NOACA
Northeast Ohio Areawide Coordinating Agency

DRAFT
Cleveland-Elyria Metropolitan Statistical Area Comprehensive Climate Action Implementation Playbook

PREPARED FOR:

Climate Pollution Reduction Grant Program

U.S. Environmental Protection Agency

July 2025

PREPARED BY:

Northeast Ohio Areawide Coordinating Agency

1299 Superior Avenue, Cleveland OH 44114

Tel: (216) 241-2414

City of Cleveland

Office of Sustainability and Climate Justice

75 Erieview Plaza, Suite 115, Cleveland OH 44114

Tel: (216) 664-2455

Table of Contents

List of Tables

List of Figures

1. Introduction

Case Western Reserve University (CWRU), through the Great Lakes Energy Institute (GLEI), and in partnership with Cleveland State University's (CSU) Energy Policy Center (EPC) and Kent State University's (KSU) Cleveland Urban Design Collaborative (CUDC) have utilized a multi-disciplinary and comprehensive approach to identify a rigorous decarbonization framework for the Cleveland-Elyria Metropolitan Statistical Area (MSA). Our approach has **regional relevance** and **implications**, while emphasizing equity and climate justice for low-income and disadvantaged communities (LIDACs). This framework will enable the Cleveland-Elyria MSA to identify, analyze, and prioritize the greenhouse gas (GHG) reduction strategies needed to achieve the region's ambitious climate targets by 2050. This framework draws upon and complements the recently Priority Climate Action Plan (PCAP) for the MSA and other existing climate action plans (CAPs) from across the region.

Community leaders, both elected and administrative, of the 164 cities, villages, and townships within the MSA are this report's primary audience, with counties and large public organizations as a secondary audience. To help community leaders use this information, the Playbook employs the six-part community typology from *Vibrant NEO 2040*. Refer to Chapter 2 of this Playbook for an explanation of typologies, and Chapter 6 for measures catered to these community types.

This Playbook can help communities across the MSA develop individual approaches to decarbonization. However, communities should use this report in tandem with the CCAP, which provides a detailed and comprehensive technical guide, including sections on how the climate is changing in Northeast Ohio, an analysis of greenhouse gas (GHG) emissions and reduction measures by sector, and technical appendices with additional detailed analysis.

This Playbook lays out different approaches to decarbonize in an accessible manner for **all** communities, recognizing that different communities across Northeast Ohio are at different steps of this process. It seeks to build upon the most advanced work, while providing on-ramps for communities that are just starting this work. Readers should note that not all the measures presented here apply to each community; communities should evaluate which measures best address their emissions reductions needs and select accordingly. The report emphasizes costs, benefits, and co-benefits - those benefits beyond just emissions reductions – to make the evaluation process easier and more impactful.

What is decarbonization? Decarbonization at its root means the process of eliminating emissions of climate pollution, like carbon dioxide (CO_2) and methane (CH_4), from our economy. The Cleveland-Elyria MSA's current dependence on burning fossil fuels to generate electricity, operate our cars, and warm our buildings will require an extremely large and dedicated effort to use energy more efficiently, and shift our energy generation to renewable or zero-emissions sources, like solar or nuclear. In this report, we take a systems-level approach to

decarbonization. Decarbonization **is distinct from climate adaptation**, which describes actions that modify our systems and infrastructure to adjust to the changing climate.

Table 1: Principles of Decarbonization

Decarbonization Principle	Description
Use Energy More Efficiently	Low Cost - Short term ROI - Optimizes use - Saves Money - lowers the amount of renewable energy needed to meet demand.
Switch from burning fossil fuels to renewable or zero-emissions sources	Construction of new energy generation to replace fossil fuels. Includes switching from gasoline and diesel to batteries, Hydrogen and other clean fuels for cars, trucks planes and ships.
Electrification	Replace gas-burning appliances, industrial equipment and furnaces with electric equivalents.
Capture and store carbon	Remove GHGs from the atmosphere, or capture them at point of emissions, using man-made and nature-based solutions.
Effective planning must be coordinated and integrated	Community planning is coordinated with neighboring communities, counties, political subdivisions and key stakeholders.

What are "net zero" emissions? Many natural processes, and some man-made ones, use carbon from the atmosphere. Trees, for instance, take in CO_2 from the atmosphere and use that carbon to build their trunk and branches. **To reach net zero, natural and man-made uptake of carbon must equal carbon emissions**. Since natural systems capture carbon slowly, capturing carbon is only a small fraction of the solution.

Why are we examining this work now? While climate pollutants like CO_2 and CH_4 have long been a part of our atmosphere, current levels of carbon in the atmosphere are **much higher** than at any previous point in human history. This extra carbon acts like a blanket, warming the planet more than in the past. We can see this with rising temperatures around the globe: 2023 and 2024 were the hottest years on record, with the last decade the hottest on record. As the planet warms by more than 1.5 degrees Celsius from historical levels, this extra warmth will upset many systems that we rely on, threatening our food and water supplies and leading to extreme weather events and other risks. To lower this risk **we quickly need to reduce our emissions** to reach net zero. The communities of the Cleveland-Elyria MSA produce significant amounts of GHGs, and we need to do our part with urgency.

Decarbonization is already underway.

The Cleveland-Elyria MSA has already taken key steps towards decarbonization. This progress can push the region towards certain technologies, policies, or strategies; such as:

Electric Sector: Perry Nuclear Power Plant in Lake County is a unique asset, and it supports efforts to decarbonize the electricity supply. Perry has the capacity to expand, giving the region an advantage in selecting nuclear power as part of its decarbonization strategy.

Transportation Sector: The MSA has begun the shift towards battery electric vehicles (BEVs), and they are the future of transportation across most of the region.

Agriculture, Forestry and other Land Uses (AFOLU): Thanks to the leadership of organizations and assets like the region's Metroparks, the Cuyahoga Valley National Park (CVNP), and Western Reserve Land Conservancy (WRLC), the MSA has incredible capacity to preserve and expand our forest area and invest in other nature-based solutions (NBS).

Organization: Several communities are already on the path to decarbonization. Municipal utilities in the MSA, including Cleveland Public Power (CPP) and Painesville Municipal Electric, produce and deliver clean electricity to residents and businesses. Communities have created sustainability offices to take action on climate. This initial progress provides a vital foundation upon which to build. Some communities have taken additional steps towards decarbonization, such as building district geothermal energy and developing more bikeable and walkable communities. Communities should review their existing efforts and consider how CCAP measures align with this work.

Where to start?

Leadership and Vision: Net zero by 2050 is impossible without leadership, as the market will not meet this goal on its own. Climate action requires leadership, planning, vision, and the commitment of community resources. Visions can unify and inspire communities to act by providing a clear picture of the goal people are working to achieve.

Committed Partnerships: Shifting the MSA to net zero emissions will be a huge effort. No community can reach this target on its own. Partnerships let communities combine their resources, engage a larger number of stakeholders, and bring the broader community together. Communities should look to the public, non-profit, and private sector for climate action partners. In the short-term, some communities may want to focus on working with a smaller set of key stakeholders that are already working on this challenge, as it can help them make progress towards 2030 targets and build momentum for broader-based, long-term action.

Durable Community Relationships: Successful climate action requires developing real relationships with communities through regular exchanges in trusted environments and with trusted representatives. This approach can build mutual trust create ways to share information.

Change Behavior, Adopt Principles, and Set Examples: Participants in CCAP engagement sessions often named schools as a priority. School buildings represent an ideal and visible setting to model how energy efficiency and clean energy can provide community benefits. Transforming our schools into climate leaders, with green buildings, sustainable coursework, and clean transportation systems, is a great way to influence public opinion and behavior.

Develop Multi-Sector Strategies: Implementing climate action on a sector-by-sector basis is not the best approach, as there are key links across different parts of the economy. Industrial development policies that targets businesses focused on decarbonization, energy efficiency, waste reduction and re-use, green building materials, tree nurseries, and the like is important for implementing the measures in this report. These businesses can also power growth for the region and its communities. EcoVillages, such as The Oberlin Project and the EcoDistrict in Cleveland's Slavic Village neighborhood, can build civic pride for residents, helping them identify as a "green community." Organizations like landbanks and land conservancy groups can help combined pieces of land for developments, nature-based solutions, and clean energy.

Benchmark and Measure: Communities across the Cleveland-Elyria MSA are at different steps of their decarbonization journey. Developing inventories of GHG emissions and regularly measuring emissions reductions are crucial to guiding the implementation of this CCAP. Subject matter experts across the MSA area available to provide support.

Adaptation and Resilience: Finally, communities must pair decarbonization with adaptation and resilience**.** Emissions continue to rise worldwide, and the gap between ambitions to reduce emissions and the necessary action continues to widen.[1] With 2023 and 2024 both being the hottest on record, adaptation should be considered in parallel with decarbonization, to ensure that precious resources meet both needs. The Playbook identifies community co-benefits that aid with adaptation, such as street-trees and pocket parks to break-up urban heat island effect. Additionally, our changing climate will at times trigger life-threatening events (e.g. wildfires, extreme weather). Regular engagement with emergency management personnel to discuss and update planning is necessary.

Decarbonization Sector Pathways:

The decarbonization strategies and measures are addressed in this report through six sectors: (1) Electricity, (2) Residential and Commercial Energy, (3) Industrial Energy, (4) Transportation, (5) Waste and Material Management, and (6) Agriculture, Forestry, and Other Land uses. Additionally, the report analyzes the workforce strengths and gaps to implement this transition. Detailed and elaborated analysis can be found in the accompanying technical report and CCAP.

Go Big Strategies

While the CCAP identifies more than 60 emissions reduction measures, there are six, key "Go Big Strategies" that will have significant economic impact and have the potential to drive new growth for our region.

These six approaches can transform the Cleveland-Elyria MSA into a thriving green region on a blue lake.

1. Expanding Nuclear Generation at Perry Nuclear Power Plant
2. Developing Offshore Wind on Lake Erie
3. Net Zero Steelmaking at Cleveland-Cliffs

4. Expanding Passenger Rail and Light-Rail Service
5. Developing a Regional Direct Air Capture (DAC) Facility to remove carbon from the atmosphere.
6. Implementing a “Headwaters Forests Initiative” to reforest 10 square miles of the region’s headwaters

Next Steps

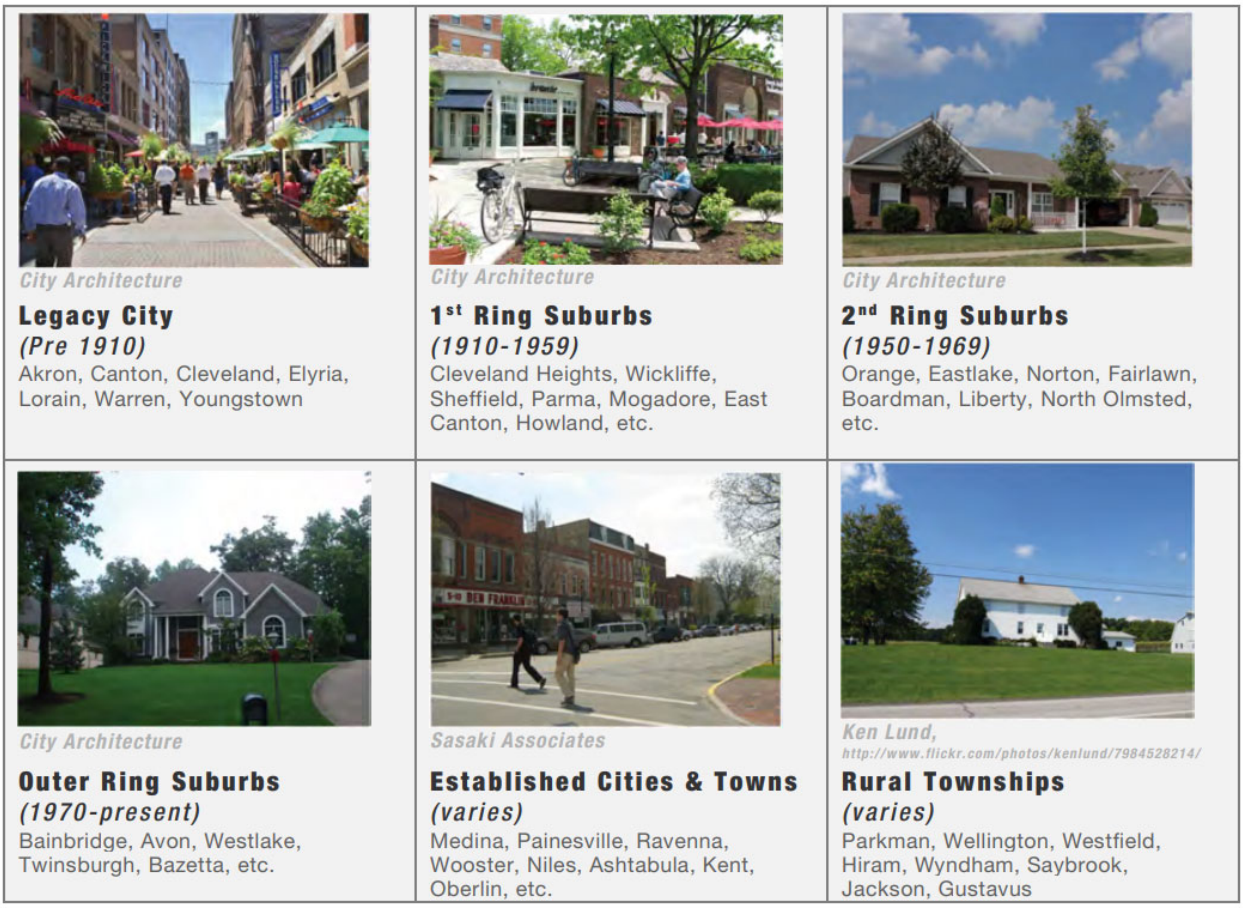
The Cleveland-Elyria MSA stands at a crossroads. The region has seen little to no growth for nearly 75 years, pushing communities within the MSA to compete with one other for business and residential development. The climate crisis presents an enormous threat to the people and systems within the MSA, as it upends the trends we have all come to expect. But the region’s relatively moderate climate, abundant freshwater resources, low cost of living, extensive built environment, and historical manufacturing base also form a strong foundation upon which we can develop as a global leader on decarbonization. This Playbook can guide communities in the Cleveland-Elyria MSA to a thriving, resilient future.

2. Community Typology Breakdown

The Cleveland-Elyria MSA contains a diverse array of community types. The geographic footprint of NOACA includes 61 cities, 45 villages, and 58 townships. This Playbook builds upon the community categorization developed and described in the Northeast Ohio Sustainable Communities Consortium's *Vibrant NEO 2040*report, though it adds other community features into this categorization.[2]

Vibrant NEO describes six major community types: Legacy Cities, First Ring Suburbs, Second Ring Suburbs, Outer-Ring Suburbs, Established Towns and Villages, and Rural Townships. Each of the community types is described in the Table 2, below, including a few examples from the region of communities that fit each typology. Figure 1 provides a visual overview of community types. The breakdown should serve as a tool that communities can draw upon, reference, and apply using their own discretion as to how their community should be best categorized. The typology should be understood as a flexible rather than a rigid template.

Figure 1 Vibrant NEO Community Typology by Growth Patterns



The typology highlights geographic divisions, but also considers communities that share characteristics. The course of action appropriate across community types will likely correspond given the shared core community features. For example, most Second Ring Suburbs lack large

scale industry or commercial operations, so they do not need to manage GHGs from these sector. Instead, the emissions reduction measures applicable to them will largely focus on municipal operations, the transportation sector, and residential sources. Communities of the same type might prove effective and efficient collaborators, establishing communities of practice that benefit from sharing strategies and successful practices.

Table 2: General Description of Communities by Typology

Community Type	Description	Examples	
Legacy Cities *(Established Pre 1910)*	Central urban communities **Housing Stock:** A variety of housing types, including multi-family buildings. **Commercial/ Retail Sector:** A central business district and industry.	Cuyahoga	Cleveland
		Lorain	Elyria Lorain
First Ring Suburbs *(Generally established as a city between 1910-1959)*	Share a boundary with a Legacy City **Housing Stock**: A variety of housing types, including single-and multi-family homes **Commercial/ Retail Sector:** Retail districts and /or corridors, and shared community spaces.	Cuyahoga	Brooklyn Cleveland Heights East Cleveland Euclid Lakewood Parma Shaker Heights
		Lorain	Sheffield Village Vermillion
		Lake	Wickliffe
Second Ring Suburbs *(Generally established as a city between 1950-1969)*	Share a boundary with one or more First Ring Suburbs **Housing Stock:** Single-family housing on larger lots. **Commercial/ Retail Sector:** Limited, auto-oriented commercial and retail uses.	Cuyahoga	Bedford Heights Orange Parma Heights Seven Hills Warrensville Heights
		Lake	Eastlake Amherst Kirkland
		Lorain	North Ridgeville
		Medina	Wadsworth
Outer Ring Suburbs *(Generally established as a city between 1970-present)*	Suburban cities that share a boundary with one or more Second Ring Suburbs **Housing Stock:** Single-family housing on larger lots. **Commercial/ Retail:** Larger-scale commercial and retail uses and commercial districts located near freeway interchanges.	Cuyahoga	Solon Brecksville Strongsville
		Geauga	Bainbridge Chesterland Auburn
		Lake	Eastlake
		Lorain	Avon Avon Lake
		Medina	Brunswick Hills

Established Cities and Towns *(varies)*	Small municipalities that are not suburbs of a larger central city. Often county seats or university towns that are organized around a central green in the Western Reserve style. **Housing Stock:** Predominantly single-family detached homes, though includes multi-family buildings and some high rise apartments. **Commercial/Retail:** Retail density is highest along main corridors.	Geauga	Chardon
		Lake	Painesville Mentor
		Lorain	Fairport Harbor Oberlin
		Medina	Medina
Rural Townships *(varies)*	Low density communities that often include agricultural land uses. **Housing Stock:** Single-family houses that are often sited on parcels one acre or more in size, with wells and septic systems. **Commercial/Retail:** limited retail that tends to be local-owned, small businesses.	Geauga	Middlefield Burton Township
		Lake	Madison Township
		Lorain	Henrietta Whiskeyville Grafton township
		Medina	Seville Sharon Township

Core demographic characteristics for each of the communities listed as examples in the table above can be found in the Technical Appendix. The Cleveland-Elyria MSA demonstrates high levels of racial and economic segregation; this shapes the makeup of each of the community types, with communities near urban cores (Cleveland and Lorain) having higher concentrations of poverty, lower median incomes, lower rates of homeownership, and greater racial diversity, as compared to the second ring and outer suburbs, which tend to have low rates of poverty, high rates of homeownership, higher median incomes, and whiter populations.[3]

3. Low-Income and Disadvantaged Communities by Typology

Low-income and disadvantaged communities (LIDACs) are those communities with high concentrations of residents who have low incomes and are disproportionately exposed to environmental burdens. This chapter outlines the character and distribution of LIDAC communities that fall within each community type. Chapter 4 provides guidance for best practices and offer tools for meaningful engagement with LIDAC residents, in order to integrate better LIDAC communities' priorities and address their concerns on climate actions. Chapter 5 provides a **Community Benefits Assessment Rubric,** a tool to help communities ensure and evaluate how their priorities and concerns align with proposed CCAP measures.

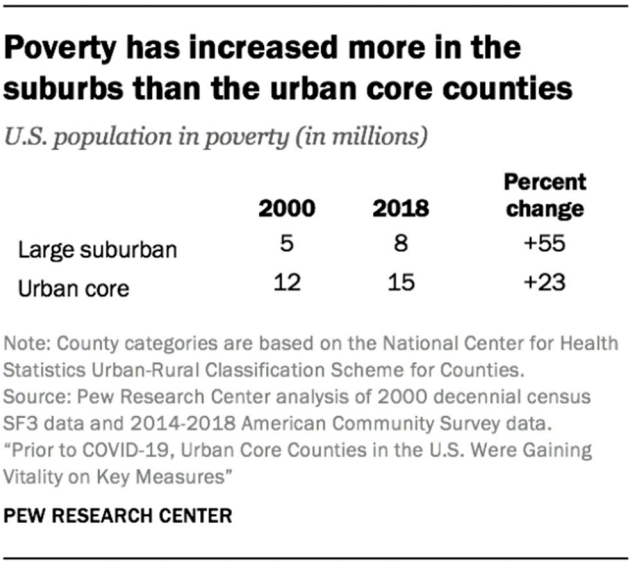
Residents of LIDAC Census tracts are at greater risk of exposure to climate hazards due to social and economic vulnerabilities. Past government processes and policies, such as redlining, have driven disinvestment and segregation, as well as contributed to the barriers to

sustainability and resilience that LIDACs face.[4] The Cleveland-Elyria MSA PCAP used the White House Council on Environmental Quality's (CEQ) *Climate and Economic Justice Screening Tool* and the United States Environmental Protection Agency's (U.S. EPA) *Environmental Justice Screening and Mapping Tool* to identify and determine if a community qualified as a LIDAC. Unfortunately, because they are longer available, it may be harder for communities to identify LIDACs going forward or to evaluate changes in these communities over time. Nevertheless, the PCAP identifies 253 LIDAC census tracts across the Cleveland-Elyria MSA. LIDAC tracts are largely concentrated in Legacy Cities (72%) and First Ring Suburbs (18%), with smaller concentrations in Second Ring Suburbs (3%), Outer Suburbs (1%), Established Cities and Towns (5%), and Rural Townships (1%). The distribution of LIDACs census tracts across various community types is outlined in Table 3.

Table 3: Distribution of LIDAC Census Tracts across Community Types

Community Type	Community Name	Number of LIDACs	Percent of Total LIDACs
Legacy Cities	Cleveland	160	86%
	Lorain	17	9%
	Elyria	9	5%
	Total	186	73%
First Ring Suburbs	Euclid	12	4%
	East Cleveland	11	4%
	Cleveland Heights	6	2%
	Garfield Heights	6	2%
	Maple Heights	4	1%
	Lakewood	4	1%
	Parma	2	1%
	Brook Park	2	1%
	Shaker Heights	1	0%
	Brooklyn	1	0%
	Highland Hills	1	0%
	Cuyahoga Heights	1	0%
	Total	51	18%
Second Ring Suburbs	Warrensville Heights	4	1%
	Parma Heights	1	0%
	Richmond Heights	1	0%
	North Randall	1	0%
	Bedford	1	0%
	Bedford Heights	1	0%
	Total	9	3%
Outer Ring Suburbs	Huntsburg	2	1%
Established Cities and Towns	Painesville	3	2%
Rural Townships	Middlefield	2	1%
Total		**253**	**100%**

Figure 2: Suburbanization of Poverty, 2000-2018



Poverty has increased more in the suburbs than the urban core counties

U.S. population in poverty (in millions)

	2000	2018	Percent change
Large suburban	5	8	+55
Urban core	12	15	+23

Note: County categories are based on the National Center for Health Statistics Urban-Rural Classification Scheme for Counties.
Source: Pew Research Center analysis of 2000 decennial census SF3 data and 2014-2018 American Community Survey data.
"Prior to COVID-19, Urban Core Counties in the U.S. Were Gaining Vitality on Key Measures"

PEW RESEARCH CENTER

During the 2000s the U.S. experienced a rapid rise of poverty in suburban areas, what some scholars have deemed the "suburbanization of poverty."[5] Between 2000 and 2018 the percent change of the population living in poverty in large suburbs grew by 55%, while the percent increase for urban cores was just 24%[6]. A 2013 report noted a 6.1% increase in the rate of suburban poverty in the Cleveland-Elyria Metro area, compared to 2.2% decline in the urban cores in the region.[7] Efforts to target vulnerable and economically disadvantaged populations in the region will need to address the growing geographic dispersion of economically disadvantaged households.

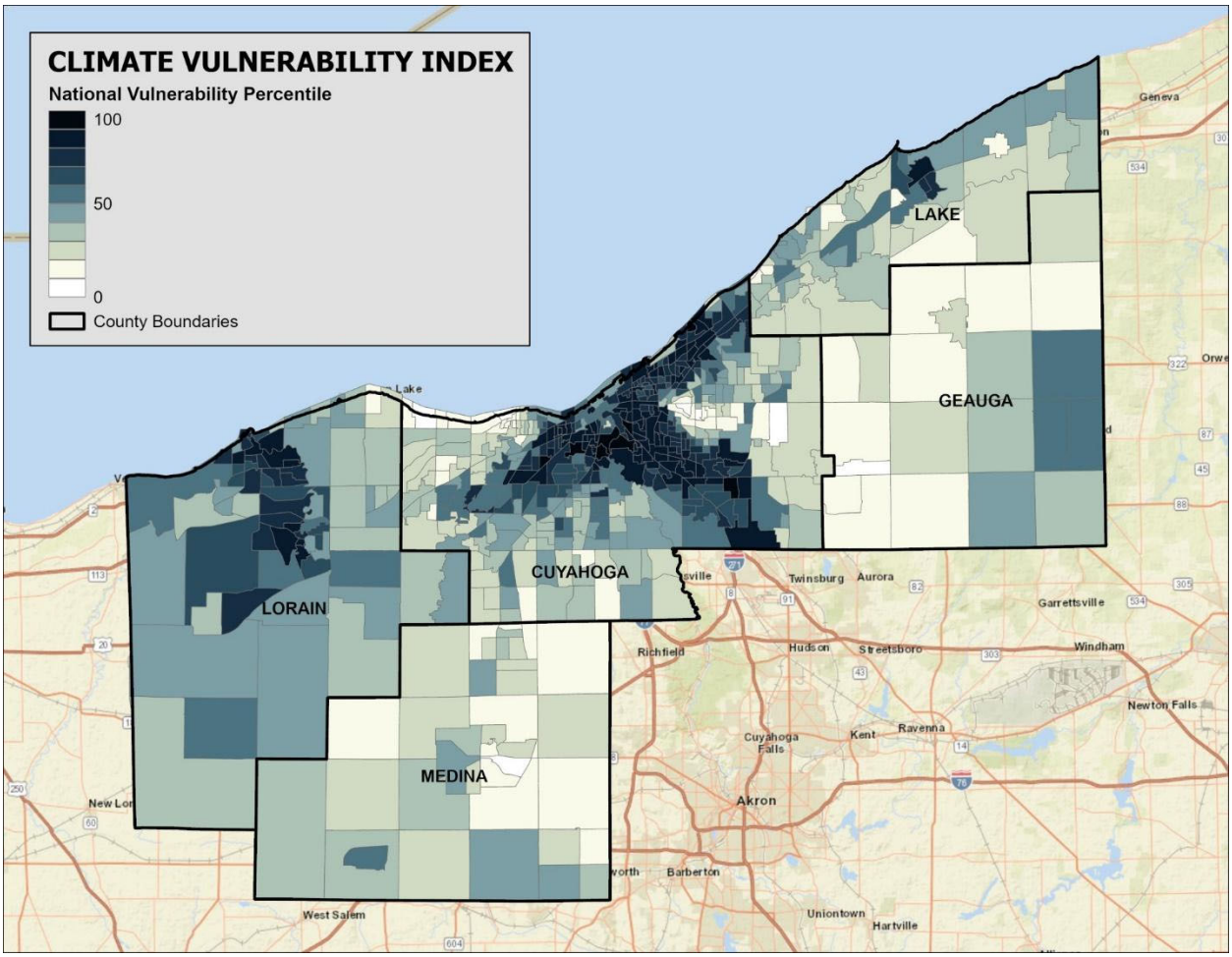
In addition, there are specific population groups that face heightened climate vulnerability. Climate vulnerability refers to one's "propensity or predisposition…to be affected adversely by hazards."[8] Vulnerability encompasses exposure, sensitivity, potential impacts, and adaptive capacity. Certain groups are more susceptible to climate hazards due to (1) their exposure to stresses associated with environmental and social changes, and (2) their limited capacity to adapt or reduce exposure to such harms.[9] A group's vulnerability stems from both social and place-based factors. Social vulnerability, largely the result of social inequalities, encompasses "those social factors that influence or shape the susceptibility of various groups to harm and that also govern their ability to respond" and place inequalities are those that are tied to specific geographic areas, including "characteristics of communities and the built environment, such as the level of urbanization, growth rates, and economic vitality."[10] There is a great deal of overlap with LIDAC communities and climate vulnerable population groups across the MSA. Areas with high concentrations of climate vulnerable individuals are largely concentrated in Cuyahoga County, particularly within the City of Cleveland. However there are exceptions, for example, with outdoor workers. In each county outdoor workers compose nearly one fifth of all workers, with slightly higher concentrations in Lorain and Geauga Counties, as shown in Table 4.[11]

Table 4: Share of Outdoor Workers by County

County	% of Workforce Employed in Outdoor Occupations
Cuyahoga	17%
Geauga	20%
Lake	21%
Lorain	18%
Medina	19%

Figure 3 displays the national percentile rank for each Census tract, according to the Climate Vulnerability Index (CVI).[12] Top ranking tracts are home to large shares of vulnerable population groups, including children under the age of 18, the elderly, households without access to vehicles, outdoor workers, people living with disabilities and health conditions, people with less than a high school diploma, racial minorities, and people with limited English proficiency. While LIDACs are not found in every community, each community type has vulnerable populations that require specific policies and special efforts to mitigate the heightened risk they face.

Figure 3: Climate Vulnerability Index Scores by Census Tract



4. Best Practices in LIDAC Engagement

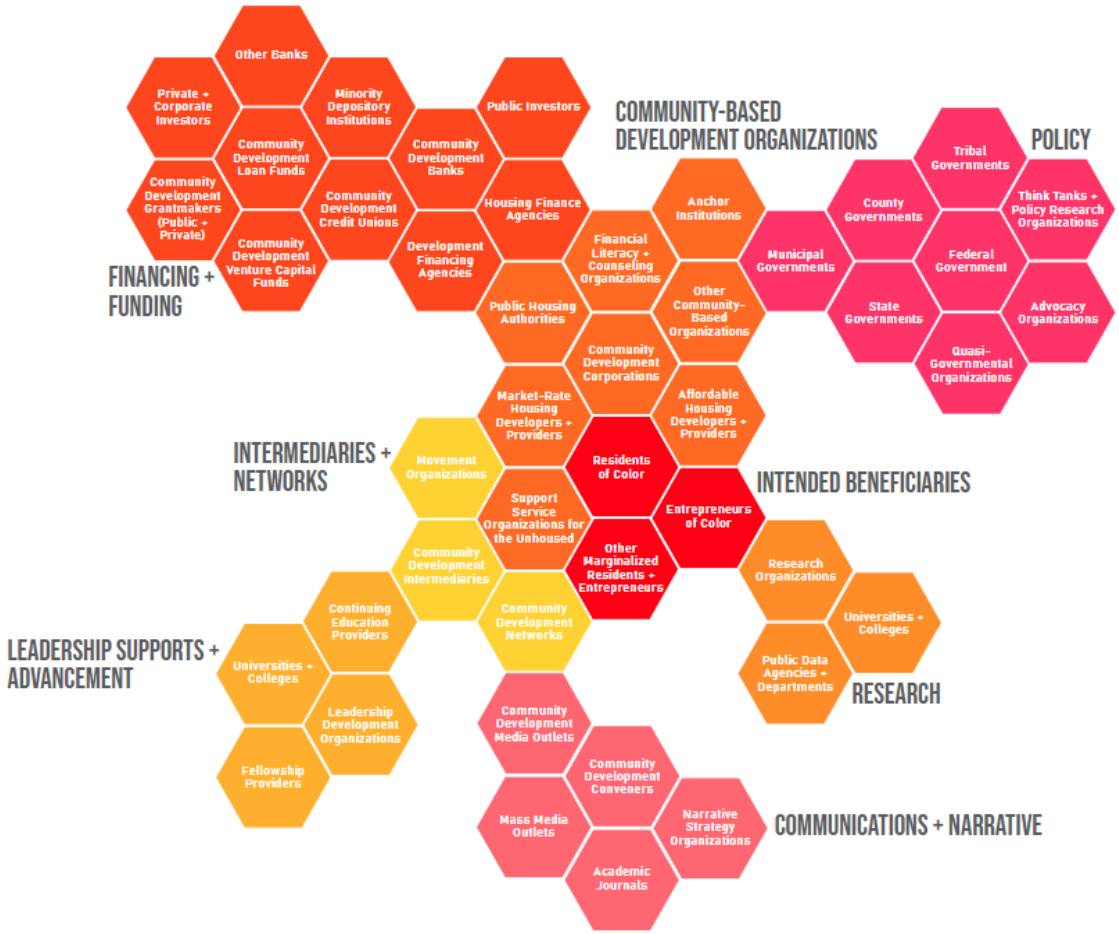
Meaningful engagement is long-term and intentional. It relies on trust and relationship building with diverse stakeholders. Aligning one's climate efforts with community priorities and centering proposed actions in community concerns requires an interactive process with multiple touchpoints and a continual feedback loop. In the section below we offer a brief review of some best practices in LIDAC engagement to provide guidance in how to approach and orchestrate a continual and inclusive process of engagement with LIDAC communities, who so often are overlooked, but whose exposure to climate hazards is often the highest.

We highlight community engagement strategies that: (1) engage **multiple stakeholder**s, (2) are **multi-phase and iterative**, (3) promote leadership structures that facilitate **community partnerships organized around co-developing priorities**, and (4) encompass **community education initiatives** at every level. While not exhaustive, this list provides a basic orientation of how to approach LIDAC engagement to ensure that it is effective in creating strategies that are inclusive of and deliver benefits to LIDAC communities.

Multi-stakeholder: Stakeholders across sectors including but not limited to community based organizations, community development corporations (CDCs), local philanthropic organizations, faith-based organizations, universities and colleges, school districts, anchor institutions, libraries, and local businesses function as an institutional ecosystem that directly interacts with and impacts LIDAC communities. Conducting outreach that facilitates connections and collaborations between parties representing diverse sectors, such as businesses and industry, community organizations, academia, labor unions, and even artists and creatives working in cultural industries, can ensure efforts are undertaken that build on and reflect diverse groups' shared goals and interests. Each stakeholder has a role to play in educating and mobilizing residents to support and engage in sustainable practices and to help advance the goals of decarbonization for LIDAC communities. Outreach efforts need to include organizations that do not traditionally work in conservation and environmental advocacy to achieve transformative and equitable change.

Successful climate action will require **moving beyond episodic "engagement" with the community,** to establishing authentic relationships with the communities through regular and frequent exchanges in trusted environments. In one example, a community-based organization (CBO) in Milwaukee has rolled out a program called the "Green Congregations Initiative,[13]" where they are working with churches as community cornerstones and trusted entities to shift their heating to heat pumps and renewable energy, with a focus on driving down cost. Such approaches build trust that can then be further passed on to congregation members, while also making that congregation a place for engagement and information exchange on further developments in the community.

Figure 4: Multi-Sector Stakeholder Engagement Map



Source: Third Space Action Lab, https://thepeoplespractice.org/research-core-characteristics/

Multi-Phase and Iterative Process: Planning for discussions and engagement with stakeholders across all phases of plan development and implementation is a critical step to ensure that the proposed measures reflect and incorporate community members' priorities and concerns as they evolve. Thinking of community engagement as an ongoing process that is iterative and interactive will facilitate long-term ties and relationships that are meaningful and mutually beneficial rather than extractive. Planning processes should allow for multiple touchpoints and the sharing of proposed measures, as well as to allow for revision and adjustments to better reflect input from community members and stakeholders. Members of the public should be informed and updated on the status of implementation through various pathways of communication. As movement beyond outlining goals is achieved, mechanisms for accountability and transparency is key. Outreach conducted on an ongoing basis allows for priorities to be reevaluated and changed as milestones are reached.

Co-Develop Priorities with Community Partners: Learning from community members and respecting their knowledge and expertise is key to incorporating them as partners with the goal of co-designing efforts and co-developing priorities. Additionally, leadership should be

distributed such that decision-making is shared and results from collaboration. At the outset principles guiding engagement should be outlined and agreed upon. For example, the Jemez Principles were used to guide environmental leaders working with community members at the Garden Valley Neighborhood House that resulted in the installation of a 14kw rooftop solar system in 2022.[14] Feedback on multiple levels can be sought in determining areas for prioritization, including outreach focused on specific projects and within a geographic footprint, as well as general goals and concerns.

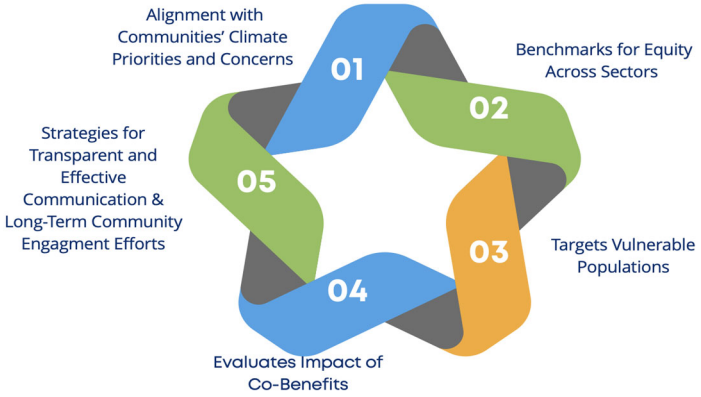
Community Education Initiatives. Education initiatives should be paramount in efforts to communicate the impact of the plan and to maintain connections to community members. Doing so can (1) educate residents of the rationale for selecting specific strategies, technologies, and policies for implementation, and (2) raise awareness of the benefits, and any disbenefits that will result from their adoption. These education initiatives can take diverse forms, including but not limited to interactive websites, fact sheets, book clubs, expert speaker series, sustainability ambassadors, ride-and-drive events to promote electric vehicles (EVs), web series, Instagram stories, TikTok videos, teach-ins, and film series.

5. Community Benefits Assessment Rubric

This chapter outlines a tool to help community leaders to evaluate emissions reduction measures and strategies. Drawing on this rubric can aid decision makers and to help the public to consider how and to what degree potential impacts of measures considered for adoption are consistent with priorities and values expressed during various modalities of community engagement. While acknowledging that it is not always possible to address all of the community members' desired outcomes, the rubric can help to consistently and quickly determine the degree of alignment of the plans proposed policies, strategies, and technologies with community concerns and needs.

Rubric Dimensions

Figure 5: Five-Point Community Benefits Assessment Rubric



The rubric entails five key dimensions:

1. Determining alignment with priorities and concerns identified during various modalities of community engagement
2. Specifying benchmarks for equity across sectors
3. Identifying the impact of measures and strategies on vulnerable populations
4. Identifying and evaluating the impact of co-benefits
5. Outlining strategies for transparent communication and effective long-term community engagement.

Each of the dimensions can be individually evaluated, but when taken together they help to capture and reveal the overall degree of plan alignment with highly salient desired outcomes captured during the plan's community engagement.

1. Alignment with Community Priorities and Concerns

Community engagement, at various levels, allows residents of the region to provide input on the plan's development. Taking from the various modalities of engagement that were conducted for the CCAP roughly 20 different priorities were identified. Priorities were often areas that could be targeted for investment or weighted more heavily when considering what to address. Additionally, community members raised concerns. Concerns raised often addressed existing problems or areas residents believed needed to be addressed or improved. For example, people were concerned about soil contamination when older homes were demolished. This is not a problem that would be exacerbated by climate change, but seen as an issue that community members considered troubling. While in many respects concerns and priorities

overlap, in some instances concerns could be tackled with efforts to improve monitoring and effectively communicate with the public, whereas priorities require the strategic dedication of resources and efforts to resolve.

A summary of priorities and concerns raised during the community engagement conducted in preparation for the CCAP are described in Table 5.

Table 5: LIDAC Community Priorities & Concerns from Community Engagement

City of Cleveland	Nature Based Solutions	Concern: Soil contamination
		Concern: Trees/ Tree Maintenance
		Concern: Sewage
		Priority: Desire for micro-level solutions, for example, rain barrels
		Priority: Gardens and urban agriculture, though concerns also raised re: contaminated soil
		Priority: Better water quality
		Priority: Vacant lots as potential green spaces
	Built Environment	Concern: Aging housing stock presents challenges
		Concern: Damage to homes due to storms/flooding
		Concern: Damage to streets and public throughways due to storms/flooding
		Concern: Renters vulnerable due to landlord neglect/ absentee landlords
		Concern: Safety/ desire for safer neighborhoods
		Concern/ Priority: Housing code enforcement
		Priority: Affordable housing
		Priority: Financial incentives and assistance needed to make improvements/ upgrades
	Resilient People	Concern: Trust of city gov. and reliability of services
		Concern: Safety
		Concern: Lack of power leading to other impacts - health/safety
		Priority: Education, including training opportunities (e.g., for tree canopy maintenance), as well as curricular changes within CMSD schools, and general public awareness
		Priority: Accessible healthy food/ healthier grocery stores/ Variety of Grocery Stores
		Priority: Authentic Engagement
	Other Sectors - Transportation	Concern: Transportation-related air pollution from traffic
		Priority: Free or low-cost bike rental / protected bike lanes

NOACA – Geauga, Lake Lorain, and Medina Counties	Priority - Jobs
	Priority - Health
	Concern - Air Quality
	Concern - Health
Cleveland Heights	Priority: Assistance for low-income households to pursue home improvements that enhance resilience and facilitate improvements for renters
	Concern: Severe storms or flooding can cause transit disruptions, this can adversely impact those who are dependent on public transit, including workers
	Concern: Lack of knowledge and awareness/ Climate Literacy
	Concern: Mental health (youth climate anxiety)
	Concern: Poor air quality, extreme heat, and severe storms impact on health
CC4CC CWRU Community Event in East Cleveland, OH*	Priority - Clean Water
	Priority - Clean Air
	Priority - More Trees/ Green Space
	Priority - Assistance for Improvements to Home
	Priority - Economic Dev. / Investments in the Community
	*While the event orchestrated by CWRU was not part of or organized for the purposes of CRDF planning, the exit survey provides crucial feedback from a community that is severely burdened. Cited above are the top 5 ranked from the exit survey administered at the event.

Proposed measures should aim to tackle as many concerns and priorities as is feasible. Clearly highlighting which community priorities, even if only a select few, are incorporated in proposed measures is critical for managing expectations and for building trust. While it is not always possible to have total and complete alignment, the degree of alignment should be optimized where and if possible, and noted and communicated to the public when not possible.

2. Benchmarks for Equity across Sectors

A second dimension of the rubric is accessing to what extent metrics have been incorporated into and proposed alongside any policies and measures to be adopted to help ensure greater distribution of benefits to LIDAC communities. This dimension of the rubric aims to ensure that efforts will be utilized to gauge improvements upon implementation particularly focused on impact on and within LIDAC communities. Defining baseline metrics and also benchmarking is key to facilitate accountability and help to track and communicate progress.

Table 6: Benchmarks and Metrics to Evaluate Impact of Proposed Measures on LIDAC Communities

Sector	Benchmark / Metric for LIDAC impact
Land Use	● Proximity to Green Space: Percentage of residents within a 10-minute walk of a public green space. ● Carbon Sequestration: Tons of CO_2 captured annually through urban forests, wetlands, and soil initiatives. ● Use of Renewable Energy on Farms ● Urban Tree Canopy restoration
Electricity - Residential Energy	● Number of Households with Above Average, High, or Severe Energy Burden
Transportation	● Transportation Burden ● Walkability Score ● Bikeability Score ● Total Amount Invested in EV Charging Stations ● Electrification/ EV ready/ charging ordinances ● EV ownership rates ● Access to energy efficient transit options for low-income populations ● Installation of EV charging stations in low-income and disadvantaged communities
Industry	● Reduction in co-pollutants ● Job creation
Building	● % buildings electrified ● % residentially-owned solar potential achieved
Cross-Sector	● Number of Cooling Centers ● Improvements in air quality

The list of metrics proposed in above Table 6 is neither exhaustive nor final. It is a preliminary list that can serve as a template; decision makers and the public should create individualized lists that can evolve and be extended or revised, as well as be aligned with community specific objectives. While the process of determining appropriate metrics is iterative, the proposed measures should be evaluated in terms of the degree that progress is measured. Additional metrics and sources to examine equity can be found in Chapter 10.

3. Impact on Vulnerable Populations

To help promote climate resilience it will be critical to consider the proposed measures not just on LIDAC communities, but also on populations that are particularly vulnerable to climate hazards. While the two groups often overlap, this is not always the case.

Climate-vulnerable populations include children under the age of 18, those with health conditions, outdoor workers, the disabled, and the unsheltered. Additional social attributes can be used to determine vulnerability, such as households without a vehicle, populations with less than a high school diploma, and minority populations. Communities should determine what vulnerable groups exist within their borders and how specific policies and strategies tools can be

adopted that target those populations to ensure greater resilience. Communities should also consider tools and strategies to prioritize impact and improve conditions for vulnerable groups.

4. Impact of Potential Co-Benefits

Emissions reduce measures can generate significant benefits, both in general and that are targeted, that directly improve outcomes for LIDACs. Evaluating the degree that measures have multiple and layered benefits is critical for ensuring the adoption of measures that can produce the most bang for the buck. When considering what measures to prioritize and in what sequence, it is important to note to what extent or scale disadvantaged communities directly benefit. This dimension requires policy makers to examine the benefits that accrue to disadvantaged communities even when measures are not specifically aligned with the communities' stated priorities and concerns.

5. Long-Term and Future Community Engagement

Across a range of proposed strategies and policies ongoing community education and engagement initiatives are needed to encourage and smooth adoption and to explain plan objectives and priorities. This dimension of the rubric will help ensure that all aspects of the plan are evaluated on the degree to which dialogue and input from the community is considered and included at the implementation stage, but also to what extent plans extend beyond the plan's adoption to ensure a long-term conversation and communication with community stakeholders takes place.

How to use the rubric

The rubric can be used to guide the development and implementation processes and to make adjustments as measures are proposed to better incorporate and address stakeholder feedback. It can be used as a tool to track progress and to communicate progress to community members.

Chapter 6 provides a summary of emissions reduction measures by community type in order to help communities quickly identify those measures that best suit their specific needs.

6. List of Measures by Community Type

To provide a foundation for action across all community types, we begin this section with a set of **Cross-Cutting Measures**. These are strategies that apply broadly and are **relevant regardless of typology**. Grouping them up front ensures that universally beneficial actions are easily accessible before diving into more tailored approaches.

6.1. Cross-cutting measures

6.1.1. Multi-Sectoral Strategies

Change behavior, adopt principles, and set examples: Organizations and residents are influenced by the examples they see around them, and communities can harness this to promote decarbonization.

Participants in CCAP engagement sessions regularly **identified schools and educational initiatives as critical priorities**. Schools are places that connect generations within and from the community, bringing people together. Incorporating this feedback we have identified school buildings as an ideal and visible physical setting to model how to use energy efficient and renewable energy technologies to provide community benefits.

Tackling decarbonization for schools requires strategies that incorporate buildings, energy use, land use, and transportation; however, schools are unique sites to model exemplary technologies because schools, as core social institutions, can additionally address education and encourage civic pride. Transforming our schools into green schools, with green buildings, green curriculum, green buses and bike racks, could prove a critical step in changing public perception and behavior. Changes to schools can help to show the benefits of decarbonization and model how strategies and technologies can produce a wide range of desirable and beneficial outcomes. If the principles of a sustainable built environment can be rooted in the region's rising generations, this step may be among the most impactful long-term.

Industrial Development Policy: Larger communities, counties or chambers of commerce, that targets businesses whose focus is decarbonization, energy efficiency, waste reduction and re-use, green building materials, tree nurseries, and similar materials, technologies or strategies needed to implement the actions in this report can fuel **economic growth** for the region and its communities.

Marketing and branding as environmental stewardship districts)"EcoVillage identity" strategy): The Cleveland-Elyria MSA is no stranger to efforts to market designated "eco-friendly" communities, with *The Oberlin Project*, *EcoDistrict* in Cleveland's Slavic Village neighborhood, and the *EcoVillage* in Detroit-Shoreway. By coupling effective marketing with vision and community participation, these districts or communities can play an outsized-role in the civic pride of residents, creating identity as a "green community" while also having positive climate impacts. Per Chrystal Johnson of Earth911, "This philosophy of intentional living within a

community makes the transition to (sustainable) living much more attainable and less inhibiting.[15]" EcoVillages function best with either a community-based organization (CBO) or Community Development Corporation (CDC) champion, or an assigned lead within town or city hall, to pursue the sustainability vision with supportive marketing, zoning, and planning efforts. Further, such EcoVillages can also benefit from participation in national or international associations of parallel community efforts; through these associations they can identify best practices, resources, and develop partnerships as they collectively model decarbonization strategies and behavior.[16]

Land parcel assembly and aggregation: While difficult, this strategy is necessary for many of the proposed measures. Land parcel assembly enables scale for three decarbonization strategies:

1. Densification in our legacy and established cities, which creates opportunities for growth, live-work-play communities, efficient new buildings and significant reductions in VMT;
2. Pocket parks and forests, for nature-based solutions; and
3. Community or utility-scale solar installations.

While the exact structure for implementation will vary from community to community, involvement of the County Land Banks, Park or Land Conservancy offices, or municipal utilities can help build momentum for land parcel assembly. Public-private financing with local lending institutions could provide the financial wherewithal to structure some of these agreements.

6.1.2. Electricity

Enrolling in aggregation contracts is a foundational step for regional energy decarbonization. **Community choice aggregation (CCA)** enables the procurement of 100% renewable energy for residential and mercantile electricity customers through organizations like SOPEC or NOPEC. This approach facilitates broad adoption of clean energy at the community scale and supports regional climate goals.

It also opens pathways for three complementary strategies:

- **Opt-in renewable energy for eligible institutions:** In communities enrolled in SOPEC, non-industrial and non-commercial organizations—excluding political subdivisions—may opt in to receive 100% renewable energy. This extends the benefits of clean energy beyond residential use to include schools, nonprofits, and other eligible facilities.
- **Procurement of out-of-region zero-emissions energy for large users:** Non-CCA-eligible entities, such as large mercantile, commercial, and industrial users, can meet sustainability targets by sourcing renewable or zero-emissions electricity from outside the region.
- **Grid modernization to support renewable integration:** Modernizing the distribution system enhances demand response, peak load management, and the engagement of grid-scale battery storage for frequency regulation and voltage control. Reducing line losses through targeted equipment upgrades further increases system efficiency and reliability.

To build resilience and enhance local generation capacity, communities should prioritize the following measures:

- **Develop microgrid and mini-grid systems** to support critical community infrastructure.

A typical system may include 5 megawatts (MW) of renewable energy generation and 20 megawatt hours (MWh) of storage to ensure continued operation during grid outages. This can be critically important for fire, police and EMS stations, town or city hall function, and warming or cooling centers for the community.
- **Complete the transition to LED lighting** for streetlights, security lighting, and ambient outdoor lighting to reduce energy consumption and operating costs.
- **Construct utility-scale solar installations within the region**, particularly in support of municipal utilities. These projects may also involve Power Purchase Agreements (PPAs) to secure long-term in-region renewable energy supply.
- **Expand behind-the-meter solutions** with standardized solar installations:
    - Single-family homes: 200 square feet (sq. ft.) / 3.45 kilowatt (kW) array
    - Commercial buildings and schools: 1000 sq. ft. / 17.25 kW array
- **Implement district thermal energy systems**, with a focus on geothermal heating and cooling where local land and geology allow. In high-density urban areas, systems may instead utilize wastewater heat recovery or industrial/data center cooling water.

6.1.3. Residential and Commercial Energy

Building performance upgrades are essential for decarbonization and resilience in both existing and new structures. Reducing energy use in buildings—while electrifying systems and enabling dynamic energy management—forms a cornerstone of long-term emissions reduction. A comprehensive approach includes energy audits, targeted retrofits, and performance standards to guide new construction. These improvements support several overarching strategies:

1. **Retrofit existing buildings** improves energy efficiency and reduces energy burdens. Prioritizing insulation, air sealing, and smarter controls in existing buildings can drastically reduce heating and cooling demand, especially in vulnerable households.
    - **Conduct building inspections** and prioritize high-impact retrofits, particularly in homes with high energy burdens. High-impact retrofits would include wall and roof insulation, air sealing, low-emissivity windows, and advanced framing techniques.
    - **Introduce occupancy and daylight sensors** to minimize unnecessary power use.
    - **Promote cool roof coatings and reflective pavements** to reduce heat absorption and cooling loads.

2. Communities should also focus on **electrifying building systems and enable load flexibility**. Transitioning from fossil-fuel-based systems to electric and responsive alternatives supports both decarbonization and grid stability. Measures include:
    - **Replace gas furnaces** and boilers with **electric heat pumps** (air source or ground source/geothermal)
    - **Encourage battery storage systems** for **backup power** and **load-shifting**.
    - **Support automated energy response systems** and **smart sensors** in residential and commercial settings.
    - Enable buildings to act as **flexible loads** through technologies that respond to:
        - Real-time grid signals
        - Utility dispatch
        - Time-of-use pricing
        - Peak-demand reduction incentives

3. **Construct new buildings to high-performance and low-carbon standards**. New development should adopt leading performance benchmarks to minimize lifecycle emissions and long-term operational costs.
    - **Require compliance with ASHRAE 90.1 (**energy efficiency) and **62.1** (indoor air quality).
    - Integrate**:**
        - **Passive solar design**
        - **Triple-glazed windows**
        - **Smart controls** for lighting, HVAC, and plug loads based on occupancy
    - **Use mass timber, low-carbon concrete**, **sustainably sourced wood**, and **recycled steel**.
    - Include optimal **solar orientation**, **thermal massing**, **shading devices**, and **daylighting** strategies.
    - Embed **life cycle assessment (LCA) tools** into the design process to guide the selection of low-GWP (Global Warming Potential) materials.
    - Deploy **intelligent monitoring and automated energy systems -** Digitally connected systems are essential to track, optimize, and adapt building energy use in real time.
      Implement **digital monitoring** of:
        - HVAC systems
        - Lighting and daylight controls
        - Plug loads and appliances
    - **Install smart devices** and **automated systems** that adjust energy use to occupant needs and can flex energy demand in response to utility pricing and conditions while maximizing efficiency and comfort.

4. **Support regional supply chains and sustainable material sourcing:** Local manufacturing of building systems and open-access tools can reduce emissions and improve performance while strengthening the regional economy.

5. **Create open-access databases** for regional recycled materials and products with low embodied energy.

6. **Support local production of full homes** or **building components** that:
    - Reduce waste
    - Lower transportation-related emissions
    - Improve construction quality and speed

7. Finally, but critically, **focus incentive programs on low-income households**, including renters and multifamily units that lack access to rooftop solar or central HVAC systems.

6.1.4. Transportation

The widespread adoption of **zero-emission vehicles (ZEVs) i**s critical to decarbonizing transportation by 2050. Achieving 99% electrification of light-, medium-, and heavy-duty vehicles requires coordinated action across infrastructure, fleets, households, and policy. Implementation strategies must align with state planning, leverage public incentives, and be complemented by

active transportation options. These actions can be organized around four interdependent strategies:

1. **Accelerate EV adoption across all vehicle classes:** Transitioning local fleets and households to electric vehicles is essential to reduce transportation emissions at scale.
   - Local government fleets should adopt electric vehicles at a rate consistent with **99% electrification of light-duty vehicles (LDVs) by 2050**, using **cooperative purchasing programs** to lower costs.
   - Household EV adoption should follow a similar trajectory, supported by a **local EV rebate program** to make electric passenger vehicles more affordable and appealing.
   - For **medium- and heavy-duty vehicles** (MHDVs), local fleets must adopt electric trucks and buses at a rate that achieves **99% electrification by 2050**, also leveraging cooperative procurement tools to ease the transition.

2. **Build out publicly accessible charging and refueling infrastructure:** A reliable and comprehensive charging network is necessary to enable mass adoption of electric and fuel cell vehicles.
   - Expand **public EV charging infrastructure for LDVs** to meet the demands of near-universal EV ownership by 2050.
   - Develop **higher-powered EV charging stations** designed specifically for MHDVs to accommodate longer charging times and greater energy needs.
   - Construct **hydrogen refueling stations** to serve **battery-dominant medium- and heavy-duty fuel cell electric vehicles (FCEVs)** as part of a broader zero-emissions freight strategy.

3. **Align regional strategies with state-level transportation planning:** Regional efforts must be coordinated with broader planning frameworks to ensure consistency and long-term effectiveness. These actions align with the Study Network in ODOT's 2025 Strategic Transportation Analysis.

4. **Expand active transportation infrastructure to support mode shift**
   Increasing bicycle use can complement vehicle electrification and reduce overall VMT.
   - Build out **protected bicycle infrastructure** to expand the demographic range of people willing to shift from cars to bicycles for some trips.
   - Prioritize comfort, safety, and connectivity to enable everyday cycling for commuting, errands, and recreation.

5. In addition, **a modal shift in freight transport** would further reduce emissions while easing some of the roadway congestion.

6.1.5. Waste and Material Management

Waste, wastewater and material management practices to reduce emissions are important and relevant across all community typologies, although some approaches may not apply in communities that do not have specific systems, such as a landfill. Measures include:

1. Installing **gas capture systems for landfill methane**. Ohio Code requires that landfills with at least 2.5 million megagrams capacity are required to have a gas capture system (large and mid-sized municipal landfills)[17]. Communities should particularly consider smaller landfills that fall below this threshold for such systems as well.
2. Restaurant and grocery **food waste reduction and composting programs** can reduce solid waste; such organic matter is often a key contributor to landfill methane emissions.
3. **Add compost bins to public facilities**, parks and sports stadiums to divert organic waste.
4. For wastewater treatment facilities, **post-incineration scrubbers with fluidized bed incinerators** should be considered.
5. **Leak detection sensors in municipal water and wastewater** systems save water and energy.
6. Replace harmful refrigerants with **climate-friendly refrigerant** alternatives.
7. Improve **end-of-equipment life facilities or dropoff/collection** programs to ensure proper containment of refrigerants. Ideally these should be co-located with hazardous waste facilities to leverage infrastructure and regulatory compliance systems.

6.1.6. Agriculture, Forestry, and Other Land Uses

Land-use plays a particularly important role in shaping GHG emissions. Density reduces distances between where we live, work and play, thereby creating system-wide efficiencies and driving down VMT. Land-use around our buildings affects heating and cooling of buildings and neighborhoods, as well as the potential for nature-based solutions to capture carbon. Many of these measures apply across all communities.

With respect to our built environment, incentivize carbon-capturing architectural design and architecture that assist in reducing the heat island effect, thereby also reducing the need to cool buildings. Consider if retrofits and building code modifications are needed to accomplish objectives.

1. **Sustainable funding strategies**, including VMT-based taxes and clean energy investments, would support long-term infrastructure resilience and emissions goals. Land use strategies could include the deployment of large-scale solar energy systems—defined as installations greater than 2.5 MW—in areas of high energy demand. These projects could serve both current energy needs and long-term sustainability goals by displacing fossil fuel reliance and supporting grid decarbonization.

2. To support deep decarbonization of the regional industrial sector, future targeted investments could focus on **carbon capture, utilization, and sequestration (CCUS)** infrastructure. This includes the development of carbon capture pipelines designed to transport emissions from smaller industrial sources to utilization or sequestration sites. A **regional CO_2 pipeline network** could serve as critical infrastructure for linking distributed emitters to centralized facilities capable of long-term carbon storage or beneficial reuse. In parallel, green hydrogen production facilities and net zero transportation networks for distributing hydrogen to industrial end users could support decarbonization of hard-to-electrify processes. Investment in **regional direct air capture (DAC)** facilities could provide a means to remove carbon dioxide from the

atmosphere, particularly for industries across the region that are challenging to decarbonize, while also supplying captured CO_2 for use in emerging utilization industries. Leaders should site DAC facilities near renewable energy resources and industrial hubs to maximize efficiency and integration.

3. **Nature-based solutions** could be layered into this approach to enhance carbon sequestration through ecological restoration and soil management. Wetland and riparian restoration could be prioritized in flood-prone areas, where the carbon sequestration benefits of wetland ecosystems also deliver co-benefits like flood mitigation and habitat enhancement. Prairie and grassland reconstruction could be implemented in appropriate locations to rebuild native plant communities and maximize soil carbon storage.

   Soil carbon enhancement practices could vary by context. In urban areas, construction activities could integrate compost and biochar into soils to increase long-term carbon retention. In agricultural zones, widespread adoption of cover cropping and minimal tillage techniques could help build healthier soils and lock away more carbon.

   Biomass and biochar programs could further strengthen this approach. Biomass from urban and agricultural waste streams could be captured and processed into biochar, which can then be returned to agricultural lands or used in landscaping applications to sequester carbon in soils over the long term.

6.2. Legacy Cities

Legacy Cities tend to have high population densities and a significant concentration of infrastructure, supported by transit accessibility and walkable street grids. However, they also face ongoing challenges related to historic disinvestment, widespread vacancy, and the presence of brownfield sites that reflect their industrial past.

6.2.1. Electricity

1. **Diversifying and decarbonizing the electricity supply:** This step is central for legacy cities to meet their long-term climate goals. The region must invest in a portfolio of renewable generation sources, storage technologies, and advanced systems integration to ensure a clean, resilient, and reliable energy grid. These actions support five interrelated strategies:
2. **Deploy utility-scale offshore wind generation in Lake Erie:** Offshore wind provides a reliable, large-scale renewable energy source that can be integrated into the regional grid.
   - Utilize **Lake Erie** for **utility-scale offshore wind** development.
   - Apply a **41% capacity factor**, based on IRENA 2023 data, to estimate output potential and grid contributions.
3. **Convert underutilized brownfields into solar power assets:** Reclaiming industrial land for clean energy aligns environmental remediation with energy production.
   - Convert **75% of the 1,107 brownfield acres** in the metropolitan statistical area (MSA) to solar—approximately **830 acres**.
   - At a density of **4.25 acres per megawatt**, this results in a generation potential of **195 MW** of solar capacity.

4. **Invest in long-duration and short-duration battery energy storage systems (BESS):** A decarbonized grid must be supported by flexible storage solutions tailored to different operational needs.
    - **Long-duration storage** (>10 hours) should be deployed at the **district or utility scale**, enabling:
        - Load balancing over extended periods
        - Backup during prolonged outages
        - Integration of variable renewables
    - **Short-duration storage** (<4 hours) should also be implemented at scale to support:
        - Peak shaving
        - Frequency regulation
        - Short-term outage mitigation
5. **Develop geothermal electricity** using advanced drilling technologies**:** Geothermal systems offer clean baseload electricity with high reliability and minimal land use.
    - Utilize **new drilling and heat-exchange technologies** (e.g., Fervo Energy's approach) to tap deep geothermal resources.
    - Projects can be planned based on an **82% capacity factor**, per IRENA 2023, indicating strong year-round performance.
6. **Incorporate low-carbon hydrogen (H_2)** into the energy system: H_2 can serve as a clean, flexible energy carrier across multiple sectors.
    - Develop **low-carbon H_2 infrastructure** for use in:
        - Energy storage
        - Heavy transportation
        - Industrial heat and processes

6.2.2. Residential and Commercial Energy

Comprehensive building retrofits are essential to improve energy performance, reduce emissions, and advance equity Retrofitting existing buildings—especially older, inefficient housing—requires a coordinated strategy of inspection, financial incentives, and progressive code development.

Targeted upgrades to mechanical systems and building envelopes, paired with renewable energy integration, support six interlinked strategies:

1. **Inspect and prioritize buildings based on need and equity:** Strategic retrofitting begins with identifying the most urgent opportunities based on condition, energy burden, and financial feasibility.
    - **Inspect and prioritize buildings** using a **cost-benefit analysis** and need-based assessments.
    - Conduct **prototyping studies** of typical **single-family** and **multi-family** buildings to tailor retrofit strategies.
    - Prioritize equity through programs like the **Equity-Focused Weatherization Program**, targeting older residential buildings and underserved populations.

2. **Replace outdated systems with high-efficiency electric alternatives:** Aging HVAC, water heating, lighting, and appliance systems must be replaced to achieve significant energy savings and electrification goals.

- Replace:
  - Inefficient HVAC systems with **air or ground source heat pumps**
  - Outdated **gas water heaters, furnaces, and boilers** with **high-efficiency electric systems**
  - Legacy **lighting, appliances, and plug load equipment** with efficient electric alternatives

3. **Improve building envelopes to minimize energy loss:** Reducing heating and cooling demand through envelope upgrades is one of the most cost-effective efficiency strategies.
   - Ensure compliance with modern codes for:
     - Wall and roof insulation
     - Air sealing
     - Low-E windows
     - Advanced framing techniques
   - Implement envelope upgrades in tandem with mechanical system improvements to maximize overall building performance.

4. **Support retrofits through financial incentives and green programs:** Public and utility-sponsored financial tools make deep retrofits accessible for homeowners, renters, and landlords.
   - Provide incentives for energy efficiency retrofits and renewable energy installations (e.g., rooftop solar)
   - Support and expand existing green programs that promote clean energy and weatherization, especially for low-income households.

5. **Adopt progressive building codes to drive future-ready construction**
   Updating building codes ensures that energy-efficient design and clean energy integration become standard practice.
   - Draft and adopt **progressive energy codes** that:
     - Prioritize energy efficiency
     - Require **renewable energy integration**
     - Enable **on-site energy storage**
   - Embed retrofit guidelines into existing code frameworks for retroactive compliance in major renovations.

6. **Incorporate nature-based design through green roofs and living walls**
   Green infrastructure can complement energy upgrades by reducing building heat gain and supporting stormwater management.
   - Install **green roofs** and **living walls** with **strategic placement** to reduce cooling demand.
   - Align these installations with broader energy efficiency and building retrofit strategies for maximum impact.

6.2.3. Industrial Energy and IPPU

Decarbonizing industrial processes requires tailored solutions for hard-to-abate sectors. Achieving net zero emissions from heavy industry demands a mix of innovative technologies, fuel switching, and carbon management. Where direct electrification is not feasible, alternative pathways like hydrogen use and carbon capture must be deployed.

The following four strategies reflect the region's industrial decarbonization roadmap:

1. **Deploy molten oxide electrolysis (MOE) for zero-emissions steel production:** Breakthrough technologies like MOE can produce steel without fossil fuels.
2. **Implement carbon capture and geologic sequestration at major industrial sites:** For industrial facilities unable to eliminate emissions entirely, CCUS can mitigate climate impacts. The MSA could work to capture carbon emissions at Cleveland Works and other high-emitting facilities, then transport and sequester that CO_2 geologically in suitable formations located in:
    - Geauga County
    - Mahoning County
    - Portage County
    - Stark County
    - Summit County
    - Trumbull County
3. **Apply post-combustion carbon capture for specific high-emission processes:** When electrification or hydrogen substitution is cost-prohibitive or technically infeasible, post-combustion capture offers a viable alternative. It is particularly relevant to **cement production**, where the calcination process generates unavoidable process emissions. Capture technologies should be coupled with **permanent storage or utilization pathways**
4. **Substitute H_2 in hard-to-electrify industrial sectors** Hydrogen can provide high-temperature heat and serve as a feedstock for industries where electrification is impractical.
    - Prioritize **H_2 switching** in industries such as:
        - Steel
        - Cement
        - Chemical manufacturing
    - All other industrial processes should aim for **direct electrification**, especially where process temperatures and cost allow.

6.2.4. Transportation

Transportation decarbonization requires both clean fuel infrastructure and demand reduction strategies. Targeted investments in EV infrastructure, alternative fuels, and land use planning can significantly reduce emissions while improving mobility access. These efforts should be concentrated in areas where they maximize community benefit and system efficiency.

Four complementary strategies support this transition:

1. **Expand equitable access to EV infrastructure in LIDACs:** Ensuring that LIDAC areas have access to EV charging is critical for inclusive transportation electrification.

- Install new EV charging stations in the **parking lots of LIDAC-designated apartment buildings**.
- Site selection is based on LIDAC census tract analysis and **proximity to community amenities** such as grocery stores, recreation centers and schools.
- This strategy increases EV access and convenience for residents who are most often excluded from early infrastructure investments.

2. **Advance the transition to sustainable fuels in maritime transportation:** Maritime ports are key nodes of industrial and freight activity and must reduce emissions from vessels and on-site equipment. Ports should promote the **adoption of sustainable liquid and gaseous fuels** (e.g., renewable diesel, green ammonia, bio-LNG) at regional maritime ports. This helps reduce GHGs and air pollution from port operations.

3. **Support the use of sustainable aviation fuel (SAF) at regional airports:** Aviation contributes significantly to transportation-sector emissions and requires alternative fuels to achieve meaningful reductions. Regional airports should accelerate the **deployment of SAF t**o lower lifecycle emissions from commercial and cargo flights. Airport operators will have to coordinate with airlines, fuel providers, and regulatory agencies to scale availability and adoption.

4. **Reduce household VMT through Transit-Oriented Development (TOD):** Compact, mixed-use development near transit drastically reduces the need for car travel and supports climate and equity goals.
   - Encourage **TOD planning and implementation** to achieve measurable VMT reductions per household compared to conventional low-density development.
   - Co-locate housing, transit, and amenities to foster **walkable, transit-accessible neighborhoods**.

6.2.5. Waste and Material Management

No strategies specific to this typology.

6.2.6. Agriculture, Forestry, and Other Land Uses

Infrastructure retrofits are key for his sector. While Legacy cities always have certain types of growth and development, the major infrastructure still needs a lot of work and retrofitting. **Building code modifications** could incentivize carbon-capturing architectural designs in urban core areas. **Green roofs** could be encouraged through **density bonuses, expedited permitting, or stormwater fee reductions**. These living roof systems could be designed specifically to maximize carbon sequestration through appropriate soil depth and plant selection while providing additional benefits like energy conservation and stormwater management.

Urban agriculture zones could be expanded, and parking lot retrofits could be incentivized to increase permeable surfaces and tree cover. In combination, urban core communities could implement targeted street tree planting and solar canopies on parking lots designed specifically to reduce ambient air temperatures while maintaining and expanding solar energy potential. Unlike conventional approaches that focus primarily on building shade, these programs would prioritize shading pavement—which absorbs and radiates significant heat—while leaving building rooftops available for solar installations. This approach would address urban heat island effects while supporting renewable energy goals.

Green corridor development could expand on certain cities current plans, creating connected networks of tree-lined streets that facilitate carbon capture while improving walkability and neighborhood aesthetics. These corridors would serve as the connective tissue between larger green spaces, extending their ecological influence throughout urban neighborhoods. **Urban green spaces** could incorporate native shrubs and groundcover plants that contribute to soil carbon accumulation while minimizing maintenance requirements. Impervious surfaces within parks could be systematically reduced and replaced with **carbon-capturing vegetation and permeable materials.**

Urban parks and green spaces could be redesigned with explicit carbon sequestration goals, moving beyond aesthetic considerations to maximize ecological function. Selection of **long-lived, native tree species with high carbon storage capacity**—including Red Oak, Sugar Maple, American Beech, and Tulip Tree—could significantly increase carbon capture potential over conventional ornamental species.

Creating **multi-layered vegetation structures** that include canopy trees, understory trees, shrubs, and ground cover plants should mimic natural forest ecosystems and maximize carbon capture per square foot—a critical consideration in land-constrained urban environments. Mixing deciduous and evergreen species could ensure year-round carbon capture, while dense, multi-species plantings in forest-like configurations could replace sparse, ornamental layouts in selected areas.

Regulations and incentives to **bury power lines along key corridors** could reduce conflicts between street trees and overhead utilities, allowing for larger tree species with greater carbon sequestration potential. This infrastructure improvement could be funded through property tax assessments based on street frontage, creating a sustainable financing mechanism while providing multiple benefits including reduced power outages during severe weather events.

6.3. First-Ring Suburbs

First Ring Suburbs are primarily residential with some retail corridors, and are characterized by modest single-family homes. They are experiencing increasing racial and economic diversity, and are defined by early 20th-century architecture and urban form. Many contain cultural landmarks or community institutions, but face challenges with reinvestment and equitable development.

6.3.1. Electricity

Promoting renewable energy aggregation, such as **Community Choice Aggregation (CCA)**, can empower individuals and municipalities to transition to clean energy sources. Additionally, the **opt-in Public Pricing Program** for mercantile customers, including local governments, political subdivisions, non-profit and faith-based organizations can quickly help key organizations within these communities transition easily to renewable energy.

6.3.2. Residential and Commercial Energy

Best practice strategies start with **building inspection and prioritizing energy efficiency**. Ensure **compliance with current building codes**. Encourage **retrofits** targeting energy efficiency, to include updating wall and roof insulation, air sealing, low-emissivity windows and advanced framing so as to reduce energy use and costs related to heating and cooling.

Replace inefficient HVAC systems with air source heat pumps, water heating, and electrical systems; lighting, appliances, and equipment with high-efficiency electric systems; and water heating, gas furnaces, and boilers with electric high-efficiency systems. **Green Roofs and Living Walls** can further insulate and reduce heating and cooling costs.

Add **rooftop solar** to residential and commercial properties, which can lower energy costs and spur electrification.

Communities should consider providing **financial incentives** while leveraging the State of Ohio's weatherization and energy programs to drive energy efficiency retrofits.

6.3.3. Industrial Energy and IPPU

If the region constructs **pipelines to transport CO_2 emissions** from industrial facilities to geologic storage sites, these pipelines may need to access industrial customers in legacy cities or first-ring suburbs.

Lighter manufacturers are distributed across First Ring suburbs, and include sectors such as chemical manufacturing, fabricated manufacturing, primary metal production, cement, hospitals, power utilities, paper manufacturing, mining, and wholesale trade. Among these, larger emitters include waste management operations, fabricated and primary manufacturing, and cement or asphalt production. Industrial strategies across these sectors could focus on significantly reducing carbon emissions through both operational and building performance improvements:

1. New industrial buildings could be **designed to maximize energy conservation** from the outset. Existing facilities could be retrofitted with energy-efficient upgrades such as LED lighting, high-performance insulation, and automated lighting and shading systems to optimize building performance. Manufacturers could look for opportunities to source materials locally, reducing transportation emissions and strengthening regional supply chains.

2. Within the industries, a **shift toward cradle-to-cradle design** could guide material life cycles by prioritizing reuse, recycling, and collaboration across industries. **On-site solar installations** could be deployed on rooftops or unused land, reducing grid dependency

and operational emissions. Communities can encourage new industrial developments to **use electric heating systems**, including electric boilers and electric arc furnaces.

3. Regional investment in **green H_2 production** and its net zero transportation and distribution could support industrial energy needs while reducing emissions. **BEV and H_2 FCV manufacturers and distributors** could be encouraged to locate in the region to anchor a clean industrial and transportation economy.

4. **Electrification of heating and cooling systems** could be pursued in alignment with grid decarbonization.

5. **Waste-to-energy technologies**—such as fluidized-bed incinerators and anaerobic digesters—could be deployed at wastewater treatment facilities to reduce emissions and generate on-site electricity.

6.3.4. Transportation

Transportation investments could support mode shift, reduce emissions, and improve regional mobility. **Expanding protected bike lanes**, spaced at one-mile intervals, can ensure broad accessibility. **Extending sidewalk networks** with a six-foot minimum width and year-round maintenance will enhance walkability. **Transit services** could be strengthened to offer 20–30 minute headways during peak hours and 60-minute coverage off-peak, aiming to reach a goal of 15% of all trips via active transportation. **Bus Rapid Transit (BRT) corridors could be extended** to reach suburban centers and townships. **Multi-use paths could be completed along 100% of connector streets** with an eight-foot width standard to ensure safe and efficient non-motorized travel.

Improve integration between cycling and transit by **equipping all transit vehicles with bike racks**. Cities can develop **compact mixed-use nodes** throughout suburban areas to promote walkable, transit-friendly development. **Bicycle highways** could connect suburban nodes to job centers and institutions.

6.3.5. Waste and Material Management

First Ring Suburbs could implement **distributed composting programs** that process organic waste locally, reducing transportation emissions while creating valuable soil amendments that enhance carbon sequestration. These programs could range from neighborhood-scale compost hubs to municipal facilities that process yard waste and food scraps into finished compost for use in public landscapes and available to residents.

6.3.6. Agriculture, Forestry, and Other Land Uses

First Ring Suburbs should emphasize the **adaptive reuse of aging commercial properties with green infrastructure** requirements. This measure could include **residential lawn conversion programs** that encourage homeowners to replace portions of conventional turf grass with native prairie and meadow plantings that offer significantly greater carbon sequestration potential. These programs should include technical assistance, plant material subsidies, and recognition programs that normalize alternative landscaping approaches.

Local governments can also develop **regenerative landscaping guidelines** that prioritize carbon-capturing plant communities, including deep-rooted native species that sequester carbon in soil as well as plant biomass. These guidelines could be incorporated into homeowner association regulations and municipal code enforcement, gradually transforming suburban landscapes into more effective carbon sinks.

Since some of the first ring suburbs deal with some level of vacancy, **expanding community garden programs on vacant parcels, institutional lands, and underutilized municipal properties** could be beneficial, especially if it incorporates carbon-focused growing practices including minimal tillage, cover cropping, and composting. School properties throughout suburban areas present particular opportunities for **educational gardens** that demonstrate carbon capture techniques while providing fresh produce and experiential learning opportunities.

6.4. Second-Ring Suburbs

Second Ring Suburbs, which are located farther from the urban core, feature aging infrastructure but maintain a relatively stable housing stock.

6.4.1. Electricity

Short-duration energy storage (<4 hours) at district-scale or utility-scale implementation can provide benefits for peak shaving, frequency regulation, and short-outages.

6.4.2. Residential and Commercial Energy

No strategies specific to this typology.

6.4.3. Industrial Energy and IPPU

No strategies specific to this typology.

6.4.4. Transportation

Second Ring Suburbs are well-positioned to adapt to evolving regional needs. With many residents employed in office-based jobs, **promoting remote and hybrid work models** could significantly reduce peak-hour commuting. A regional target of 50% adoption of remote or hybrid work by 2050 would alleviate transportation burdens, lower emissions, and ease pressure on aging infrastructure—positioning these suburbs to remain resilient and livable in the future.

6.4.5. Waste and Material Management

No strategies specific to this typology.

6.4.6. Agriculture, Forestry, and Other Land Uses

Besides adhering to most of the recommendations for the First-ring suburbs, Second-ring suburbs could also implement conservation subdivision regulations that preserve significant tree canopy and natural features.

6.5. Outer-Ring Suburbs

Outer Ring Suburbs are experience ongoing residential development, with land use patterns dominated by single-family homes on larger lots and commercial or retail centers concentrated near freeway interchanges. With their low-density layouts, neighborhoods in these suburbs are largely car-dependent and benefit from a greater availability of undeveloped land.

6.5.1. Electricity

Given their physical characteristics and development stage, Outer-Ring Suburbs present significant opportunities for clean energy deployment. These communities are ideal candidates for **large-scale solar projects**, particularly in areas with ample rooftop space, expansive parking lots, or underutilized brownfields. Solar installations greater than 2.5 MW can meet local energy demands while contributing to regional sustainability goals.

These communities should also actively promote **rooftop solar for residential and commercial properties** and **parking lot canopy solar,** as larger rooftops and parking lots at commercial or retail centers create excellent opportunities.

North Perry, an Outer Ring Suburb, is home to the Perry Nuclear Power plant. This community should work with partners across the MSA to add an additional 2 GW of zero-emissions nuclear power at Perry.

6.5.2. Residential and Commercial Energy

No strategies specific to this typology.

6.5.3. Industrial Energy and IPPU

No strategies specific to this typology.

6.5.4. Transportation

No strategies specific to this typology.

6.5.5. Waste and Material Management

No strategies specific to this typology.

6.5.6. Agriculture, Forestry, and Other Land Uses

In addition, Outer-ring suburbs could establish growth boundaries paired with TDR programs to preserve rural carbon sinks.

6.6. Established Cities and Towns

Established Cities and Towns are often county seats or university towns, historically organized around a central green in the Western Reserve style. With clearly defined downtowns or civic centers, they feature walkable, mixed-use cores that provide a balanced mix of housing and employment opportunities.

6.6.1. Electricity

Promoting renewable energy aggregation, such as **Community Choice Aggregation (CCA),** can empower individuals and municipalities to transition to clean energy sources. Small municipal utilities, several of which are located within established towns in the MSA, should be encouraged to **expand their clean energy portfolios**, tailoring strategies to ownership models.

To further climate resilience and energy independence, these towns could pursue **energy storage projects** in areas with a high return on investment and low community impact—such as rooftops, parking lots, or brownfields. **Microgrids** to power critical community infrastructure are ideal investments to ensure resilient operations and to transition to renewable energy.

Additionally, the implementation of **district geothermal energy systems** would offer efficient, community-scale heating and cooling solutions for residential and commercial buildings, significantly reducing carbon emissions while enhancing energy resilience.

6.6.2. Residential and Commercial Energy

No strategies specific to this typology.

6.6.3. Industrial Energy and IPPU

In cases where processes cannot electrify or switch to H_2 due to production costs or processes, **post-combustion carbon capture** is a viable option, particularly for cement making.

In cases where processes cannot electrify, they should **switch to H_2**. This option is particularly relevant for steel, cement, and chemical manufacturing.

6.6.4. Transportation

Established Cities and Towns can reduce household VMT by promoting **Transit Oriented Development (TOD)**. Communities that are home to regional maritime ports, such as Fairport Harbor, can advance the use of **sustainable liquid and gaseous fuels** at those ports. Communities that are home to regional airports, including Medina, can advance the use **of sustainable aviation fuel** (SAF) at regional airports

6.6.5. Waste and Material Management

No strategies specific to this typology.

6.6.6. Agriculture, Forestry, and Other Land Uses

Established Cities and Towns are well-positioned to implement forward-looking land use strategies. **Form-based codes** can support compact, pedestrian-friendly development while integrating requirements for green infrastructure. **Agricultural buffers** at their edges can help preserve carbon-rich soils and reinforce their connection to surrounding rural landscapes.

6.7. Rural Townships

Rural Townships are characterized by low-density development and a predominantly agricultural or natural landscape. These communities often consist of large parcels of land, with single-family homes situated on lots of an acre or more. The housing stock varies from older houses in need of retrofitting to newer developments of suburban homes expanding to the countryside. Rather than connecting to a centralized sewer system, most homes rely on individual wells and septic systems. Public infrastructure is limited, and residents typically have reduced access to services and amenities. The expansive land base and sparse population reflect the rural character and land-based economy of these townships, where open space, agriculture, and low-density living define the physical and social fabric of the community. Even though these are mostly rural spaces, they still have an urban center or core, the Main Street in which some community buildings, banks and small restaurants are located.

6.7.1. Electricity

Promoting renewable energy aggregation, such as **Community Choice Aggregation (CCA)**, can empower individuals and municipalities to transition to clean energy sources. At the utility scale, strategies should focus on improving the overall fuel mix by integrating more renewables into the grid. **Rural Co-ops should be encouraged to expand their clean energy portfolios**, tailoring strategies to ownership models.

On the ground, innovative practices like **solar grazing**—using livestock for vegetation management at solar farms—should be explored as dual-use solutions. In rural areas, large-scale solar and storage projects should engage agricultural stakeholders early and incorporate thoughtful design, such as **agroforestry or visual screening**, to strengthen community support. To ensure grid reliability across seasons, investments in **long-duration energy storage** are essential.

On-site solar installations, electric heating equipment (from electric boilers to arc furnaces), and integration of waste-to-energy technologies—such as anaerobic digesters and fluidized-bed incinerators at wastewater treatment plants—can further support emissions reductions while generating on-site energy.

75% of the 1107 brownfield acres in the MSA converted to solar, or 830 acres. At 4.25 acres/MW, potential for 195 MW

Geothermal electricity generation, using new drilling and heat-exchange technology, can provide clean energy. Given the region's geology, this would likely be on the eastern periphery of the region, particularly rural Geauga and Lake Counties.

6.7.2. Residential and Commercial Energy

Geothermal heating/cooling systems for residential and commercial buildings offer a scalable, high-quality solution for heating and cooling. Given the land requirements for the systems, this is an ideal solution in more rural communities.

6.7.3. Industrial Energy and IPPU

Rural communities in Geauga County (as well as in Portage, Summit, Trumbull, Mahoning, and Stark Counties) can provide geological sequestration of CO_2 emissions from major point sources, such as Cleveland Works. However, it is important to engage these communities in an open and active dialogue to ensure their concerns and needs are addressed fully.

6.7.4. Transportation

Transportation strategies should be tailored to both urban **and rural** geographies. In less dense regions, scheduled transit should be provided 2–3 times daily with on-demand service to fill in gaps. **Rural transit hubs with bike-share or e-bike options** can expand access and reduce car dependency. A region-wide **expansion of paved shoulders**—especially on county and state roads—would support safer walking and biking in rural areas. Active transportation goals should target a 10% trip share. **Comprehensive on-demand transit** using smaller, flexible vehicles could improve coverage and efficiency, especially when linked to regional bike highways and transit systems.

6.7.5. Waste and Material Management

Rural communities can play a significant role in the development of a **regional composting system**. These communities are often home to existing composting infrastructure and expertise, and the MSA can bring that to bear to reduce landfilling of organic wastes and provide valuable, healthy soil for food production.

6.7.6. Agriculture, Forestry, and Other Land Uses

Rural townships across the region control significant land resources with substantial carbon sequestration potential, particularly through agricultural practices and natural ecosystem management. **Agricultural zoning** could be strengthened to maintain large minimum lot sizes while providing flexibility for **complementary carbon-capturing uses like agroforestry**. **Conservation overlay districts** could be established in areas with significant woodland, wetland, or prairie resources.

The "**Headwaters Forests Initiative**" is particularly applicable to Rural Communities. Reforestation must be done at a very large scale to have an impact on decarbonization. This particular strategy is available to our rural and outer suburban communities. A charismatic

marketing campaign to reforest the headwaters of our region's rivers could offset the emissions of some of these communities with less carbon-intensive industries, while notably improving air and water quality. An additional **10 square miles** of reforested land along tributaries of the Chagrin, Cuyahoga, Rocky River, and Black Rivers could result in an additional 345,000 metric tons of CO2 sequestered by 2050, with more than 26,500 metric tons added each year thereafter[18]. This is a practical offset for communities in Geauga, Lake, Lorain, and Medina Counties where large land parcels could be reforested with minimal management costs.

Rural townships could identify marginal agricultural lands with poor productivity and high restoration potential for targeted carbon sequestration projects. Wetland restoration in appropriate hydrological conditions could be repurposed as high-value carbon sinks while providing additional benefits like flood mitigation and wildlife habitat. Marginally productive lands could also be for targeted reforestation efforts, creating new carbon sinks while potentially reducing erosion and improving water quality. These efforts should focus on establishing diverse, native forest communities rather than monoculture plantations, maximizing resilience and ecological function.

Expanding **regenerative agricultural practices** that enhance soil carbon while maintaining agricultural productivity. No-till farming techniques, which research from the U.S. Geological Survey indicates could significantly increase carbon sequestration on Ohio farmland, could be encouraged through technical assistance programs and recognition of farmers who adopt these practices. Regenerative agriculture should be promoted through technical and financial support for no-till practices, cover cropping, and rotational grazing. Marginal farmland can be reforested with native species to maximize long-term sequestration.

Precision agriculture—using technology to optimize fertilizer use and track soil carbon—should be widely adopted to reduce emissions and improve productivity. Such technologies simultaneously reduce emissions and enhance carbon sequestration. Variable rate technology for fertilizer application, GPS-guided equipment operation, and soil carbon monitoring systems could help farmers optimize practices for climate benefits.

Cover crop implementation could be expanded through cooperative purchasing programs, equipment sharing initiatives, and demonstration projects. These non-harvested crops protect soil during off-seasons while building organic matter and sequestering carbon.

In the agriculture, forestry, and land use sectors, **zoning and conservation overlays** can preserve large lot sizes, protect wetlands and woodlands, and allow agroforestry practices that enhance both productivity and carbon sequestration. **Expanding the regional tree canopy** through annual tree planting, maintenance, and targeted investment in historically disinvested neighborhoods will reduce urban heat, sequester carbon, and improve public health. Targeted **wetland restoration along Lake Erie and its tributaries** will provide long-term carbon storage, flood mitigation, and water quality benefits.

Restoration of natural and constructed wetlands should be prioritized to filter nutrients, enhance water quality, and buffer against flooding. These efforts should be supported by innovative funding mechanisms, including carbon credits, mitigation banking, and avoided infrastructure costs. **Agricultural soil carbon sequestration** efforts should center on sustainable practices such as organic amendments and reduced tillage. **Conservation agriculture and precision techniques** can further improve soil structure, increase water retention, and enhance soil organic carbon (SOC) accumulation.

To enable these efforts at scale, programs like USDA's Climate-Smart Commodities and the Ohio Department of Natural Resources' H2Ohio initiative should be leveraged to provide the financial support necessary for widespread adoption of climate-resilient agricultural practices. Together, these investments represent a holistic pathway to a low-carbon, high-resilience future.

7. No-Regret and Low-Regret Measures

This section identifies strategies in each sector whose benefits vastly outweigh the costs. It breaks them into two categories: no-regret and low-regret. No-regret strategies are ones that have immediate benefits beyond their decarbonization potential, low costs relative to other solutions, and are unlikely to be made obsolete with technological advancements or vulnerable from extreme weather. Low-regret strategies also have immediate benefits, can be implemented in the near term, and represent the best solutions of the moment, recognizing potential barriers for implementation specific to each solution.

7.1. Electricity Sector

7.1.1. No-Regret Strategies

1. **Transition to LEDs for Street, Security and Outdoor Lighting**: For communities, park systems and political subdivisions who still have such systems, this measure has excellent ROI and quickly reduces demand on the grid.

7.1.2. Low-Regret Strategies

1. **Rooftop Solar with Building Energy Storage Systems (BESS):** Especially for larger rooftops that are south-facing, these systems should pay for themselves within the lifetime of the unit (7-10 years for BESS). They provide significant benefits by mitigating peak load during the summer. They become even more valuable when paired with EVs. For Outer-Ring Suburbs and Rural Communities, this is an especially useful technology and strategy, though more extreme weather, such as hail and high winds, which could damage such systems.

2. **Parking Canopy, Landfill and Brownfield Solar:** Adding solar to parking lots, landfills, brownfields, and other degraded sites can improve the sites. Parking canopy solar, paired with energy storage systems, represents a particularly effective way to charge EVs at low costs. These systems can achieve a positive return on investment (ROI), especially as EV adoption increases.

3. **Community Choice Aggregation (CCA):** For dense Northeast Ohio communities where small building and house sizes are predominant (Legacy Cities, First Ring Suburbs), CCA provides an easy way to enable residents and businesses to select clean

electricity for little or no additional cost in the short-term. CCA has the added benefit of spurring building and household electrification. CCA does come with the risk of rising electricity prices, as occurred in 2022, and aggregators may have trouble procuring enough clean energy to meet demand. These risks have the potential to interrupt or delay a community from reaching its net zero commitments.

7.2. Commercial and Residential Energy Sector

7.2.1. No-Regret Strategies

1. **Adoption of Stringent Energy Efficiency Measures:** Technological advancements, such as occupancy/use sensors, and smart building management systems can easily reduce energy use by 10 to 20%. Additional and significant energy reduction can be achieved by cool-scaping buildings and neighborhoods, proper building ventilation (natural and right-sized building units), and proper use and deployment of insulation and building envelope materials. Barriers may be as simple as education, or as challenging as the lack of capital to make improvements, but the average ROI for properties less than 50 years old is less than 10 years. Property owners can achieve 61% annual energy reductions.[19]

2. **Enforcing Building Codes & Minimum Standards:** Energy codes ensure that buildings meet energy performance thresholds from the design stage. Advanced codes require performance-based approaches and life-cycle considerations.[20]

3. **Disclosure Programs**: Voluntary, public disclosure of energy use motivates action and informs buyers, tenants, and investors.[21]

4. **Building Energy Benchmarking:** Tracking and comparing energy use through benchmarking tools enables informed decision-making and policy compliance.

5. **Installation of LED Lighting and Efficient Appliances:** Upgrading to LED lighting and ENERGY STAR-rated appliances yields immediate energy savings at low cost and improves building performance.

6. **Increase Efficiency of HVAC Systems:** Replacing old heating and cooling systems with high-efficiency equipment, such as air source heat pumps, offers major energy and emissions savings. For Rural and Outer Suburban communities, ground-source heat pumps for new construction and retrofits are excellent solutions to reduce the use of natural gas, and immediately lower emissions and critical air-pollutants.

7.2.2. Low-Regret Strategies

1. **Heating and Process Electrification:** Burning natural gas at the household and building level is inefficient, results in indoor air-pollution, and inhibits emissions reductions. Importantly, excellent technology exists today to transition all household and non-industrial building systems to all-electric. Installation of such systems can also result in an overall decrease in energy use. Barriers in the short-term include the availability of electrical equipment and breaker boxes, as well as a robust workforce to do this quickly and cost-effectively.

2. **Smart Thermostats and Controls:** Installing programmable and smart thermostats and sensors helps optimize energy use and reduce energy consumption and cost.

3. **Use of Cool and Green Roofs:** Installing reflective (high-albedo) or vegetative roofs can mitigate the urban heat Island, reduce cooling loads, and extend expected roof life.[22]

4. **Biosolar:** Green roofs that combine vegetation and rooftop solar yield onsite power generation benefits and passive cooling for the building, which reduces building load.[23]

7.3. Industrial Energy and IPPU

7.3.1. No-Regret Strategies

1. **Energy Audits and Energy Savings Plans:** All industrial companies should conduct energy audits to determine their energy consumption, identify ways they can immediately save energy, and develop strategies for energy efficiency, process changes, and technological upgrades that will jumpstart net zero planning. There are free energy audits available to small to medium sized industries through the U.S. Department of Energy's (U.S. DOE) Industrial Assessment Centers (IAC).[24] The IAC program also has energy efficiency implementation funding available. Energy Star has an Industrial Energy Management program with free tools for measuring, tracking, and benchmarking energy usage.[25]

2. **Adoption of Energy and Leak Monitoring Systems:** Monitoring systems are inexpensive to install and lead to significant energy savings. This includes gaseous leak detection, energy consumption monitors, and heat loss monitoring. Having access to real data can allow facilities to adjust settings, detect problems earlier, and adopt decarbonization measures specific to individual facilities. ENERGY STAR's free Energy Management tools (Portfolio Manager) and U.S. DOE's energy footprint tool are options for beginning energy monitoring at a facility.[26]

7.3.2. Low-Regret Strategies

1. **Electrification of Process Heat:** Low-temperature process heating (<150°C) can be replaced with commercially available technologies today. Switching to electric alternatives whenever traditional heating systems near end-of-life is cost effective and paves the way for commercially viable high-temperature alternatives.

2. **On-Site Clean Energy Generation:** Incentivizing industries to develop their own on-site clean energy generation would be attractive for facility uptime and resilience and reduce industrial burden to the broader grid as industry electrifies. Investing in rooftop solar where available could optimize space, and industrial investment in onsite geothermal could aid in preheating for process heat. Installing combined heat and power (CHP) systems where possible can reduce energy demand. Nevertheless, these investments can be significant, may not always be the best use of space, and can be vulnerable to extreme weather events.

3. **Adoption of Energy Efficient Technology:** There are many existing opportunities for energy efficiency in process heating and machine drives across industries. Creating

incentives for industries to invest in the most efficient technology when replacing motors, pumps, compressors, boilers, etc. can lead to significant energy savings and keep industries mindful of energy usage. Large capital costs for some technologies and longer-term returns on investment make this a low-regret strategy instead of no-regret.

4. **Electrification of Machine Drives:** There are already many alternatives to diesel or gas compressors, pumps, and motors; however, the electric alternatives may be expensive and require plant re-designs to install.

7.4. Transportation and Mobile Sources

7.4.1. No-Regret Strategies

1. **Total Cost of Ownership (TCO) Assessments of BEVs for Public Fleets:** TCO reflects the upfront costs, recurring costs, and end-of-life costs associated with owning and operating a vehicle over its expected useful life. For certain vehicle classes and end-use applications, the TCO of BEVs is already lower than that of internal combustion engine vehicles (ICEVs). Free tools are currently available to help local governments identify BEV options that support decarbonization goals at a lower cost than ICEVs.[27]

2. **Reduce or Eliminate Parking Minimums:** Reducing or eliminating minimum parking requirements, particularly for new developments near transit stops, enables more dense development near already existing transit centers, encouraged the use of transit, and reduces VMT. This strategy costs nothing to implement, removes barriers to development while saving developers money, and can immediately benefit new projects.

3. **Expand Protected Bike Lane Network:** Protected bicycle infrastructure expands the range of people willing to shift from cars to bicycles for at least some of their trips. Creating and extending bike infrastructure through off-street trails and lane conversions protects riders and improves mobility across the region.

4. **Land Bank Prioritization:** Identify vacant parcels within ¼ mile of transit for priority development through existing land bank programs. This strategy requires no new funding, and it can expand transit access in a community.

5. **Sidewalk Gap Analysis and Prioritization:** Map and prioritize missing sidewalk segments that connect to transit stops. This enables for greater connections between communities and existing transit stops, allowing more mobility within communities and increased ridership. This planning exercise costs little but creates an actionable implementation roadmap.

6. **Employer Transit Benefit Programs:** Work with major employers to implement pre-tax transit benefits for employees (e.g. GCRTA Commuter Advantage Program). This federal program already exists but is underutilized in many regions. Communities can also work with employers in employment hubs to provide free transit, parking cash out programs, or similar benefits to their employees.

7. **Transit-Friendly Street Design Standards:** Update municipal design guidelines to incorporate transit-supportive features in routine road maintenance and reconstruction

projects. When routine road maintenance projects are underway, improvements to bus stops, sidewalks, and bike lanes would be included.

8. **Permit Streamlining for TOD:** Create expedited review processes for projects that meet basic TOD criteria near transit stops. This would incentivize developers to locate projects near existing transit stops.

7.4.2. Low-Regret Strategies

1. **Replace Fleet LDVs with BEVs during Regular Procurement Schedules:** Passenger vehicles in public fleets used for non-emergency purposes have a useful life that is commonly targeted at 10 years.[28] The 10-year total cost of ownership (TCO) of a compact and midsized BEV in Cleveland is already 4-5% less than the TCO of a comparable ICEVs.[29] The savings from EV procurement for this vehicle class are enhanced by the Commercial Clean Vehicle Credit under section 45W of the federal tax code. Local governments can capture the benefit from this credit under the elective/direct pay provisions of the tax credit, which some Ohio municipalities have already done to purchase passenger EVs.[30]

2. **Accelerate Shift to Fleet BEVs through Climate Mayors Electric Vehicle Purchasing Collaborative:** This national cooperative purchasing program leverages the collective buying power of hundreds of public-sector participants to reduce the cost of EVs and charging infrastructure for cities, counties, transits, school districts, and other governmental units.[31] The City of Cincinnati, for example, has utilized the program to acquire passenger BEVs at prices more than 11% below the manufacturer's suggested retail price.[32]

3. **Advance the Use of Sustainable Fuels:** For aviation and maritime travel, switching to alternative fuels provides a pathway to decarbonization. Challenges to adoption include availability and cost of such fuels.

4. **First/Last Mile Micromobility Pilots:** A first/last mile micromobility pilot deploys shared small vehicles (e-scooters, bikes, e-bikes) to help people conveniently travel between public transit stops and their final destinations. These pilots aim to solve the "first/last mile problem" by providing accessible transportation options for short distances that would otherwise be too far to walk, thereby increasing transit ridership and reducing car dependency. Communities could partner with private companies to establish mobility hubs at transit stations, potentially with subsidized rides for transit connections.

5. **TOD Overlay Zoning Districts:** TOD overlay zoning districts are specialized planning tools that modify existing zoning regulations in areas surrounding transit stations to encourage higher density, mixed-use development with reduced parking requirements. These districts prioritize pedestrian-friendly design, diverse housing options, and commercial amenities within walking distance of transit, creating vibrant, accessible neighborhoods that maximize public transportation investments while reducing car dependency. Communities could create overlay zones near high-capacity transit that allow greater density and mixed-use development by right.

6. **Shared Parking Agreements:** These formal arrangements allow different property owners with complementary peak-hour usage patterns to utilize the same parking

facilities, reducing the total number of parking spaces needed. These agreements optimize parking efficiency by recognizing that businesses like offices (daytime use) and restaurants or entertainment venues (evening use) can share infrastructure, thereby decreasing construction costs, preserving land for other uses, and supporting more walkable, sustainable development patterns. Government agencies or chambers of commerce could facilitate agreements between property owners with complimentary parking demand patterns to reduce total parking supply needs near transit.

7. **Transit Corridor Affordable Housing Preservation Fund:** Communities could establish a fund or a community land trust to acquire and preserve naturally occurring affordable housing near transit before property values increase.

8. **Pop-Up Retail at Transit Stops:** Create opportunities for small-scale retail and food service at major transit stops through streamlined permitting and portable infrastructure.

9. **Anchor Institution Housing Incentives:** Expand existing partnerships with universities and hospitals to offer employees homebuyer assistance for properties near transit lines that serve these institutions.

10. **Flexible Curb Zone Management:** Implement time-of-day regulations for curb spaces near commercial areas to accommodate loading, pick-up/drop-off, and transit needs based on demand patterns.

11. **Transit Signal Priority:** Implement signal priority for buses at key intersections along major transit corridors. This relatively low-cost technology improvement can immediately improve transit reliability and speeds. While improvements could encourage increased transit ridership, there could be a potential increase in vehicle idle emissions, which need to be quantified.

7.5. Waste and Material Management

7.5.1. No-Regret Strategies

1. **Gas Capture at Waste Management Facilities:** While large waste management facilities are required by Ohio law to have landfill gas capture systems in place, small facilities do not. Ensuring proper monitoring, capture, and utilization of landfill gas in the region can reduce landfill emissions and provide new energy streams through the production of renewable natural gas (RNG).[33]

7.5.2. Low-Regret Strategies

1. **Establish Municipal Composting Programs:** Nearly a quarter of all municipal solid waste is food waste. Reducing the food waste stream through composting programs could reduce landfill emissions significantly. However, this would take investment into the program itself and significant education of communities on composting.

2. **Carbon Capture Scrubbers at Wastewater Treatment Facilities:** Facilities that use combustion to break down organic matter can significantly reduce emissions by installing

post-combustion scrubbers. This is a low-regret strategy due to the challenge of determining what to do with the carbon once it is captured.

3. **Regional Adoption of Low-GWP Refrigerants:** Alternative refrigerants already exist, but tend to be expensive and may involve replacement of refrigeration and air cooling technologies that may be cost prohibitive.

7.6. Agriculture, Forestry, and Other Land Uses (AFOLU)

7.6.1. No-Regret Strategies

1. **Conduct Comprehensive Assessment of Land Use Carbon Sequestration.**

2. **Draft Model Zoning Language:** This language can be tailored to the varying needs and limitations of cities, suburbs, and townships in the region. This could be a collaborative effort of the five County Planning Commissions in the region to increase the likelihood that staff time and consulting fees lead to code implementation.

3. **Prepare Model Stakeholder Engagement Plans:** Communities across the MS have differing priorities and political views, but model stakeholder engagement plans can provide a starting point for bringing the community into the climate action planning and implementation process.

4. **Create Pilot Programs:** In communities where there is interest in decarbonization efforts, leaders can pilot climate actions that may be replicable in similar communities across the MSA.

7.6.2. Low-Regret Strategies

1. **Expand Regional Tree Canopy:** Existing investments in regional tree canopy expansion are gaining traction, whether through the Cleveland Tree Coalition, the Western Reserve Land Conservancy, or municipal tree maintenance crews. Sustaining and, where possible, expanding these efforts will slow canopy loss and cut GHG emissions. Ramping up this work could allow the region could to achieve a net gain in tree cover, which would reduce GHGs and deliver significant co-benefits, such lowering temperatures, reducing peak flooding, improving air quality, and enhancing well-being. Real conflicts between tree planting and protection and other priorities exist, especially in Legacy Cities and Established Cities and Towns. The required community engagement and careful planning make this low-regret.

2. **Advance Wetland Restoration:** Wetland restoration is one of the most cost-effective decarbonization activities available in the MSA. Temperate Ohio wetlands sequester roughly 5-10 tons of CO_2e per hectare, per year. The region already has a strong pipeline of projects that can be scaled. For example, Cleveland Metroparks' Garfield Park Pond restoration is reconnecting streams and wetlands while leveraging NEORSD and Ohio EPA funds. Doubling down on these initiatives and directing future H2Ohio and city stormwater dollars toward similar projects would mitigate GHGs while cutting flood

peaks, filtering nutrients, and enhancing recreation. However, some people don't like the possibility of having stagnant water near their homes, and new insect-borne diseases are a heightened climate risk. Wetland restoration can also be expensive.

8. Local Policy & Funding Opportunities and Gap Analysis

Among the most important tools necessary for pursuing decarbonization at the community level are funding resources and clear, supportive policies that facilitate decarbonization at all levels of government. As of the writing of this report in spring 2025, few policies exist at the state and federal level to facilitate and support decarbonization at the community level, and none provide the scale of resources needed. This section and the Technical Appendix consider those policies and funding opportunities that do exist and how they relate to the emissions reduction measures.

Pursuing decarbonization without a robust suite of supportive policy mechanisms at the federal and state level makes this a difficult and expensive task for communities in the Cleveland-Elyria MSA. Acknowledging this policy environment and the need for immediate action, there remain policies and strategies available to communities. As a matter of general strategy, communities who embark on decarbonization consider the following:

- Community leaders should collaboratively discuss with their state and federal representatives their needs for supportive policy for decarbonization. This should include requests that supportive policies be adopted and funding be allocated at the state and federal level to deploy technologies and strategies to reduce emissions.
- Start decarbonization as soon as possible, with creativity and with urgency. So long as state and federal policy remains largely silent on the matter of reducing and avoiding greenhouse gas emissions, communities will need to embark upon this path as early as possible to maximize the allocation of their own resources.

See the Appendices for implementation authorities and funding opportunities for each CCAP measure.

8.1. Introduction

This section assesses current commitments in Climate Action Plans (CAPs) to determine if additional activity would be needed to put the region on a trajectory to meet these goals and to identify opportunities for local jurisdictions in the region to take further action to support the decarbonization pathways.[34]

It includes analysis of the authority of local governments and agencies to act to influence and regulate greenhouse gas (GHG) emissions, based on a summary of key federal, state, and local agencies, and key legislation and regulation at the federal and state levels to help clarify the ability of local governments to act to reduce GHG emissions; a review of CAPs to determine the frequency of measures, and integration of social equity considerations. We use results of the

above analysis and additional research to identify opportunities for further local action and regional collaboration.[35]

In general, opportunities exist for additional GHG reductions by increasing the number of jurisdictions adopting an existing measure or policy, making existing measures or policies more aggressive, and implementing policies not previously adopted in the region. Opportunities for regional collaboration can include efforts to support local policy development and implementation and those that are regional in scope that are intended to serve the entire region.[36]

8.2. Local Jurisdiction Authority to Act to Influence GHG Emissions

To analyze local authority to implement emissions reduction measures, it is important to consider how local governments act to influence GHG emissions. Local jurisdiction authority to regulate GHGs is created by broad, general constitutionally derived "police power" or delegated authority under state or federal law. Use of police authority may not conflict with "general" law (e.g., state law) under preemption principles found in state constitutions or federal expressed or implied preemption under the Supremacy Clause of the U.S. Constitution.[37]

Police power of a city or county within its own boundaries is as broad as that of the state legislature and subject only to limitations of general law. Police power must be both:

- Reasonably related to a legitimate government purpose; and
- Have a reasonable tendency to promote the public health, morals, safety, or general welfare of the community.[38]

Police power is especially well established in enacting and enforcing land use laws. Local governments have both police power and delegated authority from the legislature to establish climate changes policies and regulations to reduce GHGs in general plans, CAPs, zoning, TOD regulations, carbon sequestration (including urban forestry), energy conservation actions through green building practices and reach codes, water conservation, and solid waste reduction. Land use authority is subject to the vested rights doctrine and Subdivision Map Act that limits how a subsequent change in local law or the authority to impose conditions apply to a particular improvement to land or a vesting tentative map for subdivisions.[39]

Local jurisdiction police power is also subject to state preemption. Counties act with more autonomy over governance decisions than common law cities; however, all local jurisdictions are controlled and subject to general state law. Because counties are the legal subdivision of the state, the state may delegate or rescind any delegated function of the state to a county.[40] Local jurisdictions also act with the authority to tax, issue bonds, and impose fees, charges, and rates.[41] This authority is derived from and limited by the Ohio Constitution and statute, including requiring voter approval for taxes and bonds.

The review of authority will analyze federal and state preemption with regards to local jurisdiction, police power and delegated authority. It will evaluate opportunities for local jurisdictions to act within existing constitutional, legislative, and regulatory frameworks and to identify uncertainty with regard to authority. It was designed to be comprehensive but not exhaustive given the complexity of some of the laws involved and the lack of activities in certain areas such as natural climate solutions. Additional work would be needed in this area to understand the opportunities and challenges presented by local policies.[42]

8.3. Review of Climate Action Plans (CAPs)

Climate Action Plans (CAPs) are planning documents that demonstrate how a local jurisdiction can achieve an adopted emissions target. This policy gap analysis focuses on the CAPs of counties and major cities encompassed by the Cleveland-Elyria MSA. Existing CAPs within this regional analysis include Cuyahoga County; the Cities of Cleveland, Cleveland Heights, Lakewood, and Oberlin; and GCRTA.

Cuyahoga County alone accounts for 64% of the GHG emissions for the target area, and thus implementation of feasible decarbonization efforts in Cleveland and Cuyahoga County are most indicative of what climate efforts are achievable. Other parts of the MSA, including Geauga, Lorain, Lake, and Medina Counties, do not have CAPs, and some have objected to NOACA's work to develop a regional CAP.

Table 7: Cleveland-Elyria MSA CAP Overview

Entity	Year Published	Emissions Targets	Sectors Covered	Equity	Last Updated
City of Cleveland	2025	Cut citywide GHG emissions by 63.3% through 2030 and achieve net zero emissions by 2050	Transportation, Buildings, Electricity Supply, Natural Climate Solutions	Yes	2025
City of Cleveland Heights	2024	Reduce GHG emissions by 30% by 2030 and achieve carbon neutrality by 2050.	Transportation, Buildings, Electricity Supply, Natural Climate Solutions	Yes	NA
Cuyahoga County	2019	45% overall reduction in GHG emissions from 2010 baseline by 2030, and net zero emissions by 2050	Transportation, Electricity, Natural Climate Solutions	NA	NA
City of Lakewood	2023	50-52% reduction in GHG emissions from 2005 levels by 2030; Net zero by 2050	Transportation, Buildings, Electricity Supply, Natural Climate Solutions	Yes	NA
City of Oberlin	2011	Reduce GHG emissions by 50% in 2015, 75% by 2030, and below 100% by 2050	Buildings, Electricity Supply, Natural Climate Solutions	Yes	2019
GCRTA	2022	Reduce GHG emissions from 2018 by 10% by 2030, 30% by 2040, and 60% by 2050.	Transportation	NA	NA

Decarbonization policy categories differ between municipalities and are enforced by implementation mechanisms such as subsidizing ‘carrots’ or regulatory ‘sticks’. Differentiation between implementation mechanisms across jurisdictions demonstrates how each local jurisdiction intends to achieve the desired activity.

Table 8: Description of CAP Implementation Mechanisms

Implementation Mechanism	Description
Capital Improvement & Infrastructure	CAP measures and actions that require municipal funds to be completed. For instance, city-wide projects such as installation of bike lanes, or projects that impact municipal facilities or operations such as conversion of the municipal fleet.
Requirement(s)	CAP measures and actions that require a GHG reduction activity through a regulation, ordinance, or some other mandatory means.
Incentive(s)	CAP measures and actions that encourage a GHG reduction activity through monetary and non-monetary incentives such as rebates and permit streaming.
Plan or Program	CAP measures and actions to expand or create new plans or programs that facilitate mitigation activity.
Education, Outreach, & Coordination	CAP measures and actions that expand awareness, communicate and share information, and/or initiate or expand partnerships and relationships.
Evaluation	CAP measures and actions that improve feedback, input, and data and information, or conduct further and new analysis.

All of the CAPs used for this report acknowledge the need for transportation emissions reduction. VMT reductions, fuel use reductions, and alternative fuel vehicles and equipment are highlighted across all plans. Decarbonizing the building supply and electricity supply are addressed unevenly across CAPs. This is likely the result of differential authority when it comes to building standards, zoning and electrification capacity. Natural climate solutions, such as carbon stock preservation and agriculture methane reduction, appear least across the CAPs used in this analysis. The below figure illustrates how much CAP measures and supporting actions contributed to the local GHG reduction in CAPs.

Table 9: Decarbonization Measures Found in Cleveland-Elyria MSA CAPs

Decarbonization Pathway	CAP Policy Category	Cleveland	Cleveland Heights	Cuyahoga County	Lakewood	Oberlin	GCRTA
Transportation	VMT Reduction	X	X	X	X	X	X
Transportation	Fuel Use Reductions	X	X	X	X	X	X
Transportation	Alternative Fuel Vehicles & Equipment	X	X		X	X	X
Buildings	Electrification	X	X			X	
Buildings	Energy Efficiency	X	X		X	X	
Buildings	Low Carbon Fuels	X					
Electricity Supply	Grid Supply	X	X		X	X	
Electricity Supply	Customer Side Supply	X	X	X	X	X	
Natural Climate Solutions	Carbon Removal and Storage	X	X	X	X		
Natural Climate Solutions	Carbon Stock Preservation						
Natural Climate Solutions	Agriculture Methane Reduction					X	

The existing CAPs also have an uneven approach to equity and justice. The City of Cleveland makes a point of noting that equity is a central tenet of its CAP. This plan more than any other focuses on the impact that decarbonization measures have on low-income and minority communities particularly. CAPs for Cleveland Heights, Lakewood, and Oberlin also address equity concerns, but to lesser degrees. Equity is nearly or entirely absent from the Cuyahoga County and GCRTA CAPs.

Table 10: Equity Measures Found in Cleveland-Elyria MSA CAPs

Equity Dimension	Cleveland	Cleveland Heights	Cuyahoga County	Lakewood	Oberlin	GCRTA
Definition of Equity	Not Addressed	Strong	Not Addressed	Strong	Not Addressed	Not Addressed
Named Priority Populations	Strong	Strong	Not Addressed	Strong	Not Addressed	Not Addressed
Community Engagement Process	Strong	Weak	Not Addressed	Weak	Weak	Not Addressed
Co-Creation or Co-Governance Models	Strong	Strong	Not Addressed	Not Addressed	Not Addressed	Not Addressed
Funding Allocated to Equity Goals	Strong	Strong	Not Addressed	Strong	Not Addressed	Weak
Equity Review Mechanism	Strong	Strong	Not Addressed	Strong	Weak	Not Addressed

Some critics of climate action complain that it can exacerbate existing income gaps. Because there is often a “green premium” for clean energy and sustainable technologies, it can seem like only affluent homeowners and families can afford these actions. In order for decarbonization measures to be socioeconomically successful, they must account for and move to remedy this discrepancy. To do so, CAPs must divert funding specifically to underserved areas to subsidize green processes there. Whereas affluent areas can be incentivized to incorporate green processes, disadvantaged communities require additional resource assistance to offset the costs of greening.

While local CAPs offer robust plans for decarbonization, localities operate in a complex web of regulations. State and federal authority preempts local efforts in many decarbonization processes such as emissions regulation. Understanding the broader regulatory scheme is necessary to analyze what decarbonization efforts localities are capable of.

8.4. State & Federal Jurisdiction

Local municipalities in Ohio are granted municipal powers of home rule under Article XVIII, §3 and §7 of the Ohio Constitution. Municipalities have “authority to exercise all powers of local self-government and to adopt and enforce within their limits such local police, sanitary and other similar regulations, as are not in conflict with general laws. When local law conflicts with general law, state law preempts local law, and federal law preempts both in areas of concurrent jurisdiction.

GHG emissions standards are regulated both federally and at the state levels. Tailpipe emissions standards are set by the federal government, and state and local governments cannot enforce alternative standards, though California is permitted to apply for waivers from

U.S. EPA under §208 of the Clean Air Act Amendments (CAAA) of 1970. Local limits on emissions from interstate commerce, aircraft, or rail in Ohio are preempted by state law under H.B. 201. Thus, the decarbonization of transportation as outlined in the CAPs of the Cleveland-Elyria MSA are subject to a complex web of concurrent regulations at the state and federal levels. This means that local emissions reduction targets can be difficult to implement.

Local governments in the Cleveland-Elyria MSA can instead use incentives to achieve their targets in the transportation sector. However, local authority can be overruled in cases where city policy is ruled to be in conflict with the statewide regulatory scheme. In 2015, the Ohio Supreme Court decided State ex rel. Morrison v. Beck Energy Corp. The court determined that the home rule amendment to the Ohio Constitution did not grant the city of Munroe Falls the power to enforce its own permitting scheme atop the state system. As such, local permitting systems are unlikely to prevail against state challenges. The same applies to bans on natural gas, which are outright preempted by H.B. 201. The bill also prohibits the restriction of use or sale of a motor vehicle based on the energy source used to power the motor vehicle. Such legislation is directly at odds with the provisions of many CAPs of which electrification of municipal fleets and public transportation is a key tenet.

8.5. Opportunities for Local Policies and Regional Collaboration

Local governments in the Cleveland-Elyria MSA find their ability to implement decarbonization measures constrained by both state and federal law. Accordingly, they are left to indirectly regulate GHG emissions. Jurisdictions can leverage Infrastructure to encourage the transition to EVs. Public utilities are subject to oversight by the Public Utilities Commission of Ohio (PUCO) and must abide by the Public Utility Regulatory Policies Act (PURPA), but they have significant room to invest in clean energy generation, distribute clean electrons produced by other suppliers, and provide incentives for energy efficiency and electrification. Communities that rely on energy from investor owned utilities (IOUs), on the other hand, are more constrained by state lawmaking and PUCO regulations, which currently preclude even voluntary energy efficiency incentive programs. Additionally, local governments cannot implement building codes are that conflict with those set by the Ohio Board of Building Standards.

Despite legal and regulatory roadblocks, there is room for localities to coordinate with the state and federal government in order to achieve meaningful decarbonization goals. In the transportation sector, state and federal agencies can provide funding for local municipalities to invest in EV charging and to electrify public fleets. By working together under, the State of Ohio can support counties and cities to achieve the decarbonization efforts in the transportation sector are most likely to be implemented successfully.

Industrial development policy that targets businesses whose focus is decarbonization, energy efficiency, waste reduction and re-use, green building materials, tree nurseries, and similar materials, technologies or strategies, can be powerful engines for growth for the region and its communities. For example, Ohio offers an incentive program to encourage the installation of solar power. Such incentives include Solar Renewable Energy Certificates (SRECs) which

allows residents and businesses to earn credit for each megawatt-hour their PV systems generate. Federal incentives include the Production Tax Credit (PTC) and the Investment Tax Credit (ITC) for clean energy installations. These incentives demonstrate how governments can use industrial development policy to foster decarbonize.

Decarbonization efforts pertaining to electrification, residential and commercial energy, waste and material management, and AFOLU require a reconciliation between state and local policy. Many state agencies such as PUCO preempt any municipal action in these areas. For decarbonization efforts to be successful, state governments would have to grant decision-making authority to local governments in these areas under the principle of home rule jurisdiction.

Additionally, more regions within the Cleveland-Elyria MSA would have to adopt CAPs. Currently, Geauga, Lake, Lorain, and Medina Counties do not have a CAP. Municipalities within those counties, with the exception of the City of Oberlin in Lorain County, also do not have CAPs. If more municipal and county governments acted as first movers to advance climate action, there may be a greater appetite within the state legislature to enact changes that would make those efforts more successful.

8.6. Opportunities to Expand Local Authority

There exist a number of opportunities for local governments within the Cleveland-Elyria MSA to promote policies that expand their ability to implement emissions reduction measures, particularly at the state level. Collaboration with utilities to pilot demand response programs for residential buildings, and advocate for State of Ohio policies that enable investor-owned utilities (IOUs) to actively participate in and scale such programs, will meaningfully contribute to decarbonization, for example.

Between now and 2030, local governments can advocate for the following state policies:

- Legislation to enable community solar, including virtual net metering policies;
- PUCO permission for communities to partner with IOUs to pilot residential demand response programs;
- Restoration and expansion of the state Energy Efficiency Portfolio Standard (EERS) and Advanced Energy Portfolio Standard (AEPS);
- Implementation of Time-of-Use (TOU) pricing structures through IOU rate cases that reward off-peak energy use;
- Rolling out smart meters and access to real-time energy data through IOU rate cases;
- Promoting the development and deployment of Virtual Power Plants (VPPs) to aggregate distributed energy resources for grid reliability, renewable integration, and emission reduction before both the PUCO and the legislature;
- Encouraging the PUCO to expand performance-based ratemaking policies for IOUs that encourage cost-effective investments in reliability and resilience, including grid-enhancing technologies (GETs);
- Fully and equitably implement state-operated clean energy and energy efficiency funding programs, including the Greenhouse Gas Reduction Fund (GGRF), Solar for All (SFA),

the Home Efficiency Rebates (HOMES) program, and High-Efficiency Electric Home Rebate Act (HEEHRA) program;
- Expand utility assistance and protection programs for residential customers, including the Low-Income Energy Assistance Program (LIHEAP), and create utility shutoff protections for customers during the summer months;
- Authorize the expansion of passenger rail within the state;
- Expand ODOT funding for public transit and other forms of sustainable transportation;
- Reduce or eliminate excess vehicle registration taxes for hybrids, plug-in hybrid EVs, and BEVs;
- Explore adoption of VMT-based user fees for transportation infrastructure
- Fully implement NEVI program for public EV charging along highway corridors; and
- Fully fund programs that promote nature-based solutions, including H2Ohio.

For more information on Authority to Implement Emissions Reduction Measures, including entities responsible for implementing each measure, consult the Technical Appendices.

8.7. Limitations of the Analysis

This work was designed to be a comprehensive overview, but not exhaustive given the complexity of some of the laws involved and the lack of activities in certain areas such as natural climate solutions. Additional work would be needed in this area to understand the opportunities and challenges presented by local policies.

The data available for analysis could be improved if more cities and counties adopted CAPs. Greater understanding of what decarbonization goals the region had, combined with the implementation strategies unique to those localities, would provide more data from which to draw a more informed analysis.

Additionally, quantitative emissions modeling is an important next step or recommendation for future analysis. Understanding the projected impact of local CAPs would increase the overall comprehension of the analysis.

Alongside quantitative emissions modeling, a more thorough examination of the demographic groups affected by projected CAPs is important. The reason for this is twofold: first because underserved communities are more likely to be adversely affected by climate change itself, and therefore these groups should be a focus of mitigation and adaptation efforts. Underserved groups are also most likely to be priced out of areas that have costly green development structures, and are less likely to be able to afford the green technologies necessary to implement decarbonization measures. Second, socioeconomic factors contribute towards a skeptical view of decarbonization more broadly. As a rust-belt state, many Ohioans, especially those in rural areas, rely on high-emissions industries, technologies, and practices to make a living. Such practices are ingrained not only in people’s way of life, but also are deeply rooted in the economy of the state. As such, not all industries can be decarbonized in a timeframe consistent with CAP goals. To understand how these goals can be achieved despite these socioeconomic factors, gaining greater information about why demographics may be resistant to

decarbonization is crucial to being able to implement CAPs that take people's livelihoods into consideration.

8.8. Conclusions

To conclude, this section assesses current commitments in Climate Action Plans (CAPs) to determine if additional activity would be needed to put the region on a trajectory to meet these goals and to identify opportunities for local jurisdictions in the region to take further action to support the decarbonization pathways. Given the complicated and often contradictory nature of concurrent federalism, greater legislative measures at the state level would be necessary in order for localities to implement CAPs adapted to their individual areas.

While municipalities and counties have home rule under Article XVIII, §3 and §7, actions that conflict with general law are preempted by the state. As a rust-belt state with a high volume of heavy emissions industries, Ohio state law is not particularly conducive to the kinds of regulation that would allow municipalities and counties to implement decarbonization. However, local areas do have some capacity to meaningfully decarbonize, including greening infrastructure, establishing green city ordinances, and electrifying public transportation. These processes are more 'carrot' than 'stick', often rely on resources from the federal government. Thus, such processes are also subject to the political complications of federal politics.

Court rulings such as *State ex rel. Morrison v. Beck Energy Corp.* (2015) and *Ohio* v. *EPA* (2024) have further reduced municipal capacity for and obligation to reduce GHG emissions. Thus, localities operate in an even more challenging decarbonization landscape.

Despite these challenges, opportunities still exist for local governments to coordinate with the state to effectuate meaningful decarbonization. The greatest opportunities can be found in the transportation sector, where local incentives combined with state regulations will have a meaningful impact on the reduction of transportation emissions. Other decarbonization pathways will require a greater volume of the Cleveland-Elyria MSA to implement CAPs in order to provoke meaningful change within the state legislature.

Generally, opportunities exist for additional GHG reductions by increasing the number of jurisdictions adopting an existing measure or policy, making existing measures or policies more aggressive, and implementing policies not previously adopted in the region.

9. How to Pay for it

This section focuses on **market-based approaches** that should be considered as mechanisms to pay for implementation.

Perhaps no other aspect of decarbonizing the economy has changed in recent months than answering the question of how to pay for it. Through the passage of the IRA and the Infrastructure Investment and Jobs Act (IIJA), the federal government made the largest investment in climate action in history. However, due to changes in policy at the federal level, many of the funding opportunities created and expanded through these bills have been eliminated, rescinded, or their future remain uncertain. For those reasons, this section focuses on actions and financial mechanisms that communities themselves can take advantage of, and have at their disposal.

Communities should strongly consider combining or “stacking” multiple financing mechanisms together to increase the viability of any project.

9.1. Cross-Cutting

1. **Community Capital and Operating Budgets:** Communities should evaluate how and when to allocate resources from their own budgets towards meeting many of the objectives presented in this plan. While community leaders may think of their own budgets as the “funder of last resort,” the scale of investment required and the urgency of action necessitate the allocation of budgetary resources. Investing early and continuously in the transition will move communities to lower emissions.

2. **Carbon Credits**: Companies, communities, or other organizations who have pledged to offset their emissions may choose to purchase carbon credits (currently through voluntary markets) to do so. By creating projects within the MSA and monetizing a portion of their carbon benefits, communities can generate revenue for certain measures while enjoying (in nearly all cases) all of the co-benefits.
    a. The Western Reserve Land Conservancy is already deploying this strategy in the Greater Cleveland MSA, with projects in Lake County. They have also supported a project undertaken by the Village of Kirtland. These projects are selling carbon credits through City Forest Credits for (i) forest preservation and (ii) reforestation projects. WRLC feels optimistic about this strategy as a way to fund these strategies across the 5-County MSA.
    b. Carbon Credits can also be a useful financing mechanism when capturing and abating fugitive methane emissions. According to Calyx Global, a global offsets ratings firm, this may be among the best options for using carbon credits in the Cleveland-Elyria MSA, given the emissions reduction potential of such projects. Companies seeking to purchase carbon credits often lack local options, meaning that local projects have the added benefit of positive marketing to the surrounding community.

3. **Public-Private Partnerships**: These can be a powerful tool to invest in projects that advance the community's decarbonization goals. Companies need tangible and specific projects to invest in, with clearly defined work, costs, and benefits. Often due to the challenges of working with the public sector, a third-party partner (e.g. a community development corporation, school or university, Chamber of Commerce, etc.) can be crucial in facilitating and implementing the project.[43] However, companies value the reputation and credibility of all partners involved in the project. Since the private sector company will want to share and report on this project, they will need to understand the visibility of these efforts. Finally, the company will want some kind of return on investment, understanding that that may mean positive marketing for their brand. Companies may be willing to make big investments, if the criteria above are well defined with notable benefits.

4. **Ohio Air Quality Development Authority (OAQDA):** This is a non-regulatory, independent state agency identifies and funds projects that will have a positive impact on Ohio by improving air quality. OAQDA is authorized to help communities and businesses access financial assistance to install pollution controls, invest in energy efficiency, and develop clean energy. OAQDA has received a $156 million Solar For All grant from U.S. EPA and is part the Coalition for Green Capital's (CGC) $5 billion Greenhouse Gas Reduction Fund (GGRF) award.

9.2. Energy Financing

1. **Financing for Large-Scale (> 2.5 MW) Solar Projects:** Solar projects at scale have repeatedly shown a positive Return on Investment for investors over the life of the project. Communities who are looking to develop their own larger scale projects can engage with firms to build, own and operate solar.

2. **Renewable Energy Credits (RECs):** Communities that do choose to build their own renewable energy projects can sell a portion of the renewable energy credits to help finance the cost of construction and operation of the project. Solar RECs are approved in limited amounts by the Ohio Air Quality Development Authority; developers of large projects should push for RECs for their projects.

3. **Net Metering:** Ohio law allows for homeowners and commercial entities to receive a credit on their electric bill, worth a percentage of the electricity produced on site and returned to the grid when not used by the property owner.[44] Property owners can install renewable energy systems that generate up to 120% of their own electricity requirements and return the excess electricity to the grid, so proper sizing of systems can make a significant difference in the financial return to the project, and can improve the project's financing.

4. **Green Banks:** Green banks, such as Growth Opps (Growth Opportunity Partners) and their Go Green Energy Fund, are private financial institutions that focus on investments in sustainable projects. Often, these banks receive capital from government or philanthropy, which they then use as collateral to mobilize private financing.

Communities and developers should be consulted green banks, like Growth Opps, during the development of any large-scale renewable energy project. Growth Opps strengthens the borrowing power of developers of renewable energy and helps with leveraging federal funding, philanthropic resources, and favorable bond tools (e.g. Green Bonds) to create viable finances for such projects.

9.3. Building Financing

1. **Reduce Parking Minimums:** Parking requires land, or a garage; both of which add to the cost of a new building project. Reducing parking minimums allows costs to come down, making projects more affordable. Cities can also impose parking impact fees or parking in-lieu fees, which enable developers to pay to avoid meeting minimum parking requirements. Cities can then use these revenues to make investments in these neighborhoods that align with CCAP strategies.

2. **Aggregate Clean Energy Demand:** Combining purchases of clean energy technologies can drive down the capital costs. Communities can do this through group purchases of solar panels (such as through the County Solar Co-Op[45]), but also through larger projects, such as driving future district geothermal projects. District energy systems such as Cleveland Thermal have long been successful strategies for building operators to reduce costs through collective action.

3. **Property Assessed Clean Energy (PACE):** This financing, which allows property owners to pay for investments through their property tax bills, is already available across all five counties. It is an excellent strategy for financing clean energy improvements, especially to commercial buildings, by leveraging existing property tax payments.

4. **On-Bill Financing:** While not currently utilized in the region, municipal utilities and IOUs can consider offering on-bill financing (OBF). Through OBF, utilities provide the upfront capital to finance energy efficiency upgrades and/or on-site clean energy generation.[46] Customers pay back these investment costs through their utility bills. OBF essentially allows property owners to cover the costs of green investments by tapping into their energy cost savings.

Table 11: Overview of Emissions Reduction Measures

CCAP Measure	Community Type	Cost	Time Frame	No/Low-Regret	Authority to Implement	Funding Secured
Community enrollment in renewable energy CCA	All	$	Short-Term	Low-Regret	Yes	N/A
Opt-in Public Pricing Program for mercantile customers	All	$	Short-Term, Medium-Term	Low-Regret	Yes	N/A
Physical Purchase Power Agreements (PPAs)	All	$	Short-Term, Medium-Term		Yes	N/A
Intelligent grid management systems	All	$$	Short- to Long-Term		Yes	No
Grid-scale power systems modernization	All	$$$	Short- to Long-Term		Yes	No
Community-serving microgrid and minigrid systems.	All	$$	Short-Term, Medium-Term		Yes	Yes
Convert lighting to LEDs	All	$	Short- to Long-Term	Low-Regret	Yes	Yes
Utility-scaled solar	All	$$	Short- to Long-Term		Yes	Yes
Offshore wind	Legacy City	$$$	Long-Term		Unclear - project approved, but in limbo	No
Brownfields to Brightfields	Legacy City, Established City & Town, Rural Community	$$	Short-Term, Medium-Term		Yes	Yes
Residential rooftop solar	All	$$	Short- to Long-Term	Low-Regret	Yes	Yes
Commercial-scale rooftop & parking lot solar	All	$$	Short- to Long-Term	Low-Regret	Yes	Yes
District thermal energy systems	All	$$$	Short- to Long-Term		Yes	No
District or utility-scale battery storage - Long duration (>10 hrs)	Legacy City	$$	Long-Term		Yes	Yes
Hydrogen as an energy carrier	Legacy City, Established City & Town, First Ring Suburb	$$$	Medium- to Long-Term		Yes, but capacity does not currently exist in MSA	Yes
New Nuclear at Perry	Outer Ring Suburb	$$$$	Long-Term		Not Currently	No

CCAP Measure	Community Type	Cost	Time Frame	No/Low-Regret	Authority to Implement	Funding Secured
Geothermal electricity generation	Legacy City, Rural Community	$$$	Long-Term		Yes	No
District or utility-scale battery storage - short duration (<4 hours)	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb	$$	Short- to Long-Term		Yes	No
Increasing Retrofit Envelope Efficiency (Deep retrofit)	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb	$$$	Short-Term	Low-Regret	Yes	Yes
Building System Electrification (Deep Retrofit)	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb	$$$	Medium- to Long-Term	Low-Regret	Yes	Yes
Incentive programs	Legacy City, Established City & Town, First Ring Suburb, Second Ring Suburb	$$	Short- to Long-Term		Yes for municipal utilities	Yes
Implementation of the latest state adopted building standards and codes	All	$$	Short- to Long-Term	No-Regret	Yes	Yes
Smart Energy Management Systems (Commercial Buildings)	All	$$$	Short- to Long-Term	Low-Regret	Yes	Yes
Material Substitution	All	$$$$	Short- to Long-Term		Yes	Yes
Modular and Prefabricated Construction	All	$$$$	Medium- to Long-Term		Yes	Yes
Automated Building Systems and Smart Devices	All	$	Medium- to Long-Term	No-Regret	Yes for municipal utilities	Yes
Active Energy Adjustment for Grid Support (Demand Response)	All	$$$	Medium- to Long-Term		Yes for municipal utilities	Yes
Energy audits	All	$	Short-Term	No-Regret	Yes for property owners municipal utilities	No
Waste heat recovery and utilization systems	All	$$$	Short-Term to Medium-Term		Yes	No
Monitoring Systems	All	$	Short-Term	Low-Regret	Yes	No

CCAP Measure	Community Type	Cost	Time Frame	No/Low-Regret	Authority to Implement	Funding Secured
Energy Efficient Equipment	All	$$	Short-Term	Low-Regret	Yes	No
Automation	All	$	Short-Term		Yes	No
Reduce industrial waste	All	$$$	Short- to Long-Term	No-Regret	Yes	No
Use lower GWP gases for anesthetics	All	$	Short-Term		Yes	No
Install leak detection equipment	All	$	Short-Term	No-Regret	Yes	No
Electrification of industrial process heat	All	$$$	Medium- to Long-Term	Low-Regret	Yes	No
Green Steel at Cleveland Works	Legacy City	$$$$	Medium-Term		Yes, but technology still being developed	No
Electrify machine drives in synergy with grid decarbonization	All	$$$	Medium- to Long-Term		Yes	No
Carbon capture at Cleveland Works	Legacy City, First Ring Suburb, Outer Ring Suburb	$$$$	Medium-Term		Not Currently - would require legislative/regulatory approval	No
Post combustion carbon capture (cement making)	Legacy City, Established City & Town	$$$	Short-Term		Not Currently - would require legislative/regulatory approval	No
Invest in a regional direct air capture facility for hard to abate sectors	All	$$$$	Long-Term		Not Currently - would require legislative/regulatory approval	No
Switch industrial processes to hydrogen (steel, cement, chemical manufacturing)	Legacy City, Established City & Town	$$$$	Short- to Long-Term		Yes, but contingent on availability of H2	Yes
Expand BEV charging infrastructure	All	$$	Short-Term to Medium-Term		Yes	Yes
BEV/FCEV adoption in government fleets	All	$$	Short- to Long-Term	Low-Regret	Yes	No
BEV adoption of light-duty passenger vehicles by households	All	$$	Medium- to Long-Term	Low-Regret	Yes	Yes
Reducing Fuel Cost Access to Electric Vehicle Infrastructure	All	$$	Short-Term		Yes	Yes

CCAP Measure	Community Type	Cost	Time Frame	No/Low-Regret	Authority to Implement	Funding Secured
Expand BEV charging infrastructure	All	$$	Short-Term to Medium-Term		Yes	No
Expand FCEV fueling infrastructure	All	$$$	Medium- to Long-Term		Yes	No
Advance the use of sustainable liquid and gaseous fuels at regional maritime ports	Legacy City, Established City & Town	$$$$	Medium- to Long-Term	Low-Regret	Yes	Yes
Advance the use of sustainable aviation fuel at regional airports	Legacy City, First Ring Suburb, Established City & Town	$$$$	Short- to Long-Term	Low-Regret	Yes, but airlines must agree to purchase SAF	No
Intercity Passenger Rail and Coordinated Transportation Planning	All	$$$$	Medium-Term		Not Currently - would require approval from State of Ohio	Yes
Expand networks of protected bike lanes, off-street trails, and lane conversions	All	$	Short-Term	No-Regret	Yes	Yes
Increase density and mix of uses around transit stations	Legacy City, First Ring Suburb, Established City & Town	$$	Short- to Long-Term	Low-Regret	Yes	Yes
install gas capture systems for landfill methane	All	$$	Short-Term	No-Regret	Yes	No
Restaurant and grocery food waste reduction/composting program	All	$$	Short-Term	Low-Regret	Yes	Yes
Add compost bins to public facilities, parks, and sports stadiums to divert organic waste from land fills	All	$$	Short-Term	Low-Regret	Yes	Yes
Support composting and food waste reduction with organic waste diversion from landfills	All	$$	Short-Term	Low-Regret	Yes	Yes
Post incineration scrubbers installed at wastewater treatment facilities with fluidized bed incinerators	All	$$$	Short-Term	Low-Regret	Yes	No
Invest in high-tech equipment to help detect water leaks in municipal water infrastructure - saving water and energy once repaired	All	$	Short-Term to Medium-Term	Low-Regret	Yes	No

CCAP Measure	Community Type	Cost	Time Frame	No/Low-Regret	Authority to Implement	Funding Secured
Use climate friendly refrigerants	All	$$	Medium-Term	Low-Regret	Yes	No
End of equipment life facilities, dropoff/collection programs for refrigerants	All	$$	Short-Term	Low-Regret	Yes	Yes
Support habitat restoration and conservation	Outer Ring Suburb, Rural Community	$	Medium-Term	Low-Regret	Yes	Yes
Expand Wetland Restoration Programs	Rural Community	$$	Short- to Long-Term	Low-Regret	Yes	Yes
Reforest agriculture lands no longer in use, increasing the regional tree canopy	Rural Community	$	Short- to Long-Term		Yes	No
Tree carbon-capture	Established City & Town, First Ring Suburb	$$	Short- to Long-Term	Low-Regret	Yes	Yes
Model mature tree protection ordinance	All	$	Short- to Long-Term	No-Regret	Yes	Yes
Expand agriculture practices to restore soil health and increase carbon sequestration	Rural Community	$	Short- to Long-Term	Low-Regret	Yes	No
Digital twin to track tree canopy	Legacy City	$$	Short- to Long-Term		Yes	No
Land bank set-asides for carbon storage	Legacy City, Rural Community	$	Short-Term	Low-Regret	Yes	No
Support community greenspace programs for small scale community-based native urban gardens, greenspaces, tree planting	All	$	Short-Term	Low-Regret	Yes	Yes

10. Resources

10.1. Federal and National Agencies

- U.S. Department of Energy (DOE) – Building Technologies Office
  https://www.energy.gov/eere/buildings/building-technologies-office
  (Includes retrofit strategies, technologies, and research)
- ENERGY STAR Residential Program
  https://www.energystar.gov/newhomes
  (Guidance on efficient appliances, HVAC, and envelope upgrades)
- U.S. Environmental Protection Agency (EPA) – ENERGY STAR Portfolio Manager
  https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager
  (Benchmarking tools for buildings)
- National Renewable Energy Laboratory (NREL)
  https://www.nrel.gov
  (Research on solar, heat pumps, zero energy homes)
- Federal Energy Management Program (FEMP)
  https://www.energy.gov/eere/femp
  (Building decarbonization guidance for public buildings)

10.2. State of Ohio

- Ohio Department of Development – Office of Energy & Environment
  https://development.ohio.gov/buildings/energy-efficiency
  (State weatherization, energy codes, and funding sources)
- Public Utilities Commission of Ohio (PUCO)
  https://puco.ohio.gov
  (Utility oversight, energy efficiency programs, net metering)
- Ohio Environmental Council (OEC)
  https://theoec.org
  (Policy advocacy and updates on energy justice and clean energy adoption)

10.3. Cleveland-Elyria MSA

- County Land Banks:
  https://cuyahogalandbank.org/
  https://lakecountylandbank.org/
  https://www.loraincountyohio.gov/728/Lorain-County-Land-Bank

Medina County created a Land Bank in 2024; contact the County Treasurer:
https://www.medinacountytax.com/#/
No land bank exists in Geauga County; Contact the County Auditor for forfeited or vacated land:
https://auditor.geauga.oh.gov/real-estate/forfeited-land-sale/

- Growth Opps (Growth Opportunity Partners) and their Go Green Energy Fund
  https://www.growthopps.org/go-green/
  (Green Bank for Northeast Ohio)
- Site Readiness For Good Jobs Fund
  https://www.sitereadycle.org/
  (Site Aggregation, remediation and development for large, complex sites)

10.4. Local Energy & Decarbonization Nonprofits

- Solar Co-Op for the MSA's Five Counties
  https://switchtogether.com/en/solar/cuyahogacounty/home
- Evergreen Cooperatives / Ohio Cooperative Solar
  https://www.evgoh.com
  (Community-based solar and energy efficiency jobs programs)
- Green Energy Ohio
  https://www.greenenergyohio.org
  (Renewable energy education and project showcases)
- Environmental Health Watch
  https://www.ehw.org
  (Healthy homes, weatherization, lead and energy co-benefits)
- RePower Ohio
  https://www.repowerohio.org
  (Outreach and tools on building decarbonization, solar installation)
- Power a Clean Future Ohio
  https://www.poweracleanfuture.org/
  (Equip local government leaders with tools and resources to reduce emissions)
- Western Reserve Land Conservancy
  https://wrlandconservancy.org/
  (Land conservation, restoration and preservation)
- ICLEI USA
  https://icleiusa.org/
  (U.S. Organization of Local Governments for Sustainability; a global network working with 2,500+ local and regional governments committed to sustainability and climate action.)

10.5. Equity Assessment Tools & Metrics

- Energy Justice Scorecard (2019).https://iejusa.org/wp-content/uploads/2019/12/The-Energy-Justice-Workbook-2019.pdf
- School for Environment and Sustainability (SEAS). 2022. “Energy Equity Project Report”. University of Michigan.
- Kime, Sage, Veronica Jacome, David Pellow, and Ranjit Deshmukh. 2023. "Evaluating equity and justice in low-carbon energy transitions." *Environmental Research Letters*. 18(12). doi: 10.1088/1748-9326/ad08f8.
- American Council for an Energy-Efficient Economy (ACEE). 2024. “City Clean Energy Scorecard.”
- City of Ann Arbor. “A2Zero. Equitable, Sustainable, Transformative.”
- Anderson et al. 2023. “LA100 Equity Strategies.” Golden, CO: National Renewable Energy Laboratory. https://www.nrel.gov/docs/ fy24osti/85960.pdf.

---

[1] https://www.unep.org/resources/emissions-gap-report-2024

[2] Northeast Ohio Sustainable Communities Consortium, *Vibrant NEO 2040 Technical Appendix: Scenario Modeling Process* (Cleveland, OH: Northeast Ohio Sustainable Communities Consortium, 2014), accessed May 4, 2025, https://vibrantneo.org/wp-content/uploads/2014/03/Vibrant-NEO-Final-Report_TECHNICAL-APPENDIX_FULL.pdf.

[3] Logan, John R. and Brian J. Stults, 2022, “Metropolitan Segregation: No Breakthrough in Sight,” *Center for Economic Studies* (*CES) Working Paper 22-14*, Washington, DC: U.S. Census Bureau, https://www2.census.gov/ces/wp/2022/CES-WP-22-14.pdf, accessed June 27, 2025.

[4] United Way of Greater Cleveland, “How Has Historic Redlining Shaped Greater Cleveland?” https://www.unitedwaycleveland.org/about-us/counties-served/the-effects-of-redlining/, accessed June 27, 2025.

[5] Kneebone, Elizabeth, and Alan Berube. Confronting Suburban Poverty in America. Brookings Institution Press, 2013. Lacy, Karyn. 2016. “The New Sociology of Suburbs: A Research Agenda for Analysis of Emerging Trends.” Annual Review of Sociology 42: 369–84.

[6] Pew Research Center 2020

[7] Kneebone, Elizabeth, and Alan Berube. Confronting Suburban Poverty in America. Brookings Institution Press, 2013

[8] United States Global Change Research Program (USGCRP), “U.S Climate Resilience Toolkit: Glossary,” https://toolkit.climate.gov/content/glossary, accessed June 27, 2025.

[9] Adger, W. Neil. "Vulnerability." *Global environmental change* 16, no. 3 (2006): 268-281.

[10] Susan L. Cutter, Bryan J. Boruff, and W. Lynn Shirley, "Social Vulnerability to Environmental Hazards," *Social Science Quarterly* 84, no. 2 (2003): 242–261, https://doi.org/10.1111/1540-6237.8402002, accessed June 27, 2025.

[11] Data from Union of Concerned Scientists, 2021, *Too Hot to Work: Assessing the Threats Climate Change Poses to Outdoor Workers*, https://www.ucs.org/sites/default/files/2021-09/Too-Hot-to-Work_9-7.pdf, accessed June 27, 2025.

[12] Environmental Defense Fund, Texas A&M University, and Darkhorse Analytics, 2025, “Climate Vulnerability Index,” https://climatevulnerabilityindex.org/, accessed June 27, 2025.

[13] Sherman Park Community Association, “Greening Congregations Initiative,” https://shermanpark.org/services/greening-congregations-initiative/, accessed June 27, 2025.

[14] Southwest Network for Environmental and Economic Justice (SNEEJ), 1996, *Jemez Principles for Democratic Organizing*, https://www.ejnet.org/ej/jemez.pdf. Re-Volve, "Garden Valley Neighborhood House," https://re-volv.org/project/garden-valley/, accessed June 27, 2025.
[15] https://earth911.com/home-garden/ecovillages-5-american-exciting-examples/
[16] https://ecovillage.org/
[17] https://codes.ohio.gov/ohio-administrative-code/rule-3745-76-07
[18] 10 sq miles = 6,400 acres. At 400 trees / acre (10' x 10' planting), minus some unsuitable areas / creeks, etc. = 2,560,000 trees by 2050, or 102,400 trees / yr. CO2 benefits, at 10.36 kg CO2 captured/yr, would be nearly 345,000 metric tons sequestered total, with an additional 26,500 metric tons added each year. These calculations only reflect the carbon captured from the trees, and do not account for additional carbon uptake in the soil, fungi, and microbial communities in a healthy forest ecosystem, per Mo, L., Zohner, C.M., Reich, P.B. *et al.* Integrated global assessment of the natural forest carbon potential. *Nature* 624, 92–101 (2023). https://doi.org/10.1038/s41586-023-06723-z; separate analysis suggests 1-3 ton/acre/yr, which would suggest a lower benefit of 13,000 tons/yr on average for 6400 acres.
Trees increase their uptake of CO2 each year, stabilizing around year 30; aggressive tree-planting is a better investment earlier than later.
[19] https://www.energystar.gov/buildings/tools-and-resources/building-upgrade-manual
[20] https://www.ashrae.org/technical-resources/bookstore/standard-90-1
[21] https://www.energystar.gov/buildings/benchmark
[22] https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands
[23] https://livingroofs.org/introduction-types-green-roof/biosolar-green-roofs-solar-green-roofs/
[24] U.S. DOE Industrial Assessment Centers
[25] Industrial Energy Management
[26] DOE Energy Footprint Tool
[27] https://electrificationcoalition.org/resource/drve/
[28] See https://phlcouncil.com/wp-content/uploads/2019/04/Fleet-Attachment-Optimal-Vehicle-Replacement-Strategy.pdf
[29] https://css.umich.edu/publications/research-publications/electric-and-gasoline-vehicle-total-cost-ownership-across-us
[30] https://climateprogramportal.org/direct-pay-tracker/
[31] https://driveevfleets.org/what-is-drive-ev-fleets/
[32] Based on comparison of MSRP for 2019 Nissan LEAF to purchase price for this make and model of vehicle as procured by the City of Cincinnati in January 2020. See https://www.cars.com/research/nissan-leaf/; https://driveevfleets.org/wp-content/uploads/2018/08/Cincinnati-New-Case-Study-Final-1.5.2021.pdf; https://data.cincinnati-oh.gov/Thriving-Neighborhoods/Fleet-Procurement/ucjy-ykv4/about_data
[33] https://codes.ohio.gov/ohio-administrative-code/rule-3745-76-07
[34] McCord, Gordon C., Elise Hanson, Murtaza H. Baxamusa, Emily Leslie, Joseph Bettles, Ryan A. Jones, Katy Cole, Chelsea Richer, Eleanor Hunts, Philip Eash-Gates, Jason Frost, Shelley Kwok, Jackie Litynski, Kenji Takahashi, Asa Hopkins, Robert Pollin, Jeannette Wicks-Lim, Shouvik Chakraborty, Gregor Semieniuk, David G. Victor, Emily Carlton, Scott Anders, Nilmini Silva Send, Joe Kaatz, Yichao Gu, Marc Steele, Elena Crete, and Julie Topf. San Diego Regional Decarbonization Framework: Technical Report. County of San Diego, California, 2022, https://www.sandiegocounty.gov/content/dam/sdc/lueg/regional-decarb-frameworkfiles/RDF_Technical_Report_FINAL_2022.pdf, accessed June 27, 2025.
[35] Ibid.
[36] Ibid.
[37] *Robinson* v. *City of Los Angeles*, 1956, https://law.justia.com/cases/california/court-of-appeal/2d/146/810.html, accessed June 27, 2025.
[38] *San Diego Regional Decarbonization Framework*.
[39] Ibid.
[40] Ibid.
[41] Ibid
[42] Ibid
[43] Interview with Jenita McGowan, Cuyahoga County, April 17, 2025
[44] PUCO, "Net metering," https://puco.ohio.gov/utilities/electricity/resources/net-metering, accessed June 27, 2025.

[45] Switch Together, “Cuyahoga County Solar Co-op,” https://switchtogether.com/en/solar/cuyahogacounty/home, accessed June 27, 2025.
[46] U.S. EPA, 2025, “On-Bill Loan Programs,” https://www.epa.gov/statelocalenergy/bill-loan-programs, accessed June 27, 2025.