City of Oberlin Climate Vulnerability Assessment Report 2021

A report on prepared for the City of Oberlin by:
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Linda Arbogast, Sustainability Coordinator, City of Oberlin
John Petersen, Professor of Environmental Studies and Biology, Oberlin College
15 Student Coordinators
53 Community Participants

Executive Summary

The local, regional, and global climate is already changing as a result of greenhouse gases emitted by humankind over the last two centuries. Swift and comprehensive action must be taken to eliminate future greenhouse gas emissions in order to secure a livable planet for future generations. However, the science is also clear that even if the most ambitious greenhouse gas reduction strategies were to be adopted today, substantial climatic change is already occurring and will increase in magnitude and intensity over the next several decades. In other words, change and important impacts on communities across the globe are inevitable. Preparation is therefore essential. In recognition of this reality, communities across the globe are now beginning to engage in what is termed a *climate vulnerability assessment and adaptation planning process*. As described in this report, this is a multistage process. With the formal initiation of a vulnerability assessment, Oberlin is at the forefront of planning efforts.

In February of 2021, the City of Oberlin, with assistance from Oberlin College's Environmental Studies Program, assembled a diverse group of community leaders to conduct a vulnerability assessment -- the first phase of this process. Between February and May of 2021, 53 members of the larger Oberlin community explored how systems critical to the functioning of the City - municipal services, emergency services, food supply, and community and cultural assets - were likely to be impacted by specific climate hazards predicted for Oberlin, such as increased flooding and heat waves. Participants explored both climate risks and the opportunities available for mitigating and enhancing community resilience in the face of these risks. Oberlin's climate vulnerability assessment was designed to achieve three goals:

1. To compile the best available scientific information related to specific climate hazards likely to impact the Oberlin community over the next century, with an emphasis on impacts between now and 2030. To translate this information into a form that is easily accessible to members of the Oberlin Community.
2. To engage a diverse group of community members in considering the particular risks associated with these climate hazards on different aspects of the Oberlin community. To begin to consider adaptive capacity as well as Oberlin's existing adaptive assets and challenges associated with these risks.
3. To summarize the insights revealed through these discussions as a report and as presentations that can be used to inform future decision-making and action by the city, organizations, and community members to reduce community vulnerabilities and enhance adaptive capacities.

The major sections of this report provide context for the vulnerability assessment and adaptation plan, describe the process undertaken, provide a science-based description of climate hazards anticipated for Oberlin,summarize insights drawn from extensive discussions and interviews with community participants, consider alignment with existing decision-making processes, and point towards next steps in the adaptation planning process. The report is organized so that the process and the community insights and conclusions are included first and the *Oberlin Climate Hazard Fact Sheet*, that formed the basis of community discussions, is included after.

The emphasis throughout the development of this report has been on sharing the science of local climate change and then learning from the collective wisdom of Oberlin community members. This document summarizes concerns, knowledge and ideas. Community participants are extensively quoted throughout the latter sections of this document. As this report makes clear, participants in the process are quite concerned about the local impacts of climate change on key community systems that support our community. However, they are likewise hopeful and, indeed, enthusiastic about pro-actively responding; members of this community see opportunities to collectively roll up our sleeves and better prepare to adapt and to be resilient in the face of the changes now underway. This report shares a wealth of insight and ideas related to how this might be accomplished that authors and participants hope will inform the next stages of the climate adaptation planning process.

Convenors, Coordinators, and Community Participants

The Oberlin Fire Department, City of Oberlin's Sustainability Office, and Oberlin College's Environmental Studies Program orchestrated the climate vulnerability assessment for the City. Fifteen Oberlin College students served as coordinators. Fifty three community members participated in the process and served as members of the community system groups identified below (student facilitators marked with an asterisk below). Affiliations and titles for community participants are included in a complete participant list at the end of this document.

Convenors:

Robert Hanmer, Chief of Oberlin Fire Department
Linda Arbogast, Sustainability Coordinator, City of Oberlin
John Petersen, Oberlin College Professor of Environmental Studies and Biology

Student Coordinators:

Max Bauders
Emily Bengston
Brigit Cann
Taylor Hoefer
Claire Kaliski
Miriam Khanukaev
Leo Lasdun
Justin Lee
Sophia Musiak
Emma Neuffer
Marina Pariser
Phoebe von Conta
Jane Vourlekis
Ian Watson
Elizabeth White

Participants in Community System Groups:

Emergency:
Reynaldo Carrion
Skip Gentry
Bridget Flynn
Robert Hanmer
Jim Ward
Ryan Warfield
*Emily Bengston
*Ian Watson

Water:
Jeff Baumann
Kevin Brown
Heather Elmer
Carl McDaniel
Brian Stubbs
Jennifer Reeves
Peter Richards
*Brigit Cann
*Marina Pariser

Energy:
Bryan Burgess
Cindy Frantz
Greg Jones
Gene Matthews
Doug McMillan
David Zalesko
*Leo Lasdun

Jobs:
Janet Haar
Carrie Handy
Ellen Maverich
Jessa New
Sharon Pearson
Kathy Perales
Diane Ramos
*Miriam Khanukaev
*Justin Lee

Culture:
Meisha Baker
Miyah Byers
Jim Eibel
Nina Fisher
David Hall
Carol Lasser
Roger Laushman
Alexandra Letvin
Elizabeth Meadows
AG Miller
Kate Pilacky
Liz Schultz
Peter Slowik
David Whitworth
*Max Bauders
*Jane Vourlekis

Health:
Kat Bray
Mary Garvin
David Hill
Alan Lockwood
David Snyder
Barbara Thomas
Charlotte Wray
*Sophia Musiak
*Emma Neuffer

Food:
Anna Kiss Mauser-Martinez
Eboni Johnson
Heather Adelman
John Gates
Liv Hanson
Peter Crowley
Pete Morris
*Taylor Hoefer
*Claire Kaliski

*Phoebe von Conta *Elizabeth White

Table of Contents:

(Click headings in electronic version of this document)

Historical Context

With a rich history of social and civil rights leadership, the Oberlin community's identity as a leader has re-emerged in the context of another generation-defining challenge: climate change. The City of Oberlin has genuine concerns about global climate change and has been working to address these concerns. Oberlin was early in making a formal commitment to reducing community-wide greenhouse gas emissions below zero, while concurrently striving to balance the environmental, social, and economic interests of the Oberlin community. In addition to reducing our emissions, however, it has become clear that climate impacts are here and will worsen over the coming decades due to past global gemissions. This is why we, as a community, need to not only continue on our trajectory to zero emissions, but also simultaneously adapt to the inevitable changes ahead. This knowledge has set us on a path to assess our vulnerabilities and begin adaptation planning.

The City of Oberlin and Oberlin College have worked in parallel and in collaboration while setting goals to address climate change. In 2006, Oberlin College signed the American College and University Presidents Climate Commitment which committed the college to become climate neutral and, subsequently, set 2025 as the target date for achieving this goal. The City of Oberlin began to address climate change in earnest in 2007 when it became one of the first Ohio members of Local Governments for Sustainability (ICLEI). ICLEI is an international organization that assists cities in setting and achieving sustainable development goals. With its ICLEI membership, Oberlin initiated the process of developing a greenhouse gas inventory and developing a climate action plan for eliminating carbon emissions. In 2010, the City and Oberlin College individually signed memoranda of understanding with the Clinton Foundation and the United States Green Building Council to participate in the Clinton Climate Positive Development Program. This committed both parties to reducing greenhouse gas emissions below zero, thus achieving "climate positive" status. To fulfill these commitments, the City of Oberlin developed and officially adopted a Climate Action Plan in 2011 which has been updated twice, most recently in 2019. This plan set systematic goals of reducing 2007 greenhouse gas emissions to 50% of baseline by 2015, 75% by 2030 and below 100% by 2050. Oberlin College, one of the largest employers and energy consumers in the City of Oberlin, has developed its own climate action plan, and is well on its way to achieving its own goals of achieving carbon neutrality by 2025.

Even in its most recent update, the focus of Oberlin's CAP is on the crucial goal of climate *mitigation* — actions the city has committed to taking to eliminate its contributions to greenhouse gasses by 2050. However, while mitigation is essential to reducing the extent of climate change, the reality is that our local climate is already changing and will continue to change even under best-case emissions reductions scenarios. This is why the City of Oberlin's 2019 CAP update specifically highlights the need for a comprehensive process to evaluate the climate resilience of the community. Accordingly, this next phase in the City of Oberlin's climate planning is, therefore, to assess *climate vulnerability* and then determine how the City can best *adapt* to and be *resilient* in the face of the inevitable change that is already well underway.

Climate Vulnerability and Adaptation Planning Process

Local Governments for Sustainability (ICLEI) Process

As it did in developing its climate action plan (CAP), the City has been consulting with and following the general guidelines provided by Local Governments for Sustainability (ICLEI) in conducting its *climate vulnerability and adaptation planning process*. As depicted in Figure 1 below, ICLEI describes climate adaptation planning as a five stage iterative process. The first stage of this process is to conduct a climate vulnerability *assessment*. This was the goal of the process conducted in spring of 2021. The insights developed through conversations with community participants are summarized in this document and provide a wealth of information that will inform each of the subsequent stages of the process.

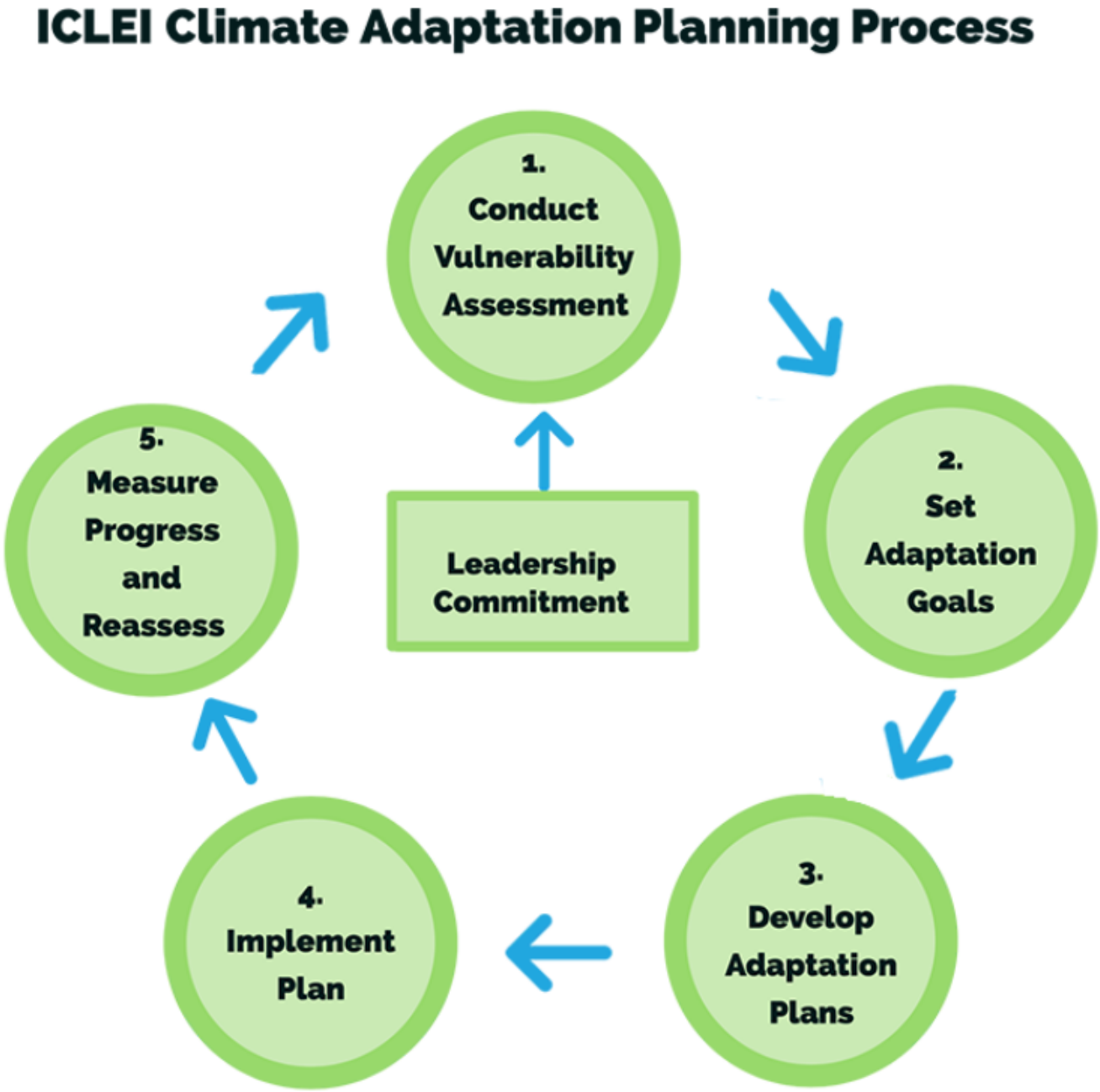


Figure 1. Conceptual model of overall climate adaptation process encouraged by Local Governments for Sustainability (ICLEI). This document reports on the first phase of this process

City of Oberlin's Climate Vulnerability Assessment Process

As with any methodology, a variety of important terms are used and imbued with specific meaning in the vulnerability assessment process. Five terms are particularly important to understanding the process and are used throughout this report:

1. *Community system:* a grouping of related activities or services that are important to community function.
2. *Climate hazard:* a category of climate events that are likely to impact one or more community systems.
3. *Climate risk:* the impact of a particular hazard on the function of a particular community system.
4. *Climate vulnerability:* the degree of susceptibility of a community system to a particular climate risk
5. *Adaptive capacity:* the ability of a community system to adjust to climate change, to moderate potential damages, to cope with consequences

As an example, emergency services (a community system) is likely to experience a particular set of risks associated with extreme hot days (a climate hazard) such as increased frequency of heat-related health events, and increased need for ambulance services. In this case, additional climate risks are associated with increased surface flooding (a hazard that leads to transportation challenges). A glossary of terms is included at the end of this report that defines all terms related to the climate vulnerability assessment and adaptation planning process (terms defined in glossary appear in italics the first time they are used in the text of this document).

Local Governments for Sustainability (ICLEI) recognizes that each community has many distinct attributes and unique climate risks, vulnerabilities, and adaptive capacities. While ICLEI provides an overall framework and a variety of tools, templates, and suggestions for adaptation planning, each community makes a variety of choices in terms of how it chooses to define community systems, the climate risks it considers, and the approaches that it takes to engaging community members in the assessment and planning process.

The City of Oberlin devised a unique approach that recognized and leveraged Oberlin College and the expertise of multiple community stakeholders. Fifteen college students enrolled in a special one-time course offering —*Practicum in Community Climate Resilience Planning in the City of Oberlin*, led by Environmental Studies and Biology Professor John Petersen. Under the direction of Oberlin's Fire Department Chief Robert Hanmer, Sustainability Coordinator Linda Arbogast, and Dr. Petersen, students in this class collaborated with 53 community participants in developing the information contained in this report.

The goals in soliciting community participation were to ensure key stakeholder involvement and local expertise for each community system group as well as to represent the diversity of community members and community organizations in Oberlin to the extent possible. For example, convenors sought leaders and members of local churches, municipal workers with expertise in municipal infrastructure, emergency workers, individuals involved in healthcare, business, arts, community services, etc. Community participants were not expected to either be or to become experts in climate change. Rather, participants were asked to review and reflect on the Oberlin Climate Hazards Fact Sheet prepared for them and then share their considerable knowledge regarding the local systems described below. By the end of the process, 53 community members had participated, each contributing as a member of one of the seven community systems groups.

The fifteen Oberlin College students enrolled in the practicum course served as researchers, facilitators,interviewers, report writers and editors,and key collaborators in orchestrating many aspects of the process. Each student was assigned to work with two of the community system groups for the duration of the semester (see participant list). As researchers, the students played a central role in developing the *Oberlin Climate Hazard Fact Sheet*. As facilitators of the community system group discussions and as interviewers, their most important task was to listen to and summarize the knowledge and ideas shared by community participants.

As outlined in Figure 2 below, the climate vulnerability assessment process can be conceptualized into five key stages. The text below describes how each stage was approached for Oberlin's process.

1. ***Identify key climate hazards:*** Local Governments for Sustainability (ICLEI) recommends that the assessment process begin by identifying a limited number of climate hazards and a limited number of community systems for initial consideration. Based on a preliminary evaluation of the climate hazards most likely to have a substantial impact on various different Oberlin systems, the conveners selected seven major climate hazards for consideration:
    - Changed seasonal patterns
    - Extreme hot days
    - Extreme winter conditions
    - Flash/surface flooding
    - Disease & other health impacts
    - Severe wind
    - Drought

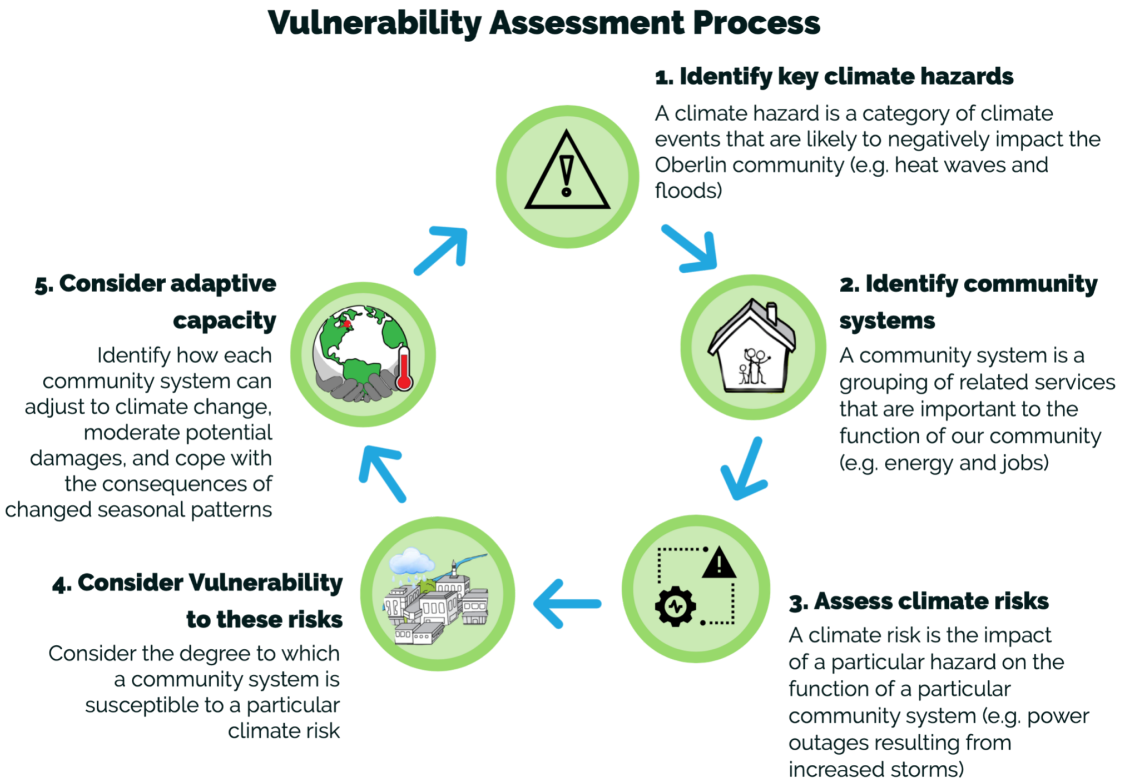


Figure 2. The five stages of the climate vulnerability assessment process for Oberlin.

2. ***Identify community systems:*** The risk of climate change will impact essentially all aspects of our lives. ICLEI identifies 26 different community systems that might be considered by participating communities. However, ICLEI recommends that a community consider only a limited subset of systems and climate risks to initiate the vulnerability assessment process. Oberlin's convenors selected seven systems and defined each to be as inclusive as possible of the particularities of the Oberlin community and potential impacts on these particularities. The color coding used to distinguish among these community systems is maintained throughout this report. The seven community systems considered for Oberlin were defined as follows:
    - **Water**: Wastewater, stormwater, and drinking water
    - **Energy**: Energy delivery, and production
    - **Jobs**: Employment, job access, and business

- **Emergency**: Emergency services
- **Health**: Public health including exercise and recreation
- **Food**: Food supply, food access, and local agriculture
- **Culture**: Community and culture including greenspace

3. ***Assess climate risks:*** The best available scientific information was assembled to assess the specific climate risks most likely to impact the City of Oberlin and surrounding systems on which it is dependent. For example, information on regional impacts was extracted from the Fourth National Assessment of the U.S.. Climate modelling tools provided by ICLEI and used by scientists affiliated with the Intergovernmental Panel on Climate Change (IPCC) were used to predict future climate impacts for the 44074 zip code. This information was summarized and shared with participants in the form of the Oberlin Climate Hazard Fact Sheet, which is included as a section of this report. Community participants were asked to review this fact sheet in preparation for initial discussions so that the entire group began the process with a clear science-based understanding of the known and predicted risks for the City of Oberlin.

4. ***Consider vulnerability to these risks:*** Group discussions within each community system group and interviews with each community participant were used to develop insight into climate risks based on deep local knowledge.

5. ***Consider adaptive capacity:*** Discussions and interviews with community participants were likewise used to document understanding and then solicit ideas for how adaptation and resilience might be enhanced for each community system. Student collaborators and convenors summarized this information in the Community Insights on Climate Vulnerability and Adaptation section of this report.

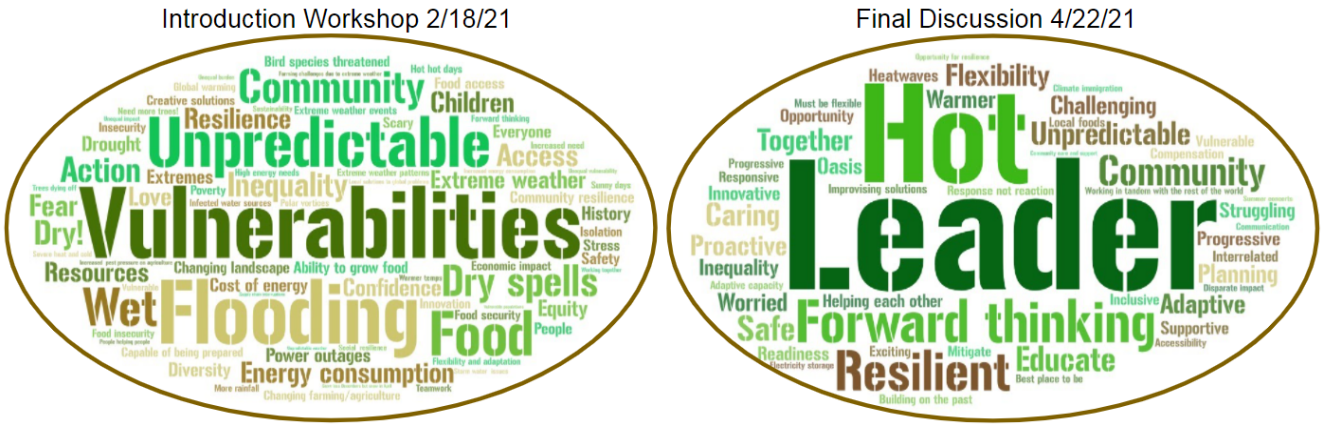
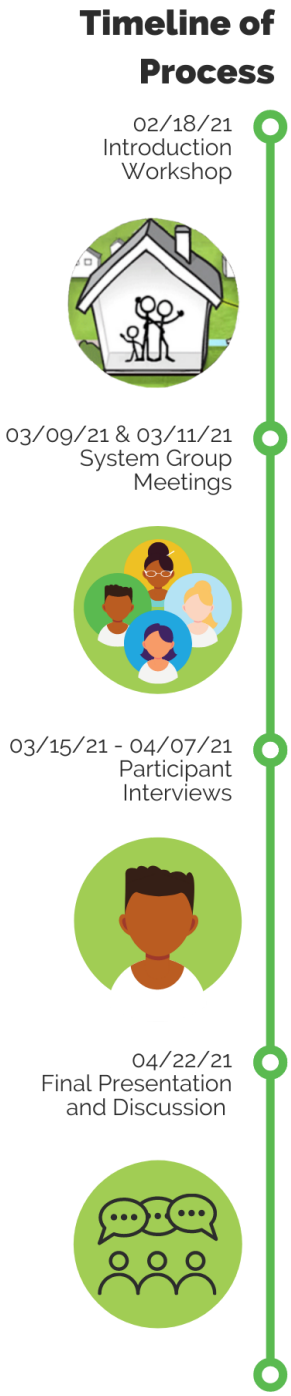


Figure 3. “Oberlin in a changing climate” word cloud. Community participants were asked to write whatever words first came to mind in response to the prompt, “Oberlin in a Changing Climate?”. The size of words included is proportional to how many times a given word was repeated amongst participant responses. The word cloud on the left was created at the start of the introductory workshop —after participants had been provided with the Oberlin climate hazard fact sheet, but before any presentation or discussion had occurred. The word cloud on the right was generated from words contributed in response to exactly the same prompt, but following group discussions and interviews and at the end of concluding presentation and discussion.

Timeline

To make for an efficient process, convenors selected the set of seven community systems as well as the seven climate hazards to be considered prior to soliciting community participants and prior to the beginning of the Oberlin College semester. Community participants were then solicited in part based on their level of expertise and engagement with the community systems considered. While Oberlin community members are generous with their time and knowledge, conveners developed a process and schedule for the process that would minimize the time commitment of participants; those invited to participate were asked to commit to three meetings and one individual interview. In several cases, participants indicated that they were willing to be interviewed, but unable to participate in the three meetings. As the process evolved, gaps in local perspective became apparent and additional community members were invited to participate to fill these gaps. The presence of the COVID-19 pandemic and associated social distancing requirements constrained the type of public engagement opportunities that were possible. All presentations, meetings, and interviews took place online over Zoom. From the outset, the convenors operated with a clear understanding that the climate vulnerability assessment is the first stage of the climate adaptation planning process and that each stage can and should develop new ways of engaging and broadening community participation (ideally without the constraints of the pandemic). The 53 participants in this initial phase provided a wealth of connections to additional community members that can be leveraged in the next stages of the process.



1. **Introductory Participant Workshop (2/18/21)**
   The purpose of this first meeting was to introduce community participants to the overall climate vulnerability assessment process, to present climate hazards, and to initiate the community system groups. The Oberlin Climate Hazard Fact Sheet was provided to community participants in advance of this meeting.

2. **Community System Group Meetings (3/9 and 3/11/21)**
   Each community system group met once as a group to discuss the particular risks, vulnerabilities, and adaptive capacities related to their system. Student coordinators facilitated these meetings. Participants were asked to focus on the following questions:
   - **a.** What are the most important climate risks associated with this hazard on the community system you have been assigned to consider?
   - **b.** What are the impacts of each risk on the Oberlin community?
   - **c.** What is your level of concern regarding community vulnerability to each climate risk?
   - **d.** How much existing adaptive capacity does Oberlin have to buffer against this risk? How might the community enhance adaptive capacity?

3. **Participant Interviews (3/15-4/7/21)**
   Over the course of four weeks, student coordinators interviewed each community participant to further explore their insights into climate risks, vulnerabilities and adaptive capacities associated with their area of expertise. For these one-on-one interviews,additional community members were included. This included individuals who had specific expertise but were unable to participate in the full process or were identified as able to fill important gaps in expertise during the process.

4. **Final Presentation and Discussion (4/22/21)**
   The information gleaned from these discussions and interviews allowed organizers to develop a summary of community insights that is included in this report. This summary of insights was provided to participants prior to the final meeting. A subset of insights was presented and then additional feedback when each community participant had the opportunity to respond to two questions: 1) What are Oberlin's greatest climate adaptation strengths? and 2) What are our greatest climate adaptation challenges? Comments made in response to these questions were incorporated into this report.

5. **Survey of participants (4/28/21)**
   A final survey of participants was conducted to assess levels of community concern regarding climate hazards and risks for particular systems. Responses are summarized in Table 1 of this report. Participants were also asked to provide any additional reflections on the two questions asked in the final presentation and discussion. These responses were incorporated into this report.

6. **Community input on this document**
   Community participants were asked for feedback at multiple stages of this process. A draft of the Community Insights on Climate Vulnerability and Adaptation was shared with community participants who were encouraged to provide corrections and feedback. The insights were revised based on this feedback and again based on input received during the final group discussion and in response to comments made on the survey. Community participants were then provided with a final opportunity to review this entire report to ensure that their ideas and quotes from discussions accurately reflected their knowledge and ideas. All participants were given the opportunity to review and comment on the penultimate version of this document and the document was revised in response.

7. **Presentation to City Council (6/21/21)**
   This report was shared with and presented to Oberlin City Council in a working session that was open to the public. The next step in the ICLEI process is to establish adaptation goals (Figure 2).

Concern Regarding Impacts of Climate Hazards on Oberlin Community Systems

For each of the seven community systems considered (Water, Energy, Jobs, Emergency, Health, Food and Culture) participants were asked to rate their level of concern regarding the potential impact of the seven climate hazards on that system. Table 1 shows the results of this survey.

Community Systems	Changed seasonal patterns	Extreme hot days	Extreme winter conditions	Flash & surface flooding	Severe wind	Drought	Disease	Average concern for system
Water	1.9	2.1	1.7	2.4	1.1	1.8	1.8	1.8
Energy	1.9	2.5	2.2	1.5	2.1	1.1	0.7	1.7
Jobs	1.8	2.1	2.0	1.7	1.6	1.3	1.9	1.8
Emergency	1.9	2.5	2.3	2.2	1.9	1.3	1.9	2.0
Health	1.9	2.7	2.2	1.8	1.4	1.6	2.5	2.0
Food	2.6	2.6	2.2	2.3	1.7	2.4	2.1	2.3
Culture	2.1	2.3	1.9	1.9	1.3	1.4	2.0	1.8

Table 1. Participants used a four-level rating to express concern: Low level of concern (0), little bit concerned (1), moderately concerned (2), very concerned (3). The numbers in each box indicate average levels of concern among participants. The colors group systems/hazard combinations by range of concern. However, it is important to note that even the item with the very lowest level of concern (impact of disease on Energy) falls in the “little bit concerned” and not “low level of concern” category. The seven community systems considered for Oberlin are defined earlier in this report

Community Insights on Climate Vulnerability and Adaptation

Each community system group met once as a whole. In these meetings, student collaborators facilitated discussions of climate risks and adaptive capacities within the scope of each individual group. The students then interviewed each community participant individually. What follows in this section of the report is a summary of the insights that emerged from both the group discussions and individual interviews. Insights are organized under each community system group. Each insight consists of a declarative statement in bold and italics followed by an explanation. Quotes from community members, gathered from both discussion and interview transcripts, are also included to help illustrate these insights.

Water: Wastewater, Stormwater, and Drinking Water

1. ***Increased frequency and magnitude of extreme weather events means more dependence on both the municipal workers and infrastructure that keep Oberlin's drinking water, wastewater, and stormwater infrastructure functional during and following such events.***

According to the 4th National Assessment report, "extreme precipitation events in the Midwest are already disrupting transportation and damaging property and infrastructure" (S3, Ch21, Background). Participants in this group recognized the critical importance of distinct but also inter-related city infrastructure that is responsible for drinking water production, wastewater treatment, and stormwater management. Although all systems are currently meeting Oberlin's needs and are well-maintained by municipal workers, group discussion recognized that both infrastructure and workers will be impacted and stressed by the changing climate. Changes in seasonal precipitation and heavy precipitation events will directly impact all three systems. Extreme heat and the possibility of hazards such as vector borne disease have the potential to negatively affect municipal workers that maintain infrastructure. Participants recognized that it is important for the City to continue to plan and take actions to address impact. Understanding that financial constraints exist, participants recognized that increased investment in stormwater infrastructure to reduce vulnerability to hazards associated with a rapidly changing climate is important. This will not only increase adaptive capacity, but will also decrease current and future maintenance costs.

Participant comments:

- "With snow melt.. there's a lot of sedimentation... [this] requires being on top of maintenance and checking and making sure things are clean and operating as they should" (Jennifer Reeves, Stormwater Coordinator)
- "When large rain events occur and the ground is still frozen, there's less capacity for the rainfall to infiltrate into the ground. So you're going to see more of a response in terms of rising water levels in tributaries and in Plum Creek and the potential for overwhelming the storm sewer infrastructure." (Heather Elmer, Executive Director of Chagrin River Watershed Partners)

2. ***Parts of Oberlin's water infrastructure, including water lines installed in homes, businesses, and municipal infrastructure, are aged, rendering it particularly vulnerable to climate hazards.***

Oberlin developed its municipal drinking, wastewater, and stormwater systems early in its history, and some components of these systems are quite antiquated. For example, shallow water lines can be particularly vulnerable to climate extremes such as freeze-thaw action, which can result in burst pipes. A variety of suggestions were offered for how community members and the City can increase adaptive capacity. In terms of drinking and wastewater, homeowners can be made aware of risks and encouraged to replace older water lines.

The City itself needs to update certain sections of both drinking and wastewater lines to decrease climate vulnerability.

Redundancy means having more than one option in place that can serve the same function. Increasing redundancy was also suggested as an action that would increase adaptive capacity; for example, alternative paths for water to flow can be created, thereby allowing damaged sections of piping to be bypassed during high flow or emergency conditions. Taking a variety of approaches to managing Oberlin's water systems is key to enhancing adaptive capacity and resilience.

Participant comments:

- "The sanitary sewer collection system is in some cases over 100 years old and the material of construction, until plastics came in a serious way in the 50s and 60s, was clay tile which is porous. Sections are between 18 inches and 24 inches long, and we've got literally miles. At every pipe section, there's opportunity for infiltration." (Jeff Baumann, Public Works Director, City of Oberlin)
- "President Biden's infrastructure plan will present a great opportunity for communities with aging infrastructure to not only replace failing water infrastructure, but also to upgrade that and improve its function in a way that benefits the environment and makes communities resilient to climate change" (Heather Elmer, Executive Director of Chagrin River Watershed Partners)
- "From a facilities and infrastructure standpoint, you run the risk of damage from intense weather events and major swings in temperature." (Kevin Brown, Chief Facilities Officer, Oberlin College)

3. Increased flooding in Oberlin will likely negatively impact buildings, public spaces, and agricultural land and pollute waterways. Flood risks can be addressed by the City, businesses, and homeowners.

Severe precipitation events and rapid snowmelt are predicted for our area and will increase flooding in low lying areas. Increased intensity of precipitation events can also wash pollutants, such as fertilizers and other agricultural chemicals, into Plum Creek and other local waterways. The City already has certain adaptive measures,such as storm drains and retention basins, in place. Participants recognized that the City will likely need to invest in enhancing the capacity of stormwater drainage systems to accommodate more intense storms. At the same time, the City and its residents are already engaged in efforts to support green infrastructure that both encourages residents and businesses to adopt new practices, and uses plants and alternative land use to store water and increase infiltration, evaporation, and transpiration of excess water. For example, participants discussed the value of promoting vegetated buffer areas between agricultural fields and rivers and storm drains. Buffer strips slow the movement of water, allowing eroding soil particles to settle and enhancing infiltration. Rain barrels, rain gardens, porous pavement, and tree planting were suggested as useful mechanisms for minimizing stormwater flow and encouraging infiltration, evaporation and transpiration. Participants suggested that educational workshops for residents, businesses, and organizations, as well as small subsidies, such as free rain barrels or tree giveaways, are some of the many mechanisms that should be employed to enhance Oberlin's adaptive capacity.

Participant comments:

- "Extreme winter weather events create more demand to salt our roadways. Chloride from salt can have negative impacts on the water quality in our streams." (Heather Elmer, Executive Director of Chagrin River Watershed Partners)
- "In the upper reaches of a watershed, you have a lot of new impervious surface being added, and there's not a lot of stormwater management capacity being added in the headwaters to accommodate this." (Heather Elmer, Executive Director of Chagrin River Watershed Partners)
- "The water table is kind of high in Oberlin, so you end up with more flooded basements and … more impact from those issues." (Kevin Brown, Chief Facilities Officer, Oberlin College)

- “Part of what I do is I try to promote low impact design that reduces the likelihood of excessive water building up to flood potential.” (Jennifer Reeves, Stormwater Coordinator)
- “It’s hard to keep up with patching roof areas. It wreaks havoc on properties.” (Meisha Baker, Principal, Eastwood Elementary School)
- "[An important] piece of managing stormwater is gaining public acceptance and [therefore], the money to address the problems." (Peter Richards, Former Director of the National Water Quality Laboratory at Heidelberg University)
- “People are beginning to realize flooding is going to be a bad problem. In the building that includes Slow Train Cafe, the developers created a system to store water onsight during heavy rains. Afterwards, they release it slowly.” (Carl McDaniel, Emeritus Professor of Biology, Rensselaer Polytechnic Institute)
- “We put in a tallgrass prairie. Over time, the grasses put down roots six feet which builds the soil and is good for water retention. Now if we had a three inch rain, we would not put any water into Plum Creek” (Carl McDaniel, Emeritus Professor of Biology, Rensselaer Polytechnic Institute)

4. Oberlin’s large reservoir and capacity for interconnection with the rural water system provides substantial adaptive capacity. Irrigation may be necessary to maintain residential and commercial food production in the face of summer drought.

Experts in this group pointed out that the City’s adaptive capacity is already quite high with respect to drinking water supply. The Parsons Road Reservoir -- the immediate source of Oberlin’s drinking water supply -- holds about one year’s worth of drinking water, so it only needs to pump from its intake on the west branch of the Black River during three weeks of the year. This allows the City to be quite selective in terms of water quality when pumping. New Russia Township uses the rural water system, and Lake Erie serves as the source of this water. The City of Oberlin’s water system is not currently connected to the rural water supply system. However, these two systems have water lines that come into close proximity, creating the capacity for rapid interconnection, should that become necessary. For example, if one of the water sources experiences a bloom of toxic algae, the source water could potentially be temporarily switched off while maintaining city services. This potential redundancy adds additional adaptive capacity and resilience to both systems. In a more general sense, it was noted that the Great Lakes hold more than 80% of North America's surface fresh water, so our region is unlikely to experience the water stress of many other states. It may, in fact, experience an influx of new residents as a result of water availability during the remainder of this century.

While the general availability of water for Oberlin and our region and the redundancies discussed above are clearly quite advantageous, drought and pollution still pose risks that need to be addressed. Participants reported that they are already noticing the increased frequency of hotter, drier, and more variable summer conditions that have been predicted for our future by climate models. Local lawns, gardens, and agricultural systems have generally relied on the relatively even rainfall that has characterized our region. With the increasing frequency of droughts, irrigation may become necessary. This will require installation of new and potentially costly infrastructure, as well as increased costs associated with water consumption.

A wide variety of options were discussed for enhancing adaptive capacity in response to drier summers that ranged from new policies to altered practices. For example, currently, residential water bills include a fee for wastewater production that is directly proportional to drinking water consumption. Oberlin customers already have the option to install a "garden" meter (at their own expense) that allows them to avoid billing for irrigation water. These are billed for water only, not sewer service. Rain barrels, which are discussed under the last insight, are an example of a residential-scale adaptive measure that helps reduce stormwater flow, while concurrently storing water that can then be used for backyard irrigation. On a larger scale, homeowners can be encouraged to install cisterns, and farmers can be encouraged to increase use of stormwater retention ponds that can be equipped with pumps to enable irrigation. It was noted that Oberlin can also learn from the many

communities that encourage “xeriscaping”. This term refers to practices that involve selecting crops, ornamentals, trees, turf mixtures, and entire landscapes that better tolerate periods of drought without irrigation.

Another important risk associated with periods of drought that was discussed is the potential for pollutants such as pesticides, oils, and grease to build up and then be released into waterways in larger amounts when rains finally do come. Enhanced efforts to control these pollutants may be necessary.

Participant comments:

- “Obviously, one of the things about living in the Great Lakes region is that it seems highly unlikely that Northeastern Ohio’s water supply will be compromised by drought, at least anytime in this geologic age.” (Jeff Baumann, Public Works Director, City of Oberlin)
- “We could have more capacity to capture the rainfall that comes in those large storm events and store it for when we do need it, whether that's a a farmer being able to detain water in a basin that they could then use for irrigation, or in a more urbanized setting like Oberlin,you could having more cisterns that can be used for watering landscapes.” (Heather Elmer, Executive Director of Chagrin River Watershed Partners)
- “You go two miles outside of Oberlin, and you’ve got commodity crops. [Drought] is going to wreak pretty significant damage on when to plant, how to plant, and where to plant.” (Brian Stubbs, Executive Director, Cleveland Water Alliance)

5. Enhancing redundancies in Oberlin’s water systems is important to enhancing adaptive capacity.

Redundancy means having more than one option in place that can serve the same function. This means that if one part of a system is damaged or fails, another can ensure that overall system function is maintained. Prior insights in this section have already pointed towards redundancies that exist with respect to Oberlin’s water supply. Building redundant water flow systems, so that alternative flow paths take the water where it needs to go when sections are damaged, is important to adaptive capacity. The City of Oberlin already has a number of redundancies in piping infrastructure that allow sections to be closed down and fixed with minimal disruption. Another example of redundancy is that both the drinking water plant and the wastewater plant have backup power generators that allow the plants to continue operation in case of power outages. Power outages may happen more frequently with increasing climate hazards such as severe winds.

Participant comments:

- “Public works is, by its nature, dependent on building in redundancies in our various systems that folks depend on. Climate change and its current and future impacts put some additional importance behind those efforts, but we have to a large degree built redundancy in, and, therefore, at least a certain measure of resiliency.” (Jeff Baumann, Public Works Director, City of Oberlin)
- “We need to look to answers that one typically finds in nature. In natural systems, you rarely come across just a single solution to an overarching problem.” (Jennifer Reeves, Stormwater Coordinator)
- “I very strongly recommend an interconnected series of grassy swales with plants that help transpire more water out of the system.” (Jennifer Reeves, Stormwater Coordinator)
- “We could start to experiment with gray water to take care of gardens but this requires local infrastructure changes.” (Peter Richards, Former Director of the National Water Quality Laboratory at Heidelberg University)

Energy: Energy Delivery and Production

1. ***Extreme weather events, including storms and heat waves, will place significant stress on the regional and local electricity grid. The ability of OMLPS to generate power locally already contributes to community resilience. Both the internal electrical grid and Oberlin's connection with the regional grid can be enhanced to increase adaptive capacity.***

Many participants pointed towards the severe impact of the 2021 polar vortex on Texas as an example of how extreme weather events can place overwhelming demands on an electrical grid, and how poor choices and lack of redundancy can compound to create tragedy. Oberlin experts suggested that, in Oberlin, the anticipated increase in extreme weather patterns will likely impact energy distribution networks more than energy generation infrastructure. The City of Oberlin's local power production facility currently provides a high level of resilience in that it can deliver power to the community when the external grid goes down. On the other hand, several participants pointed out that Oberlin depends on a single external power line from First Energy, and that this singular dependence creates vulnerability. Greater redundancy in Oberlin's connection with the external grid would enhance adaptive capacity. Greater redundancy and modernization of the internal electrical distribution network with technology that is more resistant to weather damage would likewise enhance adaptive capacity.

Participants also expressed an interest in the potential role of microgrids. Microgrids, which are increasingly being implemented in the developing world, are decentralized sources of electricity production, storage, and load (delivered power) that are normally connected to a larger grid, but can also be disconnected to function in autonomous "island mode" when the larger grid has problems.. Participants pointed out that micro-grids allowed certain communities in Texas to isolate themselves from what was otherwise a catastrophic state-wide grid shut down during the extreme weather brought on by a climate event in the winter of 2021.

Participant comments:

- "Our business is to provide reliable power. People depend on it for jobs. Companies need reliable power. We are constantly looking at what we need to do to keep our areas reliable." (Doug McMillian, Director, OMLPS)
- "You read predictions that talk about what the climate is going to be in the year 2100, and to put it in those terms makes it seem like a far off issue. It's not a far off issue;we're in it now." (Bryan Burgess, Electrician, Burgess Electric LLC)
- "During the 2003 regional outage due to improper relaying, generators [in the regional electrical grid] were not able to pick up outages. [As a result of maintaining our own generation capacity], Oberlin was a bright spot—we were able to use our power plant to have power back on in a few hours." (Doug McMillian, Director, OMLPS)
- "You should not fall short in the event something happens, even if it only happens every hundred years." (Greg Jones, Energy Advocate, POWER)
- "[The threat of outages call for] more disaster planning—it's how do you prioritize caring for people in their homes, [such as] provid[ing] warming shelters" (Bryan Burgess, Electrician, Burgess Electric LLC)

2. ***Enhanced energy efficiency will reduce the electricity used by particular appliances. However, the shift from heating with natural gas to heating with heat-pumps, combined with increased demand for air conditioning, and the impending transition to electric vehicles, is likely to substantially increase overall community demand for electricity.***

Participants pointed out that the goal of "decarbonizing" the U.S. economy means shifting towards much higher reliance on electricity for heating and transportation (electric cars, buses, and trucks). Since heat pumps are capable of using electricity to efficiently deliver both winter heating and summer cooling, they are an ideal replacement for the natural gas heaters currently used by most businesses and residents in Oberlin. Indeed,

heat pumps will operate even more efficiently in the warmer winters that will dominate Oberlin's future. Efficiency Smart and the City already have programs and financial rebates that encourage homeowners and businesses to transition to the use of heat pumps for heating, ventilation, and air conditioning (HVAC) and also for hot water heaters. This is already enhancing adaptive capacity. Participants felt that the City should continue to encourage this transition. At the same time, when combined with increased use of electricity for transportation, this transition in HVAC will substantially increase overall electrical demand. Participants recognized that the City will need to aggressively pursue a future electricity supply that meets this increasing demand.

Participant comments:

- "If we are successful in switching the City away from natural gas, then we're pushing the City towards being more reliant on electricity. That's going to increase demands on the electric system, so we have to be prepared for that." (Bryan Burgess, Electrician, Burgess Electric LLC)
- "In our climate, we need heat pumps that can operate at low temperatures—down to 5 °F or maybe even 0°F. Those are relatively recent [technologies]. In gaining experience with those, I'm pretty convinced that they are ready to be rolled out to households across Oberlin. In conjunction with the rebate programs that are being offered through Efficiency Smart, I think [it]can be done affordably." (Bryan Burgess, Electrician, Burgess Electric LLC)
- "I think the more self-sufficient Oberlin can be as a whole, the better it will be. ...I think we should have multiple [energy sources]." (Greg Jones, Energy Advocate, POWER)
- "When having debates about how important it is that we electrify, the answer is, it's really important!" (Cindy Frantz, Professor of Psychology, Oberlin College, POWER Board Member)
- "I'm actually really excited that [POWER] is going to be starting a new program focusing on [promoting energy efficiency measures for landlords and rental properties" (Cindy Frantz, Professor of Psychology, Oberlin College, POWER Board Member)

3. While Oberlin's electricity is now carbon free, a diverse electrical portfolio that expands local renewable electricity production and electricity storage will likely be critical to enhancing adaptive capacity.

The Biden administration has established a goal of transitioning the entire U.S. economy to carbon free electricity by 2035. This goal is consistent with what scientists say needs to be done to eventually stabilize the climate. Through its purchasing agreements, the City of Oberlin has already achieved this goal. Nevertheless, the City's primary sources of carbon free electricity are contracts and purchases made within the regional grid, but well outside of Oberlin.

Participants pointed towards the importance of increasing local renewable energy production within Oberlin and developing battery storage capacity as long term mitigation and adaptation strategies that enhance local self-reliance. Participants suggested that, if carefully orchestrated, the addition of solar energy within our local grid has the potential to add jobs to the local economy. Equity of access to jobs and the benefits of solar were identified as important considerations.

In interviews with participants, it became clear that there was some divergence of thought on short term strategies related to battery storage. On the one hand, participants recognized that the development of high capacity electrical storage technology will fundamentally alter the energy landscape; it would allow communities like Oberlin to exhibit a much higher level of energy independence. This would not only significantly expand our protection from outages, but would likely also bolster our local economy through avenues like renewable energy credits and jobs created with additional infrastructure development. On the other hand, despite notable progress in grid-scale battery storage technology, it is not clear how soon such technology might be accessible for communities. While some favored aggressive pursuit of opportunities, others cautioned against commitments in the face of current uncertainties.

Participant comments:

- “Solar does a good job of decentralizing our energy supply.” (David Zelasko, Solar Consultant, Third Sun Solar)
- “The biggest risk for solar...is intermittency. You need sunlight, for it to produce energy and storage as well.” (David Zelasko, Solar Consultant, Third Sun Solar)
- “Long term storage [via batteries] may be coming, [but] for now large battery storage is still expensive.” (Doug McMillian, Director, OMLPS)
- “You can't really export a solar installation job, you know you need people on the roofs, you need electricians, so that gets other people involved.” (David Zelasko, Solar Consultant, Third Sun Solar)
- “[My neighbor] retrofitted their house with solar panels and a storm drain catch system. How can residents in the southeast quadrant afford such upgrades? [Everyone needs] to be able to reap the benefits of environmental efficiencies.” (AG Miller, Pastor of House of the Lord Fellowship, Retired Religion Professor)
- “Advancing into community solar is an opportunity for other municipalities as well as Oberlin— renters, or people with shaded homes, can get involved with the clean energy revolution that's going on.” (David Zelasko, Solar Consultant, Third Sun Solar)

4. ***Oberlin’s electrical system must be prepared for extended periods of summer heat that result in prolonged periods of high electricity demand. It must likewise prepare for shorter extreme hot and cold weather events that result in spikes in electricity demand.***

Local climate predictions included in the fact sheet distributed to participants make it very clear that Oberlin is in for a dramatic increase in the number of days that exceed 90°F—from a historic average of 10 per year to 30 per year by 2030. Air conditioning loads currently drive peak annual electricity demand. As stated in the fact sheet, the number of “cooling degree days” (a measure of energy demand for air conditioning) in Oberlin is predicted to increase by 37% by 2030 relative to the baseline. This has the potential to place serious stress on the electrical grid in terms of overall summer demand, but also in terms of peak demand events. Electrical infrastructure across the board must be sized for this demand. A shift to heating with electricity will also increase winter demand. Although winters will be warmer, extreme cold events, such as the polar vortex, will create new winter peaks in electricity use. Participants suggested a number of important actions that the City, local organizations, and residents can take and are already taking to enhance adaptive capacity in the face of extreme temperatures. Enhancing the capacity of the local grid to handle larger demands and larger peaks in demand will be critical. Encouraging enhanced insulation of the building stock, through POWER, Efficiency Smart, and other initiatives, would help keep buildings cool in the summer as well as warm in the winter. The planting of shade trees on the south side of buildings was suggested as a measure that can substantially decrease building cooling needs and provide potential outdoor comfort in the shade of such trees.

Participant comments:

- “Any museum cares a lot about its HVAC system because we rely on that to keep a very regulated temperature for all of our art. … The more temperature varies, the more that we’re going to have to draw on the electrical grid to keep temperatures stable in the building.” (Alexandra Letvin, Assistant Curator of European and American Art at Allen Memorial Art Museum)
- “Our building code requires that all homes have heating. But, the result of this analysis shows that cooling is going to be just as important in the summer as heating is in the winter. We're going to have a climate very similar to that of Atlanta.” (Bryan Burgess, Electrician, Burgess Electric LLC)

Jobs: Employment, Job Access, and Business

1. ***Oberlin businesses are dependent on reliable electricity for a wide range of services—whether it be refrigerating perishable goods or having stable internet access. As***

extreme weather conditions proliferate, Oberlin's continued focus on energy reliability is essential to its adaptive capacity.

Weather hazards such as extreme heat, extreme cold, and severe wind, damage power delivery equipment. Power outages can lead to loss of products, damage to equipment, and disruption of services provided by local businesses. Members of the business community that participated in this group made it clear that reliable energy delivery is essential to supporting, retaining and attracting local business owners. Because the Oberlin grid is dependent on external transmission from First Energy, any First Energy related outages affect Oberlin. As discussed under the Energy section of this report, the capacity of OMLPS to use its local power station to maintain power to the local Oberlin grid when power from First Energy goes down adds resilience to the local grid. However, taking a full-spectrum approach to enhancing the reliability in power delivery in the face of increasing climate stresses on the system—considering both connections to the external grid and upgrades to the internal grid—is essential to supporting local businesses and the many residents that they employ.

Participant comments:

- "I was literally calling up friends who had generators to see if we could store milk in their refrigerators, so we wouldn't lose it. At the end of the day, [we lost it] because everyone had lost power. We lost a ton of money." (Jessa New, Owner Slow Train Cafe, The Local)
- "You have a huge cold spell unexpectedly in June, then all of a sudden it warms up unexpectedly and you have all this, clam chowder or something really heavy. No one's going to eat it, it's going to go to waste." (Jessa New, Owner Slow Train Cafe, The Local)

2. *As climate hazards increase, enhanced internet connectivity and emergency communication networks will become increasingly important to employers, employees, and community members.*

Participants pointed out the ways in which experiences with COVID-19 have shifted our understanding of the importance of communication technology and information delivery. Reliable, high-band width, accessible, and affordable internet has been essential to business and worker resilience in the face of the pandemic. Many of the lessons learned about the importance of internet services can also be applied to climate hazards that will likely disrupt normal business operations. At the same time, the pandemic has taught lessons about the importance of maintaining the flow of reliable, accurate, and trustworthy information about emergency conditions. This, too, is directly applicable to enhancing adaptive capacity to address climate hazards and risks. Having a diverse portfolio of media outreach strategies is essential. Lorain County's Emergency Alert Notification System (the WENS system: https://entry.inspironlogistics.com/lorain_oh/wens.cfm) provides one example of the kinds of emergency communication technology that should be expanded and enhanced to make it easier for emergency information to be shared. Opportunities to make it easier for hyper-local information to be shared to inform all residents of hazardous conditions should be sought. Beyond emergencies, enhancing community communication technologies,including all forms of social media and the Environmental Dashboard signs, strengthens community and business opportunities, further building adaptive capacity.

Participant comments:

- "As a worker who can do things remotely… having power and internet be fast and reliable are really important for me" (Kathy Perales, Attorney)
- "If there is a national disaster or community disaster of some sort, we need it to be known everywhere. The Oberlin Business Partnership communicates to the community especially through social media. We need to be connected to whatever the City is doing, and the City needs to be connected to whatever we're doing, and whatever the emergency organizations are doing" (Janet Harr, Director, Oberlin Business Partnership)

- “Communication is probably the most important part of our businesses… and when things like power outages happen, I need to make sure that everyone knows what machines to turn off, how to handle it, and what to do with baked goods” (Jessa New, Co-owner of Slow Train)
- “WENS is a text messaging system that is activated if we need to get a quick alert out to the community by zip code.” (Kat Bray, Health Education Specialist)
- “Technologies like Zoom have been very important for mental health and the continued ability [of Kendal residents and others] to engage with the wider world.” (David Snyder, Retired Clinical Counselor)

3. Extreme weather conditions, such as severe cold and flooding, may limit job access for commuters. Better housing, local housing options, improved transportation opportunities, and remote work are all parts of enhancing adaptive capacity.

The business community recognizes that housing and transportation are important issues for both job access and emergency events. Many of Oberlin’s residents work outside of Oberlin, and some of Oberlin’s workers live outside of Oberlin. Increasing the affordability and climate resilience of local housing will decrease the need for transportation as one part of the solution. However, enhancing public transportation is particularly important for residents of modest income and has the potential to address equity issues for underserved members of the community. Diverse and accessible transportation options can benefit all members of the community, but require regional collaboration within Lorain County.

Certain climate emergencies may require moving many people at the same time. The question of how to address transportation in extreme weather must be addressed moving forward. In emergency situations, it is important to develop plans in collaboration with organizations that have access to buses, such as Oberlin Public Schools, other school systems, and Lorain County Transit. More regional collaboration within Lorain County to enhance transportation and remote work options is important.

Participant comments:

- “A huge concern now, let alone with extreme weather conditions, is transportation. If gasoline [supply]or car access was to be impacted, what are we going to do for transit? We expanded Oberlin’s [public] transportation system because people need to get to work. [However, currently] it’s limited to Oberlin; people outside of Oberlin can’t use it to *get* here and people in Oberlin can’t get elsewhere in Lorain County. We need [to find solutions in collaboration with] the County” (Carrie Handy, Director of Planning and Development)
- “If people have reliable public transportation, they are getting to work more and are able to go to job training opportunities. Affordable, accessible public transportation is crucial in a lot of different areas.” (Diane Ramos, Administrative Coordinator of Communications).
- “It would be great if more people who worked here lived here. People commute to work at the FAA, and there is a substantial number of [Oberlin] professors who come in from out of town. In the last year or so, it’s been such a sellers’ marketplace. I think we need more housing because people living where they work is good for [addressing] climate change.” (Kathy Perales, Attorney)
- “In the event of natural disasters, how could we transport large numbers of people to safety? Or to a hospital? It is a likely scenario.” (Carrie Handy, Director of Planning and Development)
- “If there are opportunities in the future to continue the expansion of public transportation, this process has put me in a position where I can see how impactful it would be for jobs and people's ability to have better quality of life so they can go places that they need to go” (Elizabeth Meadows, City Council Member)

4. Changing seasonal patterns pose a risk to the aesthetics and function of greenspace and impair recreational and business opportunities. These economic and social implications can and should be addressed.

Oberlin parks, trails, bike paths, and even sidewalks are important as greenspace. Participants recognized the beauty of Oberlin's trees and parks as a distinguishing feature of this City. Outdoor vegetation is widely enjoyed by residents and plays a critical role in attracting visitors and tourists who contribute substantially to our local economy. As outlined in the Climate Hazard Fact Sheet, Oberlin will experience changes in seasonality that include increased heat and drought conditions in summers. These may infringe on the attractiveness of public outdoor spaces for locals and visitors alike and negatively impact the economy. Heat and drought may brown turf and wilt trees. Potential impacts identified by participants include reduced desirability of the outdoor sitting at restaurants in the downtown and reduced participation in the many outdoor concerts and other cultural events that attract so many visitors to Oberlin. Changes in seasonality may also extend the pollen season, increasing allergens that inhibit enjoyment of the outside. Likewise, changes in season will likely increase the abundance of ticks, mosquitos, and the diseases that they carry, a reality that also impairs enjoyment of the outdoors.

Many options were suggested for enhancing Oberlin's adaptive capacity with respect to greenspaces. Suggestions included: planting more drought tolerant turf grasses; selective irrigation of popular greenspaces in order to maintain green zones even in drought; increased shade tree planting; re-evaluation of street trees planted, to favor those from more southern ranges and those that are more drought tolerant; enhanced distribution of mosquito "dunks" and other non-toxic insect reduction measures; and enhancing and promoting the availability of cooling stations that provide refuge on hot days—for example, by encouraging museum visitation and use of spaces in restaurants.

Participant comments:

- "Oberlin is the cultural center of Lorain County, we need to be branded that way, but we aren't." (Janet Harr, Executive Director, Oberlin Business Partnership)
- "Community recreation is a particularly important thing during extremely warm days." (Carol Lasser, Emerita Professor of History, Oberlin College)

Emergency: Emergency Services

1. *Emergency service providers must be prepared for an increase in events that are specifically associated with high winds, extreme winter conditions, and flooding.*

As outlined in the Climate Hazard Fact Sheet, climate models predict that the Midwest will experience an increase in thunderstorm activity, especially in March, April, and May (S2, Ch9.3). Tornado season is already starting earlier in the calendar year (S2, Ch9.3), and Oberlin is considered to have a high risk for tornadoes (S21). Additionally, Oberlin has experienced an increase in intensity of winter storms (S2, Ch9.4), which results in extreme and unusual weather (S22). Climate predictions also indicate that the number of days in Oberlin with extreme precipitation will likely increase by 25% by 2030 (Table 3: Days/year with precip >1 in). All of these extreme weather events pose particular demands and challenges for Oberlin's emergency service providers.

Many participants brought up the need to prepare for increased instances of flooding in particular. The City of Oberlin already has emergency response plans in place to address flooding. For example, Oberlin employs "turn around, don't drown" messaging on emergency signs to inform residents of flooding risks on local roads. Kendal has developed and practices evacuation plans, and has identified evacuation sites for its residents to provide safety from flooding events. Other organizations could learn from this example. Community members suggested that, in the future, Oberlin could expand its adaptive capacity by increasing signage and education about the specific dangers associated with flooding and how to mitigate these.

In terms of increases in severe wind events, several community participants emphasized the steps Oberlin has taken to reduce the risk of downed trees and power lines. After previous incidents with fallen trees, the City of Oberlin adapted by contracting with tree trimming services to remove potentially hazardous trees and branches,

a practice that has continued since then. As a result of this trimming, neighboring communities experienced multiple downed power lines in a recent wind storm, while Oberlin did not.

To further protect the City from damage caused by severe winds, community members suggested requiring the use of hurricane clips—metal brackets that tie rafters to walls to reduce the danger of roof loss in major storm events—in new construction. Other suggestions to reduce wind risks include legislation requiring new building developments to install underground power lines.

Although models clearly predict an increase in average winter temperatures moving forward, climate disruptions caused polar vortex conditions in Oberlin several years ago and in Texas this winter (2021). Community participants expressed concerns about the safety of Oberlin's aging building stock, especially regarding the possibility of roofs collapsing from heavy snow loads during severe winter storms. Kendal at Oberlin already practices snow removal from roofs because of the potential for roof collapse, but educating residents and creating plans for addressing and monitoring snow load could occur at a City-wide level.

Overall, community participants expressed concern over changing climate conditions, but also had confidence that, with focused planning efforts, Oberlin's emergency service providers are prepared to adapt to these.

Participant comments:

- "We're dealing with all these things all the time. It's just going to be on a grander scale." (Skip Gentry, Executive Director Southern Lorain County Ambulance District)
- "Wind is an issue—there's no doubt about it." (Skip Gentry, Executive Director Southern Lorain County Ambulance District)
- "Ohio has had a 4.5-5% increase in tornadoes over the last five years. It's almost as though the Tornado Alley is expanding." (Jim Ward, Central Lorain County Joint Ambulance District)
- "At Kendal, we have a series of [emergency] drills that we practice each quarter. [For example], we have a loss of power drill, a tornado drill**,** and a fire drill. What we do is practice the scenario and assure that residents and staff members understand the course of action." (Rey Carrion, Facilities Manager, Kendal at Oberlin)
- "The biggest concern we have in [a changing] environment is that [local] buildings weren't designed for heavy snow loads. Buildings with big roof areas like Walmart [are highly vulnerable]." (Robert Hanmer, Chief of Oberlin Fire Department)
- "[An important lesson I learned in this process] is how emergency preparedness is so much broader than just response. It's getting out in front of potential concerns. It's seeing climate change as it is—a trend of situations that if we pay attention to, we can get ahead of at least to an extent. So, for me, what's exciting and challenging is to continue this mission." (Rob Hillard, Oberlin City Manager)

2. *An increased number of hot days will cause more medical emergencies. It may also increase aggression. A range of options are available for mitigating these impacts.*

As described in the Climate Hazard Fact Sheet, models predict that Oberlin will experience 30 days of extreme heat per year by 2030 (Table 3: Days with Max Temp > 90 °F). Extreme temperatures are related to a variety of heat-related diseases, such as heatstroke. Medically vulnerable populations, such as elderly people or those on medications that make it harder for them to regulate body temperature, are especially prone to the health risks of high heat. People who live alone or are bedbound may also benefit from more frequent wellness checks during periods of extreme heat.

In addition to physiological impacts, extreme heat "can lead to an increase in aggressive behaviors, including homicide" (S3, Ch21, S3, Ch14 KM1). Our emergency departments are already aware of these tendencies and feel prepared to handle them.

Community participants proposed using social media, emergency alerts, and other communication mechanisms to warn people of the dangers caused by extreme heat and means of alleviating these risks to health. Current and historic efforts to educate the public on the risks of extreme heat in Oberlin have been effective; emergency services personnel in Oberlin and Lorain County give lectures on heat and cold emergencies and use social media and television to spread information about the general risks and best responses to extreme heat. Education efforts about the risks of extreme heat can focus on the vulnerable populations discussed above, as well as spreading awareness to parents about how to keep their children safe while they play outside on hot days.

Community participants recognized that many residences in Oberlin do not have air conditioning and that the costs of equipment, installation, and elevated electrical bills may be out of reach for a number of community members. Public and non-profit service providers such as POWER, Efficiency Smart, and Oberlin Community Services should be encouraged to expand services to meet increasing need. In addition, as suggested above, enhanced use and development of public cooling centers for people to escape the heat in the warmest months reduces risk of heat stress and increases equitable access to cooling. Possible locations include the public library, museums, churches, and other accessible locations. Logistical challenges which need to be addressed to make this possible include financing, accessibility, and electrical use.

Participant comments:

- “First Church has a sleeping area because of the Sanctuary Movement… Maybe there are other churches that could think about having a room in their basement that could be ready to go in case somebody was forced out of their home for a few days to a week.” (David Hill, Pastor at First Church)
- “I’ve been thinking quite a lot about heat, particularly as someone who just celebrated his 78th birthday. The effects of heat on the elderly [is important]. [I have] also been looking at it through the adjusted lens of social justice.” (Alan Lockwood, Retired physician living at Kendal)
- “Certain medications make [it] more difficult to dissipate heat by sweating.” (Alan Lockwood, Retired physician living at Kendal)
- “[The Mount Zion fellowship hall] is a space that more people feel they are able to access, and that kind of space is critical to have in the inventory to be used as a warming or cooling center in extreme weather.” (David Snyder, Retired Clinical Counselor)
- “The Oberlin housing stock is old and needs updating. Whether it be cold or hot, [utility costs] go right out the roof or out the windows that aren't well insulated.” (Barbara Thomas, CEO, Kendal at Oberlin)
- “We really watch out for our residents, especially people that don't have a real strong social interaction or a lot of backup. We identify those folks and check on them. But, we will be concerned about the effects of heat, especially on those that aren't able to get air conditioning or get out of the heat, and people with comorbid factors.” (Skip Gentry, Executive Director Southern Lorain County Ambulance District)
- “The public is [becoming] more aware of the effects of heat. For example, I do a lecture just on heat and cold emergencies, for Medical Services and fire throughout the state.” (Skip Gentry, Executive Director Southern Lorain County Ambulance District)
- “Because we have such old building stock and a lot of elderly people in Oberlin, extreme heat is really important. [Solutions could include] opening up public buildings that have air conditioning when the temperatures rise during the day. [For example, at the College], we could open up the lobby of the Science Center.” (Bridget Flynn, Oberlin College Sustainability Manager)
- “We know that during long periods of heat, incidents of domestic violence and child abuse climb.” (Ryan Warfield, Chief of Oberlin Police Department)
- “The better tree canopy cover we have, the better we are able to mitigate a lot of the impacts of increasing temperatures. It can also help to mitigate some of the stormwater impacts for more severe storms.” (Heather Elmer, Executive Director of Chagrin River Watershed Partners)

3. Response times could suffer as inclement weather, including floods, heavy snow, and extreme storms, makes transportation more difficult. Emergency service departments can

plan and prepare for these challenges through selection of specific vehicles and increased personnel.

Extreme weather conditions such as snow, ice, and flooding lead to unsafe transportation conditions for emergency vehicles as well as for community members. This has the potential to endanger emergency personnel, result in slower response times, and, in the worst case scenarios, may prevent access to people in need of help. Emergency service providers strive to be prepared for hazardous conditions. For example, the Oberlin Fire Department closely monitors weather and places additional personnel at the fire station when conditions suggest that a snow plow or a rescue truck might be needed. The emergency personnel who participated in this discussion indicated that the Oberlin Fire Department does an excellent job of clearing roads for other emergency vehicles when necessary, though conditions do sometimes result in delay.

Lorain County has a Swift Water Rescue Team with boats that can help address flooding emergencies in Oberlin. Additionally, many emergency service departments have planned alternate access routes in case of flooding. The Police Department is considering alternate forms of transportation to allow police officers to address emergencies when flooding blocks police vehicles.

High winds and other extreme weather can prevent helicopters from landing, which impairs the ability of emergency services to provide life flights. There is a trauma unit at the airport stationed to provide care in such situations.

Although the emergency services personnel who participated in our discussion expressed confidence in preparation for near term climate hazards, it is clear that planning for the increased frequency of such hazards will be important moving forward.

Participant comments:

- “We want to make sure we're getting our personnel to the scene as fast and safely as possible. We also have a plan that [when] we're expecting a blizzard, we can commandeer a snowplow… and they'll actually lead the way to the fire.” (Robert Hanmer, Chief of Oberlin Fire Department)
- “The fire departments do a pretty good job of clearing the roads when we need to get through [blocked roads] and they're pretty fast at it. It does hamper the response time, though.” (Skip Gentry, Executive Director, Southern Lorain County Ambulance District)
- “There were a couple of occasions when the ambulance got stuck entering a driveway. When you get stuck and you're delaying patient care, you have to think outside the box.” (Jim Ward, Central Lorain County Joint Ambulance District)
- “The trauma [unit] is affected by the weather. Metro Life Flight has a helicopter right over here at Lorain County Regional Airport, [but] high winds, rains, or snows can prevent them from taking off and picking up a patient. Then we have to do ground transport. ” (Jim Ward, Central Lorain County Joint Ambulance District)
- “I pushed for a number of years to get a ground crew over at the airport for the cases that they can’t fly. Now they have a trauma unit on the ground at the airport” (Jim Ward, Central Lorain County Joint Ambulance District)

4. Climate adaptation requires that EMS workers be equipped and provisioned to function in extreme heat and extreme cold.

As extreme weather conditions become more frequent and severe , emergency service workers risk heat exhaustion and hypothermia. It is important that the equipment used to support emergency service staff evolves to address these risks. Some measures have already been taken. For example, ambulances have been outfitted with coolers to hold cold water and medication. The most recent ambulance purchased was equipped with a built-in refrigeration unit. These features not only help keep crew members safe, but also provide other resources to help residents during heat-related emergencies. Looking forward, emergency service agencies are considering investing in cooling vests and alternative uniforms to allow emergency teams to remain safe and continue doing their jobs efficiently, despite harsher climate conditions predicted for the future.

Participant comments:

- "We have been proactive. Last summer was pretty hot, and the summer before was excessively hot. So, we purchased plug-in coolers for the ambulances and kept them stocked with Gatorade and water for the crews. For our newest ambulance, I actually ordered a built-in refrigerator. We keep drinks and certain medications in there for the medics, and for residents [experiencing] a heat emergency." (Jim Ward, Central Lorain County EMS Association)
- "We monitor emergency personnel very closely on scenes. We may mandate that they go to a rehab station where they can get ice packs when it's extremely hot or hot bags if it's extremely cold." (Robert Hanmer, Chief of Oberlin Fire Department)
- "I'm always worried about the safety of my colleagues. … I worry about them being hydrated. We use special equipment for days when it's really cold, and we're concerned about hypothermia." (Skip Gentry, Executive Director, Southern Lorain County Ambulance District)

5. Collaboration in emergency communication and multiple modes of communication are already providing Oberlin with adaptive capacity to address climate emergencies.

Communication among emergency service workers, and between emergency service personnel and organizations and the public, is crucial to the health and safety of Oberlin during extreme climate events. This is particularly true for vulnerable populations. Both redundancy and diversity in modes of communication provides climate resilience. As an example of effective planning and communication, Kendal at Oberlin has a system in place that allows personnel at Kendal to communicate directly with the Oberlin Police and Fire Departments through a two way radio system. This will be of particular value if cell phone transmission fails. The Kendal community also provides an example of a much lower-tech approach to communication that provides resilience; residents put signs in windows of their homes stating if they are amenable to allowing other residents to take refuge from extreme heat or cold as they travel across the campus.

As described earlier, the WENS system allows emergency service providers within Lorain County to easily broadcast emergency information to any resident who signs up for this free service via phone and text messages. This system is already widely used to disseminate information about extreme weather and flooding events. Participants noted that this has helped with the adaptive capacity of the County, since it informs the emergency services of what to expect. Consistent with the use of this system, participants felt that there is good communication between Oberlin and surrounding cities. They felt that maintaining and enhancing these highly collaborative relationships and communication is critical to further enhancing adaptive capacity.

Participant comments:

- "At Kendall, on our extreme cold days, the residents came up with placards that they would put in their cottage windows to say you could duck in here to get warmed up or have a hot beverage. That kind of welcome[ness] that recognized that somebody may have to be out, but may need a space to step into to

keep from freezing or overheating is a whole community solution." (Barbara Thomas, CEO, Kendal at Oberlin)
- "The Lorain County Emergency Management Agency does a good job getting out severe weather alerts in really good time. We can rise to the occasion." (Skip Gentry, South Lorain County EMS Association Executive Director)
- "I get emails from the Lorain County Engineer's Office alerting me of different conditions on county roads—if there's blowing and drifting [snow] and things like that." (Jim Ward, Central Lorain County Joint Ambulance District)
- "When advisories come out, the weather news media is very well versed, and this helps a lot." (Jim Ward, Central Lorain County Joint Ambulance District)
- "We have a system in place [at Kendal] where our radios connect directly to the Oberlin Police Department [and also to the Fire Department]. So, if we do have a true emergency, just by clicking that button, we have direct access to them." (Rey Carrion, Facilities Manager, Kendal at Oberlin)
- "Coordinating [between] Lorain County Health Department, the schools, Kendal, and [Oberlin College] gives us such an advantage compared to bigger cities where no one knows each other. If something happens to you or your family, knowing who to call is one of the most important things." (Bridget Flynn, Oberlin College Sustainability Manager)
- "Severe winds could impact the way that people get in contact with the department, and [they] might make it difficult to get ahold of someone in an emergency. If the wind knocks down phone lines or power, the fire department [has] have to get to the emergency any way possible, so they will find a way" (Robert Hanmer, Chief of Oberlin Fire Department)

Health: Public Health Including Exercise and Recreation

1. Extreme weather can make outdoor recreation more difficult, even dangerous, and impacts mental and physical health. Adaptation involves increasing protection and alternative recreation activities.

As described in the Climate Hazard Fact Sheet, climate change will lead to more hot days, will negatively affect air quality, and will increase the frequency of severe weather. These conditions will make outdoor activities riskier, especially for already vulnerable populations such as children, the elderly, and those with health conditions. On the other hand, physical activity is positively linked to well-being, including physical and mental health. Oberlin residents enjoy a wide variety of outdoor activities including gardening, walking, and biking, which means many people's routines and lifestyles are vulnerable to these climate impacts. Of course, warmer winters and reduced snow cover will also extend the season for various outdoor activities such as gardening, biking, and running.

Participants discussed the need for a multifaceted approach to addressing these risks. Options discussed included planting more shade trees, educating the public about the dangers of extreme weather and heat, and even enhancing the availability of alternative opportunities for indoor physical recreation. Currently, the City has installed outdoor hydration stations, Oberlin Community Services has installed covered bike parking, and Splash Zone opens its indoor facilities to allow residents to walk indoors on hot days. Oberlin residents already receive a discounted Splash Zone membership, but as extreme weather events constrain outdoor opportunities, the City may wish to negotiate an ever lower membership price or to subsidize membership for lower income residents to enhance access.

Participant comments:
- "All sorts of things that people do are a boost to their mental health. Extreme heat, extreme cold, tons of rain—these have an impact if you're riding a bicycle or running. " (David Hill, Pastor at Oberlin First Church)

- “[Many Oberlin] residents love to walk and exercise and go into the woods. I worry about those seasons where we have a lot more mosquitoes” (Barbara Thomas, CEO, Kendal at Oberlin)
- “It’s not simply a matter of warming; it’s about disruption. We need to alter our expectations [regarding] unpredictability.” (David Snyder, Retired Clinical Counselor)
- “We've ensured that bike parking is covered at Oberlin Community Services. That was grant funding” (Kat Bray, Health Education Specialist, Lorain County Health Department)

2. High winds, warmer climate, increased heat, and increased snowfall allow disease-carrying pests to travel further into Ohio and survive longer into the year. Adaptation involves ecological management and behavior change.

Pests such as mosquitos and ticks are unpleasant pests, but worse than that, they carry pathogens like West Nile Virus and Lyme disease. Cold winter conditions have constrained the range and prevalence of these pest vectors of disease. As winter conditions warm, insects from more southern areas will be able to survive in the Ohio climate, bringing new vector-borne diseases, such as Zika virus, into our region. Additionally, with increased heat during the summers, the infectiousness of disease organisms carried by these insects is increased. Heavy spring rains and flooding events create standing pools in which mosquitos breed. High winds knock over trees and branches which can then serve as breeding grounds.

In discussions, it became clear that the City of Oberlin and Lorain County Health Department have management plans in place to address increased abundance of insect vectors of disease, and are prepared to adjust their plans to accommodate the changing climate. There is also a wealth of literature that has been produced by the College and public health departments that can educate people on personal safety measures that can be taken to reduce the risk of disease. These include staying indoors during twilight hours, using insect repellents, and managing or eliminating insect breeding grounds. The City has a program to distribute mosquito dunks. Increased education will be necessary as an adaptive strategy.

Participant comments:

- “High wind has really caused a lot of tree falls... the tree falls themselves create holes that are outstanding habitat for mosquitoes. When big limbs get blown off trees, the place in the tree rots away. You get what we call tree holes. In both of those situations, a species of mosquito that transmits LaCross encephalitis virus breeds in those habitats.” (Mary Garvin, Professor of Biology with a speciality in insect borne diseases, Oberlin College)
- “People start to feel discouraged to go out and use open spaces such as parks.” (Barbara Thomas, CEO, Kendal at Oberlin)
- “The bigger issue with climate change and vector-borne diseases is the change in the distribution of vectors of disease, such as the species of mosquito that transmits Zika [virus] (currently mostly southern).” (Mary Garvin, Professor of Biology with a speciality in insect borne diseases, Oberlin College)
- "You can try to control nature or you can work with it; carefully modifying our behavior to work with nature is a more practical and ethical approach." (Mary Garvin, Professor of Biology with a speciality in insect borne diseases, Oberlin College)

3. Oberlin’s physical and mental healthcare facilities should prepare for increased need due to extreme heat and weather-related public health risks.

Various health impacts of a changing climate, such as heat-related stress and illness, have been discussed in previous sections. An important additional health risk to consider is mold caused by flooding events which can lead to respiratory illness. Mental health problems, such as increased anxiety and stress, have already been highlighted. Indeed, the term “solastalgia” has recently been coined to describe the emotional or existential distress induced by a rapidly changing climate and environment.

Participants recognized that hospitals, clinics, and mental health care providers need to anticipate an increase in the full range of climate-related health problems. Additional means to adapt to mental and physical health stressors could include support networks to ensure that exposed and vulnerable members of the community are receiving the support they need.

Participant comments:

- “What are the backup systems that need to be planned for and put in place and regularly serviced to live healthfully [in a rapidly changing climate]?” (David Snyder, Retired Licensed Clinical Counselor)
- “What do we have on hand as far as mental and spiritual health resources, perhaps for people that may not have anticipated those needs?” (David Hill, Pastor at First Church)
- “Mental health is very important—[it’s] part of the health of your community.” (Barbara Thomas, CEO, Kendal at Oberlin)

4. Oberlin has many communication networks which can be leveraged to inform residents of hazards and preventive measures

As with participants in the groups focused on Jobs and Emergency Services, participants in the Public Health group recognized enhanced communication as both an existing strength of the Oberlin community and as an area that needs to be expanded to enhance adaptive capacity in response to climate change. Oberlin residents have many different ways of getting information to each other, ranging from newsletters to clubs to official alert systems. All of these can be harnessed to inform the public of new hazards and safety measures. Having the capacity to communicate climate hazards and risks is important, but it is also necessary to ensure that the community is aware of the resources available to enable them to adapt and be resilient. Using person-to-person networks can educate the community about how to stay safe during a crisis and how to seek help if needed.

As other groups noted, multiple networks of communication are more resilient in case one goes down in an emergency. Reaching residents who would not ordinarily know about the dangers they face helps to keep the Oberlin community safe. The health department is able to send out text messages to warn the community, and increasing their reach would be beneficial to the health of Oberlin’s residents.

Participant comments:

- “I think of Mercy and the fact that we've got almost 400 parish nurses and 90 parishes. If we messaged the churches and asked them to put up hydration stations and find places for people to find respite from the extreme temperatures, I'm sure many of them would be able to help us.” (Char Wray, CEO of Mercy Allen Hospital)
- “I just keep thinking to myself—we've got such well educated residents, and we are in a town that will continue to inspire new knowledge” (Barbara Thomas, CEO, Kendal at Oberlin)
- “We have a great relationship with the health department. … They keep us informed about emergencies … throughout Lorain County and beyond Lorain County.” (David Hall, Superintendent of School District)
- “Social infrastructure is important. If something happens to you or your family, knowing who to call is important. On the other side of the phone call, knowing what to do when you get that phone allows us to be in the right position when something goes wrong.” (Bridget Flynn, Sustainability Manager, Oberlin College)

Food: Food Supply, Food Access, and Local Agriculture

1. Changes in seasonal weather patterns have the potential to disrupt local fruit and vegetable production. Practices need to be adjusted to enhance adaptive capacity.

The changes in climate described in the Climate Hazard Fact Sheet will affect the quantity, quality, varieties, and timing of local foods available in Oberlin. The extended growing season Oberlin will experience due to increased temperatures may increase the production and extend the availability of certain crops. However, wetter springs, drier summers, extreme heat, and increased overall variability in weather will change what crops can be grown by local farmers and gardeners and how successful these crops will be. For example, early winter warming events followed by cold snaps can devastate stone fruit production. Heavy spring rains have already resulted in years without crops for local commodity agriculture (corn and soy). These conditions have also hurt fruit and vegetable production.

Participants in this group discussed a variety of ways in which the adaptive capacity of the local food system can be enhanced. A simple example is that Oberlin farmers and gardeners can choose more heat and drought tolerant crops. However, drier summers may necessitate irrigation. Some local farmers may find costs too prohibitive to install and maintain irrigation. As suggested in other sections of this report, enhanced communication is an important component of resilience. Best practices will evolve as the climate continues to change. It will be important for information to be exchanged regarding which crop growing, pest management, and land-use techniques are working and which are not working. This information needs to flow across the entire community that grows fruits and vegetables, including the Amish. As discussed in the water section of this report, enhancing on-site rainwater storage—from the scale of rain barrels to cisterns to farm ponds—is an important mechanism for storing excess rainwater and using it during drier periods.

Participant comments:

- “Even in the 10 years I have lived here, I have noticed that the springs have been really wet and the summers have been far drier than normal.”(Heather Adelman, Co-founder, Oberlin Food Hub)
- “The City Fresh program provides food on a 20 week basis. With season [changes], we've had to change our harvests which changes our budgets and that can pull apart an entire business model.” (Pete Morris, Farm Manager, George Jones Farm)
- “A couple of years ago, many local farmers weren’t able to plant their fields in the spring because [the conditions] were so wet, and by the time they were dry enough it was too late for the season. And we had farmers who pushed it and did plant only [had our] crops rot.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- “Butternut squash production was very limited in 2015. The reason was because it rained for 21 straight days in June and July, and they couldn't get the seedlings in the ground.” (Anna Kiss Mauser-Martinez, Executive Director, New Agrarian Center)
- “Drought is especially an issue because many of the farms we work with struggle with irrigation.” (Anna Kiss Mauser-Martinez, Executive Director, New Agrarian Center)
- “I think one mitigation measure that can help with extreme weather [and variability in crop production] is the Oberlin Food Hub can provide a place that farmers can sell their product (including for semi-processing/freezing), and it won’t go to waste.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- “Changes [in seasonal patterns] are going to affect the local [food] sources, whether it's our garden or local farms in the area. This affects OCS much more than national chains which have the ability to change where their sourcing occurs.” (Liv Hanson, Oberlin Community Services)
- “I work with a lot of Amish farmers. They anticipate what’s coming up in the next year based on what happened in the previous one.” (Pete Morris, Farm Manager, George Jones Farm)

2. Every climate hazard identified elicits the risk of food scarcity. A variety of challenges and opportunities exist with respect to enhancing food accessibility, availability, and equity.

Unpredictable and extreme climate events will make it more difficult to grow, store, and transport food. This poses an economic threat to both commodity agriculture and to local fruit and vegetable farmers. Lower production means higher prices at both the grocery store and the farmers market. This presents particular challenges for lower income residents who often spend a larger percentage of their paycheck on food than higher income earners. Reduced food production also affects what and how much is available at food pantries such as Oberlin Community Services.

For local producers, greater variability in climate means that production of some fruits and vegetables will likely be lower than expected in any given year. But, it likewise means that production of some crops may actually be higher than what is expected. Lack of storage capacity can then be a problem. Variable weather may also result in crops that are healthy for eating, but do not match industry standards for what is acceptable in the normal commercial marketplace. In large-scale commercial agriculture, farmers often deal with the overproduction of crops or improper sizing and other imperfections by tilling perfectly healthy vegetables and fruits back into the soil.

Participants suggested that the impacts of a changing climate on local agriculture should stimulate us to creatively address and avoid the problem of food waste. The collaboration between local farmers and non-profits like the Oberlin Food Hub provides one excellent example of how the challenges described above can be creatively addressed. The Oberlin Food Hub has a facility where they can store and distribute as well as semi-process and freeze locally produced food. Farmers can sell excess crops to the Oberlin Food Hub. This minimizes the financial loss for farmers and increases local access and equity of food availability. Another example is Oberlin Community Services Food Rescue program which seeks and distributes food (both prepared food and produce) that would otherwise be wasted.

Participant comments:

- “With extreme cold days, we did have a day where we couldn’t deliver food. It was too dangerous to have our drivers on the road, so I could see that being an issue.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- “[The food we receive and distribute at Oberlin Community Services is] very much at the end of the chain. We are getting things from grocery stores that didn't sell, were given to a food bank, and then came to us.” (Liv Hanson, Oberlin Community Services)
- “Not everybody has the opportunity to garden and grow food in their backyard, especially people who rent or live in apartments” (Eboni Johnson, Outreach and Programming Librarian, Oberlin College)
- “I had thought of the Oberlin Food Hub primarily as an economic development tool for local farmers and a distribution tool for wholesale buyers to get local food. I had never really considered the food hub as a climate resiliency tool.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- “I'm excited to think more about how [Oberlin Food Hub’s] commercial kitchen can serve as a resource to local farmers. A couple of years ago in the fall, a local farmer called us panicking because they had a giant field of bell peppers that was about to all get ruined by a really early snowstorm. We were able to help them get those harvested and get them into our kitchen where then we processed them into a local fajita mix for our local schools.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- “Oberlin Community Services’ flexibility and resiliency in the past year—responding to the greatly increased needs in our community from the pandemic—is in some ways a model that we can look to more broadly” (David Snyder, Retired Clinical Counselor)
- “One small thing, such as a change in a couple degrees of temperature, has an effect on a lot of different systems that interact with OCS and the organizations we work with. Those impacts are different for different people in the community, people with different amounts of resources already.” (Liv Hanson, Oberlin Community Services)

- “We know that changing weather patterns and changing agriculture patterns are going to change the ways that we're able to provide food to people… [We are going to need] to be flexible and adaptable in how we provide our services.” (Liv Hanson, Oberlin Community Services)

3. The majority of the food consumed in Oberlin is not regionally sourced; impacts of climate change on food production across the country and across the globe are important to our local food system. Supporting local sourcing where possible builds adaptive capacity.

The Oberlin community is highly supportive of local agriculture and has been at the forefront of the local foods movement, working to enhance production, distribution and affordability of locally grown and produced food products. However, the reality is that most of the food calories eaten in Oberlin, particularly major staples in our diets such as grains (wheat, rice, oats, barley, and other cereals), come from outside of the region. While corn and soy are major crops in the region, most of these products are sold outside of the region. Climate change is affecting food production across the globe which will impact Oberlin regardless of how much food is produced locally. Participants praised the benefits of increasing the percentage of food in our diet that is grown by local farmers and in local gardens. Participants advanced this as a mechanism for increasing Oberlin’s capacity for self-reliance by maximizing the Oberlin food system’s advantage of an abundance of freshwater.

To promote local food systems, the Oberlin community needs to find more ways to financially support and incentivize local farmers and gardeners. While most of these farms are outside of the city limits, they supply food to the Oberlin Food Hub, City Fresh, Oberlin Community Services and our local grocers and the farmers market. Supporting local farmers encourages a transition in local agriculture toward human consumption rather than feed for livestock which, in turn, increases money circulating through the local economy and supporting local jobs. Local food also reduces “food miles” and the carbon emissions associated with long-distance food transport. One important caveat is that extreme weather events during a season -- such as severe storms or heat waves-- have the potential to damage all local agriculture.

Participant comments:
- “I think the City of Oberlin can encourage more local food [production and consumption] with a more robust farmers market.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- “Honestly, most of the agriculture in this region is corn and soy and they’re not even for [direct] human consumption. It’s for animals or they make it into high fructose corn syrup. So I think there's a conversation to be had about a way to incentivize farmers who are currently growing corn and soy to grow crops for people.” (Heather Adelman, Co-founder, Oberlin Food Hub)
- "What I'm seeing is that commodity agriculture is [going to be] disrupted by climate change. The pressure will increase for local agriculture to feed people." (Peter Crowley, Community Gardening Volunteer)
- "[A community] garden's real strength is showing people how they can grow their own food in a healthy way" (Peter Crowley, Community Gardening Volunteer)

4. Food storage and distribution could be affected by severe weather events, creating decreased accessibility to food for Oberlin’s most vulnerable populations.

Oberlin has been at the forefront of efforts to increase access to fresh local foods for all members of the community. The New Agrarian Center/City Fresh, Oberlin Community Services (OCS), and the Oberlin Food Hub each play important roles in ensuring that the local farm and garden production reaches those of modest income as well as the more affluent in our community. Transportation and storage are essential to the current and future success of these and other organizations. Extreme weather events impact both. Snow, ice, and flooding can block trucks from transporting food, while extreme heat can lead to spoilage and increases in the cost of refrigeration. Power outages likewise can lead to food spoilage. In addition to the challenges of getting food to markets, there are also transportation challenges for consumers in accessing food. For example,

participants suggested that better public transportation options for those who access food from Oberlin Community Services could reduce food insecurity. Oberlin Community Services is already addressing this issue by conducting small produce distributions in various sections of town, working to identify those pockets of residents who have barriers to accessing fresh food.

Participant comments:

- "The reality is that the effects of climate change are going to affect those without resources most. We get a lot of our food bank inputs on a semi truck once a week. A couple of times, the weather has been so bad that they have to delay that. [Climate impacts on transportation will be really really difficult." (Liv Hanson, Oberlin Community Services)
- "Lorain County Transit only runs on Monday and Thursday. So, if individuals can't come on Monday, they may not have food for the week." (Liv Hanson, Oberlin Community Services)
- "Transportation is really important—most of our food comes from outside of Oberlin. Disruptions in logistics definitely do impact things." (Anna Kiss Mauser-Martinez, Executive Director, New Agrarian Center)
- "There's a lot of food availability that I'm sure lots of people don't know about. Part of that is getting the word out to people. Also, transportation is possibly an issue for some people. Being able to access all of the food that's available" (Eboni Johnson, Outreach and Programming Librarian, Oberlin College)
- "Climate change impacts the most vulnerable first and hardest. Rural food deserts are a very real thing. A public transportation system for the area, just to get to and from food sources, would help so much. " (Anna Kiss Mauser-Martinez, Executive Director, New Agrarian Center)

5. Changes in climate are likely to increase the abundance of agricultural pests. Creative ecological solutions will be increasingly important.

Several features of the changing climate are likely to favor agricultural pests. Warmer winters, for example, allow insects that had not previously inhabited this region to overwinter. Wet springs increase fungal infections in crop plants. Drought and extreme heat weaken the health of both plants and humans, and they make crops more susceptible to insect damage. Many farmers may choose to address increased pest abundance by increasing use of pesticides and fungicides. This creates direct impacts on human health via consumption of the crops. It also has the potential to affect stream water quality, particularly if application is followed by extreme precipitation events. Many good farming practices, such as creating a habitat for beneficial insects, integrated pest management, and diversified crop production may be even more important in a more harsh and variable climate that favors pests. Farm production can also be negatively impacted by disease carrying organisms such as ticks and mosquitos to which farm labor is disproportionately exposed. Community education will be particularly important for home gardeners.

Participant comments:

- "Plant diseases can potentially lead to food shortages" (Eboni Johnson, Outreach and Programming Librarian, Oberlin College)
- "My assumption is that [if winter] is not as cold as it should be, that creates a pest issue." (Heather Adelman, Co-founder, Oberlin Food Hub)
- "I'm betting the farmers around town are already intimately familiar [with plant disease], but the citizens might not be…[We need] workshops, classes, whatever kind of informational kind of ways to get the word out" (Eboni Johnson, Outreach and Programming Librarian, Oberlin College)

Culture: Community and culture, Including Greenspace

1. The role of art in community resilience is to be relevant to current challenges, help people cope, and bring people together across division.

People will experience stress from the risks associated with the climate hazards, particularly risks that endanger property, exacerbate existing inequity, and limit access to greenspaces. One avenue through which people can enhance their own psychological resilience to stress is by creating and experiencing art. To increase adaptive capacity, creators, performers, interpreters, and directors in the arts industry can prepare themselves and their art to serve the community. While art generally supports individual and societal health, participants in this discussion suggested that the arts can play a role in helping members of our community process and respond constructively to the particular challenges of climate change.

Part of the challenge will be making art accessible to a broader audience. Making art more accessible includes making it more affordable, but participants also discussed relevance and perceived relevance to people's lives as another key dimension of accessibility. Participants pointed out that, at present, various forms of art in this community appeal to and reach specific audiences and that it can be challenging to engage those who are not already engaged. Finding ways to attract new audience members is in part contingent on making connections to contemporary issues more explicit. Artists can draw in larger audiences by focusing their work on ongoing challenges, such as the risks posed by climate change. Art itself can also help relieve the tension that some risks will create, since it is often a shared experience.

Participant comments:

- "Many people are drawn to Oberlin because of the arts. The arts exercise our emotions and safely take us places that challenge us and help us grow. These art-induced experiences keep our whole emotional system healthy." (Peter Slowik, Viola Professor; Artistic Director, Credo Music)
- "Theater allows people to tell their own stories and express [themselves] in order to bring about change. (Miyah Byers, House of the Lord Fellowship Member)
- "It's not something that we like to think about, [but] we're actually going to [need to consider] how [we are contributing to] climate change." (Nina Fisher, Program Director, MAD Factory Theatre Company)
- "Art is very healing. [At the MAD Factory], we are trying to make sure that art [is] an accessible coping mechanism to everybody. We could do a community show about the effects that climate change has had on people's lives" (Nina Fisher, Program Director, MAD Factory Theatre Company)
- "We are thinking about how to provide programs that could be cathartic, helpful, or creative ways to help with climate change and help people deal with their feelings about climate change. We will be able to investigate a lot of different avenues for the arts there." (Nina Fisher, Program Director, MAD Factory Theatre Company)
- "Whether thinking about environmental sustainability and environmental change or racial justice, we [museums] want to find new ways to talk about art, to make that relevant." (Alexandra Letvin, Assistant Curator of European and American Art, Allen Memorial Art Museum)
- "The arts are a major part of the town's identity." (Alexandra Letvin, Assistant Curator of European and American Art at Allen Memorial Art Museum)

2. Climate change will disproportionately affect young people. Our community has the opportunity and responsibility to engage and empower youth to be resilient and experience self-efficacy in helping Oberlin address climate challenges.

Participants recognized the importance of explicitly considering the mental and physical health and education of youth in this vulnerability assessment and adaptation plan. Over their lifetimes, today's youth will experience more of the impacts of the changing climate than today's adults will. Children also often spend more time outdoors than adults. This means that over both the short and long term, they will more directly experience many of the climate hazards, such extreme hot days, flooding, vector-borne diseases (e.g. from ticks and mosquitos), and extreme winter conditions. As they look towards a future with uncertain and dystopian possibilities, it is important to provide youth with honest reasons for hope, opportunities to engage in positive envisioning, and the means to act in ways that bring a more positive future into existence.

Participants identified a variety of direct impacts of climate change on the health of young people in our community. For instance, extreme hot days and vector-borne diseases may limit children's access to greenspace and also require them to wear protective clothing and bug spray and pay special attention to staying hydrated. Generally, warmer winters may expand the seasons over which children can walk and bike to school. On the other hand, an increase in wet days in the spring as well as extreme winter events, particularly those that increase wind chill, may increase the number of days that small children will not be able to wait outside prior to school. Similarly, flooding in Oberlin frequently leads to pooling of water that blocks the sidewalks. Snow often does not get cleared from sidewalks. Both puddles and snowy sidewalks make it challenging for small children to walk to school. Participants recognized that economically disadvantaged children will likely experience disproportionate negative impacts of climate change. For example, children who do not have air conditioning at home may have more difficulty completing assignments during extremely hot weather. They may also be more exposed to insect-borne diseases and therefore likely to miss school. Enhancing youth access to facilities that can serve as cooling centers is one important measure that can be taken (e.g. extending hours of air conditioned school spaces, Oberlin Public Library, the Bridge, etc.) to address these disparities.

More generally, the strain on children's lives from climate change will, to some extent, impact their ability to simply be children, which community members find concerning. Participants noted that emotional as well as intellectual considerations are important as the community envisions ways to enhance the adaptive capacity of its schools and its children. The schools currently have a program called *Second Step* that focuses on helping students cultivate empathy, manage stress, and be respectful of others. These goals are particularly important to help students address the challenges of climate change. Building on this program and integrating discussions of uncertainty, anxiety, and self-efficacy into guidance counseling are ways the schools can support students and help them constructively respond to the emotional challenges of climate change.

Through the Environmental Dashboard and the new STEM lab, Oberlin's schools are already beginning to more deeply incorporate discussions that both explain climate change and provide students with opportunities to understand how their personal and collective choices impact the community and the world. Further refinement of this curriculum so that students explore the difference between mitigation and adaptation and can identify ways to positively engage will be critical as well as measures to enhance the Oberlin community's overall adaptive capacity now and in the future.

Participant comments:

- "[Children are] the people who have to live with the decisions that we're making right now." (Alexandra Letvin, Assistant Curator of European and American Art, Allen Memorial Art Museum)
- "Everything about us is wired to be renewed by being in nature. So, if it's not safe for kids to go outside, that's horrible." (Peter Slowik, Viola Professor; Artistic Director, Credo Music)
- "Our students are going to leave the climate controlled school building and go to homes that may not have the same conditions." (Jim Eibel Principal, Prospect Elementary School)
- "Making sure we've got hydration when kids are out playing at school [in extreme heat] is a concern." (Jim Eibel Principal, Prospect Elementary School)
- "As far as increased diseases [resulting from climate change], attendance is an issue. We need to be especially concerned about our students who are economically disadvantaged." (Jim Eibel Principal, Prospect Elementary School)
- "As we move to the new building, some students will have to walk a little bit further. People sometimes don't shovel the snow. I [have] concerns with travel on snowy days" (Meisha Baker, Principal, Eastwood Elementary School)
- "I would have the sidewalks cleared by the City because the privatization is not working. I live on a major route to Prospect School. I see my sidewalks not cleared all the time, [and] … families struggle with it." (Carol Lasser, Emerita Professor of History, Oberlin College*)*

- “[During COVID-19], we've gotten really good [at] contingency plans. If we can't meet because of [extreme] weather, we'll make sure that they have something to keep them occupied, so it's not so disappointing.” (Nina Fisher, Program Director, Mad Factory Theatre Company)
- “We’ll have an environmental STEM lab in our new school. We're looking for younger ages to understand the global effects of what’s going on in society” (David Hall, Superintendent of School District)
- “This process has made me think about the design of our new schools - from our pre-K-5 to our 6-12 building... We need to start educating our youth on things that are impacting our society and things are impacting from a global perspective, and getting our kids mentally ready for those challenges which are going to face them later in life” (David Hall, Superintendent of School District)

3. Basements, yards, and homes are at risk of flooding. The community can prepare by rethinking landscaping and monitoring basement spaces.

Increases in the intensity of precipitation events pose a threat to personal property, to organizations and businesses, to the preservation of historical architecture, and to people’s morale. As discussed in the Water and Health sections of this report, extreme precipitation events lead to flooded basements and resultant mold growth, particularly within the flood zone of the Plum Creek. Water damage to roofs from storm events is also a concern that was raised. Civic organizations and museums often use basements to store artwork and merchandise. Four separate community participants commented on water damage they had experienced in their homes and yards as a result of flooding.

As discussed in previous sections of this report, Oberlin has a variety of options for increasing adaptive capacity related to flooding. Options discussed exist at municipal, neighborhood, and individual home levels. Opportunities for the City to improve stormwater drainage have also been discussed earlier. An example of a complementary, but more localized solution is the creation of rain gardens in individual yards or for neighborhoods. These catchment basins are designed to collect excess water and are planted with species that benefit from periodic saturation. They are ecologically beneficial, aesthetically pleasing, and can help control mosquito populations through the inclusion of natural predators of mosquito larva. Another measure discussed was public education programming focused on the ways in which residents can upgrade historical homes to address modern flooding issues so as to encourage the preservation of these buildings far into the future. Inexpensive monitoring equipment is available to detect water entering basements. Programs that provide homeowners with easy and subsidized access to this equipment and also encourage them to monitor and share information can easily be developed, so that the extent of the problem can be tracked and community-level solutions can be informed by better knowledge.

Participant comments:

- “The City of Oberlin has infrastructure that needs to be updated. We have had serious issues with water—backup into people’s homes and flooding of the streets.” (AG Miller, Pastor of House of the Lord Fellowship, Retired Religion Professor)
- “[Climate change] wreaks havoc on historic structures. … They don't do so well in more extreme conditions.” (Carol Lasser, Emerita Professor of History, Oberlin College)
- “Some of our current school buildings have had issues with water being in the basements, which is typically where the boilers are and they don’t like to run when they’re under water.” (Jim Eibel Principal, Prospect Elementary School)
- “When people are in a flood zone, they worry. There is a woman on the west end of Smith Street who has frequent flooding in her basement. Most people like to fix up a rec room if they have a basement, but she is unable to use hers.” (Elizabeth Meadows, City Council Member)
- “[Plum Creek] was over the banks and in the street. It wouldn’t have taken a whole lot to take it up into our [Heritage Center] building.” (Liz Schultz, Executive Director, Oberlin Heritage Center)

- “When the elements can get in through the roof—that is one of the biggest dangers to the preservation of a building.” (Liz Schultz, Executive Director, Oberlin Heritage Center)
- “If you have a wetland with a working ecosystem, then you have frog larva and salamander larva that are eating mosquito larva. It is the water that accumulates in your gutters, old tires—these buckets of water where [are] especially problematic.” (Kate Pilacky, Firelands Associate Field Director, Western Land Conservancy)

4. Extreme hot days pose equity issues, especially in terms of access to air conditioning, pools, and public drinking water.

The impact of the increasing number of extreme heat days is addressed in Health Insights earlier in this document. Participants in the Community & Culture group paid particular attention to the disproportionate impacts of heat on certain groups such as those who can not afford to install or pay the utility bill associated with air conditioning, those who work outside, and the substantial population of elders in our community who are particularly vulnerable to negative health impacts of heat. This group suggested a variety of options for enhancing adaptive capacity. They discussed the value of enhancing access to drinking water in public places and expanding access to pools at Splash Zone and Oberlin College—including expanding hours of operation. Like other groups, this group identified increased planting of shade trees as an important opportunity, but also suggested building more outdoor pavilions.

As with other groups, participants highlighted the importance of public cooling centers, but also discussed the limitations of such spaces with respect to privacy. To address this equity issue, it was suggested that the community consider financial support for installing energy-efficient air conditioning in one room of each home for those who can not afford it. The goal would be to provide all Oberlin residents with a private place in their home to stay cool.

Participant comments:
- “We need to look at our community spots, whether that be Tappan or downtown, and ensure that we have more than one place to access [drinking] water. It can't just be on one side of town.” (Meisha Baker, Principal of Eastwood Elementary School)
- “Many people have full house air conditioning; I’m not one of those people. When it's really hot, I have my fans on, but I’m a senior citizen. … It's getting to the point where I will have to buy a couple of air conditioners to cool off the house.” (Elizabeth Meadows, City Council Member)
- “Access to air conditioning can relate to socioeconomic and racial lines. [It] would be nice if the public library had extended hours [to increase access to a cool place to work].” (Carol Lasser, Retired History Professor, Co- Author of *Elusive Utopia: The Struggle for Racial Equality in Oberlin, Ohio*)
- “Recently, we shut down Eastwood Elementary due to extreme heat. We’re in a very fortunate spot now where our new [PK-5] building will have air conditioning. We are currently preparing our rooms at Langston to make sure the air conditioning is working properly [and is] ready to go for extreme heat.” (David Hall, Superintendent of School District)
- “The New Union Center for the Arts is a potential cooling center.” (Nina Fisher, Program Director, MAD Factory Theatre Company)

5. In spite of the climate challenges that Oberlin faces, this community may experience an influx of migrants from more affected communities. Oberlin’s diversity in culture and opinion provide us with various opportunities to grow and adapt while also preserving what is special about this community .

By the mid-late century, coastal flooding and lack of access to fresh water will likely displace a significant fraction of the U.S population, as well as significant numbers of people globally. Oberlin’s geographic

location—away from oceans and near 20% of the planet's surface fresh water—marks it as a refuge for those who are displaced; Oberlin may see an increase in population in the coming years. Oberlin's diverse and welcoming community is an asset in ensuring resilience. Participants expressed optimism with respect to ways in which strategic planning around population growth might provide opportunities to maintain key aspects of community identity while also addressing important issues related to housing, gentrification, jobs, infrastructure and communication.

Participant comments:

- "Global concerns are a priority for us. [We have] a strong, liberal, arts community, [and] our school system is thinking outside of the box. We need to hang onto those values when people move into Oberlin." (David Hall, Superintendent of School District)
- "Oberlin is a great small town. Part of Oberlin [is that] everybody is a mile away from the center. Could you imagine Oberlin with another 5-7 thousand people? Designing Oberlin's [expansion] around new urban concepts like multiple town centers would be great." (Peter Slowik, Viola Professor; Artistic Director, Credo Music)
- "[Climate migration into Oberlin could] be a good thing—Oberlin has room. Definitely the community and the small town feel of community would be [what] Oberlin would want to preserve." (Nina Fisher, Program Director, MAD Factory Theatre Company)
- "Oberlin's not what it was when I grew up, and it's not a bad thing. … it's become this place where people stop through. It's hard to build a continuous culture, when it's always changing. That's why [climate migration] could be good and bad." (Meisha Baker, Principal, Eastwood Elementary)
- "Having studied a lot about neighborhood segregation, I would be intentional about providing [and] encouraging affordable mixed use neighborhoods; we have an opportunity to be creative in ways that will make this a more fully diverse community."(Carol Lasser, Emerita Professor of History, Oberlin College*)*
- "How do we reach out of the spaces that we're in? I feel like it happens to an extent but it can happen even more. Moving forward, I think that should be the number one priority because we can't do anything together if we don't have relationships with one another." (Miyah Byers, House of the Lord Fellowship Member)

6. Increases in the number of extreme heat days will strain cultural events in the summer as well as the organizations that host them. Adjustments in dates, times and provision of shade, cooling and water will help increase adaptive capacity.

As extreme temperature days continue to increase within Oberlin, many outdoor summer cultural events and programming such as the Chalk Walk, the Oberlin concert series, and outdoor programming for children may face delays and cancellations. In some cases, and for organizations with tight budget constraints, it may become less feasible to sponsor regular summer events. Some organizations rely on outdoor public events for revenue. Hotter temperatures will also increase air conditioning needs and associated utility costs for museums (which require continuous AC to protect art) and for indoor event spaces. These financial burdens may cause great harm as many local arts organizations run on tight budgets.

While Oberlin cannot control the weather, the City, host organizations, and downtown merchants can employ a variety of measures to mitigate heat related stress. For example, events can be planned earlier or later in the season, and in the morning or evening, to avoid the hottest part of the summer and day, respectively. Many of the measures discussed in other sections of this report can help reduce heat stress when temperatures are high—these measures include shade trees, shade structures, more public drinking water stations, cooling centers that event goers can retreat to for temporary respite. For some events and for some organizations, it may be possible to develop contingency plans such as alternative indoor locations, virtual events, or alternative dates (the heat equivalent of a rain-date). Alternatives may be particularly important for events involving children as they are more sensitive to shifts in plans. Finally, Oberlin could increase its winter cultural programming to

offset the loss in the summer months such as creating an ice skating rink (although perhaps on synthetic ice to adjust to warmer winter conditions).

Participant comments:

- “If you run a summer art school and climate change interferes with your ability to draw students, your whole existence comes into question” (Peter Slowik, Viola Professor; Artistic Director, Credo)
- “Climate change has an impact on outdoor performances—for example, above 85 degrees my viola's varnish melts, and I can't perform safely.” (Peter Slowik, Viola Professor; Artistic Director, Credo)
- “[In the summer], we have our Friday night concerts—they're a great gathering place. (Nina Fisher, Program Director, Mad Factory Theatre Company)
- “What happens to our summer concert series if it's 90-95 degrees, [and] the seniors can't come? Climate change can have a big impact on the efficiency of distribution of our artistic products!” (Peter Slowik, Viola Professor; Artistic Director, Credo)
- “[Extreme heat has] a direct impact on our energy bills. Because we are a museum, we have to keep [the temperature] steady; fluctuations can damage things.” (Liz Schultz, Executive Director, Oberlin Heritage Center)
- “Chalk Walk and Juneteenth are important events for celebrating the community but also for spending time with family in a fun environment. If those are at risk, you lose that opportunity.” (Liz Schultz, Executive Director, Oberlin Heritage Center)
- “[It] would be nice to make sure that we have alternatives for all of these [cultural events] when the weather is too [extreme].” (Carol Lasser, Retired History Professor, Co- Author of *Elusive Utopia: The Struggle for Racial Equality in Oberlin, Ohio*)
- “[We need to] look at what other museums are doing to balance preservation with new energy models. Putting solar energy on top of our roof or finding that balance between preservation and being environmentally sustainable are directions we can move forward.” (Liz Schultz, Executive Director, Oberlin Heritage Center)

7. Oberlin should carefully and intentionally consider how to maintain and enhance the diversity of greenspaces and the species within them in the face of a changing climate.

Over the last few hundred thousand years, what is now northeast Ohio experienced several periods of glaciation during which species migrated north and south as the climate warmed and cooled. Human induced climate change is occurring rapidly, and in a highly fragmented landscape that makes such natural migrations impossible. Plant species that cannot thrive in the shifted climatic conditions will vanish from our landscape. It is therefore up to us to assist in planting species from a more southern range to maintain healthy and diverse local ecosystems within our greenspaces. Participant experts suggested that species such as blackgum, Kentucky coffee tree, and sweetgum will likely do well in the warmer climate. These make excellent shade trees which will enhance greenspaces, making these important public spaces more welcoming during hot summer days. High disease resistance among these species renders them more prepared to handle high winds, flooding events, and even extreme winters.

Prior to European settlement, forested wetland ecosystems dominated the local landscape. As Oberlin prepares for wetter springs and more intense rains, it was suggested that restoration of wetland ecosystems be considered as an important addition to our greenspaces. Diverse wetland ecosystems provide a storage capacity for excess runoff, while also encouraging wildlife—some of which, such as tadpoles, consume mosquito larvae. Long-lived wetland trees such as black tupelo, and bald cypress would contribute to wetland ecosystem diversity while also providing shade and more character to local greenspaces.

Participant comments:

- “We would want to look at [planting] trees that are adapted to [areas] south of here. Maybe we’re not out of their range, but we’re at the northern edge of their range. Kentucky coffeetree is one example. Black gum is

another. They are not wind pollinated and could help pollinator populations." (Roger Laushman, Professor of Biology, Oberlin College)
- "If we start having a lot of high winds, we're going to have to, again, rethink landscaping. Pine trees for example are wonderful, but they tend to be pretty shallow rooted." (David Hill, Pastor at First Church)
- "A garden is just one of many different kinds of strategies we have to create an intentional design of our greenspaces so that we can weather the storm" (Peter Crowley, Community gardening volunteer and agroecology advocate)

Participant and Coordinator Reflections

The vulnerability assessment was explicitly designed to be a participatory process. What follows in this section are quotes from participants gathered during the final presentation and discussion and a final participant survey. Reflections from student coordinators on what they learned about the larger Oberlin community are also included. Figure 4 was developed from words shared during the final community discussion. Titles and affiliations of participants are included in a final section.

Adaptive strengths of Oberlin

- "Commitment." (Carol Lasser)
- "The willingness to take the necessary steps to adapt." (David Whitworth)
- "The community's forward thinking mindset, and the existing clean energy infrastructure." (David Zelasko)
- "The ability to recognize needs and the people to make needed changes." (Greg Jones)
- "Control of the water and electricity services." (Janet Haar)
- "Proximity to freshwater. Willingness to have this conversation." (Anna Kiss Mauser-Martinez)
- "Community support for green infrastructure investments in energy, water systems, health and safety, food, and ecosystem services." (Peter Crowley)
- "Small size, commitment to environment, educational level." (Pete Richards)
- "Businesses and nonprofits that provide access to local food." (Heather Elmer)
- "Curiosity, belief in science and evidence, willingness to entertain new ideas." (Kathy Perales)
- "Active implementation of Climate Plan, potential for town-gown collaboration." (David Snyder)
- "We are a community with more resources available to us than many small towns." (Linda Arbogast)
- "There are many organizations that [already] work together to support each other and could in relation to climate change as well." (Nina Fisher)
- "We are a close-knit community with a lot of knowledgeable and caring people in it—we will come together to help each other." (Cindy Frantz)
- "We know that climate change is happening here, and we are taking proactive steps to reduce the impact those changes may have." (Robert Hanmer)

Adaptive challenges

- "Perfectionism." (Carol Lasser)
- "Inequality." (Anna Kiss Mauser-Martinez)
- "Educating everyone and public participation." (David Whitworth)
- "Communication to the community." (Greg Jones)
- "Opening the process to those most often excluded from participation." (Peter Crowley)
- "Short period of time to act combined with slow decision making." (Ellen Mavrich)
- "[Climate] change happens quickly, and bureaucracy does not typically move quickly." (Jennifer Reeves)
- "The invisible, gradual nature of the problem; adaptability can mean getting used to the status quo as it gets worse." (Pete Richards)
- "Sustaining and expanding the City's capacity to purchase and generate carbon neutral, renewable electricity. Potential increased power supply costs for OMLPS." (Heather Elmer)
- "Food supply, creating infrastructure that can handle extreme weather events." (Cindy Frantz)

- “Lack of public transportation connecting residents to jobs and health care outside Oberlin.” (Heather Elmer)
- “Lack of support and a collective approach on the part of the larger Lorain County, and Ohio, communities.” (Eugene Matthews)
- “Building a community that is resilient to climate change may cost a lot of money up front, but in the long term it will be less costly to rebound/recover and get back to ‘normal.’” (Robert Hanmer)

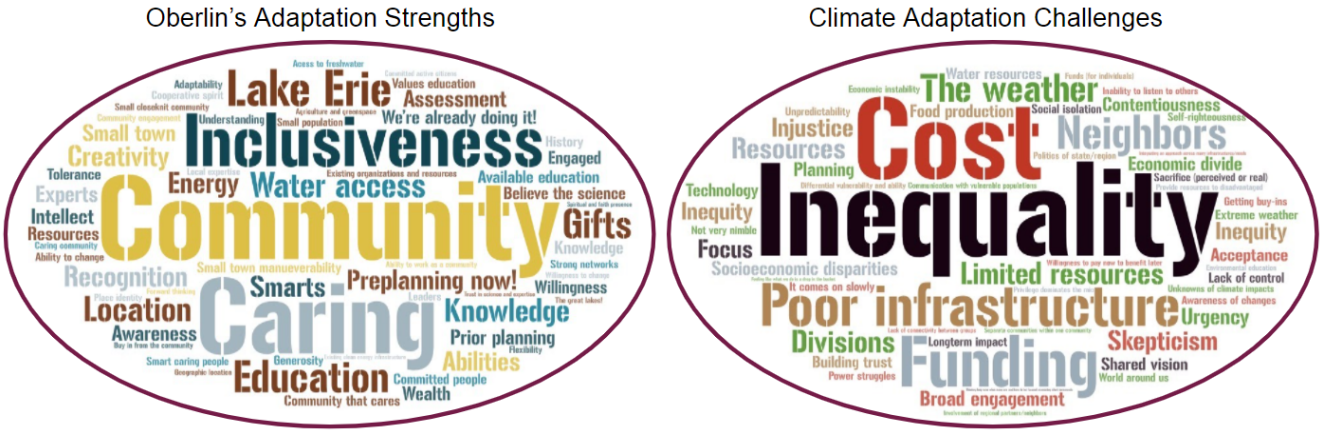


Figure 4. Word clouds for Oberlin’s climate adaptation strengths and challenges. During the final presentation and discussion, community participants were asked to write whatever words first came to mind in response to adaptation strengths and then challenges. The size of words included is proportional to how many times a given word was repeated among participant responses.

Comments related to importance/success of the vulnerability assessment process

- “As a member of Oberlin City Council, this process really educated me to think more on a systems level as opposed to just one project at a time.” (Elizabeth Meadows)
- “This experience helped me to think about how to give more focus to environmental change and how it impacts people on the ground, every day.” (A.G. Miller)
- “I really enjoyed the thoughtfulness of the process—systematically taking a look at [climate vulnerabilities and adaptation options]. I think it's really inspiring that the City has chosen to do this.” (Anna Kiss Mauser-Martinez)
- “It is a unique opportunity—the whole concept of what we are doing is unique. I just can't say enough and I thank you all for having me be a part of it.” (Greg Jones)
- “I am very impressed with the students who have helped steer this process and been so much of the boots-on-the ground, who have done the interviews with each of us.” (David Snyder)
- “I love how much participation we've had in the community and how many people are so passionate and so thoughtful in their approach.” (Bridget Flynn)
- “This conversation [about about climate adaptation] has really gotten me thinking about how we can implement the ideas that we've talked about.” (Bryan Burgess)
- “I learned a lot from this process about how different climate impacts are incredibly interrelated.” (Liv Hanson)
- “I just want to say thank you to the organizers—this was an amazingly well-organized process, and it was a pleasure to be part of it.” (Heather Adelman)
- “I think the work that's being done here is very significant and could be a model for other communities when it comes to how we look at emergency preparedness.” (Rob Hillard)
- “[This process] helped take it from the nebulous ‘climate change’ to ‘these are the things that are going to happen, in our town, to us.’ That was very, very helpful.” (Nina Fisher)

General conclusions

- “It's good that the conversation is opening up more broadly to the community to think about the way in which essential services, both of the municipality and ecosystem services, underlie pretty much everything that we do.” (Jeff Baumann)
- “I've learned again [the need to] focus on environmental sustainability as a core strategy. This project helped me to see how our efforts in the area of mitigation should be paced with our efforts to adapt. These two

sub-strategies [provide] an important, conscious direction for the City to move forward in… continuing our focus with departments to have environmental sustainability as a day to day focus in our mission to improve the lives of the citizens." (Rob Hillard)
- "I'm just really proud of the City and excited that we have so many opportunities. We have our own drinking water system, sewer system, stormwater program, and electrical system now. So, I'm excited to see how we can use [what we have] to leverage more resiliency." (Heather Adelman)
- "[Participating in this process caused me to think] much more concretely about what the world is going to be like years from now. It motivated me to be more committed to pushing harder, to emphasizing the importance of speed." (Cindy Frantz)
- "What I've learned is to try to work on helping people to find their voice." (A.G Miller)
- "I'm looking forward to coalition building with other organizations, individuals, and the City to attack these very important imminent existential goals to create adaptive capacity." (Anna Kiss Mauser-Martinez)
- "We're going to keep thinking and being flexible and adaptable in what we do. The City has been great about doing that already." (Liv Hanson)
- "I'm feeling a lot more hopeful that we're imagining all of these scenarios and being able to think about how we might respond to them in the future, and to start building plans to make sure that our community is really resilient." (Bridget Flynn)
- "What really is new and ...very exciting to me is actually seeing something happening at the planning level, instead of the academic level. So this is a fantastic experience to be part of." (Peter Richards)
- "Zip code 44074 covers about five times as much land area that is rural farmland as it does Oberlin. So, there's an implicit question of how do we move beyond just being an island in the city and actually spread this kind of information and awareness to the larger 44074, the larger Northeast Ohio and so forth, how do we export this." (Peter Richards)

Student Reflections on learning from community participants

- "From this experience, I learned that Oberlin is a very passionate community that is filled with members who care and are extremely knowledgeable about their community. We also learned so much about the community as a whole and how much they are willing to do for future generations." (Sophia Musiak)
- "Through this process, I learned that Oberlin community members are already considering how climate change will affect their daily lives and what steps they can take to prevent it; Oberlinians are eager to participate in making this city as resilient as possible." (Taylor Hoefer)
- "In my experience interviewing community members, everyone expressed a sincere commitment to making lasting change and considering vulnerability through the lens of inclusivity" (Miriam Khanukaev)
- "From this experience, I learned that Oberlin's social infrastructure is an integral part of our community's ability to adapt and respond to emergencies. Oberlin has an engaged community that is eager to collectively work toward solutions." (Emily Bengtson)
- "One of the things I've learned is that because a lot of the homeowners in Oberlin rent rather than own properties, improving individual infrastructure for each home could be a challenge: it will take creativity to motivate landlords and tenants to invest in home climate adaptations because renters may only live in homes temporarily." (Brigit Cann)
- "I learned that those involved in energy delivery and production in Oberlin are in the process of developing resilient responses to threats of climate change. With this in mind, there are far more steps to be taken." (Phoebe von Conta)
- "I appreciated learning from the community about Oberlin's energy systems and infrastructure. It made me realize the resilience advantages of being a relatively small city: there are people who have a very high degree of familiarity with the city's various sectors, and really know what has been done and what needs to be done." (Leo Lasdun)
- "From this experience, I learned about how past art depicting people's struggles might help Oberlin community members cope with climate change in the present." (Elizabeth White)
- "Something I came to appreciate is what makes Oberlin unique when comparing it to other places in the county, like the importance of arts and the commitment that people have to support one another. This uniqueness is a strength of ours as we continue to plan for climate change." (Jane Vourlekis)

- “I learned how many challenges related to greenspace have relevance for the community; making smart decisions about which trees to plant has implications for storm damage, water usage, energy use in the community—well beyond greenspaces themselves.” (Max Bauders)
- “Conversations in both the business group and energy group have enlightened me about priorities set by each cohort. While groups have different sets of issues, concerns, and solutions, they share a similar passion for engaging in the adaptation planning process.” (Justin Lee)
- “Our interviews reflected the advantage of the diversity of resources different people have in this community.” (Claire Kaliski)
- “This process really showed me the value of community participation. Few people we talked to thought of themselves as experts in climate change. And yet, the information they shared was perhaps more essential than the ‘expert’ climate knowledge because you couldn’t just look it up, you have to talk to the right people.” (Emma Neufer)
- “There is a wealth of knowledge and ways in which Oberlin community members have already been putting resilient practices into place.” (Marina Pariser)

Ideas for broadening the conversation

- “Include teachers and students of all ages.” (Kathy Perales)
- “Continuing to include diverse perspectives and voices in the conversation will help the city adapt in the most equitable and effective way.” (Heather Elmer)
- “Using a social media platform.” (David Whitworth)
- “Continued and broadening communication with and through local faith communities.” (David Snyder)
- “Do a similar exercise with Lorain County leaders and communities within the county.” (Eugene Matthews)
- “Perhaps all city departments could be asked to develop a climate resilience plan that addresses the risks that are relevant to their work.” (Cindy Frantz)
- “Keep the conversation going with measurable, achievable, short-term goals.” (Ellen Mavrich)
- “When I look at the vulnerability assessment and adaptation planning process, I can't help but apply our Community Risk Reduction (CCR) plan where I look at Education, Engineering, Enforcement, Emergency Response, Economic Incentives and Empowerment.” (Robert Hanmer)

Alignment with Existing Planning Processes and Next Steps

Like all other communities on earth, the Oberlin community has significant climate vulnerabilities that must be addressed; the City, its organizations, and its residents have important work ahead. Preparing a comprehensive adaptation plan will be a critical next step for the community. If there is good news, it is that there is significant alignment between the adaptive measures that community members suggested and with many of the most important municipal and community planning processes that are already underway. The most obvious alignment is with Oberlin’s existing Climate Action Plan. As Figure 5 and Table 2 suggest, there are actions that solely focus on reducing (i.e. mitigating) greenhouse gas emissions, andthere are actions that focus solely on enhancing Oberlin’s adaptive capacity. But, there are also a host of actions, such as adding shade trees from more southern regions of our climate zone, that accomplish both goals concurrently.

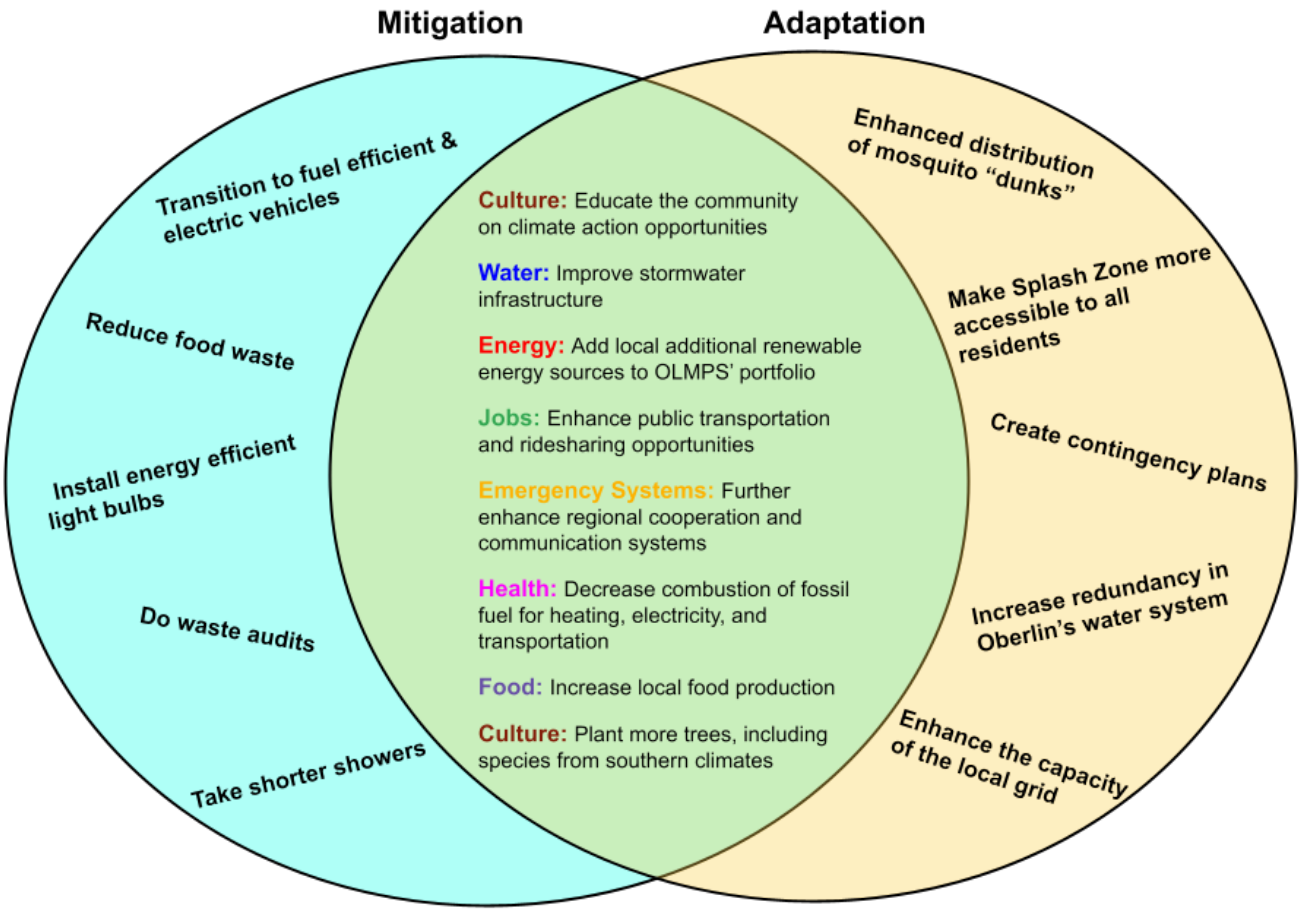


Figure 5. Climate mitigation and adaptation alignment. Some actions serve only to mitigate (reduce the extent of) climate change. Others provide adaptation without mitigation benefits. However, many actions accomplish both goals concurrently. Examples of alignment are shown within the intersecting circles above.

Community System	Climate Action Goal	Mitigation	Adaptation
Water	Improve stormwater infrastructure	Reduce water infiltration to wastewater system resulting in less energy being used in processing	Decrease flooding that might otherwise result from the increase in extreme precipitation events
Energy	Add local additional renewable energy sources to OLMPS' portfolio	Increase carbon-free energy delivered within the community	Solar coincides with peak demand on hot summer days when AC use is highest and market is most expensive
Jobs	Enhance public transportation and ridesharing opportunities	Reduced gasoline use and charging electricity for personal vehicle use	More ways to get to work and enhanced job access foster economic resilience in face of change
Emergency	Further enhance regional cooperation and communication systems	Reduce unnecessary redundancy, reduce vehicle miles and embodied carbon in excess equipment	Increase resilience in the face of increases in magnitude and frequency of extreme weather events
Health	Decrease combustion of fossil fuels for heating, electricity and transportation	Reduce associated carbon emissions	Increase respiratory health and decrease smog agents in the face of extreme heat events
Food	Increase local food production	Decrease carbon emissions involved in food production and transport	Increase resiliency through providing alternatives to national food systems
Culture: Greenspace	Plant more trees, including species from southern climates	Increased carbon sequestration	Provide shade on hot days, absorb stormwater, planting southern species prepares for shift in climate zone
Culture: Community	Educate the community on climate action opportunities	Increased awareness of mitigation strategies encourages behavioral changes	Enhance understanding of necessity for adaptation measures

Table 2. For each of the seven chosen community systems, this table describes goals from the 2019 update of Oberlin's Climate Action Plan (CAP). Although the City developed these goals with mitigation as the main focus, these goals also overlap with actions Oberlin can take to increase its adaptive capacity, as described in the table. This table highlights just eight of the many existing goals from the CAP as well as those of community organizations and individuals that will enhance Oberlin's ability to respond to climate change and ultimately allow it to be resilient.

Figure 1 points towards the next steps of the climate adaptation planning process for the Oberlin community. As this report makes clear, participants in the process are quite concerned about the local impacts of climate change on key community systems that support our community. However, they are likewise hopeful and, indeed, enthusiastic about the capacity and opportunity for members of this community to roll up their sleeves and better prepare to adapt and to be resilient in the face of the changes now underway.

Integration with planning and actions underway: examples from participating organizations

Representatives of participating organizations were asked to share examples of how the climate vulnerability assessment process and report are integrated into current actions and future plans. Specifically they were asked:

1. How do you anticipate integrating climate vulnerability assessment and adaptation *planning* into specific organization planning processes you are currently engaged in?
2. What *current actions* and initiatives is your organization engaged in that might be described as addressing climate vulnerabilities and enhancing adaptive capacity to climate change?

What follows answers to these questions shared by representatives of some of the participating organizations:

POWER

- *Planning processes:* We plan to review the Oberlin Climate Hazard Fact Sheet as part of our annual strategic planning process and consider how these hazards should inform our future work.
- *Current action:* We will continue to increase thermal efficiency in residences, now with an increased focus on preparation for future air conditioning as well as heating needs; we need to help people buffer extreme temperatures that are on the way. Our landlord/rental initiative will help ensure that large portions of the low income community are buffered from these extremes.

Oberlin Public Schools

- *Planning processes:* Our future planning processes will continue to address all aspects of climate change and climate change education.
- *Current action:* Our new PK-5 building exemplifies mitigation and adaptation planning by incorporating a high level of thermal efficiency, a solar array sized to meet most of the school's needs, central AC, shade trees and Environmental Dashboard system, and STEM learning programming that can be used to teach about climate adaptation and resilience.

City of Oberlin Public Works Department

- *Planning processes:* Climate vulnerabilities are being carefully considered in our Stormwater Master Plan, Water Distribution Strategic Plan, and Water and Environmental Protection Facility (WEPF).
- *Current action:* Significant stormwater planning is currently underway that specifically considers factors in climate change related weather variability, especially storm/flood potential. Planning in the Water and Wastewater Systems always recognizes the need to build in redundancy.

Oberlin Community Services

- *Planning processes:* We are seeking increasing flexibility in food sourcing, food distribution, and food rescue programs. We will be working closely with local farming partners to adapt to climate-driven changes in local agriculture. We will be working to increase accessibility to OCS programs via support for public transportation initiatives.
- *Current action:* Our direct service food programs provide food, including local produce, to food insecure community members. In our programs, we actively look to source food locally, including purchasing produce and dairy products from local farms, growers, and other entities. Our Food Rescue and Farm Food Rescue programs reduce food waste and increase equity in access to local food

First Church

- *Planning processes:* We are initiating work on a new strategic plan that will include direct connections between our church's ministry/mission and the surrounding community.
- *Current action:* We are connecting to the College's new heating system. We will continue to explore the potential for our facilities to serve as a heating/cooling respite location for the community.

Oberlin Heritage Center

- *Planning processes:* Sustainability efforts are included in our current strategic plan.
- *Current action:* In addition to ongoing attempts to reduce our energy consumption, we intend to be more cognizant of historic climate events that we can study to better understand both impact and opportunities for community action.

Oberlin Business Partnership

- *Planning processes:* We will routinely communicate to new and existing businesses the importance of considering their impact on the environment of all they do, including recycling, purchasing equipment and supplies, and energy consumption. We will likewise encourage our members to consider how the economic sustainability of our community is linked to global sustainability.
- *Current action:* We currently promote Oberlin as a community that values the environment and that strives to acknowledge how present actions can affect our ability to react to the effects of climate change.

Community Hub

- *Planning processes:* Promoting action and engagement related to climate adaptation as well as climate mitigation is fundamental to all of our planning efforts.
- *Current action:* Engaging in this process has prompted us to place greater emphasis on the adaptation component in new content we develop for Environmental Dashboards in Oberlin, Cleveland, and the other communities we are working in.

Oberlin Fire Department

- *Planning processes:* OFD will evaluate the risks identified in this assessment and begin the task of finding solutions to reduce the risks and to investigate what equipment and action plans need to be implemented in order to protect life, property and the environment.
- *Current action:* OFD is investing in both emergency operating equipment and station equipment to help reduce our carbon footprint. Many of our rescue tools are being converted to battery powered equipment such as our extrication tools, positive pressure fans and small power tools. We have found that most of our battery operated equipment performs more efficiently and is more reliable than our gas powered equipment. Our station is currently certified as a LEEDS Gold building, which requires ongoing maintenance to operate efficiently.

Music Arts and Drama (MAD) Factory

- *Planning processes:* We can be mindful of climate vulnerability during our artistic and administrative planning, keeping in mind questions such as: What is our energy output and can it be reduced? Is there a more sustainable way to source building materials? Do we need to reschedule certain events to a new time of year? Is there interest from audiences in performances related to climate change? What extra steps do we have to take to keep classrooms and performance spaces cool in the summer and warm in the winter? Cany any of our equipment be updated to more environmentally friendly versions
- *Current action:* Currently we try to reuse as many materials as we can—this is actually meant to be a cost saving measure, but helps to reduce waste of materials as well. We also own a small property in Lorain now that we can use as a permanent rain-contingency plan for outdoor events (depending on the nature of the event).

Allen Memorial Art Museum (AMAM)

- *Planning processes:* This year, the AMAM is beginning a strategic planning process that, in part, will examine our future facilities needs in light of climate vulnerabilities.
- *Current action:* Ramping the AMAM HVAC system's temperature and humidity setpoints biannually to maintain necessary interior conditions while allowing for flexibility in sync with seasonal weather patterns; liaising with colleagues in the Oberlin College Facilities department to address and mitigate concerns regarding water infiltration, given Oberlin's high water table and potential future weather changes, and to ensure optimum performance of the museum's HVAC system in the event of extreme heat and cold, or power outages; considering issues relating to climate and environment when making art acquisitions and planning for exhibitions and programs, as these are issues of critical importance to our audiences; maintaining the integrity of the AMAM's LEED Gold-certified building.

Next steps in the process:

After hearing a presentation on the vulnerability assessment, Oberlin City Council has agreed to create a Climate Adaptation Task Force. This task force will include experts in each community system and community/City stakeholders who have already engaged in the vulnerability assessment work.

Task Force members will do the following:

1. Share vulnerability assessment insights with the departments and organizations they represent through presentations and discussions.
2. Engage and solicit input from full diversity of the Oberlin community through their existing departmental/organizational processes (for example by hosting meetings).
3. Integrate adaptation insights and additional feedback into plans wherever relevant.
4. Meet regularly with other task force members to share progress and ideas as they develop.
5. Identify strategies that require or benefit from cooperation among groups and draft collaborative plans and MOUs.
6. Work to integrate adaptation strategies and plans into CAP update.

The overall goal in moving forward is to find ways to integrate the adaptation goals and strategies into existing planning going on in our community.

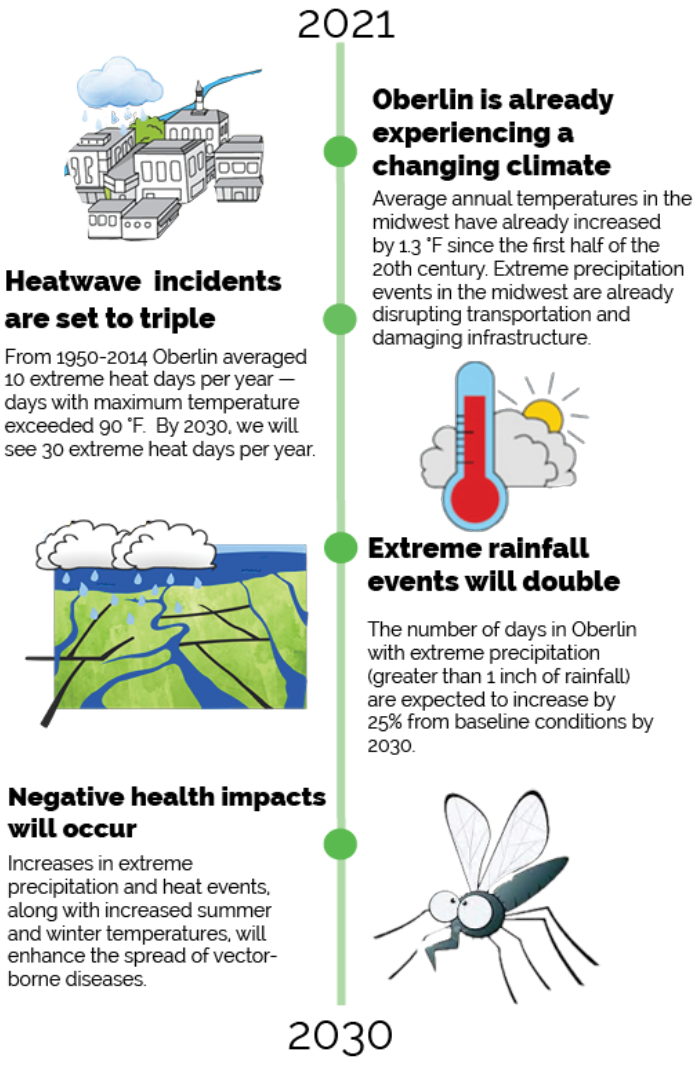
Oberlin Climate Hazard Fact Sheet

Purpose:

The Oberlin Climate Hazard Fact Sheet was prepared to summarize key scientific information regarding what is known and predicted about climate change and its anticipated impacts in the Oberlin area. Participants in the climate vulnerability assessment used this information and their knowledge to consider the likely impacts on Oberlin community systems and to explore options for addressing climate vulnerabilities.

Sources:

Statements presented in this document are supported by two types of sources. First, data and graphs are provided from *Climate Explorer*, a tool that uses respected climate models to predict local climate change (here for the 44074 zip code). Table 3: Predicted Climate Changes for Oberlin summarizes key predictions for specific climate variables. Graphs Predicting Climate Hazards for Oberlin are also included below. Factual statements in the text below are also drawn from a variety of respected sources, most notably the *4th National Climate Assessment*. The *U.S. Global Change Research Act of 1990* mandates that scientists summarize the state of knowledge on climate change in the U.S. every four years. This fact sheet draws heavily on the last two volumes (published in 2017 and 2018). Numbered citations follow each factual statement. The works cited section at the end of this report contains an annotated bibliography with all of the works cited in this fact sheet. In the factual statements presented, unless otherwise stated, the "baseline period" used to assess predicted climate conditions in 2030, 2050 and 2100 is an average of measured conditions in the years 1950-2014. Special attention was given to considering near term change expected by 2030.



Organization:

This fact sheet is composed of seven sections that include factual statements related to each climate hazard that was considered in Oberlin's climate vulnerability assessment. To help promote consideration of climate risks and adaptation opportunities relevant to each community system group, color-coded impact prompts are included at the end of each of the seven sections. The objective of these statements is to flag topics that are of particular relevance to each of the seven community community systems considered for Oberlin.

1. Changed seasonal patterns

Observed Change

- Seasons in the midwest are already experiencing the impact of human-induced climate change. Since the first half of the 20th century average annual temperature in the midwestern U.S. has increased by 1.3°F while winter temperatures have increased by 1.8°F (S2, Ch6). Documented increases in extreme precipitation events in the midwest are also directly attributable to human-induced climate change (S2, Ch7). “Over the past 30 years, increased rainfall from April to June has been the most impactful climate trend for agriculture in the Midwest” (S3, Ch21, Agriculture). Climate change induced increases in warm-season humidity and precipitation are already increasing soil erosion, creating favorable conditions for plant pests and pathogens, and degrading the quality of stored grain (S3, Ch21 KM1). Warmer winters in the midwest have increased the survival, reproduction and northward range of insect pests and crop pathogens (S3, Ch21, Agriculture). Extreme precipitation events in the midwest are already disrupting transportation, and damaging property and infrastructure (S3, Ch21, Background).

Predicted Change

- Average daily high temperatures will continue to increase throughout the coming century. For Oberlin (the 44074 zip code), climate models predict that average daily high temperature will continue to rise rapidly from the baseline temperature of 60.5°F (for 1950-2014) up to 63.5°F by 2030 under both low and high emissions scenarios. Differences in daily high temperatures between low and high emissions scenarios become substantial by the year 2050 and extreme by 2100 (1.5 and 6 °F respectively). (Table 3: Daily Maximum Temperature °F). Climate models predict increases in daily temperature lows as well as highs throughout this century (Table 3: Daily Minimum Temperature °F).
- “Warm-season temperatures are projected to increase more in the Midwest than any other region of the U.S.” (S3, Ch21, Agriculture). Relative to the baseline period, 12 additional frost free days are expected in Oberlin by 2030 under either low and high emissions scenarios (Table 3: Days with Min Temp < 32 °F).
- By 2100, under the higher emissions scenario, Ohio summers will be similar to current summers in Arkansas, and winters similar to current conditions in Virginia and North Carolina (S16 p.14, Fig. 4).
- Total annual precipitation in Oberlin (44074 zip code) is predicted to exhibit a relatively modest 3% increase from the baseline period by 2030. Oberlin can expect to see an increase of 2-2.5 inches of precipitation each year by 2100 (Table 3: Total Annual Precipitation). However, the distribution of annual precipitation is shifting towards spring months and away from summer months (S3, Ch21, Exec Sum, Background p. 883).
- The midwest and great plains regions are expected to experience the greatest increases in thunderstorm activity in the U.S.. These storms will be concentrated in March, April, and May (S2, Ch9.3).
- Projections for central and eastern U.S. indicate a decline in snowpack and a shift to more precipitation falling as rain rather than snow in the cold season (S2, Exec. Sum).

Impacts

- Higher summer temperatures translate into greater use of electricity to meet cooling needs. Under both high and low emissions scenarios, the number of “cooling degree days” (a measure of energy demand for air conditioning) in Oberlin will increase by 37% by 2030 relative to the baseline. Under high emissions scenarios cooling degree days in Oberlin will have increased 224% by 2100 (Table 3: Cooling Degree Days).
- In contrast to cooling needs, winter heating needs will decrease in Oberlin. By 2030, heating degree days (a measure of heating needs) in Oberlin will decrease by 12% (Table 3: Heating Degree Days). This reduced heating demand may render heat pumps a more practical option for both heating and cooling in Oberlin. This would be consistent with the City’s stated goal of shifting to all renewable electric energy sources.
- “Warming winters with fewer extremely cold days and fewer snow and icing events will likely extend the construction season, reduce winter road maintenance demand, and reduce vehicle accident risk” (S2, Ch12, Regional Summary).
- “Increases in growing season temperature in the Midwest are projected to be the largest contributing factor to declines in the productivity of U.S. agriculture” (S3, Ch21, Exec Sum).

- While “growing degree days”, as defined by temperature, will increase (Table 3: Growing Degree Days), the actual planting-season workdays are expected to decrease as a result of waterlogged soil in the spring (S3, Exec. Sum). “Future projections show that Midwest surface soil moisture likely will transition from excessive levels in spring due to increased precipitation to insufficient levels in summer driven by higher temperatures, causing more moisture to be lost through evaporation” (S3, Ch21, Background).
- As a result of climate change in the midwest, “Agricultural productivity (the ratio of outputs to inputs) is projected to decline by 2050 to levels of the 1980s (that is, yields may increase but at the cost of substantial increases in inputs),” (S3, Ch21, Background).
- In the midwest, by mid-century the market quality and yield of non-commodity crops such local fruits, sweet corn, and vegetables is likely to be degraded by intense heat and excessive moisture. Fruit trees are subject to untimely budbreak followed by frost leading to crop reduction (S3, Ch21, Background p. 882).
- “Without adaptive actions, breeding success and production of milk and eggs will be reduced [in the midwest] due to projected temperature extremes by mid-century” (S3, Ch21, Background p. 882).
- Heat and drought-related stress, particularly of younger trees, is projected to shift the composition and structure of forest ecosystems in the midwestern region. Changing climate conditions will favor invasive plant species and pest and disease organisms. (S3, Ch21, Background p. 884).
- Changes in temperature and precipitation are changing habitat suitability and disease exposure for local plants which will lead to shifting species compositions and changing terrestrial and aquatic ecosystems (S3, Ch21, KM2 & KM3). Ecosystem services such as crop pollination, water purification, flood control, and forest and fish harvest are being threatened (S3, Ch21, KM3 & Exec Sum.).
- The timing of season events (phenology) is changing differently for different organisms, for example the arrival of migrating bird species is not changing as rapidly as the changes in “green-up” of plants on which they depend (S3, Ch21, Background p. 889).
- Natural resources managers in the midwest are beginning to plant species native to regions further south to mitigate against continued climate change (S3, Ch21, Background p. 891).
- Shifts in seasonality are increasing pollen production and associated medical conditions such as hay fever and asthma (S3, Ch13 Exec. Sum.; S3 Ch21, Human Health, p. 896).
- Extreme weather events have been linked to mental health problems, ranging from minimal stress and distress symptoms to clinical disorders, such as anxiety, depression, post traumatic stress, and suicide (S3, Ch14, KM1; S3, Ch21 Human Health p. 899).

Areas of Consideration for Oberlin Community Systems

- **Water**: Flooding, stormwater overflow, pollution (nutrient and pesticide runoff), increased use for irrigation and cooling
- **Energy**: Infrastructure, shifts in seasonal demand
- **Jobs**: Weather effects on workforce productivity, transportation impacts, flooding of businesses, shifting insurance risks and needs
- **Emergency**: Flooding events, emergency workers, hospital capacity
- **Health**: Disease, mental health
- **Food**: Changes in growing season; changes in food costs, access and equity; market quality; yield; livestock
- **Culture**: Regional identity, equity, changing opportunities for recreation, outdoor activities and events, climate migration to Oberlin from harder hit communities, ecosystem and greenspace structure and function, awareness of climate impacts

2. Extreme hot days

Predicted Change

- Days with maximum temperatures greater than 90°F will increase substantially during the 21st century. By 2030 models predict that in Oberlin (44074 zip code) days with a high temperature greater than 90°F will increase from the baseline of 10 d/yr to 30 d/yr under both lower and higher emissions scenarios. Under the

high emissions scenario Oberlin may experience 95 d/yr with highs over 90°F! (Table 3: Days with Max Temp > 90 °F).

Impacts

- Higher temperatures are projected to drive up electricity costs not only by increasing demand but also by reducing the efficiency of power generation and delivery, and by requiring new generation capacity. Estimated increased costs to U.S. residential and commercial ratepayers range up to $30 billion per year by mid-century (S3, Exec. Sum, Nationwide Impacts on Energy).
- Extreme heat creates material stress on road pavements and bridge expansion joints. This damage may be partially offset by reduced winter damage associated with reduced freeze–thaw cycles (S3, Ch21, Transportation p. 901).
- "Outdoor workers and people who lack air conditioning may experience extreme discomfort or heat illness on hot days, especially if humidity is high and wind is light. Hot days also stress plants, animals, and infrastructure such as electric lines, roads, and rails. Increased demand for electricity to cool homes and businesses also stresses energy infrastructure on hot days" (S1).
- "Increased daytime and nighttime temperatures are associated with heat-related diseases (for example, dehydration and heatstroke) and death in the Midwest… Exposure to high temperatures impacts workers' health, safety, and productivity" (S3, Ch21, Human Health p. 897).
- "Health risks may be higher earlier in the summer season when populations are less accustomed to experiencing elevated temperatures" (S3, Ch. 14, KM1).
- Under the higher emissions scenario, the midwest is projected to have the largest increase in premature deaths resulting from heat in the U.S. In the high emissions scenario, by 2050 premature deaths and lost work hours would result in an estimated cost of $10 billion (S3, Ch21, KM4, Temperature).
- "Rising temperatures can harm air quality and amplify existing threats to human health. Warmer weather increases the production of ground-level ozone, a pollutant that causes lung and heart problems" (S19).
- "Higher temperatures can lead to an increase in aggressive behaviors, including homicide" (S3, Ch14, KM1).
- Extreme heat is likely to intensify hardship to those most vulnerable, such as the old and infirm and those without resources to control their microclimate (for example, through the use of air conditioning)" (S3, Ch21, KM6).

Areas of Consideration for Oberlin Community Systems

- **Water**: Increased demand for cooling and irrigation, increased evaporation and decreased summer rainfall
- **Energy**: Increased electricity demand and peak demand, stress on aging infrastructure, increased costs
- **Jobs**: Hardship for outdoor workers, increased health costs, increased energy costs
- **Emergency**: Increased demand for medical services
- **Health**: Threats to elderly and others without access to cooling
- **Food**: Challenges for food storage, transportation, and rescue
- **Culture**: Strain on organizations and cultural institutions from increased need for AC, impact on equity, enhanced demand for shaded greenspace, changes in recreational and outdoor opportunities

3. Extreme winter conditions

Observed Change

- Analysis of storm tracks indicates a higher frequency and intensity of winter storms since the 1950s (S2, Ch9.4). Warming in higher latitudes has weakened and destabilized the polar jet stream, causing it to more frequently dip into lower latitudes, periodically bringing polar air farther south. This results in more extreme and unusual weather patterns including increased frequency of the polar vortex (S22).

Predicted Change

- "In winter and spring, the northern part of the country is projected to become wetter as the global climate warms. In the early to middle parts of this century, this will likely be manifested as increases in snowfall. By

the latter half of the century, as temperature continues to increase, it will be too warm to snow in many current snow-producing situations, and precipitation will mostly be rainfall" (S2, Ch7.2.1).

Areas of Consideration for Oberlin Community Systems

- **Water**: Infrastructure
- **Energy**: Energy delivery, increasing demand during events, transportation issues
- **Jobs**: Accessibility, working conditions, productivity
- **Emergency**: Snow removal, traffic accidents
- **Health**: Winter injuries, access to care
- **Food**: Food transportation, food rescue, equity
- **Culture**: Snow days, access to school, commuters, equity

4. Flash/surface flooding

Observed Change

- Across the U.S. transportation infrastructure is already highly vulnerable to intense rainfall and flooding. Climate change-driven extreme precipitation events annually shut down parts of the Interstate Highway System for days or weeks due to flooding and mudslides (S3, Ch12 Precipitation and Flooding Risks). In the midwest as a whole, "Stormwater management systems, transportation networks, and other critical infrastructure are already experiencing impacts from changing precipitation patterns and elevated flood risks," (S3, Ch21, KM5).

Predicted Change

- The number of days in Oberlin with extreme precipitation (greater than 1 inch rainfall) are expected to increase by 25% from baseline conditions by 2030 and 50% by 2050 under both high and low emissions scenarios (Table 3: Days/year with precip >1 in).

Impacts

- Increased precipitation from climate change can lead to increased urban flooding, which "results from heavy precipitation events that overwhelm the existing sewer infrastructure's ability to convey the resulting stormwater" (S2, Ch8, 2).
- "The annual cost of adapting urban stormwater systems to more frequent and severe storms is projected to exceed $500 million for the Midwest by the end of the century." (S3, Ch21 p. 900).
- Extreme precipitation events result in increased traffic risks, temporary closure of roadways, and may erode the bases of bridges (S3, Ch21, Tranportiation p. 900).
- A variety of green infrastructure practices are currently being adopted to mitigate flooding. These include: increased use of trees and other vegetation in urban environments, rain gardens, bioswales, permeable pavement, green roofs, wetland and riparian restoration, and cover crops (S3, Ch21, KM5; S3, Ch21, Exec Sum & Background; S3, Ch21, Transportation & Infrastructure p. 900).
- "Individuals whose households experienced a flood or risk of flood report higher levels of depression and anxiety, and these impacts can persist several years after the event" (S3, Ch14, Mental Health).
- Flooding is a cause of increased indoor mold growth (S16, Table 2, p. 11).

Areas of Consideration for Oberlin Community Systems

- **Water**: Challenges to stormwater, wastewater, and drinking water infrastructure and capacity
- **Energy**: Damage to infrastructure and delivery
- **Jobs**: Impediments to transportation, damage to businesses and inventory
- **Emergency**: Traffic accidents, emergency transportation challenges, emergency communication
- **Health**: Mental health, mold, housing
- **Food**: Food access, food storage, gardening, regional agriculture
- **Culture**: School & church access, equity, preservation of historical places & cultural institutions

5. Vector-borne disease and other health impacts

Observed Change

- "Midwestern populations are already experiencing adverse health impacts from climate change, and these impacts are expected to worsen in the future" (S3 Ch21, Human Health, p. 896). "Pollen production has been on the rise in the Midwest in recent years, with pollen seasons starting earlier and lasting longer". (S3 Ch21, Human Health, p. 896).
- Warmer winters in the midwest have increased the survival and range of pathogen carrying pests (S3, Ch21 Recent Agricultural Trends). For example, mosquito species that carry West Nile Virus as well as deer ticks that transmit Lyme disease have expanded in habitat and range (S3, Ch21, Human Health p. 899). Lyme disease in Ohio has increased from 33 cases in 2007 to 218 in 2017and can be attributed to local infection (S16, p.18).

Predicted Change

- Predicted increases in average and extreme heat and precipitation events enhance vector-borne disease and other health impacts (see statements under Hazards 1 and 2 above).

Impacts

- "Climate change is expected to worsen existing health conditions and introduce new health threats by increasing the frequency and intensity of poor air quality days, extreme high temperature events, and heavy rainfalls; extending pollen seasons; and modifying the distribution of disease-carrying pests and insects." By mid-century, the midwest region of the U.S. is, "projected to experience substantial, yet avoidable, loss of life, worsened health conditions, and economic impacts estimated in the billions of dollars as a result of [climate] changes" (S3, Ch21 KM4).
- Continued expansion of disease-carrying insects will make spending time outside more risky (S3, Ch21, Human Health p. 899).
- When runoff from heavy precipitation exceeds the capacity of water systems, combined sewer overflow containing untreated sewage and associated pathogens is released into local waterways (S3, Ch18 Threats to Human Health).
- Increases in water temperature and changes in seasonal and precipitation patterns will likely increase in hazardous algal blooms that contain cyanobacteria in Lake Erie (S3, Ch21 Human Health). "Contact with and consumption of water contaminated with cyanobacteria have been associated with skin and eye irritation, respiratory illness, gastrointestinal illness, and liver and kidney damage" (S3, Ch21 Human Health, p. 899).
- While Oberlin's drinking water is drawn from the West Branch of the Black River, the lakeside communities to our north as well as New Russia Township extract their drinking water from Lake Erie; if Lake Erie water quality is impaired surrounding communities may potentially look to Oberlin for a clean source of drinking water.
- Climate change increases atmospheric conditions that lead to poor air quality such as ground-level ozone and particulate matter. "Exposure to [ground-level ozone and particulate matter] results in adverse respiratory and cardiovascular effects, including premature deaths, hospital and emergency room visits, aggravated asthma, and shortness of breath. Certain population groups, such as the elderly, children, and those with chronic illnesses, are especially susceptible to ozone and PM-related effects" (S3, Ch13, Air Pollution Health Effects). "In the absence of mitigation, ground-level ozone concentrations are projected to increase across most of the Midwest, resulting in an additional 200 to 550 premature deaths in the region per year by 2050" (S3, Ch21, Human Health, p 896).
- "The frequency of allergic illness, including asthma and hay fever, are expected to increase as a result of a changing climate" (S3, Overview, Human Health and Well-Being).
- The health risks associated with climate change are, "especially high for people who are less able to cope because characteristics like age, income, or social connectivity make them more vulnerable" (S3, Ch21, Human Health, p 896).

- "Improved basic health services and increased public health measures - including surveillance and monitoring - can prevent or reduce these impacts" (S3, Ch21 KM4).

Areas of Consideration for Oberlin Community Systems

- **Water**: Water borne pathogens, agricultural pollutants, potential to supply drinking water to adjacent communities more negatively impacted
- **Energy**: Staff absence due to worker illness
- **Jobs**: Increased risk associated with outdoor work, worker absence, healthcare costs, disease transmission among workforce and to customers
- **Emergency**: Strain on hospitals and emergency medical facilities
- **Health**: New and increased disease prevalence, new disease risks associated with outdoor recreation, disproportionate impacts on vulnerable populations
- **Food**: Potential increased use of pesticides and herbicides to protect crops, disease risks to farm workforce
- **Culture**: Alterations to cultural practices to prevent disease transmission, benefits and risks associated with greenspace and outdoor activities, necessary modifications to traditions and events

6. Severe wind

Predicted Change

- The midwest and great plains regions are expected to experience the greatest increases in thunderstorm activity in the U.S.. These storms will be concentrated in March, April, and May (S2, Ch9.3). Tornado season is starting earlier in the calendar year (S2, Ch9.3). Oberlin is deemed to be at high risk for tornados (S21).
- Scientific ambiguity remains in regards to future wind intensity in the Midwest. The Third National Climate Assessment, states that wind intensity in the Midwest will experience little change (S24, Ch2.5). However, models from a more recent study in 2020 show wind power increasing slightly in the spring and winter months (S23).

Impacts

- "High winds threaten damage to electricity transmission and distribution lines … and other structures associated with energy infrastructure and operations" (S3, Ch4, Executive Summary, KM1).
- More powerful thunderstorms can potentially lead to the failure of lifesaving equipment (S16, Table 2, p. 11).

Areas of Consideration for Oberlin Community Systems

- **Water**: Power outages resulting from severe winds may affect drinking and wastewater treatment
- **Energy**: Powerline damage and outages
- **Jobs**: Damage to businesses, power outages, disruptions to transportation
- **Emergency**: Damage to structures and people, transportation challenges associated with downed-trees, hazards of downed power lines
- **Health**: Increased power outages threaten electricity-dependent in home medical equipment
- **Food**: Crop damage
- **Culture**: Tree damage in greenspace, damage to historic sites, equity of exposure to wind hazards such as downed trees and powerline

7. Drought

Observed and Predicted change

- "Current understanding of drought in the Midwest is that human activity has not been a major component in historical droughts, and it remains uncertain how droughts will behave in the future. However, future projections show that Midwest surface soil moisture likely will transition from excessive levels in spring due to increased precipitation to insufficient levels in summer driven by higher temperatures, causing more moisture to be lost through evaporation" (S3, Ch21, Projected Trends and Agricultural Impacts).

Impacts

- The increased heat and drought stress during the tree-growing season is expected to lead to increased tree mortality and reduced tree growth in the midwest (S3, Ch21 KM2: Forestry).
- Because of historically even patterns in seasonal precipitation, irrigation is not a common agricultural practice in northeast Ohio. If drought does occur, short-term adaptive capacity is low. Longer term, water is abundant in the region.
- Oberlin receives a significant fraction of its electricity from hydroelectric plants on the Ohio River which are impacted by annual and seasonal patterns of precipitation. Drought leads to reduced hydroelectric production.

Areas of Consideration for Oberlin Community Systems

- **Water**: Large capacity of City of Oberlin reservoir which also allows pumping from the Black River selectively at times when the raw water quality is better.
- **Energy**: Energy supply from hydroelectric resources
- **Jobs**: Agricultural sector jobs
- **Emergency**: Preparation for severe weather events
- **Health**: Mental health impacts
- **Food**: Commodity agriculture, production of local fruits and vegetables, home vegetable gardens
- **Culture**: Damage and changes to trees species, climate migration to Oberlin due to our relatively abundant water sources, water conservation

Table 3. Changes in average climate predicted for Oberlin (44074 zip code) by 2030, 2050 and 2100.

Year	1950-2014	2030	2050	2100
Average Daily High Temp (°F)				
Low	60.5°F	63.5	64.5	66.5
High	60.5	64	66	72.5
Number of days per year with Maximum Temp > 90°F				
Low	10 d	30	38	50
High	10	30	47	95
Number of days per year with minimum temp < 32°F				
Low	132 d	110	105	91
High	132	110	98	62
Total annual precipitation				
Low	35.5 in	36	37	37.5
High	35.5	36.5	37	38
Number of days per year with > 1 inch precipitation				
Low	2 d	2.5	3	3
High	2	2.5	3	3.5
Total number of cooling degree days per year				
Low	755	1,020	1,200	1,410
High	765	1,070	1,350	2,450
Total number of heating degree days per year				
Low	6,200 d	5,500	5,300	4,600
High	6,200 d	5,400	4,900	3,700

Table 3 summarizes predicted changes in Oberlin based on modeling results extracted from the Climate Explorer tool (S1). The second row in each table includes the average of each climatic condition measured (not predicted) between 1950 and 2014. Climate model predictions of anticipated annual averages are then included for the years 2030, 2050 and 2100 based on higher and lower greenhouse gas emissions scenarios. The lower emission scenario assumes that global

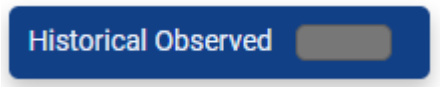
emissions of heat-trapping gases are stabilized by 2040 and then dramatically reduced. The high emissions scenario assumes that greenhouse gas emissions continue on their current trend and increase through 2100.
[a] Cooling degree days estimate how much cooling energy is needed in buildings for people to feel comfortable. Cooling degree days are calculated by subtracting 65 from each day that averages over 65°F. For example, if the average temperature for a day is 70°F, there are 5 cooling degrees for that day. The table includes the sum of all cooling degree days for a year.
[b]Heating degree days estimate how much heat energy is needed in buildings for people to feel comfortable. Heating degrees are calculated by taking the average temperature on each day that is lower than 65 and subtracting this from 65. So if the average temperature for a day is 60°F, then there are 5 heating degrees for that day. The table includes the sum of all heating degree days for each year.
[b]Growing degree days are similar in general concept to heating degree days but provide a measure of growing season length for agricultural crops. Growing degrees for a given day are calculated by averaging daily temperature on days when it is above 50 degrees and subtracting 50 from this average. Growing degree days do not consider soil moisture.

Predictive Graphs of Climate Hazards for Oberlin

Explanation: The following graphs are all extracted from [The Climate Explorer](https://crt-climate-explorer.nemac.org) (https://crt-climate-explorer.nemac.org). This tool accesses historical data and climate modeling results of models run by scientists associated with the Intergovernmental Panel on Climate Change (IPCC). Development of the Climate Explorer was directed and overseen by an interagency team of federal climate model experts, chaired by the U.S. Global Change Research Program. Federal agencies that partnered in this effort are the Environmental Protection Agency (EPA), NASA, NOAA, and the U.S. Geological Survey.

Climate Explorer uses a process known as “downscaling” to interpolate the fairly course resolution data generated by IPCC models down to a much finer regional scale that is useful for local community planning efforts. All of the visualizations below compare possible futures considering both low and higher emissions scenarios (both plausible realities). The lower emission numbers are based on model runs that assume that global emissions of heat-trapping gases are stabilized by 2040 and then dramatically reduced. The high emission numbers are based on model runs that assume that greenhouse gas emissions continue to increase through 2100. These graphs predict changes in climate specific to the 44074 area code; they are scientists’ best understanding of Oberlin’s future under lower and higher emissions scenarios. The summary information below each graph is largely drawn from the Climate Explorer website.

Notes on Interpreting the Graphs:



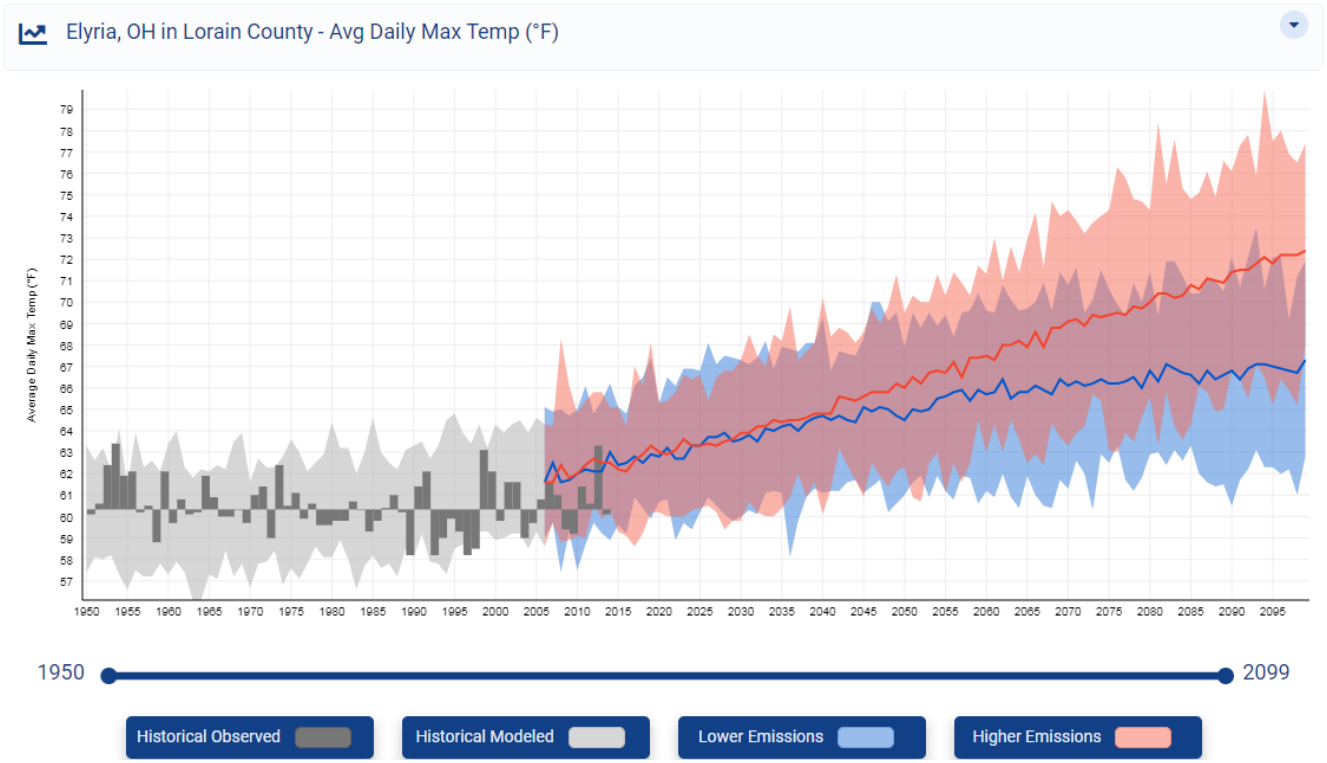
- The dark gray bars that extend to 2014 are recorded averages of measurements made in the Oberlin/Elyria area. The specific data source used is not identified, but it could be from the Lorain County Airport or other permanent weather stations in our area. Each of the bars is maximum daily temperature averaged over one entire year. The bars are shown as extending above and below the average condition from 1950 to 2014; this period essentially serves as an historic baseline condition for comparison of predicted future temperatures. The data for any given year in this baseline period may be substantially above or below the average for the baseline period. This is just normal year-to-year variability.

- The light gray area around bars for the baseline data is the output range of simulation models used by climate scientists to “predict” conditions in our area. Using models to predict or “hindcast” past

conditions for measurements is how scientists calibrate or test the climate models they create, so that they are confident about predicting the future. The upper and lower bounds of the model predictions tend to include the actual observed data. Because conditions naturally vary from year to year, it is important for the modeled predictions to include a *range* of likely possibilities rather than simply predicting an average.

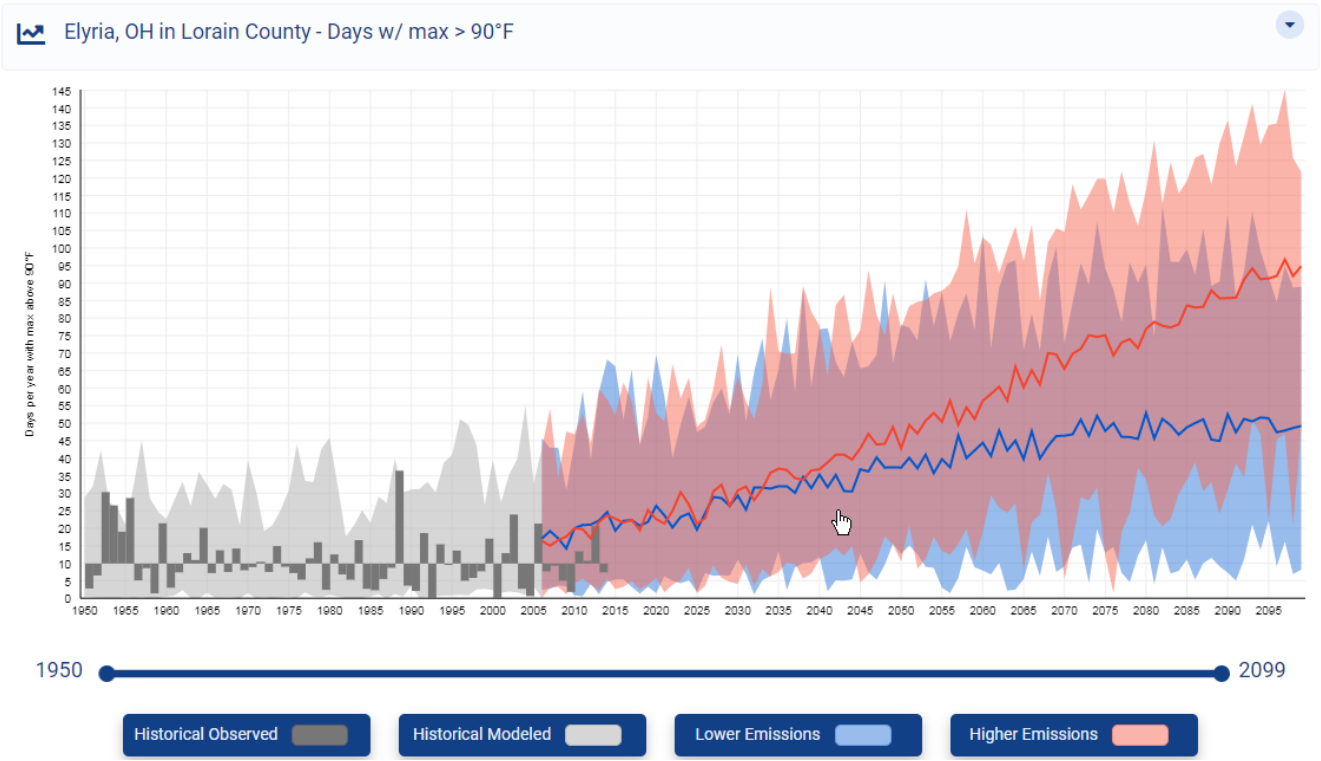
- The blue area that follows 2014 predicts the likely range of possible conditions that might be expected in Oberlin in a lower emissions future in which humanity very actively controls emissions. The top of the band represents the highest projected value among models; the bottom of the band represents the lowest projected value. The darker blue line is the average of modeling results for the low emissions scenario. Future conditions in any given year are expected to vary across the full range of projections, just as historical observed values vary about the historical median.
- The red band predicts the likely range of possible conditions expected in the future in Oberlin if humanity does a poor job of controlling emissions. The darker red line is the median of modeling results for this higher emissions scenario.
- The purplish band represents overlapping predictions that overlap between the lower and higher emissions scenarios.
- A table has also been inserted in each graph showing average conditions during the baseline reference period and then temperature maximum for 2030, 2050 and 2100 under the lower and higher emissions scenarios. In general, while the climate is changing rapidly, differences in conditions for lower and higher emissions scenarios are generally not evident until after 2030. This is because the changes that occur over the next decade are largely a result of carbon emissions that have already occurred—the climate takes time to respond to gasses already in the atmosphere. This is why adaptation planning is still vital even if mitigation plans (reductions in emissions) are highly successful.

Average Daily High Temp (°F)



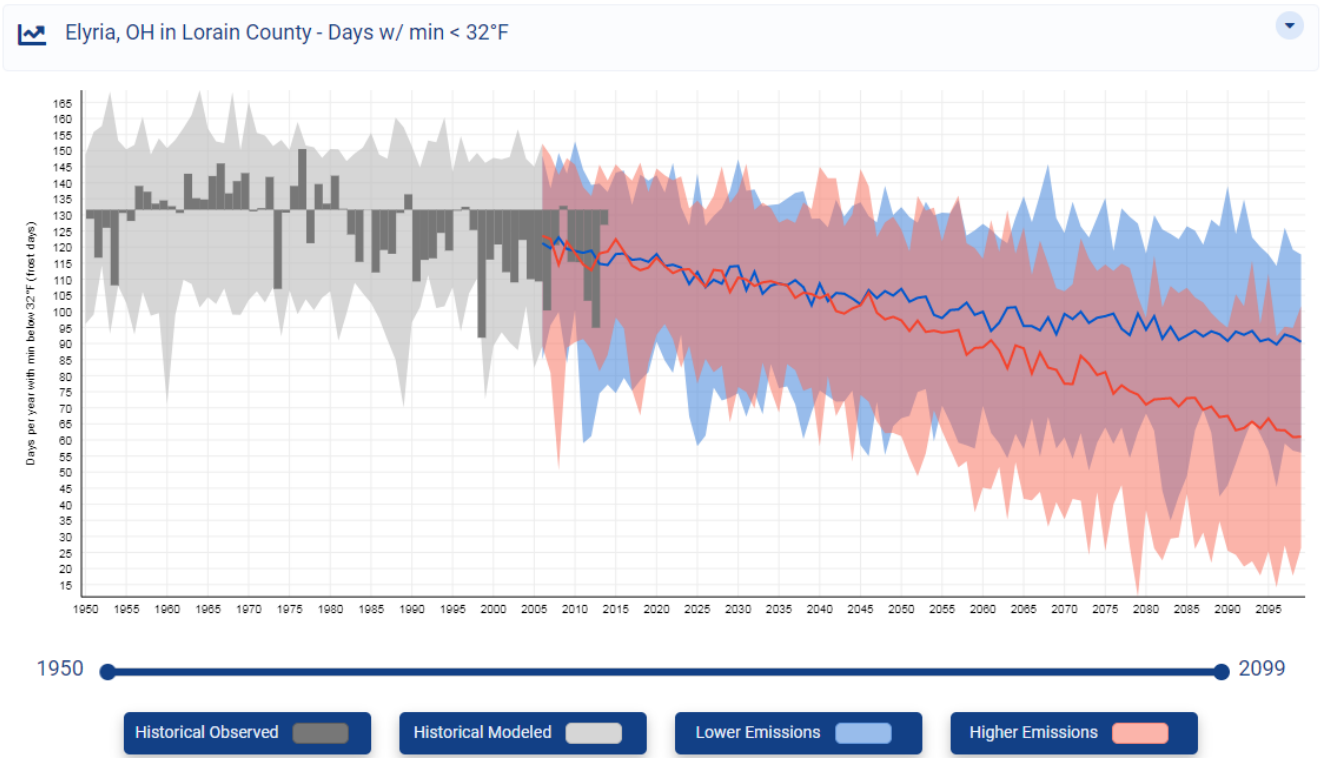
- ***What is it?*** *Daily Average Maximum or high Temperatures* in the 44074 zip code. The high temperature on any given day usually occurs in the afternoon. The way this is calculated is to record the maximum temperature on every single day of the year and then take the average of all of those measures for the year as a whole.
- ***Why is this graph important?*** The answer to that is that average high temperature serves as one measure of comfort and safety for people and for the health of plants and animals. When maximum temperature exceeds particular thresholds, people can become ill and transportation and energy infrastructure may be stressed.

Days per year with Maximum Temperature Above 90°F



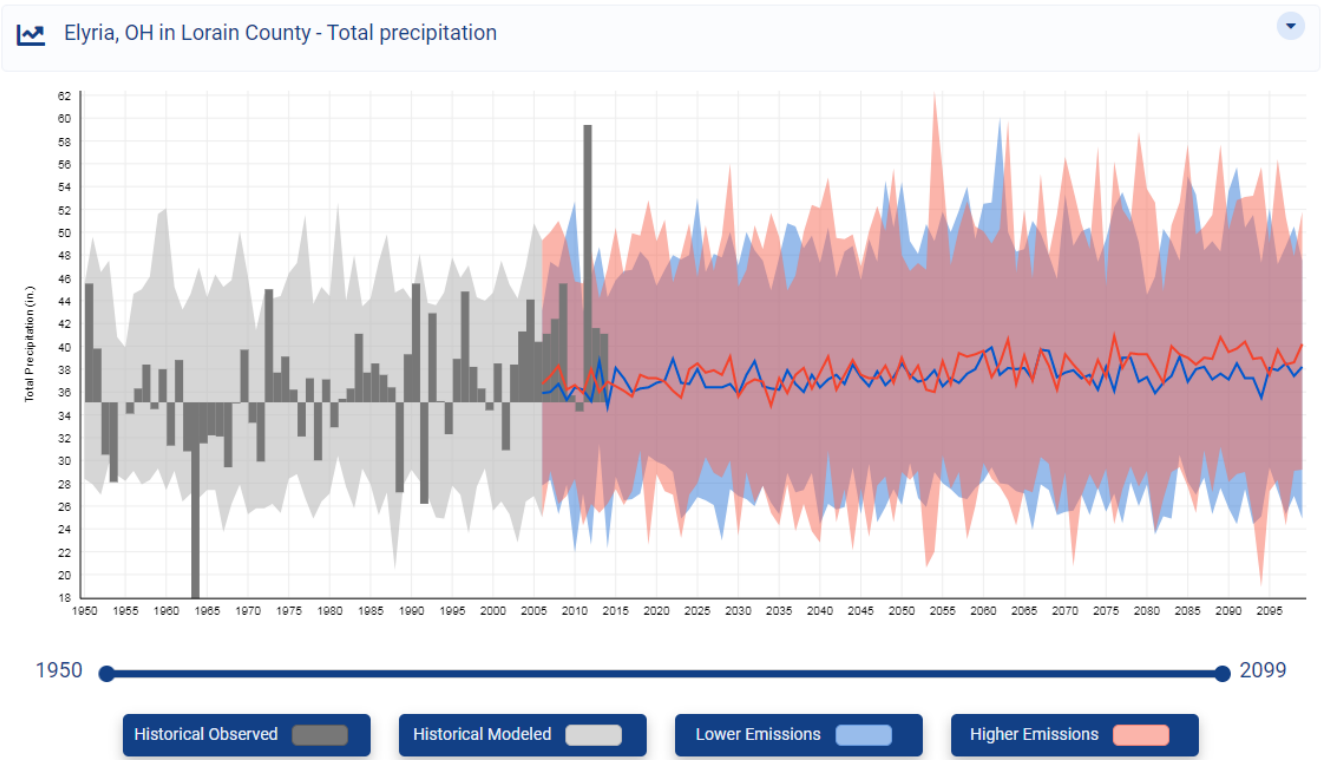
- ***What is it?*** This graph shows the count of days for each year when the high temperature exceeds 90°F.
- ***Why is it important?*** Hot days cause extreme discomfort and heat-related illness, especially if humidity is high and wind is light. Extreme heat events correspond with increased use of Emergency Services. From a psychological perspective, extreme heat can be associated with increased aggression. Like many climate hazards, certain groups are disproportionately impacted by extreme heat days -- for example people who lack access to air conditioned spaces, outdoor workers, the elderly, etc. Hot days also stress plants, animals, and infrastructure such as electric lines & roads. Increased demand for electricity to cool homes and businesses also stresses energy supply.

Days with Minimum Temperatures < 32°F



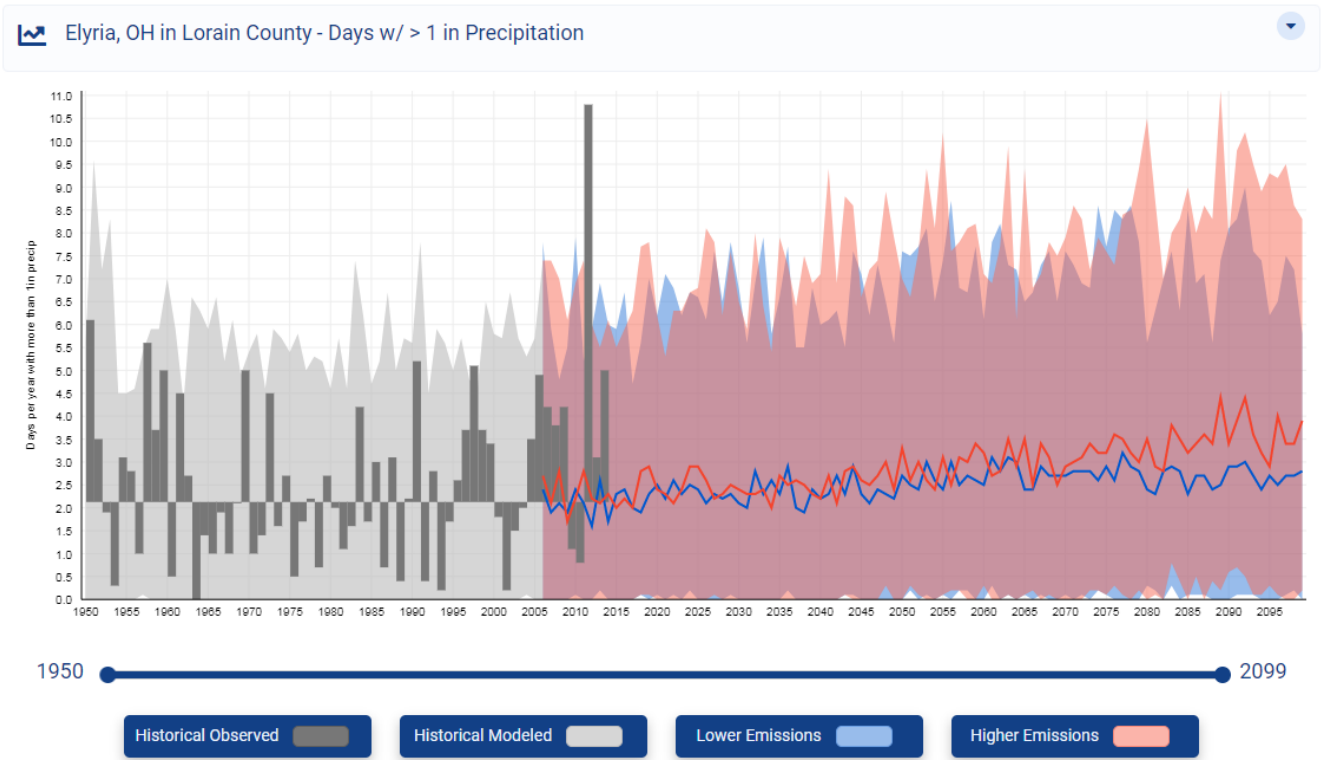
- ***What is it?*** The total number of days per year when the lowest temperature falls below 32°F is an indicator of how often cold days occur.
- ***Why is it important?*** Some plants require a cumulative number of days below freezing before they can begin budding or blooming in the spring. Fewer days below freezing also allow certain insects to overwinter, breed more easily and migrate northward, which has the potential to affect community, culture, agriculture and greenspace in a variety of ways. For example, a decrease in days below freezing can increase tick population which has the potential to affect outdoor activities as well as the spread of disease. Additionally, snow and activities associated with it are currently part of Oberlin's culture in the winter, so with less potential for snow, our community may have to find ways to adjust existing traditions and practices.

Total Annual Precipitation



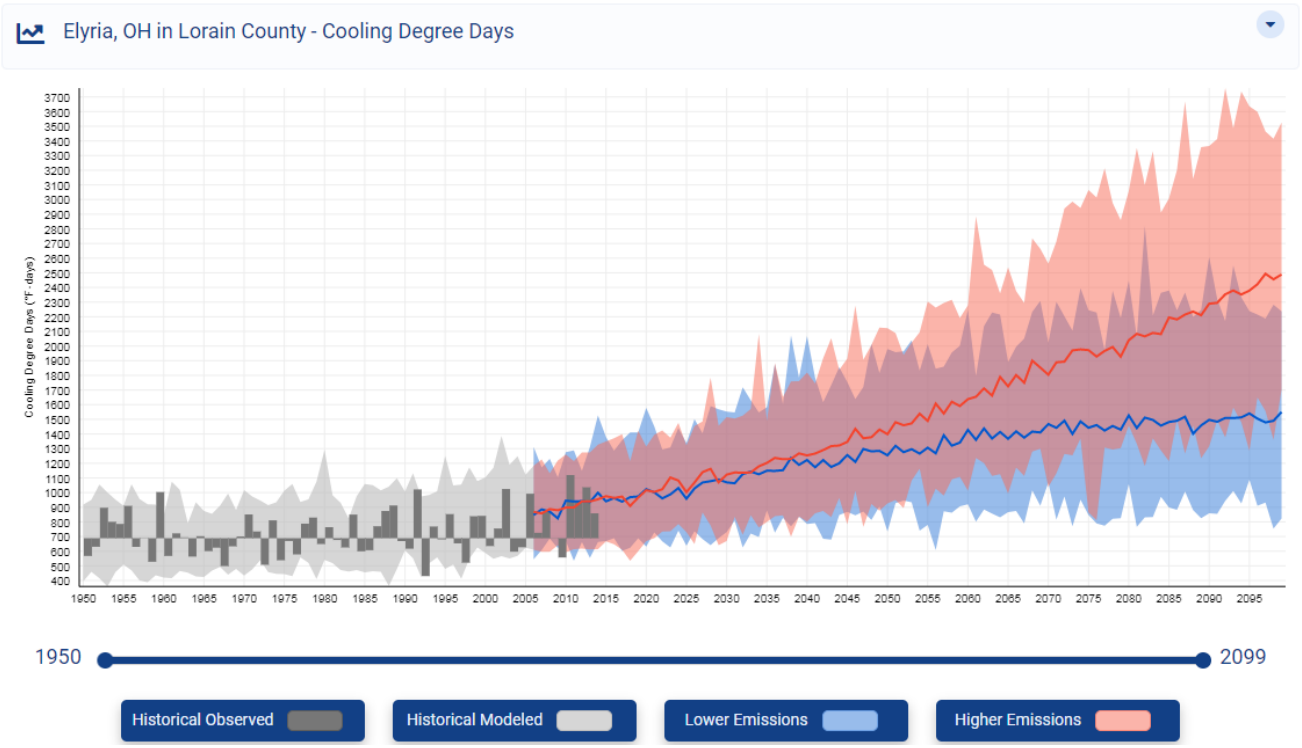
- ***What is it?*** Total amount of precipitation that occurs over each year in inches.
- ***Why is it important?*** Precipitation is obviously critical for agriculture, ecosystems and for water supply. An important reality that this graph of total annual precipitation does not show, however, is the changing seasonal distribution of precipitation; spring months are predicted to be wetter over time and summer months drier, which will likely have a negative impact on commercial agriculture.

Number of days with > 1 inch Precipitation



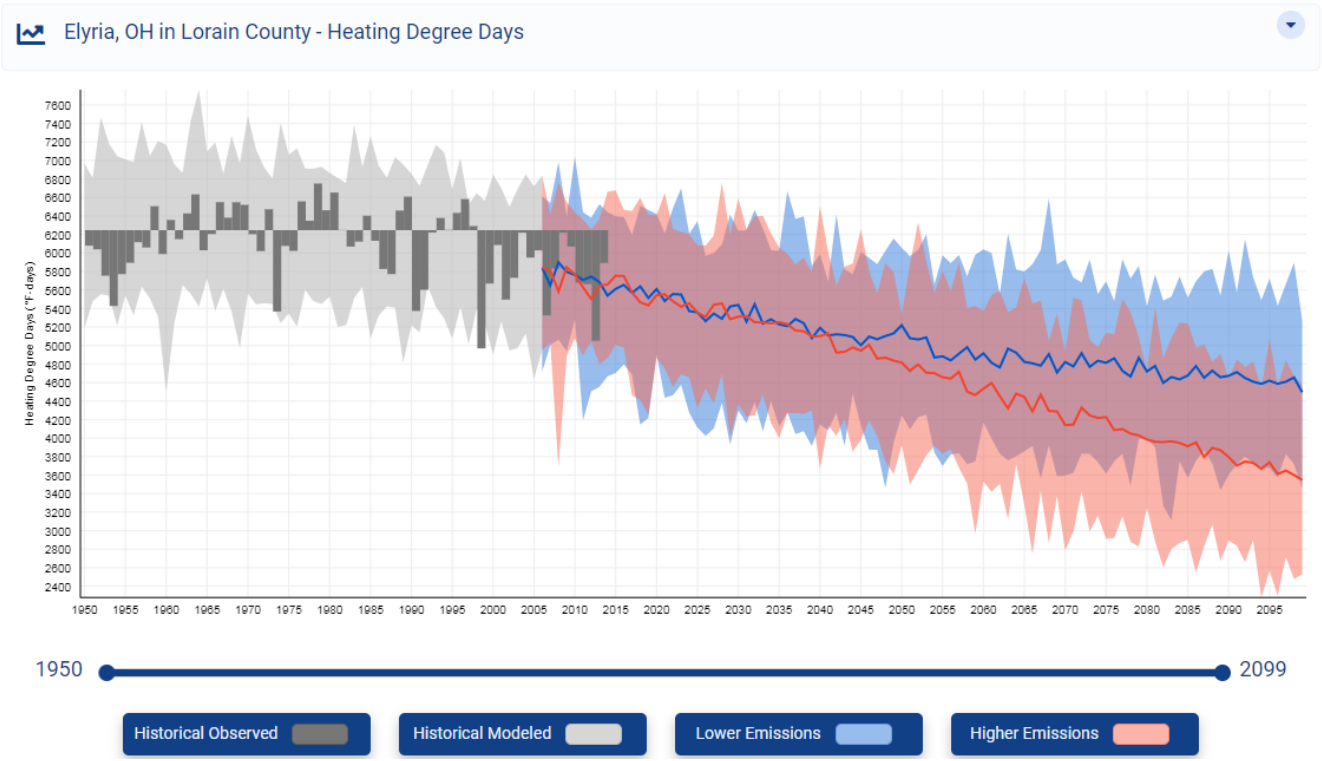
- ***What is it?*** The number of days per year when Oberlin will receive more than 1 inch of precipitation is an indicator of how often extreme flooding events may occur.
- ***Why is it important?*** As Oberlinians know, the dense clay soil and flat topography of the NE Ohio landscape makes us prone to flooding. This issue is particularly relevant to planning stormwater and other drainage infrastructure as well as to members of the community who live in the Plum Creek floodplain. Intense rain also results in soil erosion and can result in sewer overflows and associated water pollution.

Cooling Degree Days



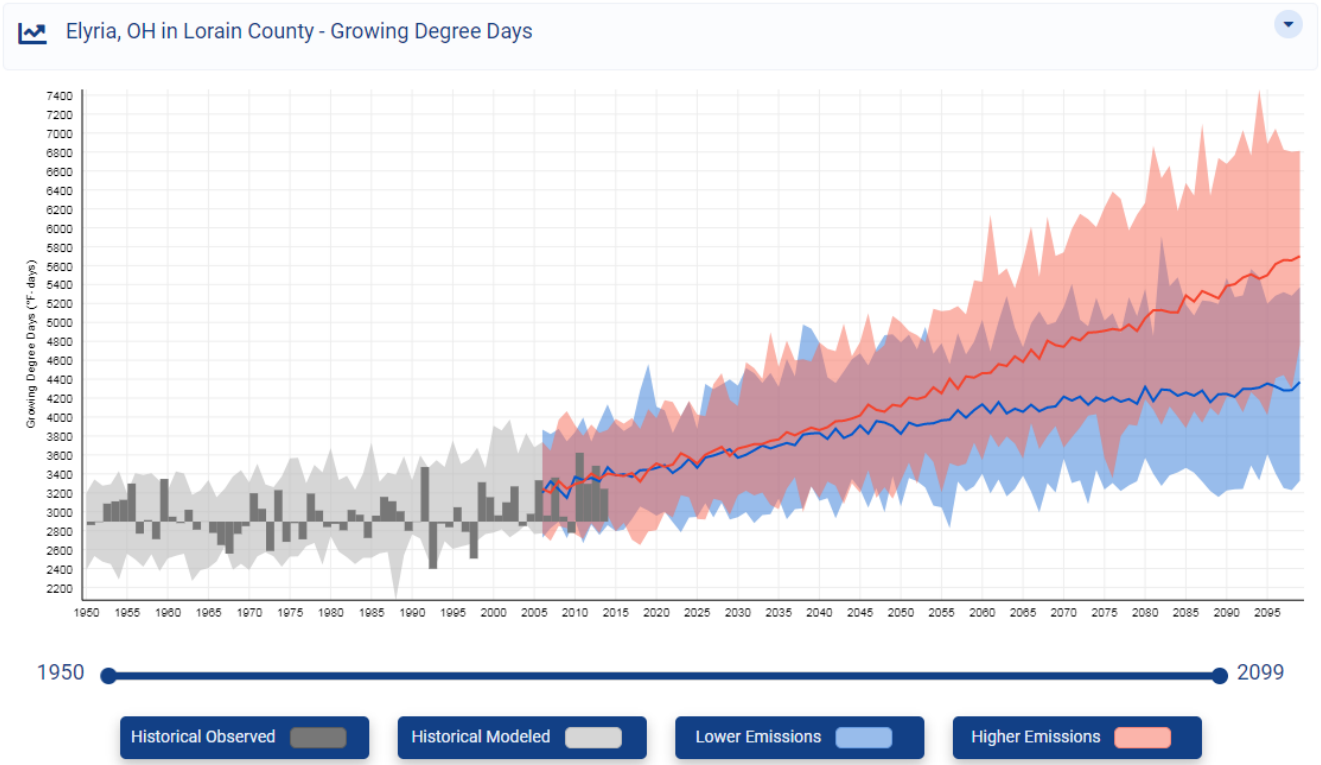
- ***What is it?*** Cooling degree days are used to estimate how much cooling energy is needed in buildings for people to feel comfortable. To calculate the cooling degrees on a given day, 65 is subtracted from average temperature for days that exceed 65°F. So if the average temperature for a day is 70, then there are 5 cooling degrees for that day. This graph adds up all the cooling degrees for a year.
- ***Why is it important?*** Cooling degrees are important because they are a measure of how much electricity will be needed to cool buildings. In Northeast Ohio total electricity demand in the summer and more importantly peak electricity demand at any given time is strongly associated with cooling needs. Building engineers and utility companies need to plan for the increase in additional electricity use needed to meet the cooling demands evident in this graph. Obviously the increased use of electricity for cooling is a financial cost that residents and businesses will need to plan for. Enhancing insulation, energy efficient building codes, shade tree planting and other measures can all potentially reduce energy use and costs.

Heating Degree Days



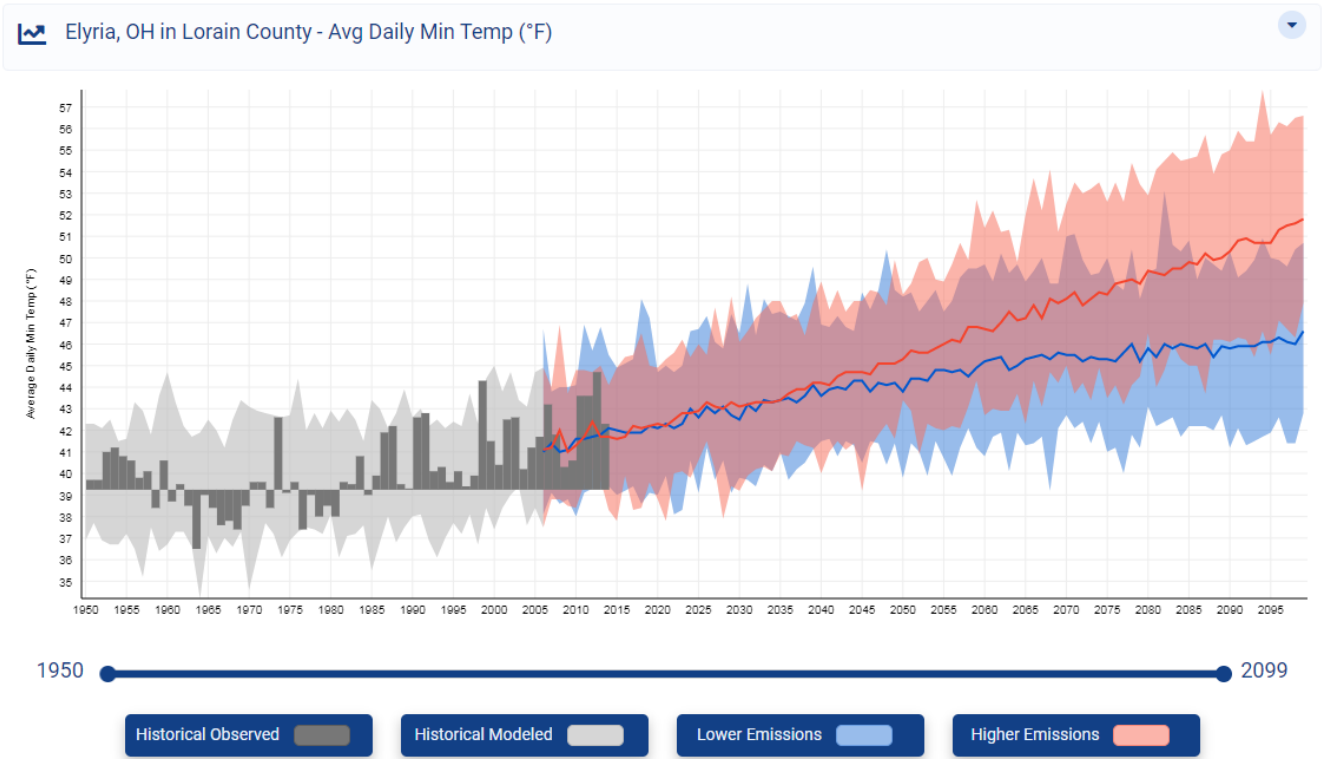
- ***What is it?*** Heating degree days are used to estimate how much heating energy is needed in winter months to keep buildings comfortable for occupants. To calculate the heating degrees on a given day, the average temperature for that day is subtracted from 65. So if the average temperature for a day is 60, then there are 5 heating degrees for that day. This graph adds up all the heating degree days for a year.
- ***Why is it important?*** Engineers and utility companies use the annual number of heating degree days as one input when estimating demand for energy in the cold season. The obvious thing to notice in this graph is a *decrease* in heating degree days. This means less energy will be needed to heat our buildings. Currently in Oberlin most homes and businesses are heated with natural gas. To meet the goal of achieving carbon neutrality, the city is encouraging consumers to shift to heating with electricity using energy-efficient heat pumps, which can also be used for air conditioning in the summer months.

Growing Degree Days



- ***What is it?*** Growing degrees for a given day are calculated by averaging daily temperature on days when it is above 50 degrees and subtracting 50 from this. Growing degree days per year have often been used to estimate the growth and development of agricultural crops.
- ***Why is it important?*** Although an increase in growing degree days is indicative of a longer and warmer summer season, plants, like people, can experience heat stress and lose more water when it is hot. In Northeast Ohio, the wetter springs that are already being experienced as a result of climate change can delay when crops can actually be planted. For example, in 2019, an excessively wet spring prevented many local corn and soybean farmers from ever planting a crop. Excessive heat in the summer can also reduce crop yield.

Average Daily Low Temperature (°F)



- ***What is it?*** A day's lowest (minimum) temperature. This typically occurs in the early morning, just before sunrise. The minimum temperature for each day of a year is averaged to produce the points on this graph
- ***Why is it important?*** Periods of low temperature give plants, animals, and people a chance to recover from daytime heat. When minimum temperatures aren't sufficiently cool, plant and animal responses can trigger ecosystem changes and increased demand for energy can stress energy infrastructure.

Glossary:

- *Adaptive capacity:* The ability of a community system to adjust to climate change, to moderate potential damages, to cope with consequences
- *Climate mitigation:* Actions a city or organization commits to and takes to reduce its contributions to greenhouse gas emissions.
- *Community system:* a term used in adaptation planning to combine groupings of related activities or services that are important to community function. ICLEI makes suggestions, but each community defines what is included within a system. For example, in Oberlin all three water systems,drinking water, wastewater and stormwater, were combined into a single group so that planning synergies could be considered.
- *Cooling degree days:* a quantity used to estimate how much cooling energy is needed in buildings for people to feel comfortable. Cooling degree days are calculated by subtracting 65 from each day that averages over 65°F. For example, if the average temperature for a day is 70°F, there are 5 cooling degrees for that day.
- *Climate adaptation plan:* A formal plan developed by organizations, departments and hole cities that formally considers how that entity will respond and plan for inevitable climate changes now underway and predicted for the future.
- *Climate hazard:* a category of climate events that is likely to impact one or more community systems.
- *Climate risk:* the impact of a particular hazard on the function of a particular community system.
- *Climate vulnerability:* The degree of susceptibility of a community system to a particular climate risk
- *Climate vulnerability assessment:* A formal process by which communities assess their degree of climate vulnerability
- *Growing degree days:* are similar in general concept to heating degree days but provide a measure of growing season length for agricultural crops. Growing degrees for a given day are calculated by averaging daily temperature on days when it is above 50°F degrees and subtracting 50°F from this average. Growing degree days do not consider soil moisture conditions that might affect when crops can be planted or the negative impacts of heat and drought conditions on plant growth.
- *Heating degree days:* estimate how much heat energy is needed in buildings for people to feel comfortable. Heating degree days are calculated by taking the average temperature on each day that is lower than 65°F and subtracting this from 65°F. So if the average temperature for a day is 60°F, then there are 5 heating degrees for that day.
- *Heat wave:* Five days in a row or longer with with maximum daily temperatures exceeding 90°F
- *ICLEI - Local Governments For Sustainability:* an international non-profit membership organization that assists cities in sustainable development and planning. Oberlin is a member and has followed ICLEI protocols and taken advantage of its consulting services and collaboration opportunities with other communities in developing its climate action plan (CAP) and its climate vulnerability assessment and adaptation plan.
- *Resilience:* The ability to resist change and/or to bounce back or “bounce forward” to a different but stable and desirable condition in response to a disturbance. The term resilience is related to the term adaptation but has been developed as a theoretical as well as a descriptive concept.

Works Cited in Oberlin Climate Hazards Fact Sheet and Other Resources

This is both an annotated bibliography and list of works cited in the Fact Sheet. Facts in the fact sheet reference the source numbers below and often also include additional information about the sections of the sources being cited. Full citations are not included here -- the electronic version of this document contains hot links to the documents and other resources cited. Additional sources that were useful in the research process but not actually cited are included as well.

S1: Climate Explorer linked here. This tool accesses historical data and climate modeling results of models run by scientists associated with the Intergovernmental Panel on Climate Change (IPCC). The site uses a process known as "downscaling" to interpolate the fairly course resolution data generated by IPCC models down to a much finer regional scale that are desirable for our local planning efforts. Many of the visualizations compare possible futures considering both low and higher emissions scenarios (both plausible realities).
Climate Explorer Data Predictions for Oberlin (Graphs and inferences) Most of our graphs and summary data for climate hazards are directly extracted from this site

S2: 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I
The Global Change Research Act of 1990 mandates that government scientists produce a report for congress every 4 years. Volume 1 (what's linked above) focuses on the state of science relating to climate change and its physical impacts with an emphasis on the implications for the U.S.

S3: 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Volume II
This second volume focuses on the *impacts* of climate change. The overview and the chapters focused on Northeast (chap 18) and Midwest (21) are particularly relevant as Oberlin is between these two zones. Note that these chapters also contain executive summaries.

S4: 2020 New Paltz NY Climate Change Report: Identifying Vulnerabilities and Taking Action. This climate vulnerability assessment and adaptation plan for New Paltz provides an example of the kind of report that might be useful for the City of Oberlin. This served as an example for Oberlin's work.

S5: 2007 Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments. This report, a collaboration with ICLEI, was produced by the a Climate Impacts Group at University of Washington. Although the group was focused on the Pacific Northwest, the document describes climate vulnerability and adaptation planning processes relevant anywhere. Information in this document is not relevant to climate hazards in Ohio, but it is nevertheless useful in providing perspective on the planning process.

S6: 2017 Community-Driven Climate Resilience Planning: A Framework. A document produced by the National Association of Climate Resilience Planners. Describes a very community-based and "community-driven" process to climate resilience planning. This document does a very nice job describing principles and best practices for making the planning process inclusive and democratic.

S7: 2018 ICLEI Climate Adaptation Plan Template. This is a template that ICLEI created to allow any ICLEI community to adapt a common format and common content in developing a climate action plan. The concept is that communities insert assessment and planning content that is specific to their own community and remove and add sections as necessary. The version linked above is a PDF version, which renders as intended in a browser. An MSWord version of this same document, which can be edited, is linked here.

S8: 2019 Climate Change Adaptation Workshops: A Planning Guide for Local Government Staff v.2. Produced by Alameda County California and intended for public agencies, this document provides a guide for planning adaptation workshops. The "core principles" on pg 6 provide some useful general guidelines. The section on "Preparing a climate impact memo" on pg 10 contains information that is relevant to preparing our fact sheet.

S9: Adaptation Clearinghouse Website - Georgetown Climate Center. This website, "seeks to assist policymakers, resource managers, academics, and others who are working to help communities adapt to climate change."

S10: 2018 Columbus, Ohio Climate Adaptation Plan. Developed by researchers from the Byrd Polar and Climate Research Center at the Ohio State University, this plan offers recommended actions for government, organizations and residents that can be taken to help Columbus and central Ohio prepare for and adapt to climate change.

S11: 2018 Green Cincinnati Plan, Ohio: Leveraging Resilience to Become a Climate Haven. The City of Cincinnati produced a report which assesses opportunities for local investments in housing and critical services for people relocating in response to climate change. The report itself does not seem to be posted on the web any longer, so the link above is to an executive summary. Cincinnati identifies itself as a future "climate haven" that may receive people relocating from more vulnerable areas impacted by climate change, like coastal areas experiencing sea-level rise and flooding.

S12: Midwestern Regional Climate Center. A cooperative program that provides information and data to explain climate and its impacts on the Midwest. This website is designed to "provide practical solutions to specific climate problems, and… to develop climate information for the Midwest on climate-sensitive issues such as agriculture, climate change, energy, the environment, human health, risk management, transportation, and water resources." Within this website, the "Climate Trends Tool" is useful for creating data visualizations related to seasonal patterns of temperature and precipitation. For example, by choosing state=Ohio, Seasonal=Spring and temperature or precipitation, you can view past and future patterns by regions within Ohio.

S13: International Labor Organization. UN agency concerned with economic and labor justice. Includes mostly non-climate related resources, but also substantial info on green jobs and likely economic and employment impacts of climate change.

S14: Weathering the Storm: Building Business Resilience to Climate Change. This report is from the Center for Climate and Energy Solutions called *Weathering the Storm.* It provides an in-depth look at the ways multi-national companies are beginning to assess and address climate change impacts. It uses a combination of case studies and analyzes the comapnies' reports to the Carbon Disclosure Project. Because multinational companies are not relevant to Oberlin, this report is not the most useful source. However, it can provide useful language for relating business strategy to changing climate and weather conditions and act as a point of comparison when discussing resiliency strategies for small businesses in Oberlin.

S15: Climate Change Preparedness and the Small Business Sector. This report is from the Small Business Majority and American Sustainable Business Council. It provides useful summary of statistics about the need for climate preparedness across a range of small business sectors. The latter half of the report uses case studies from Massachusetts, Nebraska, South Carolina, New York, and other states, where small businesses are using climate change as an opportunity to provide resilience services, like maintaining green stormwater management infrastructure or re-evaluating building design and insurance planning.

S16: Climate Resilience in Ohio: A Public Health Approach to Preparedness and Planning. This report focuses on the intersection between public health and climate change, though there is some overlap with other community systems. It was put together by the Ohio Public Health Resiliency Coalition, which was established by the Ohio Public Health Association. There is a particularly useful table on page 11, which summarizes some impacts of climate change on public health and other systems, as well as suggesting adaptation strategies for those hazards.

S17: CDC Regional Health Effects - Midwest. A concise summary of the climate-related public health concerns faced by the Midwest. It doesn't have a lot of new information (in relation to S2 and S3), but it presents its specific projections in an accessible format of key facts and easy to interpret graphics.

S18: National Weather Service Cleveland Local Weather Event Summaries. In thinking about the lack of data/climate projections for certain hazards, it might be helpful to understand past weather events and determine how our community responded to them (good adaptation, room for improvement, etc.). This resource gives information, photos, and graphics for recent and significant historic weather events in the Cleveland area. There is information on hazards including flooding, severe winds, heat/cold, and other past extreme weather events.

S19: What Climate Change Means for Ohio: EPA pdf pamphlet

S20: Town of Blacksburg, VA Climate Vulnerability Assessment, September 2020. This recently released climate vulnerability report provides another example and template for us to learn from. ICLEI also assisted with their process, but the format is distinct from the New Paltz report.

S21: Lorain County Hazard Analysis. This document was produced by the Lorain Emergency Management Agency (www.loraincounty.us/commissioners-departments/ema-homeland-security). It assesses the risks, vulnerabilities and mitigation strategies of various human induced, technological and natural disasters that might occur in Lorain County. It does not explicitly identify climate change as a causal factor that might change the frequency of natural disasters. It does, however, address many of the hazards that are predicted to increase as a result of climate change and preparation and mitigation options for these hazards. For example it explicitly addresses flooding, blizzard and snow emergencies, severe storms/hail and wind, and tornadoes in Lorain County (in which Oberlin is located).

S22: UC Davis Polar Vortex Definition This is a document describing the effects of warming in the arctic on the global trade winds and their effects on weather patterns.

S23: Impacts of Climate Change on Wind Resources Over North America Based on NA-CORDEX This document is a scientific study that uses simulations to predict the future wind changes within the United States.

S24: Climate Change in the Midwest This document is a synthesis of information within the Third National Climate Change Assessment regarding how climate change will impact the Midwest. It is outdated when compared to the Fourth Assessment, but is the most recent Climate Change Assessment that talks specifically about climate change's impact on winds rather than aggregating this information in the category of severe thunderstorms.

Community Participants with Affiliations

Heather Adelman: Co-Founder, Oberlin Food Hub, City Council member
Linda Arbogast: Sustainability Coordinator, City of Oberlin
Meisha Baker: Principal, Eastwood Elementary School
Jeff Baumann: Director, Public Works, City of Oberlin
Kat Bray: Health Education Specialist, Health Promotion & Chronic Disease Prevention, LC Health Department
Bryan Burgess: Electrician/Owner Burgess Electric LLC
Miyah Byers: Oberlin House of the Lord Fellowship Member
Rey Carrion: Facilities Manager, Kendal at Oberlin
Peter Crowley: Community Gardening Volunteer and Agroecology Advocate
Jim Eibel: Principal, Prospect Elementary
Heather Elmer: Executive Director of Chagrin River Watershed Partners
Nina Fisher: Program Director, MAD Factory
Bridget Flynn: Sustainability Manager Oberlin College
Cindy Frantz: Professor of Psychology, Oberlin College, POWER Board Member
John Gates: Farmer's Market Organizer
Mary Garvin: Professor of Biology, Oberlin College
Janet Haar: Director, Oberlin Business Partnership
David Hall: Superintendent, Oberlin City Schools
Carrie Handy: Director of Planning and Development, City of Oberlin
Robert Hanmer: Chief, Oberlin Fire Department
Liv Hanson: Food Distribution Coordinator, Oberlin Community Services
David Hill: Pastor, The First Church in Oberlin, UCC
Eboni Johnson: Outreach and Programming Librarian, Mary Church Terrell Main Library, Oberlin College
Greg Jones: Energy Advocate, POWER
Carol Lasser: Emerita Professor of History, Oberlin College
Roger Laushman: Professor of Biology, Oberlin College
Alexandra Letvin: Assistant Curator of European and American Art, Allen Memorial Art Museum
Alan Lockwood: Retired Neurologist
Gene Matthews: Board Member, POWER
Anna Kiss Mauser-Martinez: Executive Director, New Agrarian Center
Ellen Mavrich: Owner, Mavrich & Mavrich Insurance
Carl McDaniel: Emeritus Professor of Biology, Rensselaer Polytechnic Institute
Doug McMillan: Director, OMLPS
Elizabeth Meadows: City Council Member
A.G. Miller: Pastor of Oberlin House of the Lord Fellowship, Retired Religion Professor
Pete Morris: Farm Manager, George Jones Farm
Jessa New: Business Owner, Slow Train Cafe, The Local Coffee and Tea
Sharon Pearson: Mobility Manager, United Way of Greater Lorain County
Kathy Perales: Attorney
John Petersen: Professor of Environmental Studies and Biology, Oberlin College
Kate Pilacky: Associate Field Director, Western Reserve Land Conservancy
Diane Ramos: Administrative Coordinator of Communications & Human Resources, City of Oberlin

Jennifer Reeves: Stormwater Coordinator, City of Oberlin
Peter Richards: Former Director of the National Water Quality Laboratory at Heidelberg University (retired)
Liz Schultz: Executive Director, Oberlin Heritage Center
Peter Slowik : Viola Professor & Artistic Director, Credo
Brian Stubbs: Executive Director, Cleveland Water Alliance
David Snyder: Retired Licensed Clinical Counselor, POWER Board Member
Barbara Thomas: CEO, Kendal at Oberlin
Jim Ward: Paramedic, Central Lorain County Ambulance District
Ryan Warfield: Chief, Oberlin Police Department
David Whitworth: Recreation Coordinator, City of Oberlin
Char Wray: CEO, Mercy Allen Hospital
David Zelasko: Solar Consultant, Third Sun Solar