



PREPARE LOUISVILLE

Building a Climate Resilient City for All



April 2020



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EXECUTIVE SUMMARY

Prepare Louisville: Building a Climate Resilient City for All

Introduction

Louisville is already experiencing the impacts of climate change, with more extreme heat, larger storms, and record rainfall. These changes are expected to worsen in the coming decades. In order to reduce the overall magnitude of climate impacts over the long term, Louisville Metro is committed to reducing greenhouse gas emissions 80% by 2050.

But what about the impacts already being felt? Local residents are reporting flooding, heat, and health impacts. Many additional impacts are inevitable. Louisville Metro is taking a two-pronged approach to climate change: **mitigation** (reducing emissions) to reduce the magnitude of change and **adaptation** (preparing and adapting) to reduce the impacts to our community. *Prepare Louisville* is a plan to help the whole community adapt to change.

Louisville's Changing Climate

Louisville has already warmed 2° F since the historical period 1961-90¹. The region has experienced 12 additional days per year above 90° F, 9% more precipitation, and 25% less snowfall. The 3 wettest days on record have all occurred in the last decade.

If global emissions continue at current levels, the Metro region's average temperatures are expected to

warm by 4-7° F by the middle of this century (2040-2069) and 7-12° F towards the end of the century (2070-2099). If emissions are substantially reduced, warming could level off.²

Climate Equity

While climate change affects everyone in the community, it impacts some residents far more than others. Climate change exacerbates many existing stressors related to health, income, housing quality and availability, and hazardous materials exposure. *Prepare Louisville* addresses climate impacts to the entire community, with additional attention to reducing existing stressors and investing in those who have been historically marginalized.

Louisville's Climate Vulnerabilities

Every person, resource, and sector of the community will be affected by climate change. Some are more vulnerable than others based on current stressors and/or exposure to direct and indirect climate impacts. Some of Louisville's identified vulnerabilities include:

- Increasing respiratory and heart disease from heat and ozone exposure
- Mental health impacts associated with extreme events

- Overburdened capacity of health care and emergency response systems
- Increasing flood damage
- Heightened hazardous materials exposure from industry, due to floods
- Stormwater and energy infrastructure at risk from storms and heat waves
- Increasing costs of insurance, energy, and other business expenses
- Higher rates of crime and domestic violence with extreme events
- Loss of native species, ecosystems, and ecosystem function (e.g. water filtration and retention)

Climate Resilience Strategies

Louisville’s government, residents, businesses, non-profits, faith groups, and others are working collaboratively to create community resilience in the face of climate change. *Prepare Louisville* provides concrete actions that can be taken to adapt to the changes ahead. *Prepare Louisville* provides a roadmap to creating:

Equitable Neighborhoods

Louisville’s neighborhoods each have a history and character of their own. Historical legacies continue to affect well-being of residents today. Climate resilience objectives for neighborhoods include:

- Create cooler neighborhoods with greater tree canopy
- Invest without displacement
- Promote environmental justice
- Cohesively address health, sustainability, preparedness, and affordability

Some specific actions include:

- ▶ Increasing tree canopy
- ▶ Funding public cooling centers, pools and drinking fountains
- ▶ Promoting energy efficiency upgrades that benefit lower income residents
- ▶ Increasing access to green spaces
- ▶ Developing resilience hubs for neighborhoods



In addition to the changes already being experienced, by the middle of this century, Louisville can expect:

UP TO
14°F
HOTTER
summer days

Approximately
42 more days
per year above
100° F

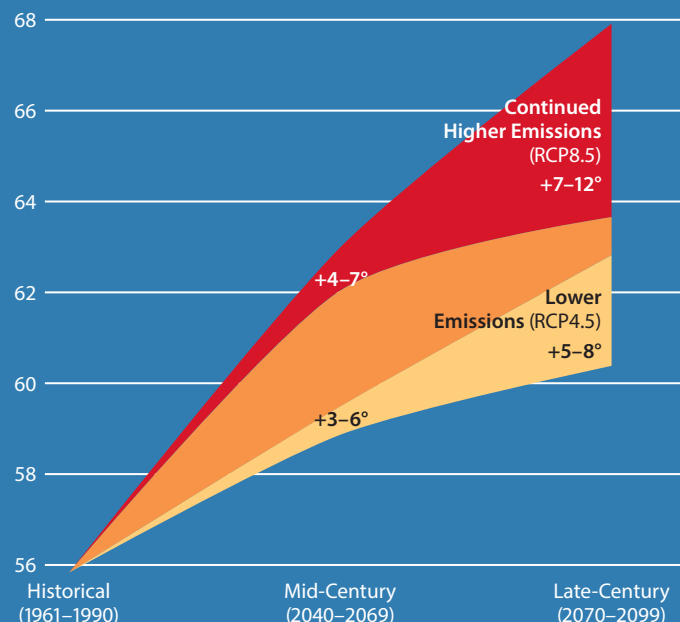
More ground level ozone

▲ More drought stress

2-3 times
more frequent large-scale flooding



Degrees (F)



Healthy Residents

Climate change affects the mental and physical health of all residents, especially our more vulnerable and disadvantaged residents. Climate resilience objectives to protect peoples' health include:

- Protect people from air pollution
- Reduce pollutants and contaminants in waterways
- Improve access to healthy food
- Monitor and reduce harmful pests and disease
- Increase access to health care

Some specific actions include:

- ▶ Increase real-time air quality monitoring
- ▶ Expand weatherization programs
- ▶ Prepare industry for extreme conditions
- ▶ Connect food delivery services to lower-income residents
- ▶ Enhance mobile health clinics

Natural Capital

Nature is vital to the quality of life of local residents. Natural capital is the value of nature including inherent biological value, recreational value, and functional value such as pollinators or water filtration. Climate resilience objectives to buffer Louisville's natural capital include:

- Increase tree canopy cover
- Increase natural vegetation, habitats, and biodiversity
- Enhance ecosystem functions, such as water filtration, flood abatement, and pollination

Some specific actions include:

- ▶ Supporting tree planting, maintenance and protection efforts
- ▶ Increasing green space in new developments
- ▶ Reducing unsafe herbicide and pesticide use
- ▶ Planting with greater species diversity
- ▶ Increasing green infrastructure for flood and stormwater management

Sustainable Businesses

Louisville's business growth over the last decade is impressive but at risk as climate impacts increase and the city/state/national/global economy recovers from the Covid-19 pandemic. More extreme conditions, disruptions to the workforce, and higher costs could impact Louisville's businesses and industries. Climate resilience objectives for local businesses focus on:

- Increasing business sustainability
- Supporting green jobs and living wages

Some specific actions include:

- ▶ Providing incentives for green and sustainable practices
- ▶ Rewarding conservation efforts with lower utility rates
- ▶ Improving emergency preparedness of local businesses and industry
- ▶ Training and skill building for green jobs and living wages
- ▶ Evolving economic strengths to align with global economy
- ▶ Diversifying the economy

Resilient Infrastructure

Larger storms and hotter temperatures create stressors to Louisville's energy, water, and transportation infrastructure. Homes and other buildings are also impacted. In order to reduce these stressors, *Prepare Louisville* identified four primary objectives:

- Scale up stormwater management
- Fund efficient, affordable transportation
- Update zoning for sustainability and resilience
- Protect homes and businesses from more extreme conditions

Some key actions include:

- ▶ Reducing impervious surfaces
- ▶ Supporting more accessible public transportation
- ▶ Expanding rideshare and HOV options
- ▶ Creating condensed housing with green spaces
- ▶ Reducing development in flood-prone areas

Community Readiness

Louisville already experiences its share of extreme events and natural disasters. With projections for more frequent and severe events and greater variability, ensuring that all community members are prepared is vital. Primary objectives related to readiness include:

- Re-evaluate and substantially expand emergency response planning
- Identify and protect those most at risk from climate impacts
- Improve technology and tools.

Some specific actions include:

- ▶ Continue to map hazardous materials/flood risk
- ▶ Developing and disseminating neighborhood disaster plans
- ▶ Conducting climate risk assessments of critical infrastructure
- ▶ Identifying vulnerable groups and ensuring support during emergencies
- ▶ Expanding tools for streamlining travel during emergencies
- ▶ Ensuring equitable access to technology

Louisville Leads

Louisville has an opportunity to lead on many issues related to climate resilience. Working within government and applying new strategies across the community, Louisville Metro Government is taking bold and innovative action to address climate change. Primary objectives include:

- Take the lead in reducing greenhouse gas emissions as a mid-sized, fossil fuel dependent, city
- Lead by example
- Update policy
- Conduct education and outreach

Specific actions include:

- ▶ Fully implementing Louisville's Emissions Reduction Plan
- ▶ Work with the state to make renewable energy more affordable and accessible
- ▶ Making all city events and meetings zero waste and carbon neutral
- ▶ Demonstrating day-to-day sustainability in operations
- ▶ Incorporating climate action goals into every LMG policy and decision
- ▶ Conducting outreach on resilience measures community wide

Looking Ahead

Prepare Louisville goes hand-in-hand with Louisville's Greenhouse Gas Emissions Reduction Plan, which together will minimize Louisville's contribution to climate change and increase resilience to extreme weather events and other climate impacts. These plans fulfill the commitment made four years ago today through the Global Covenant of Mayors for Louisville to uphold the Paris Agreement by reducing emissions 80 percent by 2050 and take steps to protect community members and businesses from changing climate conditions.

As Louisville Metro works to implement both plans, progress will require extensive collaboration

throughout the community. The Office of Advanced Planning and Sustainability will lead on implementation of the plans and be developing a citizen's advisory panel to ensure ongoing community input and participation in climate action.

Creating resilience and preparedness will require changes at every level, including households, school districts, industries, and government. Metro Louisville Government is committed to partnering and collaborating with Louisville's residents, businesses, and organizations in new and innovative ways.

Investing in the future of our community — especially our young people — means shifting to clean energy to prevent the overall magnitude of climate change impacts.

It also means taking crucial steps to protect our most at-risk community members from impacts that are already underway.



Participants at strategy design session

ACKNOWLEDGEMENTS

This report is the product of a year-long process led by Louisville Metro Government's Office of Advanced Planning & Sustainability and a Climate Adaptation Strategy Team of key stakeholders in the community. With appreciation and gratitude for their time and expertise, we expressly thank:



OFFICE OF
**ADVANCED PLANNING
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A Division of Develop Louisville

Office of Advanced Planning & Sustainability

Julie Donna, Sustainability Specialist, Project Manager for *Prepare Louisville*
Natalie Vezina, Sustainability Coordinator
Allison Smith, Brownfields Program Manager and Community Engagement Strategist
Gretchen Milliken, Director of Advanced Planning & Sustainability



Strategy Team

Betty Adkins, Louisville Metro Office of Performance Improvement & Innovation	Nick Hart, Louisville Metro Public Health & Wellness
Rebecca Cash, Louisville Gas & Electric	Andrew Gray, Jefferson County Public Schools
Hannah Crepps, Center for Neighborhoods	Mark Jeziorski, Louisville Metro Emergency Management Agency
Sarah Lynn Cunningham, Louisville Climate Action Network	Michelle King, Louisville Metro Air Pollution Control District
James Graham, Louisville Metro Public Works	Dave Marchal, Louisville Metro Develop Louisville
Gordon Garner, Center for Neighborhoods	Jeff O'Brien, Louisville Metro Develop Louisville
Arnita Gadson, NAACP Kentucky	Marc Thomas, Metropolitan Sewer District
Angela Graham, Louisville Metro Public Health & Wellness	Ray Yeager, University of Louisville Envirome Institute

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Climate Change Mitigation (n.)

Reducing greenhouse gas emissions to reduce the overall magnitude of climate change over many decades

Climate Change Adaptation (n.)

Anticipating the adverse effects of climate change and taking appropriate action to prevent or minimize the damage

Resilience (n.)

The capacity to recover quickly from difficulty

Mitigation efforts are detailed in Louisville’s Emissions Reduction Plan. *Prepare Louisville* (this plan) identifies climate impacts and vulnerabilities throughout the community, so we can prevent and minimize their damage. This plan outlines new approaches to **adapt** and build **resilience** to extreme events while creating opportunities for every community member to prosper and flourish in a future very different from today.

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Ohio river in Louisville/The Pug Father

Louisville

A compassionate city committed to climate action

In 2011, Louisville committed to a compassionate city campaign. This campaign was promoted to champion and nurture the growth of compassion across the community. Compassion comes through finding common ground and increasing both empathy and understanding among all people. Compassion is a unifying force, born out of a shared purpose and principle that fosters volunteering, mentoring, beautification, and restoration.

Why is compassion so important in the face of climate change? Climate impacts are not evenly distributed. Community members who lack adequate housing, financial resources, strong social networks or with health and mobility challenges are more at risk to the impacts of a changing climate such as heat waves and worsening air quality.

Louisville's Compassionate City Campaign has already formed broad alliances focused on serving and empowering local residents. Action on climate change will require that these alliances are strengthened and expanded, in order to support those facing climate impacts.

INTRODUCTION

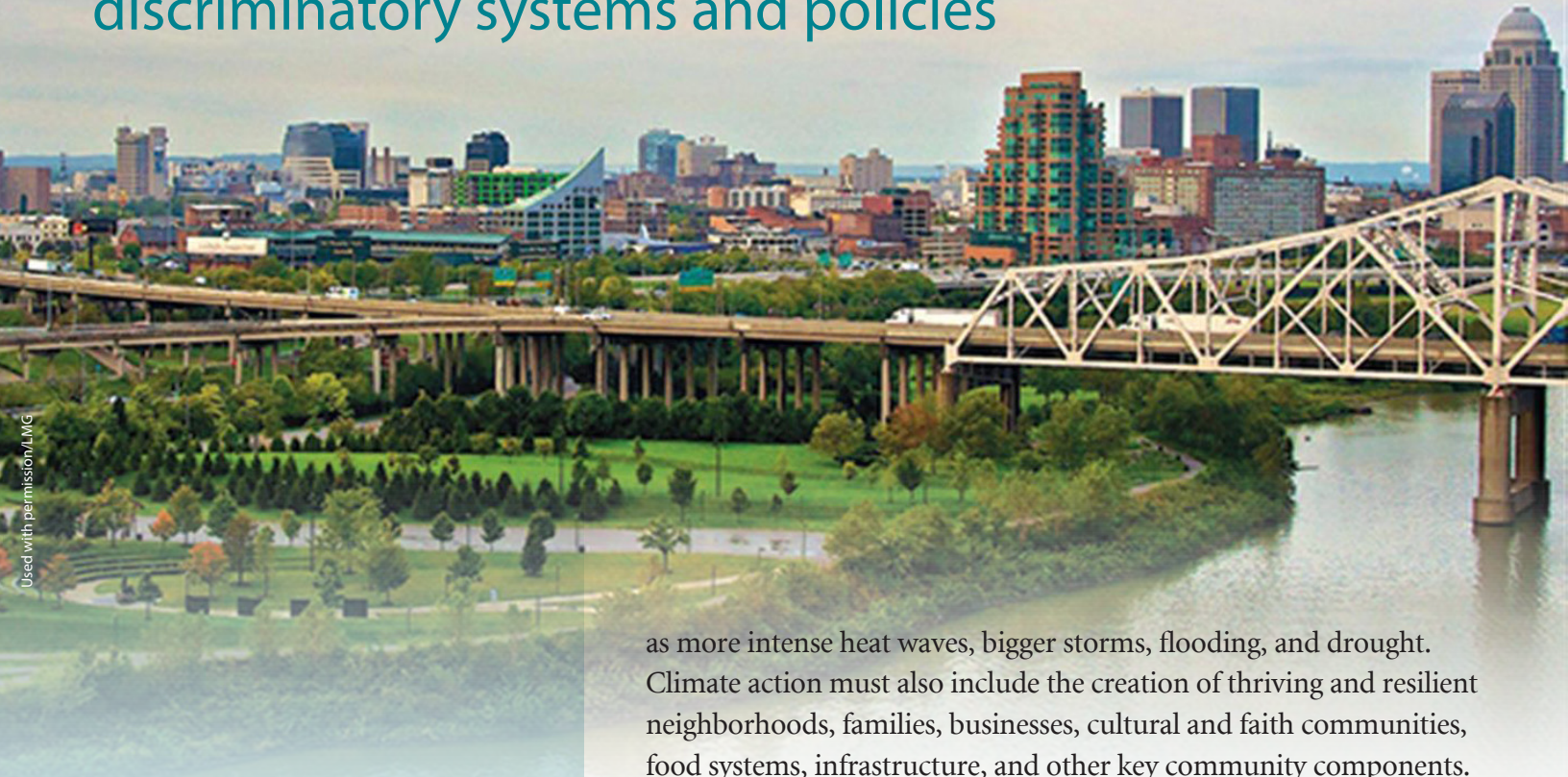
Louisville is already experiencing the impacts of climate change with more extreme heat, storms, and flooding. Louisville Metro Government (LMG) is stepping up to the challenge by taking concrete action that protects and benefits people today as well as future generations.

Reducing greenhouse gas emissions is critical to avoid locking-in more extreme climate impacts. That's why in April 2020, Louisville Metro completed a new *Greenhouse Gas Emissions Reduction Plan* (ERP) outlining actions to cut greenhouse gas emissions driving climate disruption 80 percent by 2050. This goal is in keeping with commitments made by 9,000 cities around the world participating in the Global Covenant of Mayors.

Efforts to cut greenhouse gas emissions must go hand-in-hand with action to prepare for changes to the climate that are already taking place. That's why Louisville Metro launched *Prepare Louisville* to determine the risks climate change poses and the steps that can be taken to increase resilience as outlined in this plan.

A more resilient community will be better able to withstand and bounce back from extreme events such

Louisville has an opportunity to lead on healing divisiveness, increasing equity, and dismantling discriminatory systems and policies



Climate action in Louisville creates:

- Green jobs and living wages
- Neighborhood networks and support
- Cross-cultural and interracial understanding
- Investment in underserved areas
- Opportunities to be active and healthy
- More efficient and healthier homes
- Preparedness for extreme events
- Cleaner air, waterways and parks
- Improved ecosystem health
- Greater biological diversity
- Environmental and social awareness

as more intense heat waves, bigger storms, flooding, and drought. Climate action must also include the creation of thriving and resilient neighborhoods, families, businesses, cultural and faith communities, food systems, infrastructure, and other key community components.

Preparing for climate change is not an easy task — it requires action by every member of the community, as well as government, businesses, organizations, and others. The threat of climate change also presents us with opportunities. Louisville is in a position to harness its innovation, compassion, diversity, and strong community networks to make serious and systemic change. By prioritizing green jobs, living wages, clean technology, healthy parks and waterways and social equity and justice, the *Prepare Louisville* plan aims to benefit all community members and protect future generations.

The *Prepare Louisville* plan is the culmination of an intensive and highly participatory process. The process included extensive participation by the community, with people representing many different sectors, including health care, neighborhood associations, transportation, business, government, emergency preparedness and response, non-profit organizations, environmental groups, industry, and others. A similarly diverse steering committee was tasked with ensuring that all strategies were designed to advance equity and protect those most at-risk from climate impacts.



FORGING A PATH FORWARD

In 2020, Louisville is committing to substantial and effective climate action on two fronts — reducing our greenhouse gas emissions (climate change “mitigation”) and protecting people and resources from the impacts already in motion (climate change “adaptation”). These actions will protect current and future generations from increasingly severe impacts, such as heat waves, larger storms, flooding, loss of natural resources, and declining air and water quality.

With rich history as one of the oldest cities west of the Appalachians, Louisville merged with Jefferson County to form Louisville Metro in 2003. Louisville Metro (“Louisville”) bustles with local businesses, a diverse population, and thriving tourism industry centered around historical sites including the

While the most catastrophic climate impacts can and must be avoided by reducing emissions, many others are already underway. Louisville is taking a two-pronged approach to climate change — MITIGATION to reduce the overall magnitude and ADAPTATION to protect people and resources from impacts.

birthplace of Muhammad Ali, the Kentucky Derby and a rich food, bourbon, art and museum scene.

Prepare Louisville is Louisville’s plan to reduce climate-related risk to both people and nature. Strategies and actions presented in this plan are designed to protect community members most at risk while building resilience across all people, businesses, and natural resources throughout the community.



82% of survey respondents are noticing more extreme weather events

Covering almost 400 sq. miles, the Louisville Metro area is already experiencing climate impacts like larger and more intense storms and longer, more extreme heat waves. Strategies and actions developed for this report can be applied at all scales, including individuals, neighborhoods, businesses, organizations, and government.

Climate change is a global phenomenon that affects each community in unique ways. The types and magnitude of climate impacts, and vulnerability of local residents, businesses, and resources all depend on local factors. Louisville has many strengths that help to make it resilient, but also has historical legacies that make many populations or resources more vulnerable than others. For example, those who are already marginalized are often most affected by health impacts associated with worsening heat, floods, and ozone. These populations also have the fewest resources to prepare for and/or recover from extreme events.

Even though the climate has warmed less in the southeastern U.S. than the rest of the nation, residents of Louisville are already feeling the impacts of climate change. Louisville is facing unique climate changes due to our rapidly growing urban heat island and location in the Ohio River Valley. This plan will help guide LMG and its residents in reducing risks to health, safety, business, infrastructure, water, and other natural resources.

Whole Community Adaptation

Climate change affects everyone and everything in our communities at the same time. As people implement new strategies to adapt to climate change, some could have unintended consequences. Close coordination and communication are needed to prevent redundancy or conflicting actions. We all need to work together to ensure all of Louisville are protected.



ADDRESSING THE PAST TO CREATE AN EQUITABLE FUTURE

Climate change affects everything and everyone. Preparing Louisville for the impacts of climate change demands significant investment in time and resources from across the community. New, bold, and adaptable approaches to how we live, move, and manage vital resources are needed. This plan provides strategies for all of Louisville.

Strategies not actively addressing historical discrimination will actively worsen it. Many existing systems of power maintain discrimination in our societies. Climate actions for the future must actively dismantle these past systems of power, including those that discriminate and/or oppress people based on race, language, gender, LGBTQ+ status, disability, health condition, age, income, and other factors.

What is Climate Equity? Climate Equity means removing obstacles to climate resilience such as

discrimination, poverty and their consequences. This includes addressing historic and current systems of power that have disadvantaged communities and groups of people, to ensure the benefits of climate actions are available to those most vulnerable.

Not all individuals have contributed equally to climate change. Not all individuals experience the same burdens of climate change or have the same ability to protect themselves from its impacts. Thus, environmental justice is a critical component to address climate impacts.

Dismantling these systems of power requires that historically marginalized groups play a central role leading and implementing climate solutions and benefit from investments. Resilience for those most at risk from the impacts of climate change strengthens the community as a whole.



Equitable climate action must:

- 1 **Empower** Louisville's residents
- 2 **Prioritize investment** in disadvantaged groups
- 3 **Reduce stressors** to vulnerable populations
- 4 **Engage** disadvantaged groups in decision making

CLIMATE ACTION TIMELINE

August 2003

Partnership for a Green City established between LMG, Jefferson County Public Schools (JCPS), Jefferson Community and Technical College (JCTC), and the University of Louisville (UofL)

April 2005

Mayor Jerry Abramson signed the U.S. Mayor's Climate Protection Agreement

November 2008

Louisville Metro Air Pollution Control District released the city's first Greenhouse Gas Inventory

April 2009

Partnership for a Green City published Climate Action Report

January 2012

Mayor Greg Fischer created the Louisville Metro Office of Sustainability

January 2009

A freezing rain storm doused Louisville, leaving over 200,000 people and 69 schools without power for 10 days

September 2008

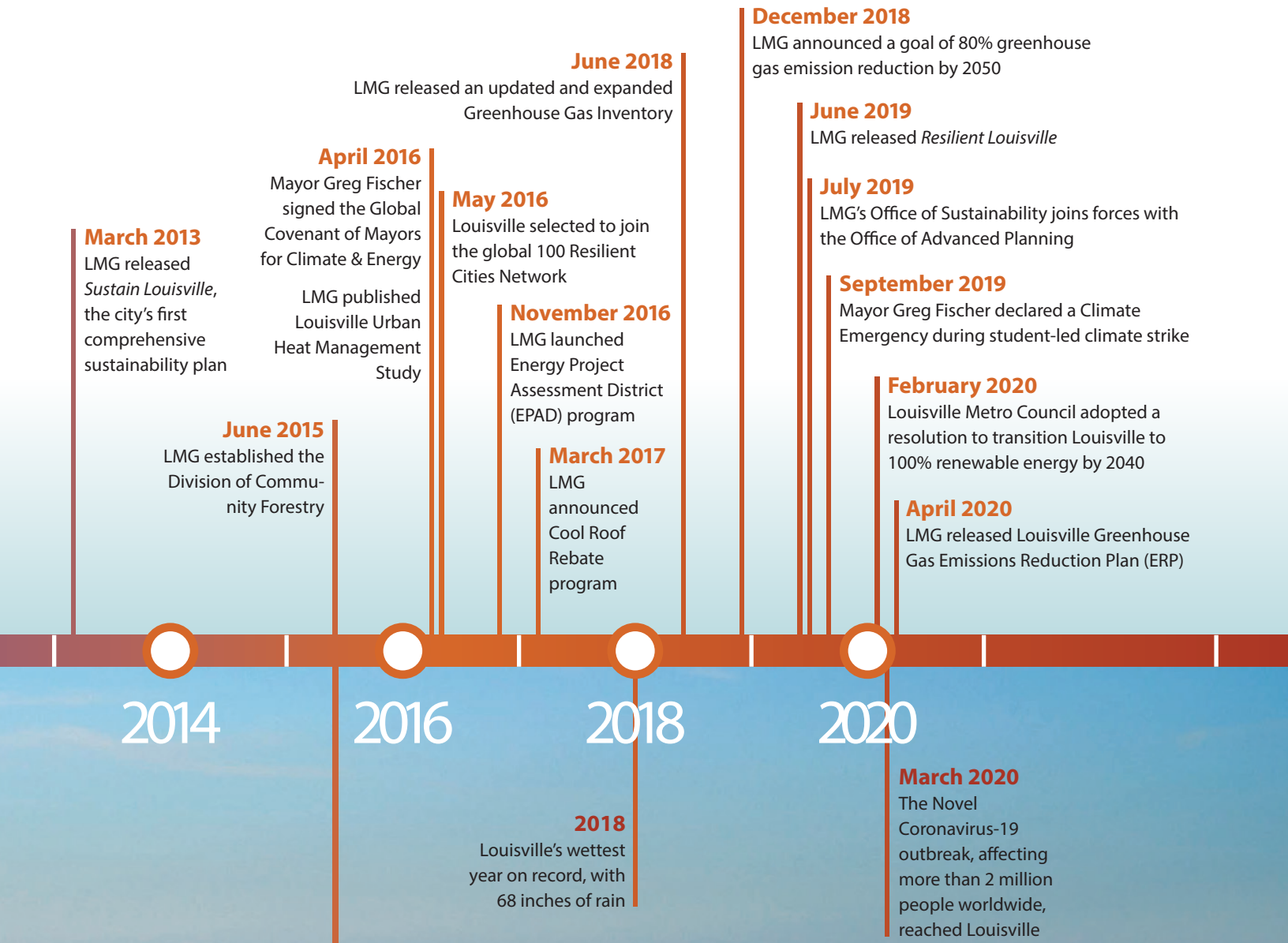
Hurricane Ike tore through Louisville, leaving over 300,000 people without power

Summer 2010

Louisville experienced its hottest summer on record

MAJOR EVENTS







L & N Bridge/lasebub_Drew

LOUISVILLE'S CHANGING CLIMATE

What's up with the weather in Louisville? Sometimes, it seems like the rain just won't stop. Other times, there are record-breaking dry spells. Long-term residents aren't just imagining it — conditions really are different than they used to be.

These changing climate conditions affect all aspects of life. Yet existing approaches for building

infrastructure, providing health care, responding to emergencies, managing natural resources and other essential functions of running the city rely on an outdated assumption: a stable, historical climate.

Rather than look to the past, we must rely on the best available science to make sound decisions for the future.³ Instead of a maximum temperature of

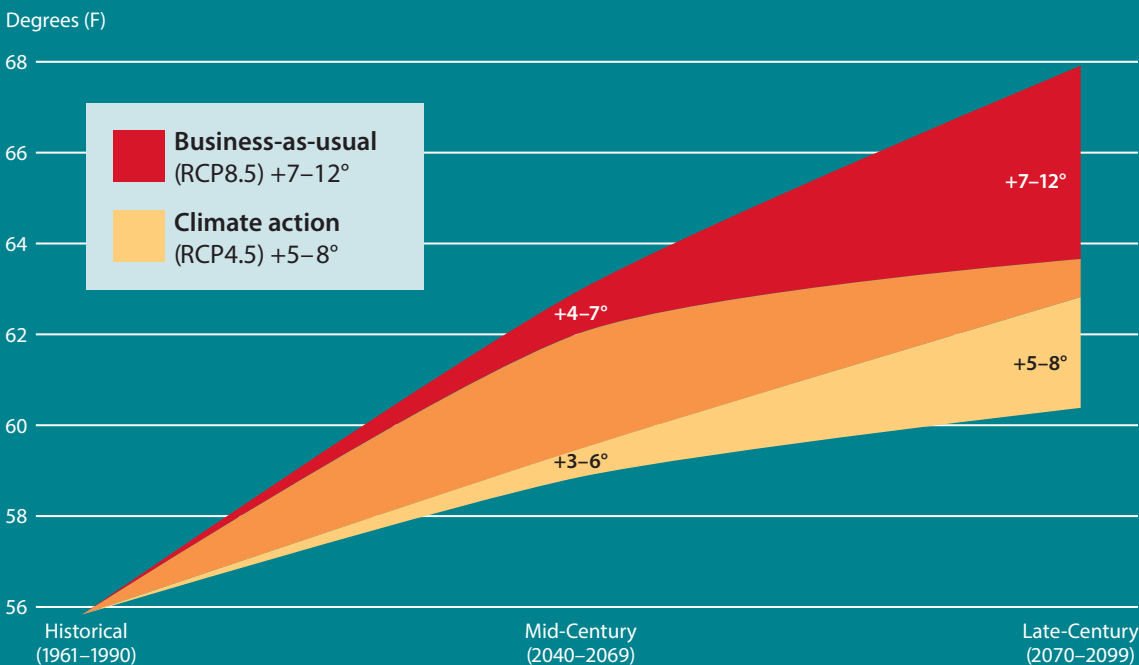


Figure 1 Continued warming is expected through the middle of this century. Future warming depends on whether or not the global community reduces emissions drastically within the next decade. If emissions are reduced quickly and aggressively, warming in Louisville may be limited to 5-8° F.

Did you know Louisville's climate has already changed?

When compared to the historical period (1961-90*):

Louisville's average temperature is 2° F warmer

The minimum temperature is 6° F warmer

Precipitation has increased by 9%

There is 25% less snowfall

The 3 wettest days occurred in the last decade

* Because weather varies day-to-day and year-to-year, average climate is generally measured over a period of 30 years. The period of 1961-1990 is often used to represent the "historical" climate as a baseline from which to measure change.

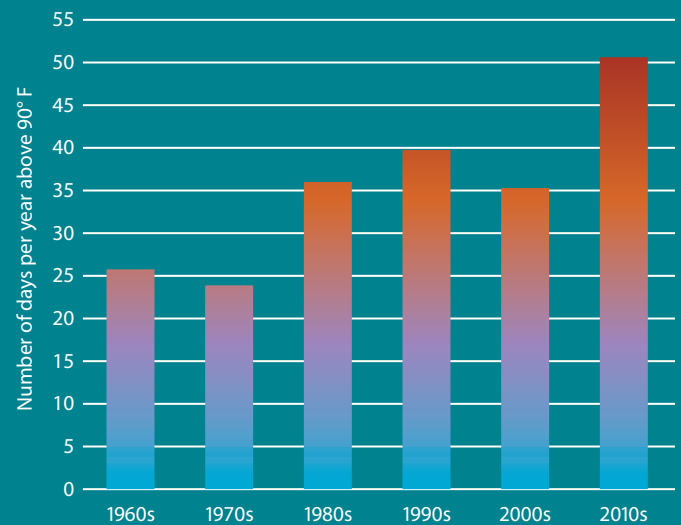


Figure 2 The average number of days per year above 90° F has doubled in Louisville (data from the Louisville Airport weather station).

102° F, for example, the health department needs to plan for maximum temperatures closer to 113° F by the middle of this century, with more than a month of extreme heat each year. The Louisville Jefferson

County Metropolitan Sewer District (MSD) will need to prepare for even larger floods occurring more frequently than they did in the past.

What can we expect in the future?^{4,5}

Compared to the historical period (1961-1990)...

By the middle of this century (2040-69), Louisville could experience:

5°-8° F warmer average temperature

Up to 14° F hotter summer days

Approximately 42 more days/yr. above 100° F

Additional ground-level ozone

Increased drought stress

By the end of this century (2070-99), if emissions are unabated, Louisville could experience:

7°-12° F warmer average temperature

Up to 20° F hotter summer days

Approximately 74 more days/yr. above 100° F

More ground-level ozone

Increased drought stress

2-3 times more frequent large-scale floods





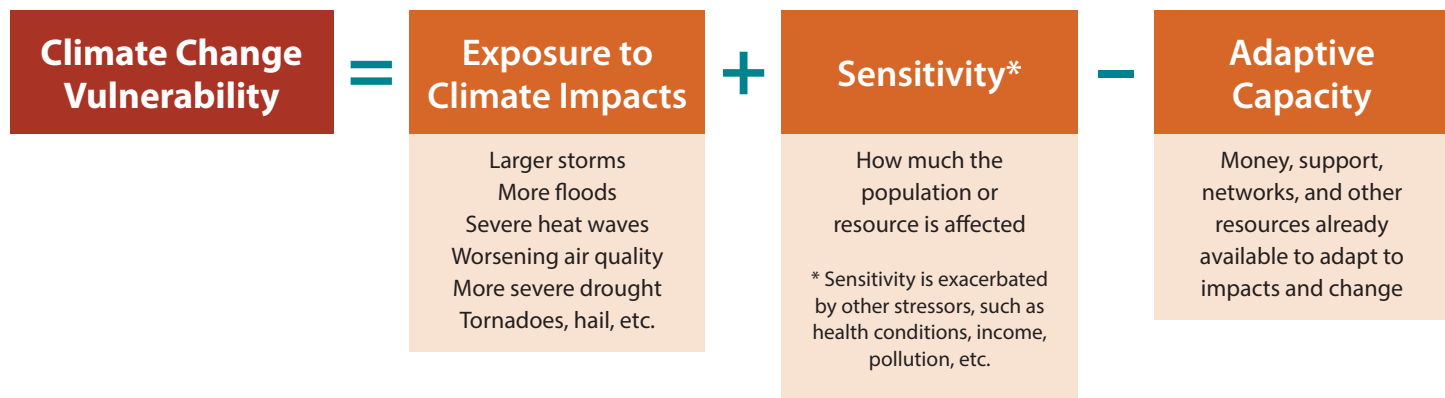
Health impacts associated with heat, ozone formation, and extreme events are expected to reduce productivity, increase risk, and increase missed days of work among outdoor workers

WHO IS MOST VULNERABLE TO CLIMATE IMPACTS?

While climate impacts affect every person, structure, business, natural resource, and organization in Louisville, some are impacted far more than others. Through extensive work with Louisville stakeholders and experts, the following populations and resources were identified as especially at-risk to climate impacts.



The Color Run Louisville 2012 /The Pug Father



Health

Heat waves, heat-induced ozone and floods impact public health. Floods can lead to exposure to hazardous materials while electrical outages can affect medically-sensitive individuals. Community members with existing health conditions and/or limited mobility; outdoor, emergency response and health care workers; people experiencing homelessness; those with limited English; and children and older adults are most at risk.

Business

The cost of doing business is rising due to disruptions in transportation, increasing energy costs and insurance rates, and recurring disasters. Heat waves could increasingly ground airplanes, affecting air cargo, business travel, and tourism. Health impacts associated with heat, ozone formation, and extreme events are expected to reduce worker productivity and increase missed days of work.

Infrastructure

Louisville's infrastructure varies in its susceptibility to climate impacts such as storms and flooding. Aging sewer infrastructure, congested transportation routes, and local dams are highly vulnerable. Inefficient homes and buildings, which includes most of the structures in Louisville, are at risk from extreme weather conditions and those occupying such buildings are more likely to face higher energy costs unless steps are taken to weatherize and increase energy efficiency. Stormwater and energy infrastructure are also threatened by extreme events.

Local Values and Culture

Louisville's neighborhoods are the core of its values and cultural diversity and ensuring their resilience is critical. At the same time, a legacy of discriminatory policies continues to cause tension around race, income, and gentrification which could be exacerbated by climate impacts. Additional climate stressors



Louisville Flood of 2006 / laserbutb_Drew

56% of survey respondents said they were affected by extreme rain and flooding

to already marginalized neighborhoods could include higher energy and housing prices, surges in violence and crime during extreme weather events, increasing homelessness and food insecurity and limited transportation options.

Natural Systems

Trees, parks, waterways, wild spaces, yards and gardens provide invaluable benefits to Louisville's residents. Wetlands naturally purify water and reduce flood risks to neighborhoods. Natural systems create cooler temperatures, provide recreational opportunities, and support biodiversity and wildlife, which have significant benefits to the mental health and well-being of Louisville's residents. Natural systems are also highly sensitive to climate impacts such as heatwaves, drought, storms, harmful pests and disease. Many species found in the area today will likely become extinct as their preferred climate disappears, leading to degraded natural areas and a loss of essential functions unless action is taken.



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STRATEGIES TO PREPARE FOR CHANGE

The following sections provide an overview of the ways that each key component of the community can become prepared and resilient in the face of advancing climate impacts. Many of the goals, strategies, and actions within the *Prepare Louisville* plan provide co-benefits, thereby strengthening the community as a whole by addressing not only climate change but many other stressors.


Areas where Louisville Metro Government can lead through direct governmental action are highlighted throughout the plan. To achieve success, actions outlined in *Prepare Louisville* must also be implemented by residents, businesses, neighborhoods, nonprofit organizations, houses of faith, schools, and others.


Prepare Louisville is organized into seven goals to help the Louisville Metro region thrive now and into the future. Within each goal is a suite of primary objectives and specific actions to begin to address them.


Prepare Louisville is a plan to create...


- Equitable Neighborhoods
- Healthy Residents
- Natural Capital
- Sustainable Businesses
- Resilient Infrastructure
- Community Readiness
- Louisville Leadership

Climate actions that help to address other important community values are highlighted throughout the plan.

 = Enhances environmental health and biological diversity

 = Supports efforts to reduce greenhouse gas emissions (mitigation)

 = Helps to build equity for historically marginalized groups

 = Cross-sector action addresses many different types of needs across the community

EQUITABLE NEIGHBORHOODS

Louisville’s neighborhoods each have a history and character of their own. Some of the oldest border the Ohio River, demonstrating the historic importance of river transport. As Louisville grew, neighborhoods such as Butchertown, Phoenix Hill and Russell developed further from the river. After the Civil War, freed slaves settled in Smoketown, Park DuValle, Griffytown, and others. Early suburbs, such as Old Louisville, Beechmont, and the Highlands, developed as transportation became available. As the suburbs expanded in the 1960’s and 1970’s, many urban neighborhoods began to decline, spurred on by the discriminatory and systemic practices of redlining and urban renewal. Residents of these neighborhoods had to rely on themselves to maintain the identity and integrity of their communities, creating a need for improved planning and preservation tactics.

Building equitable neighborhoods is a key objective in building climate resilience. Historical legacies of slavery and redlining have led to significant racial and wealth disparities (Fig. 3) among the neighborhoods of Louisville. Discrimination, disinvestment, and gentrification continue today. Climate change threatens to worsen existing tensions and inequities.⁶ That’s why addressing the historical legacy of pollution in



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Shelby Park Trees

Canopy cover in the Shelby Park neighborhood has declined to 19%. In response, the Shelby Park neighborhood association decided to plant 500 trees in 5 years. They met their goal in 2019! They worked with Louisville Grows, which partners with community and neighborhood groups to empower people who care about their neighborhood with the tools and knowledge to plant and maintain trees. Louisville Grows has also partnered with Portland, Germantown, Shawnee, Schnitzelburg, Russell, Phoenix Hill, Beechmont, Park Duvalle, and California neighborhoods.

Louisville and reducing income and wealth inequality are integral to preparing for climate change by creating climate equity.

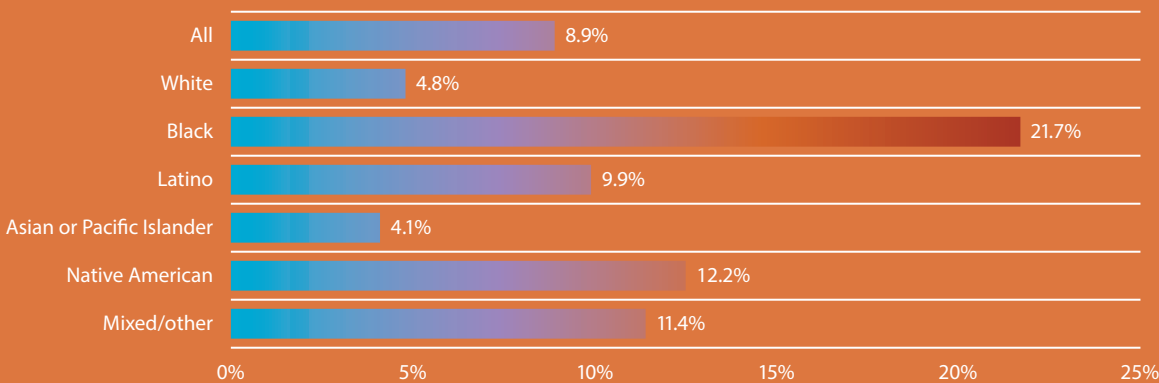


Figure 3 Percent of each racial group living in high-poverty neighborhoods in 2015 in Louisville.

From U.S. Census Bureau
GeoLytics, Inc.



Economic Inequity – Louisville’s predominantly African-American neighborhoods hold significantly less wealth than their White counterparts.⁷ Addressing income and wealth inequality is integral to creating climate equity. Economic resources are part of what determines whether or not individuals and households are able to adapt and recover from climate change impacts.

Heat Island Effects – The effects of urban heat are also unevenly distributed. Less tree canopy cover and more heat-trapping surfaces in lower-income neighborhoods lead to higher temperatures and more ozone. People who live or work outdoors are especially susceptible to heat-related illnesses and mortality.

Pollution – Addressing the historical legacy of pollution in our city also will help to address issues of

environmental and social justice. Floods and heat can worsen exposure to air pollution and contaminated soils and waterways. Lower-income households in Louisville are more likely to be exposed. Residents of neighborhoods bordering heavy industry are highly susceptible to exposure with extreme events, especially flooding.

Climate Resilience Objectives

1. **Create cooler neighborhoods**
2. **Invest without displacement**
3. **Promote environmental justice**
4. **Cohesively address inequity, health, affordability, sustainability, and preparedness**

KEY FACTS

\$560 million

the value of Louisville’s trees in stormwater interception, temperature moderation, energy savings, property values, air quality improvement, and carbon storage⁸

47 days

– the projected average number of days/yr. with a heat index above 100° F by the middle of the century, if emissions are not reduced. The number would increase to 79 days, on average, by the end of the century.

35 days

– the average number of days per year above 100° F if greenhouse gas emissions are drastically reduced, leveling off by the middle of the century

Over 800,000 ft²

the area of cool roof material that has been installed through the Cool Roof Rebate Program

45%

the recommended 40-year target for canopy cover as outlined in the Urban Tree Canopy Assessment⁹



OBJECTIVE 1:

Create Cooler Neighborhoods

Keeping people cool as temperatures continue to rise will be one of Louisville’s greatest challenges. Studies project approximately 47 days each year above 100° F by the middle of this century and summers 7°-17° F warmer towards the end of the century.

Urban heat can be significantly higher than surrounding rural areas due to the replacement of natural vegetation with heat-storing surfaces, loss of shade, and energy use. A 2016 Urban Heat Management study¹⁰ recommended specific actions to reduce localized temperatures (see box). Additional actions to reduce heat impacts include the following:

Actions

- Target tree canopy efforts (see Natural Capital section) in high-heat neighborhoods 🔄🌿🌳🍷
- Organize and coordinate community communication systems for efficient response 🔄
- Provide shelter at public places such as bus stops, parks, etc. 🍷
- Reduce non-permeable and heat-absorbing surfaces (e.g., de-paving unneeded parking lots, brownfield sites, etc.)
- Increase availability and access of community cooling centers, (e.g., public pools, spray grounds, etc.) 🔄🍷
- Install public drinking fountains in areas of high vulnerability 🍷
- Create heat stress action plan that accounts for climate change projections
- Explore cooling opportunities via Louisville’s natural aquifer 🌳

Support and/or Expand Existing Efforts

- Continue to support local non-profits dedicated to increasing tree canopy 🔄
- Continue funding for existing Metro programs like “Cool Roofs” and the Division of Community Forestry 🌿🌳
- Implement the recommendations identified in *Louisville Urban Heat Management Study* 🌳

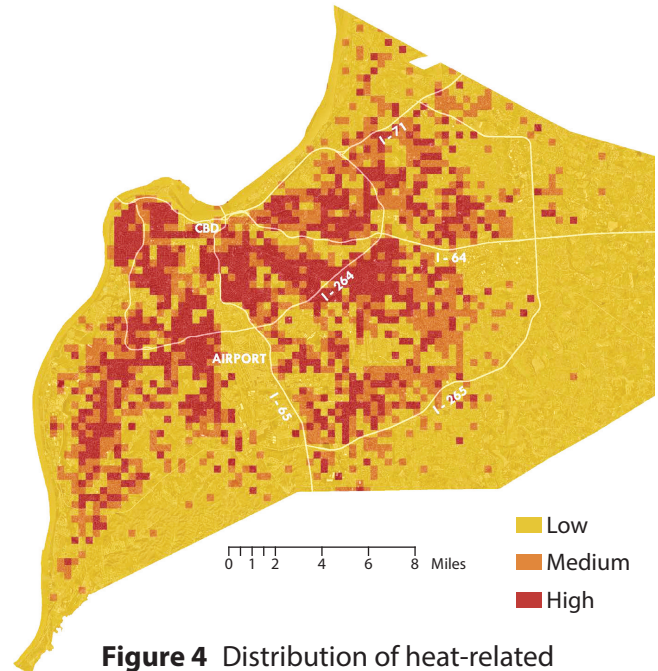


Figure 4 Distribution of heat-related deaths during May-Sept. 2012. Map from the *Louisville Urban Heat Management Study* 2016, conducted by the Urban Climate Lab of Georgia Institute of Technology.

The **Louisville Urban Heat Management Study** identified recommendations for managing Louisville’s rising heat risk. Key recommendations included:

1. Use cool materials for building in areas with limited opportunities for vegetation enhancement.
2. Tree planting and other vegetation in residential zones.
3. Expand energy efficiency programs
4. Heat management strategies should be undertaken in every zone targeted for heat adaptation planning.
5. New regulatory and economic incentive programs to bring about land cover changes and increased energy efficiency outcomes.



OBJECTIVE 2:

Invest without Displacement

Many of Louisville’s historically disadvantaged neighborhoods are prime candidates for investment in home sustainability upgrades, parks, public transportation, and job development. However, this can lead to gentrification due to increasing property values, which is a main contributor to displacement and homelessness.

Efforts including generational wealth-building, increased home ownership, and opportunities for entrepreneurship are critical to the sustainability of neighborhoods. Efforts must ensure that people at the lowest income levels are benefitting from localized investment and opportunities. Louisville’s west end is especially at risk for involuntary displacement.

Actions

- Partner with non-profit organizations to create a community land trust to provide permanent affordable housing and increase home ownership in historically disinvested neighborhoods 🏡
- Tax moratorium for long-term residents, targeted for lower-income neighborhoods 🏡
- Home efficiency loans for owners of rental properties with an agreement to not raise rents 🏡 🔄

Support and/or Expand Existing Efforts

- Increase funding for Louisville Affordable Housing Trust Fund, ensuring that housing is developed sustainably and equitably 🏡
- Increase grant availability for home repair and upgrades in environmentally and economically vulnerable areas 🏡 🔄
- LMG expands advocacy for low-income and sustainable housing 🏡

Projects Plan Responsible Revitalization

Four areas in Louisville have plans to revitalize while avoiding displacement. These include Woodlawn Ave., the south fork of Beargrass Creek, the 18th Street corridor, and East Portland.

Members of a national urban design planning organization worked to construct a development plan for each neighborhood. They held workshops to identify what the local residents wanted to see in their revitalized neighborhoods. The Center for Neighborhoods is sponsoring the Woodlawn project and other projects are being implemented by nonprofits, neighborhood associations, and city agencies.

Some of the features in the plans include:

- “complete streets” for cars, cyclists, and pedestrians
- developing neighborhood identity
- beautification through landscaping and art
- safer intersections
- improved waterways and recreational access
- markets and community gathering spaces

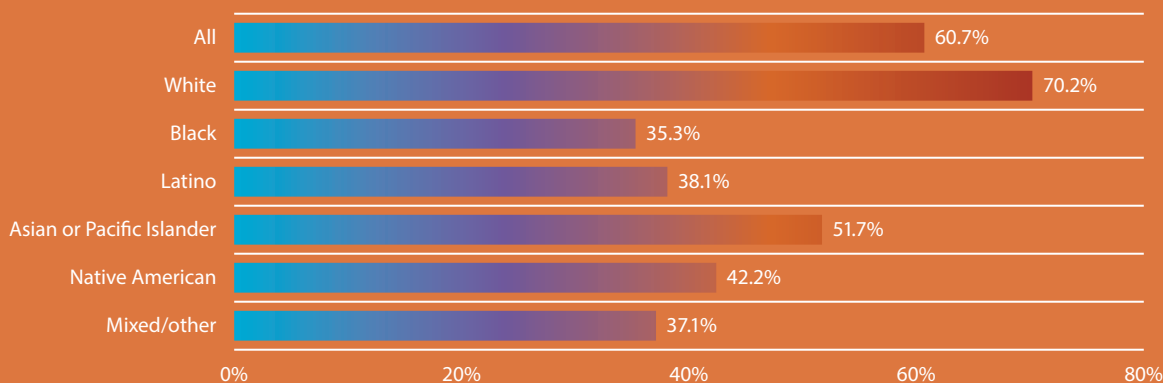


Figure 5 The racial disparity in percent of owner-occupied residences in Louisville.

From U.S. Census Bureau Geolytics, Inc.

OBJECTIVE 3:

Promote Environmental Justice

Promoting environmental justice in Louisville requires focused efforts to shift many different areas of government decision-making. Municipal zoning, land-use decisions, public health codes, and enforcement all need to incorporate environmental justice principles into planning and day-to-day operations.

Environmental justice (EJ) exists when:

1. Environmental hazards, such as pollution or toxins, are eliminated and/or evenly distributed
2. Environmental laws and standards are applied and enforced with equal rigor in all communities
3. Environmental benefits and resources are equitably distributed
4. Decision-making power is free from discrimination or bias

Actions

- Investigate establishing “green zones” in more polluted, economically burdened neighborhoods by addressing the overall environmental and economic health of the community 🔄 🌿 ❤️
- Conduct meaningful outreach that ensures two-way dialog and empowerment to groups that have experienced discrimination and lack of investment 🔄 ❤️
- Implement air and water quality objectives (see Healthy Residents section) with focus on, and investment in, more polluted, high-heat and vulnerable neighborhoods 🔄 🌿 ❤️

Support and/or Expand Existing Efforts

- Continue efforts to increase access to parks, nature and green spaces in underserved areas (e.g., the West Louisville Outdoor Recreation Initiative) 🌿 ❤️
- Continue to support an environmental justice working group to advise LMG on policies to increase EJ ❤️
- Ensure that environmental codes and regulations are strictly enforced 🌿
- Partner with and provide resources to residents advocating for cleaner air, water, and soil 🌿

A History of Injustice

Louisville has a long history of environmental injustice. Coal processing in the late 1800s led to lung and heart disease that hit African American populations hardest. Citizens living or working near industrial areas experienced safety hazards and health impacts.

In the early 1900s, sewage, industrial waste, and butchering waste were dumped directly into waterways, thereby contaminating drinking water for households downstream. Industrial areas became highly contaminated with chemicals and other pollutants.

Air, water, and soil pollution continue to plague these areas today. Neighborhoods with factories and chemical plants, such as Rubbertown, are often populated with lower-income residents and people of color, creating inequities around race and income. Pollutants released into the air, onto the land, and into the Ohio River create significant health and safety impacts.



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OBJECTIVE 4:

Cohesively address inequity, health, affordability, sustainability, and preparedness

Addressing multiple neighborhood stressors and issues together is more efficient than addressing them individually. And because they intersect, it is easier to get at the root of some of the problems when a more cohesive and systemic approach is taken. Diverse partners and resources also become available to catalyze even more significant change.

One option for addressing many different stressors to neighborhoods is to create resilience hubs. Resilience hubs are trusted neighborhood locations or facilities where residents can access resources and support on a regular basis.

Resilience hubs provide community-defined support services that increase day-to-day resilience as well as

RESILIENCE is the ability of people and their communities to anticipate, accommodate and positively adapt to or thrive amidst changing climate conditions and hazard events.

Resilient communities enjoy a high quality of life, reliable systems, and economic vitality, and they conserve resources for present and future generations.



Urban Sustainability Directors' Network

support during extreme events and assistance during the recovery period. They are focused in communities most vulnerable to climate change impacts and stressors due to the legacy of systemic racism.

In most communities, a strong partner can provide potential sites, supplies, staffing support, job creation and training support, funding support, or act as the primary implementation partner.

Shifting power and capacity to communities through the development of a network of community-driven resilience hubs can help reduce stress on systems and infrastructure such as public safety, hospitals, and transportation while increasing adaptive community capacity. Developing a resilience hub creates culture and relationships that support all residents and helps dismantle historical inequities and their root causes.

Actions

- Create and establish funding mechanisms for Resilience Hubs where residents can access mitigation assistance, resources and support 
- Provide coordination among organizations serving those impacted by climate change and other environmental effects 

Resilience Hubs shift power to those who have experienced discrimination and under-investment in the past.



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HEALTHY RESIDENTS

Maintaining and improving the physical and mental health of Louisville’s residents is a top priority. As new climate-related impacts arise, greater investment in wellness, personal resilience, access to health care, and health care capacity will be needed.

The impacts of climate change on peoples’ health are multiple and significant. They include heat-related illnesses, increasing incidences of allergies and asthma, respiratory and heart disease related to ozone exposure, exposure to contaminants and hazardous materials, food-borne and water-borne illnesses, pest-related disease, and mental health impacts. More frequent and severe storms, floods, heat waves, tornadoes, and other extreme events create additional stresses to healthcare systems and infrastructure.

Vulnerable Residents

Health-related impacts of climate change are not evenly distributed. Those who are most at risk include lower-income residents, people who work or live outdoors, infants and older adults, people with existing health conditions, and people who live in neighborhoods with higher heat, flood risk, and/or pollution.



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Louisville’s Health Equity Report outlines primary recommendations for a holistic approach to better health for all residents. They include:

- Interventions at multiple levels – individual, organizations, community, etc.
- Improve data collection and sharing systems
- Ensure opportunities for building wealth, education, and employment for those most in need
- Protect and improve environmental quality
- Create access for all persons to receive preventative and mental health care
- Expand access to healthy foods
- Improve the criminal justice system to create a thriving community
- Mitigate and prevent childhood trauma and adverse experiences
- Increase access to parks, businesses, and community organizations for all residents

OZONE

NOx + VOC + Heat & Sunlight = Ozone

Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapors, and chemical solvents are some of the major sources of oxides of nitrogen (NOx) and volatile organic compounds (VOC). Ground-level or “bad” ozone is not emitted directly into the air, but is created by chemical reactions between NOx and VOCs in the presence of heat & sunlight.

Climate Resilience Objectives

5. Protect people from worsening air pollution
6. Reduce pollutants and contaminants
7. Improve access to healthy food
8. Monitor and reduce pests and disease
9. Increase access to health care

KEY FACTS

12 years – the difference in life expectancy between the neighborhoods with the highest (82 years) and lowest (70 years) life expectancy¹²

95%

the percentage of Louisville residents with health insurance¹¹

0 the number of full-service grocery stores in the neighborhoods with the highest percentages of households without cars

20%

the percent reduction in ground-level ozone in Louisville since 2001. While overall levels have declined, ozone continues to be a major challenge and Louisville is currently in non-attainment.

13% – the percent of Louisville adults reporting being in poor mental health for more than half the month¹³

More than 2x – rate of in-patient admissions for asthma among Black vs. White residents

OBJECTIVE 5:

Protect People from Air Pollution

Higher temperatures cause more formation of ground-level ozone, a primary contributor to asthma, bronchitis, and infant mortality. In Louisville, asthma is a leading cause of hospitalizations among children, predominantly among black children. Childhood asthma is also much higher in west Louisville than the rest of Jefferson County.¹⁴

Many of the recommended actions for protecting people from air pollution also reduce greenhouse gas emissions, thereby mitigating climate change. The renewable energy goals in Louisville's Greenhouse Gas Emissions Reduction Plan (ERP) and in *Prepare Louisville* are highly complementary. It is important to emphasize that shifting our energy sources from fossil fuels to clean and renewable sources will save tens of thousands of lives.¹⁵

The city is already struggling to meet air quality standards for ground-level ozone. With the continued increase in temperature, those standards will be increasingly difficult to achieve. With a warmer future, more drastic measures will be needed to reduce emissions to meet today's air quality standards.

Lawn Care for Cleaner Air

In efforts to improve air quality, LMG has a Lawn Care for Cleaner Air program with rebates for purchases of electric yard maintenance equipment.

Did you know?

- 1 hour of use of a typical gas-powered lawn mower produces the same amount of pollution as driving your car for 200 miles
- Lawn mowers contribute significantly to ground-level ozone pollution
- Ground level ozone affects older adults, infants, and those with asthma or heart disease.

Actions

- Increase renewable energy support and incentives for individual homes and businesses 🌱
- Divest from fossil fuels and invest in renewable energy on both a utility and regional scale 🌱
- Expand bike, pedestrian and transit networks to reduce car travel (also see Resilient Infrastructure for more transportation options) 🚲 🌱 ❤️
- Increase real-time air quality monitoring and enforcement 🔄
- Encourage passive solar and green building design practices 🌱
- Develop intervention programs to prevent, detect, and treat health conditions in populations most vulnerable to air quality ❤️
- Support asthma-friendly schools and childcare facilities ❤️
- Start a Green Bank to ensure low- and moderate-income residents have access to financing for energy efficiency upgrades and investment in renewable energy 🔄 🌱 ❤️
- Create a Solar Incentive Program for residents similar to LMG's Cool Roof Rebate program 🌱
- Explore options for investment in community solar programs 🌱

Support and/or Expand Existing Efforts

- Replace gas powered tools and mowers with electric (govt. and residential) 🌱
- Expand weatherization programs 🌱 ❤️

OBJECTIVE 6:

Reduce Pollutants and Contaminants in Waterways

Reducing pollutants and contaminants in Louisville's waterways is a key priority, especially for achieving environmental justice goals. Primary sources of pollutants include industrial processes and aging sewer infrastructure. Much progress has been made in cleaning up contaminated sites and reducing the amount of pollution being released into the community.

MSD has made improvements in water quality in streams by eliminating many older, smaller wastewater treatment facilities, improving wastewater collection systems, and decreasing sewer overflows into our waterways.¹⁶ Conditions at about half of Louisville's 27 monitoring sites show improvements in water quality.

Even with progress being made to reduce contaminants, increasing flood risk from larger storms could



Cherokee Park/W.marsh

The Waterway Protection Tunnel

By the end of 2020, MSD will have completed constructing a 4-mile long Waterway Protection Tunnel to store 55 million gallons of underground rainwater and wastewater (the size of 83 Olympic pools) during heavy rain events. This is part of their \$1.15 billion Consent Decree that will reduce sewer overflows by 2024.

lead to higher exposure of local residents to hazardous materials, especially in low-lying areas, lower income neighborhoods and where former industry has left a legacy of contamination. Actions to reduce exposure to pollutants have extensive benefits for physical and mental health, especially among children, as well as the health of natural systems. The benefits will last for generations to come.

Actions

- Notification of accidental emissions in real time, with follow up information and guidance on actions 🔄
- Work with largest industrial plants to increase the magnitude of events for which they prepare, in order to prevent accidental emissions

Support and/or Expand Existing Efforts

- Identify and reduce sources of bacteria in waterways 🔄 🌱
- Require effective technology that reduces fugitive emissions and spills
- Increase efforts to address and reduce brownfield site migration of contamination 🔄 ❤️
- Fully implement MSD's *Critical Repair and Reinvestment Plan* 🔄 ❤️
- Increase efforts to promote use of safer chemicals in industrial production 🔄

OBJECTIVE 7:

Improve Availability of Healthy Food

Food availability and security are serious challenges throughout Jefferson County. About 44,000 people in Louisville live in food deserts, while 120,000 are food insecure. In addition, 20,000 seniors live a mile or more from a grocery store.¹⁶

Some major barriers to food security are affordability, access, and awareness. Many actions are already being taken through collaboration with farmers, grocers, non-profit organizations, food banks, faith groups, and others. The *Lift a Life Foundation* and *Community Foundation of Louisville* recommended expanding awareness through doctors' offices, churches, and other community hubs, expanding employer-based support, mobile delivery services, creating incentives for small grocers to partner with farmers, and targeting more services towards seniors.

As climate change progresses, lower-income residents will be hit the hardest by larger storms, heat waves, and other extreme events. Food supplies could become restricted on a national and even global level. Food prices could become inflated. Current food availability, transportation, and security concerns are expected to worsen. More needs to be done to increase access, affordability, and awareness by supporting and expanding on existing efforts.

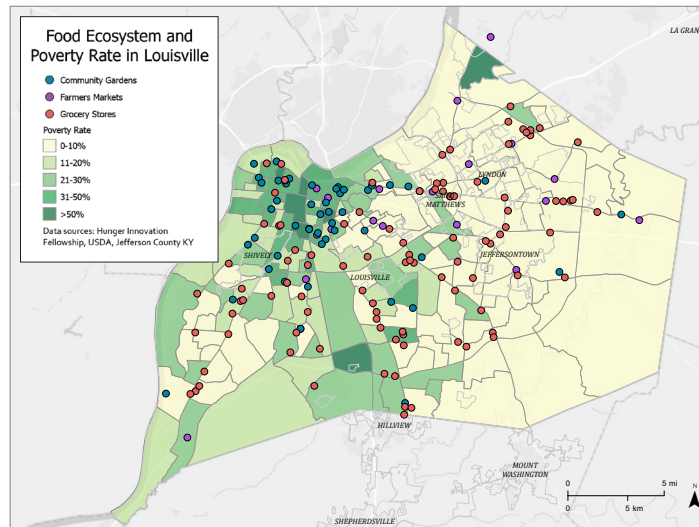


Figure 6 Distribution of grocery stores, community gardens, and farmers markets against poverty rates in Louisville.

Data from the Community Foundation of Louisville's Food Ecosystem Map

Actions

- Promote locally-grown food, community gardens, and urban gardens 🌱❤️
- Connect food delivery services to farmer's markets, fresh produce, and lower income neighborhoods 🚚❤️
- Reduce commercial food waste through redistribution and other strategies ♻️❤️
- Provide tax benefits and other incentives for establishing grocery stores in areas with limited access to affordable and nutritious food ❤️
- Transform vacant lots into edible gardens 🚶❤️

Support and/or Expand Existing Efforts

- Support existing efforts and partnerships highlighted in the *Ending Food Insecurity: It Will Take Us All* report¹⁷ ❤️

Food insecurity

means that a person or family doesn't reliably have enough food

Food deserts

are areas without access to fresh, healthy foods within a certain distance

Fresh Stop Markets

Fresh Stop Markets (FSMs) operate from the belief that **fresh food is a basic human right**. FSMs are volunteer, community-driven farm-fresh food markets that pop up at local churches, community centers, and businesses in food-insecure neighborhoods.

OBJECTIVE 8:

Monitor and Reduce Pests and Disease

Warmer temperatures, higher humidity, and severe storms with more standing water are all expected to increase the incidence of pests and disease among people, pets, livestock, wildlife, and plants. As pests or diseases expand their ranges, people, plants, and animals may be exposed to diseases for which they have no natural immunity. It will be increasingly important to monitor, control, and reduce their impacts while raising awareness of the risks.

Louisville Metro Public Health and Wellness (LMPHW) is primarily responsible for the detection and control of infectious disease in the community, and also works to reduce the spread of disease vectors. LMPHW's Division of Communicable Disease works closely with the Division of Vector (Mosquito) Control to monitor vector borne disease in Louisville.

LMPHW coordinates with partners across the state and nationally to ensure Louisville is aware of developing trends and is prepared with the most environmentally responsible prevention methods. Reducing the impacts of pests and disease using non-toxic approaches and integrated pest management helps to protect beneficial insects and other biota as well as people while controlling disease vectors.

Integrated Pest Management

Integrated Pest Management (IPM) recognizes the importance of a natural balance in reducing outbreaks or infestations, rather than over-reliance on chemical control.

- Using knowledge about the pest's habits, life cycle, needs and dislikes to reduce pests and disease
- Managing habitats to reduce incidence and spread
- Using the least toxic methods first, up to and including organic pesticides
- Monitoring the pest's activity and adjusting methods over time
- Supporting beneficial and harmless biota
- Setting a threshold to decide when it's time to act

Actions

- Reduce standing water for mosquitoes and other vectors, especially near homes (e.g. installing pervious surfaces, removing debris, fixing drainage issues)
- Require nature-based methods for reducing standing water (such as restoring riparian vegetation) into planning stage for new development 🌿
- Maintain and expand disease surveillance to detect emergence of new vectors and diseases

Support and/or Expand Existing Efforts

- Continue to implement and expand Integrated Pest Management principles
- Strengthen and maintain vector control response planning and implementation for emergency events
- Increase awareness of tick and mosquito prevention strategies



Mosquito testing/Thomas Karol (USAF)

OBJECTIVE 9:

Increase Access to Health Care

The health of Louisville’s residents intersects with many other factors. For example, good health can affect educational, economic, and emotional success. Good health is the result of many important factors, including access to health care.

Great strides have been made to increase the number of people who have health insurance in recent years, with the expansion of the Affordable Care Act (ACA) in 2013. Louisville was ranked first out of 17 peer cities in health insurance coverage (Fig. 7). This is a positive step towards creating more comprehensive health care for all Louisville residents, yet remains at risk if the ACA were to be revoked.

Ensuring access also includes proximity to care, transportation, affordability, language and cultural accommodations, navigating health care systems, building trust between communities and healthcare providers, and capacity during extreme events. As climate change progresses, making further strides in all components of health care access is essential.



Actions

- Track admissions and health impacts related to extreme events
- Enhance mobile health clinics in underserved areas ♡
- Improve cultural competency and mental health awareness in primary care ♡
- Increase number of mental health providers
- Build capacity for medical interpreters to meet demand ♡
- Increase access to neighborhood clinics and other healthcare options ♡

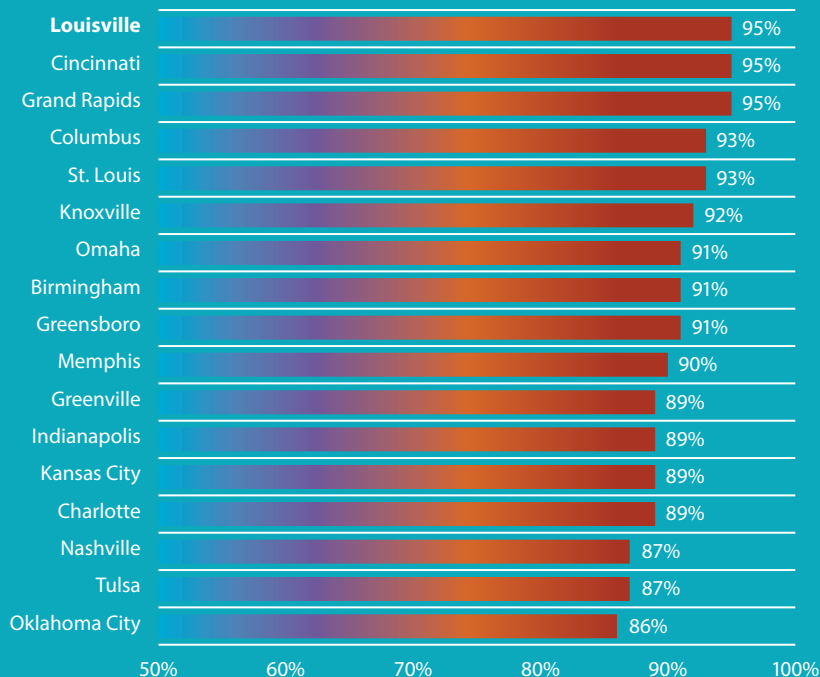


Figure 7 Among peer cities, Louisville has the highest rate of insured residents, with 94.8% insured (from Greater Louisville Project’s 2018 Competitive City Report).



Natural Capital is the value of natural systems and the services that they provide for humanity, from the inherent value of biodiversity to the economic value of flood abatement, natural pest control, or tourism.

NATURAL CAPITAL

Louisville's parks are vital to quality of life for residents and attract tourists to the region. Green spaces and nature are critical for healthy neighborhoods. Parks, clean waterways, and healthy ecosystems improve property values, provide recreational opportunities such as walking, hiking, and biking, improve physical and mental health, and support wildlife and biodiversity. Healthy natural systems can also provide valuable ecological functions, such as filtering pollutants from the air and waterways, reducing flood impacts, and reducing air temperatures. Finally, parks and open spaces contribute to social cohesion by serving as social gathering spaces for sports, education, art, and volunteer work.

In addition to parks, Louisville's rivers, creeks, and streams provide connections to nature throughout

What's Next in the Development of Waterfront Park?

Starting in 1986, Louisville's waterfront has been redeveloped from a blighted and underutilized area into a vibrant, active area. The result is Waterfront Park, which has improved the quality of life of Louisville residents and has also been a catalyst for business and residential redevelopment.

Building upon this success, Phase IV is intended to be the westward expansion. The 22-acre site serves as a continuation of community open space along the Ohio River corridor, connecting the downtown core with the Portland Neighborhood and west Louisville, giving additional neighborhoods access to open space, riverfront, paths, and recreational opportunities.



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the city. Efforts are underway to rehabilitate many of Louisville's waterways for increased recreational use and aesthetics. Also, the U.S. Army Corps of Engineers is conducting a study of and masterplan for Beargrass Creek.

Natural capital is not limited to parks and protected areas. Yards, grounds, open lots, gardens, and other vegetated areas can provide critical habitat for native insects and birds, stopover areas for migrating species, and connections between more substantial blocks of habitat. As wilderness and natural areas become stressed and/or degraded, maintaining biological diversity within cities and other inhabited areas becomes increasingly vital to the persistence of native species throughout the region.

KEY FACTS

18,000+ acres

the total coverage of Louisville's 122 parks

10% – the amount cooler that areas near parks and open spaces are, as compared to surrounding urban spaces.¹⁸

**50%
LESS**

the amount less stress among people living within 1,000 feet of parks or green spaces, compared to those more than a half mile away.¹⁹

15-55%
higher

the risk of developing mental health conditions among children who grow up with limited access to green space.²⁰

Climate Resilience Objectives

- 10. Increase tree canopy cover**
- 11. Increase natural vegetation, habitats, and biodiversity**
- 12. Enhance ecosystem services**



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OBJECTIVE 10:

Increase Tree Canopy Cover

Louisville has a wide variety of natural vegetation, including forests and woodlands, parks, tree-lined streets, and landscaped gardens, yards, and grounds. Louisville's Urban Tree Canopy Assessment²¹ showed that trees cover 37 percent (just over 94,000 acres) of Louisville's Metro area. Since 2002, 7 percent of Louisville's tree canopy has been lost, with an average loss of 820 acres or 54,000 trees per year.

Because of the importance of tree canopy to reducing the impacts of the urban heat island effect, especially in lower-income neighborhoods, the ongoing decline is worrisome in the era of climate change. Tree canopy cover could reach 21% by 2052 unless this trend is reversed.

The Urban Tree Canopy Assessment prioritized a tree planting plan that maximizes tree benefits in areas of greatest need. With a Metro goal of increasing overall cover to 45% in future years²², aggressive tree planting over the next 30 years is called for, as well as maintaining and protecting existing tree cover.

Actions

- Promote and support tree planting on public lands and through school programs 🔄 🌱
- Discourage Land Development Code waivers that allow tree removal without replacement 🌱 🚫

Support and/or Expand Existing Efforts

- Increase the Louisville Metro Government Tree Assistance Fund 🔄 🌱 🚫 ❤️
- Implement recommendations in *Urban Tree Canopy Assessment* and *Louisville Urban Heat Management Study* 🔄 🌱 🚫
- Continue to strengthen Land Development Code for preservation and enhancement of tree canopy 🌱 🚫
- Promote participation as a Tree City USA member 🌱
- Update Urban Tree Canopy Study, as needed

"Thousands of young trees will need to be planted and thousands of mature trees will need to be cared for if trees are to be embraced as a way to reduce stormwater issues, improve air and water quality, and reduce the urban heat island effects in Louisville."

Urban Tree Canopy Assessment



OBJECTIVE 11:

Increase Natural Vegetation, Habitats, and Biodiversity
















Native species and habitats are vital for the health of the environment and the people who live in Louisville and surrounding areas. As climate change progresses, native species are expected to become increasingly stressed and less able to compete with non-natives. Many species face extinction as the climate of the region changes.

Maintaining and protecting native species diversity and connectivity is imperative for the continued functioning of natural systems. Important functions that native species provide include pollination of plants and crops, protection of streambanks and riparian areas from erosion, shade and cool waterways, water storage in floodplains, wetlands, or meadows during large storms, and natural filtration of toxins and pollutants. Natural systems also provide recreational activities and aesthetic benefits to residents and tourists.

Grow More, Mow Less.

LMG Air Pollution Control District's **Grow More, Mow Less** program encourages the replacement of lawns with a greater diversity of plants. Plantings of shrubs, flowers, groundcover, edible plants, and others provide many co-benefits, including habitat for native species, less maintenance, less need for chemical applications, and better air and water quality.

Actions

- Update Land Development Code to encourage more green/natural spaces  
- Support pollinators through plantings, education, and management practices  
- Use vacant lots for trees, habitat, and pollinator gardens 
- Replace lawns with naturalized vegetation, native species, and habitats  
- Prohibit sale of invasive species 
- Discourage the use of chemical pesticides, herbicides, and fertilizers by promoting more organic alternatives and practices  
- Connect existing parks, green spaces and waterways to create cooling corridors throughout the Metro region   
- Research and promote a greater diversity of plant species that are resistant to disease, pests, and climatic change
- Facilitate urban conservation corps  

OBJECTIVE 12:

Enhance Ecosystem Services

Natural systems can often replace more expensive traditional infrastructure to provide community services such as flood control or water filtration. When natural systems are used in such a way, they are often referred to as “green infrastructure.”

Green infrastructure is more cost effective than traditional infrastructure and offers numerous co-benefits such as supporting native species and habitats, flexibility over time (especially important with climate change), aesthetic values, lower energy use, and recreational opportunities.

Ecosystem services are provided by naturally occurring ecosystems such as wetlands, rivers, floodplains, and meadows. These systems can be conserved, protected, and restored to continue to provide essential functions, such as downstream flood abatement, clean water, and recreational opportunities.

Actions

- Reduce flooding and improve water quality by creating riparian buffers, restoring wetlands, planting riparian vegetation, installing bioswales, and promoting other nature-based flood abatement actions 🔄 🌿
- Prioritize preservation and restoration of ecosystem services in neighborhoods most affected by impaired air, water, and soil quality ❤️
- Calculate economic values of green infrastructure and other ecosystem services to increase investment 🔄 🌿
- Install green roofs to provide cooling services, storm water mitigation, energy savings and biodiversity 🔄 🌿 🌱
- Plant riparian species on flood risk properties 🔄 🌿
- Protect and restore natural waterways, wetlands, and natural ecosystem function 🔄 🌿

Green Infrastructure is the use of natural and engineered ecological systems to provide specific services to the community, often in relation to stormwater management, but also including cooling, pollination, and filtration.

Some examples include:

- Rainwater harvesting
- Bioswales
- Permeable pavement
- Green roofs
- Green streets and alleys
- Urban tree canopy



Bioswale/Center for Neighborhood Technology

For examples and case studies, please visit <https://www.epa.gov/green-infrastructure/what-green-infrastructure>

SUSTAINABLE BUSINESSES

Louisville’s economy is built on a wide diversity of large and small industries and businesses. Recently experiencing a renaissance, the business sector created new jobs and attracted billions of dollars in capital investment (Fig. 8). Louisville serves as a shipping, trucking, and global air freight hub and major center for manufacturing, logistics, and lifelong wellness and aging care. The distilling industry represents an integral area of growth for Louisville, bringing tourism to the region as well as contributing to a bustling downtown restaurant and arts scene. The COVID-19 pandemic has dramatically changed the economic landscape of many cities including Louisville, the lasting impacts of which remain to be seen.

Climate change impacts businesses in many ways. More severe storms, flooding, drought, and extreme heat significantly increase business costs including for energy, insurance, goods and services and transportation. Higher costs can result in higher prices to consumers.

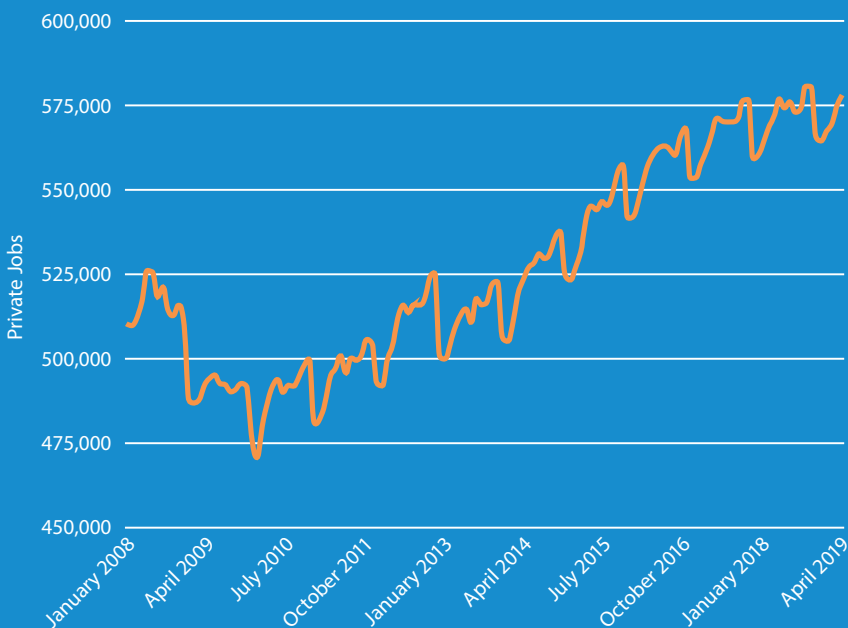


Figure 8 Private job growth in Louisville from 2008-2019. Source: BLS QCEW 2019 June. Louisville Forward.

Louisville’s Business Clusters

With its high quality of life and low cost of doing business, Louisville is home to many small and large companies experiencing success in their industries. Because of our growth and business-to-business relationships, Louisville’s economic development efforts focus on five strong business clusters.

- Advanced manufacturing
- Business services
- Food and beverage
- Lifelong wellness and aging care
- Logistics

Support for local businesses comes in the form of creating sustainable practices, which can also save money. Many of the actions in other sections of *Prepare Louisville* will support the creation of more sustainable businesses, including those that prepare companies for larger and more frequent extreme events, provide affordable housing, ensure adequate healthcare, and increase transportation options for the local workforce.

Vulnerable Businesses and Resources

More severe storms associated with climate change lead to even greater flood risk to those businesses and industries located in high and medium flood risk areas. Construction and other outdoor businesses could be especially sensitive to the impacts of extreme heat, as outdoor workers' hours of safe exposure become limited. Companies with high energy usage could be exposed to more energy outages related to extreme events. Finally, companies may need to raise prices of their goods and services due to the costs associated with extreme events such as heat waves and severe storms.



woodford50/Michelle Spomer

Climate Resilience Objectives

- 13. Increase business sustainability
- 14. Ensure green jobs and living wages

KEY FACTS

3.4%

Louisville's pre-COVID-19 unemployment rate, which is the lowest in over a decade

\$2.3 million

the amount leveraged in renewable energy and energy efficiency since the 2016 launch of Louisville's EPAD program



Roughly double

the improvement in cognitive scores among workers in green, well-ventilated offices²³

\$886,286

the amount awarded so far in METCO program Go Green energy efficiency loans

83,000 – the number of new private sector jobs over the last 8 years, along with 3,000 new businesses, and \$13 billion in capital investment



OBJECTIVE 13:

Increase Business Sustainability

Businesses have a vital role to play in greening and preparing Louisville for climate change. Not only are they some of the largest sources of pollution and greenhouse gases, they are also affected by rising energy prices, increasing insurance premiums, and repeated extreme events like flooding and heatwaves that threaten supply chains and cause business interruption. By creating more resilient and sustainable businesses, Louisville can lower its greenhouse gas emissions while also reducing risks and costs for workers and businesses throughout Metro.

Efforts to make businesses more sustainable take upfront investment but can lead to savings of money and resources. They can also lead to more holistic, lifecycle or systems-level approaches and innovations that improve marketability and economic viability over longer time frames.

For-profit companies have a new opportunity in Kentucky to increase their sustainability. State-wide Public Benefit Corporations (PBC) are now legally recognized in business filings, making way for businesses to certify that they are meeting their goals for environmentally sustainable practices. This includes reduction of vehicle emissions and waste and increased use of “green” products.

Actions

- Provide capital, tax breaks and other incentives for corporate or institutional sustainability projects 🔄 🌱
- Promote and incentivize alternative transportation and remote work options for employees 🔄 🌱 ❤️
- Investigate prohibiting single use plastics (e.g., plastic bags, drinking bottles, etc.)
- Design inclining block rates that reward energy, water, and resource conservation (e.g. higher prices for higher usage) 🔄 🌱
- Create and support a central hub for businesses seeking sustainability services 🔄 🌱
- Promote Public Benefit Corporations (PBC) and create incentives for those that certify their impact with a third-party organization 🌱
- Work with local industry to increase climate change and emergency preparedness 🔄

Support and/or Expand Existing Efforts

- Increase marketing of Louisville’s Energy Project Assessment District (EPAD) program 🌱
- Increase funding for METCO Go Green Loans 🔄 🌱
- Support Louisville Sustainability Council in convening corporate partners to share environmental best practices

Largest Solar Array in Kentucky to Power Toyota and Dow

Two of LG&E’s largest energy users, Toyota Motor Manufacturing and Dow Silicones Corporation, have signed an agreement with LG&E and Kentucky Utilities Company for 100 megawatts of solar power. The new array will be built in Hardin County.

As businesses strive to reduce their greenhouse gas emissions and meet science-based targets, the renewable power agreements offered by LG&E and KU are intended to fulfill those demands.

OBJECTIVE 14:

Ensure Green Jobs and Living Wages

Reducing emissions 80% by 2050 to avoid worsening climate impacts will take a community-wide approach to retrofitting homes and businesses, changing behaviors, installing new technology, and adopting renewable energy for residences, businesses, and at the utility-scale.

The Louisville Sustainability Council, a non-profit organization dedicated to a healthy environment, stable economy, and the well-being of residents, envisions that Louisville will be one of the top 10 sustainable metro areas by 2025. Everyone is needed to achieve this transformation. As the demand for renewable energy increases, so will the need for solar manufacturing and installers, sustainability managers, energy efficiency engineers, green manufacturing professionals, weatherization workers, and scientists and researchers in new technologies. Many of these jobs are traditional jobs, such as construction, with a layer of new knowledge and skills to meet new demands.

Because green jobs are mainly skilled and well paid, the growth of this field presents an opportunity for progress in equity. Job training programs can target lower-income residents, people of color, people with disabilities, and

others who have been historically disadvantaged or left out of educational and job growth opportunities.

A living wage covers a basic level of living expenses such as food, childcare, healthcare, transportation, and taxes. Currently, only two-thirds of working households in Louisville earn a living wage.²⁴ As technology advances and automation are furthered, more people are expected to lose their jobs, and a universal basic income may need to be considered to reduce homelessness and food insecurity. The University of Louisville is helping to lead the way by requiring all contractors to pay a living wage.

Actions

- Create green jobs and training, with potential funding and cooperation through industrial partnerships 🔄🌱♻️❤️
- Link job training and skill building to living wage jobs 🔄❤️
- Increase exposure of Jefferson County Public Schools (JCPS) students to green career paths
- Encourage economic diversification
- Support evolving economic strengths to align with global economy





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RESILIENT INFRASTRUCTURE

Infrastructure includes buildings, energy distribution, water delivery, storm- and wastewater, floodwalls, roads and highways, bridges, culverts, and many other basic structures found throughout the Metro region. Louisville’s infrastructure varies significantly in age and condition from one neighborhood to another. Improving its efficiency, resilience, function and health is a top priority. MSD’s *Critical Repair and Reinvestment Plan* lays out the specific

Primary Upgrades Recommended in the Critical Repair and Reinvestment Plan

- Upgrade floodwalls and pumping stations protecting neighborhoods from Ohio River flooding
- Improve inland stormwater and reduce neighborhood flooding
- Minimize viaduct flooding
- Upgrade water quality treatment centers
- Renew failing infrastructure (especially the sewer system)
- Comply with Consent Decree (to reduce sewer overflows and comply with federal mandate)

needs of the city’s wastewater infrastructure over the next 20 years, with a price tag of \$4.3 billion.²⁵ These upgrades will become even more critical as climate change progresses. Louisville’s aging sewer system, flood prone neighborhoods, roads and highways and energy infrastructure are most at risk from extreme weather.

Redlining has left an indelible mark across the Metro area, due to discriminatory real estate practices that created sub-optimal housing for generations of lower-income neighborhoods and people of color. Later, urban renewal policies and the Interstate Highway system further damaged many urban neighborhoods.

Preferential investment in lower-income neighborhoods and/or neighborhoods with high populations of black residents is recommended as a way to dismantle the historic legacy of discriminatory policies.

Vulnerable Infrastructure

The most at-risk infrastructure includes aging sewer systems, flood-prone neighborhoods, energy infrastructure, and flood-prone roads and highways.

Climate Resilience Objectives

- 15. Scale up stormwater management
- 16. Create streamlined transportation for all
- 17. Update zoning for sustainability
- 18. Protect homes and businesses

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KEY FACTS

**JUST
1 INCH**

the amount of rain that can cause viaducts to flood, leaving cars and commuters stranded.

200,000 – the number of people protected by 29 miles of flood protection infrastructure built in the 1940s and 1950s.



4 billion gallons

the amount of stormwater and raw sewage that entered the Ohio River and Beargrass Creek during spring storms in 2018

12,000 – the number of homes and businesses in the 100-year floodplain.



OBJECTIVE 15:

Scale up Stormwater Management

Louisville’s stormwater infrastructure was not designed to handle the more extreme storms that have been occurring in recent years and are expected to increase in size and magnitude due to climate change. Most of Louisville’s stormwater system combines with sewer or wastewater. As a result, during heavy storms a mixture of wastewater and sewage backs up into homes and onto streets creating a public health hazard due to harmful bacteria. Contaminated waters can also end up in Louisville’s creeks, rivers, and wetlands. For example, during an exceptionally wet period of time (February 19, 2018 to March 2, 2018), four billion gallons of stormwater and raw sewage went straight into the Ohio River and Beargrass Creek and other waterways in Louisville (Fig. 9).

MSD estimates that \$1.2 billion is necessary to upgrade Louisville’s inland drainage systems in accordance with the EPA Consent Decree. The *Critical Repair and Reinvestment Plan* provides details on further upgrades that are needed, as well as their cost. Many of the actions listed in Prepare Louisville can be achieved by fully funding and implementing the *Critical Repair and Reinvestment Plan*, including an additional \$4.3 billion backlog of maintenance.

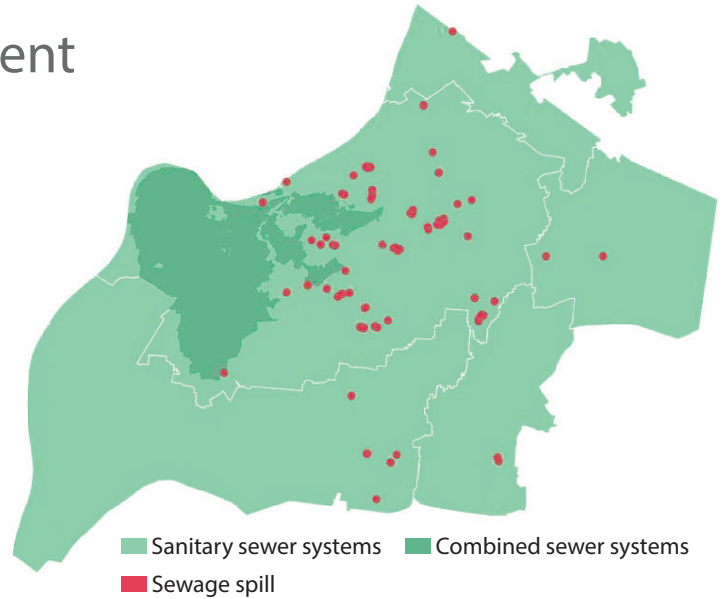


Figure 9 Over 38 million gallons of sewage and 4 billion gallons of stormwater spilled into Louisville’s streets and waterways during 2018’s flood event.

Actions

- Fully fund and implement MSD’s Critical Repair and Reinvestment Plan. If this is fully funded, many of the actions below would be achieved 🌱
- Update standards for stormwater conveyance and erosion control 🌱
- Assess ability to carry out proactive repairs of sewer systems 🚫
- Reduce impervious surfaces 🌱
- Upsize flood pump stations
- Create or expand regional retention basins
- Reduce fertilizer and chemical runoff 🚫 🌱
- Encourage “green” building practices that increase infiltration and protect water quality 🌱

Support and/or Expand Existing Efforts

- Implement MSD’s Critical Repair and Reinvestment Plan
- Enforce existing erosion control ordinance 🌱



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OBJECTIVE 16:

Create Streamlined Transportation for All

Sustainable transportation solutions are vital to achieving Louisville's climate action and sustainability objectives. An efficient transportation network can help relieve congestion problems, commuter travel times, and vehicle emissions. Less than 5 percent of workers use public transportation in Louisville.²⁶ Eighty-six percent of car trips in Louisville are single occupancy. In 2016, the Louisville Metro government released *Move Louisville*, a 20-year multi-modal transportation plan to reduce the number of vehicle miles driven.

Transportation routes are not only fundamental for people going about their daily lives within the Metro region, they are also vital for trucking goods across the nation, escape routes during flooding and other extreme events, and conducting business throughout the region. Reducing congestion and single-passenger cars will help to streamline these other important uses of Louisville's interstate highway system.

Actions

- Identify funding for free or subsidized public transportation 🚶❤
- Improve frequency and efficiency of public transit to increase ridership 🚶❤
- Improve accessibility of sidewalk infrastructure and multi-modal transportation options for better access to transit 🚶
- Expand rideshare and high occupancy vehicle options throughout Jefferson County 🚶
- Improve accessibility of sidewalk infrastructure and multi-modal transportation options for better access to transit ❤

Support and/or Expand Existing Efforts

- Implement *Move Louisville* multi-modal transportation plan 🔄🚶❤
- Expand paratransit programs 🚶❤
- Continue to improve the existing bike infrastructure and networks especially in areas with low car ownership 🔄🚶❤

Free Buses are a Win-Win-Win strategy

Across the U.S., major cities have been making public transportation free of charge, at relatively low cost. Kansas City, Missouri is the largest to date where the free transit program is expected to save working people on average \$1,000-\$1,500 per year.

Free transit dramatically reduces automobile use by up to 50 percent as well as carbon pollution. It also addresses economic inequity, saving the lowest income residents the most and improving access to jobs. Other benefits include a reduction in law enforcement and incarceration as fare evaders are no longer prosecuted.





Michelle Spomer

OBJECTIVE 17:

Update Zoning for Sustainability

Louisville's Land Development Code (LDC) implements the goals and objectives set forth in Metro's comprehensive Plan 2040. The LDC contains requirements for how parcels of land may be used. Small changes to the LDC can result in substantial impacts to sustainability.

Incorporating sustainability features into LDC is one of the most direct and effective way to prepare for climate change. Land use planning that increases multi-family housing and green space while saving energy, water, and other resources increases resilience by ensuring buildings withstand climate impacts and community members have access to healthy, comfortable housing and access to vital services and amenities. Such changes to the LDC will have positive benefits to the community for generations.

Actions

- Develop and implement *Healthy By Design* program to build resilience and improved health into urban design
- Support increases in density by encouraging equitable multi-family and mixed-use zoning districts
- Create condensed urban areas with easy access to green space, pervious surfaces, walkability, and transportation network access
- Encourage new infill development and adaptive reuse in areas served by transit and other services
- Update lot size minimums for denser and more affordable housing
- Promote transit-oriented development

OBJECTIVE 18:

Protect Homes and Businesses

Existing infrastructure codes and standards make an inaccurate assumption that the average and extreme conditions of the past represent the conditions that will be experienced over the lifetime of a structure. New standards need to be adopted and existing infrastructure upgraded and replaced to reflect the reality of a changing climate.

Over the past decade, Louisville residents filed more than \$56 million dollars in insurance claims for flood-related damage.²⁷ As storms become more severe and frequent with climate change, these costs could rise as the 12,000 homes in the 100-year flood zone face major floods three times more often than in the past.

Upgrades to businesses and homes to reduce flood risks can be combined with efforts to increase energy efficiency and reduce emissions.

Actions

- Expand buy-outs in flood-prone areas, especially those with hazardous materials (HazMat) proximity 🔄❤️
- Tighten restrictions on development in flood-prone areas 🔄🌿
- Identify and undertake prioritized retrofit program to reduce future flood impacts 🔄
- Lobby at the state level for code updates that account for future climate impacts

Support and/or Expand Existing Efforts

- Support and expand the work of Project Warm and similar programs to provide energy efficiency services to low-income households 🌿❤️



CCO

Project Warm

Project Warm is a non-profit organization that promotes energy-saving practices in the community. Project Warm delivers free services to low-income households, seniors, and people with disabilities. Project Warm began in 1982 with financial support from LG&E and LMG. Today LG&E and LMG continue to invest in Project Warm because of the positive social, economic, and environmental impact.

Benefits of Project Warm include:

- Lower energy usage
- Improved health
- Reduced climate pollution
- Increased safety
- Affordable housing
- Neighborhood stability



Brandon Debes



Cunningham's Restaurant/Jason Meredith

LENSAlert & Smart911

In August 2016 Louisville Metro Emergency Services teamed up with Bullitt County, Oldham County, and Washington County to create a regional emergency notification system — Louisville Emergency Notification System (LENSAlert). Its enhanced capabilities include using all communications modes to send alerts — mobile phones, landlines, email, text, social media, IPAWS-OPEN. Residents can take this step in being prepared for a disaster by texting “LENSAlert” to 67283.

COMMUNITY READINESS

Extreme events and emergencies can happen with or without warning. Louisville’s Emergency Management Agency has systems and policies in place to prepare for and respond to both human-caused and natural events.²⁸ Residents and businesses of Louisville also need to take steps to reduce the potential for impacts and develop preparedness.

Most of Louisville’s key hazards, including severe storms, heatwaves, flooding, sinkholes, hazardous materials exposure, hail, and tornadoes are being exacerbated by climate change and are expected to worsen in the coming decades. LMG and community members need to increase their preparation, response, recovery, and risk reduction efforts.

Communities with close-knit neighborhoods and active networks fare the best during and after disasters. Community networks, including churches, temples, interfaith groups, neighborhood associations,



Louisville EMS

Those Most At-Risk

Lower-income community members, people who lack adequate housing, older adults, those with limited mobility or health conditions, outdoor workers and people without access to a vehicle are all more at risk to extreme events. Also included are community members in care facilities, jails, dorms, or other group settings where people are dependent on others for their emergency response and evacuation. Finally, non-English speakers may not receive timely emergency instructions.

and less formal systems of friends, family, and neighbors who look out for one another are vital to resilience. Interfacing with existing networks and supporting the development of new ones creates longer-term resilience. Resilience hubs (see Equitable Neighborhoods section) are one way to create the networks and relationships needed.

Climate Resilience Objectives

- 19. Expand emergency response planning
- 20. Protect the most vulnerable populations
- 21. Improve technology and tools

CCO



KEY FACTS

Louisville residents speak as many as 130 languages!

These include English, Spanish, Chinese, Arabic Gujarati, Japanese, Vietnamese, French, Portuguese, Hindi, Italian, Tagalog, Serbo-Croatian and many African languages.

Helping all residents be prepared is a priority.

27,000
the number of people forced out of their homes during the 1937 flood, when it rained 18 inches in 16 days

MORE THAN 200 the number of people who had to be rescued from the tops of cars and houses during the 2009 flood.



60-100 miles per hour – the wind speed of a tornado in 2008 that damaged trees, many buildings on the UofL campus, a church, multiple homes and businesses, and a large training center



7 inches in 2 hours – the amount of precipitation during a flash flood in August 2009.



Up to 86 – number of people who died in 2012 heat wave, when people flocked to the library and other public places to seek air conditioning

OBJECTIVE 19:

Expand Emergency Response Planning

The Louisville Metro Government’s Emergency Management Agency (EMA) leads disaster preparation, response, recovery, and mitigation among first responders and the public. Preventing emergencies is a primary goal of the EMA. When unexpected and extreme events do occur, the EMA coordinates the work of 95 agencies in order to respond.

The words “unprecedented” and “record-breaking” have become common-place around the nation as storms get bigger and records are set and then broken again. Climate change creates a pressing need for preparedness for extremes. Recent events such as Hurricane Katrina in Louisiana and the Thomas and Camp fires in California have provided valuable lessons that can help people around the nation become more resilient in the face of emergencies.

During the Thomas fire and subsequent floods in California, for example, many residents who did not speak English or Spanish were slow to respond because they did not receive evacuation orders. Also, in some areas, people with disabilities were left without transportation. After the disasters, many lower-income and undocumented residents were forced out of the rental market and became homeless. Wealthier residents who lost their homes were able to pay higher rents. Similarly, in post-Katrina New Orleans, more than 100,000 black residents were forced to flee and unable to recover or rebuild, changing the racial makeup of the city.

EMA must update its preparedness and response abilities to reflect the changing risks associated with climate change. Aggressive efforts to reduce inequities associated with race, age, disability, gender, immigration status, language, and other factors are needed in order to protect all residents from natural and human-caused disasters.

Actions

- Map Hazardous Materials (HazMat) risk by flood elevation to determine risk
- Increase coordination among Emergency Response Plans
- Develop and disseminate neighborhood disaster and evacuation plans, with translations where needed 🇺🇸

- Conduct climate change risk assessment of critical infrastructure
- Utility maintenance and coordination to prevent disruption during extreme events
- Increase battery backup energy storage, especially linked to renewable energy 🌿❤️
- Encourage industry to have emergency plans in place for all climate change impacts ↻

Support and/or Expand Existing Efforts

- Update the Hazard Mitigation Plan with climate change projections and impacts

Louisville’s Hazard Mitigation Plan

assesses risk from 13 major hazards.

- | | |
|-----------------------|-----------------------|
| ▪ Tornado | ▪ Hazardous Materials |
| ▪ Severe Winter Storm | ▪ Drought |
| ▪ Severe Storm | ▪ Extreme Heat |
| ▪ Hail Storm | ▪ Wildfires |
| ▪ Earthquake | ▪ Dam/Levee Failure |
| ▪ Karst/Sinkhole | ▪ Flood |
| ▪ Landslide | |

Of these, only 1 was expected to not be substantially affected by climate change (earthquake).

An additional hazard was added to the list based on the likelihood of worsening impacts as air temperature continues to increase.

- Air Quality/Ozone



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OBJECTIVE 20:

Identify and Protect those Most at Risk from Climate Change

Louisville Metro is home to more than 770,000 people. The make-up of the local population continues to change over time. The percentage of white people has steadily declined, while people of color, immigrants, and refugees continue to increase, contributing to the diversity of the region. Seven percent of all residents are foreign-born, and as many as 130 languages are spoken throughout the community. People with a disability makeup 14.5% of the population.²⁹

As climate change progresses, existing stressors such as poor health, inadequate food or housing, exposure to heat, or insufficient income will be exacerbated. Reducing the stressors that exist today will not only provide immediate relief, but will also protect people from compounded impacts of the future. Populations most at risk may be geographically defined, such as lower-income neighborhoods or immigrant communities, making them easier to target for investment in reducing stressors. Other groups, however, are more dispersed and may need to be reached through places of worship, medical facilities, schools, or census

information. These include older adults, people with disabilities, people with existing health conditions, people who work outdoors, and many others.

Efforts to identify those who are (1) already at risk and (2) expected to become more at risk due to climate impacts will need to be carried out. This first step of identifying the most vulnerable populations will allow for targeted efforts to increase resilience as climate change worsens over time. They will also allow for targeted investment to improve health, wages, property values, sustainability, and quality of life.

Actions

- Identify vulnerable individuals and groups (home-bound individuals, people with disabilities, older adults, non-English speakers, etc.) for prioritizing and/or personalizing preparedness strategies 📍
- Ensure that people with disabilities, medical conditions, and non-English languages have support during emergency evacuations and recovery 🚗 📞



OBJECTIVE 21:

Improve Technology and Tools

Emergency preparedness, response, recovery, and mitigation efforts depend on timely and accurate dissemination of information. Technological advancements and tools that provide information to a wide-variety of users can save lives and property. Dissemination of new technology needs to take into account safety of electrical supply and/or battery power for reliability and access for those without or who do not engage in electronic communication.

Tools that support emergency management include:

- Publically-available mapping tools that manage traffic and congestion, especially during emergencies
- Information gateways that connect federal, state, local, non-governmental, and other parties involved in response or recovery
- Portals with resources for streamlining recovery efforts and sharing information
- Networks that connect neighborhood groups and/or vulnerable residents
- Coordinated health reporting systems
- Clinical diagnosis, response to, and treatment of emerging diseases
- Risk assessment tools and information that incorporate climate change data
- Systems to assist emergency responders in hazardous materials incidents
- Evacuation and emergency information translated into different languages
- Tools to help deliver effective mental health resources and guidance after disasters
- Mapping tools that track people reliant on home medical equipment during disasters

Actions

- Expand tools like Waze or Lens Alert for travel during emergencies 🔄
- Expand intelligent transportation systems
- Utilize emerging technologies to improve traffic flow during extreme events
- Host a Hackathon to develop better tools for emergency alerts
- Coordinate with the Environmental Justice working group to ensure equitable distribution of the benefits of preparedness technology and new tools ❤️

Waze does more than share real-time traffic information

Waze is a great tool to get information about road closures, pot holes, and traffic jams. But did you know that Waze also helps LMG determine how effective their efforts are? For instance, changes in timing of traffic lights on the Westport road corridor led to a 30% drop in the number of Waze jams, their metric for congestion.

LMG also can use Waze data to detect congestion that could indicate equipment issues. And it is used to see which factors lead to fewer traffic accidents.

All of these improvements will lead to less congestion during emergencies as well as on a daily basis. The data agreement between Waze and LMG will continue to feed new studies that can make Louisville travel safer and more streamlined.



LOUISVILLE LEADS

Louisville has an opportunity to invest in climate solutions and demonstrate leadership on many issues affecting the region. These include racial and income disparity, access to health care, emissions reductions, environmental health, sustainability, and overall quality of life. As climate change worsens, innovative approaches, and success stories demonstrating community resilience will be powerful motivators for action.

By declaring a climate emergency and setting aggressive greenhouse gas emissions reduction targets, Louisville is demonstrating bold action is underway in Kentucky. A high-profile campaign to brand the city as a leader on climate and sustainability will build support and can motivate other cities in the state to increase resilience and cut carbon.

“Louisville has realized neither its worst fears nor its highest aspirations. If we want to reach the top tier of our peer cities in the key drivers of community success, we need to change the way our community comes together to create opportunities and support one another.”

Ben Reno-Weber, Director of the Greater Louisville Project

Climate Resilience Objectives

- 22. Lead the state in reducing emissions
- 23. Lead by example
- 24. Update policy
- 25. Conduct outreach and education

KEY FACTS

1st – the Louisville Urban Heat Management Study was the first comprehensive heat management assessment undertaken by a major U.S. city

Rated **4th** Top Mid-Size City for ENERGY STAR buildings in 2020



Cool Roof Rebate Program

most robust municipal cool roof program in the nation

Selected to be a part of the worldwide

100 Resilient Cities

network in 2016

Louisville is the **1st** city in Kentucky to adopt a **100%** clean energy resolution

Louisville was selected as a

Top 10

Most Sustainable Metro Area in 2018 by Site Selection Magazine



OBJECTIVE 22:

Take the Lead in Reducing Greenhouse Gas Emissions

Louisville is already leading on reducing emissions in Kentucky. In May 2016, Mayor Greg Fischer signed the Global Covenant of Mayors, an agreement signed by over 9,000 cities across the world, which commits us to inventory and develop a strategy to reduce Louisville's greenhouse gas emissions. Globally, cities play a major role in these efforts as 70% of greenhouse gas emissions come from cities.

LMG conducted a greenhouse gas inventory, which showed that from 2010 to 2016, greenhouse gas emissions declined by 10%. A target was set to reduce emissions by 80% by 2050 and the *Louisville Greenhouse Gas Emissions Reduction Plan* (ERP) was completed in 2020. However, due to stark projections being reported by leading scientists, LMG recognized that even more drastic action is needed in order to prevent the most catastrophic impacts of climate change.³⁰ In turn, new targets have been set that include transitioning city operations to 100% renewable electricity by 2030 and clean energy community-wide by 2040. These targets have been set despite state legislation that disincentivizes investments in renewable energy.

While the ERP is the primary document for strategies and actions to reduce emissions, *Prepare Louisville* includes a suite of recommendations as well. Reducing emissions to prevent the most catastrophic impacts of climate change is imperative for climate change adaptation and resilience, because we can only adapt to a certain magnitude of change and impact.

Actions

- Work with the state to make renewable energy more feasible and cost effective 🌱❤️
- Invest in energy efficiency and renewable energy 🌱
- Renegotiate energy contracts to reduce emissions 🌱
- Encourage usage of electric vehicles and alternative fuel vehicles and increase public and private electric vehicle charging stations 🌱

Support and/or Expand Existing Efforts

- Set renewable energy targets at the utility scale 🌱
- Prioritize strategies in the *Louisville Greenhouse Gas Emissions Reduction Plan* (ERP) 🌱
- Advocate for and partner on academic and institutional research on green energy development 🌱



OBJECTIVE 23:

Lead by Example

Climate change affects all sectors of every community. Because of this, changes will need to be made throughout the community. Many of the strategies and actions in this plan can be supported by Louisville Metro government, but will need to be implemented by individuals, families, businesses, churches, neighborhood groups, non-profit organizations, and others.

An important role for Louisville Metro Government is to lead by example. When new strategies and actions are implemented at the government level, they provide powerful showcases for the rest of the community.

Actions

- Make all city meetings and events zero waste and carbon neutral 🌿♻️
- Demonstrate sustainability in LMG's day-to-day operations, with durable goods, tracking emissions of purchased goods, installing solar panels, prioritizing permeable materials, nature-based solutions to flooding, and other high-profile actions 🌿♻️
- Highlight sustainable businesses and organizations ♻️🌿♻️
- Create demonstration projects to motivate local residents and businesses

Support and/or Expand Existing Efforts

- Increase strength of LMG Division of Community Forestry 🌿

Ecological Society of America Conference 2019

The Ecological Society of America (ESA) is the nation's largest society for professional ecologists. The ESA holds its annual conference in cities around the U.S. A \$5 fee is collected from each registrant to help offset greenhouse gas emissions. The 2019 meeting was held at the Kentucky International Convention Center. \$14,000 was contributed to Louisville sustainability efforts to offset the impacts of attendees and their travel.



OBJECTIVE 24:

Update Policy

Every decision, plan, permit, contract and funding decision affects climate change. Incorporating climate goals (both emissions reduction and preparation) into government processes at every level is an efficient and impactful way to advance climate action.

Given climate change and social inequity are inextricably linked, equity goals also need to be woven into decision-making at every level of government. Much progress is being made to create a culture that values social and economic equity and dismantles discriminatory practices and systems of the past. Faced with the threat of climate change, this progress needs to be accelerated.

Actions

- Prioritize climate action in the LMG’s budget 🔄🌿♻️❤️
- Adopt an LMG environmental justice policy 🌿❤️
- Incorporate consideration of climate change science, targets, goals, actions, and vulnerabilities into all new policy and decision making 🔄🌿♻️❤️
- Advocate to remove barriers to voter registration and provide support for voting (time off work, transportation, more voting locations, childcare, etc.) 🔄❤️

Support and/or Expand Existing Efforts

- Continue efforts to strengthen LMG policy to prioritize tree planting in vulnerable areas 🔄🌿♻️❤️
- Strengthen regulatory requirements for tree canopy and growth 🌿♻️



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Vision Russell

Imagine if improvements were made so that Louisville’s four poorest neighborhoods, including Russell in West Louisville, experienced the same health, job, income and educational attainment averages as the rest of the city. Such action would save \$377 million, result in 5,000 fewer low-income children, and extend life expectancy by eight years, according to the Greater Louisville Project.

Efforts are being made towards this goal. The Vision Russell Choice Neighborhood Initiative is a collaborative effort to create and implement a dynamic and transformative plan for the Russell neighborhood, including the Beecher Terrace public housing development.



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OBJECTIVE 25:

Conduct Education and Outreach

Every person, business, and sector throughout Louisville is affected by climate change and needs to take action. Raising awareness of the risks Louisville faces due to climate change and partnering with community members to take steps to prepare for impacts and cut emissions are critical to ensuring resilience. LMG can proactively work with community organizations, nonprofits, neighborhood associations, churches, education institutions, business networks and other community hubs to achieve advance communication and outreach efforts.

Topics for education and outreach efforts to include:

For Home and Landowners

- Measures to reduce loss of tree canopy on private lands
- Importance of tree canopy and shade for wellness
- Participation in MSD downspout disconnection program
- Reduction in pesticide/herbicide use
- Green infrastructure

For Business Owners

- Sustainability actions for business/industry that can become habitual
- Make a business case for sustainability and climate action

For Both

- Specific sustainability actions that make a difference
- Recovery process and resources after flooding and other disasters
- Pollution and sediment control measures
- Awareness of programs to support energy efficiency and renewable energy



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For All Residents

- Air quality regulations, conditions, and health impacts, including asthma
- Education on asthma and air quality
- Develop and disseminate neighborhood disaster evacuation plans
- Emergency preparedness that builds community connections
- Community organizing to increase leadership, engagement, and support on climate change
- Civic engagement including voting and advocacy
- Climate advocacy from everyday people
- Public art (music, visual) related to climate action
- Value of biodiversity
- Citizen engagement and participation in the use of parks

GLOSSARY

100-year flood zone – the land that is expected to be flooded due to a flood event that has a 1 in 100 chance of being equaled or exceeded in any given year.

Biodiversity – The overall number and types of species of plants and animals in a particular place or habitat.

Biota – the animal and plant life of a particular region or habitat.

Bioswales – Channels or other low-lying areas that use plant materials and soil mixes to treat, absorb, and convey stormwater runoff, as an alternative to storm sewers. They improve water quality by removing debris and pollution. They also provide landscaping that, depending on the plant species chosen, may create habitats for birds, butterflies, and local wildlife.

Brownfields – A property that may have soil or groundwater contamination.

Carbon Storage or Sequestration – The removal of carbon (CO₂) from the atmosphere to be stored elsewhere, especially in natural systems, such as trees, soils, and wetlands.

Clean energy – Energy used by people and businesses that doesn't cause pollution. Includes electricity, transportation, buildings, and food systems.

Climate Change Adaptation – Actions that protect people or nature from, or prepare them for, the current and future impacts of climate change.

Climate Change Mitigation – Actions that reduce greenhouse gas emissions (primarily from fossil fuels combustion) or increase the storage of carbon (primarily in soils, forests, and other natural systems).

Climate Equity – Removing obstacles to climate resilience such as discrimination, poverty and their consequences.

Contaminant/toxin/pollutant – a substance that makes something less pure or makes it poisonous (contaminant); any substance poisonous to an organism (toxin); any substance, as certain chemicals or waste products,

that renders the air, soil, water, or other natural resource harmful or unsuitable for a specific purpose (pollutant).

Ecosystem services – Represent the many and varied benefits of a healthy natural environment. They include the production of food and water, the control of climate and disease, nutrient cycles and oxygen production, and spiritual and recreational benefits.

Energy efficiency – is the reduction of the amount of energy required to provide the same level of products and services.

Equity – Achieving the same level of opportunity based on variable levels of support and assistance depending on the difference in historical disparity and current need. Some types of equity of concern include racial, economic, social, and intergenerational.

Food Desert – Underserved areas that lack fresh, healthy food options.

Food Insecurity – An economic or social condition of limited or uncertain access to adequate food supply.

Fossil fuels – a group of energy sources that were formed when ancient plants and organisms were subject to intense heat and pressure over millions of years. There are three major types of fossil fuels: coal, oil, and natural gas.

Fresh Stop Markets – volunteer, community-driven farm-fresh food markets that pop up at local churches, community centers, and businesses in food insecure neighborhoods.

Gentrification – a process of changing the character of a neighborhood through the influx of more affluent residents and businesses, often shifting a neighborhood's racial/ethnic composition and average household income by developing new, more expensive housing, businesses and improved resources.

Green Building design – the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a build-

ing's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction.

Green infrastructure – is the use of natural and engineered ecological systems to provide specific services to the community, often in relation to stormwater management, but also including cooling, pollination, and filtration.

Green roofs – a roof of a building that is partially or completely covered with vegetation, planted over a waterproofing membrane, often with drainage and irrigation systems. Also sometimes called a 'living roof'.

Greenhouse Gas (GHG) – A gas that absorbs infrared radiation (heat) in the atmosphere and contributes to climate change. Greenhouse gases include carbon dioxide, methane, water vapor, nitrous oxide, and others.

HOV – short for "High Occupancy Vehicle" and refers to a motor vehicle carrying more than a specified minimum number of people.

Impervious surfaces – These are land surfaces that repel rainwater and do not permit it to infiltrate (soak into) the ground. Impervious surfaces are mainly artificial structures—such as pavements that are covered by water-resistant materials such as asphalt, concrete, brick, stone—and rooftops. Soils compacted by urban development are also highly impervious. (Also see "Pervious surfaces").

Infill – In urban planning infill refers to developing vacant or under-used parcels within existing urban areas that are already largely developed. The slightly broader term "land-recycling" is sometimes used instead.

Infrastructure – refers to the built environment such as buildings, energy generation and distribution systems, water delivery, storm- and wastewater, floodwalls, roads

and highways, bridges, culverts, and many other basic structures.

Multi-modal transportation – Travel by multiple means of transportation, including biking, driving, taking a bus or subway, riding an electric scooter, etc. It is particularly relevant for people using public transportation, because routes are usually not completely provided by one mode of transportation. For example, walking to catch a bus to a train station.

Natural Capital – the value of natural systems and the services that they provide for humanity, from the inherent value of biodiversity to the economic value of flood abatement, natural pest control, or tourism.

Passive Solar – Technology that uses sunlight without active mechanical systems. Such technologies convert sunlight into usable heat (in water, air, and thermal mass) with little use of other energy sources. This is in contrast to active solar which converts sunlight into electricity.

Pervious surfaces – Surfaces that allow water to percolate through to the area underneath rather than becoming runoff (Also see "Impervious surfaces").

Redlining – In the United States and Canada, redlining is the systematic denial of various services by federal government agencies, local governments as well as the private sector, to residents of specific neighborhoods or communities, either directly or through the selective raising of prices.

Resilience – the ability of people and their communities to anticipate, accommodate and positively adapt to or thrive amidst changing climate conditions and hazard events.

Renewable electricity – Electricity that: (1) can be extracted, generated, and consumed with neutral carbon emissions or no emissions at all, and with no current or future threat to life and the natural environment; and (2) is generated and stored from renewable

resources, which are naturally replenished on a human timescale, such as sunlight, wind, geothermal, tides, and, conditionally, bio-matter and various forms of hydro-power (definition per the LMG 100% resolution).

Renewable energy – Energy produced from sources that do not deplete or can be replenished within a human’s life time. The most common examples include wind, solar, geothermal, biomass, and hydropower.

Riparian vegetation – Refers to the plants along the river margins and banks, and are characterized by plants that like water.

Sustainability – A broad concept that refers to meeting the needs of the present without compromising the ability of future generations to meet their needs.

Urban Heat Island – The increase in temperature within an urban area as compared to the surrounding rural and naturally vegetated areas. This additional heat comes from heat-absorbing buildings, impervious surfaces, channelization of waterways, and the removal of canopy cover.

Vectors – An insect that transmits a disease is known as a vector, and the disease is referred to as a vector-borne disease.

Weatherization – Weatherization or weatherproofing is the practice of protecting a building and its interior from the elements, particularly from sunlight, precipitation, and wind, and of modifying a building to reduce energy consumption and optimize energy efficiency.

REFERENCES

- 1 Because weather varies day-to-day and year-to-year, average climate is generally measured over a period of 30 years. The period of 1961-1990 is often used to represent the “historical” climate as a baseline from which to measure recent and future change.
- 2 Climate change data are sourced from Climate NA, available through the University of Alberta. Wang, T., A. Hamann, D. L. Spittlehouse, and C. Carroll. 2016. Locally downscaled and spatially customizable climate data for historical and future periods for North America. *PLoS One* 11:e0156720.
- 3 For more information on climate change projections for Louisville, see the following publication – Geos Institute. 2019. *Climate Trends Primer: Louisville Metro Region, Kentucky*.
- 4 Data from ClimateNA (University of Alberta) as described in Wang, T., A. Hamann, D. L. Spittlehouse, and C. Carroll. 2016. Locally downscaled and spatially customizable climate data for historical and future periods for North America. *PLoS One* 11:e0156720.
- 5 Union of Concerned Scientists. 2019. *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days*
- 6 See 100 Resilient Cities. 2019. *Louisville Resilience Strategy*.
- 7 Darity, W. et al. 2019. *What We Get Wrong About Closing the Racial Wealth Gap*. Sanuel DuBois Cook Center on Social Equity. Duke University. <https://socialequity.duke.edu/portfolio-item/what-we-get-wrong-about-closing-the-racial-wealth-gap/>
- 8 City of Louisville. 2015. *Urban Tree Canopy (UTC) Fact Sheet*.
- 9 Davey Resource Group. 2015. *Louisville Urban Tree Canopy Assessment*.
- 10 Urban Climate Lab and Georgia Institute of Technology. 2016. *Louisville Urban Heat Management Study*.
- 11 Greater Louisville Project. 2019. *15 Years beyond Merger: 2018 Competitive City Report*.
- 12 Center for Health Equity. 2017 *Health Equity Report: Uncovering the Root Causes of Health*. Louisville Metro Department of Public Health and Wellness. Louisville, KY.
- 13 Greater Louisville Project. 2019. *15 Years beyond Merger: 2018 Competitive City Report*.
- 14 Center for Health Equity. 2017 *Health Equity Report: Uncovering the Root Causes of Health*. Louisville Metro Department of Public Health and Wellness. Louisville, KY.
- 15 Burney, J. A. 2020. The downstream air pollution impacts of the transition from coal to natural gas in the U.S. *Nature Sustainability*. <https://doi.org/10.1038/s41893-019-0453-5>.
- 16 MSD. 2016. *State of the Streams: 2016 Water Quality Synthesis Report*.
- 17 *Ending Food Insecurity: It Will Take Us All*. 2018. A Project of the Lift A Life Foundation and Community Foundation of Louisville. <https://www.cfloouisville.org/ending-food-insecurity-it-will-take-us-all/>
- 18 Aram, F., E. H. Garcia, E. Solgi, and S. Mansournia. 2019. Urban green space cooling in cities. *Heliyon* 5:e01339.
- 19 Active Living Research. 2015. *Making the Case for Designing Green Cities*.
- 20 Engeman, K. et al. 2019. Residential green space in childhood is associated with lower risk of psychiatric disorders from adolescence into adulthood. *PNAs* 116:5188-5193.
- 21 Davey Resource Group. 2015. *Louisville Urban Tree Canopy Assessment*.
- 22 Sustain Louisville. 2012. *Louisville Metro Government*.
- 23 Allen, J. et al. 2016. Associations of cognitive function scores with carbon dioxide, ventilation, and volatile organic compound exposures in office workers. *Environmental Health Perspectives*.
- 24 Greater Louisville Project. 2018. *15 Years Beyond merger: 2018 Competitive City Report*.
- 25 <https://louisvillemsd.org/CriticalRepairPlan>
- 26 *American Communities Survey 2009*
- 27 <https://louisvillemsd.org/CriticalRepairPlan>
- 28 Louisville Metro Government. 2016. *Louisville Metro Hazard Mitigation Plan*.
- 29 Center for Health Equity. 2017 *Health Equity Report: Uncovering the Root Causes of Health*. Louisville Metro Department of Public Health and Wellness. Louisville, KY.
- 30 Intergovernmental Panel on Climate Change (IPCC). 2018. *IPCC Special Report on Global Warming*.