eNEO2050

An Equitable Plan for Northeast Ohio

JUNE 2021

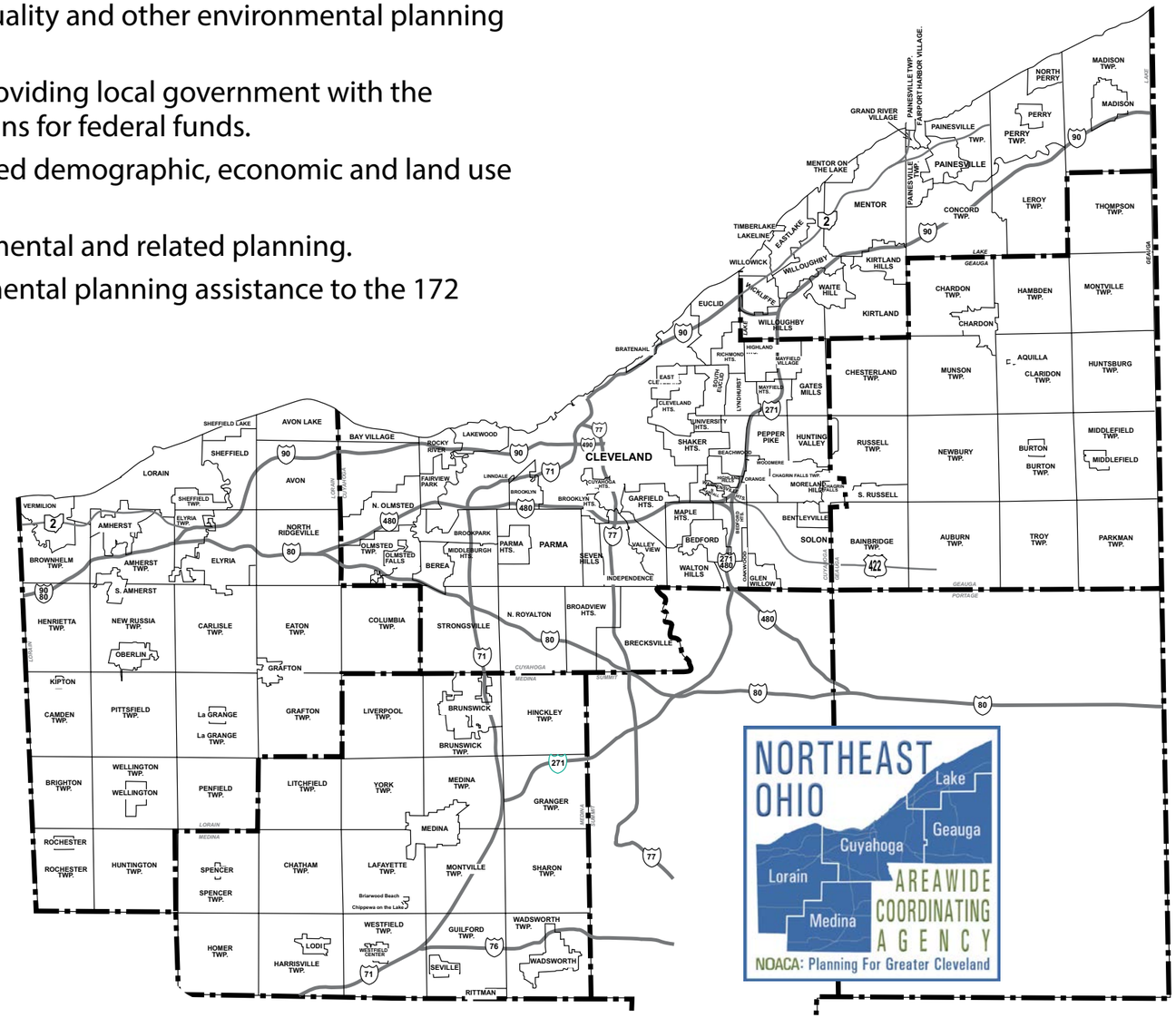
Northeast Ohio Areawide Coordinating Agency

The Northeast Ohio Areawide Coordinating Agency (NOACA) is a public organization serving the counties of and municipalities and townships within Cuyahoga, Geauga, Lake, Lorain and Medina (covering an area with 2.1 million people). NOACA is the agency designated or recognized to perform the following functions:

- Serve as the Metropolitan Planning Organization (MPO), with responsibility for comprehensive, cooperative and continuous planning for highways, public transit, and bikeways, as defined in the current transportation law.
- Perform continuous water quality, transportation-related air quality and other environmental planning functions.
- Administer the area clearinghouse function, which includes providing local government with the opportunity to review a wide variety of local or state applications for federal funds.
- Conduct transportation and environmental planning and related demographic, economic and land use research.
- Serve as an information center for transportation and environmental and related planning.
- As directed by the Board, provide transportation and environmental planning assistance to the 172 units of local, general purpose government.

The NOACA Board of Directors is composed of 47 local public officials. The Board convenes quarterly to provide a forum for members to present, discuss and develop solutions to local and areawide issues and make recommendations regarding implementation strategies. As the area clearinghouse for the region, the Board makes comments and recommendations on applications for state and federal grants, with the purpose of enhancing the region's social, physical, environmental and land use/transportation fabric. NOACA invites you to take part in its planning process. Feel free to participate, to ask questions and to learn more about areawide planning.

For more information, call (216) 241-2414 or visit http:\\www.noaca.org



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eNEO2050
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June 2021

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Board President

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Executive Director & CEO

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Introduction

Over the past 50-years, NOACA has brought together counties and municipalities in the region to discuss issues of regional significance such as transportation, water, and air quality. In the early days, there was even more in NOACA's portfolio of responsibilities. To fulfil its federal role as Metropolitan Planning Organizations, NOACA's 45-member board represents the counties of Cuyahoga, Geauga, Lorain, Lake, and Medina as well as the City of Cleveland and many municipalities. Every four years, as directed by federal law, NOACA focusses on preparing a long-range plan to envision the future of the regional transportation network. Transportation investments and the physical location and type of transportation infrastructure have a profound potential to affect the region's quality of life and future. It is more critical than ever, given the region's longstanding static population, to plan and develop such projects strategically to leverage public dollars to best reignite growth and the economic competitiveness of the region. This draft planning document assesses how the transportation networks can best support the current development patterns of the region by working with four future scenarios. Of the four scenarios, a preferred scenario is advanced as a vision for an Equitable Northeast Ohio. NOACA is extremely pleased to present this final draft of "eNEO2050 – An equitable plan for Northeast Ohio" to the NOACA board of directors for approval.

Equity as a Guiding Principle

eNEO2050 builds upon the foundation of previous planning efforts led by NOACA, yet incorporates a much more comprehensive focus on equity and a more careful examination of the relationships between transportation and other facets of a resilient region, such as land use, economic development, environmental quality, climate, and health. *eNEO2050* also adopts scenario planning and performance measures and targets as part of its future outlook, which was not part included in previous NOACA long-range plans. Equity means freedom from bias or favoritism (Merriam-Webster Dictionary). In that sense, equity applies to many questions of envisioning a future transportation system for a mature region: Equity applies to issues of job access for minority and low-income populations, to questions over modes of transportation, and issues of the geographic distribution of investments. Taking a more comprehensive perspective focused on the origin and destination of trips within the region enables us to consider how the region's transportation investments can support equity across the region.

Process

Another element of equity is to ensure that during the public engagement process, all stakeholders and especially vulnerable populations are involved to shape decisions. Besides the general public, NOACA included underrepresented groups, elected officials and staffers at all levels of government, freight and business interests as well as organizations that represent public transportation employees. Stakeholders and the public have multiple opportunities to review plan-related information starting with the discovery of issues, followed by a review of multiple alternatives and the draft preliminary plan. NOACA now presents the final draft of *eNEO2050* to the NOACA board of directors for approval. eNEO 2050 examines multiple future investment scenarios informed by a comprehensive planning perspective on transportation issues. From the investment scenario, NOACA developed the constrained and funded *eNEO2050* vision with recommendations to access future funding to build a visionary transportation system. *eNEO2050* is a bold step forward for Northeast Ohio to address decades of structural bias in the region's systems so that all stakeholders have the opportunity for a more vibrant future.

Reinvestment as a Regional Strategy for Growth

eNEO2050 presents a collective strategy for growth based on an equitable transportation system. *eNEO2050* reinvests in each community's existing infrastructure assets and ensure that we can thrive as a diverse region. Figure i-2 and Table i-1 show the diversity of cities, villages and townships across the five county region. *eNEO2050* presents an opportunity for the region to not just upgrade the legacy assets but rather to enhance and reinvest into infrastructures that strengthens our regional economies and advances each communities and counties prospects of thriving in the future. NOACA is a strong proponent of sustainable reuse of our existing infrastructure. NOACA considers the industrial legacy of the region as challenge and opportunity. As we preserve the past generation's legacy assets that we inherited, we will get to a point where we create the legacy assets for the next generation.

Figure i-2. NOACA Communities

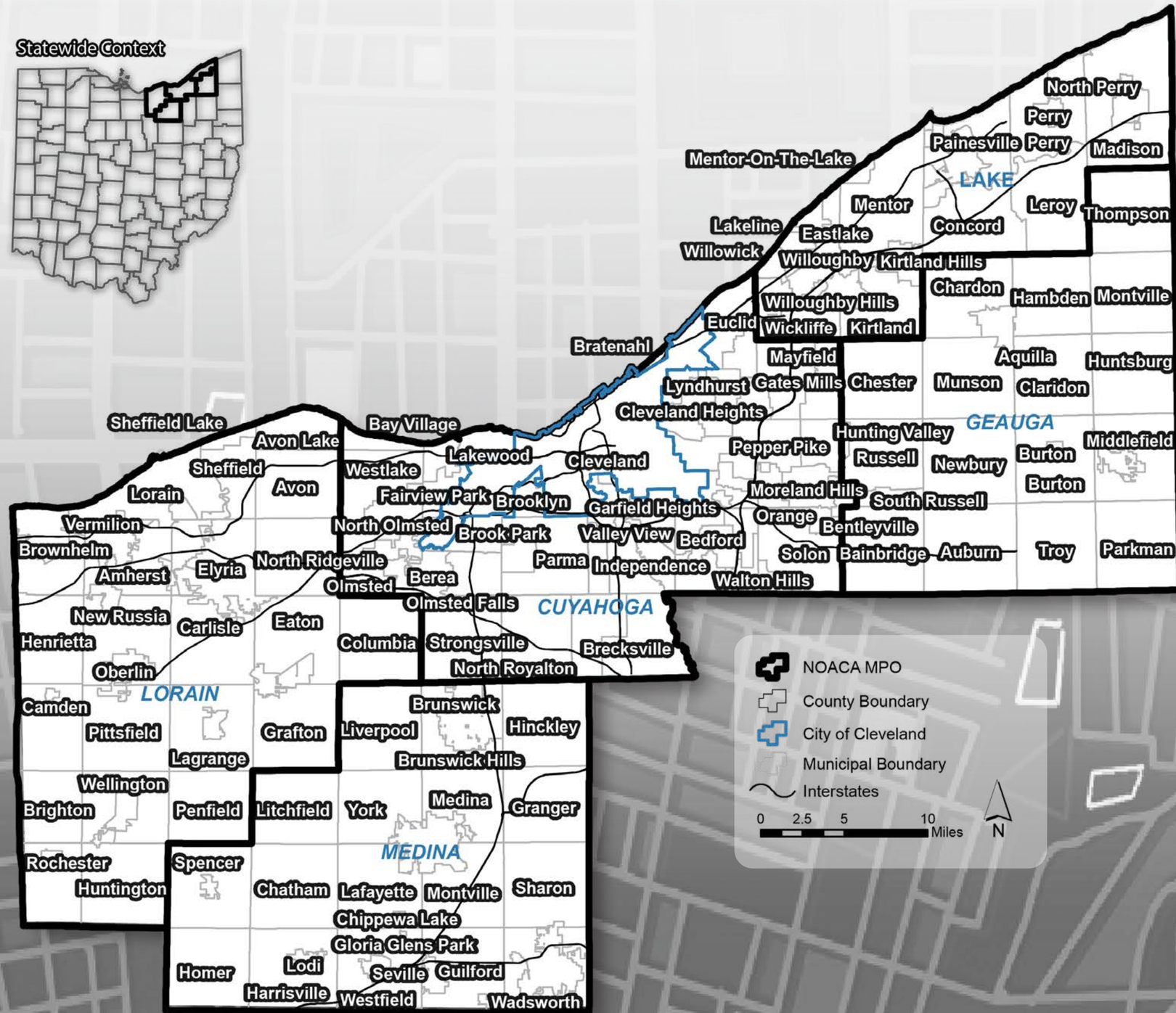


Table i-1. Communities in the NOACA Region, 2020

COUNTY/ TYPE		COMMUNITY	HOUSEHOLDS	EMPLOYMENT	TOTAL POPULATION
Cuyahoga	City	Bay Village	6,022	3,135	15,192
		Beachwood	5,215	34,933	12,058
		Bedford	6,132	9,624	12,938
		Bedford Heights	4,902	14,458	10,263
		Berea	6,954	10,874	17,707
		Brecksville	5,401	15,451	13,777
		Broadview Heights	8,011	7,284	20,164
		Brook Park	7,308	19,284	17,990
		Brooklyn	5,147	17,193	10,962
		Cleveland	159,815	353,171	370,715
		Cleveland Heights	18,929	12,276	43,220
		East Cleveland	6,926	5,420	15,079
		Euclid	20,893	25,456	45,058
		Fairview Park	7,181	6,714	16,135
		Garfield Heights	11,181	19,017	27,388
		Highland Heights	3,359	11,387	8,673
		Independence	2,843	30,924	7,292
		Lakewood	24,037	17,075	49,380
		Lyndhurst	6,038	7,713	13,096
		Maple Heights	8,867	7,464	21,367
		Mayfield Heights	9,377	23,245	18,526
		Middleburg Heights	7,499	28,452	16,760
		North Olmsted	13,251	21,005	31,764
		North Royalton	13,469	8,975	31,669
		Olmsted Falls	3,830	2,673	9,307
		Parma	33,520	38,873	78,928
		Parma Heights	9,189	5,264	19,946
		Pepper Pike	2,209	4,356	5,931
		Richmond Heights	4,772	5,453	10,660
		Rocky River	9,526	10,325	20,522
		Seven Hills	4,875	3,471	11,521
		Shaker Heights	11,378	8,910	27,399
		Solon	8,444	38,922	23,622
		South Euclid	8,695	6,501	21,471
		Strongsville	18,308	30,927	46,251
		University Heights	4,446	7,212	12,416
		Warrensville Heights	5,899	13,149	13,156
		Westlake	14,180	35,549	33,312
	Twp	Chagrin Falls	54	27	150
	Village	Olmsted	6,243	3,063	15,196
		Bentleyville	523	257	1,459
		Bratenahl	629	631	1,152
		Brooklyn Heights	707	5,535	1,742
		Chagrin Falls	1,855	3,179	4,060
		Cuyahoga Heights	320	9,144	773
		Gates Mills	959	1,254	2,344
		Glenwillow	306	3,589	856
		Highland Hills	221	5,613	1,048
		Hunting Valley*	303	867	767
		Linndale	109	191	267
		Mayfield	1,603	16,184	3,583
		Moreland Hills	1,297	1,365	3,417
		Newburgh Heights	862	472	1,944
		North Randall	373	3,777	770
		Oakwood	1,626	4,239	3,859
		Orange	1,362	3,926	3,507
		Valley View	833	13,366	2,207
		Walton Hills	894	3,059	2,122
		Woodmere	428	3,459	855
Geauga	City	Chardon	2,270	8,004	5,143
	Twp	Auburn	2,265	3,301	6,344
		Bainbridge	4,503	9,017	11,864
		Burton	1,113	2,218	3,161
		Chardon	1,823	1,634	4,780

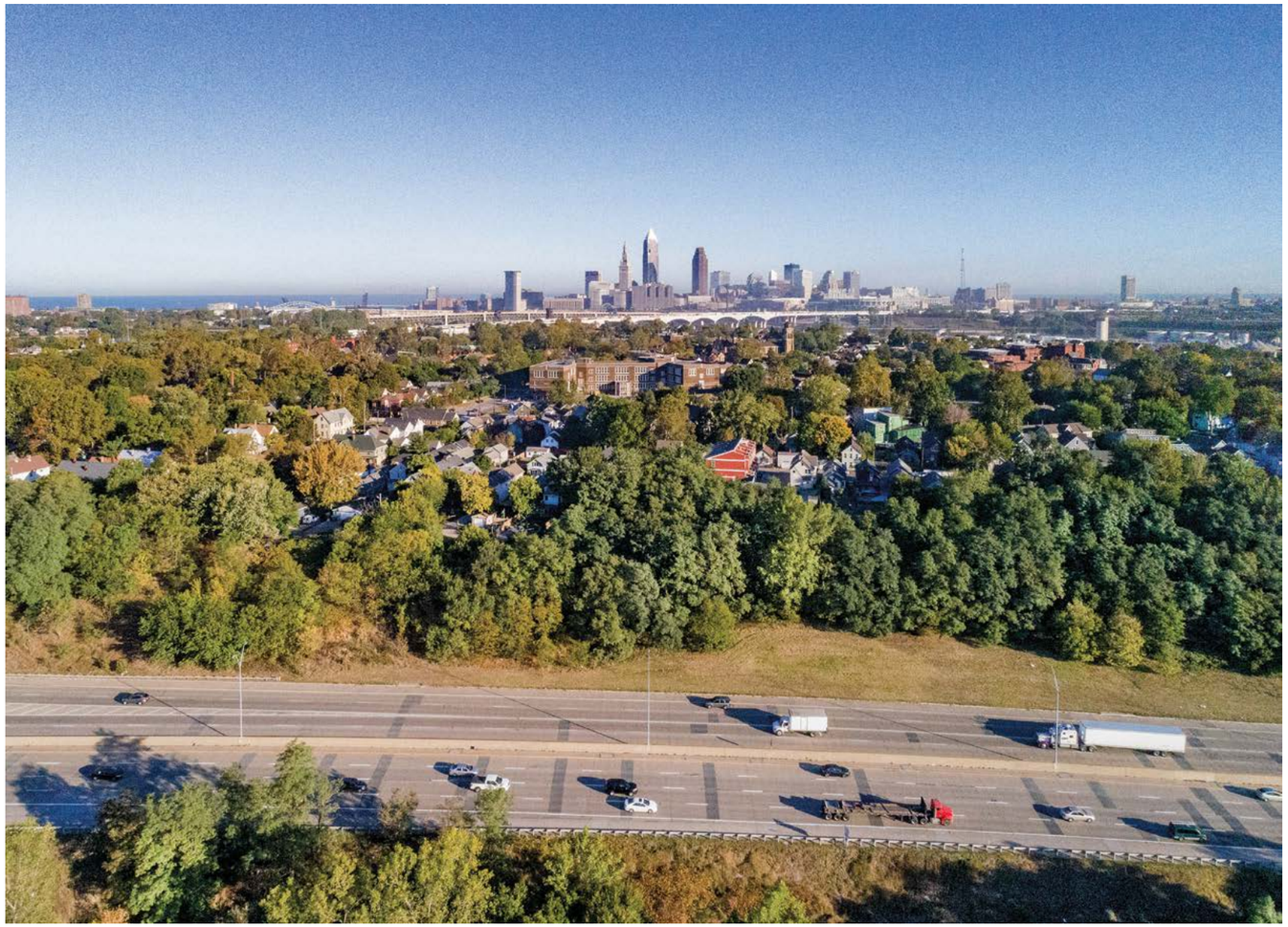
*Hunting Valley is in both Cuyahoga and Geauga Counties

COUNTY/ TYPE		COMMUNITY	HOUSEHOLDS	EMPLOYMENT	TOTAL POPULATION
Geauga (Cont.)	Twp	Chester	3,742	5,584	9,671
		Claridon	1,223	2,629	3,241
		Hambden	1,721	1,233	4,643
		Huntsburg	1,062	576	3,810
		Middlefield	1,482	3,343	4,973
		Montville	786	345	2,092
		Munson	2,423	3,633	6,716
		Newbury	2,108	3,378	5,437
		Parkman	1,198	491	4,374
		Russell	2,076	1,613	5,192
		Thompson	916	544	2,396
		Troy	991	2,226	2,920
	Village	Aquilla	17	6	42
		Burton	511	1,390	1,297
		Middlefield	1,009	6,250	2,364
		South Russell	1,305	1,037	3,606
Lake	City	Eastlake	7,833	7,627	18,402
		Kirtland	2,399	3,303	6,471
		Mentor	18,971	41,713	46,569
		Mentor-on-the-Lake	2,958	1,609	6,843
		Painesville	6,906	10,043	18,949
		Wickliffe	5,620	9,390	12,855
		Willoughby	10,118	22,625	21,560
		Willoughby Hills	4,106	2,800	8,984
		Willowick	5,572	2,661	13,039
	Twp	Concord	7,637	7,449	19,596
		Leroy	1,323	446	3,575
		Madison	6,160	5,467	16,097
		Painesville	7,037	6,619	17,702
		Perry	2,627	3,140	7,108
	Village	Fairport Harbor	1,325	741	2,898
		Grand River	160	223	416
		Kirtland Hills	396	288	1,103
		Lakeline	107	6	247

COUNTY/ TYPE		COMMUNITY	HOUSEHOLDS	EMPLOYMENT	TOTAL POPULATION
Lake (Cont.)	Village	Madison	1,328	1,093	3,418
		North Perry	421	2,792	1,059
		Perry	572	591	1,602
		Timberlake	277	41	650
		Waite Hill	341	99	814
Lorain	City	Amherst	4,705	6,912	11,953
		Avon	8,853	14,715	24,960
		Avon Lake	9,223	9,117	23,587
		Elyria	21,741	29,703	52,974
		Lorain	24,036	20,837	60,755
		North Ridgeville	13,597	10,474	35,040
		Oberlin	2,277	5,022	6,712
		Sheffield Lake	3,520	973	8,664
		Vermilion (Part)	2,211	1,608	5,796
	Twp	Amherst	2,378	2,562	6,132
		Brighton	346	80	954
		Brownhelm	783	437	2,141
		Camden	548	1,185	1,532
		Carlisle	3,232	3,572	8,349
		Columbia	2,596	1,656	7,145
		Eaton	2,446	3,150	6,753
		Elyria	1,333	2,928	3,138
		Grafton	1,108	218	3,185
		Henrietta	799	545	2,120
		Huntington	559	221	1,543
		LaGrange	1,662	694	4,546
		New Russia	1,263	2,268	3,921
		Penfield	682	217	1,888
		Pittsfield	697	1,060	1,833
		Rochester	297	139	785
		Sheffield	1,654	1,786	4,141
		Wellington	863	712	2,278

COUNTY/ TYPE		COMMUNITY	HOUSEHOLDS	EMPLOYMENT	TOTAL POPULATION
Lorain (Cont.)	Village	Grafton	822	1,857	6,199
		Kipton	26	16	68
		LaGrange	653	1,548	1,921
		Rochester	26	10	70
		Sheffield	1,957	5,788	5,011
		South Amherst	415	84	1,080
		Wellington	1,668	2,331	4,093
Medina	City	Brunswick	12,608	12,504	33,385
		Medina	10,113	18,738	26,268
		Rittman	56	37	148
		Wadsworth	8,247	12,296	20,808
	Twp	Brunswick Hills	4,708	1,707	12,698
		Chatham	846	218	2,314
		Granger	1,607	3,087	4,490
		Guilford	1,512	1,131	4,015
		Harrisville	978	1,364	2,448
		Hinckley	2,864	2,888	8,007
		Homer	484	525	1,571
		Lafayette	2,112	1,636	5,886
		Litchfield	1,216	661	3,352
		Liverpool	1,949	4,551	5,411
		Medina	3,695	8,451	9,203
		Montville township	4,972	3,309	14,092
		Sharon	1,938	4,282	5,458
		Spencer	685	249	2,036
		Wadsworth	2,266	3,467	6,129
		Westfield	1,027	2,280	2,701
		York	1,543	2,595	4,227
	Village	Chippewa Lake	294	43	670
		Creston (Part)	13	6	31
		Gloria Glens Park	72	13	162
		Lodi	856	1,328	2,069
		Seville	657	2,825	1,738
		Spencer	214	49	587
		Westfield Center	387	1,487	967

Source: NOACA Travel Forecasting Model - Population, Households, and Employment Estimates 2020



SECTION 1

eNEO2050

EMBARKING ON PLANNING

FOR AN EQUITABLE TRANSPORTATION SYSTEM

Photo by Marc-Olivier Jodoin on Unsplash

eNERGIZING THE IMAGINATION

eNEO2050

In this Chapter

Transportation infrastructure is the backbone of the economy and the foundation of a region's quality of life. Transportation investments are predictive of the future strength of a region and the quality of life it provides its residents. In a post pandemic world, it is more critical than ever, to strategically plan and develop plans, policies, programs and projects to leverage public dollars to best reignite growth and solidify the economic competitiveness of the region. However, *eNEO2050* goes beyond; it challenges what NOACA must do to envision—and attain—a more equitable future.

Scenario planning is used to explore various approaches to transportation infrastructure investments. This process allows for vivid imagining, including highlighting workforce mobility and accessibility to employment centers across the five counties that could make a real difference for residents, especially to low-income and minority populations. This planning document assesses how the transportation networks can best support the current development patterns of the region with a preferred scenario advanced as a vision for an equitable Northeast Ohio.

Leaders on the NOACA board have recognized the need to ensure prosperity and growth for everyone in the region to enable growth of the region at large. *eNEO2050* charts a course for investing in infrastructures for an equitable Northeast Ohio with thriving communities in the urbanized and rural areas. Working together to excel as a region may enable us to reclaim our national leadership and economic status. Organizations in the region are collaborating to ensuring business expansion, attraction and retention. Besides a magnificent business environment that provides jobs, the region has many cultural, entertainment, medical and educational assets for residents and visitors. Connecting people to these places is what a long range transportation plan envisions. Doing so equitably is what *eNEO2050* envisions.

Envisioning the Future: From NOACA Vision to Planning Objectives to Performance Measures

Over the past 50 years, NOACA has brought together local governments to plan for Greater Cleveland, particularly issues of regional significance such as transportation, water, and air quality. As the federally designated Metropolitan Planning Organization, NOACA's is governed by a 46-member board that represents the counties of Cuyahoga, Geauga, Lake, Lorain and Medina, as well as the City of Cleveland and many municipalities, villages and townships. (Figure 1-1). As such, NOACA is responsible for preparing a long-range transportation plan that envisions the future of the regional transportation network across the 5-county region for the coming decades. Every four years, the plan is updated to focus those transportation investments. NOACA's vision statement (Figure 1-3) has guided the development of this long-range plan.

eNEO2050 – A vision for an equitable transportation system. *eNEO2050* is a bold step forward for Northeast Ohio to reimagine the region's transportation systems so that everyone has the opportunity for a more vibrant future.

Equity

NOACA approached the question of how to invest into our regional transportation system from an equity perspective. Thus, *eNEO2050's* emphasis on equity merits some explanation on how NOACA will define its equity focus within the context of transportation and environmental planning.

An equity perspective means that *eNEO2050* pays particular attention to "environmental justice" (EJ). Including "environmental justice" in transportation planning is a federal requirement. The United States Environmental Protection Agency (US EPA) defines Environmental Justice as "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies."[1] To develop its equity approach, NOACA has taken into consideration Title VI of the Civil Rights Act of 1964, President Bill Clinton's Executive Order 12898 and best practices and recent academic findings on equity issues. NOACA performs an EJ analysis to identify and map EJ areas and to evaluate transportation planning impacts (See Figure 1-2).

Figure 1-1. NOACA Region

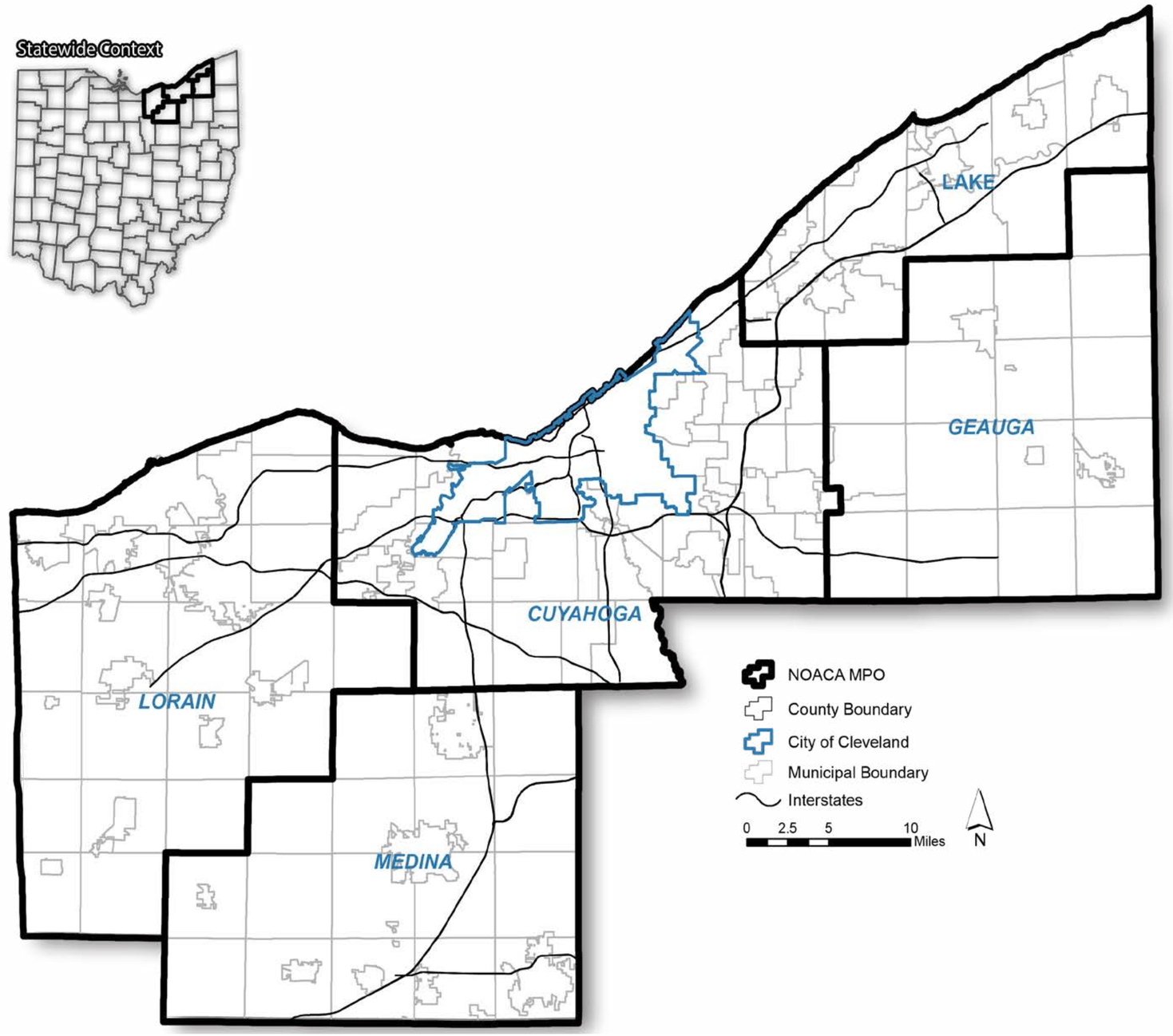


Figure 1-2. Environmental Justice (EJ) Areas

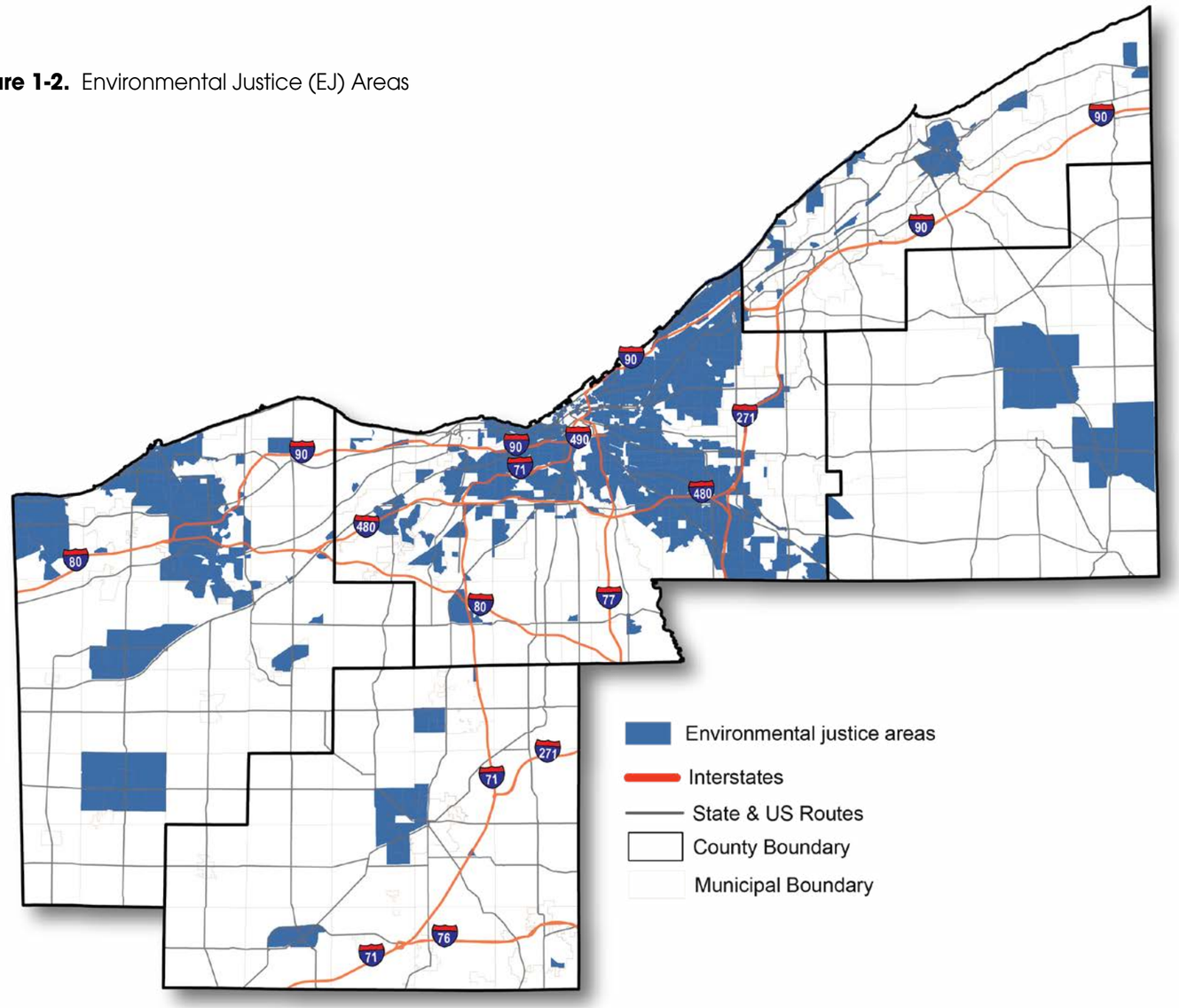


Figure 1-3. NOACA Vision

NOACA will STRENGTHEN regional cohesion, PRESERVE existing infrastructure, and BUILD a sustainable multimodal transportation system to SUPPORT economic development and ENHANCE quality of life in Northeast Ohio.

Formally adopted by the Board of Directors on January 10, 2014 as part of the regional strategic plan development.

NOACA recognizes that equity is larger than socioeconomic and racial as defined by EJ, crossing many spectrums. Equity means freedom from bias or favoritism (Merriam-Webster Dictionary). It is clear that transportation investments and the physical location and type of transportation infrastructure have a profound potential to affect the region's future as a whole, but also the future of its individual residents, often with significant disparities by zip code. In that sense, equity applies to many questions of envisioning a future transportation system for a mature region: equity applies to issues of job access for minority and low-income populations, questions over modes of transportation, issues of the geographic distribution of investments and intergenerational costs and benefits. **To acknowledge the impact transportation has on providing opportunities, the question of equity is woven throughout this planning document, ensuring that all people have access and mobility to enable them to actively participate in the economy and to enjoy the quality of life the region has to offer.** Taking a more comprehensive perspective focused on the origin and destination of trips within the region enables us to consider how the region's transportation investments can be more equitable across the region.

Vision, Goals and Objectives

NOACA's vision, goals, and objectives for *eNEO2050* incorporate and build upon those from the region's previous planning efforts over the past decade. To assess how our current transportation system is doing and to define investment priorities for the future, NOACA started this planning process with NOACA's vision statement (Figure 1-3) and a myriad of goals and objectives taken from existing plans. The emerging concepts were consolidated to represent 6 thematic objectives for the transportation system, which are overlaid with an equity lens as shown in Table 1-1. NOACA's transportation objectives are informed by federal requirements emphasized through performance measures (Figure 1-4); the goals of *Access Ohio 2045*, which is the statewide long-range planning document prepared by the Ohio Department of Transportation (Figure 1-5); and by local plans and priorities.

Table 1-1. NOACAs Transportation Objectives - Enabling Equal Opportunity

EQUITY FOCUS		eNEO2050 AIMS TO IMPROVE...	
Socioeconomic equity –Environmental Justice (racial and income equality)	Modal and geographic equity	**Access**	Access to multiple modes of transportation in a reasonable time/ distance
		Mobility	Reliable work commute times by multiple modes of transportation
		Safety	Safe transportation system with reduced number of traffic fatalities and major injuries for all modes of transportation (Vision Zero)
	Inter-generational and environmental equity	**Emission**	Carbon-neutral transportation system that supports clean air across the region
		Asset Management	Well-maintained roadway network with Average PCR of 80 and structurally deficient deck areas approaching zero
		Technology Adaptation	Modern transportation system that supports innovations in all modes of transportation

Figure 1-4. National Performance Categories Based on MAP-21 and FAST Transportation ACTs

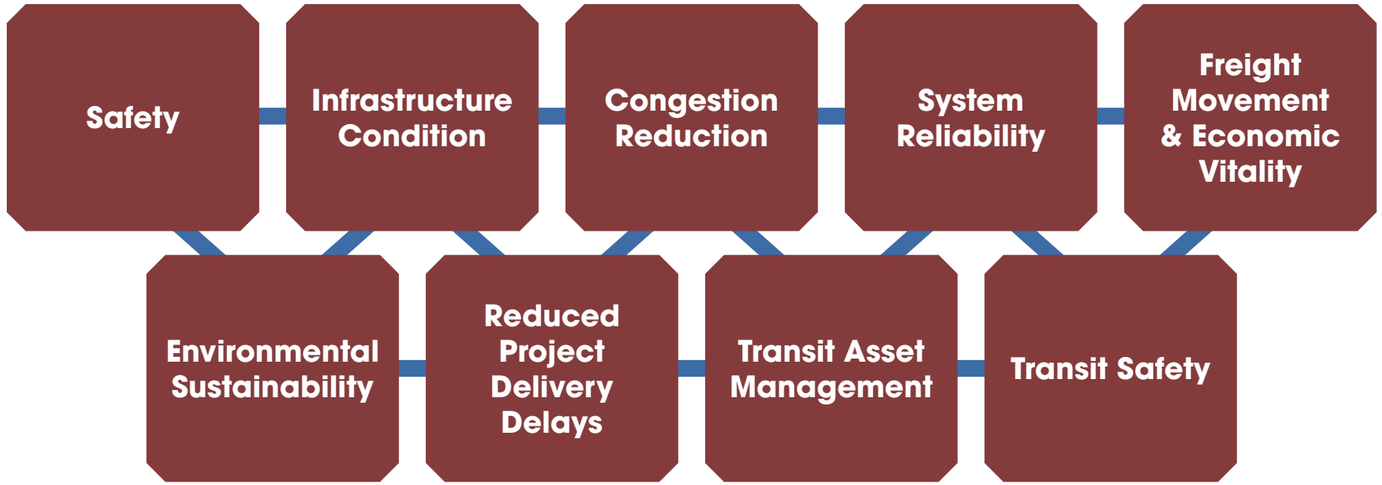


Figure 1-5. Access Ohio 2045 Goals - Ohio Department of Transportation[2]

Source: Access Ohio 2045

The development of *eNEO2050* was premised by the understanding that transportation efforts are in pursuance of increasing economic competitiveness for the purpose of improving the quality of life for residents. These overarching societal goals are underwritten by more specific transportation related objectives, mainly to ensure access and mobility for people and goods through a reliable and efficient transportation system. Safety, asset management (system preservation), emissions reduction and the utilization of emerging technologies provide confidence in the transportation system and enhance the experience of users when traveling to and from their destinations by multiple modes of transportation. In fulfillment of federal requirements, NOACAs transportation objectives are measurable through specific performance measurements (Table 1-2).

Table 1-2. NOACA Performance Measures - Enabling Equal Opportunity

	PERFORMANCE MEASURE CATEGORY	PERFORMANCE MEASURES
ACCESS	**Multimodal Transportation System**	• Percent of Non-Single Occupancy Vehicles • Annual Transit Ridership
	Access to Transportation System	• Access to all Transit Stops • Egress from All Transit Stops • Access to Highway System
MOBILITY	**Mobility & Delay**	• Total Annual Total VMT per Capita • Total Annual Freeway Delay per Capita • Annual Total Annual Principal Arterial Delay Per Capita • Annual Person Hours of Excessive Delay per Capita (PHED)
	Congestion Cost	• Annual Congestion Cost Per Capita
	Travel Time	• Average Auto Work Commute Time to All Major Job hubs • Average Transit Work Commute Time from EJ Neighborhoods to All Major Job Hubs • Average Work Commute Time From Households with Zero Cars • Maximum Level of Travel Time Reliability (LOTTR) • Maximum Truck Travel Time Reliability (TTTR)
SAFETY	**Traffic Safety**	• Fatalities, Serious Injuries and Non-motorized Fatalities and Serious Injuries
EMISSIONS	**Air Quality**	• Daily Volatile Organic Compound(VOCs) and Nitrogen Oxides (NOx) • Annual Direct PM
ASSET MANAGEMENT	**Pavement & Bridge**	• Average Highway Network Pavement Condition Rating (PCR) • Percent Structurally Deficient Deck Areas of All Bridges and NHS Bridges
TECHNOLOGY ADAPTATION	**Share of Autonomous vehicles**	• Daily Vehicular Trip Share of Autonomous, Electric Cars & Trucks

Policies, Plans, Programs, and Projects

Overall, *eNEO2050* proposes regionally significant and locally-informed policies, plans, programs and projects (4Ps) that reflect our interconnectedness as a region. By pursuing the 4Ps, *eNEO2050* moves toward implementation of NOACA's vision and transportation objectives that support federal, state and local goals. The 4Ps are actions aimed to benefit everyone in the region.

In the development of *eNEO2050,* the objectives underscored the need to consider better connecting workers to jobs and reducing commute times for all modes of transportation, so that all users can reclaim time for families, hobbies, recreation, active living and health as well as improved productivity. Increasing the efficiency of the highway and roadway network continued to be supported by the objectives due to its high use for transportation purposes, particularly for private automobiles. Movement towards a more viable transit system and a bicycle and pedestrian network was elevated to provide modal equity and choice, and congestion management that benefits all users. In focusing on a multi-modal system, *eNEO2050* respects and considers the completion of the vision from NOACA's first LRP in 1969 that included modal equity between auto and transit. Overall *eNEO2050* charts a course for investing in infrastructure for an equitable Northeast Ohio with thriving communities in the urbanized and rural areas.

While modal and geographical equity has been considered in *eNEO2050*, other elements that NOACA has been planning for over the past decade were also incorporated, including transportation asset management for a state of good repair. NOACA prioritizes reinvestment in existing assets (roads, sewers, transit vehicles, rail stations, bridges) as our mature region is currently overburdened with the maintenance costs of an infrastructure system built for a much larger population. Reinvesting in our current assets helps to preserve the character of communities and quality of life of residents, and creates the opportunities for safety improvements for all users and the utilization of excess capacity to enhance multimodal assets for the system. Furthermore, to ensure that the region is prepared as technology advances, consideration was given to the future transportation system including developments such as autonomous and electric vehicles that will improve its efficiency and effectiveness. Included was also the hope that the region can capitalize on transformational projects such as hyperloop, which will provide unique opportunities for the economic development of the region.

Lastly, NOACA acknowledges the need to invest in transportation infrastructure that is sensitive to the environment and that has a positive impact on air and water quality of the region. Accepting responsibility for the planet and its legacy for the next generation reflects intergenerational and environmental equity. All of these considerations are embedded in the 6 transportation objectives outlined above which are used throughout the document to understand the performance of our current transportation system, explore different options for our future transportation system and to decide on an investment strategy for an equitable Northeast Ohio.

Examining the Current Plans: Plans and Planning Products that Inform this Conversation

The foundation for *eNEO2050* is well-rooted in NOACA's major regional planning efforts, federal legislation and USDOT guidance, the state transportation plan, numerous NOACA local planning efforts, and NOACA staff visioning. NOACA's plans, in particular, showcase the agency's initiative to improve constantly upon each long-range plan and move the region closer to its vision. This perpetually evolving process reflects the dynamic nature of a diverse region. This section briefly highlights some of the planning efforts and documents that have factored into the development of *eNEO2050*.

NOACA and the other MPOs of Northeast Ohio collaborated to produce *Vibrant NEO 2040 (2014)*, a comprehensive regional vision framework for the future of a 12-county region.[3] This framework received the 2015 Daniel Burnham Award for a Comprehensive Plan from the American Planning Association (APA). Vibrant NEO 2040 suggests recommendations, objectives, and strategies for a vibrant, resilient and sustainable Northeast Ohio. NOACA's Board finalized *Going Forward, Together (2015)*, a regional strategic plan that captures and documents a vision, goals, and objectives that form the basis for NOACA's planning efforts.[4] *Going Forward, Together* identifies strategies for how to allocate resources—money, staffing, and Board and stakeholder activities—in pursuit of stated goals and objectives. NOACA's current long-range plan, *Aim Forward 2040 (2017)* is the agency's first based on the goals, objectives, and strategies defined in Going Forward, Together.[5]

Going Forward, Together and *Aim Forward 2040* has guided NOACA to develop additional plans that focus on particular transportation and environmental issues at a sub-regional and regional level. During the same period, NOACA developed and continue to develop comprehensive plans and studies about the region's current transportation assets, bicycle infrastructure, public transportation and transit-oriented development opportunities, multimodal freight network, specialized mobility services, safety and intelligent transportation systems (ITS), and workforce accessibility and mobility. NOACA also developed a water quality strategic plan, a comprehensive wastewater management and water quality plan, an air quality public education and outreach strategy, and an air quality communication plan. These topical plans help flesh out the broader scope of the larger scale regional and state plans to focus on specific needs to realize Northeast Ohio's desired future.

How is eNEO2050 Different from Previous Efforts?

eNEO2050 builds upon the foundation of previous planning efforts led by NOACA, yet embeds equity as guiding principle and better integrates elements of comprehensive planning, focusing on the relationship between transportation and land use, housing, economic development, and the environment. *eNEO2050* also uses scenario planning with performance measures and targets as part of its future outlook, which was not part of previous NOACA long-range plans (though it was part of a larger regional visioning effort known as Vibrant NEO 2040; see page 18 and Chapter 2).

NOACA began to shape *eNEO2050* formally in January 2020, but the concept of equity and the relationship to transportation has been evolving for years in the work of the agency. Equity across jurisdictions, from urban to suburban to rural. Equity between modes, from automobile to transit to bicycle and pedestrian. Equitable investments to ensure equitable access and mobility. Equitable transportation to lead to equal opportunity.

Specifically relative to racial equity, NOACA embraced a renewed and strengthened commitment to equity through its transportation and planning efforts articulated as a formal resolution passed by the agency's Board of Directors on June 12, 2020. The following excerpt illustrates this commitment:

> *NOACA is committed to be a leader in transforming our region into one where equity is achieved by creating access to opportunity through transportation and environmental planning, focusing on inclusive practices that empower all citizens in our regions. We will apply an equity lens, with a specific focus on racial equity, to the important work that we do, and we will do it with intentionality and transparency…* ***We are committed to understanding, evaluating and measuring how our policies and actions impact equity in our region****.*[6]

NOACA has implemented this commitment to equity throughout *eNEO2050*, where the "e" in the title of the document represents equity, and each of the chapter titles begins with "e" to remind the reader of how equity is central to all the discussions. NOACA also engaged public stakeholders with the goal of equity in mind, despite the difficulty wrought by the pandemic and accompanying lockdowns and shutdowns that hampered in-person engagement efforts. NOACA incorporated a comprehensive review of how inequity of past economic development, housing, land use, and environmental approaches created the current landscape, and identified opportunities to improve access to opportunity and mitigate disproportionately harmful impacts (See *eNEO2050* resource document). Finally, NOACA did not propose a simple, single future transportation plan for public consideration, but rather explored, modeled, and thoroughly vetted four comprehensive and distinct scenarios of how the region might invest in its transportation system differently. NOACA built each scenario around the critical theme of workforce mobility and access, particularly for low-income and minority communities, and both defined and calculated hundreds of performance measures to clarify the myriad of impacts of each scenario on what matters most.

Plans and Planning Products that Inform this Conversation

Going Forward Together

The NOACA regional strategic plan is an organizational development document. A strategic plan captures and documents the ultimate reasons that an agency does what it does, based on input from those who lead, operate, and are served by the organization. *Going Forward, Together* defines the agency's vision and goals, and identifies strategies for how to allocate resources—money, staffing, and Board and stakeholder activities—in pursuit of NOACA's vision and goals.

A vision statement received approval from the Board at its January 2014 meeting: *NOACA will STRENGTHEN regional cohesion, PRESERVE existing infrastructure, and BUILD a sustainable multimodal transportation system to SUPPORT economic development and ENHANCE quality of life in Northeast Ohio.*

The vision statement embodies the five goals of the strategic plan. Objectives were developed to support the goals based on input from the Board activities, visioning workshop, and external and internal scans. Final approval of the strategic plan was in January 2015.

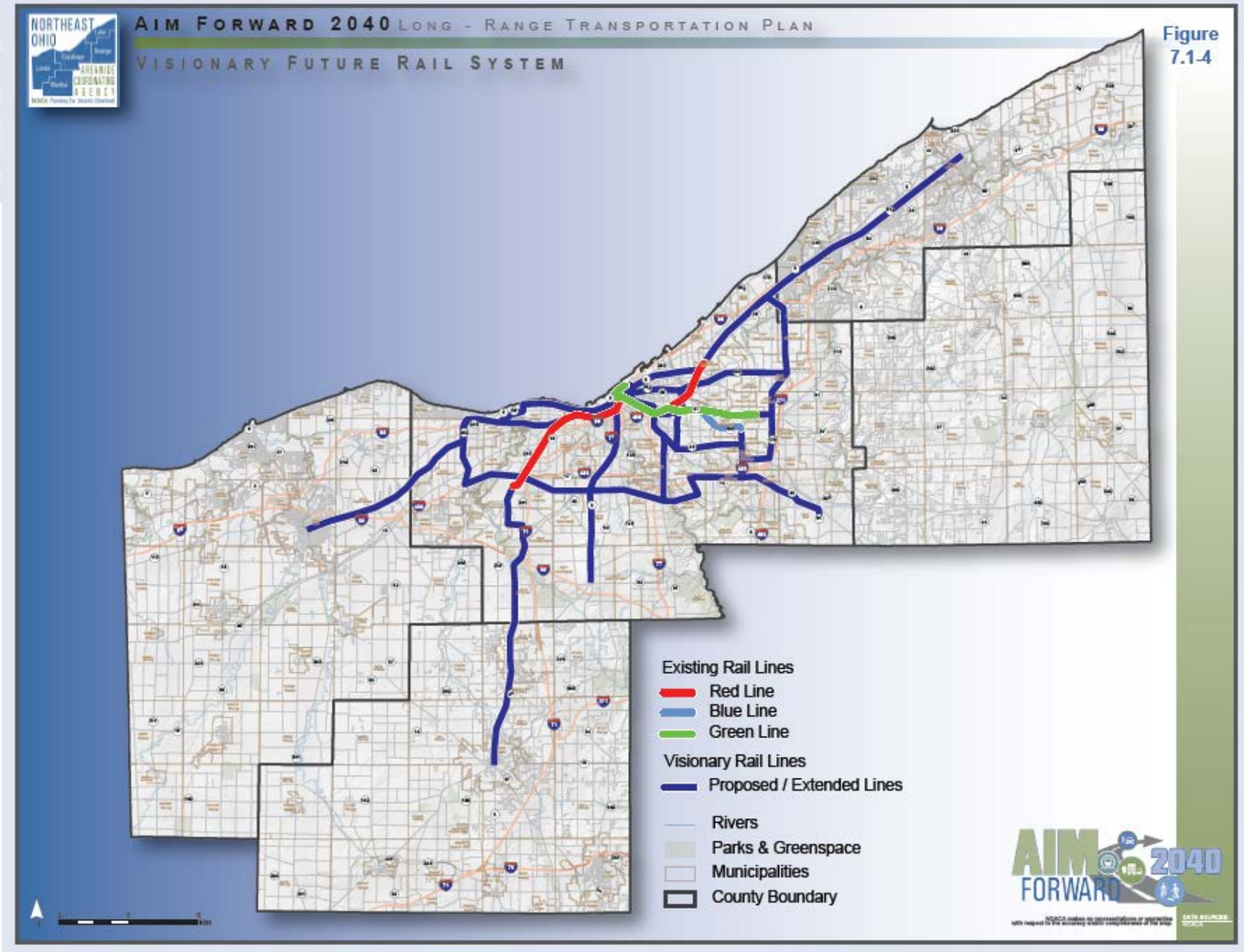
Vibrant NEO 2040

Vibrant NEO 2040 is a regional visioning framework for 12 counties in Northeast Ohio (including the five counties of NOACA): Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Mahoning, Medina, Portage, Stark, Summit, Trumbull, and Wayne. Its development began in 2010 and concluded in 2014. In 2009, the Northeast Ohio Sustainable Communities Consortium (NEOSCC), a small nonprofit established precisely for this effort, received a grant from the Partnership for Sustainable Communities, a joint effort of three cabinets of the federal government: the Environmental Protection Agency (US EPA), Housing and Urban Development (HUD), and Department of Transportation (US DOT). NEOSCC, a collaboration of 33 board member organizations, provided financial, facilities, and services support, with NOACA as lead agent. Elected officials and stakeholders throughout these communities recognized the unifying issues of housing, transportation, environment, and economy. Many Northeast Ohio communities share assets and challenges, as well as future success or failure.

Vibrant NEO 2040 developed a robust analysis of the financial implications to communities of four potential future scenarios. The scenarios differed based on assumptions about future population and employment growth as well as policies that impact the location of new growth and abandonment. The plan first drew attention to the devastating financial impacts for local budget of continued investment in transportation infrastructure expansion in a mature region. The plan did not preclude future development and infrastructure expansion – in fact, those are the assumptions in two of the four scenarios – but rather *Vibrant NEO 2040* drew attention to the potential tax implications of increasing the lane miles of infrastructure without population growth. Each new mile of infrastructure means one extra mile that needs to be maintained with a stagnant tax base.

In 2015, the American Planning Association awarded NEOSCC and NOACA the Daniel Burnham Award, its highest honor for a comprehensive plan, for *Vibrant NEO 2040*.

Figure 1-6. Envisioned Future Rail Lines[7]



Aim Forward 2040

AIM Forward 2040 is NOACA's current long-range plan; it is the framework for the agency to direct investment for all modes of transportation in Northeast Ohio. These modes include motor vehicles, bridges, public transportation (buses, bus rapid transit, light rail and heavy rail), bicycles, walking, and the movement of freight. The plan offers a vision of the region's transportation system through the year 2040 and identifies $15.8 billion in transportation investments that address accessibility, safety, and mobility for people who live and work in Northeast Ohio.

AIM Forward 2040 makes plans to manage congestion, maintain transportation assets, plan for increased freight movements, increase transportation safety and security, and mitigate environmental impacts. More than 90% of the funds identified in *AIM Forward 2040* will go toward the maintenance of existing infrastructure and investment in transit and livability projects. The plan also highlights visionary infrastructure projects, if the funds and demand justify them as essential for inclusion in NOACA's Transportation Improvement Plan (TIP) (Figure 1-6). Projects contained in *AIM Forward 2040* were included in the scenario analysis of *eNEO2050* and further advanced in the funded scenario.

Table 1-3. Existing Plans Overview

PLAN & COMPLETION YEAR	NOACA Transportation Objectives						Transportation Modes		
	Access	Mobility	Safety	Emissions	Asset Management	Technology Adaption	Motorized	Transit	Bicycle/ Pedestrian
Vibrant NEO 2040 (2014)	✓	✓	✓	✓	✓	✓	✓	✓	✓
NOACA Strategic Plan (2015)	✓	✓	✓	✓	✓		✓	✓	✓
Access Ohio 2045 (2020)	✓	✓	✓	✓	✓	✓	✓	✓	✓
Regional Bicycle Plan (2013) ACTIVATE (2021)	✓	✓	✓	✓					✓
Transportation Asset Management Plan (2016)		✓	✓		✓		✓	✓	✓
Regional TOD Scorecard & Implementation Plan (2016)	✓	✓			✓			✓	✓
Multimodal Regional Freight Plan (2017)	✓		✓	✓	✓	✓	✓		
Water Quality Strategic Plan (2017)				✓	✓				
Air Quality Communication Education, & Outreach Strategy (2019)				✓			✓	✓	✓
Intelligent Transportation Systems (ITS) Strategic Plan (2019)	✓	✓	✓			✓	✓	✓	
MOBILIZE: Accessibility for Independence (2019)	✓	✓	✓		✓	✓	✓	✓	✓
SAVE: NOACA's Plan for Transportation Safety (2019)		✓	✓		✓		✓	✓	✓
Workforce Accessibility & Mobility (2019)	✓	✓			✓	✓	✓	✓	✓
Hyperloop Feasibility Study (2019)		✓	✓	✓			✓	✓	
Clean Water 2020: A 208 Water Quality Plan (2020)				✓	✓	✓			
Regional Strategic Transit Plan (2020)	✓	✓			✓			✓	

Access Ohio 2045 (AO45)

Ohio Department of Transportation's (ODOT) long-range transportation plan, *Access Ohio 2045 (AO45)*, envisions the state "connected by a safe, smart, and collaborative transportation system that moves people and freight efficiently and reliably and supports community visions."[8] The plan explores increasing population and commuter changes, and the infrastructure, bridges, sidewalks, and roads needed to accommodate the expected population and economic growth, as well as the innovation of new technology and efficient mobility options.

AO45 aims to expand transportation data sharing; address security risks to transportation assets, coordinate planning at both system and corridor levels, support more multimodal options, leverage emerging technologies, and advance sustainable transportation funding options. Furthermore, the plan emphasizes the importance of cooperation between ODOT and community stakeholders to accomplish these initiatives.

Relationship to Objectives

Table 1-3 shows how all these plans relate to the objectives set out in *eNEO2050.*

Existing NOACA Plans

NOACA and Northeast Ohio are aligned with the regional and state plans described in the previous section, as well as several other recent NOACA planning efforts. These other efforts target specific topics and go into much greater detail than the broader regional plans. Yet, the more targeted plans still reflect NOACA's regional strategic plan and undergird its long-range plan. The following plans were developed with broad support from NOACA's Board and public stakeholders:

- NOACA Strategic Plan (2015)
- Regional Bicycle Plan (2013) and ACTIVATE (2021)
- Transportation Asset Management Plan (TAMP) (2016)
- Regional Transit-Oriented Development (TOD) Scorecard and Implementation Plan (2016)
- Multimodal Regional Freight Plan (2017)
- Water Quality Strategic Plan (2017)
- Air Quality Public Education and Outreach Strategy & Communication Plan (2019)
- Intelligent Transportation Systems (ITS) Strategic Plan (2019)
- MOBILIZE: Accessibility for Independence, NOACA's Coordinated Public Transit-Human Services Transportation Plan for Northeast Ohio (2019)
- SAVE: NOACA's Plan for Transportation Safety (2019)
- Workforce Accessibility and Mobility (2019)
- Hyperloop Feasibility Study (2019)
- Clean Water 2020: A 208 Water Quality Plan (2020)
- Regional Strategic Transit Plan (2020)

ENDNOTES

1 United States Environmental Protection Agency (US EPA), Environmental Justice, 2020, https://www.epa.gov/environmentaljustice (accessed January 15, 2021).

2 Ohio Department of Transportation (ODOT), Access Ohio 2045: Ohio's Transportation Plan, 2020, https://www.transportation.ohio.gov/wps/portal/gov/odot/programs/access-ohio-2045/resources/ao45-plan (accessed April 12, 2021).

3 Northeast Ohio Sustainable Communities Consortium (NEOSCC) and Sasaki, Vibrant NEO 2040 (Northeast Ohio Sustainable Communities Consortium, Feb. 2014); https://vibrantneo.org/vibrantneo-2040/ (accessed April 12, 2021).

4 Northeast Ohio Areawide Coordinating Agency (NOACA), Going Forward, Together (Cleveland: Northeast Ohio Areawide Coordinating Agency, 2015); https://www.noaca.org/regional-planning/major-planning-documents/regional-strategic-plan (accessed April 12, 2021).

5 Northeast Ohio Areawide Coordinating Agency (NOACA), Aim Forward 2040 (Cleveland, Northeast Ohio Areawide Coordinating Agency, June 2017); https://www.noaca.org/regional-planning/major-planning-documents/aim-forward-2040 (accessed April 12, 2021).

6 Northeast Ohio Areawide Coordinating Agency (NOACA), NOACA Board Resolution 2020-029: Commitment to Racial Equity in Planning, June 12, 2020; https://www.noaca.org/home/showpublisheddocument?id=25175 ((accessed April 12, 2021).

7 Northeast Ohio Areawide Coordinating Agency (NOACA), Aim Forward 2040 (Cleveland, Northeast Ohio Areawide Coordinating Agency, June 2017); https://www.noaca.org/regional-planning/major-planning-documents/aim-forward-2040 (accessed April 12, 2021).

8 Ohio Department of Transportation (ODOT), Access Ohio 2045: Ohio's Transportation Plan, 2020, https://www.transportation.ohio.gov/wps/portal/gov/odot/programs/access-ohio-2045/resources/ao45-plan (accessed April 12, 2021).

Photo by mauro mora on Unsplash

ENGAGING THE COMMUNITY

In this Chapter

This is “our” plan. Another element of equity is to ensure that during the public engagement process, all people, especially vulnerable populations are involved to shape decisions. NOACA developed the *eNEO2050* plan as a collaborative effort with many stakeholders and the general public. It is the culmination of exploration, education, imagination, quantification, evaluation and creation, with an emphasis on consensus. Throughout the process, NOACA provided opportunities for participation in developing the *eNEO2050* vision. The process was designed to hear, value and consider all voices across the region from the rural to the urbanized areas. Due to COVID in-person restrictions imposed by the state, NOACA meetings were held virtually, but still targeted internal and external stakeholders to ensure professional perspectives, discussions, and feedback on *eNEO2050* plan development. NOACA invited several associated groups and organizations to bring their constituents, clients, and broader audiences to the events as a way to ensure large public participation. Furthermore, NOACA specifically targeted historically underrepresented communities to make sure that every voice across the region counts.

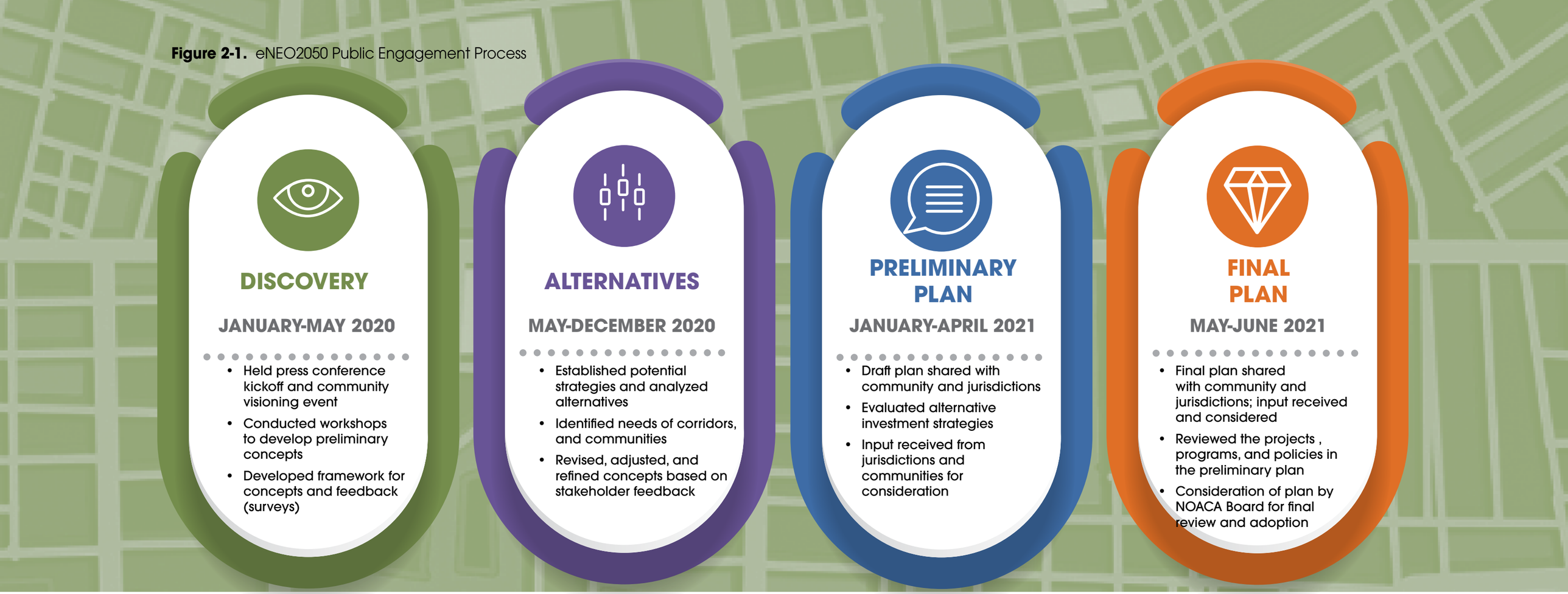
NOACA convened stakeholders and the public for discussions around large topics of regional significance as well as those of community based local interest; and, employed a wide spectrum of appropriate approaches for specific audiences. Activities reflected the broader goals, strategies, and tactics of NOACA’s *Public Engagement Plan* to provide open opportunities to learn about the project and elicit stakeholders’ and communities’ ideas and perspectives on regional issues, projects, and initiatives.

NOACA staff posted these opportunities for engagement online and communicated widely to clarify how and when the public could participate. As part of the process, NOACA utilized existing foundational planning documents (including the current long-range plan, *Aim Forward 2040*) to reflect lessons learned through those engagement strategies.

Specifically, throughout the development of *eNEO2050*, NOACA:

1. Established an *eNEO2050* website
2. Used social media and traditional outreach formats
3. Offered listening sessions, forums, and workshops
4. Created videos, podcasts and webinars
5. Designed and deployed interactive techniques and tools
6. Commissioned a statistically significant Regional Survey
7. Provided traditional participation by NOACA Board, Committees, Subcommittees and Councils.

Figure 2-1. eNEO2050 Public Engagement Process



Public Participation Process and Strategies

Throughout the public engagement planning efforts, staff worked to provide opportunities for stakeholders and the general public to participate in *eNEO2050* development and to ensure all voices were heard, valued, and considered. NOACA built on its long history of engagement activities to strengthen its comprehensive planning efforts (see Appendix 4-1 in the *eNEO2050 Resource Document*).

NOACA engaged stakeholders and the general public through four phases leading to an equitable transportation system: 1) identifying needs; 2) establishing potential strategies; 3) evaluating alternative investment scenarios, and 4) reviewing the projects, programs and policies included in the preliminary plan (Figure 2-1). During each phase, NOACA:

- Provided stakeholders and the public with multiple opportunities where NOACA could capture feedback for the plan's development;
- Created activities and approaches that align with the agency's mission and vision to communicate a clear, coordinated, and comprehensive public message; and
- Updated the public through various avenues internally with the NOACA Board, Committees, Councils, and stakeholders, while NOACA identified and contacted new, previously hard-to-reach communities and residents in environmental justice areas.

Among the new elements in *eNEO2050*, NOACA developed a more inclusive approach to transit and mobility, with equity as the focal point. NOACA used an equity lens to acknowledge the foundation of transit as a means to access housing, jobs, and economic opportunities, which are necessary components to improve the quality of life for all people.

Partners in local and state government, advocacy groups, and stakeholders each play a key role in helping to shape the work of the agency. NOACA targeted select groups at each phase of engagement, especially to help plan and shape messages and participation methods.

Specific constituencies included:–

- Historically underrepresented populations within regional planning efforts (communities of color, cultural and ethnic communities, the disability community)
- Regional residents with diverse mobility behaviors, including drivers, cyclists, pedestrians, and transit users
- Elected officials and staff of counties, cities, the state, and other relevant public agencies
- Logistics providers (including ports, shippers, freight transportation service providers)
- Business interests (employers and employees; central business district representatives within each service area)
- Organizations that represent public transportation employees, private transportation, and commuting programs (carpooling, vanpooling, parking and transit benefit programs, telework, etc.)
- Agencies that represent rural parts of the region, as well as the urban core centers, along with expertise in areas such as land use and multimodal solutions

Figure 2-2. Landing Page for eNEO2050

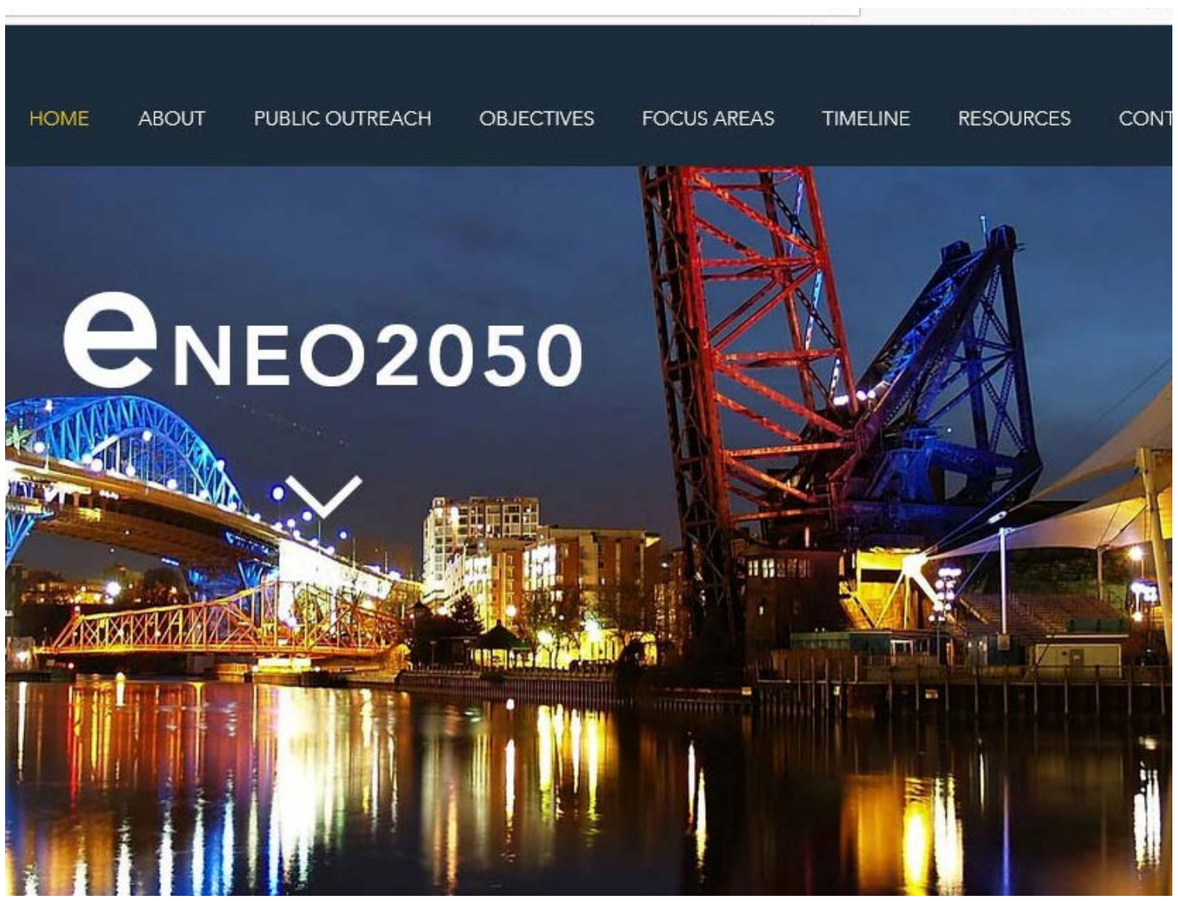


Figure 2-3. Virtual Public Meeting and Campaign Flyer

Figure 2-4. Public Engagement Strategies

1 **36** events

2 **5,802** site visits

3 **17,100** flyers

4 **20** sessions

5 **2,464** participants

6 **96** meetings

7 **599,750** impressions

8 **136,168** impressions

NOACA staff consulted with stakeholders and the public throughout the entire development of *eNEO2050*). From the discovery phase's needs assessment, public awareness campaigns, CrowdGauge Tool, and Regional Survey to the analysis of alternative transportation scenarios and performance measures, NOACA's long-range plan reflects public input during each phase of planning. Figure 2-4 gives an overview of the outreach methods that were used by NOACA. Examples of outreach material are provided in Figure 2-2, Figure 2-3, and Figure 2-7. For more details, see Figure 2-5 which shows NOACA's public engagement by the numbers. When in-person meetings were not available due to the COVID pandemic, NOACA held virtual meetings.

State and federal law requires formal public comment processes for specific short-term and long-term planning efforts. The public comment period for *eNEO2050* formally involves people in the long-range planning process. These formal comment processes occurred throughout each segment of *eNEO2050* development, in an effort and opportunity to lend voice and feedback to decision making. The final *eNEO2050* public comment period focused on the draft document for 30 days, beginning May 3, to give the public one last opportunity to review and comment on the recommended plan and the entire *eNEO2050* development process before finalization for NOACA Board review and approval at its June 11, 2021, meeting.

Figure 2-5. *eNEO2050* Public Engagement by the Numbers

DISCOVERY

JANUARY-MAY 2020

- **Kick-off** press conference at the Cleveland History Museum on January 28, 2020
- **26** presentations to NOACA Board of Directors, committees, subcommittees, advisory councils, general public, and stakeholders. Included topics like the strategic regional transit plan; Hyperloop; and sustainable, innovative technology
- **5** media releases & **10** media alerts to **77** print media, radio, and television news outlets
- **22** social media posts
- **4** newsletters to a list of **1,128** base subscribers (average **67%** open rate), **4,800** residents, and **1,100** others.
- Requested **200** media outlets, churches, libraries, public agencies, and others to post materials via website and electronic calendars of events
- Over **4,000** flyers and posters, and **3,000** postcards circulated through the region
- **4** Lunch & Learns

ALTERNATIVES

MAY-DECEMBER 2020

- **52** virtual meetings, roundtables, and CrowdGauge events in each county
- NOACA transportation day
- **3** media releases and **7** media alerts to **77** print media, radio and television news outlets; **6** external newsletters
- Delivered and handed out **3,100** public awareness flyers
- **7** Social Media Campaigns
- **12,088** total impressions and **138** engagements on Facebook
- **4,176** total site sessions from **2,592** unique visitors (an average of **324** unique visitors per month)
- **40,824** total impressions and **601** engagements on Twitter
- **4** Lunch and Learns and **5** Podcasts
- **106,128** impressions and **1,509** clicks using paid ads to reach Environmental Justice areas
- **2,464** survey responses

PRELIMINARY PLAN

JANUARY-APRIL 2021

- **12** presentations to NOACA Board, Committee, and Advisory Councils
- Press releases to **77** news outlets, which included instructions on how stakeholders could provide input
- **6,156** direct email and newsletter announcements; electronic material to reach vast audiences; website alerts; social media
- More than **185,000** impressions combined from Facebook, LinkedIn, and Twitter, along with an increase of **421** frequent monthly website users between January 1 and March 30, 2021
- **1,100** residents through project email lists
- **3** Lunch & Learns
- **1** Podcast

FINAL PLAN

MAY-JUNE 2021

- **1** public meeting to release the final plan on May 3, 2021, and announced at the public meeting on April 5, 2021. NOACA used a live YouTube feed to ensure more residents could view the meeting. For those without technology resources, NOACA made a printed summary and audio available for post-meeting consumption.
- **6** NOACA committee meetings
- **2** Lunch and Learns and **1** podcast
- Delivered and handed out **3,000** public awareness flyers, including **56** libraries in NOACA's 5 counties (Cuyahoga: **27**, Geauga: **6**, Lake: **12**, Lorain: **5**, Medina: **6**)
- Press release sent to **77** print media, radio and television news outlets
- Direct email and newsletter to **6,150** people on email lists, with information on the eNEO2050 public meeting

Figure 2-6. Public Posting of Future Transportation Scenarios and Performance Measures

NORTHEAST OHIO — Lake, Geauga, Cuyahoga, Lorain, Medina — AREAWIDE COORDINATING AGENCY — NOACA: Planning For Greater Cleveland

What is the FUTURE of NORTHEAST OHIO?

eNEO2050

Northeast Ohio is at a turning point and your input will make a valuable difference. The region is positioned to realize a new future due to its robust health-care industry, plentiful natural resources, affordable cost of living, and abundant cultural and recreational opportunities. To maximize the region's potential, the Northeast Ohio Areawide Coordinating Agency (NOACA) needs your help to better inform its next long-range plan, *eNEO2050: An Equitable Future for Northeast Ohio.*

NOACA has mapped out four possible scenarios for future transportation investment that focus particularly on workforce accessibility and equity: **MAINTAIN, CAR, TRANSIT** and **TOTAL.** The following summaries highlight the futures realized under each scenario and how they impact the region and its people. A simple matrix outlines some key differences and another matrix highlights key performance measures to help readers compare scenarios based on each scenario's impacts. NOACA staff also introduce the concept of "Environmental Justice Area," which spotlights those areas of Northeast Ohio with higher concentrations of minority populations, those who live below the poverty line, or both.

To provide input, visit www.eneo2050.com/the-future

eNEO2050 TRANSPORTATION SCENARIOS

Scenario 1: Maintaining Infrastructure System (MAINTAIN)

In this scenario, 100% of transportation funding goes toward maintenance of what is already built. The existing roads, highways, bridges and public transportation systems are the priority; there is no funding for expansion. The focus is on good repair and service. This scenario anticipates that employment and population will not change significantly from current numbers.

Scenario 2: Captivating Auto Region (CAR)

In this scenario, the funding priority is to enhance the vehicular network of the region: roads, highways and bridges (not public transportation). The goal is to expand capacity by adding new, viable highway interchanges; reinvigorating the arterial network; optimizing traffic signal timing; reducing average car commute times to major regional job hubs and regulating the flow of traffic that enters freeways (ramp metering). This scenario anticipates that employment and population will not change significantly from current numbers.

Scenario 3: TRANSportation System with Improved Transit (TRANSIT)

This scenario is nearly the flipside of CAR; it's all about expansion of public transportation service in Northeast Ohio. This scenario adds autonomous shuttle and pod routes from transit hubs to major job hubs. This scenario includes new pedestrian and bike connections from major transit hubs to major job hubs. In addition to rail expansion, this scenario would include expanded bus and bus rapid transit routes and more frequent service to Environmental Justice Areas. This scenario anticipates slight employment and population growth as outlined in the scenario matrix.

Scenario 4: Transportation with Optimal Technology and Access for All (TOTAL)

The TOTAL scenario essentially includes all anticipated projects in the CAR and TRANSIT scenarios, except for the addition of new highway interchanges. Other projects in this scenario include designated smart freeway and arterial lanes for autonomous cars and trucks, installation of electric vehicle (EV) charging ports, and construction of the hyperloop station. This scenario anticipates more substantial employment and population growth as outlined in the scenario matrix.

Given the information about each scenario, consider a set of performance measures intended to help differentiate among the future scenarios. These performance measures and the outputs for each scenario are shown in the following matrix.

1 The baseline represents current conditions (2020 conditions). The outputs reflect how the performance measure will change from the baseline to the target year (2050) under each of the four scenarios.

Sign/ Color	Green	Red
+	Increase has positive impact	Increase has negative impact
-	Decrease has positive impact	Decrease has negative impact

2 The "-" and "+" signs shown as outputs for each performance measure under each scenario indicate the direction of change. A "-" sign indicates a decrease from the baseline and a "+" sign indicates an increase from the baseline. There are two sizes for each sign, they represent the magnitude of change (smaller signs indicate slight change; larger signs indicate more substantial change).

3 The colors of the signs and numbers are also important. Red indicates a negative impact on the region, while green indicates a positive impact. While many people associate "-" signs with a negative impact and "+" signs with a positive impact, that is not always the case. It is possible to have a red "+" sign, meaning the value of that performance measure will increase under a scenario, but that increase will have a negative impact on the region.

4 Where shown, the numbers displayed quantify the outputs for some performances measures, but not all. Some performance measures are qualitative and there may be words or nothing at all below the signs to help the reader understand how a scenario will change the output for a particular performance measure.

Please review the scenarios, performance measures and outputs and provide feedback on what you like or do not like: **www.eNEO2050.com/ the-future**

eNEO2050 Performance Measures

Performance Measure	2020 Baseline	MAINTAIN	CAR	TRANSIT	TOTAL
Regional Population	2,026,866	- (42,806)	- (42,806)	+ 100,406	+ 200,892
Regional Employment	1,421,195	+ 55,850	+ 55,850	+ 66,254	+ 132,950
% AM Work Commutes Not Driving Alone	16%	SAME	SAME	+ 4%	+ 6%
Population within 15-minute walk to bus stop or rail station	1,376,439	- (95,315)	- (95,315)	+ 106,642	+ 189,021
Environmental Justice Area Population within 15-minute walk to bus stop or rail station	792,649	- (86,979)	- (86,979)	+ 49,992	+ 98,258
Jobs within 15-minute walk to bus stop or rail station	1,113,631	+ 17,610	+ 17,610	+ 96,540	+ 163,003
Population within 15-minute walk to rail station only	182,495	- (15,828)	- (15,828)	+ 219,679	+ 243,620
Population within 5-mile drive to nearest highway interchange	1,859,900	- (49,026)	- (49,026)	+ 98,266	+ 196,627
Environmental Justice Area Population within 5-mile drive to nearest highway interchange	854,576	- (84,223)	- (82,155)	+ 48,949	+ 98,536
Road and Highway Vehicle Miles Traveled (Car) Per Capita	7,345	+ 601	+ 622	+ 88	- (102)
Millions of Transit Trips Per Year	40	- (2)	- (2)	+ 42	+ 70
Average AM Commute (Minutes) to All Job Hubs by Car	26.2	- (0.5)	- (0.6)	- (1.5)	+ 1.9
Average AM Commute (Minutes) from Environmental Justice Areas to All Job Hubs by Transit	60.9	- (0.5)	- (0.6)	- (3.0)	- (6.0)

eNEO2050 Performance Measures *(continued)*

Performance Measure	2020 Baseline	MAINTAIN	CAR	TRANSIT	TOTAL
Annual Vehicle Congestion Cost in 2050$ (Per Capita)	739	+ 82	+ 68	+ 115	+ 65
Annual Emissions Cost in 2050$ (Per Capita)	551	+ 49	+ 41	+ 53	+ 33
Total Workers within 30-minute Car Commute	748,463	- (28,902)	- (21,956)	+ 17,850	+ 37,601
Total Workers within 30-minute Transit Commute	40,614	- (368)	- (243)	+ 16,305	+ 36,301
Total Jobs within 30-minute Transit Commute	220,594	+ 15,710	+ 15,743	+ 165,937	+ 247,820
Bike Lanes, Sidewalks and Bike/Walk Paths	Current bike infrastructure (lane miles of shared/separated service) and walk infrastructure (sidewalks, paths, crosswalks) in major regional job hubs	SAME	SAME	+	+
Road/Highway Money: Spend More to Maintain or Spend More to Expand New	Current % region's transportation and infrastructure funding for the TIP is dedicated to maintain and preserve existing infrastructure	+ Maintain	+ Expand	- Both	+ Both
Transit Money: Spend More to Maintain or Spend More to Expand New	Current % region's transportation and infrastructure funding for the TIP is dedicated to maintain and preserve existing infrastructure	+ Maintain	- Both	+ Expand	+ Both
More investment in Environmental Justice Areas?	Current investment within EJ areas	SAME	-	+	+
Maintain, Expand and Attract NEO Businesses	Current roster of businesses and employment in Northeast Ohio	+ Maintain	+ Roads	+ Transit	+ Both
Ecologically Sensitive and Agriculturally Productive Lands	Current acreage of ecologically sensitive and agriculturally productive lands in Northeast Ohio	-	-	SAME	-
Future Population and Employment in Communities with Peak Population in 1970	Current estimate of total population and employment for all communities whose population peak occurred on or before 1970 (another option is to consider median age of single-family homes (1970 or earlier))	-	-	+	+
Cleaned Brownfields (formerly developed, polluted sites)	Current number and acreage of brownfields	-	-	+	-
Attain National Air Quality Standards	Moderate Nonattainment for Ground-Level Ozone	-	-	-	-
Greenhouse Gas Emissions	Current greenhouse gas emissions for region	+	+	+	+
Flood Threat to Major Regional Job Hubs	Current % major job hub areas within or proximal to designated floodplains or flood hazard zones	+	+	SAME	+

NOACA Transportation Day

In July 2020, NOACA hosted a Transportation Day event, which included key stakeholders such as county commissioners, mayors, city managers, township trustees, and other public officials within NOACA's five counties. The theme was equity and what equity means in their respective areas in association with *eNEO2050*. NOACA hosted a panel discussion to hear community expert perspectives about equitable transportation access in the context of comprehensive planning. The panels discussed how transportation impacted and was impacted by the following planning disciplines:

- Economic development
- Land use
- Environment
- Housing

The CrowdGauge tool was also part of the discussion; questions were polled through the use of the interactive tool with real-time conversion results. The event was fully documented as a matter of record, including comments and the results of the CrowdGauge tool.

Lunch and Learns

NOACA directed further discussions and dialogues through a monthly Lunch and Learn virtual dialogue series to offer public engagement, conversations, and input on *eNEO2050*. NOACA hosted the series every third Thursday of each month from July to December 2020. The six segments were:

- "Planning for Age-Friendly Communities" (July 2020)
- "Transit-Oriented Development" (August 2020)
- "The Importance of Transportation for Ohio's Economy and Future Growth" - NOACA Annual Meeting (September 2020)
- "Equitable Public Engagement" (October 2020)
- "Attitudes and Progress toward Regionalism" (December 2020)
- "Cross-Talk: "Engineer-Speak and Planner-Speak for Better Understanding and Collaboration" (January 2021)
- NOACA Commuter Choice Awards (February 2021)
- Racial Equity in Planning (March 2021)

A total of 546 guests attended the Lunch and Learns during this phase.

Podcasts

NOACA staff produced podcasts on the following topics:

- *eNEO2050: An Equitable Future for Northeast Ohio* (July)
- Racial Equity in Planning: Past, Present, Future – Creating a Region of Opportunities Part 1 (August)
- Racial Equity in Planning: Past, Present, Future – Creating a Region of Opportunities Part 2 (September)
- Building Communities for Safer Mobility (November)
- The Air We Breathe (December)

Figure 2-7. Postcards of Engagement Opportunity

Figure 2-8. Postcards of Engagement Opportunity

Public Engagement Findings – Imagining an Equitable Northeast Ohio

As previously stated, NOACA developed a Regional Survey to engage the public, with the objective of ensuring adequate sample size to allow for statistically significant analysis and to ensure the sample was both geographically and demographically representative of the diverse adult population of Northeast Ohio.

Regional Survey Statistical Validity

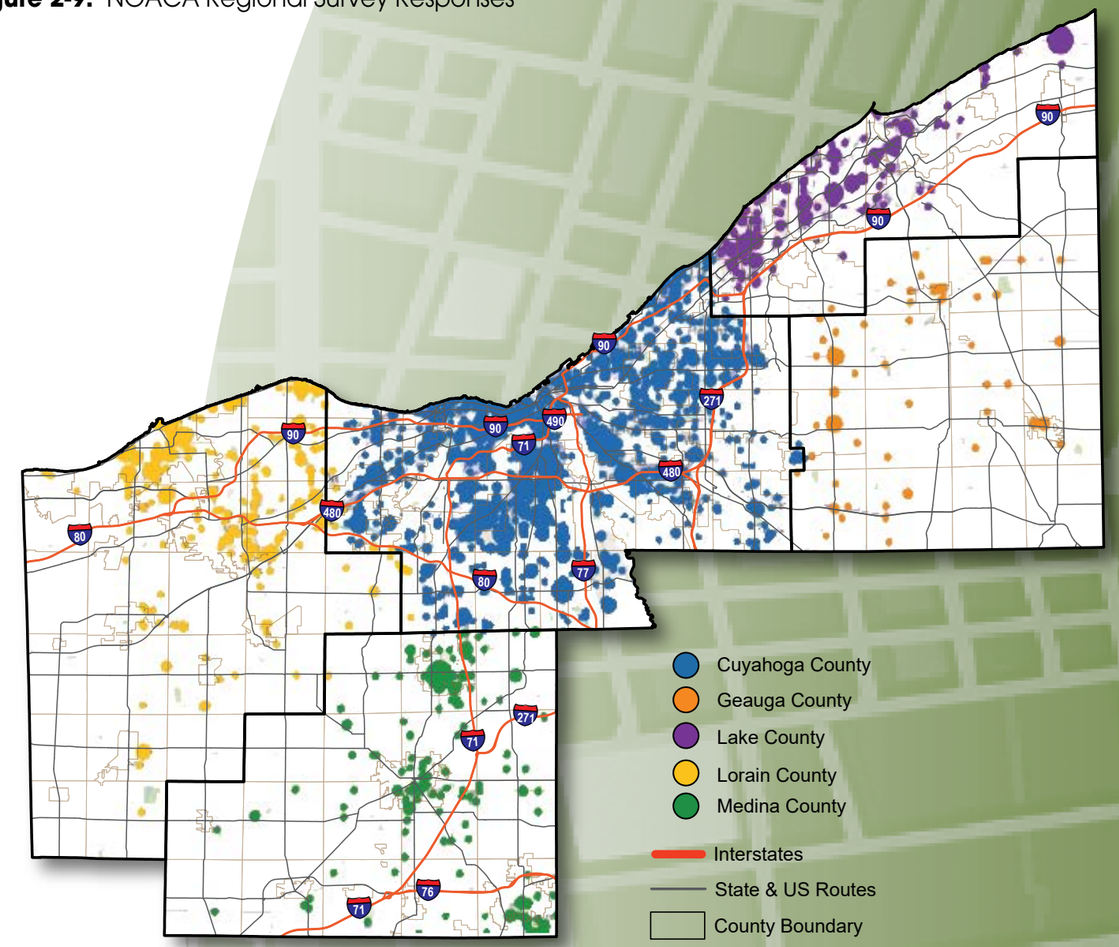
NOACA determined a sample size of at least 2,400 would ensure overall results at a "medium" confidence level of 95%, within a ±2% "low-medium" margin of error. A total of 2,464 respondents completed the survey. A high number of respondents (2,534) continued to post answers past Q8 (jobs and economic growth); 2,416 continued to post until Q18 (increase riding public transportation); and 2,249 posted all demographic answers through the final question about race (optional).NOACA's Regional Survey completion rate (the percentage of qualified respondents who answered all questions) was 77%. Many questions prefaced that respondents should answer to reflect the time before or after the COVID-19 pandemic (NOTE: During data collection, the U.S. economy went from lockdown to reopening). Data collection began June 26 and mostly concluded in four weeks (by July 24). The last week of data collection focused exclusively on black respondents and, later, representative quota compliance in Lorain County.

Figure 2-9 and Table 2-1 illustrate the distribution of the sample across NOACA's geography. Appendix 4-3 provides a comprehensive report of the survey results. More details on the statistical validity of the survey can be found in Chapter 4 in the *eNEO2050 Resource Document*.

Environmental Justice Areas

The data file was also divided into respondents from Environmental Justice (EJ) and non-EJ areas. Table 2-2 illustrates the intersection between EJ/non-EJ areas by geographic and demographic variables. Please see Appendix 4-6 in the *eNEO2050 Resource Document* for a comprehensive breakdown of Regional Survey results by Environmental Justice area status.

Figure 2-9. NOACA Regional Survey Responses



Note: Larger dots indicate higher numbers of responses

Table 2-1. NOACA Regional Survey Results: Distribution of Respondents

	NOACA SURVEY RESPONSES (#)	NOACA SURVEY RESPONSES (%)	AMERICAN COMMUNITY SURVEY POPULATION > 18
City of Cleveland	446	18	19
Cuyahoga County	1,087	44	42
Geauga County	91	4	4
Lake County	271	11	11
Lorain County	362	15	15
Medina County	207	8	9
Total	**2,464**	**100**	**100**

Table 2-2. NOACA Regional Survey Results: Responses by Race

	NOACA REGION	ENVIRONMENTAL JUSTICE AREAS	NON-ENVIRONMENTAL JUSTICE AREAS
White	78.68%	66.58%	89.93%
African American or Black	14.80%	25.45%	4.86%
Asian	2.93%	3.08%	2.82%
American Indian and Alaska Native	1.14%	1.45%	0.85%
Other(s)	2.45%	3.44%	1.54%
Total	**100%**	**100%**	**100%**

Analysis and Reports

A series of reports that focused on the overall results of the survey, as well as specific elements, were produced. While each of these reports is too lengthy to include in *eNEO2050* (see Appendices 4-2 through 4-7), data and analysis from these reports helped inform the content included here. This section provides and discusses some of the overall results of the Regional Survey.

One of the most poignant question posed to respondents was Question 12:

> *Please indicate how much of your personal income you would be willing to invest, each month, for the following concepts in the future.*

Respondents then reviewed items pertaining to concepts (future transportation projects, environmental protection, existing road maintenance, etc.) and selected from an array of dollar amounts that reflected the monthly outlay they would be willing to pay personally in support of each concept or project: $(0, 1, 5, 10, 25, 50, 100). Table 2-3 and Table 2-4 illustrate the breakdown of respondents' willingness to pay.

The order of priorities in each table indicates an overall pattern. Repair and maintenance of existing roads received the highest average monthly allocation ($14.40), followed generally by a number of environmental protection initiatives, then innovative transportation projects or technologies. The overall takeaway from these tables is that Northeast Ohio residents are willing to pay most for improved and maintained roads, but they also want climate change impact reduction and a clean environment. There is willingness to pay for innovations such as Hyperloop, commuter rail along Interstate 480, and smart crosswalks, but they are comparatively lower priority. It is noteworthy that the lowest priority item (smart crosswalks) still earned a monthly average willingness-to-pay value of $7.24, so all of the listed concepts have value among the respondents.

Table 2-3 illustrates how willingness to pay varies across the geographic location of the respondents. The colors help illustrate this pattern as well. City of Cleveland respondents generally demonstrated the highest willingness to pay, with cleaner drinking water at the top ($21.82 per month). None of the suburban respondents expressed average willingness to pay of even $15 per month for any of the listed concepts. Road repair and maintenance garnered the highest amount of support from respondents in Lake ($14.69), Medina ($13.84) and Geauga ($10.78) counties, as well as suburban Cuyahoga County ($13.70); and the third highest in Lorain County ($11.88). The other significant observation in Table 2-3 is that Geauga County respondents are the least willing to pay for most of these concepts; all monthly averages are below $10 per month except for road repair and maintenance ($10.78). The lowest overall monthly commitment was by Lake County respondents for I-480 commuter rail ($5.03).

Table 2-3. NOACA Regional Survey Results: Willingness to Pay

	CITY OF CLEVELAND	CUYAHOGA COUNTY*	GEAUGA COUNTY	LAKE COUNTY	LORAIN COUNTY	MEDINA COUNTY	NOACA REGION
Road repair and maintenance	$20.37	$13.17	$10.78	$14.69	$11.88	$13.84	$14.40
Reduce climate change impacts	$20.57	$13.11	$9.02	$13.48	$13.05	$11.17	$14.15
Cleaner rivers and lakes	$19.78	$12.63	$9.00	$10.88	$12.84	$12.26	$13.57
Cleaner drinking water	$21.82	$12.12	$7.65	$11.17	$11.79	$12.47	$13.56
Hyperloop from Cleveland to Chicago	$15.38	$12.39	$9.49	$12.39	$12.48	$11.87	$12.78
Cleaner air	$20.47	$11.40	$8.25	$10.38	$11.01	$11.42	$12.73
V2I (Vehicle-to-infrastructure communication)	$15.91	$9.50	$8.59	$10.36	$9.68	$10.48	$10.81
Hyperloop from Cleveland to Pittsburgh	$14.77	$9.82	$6.91	$10.97	$9.43	$11.07	$10.77
Transportation hub	$13.69	$9.39	$9.30	$8.20	$9.19	$11.48	$10.16
Commuter rail I-480 route	$12.87	$7.87	$6.39	$5.03	$6.46	$6.54	$8.07
Brownfield cleanup and redevelop	$13.05	$7.02	$7.01	$5.94	$6.47	$8.72	$8.03
Improve movement of goods	$13.38	$6.61	$8.25	$6.37	$7.26	$6.54	$7.93
Smart crosswalks	$13.50	$5.33	$6.91	$6.33	$6.32	$7.12	$7.24

*Does not include City of Cleveland

Table 2-4. NOACA Regional Survey Results: Willingness to Pay by Environment Justice Areas

	EJ AREA	NON-EJ AREA	NOACA REGION
Road repair and maintenance	$16.06	$12.25	$14.40
Reduce climate change impacts	$15.68	$12.34	$14.15
Cleaner rivers and lakes	$15.49	$11.30	$13.57
Cleaner drinking water	$15.93	$10.88	$13.56
Hyperloop from Cleveland to Chicago	$12.98	$12.29	$12.78
Cleaner air	$14.84	$10.32	$12.73
V2I (Vehicle-to-infrastructure communication)	$11.78	$9.60	$10.81
Hyperloop from Cleveland to Pittsburgh	$11.50	$9.76	$10.77
Transportation hub	$10.97	$9.07	$10.16
Commuter rail I-480 route	$9.49	$6.52	$8.07
Brownfield cleanup and redevelop	$9.50	$6.23	$8.03
Improve movement of goods	$9.52	$6.10	$7.93
Smart crosswalks	$9.01	$5.43	$7.24

KEY ($)
13.50+
11.50-13.49
9.50-11.49
7.50-9.49
<7.50

The pattern in Table 2-4 is fairly clear: respondents inside EJ areas demonstrate a higher willingness to pay than respondents outside EJ Areas. Professed monthly allocations for EJ area respondents are generally higher than the region as a whole, with priority given to road repair and maintenance ($16.06) and environmental protection; the lowest priority is smart crosswalks ($9.01 per month). Among non-EJ area respondents, the three highest priorities are climate change impact reduction, Hyperloop to Chicago, and road repair and maintenance, but all under $12.50 per month. The lowest priority is smart crosswalks, but at a much lower amount ($5.43) per month than respondents in EJ areas.

Figure 2-10. CrowdGauge Steps

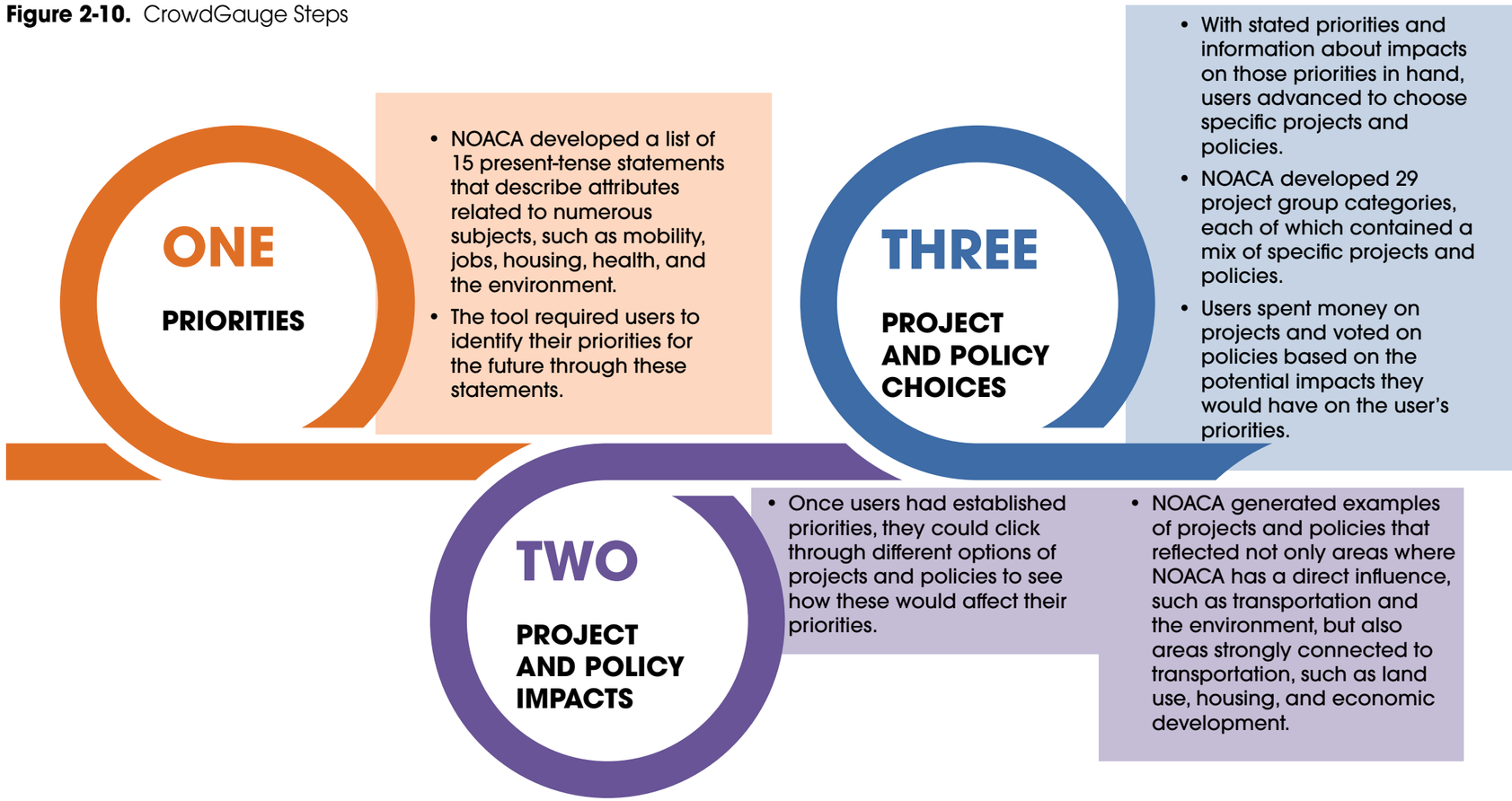
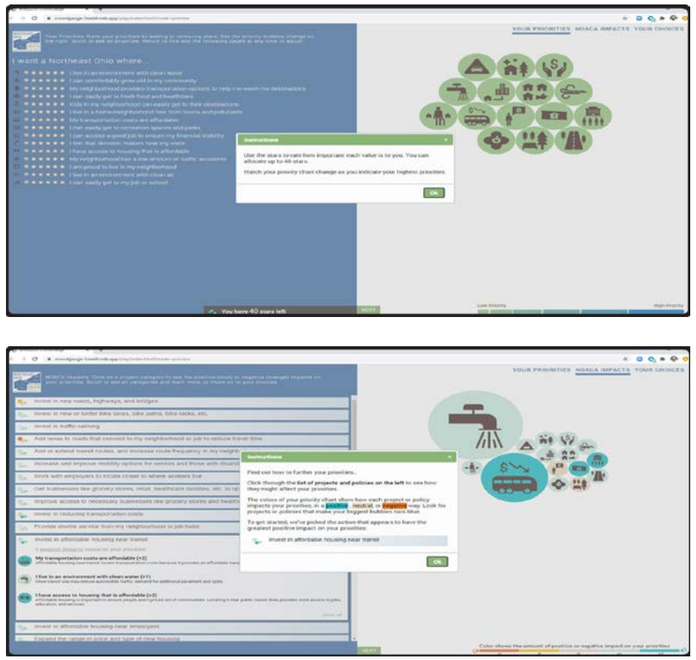


Figure 2-11. CrowdGauge Website



CrowdGauge Tool

NOACA continued to utilize the CrowdGauge software for public engagement, which it previously used in the *Aim Forward 2040* plan. The NOACA LRP versions of the tool were adapted from its use in the *Vibrant NEO 2040* plan, for which the tool was originally deployed. CrowdGauge is described as an open-source framework for creating educational online games. It first asks users to rank a set of priorities, then demonstrates how a series of actions and policies might impact those priorities. The third part of the sequence gives users a limited number of coins, asking them to put that money towards the actions they support most.[1]

NOACA's intent with CrowdGauge was to supplement its Regional Survey with a more focused effort to target input from certain stakeholders and especially from persons within Environmental Justice areas. NOACA sought input from low-income and minority populations that historically have been less engaged or not engaged with the planning process, and hoped the tool would facilitate that engagement. This was particularly important given NOACA's strong emphasis on equity in the new long-range plan and staff desire to articulate a more equitable future for the region. The following paragraphs will describe development of the CrowdGauge tool; an outreach strategy to engage all persons, but particularly those from EJ Areas; regional workshops held to engage the diverse geographic areas of the NOACA region; and analysis of participant responses.

The CrowdGauge tool involved three phases or steps: priorities (or values), project and policy impacts, and project and policy choices as shown in Figure 2-10. And although most of the items related directly to areas that NOACA can influence in its role as a transportation and environmental planning agency, some were intentionally placed outside its jurisdiction to gauge broad priorities in comparison to NOACA's responsibilities. A title page preceded these three steps; it not only provided details about the tool itself and its intended purpose, but also gave participants the opportunity to provide some basic demographic information to help NOACA better understand the characteristics of the sample, including user location.

A total of 506 stakeholders participated in the CrowdGauge exercise. This was much lower than expected, and NOACA attributes the lower participation rate to the COVID-19 pandemic. It was not possible to engage stakeholders in person. Virtual gatherings and remote distribution of information did not realize the same levels of participation as in-person engagement activities. NOACA presented the full results from the CrowdGauge tool exercise at a virtual roundtable for *eNEO2050* on November 6, 2020. Among the 506 respondents, more than half came from Cuyahoga County (270). This was to be expected given that Cuyahoga County represents more than half of the total population in the NOACA region. The second largest group of participants came from Medina County (132). Although this may seem unusual as it is not proportional to population (Medina consists of less than 10% of the population), it can be attributed to interest by the Medina County Economic Development Corporation, which facilitated participation in an individualized county workshop on the CrowdGauge tool during the participation period. The remaining counties had a lower participation rate: Lorain (31), Lake (16) and Geauga (8) counties. There was also a smattering of participants from counties outside the NOACA region.

The projects that received the top five most coins included redevelopment and clean-up of brownfield sites as well as projects that focused on regional transportation, clean water, and the construction of new parks.

A major theme emerged from the priorities rankings: priority to live in a clean environment, with access to recreation and parks, healthy food, and health care. Based on all respondents, the top five (of 15) priorities ranked in the CrowdGauge tool were as follows (each priority averaged a score of at least three stars; total stars assigned per priority are provided in parentheses):

1. I live in an environment with clean water (1,678)
2. I live in an environment with clean air (1,601)
3. I can easily get to fresh food and healthcare (1,568)
4. I live in a home/neighborhood free from toxins and pollutants (1,510)
5. I can easily get to recreation spaces and parks (1,448)

Policies Results

Most of the policies received positive reactions, with one exception. The only policy that received more negative than positive reactions was "only implement new High-Occupancy Vehicle (HOV) lanes as additions to, not in replacement of, existing highway lanes." Three of the top five positive policy responses were in support of NOACA's commitment to greater community leaders' involvement and prioritization of racial equity and diversity

1. Involve more community leaders in NOACA project review and decision making that will impact their communities (255 "for," 14 "against").
2. Support ongoing maintenance and upgrades to wastewater treatment facilities (253 "for," 4 "against").
3. NOACA uses traffic calming solutions to achieve more livable communities (252 "for," 19 "against").
4. NOACA Commitment to Racial Equity in Planning (2020): "NOACA will commit to creating a subcommittee of the Policy Committee and develop a plan to ensure racial equity is embedded in all of our work" (249 "for," 19 "against").
5. Increase racial and ethnic diversity on advisory councils that correspond to specific planning areas (245 "for," 17 "against").

Projects Results

NOACA summarized the top specific projects by the number of coins given and the number of times selected to provide a more comprehensive view that accounts for preference as well as cost.

The projects that received the top five most coins included redevelopment and clean-up of brownfield sites as well as projects that focused on regional transportation, clean water, and the construction of new parks. The top five most coins awarded to specific projects (total coins) aligns very well with the top five project categories in terms of focus on issues of mobility and the environment.

1. Redevelop 200 acres of brownfields (contaminated sites that require environmental clean-up/remediation, such as former factories, gas stations, dry cleaners, and junkyards) to attract new employers with 1,000 jobs (1,260).
2. Add 10 new miles of cross-county intercity commuter rail (1,050).
3. Invest in upgrades to 50 wastewater treatment facilities and grey infrastructure (e.g., tunnels, conduits, sewer pipes) (1,044).
4. Add bike lanes to 10% of local roads; improve sidewalks on 10% of local roads (812).
5. Build new roads and utilities (water, sewer, etc.) to facilitate development of 10,000 new homes on previously undeveloped land (680).

ENDNOTES

1 Sasaki and Associates, CrowdGauge: Gauge the values, priorities and preferences of the crowd, http://crowdgauge.org/ (accessed Feb. 3, 2021).

Photo by djedj from Pixabay

EMBODYING COMPREHENSIVE PLANNING

eNEO2050

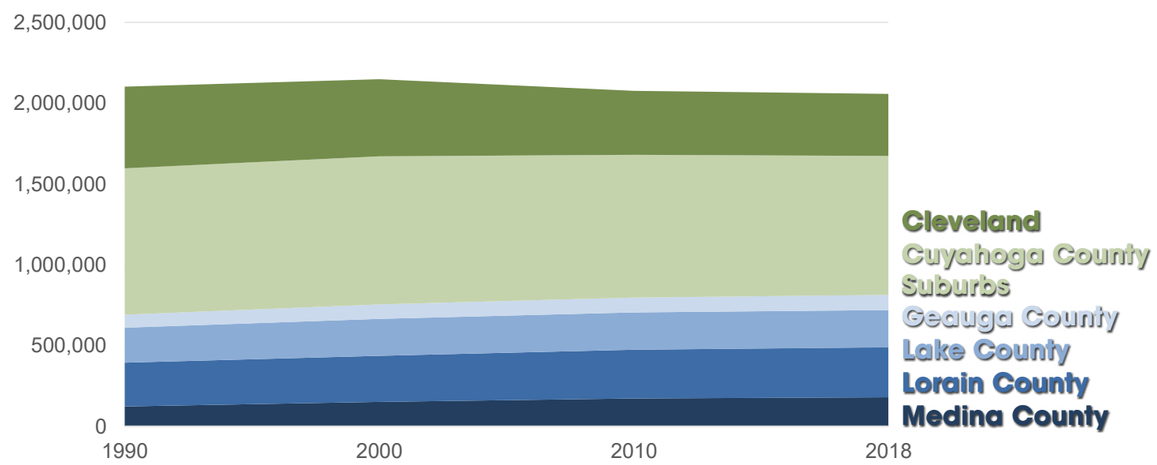
In this Chapter

People primarily travel from an origin to a destination for economic, social, recreational, and other activities, such as jobs, housing, healthcare, education, and shopping. Because travel is usually necessary to reach these destinations, access to them depends greatly on the transportation network. Getting from point A to point B is possible if travelers have safe, timely, and affordable access to the existing transportation infrastructure. Otherwise, trips may not be safe, efficient, or even possible.

For NOACA to ensure people in Northeast Ohio have access to their desired origins and destinations, it needs to understand thoroughly the development patterns in the region, which includes the spatial distribution of the primary destinations and purposes of travel in the region. The agency also needs to understand the social and economic impacts of transportation, not only the direct ones, but also the indirect impacts and consequences. Therefore, this section looks at transportation from the standpoint of comprehensive planning.

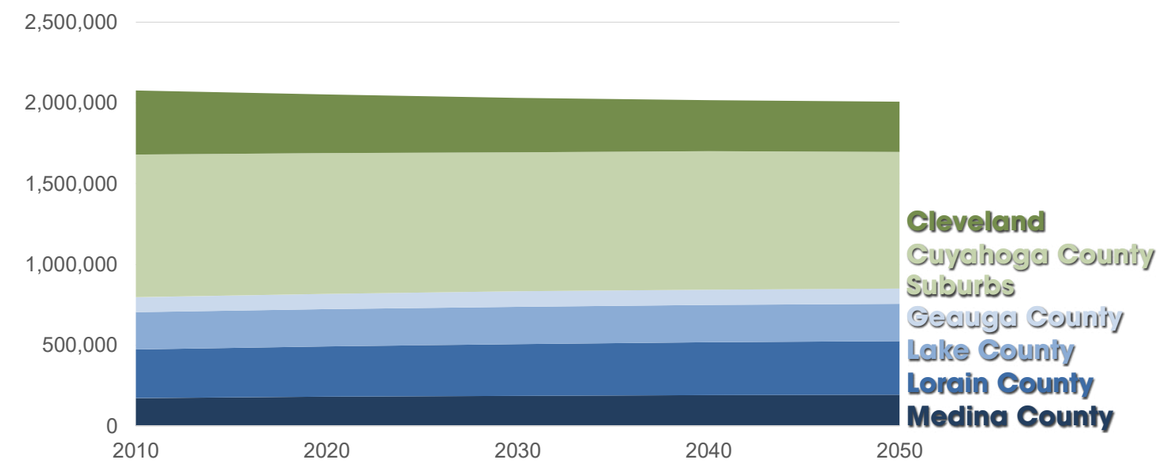
From a planning perspective, one might say, “The best transportation plan is a good land-use plan.” As a regional transportation planning agency, NOACA responds to local land-use decisions by investing in a transportation system that supports the local governments within its jurisdiction. The spatial distribution of population densities and a variety of uses (e.g. residential, commercial, office, industrial, cultural, institutional, or entertainment) influence the demand for transportation.

Figure 3-1. Regional Population, 1990 to 2018[1]



Source: U.S. Census Bureau

Figure 3-2. Projected Regional Population, 2020-2050[2]



Source: NOACA

A Mature Region

The Great Lakes region spurred the industrial revolution in the United States and drove the growth and development of the industrial Midwest. By 1910, the City of Cleveland, as the fifth largest city in the United States, was at the forefront of industry. The City of Cleveland is still a vital part of Northeast Ohio as a region. Both the city and the region are within a day's drive or about an hour's flight to nearly half of the United State's population and 36% of Canada's population. The region is home to 20 Fortune 1000 companies. The City of Cleveland is connected to its region of Northeast Ohio by a robust road and public transit system, which includes interstate highways, arterial roads, buses, rail, express bus service, and more. A system of bike trails help cyclists navigate the region and connects adjacent communities to downtown Cleveland and the north coast of Lake Erie. The region is currently enjoying the benefits of billions of dollars in new development and improvements. Over the next 20 years, the NOACA region will invest $14 billion in transportation improvements alone. These investments will be guided by NOACA's long-range plan, *eNEO2050: A Vision for an Equitable Northeast Ohio.*

NOACA's 46-member board represents more than two million residents who live and commute in the five-county region. These five counties are diverse and range from fully urbanized Cuyahoga County, with 1.2 million residents, to rural Geauga County with 93,000 residents. Besides Cuyahoga County, the region has three other urbanized counties (Lake, Lorain, and Medina), which all have a mix of small- to mid-size urban areas and large rural spaces. In the 2010 Census, all three of these counties were classified as urbanized because their urban populations exceed their rural populations. Overall, the two million residents in the five-county region travel between destinations in 61 cities, 45 villages, and 58 townships within an area that covers 2,000 square miles.

A factor in transportation investment decisions is the size of the population, because federal and state dollars are allocated to metropolitan planning organizations (such as NOACA), or its member communities, based on the regional population in the urbanized area. NOACA's regional population has experienced a slight decline in the past three decades (see Figure 3-1). Overall, the regional population has hovered at just over two million. Between 1990 and 2000, the regional population increased only slightly at a rate of 2.2% to approximately 2.15 million. After 2000, the region's population dropped to 2.05 million by 2018. Therefore, the State of Ohio predicts Northeast Ohio will have a stagnant population growth, which continues a pattern that covers several decades (see Figure 3-1 and Figure 3-2).

While our regional population has peaked at about 2.1 million residents since 2010, the past decades have seen population movement within the region. While some cities and counties have been losing population, others have been gaining population at a modest rate. Between 1990 and 2018, the collar counties surrounding Cuyahoga County (Geauga, Lake, Lorain and Medina counties) gained a combined total of 123,044 residents, while Cuyahoga County lost 168,283 residents. When reviewing the population figures by county, a pattern of migration within the region is evident.

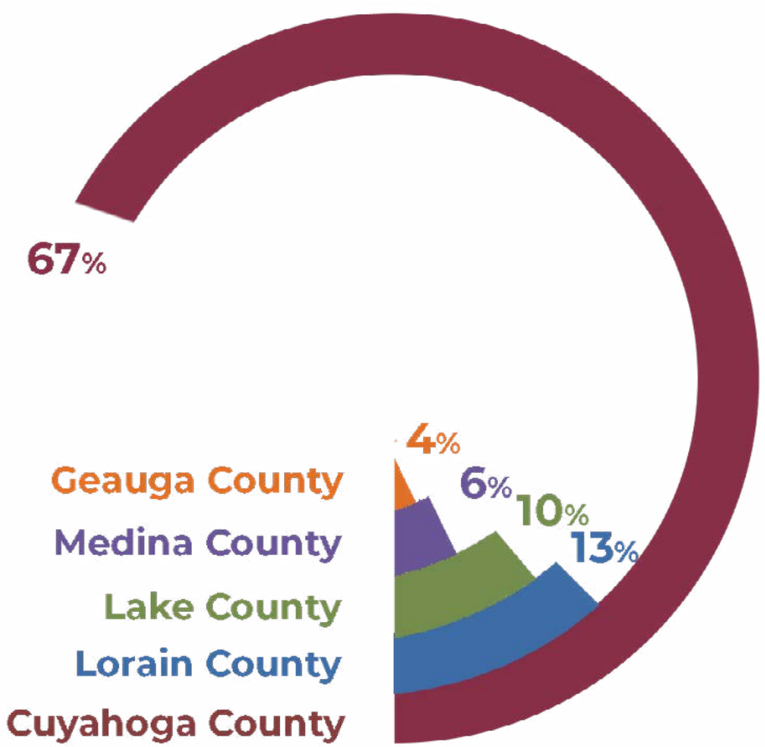
The central and most populous county of the region, Cuyahoga County, has seen the greatest decline in population (nearly 12% from 1990 to 2018). Much of the growth of the collar counties represents a shift or redistribution of population throughout the region that began in the 1960s. In 1990 Cuyahoga accounted for 67% of the regional population (see Figure 3-3). In 2018, Cuyahoga's share dropped to 60% of the regional population (see Figure 3-4). Much of the increase in regional population share occurred in Medina and Lorain counties, which experienced a 5% combined regional share increase (from 19% to 24%). Lake and Geauga counties also gained in regional population share, but they experienced a combined increase of only 2%. Despite the high level of population redistribution throughout the region, the population gains of the collar counties do not account for all of the population losses of Cuyahoga County; therefore, NOACA concluded the region's population has declined.

Despite the lack of regional growth, the historic data indicates that the rate of decline for the region has slowed. For example, Cuyahoga County, the only county to experience a decrease, has seen its rate of decline change from approximately 8% to approximately 3%. On the opposite side of the spectrum, however, Medina County has seen its growth rate decline from approximately 14% to about 4%. These historic trends seem to indicate that the rate of outward migration in the NOACA region has slowed somewhat.

While the population growth was significant for some counties, as a region we remained stagnant, and that has implications for the regional transportation system. Overall, the intraregional migration places the region in an awkward position: The roadway system was initially designed for a much larger anticipated centralized population, with the ability easily to absorb an additional million people region wide. Without the additional million people, maintaining and enhancing the existing 10,978 miles of interstate, arterial, and local roads is quite costly for tax payers across the region.

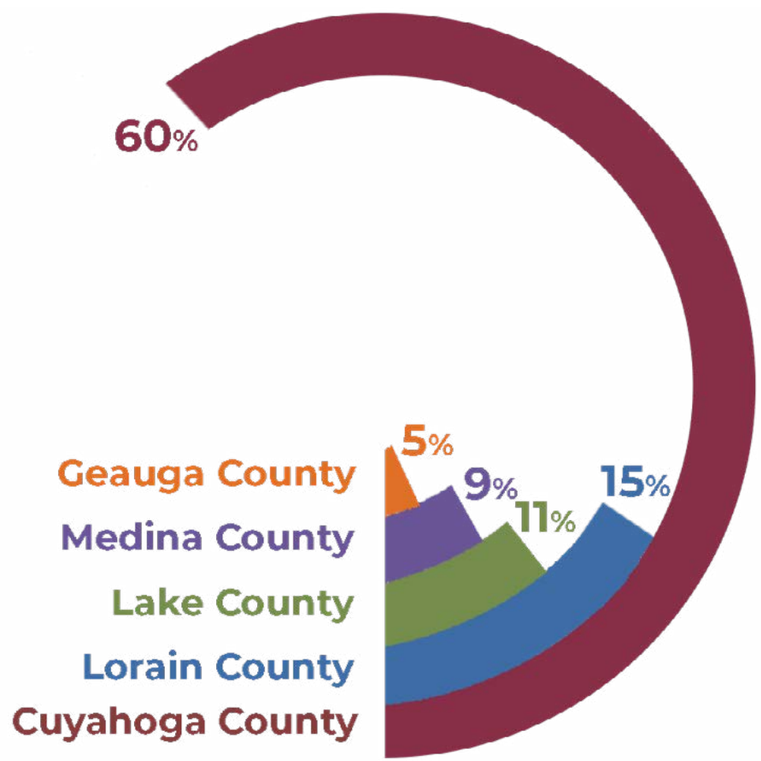
As with the population, the geographic distribution of jobs throughout the region shows a pattern of outward migration and suburbanization. Unlike the population trends, though, the job gains in the collar counties have exceeded the job losses in Cuyahoga County, so the entire region has seen an increase in the total number of jobs between 1990 and 2019. To be more specific, the total number of jobs in the region has moderately increased over the last three decades, fluctuating between 1 and 1.15 million.

Figure 3-3. County Share of Regional Population, 1990[3]



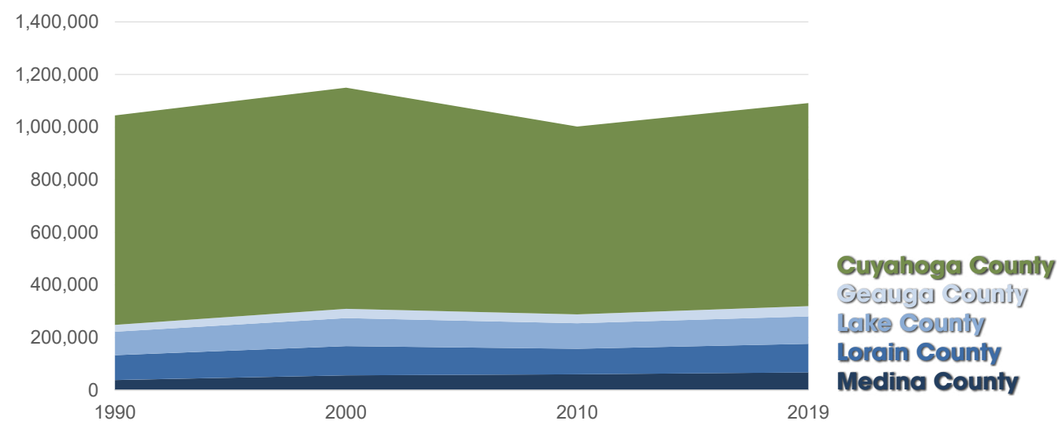
Source: U.S. Census Bureau

Figure 3-4. County Share of Regional Population, 2018[4]



Source: U.S. Census Bureau

Figure 3-7. Regional Employment, 1990 to 2019[7]

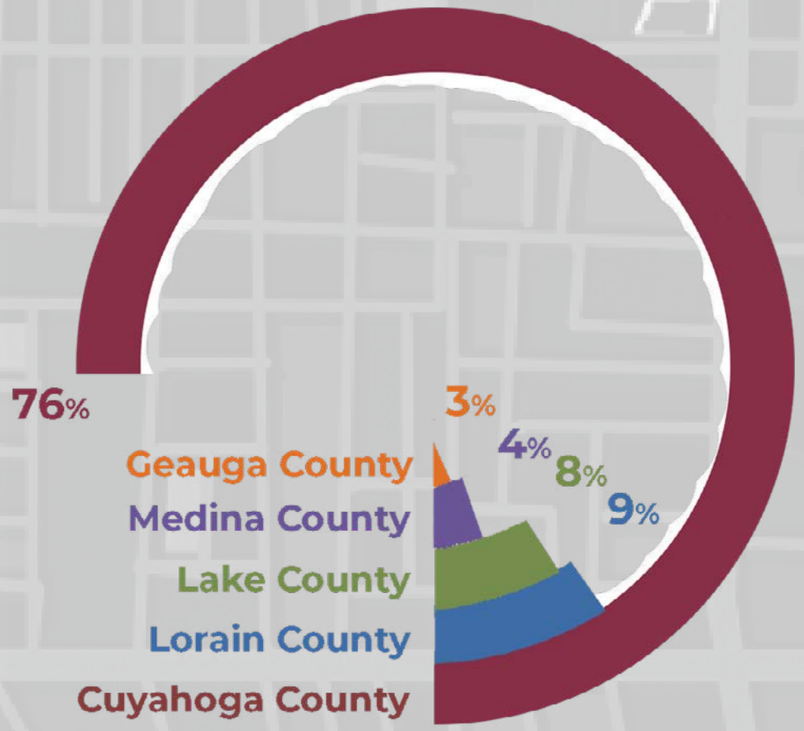


Source: Moody's Analytics from Team NEO

Unlike regional population trends, the total number of regional jobs tend to vary more dramatically, based on the health of the economy (Figure 3-7). For example, the region experienced a substantial level of job gains between 1990 and 2000 (more than 100,000 jobs at a 10% increase), but subsequently experienced a massive level of job losses between 2000 and 2010 (nearly 150,000 jobs at a 13% decrease) due to two recessions. Between 2010 and 2019, the economy recovered somewhat to end above the 1990 jobs level, but not enough to end above the 2000 jobs level. To be more precise, as a region of 2 million people, we have gained 47,158 jobs over the past 30 years. Over the course of those three decades, each collar county gained between 10,000 and 30,000 jobs (Figure 3-7), while Cuyahoga County lost 23,656 jobs. Nevertheless, this demonstrates the fairly stagnant job growth for a region hovering around 1 million jobs.

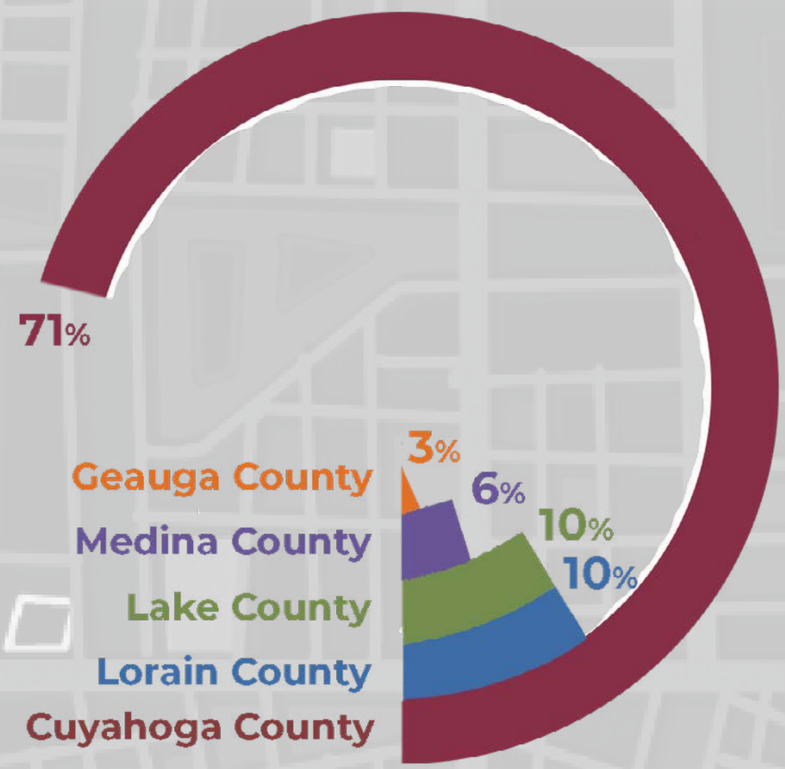
Overall, jobs are now more widely distributed throughout the outer counties, and the overall job share of Cuyahoga County has declined (see Figure 3-5 and Figure 3-6). In 1990, Cuyahoga County accounted for 76% of all jobs in the region. By 2019, Cuyahoga County's share had dropped to 71%. Nevertheless, looking at the job densities in the subsequent section indicates a variety in gains and losses within Cuyahoga County.

Figure 3-5. County Share of Regional Employment, 1990[5]



Source: Moody's Analytics from Team NEO

Figure 3-6. County Share of Regional Employment, 2018[6]



Source: Moody's Analytics from Team NEO

Efficient Land Use to Move People and Goods

Transportation provides access to developed land (housing, retail, industry, and office) as well as to undeveloped land (agricultural, resource, and recreational lands). As a region, we are fortunate to have a diversity in land uses that ensures our food security (agricultural land), provides beautiful recreational activities (parks), and enables a thriving economy (industry and office).

NOACA does not have a formal role in local land-use policy (the domain of municipal government), but the agency's regional responsibilities for both transportation and environmental planning influence land-use change and vice versa. **NOACA does not, and cannot, regulate land-use decisions within or across jurisdictions within its region.** It must, however, consider the impacts of land use in its transportation and environmental planning processes. Transportation planning and land-use planning must operate in tandem for Northeast Ohio to leverage its resources more efficiently. Land-use decisions inform the development of plans, and transportation plans inform land-use decisions; they must be addressed concurrently to be effective. This is especially important given the significant relationships introduced in previous chapters.

Land-Use Dynamics in the Region

Local government needs and priorities drive land-use decisions in Northeast Ohio. Given the power and provision of home rule, NOACA has no jurisdiction over the regulation of land use within individual communities in its region. The local governments of those communities are entrusted with determining the best and highest use of land within their jurisdictions. The challenge for NOACA is ensuring an appropriate balance to serve diverse and sometimes competing interests, especially when viewed through a regional lens. A regional perspective reveals how land cover and development patterns change over time. The population of the entire NOACA region has slowly declined during the past 50 years (see Chapter 1 of the resource document), yet simultaneously spread outward over a much larger footprint (see Chapter 7 of the resource document). This pattern is inefficient and expensive, and strains both growing and declining areas because of simultaneous demands for new infrastructure and services in growing areas and expensive maintenance of existing infrastructure and services in declining areas. Moreover, many urban areas and older communities that have suffered disproportionate losses in population increasingly experience concentrations of low-income and minority residents. These are too often the redlined neighborhoods of the past (see Chapter 6 of the resource document), which have now become the Environmental Justice areas of today (see Chapter 1 of the resource document). The remaining population in declining areas must shoulder the increased burden to maintain (i.e., finance) the underused infrastructure of an aging community.

Metropolitan planning organizations, such as NOACA, must respect the autonomy of the local governments and their land-use decisions. That being said, NOACA can certainly inform decision making, convene collaborative discussions about land-use issues with multi-jurisdictional (or regional) impact, and prioritize projects through its review process that support the goals and objectives approved by the NOACA Board in its *Regional Strategic Plan*.

Financial Implications of Land-Use Dynamics

As an investor and planner for the transportation system, NOACA has supported the land-use decisions of local governments with transportation investments over the past decades. For instance, between 2001 and 2016, land-use and transportation decisions across the region have played a role in converting nearly 65 square miles (almost the size of the City of Cleveland) from forest and farms to developed areas and grassland. Over the past 40 years, the region has build 25-30% of new infrastructure without adding new people. As an investor in the transportation network, NOACA is starting to see the financial implications of having to maintain our region's legacy assets without an increase in population. The stagnant population growth means that fewer people are paying for more infrastructure across the region. Land-use decisions are and always will be local decisions, but a broader regional strategy for our legacy assets is desperately needed from a transportation perspective.

Transportation connects residents from their homes to services and jobs. As a mature region, Northeast Ohio is facing a large financial burden being responsible for maintaining a road system, as well as water and sewer infrastructure, that was built to accommodate an additional one million people. Maintaining this system with two rather than three million people is rather costly to individuals and communities. To address this dilemma, the region needs to start attracting talent. Other regions that are currently growing have diversified their land use and housing stock in neighborhoods that are accessible by rapid transit to accommodate millennial tastes and transitioning lifestyles.

eNEO2050 presents an opportunity for the region not only to upgrade the legacy assets but also to enhance and reinvest in infrastructure that strengthens our regional economies and advances each community's and county's prospects of thriving in the future.

Reinvestment as a Regional Strategy for Growth

A collective strategy for growth means leveraging each community's existing infrastructure assets and ensuring that we can thrive as a diverse region. *eNEO2050* presents an opportunity for the region not only to upgrade the legacy assets but also to enhance and reinvest in infrastructure that strengthens our regional economies and advances each community's and county's prospects of thriving in the future. NOACA is a strong proponent of sustainable reuse of our existing infrastructure and considers the industrial legacy of the region a challenge and an opportunity. As we preserve the past generations' legacy assets that we inherited, we will get to a point where we create the legacy assets for the next generations.

Current Population and Employment Density

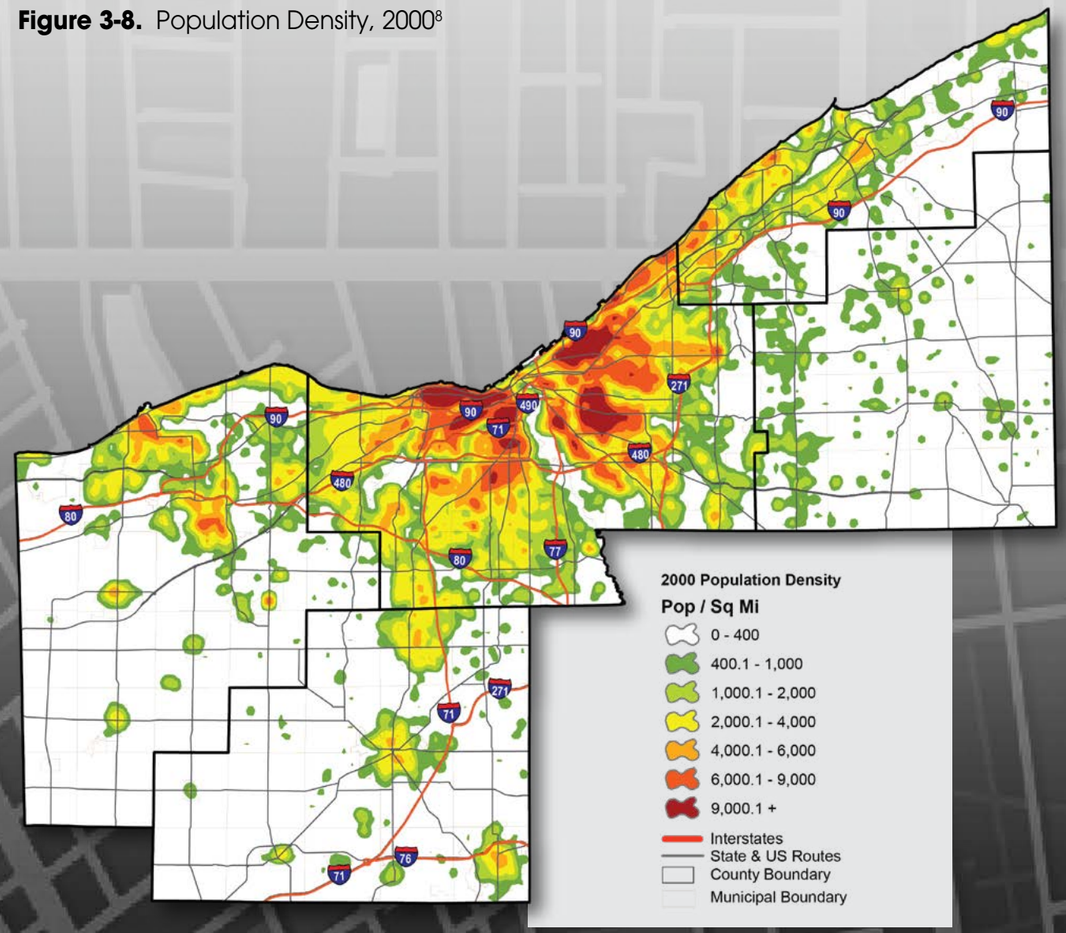
Population Densities

Outward development patterns can be seen by looking at the population densities in 2000 and 2018 (Census block-level data used to produce the following density maps is unavailable for 1990). This analysis shows regional patterns of sprawl at the subcounty level (see Figure 3-8 and Figure 3-9). In Cuyahoga County, the density of the urban core declined dramatically on its eastern side during that period, but not as much elsewhere. Therefore, the conclusion is that much of the population loss in Cuyahoga County between 2000 and 2018 is attributed to the eastern half of the urban core. Downtown Cleveland and the near west side neighborhoods (e.g., Ohio City) did not experience this same decline. Rather, from 2000 to 2018, there was a large increase in population density in these Cleveland neighborhoods. These areas account for the only noticeable increase in density within the urban core of Cuyahoga County.

Lorain County experienced a substantial change in density levels between 2000 and 2018. Its urban core (the cities of Elyria and Lorain in the north-central part of the county) shows a moderate amount of density loss. In the northeast section of the county, mainly in the suburbs of Avon Lake, Avon, and North Ridgeville, there was a great increase in population density over that same period. Medina County also saw a slight amount of population density increase. The three largest cities in that county—Brunswick, Medina, and Wadsworth—all have experienced such increases.

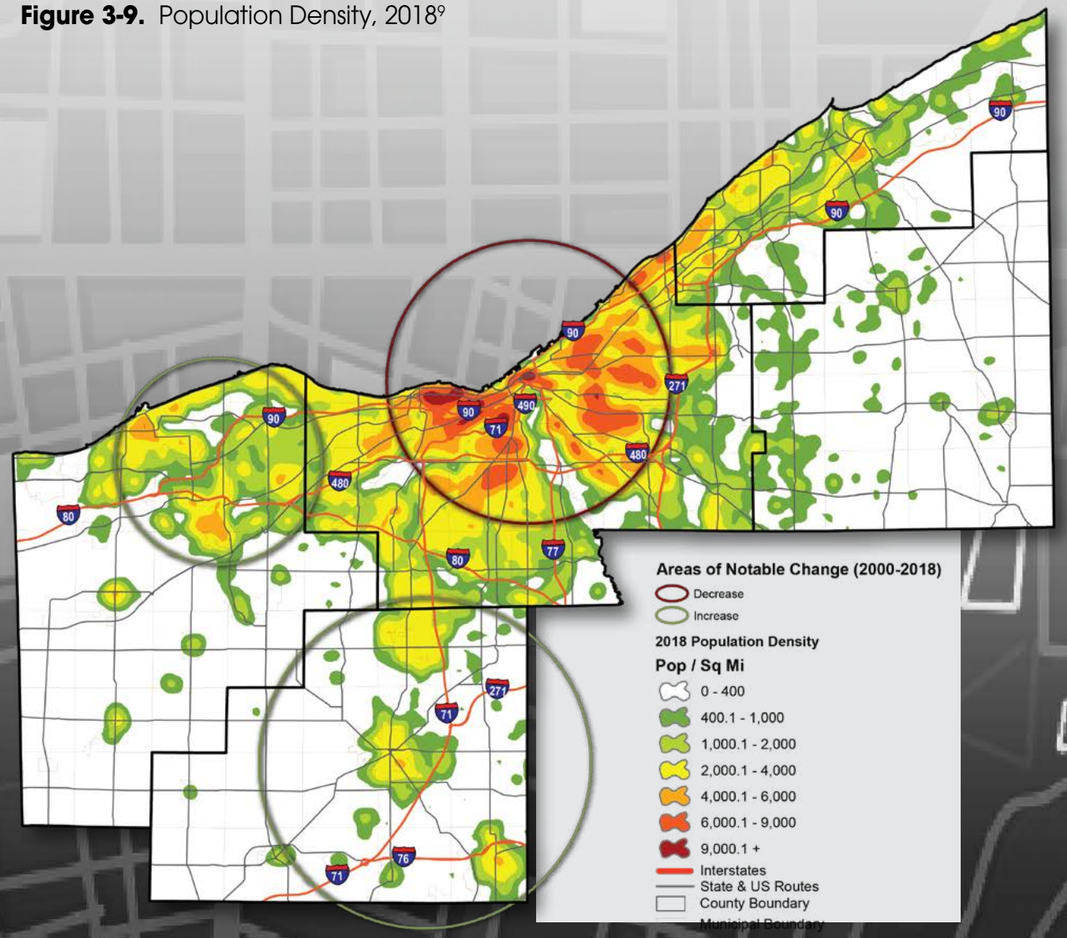
Sprawling development patterns and intraregional migration pose questions about equity with regard to mobility and access. As people and jobs move farther away from each other, it becomes harder for people to access jobs. This is particularly true in lower density areas, where public transit is not a viable option. Furthermore, the terrain

Figure 3-8. Population Density, 2000[8]



Source: U.S. Census Bureau

Figure 3-9. Population Density, 2018[9]



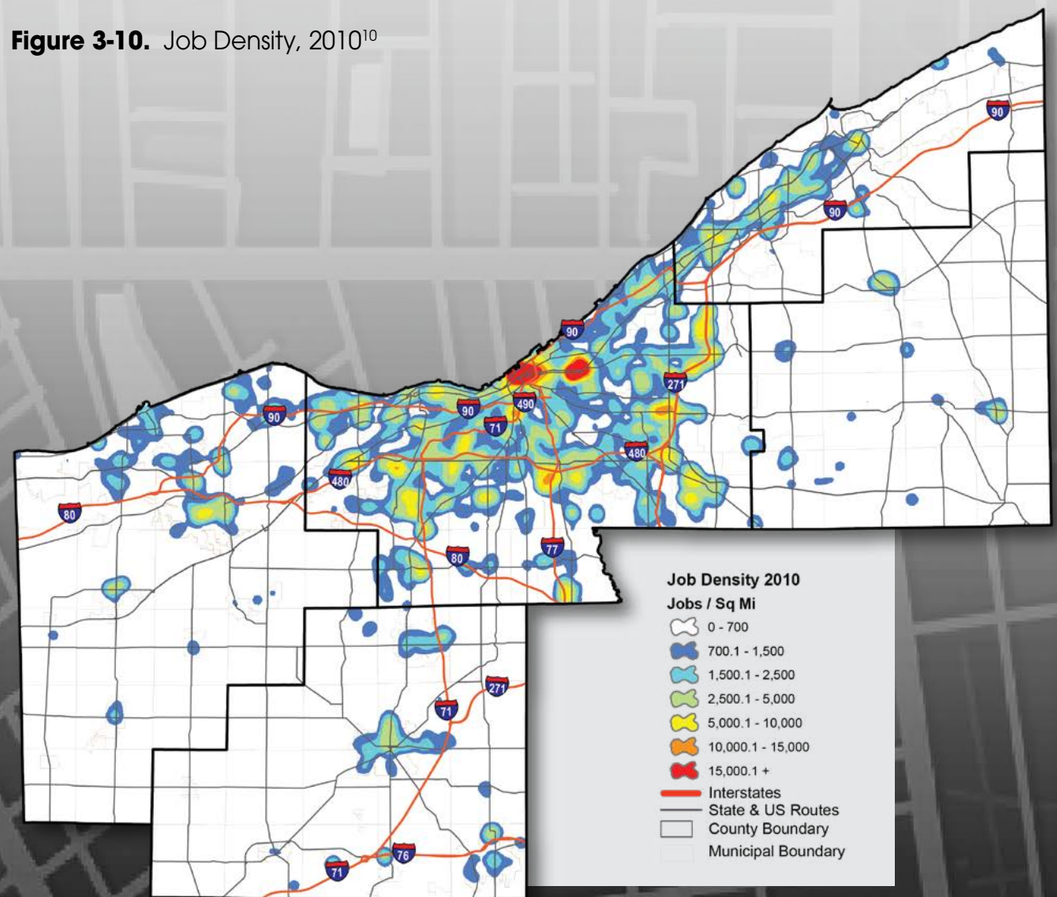
Source: NOACA forecasts developed using Ohio Development Services Agency (OSDA) forecasts

becomes more difficult to traverse for pedestrians and bicyclists. To some extent, as people and destinations spread farther apart, automobile ownership becomes a prerequisite for economic and social mobility. Therefore, *eNEO2050* takes an equity perspective to consider our current transportation system within the context of comprehensive planning and to chart a course forward for transportation investments that can improve equity across the region.

Employment Density

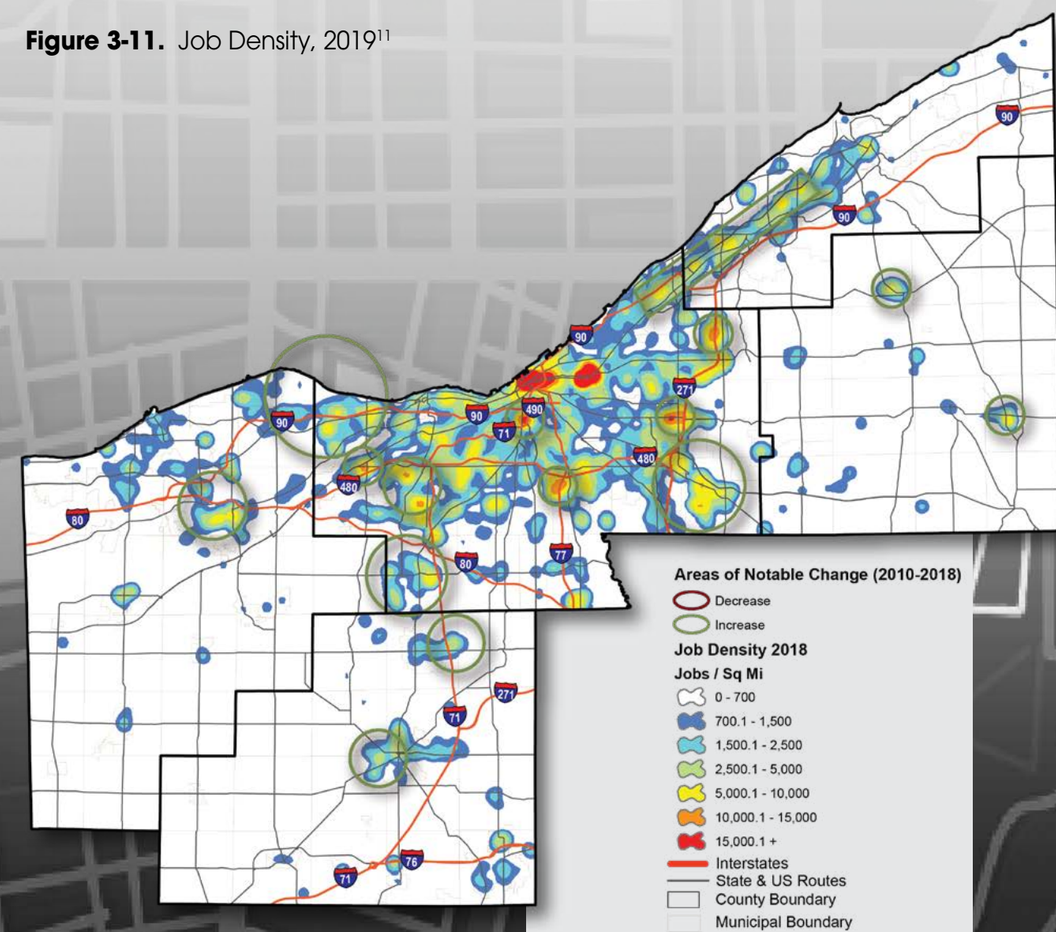
Job density levels (subcounty) between 2010 and 2019 show growth in the region after the economic downturn of 2008-2009 (employment data at the necessary scale to map job density is unavailable for years prior to 2010) (see Figure 3-10 and Figure 3-11). Suburban cities outside the inner ring, such as Strongsville, Avon, and Mentor, all experienced notable increases in job density during the past decade. Areas with a high concentration of manufacturing jobs, such as the Cleveland Hopkins Airport area, Solon, and Elyria, all saw increases in density due to the rebound of the basic sector after the recessions of the 2000s (though the longer-term trend for manufacturing is still negative; see Chapter 5 of the resource document). Major employment centers, such as Independence and Chagrin Highlands, also saw their jobs increase, as did the job hubs in more rural areas such as Medina County. Downtown Cleveland and University Circle, both in Cuyahoga County, have maintained high levels of job density (above 15,000 employees per square mile) during the past decade to remain the two largest employment hubs in the NOACA region, in terms of both job density and total jobs.

Figure 3-10. Job Density, 2010[10]



Source: Quarterly Census of Employment and Wages 2010; Moody's Analytics County Forecasts

Figure 3-11. Job Density, 2019[11]



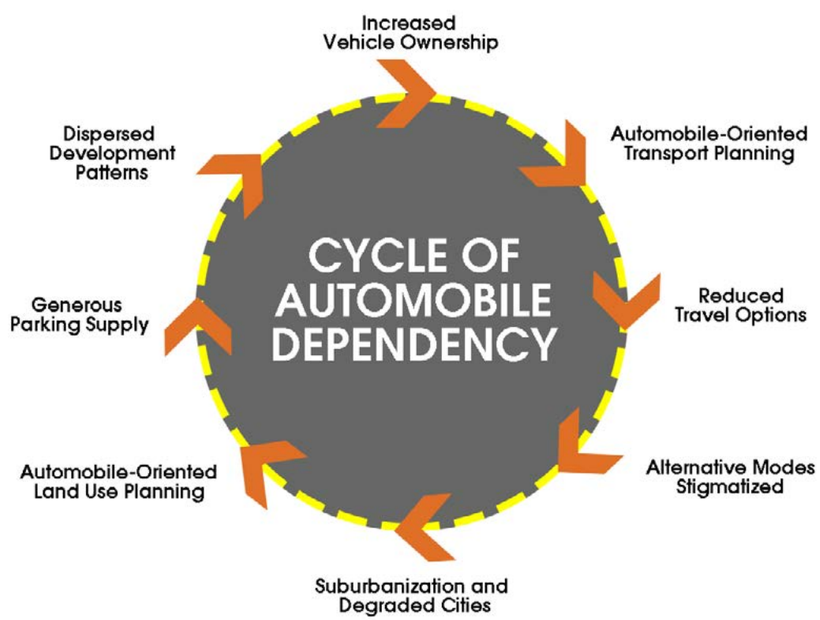
Source: NOACA forecasts developed using Moody's Analytics (from Team NEO), Bureau of Economic Analysis (BEA), and Quarterly Census of Employment and Wages (QCEW)

Implications of Densities for the Transportation System

The construction of the highway system during the last century destroyed neighborhoods in urban and rural areas across the country, eliminating livelihoods for rural farmers as well as urban business owners. Despite the promise of improved connectivity, access and mobility were still illusive to many communities. Although the highway system allowed development to flourish, it also resulted in lower densities in which the transportation system does not always serve well. As the population and jobs disbursed in the NOACA region serving the region's transportation needs amid shifting land-use patterns has been a challenge. Figure 3-12 represents the cycle of automobile dependency.

Furthermore, over the past 70 years, farming communities have been transformed into suburban communities. The pattern of development generally progressed along the fringe of urbanized areas. Expanding capacity to serve those areas is costly. Also, transit is most efficient and effective with higher population densities. NOACA and the region's transit systems will need to continue to plan accordingly to meet the needs of the region's population and employment. It will be necessary to prioritize limited transportation funding. The region must balance transit needs with demands, determining where to expand or reduce service, and where to strengthen core service.

Figure 3-12. Cycle of Automobile Dependency[12]



Source: Todd Litman, 2019

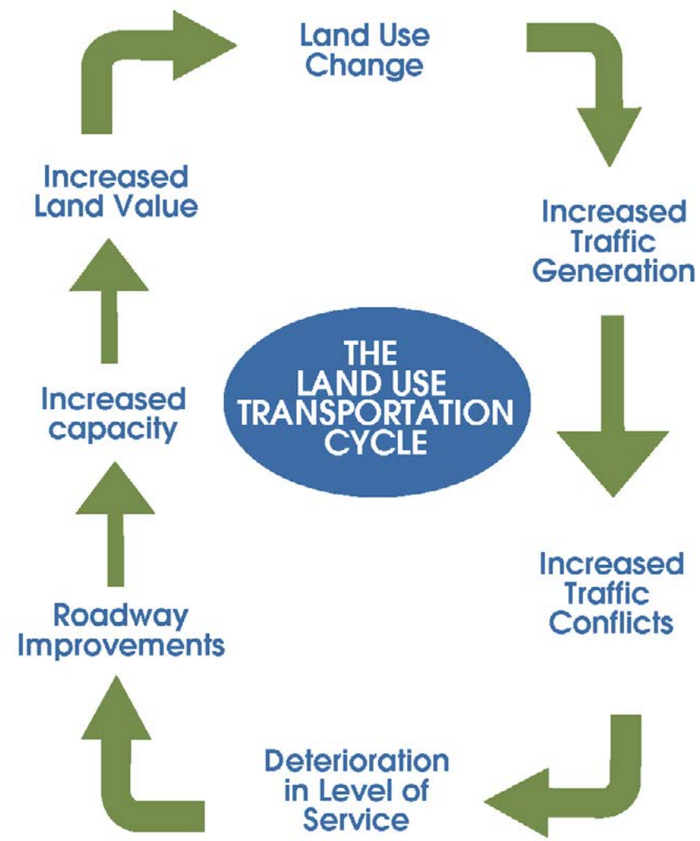
Furthermore, income moves out as people move out, which results in disinvestment in the previously developed area, often the urban core. The built environment continues to decline and becomes a burden on the smaller number of people who remain. Abandoned industrial areas, often requiring environmental remediation, increase as businesses seek new locations in new greenfield developments (see Chapter 5 of the resource document). As people and jobs move out, service sectors follow. Mostly low-income and minority communities remain and must contend with the undesirable land uses and few remaining resources; they become "overburdened."

US EPA defines "overburdened communities" as "minority, low-income, tribal, or indigenous populations or geographic locations that potentially experience disproportionate environmental harms and risks as a result of vulnerability to environmental hazards, lack of opportunity for public participation, or other factors."[14]

From an environmental perspective, land use impacts rural and developing communities as well. The challenge this creates is two-fold: 1) New development consumes a valuable resource and potentially limits growth of local agriculture and food processing (see Chapter 5 of the resource document); and 2) New development in rural areas can actually create stormwater runoff and other pollution impacts for areas downstream. Many downstream areas are the overburdened communities described above, and excessive upstream development may lead to flooding, sewage backups, pollution transport, and other harmful impacts.

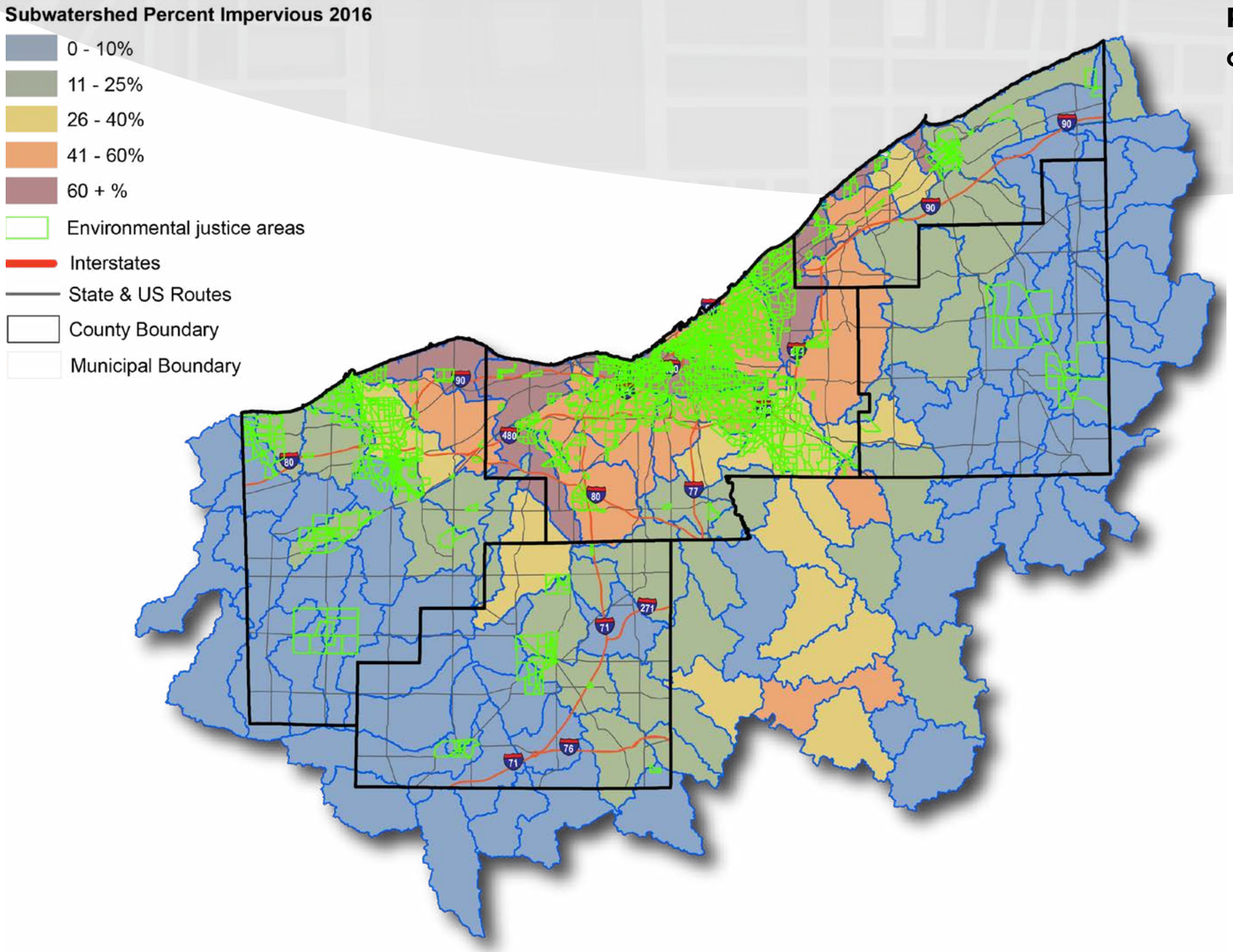
Figure 3-13 illustrates how capacity expansion of the road network incentivizes new development and use of that road until it justifies further expansion, and the cycle repeats itself (somewhat parallel to the cycle of automobile dependency shown in Figure 3-12). When capacity expansion projects receive government incentives, it is not difficult to understand the outward spread of both development and the arterial/highway infrastructure network, even in a region with declining population.

Figure 3-13. Land Use Transportation Cycle[13]



Source: Stafford (NH) Regional Planning Commission

Figure 3-14. Northeast Ohio Subwatershed Imperviousness and Environmental Justice Areas, 2016



Source: NOACA, Derived from Land-Cover Data (2016)

Another important aspect of land cover is the amount of paved or impervious surface, as natural landscapes are vital to environmental quality protection and positive health outcomes for local populations. In Figure 3-14, Environmental Justice communities and the highway network are shown along with the subwatershed percentage of impervious surface. If development continues to expand outward from the urbanized areas, higher-intensity land uses will result in rising percentages of impervious cover within watersheds where highway access is available.

Real Estate Market

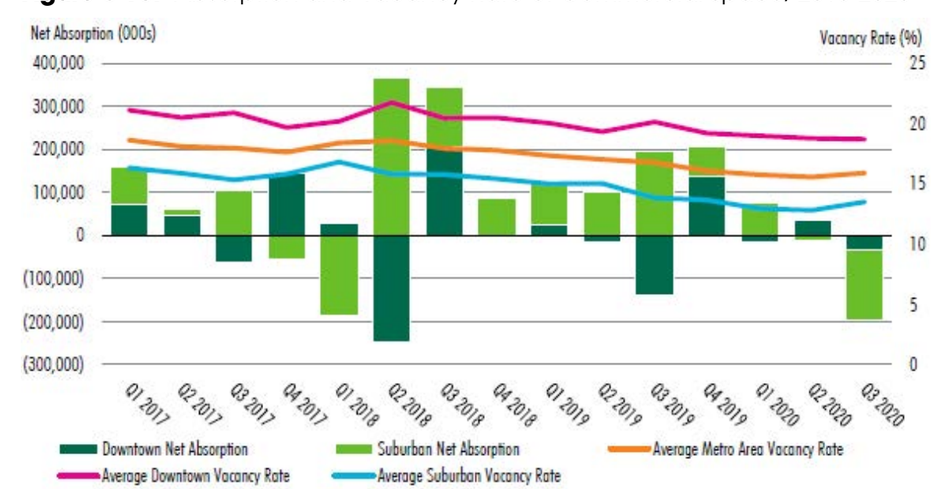
Commercial Space

Economic developers recognize that retail tends to be zero-sum, where growth in one area corresponds to decline in another area. Jurisdictions seek retailers, however, because retailers pay commercial property taxes, employ many people who pay income tax (the third largest private sector employer), and may attract people from outside the jurisdiction who will pay sales tax to the jurisdiction. This helps explain why there are 24.5 square feet of retail floor space per person in the United States, compared to 4.5 square feet per person in Europe.[15] In the Greater Cleveland-Akron-Canton area (Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Stark, and Summit counties), the amount of retail is 25.2 square feet per person as of 2019. This statistic reflects only malls, strip malls, big boxes, and other facilities of at least 50,000 square feet, which means the actual square footage per person is even higher.[16] This makes retail extremely competitive and subject to failure, especially during shocks such as the coronavirus pandemic or an economic downturn.

The lower suburban vacancy rate may reflect the amount of space available in the suburbs relative to downtown, and it also shows the strength of the suburbs to attract business over the past several decades. Additionally, the price per square foot to lease office space is far higher in the central business district than in the suburbs.[17] Interestingly, the average lease rate downtown has steadily increased over the past two years while it has declined in suburbs.

Real estate firm CBRE notes that “Cleveland is capitalizing on its central location and unique real estate opportunities. The reuse of old industrial spaces…for data centers and co-working spaces will help the region succeed in the digital economy.”[18] This is reflected in declining vacancy rates for downtown office space, although the average vacancy rate for suburban office space is much lower (see Figure 3-15).

Figure 3-15. Absorption and Vacancy Rate of Commercial Space, 2018-2020[19]



Source: CBRE

The vacancy rate for retail is far lower than that for office, but the retail trend is worse.[20] More than 470,000 square feet of existing retail space became available for lease due to businesses closing or moving in 2020. Despite this, an additional 450,000 square feet of new retail space is under construction.

Industrial Space

Unlike office and residential space, industrial property lease rates are higher in most suburban areas versus the urban core, particularly in the Chagrin-Highlands and Solon major regional job hubs.

Over the past several years, the warehouse and distribution segment has been rapidly growing, overtaking manufacturing as the largest industrial property type by square footage. Through the first three quarters of 2020, occupied warehouse space grew by nearly 300,000 square feet, while manufacturing space declined by more than 430,000 square feet; nearly 625,000 square feet of warehouse space is also under construction. This trend is likely to continue, as online shopping continues to grow and people expect fast delivery of orders. To this extent, Amazon repurposed two vacant malls in the NOACA region and a third in neighboring Summit County in since 2019.

Residential Space

Research from the Center for Population Dynamics at Cleveland State University finds that the downtown population of college-educated young adults specifically has increased after the Great Recession at a faster rate than the nation as a whole.[21] Residential growth may not seem as important to economic development as commercial or industrial growth, but cities around the country hope to attract young professionals because they are likely to have higher wages and spend more money. This further encourages commercial growth, as businesses want to be located near potential employees and customers.

Parking

Parking is a relevant, but often overlooked factor, in real estate. Its availability, the space to provide it, and the cost to build it all influence where development occurs. Public infrastructure firm WGI notes that, in 2020, the average cost to build one parking space in an above-ground parking garage in Cleveland was $21,312.[22] Surface lot spaces cost less, and underground garage spaces cost more due to materials and design. Central business district spaces cost more than those in outlying areas due to greater demand for land. This is one factor that encourages both outward migration of development and more driving to reach outlying development.

Development Impact of Proposed Wastewater Facility Planning Area (FPA) Modifications

A boundary modification of a wastewater facility planning area may shift development within the region rather than facilitate new growth. In that sense a modification would have a net negative fiscal or environmental impact to the region. Development Impact Policy requires that "the NOACA Board shall consider regional development impacts if the FPA boundary modification is primarily for new residential or commercial development."[23]

NOACA does not, and cannot, regulate land-use decisions within or across jurisdictions within its region. It must, however, consider the impacts of land use in its transportation and environmental planning processes.

Enable the Economy to Grow the Region: Moving People and Goods Efficiently

Broadly defined, economic development refers to policy interventions that aim to improve the well-being of a community through the growth of businesses and jobs. Economic security is linked directly to quality of life for individuals and society, which is often measured by income and tax base respectively, with income providing personal wealth and buying power, and a tax base providing public services for all. A regional economy needs to be inclusive, where all people and places prosper. Greater Cleveland has a growing health-care sector as well as a manufacturing sector that remains strong, despite declines in employment. Decentralization of jobs and housing away from historical population centers, however, has created a spatial mismatch. This gap between where workers live and where employers locate is especially problematic for low-income and minority workers who lack affordable and reliable access to jobs.

Overview

Historical Perspective

The Great Lakes region spurred the Industrial Revolution and drove the growth and development of the industrial Midwest. The direct access to Lake Erie has shaped Northeast Ohio's economy since its initial settlement in the 18th century. Lake Erie and its major tributaries provided easy access to the most viable transportation option at the time. Besides canals, railroads connected the region overland to the East Coast and eventually the southern and western United States. The advent of the automobile by the turn of the 20th century brought both local and federal roads. This robust infrastructure system enabled rapid growth, primarily in manufacturing. Key industries at the time not only took advantage of these modes of transportation, but also facilitated their expansion; iron and steel, shipbuilding, automobile, electrical equipment and light, and telegraph were the predominant employers.

These industries attracted workers from around the country and from overseas.[24] By 1910, Cleveland's population had grown to make the city the fifth largest in the United States.[25] Neighboring cities, such as Lorain and Elyria, also enjoyed robust growth in the shipbuilding, steel, and auto industries. Regional growth continued after World War I, predominantly from migrants who moved from Appalachia and Eastern Europe, as well as a significant number of African Americans from the South (e.g., The First Wave of the Great Migration).[26] After World War II, the expansion of the interstate and highway system increased the region's capacity to move people and goods, and shifted the region toward more polycentric development patterns.

Population and jobs began to depart the city shortly after the war, and the City of Cleveland began to decline from its 1950 population peak. Initial decline and decentralization of legacy industrial cities such as Cleveland and Lorain was small at first, with the growth of suburban and exurban areas of Northeast Ohio in the 1950s and 1960s; however, decline accelerated and expanded beyond the urban core by the 1970s, and the region as a whole entered a stagnant period of population and job growth.

For the past decade, the NOACA region has seen pockets of development, and even a resurgence of downtown Cleveland, but this has been a shifting of people and jobs from one community to another rather than broader growth. Furthermore, the pockets of recovery have not benefited all groups equally; minority populations suffered a disproportionate share of loss during the Great Recession.

This is important because the region's arterial and highway network was built in anticipation of a far greater population than ever materialized. The envisioned public transportation system, however, has not been fully built, which disproportionately strands low-income and minority populations who struggle to access employment opportunities. The loss of population and the tax revenues they would have generated exacerbate the region's struggles with infrastructure maintenance, including funding, and raises the prospect of tax increases to compensate. Both crumbling infrastructure and higher taxes discourage economic development and sharpen inequality, so it is critical that stakeholders manage a more efficient, multimodal transportation system to support strategic economic development that benefits as many residents of the region as possible.

Figure 3-16. Cleveland and the Cuyahoga River

Source: Aerial Agents

Gross Domestic Product, Income and Poverty

Greater Cleveland as a whole represents nearly 20% of Ohio's gross domestic product (GDP). GDP is a comprehensive measure of economic activity that measures the value of all of the final goods and services produced. Table 3-1 shows the GDP for each one of the 5 NOACA counties and how they rank within the state of Ohio.

GDP measures the size of the economy, but it does not necessarily translate into how much money individuals have to provide for themselves. What matters more to people is their ability to pay bills and meet their daily needs. Table 3-2 shows per capita income in the NOACA region compared to peers. It is the lowest of the three regions and lower than that of the United States, although higher than that of Ohio. Lower incomes typically also mean higher poverty. Table 3-3 shows that Greater Cleveland has the highest overall poverty rate and child poverty rate relative to peers, the state, and country.

While this data may describe a serious situation in Northeast Ohio, it is important to note that many households in the region are financially prosperous. Table 3-4 shows that more than one-quarter of area households have incomes greater than $100,000, although this rate is lower than that of peers, state, and country. Table 3-4 also shows that the region has far more households at the lowest end of the income distribution as well, compared with peers, state, and country.

Table 3-4 suggests that Northeast Ohio has substantial income inequality (nearly 47% of its households make less than $25,000 or at least $100,000). This statistic exceeds that of the State of Ohio (just over 45%); however, its peers (Columbus, 48%, and Cincinnati, 51%) and the United States (50%) are higher.

Table 3-5 indicates Cuyahoga County has the highest poverty rate in the NOACA region, but the situation in the City of Cleveland is even worse. Census estimates show that Cleveland became the poorest large city in the nation in 2019. Cleveland is the largest city in the region and the anchor of the regional economy. Improved economic conditions in the City of Cleveland could have a tremendous positive effect on all of Northeast Ohio.

Table 3-1. Gross Domestic Product (GDP), 2019[27]

COUNTY	REAL GDP (THOUSANDS)	STATE RANK
Cuyahoga	$87,921,010	1
Lake	$10,266,470	11
Lorain	$9,390,279	12
Medina	$6,802,952	18
Geauga	$3,797,778	32

Source: U.S. Bureau of Economic Analysis

Table 3-2. Peer Region per Capita Income, 2019[28]

METROPOLITAN AREA*	PER CAPITA INCOME
Cincinnati	$36,878
Cleveland-Elyria	$34,200
Columbus	$36,285
Ohio	$32,780
United States	$35,672

*Metropolitan Statistical Area
Source: U.S. Census Bureau

Table 3-3. Peer Region Poverty and Under-18 Child Poverty, 2019[29]

METROPOLITAN AREA*	POVERTY RATE	CHILD POVERTY RATE	PERCENT OF POPULATION UNDER 18
Cincinnati	11.3%	15.5%	23.2%
Cleveland-Elyria	13.5%	19.2%	20.9%
Columbus	11.5%	15.7%	23.3%
Ohio	13.1%	18.4%	22.0%
United States	12.3%	16.8%	22.2%

*Metropolitan Statistical Area
Source: U.S. Census Bureau

Table 3-4. Peer Region Population by Income Bracket, 2019[30]

METROPOLITAN AREA*	LESS THAN $10,000	$10,000 TO $14,999	$15,000 TO $24,999	TOTAL (LESS THAN $25,000)	$100,000 AND UP
Cincinnati	5.8%	3.7%	8.4%	17.9%	32.7%
Cleveland-Elyria	6.9%	5.1%	9.4%	21.4%	25.4%
Columbus	4.7%	3.2%	8.4%	16.3%	32.2%
Ohio	6.3%	4.3%	9.5%	20.1%	25.5%
United States	5.8%	4.0%	8.3%	18.1%	31.4%

*Metropolitan Statistical Area
Source: U.S. Census Bureau

Table 3-5. Household Income and Poverty by County, 2019[31]

	AVERAGE HOUSEHOLD INCOME	POVERTY RATE
Cuyahoga	$75,382	16.1%
Geauga	$104,403	4.9%
Lake	$79,074	8.6%
Lorain	$77,894	14.3%
Medina	$97,415	4.9%

Source: U.S. Census Bureau

Racial Inequality

Table 3-6 shows the poverty levels of black, Native American, and Hispanic/Latino residents in the region are each more than three times higher than the poverty level for Non-Hispanic/Latino white residents.

Most nonwhite (minority) residents live in Cuyahoga County. Table 3-7 shows that Cuyahoga County has the most minorities both in absolute terms and as a percentage of the population. This, in part, stems from the legacy of racism practiced through exclusionary zoning and transportation policy. In particular, the robust investment in building the highway system, combined with the lack of similar investment in expanding public transit, which is disproportionately used by low-income and minority populations, contributed significantly to the segregation. NOACA must work to undo these selective systems and make transportation funding more equitable.

Table 3-6. Regional Poverty Rate by Race/Ethnicity, 2019[32]

	POVERTY RATE*
White, Not Hispanic/Latino	7.7%
Asian	13.5%
Black/African American	27.2%
Native American	29.4%
Hispanic/Latino	31.0%

*Metropolitan Statistical Area
Source: U.S. Census Bureau

Table 3-7. Race/Ethnicity by County, 2018*[33]

	TOTAL POPULATION	WHITE, NOT HISPANIC/LATINO		NON-WHITE		ASIAN	BLACK/ AFRICAN AMERICAN	AMERICAN INDIAN	HISPANIC/ LATINO**
	#	#	%	#	%	#	#	#	#
Cuyahoga	1,243,857	778,016	62.5%	465,841	37.5%	38,700	363,507	3,432	76,732
Geauga	94,031	91,037	96.8%	2,994	3.2%	674	1,211	188	1,509
Lake	230,514	208,276	90.4%	22,238	9.6%	2,941	10,504	133	10,738
Lorain	309,461	265,593	85.8%	43,868	14.2%	3,396	25,734	1,071	31,642
Medina	179,146	170,228	95.0%	8,918	5.0%	1,885	2,575	104	3,823

*2019 is not available, **Hispanic or Latino people may identify as any race
Source: U.S. Census Bureau

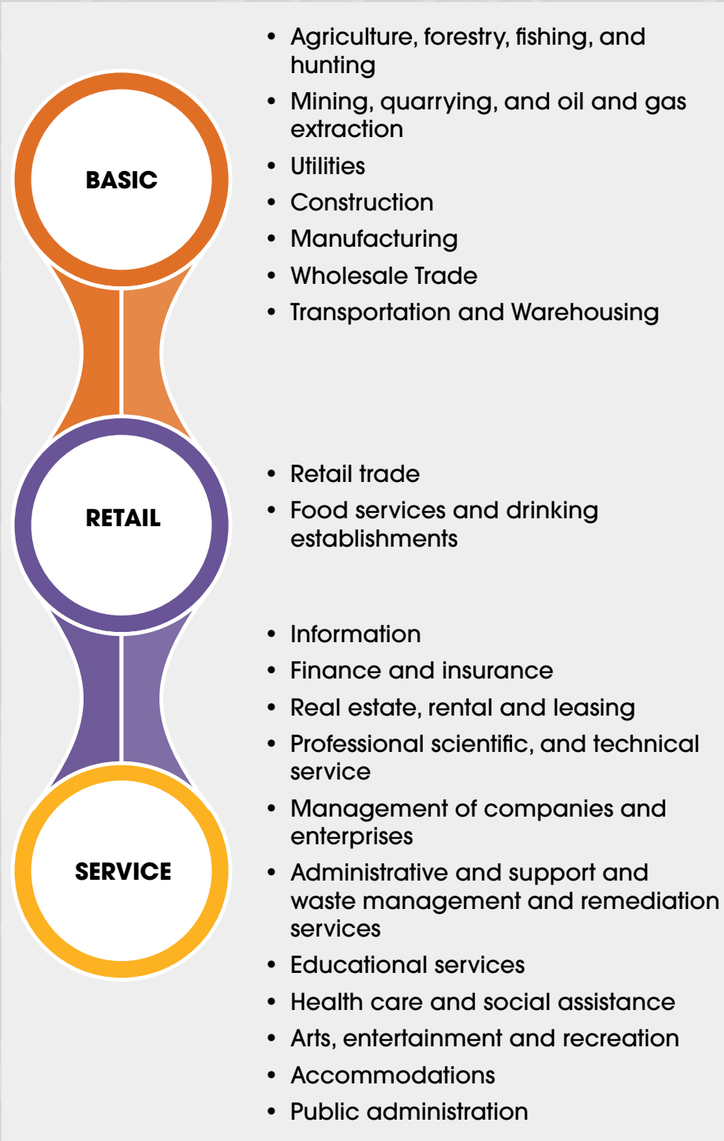
Moving People to Jobs Across the NOACA Region

For transportation analysis purposes jobs fall into three categories: basic, retail, and service. Put simply, basic jobs produce goods, retail jobs sell goods, and service jobs support basic and retail jobs. From a transportation standpoint, this categorization allows for the modeling of traffic patterns (see Chapter 5 for details). Figure 3-17 summarizes industries included in these three major classifications.

The regional job trends show the dichotomy between basic jobs and service jobs. While basic jobs declined at a rate of 26% between 1990 and 2019, service jobs increased at the same rate. Because the service industry is larger than the basic industry, the 26% increase results in a net gain for the region in terms of total jobs. The dominant dynamic has been the replacement of basic jobs with service jobs. In 1990, the basic sector accounted for 33% of all the jobs in the NOACA region; by 2019, the basic sector share had dropped to 24%. The service sector showed the opposite pattern: in 1990, 50% of the total jobs were in the service sector; by 2019, the service sector share had increased to 60%. Over the same period, the share of jobs in the retail sector stayed relatively constant. The transition from basic to service jobs reflects a trend throughout the United States for many years, especially in Midwestern regions like Northeast Ohio.

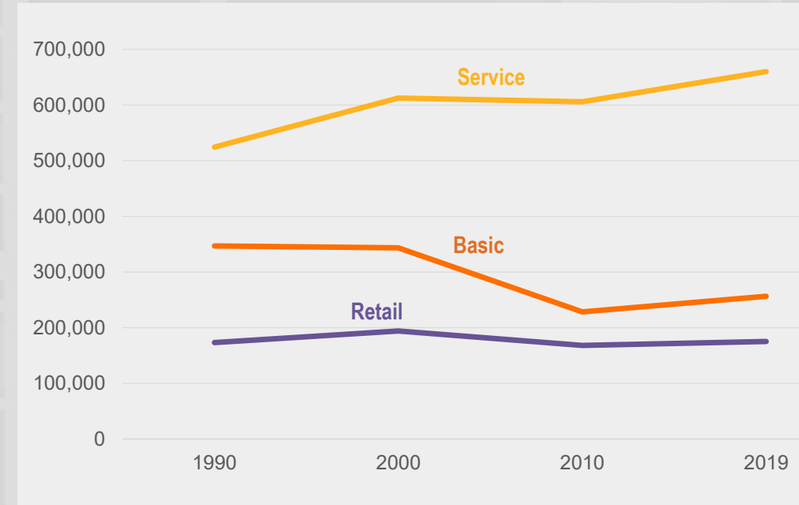
Northeast Ohio economic development has historically meant manufacturing; for decades, this sector employed more area residents than any other sector, particularly until the Great Recession (2007-2009). As shown in Figure 3-19, it remains the second largest employer today, trailing the rapidly growing health-care sector.[36] Manufacturing especially relies on robust transportation infrastructure, which means there are two ways to facilitate growth: 1) ensure there is a robust, multimodal passenger transportation system to connect available workers with jobs; and 2) ensure there is a robust intermodal freight transportation system so businesses can easily ship by truck, rail, air, or water.

Figure 3-17. Industries by Major Employment Sectors



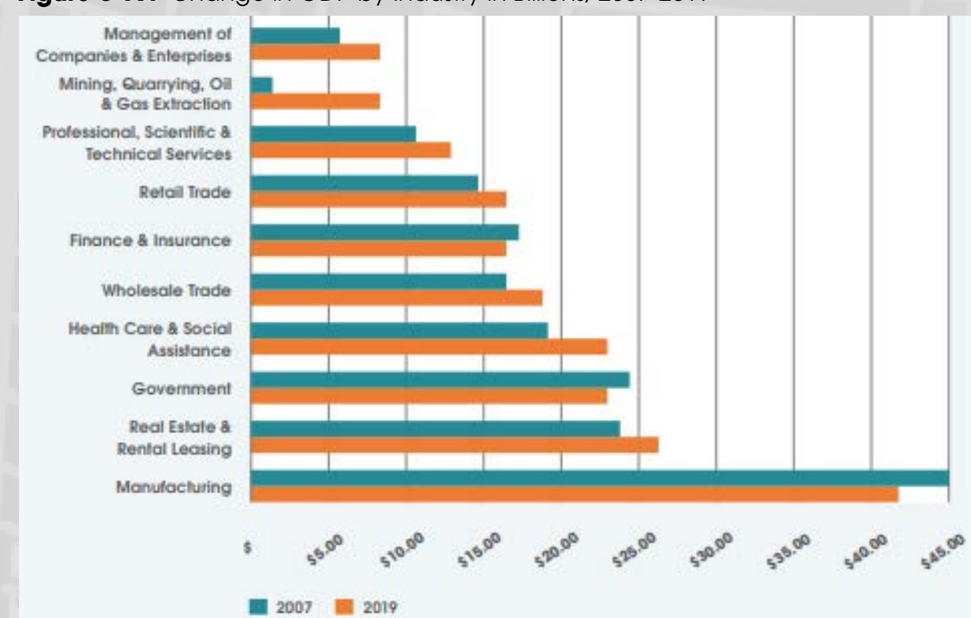
Source: NOACA Travel Demand Model

Figure 3-18. Regional Employment Sector Change, 1990-2019[34]



Source: Moody's Analytics from Team NEO

Figure 3-19. Change in GDP by Industry in Billions, 2007-2019[35]



Source: Team NEO

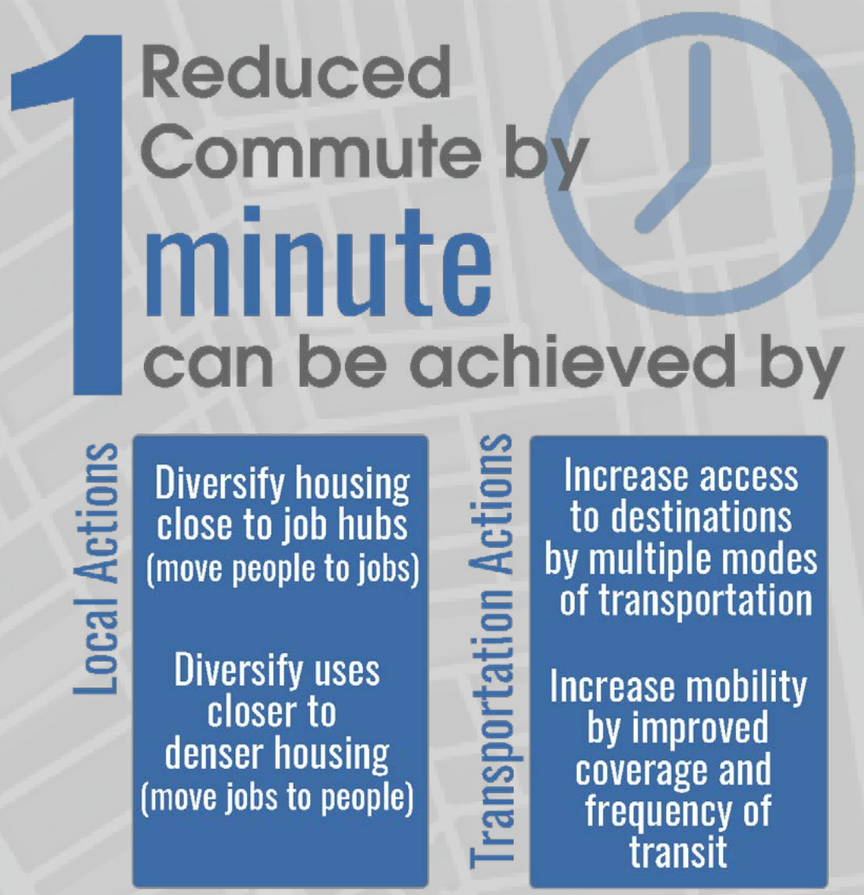
Connecting people to jobs means providing transportation choices. Individuals that lack access to private vehicles currently rely on transit and daily commute times that average three hours are simply untenable to lift up low-income, minority households and boost the regional economy (see Table 3-8). In this respect, NOACA's goal to "build a sustainable, multimodal transportation system" directly links to NOACA's goal to "support economic development."

Job dispersal (as described on page 36) has also resulted in a greater need for infrastructure to service new job sites at the same time there has been no population growth. This pattern is financially and environmentally unsustainable, and will result in raised taxes, reduced services, or a combination. NOACA can make transportation investments that help reverse these trends and create a thriving and equitable economy.

Table 3-8. NOACA Regional Survey Results: Average Number of Vehicles per Household, by Income and Race

VEHICLE TYPE	NOACA REGION	HIGHER-INCOME WHITE	LOWER-INCOME WHITE	HIGHER-INCOME NON-WHITE	LOWER-INCOME NON-WHITE
Vehicles	1.67	1.94	1.39	1.52	1.03
Bicycles	1.11	1.25	0.91	1.03	0.85
Hybrid Vehicles	0.10	0.07	0.06	0.14	0.18
Electric Vehicles	0.08	0.06	0.03	0.12	0.15
Total Respondents	2,448	1,218	531	218	233

Figure 3-21. Approaches to Reduce Commute Times



Workforce Access and Mobility for Economic Development & Quality of Life

In a region, trips are categorized by their purposes: work trips, school trips, shopping trips, social trips, etc. The most common trips in our region are work related trips. Reducing work commute time from workers place of residence to employment locations is a major transportation planning challenge. Figure 3-21 shows how local actions and transportation actions are both viable options to reduce commute times for workers. NOACA's long-range plan *eNEO2050* focuses on transportation actions that increase workforce access and mobility. Economic vitality of a region and its social equitability are important factors in the current competitive global economy and providing less costly access to jobs for workers with any income levels improves the entire region socially and economically.

To better understand workforce travel patterns, NOACA developed a Workforce Mobility study in 2019. The region's polycentric structure is characterized by multiple locations of high concentration of employment in each one of the five counties. The largest regional job hub is Downtown Cleveland. Together, the job hubs shown in Figure 3-22 account for 30% of the employment in the region. Workers commute to these regional job hubs (major, legacy, and minor) from various distances: short, medium, and long distance. In addition to regional job hubs, there are also many sub-regional (county) and local job hubs that are not shown here. The polycentric structure has implications for the movements of goods and employees/workers in the region. Between these hubs, people and goods move on our regional transportation system.

To measure current job accessibility in the NOACA region, six major job hubs were identified based on a research brief produced by NOACA in 2016, entitled "Major Employment Hubs in the Cleveland MSA" (metropolitan statistical area). These employment areas have the highest employment density in the region and include those shown in Figure 3-20.

Figure 3-20. Six Major Regional Job Hubs

1. Downtown/Near East Side
2. University Circle, including Midtown from E. 105th to E. 83rd streets
3. Solon Cochran Corridor
4. Chagrin Highlands
5. I-77 and Rockside Road Area
6. Hopkins Airport Area

The regional characteristic of a job hub, including the number of jobs and its centralized or decentralized location, are important factors in the accessibility measure. There are many local and legacy job centers, as well as jobs not within any hub or center throughout the region as well. The six major job hubs include about one quarter (25%) of current jobs in the region, while the minor and legacy job hubs include 5%. Workers commute to these three types of regional job hubs from various distances: short, medium, long distance from across the region. To summarize, Figure 3-22 shows the locations of the regional job hubs (major, minor, and legacy) in the NOACA region. The job hubs are an element of assessing the workforce accessibility and mobility across the region in Chapters 4 and 5.

Figure 3-22. Major Regional Job Hubs

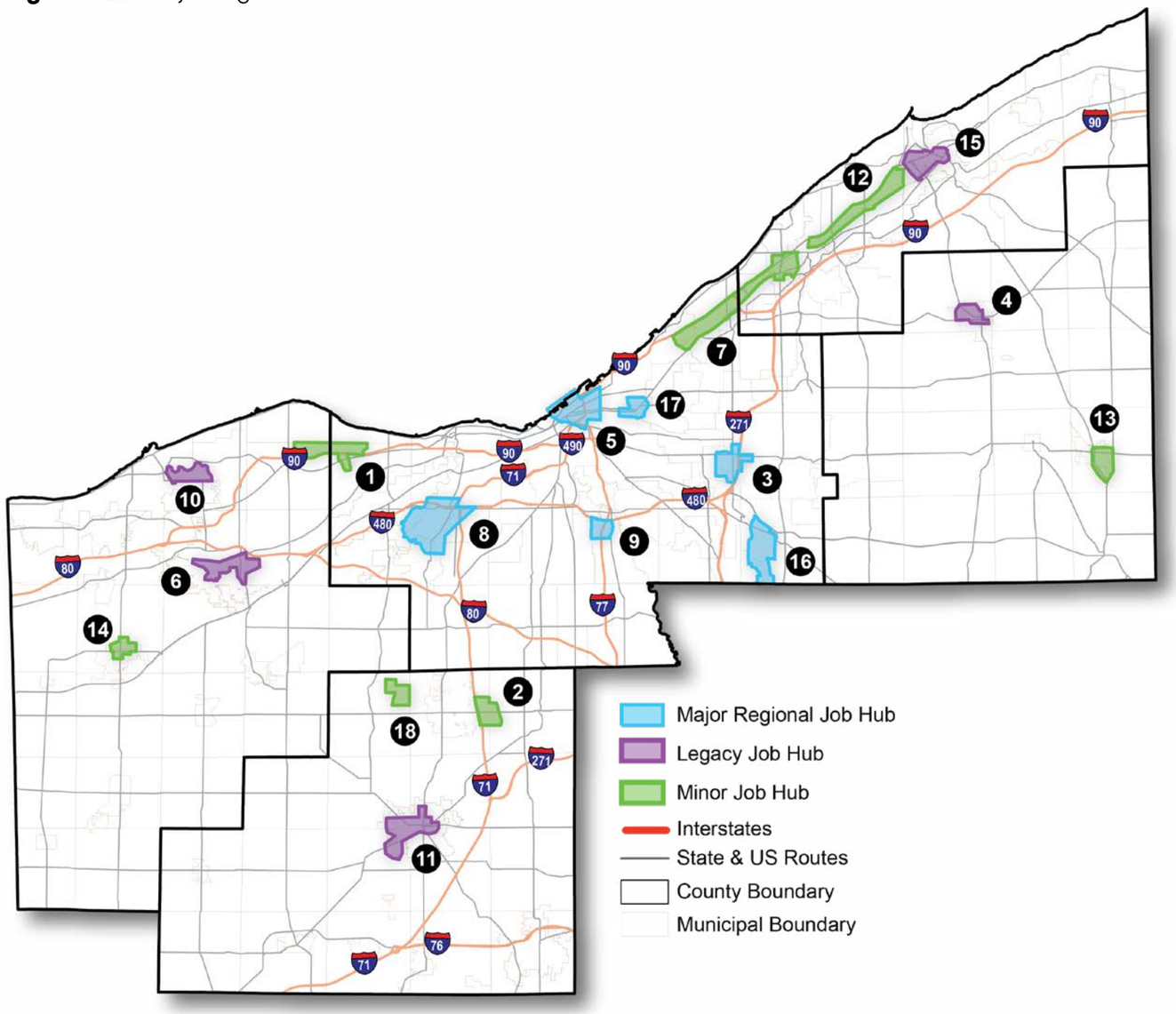
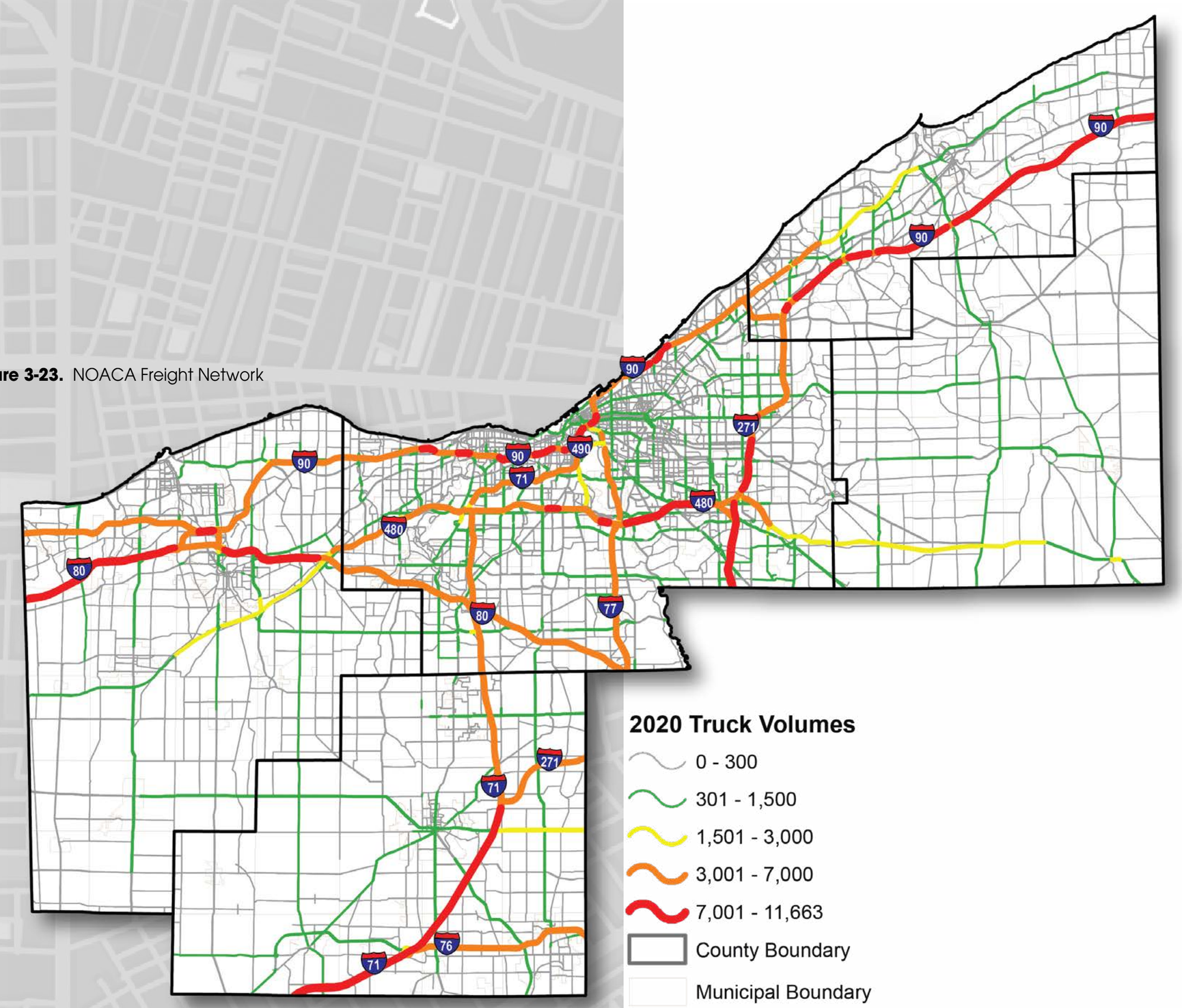


Table 3-9. Employment by Sector and Job Hub, 2020

	JOB HUB	HUB TYPE	BASIC	RETAIL	SERVICE	TOTAL
1	Avon/Westlake	Minor	2,818	2,184	7,271	12,273
2	Brunswick	Minor	2,425	636	680	3,741
3	Chagrin Highlands Area	Regional	2,701	6,489	23,346	32,536
4	Chardon	Legacy	2,179	1,874	1,950	6,003
5	Downtown Cleveland	Regional	14,077	7,351	90,079	111,507
6	Elyria	Legacy	8,641	1,356	6,822	16,819
7	Euclid/Willoughby	Minor	23,465	4,332	11,443	39,240
8	Hopkins Airport Area	Regional	15,335	1,900	13,526	30,761
9	I77-Rockside	Regional	1,384	1,407	14,663	17,454
10	Lorain	Legacy	2,052	47	75	2,174
11	Medina	Legacy	4,978	1,607	5,732	12,317
12	Mentor	Minor	13,373	2,483	5,365	21,221
13	Middlefield	Minor	5,345	365	657	6,367
14	Oberlin	Minor	327	313	2,322	2,962
15	Painesville	Legacy	3,221	1,256	4,064	8,541
16	Solon-Cochran	Regional	18,084	1,107	10,650	29,841
17	University Circle	Regional	387	2,009	71,565	73,961
18	Valley City	Minor	1,488	7	181	1,676

Source: NOACA Travel Demand Forecasting Model - Employment by Industry Estimates 2020

Figure 3-23. NOACA Freight Network



Moving Freight in Northeast Ohio

The investments in waterways, roadways and rail infrastructure over the past centuries have enabled a robust freight network that has significantly grown and still supports the regional economy. Greater Cleveland offers easy access to all forms of freight movement, making shipping efficient and inexpensive. Over 300 million tons of goods were shipped into, out of, and through the region in 2015 leveraging the expansive interstate system: Two major north-south interstates and one east-west Interstate, with a second east-west route just twenty minutes away. These interstates as well as main arterials experience some of the lowest congestion levels in the country, helping businesses reliably plan goods movement and keep costs down.

Furthermore, Cleveland Hopkins International Airport offers cargo service to all major metros for time-sensitive shipping. The Port of Cleveland provides the only direct, scheduled containerized shipping service to Europe from the Great Lakes. This route helps businesses reduce the costs of driving and avoid the regular congestion at east coast ports. CSX and Norfolk Southern both have railyards within 20 minutes of Downtown. The *NOACA Multimodal Regional Freight Plan* addresses freight in a more detailed basis. The current freight network extends beyond interstates to include many arterials and other key roads. Interstates are critical for cross-country movement of goods, which helps businesses that import or export goods over long distances. A robust freight system enables economic development because it can lay the groundwork for new or existing businesses to grow.

Excellent Housing is the Origin and Destination of All Transportation

Considering that housing is literally the origin and/or destination of all trips, transportation and housing are inextricably linked, as are their influence on equity and quality of life in a region. In addition, noting that the majority of all trips are from home to work, the location of jobs and their proximity to housing are the most significant place based associations within land use. It is extremely critical to understand the linkages between the two in order to provide the most efficient and effective transportation system for the people of the region.

Where people live creates the demands for goods and services. Over the past five decades, our region has experienced various iterations of the same pattern: As residential development expands further outwards, so do services such as churches, retail, hospitals and school, and new infrastructure is needed to help access the new locations. In many cases the development was leveraged through the implementation of the highway system, which then prompted a cycle of further infrastructure expansion to accommodate development (see Figure 3-12).

These public and private sector decisions contributed to an extensive system of roads and sewers, now in continued need of maintenance – requiring local, regional, state and federal dollars to ensure a system in a state of good repair. *eNEO2050* takes a step back to reflect on how the location of housing matters in connecting people and places, from both an individual as well as a societal perspective and a local as well as a regional one.

Transportation Policy and Housing

NOACA's primary responsibilities focus on transportation and environmental planning. Current NOACA policies such as the ones that address Environmental Justice (EJ) areas, Urban Core Communities and Disadvantaged Communities refer specifically to locations characterized by elements such as federally designated criteria related to low-income or minority households (EJ), as well as other characteristics including housing stock and population density. The NOACA Board's official Commitment to Racial Equity acknowledges the detrimental impact of past practices in transportation investment on minority and low income neighborhoods, and its New or Modified Highway Interchange Projects Policy calls specific attention to the regional impacts of proposed highway interchanges on development patterns in both urban core and exurban communities.

History

In the first part of the 20th century, zoning was used across the United States to racially segregate neighborhoods.[38] This was perpetuated by the practice of restrictive covenants and redlining in the 1930s and 1940s. Redlining was initially initiated by the insurance and loan companies which downgraded entire neighborhoods as "red districts" in which home loans were harder to obtain.[39] Even today, districts that were redlined 80 years ago still see the impacts of the lack of private investment.[40] Minority and low-income populations tend to be clustered in the previously redlined districts.

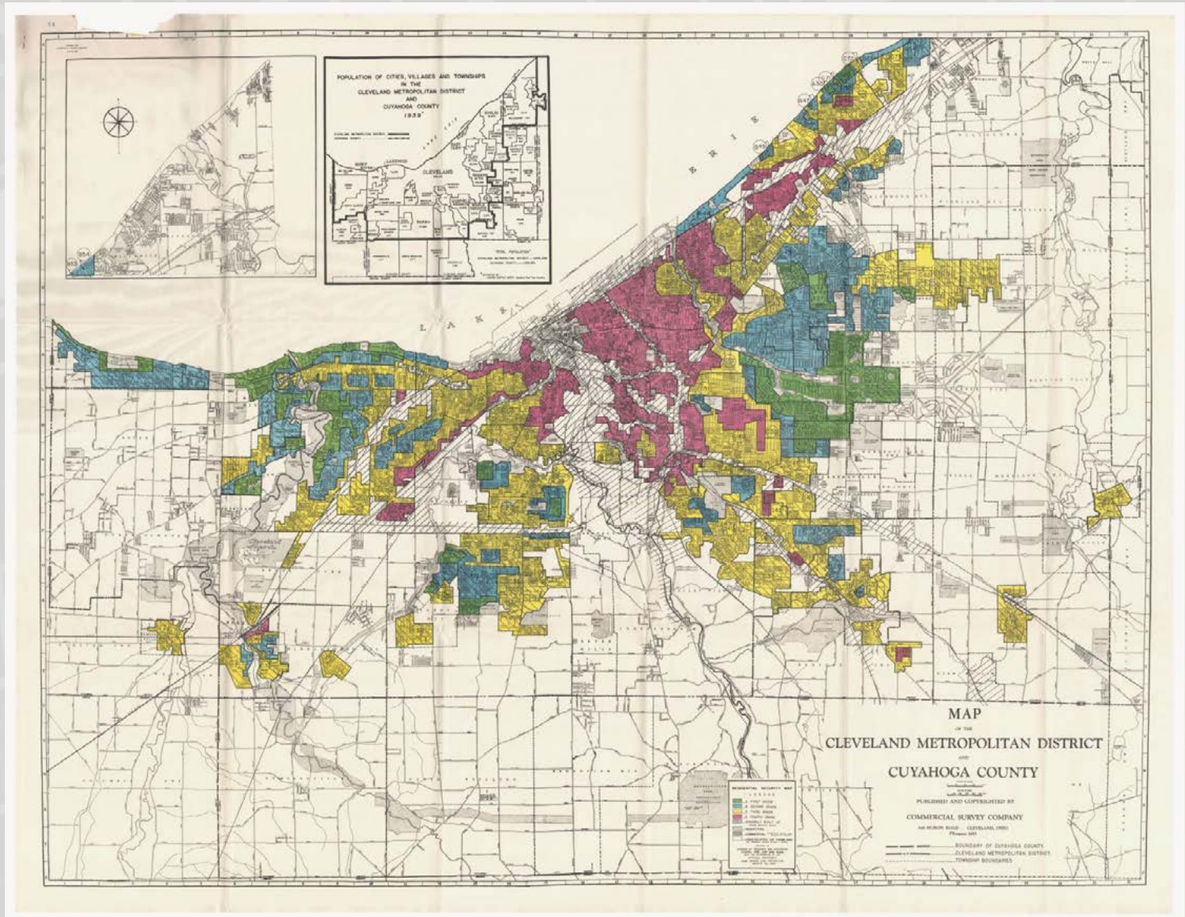
Actions under the so-called urban renewal program quite literally "paved the way" for the massive interstate highway system established, funded, and built in the decades after World War II. In the years after the Second World War, highways served as a mechanism for growth and prosperity: move people and goods, spur neighborhood development and land use, and increase property values. The planning and construction of these highways mirrored the effects of urban renewal. Expansion of the highway network meant the demise of many established minority and low-income neighborhoods.[41]

In 1944, President Roosevelt and the U.S. Congress established the National Highway System to connect major cities, inclusive of collector roads to bring traffic to the interstates.[42] The Federal-Aid Highway Act of 1956 enacted a federal gas tax to provide the funds necessary to construct the more than 40,000 miles of the National System of Interstate and Defense Highways over ten years.[43] Lane miles of concrete and asphalt replaced brick streets and streetcar tracks to more efficiently move people and goods.

Although engineers, economists, and politicians promoted highways as a way to revitalize cities and encourage redevelopment, the results were varying. Metropolitan areas across the United States, including the NOACA region, experienced an unprecedented displacement of people and businesses (primarily low-income and minority) in the name of high-speed, limited-access highways and freeways versus streetcars and trolleys. Just as housing and renewal were factors in the rapidly changing urban landscape, so, too, was the birth and growth of the U.S. Interstate Highway System.

By 1970, the combined population of NOACA's five counties peaked at 2.32 million and began to fall, following the trend of other Rust-Belt metropolitan areas. The gradual outward movement of Greater Cleveland's population created concentric rings of development, leaving a hollowed out core with deteriorated infrastructure, loss of investment, and socioeconomic struggles. For several decades, home prices were lowest in neighborhoods closest to the center of Cleveland, and gradually rose in communities farther out. Dr. Thomas Bier posits that when individuals move, they want to move up, but lack of redevelopment and renewal in aging neighborhoods

Figure 3-24. Cuyahoga County HOLC Residential Security, 1940[37]



Source: Ohio State Libraries

forced them also to move out in search of better options and diverse housing types; the buildout of the region's highway network facilitated this outward movement, which further added to urban and inner-ring suburban decline.[44]

NOACA references the impact of past transportation infrastructure planning on low-income and minority populations in its region as part of Board Resolution 2020-2029 (Commitment to Racial Equity in Planning). In the resolution, NOACA recognizes:

> *The historically inequitable results of transportation planning in Northeast Ohio and throughout the country, particularly the development of the highway system, which have facilitated and heightened racially segregated communities and disparate outcomes relative to mobility and access to opportunity. We are aware that there are still inequity implications across the region and the nation.*[45]

An Era of Demographic Change

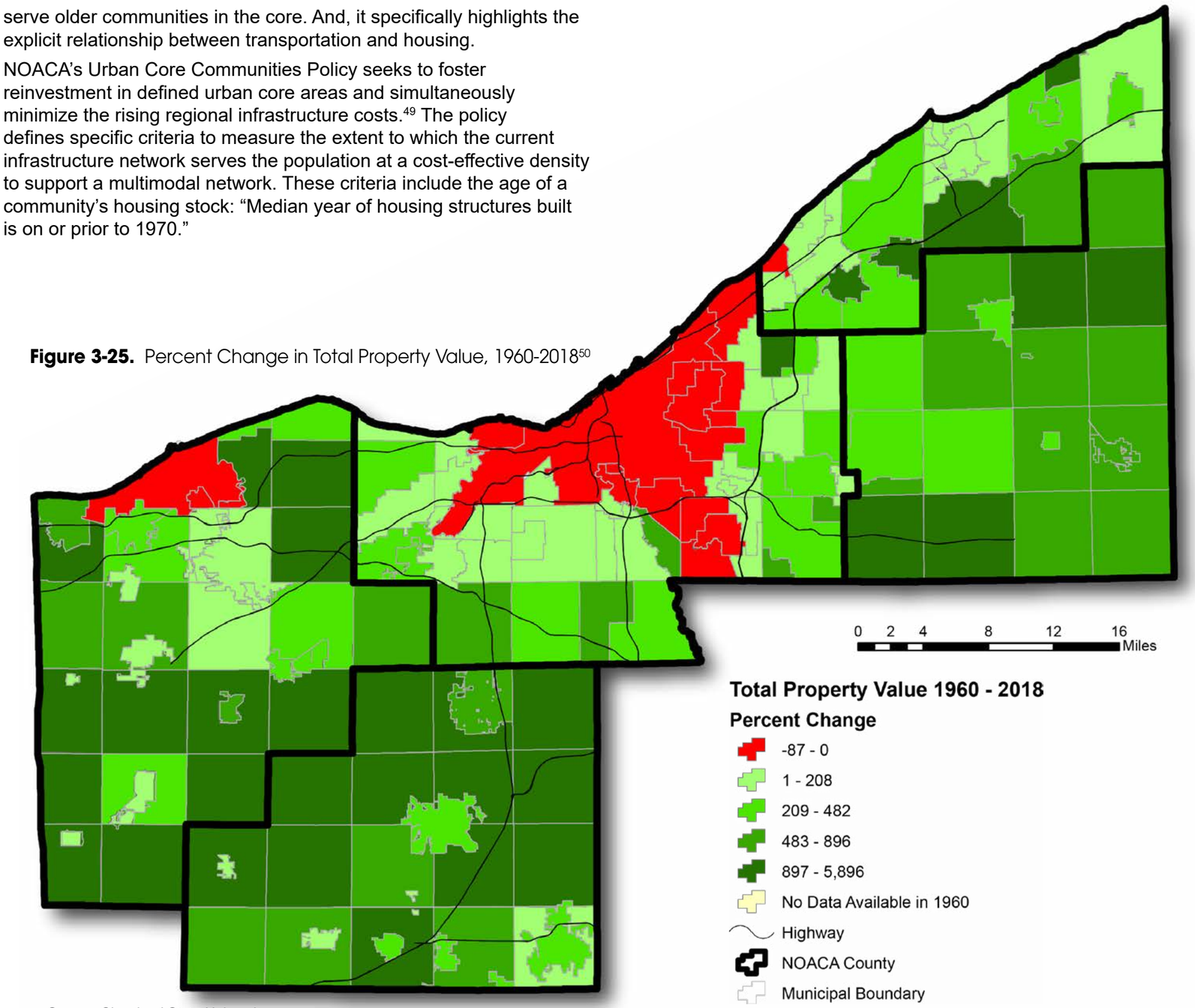
The onset of population decline was simultaneous with full development and implementation of the arterial and highway network presented in NOACA's first long-range transportation plan, *A Framework for Action*. An excess of capacity on area highways and freeways (built for a growing population that was now declining) made this possible, so commute times remained reasonably low.

The outward shift of a declining population in the region resulted in concentrations of vacant properties in urban and inner-ring suburban areas that were no longer desirable. Of the approximately 287,000 homes abandoned and demolished between 1960 and 2010 in the seven-county Northeast Ohio housing market, 150,000 were in the City of Cleveland and 8,000 were in East Cleveland.[46] While only 33,000 units of housing were built to replace the 150,000 homes demolished in Cleveland, 232,000 new homes were built outside the City of Cleveland.[47]

A 2020 study by Cleveland State University compiled assessed values (adjusted for inflation) of residential, commercial, and industrial properties in 226 communities across seven Northeast Ohio counties (1960-2018). The researchers used this data to measure change in property values and community tax bases over time (see Figure 3-25).[48] The results show how the slow decline of Northeast Ohio's population, combined with highway capacity expansion, created a clear dichotomy of the region's property values as reflected in the "green" and "red". This data demonstrates the impact of significant investment in the transportation network for vehicular traffic on the region, compared with the lack of equivalent investment in transit to serve older communities in the core. And, it specifically highlights the explicit relationship between transportation and housing.

NOACA's Urban Core Communities Policy seeks to foster reinvestment in defined urban core areas and simultaneously minimize the rising regional infrastructure costs.[49] The policy defines specific criteria to measure the extent to which the current infrastructure network serves the population at a cost-effective density to support a multimodal network. These criteria include the age of a community's housing stock: "Median year of housing structures built is on or prior to 1970."

Figure 3-25. Percent Change in Total Property Value, 1960-2018[50]



Source: Cleveland State University

NOACA Regional Survey: Housing and Accessibility

Proximity of Employment Opportunities and Affordable Housing

The NOACA Regional Survey also organized responses by other variables (age, Environmental Justice area status, income race, employment status, etc.). A review of those results reveal that income/race classification highlights the biggest differences in response to the two statements (see Figure 3-26). More specifically, Table 3-10 shows that lower-income, nonwhite respondents agree most strongly with the statement, "I prefer to live closer to my job but there aren't affordable houses or apartments." White respondents disagree, regardless of income.

Table 3-11 shows that lower-income, nonwhite respondents also agree with the statement, "It's hard for me to find a better job or make more money because of where I live." The other income/race groups disagree.

Figure 3-26. NOACA Regional Survey Results: Preferred Living and Working Arrangements

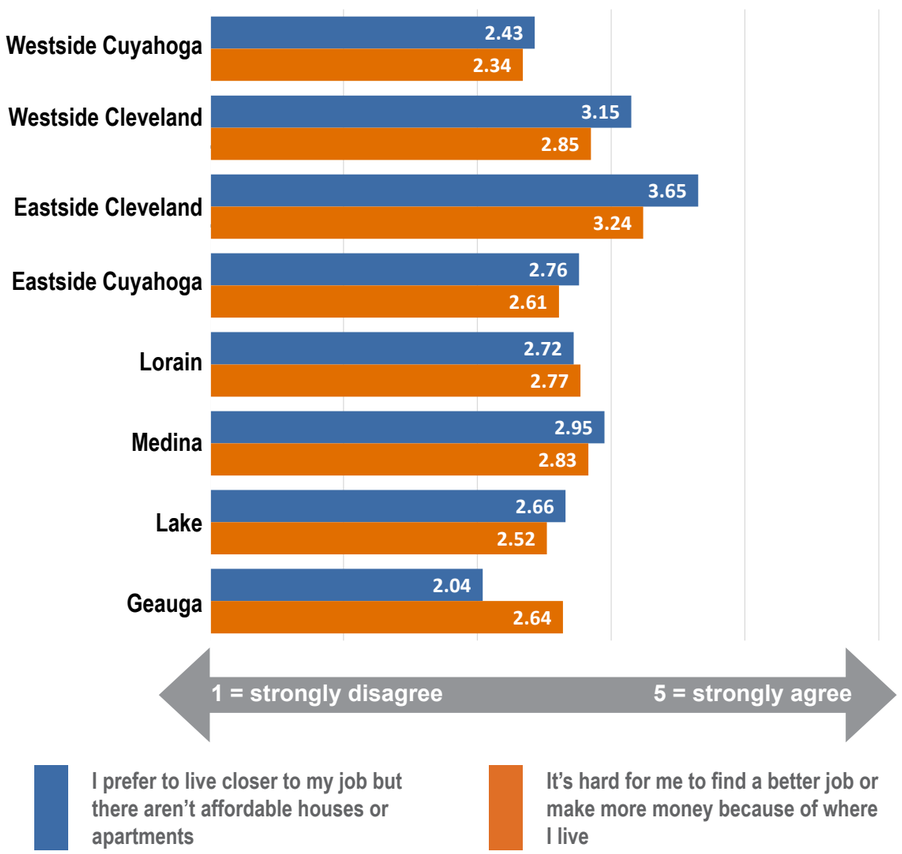


Table 3-10. NOACA Regional Survey Results: Affordable Housing Near Jobs

I PREFER TO LIVE CLOSER TO MY JOB BUT THERE AREN'T AFFORDABLE HOUSES OR APARTMENTS					
	NOACA REGION	HIGHER-INCOME WHITE	LOWER-INCOME WHITE	HIGHER-INCOME NON-WHITE	LOWER-INCOME NON-WHITE
Strongly Agree	14.48%	9.51%	13.83%	24.3%	30.83%
Somewhat Agree	17.12%	15.49%	18.97%	16.22%	26.32%
Neutral	25.57%	24.87%	26.48%	26.35%	25.56%
Somewhat Disagree	15.16%	17.71%	12.65%	14.86%	6.77%
Strongly Disagree	27.68%	32.42%	28.06%	18.24%	10.53%
Total Respondents	**100% (1,326)**	**100% (768)**	**100% (253)**	**100% (148)**	**100% (133)**
Mean	***2.76***	***2.52***	***2.78***	***3.14***	***3.60***

Table 3-11. NOACA Regional Survey Results: No Jobs Near Home

IT'S HARD FOR ME TO FIND A BETTER JOB OR MAKE MORE MONEY BECAUSE OF WHERE I LIVE					
	NOACA REGION	HIGHER-INCOME WHITE	LOWER-INCOME WHITE	HIGHER-INCOME NON-WHITE	LOWER-INCOME NON-WHITE
Strongly Agree	11.69%	8.46%	11.86%	14.86%	24.06%
Somewhat Agree	16.44%	13.80%	22.53%	18.24%	20.30%
Neutral	26.02%	25.13%	29.25%	23.65%	27.07%
Somewhat Disagree	16.82%	19.27%	11.07%	16.89%	12.03%
Strongly Disagree	29.03%	33.33%	25.30%	26.35%	16.54%
Total Respondents	**100% (1,326)**	**100% (768)**	**100% (253)**	**100% (148)**	**100% (133)**
Mean	***2.65***	***2.45***	***2.85***	***2.78***	***3.23***

Community Access to Products and Services

A final set of statements that respondents considered for the NOACA Regional Survey pertained to whether they agreed that their home community provided good access to products and services. Table 3-12 shows several types of products and services and average response scores across geographic areas. There was strongest agreement (average scores 4.00 and higher) on accessibility to services such as health care, retail stores, recreation, and entertainment. Agreement was less strong (scores below 4.00) on accessibility to education, affordable housing, jobs, and public transportation. The lowest average scores for education and affordable housing were from City of Cleveland respondents. While the Lorain County respondents averaged lower scores on accessibility to job opportunities, and all of the suburban respondents averaged lower on accessibility to public transportation (especially Lorain and Geauga counties).

When broken out by income/race groups, access scores were lowest among low-income, nonwhites and highest for high-income whites (except public transportation).

While respondents indicated they were generally satisfied with their residences, neighboring properties, communities, and access, significant challenges (aging infrastructure, disinvestment, outward migration, and lack of diverse transportation options) confront multiple entities in Northeast Ohio, including NOACA. Urban core and low-income, nonwhite respondents were least satisfied with their homes, communities, and accessibility. The needs expressed by low-income, minority respondents in core areas suggest opportunities for NOACA to focus its transportation infrastructure investment efforts more equitably to benefit existing communities and improve accessibility for the marginalized.

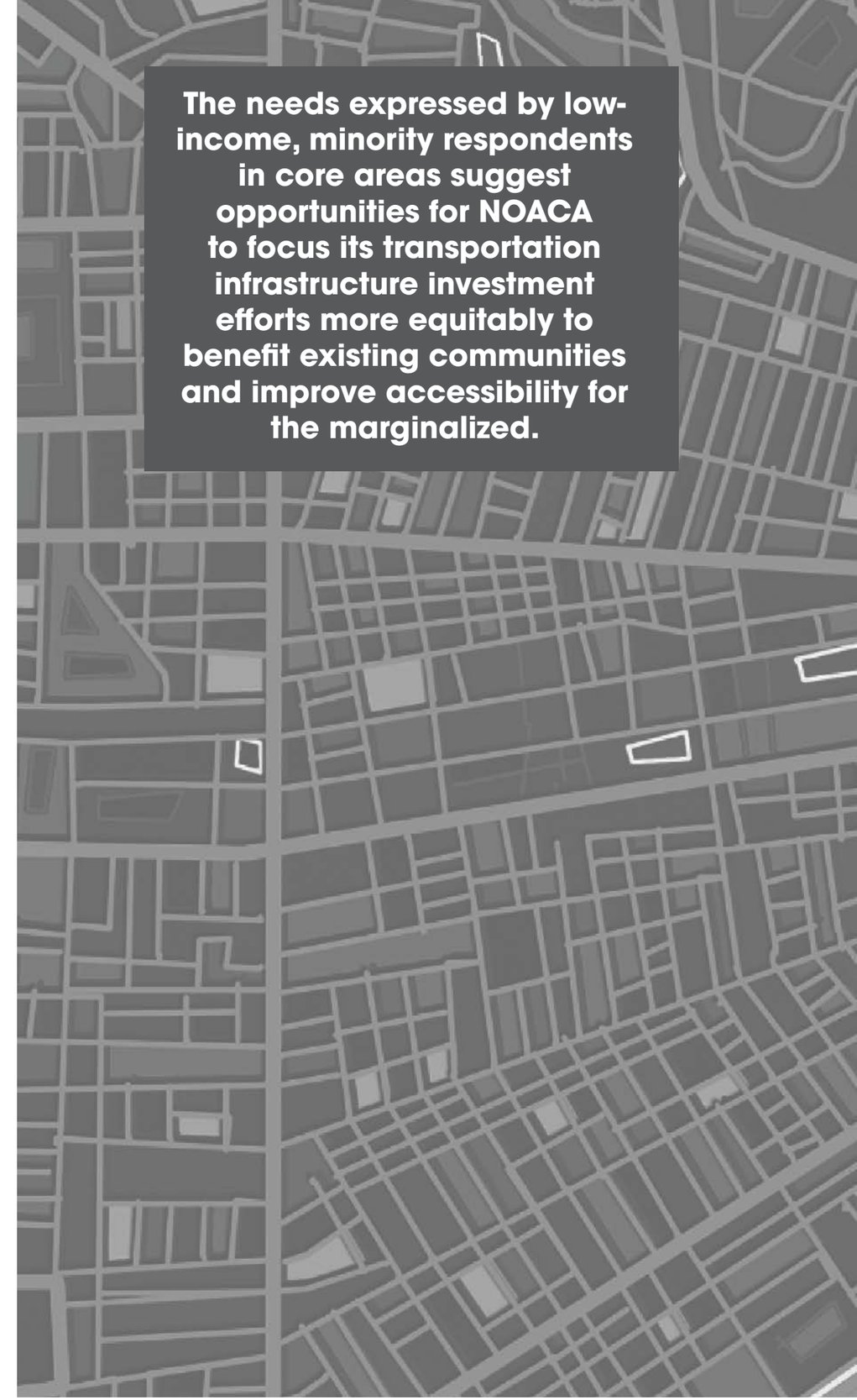
Table 3-12. NOACA Regional Survey: Community Access to Products and Services

5 = HIGHEST AND 1= LOWEST

I AGREE THAT MY HOME COMMUNITY PROVIDES GOOD ACCESS TO PRODUCTS AND SERVICES

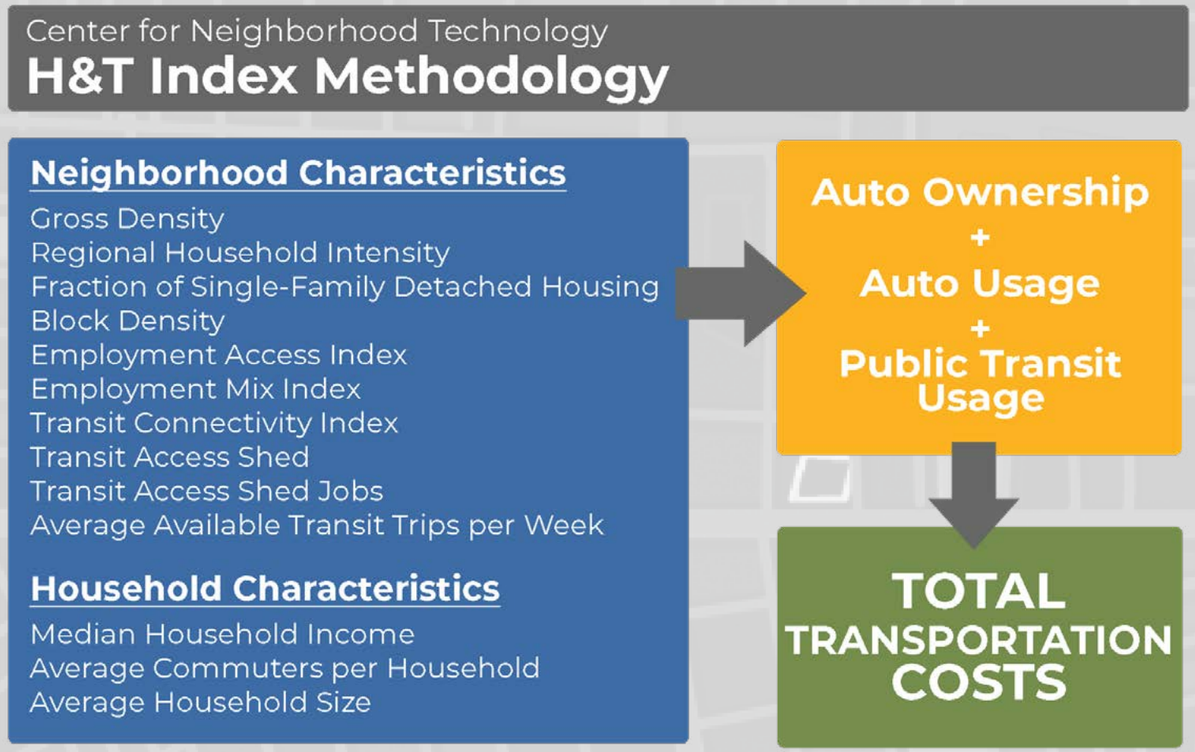
	TOTAL # RESPONSES	HOSPITALS & HEALTH CARE	STORES & GROCERY*	RECREATION**	ENTERTAINMENT & RESTAURANTS	EDUCATION & TRAINING***	AFFORDABLE HOUSING	JOB OPPORTUNITIES	JOB OPPORTUNITIES (FTEs)	PUBLIC TRANSPORTATION	PUBLIC TRANSPORTATION (IF RIDE WEEKLY+)
City of Cleveland	446	4.20	3.91	3.82	3.84	3.59	3.47	3.39	3.62	3.80	3.83
Cuyahoga County	1,086	4.44	4.38	4.20	4.19	3.88	3.67	3.55	3.65	3.62	3.84
Geauga County	91	4.40	4.37	4.23	4.00	4.05	3.71	3.67	3.71	2.82	3.24
Lake County	271	4.31	4.36	4.18	4.14	3.82	3.74	3.72	3.86	3.61	3.93
Lorain County	362	4.19	4.19	3.93	3.80	3.79	3.61	3.32	3.44	2.68	3.19
Medina County	207	4.19	4.20	4.13	3.99	3.80	3.53	3.63	3.74	3.14	3.45
NOACA Region	**2,463**	**4.32**	**4.25**	**4.08**	**4.04**	**3.81**	**3.62**	**3.52**	**3.66**	**3.44**	**3.83**

*Stores and services (including fresh food/grocery), **Recreational activities including parks, playgrounds, and swimming pools, ***Educational/training opportunities



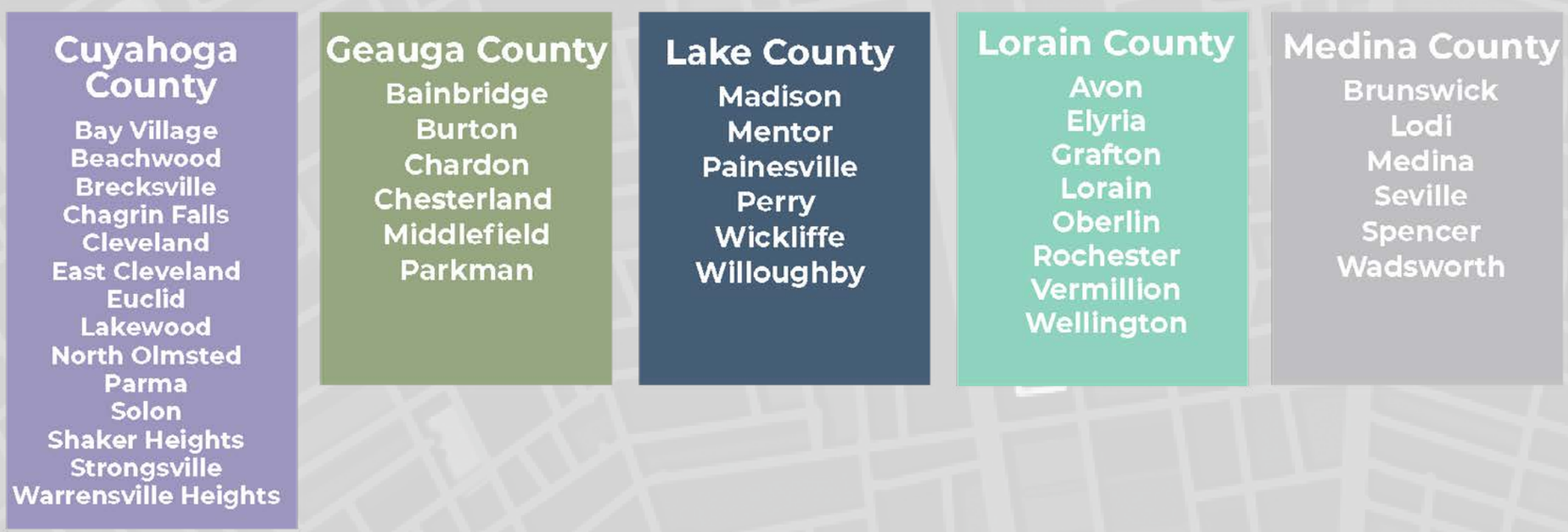
The needs expressed by low-income, minority respondents in core areas suggest opportunities for NOACA to focus its transportation infrastructure investment efforts more equitably to benefit existing communities and improve accessibility for the marginalized.

Figure 3-27. H+T Index Methodology[55]



Source: Center for Neighborhood Technology

Figure 3-28. Northeast Ohio Communities Analyzed with H&T Index



Housing and Transportation Index: The Intersection of Affordability

Northeast Ohio is generally considered to have an affordable housing market, especially when compared to other metropolitan regions in the United States. The median sale price in Cuyahoga County in 2020 was $140,000, still far below the median U.S. sale price of $274,500.[51] When monthly housing prices are viewed as just one piece of the overall cost of living, however, a different picture emerges.[52]

The Center for Neighborhood Technology (CNT) is an organization that focuses on research and technology solutions to improve sustainability and equity within economic development, climate resilience, and urban analytics. CNT created its Housing and Transportation Affordability Index (H+T Index) to inform its Location Efficiency Hub work, using technology to make places more sustainable. The H&T Index calculates affordability at the intersection of housing and transportation, as transportation is the second-highest cost burden for households (see Figure 3-27). It also ranks communities based on job and transit access, as well as density and walkability.[53] CNT sets an affordability benchmark at 45% of a household budget as the maximum allocation toward both housing and transportation costs. CNT found that only 26% of U.S. neighborhoods met this benchmark.[54]

NOACA analyzed affordability for 41 communities in the five counties in Northeast Ohio that NOACA covers (Figure 3-28). Only six communities met CNT's affordability benchmark of 45%: East Cleveland, Cleveland, Warrensville Heights, Euclid, Lodi, and Lorain, primarily due to low housing values.

Figure 3-29. H&T Index Results: Income Spent on Housing and Transportation

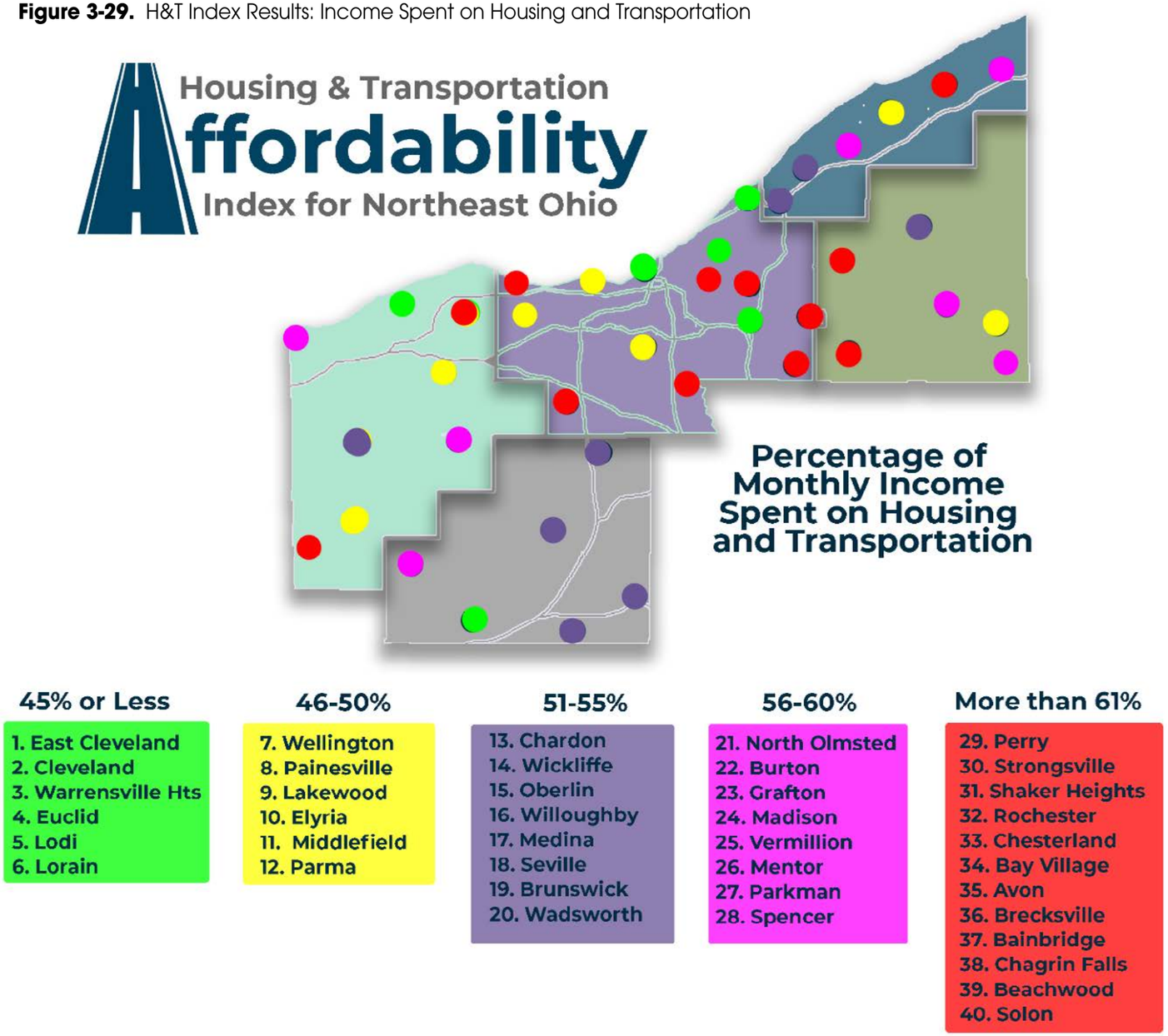


Figure 3-29 shows the total percentage of average local income spent on housing and transportation for each of the 41 communities.

To better analyze and understand the overall methodology and data outputs, NOACA examined and mapped housing and transportation costs as separate variables. To calculate housing costs, CNT used nationally available datasets.[56] The other side of the H+T Index, transportation, is "modeled based on three components of transportation behavior—auto ownership, auto use, and transit use—which are combined to estimate the cost of transportation."[57]

See Figure 3-30 for the highest and lowest housing costs as a percentage of monthly income. See Figure 3-31 for the highest and lowest transportation costs as a percentage of monthly income.

Many of the communities with low housing costs are in either older urban cities or rural areas. Those with the highest housing costs are suburban or exurban, but still close to job hubs and with most housing stock as single-family homes.

Communities with the highest transportation costs are those in rural, peripheral locations within their counties, those with limited public transit service, or those in areas that are not easily accessible by highways. Owning or having access to a personal vehicle is necessary in those locations. Conversely, those with the lowest transportation costs are urban communities close to highways and transit routes. Most communities with low transportation costs also rank highly in Job Access Score, Transit Performance Score, and Compact Neighborhood Score.

Affordable Revitalization: Workforce Housing

The data shared here suggest although some progress has been made, there are insufficient units of affordable housing within access of jobs and opportunity for some of its residents, particularly those with the greatest need.

In response to the abundant development of high-end homes, apartments, condominiums, and townhomes in the region, housing and equity advocates have called for more affordable options near jobs. Low and middle income workers do not earn enough to live in the communities in which they work. This is especially true for teachers, fire-fighters and healthcare workers, as well as hospitality staff and light manufacturing employees. The Urban Land Institute describes workforce housing as "affordable to households earning between 60 to 120 percent of area median income (AMI)".[58]

Figure 3-30. H&T Index Results: Communities with Highest and Lowest Housing Costs

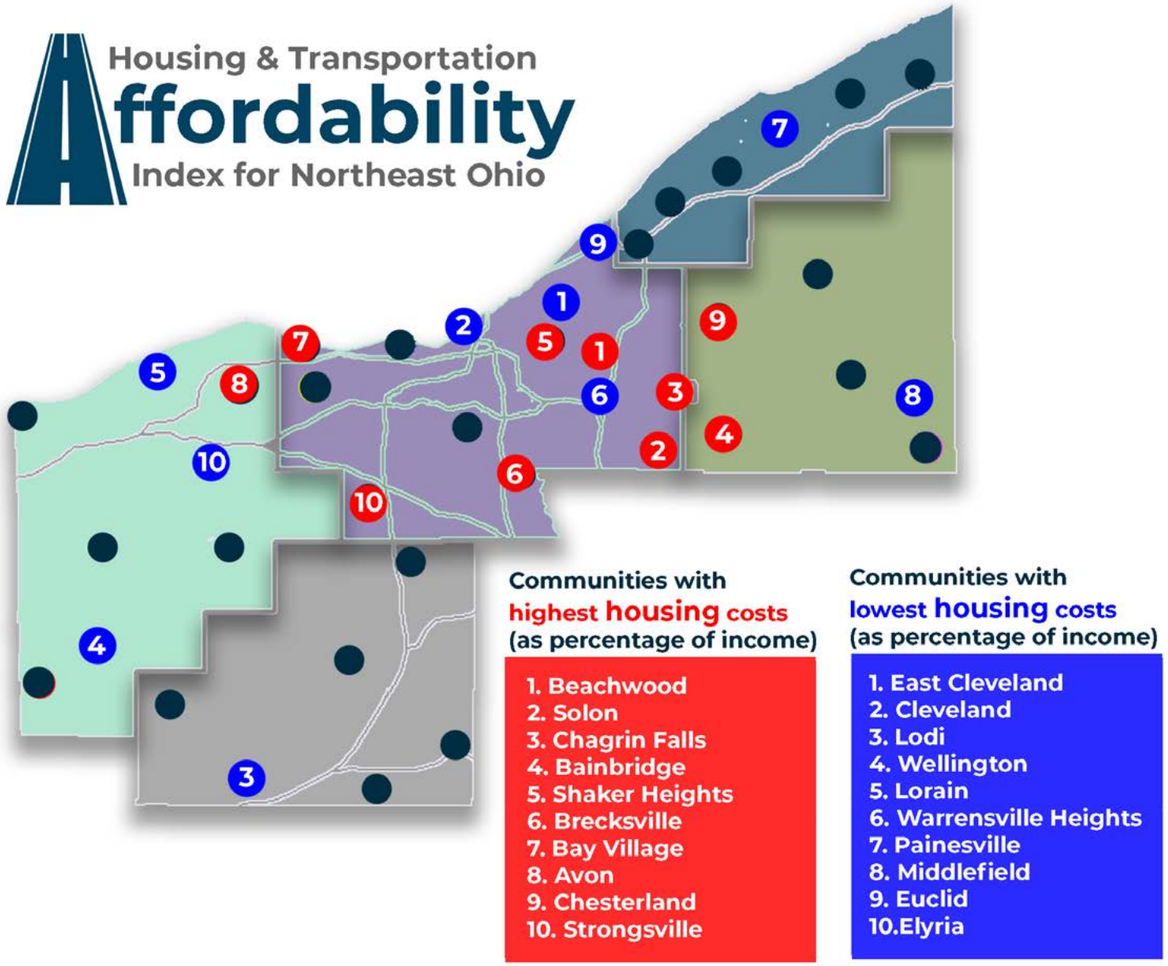
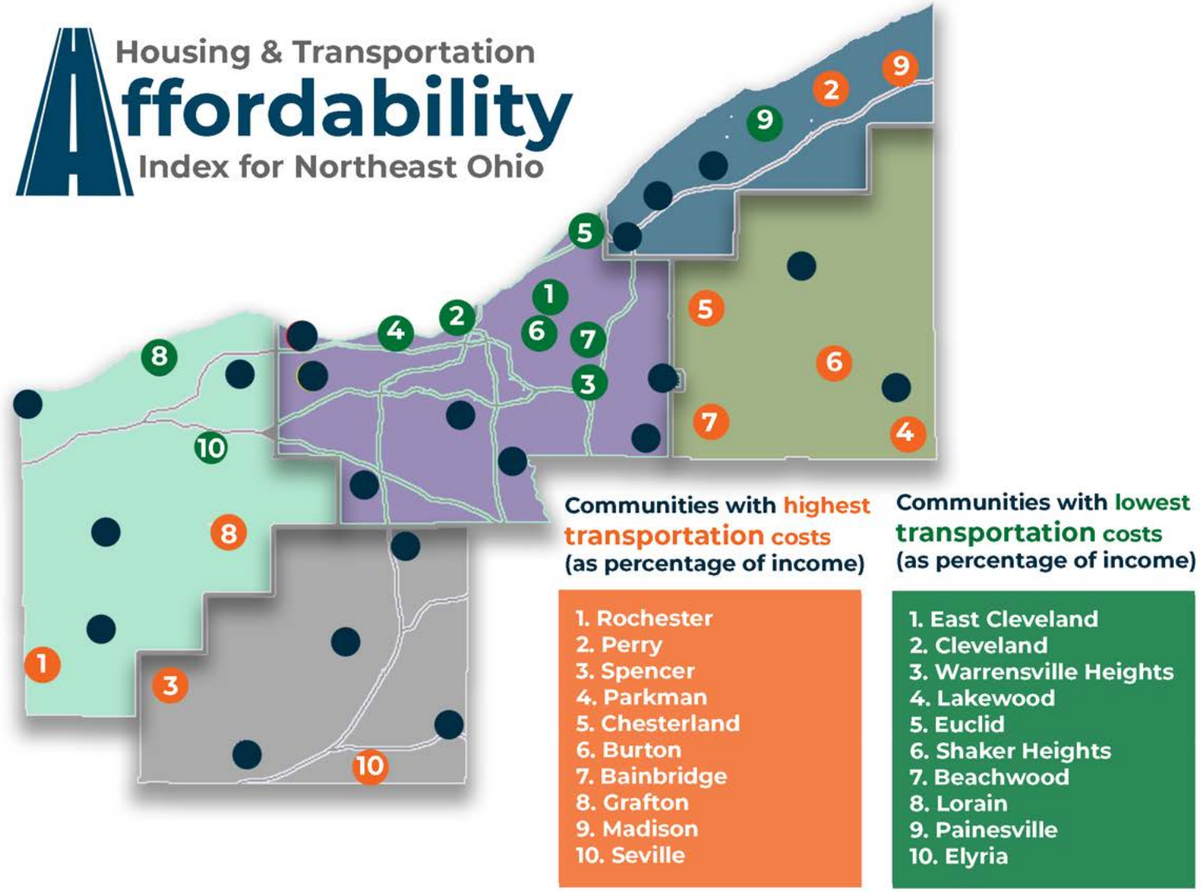


Figure 3-31. H&T Index Results: Communities with Highest and Lowest Transportation Costs



Environmental Stewardship for the Planet and its People

Individual, Societal and Long-term Impacts of Transportation

Investing in a regional transportation system influences the quality of life of the residents; this includes water and air quality but also questions over health and active lifestyles. As a designated areawide agency, NOACA is responsible for water quality planning for the region. Furthermore, as part of its transportation functions, NOACA is deeply involved with issues related to air quality with responsibility for issuing alerts for Ozone Action days and allocating resources for transportation projects that reduce mobile emissions. As an agency, when we look at investing into our regional road network, we see more than just a right-of-way designated for the movement of vehicles, but we rather see an opportunity to improve the quality of life for everyone by considering the needs of all users and potential improvements that respects the environment, particularly considering the excess capacity in some parts of the transportation network that is conducive to these considerations.

NOACA plays a major role in the analysis of both the impacts of the region's transportation investments on greenhouse gas (GHG) emissions and climate resilience, and what actions the region should take to reduce emissions in order to achieve climate goals. The agency already completes an annual GHG emissions inventory for each of its five counties, and it has the capacity to provide detailed technical support to member communities. Each year, NOACA produces its Air Quality Trends Report, which provides a comprehensive overview of air quality in Northeast Ohio and how the region performs on each of the NAAQS. Through this annual report, NOACA provides up-to-date information on how pollution levels change over time, which informs public education and policy making throughout the region.

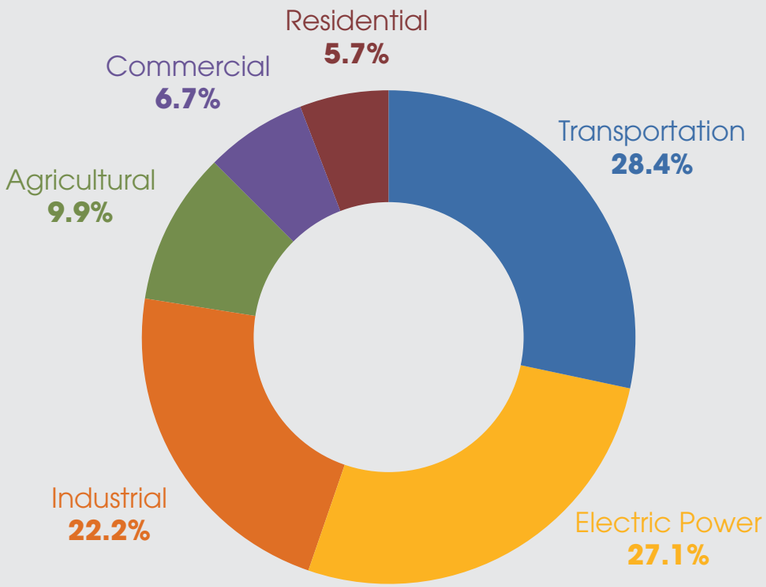
Air Quality

National Ambient Air Quality Standards (NAAQS) and Attainment Status

Historically, Northeast Ohio has struggled with poor air quality, due in part to its reliance on heavy industry and the use of coal to produce electricity. While the smokestacks from facilities such as steel mills, oil refineries, and coal-fired power plants long dominated the landscape in the region, mobile emissions have actually been the primary source of air pollution in Northeast Ohio since at least 1990. On-road vehicles continue to generate a plurality (31.6%) of criteria pollutant emissions. Additionally, two of the pollutants most closely linked to mobile emissions—ozone (O_3) and fine particulate matter ($PM_{2.5}$)—have declined by smaller margins. As Table 3-13 illustrates, while the region's air quality has improved dramatically over the past 50 years, this rate of improvement has slowed since 2010, which mirrors the national trend.[59]

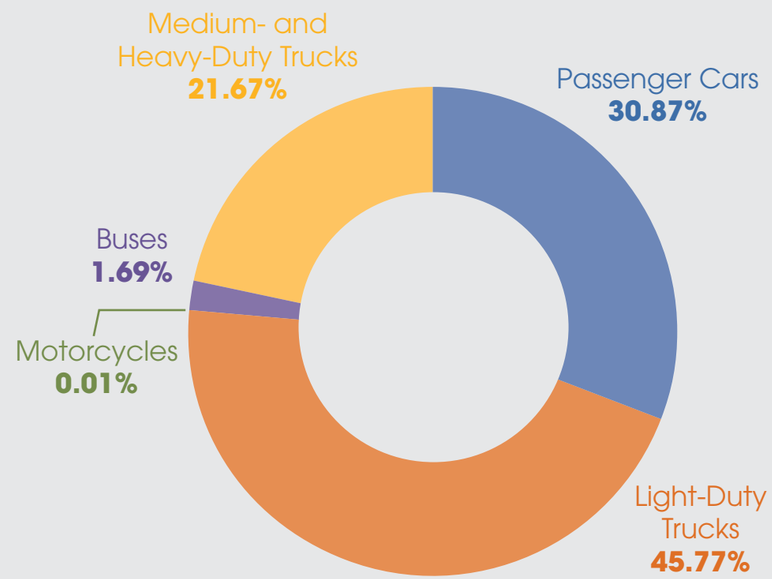
In 1970, the United States Congress passed its first round of amendments to the existing federal Clean Air Act (CAA), which laid out a framework to control air pollution at the federal, state, and local levels. Because transportation accounts for a significant portion of air pollution, the 1977 Clean Air Act Amendments (CAAA) introduced the concept of transportation conformity. Under this provision, a region's transportation plans, programs, and projects cannot interfere with the region's air quality goals.[60] MPOs such as NOACA must demonstrate that their long-range transportation plans (LRTPs) and Transportation Improvement Plans (TIPs) conform to these goals through a process known as a conformity determination.[61] The conformity determination is included in Chapter 7.

Figure 3-32. Share of GHG Emissions in the United States, by Sector[64]



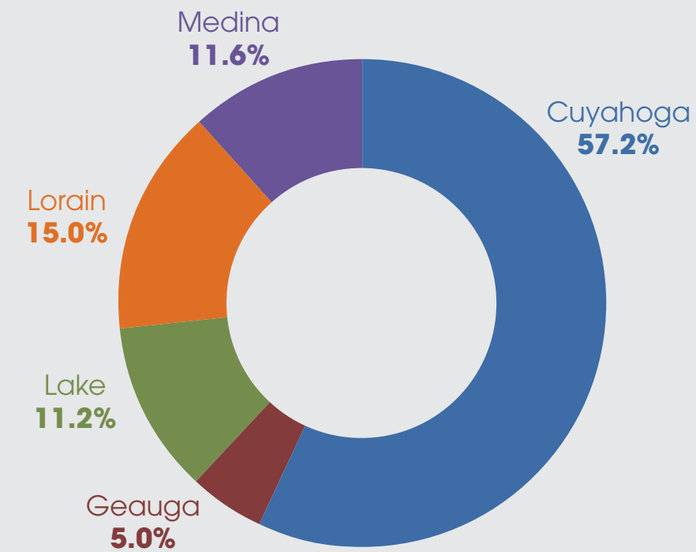
Source: U.S. EPA

Figure 3-33. Share of GHG Emissions by Vehicle Type in Northeast Ohio, 2019[65]



Source: NOACA estimates using MOVES2014a.

Figure 3-34. Share of GHG Emissions by County, 2019[66]



Source: NOACA estimates using MOVES2014a.

Relationship between Transportation and Climate Change

As Figure 3-32 shows, transportation is the leading source of GHG emissions in the U.S. at 28.4%. It overtook the electric power sector in 2016, and projections indicate its share of emissions will grow further as coal continues to play a smaller role in electricity production. Similarly, transportation accounts for around one-quarter of total GHG emissions in Northeast Ohio.[63] Transportation sector GHG emissions vary by county. Regionally, transportation accounted for more than 8.7 million metric tons of carbon dioxide equivalent ($MMTCO_2e$) during 2019 (Figure 3-34). While Cuyahoga County accounted for the largest share of total emissions (57.2%), this was lower than its share of the regional population (60.3%). In turn, both Geauga and Medina Counties made up a higher share of GHGs than their share of population. These numbers highlight the fact that individuals living in suburban and exurban areas tend to produce more GHGs from transportation. Northeast Ohio residents produced 4.3 tons of on-road CO_2e per capita during 2019, below the national average of 4.8. The per capita totals ranged from a low of four tons per capita in Cuyahoga County to a high of 5.6 tons per capita in Medina County.

Table 3-13. Summary of Nonattainment Status for Northeast Ohio[62]

POLLUTANT		AVERAGING TIME	LEVEL	ATTAINMENT STATUS	COUNTIES IN NONATTAINMENT
Carbon Monoxide (CO)		8-hour	9 ppm	Maintenance	N/A
		1-hour	35 ppm	Maintenance	N/A
Lead (Pb)		Rolling 3-month average	0.15 μg/m³	Maintenance	N/A
Nitrogen Dioxide (NO_2)		1-hour	100 ppb	Unclassifiable/Attainment	N/A
		Annual	53 ppb	Unclassifiable/Attainment	N/A
Ozone (O_3)		8-hour	70 ppb	Marginal Nonattainment	Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit
Particle Pollution	$PM_{2.5}$	Annual	12 μg/m³	Maintenance	N/A
		24-hour	35 μg/m³	Maintenance	N/A
	PM_{10}	24-hour	150 μg/m³	Maintenance	N/A
Sulfur Dioxide (SO_2)		1-hour	75 ppb	Maintenance	N/A

Source: US EPA

Table 3-14. Mobile Emissions for Criteria Pollutants in Northeast Ohio, 2017[67]

POLLUTANT		TOTAL EMISSIONS (TONS)	MOBILE EMISSIONS (TONS)	HIGHWAY VEHICLES EMISSIONS (% TOTAL)	NON-HIGHWAY VEHICLES EMISSIONS (% TOTAL)
CO		337,061	243,884	38.5%	33.9%
O_3	NO_X	49,387	37,305	48.2%	28.3%
	VOCs	91,873	20,430	12.6%	9.6%
Particle Pollution	$PM_{2.5}$	33,817	3,072	6.2%	2.9%
	PM_{10}	12,553	1,857	7.4%	7.4%
SO_2		5,373	333	3.2%	3.1%

Source: US EPA

Table 3-14 outlines the contribution of mobile sources (highway and off-highway vehicles) to each of the criteria pollutants in Northeast Ohio. These include key primary pollutants (CO, PM_{10}, $PM_{2.5}$, and SO_2) and precursors for secondary pollutants of concern (NO_x and VOCs). As the charts indicate, transportation is a significant source of several pollutants, specifically CO, NO_x, $PM_{2.5}$, and VOCs.

Table 3-15. NOACA Regional Survey Results: Air Quality

THE OUTDOOR AIR WHERE I LIVE IS CLEAN			
	NOACA REGION	ENVIRONMENTAL JUSTICE AREAS	NON-ENVIRONMENTAL JUSTICE AREAS
Strongly Agree	29.19%	22.16%	35.85%
Somewhat Agree	43.46%	41.24%	45.99%
Neutral	17.48%	22.85%	12.25%
Somewhat Disagree	7.61%	10.22%	5.11%
Strongly Disagree	2.26%	3.52%	0.81%
Total Respondents	**100% (2,432)**	**100% (1,164)**	**100% (1,233)**
Mean	**3.90**	**3.68**	**4.11**
Monthly Investment in Cleaner Air	*$12.73*	*$14.84*	*$10.32*

Table 3-16. NOACA Regional Survey Results: Perception of Clean Rivers and Lakes

THE WATER IN NORTHEAST OHIO'S RIVERS AND LAKES IS CLEAN			
	NOACA REGION	ENVIRONMENTAL JUSTICE AREAS	NON-ENVIRONMENTAL JUSTICE AREAS
Strongly Agree	13.22%	12.55%	13.89%
Somewhat Agree	34.71%	30.18%	38.83%
Neutral	27.34%	28.03%	27.05%
Somewhat Disagree	17.83%	20.03%	16.08%
Strongly Disagree	6.92%	9.20%	4.14%
Total Respondents	**100% (2,429)**	**100% (1,163)**	**100% (1,231)**
Mean	**3.29**	**3.17**	**3.42**
Monthly Investment in Cleaner Rivers and Lakes	*$13.57*	*$15.49*	*$11.30*

Environmental Justice and Air Quality

The NOACA Regional Survey asked respondents whether they agreed or disagreed with the following statement: "The outdoor air where I live is clean." Table 3-15 illustrates respondents' level of agreement or disagreement with this statement. For each set of responses, the survey consultant broke out the responses by whether respondents lived inside or outside an Environmental Justice area. Table 3-15 shows there is general agreement in Northeast Ohio that outdoor air is clean; however, there are some differences in the strength of that agreement, as indicated by the mean response scores in the tables. Table 3-15 shows stronger agreement from respondents outside Environmental Justice Areas (72% agree) than respondents inside Environmental Justice Areas (63% agree).

Air pollution is a global burden, one that the World Health Organization (WHO) has called the greatest environmental health risk.[68] There is a clear connection between land-use patterns and individual exposure to air pollution. The durability of land-use patterns prolongs the impacts of land-use decisions for decades. The result is a disproportionately negative impact from air pollution on low-income and minority communities. Air pollution is most acutely harmful to vulnerable groups in Northeast Ohio. Children suffer significant health impacts from pollution exposure. The elderly and people with existing health conditions also bear a heavy toll from air pollution, as it can exacerbate these underlying issues, reduce their quality of life, and shorten their life expectancies.

The economic, environmental and health costs of Northeast Ohio's air pollution is significant (Table 3-17); improved air quality can make the region a more attractive, equitable place to live and work. Air pollution is connected to a host of health issues, including respiratory illnesses (e.g., asthma, bronchitis, and emphysema), low birthweight, premature birth, and infant mortality, heart disease, including heart attacks, behavioral conditions and cognitive issues, lung cancer; and premature death.[69] Northeast Ohio has directly benefited from the long-term decreases in pollutant levels. One recent analysis found that, since 1970, air quality improvements associated with the CAA have extended the average life expectancy of people within the region by 2.3 years.[70]

Climate Resilience

The NOACA Regional Survey provided respondents several statements about climate change and, for each, asked whether they agreed or disagreed:

1. Climate change is real.
2. Human behavior contributes to climate change.
3. Northeast Ohio is prepared for climate change.
4. My efforts to help will contribute to doing something about climate change.

Table 3-18 illustrates respondents' level of agreement or disagreement with these statements across NOACA's primary geographic units.

Table 3-18 shows general agreement among respondents that: 1) Climate change is real; and 2) Human behavior contributes to climate change. Although there is some variation in strength of agreement among geographic units on both statements, regional scores average higher than 4.00. It is interesting to note that the City of Cleveland respondents agree most strongly with the first statement, while Geauga County respondents agree most strongly with the second statement. Medina County respondents, on the other hand, agree the least with both statements. Table 3-18 also shows general agreement among respondents that individual efforts can make a positive difference toward action about climate change. Again, Medina County respondents agree the least.

Despite agreement about the reality of the problem, Table 3-18 also shows respondents do not agree that Northeast Ohio is prepared for climate change. This disagreement is not very strong, but the sentiment is consistent across geographic units and marks a substantial gap between problem recognition and confidence in the future. These responses help frame the problem of climate change for policy makers and elected officials in Northeast Ohio.

Although no area is immune from the negative effects of a changing climate, these effects will impact communities disproportionately. Just as other negative environmental impacts tend to fall more on low-income and minority neighborhoods, the same will be true for climate change.

Table 3-17. Public Health Impacts of Mobile Emissions in the NOACA Region, 2016

TYPE OF IMPACT	INCIDENCE	TOTAL COST (2016 $)
Mortality (low estimate)	51 deaths	$545.5 million
Mortality (high estimate)	116 deaths	$1.2 billion
Nonfatal heart attacks (low estimate)	5 heart attacks	$747,410
Nonfatal heart attacks (high estimate)	44 heart attacks	$7.3 million
Respiratory Hospital Admissions	11 admissions	$387,187
ER Visits for Asthma	23 visits	$12,733
Minor Restricted Activity Days	30,464 days	$2.6 million
Lost Work Days	5,077 days	$1.0 million
Asthma Exacerbations	1,023 attacks	$75,174
Total Health Costs (low estimate)*		**$554.5 million**
Total Health Costs (high estimate)*		**$1.3 billion**

* Total costs do not include all health impacts and are therefore greater than the sum of the individual impacts.
Source: NOACA estimates using U.S. EPA's COBRA model

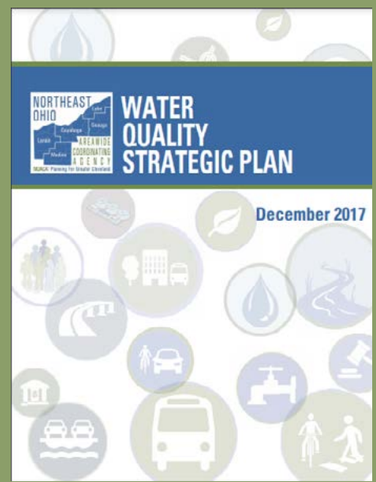
Table 3-18. NOACA Regional Survey Results: Statements About Climate Change

	5 = HIGHEST AND 1= LOWEST AGREEMENT WITH THE FOLLOWING STATEMENTS			
	CLIMATE CHANGE IS REAL	HUMAN BEHAVIOR CONTRIBUTES TO CLIMATE CHANGE	NORTHEAST OHIO IS PREPARED FOR CLIMATE CHANGE	MY EFFORTS WILL HELP
City of Cleveland	4.25	3.93	2.90	3.70
Cuyahoga County	4.16	4.13	2.76	3.80
Geauga County	3.92	4.15	2.78	3.80
Lake County	4.04	4.04	2.76	3.69
Lorain County	4.04	4.00	2.70	3.65
Medina County	3.89	3.81	2.84	3.51
Total Respondents	**4.11**	**4.04**	**2.79**	**3.72**

Figure 3-35. Highlighted NOACA Plan: *Water Quality Strategic Plan*

WATER QUALITY STRATEGIC PLAN

ADOPTED DECEMBER 2017



PLAN HIGHLIGHTS

- NOACA'S *Water Quality Strategic Plan (WQSP)* establishes a consensus-driven mission, goals, objectives, and strategies to guide the staff-supported work of the agency.
- The plan builds on current land-use and employment trends that affect water resources and infrastructure in both rural and urban communities.
- The goals of the plan include:
  1. Support Work to Restore and Protect Lake Erie and the Region's Freshwater Assets
  2. Promote Water's Value as a Regional Driver of Economic Competitiveness
  3. Identify and Inform Communities and Organizations about Regional Impacts of Local Water Infrastructure Decisions
  4. Advance the Philosophy of "One Water" through NOACA's 208 Planning Process
  5. Within NOACA's Internal Structure, Consider and Address Potential Water Quality Impacts of Transportation Projects

Figure 3-36. Highlighted NOACA Plan: *Clean Water 2020*

CLEAN WATER 2020

ADOPTED SEPTEMBER 2020

PLAN HIGHLIGHTS

- *Clean Water 2020* is NOACA's wastewater management and water quality plan under Section 208 of the Clean Water Act (CWA).
- The plan focuses on the protection and restoration of water resources in a region where the population has slowly declined while it has spread out over a larger area.
- *Clean Water 2020* emphasizes:
  - optimization of existing infrastructure
  - minimization of development impacts associated with sanitary sewer extensions
  - protection of regional water quality improvements
  - support for watershed planning
  - protection and restoration of critical water resources
  - support for efforts to manage stormwater runoff and on-site sewage treatment systems.

Regional Water Quality

Water Resource Concerns

The quality of water resources in Northeast Ohio is the product of the natural landscape and human activities. The top five causes of impairments that affect aquatic life in Northeast Ohio are impacted habitats, sedimentation/siltation, natural flow changes, presence of metals, and high levels of nutrients. The top five sources that cause these impairments are impacted streams, stormwater runoff from developed areas, natural processes, opportunistic bacteria, and agricultural impacts. Transportation policies and decisions on water and wastewater infrastructure influence the region's development patterns that link to many of the causes and sources of stream impairments. Specifically, Northeast Ohio's past outward development patterns have increased both impervious (hard) surfaces and the amount of wastewater infrastructure to serve a smaller population. Intraregional migration also removes customers from existing urban sewerage systems and disturbs groundwater recharge areas.

The conversion of natural areas or agricultural lands to residential, industrial, or commercial development increases the impervious surfaces (e.g., roads, parking lots, roofs, sidewalks, etc). See Figure 3-37 and Figure 3-38. Over the last few decades, impervious surface cover has increased substantially in multiple Northeast Ohio HUC 12 subwatersheds. Multiple studies have shown increasing imperviousness harms water quality. Impervious surfaces increase the amount and speed of water runoff and lead to increased erosion and unstable streams. More runoff also brings more pollutants (e.g., nutrients, metals, bacteria, etc.) to the local waterways. Runoff over hot impervious surfaces can increase the water temperature in local waterways and deplete the dissolved oxygen for aquatic life.[71] Figure 3-39 presents the attainment status of waterways within Environmental Justice Areas along with the subwatershed imperviousness percentage. Waterways within subwatersheds characterized by higher impervious cover are more likely to result in nonattainment. Figure 3-37 also shows waterways within identified Environmental Justice Areas are also more likely to be impaired.

Figure 3-35 and Figure 3-36 showcase NOACA's *Water Quality Strategic Plan* and *Clean Water 2020*. Both plans shape NOACA's water quality efforts.

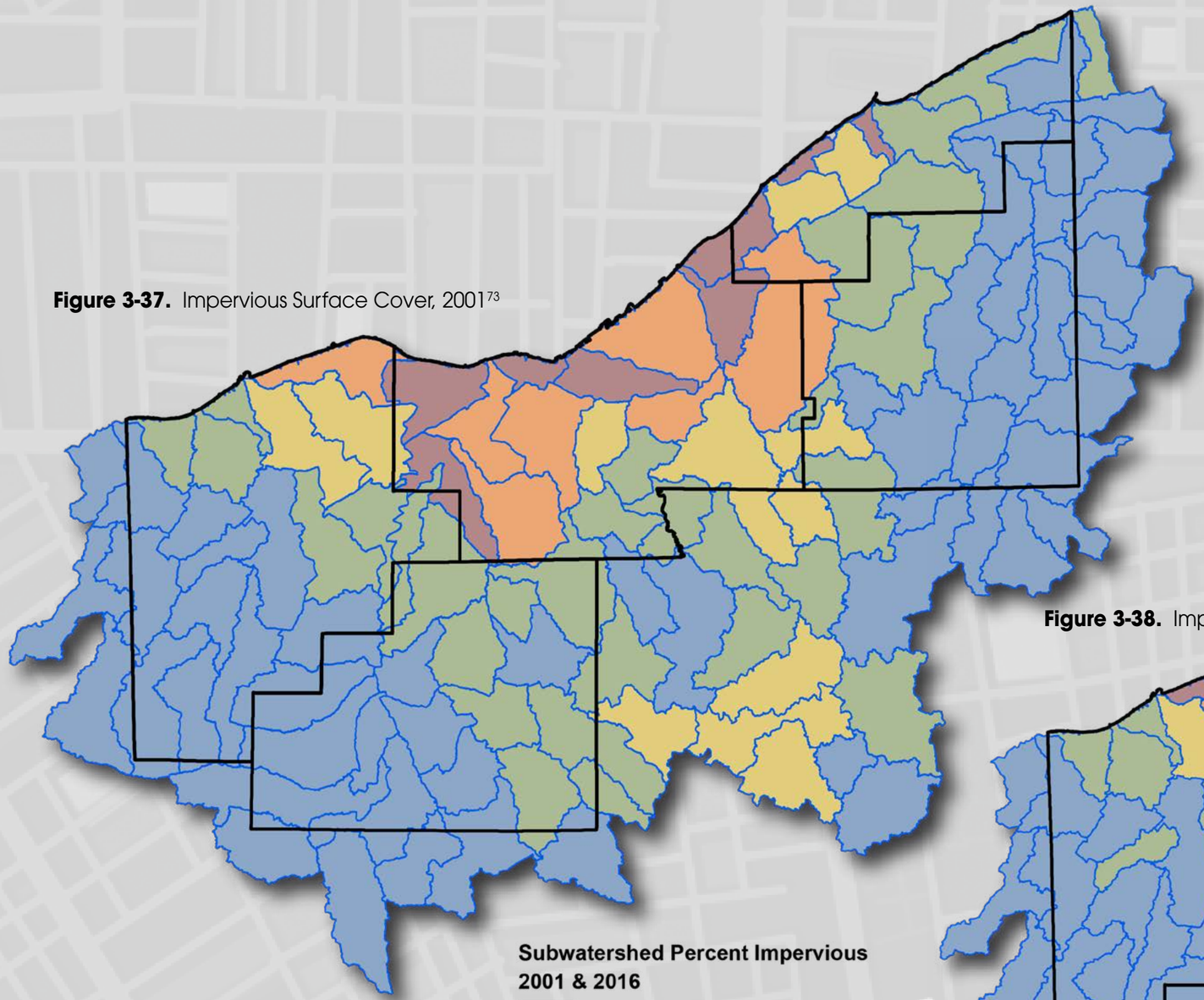
Wastewater Management

Infrastructure decisions enable development on previously undeveloped land, as well as reinvestment in the urbanized areas. These infrastructure decisions do not just include transportation but also wastewater management decisions. When it comes to these types of infrastructure, urbanized and rural areas have different needs. Adequate conveyance and treatment of wastewater is critical for watershed health. The development of urban and suburban areas can result in increased flooding. The placement of wastewater infrastructure plays a critical role in enabling the disbursement of population, businesses and services, as well as the other way around.

Groundwater Resources

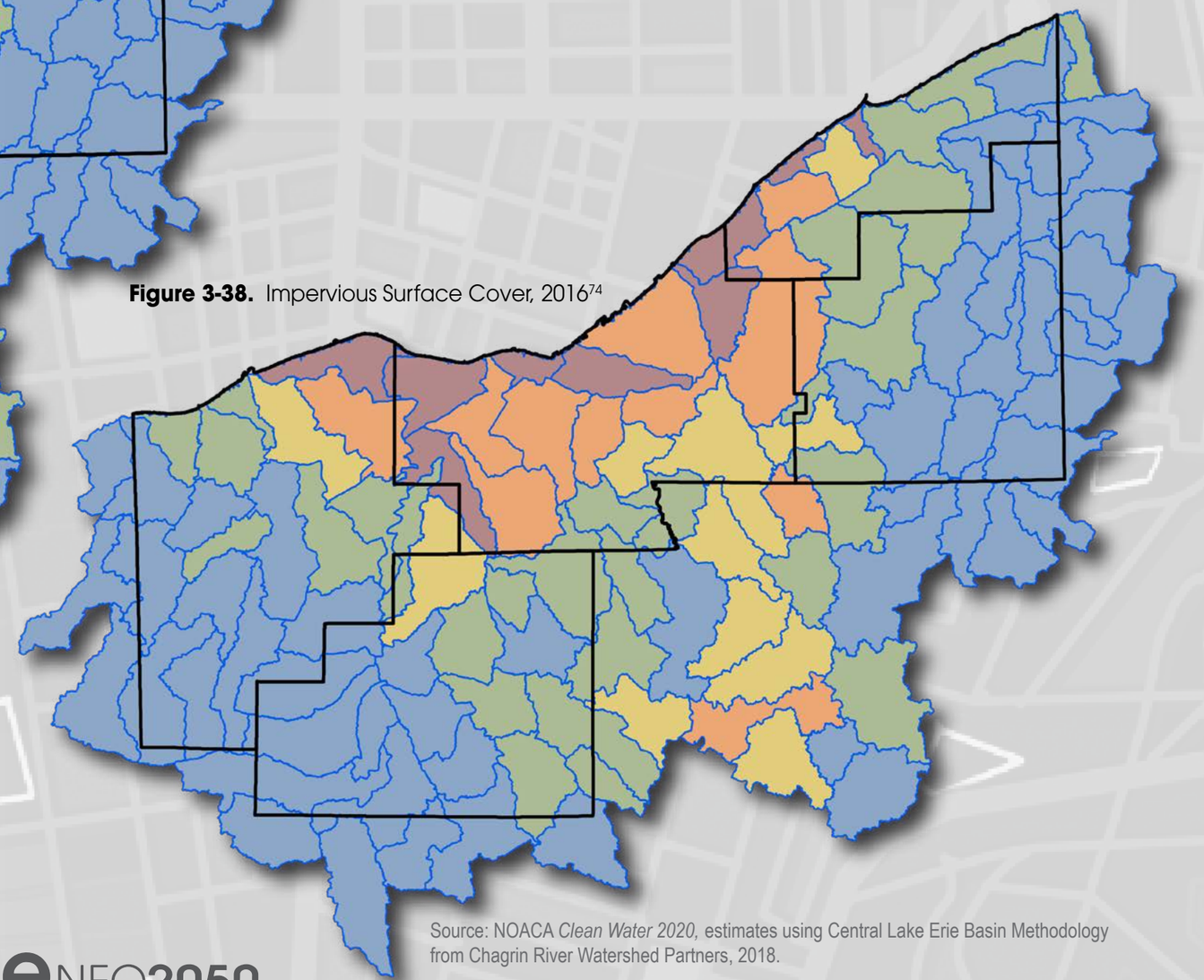
The increase in impervious surfaces from the region's development patterns also impacts the region's groundwater. Additional impervious surface from development reduces the area where water can infiltrate into the ground. The lack of groundwater recharge can lead to a lowering of the groundwater table. Streams, lakes, wetlands, and other water resources feed (connect) to the groundwater table. Groundwater primarily maintains the base flow (sustained flow without direct runoff) for most streams.[72] Many properties and communities rely on groundwater at their primary drinking water. Future transportation scenarios that are reliant on the automobile would likely result in higher percentages of impervious surface, which may result in increased vulnerability for groundwater contamination. Common groundwater pollution sources are industry; fertilizers; failing sewage treatment systems; construction sites; and runoff of oil, gas, and salt from roads and other impervious surfaces. Utilizing currently developed portions of the region, may slow the expansion of impervious surface and preserve natural open space.

Figure 3-37. Impervious Surface Cover, 2001[73]



Source: NOACA *Clean Water 2020,* estimates using Central Lake Erie Basin Methodology from Chagrin River Watershed Partners, 2018.

Figure 3-38. Impervious Surface Cover, 2016[74]

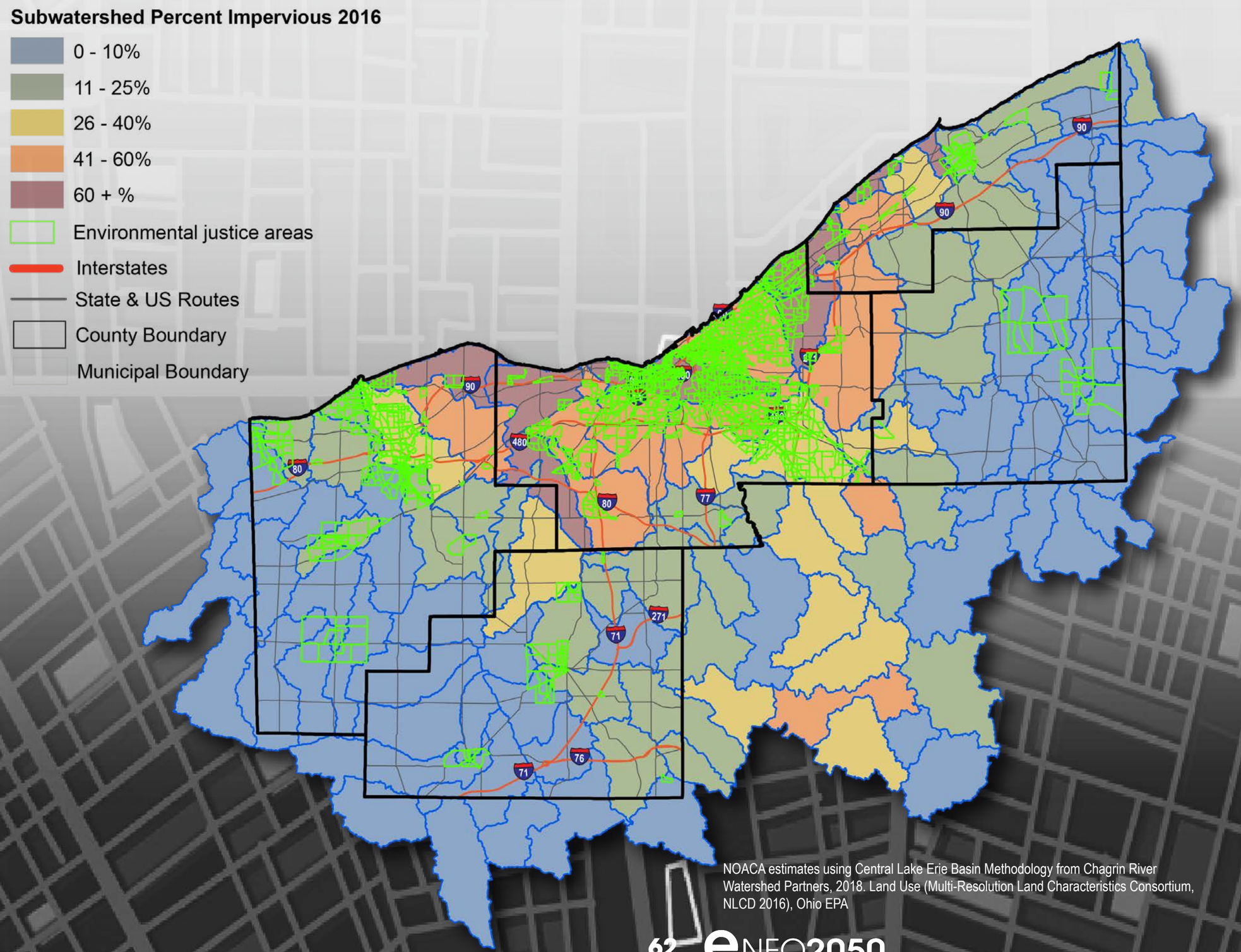


Source: NOACA *Clean Water 2020,* estimates using Central Lake Erie Basin Methodology from Chagrin River Watershed Partners, 2018.

Subwatershed Percent Impervious 2001 & 2016

- 0 - 10%
- 11 - 25%
- 26 - 40%
- 41 - 60%
- 60 + %
- County Boundaries

Figure 3-39. Northeast Ohio Subwatershed Percent Imperviousness, 2016[75]



NOACA estimates using Central Lake Erie Basin Methodology from Chagrin River Watershed Partners, 2018. Land Use (Multi-Resolution Land Characteristics Consortium, NLCD 2016), Ohio EPA

Using Transportation to Capture Water and Air Quality Benefits

On-road GHG emissions are a function of four main variables: travel mode choice, fuel efficiency, vehicle fuel type, and total VMT. From 2014 to 2018, 89.3% of commuters drove private automobiles to work in Northeast Ohio. Within Northeast Ohio, light-duty vehicles (passenger cars and SUVs), account for the vast majority of transportation sector Greenhouse Gas Emissions (76.6%). There are three approaches in the transportation sector to reducing Greenhouse Gas Emissions, as shown in Figure 3-40: (1) Improve existing technology, (2) shift to other modes, and (3) avoid the need to travel far distance. Improving existing technologies relates to investing in EV charging stations to enable residents to capitalize on the technology shifts that US-car manufacturers are currently pursuing. Shifting to other modes means investing in safe bike and transit infrastructure that connect residents to regional job hubs. Avoiding the need for transportation pertains primarily to land use questions of density and walkability which is within the domain of local governments. Many of the activities that help reduce emissions are helpful for other policy objectives as well such as health benefits from active living.

Interchange Policy

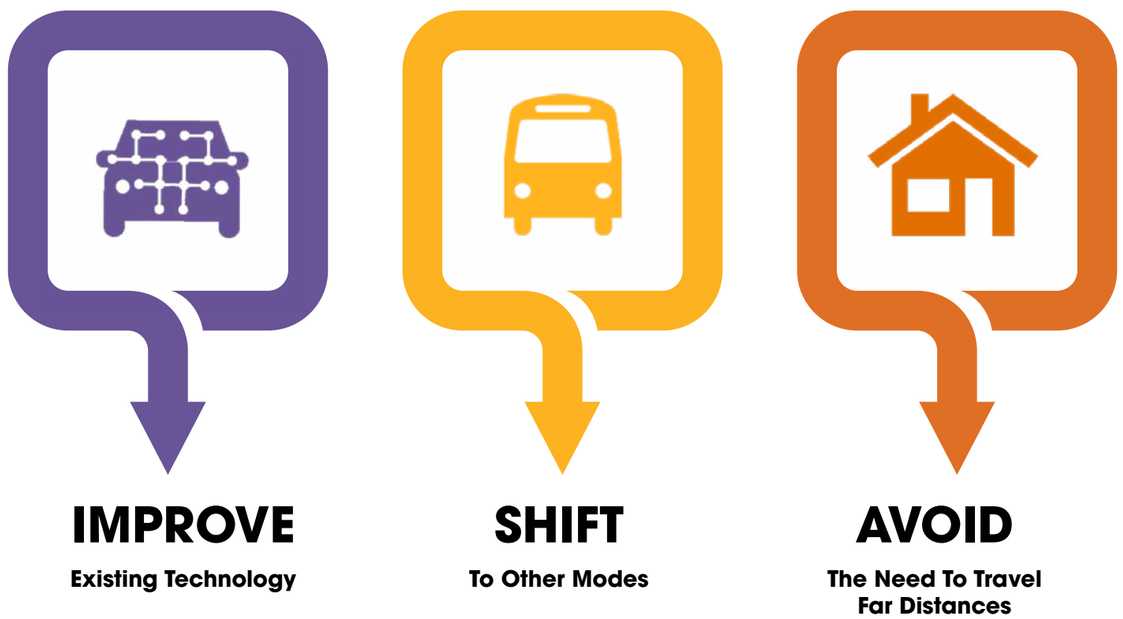
As part of its recently adopted New or Modified Highway Interchange Projects Policy, NOACA will analyze how new or modified highway interchanges will influence equity measures and regional GHG emissions. This policy goes beyond existing transportation conformity requirements and will better inform the agency as it evaluates potential highway projects. NOACA also has the unique capacity to explore how changes to the transportation network may influence mobile emissions and public health in Northeast Ohio.

Green Streets Policy

Tree-lined streets greatly enhance the visual appearance of a street but also the air and water quality of the region. As a region, we rely on groundwater for our drinking water. Streams, lakes, wetlands, and other water resources feed (connect) to the groundwater table. During rainstorms, impervious surfaces interfere with the natural way that groundwater is replenished. Impervious surfaces such as roads and parking lots contribute to combined-sewer overflows as the grey infrastructure cannot absorb heavy rainfalls in the same way that green infrastructure can. Including green infrastructure such as trees, plantings and, where appropriate, bioswales into road projects can greatly enhance the water quality in the region. NOACA has adopted a Complete and Green Streets Policy that requires all road projects to consider these issues in the design and development process and recently updated its investment policy to include incentives for funding to pay for the infrastructure. NOACA also works with partners to explore opportunities to leverage funding from other sources across the region to enhance individual road projects including the consideration of other types of pavement, such as pervious surfaces that might be suitable for some projects.

Green streets also contribute to reducing air pollution. Historically, Northeast Ohio has struggled with poor air quality, due in part to its reliance on heavy industry. While the smokestacks from facilities such as steel mills, oil refineries, and coal-fired power plants long dominated the landscape in the region, mobile emissions have actually been the primary source of air pollution in Northeast Ohio since at least 1990. On-road vehicles continue to generate a plurality (31.6%) of criteria pollutant emissions.

Figure 3-40. Approaches to Reduce GHG Emissions from Transportation



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SECTION 2

eNEO2050

eXPLORING THE POSSIBILITIES

FOR AN EQUITABLE TRANSPORTATION SYSTEM

4 EXISTING TRANSPORTATION SYSTEM

eNEO2050

In this Chapter

Transportation infrastructure are foundational structures and systems for transporting people and goods. This system supports the economy and directly impacts the competitiveness of the nation and the NOACA region. Over the years, the United States has built one of the world's most extensive transportation systems, representing trillions of dollars of public investment. The transportation system is made up of many individual elements, which ideally, should be connected to provide ease of movement for all users. These individual elements are roads, bridges, sidewalks, bikeways, transit, rail, waterways, airports and intermodal connectors. Chapter 4 starts by describing the transportation assets in Northeast Ohio by the numbers. This description is followed by a detailed discussion of access and mobility issues for drivers, transit riders, bikers and walkers. The chapter concludes with an analysis of safety issues in our regional transportation system.

Asset management, access, mobility, and safety are four of the six transportation objectives that have guided the development of *eNEO2050* (see Chapter 1). Emissions and emerging technologies are discussed in other chapters: Emissions are a central component of environmental stewardship (see Chapter 3), while emerging technologies are some of the uncertainties that need to be considered when developing scenarios (Chapter 5). Therefore, this Chapter focuses on four of the six transportation objectives outlined in Chapter 1. The analyses presented in this Chapter provides the context for considerations in the subsequent chapters on how to improve the regional transportation system over the coming three decades.

Transportation Assets by the Numbers

Roadway Network

Similar to other metropolitan areas with urban and rural configurations, roads in the NOACA region make up the most extensive network in the transportation system, connecting the various land uses in communities to each other. The NOACA region contains a significant portion of the Interstate System's total lane miles in Ohio, with local Interstates routes including I-71, I-77, I-80, I-90, I-271, I-480, and I-490. Typically, the interstate and freeway systems carry the highest volume of traffic in the region. The Interstate system was built in the late 1950s/early 1960s and is now 60+ years old. Table 4-1 displays the lane miles of the road system, except local streets, by facility type. The data is based on the 2020 highway network of the NOACA travel forecasting model.

The Federal-Aid Highway Program supports state highway systems by providing financial assistance for the construction, maintenance, and operations of the nation's 3.9 million-mile highway network, including the Interstate Highway System, primary highways, and secondary local roads. The Federal Highway Administration (FHWA) is charged with implementing the Federal-Aid Highway Program in cooperation with the states and local government.

Local government—primarily counties, cities, and towns, or local public agencies (LPAs)—own and operate about 75%, or roughly 2.9 million miles, of the nation's highway network. LPAs build and maintain this network using a variety of funding sources, including the Federal-Aid Highway Program. An estimated 7,000 LPAs manage about $7 billion annually in federal-aid projects, or roughly 15% of the total program. Understanding federal-aid requirements is important in the delivery of federal-aid projects at the local level. Federal-Aid Essentials highlight key components of the program to help LPAs and their state partners successfully manage locally administered federal-aid projects.

The Federal-Aid System in the NOACA region includes Interstate Routes (IR), US Routes, State Routes (SR), and County Routes (CR). It should be noted that the Ohio Department of Transportation (ODOT) maintains roads such as interstates, freeways, and state routes outside municipal boundaries and are thus excluded from Table 4-2.

Most vehicular trips take place through the network of highways and streets. This network is an important asset of the transportation infrastructure, and its expansion, maintenance, and operation very much depend on the available funds in any planning period. The overall pavement and bridge condition on the highways and streets is an indicator of the quality of service provided to traffic through the system. The Pavement Condition Ratings (PCR) measure is a qualitative description of the structural state of the pavement. The PCR values span a spectrum that ranges from "Very Good" to "Very Poor." Each roadway segment is scored from 0 to 100, with 0 representing completely distressed pavement and 100 indicating perfect pavement condition. The weighted lane-mile average PCR for the network all road types in 2020 was about 75. For the roads in NOACA's region that are eligible for federal aid, that average was about 73. Although this average indicates a general fair to good pavement condition for the region, it conceals the fluctuating condition on the actual road network. Figure 4-1 displays the PCR categories for 2020 of the lane miles of roads eligible for federal-aid in NOACA's region.

Table 4-1. Road Lengths by Facility Type

FACILITY TYPE	LANE MILES	PERCENT OF TOTAL
Freeway/ Expressway	1,879	18%
Highway Ramp	316	3%
Major Road (Arterial)	3,816	36%
Minor Road (Collector)	4,557	43%
Total	**10,568**	**100%**

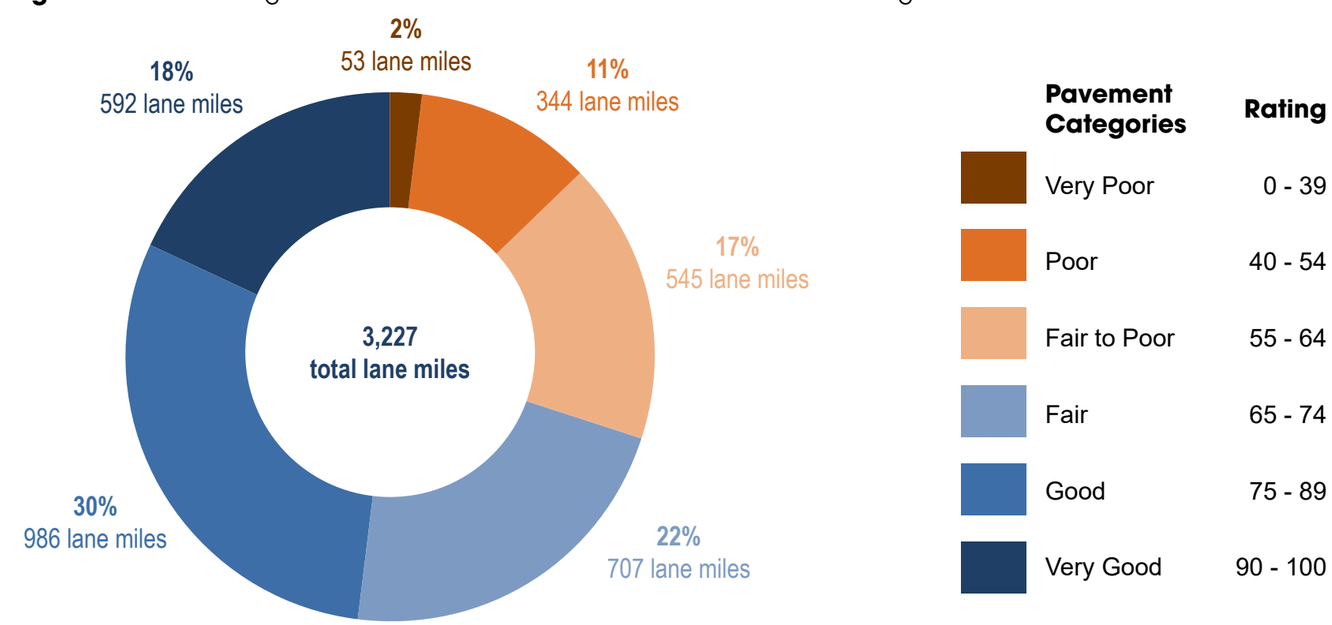
Source: NOACA Travel Forecasting Model

Table 4-2. Road Lengths by County

COUNTY	LANE MILES	FEDERAL AID LANE MILES	COUNTY PERCENT OF FEDERAL AID LANE MILES
Cuyahoga	5,173	3,178	61.4%
Geauga	878	261	29.7%
Lake	1,230	574	46.7%
Lorain	2,037	755	37.1%
Medina	1,254	351	28.0%
NOACA Region	**10,570**	**5,119**	**48.4%**

Source: NOACA Travel Forecasting Model

Figure 4-1. PCR Categories for 2020 Lane-Miles of the NOACA Federal-Aid Eligible Roads[1]



Source: Ohio Department of Transportation

Besides pavement conditions, the conditions of bridges are also critical to the performance of Northeast Ohio's transportation system because of the vital links they provide in the road system. Northeast Ohio has several major river drainage basins that flow into Lake Erie, including the Black River, Rocky River, Cuyahoga River, Chagrin River, and the Grand River. As a result, the area contains a significant number of bridges. ASCE Policy Statement 208-Bridge Safety reports the average age of the nation's bridges is 42 years, which leaves just eight years until the typical 50-year design life is exceeded. In general, it can be said that additional repairs and rehabilitation investment is likely required as bridge structures continue to age.

The National Bridge Inspection Standards (NBIS) defines Bridge Condition Ratings that apply across the United States as Good: 9-7, Fair: 6-5, and Poor: 4-0. Brief descriptors of condition ratings and consolidated bridge ratings for all the bridges in the NOACA region are provided in Table 11-10. ODOT has established a Statewide System Goal of 6.8 for its bridges, which is just slightly below the national condition rating of "Good." The goal reflects ODOT's attempt to balance limited funds among bridges and many other high-priority assets, such as interstate and freeway pavement, interchanges, traffic signs, safety features, and operations and maintenance commitments.

There are 196 bridges in the NOACA region that have bridge appraisal values of 4 or less. Appraisal values range between 0 and 9 (failure condition to excellent condition). Bridges with general appraisal values of 4 or less require urgent or prompt attention as they demonstrate a condition of poor, very poor, near failure (must be closed), or failure (closed). Bridge conditions are also evaluated using numerical "sufficiency rating" values that range from zero to 100. The current total deck areas of all the highway bridges in the NOACA region is more than 22.8 million square feet. The FHWA has presently set a target for maintaining National Highway System (NHS) bridges at less than 10.0% of deck area being considered structurally deficient. Structurally deficient NHS bridges in the NOACA region total less than 2% (405,152 square feet). The percent of NHS bridges and bridges on other type of roads in the NOACA region is less than 6.6% (1.5 million square feet).

Table 4-3. 2020 Bridge Condition Ratings for Bridges in the NOACA Region[2]

CONDITION RATINGS	CONDITION DESCRIPTION	GENERAL CONDITION	PERCENTAGE OF EACH CATEGORY
Less than or Equal to 4	Poor (Rating Value = 4) Serious (Rating Value = 3) Critical (Rating Value = 2) Imminent Failure (Rating Value = 1) Failure (Rating Value =0)	Poor (Structurally Deficient)	6%
5	Fair	Fair	12%
6	Satisfactory		27%
7	Good	Good	31%
8	Very Good		17%
9	As Built		7%

Source: National Bridge Inspection Standards (NBIS)

Figure 4-3. Existing Transit Network

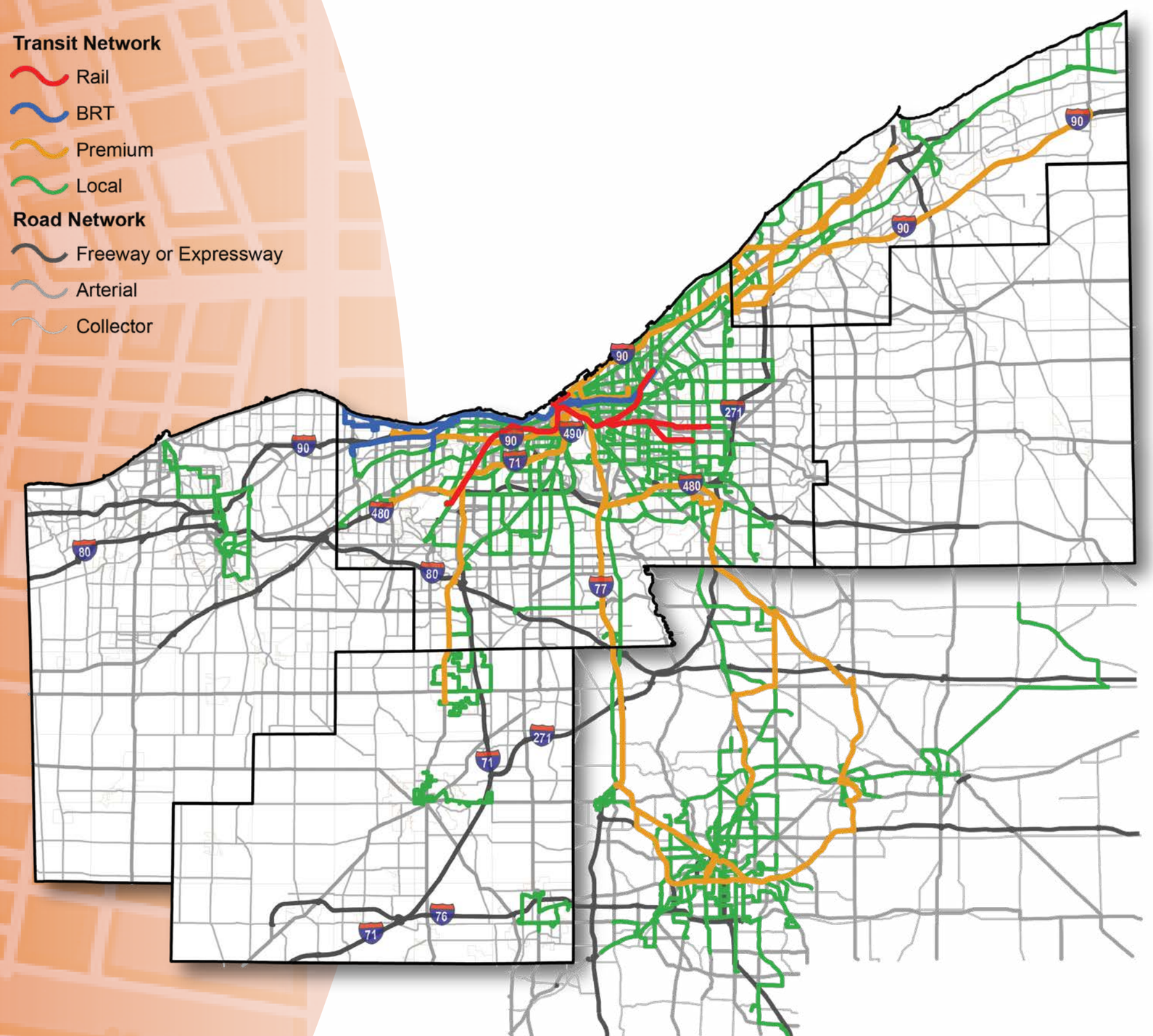


Figure 4-2. Benefits of Public Transit[3]

Expanding public transit requires significant capital investment; however, the potential advantages of a well-planned project are often greater than the costs. Public transit benefits include:

- Connecting people and jobs
- Improving mobility for people of all ages
- Stimulating and focusing new development on sites near transit
- Creating and supporting jobs by providing a reliable alternative to driving
- Moving more people in the same amount of road space
- Improving air quality and reducing greenhouse gas emissions
- Reducing household transportation costs

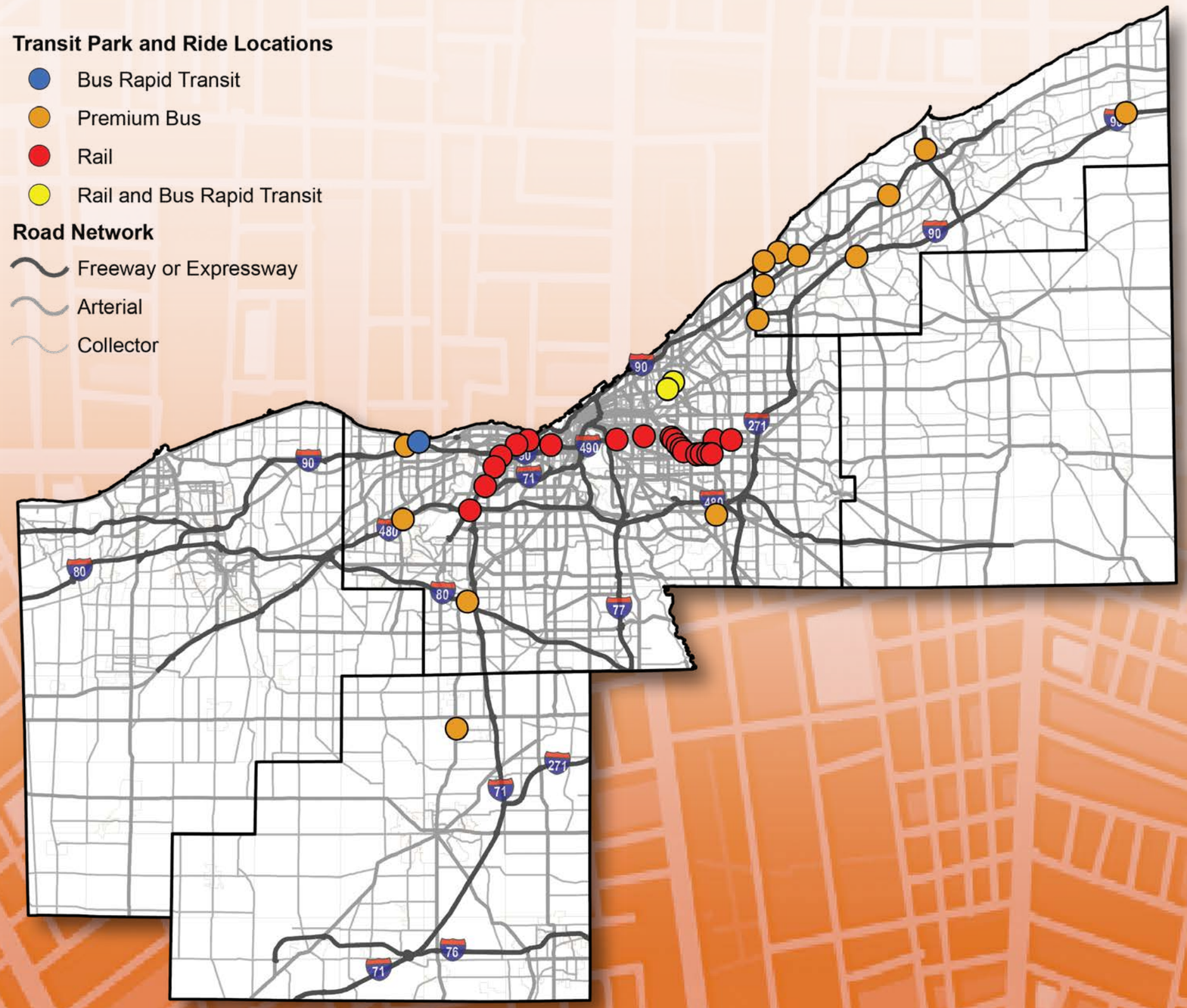
Transit Network

Mobility choices are vital to the health and vibrancy of a region. Public transit options reduce congestion, personal transportation costs, and carbon output. A robust public transit system presents residents with a choice of how to travel within the region. Public transit is a form of alternative transportation for those with automobiles, as well as a primary service for those who do not have other options, primarily lower-income households, the elderly, the young, and people with disabilities. Public transit provides many benefits, including access to employment, healthcare, entertainment, and educational facilities, among other daily activities and destinations (Figure 4-2).

There are five different transit agencies operating within the NOACA region: Geauga County Transit (GCT), the Greater Cleveland Regional Transit Authority (GCRTA), Laketran, Lorain County Transit (LTC), and Medina County Public Transit (MCPT). The Portage Area Regional Transportation Authority (PARTA) Akron Metro Regional Transit Authority, and Stark Area Regional Transit Authority also operate in the seven-county Cleveland metropolitan area.

In the NOACA region, transit services consist of a variety of bus and rail services. Bus services include local, premium and Bus Rapid Transit (BRT) which run through the existing network of highways and streets, with thousands of bus stops at different levels of passenger comfort.

Figure 4-4. Existing Transit Park and Ride Locations



Additionally, the rapid rail services comprise three lines, known as the Red Line, Blue Line, and Green Line operated by the Greater Cleveland Regional Transit Authority. The existing bus and rail services are currently supported by 37 park and ride facilities in the NOACA region. The majority of these intermodal facilities are in Cuyahoga County (27) at rail stations (20), premium bus stations (4), shared BRT and Rail stations (2), and a BRT(1) station. The other park and ride facilities are in Lake (9) and Medina (1) counties and are for premium bus services. Figure 4-3 and Figure 4-4 show the existing transit services and the locations of the current intermodal facilities in the NOACA region.

In 2019, NOACA developed a group Transit Asset Management Plan that covers the three tier II transit agencies in Lake, Lorain, and Medina counties. Together, the three counties cover a population of about 703,729 people (U.S. Census, 2010) who make up approximately 6% of the state population. Laketran is Lake County's public transportation system and provides the following services: six in-county local routes, four commuter park-and-ride routes to Cleveland, and door-to-door dial-a-ride. Laketran maintains a total of 123 revenue vehicles and reported a 2017 ridership of more than 750,000. The second plan participant, Medina County Public Transit, serves Medina County residents and provided 84,672 demand response trips, 22,048 City of Medina loop trips, and 654,897 total vehicle miles in 2012. Medina County Transit maintains a total of 23 revenue vehicles. Finally, Lorain County Transit serves Lorain County residents. The agency maintains a revenue fleet of 13 vehicles and serves an average of 120 passengers per day. In 2016, Lorain County Transit recorded a fixed-route ridership of 30,271.

In Cuyahoga County, GCRTA serves up to 200,000 customers per workday, which accounts for 45 million rides annually. GCRTA operates buses on 55 bus routes, including 6,000 bus stops and 1,100 bus shelters. Furthermore, GCRTA operates three Bus Rapid Transit Lines, one heavy-rail line (The Red Line) and two light-rail lines (The Blue and the Green Lines). On all three rail lines, GCRTA operates 74 rail cars. Additionally, GCRTA services downtown Cleveland with four downtown trolley lines and offers Paratransit services and VanShare as a Van pool service.

A central aspect of transit planning is improving the way we move around the region and provide access to support development through transportation infrastructure. Choice means increasing both the number of destinations that are easily accessible and the availability of different modes to reach those destinations. All of the region's transit systems have plans to maintain and possibly expand their respective systems better to accommodate for these conditions.

Nonmotorized Transportation Network

Nonmotorized, or active, transportation refers to being physically active for the purpose of transportation (typically biking and walking), and is distinct from being physically active for recreation. NOACA has been formally planning at the regional level for bicycling as a means of transportation since 1978, with the release of Phase I of a four-phase bicycle planning process that spanned from 1977 to 1989. The NOACA Regional Bicycle Plan was updated in 1997, 2008, and 2013, and NOACA is currently developing a new pedestrian and bicycle plan, *ACTIVATE*. This plan will provide a vision for increasing the use of bikeways and walkways for transportation and commuting, and will also serve as a guide for future bicycle and pedestrian improvements. This plan will also include a model for prioritizing investments in nonmotorized facilities - to access the public transit network.

Planning for bicycling and walking as modes of transportation is important for a variety of reasons (see Figure 4-5). Improving travel safety is always important, but improving safety for bicycling and walking is especially important because these road users are most vulnerable to fatality and severe injury in a crash. Furthermore, the perceived safety of these modes has a direct effect on how many people are willing to choose biking and walking. With limited federal and state transportation funding, encouraging a mode shift to biking and walking is an important and underused travel demand management strategy that can alleviate traffic congestion. Increased biking and walking is a form of exercise and can improve health. In addition, because biking and walking are zero-emission modes of transportation, shifting trips to these modes can improve health by improving air quality. Specifically, biking and walking are ideal modes for replacing short trips (three miles or less), which are more polluting and less efficient, per mile, by car than longer trips.[4] Moreover, a significant percentage of the population in Northeast Ohio does not have access to a car, and providing viable transportation options is vital.

Planning for bicycle and pedestrian travel has also been established as a priority by the federal government. The United States Code requires that bicyclists and pedestrians be given due consideration in the comprehensive transportation plans developed by each metropolitan planning organization and state, in accordance with sections 134 and 135, respectively. Bicycle transportation facilities and pedestrian walkways are to be considered, where appropriate, in conjunction with all new construction and reconstruction of transportation facilities, except where bicycle and pedestrian use are not permitted. Transportation plans and projects must also provide due consideration for safety and contiguous routes for bicyclists and pedestrians.

Table 4-4. Miles of Bike Facilities by County

COUNTY	ALL PURPOSE TRAIL	SEPARATED BIKE LANE	BUFFERED BIKE LANE	BIKE LANE	BIKE ROUTES*	TOTAL
Cuyahoga	201.9	0.9	5.5	71.0	107.9	387.2
Geauga	24.6					24.8
Lake	62.4			19.4	3.6	85.4
Lorain	87.2			23.8	49.7	160.6
Medina	30.5					30.5
NOACA Region	**406.6**	**0.9**	**5.5**	**114.2**	**161.3**	**688.5**

Source: NOACA Regional Bike Network, *Routes are typically marked with sharrows and/or signs

Figure 4-5. Benefits of Active Transportation[5]

Enabling active transportation requires capital investments in streets that serve all users, as appropriate; the potential advantages of a well-planned project are often greater than the costs. Active transportation benefits include:

- Alleviating traffic congestion
- Improving air quality and reducing greenhouse gas emissions
- Connecting people and jobs
- Improving mobility for people of all ages
- Moving more people in the same amount of road space
- Reducing household transportation costs
- Improving health outcomes by enabling an active lifestyle

NOACA, in coordination with partner agencies, maintains an inventory of 687 miles of existing bicycle facilities in all five counties. These facilities can be defined as segregated and shared types.

Separated

- All Purpose Trails: Open to bicyclists and are fully separated from the roadways.
- Separated Bike Lanes: On-street bike lanes that have vertical separation from traffic in the form of posts or other barriers.

On-Road

- Buffered Bike Lanes: Conventional bicycle lanes paired with a designated buffer space that separates the bicycle lane from the adjacent motor vehicle travel lane and/or parking.
- Bike Lanes: On-street bike lanes that are marked with a painted line and accompanying signage.

Shared

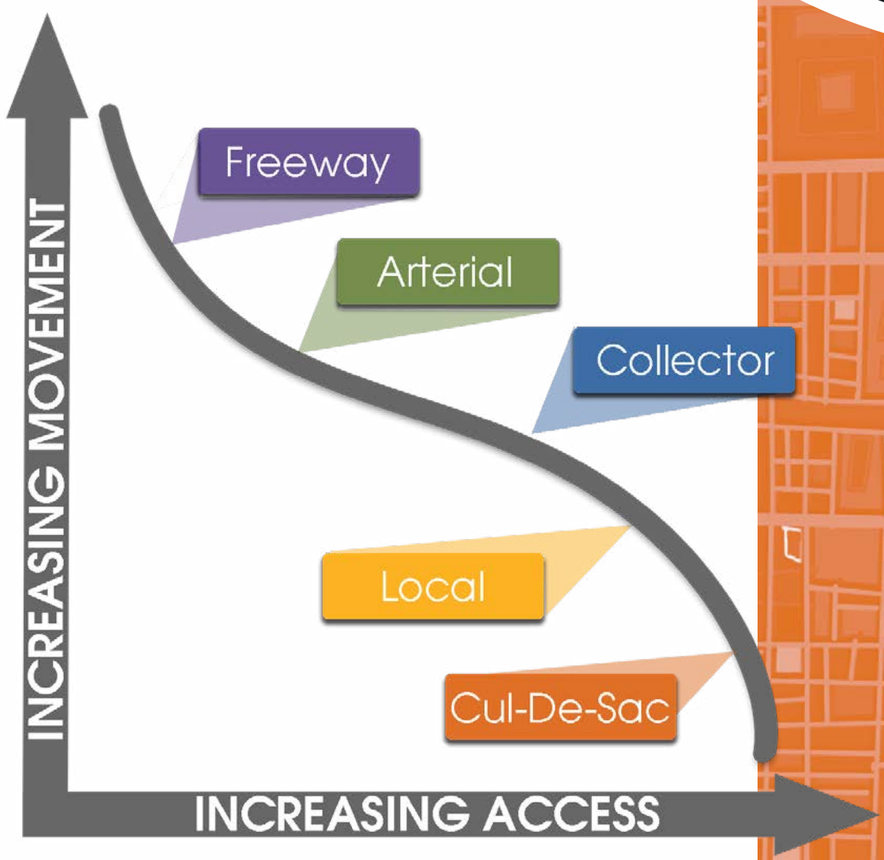
- Bike Routes: Bike routes include signed and marked routes like sharrows and bike boulevards

Maintaining bicycle and pedestrian infrastructure in a state of good repair is crucial to sustained connectivity and access for residents and visitors. Existing facilities should also be upgraded, when possible, to be ADA compliant or to provide a lower-stress environment for nonmotorized travelers. On-road and off-road bicycle facilities have unique short- and long-term maintenance needs. Bike lane markings fade over time due to weather and vehicular traffic. Markings should be regularly repainted just as vehicular lane markings are. Bike facilities should also be kept clear of debris and snow to allow unimpeded and safe movement for all users. While off-road bike facilities such as trails and side paths do not suffer degradation due to motor vehicle traffic, markings still fade and pavement breaks down over time, and long-term maintenance should be considered. Additionally, consideration of snow removal is particularly important along off-road trails as specialized equipment is typically required for these narrow corridors

Access to the Transportation System

Traffic is the movement of a large number of individual vehicles, cyclists, and pedestrians through highways, streets, sidewalks, and transit networks from their origins to their destinations. Some transportation modes, such as air transportation, have a clear separation between access and mobility. Access to an aircraft begins by passengers boarding, and once the cabin doors are closed, the aircraft is transferred from an access function to a mobility function. For highways, access and mobility do not have such clear boundaries. Road and street functional classifications attempt to define these boundaries by grouping roads, streets, and highways into a hierarchy based on the type of service they provide. Generally, how closely a highway or street actually functions compared to its defined service plays a crucial role in reducing congestion, promoting safety, and increasing transportation system efficiency. Figure 4-6 indicates the degree to which different road functional classes should accommodate movement and access. The shape of the curve in this figure illustrates the defined relation between access and mobility for each road function class.

Figure 4-6. Relationship between Access and Movement Functions of Roads & Streets



Access to the Roadway Network: The Interstate and Arterial Road Networks

People travel from an origin to a destination for the primary purposes of economic, social, recreational and other activities. Although the physical act of traveling is the secondary function, it is a necessary task for conducting the primary functions. Traveling is possible if travelers have safe, timely and affordable access to the existing transportation infrastructure components. Without access to the transportation platform, trips may not be made in a safe and efficient manner.

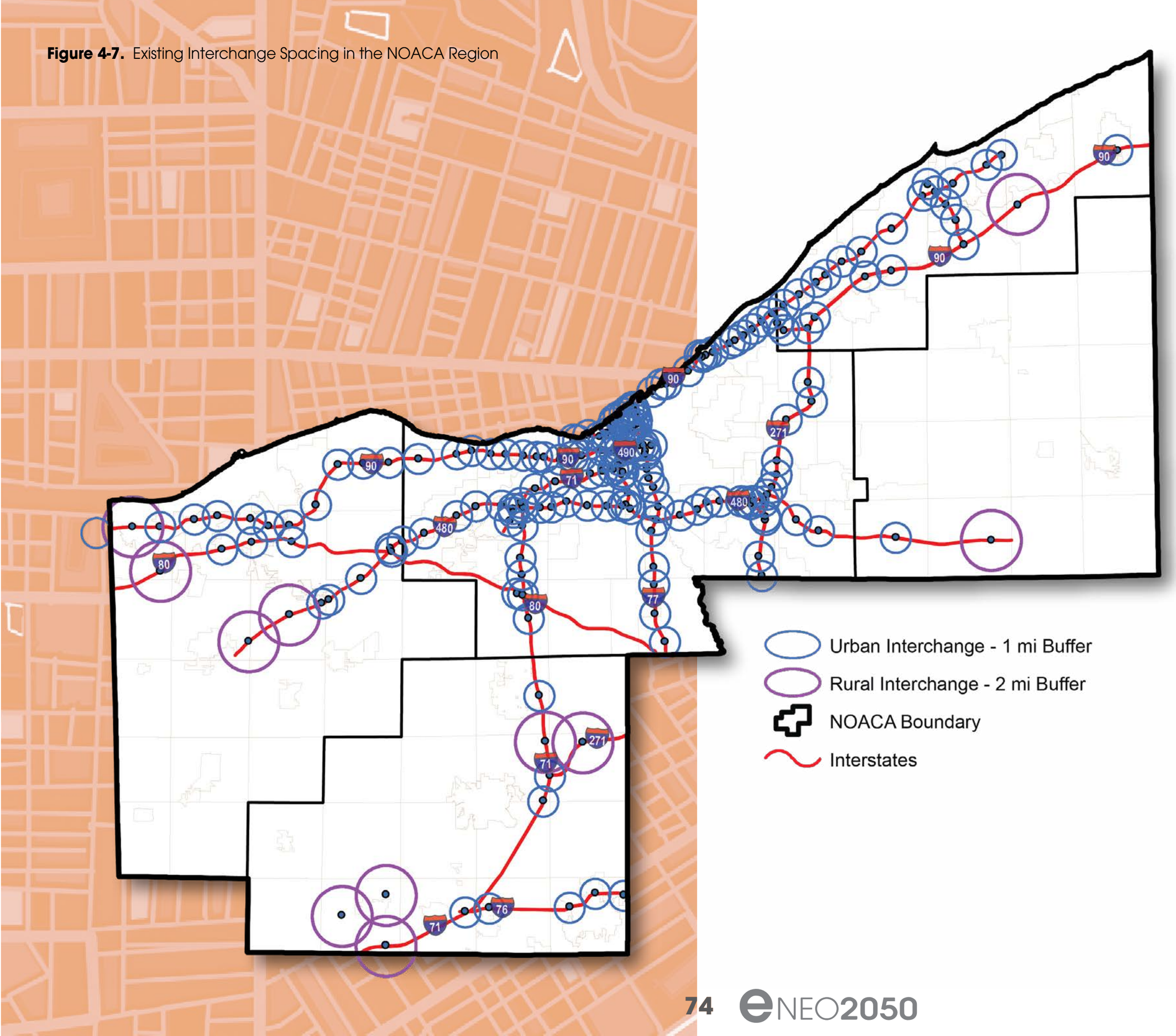
The following sections attempt to analyze the state of access in the NOACA region. A critical question is what social class has access to which part of transportation system. This section summarizes the existing access to the current transportation system in the NOACA region that will be a benchmark for planning and investing on an equitable transportation infrastructure in the next three decades.

The primary role of highways with controlled access, such as Interstate 71, Interstate 77, Interstate 480, etc., is to provide mobility for long regional and inter-county vehicular traffic at a high speed. The access to interstate highways is controlled by on-ramps, off-ramps, and interchanges. The ramp and interchange spacing is critically important in the origins and destinations of trips along those highways, as they influence mobility, safety, and traffic management.

An excessive number of access facilities such as interchanges in a freeway network diverts many short trips from the arterial and collector street network to the freeway system. This diversion has two negative effects:

- Freeways will be congested by short vehicular trips that enter from one interchange and leave the freeway system at the next interchange.
- Street network throughput will be reduced, and streets will operate under capacity and consequently seem overinvested.

Figure 4-7. Existing Interchange Spacing in the NOACA Region



The primary role of highways is to provide mobility for long regional and inter-county vehicular traffic at a high speed.

The American Association of Highway Transportation Officials' (AASHTO's) design guidelines (Green Book) recommends the following passage regarding interchange spacing:

> *In areas of concentrated urban development, proper spacing usually is difficult to attain because of traffic demand for frequent access. Minimum spacing of arterial interchange (distance between intersecting streets with ramps) is determined by interchange form, lane configuration, weaving volumes, signing, signal progression, and lengths of speed-change lanes. A general rule of thumb for minimum interchange spacing is 1 mi [1.5 km] in urban areas and 2 mi [3.0 km] in rural areas. In urban areas, spacing of less than 1 mi [1.5 km] may be developed by grade-separated ramps or by adding collector–distributor roads.*

In response to the trip chain travel demand over the last decades and the implication of the above guideline, as illustrated on Figure 4-7, the existing interchange locations in the NOACA region indicates that there may have been over investments in providing access to the freeways rather than paying attention to their mobility purposes.

Figure 4-8. Urbanized Area Access to Highway System

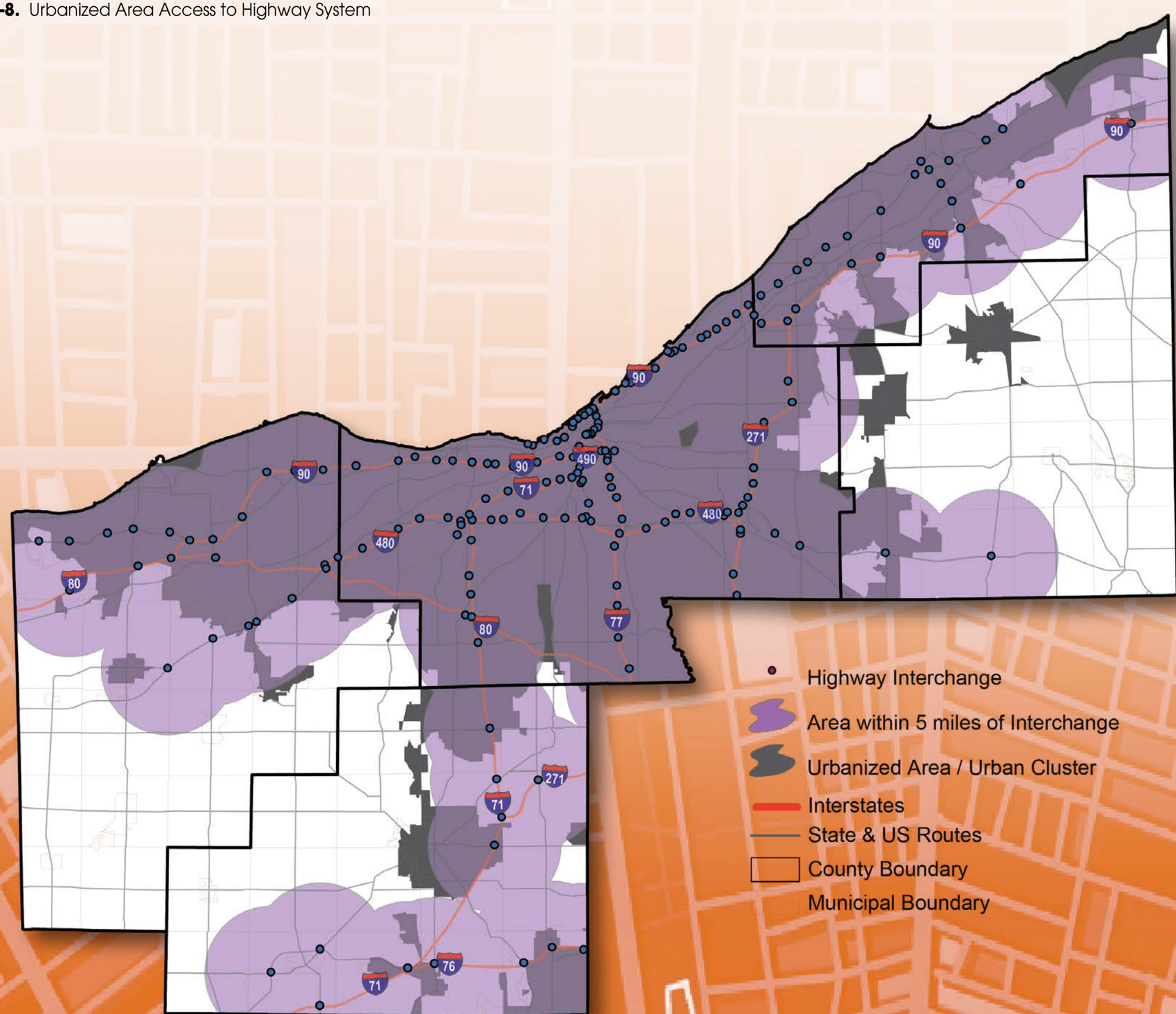
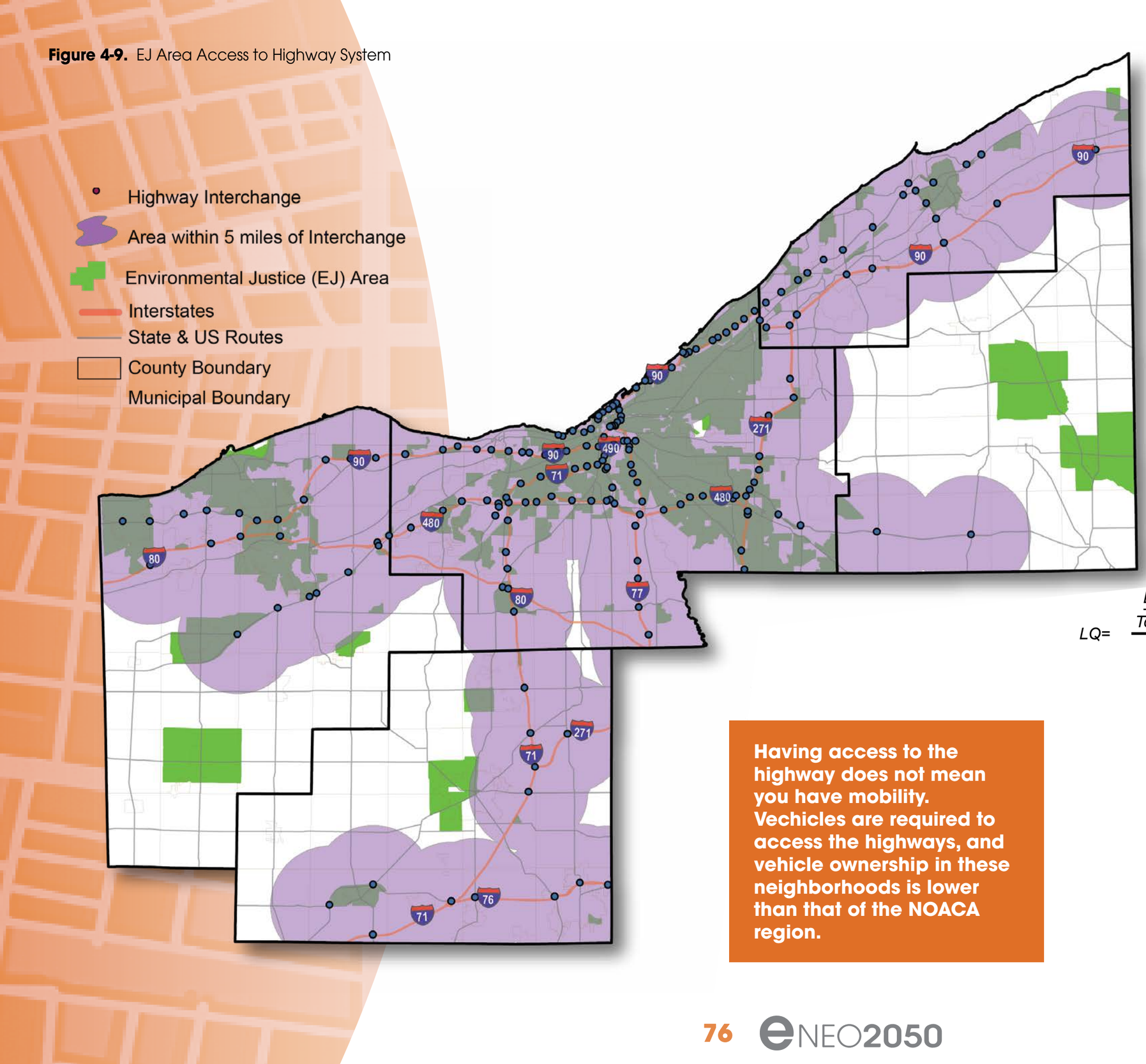


Figure 4-8 and Figure 4-9 depict the five-mile travel distance coverage for each freeway access point. Currently more than 1.8 million of NOACA's total regional population reside within five miles' driving distance from an interchange. This is more than 90% of the residents and indicates that the freeway network is accessible by a short distance regardless of what neighborhood one lives in. The overlapping areas of the five-mile circles may be assumed to be indications of excessive access and overinvestments (also see Figure 4-7). The close proximity of freeway access points suggests that there has been an emphasis on providing access to the freeways rather than paying attention to their mobility purposes.

Figure 4-9. EJ Area Access to Highway System



Having access to the highway does not mean you have mobility. Vechicles are required to access the highways, and vehicle ownership in these neighborhoods is lower than that of the NOACA region.

As illustrated, most of the urbanized area has quick access to the freeway system. Even the urbanized EJ areas also have quick access to freeway system. The overlapping areas of the 5-mile circles may be assumed as indications of excessive access and overinvestments.

Currently over 1.8 million of the total NOACA region population reside in the 5-mile driving distance from an interchange. This is over 90 percent of the residents and indicates that the freeway network is accessible by a short distance regardless of what neighborhood one lives in.

There are over 380 thousand households in EJ areas within a 5-mile driving distance from an interchange. Vehicle ownership percentage in these neighborhoods is about 80%.

The Location Quotient (LQ) method is a useful quantitative screening for potentially disparate impacts of indicators that are associated with particular geographic areas such as EJ neighborhoods.

The LQ for the EJ area population within a 5-mile driving distance from an interchange is calculated by applying the following formula:

$$LQ = \frac{\dfrac{\textit{EJ Population with 5 mile Driving Distance from an Interchange}}{\textit{Total Population with 5 mile Driving Distance from an Interchange}}}{\dfrac{\textit{EJ Population in the NOACA Region}}{\textit{Total Population in the NOACA Region}}}$$

The LQ for the EJ area population within a short driving distance to the freeway system is 1.05, which indicates that the concentration of the EJ area population in the 5-mile freeway coverage area is slightly higher relative to the entire population in the NOACA region. Unfortunately, having access to the highway does not mean you have mobility. It is worth noting that the vehicle ownership in these neighborhoods is lower than that of the NOACA region. Particularly in the City of Cleveland, vehicle ownership is 1.23 vehicles per household as compared to the region with 1.68 vehicles per household.[6] Therefore, alternative modes of transportation are a relevant element to ensure mobility. That is where the equity in modes factors into the conversation.

Access to the Arterial Network

The arterial network (see Figure 4-10) plays an alternative role to the freeway network in reducing traffic congestion and improving air quality. Arterials generally connect residential areas to many employment centers and intersect with freeways. The arterial network consists of major (or principal) and minor arterials. The major arterial network is a network of roads and streets that serve large amounts of traffic that travel relatively long distances at higher speeds. Most travelers are concerned about the length of their travel time on the major arterial network, which is generally affected by intersection delays and posted speed limits. Intersection delays are influenced by traffic control systems which include devices such as signs, road markings, traffic signals, etc. Traffic control systems consider safety and efficiency to manage journeys through the road network (see Table 4-5). Higher accessibility of these corridors has the potential to encourage more motorists to use the arterial network as an alternative to congested freeways during the morning and afternoon peak periods. This would benefit the businesses along these corridors and also reduce the traffic congestion on freeways. At the same time, pedestrian and bike safety needs to be kept in mind while improving traffic flow for motorists.

Major arterials are usually congested, and the Level of Service (LOS) measure indicates overcapacity and is calculated as

$$\frac{Volume}{Capacity} > 1$$

This means that the traffic volume is higher than the road capacity and improvement strategies generally are directed at improving the capacity (i.e., increasing the denominator) to alleviate congestion. In contrary, the LOS measures for the exiting arterial corridors in the NOACA region, generally are under capacity.

$$\frac{Volume}{Capacity} < 1$$

Capacity-improving strategies, such as signal timing optimization, attempt to increase capacity, not to reduce the ratio above, but to attract more through traffic. This would increase use of the road and restore it as an alternative to congested highways.

Generally, the arterial corridors are radial (originating from the center of Cleveland) or tangential (running “around” the periphery of downtown Cleveland at increasingly distant intervals). At further distances, the radial and tangential corridors tend to intersect with the centers of other large communities in the NOACA region.

Transit riders are often divided into two categories: “choice” riders (individuals who own cars but choose to ride transit) and “captive” riders (individuals who do not own cars and must use transit). In these corridors, transit routes operate through the arterial network providing an alternative travel mode to passenger vehicles for residents’ daily commutes. Some of these corridors run through the EJ neighborhoods, which are likely to have a high concentration of zero-vehicle households. Therefore, public transportation along these corridors is a travel necessity for some of the residents.

Most travelers are concerned about the length of their travel time on the major arterial network, which is generally affected by intersection delays and posted speed limits. However, higher accessibility of these corridors has the potential to attract more motorists to travel through the arterial network as an alternative to the existing congested freeways during the morning and afternoon peak periods. This would benefit the business along these corridors and also reduce the traffic congestion on freeways.

Table 4-5. Number of Signalized Intersections by County

COUNTY	NUMBER OF SIGNALIZED INTERSECTIONS	PERCENT OF REGION
Cuyahoga	2621	76%
Geauga	67	2%
Lake	281	8%
Lorain	340	10%
Medina	147	4%
NOACA Region	**3,456**	**100%**

Source: NOACA Travel Forecasting Model

Figure 4-10. Major Arterial Network

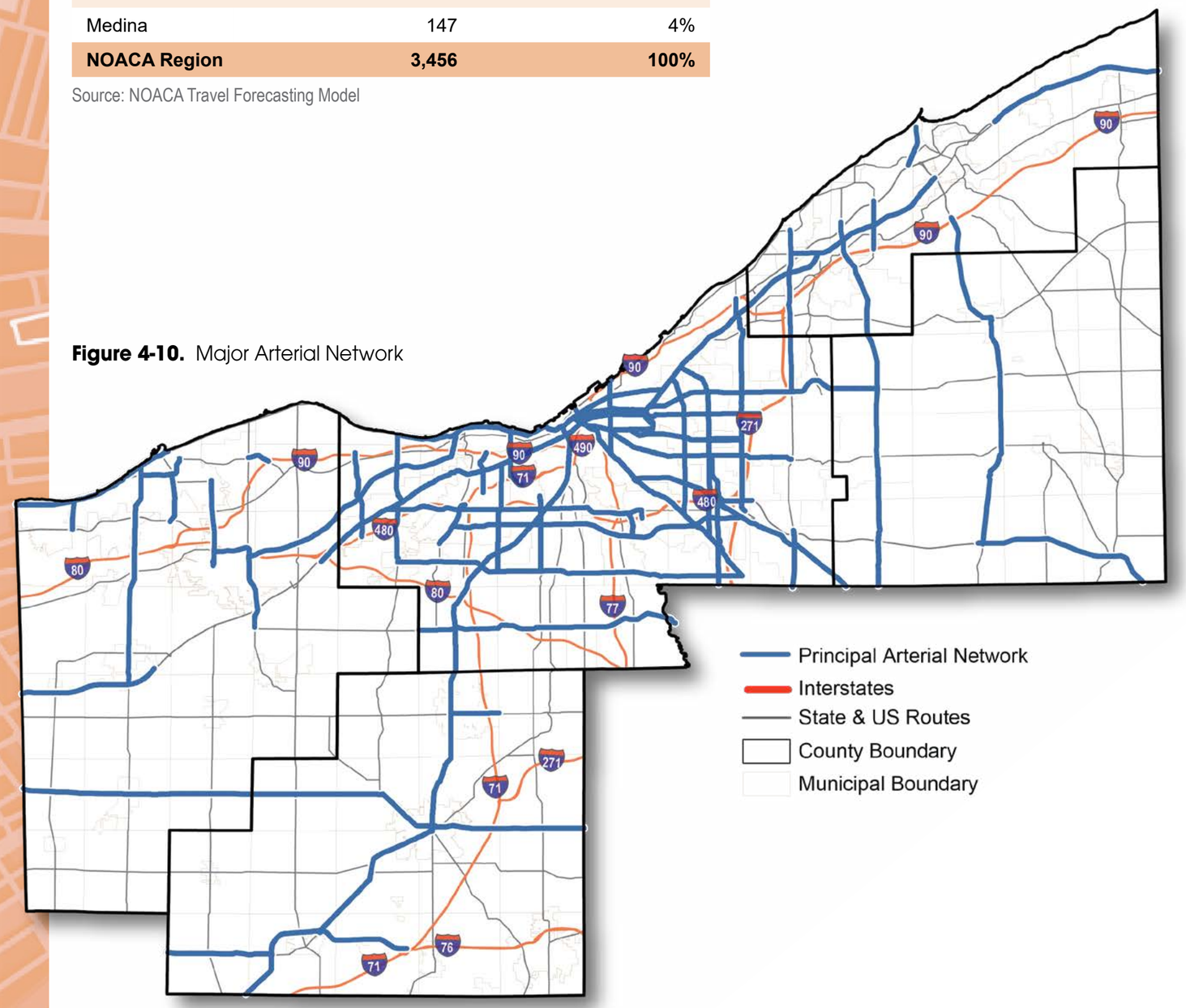


Figure 4-11. Walk Accessibility to Transit in the NOACA Region

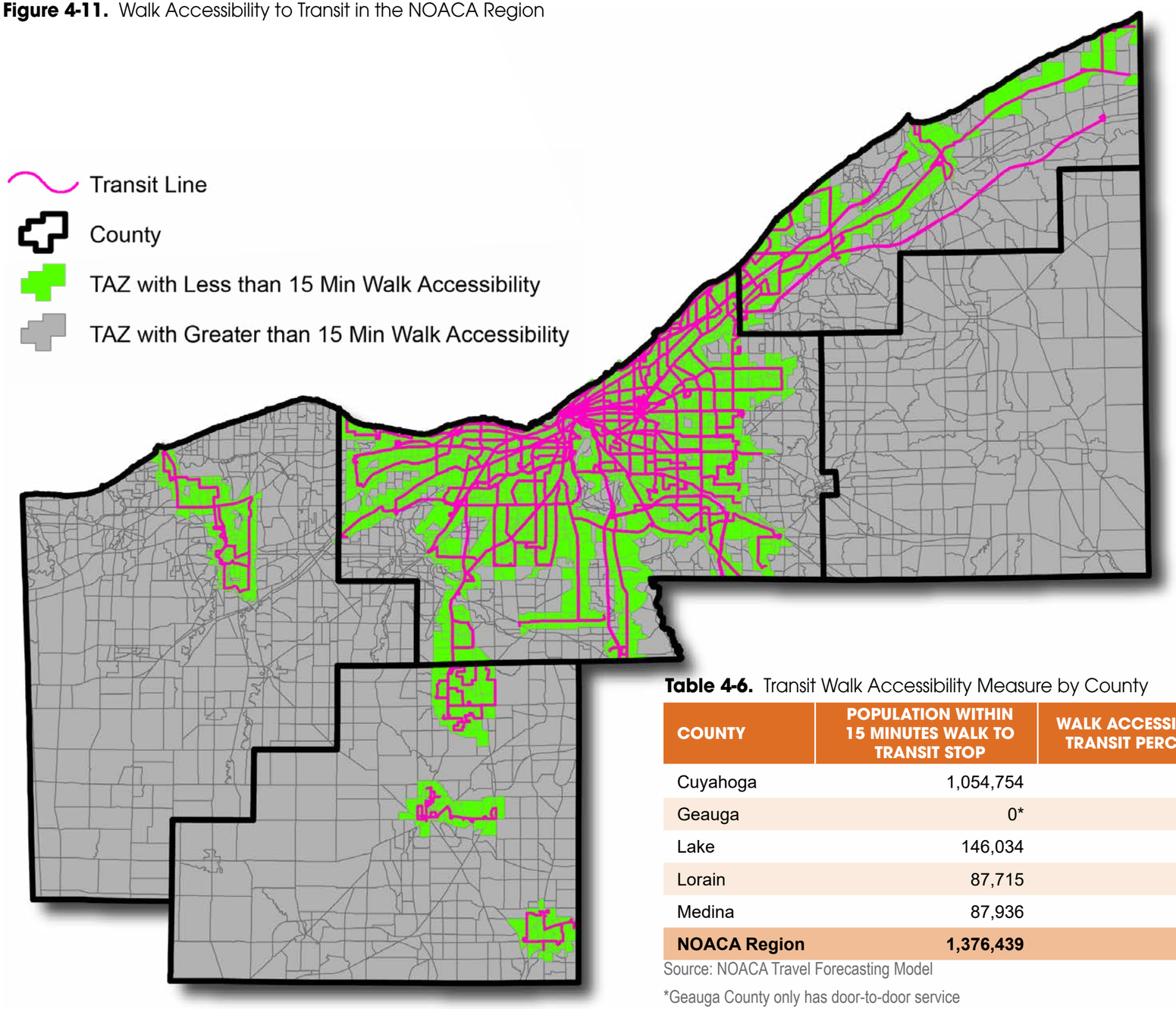


Table 4-6. Transit Walk Accessibility Measure by County

COUNTY	POPULATION WITHIN 15 MINUTES WALK TO TRANSIT STOP	WALK ACCESSIBILITY TO TRANSIT PERCENTAGE
Cuyahoga	1,054,754	87%
Geauga	0*	0%
Lake	146,034	64%
Lorain	87,715	29%
Medina	87,936	49%
NOACA Region	**1,376,439**	**68%**

Source: NOACA Travel Forecasting Model

*Geauga County only has door-to-door service

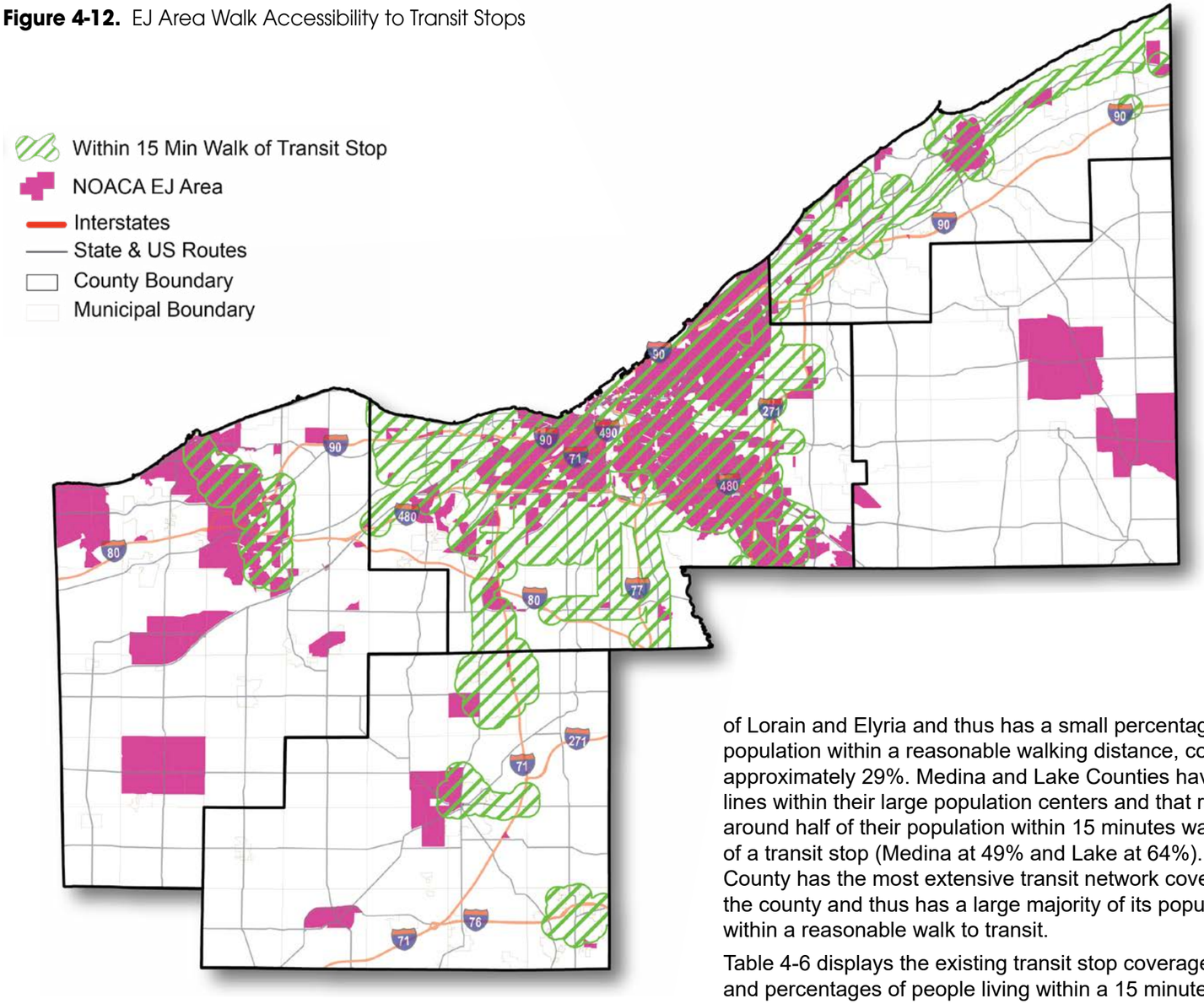
Access to the Transit Network

Bicycle and pedestrian access to transit is an important aspect of a cohesive, multimodal transportation network. These connections to the transit network are often referred to "first mile-last mile trips," those short trips that get commuters from their homes to a bus or train, or from the bus or train to their place of work. Because bus routes and rail stations cannot pick all riders up right at their front doors, most people must travel some distance before boarding a bus or train. Riders should be able to get to and from transit stops and stations safely and conveniently via a well-connected system of pedestrian and bicycle infrastructure.

The potential connectivity of residents and commuters to the regional transit network via walking and biking can be gauged by the presence and prevalence of quantifiable characteristics. For example, intersection density is an established indicator of walkability and connectivity. Grid pattern development with many intersecting perpendicular streets usually offers multiple routes between origins and destinations, while cul-de-sac developments or areas with fewer roadways and intersections can hinder direct shortest distance movement. Similarly, a high density of low-stress roadways offers pedestrians and cyclists a greater number of safer and more comfortable opportunities to move along roadways and through intersections, while a greater proportion of higher-stress roadways may discourage pedestrian and cyclist travel.

Measuring the quality and quantity of access to transit services is important in evaluating existing transit services, travel demand, allocating transportation investments, and making decisions on land-use development. In this regard, the ability to walk to transit is important for access to jobs and vital services, such as education and health care, especially for those who do not have access to a car. To measure accessibility, a distance of three quarters of a mile or equivalent to 15 minutes' walking time (assuming three miles per hour as the walking speed) is often used to represent a reasonable walking distance/time to reach a transit stop. Table 4-6 displays the existing transit stop coverage by numbers and percentages of people who live within a 15-minute walk from transit stops in each county. Figure 4-11 displays the current regional areas of walk accessibility to transit. In this map, neighborhoods are considered Traffic Analysis Zones (TAZ).

Figure 4-12. EJ Area Walk Accessibility to Transit Stops



Currently the walk accessibility to transit is not evenly distributed throughout the five counties of the NOACA region. In many counties, access to transit by walking is sparse and very limited. Geauga County has no fixed-route transit and, as a result, none of its population is within a reasonable walking distance. When the entire NOACA region is taken into account, just over two thirds of the regional population is within a reasonable walking distance of a transit stop.

Lorain County only has a few transit lines between the cities of Lorain and Elyria and thus has a small percentage of its population within a reasonable walking distance, coming in at approximately 29%. Medina and Lake Counties have more transit lines within their large population centers and that results in around half of their population within 15 minutes walking distance of a transit stop (Medina at 49% and Lake at 64%). Cuyahoga County has the most extensive transit network covering most of the county and thus has a large majority of its population (87%) within a reasonable walk to transit.

Table 4-6 displays the existing transit stop coverage by numbers and percentages of people living within a 15 minute walking distance from transit stops.

Similar to the freeway access discussed in the previous section, Table 4-7 summarizes LQ values for the EJ population access to the freeway system and different types of transit stations.

All the rail stations, including rail park and ride facilities, are in Cuyahoga County, as are most of the EJ neighborhoods. As indicated in Table 3.6, the EJ population with a short walking distance or short driving distance to rail stations are over represented relative to the total EJ population in the NOACA region.

Table 4-7. LQ Values for Population of EJ Neighborhoods

ACCESS TYPE	LQ VALUE
5-Mile Driving Distance to a Freeway Interchange	1.05
15 Minutes Walking Distance to a Bus or Rail Stop	1.31
15 Minutes Walking Distance to a Rail Station	1.94
5-Mile Driving Distance to a Premium Bus Park & Ride	0.84

Source: NOACA Travel Forecasting Model

Just over two-thirds of the regional population is within a reasonable walking distance of a transit stop. Most urbanized EJ areas have short walk and drive access to transit shops, but this does not guarantee that commute times from EJ areas are reasonable.

Considering any type of transit stop, including bus and rail stops, the LQ values result in less concentrated indications for EJ population, 1.31, compared with that of the rail stations, 1.94. Similarly, this is due to the fact that most transit stops are located in Cuyahoga County.

In contrast to bus and rail stations, most premium bus park and ride facilities are located in outer counties and therefore LQ values for the total EJ population with short driving to a bus park and ride station are 0.84. These values indicate less of a concentration of EJ area population and workers within a short driving access to premium bus stations compared with the entire population in the NOACA region.

In fact, the most urbanized EJ areas have short walk and drive access to transit stops. However, high concentration of EJ area population around the transit stations does not guarantee a reasonable work commuter time by transit. The long work journey is due to low frequencies of transit services and consequently long waiting and transfer times for riders. The next section will illustrate the long transit commute times to job hubs.

Access for Bike Riders and Pedestrians

Northeast Ohio is home to many recreational biking trails within park facilities, including the Big Creek Parkway, the Towpath Trail, and the Black River Trail in Elyria. Recreational trails can become transportation assets when they are maintained throughout the year, have adequate lighting, and connect to other bike infrastructure. Many of the region's parks do not have bike infrastructure within 500 feet of the park's boundary, however, which limits access to the park's interior trails and amenities and prevents them from being used to support active transportation. These same parks often have significant trail infrastructure inside the park itself, such as the Valley Parkway and Rocky River Reservation. Very few parks in the rural areas of the NOACA region appear to have bike facilities within 500 feet of the park boundary. In total, 199 (35%) of the region's 566 parks have bike facilities located within 500 feet of the park boundary. Figure 4-13 shows the parks in the region according to whether bike facilities are within 500 feet of the boundary of the park.

Besides biking for recreational purposes, people also bike and walk to take care of errands, to commute, and to attend events (Figure 4-14). Having access to bike and pedestrian infrastructure supports the use of active forms of transportation. Figure 4-14 highlights the most reported community needs to enable access to active transportation, including bike lanes, bike paths, bike racks, and sidewalks. Transportation investments in crosswalks, midblock crossing, and signalized intersections can ensure access for pedestrians.

Figure 4-13. Bike Facilities and Park Access

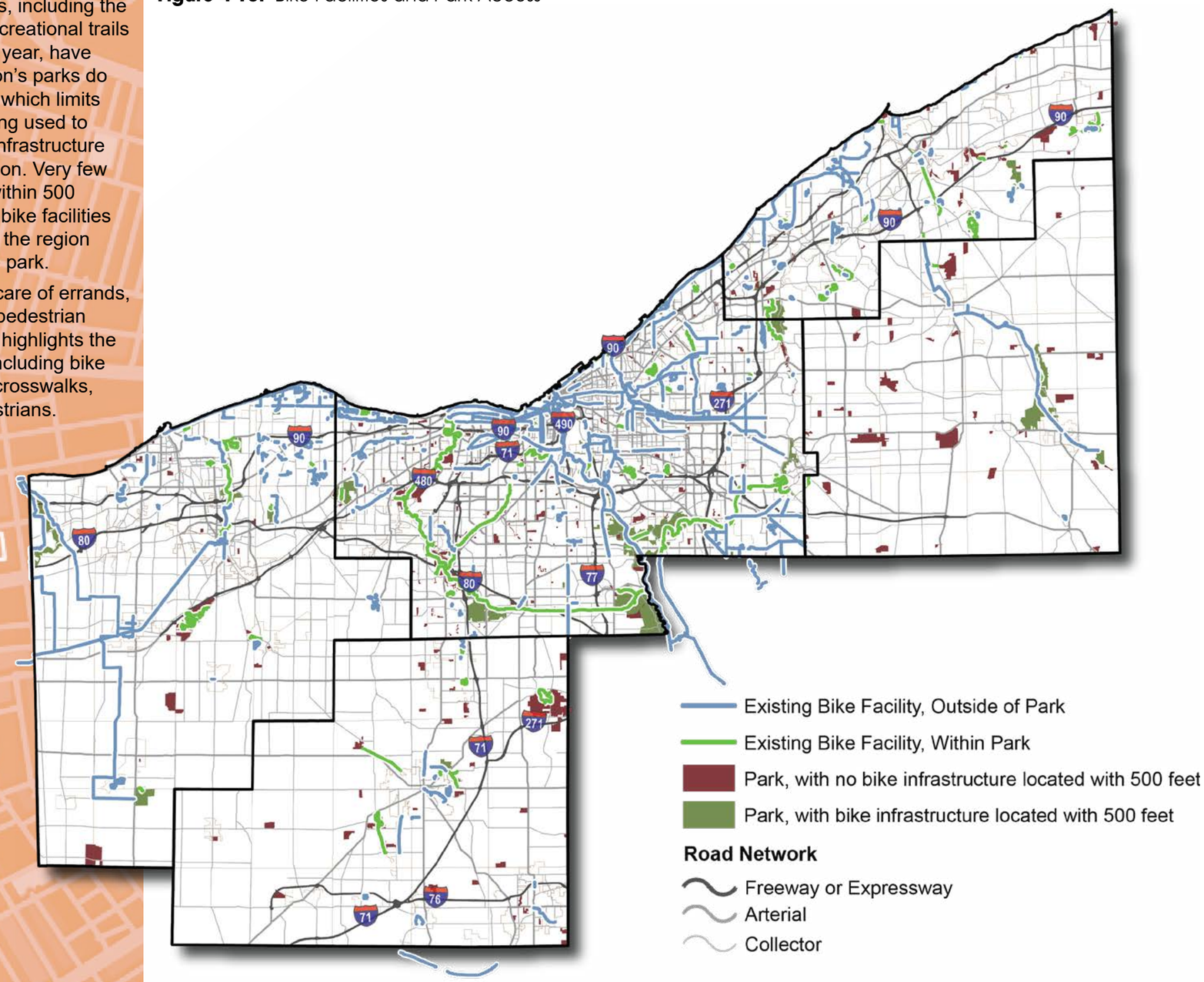
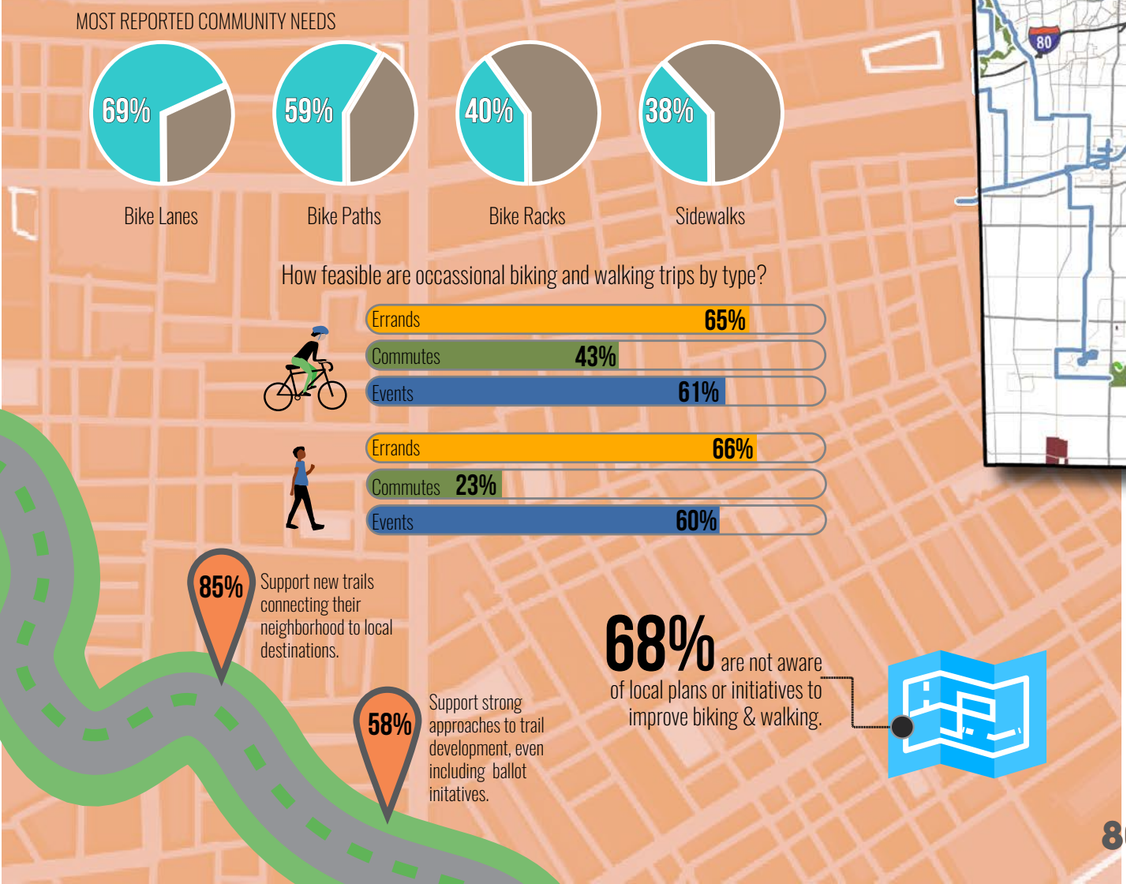


Figure 4-14. ACTIVATE Survey highlights as presented to NOACA committees in October 2020



Mobility within the Transportation System

Mobility for the Driver

Typically, the interstate and freeway systems carry the highest volume of traffic in the region, requiring more travel lanes. In the NOACA region, lane-miles length of the existing freeway/expressway system is about 2,200 miles which is about 20% of total roadway lane-miles.

Vehicle Miles Traveled (VMT) is a measure used extensively in transportation planning for a variety of purposes. VMT is the leading measure of both personal and commercial vehicle travel demand. VMT data are also useful in policy decision for infrastructure investment. Since VMT measures travel demand, it is useful in determining where resources are most needed, and it is an important measure to monitor and forecast.

The current VMT percent of the freeway/expressway system is about 54 based on the typical daily vehicle trips in the NOACA region (Source: NOACA Travel Forecasting Model). The 2020 daily VMT share of the freeway system for auto and truck trips separately are about 47% and 70% respectively.

The VMT per capita illustrates the relationship between population growth and the length of travel in the NOACA region. The current annual personal VMT estimate per capita is about 6,600 and the annual commercial VMT per capita is about one tenth of that.

Table 4-8 displays the relationship between designated functions, percentages of lane mile length, VMT and delay for the facility type based on the 2020 scenario of the NOACA Travel Forecasting Model.

Comparing the lanes miles percentages of the freeway/expressway system with the major arterial shown in Table 4-8, indicates that although the total lane miles are almost the same, the VMT percent of the freeway network is more than three times that of the major arterial network. This disproportionate shares result in daily delay on the freeway network twice than that of the major arterial network. This is additional evidence for reinforcing the argument that the major arterial network as a mobility alternative to the freeway system is currently underutilized in the NOACA region.

Traffic Congestion

Following the access to the transportation facilities, a journey begins from an origin to a destination. The journey may be measured qualitatively and quantitatively by various travel attributes: travel time, delays due to routine or unexpected congestion, travel mode, journey route, safety, trip quality, etc.

It is to be expected that large numbers of people are all trying to reach their destinations at the same time, usually during peak hours, which causes congestion and delay. If the congestion and delay is a daily routine, most travelers accept and plan for it. However, the unexpected delays are less tolerated. Delay is a quantity that indicates where the problems are, what the solutions might be and how beneficial the investment will be.

Transportation authorities continuously take actions to benefit travelers by balancing between land use access and mobility and also reducing the time spent in traveling. On the contrary, actions in pursuit of other goals, such as improving safety, may also have the unintended or unavoidable consequence of slowing travel. The purpose of this section is to evaluate reductions or increases in passenger and goods travel time that result from such actions.

As discussed in previous sections, accessibility, mobility and congestion are the main measures for evaluating the performance of the highway system in terms of how efficiently users can traverse. Mobility and congestion represent similar concepts and the same metrics, such as travel time, may be used to measure them.

Congestion describes the travel conditions on facilities and the Federal Highway Administration (FHWA) defines seven sources for traffic congestion and unreliable travel time:

Category 1: Traffic Influencing Events

- Traffic incidents,
- Work zones,
- Weather

Category 2: Traffic demand

- Fluctuation in normal traffic
- Special events

Category 3: Physical Highway Features

- Traffic control devices
- Physical bottleneck (“Capacity”)

Congestion spreads in time and space. In some areas of the NOACA region, congestion now last more than the traditional morning and evening peak hours and queues from physical bottleneck are extended to a mile or two. The following section documents the existing recurring freeway, interchange and intersection bottlenecks in the NOACA region as sources of congestion and ranks them based on their localized congestion severity. This discussion also makes a relation between the demand and supply sides of the highway system.

Table 4-8. Lane Miles, VMT, and Delay by Facility Type

FACILITY TYPE	MAIN FUNCTION	TOTAL LANE MILES PERCENT	TOTAL OF PERSONAL AND COMMERCIAL VEHICLES VMT PERCENT	TOTAL DAILY DELAY PERCENT
Freeway/ Expressway	Mobility	20%	54.1%	44.8%
Major Arterial	Mobility & Access	18%	15.5%	22.8%
Minor Road	Access	62%	30.4%	32.4%

Source: NOACA Travel Forecasting Model

Bottlenecks

FHWA offers the following definitions for a traffic bottleneck:

- A critical point of traffic congestion evidenced by queues upstream and free flowing traffic downstream
- A location of a highway where there is loss of physical capacity, surges in traffic volumes, or both
- A point where traffic demand exceeds the normal capacity
- A location where demand for usage of a highway section periodically exceeds the section's physical ability to handle it, and is independent of traffic distributing events that can occur on the roadway

The highway network in the NOACA region was assessed by using the NOACA travel forecasting model and the following congestion criteria to identify the bottleneck locations. Only "over capacity" freeway segments (a volume over capacity (V/C) ratio above 1) were considered when identifying highway bottleneck locations.

Volume over Capacity Ratio (V/C)

The volume over capacity ratio during peak periods is one of the primary criteria for evaluating traffic congestion characteristics. The Highway Capacity Manual (HCM) provides different measures for various road classifications and intersection control types; however, these measures are generally divided into six ranges and assigned a Level-Of-Service (LOS) category A through F, with LOS F being indicative of severe congestion. LOS is a qualitative measure used to relate the quality of traffic service. Table 4-9 shows highway LOS ranges that have been used to locate the intensity of traffic congestion.

Travel Time Index (TTI)

The Travel Time Index (TTI) is one of the primary metrics used to measure congestion. It is the ratio of the actual travel time divided by the travel time under free flow conditions. A TTI of 1.2 means that a trip takes 20 percent longer than it would under ideal conditions.

Figure 4-15 and Figure 4-16 present the existing freeway bottleneck locations during the AM and PM peak periods.

Table 4-9. Volume Over Capacity Ranges

VOLUME OVER CAPACITY RATIO (V/C)	LOS	DESCRIPTION
V/C < 0.3	A	Free Flow Condition
V/C < 0.5	B	Reasonably Free Flow Condition
V/C < 0.7	C	Under Capacity
V/C < 0.85	D	Near Capacity
V/C < 1	E	At Capacity
V/C > 1	F	Over Capacity

Source: NOACA Travel Forecasting Model

Figure 4-15. Existing Freeway Bottleneck Locations during the AM Peak Period

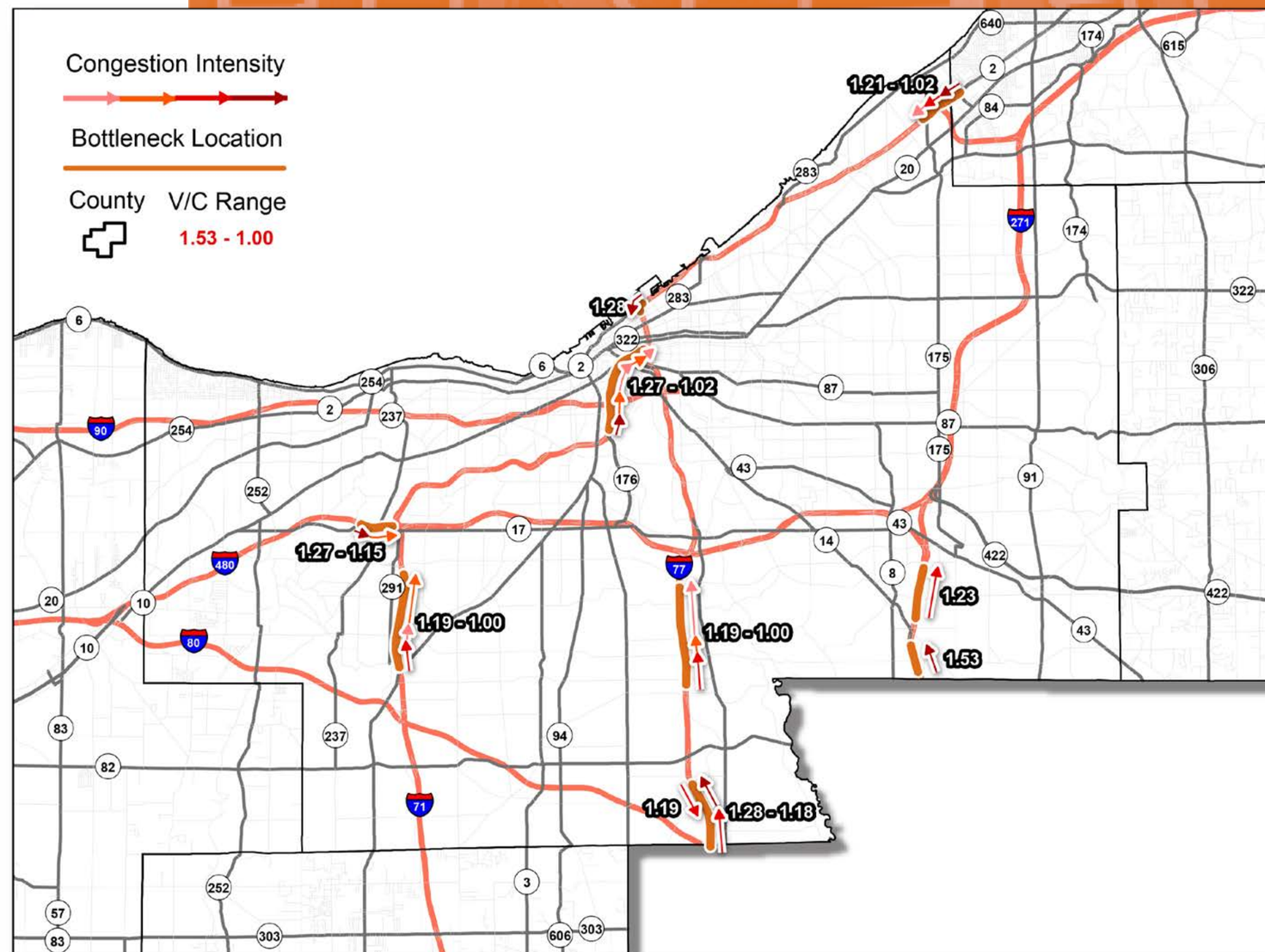


Figure 4-16. Existing Freeway Bottleneck Locations during the PM Peak Period

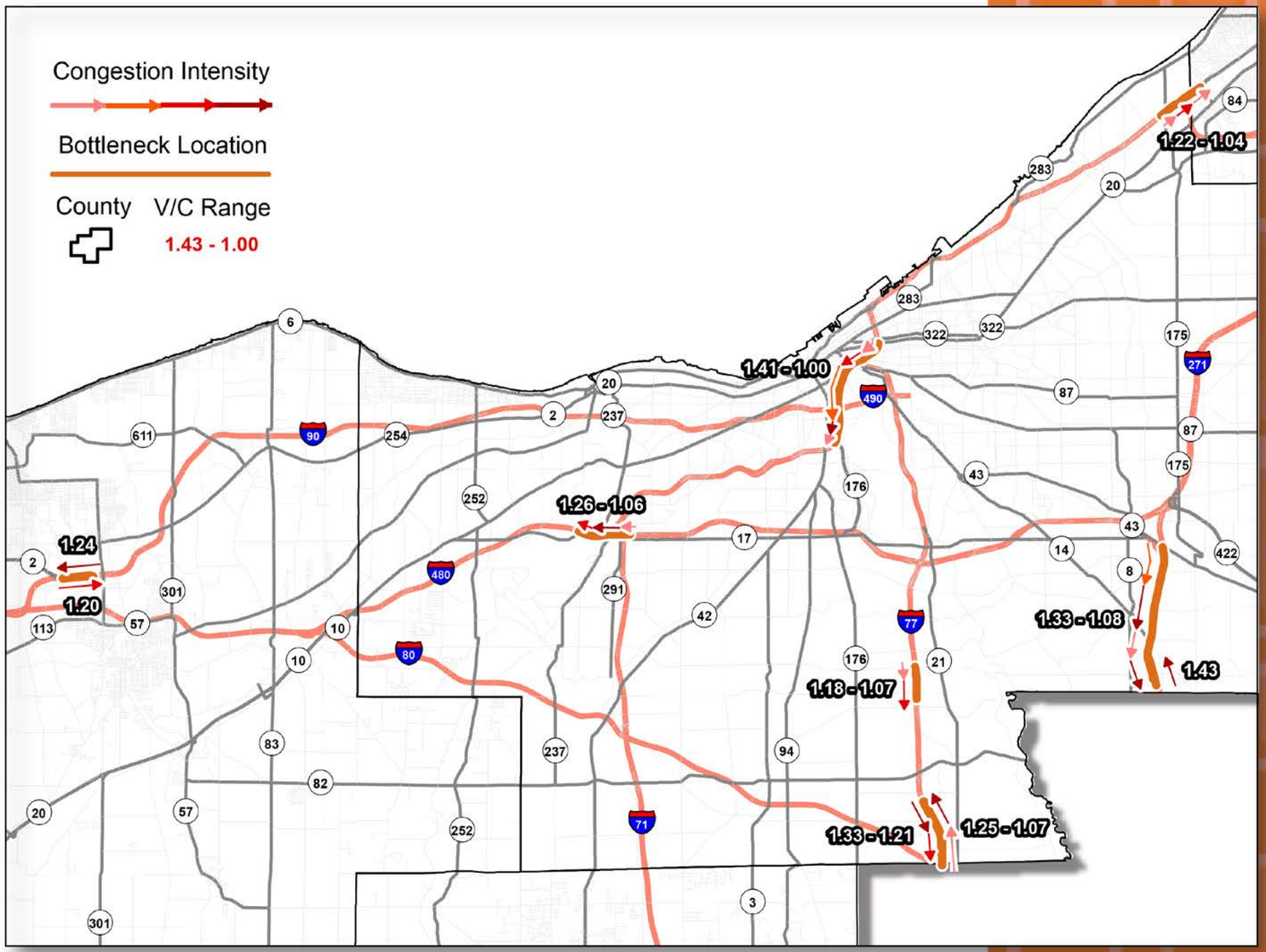


Table 4-10. Freeway Bottlenecks During the AM Peak Period

#	FREEWAY	DIRECTION	FROM	TO	V/C RANGE	TTI RANGE	ACTUAL SPEED (MPH) RANGE
1	I-271and I-480	NB/ WB	I-271 /I-480 Merge	Fairoaks Rd/Broadway Ave. Exit Ramp	1.53	7.5	8
2	I-77	NB	I-80 Entrance Ramp	Oakes Rd/Valley Pkwy	1.28 - 1.18	2.46 – 1.70	35 – 24
3	I-90	WB	SR-2 WB Split	SR-2 EB Entrance Ramp	1.28	2.27	22
4	I-480	EB	Grayton Rd/ Brookpark Rd Entrance Ramp	SR-237 Entrance Ramp	1.27 - 1.15	2.99 – 1.59	38 - 20
5	I-71 and I-90	NB/ EB	W 14th St Exit Ramp	Carnegie Ave Exit Ramp	1.27 - 1.02	2.33 – 1.02	49 - 26
6	I-271and I-480	NB/ WB	Forbes Rd Entrance Ramp	I-271/I-480 split	1.23	1.99	30
7	SR-2 and I-90	WB	Lakeland Blvd Entrance Ramp (near Lloyd Rd)	N Lakeland Blvd Exit Ramp (near E 260th St)	1.21 - 1.02	1.92 – 1.19	50 – 31
8	I-77	NB	Wallings Rd Entrance Ramp	Rockside Rd Exit Ramp	1.19 - 1.00	1.77 – 1.19	51 - 34
9	I-77	SB	Oakes Rd/Valley Pkwy	Miller Rd Exit Ramp	1.19	1.77	34
10	I-71	NB	Pearl Rd Entrance Ramp	Snow Rd Exit Ramp	1.19 - 1.00	1.71 – 1.14	53 - 35

Source: NOACA Travel Forecasting Model

Note: NB: Northbound, SB: Southbound, WB: Westbound, and EB: Eastbound

Table 4-11. Freeway Bottlenecks During the PM Peak Period

#	FREEWAY	DIRECTION	FROM	TO	V/C RANGE	TTI RANGE	ACTUAL SPEED (MPH) RANGE
1	I-271and I-480	NB/ WB	I-271/I-480 merge	Fairoaks Rd/Broadway Ave Exit Ramp	1.43	4.58	13
2	I-90 and I-71	WB/ SB	Prospect Ave Exit Ramp	W 25th St Exit Ramp	1.41 - 1.00	4.27 – 1.09	51- 14
3	I-77	SB	Oakes Rd/Valley Pkwy	I-80 Exit Ramp	1.33 - 1.21	2.99 – 1.87	32 - 20
4	I-271 and I-480	SB/ EB	Rockside Rd Exit Ramp	I-271/I-480 Split	1.33 - 1.08	2.88 – 1.30	46 - 21
5	I-480	WB	I-71 NB Entrance Ramp	Grayton Rd Exit Ramp	1.26 - 1.06	2.25 – 1.26	48 - 27
6	I-77	NB	I-80 Entrance Ramp	Oakes Rd/Valley Pkwy	1.25 - 1.07	2.19 – 1.30	46 - 27
7	I-90 and SR-2	WB	Lorain Blvd Entrance Ramp	I-90/SR-2 Split	1.24	2.73	24
8	I-90 and SR-2	EB	Lakeland Blvd Entrance Ramp (near E 260th St)	Lakeland Blvd Exit Ramp (near Lloyd Rd)	1.22 - 1.04	1.93 – 1.26	47 - 31
9	I-90 and SR-2	EB	I-90/SR-2 Merge	Lorain Blvd Exit Ramp	1.20	2.21	29
10	I-77	SB	Pleasant Valley Rd Exit Ramp	Wallings Rd Exit Ramp	1.18 - 1.07	1.68 – 1.29	47 - 36

Source: NOACA Travel Forecasting Model; Note: NB: Northbound, SB: Southbound, WB: Westbound, and EB: Eastbound

Table 4-10 and Table 4-11 present the V/C, TTI, and speed ranges for the identified freeway bottleneck locations during the AM and PM peak periods.

In order to identify the top interchange and intersection bottleneck locations, a calculation based on the following equation, was performed to average the volume over capacity (V/C) values for all approaches of a given interchange or intersection.

$$WVC = \frac{\sum_{i=1}^{n} VOL_i \times (V/C)_i}{\sum_{i=1}^{n} VOL_i}$$

Where

WVC = Weighted V/C values

n = Number of approaches

VOL = Approach traffic volume (weighting factor)

For example, a four-legged intersection has four approaches, each with their own V/C value. A weighted average of each approach's V/C value was calculated, using the total volume of each approach as the weighting factor. Weighting was used in order to give a more heavily traveled roadway's congestion level more influence over the intersection's final calculated value. The locations with the highest weighted V/C values were then identified as the top bottleneck interchanges and intersections in the region.

A number of the bottleneck locations were grouped together based on their proximity and interactions with each other. For example, in Medina County three bottleneck locations were identified along the SR-94 corridor (Ridge Rd). Since these locations are located along the same corridor, congestion at one location leads to increased congestion at a nearby location. It was determined that these locations should be grouped together and discussed as one due to these inter-relationships. Similar groupings can be seen on the map showing bottleneck locations that have some relationship between each other, such as neighboring interchanges along the same freeway and intersections in a similar geographic area, like downtown Cleveland.

Figure 4-17 and Figure 4-18 present the existing interchange and intersection bottleneck locations during the AM and PM peak periods.

Figure 4-17. Existing Interchange/Intersection Bottleneck Locations during the AM Peak Period

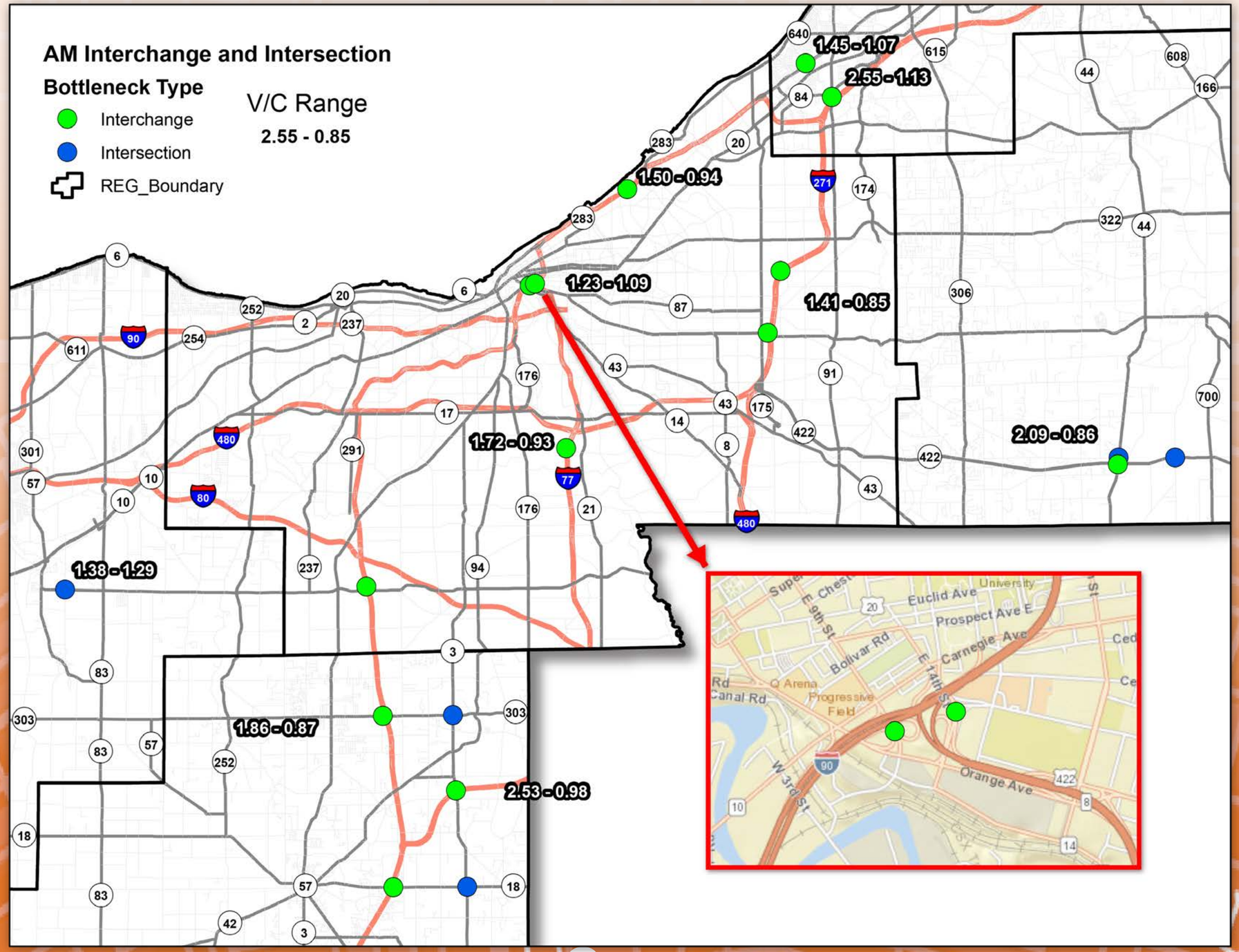


Figure 4-18. Existing Interchange/Intersection Bottleneck Locations during the PM Peak Period

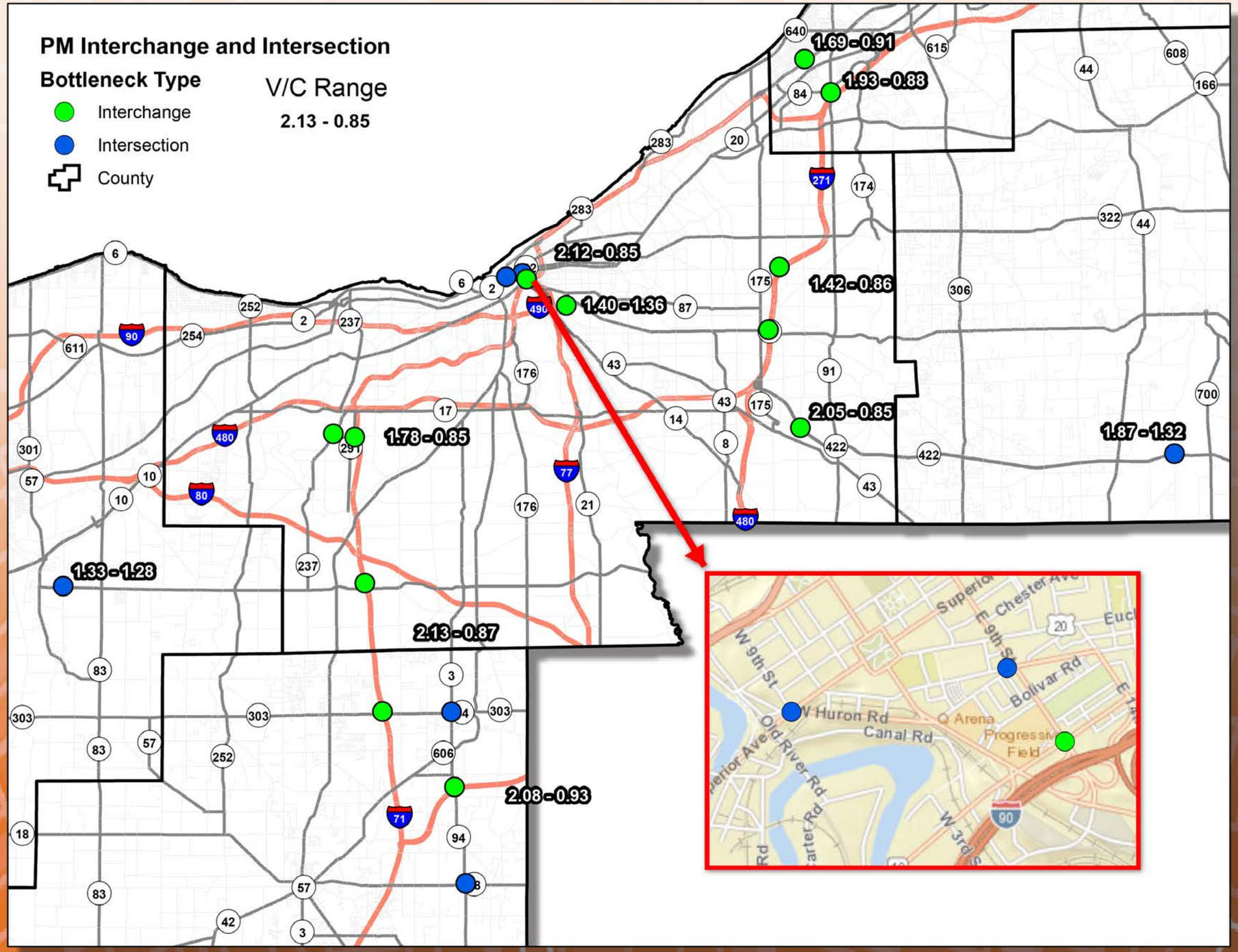


Table 4-12 and Table 4-13 present the V/C values for the identified interchanges and intersection bottleneck locations during the AM and PM peak periods.

Table 4-12. Interchange/Intersection Bottlenecks During AM Peak

#	LOCATION	COUNTY	TYPE	VOLUME WEIGHTED AVERAGE OF V/C FOR INTERSECTION APPROACHES	VOLUME OVER CAPACITY RATIO RANGE AM PEAK PERIOD
1	Ridge Rd (SR-94) Corridor	Medina	Interchange/ Intersection	1.91 - 1.11	2.53 - 0.98
	I-271 / Ridge Rd (SR-94)	Medina	Interchange	1.91	2.53 - 0.98
	Center Rd (SR-303) / Ridge Rd (SR-94)	Medina	Intersection	1.15	1.29 - 1.11
	Medina Rd (SR-18) / Ridge Rd (SR-94)	Medina	Intersection	1.11	1.28
2	I-90 / SOM Center Rd (SR-91)	Lake	Interchange	1.76 - 1.09	2.55 - 1.13
3	I-71 Corridor	Medina / Cuyahoga	Interchange	1.53 - 1.14	1.86 - 0.87
	I-71 / Center Rd (SR-303)	Medina	Interchange	1.53 - 1.21	1.84 - 0.87
	I-71 / Royalton Rd (SR-82)	Cuyahoga	Interchange	1.39 - 1.26	1.86 - 1.39
	I-71 / Medina Rd (SR-18)	Medina	Interchange	1.14	1.39 - 0.94
4	US-422 and Ravenna Rd (SR-44) area	Geauga	Interchange/ Intersection	1.44 - 1.17	2.09 - 0.86
	US-422 / Ravenna Rd (SR-44)	Geauga	Interchange	1.44	2.09 - 0.86
	Main Market Rd (US-422) / Rapids Rd	Geauga	Intersection	1.34	1.51 - 1.21
	Ravenna Rd (SR-44) / E Washington St	Geauga	Intersection	1.17	1.32 - 1.24
5	I-271 Corridor	Cuyahoga	Interchange	1.24 - 0.89	1.41 - 0.85
	I-271 / Cedar Rd / Brainard Rd	Cuyahoga	Interchange	1.24 - 0.89	1.41 - 0.86
	I-271 / Chagrin Blvd (SR-87)	Cuyahoga	Interchange	1.12 - 1.07	1.23 - 0.85
6	Royalton Rd (SR-82) / Durkee Rd	Lorain	Intersection	1.24	1.38 - 1.29
7	Innerbelt at E. 9th and E. 14th	Cuyahoga	Interchange	1.23 - 0.88	1.23 - 1.09
	I-77 NB / E 14th St / E 22nd St	Cuyahoga	Interchange	1.23 - 1.07	1.23 - 1.09
	I-90 EB / E 9th St	Cuyahoga	Interchange	1.09 - 0.88	1.11 - 1.09
8	I-77 / Rockside Rd	Cuyahoga	Interchange	1.19 - 1.04	1.72 - 0.93
9	SR-2 / E 305th St	Lake	Interchange	1.14 - 0.85	1.45 - 1.07
10	I-90 / Eddy Rd	Cuyahoga	Interchange	1.10	1.50 - 0.94

Source: NOACA Travel Forecasting Model

Table 4-13. Interchange/Intersection Bottlenecks During PM Peak

#	LOCATION	COUNTY	TYPE	VOLUME WEIGHTED AVERAGE OF V/C FOR INTERSECTION APPROACHES	VOLUME OVER CAPACITY RATIO RANGE PM PEAK PERIOD
1	Downtown Cleveland Area	Cuyahoga	Interchange/ Intersection	1.64 - 1.17	2.12 - 0.85
	I-90 WB / E 9th St / Carnegie Ave	Cuyahoga	Interchange/ Intersection	1.64	2.12 - 0.85
	Prospect Ave / Huron Rd (west of E 9th St)	Cuyahoga	Intersection	1.18	1.42 - 0.92
	Superior Ave / Huron Rd / W 9th St	Cuyahoga	Intersection	1.17	1.70 - 0.93
2	Ridge Rd (SR-94) Corridor	Medina	Interchange/ Intersection	1.64 - 1.15	2.08 - 0.93
	I-271 / Ridge Rd (SR-94)	Medina	Interchange	1.64	2.08 - 0.93
	Center Rd (SR-303) / Ridge Rd (SR-94)	Medina	Intersection	1.23	1.52 - 1.06
	Medina Rd (SR-18) / Ridge Rd (SR-94)	Medina	Intersection	1.15	1.49 - 1.10
3	Main Market Rd (US-422) / Rapids Rd	Geauga	Intersection	1.61	1.87 - 1.32
4	I-71 Corridor	Medina / Cuyahoga	Interchange	1.53 - 0.92	2.13 - 0.87
	I-71 / Royalton Rd (SR-82)	Cuyahoga	Interchange	1.53 - 1.45	2.13 - 0.87
	I-71 / Center Rd (SR-303)	Medina	Interchange	1.15 - 0.92	1.26 - 0.89
5	SR-2 / E 305th St	Lake	Interchange	1.44 - 0.86	1.69 - 0.91
6	I-271 Corridor	Cuyahoga	Interchange	1.30 - 0.86	1.42 - 0.86
	I-271 / Cedar Rd / Brainard Rd	Cuyahoga	Interchange	1.30 - 0.86	1.42 - 0.86
	I-271 / Chagrin Blvd (SR-87)	Cuyahoga	Interchange	1.16 - 1.09	1.35 - 0.87
7	I-90 / SOM Center Rd (SR-91)	Lake	Interchange	1.30 - 1.22	1.93 - 0.88
8	Snow Rd Corridor	Cuyahoga	Interchange	1.29 - 1.15	1.78 - 0.85
	I-71 / Snow Rd	Cuyahoga	Interchange	1.29	1.78 - 0.85
	SR-237 / Snow Rd	Cuyahoga	Interchange	1.15	1.45 - 0.91
9	US-422 / Harper Rd	Cuyahoga	Interchange	1.26	2.05 - 0.85
10	I-490 / E 55th St	Cuyahoga	Interchange	1.25	1.40 - 1.36
11	Royalton Rd (SR-82) / Durkee Rd	Lorain	Intersection	1.22	1.33 - 1.28

Source: NOACA Travel Forecasting Model

Fuel, Delay, and Congestion Costs

As demand approaches the capacity of a freeway (or of the interchanges along the highway), extreme traffic congestion sets in. Traffic congestion impacts the operation and performance of the freeway and causing longer trip times, slower speed and increased delay. As traffic engineering and financial performance indicators, combination of travel delay and wasted fuel due to congestion is considered as the congestion cost.

This combined measure was calculated based on;

- Average fuel cost per gallon; this measure may be considered as the quotient of total daily Vehicle Miles Traveled (VMT) divided by total daily gasoline consumption.
- Median value of time per hour; according to the US Department of Transportation and other sources the value of time measure is a range of 30 to 60 percent of average earnings.
- Average Auto occupancy during peak and off-peak periods of a day.

Congestion Cost Estimation Procedure

The following steps are used for calculating the total congestion cost for the road segments in the considered influence subarea.

- The ***average road segment delay*** is the difference between the estimated travel time under actual (often congested) conditions and under uncongested conditions.

Average Road Segment Delay (hr) =

$$\frac{\textit{Length of the road Segment (miles)}}{\textit{Road Segment congested speed (mph)}} - \frac{\textit{Length of the road Segment (miles)}}{\textit{Free Flow Speed (mph)}}$$

- The ***total delay on a road segment*** is product of the average delay and total vehicles traveling this segment.

Road Segment Delay (hr) =

Average Road Segment Delay x *Total Traffic Volume*

- The ***road segment delay cost*** is calculated by multiplying the estimated road segment delay by average passenger car occupancy and the occupants' average value of time.

Road Segment Delay Cost ($) =

Road Segment Delay x *Average Auto Occupancy* x *Average Value of Time*

- Vehicles waste additional fuel when they are under congested conditions. The ***additional consumed fuel cost*** can be estimated using the below calculated delay and auto operating cost.

Road Segment Fuel Cost ($) =

Road Segment Delay x *Road Segment Congested Speed* x *Auto Operating Cost*

- The ***average auto operating cost*** is estimated by dividing the fuel cost per gallon by the average miles a vehicle can travel on one gallon of fuel.

Average Auto Operating Cost ($) =

$$\frac{\textit{Fuel Cost per gallon}}{\textit{Average miles a vehicle can travel on one gallon of fuel}}$$

- Finally, the ***total road segment congestion cost*** comprises of two elements; delay cost and fuel cost.

Road Segment Congestion Cost ($) =

Road Segment Delay Cost + *Road Segment Fuel Cost*

Table 4-14 displays the estimated 2020 daily and annual congestion costs.

Table 4-14. Estimated 2020 Daily and Annual Congestion Costs

COST ITEM	UNIT	ESTIMATED 2020 VALUE
Daily Wasted Fuel	Gallon	115,000
Daily Wasted Fuel Cost	2020$	313,000
Total Daily Delay	Hour	127,000
Total Daily Delay Cost	2020$	2,615,000
Total Daily Congestion Cost	2020$	2,928,000
Total Annual Congestion Cost	2020$	732,076,000

Source: NOACA Travel Forecasting Model

Assumptions:

- Fuel Cost per Gallon (2020$): 2.72
- Average Traveled Miles per Gallon: 24.14
- Average Values of Time (2020$): 13.74

Mobility for the Transit Rider

Transit travel time is a critical factor when choosing to travel by private vehicle or by transit for daily work trips. As discussed, the transit system has an acceptable level of coverage in Cuyahoga County, but due to low frequency of transit services, low speed on the arterial streets, and long waiting and transfer times, work commute time by transit is still much higher than work commute time by automobile. Minimum, maximum, and average commute times for transit times are double those by auto (Table 4-15). Particularly the population in Environmental Justice areas is more dependent on transit services than other population sectors (Table 4-16). Therefore, transit accessibility and travel time are critical for work-related journeys for these people. This section provides an abbreviated discussion of a full analysis that NOACA conducted in 2019 as part of its Workforce Mobility Study.

To measure workforce mobility and accessibility in the NOACA region, regional job hubs were identified based on a research brief produced by NOACA in 2016, entitled "Major Employment Hubs in the Cleveland MSA" (metropolitan statistical area). Chapter 3 introduced the regional job hubs shown in Figure 4-19. The regional job hubs formed the foundation for NOACA's 2019 Workforce Mobility Study.

Table 4-15 and Table 4-16 illustrate the minimum, maximum and average commute times of recent work trips during the morning peak period of a typical day from workers' homes to the regional major job hubs by auto and transit. Comparing the work commute times from residential areas to the regional major job hubs by auto and transit indicate that the average transit work commute times from the EJ areas (Table 4-16) are higher than the regional average auto work commute times to major job hubs (Table 4-15). The range of the average transit times is wider than the range of the regional average auto travel time: 52-101 minutes compared with 35-42 minutes.

Comparing all of the job hubs, the average transit commute time from EJ areas is the lowest to downtown Cleveland because it is served by fairly frequent bus and rail services. The transit commute times increase from the EJ areas to job hubs farther from downtown Cleveland. For instance, a worker employed in the Independence job hub would commute much longer by transit than automobile (Figure 4-20, Figure 4-21, Figure 4-22, and Figure 4-23). An equitable transportation system would have less gap between the auto and transit commute times.

The average commute times by auto to the major job hubs are similar because all the job hubs are located close to the highway system, and the section on page 73 revealed there are abundant freeway interchanges that provide quick access from residential areas to the existing freeway system and subsequently to job hubs.

The implications of this analysis are far-reaching. On the workforce development side, the analysis and data could be used to identify undersupplies of workers who reside in areas with good accessibility to major job hubs. Several approaches can reduce the spatial mismatch between workers and employers across the region, including more frequent transit services to the major job hubs, more park-and-ride locations, the implementation of low-cost traffic engineering to remove arterial bottlenecks, and more bike facilities to access major transit stations.

Figure 4-19. Regional Job Hubs

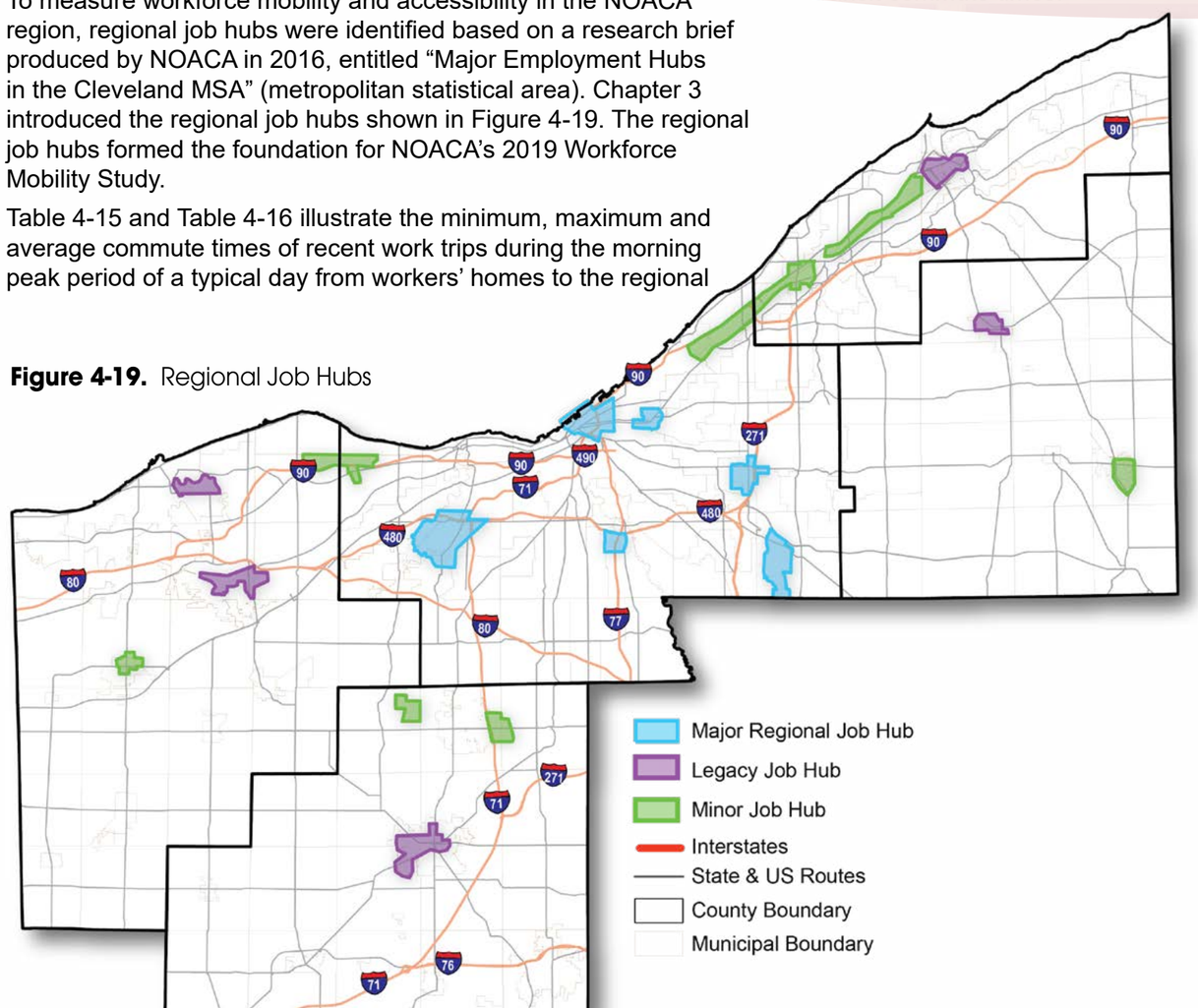


Table 4-15. Morning Work Commute Times to Job Hubs

		ORIGIN (REGION)					
		COMMUTE TIME BY TRANSIT (MINUTES)			COMMUTE TIME BY AUTO (MINUTES)		
		Min	Average	Max	Min	Average	Max
DESTINATION (MAJOR JOB HUB)	Cleveland Downtown	17	76	249	3.1	38	102
	University Circle	17	71	271	2.6	42	107
	Solon	35	106	236	3.5	42	92
	Chagrin Highlands	26	97	294	3.2	38	89
	Independence	40	106	292	2	35	89
	Hopkins Airport Area	48	106	262	4	35	92

Source: NOACA Travel Forecasting Model

Table 4-16. Morning Work Commute Times From Environmental Justice Areas to Job Hubs

		ORIGIN (EJ AREAS)					
		COMMUTE TIME BY TRANSIT (MINUTES)			COMMUTE TIME BY AUTO (MINUTES)		
		Min	Average	Max	Min	Average	Max
DESTINATION (MAJOR JOB HUB)	Cleveland Downtown	17	53	219	3.1	25	69
	University Circle	18	56	241	2.6	27	76
	Solon	38	93	217	3.7	36	81
	Chagrin Highlands	27	83	264	3.3	30	77
	Independence	45	90	263	5.7	27	66
	Hopkins Airport Area	52	101	181	4.3	27	73

Source: NOACA Travel Forecasting Model

Figure 4-20. Auto Accessibility for All Workers from Home TAZ to Downtown

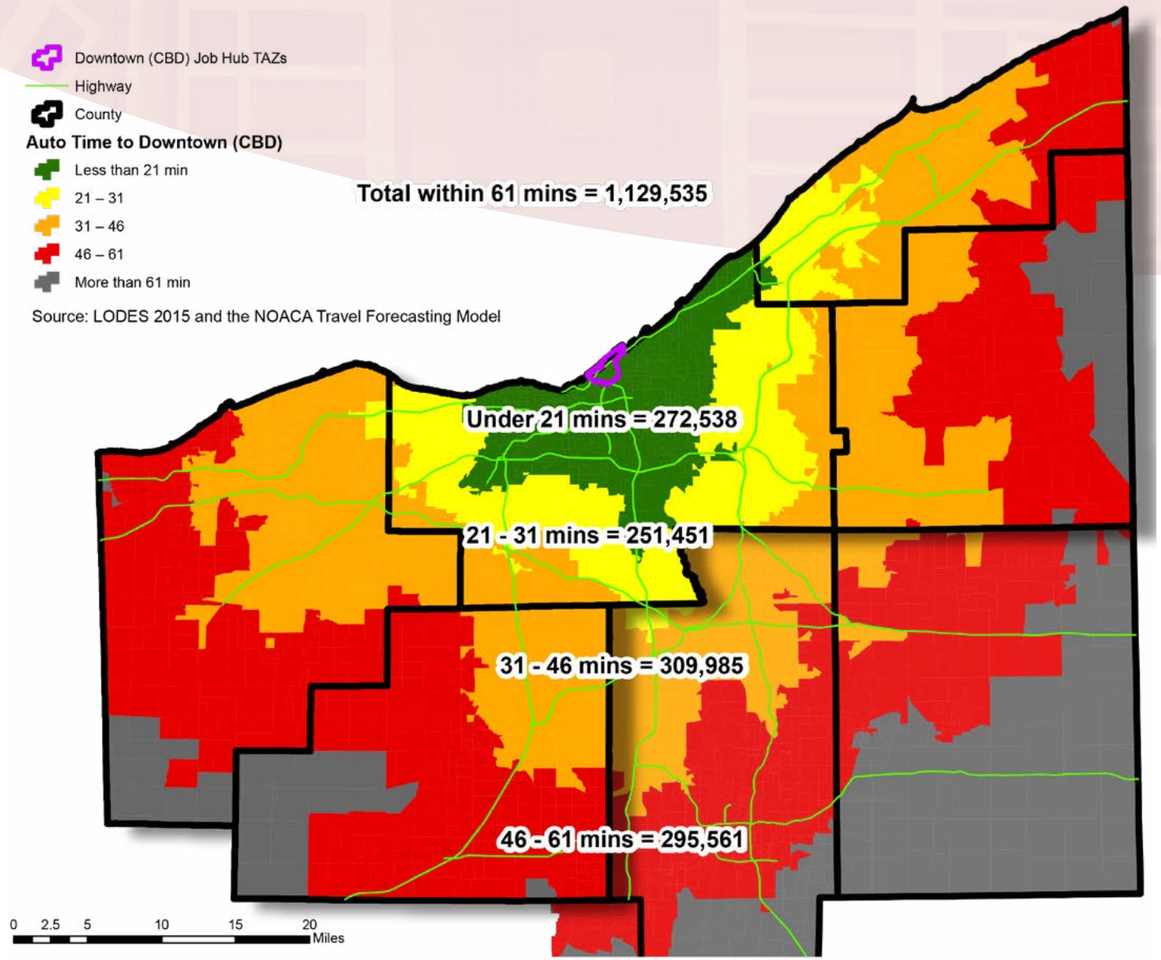


Figure 4-21. Transit Accessibility for All Workers from Home TAZ to Downtown

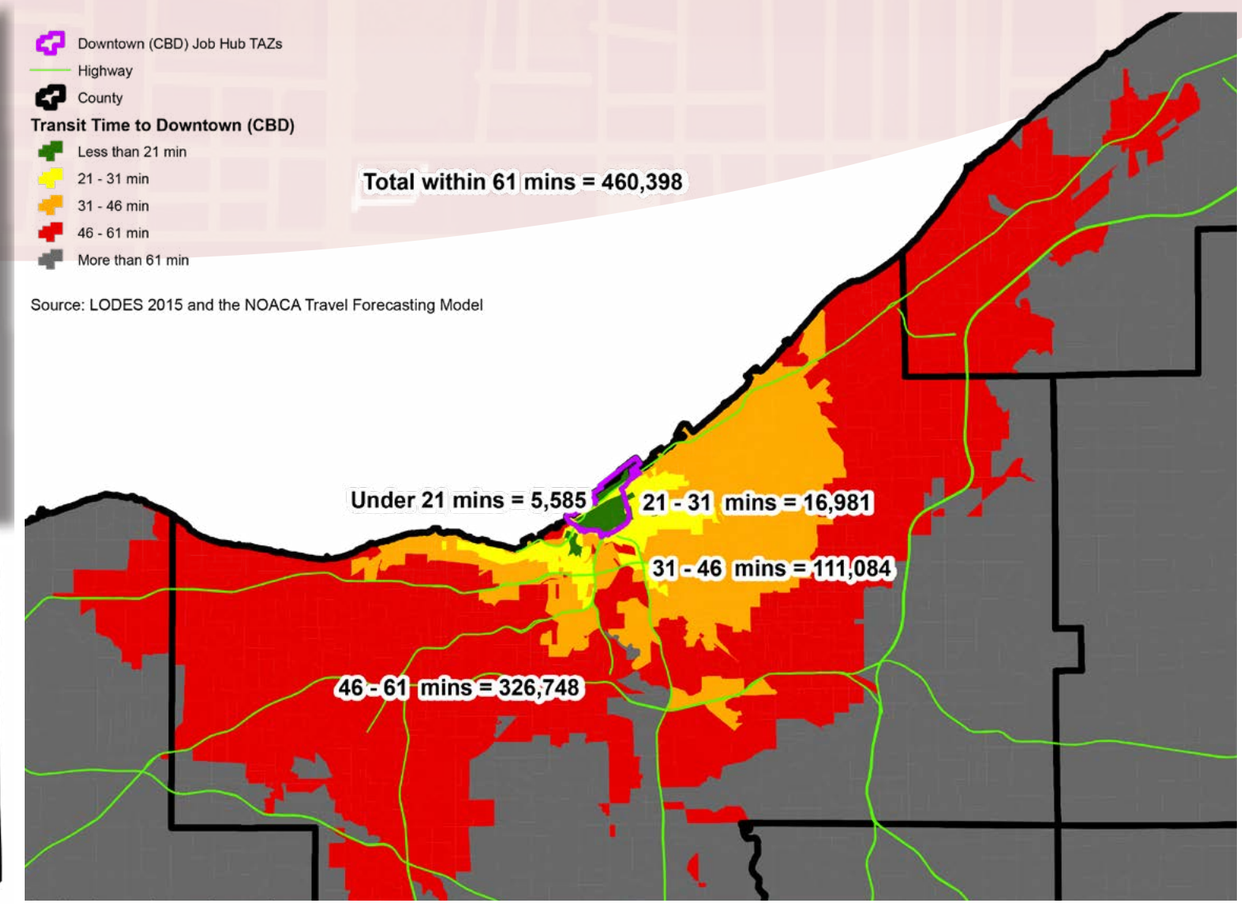


Figure 4-22. Auto Accessibility for All Workers from Home TAZ to Independence

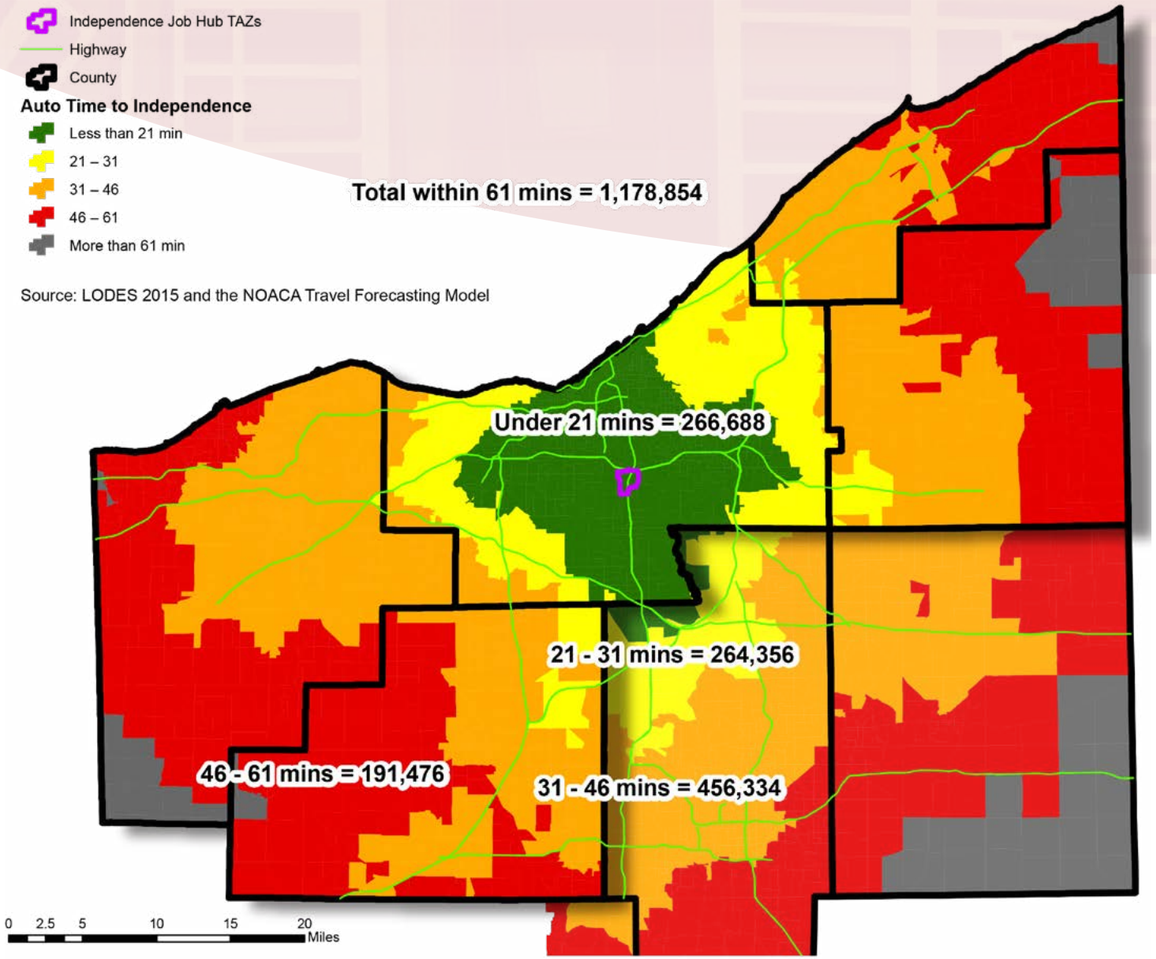
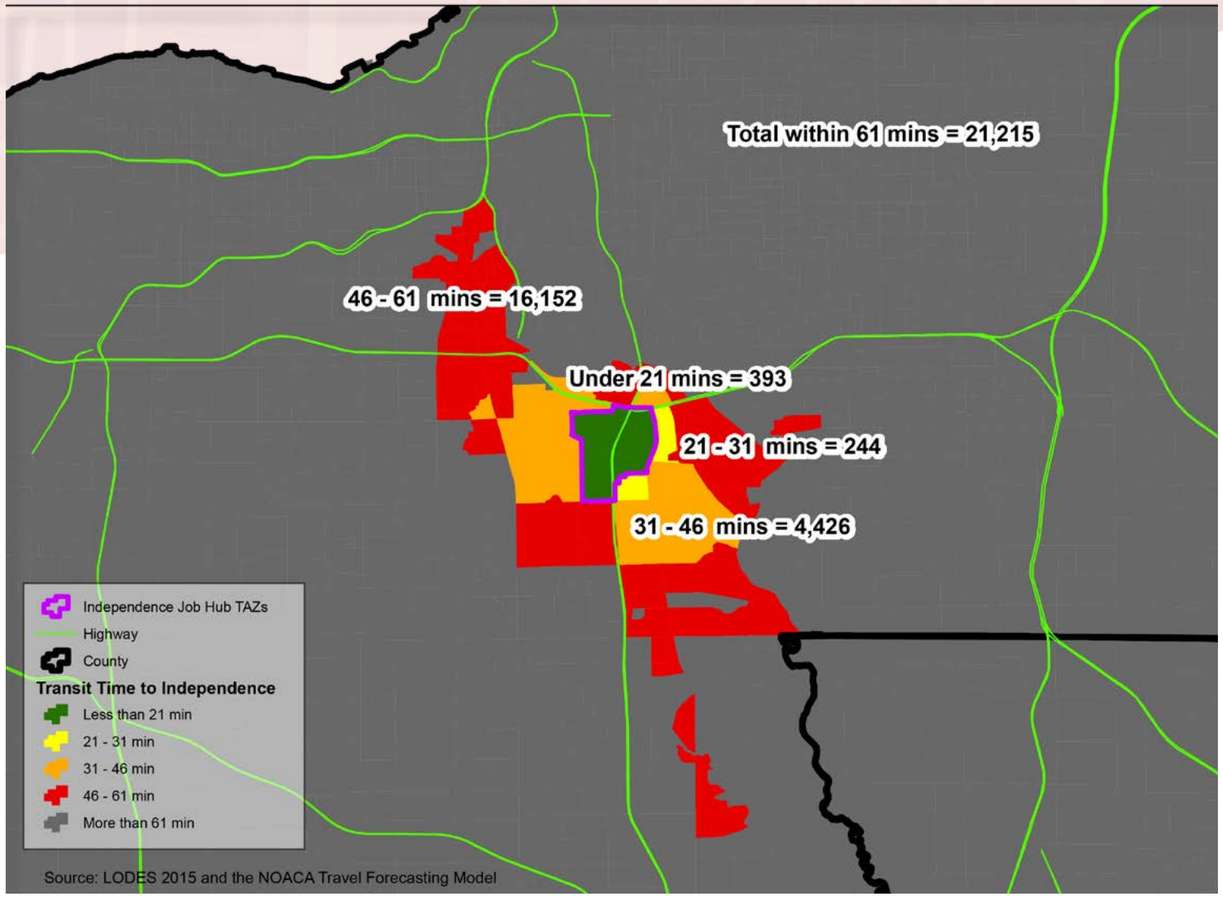


Figure 4-23. Transit Accessibility for All Workers from Home TAZ to Independence



Mobility for the Biker and Walker

NOACA's bicycle planning activities include bicycle counts, level of traffic stress analysis, access to parks analysis, crash data reviews, and analysis of locally identified bike projects such as the Eastside Greenway. Level of Traffic Stress analysis is based on the premises that most people generally avoid cycling on roads that they perceive are stressful, and that traffic (speed, volume, and distance from cyclists) is the key factor in determining cyclist stress. Researchers have developed a set of measures that broadly capture a road's stress level by classifying it in one of four levels of traffic stress from low to high. The most recent analysis of crashes in the NOACA region (NOACA's State of Safety 2019 report) uses data for the five-year period from 2015 to 2019. The analyses will be part of the ACTIVATE plan.

Table 4-17. Regional Safety Priority Bicycle Corridors[7]

FOUR OR MORE PEDESTRIAN AND BICYCLE FSI CRASHES PER MILE						2015-2019 CRASH DATA					
RANK	COUNTY	COMMUNITY	CORRIDOR	FROM	TO	PED TOTAL	PED FSI	BIKE TOTAL	BIKE FSI	ALL PED + BIKE CRASHES	PED + BIKE FSI
1	Cuyahoga	Cleveland	E 9th St	Sumner Ave	N Marginal Rd	30	6	6	0	36	6
2	Cuyahoga	Cleveland	Detroit Ave	W 95th St	W 65th St	17	4	7	1	24	5
3	Cuyahoga	Cleveland	W 25th St	Scranton Rd	Walton Ave	13	5	9	2	22	7
4	Cuyahoga	Cleveland	W 117th St	0.13 mi S of Lorain Ave	Berea Rd	12	3	9	3	21	6
5	Cuyahoga	Cleveland	St Clair Ave	E 93rd St	E 115th St	18	3	3	2	21	5
6	Cuyahoga	Cleveland	St Clair Ave	W 10th St/Old River Rd	E 13th St	18	7	1	0	19	7
7	Cuyahoga	Cleveland, Euclid	Euclid Ave	Hillview Rd	Grand Blvd (0.20 mi E of E 196th St)	16	4	3	1	19	5
8	Cuyahoga	Cleveland	Detroit Ave	W 114th St	W 95th St	11	4	5	1	16	5
9	Cuyahoga	Cleveland	E 131st St	Hoy Ave (0.14 mi S of Miles Ave)	Bartlett Ave	13	6	2	0	15	6
10	Cuyahoga	Cleveland	E 93rd St	Prince Ave (0.36 mi N of Harvard Ave)	Easton Ave (0.23 mi S of Kinsman Rd)	12	8	2	1	14	9
11	Cuyahoga	Euclid	Babbitt Rd	0.22 mi N of Lakeland Blvd	Lakeshore Blvd	11	5	3	0	14	5
12	Cuyahoga	Cleveland, East Cleveland	E Superior Ave	E 108th St	Hayden Ave	10	5	3	1	13	6
13	Cuyahoga	Parma	Ridge Rd	0.18 mi S of Regency Dr	Buckingham Dr (N of W Ridgewood Dr)	11	4	2	0	13	4
14	Cuyahoga	Cleveland	Miles Rd	E 99th St	E 124th St	10	4	2	0	12	4
15	Cuyahoga	East Cleveland	E Superior Ave/Euclid Ave	Hayden Ave	Wymore Ave	8	4	3	0	11	4
16	Cuyahoga	Cleveland	St Clair Ave	E 115th St	Casper Rd	9	4	1	0	10	4
16	Cuyahoga	Parma, Parma Heights	W Ridgewood Dr	York Rd	S Canteburry Rd (0.32 mi W of Ridge Rd)	7	4	3	0	10	4
16	Lake	Eastlake	Vine St	E 332nd St	E 359th St	5	2	5	2	10	4
17	Cuyahoga	Cleveland Hts, South Euclid	Warrensville Center Rd	Verona Rd (0.35 mi N of Cedar Rd)	Mayfield Rd	5	4	4	0	9	4

Source: ODOT GIS Crash Analysis (GCAT) Tool. Accessed August 2020.

Safety in the Transportation System

Safety is another important factor to consider when planning for the region's road network. A road safety assessment (RSA) is a formal evaluation of the safety and performance of a road segment or intersection by an independent audit team. NOACA works with the Ohio Department of Transportation (ODOT) and local communities to conduct RSAs at high-crash locations throughout Northeast Ohio. These high-crash locations are corridors and intersections identified in the State of Safety Report where high frequency of serious injury and fatal motorized vehicle crashes or high frequency of bicycle and pedestrian crashes occurred over the past five years. The RSA team observes traffic and operating conditions; identifies hazardous conditions, deficiencies, equipment malfunctions, sight distance obstructions, and other safety concerns; and considers the safety of all road users, including bicyclists, pedestrians, and people with physical challenges.

During 2019, there were 50,287 roadway crashes in the region, which resulted in 134 fatalities and 1,337 serious injuries (see Table 4-18). Both fatalities and serious injuries have significantly increased in 2019:

- A total of 22 more fatalities occurred versus 2018, a 20% increase.
- A total of 303 more serious injuries occurred versus 2018, a 29% increase.

A roadway crash is caused by one or more contributing factors. A driver can be distracted, the road could have an engineering flaw, the speed limit may be too high, or countless other factors. Achieving safety on the roads will require focusing on all aspects of the transportation system. The strategies established in *SAVE: NOACA's Plan for Transportation Safety* use a comprehensive approach to address safety on the roads by including the six Es of transportation safety: Education, Enforcement, Engineering, Evaluation, Emergency Medical Services, and Equity. Along with the strategies, the *SAVE Plan* includes a list of action steps that should be taken to implement the strategies. The progress in transportation safety will be evaluated by performance measures from year to year once the recommendations begin to be carried out. As part of the *SAVE Plan* implementation, a Safe Routes to School (SRTS) Assistance Program has been developed to provide jurisdictions and school districts with SRTS planning and implementation support. Safe Routes to School focuses on making it safe, convenient, and fun for kids and families, including those with disabilities, to walk or bicycle to school and in everyday life.

Table 4-18. Crashes by Severity, 2015-2019[8]

	TOTAL	PDO		SERIOUS INJURY		FATAL	
YEAR	#	#	% OF ALL	#	% OF ALL	#	% OF ALL
2015	49,553	36,498	74%	1,075	2.2%	133	0.3%
2016	50,233	36,628	73%	1,108	2.2%	144	0.3%
2017	49,769	36,391	73%	1,026	2.1%	157	0.3%
2018	50,069	37,144	74%	878	1.8%	106	0.2%
2019	50,287	36,351	72%	1,072	2.1%	123	0.2%
Total	249,911	183,012	73%	5,159	2.1%	663	0.3%

Source: ODOT GIS Crash Analysis (GCAT) Tool. Accessed August 2020.

NOACA's State of Safety Report helps to prioritize transportation safety concerns. It includes the top high-crash corridors in the region ranked by the number of serious injury and fatal crashes. Table 4-19 shows the top high-crash corridors based on the number of serious injury and fatal crashes of all types of crashes per mile that occurred during the five years from 2015-2019. The *State of Safety Report* is updated each year to include the latest available five-year crash data.

Table 4-19. Regional Safety Priority Corridors[9]

FIVE OR MORE FATAL OR SERIOUS INJURY (FSI) CRASHES PER MILE — **2015-2019 CRASH DATA**

RANK	COUNTY	COMMUNITY	CORRIDOR	FROM	TO	TOTAL CRASHES	FSI
1	Lake	Mentor	Mentor Ave	0.16 mi E of Hopkins Rd	Old Johnnycake Ridge Rd	229	5
2	Cuyahoga	Cleveland	St Clair Ave	E 93rd St	E 115th St	168	12
3	Cuyahoga	North Olmsted	Lorain Rd	Dover Center Rd	0.30 mi W of Great Northern Blvd	162	5
3	Cuyahoga	Cleveland	W 117th St	0.13 mi S of Lorain Ave	Berea Rd	162	5
4	Cuyahoga	Cleveland	St Clair Ave	E 115th St	Casper Rd (0.12 mi SW of Hayden Ave)	161	12
5	Cuyahoga	Cleveland, Euclid	Dille Rd/Nottingham Rd	Euclid Ave	S Waterloo Rd/I-90 EB Exit Ramp	160	10
6	Cuyahoga	Cleveland	W 25th St	0.10 mi N of Clark Ave	0.06 mi N of Lorain Rd	155	5
7	Cuyahoga	Cleveland, East Cleveland	E Superior Ave	E 108th St	Hayden Ave	153	5
8	Cuyahoga	University Hts, Cleveland Hts, South Euclid	Cedar Rd	Goodnor Rd (0.26 mi W of S Taylor Rd)	Fenwick Rd (0.21 mi E of Washington Blvd)	150	5
9	Cuyahoga	Cleveland	E 93rd St	Prince Ave (0.35 mi S of Aetna Rd)	Bessemer Ave	138	9
10	Cuyahoga	Cleveland	Detroit Ave	W 95th St	W 65th St	129	5
11	Cuyahoga	Cleveland	E Superior Ave	E 58th St	E 81st St	126	7
12	Cuyahoga	Cleveland	E 55th St	Scovill Ave	Chester Ave (US-322)	118	5
12	Cuyahoga	Cleveland	Fulton Pkwy/Fulton Rd	Memphis Ave	I-71 South Ramps	118	5
13	Cuyahoga	Cleveland, Euclid	Euclid Ave	Hillview Rd (0.30 mi W of Green Rd)	0.28 mi W of Highland Rd/Dille Rd	106	5
14	Cuyahoga	Euclid	Euclid Ave/Chardon Rd	Grand Blvd (0.28 mi W of Highland Rd/Dille Rd)	E 266th St	104	6
15	Cuyahoga	Cleveland	W 117th St	Memphis Ave/Bellaire Rd	0.13 mi S of Lorain Ave	102	5
16	Cuyahoga	Cleveland	E 131st St	Hoy Ave	Farringdon Ave	100	5
17	Cuyahoga	Euclid	Euclid Ave	Chardon Rd	Sherwood Blvd	99	5
18	Cuyahoga	Cleveland	E Superior Ave	E 33rd St	E 58th St	94	6
19	Cuyahoga	Cleveland	E Superior Ave	E 81st St	E 108th St	93	5
20	Cuyahoga	Cleveland, Shaker Hts	Buckeye Rd/S Woodland Rd	E 120th St	Warrington Rd	92	5
21	Cuyahoga	Cleveland	St Clair Ave	E 72nd St	E 93rd St	88	5
22	Cuyahoga	Bedford, Maple Hts	Broadway Ave	South Blvd	Glendale St	84	5
23	Cuyahoga	East Cleveland	E Superior Ave/Euclid Ave	Hayden Ave	Wymore Ave	76	6
24	Cuyahoga	Cleveland, Newburgh Hts	Harvard Ave	0.07 mi W of E 49th St	0.05 mi W of E 71st St	74	5
25	Cuyahoga	Strongsville	Prospect Rd	Royalton Rd	0.29 mi S of Albion Rd	72	5
25	Cuyahoga	Cleveland, Garfield Hts	Warner Rd	0.34 mi S of Garfield Blvd	Force Ave	72	5

Regional Safety Priority Corridors (Continued)

FIVE OR MORE FATAL OR SERIOUS INJURY (FSI) CRASHES PER MILE **2015-2019 CRASH DATA**

RANK	COUNTY	COMMUNITY	CORRIDOR	FROM	TO	TOTAL CRASHES	FSI
26	Cuyahoga	Euclid	Lakeshore Blvd	E 219th St	E 244th St	67	6
27	Cuyahoga	Cleveland	Detroit Ave	W 114th St	W 95th St	66	5
28	Cuyahoga	Parma	Snow Rd	W 44th St	0.26 mi W of Broadview Rd	63	5
29	Cuyahoga	Cleveland	Broadway Ave	N of Aetna Rd	Booth Ave (N of Harvard Ave)	61	5
30	Cuyahoga	Maple Hts	Libby Rd	0.12 W of Broadway Ave	Cato St	57	5
31	Cuyahoga	Euclid	Lakeshore Blvd	E 244th St	E 272nd St	53	5
32	Cuyahoga	Cleveland	W 140th St	Viola Ave	0.09 mi S of Triskett Rd	51	5
33	Cuyahoga	Parma	Pearl Rd	0.07 mi S of Snow Rd (Parma/Parma Hts Corp Line)	Maysday Ave (E of Ridge Rd)	50	5
34	Cuyahoga	North Royalton, Parma	York Rd	Lynn Dr	Pleasant Lake Blvd	48	7
35	Lake	Painesville	E Erie St	Liberty St Ext	0.06 mi W of Nottingham Pl	42	5
36	Cuyahoga	Cleveland Hts	Mayfield Rd	Lee Rd	Yellowstone Rd	41	5
37	Cuyahoga	Gates Mills	Mayfield Rd	0.39 mi N of W Hill Dr	0.32 mi E of Chagrin River Rd	32	5
37	Cuyahoga	Parma	W Ridgewood Dr	State Rd (SR-94)	0.15 mi W of Yorktown Dr	32	5
38	Cuyahoga	Bedford	Northfield Rd	E Interstate St	Avery Ave	31	5
39	Lorain	Henrietta Twp	SR-113	Gifford Rd	0.25 mi E of Baumhart Rd	19	5

Source: ODOT GIS Crash Analysis (GCAT) Tool. Accessed August 2020.

ENDNOTES

1 Ohio Department of Transportation, "Pavement Condition Rating," Transportation Information Mapping System (TIMS) https://gis.dot.state.oh.us/tims/map

2 Placeholder for the National Bridge Inspection Standards Citation

3 NEOSCC and Sasaki, Vibrant NEO2040.

4 Maggie L. Grabow; Scott N. Spak; Tracey Holloway; Brian Stone, Jr.; Adam C. Mednick; and Jonathan A. Patz, "Air Quality and Exercise-Related Health Benefits from Reduced Car Travel in the Midwestern United States," Environmental Health Perspectives 120, no. 1 (Jan. 2012), 68-76; National Library of Medicine, National Center for Biotechnology Information Resources PubMed, https://www.ncbi.nlm.nih.gov/pubmed/22049372.

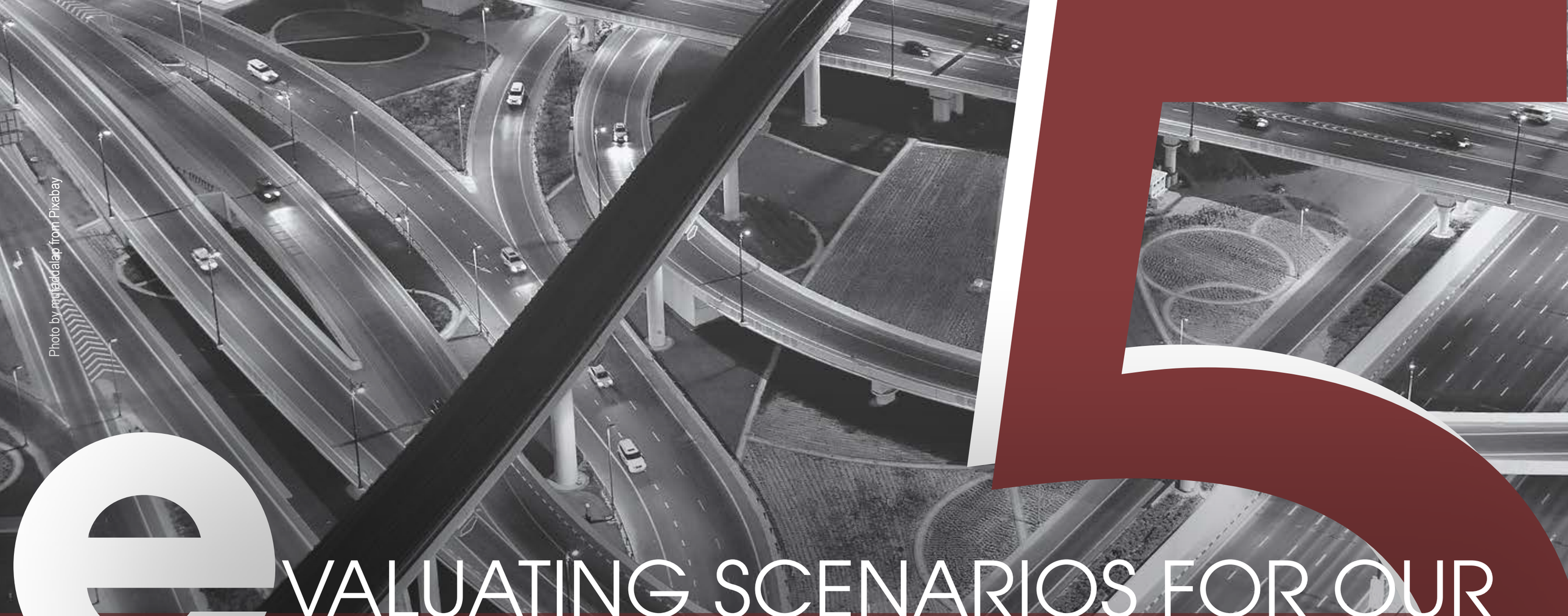
5 Northeast Ohio Sustainable Communities Consortium (NEOSCC) and Sasaki, Vibrant NEO2040, (Northeast Ohio Sustainable Communities Consortium, Feb. 2014); http://vibrantneo.org/wp-content/uploads/2014/04/Vibrant-NEO-Final-Report_3-31-14_lowres_ALL.pdf (accessed April 7, 2021).

6 NOACA Travel Forecasting Model, 2020 estimates (based on 2010 American Community Survey (ACS) 5-year estimates)

7 Ohio Department of Transportation, "2015-2019 Crashes", GIS Crash Analysis Tool, accessed August 2020, https://gis.dot.state.oh.us/tims/CrashAnalytics/Login

8 Ibid.

9 Ibid.



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5 EVALUATING SCENARIOS FOR OUR REGIONAL FUTURE

eNEO2050

In this Chapter

More than a century ago, automobiles or horseless carriages were a revolutionary transportation option. Their deployment altered land-use and travel patterns and drove the development of transportation infrastructure, policies, and regulations. Today connected and automated vehicles (CAVs) are poised to bring the next wave of changes to the transportation system in conjunction with related developments in vehicle electrification, shared mobility, and the emergence of new mode options such as electric scooters. The automobile industry is replacing "horse power" with "processing power," and there is a little doubt that the Plug-in Electric Vehicles (PEV), Connected and Autonomous Vehicles (CAV), autonomous shuttles, and other technology-driven advancements are going to fill our highway network sooner than expected. This technology will not replace the existing modes of travel overnight; however, the PEVs and CAVs will slowly replace the existing conventional cars, and eventually everyone will travel in these futuristic vehicles. As cars will be in constant communication with each other to ensure they smoothly and safety weave through traffic, this could free up more space for pedestrian areas and bicycle lanes. This may take one or two decades to come about, but it will certainly happen by 2050 with new social norms and travel patterns being established. Any future transportation plan should consider these technology advancements in different levels.

As new technologies emerge, the region is facing many uncertainties. This chapter addresses these uncertainties by exploring four potential investment scenarios for Northeast Ohio. The investment scenarios make different assumptions about future population and job growths as well as about investment priorities in the region.

Scenario Planning

Why a Scenario Analysis?

Scenario planning is a technique used to develop multiple plausible situations, or scenarios, that represent alternatives for the future; using scenarios enables better and more comprehensive planning than just preparing for one, single expected future (see Figure 5-1 and Figure 5-2). Scenario planning may consider situations that are not reachable or anticipated by current trends. For example, a traditional trend-based planning approach is unlikely to forecast a high investment in extending the current transit network in the NOACA region. Yet, considering transportation from a comprehensive perspective suggests that investing in transit and enhancing the existing transportation system may help to grow the region in the future. As an agency that prioritizes transportation projects for funding, NOACA can emphasize investment in different types of projects. Regardless of the mode of transportation, NOACA can prioritize to maintain, enhance, and/or expand infrastructure (see Figure 5-3). A scenario-planning approach shifts from predicting the future based on the past to preparing for potential futures. Similar to the traditional trend-based planning, the starting point of the scenario analysis is the current year rather than a future year.

Figure 5-1. Traditional and Risk Planning Approaches

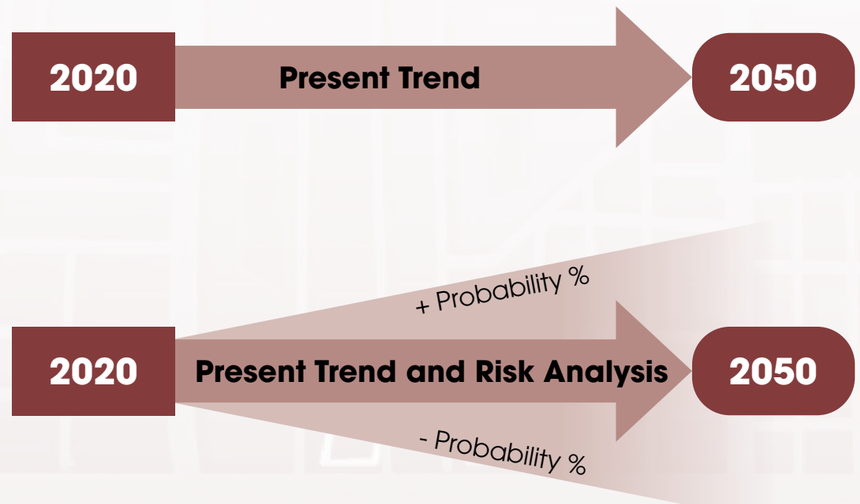
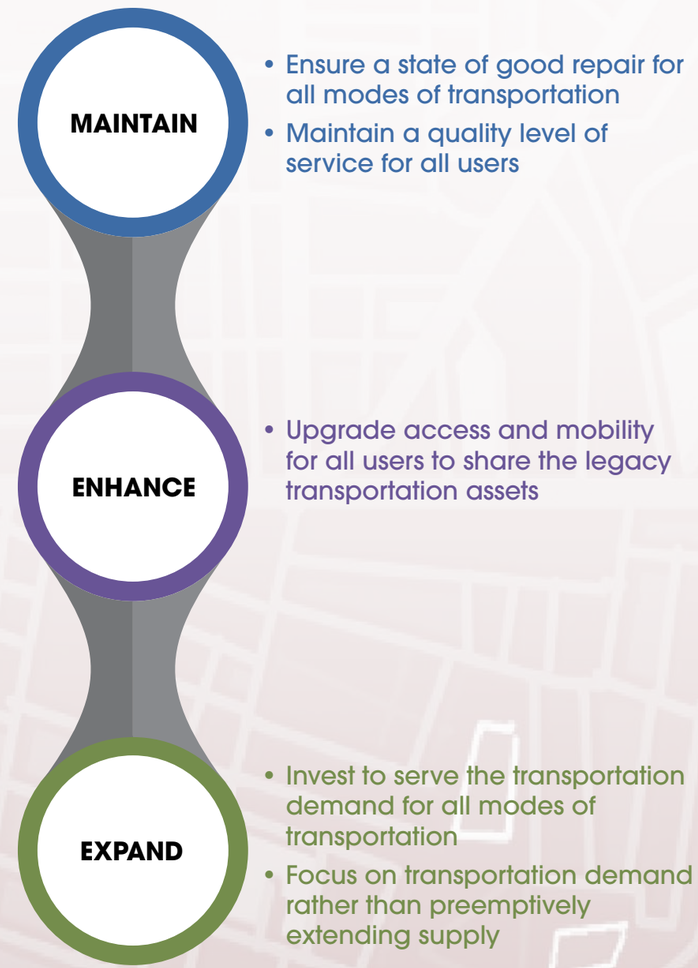


Figure 5-2. Scenario Planning Approaches

Figure 5-3. Investment Strategies



Explaining the Transportation Model to Assess the Investment Scenarios

The NOACA Travel Forecasting Model assists planners and decision-makers in evaluating the plausible outcomes of various project ideas and planning scenarios. For example, if a new roadway or transit line is proposed for the future, the NOACA Travel Forecasting Model can produce various outputs that are used to evaluate the potential impacts, such as the estimated traffic volume along the new roadway or estimated transit ridership on the new line. From a regional standpoint, the NOACA Travel Forecasting Model can also help evaluate the impact of broader planning policies related to population and jobs, like transit-orientated development. For larger planning initiatives like these, the NOACA Travel Forecasting Model (see Figure 5-4) will help planners and decision-makers understand the transportation-related impacts to the entire region, such as changes to vehicle miles traveled, average travel times to job hubs, environmental justice communities' access to transit and the prevalence of certain travel modes.

The NOACA Travel Forecasting Model is a mathematical model that takes into account many data inputs and many years of research in the field of travel modeling (see Figure 5-4). The main inputs to the model are:

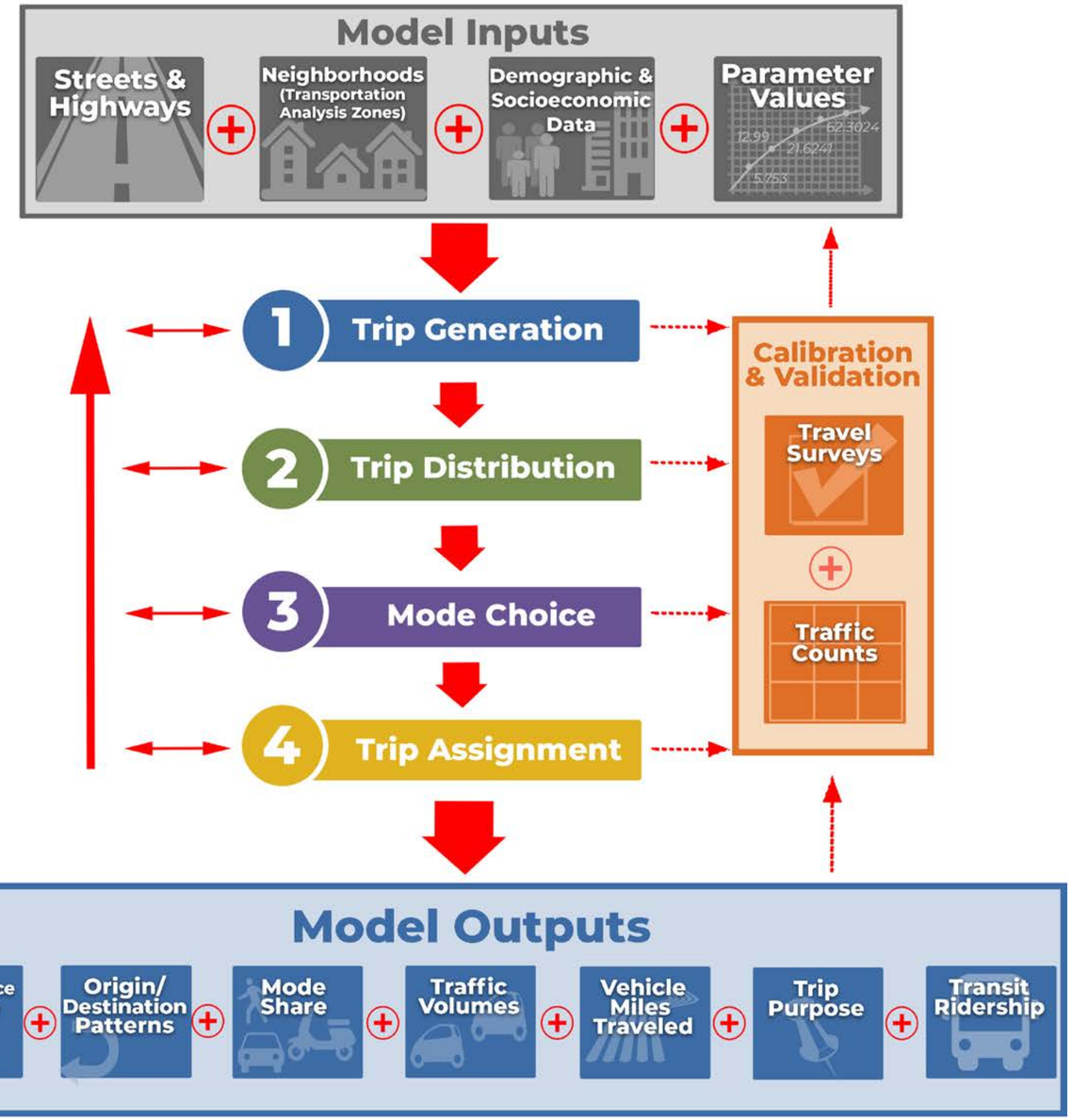
- Streets and Highways
- Neighborhoods (known in technical terms as Transportation Analysis Zones (TAZs))
- Population and Jobs
- Parameter Values (such as household trip rates, trip purpose rates, value of time, etc.)

Notable model outputs are:

- Estimated traffic volumes for all roads
- Estimated transit ridership by line
- Traffic congestion
- Vehicle Miles Traveled (VMT)
- Origin/destination patterns
- Mode share
- Trip purpose

NOACA Travel Forecasting Model

Figure 5-4. Travel Demand Model



Overview: Four Investment Scenarios for an Equitable Northeast Ohio

The four *eNEO2050* investment scenarios project the performance of the region based on different investment priorities. Because the region has many investment objectives to serve the transportation needs in the region, the four scenarios assume more extreme positions to amplify the differences between the potential investments (see Table 5-1 and Figure 5-5): Scenario 1 (MAINTAIN) prioritizes maintenance of the existing transportation system above anything else; Scenario 2 (CAR) invests in expansion of the road network; Scenario 3 (TRANSIT) explores the opportunities of implementing the Visionary Rail Network contained in the previous long-range plan Aim Forward 2040; and Scenario 4 (TOTAL) explores joining some of these priorities and also introducing future technologies. To some extent, the scenarios reflect different assumptions about the road capacities and modal choices across the region. Based on NOACAs transportation model, these scenarios were then assessed against the 2020 performance of our transportation system (see Scenario Evaluation section). The subsequent section gives an overview for the four scenarios. The overview is followed by a more detailed discussion of population and job forecasts that have informed the scenarios (see Population and Job Forecasts for 2050 by Scenarios section) and by a detailed discussion of projects that are included in the scenarios (see Transportation Trends and Improvements in Scenarios section).

The four scenarios are subsequently described. It needs to be noted that the scenarios make simplified assumptions about the transportation investments to establish reference points to explore a future mix of investments as part of the visioning. In other words, the scenarios are models that can aid a regional conversation about desirable transportation investments when developing the Transportation Improvement Program. Figure 5-6, Figure 5-7, Figure 5-8, and Figure 5-9 summarize the project types and objectives included in each scenario.

Table 5-1. Summary of Scenario Assumptions

SCENARIO	THEME	INVESTMENT ASSUMPTIONS
1: MAINTAIN Infrastructure System	**State of Good Repair**	This scenario invests 100 percent on maintaining the existing transportation system and zero dollars in road or transit expansion.
2: CAR Captivating Auto Region	**Single Occupancy Vehicle**	This scenario prioritizes investments in capacity adding road projects. It maintains current levels of transit spending.
3: TRANSIT TRANsportation System with Improved Transit	**Multimodal Transportation System**	This scenario prioritizes funding for expanding transit infrastructure to build the Visionary Rail Network that connects growing job hubs.
4: TOTAL Transportation with Optimal Technology and Access for ALL	**Advanced Multimodal Transportation System**	This scenario combines the investments of scenario 2 and 3, expanding the highway system and the transit infrastructure to serve growing job hubs.

Figure 5-5. Scenario Overview

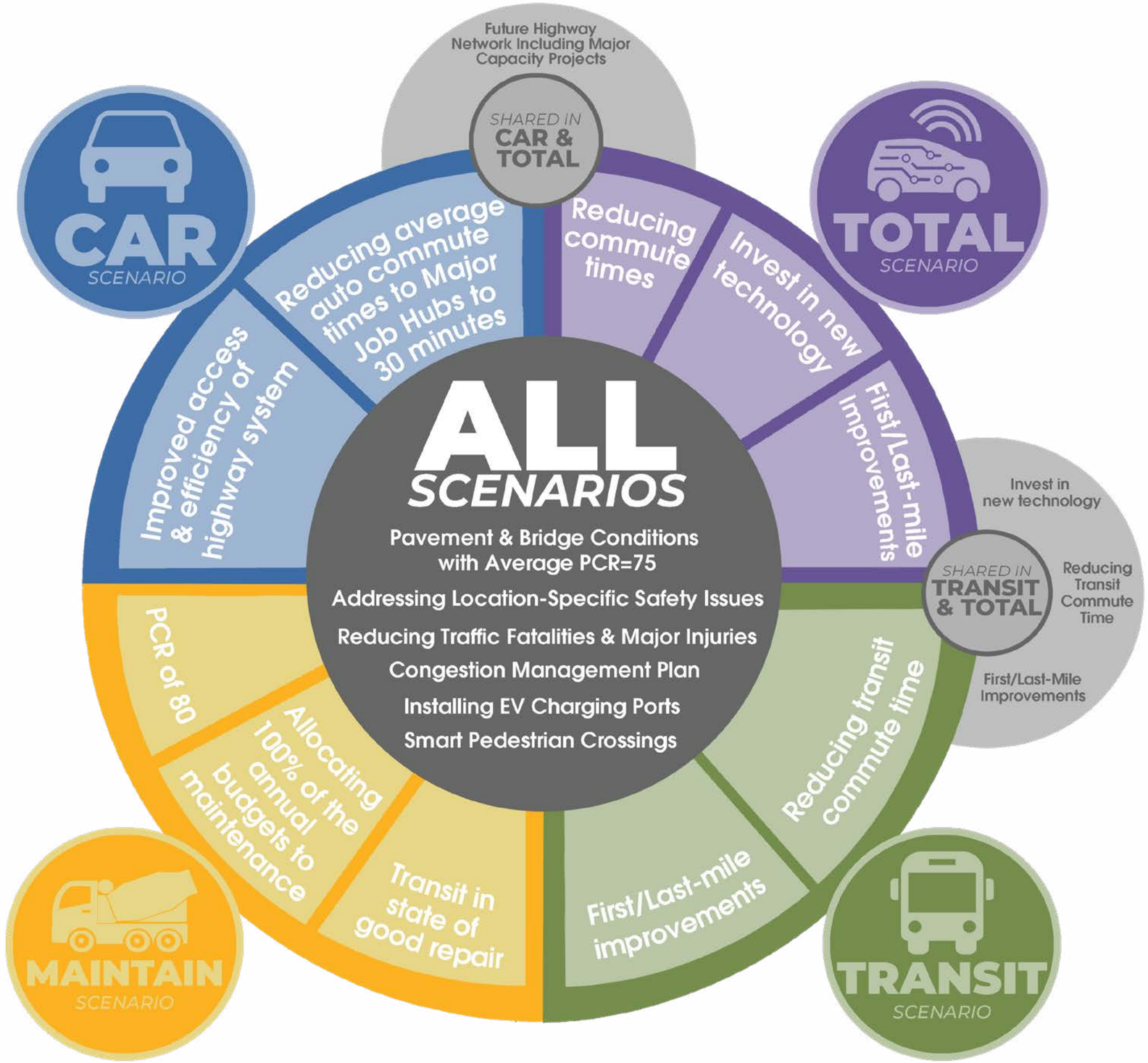
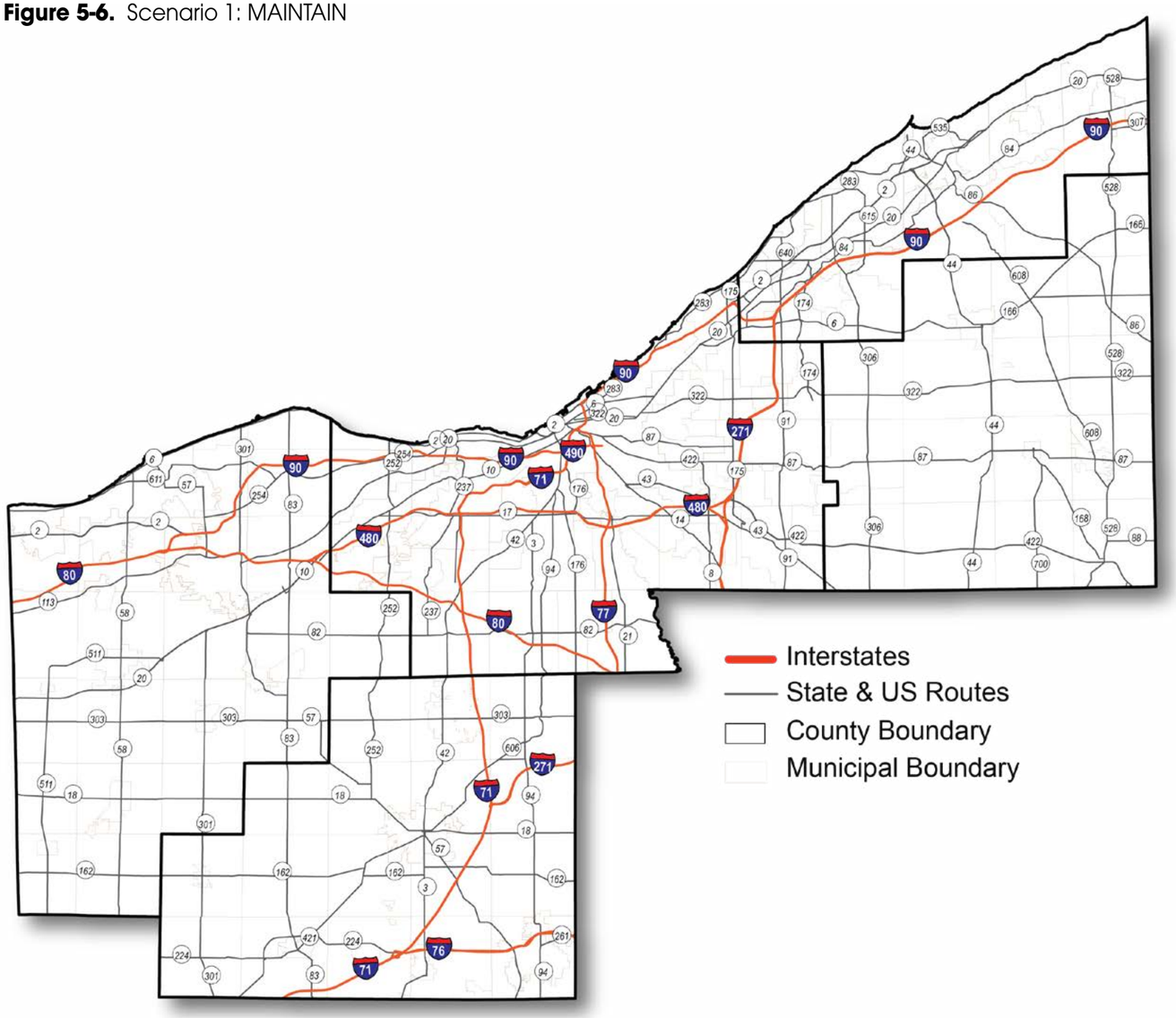
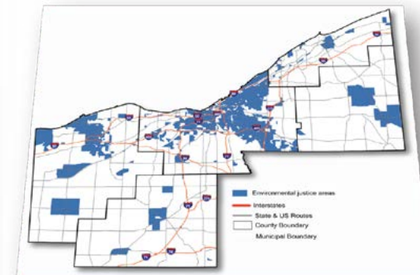
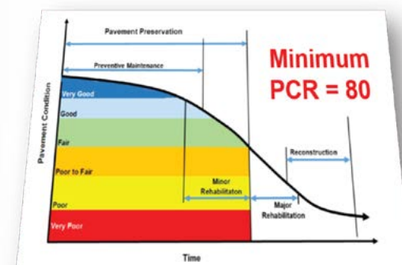


Figure 5-6. Scenario 1: MAINTAIN





ENVIRONMENTAL JUSTICE AREAS



PRESERVING EXISTING INFRASTRUCTURE

Scenario 1: MAINTAIN

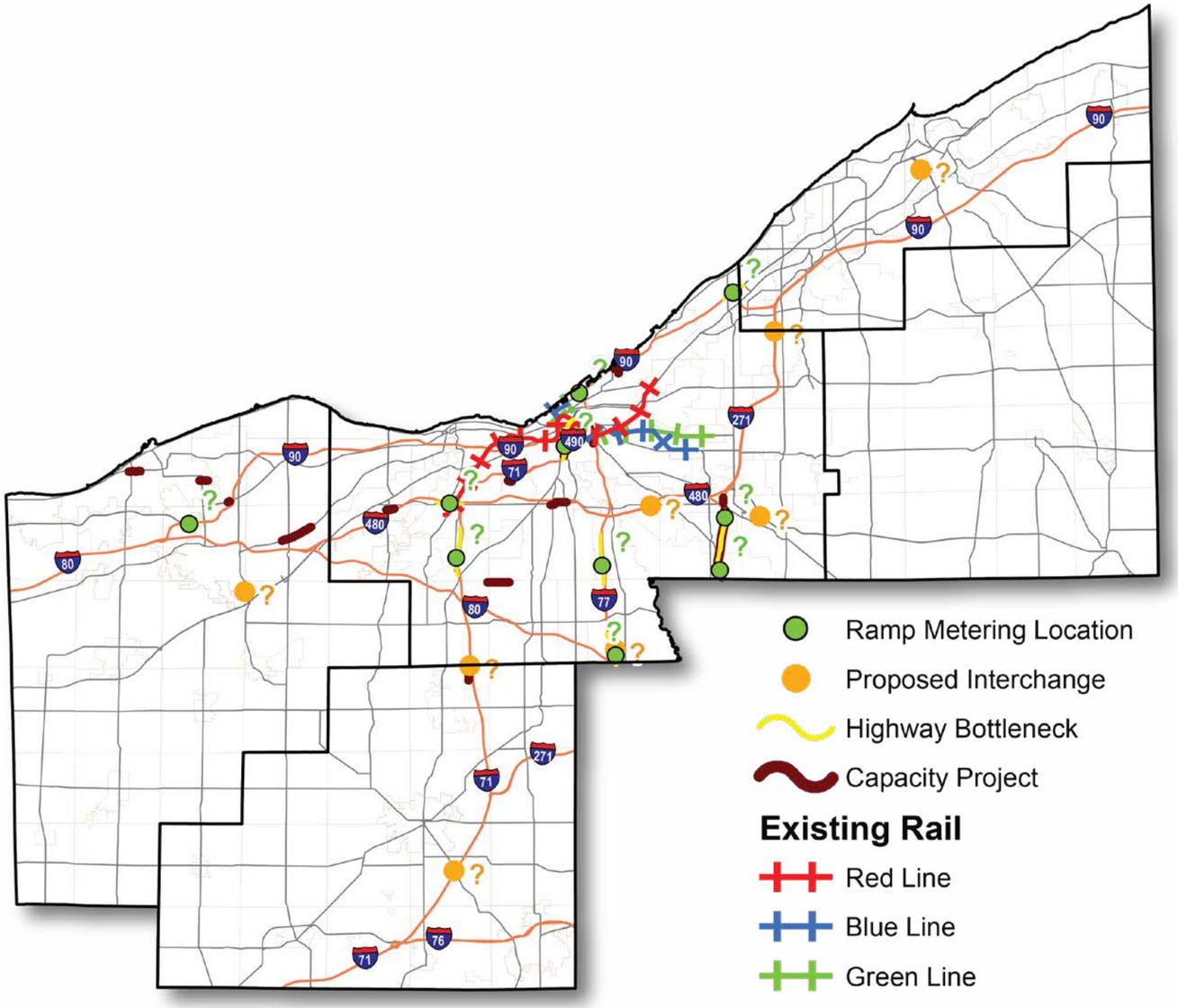
Preservation of the existing infrastructure is the theme of Scenario 1 - MAINTAIN. This scenario invests 100 percent on maintaining the existing transportation system and zero dollars in expansion. It covers all modes of transportation, including auto, transit, bicycle, and pedestrian.

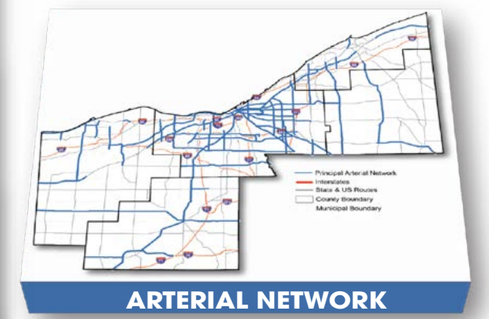
The majority of daily trips are vehicular and the highway and street network accommodate those trips. Therefore maintenance of this important asset is a crucial investment for the transportation infrastructure. In addition, maintaining the transit infrastructure and replacing transit rolling stock such as rail cars are another part of this scenario.

The focus of *eNEO2050* is Equity. While the maintenance of the entire road and transit system is a priority, special attention is paid to streets and transit services in the Environmental Justice (EJ) areas. Scenario 1 attempts to keep pavements and bridges in the EJ areas and transit vehicles serving the EJ areas in a good condition all the time.

The transit network of the Scenario 1 is the current bus, BRT, and rail networks with no extensions.

Figure 5-7. Scenario 2: CAR





Scenario 2: CAR

In the past decades, the regional investment in the transportation field was focused on supporting automobile movement. Continuation of investing in capacity adding projects is the theme of Scenario 2 – CAR.

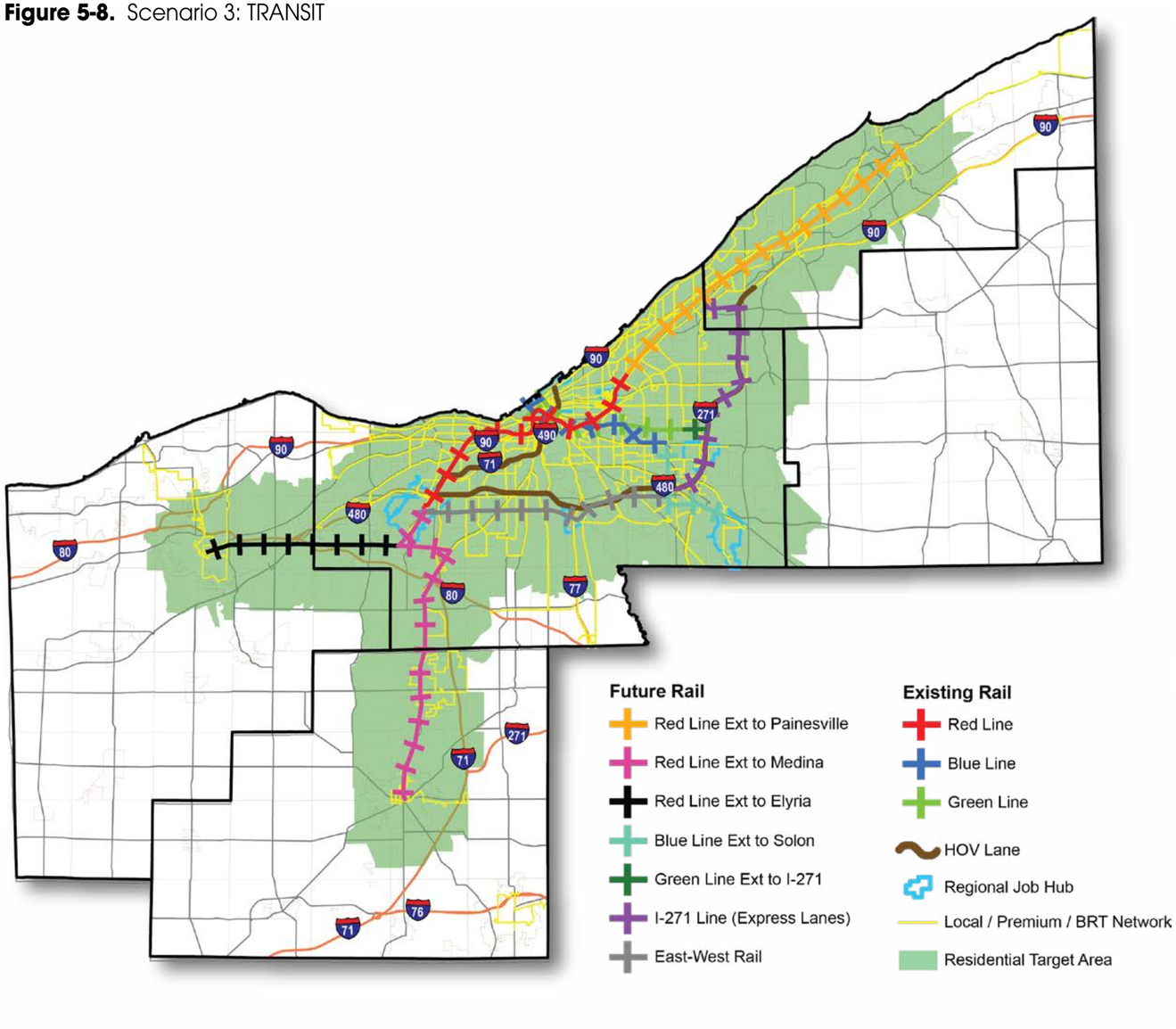
Investing in future highway network capacity projects and adding viable freeway interchanges are two major highway items in this scenario. Regulating the traffic flow entering freeways by installing ramp metering and reducing highway bottlenecks are traffic management investments in this scenario. Also, banning truck movement in the Commercial Business Districts (CBD) during the AM peak period is the other traffic management policy in this scenario.

In addition, optimizing the timing of traffic signals and other similar arterial projects will restore mobility function of arterials as an alternative to the freeway network.

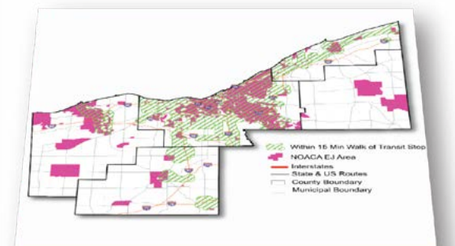
Scenario 2 attempts to achieve the average auto work commute times to the regional major hubs to 30 minutes during the AM peak period.

The transit network of the Scenario 2 is the current bus, BRT, and rail networks with no extensions.

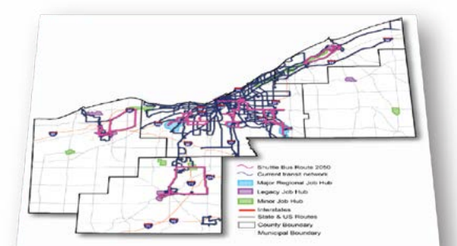
Figure 5-8. Scenario 3: TRANSIT



WALK/BIKE CONNECTIONS TRANSIT HUBS TO JOB HUBS



WALK/BIKE CONNECTIONS EJ AREAS TO TRANSIT NETWORK



SHUTTLE BUSES SERVING JOB HUBS

Scenario 3: TRANSIT

Developing a multimodal transportation system is the theme of Scenario 3 – TRANSIT. The visionary rail network contained in NOACAs long-range plan "Aim-forward 2040" is the backbone of the transit network of this scenario with some modifications for improved connections. The transit network also includes each of the transit agencies' own future bus, BRT, and rail plans.

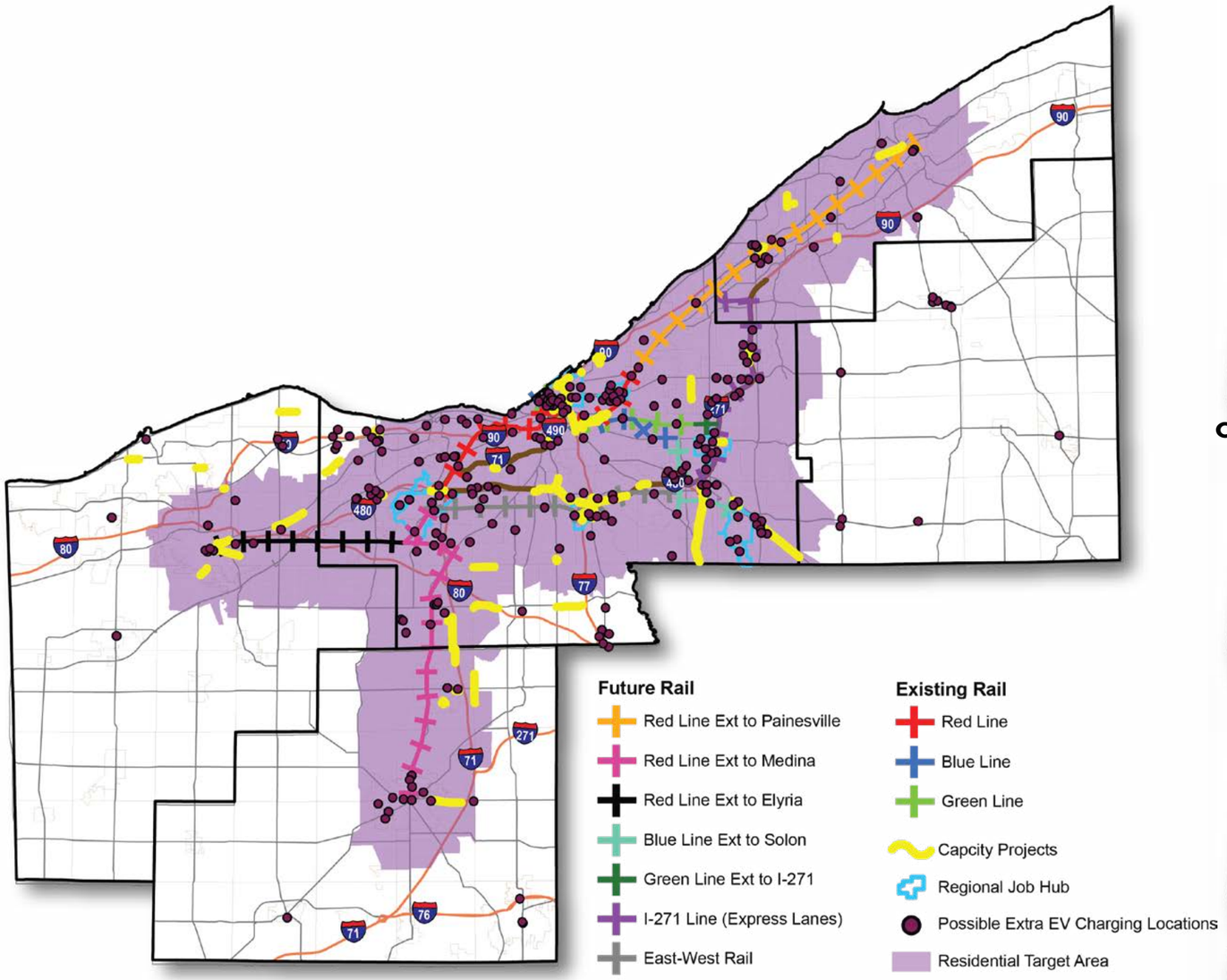
The technology advancement will add autonomous shuttle buses to Scenario for improved workers' accessibility to the regional job hubs and transit hubs. Since the focus of *eNEO2050* is equity, this scenario pays special attention to reducing transit service headways to Environmental Justice (EJ) areas. The objective of this scenario is to reduce the average transit work commute time to the regional job hubs to 45 minutes.

Scenario 3 does not include any extensions to the highway network, however, it designates some freeway lanes for High Occupancy Vehicles (HOV), which are expected to be used as express bus lanes as permit access for cars and trucks.

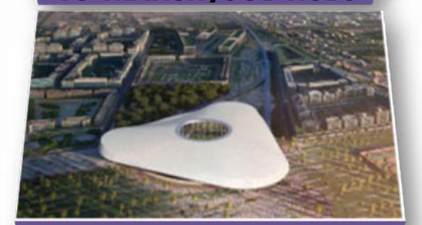
The investments in this scenario will also support significant bike and pedestrian improvements to ensure a multimodal system that supports access to jobs from EJ areas.

This scenario assumes an increase in densities around transit stations and major job hubs so more workers live closer to where they work.

Figure 5-9. Scenario 4: TOTAL

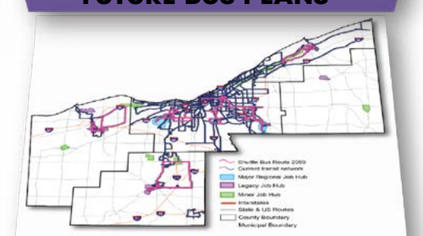


WALK/BIKE CONNECTIONS TO TRANSIT/JOB HUBS



HIGHWAY/TRANSIT CONNECTIVITY TO HYPERLOOP STATION

TRANSIT AGENCY FUTURE BUS PLANS



SHUTTLE BUSES SERVING JOB HUBS

SMART CAV LANES

Scenario 4: TOTAL

The theme of Scenario 4 – TOTAL is an advanced multimodal transportation system using emerging transportation technology. This scenario invests in all modes of travel:

- The highway network will include major capacity projects that are also included in Scenario 2.
- The visionary rail network (Scenario 3) is the major transit investment of this scenario. The transit network also includes the future plans of each transit agency, particularly bus and BRT.
- Walk and bike access is increased substantially, especially from major residential neighborhoods to the transit network and from major transit hubs to the regional major job hubs.

The emerging transportation technology will add:

- Selected smart freeway lanes to autonomous cars and trucks.
- Extra electric vehicle charging ports.
- Autonomous shuttle buses to improve workers' accessibility to the regional major job hubs and transit hubs.
- The Hyperloop station

Since the focus of the *eNEO2050* is equity, this scenario attempts to reduce the average transit work commute time to regional job hubs to 30 minutes and auto commute time to 20 -30 minutes.

Population and Job Forecasts for 2050 by Scenarios

As discussed in a previous section, the NOACA region is mature and has seen very little population growth for several decades. The following section presents how population and employment are forecasted to change in Northeast Ohio over the next 30 years. Forecasting demographic and economic trends is primarily based on looking into the past to determine the most likely pattern for the future. The forecasts included in the LRP are from the State of Ohio and represent an overall stagnant growth with continued intraregional movement. Although NOACA does not agree with those projections, using the state's department of development's numbers is a requirement for NOACA as an MPO. This trend analysis is used as a baseline in all the scenarios. The proposed projects in Scenarios 1 and 2 do not produce any changes to those assumptions, while growth associated with a visionary transit system and the hyperloop are added to Scenarios 3 and 4 as appropriate and commensurate with analysis performed for those very specific investments.

Nevertheless, it is important to note that the NOACA region is much more optimistic than the State of Ohio relative to population and economic growth over the next three decades. Although unable to be reflected in eNEO2050, NOACA anticipates that some growth will occur naturally as part of the overall growth in population and jobs expected to be realized in the United States. Specifically, the Great Lakes Megaregion that includes the NOACA geography is expected to absorb a significant portion of the national growth. With the trajectory already having been blunted somewhat over the last few years, the position of the region on Lake Erie as a fresh water source and the continuation of successful strategies for economic growth, it seems very unlikely that the NOACA region would not see growth by 2050.

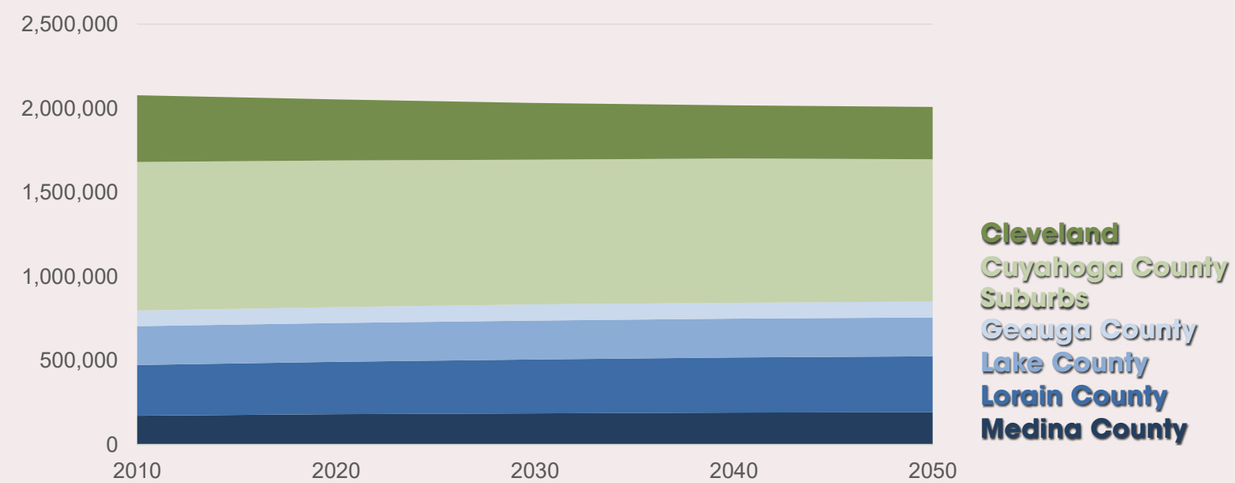
Forecasts and Assumptions in Scenarios 1 and 2

Population Forecasts in Scenarios 1 and 2

Scenarios 1 and 2 assume that the population and employment of the NOACA region will continue along the same trend lines as they have in the past. Population loss in the urban core of Cuyahoga County and other legacy cities of the region will continue in these scenarios. The pattern of outward migration will continue with modest growth along the fringes of the currently urbanized areas. However, the region as a whole will not grow, leaving fewer residents to pay for the same or more infrastructure (see Figure 5-10).

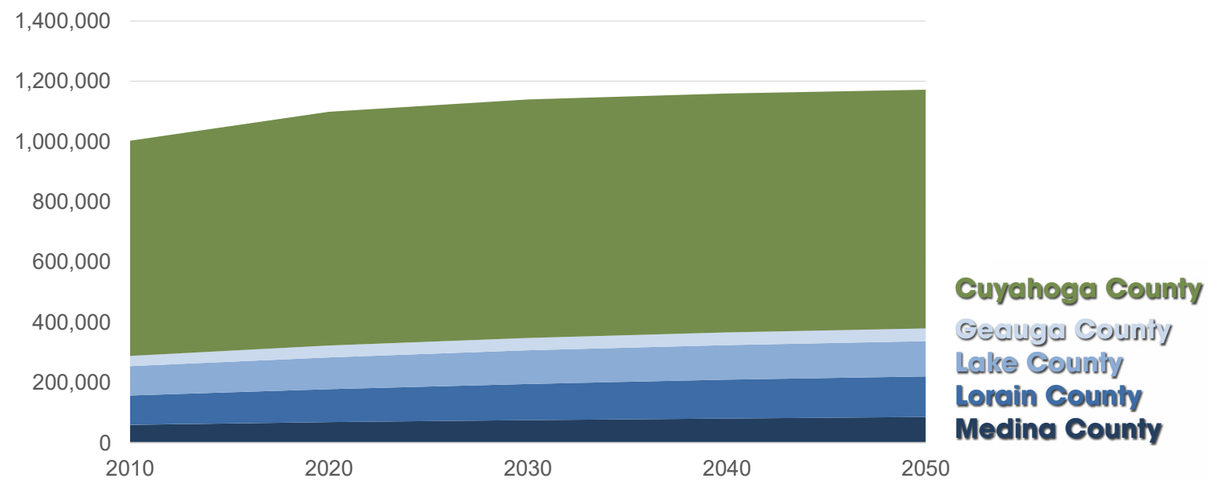
The population forecasts follow a similar trajectory as the historic population trends between 2010 and 2018. This results in a regional loss of over 43,000 residents between 2020 and 2050, which is a decrease of 2%. Similar to the historic population data, the forecasts indicate that Cuyahoga County will continue to be the main source of the population losses for the NOACA region, losing an additional 6% of its population (-77,000) during that same period.

Figure 5-10. Projected Regional Population, 2020-2050



Source: NOACA forecasts developed using Ohio Development Services Agency (ODSA) forecasts

Figure 5-12. Projected Regional Employment, 2020-2050[1]



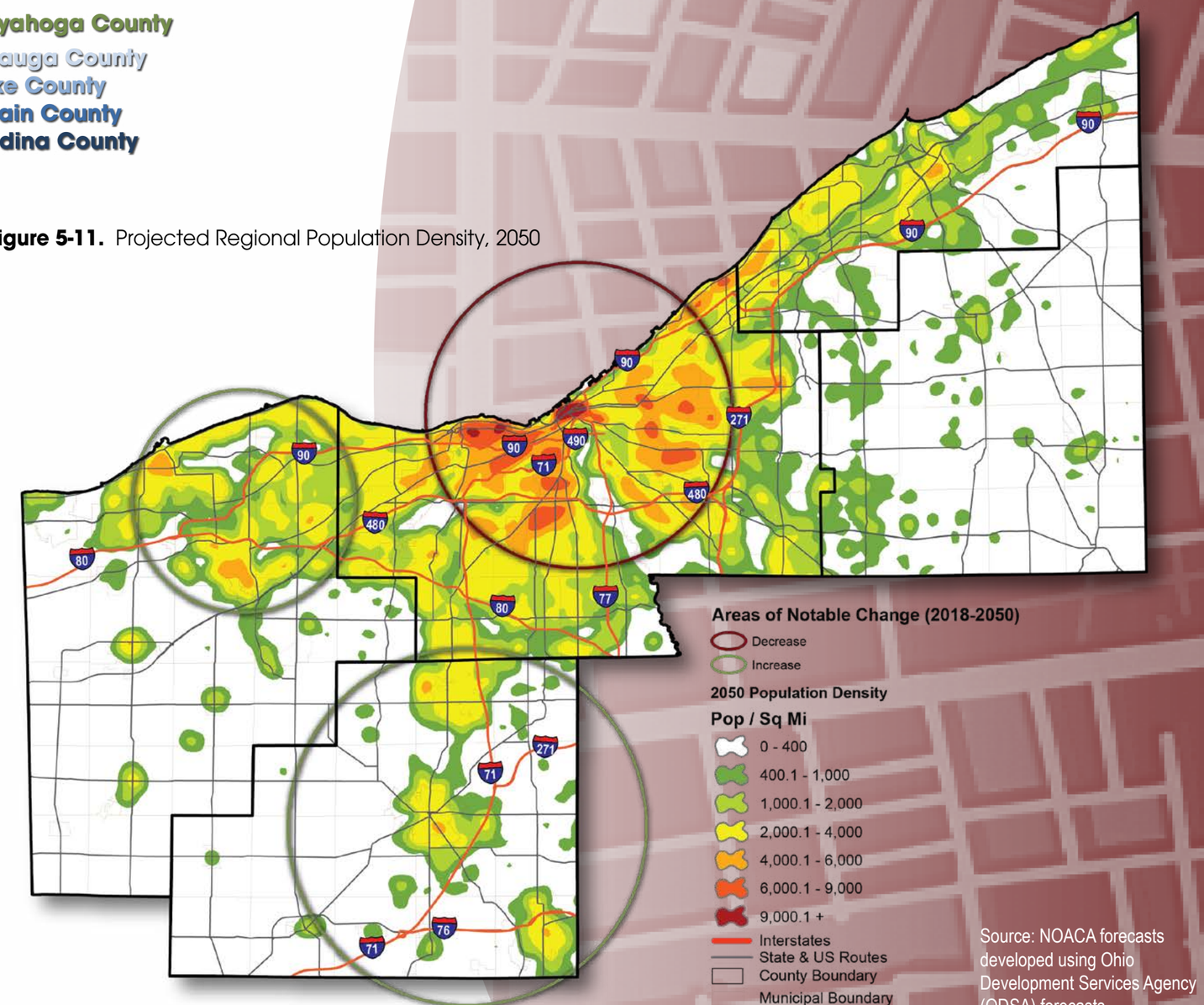
Examining the county shares of the regional population shows that the pattern of population redistribution and intraregional migration throughout the NOACA region also continues out to 2050. Future population density at the sub-county level in 2050 shows much of the same trends apparent during the period between 2000 and 2018. The urban core of Cuyahoga County is forecasted to lose population, while downtown and near west side neighborhoods continue to grow and this follows the forecasted trend of little-to-no growth at the county level. The four outer counties of the NOACA region are the main source of population gains and increases in population density (Figure 5-11). Much of this future growth occurring in the outer counties of the NOACA region is forecasted to occur in Medina and Lorain counties. Between 2020 and 2050, Medina County is forecasted to grow at approximately 7% during that period, which shows a slower growth rate than the last two decades and represents an increase of slightly over 12,000 people. Lorain County's rate of growth during the same forecast period is also approximately 7%, with slightly over 20,600 people. Lake and Geauga counties stay relatively similar in their density patterns out to 2050, with Geauga County increasing by 1% and Lake County remaining essentially the same. Taken together though, the population growth in the collar counties do not outweigh the population loss in Cuyahoga County, resulting in a negative growth rate for the region.

Job Forecasts in Scenarios 1 and 2

The historic job trends of the NOACA region saw a pattern where Cuyahoga County experienced more job losses and less job gains on a proportional scale than the region over all. This trend continues into the future with the job forecast data. Overall the NOACA region is forecasted to grow to about 1.17 million jobs from 2020 to 2050 at a rate of 7%, while Cuyahoga only grows at a rate of 2% over the same time period (Figure 5-12).

Forecasted job growth in the 4 outer counties of the NOACA region is fairly consistent from 2020 to 2050. All counties are forecasted to grow at high rates. Out of the approximately 74,000 jobs gained in the NOACA region from 2020 to 2050, the 4 outer counties account for approximately 58,000.

Figure 5-11. Projected Regional Population Density, 2050



Source: NOACA forecasts developed using Ohio Development Services Agency (ODSA) forecasts.

Job Forecasts in Scenarios 1 and 2

The historic job trends of the NOACA region saw a pattern where Cuyahoga County experienced more job losses and less job gains on a proportional scale than the region over all. This trend continues into the future with the job forecast data. Overall the NOACA region is forecasted to grow to about 1.17 million jobs from 2020 to 2050 at a rate of 7%, while Cuyahoga only grows at a rate of 2% over the same time period (Figure 5-12).

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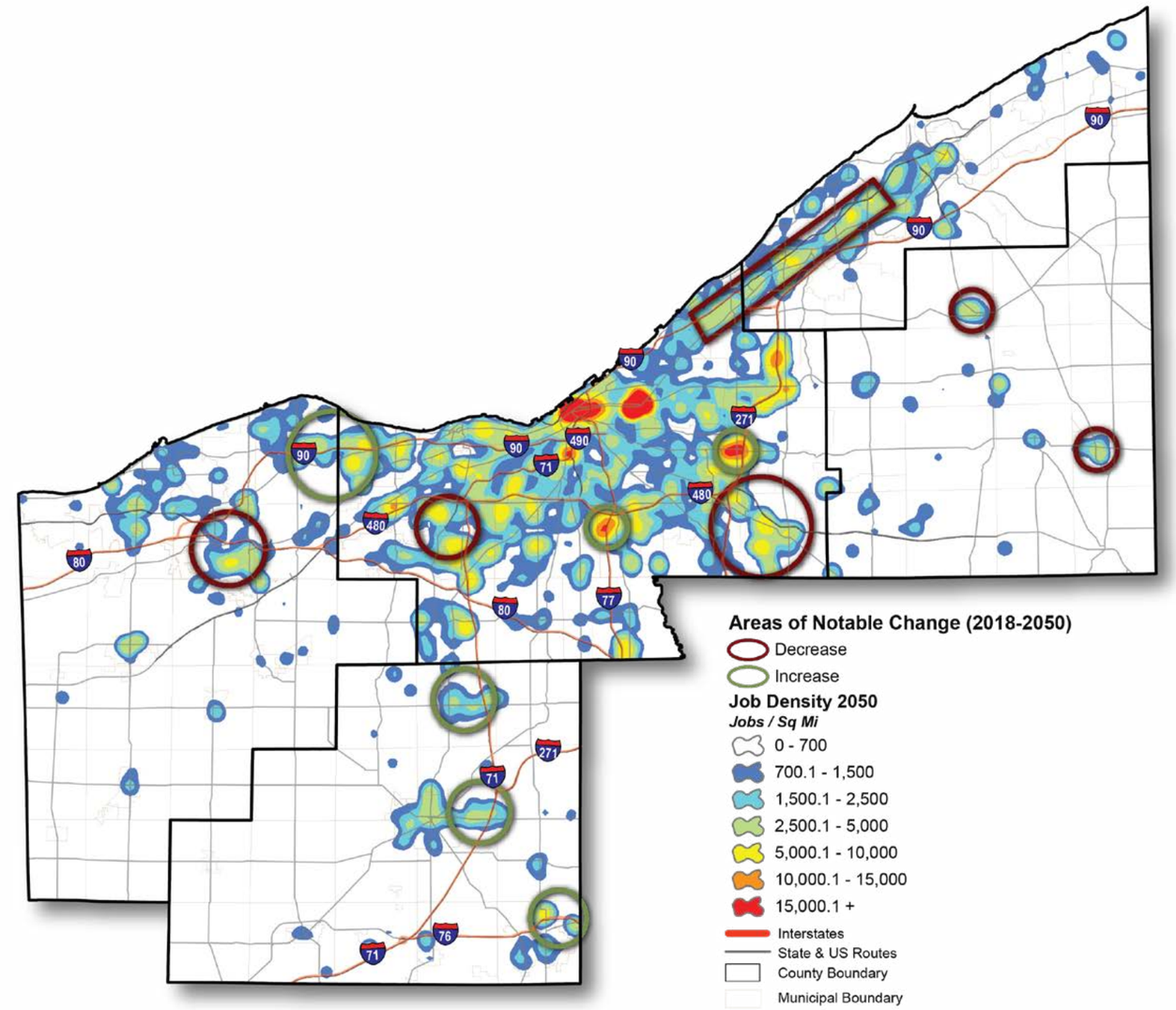
Forecasted job density trends follow a different pattern from what occurred during the period between 2010 and 2019. During those 9 years, there was a high amount of job growth throughout the region and in all sectors of the economy due to the rebound from the great recession of 2008/2009. Between 2019 and 2050, forecasts revert back to the pattern of basic jobs being replaced by service jobs, which was apparent prior to the economic recovery of the 2010s (Figure 5-13). This trend has great implications at the local level in areas that have a high concentration of basic jobs and a high concentration of service jobs. Areas with high levels of basic jobs, such as the Cleveland Hopkins airport area, Elyria, and Solon, are all forecasted to lose jobs and job density as basic jobs are lost in the future economy. Areas with high levels of service jobs, such as Avon, Medina, and Chagrin Highlands all are forecasted to see increases in their total number of jobs and density levels as the NOACA region shifts to a more service-based economy. Similar to past trends, downtown Cleveland and University Circle maintain the highest levels of job density in the region and will remain the largest employment centers in the region for the foreseeable future.

Figure 5-13. Regional Job Density, 2050 - Scenario 1 and 2[2]



Source: NOACA forecasts developed using Moody's Analytics (from Team NEO), Bureau of Economic Analysis (BEA), and Quarterly Census of Employment and Wages (QCEW)

Forecasts and assumptions in Scenarios 3 and 4

Scenarios 3 and 4 assume that growth will occur in the NOACA region, due to local government supported land use changes associated with the establishment of an expanded rail network and the implementation of the Hyperloop, both of which spur significant Transit Oriented Development (TOD). Scenario 3 assumes 5% growth from 2020 for both population and employment, which is a modest level of growth. Scenario 4 assumes a 10% growth from 2020 for both population and employment, which is a moderately high level of growth. Since the Scenarios 3 and 4 both establish an expanded rail network that connects regional job hubs of the NOACA region, the population growth apparent in these scenarios is targeted for residential areas with easy and convenient access to these new transportation options and major job locations. Scenarios 3 and 4 assume that the additional population growth will occur in areas within 5 miles of the major regional job hubs and park-and-ride locations of the expanded rail network. A distance of 5 miles encompasses both persons who would access the major regional job hubs and rail system via car, as well as those who might be accessing these same locations by non-motorized modes, such as bicycling or walking, which would occur at distances shorter than 5 miles.

The assumptions for the Hyperloop included in Scenario 4 were taken from the Great Lakes Hyperloop feasibility study completed in 2020 as part of a Public Private Partnership between NOACA and Hyperloop TT. The study included travel demand for both passenger and freight as well as revenue forecasts. A financial and economic analysis concluded the project would result in population growth, new jobs, and increased property values along the corridor from Cleveland to Chicago and Pittsburgh. It also assumed revenue would be generated from significant development around the stations, which was modeled based on international high speed rail experience.

For the transportation model, the projected population growth was distributed based on the 2020 distribution of population within the target area. The TAZs with the most population with respect to the target area's total population received more of the population growth, and those with less population received less. This type of approach increased the density of locations with the most population in 2020. With regards to the type of housing that was inputted into Scenarios 3 and 4, multi-family housing was prioritized over single-family housing, with 80% of the new housing units in the residential target area being multi-family. This was implemented to offer more equitable housing choices for areas with increased transit and job access. Table 5-2 details the increases in population, households and workers in Scenarios 3 and 4. Figure 5-14 and Figure 5-15 show the future population densities projected in Scenarios 3 and 4 across the region (see Chapter 9 in eNEO2050 Resource Document for details on the methodology).

For the employment growth in both Scenarios 3 (5%) and 4 (10%), significant job increases were assumed in the six major regional job hubs. The assumption in Scenarios 3 and 4 is that the transit investments in connecting the job hubs would increase the attractiveness of these locations for new talent and companies. This assumption is reflected in job densities used for the transportation model, particularly the TOD around transit stations and the relationship to job hubs. Table 5-3 shows the details of the employment changes for both Scenarios 3 and 4. Figure 5-16 and Figure 5-17 show the projected job densities for 2050 in Scenarios 3 and 4.

Table 5-2. Regional Population Growth in Scenarios 3 and 4, 2020-2050

	INCREASE IN NUMBER OF PERSONS, 2020-2050					PERCENT INCREASE, 2020-2050		
	POPULATION	WORKERS	HOUSEHOLDS	SINGLE FAMILY	MULTI FAMILY	POPULATION	WORKERS	HOUSEHOLD
3: TRANSIT	101,343	52.451	42,860	8,572	34,288	5	5	5
4: TOTAL	202.687	104,901	85,720	17,144	68,576	10	10	10

Source: NOACA Travel Forecasting Model (February 2021)

Table 5-3. Change in Employed Persons by Sector in Scenarios 3 and 4, 2020-2050

	SECTORS											
	TOTAL		BASIC		SERVICE		MANUFACTURING		HEALTHCARE		ACCOMMODATION/ FOOD SERVICES	
	#	%	#	%	#	%	#	%	#	%	#	%
3: TRANSIT	70,245	5	6,213	3	32,274	7	6,172	3	21,558	8	4,028	3
4: TOTAL	140,875	10	11,554	6	68,482	16	11,477	6	42,871	16	7,491	6

Source: Moody's Analytics (from Team NEO) and Bureau of Economic Analysis (BEA)

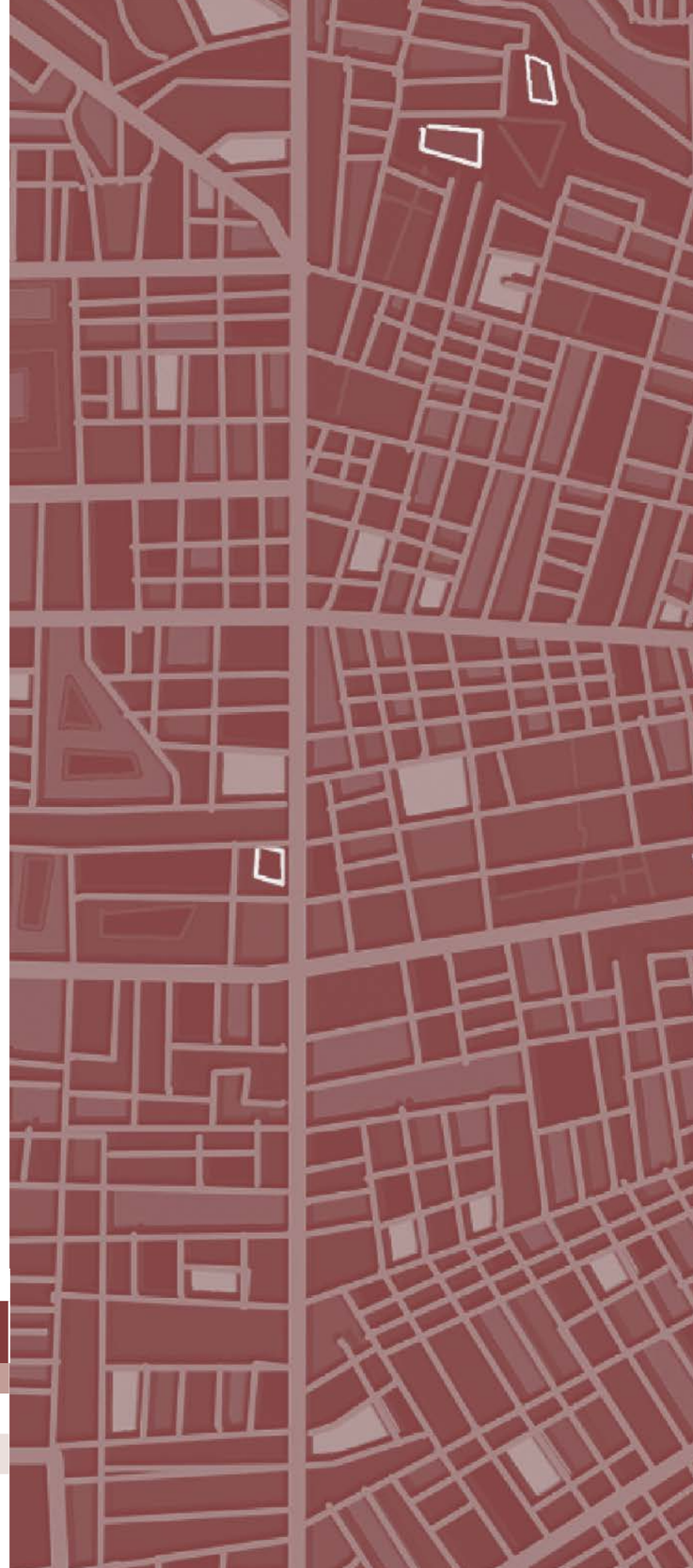
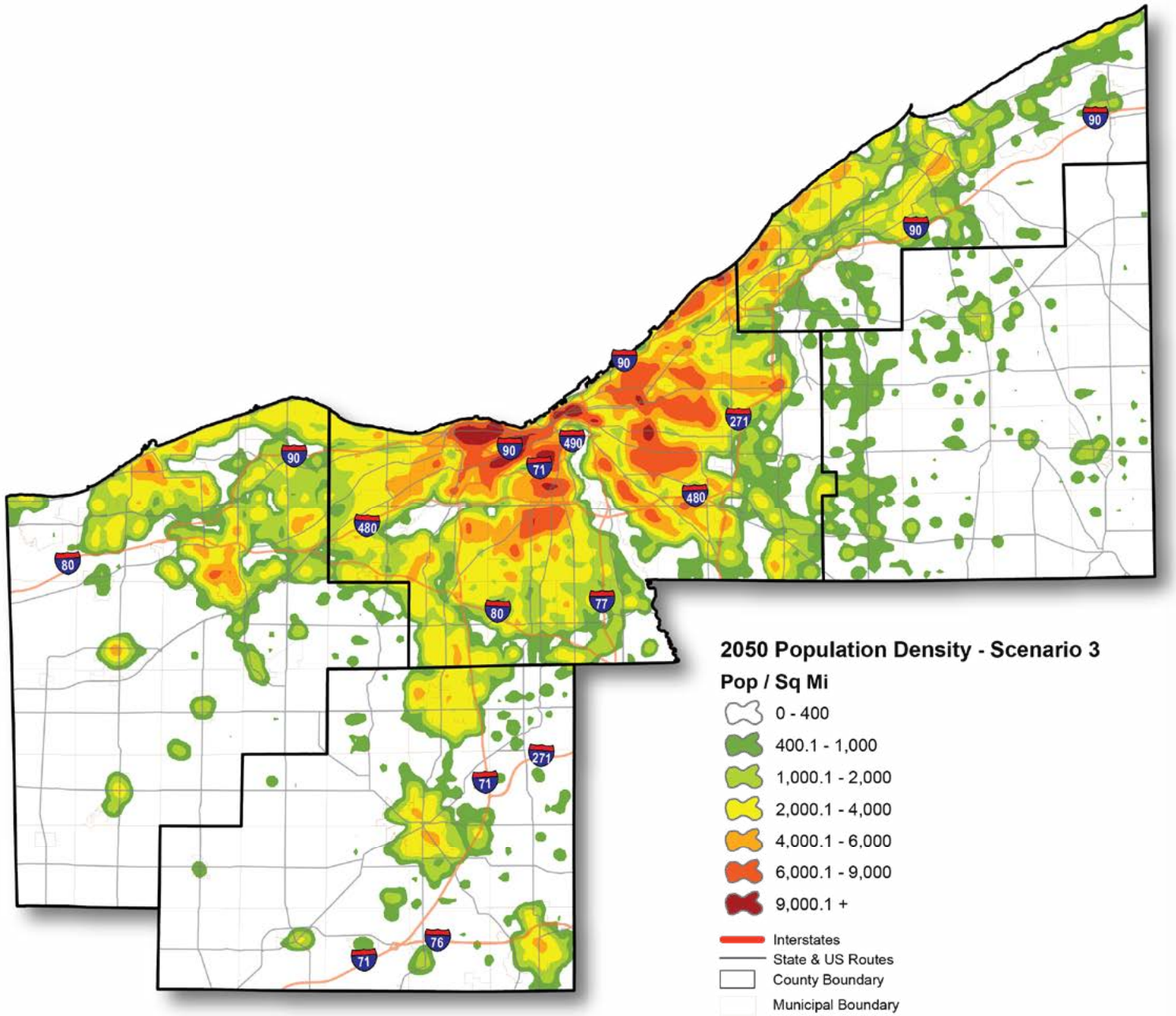
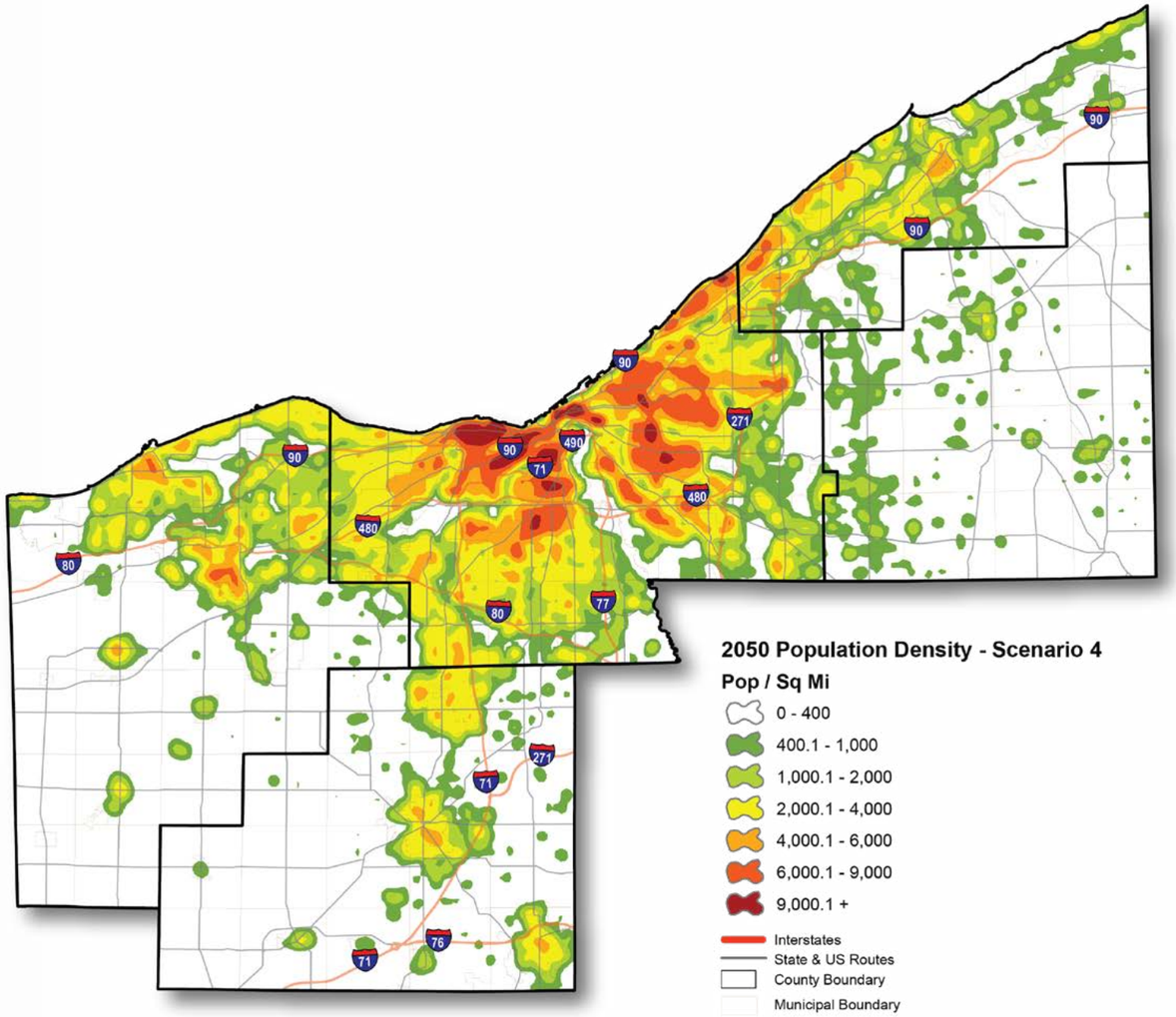


Figure 5-14. Projected Population Density 2050 – Scenario 3



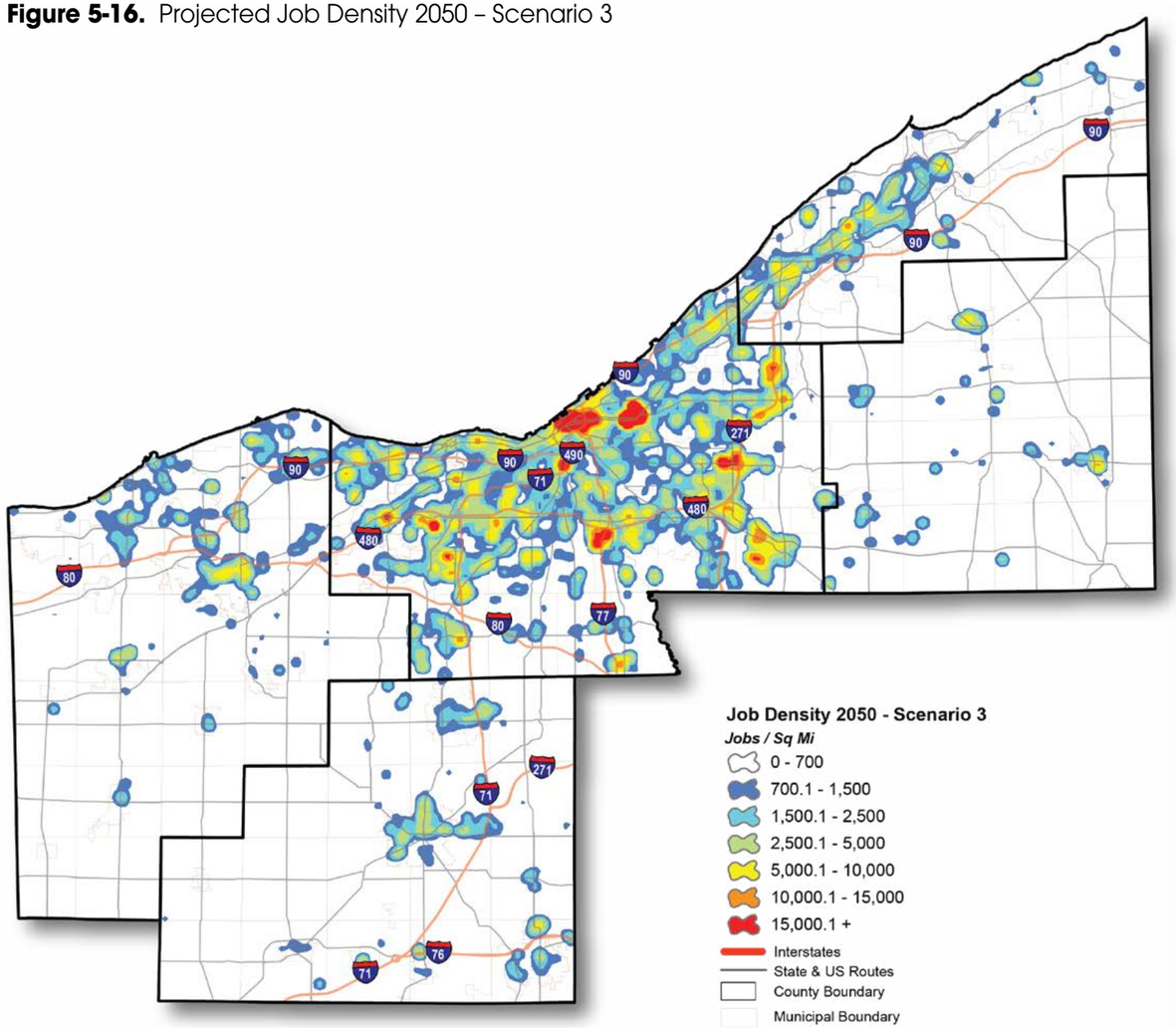
Source: Moody's Analytics (from Team NEO) and Bureau of Economic Analysis (BEA)

Figure 5-15. Projected Population Density 2050 – Scenario 4



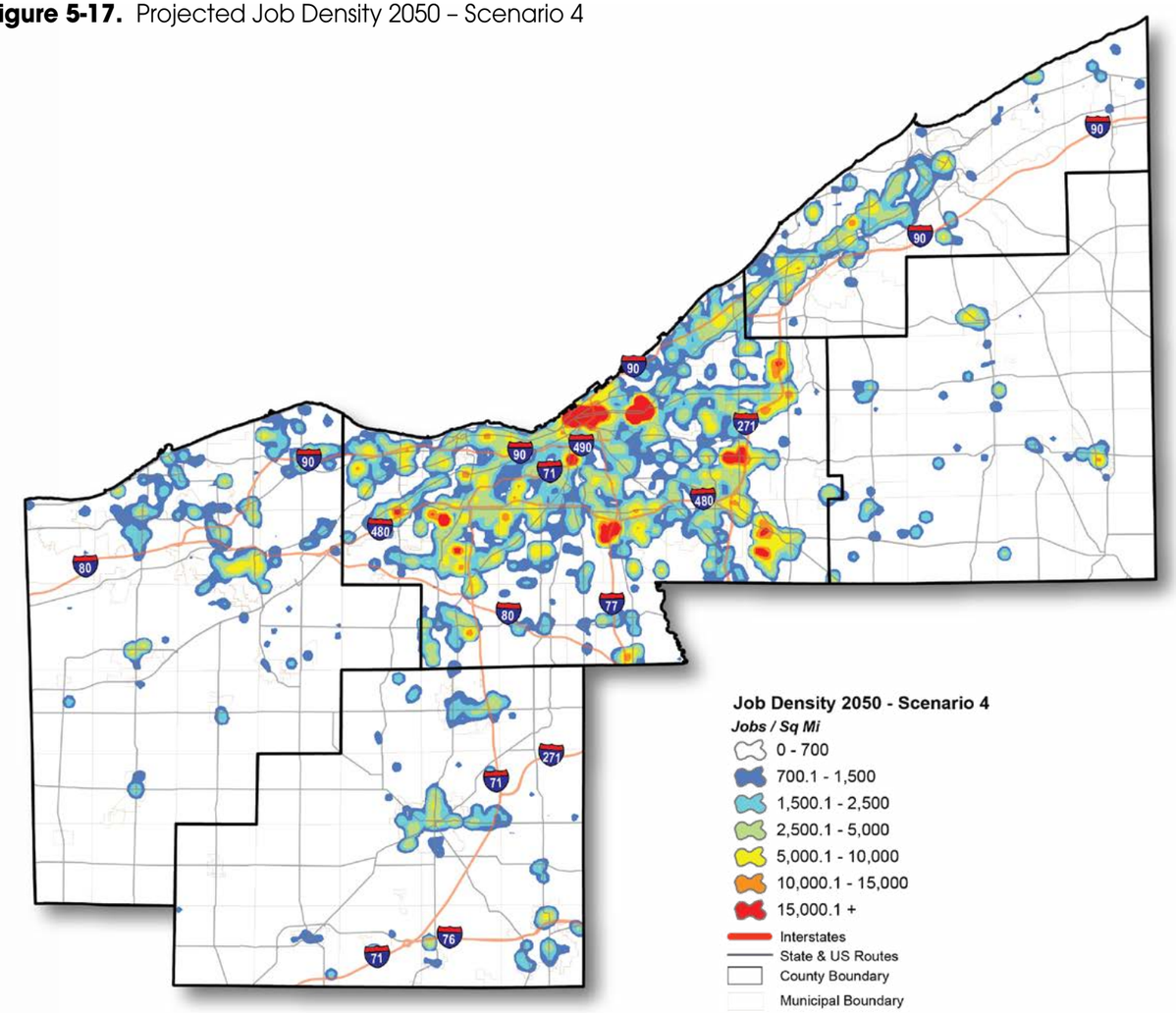
Source: Moody's Analytics (from Team NEO) and Bureau of Economic Analysis (BEA)

Figure 5-16. Projected Job Density 2050 – Scenario 3



Source: NOACA forecasts developed using Moody's Analytics (from Team NEO), Bureau of Economic Analysis (BEA), and Quarterly Census of Employment and Wages (QCEW)

Figure 5-17. Projected Job Density 2050 – Scenario 4



Source: NOACA forecasts developed using Moody's Analytics (from Team NEO), Bureau of Economic Analysis (BEA), and Quarterly Census of Employment and Wages (QCEW)

Transportation Trends and Improvements in Scenarios

The Long Range Transportation Plan (LRTP) scenarios are based on the issues discussed in previous sections. Each scenario includes a set of proposed projects, their implementation decades and applied technology levels.

Transportation trends

Technology adaptation

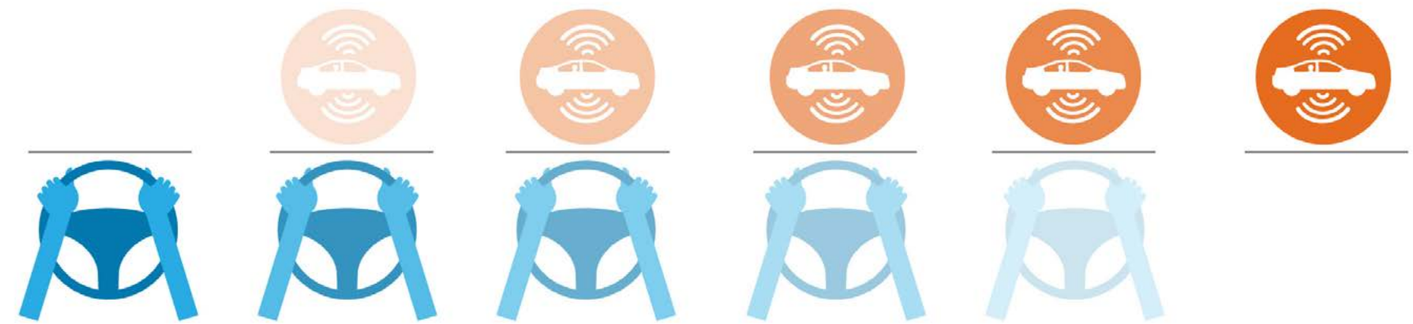
There are high uncertainties regarding how future technologies will develop, when their acceptance in the marketplace will occur and what additional investments may be needed to facilitate their adoption. Considering all these uncertainties, predicting the modal share of these advanced vehicles would generally be difficult. As with many new technologies, the opinions and forecasts among industry experts wildly vary, but all experts agree that the development of these vehicles will be incremental in the next decades advancing through the automation levels shown in Figure 5-18. Some experts believe that by 2050 cars will be fully autonomous and electric, with advanced customization technology. Others predicts that by 2050 there will be about three billion light-duty vehicles on the road worldwide, up from one billion now. At least half of them will be powered by internal combustion engines using petroleum–based fuel.

This plan considers a conservative prediction for replacing convention car and trucks by fully automated and electric vehicles and Table 5-4 shows the predicted percent of vehicle shares of daily vehicular trips for the four developed scenarios.

It should be noted that assuming higher share percent for autonomous vehicles in Scenario 4 is due to allocating smart highway lanes to these types of vehicle in the modeling process and installing extra PEV charging ports which is subsequently discussed in more detail.

While there are vehicles in the current fleet with elements of connected and automated vehicle technology, there is still considerable uncertainty in how exactly full scale deployment will play out. Although this makes it difficult to predict its impacts with certainty, this chapter explores what it means for the transportation system and its users.

Figure 5-18. Connected and Autonomous Vehicles



LEVEL ZERO	LEVEL ONE	LEVEL TWO	LEVEL THREE	LEVEL FOUR	LEVEL FIVE
No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
Zero autonomy; the driver performs all driving function.	Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.	Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.	Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.	The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option of control the vehicle.	The vehicle is capable of performing all driving functions under all conditions. The driver may have the option of control the vehicle.

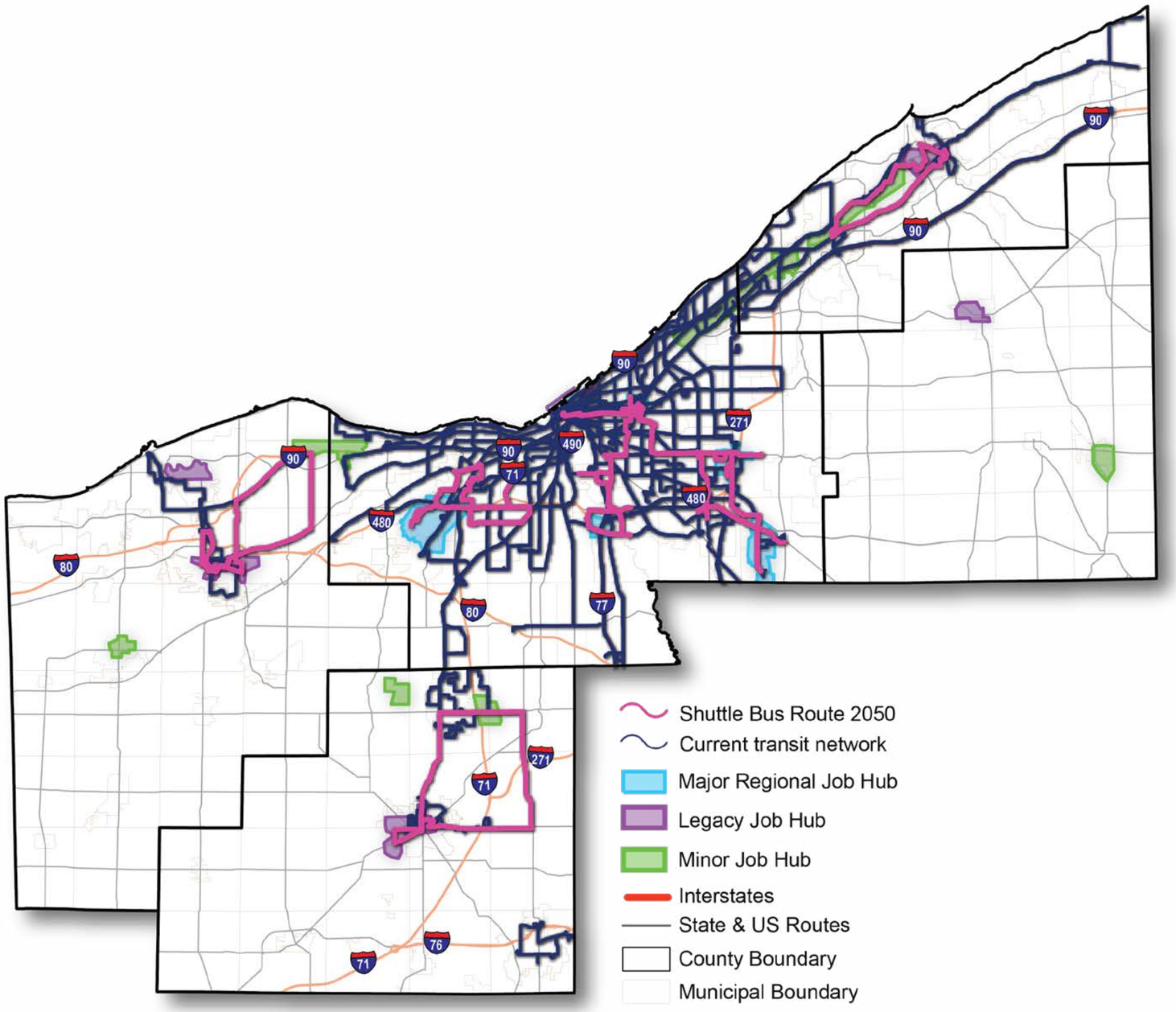
Source: Society of Automotive Engineers and National Highway Traffic Safety Administration

Table 5-4. Vehicle Shares of Daily Vehicular Trips

SCENARIO NAME	CONVENTIONAL CAR & TRUCK	PEV AND AUTONOMOUS CAR & TRUCK	AUTONOMOUS SHUTTLE, BUS, POD, AND HYPERLOOP
1: MAINTAIN	81%	18%	1%
2: CAR	81%	18%	1%
3: TRANSIT	80%	18%	2%
4: TOTAL	**68%**	**28%**	4%

Source: NOACA Travel Forecasting Model

Figure 5-19. Autonomous Shuttle Feeder Bus Routes



Potential opportunities of Connected and Autonomous Vehicles (CAVs) are:

- Improved safety by reducing user error is the main factor in crashes.
- Increased capacity, reduced congestion, and fewer high capacity improvements due to the potential to operate with fewer incidents, decreased following distances, and narrower lane widths.
- Improved first and last mile connections with transit.
- Moderated or decreased growth in vehicle miles traveled and increased growth in ridesharing, public transportation use, bicycling, and walking
- Expanded mobility for those currently unable to drive
- Increased efficiency for freight movement through improved efficiency and applications such as freight platooning
- Retrofit the built environment and provide more complete streets—for example to repurpose parking

Challenges of CAVs are:

- Ensuring safety in a mixed fleet environment during early deployment
- Ensuring security from vulnerabilities and intrusions to connected elements
- Increased vehicle miles traveled due to improved traffic flow, additional mobility options, and zero occupancy vehicles
- Decreased public transportation use due to the alternative mode options
- Cost of infrastructure required to support the new technology including need for better maintenance of the roads as vehicles rely on sensors and technology
- Disadvantaging some transportation system users who may not have access to the new mode or negatively impacting vulnerable road users
- Inducing sprawl or encouraging “super-commutes”

Proposed Autonomous Shuttle Feeder Buses

Autonomous shuttle feeder buses would assist with the last-mile connections of transit riders to jobs. Once a rider reaches a job hub via the expanded transit network, the final location of their work trip might not be within a reasonable walking distance. A series of autonomous shuttles would help circulate riders within the job hub or to other employment centers nearby. In addition, these shuttles would help feed riders into the expanded transit network from nearby residential areas with direct and frequent service to the job hub stations.

These shuttles would also provide connections to and from job hubs that might not have direct transit service between them, such as University Circle and Independence or Chagrin Highlands and Solon. Ultimately, these autonomous shuttles would serve two major purposes: helping transit riders make their last-mile connections and providing expanded access between residential areas and job hubs. Figure 5-19 illustrates the proposed future autonomous shuttle bus routes. As technologies emerge, shuttles may be able to operate not on fixed routes but rather on-demand similarly to a taxi service.

Plug-in Electric Vehicles

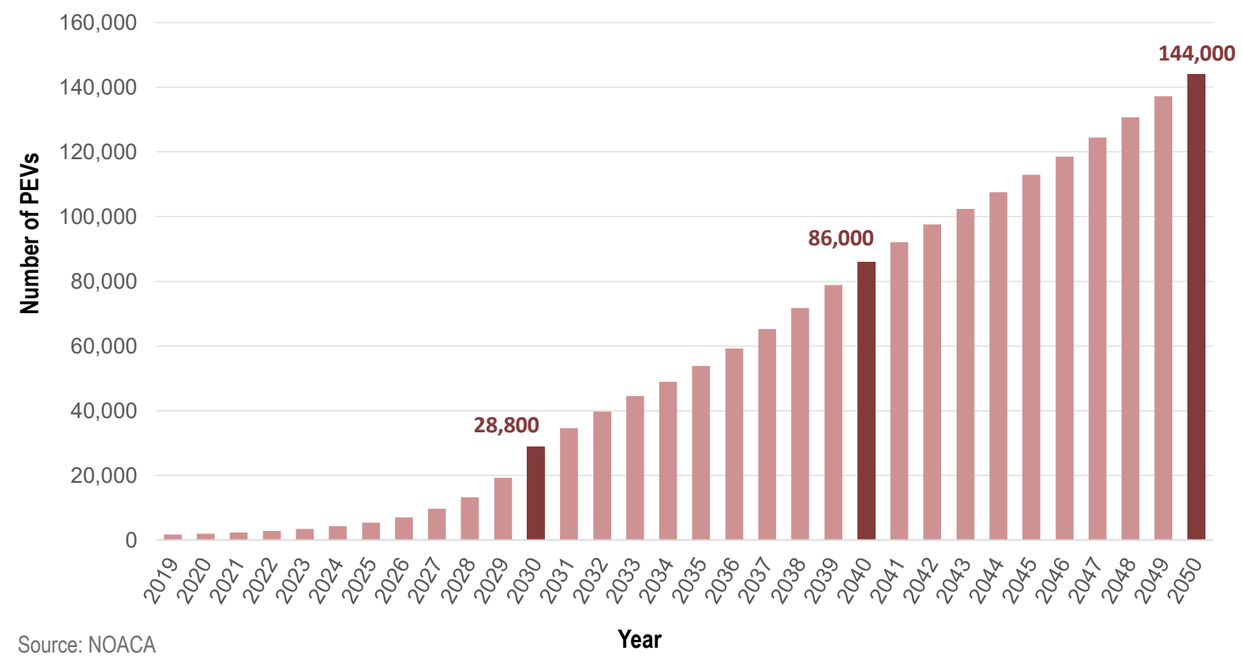
The future of Plug-in Electric Vehicles (PEVs) is evolving rapidly. The number of PEVs is projected to reach 18.7 million in 2030 up from slightly more than one million at the end of 2018. This is about seven percent of the 259 million vehicles (cars and light trucks) expected to be on U.S. roads in 2030 (Figure 5-20).[3] The National Renewable Energy Laboratory (NREL) spearheads transportation research, development and deployment to accelerate the widespread adoption of high-performance, low emission, energy-efficient passenger and freight vehicles. This section has used those reports and materials extensively.[4]

NOACA recently developed a "PEV Charging Station Site Plan". This plan discusses the current status and projected growth of PEVs over the next three decades in the NOACA region and focuses on both workplace charging stations and Direct Current Fast Charging (DCFC) stations with proposed locations for the charging stations.

PEV charging station sites are a necessary part of the required Electric Vehicle Supply Equipment (EVSE). As expected, many PEV owners currently charge their vehicles overnight at home using residential charging ports; however, residential charging will not be adequate for the expected PEV growth in the next three decades. Currently, locations of fuel stations for the conventional internal combustion engine vehicles are distributed in such a way that drivers can reach one of these locations by driving a few miles. The ultimate objective of the PEV charging port location distribution and consequently their coverage area is to mimic the current gas station distribution.

NOACA estimates the required charging ports as shown in Table 5-5. The NOACA site plan identifies the locations of the Level 2 charging stations and publically accessible DCFC stations as the required EVSE complement to residential charging. Figure 5-21 and Figure 5-22 show the selected public-owned locations and the selected privately-owned locations most suitable for PEV charging stations. According to the NOACA charging station site plan, the location of the DCFC charging stations would be located along highly traveled identified routes of PEVs and also along major highway routes for long distance travelers.

Figure 5-20. Estimated Number of PEVs in the NOACA Region



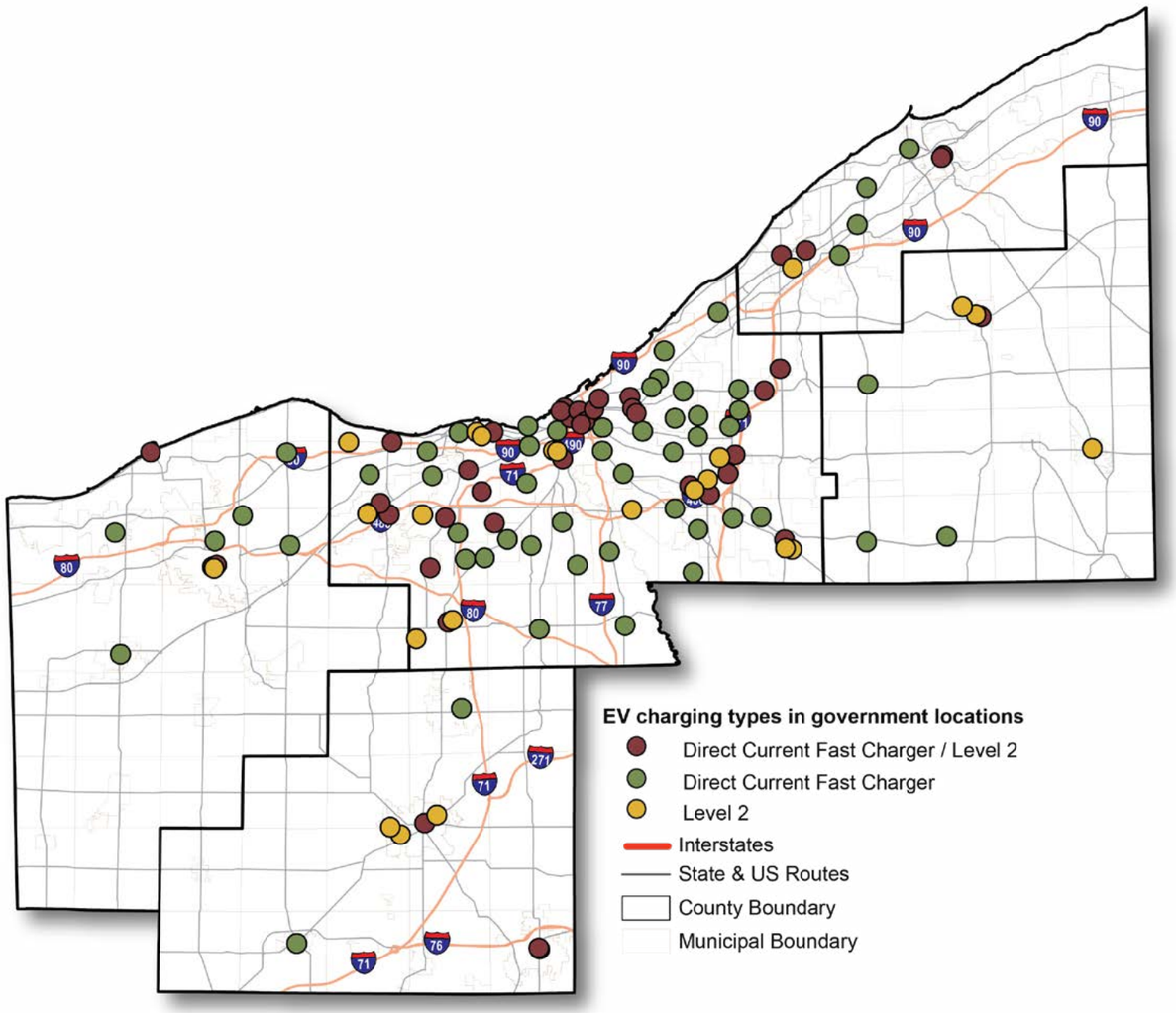
Source: NOACA

Table 5-5. Estimated Number of Required Charging Ports by Planning Year

	REQUIRED CHARGING PORTS		
CHARGING LEVEL	**2030**	**2040**	**2050**
Home Level 2	12,000	34,000	57,000
Public Level 2	800	2,300	3,900
Workplace Level 2	1,300	3,800	6,300
Public DCFC	120	290	480
Total	**14,220**	**40,390**	**67,680**
Accumulated Required Total Budget for Workplace and DCFC Ports	**$36 Million**	**$82 Million**	**$107 Million**

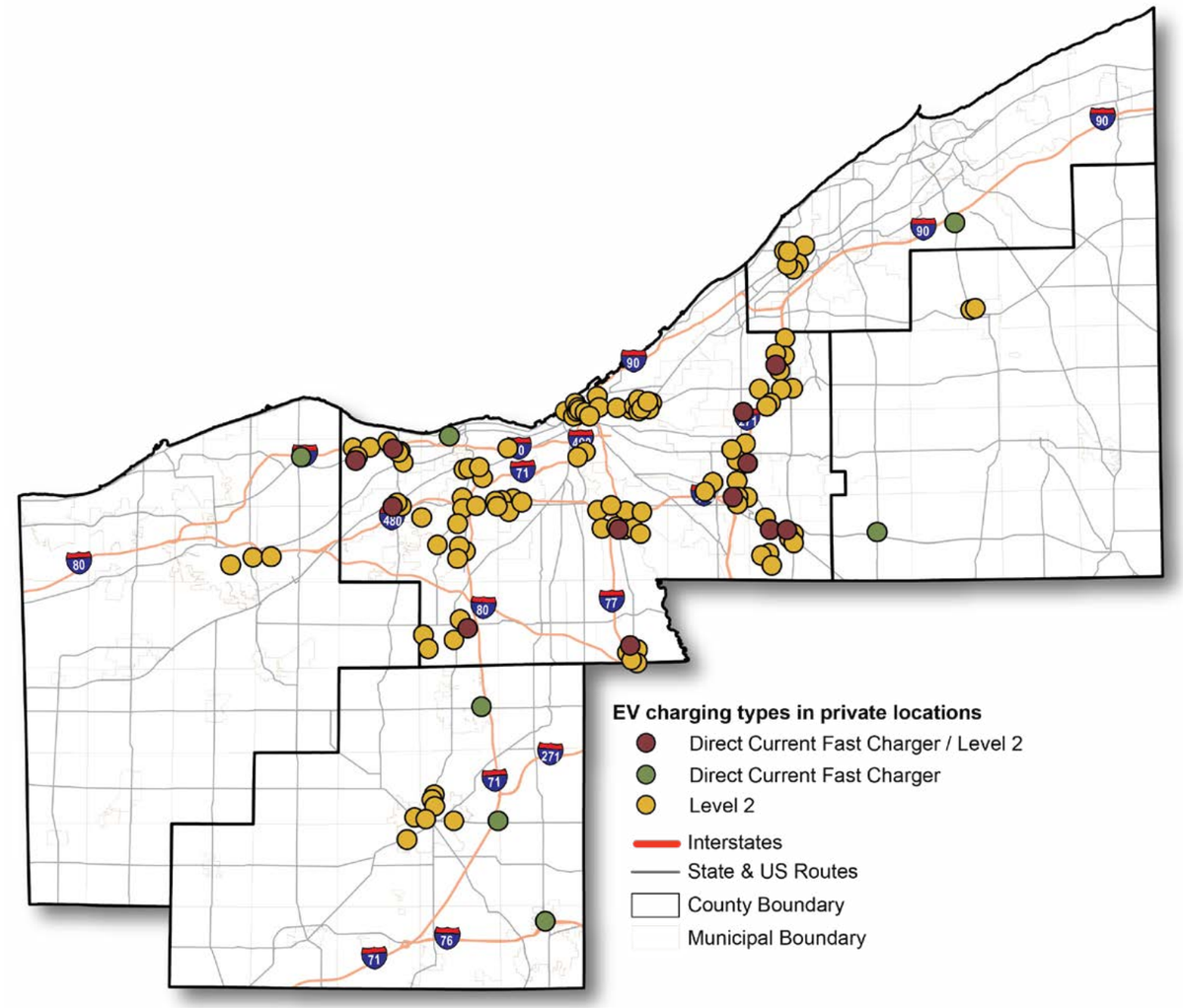
Source: NOACA

Figure 5-21. Proposed Government Owned Level 2 (Workplace) and DCFC Port Locations



Source: NOACA

Figure 5-22. Proposed Private Owned Level 2 (Workplace) and DCFC Port Locations



Source: NOACA

Major Transportation Improvements

Road capacity projects

Roadway projects include adding capacity to the current highway network that includes the freeway and arterials. Figure 5-23 shows the locations of proposed major roadway capacity projects for the period of 2020 to 2050, which include road widening as well as other corridor improvements such as adding left turn lanes.

New highway interchanges

Proposals for highway projects include a set of major high capacity interstate projects which will be added to the current highway network during the next three decades. Notably, eight interchanges, including 4 modifications to existing interchanges and 4 new interchanges are assessed for inclusion into the plan. This evaluation utilized the "New or Modify Interchange" policy adopted by the NOACA Board in December 2020. (Figure 5-25).

Applying the approved board policy, the transportation planning criteria include "Interchange Spacing" and a "Cost-Benefit Analysis". The "Cost-Benefit Analysis" is applied to three levels of geography: Influence subarea, NOACA region and if appropriate, the neighboring counties.

The "interchange spacing" criterion does not apply to the modified interchanges since they already exist. The proposed new interchanges along Interstate 71 at Boston Road and State Route 57 satisfy the interchange spacing criterion but the proposed interchange at White Road does not. Also, adequate design information about the new interchange of State Route 10 was not available at the time of developing eNEO2050 plan to evaluate it.

Figure 5-24 displays the influence subareas of the proposed interchanges, which is identified based on VMT difference density of the "Build" and "No Build" cases.

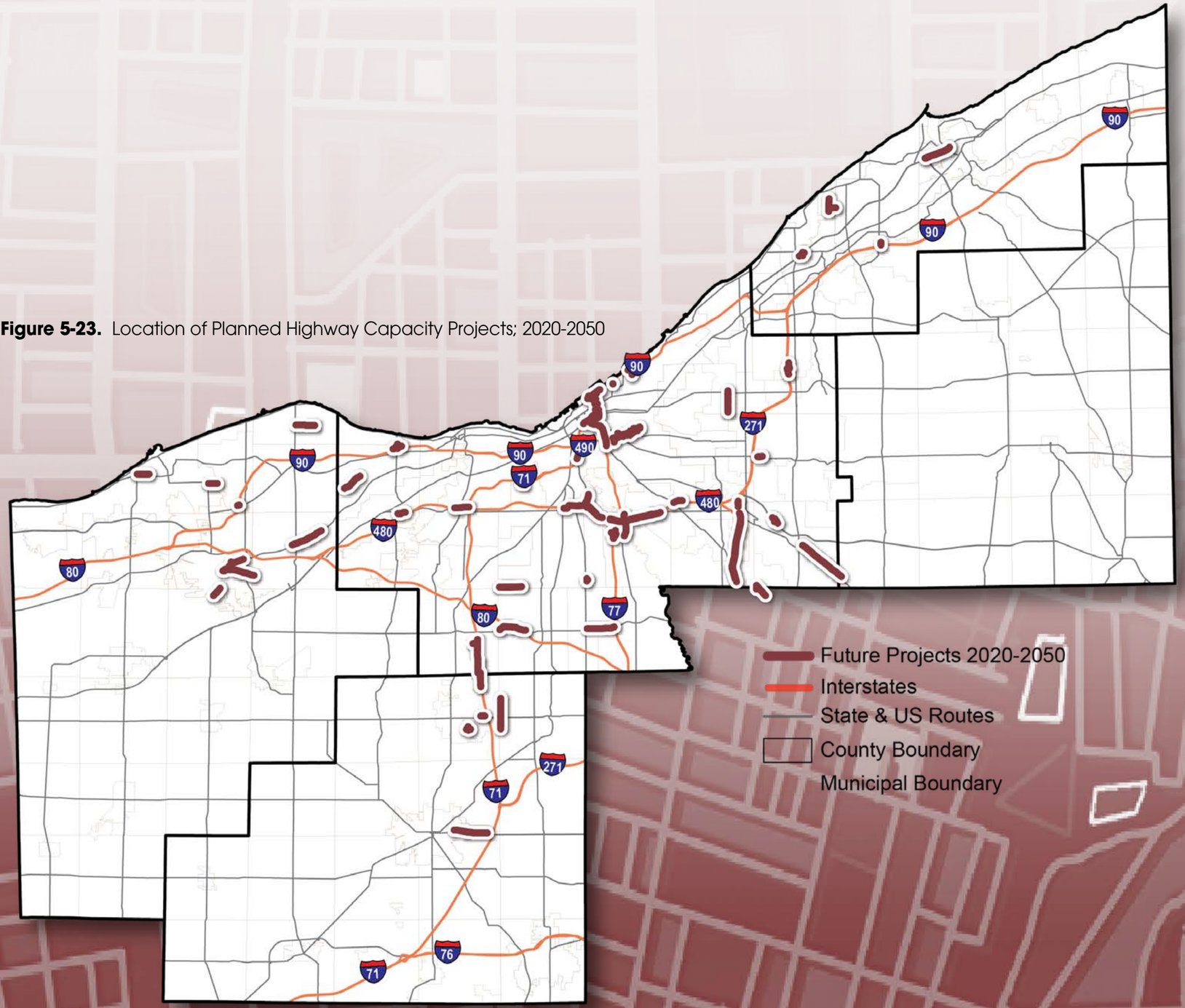
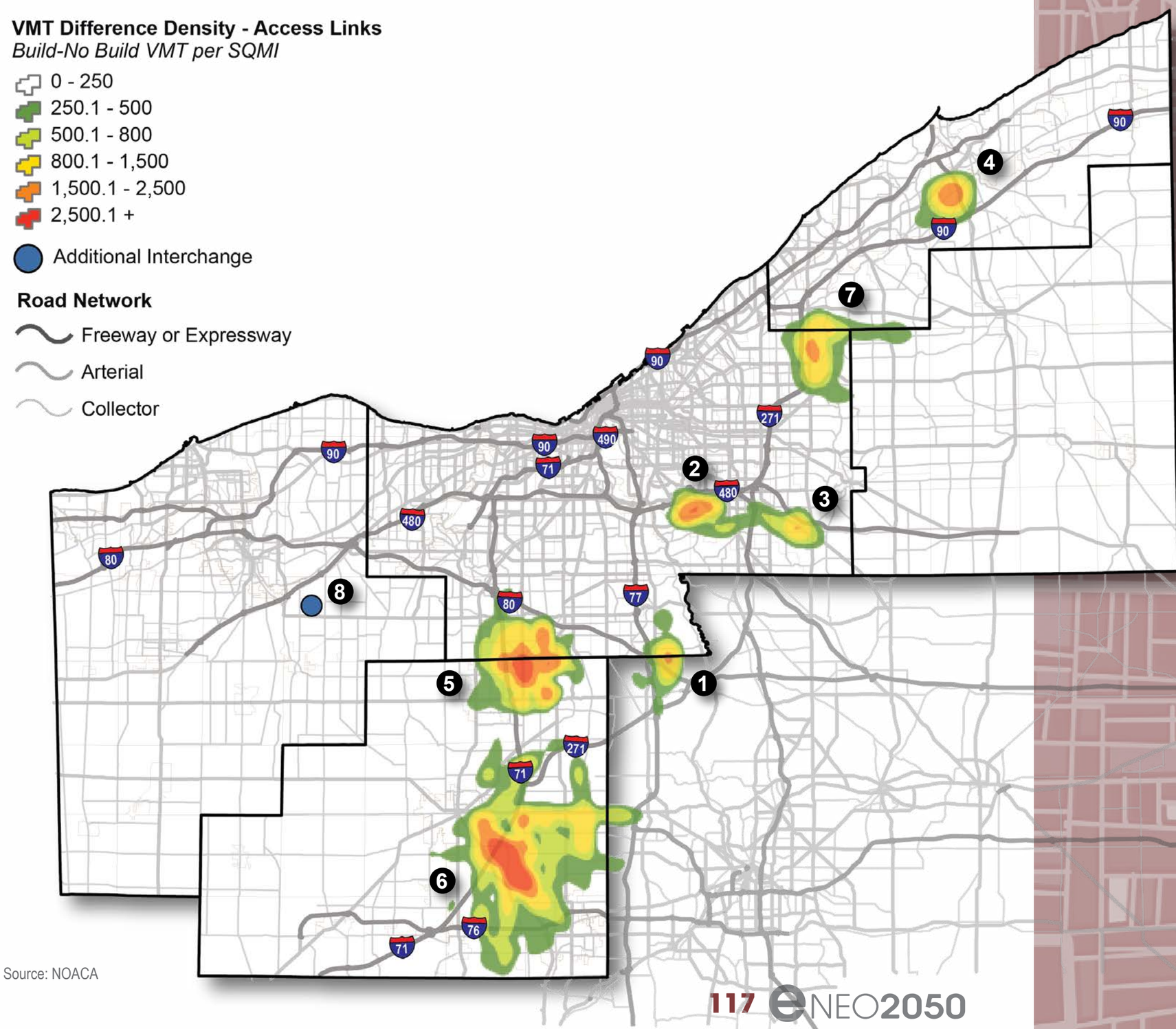


Figure 5-23. Location of Planned Highway Capacity Projects; 2020-2050

Figure 5-24. Influence Subarea of the Interchanges Proposed to NOACA for Evaluation



Source: NOACA

Figure 5-25. Evaluated Interchanges

REQUESTED - MODIFIED

1. **Interstate 77 at Miller Road**
   Brecksville, Cuyahoga County
2. **Interstate 480 at Granger Road**
   Garfield Heights, Cuyahoga County
3. **US Highway 422 at Harper Road**
   Solon, Cuyahoga County
4. **State Route 44 at Jackson Road**
   Painesville, Lake County

REQUESTED - NEW

5. **Interstate 71 at Boston Road**
   Strongsville, Cuyahoga County
6. **Interstate 71 at State Route 57 (or 162)**
   Medina, Medina County
7. **Interstate 271 at White Road**
   Highland Heights, Mayfield, Willoughby Hills, Cuyahoga, Lake Counties
8. **State Route 10 at State Route 57**
   Elyria, Lorain County

Figure 5-26 shows the cost items and procedure of the "Cost-Benefit" analysis. Table 5-6 shows the "Cost-Benefit Analysis" results for the influence subarea proposed interchanges.

As shown in Table 5-6, the "Cost-Benefit" analysis produces several values for each interchange. The positive values in the second column indicate that the total benefit for each interchanger is higher than its total cost. The third and fourth columns provide a range for the margin of errors. The margin of error is assumed as 5% of the total cost of the "No Build" case. The last column shows the minimum values for the investment returns and it is assumed the break-even value for the modified interchanges and 10% of the total cost of the "No Build" case for the new interchanges.

Therefore, using the "Cost-Benefit" analysis, the completion of the existing interchanges at Granger Road, Miller Road, Jackson Street and Harper Road satisfied the transportation planning criteria and then were considered for the regional impact analysis. The proposed new interchanges did not satisfy the transportation planning criteria at the influence subarea level; therefore were not further considered for the regional impact analysis.

As Table 5-7 indicates, an evaluation was conducted at the NOACA regional level for those interchanges as well, which included another "Cost-Benefit" analysis other regional impact criteria such as equity, environmental and economic. Although the daily cost is higher than the benefits, the difference is within the margin of error, thus meeting the threshold. The Interchange of Miller Road at I-77 is located close to border of the NOACA region and its influence subarea is extended to the neighboring county, therefore, it warrants conducting the "Cost-Benefit" analysis for the seven-county region, which also meets the threshold and satisfies the criteria.

Figure 5-26. Cost Benefit Analysis Procedure

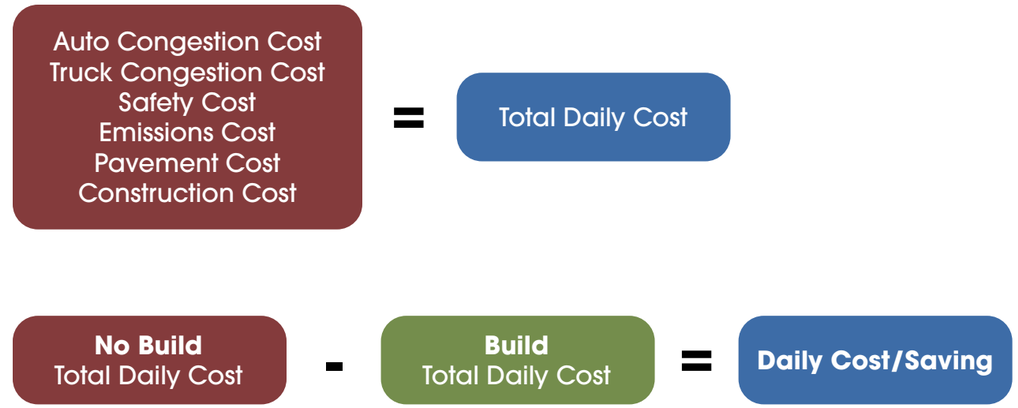


Table 5-6. Cost-Benefit Analysis Results for the Influence Subareas

INTERCHANGE	DAILY COST/SAVING (2050$)	MARGIN OF ERROR		INVESTMENT RETURN THRESHOLD (2050$)
Granger Road	+$9,890	-$25,870	+$25,870	$0 (Break/Even)
Miller Road	-$6,766	-$18,277	+$18,277	$0 (Break/Even)
Jackson Street	+$9,913	-$10,956	+$10,956	$0 (Break/Even)
Harper Road	+$14,696	-$27,251	+$27,251	$0 (Break/Even)
Boston Road	-$776	-$38,818	+$38,818	$77,636
White Road	-$5,396	-$18,524	+$18,524	$37,048
SR 57 (or 162)	-$3,144	-$60,449	+$60,449	$120,897

Source: NOACA

Table 5-7. Cost-Benefit Analysis Results for the NOACA Region

INTERCHANGE	DAILY COST/SAVING (2050$)	MARGIN OF ERROR		INVESTMENT RETURN THRESHOLD (2050$)
Granger Road	+$4,122	-$1,039,849	+$1,039,849	$0 (Break/Even)
Miller Road	-$44,738	-$1,040,053	+$1,040,053	$0 (Break/Even)
Jackson Street	-$138,223	-$1,039,882	+$1,039,882	$0 (Break/Even)
Harper Road	-$7,127	-$1,039,849	+$1,039,849	$0 (Break/Even)

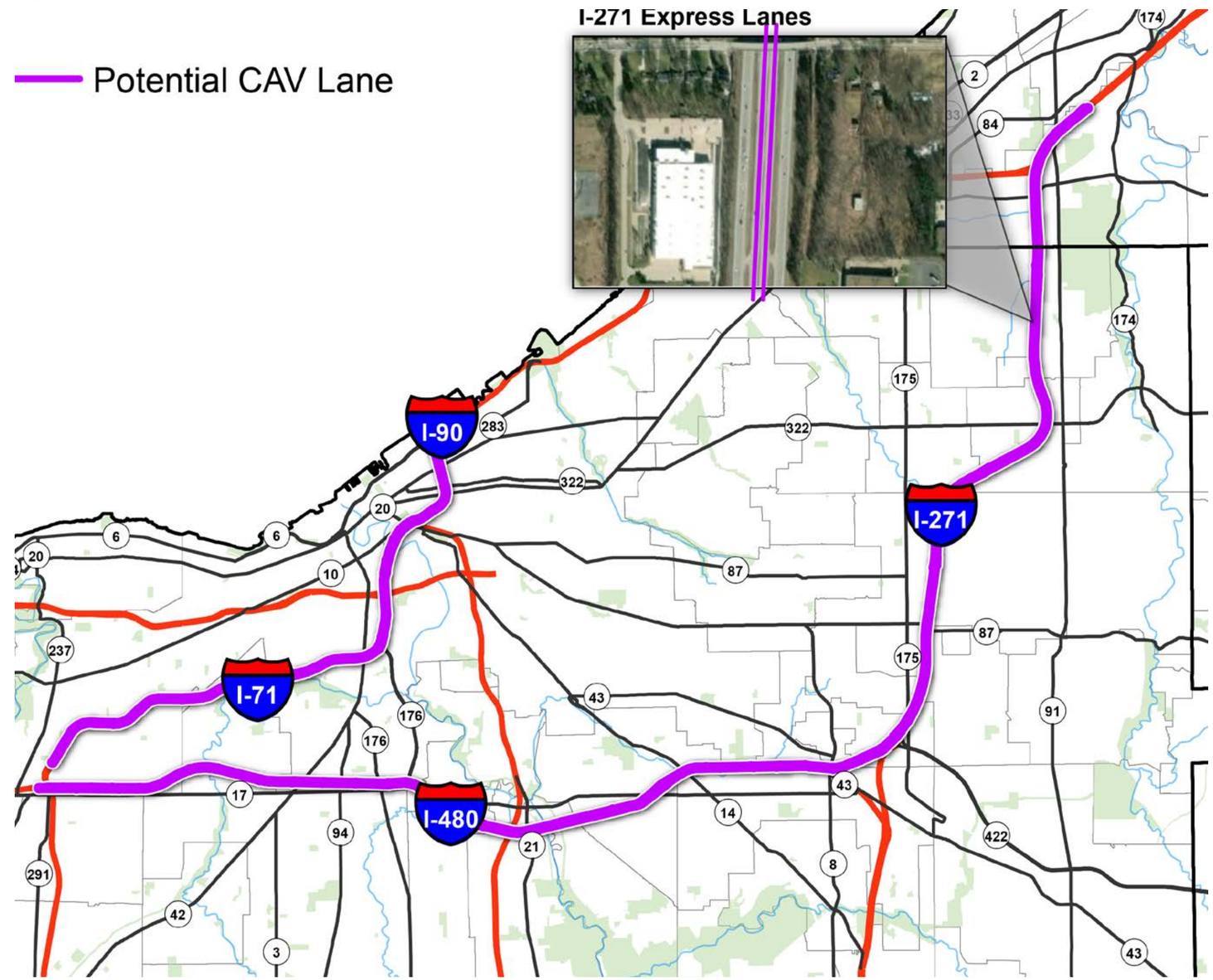
Source: NOACA

High Occupancy and Connected & Autonomous Vehicle Lanes

High Occupancy Vehicle (HOV) lanes and High Occupancy Toll (HOT) lanes are normally created to increase average vehicle occupancy with the goal of reducing traffic congestion and air pollution. The technology associated with Connected and Autonomous Vehicles (CAV) is slowly being introduced to the consumer market in the form of autopilot vehicles. With such advancement, the infrastructure they will operate on also needs to be equally advanced. Just as CAVs are operating with artificial intelligence; the highways should as well. CAVs will communicate with other vehicles and roadway infrastructure. They will use real time traffic data to anticipate congestion, make better routes, and sync their speed. In addition to improving traffic management, establishing systems of communications between vehicles and the roads will also be necessary what is known as V2I (Vehicle to Infrastructure). CAVs are going to be equipped with multiple sensors which will be their eyes when it comes to traveling on a highway. An equipped highway can sharpen these sensors.

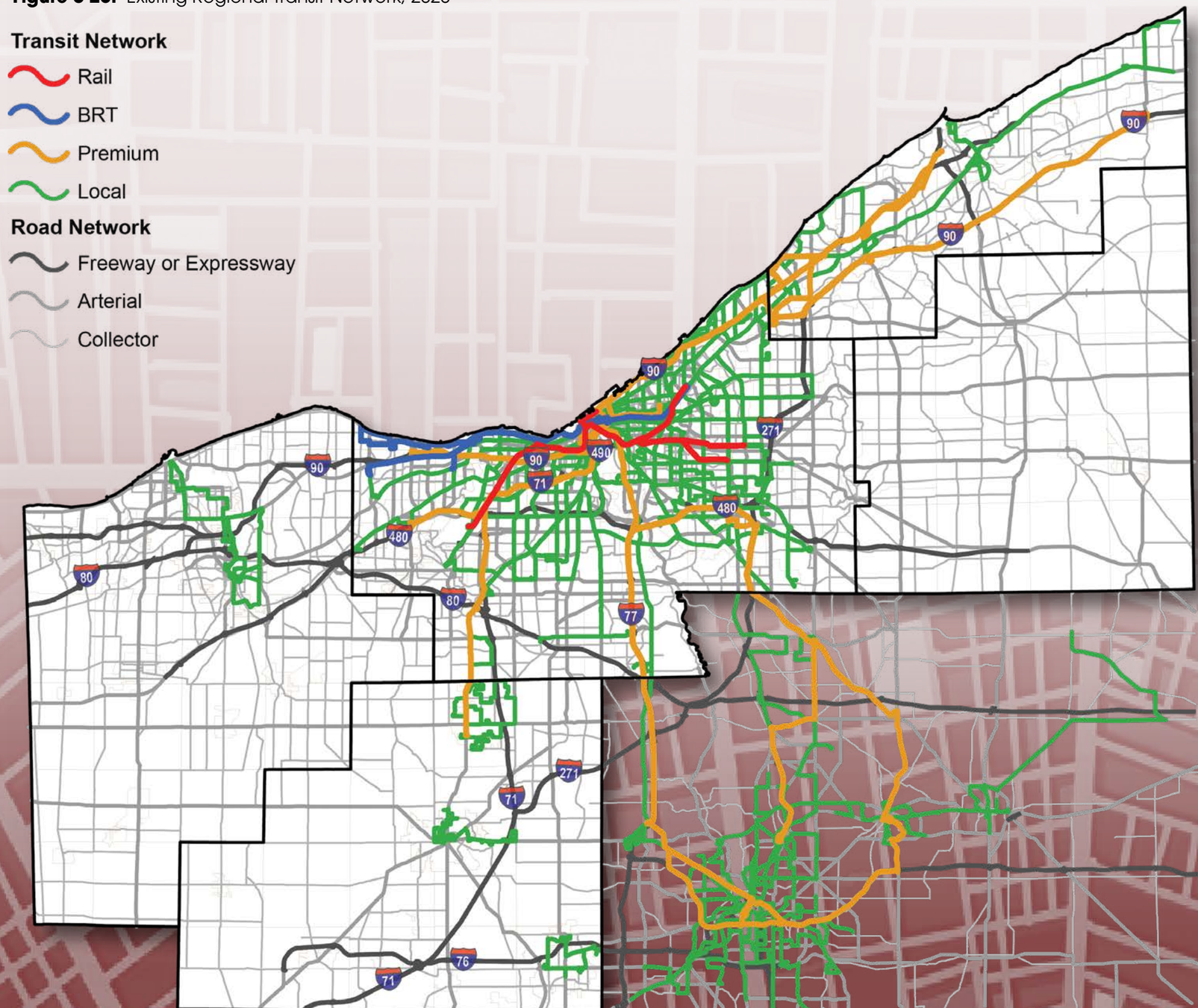
Figure 5-27 illustrates selected interstates where HOV or CAV lanes could be utilized. The exploded view depicts how the HOV or CAV could be implemented by designating two directional lanes on the existing interstates. Their applicability and effectiveness in future scenarios will be discussed in following sections.

Figure 5-27. HOV or CAV Lanes of the Future Scenarios



Source: NOACA

Figure 5-28. Existing Regional Transit Network, 2020

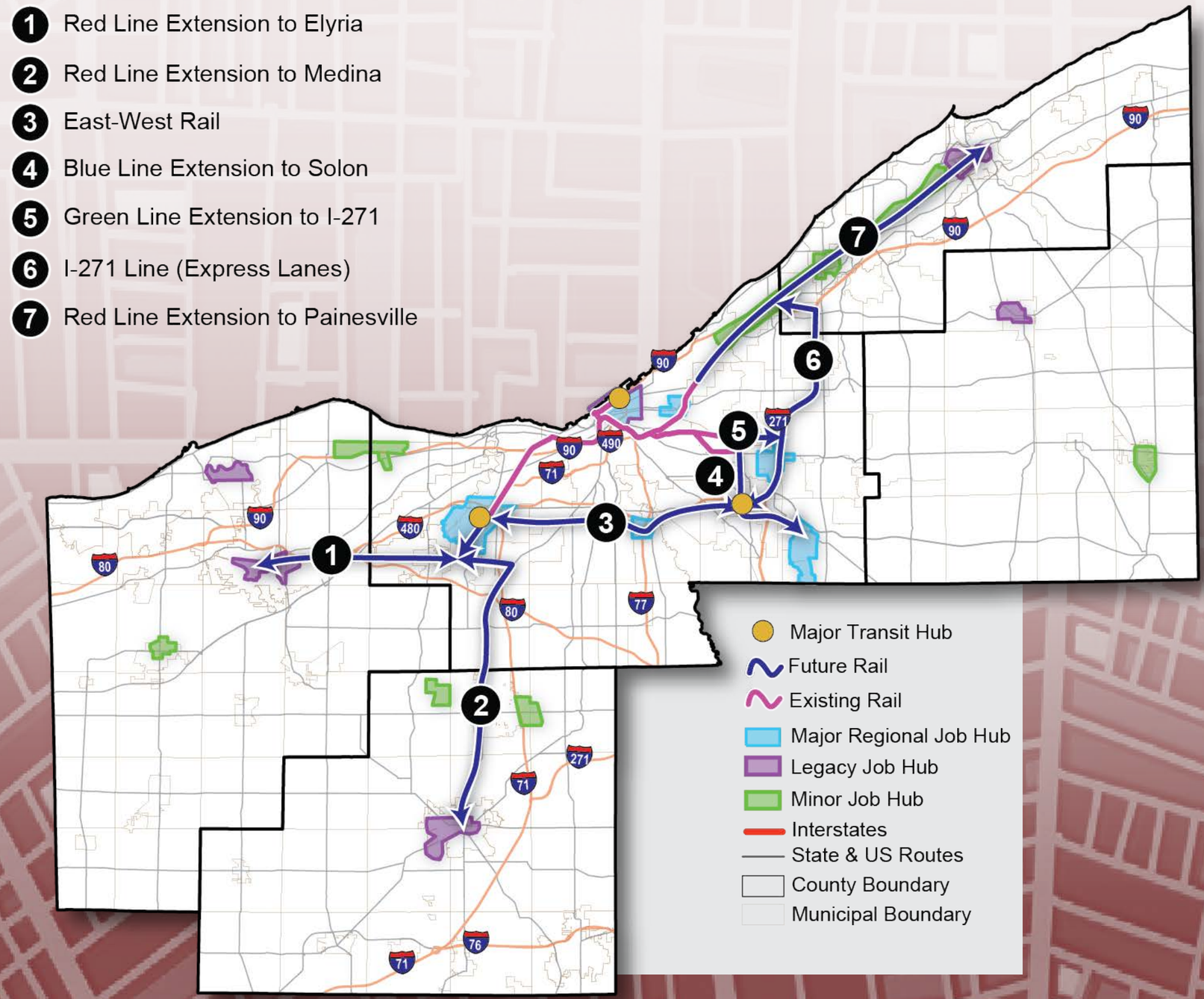


Proposed Regional Rail Extensions

As previously discussed, the current transit network consists of various modes of transit, most notably local bus, premium/park-and-ride bus, Bus Rapid Transit (BRT) and rail. Figure 5-28 shows the existing regional rail lines in the NOACA region.

The existing regional rail network only connects 3 of the 6 major regional job hubs. The existing rail network was completed in the late 1960s and the expansion of jobs into the suburbs since then has left a rail network that does not adequately connect residents to many of the major job centers of the region. Also of note is that the regional rail network only currently serves Cuyahoga County. Growth of population into the outer counties since the 1960s has also resulted in a rail network that does not connect to new population centers of the region. Figure 5-29 displays an improved 2017 visionary rail network as the proposed expanded rail network. Two future scenarios include this extended rail network which will be discussed in the next sections.

Figure 5-29. Visionary Rail Network, 2050



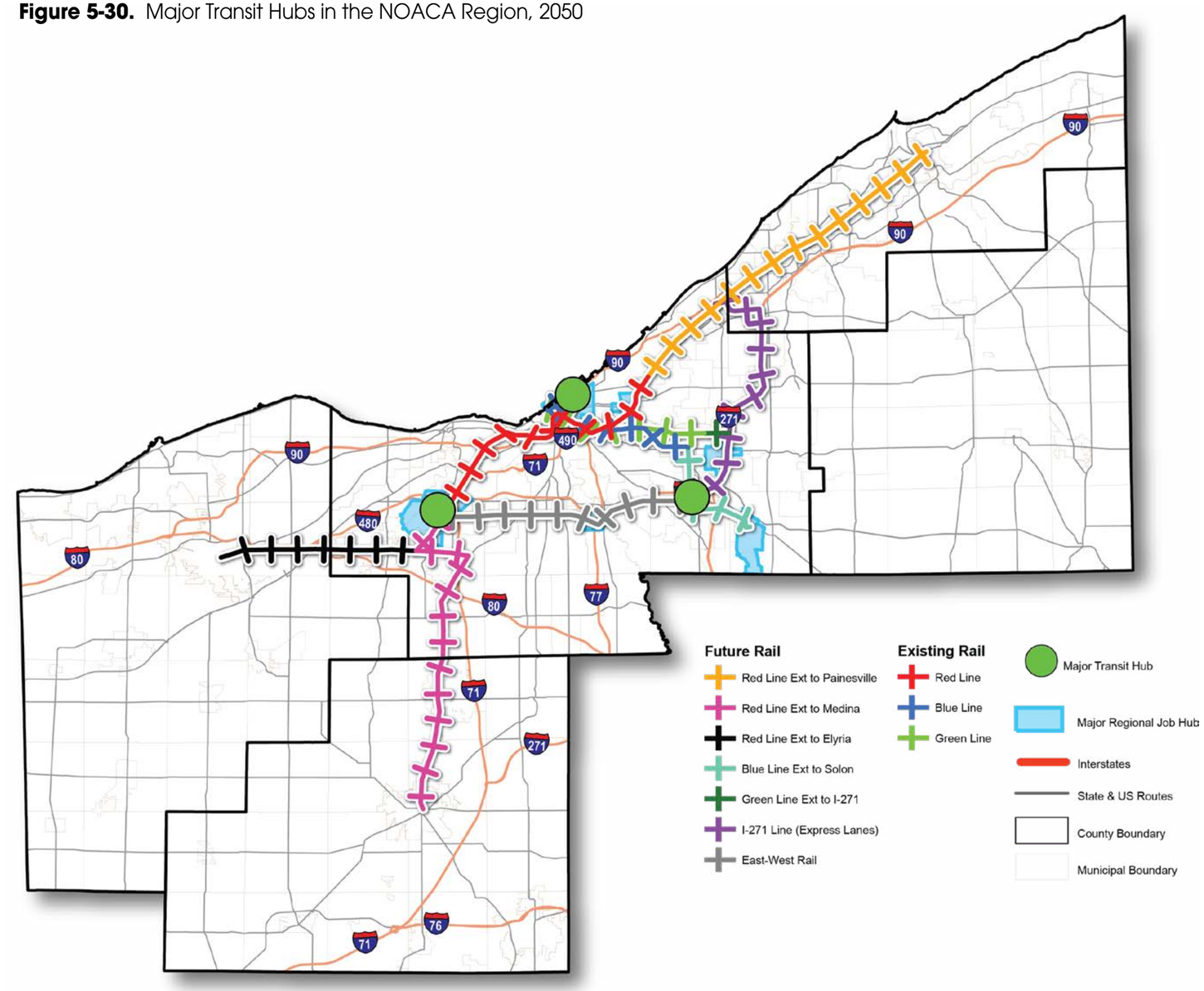
Source: NOACA

An expanded rail network, as seen in Figure 5-29, would greatly increase transit ridership in the region and connect thousands more residents to a rail network that serves all six major regional job hubs, multiple minor and legacy job hubs and the growing suburban population centers of the NOACA region. This is especially important for residents of EJ areas because an expanded regional rail network would greatly increase the number of jobs accessible within a reasonable commute time. Currently, the rail network is confined to the urban core of Cuyahoga County and does not extend the connection to many major regional job hubs or other growing job centers in the suburbs of Cuyahoga County or the four other counties of the region.

Major Transit Hubs

With the expansion of the rail network into 2050, the transit system would need the establishment of new major transit hubs that would serve as transfer points between rail lines, as well as other transit modes. Tower City and Public Square in downtown Cleveland would continue to be the largest major transit hub of the regional transit system with three rail lines serving this location, and many other transit modes, such as BRT (Healthline and Cleveland State line), premium bus, local bus, and autonomous shuttles also connecting here. The Cleveland Hopkins Airport would also become a major transit hub, with the inclusion of new a Red Line extension to Medina and the East-West Line terminating here. Local buses and autonomous shuttles would also serve the Cleveland Hopkins Airport hub, and provide connections to the Great Lakes Hyperloop station. On the eastside of Cuyahoga County, a transit hub would be established at the Southgate Transit Center in Maple Heights. This location currently has local bus service and the addition of the I-271 rail line, the East-West rail line, and the Blue line extension to Solon to this location will create an even greater need to create a major transit hub here. Figure 5-30 displays locations of the major transit hubs in the NOACA region.

Figure 5-30. Major Transit Hubs in the NOACA Region, 2050



Source: NOACA

Note: For modelling purposes, only the major transit hubs were included. The analysis can be extended to all job hubs in a future study.

Active Transportation Facilities

Scenarios 3 and 4 include potential future bicycle networks and pedestrian improvements. To determine the addition of new bicycle and pedestrian facilities, NOACA first identified active transportation projects, many that have been proposed in existing planning documents. After identifying the proposed projects, NOACA evaluated them along multiple criteria to determine likely implementation decades. This section briefly outlines both steps to provide context to the discussion of the scenarios.

Identification of potential active transportation initiatives

Active transportation facility projects are derived from various sources, both within and external to the organization. NOACA's existing "Regional Bicycle Plan" is the foundation for the mapped facilities featuring its "Regional Priority Bikeway Network". Furthermore, NOACA is currently in the process of preparing a new plan called ACTIVATE, which focuses on biking and walking as active transportation. Although ACTIVATE is not complete, some components were able to be integrated into eNEO2050. Another resource for the LRP is NOACA's Transportation for Livable Communities Initiative (TLCI) program that has completed more than 100 studies, many of which include recommendations for active transportation facilities. These studies were initiated in partnership with local communities and their insight is invaluable. Furthermore, other collaborations, such as the Cuyahoga Greenways, provided additional project ideas, as did NOACA's Bicycle and Pedestrian Council. Lastly, needs were identified as part of the *eNEO2050* planning efforts, which included research, analysis and modeling as well as significant public outreach. Bike and pedestrian facility projects are categorized according to the sources from which they were derived.

NOACA Bicycle and Pedestrian Plans helped to identify the following projects:

- Pedestrian infrastructure crossing improvements at intersections,
- Pedestrian infrastructure crossing improvements at midblock crossings, and
- Regional Priority Bike Network (RPBN) routes

eNEO2050 identifies specific needs of the transportation network that can be supported through investments in active transportation:

- Connections from major transit hubs to major job hubs
- Access connection from EJ neighborhoods to transit network stations (first-/last-mile)
- Access from major residential areas to transit network stations (first-/last-mile)
- Major transit hub bike storage improvements
- Smart crossings at midblock locations along major arterials (see Figure 5-31)

TLCI studies and plans by other organizations have identified active transportation projects for particular corridors and routes across the region:

- State and US bike routes along high stress corridors according to ODOT plans
- Bike facility and pedestrian streetscape projects
- Cuyahoga Greenways Plan network
- Bike project recommended by other studies or plans tracked in NOACA's bike network inventory file
- Projects submitted by local agencies

While there is some attention to the improved utilization of major arterials for motorized vehicles, the conclusion does not preclude bicycle facilities on major arterials. Many factors will be evaluated to ensure safe travel for all modes, such as traffic volumes, destinations, geography, redundancy and local access. To that end, bike lanes along major arterials are included when:

- An on-road facility type was specifically recommended along a potential road diet candidate
- The recommended facility is an off-road all purpose trail
- The project is already in active status
- A lane reduction was already implemented

For modelling purposes, however, bicycle facilities were excluded as non-motorized facility projects if an on-road facility type required lane reductions, but it was deemed not feasible due to roadway characteristics of the major arterial.

Prioritization based on implementation decade

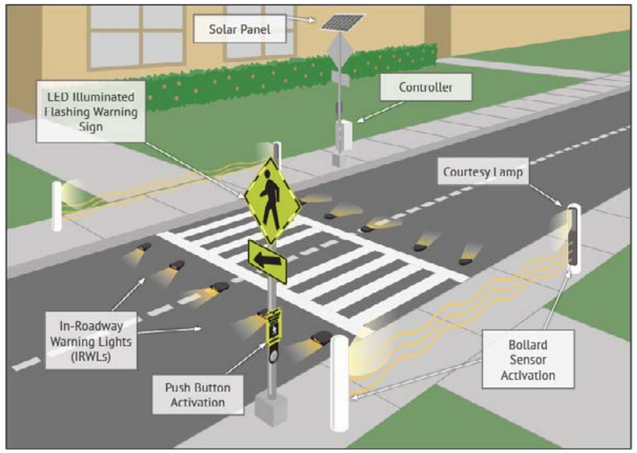
The considered bike and pedestrian projects have been divided into three Priority Tiers: HIGH, MID, and LOW, with each representing a different implementation decade of:

- 2021-2030
- 2031-2040
- 2041-2050

The project priority tier is determined based on the following criteria:

- Immediate readiness
- Fill critical gaps or connectivity needs in regional trail network
- Location in highest need or demand areas
- Intersection and midblock pedestrian crossing improvements identified in the NOACA ACTIVATE plan which connect EJ neighborhoods and major residential areas to the regional transit network
- Projects with potential funding
- Cuyahoga Greenways Plan prioritization level
- Local sponsor importance
- Presence along US or State bike route network
- Projects along high stress routes where no nearby alternative alignment exist
- Bike projects in outer counties that are in high need or demand areas
- Connections between major transit hubs and major regional job hubs
- Prioritized smart midblock pedestrian crossings based on safety issues

Figure 5-31. Smart Crosswalks



Source: lightguardsystems.com/smart-crosswalk-in-roadway-warning-light-irwl-system/

Scenario Project Highlights

Transportation projects are the building blocks of the developed scenarios and their categories are; highway, transit, non-motorized, and emerging technology. It is envisaged that these projects will progressively be implemented during the next three decades.

As discussed earlier in this chapter, each scenario comprises of common projects, shared projects with another scenario and scenario specific projects. Table 5-8 and Table 5-9 display the list of scenario projects and their planned implementation decades.

Table 5-8. Scenario Projects and Planned Implementation Decades

SCENARIO PROJECT	2021-2030	2031-2040	2041-2050
Highway			
Regulating Flow of Traffic Entering Freeways by Adding Ramp Meters	Scenario 2	Scenario 2	Scenario 2
Reinvigorating Arterial Network and Optimizing Traffic Signals	Scenario 2	Scenario 2	Scenario 2
Reducing Highway Bottlenecks	Scenario 2	Scenario 2	Scenario 2
Adding Viable Interchanges	Scenario 2	Scenario 2	Scenario 2
Maintain Pavement conditions in EJ neighborhoods with average of PCR = 80	Scenario 1	Scenario 1	Scenario 1
Adding High Occupancy Vehicle Lanes		Scenario 3	
Implementing Major Highway capacity Projects	Scenarios 2 and 4	Scenarios 2 and 4	Scenarios 2 and 4
Implementing 2024 TIP Highway and Transit Projects	All Scenarios		
Maintain Pavement Conditions with average of PCR = 75	All Scenarios	All Scenarios	All Scenarios
Addressing Location-specific Safety issues in order to Reduce Traffic Fatalities	All Scenarios	All Scenarios	All Scenarios
Maintain Bridges in Good or Fair Conditions	All Scenarios	All Scenarios	All Scenarios
Transit			
Implementing Future Transit Agencies' Bus/BRT Routes		Scenarios 3 and 4	
Adding Improved 2017 Visionary Rail Network		Scenarios 3 and 4	Scenarios 3 and 4
Maintain Transit Vehicles in the Good State in the end of each Decades	Scenario 2	Scenario 2	Scenario 2
Maintain Transit Vehicles Serving the EJ Areas in the Good State all the times	Scenario 2	Scenario 2	Scenario 2
Reducing Transit Service headways to EJ Areas		Scenario 3	
Non-Motorized Facility			
Creating Walk and Bike Access from EJ Areas to Transit Network	Scenario 3	Scenario 3	Scenario 3
Creating Walk and Bike Connections from Major Transit Hubs to Major Job Hubs	Scenario 3 and 4	Scenario 3 and 4	Scenario 3 and 4
Creating Walk and Bike Access from Major Residential Areas to Transit Network	Scenario 4	Scenario 4	Scenario 4
Implement Smart Pedestrian Crossings	All Scenarios	All Scenarios	All Scenarios

Source: NOACA

(Continued on Table 5-9)

Table 5-9. Scenario Projects and Planned Implementation Decades (Continued)

SCENARIO PROJECT	2021-2030	2031-2040	2041-2050
Workforce Accessibility and Mobility			
Improve Average Auto and Transit Commute Times to Major Job Hubs	Scenario 1		
Reducing Average Auto Commute time to Major Job Hubs to 30 minutes		Scenario 2	
Reducing Average Transit Commute Time to Major Job Hubs to 45 minutes		Scenario 3	
Reducing Average Auto Commute Time to Major Job Hubs to 20 - 30 minutes			Scenario 4
Reduce Average Transit Commute Time to Major Job Hubs to 30 minutes			
Emerging Technologies in Transportation			
Installing EV Charging Ports		All Scenarios	
Adding POD and Shuttle CAV Services from Major Transit Hubs to Major Job Hubs			Scenarios 3 and 4
Installing Extra EV Charging Ports			Scenario 4
Constructing the Hyperloop Station			
Allocating Selected Smart Freeway and Arterial Lanes to Autonomous Vehicles			

Scenario Evaluation

Evaluation Method and Performance Measures

This section discusses a set of performance measures for scenario evaluation and comparative analysis. Table 5-10 displays the performance measure categories and the selected measures.

Table 5-10. NOACAs Transportation Objectives - Enabling Equal Opportunity

	PERFORMANCE MEASURE CATEGORY	PERFORMANCE MEASURES
ACCESS	**Multimodal Transportation System**	• Percent of Non-Single Occupancy Vehicles • Annual Transit Ridership
	Access to Transportation System	• Access to all Transit Stops • Egress from All Transit Stops • Access to Highway System
MOBILITY	**Mobility & Delay**	• Total Annual Total VMT per Capita • Total Annual Freeway Delay per Capita • Annual Total Annual Principal Arterial Delay Per Capita • Annual Person Hours of Excessive Delay per Capita (PHED)
	Congestion Cost	• Annual Congestion Cost Per Capita
	Travel Time	• Average Auto Work Commute Time to All Major Job hubs • Average Transit Work Commute Time from EJ Neighborhoods to All Major Job Hubs • Average Work Commute Time From Households with Zero Cars • Maximum Level of Travel Time Reliability (LOTTR) • Maximum Truck Travel Time Reliability (TTTR)
SAFETY	**Traffic Safety**	• Fatalities, Serious Injuries and Non-motorized Fatalities and Serious Injuries
EMISSIONS	**Air Quality**	• Daily Volatile Organic Compound(VOCs) and Nitrogen Oxides (NOx) • Annual Direct PM
ASSET MANAGEMENT	**Pavement & Bridge**	• Average Highway Network Pavement Condition Rating (PCR) • Percent Structurally Deficient Deck Areas of All Bridges and NHS Bridges
TECHNOLOGY ADAPTATION	**Share of Autonomous vehicles**	• Daily Vehicular Trip Share of Autonomous, Electric Cars & Trucks

Effectiveness of the developed scenarios is linked to the accomplishment of the LRTP goals and objectives. The general effectiveness of each scenario is assessed based on its performance in regard with a set of selected transportation planning and traffic engineering measures, using a formula to obtain the Scenario Measure of Efficiency (SMOE).

The Scenario 1 (MAINTAIN) does not include any specific expansion or enhancement projects apart from the common projects. Therefore, this scenario is considered as the "Do Nothing" case in similar planning processes and its performance measures are assumed as the benchmark values for evaluating other scenarios and implementing a comparative analysis.

The evaluation process comprises of four steps:

1. The scenario performance measure values of all the selected performance measures are estimated.
2. The estimated scenario performance measures is compared with those of scenario 1 to determine the percent of differences.
3. A weighting value is assumed for each performance measure. The public feedback had some impacts on determining the weighting values.
4. All the weighted difference percent values are summed to a single Scenario Measure of Efficiency (SMOE) value.

$$\boldsymbol{SMOE}_i = \sum \alpha_j \times PM_{ij}$$

Where:

$\boldsymbol{SMOE}_i$: Total of the weighted performance measure values for scenario *i*

PM_{ij} : Difference value percent of performance measure *j* for scenario *i* compared with the same performance measure value of scenario 1

α_j: Weighting value of Performance measure *j*

Table 5-12 shows the weighting values and scenario performance measure values. In this Table, the performance measures that highlighted in green should have higher values in order to be more effective. In contrast, the performance measures that highlighted in brown should have lower values in order to be more effective.

Table 5-11 exhibits the general effectiveness of all the scenarios in achieving the goals and objectives of the LRTP compared with that of that of scenario 1 as "DO nothing" case. For instance, the total weighted MOE of scenario 4 is about six times than that of the scenario 1.

Table 5-11. Estimated Total Measures of Effectiveness

SCENARIO	RATIO OF ESTIMATED SCENARIO SMOE RELATIVE TO SCENARIO 1 SMOE
Scenario 1: MAINTAIN	1.00
Scenario 2: CAR	0.19
Scenario 3: TRANSIT	3.00
Scenario 4: TOTAL	6.00

In the following sections, the total capital cost and the annual required budgets of scenarios will be estimated and synthesize with the SMOE ratios.

Table 5-12. Estimated Scenario Performance Measures

	PERFORMANCE MEASURE	WEIGHTING VALUE	MAINTAIN SCENARIO	CAR SCENARIO	TRANSIT SCENARIO	TOTAL SCENARIO
Multimodal	Population in 15 Minutes Walk to any Transit Stop	0.34	65%	65%	70%	70%
	EJ Workers in 15 Minutes Walk to any Transit Stop	0.33	88%	88%	90%	90%
	Number of Jobs within 15 Minutes Walk egress from any Transit Stop	0.33	77%	77%	81%	82%
	Population in 5-Mile Drive Access to Freeway System	1	91%	92%	92%	92%
	Annual Transit Ridership (Including Transfer Trips) – Million Person Trips	2	38	38	91	110
	Average Transit Work Commute Time from EJ neighborhoods to All Major Job Hubs (in Minutes)	1	60.4	60.3	58.6	54.3
	Average Work Commute Time for Households with Zero Cars (in Minutes)	1	42.88	42.85	41.77	41.00
Auto	Non-Single Occupancy Vehicle Work Commute during a Typical Morning Peak Period	1	16%	16%	21%	22%
	Average Highway Network Pavement Condition Rating (PCR)	1	80	87.1	87.1	87.1
	Daily Vehicular Trip Share of Autonomous, Electric Cars and Trucks	2	19%	19%	20%	32%
	Total Annual Vehicle Miles Traveled per Capita	1	7,946	7,967	7,433	7,243
	Total Annual Freeway Delay per Capita (in Hours)	2	7.11	7.34	7.98	5.89
	Total Annual Principal Arterial Delay per Capita (in Hours)	1	7.2	6.7	7.4	8.1
	Annual Person Hours of Excessive Delay per Capita (in Hours)	2	24.89	24.38	25.1	25.64
	Average Auto Work Commute Time to All Major Job Hubs (in Minutes)	1	37.7	37.5	39.0	40.4
	Maximum Level of Travel Time Reliability (LOTTR)*	1	1.52	1.5	1.51	1.49
	Maximum Truck Travel Time Reliability (TTTR)**	1	1.83	1.86	1.88	1.86
	Annual Congestion Cost per Capita (2050$)	3	821	807	854	804
	Estimated Fatalities (Based on 2019 Crash Data and Annual 2% Reduction)	1	75	75	75	75
	Estimated Serious Injuries (Based on 2019 Crash Data and Annual 2% Reduction)	1	713	713	713	713
	Estimated Non-Motorized Fatalities and Serious Injuries (Based on 2019 Crash Data and Annual 2% Reduction)	1	91	91	91	91
	Daily Volatile Organic Compounds (VOCs) (in Tons)	1	9.25	9.28	9.28	9.48
	Daily Nitrogen Oxides (NOx) (in Tons)	1	8.34	8.36	8.36	8.54
	Annual Direct PM (in Tons)	1	209.65	210.21	210.32	214.66
	Structurally Deficient Deck Areas of NHS Bridges	1	1.77%	1.77%	1.77%	1.77%
	Structurally Deficient Deck Areas of All Bridges	1	6.57%	6.57%	6.57%	6.57%

Notes: *LOTTR values are estimated as the ratio of 80th percentile and 50th percentile of all the inter-zonal travel times; **TTTR values are estimated as the ratio of 95th percentile and 50th percentile of all the inter-zonal travel times.

Scenario Costs

This section provides a framework based on a set of performance measures for evaluating scenarios and consequently prioritizing their projects and determining their implementation decades. Some scenarios include several future projects with significant investments. In the following sections, the annual costs or required budgets of the scenarios will be estimated based on their project lists. Subsequently, the scenario budgets will be compared with the estimated annual available funding with the selected scenario required to satisfy not only the transportation system aspects, but the fiscal constraint. Obviously, the budget considerations will impact the priority and implementation decades and years of the included projects.

The plan year for the LRTP is 2050; therefore, the analysis period is comprised of three decades - 2020-2030, 2030-2040 and 2040-2050. Considering budget and revenue streams are an annualized basis, the project costs were estimated using the dollar values of the project implementation years.

Table 5-13 shows the net present value (NPV) of the capital costs of the common projects which are included in all the scenarios, and it also shows the costs specific to each scenario. It should be noted that there are other projects included in more than one scenario, in which case their costs are included in each of those scenarios. This table also includes the NPV percent of the total costs for scenario specific projects compared to the common projects.

Again, scenario 1 only maintains the system and does not include any enhancement or expansion projects. The specific project cost for this scenario is the lowest value and the specific project cost of the scenario 4 is the highest. The scenario specific projects determine the difference between scenario costs. Similar to the relative scenario effectiveness discussed in the previous section, the quotients of the additional scenario capital costs divided by the lowest scenario additional cost (that of the "Do Nothing" case) shown in Table 5-14, provide a set of comparison values.

Combining the SMOE values with the estimated scenario specific project cost ratios in Table 5-14 results in an indication for the economic return of scenarios. Table 5-15 shows the ratio of SMOE and the total costs.

Considering the ratio of SMOE and corresponding costs as an indication of economic return, then as illustrated in Table 5-15, the economic returns of all the scenarios are less than that of the scenario 1, "Do Nothing" case, as the benchmark. Therefore, these comparison results indicate that a hybrid scenario may have a higher level of economic return. The scenario costs will also be compared with the predicted available annual budgets to identify a hybrid and fiscally constrained scenario with the economic return greater than 1.

Table 5-13. NPV (2020$) of Estimated Total Specific Project Costs of Scenarios

SCENARIO	COMMON PROJECT COST (BILLIONS)	SCENARIO SPECIFIC COST (BILLIONS)	TOTAL SCENARIO COST (BILLIONS)	PERCENT COMMON PROJECT COSTS	PERCENT SCENARIO SPECIFIC COSTS
Scenario 1: MAINTAIN	9.28	1.298	10.578	87.7%	12.3%
Scenario 2: CAR	9.28	1.845	11.125	83.4%	16.6%
Scenario 3: TRANSIT	9.28	7.004	16.284	57.0%	43.0%
Scenario 4: TOTAL	9.28	9.134	18.414	50.4%	49.6%

Source: NOACA

Table 5-14. NPV Cost Comparison Ratios

SCENARIO	RATIO OF SCENARIO SPECIFIC COST PERCENT TO SCENARIO 1 SPECIFIC COST PERCENT
Scenario 1: MAINTAIN	1
Scenario 2: CAR	1.42
Scenario 3: TRANSIT	5.40
Scenario 4: TOTAL	7.04

Source: NOACA

Table 5-15. Ratio of SMOE and Scenario Cost Ratios

SCENARIO	SMOE VALUE RELATIVE TO SCENARIO 1 SMOE	SPECIFIC PROJECT COST QUOTIENT VALUES	RATIO OF SMOE VALUES AND CORRESPONDING COST VALUES
Scenario 1: MAINTAIN	1.00	1.00	1.00
Scenario 2: CAR	0.19	1.42	0.13
Scenario 3: TRANSIT	3.00	5.40	0.56
Scenario 4: TOTAL	6.00	7.04	0.85

Source: NOACA

Scenario Evaluation Summary

This section summarizes the comparative analysis results based on the scenario performance measures.

Scenario 1: MAINTAIN

- Transit ridership is the lowest
- The lowest number of people with 5-mile drive access to freeway system
- Higher VMT compared with the current VMT
- Requires the least capital investment

Scenario 2: CAR

- The percent of the drive alone choice is same as today
- Access to highway system is slightly improved
- The lowest arterial delay

Scenario 3: TRANSIT

- Doubles the transit ridership
- More people and workers have walk access to buses and rails
- Number of EJ workers living inside the 30 minutes transit commute time shed is higher than today

Scenario 4: TOTAL

- Transit ridership is almost tripled
- Access to transit and freeway systems are simultaneously improved
- Technology adaptation rate is the highest
- Higher budget and efficient distribution are required

ENDNOTES

1 Moody's Analytics, "Regional employment projections", accessed via Team NEO February, 2020, Economy.com and Bureau of Economic Analysis.

2 NOACA-forecasted data based on the Quarterly Census of Employment and Wages (QCEW) 2010 and county forecasts by Moody's Economy.com. QCEW data obtained from the Ohio Department of Transportation (ODOT) in 2012 and Moody's Economy.com data obtained from Team NEO in February 2020.

3 Adam Cooper and Kellen Schefter, "Electric Vehicle Sales Forecast and the Charging Infrastructure Required Through 2030," (Washington DC: Institute for Electric Innovation and Edison Electric Institute, 2018), 1.

4 "Northeast Ohio Plug-In Electric Vehicle Infrastructure Assessment", (Golden, CO: National Renewable Energy Laboratory, 2018), 1.

SECTION 3

eNEO2050

ELEVATING ACTIONS

THAT BUILD AN EQUITABLE TRANSPORTATION SYSTEM

Photo by Free-Photos from Pixabay

ENSURING IMPLEMENTATION

eNEO2050

In this Chapter

The backbone of *eNEO2050* is a hybrid scenario that includes individual themes from the four specific scenarios that were presented for evaluation during the planning process. . The journey of developing *eNEO2050* began in 2017 following the board approval of NOACA's *AIM Forward 2040 Long-Range Transportation Plan*. The more concentrated efforts to build and assemble *eNEO2050* began in January 2019 with the launch of a public outreach campaign. At various stages in the development of the plan, NOACA sought and considered input from the general public, historically underrepresented groups, many leaders in the region, and experts. NOACA assessed the many ideas for the transportation system from these groups against performance measures for the four scenarios. The outcome is the following vision that is supported by plans, policies, programs and projects to invest in an equitable Northeast Ohio over the coming decades.

eNEO2050 sets out a vision for investing in Northeast Ohio with equity in mind. This section of *eNEO2050* describes the 4Ps (Policies, Programs, Plans, Projects) that support an equitable Northeast Ohio by focusing on an (1) efficient and affordable highway system (Roadway), (2) enhanced roadways for all users (Roadway + Nonmotorized), (3) exciting transit system that connects people to jobs (Transit), and (4) evolution of future infrastructure and technologies (Emerging Technology). Each of the four vision statements is described in more detail in this chapter. The 4Ps are derived from the analyses presented in the Chapters above. The subsequent section includes projects in the constrained part of the plan (i.e., projects that have sufficiently advanced through the planning process and that NOACA predicts will have adequate funding) as well as projects that are illustrative. The illustrative list contains projects that have not yet met NOACA planning requirements and/or cannot demonstrate adequate funding within the forecasted revenues of the plan but still have promise and are part of a potential vision for the future, particularly if circumstances change. NOACA is pleased to present actions to advance *eNEO2050* and looks forward to working in close coordination with the many transportation stakeholders in the region on implementing a more equitable future for Northeast Ohio.

Figure 6-1. *eNEO2050* Vision


Source: Aerial Agents, 2017


Source: Alamy


Sources (clockwise): cnet.com, techcrunch.com, Best Mile, jurifilm.com

eNEO2050 **envisions an equitable Northeast Ohio with thriving communities in the urbanized and rural areas. Investing in an equitable Northeast Ohio means prioritizing an:**

ROADWAY — **EFFICIENT HIGHWAY SYSTEM**

NON-MOTORIZED / ROADWAY — **ENHANCED ROADWAYS FOR ALL USERS**

TRANSIT — **EFFECTIVE TRANSIT SYSTEM THAT CONNECTS PEOPLE TO JOBS**

EMERGING TECHNOLOGIES — **EVOLUTION OF FUTURE INFRASTRUCTURE AND TECHNOLOGIES**


Source: Aerial Agents, 2018

Figure 6-2. Transportation Principles and Objectives

eNEO2050 WILL FOCUS ON...	2020-2030	2030-2040	2040-2050
Access	Accessing at least one travel mode in reasonable time/distance	Accessing more than one travel mode in reasonable time/distance	Accessing a reliable and equitable Multimodal Transportation System
Mobility	Reducing work commute time (auto & transit)	Continually reducing travel delay & congestion cost	Developing a realistic, reliable, & affordable multimodal transportation system for any trip purpose, by any mode
Safety	Continually reducing traffic fatalities & serious injuries	Retaining an acceptable level of traffic safety for the transportation system	Approaching the number of traffic fatalities & serious injuries to zero
Emissions	Sustaining emission levels lower than NOACA region's budget	Reducing emissions towards achievement of attainment of air quality maintenance standards	Achieving air quality maintenance standards
Asset Management	Maintaining the roadway network with average pavement condition rating of 75 & less than 2% of deck areas of NHS bridges structurally deficient	Maintaining the roadway network with average pavement condition rating of 80 & less than 2% of deck areas of NHS bridges structurally deficient	Maintaining the roadway network with average pavement condition rating of 80 & near zero of deck areas of NHS bridges structurally deficient
Technology Adaptation	Installing an adequate level of EV charging ports to support the planned PEVs	Continually installing EV charging ports not only to support the existing PEVs, but encouraging residents to purchase PEVs	Allocating selected freeway & arterial lanes for autonomous cars & trucks; Running autonomous shuttle buses to provide complete transit connectivity; Accessing an EV charging port by driving only 5 miles

Figure 6-3. *eNEO2050* Transportation Strategies and Actions Envisioned

4 Project Types

ROADWAY | NON-MOTORIZED | TRANSIT | EMERGING TECHNOLOGIES

EFFICIENT HIGHWAY SYSTEM

Interchanges
eNEO2050 completes four partial existing interchanges to become full interchanges by 2050.

Congestion Management
eNEO2050 improves the performance of the transportation system by reducing congestion in accordance with CMP objectives including implementing infrastructure improvements and promoting mode shift.

Workforce Accessibility and Mobility
eNEO 2050 improves the spatial mismatch between people and jobs.

Pavement and Bridge Maintenance Management
eNEO2050 ensures that the interstate system is maintained at optimal levels as prescribed by FHWA and ODOT and maintains the average pavement condition rating at 75 in accordance with NOACA's *Asset Management Plan*, but also ensures a higher level of 80 for the EJ areas.

ENHANCED ROADWAYS FOR ALL USERS

Safety
eNEO2050 works to achieve Vision Zero as discussed in NOACAs SAVE plan. NOACA's Systemic Safety Management program is transformed into a proactive and community-based approach to safety issues.

Complete and Green Streets
eNEO2050 implements complete and green streets when appropriate and feasible in accordance with NOACA's policies.

Principle Arterial Network
eNEO2050 elevates and prioritizes principal arterial corridors for signal improvements as part of the STOP program.

Active Transportation
eNEO2050 funds 926 miles of bicycle facilities, more than 11,000 pedestrian ADA and safe crossings, and 760 bike storage lockers for cyclist in the next three decades.

Transportation for Livable Communities (TLCI)
eNEO2050 provides $15 million to fund planning studies that focus on integrating multi-modal transportation solutions to better connect communities for livability. *eNEO2050* allocates $41 million to fund the implementation of completed TLCI studies.

EFFECTIVE TRANSIT SYSTEM THAT CONNECTS PEOPLE TO JOBS

Regional Transit Service
eNEO2050 implements short- and long-term strategies from the Regional Strategic Plan that improve transit services within the 5-county region.

Transit Access to Jobs
eNEO2050 improves access and mobility in the transit system based on recommendations in NOACA's Workforce Accessibility and Mobility study.

Transit Mode Share
eNEO2050 increases annual transit ridership from 40 to 55 million people by providing access to the transit system and mobility within the transit system.

Transit-Oriented Development
eNEO2050 includes transit-oriented development (TOD) as a mechanism to better connect land uses and transportation investments.

Autonomous Shuttle Feeder
eNEO2050 pursues autonomous shuttle feeder bus services as a complement to existing modes for "First-Mile" and "Last-Mile" connections.

BRT Priority Corridors
eNEO2050 includes BRT priority corridors as shown in GCRTA 2020 strategic plan as bus-rapid-transit systems.

Transit Asset Management
eNEO2050 prioritizes $2.2 billion in funding for transit preservation projects that are classified into two categories: vehicle replacements and non-vehicle capital maintenance.

Visionary Rapid Transit Network
eNEO2050 advances a visionary rapid transit network as illustrative project to be further studied in a $5 million Feasibility Study.

EVOLUTION OF FUTURE INFRASTRUCTURE AND TECHNOLOGIES

EV Charging Stations
eNEO2050 projects that over 2,000 charging stations will be needed over the next decade to facilitate adoption rates of electric vehicles. *eNEO2050* includes $3 million for the installations of charging stations in public spaces and includes partnerships with the private sector to support the market.

Autonomous and Connected Vehicles
eNEO2050 includes infrastructure preparation for the adoption and deployment of autonomous and connected vehicles including trucks for freight infrastructure improvements.

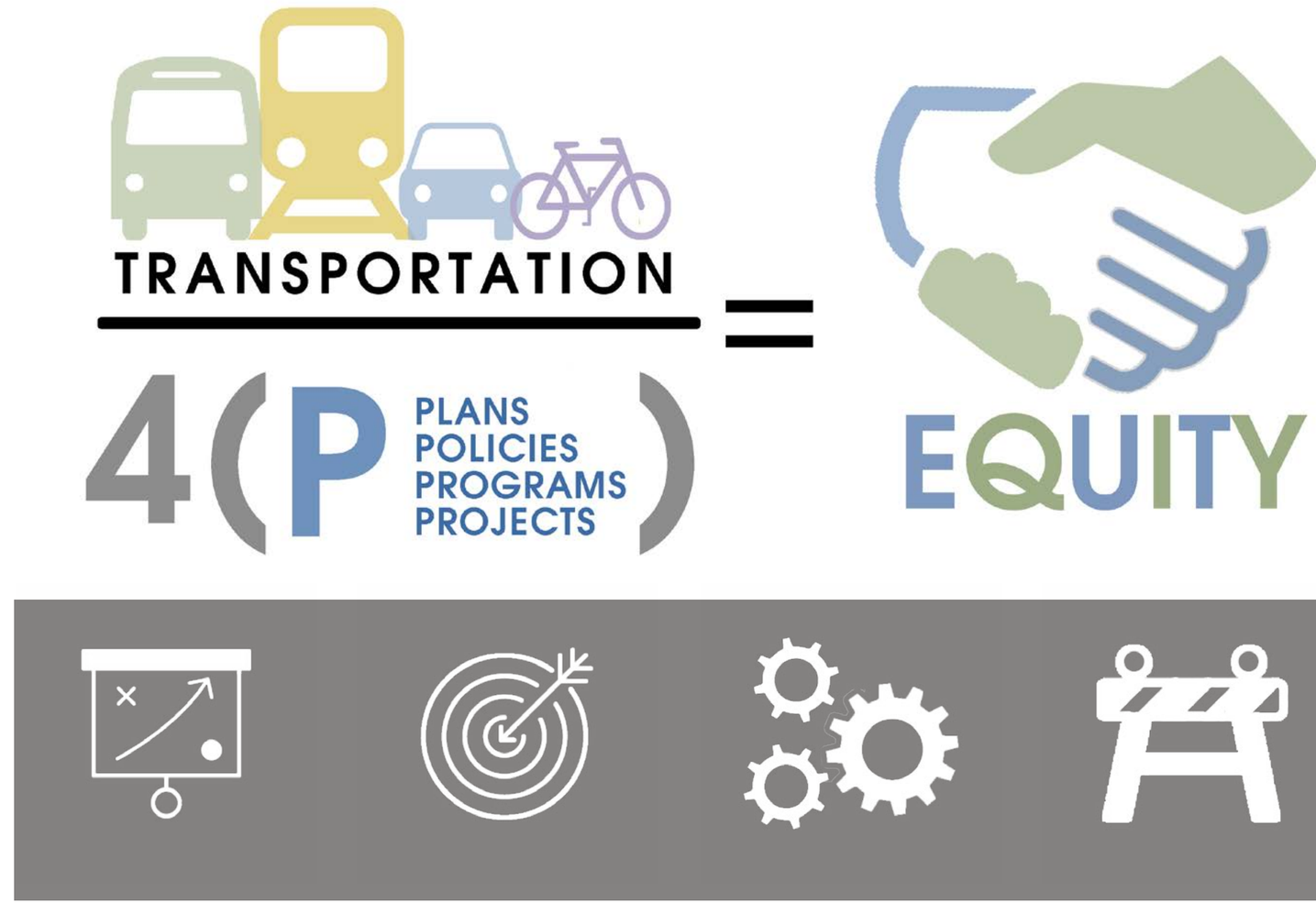
Micro-Mobility and Ride Sharing
eNEO2050 implements NOACAs Van Pool program and expands micro-mobility initiatives such as e-bikes, e-scooters, and transportation network providers (TNP).

Hyperloop
eNEO2050 includes Hyperloop as an illustrative project as NOACA continues to work with the private sector and USDOT on brining this new fifth mode of transportation to reality.

Plans, Policies, Programs, and Projects

eNEO2050 sets a vision for an equitable transportation system in Northeast Ohio (Figure 6-1). This vision is underwritten by four strategies (Figure 6-3) that support the six transportation principles and objectives (Figure 6-2). Northeast Ohio can achieve its vision by considering four types of actions. The following schedule serves as a guide for understanding the relationships between the vision, strategies, principles, objectives and actions.

Figure 6-4. 4Ps for Equity



PLANS	POLICIES	PROGRAMS	PROJECTS
ON THE PAGES THAT FOLLOW, THE "PLAN" ICON ABOVE WILL APPEAR WHEN *eNEO2050* INCLUDES PLANS, PLANNING PROCESSES, OR STUDIES.	ON THE PAGES THAT FOLLOW, THE "POLICY" ICON ABOVE WILL APPEAR WHEN *eNEO2050* CONTAINS POLICY CONSIDERATIONS	ON THE PAGES THAT FOLLOW, THE "PROGRAM" ICON ABOVE WILL APPEAR WHEN *eNEO2050* INCLUDES PROGRAMS OR INITIATIVES.	ON THE PAGES THAT FOLLOW, THE "PROJECT" ICON ABOVE WILL APPEAR WHEN *eNEO2050* INCLUDES PROJECTS.

Strategy 1: Efficient and Affordable Highway System

The majority of vehicular trips take place on the road network. This network is an important part of the transportation infrastructure and is a major asset to the regional economy. The expansion, maintenance, and operation of the roadway system depend greatly on available funds in any planning period. NOACAs transportation investments are guided by multiple agency policies such as the Transportation Asset Management Policy and the Regional Transportation Investment Policy. To address particular needs of the transportation system, NOACA has created multiple programs that support the upgrading of the roadway system such as pavement and bridge preservation and signal timing optimization. Many minor projects will be funded through these programs over the coming 3 decades. Additionally, a set of major projects was identified as part of the *eNEO2050* planning process. Chapter 7 includes the list of major projects that are on the constrained part of *eNEO2050*. Subsequently, constrained and illustrative projects are included.

EFFICIENT HIGHWAY SYSTEM

Interchanges

- *eNEO2050* completes four partial existing interchanges to become full interchanges by 2050

Congestion Management

- *eNEO2050* improves the performance of the transportation system by reducing congestion in accordance with CMP objectives including implementing infrastructure improvements and promoting mode shift.

Workforce Accessibility and Mobility

- *eNEO 2050* improves the spatial mismatch between people and jobs.

Pavement and Bridge Maintenance Management

- *eNEO2050* ensures that the interstate system is maintained at optimal levels as prescribed by FHWA and ODOT, and maintains the average pavement condition rating at 75 in accordance with NOACAs Asset Management Plan, but also ensures a higher level of 80 for the EJ areas.

INTERCHANGES

eNEO2050 completes four partial existing interchanges to become full diamond interchanges by 2050: Interstate 77 at Miller Road in Brecksville (Cuyahoga County); Interstate 480 at Granger Road in Garfield Heights (Cuyahoga County); US Highway 422 at Harper Road in Solon (Cuyahoga County); and State Route 44 at Jackson Road in Painesville (Lake County).

Project

In October 2020, the NOACA Board adopted the "New or Modified Interchange Projects Amendment Policy," and it was applied to eight proposed new or modified interchanges. As discussed in Chapters 9 and 11 of the resource document, the proposed interchanges are listed below. The modified interchanges are included in the constrained *eNEO2050*, while the new ones are included as illustrative:

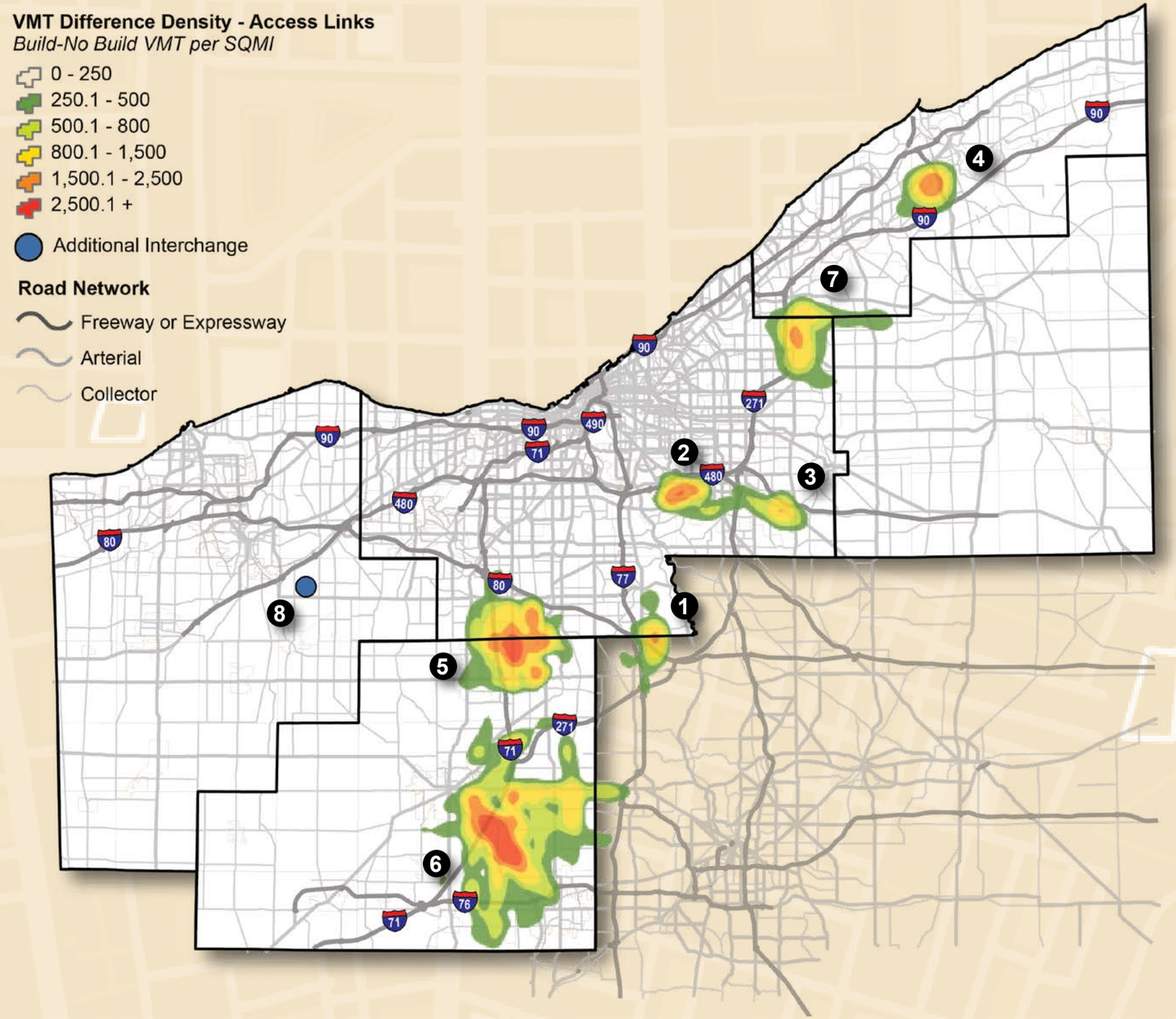
MODIFIED INTERCHANGES

1. **Interstate 77 at Miller Road**
   Brecksville, Cuyahoga County
2. **Interstate 480 at Granger Road**
   Garfield Heights, Cuyahoga County
3. **US Highway 422 at Harper Road**
   Solon, Cuyahoga County
4. **State Route 44 at Jackson Road**
   Painesville, Lake County

NEW INTERCHANGES (ILLUSTRATIVE ONLY)

5. **Interstate 71 at Boston Road**
   Strongsville, Cuyahoga County
6. **Interstate 71 at State Route 57 (or 162)**
   Medina, Medina County
7. **Interstate 271 at White Road**
   Highland Heights, Mayfield, Willoughby Hills, Cuyahoga, Lake Counties
8. **State Route 10 at State Route 57**
   Elyria, Lorain County

Figure 6-5. Influence Subarea of the Evaluated Interchanges



CONGESTION MANAGEMENT

eNEO2050 improves the performance of the transportation system by reducing congestion in accordance with CMP objectives including implementing infrastructure improvements and promoting mode shift.

Plan

Policy

Program

Project

Congestion Management Plan (CMP)

Congestion management is the application of strategies to improve transportation system performance and reliability by reducing the adverse impacts of congestion on the movement of people and goods. The CMP, which is fully integrated into the LRTP of eNEO2050, is defined in federal regulation, as an objective-driven and performance-based process that integrates effective management and safe operation of the existing multimodal transportation facilities.

The CMP is continually evolving to improve transportation system performance measures, address concerns of communities and ultimately achieve NOACA objectives and goals through.

- Identifying the spatial and temporal characteristics of traffic congestion in the region,
- Measuring the congestion severity, duration, extent, and variability and
- Developing congestion mitigation strategies for enhancing the mobility of persons and goods in the NOACA region.

NOACA established a set of specific, measurable, agreed, realistic, and time-bound (SMART) objectives for each planning decade of *eNEO2050*. The congestion management objectives define what NOACA intends to achieve in the region regarding traffic congestion management, and are part of the *eNEO2050* plan. They are a subset of NOACA's long-range objectives and goals, focus on providing a multimodal transportation system and strategies to alleviate traffic congestion.

Table 6-1. Congestion Management Objectives

Objective/Planning Decade	2020 Base	2020 - 2030	2030 -2040	2040 - 2050
Reduce total vehicle delay during typical morning and afternoon peak periods	**109,000 Hours**	Decrease by 2%	Decrease by 4%	Decrease by 6%
Increase the percentage of non-single occupancy vehicle work commutes during the morning peak period	**16%**	Increase by 2%	Increase by 4%	Increase by 6%
Reduce the average work commute time by auto to regional major job hubs during the morning peak period	**38 Minutes**	Reduce to 35 minutes	Reduce to 33 minutes	Reduce to 30 minutes
Reduce the average work commute time by transit to regional major job hubs during the morning peak period	**61 Minutes**	Reduce to 55 minutes	Reduce to 50 minutes	Reduce to 45 minutes
Implement the Signal Timing Optimization Program (STOP)	**10 Corridors**	At least ten corridors in each decade		
Implement ramp metering	**None**	At least one location in each decade		
Implement diverging diamond interchanges (DDI)	**None**	One location in each decade		
Increase the percentage of the population within a 5-mile drive to a park & ride station	**70%**	Increase to 71%	Increase to 73%	Increase to 75%
Increase the percentage of the population within a 15-minute walk to a transit station	**68%**	Increase to 70%	Increase to 72%	Increase to 75%
Increase the mode share of total trips via transit or nonmotorized mode	**6.3%**	Increase to 7%	Increase to 9%	Increase to 11%

Congestion Mitigation Strategies
The roadway category projects in eNEO2050 include ramp metering. During the scenario simulation, NOACA staff identified three locations where bottlenecks occur (see Chapter 3 of the resource document) and propose ramp metering as a solution. Figure 6-7 displays the proposed locations of the ramp meters.

Figure 6-6. Mode Share 2020 Compared to 2050

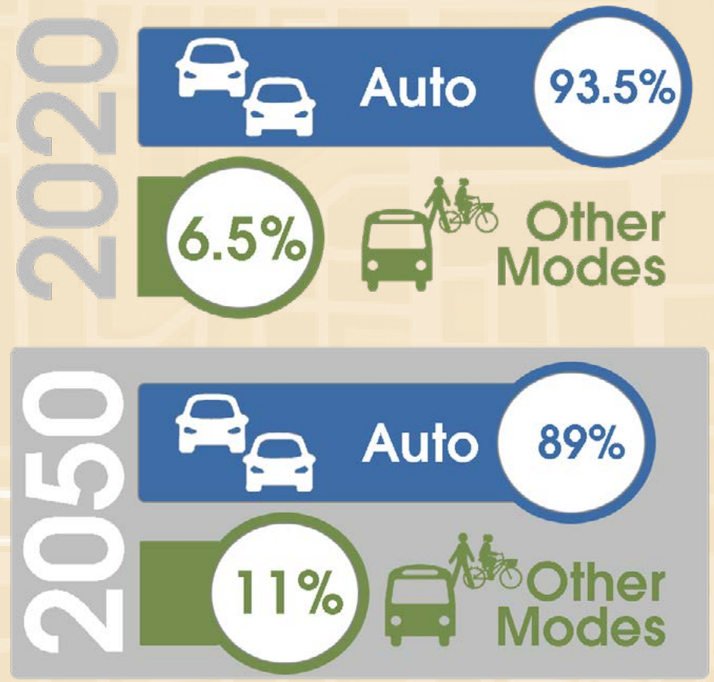


Figure 6-8. Percentage of Non-Single Occupancy Vehicle Work Commutes During the Morning Peak Period

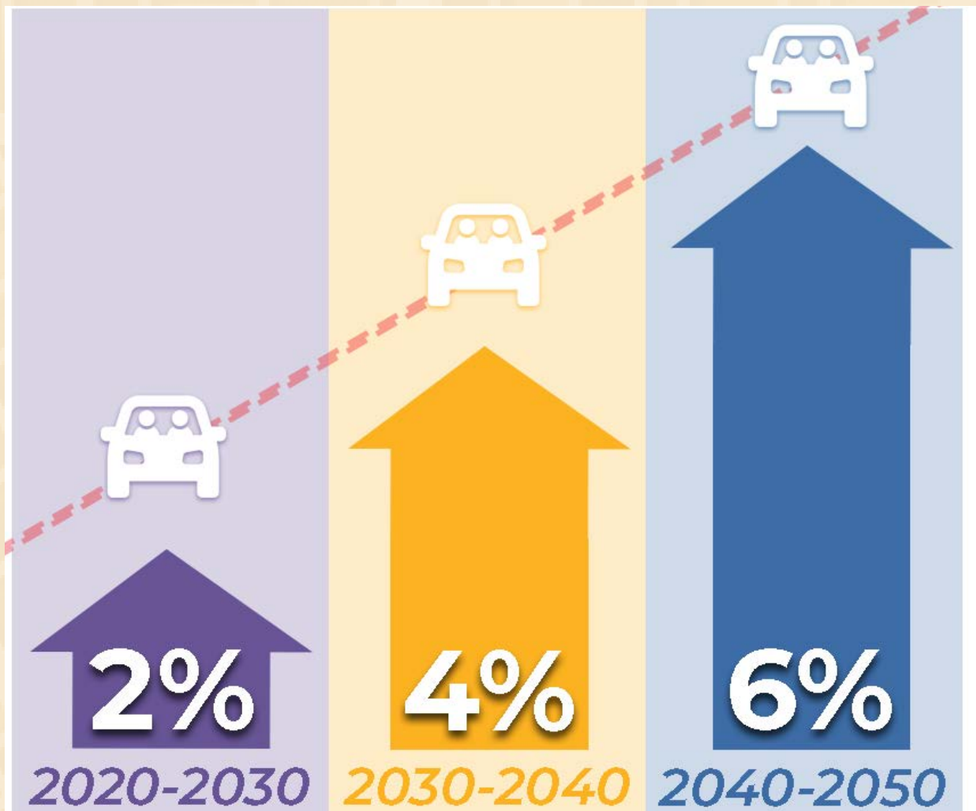
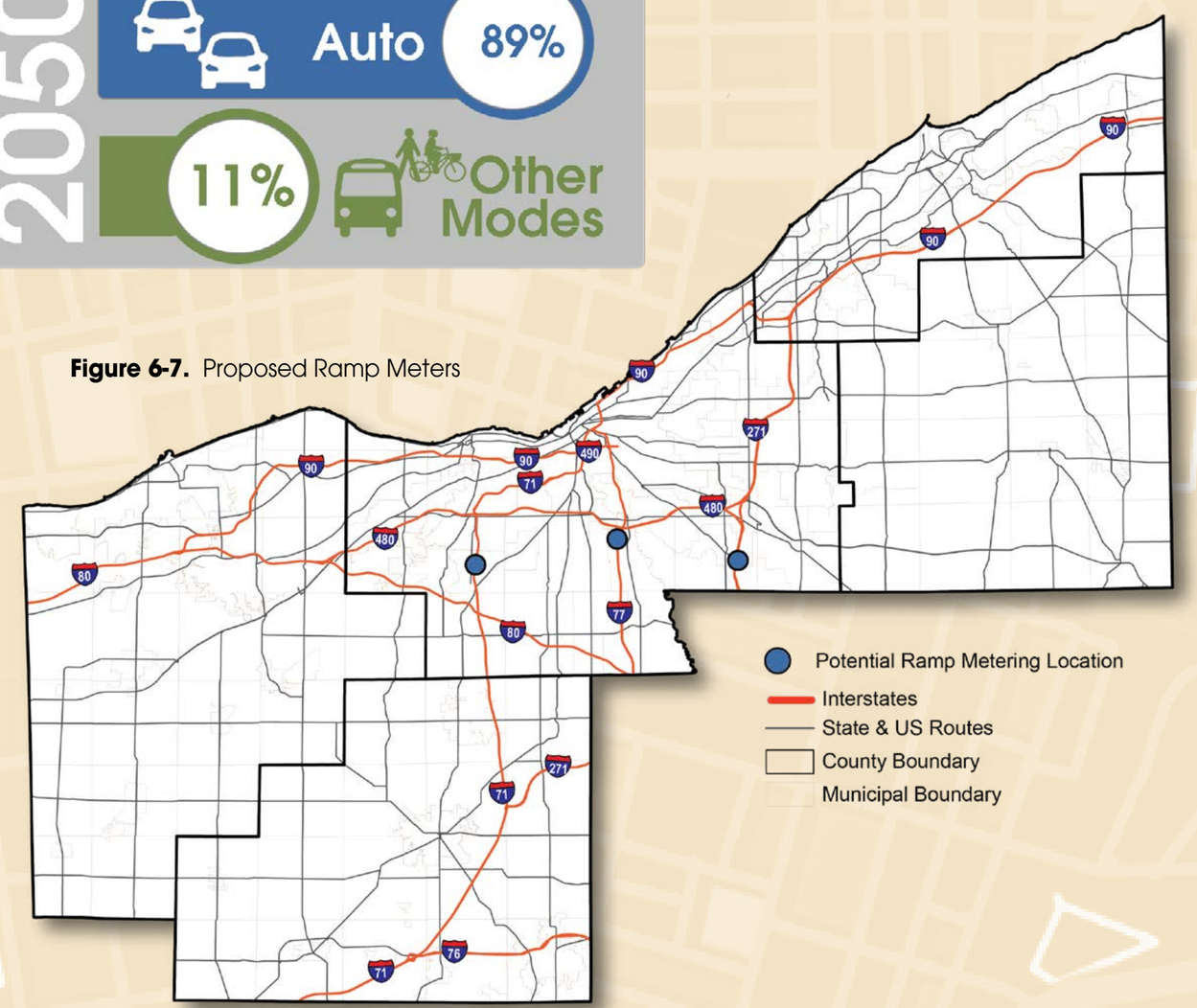


Figure 6-7. Proposed Ramp Meters



WORKFORCE ACCESSIBILITY & MOBILITY

Improving the special mismatch between people and jobs will lead to decreased travel distance from home to jobs, reducing VMT, congestion, emissions, fuel requirements, crashes, and road maintenance needs

Program

Project

Workforce Accessibility & Mobility

There is a vivid mismatch between where workers live and work that results in longer work commutes. Even workers who live in a job hub commute shed may work at different locations. Table 6 demonstrates the mismatch between workers' home and work locations within the region. In order to illustrate the mismatch, the NOACA travel forecasting model outputs were combined with Census LODES data.

Travel time is one of the largest costs of transportation, and travel time savings are often the primary justification for transportation infrastructure improvements. Shortening work travel time will not only benefit commuters relative to their own economic situation and quality of life, but will also mitigate traffic congestion severity, reduce regional VMT, improve air quality, increase safety, lessen stress and load on road pavements and lower the overall burden on the transportation system. By decreasing commute times, job access is improved and job hubs become more competitive from an employee attraction/retention standpoint.

With a one percent shift of worker's travel time to closer job hubs for auto work commutes, daily benefits in the AM peak are significant:

- Total Work Travel Times is Reduced by 5,379 Hours
- Total Delay as a measure of Congestion is Reduced by 1,184 Hours
- Total Work Travel Time Costs is Reduced by $58,419 (2018$)
- Total Congestion Cost is Reduced by $12,862 (2018$)
- Total VMT is Reduced by 249,177 Miles
- Total Fuel Consumption is reduced by 10,881 Gallons (Assuming 22.9 MPG)
- Total Fuel Cost is Reduced by $28,291 (2018 $ & Assuming Fuel Cost of $2.6 per Gallon)

Table 6-2. Inter-County Work Trip Percent by All Modes During 2018 AM Peak Period, NOACA Region Only

		Where Workers Work					
		Cuyahoga	Geauga	Lake	Lorain	Medina	Other
Where Workers Live	Cuyahoga	81.1%	1.4%	3.9%	3.9%	1.9%	7.9%
	Geauga	37.6%	38.4%	12.7%	0.4%	0.3%	10.7%
	Lake	40.2%	5.9%	48.0%	0.5%	0.2%	5.2%
	Lorain	40.4%	0.3%	0.8%	48.7%	3.6%	6.2%
	Medina	31.2%	0.3%	0.5%	5.6%	34.6%	27.8%
	Other	68.7%	7.1%	4.6%	4.6%	15.0%	n/a

Figure 6-9. Annual Time Savings from 1% Reduction in Trip Length

PAVEMENT AND BRIDGES

eNEO2050 ensures that the interstate system is maintained at optimal levels as prescribed by FHWA and ODOT. *eNEO2050* maintains the average pavement condition rating at 75 from 2020 through 2050, with a higher level of 80 ensured for the EJ areas in accordance with NOACAs Asset Management Plan.

Plan

Policy

Program

Project

Asset Management: Pavement and Bridge Preservation Program

NOACA's Pavement Preservation Program is a network-level, long-term strategy to enhance pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet motorist expectations. TAMP is an objective data-driven process that prioritizes transportation projects based on needs to maintain the transportation system in a state of good repair. The TAMP process looks at the transportation system from a regional and local perspective. Having the TAMP process in place reduces the burden on local governments thereby making the process more equitable. NOACA will continue to work closely with communities to advance identified projects for implementation.

A pavement preservation program consists primarily of four components: Reactive Maintenance, Preventive Maintenance, Minor Rehabilitation, and Major Rehabilitation/Reconstruction. *eNEO2050* includes the goal of maintaining pavement conditions with an average PCR of 80. *eNEO2050* invests $4.6 billion in pavement improvements and $3 billion in bridge improvements (Figure 6-10)

The NOACA region has a total of 3,347 centerline miles of roadways, including freeway and federal–aid highways. Because many of these roads have more than one lane, this is equivalent to 8,249 lane-miles. There are 196 bridges in the NOACA region that have bridge appraisal values that mean that they require urgent attention as they demonstrate a condition of poor, very poor, near failure (must be closed), or failure (closed).

Figure 6-10. Roadway Projects, by Work Type (Millions)

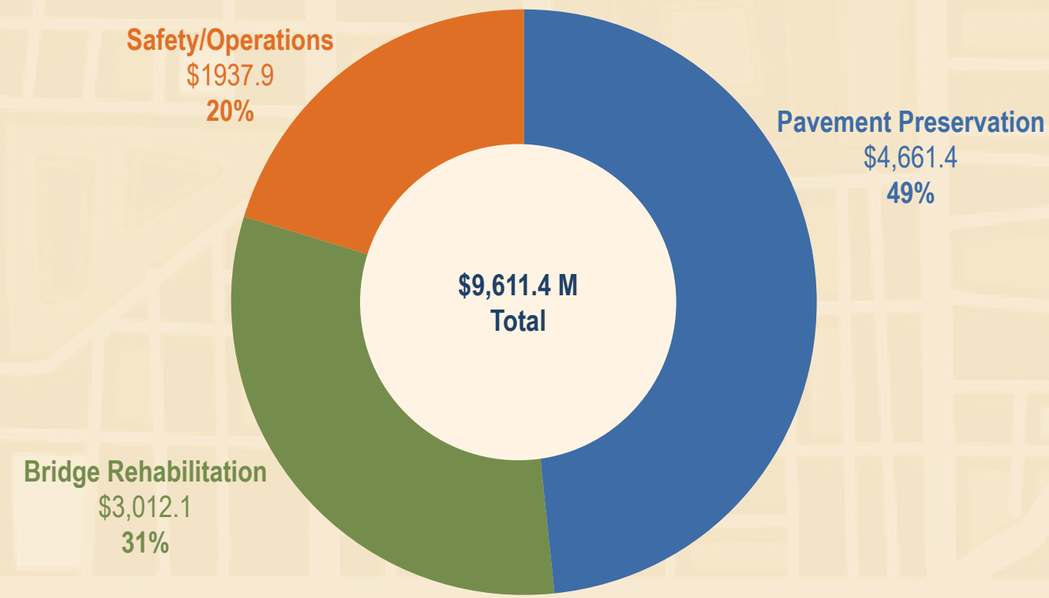
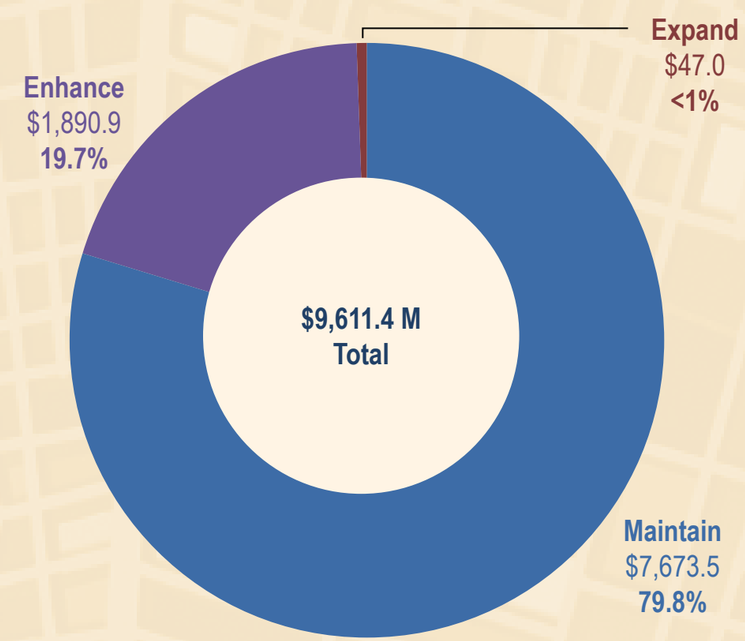


Figure 6-11. Roadway Projects, by Primary Investment Category (Millions)



Strategy 2: Enhanced Roadways for All Users

The national Vision Zero initiative aims to have a transportation network with zero deaths or injuries. One of NOACA's transportation planning goals is to achieve this vision in its five-county region. During the last few years, NOACA has initiated several safety initiatives, such as its Transportation Safety Action Plan (TSAP), Regional Safety Program (RSP), Safe Route to School (SRTS), and the largest one, the SAVE Plan, to improve the safety of the transportation system. The 4Ps presented in this section particularly support NOACAs safety objectives, particularly ensuring multimodal coexistence as well as separation when necessary. *eNEO2050* promotes "enhanced and safe roadways for all users" by investing in bike and pedestrian projects, continued funding for TLCI studies and TLCI implementation, by implementing its Regional Safety Program/Systematic Safety Management Programs and by making investment decisions in accordance with its Complete and Green Streets Policy (2020).

ENHANCED ROADWAYS FOR ALL USERS

Safety

- *eNEO2050* works to achieve Vision Zero as discussed in NOACAs SAVE plan. NOACA's Systemic Safety Management program is transformed into a proactive and community-based approach to safety issues.

Complete and Green Streets

- *eNEO2050* implements complete and green streets when appropriate and feasible in accordance with NOACA's policies.

Principle Arterial Network

- *eNEO2050* elevates and prioritizes principal arterial corridors for signal improvements as part of the STOP program.

Active Transportation

- *eNEO2050* funds 926 miles of bicycle facilities, more than 11,000 pedestrian ADA and safe crossings, and 760 bike storage lockers for cyclist in the next three decades.

Transportation for Livable Communities (TLCI)

- *eNEO2050* provides $15 million to fund planning studies that focus on integrating multi-modal transportation solutions to better connect communities for livability. *eNEO2050* allocates $41 million to fund the implementation of completed TLCI studies.

SAFETY

eNEO2050 works to achieve Vision Zero as discussed in NOACAs SAVE plan. NOACA's Systemic Safety Management program is transformed into a proactive and community-based approach to safety issues. Biennial safety reports for each community in the NOACA region to identify and implement countermeasures based on road inventory and crash data at the community level. *eNEO2050* provides for over 10,000 improvements by 2030.

Plan

Policy

Program

Project

Safety

NOACAs transportation safety strategy is outlined in detail in its SAVE Plan (2019). Similar to other traditional safety programs, the SAVE plan intends to save lives by identifying high-crash locations and implementing safety treatments at those sites. The SAVE Plan was developed with the vision that traffic deaths and injuries can be prevented with appropriate planning, policies, and programs. It has a long-term goal of reducing the number of fatalities and serious injuries by 50% by the year 2040. Figure 6-12 summarizes the safety objectives that the NOACA board has adopted as part of its SAVE Plan (2019).

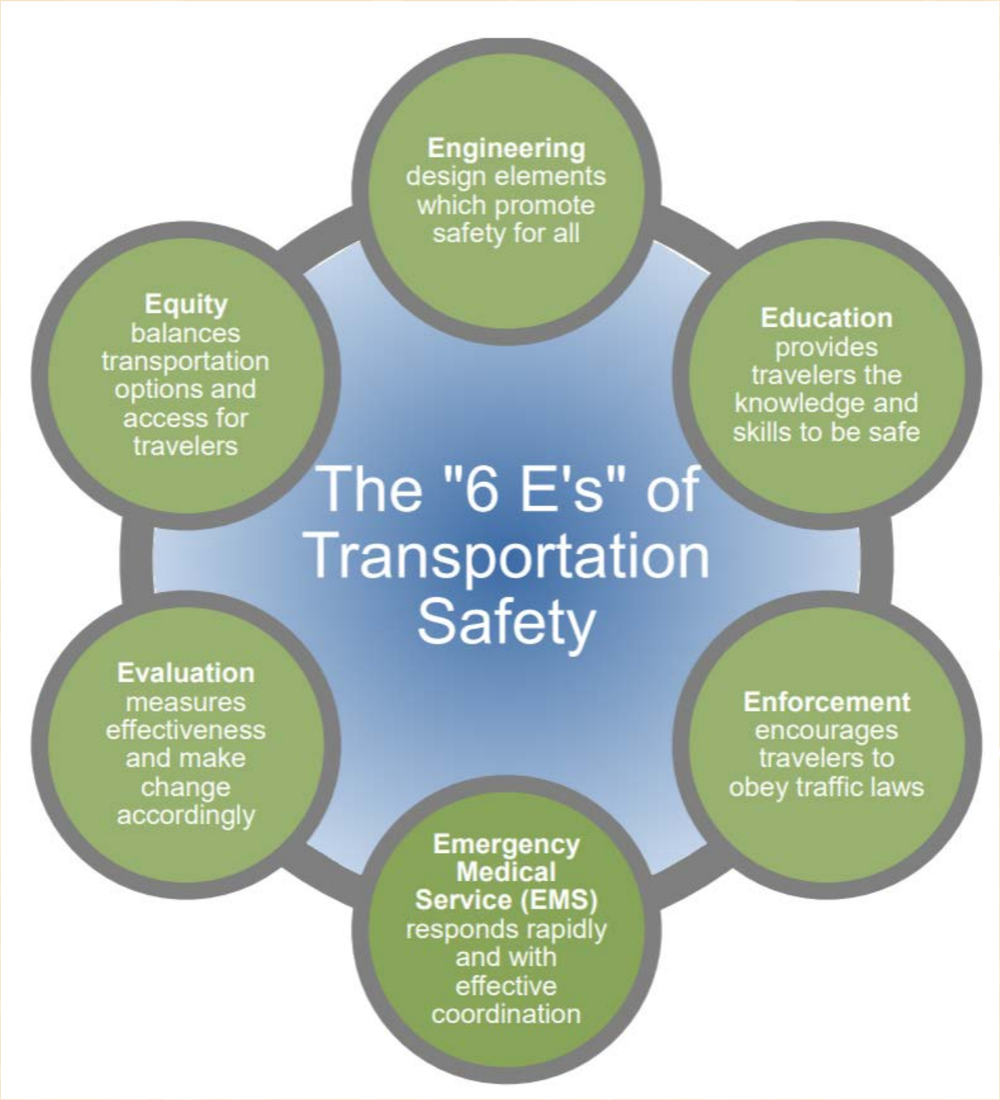
The Systemic Safety Management approach addresses crash types that occur with high frequency across the roadway network but that are not concentrated at individual locations; this means they tend to be overlooked when sites are ranked using a crash-history-based safety management approach. It also included proactive measures at locations that may not have a history of crashes but that can benefit from safety improvements to prevent crashes.

This approach is mainly based on the Highway Safety Manual (HSM), which is published by the American Association of State Highway Transportation Officials (AASHTO).

NOACA's Safety Management program includes:

- Leading road safety audits (RSAs) which are formal safety performance examinations conducted for communities at priority safety locations identified in the State of Safety Report.
- Participating in community outreach, coalition building, and recurring meetings to collaborate with multiagency partners, such as ODOT District Safety Review and Active Transportation teams, regional Safe Communities/Kids meetings, and Safe Routes to School (SRTS) forums.
- Developing a Safe Routes to School plan outlining strategies and actions improve transportation safety for students and families in communities, school districts, and partners in our region.
- Convening the Safety and Operations Council (SOC) to serve as an advisory group on the topic of safety planning and aid in the development of the RSP.

Figure 6-12. The Six Es of Transportation Safety



Source: NOACA SAVE Plan

COMPLETE & GREEN STREETS

eNEO2050 implements complete and green streets. NOACA's recently approved policy will ensure all roads that are repaved or reconstructed will implement elements of green and complete streets when appropriate and feasible. Incentives for funding green and complete streets are proposed for inclusion in NOACA's investment policy (RTIP). NOACA will implement a pilot project on E. 66 St from Euclid to Superior that will be used as a regional model for the urbanized area.

Policy

Program

Complete and Green Streets

NOACA adopted a Complete and Green Streets Policy in June 2020. Implementation of the new Complete and Green Streets policy in eNEO2050 will promote a multimodal transportation system that is integrated with sustainable green infrastructure. The main objective is to ensure roadways are designed and built to safely and comfortably accommodate all users of roadways, including motorists, cyclists, pedestrians, disabled individuals, transit and school bus riders, Amish buggies, freight haulers, and emergency responders. All users includes people of all ages and abilities.

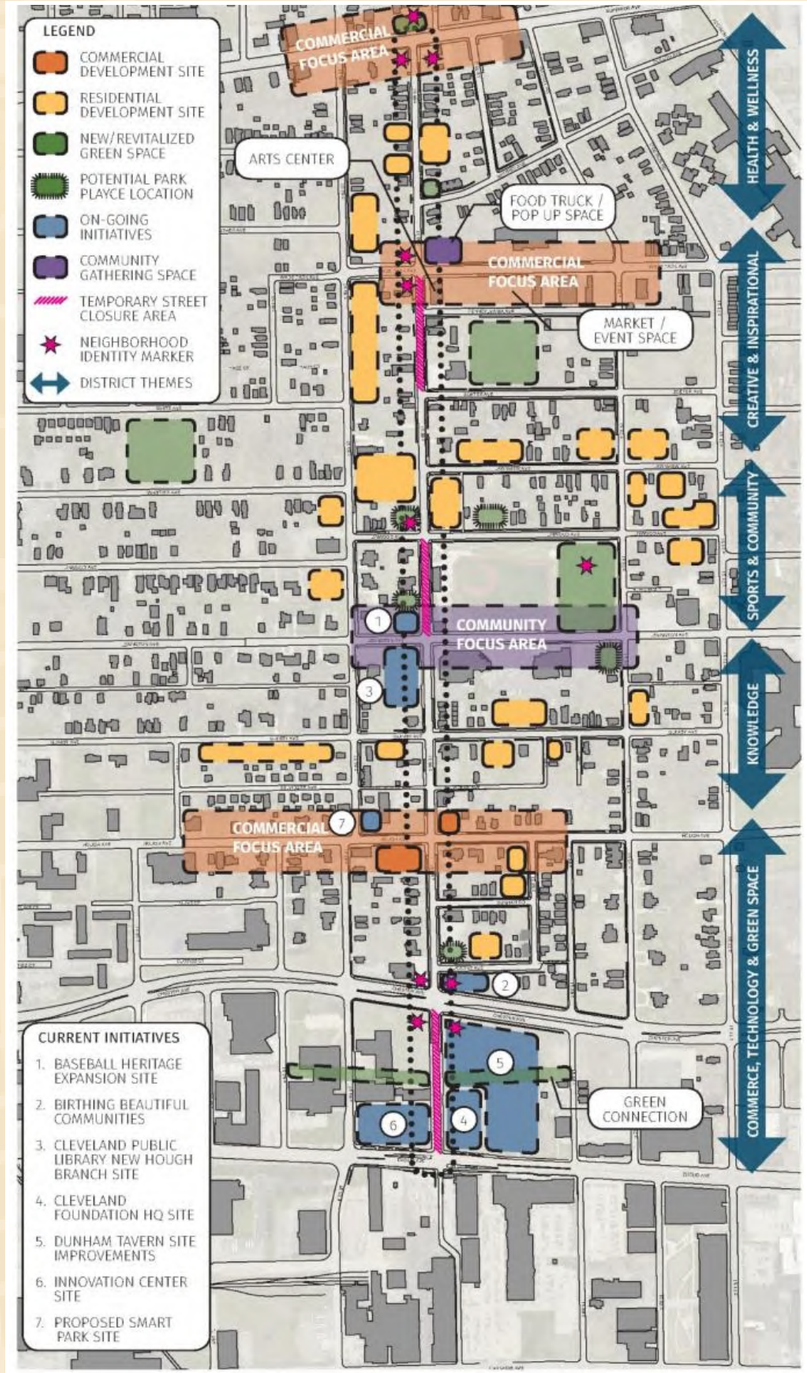
Green Streets reflect the transportation policy and design approach that minimizes environmental impact by focusing on efforts to retain, treat and eliminate runoff at the source using green infrastructure applications. Green infrastructure helps replicate natural hydrologic functions like storage, detention, infiltration, filtration, evaporation, transpiration, and uptake by plants, and can improve water quality and reduce runoff volumes. These natural functions are often lost in transportation projects where impervious road surfaces prevent rain water from soaking into the ground. Green streets incorporate infiltration, biofiltration, and/or storage and use BMPs to collect, retain, or detain stormwater runoff while also providing design elements that creates attractive streetscapes. Green Streets can foster unique and attractive streetscapes that protect and enhance neighborhood livability and integrate, rather than separate, the built and natural environments.

Complete and Green Streets create a measurably better transportation system that is more equitable, balanced, and effective and which offers every user of the public right-of-way safe, connected, and sustainable transportation options.

To support implementation of this policy NOACA investments in *eNEO2050* will:

- Incorporate recommendations for complete and green streets into regional congestion, safety, and bicycle and pedestrian plans.
- Incorporate complete and green streets policy into the TLCI program.
- Evaluate proposed projects against the complete and green streets policy in the development of recommendations for all NOACA administered funding programs:
- Evaluate non-NOACA administered funded projects for opportunities to incorporate complete and green streets strategies prior to inclusion to the LRTP and/or TIP.

Figure 6-13. Green Street Pilot Project from the TLCI *E66th Street Implementation Plan*



PRINCIPAL ARTERIAL NETWORK

eNEO2050 elevates and prioritizes principal arterial corridors for signal improvements as part of the STOP program. NOACA will work from a rolling list of top 10 corridors for implementation each decade.

Program

Principal Arterial Network and Signal Timing Optimization Program (STOP)

As discussed in Chapters 3 and 11 of the resource document, the principal arterial network plays an important role in providing mobility within the transportation system. It can be utilized more optimally than the existing freeway system for local trips, thus reducing traffic congestion, delay time, air pollution and the reliance on fossil fuels. eNEO2050 attempts to restore the mobility function of the principal arterial network by implementing capacity-improving strategies such as Signal Timing Optimization Programs (STOP). Figure 6-14 shows the principle arterial corridors and the top ten corridors as candidates for STOP (see also Table 6-3).

Today, there are more than 300,000 traffic signals in the United States. They are critical to the transportation network and are a source for significant public frustration when not operated efficiently. Traffic signal timing efficiency degrades over time as volume patterns and magnitude change, development occurs, or infrastructure is modified. Outdated or poor traffic signal timing accounts for a significant portion of traffic delay on urban arterials and traffic signal optimization is one of the most cost effective ways to reduce emissions, improve mobility, reduce delays and improve corridor safety.

NOACA developed the STOP in 2016 to address inefficient signal timing in the region. The goals of the STOP are to help Northeast Ohio achieve the following outcomes:

I. Goal: Improve air quality through decreased motor vehicle emissions and fuel consumption.

II. Goal: Improve reliability and predictability of travel along arterials.

III. Goal: Improve the safety of motorists, pedestrians, and bicyclists.

The outcomes are achieved by the development and implementation of signal coordination plans (a.m., p.m., and/or midday) that reduce travel time and delay; reduction of starts and stops of vehicles and promotion of uniform travel speeds; improvement of speed and reliability of transit vehicles; coordination of existing pedestrian crossing times and bicycle timings at intersections; and modifications at high crash locations.

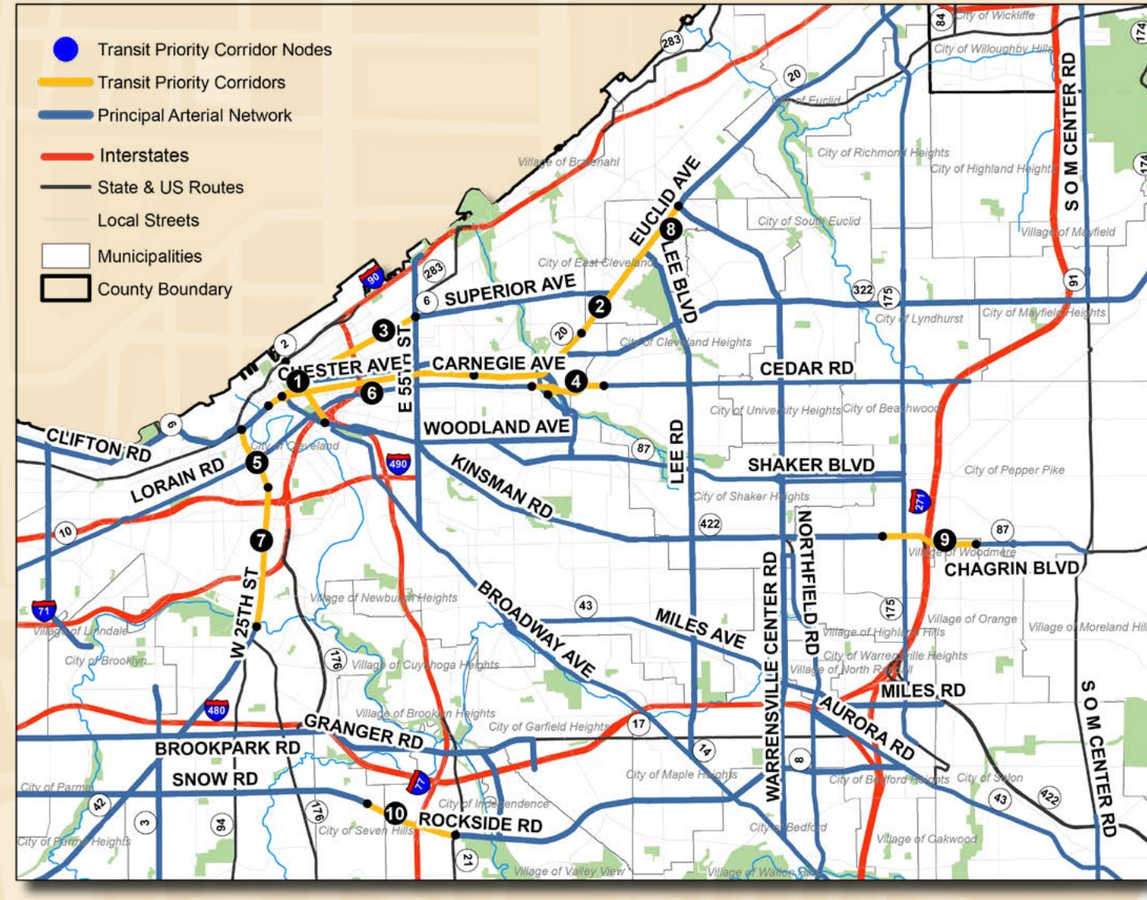
Since 2016 NOACA has optimized the signal timing on five corridors:

- Cedar Road (2.9 miles, 13 signalized intersections)
- Pearl Road (4 miles, 20 signalized intersections)
  - Benefits
    - Emissions Savings: 5,990 Metric Tons
    - Delay Savings: 907,500 Hours
    - Fuel Savings: 673,230 Gallons
    - Benefit to Cost: 31:1
- SOM Center Road (3.3 miles, 18 signalized intersections)
- West 150th/Warren Road (4.1 miles, 26 signalized intersections)
  - Benefits
    - Emissions Savings: 6,600 Metric Tons
    - Delay Savings: 729,500 Hours
    - Fuel Savings: 742,300 Gallons
    - Benefit to Cost: 26:1
- Chester Ave/Euclid Ave/Carnegie Ave/Cedar Ave: 4.6 miles, 98 signalized intersections
  - Benefits
    - Emissions Savings: 2,500 Metric Tons
    - Delay Savings: 344,000 Hours
    - Fuel Savings: 282,000 Gallons
    - Benefit to Cost: 15:1
- Bagley Road (3.5 miles, 26 intersections)
- Ridge Road (3.5 miles, 20 intersections)
  - Delayed due to COVID-19; work to begin in 2021

Table 6-3. Top 10 Priority Corridors Candidates for STOP Projects

STREET NAME	FROM	TO	RANK
East 9th Street	State Route 2	Ontario Street	1
Euclid Avenue	East 79th Street	East 123rd Street	2
Superior Avenue (US 6)	West 9th Street	East 55th Street	3
Carnegie Avenue / Cedar Road	East 105th Street	Fairmount Blvd	4
West 25th Road (US 42)	I-90 (Potter Ct)	Detroit Avenue	5
Euclid Avenue	Superior Avenue	East 79th Street	6
Pearl Road / West 25th Street (US 42)	Broadview Avenue (Brookside Park Dr.)	I-90 (Potter Ct)	7
Euclid Avenue	East 123rd Street	Noble Road	8
Chagrin Blvd.	West of Richmond Road (Commerce Park)	Belmont Road	9
Rockside Road	Crossview Road	Brecksville Road	10

Figure 6-14. Top 10 Priority Corridor Candidates for STOP Projects



ACTIVE TRANSPORTATION

eNEO2050 funds 926 miles of bicycle facilities, more than 11,000 pedestrian ADA and safe crossings, and 760 bike storage lockers for cyclist in the next three decades. *eNEO2050* implements recommendations from NOACA's existing Regional Bicycle Plan and the pedestrian and bicycle plan currently under development called ACTIVATE. The broader focus of the new plan addresses three usage categories for nonmotorized modes: utilitarian trips, access to transit services (first-/last-mile connectivity), and recreational pursuits.

Plan

Project

Active Transportation (Non-Motorized)

Active transportation (also referred to as non-motorized modes of travel) includes biking and walking for recreational, commuting, and shopping purposes. A factor in the walkability and bikeability of an area is the distance to destinations. An average distance for utilitarian biking trips is about three miles. Destinations within a quarter mile to one mile are generally considered walkable. Considering the acceptable walking and biking distances for land use and transportation planning purposes, linking nonmotorized modes to transit is an important aspect of a cohesive, multimodal transportation system. These connections to the transit network are often referred to as "first mile" and "last mile" trips, because they complete the connection from commuters' origins to their destinations.

The eNEO2050 plan recommends investing in nonmotorized facilities as a way to connect to and access the transit network and thus create a true multimodal transportation system for the NOACA region. Riders should be able to reach transit stops safely and conveniently via a well-connected system of pedestrian and bicycle infrastructure. Table 6-4 and Table 6-5 display the eNEO2050 plan proposal for nonmotorized projects by facility type and implementation timeline.

NOACA is currently developing a pedestrian and bicycle plan called ACTIVATE (see Figure 6-15) that will provide a vision for increasing the use of bikeways and walkways for transportation and commuting. It will also serve as a guide for future bicycle and pedestrian improvements, and include a model for prioritizing investments in nonmotorized facilities that connect to the transit network

Table 6-4. Pedestrian and ADA Facilities in *eNEO2050**

PROJECT	2020-2030	2030-2040	2040-2050	TOTAL
Smart Pedestrian Crossing	50	50	0	100
ADA Curb Ramp	540	42	0	582
High Visibility Crosswalk	5,858	301	0	6,159
Pedestrian Signal	4,058	166	0	4,224
Midblock Enhancements	89	15	0	104
Total Number	**10,595**	**574**	**0**	**11,169**

* All of the pedestrian projects were moved up to the first two decades in order to provide safe and accessible infrastructure for pedestrians. When the fiscally unconstrained projects move to fiscally constrained projects, there will be many more pedestrian projects proposed.

Figure 6-15. Draft Objectives of the ACTIVATE Plan

PROVIDE OPTIONS TO ALL
Safe options for biking and walking are needed in urban, suburban, and rural communities.

ENCOURAGE SHORT TRIPS
Making it easy for people to walk and bike to local, nearby destinations can reduce vehicle trips and improve quality of life region-wide.

FOCUS ON NEEDS
Focusing on improving conditions for people that currently bike and walk will help correct regional inequities.

CARE ABOUT DETAILS
Just as we support a five-county regional vision, we must plan for improvements and maintenance at the scale of someone walking or biking.

INFLUENCE POLICY
Integrate the plan's recommendations into existing policies and programs, to ensure widespread adoption.

INSPIRE COMMUNITIES
Communities in Northeast Ohio will have the knowledge and support needed to build world-class biking and walking infrastructure.

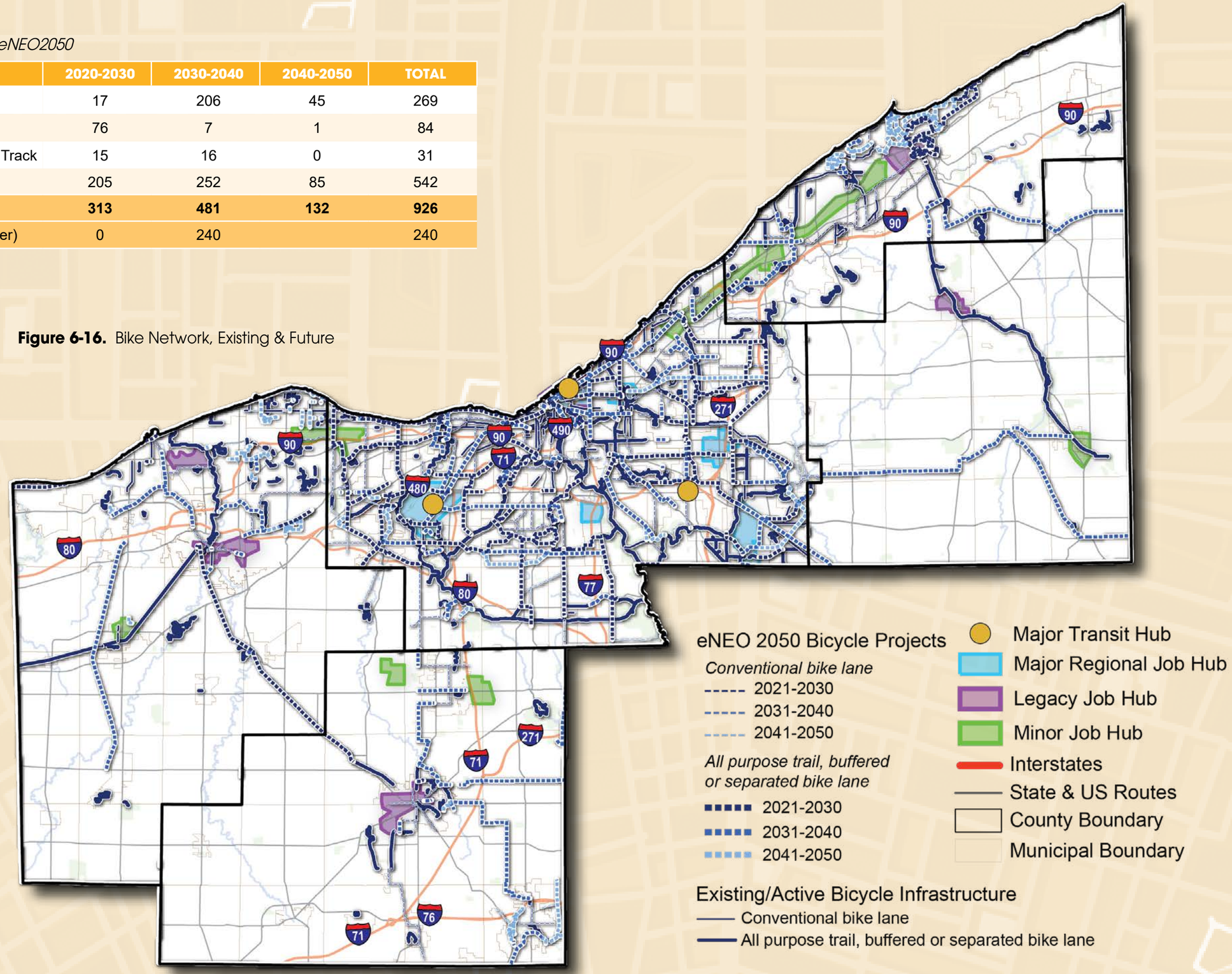
SUPPORT THE VISION
Build on and enhance the existing regional vision for connected trails.

CONNECT THE DOTS
Make it easier for people to make trips that use several modes. Support connections between biking, walking, transit, and other modes, like scooters.

Table 6-5. Bike Facilities in *eNEO2050*

PROJECT	2020-2030	2030-2040	2040-2050	TOTAL
Conventional Bike Lanes	17	206	45	269
Buffered Bike Lanes	76	7	1	84
Separate Bike Lanes / Cycle Track	15	16	0	31
All Purpose Trail	205	252	85	542
Total Miles	**313**	**481**	**132**	**926**
Bike Storage Lockers (Number)	0	240		240

Figure 6-16. Bike Network, Existing & Future



TRANSPORTATION FOR LIVABLE COMMUNITIES (TLCI)

eNEO2050 provides $15 million to fund planning studies that focus on integrating multi-modal transportation solutions to better connect communities for livability. *eNEO2050* allocates $41 million to fund the implementation of completed TLCI studies.

Plan

Program

Project

Livability: TLCI Studies

NOACA's Transportation for Livable Communities Initiative (TLCI) provides assistance to communities and public agencies for integrated transportation and land use planning and projects that strengthen community livability. TLCI advances the goals of NOACA's Regional Strategic Plan by focusing on the following objectives:

- Develop transportation projects that provide more travel options through complete streets and context sensitive solutions, increasing user safety and supporting positive public health impacts
- Promote reinvestment in underutilized or vacant/abandoned properties through development concepts supported by multimodal transportation systems
- Support economic development through place-based transportation and land use recommendations, and connect these proposals with existing assets and investments
- Ensuring that the benefits of growth and change are available to all members of a community by integrating principles of accessibility and environmental justice into projects
- Enhance regional cohesion by supporting collaboration between regional and community partners
- Provide people with safe and reliable transportation choices that enhance their quality of life

The TLCI program consists of two components: (1) planning and (2) implementation:

- Planning awards help fund planning studies that can lead to improvements to transportation systems and the neighborhoods they support.
- Implementation awards help communities move forward with the development and installation of infrastructure from past completed livability studies.

***eNEO2050* will....**

1. Continue to fund TLCI planning and implementation projects with annual investments of $500,000 for planning studies and $1.5 million for implementation for a total of $56 million dollars.
2. Use NOACA's Transportation for Livable Communities Initiative (TLCI), with its focus on multimodal infrastructure to better connect communities to promote mode shift from private automobiles to transit and non-motorized forms of transportation. More than one in every three car trips in Northeast Ohio are under three miles. Shifting half of these trip to active transportation could generate $427 million in annual benefits for the region[1].

Figure 6-17. Examples of TLCI Studies

CORRIDOR & COMPLETE STREETS

Fairview Park-*Center Ridge Road Complete Streets (2015)*
South Euclid-*Mayfield Rd. Corridor Multi-City/Modal Plan (2016)*
Parma Heights-*Pearl Rd. Complete & Green Sts Implementation (2016)*
Painesville-*Complete Street & Connectivity Plan (2017)*
Middlefield-*Village Transportation Improvement Plan (2019)*

BIKE & PEDESTRIAN

Brunswick-*Citywide Bicycle Route Master Plan (2009)*
Chagrin Falls-*Chagrin Falls Region Alternative Transp. Study (2010)*
Cleveland-*Midway Cycle Track & Protected Bike Facilities (2015)*
Rocky River-*Detroit Rd. Pedestrian Improvements Implementation(2018)*
Avon-*Citywide Bicycle & Multi-Use Path Master Plan (2018)*

TRANSIT

Greater Cleveland RTA-*Westside Transit Center Development Plan (2010)*
Cleveland- *Cleveland's Multi-Modal Transportation Facility Plan (2015)*
Lake County- *Laketran Multi-Modal Transfer Ctr Implementation (2016)*
Lorain County- *Transit Redevelopment Plan (2016)*
Lake County- *Laketran Vinestreet Cooridor Planning Study (2019)*

GREENSPACE CONNECTIONS

Lorain County- *Lakefront Connectivity Plan (2016)*
Cuyahoga County- *Community Confluence (2019)*
Cuya/Lake/Lor Counties- *Regional Lakefront Transp. Connections (2020)*
NOACA Counties-*Regional Metropark Transportation Connections (2020)*
Euclid- *Euclid Avenue Recreationway Corridor Implementation (2020)*

REDEVELOPMENT

Medina-*Smith Rd/Champion Creek Corridor Redevelopment Plan (2009)*
Cleveland/Cuyahoga Port Auth.-*Irishtown Bend Redevelopment (2016)*
Willowick-*Lakefront Connectivity & Downtown Redevelopment (2018)*
Cleveland-*Euclid Avenue Redevelopment Study (2019)*
Elyria-*Downtown Elyria Revitalization & Connectivity Implentation (2020)*

Strategy 3: Effective Transit System that Connects People to Jobs

There are multiple transit related efforts that would address workforce mobility concerns described in Chapter 4. NOACAs primary role in transit is to be a convener of the transit agencies and a facilitator of conversations with local governments. NOACAs can support building an "Exciting Transit System that Connects People to Jobs" by adopting policies for workforce mobility, working with interested local governments on transit-oriented development, funding infrastructure that connects the first-/last-mile to a transit stop, reinvesting in existing transit assets and by advancing plans that study the feasibility of the visionary rail network. This section describes the 4Ps that can support and leverage transit investments for increased mobility and access to residents in Northeast Ohio.

Over the next 30 years, the existing rail system will provides opportunities for investments in transit-oriented development. As the visionary rail network proposed in *eNEO2050* is built, more communities will have access to transit-oriented development opportunities. Most certainly, transit-oriented development serves only one segment of the housing market, and traditional suburban development will continue to be supported by road investments. Equity means ensuring that the transportation system supports diversity in housing and economic opportunity for residents in Northeast Ohio.

EFFECTIVE TRANSIT SYSTEM THAT CONNECTS PEOPLE TO JOBS

Regional Transit Service

- *eNEO2050* implements short- and long-term strategies from the Regional Strategic Plan that improve transit services within the 5-county region.

Transit Access to Jobs

- *eNEO2050* improves access and mobility in the transit system based on recommendations in NOACA's Workforce Accessibility and Mobility study.

Transit Mode Share

- *eNEO2050* increases annual transit ridership from 40 to 55 million people by providing access to the transit system and mobility within the transit system.

Transit-Oriented Development

- *eNEO2050* includes transit-oriented development (TOD) as a mechanism to better connect land uses and transportation investments.

Autonomous Shuttle Feeder

- *eNEO2050* pursues autonomous shuttle feeder bus services as a complement to existing modes for "First-Mile" and "Last-Mile" connections.

BRT Priority Corridors

- *eNEO2050* includes BRT priority corridors as shown in GCRTA 2020 strategic plan as bus-rapid-transit systems.

Transit Asset Management

- *eNEO2050* prioritizes $2.2 billion in funding for transit preservation projects that are classified into two categories: vehicle replacements and non-vehicle capital maintenance.

Visionary Rapid Transit Network

- *eNEO2050* advances a visionary rapid transit network as illustrative project to be further studied in a $5 million Feasibility Study.

REGIONAL TRANSIT SERVICE

eNEO2050 implements short- and long-term strategies from the Regional Strategic Plan. This includes short term strategies (1 to 5 years): Expand Demand Response Design to Enhance Intercounty Service, Multijurisdictional Collaboration, Unified Regional Transit Information System, Coordinated Regional Fare Policies and Systems. As well as Long Term Strategies (5 To 10 Years): Intercounty Transit Service, Regional Shared-Use Mobility And Active Modes, Support Functions, Customer Interface

Plan

Policy

Program

Project

Transit is an important aspect of the transportation network, and mobility choices are vital to the health and vibrancy of a region. Public transit options reduce congestion, personal transportation costs, and carbon output. Public transit is not just a form of alternative transportation, but provides options for lower-income households, the elderly, and people with disabilities. Public transit also provides access to healthcare, entertainment, and educational facilities, among other daily activities and destinations.

The objective of the NOACA strategic regional transit plan (2021) is to provide a strategic action plan that supports the development of a cohesive, coordinated vision for investment in public transit in the NOACA region. Ultimately, the strategic plan is to provide comprehensive, coordinated and integrated actions that would expand transit accessibility and quality to the residents of the region.

The Plan developed a set of strategies for implementation in the short- and long-term. Short-term strategies were considered as those actions that could be implemented within five years. Long-term strategies were those actions that would need a longer implementation horizon of five to ten years. In addition, some aspirational strategies were also considered as shown in .

The Plan concluded, the following: (1) widespread consensus around the need for further collaboration amongst local public transit agencies to reduce operating expenses and enhance service delivery; (2) interest in expanding cross-county public transit to specific destinations; and (3) the desire to have a central authority to coordinate and incentivize, if at all possible, inter-county partnerships.

From the recommendations in the Plan, NOACA will focus on a specific areas of potential cooperation, and the Transit Council play a more substantive role in discussion and partnership.

Table 6-6. Summary of Recommended Action Strategies in *Regional Strategic Transit Plan*

SHORT TERM ACTIONS (1 TO 5 YEARS)	LONG TERM ACTIONS (5 TO 10 YEARS)	ASPIRATIONAL ACTIONS (5 TO 10 YEARS, WITH FURTHER INVESTIGATION)
Expansion of demand response service design to enhance intercounty service • Alignment of eligibility criteria • Development of cost-sharing for cross-boundary service where warranted for seamless transit	**Intercounty transit service** • Commuter services to University Circle	**Regional high capacity transit** • Explore additional connections • Lorain/Elyria-Westlake-Rocky River-Lakewood-Cleveland • Cleveland-Solon
Multi-jurisdictional procurement and support • Consider single procurement for service contractors • Advance existing NEORide initiatives for joint vehicle and equipment procurements • Consider centralized scheduling and dispatching for regional demand response transit • Continue to collaborate through active information technology (IT) planning on shared IT services	**Regional Service** • Micro mobility, shared use mobility, active modes	**Connections to Areas Outside NOACA (High-Quality Transit/ DR/MB)** • Canton-Akron-Cleveland • Medina-Akron bus route • Existing plans for intercity transportation
Unified regional transit information systems • Provide unified graphics and combined route maps to support cohesive regional transit • Provide regional transit information helpline or website. (e.g., 411 number)	**Support Functions** • Shared administrative functions	**Regional Transit Funding** • Allocation of benefit from cross boundary travel • Contributions from existing public assistance sources • Innovative plans for additional funding to capture regional synergies
Coordinated regional fare policies • Encourage the use of existing unified fare collection systems • Coordinate regional fare structures	Customer Interface • Fare policy alignment	

Source: Regional Strategic Transit Plan

TRANSIT ACCESS TO JOBS

eNEO2050 includes a set of transit and land-use recommendations based on NOACA's Workforce Accessibility and Mobility study, which focuses on more efficient and effective trips as well as shorter commute times. This includes providing more frequent express and local buses to job hubs, extending the transit network to/from job hubs and inter-county transit services with a particular focus on EJ populations.

Policy

Project

The transit system contributes to workforce accessibility and mobility. The NOACA Workforce Accessibility and Mobility study indicated that only a small portion of low-income and minority workers live within reasonable commuting distance via transit (called transit commute sheds) of the regional major job hubs. As discussed in previous chapters, the majority of workers who live in Environmental Justice (EJ) areas currently spend more than an hour traveling from home to reach their employment location during the morning (AM) peak period. The following solutions are proposed in *eNEO2050* to reduce the work commute times:

- Offer more frequent express and local buses to regional job hubs
- Implement low-cost traffic engineering solutions at identified arterial bottleneck locations on transit routes
- Extend the transit network to/from major regional job hubs and intercounty transit services
- Add more park-and-ride locations throughout the region
- Dedicate highway lanes to express buses and car pooling
- Develop more bike lanes and sidewalks to access major transit stations

For these transportation solutions to be successful, NOACA relies on coordination with local governments on land uses that are adjacent to major transit stops and within job hubs. A transit system can be supported by looking at the use of land and densities. *eNEO2050* includes strategies from the workforce mobility study that encourages the business community and government organizations to consider shorter work commutes during the planning and decision making process. Business site selection and housing incentive programs should attempt to match the industry sectors of existing employment centers with workers of a required skill-set who reside within a shorter commuting shed. Such planning and policies will save commute time, alleviate traffic congestion, reduce accidents, and mitigate pollution in order to improve quality of life.

Figure 6-18. Achievements of *eNEO2050*

The recommendations of *eNEO2050* will achieve the following daily savings for the morning commute:

- Total Work Travel Times is Reduced by 10,328 Hours
- Total Delay as a measure of Congestion is Reduced by 2,274 Hours
- Total Work Travel Time Costs is Reduced by $112,164 (2018$)
- Total Congestion Cost is Reduced by $24,695 (2018$)
- Total VMT is Reduced by 478,420 Miles
- Total Fuel Consumption is reduced by 20,892 Gallons (Assuming 22.9 MPG)
- Total Fuel Cost is Reduced by $54,318 (2018 $ & Assuming Fuel Cost of $2.6 per Gallon)

Figure 6-19. NOACA Accessibility and Mobility Online System

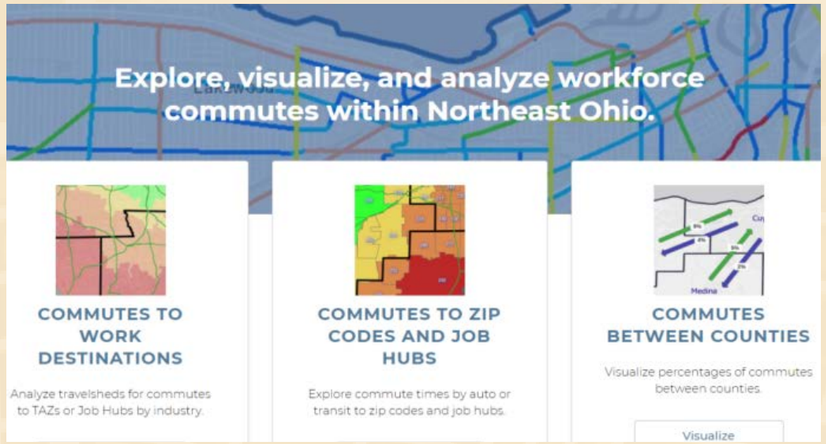


Figure 6-20. Annual Time Savings from 1% Reduction in Trip Lengths

TRANSIT MODE SHARE

eNEO2050 increases annual transit ridership from 40 to 55 million people by providing access to the transit system and mobility within the transit system. The following transit solution make transit more competitive and desirable as a mode: Low cost traffic engineering solutions at identified arterial bottleneck locations on transit routes, more park-and-ride locations throughout the region, highway lanes to express buses and car pooling, more bike lanes and side walks to access major transit stations, and bike racks adjacent to transit stops.

Policy

Project

Promoting a mode shift towards improved transit usage across the region will improve pollutant levels. Northeast Ohio has directly benefited from the long-term decreases in pollutant levels. One recent analysis found that, since 1970, air quality improvements have extended the average life expectancy of people within the region by 2.3 years.[2]

The following transit solution make transit more competitive and desirable as a mode and help improve air quality:

- Low cost traffic engineering solutions at identified arterial bottleneck locations on transit routes
- More park-and-ride locations throughout the region
- Highway lanes to express buses and car pooling
- More bike lanes and side walks to access major transit stations
- Bike racks adjacent to transit stops

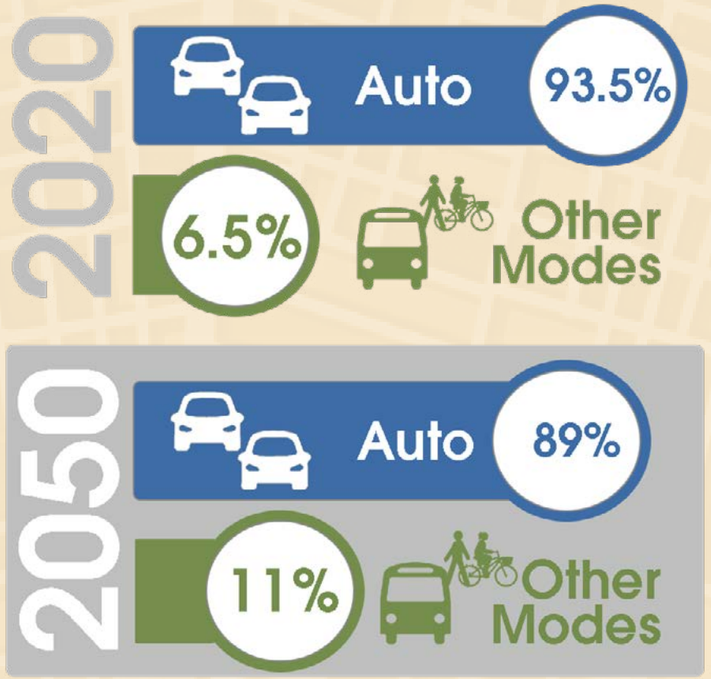
Figure 6-21. NOACA Transit and Workforce Mobility Recommendations

Regarding the solutions recommended above, the potential planning policies currently under discussion by NOACA's Policy Committee are:

- Support and prioritize transportation funding, especially transit expansion and enhancements around major job hubs
- Support and prioritize funding for multimodal accessibility to job hubs and connections to transit services
- Support a regionalized transit system with intercounty transit routes and an expanded park-and-ride system
- Encourage efficient mixed-use development
- Undertake a mobility-accessibility study for any current or potential employment centers
- Encouraging shorter commutes saves travel time, and attracts more ridership
- *eNEO2050* promotes reduction of trip length as a strategy for increased transit mode share

NOACA will also extent is workforce mobility study to include the minor and legacy job hubs.

Figure 6-22. Mode Share 2020 Compared to 2050



TRANSIT-ORIENTED DEVELOPMENT

eNEO2050 includes transit-oriented development (TOD) as a mechanism to better connect land uses and transportation investments. NOACA has been actively working with the City of Cleveland and GCRTA to advance specific TOD sites. NOACA will continue to facilitate the development of TOD based on the TOD study and scorecard.

Plan

Policy

Project

eNEO2050 implements the goal in NOACA's 2015 *Regional Strategic Plan* to "Encourage transit oriented development in higher density urban corridors and other higher density areas of the region and retrofitting transit oriented elements in appropriate lower density areas." Locally-supported Transit-Oriented Development (TOD) is one element to ensure dense clusters of residents and jobs are located in close proximity to rapid transit stations. This, in turn, ensures equitable participation in the economy that is not dependent on owning a private vehicle. Besides aiding minority and low-income populations, transit-oriented development is also extremely attractive to high-skilled workers and millennials who currently choose to relocate elsewhere in the country.

NOACA's region is fortunate to have invested in an extensive rail system more than 40+ years ago (Red, Blue, and Green Lines) when its residents voted to create GCRTA in 1974 merging several transit systems. The city is also a leader in Bus Rapid Transit (BRT), providing more than five million trips. *eNEO2050* recognizes that the existing rapid transit system and proposed BRT corridors present prime opportunities for redevelopment.

eNEO2050 expands the work on the TOD scorecard (2016). The second Phase is currently underway. NOACA and communities are working closely with LOCUS to support new TOD developments. Northeast Ohio presents a wealth of opportunities for development and NOACA can advance TOD by acting as a regional advocate.

Figure 6-23. Transit-Oriented Development on West 25th Street, Cleveland

AUTONOMOUS SHUTTLE FEEDER

eNEO2050 pursues autonomous shuttle feeder bus services as a complement to existing modes for "First-Mile" and "Last-Mile" connections.

Project

Another important factor in increasing transit ridership is connectivity. The "first mile" and "last mile" of bus services provide complete transit connectivity from riders' actual origins to their destinations. Autonomous shuttle buses can not only satisfy local demand but also complete the connectivity of transit services that run through the main corridors. With new technology, some companies will offer automated on-demand bus shuttle services that operate similar to taxis. Exploring these technologies for Northeast Ohio can be a viable option to connect residents to nearby rapid transit stops and job hubs. Furthermore, investment in bike sharing infrastructure as well as separate bike lanes within a two-mile radius of job hubs and rapid transit stops will increase the mobility of residents in the region.

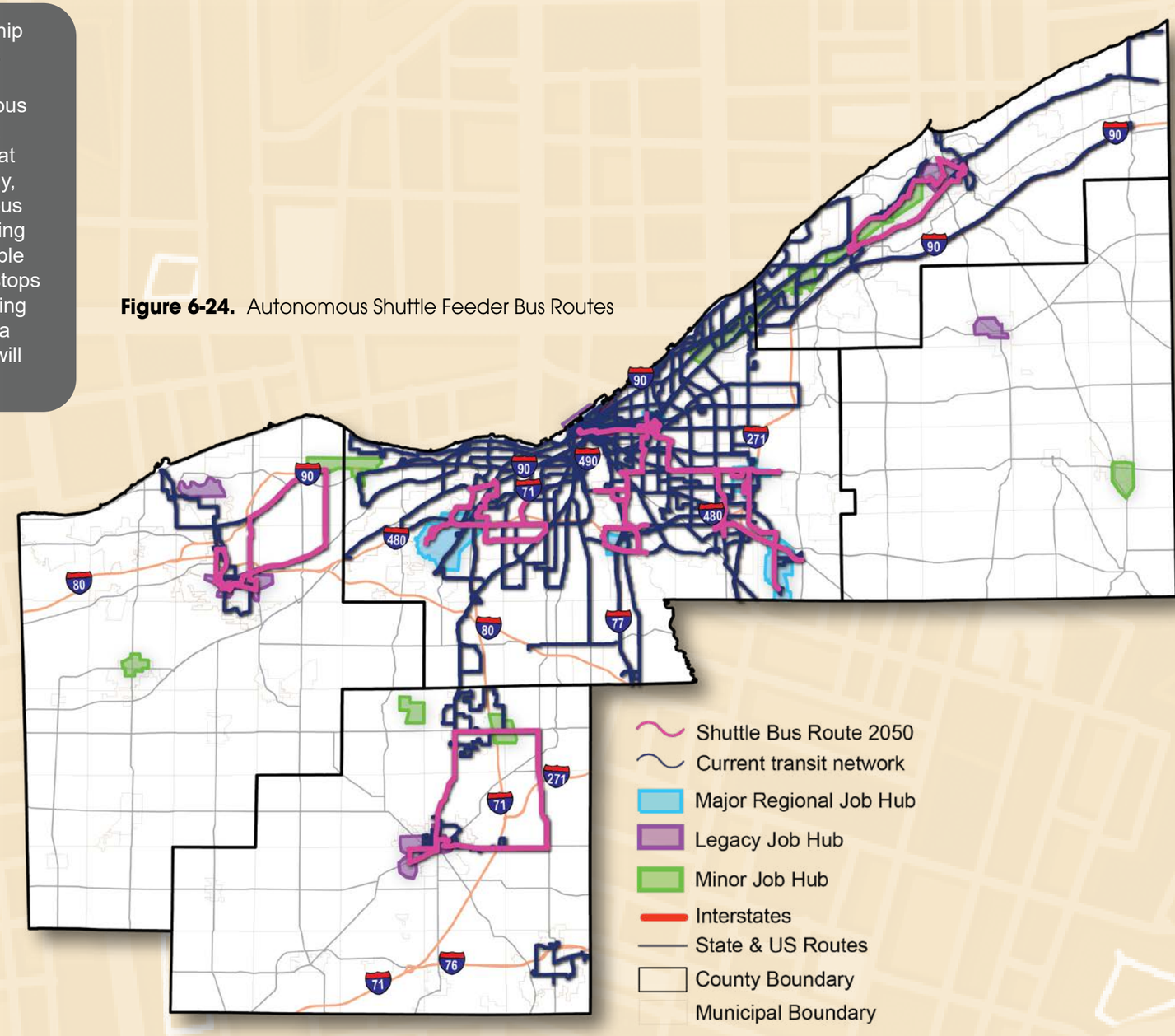


Figure 6-24. Autonomous Shuttle Feeder Bus Routes

BRT PRIORITY CORRIDORS

eNEO2050 includes BRT priority corridors as shown in GCRTA 2020 strategic plan as Bus-Rapid-Transit systems. NOACA will continue to work with GCRTA on improving speed, reliability, pedestrian safety and convenience, dedicated bus lanes, and improved transit waiting environments along these corridors.

Project

Corridors with higher residential and employment densities are the backbone of the transit network. Rapid transit is most viable at densities of at least 30 units per acre or 50 to 75 employees per acre. To compare, the minimum density for regular on-street bus service is about 6 to 8 units per acre. Interested municipalities can support the transit system by ensuring sufficient densities that permit the operation of transit services. The priority corridors are a central component of shifting the transit mode share and encouraging transit-oriented development in interested communities.

Figure 6-25. Top 10 Priority Corridors for Transit

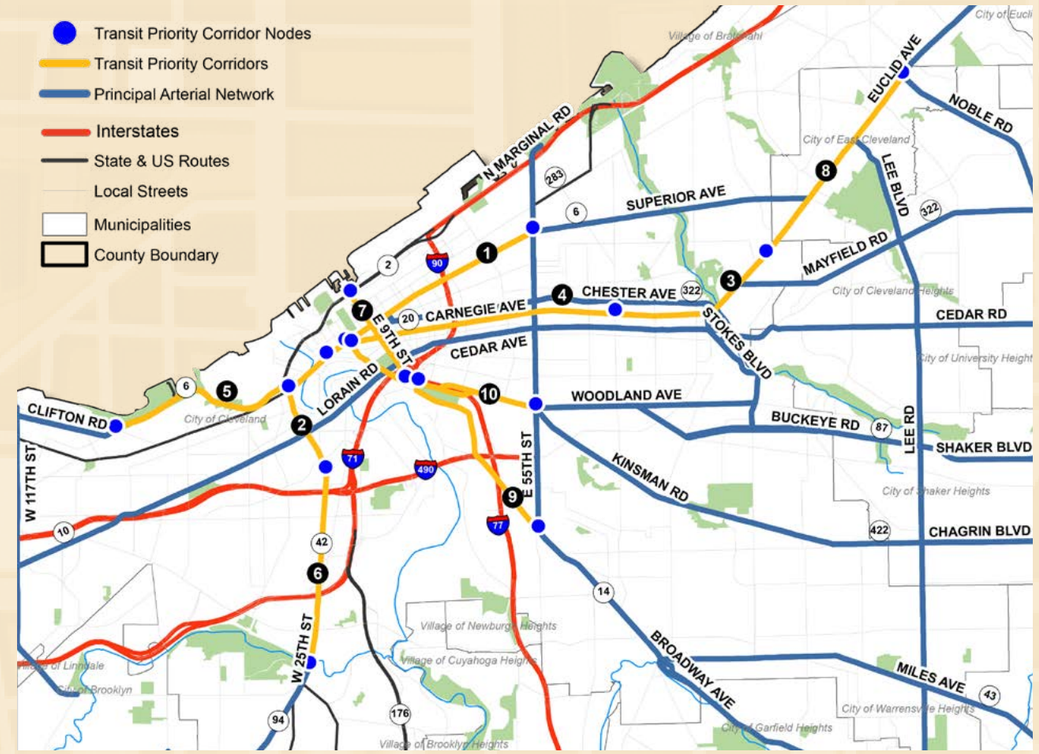


Table 6-7. Top 10 Priority Corridors for Transit

STREET NAME	FROM	TO	RANK
Superior Avenue (US 6)	West 9th Street	East 55th Street	1
West 25th Street (US 42)	I-90 (Potter Ct)	Detroit Avenue	2
Euclid Avenue	East 79th Street	East 123rd Street	3
Euclid Avenue	Superior Avenue	East 79th Street	4
Clifton Road /W. Shoreway / Superior Avenue	Lake Avenue	West 9th Street	5
Pearl Road / West 25th Street (US 42)	Broadview Avenue (Brookside Park Dr.)	I-90 (Potter Ct)	6
East 9th Street	State Route 2	Ontario Street	7
Euclid Avenue	East 123rd Street	Noble Road	8
Broadway Road (State Route 14)	Orange Avenue	East 55th Street	9
Ontario Road/ Orange Avenue / Woodland Road (US 42)	Euclid Avenue	East 55th Street	10

Figure 6-26. GCRTA Priority Corridors[3]

TRANSIT ASSET MANAGEMENT

eNEO2050 prioritizes $2.2 billion in funding for transit preservation projects that are classified into two categories: vehicle replacements and non-vehicle capital maintenance. *eNEO2050* advocates to ensure adequate funding is available to maintain the rail system, which would cost $4 billion to build today and is a lifeline for many people to access jobs, particularly for EJ communities.

Plan

Project

NOACA and the regional transit agencies identifies appropriate projects. Each of the five counties in NOACA's region has a transit agency that operates and maintains its own individual system. For *eNEO2050*, transit preservation projects are classified into two categories: vehicle replacements and non-vehicle capital maintenance. Vehicle replacements include all costs necessary to keep rolling stock fleets, including standard bus, BRT, light transit vehicles, and rail cars, in a state of good repair in accordance with FTA useful life guidelines. Non-vehicle capital maintenance projects include all costs necessary to maintain safe stations, shelters, rail lines and appurtenances, fueling stations, and other capital assets.

In 2019, NOACA developed a Transit Asset Management Plan in collaboration with the transit agencies in Lake, Lorain, and Medina counties. The Greater Cleveland Transit Authority (GCRTA) has its own asset management. A particular asset management concern is the replacement of its heavy and light rail vehicles. GCRTAs "Rail Car Replacement Study" estimates that the heavy rail car have an estimated remaining life of 5 years and the light rail vehicles of 10 years. GCRTA is working on a Rail Car Replacement Program. NOACA supports GCRTAs efforts. There currently is a backlog of $344 million unfunded capital projects.

Replacement vehicles are a consistent need amongst all of the regional transit agencies, with a total of 491 vehicles in direct operation. Figure 6-27 and Figure 6-28 summarize transit preservation by mode and project. Estimated costs for the preservation of transit assets for the region total $2.5 billion over the life of the plan. Transit vehicle replacement costs represent $0.8 billion and non-vehicle capital (i.e. corridor enhancement, rail and bridge rehabilitation, stations, fare and communications collection systems, etc.) represent $1.7 billion, largely associated with GCRTA's expansive bus and rail systems.

Figure 6-27. Transit Preservation Projects by Mode, in Millions[4]

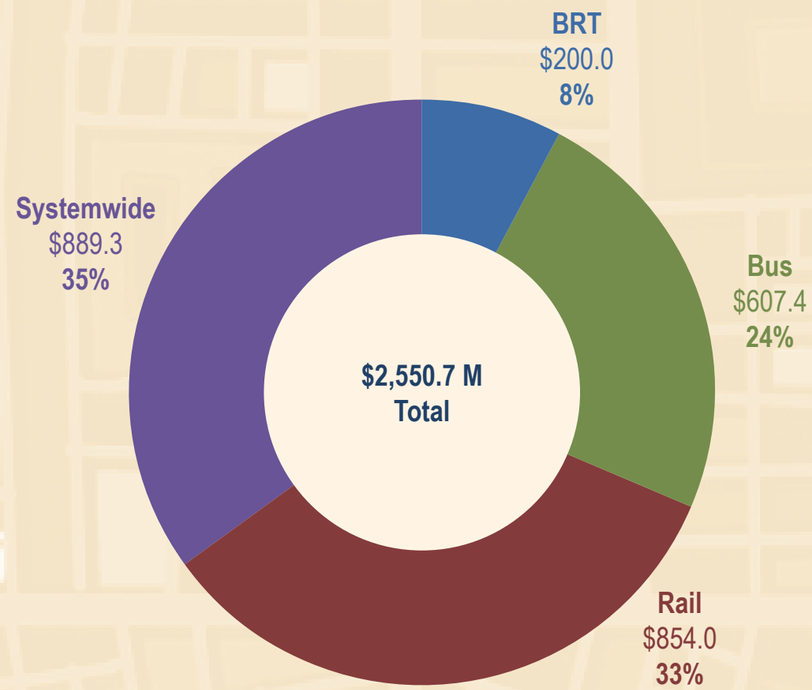
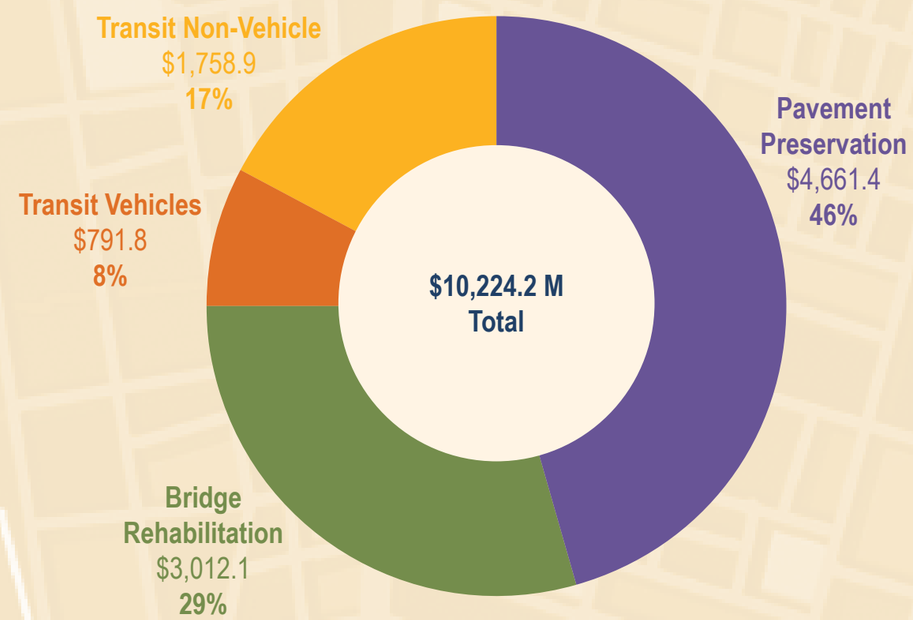


Figure 6-28. Asset Management Projects included in eNEO2050, in Millions



VISIONARY RAPID TRANSIT NETWORK

eNEO2050 advances a visionary rapid transit network as illustrative project to be further studied in a $5 million Feasibility Study. The Study will determine the feasibility of expanding rapid transit service across the region to provide .access to regional assets and to better connect people to regional job hubs within Cuyahoga County and into Lake, Lorain and Medina to serve their job hubs. Although initially envisioned as rail service, BRT will be considered as an option as well. Furthermore, a phasing and funding plan will be developed as part of the study.

Plan

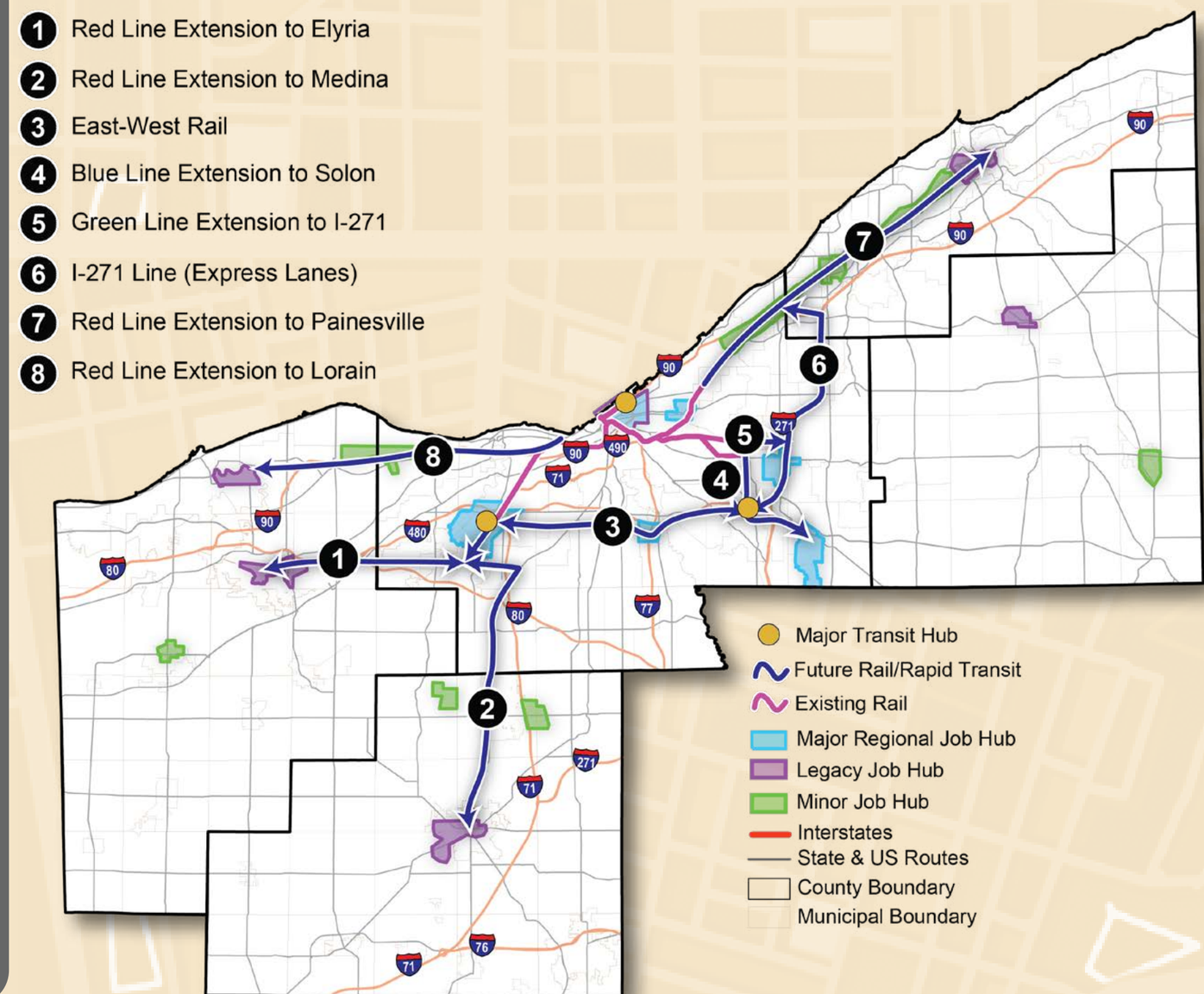
Project

The scenario discussion in Chapter 5 included an expanded rail system for intercounty connectivity as part of Scenarios 3 and 4. Figure 6-29 shows the visionary rapid transit network. The intermediate phase of the visionary future rapid transit network will extend the current 34 miles of rail to 135 miles, and the number of stations will increase from 49 to 111. The length of the "Final" phase of the visionary rail/rapid transit network will be 205 miles and include 186 stations. As NOACA currently does not anticipate enough funding from known sources to schedule this ambitious project, no rail expansion projects can be included in the fiscally constrained portion of the long-range plan.

Corridors with higher residential and employment densities are the backbone of the transit network. Rapid transit/rail is most viable at densities of at least 30 units per acre or 50 to 75 employees per acre. To compare, the minimum density for on-street bus service is about six to eight units per acre. Municipalities in the urban core can support the transit system by ensuring sufficient densities that permit the operation of transit services.

Expanding rail services can occur in multiple phases. To assess multiple options, part of the constrained long-range plan includes a feasibility study to stage future rail extensions based on different alignment and technology options. The Visionary Rail/Rapid Transit Network Phasing Study will develop a 30-year phased plan to prioritize the proposed corridors based on an assessment of alternative route alignments and technologies for each corridor. For instance, job hubs could initially be served by bus rapid transits that operate along the highways in high-occupancy lanes. As demand grows for these routes, investment in rapid transit rail will become increasingly necessary. Multiple technologies (light rail, heavy rail, or fully automated light rail system) should be explored for the feasibility study. Alternatives for each corridor should be evaluated along multiple alignments to determine a preferred alternative.

Figure 6-29. Intermediate Phase of the Visionary Rapid Transit Network



Strategy 4: Evolution of Future Infrastructure and Technologies

NOACA has been studying opportunities for the region to leverage future technologies. The 4Ps presented in this section include the Hyperloop as an Illustrative Project in *eNEO2050*. To further advance consideration of the hyperloop, NOACA will advance the Preliminary Development Study as a public-private partnership. Furthermore, NOACA is funding EV Charging Stations across the region.

EVOLUTION OF FUTURE INFRASTRUCTURE AND TECHNOLOGIES

EV Charging Stations

- *eNEO2050* projects that over 2,000 charging stations will be needed over the next decade to facilitate adoption rates of electric vehicles. *eNEO2050* includes $3 million for the installations of charging stations in public spaces and includes partnerships with the private sector to support the market.

Autonomous and Connected Vehicles

- *eNEO2050* includes infrastructure preparation for the adoption and deployment of autonomous and connected vehicles including trucks for freight infrastructure improvements.

Micro-Mobility and Ride Sharing

- *eNEO2050* implements NOACAs Van Pool program and expands micro-mobility initiatives such as e-bikes, e-scooters, and transportation network providers (TMP).

Hyperloop

- *eNEO2050* includes Hyperloop as an illustrative project as NOACA continues to work with the private sector and USDOT on brining this new fifth mode of transportation to reality.

EV CHARGING STATIONS

eNEO2050 projects that over 2,000 of charging stations will be needed over the next decade to facilitate adoption rates of electric vehicles. *eNEO2050* includes $3 million for the installations of charging stations in public spaces and plan includes partnerships with the private sector to support the market.

Policy

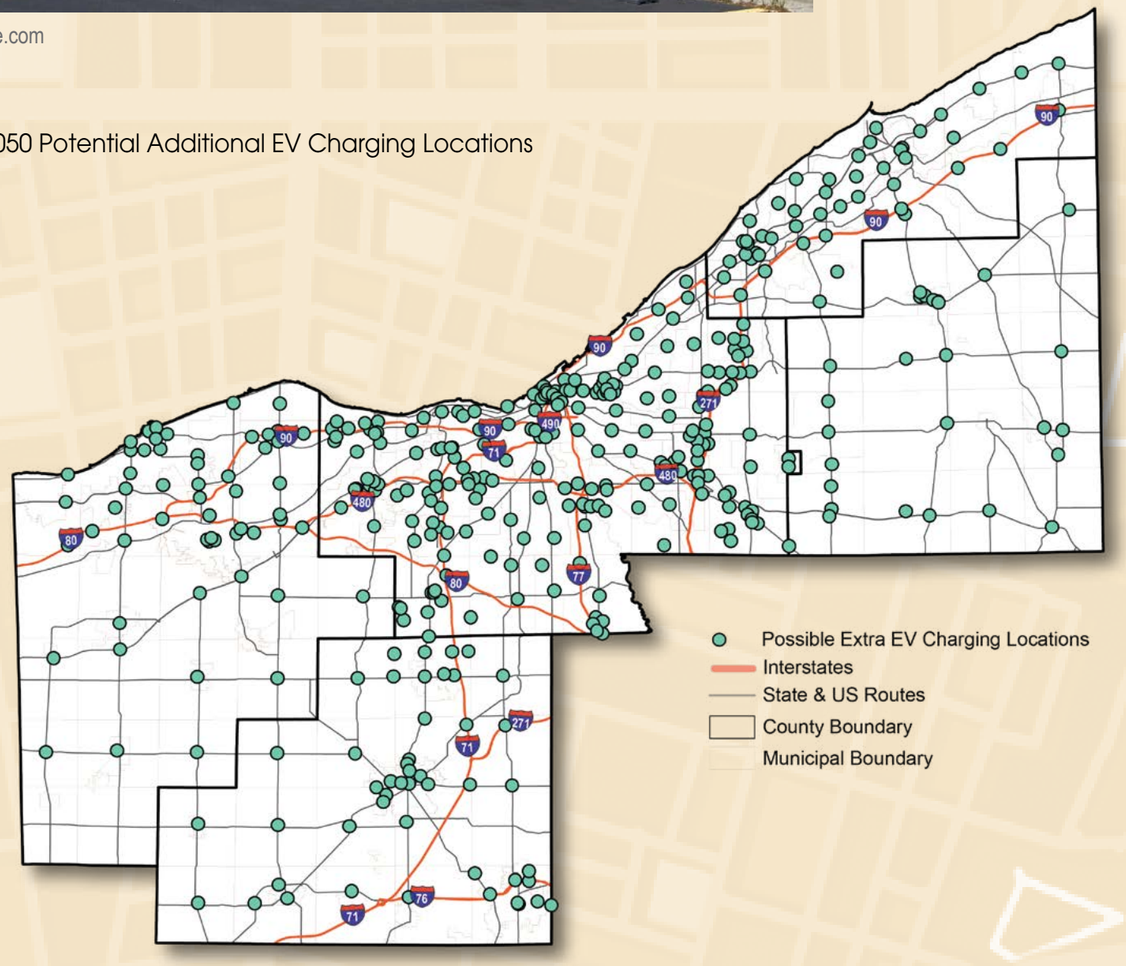
Project

As projected in Chapter 9 of the resource document, there will be about 144,000 electric vehicles in the NOACA region by 2050. Evaluating a future with that many electric vehicles includes estimating the potential benefits for air quality. As noted in Chapter 8 of the resource document, EVs do not emit any exhaust emissions into the environment. According to an analysis from NOACA staff, including 144,000 EVs in the passenger vehicle fleet for Northeast Ohio will reduce emissions of GHGs, NOx, VOCs, and SO2 by roughly 8.4% in 2050.[5] Though some of these reductions may be offset by emissions from electricity generation, the benefits will remain. EVs also present a complex environmental justice issue. As discussed in Chapters 8, 9, and 11 of the resource document, policies that target EV subsidies and charging infrastructure to low-income communities of color may go a long way toward enhancing the environmental justice benefits from EVs in Northeast Ohio.

Figure 6-30. Electric Vehicle Charging Station

Source: ©Noel - stock.adobe.com

Figure 6-31. eNEO2050 Potential Additional EV Charging Locations



AUTONOMOUS & CONNECTED VEHICLES

eNEO2050 includes infrastructure preparation for the adoption and deployment of autonomous and connected vehicles including trucks for freight infrastructure improvements will be made to the right-of-way, signalization and other necessary installations of technology.

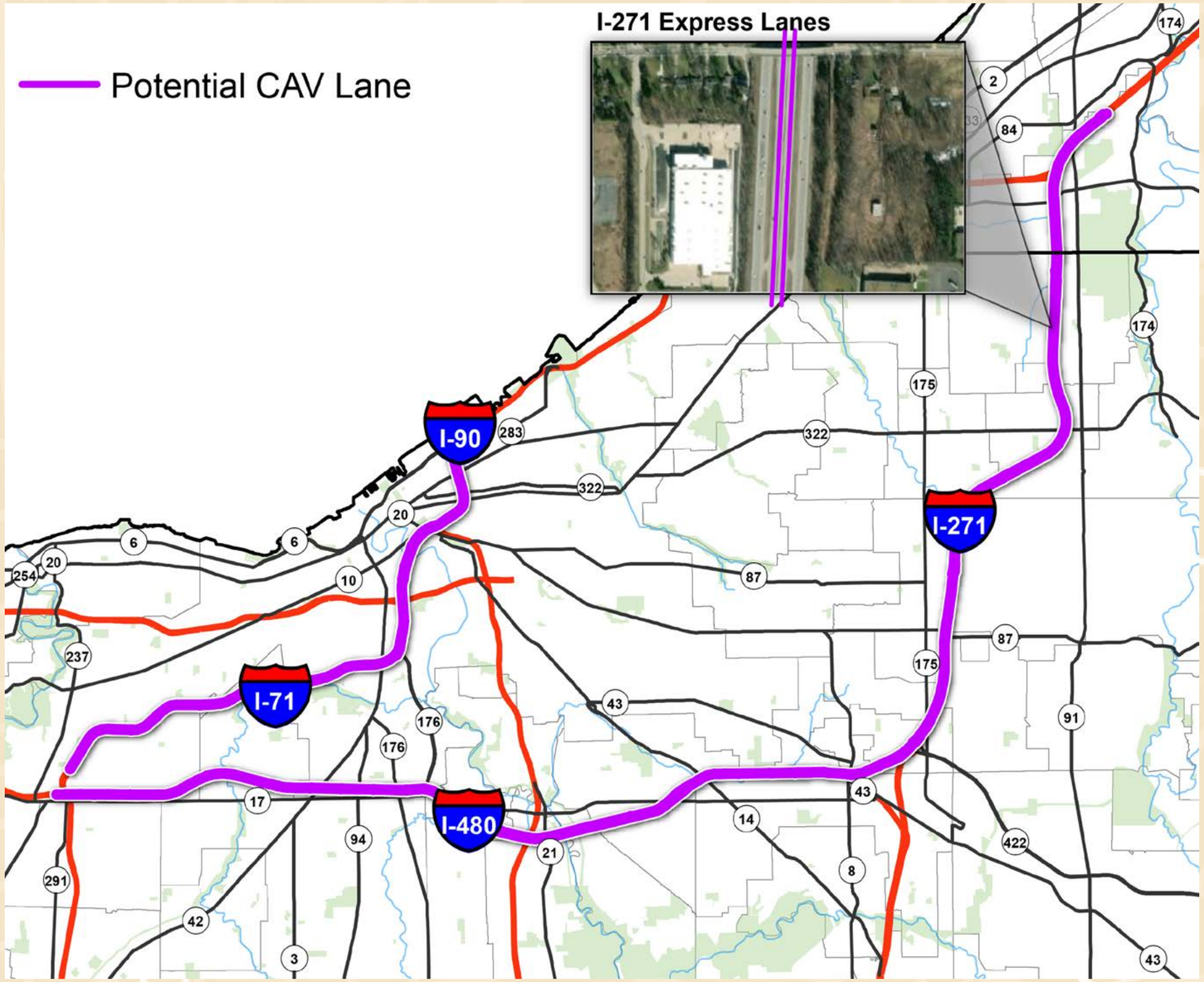
Plan

More than a century ago, automobiles or horseless carriages were a revolutionary transportation option. Their deployment altered land use and travel patterns, and drove the development of transportation infrastructure, policies, and regulations. Today, Connected and Automated Vehicles (CAVs) are poised to bring the next wave of changes to the transportation system in conjunction with related developments in vehicle electrification, shared mobility, and the emergence of new mode options such as electric scooters.

Connected vehicles are connected through interoperable wireless communications to other vehicles (V2V), transportation infrastructure (V2I), and to everything (V2X).

Automated vehicles use on-board and remote hardware and software to perform driving functions. The National Highway Traffic Safety Administration (NHTSA) has adopted six automation levels: Level Zero: No Automation; Level One: Driver Assistance; Level Two: Partial Automation; Level Three: Conditional Automation; Level Four: High Automation; and Level Five: Full Automation, which is projected to be achieved by the 2050 horizon year of the *eNEO2050* plan.

Figure 6-32. HOV or CAV Lanes of the Future Scenarios



Source: NOACA

MICRO-MOBILITY AND RIDE SHARING

NOACA is implementing a Van Pool program. NOACA will work with interested communities to implement micro-mobility initiatives such as e-scooters, e-bikes, and transportation network providers (TMP).

Plan

Program

Project

NOACA has helped to implement Bike Sharing in the City of Cleveland. With new technologies such as e-scooters and Van Sharing emerging, *eNEO2050* supports further exploration of these new technologies. Micro-mobility enables people to have access to transit (first-/last-mile connectivity), run errands or attend events using alternative modes of transportation. Some might even choose micro-mobility options to commute to work if feasible. Considering the acceptable walking and biking distances for transportation planning purposes, access to micro-mobility is an important aspect of a cohesive, multimodal transportation system.

Figure 6-34. NOACA Activate Survey Result

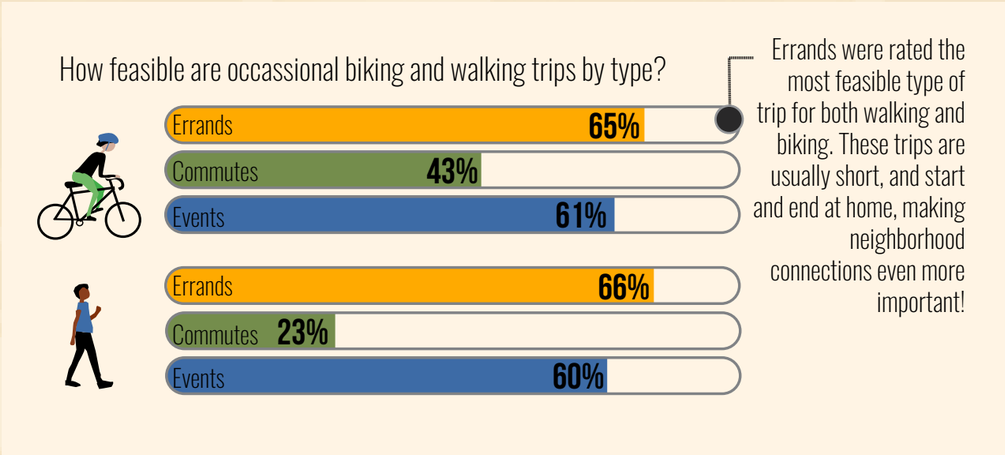


Figure 6-33. E-Scooters in the City of Cleveland

Source: Robert Higgs, Cleveland.com

HYPERLOOP

eNEO2050 includes Hyperloop as an illustrative project as NOACA continues to work with the private sector and USDOT on bringing this new fifth mode of transportation to reality. Although Hyperloop technology is not yet fully commercialized, NOACA continues to monitor its development and work with private sector partners to support the Cleveland to Chicago and Pittsburgh corridor, placing the region in the forefront nationally with regard to this new travel mode. NOACA is optimistic about the possibilities and includes the Hyperloop as an illustrative project in the *eNEO2050* plan.

Plan

Project

The Hyperloop is an entirely new mode of transportation. Hyperloop consists of an evacuated guideway tube within which a magnetic levitation system is used to propel self-contained capsules carrying either passengers or cargo. Capsules are powered by passive magnetic levitation, powered by solar power. Creating a corridor, and eventually a network, for ultra high-speed transportation between remote regional hubs will enhance opportunity and economic mobility throughout the region. The Hyperloop will have transformational impacts to the communities it serves. NOACA and Hyperloop Transportation Technologies (HTT) entered into a public private partnership to complete a feasibility study for the technical analysis and evaluation of a Cleveland, Ohio to Chicago, Illinois and Pittsburgh, Pennsylvania corridor; known as the Great Lakes Hyperloop Feasibility Study. . The project had many collaborating partners such as: Illinois Department of Transportation, Indiana Toll Road, Federal Highway Administration, NASA, Eastgate Regional Council of Governments, Erie Regional Planning Commission, Southwestern Pennsylvania Commission, Team NEO, and Toledo Metropolitan Area Council of Governments.

The Feasibility Study for the Great Lakes Hyperloop revealed positive financial and cost-benefit results, thus creating a strong case for developing a corridor to connect Chicago, Cleveland, and Pittsburgh as a passenger and freight system. The feasibility study assessed the technical and financial feasibility for the environmental, financial, operational, and structural requirements to create a Hyperloop Transportation System. The feasibility study also addressed the requirements for building and achieving optimal alignment of the system, siting requirements for the location of major structures, assessing the constraints on the alignment of the system, integrating the Hyperloop transportation system with existing transportation infrastructure, and identifying issues with construction of the optimized system. As a result of these positive findings, the Preliminary Development phase becomes the next step in the project development process.

Table 6-8. Potential Socioeconomic and Tax Benefits of Hyperloop, 2025-2050

SOCIOECONOMIC BENEFIT	TAX BENEFIT	IMPACT (INCREASE)
Employment		931,745 persons per year
Income		$47,577 M
Property Value		$74,842 M
	Local Income Tax	$2,021 M
	Federal Income Tax	$9,401 M
	Property Tax	$1,273 M

Source: Great Lakes Feasibility Study

Figure 6-35. Hyperloop Connecting Pittsburgh to Cleveland to Chicago, Potential Routes

Table 6-9. *eNEO2050* Scenario Performance Measures

	PERFORMANCE MEASURE	2020 BASE	SCENARIO 1	eNEO2050
MULTIMODAL	Population in 15 Minutes Walk to any Transit Stop	68%	65%	68%
	EJ Workers in 15 Minutes Walk to any Transit Stop	89%	88%	88%
	Number of Jobs within 15 Minutes Walk egress from any Transit Stop	78%	77%	78%
	Population in 5-Mile Drive Access to Freeway System	92%	91%	91%
	Annual Transit Ridership (Including Transfer Trips) – Million Person Trips	40	38	55
	Average Transit Work Commute Time from EJ neighborhoods to All Major Job Hubs (in Minutes)	60.9	60.4	56.8
	Average Work Commute Time for Households with Zero Cars (in Minutes)	43.25	42.88	41.82
AUTO	Non-Single Occupancy Vehicle Work Commute during a Typical Morning Peak Period	16%	16%	17.66%
	Average Highway Network Pavement Condition Rating (PCR)	75.0	80	87.1
	Daily Vehicular Trip Share of Autonomous, Electric Cars and Trucks	0.16%	19%	31%
	Total Annual Vehicle Miles Traveled per Capita	7,345	7,946	7,902
	Total Annual Freeway Delay per Capita (in Hours)	6.63	7.11	6.00
	Total Annual Principal Arterial Delay per Capita (in Hours)	6.64	7.2	6.7
	Annual Person Hours of Excessive Delay per Capita (in Hours)	23.04	24.89	21.06
	Average Auto Work Commute Time to All Major Job Hubs (in Minutes)	38.2	37.7	37.7
	Maximum Level of Travel Time Reliability (LOTTR)*	1.48	1.52	1.52
	Maximum Truck Travel Time Reliability (TTTR)*	1.83	1.83	1.90
	Annual Congestion Cost per Capita (2050$)	739	821	684
	Estimated Fatalities (Based on 2019 Crash Data and Annual 2% Reduction)	138	75	75
	Estimated Serious Injuries (Based on 2019 Crash Data and Annual 2% Reduction)	1,307	713	713
	Estimated Non-Motorized Fatalities and Serious Injuries (Based on 2019 Crash Data and Annual 2% Reduction)	167	91	91
	Daily Volatile Organic Compounds (VOCs) (in Tons)	25.51	9.25	9.2
	Daily Nitrogen Oxides (NOx) (in Tons)	18.35	8.34	8.29
	Annual Direct PM (in Tons)	565.09	209.65	208.49
	Structurally Deficient Deck Areas of NHS Bridges	1.77%	1.77%	1.77%
	Structurally Deficient Deck Areas of All Bridges	6.57%	6.57%	6.57%

Notes: *LOTTR values are estimated as the ratio of 80th percentile and 50th percentile of all the inter-zonal travel times; **TTTR values are estimated as the ratio of 95th percentile and 50th percentile of all the inter-zonal travel times.

To summarize, the presented *eNEO2050* funded scenario in this Chapter is a hybrid of the four scenarios presented in Chapter 5. As a hybrid, the *eNEO2050* funded scenario combines various investment priorities represented in Scenarios 1 through 4. Table 6-9 shows the performance of the *eNEO2050* funded scenario as compared to Scenario 1 which is similar to a no-build scenario and compared to the performance of today's transportation system.

A Guide to Actions Envisioned by *eNEO2050*

eNEO2050 sets a vision for an equitable transportation system in Northeast Ohio. This vision is underwritten by four strategies that support the six transportation principles and objectives. Northeast Ohio can achieve its vision by considering four types of actions –policy, plans, programs, projects. The following schedule serves as a guide for understanding the relationships between the vision, strategies, principles, objectives and actions.

Table 6-10. Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Planning Principles						4 Ps			
		Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
Strategy 1: Efficient and Affordable Highway System											
Interchanges: eNEO 2050 completes four partial existing interchanges to become full interchanges by 2050.	eNEO 2050 - Highlights	x									x
Major Projects list - New interchange	eNEO 2050 evaluation	x	x								x
Illustrative list - Proposed interchanges	eNEO 2050 evaluation	x	x								x
Congestion Management Plan (CMP): eNEO 2050 improves the performance of the transportation system by reducing congestion in accordance with CMP objectives.	eNEO 2050 - Highlights		x	x	x			x	x	x	x
Add capacity to the transit system, non-freeway corridors and create HOV lanes	Congestion Management Plan		x					x	x	x	x
Operate existing capacity more efficiently	Congestion Management Plan		x					x	x	x	x
Encourage congestion reducing strategies such as mode shift to non-motorized and transit as well as flexible work-hours and telecommuting	Congestion Management Plan		x		x			x	x	x	x
Increase intercity freight rail capacity to reduce truck use of highways	Congestion Management Plan		x		x			x	x	x	x
Use targeted strategies to reduce congestion where it impedes freight movement.	Multimodal Regional Freight Plan (2017)		x		x					x	x
Illustrative list - Road Enhancements - Minor Road Widening	eNEO 2050 Scenarios		x	x							x
Illustrative list - Major Road Widening	eNEO 2050 Scenarios		x	x							x
Illustrative list - Grade Separation	eNEO 2050 Scenarios		x	x							x
Illustrative list - New bridge and road approaches	eNEO 2050 Scenarios		x								x
Illustrative list - New roads	eNEO 2050 Scenarios		x								x
Illustrative list - Roadway realignment	eNEO 2050 Scenarios		x								x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 1: Efficient and Affordable Highway System											
Workforce Accessibility and Mobility: eNEO improves the spatial mismatch between people and jobs.	eNEO 2050 - Highlights	x	x	x	x				x		x
Develop a robust network of regional job centers connected by multimodal transportation corridors within and between counties	Vibrant NEO 2040	x	x	x						x	
Encourage mixed-use development around job hubs	Workforce Access and Mobility (2019)	x	x	x	x			x			
Support policies for housing development closer to job hubs	Workforce Access and Mobility (2019)	x	x	x	x			x			
Implement a mobility-accessibility study for any current and potential employment centers	Workforce Access and Mobility (2019)	x	x	x	x			x			
Pavement and Bridge Maintenance Management: eNEO 2050 ensures that the interstate system is maintained at optimal levels as prescribed by FHWA and ODOT. eNEO 2050 maintains the average pavement condition rating at 75 in accordance with NOACAs Asset Management Plan, but also ensures a higher level of 80 for the EJ areas.	eNEO 2050 - Highlights, TAMP 2016	x	x			x		x	x	x	x
Promote a least-life-cycle cost approach to transportation infrastructure investment	TAMP 2016					x		x			
Establish Transportation Asset Management as a regional priority	TAMP 2016					x		x			
Prioritize maintenance over capacity additions, particularly improve pavement condition on freight intermodal connectors and on corridors where either average daily truck traffic (ADTT) is greater than 1,600 or trucks make up at least 8% of all vehicles	Multimodal Regional Freight Plan (2017)					x				x	
Major Projects list - Bridge maintenance/rehabilitation	eNEO 2050 Scenarios	x	x								x
Illustrative list - Bridge Maintenance/Rehabilitation	eNEO 2050 Scenarios	x	x								x
Major Projects list - Road Resurfacing/Rehabilitation	eNEO 2050 Scenarios	x	x								x
Illustrative list - Other: Road revitalization	eNEO 2050 Scenarios	x	x								x
Illustrative list - Road resurfacing/ rehabilitation	eNEO 2050 Scenarios	x	x								x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 2: Enhanced Roadways for all users											
Safety: eNEO 2050 works to achieve Vision Zero as discussed in NOACAs SAVE plan. NOACA's Systemic Safety Management program is transformed into a proactive and community-based approach to safety issues.	eNEO 2050 - Highlights			x				x	x	x	x
Provide NOACA and other agencies with tools to ensure that the planning, deployment and integration of ITS systems throughout the region is done with a common framework through ITS architecture and standards development	ITS Plan	x	x	x						x	
Assist in the maintenance and operations of ITS projects throughout the five–county region.	ITS Plan			x							x
Assist in the implementation of multiple ITS projects	ITS Plan			x							x
Collect and analyze data to identify high crash locations	SAVE PLAN (2019)										x
Support the implementation of proven and low-cost infrastructure safety countermeasures	SAVE PLAN (2019)							x			
Promote safe behaviors that contribute to the reduction of roadway departure fatalities and injuries, particularly among young drivers	SAVE PLAN (2019)									x	
Enhance education and enforcement through partnerships with coalitions	SAVE PLAN (2019)							x			
Support the planning and implementation of infrastructure that enhances safety of bicyclists and pedestrians	SAVE PLAN (2019)			x						x	
Support policy changes and promote education and outreach strategies that convey messages regarding distracted driving, safe driving behavior on and around motorcycles, risks and mobility options for seniors and skills of young drivers	SAVE PLAN (2019)			x							x
Assist communities with implementing countermeasures that promote speed zone compliance	SAVE PLAN (2019)			x							x
Collaborate with school districts and local communities to further develop safe routes to school, encouraging walking and biking, and site new schools in walkable locations.	Vibrant NEO 2040	x	x	x						x	x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 2: Enhanced Roadways for all users											
Complete and Green Streets: eNEO 2050 implements complete and green streets when appropriate and feasible in accordance with NOACA's policies.	eNEO 2050 - Highlights, ACTIVATE	x	x	x	x	x		x	x		
Provide options to all - Safe options for biking and walking are needed in urban, suburban, and rural communities.	ACTIVATE (2021)	x	x	x	x					x	
Facilitate all modes of shipping.	Multimodal Regional Freight Plan (2017)	x	x							x	
Consider and Address Potential Water Quality Impacts of Transportation Projects	Water Quality Strategic Plan (2017)					x				x	
Promote "Complete Streets" through regional policy and the identification of local champions.	Vibrant NEO 2040	x	x	x	x			x			x
Major Projects list - Complete and Green Streets	eNEO 2050 Scenarios	x	x	x	x	x					x
Illustrative list - Road diet - Bicycle lane	eNEO 2050 Scenarios	x	x	x	x						x
Illustrative list - Road streetscape	eNEO 2050 Scenarios	x	x	x	x	x					x
Principal Arterial Network: eNEO 2050 elevates and prioritizes principal arterial corridors for signal improvements as part of the STOP program		x	x	x					x		
Major Projects list - Traffic Signalization	eNEO 2050 Scenarios	x	x								x
Illustrative list - Traffic signalization	eNEO 2050 Scenarios	x	x								x
Illustrative list - Road enhancements - intersection improvements	eNEO 2050 Scenarios	x	x	x							x
Transportation for Livable Communities (TLCI): eNEO 2050 provides $15 million to fund planning studies that focus on integrating multi-modal transportation solutions to better connect communities for livability. eNEO 2050 allocates $41 million to fund the implementation of completed TLCI studies.	eNEO 2050 - Highlights	x	x	x	x	x	x		x	x	x
Encourage short trips - Making it easy for people to walk and bike to local, nearby destinations can reduce vehicle trips and improve qualitz of life region-wide	ACTIVATE (2021)	x	x	x	x			x			
Inspire communities - Communities in Northeast Ohio will have the knowledge and support needed to build world-class biking and walking infrastructure	ACTIVATE (2021)	x	x	x	x			x			
TLCI Program	eNEO 2050	x	x	x	x	x	x		x		x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 2: Enhanced Roadways for all users											
Active Transportation: eNEO2050 funds 926 miles of bicycle facilities, more than 11,000 pedestrian ADA and safe crossings, and 760 bike storage lockers for cyclist in the next three decades.	eNEO 2050 - Highlights	x	x	x	x					x	x
Focus on needs - Focussing on Improving conditions for people that currently bike and walk will help correct regional inequalities	ACTIVATE (2021)	x	x	x	x					x	
Support the vision - Build on and enhance the existing regional vision for connected trails	ACTIVATE (2021)	x	x	x	x			x			
Connect the dots - Make it easier for people to make trips that use several modes. Support connections between biking, walking, transit and other modes, like scooters	ACTIVATE (2021)	x	x	x	x					x	
Care about details - Just as we support a five county regional vision, we must plan for improvements and maintenance of the scale of someone walking or biking	ACTIVATE (2021)	x	x	x	x					x	
Repair existing sidewalks and crosswalks and add new ones as needed wherever a fixed-route bus service is in operation.	Vibrant NEO 2040	x	x	x				x			
Enhance walking and cycling as transportation options to increase regional mobility and improve public health	Vibrant NEO 2040	x	x	x	x						x
Major Projects list - Separated bikepath	eNEO 2050 Scenarios	x	x	x	x						x
Expand the existing bicycle lane and trail system and connect it to regional transit hubs via on-and-off street facilities.	Vibrant NEO 2040	x	x	x	x						x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 3: Effective Transit System That Connects People to Jobs											
Regional Transit Service: eNEO 2050 implements short- and long-term strategies from the Regional Strategic Plan that improve transit services within the 5-county region.	eNEO 2050 - Highlights	x	x		x			x	x	x	x
Collaborate on administrative functions and multi-jurisdiction procurement and support	Regional Strategic Transit Plan (2020)	x	x					x			
Provide unified regional transit information system	Regional Strategic Transit Plan (2020)	x	x							x	
Coordinate regional fare policies	Regional Strategic Transit Plan (2020)	x	x					x			
Provide intercounty transit service: Commuter service to University Circle	Regional Strategic Transit Plan (2020)	x	x							x	
Expansion of demand response service design to enhance intercounty service	Regional Strategic Transit Plan (2020)	x	x							x	
Seniors and individuals with disabilities: Improve and expand transportation options for seniors and individuals with disabilities; Enhance accessibility, affordability, and quality of transportation services for seniors and individuals with disabilities. Provide platform for identifying transportation resources and service.	MOBILIZE 2019	x	x	x					x	x	
Operational improvements for seniors and individuals with disabilities: Explore accessibility and relationships with transportation network companies. Increase night, weekend, and last-minute transportation options. Improve access to underserved and unserved areas. Improve cross-county transportation options and efficiencies. Improve frequency and timeliness of service	MOBILIZE 2019	x	x	x						x	
Enhance and coordinate the region's rail and bus services	Vibrant NEO 2040	x	x		x					x	
Transit Access to Jobs: eNEO2050 improves access and mobility in the transit system based on recommendations in NOACA's Workforce Accessibility and Mobility study.	eNEO 2050 - Highlights	x	x		x			x			x
Implement low-cost traffic engineering solutions at identified arterial bottleneck locations on transit routes	Workforce Access and Mobility (2019)	x	x	x	x					x	
Dedicate highway lanes to express buses and car pools	Workforce Access and Mobility (2019)	x	x	x	x					x	
Develop more bike lanes to access major transit stations	Workforce Access and Mobility (2019)	x	x	x	x					x	
Evaluate the condition of all existing rail trackage and rail crossings to determine what investments would be necessary to bring substandard infrastructure up to standard for freight and passenger service.	Vibrant NEO 2040		x	x					x		x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 3: Effective Transit System That Connects People to Jobs											
Transit Mode share: eNEO 2050 promotes a mode shift towards improved transit usage across the region by providing access to the transit system and mobility within the transit system.	eNEO 2050 - Highlights	x	x		x			x			x
Support and prioritize funding for multimodal accessibility to job hubs and connections to transit services	Workforce Access and Mobility (2019)	x	x	x	x			x			
Add more park-and-ride locations throughout the region	Workforce Access and Mobility (2019)	x	x	x	x					x	
Support a regionalized transit system—intercounty transit routes and expansion of park and ride systems	Workforce Access and Mobility (2019)	x	x	x	x			x			
Major Projects list - Transit Passenger Facilities - Shelters & Park-N-Ride	eNEO 2050 Scenarios	x		x	x						x
Major Projects list - Transit Passenger Facilities - Rail Stations	eNEO 2050 Scenarios	x		x	x						x
Major Projects list - Transit Equipment - Bus Garages & Rail Yard	eNEO 2050 Scenarios		x	x	x						x
Transit-Oriented Development: eNEO 2050 includes transit-oriented development (TOD) as a mechanism to better connect land uses and transportation investments.	eNEO 2050 - Highlights	x	x		x			x		x	x
"Utilize TOD place typology with seven categories: Metro Core, Town Center, Neighborhood Center, Main Street, Neighborhood Residential, Industrial/Transitional, Special Destination "	TOD Scorecard (2016)	x	x	x	x			x			
Implement plans for three pilot sites: West Boulevard Cudell Rapid Station, East 116th Rapid Station, and Broadway/Slavic Village Bus Corridor.	TOD Scorecard (2016)	x	x	x	x					x	
Expand market analysis to other sites	TOD Scorecard (2016)	x	x	x	x					x	
Use transit oriented development (TOD) to create stronger, more accessible, regional job centers.	Vibrant NEO 2040	x	x	x	x					x	
Encourage mixed-use development along existing major transit corridors	Workforce Access and Mobility (2019)	x	x	x	x			x			
Autonomous Shuttle Feeder: eNEO 2050 pursues autonomous shuttle feeder bus services as a complement to existing modes for “First-Mile” and “Last-Mile” connections.	eNEO 2050 - Highlights	x	x		x		x				x
Evolving technologies in shared use mobility will be monitored to establish an autonomous shuttle feeder system to the BRT priority corridors, rail networks and job hubs	Strategic Regional Transit Plan	x	x		x		x				x
BRT Priority Corridors: eNEO 2050 includes BRT priority corridors as shown in GCRTA 2020 strategic plan as bus-rapid-transit systems.	eNEO 2050 - Highlights	x	x	x	x						x
Schedule more frequent express and local buses to major regional job hubs	Workforce Access and Mobility (2019)	x	x	x	x					x	
BRT Priority Corridors for Cuyahoga County	GCRTA Strategic Plan	x	x	x	x						x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 3: Effective Transit System That Connects People to Jobs											
Transit Asset Management: eNEO 2050 prioritizes $300 million in funding for transit preservation projects that are classified into two categories: vehicle replacements and non-vehicle capital maintenance.	eNEO 2050 - Highlights	x	x	x	x	x	x			x	x
Major Projects list - Transit Vehicle Replacements - Buses	eNEO 2050 Scenarios	x	x	x		x					x
Major Projects list - Tansit Vehicle Replacements - Rail Cars	eNEO 2050 Scenarios	x	x	x		x					x
Major Projects list - Transit Rail Infrastructure - Track & Catenary	eNEO 2050 Scenarios		x	x		x					x
Illustrative list - Transit Facilities - Maintenance & Rehab	eNEO 2050 Scenarios	x		x		x					x
Visionary Rapid Transit Network: eNEO 2050 advances a visionary rapid transit network as an illustrative project to be further studied in a $5 million Feasibility Study.	eNEO 2050 - Highlights	x	x	x	x	x	x			x	x
Regional high capacity transit: Explore additional connections: Lorain/Elyria-Westlake-Rocky River-Lakewood-Cleveland; Cleveland-Solon	Regional Strategic Transit Plan (2020)	x	x							x	
Consider connections to Areas outside NOACA: Canton-Akron-Cleveland, Medina-Akron bus route, existing plans for intercity transportation	Regional Strategic Transit Plan (2020)	x	x							x	
Consider Regional Transit Funding	Regional Strategic Transit Plan (2020)	x	x					x			
Extend the transit network to/from major regional job hubs and intercounty transit services	Workforce Access and Mobility (2019)	x	x	x						x	
Illustrative list - Other: Transit – New service	eNEO 2050 Scenarios	x	x		x		x				x
Illustrative list - Transit Facilities - New	eNEO 2050 Scenarios	x	x		x						x

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
		Planning Principles						4 Ps			
Strategy 4: Evolution of Future Infrastructure and Technologies											
EV Charging Stations: eNEO 2050 projects that over 2,000 charging stations will be needed over the next decade to facilitate adoption rates of electric vehicles. eNEO2050 includes $3 million for the installations of charging stations in public spaces and includes partnerships with the private sector to support the market.	eNEO 2050 - Highlights				x		x	x			x
Installation of EV charging stations	eNEO 2050 scenario projects				x		x				x
Autonomous and Connected vehicles: eNEO 2050 includes infrastructure preparation for the adoption and deployment of autonomous and connected vehicles including trucks for freight infrastructure improvements.	eNEO 2050 - Highlights	x	x		x		x			x	
High-Occupance Vehicle lanes are part of congestion management and add capacity to the transportation system. As new technologies emerge, HOV and CAV lanes can be combined.	Congestion Management Plan	x	x		x		x			x	
Vehicle safety systems enable communication with other vehicles and roadside systems and traffic signals to acquire information about traffic and travel conditions.	ITS planning	x	x	x	x		x			x	
Study needed infrastructure to support autonomous and connected vehciles in more depth.	eNEO 2050 scenario	x	x		x		x			x	
Micro-Mobility and Ride Sharing: eNEO 2050 implements NOACAs Van Pool program and expands micro-mobility initiatives such as e-bikes, e-scooters, and transportation network providers (TMP).	eNEO 2050 - Highlights	x	x		x				x	x	x
Integrate micro mobility, shared use mobility, active modes into regional services	Regional Strategic Transit Plan (2020)	x	x							x	
Hyperloop: eNEO 2050 includes Hyperloop as an illustrative project as NOACA continues to work with the private sector and USDOT on brining this new fifth mode of transportation to reality.	eNEO 2050 - Highlights	x	x				x			x	x
Develop an inclusive political framework that enables the Great Lakes Hyperloop to be utilized by local communities and individuals within historically underserved or disadvantaged populations	Hyperloop feasibility study						x	x			
Formalization of the Great Lakes Hyperloop into an P3 operational entity that will enable the coordination and collaboration with state and local planning authorities in subsequent phases of the study along the representative routes.	Hyperloop feasibility study						x	x		x	
Further studying the socioeconomic and community impacts and benefits of the Great lakes Hyperloop.	Hyperloop feasibility study						x			x	

Table 6-10 (Continued). Actions Envisioned by eNEO2050

eNEO 2050 TRANSPORTATION ACTIONS	Universe of Plans	Planning Principles						4 Ps			
		Access	Mobility	Safety	Emissions	Asset Management	Emerging Technologies	Policy	Program	Plan	Project
Environmental Stewardship as an agency responsible for environmental planning											
Increase awareness of the air quality challenge in Northeast Ohio including potential solutions.	Air Quality Public Education and Outreach Strategy & Communication Plan (2019)				x					x	
Promote strategies to change transportation and infrastructure policy and increase clean air funding.	Air Quality Public Education and Outreach Strategy & Communication Plan (2019)				x					x	
Optimize investment in existing infrastructure to support existing and infill development and not encourage new development on greenfield sites.	Clean Water 2020					x		x			
Provide a framework for locally determined development density that mitigates water quality impacts.	Clean Water 2020							x			
Protect regional water quality gains and guide implementation measures to improve water resources that do not yet meet designated uses.	Clean Water 2020									x	
Support programs that address stormwater and sewage treatment systems management.	Clean Water 2020									x	
Protect and restore valuable water resource areas.	Clean Water 2020									x	
Support watershed planning activities that address point and nonpoint source pollution.	Clean Water 2020									x	
Principle Arterial Network: eNEO 2050 elevates and prioritizes principal arterial corridors for signal improvements as part of the STOP program.	eNEO 2050 - Highlights								x		
Support Work to Restore and Protect Lake Erie and the Region's Freshwater Assets	Water Quality Strategic Plan (2017)								x		
Promote Water's Value as a Regional Driver of Economic Competitiveness	Water Quality Strategic Plan (2017)								x		
Identify and Inform leaders, stakeholders and communities about Regional Impacts of Local Water Infrastructure Decisions	Water Quality Strategic Plan (2017)									x	
Advance the Philosophy of "One Water" through NOACA's 208 Planning Process	Water Quality Strategic Plan (2017)									x	

ENDNOTES

1 Maggie L. Grabow, Scott N. Spak, Tracey Holloway, Brian Stone, Adam C. Mednick, and Jonathan .A. Patz, "Air Quality and Exercise-Related Health Benefits from Reduced Car Travel in the Midwestern United States," Environmental Health Perspectives 120, no. 1 (2012), 68-76.

2 GCRTA Strategic Plan (2020). Priority Corridor Update. Retrieved on June 3, 2021 from http://www.riderta.com/sites/default/files/pdf

3 US EPA, Co-Benefits Risk Assessment (COBRA) Health Impacts Screening and Mapping Tool, https://www.epa.gov/statelocalenergy/co-benefits-risk-assessment-cobra-health-impacts-screening-and-mapping-tool (accessed April 8, 2021).

4 Federal Transit Administration - National Transit Database (NTD) 2019 Annual Agency Profiles, https://www.transit.dot.gov/ntd/transit-agency-profiles
Ibid.

5 NOACA estimates used U.S. EPA's Motor Vehicle Emissions Simulator, version 2014a (MOVES2014a).

Photo by Marc-Olivier Jodoin on Unsplash

EXCITING INVESTMENTS

In this Chapter

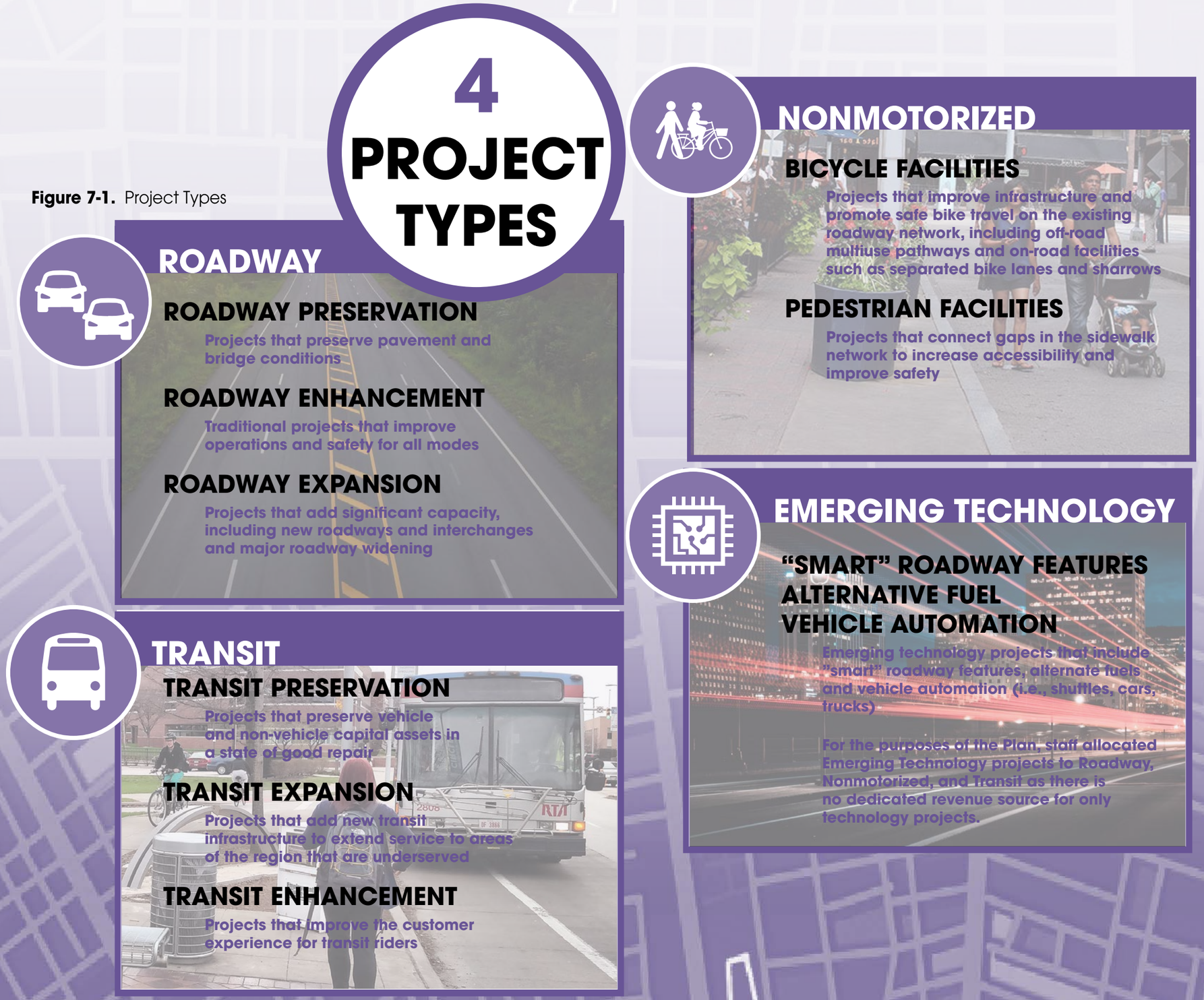
- *eNEO2050* **Financial Plan**
- **Revenue Forecasts**
- **Major and Illustrative Projects**
- **Transportation Conformity**

The financial plan demonstrates that *eNEO2050* is implementable and fiscally constrained, meaning that projects and strategies contained in the plan do not exceed the amount of funding "reasonably expected to be available." The plan also includes visionary, or illustrative, projects that are cost prohibitive for adoption in the plan but are critical to achieve *eNEO2050's* vision. The financial plan includes lists of all major, minor and illustrative projects. Major projects include those subject to demonstration of compliance with federal air quality conformity regulations.

Two revenue forecasts were developed for estimating future federal, state and local primary funding: (1) A baseline revenue forecast estimates future revenues based on historic levels of funding received. (2) The equitable revenue forecast explores what the region should receive in funding based on its' share of statewide assets and system users. Three growth rates were also explored: No Growth (0%), Continued Growth (2%), and High Growth (4%).

The "Baseline Revenue - continued growth forecast" is the most likely to occur and serve as the selected forecast for demonstration of fiscal constraint. This forecast anticipates $14.0 billion to be available. Under the "Equitable - continued growth forecast", the region could receive $17.2 billion, $3 billion in additional funding over the baseline revenue - continued growth forecast". This would require significant policy changes at the state level, but would allow for all of the $1.544 billion in illustrative roadway and non-motorized projects to advance to the fiscally constrained plan and/or contribute to phases of the $14.0 billion illustrative transit rail expansion project.

Figure 7-1. Project Types



Project Types in Constrained *eNEO2050* Plan

eNEO2050 identifies and prioritizes projects and strategies to maintain, enhance, and expand the region's multimodal transportation network through the year 2050. The purpose of the financial plan is to demonstrate that *eNEO2050* is implementable and fiscally constrained. This means projects and strategies contained in the transportation plan (Chapter 6) cannot exceed the amount of funding "reasonably expected to be available" during the life of the plan. The projects included in Chapter 6 may also include visionary, or illustrative, projects that are cost prohibitive for adoption in the constrained list of projects. Nevertheless, the illustrative projects may even be critical to achieve the *eNEO2050* vision. These projects may advance if funding becomes available and if the projects align with NOACA planning requirements during the life of the Plan.

Federal, state, and local generated revenue sources make up the majority of funding to support transportation system projects in the Plan. The financial resources projected to be available for the *eNEO2050* planning horizon come from the various federal, state, and local funding sources explored in previous sections of this chapter. NOACA does not control all the funding that is contained in *eNEO2050*, in fact, NOACA only controls a portion of the funding. NOACA recognizes the need for increased revenue to support the maintenance and enhancement of the state and regional transportation system.

Figure 7-2 provides an overview of the project types that are included in the constrained list of *eNEO2050*.

Table 7-1. Projects in Constraint *eNEO2050* Plan

SCENARIO PROJECTS	ORIGINAL SCENARIO	DECADES 2020-2030	2030-2040	2040-2050
ROADWAY				
Efficient and Affordable Highway System				
Enhanced Roadways for All Users (Part)				
Implementing 2024 TIP Highway and Transit Projects	Maintain, Car, Transit, Total	●	○	○
Implementing Major Highway capacity Projects	Car	●	●	●
Adding Harper Road, Jackson Street, Miller Road, and Granger Road Interchanges	Car	●	●	○
Reducing Highway Bottlenecks	Car	●	●	●
Regulating Flow of Traffic Entering Freeways by Adding Ramp Meters	Car	●	●	●
Reinvigorating Arterial Network	Car	●	●	●
Maintain Pavement Conditions with average of PCR = 75	Maintain, Car, Transit, Total	●	●	●
Maintain Bridges in Good or Fair Conditions	Maintain, Car, Transit, Total	●	●	●
Addressing Location-specific Safety issues in order to Reduce Traffic Fatalities	Maintain, Car, Transit, Total	●	●	●
NON-MOTORIZED FACILITY				
Enhanced Roadways for All Users (Part)				
Creating Walk and Bike Access from EJ Areas to Transit Network	Transit	●	●	●
Creating Walk and Bike Connections from Major Transit Hubs to Major Job Hubs	Transit, Total	○	○	●
Creating Walk and Bike Access from Major Residential Areas to Transit Network	Total	○	●	○
Implement Smart Pedestrian Crossings	Maintain, Car, Transit, Total	●	●	●
TRANSIT				
Effective Transit System that Connects People to Jobs				
Implementing Future Transit Agencies' Bus/BRT Routes	Transit, Total	○	●	○
Conduct Feasibility Studies and/or Environmental Impact Statement (EIS) for Achieving the Visionary Rail Scenario and Great Lakes Hyperloop	Transit, Total	●	●	○
Maintain Transit Vehicles in the Good State in the end of each Decade	Car	●	●	●
Maintain Transit Vehicles Serving the EJ Areas in the Good State all the times	Car	●	●	●
EMERGING TECHNOLOGIES IN TRANSPORTATION				
Evolution of Future Infrastructure and Technologies				
Installing EV Charging Ports	Maintain, Car, Transit, Total	●	●	●
Adding POD and Shuttle CAV Services from Major Transit Hubs to Major Job Hubs	Transit, Total	○	○	●
Installing Extra EV Charging Ports	Total	○	○	●
Allocating Selected Smart Freeway and Arterial Lanes to Autonomous Vehicles	Total	○	○	●

● = MAINTAIN SCENARIO
● = CAR SCENARIO
● = TRANSIT SCENARIO
● = TOTAL SCENARIO

Figure 7-2. Baseline Revenue Forecast and Projected Expenditures for *eNEO2050* Projects

Project Category	BASELINE REVENUE FORECAST (2020$)			CONSTRAINED eNEO2050
	No Growth	Continued Growth (2%)	High Growth (4%)	Net Present Value (2020$)
Roadway	$10.1 billion	$11.6 billion	$14.1 billion	$9.6 billion
Transit	$1.6 billion	$2.1 billion	$2.8 billion	$2.8 billion
Nonmotorized	$271 million	$352 million	$469 million	$540 million
Emerging Technology	N/A	N/A	N/A	$452 million
eNEO2050 Plan Total	$12 billion	$14 billion	$17.4 billion	$13.4 billion

Figure 7-3. Projected Continued Growth Revenue & Cost Comparison for *eNEO2050* Projects

Project Category	Projected Revenue	Projected Cost	Difference
Roadway	$11.6 billion	$9.6 billion	$2 billion
Transit	$2.1 billion	$2.8 billion	-$733 million
Nonmotorized	$352 million	$540 million	-$188 million
Emerging Technology	N/A	$452 million	-$452 million
eNEO2050 Plan Total	$14 billion	$13.4 billion	$626 million

Revenue Forecast

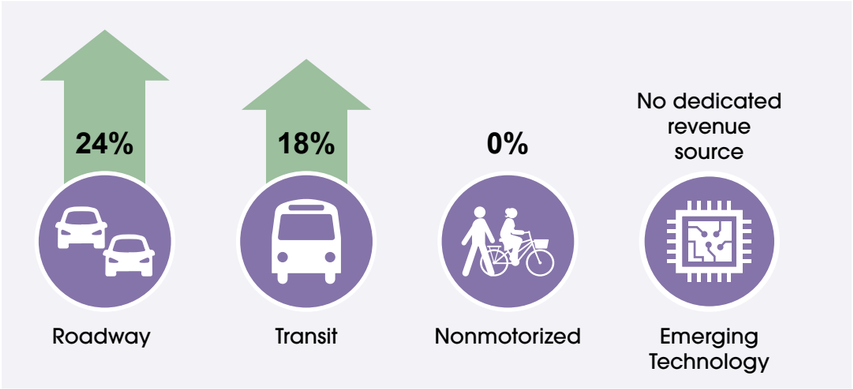
Table 7-1 shows the projects that are in the constrained plan that support this Vision for an equitable Northeast Ohio.

The total project costs included in the hybrid scenario total $13.415 billion USD, therefore fiscal constraint requirements are satisfied. Comparing the baseline forecast to the constrained list of projects (Figure 7-2 and Figure 7-3), it is important to note that dedicated sources of revenue to non-motorized and transit are insufficient, while dedicated sources for roadway are in excess of project needs. It is expected that a modest amount of available roadway funding will be utilized to supplement non-motorized project needs as many of these projects are done in coordination with roadway projects – i.e. bike lanes, sidewalks, and improvements to pedestrian crossings. It is expected also that available roadway funding will be utilized to supplement transit project needs through flex fund transfers of eligible federal funds, such as STBG and CMAQ.

While the Baseline Revenue Forecast represents what is reasonably expected to be available during the life of the *eNEO2050* plan, the Equitable Revenue Forecast demonstrates what the NOACA region should receive based on its share of statewide assets and populations.

Lastly, the Equitable Revenue Forecast (Figure 7-4) was developed to demonstrate what the NOACA region should receive based on its share of statewide assets and populations, consistent with the federal and state purpose of those funding allocations. Under the Equitable-Continued Growth scenario, the NOACA region would expect to receive $17.243 billion, equating to $3.2 billion in additional funding over the Baseline Revenue Forecast. This funding would allow for all of the $1.544 billion in Illustrative roadway and non-motorized projects to advance to the fiscally constrained plan and/or contribute to phases of the $14.0 billion Illustrative transit rail expansion project needs. As such, NOACA will continue to advocate for funding allocations to the region in line with the Equitable Revenue Forecast.

Figure 7-4. Equitable Revenue Forecast Funding Increase Over Baseline



List of Major, Minor, and Illustrative Projects

Projects contained within *eNEO2050* are categorized by general type of system improvement: Maintain - Projects that preserve existing transportation system assets, Enhance - Projects that enhance safety, operations, and multimodal options on the transportation system, or Expand - Projects that expand capacity of the transportation system through the addition of new infrastructure (Figure 7-5). As contained in the *Going Forward, Together* regional strategic plan, NOACA has committed that at least 90% of the funding planned and programmed in the region will be for projects that maintain and enhance the existing system. These projects represent 99% of the total planned projects, while only 1% of planned projects seek to expand the existing system. Projects that expand the system grow the region's future maintenance responsibility – physically and financially, and have the potential to further disconnect people from places of employment and business.

Projects are also grouped by mode, based on primary project improvement types. Grouping projects by mode allows for a consistent comparison with primary transportation revenue estimates, which are dedicated through specific federal and state programs for specific purposes and goals. The projects contained in *eNEO2050* account for 72% of the spending for roadway projects, 21% for transit projects, 4% for non-motorized projects, and 3% for emerging technology projects. The spending on roadway projects includes improvements that enhance roadways for nonmotorized and transit modes as many of these projects are done in coordination with roadway projects – i.e. bike lanes, sidewalks, transit waiting improvements. It is also expected that available roadway funding will be utilized to supplement transit project needs through flex fund transfers of eligible federal funds, such as STBG and CMAQ.

The federal requirements (23 CFR 450.324) for transportation plans require a list of major projects proposed for implementation in the region during the Plan's life. NOACA defines major projects as those greater than $12 million that also meet the federal definition of a Regionally Significant Project (23 CFR, Section 450.104), or projects not defined as exempt in EPA's transportation conformity regulations (40 CFR part 93, subpart A). Figure 7-9 contains a map of major projects contained in eNEO2050, and Table 7-2 provides more information. For more details, please see Table 7-3. This table contains a list of proposed major and minor illustrative projects included in *eNEO2050* that are pending review against NOACA planning requirements and/or demonstration of fiscal constraint.

Fiscally constrained minor projects, or those that do not meet the definition of "major" (see above), appear in the appendices as follows:

- Appendix 10-1: List of all minor projects ranging in cost of $500,000 to $11,999,999. This list is a comprehensive listing of all minor projects generated from NOACA pavement, bridge, and nonmotorized plans and tools; and through the community and regional agency project solicitation.
- Appendix10-2: Maps of Transportation Asset Management road rehabilitation projects (annual)
- Appendix 10-3: Map of *eNEO2050* bicycle facilities projects
- Appendix 10-4: Map of pedestrian facilities projects

Figure 7-5. *eNEO2050* Constrained Projects by Investment Strategy

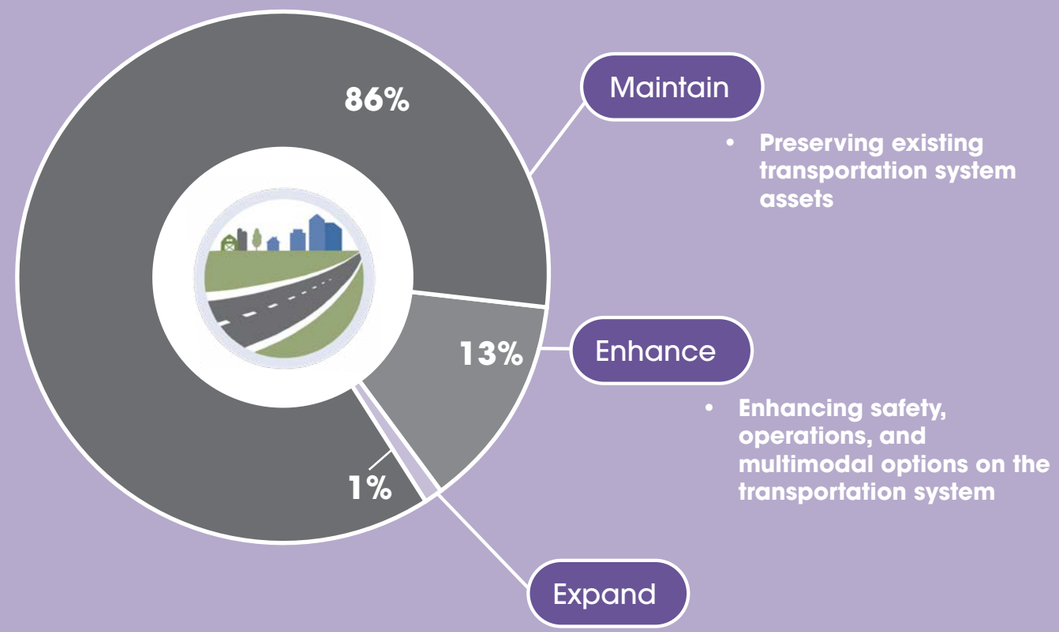


Figure 7-6. *eNEO2050* Constrained Projects by Category

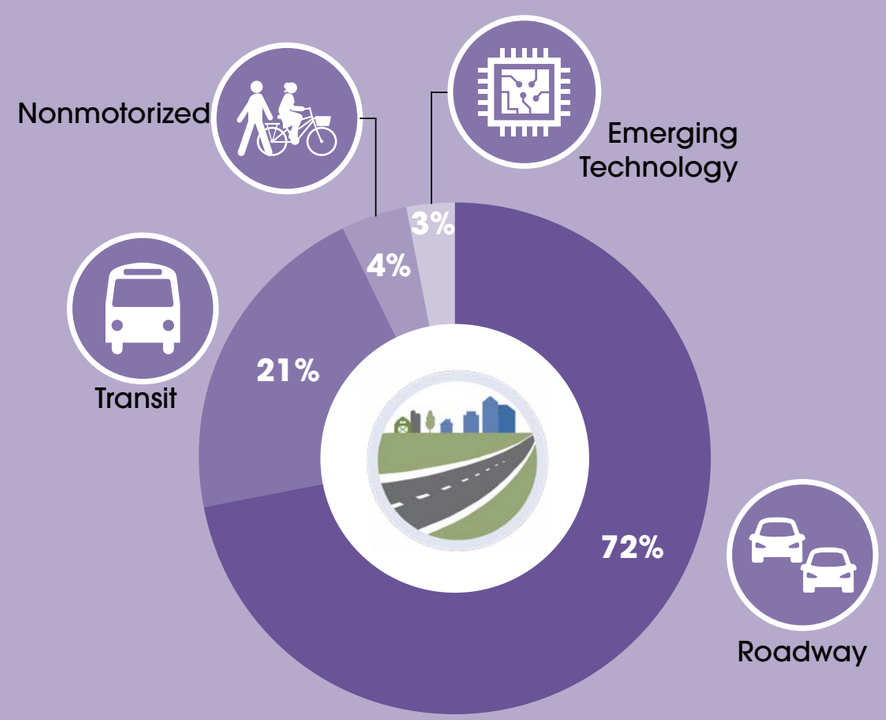


Figure 7-7. *eNEO2050* Illustrative Projects by Investment Strategy

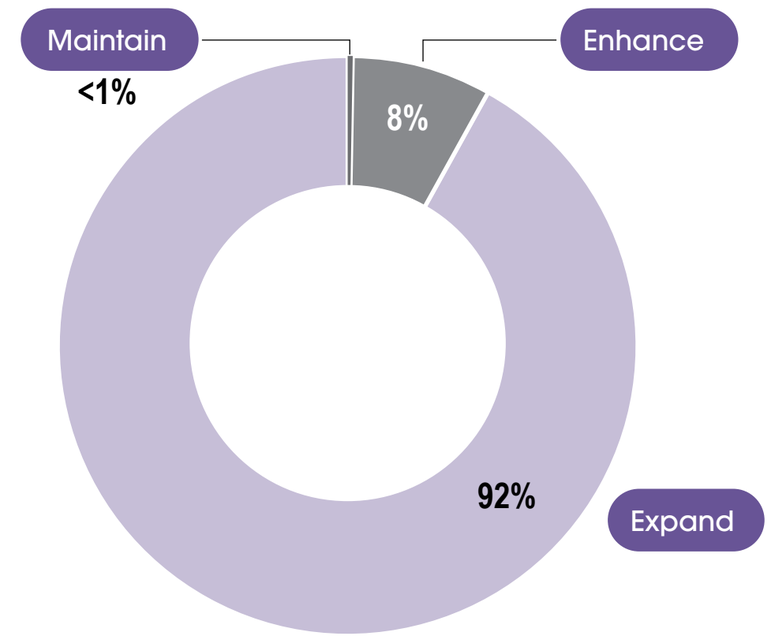


Figure 7-8. *eNEO2050* Illustrative Projects by Category

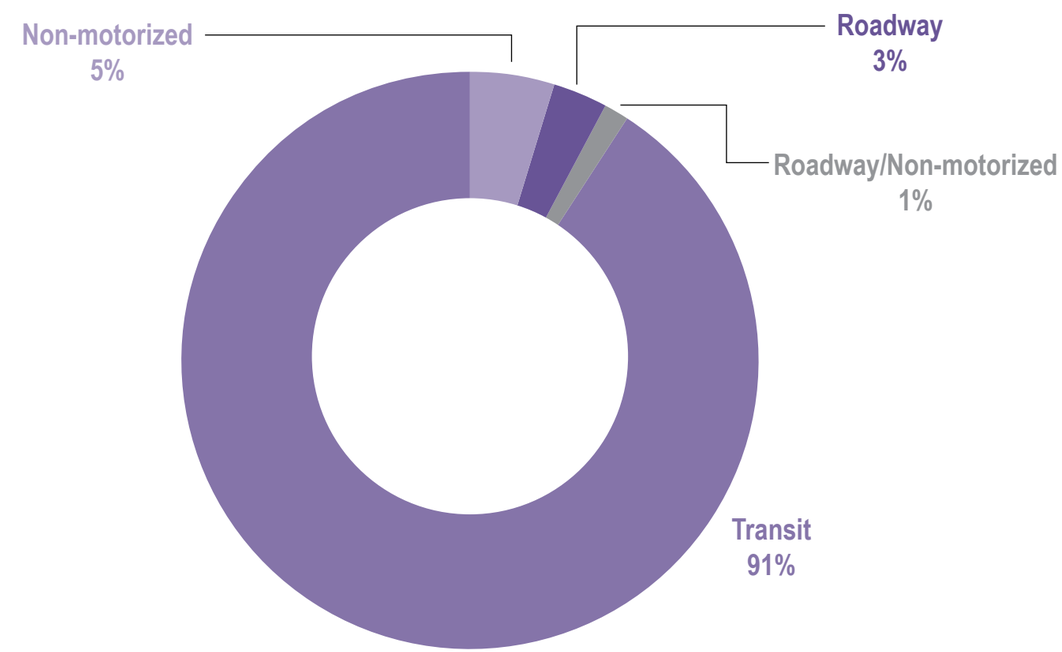
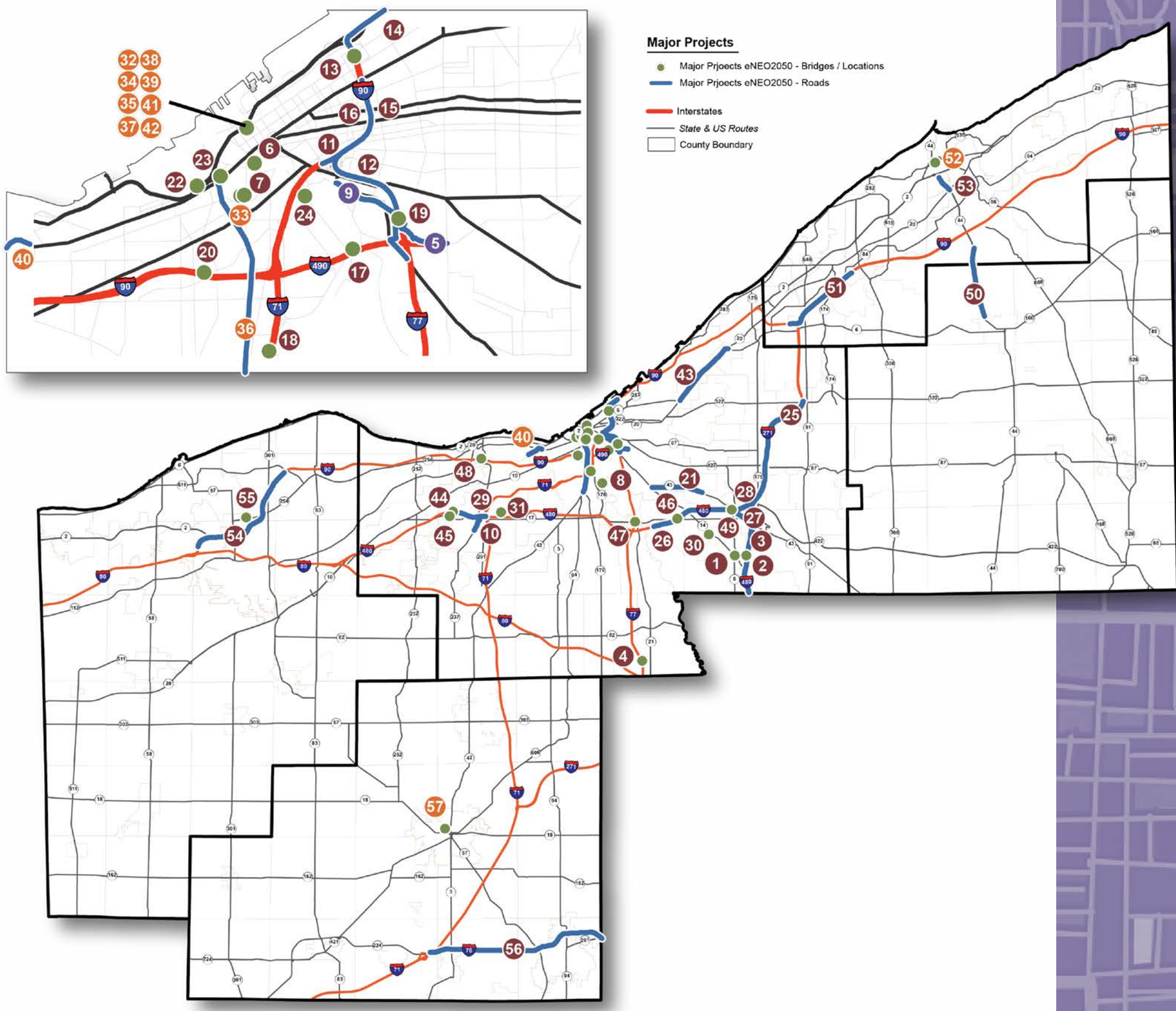


Figure 7-9. Major Projects



	PROJECT NAME	
1	SR-8 BRIDGE REHABILITATION OVER SR-14, TINKERS CREEK & WLE RR	ROADWAY
2	I-271 N.B. BRIDGE REHABILITATION OVER TINKERS CREEK, WLE RR & SOLON RD	ROADWAY
3	I-271 S.B. BRIDGE REHABILITATION OVER TINKERS CREEK, WLE RR & SOLON RD	ROADWAY
4	I-77 0.42 / MILLER ROAD NEW INTERCHANGE	ROADWAY
6	CARTER LIFT BRIDGE REHABILITATION OVER CUYAHOGA RIVER	ROADWAY
7	COLUMBUS ROAD LIFT BRIDGE REHABILITATION OVER CUYAHOGA RIVER	ROADWAY
8	DENISON-HARVARD BRIDGE REHABILITATION OVER CUYAHOGA RIVER & RRs	ROADWAY
10	HOPKINS AIRPORT ACCESS / BEREA FREEWAY IMPROVEMENTS	ROADWAY
11	INNERBELT CCG3A I-90 CENTRAL INTERCHANGE REHAB. & STANDARDIZATION	ROADWAY
12	INNERBELT CCG3B I-77 14.57 REHABILITATION & STANDARDIZATION	ROADWAY
13	INNERBELT CCG4C NORFOLK SOUTHERN RAILROAD REHAB. AND STANDARDIZATION	ROADWAY
14	INNERBELT CCG4E I-90 CURVE REHABILITATION AND STANDARDIZATION	ROADWAY
15	INNERBELT CCG5B 1-90 EB PAVEMENT REHABILITATION AND STANDARDIZATION	ROADWAY
16	INNERBELT CCG5C 1-90 WB PAVEMENT REHABILITATION AND STANDARDIZATION	ROADWAY
17	I-490 BRIDGE REHABILITATION OVER CUYAHOGA RIVER	ROADWAY
18	I-71 N.B. BRIDGE REHABILITATION OVER SR-176 JENNINGS FREEWAY	ROADWAY
19	I-77 BRIDGE REHABILITATION OVER KINGSBURY RUN, RTA, & NSC RR	ROADWAY
20	I-90 BRIDGE REHABILITATION OVER NSC RR & TRAIN AVE	ROADWAY
21	MILES RD (SR-43) REHABILITATION FROM LEE RD TO BROADWAY AVE	ROADWAY
22	SR-2 BRIDGE REHABILITATION OVER CUYAHOGA RIVER, RTA, & FLATS	ROADWAY
23	US- 6 BRIDGE REHABILITATION OVER CUYAHOGA RIVER & RTA	ROADWAY
24	WEST 3RD LIFT BRIDGE REHABILITATION OVER CUYAHOGA RIVER	ROADWAY
25	I-271 MAJOR REHABILITATION FROM I-480 N TO I-90	ROADWAY
26	I-480 MAJOR REHABILITATION FROM I-77 TO I-480 N	ROADWAY
27	I-480 MAJOR REHABILITATION FROM I-480 N TO I-271	ROADWAY
28	I-480 MAJOR REHABILITATION FROM I-480 TO I-271	ROADWAY
29	I-480 MAJOR REHABILITATION FROM THE ROCKY RIVER TO I-71	ROADWAY
30	ROCKSIDE RD CR 53 BRIDGE REHABILITATION OVER NS & CONRAIL RRs	ROADWAY
31	WEST 150TH ST BRIDGE REHABILITATION OVER NS RR	ROADWAY
43	EUCLID AVE (US-6) REHAB. FROM SUPERIOR RD TO IVANHOE RD/BELVOIR RD	ROADWAY
44	I-480 BRIDGE REHABILITATION OVER ROCKY RIVER	ROADWAY
45	SR-17 BRIDGE REHABILITATION OVER ROCKY RIVER	ROADWAY
46	I-480 / GRANGER ROAD NEW INTERCHANGE	ROADWAY
47	I-77 BRIDGE REHABILITATION OVER CUYAHOGA RIVER, CANAL RD, & CSX	ROADWAY
48	I-90 BRIDGE REHABILITATION OVER ROCKY RIVER VALLEY	ROADWAY
49	I-480N BRIDGE REHABILITATION OVER SR-8 & I-480 WB	ROADWAY
50	SR-44 MAJOR REHABILITATION IN CHARDON/CONCORD TWPs	ROADWAY
51	I-90 MAJOR REHABILITATION FROM ROCKEFELLER TO W OF KIRTLAND RD	ROADWAY
53	SR-44 ST 05.10 / JACKSON STREET NEW INTERCHANGE	ROADWAY
54	I-90 MAJOR REHAB. FROM OHIO TURNPIKE BRIDGE TO FRENCH CREEK BRIDGE	ROADWAY
55	NORTH RIDGE ROAD BRIDGE REHABILITATION OVER BLACK RIVER	ROADWAY
56	I-76 MAJOR REHABILITATION FROM I-71 TO SUMMIT CO LINE	ROADWAY
32	COMMUNICATION SYSTEM REPLACEMENTS	TRANSIT
33	CUYAHOGA VIADUCT DECK REPLACEMENT OVER CUYAHOGA RIVER	TRANSIT
34	FARE COLLECTION SYSTEM REPLACEMENTS	TRANSIT
35	GCRTA BUS REPLACEMENTS	TRANSIT
36	METROHEALTH LINE BRT FROM SUPERIOR RD TO BROADWAY AVE	TRANSIT
37	UPGRADE PRIORITY TRANSIT CORRIDORS IDENTIFIED IN GCRTA STRATEGIC PLAN	TRANSIT
38	RAIL CAR MID-LIFE OVERHAULS	TRANSIT
39	RAIL CAR REPLACEMENTS	TRANSIT
40	RED LINE S-CURVE RELOCATION	TRANSIT
41	SECTION 5307 URBAN CAPITAL PROGRAM	TRANSIT
42	SECTION 5337 STATE OF GOOD REPAIR PROGRAM	TRANSIT
52	LAKETRAN BUS REPLACEMENTS	TRANSIT
57	TRANSIT VEHICLE REPLACEMENTS	TRANSIT
5	BROADWAY CONNECTOR BICYCLE-MULTIPURPOSE TRAIL	NON-MOTORIZED
9	DOWNTOWN CLEVELAND CONNECTOR, PHASE 2 SEPARATED BIKEPATH	NON-MOTORIZED

Table 7-2. List of eNEO2050 Major Projects: Projects >$12 Million or with Significant Impact to the System or Air Quality

MAP ID	PROJECT NAME	NEED SFY	ESTIMATED COST	MAINTAIN/ ENHANCE/ EXPAND	MODE	PRIMARY WORK TYPE
1	SR-8 BRIDGE REHABILITATION OVER SR-14, TINKERS CREEK & WLE RR	2030-2040	$15,168,404	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
2	I-271 N.B. BRIDGE REHABILITATION OVER TINKERS CREEK, WLE RR & SOLON RD	2040-2050	$14,274,802	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
3	I-271 S.B. BRIDGE REHABILITATION OVER TINKERS CREEK, WLE RR & SOLON RD	2040-2050	$13,947,311	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
4	I-77 0.42 / MILLER ROAD NEW INTERCHANGE	2023	$21,300,000	EXPAND	ROADWAY	NEW INTERCHANGE
6	CARTER LIFT BRIDGE REHABILITATION OVER CUYAHOGA RIVER	2025	$50,000,000	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
7	COLUMBUS ROAD LIFT BRIDGE REHABILITATION OVER CUYAHOGA RIVER	2038	$15,000,000	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
8	DENISON-HARVARD BRIDGE REHABILITATION OVER CUYAHOGA RIVER & RRs	2025-2030	$28,721,702	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
10	HOPKINS AIRPORT ACCESS / BEREA FREEWAY IMPROVEMENTS	2026	$17,200,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
11	INNERBELT CCG3A I-90 CENTRAL INTERCHANGE REHABILITATION & STANDARDIZATION	2025	$160,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
12	INNERBELT CCG3B I-77 14.57 REHABILITATION & STANDARDIZATION	2026	$160,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
13	INNERBELT CCG4C NORFOLK SOUTHERN RAILROAD REHABILITATION AND STANDARDIZATION	2029	$55,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
14	INNERBELT CCG4E I-90 CURVE REHABILITATION AND STANDARDIZATION	2029	$300,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
15	INNERBELT CCG5B 1-90 EB PAVEMENT REHABILITATION AND STANDARDIZATION	2031	$250,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
16	INNERBELT CCG5C 1-90 WB PAVEMENT REHABILITATION AND STANDARDIZATION	2031	$170,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION/ STANDARDIZATION
17	I-490 BRIDGE REHABILITATION OVER CUYAHOGA RIVER	2030-2040	$68,107,768	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
18	I-71 N.B. BRIDGE REHABILITATION OVER SR-176 JENNINGS FREEWAY	2030-2040	$16,492,760	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
19	I-77 BRIDGE REHABILITATION OVER KINGSBURY Run, RTA, & NSC RR	2040-2050	$46,334,346	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
20	I-90 BRIDGE REHABILITATION OVER NSC RR & TRAIN AVE	2030-2040	$12,670,101	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
21	MILES RD (SR-43) REHABILITATION FROM LEE RD TO BROADWAY AVE	2023	$14,384,322	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
22	SR-2 BRIDGE REHABILITATION OVER CUYAHOGA RIVER, RTA, & FLATS	2025-2030	$72,508,024	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION

Table 7-2 (Continued). List of eNEO2050 Major Projects: Projects >$12 Million or with Significant Impact to the System or Air Quality

MAP ID	PROJECT NAME	NEED SFY	ESTIMATED COST	MAINTAIN/ ENHANCE/ EXPAND	MODE	PRIMARY WORK TYPE
23	US- 6 BRIDGE REHABILITATION OVER CUYAHOGA RIVER & RTA	2025-2030	$29,153,744	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
24	WEST 3RD LIFT BRIDGE REHABILITATION OVER CUYAHOGA RIVER	2030	$12,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
25	I-271 MAJOR REHABILITATION FROM I-480 N TO I-90	2030	$166,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
26	I-480 MAJOR REHABILITATION FROM I-77 TO I-480 N	2027	$160,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
27	I-480 MAJOR REHABILITATION FROM I-480 N TO I-271	2028	$38,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
28	I-480 MAJOR REHABILITATION FROM I-480 TO I-271	2028	$46,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
29	I-480 MAJOR REHABILITATION FROM THE ROCKY RIVER TO I-71	2030	$22,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
30	ROCKSIDE RD CR 53 BRIDGE REHABILITATION OVER NS & CONRAIL RRs	2041	$23,000,000	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
31	WEST 150TH ST BRIDGE REHABILITATION OVER NS RR	2046	$18,000,000	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
43	EUCLID AVE (US-6) REHABILITATION FROM SUPERIOR RD TO IVANHOE RD/BELVOIR RD	2023	$13,109,275	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
44	I-480 BRIDGE REHABILITATION OVER ROCKY RIVER	2030-2040	$32,190,935	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
45	SR-17 BRIDGE REHABILITATION OVER ROCKY RIVER	2025-2030	$18,176,255	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
46	I-480 / GRANGER ROAD NEW INTERCHANGE	2030-2040	$13,000,000	EXPAND	ROADWAY	NEW INTERCHANGE
47	I-77 BRIDGE REHABILITATION OVER CUYAHOGA RIVER, CANAL RD, & CSX	2040-2050	$60,194,581	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
48	I-90 BRIDGE REHABILITATION OVER ROCKY RIVER VALLEY	2025-2030	$15,570,943	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
49	I-480N BRIDGE REHABILITATION OVER SR-8 & I-480 WB	2040-2050	$13,342,980	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
50	SR-44 MAJOR REHABILITATION IN CHARDON/CONCORD TWPs	2026	$10,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
51	I-90 MAJOR REHABILITATION FROM ROCKEFELLER TO W OF KIRTLAND RD	2030	$83,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
53	SR-44 ST 05.10 / JACKSON STREET NEW INTERCHANGE	2030-2040	$15,000,000	EXPAND	ROADWAY	NEW INTERCHANGE
54	I-90 MAJOR REHABILITATION FROM OHIO TURNPIKE BRIDGE TO FRENCH CREEK BRIDGE	2024	$52,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
55	NORTH RIDGE ROAD BRIDGE REHABILITATION OVER BLACK RIVER	2040-2050	$17,693,150	MAINTAIN	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
56	I-76 MAJOR REHABILITATION FROM I-71 TO SUMMIT CO LINE	2030-2040	$120,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION

Table 7-2 (Continued). List of eNEO2050 Major Projects: Projects >$12 Million or with Significant Impact to the System or Air Quality

MAP ID	PROJECT NAME	NEED SFY	ESTIMATED COST	MAINTAIN/ ENHANCE/ EXPAND	MODE	PRIMARY WORK TYPE
32	COMMUNICATION SYSTEM REPLACEMENTS	2032, 2044	$30,000,000	MAINTAIN	TRANSIT	TRANSIT EQUIPMENT
33	CUYAHOGA VIADUCT DECK REPLACEMENT OVER CUYAHOGA RIVER	2043	$106,000,000	MAINTAIN	TRANSIT	BRIDGE MAINTENANCE/ REHABILITATION
34	FARE COLLECTION SYSTEM REPLACEMENTS	2025, 2037, 2049	$75,000,000	MAINTAIN	TRANSIT	TRANSIT EQUIPMENT
35	GCRTA BUS REPLACEMENTS	2025-2050	$520,000,000	MAINTAIN	TRANSIT	VEHICLE REPLACEMENTS
36	METROHEALTH LINE BRT FROM SUPERIOR RD TO BROADWAY AVE	2025	$40,000,000	ENHANCE	TRANSIT	" ROAD RESURFACING/ REHABILITATION/ TRAFFIC SIGNALS/ TRANSIT SHELTERS "
37	UPGRADE PRIORITY TRANSIT CORRIDORS IDENTIFIED IN GCRTA STRATEGIC PLAN	2027-2034	$160,000,000	ENHANCE	TRANSIT	" ROAD RESURFACING/ REHABILITATION/ SIGNS/ TRAFFIC SIGNALS/ TRANSIT SHELTERS "
38	RAIL CAR MID-LIFE OVERHAULS	2050	$60,000,000	MAINTAIN	TRANSIT	VEHICLE REPLACEMENTS
39	RAIL CAR REPLACEMENTS	2025-2030	$150,000,000	MAINTAIN	TRANSIT	TRANSIT- VEHICLE REPLACEMENTS
40	RED LINE S-CURVE RELOCATION	2030	$18,000,000	ENHANCE	TRANSIT	TRANSIT - RAIL INFRASTRUCTURE
41	SECTION 5307 URBAN CAPITAL PROGRAM	2025-2050	$780,000,000	MAINTAIN	TRANSIT	" VEHICLE REPLACEMENTS/ RAIL INFRASTRUCTURE/ PARK AND RIDE LOTS/ FACILITY REHABILITATION "
42	SECTION 5337 STATE OF GOOD REPAIR PROGRAM	2025-2050	$520,000,000	MAINTAIN	TRANSIT	TRANSIT - RAIL INFRASTRUCTURE
52	LAKETRAN BUS REPLACEMENTS	2028-2045	$20,000,000	MAINTAIN	TRANSIT	TRANSIT- VEHICLE REPLACEMENTS
57	TRANSIT VEHICLE REPLACEMENTS	2025-2050	$19,500,000	MAINTAIN	TRANSIT	TRANSIT- VEHICLE REPLACEMENTS
5	BROADWAY CONNECTOR BICYCLE-MULTIPURPOSE TRAIL	2030	$12,000,000	ENHANCE	NON-MOTORIZED	SEPARATED BIKEPATH
9	DOWNTOWN CLEVELAND CONNECTOR, PHASE 2 SEPARATED BIKEPATH	2035	$15,000,000	ENHANCE	NON-MOTORIZED	SEPARATED BIKEPATH

Illustrative Projects (Highights)

For a full listing of illustrative projects, see Table 7-3


Source: HyperloopTT/NOACA

GREAT LAKES HYPERLOOP

Conduct an Environmental Impact Statement for the Great Lakes Hyperloop

Need Years: 2025-2030

Cost: $10,000,000

REGIONAL AIRPORT ACCESS

Combine several smaller projects aimed at improving ingress and egress to reduce congestion and improve operations. These projects are still conceptual but may include roadway reconfigurations, adjusted curbs, added public parking and rental car access, and elimination of some traffic crossings and signals.

Need Years: 2025-2030

Cost: $100,000,000

VISIONARY RAIL EXTENSION

Extension of the existing GCRTA rail network within Cuyahoga County Suburbs, and to the Cities of Elyria, Medina, Solon, and Mentor in the surrounding counties. The extended network would connect residents to major job hubs and regional places of business and attraction.

Need Years: 2040-2050

Cost: $14,000,000,000

ADDITIONAL INTERCHANGES

Construct new interchanges at IR-271 and White Road in Mayfield, IR-71 and Boston Road in Brunswick/Medina County, and IR-71 and SR-57 in Medina County.

Need Years: TBD

Cost: TBD

REGIONAL LAKEFRONT TRAIL

Provide erosion mitigation and public multipurpose access along the shoreline of Lake Erie in Cuyahoga, Lake, and Lorain Counties. Parts of this project could be modeled after a similar project constructed in the City of Euclid.

Need Years: 2025-2030

Cost: $750,000,000

ROADWAY EXPANSIONS

Various capacity improvement and roadway expansions throughout the region, as identified by communities. See Appendix for full listing of locations.

Need Years: TBD

Cost: TBD

Table 7-3. List of eNEO2050 Illustrative Projects (Projects Pending Review against NOACA Planning Requirements and/or Demonstration of Fiscal Constraint)

COUNTY	LOCATION	PROJECT NAME	PROJECT DESCRIPTION	NEED YEAR	COST	MAINTAIN / EHANACE / EXPAND	MODE	PRIMARY WORK TYPE
CUYAHOGA	BEACHWOOD	CUY - 271/422 - 7.80/10.77	ALONG CHAGRIN BOULEVARD BETWEEN RICHMOND ROAD AND ORANGE PLACE-WIDEN THE SB/NB APPROACHES TO THE CHAGRIN BLVD./ RICHMOND RD. INTERSECTION, CONSTRUCT A WB RIGHT TURN LANE AT CHAGRIN BLVD / RICHMOND RD AND EXTEND THE THIRD EB TRAVEL LANE ON CHAGRIN BLVD. BEYOND RICHMOND RD, WIDEN THE I-271 NB EXIT RAMP FOR DUAL LEFT/RIGHT TURN LANES, WIDEN EB/WB CHAGRIN BLVD., INCLUDING THE BRIDGE OVER I-271	2024	$16,378,700	ENHANCE	ROADWAY	"ROAD WIDENING/ REHABILITATION/ INTERSECTION IMPROVEMENT/ TRAFFIC SIGNALS"
CUYAHOGA	CLEVELAND	CLEVELAND'S MULTIMODAL TRANSPORTATION FACILITY TRANSIT-NEW FACILITIES	CONSTRUCT CLEVELAND'S MULTIMODAL TRANSPORTATION FACILITY	2040	$46,700,000	ENHANCE	TRANSIT	TRANSIT-NEW FACILITIES
CUYAHOGA	CLEVELAND	LAKEFRONT PEDESTRIAN CONNECTION	ENHANCED PEDESTRIAN ACCESS TO THE LAKEFRONT CONNECTING DOWNTOWN CLEVELAND AND LEVERAGE A COHESIVE AND OPEN CITY GRID AND CREATE SITES FOR ECONOMIC DEVELOPMENT.	2025-2030	$200,000,000	ENHANCE	ROADWAY/ NON-MOTORIZED	BICYCLE/PEDESTRIAN FACILITIES
CUYAHOGA	CLEVELAND	REGIONAL AIRPORT ACCESS IMPROVEMENTS	COMBINE SEVERAL SMALLER PROJECTS AIMED AT IMPROVING INGRESS AND EGRESS TO REDUCE CONGESTION AND IMPROVE OPERATIONS. ALTHOUGH STILL IN A CONCEPTUAL PHASE, RECOMMENDED IMPROVEMENTS INCLUDE A REVISED ROADWAY CONFIGURATION, ADJUSTED CURB CONFIGURATION AND OPERATION, ADDED PUBLIC PARKING WITH WALKABLE ACCESS, IMPROVED RENTAL CAR ACCESSIBILITY, AND ELIMINATING CERTAIN TRAFFIC CROSSINGS AND SIGNALS.	2025-2030	$100,000,000	ENHANCE	ROADWAY	ROADWAY REALIGNMENT/ NEW ROAD
CUYAHOGA	CLEVELAND	SHAKER SQUARE SQ-RECONFIGURATION ROAD REHABILITATION	REALIGNMENT OF SR 87, MORELANDS, VAN AIKEN, NEW TRAFFIC CONTROL, PEDESTRIAN ENHANCEMENTS	2032	$12,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
CUYAHOGA	CLEVELAND	WHISKEY ISLAND BRIDGE ACCESS NEW BRIDGE AND ROAD APPROACHES	WHISKEY ISLAND BRIDGE OVER CUYAHOGA RIVER ABANDONING WILLOW LIFT BRIDGE CREATING RELIABLE ISLAND ACCESS FOR REGIONAL SALT AND AGGREGATE SUPPLIERS	2026	$85,000,000	EXPAND	ROADWAY	NEW BRIDGE AND ROAD APPROACHES
CUYAHOGA	INDEPENDENCE	BRECKSVILLE ROAD RECONSTRUCTION AND STREETSCAPE IMPROVEMENTS	THIS PROJECT PROPOSES TO CONSTRUCT A 14' BOULEVARD ALONG THE CENTER OF BRECKSVILLE ROAD NORTH OF ROCKSIDE ROAD, SIMILAR TO WHAT CURRENTLY EXISTS SOUTH OF ROCKSIDE ROAD. THE CROSS SECTION PROVIDES 2 TRAVEL LANES IN EACH DIRECTION, A 14' MEDIAN, 8' SIDEWALK ON ONE SIDE OF BRECKSVILLE ROAD AND A 5' SIDEWALK ON THE OTHER. THE EXISTING BRIDGE OVER I-480 WILL NEED TO BE WIDENED 16' AS PART OF THIS PROJECT.	2023	$17,976,522	EXPAND	ROADWAY	ROAD REHABILITATION / WIDENING/ STREETSCAPE

Table 7-3 (Continued). List of eNEO2050 Illustrative Projects (Projects Pending Review against NOACA Planning Requirements and/or Demonstration of Fiscal Constraint)

COUNTY	LOCATION	PROJECT NAME	PROJECT DESCRIPTION	NEED YEAR	COST	MAINTAIN / EHANACE / EXPAND	MODE	PRIMARY WORK TYPE
CUYAHOGA	INDEPENDENCE	I-77 / PLEASANT VALLEY ROAD INTERCHANGE IMPROVEMENT	THIS PROJECT WILL IMPROVE THE SAFETY AND INCREASE THE CAPACITY OF THE I-77 / PLEASANT VALLEY ROAD INTERCHANGE WITHIN THE CITY OF INDEPENDENCE.	2026	$6,000,000	EXPAND	ROADWAY	"FACILITY RENOVATION ROAD WIDENING/ REHABILITATION/ INTERSECTION IMPROVEMENT/ TRAFFIC SIGNALS/ INTERCHANGE IMPROVEMENT"
CUYAHOGA	MAYFIELD	I-271 AND WHITE ROAD INTERCHANGE	CONSTRUCT A NEW INTERCHANGE AT IR-271 AND WHITE ROAD	TBD	TBD	EXPAND	ROADWAY	NEW INTERCHANGE
CUYAHOGA	MAYFIELD	I-271 AND WILSON MILLS ROAD INTERCHANGE MODIFICATION	ADDITION OF A THIRD LANE IN BOTH THE EAST AND WEST BOUND DIRECTION ON WILSON MILLS ROAD TO FACILITATE AN ADDITIONAL LEFT TURN LANE ONTO BOTH I-271 NORTH AND SOUTH BOUND ON RAMPS. THE WIDENING OF THE EXISTING NORTH AND SOUTH BOUND ON RAMPS FROM ONE LANE TO TWO LANES TO ACCEPT THE ADDITIONAL LEFT TURN LANE FROM WILSON MILLS ROAD. THIS IMPROVEMENT WILL ALSO REQUIRE THE MODIFICATION OF THE EXISTING TRAFFIC SIGNALS ON BOTH THE NORTH AND SOUTH BOUND ON/OFF RAMPS.	2026	$2,000,000	EXPAND	ROADWAY	ROAD WIDENING/NEW ROAD
CUYAHOGA	NORTH ROYALTON	ROYALTON ROAD (SR82) RIDGE ROAD TO BROADVIEW HEIGHTS CORP LINE PHASE III	WIDEN ROYALTON ROAD FROM 2 TO 3 LANES FOR A CENTER TWO-WAY LEFT TURN LANE, FROM RIDGE ROAD TO BROADVIEW HEIGHTS CORP LINE	2025	$14,000,000	ENHANCE	ROADWAY	MINOR ROAD WIDENING
CUYAHOGA	NORTH ROYALTON	ROYALTON ROAD (SR82) YORK RD TO RIDGE RD PHASE II	WIDEN ROYALTON ROAD FROM 2 TO 3 LANES FOR A CENTER TWO-WAY LEFT TURN LANE, FROM YORK ROAD TO RIDGE ROAD	2025	$12,500,000	ENHANCE	ROADWAY	MINOR ROAD WIDENING
CUYAHOGA	SOUTH EUCLID	S. GREEN ROAD (CR 14) RESURFACING, SOUTH	"MILL AND RESURFACE, INSTALL NEW SIGNALS AT THREE INTERSECTIONS, RECONFIGURE FOUR LANE ROADWAY INTO A ""ROAD DIET"" CONFIGURATION. TRAFFIC CONTROL PAVEMENT MARKINGS AND SIGNAGE WILL BE REPLACED FOR THIS NEW CONFIGURATION. "	2022, 2037	$2,073,000	ENHANCE	ROADWAY/ NON-MOTORIZED	"ROAD DIET/ BICYCLE LANE/ ROAD REHABILITATION/ TRAFFIC SIGNALS"
CUYAHOGA	STRONGSVILLE	HOWE ROAD WIDENING	WIDENING OF HOWE ROAD FROM BOSTON ROAD TO POMEROY BOULEVARD FROM A 2 LANE ROAD WITH NO CURBS AND DRAINAGE DITCHES TO A 3 LANE ROAD WITH CURBS AND STORM SEWERS.	2025	$10,000,000	EXPAND	ROADWAY	ROAD WIDENING/NEW ROAD
CUYAHOGA	UNIVERSITY HEIGHTS	CEDAR ROAD WEST RESURFACING AND ROAD DIET	RESURFACING WITH MINOR BASE REPAIRS, AS NECESSARY, COVERING APPROXIMATELY THREE-QUARTERS OF A MILE OF CEDAR ROAD FROM TAYLOR ROAD TO FENWICK ROAD. INCLUDES A ROAD DIET BETWEEN S. TAYLOR ROAD AND WASHINGTON BOULEVARD, INCLUDING MID-BLOCK CROSSWALKS.	2042	$1,255,556	MAINTAIN	ROADWAY/ NON-MOTORIZED	ROAD DIET/ BICYCLE LANE/ REHABILITATION

Table 7-3 (Continued). List of eNEO2050 Illustrative Projects (Projects Pending Review against NOACA Planning Requirements and/or Demonstration of Fiscal Constraint)

COUNTY	LOCATION	PROJECT NAME	PROJECT DESCRIPTION	NEED YEAR	COST	MAINTAIN / EHANACE / EXPAND	MODE	PRIMARY WORK TYPE
LAKE	EASTLAKE	SR-91 AND SR - 640 INTERSECTION UPGRADE AND SAFETY IMPROVEMENTS	REALIGN INTERSECTION, ADD NEW LANES AS NEEDED, NEW SIGNALS, RECONFIGURE ADJACENT BIKE PATHS, AND PEDESTRIAN CROSSINGS TO ENHANCE ECONOMIC DEVELOPMENT FOR FACILITIES APPURTENANT TO CLASSIC PARK	2023	$1,925,000	ENHANCE	ROADWAY/ NON-MOTORIZED	BICYCLE LANE/SHARROW FACILITY RENOVATION ROAD WIDENING/NEW ROAD PAVEMENT MARKING SAFETY (GUARDRAIL UPGRADE/REPLACE, INTERSECTION IMPROVEMENT) SIDEWALKS-NEW SIDEWALK-IMPROVEMENTS SIGNALS SIGNS TRAFFIC SIGNALS
LAKE	LAKE COUNTY	JACKSON STREET REALINGMENT	REALIGNMENT OF JACKSON STREET ON THE WEST SIDE OF PROPOSED SR44 INTERCHANGE.	2026	$4,000,000	ENHANCE	ROADWAY	ROAD RESURFACING/ REHABILITATION
LAKE	LAKE COUNTY	LANE ROAD WIDENING AND GRADE SEPARATIONS	WIDENING OF LANE ROAD, ROW ACQUISITION, GRADE SEPARATION AT TWO RAILROAD CROSSINGS, TWO CULVERT WIDENINGS/REPLACEMENTS, AND DRAINAGE IMPROVEMENTS.	2026	$25,000,000	ENHANCE	ROADWAY	BRIDGE MAINTENANCE/ REHABILITATION
LAKE	LAKE COUNTY	SR2 REHABILITATION-EAST OF SR 44 TO RICHMOND ROAD INTERCHANGE	EXTEND 3-LANES IN BOTH DIRECTION FROM THE END OF 2012 3 LANE EXTENSION PROJECT. WIDEN BRIDGES AND CULVERTS AS REQUIRED. CENTERLINE MEDIAN BARRIER AND DRAINAGE SYSTEM REPLACEMENT. LED LIGHT POLES AND SOUND BARRIERS AS REQUIRED.	2035	$45,000,000	EXPAND	ROADWAY	ROAD RESURFACING/ REHABILITATION
LAKE	LAKE COUNTY	SR-2 REHABILITIATION, LAK 2- 0.00-3.63	RECONSTRUCT THE PAVEMENT AND REPLACE THE ROCKING CONCRETE SLABS BENEATH. ALSO INCLUDED ARE REPLACEMENT OF DRAINAGE SYSTEM AND SINGLE CENTER MEDIAN WALL REPLACEMENT.	2035	$30,000,000	MAINTAIN	ROADWAY	ROAD RESURFACING/ REHABILITATION
LAKE	LAKETRAN	COMMUTER EXPRESS TO UNIVERSITY CIRCLE	NEW COMMUTER EXPRESS SERVICE FROM EXISTING LAKETRAN PARK-N-RIDE LOTS TO KEY SITES IN UNIVERSITY CIRCLE SUCH AS CLEVELAND CLINIC AND UNIVERSITY HOSPITAL.	"2022 2023"	$5,356,000	EXPAND	TRANSIT	OTHER: TRANSIT - NEW SERVICE
LAKE	LAKETRAN	VINE ST. CORRIDOR IMPROVEMENT	LAKETRAN AND THE CITIES OF WILLOWICK, EASTLAKE, AND WILLOUGHBY PARTNER TO IMPROVE LIGHTING AND SIGNAGE, ROAD DIETS AND TRAFFIC CALMING, TRANSIT WAITING ENVIRONMENTS, SIDEWALKS AND CROSSWALKS AND BIKE PARKING AND LANES.	"2023-2027"	$2,000,000	ENHANCE	NON-MOTORIZED	"ROAD DIET/ BICYCLE LANE/ INTERSECTION IMPROVEMENT/ SIGNALS"
LAKE	MENTOR	LAK-90-09.45 BRIDGE WIDENING	WIDENING OF SR 615 BRIDGE OVER I-90 TO FOUR LANES WITH INTERCHANGE RAMP AND SIGNAL MODIFICATIONS. PROJECT NECESSARY TO ACCOMMODATE TRAFFIC GROWTH FROM NEARBY DEVELOPMENT.	2030	$2,360,000	EXPAND	ROADWAY	ROAD WIDENING/ BRIDGE MAINTENANCE/ REHABILITATION
LAKE	WILLOUGHBY	ERIE STREET GRADE SEPARATION	"GRADE SEPARATION AT ERIE STREET. PART OF LARGER PLAN TO UPDATE UNDERSIZED STORM SEWERS OF ERIE STREET. "	2035	$20,000,000	ENHANCE	ROADWAY	GRADE SEPARATION

Table 7-3 (Continued). List of eNEO2050 Illustrative Projects (Projects Pending Review against NOACA Planning Requirements and/or Demonstration of Fiscal Constraint)

COUNTY	LOCATION	PROJECT NAME	PROJECT DESCRIPTION	NEED YEAR	COST	MAINTAIN / EHANACE / EXPAND	MODE	PRIMARY WORK TYPE
LAKE	WILLOUGHBY	I-90 AT SR-91 INTERCHANGE CITY GATEWAY	"REVITALIZATION OF MAJOR ENTRY POINT FOR CITY "	2036	$10,000,000	ENHANCE	ROADWAY	OTHER: ROAD REVITALIZATION
LAKE	WILLOUGHBY	THOROUGHFARE INTELLIGENT TRAFFIC MANAGEMENT SYSTEM	"PHASED IMPROVEMENTS TO ENCOURAGE PARKING, MARKETING, PUBLIC OPEN SPACES, AND RETAIL. "	2035	$2,000,000	ENHANCE	ROADWAY	TRAFFIC SIGNALS
LAKE	WILLOUGHBY	VINE STREET SMART TRAFFIC SYSTEM [WLBY - LAKE ERIE]	"WIDEN VINE STREET, RECONFIGURE STREET PARKING, AND CREATE A MORE PEDESTRIAN & BUSINESS FRIENDLY ENVIRONMENT. "	2030	$1,500,000	ENHANCE	ROADWAY/ NON-MOTORIZED	ROAD WIDENING/ REHABILITATION/ TRAFFIC SIGNALS
LORAIN	AVON LAKE	WALKER ROAD WIDENING LEFT TURN LANE PROJECT	WIDEN WALKER ROAD TO ADD A CENTER LEFT TURN LANE AND ADDITIONALLY WIDEN THE BIKE LANES TO 6 FEET. THIS PROJECT HAS BEEN REVIEWED BY ODOT AND IS FOR SAFETY IMPROVEMENTS TO BOTH VEHICULAR AND BICYCLE TRAVEL. TOTAL PAVEMENT WIDENING SHALL BE 16 FEET, (8 FT ON EITHER SIDE), TO CREATE 12 FT WIDE VEHICLE LANES AND 6 FT WIDE HARD BERM BIKE LANES.	2023	$2,500,000	EXPAND	ROADWAY/ NON-MOTORIZED	ROADWAY REHAB / MINOR WIDENING
LORAIN	ELYRIA	2ND ST IMPROVEMENTS	PERFORM A ROAD DIET ON THE 4 LANE PORTION OF THE PROJECT LIMITS. IMPROVEMENT TRAFFIC SIGNALS AT GATEWAY, W. RIVER, EAST AVE AND BROAD. APPLY TRAFFIC CALMING TECHNIQUES TO THE DOWNTOWN BUSINESS AREA.	2027	$2,566,029	ENHANCE	ROADWAY/ NON-MOTORIZED	"ROAD RESURFACING/ REHABILITATION/ TRAFFIC SIGNALS"
LORAIN	ELYRIA	E. BROAD ST (ABBE RD S. TO NORTH RIDGEVILLE CORP. LIMITS)	WIDEN ROADWAY TO INCLUDE TWLTL, IMPROVE TRAFFIC SIGNALS TO INCLUDE PEDESTRIAN TRAFFIC, PREEMPTION, AND VEHICLE DETECTION. INCORPORATE NEW SIDEWALKS/BICYCLE TRAIL.	2025	$1,453,965	ENHANCE	ROADWAY/ NON-MOTORIZED	"ROAD WIDENING/ REHABILITATION/ INTERSECTION IMPROVEMENT/ TRAFFIC SIGNALS"
LORAIN	ELYRIA	OBERLIN-ELYRIA RD. (MIDDLE AVE TO CARLISLE TOWNSHIP CORP LIMIT)	PERFORM ROAD DIET TO REDUCE 4 LANES TO 3 LANE WITH CENTER LANE BEING A TWLTL. UPGRADE TRAFFIC SIGNAL AT WEST AVE. MODIFY SIGNAL AT MIDDLE AVE. INSTALL NEW SIDEWALK AND/OR MULTI-USE PATH. RECONFIGURE WEST AVE INTERSECTION	2026	$1,208,742	ENHANCE	ROADWAY/ NON-MOTORIZED	ROAD DIET/ BICYCLE LANE/ REHABILITATION
MEDINA	BRUNSWICK	SR 303 / CENTER ROAD RIGHT TURN LANE	EXTEND WESTBOUND THIRD LANE ON SR 303 TO NORTH CARPENTER ROAD INTERSECTION TO PROVIDE A RIGHT TURN LANE	2023	$550,000	EXPAND	ROADWAY	ROAD WIDENING
MEDINA	BRUNSWICK	WEST 130TH STREET - SOUTH	REHABILITATION / WIDENING FOR TWO WAY LEFT TURN LANE	2025	$2,940,000	EXPAND	ROADWAY	"ROAD WIDENING/ REHABILITATION/ TRAFFIC SIGNALS"
MEDINA	BRUNSWICK/ MEDINA COUNTY	IR-71 AND BOSTON ROAD INTERCHANGE	CONSTRUCT A NEW INTERCHANGE AT IR-71 AND BOSTON ROAD	TBD	TBD	EXPAND	ROADWAY	NEW INTERCHANGE
MEDINA	MEDINA COUNTY	IR-71 AND SR-57 (OR SR-162)	CONSTRUCT A NEW INTERCHANGE AT IR-71 AND SR-57 (OR SR-162)	TBD	TBD	EXPAND	ROADWAY	NEW INTERCHANGE

Table 7-3 (Continued). List of eNEO2050 Illustrative Projects (Projects Pending Review against NOACA Planning Requirements and/or Demonstration of Fiscal Constraint)

COUNTY	LOCATION	PROJECT NAME	PROJECT DESCRIPTION	NEED YEAR	COST	MAINTAIN / EHANACE / EXPAND	MODE	PRIMARY WORK TYPE
REGIONAL	CUYAHOGA, LAKE, LORAIN COUNTIES	LAKE ERIE LAKEFRONT TRAIL	PROVIDE EROSION MITIGATION AND PUBLIC MULTIPURPOSE ACCESS ALONG THE SHORELINE OF LAKE ERIE IN CUYAHOGA, LAKE AND LORAIN COUNTIES. PARTS OF THIS PROJECT COULD BE MODELED AFTER A SIMILAR PROJECT CONSTRUCTED BY THE CITY OF EUCLID, AND OTHER PARTS WOULD PROVIDE GENERAL ACCESS TO ENHANCE CONNECTIVITY FOR RESIDENTS AND VISITORS. NOACA AND CUYAHOGA COUNTY ARE CURRENTLY PERFROMING STUDIES ALONG THE LAKE ERIE SHORELINE.	2025-2030	$750,000,000	ENHANCE	NON-MOTORIZED	BICYCLE FACILITY
REGIONAL	HYPERLOOP	GREAT LAKES HYPERLOOP	CONDUCT AN ENVIRONMENTAL IMPACT STATEMENT FOR THE GREAT LAKES HYPERLOOP	2025-2030	$5,000,000	EXPAND	TRANSIT	TRANSIT FACILITIES
REGIONAL	REGIONAL / GCRTA	REGIONAL RAIL EXTENSION	EXTENSION OF THE EXISTING GCRTA RAIL NETWORK WITHIN CUYAHOGA COUNTY SUBURBS, AND TO THE CITIES OF ELYRIA, MEDINA, SOLON, AND MENTOR IN THE SURROUNDING COUNTIES. THE EXTENDED RAIL NETWORK WOULD CONNECT RESIDENTS TO MAJOR JOB HUBS AND REGIONAL PLACES OF BUSINESS AND ATTRACTION.	2040-2050	$14,000,000,000	EXPAND	TRANSIT	TRANSIT FACILITIES

Transportation Conformity

All regions designated as nonattainment or maintenance areas for the National Ambient Air Quality Standards (NAAQS) related to mobile emissions—specifically ozone (O_3), coarse particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and carbon monoxide (CO)—must demonstrate that emissions from planned transportation system improvements will not exceed an area's motor vehicle emissions budgets (MVEBs). This requirement is known as transportation conformity. US DOT issues formal transportation conformity determinations to nonattainment areas following a quantitative analysis that demonstrates that emissions from vehicles that travel on the planned transportation system are less than the area's MVEBs (or other emission targets in the absence of an approved budget). Transportation conformity determinations ensure that the transportation sector contributes to an area's progress toward national air quality standards.

MPOs in Ohio and ODOT must establish conformity for the 2006 and 2012 $PM_{2.5}$ NAAQS and the 2008 and 2015 8-hour O_3 NAAQS when they adopt new LRTPs or TIPs. Because conformity is determined at the level of the nonattainment/maintenance area rather than at the sub-area level, each of the area's planning partners must approve a new conformity finding for the area based on these updates.

The analyses for O_3 and the 2006 $PM_{2.5}$ NAAQS cover the pertinent portions of the counties of Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, and Summit. The analysis for the 2012 $PM_{2.5}$ NAAQS includes only Cuyahoga and Lorain counties, as they were the only counties included in the region's moderate nonattainment area for this standard. The analysis for the 2008 O_3 NAAQS covers Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, and Summit counties, while the 2015 NAAQS covers Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, and Summit.

Conformity for both O_3 analyses is based upon the MVEB developed for the 2008 NAAQS. The analyses for the 2006 and 2012 $PM_{2.5}$ NAAQS are based on the budgets outlined for the 1997 and 2006 $PM_{2.5}$ maintenance plans, which the Ohio Environmental Protection Agency (Ohio EPA) developed. The current analyses reflect a comparison of projected transportation emissions against the approved or submitted budgets for each standard. All analyses used the MOVES2014a, an approved emissions modeling tool from US EPA.

Federal law requires that *eNEO2050* contain the design concept and design scope descriptions of all existing and proposed transportation facilities in sufficient detail, regardless of funding source, in nonattainment and maintenance areas for conformity determinations under the US EPA's transportation conformity regulations (40 CFR part 93, subpart A).

These tests are required because all areas with a current or former designation of nonattainment must maintain conformity findings for the designated pollutants. The tests ensure that transportation planning efforts do not hinder efforts to bring the area into attainment of the standards or maintain attainment of the standards. Table 7-4, Table 7-5, Table 7-6, and Table 7-7 show the test results. For all tests, projected emission levels are beneath the respective MVEBs, demonstrating conformance with the goals of the Clean Air Act.

Table 7-4. 2015 Daily 8-Hour Ozone Standard

Attainment status: 2015 8-Hour Ozone standard – marginal nonattainment area (Federal Register / Vol. 83, No. 107 / Monday, June 4, 2018)

SIP Status: Federal Register /Vol. 82, No. 4 /Friday, January 6, 2017 – direct final rule adequacy finding for Motor Vehicle Emission Simulator (MOVES) based 2008 ozone standard MVEB

No submittals required under 2008 8-Hour ozone standard until approved budgets are received. The budgets found adequate for 2008 standard will satisfy the 2015 tests, per U.S. EPA.

8-Hour Geography: Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit counties, OH

Conformity Tests: 2008 Standard 8-Hour budget tests

Analysis Years: 2021 Attainment and 1st Analysis year
2030 Interim and SIP Budget year
2040 Interim year
2045 AMATS/ERPC Plan horizon year
2050 NOACA Plan horizon year

			EMISSIONS BY YEAR (TONS/DAY)			
8-HOUR OZONE TEST	2021 EMISSIONS	2030 8-HOUR BUDGET	2030	2040	2045	2050
AMATS						
VOC	7.07		3.26	2.95	3.05	2.96
NO_x	9.74		4.05	3.31	3.28	3.28
NOACA						
VOC	21.88		13.22	9.02	8.66	9.20
NO_x	29.01		14.75	8.95	8.74	8.29
TOTALS						
VOC	28.95	30.80	16.48	11.97	11.71	12.16
NO_x	38.75	43.82	18.80	12.26	12.02	11.57

Table 7-5. 2008 Daily 8-Hour Ozone Standard

Attainment status: 2008 8-Hour Ozone standard – maintenance area (Federal Register / Vol. 82, No. 4 /Friday, January 6, 2017)

1997 8-Hour Ozone Standard - maintenance area (Federal Register Notice Final Rule Tuesday, September 15, 2009)

SIP Status: Federal Register /Vol. 78, No. 53 /Tuesday, March 19, 2013 – direct final rule adequacy finding for MOVES based 1997 Ozone standard MVEB

No submittals required under 2008 8-Hour Ozone standard until approved budgets are received. The budgets found adequate for the 1997 standard will satisfy both 1997 and 2008 tests for the time being per U.S. EPA.

8-Hour Geography: Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit Counties, OH

Conformity Tests: 1997 Standard 8-Hour budget tests

Analysis Years: 2021 1st Analysis year
2030 Interim and SIP Budget year
2040 Interim year
2045 AMATS/ERPC Plan horizon year
2050 NOACA Plan horizon year

			EMISSIONS BY YEAR (TONS/DAY)			
8-HOUR OZONE TEST	2021 EMISSIONS	2030 8-HOUR BUDGET	2030	2040	2045	2050
AMATS						
VOC	7.07		3.26	2.95	3.05	2.96
NO_x	9.74		4.05	3.31	3.28	3.28
NOACA						
VOC	21.88		14.26	9.88	8.66	9.20
NO_x	29.01		15.54	8.95	8.74	8.29
ASHTABULA COUNTY						
VOC	1.16		0.53	0.50	0.51	0.50
NO_x	1.50		0.62	0.52	0.51	0.52
TOTALS						
VOC	30.11	30.80	18.05	13.33	12.22	12.66
NO_x	40.25	43.82	20.21	12.78	12.53	12.09

Table 7-6. $PM_{2.5}$ 2006 Standard

Attainment/ 2006 Annual $PM_{2.5}$ Standard – maintenance area (Federal Register / Vol. 78, No. 144 / Friday, July 26, 2013)

SIP Status: Cleveland area to attainment for 1997 and 2006 $PM_{2.5}$ Standards – FR notice included an adequacy finding for the MOVES based MVEBs

Geography: Cuyahoga, Lake, Lorain, Medina, Portage, Summit counties, OH, and Ashtabula Township (Ashtabula County, OH)

Conformity Tests: Budget tests

Analysis Years: 2022 $PM_{2.5}$ Budget Year
2030 Interim year
2040 Interim year
2045 AMATS/ERPC Plan horizon year
2050 NOACA Plan horizon year

		EMISSIONS BY YEAR (TONS/YEAR)				
$PM_{2.5}$ TEST	2022 BUDGET	2022	2030	2040	2045	2050
AMATS						
Direct PM		111.92	90.78	93.92	88.26	89.61
NO_x		2,108.06	1,414.19	1,297.58	1,291.22	1,297.47
NOACA						
Direct PM		397.13	262.18	209.93	209.24	208.49
NO_x		10,447.02	4,721.64	2,988.83	2,930.40	2,891.73
ASHTABULA TWP						
Direct PM		1.9	1.53	1.61	1.5	1.53
NO_x		33.8	22.78	20.88	20.77	20.7
TOTALS						
Direct PM	880.89	510.95	354.49	305.46	299.00	299.63
NO_x	17,263.65	12,588.88	6,158.61	4,307.29	4,242.39	4,209.9

Table 7-7. $PM_{2.5}$ 2012 Standard

Attainment status: 2012 Annual $PM_{2.5}$ Standard – maintenance area (80 FR 2205 /January 14, 2015)

SIP Status: Federal Register /Vol. 83, No. 246 /Wednesday, December 26, 2018 – approval of SIP and finding in support of MOVES based 2012 standard $PM_{2.5}$ MVEB

Geography: Cuyahoga and Lorain counties, OH

Conformity Tests: 2012 SIP Maintenance Plan tests

Analysis Years: 2022 $PM_{2.5}$ Budget year
2030 Interim year
2040 Interim year
2045 AMATS/ERPC Plan horizon year
2050 NOACA Plan horizon year

				EMISSIONS BY YEAR (TONS/DAY)			
$PM_{2.5}$ TEST	2022 BUDGET	2022 EMISSIONS	2030 BUDGET	2030	2040	2045	2050
Direct PM	406.79	290.22	270.57	186.73	149.28	148.61	148.04
NO_x	9,432.04	7,492.24	4,907.54	3,152.17	1,971.10	1,928.35	1,899.30

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An Equitable Plan for Northeast Ohio

JUNE 2021

Northeast Ohio Areawide
Coordinating Agency