

Air Quality & Energy

A photograph of two wind turbines in a field. The turbines have orange and red towers and white blades. The sky is overcast with grey clouds. The foreground is a flat, brownish field.

Actions

N3

Modernize electric grid for greater resilience and more efficient energy distribution.

N4

Implement educational campaign on idling reduction.

A3

Implement educational campaign on energy audits and renewable energy to reduce emissions for residential and business users.

A4

Increase number of air quality monitoring stations to provide baseline data and public educational opportunities.

A5

Use data and best practices to adapt transportation modes and inform economics of transportation.

Background

Increasing temperatures will likely lead to deteriorated air quality in Columbus.¹ More people will be exposed to ground-level ozone (smog) and small liquid droplets or solids (particulate matter: PM) that are harmful to their health. While the federal **Clean Air Act** combined with local efforts have significantly improved air quality in Central Ohio, climate change threatens to set back some of this progress.² While all actions in this plan are primarily designed to adapt to climate change rather than mitigate it, action statements within this chapter may yield reduced greenhouse gas (GHG) emissions as a co-benefit. For instance, actions to reduce emissions of other airborne pollutants from transportation and heating sources in the city, such as ground-level ozone and PM, will also reduce GHGs.

An anticipated population increase in the Central Ohio region of between 500,000 and 1 million new residents will likely increase demand for electricity in Franklin County and Columbus, making resiliency planning in the event of extreme heat events even more important.³ Extreme heat events will likely lead to increased demand for electricity to provide cooling, which may tax electrical systems when they are least efficient. Actions in this chapter that reduce energy use will provide climate adaptation through the creation of a more resilient grid while also yielding the co-benefit of climate change mitigation through reduced GHGs.

Increasing frequency and intensity of extreme precipitation events also threaten vulnerable utility infrastructure through both localized flooding and flooding of rivers. Relocation and replacement of infrastructure deemed to be at risk will provide an additional level of climate adaptation.

Air Quality

Pollution and its associated air quality impacts are not new problems for cities. Humans have long burned biomass for energy, transportation, and heat. Two pollutants of concern are PM and ground-level ozone. PM can enter the bloodstream and cause major health issues, while ground-level ozone can cause irritation of the nose and throat, chest tightness, coughing, and shortness of breath. Episodes of elevated PM are more frequent during the wintertime when the atmosphere is more likely to be stable. During summer, increased sunlight duration, combined with emissions from power plants and vehicles, can lead to the development of ground-level ozone. Increasing duration of consecutive hot days also leads to air stagnation and the buildup of ground-level ozone over time. Under particular circumstances, Central Ohio receives air pollution from upwind areas outside the region, including Cincinnati and Dayton. Together, these processes can lead to elevated air pollution levels and impacts to public health.

People most sensitive to the health effects of ground-level ozone and PM are those with heart or lung disease, children and the elderly, and those that are often active outdoors. In Columbus, the **Mid-Ohio Regional Planning Commission (MORPC)** monitors both of these pollutants, issuing daily air quality forecasts and providing alerts when levels are considered unhealthy for sensitive groups of people.⁴ The **End of Season Report from 2017** showed that pollutant levels considered unhealthy for sensitive groups were reached on 2 days.⁵ On 80 days in 2017, ozone pollution levels were “moderate or higher” according to the Air Quality Index system, and on 25 days PM pollution levels were “moderate or higher”. Air quality has

continued to improve in Central Ohio in recent decades despite population growth in the region (Fig. 3).

Decreases in ground-level ozone and PM are driven by changes in emissions from vehicles and power plants.⁷ Ground transportation is still the largest source of volatile organic compounds (VOCs) and nitrogen oxides (NOx), which react with sunlight to form ground-level ozone. However, national emission control programs have served to decrease emissions from this sector significantly. The decrease in emissions from power plants has been driven by a mix of both national emission control programs and the decrease in numbers of coal-fired power plants

due to the falling price of natural gas and subsequent coal plant retirements.

Along with these two main drivers, local efforts to improve air quality have been increasing.⁷ Local governments and public transit providers have been converting their fleets to cleaner fuels and electric vehicles (EV); more businesses and governments are adopting no-idling policies and employing anti-idling technologies in their fleets; the **Central Ohio Greenways** trail system has expanded; and MORPC and partners are working to increase the number of commuters biking, busing and carpooling to work instead of driving alone through initiatives like the annual **Central Ohio Commuter Challenge**.^{8,9} Taken together,

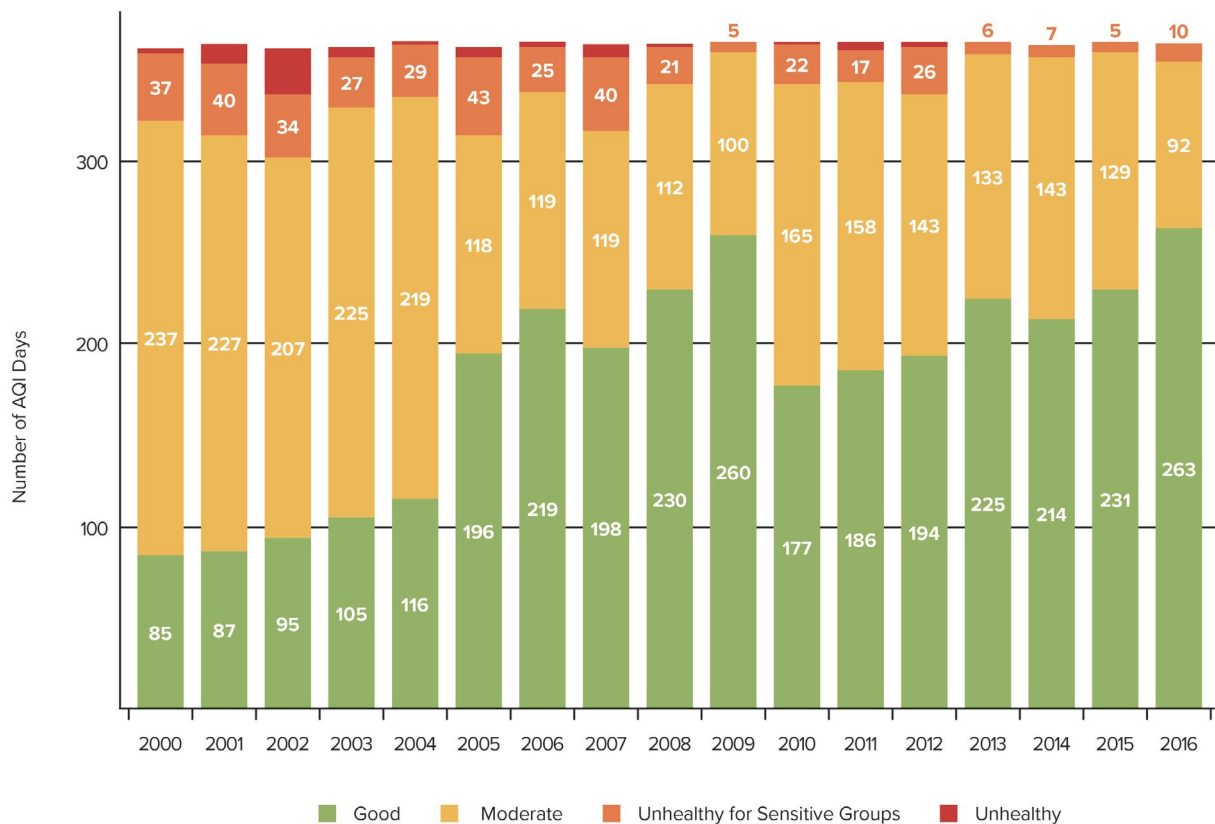


Figure 3. Number of days meeting various air quality standards for Central Ohio from 2000 to 2016. Mid-Ohio Regional Planning Commission, 2017.⁶

these efforts lead to cleaner air and are important for shifting the norms and behaviors that affect air quality, especially with a future of continued population growth and climate change impacts in the region.

Energy

Temperatures in Columbus have been rising at rates greater than the national average and are expected to continue to rise in the future.¹ Evidence shows that nights are warming faster than days, creating additional demand for cooling. Ultimately, these increasing temperatures could lead to greater energy consumption and emissions from power plants.

The recently released ***Franklin County Energy Study*** provides a detailed look at energy use within Franklin County between 2010 and 2015.¹⁰ Franklin County is a net importer of energy in both fuels for transportation and heating and electricity for use in residential, commercial, and industrial settings. Overall, 69% of energy in Franklin County dissipates as heat rather than being used for its intended function. This number suggests that there are significant savings and

environmental benefits to be derived from improving energy efficiency. Much of the energy generation and distribution system for Franklin County is regulated by state and federal agencies, which limits direct actions that the City can take to improve resilience and efficiency. There are a number of initiatives currently offered by Franklin County, the City of Columbus, local electricity and natural gas providers to improve energy efficiency for customers, which reduces overall energy consumption and stress on the grid.

This plan focuses on maintaining or improving air quality by reducing emissions of airborne pollutants and by providing a more resilient electrical grid through reduced peak demand and modernized infrastructure. Acknowledging that Columbus faces impacts of climate change, including extreme heat and intense rainfall events, regardless of future emissions, this chapter outlines two necessary (N) actions and three aspirational (A) actions that can be taken to adapt to these imminent changes. While climate mitigation steps that seek to reduce emissions of GHGs for their own sake should also be taken by Columbus, such efforts are outside the scope of this plan.

Modernize electric grid for greater resilience and more efficient energy distribution.

While modernizing the electric grid and making distribution more efficient have the co-benefit of reducing GHG emissions and may be seen as climate change mitigation efforts, their inclusion in this document focuses on climate adaptation. Increasing temperatures will result in the need for greater cooling capacity. Individuals who already use air conditioning might need to run it more, and those who currently do not use air conditioning might elect to do so. This greater need for cooling will subsequently create periods of increased load on the electric grid. At the same time, rising temperatures make cooling processes and electrical distribution less efficient and lead to increasing infrastructure (i.e., transformers) failures. By making the grid more efficient and reducing consumer demand, electrical systems will not be overtaxed when they operate least efficiently and are of critical need for public health. By making the electric grid more resilient, its components will be able to operate in extreme temperatures while facing high demand. Likewise, components of the grid should be moved out of hazard zones (e.g., floodplains) that are more vulnerable to climate change impacts.

American Electric Power (AEP) Ohio and Columbus Division of Power (CDOP) provide electricity to the majority of Columbus customers. AEP Ohio has been implementing a number of grid modernization initiatives, each needing approval by the Public Utilities Commission of Ohio (PUCO). AEP Ohio has moved forward with advanced metering, appliance incentives, energy audits, and demand response. While the City of Columbus does not have any direct control over these initiatives involving AEP, the city could advocate for those that enhance efficient energy distribution and reduce energy usage during peak demand. Likewise, efforts to make the electrical grid more resilient, such as the movement of an

AEP Ohio substation out of the floodplain near The Ohio State University campus, should continue, and careful consideration should be given to the conditions (i.e., temperatures and durations at those temperatures) under which components of the grid will need to operate over their expected life spans.

CDOP serves approximately 14,000 customers and the street light system (53,000+ lights) throughout the City. The division purchases its power through long-term contracts with energy suppliers and uses the revenue from its energy sales to support and maintain the street light system at no cost to taxpayers.¹¹ Like AEP Ohio, CDOP is proceeding with advanced metering infrastructure and offers a demand response program to customers. Demand response gives customers an opportunity to play a major role in the operation of the electric grid by reducing or shifting their electricity usage during peak periods in response to time-based rates or other forms of financial incentives. Columbus has greater control over the actions of the CDOP because it is a division of city government. It is important to note that any actions taken by the City should ensure that citizens still receive affordable and reliable electricity. In addition to its current initiatives, it is recommended that CDOP examine the resilience of its components to threats of extreme heat and flooding.

Part of grid modernization includes variable rate billing, like time-of-use pricing, that will incentivize consumers to use electricity when it is not at peak demand. For such programs to succeed, consumers will need to be educated and have access to tools to make decisions to reduce their consumption during certain times of the day. Without education and tools, consumers who are unaware of when they consume electricity or do not have a choice when they consume electricity could face higher costs, and the benefits of variable rate billing could be more difficult to accomplish.

Smart Columbus

The **Smart Columbus** initiative has a priority to promote decarbonization through utility-scale renewable projects like AEP Solar and Wind Generation and grid modernization projects like Advanced Metering Infrastructure (AMI).¹² Likewise, this program is working to increase the adoption of electric vehicles (EV) and multi-modal mobility options. An example of a Smart Columbus initiative was a \$3,000 rebate on the purchase of EVs by public fleets in Summer 2017. Without transitioning toward greater use of renewables, the use of EVs could merely shift the problems of ground-level ozone and PM emitted for transportation in Columbus from Central Ohio to other regions.

N4

Implement educational campaign on idling reduction.

An idling reduction education campaign will allow for climate adaptation by reducing emissions that contribute to deteriorated air quality, especially during extreme heat conditions. Idling reduction policies have been implemented by many school districts to protect youth and reduce the inhalation of PM from diesel exhaust. Still, while it is more common to see anti-idling signage in close proximity to building air intakes, there are a significant number of fleets and individual vehicles that continue to idle when not in motion. A focused educational campaign within Columbus could help alter these harmful practices. Unfortunately, many individuals are still idling their vehicles based on outdated practices that are not necessary with modern vehicles.¹³ For instance, driving off gently after running the vehicle for 30 seconds will warm up the engine and interior more quickly than idling. Starters and batteries are more durable than in the past and

will not be damaged by being turned on and off when stopped at a drive through or to pick someone up.

This campaign should include vehicles with gasoline engines, whereas previous campaigns only targeted those with diesel engines. The message should clearly articulate the economic and environmental benefits of reduced idling and a description of why these practices are not needed with modern vehicles. High-impact target audiences could include fleet managers and delivery services. The city should create ways of conveying this information to the general public by utilizing freeway traffic information boards and social media outlets. With the shift towards electric fleets and personal vehicles, the need for this program will be reduced over time as internal combustion engines become a smaller part of the transportation sector. Projected changes in the vehicle market show considerable growth for EVs.¹⁴

Implement educational campaign on energy audits and renewable energy to reduce emissions for residential and business users.

While this action has the co-benefit of reducing GHG emissions and may be seen as a climate change mitigation effort, its inclusion in this document focuses on climate adaptation. As was described earlier in this chapter, increasing temperatures may result in the greater need for cooling. By reducing demands by individuals and businesses, the electric grid will not be overtaxed at a time when it is least efficient and of critical need for public health.

Energy efficiency programs are provided by utilities under programs funded by ratepayers and approved by PUCO. In Columbus, both **AEP Ohio** and **Columbia Gas** provide energy efficiency programs, including online information, rebates, and energy audits.^{15,16} Energy audits are one of the most cost-effective ways to reduce energy consumption. As part of these programs, an expert conducts an independent analysis, property owners are given a detailed report that includes payback periods for energy efficiency actions, and contractors can be hired to make remediations on a schedule determined by the property owner. For the convenience of customers, audits for both electricity and natural gas can often be completed at the same time. To incentivize high-impact actions, the utilities often subsidize actions with short repayment periods. There are additional programs for both energy audits and energy efficiency remediations targeted at low-income populations. While these programs have the potential to save customers money and have a significant environmental benefit, the programs have already saturated the market of early adopters and face increasing difficulty engaging the next tier of customers. For many, it may seem counterintuitive that the utility would offer programs to save them money and reduce their consumption of energy, but Ohio law

and regulations established a **ratepayer-funded program for energy efficiency** delivered through the utilities.^{17,18} The CDOP does not currently offer but is considering the implementation of a program similar to AEP Ohio.¹⁹

The City of Columbus should build on its partnership with utilities like AEP and Columbia Gas to serve as trusted ambassadors in an educational campaign to reach new audiences. Conversations with utility providers revealed interest in reaching a larger audience with these programs, presenting an opportunity for partnership with the City of Columbus. Audiences to be targeted should include those who offer the overall greatest energy savings for the investment of financial resources and those that lack the financial resources to make remediation on their own and for which utilities are a disproportionately high cost.

In recent years, AEP Ohio and Columbia Gas have partnered with the City of Columbus to develop an **Energy Efficiency Roadmap for Columbus Businesses and Organizations** and pilot a **Community Energy Savers** initiative.^{20,21} AEP Ohio and the City worked with the Discovery District as the first Columbus Community Energy Savers neighborhood. Since then, AEP Ohio and the City teamed up with Columbia Gas of Ohio to work with other neighborhoods within Columbus. Community Energy Savers is a program that offers a framework for public utilities to work collaboratively with the City and neighborhood partners to deliver an educational campaign that works to accomplish mutually beneficial goals of reducing energy consumption and saving customers money.

Educational campaigns should inform AEP Ohio and Columbia Gas customers about the portfolio of energy audits available and share **Community Assistance Programs** available to low-income populations.^{22,23} The City of Columbus had success with its **GreenSpot** program, which encourages and provides resources to residents,

Financing Energy Efficiency

The Columbus-Franklin County Finance Authority's EnergyWorks program provides financing to businesses and non-profit organizations located in Franklin County for cost-effective energy efficiency programs in both new and existing facilities.²⁵ This initiative can be combined with Property Assessed Clean Energy (PACE), allowing property owners to finance their improvements through future property tax payments, thus enabling the use of upfront funds for improvements that can be paid back incrementally over time.²⁶ The recent energy efficiency renovation of the PNC Plaza in downtown Columbus is an example of a project that took advantage of EnergyWorks and PACE. Energy efficiency can be increased and peak demand can be reduced through careful design of new facilities and retrofitting of existing facilities.

businesses, and community groups to implement green practices.²⁴ This project might provide insight for an educational campaign on energy audits and renewable energy.

In any built system, human behavior is often a determinant in performance. This is especially true in residential and business properties with spaces that are shared by multiple users who are not directly responsible for energy costs. In addition to infrastructure improvements, successful incentives will need to be based on understanding behaviors and target those that align with reduced consumption by individuals living and working within a building.

Therefore, social scientists, in addition to engineers, should contribute to efforts to improve energy efficiency and reduce peak demand. Likewise, any educational campaign, especially one targeted at businesses and nonprofits, should highlight the Columbus-Franklin County Finance Authority's **Energy Works** and **Property Assessed Clean Energy (PACE)** programs.^{25, 26} These programs offer critical

financial arrangements that make large up-front investments viable by distributing their costs to businesses and nonprofits over a period of time and impacting how these costs appear on an organization's balance sheet. Greater details about such an initiative are anticipated in the forthcoming **Local Government Energy Partnership** from MORPC.²⁷

Columbus customers who receive their electricity through the CDOP or AEP Ohio have the opportunity to purchase a portion or all of their electricity from renewable sources. Over the past two years, CDOP has developed the **EcoSmart Choice Green Pricing Program** and taken steps to educate customers including: updating the CDOP website with new content about advanced metering infrastructure (AMI), EcoSmart and green purchase power commitments and providing a link for customers to enroll in EcoSmart; designing and sending EcoSmart postcards to customers; issuing a press release regarding CDOP Green Energy Options; forwarding talking points for EcoSmart to CDOP staff and Department of Public Utilities

(DPU) customer service representatives; posting social media content to DPU social media accounts; and including information within a newsletter mailed to CDOP customers as a monthly bill insert in September/October 2017.²⁸ A campaign promoting renewable energy options to AEP Ohio customers would need to focus on explaining the process for selecting an electricity supplier and navigating the PUCO **Apples to Apples Comparison** tool (specifically the renewable energy field).²⁹

Installing energy efficient appliances and performing remediations recommended by energy audits provide greater grid resilience through reduced peak demand. Likewise, on-site electricity production, provided by systems such as residential solar, can reduce peak demand if electricity production is coupled with demand. For instance, solar panels are likely to deliver maximum production during sunny days in the summer when demand for electricity for air conditioning is also likely to be greatest.

Regardless of whether Columbia Gas, AEP Ohio, or CDOP are involved, an educational campaign focused on energy efficiency or renewable energy should look closely at current awareness and participation among customers and subsequently work to reduce identified barriers to participation. Establishing key milestones will allow success to be monitored and campaign efforts to be adapted.

A4

Increase number of air quality monitoring stations to provide baseline data and public educational opportunities.

An increased number of air quality monitoring stations will provide more data to inform planning by MORPC and the City of Columbus and encourage individuals to change behaviors in ways that will reduce both emissions and

exposure. There is a growing body of research on the localized nature of air pollution that suggests traditional estimates of citywide air pollution based on a few select measurements are inaccurate, and personal exposure can vary tremendously between locations, even those short distances apart.³⁰ Infrastructure, including plantings, also plays a role in the transport and removal of air pollutants.³¹ There are currently three ground-level ozone sensors and two PM sensors, maintained by **Ohio EPA**, collecting data from three sites in Columbus; a fourth site is currently offline.³² These stations provide near real-time data for air quality alerts and long-term data sets for planning. Likewise, data collected from these stations determine Columbus' compliance with federal air quality standards. The stations provide a coarse look at air pollution within the city but do not capture the differences in air quality that occur across Columbus neighborhoods.

Therefore, to enhance observations specific to areas throughout the city and improve both planning and education, Columbus should increase the number of stations within the network. The extra monitors added by the City would not be part of the Ohio EPA monitoring network as there are specific criteria for inclusion in that network. Hence, these additional sensors would not be for compliance with federal **National Ambient Air Quality Standards (NAAQS)**, but rather to collect additional data for the Columbus region to inform planning and educate the public.³³ This initiative would provide a structure for air quality monitoring similar to one that already exists for water quality monitoring within the state. In Ohio, there are three levels of classification for water quality data, with Level 1 used solely for education to Level 3 used for regulation. Watershed groups, largely volunteers, play a critical role in collecting Level 2 data that promotes public awareness while also serving as an initial water quality screening and identifying problematic pollution

Yay Bikes!

Bicycle advocacy organization **Yay Bikes!** influences the conditions that help people safely and comfortably ride bicycles for transportation.³⁸ Surveys show that most people would like to ride more for that purpose, but obstacles such as fear of riding in traffic can prevent them from doing so. Upon engaging thousands of these “bike curious” folks on fun, educational How We Roll and Year of Yay! rides, it’s clear that, for many, mode shift is just a short ride away. Once they’re riding, Yay Bikes! provides parking solutions through Dero bike rack consulting and Yay Valet! event-day bike valets. Meanwhile, Yay Bikes! Professional Development Rides are transforming the way hundreds of professionals throughout Ohio are designing for bicycle friendly communities.

sources that are beyond the financial resources of Ohio EPA to monitor.³⁴ The model that has been employed for water quality could be mirrored for air quality.

Due to infrastructure costs, the technical skills required of staff, the need to validate data, and possible logistical considerations of siting, station placement is critical. Data collected in early years will provide an air pollution baseline for comparison as the city continues to grow in population and development, and transportation patterns change. Educational opportunities should include the health impacts of ground-level ozone and PM to contextualize the importance of data collection. Likewise, finer resolution data collection is more likely to motivate individuals to consider air quality impacts in the places where they live, work, and play. Such awareness could inform decision-making (e.g., where and when to exercise, the undesirability of a residence downwind of a heavily used interstate) and advocacy for public policies (e.g., better emissions controls, improved public transportation). Likewise, individuals can elect to

change their behaviors to reduce their emissions of air pollutants (e.g. for instance, by electing to drive less) or reduce their exposure to air pollutants (e.g., by avoiding the outdoors during times of elevated air pollution).

Air quality monitoring stations, while traditionally expensive, have been declining in cost over the past few years. In fact, some consumer-grade systems have been developed and integrated into networks that allow citizen scientists to collect data. One of the concerns about these systems is maintaining quality control of data; but, with sufficient education about their limitations, there may be a role that consumer-grade systems can play in both supplementing data collection and educating the public. Over time, a larger network of stations should provide a more refined temporal and spatial view of pollution, allowing the City of Columbus and individuals to make decisions that improve public health and quality of life. An example of a citizen science network with a digital platform that aggregates and displays data collected using low-cost, easily-installed sensors for PM is **PurpleAir**.³⁵

Central Ohio Transit Authority — COTA

As central Ohio's population continues to grow, access to diverse mode choices becomes increasingly important. COTA has taken a proactive approach to expand mode choice by launching the CBUS, a free Downtown circulator, and CMAX Cleveland Avenue Bus Rapid Transit, which connects low-income communities to jobs, education, training and medical appointments. On May 1, 2017, COTA restructured its bus network to better serve our growing region; by using demographic and travel data and an emerging method of splitting competing service purposes into two design criteria, COTA created a more effective bus network.

A5

Use data and best practices to adapt transportation modes and inform economics of transportation.

Reducing emissions from vehicles with internal combustion engines will reduce emissions of GHGs and other airborne pollutants. Ground-level ozone pollution levels are observed to increase with higher temperatures resulting in worse air quality. As such, this action is specifically designed to address deteriorated air quality that could result from transportation emissions interacting with extreme heat in Columbus.

There is a growing and changing landscape of transportation options in large cities such as Columbus, and an expanding suite of data collection tools available to better understand people's needs and preferences. This data collection, in coordination with planning among the various players in transportation, allows Columbus' transportation options to serve people in a more effective and efficient way with lower transportation emissions. Small nudges, whether incentives or disincentives, could be introduced to promote behaviors that move the system in

this direction. These incentives and disincentives could focus on a suite of efforts to reduce overall transportation pollution through a reduced number of single-occupancy trips, lowered use of polluting fuels, increased use of low-emissions vehicles, expanded access to EV charging stations, and expanded transportation options and times.

Change is easiest when financial decisions of individuals align with desired behaviors. For example, variable demand-based fares could be introduced to incentivize transportation, including commutes outside of peak hours. With commuters, this structure is only likely to work if educational campaigns or other incentives engage employers who have the ability to adjust work hours. Sometimes, these barriers to behavioral change are not readily obvious, but once overcome, can tip a system toward greater adoption. For instance, research has shown that while many employees express interest in vanpools, many are unwilling to actually participate once such programs begin. With the addition of a limited number of rides home in a cab each year in cases of emergencies

(a relatively small cost), a greater number of individuals were willing to join the vanshares.³⁶ Finding the root of barriers to participation may require careful data collection and consultation with social scientists.

We also know that the “last mile” of transport (a phrase initially coined for delivery of goods but more recently applied to the stretch between a primary mode of transport and an individual’s final destination) is often the missing link in a system and a focus of the Smart Columbus initiative.³⁷ Careful consideration should be given to ways that existing components of the transportation system can bridge the “last mile”, and where new components need to be created to fill voids. When various options are explored,

all other things being equal, those that result in lower emissions should be given preference. These decisions should be underpinned by the data collected in Columbus, experts in the transportation sector, and research conducted globally. Efforts to incentivize purchase of a greater number of EVs and provide charging stations, in addition to offering multi-modal transportation options, are all being led by the Smart Columbus initiative.¹² Other options to be explored include encouraged use of bicycling and walking for short-distance trips, increased circulation of free buses through high traffic areas, exploration of special circulators on certain days or weeks of the year, and special programs that expose and allow individuals to explore alternate transportation modes.

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³⁷ “Mobility Matters Podcast.” *TransLoc Studios*. Episode 001, Part 1: Aug. 2017. <http://go.transloc.com/mobility-matters-podcast>. (Accessed Jan. 2018).

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