Renewable Energy

INTRODUCTION

When assembling a holistic approach for sustainable communities, the management of energy resources and consumption proves to be the greatest challenge. Here, energy includes electric power and thermal (heating and cooling) delivery, and its production and consumption account for close to 66% of global greenhouse gas (GHG) emissions.

In Oberlin, early changes to the production, procurement, and use of electricity have yielded significant benefits. Oberlin uses financial structures to leverage maximum community benefit, such as the City's sustainable reserve fund and the Oberlin College Student Senate Green Edge Fund. We have also implemented renewable generation projects, including a 2.27 megawatt (MW) solar array and 40 customer-owned solar installations. Energy use is affected by projects like the Oberlin Environmental Dashboard, a community-level, resource-awareness and conservation tool—which also serves as a building monitoring platform for facility operators. In the past decade, the City of Oberlin met its target of cutting 2012 greenhouse gas emissions by 50%, while simultaneously achieving approximately 85% green power for the community.[1]

Reaching and maintaining 85% renewable power is a massive accomplishment. As a community, though, we have yet to address the carbon impact of our thermal (heating and cooling) needs in a meaningful way. The largest opportunity for carbon reduction is finding solutions—especially renewable options—for heating and cooling buildings and processes throughout the City.

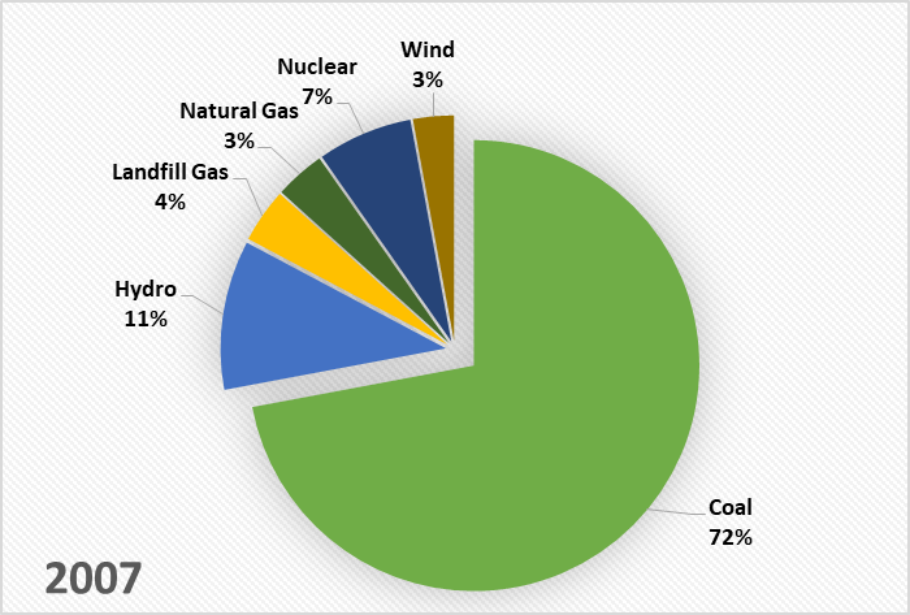
BACKGROUND: THE CITY OF OBERLIN'S ELECTRIC ENERGY PORTFOLIO

Since the City maintains its own municipally operated electricity system, City leaders can make decisions on the composition of its power supply—an opportunity unavailable to most US cities. Furthermore, as a member of American Municipal Power (AMP), Oberlin is involved in a renewable/carbon-neutral joint power supply project and purchases other renewable energy. Since 2007, Oberlin has worked to systematically convert its electric energy portfolio from predominantly fossil fuels to predominantly renewable energy.

Oberlin's 2007 baseline (figure 1) renewable/carbon-neutral power supply included a mix of landfill gas (LFG), hydro, wind, and solar. Still, with the high percentage of coal resources in Oberlin's portfolio, electricity accounted for 55% of community-wide GHG emissions in 2007.

[1] EPA defines green power as electricity produced from solar, wind, geothermal, biogas, eligible biomass, and low-impact small hydroelectric sources. Green power is a subset of renewable energy and represents those renewable energy resources and technologies that provide the highest environmental benefit. www.epa.gov/greenpower.

FIGURE 1: OBERLIN'S ENERGY PORTFOLIO (BASELINE 2007)



Energy used for space heating and transportation presents a different challenge, as the fossil fuel-based sources for these sectors are outside of City control. Natural gas is the major energy source for space heating and is supplied to most customers through an investor-owned utility. Transportation is heavily reliant on oil, which is sold commercially, reducing Oberlin's direct influence on these emissions. Reducing carbon dioxide equivalents (CO_2e) in these sectors can be accomplished by encouraging and promoting the transition from fossil-fuel powered equipment to efficient, renewable, low-carbon, or carbon-neutral alternatives.

RENEWABLE ENERGY GOALS

The City of Oberlin is committed to developing and maintaining an electricity portfolio of renewable resources to provide residents with reliable power at reasonable prices. Specifically, the City strives to:

- eliminate fossil fuel use for electricity generation no later than 2050; and
- transition from fossil fuels to carbon-neutral alternatives in energy sectors for space heating and transportation, to begin as viable technologies allow, with regards to efficiencies and economics.

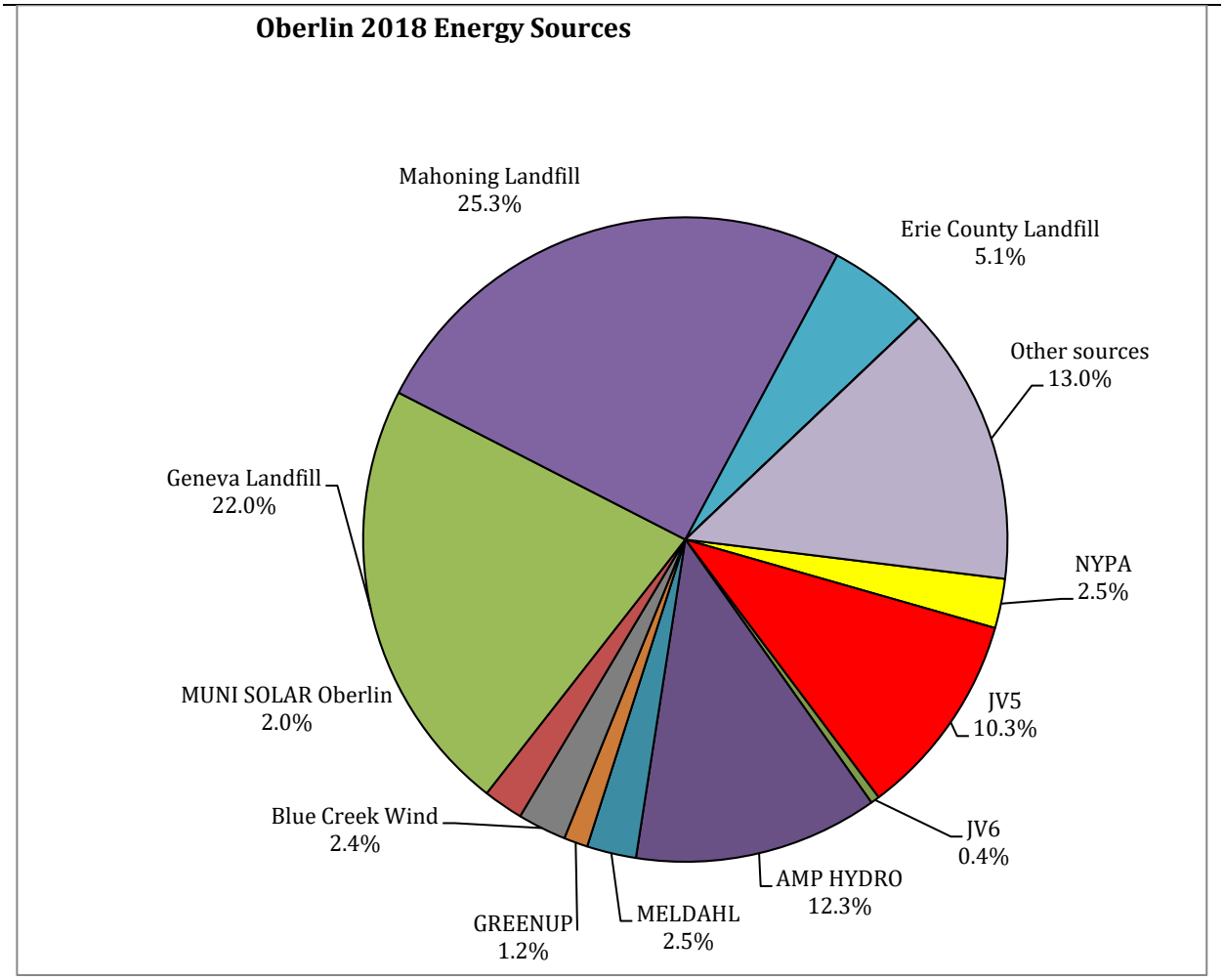
As recommended in the introduction of this document, a GHG inventory is to be completed every five years to monitor the CO_2e reductions in Oberlin's energy use.

PRESENT STRATEGIES

Based on power supply commitments established in 2012, Oberlin's municipal electric utility had an 85% carbon-neutral portfolio of energy sources (figure 2), reducing community-wide emissions by approximately 50%.

Oberlin's electric power supply portfolio continues to move towards the elimination of fossil fuel sources. The Spear Point 2.27 MW solar array, along with the addition of 193 kilowatts (kW) of rooftop solar, has added solar as a measurable component of the portfolio.

FIGURE 1: OBERLIN'S ENERGY PORTFOLIO (2018)



See the appendix for the list of our present strategies for increasing the use of renewable and carbon-neutral energy.

SPOTLIGHT: SPEAR POINT SOLAR ENERGY 2.27 MW PV FIELD AND ROOFTOP SOLAR

In 2012, the City and the College collaborated on the development of a 2.27 MW solar photovoltaic facility located on 11 acres of college-owned property in New Russia Township. The solar

photovoltaic project was designed and constructed by SPG Solar of Novato, California, and incorporates a single-axis tracking system for solar production enhancement. The City and the College entered into an agreement to permit interconnection of the photovoltaic solar facility to the City's electric distribution network to virtually deliver the solar generation output to college properties. The College entered into a power purchase agreement with the owner, Spear Point Energy of Aspen, Colorado, to purchase the renewable solar energy. The project produces almost 3,000 megawatt hours (MWh) of renewable energy annually, which equals close to 12% of the College's power supply requirements. Additionally, the project offers benefits to the City as a renewable fuel resource and reduces wholesale power transmission and capacity costs.

SPOTLIGHT: LORAIN SUN

In 2015, a group of Oberlin residents identified as Oberlin Peoples Electric Cooperative (OPEC) came together to form a community-based solar cooperative (of sorts). The group worked with the Community Power Network (CPN), which provided technical and organizational expertise. CPN had worked with local groups to create "solar neighborhoods" in Washington DC, West Virginia, and Maryland. CPN collaborated with OPEC to provide educational forums, develop and solicit quotes from multiple solar installation companies, evaluate bids, and select the successful installer. Due to the expanding interest in solar beyond Oberlin, the organization became Lorain Sun. To date, Lorain County has completed 50 installations due to Lorain Sun influence, totaling 328.27 kW. Thirty-one of these arrays, totaling 194 kW, were installed on Oberlin businesses, churches, and homes. Following its establishment in Oberlin, the Ohio CPN has grown to over a dozen communities across the state**.**

CAPITALIZE ON THE MARKET FOR RENEWABLE ENERGY CREDITS

Renewable energy credits (RECs) represent the environmental benefits associated with renewable energy production in the form of tradable commodities. RECs can be sold to create a separate revenue stream to fund renewable energy projects and may be used as a regulatory compliance tool to meet mandatory renewable portfolio standards. Once a REC is sold, the environmental attributes associated with the renewable energy production can no longer be claimed. A number of OMLPS' renewable energy sources within the state have higher-value RECs than out-of-state RECs. Oberlin has successfully utilized the REC market to collect over $3,000,000 since 2006 for use in the City of Oberlin's Sustainable Reserve Program.

THE SUSTAINABLE RESERVE PROGRAM AND THE SUSTAINABLE RESERVE FUND

The sustainable reserve program is managed by OMLPS and funds electric-related sustainability efforts in municipal facilities, including:

- Providing Oberlin with Efficiency Responsibly (POWER; see the chapter on energy use, conservation, and efficiency);
- the Oberlin super rebate programs for residential electrical appliances;
- commercial light emitting diode (LED) lighting and electric home weatherization; and
- numerous municipal electrical efficiency measures (e.g., LED street lighting).

The sustainable reserve fund is managed by the sustainability coordinator, and it funds other sustainability efforts outlined in the Oberlin Climate Action Plan, including:

- the expanded use of the sustainable reserve fund to assist environmentally positive endeavors, in terms of funding capacity and scope of allowable projects; and
- greater funding to achieve higher targets of energy efficiency than proposed in the current Efficiency Smart program offered through AMP.

POTENTIAL STRATEGIES

Given the goal of eliminating fossil fuel use, Oberlin will continue to acquire assets of renewable energy to supply our community's electricity and other needs, as technology and opportunity allow. In turn, the City can promote transitioning to carbon-neutral electricity for sectors relying on fossil fuel, and to utilize existing opportunities in the renewable energy market to finance additional GHG reduction efforts.

REPLACE NATURAL GAS FOR HEATING

Natural gas is widely used in Oberlin for space heating, domestic hot water (DHW), and cooking. Replacement of natural gas use with electricity or carbon-neutral energy sources should be encouraged. Both traditional insulated-tank and newer on-demand water heaters can be purchased as electric models and are an efficient method of providing DHW. Electric air-source and ground-source heat pumps have been proven to be successful for over 20 years, and their prices continue to fall as their efficiency improves. Even though equipment costs have decreased, the installation cost of space- and water-heat pump systems remains significantly higher than natural gas systems. Oberlin has implemented a successful electric efficiency incentive rebate program and should consider implementation of additional financing and rebate programs to encourage the replacement of fossil-fuel heating equipment with high efficiency electric water- and space-heating equipment with electricity supplied from the City's renewable and carbon-neutral portfolio.

LANDFILL GENERATION WASTE HEAT RECOVERY

A possibility currently under review involves Oberlin accessing high temperature hot water from the landfill generation facility located east of the city. Presently the landfill methane gas is burned in engines that generate electricity. This process creates a large amount of heat that is presently being released to the atmosphere. A project, in the conceptual design phase, is being considered that would capture this waste heat and use it to generate high-temperature hot water to heat and cool many facilities in Oberlin. An underground distribution piping system could deliver the hot water to commercial and industrial facilities, including the Oberlin City Schools, municipal facilities, churches, and college facilities. This project is expected to offset a substantial amount of natural gas usage for heating. The waste heat could also be utilized, for example, as absorption chillers for cooling in the summer months.

REPLACE GASOLINE AND DIESEL FUEL

Gasoline and diesel are the common fuels utilized for motorized transport. To encourage electric vehicle use the City should consider adoption of policies that encourage electrified transport such as

targeted rates for charging electric vehicles during off-peak hours or other mechanisms that ensure cost-effective and carbon-neutral vehicle charging.

Municipal Building Solar Expansion

Presently the fire station and the Oberlin Municipal Light and Power System (OMLPS) technical services building have solar arrays installed. These arrays have been successful in reducing purchased power for the City electrical use. The City will continue to research additional public building sites for solar array installation.

EcoSmart Choice Program

EcoSmart Choice® is a green-pricing program offered by AMP through its member municipal electric systems. Residential, commercial, and industrial customers with EcoSmart Choice are able to offset levels of monthly electric usage with renewable energy for an additional cost of 0.3 cents per kWh (i.e., $0.003/kWh) or $3.00/MWh. The current EcoSmart Choice solicitation offers participation levels of 25%, 50%, 75%, or 100%. The City will look at participating in the EcoSmart Choice program. As a participating municipality, customers can sign up for the program via the website (www.ecosmartchoice.org), phone call, a visit to the utility office, or response via US post—depending upon the local utility. Customers can join or drop out at any time, without penalty.

Municipal Renewable Energy Educational Facility

A solar array coupled with a small wind turbine and energy storage technology would provide both additional renewable power and an educational facility for the public. This interactive renewable energy facility could be located in the open area just east of the Underground Railroad Museum and McDonald's. Informational signage would be included to explain the renewable energy sources and the potential for energy storage.

Conclusion

Oberlin maintains a long-standing commitment to renewable energy and strives to eliminate carbon emissions from electricity generation no later than 2050. In 2018, Oberlin's municipal electric utility had an 80% carbon-neutral portfolio of energy resources and is projected to be at 85% renewable in 2019. Reduction of CO_2e emissions from other sectors relying on oil or natural gas can be accomplished by transitioning to carbon-neutral electricity. As technology and opportunity allow, Oberlin will continue to acquire renewable energy generation to supply our community's electricity needs.

APPENDIX

TABLE 1: STRATEGIES IN RENEWABLE AND CARBON-NEUTRAL ENERGY

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
AMPJV6: Bowling Green wind project	OMLPS	1999–2030	Owned asset, renewable
New York Power Authority (NYPA)	OMLPS	1999–2030	Low cost, baseload resource, renewable
Belleville Hydro Project	OMLPS	1999–2050	Owned asset, baseload resource, renewable
Customer-owned solar generation	Utility customers	1999–ongoing	Local assets, peaking resource, renewable
Sustainable reserve fund	OMLPS	2007–ongoing	Provides funding for GHG reduction efforts
Ohio Renewable Energy Services, LLC; Erie County LFG	OMLPS	2010–2022	Contract capacity and ½ RECs, baseload resource, carbon-neutral
Iberdrola Renewables Blue Creek wind project	OMLPS	2012–2022	Contract capacity/RECs, renewable
Spear Point Solar One, LLC, the College solar field	college	2012–2036	Customer-owned generation, peaking resource, renewable
Waste Management Renewable Energy, LLC; Mahoning & Geneva County LFG	OMLPS	2013–2027	Contract capacity/RECs, baseload resource, carbon-neutral
AMP hydro phase I: Cannelton, Smithland, and Willow Island	OMLPS	2013–2080	Owned asset, baseload resource, renewable
AMP hydro phase II: Meldahl and Green-up	OMLPS	2014–2080	Owned asset, baseload resource, renewable
Explore energy-storage technology	OMLPS	2018–2023	
Landfill generated distributed hot water	City and college	2020–2024	Reduces GHG from natural gas
Purchase additional RECs to offset market power purchases	OMLPS	2019–ongoing	Keep electric costs low while reducing our carbon footprint
Join EcoSmart Choice to provide opportunities for electric customers to purchase RECs to offset their GHG emissions and research possibilities to offset natural gas through EcoSmart as well	OMLPS–AMP	2019	More GHG mitigation options for residents and businesses
Install municipally owned solar	OMLPS	2019–2024	Increased renewable energy percentage
Incentivize the replacement of gasoline and diesel fuel	City	2019–ongoing	Reduced GHG
Municipal renewable energy educational facility	City	2020	Educate residents
Add additional renewable energy sources to portfolio	OMLPS	2019–ongoing	Reduced use of fossil fuels

Renewable Energy Sidebars

RE Sidebar 1: About Renewable Energy

WHAT IS RENEWABLE ENERGY?

Renewable energy resources are replenished eternally. According to the National Renewable Energy Laboratory (NREL), renewable energy sources include solar, wind, biomass, geothermal, ocean, and hydropower.

BENEFITS OF RENEWABLE ENERGY

Renewable energy creates tangible benefits for Oberlin and our region, including environmental improvement, increased fuel diversity and security, regional economic development benefits, and local revenue.

- **Environmental.** Emissions of carbon dioxide, mercury, nitrous oxide, sulfur dioxide, and particulate matter are significantly reduced. Damage associated with fuel extraction, processing, and transport is almost eliminated.
- **Fuel diversity and security.** Multiple energy assets mitigate risk from underperformance or loss of any one source. Energy sources spread across two regional transmission organizations and multiple transmission networks serves to minimize risk. Energy sources within Oberlin are effectively insulated from regional grid outage.
- **Economic benefits.** Rate stability immune to the volatile market swings of fossil fuels. Utility revenues paid to Ohio-based companies provide local jobs and circulate money through the local economy. Oberlin-based energy sources avoid transmission fees and garner capacity credits, both of which lower electricity rates. Reliable electricity with stable rates is attractive to new and existing businesses that provide jobs for the community and support a healthy tax base.
- **Local revenue.** Since 2006, the City has benefited financially from selling RECs to the College. A REC encapsulates the positive environmental attributes of electricity from a renewable source and can be sold as an asset to another entity wishing to offset the negative environmental attributes of its power source.

CHALLENGES OF TRANSITIONING TO RENEWABLE ENERGY

The wind does not always blow, and the sun does not always shine. Still, we are accustomed to making use of electricity at the flip of a switch. Replacing fossil fuel generators running continuously with highly intermittent renewable energy is not a satisfactory solution. Until the technology is available to efficiently store and utilize renewable energy with low capacity factors (e.g., solar and wind power offer 10%–40% capacity factors), we have little choice but to rely upon interim sources of low-carbon or carbon-neutral power. The most promising of these energy sources is landfill gas (LFG), which is derived from the decomposition of organic matter in municipal solid waste and is widely considered a carbon-neutral energy resource. LFG, though, is a byproduct of landfills, and landfills are only replenished as long as we continue to generate and dispose of waste in the same way. While LFG is considered renewable, it will eventually be depleted if we continue to improve the rate and volume of recycling and, in turn, reduce the use of landfills. Note, too, that GHG

emissions are produced in the initial construction and continuing operations and maintenance of renewable energy infrastructure—a.k.a. as the embodied carbon footprint.

OUR GOALS AND OUR MEANS TO ACHIEVE THEM

RE SIDEBAR 2: OBERLIN'S RENEWABLE ELECTRICITY PORTFOLIO

Renewable energy became a key component of the power supply of the City in 1994, when Oberlin City Council voted to join 41 other AMP communities to develop the Belleville Hydro Plant, a 42 MW hydro project on the Ohio River. This renewable project (est. 1999) now provides Oberlin with 7.1% of its annual power supply. This effort has continued with further investments in hydro, wind, and LFG resources.

The then-impending closure of AMP's Gorsuch coal-fired power plant in 2011 provided the impetus for Oberlin's quest to find a better source of affordable and reliable electricity. Oberlin commissioned a power supply study by the consulting firm Black & Veatch in 2009 to identify energy sources with an appropriate balance of cost, long-term reliability, and sustainability.

The results of that study and subsequent diligence in power-supply procurement have transformed Oberlin's energy portfolio from one heavily reliant on fossil fuels to a portfolio replete with renewable and low-carbon energy sources.

SIDEBAR: GREENHOUSE GAS CONSIDERATIONS WHEN SWITCHING FROM FOSSIL FUEL TO ELECTRICITY USE

In the near future, the City of Oberlin will have an electric supply that is largely carbon-free. Thereafter, most of the City's GHG emissions will be associated with non-electric uses of energy, including natural gas used for heating and fossil fuels for transportation.

One option to reduce natural gas usage is to switch to carbon-free electric technologies for heating and transportation; however, there are a couple of important things to consider. First and foremost, switching from natural gas to carbon-free electric energy would be one way to reduce GHG emissions, if Oberlin's carbon-free electric supply were not finite and Oberlin were an energy island—i.e., not connected to the larger electric grid. Since neither of these conditions prevails, both have important GHG implications for any increase in electric load.

Should demand upon Oberlin's renewable electric supply reach maximum capacity and additional renewable power resources are not available, any additional electric load is to be supplied by market power. This market power is mostly generated by burning natural gas or coal at roughly 33% efficiency. Therefore, on average, every unit of natural gas heating energy in Oberlin that is replaced with one unit of electric energy results in the burning of three units of natural gas (or coal) at a power plant within the grid. As a result, GHG emissions (outside of Oberlin) are three times greater than they would have been in Oberlin, had natural gas been used for heating in the first place. In general, switching from natural gas to electric energy for heating results in increased GHG emissions—unless the electric technology employed for heating will use 33% as much electric energy as the alternate natural gas heating system it would replace. Some, but not all, air-to-air and ground-source heat pump systems can deliver such savings. And, an electric domestic instant-hot water system may also deliver such savings (since it does not have the standby losses of the typical hot water storage tank). This prospect depends on the details of the usage.

The City should encourage fuel switching from natural gas to electric energy, first, when the technology employed is cost-effective and, second, when such switching will result in the overall reduction in primary energy use or overall GHG emissions. As fuel switching increases electricity use in Oberlin, OMLPS will need to increase its carbon-neutral resources, customers will need to increase energy efficiency efforts to offset the increase, or both.

This CAP aims to be holistic. The relationship of energy efficiency and fuel switching needs to be a symbiotic one. Oberlin needs to establish its optimal level of consumption from the grid and then strategically balance fuel switching and energy conservation to maintain that balance.

# # #

Energy: Use, Conservation, and Efficiency

INTRODUCTION

Every activity requires the expenditure of energy. Where we source that energy and how to maximize its use are important factors to consider in the reduction of carbon emissions. The traditional goal of energy efficiency is to accomplish a given set of tasks with less energy. Energy efficiency can result from improvements in technology, better management of existing technology, or better organization of existing systems. Increasing the energy efficiency of fossil fuel-based systems will decrease costs and carbon emissions. Still, this activity will never achieve the long-term goal of becoming climate positive. Rather than using fossil fuels more efficiently, our goal is to eliminate our reliance on fossil fuels.

BACKGROUND: IMPACT OF ENERGY EFFICIENCY ON OBERLIN'S GREENHOUSE GAS EMISSIONS

Efficient use of electricity and natural gas are both important to pursue as energy efficiency is an important way to reduce greenhouse gas (GHG) emissions. In fact, you may be surprised to know that this remains true even though Oberlin's electricity portfolio is mostly carbon neutral, due to Oberlin's connection to the nation's electric grid, which remains inefficient and carbon-intensive. As covered in the chapter on renewable energy, Oberlin's current portfolio varies from 80-85% carbon neutral and 15–20% fossil fuels. Natural gas, the major energy source for space and water heating, accounts for close to 18% of Oberlin's GHG emissions. Therefore, increasing the heating efficiency of Oberlin's building stock is an important short-term strategy for reducing GHG emissions.

A longer-term goal for achieving climate positive status will be to shift heating from natural gas to renewable resources. Because natural gas is widely used by businesses and households, maximizing GHG emission reductions through fuel switching will be labor intensive and expensive. Creating a system that motivates people to use less energy and providing homeowners and businesses with the resources they need to make informed decisions will be crucial to maximizing efficiency, improving comfort, and saving money.

ENERGY EFFICIENCY GOALS

The City's electric power supply commitments create a near-term baseload energy surplus: i.e., the City can accommodate additional electricity sales from our carbon-neutral portfolio. Conversely, a reduction in electricity sales would necessitate an increase in electric rates to cover the operating costs of the utility. The City must seek an appropriate balance between energy efficiency reductions and managing its load profile for the fiscal health of the utility. Therefore, the City aims coincidentally to reduce electricity demand through efficiency improvements and increase electricity demand by replacing natural gas and gasoline usage with electricity.

PRESENT STRATEGIES

SUSTAINABLE RESERVE PROGRAM

This program offers a funding mechanism for CAP goals related to electricity use (est. 2007, reaffirmed by Oberlin voters in 2017), and allows market trading of the utility's renewable energy credits (RECs), which results in positive cash flow.

Pay-it-forward Program in Churches

In 2016, First Church in Oberlin underwent an LED upgrade of all their lighting. The congregation decided to donate the resulting Efficiency Smart rebate money to Rust Methodist Church, to help fund their own LED upgrade. The rebate money from that project was then paid forward to help another church. Super-rebate money from the City's sustainable reserve program was combined with a grant from the College's Green Edge Fund to further advance this cascading benefit for local churches. This pay-it-forward program is successful and growing. Not only does each church facility realize lower utility bills, church members may be inspired to implement energy efficiency in their own homes.

Environmental Dashboard

The dashboard provides a real-time display of electricity use, water flows, and environmental conditions across the City, in order to communicate the collective impact of individual choices. Dashboard displays are now installed in local public schools, the College, the public library, City hall, the Hotel at Oberlin, the IGA grocery store, and businesses in the downtown district. See www.environmentaldashboard.org for more information.

Providing Oberlin with Efficiency Responsibly (POWER)

POWER was founded in 2008 in collaboration with Zion Community Development Corporation and Oberlin Community Services. The purpose of this non-profit, grassroots, environmental justice organization is to increase the energy efficiency of Oberlin housing and, in particular, to help modest-income residents outfit their homes with energy efficiency upgrades. Since 2008, POWER has insulated and weatherized 138 houses, resulting in reduced emissions of CO2e. POWER estimates that 40% of the housing stock (approximately 800 homes) still require efficiency upgrades. POWER aims to facilitate efficiency retrofits of the inefficient housing stock in Oberlin through 2025.

Related Strategies

- Lighting and appliance upgrades in municipal buildings;
- replacement of heating/cooling systems with air-source heat pumps;
- LED upgrade of municipal lighting (traffic signals, street lights, etc.);
- electric vehicles and fleet fuel economy; and
- Efficiency Smart: commercial energy consulting.

Near-term Strategies

The strategies recommended below are expected to help Oberlin achieve its energy use and efficiency goals. They are based on best practices and policies identified by other electric utilities. Adoption of new technology and policies will depend on research, feasibility of implementation, and cost-benefit analyses.

Building Performance Audits and Disclosures for Residential and Commercial Properties

Consumers need better information about the energy costs of buildings when they consider buying, renting, or leasing properties. A growing practice across the country is to require sellers and landlords to share this information with prospective buyers and tenants. The City should consider either a building energy performance audit program or a voluntary rating system.

Commercial Customer Energy Advocate

The City can build on the success of POWER in the residential sector by establishing a one-stop shop for commercial energy efficiency information and assistance. This may take the form of an expanded relationship with Efficiency Smart, a new position within the City, or a contract through an energy service company. The energy advocate would promote the various energy efficiency programs offered, work with customers to identify cost-effective methods for lowering energy bills, specify and monitor the upgrades as necessary, and ensure that the rebates are processed in a timely manner. The energy advocate at POWER has been invaluable, and a similar position for commercial customers can aid our pursuit of our climate action plan (CAP) goals.

Municipal Buildings: Fuel Switching

All municipal facilities will be supplied by 100% carbon-neutral energy by 2025—where it makes financial sense.[2] The City should commit to reducing existing energy use, replacing natural-gas heating and cooling systems with heat pumps, subscribing to carbon-neutral natural gas supply, and investing in solar photovoltaics to make-up the remaining 15–20% of the energy portfolio from "carbon-positive" electricity sources. This could be done either on or off site, via a third party to take advantage of existing federal incentives, utilize unused municipal property, or in partnership with other AMP communities through a joint venture.

Water Heater Replacement Program: Fuel Switching

Under the sustainable reserve program, the City will establish a water heater replacement program for customers of Oberlin Municipal Light and Power System (OMLPS). Customers replacing a natural gas water heater with a high-efficiency, electric heat-pump water heater may qualify for one or more of the following: an Efficiency Smart rebate, a SRP Super Rebate, and a federal tax credit. The utility could facilitate loans, cover the remaining balance through an administered grant program, or both. Electric water heaters using carbon-neutral electricity will reduce carbon emissions and increase electricity sales for the utility.

Heating, Ventilating, and Air-Conditioning Upgrades

Under the sustainable reserve program, the City will establish incentives to encourage and assist with the installation/replacement of space heating and cooling units. New natural gas units must be Energy Star certified to qualify, and units listed as Energy Star "most efficient" should receive added incentive. In addition, efficient all-electric units such as air-source and ground-source heat pumps with a Seasonal Energy Efficiency Ratio rating of 18 or higher will qualify for substantial SRP

[2] To be determined by a payback of 15 years or less or an increased cost of no more than 20% utilizing our carbon neutral electric grid.

rebates beyond the rebates offered for high-efficiency gas furnaces or boilers. Rebates for heating, ventilating, and air-conditioning (HVAC) equipment are not currently offered by Efficiency Smart, while SRP offers local rebates. All-electric HVAC equipment using the utility's carbon-neutral electricity will reduce carbon emissions and increase electricity sales.

UPDATE OMLPS AUTHORIZATION: OBERLIN CODIFIED ORDINANCES CHAPTER 913

The defining authorization for OMLPS is Oberlin Codified Ordinance Chapter 913, which received its last substantial update in 1957. Due consideration should be given to an update of chapter 913 to explicitly provide for both the provision and conservation of electricity to furnish light, power, and heat services. Based on the establishing ordinance of 1927, the purpose of the utility included electricity for heating. That purpose was reiterated in ordinance no. 119 of 1934. Interestingly, with the codification of 1954, no express purpose was attributed to the utility, although further reading of chapter 913 seems to indicate its primary purpose is the contractual provision of electric service. It also lists a cross reference to the Ohio Revised Code (ORC) 715.06, which expressly provides for a municipality to furnish its inhabitants with light, power, and heat. Based on its founding ordinances and citation of ORC 715.06 in the 1954 codification as a municipal department, OMLPS was created with and still has the authority to provide light, power, and heat services. Plain language codification would eliminate interpretive ambiguities and provide clarity to the role of the electric utility in energy conservation. Additionally, a municipal service created for the express purpose of energy conservation and efficiency, the new Office of Sustainability, will operate parallel to OMLPS and administer the sustainable reserve fund to implement the measures outlined in the CAP.

RESEARCH HOW TO AGGREGATE OUR NATURAL GAS SUPPLY AND ADD CARBON FEE

In 2018, Athens, Ohio, the home of Ohio University, became the first City in the state to enact a carbon fee through a voluntary opt-out electric aggregation program. Customers realize savings through lower rates and contribute less than $2 a month toward funding a community solar program. In 2011, voters approved a ballot initiative to allow the City of Cincinnati to negotiate on behalf of its citizens and small businesses for a favorable price from suppliers of electricity and natural gas. It is the first aggregation program in the nation to offer 100% carbon-free energy for natural gas and electricity. Oberlin will investigate this possibility and consider a natural gas aggregation program with an associated carbon fee.

FUTURE STRATEGIES

> "It's tough to make predictions, especially about the future."
> Yogi Berra

The following strategies highlight future investigations that are likely outside the five-year time frame of the CAP 2019 update. It is important to note, though, that the concept of fuel-switching was not fully developed and yet received mention in the 2013 CAP.

OBERLIN MUNICIPAL LIGHT AND POWER SYSTEM: AN ENERGY SERVICE COMPANY

Municipal electric utilities such as OMLPS must transition quickly from the traditional electricity sales-based business model to an à la carte energy services provider to remain viable. Energy service companies (ESCOs) have been reducing their customers' bills via installed energy efficiency improvements for quite some time. However, utilities such as OMLPS have noticed flat or declining

sales as their collective customer base purchases less electricity due in large part to these efficiency measures. Rising costs for the utility coupled with declining sales would lead to a budget crunch. So, if this energy efficiency scheme is bad for the utility, then why are we doing it?

Operating as an ESCO provides one solution to declining energy sales without raising rates to compensate. First, the utility can institute efficiency services such as weatherization, lighting, and appliances as a low-cost or at-cost offering to their customers. Second, the reduced electricity sales due to energy efficiency can be compensated through increased electricity sales attributed to fuel switching. Appliances previously utilizing natural gas such as water heaters, furnaces, or kitchen ranges could be replaced with electric appliances as part of the ESCO service. Electric vehicles which replace gasoline-powered vehicles would also qualify. Incentives offered may include reduced-rate bank financing, direct rebates, preferential electricity rates on additional customer meters, or group buy offerings. The business model for fuel switching is sound. A simultaneous reduction in carbon emissions will be achieved so long as the energy portfolio of the utility has lower carbon emissions than direct combustion of natural gas. Currently, OMLPS's portfolio is 80%-85% carbon neutral. In turn, we can work to reduce customers' bills, increase revenue for our electric utility, and reduce our overall carbon emissions.

Finally, an important source of revenue for the utility comes from outside of the traditional customer base. One longstanding source of revenue for OMLPS is capacity credits from its generation plant. Another profitable benefit of OMLPS's energy portfolio is the trading of RECs, whereby the utility benefits, first, by selling RECs to satisfy the renewable portfolio standards of adjacent states and, second, replaces them with low-cost RECs from western wind farms. A third revenue source for the utility is aggregating and monetizing unused electricity resulting from energy efficiency improvements. A fourth benefit to the utility is decreased demand charges levied by the PJM Interconnection LLC (a regional transmission organization) due to electricity generation from local behind-the-meter solar and landfill gas generators and AMP collaborative peaking projects. Opportunities for additional outside revenue must be explored: e.g., additional service offerings, public/private partnerships that may access markets and tax-related benefits not available to a traditional public utility.

Evaluate and Consider Adoption of Smart Grid Technologies for Future Real-Time Monitoring of Energy Consumption and Load Control Opportunities

Advanced Metering Infrastructure (AMI), which allows for two-way communication between the customer's meter and the utility through software and hardware upgrades, can offer opportunities for a utility to better manage its peak-load requirements and help customers understand and better manage their energy consumption. In consideration of future upgrades to its metering infrastructure, OMLPS will research the benefits and costs of AMI, including real-time monitoring, load control, and other enhanced customer services.

Conservation Goals

Behavior and Education

Developed by Professor John Petersen and students of Oberlin College, energy orbs make basic electricity use information visible to residents by translating a building or floor's current level of consumption into a spectrum of colors. The glowing colors display how much a building is

consuming at that moment relative to normal consumption. The orb glows red if a dorm is consuming double or more of its normal electricity use. It shifts toward yellow as consumption approaches a typical rate. The color of the orb further shifts towards green as consumption approaches half of its normal electricity use. In spring 2008, energy orbs were installed in the lobbies of six residence halls at the College and, since then, controlled research has established clear reductions in energy consumption in dorms with energy orbs. Surveys found that residents viewed the orbs regularly and that the orbs motivated conservation and improved understanding, interest, and awareness of electricity use.

The environmental dashboard team went on to develop the characters "Flash" the energy squirrel and "Wally" Walleye on their website. Like the orbs, Flash and Wally's behavior reflects the relative consumption of energy. Behavior of individuals greatly impacts energy use and can exceed energy savings through efficiency measures alone. During the school year, students at the College and the Oberlin public schools compete in the Eco Olympics for bragging rights over comparative energy savings. During the competition, students often unplug vending machines, remove light bulbs, and find comparably unorthodox ways to reduce electricity use. However, these practiced behaviors tend to become habitual: post-competition energy use is consistently lower. Clearly, changes to behavior based on education and feedback can have a marked and lasting impact on energy consumption. (See, too, the chapter on education in this report.) The City should consider providing utility customers with emotional feedback on electricity consumption compared against their own long-term average and against that of their neighbors to induce behavior change through friendly competition.

PROGRAMMABLE THERMOSTATS

While it may not always be cost-effective to replace HVAC systems with more efficient units, significant energy savings can be achieved for any central heating/cooling system with the use of a programmable thermostat. According to the US Department of Energy, you can save as much as 10% per year on heating and cooling by simply turning your thermostat back 7-10°F for eight hours a day from its normal setting. Smart thermostats can perform this function automatically using occupancy sensors or a phone app to maximize energy savings without sacrificing comfort. The City offers rebates for smart thermostats through Efficiency Smart and the Super Rebate program as a benefit to all customers to reduce energy consumption through conservation.

CONCLUSION

With the creation of the Energy Services Division of OMLPS in 1998, Oberlin took a proactive role to promote energy efficiency services and programs to residents and businesses, leading to the adoption of Efficiency Smart and POWER in 2011. Rebates and technical assistance through these programs have resulted in carbon emission reductions and millions of dollars in energy savings. Oberlin will continue to reduce its existing electrical consumption while promoting fuel switching to simultaneously increase electricity sales. POWER has weatherized 138 homes and continues to increase its weatherization and energy education efforts. Projects, programs, education, and incentives by the City, the College, and the community have brought energy efficiency to the forefront in our mission to reduce energy usage and GHG emissions. It is important to emphasize the benefits of energy efficiency and fuel-switching in order for all stakeholders to fully embrace and practice efficient use of energy.

APPENDIX

TABLE 1: STRATEGIES IN ENERGY USE, CONSERVATION AND EFFICIENCY

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Building performance audits and disclosures for residential and commercial properties	City	2020	Commercial and residential buyers will be able to make informed decisions
Municipal buildings: fuel switching.	City	2019–ongoing	All municipal facilities will be supplied by 100% carbon-neutral energy by 2025 when economically feasible
Water heater replacement program: fuel switching	City	2020	Under the sustainable reserve fund, the City will establish a water heater replacement program for OMLPS customers
HVAC upgrades incentive program	City	2020	Under the sustainable reserve fund, the City will establish incentives to encourage and assist with the installation/replacement of space heating and cooling units
Update OMLPS authorization: Oberlin codified Ordinances Chapter 913	City Council	2019	Clarify that energy conservation is part of the mandate of OMLPS
Aggregate natural gas supply and carbon fee	City	2019–ongoing	More research required but it has the potential to reduce gas rates.

# # #

Transportation

According to the Environmental Protection Agency, the US transportation sector accounts for 27% of domestic greenhouse gas (GHG) emissions. Light-duty vehicles account for 60% and medium- and heavy-duty trucks account for 23%.

The total vehicle miles traveled (VMT) in 2006 for the City of Oberlin was 40.6 million miles, a 2.5% increase from 2000. In comparison, VMT grew 10% nationally during the same period. National VMT has been on the rise for decades and is expected to grow until 2035. If this trend were to continue locally, Oberlin VMT would increase 20% above baseline by 2050. In order to reduce Oberlin's transportation-related GHG emissions, it is necessary to address the transportation needs of constituencies on multiple fronts.

Based on the 2007 CAP goals, the climate action committee set a goal of reducing emissions from the transportation sector by 1.5% annually.

The City of Oberlin will promote a more sustainable transportation system that serves the needs of the Oberlin community. Since transportation networks cross political boundaries, the City's goals will be pursued in partnership with local, county, regional, and state entities and stakeholders. Re-visioning and ultimately re-creating local and regional transportation systems will reduce GHG emissions and have numerous environmental, social, health, and economic benefits. The City of Oberlin will strive to achieve the goals noted below:

- **Reduction of the amount of fuel consumed.** Work with local and regional partners toward a more complete network of affordable, environmentally-friendly transportation choices. These improvements will provide the structure to encourage the community to travel, commute, and shop using low-carbon methods of transportation such as transit, biking, walking, ride sharing, and car sharing.
- **Reduction of the carbon content of fuel consumed.** Increase electric and alternative fuel adoption for fleets and residents. Electric-powered vehicles "filling up" in Oberlin will use renewable/carbon-neutral energy resources, and energy dollars will stay in the region.

The key strategies to achieve these goals are included in the appendices of this chapter.

The reduction of the transportation-related carbon emissions is to include:

- the promotion of the safety, convenience, and social acceptability of biking and walking;
- the improvement of the availability and reliability of no- and low-carbon fuel sources; and
- the reduction of travel demands.

These approaches must be considered in the context of the widely divergent transportation needs of the community. Continued cooperation between the City, local institutions, and regional, state, and federal entities will be necessary to rethink how to provide a more comprehensive network of no- and low-carbon transportation options. Oberlin has many assets in place that provide the foundation for achieving these goals. To meet the goal of reducing transportation-related GHG emissions, the City will need to continue to implement its Complete Streets Policy and develop new

programs and policies to provide the necessary framework for progress to meet—and possibly exceed—the incremental goals.

Spotlight: Complete Streets Resolution

In May 2015, the City adopted a complete streets resolution. Oberlin was the first city in Lorain County to adopt such a policy. The Complete Streets framework is intended to ensure that the City's streetscapes are consistently designed with all users in mind—including bicyclists and pedestrians of all ages and abilities, emergency and safety service vehicles, cars and trucks and, where applicable, public transportation. The resolution demonstrates the City's commitment to maintaining, developing, and promoting a multi-modal transportation system and to serve the needs of all Oberlin residents and visitors in coordination with local, county, and regional partners. The resolution also displays the City's commitment to reducing carbon emissions. Complete Streets also helps improve the local economy, the community, and the environment and ultimately, help the City achieve its goal of becoming a climate positive community by the year 2050.

Transportation Sidebars (To be integrated into the main document)

Transportation Sidebar 1: Vehicle Miles Traveled (VMT) in Oberlin

Generally, transportation-related emissions can be described as the product of the carbon content of the fuel, vehicle miles traveled, and fuel consumption of the vehicle.

Emissions $_{[Carbon]}$ = (gallons/mile) (miles traveled/vehicle)(carbon/gallon) or fuel consumption * activity * carbon content[2]

Transportation Sidebar 2:

BACKGROUND: TRANSPORTATION PROFILE OF OBERLIN

Nationally, the transportation sector accounts for approximately 27% of GHG emissions. By contrast, Oberlin's transportation sector accounted in 2007 for 15% of community-wide emissions (23,887 metric tons), in part because so many Oberlin residents work locally. In fact, 53% of commuters travel less than ten minutes to work, and 53% drive to work (US average: 86%). To get from home to work, 12% of residents carpool, 32% walk, and 6% bike. Thirty-two percent of Oberlin households own two motor vehicles, 51% own one car, 13% have none—which equates to 1.5 vehicles per household (US average: 1.7 vehicles per household).

Virtually all vehicles on Oberlin's roads are powered by fossil fuels (close to 82% gasoline and 18% diesel), though hybrid-electric and all-electric vehicles are becoming more popular. In order to encourage the expansion of electric vehicles, the City and College have installed free charging stations—with the City installing two since the last CAP.

TRANSPORTATION AND THE REDUCTION OF THE CARBON CONTENT OF FUEL

PRIMARY GOAL

The City and its partners aim to reduce the carbon content of fuel by providing engineering solutions and education, encouragement, enforcement, and evaluation strategies that promote and incentivize the use of fuel efficient, low- and no- carbon emissions vehicles.

PERFORMANCE METRICS AND STATUS: ENGINEERING

Progress. In 2013, the City received a grant from the state's Local Government Innovation Fund program to conduct the Oberlin Fleet and Fuels Emissions Reduction Strategy (OFFERS). Working with the Clean Energy Coalition, the City coordinated a working group of local fleet partners. Each fleet was inventoried and analyzed to develop recommendations for potential alternative fuel platforms. The final report can be viewed @: www.Cityofoberlin.com/wp-content/uploads/2014/07/OFFERS-Final-Report-v51.pdf.

By far the most significant adaptation has been by our largest fleet partner, Republic Waste, which is presently converting its Lorain County-based fleet of refuse and recycling vehicles from diesel fuel to compressed natural gas. Their fueling station is not available to the public. The City currently has two EVs in its fleet, and the City has deployed Parker-Hannifin's hybrid hydraulic drive system on three refuse/recycling collection vehicles.

Plans. The City will continue to monitor the rapidly evolving hybrid, EV, and alt-fuel vehicle and equipment marketplace to make informed determinations on select vehicles and equipment.

PERFORMANCE METRICS AND STATUS: EDUCATION AND ENCOURAGEMENT

Progress. The City currently offers two free EV charging stations. Additional charging facilities will be installed at the Oberlin Underground Railroad Center. Other locations will be evaluated for future installations. The City has adopted and disseminated an anti-idling policy for municipal drivers. This is the first step in driver education.

Plans. At this time, the City intends to continue to incentivize the use of EVs by providing free public access to charging stations. The City will continue to promote the federal incentive program and consider the development of local incentives, too. The City will encourage and potentially incentivize the incorporation of a combination of hybrid vehicles, EVs, and alt-fuel vehicles into the local rental marketplace. The City can promote a more comprehensive approach to vehicle/equipment operations by deploying training developed through OFFERS to provide strategic, tactical, and operational information to our drivers with the goals of raising awareness and reducing fuel consumption.

PERFORMANCE METRICS AND STATUS: EVALUATION

Progress. The City should continue to monitor fuel and emissions reductions related to its deployment of hybrid, EV and alt-fuel vehicles. The City should meter electricity provided by its public charging stations to evaluate trends and future needs.

Plans. In order to fully evaluate and address GHG emissions from the municipal fleet specifically and the transportation sector more generally, it will be necessary to develop and maintain a more robust assessment methodology.

Why are these metrics important? Encouraging and incentivizing the use and ownership of hybrid, EV and alt-fuel vehicles are critical to lowering the carbon content of the fuel. If vehicle miles traveled (VMT) trend were to continue under a "business as usual" scenario, Oberlin VMT would increase by 20% by 2050. Choosing to use or own a vehicle with lower carbon content will

reduce transportation-related CO2e emissions, which accounts for a large percentage of carbon emissions in Oberlin.

TRANSPORTATION SERVICES AND OPTIONS

Goal. The City and its partners will endeavor to lower the amount of fuel consumed by providing engineering solutions and education, encouragement, enforcement, and evaluation strategies that promote travel by reducing carbon emissions, but also endeavor to increase health, safety, convenience, and mobility.

PERFORMANCE METRICS AND STATUS: ENGINEERING

Progress. The City application of Complete Streets policies will benefit public transit by designing appropriate roads. Although the Oberlin Connector Transit Service is a demand-response system, Lorain County Transit (LCT) has temporarily stopped the Oberlin route. There have been designated LCT stops throughout Oberlin in anticipation of service renewal. Meanwhile, there are other services offered to various segments of Oberlin by private institutions.

The Oberlin CarShare Program features vehicles available to enrolled residents. The program started with three cars. Now it has four. Students take the greatest number of trips, but faculty, staff, and community members also utilize the vehicles. Hundreds of hours of rides are taken each month. The program has been quite a success for the community and there are plans to expand it.

Plans. The City of Oberlin Underground Railroad Center has established a park-n-ride area that allows people in cars, on bikes, or on foot to access the Oberlin Connector Transit Service and the LCT for trips to and from Oberlin.

PERFORMANCE METRICS AND STATUS: EDUCATION AND ENCOURAGEMENT

Progress. Private organizations in Oberlin offer transportation services to their segment of the community. For example, Kendal at Oberlin provides transportation services to its residents within Lorain County.

The College has established several means of transportation with a focus on students, although most services are also available to the public. The College charters shuttle to the airport during the school semester, which also includes a shopping shuttle on Saturdays to a handful of local shopping locations.

The College also offers private transportation services for students during the academic year. Students can ride a campus shuttle to get around campus during the week. This is a free service for anyone with an Oberlin College ID. Oberlin has arranged for private shuttle services for students to and from campus to the airport and to local venues. For students that live in Chicago, Washington DC, and New York, there is a student-built mass transit service called Shuttle Home. This is a community-based transportation company that provides students with coach bus service directly from their college campus to their City during school breaks at 50% of the cost of flying.

Plans. Mobility and Opportunity for a Vibrant Economy (MOVE) Lorain County is working with various organizations and sectors throughout the county to develop a coordinated transportation plan. The purpose of locally developed, coordinated public transit is to identify community

resources for transportation and mobility, understand the gaps and unmet needs within those resources, and to determine the approach to addressing those gaps and unmet needs. The MOVE organization was founded in association with residents of Oberlin, Kendal at Oberlin, and the Oberlin Project.

Performance Metrics and Status: Evaluation

Progress. The Lorain County Commissioners reduced LCT fares by over 50% in December 2017—from $4.10 to $2.00. This is important to note since the City of Oberlin contracts with the Lorain County Commissioners for the Oberlin Connector, which is a two-day-a-week service. This new fare affects riders of the Oberlin Connector, too.

The Oberlin CarShare Program remains popular, and its provider identifies the Oberlin program as exemplary.

Plan. The coordinated transportation plan under development by MOVE Lorain County encourages regular assessments of both the needs of county residents and the effectiveness of the services provided.

Why are these metrics important? The use of public transit has been shown to assist with creating healthier lifestyles, reduce carbon emissions, while also serving as an economic driver. According to the American Public Transportation Association, "the average household spends 18 cents of every dollar on transportation, and 96% of this goes to buying, maintaining, and operating cars, the largest expenditure after housing." In addition, mass transit users are healthier because mass transit riders get three times the physical activity than people who drive alone. Being more active lowers the risk of serious illness and diseases, including diabetes, joint/back problems, heart disease, and depression—and it reduces carbon emissions.

Transportation as Walking and Cycling

Primary Goal

The City and its partners endeavor to lower the amount of fuel consumed by providing engineering solutions and education, enforcement, and evaluation strategies that promote travel by walking and cycling for its climate and public health benefits.

Performance Metrics and Status: Engineering

Progress. Under the broad auspices of the City's Complete Streets policy, the public works department has constructed, from 2011 to 2017, numerous cycling and walking improvements.

Tables 1 and 2: Infrastructure Improvements for Cyclists and Pedestrians

Cycling Related Improvements	
New multi-use trail	1,877 lane feet (LF)
Multi-use trail maintenance	17,113 LF

New on-street bike lanes	8,140 LF
"Sharrows" (i.e., share arrows)	21,350 LF
Association of Pedestrian and Bicycle Professionals bike racks	16
WALKING RELATED IMPROVEMENTS	
New sidewalks	1,580 LF
Sidewalk maintenance	14,476 LF
Accessible ramps	188
Pedestrian bump-outs	3
Crosswalk markings	103

IMAGES: BIKE PARKING IN THE CENTRAL BUSINESS DISTRICT (EST. 2015), WITH SIGNAGE ON THE PROTECTIVE BOLLARDS

Plans. In 2018, the public works department implemented the City's Safe Routes to School Project. Eleven sidewalk infill projects, comprising nearly 7,000 linear feet, were developed. The project also included the installation of a school zone flasher system at Prospect Elementary School. The public works department has also conducted the fourth and final planned round of the City's sidewalk maintenance and repair program. The department will continue to apply complete streets principles

to its capital projects. In 2019, the public works and planning departments will collaborate in the development of a walking/cycling master plan for the City.

Performance Metrics and Status: Education and Encouragement

Progress. In 2016, the Oberlin Police Department updated the City's ordinances regarding bicycle parking. The current regulations and information about how to register a bicycle in Oberlin can be found @ oberlinpd.com/bike-licensing/.

The public works department inventoried available bicycle parking in the Central Business District. We found a total of 430 bicycle parking spaces—many owned and operated by the College—close to college facilities, including the Allen Memorial Art Museum. The CBD bike parking map is available at the police department link above.

Plans. Oberlin Community Services recently completed installation of a covered bike parking facility for its bicycles. The College is considering implementation of a privately managed bike share. Other education and encouragement tools to develop and implement include:

- cycling and walking education and safety programming;
- cycle- and walk-to-work (or school) promotions; and
- promotion of the "Your Move Ohio" social media campaign.

Performance Metrics and Status: Evaluation

Progress. In spring 2015, the City received a bronze rating as a bicycle friendly community from the League of American Bicyclists.

Plans. Update the City's bike friendly community application; review the 2018-2019 walking and cycling master thoroughfare plan; and evaluate and deploy cycling/walking use metrics.

Why are these metrics important? Maintaining, improving and expanding walking/cycling infrastructure provides more active transportation choices for Oberlin residents and visitors. Choosing to walk or cycle has the dual benefits of reducing transportation-related CO2e emissions and improving public health.

THE APPENDIX

TABLE 3: STRATEGIES IN TRANSPORTATION

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Increase cycling and walking	City and College	2019–ongoing	Zero-carbon transportation and health benefits of exercise
Increase car sharing and ridesharing	City and College	2019–ongoing	Carbon reduction from fewer trips
Enhance public transportation	City	2019–ongoing	Reduce the need for private motor vehicles
Increase use of low carbon vehicles and practices	City	2019–ongoing	Reduce the need for private motor vehicles
Improve and enhance green fleets	City	2019–ongoing	Carbon reduction
Expand EV charging station infrastructure.	OMLPS	2019–ongoing	Support more EV purchases
Evaluate alternative fuel options for fleet vehicles and equipment. In addition to EVs, potential options include compressed natural gas (CNG); liquid natural gas (LNG); propane and biofuels.	City	2019–ongoing	Carbon reduction
Develop eco-driving training including enforcement of the City's (internal) anti-idling policy	City	2019–ongoing	Carbon reduction
Develop efficient fleet standards	City	2019–ongoing	Reductions of energy use for City fleet
Subsidize fuel switching: encourage hybrid and EV rentals	City	2019–ongoing	Increased number of hybrids and EVs purchased

# # #

High-performance Buildings

Introduction

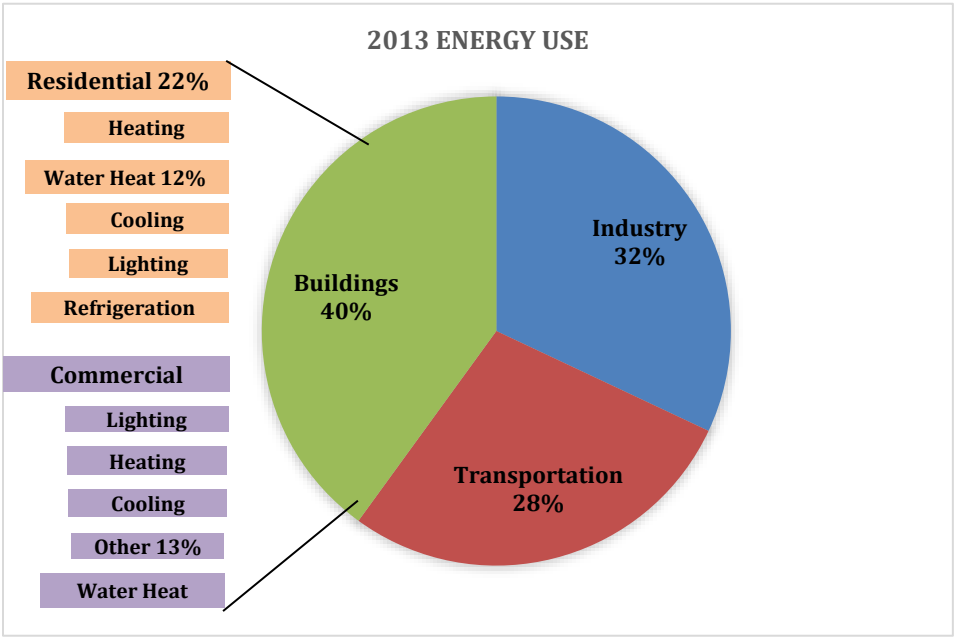
The high-performance building movement promotes the use of ecological principles in the creation of buildings and communities. In addition, high-performance buildings and communities can conserve resources, save money on energy and water bills, and provide a comfortable and healthy environment. High performance buildings are proving to be cost effective, more desirable, and more valuable than conventional buildings. Both new and existing structures benefit from green-building best practices, which can result in climate positive buildings.

Background: Energy Use and Greenhouse Gas Emissions in Buildings

The operation of buildings accounts for close to 40% of the energy used in the US (residential energy: 22%; commercial buildings: 18%). In the residential sector, four areas account for 66% of the energy used: heating, 31%; cooling, 12%; hot water, 12%; and lighting, 11%. In the commercial sector, three areas account for 53% of the energy used: lighting, 26%; heating, 14%; and cooling, 13%. Electricity represents about 75% of the primary energy used in buildings. In Oberlin's 2007 GHG emissions inventory, residential buildings accounted for 16% of emissions while commercial buildings were 38%.

Figure 1: Energy Use in the US (2013)

Background: Energy-consuming Behaviors in Buildings

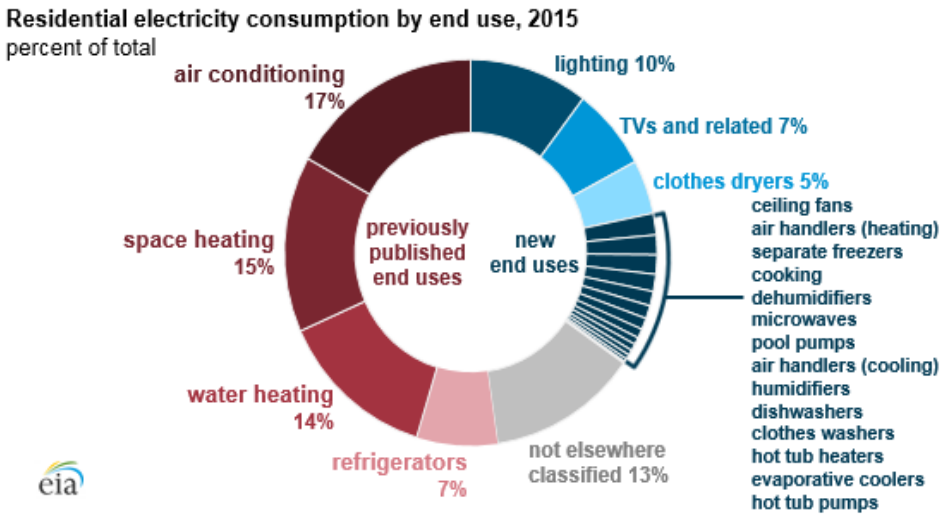


From 1990 through 2013, the US Energy Information Administration identified consumption and expenditures for four end-use categories: space heating, air conditioning, water heating, and refrigeration; the remainder was aggregated as "other." As certain appliances and equipment have become more prevalent in homes, this remainder category became a larger share of residential energy consumption, especially for electricity.

In 2015, the US International Energy Agency's (IEA) Residential Energy Consumption Survey introduced percentages of energy consumption for an expanded list of energy end uses. For electricity, the number of end uses jumped from four to 26 by adding estimates, to begin, for dishwashers, clothes washers, clothes dryers, televisions, and lighting.

In 2015, nearly 50% of residential electricity consumption fell into the other category. Adding several new characterizations of end uses provides a better accounting of energy use in homes, and now the IEA survey attributes only 13% of residential electricity consumption to end uses not elsewhere classified.

FIGURE 2: RESIDENTIAL ENERGY USE IN THE US (2015)



Since building energy use is so large and varied, it is imperative that Oberlin focus on improving the energy performance of all new and existing buildings. There must be a coordinated set of strategies to reduce the overall energy consumption of the City's building stock. These strategies should be prioritized to focus on the end-use behaviors associated with the highest levels of consumption.

WHAT IS A HIGH-PERFORMANCE BUILDING?

A high-performance building operates on up to 70% of the average amount of energy used by a similar type of building located in the same region of the country.

HOMES

In its most recent report, the Energy Information Agency tallied the average annual energy consumption for the East North Central region of the US:

- electricity: 9,129 kilowatt hours (kWh) (Oberlin's average residential usage is 7,800 kWh);
- natural gas: 805 centum cubic feet (ccf);
- propane: 549 gallons;
- fuel oil: 287 gallons.

Applying the 70% factor gives homeowners a target ceiling for higher energy performance:

- electricity: 7,800 kWh*.7 = 5,460 kWh;
- natural gas: 800 ccf*.7 = 560 ccf;
- propane: 549 gallons*.7 = 384 gallons; and
- fuel oil: 287*.7 = 201 gallons.

OMLPS reports that between 2013 and 2018, the average annual residential electricity consumption dropped from 9,000 kWh to 7,800 kWh. Each kWh of electricity generated equals 1.8 pounds of carbon dioxide released into the atmosphere. While Oberlin's energy portfolio is 85% renewable, this figure represents a reduction of 392 metric tons of CO2 from the atmosphere each year.

Natural gas generates 1.27 pounds of carbon for every 100 cubic feet of gas burned.

If 50 homes receive retrofits per year, and they realize a 30% reduction in gas and electric consumption, the carbon reduction would equal an additional 78 metric tons each year.

For all-electric homes, a 30% reduction is a reasonable goal.

COMMERCIAL PROPERTIES

The same strategies can be applied to commercial buildings. The EIA states that commercial buildings typically consume 14 kWh per square foot and 42 cubic feet of gas per square foot.

The application of established energy conservation measures, along with greater use of renewable energy, should make the goal of higher performance achievable for all homes and businesses in our community.

PRESENT STRATEGIES

As the City strives to set the standard for sustainable practices with regards to new City buildings, the City of Oberlin's Green Building Policy may be established to provide guidelines to architects, engineers, and constructions crews for City buildings. The City needs to review the policy and determine if it's appropriate to current building standards and readily enforceable.

Please see below the text of the green building policy:

> The City of Oberlin shall incorporate green building principles and practices into the design, construction, and operations of all City facilities, City funded projects and infrastructure projects to the fullest extent possible.
>
> All new construction exceeding 5,000 sq. ft. and major renovations exceeding 1,000 sq. ft. of municipally owned and operated facilities shall be required to meet minimally the U.S. Green Building Council's latest version of LEED Silver certification.
>
> In addition, the City shall evaluate all land purchases for future development on the basis of reducing environmental impacts that include but are not limited to transit and

bicycle accessibility, urban and brownfields redevelopment, solar access, on-site stormwater mitigation capacity and vegetation and habitat restoration.

Furthermore, the City will provide the leadership and guidance to encourage the application of green building practices in private sector development. To this end, the City shall endeavor to resolve any code or other regulatory conflicts with green building practices.

This Policy is expected to yield long-term cost savings to the City's taxpayers due to the substantial improvements in life-cycle performance and reduced lifecycle costs.

POTENTIAL STRATEGIES

Collaborate with POWER to implement energy conservation projects in homes and businesses.

- POWER has successfully implemented and facilitated many energy conservation programs in homes, non-profits, and businesses. The services include facilitating energy audits, soliciting contracted services, and providing assistance to homeowners applying to rebate programs. In addition, POWER has provided substantial support to community churches involved in the "pay-it-forward" program and has facilitated LED lighting retrofits in small businesses. City Council has taken the initiative to provide more flexible funding for energy initiatives, and some of that funding could support POWER initiatives. POWER should collaborate with the City sustainability coordinator to identify potential projects for funding.

Facilitate the development of the City-owned vacant properties in a sustainable manner.

- Sites such as the Bait Canteen and Green Acres provide the City with the opportunity, through creative design, to not only move toward a climate positive neighborhood through the application of renewable energy, but also one that has common open space and vegetable gardens, aesthetically pleasing locations and relationships among houses, and attractive landscaping created to compliment neighboring properties. There are commercial surplus properties in the industrial park area that should be developed in a sustainable manner as well.

Develop commercial and residential building performance certification programs.

- Ohio law limits the ability of cities to establish more stringent building codes than those required by the State. This restriction, however, can be overcome in at least two ways. First, the City could certify buildings as "green" if they meet green building standards established by the City, with separate criteria for commercial and residential buildings.
- Second, the City could develop a residential building standard in which homes could be rated based on high performance and ecological criteria.
- In establishing high-performance building performance certification programs, criteria could come from one of the established certification programs, including US Green Building Council Leadership in Energy and Environmental Design (LEED) existing buildings, LEED for homes, passive house, Living Building Challenge, Energy Star Certified New Homes, and National Association of Home Builders. Criteria would ensure that all certified houses would be high performance and potentially climate positive or positive energy (see appendix VI, Green Building, E). These certification programs can be paired with incentives to make such

certifications attractive (see below).

Establish procedures and policies that encourage green building.

- The City should consider procedures and policies that encourage builders and homeowners to build high performance, climate positive, or positive energy homes. Positive energy homes generate more energy than they use, meaning they can export electricity back to the grid. These procedures and policies should include opinion pieces and editorials in local newspapers, City Council proclamations, "green house" plaques, reduced permit fees, or other actions that will be of minimal cost to the City. Establish procedures and policies that incentivize performance improvements for existing buildings.
- While much of this chapter has focused on implementing best practices relating to the construction of new buildings, we must remember that more than 90% of the buildings in Oberlin were built before the development of efficiency standards. New high-performance buildings will do nothing to offset the energy consumption of existing buildings. The City should also consider establishing similar policies and procedures for commercial building and home owners to reduce the consumption of energy in these existing buildings. Incentives such as low or no interest loans, or outright financial support for implementing recognized efficiency measures should be established. Builders and developers should be encouraged to perform lifecycle cost analyses to confirm the savings in energy costs as well as repair and replacement costs compared to conventional building practices. As with the new construction, there are several programs and incentives that could provide recognition and encouragement for improving the energy performance of an existing home or commercial building.

Promote a lifecycle savings policy.

- The Builders Association estimates that the costs of construction represent approximately 20% of the total cost of a building with a life expectancy of 40 years. In the construction of new buildings, minimal increase in construction costs is more than offset by the lifecycle costs savings in terms of energy and maintenance. The City should consider a policy that requires builders to provide lifecycle cost analyses of new City buildings and their infrastructure. For example, the life cycle cost difference of installing LED lighting versus the most efficient fluorescent lighting should include the cost of lamp and ballast replacement, as well as the respective costs of electricity consumption. This type of analysis should be conducted for all major energy consuming equipment in the building, as well as shell components (i.e., roofing, windows, and exterior wall materials).

Best Practices for Building Envelope and Lighting Efficiency

A building's envelope—i.e., the slab, walls, and ceiling or roof—defines the movement of heat and light into and out of the building, which in turn determines the energy required to light, heat, and cool that building. For existing structures, eliminating air leaks is the most cost-efficient change for heating and cooling energy, with typical paybacks of 1-4 years. Additional insulation in attics and walls is second with paybacks of 3-6 years. Daylighting followed by lighting with linear fluorescent and LED bulbs provide the most energy efficient lighting. These efficiency measures are followed by replacement windows, which have typical paybacks of 10 years or less.

DESIGN, COST, AND PERFORMANCE

When designing a new building, it is important to keep in mind the design decisions that dictate the building's lifecycle energy performance. The three most important decisions in making a high-performance building for the 21st century include:

- size: make it as small as possible for the functions to be served;
- envelope: make it super insulated and very tight; and
- orientation: design it with the long axis oriented east-west to employ passive and active solar strategies.

In building rehabilitations, size and envelope decisions can often be addressed, but orientation cannot. Passive and active solar, however, should be employed whenever possible. (See Green building appendix H for reference on green building in general and passive solar in particular).

It is important to understand that the conversion and renovation of existing building stock to improve performance will be a long-term effort. The obstacles include lack of motivation of building owners, cost, and lack of information. POWER's efforts to improve the energy efficiency of homes and small businesses have uncovered a variety of challenges. However, through creative programs and policies, these obstacles can be addressed successfully.

CONCLUSION

The City and the College have made notable strides in embracing high-performance building standards. It is important for the City and the College to use not only building certification programs and other best practice standards for new construction and renovations, but also to develop policies and mechanisms to reduce construction costs. Building performance should also be monitored over several years. Such policies can correct missteps and improve future policies.

APPENDICES

APPENDIX 1: SPOTLIGHTS

SPOTLIGHT ON SMITH STREET HOUSE

The Smith Street House was designed and built as a high-performance home, with a modest footprint at 1,400sf.

The house is oriented with its long axis east to west to maximize sunlight in the winter. The shell of the house is very tight, which prevents air leaks. The floor is insulated at R-30, the walls at R-40, the roof at R-60, and the attic at R-84.

There are double-paned thermal windows. It is an all-electric home that has a 4.48 kilovolt photovoltaic array to provide a large portion of its electricity. All appliances are Energy Star rated.

In the first year of occupancy, the all-electric home consumed a total of 6,333 kWh, which compares favorably to the annual consumption of 9,000 kWh for the average home in Oberlin. In addition,

most homes in Oberlin use gas for space and water heating. When all forms of energy are calculated, the Smith Street house uses approximately 21% of the energy of the average home.

Spotlight on Oberlin IGA

The Oberlin IGA is an example of an existing commercial building whose energy performance improved considerably through the application of effective energy conservation measures (ECMs). The variety of ECMs implemented include:

- installation of a highly reflective roof to reduce heat infiltration;
- LED lighting retrofit throughout the store;
- replacement of all refrigeration equipment with the most energy efficient equipment available;
- installation of variable frequency drives on all HVAC equipment; and
- a heat reclamation system which captures exhausted heat and is used to warm the building.

The store has realized a 22% reduction in energy consumption.

Spotlight on 340 South Pleasant

The home of Mrs. Hattie Jones is a one-story ranch home of 1,000sf. The home has vinyl siding, forced-air, gas-furnace heating, single-pane windows. In March 2015, POWER began to add blown cellulose insulation to the home. The attic was raised to R-30 and the sloped ceiling received six inches of insulation. Additional cellulose was blown into the walls, raising the R value to 19. POWER staff also performed weather sealing and installed LED bulbs throughout the home.

Using the 2014 utilities as a base year, the home's annual gas consumption dropped from 623 hundred cubic feet to 461 hundred cubic feet: a reduction of 33%. The annual electric consumption dropped from 3,698 kWh to 2,295 kWh: a reduction of 61%.

How to Calculate a Building's Energy Utilization Index

A measure of the energy consumption of a building is called the Energy Utilization Index (EUI). This measure provides a common energy measurement across different fuel and energy sources. All energy forms consumed in use of the building is converted to its British thermal unit (Btu) equivalent, a standard measure of energy.

Electricity contains 3,412 BTUs per kWh and natural gas contains 1,015 Btus per ccf.

So, to determine your home or building's EUI:

- multiply your annual electricity consumption in kWh by 3,412;
- divide that number by 1,000 to determine the kBtus of electricity;
- multiply your annual total hundred ccf of gas by 103,700;
- divide that number by 1,000 to determine the kBtus of natural gas;
- add these two numbers together; and

- divide this sum by the square footage of the home or building.

The resulting kBtus/sf is the annual EUI.

Top Ten Energy Efficient Measures for Home and Business

These energy efficiency steps are ranked by cost, from lowest to highest. They include the range of costs and the relative energy and cost savings. Each measure has a separate fact sheet that provides more details and information on costs and savings.

Install LED light bulbs or fixtures.

- Led lamps cost between $1 and $5 and have simple payback of less than two years. On average, replacing 15 standard light bulbs with Energy Star LEDs can save about $50 per year. LED fixtures range from a few dollars to a little more than $100. They range from decorative interior fixtures to shop lights to exterior lighting. Part of the savings is in annual lamp replacement costs, since standard incandescent lamps last for 1,000 hours, compact fluorescent lamps last for 10,000 hours, and LED lamps last for 50,000 hours.

Replace furnace filters regularly.

- Furnace filters cost between $3 and $5 each. The Department of Energy indicates that the average household spends about $2,200 per year on its energy bill. When you change your air filter regularly, you can save 5–15% on utility costs.

Insulate your hot water tank and exposed hot water pipes, and lower your water temperature setting.

- Just like insulating your walls or roof, insulating your hot water tank is an easy and inexpensive way to improve energy efficiency. If you have an older hot water tank, check to see if it has insulation with an R-value of at least 24. If not, consider insulating your water tank, which could reduce standby heat losses by 25–45%, reduce water heating costs by 7–16%, and pay for itself in about a year. You can find pre-cut jackets or blankets available for $20 and can reduce water heating costs by $20–$45 each year.
- Insulating your hot water pipes reduces heat loss and can raise water temperature 2°F–4°F hotter than uninsulated pipes can deliver, allowing you to lower your water temperature setting. You also won't have to wait as long for hot water when you turn on a faucet or showerhead, which helps conserve water. Polyethylene pipe insulation costs less than $1 per foot and can reduce water heating costs by $8–$12 per year.
- Although some manufacturers set water heater thermostats at 140ºF, most households usually only require them to be set at 120ºF, which also slows mineral buildup and corrosion in your water heater and pipes. Water heated at 140ºF also poses a safety hazard—scalding. Savings resulting from turning down your water heater temperature are based on two components: reduced standby losses (heat lost from water heater into surrounding basement area); and consumption (from water demand or use in your home). Lowering your water temperature can save $12–$60 per year in water heating costs.

Install low-flow shower heads, faucets, and aerators.

- You can lower your water heating costs by using and wasting less hot water in your home.

Water heating is the second largest energy expense in your home (after heating and cooling). It typically accounts for about 18% of your utility bill. For maximum water efficiency, select a shower head with a flow rate of less than 2.5 gallons per minute (gpm).

- New faucet flow rates can't exceed 2.5 gpm at 80 psi or 2.2 gpm at 60 psi. You can purchase a quality, low-flow fixture for $10–$20 and achieve water savings of 25%–60%.
- The aerator—the screw-on tip of the faucet—ultimately determines the maximum flow rate of a faucet. Typically, new kitchen faucets come equipped with aerators that restrict flow rates to 2.2 gpm, while new bathroom faucets restrict flow rates from 1.5 to 0.5 gpm. Aerators are inexpensive, and they can be one of the most cost-effective water conservation measures. For maximum water efficiency, purchase aerators that have flow rates of no more than 1.0 gpm. Some aerators even come with shut-off valves that allow you to stop the flow of water without affecting the temperature. When replacing an aerator, bring the one you're replacing to the store to ensure a proper fit.

Annual maintenance on your heating and cooling systems.

- Space heating is likely the largest energy expense in your home and can account for close to 45% of your energy bills.
- Every home heating system accumulates dust, dirt, and other particulates that affect performance and efficiency. This can cause your utility bills to soar. A professional heating oil furnace or boiler tune-up and cleaning eliminates the grime and ensures all components are in good working order, so when it's time to turn up the thermostat on the first chilly morning of fall, you have heat. The main benefits of a professional heating system tune-up include:
    - improved system efficiency, which means better heating performance and lower heating costs;
    - reduced risk of heating system failure—you don't want to be without heat when the temperature is sub-zero;
    - minimized possibility of needing major repair; emergency service always costs more than preventative maintenance; and
    - annual tune-ups cost $90–$200 and, if the system hasn't been tuned in the past two years, can have a payback of one year.

Install a programmable thermostat.

- Just as your water heater maintains a set temperature when it isn't being used, a thermostat does the same thing for the entire house. Just letting it cool off (or warm up) when there isn't anyone awake can save energy and money, too. Without sacrificing comfort, it can also be close to half of what air sealing would save you. This change usually pays for itself in about three years. Programmable thermostats cost between $100–$300. Qualified programmable thermostats are eligible for a $25 Efficiency Smart rebate. Smart thermostats can reduce heating and cooling costs by $80 per year.

Seal and caulk all openings in the shell of your house.

- Reducing the amount of air that leaks in and out of your home is a cost-effective way to cut

heating and cooling costs, improve durability, increase comfort, and create a healthier indoor environment. Caulking and weatherstripping are two simple and effective air-sealing techniques that offer quick returns on investment. Heating and cooling savings can be $80–$160 per year.

Install additional insulation in your attic and/or walls.

- Unless your home was specially constructed for energy efficiency, you can probably reduce your energy bills by adding more insulation. Many older homes have less insulation than homes built today, but even adding insulation to a newer home can pay for itself within a few years. To determine whether you should add insulation, you first need to find out how much insulation you already have. A qualified home energy auditor will include an insulation check as a routine part of a whole-house energy assessment. An energy assessment, also known as a home energy audit, will also help identify areas of your home that are in need of air sealing. (Before you insulate, you should make sure that your home is properly air sealed.)

Upgrade your appliances to Energy Star rated products.

- An Energy Star label identifies the product carrying it as more efficient than most of its peers. An Energy Star dishwasher, for example, must be 10% more efficient than the least efficient unit, while washing machines must be 37% more efficient. Replacing a pre-1994 clothes washer will save you as much as $110 per year. A new Energy Star dishwasher will save you about $25 per year.

Replace all windows and doors with energy star rated products

- The installation of Energy Star qualified windows lowers energy bills and saves you money over single-pane and even new double-pane, clear-glass windows. For a typical home, choose Energy Star and save $126–$465 per year when replacing single-pane windows, or $27–$111 when replacing double-pane, clear-glass windows.

APPENDIX 2

TABLE 2: STRATEGIES FOR HIGH PERFORMANCE BUILDINGS

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
City Green Building Policy	City	2007-ongoing	New construction/major renovations LEED Silver or equivalent
Collaborate with POWER to implement energy conservation projects in homes and businesses	City of Oberlin and POWER	2018–ongoing	Energy conservation projects become more accessible to home and business owners.
Facilitate the development of City-owned vacant properties in a sustainable manner	City	2018–ongoing	Development of affordable and sustainable neighborhoods.
Develop commercial and residential building performance certification programs	City	2018–ongoing	Establish certification for homes and businesses that achieve between 10% and 30% energy reductions. Recognition for achievement could encourage more participation.
Establish procedures and policies that encourage green building	City	2018–ongoing	The development of such policies could make building high-performance buildings more desirable than standard building practices.
Establish procedures and policies that incentivize performance improvements for existing buildings	City	2018–ongoing	Reduction of utility expenses and improved indoor air quality for residents.
Lifecycle savings policy	City	2018–ongoing	Long term savings over conventional building and equipment practices.

# # #

Waste Management

INTRODUCTION

Effective waste management to minimize CO2e emissions entails the reduction of solid and industrial waste and the diversion of remaining waste from landfills. The present and future strategies addressed in this plan encompass residential, commercial, institutional, and industrial solid wastes—as well as residual waste products from wastewater treatment. Strategies to minimize emissions include waste reduction and diversion, recycling, composting, and methane recapture.

BACKGROUND: MEASUREMENT OF GREENHOUSE GAS EMISSIONS FROM WASTE MANAGEMENT

Reduction in CO2e emissions from waste management strategies is measured in emissions from terminal waste management (i.e., landfilling, recycling, composting, etc.). Anaerobic decomposition of organic wastes in landfills or compost facilities can release significant carbon dioxide and, more importantly, methane, which has heat-trapping potential approximately 21 times that of carbon dioxide. Per the City's 2014 emissions inventory, the waste management sector accounted for 1,395 CO2e tons, equal to 2.7% of the community's greenhouse gas (GHG) emissions. Note that CO2e emissions associated with collection, transport, and processing of wastes are measured in the transportation and energy sectors.

SOLID WASTE MANAGEMENT

Estimated reductions in CO2e emissions for the solid waste sector are linked to waste disposal by landfilling. Reductions in the disposal quantity are attributed to the following factors: reduced consumption, improved re-use, and increases in recycling and composting. Such reductions are likely to be tied to programs and policies, as well as external factors, including local, regional, and global economic conditions and technological advancements. Measurable goals can be set to reduce solid waste disposal. These reductions can be modeled to project corresponding reductions in CO2e emissions.

In 2013, the City created its Zero Waste Plan (ZWP) as a pilot initiative sponsored by the Lorain County Solid Waste Management District. The ZWP was developed in partnership with the District and its consultant, GT Environmental; the City's Resource Conservation and Recovery Commission; and the College. The ZWP was adopted by City Council in May 2014:

> Zero waste is the City's goal to minimize the final disposal of waste materials as completely and rapidly as possible. This reduction will be achieved using a combination of environmentally sound strategies with an emphasis on education, on source reduction and reuse and on recycling and composting (ZWP, ES-1).

Recognizing that it may not be possible to eliminate all waste, the ZWP establishes a goal of 90% waste reduction/diversion by 2050. The City's Zero Waste Plan can be viewed @ https://www.Cityofoberlin.com/wp-content/uploads/2014/07/Oberlin-ZWP-Portfolio.pdf.

PRESENT STRATEGIES: SOLID WASTE

The Zero Waste Plan is the City's framework for reducing CO2e emissions from solid waste management activities. The ZWP provides an inventory and overview of the City's equipment and services at the time the plan was created. The ZWP evaluates various options for increasing diversion in three phases:

- phase 1 covers 2014–2020;
- phase 2 extends from 2021–2030; and
- phase 3 extends from 2031–2050.

Many of the programmatic recommendations from phase I have been implemented since adoption of the ZWP. See the appendix for the list of different strategies.

The following table depicts the most recent five years of data on refuse and recycling collection service in Oberlin (all measurements in tons):

TABLE 1: REFUSE AND RECYCLING COLLECTION IN OBERLIN, 2013–2017

MATERIALS RECOVERED	ACTUAL 2013	ACTUAL 2014	ACTUAL 2015	ACTUAL 2016	ACTUAL 2017
Mixed recycling	803.46	247.10	841.77	883.49	962.83
Ferrous metal	22.18	3.99	6.53	38.13	8.77
Non-ferrous metal	3.09	0.73	4.42	3.84	4.88
Styrofoam	0.00	0.00	0.00	0.31	0.11
Paper and old, corrugated cardboard	411.99	181.92	93.57	80.60	117.43
Hazardous household waste	8.60	4.82	2.83	4.26	4.34
E-Scrap	12.25	6.98	7.49	8.27	6.56
Lamp/ballast	2.40	1.15	1.38	1.35	1.65
Rubber	9.80	10.01	9.58	9.63	11.45
Other HHW	1.23	3.27	6.38	7.46	8.10
Textiles	23.31	22.42	11.99	13.75	15.06
Wood	0.00	0.00	0.00	0.00	145.31
Yard waste	485.23	497.70	493.99	547.31	269.95

Food waste	0.00	0.00	55.09	65.93	69.21
Total recovery	1,783.55	980.08	1,535.02	1,664.33	1,625.64
Disposal	3,524.55	3,955.16	3,504.82	3,567.94	3,599.31
Re-use/source reduction					
Total generation	5,308.10	4,935.24	5,039.84	5,232.27	5,224.95
Diversion rate	33.60%	19.86%	30.46%	31.81%	31.11%

POTENTIAL STRATEGIES: SOLID WASTE

To continue the City's push towards zero waste, it will be necessary to continue to offer and to expand on phase 1 of the ZWP (2014–2020). The City has achieved the most success in its continuing management of organic wastes at its class IV composting facility, in its conversion to universal cart-based collection systems, and its ongoing partnerships with the Lorain County Solid Waste Management District to manage household hazardous waste, electronics, tires, and other special wastes. Both Kendal at Oberlin and the College have initiated pilot programs in food waste composting. For more information about food waste see the chapter on Local Food and Agriculture.

WASTEWATER MANAGEMENT

Measuring reductions in CO2e emissions associated with wastewater are linked to biological decomposition of organic materials through treatment processes. Improving methane production, capture, and beneficial re-use may be considered a climate-positive function to offset CO2e emissions in other sectors.

PRESENT STRATEGIES: WASTEWATER

The City owns, operates, and maintains a class IV water environment protection facility (WEPF) that provides comprehensive wastewater treatment services. The rated capacity at the WEPF is 1.5 million gallons per day (MGD). The average daily flow is just under 1.0 MGD.

As described above, CO2e emissions associated with sanitary sewer collection and the wastewater treatment processes are primarily measured in the transportation and energy sectors. There may be, however, CO2e emissions associated with the biological decomposition of bio-solids. Solids from the primary and final settling tanks must be further treated prior to disposal. The WEPF uses both aerobic and anaerobic digestion processes. Sludge is heated in the anaerobic digester to 90°F–100°F. The methane by-product of anaerobic digestion is captured in the digester and combusted to heat the boiler that maintains digester temperature. Digested solids are sent to the sand drying beds or stored in the sludge holding lagoons. Class B bio-solids are sampled and analyzed prior to land application at agronomic rates in accordance with all applicable Ohio Environmental Protection Agency regulations.

TABLE 2: WEPF

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Anaerobic digestion	City	Ongoing	Approved wastewater treatment process. Recaptured methane is used to heat the digester off-setting the purchase of natural gas.
Land application of class b bio-solids	City	Ongoing	Beneficial re-use of bio-solids in local (non-human) crop production.

POTENTIAL STRATEGIES: WASTEWATER

Although the primary mission of the WEPF must be compliance with National Pollutant Discharge Elimination System requirements, the public works department will continue to support the efforts of WEPF staff to operate the plant as efficiently as possible. This will include continuing efforts to maximize energy conservation through efficiency measures and to examine opportunities to enhance resource recovery (energy and organic matter) associated with the treatment of wastewater.

Anaerobic digestion. The City intends to evaluate its anaerobic digestion capabilities to upgrade equipment and to enhance system redundancy. We will also consider opportunities to maximize energy production, including both methane and electricity. Examples for consideration include: an enhanced or comprehensive food waste digestion system and improved treatment and recovery of the embodied energy in fats, oil, and grease. Recovered methane could be used to power a co-generation system with the electricity available for use on site and the heat from the generator recovered to maintain sludge temperatures.

Evaluation of costs and benefits associated with the production of Class A bio-solids. Enhanced digestion may also allow the City to produce Class A bio-solids which may be applied without restriction to farm lands, gardens and landscapes. As a more desirable soil amendment, Class A bio-solids could reduce the City's transportation costs associated with land application of Class B bio-solids.

CONCLUSION

Although waste management currently accounts for a small percentage of the City's GHG emissions (2.7%), this relative percentage will increase as the City makes progress towards reducing its CO2e emissions portfolio in other sectors. Ongoing tabulation of waste management GHG emissions will be necessary to evaluate progress in decreasing related emissions from the 2007 emissions inventory level of 1,395 CO2e tons.

Continuous evaluation and improvement of solid waste and wastewater management practices will also result in important related climate-positive benefits that will accrue in every other sector of the Climate Action Plan.

APPENDIX

TABLE 3: STRATEGIES IN WASTE MANAGEMENT

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Implement fully-automated cart collection system for refuse and recycling	City	Complete; ongoing Nov 2014	Ease of use increases participation
Develop/implement OC waste management recommendations	City	Ongoing	Numerous internal and municipal programs in place to increase diversion
Waste audits	City, Republic Waste	2019–ongoing	Necessary information to identify diversion/recovery opportunities
Data tracking and management	City	Ongoing	Provides necessary information to manage and enhance programming
Special wastes, electronics and HHW	City	Ongoing	Through Lorain County Solid Waste Management District Collection Center
Reuse and source reduction programs	City	2019–ongoing	Less energy expended in materials overall
Yard waste management	City	Complete/ ongoing	All yard waste diverted from landfill
Multi-family residential recycling	City	Ongoing	Increased opportunity to participate
Food waste recovery/composting pilot program	City, private business	Ongoing	Kendal and the College; diverts food waste from landfill
Business plan for full scale implementation of food waste recovery program	City, schools, non-profits	2019–ongoing	Food waste reduction
Implementation of food waste recovery	City, schools, non-profits	2019–ongoing	Food waste reduction
Construction and demolition materials recovery	City	2019–ongoing	Material reuse
Municipal procurement policy	City	2019–ongoing	Green purchasing
The development of regional facilities necessary to assist in recovery	City	2019–ongoing	Regional promotion of materials recovery
Regulatory and financial incentives	City	2019–ongoing	increased reuse of materials
Zero Waste Plan update	City	2019–ongoing	Plan reflects current environment

# # #

Water Management

INTRODUCTION

The production and distribution of safe drinking water—along with the collection, transportation, and treatment of wastewater—have climate impacts, most notably through electricity use. This chapter explores how the City can reduce impacts through enhanced management strategies at the water treatment plant (WTP), the water environment protection facility (WEPF), storm water management, and through general water conservation opportunities in the community. Reducing water use through conservation and by minimizing water distribution system losses will save water and thereby reduce energy costs associated with the City's water systems.

Although Oberlin is considered "water rich," the City is expected to experience greater variability in weather, with regional changes expected in water quality and water resiliency. Although drought is not something Northeast Ohio communities currently face, action related to water conservation and water use are important in order to reduce regional and local impacts. Efforts to reduce the amount of water pumped and processed will reduce greenhouse gas (GHG) emissions. Although the total GHG emissions related to water pumping and treatment are a small proportion of Oberlin's total emissions, reduction in this area may provide ancillary benefits, including the development of adaptation strategies for future drought and flood episodes. Efforts should be made to reduce the amount of water treated at the WEPF by promoting water conservation by residential and commercial customers.

The WTP and WEPF are responsible for 48% of the City's electricity consumption, with waste water typically consuming twice as much as water treatment. The City should develop measurable goals to reduce water use from a set baseline with an acknowledgement that reduction in water usage corresponds with a similar reduction in revenues. Program development and implementation will need to balance these factors. The following strategies will be considered for implementation.

POTENTIAL STRATEGIES

Climate change has increased the relative frequency of heavy rain events in Oberlin. As the climate variability increases, these events are expected to continue to increase. Opportunities to reduce inflow and infiltration to the sanitary sewer collection system can reduce the amount of water needing processing at the wastewater treatment plant. In order to minimize potential for inflow and infiltration, improved stormwater control measures for both residential and non-residential properties can be considered.

APPENDIX

TABLE 1: STRATEGIES IN WATER USE AND CONSERVATION

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Reduce water use at City facilities through a variety of water conservation measures including physical changes, education, and incentives.	City	2019–ongoing	Water conservation
Improve water efficiency through assessments and upgrades in City facilities. Require high efficiency sinks, toilets, showerheads, and other equipment in all City buildings when building new or when needing replacement.	City	2019–ongoing	Water conservation
Install variable frequency drives (VFDs) on the high service pumps at the water treatment plant. Evaluate the cost/benefit of adding VFDs to other pumping equipment.	City	2019–ongoing	energy reduction
Continue to perform analysis of distribution system leaks.	City	2019–ongoing	Water conservation
Explore offering rebates for US EPA WaterSense-labeled products to residential and commercial customers.	City	2019–ongoing	Water conservation and cost savings
Explore the creation of a formal program to conduct water leak detection audits for residential and commercial customers.	City	2019–ongoing	Water conservation and cost savings

TABLE 2: REDUCING INFLOW AND INFILTRATION TO THE SANITARY SEWER COLLECTION SYSTEM

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Continue to identify and eliminate inflow and infiltration through inspection, maintenance, repair and replacement of sanitary sewer mains and laterals.	OMLPS	2019–ongoing	Water quality
Increase residential and commercial rainwater capture and reuse.	City	2019–ongoing	Energy use reduction and water conservation
Incorporate green infrastructure in business expansion projects to capture stormwater.	City	2019–ongoing	Energy use reduction
Install stormwater control measures on all feasible development projects.	City	2019–ongoing	Energy use reduction

Expand green roof opportunities/installations.	City	2019–ongoing	Energy use reduction
Increase residential and commercial rainwater capture and reuse.	City	2019–ongoing	Energy use reduction and water conservation

# # #

Education and Outreach

INTRODUCTION

Effective communication and education are essential to the long-term success of the Climate Action Plan (CAP). Achieving our carbon neutrality goal will require commitment, participation, and creativity from private citizens; businesses, schools, and churches; City staff; and elected leaders. It will also require that key decision makers stay well informed about evolving technologies and opportunities. The goals and strategies outlined in this chapter provide a broad strategy about the resources, knowledge base, and motivation required for widespread community support and behavior change.

The carbon-producing choices people make (what they do) are constrained by a variety of things: what they have (the physical structures around them, such as access to local food, charging stations, efficient appliances), how they think (e.g., valuing reducing carbon emissions, understanding how to reduce energy consumption), and the larger cultural context (e.g., local and federal tax rebates, networks such as Local Governments for Sustainability and supportive social norms). For the CAP to be successful, the community needs to provide the physical infrastructure, information, and motivation to enable a shift to more sustainable behaviors. We also need to leverage and promote the broader cultural context needed to support the CAP's goals. The ultimate goal of changing what people *do* (the carbon-producing choices people make) requires two key strategies:

- provide accessible and engaging role-appropriate learning opportunities (to shape what people think); and
- provide the necessary resources and positive incentives for all community constituencies (to provide a supportive context).

There is a considerable amount of research on how to motivate people, shift attitudes, and change behavior, particularly in the context of promoting sustainable behavior. The community-wide communications plan, incentive structures, and behavioral interventions will be informed by this research. In particular, a community-based social marketing (CBSM) approach to designing interventions will be used whenever possible. CBSM takes a systematic, empirical approach to behavior change, thereby maximizing the effectiveness of program dollars. This method has five steps:

1. Select the right behaviors: focus resources and energy on behaviors that have a large carbon impact, are easily changed, and are not already common.

2. Identify barriers and benefits: determine why people do not engage in a behavior, and what benefits they can see from doing so.

3. Develop strategies to change behaviors: design programs and campaigns that minimize the barriers to a behavior, and maximize or emphasize the benefits, drawing on strategies that empirical research has established are effective.

4. Pilot strategies and evaluate the impact: conduct pilot programs and assess the effectiveness of key strategies, make improvements as needed.

5. Broad-scale implementation and evaluation: launch programs community-wide; continually evaluate and adjust to maximize effectiveness.

Oberlin City schools recently completed a strategic planning process and identified core values and strategies to guide decision making over the next five years. The core value of educational excellence through rigor, innovation, and challenge to the status quo aligns well with the City's goal of achieving carbon neutrality. Similarly, the strategy focused on creating facilities that are optimized for the needs of our students and community is likewise highly consistent with the goal of creating high-performance buildings.

Work with the relevant subcommittees that emerged from the Oberlin school district's strategic planning process, particularly:

- the educational committee to ensure that sustainability literacy is incorporated as appropriate throughout the curriculum; and
- the finance and facilities committee to ensure that the new school campus is a high-performance building that also serves as a teaching tool.

Background

The previous CAP outlined the following goals:

- motivate residents and businesses to change their behavior to reduce carbon emissions and help the City reach its climate positive goal by 2050;
- empower K–12 educators to create learning environments that support sustainability, and promote sustainability and environmental studies majors at higher education institutions; and
- provide ongoing sustainability-related learning opportunities for all interested community members, institutions, and students through service learning, community events, workshops, and other educational programs.

To meet these goals, multiple strategies were implemented:

- environmental dashboards were installed at the College, Oberlin City schools, City hall, the Oberlin Public Library, and private businesses;
- the Oberlin City schools expanded the sustainability curriculum through a partnership with Creative Change Educational Solutions, a nonprofit organization in Michigan;
- the City partnered with POWER to promote a "one-stop shop" for information and assistance with energy efficiency programs for Oberlin residents (to great success);
- through the work of the Oberlin Project, sustainability tracking, assessment, and rating system assessments (STARS) were encouraged at all partner schools, and Oberlin College and Lorain County Community College completed STARS assessments; and
- the City created a new sustainability coordinator position that reports directly to the City manager. The sustainability coordinator is responsible for CAP implementation.

Building on our past goals we have developed a set of ambitious strategies for the next five-year period as follows:

APPENDIX

TABLE 1: STRATEGIES IN EDUCATION AND OUTREACH

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Create a climate action committee (CAC)	City of Oberlin	1st quarter 2019	An advisory group will provide support and feedback on goals and efforts
Provide regular CAP training for City employees and include their participation in annual evaluations	City of Oberlin	Scheduled annually (or more often)	City employees will have knowledge skills they need to further goals of CAP
Research, develop and enforce appropriate internal policies impacting City buildings/staff. The possibilities include: energy policy, green purchasing policy for vehicles and equipment, printing policy, green meeting policy, local purchasing policy, etc.	City of Oberlin and CAC	2019–ongoing	Will ensure City staff is in compliance with CAP goals; sets a model for the community
Develop education and enforcement plans for policies covered by this CAP (e.g. anti-idling)	City of Oberlin	2019–ongoing	Provides relevant stakeholders with necessary information; makes compliance more likely
Create mechanisms of accountability for City employees tasked with implementing portions of the CAP	City of Oberlin	2019–ongoing	Makes compliance more likely
Dashboard: Research how to monitor all City buildings so occupants and building managers can make more informed decisions about resource use	City of Oberlin, the dashboard group	2019	Improves decision making, saves resources

TABLE 2: STRATEGIES FOR PUBLIC PARTICIPATION AND EDUCATION

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Encourage community organizations and households to create their own climate action plans.	Sustainability coordinator, CAC, POWER, college students, et al.	2019–ongoing	Increases community participation, encourages citizens to contribute to overall greenhouse gas emissions
Continue shop local campaign efforts—promote buying local, farmers markets, etc.	Sustainability coordinator and outside organizations—e.g., Oberlin Business Partnership.	2019–ongoing	Boosts local economy, reduces carbon emissions from driving to stores outside the community

Each responsible group for CAP goal to share progress with CAC on a scheduled timeline	City of Oberlin	2019–ongoing	Improves communication and transparency; provides mechanisms for accountability and feedback
Update City website to include trackable goals related to CAP	City of Oberlin, sustainability coordinator	2019–ongoing	Provides transparency and accountability
Design and hold community workshops—"e.g., develop your own climate action plan"—to encourage individual participation in positive climate action activities	Sustainability coordinator	2019–ongoing	Increases community participation, encourages citizens to contribute to overall greenhouse gas emissions
With local realtors, design a "welcome package" for new homeowners and business owners with information on the CAP	POWER, sustainability coordinator, local realtors	2019–ongoing	Increases community participation, encourages citizens to contribute to overall greenhouse gas emissions, saves money
Revise the City's sustainable reserve program website	City of Oberlin and the CAC	2019–ongoing	Increases transparency and community engagement. Maximizes the chance that high-quality projects will be proposed
Expand environmental dashboard content to highlight CAP strategies, educational opportunities, and incentive programs	Environmental studies group at the College; City representative; CAC	2019–ongoing	Increases community awareness about CAP goals and programs.
Support POWER's efforts to raise awareness of residential energy opportunities and encourage participation in the programs offered	POWER, CAC	2019–ongoing	Increases community engagement, reduces energy waste, saves homeowners money, boosts the local economy
Create community and business awards to encourage participation in climate action activities	Sustainability coordinator, outside organizations	2019–ongoing	Increases community engagement and buy-in, highlights those who can serve as role models for others
In concert with Oberlin City schools, identify knowledge, skills, and attitudes that correspond with carbon-neutral goals, and integrate into K-12 curriculum	Sustainability coordinator, Oberlin City School District	2019–ongoing	Focuses environmental education efforts on most important elements, provides Oberlin youth with important skills

# # #

Section: Oberlin College

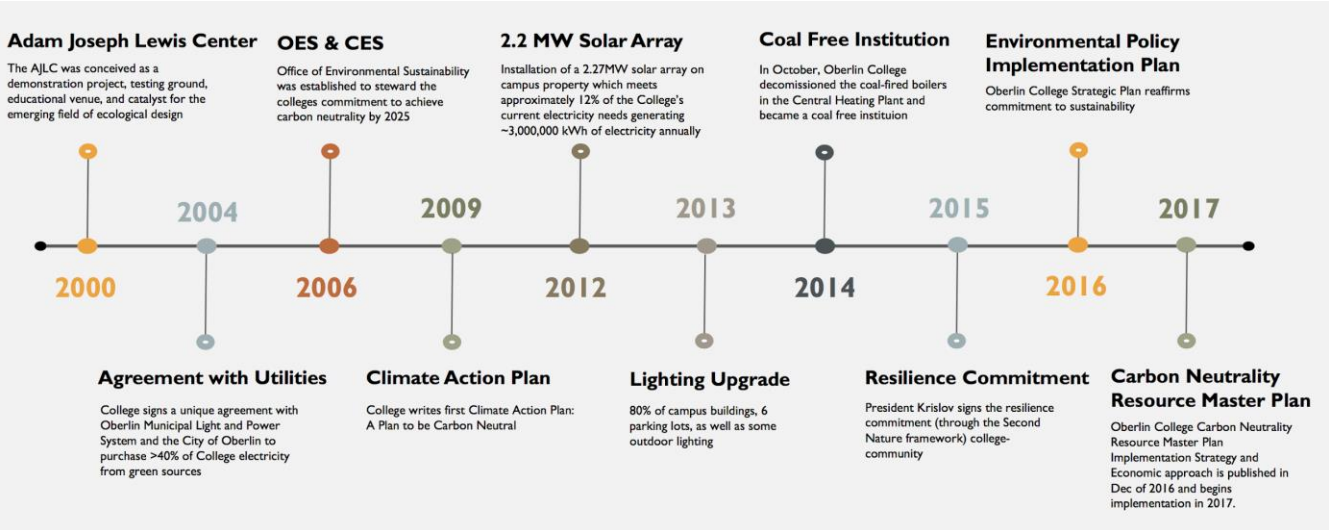
Oberlin College uses close to 25% of the City's electricity and is responsible for close to 25% of the City's carbon emissions. In 2006, the College joined the Carbon Commitment—formerly the American College and University President's Climate Commitment (ACUPCC)—with a similar goal to become climate neutral. Likewise, in December 2015, the College was one of the first US colleges to sign the ACUPCC Resilience Commitment, which entails partnering with the City to explore climate adaptation and resilience planning.

Together, the concepts of carbon neutrality and climate resilience constitute a new, integrated climate commitment for the College. These commitments share common elements in their core philosophy, most notably the ability to transcend traditional campus silos of academics, operations, student life, community engagement, and administration for holistic social impact. The network of signatory institutions, of which the College is a part of, is called the Climate Leadership Network. It encourages and enforces the need for strong ties and connections to address the climate goals of the College and the City.

Managing the College energy use and water resources are the most challenging emissions issues to address. Thermal (heating and cooling) solutions present the largest impact to college greenhouse gas (GHG) accounting, just as it does with the City. The College has established an aggressive climate action plan with GHG reduction targets of 100% by 2025.

Over the past two decades, significant administrative and programmatic infrastructure investment by the College has been put in place to champion and facilitate the shared goals of the College and the City for a carbon positive community.

TIMELINE



The College has a long history of progressive leadership on social justice issues and a shorter, but equally impressive history in environmental stewardship. The pursuit of carbon neutrality in many ways represents the ultimate liberal art. For the College to pursue its mission of education requires meeting the needs of the present without compromising its ability to educate future generations of students, too. A community that understands the dynamic interactions of species and communities over time and during changing ecological conditions is one that recognizes the interconnections between the environment, economics, equity and education. A college that embraces carbon neutrality commits itself to create new possibilities and apply ecological imaginations in any discipline or endeavor.

Since 2012 the College has implemented renewable generation projects on campus like a 2.27 megawatt (MW) solar array, as well as energy behavior-change-projects like the Oberlin Environmental Dashboard, a community-level resource awareness and conservation tool that also serves as a building monitoring platform for facility operators. The College central heating plant, which heats and cools most buildings on campus as well as a few community buildings, became a coal-free operation in March 2014. The College has also arranged financial structures to leverage maximum community benefit, such as the decision of the Oberlin College Student Senate to finance the community carbon management fund through student fees.

These efforts, in addition to others over the past 10 years, resulted in approximately 50% reduction of scope one and two GHG emissions from the College (baseline year: 2007). In December 2016, the Office of Environmental Sustainability, in conjunction with the Board of Trustees Carbon Neutrality Subcommittee of the Capital Planning Committee, presented an actionable and financially feasible plan for achieving Oberlin's commitment to carbon neutrality by 2025. *The Oberlin College Carbon Neutrality Resource Master Plan, Implementation Strategy, and Economic Approach* includes a well-elaborated community benefit component.

Click here for the complete Oberlin College CAP

# # #

Land-use Planning

INTRODUCTION

Land-use planning, a new topic for the Climate Action Plan, involves decisions that shape the entire community, including setting priorities for new and existing development, making zoning recommendations, guiding new commercial and neighborhood development, and defining boundaries or connections between different parts of the City. Land-use planning is extensively interconnected with transportation decisions, energy use, carbon sinks within City limits, efficient delivery of City services, health and safety, quality of life, success of businesses, and almost every other topic covered by this CAP update. In addition to addressing the general area of land-use planning, this section focuses specifically on green space planning and urban forestry as important examples of how land-use planning can address climate change adaptation, mitigation, and resilience.

BACKGROUND

Local communities have opportunities to address climate impacts via land-use planning and, in turn, play their role in the global effort to mitigate the effects of climate change. Capital investments in "green" infrastructure that preserve natural assets or expand mobility choices in work and housing have climate positive effects. "Smart growth" strategies that link public transportation with higher density development make the built environment more energy efficient and thus reduce greenhouse gas (GHG) emissions. Communities also reduce their carbon footprint through local distributed systems of renewable energy and food production. The execution of local strategies has long term benefits, for sustainable, independent communities minimize their dependence upon global market commodities, including fossil fuels. Ongoing climate change impacts will not be completely mitigated by reduced GHG emissions, so communities can develop resilience strategies to protect vulnerable areas and communities from more frequent extreme weather events. Transfer of development rights can reserve land needed to buffer riparian systems. Land trusts can ensure that vulnerable members of a community—e.g., children, elderly citizens, and low-income families—will not be displaced when communities rebuild after natural disasters.

Local, regional, and national decision makers will need to embrace an interdisciplinary approach to establish benchmarks, collect information, and measure key conditions. Each community will need to evaluate its unique conditions and determine how to mitigate and adapt to climate change. A comprehensive land-use planning process engages the community in order to establish a consistent vision, set goals, and evaluate appropriate strategies for sustainability. The planning process becomes more relevant and accessible with real time data collection, rapid analyses, and dissemination to key decision makers and stakeholders. These planning tools can provide the same opportunities for innovations in specific places and neighborhoods. Placemaking strategies prioritize the key elements that maximize scarce resources for site-specific reinvestment. Planning tools that access multiple data sources and disciplines allow communities to gain a deeper understanding of the emerging challenges and opportunities. Oberlin will be well equipped to harness those challenges and nurture any opportunities to build a more resilient community.

Green space in Oberlin includes parks, arboretums, athletic facilities, trail corridors such as the Plum Creek Greenway, and other undeveloped land that is either publicly or privately owned. The City of Oberlin's Open Space and Visual Environment Commission of the City advises City Council on the management of Oberlin's open spaces, including its green spaces.

These spaces play an important role in climate change mitigation and resilience by sequestering carbon and encouraging climate-friendly recreation and transportation. Vegetation in cities can capture about four tons of CO2/acre (Shammin et al., 2012). Local, accessible parks can reduce greenhouse gas emissions by reducing motor vehicle use, limiting urban "heat island" effects created by paved surfaces and buildings, and sequestering carbon in trees. Bike paths, trail corridors, and greenways facilitate bicycle and pedestrian transportation options as alternatives to motor vehicle use. The permeable surface provided by parks and other undeveloped open spaces allows stormwater infiltration, which reduces stormwater runoff. Less runoff reduces the need for water treatment, which generates GHG emissions. Land-use planning that maintains and enhances Oberlin's green space will ensure that these climate positive benefits continue.

Oberlin's urban forest encompasses all trees within the City. Urban forests act as a carbon sink by capturing and storing atmospheric carbon dioxide during photosynthesis. This carbon is stored in the trees and surrounding urban soils. Maintaining the existing tree canopy and surrounding urban soils therefore helps maintain existing carbon sinks. Denser tree canopies reduce stormwater runoff and erosion of soils that store carbon dioxide. Trees also reduce the heat-island effect by providing shade, reducing *albedo* (i.e., the amount of solar radiation reflected back into the environment), and cooling air through evapotranspiration (evaporation of water from plants, which consumes heat). These effects typically reduce building energy use and, in turn, energy-related GHG emissions. Trees can also act as a wind barrier in winter, reducing heating energy and costs.[3] Finally, green spaces or any kind of vegetation can absorb pollutants from the air.[4] Shammin et al. (2012) determined that the vegetation of the average northern Midwest and Great Lakes City can absorb 1.8 grams of sulfur dioxide, 1.7 grams of nitrous dioxide, 3.9 grams of ozone, 6.0 grams of particulate matter 10, and 0.4 grams of carbon monoxide, per kg of plant biomass.

GOALS: LAND-USE PLANNING

- Integrate CAP's short, medium, and long-term goals with local land use policies and practices. Apply placemaking strategies to stimulate sustainable reinvestment in neighborhoods where it is needed;
- maintain and preserve existing green spaces that act as carbon sinks and encourage climate-positive recreation and transportation;
- add additional land to Oberlin's publicly-owned green space and add new trail connections for bicycle and pedestrian transport (where appropriate);
- maintain Oberlin's existing tree canopy and add additional trees where appropriate; and
- develop metrics to assess progress and measure success.

[3] H. Safford, E. Larry, E.G. McPherson, D.J. Nowak, and L.M. Westphal (August 2013). Urban Forests and Climate Change. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center, https://www.fs.usda.gov/ccrc/topics/urban-forests-and-climate-change.

[4] For information on the US, see Nowak et al., 2006, and McPherson et al., 1994, and, for information on Europe see Bolund and Hunhammar, 1999.

Present Strategies: Land-use Planning

Oberlin's most recent comprehensive plan (2004; reaffirmed in the 2011 comprehensive plan update) included the following goals and strategies to incorporate sustainability in the planning process:

- planning for interconnected streets;
- planning for expanded walking and biking facilities;
- promoting infill development and redevelopment of existing structures;
- planning for preservation of natural areas, including waterways and habitat; and
- planning for efficient infrastructure extension.

Present Strategies: Green Space

The City has designated the Plum Creek Greenway to include parks and open space along Plum Creek. There is ongoing collaboration between the City administration, City Council, and City commissions to preserve and improve this greenway. The greenway project includes improving pedestrian and bicycle transportation, environmental education, green space and urban forest conservation, and erosion prevention components.

The Western Reserve Land Conservancy is working with the City and private property owners to preserve agricultural land and forested areas and to restore prairie habitat within the City.

The most recent comprehensive plan prioritizes preservation of green space, especially along Plum Creek, and the connection of Oberlin's open spaces for bicycle and pedestrian transport.

The City has a naturalized vegetation ordinance to allow native vegetation that can act as a more effective carbon sink than lawns and which does not require the intensive mowing which consumes fuel and generates more GHG emissions.

Present Strategies: Urban Forestry

The department of public works maintains trees on public land and in public rights-of-way. The City hired an urban forestry intern in 2017 to inventory the current population of trees in the urban forest. The City also obtained a Black River Watershed Canopy Restoration Grant from the Ohio Department of Natural Resources to plant trees on public land and in the public right-of-way. The City had planted 105 new trees as of July 2017, with a total of up to 350 trees to be planted.

The open space and visual environment commission serves as the de facto tree commission, working with the department of public works to maintain Oberlin's designation as a Tree City USA from the Arbor Day Foundation, which the City has achieved for 19 years. This commission worked with City Council to expand the tree planting list for trees on public property and in the public right-of-way to include a wider range of native species. This increased focus on biodiversity is intended to maintain a healthy tree canopy that is resilient in a changing climate.

The climate action planning goals for land use can be accomplished through a variety of programs and strategies. The strategies noted in the appendix are offered for consideration during the public input process.

QUESTIONS REMAINING AND METRICS FOR SUCCESS

In addition to seeking public input and feedback on the potential strategies outlined above, obtaining answers to the following questions would provide important information about which strategies should be implemented.

- Which green spaces are most important to community members for recreational purposes? Transportation purposes? Are there ways in which these spaces are not serving the community as well as they could?
- What incentives or programs would encourage private property owners to preserve and increase the tree canopy on their property?

Additional data should be collected as baseline indicators and metrics for success:

- Extent and health of Oberlin's tree canopy.
- Ecological health of Oberlin's green space and evaluation of the extent to which each green space acts as a carbon sink or source.
- Use of trails and bikeways in green space for non-motorized transportation, and the resulting amount of reduction in motor vehicle use.

APPENDIX

TABLE 1: STRATEGIES IN LAND USE PLANNING

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Incorporate smart-growth principles and Paris Agreement climate change planning guidance in comprehensive plan update	Planning department of City	2019	Carbon reduction guidelines of Paris agreement utilized
Preserve additional undeveloped open space in and around Oberlin, prioritizing forested open space and restoration of native vegetation	City	2019-ongoing	Carbon sequestration
Improve existing trails and add new trails	City Council, staff, and commissions	2019–ongoing	Reduction in motor vehicle use and GHG emissions. Increased community resilience (positive economic development and quality of life outcomes).
Promotion and education about the existing naturalized vegetation ordinance and consideration revision of the ordinance	City of Oberlin, Western Reserve Land Conservancy	2018–2020	Increased carbon sequestration. Increased biodiversity (important for resilience and climate change adaptation)
Addition of a new City park in west Oberlin near the western end of College Street	City Council, staff, and commissions	2018–2025	Reduced motor vehicle use, creation of a carbon sink, increased community resilience
Create an urban forestry ordinance with specific goals to protect healthy and significant trees and ensure planting of new trees	City Council, staff, and commissions	2018–2019	Increased health and biodiversity (resilience) of urban forest.
Develop and implement an urban forest management plan, focusing on public land and right of ways and incentives for private landowners	Staff and commissions	2018–2021	Increased health and biodiversity (resilience) of urban forest. Increased carbon sequestration, reduction in energy use and GHG emissions through decreased urban "heat island" effect.
Create a program to advise and educate private property owners about tree planting and care	Staff, commissions, arborists	2018–2020	Increased health and biodiversity (resilience) of urban forest. Increased carbon sequestration, reduction in energy use and GHG emissions through decreased urban "heat island" effect.
Incorporate credits or incentives for preservation and planting of trees, or other native vegetation, or both, in the stormwater utility program	City Council, staff, and commissions	2018–2019	Reduction of stormwater runoff, water treatment energy use, heating/cooling energy use and GHG emissions; carbon sequestration.

# # #

Local Food and Agriculture

INTRODUCTION

Local agriculture and food rescue are a vital part of the innovative vision for a post-fossil fuel community. Growing and processing food locally supports local farmers and small businesses and reduces our collective carbon footprint. Rescuing edible foods that would have added to landfill waste reduces methane in the atmosphere and provides nutritious meals to residents subject to food insecurity. The long-term goal is to work towards a more sustainable and more productive local food system that yields less waste.

The environmental effects of a local food economy are demonstrably positive when it comes to economic development, soil health, water quality, runoff, and public health. Urban agriculture sites can capture about four tons of CO2/acre annually (Shammin et al., 2012). Urban farming reduces urban carbon footprints in a variety of ways:

- reduced energy used by wastewater treatment plants due to avoided combined sewer overflow (CSO) volume;
- reduced distance traveled by food from farm to plate; reduced transportation energy used by people in the community who are now able to walk to farms; and
- reduced carbon emissions compared to food produced from large conventional farms using industrial agricultural practices.

Shammin et al. (2012) estimates that 0.74 tons of CO2 emissions can be prevented per acre of urban agriculture due to reduced combined sewer overflow and associated wastewater treatment needs. While the other factors mentioned above are more difficult to quantify, it is important to recognize that the potential for significant additional reduction of greenhouse gas (GHG) emissions associated with local food production. Finally, a key aspect of building resilient communities is to develop more self-reliance with respect to critical resources, in order to foster shorter feedback loops so that the community can better adapt their practices in response to a changing climate. The environmental benefits of a strong local food economy are clearly consistent with the broad goals of this plan.

With food waste, calculations are much clearer. The US spends "$218 billion a year, or 1.3% of GDP, growing, processing, transporting and disposing of food that is never eaten."[5] Specifically, wasted food consumes 21% of all freshwater, 19% of fertilizer, 18% of cropland, and 21% of landfill volume. Yard trimmings and food residuals together constitute 23% of the US municipal solid waste stream. Organic trash in the waste stream generates methane gas in landfills, and methane gas is 21 times more potent as a GHG than carbon dioxide. In turn, the reduction of methane gas production is key in the fight against GHG emissions. In addition, the production of fertilizer uses energy and fossil fuels. If we reduce the amount of food waste, we save water, reduce fossil fuel consumption, and reduce methane production in landfills. As a bonus, the land that is not needed for food production can be converted into areas for carbon sequestration.

[5] See the 2018 U.S. Food Waste Investment Report, @ https://www.refed.com/?sort=economic-value-per-ton.

BACKGROUND

The City of Oberlin acknowledges the pressing issues related to food sourcing and food waste. As a community, Oberlin residents and organizations have committed to increasing the quantity of locally sourced food and to reducing the amount of food that is wasted.

EXISTING CONDITIONS

Currently the City does not collect or maintain data on local food sourcing, urban agriculture, or food rescue. However, private entities have attempted to quantify the amount of local food consumed in Oberlin. In 2012, the Oberlin Project estimated that 6-7% of produce consumed in Oberlin was grown within our "foodshed," which comprises Lorain County and the six adjacent counties. While we have limited data on food rescue, the City of Oberlin operates its own waste collection system—which is unusual for a City this size—for effective and sustainable waste, recyclables, and yard waste collection.

ACCOMPLISHMENTS TO DATE FOR THE CITY OF OBERLIN

The City provides support for two significant local food and urban agriculture endeavors. Both the Oberlin Farmers Market and the Legion Field Community Garden are located on City property and supported by City administration.

In addition, the City has taken steps towards reducing waste and managing waste in a responsible and sustainable fashion. In 2013, the City completed a Zero Waste Plan, a major success solidifying the City's commitment to waste reduction. In 2016, the City of Oberlin introduced a composting incentivization program—offering full reimbursement to any private citizen who purchased a home composting bin for under $100.

PRIVATE ACCOMPLISHMENTS TO DATE

Community members and organizations have made progress on waste and food sourcing. The College and Kendal collectively rescue between 200 and 300 pounds a week of leftover, edible prepared foods, freeze this product, and donate it to the Oberlin Community Services pantry and the Oberlin weekday community meals program. Oberlin Community Services is working to expand this initiative to rescue food from other entities. Lorain County Public Health sanitarians are available to address concerns about food rescue and how to safely donate extra food.

City Fresh (est. 2005) employs a community-supported agriculture model to support local farmers and deliver organic produce to the College, local restaurants, and "fresh stops" in Lorain and Cuyahoga counties. City Fresh operates at the George Jones Farm in Oberlin, pays its farmers $.81 of every shareholder dollar spent, and allows households on limited incomes to purchase shares at a reduced rate. Dozens of college students learn about sustainable agriculture and carbon sequestration on the farm every year, and efforts are underway to expand the quantity of college food waste composted at the farm.

The Oberlin Food Hub (est. 2016) serves as a central aggregation and distribution center, sourcing hyper-local agriculture products from small-to medium-sized farms in the Oberlin food shed, primarily comprised of Lorain, Cuyahoga, Ashland, Erie, Huron, Medina, and Wayne counties.

The Oberlin Food Hub (OFH) provides wholesale customers access to hyper local produce from multiple farmers at a single location. The OFH is designed to strengthen the regional agricultural economy through buyer education, improve food access to all food consumers and reduce the carbon footprint of the northeast Ohio food supply chain through development of infrastructure to link producers with wholesale buyers, train food entrepreneurs, and create new markets for local foods including aesthetically imperfect but nutritionally sound produce "seconds."

QUESTIONS REMAINING FOR PUBLIC PARTICIPATION

The City acknowledges that public input and improved data collection in coming years will form the backbone of future strategies. Therefore, before formulating specific strategies, the City proposes that the following set of questions be posed to the public.

- What would it entail for Oberlin to become a zero-food-waste City?
- What are the barriers to eliminating food waste—for individual households, for restaurants, for stores, for farms?
- How can we make food waste part of a sustainable community cycle? Are there opportunities to create a closed-loop system?
- Is gleaning a viable mechanism for eliminating farm food waste? How can we organize gleaning services for farms on a City-wide scale?
- How can we assuage concerns about food donation-related liability?
- How can we incentivize composting on an individual level? What are the best metrics for success?
- For those who have backyard or kitchen space—if you knew how to compost on your own, and if the materials were provided to you, would you do it?
- For those who do not: would you compost if Oberlin provided a City-wide composting service?
- For restaurants/stores: would you donate all edible food waste if it were picked up on a regular basis by rescue groups? Would you compost your food waste if the City were to issue you a rebate based on weight of compost material?
- How can we encourage residents to value local food/growing their own food?
- How might we integrate food system education into the high school curriculum?
- What is the best way to spread information about sustainable food production? What resources for sustainable food production ought Oberlin to offer residents?
- Would you support City-organized workshops about food system matters, including planting, harvesting, building raised beds, seed saving, cooking, and canning?
- How can we source more food locally?
- How can we make local food more affordable?
- For restaurants, stores, schools: would you commit to buying a given amount of food locally

if it was affordable? What percentage?

- Do we want to reserve a specific percentage of public land for agriculture? What percentage?
- How can we incentive the use of private land for agriculture?
- What are the barriers to individual/community gardening/farming?
- How do we incentivize and reward growing our own food on a community or individual scale?
- What would it look like for you to feel financially secure as a farmer/gardener?
- Would you start a home/personal garden if the City supported you with funding and materials?

In addition, data should be collected on the following indicators related to local food, local agriculture, and food waste:

- the number of existing community gardens;
- the percentage of individuals who garden
- acreage of unused lands, public and private;
- public lands with potential for agricultural use;
- effective collective gardening and urban agriculture models employed in other semi-urban areas;
- percentage of edible food wasted; and
- percentage of wasted food that is composted on an institutional level, and, through survey data, on an individual level.

GOALS: LOCAL FOOD AND AGRICULTURE

As broad policy goals, the City commits to:

- decreasing the percentage of edible food wasted;
- increasing the percentage of food diverted from landfills through composting and rescue and donations efforts;
- increasing the percentage of locally sourced food consumed in Oberlin;
- increasing the percentage of land in Oberlin used for agriculture; and
- conducting targeted research about how other cities have accomplished these goals and incentivized these activities.

POTENTIAL STRATEGIES: LOCAL FOOD AND AGRICULTURE

These goals can be accomplished through a variety of programs and strategies. The following potential strategy options are presented below for consideration during the public participation process.

TABLE 1: STRATEGIES IN LOCAL FOOD AND AGRICULTURE

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Update the Zero Waste Plan to include food rescue and revise the community composting section	City Council, staff, and appropriate City commissions	2019	Organic waste diverted from landfill; amount of methane gas produced by landfill reduced; food insecurity of community residents reduced; reduction in GHG emissions related to decreased need for food production because of rescued food.
Provide for public compost pick-up and develop a local composting facility to produce a marketable product	City Council, staff, and either the Rust Belt Riders, the County Solid Waste District or both	2019–2020	Reduced amount of waste going to landfill; fertilizer/compost available for local biomass production and carbon sequestration.
Support food rescue and donation by launching an educational campaign about the Bill Emerson Good Samaritan Act, by funding rescue efforts via food waste collectors	City Council, staff, and appropriate City commissions	2019	Organic waste diverted from landfill; amount of methane gas produced by landfill reduced; food insecurity of community residents reduced; reduction in GHG emissions related to decreased need for food production because of rescued food.
Food waste from the College could once again be composted and used as fertilizer	College and City and private business partnership	2019–ongoing	Organic waste diverted from landfill
Local food use as an indicator in determinations about green restaurant certifications	City and Lorain County Public Health could partner to offer "green" restaurant certifications to promote local food.	2019–2020	Increased use of local food by local restaurants; reduced GHG emissions due to reduction in food transportation costs.
Expand support for local farmers markets	City could partner with organizations involved with local farmers markets to increase local food availability.	2019–2020	More local food purchased by the community; increased revenue for local food producers.
Reduce barriers related to the availability and cost of local food	City could form a local task force of local food stakeholders to develop solutions to reducing the cost and increasing the availability of local food to all citizens in Oberlin.	2019–2020	More local food purchased and consumed by the community; reduction in food insecurity for local residents; possible increased public health as more local produce is consumed by the community.
Establish a strong farm-to-school program to increase local food and nutrition education in school meals	Oberlin City Schools, local food producers	2018–2020	Increase in amount of local food consumed by school children; increased awareness in school

			children of local food and nutrition; possible increase in health of local children
Adopt an urban agriculture policy through changes to the zoning code	City planning director	June 2019	Increased opportunities in the City for local food production; elimination of barriers to urban agriculture.
Increase the number of private individual and collective gardens	Sustainability coordinator	2019–ongoing	Increased number of local gardens; increased local food production; reduced GHG emissions due to local food production and increased carbon sequestration in local biomass; greater awareness about gardening.
Establish guidelines about the percentage of public land used for agriculture	City Council and staff could research this issue and, with public input, develop these guidelines.	2019–2023	Public land available for local food production; increased community resilience around food production.

# # #

Resilience Section

Adaptation and Resilience

Natural disasters that affect vulnerable populations are occurring with increasing frequency and severity. During this plan update, we witnessed the most active month of any Atlantic hurricane season on record. September 2017 included Hurricane Irma (Category 5), Hurricane Maria (5), and Hurricane Jose (4). Local and national discussions about sustainability focus attention on the prevention of further climate change. However, in the face of climate disruption and extreme change resulting in multiple consequences, we recognize that adaptation needs to be more fully addressed.

The standard for adaptive strategies—behavioral, technological, and infrastructural changes—is resilience, which is the capacity of ecosystems, critical infrastructure, and the built environment to absorb varied changes without significant change in core functions. In the case of people and communities, resilience also means resisting, responding to, and recovering from shocks in ways that allow us to preserve our core values and livelihoods and, at the same time, make good use of the opportunity to make the types of changes that provide more security, equity, and happiness in the future. Creating resilient patterns of habitation that can absorb the expected variances of climate change and adaptive strategies for when resilience is overcome are concerns that are being addressed by the community through the Campus Community Resilience Task Force. The task force is also working to address adaptive approaches in the scenario our community would welcome refugees displaced from extreme climate events.

Campus Community Resilience Task Force

The Campus Community Resilience Task Force formed in 2016 to ensure alignment of the climate action plans with community goals, and to facilitate joint action regarding building a resilient campus and community. As a signatory institution to the Climate Leadership Resilience Commitment, the College supports such a joint campus-community task force by providing facilitation services to the task force and access to resilience planning tools. With its strong CAP, the City played a primary role in defining the task force focus and organization of the representative members. The following organizations hold seats on the task force: the City of Oberlin, Oberlin City School District, Oberlin Community Services, Mercy Allen Hospital, the industrial park, Kendal at Oberlin, the College, and the Oberlin faith community. The task force has one advisor, Ben Wisner, local Oberlin resident and professor at the Institute for Risk and Disaster Reduction at University College London, UK.

The task force defined resilience in the following way:

> The capacity of our city, organizations, individuals, and systems to survive, adapt, transform, and thrive in the face of changing natural conditions and disaster. Building resiliency within our campus community is about being better prepared to withstand catastrophic events—both those triggered by natural hazards and triggered by technological failures—and able to bounce back more quickly and emerge stronger from stresses, that is, to bounce forward.

According to *The Oxford Encyclopedia*, natural hazard governance chapter 38, by Ben Wisner,

> Many government policies and practices influence disaster risk indirectly in areas such as housing, health, social assistance, economic development and even trade and foreign investment. However, two areas of government policy and practice bear directly on the management and possible outcomes of natural hazards, namely, mitigation and preparedness. Mitigation consists of actions taken to reduce possible losses and harm caused by a natural event or process impacting a vulnerable and exposed population and their assets. Preparedness concerns activities and decisions focused on achieving and maintaining readiness to respond to disruption, damage and injury produced by impacts of primary natural hazard events and possible cascading secondary events.

At the core of the framework guiding national risk governance for countries and cities lie some of the most common and most effective programmatic forms of mitigation. Generally, these include:

- government disaster relief strategies;
- early-warning systems for floods, power outages, and biological outbreaks;
- insurance;
- structural mitigation, including hospital and school building codes; and
- training and certifying of architects, engineers, contractors, and builders so that their work always meets current safety standards.

RESILIENCE FRAMEWORK

Key strategies to ensure resilience are noted in the appendix below.

Some of the future explorations for building a more resilient community are interconnected among other sections of the CAP; and may include battery technology exploration, storm water utility, and a robust and coordinated readiness plan. The City and the College will continue in leadership roles as they strive to transform Oberlin into an even more sustainable and resilient community.

APPENDIX

TABLE 1: STRATEGIES IN RESILIENCE

STRATEGY	LEAD ENTITY	TIMELINE	BENEFITS
Reconvene task force meetings	City manager	2019–ongoing	Representation and input from all the major entities in the community
Incorporation of resilience into policy-level planning process and documents	Task force	2019–ongoing	Social equality and governance
Community communication system created	Task force	2019–ongoing	More community resilience via emergency preparedness trainings, workshops, or both
Build agreements to share assets	Task force	2019–ongoing	Build agreements among organizations within the community populations to access facilities and/or assets in the event of major climate disruption and displacement (e.g., Splash Zone has an agreement to act as a refugee site in the case of large population relocation)

# # #