

City of Milwaukee Energy Plan for Municipal Operations

Summary & Recommendations



Prepared by the Energy Reduction Team with support from Edison Energy

City of Milwaukee – Energy Reduction Team

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Definitions

AHU	Air-Handling Unit
CEP	Comprehensive Energy Plan
DOE	Department of Energy
ECO	Environmental Collaboration Office
ERT	Energy Reduction Team
EUI	Energy Usage Intensity
EV	Electric Vehicle
GHG	Greenhouse Gas
HVAC	Heating, Ventilation, and Air Conditioning
kW	Kilowatt (a measure of power)
kWh	Kilowatt-hour (a unit of energy)
LEED	Leadership in Energy and Environmental Design
MMBTU	One million British Thermal units
MW	Megawatt (a measure of power)
MWh	Megawatt-hour (a unit of energy)
O&M	Operations and Maintenance
OEI	State of Wisconsin Office of Energy Innovation

Background

In 2011, President Obama launched the Better Buildings Challenge¹ through the U.S. Department of Energy (DOE), a national initiative to improve the energy efficiency of commercial, public, industrial, and residential buildings by at least 20 percent over ten years. The City of Milwaukee became a partner in the Better Buildings Challenge in 2012, pledging to reduce the energy use of the City's building portfolio 20 percent. Previously, Milwaukee Mayor Barrett set a goal to reduce City energy use 10% from 2005 levels. Since that time, the Mayor and Common Council have set forth these additional energy goals.

City Energy Goals

Department of Energy Better Buildings Challenge: Reduce energy use in across city's building portfolio by 20% over 2009 baseline

Paris Climate Accord: Mayor Barrett and the Milwaukee Common Council support the principles of the Paris Climate Accord, limiting global temperature increase below 2 degrees Celsius above pre-industrial levels and to pursue new actions to limit the temperature increase even further to 1.5 degrees Celsius

Mayoral Initiatives: Mayor Barrett is a member of the Climate Mayors and Global Covenant of Mayors for Climate & Energy groups; coalitions of U.S. and worldwide mayors pledging to uphold principles of the Paris Agreement and to reduce their city's greenhouse gas emissions to curb climate change.

25x25 Goal: 25% of the City's electricity generated from renewable resources by 2025.

Climate and Equity Task Force: Reduce community-wide net greenhouse gas (GHG) emissions by at least 45% by the year 2030 and achieve net zero greenhouse gas emissions by 2050 or sooner.



¹ [DOE Better Buildings Challenge](#)

Municipal Building Portfolio and Benchmarking

ECO tracks energy consumption across 98 municipal buildings through EPA’s ENERGY STAR Portfolio Manager². City buildings use energy from electricity, natural gas and, in the downtown area, steam purchased from We Energies. Electricity is commonly metered and billed in kilowatt hours (kWh), natural gas in therms, and steam in millions of pounds (MLBS). These units are converted to thousands of British Thermal Units (kBtu) to measure total energy use in a building. This consumption amounts of each fuel source is acquired directly from We Energies and benchmarked against the 2009 baseline year. This data is then reviewed by the DOE for accuracy and the city’s reduction percentage from the baseline is calculated.

When benchmarking energy use, it is essential to differentiate between site energy and source energy. *Site energy* is the energy use as metered at the building by the utility company. *Source energy* “represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses. By taking *all* energy use into account, the score provides a complete assessment of energy efficiency in a building. EPA has determined that *source energy* is the most equitable unit of evaluation.”³ The final review and reduction percentage from the DOE is focused only on source energy use.

The City currently spends approximately \$4.5 -5.5 million on energy each year to operate its buildings⁴, emitting roughly 30,000 tons of CO₂ annually in the process. A 20% energy reduction represents an opportunity of approximately \$1 million savings annually and a reduction in CO₂ emissions equivalent to 6.6 million pounds of coal burned.⁵ The figures above only include the 98 municipal buildings that are currently benchmarked, such as the City Hall Complex, and all police stations, fire houses, library, and public works facilities. Table 1 below shows 2019 energy totals, cost, and emissions by department.

Benchmarked Building 2019 Energy Data						
Department	Number of Properties	Total Electricity Use (kWh)	Total Natural Gas Use (therms)	Total District Steam (kBtu)	Energy Cost (\$)	GHG Emissions (Metric Tons CO ₂ e)
DPW	34	17,430,268	758,502	27,547,900	\$ 2,500,736	15,752
Fire	38	2,983,657	333,909	1,343,387	\$ 594,457	3,556
Libraries	13	5,046,736	76,156	13,416,071	\$ 944,207	4,160
Police	11	8,922,057	197,568	26,508,261	\$ 1,154,944	7,874
Port	2	14,471	9,035	0	\$ 4,132	56
Grand Total	98	34,397,188	1,375,169	68,815,619	\$ 5,198,475	31,399

Table 1. Total energy use in 2019 across 98 building currently benchmarked by ECO. Data pulled from Portfolio Manager and We Energies.

² [ENERGY STAR Portfolio Manager®](#)

³ <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/difference>

⁴ Buildings included in these numbers and the grant study do not include Water Works facilities, bridge houses, or street lighting.

⁵ [EPA Greenhouse Gas Equivalency Calculator](#)

City Fleet

The city fleet is comprised of all vehicles used by city departments, primarily Police, Fire, DPW, DNS, Health, Parking, and Water Works, to complete necessary tasks. The majority of the fleet assets of the City of Milwaukee are maintained by the Department of Public Works, Operations Division-Fleet Services Section. These assets cover internal Department of Public Works (DPW) vehicles, as well as the other departments of the City, excluding the Fire Department. The Fire Department orders and maintains its own vehicles, and has a separate fleet manager. The Police Department vehicles are maintained by DPW, but has its own fleet staff with decision making capacity for vehicle selection and specification. DPW assists the other city departments (excluding Fire) in vehicle selection based upon departmental input.



Energy Reduction Team

The City of Milwaukee Energy Reduction Team (ERT) is coordinated by ECO and made up of senior facilities, engineering, and maintenance staff from each of the cities departments: Public Works, Libraries, Police, Fire, Parking, and Fleet. The group is focused on reducing the city’s energy use, while still maintaining services and operations, to reach the previously stated energy goals. Each department is responsible for the operation and maintenance of their own buildings, with some oversight from DPW – Buildings and Bridges Section.

ECO and the ERT have been working to reduce energy consumption since joining the Better Buildings Challenge, primarily through retrocommissioning⁶, lighting upgrades, and general HVAC upgrades. Through the efforts of the Energy Reduction Team and facilities staff, we have seen reductions in specific buildings where projects were implemented, some examples are given below (Table 2).

Examples of Improved Building - 2019 to 2009 Baseline			
Property Name	Project(s)	kBTU Improvement	EUI % Improvement
MaCarthur Sq Parking	Lighting Retrofit, Digital Controls	10,936,967	50%
Port Admin Building	Wind Turbine, Lighting Retrofit	526,030	40%
MPD Storage Garage	Lighting Retrofit	112,560	20%
Police District 3	Retrocommissioning	2,961,000	9%
Central Repair Garage	Lighting Retrofit, Retrocommissioning	2,309,923	8%
Zablocki Library	HVAC Controls, Lighting Retrofit	601,062	24%

Table 2. Examples of improvements due to ERT projects

⁶ [Retrocommissioning](#) - a process to improve the efficiency of an existing building’s equipment and systems.

Energy Plan Summary

In 2018 ECO was awarded a grant from the State Office of Energy Innovation (OEI) to create a Comprehensive Energy Plan (CEP) that would identify opportunities, issues, and create a roadmap of projects that would need to be implemented over the next 5 years to reach 20% reduction. ECO and the ERT thought this planning would be useful in creating a clear path to 20% and implementing projects across the portfolio, rather than choosing individual projects while combating backslide. The grant was completed in 2019 with final reports being finalized in 2020. A summary of the grant findings follow.

To create the CEP, ECO and the ERT partnered with Edison Energy to perform investment grade audits of 97 city buildings to identify energy savings opportunities that were applicable across numerous municipal building types and that might realistically be pursued in the near-term. For example, major equipment upgrades were included only where equipment was found to be nearing its end of life. Findings from these audits were also entered into an excel tool to help staff quickly find and prioritize identified projects.

A small subset of the City's facilities were intentionally excluded from this study due to near-term plans to demolish or sell the buildings. In addition, Water Works facilities were not included in this study since ECO is focused on reducing energy use in operations of general city departments funded through the tax levy. The study also excludes municipal streetlights and traffic lights. ECO requested grant funds to include streetlights as part of the study, but did not received it.

In addition to the building audits, Edison helped to create:

- **Minimum HVAC and Lighting Energy Efficiency Standards** – simple guidelines for minimum efficiency standards and equipment specifications. To be used by all city departments when purchasing new or replacement equipment.
- **Green Fleet Study** – study of entire city fleet to identify energy and fuel saving improvements using alternative fuel vehicles, low carbon fuels, optimizing policies, and potential vehicle fleet consolidation.
- **Battery Feasibility Study** – an investigation of potential battery storage installation at DPW Field Headquarters in conjunction with previously designed solar PV system. This study included both energy and current financial projections to determine potential capital cost and long term savings.
- **Implementation Road Map** – a detailed guide of facilities projects to be implemented by each department over the next 5 years to reach 20% energy reduction, as well as long term projects that can be prioritized over 10 years.

Building Audit Findings

The Comprehensive Energy Plan has identified energy conservation measures, which, if implemented, are estimated to reduce the City’s total energy consumption by 26.7% and the over source energy usage intensity (EUI)⁷ by 26.3%.

Implementation of these measures is estimated to save the City:

- **9,686,284 kWh/year of electrical energy**
- **54,168 MMBtu/year thermal energy**
- **\$1,500,793 in energy costs per year**

With an estimated total implementation **cost of \$8,413,355** and potential **incentive opportunity of \$659,410**, these measures have a potential simple **pay back of 5.2 years**.

These savings totals are estimates and do not take into account interactive effects between measures or changes in Focus on Energy incentives. The cost and savings are estimates based on current conditions and do not include actual bid pricing needed to get an exact total. The estimates given are calculated in a stand-alone manner and do not include other modifications that may be needed due to project installation. For example, installing LED light fixtures may cause disturbance of asbestos, requiring remediation at an additional cost.

Implementation Roadmap

Edison Energy worked with department representatives from the Energy Reduction Team to create a 5-year Implementation Roadmap to reach a total energy reduction above 20% for the building portfolio. The projects were prioritized based on energy savings, payback time, current equipment age, and current department maintenance schedules. Completing projects with higher savings or quicker payback early on can help fund additional projects in future years. Table 3 shows the total energy and financial impact by year if the roadmap were to be followed.

Year	Electrical Energy Savings (kWh/yr)	Average Electrical Demand Savings (kW/mo)	Thermal Energy Savings (MMBtu/yr)	Site EUI Savings (kBtu/ft ²)	Cost Savings (\$/yr)	Implementation Cost (\$)	Incentive (\$)
2020	2,387,640	1,708	2,737	331	329,423	1,078,123	137,874
2021	2,683,056	1,204	1,515	670	306,171	767,534	176,855
2022	930,905	81	4,783	309	131,325	635,746	41,879
2023	746,659	47	11,289	435	159,210	918,204	55,875
2024	987,204	29	7,780	476	164,288	814,422	42,647
6 to 10 Year Projec	912,100	6	18,827	806	249,050	2,412,818	164,975

Table 3 – Edison Energy Roadmap Summary of Savings by year

⁷ **EUI** - calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building.

[Green Fleet Study Findings](#)

The Green Fleet Study aimed to identify opportunities to decrease overall fuel use, transition to alternative, low carbon fuels, and provide strategies and recommendations to reach 20% energy reduction and 25% renewable fuel use.

The study found that the city could reduce the overall amount of vehicles in its fleet by creating larger pools to be shared among departments, rather than each purchasing their own vehicle. Pooling would allow for fewer vehicles to be purchased and instead use additional funds to invest in alternative fuel vehicles. Other recommendations include creation of an Electric Vehicle (EV) steering committee, exploration of Renewable Natural Gas (RNG) procurement, and continued investment into compressed natural gas (CNG), Hybrid, and other alternative fuel vehicles.

Recommended Principles for Energy Practices

The City of Milwaukee, through the leadership of Mayor Barrett and the Common Council, has set sizeable Climate and Energy goals that reflect the urgent need for action on climate change. These goals are strongly tied to the city's energy and fuel use for municipal buildings and fleet operations. Based on the findings from the CEP, a strong set of principles for energy practices has been created by ECO and the ERT and will need to be implemented if the identified issues are to be resolved and goals achieved.

Existing Buildings

- Training and education is needed, with buy-in and participation from management and elected officials, to address energy culture at the workplace. Cultural plans that reinforce turning off lights, power strips, office equipment, etc. can have a dramatic impact on energy use and have no/low cost.
- LED lighting must be mandatory – large scale replacements should be made a top priority for the City as this is the easiest and quickest payback.
- Newly purchased HVAC equipment & lighting must adhere to Minimum Energy Efficiency standards set by the ERT through our OEI grant.
- Continue to use and expand alternative financing methods to invest in energy efficiency projects such as energy saving performance contracts and equipment lease financing.
- Work with DPW management, DER, and the Budget office to address building maintenance and engineering staffing issues. Consistent turnover and staffing cuts have put additional strain on the remaining staff and impacted the ability to manage energy use.
- Incentivize staff to pursue certifications that prioritize energy savings and sustainable practices.
- Over 15 MW of additional renewable energy production is needed to meet the 25x25 goal – additional funding may be needed to continue installation of solar at city buildings in conjunction with utility scale solar at brownfields and other locations. The city should set an annual goal of specific MW's to be installed and budget accordingly, while working toward an extensive single utility-scale arrangement.

New Buildings

- New city owned buildings should be designed and built at least 10% beyond the State of Wisconsin energy code, which is far behind many States.
- A consensus needs to be reached on what standards to build to, with an eye towards future net zero goals set by the Common Council. The City of Eau Claire has developed [a Net Zero Energy Building Guide](#) that could be used for new buildings.
- New buildings should be built, at a minimum, solar ready, if not designed with renewable energy systems to begin with.

- New parking lots should be built EV-Charger ready. Laying conduit during construction is much cheaper and allows for expansion of additional chargers over time at a lower cost.
- All new buildings and building energy systems should be commissioned.

City Fleet

- Create an interdepartmental Electric Vehicle Implementation Committee to start planning for widespread EV use – goals include infrastructure placement, selection of vehicles, evaluation of savings, avoidance of demand charges, and training departments.
- Decrease the amount of overall vehicles through creation of a larger pool with shared use by departments. Numerous fleet vehicles are not sufficiently used currently, shared vehicle use can greatly decrease fleet size, the amount of new vehicles purchased per year, and maintenance costs. Divestment in aged assets can occur by developing minimum usage requirements to retain a vehicle.
- Increase purchasing of hybrid or full electric vehicles – if a comparable alternative fuel vehicle exists and the marginal cost increase can be offset by fuel/O&M savings, the alternative fuel vehicle should be made the standard.
- A high priority recommendation was given to make the Hybrid Police Interceptors the standard Milwaukee Police Department patrol vehicle. This is the hybrid version of the same vehicle MPD currently purchases –savings on fuel and O&M would result in a payback of the cost differential of less than 2 years. MPD has the largest light duty fleet and such a change could have a dramatic impact on fuel use and emissions.
- Create a system for charging electric vehicles outside of peak demand time to avoid additional charging costs. Investment in solar on parking/charging facilities or solar canopies can also offset increased electric use for charging vehicles and help shave demand charges.
- The City can plan for an electric vehicle future by placing a clause into its building and zoning code requiring developers of multi-family housing and redevelopment projects for residential or commercial use to place charging infrastructure at their sites.
- The City can transform its fleet by repealing its mid-2000's era Department of Administration Code of Ordinance Section 310-18, which specifies the "purchase of Ethanol-fueled vehicles" which have the "capacity to operate with an ethanol content of at least 85%, to the greatest extent possible". This ordinance could also be converted to language for hybrid, electric, or other alternative fuel vehicles.
- Continue growth and funding of Compressed Natural Gas fleet and explore possible procurement of Renewable Natural Gas (RNG) to further supplement the program. RNG procurement is complex and should begin as soon as possible.