Towards a Sustainable, Resilient Future
A Climate Action Plan for Oxford, Ohio

Acknowledgements
Climate neutrality and resilience is a community-wide effort. This plan was developed with the support of many individuals and organizations who donated their time, energy, and resources to share ideas and shape the future of our community. Special thanks to the following individuals for their contributions to our sustainable future:

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Letter to Residents

Climate action is not new to our city and our community's care for the planet. In 2019, our community joined the Global Covenant of Mayors for Climate and Energy to show our commitment to climate responsiveness. Next, we formed the Climate Action Steering Committee to organize and promote our climate action plans. In 2023, the community identified creating "A Sustainable Oxford" as a key pillar in the *Oxford Tomorrow Comprehensive Plan.* This Climate Action Plan is a detailed extension of the *Oxford Tomorrow Comprehensive Plan*, by elaborating on specific goals and tactics our community can implement to reduce emissions or build resilience in a changing climate. Climate Action is also one of Council's stated Top Three Goals.

As citizens of Oxford, we are all stewards of our community and our environment. This plan provides a roadmap for bringing about a high quality, low carbon, and prosperous life for all community members, present and future. We cherish our strengths as a forward-thinking, climate responsive city, but we also recognize the realities and challenges that await us in the face of climate change. Together, I am confident we can confront our challenges and become an even more sustainable Oxford.

The process of crafting the Oxford Climate Action Plan involved input from community members of all ages and affiliations. I am thankful to everyone who contributed their expertise, time and energy to help shape this plan. I am particularly grateful for the Climate Action Steering Committee and the many City of Oxford staff members who made this plan a reality. Oxford is quite lucky to have such a passionate citizenry and excellent staff dedicated to making our community as beautiful and sustainable as it can be.

On behalf of the Oxford City Council, I would like to extend our sincere appreciation to every individual who participated in the creation of the Climate Action Plan!

William B. Snavely

Mayor, City of Oxford

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Executive Summary

Climate change is no longer an issue for the future. It's here and happening now. Our carbon-intensive way of life threatens not only the planet and future generations, but also our daily lives as temperatures rise, storms become more intense, and flooding becomes more frequent. However, with bold and quick action we can stop climate change from getting worse and ensure Oxford remains a resilient and thriving community for generations to come. This Climate Action Plan provides a guide to that more sustainable, resilient future we hope to see in Oxford.

This Climate Action Plan is informed by the community priorities in the *Oxford Tomorrow* Comprehensive Plan and includes 1) a mitigation plan and 2) an resilience plan.

Mitigation Plan

Communities, even small ones like Oxford, can think globally while acting locally by reducing or *mitigating* our emissions. In 2020, Oxford adopted emissions reduction targets to guide our journey to carbon neutrality. Our science-based reduction targets are:

- *By 2030: 50% reduction in GHG emissions over 2019 baseline*
- *By 2040: 90% reduction in GHG emissions over 2019 baseline*
- *By 2045: Community-wide net neutrality*

This document details how we will achieve these mitigation targets by focusing on 5 main goals, each with their own implementation strategies:

- Achieve Carbon Neutral Energy
- Create Carbon Neutral Mobility Systems
- Become A Zero Waste Community
- Provide Carbon Neutral Water Systems
- Enhance Carbon Sequestration

Resilience Plan

Reducing carbon emissions is only half of the picture. We must also prepare for consequences of climate changes that are already beginning and will accelerate. R*esilience planning* can help us not only adapt to climate change, but strengthen our community overall. The Resilience Plan focuses on addressing 5 main vulnerabilities in the face of climate change, each with their own strategies:

- Decrease Risks of Increasing Temperatures and Heat
- Build Resilience to Precipitation Changes like Flooding and Drought
- Prepare for Increased Severe Storm Events
- Strengthen Ecosystems and Urban Forests

This plan cannot be achieved without collaboration across all aspects of our community. Together, we can play a meaningful role in building a more sustainable Oxford that is socially equitable and economically vibrant.

Introduction

There is no greater sustainability challenge facing our community and planet than climate change. Fortunately the Oxford community cares deeply about our environment. Creating "A Sustainable Oxford" is a core goal of the *Oxford Tomorrow Comprehensive Plan*. This *Climate Action Plan* advances that goal and Oxford's commitment to neutrality as part of the Global Covenant of Mayors for Climate and Energy by establishing specific goals and tactics to help reduce emissions and become more resilient.

Oxford is a small town, but is committed to thinking globally and acting locally for the general welfare of our community and planet, present and future.

The science is clear: our climate is changing and humans are to blame. Atmospheric "greenhouse gasses" (GHGs) are essential to regulate the climate of our planet, making Earth habitable. But even small changes in carbon dioxide, methane, nitrogen oxides, and fluorinated gasses can have significant impacts by trapping solar radiation on Earth. By burning fossil fuels and emitting GHGs, humans have altered our atmosphere and warmed our planet, disrupting regional and global climate patterns. Decades of research has confirmed that human-induced climate change has already increased air and ocean temperature, sea levels, and storms or flooding, all of which threatens human health and biodiversity. To learn more about Greenhouse Gasses and Climate Change, please visit the Environmental Protection Agency's (EPA) webpage (https://www.epa.gov/ghgemissions) or the Intergovernmental Panel on Climate Change (https://www.ipcc.ch/).

It's not too late to avert catastrophe, but we have to act now. Our carbon-intensive way of life threatens not only the planet and future generations, but increasingly our lives locally and today. However, with timely bold action we can reduce our emissions to net zero by mid-century. While climate change is a complex and global phenomenon, all emissions are local. So even small communities, like Oxford, can do our part by taking actions to reduce our emissions, contributing to regional, national, and even global *mitigation*.

But we must also prepare for changes that are already happening and are projected to become worse.. Oxford is projected to suffer more intense storms and flooding, higher temperatures, and more variability between the seasons in the near future. We need to prepare for these changes and learn how to adapt and bounce back. Such *resilience planning* can help us not only confront climate change, but strengthen our community overall.

This Climate Action Plan is embedded in the vision and goals of 2023 *Oxford Tomorrow Comprehensive Plan,* as linking comprehensive and climate action planning is a growing best practice, but both plans are only as good as their implementation. Therefore ,his Climate Action Plan offers a detailed set of objectives and strategies for achieving neutrality and building resilience.

Plan Creation and Stakeholder Engagement

The Climate Action Plan (CAP) is a subplan of the *Oxford Tomorrow Comprehensive Plan.* The CAP was spearheaded by the Climate Action Steering Committee and City Staff. The planning process combined research, benchmarking with other municipalities, and community engagement, through outreach and public meetings for the Comprehensive Plan and the Climate Action Plan. A special thank you to the Oxford League of Women Voters and the Oxford Seniors Eco-Club for co-hosting a Climate Action Plan public engagement session. All Oxford residents, employees, and stakeholders are invited to continue to help shape the city and climate future we share.

<u>The Plan Ahead</u>

This Climate Action Plan outlines how Oxford will do its part by reducing emissions to net zero and becoming more resilient in a changing climate. It includes two major components: 1) a mitigation plan and 2) an adaptation/resilience plan. Both require strategies – short, medium, and long term – integrated towards a holistic vision of a sustainable Oxford that is environmentally responsible, socially equitable, and economically vibrant.

Insert graphic of the following timeline

2015:	Electrical aggregation program begins, supplying residents and small businesses with renewable energy
2019:	Drop-off food scrap composting program created
2019:	Oxford joins the Global Covenant of Mayors
2020:	Climate Action Steering Committee (OCASC) created
2020:	greenhouse gas inventory establishes baseline emissions (2019)
2020:	initial vulnerability and risk assessment undertaken
2021:	Oxford sets mitigation targets towards neutrality by 2045
2021:	City installs first electric vehicle and charging stations
2023:	City adopts *Oxford Tomorrow Comprehensive Plan* which includes sustainability pillars
2023:	City establishes a full time Sustainability Coordinator role

Guiding Principles

The goals and recommendations guiding this plan are based on feasibility, available technology, and sustainability over time. These goals, and their implementation, should be guided by the following principles:

- Reducing Environmental Inequity: prioritizing the fair distribution of environmental health and benefits
- *Centering Vulnerable Populations:* addressing the needs of ***all*** *community* members
- *Protecting Natural Resources:* strengthening our natural resources and mitigating threats
- *Maintaining Service Excellence and Fiscal Responsibility:* Considering both long and short term fiscal responsibility
- *Ensuring Government Transparency:* setting the example for accessible, open communication
- *Fostering Collaborative Growth:* Working together for a climate responsive community

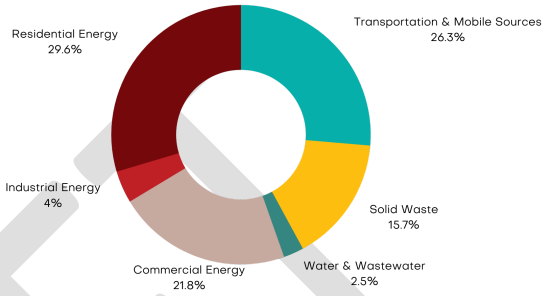
Mitigation Plan:
Achieving a Carbon Neutral Oxford

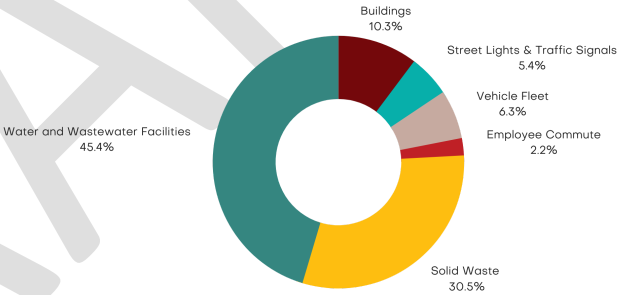
Reducing Emissions, the First Step to Sustainability

Climate action and mitigation is a process that 1) identifies the source and scale of our emissions, 2) sets science-based emission reduction targets towards carbon neutrality and 3) achieves those reductions by developing goals and tactics. Mitigation can include reducing emissions by decarbonizing our community and economy, or "sequestering" carbon in our natural landscapes, or (as a last resort) purchasing carbon offset credits.

1. *Our Baseline: 2019 Greenhouse Gas Inventory*

To reduce emissions, we have to know where they are coming from. In 2020, a team of graduate students in the Institute for the Environment and Sustainability (IES) at Miami University conducted a GHG inventory of local government operations (LGO) and city-wide community scale (CS) emissions. LGO inventories typically include city operations such as water and wastewater treatment, solid waste management, street maintenance, and more. CS inventories typically include both LGO and the rest of the community, including residential and commercial energy, transportation, landfilled waste, etc. It is important to note that Oxford's CS inventory excludes Miami University operations, since the university largely governs its own affairs and has its own climate action plan. However, the city and university work closely together to develop and implement compatible climate action plans.





Community emissions can be broken down based on scopes, or where an emission occurs. For more information about our emissions by scope, please view Appendix 1.

2. *Emission Reduction Targets*

Mitigation requires setting science-based targets to achieve carbon neutrality that include reductions and when to achieve them. Oxford's Climate Action Steering Committee developed reduction and neutrality targets by benchmarking aspirational peer communities, researching best practices, and relating both to local conditions. Most importantly, Oxford is guided by the scientific projections of the Intergovernmental Panel on Climate Change (IPCC) and the Paris Climate Accords, which highlight the need to achieve net neutrality no later than 2050 to limit warming to 1.5 to 2 degrees Celsius.

On May 18th, 2021, City Council formally adopted the following emission reduction targets, adhering to its commitment under the Global Covenant of Mayors. These targets are now embedded within the goals and objectives of the *Oxford Tomorrow Comprehensive Plan.*

Emission Reduction Targets:
Apply to community scale emissions within the City of Oxford, excluding Miami University

- *By 2030: 50% reduction in GHG emissions over 2019 baseline*
- *By 2040: 90% reduction in GHG emissions over 2019 baseline*
- *By 2045: Community-wide net neutrality*

3. Mitigation Goals, Objectives, and Strategies

While our emission reduction targets outline where we want to be, our mitigation plan details how to reach them. These goals were formed using established best practices, input from City Staff and Commissions, as well as public feedback received through the Oxford Tomorrow Comprehensive Plan Update. Our 5 main goals are as follows:

- Achieve Carbon Neutral Energy
- Create Carbon Neutral Mobility Systems
- Become A Zero Waste Community
- Provide Carbon Neutral Water Systems
- Enhance Carbon Sequestration

Carbon Neutral goals refer to a balance of greenhouse gasses being emitted and absorbed. However, this cannot be achieved without ***significantly*** reducing emissions first.

Many of these goals emerged concurrently through the 2023 *Oxford Tomorrow Comprehensive Plan*, which are labeled with their respective objective and action number. For example:
"Develop regulations and incentives to ensure electrification of new construction with high-efficiency space and water heating *S1-A3*" (In this example, S1 refers to Sustainability Chapter Objective 1 and A3 refers to Action 3 under objective 1).

Goal: Carbon Neutral Energy

A large proportion of local emissions come from how we power, heat, and cool our buildings. Energy sources produced by burning fossil fuels contribute 56% of our community scale emissions, divided among residential energy (30%), commercial energy (22%), and industrial energy (4%). There are two main ways we can reduce energy-related emissions: 1) reduce our energy consumption and 2) decarbonize our energy supply through electrification and renewable energy generation. Currently, the city participates in an electric aggregation program which provides residents and small businesses with renewably sourced energy. However, locally generated renewable energy is preferred as it would also make our community more resilient, and less dependent on the larger power grid. Objectives and tactics to reduce and decarbonize Oxford's energy consumption include:

Reduce Oxford's energy demand through energy efficient infrastructure

- Adopt green building standards for public and private development S1-A3
- Establish an Energy Special Improvement District (ESID) S1-A6
- Promote retrofitting of existing buildings with energy conservation and electrification S1-A4
- Develop regulations and incentives to ensure electrification of new construction with high-efficiency space and water heating S1-A3
- Adopt energy performance metrics and require a "scorecard" to be published on a transparent platform
- Encourage solar-readiness (e.g. subdivision street orientation) in new construction through land development regulations

Decarbonize Oxford's energy supply

- Develop an energy plan to meet Oxford's demand with renewables generated locally and/or regionally S1-A1
- Promote incentives for on-site solar and wind for residential and commercial properties, including state and federal subsidies (e.g. Inflation Reduction Act) S1-A2
- Collaborate with partners and property owners to develop a climate pledge program for households, organizations, and businesses
- Prioritize renewable energy generation on suitable areas, such as impervious surfaces
- Continue Oxford's electric aggregation program
- Explore local subsidies or loans for residential-scale renewable energy generation
- Identify revenue source to support local Property Assessed Clean Energy (PACE) programs
- Identify local revenue source to incentivize conversion to electrification

Lead by example through local government operations

- Convert all street and public lighting to energy efficient LEDs
- Explore 'dark sky' standards which balance safety and efficiency in public lighting
- Expand municipal generation of electricity and optimize renewable energy production on City-owned properties
- Conduct a feasibility study for solarizing all City facilities by 2023

- Retrofit existing government facilities to meet current, high-efficiency energy codes, including use of variable frequency drives to increase efficiencies

Goal: Carbon Neutral Mobility Systems

Transportation and mobile sources (i.e. personal vehicles) are the second largest contributor to our community scale emissions. 26% of our emissions come from how we get around, typically in vehicles powered by burning fossil fuels like gasoline. Reducing these emissions may be achieved through reducing the number trips taken, utilizing alternative modes of transportation, and/or by electrifying the vehicles used. The City has taken steps to reduce transportation emissions through bike lanes and expansion of the Oxford Area Trails, and the installation of electric vehicle chargers. Overall, Oxford aims to equitably increase the accessibility and convenience of alternative modes of transportation. Objectives and tactics to make our mobility systems carbon neutral include:

Reduce Trips and Vehicle Miles Traveled by Single-Occupancy Vehicles

- Encourage commuter transit connections to/from other regional hubs M1-A5
- Expand bus and/or shuttle transportation options to provide service accessible within a 1/4 mile to all City residents M1-A3
- Establish passenger rail service to/from Oxford M1-A4
- Adopt regulations for micro-mobility options to ensure access and safety for users and non-users M1-A7

Make walking and biking safe and convenient across all of Oxford

- Treat pedestrian and cyclist mobility with equal importance to vehicular mobility M3-A1
- Identify proper staffing and funding to ensure key sidewalks are cleared of snow M3-A4
- Identify costs to become a designated Bicycle Friendly Community by the League of American Bicyclists by 2025 M3-A9
- Expand the Oxford Area Trails System by completing the perimeter loop and linking to neighborhoods and commercial areas M3-A2
- Conduct a feasibility study for connections between the Oxford Area Trail System (OATS) and business districts M3-A3
- Establish a green alley system in the Mile Square to create a network of shared, low impact streets M3-A5
- Enable safe walking and biking to in-town schools through infrastructure improvements and programming in partnership with Talawanda School District M3-A8
- Complete interconnected pedestrian and bicycle network within Oxford
- Collaborate with neighboring jurisdictions towards regional bicycle network connectivity
- Explore bike sharing programs to expand micro mobility

Follow sustainable development practices to increase Oxford's walkability

- Modernize the Oxford Zoning Code to include a hybrid of use-based and form-based approaches to standards L1-A3
- Refine zoning districts to promote mixed-use and neighborhood-oriented commercial development L1-A4
- Explore increasing allowable building height in one or more targeted locations L1-A2

- Favor traditional neighborhood qualities over conventional, auto-oriented designs L1-A1
- Favor infill development over physical expansion of districts as much as possible L3-A1
- Ensure sustainable development is socially equitable
- Ensure multimodal design in new construction

Continue to prioritize Complete Streets principles and practices

- Ensure new private developments embrace Complete Streets principles and practices M1-A1
- Implement Complete Streets principles and practices in public infrastructure projects M1-A2
- Retrofit existing street network to Complete Streets principles and practices
- Update Typical Sections in the Subdivision Regulations to ensure high quality, complete streets M3-A7

Ensure equitable access to low carbon transportation

- Analyze public transit access and transportation costs for neighborhoods with housing affordable to low- and moderate-income households M1-A6
- Construct or retrofit transportation infrastructure to meet standards in the Americans with Disabilities Act M3-A11

Reimagine parking in our community to meet demand while prioritizing walkability

- Create a plan for replacement of surface parking with structured parking M4-A5
- Explore opportunities for shared parking agreements to boost available parking supply when needed M4-A1
- Encourage Mile Square student renters to utilize long-term parking facilities on campus M3-A10
- Reduce off-street parking minimums in certain areas of town M3-A6

Expand Electric Vehicle (EV) Charging and Infrastructure

- Adopt EV charging infrastructure requirements for new multi-family and commercial developments S1-A5
- Install EV charging stations in places available for public use S1-A6
- Identify revenue sources for EV infrastructure
- Explore private partnerships to support EV infrastructure

Lead by example through Local Government Operations

- Convert the city vehicle fleet to hybrid and/or electric vehicles, where appropriate ensuring fleet is able to carry out all expected functions S1-A7
- Promote state, federal, and other incentives for private EV purchase
- Explore internal incentives for EV purchase

Goal: Become a Zero Waste Community

Waste contributes directly and indirectly to both local and community scale emissions. Organic material sent and buried in the landfill creates methane, a powerful greenhouse gas. And while not directly part of our greenhouse gas inventory, plastics – particularly single use plastics – are a growing contributor to global warming. In Oxford waste contributes 15% of our community scale emissions. In 2019, Oxford had a 24.91% residential solid waste diversion rate, meaning less than ¼ of residential waste was recycled, composted as yard waste, or composted through our food scrap program. The motto "reduce, reuse, recycle" summarizes key strategies for making Oxford a community that is both "zero waste" and "net zero". Objectives and tactics to improve our waste management include:

Increase community waste diversion through recycling S3-A1

- Require all commercial properties, including multi-unit apartment complexes, to recycle *S3-A3*
- Increase residential diversion rate from 25% (2019) to 30% in 2030.
- Establish measurement methods for commercial diversion rates
- Expand recycling education program
- Advocate for expansion of regional recycling capacity S3-A2

Increase community waste diversion through composting S3-A1

- Expand residential composting (Food Scrap Program)
- Pilot and launch a curbside and commercial composting program S3-A5
- Advocate for expansion of regional composting capacity S3-A2
- Continue the yard waste composting service

Increase community waste diversion through food rescue and recovery

- Expand community-wide food rescue and recovery

Incentivize a zero-waste local economy

- Encourage retailers to itemize a charge for single-use plastics S3-A6
- Promote reusable serviceware for dine-in restaurants, and compostable serviceware and containers for take-out S3-A7
- Incentivize composting for dine-in restaurants
- Collaborate with partners towards green business certification program

Manage additional waste effectively

- Establish Community Clean-Up Days to provide opportunities for disposal of bulky, sensitive, or hazardous items S3-A4
- Increase diversion of construction and demolition waste through incentives or codes

Lead by example through Local Government Operations

- Expand recycling and composting to all city facilities by 2024

- Require events serving food/drink in public facilities be zero waste through reduction, recycling, and composting by 2024
- Reduce emissions from the closed sanitary landfill through the installation of a solar flare by 2023

Goal: Carbon-Neutral Water Systems

Through municipal utilities, Oxford provides the services of drinking water treatment, wastewater treatment and stormwater management. These water related activities contribute 3% of our community scale emissions and 40% of the emissions from our local government operations. These generate emissions through the energy required for operations and through direct emissions like methane released from wastewater treatment. It is possible through efficiency improvements and innovation to maintain these essential, high-quality public services while limiting their environmental impact. Objectives and tactics for decarbonizing water systems include:

Treat Drinking Water Efficiently

- Explore on-site renewable energy generation
- Optimize energy efficient water pumping, treatment, and distribution methods

Treat Wastewater Efficiently

- Explore onsite renewable energy generation
- Optimize energy efficient wastewater treatment methods
- Eliminate organics loading from commercial food preparation
- Optimize methane capture for energy sourcing

Manage stormwater runoff effectively U2

- Promote Low Impact Development (LID) techniques, such as rain barrels and bioswales to reduce runoff at the source U2-A1
- Revise development codes to promote low impact stormwater management S4-A7
- Revise street design guidelines to incorporate green infrastructure for stormwater retention, filtration, and tree canopy goals. S4-A5
- Establish a revenue source for the enterprise fund for stormwater improvements and mitigation U2-A2
- Implement an "Adopt Your Drain" program for individuals to prevent water pollution through storm drains by 2025 S4-A4

Conserve water and reduce Oxford's water demand U2-A2

- Adopt regulations or incentives to promote efficient residential and commercial water use (and reuse/harvesting) S4-A6
- Educate renters and homeowners on low flow alternatives in their homes
- Promote water conservation tips for lawns and home gardens

Lead by example through local government operations

- Conduct a water efficiency audit for all City owned properties
- Implement best practices for water conservation on city owned lawns and gardens, while maintaining recreational fields surface quality for play

Goal: Enhance Carbon Sequestration

Oxford is a major landowner and manager, providing the opportunity to go beyond reducing emissions through decarbonization to sequestering carbon from the atmosphere. Carbon sequestration is the process for capturing and storing carbon dioxide from the atmosphere, particularly through naturally-occurring processes in ecosystems and the soil. Plants, particularly trees and especially mature forests, are great for capturing and storing carbon dioxide. But it's also possible to naturalize current landscapes with native grasslands, pollinator gardens, wetlands, etc. to increase their carbon sequestration potential, while also enhancing biodiversity, reducing mowing, and creating beautiful places. Enhancing carbon sequestration is therefore essential to achieving carbon neutrality, especially to offset those emissions that are hard to mitigate. Objectives and tactics to increase carbon sequestration include:

Expand Oxford's tree canopy

- Expand the city's urban tree canopy from 35% to 50% by 2050 by supporting tree planting and urban forestry programs S4-A2
- Strengthen conservation of mature forests and other significant environmental areas in development review S4-A1
- Prioritize equitable tree planting in vulnerable areas of our community

Optimize Soil Carbon Sequestration

- Reduce the amount of impervious surface per dwelling unit or gross square footage
- Promote compact, infill development within urban core, conservation development at edge
- Revise urban development codes to optimize landscape management
- Promote nativization of landscapes on private land through code revision and public education

Lead by example through Local Government Operations

- Expand public education on sustainability and conservation, using public lands and facilities as models S4-A8
- Utilize alternatives to conventional pesticides on public property S4-A3

Resilience Plan:
Building Resilience for a Changing Climate

Getting Ready for a Challenging Future
Confronting the climate crisis also means adapting to a changing world. Our climate is already changing and will present growing challenges to public health, safety, and general welfare. In tandem with a Mitigation Plan, this Resilience Plan will help Oxford best navigate an uncertain climate future.

Resilience and adaptation planning is a process to 1) identify present and projected environmental hazards, 2) assess the vulnerability of the community and particular groups to these threats, 3) evaluate local adaptive capacity (in terms of our strengths and weaknesses to adapt to a changing climate), and 4) recommend actions and goals that can help make our community more resilient in the face of change.

Creating a more resilient future will require long-term commitment and collaboration among City leadership and staff, elected and appointed officials, Miami University, local institutions and organizations, as well as community members.

Climate Hazards, Vulnerability, and Adaptive Capacity
Each community is unique in its combination of locally-specific threats and vulnerabilities. In 2020, a group of Miami University Masters of Environmental Science students engaged key stakeholders in an initial vulnerability and hazard assessment. They identified key vulnerabilities of: **increasing temperatures and heat risk, precipitation changes like flooding and drought, severe storm events, and changing ecosystems and urban forests**. . Thus, the goals of the resilience plan include:

- Decrease Risks of Increasing Temperatures and Heat
- Build Resilience to Precipitation Changes like Flooding and Drought
- Prepare for Increased Severe Storm Events
- Strengthen Ecosystems and Urban Forests

The following section elaborates on each of our hazards, using climate projections for our region from the U.S. Global Change Research Program *Fourth National Climate Assessment* (NCA4) and other scientific studies, as well as local experts and data (e.g. meteorological records) to synthesize data on recent hazards, social vulnerability, and adaptive capacity.

Knowing the risks we face and our vulnerabilities to them is essential to weathering and prospering in the future that is increasingly already here.

Goal: Decrease Risks of Increasing Temperatures and Heat

Current and Projected Environmental Risk and Vulnerability

Extreme heat will be a primary threat to Oxford in the future. Ohio has already warmed 0.8^0 C (1.5^0 F) since 1900, more in winter than summer (Vose et al. 2017). Warm-season temperatures are projected to increase more in the Midwest than any other U.S. region (NCA4). Optimistic climate models based on vigorous climate action and emissions reductions (RCP 4.5) project warming of 2.3^0 C (4.2^0 F) by midcentury and 3.1^0 C (5.5^0 F) by late century. More pessimistic "business as usual" scenarios (RCP 8.5) project 2.9^0 C (5.3^0 F) warming by midcentury and 5.3^0 C (9.5^0 F) by the late century. These will lead to an increase in the frequency and intensity of heat waves. Business-as-usual scenarios suggest an increase of 20-30 days above 90^0 F by mid-century, with the potential for 10-30 days per year over 100° by end-of-century (NCA4).

Our region has already experienced increasing summer temperatures and risk of heat exposure. Oxford has also experienced warmer winters, which reduce weather severity but can entail other risks, such as increases in insects and insect-borne disease. In addition, the high variability in weather patterns have stressed residential, agricultural, and wild landscapes, exacerbated by greater temperature extremes.

Increased temperatures will make vulnerable groups even more vulnerable. Vulnerable groups include people without air conditioning, those who work outdoors, people with respiratory health concerns, renters, senior citizens, and low-income households. High summer temperatures are linked to an increased risk of a range of illnesses, particularly among older adults, pregnant women, and children. People living in more urbanized areas like Uptown, the Mile Square, College Corner Pike, or the Locust Street corridor may experience higher ambient temperatures because of urban heat island effects and greater heat-related risks (NCA4). Exposure to high temperatures will impact workers' health, safety, and productivity, particularly those in rural communities who work outdoors. Increased daytime and nighttime temperatures are associated with public health issues like dehydration and heatstroke. Among U.S. regions, the Midwest is projected to have the largest increase in extreme temperature-related premature deaths under business-as-usual scenarios (RCP8.5; NCA4).

Other vulnerabilities to excessive heat are less direct, but no less worrisome. Warmer temperatures will increase ground-level ozone, which coupled with particulate matter, will affect the prevalence of various lung and cardiovascular diseases (NCA4). Climate change is also expected to alter the geographic range, seasonal distribution, and abundance of disease carrying insects, exposing more people in North America to ticks that carry Lyme disease or other agents, and to mosquitoes that transmit West Nile, chikungunya, dengue, and Zika viruses (*ibid.*). Increased cooling needs will create additional utility costs and add to energy insecurity for our poorer residents, and peak utility demands during heat events can strain our electric grid and threaten outages. High temperatures will impact our local agricultural community, as maximum temperatures move further above optimum conditions and risk reproductive failure for key crops (NCA4).

Adaptive Capacity

The City of Oxford is currently able to withstand current temperature-related risks, but risks are expected to increase. Many Oxford residents have access to heating and AC. However, some low-income and other residents (e.g. renters) are likely more vulnerable due to lack of AC. The City currently has cooling shelters and preparedness plans that can be activated in emergencies.

A heat wave, potentially exacerbated by power outage, will stress our medical system. McCullough-Hyde Memorial Hospital (MHMH) currently can treat approximately 20 patients in acute care and surge to 46 patients. MHMH has multiple chillers, redundant HVAC systems, and backup generators. If necessary, MHMH can rely on additional support from other TriHealth facilities.

Miami University is an important collaborator when building resilience to heat. While Miami manages its own buildings, infrastructure, and landscape, sharing cooling centers and having coordinated emergency responses will be critical in the event of a heat wave.

Adapting to changing temperatures will require partnership with property owners and managers responsible for how private houses, apartment buildings, and businesses are powered, heated, and cooled. The City encourages adaptation planning, but capacity to adapt will vary according to the responsible party.

Resilience Recommendations and Goals

Reduce the impact of increasing temperature community wellness

- Explore ways to build redundancy (back ups) into local electricity supply and support local energy generation and storage for the event of grid failure
- Ensure community cooling shelters adequate to public need, including but not limited to locations listed in Oxford's Emergency Operations Plan (page 51).
- Adapt outdoor work schedules to protect public health.
- Ensure local emergency health capacity exists for projected health emergencies.
- Develop a coordinated neighbor check-in program in coordination with community organizations by 2025.

Reduce the Urban Heat Island Effect and increase cooling capacity

- Adopt climate responsive and resilient building and zoning codes (i.e. incentivizing reflective roofs and parking to reduce heat gain, building orientation, and energy efficient cooling capacity).
- Expand the city's urban tree canopy from 35% to 50% by 2050 by supporting tree planting and urban forestry programs on both public and private lands. in collaboration with local property owners and managers.

Goal: Build Resilience to Precipitation Changes like Flooding and Drought

Current and Projected Environmental Risk and Vulnerability

Another primary hazard is extreme precipitation events, including flooding and drought. The Midwest has experienced a 3% increase in precipitation per year from 1979-2014, with the greatest increases in fall and spring. Winter and spring precipitation – key to flood risk in the Midwest – is projected to increase by up to 30% by the end of this century (NCA4). We have experienced a significant increase in extreme precipitation events (defined as >2 inches in a 24-hour period), including increases in both storm duration (4% per decade), frequency (11% per decade), and intensity (Easterling et al.1997). Models predict Ohio will see wetter winters and springs, when flooding risk is greater, and a projected increase in frequency, intensity and duration of extreme precipitation events, including mesoscale convective systems.

While Oxford has not experienced widespread flooding, we have experienced notable precipitation events. A precipitation event was witnessed on June 3, 2021 in which nearly 2 inches of rain fell in a few hours, including a period of almost 4 inches per hour, which produced local flash flooding.. Another event in June 2022 had 2+ inches of rain, which caused local flash flooding. While Oxford's sanitary and stormwater are separate, inflow and infiltration has contributed to bypass events at the wastewater treatment system and periodic National Pollutant Discharge Elimination System (NPDES) violations, and poses risks of basement sewer back ups.

Vulnerability to changing precipitation can include damage from flooding, which can overwhelm stormwater and sewage systems, disrupt transportation networks, and cause damage to infrastructure and property (NCA4). Vulnerable groups include homeowners with basements, people isolated during storm events, residents in or near floodways and floodplains, transportation system users (including health transportation and emergency services), landscape managers and agricultural producers, and the City (as the operator of storm and sewer infrastructure).

At the same time, models predict reduced precipitation in summer, which combined with increased temperatures, will create greater risk of drought in summer months (NCA4). Oxford and its surrounding region have experienced periodic drought. The most acute drought in recent history was 1988, which caused major crop losses in the region and created a shortage in Oxford's groundwater drinking water supplies.

Oxford's primary vulnerability to drought relates to its dependence on local single-source aquifers. After the 1988 drought the City expanded its well fields beyond the Four Mile Creek watershed into the adjacent Seven Mile Creek watershed to increase supply and reduce vulnerability. Water scarcity related to future drought events would be experienced across the community.

Adaptive Capacity to Precipitation Changes

The City of Oxford has been able to manage recent precipitation variability. However, extreme weather events can cause property damage, infrastructure challenges, and erosion issues related to urban stormwater and infrastructure. Future Infrastructure improvements should be designed to anticipate flooding risk.

Private property owners will play a key role in adapting to changing precipitation regimes. For example, better management of stormwater on-site (i.e. low impact development) can help reduce downstream flooding, and responsible water use during droughts can help ensure demand does not exceed our limited supply. The community likely has the capacity to adapt, but will require careful leadership by the City, as well as changes to land use and human behaviors.

Miami University will be an essential partner in adaptation, whether managing water demand during droughts, reducing inflow and infiltration into Oxford's sanitary sewers, or managing its stormwater.

<u>Precipitation Changes Resilience Recommendations and Goals:</u>
Improve stormwater management to meet expected increases in precipitation

- Revise development and building codes to incorporate low impact stormwater management and model infrastructure on projected future conditions
- Retrofit public streets to incorporate blue/green infrastructure, which connects natural areas and increases ecosystem services to an area, like flood resilience
- Update community-wide stormwater management plan based on model predictions of future events. Employ tools such as US EPA's Climate Resilience Evaluation and Awareness Tool (CREAT) Risk Assessment Application for Water Utilities and National Stormwater Calculator
- Develop and adopt stormwater utility and water pricing to encourage low impact development and generate revenue to mitigate harms
- Strengthen efforts to reduce inflow and infiltration of stormwater into the sanitary system

Promote water conservation

- Adopt regulations or incentives to promote efficient residential and commercial water use
- Promote water conservation through residential and commercial landscape (e.g. native and drought tolerant landscaping, water harvesting, permit greywater harvesting)
- Develop plans to ensure adequate water supplies, managing both supply and demand, for projected future conditions

Goal: Prepare for Increased Severe Storm Events

Current and Projected Environmental Risk and Vulnerability

Severe storms also pose significant risks to Oxford. Given its geographical location in the Midwest, Oxford is subject to severe weather typically related to mesoscale convective systems. Climate models project an increase in the frequency, intensity and duration of these systems. These storms can bring lightning, heavy precipitation, high winds, and in some cases tornadoes. More frequent or intense storm events pose a risk to lives and property both directly (e.g. flooding, wind or hail damage to structures) and indirectly (e.g. downed trees, damaged utilities, and loss of power).

Oxford has already experienced frequent extreme weather events which have produced high winds and related damage. Tornados are the most severe hazard, but are highly localized in impact. Oxford has been spared from such damage, but its location places it at equivalent risk to other places in the region that have not been so lucky (recently the Dayton region in 2019, and historically Xenia in 1974 and 2000). More typically the damage from storms relates to high and/or straight line winds. The most significant wind-related damage resulted from the remnants of Hurricane Ike in September 2008, in which thousands of Oxford residents lost power and remained without it for days. In 2022 alone, severe icing events caused extensive power outages across Ohio that were followed by frigid temperatures, and severe summer thunderstorms caused days-long outages amidst record-breaking high temperatures. Oxford was luckily spared but these are indicative of future risks.

Oxford is quite vulnerable to extreme storm events due to the above-ground location of most energy and communications infrastructure and the abundance of mature trees. This threat will become more acute as other weather-related extremes stress our urban forest, leading to greater risk of downed limbs and trunks. The loss of electricity can quickly combine with other weather conditions – extreme heat in the summer or cold in the winter – to create risk for property and/or health. All households are vulnerable to power loss, but not all have resources to endure prolonged outages (e.g. money for hotels in nearby places, generators, etc.). Those who rely on electricity for medical equipment are particularly vulnerable.

Adaptive Capacity to Extreme Storm Events

The City has emergency preparedness plans for severe storm events, which mobilize local resources in collaboration with Butler County and agencies like the Red Cross.

The City has electric generation at all critical facilities for emergencies or when grid power is not available.

Non-critical facilities and residential areas are dependent on the regional grid and suppliers. Increasing local generation and storage capacity could help Oxford weather extreme events, even if regional grids fail.

Miami University manages its facilities and has the capacity to adapt to severe storm events. It is well prepared with generators and contingency planning, which can support, not only its own operations, but potentially serve a wider community need.

Many individual property owners are currently unprepared for extensive power outages, especially during extreme cold or heat. More work needs to be done to build the capacity of local residents and businesses to weather future extreme events.

<u>Recommendations for Resilience to Severe Storm Events</u>

Strengthen our energy infrastructure

- Expand local, utility-scale renewable energy production and storage towards a long-term goal of self-sufficiency
- Transition our local electricity distribution to below-ground utilities, where feasible
- Create regulatory or other incentives to expand residential and commercial battery/backup energy (preferentially renewable)

Reduce the risk of storm intensity on community wellness

- Update emergency plans to ensure cooling/heating centers within walking distance of all residents
- Identify tornado shelters within ¼ mile of all residents
- Establish neighbor check-in programs focused on those reliant on electricity for medical devices, develop strategies to meet need in event of power outages.

Goal: Strengthen Ecosystems and Urban Forests

Current and Projected Environmental Risk and Vulnerability

Southwestern Ohio has experienced a range of threats to native and urban forests, from climatic changes and extremes to invasive species and pests. While Midwestern plant species have shown ability to shift their range, they may not be shifting quickly enough to keep up with a changing climate (NCA4), and species loss will contribute to a net loss of biodiversity. Declines in native pollinator species are another important concern in the Midwest, as both native and managed pollinator species (honeybee) play vital roles in supporting food production and farmer livelihoods and are critical for supporting wild plant reproduction and diversity (*ibid.*).

In recent decades Oxford has experienced record heat, record low temperatures, and severe drought, which can stress the health of our forests. At the same time, pests like the Emerald Ash Borer have almost eliminated various species of Ash tree, which were a significant portion of local and urban forests, with major ecological impacts and tree-removal costs to landowners. Introduced species like bush honeysuckles also compete with native species. While these invasions are not attributable to climate change, additional non-native species are expected to invade as climate changes, so they suggest the kind of threats and costs posed by climate change to our region.

Threats to ecosystems and urban forests also create vulnerabilities for people. Trees and other vegetation provide valuable cooling in urban environments due to evapotranspiration and direct shading from these trees. Tree canopy varies across neighborhoods, often with the least shading in more urbanized and lower-income neighborhoods, making those residents more vulnerable to urban heat island effects. By increasing the tree canopy in urbanized areas, cooling effects can be greatest (Wang et al. 2022). The cooling effect depends on many factors (tree abundance, size, species, and spatial arrangement, surface features of the city, weather conditions), but it is estimated each 1% increase in urban tree area provides 0.2^{0} C of surface cooling during heat waves in U.S. cities (Wang et al. 2019).

Adaptive Capacity

The City has direct management control over the lands it owns, which include recreational parks and utility sites. The City also manages the urban forest planted within the public right of way, and can manage this resource for these same goals. However, staffing capacity is limited.

Miami University is also a major land owner/manager and can partner in landscape management. It has great potential to manage its lands for both mitigation and resilience. However, its staffing is also likely insufficient (i.e. Miami does not have a full-time arborist).

Most lands in Oxford are privately owned. Thus, public education to promote climate conscious landscape management is essential. However, staffing capacity has limited the scale of public education.

Recommendations for Resilience

Expand city tree canopy

- Expand the city's urban tree canopy from 35% to 50% by 2050 by supporting tree planting and urban forestry programs on both public and private lands. in collaboration with local property owners and managers.
- Develop a more robust urban forestry plan, particularly within the public right of way, and consider employing a full-time arborist.
- Revise tree planting lists by 2025 to select for those native to North America and tolerant of projected climate change.

Expand naturalization to promote biodiversity

- Promote landscape naturalization and tree planting on private properties
- Adopt a landscape naturalization plan for City-owned lands to promote biodiversity and reduced maintenance
- Require robust landscape maintenance plans of new development

On to Implementation

From Plan to Action

Climate Action Planning does not end with the adoption of the plan. That's only the beginning. Becoming carbon neutral and climate resilient will require a community-wide effort, relying on public, organizational, and individual action. Now it's time for the City of Oxford, community leaders, and everyday people to act.

Climate Action Planning should be a dynamic process. It should inform and be informed by other policy and planning efforts. This plan will be reevaluated and updated every 5 years to ensure progress that meets changing community needs. Reports will be published every 2 years to share progress in reducing emissions reductions and adapting Oxford to a changing climate.

In this historic project we must be equally bold and pragmatic. The challenge before us is unprecedented, so our efforts must be too. We cannot achieve neutrality or resilience with incremental progress over the *status quo*, but will need unprecedented ambition. And since change is never easy, and not always made easier by state and national policy contexts, we must be clear eyed about the challenges ahead. But every single goal, objective, and strategy in this plan is feasible, however, relying on tested best practices and technology. And all are achievable within a few decades.

A more sustainable and resilient future for Oxford is within reach. We *can* do this. This road map can help us get there.

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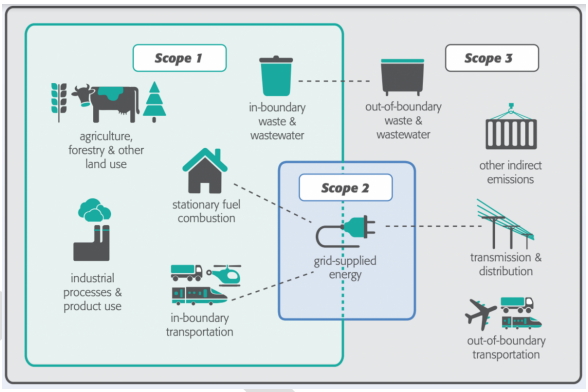
Appendix 1: Oxford's Emissions by Scope

Our emissions can be categorized based on scope, or where an emission occurs.

Scope 1

Scope 1 includes direct greenhouse gas (GHG) emissions that come from sources within the city boundaries. In this scope, the biggest contribution to emissions from Local Government Operations (LGO) is from solid waste facilities. More broadly on the Community Scale (CS), the two main sources of GHG Emissions are commercial energy and transportation & mobile sources.



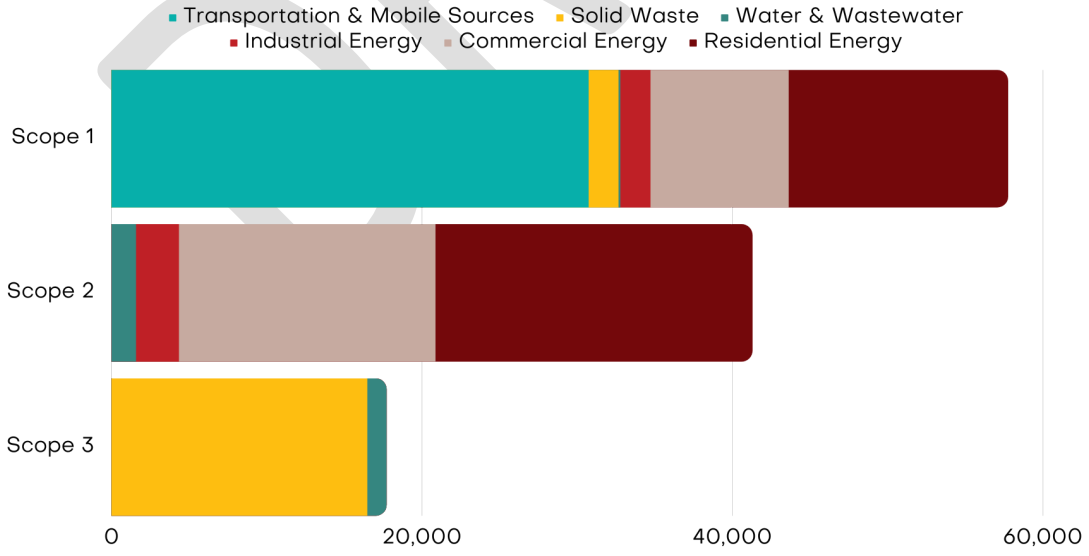
Scope 2

Scope 2 involves indirect emissions that occur because of grid-supplied energy in the city. For LGO, the biggest source of emissions is water & wastewater treatment facilities. Looking at CS, the biggest contributor to emissions is commercial energy.

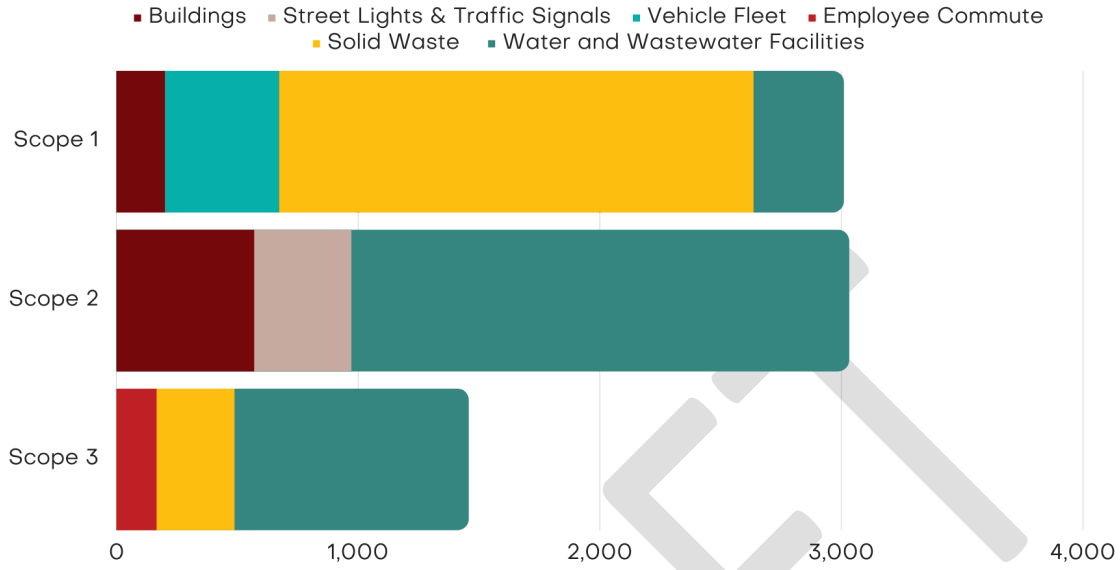
Scope 3

Scope 3 represents all other emissions that occur outside of city limits because of activity that is happening within city limits. GHG emissions from LGO are mostly attributed to water and wastewater treatment facilities in this scope. CS emissions in Scope 3 were much lower than in the other 2 scopes and were almost exclusively credited to solid waste.

2019 Community Scale Emissions by Sector and Scope



2019 Local Government Operations by Sector and Scope



Both charts represented in CO2e.