



# CUYAHOGA COUNTY

## Climate Change Action Plan

May 15<sup>th</sup> 2019



# Message from Cuyahoga County Executive Armond Budish

Dear Resident of Cuyahoga County,

Climate Change is real and it is local. The recent UN report that 1 million plant and animal species are at risk of extinction because of human activity is only the latest, frankly, horrifying development. But the good news in that report and in other data is that communities can take local action that can result in positive change. We can stop some of the momentum. Where we cannot change the trajectory, we can make our communities and our residents more resilient. That is what this Climate Action Plan is – our road map for the work that lies ahead. One of the most important things we must do is recognize and focus on the fact that climate change effects our most vulnerable – the poor, the very young, the elderly. These are some of the very same people the County provides benefits and services to every day. The challenge is enormous. To meet it we are focusing on five areas: energy; land use; transportation; ecosystem and health. In each of these areas we brought people and organizations together in a true collaboration. We cannot fight this fight in silos. There is a lot of work to do. Cuyahoga County will not solve the ills of global climate change by ourselves of course. But we will do our part. This plan is one that will evolve as we learn and gain experience in the fight to keep our County safe for our children and for generations to come.



Very truly yours,

*Armond Budish*

Armond Budish  
County Executive  
Cuyahoga County

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Focus Area Groups and Supporting Agencies

Energy

- Cuyahoga County Department of Economic Development
- The City of Cleveland Office of Sustainability
- Cuyahoga Community College
- McDonald Hopkins, LLC
- Cleveland State University
- Case Western University
- Better Together Solar
- Yellowlite Solar
- Keybank
- Greater Cleveland Partnership/Council of Smaller Enterprises
- Cleveland Metropolitan Housing Authority
- Sierra Club
- Green Strategies, LLC
- Emerald Cities
- Gund Foundation
- Cleveland Foundation

Transportation

- Northeast Ohio Regional Coordinating Agency (NOACA)
- City of Cleveland Office of Sustainability
- Greater Cleveland Regional Transit Authority
- Clevelanders for Public Transit
- University Circle, Inc.
- GreenCityBlueLake / Cleveland Museum of Natural History

Natural Systems

- Cuyahoga County Board of Health
- Cuyahoga County Department of Public Works
- Cuyahoga County Soil and Water Conservation District
- Holden Forests & Gardens
- Cleveland Water
- Northeast Ohio Regional Sewer District
- Ohio Sea Grant

Health

- Cuyahoga County Board of Health
- MetroHealth
- University Hospitals

Land Use

- Cuyahoga County Planning Commission
- Northeast Ohio Regional Coordinating Agency
- Trust for Public Land
- Cuyahoga County Solid Waste District
- Cleveland Metroparks
- Cuyahoga County Office of Emergency Management
- University at Buffalo, SUNY

**Special Thank you to Cuyahoga County Administration and Council for their support and leadership on climate action.**





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# Introduction

## Overview of Cuyahoga County Climate Change Action Plan

### Call to Action

When President Trump pulled out of the Paris Climate Agreement in 2017, Cuyahoga County knew it was time to step up its effort in fighting climate change. In July 2017, Executive Budish signed on to the Global Covenant of Mayors for Climate & Energy, joining local governments across the world, including the City of Cleveland, in a commitment to measure, track, and reduce greenhouse gas emissions; and, prepare for the impacts of climate change, especially on those who are most vulnerable. We already know that the impacts of climate change are here in Northeast Ohio with increased temperatures and precipitation, changes to ice cover on Lake Erie, and changes to our growing season.<sup>1</sup>

Local climate change takes place within the context of global climate change and greenhouse gas (GHG) emissions. Carbon dioxide (CO<sub>2</sub>), a potent GHG, has increased from 280 parts per million (ppm) in the pre-industrial era to 400 ppm today, a level that the earth has not seen in at least 800,000 years. This is caused primarily through the burning of fossil fuels, which emits greenhouse gases into the atmosphere. As we burn more coal, natural gas, and oil, the “blanket” of GHGs in the atmosphere gets thicker, and the earth gets hotter.<sup>2</sup>



Climate change affects the natural, built, and social systems we rely on individually and through their connections to one another. These interconnected systems are increasingly vulnerable to cascading impacts that are often difficult to predict, threatening essential services within and beyond the Nation's borders.

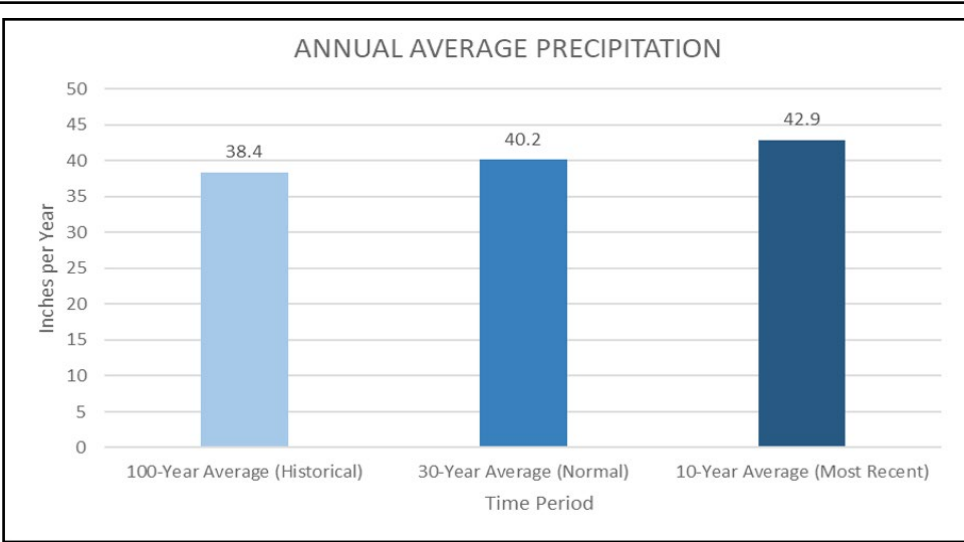
-National Climate Assessment, 2018



### Climate Change Indicators in Cuyahoga County

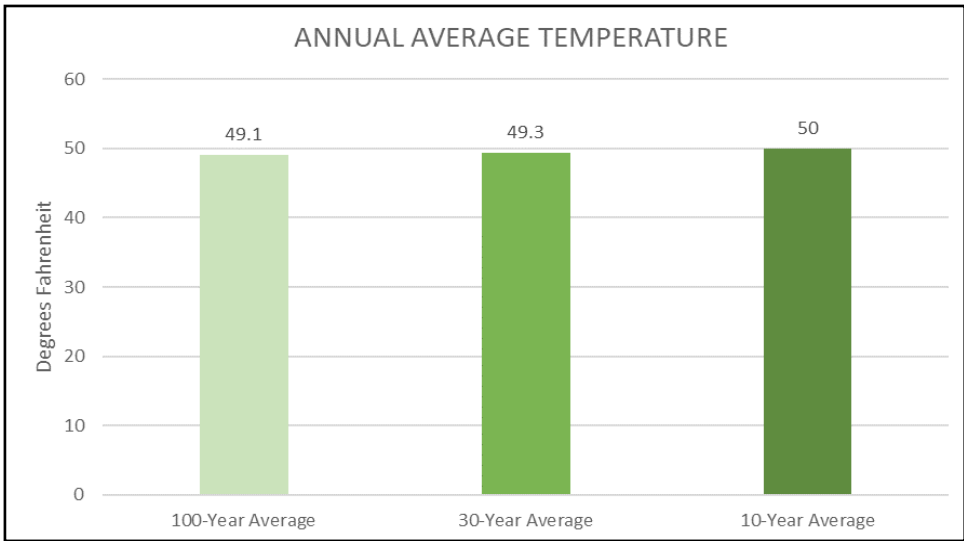
The main climate indicators in our region are increased temperatures and precipitation. The graphs below show increases in average annual precipitation and

temperature. These drastic changes in climate impact the way we plan and live within our region.



Annual Average Precipitation illustrates the three climate periods including: 100-Year Average, 30-Year Average, and the Most Recent 10-Year Average.

Annual Average Precipitation	Inches per period
100 Year Average	38.4
30 Year Average	40.2
10 Year Average	42.9



Annual Average Temperature illustrates the three climate periods including: 100-Year Average, 30-Year Average, and the Most Recent 10-Year Average.

Annual Average Temperature	Average Temperature
100 Year Average	49.1
30 Year Average	49.3
10 Year Average	50

### Climate Change Indicators in Cuyahoga County Continued...

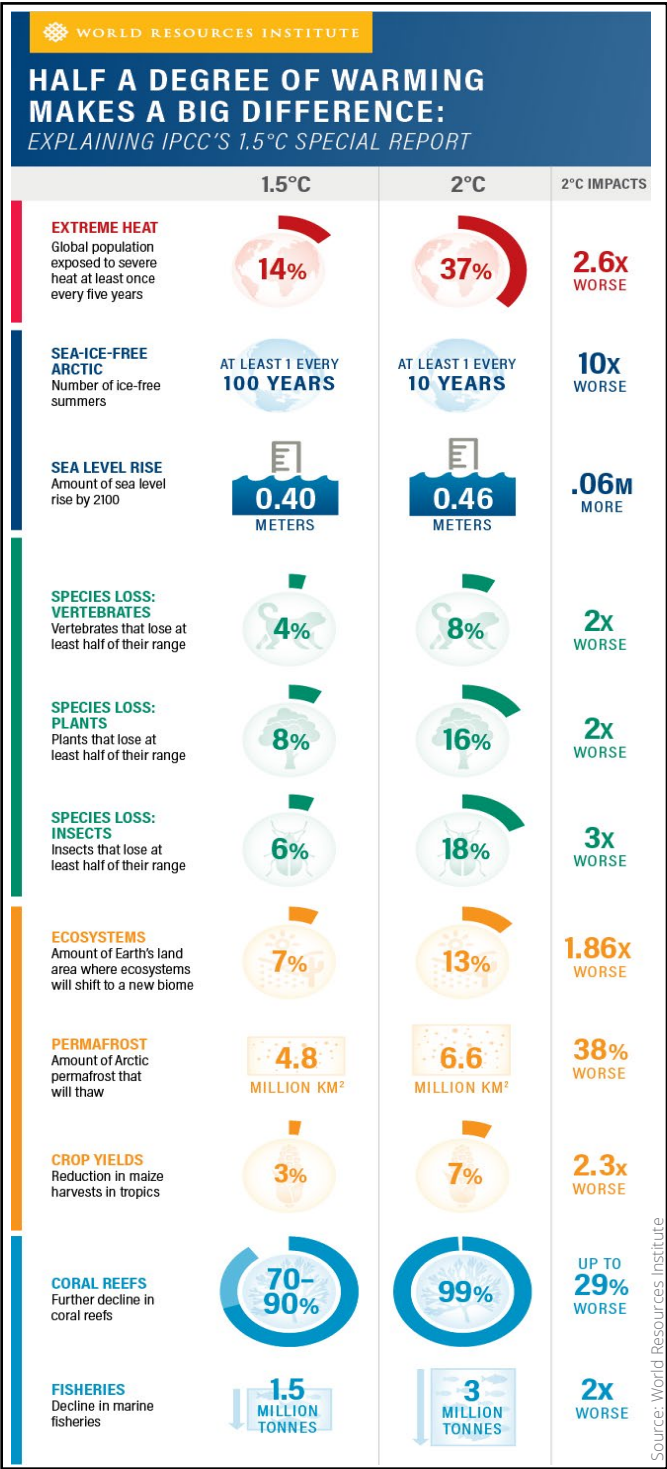
More in-depth information on climate impacts and general best practices for mitigation and adaptation in the Midwestern region can be found in the [National Climate Assessment](#), released in 2018 from the U.S Global Change Research Program.

#### If We Do Not Act Now...

The exponential increase of GHG emissions into our atmosphere has warmed the earth 1°C (1.8°F) since the dawn of the industrial revolution. Global emissions continue to rise as the energy sector is still predominately fossil-fuel based. In addition, transportation-related emissions are increasing. The Intergovernmental Panel on Climate Change (IPCC) projects up to 5.8°C (10.44°F) of warming by the end of the century if drastic measures to mitigate emissions are not taken.<sup>3</sup>

The 2016 Paris Agreement set a goal to limit warming to at most 2°C (3.6 °F) within the century, with a more ambitious limit of 1.5°C (2.7°F). This set the United State's goal to 26-28% emissions reduction below 2005 levels by 2025. However, the IPCC's latest report, released in October 2018, details the difference in climatic changes from 1.5°C (2.7°F) to 2°C (3.6°F) of warming.<sup>4</sup>

The report makes clear that half a degree matters, and we must keep global temperatures from rising above 1.5°C (2.7°F) to avoid catastrophic changes to our climate. This requires reducing global greenhouse gas emissions 45% below 2010 levels by 2030 and reaching net zero emissions by 2050.<sup>5</sup>

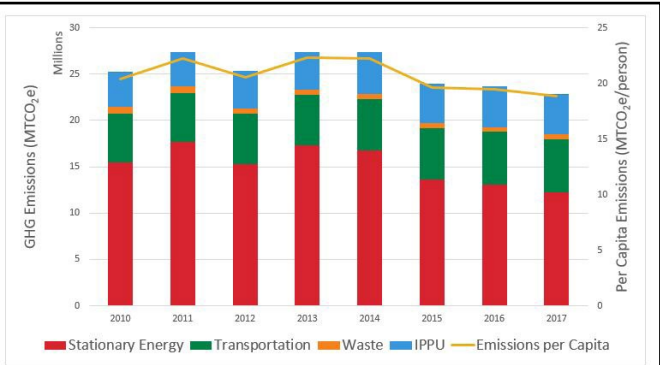


## Cuyahoga County Greenhouse Gas Emissions Inventory

As the first step in the County's commitment to the Global Covenant of Mayors, the Department of Sustainability worked with consultants from the Brendle Group, to conduct our first Greenhouse Gas Emissions Inventory. The inventory was conducted between November 2017 – June 2018 and collected 2010-17 data for the four main greenhouse gas emitting sectors in the region: energy, transportation, industrial processes, and waste. A summary of the findings is included here, and the complete inventory can be found on the [Cuyahoga County Planning Commission's Website](#).

### Summary of Key Findings

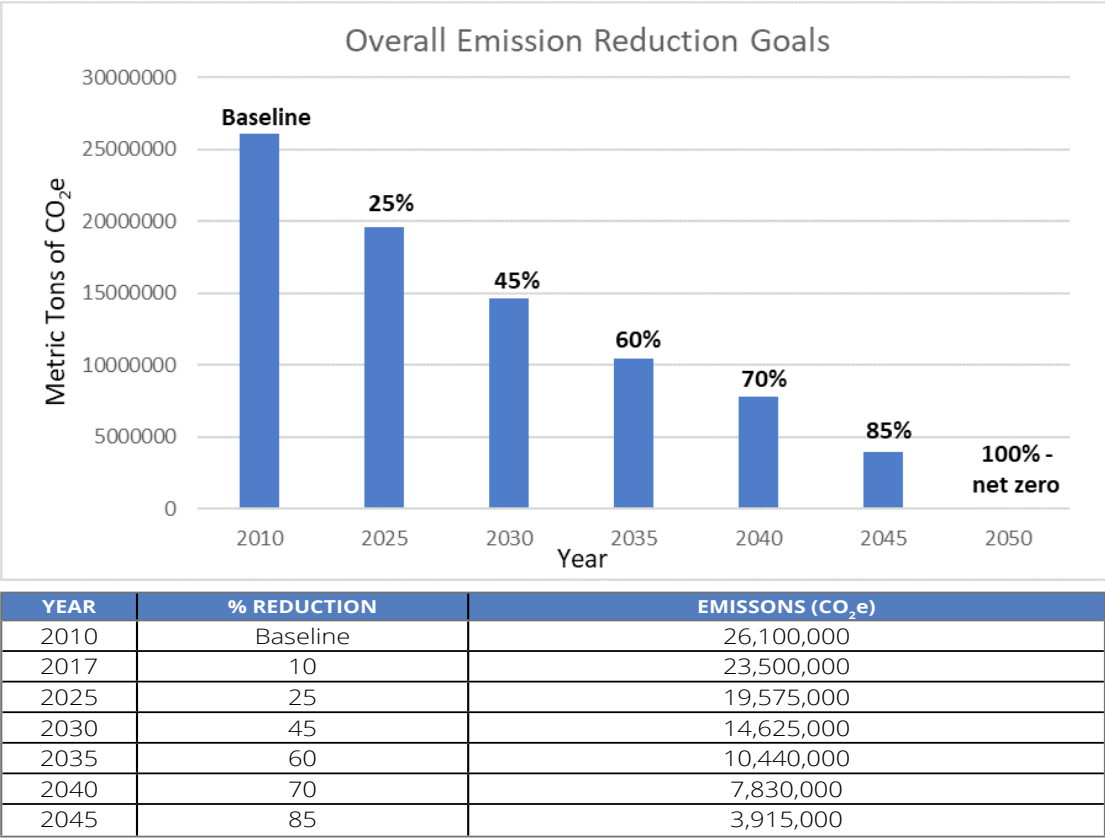
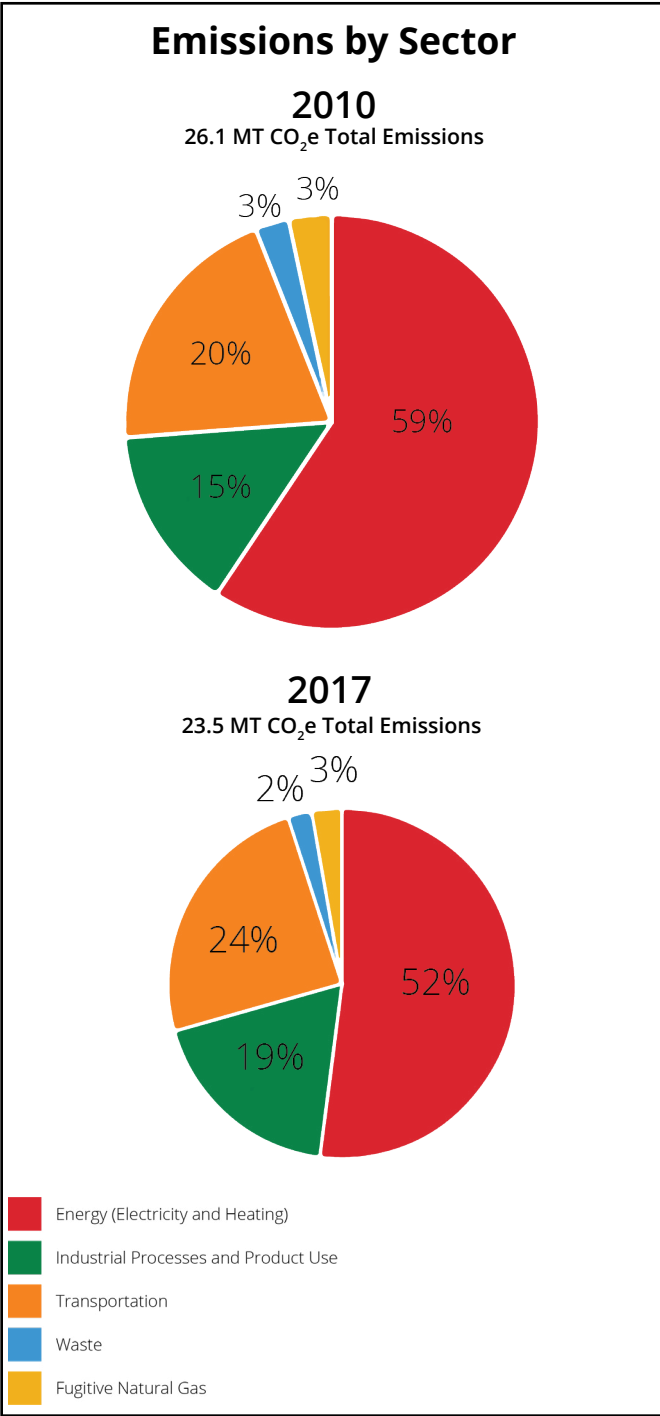
The Global Protocol for Community-Scale (GPC) GHG Inventories was chosen as the basis for the inventory calculations, reporting at the basic level.



- 10% reduction in overall GHG emissions from 26.1 to 23.5 million metric tons of carbon dioxide equivalent (MT CO<sub>2</sub>e).
- 21% reduction in emissions from stationary energy (electricity and natural gas). 9% increase in emissions from transportation.\*

\*While our original data as of June 2018 showed a 9% increase in transportation-related emissions, 2019 updates to the model from our data source significantly changed the trend by showing a slight decrease in emissions over time. The project team is still working to validate and make updates to reflect this. Nevertheless, the goals and actions of the transportation focus area will remain the same as transportation-related emissions still need to be reduced exponentially to achieve our overall reduction goals.

From 2010-17, energy related emissions have decreased from 59% of County total emissions to 52%. However, transportation-related emissions have increased from 20% to 24% of County total emissions.



## Cuyahoga County Greenhouse Gas Emissions Reduction Goals

Following the latest Intergovernmental Panel on Climate Change (IPCC) report, the county aspires to a 45% overall reduction in GHG emissions from our 2010 baseline by 2030 and net-zero emissions by 2050, with following target year reductions as shown above.

Our process began in June 2018, when we presented the findings from our completed Greenhouse Gas Emissions Inventory and Vulnerability Assessment map tool to stakeholder/practitioners across the County.

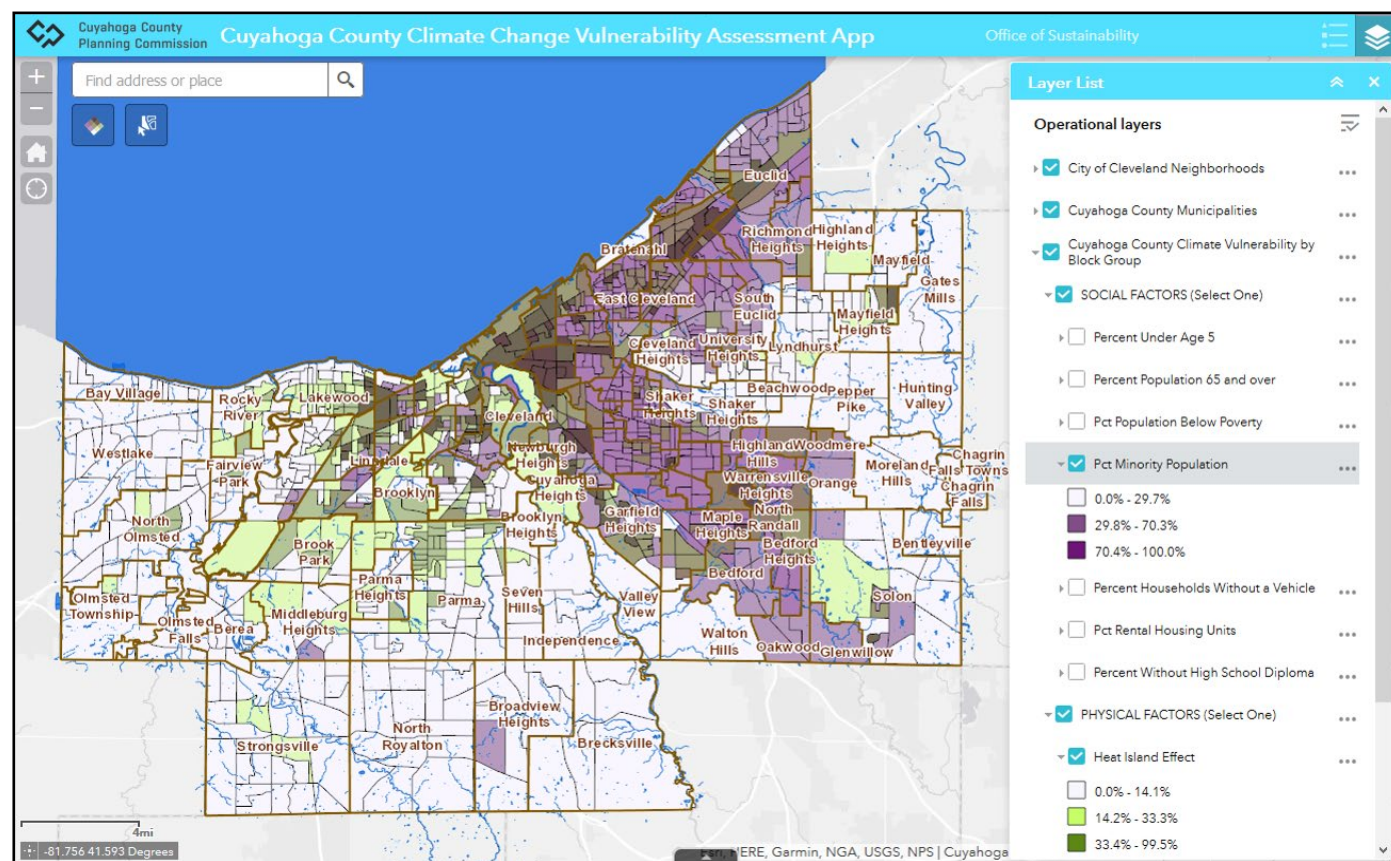
Achieving these ambitious county-wide emissions reductions requires coordinated efforts from our regional stakeholders – municipalities, businesses, non-profits, and citizens. We are fortunate to have so many stakeholders already working towards climate mitigation and adaptation. The efforts of municipalities, non-profits, businesses, higher education institutions, and communities of individuals across the county, have set a solid foundation for our climate action planning.



## Cuyahoga County Vulnerability Assessment

Our [Vulnerability Assessment map](#) identifies both physical and social factors associated with the impacts of climate change. We know that a changing climate will be experienced differently by residents across Cuyahoga County, influenced by factors such as income, age, health, and zip code. Our map, in conjunction with the City of Cleveland's complete [Vulnerability Assessment](#), informs where we should prioritize and focus certain actions and resources as we implement our plan. As the City of Cleveland has identified in their 2018 [Climate Action Plan Update](#),

"the negative effects of climate change such as extreme storms and flooding have been shown to disproportionately impact communities of color and low income communities." Prioritizing actions within communities of color and low-income neighborhoods will have a greater impact because these populations have traditionally been disproportionately effected by pollution sources and development patterns, both of which contribute to climate change.<sup>6</sup> To find out more about the Cuyahoga County Climate Change Vulnerability Assessment App (see [Appendix B](#)).



Source: Cuyahoga County Planning Commission

## Definitions:

**Climate Change** - a change in global or regional climate patterns, in particular a change apparent from the mid to late 20th century onward and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

**Greenhouse Gas (GHG)** - a gas that contributes to the greenhouse effect by absorbing infrared radiation. The following are various Greenhouse Gases emitted into our atmosphere through driving, energy production, etc:

- **Carbon Dioxide (CO<sub>2</sub>)** - a colorless, odorless gas produced by burning carbon and organic compounds and by respiration. It is naturally present in the air (about 0.03 percent) and is absorbed by plants through photosynthesis. CO<sub>2</sub> is the major driver of climate change. Due to the burning of fossil fuels there is now more CO<sub>2</sub> in the atmosphere than at any time in the last 3 million years. CO<sub>2</sub> is the most abundant greenhouse gas because it can remain in the atmosphere for hundreds, even thousands of years.

- **Nitrous Oxide** - a colorless gas with a sweetish odor, prepared by heating ammonium nitrate. It produces exhilaration or anesthesia when inhaled and is used as an anesthetic and as an aerosol propellant.
- **Methane** - a colorless, odorless flammable gas which is the main constituent of natural gas. It is the simplest member of the alkane series of hydrocarbons is produced by decomposition of vegetation.
- **Chlorofluorocarbons (CFCs)** - are nontoxic, nonflammable chemicals containing atoms of carbon, chlorine, and fluorine. They are used in the manufacture of aerosol sprays, blowing agents for foams and packing materials, as solvents, and as refrigerants.
- **Metric Tons of CO<sub>2</sub> equivalent (MT CO<sub>2</sub>e)** - Standard units for reporting GHG emissions under international protocol.

## References:

- 1.) Climate Change in the Great Lakes Region. (2014). GLISA. Retrieved from [http://glisa.umich.edu/media/files/GLISA\\_climate\\_change\\_summary.pdf](http://glisa.umich.edu/media/files/GLISA_climate_change_summary.pdf)
- 2.) Climate change causes: A blanket around the Earth. (2018, August 08). Retrieved from <https://climate.nasa.gov/causes/>
- 3.) Leahy, S. (2017, December 06). Earth Will Likely Be Much Warmer in 2100 Than We Anticipated, Scientists Warn. Retrieved from [https://motherboard.vice.com/en\\_us/article/xwvx5q/earth-will-likely-be-much-warmer-in-2100-ippc-projections](https://motherboard.vice.com/en_us/article/xwvx5q/earth-will-likely-be-much-warmer-in-2100-ippc-projections)
- 4.) IPCC, 2018: Summary for Policymakers. In: Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp.
- 5.) Levin, K. (2018, October 7). 8 Things You Need to Know About the IPCC 1.5°C Report. Retrieved from <https://www.wri.org/blog/2018/10/8-things-you-need-know-about-ippc-15-c-report>
- 6.) United States, City of Cleveland, Mayor's Office of Sustainability. (2018). Cleveland Climate Action Plan Update.

# Focus Areas

## Energy

*100% Renewable Energy by 2050.*

**Page 19**

## Transportation

*Cleaner Fuel Vehicles.  
More Public Transit, Biking,  
and Walking.*

**Page 23**

## Natural Systems

*Understand what's coming. Expand and Protect what's here.*

**Page 29**

## Health

*Extreme Weather.  
Extreme Heat.  
New Diseases.  
New Stresses.*

*Be Prepared and Ready.*

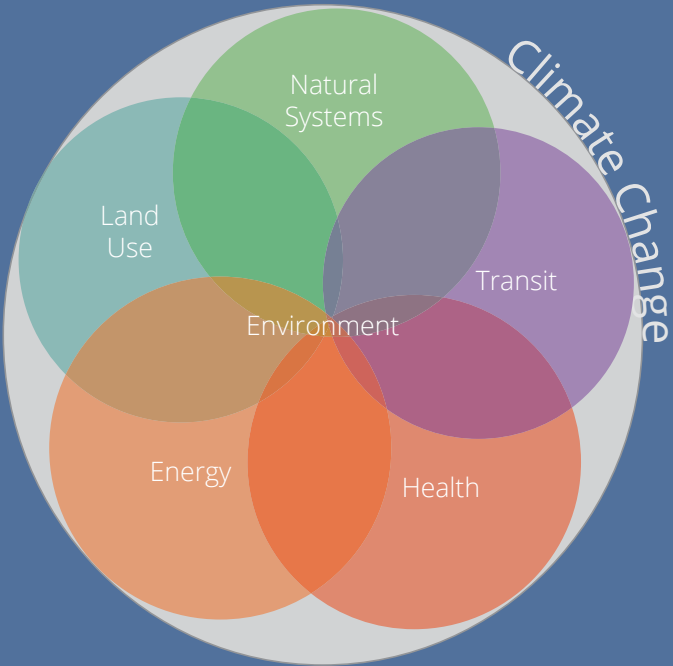
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### Overview of Focus Areas

To achieve both our overall mitigation goals and adapt to an already changing climate, we have identified 5 key focus areas: Energy, Transportation, Natural Systems, Health, and Land Use. Each of these areas is vital to focus our attention on, and we must implement mitigation and adaptation actions in each area to make progress on fighting climate change in Northeast Ohio. Our Energy and Transportation sections focus mostly on **mitigating emissions**, while our Natural Systems, Health, and Land Use sections focus more on **adaptation and preparing for a changing climate**. For each focus area, the County convened a group of stakeholders in the field to provide input on current conditions across the county and to suggest recommendations for mitigation and adaptation, policies, and programs. The work of the focus area groups is captured in individual papers, authored by one lead agency; each one serves as a plan for the County and its partner agencies to implement and track progress from. The following serves as an overview of each area – summarizing our overarching vision and the actions to achieve carbon neutrality and climate resiliency.

### Definitions:

- **Mitigation** – Mitigation strategies work to reduce the amount of emissions going into the atmosphere, and thus, reduce the magnitude of climate change. Examples would be installing solar panels and incentivizing alternative transportation modes.
- **Adaptation** – Adaptation strategies work to prepare humans and infrastructure for the impacts of climate change we are already experiencing and will continue to experience. Examples would be emergency response planning and promoting green infrastructure.



*Each of the Focus Area groups are independent environmental impacts that contribute to overall climate change on local, national, and global scales.*

## Land Use

*Develop Wisely, More Trees and Greenspace.*

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## Focus Areas Interrelation to Climate Change

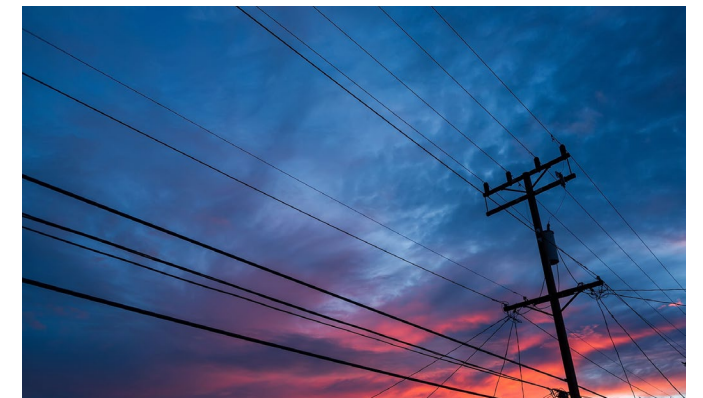




## Introduction

Not surprisingly, energy use is responsible for most of the emissions attributable to Cuyahoga County. People need electricity to keep the lights on and appliances running, and natural gas to heat their homes and workplaces.

This would not be a problem if we had all our electricity powered by renewables or lived in a geography where there was no need to heat our homes when the weather got cold. But of course, we do not. We have winters that can be very cold and summers that can be hot and humid. Energy to make our indoor climate comfortable is supplied principally by burning natural gas and coal.\* Relative to the rest of the United States, and especially the East and West Coasts, Ohio has relatively affordable electricity costs. This is in part due to the abundant natural gas reserves in our region, which contributes to cheaper electricity. Neither State policy, nor market forces have moved fast enough in Ohio for renewable power sources to effectively compete with carbon intensive ones yet. In our region, we currently only receive approximately 2.4%\*\* of our power from renewable resources.



## Impacts

A key finding in our Greenhouse Gas Emissions Inventory is that energy use (electricity and natural gas) make up over half of our total emissions. Continuing to burn fossil fuels for our energy needs will lead to even more greenhouse gases trapped in our atmosphere, further worsening global warming and climate change. We are already seeing the impacts of climate change in our region, as we note in our "Climate Change Indicators" section; these impacts will continue to worsen if we do not do our part to clean up our regional electricity grid and implement more efficiency measures.

### Find Out More:

\* Nuclear power currently provides around 15-19% of the power in Cuyahoga County according to 2017 data from the U.S. Energy Information Administration and PJM, the area's regional transmission organization. However, the future of nuclear power in northern Ohio is uncertain. FirstEnergy Solutions, which operates the Perry Nuclear Power plant that supplies Northeast Ohio, has declared bankruptcy, and is looking to sell its nuclear plants. But the cost of nuclear power generation makes it likely that the plant may close in the near term. Nuclear accounted for 15% of state-wide electricity generation in 2017 according to the [EIA](#). For [PJM](#) territory in 2017, nuclear accounted for 19% of installed generation capacity.

\*\* Calculations based on 2017 data obtained from the U.S. Energy Information Administration's (EIA) Electricity Data Browser available [here](#). This data includes small-scale, behind-the-meter deployment of solar PV. The EIA defines "renewable resources" as including conventional hydroelectric power, wind, biomass, solar, and geothermal. See "What is U.S. electricity generation by energy source?" [here](#).

"The Midwest is a major consumer of coal. In 2015, coal provided 56% of the electricity consumed in the region, and the eight states in the region accounted for 32% of the Nation's coal consumption (in BTUs)."

-National Climate Assessment, 2018



## Solutions:

We believe that the public sector must step in to drive clean energy development and energy efficiency forward in our state. It is evident that the private market cannot/will not effectively overcome financial and historical barriers in implementing clean energy before our region, and our world, begins to see the worst effects of climate change.

As a County, community-wide, we spend about \$1.39 billion on electricity and \$640.1 million on natural gas per year for heating. It is imperative that we, as a County government, help transition more of these dollars to energy efficiency programs and to renewable energy development.

## Strategies We Are Committed To:

- Assess/take inventory of viable solar locations in the county through LiDAR and NASA Satellite data by August 2019.
- Develop a county-wide green bank with a launching minimum of \$25 million available for loans, credit enhancements, and creation of new financing methods to scale up energy efficiency and renewables.
- Continue solar co-operative programs at both the residential and municipal level.
- Advocate at the state/national level for policies that encourage rapid development and adoption of energy efficiency and clean energy – i.e. virtual net metering, community solar.
- Continue to develop brownfields/landfills for clean energy generation.



## Local Efforts: Brooklyn Solar Farm

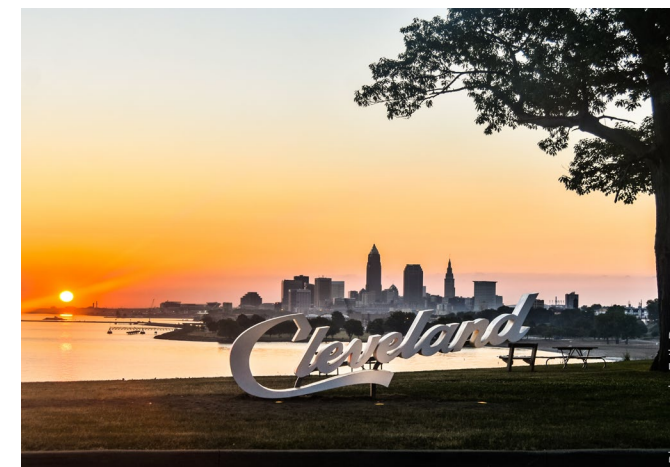
This 4.0MW array was constructed on approximately 17 acres of a 75-acre former landfill site and is designed to generate over 5,000,000 kWh of electricity annually. The system covers about 8% of the electricity consumption for 10 County-owned buildings.

## What You Can Do:

- **Go Solar** – reduce your consumption of fossil fuels from the grid and produce clean energy for your house! Programs like [our solar co-op](#) help residences save money by going solar.
- **Choose clean energy** – we have energy choice in Ohio, you can use the [Public Utility Commission of Ohio's \(PUCO\) online "apples-to-apples" comparison](#) to find and purchase green energy.
- **Weatherize your home** – conduct an energy audit done of your home. Take measures to weatherize your home (wall insulation, efficient windows, etc.) to help make your home more comfortable, save money and help the environment.

## Contributing Agencies:

- Cuyahoga County Department of Economic Development
- Cuyahoga Community College
- City of Cleveland Office of Sustainability
- McDonald Hopkins, LLC
- Cleveland State University
- Case Western University
- Better Together Solar
- Yellowlite Solar
- Keybank
- Greater Cleveland Partnership/Council of Smaller Enterprises
- Cleveland Metropolitan Housing Authority
- Sierra Club
- Green Strategies, LLC.



## Definitions:

**BTU** - British Thermal Unit; defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit.

**LIDAR** - Light Detection and Ranging—is a remote sensing method used to examine the surface of the Earth



# Transportation



Photograph: Erik Drost

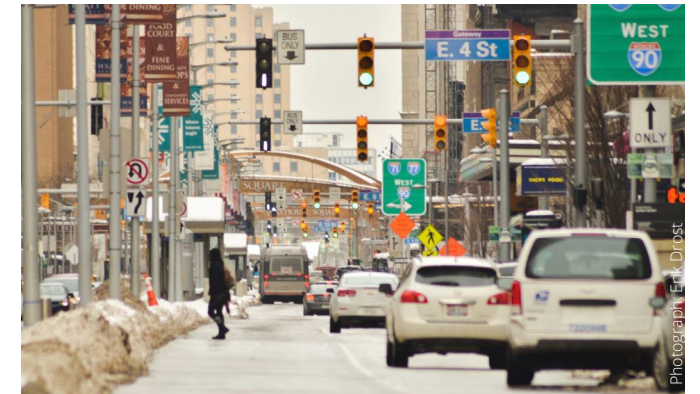
Transportation is vulnerable to the impacts of climate change (extreme heat and precipitation threaten to increase the cost of maintaining infrastructure), but it also contributes significantly to the causes of climate change. In 2016, the transportation sector became the top contributor to U.S. greenhouse gas emissions

-National Climate Assessment, 2018

## Introduction

Cuyahoga County is home to a robust, multimodal transportation system that includes infrastructure for passenger vehicles, freight, transit, biking, walking, and air travel. This includes:

- 5,030.5 total miles of roads, 1,314 bridges, 191.1 total miles of bike lanes and multipurpose trails, 320.2 miles of freight railroad tracks, and 27.4 miles of navigable waterways.<sup>7</sup>
- Three airports (Cleveland-Hopkins International, Burke Lakefront, and Cuyahoga County) that recorded a combined 4.46 million enplanements in 2017, a 9% increase over 2016.<sup>8</sup>
- A port that moved 13.3 million tons of domestic and foreign cargo during 2017, making it the 45th largest port in the United States and the fifth largest Great Lakes Region port in the country.<sup>9</sup>
- The Greater Cleveland Regional Transit Authority (GCRTA), the largest transit agency in Ohio, delivering more than 40% of all public transit trips in the state. During 2017, GCRTA provided 39.6 million passenger trips across its 43 bus, four downtown trolley, two bus-rapid transit (BRT), three light-rail, and one heavy-rail routes. GCRTA operates 443 buses and trolleys, 40 light-rail cars, 52 heavy-rail cars, and 157 paratransit vehicles, and it maintains 19 miles of heavy-rail and 15.3 miles of light-rail tracks.<sup>10</sup>



Photograph: Erik Drost

While greenhouse gas (GHG) emissions have fallen in nearly every sector since 2010, transportation has bucked that trend. Transportation emissions rose 9% from 2010 to 2017 in Cuyahoga County.\* Transportation sector emissions come primarily from on-road vehicles. On-road GHG emissions are a function of four main variables: travel mode choice, fuel efficiency, vehicle fuel type, and total vehicle miles traveled (VMT). The overwhelming majority of on-road vehicles in Ohio have internal combustion engines fired by fossil fuels, though the number of alternative fuel vehicles has begun to slowly increase. In 2010, there were just 614 hybrid vehicles sold in the state; by the end of 2017, there were 74,085 alternative fuel vehicles on Ohio's roads, of which 2,800 (3.8%) were full electric vehicles (EVs) and 4,894 (6.6%) were plug-in hybrid electric vehicles (PHEVs).<sup>11</sup> The chief source of transportation sector GHG emissions in Cuyahoga County is private automobiles.

\*While our original data as of June 2018 showed a 9% increase in transportation-related emissions, 2019 updates to the model from our data source significantly changed the trend by showing a slight decrease in emissions over time. The project team is still working to validate and make updates to reflect this. Nevertheless, the goals and actions of the transportation focus area will remain the same as transportation-related emissions still need to be reduced exponentially to achieve our overall reduction goals.



Cuyahoga County is particularly auto-dependent, with 79.8% of commuters driving alone to work, above the national average of 76.4%.<sup>12</sup> The average commuter drove 24.8 miles roundtrip in Northeast Ohio during 2017, also higher than the national average.<sup>13</sup> The cause of the County's car dependence is its sprawl-based development patterns. While many parts of the country have become denser and more compact in recent years, the opposite has occurred in this region. From 2000 to 2010, the Cleveland urbanized area sprawled by 13.3%, the tenth largest relative increase in the country.<sup>14</sup>

According to the Brookings Institution, the number of jobs accessible to the average resident of the Cleveland metropolitan area fell by 26.5% from 2000 to 2012, ranking the region last of the 96 examined.<sup>15</sup> This mismatch between jobs and housing also undermines the viability of alternative transportation modes. The region's lack of traffic congestion and abundant road infrastructure also makes it fairly cheap and easy to drive around Cuyahoga County, contributing to the decrease in transit and carpooling that we have seen since 2010.

### Impacts

Our local trend of rising transportation-related emissions matches the national trend; transportation-related emissions are the largest emitting sector in the US. If we do not put concerted effort into changing our region's transportation and development habits – centered around commuting, via single-occupancy, fossil-fuel powered vehicles, between sprawled out suburbs and workplaces – we will continue to contribute to climate change and see worsening impacts from it. In its long-range transportation plan, AIM Forward 2040, NOACA forecasts what the transportation system would look like based on current policy and funding trajectories. In this plan, NOACA projected how the region's travel habits will shift based upon these investments from 2015 to 2040. In 2015, 93.7% of trips taken in the NOACA region occurred in passenger vehicles, while biking, transit, and walking accounted for just 0.35%, 2.46%, and 3.47%, respectively.



NOACA projects that travel habits will remain largely unchanged by 2040 with passenger vehicles accounting for 93.4% of trips, transit declining to 2.3%, and walking making up 0.4% and 3.9%, respectively.<sup>16</sup> The Agency also projected the GHG emissions from on-road transportation in the region through 2040. If the projects identified in AIM Forward 2040 are implemented as outlined, NOACA forecasts that GHG emissions in Cuyahoga County will decrease by 25% to 3.9 million metric tons of CO<sub>2</sub> equivalent (MMTCO<sub>2</sub>e), due to improvements in passenger vehicle fuel efficiency that will take place from 2020 to 2035.<sup>17</sup> While the outlook for emissions is hopeful when taking into consideration future fuel efficiency standards, the reductions expected from those standards are not enough to halt the impending catastrophic impacts of climate change.

### Solutions:

The transportation sector is currently going through a large disruptive period. Between ride sharing services like Lyft and Uber, automotive manufacturers producing more and more electric vehicles, bike and scooter share operators moving into cities, and even ideas like the [hyperloop](#) receiving significant pre-development capital, large scale changes are occurring in a relatively short period of time.

We need to be cognizant of and smart about the changes that are occurring, and be ready to adapt rapidly to technologies that have positive emission reduction capabilities. But we also need to use the public transit system we have more effectively and reduce the sprawl that has led to transportation related higher emission scenarios that are unsustainable.

### Strategies We Are Committed To:

#### Reduce Trips Taken by Automobiles

As mentioned in the introduction for this section, trips taken via passenger vehicle is projected to remain almost unchanged in Northeast Ohio through 2040. In order to cut GHG emissions from transportation, Cuyahoga County will have to shift towards more sustainable transportation modes and invest in the infrastructure systems necessary to facilitate this shift.

- Return public transit service and ridership to 2006 levels by 2025 and increase the transit mode share.
- Advocate for increased funding for public transit at the state level.
- Identify and pursue funding options for transit at the local level.
- Increase job accessibility via public transit.
- Make Cuyahoga County a much more bikeable and walkable location in the country and increase the combined mode share of biking and walking.

- Expand upon the existing UHBikes bikeshare to create a robust system that includes dockless bikes, e-bikes, electric scooters, and other recent technologies.
- Create comprehensive Transportation Demand Management (TDM) portfolio for employers and commuters throughout Cuyahoga County.

#### Reduce The Carbon Intensity of The Vehicle Fleet, Community-wide

While it will be necessary to shift as many trips to other modes as possible, the automobile will remain the dominant transportation mode in Cuyahoga County for the foreseeable future. Thus, it will be necessary to make that fleet of vehicles as clean and fuel efficient as possible.

- Ensure that all new vehicles are zero emissions/EVs by 2050.
- Double the fuel efficiency of the vehicle fleet by 2040.
- Make the public and private vehicle fleet in Cuyahoga County cleaner and more fuel efficient:
  - Develop countywide EV plan and implement network of publicly accessible EV charging infrastructure, adding 250 EV charging stations by the end of 2021.
  - Electrify school and transit bus fleets, identify government and commercial fleets to target for electrification and other alternative fuels, starting with school and transit buses.
  - Eliminate all unnecessary vehicle idling.



### Prioritize Dense, Mixed-Use, Transit-Oriented, Infill Development and Efficient Traffic Flow

Northeast Ohio's transportation system was designed to support a population roughly 50% larger than what we have today. This overbuilt infrastructure is expensive to maintain and fostered the region's sprawl and auto dependence. While this existing system has been a challenge to date, it also presents a real opportunity – we can repurpose much of this system for alternative modes of transportation (e.g. dedicated bus lanes, bike lanes) without creating major congestion issues.

- Create model zoning codes that promote mixed-used, infill development and density bonuses.
- Pedestrian Scaled Infrastructure
- Adopt and implement the Cuyahoga Greenways Plan.
- Create model ordinances/zoning codes that reduce/eliminate parking minimums or establish parking maximums in their place.
- Synchronize traffic lights
- Replace traffic lights with roundabouts



### Local Efforts: UH Bikes

UH Bikes launched in 2016 with 250 bikes at 29 stations across the City of Cleveland. The initial program funding came through a grant from the Northeast Ohio Regional Coordination Agency's (NOACA) Transportation for Livable Communities (TLCI) grant. It is run through a public-private partnership between Cuyahoga County, City of Cleveland, BikeCleveland, and Cyclehop. Through May 2019, the system has seen more than 61,000 overall trips and has reduced 101,688 lbs of CO<sub>2</sub> from the atmosphere. The partners received additional funding from the TLCI grant in 2018 and are currently working on expanding the network across the County.

### What You Can Do:

- Try to walk, bike, take public transit, or carpool between destinations.
- Support active transportation policy priorities – bike lanes, public transit, EV infrastructure.
- In the market for a new car? Look into getting an electric vehicle or a hybrid.
- Considering a move? Move closer to your job; reduce your commute!

### Contributing Agencies:

- Northeast Ohio Regional Coordinating Agency (NOACA)
- City of Cleveland Office of Sustainability
- Greater Cleveland Regional Transit Authority
- Clevelanders for Public Transit
- University Circle, Inc.
- GreenCityBlueLake / Cleveland Museum of Natural History

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# Natural Systems



“The ecosystems of the Midwest support a diverse array of native species and provide people with essential services such as water purification, flood control, resource provision, crop pollination, and recreational opportunities.”

-National Climate Assessment, 2018

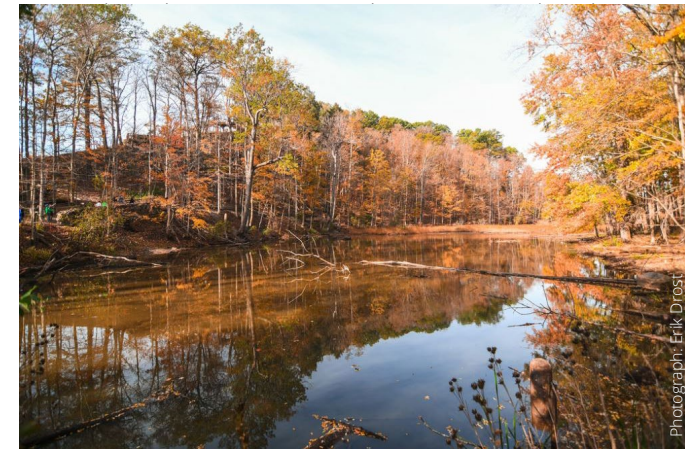
## Introduction

Cuyahoga County is entirely within the Lake Erie Basin, meaning that all rivers, streams, headwaters, ground water, and storm water drain into Lake Erie. This complex network of open water features—lakes, ponds, rivers, and streams—has not only shaped the landscape of Cuyahoga County but provides a diverse living system for terrestrial and aquatic life. It supplies most of this region’s population with water and provides many “ecosystem services”—benefits that improve human health, economy, and outdoor experiences. Our Urban Tree Canopy provides the same benefits; specifically, our tree canopy helps improve water quality, reduces erosion and storm water runoff, saves energy, lowers city temperatures, reduces air pollution, enhances property values, provides wildlife habitat, facilitates social and educational opportunities, and provides aesthetic benefits.<sup>18</sup> The Cuyahoga County Planning Commission’s Greenprint Guide Book, completed in June 2015, provides more in-depth information on natural features across the county and an interactive mapping tool .

## Impacts

### Watershed: Rivers, Streams, and Lake Erie

Lake Erie forms the largest and most significant water feature for Cuyahoga County; it supplies most of Cuyahoga County’s population with water, as well as ecosystem services for human health, economy, and recreation. Additionally, ecosystem functions include sediment transport, floodwater mitigation, water purification and habitat for fish, microorganisms, and macroinvertebrates. Recreational fishing, such as sport angling, and commercial fishing are important for revenue and jobs. However, poor water quality, from algal blooms, industrial chemicals, plastics, and heavy metals threatens the living organisms within our water



There are three main rivers that drain the County: the Chagrin River, the Cuyahoga River, and the most westerly, the Rocky River. Between these rivers watershed systems and tributaries, are numerous small, water-bodies with apparently no connection to any of the rivers or streams. However, they all have subterranean, groundwater connections and with rain and snow-melt, recharge groundwater aquifers.

Increasing precipitation and frequency of heavy precipitation will affect our waterways, with the potential to reduce water quality and increase waterborne diseases that may have consequences on human health. Our [human health section](#) discusses more on the relationship between our watershed, climate change, and human health.

The [Cuyahoga County Board of Health](#) (CCBH) has ongoing programs for monitoring Lake Erie beaches as well as stormwater runoff in rivers.



### Vegetation: Biodiversity, Forests, and Trees, which include Ecological Services

A significant problem in urban environments is the reduction in native vegetation biodiversity due to the removal of indigenous trees, and subsequent planting of exotic and non-native species. Planting lawns has also significantly reduced indigenous plant biodiversity and tree canopy cover. Protecting the existing tree canopy will ensure diverse, indigenous biodiversity. This includes ecological services and resilience in a changing climate. The US Forestry Department's Planning the Urban Forest: Ecology, Economy, and Community Development, provides useful information on maintaining healthy trees and forests in urban areas. Additionally, the Cleveland Tree Coalition lists native tree species and related environmental parameters directly applicable for Cuyahoga and adjacent Counties.<sup>19,20</sup>

### Human Health and Urban Ecology; Aesthetics, Pragmatism and Seeing Green

Urban ecology is a relatively new branch of traditional ecology and includes anthropogenic (human-made) biomes, also known as Anthromes.<sup>21</sup> It uses the same methods as traditional ecology but concentrates on regions with high-density, commercial, and residential buildings with paved roads, parking lots and other impermeable surfaces, limited vegetation, depaupered biodiversity, and a highly modified watershed system. All these features combine to create a unique landscape - the built-environment, highly modified from the agrarian or natural surroundings, and dissimilar to previous, natural ecosystems formerly studied by ecologists.<sup>22</sup> The dense concentrations of humans in urban environments creates unique habitats and concomitant, novel human health conditions. Since more than 50% of the world's population now live in cities, urban ecology and the effects of climate change on human health are pressing issues.<sup>23</sup>



Cuyahoga County is the most extensive, urbanized, built environment, with the greatest amount of impermeable surface and the second most populated County in the State. Consequently, Cuyahoga County it is likely to suffer the greatest effects of climate change impacts on human health and ecosystems.

### Heat Island Effect and Albedo

A feature unique to large 20th Century, industrialised, metropolitan cities is the heat island effect. This is where the temperature of the city with its black and impervious surfaces absorbs infrared radiation and may make the city 12° C (21.6 °F) hotter than the surrounding suburban or rural areas. Even at night the temperature will not drop, increasing consumption of electricity for air conditioners, emissions, utility costs and increase threats to human health. The key ecological issue here is the albedo (whiteness or reflectiveness of a surface) which can be increased by planting trees, having vertical green walls, roof gardens and painting road and black surfaces white.

### Solutions:

We also know that we can act today to both ensure we're monitoring and able to adapt to the inevitable changes that climate change will bring to our ecosystems. We can also ensure that we are preserving and expanding the natural resources, like our tree canopy, in order to help create climate resiliency for our region.

### Strategies We Are Committed To:

- Expand and promote greater adoption of storm water fee credit.
- Integrate climate change mitigation measures into the Cuyahoga County Office of Emergency Management's All Hazards Mitigation Plan.
- Integrate climate change data and projections into the Cuyahoga County Office of Emergency Management's Emergency Operations Plan.
- Establish tree canopy goals with each municipality and across the County.
- Create a County-wide tree fund, prioritizing planting in areas that are most vulnerable, per County Planning's Vulnerability Assessment Tool.
- Promote County Planning's Greenprint Guidebook recommendations.
- Implement the recommendations of the Cuyahoga Greenways Plan.



### Local Efforts: Reinvesting in our Tree Canopy

In his 2019 State of the County Address, Executive Armond Budish announced two significant new programs to positively affect natural systems throughout the regions. 1) As noted elsewhere in this document, the Cuyahoga County Planning Department has developed an extensive plan to increase the amount of bike and pedestrian routes in the County. Our Public Works Department has identified key overlaps with the plan and will spend approximately \$2 million in 2019-20 to expand new routes and help this expanding network. 2) Working with the Soil and Water Conservation District, the County will contribute \$1 million dollars a year for the next five years in conjunction with an expanded tree canopy coverage plan. Trees are vital for many reasons including managing storm water, reducing heat island effect, minimizing local air pollution and enhancing overall mental and physical health. Cleveland and many first ring suburbs especially have woefully low tree canopy percentages. Take a look at our Tree Canopy Assessment [here](#).



What You Can Do:

- Support local efforts to protect our natural environment such as beach clean ups and legislation.
- Try to reduce use of single-use items that can end up littering our environment.
- Stay up to date on the latest research and reports.
- Plant native trees in your yard as they ensure the following ecosystem services:
  - Increase aesthetic value
  - Reduce noise
  - Absorb air pollution
  - Reduce wind velocity
  - Cool and moisten the air
  - Plant trees to shade lakes, ponds and rivers which cool the water and providing an oxygen-rich environment increasing indigenous fish and other aquatic species.
  - Paint dark surfaces white.
  - Cover buildings with vertical vegetation and plant roof gardens.



Contributing Agencies:

- Cuyahoga County Board of Health
- Cuyahoga County Department of Public Works
- Cuyahoga County Soil and Water Conservation District
- Holden Forests and Gardens
- The City of Cleveland Division of Water
- Northeast Ohio Regional Sewer District
- Ohio Sea Grant

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# Health

## Introduction

Cuyahoga County is home to many health care systems, community health centers, non-profits, and businesses. Our major health care institutions include the Cleveland Clinic, University Hospitals, and the County's Metrohealth system. Recognizing that changing climate will add additional stressors and exacerbate risks related to human health, the County is committed to protecting public health by collaborating with a wide variety of regional partners to prepare our residents for the impacts of an already changing climate.

Climate change and the effects on human health are linked in a complex manner. Within the Climate Change and Health Action Plan, six primary focus areas are identified. These constitute the biggest threats related to the impacts of climate change on human health in our region.

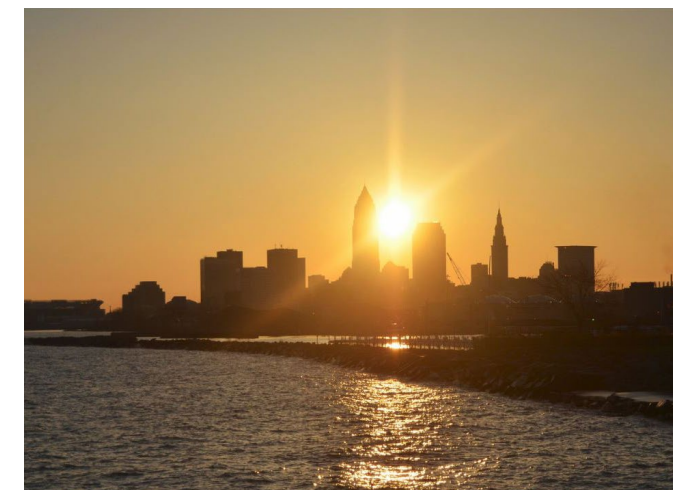
## Impacts

### Extreme Weather

#### Extreme Heat

Extreme heat poses a greater threat to human health than extreme cold. The temperature at which extreme heat starts to become a human health concern occurs at the average human body temperature of approximately 37°C (98.6°F). Beyond this temperature, the human body cannot cool efficiently, which can result in significant health issues, including death.<sup>24</sup> Many homes across the county are not sufficiently equipped to handle extreme heat conditions (lack air conditioning units, etc.), and lack adequate tree canopy for shading.

Studies throughout the United States link the effects of extreme heat from climate change and increasing levels of violent crime. For Cleveland, there is "an absolute increase in crime during hotter conditions", and heat-exacerbated violent crime in the City is more than double the national average.<sup>25</sup>



People with chronic health conditions (e.g. heart conditions, stroke, and obesity) will be more susceptible to heat-related ailments. Social factors (e.g. – poverty and age) will make certain populations more vulnerable. For extreme heat events – temperatures over 35°C (95°F), vulnerable populations include the elderly, young children, mentally ill, outdoor workers, homeless people, those without air conditioning and the socially isolated.<sup>26</sup>

#### Increased Precipitation

Increased precipitation will provide ideal conditions for mushroom and other fungal growth. All fungi produce spores, some of which have a more pronounced effect on human health.<sup>27</sup> The black mold (*Stachybotrys chartarum* syn. *Stachybotrys atra*), commonly found in basements, can cause a major anaphylactic reaction in susceptible humans, especially those with compromised immune response.<sup>28</sup> Basement flooding and damp conditions will proliferate black fungus growth and exacerbate respiratory diseases and asthma.

"Climate change is expected to worsen existing health conditions and introduce new health threats by increasing the frequency and intensity of poor air quality days, extreme high temperature events, and heavy rainfalls; extending pollen seasons; and modifying the distribution of disease-carrying pests and insects."

- National Climate Assessment, 2018

Photograph: Erik Drost



### Food Safety, Nurition and Access

Climate change associated diseases comprised 4.6% of all environmental risks and show a steady increase since 2012.<sup>29</sup> This includes foodborne diseases and the pathogens which affect food safety and human health. These pathogens are thermophilic (meaning they proliferate in warmer temperatures). The temperature danger zone is 5°C- 57.2°C (41°F -135°F) which provides ideal breeding conditions for *E. coli*, Botulism, hepatitis A and E, *Salmonella enterica* and norovirus. This temperature danger zone becomes more important as climate change predicts increased days with temperatures in and above this danger zone. Continued monitoring and inspections of all restaurants and locations producing cooked foods, will reduce foodborne disease outbreaks.

In addition, there are many food deserts that exist across the county; as many as 450,000 people in the county live in one.<sup>30</sup> Food deserts mostly exist in rural, minority, and low-income areas where people lack access to affordable fruits, vegetables, whole grains, and other foods that make up a healthy diet. Global agriculture will be impacted by a changing climate; this will threaten food systems and could contribute to more food deserts.

### Vector-Borne Diseases and Epidemiology

As climate change increases the length of warm weather periods, we will undoubtedly have to deal with changing geographic conditions and an increase in the growing period and lifespan of vectors (mosquitoes, ticks and fleas). This also alters the range of vectors and the potential exposure to emerging vector-borne diseases. Some of the most threatening for Cuyahoga County include tick-borne diseases, like Lyme disease, and mosquito-borne viral diseases, including West Nile, Zika, and Malaria. Rising temperatures associated with climate change, coupled with increasing international travel, will most likely result in an increase in exposure to other tropical diseases such as Dengue and Chikungunya.<sup>31</sup>

### Water Supplies and Waterborne Illnesses

Climate change will directly affect the quantity and quality of freshwater and will lead to increased risk of waterborne disease. Since the Great Lakes region holds a fifth of the world’s freshwater, the quantity of potable water may not be the main problem. However, freshwater quality will be affected by increased precipitation, which can lead to flooding and a resulting increase in the potential for the proliferation of waterborne disease-producing pathogens. Water-related illnesses from toxins produced by harmful cyanobacteria (blue-green algae) blooms will continue to increase. The rising water temperatures, increased agricultural use of nitrogen, and phosphorous-laden stormwater discharges that impact Lake Erie also promote massive toxic-producing algal blooms.<sup>32</sup>

Plastic contamination of freshwater poses a recent and increasing, threat to human and ecosystem health.<sup>33</sup> Plastics do not breakdown into non-plastic components; consequently, plastic debris is now found throughout all the Great Lakes, with Lake Erie the second most contaminated.<sup>34</sup>

In addition, plastic bags, cups, and bottles, metal cans and other containers can provide ideal, urban breeding sites for disease-spreading mosquitoes when they are filled with rainwater during periods of warm weather.

### Air Quality

Vehicles produce many harmful air pollutants, including CO<sub>2</sub> (Carbon dioxide), CH<sub>4</sub> (Methane), N<sub>2</sub>O (Nitrous oxide) and HFC’s (Hydrofluorocarbons, which are used in air conditioners). This not only contributes to greenhouse gas emissions, but also to high levels of ground-level ozone. Ground-level ozone is created when pollutants generated by the burning of fossil fuels and vehicle exhaust combine with nitrogen and other chemicals, and that combination reacts with sunlight. In 2016, Cleveland was ranked ninth in a national study of air pollution-related deaths and serious illnesses in cities. The area suffered an estimated 196 deaths and 487 major health episodes.<sup>35</sup>

Asthma is greatly exacerbated by ground-level ozone.<sup>36</sup> Cleveland is a part of the ‘Ohio Asthma Belt’ that stretches from Louisville/Cincinnati to Northeast Ohio and Detroit.<sup>37</sup> 12% of Clevelanders suffer from Asthma. In 2018, Cleveland was designated as an Asthma Capital by the Asthma and Allergy Foundation of America. It was ranked as the fifteenth most challenging city to deal with asthma.<sup>38</sup>

As previously mentioned, climate change increases the length of the growing season and the plants that produce allergenic pollen. Most significant of these allergenic pollen-producing plants are the Common Ragweed (*Ambrosia artemisiifolia* L.) and Greater Ragweed (*Ambrosia trifida* L.).<sup>39</sup>

### Mental Health and Well-being

Mental health and wellbeing are profoundly interconnected with effects of climate change, rising temperature, drought, extreme weather events, flooding and snowstorms. Combined, these effects increase anxiety, stress, and a sense of helplessness.<sup>40</sup> Looking at trees and greenery improves humans’ sense of well-being, mental and physical health.<sup>41;42</sup>



Numerous studies show at least 8 important physical and mental health benefits from looking at trees and walking in forests<sup>43</sup> Unlike taking prescription drugs, there are no negative side effects and it's free! Substantial portions of Cuyahoga County are highly urbanized; this increases the importance of enlarging existing urban greenspaces to providing urban populations with more access to trees and open spaces<sup>44;45</sup>



### Solutions:

The following is a summary of the [Human Health Plan](#) to ensure that we are preparing for the health impacts of climate change, especially for our most vulnerable communities and individuals.

### Strategies We Are Committed To:

- Develop a warning system for high heat days (establishing a communication plan to provide public information prior to events) and create emergency response plans to prepare for and deal with extreme weather events.
- Ensure local agencies are collaborating to identify areas with populations vulnerable to extreme heat and to develop programs to address their needs.
- Monitor and report occurrences of disease causing vectors – i.e. ongoing monitoring and trapping, identification and testing of mosquitoes and ticks with subsequent eradication if necessary.
- Develop educational materials and coordinate workshops for community officials and planners, health care providers, etc. on the wide range of health impacts associated with climate change.
- Continue working with partners to establish sources of safe and healthy foods in neighborhoods identified as “food deserts” and promote urban agriculture and locally sourced foods.



### Local Efforts: MetroHealth EcoDistrict

When MetroHealth launched its Campus Transformation initiative in 2018, a big aspect of it was turning its neighborhood into an EcoDistrict. Located in the Clark-Fulton neighborhood, MetroHealth is committed to their neighbors and sustaining a prosperous community that is healthy, vibrant, and fun, which is the mission of the EcoDistricts’ movement. The EcoDistrict planning and implementation process serves as a nexus for multiple stakeholder organizations, including Cuyahoga County, the City of Cleveland, Cleveland Neighborhood Progress, the MetroWest and Tremont West CDCs, the Greater Cleveland Partnership, the Cleveland Foundation, Enterprise Community Partners, and, most importantly, the residents of the surrounding neighborhoods. Together they are endeavoring to revitalize this neighborhood toward greater resilience, sustainability, and equity. Projects already in the works include the MetroHealth Line bus-rapid-transit (BRT) system, a free neighborhood wi-fi network, the La Villa Hispana Streetscape, an extension of the Towpath Trail, and the Lincoln Building rehabilitation project that includes a new home – in the neighborhood – for the MetroHealth Police Department. Learn more about MetroHealth’s commitment to the health of people and the planet [here](#).



MetroHealth Campus Map





### What You Can Do:

- Choosing alternative transportation modes – walking, biking, transit – helps reduce harmful pollutants that lower our regional air quality and threaten human health.
- Walk along leafy lanes to reduce stress and promote well-being.
- Increase outdoor exercise, it reduces anxiety and improves mental and physical health.
- Reduce expensive and impervious lawns by planting trees and native plants species.
- Plant indigenous trees, they reduce flooding, are calming to look at, cool the house and reduce utility bills, and provide habitat for birds and other indigenous biodiversity.
- Improve diet by eating health locally grown foods, reduce red meat to one meal a week, and start a garden in your backyard to reduce VMT to your local grocery store.
- Improve mental health and well-being by establishing conversation groups to talk about climate change anxiety.



### Definitions:

- **Epidemiology** - the branch of medicine which deals with the incidence, distribution, and possible control of diseases and other factors relating to health.
- **Vector-borne zoonotic diseases** - Animals, such as mosquitoes or ticks which act as agents (vectors) and spread diseases from non-human animals to human animals e.g. Zika, West Nile Virus, Rift Valley Fever Virus.
- **Arbovirus** – viruses transmitted by Arthropods which are all jointed legged animals e.g. mites, ticks, mosquitoes, spiders, centipedes.

### Contributing Agencies:

- Cuyahoga County Board of Health
- MetroHealth
- University Hospitals

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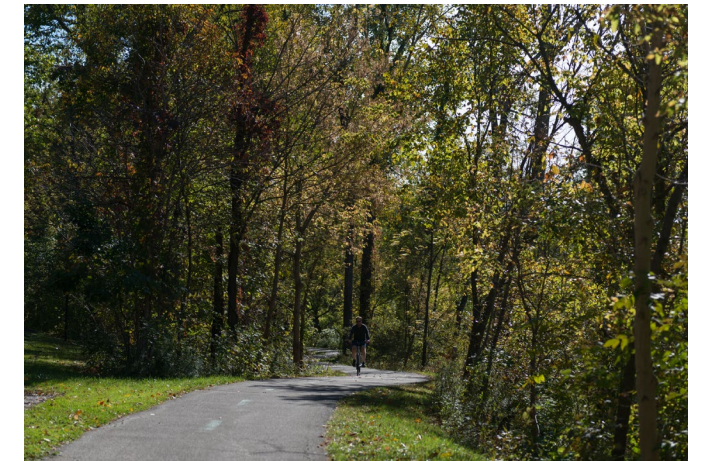
Photograph: Erik Drost

## Introduction

As part of its [Policy Guide on Planning and Climate Change](#), the American Planning Association recognizes that land use patterns and development have a significant influence on Vehicular Miles Traveled (VMT). Therefore it is vital we acknowledge our current land use and development patterns within Cuyahoga County; all while working towards implementing sustainable development practices, linking routes to provide a regional transit network for bicycles and pedestrians, and be environmentally coconscious when planning for our future.

Cuyahoga County encompasses nearly 460 square miles, almost completely built-out with the following land uses:

- Residential is 53% of the total land area (244 square miles).
- Parks & Open Space is 15% of total land area (69 square miles).
- Industrial is 9% of total land area (41 square miles).
- Commercial is 6% of total land area (28 square miles).
- Institutional is 5% of total land area (23 square miles).
- Transportation & Utilities is 3% of total land area (14 square miles).
- Vacant\* is 9% of total land area (41 square miles).



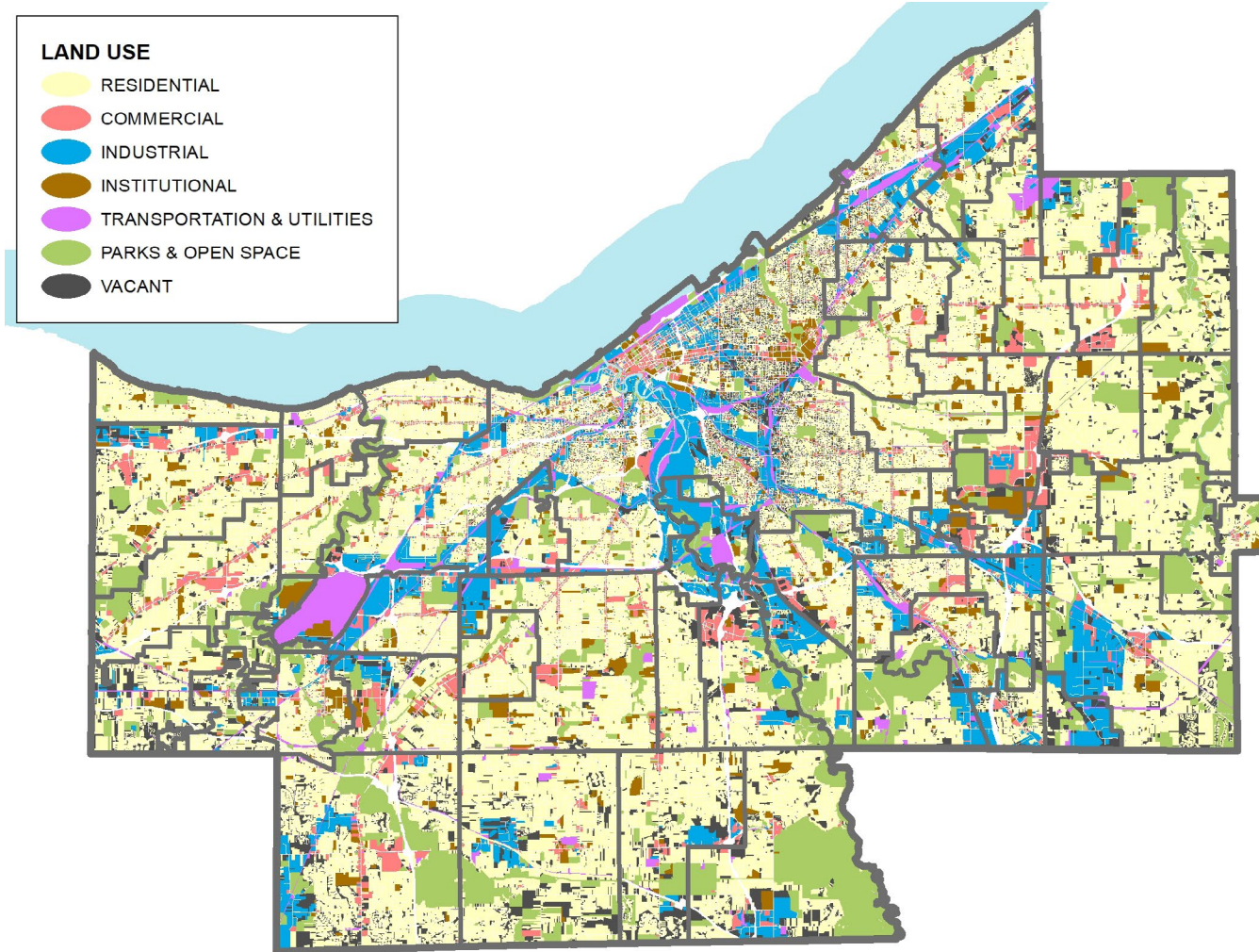
Cuyahoga County has witnessed unchecked urban sprawl and its adverse impacts on daily commutes, and development at the regional and local levels. Between 2010 and 2017, Cuyahoga County has experienced an 8.2% decrease in population; by 2050, while surrounding counties continue to increase in population. From 1990 to 2015, over 18,000 single-family residences were built in eight exurban suburban communities, while during the same period, only 4,600 new homes were built in Cleveland.

“Land conversion, and a wide range of other stressors, has already greatly reduced biodiversity in many of the region’s prairies, wetlands, forests, and freshwater systems. Species are already responding to changes that have occurred over the last several decades, and rapid climate change over the next century is expected to cause or further amplify stress in many species and ecological systems in the Midwest.

-National Climate Assessment, 2018

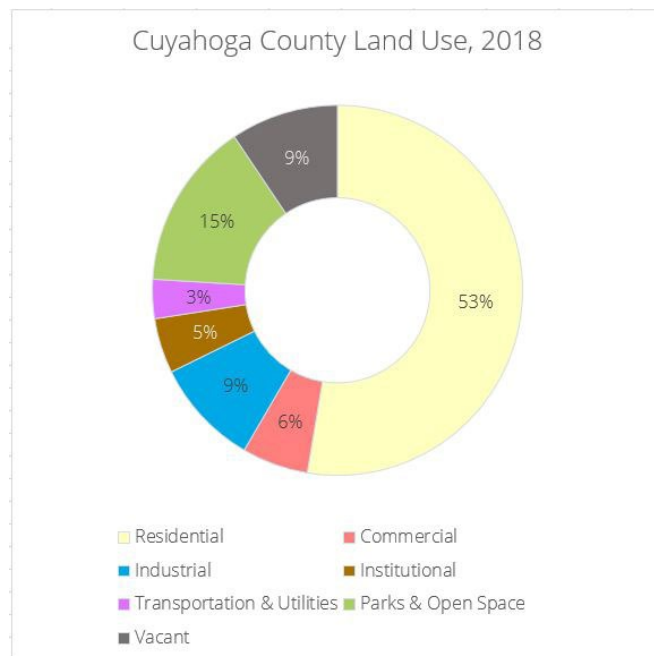
\* Vacant Land Use is a combination of Residential, Industrial, Commercial, Institutional, and Municipal parcels that have either not been developed or had a structure that has been demolished as of the date of publication of map on the next page.





When looking at the County as a whole, the impact that driving has on land use can be seen in development patterns and shows that compact development can reduce the number of VMT up to 40 percent.

If the rate of urban sprawl continues, it becomes important to promote infill and compact developments within the region. By expanding infill and compact development efforts, the County could expect to see reduced VMT, which then could also reduce total transportation related CO<sub>2</sub> emissions.



## Impacts

If nothing changes, Cuyahoga County and the region will continue to be at risk, and there will be extensive and irreversible impacts. According to the National Climate Assessment, "The impacts of climate change are already being felt in communities across the country. More frequent and intense extreme weather and climate-related events, as well as changes in average climate conditions, are expected to continue to damage infrastructure, ecosystems, and social systems that provide essential benefits to communities. Future climate change is expected to further disrupt many areas of life, exacerbating existing challenges to prosperity posed by aging and deteriorating infrastructure, stressed ecosystems, and economic inequality. Impacts within and across regions will not be distributed equally. People who are already vulnerable, including lower-income and other marginalized communities, have lower capacity to prepare for and cope with extreme weather and climate-related events and are expected to experience greater impacts. Prioritizing adaptation actions for the most vulnerable populations would contribute to a more equitable future within and across communities. Global action to significantly cut greenhouse gas emissions can substantially reduce climate-related risks and increase opportunities for these populations in the longer term."

## Solutions:

To reduce urban sprawl and its associated increase in VMT and GHG, Cuyahoga County can aspire to achieve carbon-neutrality, Cuyahoga County must lead the region with the following actions:

## Strategies We Are Committed To:

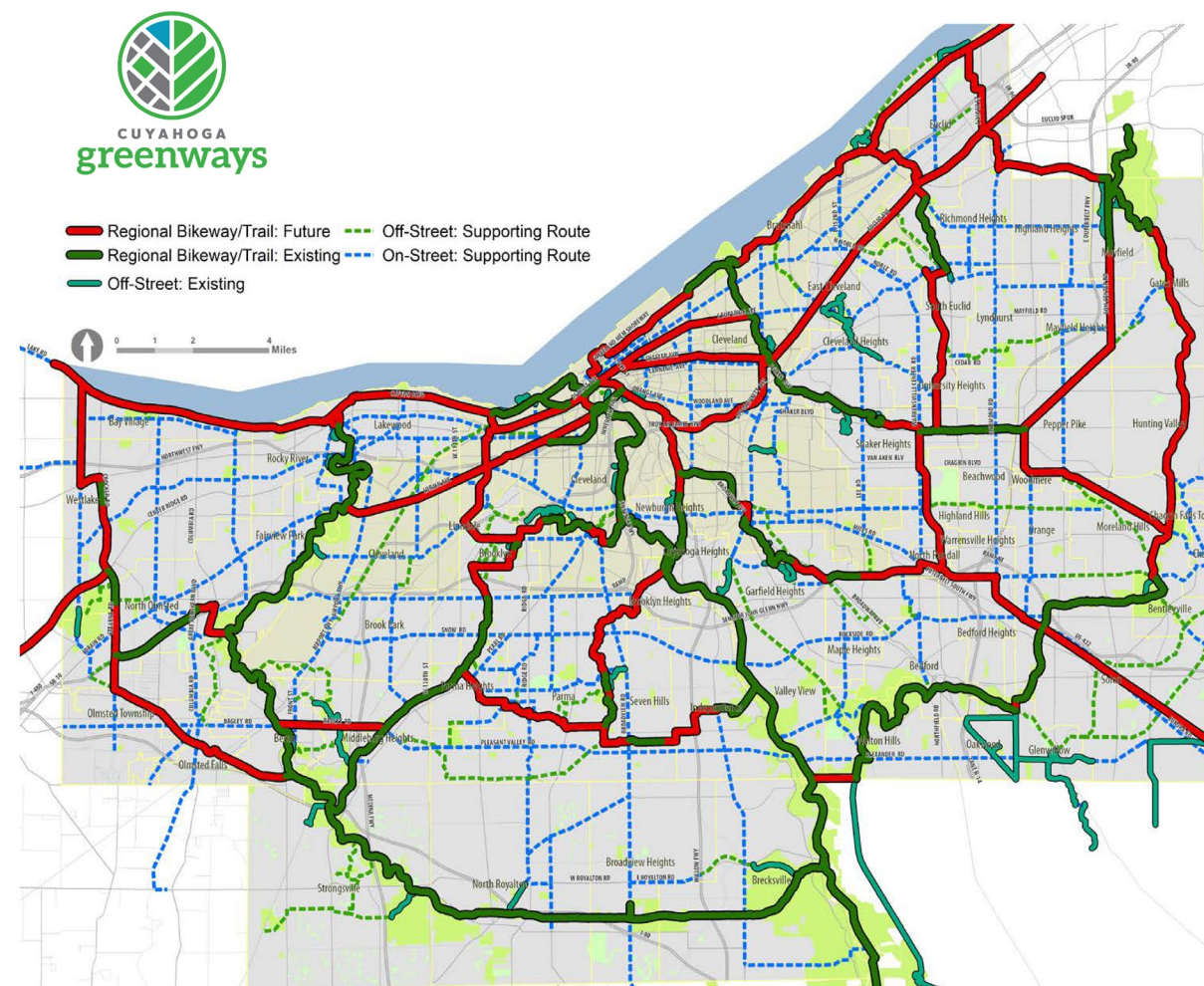
### Incorporate Best Practices in Community Master Plan Updates and Zoning Code Amendments to:

- Promote higher-density mixed-use development to conserve land area and public resources. Communities must plan for development patterns

that mix land uses so that jobs, services, schools, shopping, and other destinations are near residents' homes and neighborhoods.

- Amend zoning regulations to include Design Guidelines for private and public improvements, reduce parking requirements, and incentivize LEED standards. Zoning and other development standards should be more flexible to design residential and commercial developments, neighborhoods, and communities that reduce energy consumption, and promote walkability, bikeability, and transit use.
- Develop a Cuyahoga County 'Complete and Green Streets' model ordinance to promote walkability and bikeability, and to improve stormwater retention and pretreatment. Integrating land use and transportation planning will result in development patterns that support mobility choices and reduce trip lengths, create streets that support active transportation users of all ages and abilities, and accommodate green infrastructure.
- Adopt at the County and municipal levels the Cuyahoga Greenways Plan to promote active transportation options and connectivity between homes, workplaces, parks and transit.
- Establish and sustain tree canopy.
- Manage stormwater at a regional level.
- Improve connectivity between home and work by implementing the recommendations of the Countywide Housing Study and the Place-based Economic Development Strategy. Planning for job centers and appropriately priced housing in close proximity will allow people of all income levels to live close to their workplaces.





### Local Efforts: Cuyahoga Greenways Plan

Cuyahoga Greenways is a countywide initiative to envision, plan, and implement over 800-miles of greenways and urban trails throughout the region. This is a network for non-motorized transportation that is safe and welcoming to all. Key leaders in making this vision come to life are the Cuyahoga County Planning Commission, Cleveland Metroparks, and Northeast Ohio Areawide Coordinating Agency. The goal is to build a connected and accessible trail system that links and binds green infrastructure, community health, and economic vitality.

### What You Can Do:

#### As a City Official, You Can:

- Amend zoning codes to create vibrant mixed-use districts that revitalize commercial districts and promote walkability.
- Incentivize the development community to build projects that are transit-oriented, mixed-use, and inclusionary by offering bonuses for higher-density development.
- Acquire and assemble vacant properties to support infill development.
- Adopt a Complete & Green Streets ordinance to promote multimodal transportation (especially active transportation like walking and bicycling) and green infrastructure, and to create and sustain the urban tree canopy.
- Adopt City Tree replacement policy.

#### As a Developer, You Can:

- Work with established communities to create a market for infill development projects that take advantage of proximity to existing neighborhoods, commercial districts, parks, schools, and job centers.
- Adapt and reuse historic buildings and utilize Historic Preservation Tax Credits.
- Develop projects in urbanized areas with existing utilities and transportation infrastructure, and connections to transit.
- Design and build projects to United States Green Building Coalition LEED (Leadership in Energy & Environmental Design) standards for Building Design + Construction and for Neighborhood Development.



Photograph: Erik Drost

#### As a Homeowner and Citizen, You Can:

- Ask your utility provider for assistance in conducting a residential energy audit of your home.
- Take advantage of existing programs to install rooftop solar panels.
- Create sustainable landscapes and reduce the size of grass lawns with native plants and trees.
- Advocate for and support community efforts to promote best practices and policies such as those outlined above.
- Bike and walk whenever possible to reduce GHG Emissions.



### Contributing Agencies:

- Cuyahoga County Planning Commission
- Cleveland Metroparks
- Cuyahoga County Office of Emergency Management
- Cuyahoga County Solid Waste District
- Northeast Ohio Areawide Coordinating Agency
- Trust for Public Land
- University at Buffalo, SUNY



### Find Out More:

- [American Planning Association, Policy Guide on Planning & Climate Change, 2011](#)
- [Green City Blue Lake, Sustainable Cuyahoga: A Toolkit of Best Practices for Communities in Cuyahoga County, 2016](#)
- [Northeast Ohio Sustainable Communities Consortium, Vibrant NEO 2014: A Vision, Framework, and Action Products for Our Future, 2014](#)
- [U.S. Global Change Research Program, Fourth National Climate Assessment, Volume II Impacts, Risks, and Adaption in the United States, 2018](#)
- [Cuyahoga Greenways](#)

### Definitions:

- **Urban Sprawl**-The term, as used by land developers, planners and governmental institutions, critically describes a pattern of low-density, often unsightly, automobile dependent development that has been a common form of growth outside of urban areas since at least World War II.
- **Land Use**- A use of land that may result in an earth change, including but not limited to subdivision, residential, commercial, industrial, recreational, agricultural and forestry practices, or other development, private and public highway, road, and stream construction, and drainage construction.
- **Zoning**- The division of a city or county by legislative regulations into areas, or zones, which specify allowable uses for real property and size restrictions for buildings within these areas. Also, a program that implements policies of the general plan.
- **Green Infrastructure**- Infrastructure that takes advantage of the natural landscape, and that cleans the air and water, replenishes aquifers, reduces flooding, and moderates the climate.
- **Complete Streets**- describes a program of safe, comfortable, and convenient travel in a community by automobile, foot, bicycle, and transit, regardless of age and ability.
- **Leadership in Energy and Environmental Design (LEED)** - is the most widely used green building rating system in the world. Available for virtually all building project types, from new construction to interior fit-outs and operation & maintenance, LEED provides a framework that project teams can apply to create healthy, highly efficient, and cost-saving green buildings. LEED certification is a globally recognized symbol of sustainability achievement.

### References:

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# Next Steps



“Communities, governments, and businesses are working to reduce risks from and costs associated with climate change by taking action to lower greenhouse gas emissions and implement adaptation strategies. While mitigation and adaptation efforts have expanded substantially in the last four years, they do not yet approach the scale considered necessary to avoid substantial damages to the economy, environment, and human health over the coming decades.”

National Climate Assessment, 2018

As a County, we are committed to building a thriving region that supports people. From bike sharing to clean energy ventures, recycling programs to greenway plans, we and our affiliated agencies have completed many projects that help reduce our carbon footprint and promote sustainability. While these have been sincere efforts, we know we need to do more. This plan sets the vision for our commitment to systematically address our contributions to climate change and the threats it brings to our region.

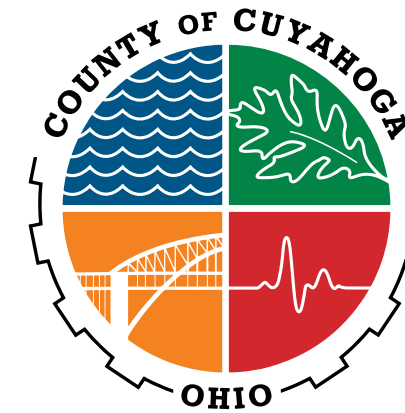
Below are 4 procedural next steps that we plan to complete within the next year.

- **Public Engagement:** This plan, as developed, is our general vision, but just a starting point. We want and need public input and advice. We will work with local media and interested groups to engage the public and solicit feedback.
- **Climate Council:** Develop a County-wide Climate Council that meets at least quarterly and is a place for goal setting, reporting, education, and continued work on focus areas.
- **Data Collection:** Continue data collection and reporting on our greenhouse gas inventory. Publish progress annually.
- **Further Research:** We know we need to conduct further technical and economic analysis on the actions we want to implement. By the beginning of summer 2020, we hope to put a price tag on the work we need to do by 2030. In addition, we want to develop a framework and campaign to create a funding stream(s) that can continuously support clean energy, tree plan expansion, greenway development, health care preparedness, and other activities.



Climate Change is a human caused threat to our collective existence. Individual acts are important, but we need policy and programs that create large scale change in the amount of greenhouse gases we emit into the atmosphere. Through this plan, we are pledging to develop policies and programs that clean up our energy grid, transform how we move around, protect and strengthen our ecosystems, practice smart development, and address the health care consequences that come with a changing climate.





# CUYAHOGA COUNTY

## Climate Change Action Plan

*Appendix A: Key Concepts and Definitions*



*"Together We Thrive"*  
CUYAHOGA COUNTY  
Climate Change Action Plan



# Appendix A: Key Terms

### 1. What is climate change?

First used by Broecker in 1956, and defined as: The temperature increase due to rising CO<sub>2</sub> levels. These climate-induced rising temperatures will cause;

- Change in precipitation (substantial increase or decrease)
- Change in wind patterns and velocity
- Sea level rise; already 35 mm (1.5 ins.) per year as occurring in Florida.

All three factors have profound effects on ecosystems, living organisms, nutrient cycles and human health. In 2016, global sea level was 3.2 inches (82 mm) above the 1993 average—the highest annual average in the satellite record (1993-present).

### 2. What is global warming?

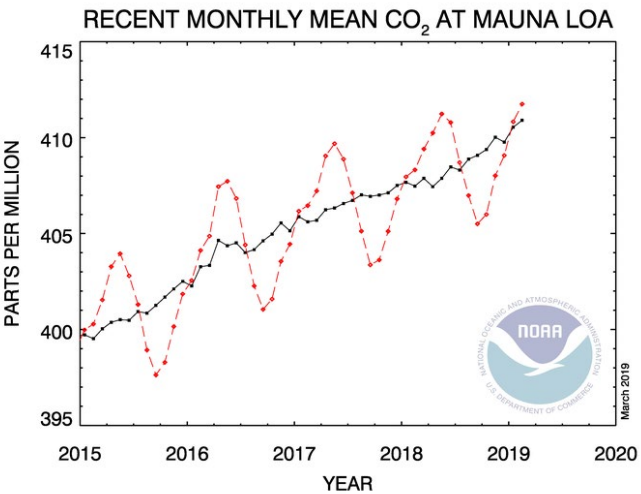
First used by Plass in 1975, and defined as:

The average increase in terrestrial surface temperature, globally, since the Industrial Revolution. Global warming is caused by;

- Emissions of greenhouse gases from burning fossil fuels.
- Land-use change from farming, urbanization, deforestation, desertification and sealed roads which increases impervious surfaces,

### 3. What causes climate change? Why rising CO<sub>2</sub> levels?

Climate change is caused by rising levels of atmospheric CO<sub>2</sub> caused by anthropogenic (human created) burning fossil fuels (coal and oil). A rapid increase has been recorded in the last 50 years, but started with the Industrial Revolution from industrial processes release CO<sub>2</sub>, now augmented by automobile exhaust emissions. An exponential increase in human population, ±1.6 billion in 1900 to ±7.7 billion in 2018, increases consumption, vehicle miles travelled and atmospheric CO<sub>2</sub>. Previously, CO<sub>2</sub> levels were the result of natural processes (volcanoes erupting, herbivory, plants decaying). Current CO<sub>2</sub> levels are largely anthropogenic from industrial processes. Anthropogenic is derived from the Greek antho or andro ‘man’ or ‘human’, and genic or genesis for ‘created’, or ‘made’. Current CO<sub>2</sub> levels are the highest recorded over the last 100 000 years. They have been as high as 7000 ppm in Cambrian era (550 mil years ago). Data from NOAA (see below), shows CO<sub>2</sub> levels for February 2019, at 414.83 ppm, in February 2018 levels were 408.35 ppm and April 13, 2007 levels were 404.83 ppm.



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**4. What is the difference between weather and climate?**

Weather occurs every day, and is happening now, all over the planet. It includes fog, rain, snow, cloud cover, tornadoes, winds and the effects on waves and the ocean. It's what we can see, feel and perceive directly; how hot or cold it will be today, tomorrow or the next day. Weather forecasters on TV or radio, use meteorological data to predict the statistically probability of what the weather may be in the near future, 1 to 5 day time. Predictions for more than a week become too difficult due to stochasticity – randomness, of the variables and sheer number of possible combinations. This is the Butterfly Concept after Lorentz, which states that if a butterfly flaps its wings it might ultimately cause a tornado. The butterfly effect is also known as the “sensitive dependence on initial conditions,” the corollary is that it's impossible to predict the future.

Climate is what has happened historically, in the past, and what models may predict for the future, all over Earth. It includes long-term changes and fluctuations in sea levels, concentrations of atmospheric gases including CO<sub>2</sub>, and other greenhouse gases, extent and thickness of ice-sheets, effects of volcanicity and vegetation composition. All of these ecological parameters are measured and used in modeling predicted changes to climate according to how these forces combine to modify ecosystems and the conditions for live on Earth. Ice cores, marine and freshwater sediment cores, soil cores, dung midden cores, and tree cores are used to determine palaeoclimates, vegetation composition, plant species and atmospheric CO<sub>2</sub> levels in the past.

**5. What are Greenhouse Gases?**

There are four naturally occurring Greenhouse Gases (GHG) and one manufactured (human-made) GHG. The 4 naturally occurring GHG's are; Carbon dioxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Nitrous Oxide (N<sub>2</sub>O) and water (H<sub>2</sub>O) – as vapour. The manufactured GHG is Hydrofluorocarbon (HFC). All GHG's absorb and emit infrared radiation (Infrared radiation extends from the red edge of the visible spectrum at 700 nanometers

(nm) to 1 millimeter (mm). GHG's do not interact with sunlight in the visible spectrum (the human eye sees wavelengths from 380 to 740 nanometers). The greenhouse effect is directly related to the absorption and emission of infrared radiation. Greenhouse Gases include all absorb infrared, while O<sub>2</sub> and O<sub>3</sub> absorb almost all wavelengths shorter than 300 nanometres. Three gasses; Nitrogen, Oxygen and Argon combined equal 99% of the gaseous atmosphere; however, none of these gases absorb infrared radiation and are not Greenhouse Gases.

**6. What is the atmospheric composition of gases, and Greenhouse Gases?**

By volume, dry air contains 78.09% nitrogen, 20.98% oxygen, 0.93% argon and 0.04% carbon dioxide (CO<sub>2</sub> level for February 2019, ≥414 ppm = 0.0414%), with all the other gases combined equalling less than 1 percentage (Scripps CO<sub>2</sub> Program). The four main GHG's have very low percentages in the atmosphere but have huge effect on temperature by absorbing infrared radiation. Clouds (H<sub>2</sub>O) are strong absorbers and emitters of infrared radiation. This is also why it becomes colder at night at higher elevations if there are no clouds to hold and emit infrared.

**7. Why will climate change effects of atmospheric CO<sub>2</sub> continue for thousands of years?**

Even if all emissions stopped today, the inertia - the amount of CO<sub>2</sub> in the atmosphere, will take time to be sequestered (absorbed), and processed by the natural oceanic chemical cycles and terrestrial ecosystems processes (plants and soils) of the earth. Natural processes include terrestrial routes; (soil formation and photosynthesis) and oceanic chemical cycles absorbing Carbon to form carbonate rocks; limestone and dolomite.

**8. What is the Greenhouse Effect?**

The Greenhouse effect is the increased heating of the planet due to the reflection and absorption of infrared radiation by Greenhouse Gases and water vapor.



This is made worse by Chlorofluorocarbons (CFC's) and HFC's. Due to the depletion of the Ozone layer by CFC's and Halogen largely used in air-conditioners, in the mid 1980's, HFC's where invented to replace CFC's and Halogen. CFC's and HFC's have 100-3770 times greater warming potential that CO<sub>2</sub> (Scripps CO<sub>2</sub> Program). However, CFC's, HFC's and Halogen are found in very low concentrations (parts per trillion, ppt) reducing their Greenhouse effect.

**9. What are the effects of climate change on Earth?**

The effects of climate change will continue to increase both terrestrial and ocean temperatures. This effect is triggering acidification of the oceans and possibly freshwater including the Great Lakes, causing bleaching of coral reefs, catastrophic loss of species, icecap melting and sea level rise. Climate change is also increasing energy available for storms resulting in more extreme weather events with greater intensity. Rising CO<sub>2</sub> levels are also reducing the productivity of ecosystems and biodiversity. Major alterations and loss of habitat are occurring with accompanying loss of plants and death of animals and ultimately, extinction of whole species and genera.

**10. What are ecosystems?**

The Merriam-Webster dictionary defines an ecosystem as 'the complex of a community of organisms and its environment, functioning as an ecological unit'. Ecosystems include aquatic, terrestrial and atmospheric ecosystems.

A more detailed definition states: An ecosystem is a community made up of living organisms (biotic) and non-living (abiotic) components such as air, water, altitude, temperature, weather and soils. Other measurable ecological parameters include; atmospheric pressure, wind velocity, solar radiation, cloud cover, land and ocean temperatures and albedo. Some scientists regard the entire Earth as one ecosystem.

**11. What are ecosystem services?**

Ecosystem services are the collective benefits humans gain for free, from naturally functioning ecosystems which include; providing clean drinking water, decomposing wastes, and insect pollination of all flowering plants including crops. The term “environmental services” was introduced in a 1970 report of the Study of Critical Environmental Problems (SCEP, 19701), which listed services including insect pollination, fisheries, climate regulation and flood control. In following years, variations of the term were used, but eventually ‘ecosystem services’ became the standard in scientific literature (Ehrlich and Ehrlich, 1981).



# CUYAHOGA COUNTY

## Climate Change Action Plan

*Appendix B: Climate Vulnerability Assessment*



"Together We Thrive"  
CUYAHOGA COUNTY  
Climate Change Action Plan



# Appendix B: Vulnerability Assessment

## Introduction

A key component of Adaptation planning under the Mayors Compact is to conduct a local Climate Vulnerability Assessment.

The Vulnerability Assessment addresses climate-related hazards to the County as a whole, as well as how those threats might affect different sub-populations within the County. Each of the measures is displayed in three categories depicting low, medium, and high vulnerability.

## Climate-Related Hazards

Due to its regional context, Cuyahoga County and its residents are not directly subject to some commonly associated risk factors like rising sea level or drought. Instead, our local climate risks include extreme precipitation events (both rain and snow), and extreme temperatures.

In 2017, the Cuyahoga County Office of Emergency Management released its “2017-2022 All-Hazards Mitigation Plan”. The Plan currently identifies several “Medium Risk” climate-related hazards (p. 4-2), each of which can be expected to worsen with the effects of climate change:

- Health Related Emergency (including vector-borne diseases)
- Flooding
- Temperature Extremes
- Severe Thunderstorms
- Tornadoes
- Drought

Risk factors were calculated for each hazard, consisting of a combination of ratings of Probability, Impact, Spatial Extent, Warning Time, and Duration. Each rating is scored 1-4 in varying degrees of risk, with a weighting factor for each to calculate and overall risk factor.

which highlights Flooding, Extreme Temperatures, and Severe Winter Storms as “Medium Risk Hazards” in Cuyahoga County. While those hazards have been ongoing threats, they are expected to be exacerbated by effects of climate change.

Table 4-1 Risk Factor Table

	Natural Hazards	Probability		Impact		Spatial Extent		Warning Time		Duration		RF Factor
1	Health Related Emergencies	2	0.6	3	0.9	4	0.8	1	0.1	4	0.4	2.8
2	Flooding	4	1.2	2	0.6	1	0.2	4	0.4	3	0.3	2.7
3	Temperature Extremes	4	1.2	1	0.3	4	0.8	1	0.1	3	0.3	2.7
4	Severe Winter Weather	4	1.2	2	0.6	3	0.6	1	0.1	1	0.1	2.6
5	Earthquake	2	0.6	2	0.6	4	0.8	4	0.4	2	0.2	2.6
6	Severe Thunderstorms	4	1.2	2	0.6	2	0.4	2	0.2	2	0.2	2.6
7	Tomadoes	3	0.9	2	0.6	1	0.2	4	0.4	2	0.2	2.3
8	Drought	2	0.6	1	0.3	4	0.8	1	0.1	4	0.4	2.2

## Cuyahoga County Vulnerability Assessment Tool

With input from the City of Cleveland's Climate Action Plan team, and building upon their comprehensive "Climate & Social Vulnerability Assessment", County Planning has developed a map-based tool to supplement those findings and to help identify specific neighborhoods and sub-populations of the County that have higher degrees of vulnerability to different climate hazards.

The County Vulnerability Assessment mapping tool will allow users to identify clusters among more than 1,100 census block group areas. Users may select combinations of Social and Physical factors (described in detail below), and visualize areas with high vulnerabilities.

Following the methodology utilized by the City of Cleveland in its recent Vulnerability Assessment, each of the eight social and five physical vulnerability measures was assigned a severity category (low, medium, high) and a score based on how each census tract's measure falls in comparison to the countywide mean, as follows:

- Below countywide mean value = 0 points
- Between mean and 1 standard deviation = 1 point
- More than 1 standard deviation above the mean = 2 points

Each of those measures was mapped in light-to-dark shades corresponding to the above categories, with darker shades showing more severe vulnerability. Each of the Social factors are depicted in shades of purple, and the Physical factors in shades of green. When overlaid, areas with more severe combined vulnerabilities appear in darker shades that combine the two color sets.

Click below to view our Interactive version of our countywide Vulnerability Assessment Map:

[Interactive Vulnerability Map](#)

### Social Factors

Cuyahoga County has a diverse population of 1,248,514 as of 2017, the second largest county in Ohio. As in many other metropolitan areas, social vulnerabilities are often considered in a central city vs. suburban context. In actuality, many social vulnerabilities are clustered in particular Cleveland neighborhoods and in several inner ring suburbs (and beyond).

For example, ten suburban communities (in addition to Cleveland) have poverty rates exceeding the County average of 18.3% of households below poverty level (ACS, 2012-2017, Table S1701).

The Social factors considered in the Vulnerability Assessment are listed below. (\*High Correlation with Composite Social Score)

- **Age:** Both the very young and very old are more susceptible to excessive heat and may be less mobile in reacting to a sudden event.
  - *Percent Under Age 5*
  - *Percent Age 65+*
- **Income and Mobility:** Households that are poor, disabled, and/or lack access to vehicles are less able to cope with extreme hazards.
  - *Percent Below Poverty Level\**
  - *Percent of Households Without Vehicle\**
  - *Percent Disabled\**
- **Rental Households:** Renters are less likely to be able to make adaptations to their own dwelling units, such as adding air conditioning or shade trees.
  - *Percent Rental Units\**

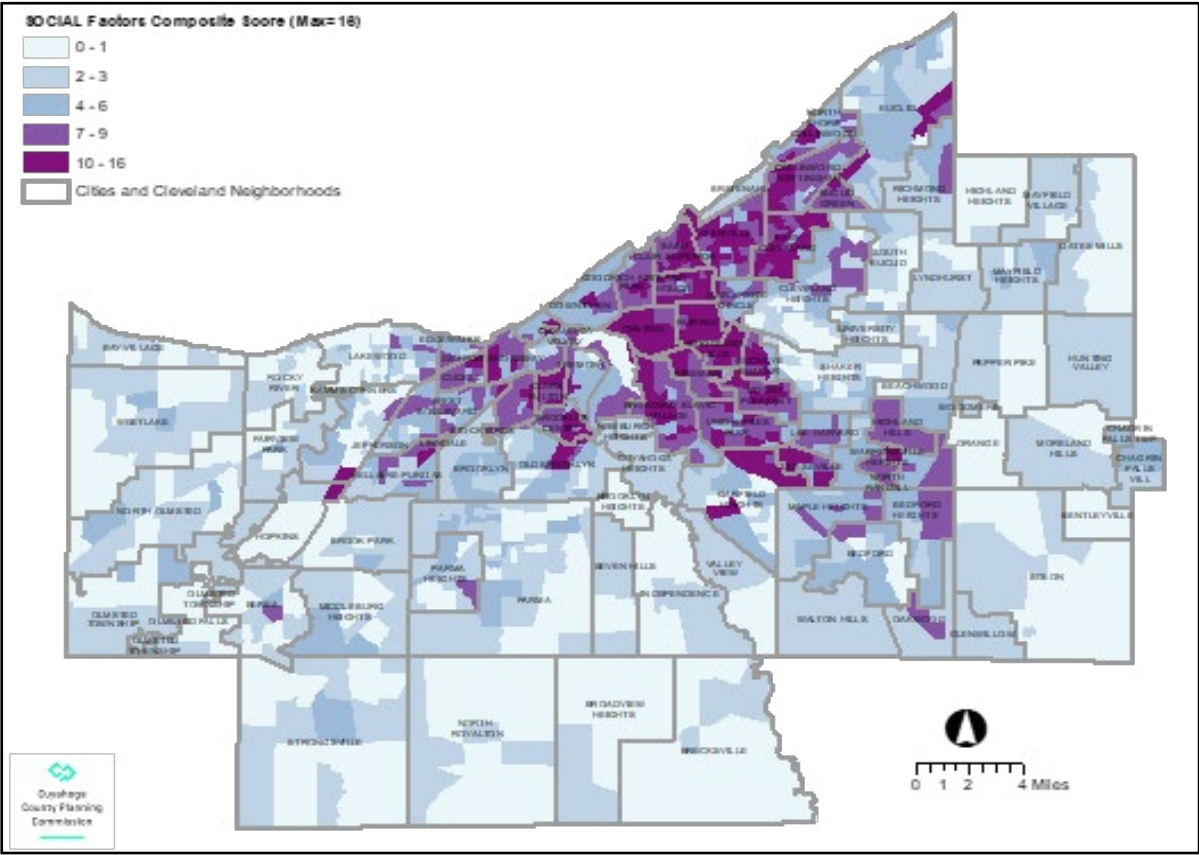
- **Minority Status:** Minorities are disproportionately vulnerable to the effects of natural disasters and extreme heat. The City of Cleveland's recent vulnerability assessment (p. 22) points to a number of factors at play, including substandard housing and poor health.
  - *Percent Non-White\**
- **Educational Attainment:** As noted in the City of Cleveland Vulnerability Assessment, those lacking in educational attainment are also much more likely to lack health insurance and to live with poor health conditions.
  - *Percent Without a High School Diploma*

High social overall vulnerability is closely associated with high concentrations of nearly all the factors, except concentrations of children and elderly. It is likely that those age measures do not vary as much as the other factors.

As a result, the overall vulnerability is highest in traditionally poorer, minority areas of the City of Cleveland and some of its inner ring suburbs, particularly to the southeast of the City.

See Map 1 below.

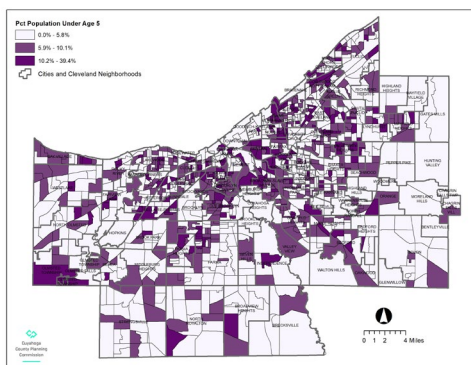
Map 1: Social Vulnerability Composite Scores by Block Group



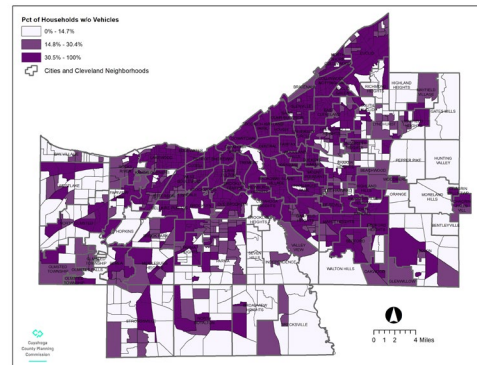


## Social Vulnerabilities

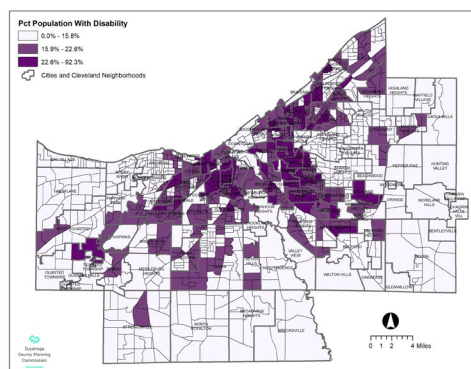
Percent of Population Under 5



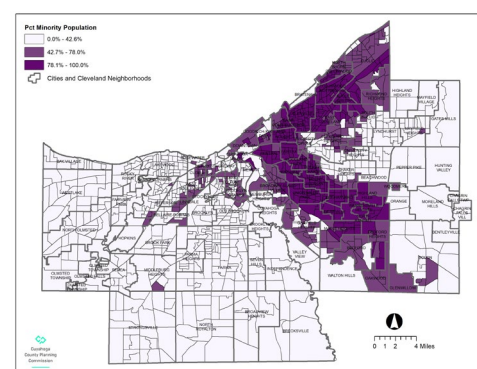
Percent of Households Without Vehicles



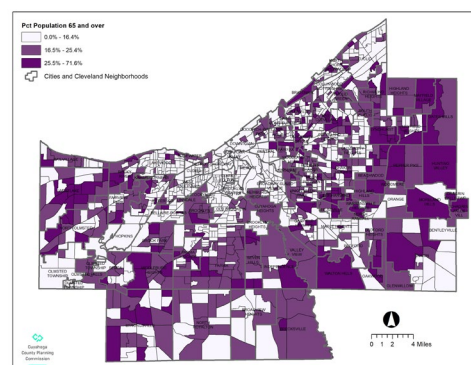
Percent of Population with Disability



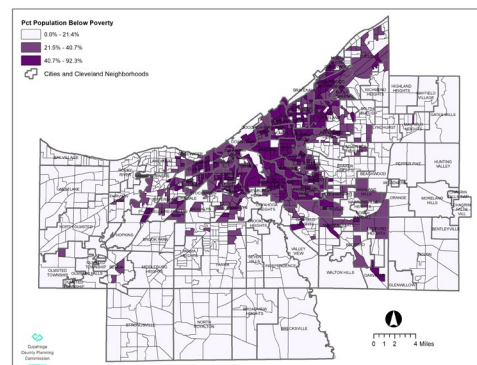
Percent of Minority Population



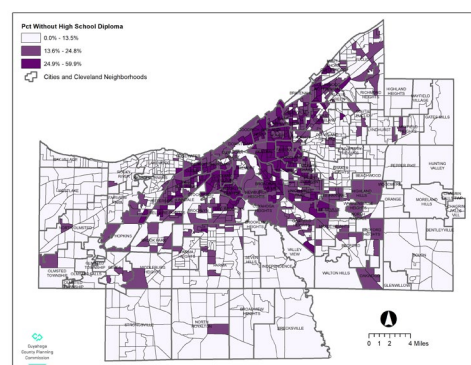
Percent of Population 65 and Over



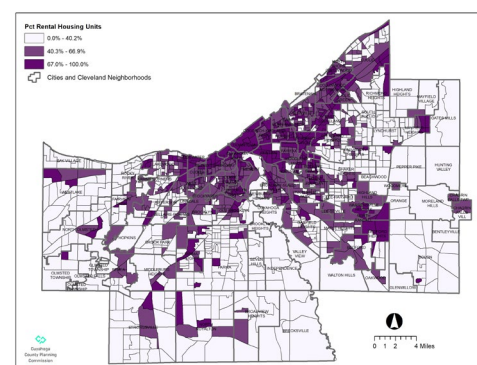
Percent of Population Below Poverty



Percent of Population without High School Diploma



Percent of Rental Housing Units



## Physical Factors

As with its social factors, Cuyahoga County has a wide range of physical factors that affect its population's overall climate vulnerability. Many residents know about variations in temperature and precipitation (especially snow) due to proximity to Lake Erie.

Several other physical factors are considered in our analysis, most of which are driven by land cover (tree cover, impervious surface, urban heat islands) and the nature of the existing housing stock.

The Physical factors considered in the Vulnerability Assessment are listed below. (\*High Correlation with Composite Physical Score)

- **Percent Area Impervious\***

Impervious land cover is typically unvegetated hard-surface land, primarily pavement and buildings. Two effects of imperviousness are increased storm water runoff and urban heat island effect. Increased storm water runoff may cause flooding both locally and downstream. Urban flooding will commonly take the form of street and basement flooding when the storm water infrastructure is overwhelmed.

- **Percent Area in Heat Island\***

In addition to prevalence of impervious surface, a more direct measure of heat island effect is provided in the Vulnerability Assessment, and is documented in the Climate section of the main document. Urban heat island effect is likely to affect areas immediately surrounding highly impervious areas, particularly surrounding commercial and densely developed areas. The Center for Disease Control has published a highly informative guide that documents the causes and effects of extreme heat: *Climate Change and Extreme Heat: What You Can Do to Prepare*.

- **Percent Buildings Constructed Prior to 1939\***

Age of housing often determines the ability of a structure's adaptability to extreme weather, particularly extreme heat due to lack of air conditioning. In addition, age of housing can also help identify areas with older, substandard housing – which affects both cooling and heating problems during extreme cold conditions.

- **Percent Area in Flood Plain**

Flood plain areas are typically low-lying areas in proximity to rivers and streams. It is important to note that so-called 100- and 500-year flood plains are subject to more increased frequency of flooding with an increasing frequency of extreme precipitation events.

- **Percent Area Without Tree Canopy\***

Tree Canopy provides natural shading and cooling effects in response to extreme heat. In addition, trees provide immense capacity to absorb rainwater, thus lessening flooding effects both locally and downstream.

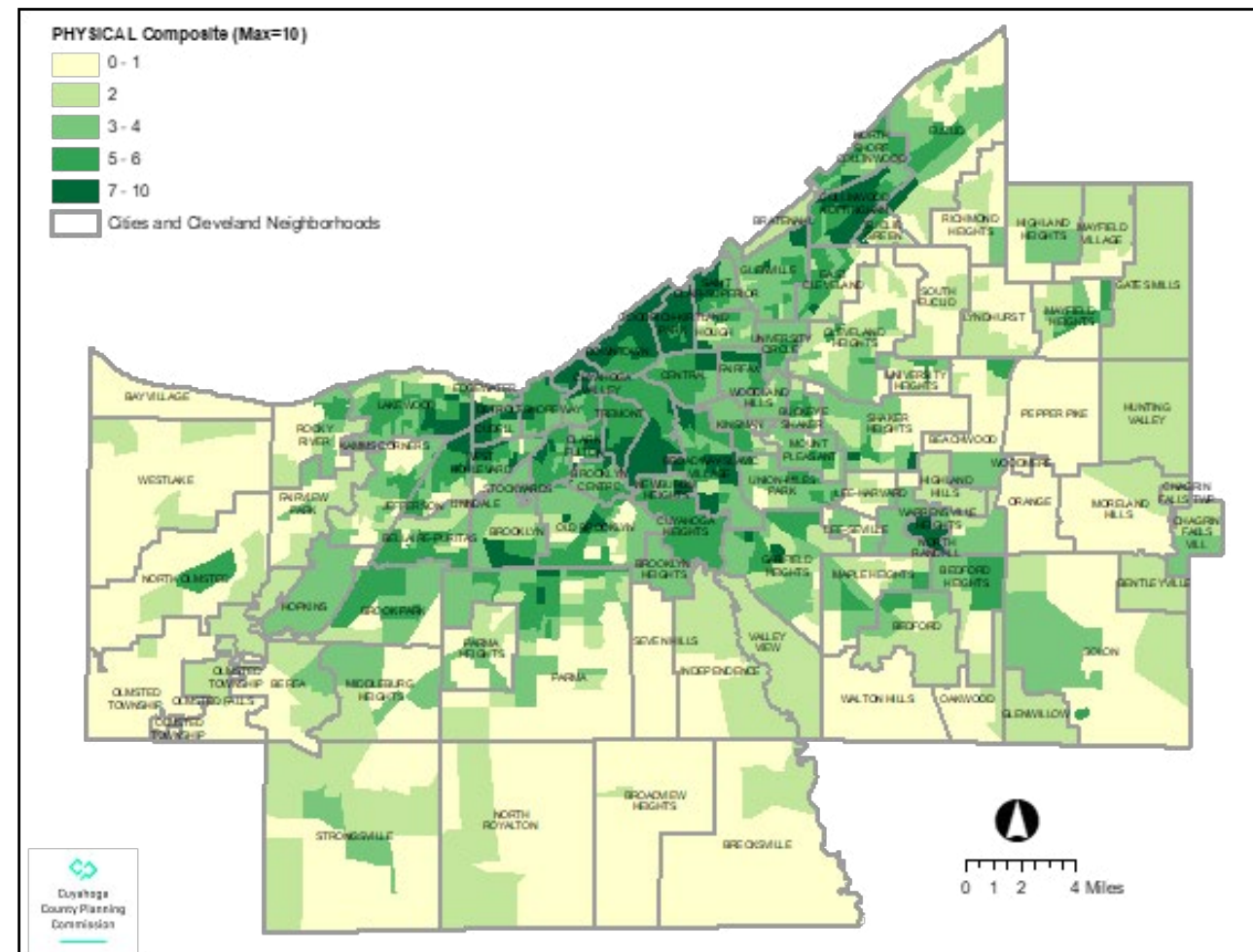
\*High Correlation with Composite Physical Score



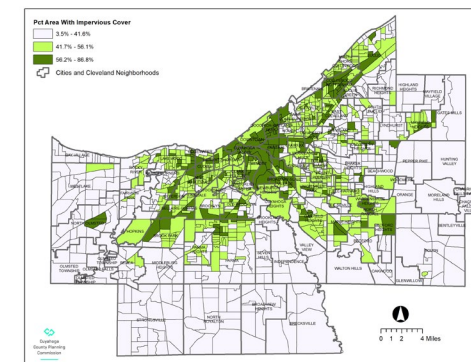
## Physical Vulnerabilities

Physical factors are more widely distributed throughout the County, corresponding with areas with high concentrations of impervious cover (including shopping malls) and older buildings (Cleveland, Euclid, Lakewood).

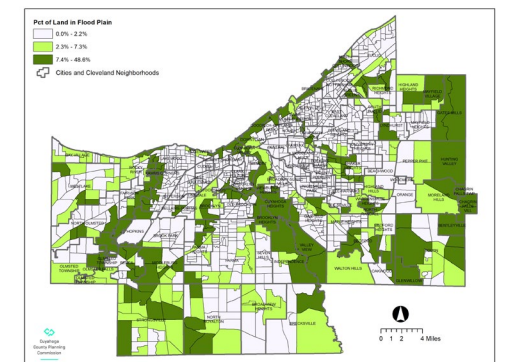
**Map 2: Physical Vulnerability Composite Scores by Block Group**



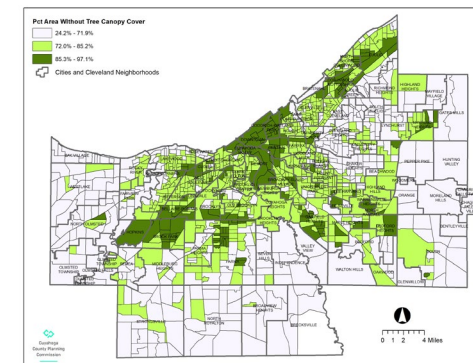
**Percent of with Impervious Cover**



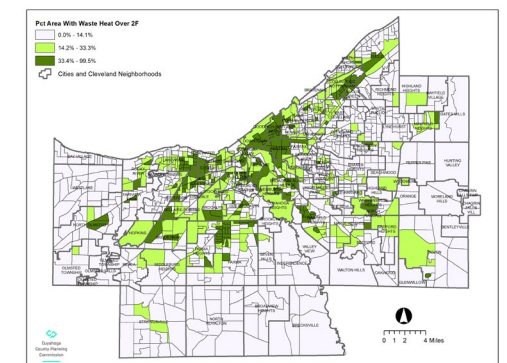
**Percent of Land in Flood Plain**



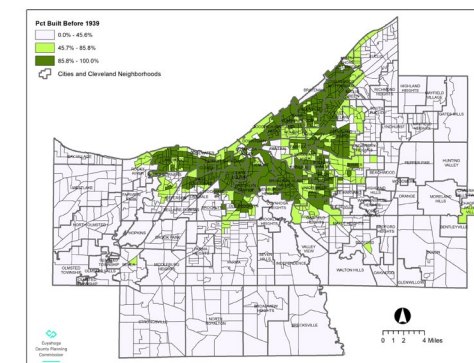
**Percent of Area without Tree Canopy Cover**



**Percent of Area with Waste Heat Over 2°F**



**Percent of Built Before 1939**

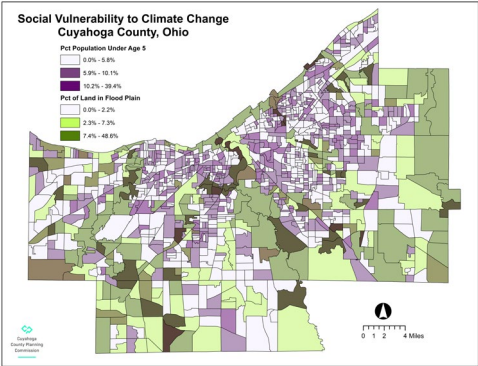




Combined Vulnerabilities

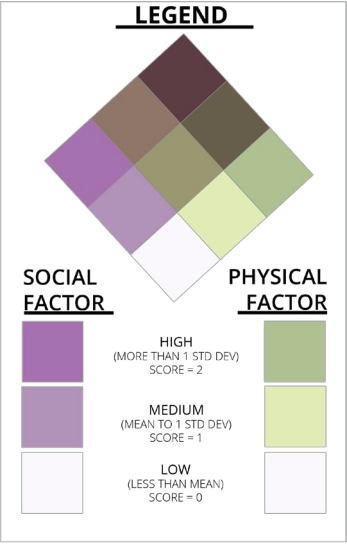
When scores are combined they pin point areas that are impacted by Climate Change. Below are examples of Population Under 5 against Physical Factors ( Tree Canopy, Land in Flood Plain, Area with Waste Heat Over 2 °F, Homes Built Before 1939, Area with Impervious Cover) by combining the factors we can indicate the most vulnerable areas to climate change.

Percent of Land in Flood Plain

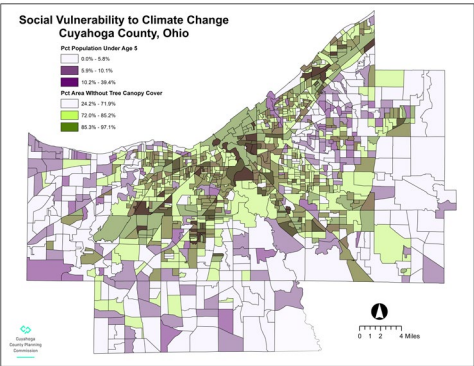


Composite Scores

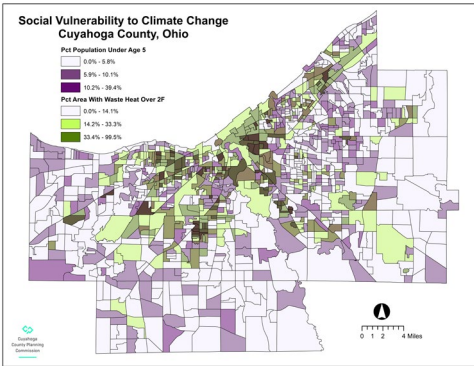
Based on that scoring, a set of composite scores was developed. For the eight Social factors, scores can range from a total of 0 (all 8 measures in the “Low” category, 0 points each) to a maximum of 16 (all eight measures in the “High” category, 2 points each). Likewise, for the five Physical factors, scores can range from 0 to 10 (five factors times a maximum score of 2 each). Finally, an overall composite vulnerability score was calculated by adding together all of the thirteen factors (maximum score of 26).



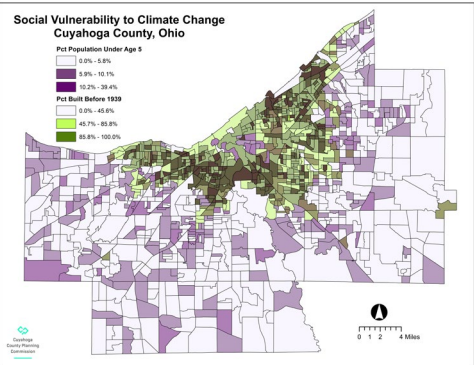
Percent without Tree Canopy



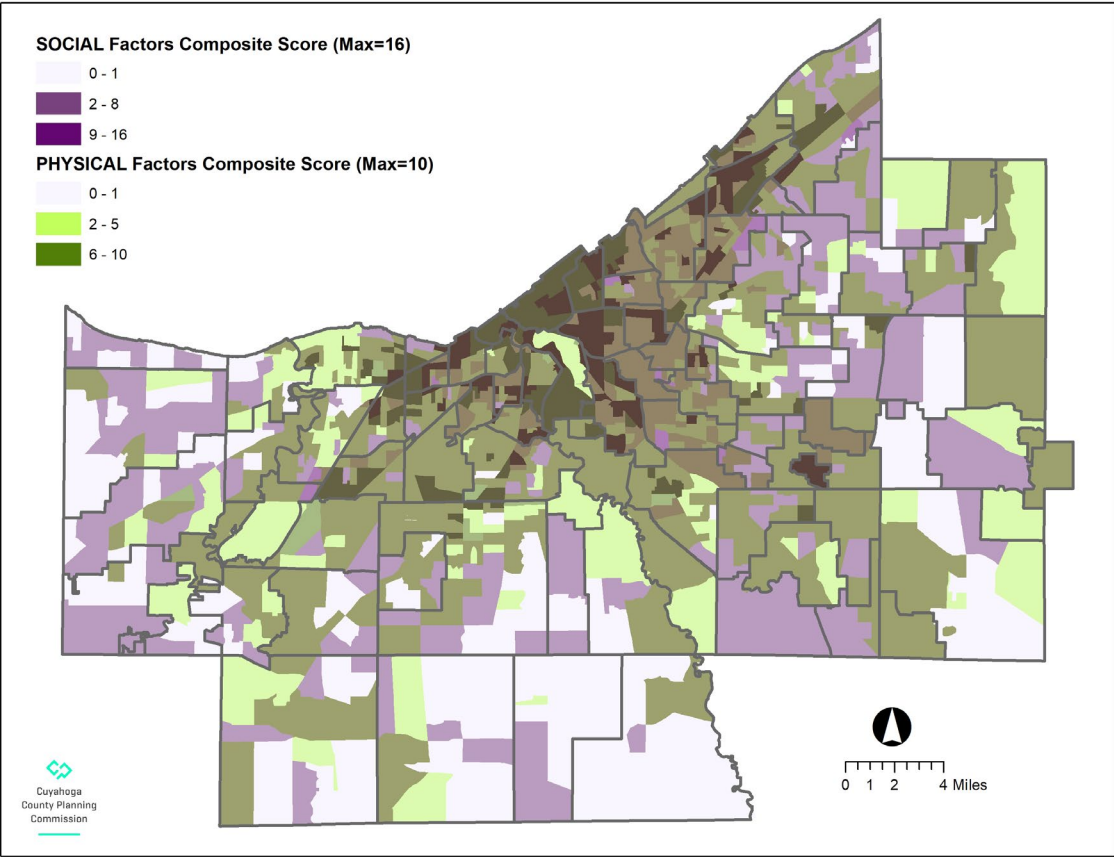
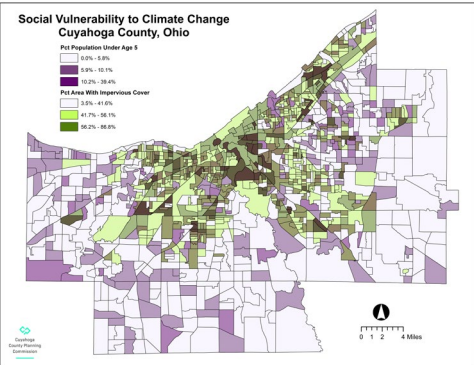
Percent of Area with Waste Heat Over 2°F



Percent of Homes Built before 1939



Percent of Area with Impervious Cover





*"Together We Thrive"*

**CUYAHOGA COUNTY**  
Climate Change Action Plan