Creating a More Resilient Washtenaw: Reducing Energy Use, Costs, and Greenhouse Gas Emissions in Municipalities' Buildings

A project submitted in fulfillment of the requirements for the Master of Science degree at the University of Michigan School for Environment and Sustainability.

April 2024

Authors:

Bridget Corwin, *School for Environment and Sustainability and Ford School of Public Policy*
Sam Fleckenstein, *School for Environment and Sustainability*
Graham Fordice, *School for Environment and Sustainability and College of Engineering*
Ann Marie Nicholson, *School for Environment and Sustainability*
Haley Willman, *School for Environment and Sustainability*

Advisor:

Dr. Geoffrey Lewis, *Center for Sustainable Systems*

Clients:

Jan Culbertson, *Ann Arbor/Washtenaw 2030 District*
Lissa Spitz, *Ann Arbor/Washtenaw 2030 District*
Andrew DeLeeuw, *Washtenaw County*

This page intentionally left blank.

Table of Contents

Abstract

This project analyzed the barriers to increasing municipal building energy efficiency in Washtenaw County. It was completed in three phases: first, a data collection stage through surveys and interviews with officials from cities, villages, and townships (CVTs) in Washtenaw County. The second phase utilized the CVT data and feedback to create an energy efficiency toolkit guiding users through the energy efficiency improvement process from benchmarking to decarbonization. The third phase was an outreach webinar to foster collaboration between CVTs and the Ann Arbor/Washtenaw 2030 District using the toolkit and connecting CVTs to other sustainability resources in Michigan.

The data collection phase found significant variability in size, capacity, and political alignment within the study population, meaning that multiple factors were influential in determining interest in energy efficiency practices. The study found that CVTs with larger average annual budgets and more employees were more responsive, suggesting that staff capacity is a major factor in implementing energy efficiency. A central theme from surveys and interviews was a need for funding and other forms of technical assistance. The commonalities across all interviews and surveys were a lack of capacity to analyze cost-effective and appropriate energy efficiency upgrades, and a perceived lack of funding.

The surveys and interviews influenced the structure and content of the toolkit. CVTs are generally aware of their buildings' most pressing energy efficiency needs, but are impeded in implementation by capacity and budget constraints. This led to the creation of the toolkit *Creating a more Resilient Washtenaw: Reducing energy use, costs, and greenhouse gas emissions in municipalities' buildings, A toolkit for local governments,* which provides a roadmap for improving municipal building energy efficiency , including funding avenues and technical resources. This toolkit allows the Ann Arbor/Washtenaw 2030 District to provide outreach and connection to CVTs at any point in their energy efficiency journey, furthering county-wide goals of sustainability and decarbonization.

Acknowledgements

We extend sincere gratitude to all those who have helped and supported us in making our project a success. First, we would like to thank our project advisor, Dr. Geoffrey Lewis, for his guidance throughout this process. Second, Jan Culbertson, our client from the Ann Arbor/Washtenaw 2030 District, alongside Andrew DeLeuuw from Washtenaw County, and Lissa Spitz from the Ann Arbor/Washtenaw 2030 District, whose insights were crucial to the completion of our project.

We are also grateful to the cities, villages, and townships who provided us with initial support through feedback during our pilot interview process: Jessica West (Pittsfield Township), Steve Wyzgoski (Scio Township), and Justin Breyer (City of Dexter). In addition to those who responded to our survey: Karen Sikkenga (Dexter Township), Bonnie Wessler (City of Ypsilanti), Ronald Milkey (Manchester Township), Kathleen Kennedy (Sylvan Township), John Kingsley (Webster Township), Valisa Bristle (Freedom Township), Laurie Lutomski (Ypsilanti Township), Michael Sessions (Village of Manchester), Jan Godek (Lodi Township), Carlene Colvin-Garcia (Ann Arbor Township), Chuck Tellas (York Township), Colleen O'Toole (City of Saline), and Kenneth Schwartz (Superior Township). Further, those who supported us through interviews following the survey: Carlene Colvin-Garcia (Ann Arbor Township), Bonnie Wessler (City of Ypsilanti), Jan Godek (Lodi Township), Ronald Milkey (Manchester Township), Chuck Tellas (York Township), and Micheal Saranen, John Hines, Laurie Lutomski (Ypsilanti Township).

And those who supported us in the development of our toolkit and provided valuable feedback: Micheal Saranen, John Hines, and Laurie Lutomski of Ypsilanti Township and Jason Fee, Mary Braun, and Nicholas Woods of Washtenaw County. We would also like to thank Dainelle Beard of Michigan Green Communities for participating in our webinar. Lastly, we thank the School for Environment and Sustainability at the University of Michigan for the financial support of our project.

Introduction

This project aims to analyze the barriers to achieving greater municipal building energy efficiency in Washtenaw County, and proposes actionable solutions to some of these barriers. Our project is situated within a broader context of emissions mitigation and climate change-focused projects in Washtenaw County. Crucial to this project is the Resilient Washtenaw Plan, which creates a framework for dealing with the ongoing impacts of climate change on Washtenaw County, as well as a framework for achieving carbon neutrality by 2030. The plan outlines strategies for achieving these goals, which were developed through a public engagement process and staff strategy sessions. Our project builds upon this foundation, specifically addressing the building energy use and building fossil fuel use portions of the plan (Washtenaw County, 2022).

History and Context of the Ann Arbor/Washtenaw 2030 District

The Ann Arbor/Washtenaw 2030 District (formerly the Ann Arbor 2030 District) is a member of the 2030 Districts Network. The Network seeks "to establish a global network of thriving high-performance building districts and cities, uniting communities to catalyze transformation in the built environment and its role in mitigating and adapting to climate change" (2030 Districts Network, 2023). It was born out of goals set in Architecture 2030 to achieve 50-65% emissions reductions from a 2022 baseline in the sectors of water, energy, and transportation. The Network is made up of individual city-based organizations working locally to achieve these goals.

Ann Arbor/Washtenaw 2030 District has divided their work based on building type. They currently run working groups for houses of worship, multifamily residences, and food service establishments (Ann Arbor/Washtenaw 2030 District, 2024). They also provide technical support for solar installations, as well as free building energy audits for members. Most recently, they are providing technical support for buildings required to report energy and water use data under Ann Arbor's Benchmarking Ordinance (City of Ann Arbor, 2023). The Ann Arbor/Washtenaw 2030 District has broadened their focus from Ann Arbor to all of Washtenaw County to support the county in achieving the goals set out by the Resilient Washtenaw plan. In addition to the expanded geographic focus, this project is an opportunity for Ann Arbor/Washtenaw 2030 District to expand their scope of work to include municipal building energy efficiency measures. This prompted the SEAS Resilient Washtenaw team to research and create a framework for municipal building energy efficiency measures.

Past Ann Arbor 2030/Washtenaw District Projects

The Ann Arbor/Washtenaw 2030 District and SEAS have previously collaborated on three projects, all focused on addressing different aspects of the goals laid out by the 2030 Districts Network. In 2020, a practicum by Kori Johnson-Lane established water baselines using the metric of water use intensity (WUI) (Johnson-Lane, 2020). Because the 2030 Districts all have a goal of reducing water and energy use by 50% from baseline by 2030, establishing a customized baseline for Ann Arbor is an important step toward more efficient water use, and provides a starting point for further water use efficiency measures.

In 2021, a team of students studied transportation greenhouse gas emissions in Ann Arbor, establishing a baseline that accounted for transportation differences before and after the pandemic (Fields et al., 2021). As stated above, because the baseline is such an integral part of how the 2030 Districts conceptualize their

goals and reductions, creating this baseline is an important step toward limiting future emissions. In 2022, a practicum by Kacey Eis focused on tenant engagement surrounding conservation of electricity, energy, and water in multifamily rental residences (Eis, 2022). Because of the large amount and frequent turnover of rental housing in Ann Arbor, studying how tenants and landlords can be better involved in resource conservation efforts is important for meeting emissions reductions goals. Since Ann Arbor is a college town, tailored strategies for student rental engagement and low income renters are both important for program participation and efficacy, and this practicum helps to address both of these communities effectively.

The Ann Arbor/Washtenaw 2030 District's next project will focus on restaurant resource conservation opportunities (e.g., waste management, electrification, etc.). By isolating a specific high-waste sector in Ann Arbor, they are hoping to have a concentrated impact on emissions reductions, bringing the city closer to its 2030 goals.

What is a SEAS Capstone Project?

A SEAS capstone project is meant to "develop greater experience working with an interdisciplinary team on an external client's real-world sustainability challenge" (University of Michigan School for Environment and Sustainability, 2023). In this case, our client, as discussed above, is working with the team to create a toolkit and framework that will aid their sustainability outreach efforts to municipal governments in Washtenaw County. A focus on energy efficiency is one aspect of sustainability that has concrete benefits for the implementing organization, namely long-term energy cost savings. It also provides an avenue to begin discussing more complex aspects of sustainability at the municipal level at a later date. Our team members specialize in Sustainable Systems, Environmental Policy & Planning, and Environmental Justice at SEAS. Each brings a unique background across a variety of topics including engineering, community relations, local government work, and technical communication.

About Washtenaw County

Washtenaw County is located in southeast Michigan, approximately 30 miles west of the City of Detroit. It covers an area of 720 square miles and is home to around 366,000 residents in a variety of urban, suburban, and rural settings (United States Census Bureau, 2023) (University of Michigan Economic Growth Institute, 2018). The urban centers are primarily located on the east side of the county, while rural areas lie in the south and west. Washtenaw County's 28 municipalities comprise six cities, two villages, and 20 townships, as shown in Figure 1.

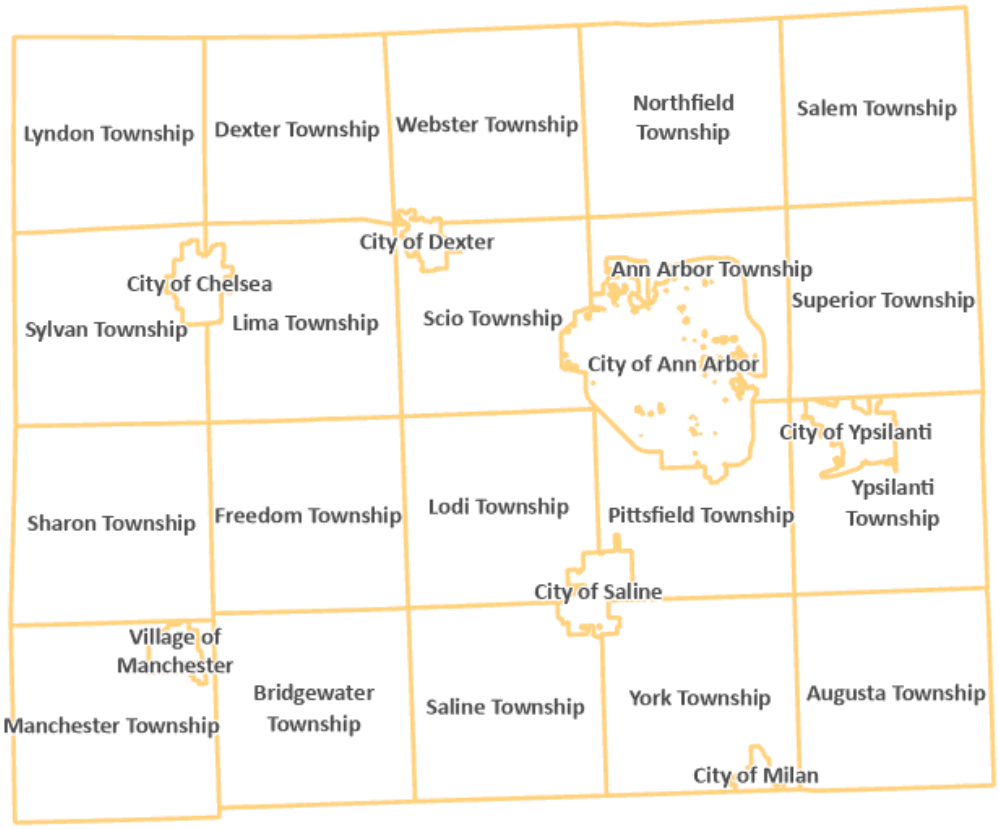


Figure 1. A map of Washtenaw County municipalities (Washtenaw County, 2023)

The three largest municipalities are: Ann Arbor (~123,000 residents), Ypsilanti Township (~54,000 residents), and Pittsfield Township (~39,000 residents). The City of Ann Arbor holds about a third of the population of Washtenaw County and is the fifth largest city in the state of Michigan (Cubit Planning, Inc, 2022). The City of Ypsilanti and parts of the surrounding municipalities (shown in Figure 2) are recognized as Justice40 disadvantaged communities as of May 2022. Disadvantaged communities are those that endure a socioeconomic burden and a burden in at least one of the eight following categories: climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development (Office of Energy Justice and Equity, U.S. Department of Energy, n.d.).

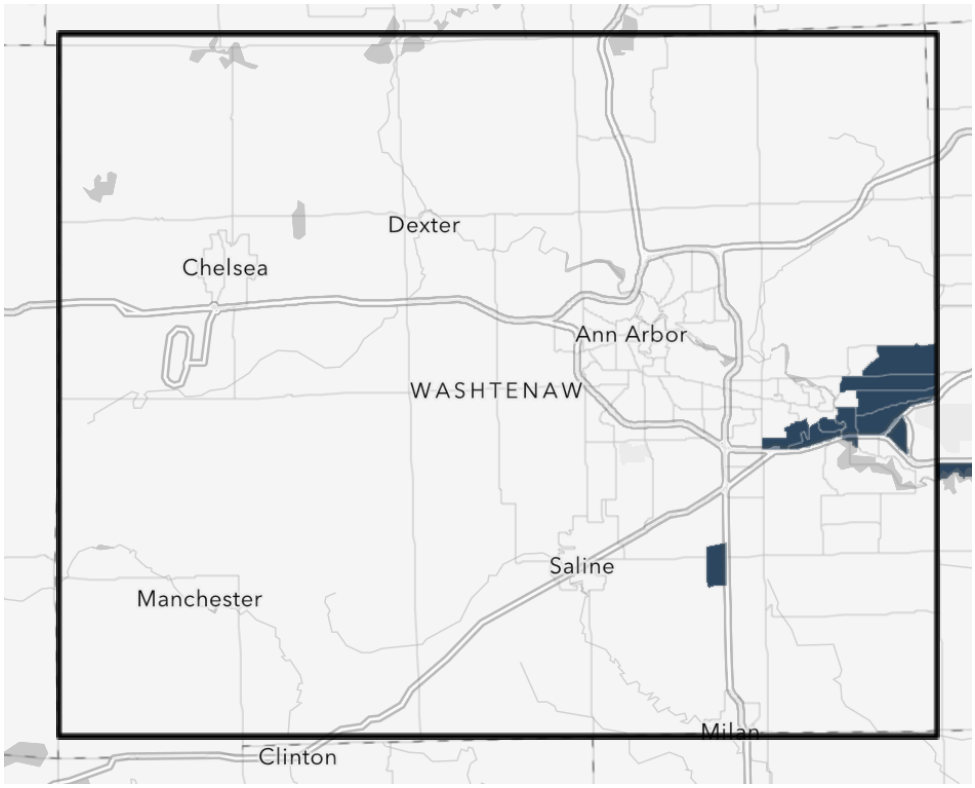


Figure 2. This figure shows where the Justice40 census tracts (shown in blue) are located relative to Washtenaw County (approximate boundaries shown by black outline) (Esri Demographics Team, 2022)

The county is home to two major public universities: Eastern Michigan University located in Ypsilanti and the University of Michigan's Ann Arbor campus, both of which support community projects (similar to this one) to help Washtenaw County and the communities within it. More than 57% of the Washtenaw County population has a bachelor's degree or above (United States Census Bureau, 2023), compared to a national average of 34.3% (United States Census Bureau, 2023). The median household income of the county is $84,245, which is $9,665 higher than the national average of $74,580 (United States Census Bureau, 2023) (Guzman & Kollar, 2023). While Washtenaw County has higher levels of education and income than the national average, these are largely concentrated in suburban areas. Additionally,education and income vary significantly within the county.

One important factor when discussing energy efficiency is the source of the energy being consumed. Washtenaw County's electric utility services are provided by both DTE Energy and Consumers Energy. Consumers Energy is only present on the western edge of the county, while DTE serves all other parts (Michigan Public Service Commission, n.d.). Both of these providers are a part of the RFCM portion of the national grid, which as of 2022 has a greenhouse gas emissions factor of 1,224.2 kg CO_2e/MWh of electricity, the fifth most of any subregion in the country, and 47.9% more than the national average. Coal is the fuel used for 36.6% of this electricity, and 38.5% is gas-generated (eGRID, Environmental Protection Agency, 2024). Because of the carbon-intensive nature of electricity production in Michigan, efficiency measures are crucial to reducing the amount of greenhouse gas emissions from electricity. Efficiency measures can help reduce emissions with the current grid fuel composition by decreasing the amount of electricity necessary for building operations. DTE Energy is also working towards decarbonizing, with a goal of 85% carbon emissions reduction by 2032, the same year that they plan to

close both the Belle River and Monroe coal power plants (DTE Energy, 2024), (DTE Energy, 2023). By increasing energy efficiency and moving toward building electrification, a building will decarbonize as the grid decarbonizes, while continued fossil fuel use for heating will never allow for full building decarbonization.

Washtenaw County has demonstrated that carbon neutrality is an important part of its identity with the passing of the Resilient Washtenaw Plan in December of 2022, as discussed previously. The Resilient Washtenaw plan was approved by the County Board of Commissioners and "includes a set of aggressive but practical strategies, principles, goals and actions to help Washtenaw County reach carbon neutrality, as an organization by 2030, and as a community, by 2035" (Washtenaw County, 2022). Several communities within Washtenaw County have also begun to create their own sustainability or climate action plans as well. The City of Ann Arbor created the A2Zero Climate Action Plan, a living carbon neutrality plan for the city that "outlines the path needed to achieve a just transition to carbon neutrality, community-wide, by the year 2030" (A2Zero, 2020). The City of Ypsilanti has both a Climate Action Plan and a Sustainability Plan to coordinate "municipal and community efforts to reduce greenhouse gas emissions and address climate change" (Michigan Suburbs Alliance, 2012). In Scio Township's Environmental Sustainability & Climate Action Plan, it committed to collaborating with the Resilient Washtenaw plan to "foster regional cooperation and community engagement in meeting climate and sustainability goals" (Scio Township Environmental Sustainability Task Force, 2023). The most recent climate action plan in the county is Ann Arbor Township's Climate Action Plan from November 2023. This plan is designed to support the Resilient Washtenaw plan and those from other cities, townships, and villages in the county. Their plan will guide and integrate "operations, services, planning, policies, ordinances, and investments to ensure the most sustainable, inclusive, greenhouse gas (GHG) emission reduction options are implemented" within the Township (Ann Arbor Charter Township Climate Action Plan Team, 2023). Although Washtenaw County has several climate resiliency or sustainability plans in place, these are largely concentrated in the municipalities with above average numbers of employees, populations, and household median incomes, meaning that smaller communities would benefit from more support to achieve the goals set by the county.

Benefits of Energy Efficiency Adoption in Municipalities

An energy-efficient building creates comfortable living conditions with the least possible energy consumption, maximizing efficiency in use of resources (Gupta & Chakraborty, 2021). Making these improvements directly benefits the municipality, by assisting in achieving sustainability goals at various government levels. Municipal buildings across Washtenaw County have a diverse range of sizes and uses including recreation, public safety, and administration. Many of the smaller townships have only one building, a township hall, some of which are the original building from 1900 or earlier. Some have additional fire stations or sheriff outposts, while cities tend to have the most municipal buildings, although the ages of the buildings vary greatly. Nationwide, 84% of municipal-owned buildings are often smaller than 50,000 square feet, 80% are more than 20 years old, and cost around $6,684 per year to operate (Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, 2021). This is important because as taxpayer-funded entities, government operations of older, less efficient buildings cost money that could be allocated to other services. Energy efficiency efforts are tailored to the specific building, and are dependent on the size, use, and age of the infrastructure. The literature discussed below is relevant for buildings similar to the size and age of the national average. A gap analysis was conducted on municipal-owned building energy efficiency literature across the United States. Since Washtenaw

County's buildings largely fit the description of the national average, these results were assumed to be relevant for Washtenaw County buildings.

Energy efficient building design and equipment selection can directly influence the air exchange rates, indoor air and surface temperatures, and relative humidity levels, and is therefore crucial in creating a healthy indoor environment (Baniassadi et al., 2021). These efficient design choices can have positive impacts on the work environment, attitude, and health of its users. Energy efficiency plays a role in occupants' health and well-being (Baniassadi et al., 2021). Furthermore, low- or no-cost measures to reduce energy consumption can result in significant cost savings, allowing for these dollars to be put back into the community. Investments in energy efficiency projects have a high return on investment: on average, "for every dollar invested in energy efficiency end-uses, four dollars are returned to the local unit of government" (Barnett & Yu, n.d.). Whether commissioning new buildings or retrofitting existing buildings for energy efficiency technologies, the Environmental Protection Agency's (EPA) State and Local Climate and Energy Program offers cost savings estimates for both opportunities. They reported the average savings of a new building are $\$0.05/ft^2$, while retro-commissioning existing buildings saves around $\$0.27/ft^2$, resulting in 15% energy savings and a payback period of 0.7 years (United States Environmental Protection Agency State and Local Climate and Energy Program, n.d.). Additionally, increasing the energy efficiency of municipal buildings can help create healthier communities. Reductions in energy use and resources leads to greenhouse gas emission reductions and therefore contributes to a healthier community.

Buildings are responsible for 18% of U.S. greenhouse gas emissions, most of which are the result of burning of fossil fuels to provide heating, cooling, and electricity. As climate change impacts worsen and more temperature controls are required in buildings, it establishes a positive feedback loop between increased demand for energy use and emissions (Baniassadi et al., 2021). While "positive feedback" typically implies a beneficial process, in this context it establishes an adverse cycle of further energy consumption contributing to global emissions. Reducing the environmental impact of buildings helps support local sustainability efforts and a healthy environment in the local community. Washtenaw County already has established sustainability and climate goals. These plans require each municipality to make sustainability changes to achieve county-wide goals and initiatives. Many cities and states across the United States are also beginning to implement mandatory energy benchmarking and reporting ordinances to meet sustainability goals, so communities would also benefit from adopting energy efficient practices now, before mandatory guidelines are enacted. Although Washtenaw County does not have a specified level of energy performance, there is a goal of community-wide carbon neutrality by 2035. Energy-efficient buildings reduce the use of these fossil fuels and are better equipped to switch to renewable energy, which does not produce harmful emissions (Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, n.d.). By minimizing energy consumption through efficient design these buildings decrease their reliance on fossil fuels. They also offer lower energy demands, reducing the cost of electrification for building owners (U.S. Environmental Protection Agency, 2018).

Energy efficiency can be framed as politically neutral and will therefore face less opposition than terms such as climate change, carbon neutrality, and greenhouse gas emissions, which can sometimes be ill-received. One study conducted using data from all 50 U.S. states calculated energy efficiency using various models and found that when establishing energy efficiency goals in their respective states, Democratic administrations consider the reduction of environmental impact while Republican administrations consider only financial expenditures (Antunes et al., 2023). Therefore, energy efficiency

can be a gateway towards other environmentally beneficial outcomes. Framing energy efficiency goals in terms of the financial benefits they provide offers a political advantage, and therefore a greater likelihood of bipartisan support to adopt these policies (Leffel et al., 2024). As mentioned above, there are several benefits to energy efficiency work beyond cost savings, such as better work environment, reallocation of funds, and establishing healthier communities. Using a framework of politically neutral co-benefits allows for sustainability work to enter communities that may otherwise be opposed to the more polarizing framings of carbon emissions or climate change.

Energy Efficiency Planning in Municipalities

In addition to the benefits of energy efficiency there is a multitude of literature on how to integrate energy efficiency planning into municipal government. The integration of energy efficiency can begin with the development of a municipal energy action plan (MEAP) and an understanding of the programs that exist to assist with the establishment of the MEAP (Brandoni & Polonara, 2012). The U.S. Department of Energy, Office of Energy Efficiency & Renewable Energy released a document designed to help small-and medium-sized public facilities achieve energy savings. Common barriers include a lack of necessary staff, procurement, contracting, legal support, and limited budgets that are allocated for more immediate needs (Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, 2021). Smaller buildings often do not have staff or funding available to conduct regular repairs and replacements of existing building systems, which results in significant deferred-maintenance backlogs (Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, 2021). This DOE document also outlines the standard motivation that these small- and medium-sized facilities often operate on: urgent need to replace equipment. Reactive upgrades can lead to rushed procurement without efficiency considerations, or improperly installed systems that can result in a 30% loss in system efficiency versus proactive upgrades where careful planning and consideration can lead to maximum energy savings (Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy, 2021).

ENERGY STAR offers their “Guidelines for Energy Management," which assists in creating an energy management program focused on continuous improvement of energy performance (ENERGY STAR, U.S. Environmental Protection Agency, 2013). They also offer their own program, ENERGY STAR Portfolio Manager (ESPM), which makes it easy to gather energy data and track energy use over time. The ENERGY STAR’s “Local Government Climate and Energy Strategy Series" guidelines show seven steps for municipalities to develop energy management in existing buildings (United States Environmental Protection Agency, 2011), illustrated in Figure 3.

Figure 3. Seven-step ENERGY STAR guidelines for energy management (United States Environmental Protection Agency, 2011)

This guide also offers strategies for effective program implementation through: engaging management, providing adequate information, utilizing measurement tools and methods, pursuing creative financing options, and developing political consensus (United States Environmental Protection Agency, 2011). This guide was piloted in Ann Arbor to optimize energy efficiency of their street lights and signals. Implementation of this framework into city operations reduced annual energy costs by $100,000 and was funded using a local grant (United States Environmental Protection Agency, 2011).

There are several programs and organizations in the State of Michigan that can assist with the implementation of energy efficiency into municipal buildings. Within Washtenaw County, this includes: Michigan Green Communities (MGC), Southeast Michigan Council of Governments (SEMCOG), and Department of Environment, Great Lakes, and Energy's (EGLE) Catalyst Communities. MGC was established in 2009 as a statewide sustainability benchmarking, networking, and technical assistance program (Michigan Green Communities, n.d.). MGC is led by a steering committee composed of local government leaders and representatives from relevant Michigan governmental departments and is designed to foster peer learning and information sharing to promote sustainability solutions at the local, regional, and state level.

SEMCOG supports local planning through technical, data, and intergovernmental resources (Southeast Michigan Council of Governments, 2024). SEMCOG serves the Southeast Michigan region, made up of Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties. Membership is open to all counties, cities, villages, townships, intermediate school districts, and community colleges although

they must request to become members. A map of all of the city, townships, and villages in Washtenaw County that are members is shown in Figure 4.

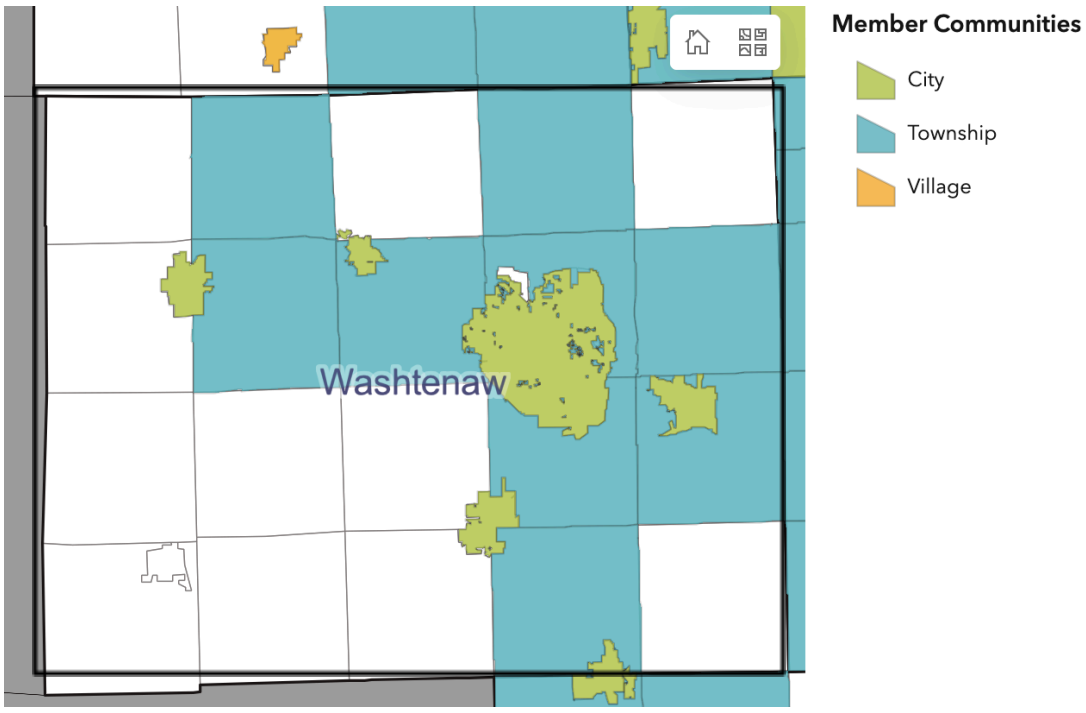


Figure 4. Map of CVTs across Washtenaw County that are members of SEMCOG with the approximate County border shown in black (Southeast Michigan Council of Governments, 2024)

Funding from the Inflation Reduction Act through the EPA's Climate Pollution Reduction Grant, will allow SEMCOG to develop a Healthy Climate Plan for Southeast Michigan. This plan will provide funding opportunities to its members as well as assistance in energy efficiency within municipal operations through decarbonizing buildings and industry (Southeast Michigan Council of Governments, 2024).

Finally, the Catalyst Communities Initiative "is a comprehensive program to provide education, training, planning and technical resources to local governments as they work toward their sustainability goals. This program offers an array of resources on various environmental, social, and economic topics to help communities across Michigan make a just transition to decarbonization. The Catalyst Communities Initiative aims to provide a range of options to meet communities wherever they are, regardless of geography, population size, or pre-existing knowledge" (Department of Environment, Great Lakes, and Energy, n.d.). The Catalyst Communities Initiative's work on energy efficiency and renewable energy offers resources, webinars, and community examples for all levels of familiarity with energy efficiency, whether just beginning or continuing efforts. They offer resources on the following topics: benchmarking and tracking, funding energy efficiency and renewable energy, renewable energy deployment, energy efficiency improvements, efficient street lighting, community energy use, food waste reduction, and fleet management.

As presented, there are several methods for municipalities to integrate energy efficiency into their operations. Literature generally follows a process of first establishing current use patterns, then

developing a plan to address gaps in current use, and finally activating this plan and following up by tracking its progress. Regardless of how municipalities decide to implement their Municipal Energy Action Plan (MEAP), an understanding of the current resources that exist in Washtenaw County is essential. Any municipality, irrespective of its size, income, or number of employees, can develop a MEAP and access relevant resources to aid in this endeavor.

Historically, energy planning has been deprioritized in the municipal planning process (Poggi et al., 2017), meaning that many municipalities (nationwide and in Washtenaw County) do not have a plan for implementing energy efficiency. The result is a lack of research on energy efficiency in municipalities, creating a vicious cycle: a lack of research means that municipalities have to start from scratch, decreasing the likelihood of energy efficiency planning, meaning there is little data to study and publish. To address this, coordination of information and resources among levels of government is essential, as demonstrated above with local, state, and federal energy efficiency guidelines, each of which offer guidance and resources to implement this into municipal operations.

We will use best practices in energy efficiency to highlight the importance of reducing emissions as well as implementing energy efficiency and water use strategies. Best practices in municipal energy management include (South Bend Green Ribbon Commission Energy Group, 2015):

1. Energy audits and baseline analyses
2. Established and ambitious metrics for energy savings
3. Summer and winter temperature set points across municipal facilities
4. Energy-efficient procurement policy
5. Dedicated energy savings reinvestment plans
6. Municipal building upgrades and retrofits
7. Municipal fleet fuel efficiency

These best practices guided our work, recommendations, and deliverables.

Need of the Community

This project serves as outreach for implementation of energy efficiency and carbon neutrality measures within the Washtenaw County municipalities in conjunction with the Resilient Washtenaw plan. Although each CVT in the county is at a different stage of executing this plan within their own communities, supporting efforts to improve the energy efficiency of municipal-owned buildings can serve as an impactful and accessible initiative for all municipalities. Ensuring county operations are energy efficient leads to positive community benefits through reduced costs, reduced emissions, and healthier communities. While many of the county's larger municipalities have established aggressive climate action plans, smaller CVTs are still working to implement the Resilient Washtenaw plan and Ann Arbor/Washtenaw 2030 District goals. We prioritize rural areas that do not currently have an energy efficiency plan in place, and may lack the capacity to generate a sustainability plan with building energy efficiency goals. To ensure that we are accurately representing and addressing the needs of CVTs in Washtenaw County, we decided to create a survey and interview process. The information gained from this outreach informed our final products.

Project Goals

This project aims to address gaps in Washtenaw County's CVT sustainability plans and energy efficiency action plans. While the county has initiated energy efficiency projects in larger cities through the Resilient

Washtenaw Plan and A2Zero initiatives, there is a need to understand common challenges and extend efforts to more communities, which constitutes our first project goal of assisting Washtenaw County in achieving its energy goals. Our project team collaborated with county officials and the Ann Arbor/Washtenaw 2030 District, conducting surveys and meetings with local government officials from CVTs across the county to meet our second goal of integrating community input into our final deliverables. The gathered information laid the foundation for creating a toolkit to assist municipalities in integrating energy efficiency into their individual plans, our third goal. This toolkit, along with an accompanying webinar, provides resources, funding sources, and connections, achieving our fourth and final goal of fostering collaboration between municipalities and local organizations.

Methods & Data Collection

Overview

This project was completed in three phases: the first was data collection from CVTs in Washtenaw County through both a survey and interview. The second phase utilized results from phase one to create a toolkit. The third phase combined phases one and two by creating a webinar to foster collaboration between CVTs and the Ann Arbor/Washtenaw 2030 District using the toolkit.

The team conducted data collection through an initial pilot stage and a general outreach stage. Both stages had two components, a survey sent to 27 of the 28 CVTs (the City of Ann Arbor was excluded due to their robust energy efficiency plans and resources) and a follow-up interview with those same CVTs.

During the initial pilot stage, the team contacted three CVTs that are already engaged with sustainability work and used their feedback to refine both the survey and the interview process for the general stage where the remaining 24 CVTs were contacted. The sections of the survey and interviews were selected using insight from the Ann Arbor/Washtenaw 2030 District and research on energy efficiency strategies in buildings.

Pilot Stage

Outreach

The capstone team sent a pilot survey to officials from Pittsfield Township (Jessica West, Director of Community Development), Scio Township (Steve Wyzgoski, Director of Utilities), and the City of Dexter (Justin Breyer, City Manager). These CVTs were selected because they had existing relationships with Ann Arbor/Washtenaw 2030 District, had established community-wide sustainability plans, and had already taken actions to increase energy efficiency in their municipal buildings. These factors led the capstone team to believe that these CVTs would be highly knowledgeable and willing to take the time to fill out and give feedback on the pilot survey.

Survey

This draft survey was sent to only the three pilot CVTs to gain their feedback and ensure that the finalized survey was clear, concise, and relevant for the larger group of respondents in Washtenaw County. In

addition to obtaining valuable feedback on the structure and content of the survey, this pilot stage also allowed the capstone team to gain initial insight on common challenges CVTs face in pursuing energy efficiency upgrades in their municipal buildings. This survey can be found in Appendix A - Pilot Survey.

Based on the capstone team's building energy efficiency research and guidance from Washtenaw County and the Ann Arbor/Washtenaw 2030 District, the pilot survey contained questions about five main topics related to CVTs' municipal buildings:

1. Energy and water use
2. Age, type, and service frequency of building equipment (including windows, insulation, lighting, HVAC, and smart controls)
3. Recent or planned building renovations,
4. Whether CVTs operated electric vehicle charging stations or on-site renewable energy production at any buildings
5. Payback period requirements

Interviews

After officials from the three CVTs responded to the pilot survey, the capstone team conducted interviews with two of them (Pittsfield Township and the City of Dexter) via Zoom. These interviews allowed the capstone team to gather feedback about the structure of the initial survey and gain further insight into officials' responses. Along with specific questions about their responses, the capstone team asked the following questions during pilot interviews to understand how to improve the survey:

1. Were the questions in the pilot survey clear?
2. How did you feel about the length and depth of the survey?
3. Were there any topics or questions related to municipal buildings that you felt were missing from the survey?
4. Were there any topics or questions related to municipal buildings in the survey that you felt were not relevant?
5. How difficult was it for you to find the municipal building information requested in the survey?
6. How difficult do you think it would be for officials from other CVTs to find the municipal building information requested in the pilot survey?
7. Do you have any concerns about the accuracy of the municipal building information you provided in the survey?

These interview questions can be found in Appendix B - Pilot Interview Questions.

Feedback and Survey Changes

The interviewed officials provided the capstone team with a variety of suggestions on how to improve the survey before distributing it to the rest of the CVTs in Washtenaw County. Most officials shared that it took more time and effort than expected to find data on their municipal buildings. To address this, one CVT recommended that in the initial outreach to other CVTs, the capstone team should provide a summary of the survey questions and suggestions on who to connect with to find the requested information.

Many officials also found it challenging to answer questions about their CVT's municipal buildings "in general", as these buildings often varied greatly in their age, equipment, occupancy, and uses. The capstone team addressed this in the general stage survey by asking officials to only answer equipment-specific questions about their CVT's "primary administrative building," or the building where most local government operations occurred. This would allow officials to answer questions about a familiar building with high use and occupancy, as well as give the team a single building to analyze and compare from each CVT.

The interviewed officials also felt that the survey did not adequately capture information about energy efficient behaviors and what kinds of energy efficiency support CVTs were interested in receiving for their primary administrative buildings. The capstone team added specific questions about these topics to the general stage survey. The updated survey can be found in Appendix C - General Survey Questions.

General Stage

Outreach

The team collected a list of contact information for officials in all of the municipalities in Washtenaw County, with a focus on positions likely to know about energy efficiency work. Once that list was finalized, the team handed it off to Culbertson and DeLeeuw who sent the initial contact emails to CVTs, including a brief introduction to the project and the team. This was done to try to get a better response rate than the team would be able to get by initiating contact themselves. Immediately after the initial email, team members emailed the CVTs to establish single points of contact in case of questions about the survey or project. Some CVTs responded quickly to the survey request but the team also followed up with many CVTs via emails and phone calls to gather more responses. Out of the 24 CVTs contacted, 17 completed the survey.

After CVTs filled out their surveys, the team worked to schedule follow-up interviews, relying on email and phone calls. Of the 17 CVTs that completed the survey, the team was able to interview 8. The team conducted interviews over the phone or Zoom, generally one-on-one but with multiple team members or multiple interviewees in some cases. Interview questions were largely standardized and can be found in Appendix D - General Interview Questions. Team members came into the interviews with specific questions to ask but also with the leeway to go off-script if questions weren't applicable or if interviewees brought up topics of interest that weren't covered by the questions.

Survey

This project began its broader outreach by sending surveys to all the municipalities in Washtenaw County. The survey was intended to be quick to complete while still being comprehensive enough to gather the essential information about CVT buildings. The goals of this survey were to 1) learn about the needs of each CVT, 2) understand what energy efficiency measures were already in place, and 3) discover the potential areas for improvement in each municipality. While the number of buildings for each CVT can vary greatly, the survey was mainly focussed on the primary administrative building. With a focus on these guidelines and goals, the team then worked to determine which questions would result in the most productive answers. These questions were then divided into the sections General, Equipment, and All Buildings for organizational purposes. This survey can be found in Appendix C - General Survey Questions.

General

This section was designed to provide a baseline of the building in question and which tools, if any, the CVT had utilized to improve efficiency. An initial question asked was whether the representative from the CVT was familiar with the Resilient Washtenaw plan. This was about getting an understanding of how well that plan had been communicated to the members of Washtenaw County. Following this, we asked if the CVT had any on-site renewable generation or if they were enrolled in a renewable energy purchasing program. With this, we could better understand the potential opportunities for reducing carbon emissions for CVTs. If most of them answered no to both of these, then it is very important to include information about the opportunities to get renewable electricity and the potential benefits of doing so.

We then asked if there was any major work planned for the building in the future (i.e., additions or renovations). This question helped ascertain if there were any opportunities to integrate energy efficiency into projects already under consideration. If resources were being invested into major work, adding energy efficiency could be more cost effective than starting a new project focussed on energy efficiency. Next, we asked if they tracked building resource use (specifically water, electricity, or gas) with a tool like ESPM. The purpose of this question was to determine if and how CVTs were tracking resource use. To determine paths toward energy savings, establishing baseline resource use is an important first step. If most CVTs responded no to this question, then adding guidance on a resource tracker like ESPM would be important for the toolkit created from this survey. If they answered yes to this question, that would mean there was resource consumption information available to be used for the toolkit.

Following that, the survey asked if building efficiency had been assessed through an energy audit or assessment, and what year that activity took place. If most CVTs hadn't had their efficiency evaluated, then a logical place for the toolkit to start would be providing resources and information regarding energy assessments/audits. If CVTs had already assessed their efficiency, then the toolkit could provide guidance on how to respond to the different assessment outcomes. The final question in this section asked if their main building had vestibule entries or airlocks. This was a simple question to better understand the building construction. Vestibules/airlocks help to reduce the amount of air lost when one enters or leaves the building, helping to reduce heating and cooling costs. This is an important thing to consider when evaluating the efficiency of a building, as one with a vestibule will likely have lower heating and cooling costs compared to one without.

Equipment

This section of the survey was designed to understand the main factors impacting the efficiency of the main CVT building. Many of the questions here pertain to components that have a shorter lifetime than the building itself. The goal is to establish a baseline for how efficient the equipment is to better understand how much room for improvement exists, and therefore the appropriate toolkit focus areas. Insulation was chosen as the starting question for equipment as it is incredibly important for improving the efficiency of a building. Regardless of the HVAC system in place, better insulation will help to reduce costs and energy use. Like any of the questions in the survey, understanding where the CVTs are with insulation can inform the development of the toolkit to be more relevant to the needs of Washtenaw County. Windows were the next area of inquiry as they are effectively transparent insulation. Windows are a common area for high levels of heat loss in a building, especially in older buildings. By understanding how old the windows are and how resistant to heat flow they are, the toolkit can better address the concerns CVTs may have when they consider improving their building envelope.

The next question asked about lighting, as this is one of the easiest ways a CVT can reduce energy consumption. Not only is updating lighting fairly easy, it can have a large impact as lighting accounts for anywhere from 10-20% of the energy used in a commercial style building. If CVTs don't already have LED lights, that's an extremely easy first step for the toolkit to address. The expectation was that many CVTs would already have LED lights, so the lighting section also asked about the implementation of smart controls to further reduce the energy consumption from lights. This section also asked those who already have upgrades in place how much energy they have saved from those upgrades. By asking this, there is more relevant information that can be provided to other CVTs who want to better understand the potential benefits of undertaking these upgrades.

The next point of questioning was the type and age of HVAC in the building. Heating and cooling are arguably the most important aspects of a building to be considered, as they account for 30-50% of the energy consumed in commercial buildings. Understanding the type of HVAC equipment being used informs what potential upgrades should be included in the toolkit, while the age of the HVAC system helps determine if upgrades might be needed soon. Similar to lighting, CVTs were also asked about smart thermostat controls as that is easier than replacing HVAC equipment and can still reduce energy consumption. This section also asked what savings CVTs have seen that completed upgrades to, again, give a better understanding to other CVTs considering upgrades.

The final portion of the equipment section asked for information on any other smart controls the building might have and if the building has EVs charging opportunities on site. If there are other smart controls in place, understanding what they are and what they do is important for developing plans to improve a building. Asking about EV charging provides further context for what infrastructure already exists at a building, helping to inform the relevance of future suggestions that might be made (like adopting EVs).

All Buildings

The final section of the survey was designed to address general information related to the CVT and all of its buildings. The first question here was to determine the total number of buildings that the CVT has, their age, their square footage, and the primary use. With this information, we would gain a better understanding of how much work each CVT might need to do in order to improve overall energy efficiency of their operations.

The next question was asking if the CVT had any payback period requirements for efficiency projects and what those payback requirements were. If we found that many CVTs had strict payback requirements, we could then adjust our recommendations to be dominated by faster payback period improvements, regardless of their emissions reduction potential. Otherwise, we could include a wider variety of improvements that have longer payback times in addition to those with shorter payback periods.

The final question of this section was asking if the CVT had specific goals regarding energy efficiency and if there was a specific type of support they would be interested in for improving energy efficiency. These included free energy assessments, free building benchmarking services, on-site solar technical assistance, procurement of off-site renewable energy, and building energy efficiency grant support. Of all the questions, these gave our team the most insight into how we could make our toolkit most effective. Not only this, but it would also give us some valuable information to bring back to our client so they could determine what resources Ann Arbor/Washtenaw 2030 should invest in.

Interviews

After CVT officials completed their surveys, the team conducted follow up interviews with 8 of the 17 CVTs that completed the survey. The objective of holding interviews was to connect directly with CVTs to give the space for more organic, nuanced responses beyond filling out the survey. In addition, this gave the opportunity to get more detailed information about any barriers CVTs face to doing energy efficiency work, be that in collecting data about their buildings, making upgrades, funding, or staffing. Interview questions were grouped into the same categories as survey questions: buildings, equipment, and upgrades. In addition, the team asked about staff capacity CVTs have for doing energy efficiency work, whether that is people focused on sustainability and efficiency, specific staff expertise, etc. A full list of the interview questions can be found in Appendix D - General Interview Questions.

Results

We contacted 27 total CVTs (five cities, two villages, and twenty townships) asking for surveys to be filled out and then a follow up interview. Out of these 27, 10 (37%) did not respond, 9 (33%) completed only the survey, and 8 (30%) completed both the survey and an interview.

The results sorted by either city, village, or township are listed below, with additional contextual information of population, median income, budget, number of employees, and general political affiliations in the 2020 election cycle included for clarity.

City (5 total)

- Type of Response
  - 40% (2) did not respond
  - 20% (1) completed only the survey
  - 40% (2) completed both the survey and an interview
- City Averages
  - Population: 9,086
  - Median Household Income: $70,384
  - Annual Municipal Budget: $11,240,000
  - Number of Municipal Employees: 46
- Other Contextual Information
  - All Washtenaw County cities voted Democrat in the 2020 Presidential Election

Village (2 total)

- Type of Response
  - 50% (1) did not respond
  - 50% (1) completed only the survey
  - 0% (0) completed both the survey and an interview
- Village Averages
  - Population: 1,237
  - Median Household Income: $160,976
  - Annual Municipal Budget: $1,150,000
  - Number of Municipal Employees: 7
- Other Contextual Information
  - All Washtenaw County villages voted Democrat in the 2020 Presidential Election

Township (20 total)

- Type of Response
  - 35% (7) did not respond
  - 35% (7) completed only the survey
  - 30% (6) completed both the survey and an interview
- Township Averages
  - Population: 10,239
  - Median Household Income: $102,537
  - Annual Municipal Budget: $5,439,845
  - Number of Municipal Employees: 23
- Other Contextual Information
  - Slightly over half of townships in Washtenaw County voted Democrat in the 2020 Presidential Election.

Survey

The following describes the answers received from CVTs on the survey. To see the complete list of the survey questions, refer to Appendix C - General Survey Questions.

General

Resilient Washtenaw and Renewables

Of the 17 CVTs who filled out the survey, only the City of Ypsilanti had any onsite renewable energy production. None of the CVTs reported purchasing additional renewables. Nine of the CVTs indicated being familiar with the Resilient Washtenaw Plan and its provisions.

Building Portfolio Information, Planned Future Work, and Renewables

The number of buildings CVTs own and operate range from one to fourteen, with the most common number being two buildings. Most CVTs do not have access to a list of all their occupied buildings with ages, square footage, and uses, but many have at least some of this information. Six CVTs reported having major work planned for one or more of their municipal buildings in the near future. This major work includes building remodels, additions, renovations, and tear-downs.

Energy and Water Tracking and Auditing

Three CVTs have had their primary administrative building evaluated for energy use, one CVT had water evaluated in their primary administrative building, and one had both energy and water evaluated for a total of five CVTs with resource evaluation. Similarly, only four CVTs utilize ESPM or other programs to track their energy and water use. One CVT tracks both energy and water, one CVT tracks just water, and two CVTs track just energy. One reason tracking energy could be more common than water is that many of the CVT buildings utilize private (unmetered) wells.

Vestibules

The ten CVTs reported having vestibules on their buildings. Five of these responses did come with the caveat that not all entrances had vestibule-style entrances or that not every building within a given municipality had a vestibule.

Equipment

Insulation

CVTs know very little about the amount, type, and age of insulation used in their buildings. There appears to be significant variation in these factors between buildings, and few recent upgrades have been made. Although some CVTs have installed foil, foam, and radiant barriers, the most common type of insulation used is fiberglass.

Windows and Doors

Similar to insulation, the amount, type, and ages of windows vary considerably between different buildings. Five CVTs have made recent upgrades to their windows. 13 CVTs reported that at least some of their windows are double panes, and range in age from 5 to 73 years old. Four CVTs struggle with regular draftiness, while only one reported frost inside their windows, indicating that the seals are intact.

Lighting

Although CVTs generally do not know much about the ages and frequency of service for their lighting, eight of them have made recent upgrades to LED and CFL light bulbs. Nine CVTs have smart controls (like motion sensors or daylight controls) installed in their primary administrative building, but six of them reported they are unsure about how to determine the energy or cost savings from these changes.

HVAC

CVTs know a substantial amount about their HVAC systems. These systems range in age from 2 to 45 years, with most being serviced quarterly or annually. One CVT was able to install a heat pump system in their primary administrative building, but the most common HVAC systems are boiler, forced air, and radiant. Common fuel types used include natural gas and propane. Seven CVTs have made recent HVAC upgrades and with four of them having installed smart controls (like smart thermostats or building automation systems). Similarly to smart controls for lighting, CVTs said they are unsure about how to determine the energy or cost savings from these changes.

Smart Controls and EV Charging

Beyond the smart controls mentioned for Lighting and HVAC, there were few examples of other smart controls in place for efficiency. One CVT has motion-activated faucets and another has timers and light sensors for exterior lighting. Regarding EV charging, only one, Pittsfield Township, reported having any installed with a total of four charging stations.

Energy Efficiency Facilitation

Number of Buildings and Payback Requirements

Nine of the CVTs who responded reported having at least one additional building beyond their primary administrative building with four CVTs having more than two total buildings. Of all the CVTs that responded, none of them said that they had any specific payback requirements that needed to be met for any cost saving measures.

Specific Goals Regarding Energy Efficiency

Three CVTs did express some specific goals they had for energy efficiency or related topics. One planned to investigate the potential for EVs for their fleet (excluding plow vehicles). Scio Township said they intended to participate in the 2030 initiative, likely referring to the 2030 District goals. Another shared a link to their energy plan and another said they are in the process of creating a climate resilience plan.

Building Energy Efficiency Support Interests

Nine CVTs said they were interested in free energy assessments or audits, eight were interested in building energy efficiency grant support, four were interested in free building benchmarking services and on-site solar technical assistance, three were interested in procurement of off-site renewable energy, and one was interested in building replacement funding support.

Interviews

While several CVTs are aware of the kinds of sustainability improvements that are possible in their buildings, and often want to make them, there are a number of significant challenges preventing them from doing so.

Lack of Capacity

CVTs have many areas of governance to manage with very few employees. In many of these CVTs, there is no one dedicated to sustainability work. In addition, many have no formalized practice of considering sustainability issues. Due to the limited resources of these CVTs, if it isn't broken, it isn't examined or improved.

Institutional Knowledge Loss

CVTs are generally confident in the accuracy of the information they have on the ages and characteristics of their buildings and equipment. But often only one or a few employees know these details and do not write them down for future employees. Based on our interviews, it appears there are significant concerns about building knowledge being completely lost when these cornerstone employees leave or retire after working with a CVT for many years.

Older Buildings

An amalgamation of upgrades over the years makes it difficult to keep track of the current status of buildings. This impedes managers' ability to know what could or should be upgraded. Lost records or lost institutional knowledge can mean that this information may not exist in written form. Furthermore, bringing older buildings up to code is prohibitively expensive, especially for CVTs working with limited budgets. Some CVTs are also considering new buildings in the near future, so they don't want to invest in current buildings until they are certain that they will not be wasting taxpayer dollars.

Funding

A common theme among many of the interviews was that going into debt to pay for building upgrades is an unwanted burden for taxpayers. CVTs cannot justify this expense to their constituents. Furthermore, while officials know that grants and other funding exists, it can be difficult to find funding for the specific situations many CVTs face. For example, a CVT may be too wealthy for many funding opportunities, but not wealthy enough to afford upgrades on their own. Or, a CVT may have buildings that are too old to qualify for grants, as many grants focus on buildings constructed in the 1990s or later. However, some CVTs have been able to acquire funding for energy efficient upgrades in their buildings through Ann Arbor/Washtenaw 2030 District, local grants, state grants, and provisions in the American Rescue Plan Act (ARPA).

Challenges with Technology

Although CVTs expressed interest in tracking energy and water use in their buildings, many struggled with using the ENERGY STAR Portfolio Manager platform. The tool will only work correctly if building information is properly synced with local utility accounts, with small mistakes leading to inaccurate or missing data. This makes it difficult for many CVTs to track energy and cost savings from energy efficient upgrades. Some CVTs have also struggled with utilizing smart controls like smart thermostats and motion sensors, reverting to less efficient but more reliable systems. Although many CVTs believed that incorporating these technologies into their buildings would be beneficial, most felt that they lacked the support necessary to address any related installation or maintenance issues.

Analysis /Discussion

It should be noted that the data represents a portion of CVTs in Washtenaw County (27 CVTs contacted, 17 survey responses, 8 interviews), which may suggest some self-selection bias in the results. CVTs more interested in energy efficiency may have been more likely to fill out the survey and agree to an interview.

There is also significant variability in size, capacity, and political alignment within the study population, meaning that it is not always clear which factors are the most influential in determining interest in energy efficiency practices. Annual CVT budgets range from under $600,000 to $42 million, and staffing capacity ranges from three to nearly 100. Median household incomes in these CVTs also vary widely, from $40,000 to $250,000 per year. We found that CVTs with larger average annual budgets and more employees were more likely to give interviews. These results were determined by comparing the average annual budget, and average number of employees across all CVTs of their respective type against the response rate of the survey and interview. These results are summarized in Table 1 below:

	Total Number	**Average Annual Budget ($)**	**Average Number of Employees**	**Response Rate to Survey (%)**	**Response Rate to Interview (%)**
City	5	11,240,000	46	40	40
Village	2	1,150,000	7	50	0
Township	20	5,439,845	23	35	30

Table 1: Summary of Responses Compared to Average CVT Budget and Number of Employees

Within these constraints, the survey responses show that cities were most likely to agree to an interview, but the small number of cities in the county should be acknowledged. As compared to Washtenaw County villages and townships, cities have the lowest average median household incomes, highest average annual budgets, highest average number of employees. This capacity difference suggests that cities may have more capacity to respond to queries about energy efficiency because they have staff that can spend time on a slightly lower priority project.

As compared to Washtenaw County cities and townships, villages have the lowest average populations, highest average median household incomes, lowest average annual budgets, and lowest average number of employees. There are two villages in Washtenaw County, and one responded to the survey. It is possible that the lack of capacity within village governments reduces their ability to address issues like building energy efficiency in favor of managing higher priority duties.

Townships have the highest average populations and were most likely to finish the survey, however, there are also significantly more townships in Washtenaw County than cities or villages. When only looking at townships, those with larger annual budgets and a greater number of employees were more likely to finish the survey and agree to an interview, suggesting that capacity is an important factor in uptake and interest in energy efficiency practices.

As discussed above, politics often influence energy efficiency work in communities. 66.67% of Washtenaw County CVTs voted Democrat in the 2020 Presidential Election, while 33.33% voted Republican. CVTs that voted Republican in the 2020 Presidential Election were less likely to give interviews, suggesting that the political appetite for energy efficiency may align with political views on climate change. CVTs that voted Democrat in the 2020 Presidential Election were more likely to give interviews. The Democrat CVTs who gave interviews also had lower median incomes, larger annual budgets, and greater numbers of employees. It is possible that these capacity differences matter more than political leaning. It is not clear that political affiliation is a definitive factor in interest in energy efficiency.

Themes common across all interviews and surveys were a lack of capacity to analyze cost-effective and appropriate energy efficiency upgrades, and a perceived lack of funding. We determined that a toolkit providing a roadmap for improving energy efficiency within municipal buildings, including a funding and resources section, would best serve CVTs in Washtenaw County. This would allow the Ann Arbor/Washtenaw 2030 District to provide outreach and connection to all CVTs regardless of how much (or little) energy efficiency work they had previously completed. A more in-depth discussion of the toolkit and its components continues below.

Toolkit

Overview

The toolkit was developed by reviewing existing energy efficiency toolkits, working alongside the Ann Arbor/Washtenaw 2030 District and community input received during phase one. After analyzing the needs of the CVTs that were expressed during phase one, we researched various energy efficiency toolkits that exist to inform the development of our toolkit. The sections of the toolkit were also researched extensively to ensure the most recent, relevant, and best practices in energy efficiency were used. The goals of our toolkit were threefold:

1) Present relevant and recent energy efficiency data and upgrade information
2) Easy to read and understand by municipal staff at any level
3) Directly address the needs expressed by CVTs

Existing Energy Efficiency Toolkits

Several energy efficiency toolkits exist, some of which specifically address municipal buildings. The team read through each of these toolkits to look for potential inclusion in our toolkit, clever ways to present or display information, and overall formatting and structure. The first toolkit was “A Guide to Energy Efficiency Planning for Rural Michigan Communities” developed by the Western Upper Peninsula and Planning and Development Region. (Barnett & Yu, n.d.) This toolkit introduces the topic of community

energy planning and outlines how to create a community leadership team and the importance of identifying and engaging stakeholders. Then, it moves into establishing an energy vision, creating a municipal energy profile, and developing an energy action plan. The toolkit then concludes with financing municipal energy investments. The team liked how the toolkit highlighted financing options for energy efficiency work, discussed the importance of energy audits, and provided a screening matrix to help figure out where to start with energy efficiency work. The team also felt that this toolkit was too wordy and wanted to be sure to avoid this when writing our toolkit.

The next toolkit was the "Energy Efficiency Measure Toolkits" from the National Center for Appropriate Technology. (National Center for Appropriate Technology, n.d.) This toolkit was sorted by system type (HVAC, building envelope, etc.). Each system had its own toolkit that was set up like a website. The team liked that this information was easier to read and more approachable and felt it provided a good balance of relevant information while still maintaining academic integrity. They also offered very simple comparisons between products alongside energy and monetary savings associated with each product that the team thought was an intuitive way of displaying this information. The team did not like the website format and felt that all information should be accessible in a single document.

ENERGY STAR, the program run by the U.S. Environmental Protection Agency and U.S. Department of Energy that promotes energy efficiency also has their "Building Upgrade Manual," which outlines a comprehensive guide to energy efficiency upgrades (Energy Star, 2008). This manual is not specifically designed for municipalities. It is broken down into chapters that address ENERGY STAR's five-stage approach, leading you through the entire planning, financing, and implementation process of energy efficiency. A few things that we liked about this manual were that it was very interactive and designed to change depending on the specific building. They also had good graphics that were easy to follow along with while still providing useful content. This manual taught us that we wanted to make sure that our priorities are organized by importance to ensure the most accessible steps are first so no one gets immediately turned away.

Lastly, the "Public Building Portfolio Management Implementation Guide" supported by the Northwest Energy Efficiency Alliance (NEEA) and the DOE Buildings Technology Office, "outlines a process to help staff engage stakeholders, set tangible goals, target opportunities, and develop a plan to achieve deep and ongoing energy reductions in public building portfolios" (New Buildings Institute, Inc, 2018). This framework is applicable to any city, county, regional government, state agency, or school district interested in saving on operating costs, reducing emissions, and leading by example in their community. This toolkit was very informative and the team liked the overall layout and structure and thought this could serve as a model for the desired aesthetic and feel of our toolkit. One thing the team wanted to address after reviewing this toolkit was to ensure we did not just provide links but also how to use those links or how they can be used. Dead links were also something the team wanted to avoid.

Overall, reviewing existing toolkits helped to determine what should and should not be included. Based on our research we wanted to include the following in our toolkit: keep words at a minimum and focus on visuals, emphasize the importance of energy audits, direct comparison between products, organized as a process, and easily displayed cost saving potential. This review helped us to understand how we could present information, visual layouts that were successful, and offered a good starting point in the creation of the toolkit.

Toolkit Development

Development of the toolkit began with establishing an overall goal and title. The goal of the toolkit was to assist Washtenaw County municipalities implement energy efficiency into their municipality plan with ease by providing resources, funding sources, connections to other municipalities and local initiatives within the county. The title that was decided upon was *Creating a more Resilient Washtenaw: Reducing energy use, costs, and greenhouse gas emissions in municipalities' buildings, A toolkit for local governments*. In accordance with toolkits the team reviewed, the toolkit should be easy to read, maintain academic integrity, and contain visual representations in addition to text. It needed to directly address the needs of the community expressed in the surveys and interviews, specifically the lack of capacity to implement this work, previous challenges with technology, relevant funding sources, institutional knowledge loss, and the added challenge of older buildings. The toolkit was divided into these sections:

- Introduction
- Baseline and Tracking
- Energy Audit
- Improve Efficiency
- Decarbonize Sources
- Funding and Resource Assistance

and contained a master graphic that served as the backbone of the toolkit, shown below as Figure 5. The graphic shares a story of progress through the energy transition and highlights how to measure and track current energy use (baseline and tracking), the importance of an energy audit in the transition to energy efficiency, how to improve efficiency in building operations and equipment, electrify equipment and switch to renewable energy (decarbonize sources), and funding and resource assistance to help throughout each of the phases.

Figure 5. Graphic used as guide through the toolkit.

After a first draft was created, the team met with CVTs to ensure the final product could be easily used and understood by its users. The team met with members from the Washtenaw County government: Jason Fee (Director, Facilities Management), Mary Braun (Energy and Sustainability Coordinator), and Nicholas Woods (Facilities Manager). They also met with Ypsilanti Townships' John Hines (Municipal Services Director), Laurie Lutomski (Community Resource Coordinator), and Michael Saranen (Hydro Operations Manager). These meetings were designed to get their feedback on the general layout, usefulness, and content of the toolkit.

The interview with representatives from Washtenaw County provided feedback under the "Improve Efficiency" section to HVAC and building envelope. They suggested additions and edits to current information based on what they have seen work or not work in their buildings. They also suggested edits to the funding and resource assistance section to highlight resources and connections that can be made county-wide (such as a database, specific contacts of people who applied to the grant previously, and connections to other municipalities who are doing similar work) to make applying for funding and grant

writing easier county-wide. They liked the current organization of the toolkit by equipment type (HVAC, lighting, etc.) and the entire section dedicated to funding and resources.

Lastly, the interview with Ypsilanti Township focused on the funding and resource section as they thought this could be an area that CVTs could benefit the most from. They suggested a list of contacts who have already done some energy efficiency upgrades to serve as a contact point for other CVTs to begin this work and thought grant-writing pitch and letters of support templates or tutorials would be helpful. Meetings with these communities emphasized the importance of the "funding and resource assistance" section as imperative to helping CVTs implement energy efficiency work. It also highlighted relevant sections that were missing such as discussing peak rate charges and a thermal imaging camera as a useful tool.

After meeting with CVTs, the team made the appropriate edits and sent a second draft to the project clients and advisor for a final feedback period before sharing the toolkit with all CVTs. Their feedback included advice on restructuring sections for aiding users in understanding which actions they should undertake first. It also included editing some sections to focus the content more clearly for users, as well as suggesting places where clearer language would benefit users. This feedback was important to ensuring the toolkit was as user-friendly and clear as possible. The team integrated their feedback to create the final version of the toolkit which can be found in Appendix E - Toolkit.

Webinar

Overview

At the request of our clients, the capstone team conducted a webinar titled "Creating a More Resilient Washtenaw: Reducing Energy Use, Costs, and Greenhouse Gas Emissions in Municipalities' Buildings" for Washtenaw County CVTs from 12:00-1:00 p.m. on Thursday April 11th, 2024. The purpose of this webinar was to inform CVTs about the content of the team's toolkit, municipal building energy efficiency resources from Michigan Green Communities and Ann Arbor/Washtenaw 2030 District, and present a case study on how Scio Township has benefitted from utilizing these resources to improve the energy efficiency of their own municipal buildings.

Outreach

The capstone team created an invitation message and graphic to email to all CVT contacts. Andrew DeLeeuw from Washtenaw County sent out the first set of email invitations to these contacts on March 21st, 2024, and our team followed up with another set of email invitations on March 27th, 2024 to their survey and interview contacts, introducing Lissa Spitz as the primary contact for municipal energy efficiency at the Ann Arbor/Washtenaw 2030 District going forward. Jan Culbertson sent out the final set of email invitations on April 1st, 2024.

Summary

The webinar included an overview of the toolkit by the SEAS Resilient Washtenaw Team, a presentation by Danielle Beard from Michigan Green Communities on the Michigan Green Communities Challenge,

an introduction to the Ann Arbor/Washtenaw 2030 District by Lissa Spitz, and a case study presentation on Scio Township's energy efficiency work by Jan Culbertson. The full agenda from the webinar can be found in Appendix F - Webinar Agenda. Slides from the presentations, as well as a link to the webinar recording, can be found in Appendix G - Webinar Slides and Recording. A total of 26 attendees from 20 different organizations, including 10 CVTs, were present at the webinar.

Conclusions

We began this project by asking how CVTs could best improve their building energy efficiency with their limited resources. Through surveys and interviews, we found that CVTs were constrained by information access, organizational capacity, and funding. To help address these challenges, we set four goals with this project. First, to assist Washtenaw County in achieving its energy goals. The toolkit and webinar both provide resources for CVTs to improve the energy efficiency of their municipal buildings, which in turn helps the county achieve its energy goals. Our second goal was to ensure that our final deliverables were built around integrating community input. The toolkit was designed from the very beginning to address the needs of municipal governments, based directly on the feedback we received through surveys and interviews. The webinar was built off of content from the toolkit, meaning it also centers the needs we found through community input. We met our next goal, to assist municipal governments in integrating energy efficiency into their planning, through the topics we chose to center in the toolkit and webinar, all of which were directly or very closely - in the case of equipment electrification and renewable energy - related to energy efficiency. Our fourth goal was to foster collaboration between municipalities and local organizations, which we achieved in both the toolkit and the webinar. The toolkit has a section listing resources available to CVTs to assist in their energy efficiency work, which includes a number of county- and state-wide organizations. Similarly, the webinar featured presentations from Michigan Green Communities and the Ann Arbor/Washtenaw 2030 District, two of these organizations. We hope that the toolkit's funding and resource section, along with the continued outreach, technical assistance, and expertise of the Ann Arbor/Washtenaw 2030 District will assist CVTs in overcoming these barriers, bringing all of Washtenaw County closer to its emissions reductions goals.

References

A2Zero. (2020, April). *Ann Arbor's Living Carbon Neutrality Plan*. The City of Ann Arbor. Retrieved March 28, 2024, from https://www.a2gov.org/departments/sustainability/Documents/A2Zero%20Climate%20Action%20Plan%20_4.0.pdf

Ann Arbor Charter Township Climate Action Plan Team. (2023, November 20). *Ann Arbor Township Climate Action Plan*. Ann Arbor Charter Township. Retrieved March 28, 2024, from https://aatwp.org/wp-content/uploads/2023/11/Ann-Arbor-Charter-Township-Final-BOT-DRAFT-Climate-Action-Plan-11202023-.pdf

Ann Arbor/Washtenaw 2030 District. (2024). *Ann Arbor/Washtenaw 2030 District*. 2030 Districts Network. Retrieved March 28, 2024, from https://2030districts.org/annarbor/

Antunes, J. J. M., Neves, J. C., Elmor, L. R. C., De Araujo, M. F. R., Wanke, P. F., & Tan, Y. (2023, January). A new perspective on the U.S. energy efficiency: The political context. *Technological Forecasting and Social Change*, *186*. https://doi.org/10.1016/j.techfore.2022.122093

Baniassadi, A., Heusinger, J., Gonzalez, P. I., Weber, S., & Samuelson, H. W. (2021, August 21). Co-benefits of energy efficiency in residential buildings. *Energy*, *238*. https://www.sciencedirect.com/science/article/pii/S0360544221020168

Barnett, B., & Yu, A. (n.d.). *A Guide to Energy Efficiency Planning for Rural Michigan Communites*. Western U.P. Planning & Development Region. Retrieved March 28, 2024, from https://static1.squarespace.com/static/5f5784a77a79a6713d7c703d/t/603936d68d1a8715d6e7afb7/1614362341750/EnergyPlanGuideWUPPDR_FinalDraft.pdf

Brandoni, C., & Polonara, F. (2012, December). The role of municipal energy planning in the regional energy-planning process. *Energy*, *48*(1), 323-338. https://doi.org/10.1016/j.energy.2012.06.061

City of Ann Arbor. (2023). *Energy and Water Benchmarking and Disclosure Ordinance*. The City of Ann Arbor. Retrieved March 28, 2024, from

https://www.a2gov.org/departments/sustainability/Sustainability-Me/Businesses/Pages/Commercial-Benchmarking.aspx

Cubit Planning, Inc. (2022). *Michigan Cities by Population*. Michigan Demographics. Retrieved March 28, 2024, from https://www.michigan-demographics.com/cities_by_population

Department of Environment, Great Lakes, and Energy. (n.d.). *Catalyst Communities*. State of Michigan Department of Environment, Great Lakes, and Energy. Retrieved March 29, 2024, from https://www.michigan.gov/egle/outreach/catalyst-communities

Doris, E., Cochran, J., & Vorum, M. (2009, December). *Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government*. NREL: Transforming Energy. Retrieved March 29, 2024, from https://www.nrel.gov/docs/fy10osti/46532.pdf

DTE Energy. (2023, July 21). *2022 DTE Integrated Resource Plan (IRP)*. DTE Energy--Net Zero Carbon Emissions by 2050. Retrieved April 17, 2024, from https://dtecleanenergy.com/downloads/IRP_One_pager_2023.pdf

DTE Energy. (2024). *Michigan's Energy Future*. DTE Energy--Net Zero Carbon Emissions by 2050. Retrieved April 17, 2024, from https://dtecleanenergy.com/

eGRID, Environmental Protection Agency. (2024, January 29). *eGRID Summary Tables 2022*. eGRID Summary Tables 2022. Retrieved April 1, 2024, from https://www.epa.gov/system/files/documents/2024-01/egrid2022_summary_tables.pdf

Eis, K. (2022, April 20). Ann Arbor 2030 District Tenant Engagement. *Deep Blue*. https://dx.doi.org/10.7302/4354

ENERGY STAR, U.S. Environmental Protection Agency. (2013, June 21). *ENERGY STAR Guidelines for Energy Management*. ENERGY STAR. Retrieved March 29, 2024, from https://www.energystar.gov/sites/default/files/buildings/tools/Guidelines%20for%20Energy%20Management%206_2013.pdf

ENERGY STAR, U.S. Environmental Protection Agency. (2008, April 21). *Energy Star Building Upgrade Manual*. ENERGY STAR. Retrieved March 29, 2024, from https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_Full.pdf

Esri Demographics Team. (2022, November 28). *Justice40 Tacts Map May 2022*. Justice40 Tracts Map May 2022 - Overview. Retrieved April 1, 2024, from https://www.arcgis.com/home/item.html?id=bdac3e391cd04d2396983fc67c23bf1c

Fields, T., Prichard, J., & Akash, S. (2021, April). Transportation Greenhouse Gas Emissions Baseline and Associated Policy Recommendations for the Ann Arbor 2030 District. https://dx.doi.org/10.7302/1044

Gupta, J., & Chakraborty, M. (2021). Energy Efficiency in Buildings. *Sustainable Fuel Technologies Handbook*, 457-480. https://doi.org/10.1016/B978-0-12-822989-7.00016-0

Guzman, G., & Kollar, M. (2023, September 12). *Income in the United States: 2022*. Census Bureau. Retrieved March 28, 2024, from https://www.census.gov/library/publications/2023/demo/p60-279.html

Johnson-Lane, K. (2020, August). Determining the Water Baseline for the Ann Arbor 2030 District. *Deep Blue*. https://dx.doi.org/10.7302/828

Leffel, B., Lyon, T. P., & Newell, J. P. (2024, March). Filling the climate governance gap: Do corporate decarbonization initiatives matter as much as state and local government policy? *Energy Research & Social Science*, *109*. https://doi.org/10.1016/j.erss.2023.103376

Michigan Green Communities. (n.d.). *About Michigan Green Communities*. Michigan Green Communities. Retrieved March 29, 2024, from https://migreencommunities.com/about/

Michigan Public Service Commission. (n.d.). *Electricity - Electric Utility Service Area Map*. Michigan Public Service Commission. Retrieved March 28, 2024, from https://www.michigan.gov/mpsc/consumer/electricity/electric-utility-service-area-map

Michigan Suburbs Alliance. (2012, July). *The City of Ypsilanti Climate Action Plan*. City of Ypsilanti. Retrieved March 28, 2024, from https://cityofypsilanti.com/DocumentCenter/View/309/Climate-Action-Plan-PDF

National Center for Appropriate Technology. (n.d.). *Energy Toolkit – National Center for Appropriate Technology*. National Center for Appropriate Technology. Retrieved March 29, 2024, from https://www.ncat.org/energy/energy-toolkit/

New Buildings Institute, Inc. (2018). *Public Buildings Portfolio Management Implementation Guide*. New Buildings Institute. Retrieved March 29, 2024, from https://newbuildings.org/wp-content/uploads/2019/06/NBI_PublicBuildingsPortfolioManagementGuide2019.pdf

Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy. (n.d.). *Energy Efficiency: Buildings and Industry*. Department of Energy. Retrieved March 29, 2024, from https://www.energy.gov/eere/energy-efficiency-buildings-and-industry

Office of Energy Efficiency & Renewable Energy, U.S. Department of Energy. (2021, May). *Achieving Energy Savings in Small- and Medium-Sized Public Facilities: A Strategic Approach to Prioritizing and Financing*. Department of Energy. Retrieved March 28, 2024, from https://www.energy.gov/scep/slsc/articles/achieving-energy-savings-small-and-medium-sized-public-facilities-strategic

Office of Energy Justice and Equity, U.S. Department of Energy. (n.d.). *Justice40 Initiative*. Department of Energy Office of Energy Justice and Equity. Retrieved March 30, 2024, from https://www.energy.gov/justice/justice40-initiative

Poggi, F., Firmino, A., & Amado, M. (2017, August). Assessing energy performances: A step toward energy efficiency at the municipal level. *Sustainable Cities and Society*, *33*, 57-69. https://doi.org/10.1016/j.scs.2017.05.014

Scio Township Environmental Sustainability Task Force. (2023, October 1). *Scio Township Environmental Sustainability & Climate Action Plan*. Scio Township. Retrieved March 28, 2024, from https://www.sciotownship.org/home/showpublisheddocument/2664/638326206699570000

South Bend Green Ribbon Commission Energy Group. (2015, December 7). *Best Practices in Municipal Energy Management and Efficiency*. Indiana University South Bend College of Liberal Arts and Sciences. Retrieved March 28, 2024, from https://clas.iusb.edu/pdf/sustainability-studies/white-papers/SB%20Energy%20Management%20White%20Paper_Final%2012-7-15.pdf

Southeast Michigan Council of Governments. (2024). *About SEMCOG*. SEMCOG | Southeast Michigan Council of Governments. Retrieved March 29, 2024, from https://www.semcog.org/about-semcog

Southeast Michigan Council of Governments. (2024). *SEMCOG Membership*. SEMCOG | Southeast Michigan Council of Governments. Retrieved March 30, 2024, from https://maps.semcog.org/membership/

Southeast Michigan Council of Governments. (2024, February). *Priority Climate Action Plan*. Southeast Michigan Healthy Climate Plan. Retrieved March 29, 2024, from http://southeastmichiganpriorityclimateactionplan_january2024.pdf

2030 Districts Network. (2023). *About Us*. 2030 Districts Network. Retrieved March 28, 2024, from https://2030districts.org/about/

United States Census Bureau. (2023, July 1). *United States Census Bureau QuickFacts*. U.S. Census Bureau QuickFacts: United States. Retrieved March 30, 2024, from https://www.census.gov/quickfacts/

United States Census Bureau. (2023, July 1). *Washtenaw County, Michigan*. Census Bureau. Retrieved March 28, 2024, from https://www.census.gov/quickfacts/washtenawcountymichigan

United States Environmental Protection Agency. (2011). *Energy Efficiency in Local Government Operations*. United States Environmental Protection Agency. Retrieved March 29, 2024, from https://www.epa.gov/sites/default/files/2017-06/documents/ee_municipal_operations.pdf

U.S. Environmental Protection Agency. (2018, July 12). *The Multiple Benefits of Energy Efficiency and Renewable Energy, Part One*. Environmental Protection Agency. Retrieved April 18, 2024, from https://www.epa.gov/sites/default/files/2018-07/documents/mbg_1_multiplebenefits.pdf

United States Environmental Protection Agency State and Local Climate and Energy Program. (n.d.). *Rules of Thumb for Energy Efficiency in Buildings*. United States Environmental Protection Agency State and Local Climate and Energy Program. Retrieved March 28, 2024, from https://www.epa.gov/sites/default/files/2016-03/documents/table_rules_of_thumb.pdf

University of Michigan Economic Growth Institute. (2018, August). *County Specific Data: Washtenaw County Economic Graphs*. Economic Growth Institute. Retrieved March 28, 2024, from https://economicgrowth.umich.edu/wp-content/uploads/2016/08/washtenaw-county-profile.pdf

University of Michigan School for Environment and Sustainability. (2023). *Master's Capstone Options*. University of Michigan School for Environment and Sustainability. Retrieved March 28, 2024, from https://seas.umich.edu/research-impact/student-research/masters-capstone-options

Washtenaw County. (2022, December 7). *Resilient Washtenaw*. Washtenaw County. Retrieved March 28, 2024, from https://www.washtenaw.org/DocumentCenter/View/29331/Resilient-Washtenaw---Final?bidId=

Washtenaw County. (2023). *MapWashtenaw*. Washtenaw County | MapWashtenaw. Retrieved April 4, 2024, from https://gisappsecure.ewashtenaw.org/mapwashtenaw/

Wilson, R. (2014, April 29). *The Washington Post*. https://www.washingtonpost.com/blogs/govbeat/wp/2014/04/29/how-well-educated-is-your-home-county/

Appendix A - Pilot Survey

Resilient Washtenaw - Energy Use in Municipal Buildings Survey

This survey consists of 3 sets of questions regarding the current state of your city, village, or township's municipal buildings. ***The questions only apply to municipal buildings with more intensive use (town halls, fire stations, etc.), and do not cover seasonal use buildings (park public restrooms, etc.).***

This survey is structured as followed:

1. Buildings (5 minutes, 6 total questions)
2. Equipment (10 minutes, 5 total questions)
3. Upgrades (<1 minute, 2 total questions)

There are several opportunities for you to provide short answer responses to support your answers. If you don't have the data for any of these questions, feel free to skip them.

Thank you!

1. Email *

_____

2. Are you familiar with the Resilient Washtenaw plan from the Washtenaw County Board of Commissioners?

Mark only one oval.

- ◯ Yes
- ◯ No

3. What city, village, or township are you representing?

_____

Skip to question 4

Buildings - Question 1 of 6

4. **Do you have a list of your municipal buildings with ages, square footage and uses?**

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I have some of this information

5. **If applicable, please provide additional information regarding a list of your municipal buildings.**

_____

_____

_____

_____

_____

Skip to question 6

Buildings - Question 2 of 6

6. **Do any of your municipal buildings engage in the following energy initiatives? (select all that apply)**

Check all that apply.

- ☐ On-site renewable energy production
- ☐ Renewable energy purchasing

7. **If applicable, what percentage of your municipal building operations are powered by either on-site or purchased renewable energy?**

_____

Skip to question 8

Buildings - Question 3 of 6

8. **Is there major work planned for any of your municipal buildings in the near future (ex: additions, renovations, etc.)?**

Mark only one oval.

- ◯ Yes
- ◯ No *Skip to question 10*

9. **If applicable, please elaborate on the type of work planned for your municipal buildings and which building(s) will be affected.**

_____

_____

_____

_____

_____

Skip to question 10

Buildings - Question 4 of 6

10. **Do you track the use of any of the following resources in your municipal buildings using a tracker like Energy Star Portfolio Manager? (select all that apply)**

Check all that apply.

- ☐ Water
- ☐ Energy (electric & gas)

Skip to question 11

Buildings - Question 5 of 6

11. **Have you had the efficiency evaluated (Ex: energy assessment or energy audit) for any of the following resources in your municipal buildings? (select all that apply)**

Check all that apply.

- [ ] Water
- [ ] Energy (electric & gas)

12. **If applicable, what year was your municipal buildings' water efficiency evaluated?**

_____

13. **If applicable, what year was your municipal buildings' energy efficiency evaluated?**

_____

Skip to question 14

Buildings - Question 6 of 6

14. **Do any of your municipal buildings have vestibule entries or airlocks? These are two sets of doors at entrances, pictured below.**

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Some buildings but not others

Skip to question 15

Equipment - Question 1 of 5 (Insulation)

15. **What types of insulation are used in your municipal buildings?**

_____

16. **How would you characterize the insulation status of your municipal buildings?**

Mark only one oval.

- ◯ High level of insulation
- ◯ Moderate level of insulation
- ◯ Low level of insulation
- ◯ Mixed levels of insulation
- ◯ Other: _____

17. **Have there been recent insulation upgrades made in your municipal buildings?**

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I don't know

18. **If applicable, please elaborate on *what* recent insulation upgrades were made in your municipal buildings and *when* they were done.**

_____

_____

_____

_____

_____

Skip to question 19

Equipment - Question 2 of 5 (Windows)

19. **How old, on average, are the windows in your municipal buildings?**

_____

20. **Are the windows in your municipal buildings dual pane?**

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Some are
- ◯ I don't know
- ◯ Other: _____

21. **Do you know of any windows in your municipal buildings that get frost on the inside?**

Mark only one oval.

- ◯ Yes
- ◯ No

22. **Do you know of any drafty windows in your municipal buildings?**

Mark only one oval.

- ◯ Yes
- ◯ No

23. **Have there been recent window upgrades made in your municipal buildings?**

Mark only one oval.

- Yes
- No
- I don't know

24. **If applicable, please elaborate on *what* recent window upgrades were made in your municipal buildings and *when* they were done.**

Skip to question 25

Equipment - Question 3 of 5 (Lighting)

25. **What types of lighting are used in your municipal buildings?**

26. **Have there been recent lighting upgrades made in your municipal buildings?**

Mark only one oval.

- Yes
- No
- I don't know

27. **If applicable, please elaborate on *what* recent lighting upgrades were made in your municipal buildings and *when* they were done.**

28. **Do you have any smart controls in place for lighting in your municipal buildings (ex: motion sensors, daylight controls)?**

Mark only one oval.

- Yes
- No
- I don't know

29. **If applicable, please elaborate on what smart controls are in place for lighting in your municipal buildings.**

30. **If applicable, please elaborate on how monthly energy costs or use in your municipal buildings has changed after installing lighting upgrades and/or smart controls.**

_____

Skip to question 31

Equipment - Question 4 of 5 (HVAC)

31. **What types of HVAC systems are used in your municipal buildings?**

_____

32. **How old, on average, are HVAC systems in your municipal buildings?**

_____

33. **How frequently are HVAC systems in your municipal buildings serviced?**

_____

34. **Have there been recent HVAC system upgrades made in your municipal buildings?**

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ I don't know

35. **If applicable, please elaborate on *what* recent HVAC upgrades were made in your municipal buildings and *when* they were done.**

36. **Do you have any smart controls in place for HVAC systems in your municipal buildings (ex: smart thermostat or building automation system (BAS))?**

Mark only one oval.

- Yes
- No
- I don't know

37. **If applicable, please elaborate on what smart controls are in place for HVAC systems in your municipal buildings.**

38. **If applicable, please elaborate on how monthly energy costs or use in your municipal buildings has changed after installing HVAC upgrades and/or smart controls.**

Skip to question 39

Equipment - Question 5 of 5 (Other)

39. **Please share any other kinds of smart controls in your municipal buildings that were not previously mentioned.**

40. **How many total EV charging stations do your municipal buildings have?**

Skip to question 41

Upgrades - Question 1 of 2

41. **Are there payback period requirements for your current or future efficiency upgrades to your municipal buildings?**

Mark only one oval.

- Yes
- No
- I don't know

42. **If applicable, please share the number of years in your payback periods.**

Skip to question 43

Upgrades - Question 2 of 2

43. **Please share any energy efficiency/reduction/transition goals for your municipal buildings.**

44. **What kind of energy efficiency support would you be interested in?**

Check all that apply.

- [ ] Free energy assessments or audits
- [ ] Free building benchmarking services
- [ ] On-site solar technical assistance
- [ ] Procurement of off-site renewable energy
- [ ] Other: _____

Appendix B - Pilot Interview Questions

Survey

- How many buildings does your municipality cover and what are these buildings used for?
- Did you feel there were any questions missing that could be useful for our goals?
- Do you feel the survey was an adequate use of time that would yield helpful results for Washtenaw County or your municipality?
- Were there any questions or sections that you felt were not pertinent to our goals?
- Do you feel the information asked would be readily available in other CVTs?
- Was the information we asked for readily available for you?
- What is your confidence in this information? Any reasons you do or don't trust it to be accurate like unavailable info, staff with institutional knowledge who have left, etc?
- How could the info we provide around energy efficiency be most useful to you? Focus on a specific area? Delivered in a specific format?

Buildings

- Survey: Do you have a list of your CVT's municipal buildings with ages, square footage and uses?
    - Interview: If no, what barriers are there to getting this data?
- Survey: Is there any major/minor work planned for your CVT's municipal buildings in the near future (ex: additions, renovations, etc.)?
    - Interview: If you are already planning on doing work, are there opportunities for energy efficiency to be improved at the same time?
- Survey: Do you track the use of any of the following resources in your CVT's municipal buildings? (select all that apply)
    - Potential answers: Water, energy
    - Interview: If neither, what barriers are there to tracking this data?
    - Interview: If you track one or both, how do you do this?
- Survey: Have you had the efficiency evaluated for any of the following resources in your CVT's municipal buildings? (select all that apply)
    - Potential answers: Water, energy
    - Interview: If no, what barriers are there to getting this evaluated?
    - Interview: If you have had one or both evaluated, can you tell us about the results? Who did this evaluation?

Equipment

- Interview: What barriers have you faced in installing upgrades or smart controls?
- Interview: Are there any other benefits you've experienced from upgrades?

Upgrades

- Interview: Are you interested in any upgrades that aren't currently planned for your CVT's municipal buildings?
    - Note: this covers buildings, heating/cooling, other equipment, anything else we've talked about
    - Interview: What are the barriers to getting these upgrades?
- Interview: What funding do you have for efficiency upgrades in your CVT's municipal buildings?
    - Interview: What are your plans for getting funding in the future?

People

- Interview: What kind of capacity do you have for energy efficiency work in your CVT's municipal buildings?
    - Note: Specify that this means expertise, people, etc.
- Interview: Do you have people on your team that focus on or work with energy efficiency or sustainability?

Appendix C - General Survey Questions

Survey

- Are you familiar with the Resilient Washtenaw plan from the Washtenaw County Board of Commissioners?
- What city, village, or township are you representing?
- Are you the primary facilities contact for your city, village, or township? If not, please provide the name and email of the appropriate contact below under "Other."

General (primary administrative building)

- Does this building engage in the following energy initiatives? (select all that apply)
    - On-site renewable energy production
    - Renewable energy purchasing
- If applicable, what total percentage of this building's operations are powered by on-site and purchased renewable energy?
- Is there major work planned for this building in the near future (ex: additions, renovations, etc.)?
    - If applicable, please elaborate on the type of work planned.
- Do you track the use of any of the following resources in this building using a tracker like Energy Star Portfolio Manager? (select all that apply)
- Have you had the efficiency evaluated (Ex: energy assessment or energy audit) for any of the following resources in this building? (select all that apply)
    - Water
    - Energy (electric & gas)
    - If applicable, what year was this building's water efficiency evaluated?
    - If applicable, what year was this building's energy efficiency evaluated?
- Does this building have vestibule entries or airlocks? These are two sets of doors at entrances, pictured below.

- What are the primary uses of this building? Is there any other information you think we should know?

Equipment (insulation)

- What types of insulation is used in this building? If there are different types in walls and ceilings, please use separate response lines for each.
- How would you characterize the insulation status of this building?
- Have there been recent insulation upgrades made to this building?
    - If applicable, please elaborate on what recent insulation upgrades were made in this building and when they were done.

Equipment (windows)

- How old, on average, are the windows in this building?
- Are the windows in this building double pane?
- Are there any windows in this building that get frost on the inside?
- Are there any drafty windows in this building?
- Have there been recent window upgrades made in this building?
    - If applicable, please elaborate on what recent window upgrades were made in this building and when they were done.

Equipment (lighting)

- What types of built-in lighting are used in this building? Please exclude desk and table lamps.
- Have there been recent lighting upgrades made in this building?
    - If applicable, please elaborate on what recent lighting upgrades were made in this building and when they were done.
- Do you have any smart controls in place for lighting in this building (ex: motion sensors, daylight controls)?
    - If applicable, please elaborate on what smart controls are in place for lighting in this building.
    - If applicable, please elaborate on how monthly energy costs or use in this building have changed after installing lighting upgrades and/or smart controls.

Equipment (HVAC)

- What types of HVAC systems are used in this building?
- How old, on average, are HVAC systems in this building?
- How frequently are HVAC systems in your municipal buildings serviced?
- Have there been recent HVAC system upgrades made in this building?
    - If applicable, please elaborate on what recent HVAC upgrades were made in this building and when they were done.

- Do you have any smart controls in place for HVAC systems in this building (ex: smart thermostat or building automation system (BAS))?
    - If applicable, please elaborate on what smart controls are in place for HVAC systems in this building.
    - If applicable, please elaborate on how monthly energy costs or use in this building have changed after installing HVAC upgrades and/or smart controls.

Equipment (other)

- Please share any other kinds of smart controls in this building that were not previously mentioned.
- How many total EV charging stations does this building have?
- Is there anything else you would like us to know regarding equipment in this building?

General (all buildings)

- How many occupied buildings does your municipality own/operate besides the primary administrative building?
- Do you have a list of your occupied municipal buildings with ages, square footage and uses?
- Is there anything else you would like us to know regarding use?
- Are there payback period requirements for current or future efficiency upgrades to your city, village, or township's buildings?
- If applicable, please share the number of years in the payback periods.
- Is there anything else you would like us to know regarding upgrades?
- Please share any energy efficiency/reduction/transition goals you have for your city, village, or township's buildings.
- What kind of energy efficiency support would you be interested in for your city, village, or township's buildings?

Appendix D - General Interview Questions

Survey

- What is your confidence in this information? Any reasons you do or don't trust it to be accurate like unavailable info, staff with institutional knowledge who have left, etc?
- How could the info we provide around energy efficiency be most useful to you? Focus on a specific area? Delivered in a specific format?

Buildings

- Survey: Do you have a list of your CVT's municipal buildings with ages, square footage and uses?
    - Interview: If no, what barriers are there to getting this data?
- Survey: Is there any major/minor work planned for your CVT's municipal buildings in the near future (ex: additions, renovations, etc.)?
    - Interview: If you are already planning on doing work, are there opportunities for energy efficiency to be improved at the same time?
- Survey: Do you track the use of any of the following resources in your CVT's municipal buildings? (select all that apply)
    - Potential answers: Water, energy
    - Interview: If neither, what barriers are there to tracking this data?
    - Interview: If you track one or both, how do you do this?
- Survey: Have you had the efficiency evaluated for any of the following resources in your CVT's municipal buildings? (select all that apply)
    - Potential answers: Water, energy
    - Interview: If no, what barriers are there to getting this evaluated?
    - Interview: If you have had one or both evaluated, can you tell us about the results? Who did this evaluation?

Equipment

- Interview: What barriers have you faced in installing upgrades or smart controls?
- Interview: Are there any other benefits you've experienced from upgrades?

Upgrades

- Interview: Are you interested in any upgrades that aren't currently planned for your CVT's municipal buildings?
    - Note: this covers buildings, heating/cooling, other equipment, anything else we've talked about
    - Interview: What are the barriers to getting these upgrades?
- Interview: What funding do you have for efficiency upgrades in your CVT's municipal buildings?
    - Interview: What are your plans for getting funding in the future?

People

- Interview: What kind of capacity do you have for energy efficiency work in your CVT's municipal buildings?
    - Note: Specify that this means expertise, people, etc.
- Interview: Do you have people on your team that focus on or work with energy efficiency or sustainability?

Appendix E - Toolkit

The toolkit is included below or please contact Jan Culbertson at jculbertson@a3c.com for a copy.

Creating a more Resilient Washtenaw

Reducing energy use, costs, and greenhouse gas emissions in municipalities' buildings

A toolkit for local governments

Prepared By:

Ann Arbor/Washtenaw 2030 District

U-M SEAS Resilient Washtenaw Capstone Team

Washtenaw County

Table of Contents

Glossary

AERC Attachments Energy Rating Council

BTU British Thermal Unit (measure of energy use, usually for non-electric sources)

CCF 100 Cubic Feet (Often of Natural Gas)

COP Coefficient of Performance, ratio of heating/cooling effect to net work input, unitless.

CVT City, Village, or Township

DOE U.S. Department of Energy

EER Energy Efficiency Ratio, the average rate of cooling to the average rate of electrical energy consumed, measured in Btu/Watt-hour

EPA U.S Environmental Protection Agency

HSPF2 Heating Seasonal Performance Factor (2), an updated heating energy efficiency metric from the HSPF metric.

kWh kilowatt hour (a measure of energy use, usually for electricity)

MEAP Municipal Energy Action Plan

NFRC National Fenestration Rating Council

PPA Power Purchase Agreement

RECs Renewable Energy Certificate

When one MWh of renewable energy is generated, a tradeable credit is created, called a renewable energy certificate. This REC represents the social and environmental benefits of that electricity, the most frequently cited benefit being the emissions reductions as compared to fossil fuel generation. Not all RECs are created equal. The highest-quality RECs:

- Support projects that are "additional", meaning the project wouldn't have happened without the purchase of that REC[1]
- Are verifiable; come from a third-party certified generation facility[1]
- Come from local sources, supporting local businesses and reducing emissions within Michigan[1]

For more information on RECs, please see the **EPA's writeup**.

SEER2 Seasonal Energy Efficiency Ratio, an updated measure of cooling efficiency from SEER. It measures cooling output over a typical season over the energy it uses in Watt-hours.

UEF Uniform Efficiency Factor (measure of the efficiency of water heaters)

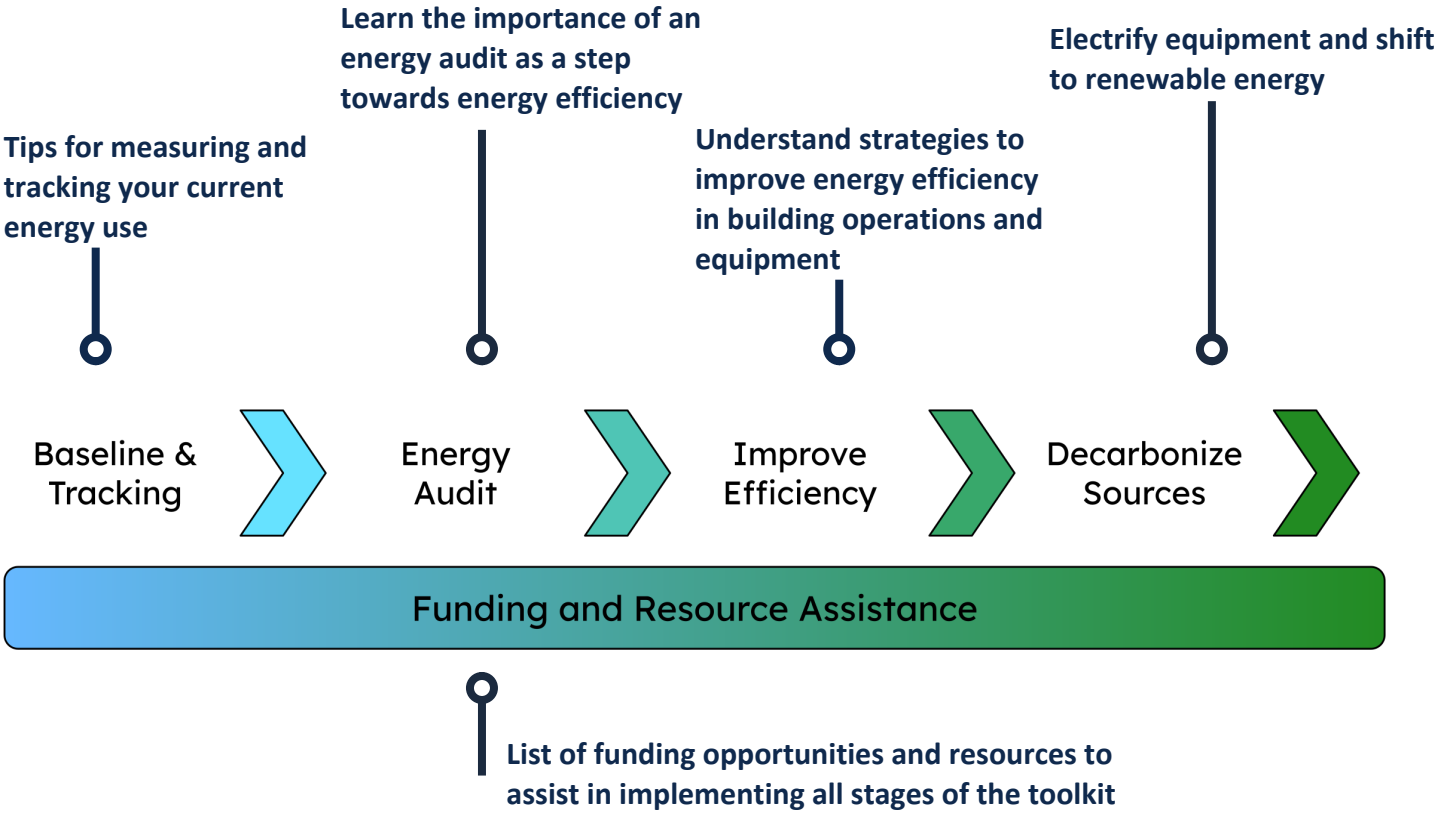
Introduction

TOOLKIT GOAL

Communities in Washtenaw County have been leaders in implementing energy efficiency projects. With the adoption of the **Resilient Washtenaw Plan**, Washtenaw County looked to learn more about common challenges, provide resources to support communities, and accelerate the pace of energy efficiency project adoption. While working with Washtenaw County officials and the **Ann Arbor/Washtenaw 2030 District**, our project team met with local government officials from CVTs across the county to learn about their experiences with energy efficiency in their municipal-owned buildings. These meetings established the foundation for this toolkit, designed to assist Washtenaw County municipalities with energy efficiency implementation. Based on the size and structure of many municipal buildings, the information is tailored for smaller buildings. For more information on larger commercial buildings, consider visiting the resources we have linked throughout the toolkit.

Toolkit Roadmap

This toolkit is split into steps in an energy efficiency journey, starting with developing an understanding of current energy use and ending with electrification and renewable energy. Each of these steps may require support, which can be found in the **Funding and Resource Assistance** section. This guide is color coded for your convenience, beginning in light blue (Baseline & Tracking) and becoming greener as you implement changes in your building(s) from efficiency improvements to decarbonizing sources.



Baseline & Tracking

TRACK ENERGY USE IN YOUR BUILDING

Tracking energy use in your building allows you to gain a more in-depth understanding of how much energy is being used, at what times energy is being used, and what activities use the most energy. It also helps you document the tangible benefits from making energy efficiency improvements in your building.

Before establishing any energy efficiency targets for your building(s), it is important to understand existing building energy use. Energy benchmarking is a quick and simple way to begin to estimate energy use intensity for a building with readily available information from gas and electric bills. This enables facilities managers to assess energy use over time. **ENERGY STAR Portfolio Manager** is a free program created by the EPA that tracks electricity and gas use for municipalities. It may be more expedient to partner with the Ann Arbor/Washtenaw 2030 District, which has experience connecting utility accounts to buildings for accurate tracking and will not charge you for this service.

ENERGY STAR Portfolio Manager offers an accurate, comprehensive, and secure energy use tracking system. Although some steps in setting up ENERGY STAR Portfolio Manager for your building can be complicated, the Ann Arbor/Washtenaw 2030 District is experienced with this system and is ready to assist you - please reach out to **jculbertson@2030Districts.org**.[2]

Information needed for each building includes:

- Year building constructed (estimate is fine)
- Building square footage
- Building uses (e.g. office, police station, fire station), and approximate square footage (or percentage of building space) associated with each use
- Account number(s) for gas & electricity
- Written consent for DTE to share this information with Ann Arbor/Washtenaw 2030 District

We feature municipal buildings from across the county throughout the report. A photo of the township hall for each city, village, and township is presented alongside the year it was founded.

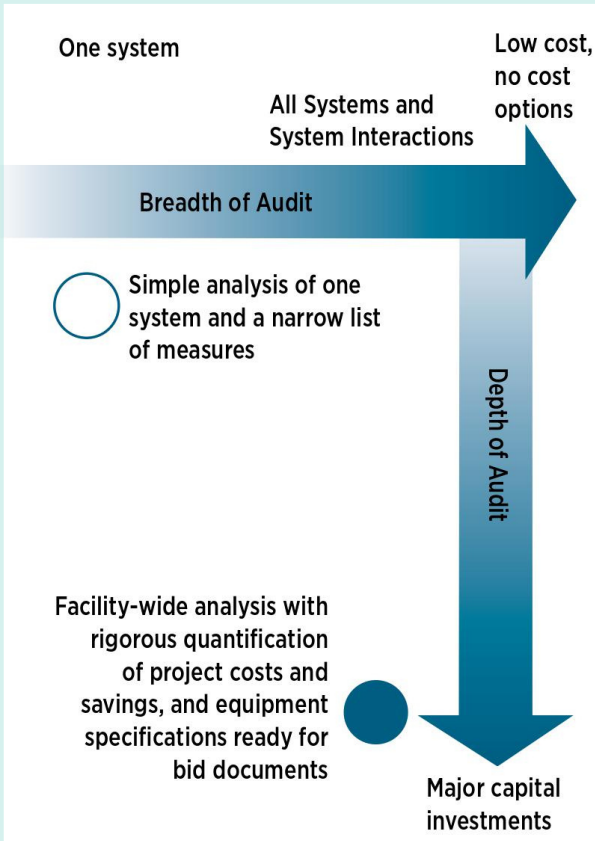
ANN ARBOR TOWNSHIP

Founded in 1827

Energy Audit

WHAT IS AN ENERGY AUDIT?

An energy audit documents a building's energy flows, including assessing the building's shell, mechanical systems, and lighting system. An audit provides information such as the amount of energy used during a given period, where inefficiencies lie, and which problem areas should be pursued.[3] By understanding and prioritizing specific areas of building efficiency, you can deploy resources effectively while achieving improvements in energy use. This video summarizes commonly asked questions. Energy audits are comprehensive assessments of a building's overall energy use. They can either be conducted by building managers or by certified professional energy auditors.



Range of potential audit breadth and depth

Source: PNLL for DoE: A Guide to Energy Audits[4]

The manager or auditor will analyze the building's previous energy bills, gather background information about the age and composition of the building, gather information from building occupants on any temperature issues, and examine the equipment and layout of every room in the building. The manager or auditor will then offer recommendations on how to best address energy efficiency-related issues in the building that help to maximize cost savings and comfort.[3] Conducting an energy audit is an excellent first step in learning more about overall energy use in your building and determining areas for improvement![5]

AUGUSTA TOWNSHIP

Founded in 1836

BARTON HILLS VILLAGE

Founded in 1913

Energy Audit

TYPES OF ENERGY AUDITS

An energy audit can help you identify energy waste, improve efficiencies, and save money. Energy audits come in different shapes and sizes, but there are three main types for commercial facilities, as defined by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), the body that oversees and sets energy audit standards.

A **Level One** audit (or Energy Assessment) is the most basic kind of energy audit. It is often offered by utility companies at no cost. It gives general energy savings ideas for building managers, but does not include specific energy analysis, costs, or savings estimates. It is a great starting point for buildings that have never been audited before, as well as giving managers an idea of whether the building is a good candidate for further assessment.

A **Level Two** audit includes a more detailed analysis of a building's energy costs and use (usually through examination of energy bills), and includes conducting a brief on-site survey of the building. This analysis will identify and provide a savings and cost analysis of low-cost/no-cost measures. It will also provide a list of potential capital improvements that merit further consideration, and an initial judgment of potential costs and savings.

A **Level Three** audit, or "investment grade" audit is a more detailed building survey and energy analysis. This will include a breakdown of the energy use within the building, as well as identifying and providing savings and cost analysis of all practical measures that meet the owner's constraints and economic criteria. It will also include a discussion of any changes to operation and maintenance procedures and provide a listing of potential capital-intensive improvements that require more thorough investigation and financial analysis.

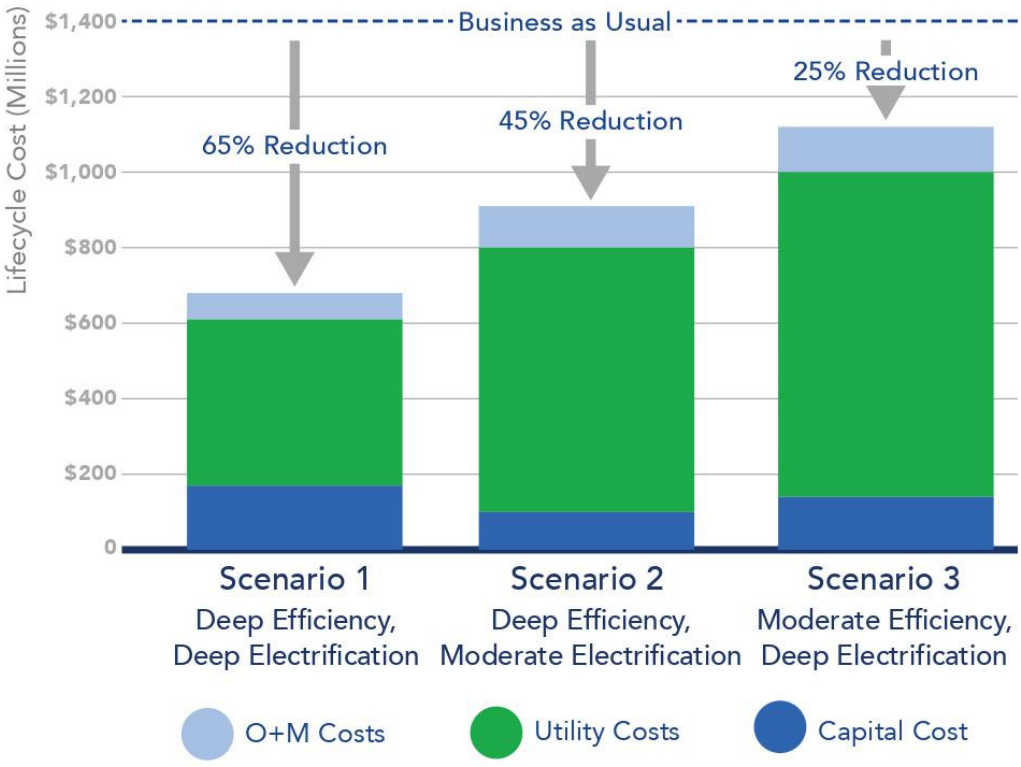
Energy Audit Summary[4]

TYPE	COST	LEVEL OF ANALYSIS	PROJECT COST ANALYSIS	USE CASE
Level One	$	Surface	No	Small facilities without capital improvement budget
Level Two	$$	More in-depth	General	Larger facilities without previous audits, or facilities looking to undergo renovations
Level Three	$$$	Complex	More specific	Larger facilities without previous audits, or facilities looking to undergo renovations

Improve Efficiency

SECTION 1: EXISTING EQUIPMENT

Lifecycle cost analysis can help organizations evaluate the longterm implications of their emission reduction investments. This figure illustrates how different scenarios can be compared from a lifecycle cost perspective, with higher upfront investments leading to lower long-term operational costs.



Source: DOE Better Climate Challenge[6]

RETROFIT VERSUS UPGRADE

Retrofitting

- Quicker
- Cheaper
- Preferred if the building is largely efficient, has a small budget, or a limited amount of time.[7] An example of retrofitting would be adding timers or installing motion sensors to the current lighting system

Upgrading

- Better option if the building is largely inefficient with significant areas that can be improved.[8]
- Upgrading involves changing the physical parameters of the building. One example of an upgrade would be installing an entirely new lighting system.[9]

Improve Efficiency

Create a Facility Equipment List

Creating a facility equipment list (if one does not already exist) is another option to help plan and prioritize energy efficiency improvements. It will take some time for your facilities manager to compile. By ensuring easy access to the information shown below, current and future facilities managers will be able to make decisions on equipment based on a single, easy to consult source of information, increasing the ease of future projects. Centrally tracking existing equipment, including age and condition, enables and streamlines the implementation of equipment efficiency and performance standards.[10]

Kinds of equipment often included:

- Rooftop HVAC units and air handlers
- Boilers, furnaces, air conditioners
- Pumps and fans
- Building management systems and other controls

Information about equipment often included:

- Location (facility)
- Type, model, description, etc.
- Capacity
- Unit age or date installed
- Anticipated life (total and remaining)

Establish Reduction Goals & Create a Municipal Energy Action Plan[96]

Once the energy audit is complete, begin establishing reduction goals and a municipal energy action plan (MEAP) specific for each system.[7] One strategy is to consider the following:

- Develop concise, measurable goals for your municipality's energy use
- Identify implementable strategies assigned to specific departments or individuals to help achieve these goals
- Establish a timeline for completing or implementing your strategies
- Estimate the costs and funding resources for your strategies
- Share your MEAP with stakeholders and community leaders to solicit feedback and support
- Legitimize your MEAP through adoption by your local unit of government

CITY OF DEXTER

Founded in 1824

CITY OF MILAN

Founded in 1831

Improve Efficiency

Applying Evaluation Criteria to Scenarios

The figure shown below provides one example of using evaluation criteria to evaluate various depth of upgrades scenarios. Evaluation criteria help you answer the question: What information do stakeholders need to evaluate decarbonization pathways? The evaluation criteria is different for each building. This example highlights an organization using a qualitative assessment of equally weighted criteria to compare three different scenarios. Each scenario is evaluated based on the depth of the energy efficiency and electrification upgrades. Selecting a pathway is a critical step in improving efficiency. This evaluation should focus on identifying the best pathway for the organization to meet its target based on the established evaluation criteria.

Evaluation Criteria	SCENARIOS: Deep Efficiency, Deep Electrification	SCENARIOS: Deep Efficiency, Moderate Electrification	SCENARIOS: Moderate Efficiency, Deep Electrification	NOTES
Lifecycle Cost	●	◒	○	Deep efficiency scenarios reduce operating costs, and full electrification allows for more cost to be offset by on-site solar.
Capital Cost	○	●	◒	Full electrification has a higher capital cost, but pairing it with deep efficiency measures mitigates some of these costs. Moderate efficiency requires more solar/storage to meet goals.
Emissions Reductions	●	◒	◒	Partial electrification reduces the ability to displace emissions with on-site and off-site renewables and lowers benefit of a Greening Grid.
Occupant Benefits	●	●	◒	Deep efficiency options improve thermal comfort and occupant well-being.
Risk	●	○	◒	Deep efficiency/moderate electrification has a small margin of safety for achieving the 80% reduction target and leaves regulatory risk due to continued reliance on natural gas

○ Fair ◒ Good ● Best

Source: DOE Better Climate Challenge[6]

BRIDGEWATER TOWNSHIP

Founded in 1832

CITY OF CHELSEA

Founded in 1820

SECTION 2: LIGHTING

Lighting is the starting point to improve energy efficiency and there are several easy, low-cost strategies to reduce energy use while also creating a happier and more productive environment.[11]

To ensure that a lighting upgrade leads to an effective and efficient system, design the system to provide the appropriate amount of light for the tasks to be performed in that space. To determine the amount of foot-candles currently in your buildings, divide the current lumen rating of your light fixtures by the total square footage. If there are multiple lighting sources add the total lumens together and divide by total square footage.[12]

The table below from ENERGY STAR Portfolio Manager offers a guide for foot-candle targets based on the tasks being performed in the space.[11] Keep in mind that the lighting level targets should be considered average maintained levels for the task; they should not necessarily be applied uniformly as the ambient light level for the entire space. Lighting levels should be customized through the use of supplemental task lighting in areas requiring higher localized levels. Target lighting levels should be the sum of the ambient and task lighting levels.

Category	Description	Illuminance (foot-candles)
Orientation and simple visual tasks in public spaces where reading and visual inspection rarely take place and visual performance is not crucial. Higher levels recommended for tasks where visual performance might be required.		
A	Public spaces	3
B	Simple orientation for short visits	5
C	Working spaces where simple visual tasks are performed	10
Common visual tasks in commercial, industrial, and residential applications—where visual performance is important. Recommended illuminance levels differ based on the visual tasks being illuminated. Higher levels recommended for visual tasks with critical elements of low contrast or small size.		
D	Performance of visual tasks of high contrast and large size	30
E	Performance of visual tasks of high contrast and small size or low contrast and large size	50
F	Performance of visual tasks of low contrast and small size	100
Special visual tasks including tasks with critical elements of very small or very low contrast. Visual performance is critical. Recommended illuminance levels should be achieved with supplementary task lighting. Higher recommended levels are often achieved by moving the light source closer to the task.		
G	Performance of visual tasks near threshold	300–1,000

Source: EPA ENERGY STAR Portfolio Manager[11]

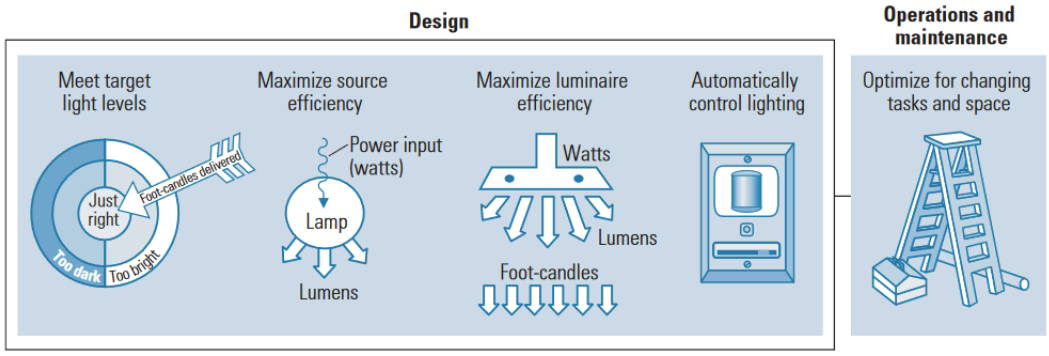
Improve Efficiency

Determine the total number and type of lights present in municipal buildings. If it is difficult to determine the specific type, NCAT's article on common lighting types may be helpful. This will set a baseline level of energy that the current lighting system uses and the lumens, or amount of light, produced. This is the appropriate time for an energy audit and facility equipment list. These create easy access to information, making a single record for facilities managers to track lighting history and plan for future upgrades. The energy audit results will help yield an action plan for lighting changes.

Lighting options to increase efficiency:

- Changing incandescent light bulbs to LEDs (easy and offers several benefits such as lifespan, energy efficiency, durability, and are ecologically friendly)[13]
- Installing timers on lights where necessary (i.e. areas that are not used often, outdoor lights)[14]
- Motion sensor lights (achieve 30-60% energy savings)[14]
- Smart lights or remotely controlled lights
- Implementing daylight dimming will adjust the brightness or color of the lights based on the amount of light coming into the building

Example of a comprehensive lighting upgrade strategy roadmap



Source: EPA ENERGY STAR [11]

The potential cost savings of switching to energy efficient lighting are summarized below:

Lifetime Savings for Efficient Omni Directional Light Bulb Models

PERFORMANCE	BEST AVAILABLE	ENERGY STAR	LESS EFFICIENT
Light Output (lumen)	800	800	800
Input Power (watt)	5.5	11	18
Annual Energy Use (kWh)	21.45	43	70
Annual Energy Cost	$2.12	$4.25	$6.95
Lifetime Energy Cost	$11.60	$23.19	$37.95
Lifetime Cost Savings	$26.35	$14.76	======

Source: Federal Energy Management Program[15]

SECTION 3: HVAC

Starting Out

Beginning an energy efficiency process for building systems can seem daunting and expensive. While this is certainly a concern for capital projects, there are many low-cost steps to increase system efficiency while they are planning for future building upgrades.

Maintenance

Replacing air filters every three months is one of the simplest measures to increase operating efficiency of your furnace.[16] This, combined with other recommended maintenance from ENERGY STAR's checklist, like checking thermostat settings and system controls, can help improve your equipment's operations at very little cost.[17]

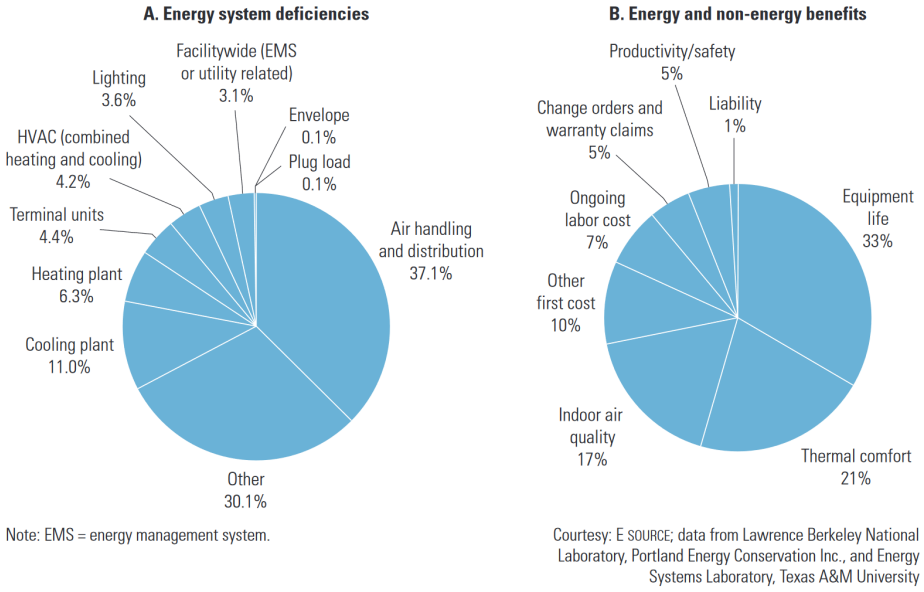
Retrocommissioning

Retrocommissioning your HVAC system is a process to examine existing systems to ensure proper function, going beyond basic maintenance practices. It's a whole-building approach that considers occupant comfort (and often other systems like lighting) in addition to equipment function. This process can be jumpstarted by an Energy Audit. The below diagram from ENERGY STAR shows the benefits of retrocommissioning for your building.[18] The EPA estimates that retrocommissioning can result in 15% energy savings and a payback period of 0.7 years.[18]

The EPA shows that retrocommissioning increases thermal comfort, indoor air quality, and equipment longevity, saving money and improving the work environment.[18]

Benefits of Retrocommissioning

Building energy system deficiencies: A recent study of retrocommissioning revealed a wide variety of problems—those related to the overall HVAC system were the most common type (A). Energy and non-energy benefits: Retrocommissioning provided both energy and non-energy benefits—the most common of these, noted in one-third of the buildings surveyed, was the extension of equipment life (B).



Note: EMS = energy management system.

Courtesy: E SOURCE; data from Lawrence Berkeley National Laboratory, Portland Energy Conservation Inc., and Energy Systems Laboratory, Texas A&M University

Source: ENERGY STAR Building Upgrade Manual Chapter 5[18]

Retrocommissioning Continued

One particularly important aspect of retrocommissioning an HVAC system is appropriately sealing air leaks in ductwork. It is estimated that 20-30% of air is lost from ducts,[19] decreasing system efficiency by as much as 20%.[20] By finding and addressing these inefficiencies, you can save money and energy on heating and cooling. These steps also increase occupant comfort and safety, as they improve air circulation, and reduce the risk of "backdrafting", a process by which carbon monoxide or other combustion gases are drawn into living spaces, potentially harming the occupants.[21]

Continued Progress

Once you have accomplished the basics in **Section 1** and the retrocommissioning process discussed n the previous page, you may seek to make more complex changes to your building(s)'s heating and cooling systems.

Programmable Thermostats

Switching to a programmable thermostat is a great way to improve the efficiency of an HVAC system. These thermostats allow building users to set active hours without manually changing the thermostat, increasing comfort for office users without the chill or heat that comes with changing the thermostat upon arrival.

As discovered while speaking to peer municipalities, not every programmable thermostat works with every HVAC system, so this should be done in consultation with an installer who can confirm compatibility and troubleshoot if needed. The ENERGY STAR program provides a buying guide and comparison tool, **linked here**.

Airflow Management

Another tool of facilities managers is the ability to reduce or eliminate airflow to areas of the building that are not in use at certain times, saving energy by reducing unnecessary heating and cooling. Some occupancy sensors (see **Lighting**) may give managers the ability to connect the two systems for maximum energy efficiency during unoccupied periods.[18]

Replacement

Eventually, all systems must be replaced. This is an excellent time to implement a less carbon-intensive heating and cooling system. We believe that electric systems are the future of low-carbon, efficient buildings and should be your first choice in system replacement. For more information, see **Heating and Cooling Decarbonization.**

For more information on this and other heating and cooling strategies, consider visiting the Department of Energy's Better Buildings Website

SECTION 4: BUILDING ENVELOPE

Starting Out

Air Seal Your Building

There are many areas in buildings that are prone to leaking air - both from the inside-out and the outside-in. Air sealing can be done through two main methods: caulking and weatherstripping. Caulking involves applying sealing material around stationary building features like window frames, door frames, air conditioners, electrical wiring, plumbing, and ducting. The DOE has determined that the most effective materials for caulking are caulk, rubber, and foam.[22] Weatherstripping involves applying insulating material around movable building features like windows and doors. Common weatherstripping materials include foam, vinyl, and magnets.[23]

You can identify the air leaks in your building in a few different ways. The most simple and preliminary way is to visually inspect the areas around windows, doors, air conditioners, vents, electrical outlets, switch plates, electrical wiring, plumbing, and ducting for cracks and gaps.[24] You could also use a thermal imager to identify areas of your building with more extreme temperatures. For a more comprehensive understanding of where air leaks are in your building, you can conduct a "blower door test" during your building's energy audit. This test involves mounting a specialized fan in the frame of an exterior door to suck air out of the building. This causes higher-pressure outside air to rush into any cracks or gaps in your building, allowing you to more clearly identify which areas would benefit most from air sealing.[25]

Install Thermal Blinds or Shades on Windows

Insulating materials' resistance to conductive heat flow is measured through a number called an R-value, with higher R-values correspond to greater effectiveness. Along with providing an additional physical barrier on windows to prevent air from entering and escaping, thermal blinds or shades are designed to increase the R-value of your windows by trapping cool air in summer and warm air in winter.[22] If you decide to install thermal blinds or shades, look for products that have the AERC certification. This indicates that the product has been designed and tested to improve energy efficiency and indoor comfort.[26]

Apply Window Films

If you want to improve the R-value of your windows but don't want to compromise your view, you can apply window films to maintain comfortable indoor temperatures. These polyester films alone can block up to 78% of heat from the sun and lower your energy bills by 30% during the hottest months of the year.[27] Another benefit of these films is that they are relatively low-cost and accessible. As with thermal blinds or shades, look for products that have the AERC certification.[26]

Improve Efficiency

Continued Progress

Improve Insulation

According to the Department of Energy (DOE), the amount and type of insulation you will need for your building "depends on your climate, type of heating and cooling system, and the part of the [building] you plan to insulate."[28] You can also use the DOE's **insulation resources** to determine the most energy efficient and cost-effective amount and placement of insulation in your building.[29]

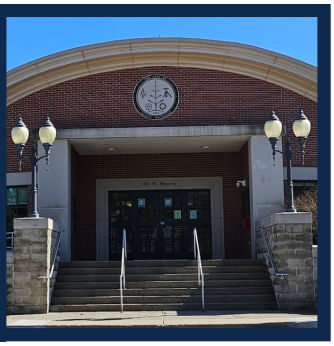
Generally, you should install insulation in the following places in your pre-existing or newly-constructed buildings:

- Attics
  - If unfinished, floor joists, rafters, and access doors
  - If finished, between the studs of "knee" walls, and between the studs and rafters of the exterior walls and the roof, joist space, and ceilings
- Walls
  - All exterior walls
  - Walls connected to unheated garages, sheds, roofs, or storage areas
  - Foundation walls above ground level
  - Foundation walls in heated basements
  - Foundation walls of unvented crawl spaces
- Floors
  - Floors above unconditioned spaces like vented crawl spaces and unheated garages
  - Any portion of the floor in a room that is cantilevered beyond the exterior wall below
  - Slab floors built directly on the ground
- Ducts in unconditioned spaces
- All band joists
- All windows and doors (through caulking)[29]

Strategic placement of high-quality insulation materials in your building can save you an average of 16% on your annual heating and cooling bills in southeast Michigan.[30]

CITY OF SALINE

Founded in 1825



CITY OF YPSILANTI

Founded in 1825

Improve Efficiency

Below is information on the materials, installation methods, and advantages associated with the most common types of insulation:

Materials, Installation Methods, and Advantages of Common Insulation Types

INSULATION TYPE	POSSIBLE MATERIALS	INSTALLATION METHOD	ADVANTAGES
Blanket: Batts & Rolls	• Fiberglass • Mineral (rock or slag) wool • Plastic fibers • Natural fibers	• Fitted between studs, joists, and beams	• Simple Installation • Suited for standard stud and joist spacing that is relatively free from obstructions • Relatively inexpensive
Concrete Block Insulation	• Foam board	• Require specialized skills • Can be stacked without mortar (dry-stacked) and surface bonded	• Moderate indoor temperatures • 10 times the insulating value of conventional concrete
Foam Board or Rigid Foam	• Polystyrene • Polyisocyanurate • Polyurethane • Phenolic	• Interior: must be covered with 1/2-inch gypsum board for fire safety • Exterior: must be covered with weatherproof facing	• High insulating value for relatively little thickness • Can block thermal short circuits when installed continuously over frames or joists
Insulating Concrete Forms (ICFs) (New Construction Only)	• Foam board • Foam blocks	• Installed as part of the building structure • Cores in the blocks are typically filled with concrete to create the structural component of the wall	• Insulation is literally built into the building's walls, creating high thermal resistance
Loose-Fill & Blow-In	• Cellulose • Fiberglass • Mineral wool	• Blown into place using special equipment	• Good for adding insulation to existing finished areas, irregularly shaped areas, and around obstructions

Improve Efficiency

Materials, Installation Methods, and Advantages of Common Insulation Types

INSULATION TYPE	POSSIBLE MATERIALS	POSSIBLE MATERIALS	ADVANTAGES
Reflective	• Foil-faced kraft paper • Plastic film • Polyethylene bubbles • Cardboard	• Foils, films, or papers fitted between wood-frame studs, joists, rafters, and beams	• Simple Installation • Prevents downward heat flow
Rigid Fibrous	• Fiberglass • Mineral wool	• HVAC contractors fabricate the insulation into ducts either at their shops or at the job sites	• Can withstand high temperatures
Sprayed Foam or Foam-in-Place	• Cementitious • Phenolic • Polyisocyanurate • Polyurethane	• Applied using small spray containers • In larger quantities, installed as a pressure sprayed (foamed-in-place) product	• Good for adding insulation to existing finished areas, irregularly shaped areas, and around obstructions

Source: U.S. Department of Energy[31]

DEXTER TOWNSHIP

Founded in 1825

FREEDOM TOWNSHIP

Founded in 1834

Improve Efficiency

Below are the DOE's recommendations on which insulation types should be used in different areas of your building:

Recommended Types of Insulation for Each Building Area

BUILDING AREA	RECOMMENDED TYPES OF INSULATION
Unfinished Walls	Blanket: Batts & Rolls, Concrete Block Insulation, Foam Board or Rigid Foam, Insulating Concrete Forms (ICFs), Reflective, Structural Insulated Panels (SIPS)
Finished Walls	Concrete Block Insulation
Unfinished Floors	Reflective, Structural Insulated Panels (SIPS)
Unfinished Attic Floors	Loose-Fill & Blow-In, Sprayed Foam or Foam-in-Place
Finished Floors	Blanket: Batts & Rolls, Foam Board or Rigid Foam
Unfinished Ceilings	Structural Insulated Panels (SIPS)
Finished Ceilings	Blanket: Batts & Rolls, Foam Board or Rigid Foam
Ducts in Unconditioned Places	Rigid Fibrous

Source: U.S. Department of Energy[31]

LIMA TOWNSHIP

Founded in 1832

LODI TOWNSHIP

Founded in 1834

It is also important to consider the embodied carbon of different insulation materials. According to the EPA, embodied carbon "refers to the amount of greenhouse gas emissions associated with upstream stages (extraction, production, transport, and manufacturing) of a product's life."[32] Below are the embodied carbon of various common insulation materials:

Embodied Carbon of Common Insulation Materials

MATERIAL	EMBODIED CARBON BY WEIGHT*
Straw Bales	0.063 kg CO_2e/kg
Mineral Wool Batt	1.28 kg CO_2e/kg
Fiberglass Batt	1.35 kg CO_2e/kg
Denim Batt	1.5 kg CO_2e/kg
Dense Packed Cellulose	0.63 kg CO_2e/kg
Extruded Polystyrene Foam	3.42 kg CO_2e/kg
Expanded Polystyrene Foam	3.29 kg CO_2e/kg
	*Figures from Inventory of Carbon and Energy (ICE) 2.0

Carbon Smart Materials Palette[33]

Final Steps

Install Storm Windows

If you are looking to significantly improve the energy efficiency of your windows without completely replacing them, consider installing storm windows. These windows are attached to the interior or exterior of preexisting windows and help to reduce air flowing in and out of them. According to the DOE, installing storm windows can yield similar energy savings to installing new double- or triple-pane windows for a third of the cost.[41]

While older models of storm windows were meant to be seasonal fixtures that would be removed in summer, many modern models are permanent installations that still allow preexisting windows to be opened and closed. Most modern models also have low-emissivity (low-e) coatings that more effectively insulate buildings in winter and keep heat out in summer.[41]

Improve Efficiency

Install Double or Triple Pane Windows

Replacing single pane windows with ENERGY STAR certified double pane windows can save you an average of $101 - $538 per year on your energy bill.[34] Unlike typical single pane windows, double and triple pane windows have two and three panes of glass respectively to assist with insulation.[35] Because these windows have multiple panes, manufacturers can insert argon gas between them for even greater insulation.[36] To get the greatest reductions in heating and cooling costs, multi-pane windows should have low-emissivity (low-e) coatings and be paired with strong and insulating window frame materials like vinyl, fiberglass, and composite wood.[37]

The energy efficiency of windows and doors is often measured by a U-value or U-factor. The U-value represents "the rate at which a window or door transmits non-solar heat flow," with lower U-values indicating greater insulation. This number is the inverse of an R-value, which is defined in the previous section on thermal blinds.[38]

If you decide to replace your building's windows, look for windows that have ENERGY STAR and/or NFRC labels- these provide key information about their U-values and indicate that they are energy efficient products.[39]

Lifetime Savings for Efficient Residential Window Models

PERFORMANCE	BEST AVAILABLE	ENERGY STAR	LESS EFFICIENT
Annual Energy Use (kBtu/ft^2)	108	137	174
Annual Energy Cost ($/ft^2)	$1	$1	$2
Lifetime Energy Cost ($/ft^2)	$16	$17	$20
Lifetime Cost Savings ($/ft^2)	$4	$2	======

Source: Federal Energy Management Program[40]

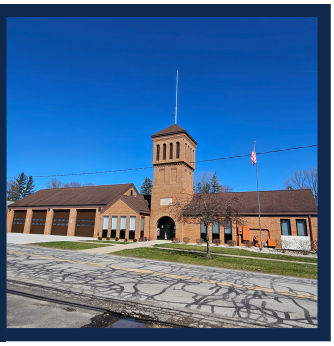
These are estimates for residential windows, performance depends on the size and type of building.

LYNDON TOWNSHIP

Founded in 1836

MANCHESTER TOWNSHIP

Founded in 1837



Install New Exterior Doors

Old, uninsulated, and improperly air-sealed doors can cause air leakage in your building and increase heating and cooling costs.[43] Below are the benefits and drawbacks associated with the most common door materials, sorted in order from most to least insulating:

Benefits and Drawbacks of Common Door Materials

DOOR MATERIAL	PROS	CONS
Fiberglass	• The most insulating material for doors • Does not warp, rot, or expand • Can be made in a variety of styles	• Cannot be installed in all buildings
Vinyl	• Low-cost • Lightweight	• Can be broken down by sun
Steel	• Does not warp • Offers extra security and soundproofing	• Requires inner foam layer to be effective • Can be easily dented or scratched
Wood	• Can be made in a variety of styles	• The least insulating material for doors • Can warp, rot, or expand • Often require storm doors and weatherstripping

Sources: Constellation[40], Brothers Services Company[44]

To get the greatest reductions in heating and cooling costs, new doors should be paired with strong and insulating door frame materials like fiberglass, vinyl, and thermally-broken aluminum.[42] Thermal breaks are plastic insulators that are installed between the inner and outer parts of door and window frames.[45]

During installation, ensure that the new door frame is as square as possible so the new door can fit snugly to the jamb. Foam caulk should be applied around the new door frame to further reduce the risk of air leaks.[45]

If you decide to install new exterior doors, look for ones that have ENERGY STAR and/or NFRC labels. These provide key information about their U-values and indicate that they are energy efficient products.[45]

SECTION 5: WATER HEATING

Water heating is a small but important portion of energy consumption in municipal buildings at around 5% of end-use energy consumption.[46] While the only way to fully decarbonize water heating would be through purchasing an electric water heater and powering it with clean electricity, there are a variety of steps that can be taken to help minimize the cost and emissions from hot water before investing in a new water heater.

Starting Out

The simplest and cheapest step to reduce the energy consumption from heating water is to lower the temperature of your water heater.[47] Doing so is completely free and could result in significant savings on your energy bill. Another easy and cheap way to reduce your water heating costs is to ensure that your hot water pipes are all insulated. By insulating your pipes, the water that initially comes out of the faucet will be warmer and the average hot water temperature will also increase. By doing this, you may have the opportunity to lower your water heater temperature even further to maximize your savings.

Another low cost option to reduce hot water consumption is to install low-flow fixtures. Low-flow fixtures also reduce the energy required for heating water by reducing the total amount of hot water used. If all of the faucets in your building currently have a two gallon per minute flow rate, adding aerators that have a one gallon per minute flow rate could reduce your hot water consumption by as much as 50%. With aerators costing around two dollars each, reducing hot water consumption through this method can be incredibly affordable and pay for itself quickly. This option also has the additional benefit of reducing total water consumption and saving you money on your water bill.

Source: EPA[48]

When replacing fixtures, look for the "WaterSense" faucets and aerators to find which ones meet EPA requirements for water flow.

Continued Progress

The steps listed above are a great way to start saving money on water heating. One of the important benefits of those options is that they can be done at any point in a water heater's life. If you want to go even further, that will require replacing your water heater. One option would be to upgrade to a more efficient water heater when your current water heater needs to be replaced. By doing this, the only additional investment you are making to save money and energy would be the cost premium of the efficient model compared to the standard model. When upfront investment isn't as much of a concern, you should compare the cost of purchasing a new unit before your old one reaches the end of its life with the benefits of saving money over time. To maximize emissions reductions, replacing an inefficient water heater with an efficient water heater as soon as possible will always be the best option.

There are many different types of water heaters available today with multiple different fuel options. For the purposes of this toolkit, we will discuss the following options:[49]

- Standard Natural Gas Tank
- Efficient Natural Gas Tank
- Standard Natural Gas Tankless
- Efficient Natural Gas Tankless
- Resistance Electric Water Heater
- Electric Heat Pump
- Higher Efficiency Electric Heat Pump

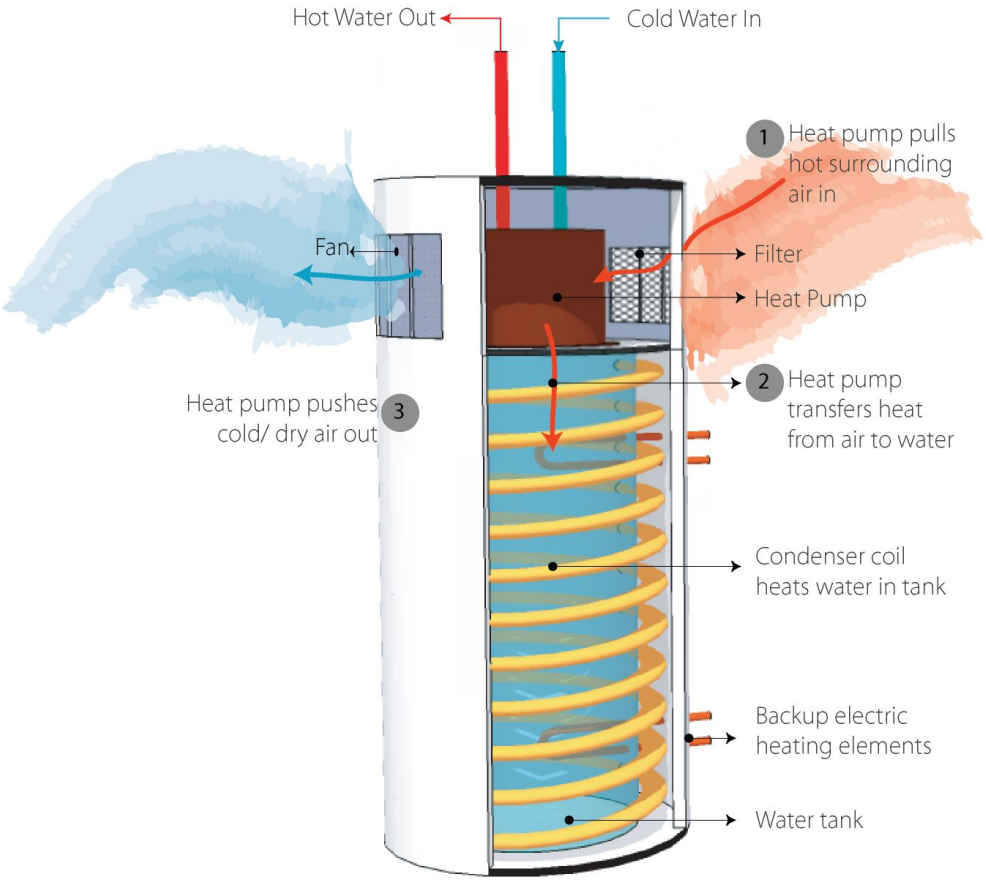
A water heater with a tank is designed to store hot water ready to be used. Because of this storage period, there are heat losses that increase the cost of hot water, especially during extended periods where hot water isn't being used. One problem with tank water heaters is that they can run out of hot water if hot water is continuously being consumed over an extended period.

A tankless water heater is designed to heat water on demand. Assuming the water heater is adequately sized, this will meet all hot water needs at a higher energy efficiency due to the lack of heat loss during storage. If the water heater is not adequately sized, that means it will not be able to simultaneously meet all the hot water demands of the building and some areas will not get all the hot water demanded.

Natural gas, propane, and resistance electric water heaters (tankless or with a tank) all heat water through the conversion of energy. In a natural gas or propane water heater, gas is burned to produce heat which is then used to heat up the water. A resistance electric water heater uses electricity to make heat, similar to an electric cooktop, and uses that generated heat to heat up the water. While natural gas water heaters tend to have lower emissions than resistance electric water heaters currently, this will change as the electricity grid moves towards more low or zero carbon sources of electricity. Electricity will get cleaner, while natural gas will not.

Improve Efficiency

A heat pump water heater works very differently from a resistance electric water heater. Instead of using electricity to generate heat, it uses electricity to move heat from the surroundings, like a refrigerator in reverse. While a refrigerator takes heat out from inside and moves it to the surroundings, a heat pump water heater takes heat from the surroundings and moves it to the water. By moving heat instead of converting electricity into heat, you get extremely high efficiency and cost savings. It is worth noting that heat pump water heaters usually include a storage tank, meaning they can run out of hot water just like any other tank water heater.



Source: Department of Energy[50]

When looking at any water heater, the most important value to consider is the uniform energy factor (UEF). This tells you how much your water is heated per unit of energy that you pay for after accounting for heat losses. The tables below shows how much energy is required to heat 100 gallons of water to 125 °F based on different UEFs. The cost to do so is based on a natural gas price of $0.82 per CCF and an electricity price of $0.1673 per kWh as listed on DTE's website.[51, 52] The emissions factors used in the table are 5.5 kg CO_2 per CCF of natural gas combusted and 0.55 kg CO_2 per kWh (Michigan Electricity Average Emissions) as sourced from the EPA.[53, 54]

Improve Efficiency

Comparing the Energy Consumption, Cost, and Emissions of Natural Gas Water Heaters

	STANDARD NATURAL GAS TANK	EFFICIENT NATURAL GAS TANK	STANDARD NATURAL GAS TANKLESS	EFFICIENT NATURAL GAS TANKLESS
UEF	0.63	0.93	0.82	0.97
Energy (CCF)	1.00	0.68	0.77	0.65
kg CO_2 Emissions	5.51	3.74	4.24	3.58
Energy Cost	$0.82	$0.56	$0.63	$0.53
$ Savings Relative to Standard Tank	$0.00	$0.26	$0.19	$0.29
kg CO_2 Savings Relative to Standard Tank	0.00	1.77	1.27	1.93

Sources: ENERGY STAR Building Manual,[55] "What is Uniform Energy Factor?"[56]

To reduce energy costs and carbon emissions, the most important step is to move away from the least efficient options listed. If you currently have an electric resistance water heater, replacing it with a heat pump water heater will reduce carbon emissions and energy costs by 71% to 77%. While the savings are less dramatic from upgrading an inefficient natural gas water heater to a more efficient natural gas water heater, you could still reduce emissions and energy costs by 23% to 35%.

Comparing the Energy Consumption, Cost, and Emissions of Electric Water Heaters

	ELECTRIC RESISTANCE	ELECTRIC HEAT PUMP	HIGHER EFFICIENCY ELECTRIC HEAT PUMP
UEF	0.94	3.30	4.10
Electricity (kWh)	19.68	5.61	4.51
kg CO_2 Emissions	10.83	3.08	2.48
Energy Cost	$3.29	$0.94	$0.75
$ Savings Relative to Electric Resistance	$0.00	$2. 35	$2.54
kg CO_2 Savings Relative to Electric Resistance	0.00	7.75	8.35

Source: ENERGY STAR[56]

Decarbonize Sources

HEATING & COOLING DECARBONIZATION

Replacing Your HVAC System

When upgrading HVAC equipment, look for a high efficiency model. Much of this process is building specific and depends on the size and needs of your facility. ENERGY STAR provides a guide that separates systems by type and provides a more detailed analysis, **found here**.[57]

Replacing Your Furnace with a Heat Pump

Heat pumps installed in cooler climates, like Washtenaw County, need to be designed to manage lower temperatures.[58] They are a less carbon-intensive than a traditional natural gas furnace, and also combine heating and cooling functions in a single unit, eliminating the need for a separate air conditioner. They also can provide more efficient heating than furnaces.[59] To find out how much money and greenhouse gas emissions a heat pump will save your building and organization, use the **ENERGY STAR Savings Calculator**. A very brief overview of the three most common types of heat pumps is shown below. Air source heat pumps are most compatible with existing HVAC ducts. To see ENERGY STAR's list of certified heat pumps and buying guidance, click **here**.

AIR SOURCE HEAT PUMPS	GEOTHERMAL HEAT PUMPS (GROUND OR WATER SOURCE)	ABSORPTION HEAT PUMPS
• Most common • Most compatible with existing ductwork • More effective at dehumidifying than standard air conditioning system • Depending on the price of electricity, may be more expensive to heat your building compared to a natural gas furnace.	• More expensive to install • Installation feasibility is extremely site-specific • Include a cooling system that may run underground, taking advantage of the temperature differential to heat/cool the building passively • Lower operating costs (long term), and can reduce energy use by 70-80% • More reliable in extreme climates	• Relatively new technology • More expensive than air-source heat pumps • Less common • Can use natural gas as a fuel source, so do not necessarily see the same emissions reductions associated geothermal or air source heat pumps.

Source: Energy Saver, DOE[59]

NORTHFIELD TOWNSHIP

Founded in 1832

PITTSFIELD TOWNSHIP

Founded in 1824

Decarbonize Sources

Because the majority of municipal buildings in Washtenaw County are comparable to residential buildings in size, the below tables include cost savings models for residential capacity units. If your municipal buildings are larger than this, consider visiting the **Federal Energy Management Program's website** for information on cost savings for commercial heating and cooling systems.

The chart below shows savings on efficient air-source heat pumps. Seasonal Energy Efficiency Rating (SEER2) and Heating Seasonal Performance Factor (HSPF2) are measures of cooling and heating efficiency, respectively. The standards for these measurements are set by the DOE.[60,61]

Lifetime Savings for Efficient Residential Air-Source Heat Pump Models

PERFORMANCE	BEST AVAILABLE	ENERGY STAR	LESS EFFICIENT
SEER2/HSPF2	28.1/11.5	15.2/7.8	14.3/7.5
Annual Energy Use—Heating and Cooling (kWh)	6,176 kWh	9,777 kWh	10,244 kWh
Annual Energy Cost—Heating and Cooling ($)	$533	$844	$885
Lifetime Energy Cost-15 years ($)	$6,037	$9,557	$10,014
Lifetime Cost Savings ($)	$3,977	$457	======

Source: Federal Energy Management Program[62]

FEMP also provides measurements of cost savings for ground-source, or geothermal heat pumps, which may be more effective in colder climates, but are also more expensive to install. Energy Efficiency Ratio (EER) measures the cooling efficiency of a heat pump at 95°F.[63] The Coefficient of Performance (COP) is the ratio of cooling or heating effect to its net work input.[60]

Lifetime Savings for Efficient Geothermal Heat Pumps

PERFORMANCE	BEST AVAILABLE	ENERGY STAR	LESS EFFICIENT
EER/COP	30.5/5.2	17.1/3.6	15.0/3.1
Annual Energy Use-Heating and Cooling (kWh)	4,493 kWh	7,050 kWh	8,125 kWh
Annual Energy Cost-Heating and Cooling ($)	$388	$609	$702
Lifetime Energy Cost-15 years($)	$6,339	$9,948	$11,464
Lifetime Cost Savings ($)	$5,124	$1,516	======

Source: Federal Energy Management Program[62]

WATER HEATING DECARBONIZATION

Replacing Your Water Heater

Decarbonizing water heating is an important step in minimizing carbon emissions. Based on the average emissions of Michigan's 2024 electricity grid, heating water via electric resistance is the most energy and carbon intensive option.[65] While natural gas water heaters currently have lower emissions than resistance electric water heaters, this will not be the case as the carbon intensity of Michigan's electricity decreases as Michigan heads to 100% clean electricity by 2040.[66]

If you are unable to move away from natural gas or propane, upgrading to an efficient tankless natural gas water heater can reduce emissions from water heating by up to 35%. If you already have an electric water heater or want to move to electric, a high efficiency heat pump water heater is your best replacement option. They are already the lowest emissions option among all water heaters and those emissions will continue to go down as Michigan's electricity grid is decarbonized or if your building uses an increases share of renewable electricity.

Comparing the Emissions of Different Water Heaters for Heating 100 Gallons of Water

	ELECTRIC RESISTANCE	EFFICIENT NATURAL GAS TANK	EFFICIENT NATURAL GAS TANKLESS	HIGH EFFICIENCY ELECTRIC HEAT PUMP
UEF	0.94	0.93	0.97	4.10
Energy	19.68 kWh	0.68 CCF	0.65 CCF	4.51 kWh
kg CO_2 Emissions	10.83	3.74	3.58	2.48
kg CO_2 Savings Relative to Electric Resistance	0.00	7.09	7.25	8.35

Source: ENERGY STAR[56]

SALEM TOWNSHIP

Founded in 1833

SALINE TOWNSHIP

Founded in 1819

Decarbonize Sources

RENEWABLE ENERGY

There are many opportunities to increase the use of renewable energy in your municipality and take advantage of its associated benefits. The most commonly cited benefit is reduced carbon emissions, as nearly 60% of Michigan's electricity came from natural gas and coal in 2022.[67] There are many other benefits, including reduced energy costs, increased resilience in the face of power outages, and supporting local businesses. Some of the solutions below may not be achievable in the near-term for your municipality, but could serve as longer-term goals.

Emissions Savings

Determining whether a project or purchase will result in emissions savings is not entirely straightforward, and has two main components: whether overall emissions are reduced, and who gets to claim those reductions.

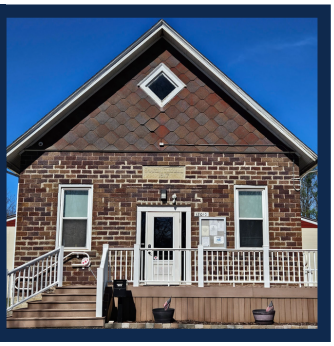
Determining whether overall emissions are reduced depends on whether this project or purchase involves electricity or just renewable energy certificates (RECs). If electricity is involved, then emissions are reduced when that electricity is coming from sources that are cleaner than the grid. In the case of renewable energy in Michigan, this is currently true because of the amount of electricity on the grid coming from natural gas and coal. If only RECs are involved, then overall emissions are reduced when those RECs are high-quality**.** More information on what defines high-quality RECs can be found in the **Glossary**.

SCIO TOWNSHIP

Founded in 1832

SHARON TOWNSHIP

Founded in 1834



Decarbonize Sources

Section Summary

This table provides a summary of the options for renewable energy that are covered in this section:

- Utility green power
- Physical power purchase agreement (PPA)
- Virtual PPA
- On-site generation

	EASE OF IMPLEMENTATION	IMPLEMENTATION COST	FINANCIAL SAVINGS	EMISSION SAVINGS
UTILITY GREEN POWER				
PHYSICAL PPA				
VIRTUAL PPA				
ON-SITE GENERATION				

Weakness ← → Strength

SUPERIOR TOWNSHIP

Founded in 1831

SYLVAN TOWNSHIP

Founded in 1883

Decarbonize Sources

Utility Green Power

One of the simplest options to start using renewable energy is to join your utility's green energy program, which supports renewable energy generation projects from your utility. With DTE's MI Green Power, enrolled customers currently *save* $0.0034 per kWh due to DTE's pricing model.[68] Consumers' Solar Gardens program is slightly more complicated: customers who opt-in pay $8 per 0.5 kW of solar generation capacity, then receive a bill credit each month based on how much electricity that capacity generated.[69] This means that the bill credit will fluctuate month by month, as there is more generation on sunny days than overcast days. In 2018, the average monthly credit was $4.54 per 0.5 kW of generation capacity.[70]

MI Green Power is a popular option for residential as well as larger customers, with Dearborn enrolling to cover all of the energy needs of its municipal buildings,[71] and both the Detroit Zoo and Washtenaw Community College have committed to covering 100% of their electricity needs through the program.[72, 73]

Financial Savings

Financial savings vary depending on the specifics of your utility's program. DTE's program currently results in small savings on electricity bills but Consumer's does not result in any savings compared to standard electricity.

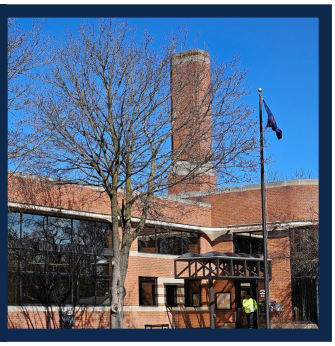
Emission Savings

Both Consumers and DTE programs will result in emissions reductions because they support new renewable energy facilities in Michigan, however neither company publishes data on reduction amounts.[68, 69, 74]

Scio Township has implemented utility green power. All Scio Township buildings and infrastructure (except for seven streetlights) are enrolled in MI Green Power at 85%, as of March 2023. The DTE's generation averages 15% renewables, so the combination totals 100% renewable power. Streetlights are not metered and not eligible for enrollment. All but two streetlights are LED.[75]

VILLAGE OF MANCHESTER

Founded in 1826



WEBSTER TOWNSHIP

Founded in 1833

Physical PPA

A physical PPA is an alternative to owning and maintaining renewable energy generation infrastructure. In these agreements, a third party develops, finances, and owns the infrastructure that is built on the host's site. Both parties then sign a contract for the host to purchase the generated electricity, generally at a rate that is lower than market rate.[76] Depending on the specifics of the contract, the associated RECs may be owned by the developer or the host.[76] In 2017, Michigan State University entered into a power purchase agreement for on-campus solar arrays that are projected to save the school $10 million over 25 years.[77]

Financial Savings

Financial savings will depend on the contract negotiated between the host and developer, but some savings should be expected.[78]

Emission Savings

Given the significant use of fossil fuels to power the current electricity grid in the Midwest, physical PPAs will displace grid electricity use and result in emissions savings.[79]

Virtual PPA

A virtual PPA is an agreement between a renewable energy generator and a buyer where the buyer purchases only the RECs, while the electricity is sold to other customers.[74] This allows the buyer to support the building of new renewable energy facilities when barriers like distance to generating facilities make directly using the electricity infeasible.

Financial Savings

Because this is a method of purchasing RECs, not electricity, there are no financial savings over just purchasing electricity. However, depending on the specifics of the agreement negotiated between the generator and the buyer, purchasing RECs through a virtual PPA may be cheaper than purchasing RECs on the open market.

Emission Savings

Where the RECs are purchased from will impact overall emissions savings, as only projects that are supporting additional, verifiable renewable energy generation will result in overall savings.

Decarbonize Sources

On-Site Generation

On-site generation is an alternative to purchasing renewable electricity or RECs where the organization owns, operates, and maintains the generation equipment. This can require a significant amount of work and expertise.

The equipment may be located directly on or near municipal buildings, (allowing the electricity to be used in that building) or it may be located off-site (in which case the electricity can be sold to a utility). Either setup will generate RECs, which can be held on to or sold. Adding battery storage to a project will increase its cost, but will mean that excess electricity can be stored to use later if power from the grid is interrupted.

This generation infrastructure can go in a variety of locations. Mounting on the roof of an existing building is a popular option, as is mounting directly on the ground, carports, or another type of covered parking.

Many municipal governments across the state have installed solar panels. The city of Harrison in Clare County, for example, undertook a project to install 659 kW of solar panels in 2021, which is projected to save $162,000 in electricity costs each year for 30 years.[80]

Financial Savings

With the Inflation Reduction Act funding, the Commercial Technical Assistance program of the 2030 District has generally found that the payback ranges from 7-10 years depend on the size and location of the system.[81]

Emission Savings

On-site generation will displace grid electricity use and result in overall emissions reductions.[79]

YORK TOWNSHIP

Founded in 1834

YPSILANTI TOWNSHIP

Founded in 1827

Funding and Resource Assistance

FINAL REMARKS

Energy efficiency gains can be achieved through a variety of pathways. While we hope that the information provided in this toolkit is sufficient to meet your energy efficiency goals, we wanted to connect you with additional resources and funding to help reach those goals. Below is a list of resources to further assist you in your energy efficiency and decarbonization efforts. Good Luck!

FUNDING FOR ENERGY AUDITS

Ann Arbor/Washtenaw 2030 District[82]

- Link to Learn More
- Link to Apply

RESTART (Lawrence Tech & EGLE Technical Assistance Partnership)[83]

- Link to Learn More
- Link to Apply

DTE Small Business Program[84]

- Link to Learn More
- Call 855.748.2525 or email DTE-Small-Business@franklinenergy.com to apply

Consumer's Small Business Program[85]

- Link to Learn More and Apply

FUNDING FOR ENERGY EFFICIENCY AND SOLAR

SEMCOG (Southeast Michigan Council of Governments)[86]

- Link to Learn More and Apply

Community Energy Management Program[87]

- Award Amount $5,000-$100,000
- Link to Learn More
- Link to Apply
- Request for Proposals

Energy Efficiency and Conservation Block Grant (EECBG) Program Formula Grant[88]

- Link to Learn More and Apply

Federal Solar Tax Credits[89]

- Award Amount usually ranges from 30-60% of Solar Array Cost
- Link to Learn More

Funding and Resource Assistance

TECHNICAL ASSISTANCE

- *NREL Technical Assistance*[90]
  - Link to Learn More
  - Clean Energy RFP Information
  - Contact NREL for Assistance

- *Solar Energy Planning Guide*[91]
  - Link to Learn More

MICHIGAN GREEN COMMUNITIES

Michigan Green Communities (MGC) is a statewide network of local government staff and officials that collaborate with one another, through peer learning and information sharing, to promote innovative sustainability solutions at the local, regional, and state level.[92]

Michigan Green Communities Challenge: The Challenge includes several categories and each is comprised of several action items. Communities earn points by completing these action items. Participation is free and open to any local government in Michigan

They also offer research funding opportunities and a template for sustainability plan resources!

The City of Ypsilanti and Pittsfield Township participated in the 2022 MGC Challenge

SEMCOG

SEMCOG can help local governments apply for grant funding in many ways:[86]

- SEMCOG membership includes access to GrantFinder, the largest searchable database of private, state, and federal grants available to municipalities and local non-profits
- Dedicated staff that can assist in specific project funding
- Their database holds relevant information on: people, economy and jobs, housing, transportation, and environment and land use information by region, county, community or custom geography, which can support grant applications
- Access to Data and Maps provides interactive databases and mapping applications featuring demographic, transportation, economic, employment, land use, aerials, and GIS information

SEMCOG member governments may request a Grant Writing USA scholarship for a two-day workshop on grant writing or grant management. The grant writing course covers how to write grant proposals from start to finish and how to locate and track relevant grant opportunities. Federal, state, local and non-governmental, and private sector grants are covered. You'll learn everything you need to know to get started writing grants.

Funding and Resource Assistance

CATALYST COMMUNITIES

The Catalyst Communities Initiative is a comprehensive program to provide education, training, planning and technical resources to local governments as they work toward their sustainability goals.[93]

This program offers an array of resources on various environmental, social, and economic topics to help communities across Michigan make a just transition to decarbonization. The Catalyst Communities Initiative aims to provide a range of options to meet communities wherever they are, regardless of geography, population size, or pre-existing knowledge.

They offer a database comprised of federal funding opportunities along with webinars and technical assistance to support local and tribal governments who seek to access federal funding through the Bipartisan Infrastructure Law (BIL) (also known as the Infrastructure Investment and Jobs Act [IIJA]) and the Inflation Reduction Act (IRA).[94]

They have a large suite of webinars on various topics, a few that may be of most help for this work include:

- **Community Energy Management (CEM) Program Request for Proposal and Application Overview Webinar:** Discusses the CEM Program and highlights the additional funding and increased award sizes that are available, along with the expanded eligible project areas that communities can consider when applying.[95]
  - Zoom Link to watch webinar

- **Conducting Energy Audits on Municipal Facilities:** In this webinar, Tracey Laitinen (Operations Manager, Sault Ste. Marie), Eric Witte (Deputy Director of Public Works, Dearborn), and Dave Norwood (Sustainability Coordinator, Dearborn) share their experiences and tips conducting energy audits.[95]
  - YouTube Link to watch webinar

- **EGLE's Energy Efficiency Programs for Communities:** Join the State Energy Program Specialist, Julie Staveland, and the EGLE Community Programs Coordinator, Miles Biel, as they introduce EGLE's wide variety of Energy Services and Community Energy Management programs. Hear what programs and levels of assistance are available, including success stories from across the state.[95]
  - Link to watch webinar

These are just a few of the webinars they offer, spanning a wide variety of topics such as climate and federal funding technical assistance. We encourage you to check out these webinars as well!

Sources

GLOSSARY

[1] Bullfrog Power, *Renewable energy certificates explained*, 30 July 2021, https://bullfrogpower.com/blog/renewable-energy-certificates-explained/

BASELINE AND TRACKING

[2] Energy Star, *Benchmark Your Building With Portfolio Manager*, n.d., https://www.energystar.gov/buildings/benchmark

ENERGY AUDIT

[3] Department of Energy, *Home Energy Assessments*, n.d., https://www.energy.gov/energysaver/home-energy-assessments
[4] Department of Energy, *A Guide to Energy Audits,* 25 September 2011, https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20956.pdf
[5] Department of Energy, *Professional Home Energy Assessments*, https://www.energy.gov/energysaver/professional-home-energy-assessments

IMPROVE EFFICIENCY
Existing Equipment

[6] Department of Energy, *Framework for Greenhouse Gas Emissions Reduction Planning: Building Portfolios*, https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/ERP_Framework_Building_Portfolios.pdf
[7] National Center for Appropriate Technology, *Energy Efficient Lighting Toolkit*, n.d., https://www.ncat.org/energy/energy-toolkit/energy-efficient-lighting/
[8] ENERGY STAR, *Upgrade Your Lighting*, n.d., https://www.energystar.gov/buildings/save_energy_commercial_buildings/ways_save/upgrade_lighting
[9] Husin et. al, *Implementing sustainability in existing building through retrofitting measures*, January 2019, https://www.researchgate.net/figure/Difference-between-Refurbishment-Renovation-and-Retrofit-Definition-Source-Che-Husin_fig3_331043585
[10] Northwest Energy Efficiency Alliance, *Public Buildings Portfolio Management Implementation Guide*, June 2019, https://newbuildings.org/wp-content/uploads/2019/06/NBI_PublicBuildingsPortfolioManagementGuide2019.pdf
[96] Barrett, Brad & Yu, Angela, Western Upper Peninsula Planning and Development Region, *A Guide to Energy Efficiency Planning for Rural Michigan Communities,* 5 October 2020, https://static1.squarespace.com/static/5f5784a77a79a6713d7c703d/t/603936d68d1a8715d6e7afb7/1614362341750/EnergyPlanGuideWUPPDR_FinalDraft.pdf

Lighting

[11] ENERGY STAR, *Building Upgrade Manual: Ch.6 Lighting*, November 2006, https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH6_Lighting.pdf
[12] Point, Michelle, *What Is a Foot Candle? How Many Do I Need?*, 16 November 2023, https://wattlogic.com/blog/what-is-a-foot-candle/
[13] DTE Energy, *Find energy-efficient, long-lasting light bulbs in your preferred style and brightness*, n.d., https://www.dteenergy.com/us/en/residential/save-money-energy/tips-and-how-tos/selecting-the-right-lights.html
[14] Indiana University of Pennsylvania, *LED Lighting Benefits*, n.d., https://www.iup.edu/energymanagement/howto/led-lighting-benefits.html

Sources

[15] Department of Energy, *Purchasing Energy-Efficient Light Commercial Heating and Cooling Equipment*, n.d., https://www.energy.gov/femp/purchasing-energy-efficient-light-commercial-heating-and-cooling-equipment

HVAC

[16] ENERGY STAR, *Heat and Cool Efficiently*, n.d., https://www.energystar.gov/saveathome/heating-cooling
[17] ENERGY STAR, *Maintenance Checklist*, n.d., https://www.energystar.gov/saveathome/heating-cooling/maintenance-checklist
[18] ENERGY STAR, *Building Upgrade Manual Ch. 5: Retrocommissioning*, October 2007, https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH5_RetroComm.pdf
[19] ENERGY STAR, *Duct Sealing*, n.d., https://www.energystar.gov/saveathome/heating-cooling/duct-sealing
[20] ENERGY STAR, *Duct Sealing with ENERGY STAR*, 7 January 2018, https://www.energystar.gov/sites/default/files/asset/document/ES_Duct_Sealing_flyer.pdf
[21] ENERGY STAR, *Benefits of Duct Sealing*, n.d. https://www.energystar.gov/saveathome/heating-cooling/duct-sealing/benefits

Building Envelope

[22] Building Energy Exchange, *Building Envelope Solution Package,* n.d., https://be-exchange.org/wp-content/uploads/2020/04/20200424_Envelope-Solutions.pdf
[23] Department of Energy, *Weatherstripping*, n.d., https://www.energy.gov/energysaver/weatherstripping
[24] Department of Energy, *Detecting Air Leaks*, n.d., https://www.energy.gov/energysaver/detecting-air-leaks
[25] Department of Energy, *Blower Door Tests*, n.d., https://www.energy.gov/energysaver/blower-door-tests
[26] Department of Energy, *Energy Efficient Window Coverings*, n.d., https://www.energy.gov/energysaver/energy-efficient-window-coverings
[27] 3M United States, *Home Window Energy Savings*, n.d., https://www.3m.com/3M/en_US/home-window-solutions-us/solutions/energy-savings/
[28] Department of Energy, *Insulation*, n.d., https://www.energy.gov/energysaver/insulation
[29] Department of Energy, *Where to Insulate in a Home*, n.d., https://www.energy.gov/energysaver/where-insulate-home
[30] ENERGY STAR, *Methodology for Estimated Energy Savings*, n.d., https://www.energystar.gov/saveathome/seal_insulate/methodology
[31] Department of Energy, *Types of Insulation*, n.d., https://www.energy.gov/energysaver/types-insulation
[32] Environmental Protection Agency, *What is Embodied Carbon?*, n.d., https://www.epa.gov/greenerproducts/what-embodied-carbon
[33] Carbon Smart Materials Palette, *Insulation*, n.d., https://www.materialspalette.org/insulation/

Sources

[34] ENERGY STAR, *Residential Windows, Doors, & Skylights*, n.d., https://www.energystar.gov/products/res_windows_doors_skylights
[35] Pella, *Single vs Double Pane Windows: What's the Difference?*, January 2017 https://www.pellabranch.com/windows-doors/windows/single-vs-double-pane-windows-know-the-difference/
[36] Pella, *Triple vs Double Pane Windows: What's the Difference?*, April 2023, https://www.pella.com/ideas/windows/triple-pane-vs-double-pane-windows/
[37] Department of Energy, *Window Types and Technologies*, n.d., https://www.energy.gov/energysaver/window-types-and-technologies
[38] Department of Energy, *Energy Performance Ratings for Windows, Doors, and Skylights*, n.d., https://www.energy.gov/energysaver/energy-performance-ratings-windows-doors-and-skylights
[39] Department of Energy, *Update or Replace Windows*, n.d., https://www.energy.gov/energysaver/update-or-replace-windows
[40] Department of Energy, *Purchasing Energy-Efficient Residential Windows, Doors, and Skylights*, n.d., https://www.energy.gov/femp/purchasing-energy-efficient-residential-windows-doors-and-skylights
[41] Department of Energy, *Storm Windows*, n.d., https://www.energy.gov/energysaver/storm-windows
[42] Department of Energy, *Doors*, n.d., https://www.energy.gov/energysaver/doors
[43] Constellation, *How Doors Affect Your Home's Energy Use*, November 2020, https://blog.constellation.com/2020/11/30/energy-efficient-doors/
[44] Brothers Services Company, *Pros and Cons of Front Door Materials: Which is Right for Your Home?*, n.d., https://www.brothersservices.com/blog/pros-and-cons-of-front-door-materials/
[45] Window World, *The Power of Energy-Efficient Doors: Comfort and Savings Combined*, September 2023, https://www.windowworld.com/blog/choosing-energy-efficient-doors

Water Heating

[46] U.S. Energy Information Administration, *Use of energy in commercial buildings - U.S. Energy Information Administration*, 29 June 2023, https://www.eia.gov/energyexplained/use-of-energy/commercial-buildings.php
[47] Matulka, Rebecca, *New Infographic and Projects to Keep Your Energy Bills Out of Hot Water,* 2013, https://www.energy.gov/energysaver/articles/new-infographic-and-projects-keep-your-energy-bills-out-hot-water.
[48] Environmental Protection Agency, *Bathroom Faucets*, n.d., https://www.epa.gov/watersense/bathroom-faucets#tab-2
[49] Department of Energy. *Selecting a New Water Heater - Selecting a New Water Heater*. Department of Energy. n.d., https://www.energy.gov/energysaver/selecting-new-water-heater
[50] Department of Energy, Components of a Heat Pump Water Heater, n.d., https://www.epa.gov/watersense/bathroom-faucets#tab-2

Sources

[51] DTE Energy. *Compare Natural Gas Costs*. n.d., https://www.dteenergy.com/us/en/business/service-request/natural-gas/compare-natural-gas-costs.html.
[52] DTE Energy. *Electric Pricing Options*. n.d., https://www.dteenergy.com/us/en/residential/service-request/pricing/rate-options/residential-pricing-options.html
[53] United States Environmental Protection Agency. *Greenhouse Gases Equivalencies Calculator - Calculations and References,* 19 March 2024, https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.
[54] United States Environmental Protection Agency, *eGrid Data Explorer,*26 February 2024, https://www.epa.gov/egrid/data-explorer.
[55] ENERGY STAR, *Building Upgrade Manual: Heating & Cooling*, n.d., https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH9_HVAC.pdf
[56] Jutras, Nate, *What is Uniform Energy Factor and Why Does it Matter?*, n.d., https://www.energystar.gov/products/ask-the-experts/what-uniform-energy-factor-and-why-does-it-matter.

DECARBONIZE SOURCES

Heating Cooling Decarbonization

[57] ENERGY STAR, *Building Manual*, *Chapter 9: Heating and Cooling*, January 2008, https://www.energystar.gov/sites/default/files/buildings/tools/EPA_BUM_CH9_HVAC.pdf
[58] Energy Saver DOE, *Heat Pump Systems*, n.d., https://www.energy.gov/energysaver/heat-pump-systems
[59] Federal Energy Management Program, *Incorporate Minimum Efficiency Requirements for Heating and Cooling Products into Federal Acquisition Documents*, n.d., https://www.energy.gov/femp/incorporate-minimum-efficiency-requirements-heating-and-cooling-products-federal-acquisition#airsource
[60] Trane, *What's a Good SEER2 Rating?*, 5 December 2022, https://www.trane.com/residential/en/resources/blog/whats-good-seer-rating/
[61] Trane, *What is HSPF2?*, n.d., https://www.trane.com/residential/en/resources/glossary/what-is-hspf/
[62] Federal Energy Management Program, *Purchasing Energy-Efficient Residential Air-Source Heat Pumps*, December 2022, https://www.energy.gov/femp/purchasing-energy-efficient-residential-air-source-heat-pumps
[63] Trane, *EER2 What is a Good EER2 Rating*, n.d. https://www.trane.com/residential/en/resources/glossary/what-is-eer/
[64] Federal Energy Management Program, *Purchasing Energy-Efficient Geothermal Heat Pumps*, December 2022, https://www.energy.gov/femp/purchasing-energy-efficient-geothermal-heat-pumps

Water Heating Decarbonization

[65] United States Environmental Protection Agency, *eGrid Data Explorer,* 26 February 2024, https://www.epa.gov/egrid/data-explorer.

Sources

[66] State of Michigan Executive Office of the Governor, *Governor Whitmer Signs historic clean energy climate action package*, 28 November 2023, https://www.michigan.gov/whitmer/news/press-releases/2023/11/28/governor-whitmer-signs-historic-clean-energy-climate-action-package

Renewable Energy

[67] United States Energy Information Administration, *Electricity Data Browser*, 2023, https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2,0,1&fuel=vtvv&geo=g&sec=g&linechart=ELEC.GEN.ALL-US-99.A~ELEC.GEN.COW-US-99.A~ELEC.GEN.NG-US-99.A~ELEC.GEN.NUC-US-99.A~ELEC.GEN.HYC-US-99.A~ELEC.GEN.WND-US-99.A~ELEC.GEN.TSN-US-99.A&columnchart=ELEC.GEN.ALL-US-99.A~ELEC.GEN.COW-US-99.A~ELEC.GEN.NG-US-99.A~ELEC.GEN.NUC-US-99.A~ELEC.GEN.HYC-US-99.A~ELEC.GEN.WND-US-99.A&map=ELEC.GEN.ALL-US-99.A&freq=A&ctype=linechart<ype=pin&rtype=s&maptype=0&rse=0&pin=

[68] DTE Energy, *DTE CleanVision MIGreenPower*, 2024, https://solutions.dteenergy.com/dte/en/Products/DTE-CleanVision-MIGreenPower/p/MIGPGREEN

[69] Consumers Energy, *Solar Gardens*, 2024, https://www.consumersenergy.com/residential/renewable-energy/solar-gardens

[70] Consumers Energy, *Solar Gardens Frequently Asked Questions,* 2024, https://www.consumersenergy.com/residential/renewable-energy/solar-gardens/faq

[71] City of Dearborn, *City of Dearborn commits to 100 percent renewable energy at municipal buildings through enrollment in DTE Energy's MIGreenPower program*, 11 January 2024, https://cityofdearborn.org/news-and-events/city-news/2891-city-of-dearborn-commits-to-100-percent-renewable-energy-at-municipal-buildings-through-enrollment-in-dte-energy-s-migreenpower-program

[72] Detroit Zoo, *Detroit Zoo to Meet 100% Renewable Energy Goal,* 22 August 2019, https://detroitzoo.org/press-release/detroit-zoo-to-meet-100-renewable-energy-goal/

[73] Washtenaw Community College, *WCC furthers sustainability goals with DTE Energy's MIGreenPower program,* 23 June 2021, https://www.wccnet.edu/news/articles/2021-06-23-migreenpower.php

[74] City of Ann Arbor, *City of Ann Arbor 100% Renewable Energy Options Analysis,* October 2023, https://www.a2gov.org/departments/sustainability/Documents/Ann%20Arbor%20Renewable%20Energy%20report%20final.pdf

[75] Scio Township, *Scio Township Environmental Sustainability & Climate Action Plan*, 2023, https://www.sciotownship.org/home/showpublisheddocument/2664/638326206699570000

[76] United States Environmental Protection Agency, *Guide to Purchasing Green Power,* September 2018, https://www.epa.gov/sites/default/files/2016-01/documents/purchasing_guide_for_web.pdf

[77] Environment America Center, *Renewable Energy Purchasing,* 2 October 2017, https://publicinterestnetwork.org/wp-content/uploads/2017/10/Renewable-Purchasing-Environment-America-October-2017.pdf

[78] United States Environmental Protection Agency, *Physical PPA,* 18 October 2023, https://www.epa.gov/green-power-markets/physical-ppa

[79] United States Environmental Protection Agency, *Power Profiler*, 13 February 2024, https://www.epa.gov/egrid/power-profiler#/RFCM

Sources

[80] Smart Energy Decisions, *The City of Harrison Installs Solar Across Municipal Buildings*, 8 June 2021, https://www.smartenergydecisions.com/renewable-energy/2021/06/08/the-city-of-harrison-installs-solar-across-municipal-buildings
[81] Ann Arbor/Washtenaw 2030 District, *Case Studies,* n.d., https://2030districts.org/annarbor/a2-area-commercial-solarize-case-studies/

Funding and Resource Assistance

[82] Ann Arbor/Washtenaw 2030 District, *Energy Management Grant Form,* n.d., https://2030districts.org/annarbor/financing-resources/
[83] EGLE Media Office, *Retired professionals skills advance environmental goals,* 1 February 2023, https://www.michigan.gov/egle/newsroom/press-releases/2023/02/01/retired-professionals-skills-advance-environmental-goals
[84] DTE Energy, *Small and Medium Business Program.* n.d., https://dteenergy.com/smallbusiness
[85] Consumers Energy, *Small Business Energy Assessment,* n.d., https://www.consumersenergy.com/business/energy-efficiency/small-business-solutions/small-business-assessment
[86] SEMCOG, *Grant Opportunities,* n.d., https://www.semcog.org/grant-opportunities
[87] Evans, Cody, *Community Energy Management Program,* n.d., https://www.michigan.gov/egle/about/organization/materials-management/energy/rfps-loans/community-energy-management-program.
[88] Office of State and Community Energy Programs, *Energy Efficiency and Conservation Block Grant Program - EECBG Program Formula Grant Application Hub, n.d.,* https://www.energy.gov/scep/eecbg-program-formula-grant-application-hub
[89] Solar Energy Technologies Office, *Federal Solar Tax Credits for Businesses,* August 2023, https://www.energy.gov/eere/solar/federal-solar-tax-credits-businesses
[90] NREL, *Technical Support Services | State, Local, and Tribal Governments,* n.d.*,* https://www.nrel.gov/state-local-tribal/technical-support-services.html
[91] Beyea, Wayne, et al, *Planning & Zoning for Solar Energy Systems: A Guide for Michigan Local Governments - Planning,* 5 October 2021, https://www.canr.msu.edu/resources/planning-zoning-for-solar-energy-systems-a-guide-for-michigan-local-governments
[92] Michigan Green Communities, *About Michigan Green Communities,* n.d., https://migreencommunities.com/
[93] Department of Environment, Great Lakes, and Energy, *Catalyst Communities*, n.d., https://www.michigan.gov/egle/outreach/catalyst-communities
[94] Department of Environment, Great Lakes, and Energy, *Federal Funding Technical Assistance*, n.d., https://www.michigan.gov/egle/outreach/catalyst-communities/federal-funding-technical-assistance
[95] Department of Environment, Great Lakes, and Energy, *Catalyst Communities Webinars,* n.d., https://www.michigan.gov/egle/outreach/catalyst-communities/webinars

Appendix F - Webinar Agenda

12-12:05 p.m.: Introduction by the Capstone Team
The capstone team introduced ourselves and gave a brief summary of the purpose of this webinar and their project.

12:05-12:25 p.m.: Toolkit Walk-Through by the Capstone Team
The capstone team explained the toolkit's purpose and highlighted key points from each of its sections. Webinar attendees also saw what the toolkit looked like, learned how to navigate it, and found where they could access it on the Ann Arbor/Washtenaw 2030 District website.

12:25-12:30 p.m.: Toolkit Question & Answer Portion by the Capstone Team
The capstone team answered webinar attendees' questions about the toolkit. We also shared our team email address and encouraged attendees to share any additional toolkit questions or comments with us there.

12:30-12:45 p.m.: Michigan Green Communities Overview & Resources by Danielle Beard
Michigan Green Communities Coordinator Danielle Beard provided an overview of the Michigan Green Communities program and the resources it can provide to Washtenaw County CVTs pursuing energy efficiency in their municipal buildings.

12:45-12:58 p.m.: Ann Arbor/Washtenaw 2030 District Overview & Scio Township Case Study by Jan Culbertson & Lissa Spitz
Ann Arbor/Washtenaw 2030 District Leadership Chair Jan Culbertson and associate Lissa Spitz provided an overview of the Ann Arbor/Washtenaw 2030 District and the resources it can provide to Washtenaw County CVTs pursuing energy efficiency in their municipal buildings. They also showcased how Washtenaw County CVT Scio Township has benefitted from these updates and utilized local, state, and federal resources to enact these changes.

12:58-1:00 p.m.: Wrap-Up by the Capstone Team
The capstone team thanked attendees for coming to the webinar and Danielle Beard, Jan Culbertson, and Lissa Spitz for presenting. We provided emails for our team, Danielle, and Jan once again, and encouraged attendees to reach out to us with any comments or questions about the content of the webinar.

Appendix G - Webinar Slides and Recording

The webinar recording can be found here and the slides are included below. Alternatively, reach out to Jan Culbertson at jculbertson@a3c.com for a copy of either the slides or recording.

Creating a more Resilient Washtenaw

Reducing energy use, costs, and greenhouse gas emissions in municipalities' buildings

MICHIGAN GREEN COMMUNITIES

WASHTENAW COUNTY MICHIGAN 1826

ANN ARBOR/WASHTENAW 2030 DISTRICT®

M | SEAS

Toolkit Structure

Learn tools/tips that can measure and track your current energy use

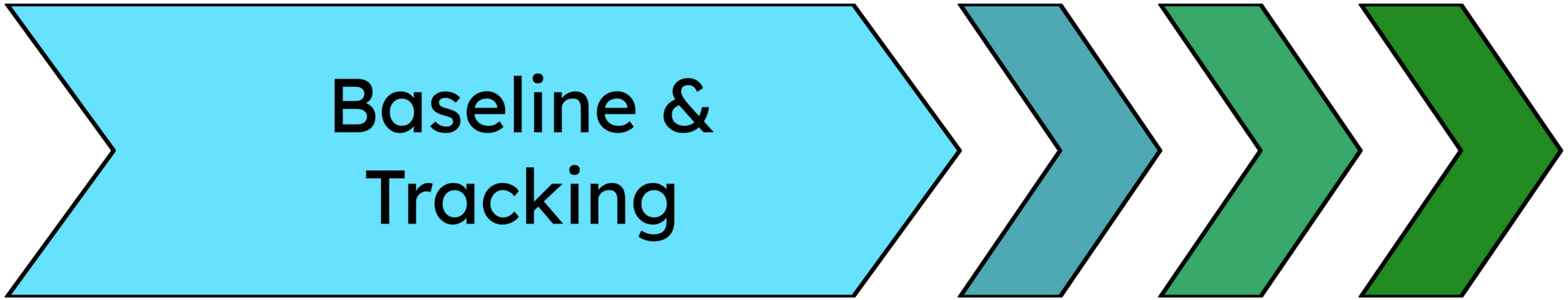
Learn the importance of an energy audit and the importance of it as a step towards energy efficiency

Understand strategies to improve energy efficiency in building operations and equipment

Electrify equipment and shift to renewable energy

Funding and Resource Assistance

List of funding opportunities and resources to assist in implementing all stages of the toolkit


Baseline &
Tracking

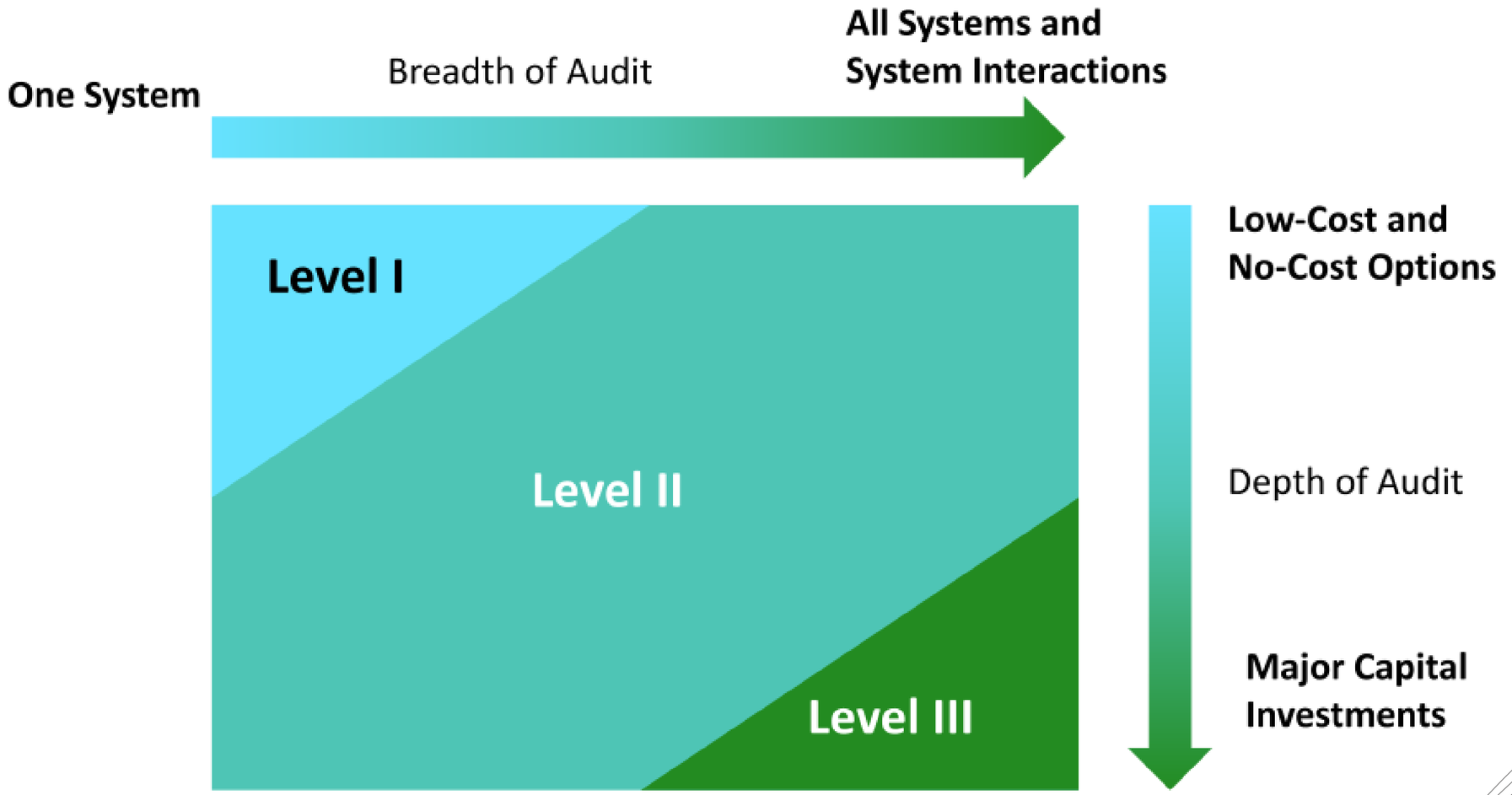
ENERGY STAR® Portfolio Manager®

- ENERGY STAR Portfolio Manager offers an accurate, comprehensive, and secure energy use tracking system.
- DTE will connect your gas and electric accounts directly to your buildings once they are created.
- Ann Arbor/Washtenaw 2030 District is available to assist with setting up your buildings in the program

Information Required

- Year constructed
- Square footage
- Building uses (e.g. office, police station, fire station), and approximate square footage (or percentage of building space) associated with each use.
- Account number(s) for gas & electricity
- Written consent for DTE to share this information with Ann Arbor/Washtenaw 2030 District (if they are helping you set up your buildings).


Energy
Audit



Source: New Buildings Initiative

Energy Audit Summary

TYPE	COST	LEVEL OF ANALYSIS	PROJECT COST ANALYSIS	USE CASE
Level One	$	Surface	No	Small facilities without capital improvement budget
Level Two	$$	More in-depth	General	Larger facilities without previous audits, or facilities looking to undergo renovations
Level Three	$$$	Complex	More specific	Larger facilities without previous audits, or facilities looking to undergo renovations


Improve
Efficiency

Existing Equipment

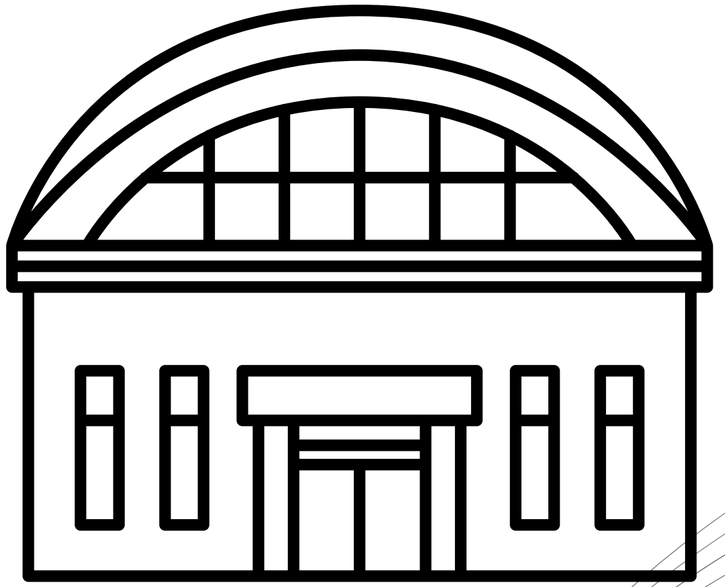
- Create a facility equipment list
  - Help plan and prioritize energy efficiency improvements
- Create a Municipal Energy Action Plan
  - Include measurable energy goals
  - Consider the timeline
  - Plan ahead for costs and funding

Lighting

- Determine target light level to maximize efficiency
- Switch to LEDs for longer lasting and cheaper light
- Consider motion sensor lights for further savings

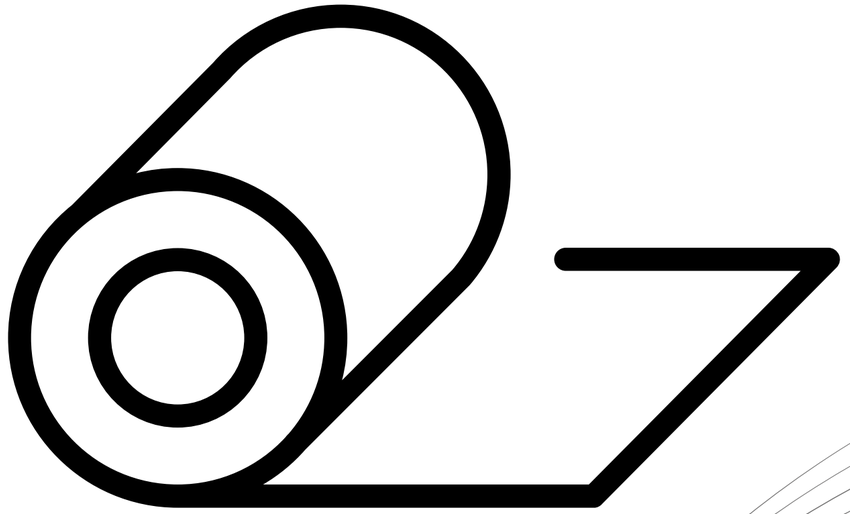
Building Envelope

- Airseal your building
  - ID leaks visually or with a blower door test
  - Seal using caulk or weatherstripping



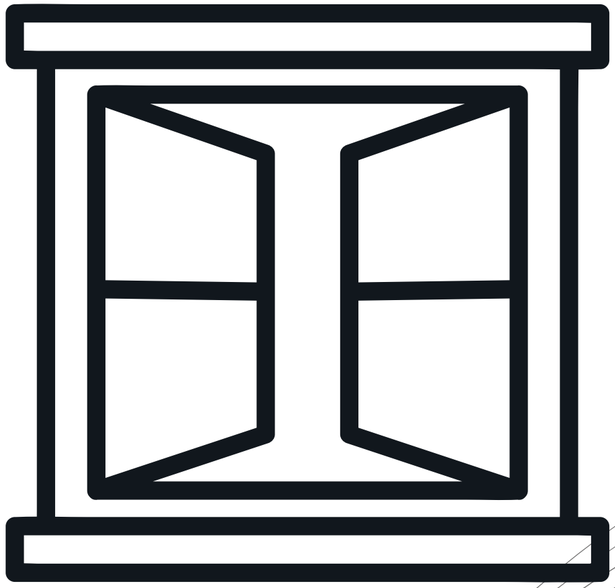
Building Envelope

- Insulation
  - Use the DOE’s Home Energy Saver Tool
  - Where to put what types in your building



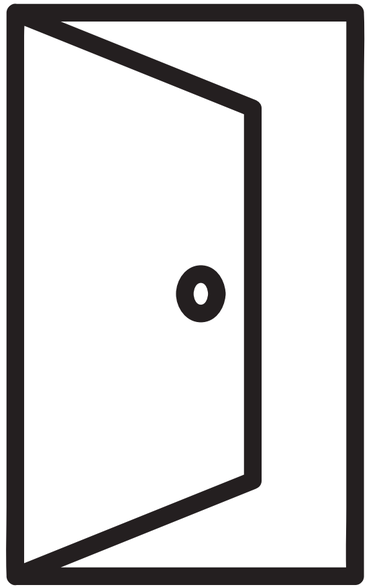
Building Envelope

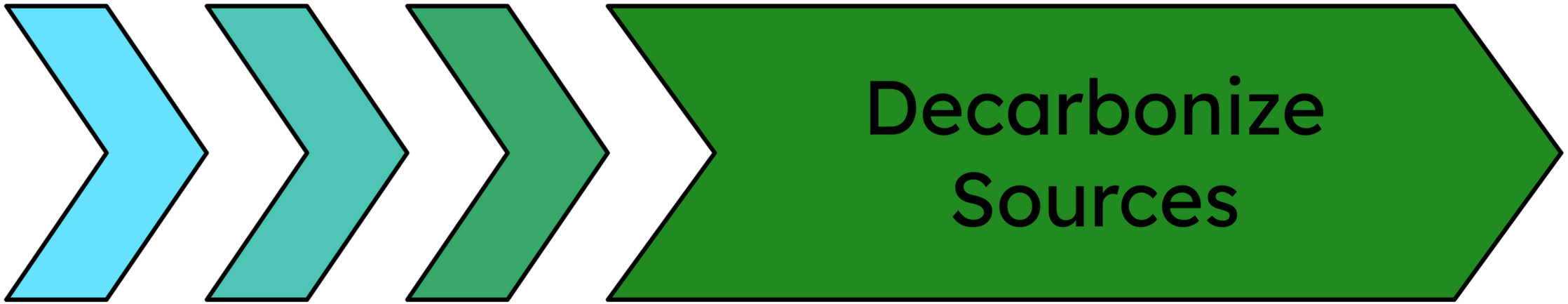
- Windows
  - Window films, thermal shades/blinds, or storm windows
  - OR, invest in new double- or triple-pane with low-e



Building Envelope

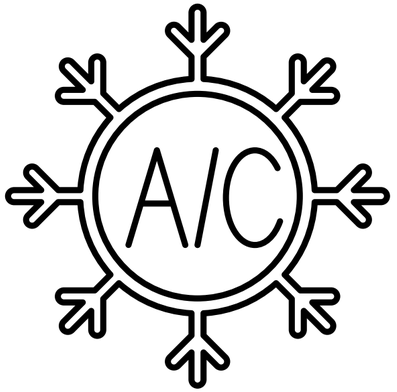
- Doors
  - Fiberglass & vinyl are best
  - Pair with insulating door frame
  - Proper installation is key!

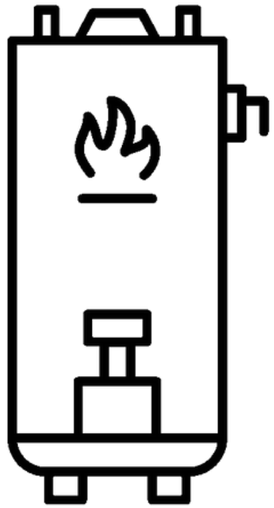


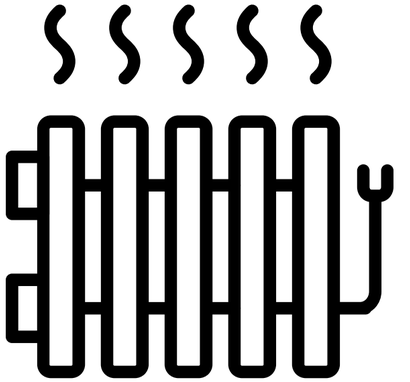

Decarbonize
Sources

HVAC & Water Heating

- When replacing, choose high-efficiency models
  - Energy Star certified
  - Tankless water heaters
- Go electric ⚡
  - Heat pumps

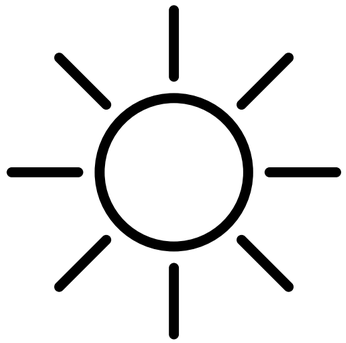


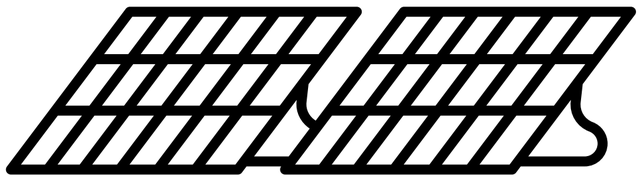




Renewable Energy

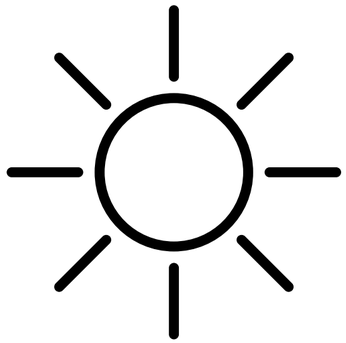
- Renewable Energy Certificates (RECs)
  - Tradeable
  - Allow generation benefits to be claimed
  - Must be retired

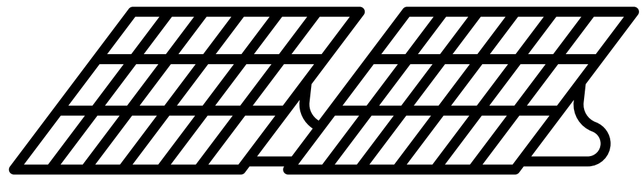




Renewable Energy

- Utility green power
- Power Purchase Agreement (PPA)
  - Physical
  - Virtual
- On-site generation






Baseline & Tracking
Energy Audit
Improve Efficiency
Decarbonize Sources
Funding and Resource Assistance

Funding and Resource Assistance

Energy Audits

ANN ARBOR/WASHTENAW 2030 DISTRICT®

DTE

Consumers Energy Count on Us®

RESTART @ LTU

Energy Efficiency and Solar

SEMCOG

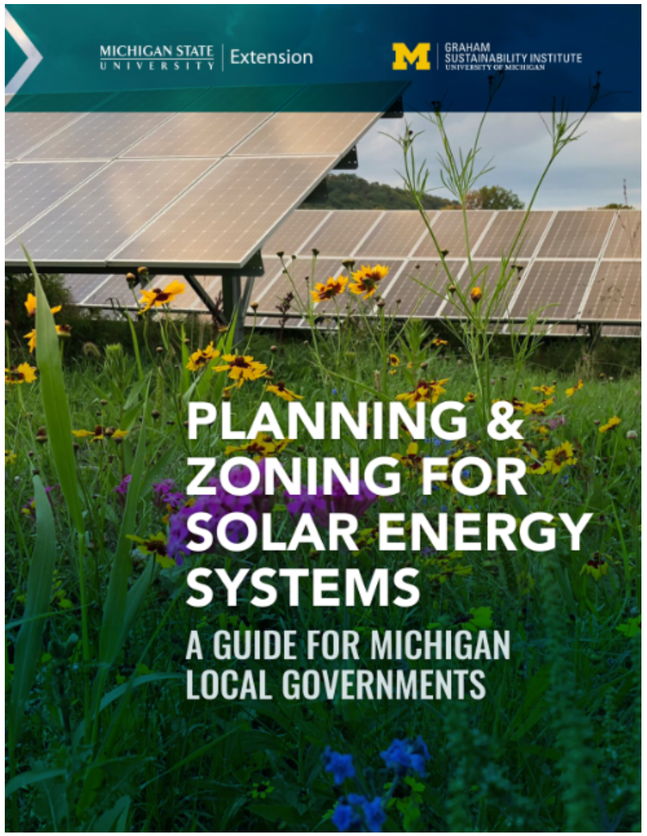
U.S. DEPARTMENT OF ENERGY

EGLE

MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

Funding and Resource Assistance

TECHNICAL ASSISTANCE



NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Funding and Resource Assistance

SEMCOG

MICHIGAN GREEN COMMUNITIES

ANN ARBOR/WASHTENAW 2030 DISTRICT

CATALYST COMMUNITIES


Baseline & Tracking
Energy Audit
Improve Efficiency
Decarbonize Sources
Funding and Resource Assistance

THANK YOU
Questions?