	50470	Pantages Theater complex

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Photos of drawings are saved in the SOW folder. The square footage is 12,458 Office + 11,500 Theater Stage +11,500 Finished Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	1,566	$1,699
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,699**

Pre-ROM Financials

	Low	High	Notes
First Cost	$25,000	$55,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$1,189	$2,209	
Carbon Savings (MT CO2e)	8.3	8.3	
Annual Social Cost of Carbon	$757	$757	
Potential Incentives	$10,558	$10,558	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	21-Jul-23

FIM Number	50506	Pantages Theater complex

FIM Description	03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings are in the SOW folder. The square footage is 12,458 Office + 11,500 Theater Stage +11,500 Finished Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	9,280	$555
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$555**

Pre-ROM Financials

	Low	High	Notes
First Cost	$210,000	$447,500	
Base Case Cost	$52,500	$111,875	
Annual Utility Savings	$388	$721	
Carbon Savings (MT CO2e)	0.1	0.1	
Annual Social Cost of Carbon	$8	$8	
Potential Incentives	$2,784	$2,784	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	21-Jul-23

FIM Number	50543	Pantages Theater complex

FIM Description 18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	39	$93
Sewer	CCF	39	$306
Total			**$399**

Pre-ROM Financials

	Low	High	Notes
First Cost	$17,500	$40,000	
Base Case Cost	$6,125	$14,000	
Annual Utility Savings	$279	$518	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$16	$16	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50432	Police Headquarters

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: 10% of lighting has been upgraded to LED for interior lighting (as TIs are done.) Common areas have LED lighting which is not shown on the asbuilts. The exterior lighting was mostly converted to LED (2011 project) except for the parking. The parking lighting was partially upgraded to LED on some poles.

Proposed Upgrades: Convert all remaining interior and exterior lighting to LED. Includes upgrading the lighting control panel per COT's request.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	224,462	$12,506
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$12,506**

Pre-ROM Financials

	Low	High	Notes
First Cost	$307,500	$657,500	
Base Case Cost	$107,625	$230,125	
Annual Utility Savings	$8,754	$16,257	
Carbon Savings (MT CO2e)	2.2	2.2	
Annual Social Cost of Carbon	$204	$204	
Potential Incentives	$38,159	$38,159	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50441	Police Headquarters

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: There are (2) existing 1 mil BTUH natural gas boilers. These boilers operate 24/7/365 due to faulty Victaulic pipe fittings that leak if the HW is allowed to cool down.

Proposed Upgrades: Demo (2) existing 1 mil BTUH NG Boilers, demo associated piping and NG supply lines, cap off breaching. Replace with 1.5 mil BTUH of heating capacity via Transom air-water low GWP refrigerant heat pumps located outdoors. Match existing pipe sizes. Add alternate included for a 50 ton water-water heat recovery chiller to share heat between the CHW loop and the HW loop. Also includes replacing the Victaulic gaskets to allow OSA heating lockout during warm weather.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-369,394	($18,725)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	39,387	$43,309
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$24,584**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,780,000	$3,815,000	
Base Case Cost	$1,246,000	$2,670,500	
Annual Utility Savings	$17,208	$31,959	
Carbon Savings (MT CO2e)	205.5	205.5	
Annual Social Cost of Carbon	$18,694	$18,694	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50450	Police Headquarters

FIM Description	12.01 Convert to Heat Pump Domestic Hot Water

Existing Conditions: There are 2 existing natural gas fired DHW Heaters at 100 gal, 250 MBH each. There is also an existing auxiliary DHW storage tank.

Proposed Upgrades: Demo the 2 existing DHW Heaters and replace with split system CO2 refrigerant heat pump water heaters. 285 gal, 100 MBH to reduce electrical load to minimize the electrical load. https://www.eco2waterheater.com/product-info The existing DHW storage tank shall remain.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-53,338	($2,704)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	5,688	$6,254
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$3,550**

Pre-ROM Financials

	Low	High	Notes
First Cost	$252,500	$542,500	
Base Case Cost	$176,750	$379,750	
Annual Utility Savings	$2,485	$4,615	
Carbon Savings (MT CO2e)	29.7	29.7	
Annual Social Cost of Carbon	$2,699	$2,699	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50468	Police Headquarters

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Architectural drawings are saved in the SOW folder. All FIMs exclude the fleet warehouse. The square footage is 72,740.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	1,718	$1,889
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,889**

Pre-ROM Financials

	Low	High	Notes
First Cost	$30,000	$62,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$1,323	$2,456	
Carbon Savings (MT CO2e)	9.1	9.1	
Annual Social Cost of Carbon	$830	$830	
Potential Incentives	$11,583	$11,583	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50495	Police Headquarters

FIM Description	13.02 Envelope Upgrades

Existing Conditions: The south facing glass at the atrium is high performance and low SHGF, but the atrium still gets unacceptably hot.

Proposed Upgrades: Add exterior horizontal shading devices.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	21,256	$1,184
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,184**

Pre-ROM Financials

	Low	High	Notes
First Cost	$545,000	$1,167,500	
Base Case Cost	$381,500	$817,250	
Annual Utility Savings	$829	$1,539	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$19	$19	
Potential Incentives	$4,889	$4,889	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50504	Police Headquarters

FIM Description 03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings are in the SOW folder. All FIMs exclude the fleet warehouse. The square footage is 72,740.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	33,021	$1,840
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,840**

Pre-ROM Financials

	Low	High	Notes
First Cost	$307,500	$657,500	
Base Case Cost	$76,875	$164,375	
Annual Utility Savings	$1,288	$2,392	
Carbon Savings (MT CO2e)	0.3	0.3	
Annual Social Cost of Carbon	$30	$30	
Potential Incentives	$9,906	$9,906	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50513	Police Headquarters

FIM Description	10.01 Solar PV and Storage

Existing Conditions: Current building equipment does not include renewable energy.

Proposed Upgrades: Install a 52 kW-DC / 36 kW-AC, fixed-tilt solar PV system on the roofs of the building. Interconnect to the grid and set-up for net metering with the utility. Install a 125 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	54,746	$2,999
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,999**

Pre-ROM Financials

	Low	High	Notes
First Cost	$885,000	$1,900,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$2,099	$3,899	
Carbon Savings (MT CO2e)	0.5	0.5	
Annual Social Cost of Carbon	$50	$50	
Potential Incentives	$506,388	$506,388	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50541	Police Headquarters

FIM Description 18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	209	$497
Sewer	CCF	209	$1,639
Total			**$2,136**

Pre-ROM Financials

	Low	High	Notes
First Cost	$30,000	$65,000	
Base Case Cost	$10,500	$22,750	
Annual Utility Savings	$1,495	$2,777	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$88	$88	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50550	Police Headquarters

FIM Description 05.01 Low-No Cost Measures and BAS

COT has reached out to the McKinstry SPG team for urgent Existing Building Commissioning (EBCx) and Testing Adjusting Balancing (TAB). Therefore, we are excluding from this report.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	191,750	$10,683
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$10,683**

Pre-ROM Financials

	Low	High	Notes
First Cost	$72,500	$155,000	
Base Case Cost	$25,375	$54,250	
Annual Utility Savings	$7,478	$13,888	
Carbon Savings (MT CO2e)	1.9	1.9	
Annual Social Cost of Carbon	$174	$174	
Potential Incentives	$44,102	$44,102	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50433	Tacoma Convention Center

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: COT stated that in November of 2022 they were going to self-perform an LED upgrade for the atrium only. The garages (internal/external) are already LED. McKinstry provided an ESCO Energy Services Proposal (ESP) in the summer of 2022 ESP. The ESP FIM description stated that it would convert a selection of areas in the back of house that function as support areas. These areas include kitchen and food prep areas, support hallways and storage, mechanical and electrical rooms.

Proposed Upgrades: Provide interior and exterior LED lighting upgrades for all areas not previously converted, in the process of being converted, or in the ESP for conversion to LED.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	171,164	$8,172
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$8,172**

Pre-ROM Financials

	Low	High	Notes
First Cost	$282,500	$605,000	
Base Case Cost	$98,875	$211,750	
Annual Utility Savings	$5,720	$10,623	
Carbon Savings (MT CO2e)	1.7	1.7	
Annual Social Cost of Carbon	$156	$156	
Potential Incentives	$29,098	$29,098	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50442	Tacoma Convention Center

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions:: There are two (2) Weil-McClain 5.5M BTU sectional natural gas boilers located on level 4 of 5.

Proposed Upgrades: Demo two (2) Weil-McClain 5.5M BTU sectional gas boilers located on level 4 of 5. Demo associated piping and NG supply lines, cap off breaching. Replace with 5 mil BTUH of heating capacity via Transom air-water low GWP (160 degree HWST capable based on operator interview reset limit) refrigerant heat pumps located outdoors on the low roof. Match existing pipe sizes.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-238,715	($11,103)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	25,452	$25,678
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$14,576**

Pre-ROM Financials

	Low	High	Notes
First Cost	$3,260,000	$6,985,000	
Base Case Cost	$2,282,000	$4,889,500	
Annual Utility Savings	$10,203	$18,948	
Carbon Savings (MT CO2e)	132.8	132.8	
Annual Social Cost of Carbon	$12,080	$12,080	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50451	Tacoma Convention Center

FIM Description 12.01 Convert to Heat Pump Domestic Hot Water

Existing Conditions: There are two (2) Laars domestic hot water boilers located on the 4th floor of five in convention center. Assuming an additional 5 DHW gas fired tank type heaters not shown on the drawings.

Proposed Upgrades: Demo the two existing Two (2) Laars domestic hot water boilers. Replace with split system CO2 refrigerant heat pump water heaters. Qty. (2) 500 gal, 120 MBH to minimizer electrical load. https://www.eco2waterheater.com/product-info Assume the additional 5 DHW gas fired tank type heaters to be replaced similar to the Lighthouse senior center DHW heater FIM.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-36,101	($1,679)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	3,849	$3,883
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,204**

Pre-ROM Financials

	Low	High	Notes
First Cost	$257,500	$552,500	
Base Case Cost	$180,250	$386,750	
Annual Utility Savings	$1,543	$2,865	
Carbon Savings (MT CO2e)	20.1	20.1	
Annual Social Cost of Carbon	$1,827	$1,827	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50460	Tacoma Convention Center

FIM Description 15.01 Convert Gas Cooking to Electric

Existing Conditions: Natural Gas Kitchen Equipment consists of:
Pressure Steamer
Tilting Skillets
Combi-Oven/Steamer
Convection Oven
Upright Broiler
Fryer
Griddle Range
Open Burner Range
Griddle
Fryer

Proposed Upgrades: Replace all gas cooking equipment with electric equivalent equipment.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-40,266	($1,873)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	3,434	$3,465
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,592**

Pre-ROM Financials

	Low	High	Notes
First Cost	$702,500	$1,505,000	
Base Case Cost	$491,750	$1,053,500	
Annual Utility Savings	$1,115	$2,070	
Carbon Savings (MT CO2e)	17.8	17.8	
Annual Social Cost of Carbon	$1,623	$1,623	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50469	Tacoma Convention Center

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Mech and pluming drawings are saved in the SOW folder - we do not have architectural drawings. The square footage is 209,088.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	2,862	$2,887
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,887**

Pre-ROM Financials

	Low	High	Notes
First Cost	$40,000	$85,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$2,021	$3,754	
Carbon Savings (MT CO2e)	15.2	15.2	
Annual Social Cost of Carbon	$1,383	$1,383	
Potential Incentives	$19,293	$19,293	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50505	Tacoma Convention Center

FIM Description 03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings (full mech set) are in the SOW folder. The square footage is 209,088.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	49,430	$2,360
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$2,360**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,027,500	$2,202,500	
Base Case Cost	$256,875	$550,625	
Annual Utility Savings	$1,652	$3,068	
Carbon Savings (MT CO2e)	0.5	0.5	
Annual Social Cost of Carbon	$45	$45	
Potential Incentives	$14,829	$14,829	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50514	Tacoma Convention Center

FIM Description	10.01 Solar PV and Storage

Existing Conditions: Current building equipment does not include renewable energy.

Proposed Upgrades: Install a 723 kW-DC / 540 kW-AC, flush-mount solar PV system on the roof of the building. Interconnect to the grid and set-up with the utility. Install a 375 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	695,887	$38,121
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$38,121**

Pre-ROM Financials

	Low	High	Notes
First Cost	$3,957,500	$8,480,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$26,684	$49,557	
Carbon Savings (MT CO2e)	7.0	7.0	
Annual Social Cost of Carbon	$633	$633	
Potential Incentives	$2,261,085	$2,261,085	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50542	Tacoma Convention Center

FIM Description 18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	533	$1,268
Sewer	CCF	533	$4,179
Total			**$5,447**

Pre-ROM Financials

	Low	High	Notes
First Cost	$45,000	$100,000	
Base Case Cost	$15,750	$35,000	
Annual Utility Savings	$3,813	$7,081	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$224	$224	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50551	Tacoma Convention Center

FIM Description	05.01 Low-No Cost Measures and BAS

Existing Conditions: For buildings with high energy use, we included Existing Building Commissioning (EBCx.)

Proposed Upgrades: Provide EBCx and BAS (assume steam traps, if any, will go away)

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	246,601	$11,773
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$11,773**

Pre-ROM Financials

	Low	High	Notes
First Cost	$100,000	$217,500	
Base Case Cost	$35,000	$76,125	
Annual Utility Savings	$8,241	$15,305	
Carbon Savings (MT CO2e)	2.5	2.5	
Annual Social Cost of Carbon	$224	$224	
Potential Incentives	$56,718	$56,718	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50436	Tacoma Main Library

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: The planned refresh on floors 1 and 2 (mostly main building and a little in Carnegie,) will not include the 400 W indirect Metal Halide 2nd floor upgrade to LED. Finishes mainly, so this FIM will assume lighting isn't part of the refresh. T8 Main direct/indirect for most areas with surface mount in the basement. Some recessed and track lighting. The FCA lists lighting controls as a deficiency with a $200k budget, currently controlled by breakers. No motion sensors (few offices have) and no daylight control. Good daylight potential in some sections. Some glare issues also. For the exterior, there is no parking, and the wall packs are converted to LED already and use photo cells.

Proposed Upgrades: Retrofit the direct/indirect lighting to LED. Use flat panel kits for the surface mount fixtures in the basement. 95,727 Sq. Ft. library use (Basement plus 3 floors and includes Carnegie.)

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	132,983	$5,804
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$5,804**

Pre-ROM Financials

	Low	High	Notes
First Cost	$442,500	$947,500	
Base Case Cost	$154,875	$331,625	
Annual Utility Savings	$4,063	$7,545	
Carbon Savings (MT CO2e)	1.3	1.3	
Annual Social Cost of Carbon	$121	$121	
Potential Incentives	$22,607	$22,607	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50445	Tacoma Main Library

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: There are two natural gas fueled boilers (1.2 mil BTUH each.) There are two chases from the roof to the basement that are suitable for pipe routing.

Proposed Upgrades: Demo the two boilers. Provide a low GWP refrigerant 2 mil BTUH Transom high temperature air-water heat pump on the roof. Use the existing chases to route 6" piping down to the boiler room.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-189,519	($7,488)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	20,207	$17,318
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$9,830**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,827,500	$3,912,500	
Base Case Cost	$1,279,250	$2,738,750	
Annual Utility Savings	$6,881	$12,779	
Carbon Savings (MT CO2e)	105.4	105.4	
Annual Social Cost of Carbon	$9,591	$9,591	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50472	Tacoma Main Library

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Architectural drawings are saved in the SOW folder. The square footage is 95,727.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	1,026	$879
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$879**

Pre-ROM Financials

	Low	High	Notes
First Cost	$15,000	$30,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$616	$1,143	
Carbon Savings (MT CO2e)	5.4	5.4	
Annual Social Cost of Carbon	$496	$496	
Potential Incentives	$6,916	$6,916	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50508	Tacoma Main Library

FIM Description 03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings are in the SOW folder. The square footage is 95,727.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	18,477	$806
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$806**

Pre-ROM Financials

	Low	High	Notes
First Cost	$292,500	$625,000	
Base Case Cost	$73,125	$156,250	
Annual Utility Savings	$564	$1,048	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$17	$17	
Potential Incentives	$5,543	$5,543	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50517	Tacoma Main Library

FIM Description	10.01 Solar PV and Storage

Existing Conditions: Current building equipment does not include renewable energy.

Proposed Upgrades: Install a 144 kW-DC / 100 kW-AC, fixed-tilt solar PV system on the roofs of the building. Interconnect to the grid and set-up for net metering with the utility. Install a 125 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	153,049	$8,384
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$8,384**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,180,000	$2,527,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$5,869	$10,899	
Carbon Savings (MT CO2e)	1.5	1.5	
Annual Social Cost of Carbon	$139	$139	
Potential Incentives	$674,235	$674,235	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50545	Tacoma Main Library

FIM Description	18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	51	$121
Sewer	CCF	51	$400
Total			**$521**

Pre-ROM Financials

	Low	High	Notes
First Cost	$10,000	$22,500	
Base Case Cost	$3,500	$7,875	
Annual Utility Savings	$365	$678	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$21	$21	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50429	Tacoma Municipal Building

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: Permitting department replaced troffers with LEDs, but most TIs leave lights since there's not much ceiling work. Significant LED potential.

Proposed Upgrades: Retrofit existing troffers to flat panel LED. Price based on square footage: Pierce Co Parcel: 147,295 Office + 52,167 Parking + 9,642 Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	235,561	$11,593
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$11,593**

Pre-ROM Financials

	Low	High	Notes
First Cost	$680,000	$1,457,500	
Base Case Cost	$238,000	$510,125	
Annual Utility Savings	$8,115	$15,071	
Carbon Savings (MT CO2e)	2.4	2.4	
Annual Social Cost of Carbon	$214	$214	
Potential Incentives	$40,045	$40,045	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50438	Tacoma Municipal Building

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: This building is already electric resistance, but there is an opportunity for an air-water heat pump to serve the existing water-air heat pumps.

Proposed Upgrades: Install an air-water heat pump (two 60 ton modules) on the roof beside the cooling tower. Pricing includes the crane. Connect the heat pump to the condenser water loop at the cooling tower with 6" outdoor insulated piping, 50 feet supply, 50 feet return, a 360 gpm variable speed circulation pump, and a insulated 4-port 500 gallon buffer tank. Replace dampers in the cooling tower to prevent winter heat loss. Keep the electric steam boiler to serve the few remaining steam loads, and leave the steam-condenser water heat exchanger to allow for backup to the air-water heat pump.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	442,594	$21,782
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$21,782**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,415,000	$3,032,500	
Base Case Cost	$990,500	$2,122,750	
Annual Utility Savings	$15,247	$28,316	
Carbon Savings (MT CO2e)	4.4	4.4	
Annual Social Cost of Carbon	$403	$403	
Potential Incentives	$132,778	$132,778	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50465	Tacoma Municipal Building

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Floor plans are saved in the SOW folder. The square footage is 147,295 Office + 9,642 Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	25,439	$1,252
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,252**

Pre-ROM Financials

	Low	High	Notes
First Cost	$15,000	$35,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$876	$1,628	
Carbon Savings (MT CO2e)	0.3	0.3	
Annual Social Cost of Carbon	$23	$23	
Potential Incentives	$5,851	$5,851	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50501	Tacoma Municipal Building

FIM Description 03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. No sheet metal drawings are available. The square footage is 147,295 Office + 9,642 Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	24,571	$1,209
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,209**

Pre-ROM Financials

	Low	High	Notes
First Cost	$895,000	$1,915,000	
Base Case Cost	$223,750	$478,750	
Annual Utility Savings	$846	$1,572	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$22	$22	
Potential Incentives	$7,371	$7,371	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50510	Tacoma Municipal Building

FIM Description	10.01 Solar PV and Storage

Existing Conditions: Current building equipment does not include renewable energy.

Proposed Upgrades: Install a 27.8 kW-DC / 25 kW-AC, fixed-tilt solar PV system on the roof of the building. Interconnect to the grid and set-up for net metering with the utility. Install a 65 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	19,075	$1,045
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,045**

Pre-ROM Financials

	Low	High	Notes
First Cost	$737,500	$1,580,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$731	$1,358	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$17	$17	
Potential Incentives	$421,539	$421,539	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50538	Tacoma Municipal Building

FIM Description 18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	1,133	$2,695
Sewer	CCF	1,133	$8,883
Total			**$11,578**

Pre-ROM Financials

	Low	High	Notes
First Cost	$45,000	$95,000	
Base Case Cost	$15,750	$33,250	
Annual Utility Savings	$8,105	$15,052	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$476	$476	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50430	Tacoma Municipal Building North

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: The lighting hasn't been upgraded since the 1995 remodel.

Proposed Upgrades: Upgrade T-8 lighting with flat panel kits. The square footage is 34,310 office + 3,431 Finished Basement + 3,431 Unfinished Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	82,174	$3,550
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$3,550**

Pre-ROM Financials

	Low	High	Notes
First Cost	$170,000	$365,000	
Base Case Cost	$59,500	$127,750	
Annual Utility Savings	$2,485	$4,615	
Carbon Savings (MT CO2e)	0.8	0.8	
Annual Social Cost of Carbon	$75	$75	
Potential Incentives	$13,970	$13,970	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50439	Tacoma Municipal Building North

FIM Description	01.01 Convert to Heat Pump Heating

Existing Conditions: There are two electric boilers in the basement (716 MBH heating output each.) There are two gas fired RTUs on the roof.

Proposed Upgrades: Demo one of the two existing electric boilers in the basement. Install a 716,000 BTUH Transom low GWP refrigerant high temperature air-water heat pump on the roof of floor 5. The RTUs are gas fired, so this FIM includes adding HW coils in place of the RTU gas furnaces - note that HW coils in these RTUs was the original 1995 design: 13,200 CFM each with 45 degree entering air temp and 100 degree leaving air temp. The air-water heat pump is sized to meet the RTU load.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	134,976	$5,831
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	159	$149
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$5,980**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,250,000	$2,680,000	
Base Case Cost	$875,000	$1,876,000	
Annual Utility Savings	$4,186	$7,774	
Carbon Savings (MT CO2e)	2.2	2.2	
Annual Social Cost of Carbon	$199	$199	
Potential Incentives	$40,493	$40,493	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50448	Tacoma Municipal Building North

FIM Description	12.01 Convert to Heat Pump Domestic Hot Water

Existing Conditions: Domestic water distribution is copper. The main water entrance is galvanized steel. Three circa 1995 electric tank-type A.O. Smith DHW heaters with recirculation pump(s).

Proposed Upgrades: Replace the 3 electric water heaters with 3 packaged https://www.hotwater.com/water-heaters/commercial/water-heaters/heat-pump/chp-120-fully-integrated-heat-pump/ A.O. Smith heat pump water heaters. Assume reduction in electrical load. Assume that the room has adequate airflow to prevent overcooling of the room by the heat pump water heaters.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	5,071	$219
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$219**

Pre-ROM Financials

	Low	High	Notes
First Cost	$192,500	$410,000	
Base Case Cost	$134,750	$287,000	
Annual Utility Savings	$153	$285	
Carbon Savings (MT CO2e)	0.1	0.1	
Annual Social Cost of Carbon	$5	$5	
Potential Incentives	$1,166	$1,166	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50466	Tacoma Municipal Building North

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Floor plans and architectural drawings are saved in the SOW folder. The square footage is 34,310 office + 3,431 Finished Basement + 3,431 Unfinished Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	26,943	$1,164
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,164**

Pre-ROM Financials

	Low	High	Notes
First Cost	$10,000	$22,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$815	$1,513	
Carbon Savings (MT CO2e)	0.3	0.3	
Annual Social Cost of Carbon	$25	$25	
Potential Incentives	$6,197	$6,197	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50502	Tacoma Municipal Building North

FIM Description	03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them. This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings are in the SOW folder. The square footage is 34,310 Office + 3,431 Finished Basement + 3,431 Unfinished Basement.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	16,869	$729
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$729**

Pre-ROM Financials

	Low	High	Notes
First Cost	$227,500	$485,000	
Base Case Cost	$56,875	$121,250	
Annual Utility Savings	$510	$947	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$15	$15	
Potential Incentives	$5,061	$5,061	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50539	Tacoma Municipal Building North

FIM Description	18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	121	$288
Sewer	CCF	121	$949
Total			**$1,237**

Pre-ROM Financials

	Low	High	Notes
First Cost	$22,500	$50,000	
Base Case Cost	$7,875	$17,500	
Annual Utility Savings	$866	$1,607	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$51	$51	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50435	Tacoma Solid Waste Admin and Shop

FIM Description 09.01 Lighting / Lighting Controls

Existing Conditions: The lighting hasn't been upgraded since the 2011 original construction.

Proposed Upgrades: Upgrade T-8 lighting with flat panel kits. The square footage is 34,232. Upgrade the exterior lighting to LED.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	89,420	$6,691
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$6,691**

Pre-ROM Financials

	Low	High	Notes
First Cost	$150,000	$320,000	
Base Case Cost	$52,500	$112,000	
Annual Utility Savings	$4,683	$8,698	
Carbon Savings (MT CO2e)	0.9	0.9	
Annual Social Cost of Carbon	$81	$81	
Potential Incentives	$15,201	$15,201	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50444	Tacoma Solid Waste Admin and Shop

FIM Description 01.01 Convert to Heat Pump Heating

Existing Conditions: The shop building has a large natural gas burner (650,000 BTUH, 15,000 CFM) designed for 84 degree DAT (assuming existing heat recovery is 50% effective as noted in the existing equipment schedules). The administration building is served by two 0.4 mil BTUH natural gas fired HW boilers.

Proposed Upgrades: For the shop building, demo the gas burner and replace with a 650,000 BTUH, 15,000 CFM DX coil served by 650,000 BTUH of LG (VRF style) low GWP heat pump outdoor units on the roof next to the DX coil, and provide refrigerant piping to the DX coil. For the administration building, demo the two 0.4 mil BTUH gas boilers and replace with 800,000 BTUH capacity of Transom low GWP air-water high temperature heat pumps located at grade and piped to the second floor boiler room via 4" insulated outdoor pipes attached to the building.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-125,101	($4,375)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	13,339	$10,119
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$5,744**

Pre-ROM Financials

	Low	High	Notes
First Cost	$1,537,500	$3,295,000	
Base Case Cost	$1,076,250	$2,306,500	
Annual Utility Savings	$4,021	$7,467	
Carbon Savings (MT CO2e)	69.6	69.6	
Annual Social Cost of Carbon	$6,331	$6,331	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2050

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50453	Tacoma Solid Waste Admin and Shop

FIM Description 12.01 Convert to Heat Pump Domestic Hot Water

Existing Conditions: There are (3) HTP Phoenix condensing natural gas fired HW heaters (119 gal and 199 MBH each) located in room 205.

Proposed Upgrades: Replace the (3) HTP Phoenix condensing gas HW heaters with three split system CO2 refrigerant heat pump water heaters. 285 gal, 60 MBH to minimize electrical load, https://www.eco2waterheater.com/product-info

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	-25,900	($906)
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	2,762	$2,095
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,189**

Pre-ROM Financials

	Low	High	Notes
First Cost	$287,500	$617,500	
Base Case Cost	$201,250	$432,250	
Annual Utility Savings	$832	$1,546	
Carbon Savings (MT CO2e)	14.4	14.4	
Annual Social Cost of Carbon	$1,311	$1,311	
Potential Incentives	$0	$0	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50471	Tacoma Solid Waste Admin and Shop

FIM Description 13.01 Envelope Air Sealing

Existing Conditions: The envelope has not been recently sealed. Air sealing the building envelope is an important step in improving the energy efficiency. It can help to reduce the amount of air leakage, which can lead to drafts, higher energy bills, and decreased comfort. It can also help to reduce the amount of moisture that enters the building, which can lead to mold and other indoor air quality issues.

Proposed Upgrades: Provide spray foam sealing of gaps and cracks, door sweeps, weather stripping, and caulking. This FIM is combined with mech. insulation for subcontractor efficiency. Architectural drawings are saved in the SOW folder. The square footage is 34,232. This is for the administration building only not the maintenance shop.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	1,974	$1,497
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,497**

Pre-ROM Financials

	Low	High	Notes
First Cost	$25,000	$50,000	
Base Case Cost	$0	$0	
Annual Utility Savings	$1,048	$1,946	
Carbon Savings (MT CO2e)	10.5	10.5	
Annual Social Cost of Carbon	$954	$954	
Potential Incentives	$13,304	$13,304	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50507	Tacoma Solid Waste Admin and Shop

FIM Description 03.01 Duct Sealing

Existing Conditions: Studies showing that on average about 10-30% of the air that is delivered through ductwork is lost through leaks.

Proposed Upgrades: Provide Aeroseal duct sealing. Aeroseal is a technology that seals leaks in ductwork, which can save energy by reducing the amount of conditioned air that is lost through leaks. The process involves injecting a sealant into the ductwork, which then attaches to the leaks and hardens, effectively sealing them.This can reduce the amount of energy needed to heat or cool a building, as less air is escaping through leaks and more is being delivered to the intended spaces. Additionally, sealing ductwork leaks can also improve the overall indoor air quality of a building. The sheet metal drawings are in the SOW folder in a huge file. The square footage is 34,232. This is for the administration building only not the maintenance shop.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	5,512	$412
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$412**

Pre-ROM Financials

	Low	High	Notes
First Cost	$225,000	$482,500	
Base Case Cost	$56,250	$120,625	
Annual Utility Savings	$289	$536	
Carbon Savings (MT CO2e)	0.1	0.1	
Annual Social Cost of Carbon	$5	$5	
Potential Incentives	$1,653	$1,653	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50516	Tacoma Solid Waste Admin and Shop

FIM Description 10.01 Solar PV and Storage

Existing Conditions: Current building includes a solar DHW system.

Proposed Upgrades: Install a combined 460 kW-DC / 350 kW-AC solar PV system on the Administrative Building and Transfer Station rooftops. Interconnect to the grid and set-up with the utility. Install a 125 kW-AC, behind-the-meter, Battery Energy Storage System (BESS) and microgrid control system to provide electricity to the building upon grid failure. Provide a turnkey data acquisition system that allows for monitoring and diagnosing of the charging/discharging/operating data of the BESS.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	481,237	$26,362
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$26,362**

Pre-ROM Financials

	Low	High	Notes
First Cost	$2,182,500	$4,677,500	
Base Case Cost	$0	$0	
Annual Utility Savings	$18,454	$34,271	
Carbon Savings (MT CO2e)	4.8	4.8	
Annual Social Cost of Carbon	$438	$438	
Potential Incentives	$1,247,074	$1,247,074	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50544	Tacoma Solid Waste Admin and Shop

FIM Description 18.01 Water Conservation

Existing Conditions: Buildings of this vintage typically have 1.6 GPF toilet flushometers, 1.0 GPF urinal flushometers, and 2.2 gpm lavatory aerators, but we have found in our past projects that most flushometers are not optimized to provide maximum performance and minimum GPF.

Proposed Upgrades: Provide new (0.5 or lower gpm) aerators, 1.5 or 2.0 gpm shower heads, low flow kitchen spray heads, and other recommended items. Upgrade and commission/tune flushometers and tank toilet kits. Excludes irrigation and replacing plumbing fixtures. Toilets and urinals do not save energy directly but indirectly reduce greenhouse gas emissions by reducing water use and associated wastewater treatment energy.

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	0	$0
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	90	$214
Sewer	CCF	90	$706
Total			**$920**

Pre-ROM Financials

	Low	High	Notes
First Cost	$5,000	$10,000	
Base Case Cost	$1,750	$3,500	
Annual Utility Savings	$644	$1,196	
Carbon Savings (MT CO2e)	0.0	0.0	
Annual Social Cost of Carbon	$0	$0	
Potential Incentives	$38	$38	

Other FIM Considerations

Year Selected 2030

FIM Detail Report

Project	City of Tacoma Decarbonization
Scenario	COT MFDS
Company	City of Tacoma
Report Date	7-Jul-23

FIM Number	50553	Tacoma Solid Waste Admin and Shop

FIM Description 05.01 Low-No Cost Measures and BAS

Existing Conditions: For buildings with high energy use, we included Existing Building Commissioning (EBCx.)

Proposed Upgrades: Provide EBCx and BAS (assume steam traps, if any, will go away)

Cost/Benefit

Utility Type	Utility Unit	Quantity Savings (mid-point of ROM)	Dollar Savings (mid-point of ROM)
Electricity	kWh	20,164	$1,509
Electric Demand (to be calculated during IGA)	kW	0	$0
Natural Gas	Therm	0	$0
Water	CCF	0	$0
Sewer	CCF	0	$0
Total			**$1,509**

Pre-ROM Financials

	Low	High	Notes
First Cost	$50,000	$105,000	
Base Case Cost	$17,500	$36,750	
Annual Utility Savings	$1,056	$1,961	
Carbon Savings (MT CO2e)	0.2	0.2	
Annual Social Cost of Carbon	$18	$18	
Potential Incentives	$4,638	$4,638	

Other FIM Considerations

Year Selected 2030

McK8760 - General Information

Fire Station 08

Project Information:

Project Name	City of Tacoma Decabonization	FIM Name	Baseline Model
TCO Project ID		Tech Contact	Sarah Stevens
TCO Tool FIM ID	50440	Date	3/17/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline Model

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	Office
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	Office
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		411	144,818	6,634	0	66.53
	Savings ►					*66.53*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
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	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00

Notes:

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Inputs

Fire Station 08

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	17,400	17,400	TCO
I8	Roof Area		ft^2	10,397	10,397	Drawings
I9	Opaque Wall Area		ft^2	7,417	7,417	Drawings
I10	Glazing Area	***Glazing***	ft^2	1,565	1,565	Drawings
I12	Roof U-Factor	***Roof***	$BTU/ft^2/°F$	0.036	0.036	building codes
I13	Opaque Wall U-Factor	***Walls***	$BTU/ft^2/°F$	0.062	0.036	Drawings/building code
I14	Glazing U-Factor	***Glazing***	$BTU/ft^2/°F$	0.680	0.680	Drawings/building code
I15	Glazing Solar Heat Gain Coefficient (SHGC)	***Glazing***	-	0.650	0.650	estimate
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	estimate
I17	Average Space Height (Floor to Ceiling)		ft	14.0	14.0	drawings/estimate
I18	Infiltration		ach	0.400	0.400	large roll up doors
I19	Peak Number of Occupants		Qty	20	20	estimate
I20	Sensible Heat Gain Per Person		Btu/h	250	250	estimate
I21	Latent Heat Gain Per Person		Btu/h	250	250	estimate
I22	Peak Lighting Load Power Density		W/ft^2	1.000	1.00	estimate-typical
I23	Peak Plug Load Power Density		W/ft^2	0.5000	0.5000	estimate-typical
I24	Peak Exterior Lighting Load		kW	0	0	Document your baseline assumption basis
I25	Peak Miscellaneous Load (Electrical)		Watt	5,000.0	5,000.0	Electric Heaters
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	75.0	75.0	24/7 facility
I28	HVAC Off Cooling Space Temperature Set Point		°F	85.0	85.0	24/7 facility
I29	HVAC On Heating Space Temperature Set Point		°F	72.0	72.0	24/7 facility
I30	HVAC Off Heating Space Temperature Set Point		°F	72.0	72.0	24/7 facility

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	schedule
I35	Occupied Fan Operation		Type	Continuous	Continuous	schedule
I36	Maximum AHU CFM		CFM	7,040	7,040	schedue
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	26.0%	26.0%	schedule
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	Document your baseline assumption basis
I39	Minimum % Outside Air (Occupied)		%	~~26.0%~~	~~20.0%~~	schedule
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	estimate
I41	Economizer High Limit Set Point		°F	65.0	65.0	typical
I42	Economizer Low Limit Set Point		°F	65.0	65.0	typical
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	Yes	Yes	schedule
I44	DCV Airflow Per Person (Based on Space Type)	***DCV Tab***	CFM/Per	7.50	7.50	code
I45	DCV Airflow Per Area (Based on Space Type)	***DCV Tab***	CFM/ft^2	0.12	0.12	code
I46	AHU Fan TSP (At Max CFM)		in w.c.	0.500	0.500	schedule
I47	Fan Efficiency		%	65.0%	65.0%	typical value
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	typical
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	estimate
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	estimate
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	estimate
I52	AHU Cooling Efficiency (EER)		BTU/Watt	15.0	15.0	schedule
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	estimate
I54	AHU Cooling Lockout Below		°F	55.0	55.0	typical value
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	0.90	0.90	schedule
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	0.90	0.90	schedule
I57	AHU Heating Energy Source		Type	Natural Gas	Natural Gas	Document your baseline assumption basis
I58	AHU Heating Lockout Above		°F	65.0	65.0	typical
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	schedule
0.72	Heat Recovery % Effectiveness		%	0.7	0.7	schedule (72%)
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	electric heaters
I66	Zone Heating Lockout Above		°F	60.0	60.0	estimate
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.98	0.98	typical
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	0.98	0.98	typical
I69	Heating Energy Source Zone		Type	Electric	Electric	schedule
I70	Unoccupied Heating Done By		Zone, AHU	AHU Coil	AHU Coil	schedule
I71	SFPMB Terminal Unit Power		W/CFM	0.00	0.00	typical

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description	Units	Baseline	Proposed	Basis
I129	DHW Fuel Type	Type	Natural Gas	Natural Gas	estimate
I130	Energy Factor	-	0.60	0.60	estimate
I131	Working Days Per Year (Used Only For DHW Calc)	Qty	365	365	always occupied
I132	Average Daily Hot Water Consumption Per Person	Gallons	13.0	13.0	typical value
I133	Average Entering Cold Water Temperature	°F	50.0	50.0	typical value
I134	Supply Hot Water Temperature	°F	120.0	120.0	typical value

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Outputs

Baseline Model

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	16	-	15	-	0	2.1%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O10	Fan Peak kW	kW	1	-	1	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	17	-	17	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	0	-	0	-	0	0.0%	-
O13	Plug Load Peak kW	kW	8	-	8	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	4		4	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	40	-	40	-	0	0.2%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	411	-	412	-	-1	-0.3%	-

Electricity

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	10,349	2.03	10,557	2.07	-209	-2.0%	-0.04
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	0	0.00	0	0.00	0	15.3%	0.00
O26	AHU Fans	kWh/Yr	5,578	1.09	5,578	1.09	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	96,535	18.94	96,535	18.94	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	23,716	4.65	23,716	4.65	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	8,640	1.69	8,640	1.69	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	144,818	28.41	145,027	28.45	-209	-0.1%	-0.04

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	4,765	27.39	4,408	25.33	358	7.5%	2.06
O41	Zone Heating	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	919	5.28	919	5.28	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	950	5.46	950	5.46	0	0.0%	0.00
O44	Total	Therm/Yr	6,634	38.13	6,276	36.07	358	5.4%	2.06

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	1,157,655	67	1,122,592	64.52	35,063	3.0%	2.02

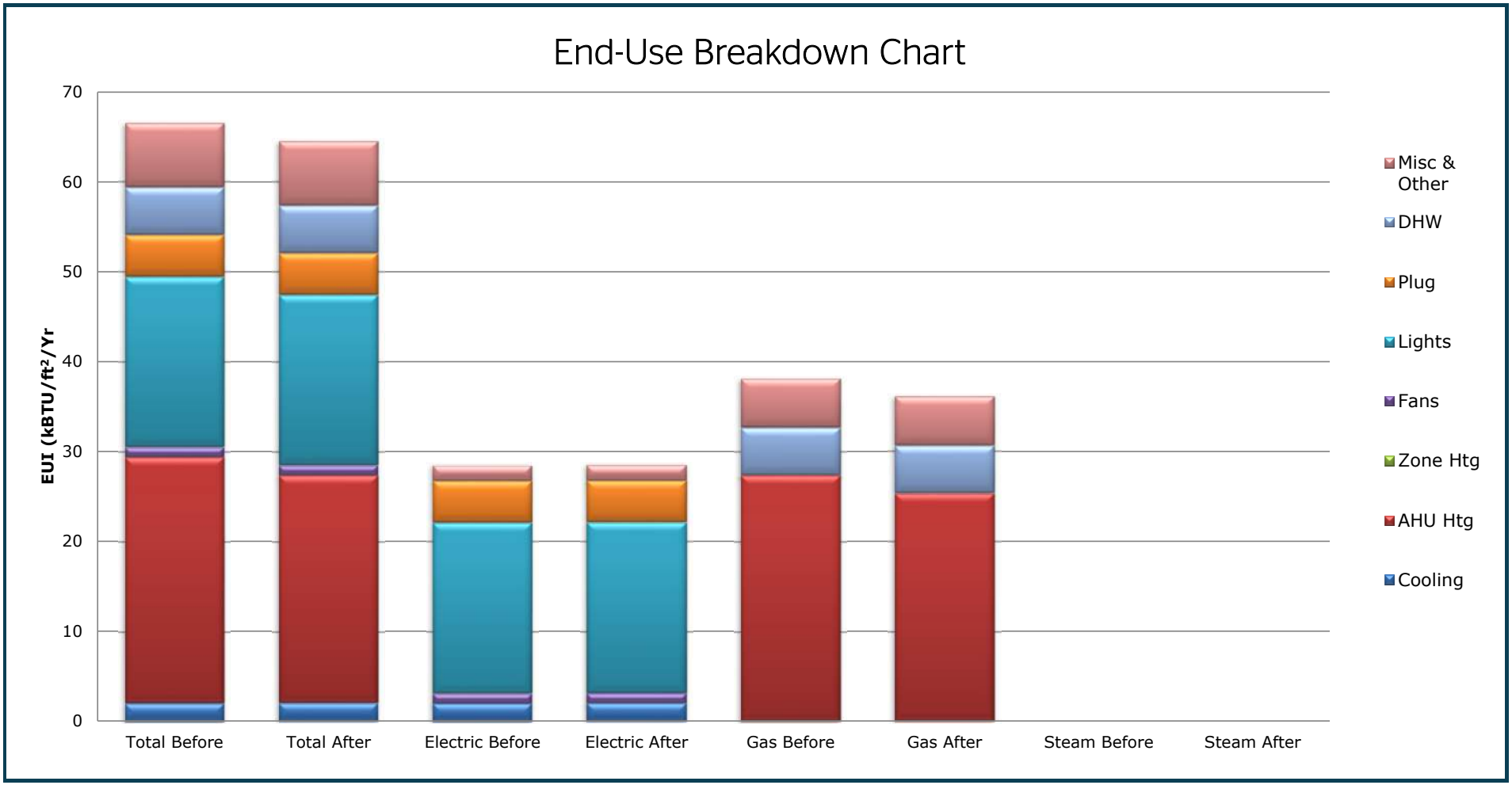
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	2.03	27.39	0.00	1.09	18.94	4.65	5.28	7.15	66.53
Total After	2.07	25.33	0.00	1.09	18.94	4.65	5.28	7.15	64.52
Electric Before	2.03	0.00	0.00	1.09	18.94	4.65	0.00	1.69	28.41
Electric After	2.07	0.00	0.00	1.09	18.94	4.65	0.00	1.69	28.45
Gas Before	0.00	27.39	0.00	0.00	0.00	0.00	5.28	5.46	38.13
Gas After	0.00	25.33	0.00	0.00	0.00	0.00	5.28	5.46	36.07
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		13,880	758		123,177	7.08	10%
Feb		13,013	945		138,905	7.98	12%
Mar		11,107	772		115,061	6.61	10%
Apr		11,867	484		88,919	5.11	8%
May		10,467	328		68,486	3.94	6%
Jun		12,000	227		63,645	3.66	5%
Jul		12,213	251		66,829	3.84	6%
Aug		13,813	293		76,419	4.39	6%
Sep		11,213	336		71,906	4.13	6%
Oct		10,653	475		83,899	4.82	7%
Nov		10,827	802		117,120	6.73	10%
Dec		12,787	1,204		164,054	9.43	14%
Total	0	143,840	6,875	0	1,178,419	67.73	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	30.6	13,662	970	0	143,595	8.25	12%
Feb	34.5	12,403	853	0	127,607	7.33	11%
Mar	29.8	10,822	759	0	112,849	6.49	10%
Apr	35.1	10,958	495	0	86,904	4.99	8%
May	34.3	11,343	378	0	76,518	4.40	7%
Jun	35.5	11,938	246	0	65,318	3.75	6%
Jul	39.7	13,282	154	0	60,749	3.49	5%
Aug	38.4	13,408	145	0	60,312	3.47	5%
Sep	39.5	11,827	348	0	75,148	4.32	6%
Oct	33.2	11,163	548	0	92,932	5.34	8%
Nov	30.3	10,416	789	0	114,415	6.58	10%
Dec	30.2	13,596	949	0	141,307	8.12	12%
Total	411	144,818	6,634	0	1,157,655	66.53	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	30.9	13,663	919	0	138,533	7.96	12%
Feb	34.7	12,408	811	0	123,445	7.09	11%
Mar	30.1	10,827	716	0	108,544	6.24	10%
Apr	35.2	10,976	464	0	83,863	4.82	7%
May	34.3	11,380	354	0	74,288	4.27	7%
Jun	35.6	11,980	231	0	64,014	3.68	6%
Jul	39.6	13,297	146	0	59,939	3.44	5%
Aug	38.4	13,423	138	0	59,571	3.42	5%
Sep	39.3	11,862	333	0	73,779	4.24	7%
Oct	33.3	11,195	521	0	90,269	5.19	8%
Nov	30.5	10,418	744	0	109,988	6.32	10%
Dec	30.4	13,598	900	0	136,360	7.84	12%
Total	412	145,027	6,276	0	1,122,592	64.52	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	-0.2	-2	51	0	5,063	0.29	14%
Feb	-0.2	-5	42	0	4,162	0.24	12%
Mar	-0.3	-5	43	0	4,305	0.25	12%
Apr	-0.1	-18	31	0	3,041	0.17	9%
May	0.0	-37	24	0	2,231	0.13	6%
Jun	-0.1	-42	14	0	1,304	0.07	4%
Jul	0.1	-15	9	0	810	0.05	2%
Aug	0.0	-15	8	0	741	0.04	2%
Sep	0.2	-35	15	0	1,369	0.08	4%
Oct	-0.1	-32	28	0	2,663	0.15	8%
Nov	-0.2	-2	44	0	4,427	0.25	13%
Dec	-0.3	-2	50	0	4,947	0.28	14%
Total	-1	-209	358	0	35,063	2.02	100%

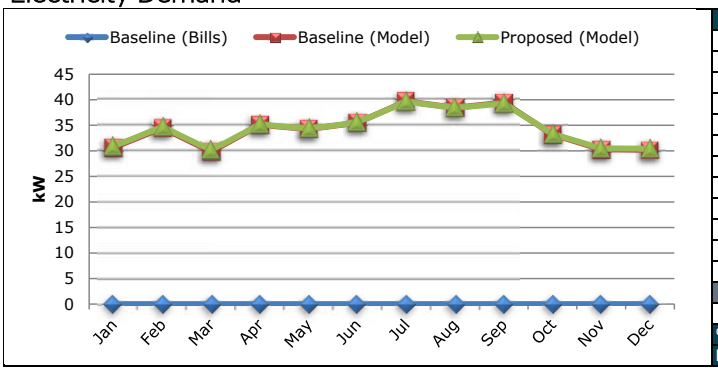
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

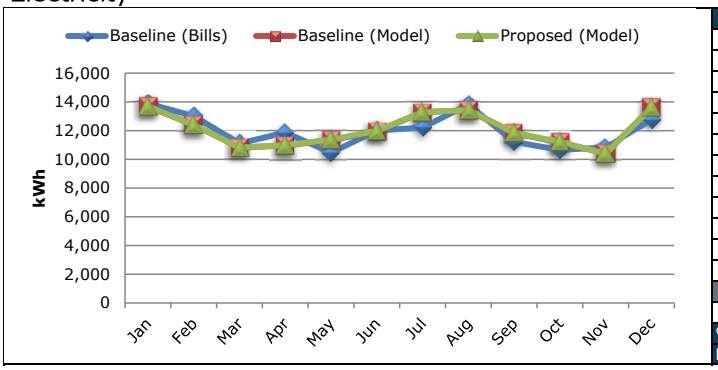
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	31	31
Feb	0	34	35
Mar	0	30	30
Apr	0	35	35
May	0	34	34
Jun	0	36	36
Jul	0	40	40
Aug	0	38	38
Sep	0	39	39
Oct	0	33	33
Nov	0	30	30
Dec	0	30	30
Total	0	411	412

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

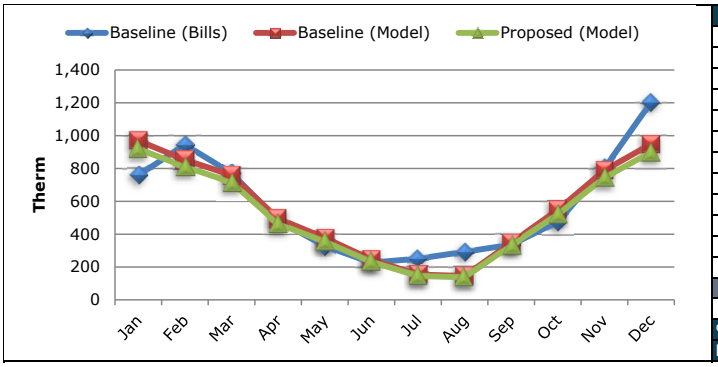
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	13,880	13,662	13,663
Feb	13,013	12,403	12,408
Mar	11,107	10,822	10,827
Apr	11,867	10,958	10,976
May	10,467	11,343	11,380
Jun	12,000	11,938	11,980
Jul	12,213	13,282	13,297
Aug	13,813	13,408	13,423
Sep	11,213	11,827	11,862
Oct	10,653	11,163	11,195
Nov	10,827	10,416	10,418
Dec	12,787	13,596	13,598
Total	143,840	144,818	145,027

% Delta Between Baseline (Bills) & Baseline (Model)	1%
RSQ (Correlation Coefficient)	0.71

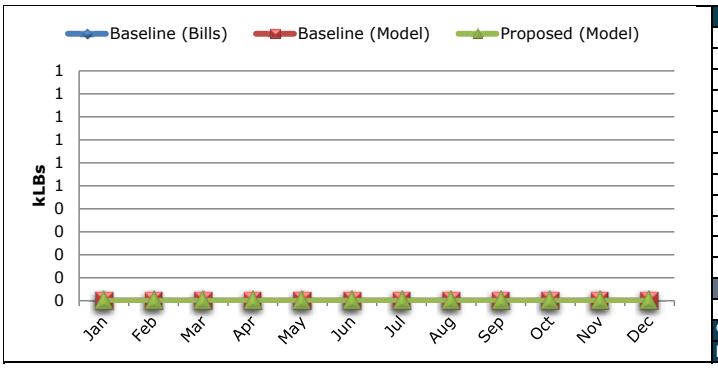
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	758	970	919
Feb	945	853	811
Mar	772	759	716
Apr	484	495	464
May	328	378	354
Jun	227	246	231
Jul	251	154	146
Aug	293	145	138
Sep	336	348	333
Oct	475	548	521
Nov	802	789	744
Dec	1,204	949	900
Total	6,875	6,634	6,276

% Delta Between Baseline (Bills) & Baseline (Model)	-4%
RSQ (Correlation Coefficient)	0.86

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Lighthouse Senior Center

Project Information:

Project Name	City of Tacoma Decarbonization	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50446	Date	3/17/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	School
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		405	113,416	7,400	0	128.42
	Savings ▶					*128.42*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
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	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00

Notes:

McK8760 - Inputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	8,777	8,777	tco
I8	Roof Area		ft^2	5,609	5,609	drawings
I9	Opaque Wall Area		ft^2	5,266	5,266	drawings/estimate
I10	Glazing Area	*Glazing*	ft^2	1,316	1,316	drawings/estimate
I12	Roof U-Factor	*Roof*	$BTU/ft^2/°F$	0.100	0.100	estimate/ no drawings
I13	Opaque Wall U-Factor	*Walls*	$BTU/ft^2/°F$	0.180	0.180	estimate/no drawings
I14	Glazing U-Factor	*Glazing*	$BTU/ft^2/°F$	0.650	0.650	estimate/ no drawings
I15	Glazing Solar Heat Gain Coefficient (SHGC)	*Glazing*	-	0.650	0.650	Document your baseline assumption basis
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	Document your baseline assumption basis
I17	Average Space Height (Floor to Ceiling)		ft	9.0	9.0	estimate
I18	Infiltration		ach	0.250	0.250	Document your baseline assumption basis
I19	Peak Number of Occupants		Qty	50	50	estimate
I20	Sensible Heat Gain Per Person		Btu/h	245	245	typical value
I21	Latent Heat Gain Per Person		Btu/h	155	155	typical value
I22	Peak Lighting Load Power Density		W/ft^2	1.000	1.00	typical value
I23	Peak Plug Load Power Density		W/ft^2	0.3000	0.3000	typical value
I24	Peak Exterior Lighting Load		kW	1	1	Document your baseline assumption basis
I25	Peak Miscellaneous Load (Electrical)		Watt	0.0	0.0	typical value
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	73.0	73.0	
I28	HVAC Off Cooling Space Temperature Set Point		°F	73.0	73.0	
I29	HVAC On Heating Space Temperature Set Point		°F	70.0	70.0	typical-verify
I30	HVAC Off Heating Space Temperature Set Point		°F	60.0	60.0	typical-verify

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	Document your baseline assumption basis
I35	Occupied Fan Operation		Type	Continuous	Continuous	Document your baseline assumption basis
I36	Maximum AHU CFM		CFM	8,703	8,703	drawings
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	typical value
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	typical value
I39	Minimum % Outside Air (Occupied)		%	20.0%	20.0%	typical value
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	typical value
I41	Economizer High Limit Set Point		°F	100.0	100.0	NA
I42	Economizer Low Limit Set Point		°F	100.0	100.0	NA
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	
I44	DCV Airflow Per Person (Based on Space Type)	*DCV Tab*	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	*DCV Tab*	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	0.600	0.600	drawings
I47	Fan Efficiency		%	50.0%	50.0%	typical value
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	Document your baseline assumption basis
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	Document your baseline assumption basis
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	
I52	AHU Cooling Efficiency (EER)		BTU/Watt	7.5	7.5	drawings-derated for age
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	heat pump
I54	AHU Cooling Lockout Below		°F	70.0	70.0	
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	3.60	3.60	drawings-derated for age
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	3.60	3.60	drawings- derated for age
I57	AHU Heating Energy Source		Type	Electric	Electric	schedule
I58	AHU Heating Lockout Above		°F	65.0	65.0	typical value
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	NA
I60	Heat Recovery % Effectiveness		%	0.0	0.0	NA
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	Document your baseline assumption basis
I66	Zone Heating Lockout Above		°F	65.0	65.0	Document your baseline assumption basis
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	1.00	1.00	electric
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	1.00	1.00	electric
I69	Heating Energy Source Zone		Type	Electric	Electric	drawings
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	drawings
I71	SFPMB Terminal Unit Power		W/CFM	0.20	0.20	typical

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I129	DHW Fuel Type		Type	Natural Gas	Natural Gas	Document your baseline assumption basis
I130	Energy Factor		-	0.70	0.70	estimate
I131	Working Days Per Year (Used Only For DHW Calc)		Qty	156	156	schedule-estimate
I132	Average Daily Hot Water Consumption Per Person		Gallons	1.0	1.0	Document your baseline assumption basis
I133	Average Entering Cold Water Temperature		°F	50.0	50.0	Document your baseline assumption basis
I134	Supply Hot Water Temperature		°F	120.0	120.0	Document your baseline assumption basis

McK8760 - Outputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	24	-	24	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	20	-	20	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	38	-	38	-	0	0.0%	-
O10	Fan Peak kW	kW	3	-	3	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	8	-	8	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	1	-	1	-	0	0.0%	-
O13	Plug Load Peak kW	kW	3	-	3	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	0		0	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	42	-	42	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	405	-	405	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	6,296	2.45	6,296	2.45	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	8,315	3.23	8,315	3.23	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	56,300	21.89	56,300	21.89	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	4,610	1.79	4,610	1.79	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	2,787	1.08	2,787	1.08	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	23,926	9.30	23,926	9.30	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	4,380	1.70	4,380	1.70	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	6,801	2.64	6,801	2.64	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	113,416	44.10	113,416	44.10	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	5,502	62.68	5,502	62.68	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	1,165	13.27	1,165	13.27	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	734	8.36	734	8.36	0	0.0%	0.00
O44	Total	Therm/Yr	7,400	84.32	7,400	84.32	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	1,127,127	128	1,127,127	128.42	0	0.0%	0.00

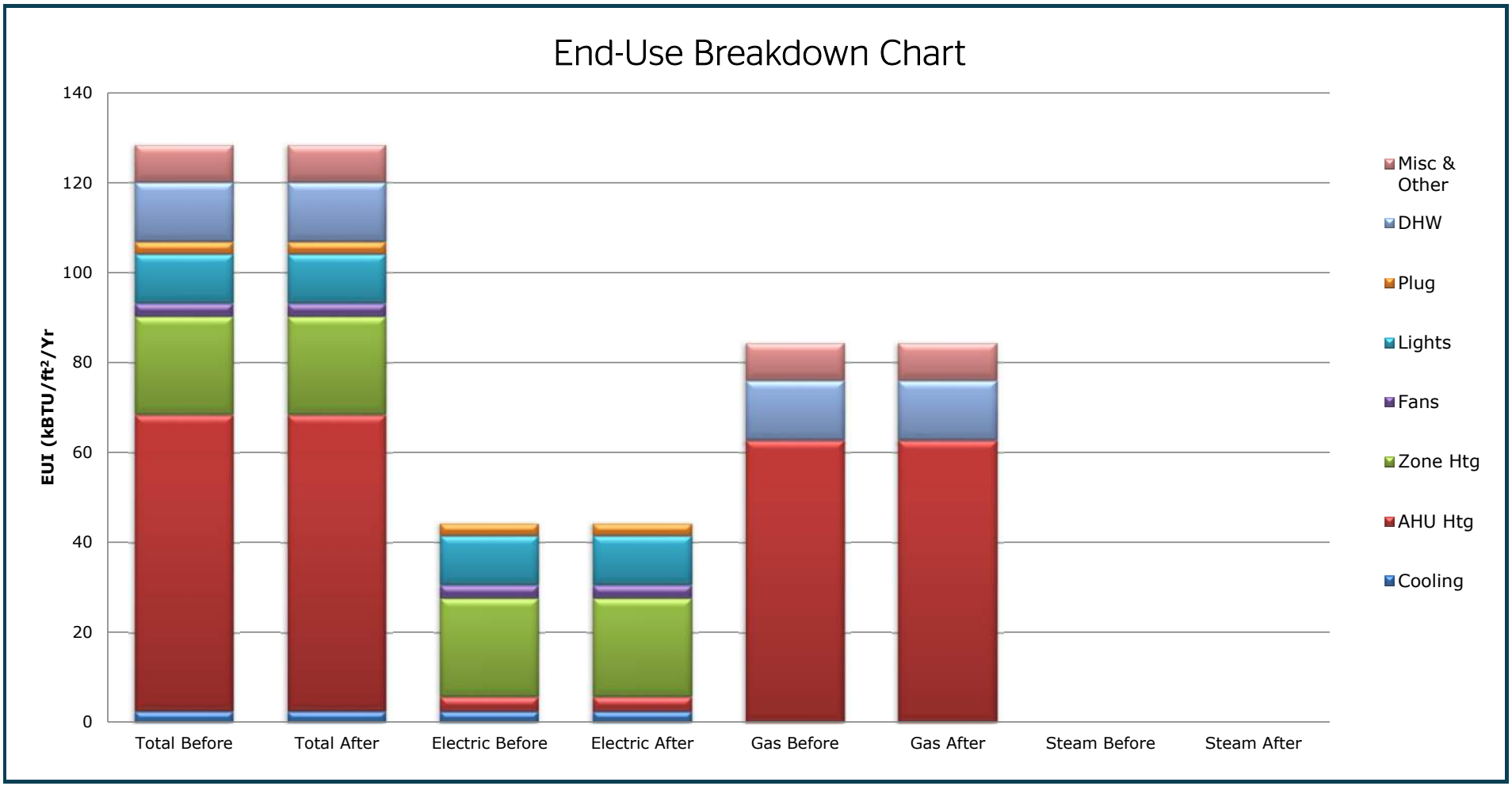
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	2.45	65.92	21.89	2.88	11.01	2.64	13.27	8.36	128.42
Total After	2.45	65.92	21.89	2.88	11.01	2.64	13.27	8.36	128.42
Electric Before	2.45	3.23	21.89	2.88	11.01	2.64	0.00	0.00	44.10
Electric After	2.45	3.23	21.89	2.88	11.01	2.64	0.00	0.00	44.10
Gas Before	0.00	62.68	0.00	0.00	0.00	0.00	13.27	8.36	84.32
Gas After	0.00	62.68	0.00	0.00	0.00	0.00	13.27	8.36	84.32
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		12,213	781		119,822	13.65	11%
Feb		11,347	780		116,696	13.30	10%
Mar		9,773	1,022		135,577	15.45	12%
Apr		7,947	1,114		138,474	15.78	12%
May		6,827	609		84,201	9.59	8%
Jun		7,413	231		48,365	5.51	4%
Jul		6,973	176		41,357	4.71	4%
Aug		7,293	172		42,113	4.80	4%
Sep		6,987	304		54,256	6.18	5%
Oct		9,627	408		73,656	8.39	7%
Nov		11,533	870		126,330	14.39	11%
Dec		14,587	870		136,748	15.58	12%
Total	0	112,520	7,336	0	1,117,596	127.33	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	37.1	13,913	787	0	126,164	14.37	11%
Feb	42.3	11,794	785	0	118,764	13.53	11%
Mar	32.4	12,283	1,028	0	144,684	16.48	13%
Apr	29.5	9,215	1,119	0	143,344	16.33	13%
May	24.4	7,453	614	0	86,879	9.90	8%
Jun	26.2	5,499	236	0	42,370	4.83	4%
Jul	34.6	6,182	181	0	39,195	4.47	3%
Aug	31.2	6,379	178	0	39,533	4.50	4%
Sep	34.2	5,930	310	0	51,190	5.83	5%
Oct	36.8	8,535	413	0	70,470	8.03	6%
Nov	35.3	12,745	875	0	131,004	14.93	12%
Dec	41.2	13,486	875	0	133,532	15.21	12%
Total	405	113,416	7,400	0	1,127,127	128.42	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	37.1	13,913	787	0	126,164	14.37	11%
Feb	42.3	11,794	785	0	118,764	13.53	11%
Mar	32.4	12,283	1,028	0	144,684	16.48	13%
Apr	29.5	9,215	1,119	0	143,344	16.33	13%
May	24.4	7,453	614	0	86,879	9.90	8%
Jun	26.2	5,499	236	0	42,370	4.83	4%
Jul	34.6	6,182	181	0	39,195	4.47	3%
Aug	31.2	6,379	178	0	39,533	4.50	4%
Sep	34.2	5,930	310	0	51,190	5.83	5%
Oct	36.8	8,535	413	0	70,470	8.03	6%
Nov	35.3	12,745	875	0	131,004	14.93	12%
Dec	41.2	13,486	875	0	133,532	15.21	12%
Total	405	113,416	7,400	0	1,127,127	128.42	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

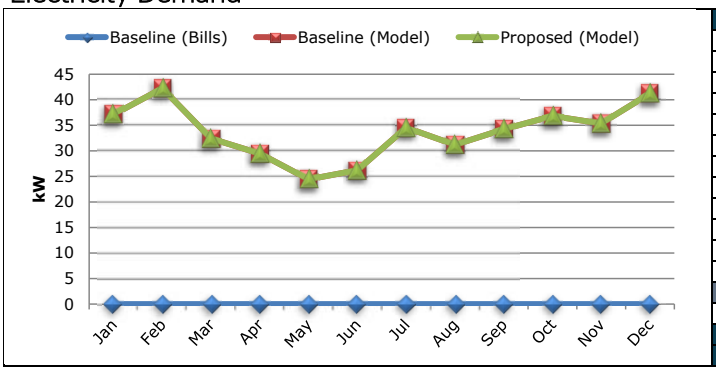
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

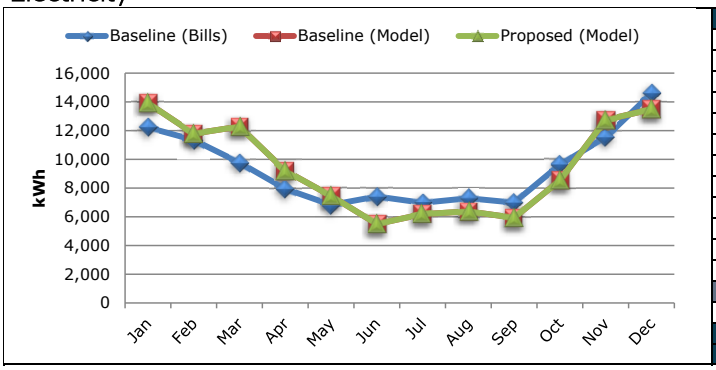
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	37	37
Feb	0	42	42
Mar	0	32	32
Apr	0	29	29
May	0	24	24
Jun	0	26	26
Jul	0	35	35
Aug	0	31	31
Sep	0	34	34
Oct	0	37	37
Nov	0	35	35
Dec	0	41	41
Total	0	405	405

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

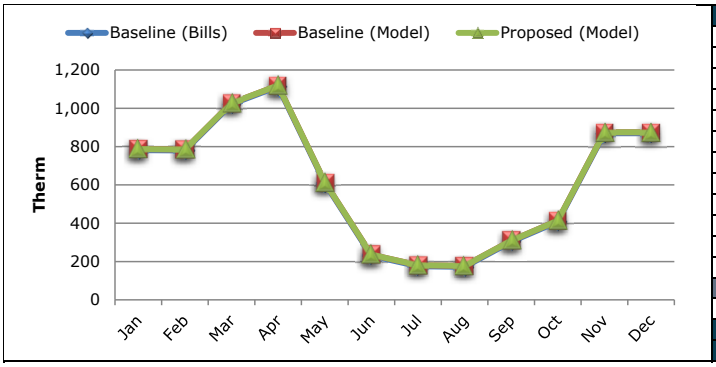
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	12,213	13,913	13,913
Feb	11,347	11,794	11,794
Mar	9,773	12,283	12,283
Apr	7,947	9,215	9,215
May	6,827	7,453	7,453
Jun	7,413	5,499	5,499
Jul	6,973	6,182	6,182
Aug	7,293	6,379	6,379
Sep	6,987	5,930	5,930
Oct	9,627	8,535	8,535
Nov	11,533	12,745	12,745
Dec	14,587	13,486	13,486
Total	112,520	113,416	113,416

% Delta Between Baseline (Bills) & Baseline (Model)	1%
RSQ (Correlation Coefficient)	0.82

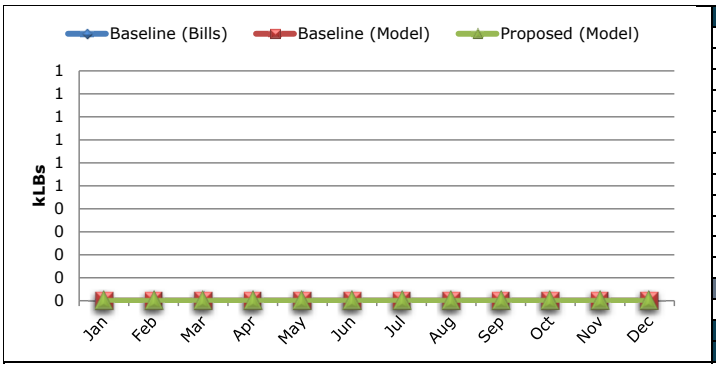
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	781	787	787
Feb	780	785	785
Mar	1,022	1,028	1,028
Apr	1,114	1,119	1,119
May	609	614	614
Jun	231	236	236
Jul	176	181	181
Aug	172	178	178
Sep	304	310	310
Oct	408	413	413
Nov	870	875	875
Dec	870	875	875
Total	7,336	7,400	7,400

% Delta Between Baseline (Bills) & Baseline (Model)	1%
RSQ (Correlation Coefficient)	1.00

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Pantages Theater

Project Information:

Project Name	Tacoma Decarbonization	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50443	Date	3/17/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	Assembly
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	Assembly
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		779	228,733	14,220	0	62.12
	Savings ▶					*62.12*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
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	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00

Notes:

McK8760 - Inputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	35,458	35,458	Tco
I8	Roof Area		ft^2	16,400	16,400	Document your baseline assumption basis
I9	Opaque Wall Area		ft^2	18,832	18,832	estimate
I10	Glazing Area	*Glazing*	ft^2	4,708	4,708	estimate
I12	Roof U-Factor	*Roof*	$BTU/ft^2/°F$	0.040	0.040	estimate/code
I13	Opaque Wall U-Factor	*Walls*	$BTU/ft^2/°F$	0.110	0.110	estimate/code
I14	Glazing U-Factor	*Glazing*	$BTU/ft^2/°F$	0.500	0.500	estimate/code
I15	Glazing Solar Heat Gain Coefficient (SHGC)	*Glazing*	-	0.650	0.650	typical
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	typical
I17	Average Space Height (Floor to Ceiling)		ft	13.0	13.0	estimate
I18	Infiltration		ach	0.220	0.220	typical
I19	Peak Number of Occupants		Qty	1,200	1,200	internet
I20	Sensible Heat Gain Per Person		Btu/h	245	245	typical
I21	Latent Heat Gain Per Person		Btu/h	105	105	typical
I22	Peak Lighting Load Power Density		W/ft^2	0.800	0.80	theater
I23	Peak Plug Load Power Density		W/ft^2	0.1500	0.1500	theater
I24	Peak Exterior Lighting Load		kW	2	2	estimate
I25	Peak Miscellaneous Load (Electrical)		Watt	5,000.0	5,000.0	estimate
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	na
I27	HVAC On Cooling Space Temperature Set Point		°F	78.0	78.0	typical
I28	HVAC Off Cooling Space Temperature Set Point		°F	90.0	90.0	off during unoccupied
I29	HVAC On Heating Space Temperature Set Point		°F	72.0	72.0	
I30	HVAC Off Heating Space Temperature Set Point		°F	65.0	65.0	typical

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	drawings
I35	Occupied Fan Operation		Type	Continuous	Continuous	drawings
I36	Maximum AHU CFM		CFM	44,000	44,000	drawings
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	typical
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	typical
I39	Minimum % Outside Air (Occupied)		%	20.0%	20.0%	typical
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	typical
I41	Economizer High Limit Set Point		°F	65.0	65.0	drawings
I42	Economizer Low Limit Set Point		°F	65.0	65.0	drawings
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	drawings
I44	DCV Airflow Per Person (Based on Space Type)	*DCV Tab*	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	*DCV Tab*	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	2.500	2.500	drawings
I47	Fan Efficiency		%	60.0%	60.0%	typical
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	Document your baseline assumption basis
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	Document your baseline assumption basis
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	Document your baseline assumption basis
I52	AHU Cooling Efficiency (EER)		BTU/Watt	16.0	16.0	schedule/estimate
I53	Evaporative Cooling Effectiveness (Air side)		%	85.0%	85.0%	schedule/estimate
I54	AHU Cooling Lockout Below		°F	50.0	50.0	Document your baseline assumption basis
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	0.80	0.80	typical-drawings
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	0.80	0.80	typical-drawings
I57	AHU Heating Energy Source		Type	Natural Gas	Natural Gas	Document your baseline assumption basis
I58	AHU Heating Lockout Above		°F	60.0	60.0	Document your baseline assumption basis
I59	Evaporative Pre-Cooling on Condenser		Yes/No	Yes	Yes	schedule
I60	Heat Recovery % Effectiveness		%	0.0	0.0	NA
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	drawings
I66	Zone Heating Lockout Above		°F	70.0	70.0	Document your baseline assumption basis
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.75	0.75	estimate-typical
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	0.75	0.75	estimate-typical
I69	Heating Energy Source Zone		Type	Natural Gas	Natural Gas	drawings
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	drawings
I71	SFPMB Terminal Unit Power		W/CFM	0.20	0.20	Document your baseline assumption basis

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description	Units	Baseline	Proposed	Basis
I129	DHW Fuel Type	Type	Natural Gas	Natural Gas	Document your baseline assumption basis
I130	Energy Factor	-	0.70	0.70	typical
I131	Working Days Per Year (Used Only For DHW Calc)	Qty	250	250	Document your baseline assumption basis
I132	Average Daily Hot Water Consumption Per Person	Gallons	0.1	0.1	Document your baseline assumption basis
I133	Average Entering Cold Water Temperature	°F	50.0	50.0	Document your baseline assumption basis
I134	Supply Hot Water Temperature	°F	120.0	120.0	Document your baseline assumption basis

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Outputs

Baseline Model

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	21	-	21	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O10	Fan Peak kW	kW	30	-	30	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	26	-	26	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	2	-	2	-	0	0.0%	-
O13	Plug Load Peak kW	kW	5	-	5	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	5		5	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	73	-	73	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	779	-	779	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	3,190	0.31	3,190	0.31	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	102,936	9.91	102,936	9.91	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	16,521	1.59	16,521	1.59	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	81,795	7.87	81,795	7.87	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	4,950	0.48	4,950	0.48	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	15,336	1.48	15,336	1.48	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	4,005	0.39	4,005	0.39	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	228,733	22.02	228,733	22.02	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	7,639	21.54	7,639	21.54	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	4,749	13.39	4,749	13.39	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	1,832	5.17	1,832	5.17	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O44	Total	Therm/Yr	14,220	40.10	14,220	40.10	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	2,202,626	62	2,202,626	62.12	0	0.0%	0.00

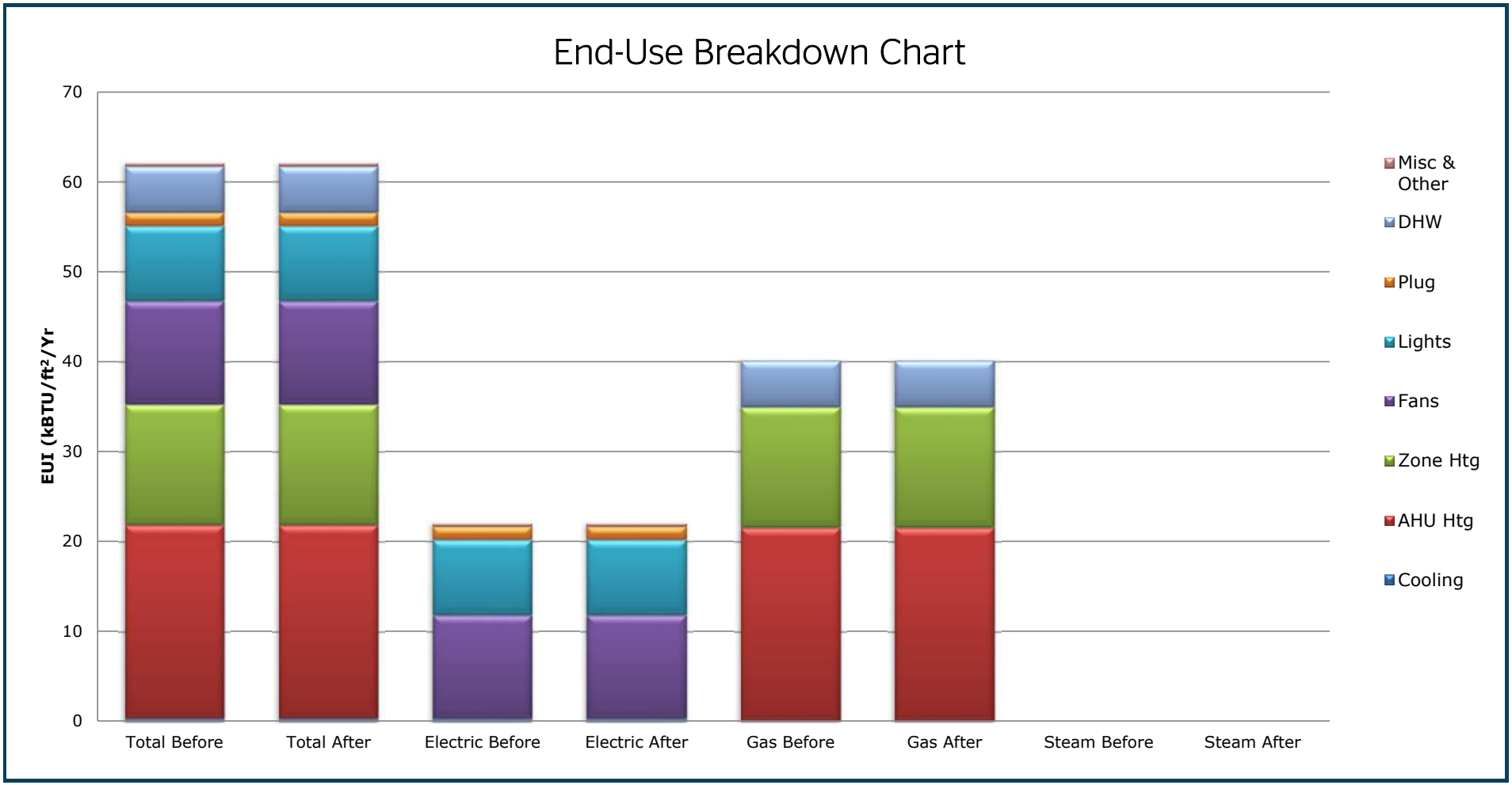
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	0.31	21.54	13.39	11.50	8.35	1.48	5.17	0.39	62.12
Total After	0.31	21.54	13.39	11.50	8.35	1.48	5.17	0.39	62.12
Electric Before	0.31	0.00	0.00	11.50	8.35	1.48	0.00	0.39	22.02
Electric After	0.31	0.00	0.00	11.50	8.35	1.48	0.00	0.39	22.02
Gas Before	0.00	21.54	13.39	0.00	0.00	0.00	5.17	0.00	40.10
Gas After	0.00	21.54	13.39	0.00	0.00	0.00	5.17	0.00	40.10
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

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Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		17,867	3,415		402,493	11.35	15%
Feb		19,467	3,200		386,405	10.90	14%
Mar		20,200	2,613		330,283	9.31	12%
Apr		18,267	1,732		235,547	6.64	9%
May		18,000	523		113,765	3.21	4%
Jun		17,667	179		78,232	2.21	3%
Jul		16,733	116		68,665	1.94	2%
Aug		16,133	43		59,394	1.68	2%
Sep		17,867	208		81,787	2.31	3%
Oct		18,533	1,063		169,577	4.78	6%
Nov		20,600	2,683		338,647	9.55	12%
Dec		19,800	4,223		489,880	13.82	18%
Total	0	221,133	19,999	0	2,754,676	77.69	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	65.2	20,606	2,110	0	281,303	7.93	13%
Feb	65.2	18,536	1,800	0	243,255	6.86	11%
Mar	65.2	20,590	1,816	0	251,917	7.10	11%
Apr	61.3	18,420	1,211	0	183,954	5.19	8%
May	62.7	19,094	916	0	156,732	4.42	7%
Jun	64.3	17,886	437	0	104,715	2.95	5%
Jul	73.1	18,697	205	0	84,336	2.38	4%
Aug	70.8	18,791	172	0	81,297	2.29	4%
Sep	66.6	18,164	473	0	109,250	3.08	5%
Oct	60.8	19,406	1,177	0	183,921	5.19	8%
Nov	60.7	19,206	1,877	0	253,218	7.14	11%
Dec	63.5	19,338	2,027	0	268,730	7.58	12%
Total	779	228,733	14,220	0	2,202,626	62.12	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	65.2	20,606	2,110	0	281,303	7.93	13%
Feb	65.2	18,536	1,800	0	243,255	6.86	11%
Mar	65.2	20,590	1,816	0	251,917	7.10	11%
Apr	61.3	18,420	1,211	0	183,954	5.19	8%
May	62.7	19,094	916	0	156,732	4.42	7%
Jun	64.3	17,886	437	0	104,715	2.95	5%
Jul	73.1	18,697	205	0	84,336	2.38	4%
Aug	70.8	18,791	172	0	81,297	2.29	4%
Sep	66.6	18,164	473	0	109,250	3.08	5%
Oct	60.8	19,406	1,177	0	183,921	5.19	8%
Nov	60.7	19,206	1,877	0	253,218	7.14	11%
Dec	63.5	19,338	2,027	0	268,730	7.58	12%
Total	779	228,733	14,220	0	2,202,626	62.12	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

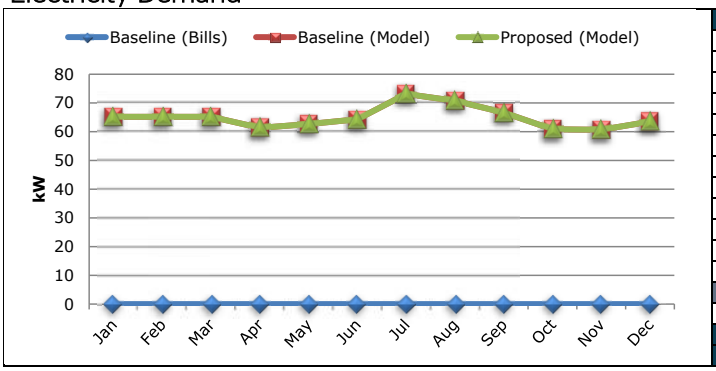
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

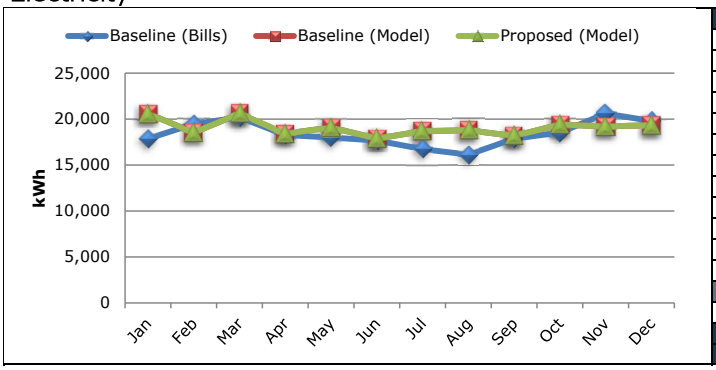
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	65	65
Feb	0	65	65
Mar	0	65	65
Apr	0	61	61
May	0	63	63
Jun	0	64	64
Jul	0	73	73
Aug	0	71	71
Sep	0	67	67
Oct	0	61	61
Nov	0	61	61
Dec	0	63	63
Total	0	779	779

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

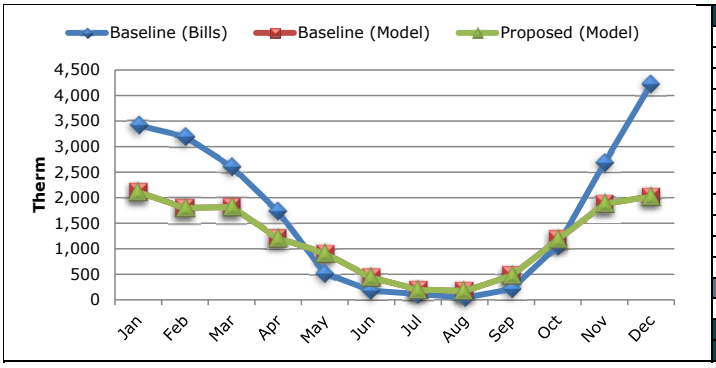
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	17,867	20,606	20,606
Feb	19,467	18,536	18,536
Mar	20,200	20,590	20,590
Apr	18,267	18,420	18,420
May	18,000	19,094	19,094
Jun	17,667	17,886	17,886
Jul	16,733	18,697	18,697
Aug	16,133	18,791	18,791
Sep	17,867	18,164	18,164
Oct	18,533	19,406	19,406
Nov	20,600	19,206	19,206
Dec	19,800	19,338	19,338
Total	221,133	228,733	228,733

% Delta Between Baseline (Bills) & Baseline (Model)	3%
RSQ (Correlation Coefficient)	0.14

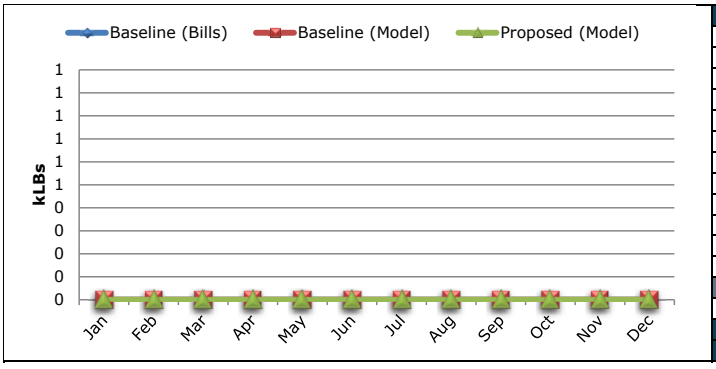
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	3,415	2,110	2,110
Feb	3,200	1,800	1,800
Mar	2,613	1,816	1,816
Apr	1,732	1,211	1,211
May	523	916	916
Jun	179	437	437
Jul	116	205	205
Aug	43	172	172
Sep	208	473	473
Oct	1,063	1,177	1,177
Nov	2,683	1,877	1,877
Dec	4,223	2,027	2,027
Total	19,999	14,220	14,220

% Delta Between Baseline (Bills) & Baseline (Model)	-41%
RSQ (Correlation Coefficient)	0.91

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Police Headquarters

Project Information:

Project Name	Tacom Decarbonization Project	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50441	Date	3/17/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	School
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		2,767	1,165,231	43,299	0	113.79
	Savings ►					*113.79*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
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	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00

Notes:

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Inputs

Baseline Model

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	73,000	73,000	TCO
I8	Roof Area		ft^2	34,420	34,420	Drawings
I9	Opaque Wall Area		ft^2	31,400	31,400	Drawings
I10	Glazing Area	***Glazing***	ft^2	11,143	11,143	Drawings
I12	Roof U-Factor	***Roof***	$BTU/ft^2/°F$	0.035	0.035	notes-sky lights
I13	Opaque Wall U-Factor	***Walls***	$BTU/ft^2/°F$	0.052	0.052	drawings
I14	Glazing U-Factor	***Glazing***	$BTU/ft^2/°F$	0.500	0.500	notes
I15	Glazing Solar Heat Gain Coefficient (SHGC)	***Glazing***	-	0.350	0.350	notes
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	typical
I17	Average Space Height (Floor to Ceiling)		ft	10.0	10.0	drawings
I18	Infiltration		ach	0.300	0.300	typical-estimate
I19	Peak Number of Occupants		Qty	95	95	estimate-confirm
I20	Sensible Heat Gain Per Person		Btu/h	250	250	typical
I21	Latent Heat Gain Per Person		Btu/h	200	200	typical
I22	Peak Lighting Load Power Density		W/ft^2	1.200	1.20	typical value
I23	Peak Plug Load Power Density		W/ft^2	0.7000	0.7000	typical value-extra plug equipemtn
I24	Peak Exterior Lighting Load		kW	2	2	Document your baseline assumption basis
I25	Peak Miscellaneous Load (Electrical)		Watt	800.0	800.0	estimate-electric water heater
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	73.0	73.0	24/7 assumed
I28	HVAC Off Cooling Space Temperature Set Point		°F	80.0	80.0	24/7 assumed
I29	HVAC On Heating Space Temperature Set Point		°F	72.0	72.0	24/7 assumed
I30	HVAC Off Heating Space Temperature Set Point		°F	72.0	72.0	24/7 assumed

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	drawings
I35	Occupied Fan Operation		Type	Continuous	Continuous	drawings
I36	Maximum AHU CFM		CFM	74,810	74,810	schedule
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	typical
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	typical
I39	Minimum % Outside Air (Occupied)		%	20.0%	20.0%	typical
I40	Minimum % Outside Air (Unoccupied)		%	20.0%	20.0%	typical
I41	Economizer High Limit Set Point		°F	55.0	55.0	schedule
I42	Economizer Low Limit Set Point		°F	45.0	45.0	schedule
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	confirm this- controls talks about CO2 sensors but th
I44	DCV Airflow Per Person (Based on Space Type)	***DCV Tab***	CFM/Per	~~5.00~~	~~5.00~~	typical value
I45	DCV Airflow Per Area (Based on Space Type)	***DCV Tab***	CFM/ft^2	~~0.06~~	~~0.06~~	typical value
I46	AHU Fan TSP (At Max CFM)		in w.c.	2.200	2.200	schedule
I47	Fan Efficiency		%	55.0%	55.0%	estimate
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	Document your baseline assumption basis
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~55~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	80	80	typical
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	typical
I52	AHU Cooling Efficiency (EER)		BTU/Watt	8.5	8.5	schedule-derated for age
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	Document your baseline assumption basis
I54	AHU Cooling Lockout Below		°F	50.0	50.0	typical
I55	AHU Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.75	0.75	schedule-derated for age
I56	AHU Heating Efficiency or COP @ OAT ---------->	30.0	COP	0.75	0.75	schedule-derated for age
I57	AHU Heating Energy Source		Type	Natural Gas	Natural Gas	schedule
I58	AHU Heating Lockout Above		°F	80.0	80.0	typical
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	NA
I60	Heat Recovery % Effectiveness		%	0.0	0.0	NA
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	Document your baseline assumption basis
I66	Zone Heating Lockout Above		°F	80.0	80.0	Document your baseline assumption basis
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.60	0.60	typical
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	0.60	0.60	typical
I69	Heating Energy Source Zone		Type	Natural Gas	Natural Gas	schedlue
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	schedule
I71	SFPMB Terminal Unit Power		W/CFM	0.20	0.20	typical

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I129	DHW Fuel Type		Type	Natural Gas	Natural Gas	schedule-does have electric tank as well
I130	Energy Factor		-	0.70	0.70	schedule
I131	Working Days Per Year (Used Only For DHW Calc)		Qty	365	365	Document your baseline assumption basis
I132	Average Daily Hot Water Consumption Per Person		Gallons	16.0	16.0	estimate- locker rooms
I133	Average Entering Cold Water Temperature		°F	50.0	50.0	Document your baseline assumption basis
I134	Supply Hot Water Temperature		°F	130.0	130.0	typical value

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Outputs

Baseline Model

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	146	-	146	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O10	Fan Peak kW	kW	50	-	50	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	83	-	83	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	2	-	2	-	0	0.0%	-
O13	Plug Load Peak kW	kW	49	-	49	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	0		0	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	292	-	292	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	2,767	-	2,767	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	86,470	4.04	86,470	4.04	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	308,247	14.41	308,247	14.41	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	42,761	2.00	42,761	2.00	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	456,571	21.35	456,571	21.35	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	8,760	0.41	8,760	0.41	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	261,019	12.20	261,019	12.20	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	1,402	0.07	1,402	0.07	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	1,165,231	54.48	1,165,231	54.48	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	38,037	52.11	38,037	52.11	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	5,263	7.21	5,263	7.21	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O44	Total	Therm/Yr	43,299	59.31	43,299	59.31	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	8,306,865	114	8,306,865	113.79	0	0.0%	0.00

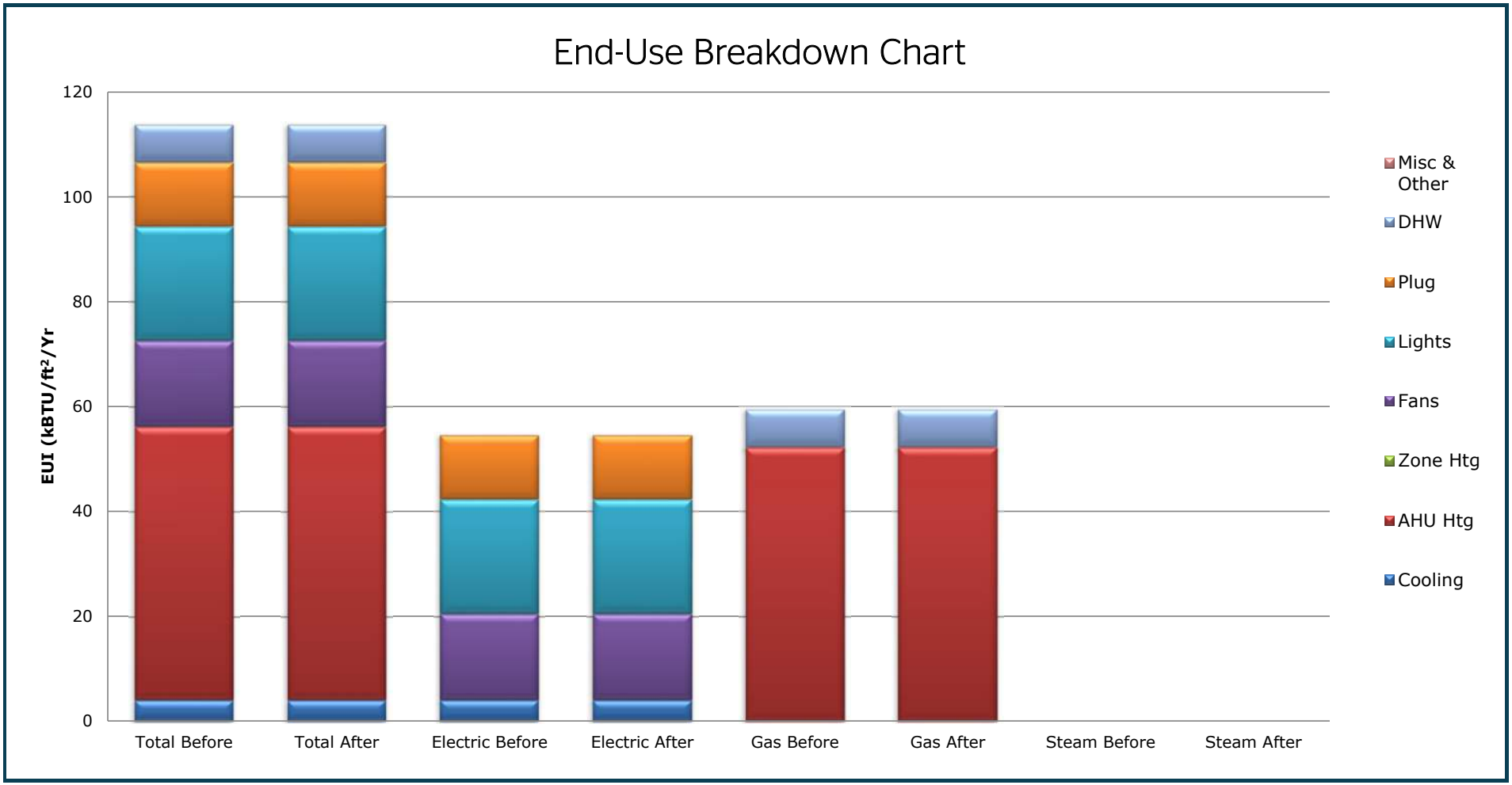
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	4.04	52.11	0.00	16.41	21.76	12.20	7.21	0.07	113.79
Total After	4.04	52.11	0.00	16.41	21.76	12.20	7.21	0.07	113.79
Electric Before	4.04	0.00	0.00	16.41	21.76	12.20	0.00	0.07	54.48
Electric After	4.04	0.00	0.00	16.41	21.76	12.20	0.00	0.07	54.48
Gas Before	0.00	52.11	0.00	0.00	0.00	0.00	7.21	0.00	59.31
Gas After	0.00	52.11	0.00	0.00	0.00	0.00	7.21	0.00	59.31
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		96,480	6,049		934,234	12.80	11%
Feb		86,827	6,326		928,953	12.73	11%
Mar		86,507	5,252		820,438	11.24	9%
Apr		94,320	4,425		764,412	10.47	9%
May		99,733	2,502		590,611	8.09	7%
Jun		100,080	2,428		584,380	8.01	7%
Jul		122,533	1,988		617,030	8.45	7%
Aug		119,253	1,016		508,598	6.97	6%
Sep		124,507	2,252		650,118	8.91	7%
Oct		89,173	3,341		638,482	8.75	7%
Nov		91,147	5,035		814,569	11.16	9%
Dec		99,787	5,034		843,999	11.56	10%
Total	0	1,210,347	45,649	0	8,695,824	119.12	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	182.1	92,533	6,276	0	943,416	12.92	11%
Feb	184.0	84,273	5,308	0	818,418	11.21	10%
Mar	196.0	93,741	5,316	0	851,582	11.67	10%
Apr	248.9	93,492	3,771	0	696,141	9.54	8%
May	232.9	95,531	2,736	0	599,663	8.21	7%
Jun	255.8	100,113	1,563	0	497,974	6.82	6%
Jul	292.0	112,915	856	0	470,968	6.45	6%
Aug	281.4	114,276	786	0	468,648	6.42	6%
Sep	283.6	99,288	1,622	0	501,104	6.86	6%
Oct	233.8	94,652	3,349	0	657,957	9.01	8%
Nov	194.7	91,031	5,572	0	867,846	11.89	10%
Dec	182.1	93,385	6,144	0	933,149	12.78	11%
Total	2,767	1,165,231	43,299	0	8,306,865	113.79	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	182.1	92,533	6,276	0	943,416	12.92	11%
Feb	184.0	84,273	5,308	0	818,418	11.21	10%
Mar	196.0	93,741	5,316	0	851,582	11.67	10%
Apr	248.9	93,492	3,771	0	696,141	9.54	8%
May	232.9	95,531	2,736	0	599,663	8.21	7%
Jun	255.8	100,113	1,563	0	497,974	6.82	6%
Jul	292.0	112,915	856	0	470,968	6.45	6%
Aug	281.4	114,276	786	0	468,648	6.42	6%
Sep	283.6	99,288	1,622	0	501,104	6.86	6%
Oct	233.8	94,652	3,349	0	657,957	9.01	8%
Nov	194.7	91,031	5,572	0	867,846	11.89	10%
Dec	182.1	93,385	6,144	0	933,149	12.78	11%
Total	2,767	1,165,231	43,299	0	8,306,865	113.79	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

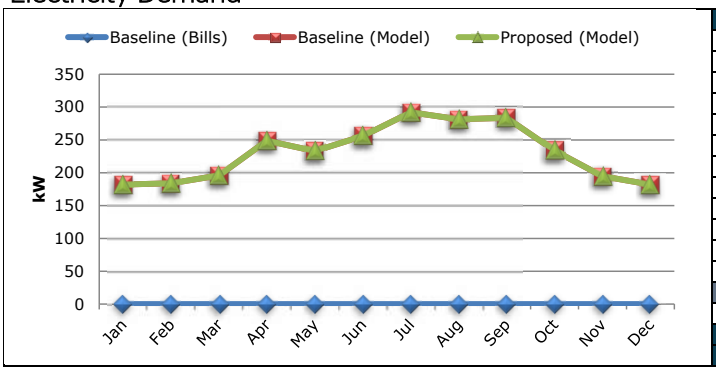
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

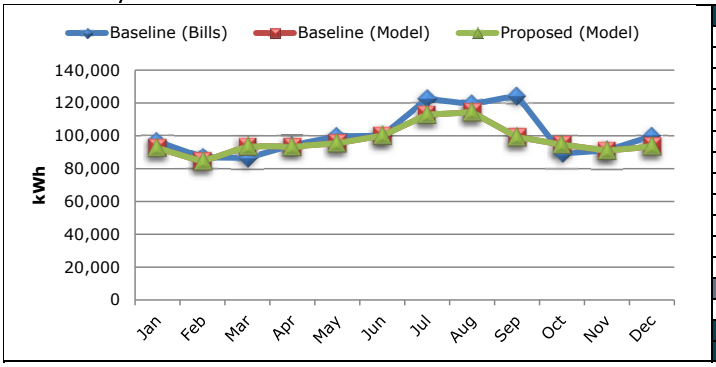
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	182	182
Feb	0	184	184
Mar	0	196	196
Apr	0	249	249
May	0	233	233
Jun	0	256	256
Jul	0	292	292
Aug	0	281	281
Sep	0	284	284
Oct	0	234	234
Nov	0	195	195
Dec	0	182	182
Total	0	2,767	2,767

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

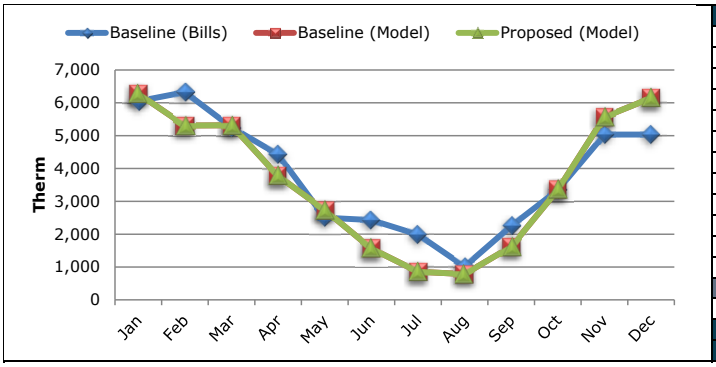
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	96,480	92,533	92,533
Feb	86,827	84,273	84,273
Mar	86,507	93,741	93,741
Apr	94,320	93,492	93,492
May	99,733	95,531	95,531
Jun	100,080	100,113	100,113
Jul	122,533	112,915	112,915
Aug	119,253	114,276	114,276
Sep	124,507	99,288	99,288
Oct	89,173	94,652	94,652
Nov	91,147	91,031	91,031
Dec	99,787	93,385	93,385
Total	1,210,347	1,165,231	1,165,231

% Delta Between Baseline (Bills) & Baseline (Model)	-4%
RSQ (Correlation Coefficient)	0.67

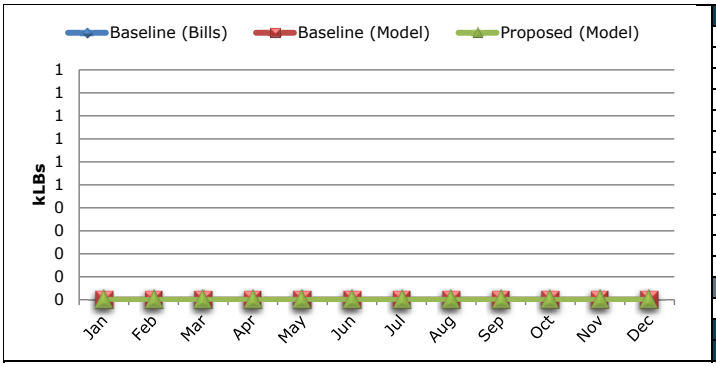
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	6,049	6,276	6,276
Feb	6,326	5,308	5,308
Mar	5,252	5,316	5,316
Apr	4,425	3,771	3,771
May	2,502	2,736	2,736
Jun	2,428	1,563	1,563
Jul	1,988	856	856
Aug	1,016	786	786
Sep	2,252	1,622	1,622
Oct	3,341	3,349	3,349
Nov	5,035	5,572	5,572
Dec	5,034	6,144	6,144
Total	45,649	43,299	43,299

% Delta Between Baseline (Bills) & Baseline (Model)	-5%
RSQ (Correlation Coefficient)	0.90

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Tacoma Municiple Building

Project Information:

Project Name	Tacoma Decarbonization Project	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50442	Date	3/19/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	School
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		7,821	2,383,369	30,225	0	49.05
	Savings ▶					*49.05*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
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	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00

Notes:

McK8760 - Inputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	227,449	227,449	energy star audit
I8	Roof Area		ft^2	85,711	85,711	Google earth
I9	Opaque Wall Area		ft^2	43,280	43,280	estimate-no arch. Drawings
I10	Glazing Area	***Glazing***	ft^2	50,580	50,580	estimate-no arch. Drawings
I12	Roof U-Factor	***Roof***	$BTU/ft^2/°F$	0.036	0.036	estimate-codes
I13	Opaque Wall U-Factor	***Walls***	$BTU/ft^2/°F$	0.062	0.062	estimate-codes
I14	Glazing U-Factor	***Glazing***	$BTU/ft^2/°F$	0.400	0.400	estimate-codes
I15	Glazing Solar Heat Gain Coefficient (SHGC)	***Glazing***	-	0.650	0.650	Document your baseline assumption basis
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	Document your baseline assumption basis
I17	Average Space Height (Floor to Ceiling)		ft	15.0	15.0	estimate-no arch. Drawings
I18	Infiltration		ach	0.169	0.169	typical value
I19	Peak Number of Occupants		Qty	4,500	4,500	largest room capacity
I20	Sensible Heat Gain Per Person		Btu/h	275	275	standing/walking
I21	Latent Heat Gain Per Person		Btu/h	275	275	standing/walking
I22	Peak Lighting Load Power Density		W/ft^2	1.250	1.25	typical convention center
I23	Peak Plug Load Power Density		W/ft^2	0.4000	0.4000	typical convention center
I24	Peak Exterior Lighting Load		kW	3	3	estimate
I25	Peak Miscellaneous Load (Electrical)		Watt	800.0	800.0	Document your baseline assumption basis
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	75.0	75.0	estimate-confirm
I28	HVAC Off Cooling Space Temperature Set Point		°F	85.0	85.0	estimate-confirm
I29	HVAC On Heating Space Temperature Set Point		°F	68.0	68.0	estimate-confirm
I30	HVAC Off Heating Space Temperature Set Point		°F	55.0	55.0	estimate-confirm

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	Document your baseline assumption basis
I35	Occupied Fan Operation		Type	Continuous	Continuous	Document your baseline assumption basis
I36	Maximum AHU CFM		CFM	260,250	260,250	drawings
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	100.0%	100.0%	typical-assumed
I38	Maximum % Outside Air (Economizer % OSA)		%	53.6%	53.6%	schedule
I39	Minimum % Outside Air (Occupied)		%	20.0%	20.0%	typical-assumed
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	typical-assumed
I41	Economizer High Limit Set Point		°F	55.0	55.0	typical-assumed
I42	Economizer Low Limit Set Point		°F	55.0	55.0	typical-assumed
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	schedule
I44	DCV Airflow Per Person (Based on Space Type)	***DCV Tab***	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	***DCV Tab***	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	4.380	4.380	schedule
I47	Fan Efficiency		%	85.0%	85.0%	schedule- derated for age
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	Document your baseline assumption basis
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	80	80	typical-assumed
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	typical-assumed
I52	AHU Cooling Efficiency (EER)		BTU/Watt	10.0	10.0	schedule
I53	Evaporative Cooling Effectiveness (Air side)		%	80.0%	80.0%	estimate-typical value
I54	AHU Cooling Lockout Below		°F	45.0	45.0	typical
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	0.80	0.80	schedule
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	0.80	0.80	schedule
I57	AHU Heating Energy Source		Type	Natural Gas	Natural Gas	schedule
I58	AHU Heating Lockout Above		°F	60.0	60.0	typical
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	Document your baseline assumption basis
I60	Heat Recovery % Effectiveness		%	0.0	0.0	NA
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	schedules
I66	Zone Heating Lockout Above		°F	65.0	65.0	typical
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.90	0.90	NG
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	0.85	0.85	NG
I69	Heating Energy Source Zone		Type	Natural Gas	Natural Gas	schedule
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	Document your baseline assumption basis
I71	SFPMB Terminal Unit Power		W/CFM	0.40	0.40	typical

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I129	DHW Fuel Type		Type	Natural Gas	Natural Gas	schedule
I130	Energy Factor		-	0.80	0.80	Document your baseline assumption basis
I131	Working Days Per Year (Used Only For DHW Calc)		Qty	200	200	estimate
I132	Average Daily Hot Water Consumption Per Person		Gallons	0.5	0.5	convention center
I133	Average Entering Cold Water Temperature		°F	50.0	50.0	Document your baseline assumption basis
I134	Supply Hot Water Temperature		°F	120.0	120.0	Document your baseline assumption basis

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Outputs

Baseline Model

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	359	-	359	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O10	Fan Peak kW	kW	262	-	262	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	270	-	270	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	3	-	3	-	0	0.0%	-
O13	Plug Load Peak kW	kW	86	-	86	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	0		0	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	817	-	817	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	7,821	-	7,821	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	48,288	0.72	48,288	0.72	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	610,634	9.16	610,634	9.16	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	150,967	2.27	150,967	2.27	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	1,193,396	17.91	1,193,396	17.91	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	13,140	0.20	13,140	0.20	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	366,943	5.51	366,943	5.51	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	2,383,369	35.76	2,383,369	35.76	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	9,300	4.09	9,300	4.09	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	14,741	6.48	14,741	6.48	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	3,268	1.44	3,268	1.44	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	2,916	1.28	2,916	1.28	0	0.0%	0.00
O44	Total	Therm/Yr	30,225	13.29	30,225	13.29	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	11,156,909	49	11,156,909	49.05	0	0.0%	0.00

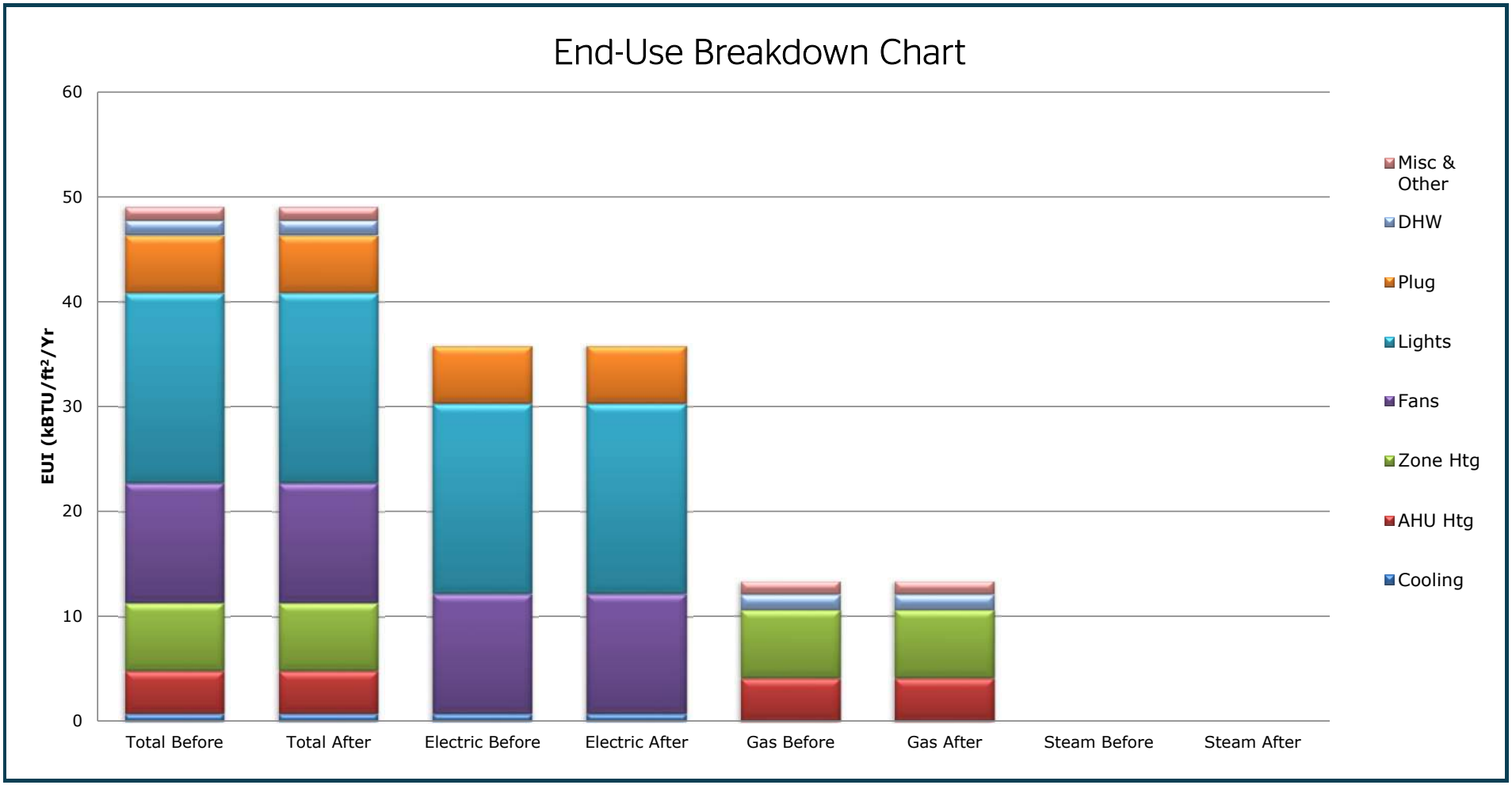
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	0.72	4.09	6.48	11.43	18.10	5.51	1.44	1.28	49.05
Total After	0.72	4.09	6.48	11.43	18.10	5.51	1.44	1.28	49.05
Electric Before	0.72	0.00	0.00	11.43	18.10	5.51	0.00	0.00	35.76
Electric After	0.72	0.00	0.00	11.43	18.10	5.51	0.00	0.00	35.76
Gas Before	0.00	4.09	6.48	0.00	0.00	0.00	1.44	1.28	13.29
Gas After	0.00	4.09	6.48	0.00	0.00	0.00	1.44	1.28	13.29
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		206,347	4,897		1,193,995	5.25	10%
Feb		226,293	5,609		1,333,272	5.86	12%
Mar		223,040	3,982		1,159,402	5.10	10%
Apr		197,333	2,353		908,765	4.00	8%
May		195,307	1,134		779,948	3.43	7%
Jun		177,440	650		670,569	2.95	6%
Jul		203,360	714		765,468	3.37	7%
Aug		202,613	727		764,186	3.36	7%
Sep		197,973	1,126		788,283	3.47	7%
Oct		212,160	2,267		950,769	4.18	8%
Nov		202,507	3,460		1,037,189	4.56	9%
Dec		210,240	3,299		1,047,482	4.61	9%
Total	0	2,454,613	30,217	0	11,399,329	50.12	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	618.3	206,154	5,451	0	1,248,664	5.49	11%
Feb	618.3	185,757	3,992	0	1,033,203	4.54	9%
Mar	618.3	205,188	3,862	0	1,086,479	4.78	10%
Apr	618.3	194,369	2,203	0	883,669	3.89	8%
May	618.3	201,097	1,227	0	809,010	3.56	7%
Jun	618.3	187,593	693	0	709,565	3.12	6%
Jul	817.1	206,563	522	0	757,182	3.33	7%
Aug	749.8	201,127	533	0	739,739	3.25	7%
Sep	689.7	191,117	827	0	734,939	3.23	7%
Oct	618.3	199,670	1,784	0	859,832	3.78	8%
Nov	618.3	198,849	4,014	0	1,080,070	4.75	10%
Dec	618.3	205,885	5,119	0	1,214,557	5.34	11%
Total	7,821	2,383,369	30,225	0	11,156,909	49.05	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	618.3	206,154	5,451	0	1,248,664	5.49	11%
Feb	618.3	185,757	3,992	0	1,033,203	4.54	9%
Mar	618.3	205,188	3,862	0	1,086,479	4.78	10%
Apr	618.3	194,369	2,203	0	883,669	3.89	8%
May	618.3	201,097	1,227	0	809,010	3.56	7%
Jun	618.3	187,593	693	0	709,565	3.12	6%
Jul	817.1	206,563	522	0	757,182	3.33	7%
Aug	749.8	201,127	533	0	739,739	3.25	7%
Sep	689.7	191,117	827	0	734,939	3.23	7%
Oct	618.3	199,670	1,784	0	859,832	3.78	8%
Nov	618.3	198,849	4,014	0	1,080,070	4.75	10%
Dec	618.3	205,885	5,119	0	1,214,557	5.34	11%
Total	7,821	2,383,369	30,225	0	11,156,909	49.05	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

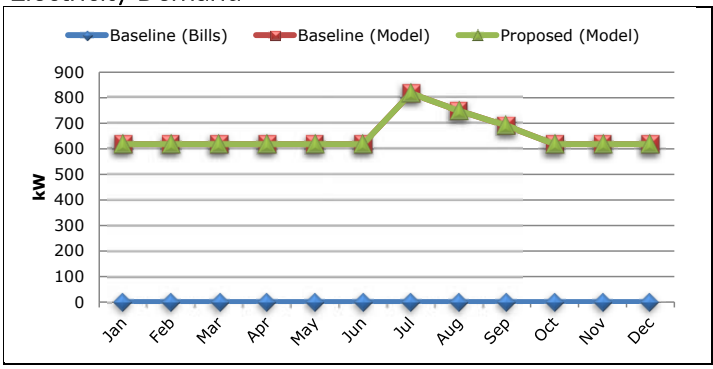
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

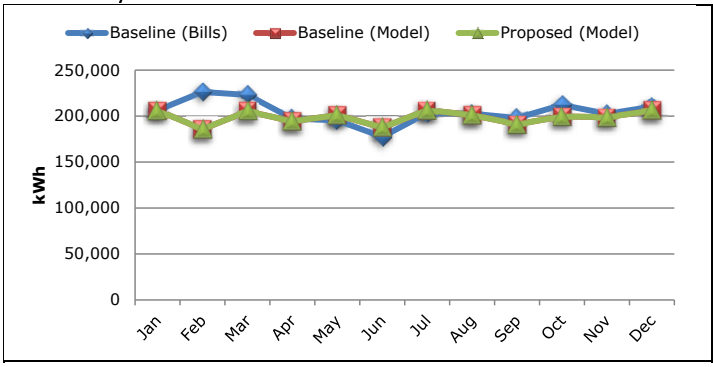
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	618	618
Feb	0	618	618
Mar	0	618	618
Apr	0	618	618
May	0	618	618
Jun	0	618	618
Jul	0	817	817
Aug	0	750	750
Sep	0	690	690
Oct	0	618	618
Nov	0	618	618
Dec	0	618	618
Total	0	7,821	7,821

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

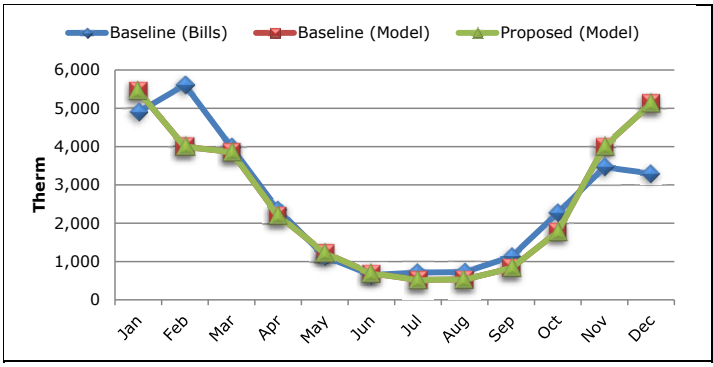
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	206,347	206,154	206,154
Feb	226,293	185,757	185,757
Mar	223,040	205,188	205,188
Apr	197,333	194,369	194,369
May	195,307	201,097	201,097
Jun	177,440	187,593	187,593
Jul	203,360	206,563	206,563
Aug	202,613	201,127	201,127
Sep	197,973	191,117	191,117
Oct	212,160	199,670	199,670
Nov	202,507	198,849	198,849
Dec	210,240	205,885	205,885
Total	2,454,613	2,383,369	2,383,369

% Delta Between Baseline (Bills) & Baseline (Model)	-3%
RSQ (Correlation Coefficient)	0.06

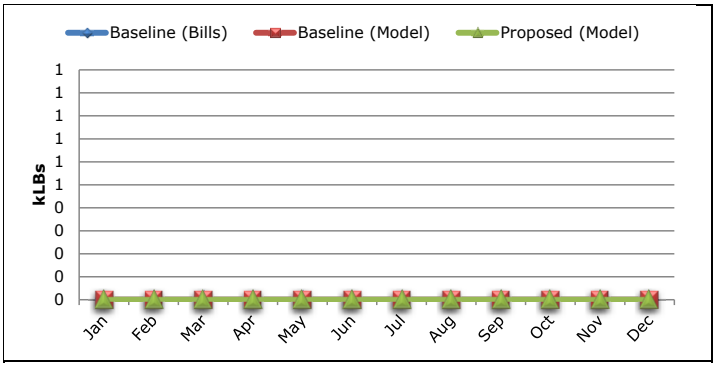
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	4,897	5,451	5,451
Feb	5,609	3,992	3,992
Mar	3,982	3,862	3,862
Apr	2,353	2,203	2,203
May	1,134	1,227	1,227
Jun	650	693	693
Jul	714	522	522
Aug	727	533	533
Sep	1,126	827	827
Oct	2,267	1,784	1,784
Nov	3,460	4,014	4,014
Dec	3,299	5,119	5,119
Total	30,217	30,225	30,225

% Delta Between Baseline (Bills) & Baseline (Model)	0%
RSQ (Correlation Coefficient)	0.82

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Tacoma Main Library

Project Information:

Project Name	Tacoma Decarbonization Project	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50445	Date	3/18/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	School
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		2,971	696,996	15,314	0	40.85
	Savings ►					*40.85*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
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	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00
	Savings ►					*0.00*
	Usage ►					0.00

Notes:

McK8760 - Inputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	95,727	95,727	TCO
I8	Roof Area		ft^2	28,350	28,350	Drawings
I9	Opaque Wall Area		ft^2	24,335	24,335	Drawings
I10	Glazing Area	*Glazing*	ft^2	4,294	4,294	Drawings
I12	Roof U-Factor	*Roof*	$BTU/ft^2/°F$	0.050	0.050	estimate/code
I13	Opaque Wall U-Factor	*Walls*	$BTU/ft^2/°F$	0.140	0.140	drawings/code
I14	Glazing U-Factor	*Glazing*	$BTU/ft^2/°F$	0.750	0.750	estimate/code
I15	Glazing Solar Heat Gain Coefficient (SHGC)	*Glazing*	-	0.650	0.650	typical
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	typical
I17	Average Space Height (Floor to Ceiling)		ft	9.6	9.6	drawings
I18	Infiltration		ach	0.300	0.300	typical
I19	Peak Number of Occupants		Qty	200	200	estimate verify
I20	Sensible Heat Gain Per Person		Btu/h	245	245	typical
I21	Latent Heat Gain Per Person		Btu/h	155	155	typical
I22	Peak Lighting Load Power Density		W/ft^2	1.200	1.20	library
I23	Peak Plug Load Power Density		W/ft^2	0.6000	0.6000	library
I24	Peak Exterior Lighting Load		kW	2	2	typical
I25	Peak Miscellaneous Load (Electrical)		Watt	0.0	0.0	Document your baseline assumption basis
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	75.0	75.0	estimate-verify
I28	HVAC Off Cooling Space Temperature Set Point		°F	85.0	85.0	estimate-verify
I29	HVAC On Heating Space Temperature Set Point		°F	72.0	72.0	schedule
I30	HVAC Off Heating Space Temperature Set Point		°F	65.0	65.0	estimate-verify

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	Document your baseline assumption basis
I35	Occupied Fan Operation		Type	Continuous	Continuous	Document your baseline assumption basis
I36	Maximum AHU CFM		CFM	15,000	15,000	schedule
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	typical
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	typical
I39	Minimum % Outside Air (Occupied)		%	57.0%	57.0%	schedule
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	typical
I41	Economizer High Limit Set Point		°F	65.0	65.0	schedule
I42	Economizer Low Limit Set Point		°F	45.0	45.0	schedule
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	Document your baseline assumption basis
I44	DCV Airflow Per Person (Based on Space Type)	*DCV Tab*	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	*DCV Tab*	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	2.500	2.500	estimate
I47	Fan Efficiency		%	50.0%	50.0%	estimate
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	typical
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	typical
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	typical
I52	AHU Cooling Efficiency (EER)		BTU/Watt	11.3	11.3	schedule-derated for age
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	Document your baseline assumption basis
I54	AHU Cooling Lockout Below		°F	64.0	64.0	schedule
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	0.75	0.75	original 80%, derated for age
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	0.75	0.75	original 80%, derated for age
I57	AHU Heating Energy Source		Type	Natural Gas	Natural Gas	drawings
I58	AHU Heating Lockout Above		°F	70.0	70.0	Document your baseline assumption basis
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	NA
I60	Heat Recovery % Effectiveness		%	0.0	0.0	NA
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	drawings
I66	Zone Heating Lockout Above		°F	70.0	70.0	Document your baseline assumption basis
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.75	0.75	estimate-typical
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	0.75	0.75	estimate-typical
I69	Heating Energy Source Zone		Type	Natural Gas	Natural Gas	drawings
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	drawings
I71	SFPMB Terminal Unit Power		W/CFM	0.40	0.40	Document your baseline assumption basis

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description	Units	Baseline	Proposed	Basis
I129	DHW Fuel Type	Type	Electric	Electric	Document your baseline assumption basis
I130	Energy Factor	-	0.60	0.60	estimate
I131	Working Days Per Year (Used Only For DHW Calc)	Qty	260	260	occupancy schedule
I132	Average Daily Hot Water Consumption Per Person	Gallons	1.0	1.0	typical value
I133	Average Entering Cold Water Temperature	°F	50.0	50.0	Document your baseline assumption basis
I134	Supply Hot Water Temperature	°F	130.0	130.0	Document your baseline assumption basis

McK8760 - Outputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	145	-	145	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O10	Fan Peak kW	kW	15	-	15	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	109	-	109	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	2	-	2	-	0	0.0%	-
O13	Plug Load Peak kW	kW	46	-	46	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	0		0	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	309	-	309	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	2,971	-	2,971	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	103,393	3.69	103,393	3.69	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	54,346	1.94	54,346	1.94	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	16,296	0.58	16,296	0.58	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	353,164	12.59	353,164	12.59	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	8,760	0.31	8,760	0.31	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	144,176	5.14	144,176	5.14	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	16,861	0.60	16,861	0.60	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	696,996	24.85	696,996	24.85	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	4,557	4.76	4,557	4.76	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	10,757	11.24	10,757	11.24	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O44	Total	Therm/Yr	15,314	16.00	15,314	16.00	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	3,910,296	41	3,910,296	40.85	0	0.0%	0.00

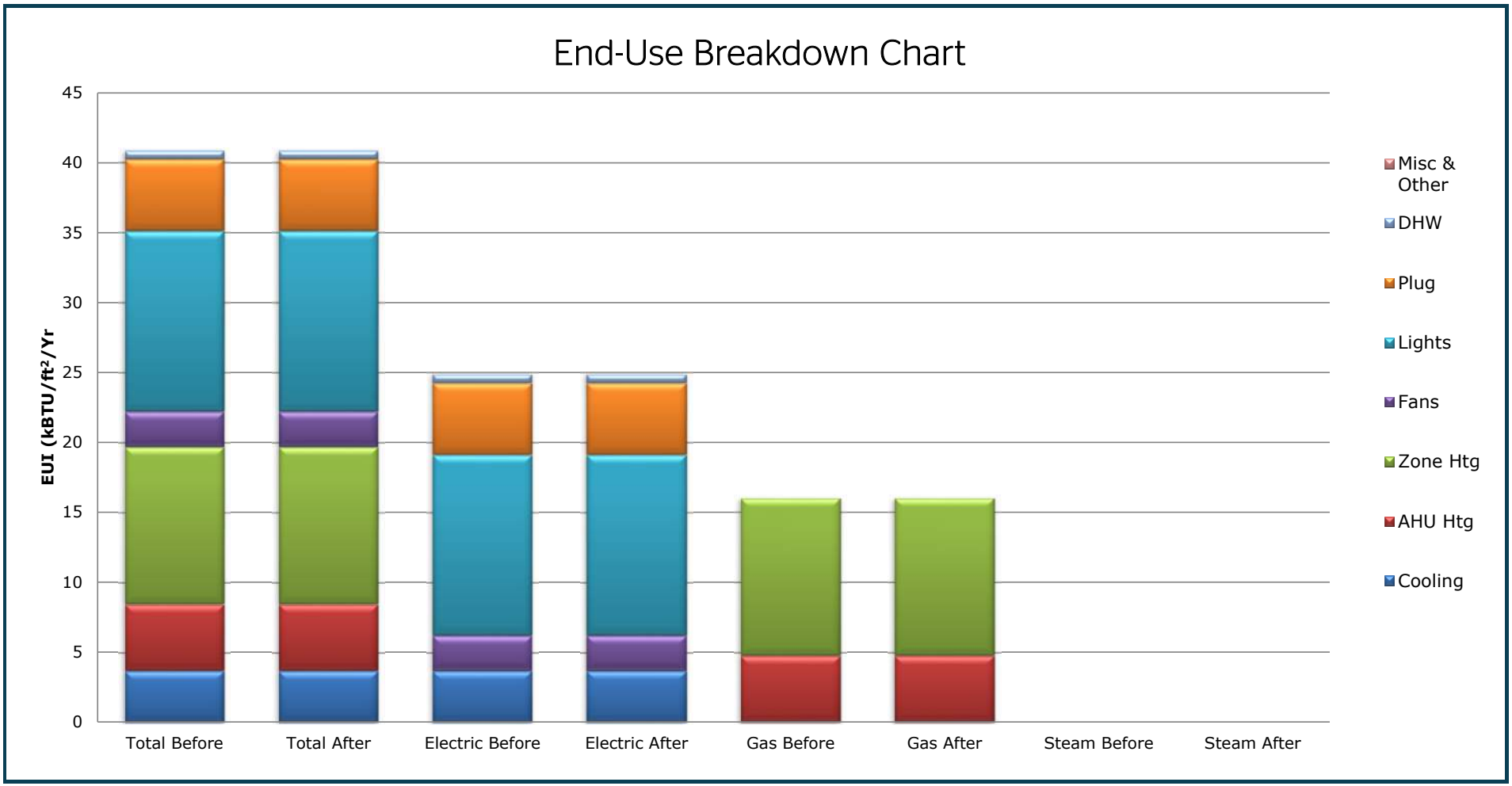
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	3.69	4.76	11.24	2.52	12.90	5.14	0.60	0.00	40.85
Total After	3.69	4.76	11.24	2.52	12.90	5.14	0.60	0.00	40.85
Electric Before	3.69	0.00	0.00	2.52	12.90	5.14	0.60	0.00	24.85
Electric After	3.69	0.00	0.00	2.52	12.90	5.14	0.60	0.00	24.85
Gas Before	0.00	4.76	11.24	0.00	0.00	0.00	0.00	0.00	16.00
Gas After	0.00	4.76	11.24	0.00	0.00	0.00	0.00	0.00	16.00
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		63,760	2,063		423,913	4.43	11%
Feb		61,520	1,509		360,868	3.77	9%
Mar		50,000	1,427		313,350	3.27	8%
Apr		58,960	1,073		308,530	3.22	8%
May		60,080	626		267,653	2.80	7%
Jun		65,600	285		252,393	2.64	6%
Jul		60,880	24		210,183	2.20	5%
Aug		69,600	15		239,045	2.50	6%
Sep		53,760	296		213,083	2.23	5%
Oct		53,040	1,631		344,126	3.59	9%
Nov		62,320	3,219		534,598	5.58	13%
Dec		55,440	3,112		500,417	5.23	13%
Total	0	714,960	15,280	0	3,968,158	41.45	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	171.9	51,911	3,200	0	497,191	5.19	13%
Feb	207.3	48,084	2,218	0	385,951	4.03	10%
Mar	229.3	54,102	1,610	0	345,695	3.61	9%
Apr	275.7	54,234	996	0	284,743	2.97	7%
May	255.2	56,858	520	0	246,041	2.57	6%
Jun	293.5	64,380	168	0	236,495	2.47	6%
Jul	308.7	73,077	31	0	252,553	2.64	6%
Aug	298.8	74,545	39	0	258,288	2.70	7%
Sep	297.3	62,653	318	0	245,667	2.57	6%
Oct	230.1	51,691	1,072	0	283,622	2.96	7%
Nov	230.7	52,527	2,310	0	410,256	4.29	10%
Dec	171.9	52,935	2,831	0	463,793	4.84	12%
Total	2,971	696,996	15,314	0	3,910,296	40.85	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	171.9	51,911	3,200	0	497,191	5.19	13%
Feb	207.3	48,084	2,218	0	385,951	4.03	10%
Mar	229.3	54,102	1,610	0	345,695	3.61	9%
Apr	275.7	54,234	996	0	284,743	2.97	7%
May	255.2	56,858	520	0	246,041	2.57	6%
Jun	293.5	64,380	168	0	236,495	2.47	6%
Jul	308.7	73,077	31	0	252,553	2.64	6%
Aug	298.8	74,545	39	0	258,288	2.70	7%
Sep	297.3	62,653	318	0	245,667	2.57	6%
Oct	230.1	51,691	1,072	0	283,622	2.96	7%
Nov	230.7	52,527	2,310	0	410,256	4.29	10%
Dec	171.9	52,935	2,831	0	463,793	4.84	12%
Total	2,971	696,996	15,314	0	3,910,296	40.85	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

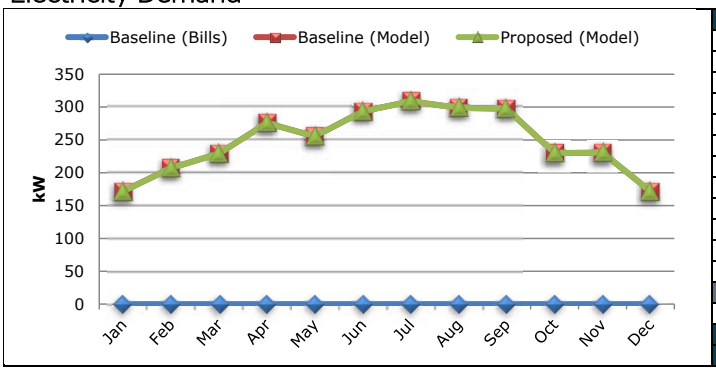
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

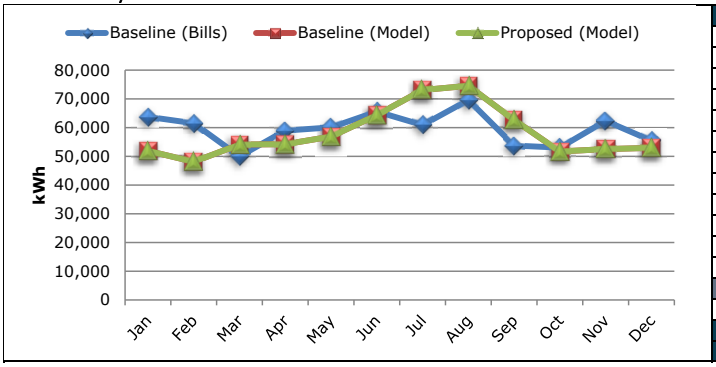
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	172	172
Feb	0	207	207
Mar	0	229	229
Apr	0	276	276
May	0	255	255
Jun	0	294	294
Jul	0	309	309
Aug	0	299	299
Sep	0	297	297
Oct	0	230	230
Nov	0	231	231
Dec	0	172	172
Total	0	2,971	2,971

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

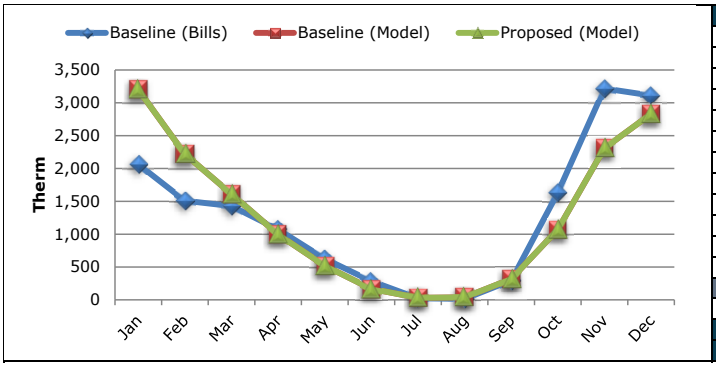
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	63,760	51,911	51,911
Feb	61,520	48,084	48,084
Mar	50,000	54,102	54,102
Apr	58,960	54,234	54,234
May	60,080	56,858	56,858
Jun	65,600	64,380	64,380
Jul	60,880	73,077	73,077
Aug	69,600	74,545	74,545
Sep	53,760	62,653	62,653
Oct	53,040	51,691	51,691
Nov	62,320	52,527	52,527
Dec	55,440	52,935	52,935
Total	714,960	696,996	696,996

% Delta Between Baseline (Bills) & Baseline (Model)	-3%
RSQ (Correlation Coefficient)	0.19

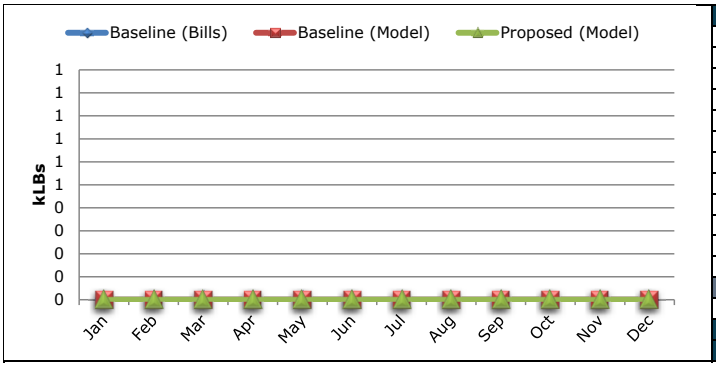
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	2,063	3,200	3,200
Feb	1,509	2,218	2,218
Mar	1,427	1,610	1,610
Apr	1,073	996	996
May	626	520	520
Jun	285	168	168
Jul	24	31	31
Aug	15	39	39
Sep	296	318	318
Oct	1,631	1,072	1,072
Nov	3,219	2,310	2,310
Dec	3,112	2,831	2,831
Total	15,280	15,314	15,314

% Delta Between Baseline (Bills) & Baseline (Model)	0%
RSQ (Correlation Coefficient)	0.79

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Tacoma Municipal Building

Project Information:

Project Name	Tacoma Decarbonization Project	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50438	Date	3/19/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	School
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		7,663	2,140,463	0	0	35.29
	Savings ▶					35.29
	Usage ▶					0.00
	Savings ▶					0.00
	Usage ▶					0.00
	Savings ▶					0.00
	Usage ▶					0.00
	Savings ▶					0.00
	Usage ▶					0.00
	Savings ▶					0.00
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	Usage ▶					0.00
	Savings ▶					0.00
	Usage ▶					0.00
	Savings ▶					0.00
	Usage ▶					0.00
	Savings ▶					0.00
	Usage ▶					0.00

Notes:

McK8760 - Inputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	207,020	207,020	TCO
I8	Roof Area		ft^2	16,894	16,894	drawings
I9	Opaque Wall Area		ft^2	38,026	38,026	drawings/estimate
I10	Glazing Area	***Glazing***	ft^2	25,350	25,350	drawings/estimate
I12	Roof U-Factor	***Roof***	$BTU/ft^2/°F$	0.050	0.050	code
I13	Opaque Wall U-Factor	***Walls***	$BTU/ft^2/°F$	0.140	0.140	code
I14	Glazing U-Factor	***Glazing***	$BTU/ft^2/°F$	0.750	0.750	code
I15	Glazing Solar Heat Gain Coefficient (SHGC)	***Glazing***	-	0.650	0.650	Document your baseline assumption basis
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	Document your baseline assumption basis
I17	Average Space Height (Floor to Ceiling)		ft	10.0	10.0	drawings
I18	Infiltration		ach	0.250	0.250	typical value
I19	Peak Number of Occupants		Qty	350	350	estimate-confirm
I20	Sensible Heat Gain Per Person		Btu/h	245	245	typical-office
I21	Latent Heat Gain Per Person		Btu/h	155	155	typical-office
I22	Peak Lighting Load Power Density		W/ft^2	1.500	1.50	typical office
I23	Peak Plug Load Power Density		W/ft^2	0.8500	0.8500	typical office
I24	Peak Exterior Lighting Load		kW	1	1	estimate
I25	Peak Miscellaneous Load (Electrical)		Watt	800.0	800.0	Document your baseline assumption basis
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	75.0	75.0	estimate-confirm
I28	HVAC Off Cooling Space Temperature Set Point		°F	80.0	80.0	estimate-confirm
I29	HVAC On Heating Space Temperature Set Point		°F	72.0	72.0	estimate-confirm
I30	HVAC Off Heating Space Temperature Set Point		°F	62.0	62.0	estimate-confirm

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	Document your baseline assumption basis
I35	Occupied Fan Operation		Type	Continuous	Continuous	Document your baseline assumption basis
I36	Maximum AHU CFM		CFM	13,800	13,800	drawing
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	typical-value
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	typical-value
I39	Minimum % Outside Air (Occupied)		%	20.0%	20.0%	typical-value
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	typical-value
I41	Economizer High Limit Set Point		°F	65.0	65.0	estimate
I42	Economizer Low Limit Set Point		°F	45.0	45.0	estimate
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	Document your baseline assumption basis
I44	DCV Airflow Per Person (Based on Space Type)	***DCV Tab***	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	***DCV Tab***	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	1.200	1.200	drawings
I47	Fan Efficiency		%	65.0%	65.0%	typical-value
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	estimate
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	estimate
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	estimate
I52	AHU Cooling Efficiency (EER)		BTU/Watt	9.0	9.0	estimate-not many drawings
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	Document your baseline assumption basis
I54	AHU Cooling Lockout Below		°F	70.0	70.0	typical-value
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	1.00	1.00	electric resitance
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	1.00	1.00	electric resitance
I57	AHU Heating Energy Source		Type	Electric	Electric	electric resitance
I58	AHU Heating Lockout Above		°F	80.0	80.0	typical-value
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	NA
I60	Heat Recovery % Effectiveness		%	40.0	40.0	estimate
I61	Onsite Central Plant?		Yes/No	No	No	Document your baseline assumption basis

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	typical
I66	Zone Heating Lockout Above		°F	80.0	80.0	typical
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	1.00	1.00	electric resitance
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	1.00	1.00	electric resitance
I69	Heating Energy Source Zone		Type	Electric	Electric	drawings
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	estimate
I71	SFPMB Terminal Unit Power		W/CFM	0.40	0.40	typical

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I129	DHW Fuel Type		Type	Electric	Electric	Document your baseline assumption basis
I130	Energy Factor		-	0.85	0.85	Document your baseline assumption basis
I131	Working Days Per Year (Used Only For DHW Calc)		Qty	252	252	Document your baseline assumption basis
I132	Average Daily Hot Water Consumption Per Person		Gallons	1.0	1.0	Document your baseline assumption basis
I133	Average Entering Cold Water Temperature		°F	50.0	50.0	Document your baseline assumption basis
I134	Supply Hot Water Temperature		°F	120.0	120.0	Document your baseline assumption basis

McK8760 - Outputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	347	-	347	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	490	-	490	-	0	0.0%	-
O10	Fan Peak kW	kW	9	-	9	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	295	-	295	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	1	-	1	-	0	0.0%	-
O13	Plug Load Peak kW	kW	167	-	167	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	0		0	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	812	-	812	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	7,663	-	7,663	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	90,196	1.49	90,196	1.49	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	662,703	10.93	662,703	10.93	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	19,924	0.33	19,924	0.33	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	19,405	0.32	19,405	0.32	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	846,505	13.96	846,505	13.96	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	4,380	0.07	4,380	0.07	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	479,686	7.91	479,686	7.91	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	17,664	0.29	17,664	0.29	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	2,140,463	35.29	2,140,463	35.29	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O44	Total	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	7,305,401	35	7,305,401	35.29	0	0.0%	0.00

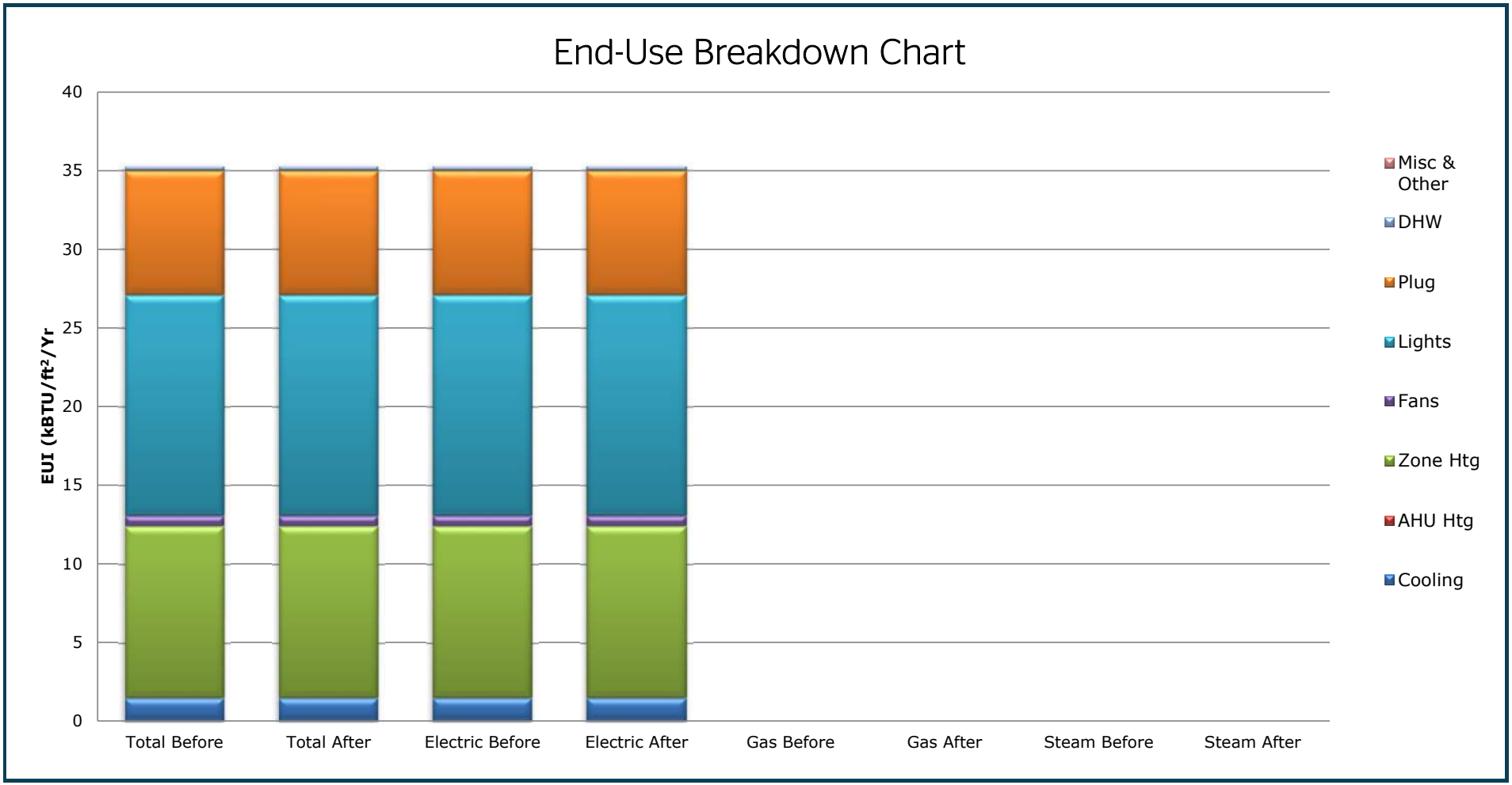
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	1.49	0.00	10.93	0.65	14.03	7.91	0.29	0.00	35.29
Total After	1.49	0.00	10.93	0.65	14.03	7.91	0.29	0.00	35.29
Electric Before	1.49	0.00	10.93	0.65	14.03	7.91	0.29	0.00	35.29
Electric After	1.49	0.00	10.93	0.65	14.03	7.91	0.29	0.00	35.29
Gas Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gas After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		230,133			785,445	3.79	10%
Feb		244,067			833,000	4.02	11%
Mar		224,000			764,511	3.69	10%
Apr		174,400			595,226	2.88	8%
May		159,733			545,170	2.63	7%
Jun		144,667			493,747	2.39	7%
Jul		147,733			504,213	2.44	7%
Aug		151,333			516,498	2.49	7%
Sep		137,666			469,854	2.27	6%
Oct		143,666			490,332	2.37	6%
Nov		194,999			665,533	3.21	9%
Dec		273,000			931,749	4.50	12%
Total	0	2,225,396	0	0	7,595,278	36.69	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	465.2	218,478	0	0	745,666	3.60	10%
Feb	524.1	191,943	0	0	655,101	3.16	9%
Mar	465.2	205,682	0	0	701,993	3.39	10%
Apr	677.0	169,992	0	0	580,183	2.80	8%
May	694.6	163,883	0	0	559,334	2.70	8%
Jun	804.4	146,328	0	0	499,416	2.41	7%
Jul	797.0	146,693	0	0	500,664	2.42	7%
Aug	811.7	159,067	0	0	542,894	2.62	7%
Sep	789.5	147,251	0	0	502,567	2.43	7%
Oct	657.6	171,232	0	0	584,416	2.82	8%
Nov	465.2	208,127	0	0	710,338	3.43	10%
Dec	511.4	211,787	0	0	722,829	3.49	10%
Total	7,663	2,140,463	0	0	7,305,401	35.29	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	465.2	218,478	0	0	745,666	3.60	10%
Feb	524.1	191,943	0	0	655,101	3.16	9%
Mar	465.2	205,682	0	0	701,993	3.39	10%
Apr	677.0	169,992	0	0	580,183	2.80	8%
May	694.6	163,883	0	0	559,334	2.70	8%
Jun	804.4	146,328	0	0	499,416	2.41	7%
Jul	797.0	146,693	0	0	500,664	2.42	7%
Aug	811.7	159,067	0	0	542,894	2.62	7%
Sep	789.5	147,251	0	0	502,567	2.43	7%
Oct	657.6	171,232	0	0	584,416	2.82	8%
Nov	465.2	208,127	0	0	710,338	3.43	10%
Dec	511.4	211,787	0	0	722,829	3.49	10%
Total	7,663	2,140,463	0	0	7,305,401	35.29	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

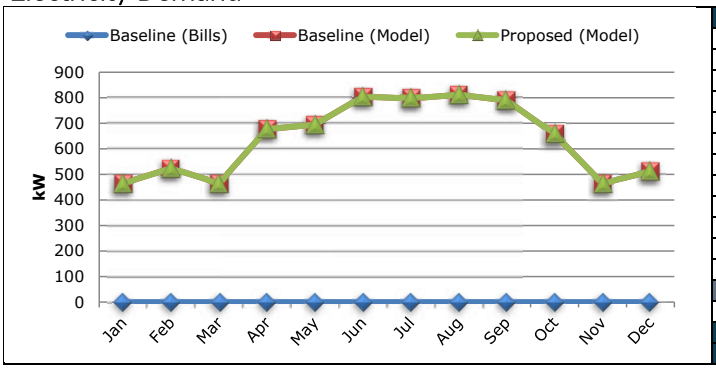
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

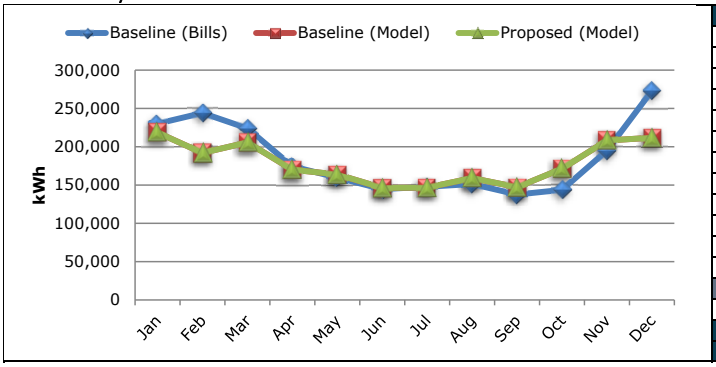
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	465	465
Feb	0	524	524
Mar	0	465	465
Apr	0	677	677
May	0	695	695
Jun	0	804	804
Jul	0	797	797
Aug	0	812	812
Sep	0	790	790
Oct	0	658	658
Nov	0	465	465
Dec	0	511	511
Total	0	7,663	7,663

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

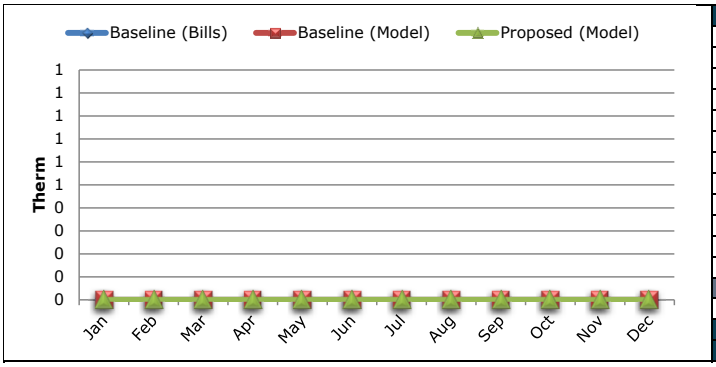
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	230,133	218,478	218,478
Feb	244,067	191,943	191,943
Mar	224,000	205,682	205,682
Apr	174,400	169,992	169,992
May	159,733	163,883	163,883
Jun	144,667	146,328	146,328
Jul	147,733	146,693	146,693
Aug	151,333	159,067	159,067
Sep	137,666	147,251	147,251
Oct	143,666	171,232	171,232
Nov	194,999	208,127	208,127
Dec	273,000	211,787	211,787
Total	2,225,396	2,140,463	2,140,463

% Delta Between Baseline (Bills) & Baseline (Model)	-4%
RSQ (Correlation Coefficient)	0.77

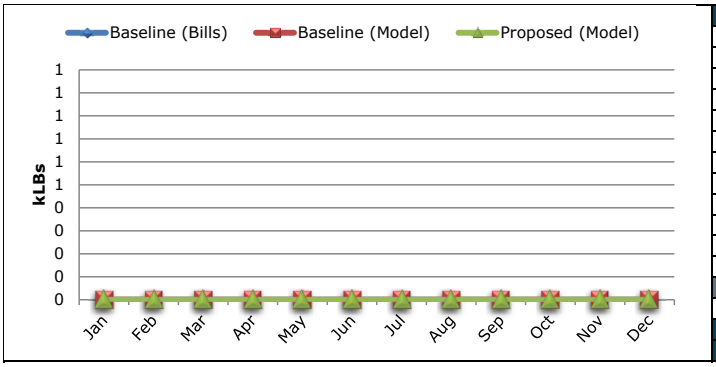
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Municiple Building North

Project Information:

Project Name	Tacoma Decarbonization	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50439	Date	3/19/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	Office
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		2,929	570,223	125	0	47.31
	Savings ▶					*47.31*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
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	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00
	Savings ▶					*0.00*
	Usage ▶					0.00

Notes:

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Inputs

Baseline Model

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	41,400	41,400	tco
I8	Roof Area		ft^2	6,855	6,855	drawings
I9	Opaque Wall Area		ft^2	11,834	11,834	estimate/drawings
I10	Glazing Area	***Glazing***	ft^2	4,082	4,082	estimate/drawings
I12	Roof U-Factor	***Roof***	$BTU/ft^2/°F$	0.075	0.075	estimate
I13	Opaque Wall U-Factor	***Walls***	$BTU/ft^2/°F$	0.095	0.095	estimate
I14	Glazing U-Factor	***Glazing***	$BTU/ft^2/°F$	0.600	0.600	Document your baseline assumption basis
I15	Glazing Solar Heat Gain Coefficient (SHGC)	***Glazing***	-	0.650	0.650	Document your baseline assumption basis
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	typical value
I17	Average Space Height (Floor to Ceiling)		ft	10.0	10.0	Document your baseline assumption basis
I18	Infiltration		ach	0.250	0.250	typical value
I19	Peak Number of Occupants		Qty	150	150	estimate
I20	Sensible Heat Gain Per Person		Btu/h	250	250	typical value
I21	Latent Heat Gain Per Person		Btu/h	155	155	typical value
I22	Peak Lighting Load Power Density		W/ft^2	1.200	1.20	office value
I23	Peak Plug Load Power Density		W/ft^2	0.6000	0.6000	office value
I24	Peak Exterior Lighting Load		kW	1	1	estimate
I25	Peak Miscellaneous Load (Electrical)		Watt	0.0	0.0	Document your baseline assumption basis
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	72.0	72.0	typical value
I28	HVAC Off Cooling Space Temperature Set Point		°F	78.0	78.0	typical value
I29	HVAC On Heating Space Temperature Set Point		°F	70.0	70.0	typical value
I30	HVAC Off Heating Space Temperature Set Point		°F	60.0	60.0	typical value

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	Document your baseline assumption basis
I35	Occupied Fan Operation		Type	Continuous	Continuous	Document your baseline assumption basis
I36	Maximum AHU CFM		CFM	52,000	52,000	drawings-confirm
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	typical
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	typical
I39	Minimum % Outside Air (Occupied)		%	20.0%	20.0%	Document your baseline assumption basis
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	Document your baseline assumption basis
I41	Economizer High Limit Set Point		°F	65.0	65.0	Document your baseline assumption basis
I42	Economizer Low Limit Set Point		°F	65.0	65.0	Document your baseline assumption basis
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	drawings
I44	DCV Airflow Per Person (Based on Space Type)	***DCV Tab***	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	***DCV Tab***	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	3.000	3.000	drawings
I47	Fan Efficiency		%	60.0%	60.0%	typical value
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	Document your baseline assumption basis
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	Document your baseline assumption basis
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	Document your baseline assumption basis
I52	AHU Cooling Efficiency (EER)		BTU/Watt	5.0	5.0	estimate-not listed
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	Document your baseline assumption basis
I54	AHU Cooling Lockout Below		°F	45.0	45.0	typical value
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	1.00	1.00	electric
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	1.00	1.00	electric
I57	AHU Heating Energy Source		Type	Electric	Electric	Document your baseline assumption basis
I58	AHU Heating Lockout Above		°F	70.0	70.0	Document your baseline assumption basis
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	NA
I60	Heat Recovery % Effectiveness		%	0.0	0.0	NA
I61	Onsite Central Plant?		Yes/No	No	No	NA

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	drawings
I66	Zone Heating Lockout Above		°F	70.0	70.0	drawings
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	1.00	1.00	electric
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	1.00	1.00	electric
I69	Heating Energy Source Zone		Type	Electric	Electric	drawings
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	drawings
I71	SFPMB Terminal Unit Power		W/CFM	0.20	0.20	Document your baseline assumption basis

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description	Units	Baseline	Proposed	Basis
I129	DHW Fuel Type	Type	Electric	Electric	could not find on schedule-confirm
I130	Energy Factor	-	1.00	1.00	electric
I131	Working Days Per Year (Used Only For DHW Calc)	Qty	261	261	office schedule
I132	Average Daily Hot Water Consumption Per Person	Gallons	1.0	1.0	typical office
I133	Average Entering Cold Water Temperature	°F	50.0	50.0	typical
I134	Supply Hot Water Temperature	°F	120.0	120.0	typical

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

McK8760 - Outputs

Baseline Model

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	148	-	148	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	259	-	259	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	82	-	82	-	0	0.0%	-
O10	Fan Peak kW	kW	41	-	41	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	47	-	47	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	1	-	1	-	0	0.0%	-
O13	Plug Load Peak kW	kW	24	-	24	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	0		0	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	322	-	322	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	2,929	-	2,929	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	79,888	6.59	79,888	6.59	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	71,507	5.90	71,507	5.90	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	107,857	8.89	107,857	8.89	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	96,503	7.96	96,503	7.96	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	6,094	0.50	6,094	0.50	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	129,615	10.69	129,615	10.69	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	4,380	0.36	4,380	0.36	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	67,714	5.58	67,714	5.58	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	6,665	0.55	6,665	0.55	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	570,223	47.01	570,223	47.01	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	125	0.30	125	0.30	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O44	Total	Therm/Yr	125	0.30	125	0.30	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	1,958,624	47	1,958,624	47.31	0	0.0%	0.00

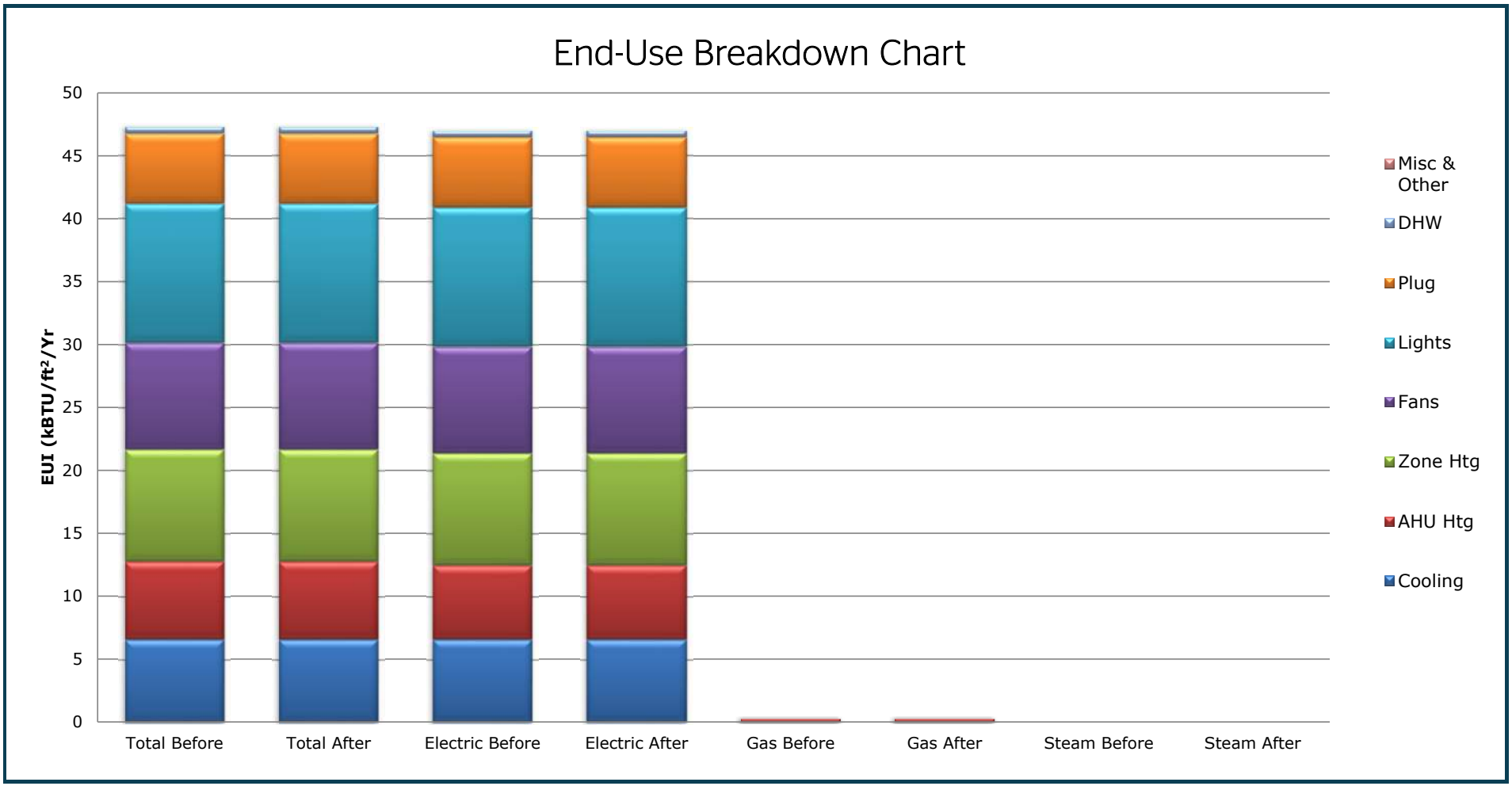
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	6.59	6.20	8.89	8.46	11.05	5.58	0.55	0.00	47.31
Total After	6.59	6.20	8.89	8.46	11.05	5.58	0.55	0.00	47.31
Electric Before	6.59	5.90	8.89	8.46	11.05	5.58	0.55	0.00	47.01
Electric After	6.59	5.90	8.89	8.46	11.05	5.58	0.55	0.00	47.01
Gas Before	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30
Gas After	0.00	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.30
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		57,333	17		197,347	4.77	10%
Feb		52,200	34		181,562	4.39	9%
Mar		48,867	6		167,370	4.04	8%
Apr		37,067	0		126,513	3.06	6%
May		44,733	0		152,675	3.69	8%
Jun		47,067	0		160,639	3.88	8%
Jul		49,800	0		169,967	4.11	9%
Aug		48,533	0		165,644	4.00	8%
Sep		45,867	0		156,543	3.78	8%
Oct		41,733	10		143,413	3.46	7%
Nov		47,867	47		168,036	4.06	9%
Dec		52,333	11		179,758	4.34	9%
Total	0	573,400	125	0	1,969,467	47.57	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	280.9	59,010	17	0	203,071	4.91	10%
Feb	322.1	50,260	34	0	174,940	4.23	9%
Mar	229.9	53,218	6	0	182,223	4.40	9%
Apr	192.3	43,049	0	0	146,932	3.55	8%
May	184.0	39,703	0	0	135,507	3.27	7%
Jun	199.0	41,083	0	0	140,215	3.39	7%
Jul	236.5	44,759	0	0	152,763	3.69	8%
Aug	225.5	47,722	0	0	162,874	3.93	8%
Sep	238.6	40,405	0	0	137,902	3.33	7%
Oct	245.6	41,980	10	0	144,255	3.48	7%
Nov	267.3	52,785	47	0	184,823	4.46	9%
Dec	307.1	56,249	11	0	193,121	4.66	10%
Total	2,929	570,223	125	0	1,958,624	47.31	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	280.9	59,010	17	0	203,071	4.91	10%
Feb	322.1	50,260	34	0	174,940	4.23	9%
Mar	229.9	53,218	6	0	182,223	4.40	9%
Apr	192.3	43,049	0	0	146,932	3.55	8%
May	184.0	39,703	0	0	135,507	3.27	7%
Jun	199.0	41,083	0	0	140,215	3.39	7%
Jul	236.5	44,759	0	0	152,763	3.69	8%
Aug	225.5	47,722	0	0	162,874	3.93	8%
Sep	238.6	40,405	0	0	137,902	3.33	7%
Oct	245.6	41,980	10	0	144,255	3.48	7%
Nov	267.3	52,785	47	0	184,823	4.46	9%
Dec	307.1	56,249	11	0	193,121	4.66	10%
Total	2,929	570,223	125	0	1,958,624	47.31	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

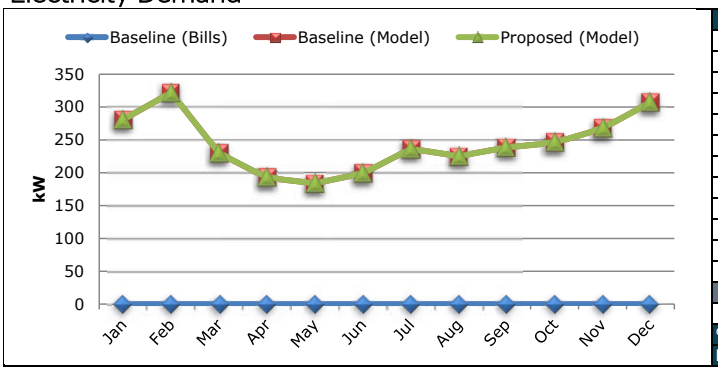
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

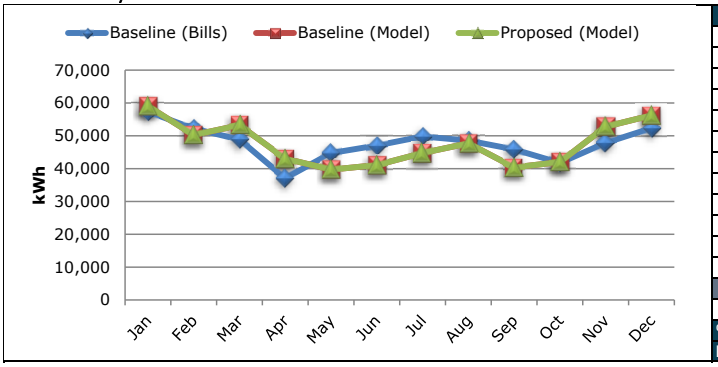
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	281	281
Feb	0	322	322
Mar	0	230	230
Apr	0	192	192
May	0	184	184
Jun	0	199	199
Jul	0	236	236
Aug	0	225	225
Sep	0	239	239
Oct	0	246	246
Nov	0	267	267
Dec	0	307	307
Total	0	2,929	2,929

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

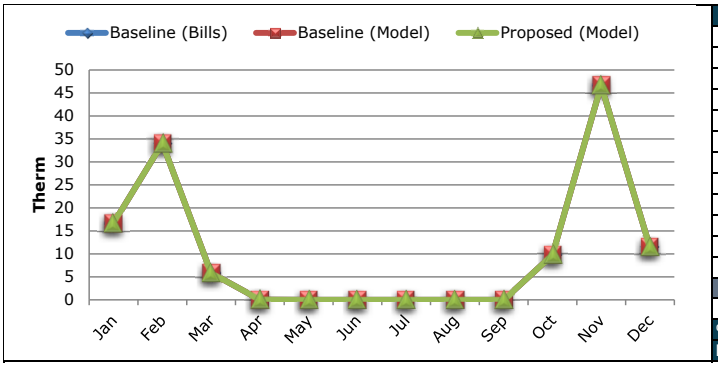
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	57,333	59,010	59,010
Feb	52,200	50,260	50,260
Mar	48,867	53,218	53,218
Apr	37,067	43,049	43,049
May	44,733	39,703	39,703
Jun	47,067	41,083	41,083
Jul	49,800	44,759	44,759
Aug	48,533	47,722	47,722
Sep	45,867	40,405	40,405
Oct	41,733	41,980	41,980
Nov	47,867	52,785	52,785
Dec	52,333	56,249	56,249
Total	573,400	570,223	570,223

% Delta Between Baseline (Bills) & Baseline (Model)	-1%
RSQ (Correlation Coefficient)	0.56

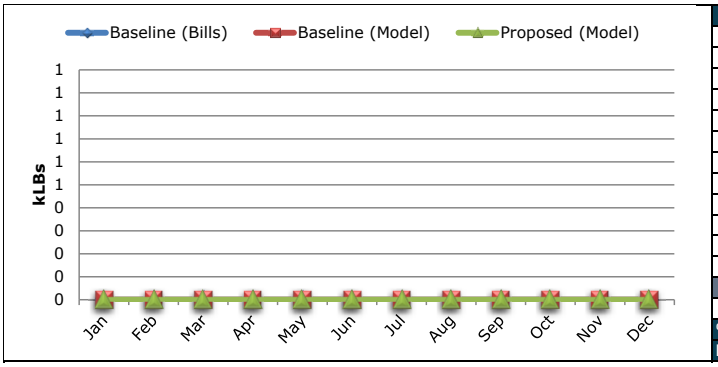
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	17	17	17
Feb	34	34	34
Mar	6	6	6
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	10	10	10
Nov	47	47	47
Dec	11	11	11
Total	125	125	125

% Delta Between Baseline (Bills) & Baseline (Model)	0%
RSQ (Correlation Coefficient)	1.00

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

McK8760 - General Information

Tacoma Solid Waste and Admin Shop

Project Information:

Project Name	Tacoma Decarbonization Project	FIM Name	Baseline Model
TCO Project ID	3406	Tech Contact	Sarah Stevens
TCO Tool FIM ID	50444	Date	3/17/2023

Weather Data:

Nearest Weather Station	WA, TACOMA MCCHORD AFB	Station ID	742060TY.xls

Description of FIM From TCO Tool:

Baseline model.

HVAC & Load Schedules:

Schedule A Title	Load Schedule A	ASHRAE Schedule Type	School
Schedule B Title	Load Schedule B	ASHRAE Schedule Type	School
Schedule C Title	Load Schedule C	ASHRAE Schedule Type	School

Utility Rate Schedules

Schedule 1 Title	Rate Schedule 1
Schedule 2 Title	Rate Schedule 2
Schedule 3 Title	Rate Schedule 3

Zone Data (for multi-model buildings)

Zone Name	Zone Name (e.g. RTU-1 or West Wing)
Zone Description	Zone Description

Savings Tracker (Use if Modeling Multiple Efficiency Measures)

Measure Description		Electric Demand (kW)	Electricity (kWh)	Natural Gas (Therm)	Steam (kLB)	EUI (kBTU/SqFt/Yr)
Baseline Building Performance		1,536	444,897	11,539	0	78.07
	Savings ►					78.07
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00
	Savings ►					0.00
	Usage ►					0.00

Notes:

McK8760 - Inputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Zone Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I7	Floor Area		ft^2	34,232	34,232	TCO
I8	Roof Area		ft^2	16,894	16,894	drawings
I9	Opaque Wall Area		ft^2	15,075	15,075	D
I10	Glazing Area	***Glazing***	ft^2	1,675	1,675	drawings/estimate
I12	Roof U-Factor	***Roof***	$BTU/ft^2/°F$	0.085	0.085	estimate
I13	Opaque Wall U-Factor	***Walls***	$BTU/ft^2/°F$	0.105	0.105	estimate
I14	Glazing U-Factor	***Glazing***	$BTU/ft^2/°F$	0.550	0.550	estimate
I15	Glazing Solar Heat Gain Coefficient (SHGC)	***Glazing***	-	0.650	0.650	Document your baseline assumption basis
I16	Glazing Solar Gain Bldg Shape Factor		-	0.300	0.300	Document your baseline assumption basis
I17	Average Space Height (Floor to Ceiling)		ft	13.0	13.0	drawings
I18	Infiltration		ach	0.350	0.350	roll up doors in shop
I19	Peak Number of Occupants		Qty	30	30	estimate
I20	Sensible Heat Gain Per Person		Btu/h	250	250	typical-light work
I21	Latent Heat Gain Per Person		Btu/h	250	250	standing-walking
I22	Peak Lighting Load Power Density		W/ft^2	1.700	1.70	estimate/adjust
I23	Peak Plug Load Power Density		W/ft^2	0.8000	0.8000	typical office/workshop
I24	Peak Exterior Lighting Load		kW	2	2	estimate
I25	Peak Miscellaneous Load (Electrical)		Watt	20,000.0	20,000.0	estimate-heating plug loads for winter
I26	Miscellaneous Load Located in Conditioned Space		Yes/No	No	No	Document your baseline assumption basis
I27	HVAC On Cooling Space Temperature Set Point		°F	73.0	73.0	estimate-confirm
I28	HVAC Off Cooling Space Temperature Set Point		°F	80.0	80.0	estimate-confirm
I29	HVAC On Heating Space Temperature Set Point		°F	72.0	72.0	estimate-confirm
I30	HVAC Off Heating Space Temperature Set Point		°F	62.0	62.0	estimate-confirm

AHU & Plant Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I34	AHU Fan Power based on Control Type		Type	CV	CV	estimate
I35	Occupied Fan Operation		Type	Continuous	Continuous	estimate
I36	Maximum AHU CFM		CFM	15,675	15,675	drawings
I37	Min AHU CFM (% of Max CFM) (If CV+Cycles: min occ % run time)		%	70.0%	70.0%	estimate/typical
I38	Maximum % Outside Air (Economizer % OSA)		%	100.0%	100.0%	estimate/typical
I39	Minimum % Outside Air (Occupied)		%	51.0%	51.0%	estimate/typical
I40	Minimum % Outside Air (Unoccupied)		%	3.0%	3.0%	estimate/typical
I41	Economizer High Limit Set Point		°F	65.0	65.0	Document your baseline assumption basis
I42	Economizer Low Limit Set Point		°F	65.0	65.0	Document your baseline assumption basis
I43	Demand Controlled Ventilation (For Outside Air Control)		Yes/No	No	No	drawings
I44	DCV Airflow Per Person (Based on Space Type)	***DCV Tab***	CFM/Per	~~10.00~~	~~10.00~~	Document your baseline assumption basis
I45	DCV Airflow Per Area (Based on Space Type)	***DCV Tab***	CFM/ft^2	~~0.06~~	~~0.06~~	Document your baseline assumption basis
I46	AHU Fan TSP (At Max CFM)		in w.c.	1.500	1.500	drawings
I47	Fan Efficiency		%	55.0%	55.0%	typical
I48	Occupied Supply Air Temperature @ OAT ---------->	85.0	°F	Single Zone	Single Zone	Document your baseline assumption basis
I49	Occupied Supply Air Temperature @ OAT ---------->	65.0	°F	~~65~~	~~65~~	Document your baseline assumption basis
I50	Unoccupied Heating Supply Air Temperature Setpoint		°F	85	85	Document your baseline assumption basis
I51	Unoccupied Cooling Supply Air Temperature Setpoint		°F	55	55	Document your baseline assumption basis
I52	AHU Cooling Efficiency (EER)		BTU/Watt	9.0	9.0	no cooling info-confirm
I53	Evaporative Cooling Effectiveness (Air side)		%	0.0%	0.0%	no cooling info-confirm
I54	AHU Cooling Lockout Below		°F	55.0	55.0	no cooling info-confirm
I55	AHU Heating Efficiency or COP @ OAT ---------->	28.0	COP	0.80	0.80	drawings
I56	AHU Heating Efficiency or COP @ OAT ---------->	27.0	COP	0.80	0.80	drawings
I57	AHU Heating Energy Source		Type	Natural Gas	Natural Gas	Document your baseline assumption basis
I58	AHU Heating Lockout Above		°F	70.0	70.0	typical
I59	Evaporative Pre-Cooling on Condenser		Yes/No	No	No	Document your baseline assumption basis
I60	Heat Recovery % Effectiveness		%	0.0	0.0	Document your baseline assumption basis
I61	Onsite Central Plant?		Yes/No	No	No	Document your baseline assumption basis

Terminal Devices Inputs (Reheat Coils, VAV Boxes, Baseboard Heaters, etc)

Tag	Variable Description		Units	Baseline	Proposed	Basis
I65	Terminal Devices		Yes/No	Yes	Yes	radiant heaters in shop
I66	Zone Heating Lockout Above		°F	70.0	70.0	typical
I67	Zone Heating Efficiency or COP @ OAT ---------->	60.0	COP	0.60	0.60	radiant heater efficiency
I68	Zone Heating Efficiency or COP @ OAT ---------->	50.0	COP	0.60	0.60	radiant heater efficiency
I69	Heating Energy Source Zone		Type	Natural Gas	Natural Gas	natuarl gas
I70	Unoccupied Heating Done By		Zone, AHU	Zone Coil	Zone Coil	Document your baseline assumption basis
I71	SFPMB Terminal Unit Power		W/CFM	0.00	0.00	no fan

Chilled Water and Heating Plants Inputs:

Domestic Hot Water Inputs:

Tag	Variable Description		Units	Baseline	Proposed	Basis
I129	DHW Fuel Type		Type	Natural Gas	Natural Gas	Document your baseline assumption basis
I130	Energy Factor		-	0.70	0.70	typical NG
I131	Working Days Per Year (Used Only For DHW Calc)		Qty	365	365	typical work days
I132	Average Daily Hot Water Consumption Per Person		Gallons	1.0	1.0	office/shop
I133	Average Entering Cold Water Temperature		°F	50.0	50.0	typical
I134	Supply Hot Water Temperature		°F	120.0	120.0	typical

McK8760 - Outputs

Baseline Model

Note: only the baseline column was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Electric Demand

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O7	Cooling Peak kW	kW	92	-	92	-	0	0.0%	-
O8	AHU Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O9	Zone Heating Peak kW	kW	0	-	0	-	0	0.0%	-
O10	Fan Peak kW	kW	5	-	5	-	0	0.0%	-
O11	Interior Lighting Peak kW	kW	55	-	55	-	0	0.0%	-
O12	Exterior Lighting Peak kW	kW	2	-	2	-	0	0.0%	-
O13	Plug Load Peak kW	kW	26	-	26	-	0	0.0%	-
O14	Pumps Peak kW	kW	0	-	0	-	0	0.0%	-
O15	Heat Rejection kW	kW	0	-	0	-	0	0.0%	-
O16	Miscellaneous Load Peak kW	kW	19		19	-	0	0.0%	-
O17	Other Peak kW	kW	0	-	0	-	0	0.0%	-
O18	Peak kW	kW	174	-	174	-	0	0.0%	-
O19	Peak kW (Sum 12 Monthly Peaks)	kW	1,536	-	1,536	-	0	0.0%	-

Electricity

0 0

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O23	Cooling	kWh/Yr	45,221	4.51	45,221	4.51	0	0.0%	0.00
O24	AHU Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O25	Zone Heating	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O26	AHU Fans	kWh/Yr	25,469	2.54	25,469	2.54	0	0.0%	0.00
O27	Zone Fans	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O28	Interior Lighting	kWh/Yr	244,271	24.35	244,271	24.35	0	0.0%	0.00
O29	Exterior Lighting	kWh/Yr	8,760	0.87	8,760	0.87	0	0.0%	0.00
O30	Plug Loads	kWh/Yr	83,136	8.29	83,136	8.29	0	0.0%	0.00
O31	Pumps	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O32	Heat Rejection	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O33	Miscellaneous Loads	kWh/Yr	38,040	3.79	38,040	3.79	0	0.0%	0.00
O34	Domestic Hot Water	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O35	Other Electricity	kWh/Yr	0	0.00	0	0.00	0	0.0%	0.00
O36	Total	kWh/Yr	444,897	44.36	444,897	44.36	0	0.0%	0.00

Natural Gas

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O40	AHU Heating	Therm/Yr	4,759	13.90	4,759	13.90	0	0.0%	0.00
O41	Zone Heating	Therm/Yr	5,017	14.65	5,017	14.65	0	0.0%	0.00
O42	Domestic Hot Water	Therm/Yr	1,763	5.15	1,763	5.15	0	0.0%	0.00
O43	Other Natural Gas	Therm/Yr	0	0.00	0	0.00	0	0.0%	0.00
O44	Total	Therm/Yr	11,539	33.71	11,539	33.71	0	0.0%	0.00

Steam

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O48	AHU Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O49	Zone Heating	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O50	Domestic Hot Water	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O51	Other Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00
O52	Total Steam	kLB/Yr	0	0.00	0	0.00	0	0.0%	0.00

Total Energy

Tag	Description	Units	Baseline	EUI	Proposed	EUI	Savings	Savings (%)	EUI
O56	Total Energy	kBtu/Yr	2,672,331	78	2,672,331	78.07	0	0.0%	0.00

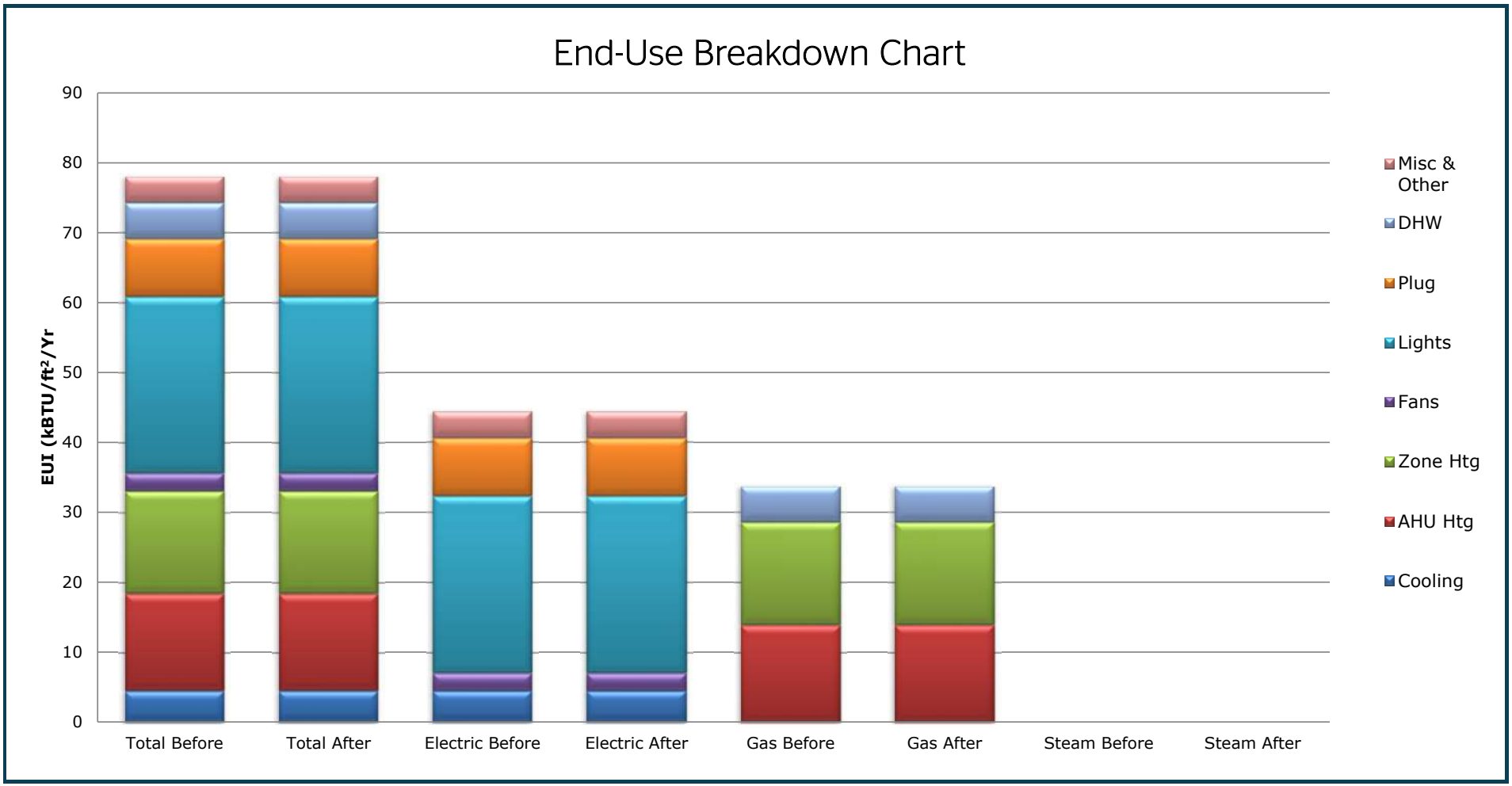
McK8760 - End-Use Breakdown

Baseline Model

Note: only the "Before" values were used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

EUI By Category	Cooling	AHU Htg	Zone Htg	Fans	Lights	Plug	DHW	Misc & Other	Total
Total Before	4.51	13.90	14.65	2.54	25.23	8.29	5.15	3.79	78.07
Total After	4.51	13.90	14.65	2.54	25.23	8.29	5.15	3.79	78.07
Electric Before	4.51	0.00	0.00	2.54	25.23	8.29	0.00	3.79	44.36
Electric After	4.51	0.00	0.00	2.54	25.23	8.29	0.00	3.79	44.36
Gas Before	0.00	13.90	14.65	0.00	0.00	0.00	5.15	0.00	33.71
Gas After	0.00	13.90	14.65	0.00	0.00	0.00	5.15	0.00	33.71
Steam Before	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Steam After	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



McK8760 - Model Tuning Data

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

Baseline (Bills)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan		38,453	1,387		269,907	7.88	10%
Feb		41,013	2,067		346,724	10.13	13%
Mar		34,000	1,733		289,292	8.45	11%
Apr		34,747	754		193,954	5.67	7%
May		36,373	297		153,880	4.50	6%
Jun		35,680	194		141,150	4.12	5%
Jul		41,493	182		159,782	4.67	6%
Aug		45,653	212		177,044	5.17	7%
Sep		39,093	265		159,909	4.67	6%
Oct		30,507	631		167,266	4.89	6%
Nov		40,693	1,161		255,035	7.45	9%
Dec		40,027	2,651		401,692	11.73	15%
Total	0	457,733	11,534	0	2,715,636	79.33	100%

Baseline (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	110.7	40,095	1,891	0	325,950	9.52	12%
Feb	113.1	36,352	1,549	0	278,940	8.15	10%
Mar	98.5	31,472	1,496	0	257,035	7.51	10%
Apr	137.3	32,697	946	0	206,229	6.02	8%
May	120.1	33,118	589	0	171,929	5.02	6%
Jun	128.4	36,200	291	0	152,694	4.46	6%
Jul	173.8	43,069	111	0	158,052	4.62	6%
Aug	154.3	43,462	88	0	157,149	4.59	6%
Sep	156.8	36,611	309	0	155,861	4.55	6%
Oct	119.3	32,975	784	0	190,922	5.58	7%
Nov	115.8	38,992	1,611	0	294,202	8.59	11%
Dec	108.0	39,855	1,873	0	323,369	9.45	12%
Total	1,536	444,897	11,539	0	2,672,331	78.07	100%

Proposed (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	110.7	40,095	1,891	0	325,950	9.52	12%
Feb	113.1	36,352	1,549	0	278,940	8.15	10%
Mar	98.5	31,472	1,496	0	257,035	7.51	10%
Apr	137.3	32,697	946	0	206,229	6.02	8%
May	120.1	33,118	589	0	171,929	5.02	6%
Jun	128.4	36,200	291	0	152,694	4.46	6%
Jul	173.8	43,069	111	0	158,052	4.62	6%
Aug	154.3	43,462	88	0	157,149	4.59	6%
Sep	156.8	36,611	309	0	155,861	4.55	6%
Oct	119.3	32,975	784	0	190,922	5.58	7%
Nov	115.8	38,992	1,611	0	294,202	8.59	11%
Dec	108.0	39,855	1,873	0	323,369	9.45	12%
Total	1,536	444,897	11,539	0	2,672,331	78.07	100%

Savings (Model)

Month	Electric Demand	Electricity	Natural Gas	Steam	Total	Total	Total
	kW	kWh	Therm	kLB Steam	kBTU	kBTU/ft^2	%
Jan	0.0	0	0	0	0	0.00	
Feb	0.0	0	0	0	0	0.00	
Mar	0.0	0	0	0	0	0.00	
Apr	0.0	0	0	0	0	0.00	
May	0.0	0	0	0	0	0.00	
Jun	0.0	0	0	0	0	0.00	
Jul	0.0	0	0	0	0	0.00	
Aug	0.0	0	0	0	0	0.00	
Sep	0.0	0	0	0	0	0.00	
Oct	0.0	0	0	0	0	0.00	
Nov	0.0	0	0	0	0	0.00	
Dec	0.0	0	0	0	0	0.00	
Total	0	0	0	0	0	0.00	

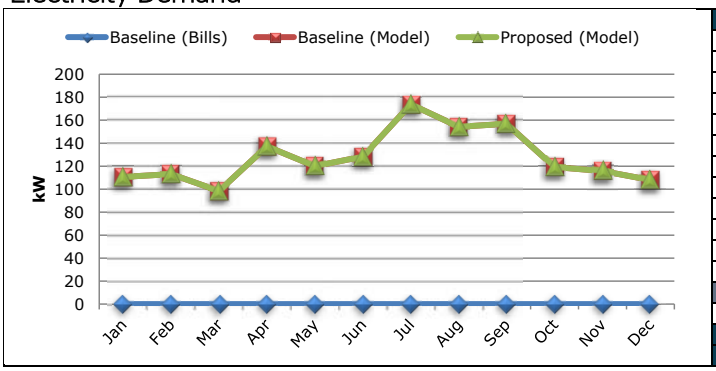
McK8760 - Model Tuning Charts

Baseline Model

Note: only the baseline model was used for this study.

The proposed column does not apply. Since the Facility Improvement Measures (FIMs) were targeted at specific end uses, we applied efficiency upgrades to the end use values to calculate the energy savings for each FIM.

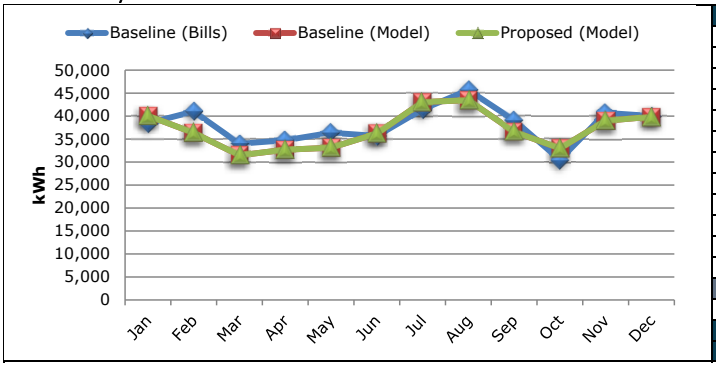
Electricity Demand



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	111	111
Feb	0	113	113
Mar	0	98	98
Apr	0	137	137
May	0	120	120
Jun	0	128	128
Jul	0	174	174
Aug	0	154	154
Sep	0	157	157
Oct	0	119	119
Nov	0	116	116
Dec	0	108	108
Total	0	1,536	1,536

% Delta Between Baseline (Bills) & Baseline (Model)	100%
RSQ (Correlation Coefficient)	#DIV/0!

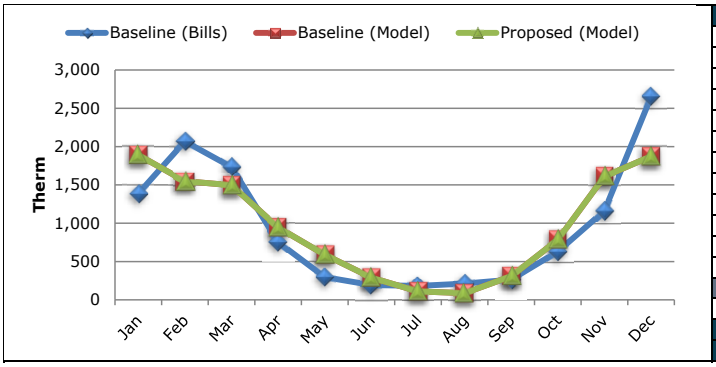
Electricity



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	38,453	40,095	40,095
Feb	41,013	36,352	36,352
Mar	34,000	31,472	31,472
Apr	34,747	32,697	32,697
May	36,373	33,118	33,118
Jun	35,680	36,200	36,200
Jul	41,493	43,069	43,069
Aug	45,653	43,462	43,462
Sep	39,093	36,611	36,611
Oct	30,507	32,975	32,975
Nov	40,693	38,992	38,992
Dec	40,027	39,855	39,855
Total	457,733	444,897	444,897

% Delta Between Baseline (Bills) & Baseline (Model)	-3%
RSQ (Correlation Coefficient)	0.72

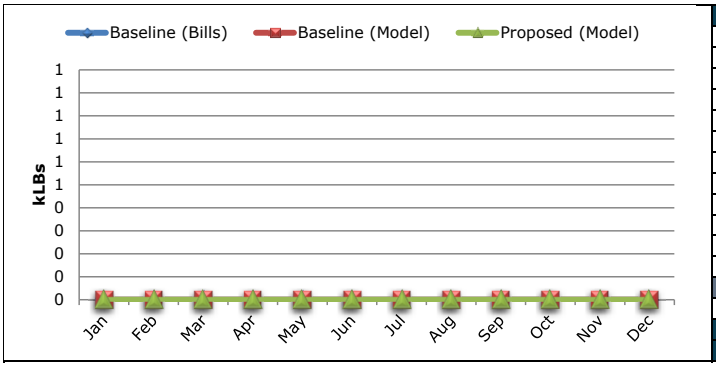
Natural Gas



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	1,387	1,891	1,891
Feb	2,067	1,549	1,549
Mar	1,733	1,496	1,496
Apr	754	946	946
May	297	589	589
Jun	194	291	291
Jul	182	111	111
Aug	212	88	88
Sep	265	309	309
Oct	631	784	784
Nov	1,161	1,611	1,611
Dec	2,651	1,873	1,873
Total	11,534	11,539	11,539

% Delta Between Baseline (Bills) & Baseline (Model)	0%
RSQ (Correlation Coefficient)	0.80

Steam



Month	Baseline (Bills)	Baseline (Model)	Proposed (Model)
Jan	0	0	0
Feb	0	0	0
Mar	0	0	0
Apr	0	0	0
May	0	0	0
Jun	0	0	0
Jul	0	0	0
Aug	0	0	0
Sep	0	0	0
Oct	0	0	0
Nov	0	0	0
Dec	0	0	0
Total	0	0	0

% Delta Between Baseline (Bills) & Baseline (Model)	#DIV/0!
RSQ (Correlation Coefficient)	#DIV/0!

Tacoma Municipal Building-JTK_v1 City of Tacoma, 1500 Commerce St, Tacoma, WA

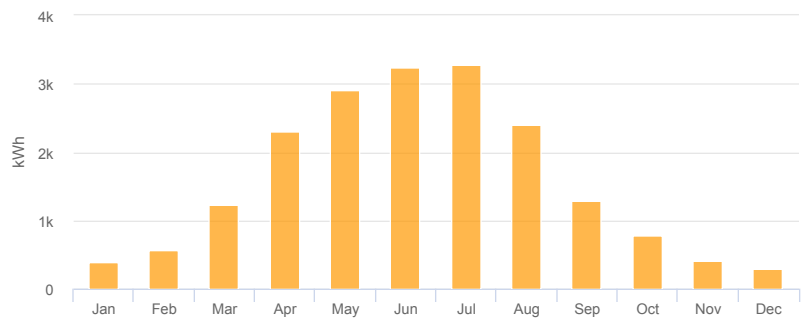
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Pacific Northwest Jacob Keith jacobk@mckinstry.com

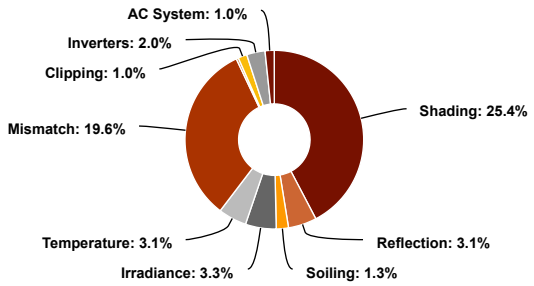
System Metrics

Design	Tacoma Municipal Building-JTK_v1
Module DC Nameplate	27.8 kW
Inverter AC Nameplate	25.0 kW Load Ratio: 1.11
Annual Production	19.08 MWh
Performance Ratio	52.1%
kWh/kWp	685.7
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	28179409b0-e97228905f-dee8ce9e64-bbf3497f23

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,316.1	6.2%
	Shaded Irradiance	981.4	-25.4%
	Irradiance after Reflection	951.2	-3.1%
	Irradiance after Soiling	938.5	-1.3%
	Total Collector Irradiance	**938.2**	**0.0%**
Energy (kWh)	Nameplate	26,427.0	
	Output at Irradiance Levels	25,542.2	-3.3%
	Output at Cell Temperature Derate	24,756.0	-3.1%
	Output After Mismatch	19,901.3	-19.6%
	Optimal DC Output	19,852.9	-0.2%
	Constrained DC Output	19,661.6	-1.0%
	Inverter Output	19,268.4	-2.0%
	Energy to Grid	**19,075.7**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp	13.1 °C	
	Avg. Operating Cell Temp	20.9 °C	
Simulation Metrics			
	Operating Hours	4258	
	Solved Hours	4258	

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type						U_{const}				U_{wind}	
	Fixed Tilt						20				0	
	Flush Mount						15				0	
	East-West						20				0	
	Carport						29				0	
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	
	3	4	2	1	1	1	1	1	1	0	4	
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle									Backtracking		
	60°									Enabled		
Module Characterizations	Module			Uploaded By			Characterization					
	JAM72D30-535/MB (JA Solar)			McKinstry Solar			JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN					
Component Characterizations	Device								Uploaded By		Characterizatio	
	CPS SCA25KTL-DO-R/US-480 (Chint Power)								HelioScope		Spec Sheet	

Components

Component	Name	Count
Inverters	CPS SCA25KTL-DO-R/US-480 (Chint Power)	1 (25.0 kW)
Strings	10 AWG (Copper)	3 (102.8 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	52 (27.8 kW)

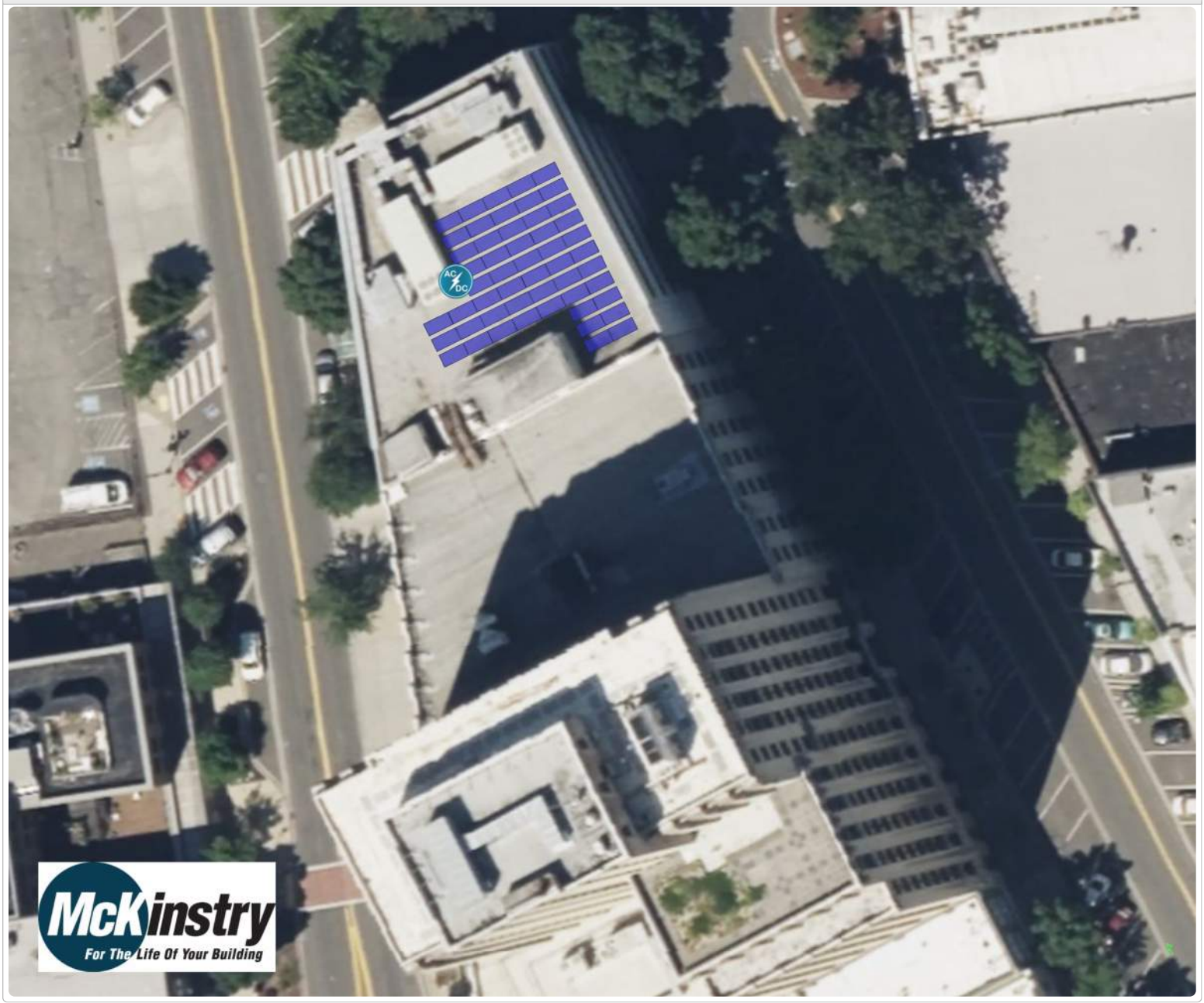
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	17-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Fixed Tilt	Landscape (Horizontal)	10°	153.536°	1.2 ft	1x1	52	52	27.8 kW

Detailed Layout



Fire Station #08-JTK_v0 City of Tacoma

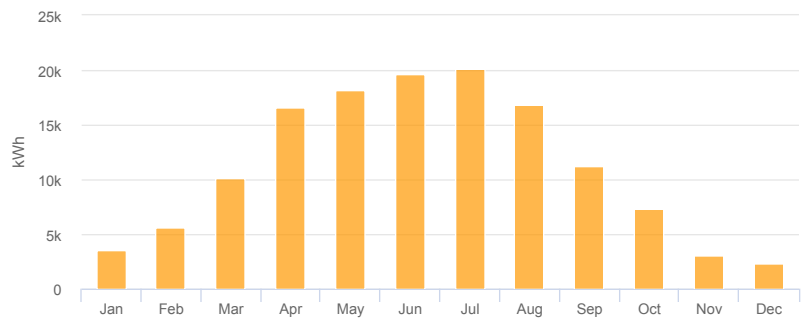
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Jacob Keith jacobk@mckinstry.com

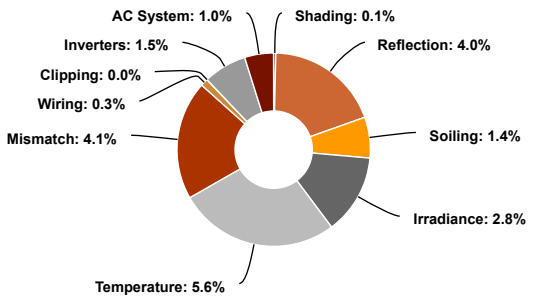
System Metrics

Design	Fire Station #08-JTK_v0
Module DC Nameplate	134.8 kW
Inverter AC Nameplate	100.0 kW Load Ratio: 1.35
Annual Production	134.4 MWh
Performance Ratio	82.0%
kWh/kWp	997.1
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	ea195126f3-3db08aa5b1-d805f20fa7-09c9f87a3a

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,215.5	-1.9%
	Shaded Irradiance	1,214.6	-0.1%
	Irradiance after Reflection	1,166.4	-4.0%
	Irradiance after Soiling	1,150.0	-1.4%
	Total Collector Irradiance	**1,150.0**	**0.0%**
Energy (kWh)	Nameplate	156,976.6	
	Output at Irradiance Levels	152,637.4	-2.8%
	Output at Cell Temperature Derate	144,140.8	-5.6%
	Output After Mismatch	138,211.7	-4.1%
	Optimal DC Output	137,857.3	-0.3%
	Constrained DC Output	137,854.0	0.0%
	Inverter Output	135,786.2	-1.5%
	Energy to Grid	**134,428.3**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp	13.1 °C	
	Avg. Operating Cell Temp	25.9 °C	
Simulation Metrics			
	Operating Hours	4258	
	Solved Hours	4258	

Condition Set

Description	Condition Set 1
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Solar Angle Location	Project Lat/Lng
Transposition Model	Perez Model
Temperature Model	Diffusion Model

Temperature Model Parameters

Rack Type	U_{const}	U_{wind}
Fixed Tilt	20	0
Flush Mount	15	0
East-West	20	0
Carport	29	0

Soiling (%)

J	F	M	A	M	J	J	A	S	O	N
3	4	2	1	1	1	1	1	1	0	4

Irradiation Variance	3.5%
Cell Temperature Spread	3° C
Module Binning Range	0% to 2.5%
AC System Derate	1.00%

Trackers

Maximum Angle	Backtracking
60°	Enabled

Module Characterizations

Module	Uploaded By	Characterization
JAM72D30-535/MB (JA Solar)	McKinstry Solar	JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN

Component Characterizations

Device	Uploaded By	Characterizatio
CPS SCA50KTL-DO/US-480 (Sept17) (Chint)	HelioScope	Spec Sheet

Components

Component	Name	Count
Inverters	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)	2 (100.0 kW)
Strings	10 AWG (Copper)	14 (1,514.4 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	252 (134.8 kW)

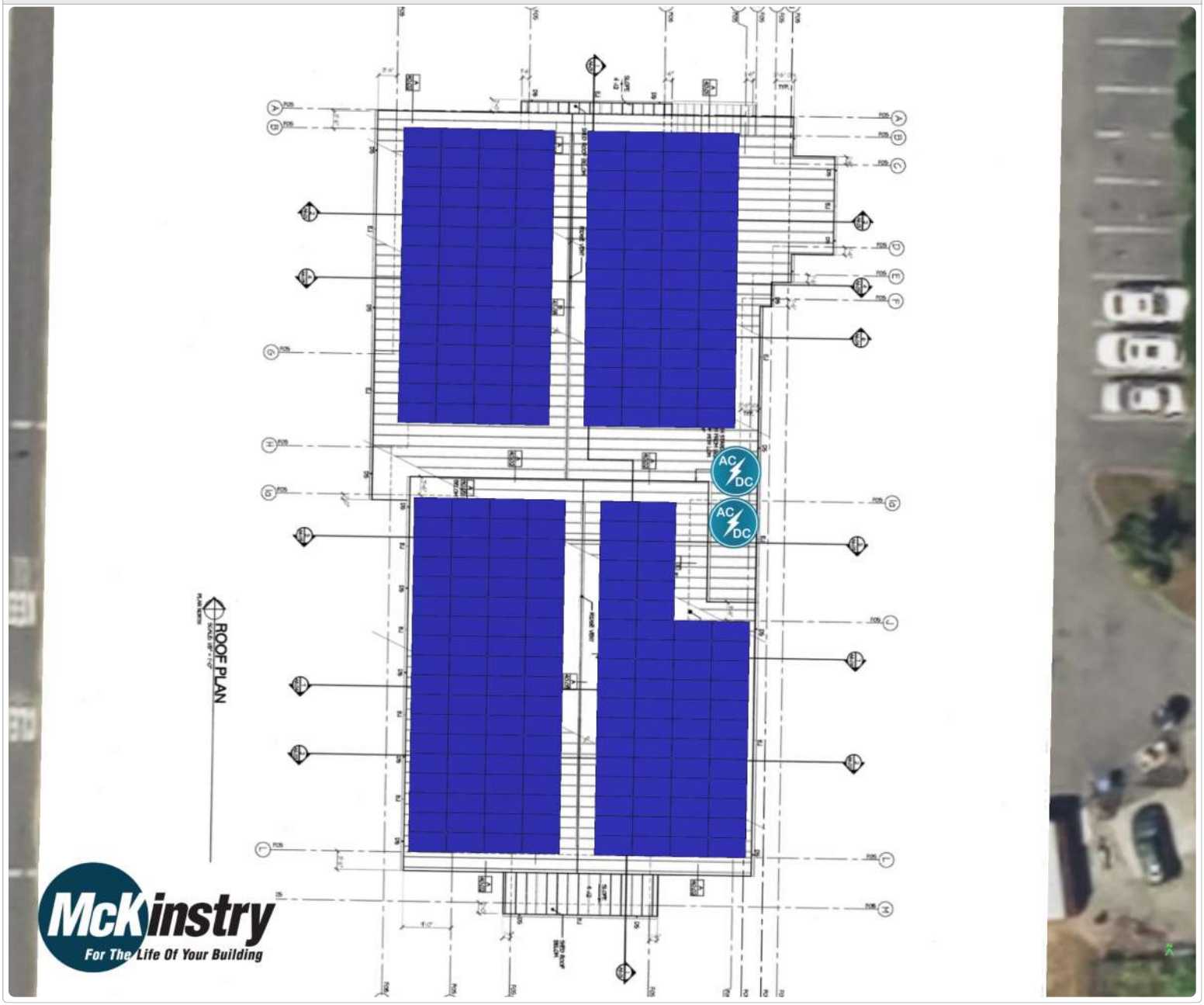
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	18-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Flush Mount	Portrait (Vertical)	18°	270.96564°	0.1 ft	1x1	72	72	38.5 kW
Field Segment 2	Flush Mount	Portrait (Vertical)	18°	91.03362°	0.1 ft	1x1	60	60	32.1 kW
Field Segment 3	Flush Mount	Portrait (Vertical)	18°	271.17902°	0.1 ft	1x1	60	60	32.1 kW
Field Segment 4	Flush Mount	Portrait (Vertical)	18°	90.81961°	0.1 ft	1x1	60	60	32.1 kW

Detailed Layout



Police Headquarters-JTK_v0 City of Tacoma

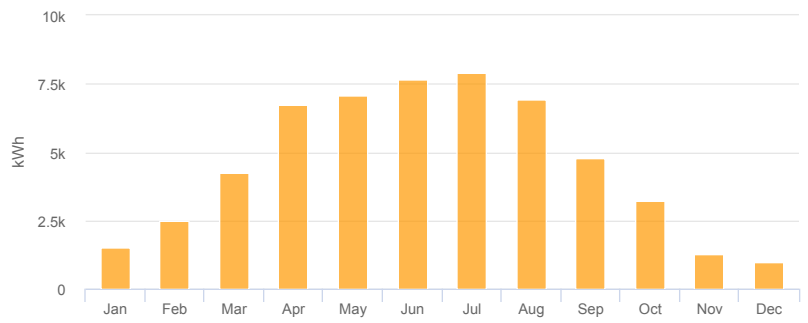
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Jacob Keith jacobk@mckinstry.com

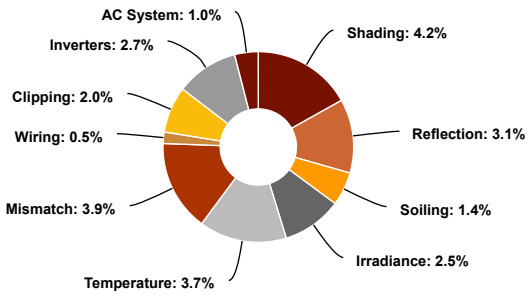
System Metrics

Design	Police Headquarters-JTK_v0
Module DC Nameplate	52.4 kW
Inverter AC Nameplate	36.0 kW Load Ratio: 1.46
Annual Production	54.75 MWh
Performance Ratio	78.5%
kWh/kWp	1,044.2
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	ea195126f3-3db08aa5b1-d805f20fa7-09c9f87a3a

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,329.6	7.3%
	Shaded Irradiance	1,273.5	-4.2%
	Irradiance after Reflection	1,233.6	-3.1%
	Irradiance after Soiling	1,216.0	-1.4%
	Total Collector Irradiance	**1,216.1**	**0.0%**
Energy (kWh)	Nameplate	64,553.0	
	Output at Irradiance Levels	62,909.0	-2.5%
	Output at Cell Temperature Derate	60,570.6	-3.7%
	Output After Mismatch	58,228.7	-3.9%
	Optimal DC Output	57,945.2	-0.5%
	Constrained DC Output	56,805.7	-2.0%
	Inverter Output	55,299.1	-2.7%
	Energy to Grid	**54,746.1**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp		13.1 °C
	Avg. Operating Cell Temp		23.3 °C
Simulation Metrics			
	Operating Hours		4258
	Solved Hours		4258

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type				U_{const}			U_{wind}				
	Fixed Tilt				20			0				
	Flush Mount				15			0				
	East-West				20			0				
	Carport				29			0				
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	
	3	4	2	1	1	1	1	1	1	0	4	
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle							Backtracking				
	60°							Enabled				
Module Characterizations	Module		Uploaded By		Characterization							
	JAM72D30-535/MB (JA Solar)		McKinstry Solar		JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN							
Component Characterizations	Device				Uploaded By			Characterizatio				
	CPS SCA36KTL-DO/US-480 (2023) (CPS)				HelioScope			Spec Sheet				

Components

Component	Name	Count
Inverters	CPS SCA36KTL-DO/US-480 (2023) (CPS)	1 (36.0 kW)
Strings	10 AWG (Copper)	6 (1,104.5 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	98 (52.4 kW)

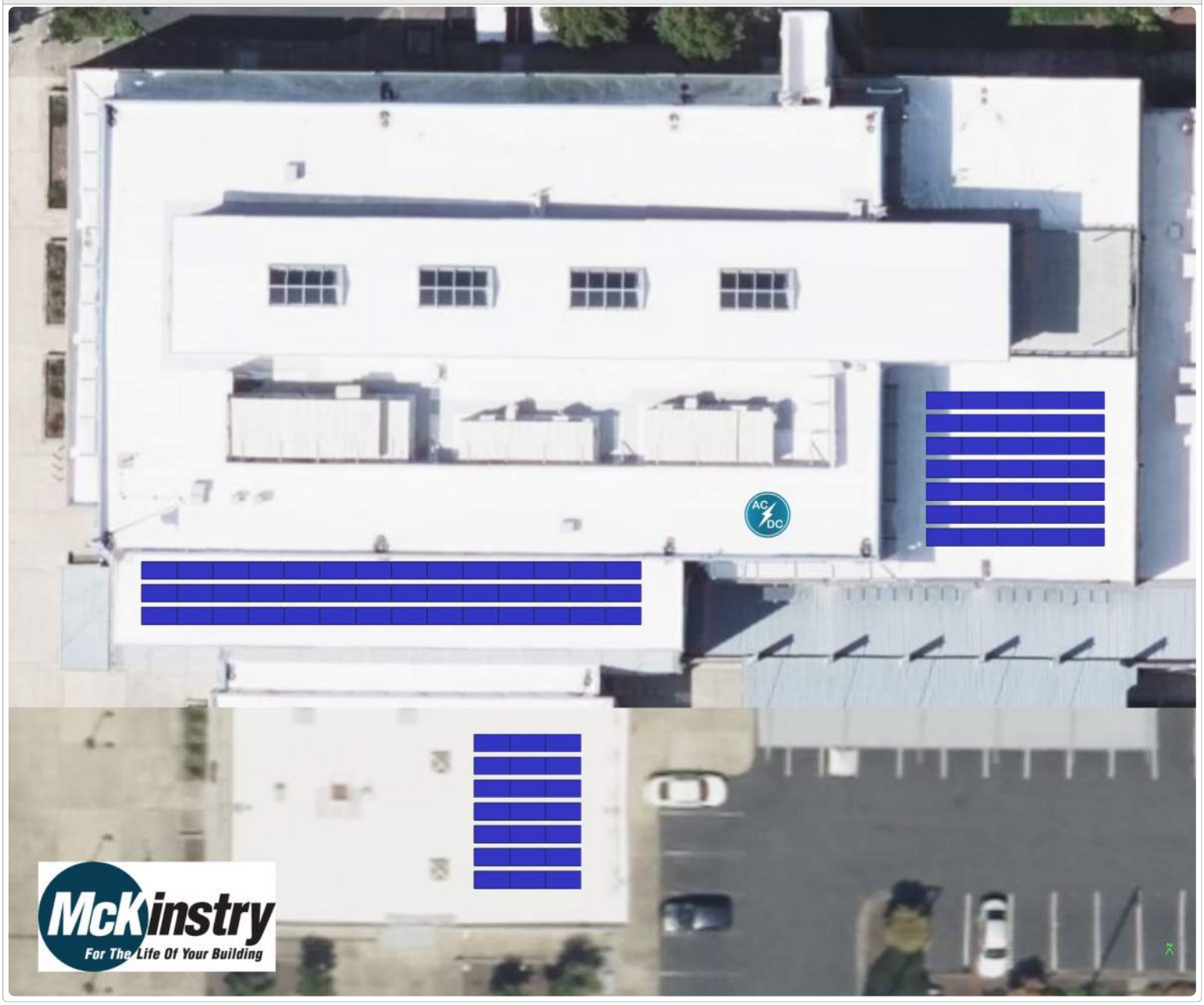
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	16-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Removed	Flush Mount	Landscape (Horizontal)	4°	90°	1.2 ft	1x1			0
Field Segment 2	Fixed Tilt	Landscape (Horizontal)	10°	180°	1.2 ft	1x1	42	42	22.5 kW
Field Segment 3	Fixed Tilt	Landscape (Horizontal)	10°	180°	1.2 ft	1x1	35	35	18.7 kW
Field Segment 4	Fixed Tilt	Landscape (Horizontal)	10°	180°	1.2 ft	1x1	21	21	11.2 kW

Detailed Layout



Tacoma Convention Center-JTK_v0 City of Tacoma

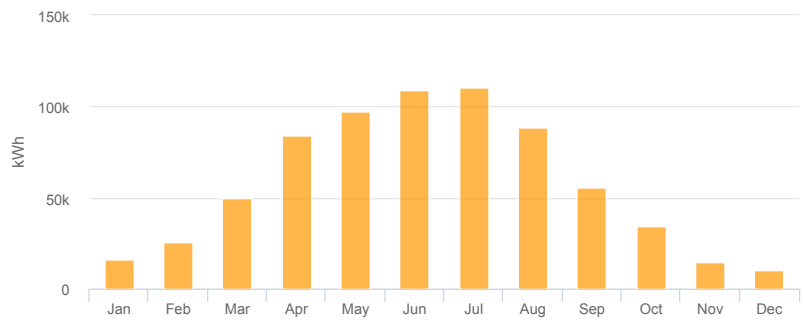
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Jacob Keith jacobk@mckinstry.com

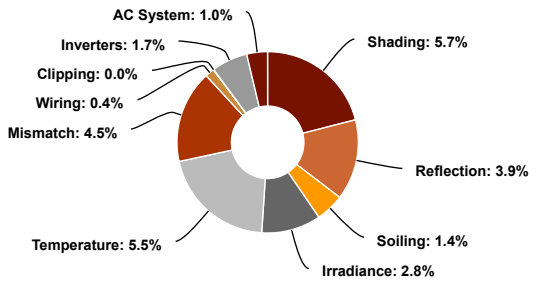
System Metrics

Design	Tacoma Convention Center-JTK_v0
Module DC Nameplate	723.9 kW
Inverter AC Nameplate	540.0 kW Load Ratio: 1.34
Annual Production	695.9 MWh
Performance Ratio	76.9%
kWh/kWp	961.4
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	ea195126f3-3db08aa5b1-d805f20fa7-09c9f87a3a

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,250.5	0.9%
	Shaded Irradiance	1,179.8	-5.7%
	Irradiance after Reflection	1,134.1	-3.9%
	Irradiance after Soiling	1,118.6	-1.4%
	Total Collector Irradiance	**1,118.3**	**0.0%**
Energy (kWh)	Nameplate	819,579.7	
	Output at Irradiance Levels	796,229.0	-2.8%
	Output at Cell Temperature Derate	752,120.6	-5.5%
	Output After Mismatch	718,600.5	-4.5%
	Optimal DC Output	715,438.1	-0.4%
	Constrained DC Output	715,310.4	0.0%
	Inverter Output	702,917.1	-1.7%
	Energy to Grid	**695,887.9**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp		13.1 °C
	Avg. Operating Cell Temp		25.6 °C
Simulation Metrics			
	Operating Hours		4258
	Solved Hours		4258

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type						U_{const}				U_{wind}	
	Fixed Tilt						20				0	
	Flush Mount						15				0	
	East-West						20				0	
	Carport						29				0	
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	
	3	4	2	1	1	1	1	1	1	0	4	
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle									Backtracking		
	60°									Enabled		
Module Characterizations	Module			Uploaded By			Characterization					
	JAM72D30-535/MB (JA Solar)			McKinstry Solar			JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN					
Component Characterizations	Device						Uploaded By			Characterization		
	CPS SCA60KTL-DO/US-480 (Chint Power Systems)						HelioScope			Default Characterization		

Components

Component	Name	Count
Inverters	CPS SCA60KTL-DO/US-480 (Chint Power Systems)	9 (540.0 kW)
Strings	10 AWG (Copper)	81 (12,805.2 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	1,353 (723.9 kW)

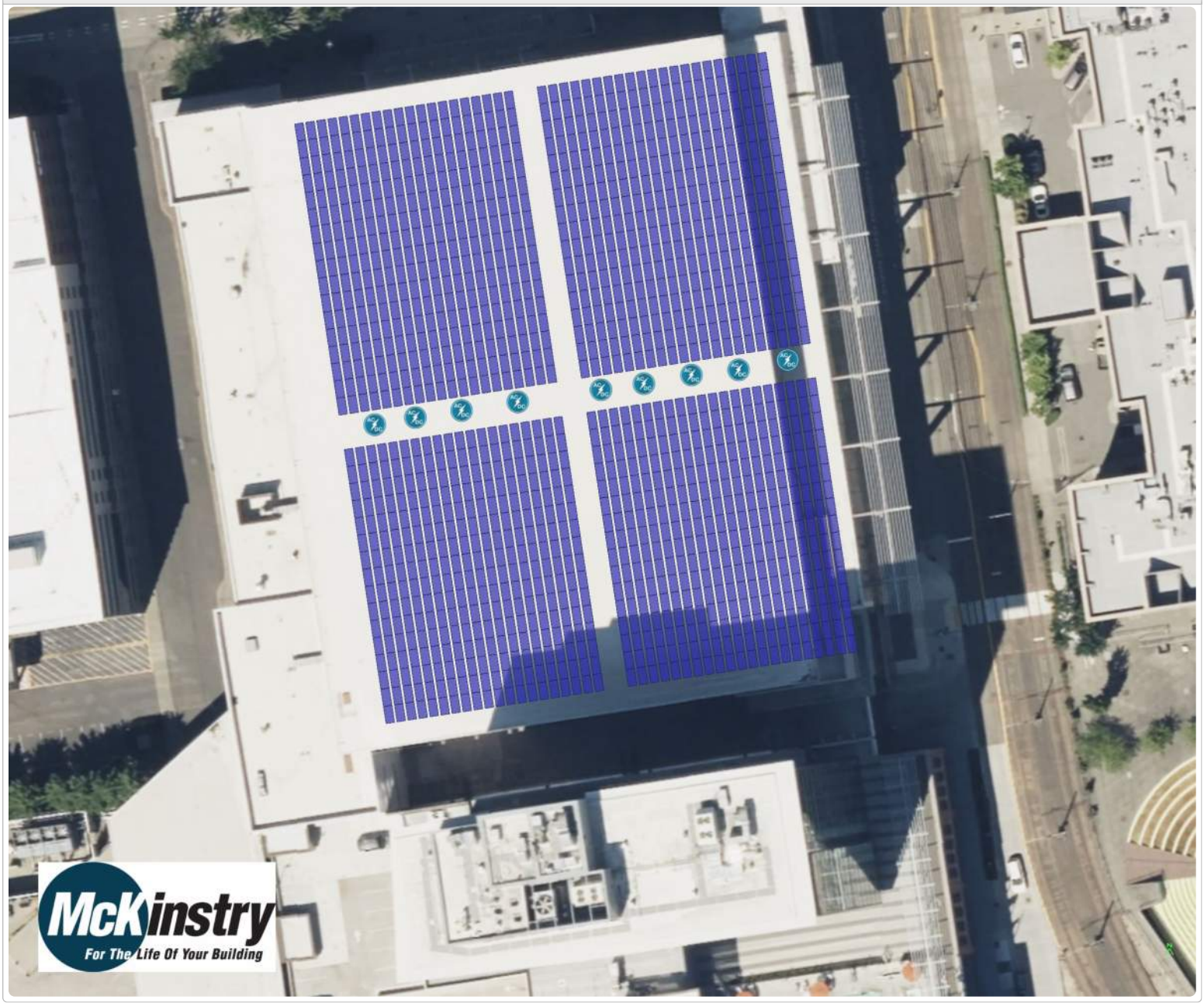
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	15-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Field Segment 1	Flush Mount	Landscape (Horizontal)	5°	261.32486°	1.2 ft	1x1	1,353	1,353	723.9 kW

Detailed Layout



Tacoma Recovery & Transfer Center-JTK_v0 City of Tacoma

Tacoma, WA

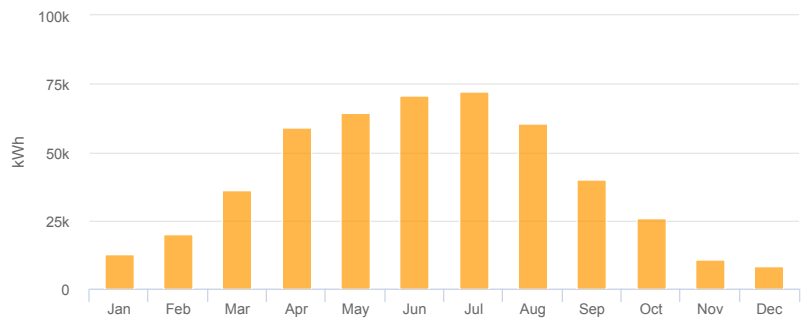
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Jacob Keith jacobk@mckinstry.com

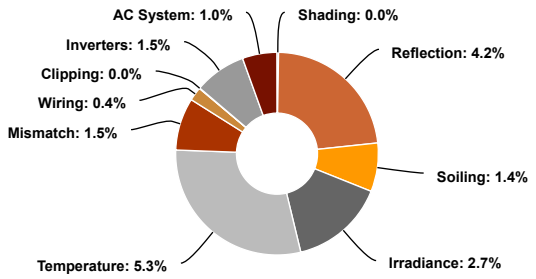
System Metrics

Design	Tacoma Recovery & Transfer Center-JTK_v0
Module DC Nameplate	460.6 kW
Inverter AC Nameplate	350.0 kW Load Ratio: 1.32
Annual Production	481.2 MWh
Performance Ratio	84.2%
kWh/kWp	1,044.7
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	ea195126f3-3db08aa5b1-d805f20fa7-09c9f87a3a

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,240.9	0.1%
	Shaded Irradiance	1,240.3	0.0%
	Irradiance after Reflection	1,188.4	-4.2%
	Irradiance after Soiling	1,171.7	-1.4%
	Total Collector Irradiance	**1,171.7**	**0.0%**
Energy (kWh)	Nameplate	546,453.8	
	Output at Irradiance Levels	531,436.3	-2.7%
	Output at Cell Temperature Derate	503,166.7	-5.3%
	Output After Mismatch	495,533.1	-1.5%
	Optimal DC Output	493,565.1	-0.4%
	Constrained DC Output	493,501.7	0.0%
	Inverter Output	486,098.3	-1.5%
	Energy to Grid	**481,237.3**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp	13.1 °C	
	Avg. Operating Cell Temp	26.0 °C	
Simulation Metrics			
	Operating Hours	4258	
	Solved Hours	4258	

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type				U_{const}			U_{wind}				
	Fixed Tilt				20			0				
	Flush Mount				15			0				
	East-West				20			0				
	Carport				29			0				
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	
	3	4	2	1	1	1	1	1	1	0	4	
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle							Backtracking				
	60°							Enabled				
Module Characterizations	Module		Uploaded By		Characterization							
	JAM72D30-535/MB (JA Solar)		McKinstry Solar		JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN							
Component Characterizations	Device							Uploaded By			Characterizatio	
	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)							HelioScope			Spec Sheet	

Components

Component	Name	Count
Inverters	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)	7 (350.0 kW)
Strings	10 AWG (Copper)	49 (10,849.7 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	861 (460.6 kW)

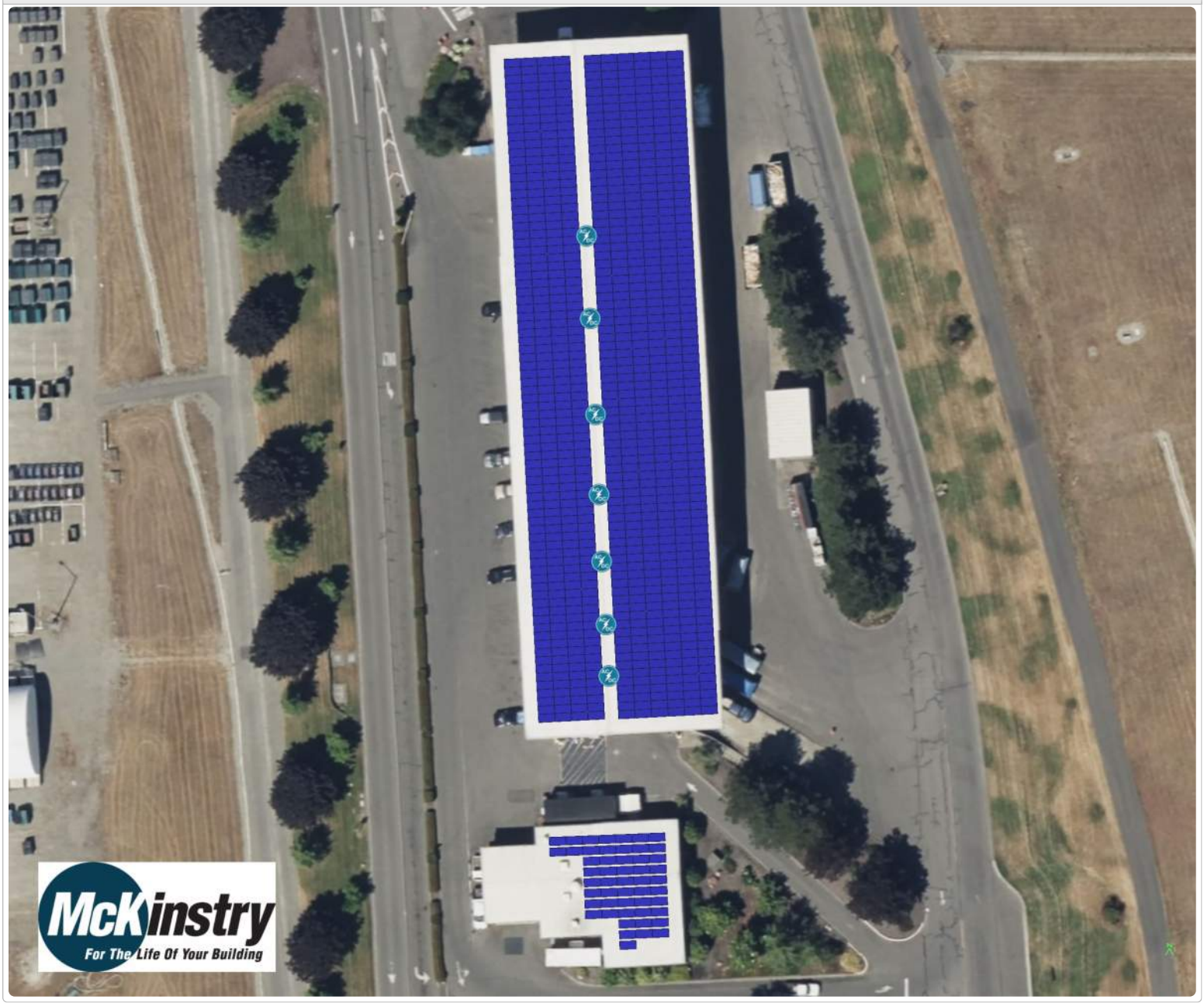
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	17-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Transfer Station W	Flush Mount	Portrait (Vertical)	5°	266.994°	0.1 ft	1x1	324	324	173.3 kW
Transfer Station E	Flush Mount	Portrait (Vertical)	5°	86.99358°	0.1 ft	1x1	486	486	260.0 kW
Admin Bldg.	Fixed Tilt	Landscape (Horizontal)	5°	177.72955°	1.2 ft	1x1	51	51	27.3 kW

Detailed Layout



Tacoma Public Library - Main Branch-JTK_v0 City of Tacoma

Tacoma, WA

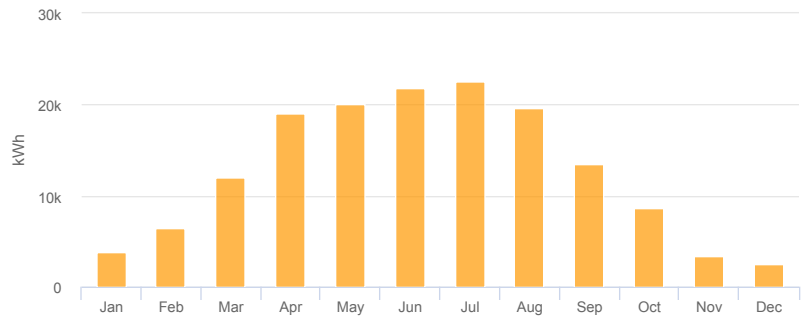
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Jacob Keith jacobk@mckinstry.com

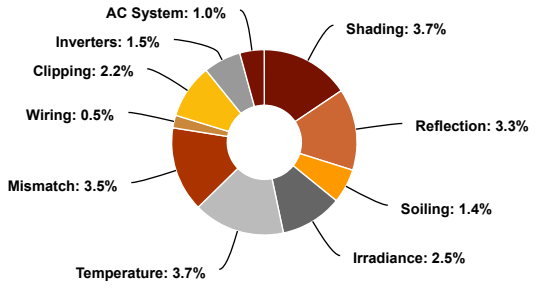
System Metrics

Design	Tacoma Public Library - Main Branch-JTK_v0
Module DC Nameplate	144.5 kW
Inverter AC Nameplate	100.0 kW Load Ratio: 1.44
Annual Production	153.0 MWh
Performance Ratio	79.8%
kWh/kWp	1,059.5
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	ea195126f3-3db08aa5b1-d805f20fa7-09c9f87a3a

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,327.2	7.1%
	Shaded Irradiance	1,278.7	-3.7%
	Irradiance after Reflection	1,236.0	-3.3%
	Irradiance after Soiling	1,218.7	-1.4%
	Total Collector Irradiance	**1,218.7**	**0.0%**
Energy (kWh)	Nameplate	178,241.7	
	Output at Irradiance Levels	173,711.7	-2.5%
	Output at Cell Temperature Derate	167,215.4	-3.7%
	Output After Mismatch	161,395.7	-3.5%
	Optimal DC Output	160,565.2	-0.5%
	Constrained DC Output	157,003.9	-2.2%
	Inverter Output	154,595.5	-1.5%
	Energy to Grid	**153,049.5**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp		13.1 °C
	Avg. Operating Cell Temp		23.3 °C
Simulation Metrics			
	Operating Hours		4258
	Solved Hours		4258

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type				U_{const}			U_{wind}				
	Fixed Tilt				20			0				
	Flush Mount				15			0				
	East-West				20			0				
	Carport				29			0				
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	
	3	4	2	1	1	1	1	1	1	0	4	
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle							Backtracking				
	60°							Enabled				
Module Characterizations	Module		Uploaded By		Characterization							
	JAM72D30-535/MB (JA Solar)		McKinstry Solar		JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN							
Component Characterizations	Device							Uploaded By			Characterizatio	
	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)							HelioScope			Spec Sheet	

Components

Component	Name	Count
Inverters	CPS SCA50KTL-DO/US-480 (Sept17) (Chint)	2 (100.0 kW)
Strings	10 AWG (Copper)	15 (3,480.7 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	270 (144.5 kW)

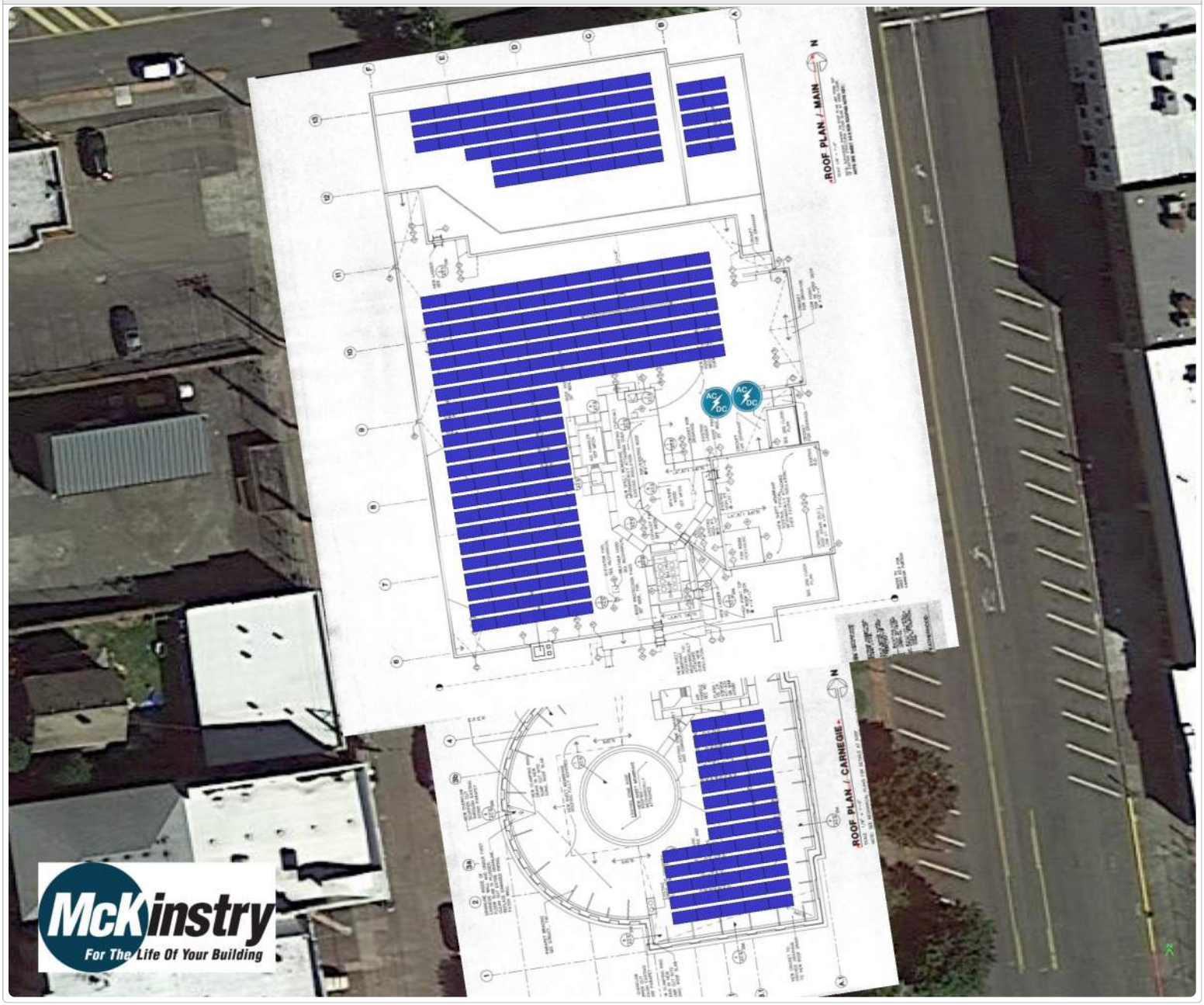
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	18-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
Central Segment	Fixed Tilt	Landscape (Horizontal)	10°	171.00432°	1.2 ft	1x1	159	159	85.1 kW
North Segment	Fixed Tilt	Landscape (Horizontal)	10°	171.00432°	1.2 ft	1x1	62	62	33.2 kW
South Segment	Fixed Tilt	Landscape (Horizontal)	10°	171.00432°	1.2 ft	1x1	49	49	26.2 kW

Detailed Layout



Lighthouse Senior Center-JTK_v0 City of Tacoma

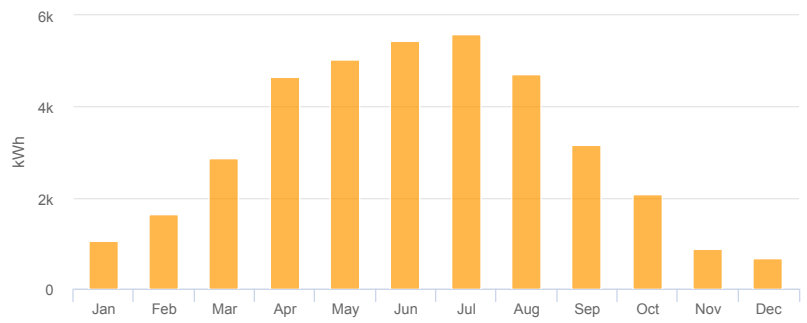
Report

Project Name	City of Tacoma
Project Address	1500 Commerce St, Tacoma, WA
Prepared By	Jacob Keith jacobk@mckinstry.com

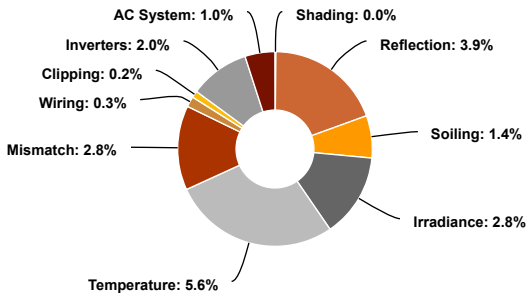
System Metrics

Design	Lighthouse Senior Center-JTK_v0
Module DC Nameplate	38.5 kW
Inverter AC Nameplate	25.0 kW Load Ratio: 1.54
Annual Production	37.79 MWh
Performance Ratio	82.5%
kWh/kWp	980.9
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)
Simulator Version	ea195126f3-3db08aa5b1-d805f20fa7-09c9f87a3a

Monthly Production



Sources of System Loss



Annual Production

	Description	Output	% Delta
Irradiance (kWh/m²)	Annual Global Horizontal Irradiance	1,239.4	
	POA Irradiance	1,189.0	-4.1%
	Shaded Irradiance	1,188.6	0.0%
	Irradiance after Reflection	1,142.4	-3.9%
	Irradiance after Soiling	1,126.3	-1.4%
	Total Collector Irradiance	**1,126.2**	**0.0%**
Energy (kWh)	Nameplate	43,922.3	
	Output at Irradiance Levels	42,690.6	-2.8%
	Output at Cell Temperature Derate	40,309.3	-5.6%
	Output After Mismatch	39,170.8	-2.8%
	Optimal DC Output	39,034.8	-0.3%
	Constrained DC Output	38,947.6	-0.2%
	Inverter Output	38,166.9	-2.0%
	Energy to Grid	**37,785.3**	**-1.0%**
Temperature Metrics			
	Avg. Operating Ambient Temp	13.1 °C	
	Avg. Operating Cell Temp	25.7 °C	
Simulation Metrics			
	Operating Hours	4258	
	Solved Hours	4258	

Condition Set

Description	Condition Set 1											
Weather Dataset	TMY, TACOMA NARROWS, NSRDB (tmy3, II)											
Solar Angle Location	Project Lat/Lng											
Transposition Model	Perez Model											
Temperature Model	Diffusion Model											
Temperature Model Parameters	Rack Type				U_{const}			U_{wind}				
	Fixed Tilt				20			0				
	Flush Mount				15			0				
	East-West				20			0				
	Carport				29			0				
Soiling (%)	J	F	M	A	M	J	J	A	S	O	N	
	3	4	2	1	1	1	1	1	1	0	4	
Irradiation Variance	3.5%											
Cell Temperature Spread	3° C											
Module Binning Range	0% to 2.5%											
AC System Derate	1.00%											
Trackers	Maximum Angle							Backtracking				
	60°							Enabled				
Module Characterizations	Module			Uploaded By			Characterization					
	JAM72D30-535/MB (JA Solar)			McKinstry Solar			JASOLAR_JAM72D30_535_MB_RETC_131_210301_PV 79.PAN, PAN					
Component Characterizations	Device						Uploaded By			Characterizatio		
	CPS SCA25KTL-DO-R/US-480 (Chint Power)						HelioScope			Spec Sheet		

Components

Component	Name	Count
Inverters	CPS SCA25KTL-DO-R/US-480 (Chint Power)	1 (25.0 kW)
Strings	10 AWG (Copper)	4 (559.3 ft)
Module	JA Solar, JAM72D30-535/MB (535W)	72 (38.5 kW)

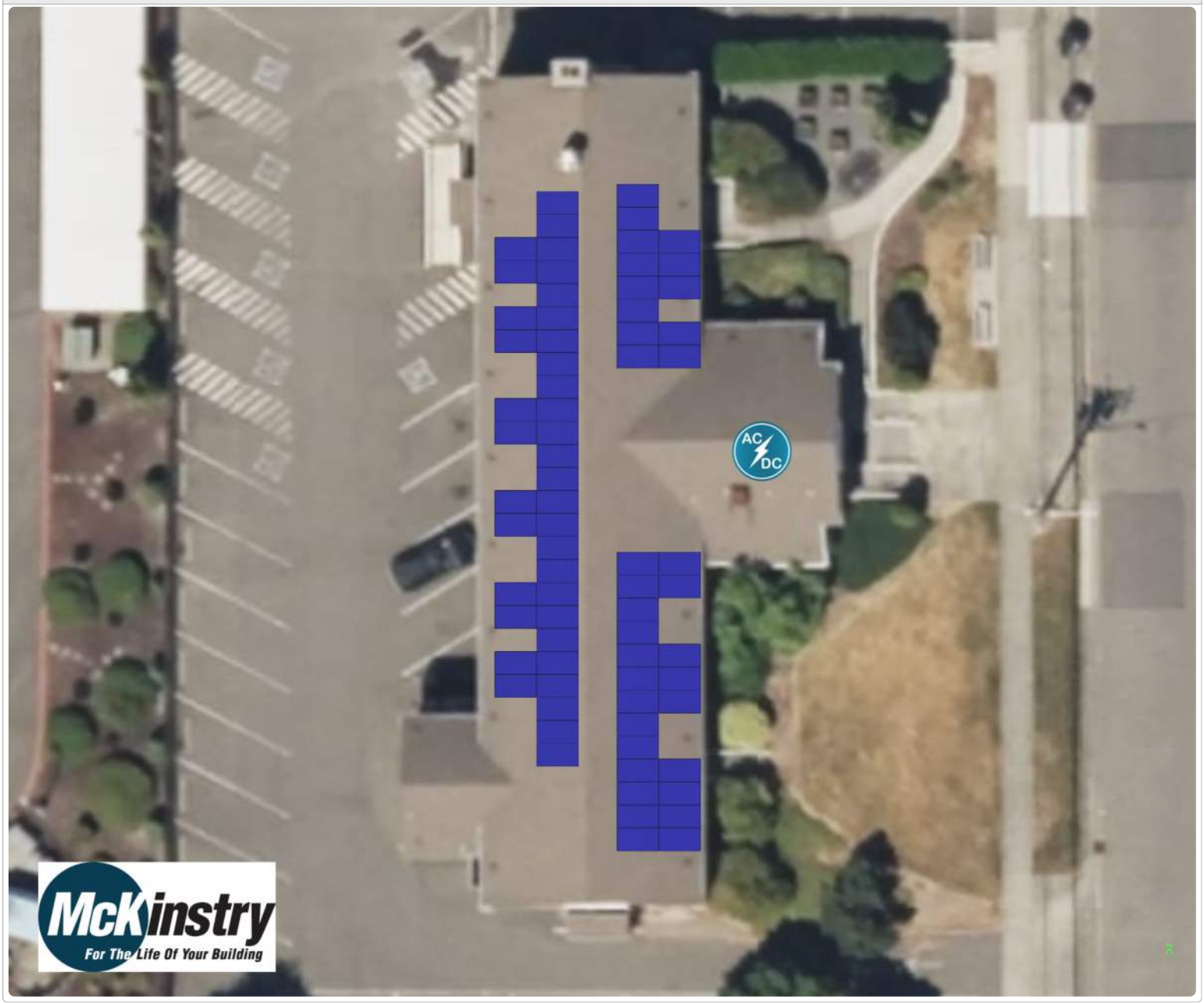
Wiring Zones

Description	Combiner Poles	String Size	Stringing Strategy
Wiring Zone	-	18-18	Along Racking

Field Segments

Description	Racking	Orientation	Tilt	Azimuth	Intrarow Spacing	Frame Size	Frames	Modules	Power
West Segment	Flush Mount	Portrait (Vertical)	26°	270°	0.1 ft	1x1	37	37	19.8 kW
East Segment	Flush Mount	Portrait (Vertical)	26°	90°	0.1 ft	1x1	35	35	18.7 kW

Detailed Layout



OVERVIEW

BUILDING INFORMATION

Tacoma Municipal Building
747 Market St
Tacoma, WA 98402

Report Type	**WA Commerce Clean Buildings - Form D Report**
Gross Floor Area:	**207,020.0 ft²**
Building ID #:	**28129**
Project Name	**City of Tacoma Decarbonization**
Report Status:	**In Progress**
Report Date:	**03/21/2023**
Year Built:	**2023**
Software Release:	2023.0.0.486
Washington State Building ID	**1**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

This report follows the ASHRAE/ACCA Standard 211P, Standard for Commercial Building Energy Audits. It also includes additional data fields required by specific cities, where applicable. The icons below identify data categories.

- ASHRAE Level 2 inputs
- City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with * indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.

CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Tacoma Municipal Building**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Tacoma Municipal Building**

Building Characteristics

Gross Floor Area*	207020.0
Total Conditioned Floor Area	0.0
Historic Building?*	Yes

Use Types

Office

Use Type / Space Function / Building Area Type*	Office
Gross Floor Area*	207020.0
Number of Occupants*	477
Use (hours/week)*	65.0
Use (weeks/year)*	52.0

Building Name: **Tacoma Municipal Building**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
01/01/2018	01/31/2018	31	271599.969	0.0	0.0	0%	8761	29894
02/01/2018	02/28/2018	28	275600.0	0.0	0.0	0%	9843	33584
03/01/2018	03/31/2018	31	235200.031	0.0	0.0	0%	7587	25887
04/01/2018	04/30/2018	30	189799.969	0.0	0.0	0%	6327	21587
05/01/2018	05/31/2018	31	175399.969	0.0	0.0	0%	5658	19305
06/01/2018	06/30/2018	30	154400.031	0.0	0.0	0%	5147	17560
07/01/2018	07/31/2018	31	171600.031	0.0	0.0	0%	5535	18887
08/01/2018	08/31/2018	31	170199.969	0.0	0.0	0%	5490	18733
09/01/2018	09/30/2018	30	147600.0	0.0	0.0	0%	4920	16787
10/01/2018	10/31/2018	31	182200.031	0.0	0.0	0%	5877	20054
11/01/2018	11/30/2018	30	206800.0	0.0	0.0	0%	6893	23520
12/01/2018	12/31/2018	31	256999.969	0.0	0.0	0%	8290	28287
01/01/2019	01/31/2019	31	255599.969	0.0	0.0	0%	8245	28132
02/01/2019	02/28/2019	28	285400.031	0.0	0.0	0%	10193	34778
03/01/2019	03/31/2019	31	244800.0	0.0	0.0	0%	7897	26944
04/01/2019	04/30/2019	30	205999.969	0.0	0.0	0%	6867	23429
05/01/2019	05/31/2019	31	214000.0	0.0	0.0	0%	6903	23554
06/01/2019	06/30/2019	30	173400.0	0.0	0.0	0%	5780	19721
07/01/2019	07/31/2019	31	166600.031	0.0	0.0	0%	5374	18337
08/01/2019	08/31/2019	31	166999.969	0.0	0.0	0%	5387	18381
09/01/2019	09/30/2019	30	155400.0	0.0	0.0	0%	5180	17674
10/01/2019	10/31/2019	31	221199.938	0.0	0.0	0%	7135	24346
11/01/2019	11/30/2019	30	204600.0	0.0	0.0	0%	6820	23270
12/01/2019	12/31/2019	31	227399.969	0.0	0.0	0%	7335	25029
01/01/2020	01/31/2020	31	241400.031	0.0	0.0	0%	7787	26570
02/01/2020	02/29/2020	29	213399.969	0.0	0.0	0%	7359	25108
03/01/2020	03/31/2020	31	221400.0	0.0	0.0	0%	7142	24368
04/01/2020	04/30/2020	30	160799.969	0.0	0.0	0%	5360	18288
05/01/2020	05/31/2020	31	139400.0	0.0	0.0	0%	4497	15343
06/01/2020	06/30/2020	30	130800.0	0.0	0.0	0%	4360	14876

Building Name: **Tacoma Municipal Building**

07/01/2020	07/31/2020	31	140400.0	0.0	0.0	0%	4529	15453
08/01/2020	08/31/2020	31	140200.0	0.0	0.0	0%	4523	15431
09/01/2020	09/30/2020	30	129599.977	0.0	0.0	0%	4320	14740
10/01/2020	10/31/2020	31	62400.0	0.0	0.0	0%	2013	6868
11/01/2020	11/30/2020	30	190599.969	0.0	0.0	0%	6353	21678
12/01/2020	12/31/2020	31	336999.969	0.0	0.0	0%	10871	37092
01/01/2021	01/31/2021	31	193399.969	0.0	0.0	0%	6239	21286
02/01/2021	02/28/2021	28	233400.031	0.0	0.0	0%	8336	28441
03/01/2021	03/31/2021	31	205800.031	0.0	0.0	0%	6639	22651
04/01/2021	04/30/2021	30	156400.0	0.0	0.0	0%	5213	17788
05/01/2021	05/31/2021	31	125799.977	0.0	0.0	0%	4058	13846
06/01/2021	06/30/2021	30	129800.031	0.0	0.0	0%	4327	14763
07/01/2021	07/31/2021	31	136200.0	0.0	0.0	0%	4394	14991
08/01/2021	08/31/2021	31	146800.031	0.0	0.0	0%	4735	16157
09/01/2021	09/30/2021	30	128000.031	0.0	0.0	0%	4267	14558
10/01/2021	10/31/2021	31	147400.0	0.0	0.0	0%	4755	16224
11/01/2021	11/30/2021	30	189800.0	0.0	0.0	0%	6327	21587
12/01/2021	12/31/2021	31	254599.969	0.0	0.0	0%	8213	28022
01/01/2022	01/31/2022	31	243799.969	0.0	0.0	0%	7865	26834
02/01/2022	02/28/2022	28	211200.031	0.0	0.0	0%	7543	25736
03/01/2022	03/31/2022	31	192600.0	0.0	0.0	0%	6213	21198
04/01/2022	04/30/2022	30	188199.969	0.0	0.0	0%	6273	21405
05/01/2022	05/31/2022	31	162200.0	0.0	0.0	0%	5232	17852
06/01/2022	06/30/2022	30	146000.031	0.0	0.0	0%	4867	16605
07/01/2022	07/31/2022	31	157400.0	0.0	0.0	0%	5077	17324
08/01/2022	08/31/2022	31	167000.031	0.0	0.0	0%	5387	18381
09/01/2022	09/30/2022	30	147999.969	0.0	0.0	0%	4933	16833
10/01/2022	10/31/2022	31	157999.969	0.0	0.0	0%	5097	17390
11/01/2022	11/30/2022	30	221600.031	0.0	0.0	0%	7387	25203
12/01/2022	12/31/2022	31	269200.0	0.0	0.0	0%	8684	29629
01/01/2023	01/31/2023	31	219800.031	0.0	0.0	0%	7090	24192
	Average Annual Total		**0**	**0**	**0**	**0%**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

UTILITY DATA AND BENCHMARKING

Building Name: **Tacoma Municipal Building**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	40.5
Target Site Energy Intensity*	66.0

Building Name: **Tacoma Municipal Building**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	90196	307749	26.3
Space Heating	662703	2261143	193.26
Air Distribution	39329	134191	11.47
Lighting	850885	2903220	248.13
Plug Loads	479686	1636689	139.88
Service Water Heating	17664	60270	5.15
Total	**2140463**	**7303260**	**624.2**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**2140463**	**7303260**	**624.2**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

OVERVIEW

BUILDING INFORMATION

Tacoma Municipal Building North
733 Market St
Tacoma, WA 98402

Report Type	**WA Commerce Clean Buildings - Form D Report**
Gross Floor Area:	**41,400.0 ft²**
Building ID #:	**28135**
Project Name	**City of Tacoma Decarbonization**
Report Status:	**In Progress**
Report Date:	**03/21/2023**
Year Built:	**2023**
Software Release:	2023.0.0.486
Washington State Building ID	**2**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

This report follows the ASHRAE/ACCA Standard 211P, Standard for Commercial Building Energy Audits. It also includes additional data fields required by specific cities, where applicable. The icons below identify data categories.

- ASHRAE Level 2 inputs
- City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with * indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.

CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Tacoma Municipal Building North**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Tacoma Municipal Building North**

Building Characteristics

Gross Floor Area*	41400.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Office

Use Type / Space Function / Building Area Type*	Office
Gross Floor Area*	41400.0
Number of Occupants*	96
Use (hours/week)*	65.0
Use (weeks/year)*	52.0

Building Name: **Tacoma Municipal Building North**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
01/01/2018	01/31/2018	31	54653.605	0.0	0.0	0%	1763	6015
02/01/2018	02/28/2018	28	48162.719	0.0	0.0	0%	1720	5869
03/01/2018	03/31/2018	31	50561.43	0.0	0.0	0%	1631	5565
04/01/2018	04/30/2018	30	45710.348	0.0	0.0	0%	1524	5199
05/01/2018	05/31/2018	31	47584.496	0.0	0.0	0%	1535	5237
06/01/2018	06/30/2018	30	44790.008	0.0	0.0	0%	1493	5094
07/01/2018	07/31/2018	31	48473.801	0.0	0.0	0%	1564	5335
08/01/2018	08/31/2018	31	46073.711	0.0	0.0	0%	1486	5071
09/01/2018	09/30/2018	30	45898.711	0.0	0.0	0%	1530	5220
10/01/2018	10/31/2018	31	46531.039	0.0	0.0	0%	1501	5121
11/01/2018	11/30/2018	30	48435.699	0.0	0.0	0%	1615	5509
12/01/2018	12/31/2018	31	49988.98	0.0	0.0	0%	1613	5502
01/01/2019	01/31/2019	31	57716.121	0.0	0.0	0%	1862	6352
02/01/2019	02/28/2019	28	51948.594	0.0	0.0	0%	1855	6330
03/01/2019	03/31/2019	31	53207.121	0.0	0.0	0%	1716	5856
04/01/2019	04/30/2019	30	47151.73	0.0	0.0	0%	1572	5363
05/01/2019	05/31/2019	31	48634.496	0.0	0.0	0%	1569	5353
06/01/2019	06/30/2019	30	48886.664	0.0	0.0	0%	1630	5560
07/01/2019	07/31/2019	31	58940.914	0.0	0.0	0%	1901	6487
08/01/2019	08/31/2019	31	58247.422	0.0	0.0	0%	1879	6411
09/01/2019	09/30/2019	30	53573.273	0.0	0.0	0%	1786	6093
10/01/2019	10/31/2019	31	46903.461	0.0	0.0	0%	1513	5162
11/01/2019	11/30/2019	30	49354.164	0.0	0.0	0%	1645	5613
12/01/2019	12/31/2019	31	52591.09	0.0	0.0	0%	1696	5788
01/01/2020	01/31/2020	31	58023.039	0.0	0.0	0%	1872	6386
02/01/2020	02/29/2020	29	56266.676	0.0	0.0	0%	1940	6620
03/01/2020	03/31/2020	31	53877.844	0.0	0.0	0%	1738	5930
04/01/2020	04/30/2020	30	40480.305	0.0	0.0	0%	1349	4604
05/01/2020	05/31/2020	31	45321.836	0.0	0.0	0%	1462	4988
06/01/2020	06/30/2020	30	46002.082	0.0	0.0	0%	1533	5232

Building Name: **Tacoma Municipal Building North**

07/01/2020	07/31/2020	31	52448.477	0.0	0.0	0%	1692	5773
08/01/2020	08/31/2020	31	54216.09	0.0	0.0	0%	1749	5967
09/01/2020	09/30/2020	30	49142.527	0.0	0.0	0%	1638	5589
10/01/2020	10/31/2020	31	47595.105	0.0	0.0	0%	1535	5239
11/01/2020	11/30/2020	30	43847.773	0.0	0.0	0%	1462	4987
12/01/2020	12/31/2020	31	50063.074	0.0	0.0	0%	1615	5510
01/01/2021	01/31/2021	31	52880.246	0.0	0.0	0%	1706	5820
02/01/2021	02/28/2021	28	43812.926	0.0	0.0	0%	1565	5339
03/01/2021	03/31/2021	31	48166.383	0.0	0.0	0%	1554	5301
04/01/2021	04/30/2021	30	41441.383	0.0	0.0	0%	1381	4713
05/01/2021	05/31/2021	31	35217.234	0.0	0.0	0%	1136	3876
06/01/2021	06/30/2021	30	38937.516	0.0	0.0	0%	1298	4428
07/01/2021	07/31/2021	31	40831.477	0.0	0.0	0%	1317	4494
08/01/2021	08/31/2021	31	38397.684	0.0	0.0	0%	1239	4226
09/01/2021	09/30/2021	30	37752.695	0.0	0.0	0%	1258	4294
10/01/2021	10/31/2021	31	40980.656	0.0	0.0	0%	1322	4511
11/01/2021	11/30/2021	30	37612.516	0.0	0.0	0%	1254	4278
12/01/2021	12/31/2021	31	40823.859	0.0	0.0	0%	1317	4493
01/01/2022	01/31/2022	31	40080.863	0.0	0.0	0%	1293	4411
02/01/2022	02/28/2022	28	35545.254	0.0	0.0	0%	1269	4331
03/01/2022	03/31/2022	31	41620.254	0.0	0.0	0%	1343	4581
04/01/2022	04/30/2022	30	39310.348	0.0	0.0	0%	1310	4471
05/01/2022	05/31/2022	31	38473.566	0.0	0.0	0%	1241	4235
06/01/2022	06/30/2022	30	39363.629	0.0	0.0	0%	1312	4477
07/01/2022	07/31/2022	31	44507.621	0.0	0.0	0%	1436	4899
08/01/2022	08/31/2022	31	44663.367	0.0	0.0	0%	1441	4916
09/01/2022	09/30/2022	30	39316.004	0.0	0.0	0%	1311	4472
10/01/2022	10/31/2022	31	39749.004	0.0	0.0	0%	1282	4375
11/01/2022	11/30/2022	30	44709.0	0.0	0.0	0%	1490	5085
12/01/2022	12/31/2022	31	48685.992	0.0	0.0	0%	1571	5359
01/01/2023	01/31/2023	31	18890.006	0.0	0.0	0%	609	2079
	Average Annual Total		**0**	**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
01/01/2018	01/31/2018	31	219.94	0.0	7	709
02/01/2018	02/28/2018	28	64.64	0.0	2	231
03/01/2018	03/31/2018	31	14.77	0.0	0	48
04/01/2018	04/30/2018	30	0.52	0.0	0	2
05/01/2018	05/31/2018	31	0.0	0.0	0	0
06/01/2018	06/30/2018	30	0.0	0.0	0	0
07/01/2018	07/31/2018	31	6.94	0.0	0	22
08/01/2018	08/31/2018	31	0.5	0.0	0	2
09/01/2018	09/30/2018	30	0.0	0.0	0	0
10/01/2018	10/31/2018	31	0.0	0.0	0	0

Building Name: **Tacoma Municipal Building North**

11/01/2018	11/30/2018	30	0.0	0.0	0	0
12/01/2018	12/31/2018	31	8.97	0.0	0	29
01/01/2019	01/31/2019	31	3.4	0.0	0	11
02/01/2019	02/28/2019	28	83.88	0.0	3	300
03/01/2019	03/31/2019	31	15.51	0.0	1	50
04/01/2019	04/30/2019	30	0.0	0.0	0	0
05/01/2019	05/31/2019	31	0.0	0.0	0	0
06/01/2019	06/30/2019	30	0.0	0.0	0	0
07/01/2019	07/31/2019	31	0.0	0.0	0	0
08/01/2019	08/31/2019	31	0.0	0.0	0	0
09/01/2019	09/30/2019	30	0.0	0.0	0	0
10/01/2019	10/31/2019	31	29.3	0.0	1	95
11/01/2019	11/30/2019	30	17.81	0.0	1	59
12/01/2019	12/31/2019	31	8.69	0.0	0	28
01/01/2020	01/31/2020	31	36.75	0.0	1	119
02/01/2020	02/29/2020	29	10.83	0.0	0	37
03/01/2020	03/31/2020	31	2.14	0.0	0	7
04/01/2020	04/30/2020	30	0.13	0.0	0	0
05/01/2020	05/31/2020	31	0.0	0.0	0	0
06/01/2020	06/30/2020	30	0.0	0.0	0	0
07/01/2020	07/31/2020	31	0.0	0.0	0	0
08/01/2020	08/31/2020	31	0.0	0.0	0	0
09/01/2020	09/30/2020	30	0.0	0.0	0	0
10/01/2020	10/31/2020	31	0.0	0.0	0	0
11/01/2020	11/30/2020	30	4.31	0.0	0	14
12/01/2020	12/31/2020	31	14.19	0.0	0	46
01/01/2021	01/31/2021	31	9.91	0.0	0	32
02/01/2021	02/28/2021	28	7.4	0.0	0	26
03/01/2021	03/31/2021	31	0.0	0.0	0	0
04/01/2021	04/30/2021	30	0.0	0.0	0	0
05/01/2021	05/31/2021	31	0.0	0.0	0	0
06/01/2021	06/30/2021	30	0.0	0.0	0	0
07/01/2021	07/31/2021	31	0.0	0.0	0	0
08/01/2021	08/31/2021	31	0.0	0.0	0	0
09/01/2021	09/30/2021	30	0.0	0.0	0	0
10/01/2021	10/31/2021	31	0.0	0.0	0	0
11/01/2021	11/30/2021	30	117.88	0.0	4	393
12/01/2021	12/31/2021	31	711.14	0.0	23	2294
01/01/2022	01/31/2022	31	348.12	0.0	11	1123
02/01/2022	02/28/2022	28	117.96	0.0	4	421
03/01/2022	03/31/2022	31	264.35	0.0	9	853
04/01/2022	04/30/2022	30	141.29	0.0	5	471
05/01/2022	05/31/2022	31	137.23	0.0	4	443
06/01/2022	06/30/2022	30	73.55	0.0	2	245
07/01/2022	07/31/2022	31	17.86	0.0	1	58
08/01/2022	08/31/2022	31	13.46	0.0	0	43

Building Name: **Tacoma Municipal Building North**

09/01/2022	09/30/2022	30	37.75	0.0	1	126
10/01/2022	10/31/2022	31	143.66	0.0	5	463
11/01/2022	11/30/2022	30	290.8	0.0	10	969
12/01/2022	12/31/2022	31	315.85	0.0	10	1019
01/01/2023	01/31/2023	31	0.0	0.0	0	0
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Tacoma Municipal Building North
Gross Conditioned Square Feet	41400.0

UTILITY DATA AND BENCHMARKING

Building Name: **Tacoma Municipal Building North**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	51.9
Target Site Energy Intensity*	66.0

Building Name: **Tacoma Municipal Building North**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	79888	272578	23.3
Space Heating	179364	611990	52.97
Air Distribution	102597	350061	29.92
Lighting	133995	457191	39.08
Plug Loads	67714	231040	19.75
Service Water Heating	6665	22741	1.94
Total	**570223**	**1945601**	**166.29**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**570223**	**1945601**	**166.29**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	125	12500	52.97
Total	**125**	**12500**	**0.66**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**125**	**12500**	**0.66**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

OVERVIEW

BUILDING INFORMATION

Fire Station 08
4911 S Alaska St
Tacoma, WA 98408

Report Type	**WA Commerce Clean Buildings - Form D Report**
Gross Floor Area:	**17,400.0 ft²**
Building ID #:	**28137**
Project Name	**City of Tacoma Decarbonization**

Report Status:	**In Progress**
Report Date:	**03/21/2023**
Year Built:	**2023**
Software Release:	2023.0.0.486
Washington State Building ID	**3**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

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- ASHRAE Level 2 inputs
- City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with * indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.

CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Fire Station 08**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Fire Station 08**

Building Characteristics

Gross Floor Area*	17400.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Fire Station

Use Type / Space Function / Building Area Type*	Fire Station
Gross Floor Area*	17400.0

Building Name: **Fire Station 08**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
01/01/2018	01/31/2018	31	15590.593	0.0	0.0	0%	503	1716
02/01/2018	02/28/2018	28	14301.935	0.0	0.0	0%	511	1743
03/01/2018	03/31/2018	31	14274.619	0.0	0.0	0%	460	1571
04/01/2018	04/30/2018	30	12488.277	0.0	0.0	0%	416	1420
05/01/2018	05/31/2018	31	12601.847	0.0	0.0	0%	407	1387
06/01/2018	06/30/2018	30	11903.342	0.0	0.0	0%	397	1354
07/01/2018	07/31/2018	31	11896.22	0.0	0.0	0%	384	1309
08/01/2018	08/31/2018	31	14229.807	0.0	0.0	0%	459	1566
09/01/2018	09/30/2018	30	11035.609	0.0	0.0	0%	368	1255
10/01/2018	10/31/2018	31	11836.401	0.0	0.0	0%	382	1303
11/01/2018	11/30/2018	30	12748.359	0.0	0.0	0%	425	1450
12/01/2018	12/31/2018	31	13163.629	0.0	0.0	0%	425	1449
01/01/2019	01/31/2019	31	15050.322	0.0	0.0	0%	485	1657
02/01/2019	02/28/2019	28	13872.45	0.0	0.0	0%	495	1690
03/01/2019	03/31/2019	31	12146.22	0.0	0.0	0%	392	1337
04/01/2019	04/30/2019	30	12057.942	0.0	0.0	0%	402	1371
05/01/2019	05/31/2019	31	11283.089	0.0	0.0	0%	364	1242
06/01/2019	06/30/2019	30	11525.997	0.0	0.0	0%	384	1311
07/01/2019	07/31/2019	31	12183.998	0.0	0.0	0%	393	1341
08/01/2019	08/31/2019	31	14218.758	0.0	0.0	0%	459	1565
09/01/2019	09/30/2019	30	9321.952	0.0	0.0	0%	311	1060
10/01/2019	10/31/2019	31	9727.315	0.0	0.0	0%	314	1071
11/01/2019	11/30/2019	30	9837.456	0.0	0.0	0%	328	1119
12/01/2019	12/31/2019	31	11745.135	0.0	0.0	0%	379	1293
01/01/2020	01/31/2020	31	11706.741	0.0	0.0	0%	378	1288
02/01/2020	02/29/2020	29	11780.598	0.0	0.0	0%	406	1386
03/01/2020	03/31/2020	31	11820.691	0.0	0.0	0%	381	1301
04/01/2020	04/30/2020	30	11396.396	0.0	0.0	0%	380	1296
05/01/2020	05/31/2020	31	10603.635	0.0	0.0	0%	342	1167
06/01/2020	06/30/2020	30	11769.373	0.0	0.0	0%	392	1339

Building Name: **Fire Station 08**

07/01/2020	07/31/2020	31	12488.775	0.0	0.0	0%	403	1375
08/01/2020	08/31/2020	31	13040.563	0.0	0.0	0%	421	1435
09/01/2020	09/30/2020	30	11643.348	0.0	0.0	0%	388	1324
10/01/2020	10/31/2020	31	11878.077	0.0	0.0	0%	383	1307
11/01/2020	11/30/2020	30	10956.741	0.0	0.0	0%	365	1246
12/01/2020	12/31/2020	31	12864.508	0.0	0.0	0%	415	1416
01/01/2021	01/31/2021	31	12317.233	0.0	0.0	0%	397	1356
02/01/2021	02/28/2021	28	10628.957	0.0	0.0	0%	380	1295
03/01/2021	03/31/2021	31	11907.972	0.0	0.0	0%	384	1311
04/01/2021	04/30/2021	30	11711.313	0.0	0.0	0%	390	1332
05/01/2021	05/31/2021	31	11458.471	0.0	0.0	0%	370	1261
06/01/2021	06/30/2021	30	12343.494	0.0	0.0	0%	411	1404
07/01/2021	07/31/2021	31	13713.893	0.0	0.0	0%	442	1509
08/01/2021	08/31/2021	31	13605.275	0.0	0.0	0%	439	1497
09/01/2021	09/30/2021	30	12066.442	0.0	0.0	0%	402	1372
10/01/2021	10/31/2021	31	12057.21	0.0	0.0	0%	389	1327
11/01/2021	11/30/2021	30	11932.913	0.0	0.0	0%	398	1357
12/01/2021	12/31/2021	31	13433.998	0.0	0.0	0%	433	1479
01/01/2022	01/31/2022	31	15256.771	0.0	0.0	0%	492	1679
02/01/2022	02/28/2022	28	12995.985	0.0	0.0	0%	464	1584
03/01/2022	03/31/2022	31	14348.007	0.0	0.0	0%	463	1579
04/01/2022	04/30/2022	30	14157.005	0.0	0.0	0%	472	1610
05/01/2022	05/31/2022	31	14380.012	0.0	0.0	0%	464	1583
06/01/2022	06/30/2022	30	13475.0	0.0	0.0	0%	449	1533
07/01/2022	07/31/2022	31	14428.986	0.0	0.0	0%	465	1588
08/01/2022	08/31/2022	31	15341.999	0.0	0.0	0%	495	1689
09/01/2022	09/30/2022	30	14531.009	0.0	0.0	0%	484	1653
10/01/2022	10/31/2022	31	13781.009	0.0	0.0	0%	445	1517
11/01/2022	11/30/2022	30	14580.012	0.0	0.0	0%	486	1658
12/01/2022	12/31/2022	31	16191.003	0.0	0.0	0%	522	1782
01/01/2023	01/31/2023	31	12785.991	0.0	0.0	0%	412	1407
	Average Annual Total	**0**		**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
01/01/2018	01/31/2018	31	688.14	0.0	22	2220
02/01/2018	02/28/2018	28	673.85	0.0	24	2407
03/01/2018	03/31/2018	31	449.89	0.0	15	1451
04/01/2018	04/30/2018	30	310.29	0.0	10	1034
05/01/2018	05/31/2018	31	272.63	0.0	9	879
06/01/2018	06/30/2018	30	119.89	0.0	4	400
07/01/2018	07/31/2018	31	104.65	0.0	3	338
08/01/2018	08/31/2018	31	116.94	0.0	4	377
09/01/2018	09/30/2018	30	137.44	0.0	5	458
10/01/2018	10/31/2018	31	222.14	0.0	7	717

Building Name: **Fire Station 08**

11/01/2018	11/30/2018	30	406.13	0.0	14	1354
12/01/2018	12/31/2018	31	661.77	0.0	21	2135
01/01/2019	01/31/2019	31	644.49	0.0	21	2079
02/01/2019	02/28/2019	28	948.44	0.0	34	3387
03/01/2019	03/31/2019	31	528.46	0.0	17	1705
04/01/2019	04/30/2019	30	228.36	0.0	8	761
05/01/2019	05/31/2019	31	133.4	0.0	4	430
06/01/2019	06/30/2019	30	118.07	0.0	4	394
07/01/2019	07/31/2019	31	106.17	0.0	3	342
08/01/2019	08/31/2019	31	99.42	0.0	3	321
09/01/2019	09/30/2019	30	130.53	0.0	4	435
10/01/2019	10/31/2019	31	279.35	0.0	9	901
11/01/2019	11/30/2019	30	448.02	0.0	15	1493
12/01/2019	12/31/2019	31	477.13	0.0	15	1539
01/01/2020	01/31/2020	31	628.76	0.0	20	2028
02/01/2020	02/29/2020	29	626.35	0.0	22	2160
03/01/2020	03/31/2020	31	936.64	0.0	30	3021
04/01/2020	04/30/2020	30	680.13	0.0	23	2267
05/01/2020	05/31/2020	31	438.81	0.0	14	1416
06/01/2020	06/30/2020	30	339.27	0.0	11	1131
07/01/2020	07/31/2020	31	311.03	0.0	10	1003
08/01/2020	08/31/2020	31	363.29	0.0	12	1172
09/01/2020	09/30/2020	30	441.81	0.0	15	1473
10/01/2020	10/31/2020	31	327.66	0.0	11	1057
11/01/2020	11/30/2020	30	744.02	0.0	25	2480
12/01/2020	12/31/2020	31	966.21	0.0	31	3117
01/01/2021	01/31/2021	31	1000.89	0.0	32	3229
02/01/2021	02/28/2021	28	1259.91	0.0	45	4500
03/01/2021	03/31/2021	31	849.51	0.0	27	2740
04/01/2021	04/30/2021	30	544.06	0.0	18	1814
05/01/2021	05/31/2021	31	410.68	0.0	13	1325
06/01/2021	06/30/2021	30	223.34	0.0	7	744
07/01/2021	07/31/2021	31	337.14	0.0	11	1088
08/01/2021	08/31/2021	31	415.5	0.0	13	1340
09/01/2021	09/30/2021	30	436.71	0.0	15	1456
10/01/2021	10/31/2021	31	819.17	0.0	26	2642
11/01/2021	11/30/2021	30	1213.02	0.0	40	4043
12/01/2021	12/31/2021	31	2169.05	0.0	70	6997
01/01/2022	01/31/2022	31	1887.03	0.0	61	6087
02/01/2022	02/28/2022	28	1583.83	0.0	57	5657
03/01/2022	03/31/2022	31	1263.03	0.0	41	4074
04/01/2022	04/30/2022	30	1255.52	0.0	42	4185
05/01/2022	05/31/2022	31	507.91	0.0	16	1638
06/01/2022	06/30/2022	30	171.31	0.0	6	571
07/01/2022	07/31/2022	31	348.86	0.0	11	1125
08/01/2022	08/31/2022	31	208.78	0.0	7	673

Building Name: **Fire Station 08**

09/01/2022	09/30/2022	30	280.96	0.0	9	937
10/01/2022	10/31/2022	31	320.57	0.0	10	1034
11/01/2022	11/30/2022	30	825.33	0.0	28	2751
12/01/2022	12/31/2022	31	1139.81	0.0	37	3677
01/01/2023	01/31/2023	31	0.0	0.0	0	0
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Fire Station 08
Gross Conditioned Square Feet	17400.0

UTILITY DATA AND BENCHMARKING

Building Name: **Fire Station 08**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	49.5
Target Site Energy Intensity*	65.0

Building Name: **Fire Station 08**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	10349	35311	3.02
Air Distribution	5578	19032	1.63
Lighting	96535	329377	28.15
Plug Loads	23716	80919	6.92
Other	8640	29480	2.52
Total	**144818**	**494119**	**42.23**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**144818**	**494119**	**42.23**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	4765	476500	25.31
Service Water Heating	919	91900	4.88
Cooking	950	95000	5.05
Total	**6634**	**663400**	**35.23**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**6634**	**663400**	**35.23**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.
Other End Use Types include:

OVERVIEW

BUILDING INFORMATION

Police Headquarters
3701 S Pine St
Tacoma, WA 98409

Report Type	**WA Commerce Clean Buildings - Form D Report**
Gross Floor Area:	**73,000.0 ft²**
Building ID #:	**28138**
Project Name	**City of Tacoma Decarbonization**

Report Status:	**In Progress**
Report Date:	**03/21/2023**
Year Built:	**2023**
Software Release:	2023.0.0.486
Washington State Building ID	**4**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

This report follows the ASHRAE/ACCA Standard 211P, Standard for Commercial Building Energy Audits. It also includes additional data fields required by specific cities, where applicable. The icons below identify data categories.

- ASHRAE Level 2 inputs
- City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with * indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.

CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Police Headquarters**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Police Headquarters**

Building Characteristics

Gross Floor Area*	73000.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Police Station

Use Type / Space Function / Building Area Type*	Police Station
Gross Floor Area*	73000.0

Building Name: **Police Headquarters**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
12/01/2017	12/31/2017	31	81247.273	0.0	0.0	0%	2621	8942
01/01/2018	01/31/2018	31	122756.828	0.0	0.0	0%	3960	13511
02/01/2018	02/28/2018	28	85630.367	0.0	0.0	0%	3058	10435
03/01/2018	03/31/2018	31	93310.375	0.0	0.0	0%	3010	10270
04/01/2018	04/30/2018	30	104358.648	0.0	0.0	0%	3479	11869
05/01/2018	05/31/2018	31	97961.547	0.0	0.0	0%	3160	10782
06/01/2018	06/30/2018	30	96929.664	0.0	0.0	0%	3231	11024
07/01/2018	07/31/2018	31	114631.539	0.0	0.0	0%	3698	12617
08/01/2018	08/31/2018	31	129478.813	0.0	0.0	0%	4177	14251
09/01/2018	09/30/2018	30	109754.313	0.0	0.0	0%	3658	12483
10/01/2018	10/31/2018	31	107319.492	0.0	0.0	0%	3462	11812
11/01/2018	11/30/2018	30	100629.195	0.0	0.0	0%	3354	11445
12/01/2018	12/31/2018	31	88347.156	0.0	0.0	0%	2850	9724
01/01/2019	01/31/2019	31	95337.227	0.0	0.0	0%	3075	10493
02/01/2019	02/28/2019	28	84681.391	0.0	0.0	0%	3024	10319
03/01/2019	03/31/2019	31	93279.984	0.0	0.0	0%	3009	10267
04/01/2019	04/30/2019	30	98246.195	0.0	0.0	0%	3275	11174
05/01/2019	05/31/2019	31	88818.609	0.0	0.0	0%	2865	9776
06/01/2019	06/30/2019	30	90361.375	0.0	0.0	0%	3012	10277
07/01/2019	07/31/2019	31	121850.328	0.0	0.0	0%	3931	13411
08/01/2019	08/31/2019	31	122296.367	0.0	0.0	0%	3945	13460
09/01/2019	09/30/2019	30	132816.063	0.0	0.0	0%	4427	15106
10/01/2019	10/31/2019	31	80042.234	0.0	0.0	0%	2582	8810
11/01/2019	11/30/2019	30	86012.516	0.0	0.0	0%	2867	9782
12/01/2019	12/31/2019	31	88454.016	0.0	0.0	0%	2853	9736
01/01/2020	01/31/2020	31	93211.141	0.0	0.0	0%	3007	10259
02/01/2020	02/29/2020	29	78504.43	0.0	0.0	0%	2707	9236
03/01/2020	03/31/2020	31	88926.0	0.0	0.0	0%	2869	9788
04/01/2020	04/30/2020	30	88777.578	0.0	0.0	0%	2959	10097
05/01/2020	05/31/2020	31	111583.852	0.0	0.0	0%	3599	12281

Building Name: **Police Headquarters**

06/01/2020	06/30/2020	30	108175.5	0.0	0.0	0%	3606	12303
07/01/2020	07/31/2020	31	123738.953	0.0	0.0	0%	3992	13619
08/01/2020	08/31/2020	31	120077.695	0.0	0.0	0%	3873	13216
09/01/2020	09/30/2020	30	110901.117	0.0	0.0	0%	3697	12613
10/01/2020	10/31/2020	31	99325.617	0.0	0.0	0%	3204	10932
11/01/2020	11/30/2020	30	91666.648	0.0	0.0	0%	3056	10426
12/01/2020	12/31/2020	31	94992.266	0.0	0.0	0%	3064	10455
01/01/2021	01/31/2021	31	88162.578	0.0	0.0	0%	2844	9704
02/01/2021	02/28/2021	28	82807.711	0.0	0.0	0%	2957	10091
03/01/2021	03/31/2021	31	90863.633	0.0	0.0	0%	2931	10001
04/01/2021	04/30/2021	30	105026.234	0.0	0.0	0%	3501	11945
05/01/2021	05/31/2021	31	103570.844	0.0	0.0	0%	3341	11399
06/01/2021	06/30/2021	30	0.0	0.0	0.0	0%	0	0
07/01/2021	07/31/2021	31	0.0	0.0	0.0	0%	0	0
08/01/2021	08/31/2021	31	0.0	0.0	0.0	0%	0	0
09/01/2021	09/30/2021	30	0.0	0.0	0.0	0%	0	0
10/01/2021	10/31/2021	31	0.0	0.0	0.0	0%	0	0
11/01/2021	11/30/2021	30	0.0	0.0	0.0	0%	0	0
12/01/2021	12/31/2021	31	0.0	0.0	0.0	0%	0	0
01/01/2022	01/31/2022	31	0.0	0.0	0.0	0%	0	0
02/01/2022	02/28/2022	28	0.0	0.0	0.0	0%	0	0
03/01/2022	03/31/2022	31	0.0	0.0	0.0	0%	0	0
04/01/2022	04/30/2022	30	0.0	0.0	0.0	0%	0	0
05/01/2022	05/31/2022	31	0.0	0.0	0.0	0%	0	0
06/01/2022	06/30/2022	30	0.0	0.0	0.0	0%	0	0
07/01/2022	07/31/2022	31	0.0	0.0	0.0	0%	0	0
08/01/2022	08/31/2022	31	0.0	0.0	0.0	0%	0	0
09/01/2022	09/30/2022	30	0.0	0.0	0.0	0%	0	0
10/01/2022	10/31/2022	31	0.0	0.0	0.0	0%	0	0
11/01/2022	11/30/2022	30	0.0	0.0	0.0	0%	0	0
12/01/2022	12/31/2022	31	0.0	0.0	0.0	0%	0	0
	Average Annual Total		**0**	**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
12/01/2017	12/31/2017	31	5666.341	0.0	183	18279
01/01/2018	01/31/2018	31	5818.838	0.0	188	18770
02/01/2018	02/28/2018	28	5617.73	0.0	201	20063
03/01/2018	03/31/2018	31	5054.693	0.0	163	16305
04/01/2018	04/30/2018	30	3989.129	0.0	133	13297
05/01/2018	05/31/2018	31	2436.812	0.0	79	7861
06/01/2018	06/30/2018	30	2016.704	0.0	67	6722
07/01/2018	07/31/2018	31	703.524	0.0	23	2269
08/01/2018	08/31/2018	31	3417.433	0.0	110	11024
09/01/2018	09/30/2018	30	1830.088	0.0	61	6100

Building Name: **Police Headquarters**

10/01/2018	10/31/2018	31	4019.8	0.0	130	12967
11/01/2018	11/30/2018	30	5424.196	0.0	181	18081
12/01/2018	12/31/2018	31	6840.747	0.0	221	22067
01/01/2019	01/31/2019	31	6748.079	0.0	218	21768
02/01/2019	02/28/2019	28	6727.993	0.0	240	24029
03/01/2019	03/31/2019	31	5737.667	0.0	185	18509
04/01/2019	04/30/2019	30	4946.274	0.0	165	16488
05/01/2019	05/31/2019	31	2650.985	0.0	86	8552
06/01/2019	06/30/2019	30	2470.82	0.0	82	8236
07/01/2019	07/31/2019	31	1872.958	0.0	60	6042
08/01/2019	08/31/2019	31	381.332	0.0	12	1230
09/01/2019	09/30/2019	30	2238.733	0.0	75	7462
10/01/2019	10/31/2019	31	3567.033	0.0	115	11507
11/01/2019	11/30/2019	30	4120.209	0.0	137	13734
12/01/2019	12/31/2019	31	5330.743	0.0	172	17196
01/01/2020	01/31/2020	31	5390.92	0.0	174	17390
02/01/2020	02/29/2020	29	5037.375	0.0	174	17370
03/01/2020	03/31/2020	31	5191.084	0.0	167	16745
04/01/2020	04/30/2020	30	3459.642	0.0	115	11532
05/01/2020	05/31/2020	31	2579.902	0.0	83	8322
06/01/2020	06/30/2020	30	2247.308	0.0	75	7491
07/01/2020	07/31/2020	31	1986.62	0.0	64	6408
08/01/2020	08/31/2020	31	2011.845	0.0	65	6490
09/01/2020	09/30/2020	30	2209.412	0.0	74	7365
10/01/2020	10/31/2020	31	3460.451	0.0	112	11163
11/01/2020	11/30/2020	30	5158.926	0.0	172	17196
12/01/2020	12/31/2020	31	5254.045	0.0	169	16949
01/01/2021	01/31/2021	31	5402.767	0.0	174	17428
02/01/2021	02/28/2021	28	5791.902	0.0	207	20685
03/01/2021	03/31/2021	31	7661.108	0.0	247	24713
04/01/2021	04/30/2021	30	5365.294	0.0	179	17884
05/01/2021	05/31/2021	31	2192.221	0.0	71	7072
06/01/2021	06/30/2021	30	2489.035	0.0	83	8297
07/01/2021	07/31/2021	31	2338.386	0.0	75	7543
08/01/2021	08/31/2021	31	2261.345	0.0	73	7295
09/01/2021	09/30/2021	30	2440.906	0.0	81	8136
10/01/2021	10/31/2021	31	3608.627	0.0	116	11641
11/01/2021	11/30/2021	30	4701.783	0.0	157	15673
12/01/2021	12/31/2021	31	8054.155	0.0	260	25981
01/01/2022	01/31/2022	31	6594.644	0.0	213	21273
02/01/2022	02/28/2022	28	5606.72	0.0	200	20024
03/01/2022	03/31/2022	31	5251.164	0.0	169	16939
04/01/2022	04/30/2022	30	3887.52	0.0	130	12958
05/01/2022	05/31/2022	31	3276.079	0.0	106	10568
06/01/2022	06/30/2022	30	2490.973	0.0	83	8303
07/01/2022	07/31/2022	31	2067.954	0.0	67	6671

Building Name: **Police Headquarters**

08/01/2022	08/31/2022	31	2130.73	0.0	69	6873
09/01/2022	09/30/2022	30	2197.76	0.0	73	7326
10/01/2022	10/31/2022	31	3154.6	0.0	102	10176
11/01/2022	11/30/2022	30	6222.489	0.0	207	20742
12/01/2022	12/31/2022	31	6941.681	0.0	224	22393
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Police Headquarters
Gross Conditioned Square Feet	73000.0

UTILITY DATA AND BENCHMARKING

Building Name: **Police Headquarters**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	116.7
Target Site Energy Intensity*	65.0

Building Name: **Police Headquarters**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	86470	295036	25.22
Air Distribution	351008	1197639	102.36
Lighting	465331	1587709	135.7
Plug Loads	261019	890597	76.12
Other	1402	4784	0.41
Total	**1165230**	**3975765**	**339.8**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**1165230**	**3975765**	**339.8**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	38037	3803700	202.01
Service Water Heating	5263	526300	27.95
Total	**43300**	**4330000**	**229.97**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**43300**	**4330000**	**229.97**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.
Other End Use Types include:

OVERVIEW

BUILDING INFORMATION

Tacoma Convention Center
1500 Commerce St
Tacoma, WA 98402

Report Type	**WA Commerce Clean Buildings - Form D Report**	Report Status:	**In Progress**
		Report Date:	**03/21/2023**
Gross Floor Area:	**209,088.0 ft²**	Year Built:	**2023**
Building ID #:	**28139**	Software Release:	2023.0.0.486
Project Name	**City of Tacoma Decarbonization**	Washington State Building ID	**5**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

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- ASHRAE Level 2 inputs
- City specific inputs

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CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Tacoma Convention Center**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Tacoma Convention Center**

Building Characteristics

Gross Floor Area*	209088.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Convention Center

Use Type / Space Function / Building Area Type*	Convention Center
Gross Floor Area*	227449.0
Number of Occupants*	16
Use (hours/week)*	54.0
Use (weeks/year)*	52.0

UTILITY DATA AND BENCHMARKING

Building Name: **Tacoma Convention Center**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
01/01/2018	01/31/2018	31	205279.953	0.0	0.0	0%	6622	22594
02/01/2018	02/28/2018	28	236000.031	0.0	0.0	0%	8429	28758
03/01/2018	03/31/2018	31	237920.016	0.0	0.0	0%	7675	26187
04/01/2018	04/30/2018	30	209759.969	0.0	0.0	0%	6992	23857
05/01/2018	05/31/2018	31	203360.0	0.0	0.0	0%	6560	22383
06/01/2018	06/30/2018	30	171680.016	0.0	0.0	0%	5723	19526
07/01/2018	07/31/2018	31	198719.984	0.0	0.0	0%	6410	21872
08/01/2018	08/31/2018	31	206880.047	0.0	0.0	0%	6674	22770
09/01/2018	09/30/2018	30	174880.047	0.0	0.0	0%	5829	19890
10/01/2018	10/31/2018	31	199679.984	0.0	0.0	0%	6441	21978
11/01/2018	11/30/2018	30	198560.0	0.0	0.0	0%	6619	22583
12/01/2018	12/31/2018	31	193440.016	0.0	0.0	0%	6240	21291
01/01/2019	01/31/2019	31	195839.953	0.0	0.0	0%	6317	21555
02/01/2019	02/28/2019	28	221119.984	0.0	0.0	0%	7897	26945
03/01/2019	03/31/2019	31	210399.969	0.0	0.0	0%	6787	23158
04/01/2019	04/30/2019	30	192479.984	0.0	0.0	0%	6416	21891
05/01/2019	05/31/2019	31	189759.969	0.0	0.0	0%	6121	20886
06/01/2019	06/30/2019	30	178079.984	0.0	0.0	0%	5936	20254
07/01/2019	07/31/2019	31	199839.984	0.0	0.0	0%	6446	21995
08/01/2019	08/31/2019	31	214079.984	0.0	0.0	0%	6906	23563
09/01/2019	09/30/2019	30	197279.984	0.0	0.0	0%	6576	22437
10/01/2019	10/31/2019	31	202560.031	0.0	0.0	0%	6534	22295
11/01/2019	11/30/2019	30	199679.984	0.0	0.0	0%	6656	22710
12/01/2019	12/31/2019	31	207040.031	0.0	0.0	0%	6679	22788
01/01/2020	01/31/2020	31	210399.969	0.0	0.0	0%	6787	23158
02/01/2020	02/29/2020	29	206560.0	0.0	0.0	0%	7123	24303
03/01/2020	03/31/2020	31	157440.031	0.0	0.0	0%	5079	17329
04/01/2020	04/30/2020	30	84000.0	0.0	0.0	0%	2800	9554
05/01/2020	05/31/2020	31	71680.016	0.0	0.0	0%	2312	7889
06/01/2020	06/30/2020	30	71040.008	0.0	0.0	0%	2368	8080

Building Name: **Tacoma Convention Center**

07/01/2020	07/31/2020	31	97440.039	0.0	0.0	0%	3143	10725
08/01/2020	08/31/2020	31	84000.0	0.0	0.0	0%	2710	9245
09/01/2020	09/30/2020	30	78240.008	0.0	0.0	0%	2608	8898
10/01/2020	10/31/2020	31	86400.0	0.0	0.0	0%	2787	9510
11/01/2020	11/30/2020	30	106400.031	0.0	0.0	0%	3547	12101
12/01/2020	12/31/2020	31	106559.969	0.0	0.0	0%	3437	11728
01/01/2021	01/31/2021	31	114719.992	0.0	0.0	0%	3701	12627
02/01/2021	02/28/2021	28	117439.977	0.0	0.0	0%	4194	14311
03/01/2021	03/31/2021	31	114560.0	0.0	0.0	0%	3695	12609
04/01/2021	04/30/2021	30	99840.039	0.0	0.0	0%	3328	11355
05/01/2021	05/31/2021	31	93120.016	0.0	0.0	0%	3004	10249
06/01/2021	06/30/2021	30	116640.039	0.0	0.0	0%	3888	13266
07/01/2021	07/31/2021	31	147360.031	0.0	0.0	0%	4754	16219
08/01/2021	08/31/2021	31	174239.984	0.0	0.0	0%	5621	19178
09/01/2021	09/30/2021	30	120479.984	0.0	0.0	0%	4016	13703
10/01/2021	10/31/2021	31	120639.977	0.0	0.0	0%	3892	13278
11/01/2021	11/30/2021	30	136960.031	0.0	0.0	0%	4565	15577
12/01/2021	12/31/2021	31	154240.016	0.0	0.0	0%	4975	16976
01/01/2022	01/31/2022	31	166880.047	0.0	0.0	0%	5383	18368
02/01/2022	02/28/2022	28	167360.0	0.0	0.0	0%	5977	20394
03/01/2022	03/31/2022	31	177120.016	0.0	0.0	0%	5714	19495
04/01/2022	04/30/2022	30	184480.047	0.0	0.0	0%	6149	20982
05/01/2022	05/31/2022	31	165119.984	0.0	0.0	0%	5326	18174
06/01/2022	06/30/2022	30	178400.031	0.0	0.0	0%	5947	20290
07/01/2022	07/31/2022	31	174079.984	0.0	0.0	0%	5615	19160
08/01/2022	08/31/2022	31	188047.984	0.0	0.0	0%	6066	20697
09/01/2022	09/30/2022	30	191389.016	0.0	0.0	0%	6380	21767
10/01/2022	10/31/2022	31	186388.047	0.0	0.0	0%	6013	20515
11/01/2022	11/30/2022	30	158285.0	0.0	0.0	0%	5276	18002
12/01/2022	12/31/2022	31	161240.969	0.0	0.0	0%	5201	17747
01/01/2023	01/31/2023	31	166732.031	0.0	0.0	0%	5378	18351
	Average Annual Total		**0**	**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
01/01/2018	01/31/2018	31	4975.091	0.0	160	16049
02/01/2018	02/28/2018	28	4723.099	0.0	169	16868
03/01/2018	03/31/2018	31	3904.199	0.0	126	12594
04/01/2018	04/30/2018	30	2692.02	0.0	90	8973
05/01/2018	05/31/2018	31	738.88	0.0	24	2383
06/01/2018	06/30/2018	30	574.98	0.0	19	1917
07/01/2018	07/31/2018	31	703.06	0.0	23	2268
08/01/2018	08/31/2018	31	880.18	0.0	28	2839
09/01/2018	09/30/2018	30	1299.31	0.0	43	4331
10/01/2018	10/31/2018	31	1729.52	0.0	56	5579

Building Name: **Tacoma Convention Center**

11/01/2018	11/30/2018	30	3548.34	0.0	118	11828
12/01/2018	12/31/2018	31	7034.629	0.0	227	22692
01/01/2019	01/31/2019	31	5876.921	0.0	190	18958
02/01/2019	02/28/2019	28	5823.58	0.0	208	20799
03/01/2019	03/31/2019	31	4087.13	0.0	132	13184
04/01/2019	04/30/2019	30	2452.67	0.0	82	8176
05/01/2019	05/31/2019	31	1404.18	0.0	45	4530
06/01/2019	06/30/2019	30	725.43	0.0	24	2418
07/01/2019	07/31/2019	31	771.32	0.0	25	2488
08/01/2019	08/31/2019	31	747.71	0.0	24	2412
09/01/2019	09/30/2019	30	1223.89	0.0	41	4080
10/01/2019	10/31/2019	31	3262.049	0.0	105	10523
11/01/2019	11/30/2019	30	6572.301	0.0	219	21908
12/01/2019	12/31/2019	31	2650.9	0.0	86	8551
01/01/2020	01/31/2020	31	321.46	0.0	10	1037
02/01/2020	02/29/2020	29	821.81	0.0	28	2834
03/01/2020	03/31/2020	31	2356.73	0.0	76	7602
04/01/2020	04/30/2020	30	1075.02	0.0	36	3583
05/01/2020	05/31/2020	31	544.73	0.0	18	1757
06/01/2020	06/30/2020	30	252.58	0.0	8	842
07/01/2020	07/31/2020	31	68.25	0.0	2	220
08/01/2020	08/31/2020	31	27.9	0.0	1	90
09/01/2020	09/30/2020	30	589.76	0.0	20	1966
10/01/2020	10/31/2020	31	1416.44	0.0	46	4569
11/01/2020	11/30/2020	30	4478.619	0.0	149	14929
12/01/2020	12/31/2020	31	1501.96	0.0	48	4845
01/01/2021	01/31/2021	31	3636.88	0.0	117	11732
02/01/2021	02/28/2021	28	5309.391	0.0	190	18962
03/01/2021	03/31/2021	31	4799.191	0.0	155	15481
04/01/2021	04/30/2021	30	1646.91	0.0	55	5490
05/01/2021	05/31/2021	31	729.22	0.0	24	2352
06/01/2021	06/30/2021	30	360.08	0.0	12	1200
07/01/2021	07/31/2021	31	563.1	0.0	18	1816
08/01/2021	08/31/2021	31	1160.71	0.0	37	3744
09/01/2021	09/30/2021	30	971.47	0.0	32	3238
10/01/2021	10/31/2021	31	1625.41	0.0	52	5243
11/01/2021	11/30/2021	30	4409.079	0.0	147	14697
12/01/2021	12/31/2021	31	8448.501	0.0	273	27253
01/01/2022	01/31/2022	31	4435.66	0.0	143	14309
02/01/2022	02/28/2022	28	2951.749	0.0	105	10542
03/01/2022	03/31/2022	31	3869.851	0.0	125	12483
04/01/2022	04/30/2022	30	5164.581	0.0	172	17215
05/01/2022	05/31/2022	31	1422.51	0.0	46	4589
06/01/2022	06/30/2022	30	1723.32	0.0	57	5744
07/01/2022	07/31/2022	31	352.34	0.0	11	1137
08/01/2022	08/31/2022	31	586.85	0.0	19	1893

Building Name: **Tacoma Convention Center**

09/01/2022	09/30/2022	30	238.91	0.0	8	796
10/01/2022	10/31/2022	31	1514.18	0.0	49	4884
11/01/2022	11/30/2022	30	3773.199	0.0	126	12577
12/01/2022	12/31/2022	31	5326.981	0.0	172	17184
01/01/2023	01/31/2023	31	0.0	0.0	0	0
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Tacoma Convention Center
Gross Conditioned Square Feet	209088.0

UTILITY DATA AND BENCHMARKING

Building Name: **Tacoma Convention Center**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	50.9
Target Site Energy Intensity*	50.0

Building Name: **Tacoma Convention Center**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	48288	164759	14.08
Air Distribution	761601	2598583	222.1
Lighting	1206536	4116701	351.85
Plug Loads	366943	1252009	107.01
Total	**2383368**	**8132051**	**695.03**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**2383368**	**8132051**	**695.03**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	24041	2404100	127.68
Service Water Heating	3268	326800	17.36
Cooking	2916	291600	15.49
Total	**30225**	**3022500**	**160.52**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**30225**	**3022500**	**160.52**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

OVERVIEW

BUILDING INFORMATION

Pantages Theater
901-909 Broadway
Tacoma, WA 98402

Report Type	**WA Commerce Clean Buildings - Form D Report**	Report Status:	**In Progress**
		Report Date:	**03/21/2023**
Gross Floor Area:	**35,458.0 ft²**	Year Built:	**2023**
Building ID #:	**28140**	Software Release:	2023.0.0.486
Project Name	**City of Tacoma Decarbonization**	Washington State Building ID	**6**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

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- City specific inputs

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CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Pantages Theater**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Pantages Theater**

Building Characteristics

Gross Floor Area*	35458.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Performing Arts

Use Type / Space Function / Building Area Type*	Performing Arts
Gross Floor Area*	35458.0
Number of Occupants*	10
Use (hours/week)*	40.0
Use (weeks/year)*	52.0

UTILITY DATA AND BENCHMARKING

Building Name: **Pantages Theater**

Existing Building EUI/ECI

Building Name	Pantages Theater
Gross Conditioned Square Feet	35458.0

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	100.1
Target Site Energy Intensity*	55.0

Building Name: **Pantages Theater**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	3190	10884	0.93
Air Distribution	119457	407587	34.84
Lighting	86745	295974	25.3
Plug Loads	15336	52326	4.47
Other	4005	13665	1.17
Total	**228733**	**780437**	**66.7**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**228733**	**780437**	**66.7**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	12388	1238800	65.79
Service Water Heating	1832	183200	9.73
Total	**14220**	**1422000**	**75.52**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**14220**	**1422000**	**75.52**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.
Other End Use Types include:

OVERVIEW

BUILDING INFORMATION

Tacoma Solid Waste Admin and Shop
3510 S Mullen St
Tacoma, WA 98409

Report Type	**WA Commerce Clean Buildings - Form D Report**	Report Status:	**In Progress**
		Report Date:	**03/21/2023**
Gross Floor Area:	**34,232.0 ft²**	Year Built:	**2023**
Building ID #:	**28141**	Software Release:	2023.0.0.486
Project Name	**City of Tacoma Decarbonization**	Washington State Building ID	**7**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

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- ASHRAE Level 2 inputs
- City specific inputs

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CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Tacoma Solid Waste Admin and Shop**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Tacoma Solid Waste Admin and Shop**

Building Characteristics

Gross Floor Area*	34232.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Office

Use Type / Space Function / Building Area Type*	Office
Gross Floor Area*	34232.0
Number of Occupants*	50
Use (hours/week)*	50.0
Use (weeks/year)*	52.0

Building Name: **Tacoma Solid Waste Admin and Shop**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
02/01/2018	02/28/2018	28	38327.082	0.0	0.0	0%	1369	4670
03/01/2018	03/31/2018	31	38295.984	0.0	0.0	0%	1235	4215
04/01/2018	04/30/2018	30	35665.418	0.0	0.0	0%	1189	4056
05/01/2018	05/31/2018	31	40306.215	0.0	0.0	0%	1300	4436
06/01/2018	06/30/2018	30	37219.988	0.0	0.0	0%	1241	4233
07/01/2018	07/31/2018	31	45259.996	0.0	0.0	0%	1460	4982
08/01/2018	08/31/2018	31	43493.32	0.0	0.0	0%	1403	4787
09/01/2018	09/30/2018	30	38697.625	0.0	0.0	0%	1290	4401
10/01/2018	10/31/2018	31	33429.047	0.0	0.0	0%	1078	3679
11/01/2018	11/30/2018	30	42300.0	0.0	0.0	0%	1410	4811
12/01/2018	12/31/2018	31	39078.781	0.0	0.0	0%	1261	4301
01/01/2019	01/31/2019	31	41110.551	0.0	0.0	0%	1326	4525
02/01/2019	02/28/2019	28	39792.613	0.0	0.0	0%	1421	4849
03/01/2019	03/31/2019	31	35938.07	0.0	0.0	0%	1159	3956
04/01/2019	04/30/2019	30	40242.762	0.0	0.0	0%	1341	4577
05/01/2019	05/31/2019	31	37037.25	0.0	0.0	0%	1195	4076
06/01/2019	06/30/2019	30	36851.613	0.0	0.0	0%	1228	4191
07/01/2019	07/31/2019	31	41148.391	0.0	0.0	0%	1327	4529
08/01/2019	08/31/2019	31	56130.012	0.0	0.0	0%	1811	6178
09/01/2019	09/30/2019	30	37950.0	0.0	0.0	0%	1265	4316
10/01/2019	10/31/2019	31	27185.873	0.0	0.0	0%	877	2992
11/01/2019	11/30/2019	30	32188.248	0.0	0.0	0%	1073	3661
12/01/2019	12/31/2019	31	34551.055	0.0	0.0	0%	1115	3803
01/01/2020	01/31/2020	31	37034.848	0.0	0.0	0%	1195	4076
02/01/2020	02/29/2020	29	42640.008	0.0	0.0	0%	1470	5017
03/01/2020	03/31/2020	31	29609.701	0.0	0.0	0%	955	3259
04/01/2020	04/30/2020	30	31339.273	0.0	0.0	0%	1045	3564
05/01/2020	05/31/2020	31	33226.027	0.0	0.0	0%	1072	3657
06/01/2020	06/30/2020	30	34200.176	0.0	0.0	0%	1140	3890
07/01/2020	07/31/2020	31	38984.82	0.0	0.0	0%	1258	4291

Building Name: **Tacoma Solid Waste Admin and Shop**

08/01/2020	08/31/2020	31	42480.012	0.0	0.0	0%	1370	4676
09/01/2020	09/30/2020	30	37600.0	0.0	0.0	0%	1253	4276
10/01/2020	10/31/2020	31	36141.18	0.0	0.0	0%	1166	3978
11/01/2020	11/30/2020	30	35717.645	0.0	0.0	0%	1191	4062
12/01/2020	12/31/2020	31	36618.758	0.0	0.0	0%	1181	4030
01/01/2021	01/31/2021	31	38058.441	0.0	0.0	0%	1228	4189
02/01/2021	02/28/2021	28	41910.902	0.0	0.0	0%	1497	5107
03/01/2021	03/31/2021	31	48344.844	0.0	0.0	0%	1560	5321
04/01/2021	04/30/2021	30	44098.594	0.0	0.0	0%	1470	5015
05/01/2021	05/31/2021	31	45232.355	0.0	0.0	0%	1459	4978
06/01/2021	06/30/2021	30	52660.785	0.0	0.0	0%	1755	5989
07/01/2021	07/31/2021	31	57351.555	0.0	0.0	0%	1850	6312
08/01/2021	08/31/2021	31	51065.008	0.0	0.0	0%	1647	5620
09/01/2021	09/30/2021	30	50480.012	0.0	0.0	0%	1683	5741
10/01/2021	10/31/2021	31	44050.91	0.0	0.0	0%	1421	4848
11/01/2021	11/30/2021	30	47563.629	0.0	0.0	0%	1585	5410
12/01/2021	12/31/2021	31	51694.551	0.0	0.0	0%	1668	5690
01/01/2022	01/31/2022	31	47645.574	0.0	0.0	0%	1537	5244
02/01/2022	02/28/2022	28	46581.887	0.0	0.0	0%	1664	5676
03/01/2022	03/31/2022	31	54457.945	0.0	0.0	0%	1757	5994
04/01/2022	04/30/2022	30	49288.102	0.0	0.0	0%	1643	5606
05/01/2022	05/31/2022	31	49832.094	0.0	0.0	0%	1607	5485
06/01/2022	06/30/2022	30	52800.0	0.0	0.0	0%	1760	6005
07/01/2022	07/31/2022	31	61390.328	0.0	0.0	0%	1980	6757
08/01/2022	08/31/2022	31	59255.012	0.0	0.0	0%	1911	6522
09/01/2022	09/30/2022	30	51050.0	0.0	0.0	0%	1702	5806
10/01/2022	10/31/2022	31	49909.996	0.0	0.0	0%	1610	5493
11/01/2022	11/30/2022	30	0.0	0.0	0.0	0%	0	0
12/01/2022	12/31/2022	31	54201.992	0.0	0.0	0%	1748	5966
01/01/2023	01/31/2023	31	55060.992	0.0	0.0	0%	1776	6060
02/01/2023	02/28/2023	28	3557.005	0.0	0.0	0%	127	433
	Average Annual Total		**0**	**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
02/01/2018	02/28/2018	28	2616.38	0.0	93	9344
03/01/2018	03/31/2018	31	1920.7	0.0	62	6196
04/01/2018	04/30/2018	30	1194.63	0.0	40	3982
05/01/2018	05/31/2018	31	917.45	0.0	30	2960
06/01/2018	06/30/2018	30	370.34	0.0	12	1234
07/01/2018	07/31/2018	31	194.0	0.0	6	626
08/01/2018	08/31/2018	31	317.32	0.0	10	1024
09/01/2018	09/30/2018	30	771.97	0.0	26	2573
10/01/2018	10/31/2018	31	1128.11	0.0	36	3639
11/01/2018	11/30/2018	30	1754.05	0.0	58	5847

Building Name: **Tacoma Solid Waste Admin and Shop**

12/01/2018	12/31/2018	31	2385.09	0.0	77	7694
01/01/2019	01/31/2019	31	2959.43	0.0	95	9547
02/01/2019	02/28/2019	28	3462.76	0.0	124	12367
03/01/2019	03/31/2019	31	2140.62	0.0	69	6905
04/01/2019	04/30/2019	30	1209.51	0.0	40	4032
05/01/2019	05/31/2019	31	599.1	0.0	19	1933
06/01/2019	06/30/2019	30	495.56	0.0	17	1652
07/01/2019	07/31/2019	31	269.68	0.0	9	870
08/01/2019	08/31/2019	31	277.22	0.0	9	894
09/01/2019	09/30/2019	30	432.43	0.0	14	1441
10/01/2019	10/31/2019	31	1422.97	0.0	46	4590
11/01/2019	11/30/2019	30	2287.78	0.0	76	7626
12/01/2019	12/31/2019	31	2517.28	0.0	81	8120
01/01/2020	01/31/2020	31	2170.95	0.0	70	7003
02/01/2020	02/29/2020	29	1723.84	0.0	59	5944
03/01/2020	03/31/2020	31	1860.73	0.0	60	6002
04/01/2020	04/30/2020	30	1220.55	0.0	41	4069
05/01/2020	05/31/2020	31	599.18	0.0	19	1933
06/01/2020	06/30/2020	30	207.47	0.0	7	692
07/01/2020	07/31/2020	31	181.2	0.0	6	585
08/01/2020	08/31/2020	31	203.44	0.0	7	656
09/01/2020	09/30/2020	30	235.71	0.0	8	786
10/01/2020	10/31/2020	31	337.29	0.0	11	1088
11/01/2020	11/30/2020	30	546.66	0.0	18	1822
12/01/2020	12/31/2020	31	773.99	0.0	25	2497
01/01/2021	01/31/2021	31	1108.16	0.0	36	3575
02/01/2021	02/28/2021	28	2221.43	0.0	79	7934
03/01/2021	03/31/2021	31	2158.07	0.0	70	6962
04/01/2021	04/30/2021	30	854.13	0.0	28	2847
05/01/2021	05/31/2021	31	373.22	0.0	12	1204
06/01/2021	06/30/2021	30	198.46	0.0	7	662
07/01/2021	07/31/2021	31	183.12	0.0	6	591
08/01/2021	08/31/2021	31	180.68	0.0	6	583
09/01/2021	09/30/2021	30	251.45	0.0	8	838
10/01/2021	10/31/2021	31	763.95	0.0	25	2464
11/01/2021	11/30/2021	30	1464.57	0.0	49	4882
12/01/2021	12/31/2021	31	3369.111	0.0	109	10868
01/01/2022	01/31/2022	31	2894.5	0.0	93	9337
02/01/2022	02/28/2022	28	2147.27	0.0	77	7669
03/01/2022	03/31/2022	31	1546.25	0.0	50	4988
04/01/2022	04/30/2022	30	2941.56	0.0	98	9805
05/01/2022	05/31/2022	31	588.03	0.0	19	1897
06/01/2022	06/30/2022	30	268.03	0.0	9	893
07/01/2022	07/31/2022	31	255.4	0.0	8	824
08/01/2022	08/31/2022	31	231.39	0.0	7	746
09/01/2022	09/30/2022	30	230.7	0.0	8	769

Building Name: **Tacoma Solid Waste Admin and Shop**

10/01/2022	10/31/2022	31	579.54	0.0	19	1869
11/01/2022	11/30/2022	30	2399.6	0.0	80	7999
12/01/2022	12/31/2022	31	3350.88	0.0	108	10809
01/01/2023	01/31/2023	31	0.0	0.0	0	0
02/01/2023	02/28/2023	28	0.0	0.0	0	0
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Tacoma Solid Waste Admin and Shop
Gross Conditioned Square Feet	34232.0

UTILITY DATA AND BENCHMARKING

Building Name: **Tacoma Solid Waste Admin and Shop**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	94.3
Target Site Energy Intensity*	63.0

Building Name: **Tacoma Solid Waste Admin and Shop**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	45221	154294	13.19
Air Distribution	25469	86900	7.43
Lighting	253031	863342	73.79
Plug Loads	83136	283660	24.24
Other	38040	129792	11.09
Total	**444897**	**1517989**	**129.74**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**444897**	**1517989**	**129.74**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	9776	977600	51.92
Service Water Heating	1763	176300	9.36
Total	**11539**	**1153900**	**61.28**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**11539**	**1153900**	**61.28**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.
Other End Use Types include:

OVERVIEW

BUILDING INFORMATION

Tacoma Main Library
1102 Tacoma Ave S
Tacoma, WA 98402

Report Type	**WA Commerce Clean Buildings - Form D Report**	Report Status:	**In Progress**
		Report Date:	**03/21/2023**
Gross Floor Area:	**95,727.0 ft²**	Year Built:	**2023**
Building ID #:	**28142**	Software Release:	2023.0.0.486
Project Name	**City of Tacoma Decarbonization**	Washington State Building ID	**8**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

This report follows the ASHRAE/ACCA Standard 211P, Standard for Commercial Building Energy Audits. It also includes additional data fields required by specific cities, where applicable. The icons below identify data categories.

- ASHRAE Level 2 inputs
- City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with * indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.

CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Tacoma Main Library**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Tacoma Main Library**

Building Characteristics

Gross Floor Area*	95727.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Library

Use Type / Space Function / Building Area Type*	Library
Gross Floor Area*	95727.0
Number of Occupants*	81
Use (hours/week)*	73.0
Use (weeks/year)*	52.0

Building Name: **Tacoma Main Library**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
12/01/2017	12/31/2017	31	65287.047	0.0	0.0	0%	2106	7186
01/01/2018	01/31/2018	31	70474.797	0.0	0.0	0%	2273	7757
02/01/2018	02/28/2018	28	64722.863	0.0	0.0	0%	2312	7887
03/01/2018	03/31/2018	31	65358.617	0.0	0.0	0%	2108	7194
04/01/2018	04/30/2018	30	65507.184	0.0	0.0	0%	2184	7450
05/01/2018	05/31/2018	31	64750.207	0.0	0.0	0%	2089	7127
06/01/2018	06/30/2018	30	64232.004	0.0	0.0	0%	2141	7305
07/01/2018	07/31/2018	31	73012.664	0.0	0.0	0%	2355	8036
08/01/2018	08/31/2018	31	75307.359	0.0	0.0	0%	2429	8289
09/01/2018	09/30/2018	30	71331.305	0.0	0.0	0%	2378	8113
10/01/2018	10/31/2018	31	66628.961	0.0	0.0	0%	2149	7333
11/01/2018	11/30/2018	30	61163.484	0.0	0.0	0%	2039	6956
12/01/2018	12/31/2018	31	60600.969	0.0	0.0	0%	1955	6670
01/01/2019	01/31/2019	31	58800.031	0.0	0.0	0%	1897	6472
02/01/2019	02/28/2019	28	63997.246	0.0	0.0	0%	2286	7799
03/01/2019	03/31/2019	31	78998.711	0.0	0.0	0%	2548	8695
04/01/2019	04/30/2019	30	70430.25	0.0	0.0	0%	2348	8010
05/01/2019	05/31/2019	31	72123.039	0.0	0.0	0%	2327	7938
06/01/2019	06/30/2019	30	72590.508	0.0	0.0	0%	2420	8256
07/01/2019	07/31/2019	31	77385.789	0.0	0.0	0%	2496	8517
08/01/2019	08/31/2019	31	80151.734	0.0	0.0	0%	2586	8822
09/01/2019	09/30/2019	30	71122.773	0.0	0.0	0%	2371	8089
10/01/2019	10/31/2019	31	59647.246	0.0	0.0	0%	1924	6565
11/01/2019	11/30/2019	30	61144.844	0.0	0.0	0%	2038	6954
12/01/2019	12/31/2019	31	55852.434	0.0	0.0	0%	1802	6147
01/01/2020	01/31/2020	31	68168.727	0.0	0.0	0%	2199	7503
02/01/2020	02/29/2020	29	65971.516	0.0	0.0	0%	2275	7762
03/01/2020	03/31/2020	31	40227.668	0.0	0.0	0%	1298	4428
04/01/2020	04/30/2020	30	44813.805	0.0	0.0	0%	1494	5097
05/01/2020	05/31/2020	31	60248.535	0.0	0.0	0%	1944	6631

Building Name: **Tacoma Main Library**

06/01/2020	06/30/2020	30	52762.516	0.0	0.0	0%	1759	6001
07/01/2020	07/31/2020	31	55336.547	0.0	0.0	0%	1785	6091
08/01/2020	08/31/2020	31	64063.453	0.0	0.0	0%	2067	7051
09/01/2020	09/30/2020	30	58800.0	0.0	0.0	0%	1960	6688
10/01/2020	10/31/2020	31	56400.0	0.0	0.0	0%	1819	6208
11/01/2020	11/30/2020	30	57861.813	0.0	0.0	0%	1929	6581
12/01/2020	12/31/2020	31	59985.934	0.0	0.0	0%	1935	6602
01/01/2021	01/31/2021	31	54352.258	0.0	0.0	0%	1753	5982
02/01/2021	02/28/2021	28	46175.176	0.0	0.0	0%	1649	5627
03/01/2021	03/31/2021	31	52353.109	0.0	0.0	0%	1689	5762
04/01/2021	04/30/2021	30	0.0	0.0	0.0	0%	0	0
05/01/2021	05/31/2021	31	0.0	0.0	0.0	0%	0	0
06/01/2021	06/30/2021	30	0.0	0.0	0.0	0%	0	0
07/01/2021	07/31/2021	31	0.0	0.0	0.0	0%	0	0
08/01/2021	08/31/2021	31	0.0	0.0	0.0	0%	0	0
09/01/2021	09/30/2021	30	0.0	0.0	0.0	0%	0	0
10/01/2021	10/31/2021	31	0.0	0.0	0.0	0%	0	0
11/01/2021	11/30/2021	30	0.0	0.0	0.0	0%	0	0
12/01/2021	12/31/2021	31	0.0	0.0	0.0	0%	0	0
01/01/2022	01/31/2022	31	0.0	0.0	0.0	0%	0	0
02/01/2022	02/28/2022	28	0.0	0.0	0.0	0%	0	0
03/01/2022	03/31/2022	31	0.0	0.0	0.0	0%	0	0
04/01/2022	04/30/2022	30	0.0	0.0	0.0	0%	0	0
05/01/2022	05/31/2022	31	0.0	0.0	0.0	0%	0	0
06/01/2022	06/30/2022	30	0.0	0.0	0.0	0%	0	0
07/01/2022	07/31/2022	31	0.0	0.0	0.0	0%	0	0
08/01/2022	08/31/2022	31	0.0	0.0	0.0	0%	0	0
09/01/2022	09/30/2022	30	0.0	0.0	0.0	0%	0	0
10/01/2022	10/31/2022	31	0.0	0.0	0.0	0%	0	0
11/01/2022	11/30/2022	30	0.0	0.0	0.0	0%	0	0
12/01/2022	12/31/2022	31	0.0	0.0	0.0	0%	0	0
	Average Annual Total		**0**	**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
12/01/2017	12/31/2017	31	2510.87	0.0	81	8100
01/01/2018	01/31/2018	31	0.0	0.0	0	0
02/01/2018	02/28/2018	28	120.03	0.0	4	429
03/01/2018	03/31/2018	31	759.19	0.0	24	2449
04/01/2018	04/30/2018	30	638.64	0.0	21	2129
05/01/2018	05/31/2018	31	631.77	0.0	20	2038
06/01/2018	06/30/2018	30	226.16	0.0	8	754
07/01/2018	07/31/2018	31	16.67	0.0	1	54
08/01/2018	08/31/2018	31	30.85	0.0	1	100
09/01/2018	09/30/2018	30	4.25	0.0	0	14

Building Name: **Tacoma Main Library**

10/01/2018	10/31/2018	31	790.0	0.0	25	2548
11/01/2018	11/30/2018	30	2014.58	0.0	67	6715
12/01/2018	12/31/2018	31	2484.43	0.0	80	8014
01/01/2019	01/31/2019	31	2506.37	0.0	81	8085
02/01/2019	02/28/2019	28	2899.291	0.0	104	10355
03/01/2019	03/31/2019	31	2096.66	0.0	68	6763
04/01/2019	04/30/2019	30	1508.02	0.0	50	5027
05/01/2019	05/31/2019	31	620.57	0.0	20	2002
06/01/2019	06/30/2019	30	344.92	0.0	11	1150
07/01/2019	07/31/2019	31	32.0	0.0	1	103
08/01/2019	08/31/2019	31	0.0	0.0	0	0
09/01/2019	09/30/2019	30	588.32	0.0	20	1961
10/01/2019	10/31/2019	31	2472.61	0.0	80	7976
11/01/2019	11/30/2019	30	4424.391	0.0	147	14748
12/01/2019	12/31/2019	31	3739.691	0.0	121	12064
01/01/2020	01/31/2020	31	2493.22	0.0	80	8043
02/01/2020	02/29/2020	29	3488.361	0.0	120	12029
03/01/2020	03/31/2020	31	4261.17	0.0	137	13746
04/01/2020	04/30/2020	30	2493.45	0.0	83	8311
05/01/2020	05/31/2020	31	1415.84	0.0	46	4567
06/01/2020	06/30/2020	30	712.22	0.0	24	2374
07/01/2020	07/31/2020	31	181.58	0.0	6	586
08/01/2020	08/31/2020	31	101.27	0.0	3	327
09/01/2020	09/30/2020	30	409.51	0.0	14	1365
10/01/2020	10/31/2020	31	3009.8	0.0	97	9709
11/01/2020	11/30/2020	30	4543.74	0.0	151	15146
12/01/2020	12/31/2020	31	7374.621	0.0	238	23789
01/01/2021	01/31/2021	31	5011.231	0.0	162	16165
02/01/2021	02/28/2021	28	8306.81	0.0	297	29667
03/01/2021	03/31/2021	31	5960.069	0.0	192	19226
04/01/2021	04/30/2021	30	3043.761	0.0	101	10146
05/01/2021	05/31/2021	31	1292.76	0.0	42	4170
06/01/2021	06/30/2021	30	1493.09	0.0	50	4977
07/01/2021	07/31/2021	31	572.48	0.0	18	1847
08/01/2021	08/31/2021	31	101.46	0.0	3	327
09/01/2021	09/30/2021	30	1758.53	0.0	59	5862
10/01/2021	10/31/2021	31	2923.36	0.0	94	9430
11/01/2021	11/30/2021	30	4333.509	0.0	144	14445
12/01/2021	12/31/2021	31	7095.249	0.0	229	22888
01/01/2022	01/31/2022	31	4102.639	0.0	132	13234
02/01/2022	02/28/2022	28	5062.481	0.0	181	18080
03/01/2022	03/31/2022	31	4499.139	0.0	145	14513
04/01/2022	04/30/2022	30	2219.44	0.0	74	7398
05/01/2022	05/31/2022	31	1077.07	0.0	35	3474
06/01/2022	06/30/2022	30	142.44	0.0	5	475
07/01/2022	07/31/2022	31	9.24	0.0	0	30

Building Name: **Tacoma Main Library**

08/01/2022	08/31/2022	31	0.0	0.0	0	0
09/01/2022	09/30/2022	30	0.0	0.0	0	0
10/01/2022	10/31/2022	31	855.68	0.0	28	2760
11/01/2022	11/30/2022	30	2529.55	0.0	84	8432
12/01/2022	12/31/2022	31	2892.42	0.0	93	9330
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Tacoma Main Library
Gross Conditioned Square Feet	95727.0

UTILITY DATA AND BENCHMARKING

Building Name: **Tacoma Main Library**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	50.2
Target Site Energy Intensity*	56.0

Building Name: **Tacoma Main Library**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	103393	352777	30.15
Air Distribution	70642	241030	20.6
Lighting	361924	1234885	105.54
Plug Loads	144176	491929	42.04
Service Water Heating	16861	57530	4.92
Total	**696996**	**2378150**	**203.26**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**696996**	**2378150**	**203.26**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	15314	1531400	81.33
Total	**15314**	**1531400**	**81.33**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**15314**	**1531400**	**81.33**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

OVERVIEW

BUILDING INFORMATION

Lighthouse Senior Center
5016 A ST
Tacoma, WA 98408

Report Type	**WA Commerce Clean Buildings - Form D Report**	Report Status:	**In Progress**
		Report Date:	**03/21/2023**
Gross Floor Area:	**8,777.0 ft²**	Year Built:	**2023**
Building ID #:	**28143**	Software Release:	2023.0.0.486
Project Name	**City of Tacoma Decarbonization**	Washington State Building ID	**9**

AUDIT TEAM

McKinstry
5005 3rd Ave S
Seattle, WA 98134
(206) 790-8071

DATA SUMMARY

This report was generated from data entered into the Building Energy Asset Score (Asset Score) tool, developed by the Pacific Northwest National Laboratory (PNNL) for the U.S. Department of Energy (DOE). Asset Score is a national standardized tool for assessing the physical and structural energy efficiency of commercial and multifamily residential buildings. It also facilitates building energy audit data collection and reporting.

This report follows the ASHRAE/ACCA Standard 211P, Standard for Commercial Building Energy Audits. It also includes additional data fields required by specific cities, where applicable. The icons below identify data categories.

- ASHRAE Level 2 inputs
- City specific inputs

If this report is used to comply with a local energy audit ordinance, the fields marked with * indicate the minimum data to be reported. The audit team listed above is responsible for any information entered and reported through Asset Score. DOE and PNNL do not warranty data accuracy, completeness, legality, and reliability.

CONTACT INFORMATION AND AUDIT DETAILS

Building Name: **Lighthouse Senior Center**

Audit Details

Date of Completion for Level 2 Audit*	03/20/2023

Audit Team and Building Staff

Auditor

Name*	Ron Fues
Company Name or Organization*	McKinstry
Phone*	(206) 790-8071
Email*	ronf@mckinstry.com
Certificate	
Type of Certification*	Licensed Professional Engineer (PE)
Auditor's Years of Experience*	27

Building Owner

Name*	Perry Spring
Company Name or Organization*	City of Tacoma
Phone*	(253) 254-1056
Email*	pspring@cityoftacoma.org

FACILITY DESCRIPTION

Building Name: **Lighthouse Senior Center**

Building Characteristics

Gross Floor Area*	8777.0
Total Conditioned Floor Area	0.0
Historic Building?*	No

Use Types

Social/Meeting Hall

Use Type / Space Function / Building Area Type*	Social/Meeting Hall
Gross Floor Area*	8777.0
Number of Occupants*	10
Use (hours/week)*	40.0
Use (weeks/year)*	52.0

Building Name: **Lighthouse Senior Center**

Metered Energy

Energy Type: Electricity

Start Date	End Date	Days	Use (kWh)	Cost ($)	Peak (kW)	Load Factor	kWh / day	kBtu / day
01/01/2018	01/31/2018	31	11851.935	0.0	0.0	0%	382	1304
02/01/2018	02/28/2018	28	9576.437	0.0	0.0	0%	342	1167
03/01/2018	03/31/2018	31	9663.57	0.0	0.0	0%	312	1064
04/01/2018	04/30/2018	30	7838.628	0.0	0.0	0%	261	892
05/01/2018	05/31/2018	31	8061.548	0.0	0.0	0%	260	887
06/01/2018	06/30/2018	30	7120.34	0.0	0.0	0%	237	810
07/01/2018	07/31/2018	31	8034.672	0.0	0.0	0%	259	884
08/01/2018	08/31/2018	31	7662.485	0.0	0.0	0%	247	843
09/01/2018	09/30/2018	30	7247.832	0.0	0.0	0%	242	824
10/01/2018	10/31/2018	31	8946.22	0.0	0.0	0%	289	985
11/01/2018	11/30/2018	30	9801.085	0.0	0.0	0%	327	1115
12/01/2018	12/31/2018	31	11920.428	0.0	0.0	0%	385	1312
01/01/2019	01/31/2019	31	12800.0	0.0	0.0	0%	413	1409
02/01/2019	02/28/2019	28	10321.923	0.0	0.0	0%	369	1258
03/01/2019	03/31/2019	31	9832.415	0.0	0.0	0%	317	1082
04/01/2019	04/30/2019	30	9440.006	0.0	0.0	0%	315	1074
05/01/2019	05/31/2019	31	7112.573	0.0	0.0	0%	229	783
06/01/2019	06/30/2019	30	6899.003	0.0	0.0	0%	230	785
07/01/2019	07/31/2019	31	7671.161	0.0	0.0	0%	247	844
08/01/2019	08/31/2019	31	8344.842	0.0	0.0	0%	269	918
09/01/2019	09/30/2019	30	7379.309	0.0	0.0	0%	246	839
10/01/2019	10/31/2019	31	8433.089	0.0	0.0	0%	272	928
11/01/2019	11/30/2019	30	9116.999	0.0	0.0	0%	304	1037
12/01/2019	12/31/2019	31	12020.897	0.0	0.0	0%	388	1323
01/01/2020	01/31/2020	31	12521.688	0.0	0.0	0%	404	1378
02/01/2020	02/29/2020	29	10591.999	0.0	0.0	0%	365	1246
03/01/2020	03/31/2020	31	10034.086	0.0	0.0	0%	324	1104
04/01/2020	04/30/2020	30	7951.583	0.0	0.0	0%	265	904
05/01/2020	05/31/2020	31	7770.34	0.0	0.0	0%	251	855
06/01/2020	06/30/2020	30	6968.757	0.0	0.0	0%	232	793

Building Name: **Lighthouse Senior Center**

07/01/2020	07/31/2020	31	7230.569	0.0	0.0	0%	233	796
08/01/2020	08/31/2020	31	7100.704	0.0	0.0	0%	229	782
09/01/2020	09/30/2020	30	6310.346	0.0	0.0	0%	210	718
10/01/2020	10/31/2020	31	8634.174	0.0	0.0	0%	279	950
11/01/2020	11/30/2020	30	10545.486	0.0	0.0	0%	352	1199
12/01/2020	12/31/2020	31	12263.951	0.0	0.0	0%	396	1350
01/01/2021	01/31/2021	31	12972.948	0.0	0.0	0%	418	1428
02/01/2021	02/28/2021	28	11728.106	0.0	0.0	0%	419	1429
03/01/2021	03/31/2021	31	12047.216	0.0	0.0	0%	389	1326
04/01/2021	04/30/2021	30	10127.784	0.0	0.0	0%	338	1152
05/01/2021	05/31/2021	31	7442.996	0.0	0.0	0%	240	819
06/01/2021	06/30/2021	30	7015.006	0.0	0.0	0%	234	798
07/01/2021	07/31/2021	31	7300.0	0.0	0.0	0%	235	803
08/01/2021	08/31/2021	31	7077.99	0.0	0.0	0%	228	779
09/01/2021	09/30/2021	30	7552.99	0.0	0.0	0%	252	859
10/01/2021	10/31/2021	31	10801.993	0.0	0.0	0%	348	1189
11/01/2021	11/30/2021	30	11289.01	0.0	0.0	0%	376	1284
12/01/2021	12/31/2021	31	14220.985	0.0	0.0	0%	459	1565
01/01/2022	01/31/2022	31	15183.001	0.0	0.0	0%	490	1671
02/01/2022	02/28/2022	28	12716.999	0.0	0.0	0%	454	1550
03/01/2022	03/31/2022	31	12511.987	0.0	0.0	0%	404	1377
04/01/2022	04/30/2022	30	10288.013	0.0	0.0	0%	343	1170
05/01/2022	05/31/2022	31	7444.988	0.0	0.0	0%	240	819
06/01/2022	06/30/2022	30	6219.988	0.0	0.0	0%	207	707
07/01/2022	07/31/2022	31	7411.987	0.0	0.0	0%	239	816
08/01/2022	08/31/2022	31	7183.001	0.0	0.0	0%	232	791
09/01/2022	09/30/2022	30	6106.008	0.0	0.0	0%	204	694
10/01/2022	10/31/2022	31	7925.997	0.0	0.0	0%	256	872
11/01/2022	11/30/2022	30	12143.992	0.0	0.0	0%	405	1381
12/01/2022	12/31/2022	31	13233.998	0.0	0.0	0%	427	1457
01/01/2023	01/31/2023	31	4969.988	0.0	0.0	0%	160	547
	Average Annual Total		**0**	**0**	**0**	**0%**		

Energy Type: Natural Gas

Start Date	End Date	Days	Use (therms)	Cost ($)	therms / day	kBtu / day
01/01/2018	01/31/2018	31	598.67	0.0	19	1931
02/01/2018	02/28/2018	28	670.93	0.0	24	2396
03/01/2018	03/31/2018	31	671.4	0.0	22	2166
04/01/2018	04/30/2018	30	600.58	0.0	20	2002
05/01/2018	05/31/2018	31	590.98	0.0	19	1906
06/01/2018	06/30/2018	30	113.43	0.0	4	378
07/01/2018	07/31/2018	31	33.41	0.0	1	108
08/01/2018	08/31/2018	31	91.1	0.0	3	294
09/01/2018	09/30/2018	30	260.07	0.0	9	867
10/01/2018	10/31/2018	31	565.13	0.0	18	1823

Building Name: **Lighthouse Senior Center**

11/01/2018	11/30/2018	30	1026.67	0.0	34	3422
12/01/2018	12/31/2018	31	639.93	0.0	21	2064
01/01/2019	01/31/2019	31	744.54	0.0	24	2402
02/01/2019	02/28/2019	28	1249.24	0.0	45	4462
03/01/2019	03/31/2019	31	893.78	0.0	29	2883
04/01/2019	04/30/2019	30	1174.16	0.0	39	3914
05/01/2019	05/31/2019	31	475.43	0.0	15	1534
06/01/2019	06/30/2019	30	207.05	0.0	7	690
07/01/2019	07/31/2019	31	95.21	0.0	3	307
08/01/2019	08/31/2019	31	91.19	0.0	3	294
09/01/2019	09/30/2019	30	277.23	0.0	9	924
10/01/2019	10/31/2019	31	507.89	0.0	16	1638
11/01/2019	11/30/2019	30	561.33	0.0	19	1871
12/01/2019	12/31/2019	31	602.92	0.0	19	1945
01/01/2020	01/31/2020	31	593.46	0.0	19	1914
02/01/2020	02/29/2020	29	543.21	0.0	19	1873
03/01/2020	03/31/2020	31	1141.77	0.0	37	3683
04/01/2020	04/30/2020	30	1117.57	0.0	37	3725
05/01/2020	05/31/2020	31	349.74	0.0	11	1128
06/01/2020	06/30/2020	30	236.58	0.0	8	789
07/01/2020	07/31/2020	31	244.75	0.0	8	790
08/01/2020	08/31/2020	31	239.02	0.0	8	771
09/01/2020	09/30/2020	30	226.62	0.0	8	755
10/01/2020	10/31/2020	31	543.26	0.0	18	1752
11/01/2020	11/30/2020	30	1094.03	0.0	36	3647
12/01/2020	12/31/2020	31	1135.53	0.0	37	3663
01/01/2021	01/31/2021	31	1006.14	0.0	32	3246
02/01/2021	02/28/2021	28	546.65	0.0	20	1952
03/01/2021	03/31/2021	31	1031.07	0.0	33	3326
04/01/2021	04/30/2021	30	1048.84	0.0	35	3496
05/01/2021	05/31/2021	31	1001.89	0.0	32	3232
06/01/2021	06/30/2021	30	248.27	0.0	8	828
07/01/2021	07/31/2021	31	186.76	0.0	6	602
08/01/2021	08/31/2021	31	186.41	0.0	6	601
09/01/2021	09/30/2021	30	408.47	0.0	14	1362
10/01/2021	10/31/2021	31	172.86	0.0	6	558
11/01/2021	11/30/2021	30	953.64	0.0	32	3179
12/01/2021	12/31/2021	31	870.45	0.0	28	2808
01/01/2022	01/31/2022	31	1445.81	0.0	47	4664
02/01/2022	02/28/2022	28	1163.12	0.0	42	4154
03/01/2022	03/31/2022	31	1282.75	0.0	41	4138
04/01/2022	04/30/2022	30	1145.48	0.0	38	3818
05/01/2022	05/31/2022	31	163.98	0.0	5	529
06/01/2022	06/30/2022	30	74.17	0.0	2	247
07/01/2022	07/31/2022	31	73.34	0.0	2	237
08/01/2022	08/31/2022	31	74.65	0.0	2	241

Building Name: **Lighthouse Senior Center**

09/01/2022	09/30/2022	30	73.58	0.0	2	245
10/01/2022	10/31/2022	31	333.22	0.0	11	1075
11/01/2022	11/30/2022	30	684.52	0.0	23	2282
12/01/2022	12/31/2022	31	1223.34	0.0	39	3946
01/01/2023	01/31/2023	31	0.0	0.0	0	0
		Average Annual Total	**0**	**0**		

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

Existing Building EUI/ECI

Building Name	Lighthouse Senior Center
Gross Conditioned Square Feet	8777.0

UTILITY DATA AND BENCHMARKING

Building Name: **Lighthouse Senior Center**

Benchmarking

Year Benchmarked*	2019
Benchmark Site Energy Use Intensity*	116.5
Target Site Energy Intensity*	50.0

Building Name: **Lighthouse Senior Center**

Building Energy Use and Carbon Emissions by End Use

Energy Type: Electricity

End Use	Electricity (kWh)	Electricity (kBtu)	Carbon (t CO_2e)
Space Cooling	6296	21482	1.84
Space Heating	64615	220466	48.06
Air Distribution	7397	25239	2.16
Lighting	28306	96580	8.25
Plug Loads	6801	23205	1.98
Total	**113415**	**386972**	**33.07**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**113415**	**386972**	**33.07**
% Difference	**0%**	**0%**	**0%**

Energy Type: Natural Gas

End Use	Natural Gas (therms)	Natural Gas (kBtu)	Carbon (t CO_2e)
Space Heating	5502	550200	48.06
Service Water Heating	1165	116500	6.19
Cooking	734	73400	3.9
Total	**7401**	**740100**	**39.31**
Total (from annual summary)	**0**	**0**	**0.0**
Difference	**7401**	**740100**	**39.31**
% Difference	**0%**	**0%**	**0%**

Note: fields displayed in green indicate values calculated by the tool and not directly entered by the user.

EXHIBIT A

CITY OF TACOMA
MUNICIPAL FACILITIES DECARBONIZATION STUDY (MFDS)
SCOPE OF WORK

Project Goals and Summary

Report that will provide strategic guidance for projects to decarbonize the occupied facilities in City's property portfolio with very high annual Greenhouse Gas Emissions (GHG). It will provide specific decarbonization strategies and associated budget estimates for the evaluated facilities. Report will provide a template for use in completing similar analysis for other similar facilities in City's portfolio.

Objectives

- Satisfy directive in Council adopted Decarbonization Resolution 40776
- Support Carbon Neutrality Strategy for municipal operations within 2030 Tacoma Climate Action Plan
- Propose Strategic investments toward meeting municipal operation emission targets
- Coordinate decarbonization strategies with asset management, capital project planning, and deferred maintenance needs
- Provide resources that support leveraging of project funding through both internal City sources, and successful City-led applications to relevant external grant sources

TASK 1: PROJECT MANAGEMENT

Provide quality client service by maintaining frequent client and internal team communications, regular updates and accurate invoicing.

SUBTASKS

- Conduct a Project Team kickoff meeting and correspondences to clarify existing information available, expectations, and milestones for the project
- Prepare project work plan, and monitor progress, report regularly on progress and budget
- Prepare for and conduct regularly scheduled project team meetings and provide meeting minutes
- Provide monthly invoices and progress reports

ASSUMPTIONS

- Approximate 6-month project duration; presentation to Council IPS committee upon substantial project completion.
- Up to 12 virtual meetings (averaging one-hour each); monthly check-ins with City project team lead plus sessions with Site facility management on an as-needed basis only. Specific responses to information requests primarily via email with some phone/video chats.

TASK 2: CURRENT STATE ASSESSMENT OF EXISTING FACILITIES

For each of the selected City owned facilities, conduct both building ASHRAE Level II audits, and assessment of the property that addresses back up power and renewable energy

potential for site level carbon neutrality analysis. Complete assessment of each facility and its site.

SUBTASKS

- Provide prioritized list of data needs. Access provided information for completeness and QA/QC
- For each site, determine if virtual or onsite walk-thru is needed to complete Level II ASHRAE Audit
- Conduct Site team meeting / interviews to clarify and enhance provided information
- Include back-up power and renewable energy analysis in site assessment findings

ASSUMPTIONS

- City staff to provide existing available information for each of the 8 sites to the Contractor; includes specifics on the Property, Buildings, Energy Loads, Utility data, Building Improvements, and Financials
- City project lead will provide vetted Stakeholder list to consultant
- City to provide 2018 Facility Conditions Assessment reports for 4 Public Works buildings, and others as available
- City Tacoma Public Utilities representative(s) will provide assistance in identifying existing electrical infrastructure serving the site
- The information collected, compiled, and shared by City staff will be consistent in format and a high degree of completeness for elements
- City to deliver all information in a timely manner before consultant proceeds with the analysis. If City lacks specific information as existing documentation, parties will reach mutual agreement on method for establishing proximate or industry typical information

TASK 3: EVALUATE FACILTY RETROFIT OPPORTUNITIES

Evaluate feasibility at each facility for deep energy retrofitting, decarbonization fuel switching, and onsite renewable power systems. Evaluate alternative strategies and appropriateness of currently available / known near-term available technology.

SUBTASKS

- Calculate available electrical capacity for each facility (with assistance from Tacoma Power). Assess impact of proposed facility energy efficiency improvements on peak loads and existing electrical capacity.
- Analyze increased electrical capacity required for proposed strategies
- Use whole buildings analysis to include envelope, lighting, and process loads in addition to Mechanical, Electrical, and Plumbing
- Analyze facilities on a Life Cycle Planning basis, identifying End-of-Life equipment replacement opportunities where decarbonization would only be an incremental expense
- Address resiliency: for facilities supporting City essential functions/services, evaluate potential for low carbon onsite back-up power opportunities based on site needs and cost-effective strategies currently available within the 2030 horizon

- Assess and calculate renewable energy generation capacity and feasibility at select sites
- Direct analysis related questions to City project lead who will inquire directly with the appropriate City staff; interviews/meetings with City facility management staff only on an as needed basis / upon substantial completion of key project milestones

ASSUMPTIONS

- Once City staff has delivered information available to Consultant, then their analysis can proceed. If there is new or additional information added after the analysis has begun, that would be may be considered additional scope, effort and schedule, which can be negotiated between the consultant and the client.
- Tacoma Public Utilities representative(s) will provide assistance in calculating existing electrical infrastructure capacity and determining specific additional equipment required for proposed decarbonization strategies.
- Sites that are subject to WA Clean Buildings Performance Standards, both Tier 1 and 2, will be identified by City Project Lead
- City's EV Siting Study underway with preliminary findings due late Summer 2022. Only 2 of the 8 Facility Decarb Study are primary fleet domicile sites. Assume electrical capacity needed for moderate fleet electrification by 2030.

TASK 4: DECARBONIZATION RECOMMENDATIONS AND BUDGET ESTIMATES

Develop a Report that includes recommended decarbonization strategies and provide project cost estimates for each facility.

SUBTASKS

- Prepare recommendations addressing the most suitable decarbonization strategies for each site
- Identify specific systems for replacement / retrofitting / addition
- Define electrical infrastructure upgrades required and the associated costs – both utility side and customer side costs
- Prepare recommendations for low carbon back-up power only at Sites with mission critical functions
- Provide rough order cost estimates for all recommendations, including capital costs, life cycle costs and savings (operations. Maintenance, others)
- Prepare conceptual Project Timelines for proposed retrofits / electrical infrastructure upgrades / onsite renewable power recommendations with emphasis on chronology
- Develop a phasing strategy for implementation of recommendations at the portfolio scale; this can include WA Clean Buildings Performance Standard compliance considerations
- Include resources to support City-led grant funding applications, including ASHRAE Level 2 audits in electronic format
- Include a dashboard type tool for both presenting building decarbonization options, and for applying strategies for buildings of similar type to those included in study

ASSUMPTIONS

- Client to provide all data requested and provide access to field review of service panel if needed
- Estimates provided will be a Preliminary Feasibility Analysis intended for planning-level budgetary guidance for the agency
- Fuel switching and deep retrofits is preferred option, but evaluation of renewable fuels and offsets should be considered.

TASK 5: PREPARE REPORT

Compile the work product from each subsequent task into a comprehensive report intended to guide decarbonization deployment at each representative City facility in the study.

SUBTASKS

- Prepare draft report for client review
- Conduct presentation of preliminary findings to select staff stakeholders
- Finalize report based on client feedback
- Conduct presentation of final report and recommendations to City's executive management

8 CITY-OWNED & OPERATED SITES FOR THIS STUDY

Site	Year Built	Gross Floor Area (SF)	2019 Nat Gas (MMBTU)	2019 Energy (MMBTU)	2019 Emissions MT CO2e	Energy Systems to address	Challenges
Police HQ	2005	73,000	4,940	8,973	286	NG HVAC & WH, 24/7, atrium	HRH distribution piping
Convention Center	2004	209,088	3,462	11,679	239	NG HVAC & WH, atrium	Peak loads, Nat Gas Kitchen
Pantages Theater	1917	51,700	2,714	3,309	101	NG HVAC replace w/ VRF	Cap Project Budget Est
SWM Admin Bldg @ TRTC	2011	34,232	1,807	3,377	105	NG HVAC & WH, ltg, controls	Double shift
Tacoma Main Library	1902	95,727	1,562	4,368	101	NG loads, renovations	Historic
TMB complex	1919	248,420	16	2,156	64	Automate controls, ltg	Historic, envelope

Lighthouse Senior Center	1954	8,777	629	1,002	36	NG HVAC & WH	Low Basement Clg
Fire Station 08	2003	17,400	414	902	25	NG HVAC & WH	

9 PROJECT FEE SCHEDULE

Project Fee Schedule: for periodic billing not to exceed contract price of $50,000			
McKinstry Essention LLC	Hourly Rates		
Services - Personnel Category	**2021-22**	**2023**	**2024**
Project Executive	$ 275.00	$ 283.25	$ 291.75
Project Director	$ 205.00	$ 211.15	$ 217.48
Sr. Program Manager/Sr. Data Analyst	$ 185.00	$ 190.55	$ 196.27
Program Manager	$ 175.00	$ 180.25	$ 185.66
Sr. Cx Engineer	$ 175.00	$ 180.25	$ 185.66
Engineer	$ 175.00	$ 180.25	$ 185.66
Cx Specialist - Trained on Biogas System	$ 193.00	$ 198.79	$ 204.75
Cx Specialist	$ 165.00	$ 169.95	$ 175.05
Cx Specialist	$ 175.00	$ 180.25	$ 185.66
Data Analyst	$ 150.00	$ 154.50	$ 159.14
Business Operations Specialist	$ 113.00	$ 116.39	$ 119.88

TACOMA CLIMATE ACTION PLAN

SECTION 9, MUNICIPAL CARBON NEUTRALITY STRATEGY

WHY DOES THE CITY OF TACOMA NEED A MUNICIPAL CARBON NEUTRALITY STRATEGY?

The devastating impacts of climate change are manifesting locally. June 2021 heat dome extreme temperatures and elevated air pollution from increased regional wildfires are examples that impact the health of the City and the ecology that supports us. City elected officials have asked staff to deliver transformative solutions that reduce City greenhouse gas (GHG) emissions.

Leading-By-Example has been a hallmark of the City's work to mitigate climate change since adoption of 2008 Climate Action Plan (CAP) 1.0. This City-as-model approach was explicit in the development of actions and targets in the 2015 Environmental Action Plan (CAP 2.0). Lessons learned from the 2016 through 2020 include developing an overarching and clear goal to guide the Plan and City work as well as separate actions specific to municipal operations into their own section.

With the adoption of Climate Emergency Resolution 40509 in December 2019, City leadership tasked the Office of Environmental Policy and Sustainability (OEPS) with updating the CAP. This included laying out a clear pathway to toward reaching the City's 2050 carbon reduction goals of municipal carbon neutrality.

While the City's municipal operations make up less than 1% of total community-wide emissions, it is important that the City prioritizes carbon emission reduction.

Reasons the City should pursue aggressive GHG pollution reduction goals:

- **Accountability:** Setting clearly defined goals and measuring progress is critical for making progress and building trust with our community
- **Innovation:** Investing in a clean energy future that promotes innovation, supports economic development, and fosters creativity in solutions
- **Cost Savings:** Conserving resources and reducing emissions saves money now and in the future
- **Health:** Reducing emissions and other types of air pollution has benefits for public health and safety
- **Leadership:** Setting ambitious goals can demonstrate success and inspire action by employees, other governments, and businesses

Implementing the staff directives in the climate emergency resolution led to a clear consensus that a Municipal Carbon Neutrality Strategy (MCN Strategy hereafter) needed to be developed for Municipal Operations. Working with Sustainability Tacoma Commission and Tacoma City Council (Council) leadership, a Decarbonization Resolution 40776 was adopted in April 2021.

Specific to Municipal Operations, the Decarbonization Resolution directs staff to:

- Exclude fossil fuel energy sources in heating, lighting, and to power all new buildings and major renovations
- Use low carbon fuels including renewable diesel, biodiesel, renewable natural gas, electrolytic hydrogen, and electricity derived or generated from sustainable and

renewable resources. Exceptions or exemptions should only be allowed when insufficient reliable, resilient, technical, or cost-feasible options are available

- Inventory the City-owned facilities within the City Limit that use fossil fuels, evaluating for feasibility of retrofitting these buildings to low-emission sources by 2030. Evaluations should make use of existing reports, and recommendations prepared regarding feasibility and life-cycle costs
- Prioritize new fleet vehicles that are zero-emission, low-emission, or non-motorized vehicles with specific criteria for evaluation and selection, and
- Develop a plan to retrofit all City-owned parking facilities and buildings with electric vehicle charging stations by 2030

Implementing the requirements of the decarbonization resolution, the MCN Strategy will guide Scope 1 and 2 emission reductions and help the City prepare for climate impacts through 2030, keeping us on track for carbon neutrality in 2050.

TRACKING OUR PROGRESS & PAST MUNICIPAL EMISSIONS

The City has been conducting inventories of emissions associated with general government and Tacoma Public Utilities (TPU) operations within the City limits since 2005. Per international standards, government operations emissions are tracked for 5 Sectors: Fleet, Buildings, Streetlights/Signals, Water/Wastewater, and Employee Commute. Fleet includes all City-operated on-road vehicles and non-road equipment used for transport of goods and materials. Buildings include all facility types including infrastructure. Employee Commute includes emissions from how staff travel to work and is a Scope 3 emission source. Scope 3 emissions are indirect, meaning the City has less control over their production, unlike Scope 1 and 2 emissions. The MCN Strategy will focus on Scope 1 and 2 emission sources for the sectors Fleet, Buildings, Streetlights/Signals, and Water/Wastewater across departments.

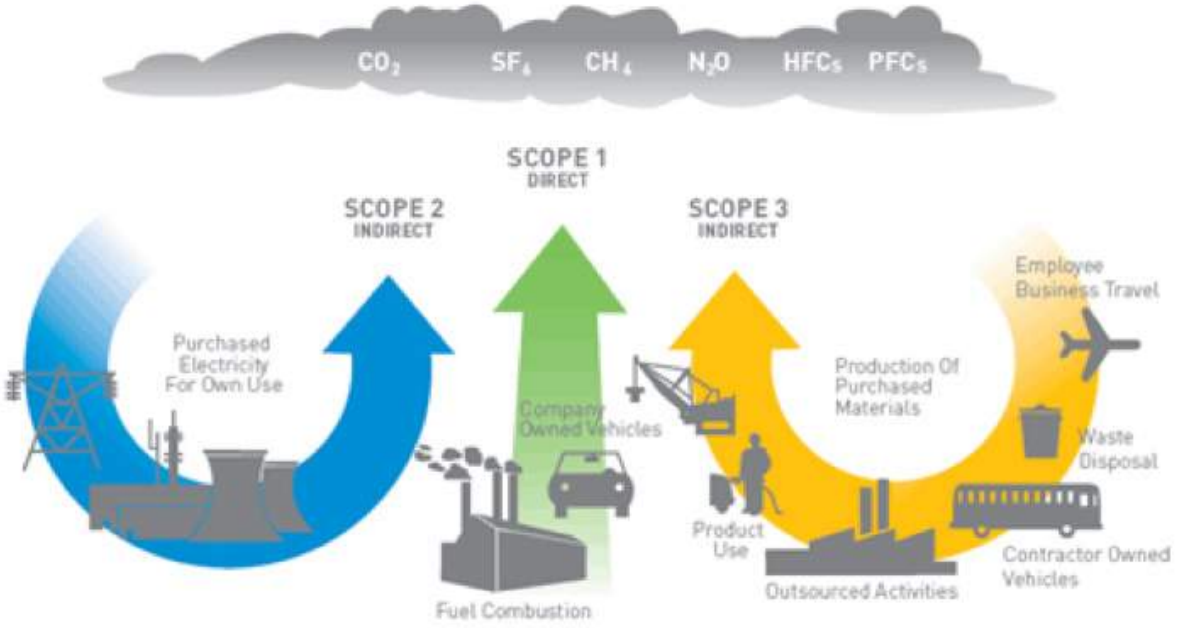

Figure 1. A graphic representation of the carbon footprint from the Life Cycle Initiative.

Figure 2. Government operation emissions over time Scope 1 & 2 ($MTCO_2e$).

To date, the City's government operations has not made significant reductions to their emissions. Results from the 2019 GHG Emission Inventory show that Government Operations emissions decreased only 3% between 2005 and 2019. At 84%, Fleet was the highest contributing sector to municipal emissions in the 2019 Inventory followed by Buildings at 12% of emissions. While Fleet emissions have decreased by 13% since 2005, Buildings emissions have increased 46% since 2005 and 16% when compared to 2012.

BUILDING ON ACCOMPLISHMENT SINCE 2015

This MCN Strategy builds on significant progress towards 2015 Environmental Action Plan (CAP 2.0) targets and actions. Among the many noteworthy municipal operations accomplishments are:

- New positions per CAP 2.0 were established and hired – Resource Conservation Manager, Facilities Conservation Manager, and Green Building and Resilience Specialist
- Strategic Energy Management programs have been established in 4 facilities with high annual energy loads. In 2011, Environmental Services enrolled the Central Treatment Plant in Tacoma Power's initial Industrial SEM administered by Energy Smart Industrial. The CTP's Energy Management Team has worked continuously to produce significant year-after-year electricity savings. In 2018, three of the City's facilities were enrolled in a pilot 2-year Commercial SEM program: the Convention Center, Police-Fleet campus, and TPU campus. Collectively these 4 facilities have saved nearly 13,000 MWh over 7+ years versus business-as-usual energy model. The aggregate average annual savings are approaching 2,850 MWh.
- Streetlights LED Replacement Project: Public Works and Tacoma Public Utilities worked together to replace 75% of City's aging streetlights with new energy efficient LED fixtures. The project is forecast to save 11,500 MWh per year for at least 15 years.
- Fleet Decarbonization: More than 3% of City's passenger vehicles are plug-in electrics. A transition is underway to shift from fossil to renewable diesel in existing fleet vehicles.
- Fleet CNG collection trucks and Renewable Gas Production: Environmental Services has coordinated the modernization of its solid waste collection trucks with production of marketable Renewable Natural Gas production at its wastewater treatment plant. Over one-third of Solid Waste' collection fleet was updated from diesel to CNG trucks. Recent expansion of CNG fuel station capacity can support the full collection fleet. At the City's wastewater treatment plant, construction nearing completion of system to convert historically flared biogas into useable Renewable Natural Gas. It is forecast that upon completion, that up to 788 tons of carbon could be removed annually from diesel fleet vehicles.

COMMUTE TRIP REDUCTION

Employee commuting, in 2019 was ~31% of municipal operation emissions when including scope 3 sources.

Commute Trip Reduction program (CTR) has been promoted towards reducing staff traveling via Single Occupancy Vehicles (SOV). Employee Transportation Coordinators, Orca Cards, and Van Pool have been deployed towards reducing SOV, with modest success. At the onset of COVID-19 pandemic, the City responded with both an emergency Telecommuting directive, and formation of a cross-departmental task force to update policy and procedures.

The December 2020 bi-annual CTR survey revealed a more than 50% reduction in emissions from staff commuting compared with 2018 survey. A new telework policy is being implemented as safe ways to return to workplace are established. With both hybrid and full-time telework options, City intends to maintain the many telework co-benefits including emissions reductions.

WHAT DOES THIS STRATEGY INCLUDE?

This MCN Strategy establishes both an overarching goal of carbon neutrality and specific initiatives towards achieving the City's stated 2030 and 2050 emission reduction goals. This MCN Strategy is Section 9 of the City's third Climate Action Plan with discreet goals to achieve by 2030 and actions to catalyze success in the first three years (2022 – 2024).

This MCN Strategy empowers staff to take direct control of the carbon intensity associated with operational decisions and actions. This includes but is not limited to: City-owned facilities, fleet equipment, travel for City business, procurement of materials goods and services, and post-use management of all City-owned tangible property (i.e. materials, equipment, structures, and real estate).

In the earlier versions of the City's CAP, municipal actions and target addressed "low-hanging fruit" opportunities, which engaged a limited set of City staff. This MCN Strategy is directed at all levels of City management and involves all City staff decisions and actions.

MCN Strategy sets incremental 10-year carbon reduction targets through the year 2050 with an aspirational aim towards making City operations carbon-neutral by 2050 (Resolution 40509, Dec. 2019). Consistent with Washington State 2021 Energy Strategy, the City defines its 2050 municipal operations goal as 95% Carbon Neutrality of Scope 1 and 2.

2030 MUNICIPAL OPERATION TARGETS

- **Fleet** – Carbon Pollution reduction by **50% from 2020 levels**
- **Facilities** – Carbon pollution reduction by **30% from 2020 levels**
- **Employee Commuting Reduction** – Single Occupancy Vehicles only **65% of mix by 2030**
- **Employee Engagement** – **95%** of employees engaged

This MCN Strategy is the result of an on iterative collaborative process. The City contracted with Sustainable Solutions Group (SSG), a consulting firm specialized in working with cities to address climate planning challenges. Working with Office of Environmental Policy and Sustainability staff, SSG organized a series of staff stakeholder workshops to review past performance, address the challenges ahead, and identify potential solutions and existing barriers. Direct contacts with key management staff supplemented these workshops. As MCN Strategy began to take shape, more focused workshops with Fleet and Facilities stakeholders collated independent suggestions into consensus **prioritized actions identified by:**

- Climate benefit
- Feasible
- Alignment with other City policies and priorities
- Leadership and Partnership Opportunities
- Coordinating funding needed with budgetary process

The Action Table of this MCN Strategy has been reviewed and refined with stakeholder involvement.

The specific actions of this MCN Strategy are organized into 6 categories: 1) Fleet & Fuel, 2) Buildings & Infrastructure, 3) Investment, 4) Purchasing, 5) Organizational Capacity, and 6) Education & Engagement. The Action Table presents 18 specific actions. City policies and resolutions associated with municipal operation emission reduction are listed.

IMPLEMENTATION OPPORTUNITIES

Federal, state, and utility programs present both requirements and opportunities for improving municipal operations, including but not limited to:

- Clean Buildings Performance Standard (HB 1257, 2019, Commerce) – large commercial buildings reduces pollution from fossil fuel consumption through early adopter incentives and compliance with energy intensity targets.
- Clean Fuel Standard (HB 1091, 2021, Ecology) – requires fuel suppliers to reduce carbon intensity of transportation fuels and stimulates economic development in low carbon fuel production. The standard includes purchasing credits for electric vehicle charging providers. Similar standards are already working in California, Oregon, and British Columbia
- Cap and Invest (SB 5126, 2021, Ecology) – caps emissions statewide and creates tradeable allowances. Funds will support climate change reduction and resilience activities
- Existing Washington State programs that award grants and loans to local governments, including but not limited to: Electrified Transportation System (Commerce), Energy Retrofits for Public Buildings (Commerce), Clean Air & Climate (Ecology), LOCAL (Treasurer), Preparedness Grants for resilient facilities (Emergency Management Division), and Enterprise Services' Energy Program
- Utility incentives are rebates: offered by Tacoma Power and Puget Sound Energy, a wide range of incentives promote high-efficiency systems, energy-conserving projects, and EV Charging

PERFORMANCE METRICS TO DATE

An important principle of evidence-based decision making involves establishing metrics which document historical patterns and track progress towards Climate mitigation goals. The following presents key performance of Municipal Operations, especially fleet and facilities:

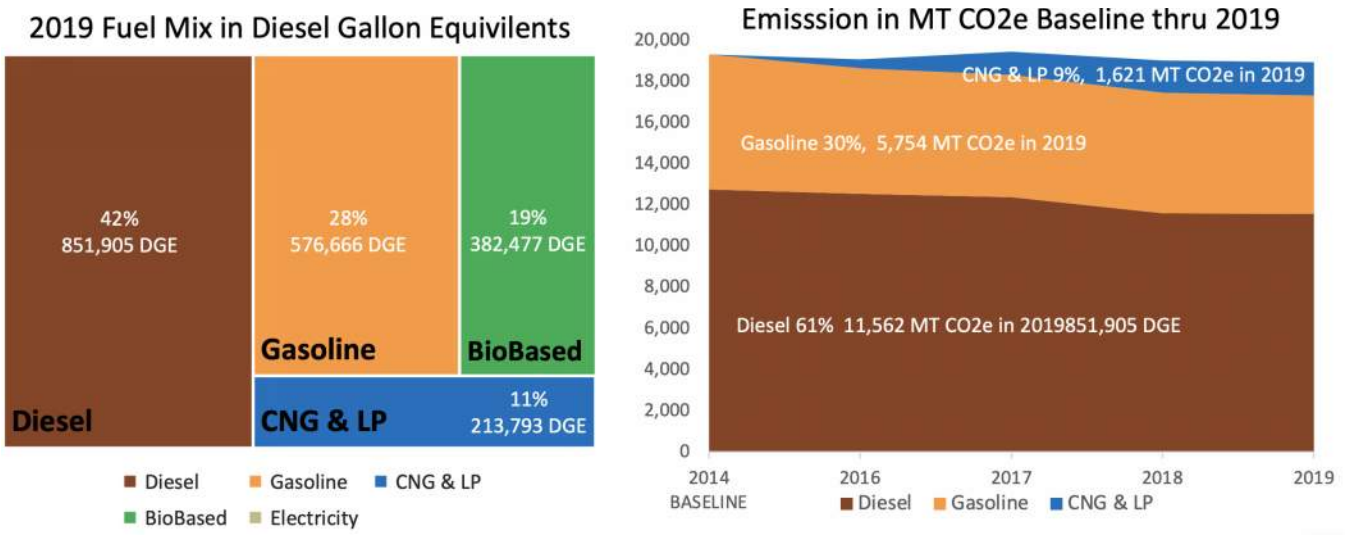

Figure 3. 2019 fuel mix vs emissions through 2019.

Diesel is 42% of the annual fuel volume and 61% of the emissions.

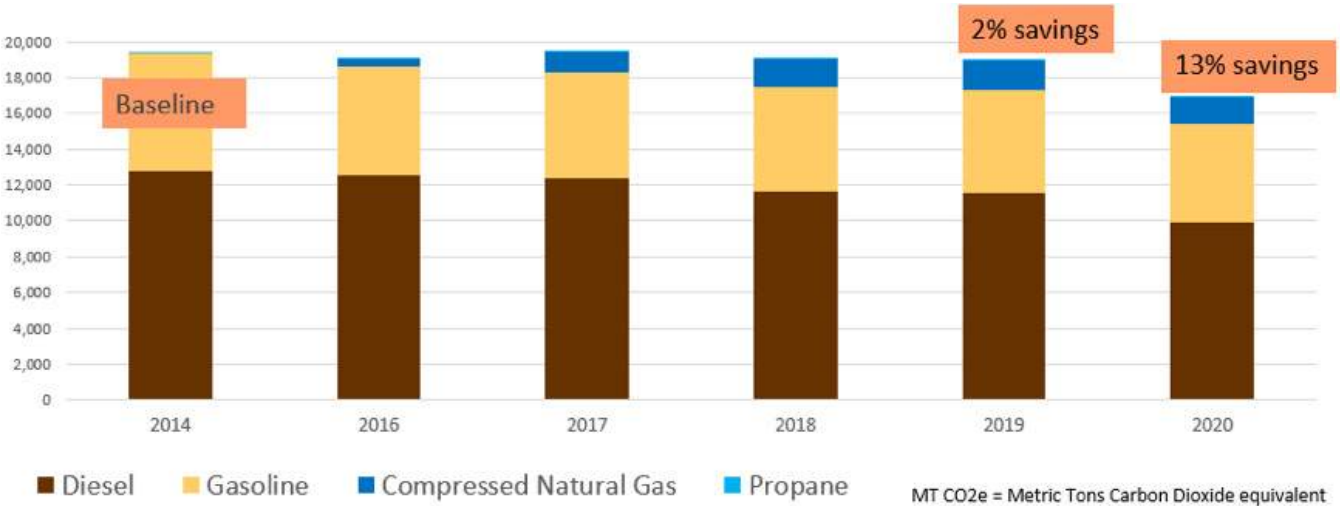

Figure 4. Fleet annual emissions in MTC02e.

Diesel emissions have decreased, primarily through a switch from fossil-based to renewable diesel.

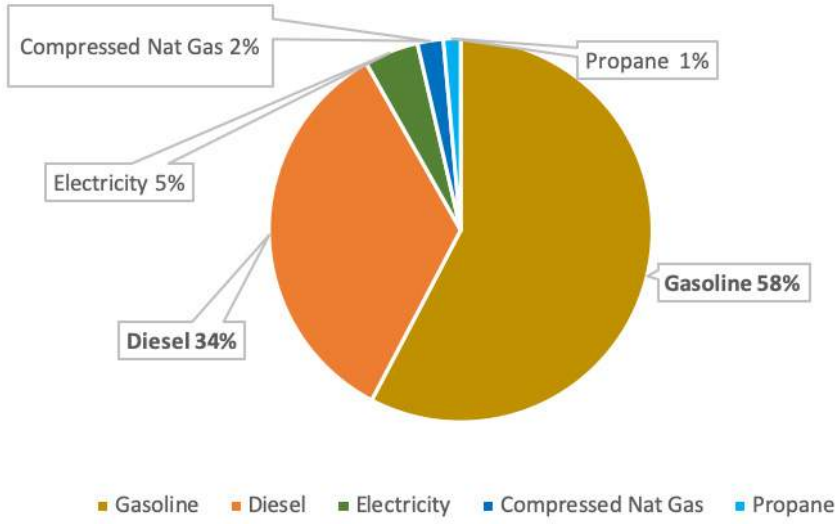

Figure 5. 2021 Tacoma city fleet by fuel type (on-road vehicles and non-road equipment).

Gasoline burning vehicles are almost 60% of vehicles, but only 30% of emissions. Diesel burning vehicles produce 50% of emissions while only accounting for 34% vehicles.

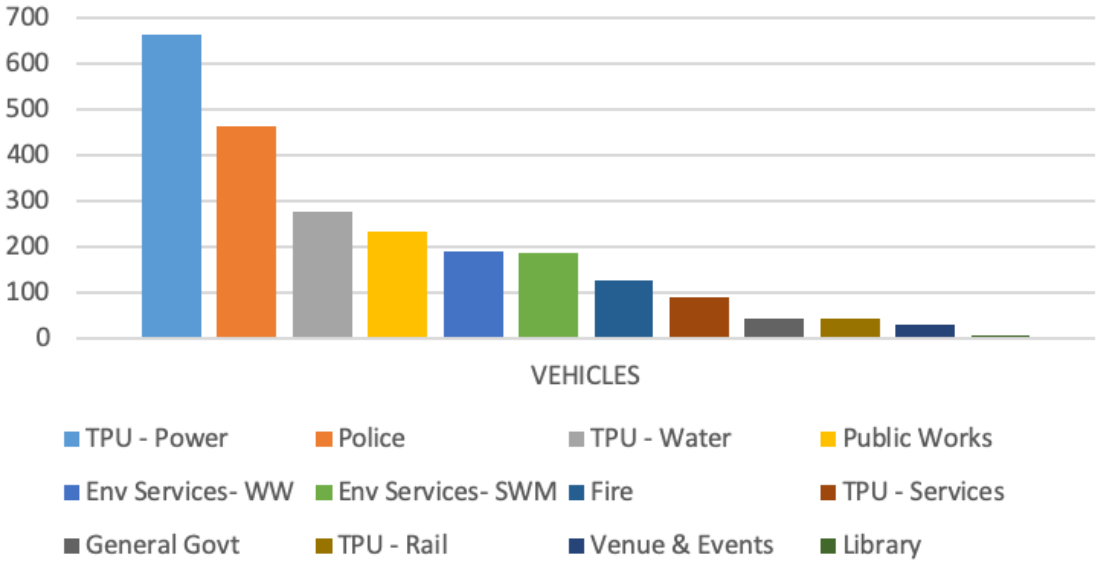

Figure 6. City fleet vehicles by department.

Five departments account for 86% of the fleet vehicles - Power, Police, Water, Environmental Services, and Public Works.

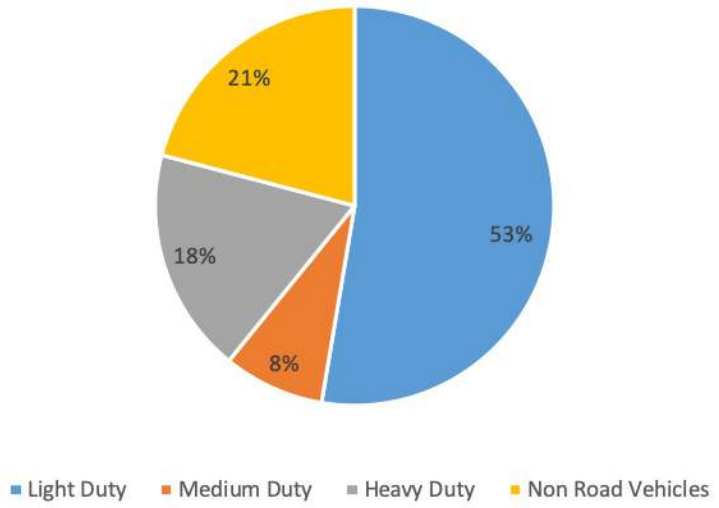

Figure 7. Fleet vehicles by duty.

While Light Duty Vehicles are 53% of the vehicle inventory, almost all are gasoline burning, accounting for less than 30% of emissions. The majority of Heavy Duty and Non-Road vehicles are diesel burning and account for nearly 50% of emissions.

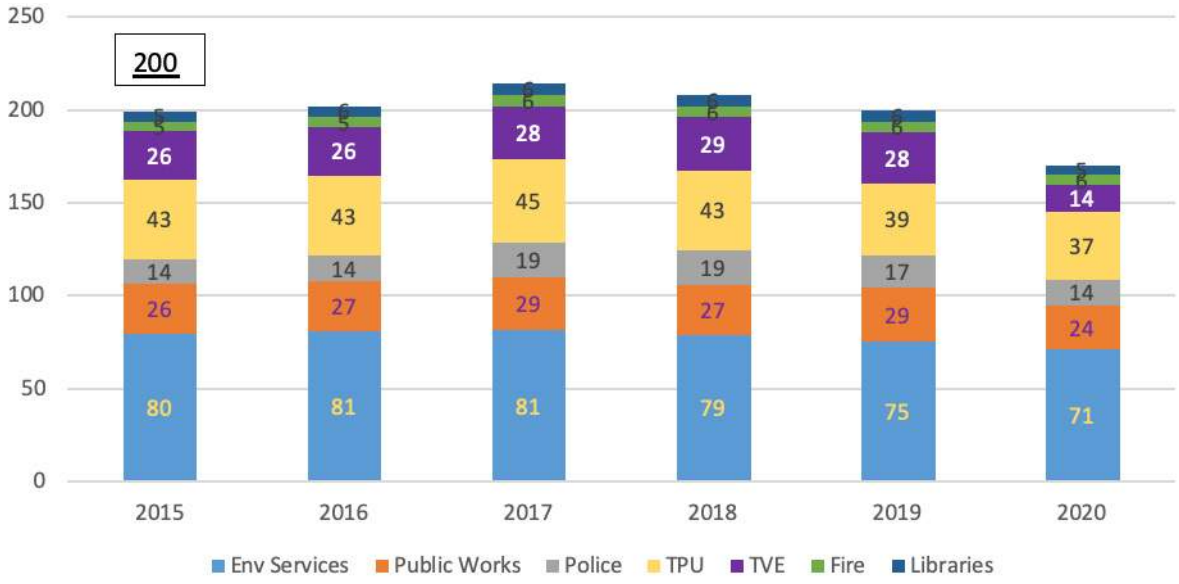

Figure 8. City facilities energy use by year.

Facilities energy in 2020 is 14% less than baseline. Lower facilities occupancy from the pandemic accounts for most of the reduction from 2019 (equivalent to baseline). Environmental Services accounts for about 40% of total, primarily from two industrial wastewater treatment plants.

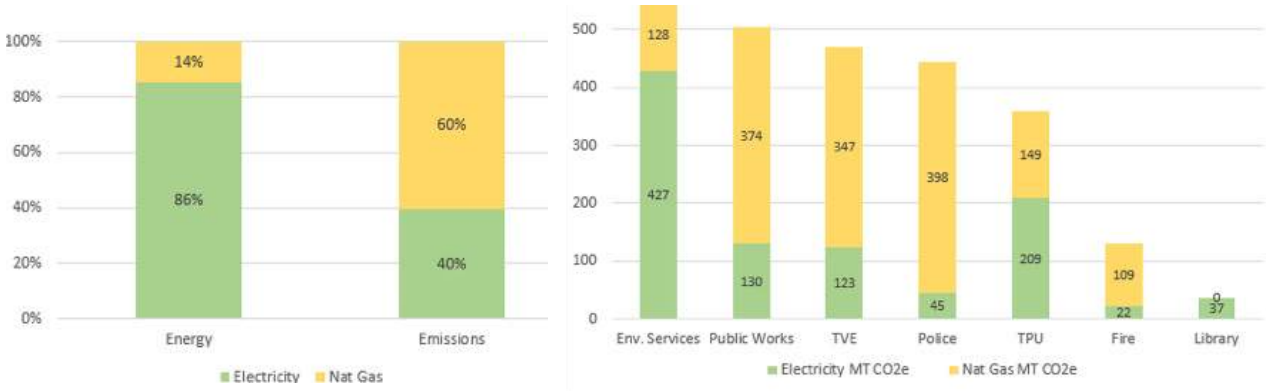

Figure 9. Top 15 City Facility Sites with Nat Gas annual use

Natural Gas has a carbon intensity 9 times higher than Tacoma Power electricity. Even though natural gas is only 14% of facility annual energy use, it is 60% of emissions. When Police, Public Works, and Tacoma Venue and Events (TVE) Departments convert their natural gas using facilities to electricity, they will significantly reduce City's facility emissions.

Table 1. Tacoma sites with natural gas use, number of buildings listed in brackets on the right.

2019 HI-TO-LOW	SITES W/ NAT GAS USE (# OF BUILDINGS)	2020 V 2019	SYSTEM TO CONVERT TO ELECTRIC
1st	Central Wastewater Treatment Plant (20)	-18%	Process loads
2nd	Police Headquarters	-11%	Space & Water
3rd	Tacoma Public Utilities campus (9)	-17%	Space at Mech Rm
4th	Convention Center	-42%	Boilers & Water
5th	Tacoma Dome	-36%	Boilers & Water
6th	Asphalt Plant	-38%	Process Heat
7th	Police Fleet Warehouse & Admin Building	-30%	Space & Water
8th	Recovery & Transfer Ctr - Admin Building	-75%	Space, Water, & Process
9th	Tacoma Water Buildings (3)	-5%	Space & Water
10th	Beacon Senior Center	-7%	Space & Water
11th	Tacoma Municipal Building complex (2)	-28%	Space Heat
12th	Streets Ground Maint & Shop (2)	+8%	Space & Water
13th	Center For Urban Waters (2)	-17%	Water Heater
14th	North End Wastewater Treatment Plant	+14%	Process loads

2019, rather than 2020, reflects typical historical occupancy and thus is a better baseline for comparing between buildings with high use. Eleven of the fourteen buildings with the highest energy use have significant natural gas systems that can be converted to electricity, primarily through high efficiency heat pump technology.

Table 1. Municipal Carbon Neutrality Strategy 2022-2024 ACTIONS TABLE: These actions are to jump-start City achieving of 2030 goals

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Fleet & Fuels 1	Develop and publish quarterly report on fleet and fuel metrics, including idling telematics, with breakouts by Department and Division. Sourced from City's databases including SAP.	Reports developed and shared with supervisors as a continuous improvement and strategy action tool.	Fleet Mgmt, OEPS	IT	Fleet Decarbonization & Fuel Conservation PMP	Staff time for initial setup, ongoing analysis	On-going	Staff time and expertise	Communicate successes with staff	Cost Savings and better management
Fleet & Fuels 2	Expand bulk renewable fuel delivery at city facilities to the greatest extent needed.	Delivery established at all applicable facilities.	Fleet Mgmt	Public Works, Env Services	Decarbonization Resolution	$100K - 750K. Site work for storage tanks, premium $/gal declining with LCFS	On-going	Onsite Storage and access	Premium fuel price will go down with Clean Fuel Standard	Reduced localized air pollution, maintenance savings

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Fleet & Fuels 3	Using results from the EV Siting Study, Expand EV charging infrastructure at all City prioritized fleet sites, use federal & low carbon fuel standard credits for funding.	EV charging at all key facilities.	OEPS	Fleet, Facilities, Tacoma Power	Decarbonization Res 40776	~$100K - $1M (match)	One-time with minimal yearly fees	Grant match funds, financing	Electrical capacity needed	Clean air and maintenance savings
Fleet & Fuels 4	Increase funding for fleet capital budget to accelerate replacement with low emission vehicles.	Increased funding over historic levels.	Fleet Mgmt/ Depts	OMB	Decarbonization Res 40776	Millions	On-going	Grant funding	Prioritize high use vehicles	Increased safety and reliability
Buildings & Infrastructure 1	Implement energy saving O&M policies, procedures & guidelines for each key facility/facility type.	All facilities staff understand & implement RCM policies, procedures & guidelines. Building performance data shared and discussed regularly.	All Facility Mgmt departments (PW, TPU, ES, & TVE)	OEPS, TPU	Resource Conservation Plan, Draft Muni Sus Facilities Policy. Sustainable Purchasing Policy	$50K to $500K per year (staffing, materials)	On-going	Utility led Strategic Energy Management programs	Building Operator Certification training	Improved comfort, reduce maintenance and utility costs, move to pro-active maintenance

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Buildings & Infrastructure 2	Develop Opportunity Register for each facility with natural gas. Typically low-hanging fruit items that can be addressed opportunistically.	Top 2 actions completed where appropriate for each facility (emphasize NG reduction). Facilities with impending retirement may be exempted.	All Facility Mgmt departments	OEPS	Draft Municipal Sustainable Facilities Policy	$200K to $750K per Year (contractors, 4 departments)	On-going with yearly updating	Applications for project management and emission tracking; Sensi, GRIT, or equivalents. Operator training	Shared responsibility across staff of facility mgmt	Keep high priority actions highlighted
Buildings & Infrastructure 3	Building Tune-ups - one building per department providing facility management services (ES, TPU, PW, TVE). Systematic process completed once every 5 years.	4 facilities tuned (recommissioned) with significant facilities staff involvement to sustain benefits.	All Facility Mgmt departments	OEPS	Municipal Green Building Res 38249	$100K to $500K	Initial four sites	Staff specialists, tune-up contractors, Smart Buildings Center to lead preview workshop	Building selection key to reducing emissions, interplay between staff and contractor, specific staff leads assigned	Better real-time building management, more automation

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Buildings & Infrastructure 4	Complete assessment on largest facilities with largest Natural Gas loads for conversion or replacement opportunities.	Each facilities department prioritizes one facility for conversion/ replacement with associated budget funds.	All Facility Mgmt departments	OEPS	Decarbonization Res 40776	$50K - $100K+ for consultant contract(s)	One-time	Vetted electrical equipment which can meet facilities needs	HVAC distribution may need resizing for lower output temp	Improved indoor air quality, eliminate burner maintenance & wear
Buildings & Infrastructure 5	Dedicate funding for efficiency, resiliency, and decarbonization in existing and replacement facilities, including staffing where necessary to carry out actions.	New staff hired and dedicated funding established in each fund. $500,000 for general fund facilities.	OMB, Finance	Facility Mgmt, OEPS	Decarbonization Res 40776. Green Building Res 38249	$5M to 15M (Capital Expense)	On-Time (projects)	Choosing based on Life Cycle Cost Analysis	Data Management system required to track and report	Improved building conditions for occupants, City funding for grant match important
Investments 1	Internal carbon pricing – shadow or real.	Price and process developed by Steering Committee.	OEPS	OMB, Finance	Sustainability in Decision Making Res 38247	To Be Determined	On-going with yearly updating	USDN, GRIT, other software	Shadow - decision analysis only. Real - department contribution/ project	Connects carbon reduction more directly to procurement process

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Purchasing 1	Develop and incorporate contractor fuel emissions reduction standards into bids and contracts to ensure construction contractors doing work on the City's behalf are using fuel efficient and low polluting vehicles and equipment when feasible and practicable.	PW, ES, TVE, and TPU contracts incorporate standards into bids and contracts.	OEPS/ PW/ ES	Purchasing	EAP	0	On-going		Need to consider equity in development	Clean air
Purchasing 2	Develop a City Sustainable and Healthy Meeting policy that prioritizes low greenhouse gas generating foods, delivery, and meeting access.	Policy developed and implemented.	OEPS	Purchasing	Sustainable Purchasing/HR Policy	0	On-going			Supports local businesses
Purchasing 3	Develop and implement large venue waste reduction program and actions.	Establish incremental targets to achieve 50% increase in recycled materials, and 30% reduction in refuge off-site export by 2030.	TVE	SW/ OEPS	Sun Materials & Mgt Plan. SPP	To Be Determined	On-going		Concession contracting, on-site durables, trade association best practices	Reduced food waste

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Organizational Capacity 1	Department Resource Conservation & Climate Plans.	Department Plans developed with annual reporting.	OEPS	HR-CI	REAPs	0	On-going	Training and support	Coordination with Racial Equity Action Plans	Staff engagement
Organizational Capacity 2	Capital Projects inter-departmental team convenes to ensure all capital projects, including upgrades and maintenance, include sustainability (urban forestry, art, historic preservation, ADA, stormwater, active transportation, climate mitigation, and adaptation) review.	Team created and active; Meet at least six times per year.	City Managers Office		Green Buildings Resolution, Urban Foresty Plan, Stormwater LID standards, cultural and historical preservation standards	0	On-going	Scheduling of meetings		Staff coordination & better projects

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Education & Engagement 1	Annual Directors Presentation/Training.	Annual presentation/ training occurs.	OEPS			0	On-going			
Education & Engagement 2	One City Stewards program - assemble inter-department, cross-functional team to participate in tours that showcase projects / facilities contributing to climate mitigation / adaption , and triple-bottom line sustainability.	First cohort initiated in 2022.	OEPS-Envirochallengers		Comprehensive Plan, Tacoma 2025, Sustainable Materials Management Plan, Climate Action Plan, others	Minimal	On-going	Site hosts, staff time, safety equipment	Departmental recruitment communication	Staff education, departmental sustainability champions, improve customer services

CATEGORY	ACTION	2024 OUTPUT	LEAD DEPT	SUPPORTING DEPTS	TIES TO OTHER PLANS, POLICIES	CITY INVESTMENT COST	ONE-TIME OR ON-GOING	OTHER RESOURCES NEEDED	KEY CONSIDERATIONS	ADDITIONAL BENEFITS & IMPACTS
Education & Engagement 3	Sustainability integrated into new employee orientation and onboarding.	Full suite of resources developed, initial use in 2022, 100% employee participation by 2024.	OEPS	HR	Commute Trip Reduction program, Active Transportation program, Motor Pool Policy, Recycle Right program, Municipal Carbon Neutrality Strategy, and applicable Personnel Management Policies	Modest	On-going	City's training platforms, including Linked In Learning, department specific onboarding"	Delivery method - in person, online live or recorded	Reduced fleet fuel and associated emissions, increased transit uses and micro-mobility, reduced refuse

POLICIES & RESOLUTIONS ASSOCIATED WITH MUNICIPAL OPERATIONS GREENHOUSE EMISSION REDUCTIONS

1. City Council Decarbonization Resolution 40776 (April 2021): reduces the City's municipal carbon footprint by restricting the use of natural gas and new fossil fuel for existing facilities and fleet future capital investments, encouraging other local jurisdictions to do the same, and assessing impacts for imposing the same restrictions on new commercial and residential construction; effective January 1, 2022.
2. City Council Climate Emergency Resolution 40509 (December 2019): declares the threats of climate change require immediate action to minimize harm to current and future generations, and therefore constitutes a public emergency. Requires an organization-wide assessment of current Greenhouse Gas emission and set 10-year reduction targets towards making City operations carbon-neutral by 2050; to be done in coordination with update of City's Climate Action Plan.
3. WA State law RCW 43.16.648 and Chapter 194-29 WAC require clean vehicle and fuel purchases and describes "Practicable Use of Electricity and Biofuels to Fuel Local Government Vehicles, Vessels, and Construction Equipment."
4. WA State Clean Fuel Standard for transportation fuels (E3SHB 1091, May 2021): Department of Ecology is responsible for implementation toward curbing carbon pollution from transportation. The Standard requires fuel suppliers to gradually reduce carbon intensity of fuels to 20% percent below 2017 levels by 2038. Fuel suppliers can achieve carbon intensity reductions through several market-based pathways, including: improving efficiency of fuel production processes, producing or blending low-carbon biofuel, and, purchasing credits generated by low-carbon fuel providers such as electric vehicle charging providers.
5. WA State Climate Commitment Act (SB 5126, May 2021): Known as Cap and Invest, the act aims to deliver certainty of emission reductions at the scale and pace required to address climate change while co-benefits foster a more prosperous, equitable, and resilient Washington. Cap and Invest is a market-based approach that allows businesses to find the most efficient path to lower carbon emissions.
6. WA State Clean Buildings Performance Standard (E3SHB 1257, 2019): The Department of Commerce is responsible for implementing this standard towards lowering costs and pollution from fossil fuel consumption in the state's existing buildings, especially large commercial buildings (50,000 Sq Ft Gross Floor Area and above). The Standard includes early adopter incentives, and a non-compliance penalties reporting schedule.
7. City Council Municipal Green Building Resolution 38249 (2011): all new or renovated City facilities must strive for LEED Gold certification. All new construction and major renovation must exceed current WA State Energy Code by at least 5%. All existing LEED-certified municipal buildings must strive towards LEED Existing Building Operation and Maintenance Silver certification.

8. City Council Life-Cycle Assessments Resolution 38188 (2011): expresses support of life-cycle assessments and life-cycle thinking in City relevant legislation and management decisions.
9. City Council Sustainable Purchasing Policy Resolution 38248 (2011): prioritizes doing businesses with vendors who best align with City's sustainabilty goals, develop resources for staff to produce sustainable procurement, and empower staff innovation to meet policy goals.

RESOLUTION NO. 40776

BY REQUEST OF MAYOR WOODARDS AND COUNCIL MEMBERS BEALE AND WALKER

A RESOLUTION relating to reducing the City's municipal carbon footprint by restricting the use of natural gas and new fossil fuel for existing City buildings and future City capital investments, encouraging other local jurisdictions to do the same, and assessing impacts for imposing the same restrictions on new commercial and residential construction.

WHEREAS the 11th United Nations Intergovernmental Panel on Climate Change ("IPCC") report from October 2018 states that we have only until 2030 to limit devastating global warming and avoid a climate catastrophe, and

WHEREAS globally and locally, Black, Indigenous, and people of color communities and low-income communities are most vulnerable to the financial and human health stresses or shocks resulting from climate damage, and are disproportionately impacted, and

WHEREAS the climate crisis poses an imminent, existential threat to all life on Earth that demands timely action at the scale and speed necessary to mitigate harm to all people, including the residents of the City of Tacoma, and

WHEREAS, in December 2019, the City declared a Climate Emergency through Resolution No. 40509, which articulates the aspirational goal of "seeking a path to making City operations carbon-neutral by 2050," and requested the City Manager to identify and propose sustainable funding mechanisms for actions described in the Environmental Action Plan, including building electrification, and

WHEREAS the City's 2016 Greenhouse Gas Inventory identifies combined emissions from the City's municipal buildings and fleet contribute approximately

28 percent of overall municipal emissions, and we know that we cannot meet our municipal and community carbon reduction goals without tackling clean transportation and clean buildings as we move forward, and

WHEREAS, in Washington State, homes and buildings are the single fastest growing source of carbon pollution, up 50 percent since 1990, and now account for 27 percent of Washington's carbon emissions, and

WHEREAS Tacoma Public Utilities provides customers in Tacoma plentiful, non-fossil fuel generated, and comparatively affordable electricity for powering its municipal operations, maintenance, and growth, along with all of its community-wide electricity needs, and

WHEREAS the City has the opportunity to lead by example to make decisive, transformative, and sustainable changes in its municipal energy consumption, and can significantly lower the City's greenhouse gas emissions and overall carbon impact, and

WHEREAS investments that make it easier and safer for people to ride the bus, walk, bike, and roll often have the added benefit of not only reducing carbon emissions, but improving affordable access to jobs, education and services, reducing stormwater pollution and local air pollution, improving physical activity, and supporting local, living wage construction and operation jobs, and

WHEREAS the City encourages the use of non-motorized travel to and from City facilities, including a Commute Trip Reduction program for employees, and through the use of investments of safe biking and walking infrastructure around City

buildings, parking for bicycles or other shared mobility services, transit passes for employees, and comfortable and ADA-compliant sidewalks around all facilities, and

WHEREAS the City supports a legislative agenda that advances decarbonization through increased electrification of energy use, and

WHEREAS the City already follows state law, RCW 43.19.648 and Chapter 194-29 WAC, which requires clean vehicles and fuels and describes "practicable use of electricity and biofuels to fuel local government vehicles, vessels, and construction equipment," and

WHEREAS planning for clean energy in City assets represents a sound investment of the City's resources into long-term infrastructure that is in line with its carbon reduction goals, and

WHEREAS vulnerable, underrepresented, and historically oppressed communities in the City, including low-income communities and those with pre-existing medical conditions, along with Black, Indigenous, and people of color communities are disproportionately harmed by indoor pollution (including from gas stoves) and outdoor air pollution, and have less access to healthcare and resources to mitigate this impact; Now Therefore,

BE IT RESOLVED BY THE COUNCIL OF THE CITY OF TACOMA:

Section 1. That the City Manager is directed to require all new City-owned buildings and major renovations of existing City buildings within the City of Tacoma to exclude natural gas and other fossil fuel energy sources for heating, lighting, and power, and use low carbon fuels such as biodiesel, renewable diesel, renewable natural gas, electrolytic hydrogen, and electricity or other electricity derived fuels

generated from sustainable and renewable resources; except where exemptions are necessary due to reliability and resiliency of resources, technical or cost infeasibility. This policy will become effective January 1, 2022.

Section 2. That the City Manager is directed to inventory City-owned facilities within the City of Tacoma that use fossil fuels and evaluate the feasibility of retrofitting existing buildings to low-emission sources by 2030. This inventory and evaluation will make use of existing reports and data to prepare recommendations regarding feasibility and life-cycle costs. The report will be completed by January 1, 2023, and a presentation will be made to the Infrastructure, Planning and Sustainability ("IPS") Committee.

Section 3. That the City Manager is directed to develop a plan to retrofit each City-owned parking facility and building within the City of Tacoma with electric vehicle ("EV") charging stations by 2030. This plan will be completed by January 1, 2023, and a report will be made to the IPS Committee. Zero-emission, low-emission, or non-motorized vehicles will be prioritized in all new vehicle purchases whenever:

A. Suitable equipment exists for the duty;

B. Gross vehicle weight is less than 19,501 pounds (Class 5 vehicles and lower). The necessity and type of exemptions will be reviewed in conjunction with updates to the Environmental Action Plan;

C. Life Cycle Cost Analysis shows the premium at less than 10 percent; and

D. Suitable EV-charging or other infrastructure to recharge or fuel equipment is in place, or anticipated to be, preferably at the equipment's assigned stationary location.

Consideration of the addition of EV charging equipment at such stationary locations will be considered in decision-making.

Section 4. That the City will encourage other local entities, such as the County, school districts, and major institutions, to join in this step to invest in clean energy assets by adopting similar policies.

Section 5. That the City Manager is directed to complete an impact assessment of requiring non-fossil fuel sourced heating, lighting, and power in new commercial and residential development in the City, and will report back to the IPS Committee by January 1, 2023, with findings, including stakeholder involvement, that will look at potential opportunities and challenges related to:

- Public health and safety;
- Economic costs and savings;
- Technical feasibility;
- Legal implications;
- Labor and workforce;
- Operations;
- Housing affordability; and
- Equity.

Adopted _____

_____
Mayor

Attest:

_____
City Clerk

Approved as to form:

_____
Chief Deputy City Attorney

City of Tacoma Municipal Facilities Portfolio		6/30/2023		2019[12]							2022[12]
Property Name[11]	GFA in SF[0]	Year Built[11]	Dept	Electricity kBTU	Nat Gas kBTU	2019 Energy kBTU	EUI	Electric MT CO2e	Nat Gas MT CO2e	MT CO2e	Energy MT CO2e
Asphalt Plant[1]	*19,992*	1987	PW	1,438,635	5,712,080	7,150,715	358	4	303	307	1,240
Beacon Activity Center	11,665	1941	PW	244,516	1,603,270	1,847,786	158	1	85	86	134
Cavanaugh Building Stability Site[9]	24,200	1951	PW	2,552,021	0	2,552,021	105	7	0	7	7
Central Wastewater Treatment Plant[2,10]	*180,642*	1952	ES	56,207,916	105,150	56,313,066	312	165	6	170	1,848
Cheney Stadium	*92,280*	1960	TVE	125,895	0	125,895	1.4	0	0	0	0
Convention Center [1,9]	227,449	2004	PW	8,216,640	3,559,810	11,776,450	52	24	189	213	187
Convention Center Parking Garage	148,486	2004	PW	144,191	0	144,191	1	0	0	0	1
CUW - Center for Urban Waters[9]	51,452	2010	ES	3,510,675	345,920	3,856,595	75	10	18	29	26
CUW - Survey Building	1,760	1998	ES	88,241	0	88,241	50	0	0	0	0
Fern Hill Branch Library	7,996	1989	TPL	374,675	0	374,675	47	1	0	1	1
Fire Communications Center	3,530	1929	TFD	1,297,035	0	1,297,035	367	4	0	4	4
Fire Elec Maint Building	4,700	1910	TFD	23,780	0	23,780	5	0	0	0	0
Fire Emergency Operations Center	6,700	1957	TFD	0	199,890	199,890	30	0	11	11	12
Fire Garage Vehicle Shop	4,800	1984	TFD	138,561	364,230	502,791	105	0	19	20	16
Fire Prevention Bureau	4,649	1955	TFD	86,203	304,400	390,603	84	0	16	16	36
Fire Station #01 Headquarters	16,600	1967	TFD	1,019,001	0	1,019,001	61	3	0	3	3
Fire Station #02	16,380	1927	TFD	228,245	280,250	508,495	31	1	15	16	29
Fire Station #03	2,816	1980	TFD	201,964	0	201,964	72	1	0	1	1
Fire Station #04 w Radio Tower	6,115	1935	TFD	189,688	303,580	493,268	81	1	16	17	27
Fire Station #05 - new	5,630	2021	TFD	99,502	0	99,502	18	0	0	0	1
Fire Station #05 - historic #15	3,300	1929	TFD	-	-	-	-	-	-	-	-
Fire Station #06	4,200	1964	TFD	77,017	265,080	342,097	81	0	14	14	19
Fire Station #07	2,081	1959	TFD	171,586	0	171,586	82	1	0	1	0
Fire Station #08 [1]	17,400	2003	TFD	487,816	414,180	901,996	52	1	22	23	54
Fire Station #09	5,430	1965	TFD	180,221	335,860	516,081	95	1	18	18	17
Fire Station #10	1,963	1928	TFD	92,108	154,150	246,258	125	0	8	8	15
Fire Station #11	5,121	1909	TFD	148,580	0	148,580	29	0	0	0	0
Fire Station #12	9,970	1975	TFD	531,044	0	531,044	53	2	0	2	2
Fire Station #13	9,900	1911	TFD	150,575	0	150,575	15	0	0	0	0
Fire Station #14	1,963	1928	TFD	95,002	85,380	180,382	92	0	5	5	10
Fire Station #15	842	2006	TFD	75,702	0	75,702	90	0	0	0	0
Fire Station #15 - Garage	1,274	2006	TFD	100,929	0	100,929	79	0	0	0	0
Fire Station #16	11,000	1999	TFD	211,166	912,680	1,123,846	102	1	48	49	51
Fire Station #17	8,994	1979	TFD	503,359	0	503,359	56	1	0	1	2
Fire Station #18 - Dock & Shed	4,229	1960	TFD	108,865	0	108,865	26	0	0	0	0
Fire Station #18 - Fire Boats	1,752	1929	TFD	61,381	0	61,381	35	0	0	0	0
Fire Training Center	9,450	1996	TFD	367,181	177,960	545,141	58	1	9	11	21
Harrison Pistol Range	8,062	1960	TFD	229,361	0	229,361	28	1	0	1	1
Kobetich Branch Library	5,000	1979	TPL	247,574	0	247,574	50	1	0	1	1
Lighthouse Senior Center [1]	8,777	1950	PW	373,178	688,000	1,061,178	121	1	36	38	42
Marine Security Joint Operations Center	2,985	1980	TFD	110,189	0	110,189	37	0	0	0	0
Moore Branch Library	15,779	1989	TPL	454,486	0	454,486	29	1	0	1	1
Mottet Branch Library	5,025	1930	TPL	447,011	0	447,011	89	1	0	1	1
Municipal Services Center	6,857	1960	PW	743,661	0	743,661	108	2	0	2	2
Museum of Glass Parking Garage	*65,165*	2002	PW	445,765	0	445,765	7	1	0	1	1
North End Wastewater Treatment Plant	*2,970*	1951	ES	6,219,766	0	6,219,766	2,094	18	0	18	20
Old Town Dock & Restroom (PW)	*100*	1992	PW	43,423	0	43,423	434	0	0	0	0
Pacific Plaza Garage - RPNW #83	*144,559*	2010	PW	596,185	0	596,185	4	2	0	2	1
Pantages Theater complex[1,7,9]	90,508		TVE	1,849,418	2,713,740	4,563,158	50	5	144	149	245
Pantages Theater	23,958	1917	TVE	-	-	-	-	-	-	-	-
Annex- Jones Building	13,306	1919	TVE	-	-	-	-	-	-	-	-
Theater on the Square	53,244	1993	TVE	-	-	-	-	-	-	-	-
Park Plaza North Garage (RPNW#82)	*158,350*	1985	PW	818,077	0	818,077	5	2	0	2	2
Parking Services Office - N Pk Garage	8,000	1969	PW	682,763	0	682,763	85	2	0	2	2
Point Defiance-Rustin Senior Center	3,806	1965	PW	106,768	0	106,768	28	0	0	0	0
Police Warehouse w/ Fleet Services[9]	129,000	1992	TPD	2,430,907	2,569,630	5,000,537	39	7	136	143	266
Police Headquarters [1,9]	73,000	2005	TPD	4,033,653	4,679,280	8,712,933	119	12	248	260	276
Rialto Theater (TVE)	10,800	1919	TVE	208,348	471,830	680,178	63	1	25	26	56
South Tacoma Branch Library	7,475	1955	TPL	206,842	0	206,842	28	1	0	1	1
Streets Ops & Grounds Maint complex[9]	55,940	1900	PW	808,975	907,700	1,716,675	31	2	48	50	69
Swasey Branch Library	9,686	1960	TPL	308,684	0	308,684	32	1	0	1	1
T.A.C.I.D. (City bldg on TCC property)	10,367	1983	PW	813,507	0	813,507	78	2	0	2	2
Tacoma Dome & Exhibition Hall[7]	220,618	1981	TVE	12,563,944	2,930,930	15,494,874	70	37	155	192	336
Tacoma Main Library [1,9]	95,727	1902	TPL	2,805,498	2,123,280	4,928,778	51	8	113	121	131
Tacoma Municipal Building & Garage [1,9]	207,020	1919	PW	8,603,015	0	8,603,015	42	25	0	25	23
Tacoma Municipal Building North [1,8]	41,400	1954	PW	2,139,853	15,860	2,155,713	52	6	1	7	15
Tacoma Parking Garage (A Street Garage)	197,446	1987	PW	771,048	0	771,048	4	2	0	2	2

Footnotes on 2nd page of this table

City of Tacoma Municipal Facilities Portfolio			6/30/2023	2019[11]							2022[12]
Property Name[11]	GFA in SF[0]	Year Built[11]	Dept	Electricity kBTU	Nat Gas kBTU	2019 Energy kBTU	EUI	Electric MT CO2e	Nat Gas MT CO2e	Energy MT CO2e	Energy MT CO2e
Tacoma Rail campus [6]	16,444	1966	TR	893,454	0	893,454	54	3	0	3	7
TRTC Industrial Facilities [5,10]	85,235	1988	ES	2,614,763	160,860	2,775,623	33	8	9	16	19
TRTC Admin & Vehicle Shop Building [1,5,9]	34,232	2011	ES	1,569,951	1,807,430	3,377,381	99	5	96	100	99
TRTC - EnviroHouse (w Solar)[4]	1,000	2006	ES	28,163	0	28,163	28	0	0	0	0
TRTC - Main Receiving Building[1,5,9]	87,283	2011	ES	3,071,382	0	3,071,382	35	9	0	9	10
Tacoma Water Buildings #1[1,9]	39,200	1937	TW	1,246,504	3,209,990	4,456,494	114	4	170	174	110
Tacoma Water Building # 2	6,250	1974	TW	118,548	0	118,548	19	0	0	0	0
TPD Sector 1 (Central)	3,500	2006	TPD	221,597	0	221,597	63	1	0	1	1
TPD Sector 2 (North)	3,500	2006	TPD	203,038	0	203,038	58	1	0	1	0
TPD Sector 3 (Wapato)	3,500	2006	TPD	215,161	0	215,161	61	1	0	1	1
TPD Sector 4 (Stewart Heights)	3,500	2009	TPD	200,423	0	200,423	57	1	0	1	1
TPD Sector Northeast	3,500	2006	TPD	192,211	0	192,211	55	1	0	1	1
Tacoma Public Utilities campus [8,9]	518,022	1931	TPU	33,381,640	1,236,610	34,618,250	67	98	66	163	188
Traffic Signal Shop	12,000	1983	PW	562,021	0	562,021	47	2	0	2	2
Wheelock Branch Library	16,932	1927	TPL	851,434	0	851,434	50	2	0	2	3
TOTALS	3,355,231			173,982,105	38,639,010	212,621,115	63	510	2,049	2,559	5,702

1, MFD Study buildings italicized name, gray highligted

2. Ashalt Plant has 12 Industrial Structures

3. Central Treatment Plant has 24 Industrial structures

4. TRTC = Tacoma Recovery & Transfer Center, has 13 industrial structures

5. TRTC has 14 industrial structures, and 4 commercial buildings; Admin, Vehicle Shop, Main Receiving Building, and EnviroHouse

6. Tacoma Rail campus with 5 buildings (A,B,C,D,&F); each less than 20,000 sf GFA.

7. Theater complex has common natural gas meter for 3 buildings; Pantages and TOTS are more than 20,000 sf GFA.

8. TPU Campus includes 9 commercial buildings; 5 are over 50,000 sf GFA

9. Site with buildings more than 20,000 GFA, subject to WA Clean Buildings Performance Standard

10. Italicized GFA are unconditioned or industrial process structures or enclosures, not subject the Clean Building Performance Standard

11. Renovation and improvement years available upon request

12. Baseline year is 2019. Most recent year of performance is 2022.

City of Tacoma buildings required to comply with WA Clean Building Performance Standard

Property Name	Tier[2]	Building Sq. Ft.	Year Built (original)	2019[1] Bldg Energy Use (kBtu)	Bldg EUI	Target (EUIt)	EUI above / below Target
Center for Urban Waters[4]	Tier 1	52,200	2010	3,856,599	74	66	**8**
Convention Center, Greater Tacoma	Tier 1	209,088	2004	11,577,026	55	74	-18
Police Headquarters[3,4]	**Tier 1**	**73,000**	**2005**	**8,521,305**	**117**	*72*	**45**
Police Warehouse includes Fleet Services[4]	Tier 1	129,000	1992	4,636,122	36	*66*	-30
Tacoma Dome[4]	Tier 1	220,618	*1981*	15,118,046	69	74	-5
Tacoma Main Library	Tier 1	95,727	1903	4,799,323	50	62	-11
Tacoma Municipal Building (garage GFA excluded)	Tier 1	147,295	*1954*	8,386,908	57	66	-9
Tacoma Public Utilities campus (5 of 9 buildings)[3,4,5,6]	**Tier 1**	**483,275**	**1931**	**41,902,575**	**87**	***66***	**21**
TPUc - Admin Building North [5]	*Tier 1*	*156,520*	*1952*	-	-	*66*	
TPUc - Admin Building South [5]	*Tier 1*	*118,683*	*2006*	-	-	*66*	
TPUc - GAR - Fleet Operations [5]	*Tier 1*	*56,719*	*1931*	-	-	*77*	
TPUc - Shops Building [5]	*Tier 1*	*58,729*		-	-	*43*	
TPUc - Warehouse [5]	*Tier 1*	*92,624*	*1967*	-	-	*79*	
TRTC Main Receiving Building	Tier 1	87,283	2011	3,071,383	35	79.2	-44
Theater complex: Pantages+Jones+TOTS[5,7]	Tier 1	90,508	1917 / 1993	4,563,158	50	59	-9
Cavanaugh Building Stability Site[3]	**Tier 2**	**24,200**	**1952**	**2,448,852**	**101**	***74***	**27**
Cheney Stadium	Tier 2	24,200	1960	125,895	5	*40*	-35
Streets Grounds Maintenance & Sign Shop	Tier 2	28,600	1900	762,556	27	71	-44
Streets Operations Building	Tier 2	27,340	1909	712,558	26	71	-45
Tacoma Municipal Building North	Tier 2	41,400	1954	2,150,544	52	66	-14
TRTC Admin & Vehicle Shop[3,4]	**Tier 2**	**34,232**	**2011**	**3,227,598**	**94**	**66**	**28**
Tacoma Water Building #1	**Tier 2**	**39,200**	**1937**	**2,751,422**	**70**	***66***	**4**

1. 2019 is baseline year per the Clean Building Performance Standard (CBPS)
2. Tier 1 buildings are above 50,000 sf GFA. Tier 2 buildings are 20,000 to 50,000 sf GFA
3. Buildings with EUI above target has name in bold and number in red. Those more than 15 above are highlighted in orange; these buildings may qualify for early adopter financial incentives if they complete Energy Savings Measures prior to CBPS specified deadlines (GFA dependent).
4. Buildings with more than 1 ASHRAE identified space type. Target EUI derived through a weighted average calculation based on GFA of each space type. Only the EUIt of the dominant space type is shown in this table.
5. Buildings with shared meter. EUI target is reference only. Compliance via CBPS Investment Criteria Path.
6. TPU campus has master electric meter for 9 buildings. 5 of these buildings are more than 50,000 sf GFA
7. Theater complex's gas meter shared by 3 buildings. GFA in sf: Pantages 23,958, Jones, 13,306, TOTS 53,244