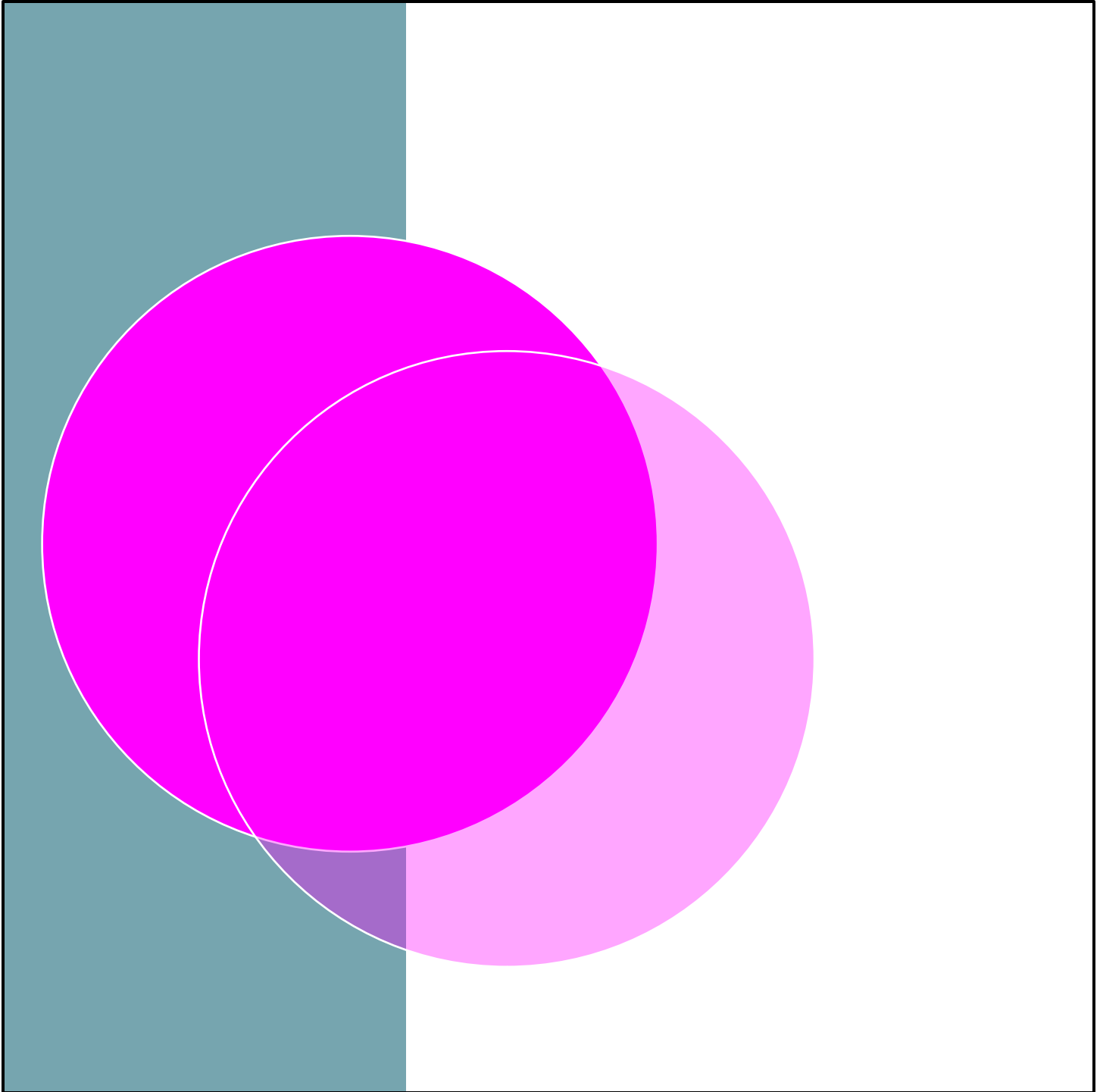


City of Dayton

2019 Greenhouse Gas Inventory



This report was funded by Power a Clean Future Ohio and developed by UNPREDICTABLEcity.

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At a Glance

Year 2019
Geography City of Dayton, Ohio
Tool US EPA Local Greenhouse Gas Inventory Tool

GHG Emissions **2,119,544 MT CO₂e** Total net GHG emissions for Dayton in 2019
29,075 MT CO₂e Emissions sequestered by Dayton's tree canopy in 2019
15 MT CO₂e per Capita Dayton's per capita emissions is lower than the national average

Action Priority Sectors
Residential The residential sector was responsible for 32% of emissions in 2019, 36% of which were from personal transportation sources
Commercial The commercial sector was responsible for 44% of emissions in 2019, 51% of which were from the use of electricity and natural gas
City Operations City operations accounted for 14% of total emissions for Dayton, 49% of which were a result of wastewater treatment

Action Priority Sources
Building Energy Use was responsible for 67% of total emissions in 2019
Vehicles were responsible for 24% of total emissions in 2019

Action Priority Fuels
Electricity was responsible for 45% of total emissions in 2019
Natural Gas was responsible for 22% of total emissions in 2019
Gasoline/Diesel was responsible for nearly 24% of total emissions in 2019

Home Energy Burden
40% of households in Dayton have affordable energy bills
27% of households in Dayton may struggle with some of their home energy bills
33% of households in Dayton cannot afford their home energy bills

Inclusion Priority Communities Women, those belonging to BIPOC communities, the un- and underemployed, those without a college degree, and youth.

Additional Communities for Inclusion LGBTQIA+, veterans, elderly, immigrant and FLNE, people with disabilities.

The Inventory

What is a greenhouse gas inventory?

A greenhouse gas (GHG) inventory is an accounting of the emissions which result from the different processes that support everyday life. An inventory itself should not interpret results, but simply provide data in an objective manner for further analysis.

Data

This inventory assesses emissions for activities that occurred within the city limits of Dayton, Ohio. When data were not available, estimates were used if a certain level of confidence could be achieved. Data were provided by the City of Dayton or estimated by UNPREDICTABLEcity.

Sectors

This analysis uses the common reporting sectors of residential, commercial, industrial, and energy generation. As such, transportation emissions are captured within their respective sectors. Emissions from local government operations are included in the Commercial sector.

Important Definitions¹

The following terms are used in the report:

CO₂e

This stands for carbon dioxide equivalent. There are various gasses that contribute to climate change; however, some contribute more to climate change than others. To make sure we're comparing apples-to-apples, this analysis provides emissions data in terms of CO₂e.

The gases included in CO₂e are primarily carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O).

MT

Emissions are presented in metric tons or MT, which is the international standard for reporting emissions. A metric ton is equal to 2,204.62 pounds.

Scope 1

Scope 1 GHG emissions are direct emissions from sources that are owned or controlled by individuals or organizations within the geography of analysis. For Dayton, this is primarily from natural gas being used to heat water and buildings, emissions from vehicles, wastewater treatment, and solid waste.

Scope 2

Scope 2 GHG emissions are indirect emissions from sources that are owned or controlled by individuals or organizations within the geography of analysis. For Dayton, this is primarily electricity.

Scope 3

Scope 3 GHG emissions are from sources not owned or directly controlled by individuals or organizations within the geography of analysis but are related to the activities that occur there. For Dayton, this is primarily from land management and the tree canopy.

¹ Scope 1, 2, and 3 definitions adapted from the US EPA. <https://www.epa.gov/greeningepa/greenhouse-gases-epa>. Accessed: 08 Dec 2021.

Source Definitions²

Stationary Combustion

The onsite combustion of fuels to produce electricity or heat using equipment in a fixed location. This is primarily natural gas and heating oil.

Mobile Combustion

The combustion of fuels to power a moving vehicle, such as gasoline or diesel fuel in a car or truck.

Solid Waste

Organic waste that anaerobically decomposes in landfills emits methane.

Wastewater

The treatment of wastewater produces methane and nitrous oxide.

Electricity

Fossil fuel-based electricity generation (primarily coal and natural gas) produces carbon dioxide, methane, and nitrous oxide.

Water

Importing water requires electricity, which produces greenhouse gases during its production.

Agriculture and Land Management

Greenhouse gas emissions from agriculture come from livestock and the application of fertilizers.

Urban Forestry

Greenscapes, and trees in particular, sequester carbon from the atmosphere. Urban forestry tends to reduce a community's total emissions.

Waste Production

Some solid waste is exported to landfills outside of the community. Emissions from this source are considered Scope 3 as the community has little control if any to influence how the waste is managed.

² Definitions provided by or adapted from the US EPA. <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>. Accessed: 29 Mar 2022.

Community-Wide Emissions by Scope, Source, and Gas

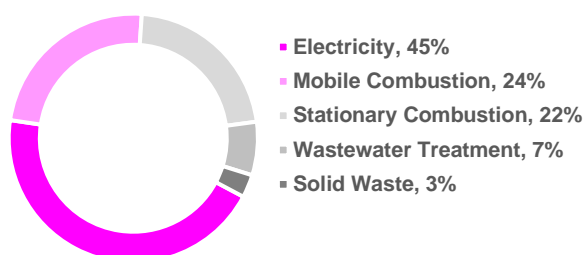


Figure 1.
Percentage of Gross Emissions by Source – City of Dayton 2019

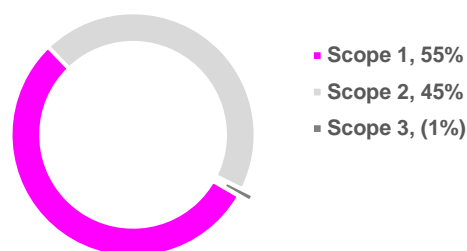


Figure 2.
Percentage of Emissions by Scope – City of Dayton 2019

| 2019 Emissions by Source - MT CO ₂ e | CO ₂ | CH ₄ | N ₂ O | Total | Percent of Total |
|---|------------------|-----------------|------------------|------------------|------------------|
| Scope 1 | 971,636 | 204,109 | 14,300 | 1,190,045 | 55% |
| Stationary Combustion | 480,937 | 1,068 | 271 | 482,276 | 22% |
| Mobile Combustion | 490,699 | 1,402 | 13,322 | 505,423 | 24% |
| Solid Waste | - | 56,683 | - | 56,683 | 3% |
| Wastewater Treatment | - | 144,956 | 707 | 145,663 | 7% |
| Scope 2 | 952,578 | 2,208 | 3,722 | 958,508 | 45% |
| Electricity | 952,578 | 2,208 | 3,722 | 958,508 | 45% |
| Scope 3 | (29,705) | 16 | 49 | (29,009) | (1%) |
| Water | - | - | - | - | - |
| Agriculture & Land Management ³ | - | - | 49 | 49 | 0% |
| Urban Forestry | (29,075) | - | - | (29,075) | -1% |
| Waste Production | - | 16 | - | 16 | 0% |
| 2019 Total Gross Emissions | 1,194,214 | 206,334 | 18,071 | 2,148,619 | 100% |
| 2019 Total Net Emissions | 1,895,139 | 206,334 | 18,071 | 2,119,544 | |

³ Only City Operations fertilizer use data were reported.

Community-Wide Emissions by Sector

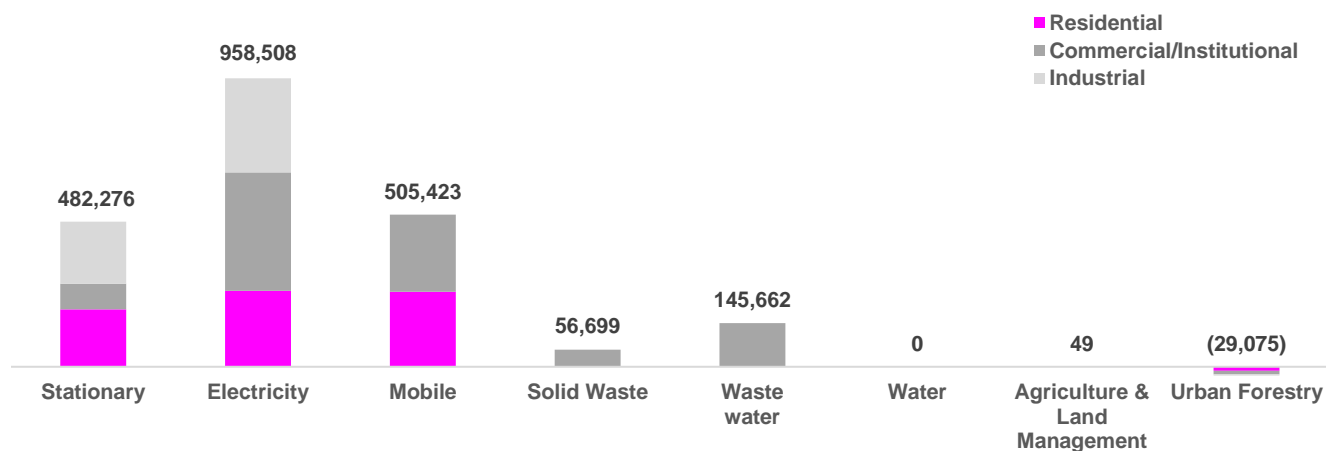


Figure 3.
Emissions by Source and Sector – City of Dayton 2019 (MTCO_{2e})

| 2019 Gross Emissions by Sector | Total MT CO _{2e} | Percent of Total |
|--------------------------------|---------------------------|------------------|
| Residential | 692,037 | 32% |
| Commercial/Institutional | 937,105 | 44% |
| Industrial | 519,477 | 24% |

| 2019 Gross Emissions by Source and Sector | Stationary | Electricity | Mobile | Solid Waste | Wastewater | Water | Ag + Land Mgmt. | Urban Forestry | Total Gross MT CO _{2e} | Total Net MT CO _{2e} |
|---|----------------|----------------|----------------|---------------|----------------|----------|-----------------|-----------------|---------------------------------|-------------------------------|
| Residential | 190,952 | 252,085 | 249,000 | - | - | - | - | (13,113) | 692,037 | 678,923 |
| Com/Inst | 84,539 | 393,732 | 256,423 | 56,669 | 145,662 | - | 49 | (11,776) | 937,105 | 925,329 |
| Industrial | 206,785 | 312,692 | - | - | - | - | - | (4,185) | 519,477 | 515,292 |
| Total MT CO_{2e} | 482,276 | 958,508 | 505,423 | 56,699 | 145,662 | - | 49 | (29,075) | 2,148,619 | 2,119,544 |

| 2019 Gross Residential Emission Source | Total MT CO ₂ e | Percent of Total |
|--|----------------------------|------------------|
| Stationary | 190,952 | 28% |
| Electricity | 252,085 | 36% |
| Mobile | 249,000 | 36% |
| Solid Waste ⁴ | - | - |
| Wastewater ⁵ | - | - |
| Water ⁶ | - | - |
| Agriculture + Land Management ⁷ | - | - |
| Gross Sector Total | 692,037 | 100% |
| Urban Forestry | (13,113) | (2%) |

| 2019 Gross Commercial/Inst. Emission Source | Total MT CO ₂ e | Percent of Total |
|---|----------------------------|------------------|
| Stationary | 84,539 | 9% |
| Electricity | 393,732 | 42% |
| Mobile | 256,423 | 27% |
| Solid Waste | 56,699 | 6% |
| Wastewater | 145,662 | 16% |
| Water ⁸ | - | - |
| Agriculture + Land Management ⁹ | 49 | 0% |
| Gross Sector Total | 937,105 | 100% |
| Urban Forestry | (11,776) | (1%) |

⁴ Emissions from solid waste are captured in the Commercial/Institutional sector.

⁵ Emissions from wastewater treatment are captured in the Commercial/Institutional sector.

⁶ Dayton does not import water and therefore produces no emissions, except for that captured within wastewater treatment and electricity used for conveyance. Both of which are captured in the Commercial/Institutional sector.

⁷ Residential use of fertilizers was not estimated for this analysis.

⁸ See footnote 5.

⁹ Only city use of fertilizers was captured in this analysis.

| 2019 Gross Industrial Emission Source | Total MT CO ₂ e | Percent of Total |
|---|----------------------------|------------------|
| Stationary | 206,785 | 40% |
| Electricity | 312,692 | 60% |
| Mobile ¹⁰ | - | - |
| Solid Waste ¹¹ | - | - |
| Wastewater ¹² | - | - |
| Water ¹³ | - | - |
| Agriculture + Land Management ¹⁴ | - | - |
| Gross Sector Total | 519,477 | 100% |
| Urban Forestry | (4,185) | (1%) |

¹⁰ Emissions from mobile combustion in the Industrial sector are included in the Commercial/Institutional sector.

¹¹ See footnote 3.

¹² See footnote 4.

¹³ See footnote 5.

¹⁴ Industrial use of fertilizers was not captured in this analysis.

Emissions from City Operations

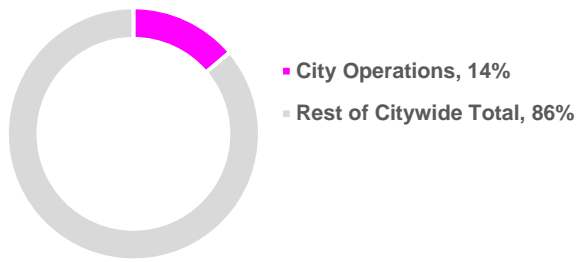


Figure 4.
City Operations Emissions as a Percentage of Total Gross Emissions – City of Dayton 2019

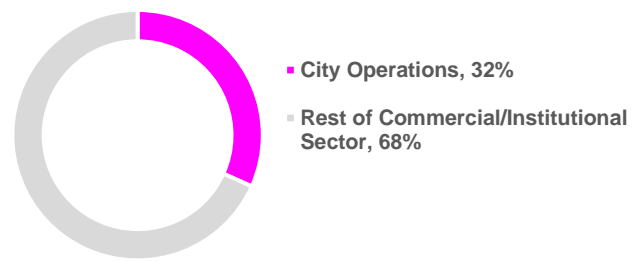


Figure 5.
City Operations Emissions as a Percentage of Total Gross Commercial/Institutional Sector¹⁵ Emissions – City of Dayton 2019

| 2019 City Operations Emissions by Source - MT CO ₂ e | CO ₂ | CH ₄ | N ₂ O | Total | Percent of Total City Operations |
|---|-----------------|-----------------|------------------|----------------|----------------------------------|
| Scope 1 | 31,733 | 201,833 | 5,364 | 238,930 | 80% |
| Stationary Combustion | 23,445 | 52 | 13 | 23,510 | 8% |
| Mobile Combustion | 8,288 | 143 | 555 | 8,985 | 3% |
| Solid Waste | - | 56,683 | - | 56,683 | 19% |
| Wastewater Treatment | - | 144,956 | 707 | 145,663 | 50% |
| Scope 2 | 54,852 | 127 | 214 | 55,193 | 19% |
| Electricity | 54,852 | 127 | 214 | 55,193 | 19% |
| Scope 3 | (1,918) | 16 | 49 | (1,853) | (1%) |
| Employee Commute | 2,959 | - | - | 2,959 | 1% |
| Water | - | - | - | - | - |
| Agriculture & Land Management | - | - | 49 | 49 | 0% |
| Urban Forestry | (4,877) | - | - | (4,877) | -1% |
| Waste Production | - | 16 | - | 16 | 0% |
| 2019 City Operations Total Gross Emissions | 89,543 | 201,977 | 5,627 | 297,147 | 100% |
| 2019 City Operations Total Net Emissions | 84,666 | 201,977 | 5,627 | 292,270 | |

¹⁵ Emissions from City Operations are included in the Commercial/Institutional sector shown in the previous section. As Dayton has a high-level of control over these emissions, an additional analysis was performed to estimate the city's specific contributions to total citywide emissions.

Emissions per Capita

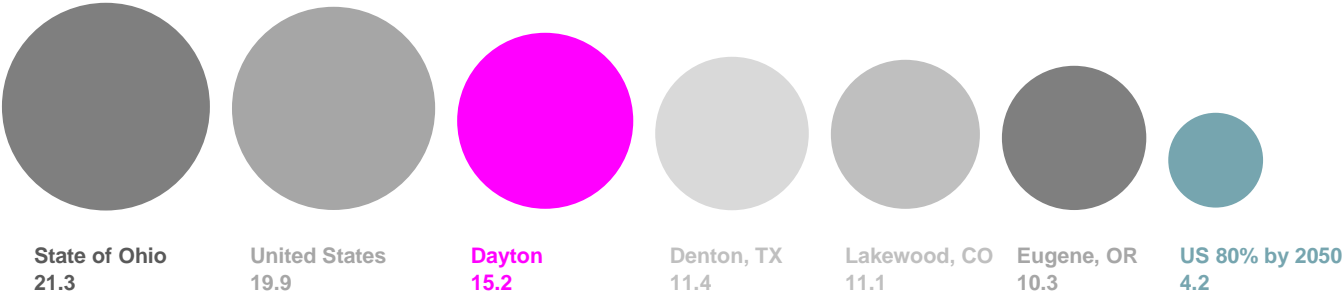


Figure 6.
2019 Gross Emissions per Capita

| Gross Emissions per Capita | 2019 MT CO ₂ e per Capita | 2019 Population | Square Miles |
|--|--------------------------------------|-----------------|--------------|
| State of Ohio | 21.3 | 11,689,100 | 44,825 |
| United States | 19.9 | 328,239,523 | 3,796,742 |
| Dayton, Ohio | 15.2 | 140,569 | 56 |
| Denton, Texas | 11.4 | 136,195 | 96 |
| Lakewood, Colorado | 11.1 | 155,146 | 44 |
| Eugene, Oregon | 10.3 | 168,302 | 44 |
| United States 80% by 2050 Goal ¹⁶ | 4.2 | | |

¹⁶ An emissions reduction of 80% by 2050 was set as part of the United States Mid-Century Strategy for Deep Decarbonization, keeping the nation in line with targets proposed as part of the Paris Climate Accords. https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf. Accessed: 29 Mar 2022.

Equity Considerations

Approaching climate action with a lens of equity means that we are cognizant of, and responsive to, the individual needs of all residents in our communities. Often, this means prioritizing the inclusion of those groups that have been intentionally and unintentionally excluded from the decision-making process in the past.

We know climate change is and continues to disproportionately impact low-income communities and communities of color. As well, low-income communities in particular are less able to adapt to the new normals we face, be it heat waves, cold snaps, or flooding. This disadvantage broadens the gap in health and livelihood outcomes.

Underscoring our responsibility to address equity issues now, is the

continued persistence of these issues. Study after study confirms that a child born in poverty will most likely live at least a portion of their adult life in poverty. As poverty and income are indicators of resilience, they are inherently tied to climate change.

Another example is educational attainment. On average, 34% to 40% of children will go on to complete college by age 25. For those who lived at least half of their childhood in poverty however, only 3% will have completed college by 25 years of age.¹⁷ Through no fault of their own, many Americans are born into cycles which make personal progress difficult, if not impossible. These issues left unaddressed, will further reduce one's ability to be resilient in the face of climate change.

Who lives in Dayton?¹⁸

Census data have limits, but they can help us begin to develop a picture of our communities and the issues they face. Using Census data in this manner should be viewed as a first step and can serve as a starting point for more in-depth conversations.

How do residents experience Dayton?

As one can see from the following data, the City of Dayton has compounding factors for climate security such as low median incomes and low educational attainment across categories.

¹⁷ C. Ratcliffe. " Child Poverty and Adult Success." Urban Institute. Link:

<https://www.urban.org/sites/default/files/publication/65766/2000369-Child-Poverty-and-Adult-Success.pdf>. Accessed 08 Dec 2021.

¹⁸ US Census 2019 ACS 5-Year Survey. Accessed: 16 Feb 2022.

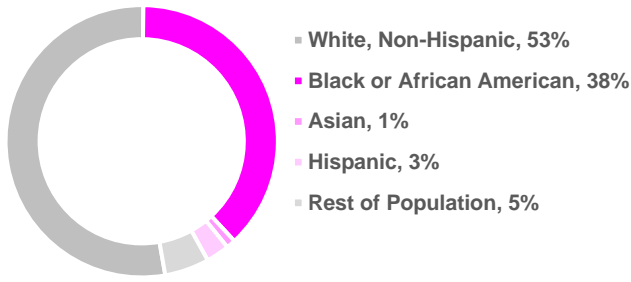


Figure 7.
Population by Race – City of Dayton 2019¹⁹

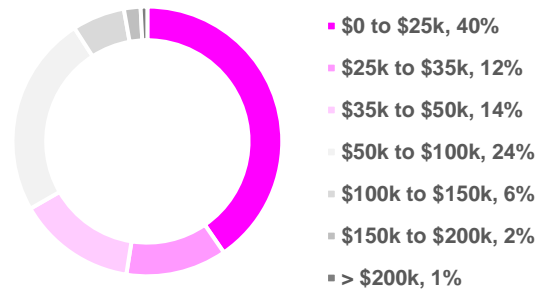


Figure 8.
Population by Income – City of Dayton 2019

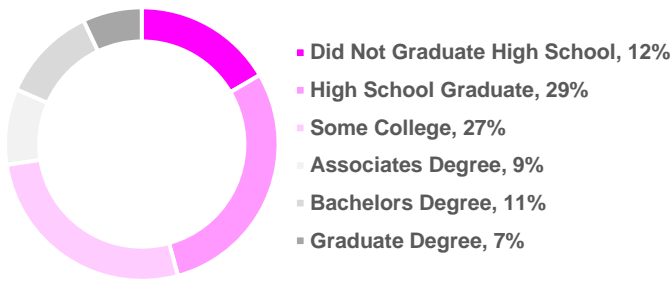


Figure 9.
Educational Attainment – City of Dayton 2019

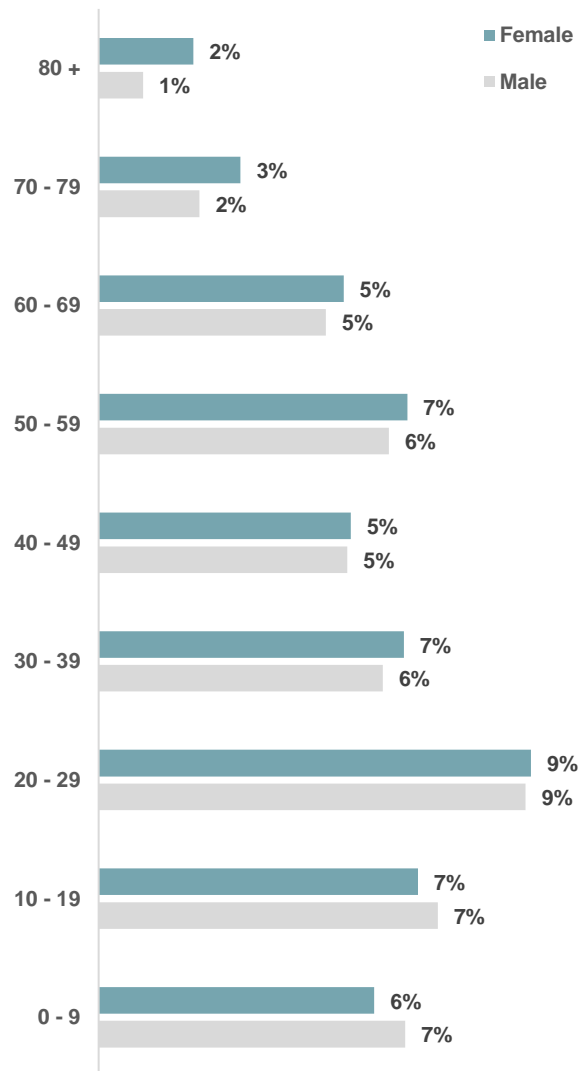


Figure 11.
Percentage of Age Cohort by Sex – City of Dayton 2019

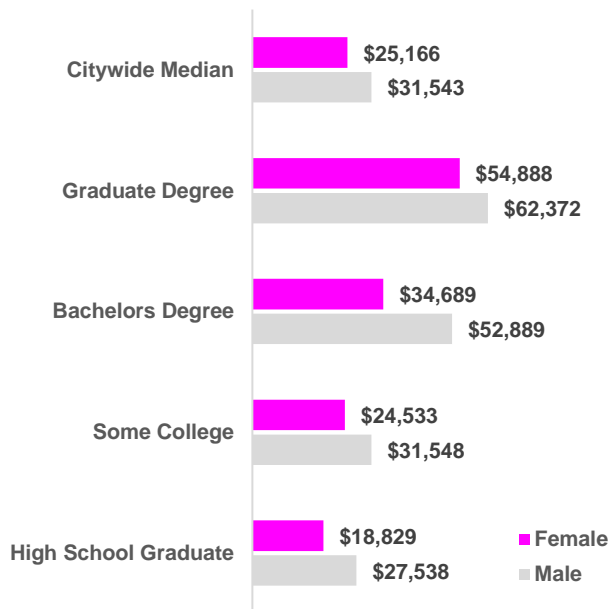


Figure 10.
Median Salary by Education – City of Dayton 2019

¹⁹ Rest of population includes categories of less than one percent, those of two or more races, and those who did not identify.

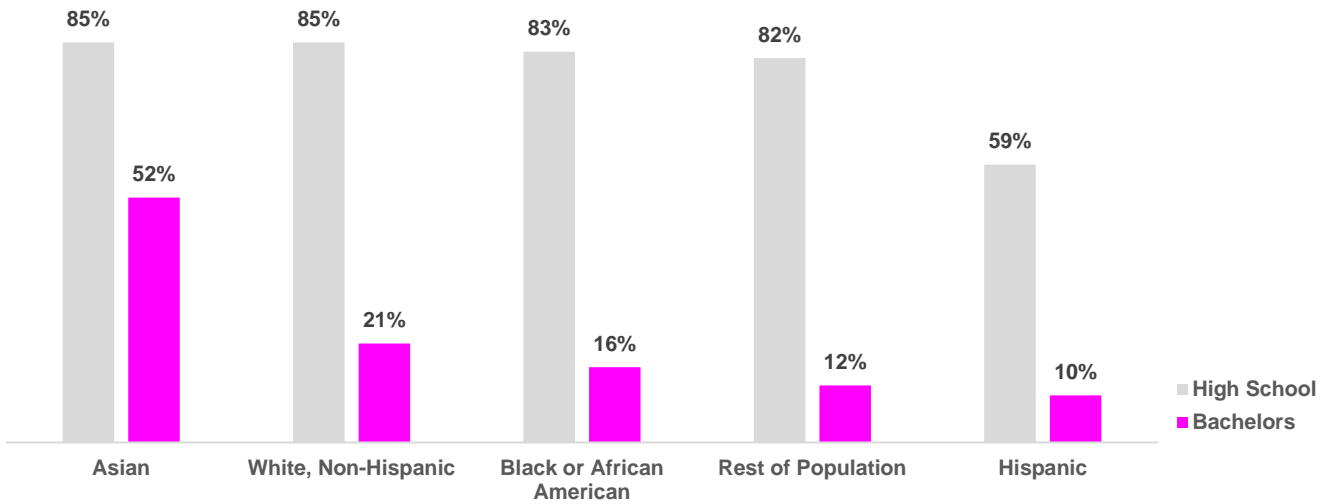


Figure 12.
Educational Attainment by Race – City of Dayton 2019²⁰

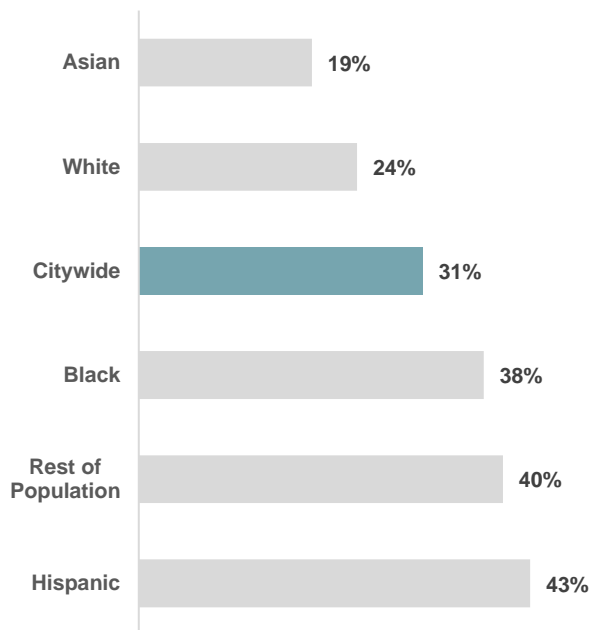


Figure 13.
Poverty Rate by Race – City of Dayton 2019

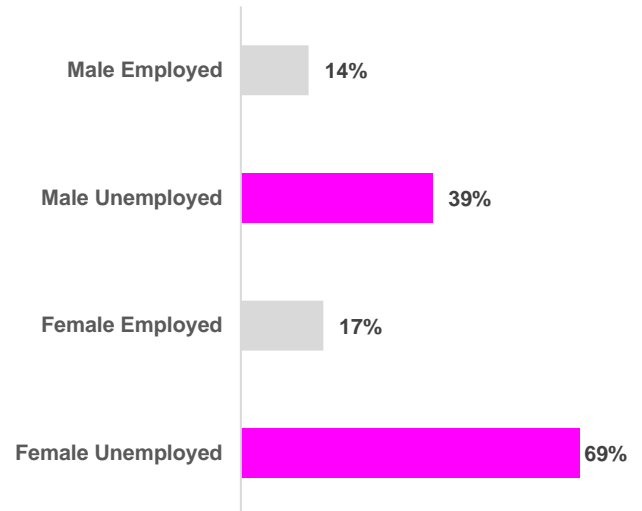


Figure 14.
Poverty Rate by Sex and Employment Status – City of Dayton 2019

²⁰ Rest of population includes categories of less than one percent, those of two or more races, and those who did not identify.

Home Energy Burden

What is home energy burden?

Home Energy Burden is the percentage of your household income that goes towards your home energy costs (heating, cooling and electricity). A healthy home energy burden is under 5%. Between 5% and 10%, a household may struggle to pay a bill here and there, but generally is able to manage though often at the expense of other needs. Over 10%, a household will almost certainly need assistance and will often fall behind on bills.

Why is it important?

Energy is a need, just like food and shelter. As climate change continues to become more severe, our need for heating, cooling, and transportation will certainly grow. To ensure that everyone is prepared, we will have to truly understand the individual needs in our communities.

In Dayton, a household income of at least \$41,000 is needed to maintain an energy burden below 5%. This assumes an individual or family is living in the average size and age home for Dayton. As was noted in the Franklin County Energy Study²¹, older homes are more likely to be inefficient and so other considerations may be necessary.

Who earns enough?

In Dayton, those with at least one bachelor's degree in their household will likely be earning enough to meet their energy needs, however this differs between sexes. Only 18% of Dayton residents have a bachelor's degree or higher.

Roughly 60% of households in Dayton are struggling to some degree to meet their energy needs. It is essential to ensure their inclusion in the development of climate actions, as they will be at a significant risk to the impacts of climate change.

²¹ MORPC. Franklin County Energy Study. 2018. Link: <https://www.morpc.org/wordpress/wp-content/uploads/2018/06/2018-Franklin-County-Energy-Study.pdf>. Accessed: 16 Feb 2022.

40% of Dayton households can afford their home energy bills.



Households with less than 5% home energy burden

27% of Dayton households may be struggling with some of their home energy bills.



Households with home energy burdens between 5% and 10%

Another **33%** of Dayton households are unable to afford their home energy bills.



Households with home energy burdens above 10%

Recommendations

We measure greenhouse gases in order to minimize the impacts of climate change. For Ohio, those impacts are primarily:

- An increase in extreme heat events
- An increase in extreme cold events
- An increase likelihood of economic disruption across sectors
- An increase in flooding events, both frequency and severity
- An increase in nighttime temperatures during the growing season
- A longer vector-borne disease season
- A decrease in health and livelihood outcomes

Decreasing our emissions now will lessen the severity of these impacts in the future, however, it will be years before the course can be reversed. We should expect to

see the impacts of climate change grow over the next few decades. This is why we must take the two-pronged approach of mitigation and adaptation.

The recommendations that follow focus on efforts that will mitigate future impacts and increase our resiliency in the present. These are not exhaustive and additional interventions should be identified and pursued. Adaptation measures not discussed in these recommendations must be considered as well.

Tackling climate change and addressing equity go hand-in-hand. This inventory illuminates two very specific target sectors: building energy consumption and transportation. Energy efficiency, renewable energy, and fuel switching reduces our current emissions (a mitigation approach that protects the future), can improve our health outcomes, and

will insulate our current economics from price and supply fluctuations that can be expected with climate change.

As well, this report identifies groups that are essential to equitable program development in Dayton: women, those belonging to BIPOC communities, the un- and underemployed, those without a college degree, and youth.

Be sure to think about these recommendations holistically. Often it will make sense and be easier to accomplish these simultaneously or in tandem.

The city's **Strategy for a Sustainable Dayton** provides valuable approaches to address climate security. The activities suggested in that document should serve to complement the recommendations on the following pages.

Building Energy Consumption

Efficiency

Reducing energy demand is always the first step. For one, it reduces the amount of energy needed, thus ensuring resources are not unnecessarily spent on superfluous generation. Secondly, it frees up capital to take additional climate action. Most importantly, energy efficiency immediately reduces our exposure to air pollution and other environmental toxins, particularly when it involves the reduction of fossil fuel consumption.

Prior to considering any intervention, the City should commit to making energy efficiency a priority. Through this, the City ensures actions have teeth and continue through to completion. Additional information follows to help guide decisions.

Actions to Take Next:

1. Create a task force to serve as both an advisory and working group to establish the City's focus on energy efficiency.
2. Ensure the task force is familiar with energy equity considerations.
3. Identify stakeholders. It will be essential to have open channels of engagement with community groups.
4. Set a target for energy efficiency based on climate and equity goals. Be sure that no resident experiences a home energy burden above 5%.
5. Pass a resolution to ensure action is taken and establish the City's commitment.
6. Identify priority actions to achieve the energy efficiency target. Be sure to focus on local government operations, private homes, and commercial buildings.
7. Agree to the priority actions. This may include opportunities such as: utility programs and property assessed clean energy (PACE).

8. Identify action partners. Not only will you need people with technical skills to implement projects and programs, you will also need community partners to help with outreach and for evaluation.
9. Identify funding sources.
10. Develop a work plan and begin.

Resources:

USDN's ***A Guidebook on Equitable Clean Energy Program Design for Local Governments and Partners***

www.cadmusgroup.com/wp-content/uploads/2018/09/Cadmus-USDN-Equitable-Clean-Energy-Guidebook.pdf

US EPA's ***Energy Efficiency in Local Government Operations***

www.epa.gov/sites/default/files/2015-08/documents/ee_municipal_operations.pdf

US DOE's ***Residential Energy Efficiency for Local Governments***

www.betterbuildingsolutioncenter.energy.gov/bca/residential-energy-efficiency-local-governments

Dayton Energy Collaborative

daytonenergycollaborative.org

Energy Efficiency Decision Guidance

| Energy Efficiency and Fuel Switching | Level of Technical Difficulty | Implementation Cost | Payback Duration |
|---|-------------------------------|---------------------|------------------|
| Existing Residential Buildings | | | |
| Lighting - Residential | Low | Low | Short |
| Appliance and Electronics - Residential | Low | Low | Short |
| Space Heating - Residential | High | Moderate | Moderate |
| Cooling - Residential | High | Moderate | Moderate |
| Water Heating - Residential | Moderate | Moderate | Moderate |
| Water Fixtures - Residential | Low | Low | Short |
| Building Envelopes - Residential | Moderate | Moderate | Moderate |
| Existing Commercial Buildings | | | |
| Lighting - Commercial | Low | Low | Short |
| Appliances and Electronics - Commercial | Low | Low | Short |
| Space Heating - Commercial | High | Moderate | Moderate |
| Cooling - Commercial | Moderate | Moderate | Moderate |
| Water Heating - Commercial | Moderate | Moderate | Moderate |
| Water Fixtures - Commercial | Low | Low | Short |
| Building Envelope - Commercial | High | High | Moderate |
| New Residential Buildings | | | |
| Efficient Construction - Residential | Low | Moderate | Short |
| Appliance and Electronics - Residential | Low | Low | Short |
| Space Heating - Residential | High | Moderate | Moderate |
| Cooling - Residential | High | Moderate | Moderate |
| Water Heating - Residential | Moderate | Moderate | Moderate |
| Water Fixtures - Residential | Low | Low | Short |
| Building Envelopes - Residential | Moderate | Moderate | Moderate |
| New Commercial Buildings | | | |
| Efficient Construction - Commercial | Low | Moderate | Short |
| Appliances and Electronics - Commercial | Low | Moderate | Moderate |
| Space Heating - Commercial | Low | Moderate | Moderate |
| Cooling - Commercial | Low | Moderate | Moderate |
| Water Heating - Commercial | Low | Moderate | Moderate |
| Water Fixtures - Commercial | Low | Low | Low |
| Building Envelope - Commercial | Low | Moderate | Moderate |
| Existing Municipal Buildings | | | |
| Lighting - Municipal | Low | Low | Short |
| Space Heating - Municipal | Moderate | High | Moderate |
| Cooling - Municipal | Moderate | High | Moderate |
| Building Envelope - Municipal | Moderate | Moderate | Moderate |

| Energy Efficiency and Fuel Switching | Level of Technical Difficulty | Implementation Cost | Payback Duration |
|---|--------------------------------------|----------------------------|-------------------------|
| New Municipal Buildings | | | |
| Lighting - Municipal | Low | Moderate | Short |
| Space Heating - Municipal | Low | Moderate | Moderate |
| Cooling - Municipal | Low | Moderate | Moderate |
| Building Envelope - Municipal | Very High | High | Long |
| Street & Other Public Lighting | | | |
| Streetlights | Low | Moderate | Moderate |
| Traffic Signals | Low | Moderate | Moderate |
| Wastewater Biogas-to-Energy Optimization | | | |
| Biogas-to-Energy from Anaerobic Lagoons | Moderate | Moderate | Moderate |
| Biogas-to-Energy from Anaerobic Digesters | Very High | High | Long |
| Water Conveyance Pump Improvements | | | |
| Water Conveyance Pump Efficiency | High | High | Long |

Building Energy Consumption

Solar

According to National Renewable Energy Laboratory's State and Local Planning for Energy platform, Montgomery County has over 2,300 gigawatt hours (GWh) of annual solar generation potential for residential and commercial systems²². To put this in perspective, the entire City of Dayton consumed just over 2,100 GWh of electricity in 2019. When also accounting for utility scale solar systems, an additional 30,000 GWh of electricity could be produced annually within the county.

Based on satellite imagery, nearly 50,000 rooftops within the City of Dayton are viable for solar production when incorporating their solar exposure²³.

These are technical potentials however, and further considerations are necessary to understand what is actually achievable. Although solar has a net-positive payback over the lifetime of the system when sized correctly, it typically requires a significant upfront cost for owners. A barrier for certain, but not insurmountable. As well, there are employment, environmental, and resilience components to onsite solar that can make its pursuit worthwhile.

To illustrate the impact that solar can have, several residential solar penetration goals were modeled by UNPREDICTABLEcity for the City of Dayton. Although emission reductions are relatively low compared to the City's 2019 total gross emissions, a modest 5% solar goal for residential buildings would save consumers over \$2 million annually. Nearly \$6 million annually would remain local to stimulate Dayton's economy. It should be noted that emission savings will likely decrease as utilities decarbonize their generation facilities. (See table on following page.

It is important to recognize that the City has entered into an agreement with Sustainable Ohio Public Energy Council (SOPEC) to provide eligible customers with 100% renewable energy primarily from Texas-based wind facilities. This is an important step in moving the United States towards

a clean energy future. Dayton should consider future opportunities to include more Ohio-based renewable generation in their aggregation program in order to ensure that the economic and resilience benefits provided by local clean energy are realized.

In order for the City of Dayton to take advantage of the benefits of solar, the following actions are suggested. Power a Clean Future Ohio members can take advantage of PCFO's solar market development technical assistance to facilitate this work.

Actions to Take Next:

1. Work with the efficiency task force to identify the amount of local renewable generation needed to reach your equity and climate goals **after** efficiency is taken into account.
2. Identify stakeholders. It will be essential to have open channels of engagement with community groups.
3. Pass a resolution that creates a city-wide goal for solar installations, incorporating equity and access considerations.
4. Ensure that zoning, permitting, and inspection processes are up to date and in line with best practices.
5. Identify and agree upon priority actions to achieve the solar goal. Pursue utility scale projects on city-owned land.
6. Identify action partners. Not only will you need people with technical skills to implement projects and programs, you will also need community partners to help with outreach and for evaluation.
7. Identify funding sources.
8. Develop a work plan and begin.

Resources:

Power a Clean Future Ohio
poweracleanfuture.org

SolSmart
solsmart.org

²² National Renewable Energy Laboratory, State and Local Planning for Energy. <https://maps.nrel.gov/slope/>. Accessed 08 Mar 2022.

²³ Project Sunroof. <https://sunroof.withgoogle.com/data-explorer/place/ChIJAxTdrfWAQIqR5EwO8pLIQKY/>. Accessed 08 Mar 2022.

| Rooftop Solar Generation Potential | Roof Space | Capacity | Annual Electricity |
|---|---------------------------|------------------|---------------------------|
| Total | 56 million sq. ft. | 0.8 GW DC | 923 GWh AC |
| Average Rooftop | 423 sq. ft. | 6 KW DC | 6.8 KWh AC |

| Residential Solar Penetration Goal | Electricity Produced (GWh) | Annual MT CO₂e Reduced Regionally | Percent of Dayton 2019 Gross GHG Emissions | Annual Residential Savings (\$USD) | Annual Dollars Kept Local (\$USD) |
|---|-----------------------------------|---|---|---|--|
| 5% | 46 | 20,741 | 1% | \$2,205,970 | \$5,897,970 |
| 10% | 92 | 41,482 | 2% | \$4,411,940 | \$11,795,940 |
| 20% | 185 | 82,965 | 4% | \$8,823,880 | \$23,591,880 |

Transportation

Mass transit and active transportation, such as bicycling, are the most cost-effective and environmentally friendly options for moving people. Unfortunately, commuting by bus, bike, or foot does not always meet our needs, particularly when traveling long distances, for those with children, or those who are less able. As Ohio communities are and will likely remain car-dependent for the foreseeable future, the recommendations below are focused on transitioning personal vehicles from gasoline powered internal combustion engines to electric vehicles (EV). It is nonetheless recommended to identify mode-shift solutions whenever possible.

Over the next five years, Ohio will be receiving \$140 million to facilitate the development of EV infrastructure as a part of the Bipartisan Infrastructure Law. The funds are available to “help states create a network of EV charging stations along designated Alternative Fuel Corridors, particularly along the Interstate Highway System.” Furthermore, a second competitive grant program is to be announced later this year, focused on EV charging access in rural and underserved communities.²⁴

As of 31 December 2021, there were 785 battery-powered EVs and 506 plug-in hybrid EVs registered in the City of Dayton. This is double the amount of EVs registered in Dayton at the end of 2020. This growth will likely continue as car manufacturers phase out the internal combustion engine over the next 15 years. Preparing for this shift is essential to ensure the inclusion of all community members.

Electrify

In order to transition the City of Dayton, its residents and its businesses to electrified transportation, everyone will need to feel secure in that their individual transportation needs will be met. This will include addressing range anxiety, affordability, and suitability of available technologies. This is more than most cities can handle on their own. Fortunately, there are many organizations active in Ohio that can help.

Although city fleets are responsible for less than 1% of total emissions for the City of Dayton, electrification of city vehicles holds a significant opportunity for the City as a whole. Electrification of city fleets would:

- Catalyze the development of public EV charging infrastructure, which is needed especially for those who lack access to home charging, and
- Allow the opportunity for city employees to become comfortable with the technology, thus encouraging EV purchases at home.

We highly recommend continuing work with PCFO and Clean Fuels Ohio to map out the City’s fleet transition and the development of public EV charging infrastructure. Be sure to consider aesthetics, ownership models, and maintenance.

Additionally, as transportation accounted for 24% of Dayton’s total emissions, the City could make significant progress towards emission reductions with programs and campaigns to facilitate EV purchases by residents and businesses. Many approaches to this can be taken. To help the City decide which approach is best for them, the following table can be used to assist in justifying interventions. These values were modeled by UNPREDICTABLEcity in October of 2021 for the State of Ohio. Currently, gasoline prices are 50% higher due primarily to increased demand and international conflict. Current prices were not modeled as they are not expected to continue, though can be if desired by the City.

²⁴ President Biden, USDOT and USDOE Announce \$5 Billion over Five Years for National EV Charging Network, Made Possible by Bipartisan Infrastructure Law. February 10, 2022. <https://highways.dot.gov/newsroom/president-biden-usdot-and-usdoe-announce-5-billion-over-five-years-national-ev-charging>. Accessed 08 Mar 2022.

Actions to Take Next:

1. Continue working with PCFO and Clean Fuels Ohio to develop a transition plan for city fleet vehicles.
2. Begin conversations around how Dayton can address equity issues through the planning of a community-wide transition to EVs. Be sure to include the Miami Valley Regional Planning Commission in these conversations.
3. Identify and agree upon priority actions for an equitable community transition to EVs.
4. Identify action partners. Not only will you need people with technical skills to implement projects and programs, you will also need community partners to help with outreach and for evaluation.
5. Identify funding sources.
6. Develop a work plan and begin.

Resources:

Power a Clean Future Ohio
poweracleanfuture.org

Clean Fuels Ohio
cleanfuelsohio.org

UNPREDICTABLEcity's Transportation Burden Calculator
unpredictable.city

| Savings per Vehicle Switched to an EV from an Internal Combustion Engine - Ohio | Annual Dollar Savings in Fuel (USD) | Annual Reduction in Wasted Energy (Btu) | Annual Emissions Reductions (MT CO₂e) | Annual Vehicle Pollution Reductions (lbs) |
|--|--|--|---|--|
| Charged via Grid | \$1,027 | 16,422,692 | 2.65 | 107 |
| Charged via Residential On-Site Solar | \$1,215 | 42,932,326 | 4.26 | 111 |

Equity

Low-income communities and communities of color will bear a disproportionate share of climate change's impacts. Energy consumption is expected to rise to counter hotter summers and colder winters. This will increase pollution exposure which is already concentrated in these communities. At the same time, home energy and transportation burdens will increase, further exacerbating the physical, social, and mental health impacts of climate change.

As these communities are at a disadvantage when it comes to adapting to climate change, it is paramount for the City to focus efforts here. Fortunately, addressing home energy efficiency can help. A 10% increase in residential energy efficiency would reduce the energy burden for 4,000 households to below 5%. A 20% increase would move 7,000 households into affordable energy burden levels.

Unfortunately, however, 26,000 households in Dayton will likely struggle to afford energy despite energy efficiency goals due to exceptionally low incomes. As many of these households are rental units, our recommendations align with ACEEE's **Energy Equity for Renters** initiative and **Housing is a Human Right**'s goals to "protect tenants' right to fair, affordable, healthy, safe, and environmentally sustainable housing; preserve communities and housing as affordable for low-income residents; and/or produce housing that is both affordable for low-income households and environmentally sustainable."

ACEEE outlines equitable policy actions²⁵, such as:

- Adopting a renter right of first refusal on property sale
- Creating a rental energy disclosure policy
- Promoting existing state and utility efficiency programs to renters and landlords
- Adopting a rental energy performance standard and assisting affordable housing providers with compliance
- Designing rental efficiency loan and grant programs with affordability covenants
- Granting renters the right to make efficiency improvements
- Instituting limited-scope (minor efficiency upgrades) rental property retrofit requirements
- Advocating to expand state and utility rental efficiency programs

- Coupling public housing energy-efficient rehab projects with inclusive workforce development
- Including energy efficiency in competitive affordable housing funding criteria

Similar to energy burden within the home, our transportation choices also carry a burden. Here, 10% of income is typically what is considered affordable for transportation. Lower income residents are more likely to purchase used cars with cash than new cars with a loan. Whereas this eliminates a monthly car payment, older vehicles are typically less efficient thus increasing the amount of money spent on fuel, and likely have higher maintenance costs. For someone without a car payment, in order to maintain a 10% transportation burden they would need to have an income of at least \$40,623 if the vehicle runs on gasoline. However, if the same person owned an EV without a car payment, they would only need an income of \$27,953 to maintain a 10% transportation burden.

There is significant consideration that must be given here. On one hand, EVs have the potential to make transportation burden affordable for over 3,500 households. On the other hand, if these EVs are not powered by 100% renewable energy from Dayton's regional grid, they will still contribute to climate change. Local pollution reductions from removing gasoline powered vehicles should be strongly valued in this consideration.

Actions to Take Next:

1. Continue to develop the City of Dayton's capacity to understand and address equity issues through PCFO's Equity Coaching Program.

Resources:

ACEEE's Energy Equity for Renters

<https://www.aceee.org/energy-equity-for-renters>

ACEEE's A New Lease on Energy: Guidance for Improving Rental Housing Efficiency at the Local Level

www.aceee.org/research-report/u2102

UNPREDICTABLEcity's Transportation Burden Calculator

unpredictable.city

²⁵ ACEEE's Energy Equity for Renters <https://www.aceee.org/energy-equity-for-renters>. Accessed 08 Mar 2022.

Future Greenhouse Gas Inventories

Greenhouse gas inventories are highly data driven and rely on assessing the same geographies and sectors from year to year. The City of Dayton's Sustainability Specialist worked closely with UNPREDICTABLEcity to identify the correct information, establish contacts with the correct departments, and understand the process for using the US EPA's Local Greenhouse Gas Inventory Tool. The intent has always been for the City of Dayton to bring this analysis "in house" to continue monitoring progress and identify opportunities for further reductions.

Greenhouse gas inventories do not need to be completed annually, as most actions will take multiple years to implement and evaluate. However, data collection processes are most consistent when conducted annually, thus ensuring familiarity with the process for those involved. It is recommended to conduct a greenhouse gas inventory at least once every three years, although annually is ideal. The most important thing is to commit to conducting them on a regular basis.

Actions to Take Next:

1. Pass a resolution that establishes Dayton's Greenhouse Gas Monitoring Program and empowers city staff to collect and share the data needed for greenhouse gas inventorying.
2. Inform outside organizations which data are needed and the timeframes that will be used.

3. Ensure that greenhouse gas inventorying is housed in one department and that it becomes the responsibility of the analyst, thus ensuring consistency. Make the process part of their written job description.
4. Identify areas of the inventory where data were calculated rather than collected. Utilize PCFO's education and training opportunities to ensure staff know how to complete additional analyses.
5. Identify additional areas where the inventory can be improved.
6. Document the process explicitly in order to ensure continuation and consistency of the analysis.

Resources:

US EPA's Local Greenhouse Gas Inventory Tool

www.epa.gov/statelocalenergy/local-greenhouse-gas-inventory-tool

Power a Clean Future Ohio

poweracleanfuture.org

UNPREDICTABLEcity

unpredictable.city

About

The Project

This greenhouse gas inventory was developed as part of Power a Clean Future Ohio's Equity Coaching Program. For more information about PCFO and the services offered to cities, please visit poweracleanfuture.org.

The 2019 City of Dayton Greenhouse Gas Inventory was created with the support of staff time from Meg Maloney, Sustainability Specialist with the City of Dayton's Office of the City Manager.

The Analyst

UNPREDICTABLEcity works with governments, nonprofit organizations, and community groups to strengthen the foundations of change in our built environment.

This analysis was completed by:

**Jon-Paul d'Aversa, AICP
Principal**

For further information about UNPREDICTABLEcity and services offered, please visit [UNPREDICTABLE.city](https://unpredictablecity.com).

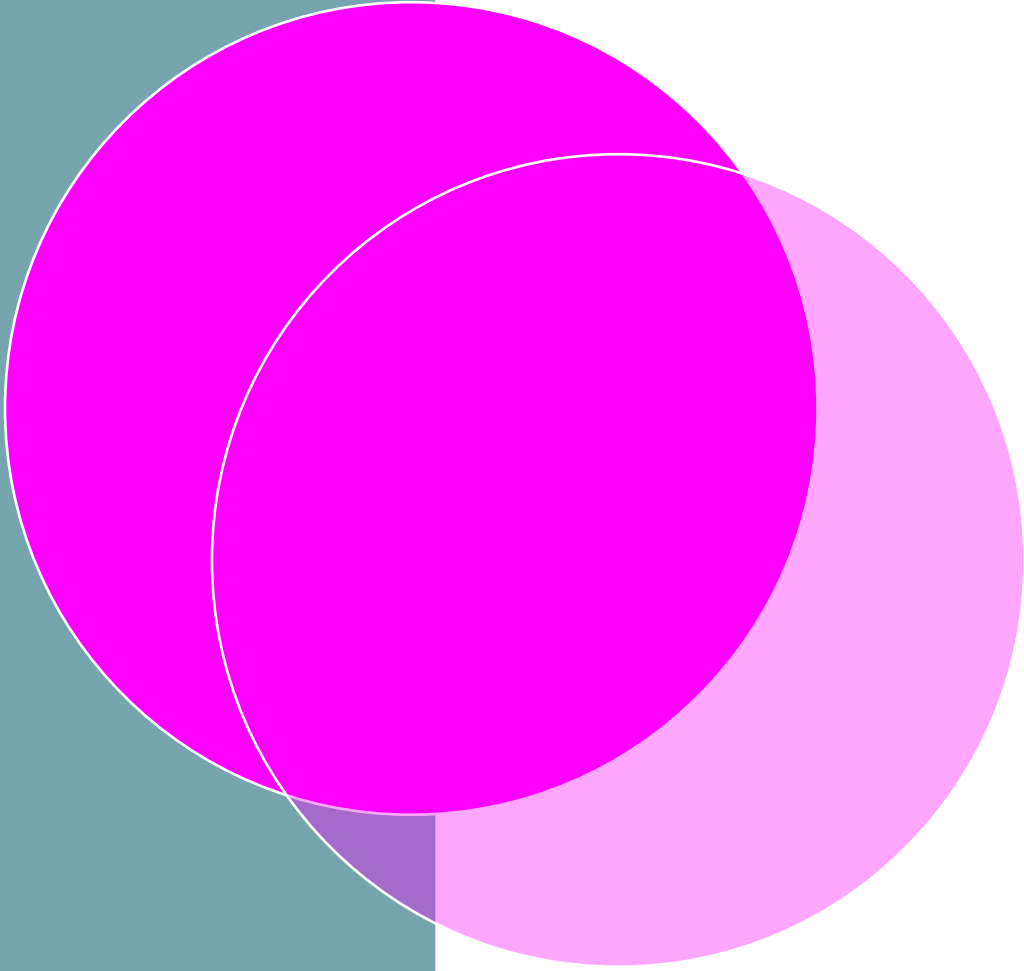
The Analysis

Even though 2020 data were available, this inventory uses 2019 data as it will likely be more reflective of 2021 and beyond. This inventory can be used as a baseline to measure the impact of future climate action.

The analysis uses the US Environmental Protection Agency's Local Greenhouse Gas Inventory Tool (last updated in November 2020). More information about the tool can be found on the US EPA's [website](https://www.epa.gov/local-greenhouse-gas-inventories).

Whereas there is sufficient confidence in the data analyzed, there is an acknowledgement that some data are missing. Further iterations of the greenhouse gas inventory for Dayton should seek to include data that were unavailable for the 2019 inventory.

For questions about the inventory and data, please contact UNPREDICTABLEcity.



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