

CONNECTIONS

2045

Plan for Greater Philadelphia

OCTOBER 2017

BOARD
ADOPTED VERSION



DVRPC's vision for the Greater Philadelphia Region is a prosperous, innovative, equitable, resilient, and sustainable region that increases mobility choices by investing in a safe and modern transportation system; that protects and preserves our natural resources while creating healthy communities; and that fosters greater opportunities for all.

DVRPC's mission is to achieve this vision by convening the widest array of partners to inform and facilitate data-driven decision-making. We are engaged across the region, and strive to be leaders and innovators, exploring new ideas and creating best practices.

The Delaware Valley Regional Planning Commission

is the federally designated Metropolitan Planning Organization for a diverse nine-county region in two states: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey.

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T.O.C.

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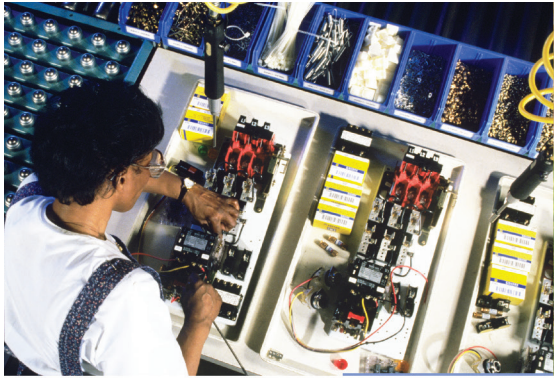
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EXECUTIVE SUMMARY

Connections 2045 is the long-range plan for Greater Philadelphia that establishes a vision for the growth and development of the region, and serves as a blueprint for prioritizing transportation funding over the next 28 years. The Plan was developed with the input and support of DVRPC's working committees, regional planning partners, stakeholder groups, and residents. It was adopted by the DVRPC Board on October 26, 2017.

Connections 2045 considers transportation, land use, the environment, economic competitiveness, equity, and quality of life issues in planning for the region's long-term growth. The Plan helps to prepare the region for a forecasted increase of more than 658,000 residents (+11.5 percent) and over 372,000 jobs (+12 percent) by 2045. It recognizes that profoundly changing demographics may affect regional lifestyle preferences and travel trends in the coming years, when everyone, from baby boomers to millennials, will expect a range of housing and transportation options, and may gravitate toward more walkable, urban environments. The Plan also focuses on technology and Greater Philadelphia's evolving

transportation network and information economy, while exploring other key forces that are shaping the region, such as climate change and the Digital Revolution.

Based on analysis of current trends, future forecasts, and outreach to stakeholders and the public, *Connections 2045* forms a vision for the future around five inter-related core principles: Sustain the Environment, Develop Livable Communities, Expand the Economy, Advance Equity and Foster Diversity, and Create an Integrated, Multimodal Transportation Network. It also identifies a series of goals and strategies to achieve each of the core principles and bring about the vision.

The Plan aims to **SUSTAIN THE ENVIRONMENT** by permanently protecting one million acres of open space. This will help to improve the region's air and water quality, preserve historic and cultural resources, and increase access to healthy, locally produced food. *Connections 2045* establishes a goal of reducing 2005 greenhouse gas (GHG) emissions by 80 percent by the year 2050 by generating cleaner energy and by making the region more energy efficient. Rising levels of carbon in the atmosphere magnify the risks of increased extreme heat episodes, more intense precipitation events, and sea level rise. This means the region must begin to

adapt to a changing climate through more intergovernmental coordination, identification of at-risk assets, updates to floodplain ordinances and building codes, and protection of open space and use of green stormwater infrastructure to better manage water quality and stormwater runoff.

The Plan seeks to **DEVELOP LIVABLE COMMUNITIES** by focusing growth in more than 125 Centers across the region. These Centers are vibrant, healthy, mixed-use communities with walkable main streets and downtowns. They provide access to green space, live/work opportunities, and a variety of affordable housing options. More compact, mixed-use development will shorten distances between destinations and encourage alternative and active forms of transportation. This will reinvigorate existing communities that have established residential and employment bases and existing infrastructure in place, while helping to build network effects and agglomeration economies needed for regional competitiveness in the global information economy.

The Plan will work to diversify and **EXPAND THE ECONOMY**, making it more competitive on the global stage with increased employment opportunities, business retention, entrepreneurialism, advanced manufacturing, and expansion of the tech sector. The region's key economic sectors include knowledge-based industries, such as education and health services, professional and business services, financial activities, life sciences, information technology (IT), and chemicals. The region must remain on the cutting edge of

innovation, and work with higher education institutions and others as the incubators of new technologies and business opportunities. Government and regulations will need to become more efficient to enhance the climate for business growth. The region must expand its connections to the global economy, ensure a well-trained and productive workforce, and become more energy efficient to gain competitiveness and desirability in the information economy.

The Plan aims to **ADVANCE EQUITY AND FOSTER DIVERSITY** with a reduction in poverty, increase in economic mobility, and fostering of racially and socioeconomically integrated communities. Equitable access to transportation is critical to ensuring economic and social opportunity. Recognizing that all people want to live in safe and vibrant communities, the Plan recommends finding ways to develop without displacement of low-income populations in areas that are experiencing rapid redevelopment. It also encourages forming inclusive communities throughout the region, and increasing the availability of low-income housing. Education is critical to future success. The Plan sets a goal of giving all children in the region, no matter where they live, access to good schools and an education that prepares them for the jobs of the future.

Lastly, the Plan will improve mobility choices by **CREATING AN INTEGRATED, MULTIMODAL TRANSPORTATION NETWORK** that is well-maintained, provides accessibility, reduces congestion and auto-dependence, incorporates new services and technologies, and moves the region toward zero roadway deaths. Integrated,

multimodal transportation networks plan for and build multimodal facilities, aim for space-efficiency, and make seamless connections between modes. The Plan continues an emphasis on rebuilding the region's aging transportation infrastructure, and identifies the investments needed to maximize the efficiency of the region's existing infrastructure through improved operations and management. It recommends using key strategies around design, markets, and technology to achieve the vision. The Plan contains a prioritized set of projects, based on a quantitative analysis of need, which are able to be funded with anticipated revenues over the life of the Plan. Unfortunately, due to declining transportation funding, we can only achieve only about half of this vision with anticipated revenues. *Connections 2045* examines the causes of our funding crisis and puts forth some options for addressing the shortfall to create a regional discussion on how we can achieve the vision in its totality.

Implementing the Plan is an ongoing process. Building smart cities, data sharing and coordination, and multimunicipal planning efforts are all important factors in two of the most integral strategies of the Plan: regional cooperation and government efficiency. *Connections 2045* concludes by highlighting activities that DVRPC and its planning partners are currently undertaking to help bring the plan to fruition, while also identifying actions everyone can take to advance the vision. The region will need to be flexible and adaptable to potentially fast-moving future changes, while not losing sight of the greater vision of where we collectively want the Greater Philadelphia region to be in 2045.



Source: USGS Landsat Project.

1. INTRODUCTION

The Connections 2045 Plan for Greater Philadelphia (Connections 2045 or the Plan) outlines a long-range vision and goals, and identifies strategies for the future growth of the Greater Philadelphia region. The vision, goals, and strategies are based on a thorough review and analysis of trends and forecasts, along with future external forces that will bring change to the region, as well as extensive public and stakeholder outreach. *Connections 2045* maintains the four core principles from the previous *Connections 2040 Plan*, and has added equity as a separate core principle. *Connections 2045* focuses on our evolving transportation network and the continuing challenge of rebuilding our transportation infrastructure.

DVRPC

DVRPC is the federally designated Metropolitan Planning Organization (MPO) for the nine-county Greater Philadelphia region. DVRPC serves Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. DVRPC's mission is to plan for the orderly growth and development of the region in concert with multiple planning partners. DVRPC builds consensus on improving transportation,

promoting smart growth, protecting the environment, enhancing the economy, and fostering equity. A key role of an MPO is to work with local officials to prioritize transportation investments to be funded by federal and state revenue. DVRPC is governed by an 18-member board, composed of state, county, and city representatives from its member governments, as well as various participating, nonvoting members, and federal agency observers.

FIGURE 1: DVRPC NINE-COUNTY REGION



Source: DVRPC, 2017.

Key Planning Factors:

- Support the economic vitality of the metropolitan area, especially by enabling global competitiveness, productivity, and efficiency.
- Increase the safety of the transportation system for motorized and nonmotorized users.
- Increase the security of the transportation system for motorized and nonmotorized users.
- Increase the accessibility and mobility of people and for freight.
- Protect and enhance the environment, promote energy conservation, improve the quality of life, and promote consistency between transportation improvements and state and local planned growth and economic development patterns.
- Enhance the integration and connectivity of the transportation system, across and between modes, for people and freight.
- Promote efficient system management and operation.
- Emphasize the preservation of the existing transportation system.
- Improve the resiliency and reliability of the transportation system, and reduce or mitigate stormwater impacts of surface transportation.
- Enhance travel and tourism.

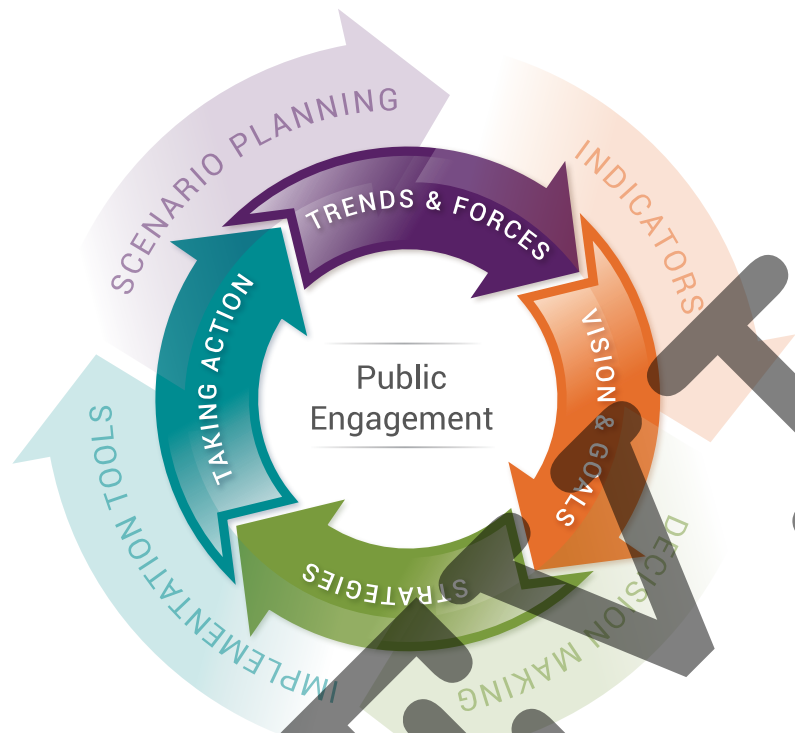
THE LONG-RANGE PLAN

As the region's MPO, DVRPC is required by the U.S. Department of Transportation (U.S. DOT), in accordance with federal planning regulations, to develop a long-range transportation plan that covers a minimum 20-year planning horizon. The Plan outlines how the region intends to invest in the transportation network. It has been developed through a **Comprehensive, Cooperative, Continuing, Coordinated, and Compatible** process that incorporates the key planning factors contained in the federal transportation planning regulations.

Congress, through the most recent federal transportation authorizations, has mandated that states and MPOs incorporate performance measures; set targets; and monitor progress in the areas of safety, highway and transit asset condition, congestion and system performance, freight movement system performance, and environmental sustainability in their long-range plans. These rules will continue to be implemented after the adoption of this long-range plan update, and DVRPC will continue to work with federal, state, and local planning partners to move forward with performance measures planning, and to develop targets within the framework of the adopted long-range plan.

DVRPC's long-range plan is part of an integrated planning process. It has four key steps: identifying trends and forces shaping the region; working with the public and stakeholders to develop a collective vision and goals for regional development; then recommending strategies to help achieve the vision; and taking action. Implementation is an ongoing effort that is carried out through DVRPC's annual work program and by building partnerships with planning partners and stakeholder agencies to bring the vision to fruition. There are a number of efforts that DVRPC uses to

FIGURE 2: DVRPC LONG-RANGE PLANNING PROCESS



Source: DVRPC, 2017.

develop and analyze regional conditions and trends, including scenario planning, indicators, and other implementation tools—all of which are considered when making decisions.

The Plan serves as a blueprint for prioritizing capital transportation investment funding for the region. Recognizing the integrated and holistic relationship between transportation and the built environment, the long-range plan also considers land use, the environment, economic development, equity, and quality of life issues, and offers comprehensive policy guidance for the region and the work of DVRPC.

CONNECTIONS 2045

Federal planning regulations also require that the long-range plan be updated every four years in order to reflect and respond to the most recent trends and needs. *Connections 2045* was adopted by the DVRPC Board on October 26, 2017, and serves as an update of the previous long-range plan, *Connections 2040*.

The Plan was developed around five integrated core principles:

1. Sustain the Environment
2. Develop Livable Communities
3. Expand the Economy
4. Advance Equity and Foster Diversity
5. Create an Integrated, Multimodal Transportation Network

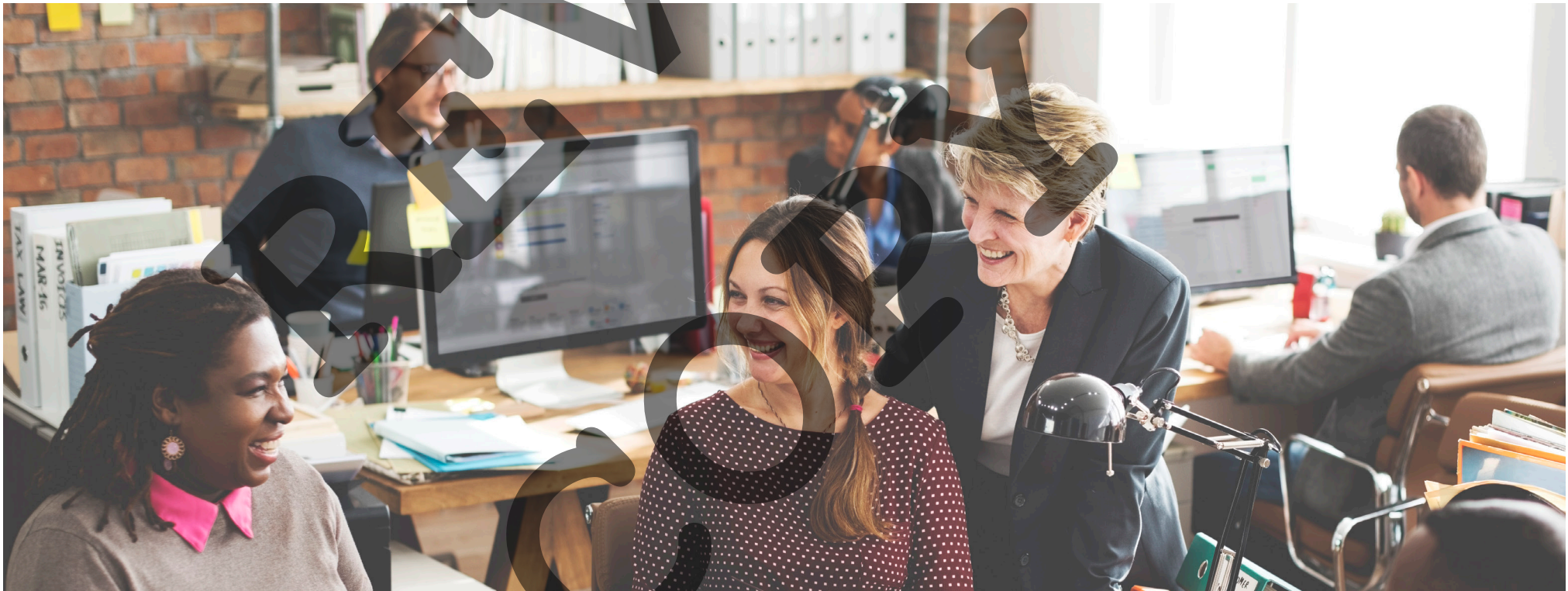
Each principle has a series of goals, and identifies strategies to achieve them. It will take the coordinated efforts of governments at all levels, private and nonprofit organizations, and individuals working in concert with each other to make the vision a reality.

Connections 2045 introduces several new planning factors to the long-range plan. The Plan highlights the importance of equity in the regional vision. It addresses the importance of education in recognition of the fact that this basic service is vital to the region's ability to meet its other goals. This update also places an increased emphasis on the necessity of regional cooperation, government efficiency, and innovation in implementing the strategies identified in this plan. The Plan continues a performance-based planning approach that addresses system performance, links transportation investments to long-range plan goals, and tracks a set of indicators to gauge progress. The concept of sustainability is a key policy value that is woven

throughout the Plan. Sustainability refers to the ability of a region to meet its present needs without compromising the ability of future generations to meet their needs. The Plan includes a number of goals to ensure a sustainable future and outlines what investments and policy decisions the region will need to make over the life of the Plan to achieve the goals.

STAKEHOLDER AND PUBLIC OUTREACH

Long-range planning is a collaborative process that involves close working relationships with regional stakeholders. In addition to the DVRPC Board, DVRPC convenes a number of committees, consisting of representatives from various fields, including the Public Participation Task Force (PPTF), Regional Technical Committee (RTC), Delaware Valley Goods Movement Task Force (DVGMTF), Regional Aviation Committee (RAC), Transportation Operations Task Force (TOTF), Central Jersey Transportation Forum (CJTF), Regional Community and Economic Development Forum (RCEDF), Regional Safety Task Force (RSTF), Information Resources Exchange Group (IREG), Air Quality Partnership (AQP), Coastal Zone Management Program (CZMP), Greater Philadelphia Futures Group (GPFG), and Healthy Communities Task Force (HCTF).



DVRPC also collaborated with regional planning partners, business and economic development groups, environmental and transportation advocacy groups, and the general public in developing the Plan. Public participation is an integral part of the long-range planning process, allowing stakeholders and residents to learn about issues facing the region and participate in the creation of the Plan. The PPTF is the primary vehicle for ongoing public participation in DVRPC's activities. With representatives from the private sector, social services agencies, environmental organizations, and other interested parties, the PPTF has been involved throughout the development of the Plan.

For *Connections 2045*, DVRPC carried out a number of outreach activities to gather input. The purpose of these outreach activities was to give the people who live and work throughout the Greater Philadelphia region an opportunity to share their vision for the region's future and to provide input as to how they would like to see the region grow and prosper. Following the visioning exercises, another round of outreach was conducted to identify appropriate strategies for achieving the vision and attaining the goals outlined in the Plan. DVRPC used a variety of outreach strategies, including in-person workshops and online surveys, to capture the many concerns and recommendations of the region's residents, government officials, and stakeholders. Special emphasis was placed on engaging individuals and organizations that have not participated in previous DVRPC planning exercises.

PLAN CONSISTENCY AND MEGAREGIONAL PLANNING

DVRPC's long-range plan and planning process strive to be consistent with and complementary to the goals and policies of the plans and programs of member municipal and county governments, and the statewide transportation plans of the Pennsylvania and New Jersey departments of transportation (DOTs).

There are many planning issues that extend beyond an MPO's boundary, such as transportation network expansion projects, sprawling development patterns, congestion, climate change, air and water quality, energy reliance, and transportation funding. DVRPC works with its planning partners, including neighboring MPOs, to identify cross-boundary issues. DVRPC then explores ways to address those issues, both formally and informally, through enhanced coordination and communication with the appropriate planning and operating agencies. These efforts are carried out under the auspices of the Pennsylvania Department of Transportation (PennDOT) Planning Partners meetings, New Jersey Department of Transportation (NJ DOT) MPO Coordination meetings, the Metropolitan Area Planning Forum (New York, New Jersey, and Connecticut MPOs), Mid-Atlantic Regional Planning Roundtable (Pennsylvania, New Jersey, Delaware, Maryland, and Virginia MPOs), CJTF, and many more informal channels.



Photo Credit: Benjamin's Desk

Photo Credit: Leap Transit

2. TRENDS, FORECASTS, AND FORCES

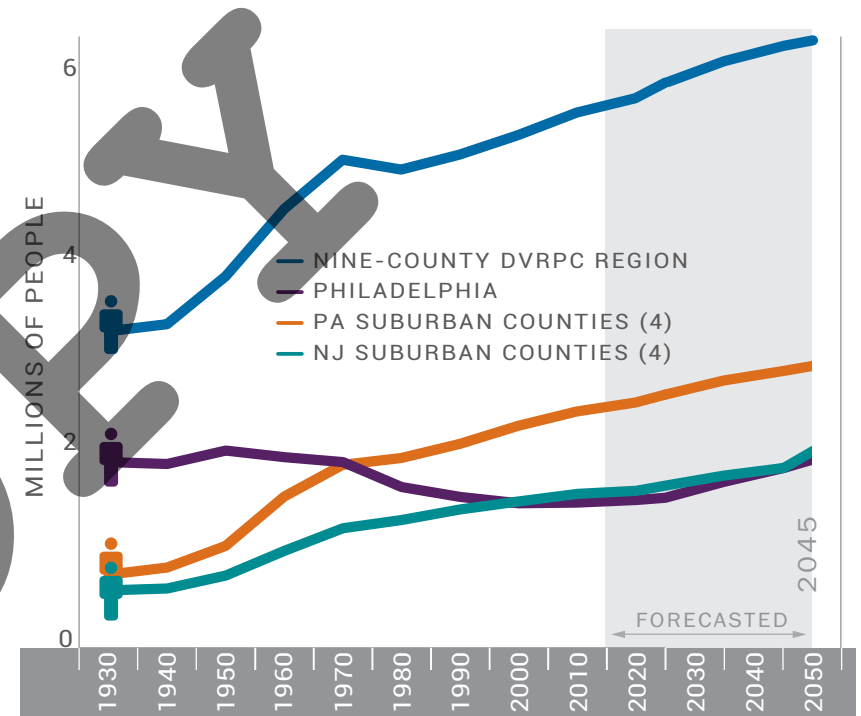
There are many factors that will influence the future including, but not limited to, current conditions and trends, decisions we make today, technological advances, social and political movements, and forces of change that may be barely perceptible at the present time. DVRPC continuously monitors various trends and forecasts to determine the current state of the region, and to identify concerns and ideas for the future. These factors will affect not only the collective vision for 2045, but also the specific issues that are covered in the Plan and the recommendations that are made in it. External forces of change that have the potential for significant disruptions were also examined.

POPULATION AND EMPLOYMENT FORECASTS

Population and employment forecasts are a critical component of long-range land use and transportation planning. The 2045 population forecasts incorporate the results of the 2015 Census estimates, and the 2045 employment forecasts are based on the 2015 National

Establishment Time-Series (NETS) database. DVRPC worked with its member counties in developing the forecasts, which were adopted by the DVRPC Board. The DVRPC region is forecasted to gain over 658,000 residents between 2015 and 2045, an 11.5 percent increase.

FIGURE 3: REGIONAL POPULATION (1930–2045)



Source: DVRPC, 2017.

FIGURE 4: 2045 MUNICIPAL POPULATION FORECAST

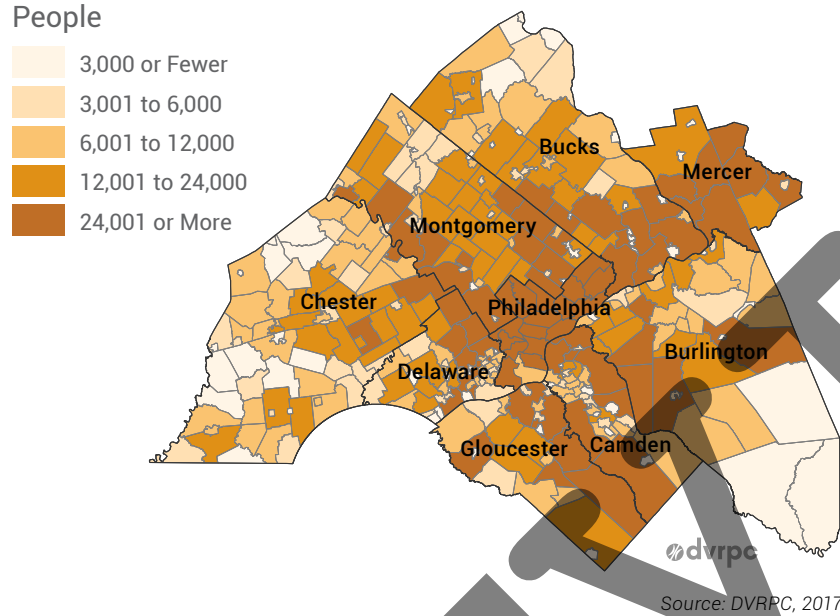


FIGURE 5: ABSOLUTE POPULATION CHANGE (2015–2045)

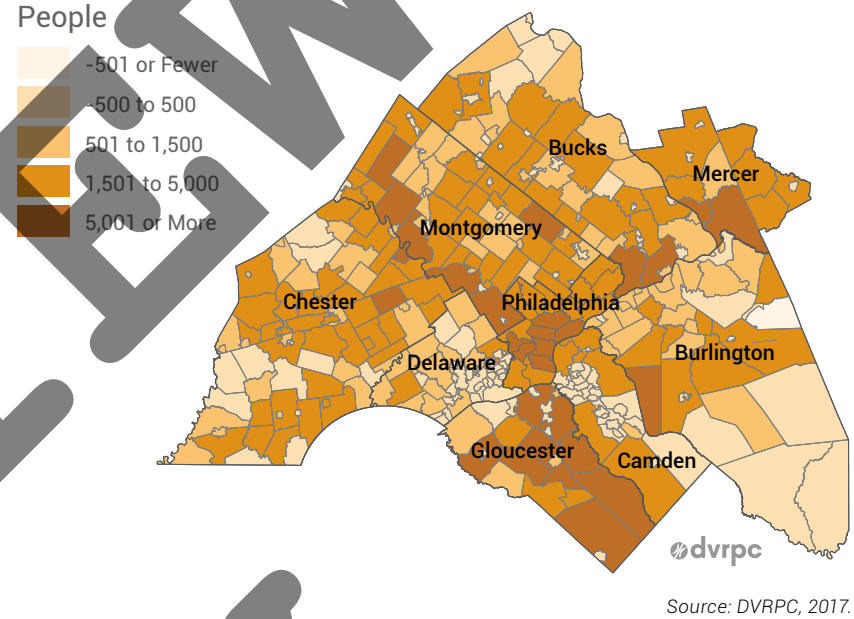
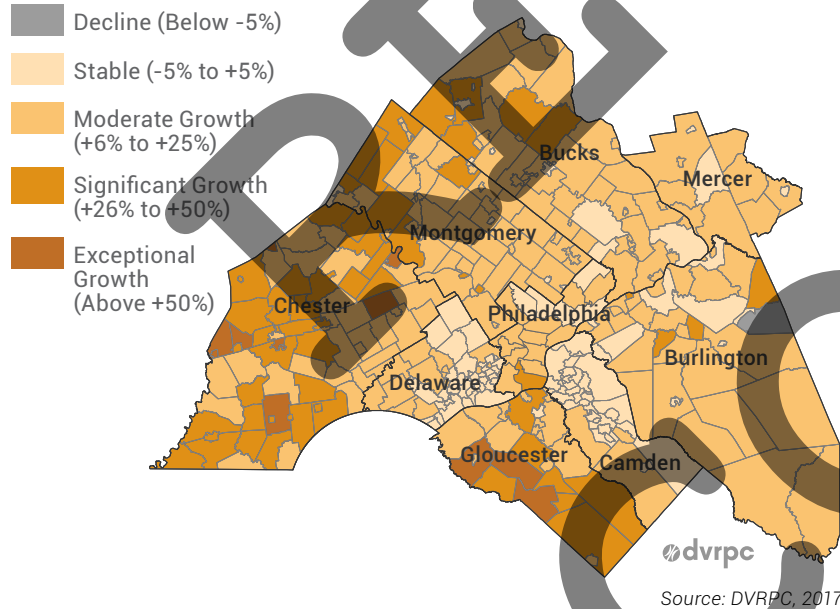


FIGURE 6: PERCENTAGE POPULATION CHANGE (2015–2045)



The population of the City of Philadelphia increased between 2010 and 2015, with the city adding more than 41,000 residents. This population gain continues a turning point that began in the mid-2000s after a half-century of declining population that the city had experienced since the 1950s. The population increase is forecasted to continue, with the city's population expected to increase by over 8 percent by 2045.

The share of the region's population living in the city is expected to increase slightly, from 26 percent in 2015 to 27 percent by 2045. The highest percentage population growth, however, is forecasted to continue on the periphery of the region, with slower growth in the region's core. This development pattern requires the building of additional transportation, sewer, water, and other infrastructure while already built facilities are underutilized in previously developed areas.

TABLE 1: FORECASTED POPULATION BY COUNTY, 2015–2045

COUNTY	2010 CENSUS	2015 CENSUS ESTIMATE	2020 FORECAST	2025 FORECAST	2030 FORECAST	2035 FORECAST	2040 FORECAST	2045 FORECAST	ABSOLUTE CHANGE, 2015–2045	PERCENT CHANGE 2015–2045
Bucks County	625,249	627,367	640,495	654,792	669,299	681,273	691,111	699,498	72,131	11.5%
Chester County	498,886	515,939	543,702	571,641	599,932	624,832	645,562	662,283	146,344	28.4%
Delaware County	558,979	563,894	568,337	572,758	577,248	581,136	584,329	587,037	23,143	4.1%
Montgomery County	799,874	819,264	840,934	863,327	884,387	903,114	918,918	932,820	113,556	13.9%
Philadelphia County	1,526,006	1,567,443	1,594,787	1,616,816	1,643,971	1,667,290	1,683,402	1,696,133	128,690	8.2%
FIVE PENNSYLVANIA COUNTIES	4,008,994	4,093,907	4,188,255	4,279,333	4,374,837	4,457,645	4,523,322	4,577,771	483,864	11.8%
Burlington County	448,734	450,226	459,344	468,428	475,978	482,560	488,026	492,709	42,483	9.4%
Camden County	513,657	510,923	514,006	517,073	520,189	522,886	525,101	526,997	16,074	3.1%
Gloucester County	288,288	291,479	307,766	323,969	340,425	354,677	366,383	376,308	84,829	29.1%
Mercer County	367,511	371,398	377,328	383,227	389,219	394,407	398,669	402,283	30,885	8.3%
FOUR NEW JERSEY COUNTIES	1,618,190	1,624,026	1,658,444	1,692,697	1,725,811	1,754,530	1,778,179	1,798,2967	174,270	10.7%
NINE-COUNTY DVRPC REGION	5,627,184	5,717,933	5,846,699	5,972,030	6,100,648	6,212,175	6,301,501	6,376,068	658,134	11.5%

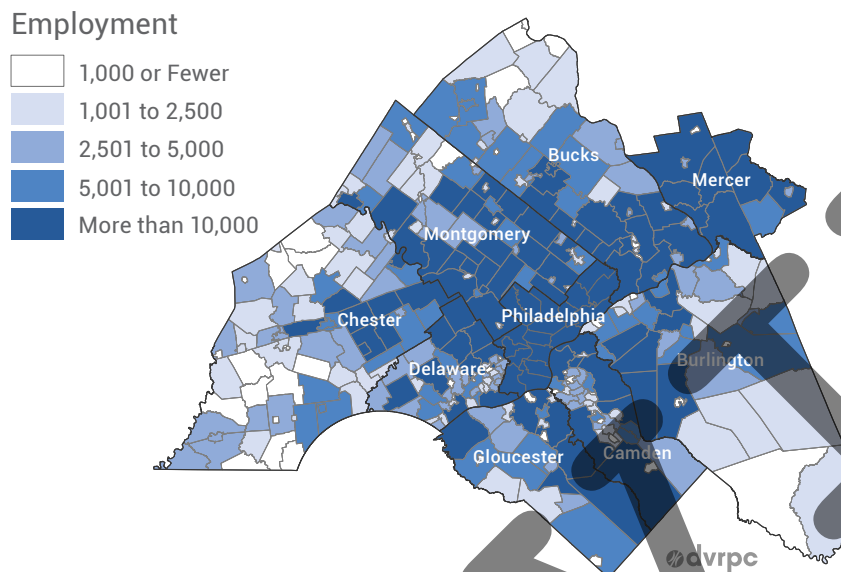
Source: DVRPC, 2016.

TABLE 2: FORECASTED EMPLOYMENT BY COUNTY, 2015–2045

COUNTY	2010 NETS EMPLOYMENT	2015 ESTIMATE	2020 FORECAST	2025 FORECAST	2030 FORECAST	2035 FORECAST	2040 FORECAST	2045 FORECAST	ABSOLUTE CHANGE, 2015–2045	PERCENTAGE CHANGE 2015–2045
Bucks County	311,930	322,731	329,645	337,203	344,859	351,310	356,671	361,124	38,393	11.9%
Chester County	296,351	309,605	326,320	343,050	359,774	374,967	387,391	397,405	87,800	28.4%
Delaware County	253,980	268,054	270,167	272,269	274,401	276,248	277,763	279,050	10,996	4.1%
Montgomery County	558,374	582,443	598,434	614,469	629,563	642,996	654,966	664,385	81,942	14.1%
Philadelphia County	738,546	772,847	786,308	797,156	810,574	822,002	829,937	836,825	63,978	8.3%
FIVE PENNSYLVANIA COUNTIES	2,159,181	2,255,680	2,310,874	2,364,147	2,419,171	2,467,523	2,506,728	2,538,789	283,109	12.6%
Burlington County	236,921	241,298	246,351	251,368	255,562	258,363	261,195	263,622	22,324	9.3%
Camden County	263,888	263,582	265,169	266,753	268,359	269,750	270,892	271,869	8,287	3.1%
Gloucester County	117,556	121,382	128,161	134,902	141,752	147,682	152,554	156,686	35,304	29.1%
Mercer County	282,209	286,295	290,864	295,408	300,025	304,021	307,302	310,084	23,789	8.3%
FOUR NEW JERSEY COUNTIES	900,574	912,557	930,545	948,431	965,698	979,816	991,943	1,002,261	89,704	9.8%
DVRPC REGION	3,059,755	3,168,237	3,241,419	3,312,578	3,384,869	3,447,339	3,498,671	3,541,050	372,813	11.8%

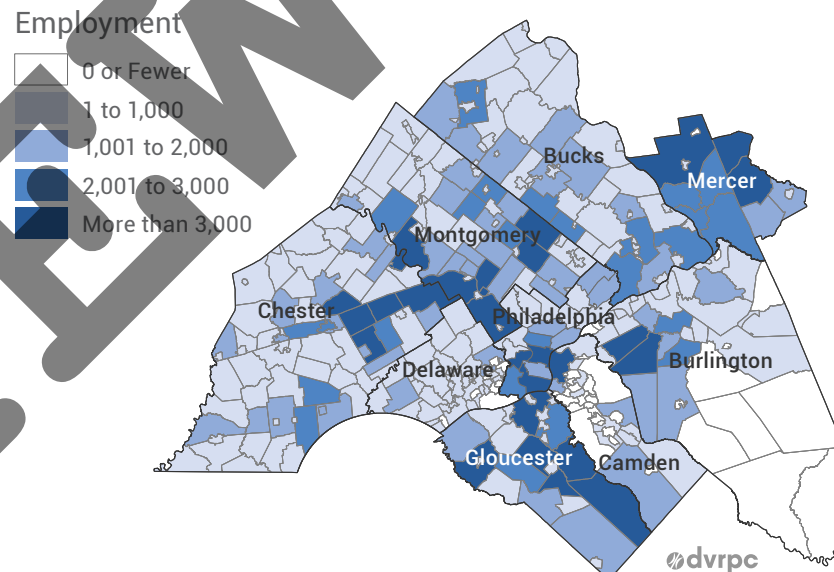
Source: DVRPC, 2016. Base employment data from the NETS database, 2010 and 2013.

FIGURE 7: 2045 MUNICIPAL EMPLOYMENT FORECAST



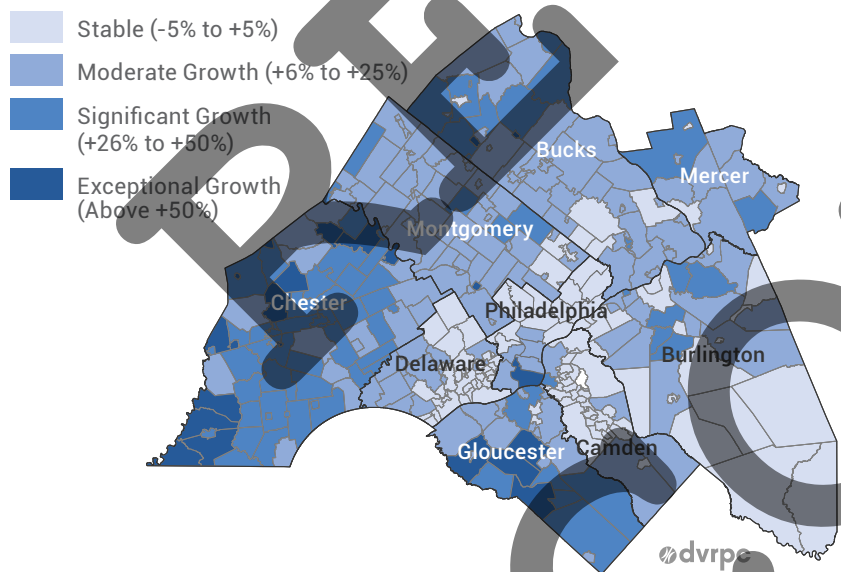
Source: DVRPC, 2017.

FIGURE 8: ABSOLUTE EMPLOYMENT CHANGE (2015–2045)



Source: DVRPC, 2017.

FIGURE 9: PERCENTAGE EMPLOYMENT CHANGE (2015–2045)



Source: DVRPC, 2017.

The forecasts are what we can expect to occur in the future based on current programs and patterns. The Plan includes policies and strategies that may ultimately influence actual population and employment in the region.

The region's five southeastern Pennsylvania counties are forecasted to experience a 12.6 percent increase in employment, while employment in the four New Jersey counties is expected to increase by 9.8 percent. In total, the DVRPC region is forecasted to gain over 372,000 jobs between 2015 and 2045, an increase of almost 12 percent.

The largest percentage increases are forecasted for Gloucester County, New Jersey, and Chester County, Pennsylvania, where employment is forecasted to increase by about 29 percent. The largest absolute

increase is forecasted for Chester County, which is expected to gain 87,800 jobs. Other counties forecasted to see a significant number of additional employees include Montgomery County (+ 81,900 jobs) and Philadelphia (+ 64,000 jobs). Both Philadelphia and Camden City, New Jersey, are forecasted to gain employment with percentage increases of 8.3 percent and 10.1 percent, respectively. The region's other two Core Cities are expected to see their employment stabilize, with a net gain of 2,200 jobs in Trenton, New Jersey, and a gain of 300 jobs in Chester City, Pennsylvania. Similar to future population trends, the highest percentage employment growth is forecasted to occur on the outer edges of the region.

THE IMPACT OF CHANGING DEMOGRAPHICS

Changing demographics may have a profound impact on regional lifestyle preferences and travel trends in the coming years. The region's largest demographic group is the baby boomers, born between 1946 and 1964 and reaching retirement age between now and 2030. Today's boomers are different from previous generations—not only are there more of them than any generation before, but they are more diverse and mobile, and expect a range of housing and transportation options that will keep them independent and living at home for as long as possible.

Some of these retirees may prefer to live in the region's Centers, provided there are affordable housing options available to them in desirable, safe neighborhoods. Many of them, however, expect to remain where they have spent most of their lives: in the auto-dependent suburbs. Over time, the ability to drive safely decreases, and accessing goods and services can become difficult. Mixed-use communities that are walkable, bikeable, and accessible by public transit can enhance quality of life and improve access to necessary services for all residents, including the elderly.

Millennials—those young adults largely born during the 1980s and 1990s—are currently the largest generation in America. As they continue to establish themselves in communities and workplaces around the country, their attitudes and beliefs will play an increasingly important role in shaping the country.

While it is often difficult to predict the ways in which demographics, changing attitudes, and technology will influence travel behavior and land use patterns, the current behavior and stated preferences of young adults offer us clues on how they think about mobility and the types of communities they will be attracted to. Current behavior is no guarantee of future actions, and the attitudes and beliefs of millennials will certainly evolve and change as they grow older. That said, recent research and data suggest that today's young adults differ from previous generations in a way that may profoundly affect the communities in our region. Some broad-based observations include:

- Millennials are the most racially diverse generation in American history. They are projected to become the most educated generation as well; however, they face a number of economic challenges.
- Young adults have disproportionately been attracted to urban environments in our region and throughout the country. Philadelphia, in particular, has seen impressive growth in its young adult population. Nearly 35 percent of young adults in our region live in Philadelphia. Roughly 40 percent of these young adults live within the five planning districts that constitute the city's urban core.

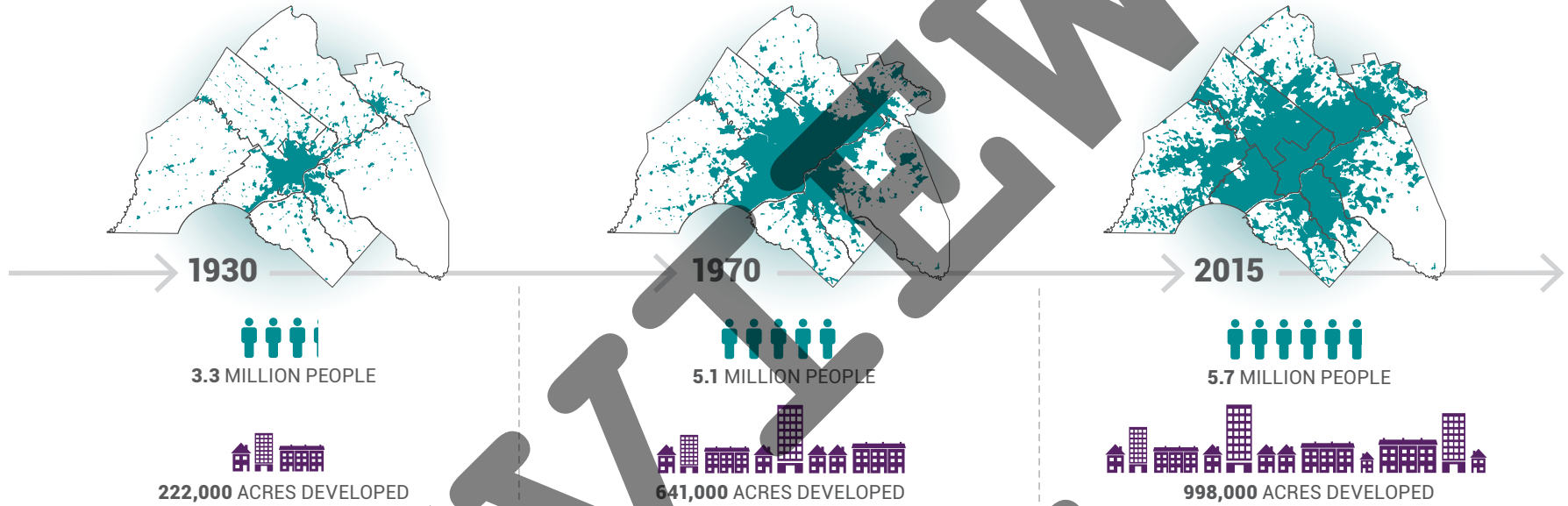
FIGURE 10: 2015 LAND USE

- Residential
- Other Developed
- Agriculture
- Wooded or Vacant
- Water



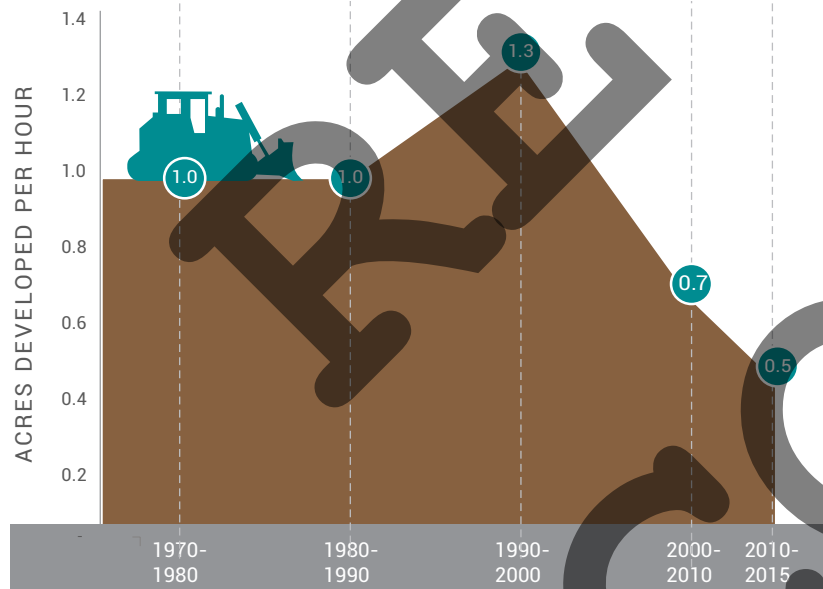
Source: DVRPC, 2017.

FIGURE 11: EXTENT OF REGIONAL DEVELOPMENT (1930–2015)



Source: DVRPC, 2017. U.S. Census Bureau 1930-1970. American Community Survey, 2015.

FIGURE 12: ACRES DEVELOPED PER HOUR (1970–2015)



Source: DVRPC, 2017.

- Young adults also drive less and use other modes of transportation at higher rates than other generations. Although a portion of this behavior can be attributed to the fact that many millennials currently reside in more urban locations with a variety of transportation options, this behavior may signal a willingness to think more broadly about how they meet their transportation needs in the future.

- They are technologically adept but have been slow to marry. A growing number of millennials will relocate to the suburbs in the coming years. However, some evidence suggests that they will be most attracted to mixed-use walkable communities that offer a mix of urban and suburban benefits.

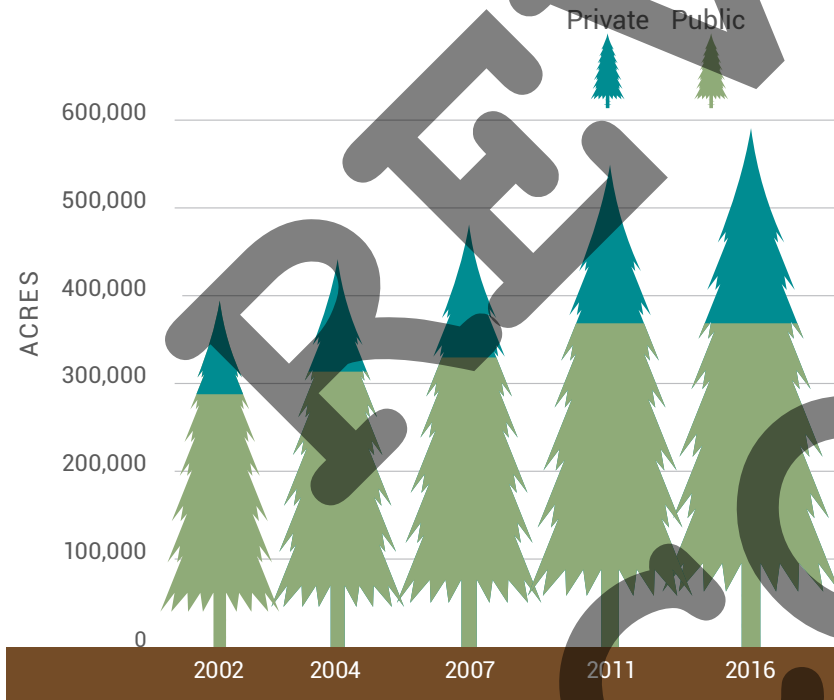
TABLE 3: 2016 DVRPC OPEN SPACE INVENTORY (ACRES)

COUNTY	PUBLIC PROTECTED OPEN SPACE					PRIVATE PROTECTED OPEN SPACE		TOTAL PROTECTED OPEN SPACE	PERCENT OF TOTAL AREA	
	FEDERAL	STATE	COUNTY	MUNICIPAL	TOTAL PUBLIC OPEN SPACE	NON-PROFIT	PRESERVED FARMLAND			TOTAL PRIVATE OPEN SPACE
Bucks	0	12,356	9,026	14,289	35,671	23,311	18,860	42,171	77,842	19.6%
Chester	1,290	8,006	5,444	12,982	27,722	58,741	39,973	98,714	126,436	26.0%
Delaware	948	2,592	1,393	4,599	9,531	1,627	1,517	3,144	12,675	10.4%
Montgomery	3,043	3,873	5,250	13,282	25,448	5,849	9,215	15,065	40,512	13.0%
Philadelphia	366	224	11,490	0	12,080	334	0	334	12,414	13.6%
PA SUBREGION	5,647	27,051	32,604	45,151	110,453	89,862	69,565	159,427	269,880	19.2%
Burlington	2,652	158,367	3,411	12,306	176,736	8,949	37,598	46,547	223,283	42.6%
Camden	0	20,562	2,919	5,093	28,574	0	1,902	1,902	30,476	20.9%
Gloucester	0	9,351	2,196	5,804	17,351	1,300	17,940	19,241	36,592	17.0%
Mercer	0	4,355	8,613	9,000	21,968	4,663	7,562	12,225	34,193	23.4%
NJ SUBREGION	2,652	192,634	17,139	32,204	244,629	14,912	65,003	79,915	324,544	31.5%
DVRPC REGION TOTAL	8,299	219,685	49,743	77,355	355,082	84,359	134,568	239,342	594,424	24.4%

Source: DVRPC, 2016. Base employment data from the NETS database, 2010 and 2013.



FIGURE 13: 2016 PROTECTED OPEN SPACE INVENTORY (ACRES)



Source: DVRPC, 2017.

The growth of the immigrant population will also have an impact on land use preferences and travel patterns. Research has shown that new immigrants have more children, and at an earlier age, and often live in larger households with their extended families. They typically travel fewer miles; make fewer vehicle trips; and more often take transit, walk, and bike. Hispanic immigrants are also more likely to carpool.

LAND USE

Land use analysis is another fundamental factor in the planning process. Over the past 85 years, the region has experienced a rapid suburbanization, characterized by “leap frog” development and sprawl. Over this time period, population has increased by 73 percent, but the amount of land consumed for development has increased by 450 percent. This has led to many negative externalities, including:

- increased reliance on driving and congestion;
- a drastic reduction in open space and agricultural land;
- detrimental impacts to air and water quality; and

- increased need for infrastructure and services.

Between 2010 and 2015, approximately 14,800 acres were developed regionwide, compared with almost 27,400 acres between 2005 and 2010. This is not surprising, given the continued slow recovery from the national and regional economic recession. Similarly, residential acreage increased by approximately 1.4 percent between 2010 and 2015, compared with the 2.3 percent increase during the previous five years. This reduction in land consumption may, in part, be due to higher-density development and redevelopment in the region's Core Cities

and older, Developed Communities. It may also reflect the impacts of the recession, as college graduates move back home, or the impact of immigration, as immigrants often live in multigenerational households.

The rate of development has been decreasing recently. From 1970 to 1990, development occurred at a rate of approximately one acre per hour; between 1990 and 2000, the rate accelerated to one acre every 45 minutes. Between 2000 and 2010, the rate slowed to approximately one acre of land developed every 82 minutes; and between 2010 and 2015, the rate of development slowed further to one acre every 117 minutes.

FIGURE 14: REGIONAL AGRICULTURAL LAND



Source: DVRPC, 2017.

OPEN SPACE INVENTORY

DVRPC maintains an inventory of protected public and private open space in the region. The inventory tracks all publicly owned open space, preserved farmland, and nonprofit protected open space. State, county, and municipal programs preserve farms by purchasing development rights with public funds. Nonprofits, such as land trusts and conservancies, protect privately owned open space lands by purchasing easements or by acquiring land outright with a combination of public and private funds. Between 2002 and 2016, the region has steadily increased its inventory of protected public and private open space (Figure 13 and Table 3): a necessary step in managing growth and protecting the environment throughout the region.

Despite strides made toward open space protection, the region has suffered from a steady loss in agricultural lands in both the Pennsylvania and New Jersey subregions. Figure 14 shows the decline in agricultural lands (those not preserved through easements or acquisitions) between 1995 and 2015.

Across the region, the largest category of protected open space is state-owned land, which makes up 37 percent of all protected open space. This is followed by preserved farmland, which makes up 24 percent of all protected open space.

- Protected open space makes up 24 percent of the nine-county Greater Philadelphia region. This is divided into 15 percent public open space and 10 percent private open space.
- The inventory of protected open space increased by 43,280 acres, or 8 percent, between 2011 and 2016.
- Preserved farmland, which increased by over 24,000 acres, had the largest gain in protected open space of any category of protected open space between 2011 and 2016.
- The county with the greatest amount and percentage increase in protected land was Chester County, which saw a 19,644 acre and 18.4 percent increase, respectively, in its protected open space.
- Burlington County has the greatest amount of protected open space by far, both in total acreage and as a percentage of the county, due primarily to land protection in the Pinelands.
- Between 2011 and 2016, 67 percent of the increase in protected open space was located in a Rural Resource Area or the Greenspace Network, designated for preservation in the Plan.

TRANSPORTATION

The Greater Philadelphia region has one of the most comprehensive transportation networks in the nation. This includes an extensive highway system, four public transit service providers, two Class I freight railroads, two commercial service airports, numerous intermodal port facilities, and a growing on- and off-road bicycle network. However, the system is mature and many of the aging facilities require significant investment. Recent years have witnessed some change in long-standing travel patterns. This update considers the impact these trends will have on the future needs of travelers in the region.

The number of vehicle miles traveled (VMT) has decreased regionally by 4.9 percent between the 2007 peak and 2015. As the economy has recovered from the late-2000s recession, VMT has held steady in the Pennsylvania portion of the region, well below 2007 levels. However, VMT is increasing again in the New Jersey portion of the region, setting a new peak at 15.3 billion VMT in 2015 (1.2 percent higher than in 2007).

Regionally, transit ridership has been on an upswing since 2000. Between 2000 and 2015, ridership in the region increased 11.3 percent overall. Between 2010 and 2015, ridership increased 34 percent on NJ TRANSIT, increased 17 percent on Pottstown Area Rapid Transit, and remained flat on the Southeastern Pennsylvania Transportation Authority (SEPTA) and the Port Authority Transit Corporation (PATCO). Public transit use gained momentum in the mid-2000s when gas prices above \$4 per gallon drove an increase in ridership. This growth correlates with the increased economic activity and residential development in and around Center City starting in the late 1990s: the focal point of the regional transit system. Most recently, the

region has seen trends of reduced car ownership among younger people; the rise of on-demand transportation, such as carsharing and Transportation Network Companies (TNC) services like Uber and Lyft; and revitalization of transit-friendly communities. While these trends seem to have solidified the resurgence of transit use in the region, there are some concerns. TNCs are growing quickly and may be replacing some transit trips, particularly for choice users. From 2016 to 2017, SEPTA ridership declined by 5.5 percent, which was primarily due to low gas prices, regional rail reliability issues when 115 Silverliner V cars had to be pulled out of service for emergency repairs, a six-day transit strike, and increased competition. Declining transit ridership has been occurring across the nation over the past few years.

More than 72 percent of commuters in the region travel to work by single-occupant vehicle (SOV). Between 2010 and 2015, the growth of commuters who drove alone (1.6 percent) was less than the growth of the total number of commuters (1.8 percent). Since 2000, the number of commuters carpooling has decreased by nearly 18 percent, while walking and bicycling to work increased by 16 percent, and transit commuting increased by 12 percent. Also during this time period, significant growth has occurred in other modes, such as motorcycles or taxi cabs (31 percent), and in working from home (54 percent). High growth in taxi and other modes may be a reflection of the fast TNC growth in Greater Philadelphia.

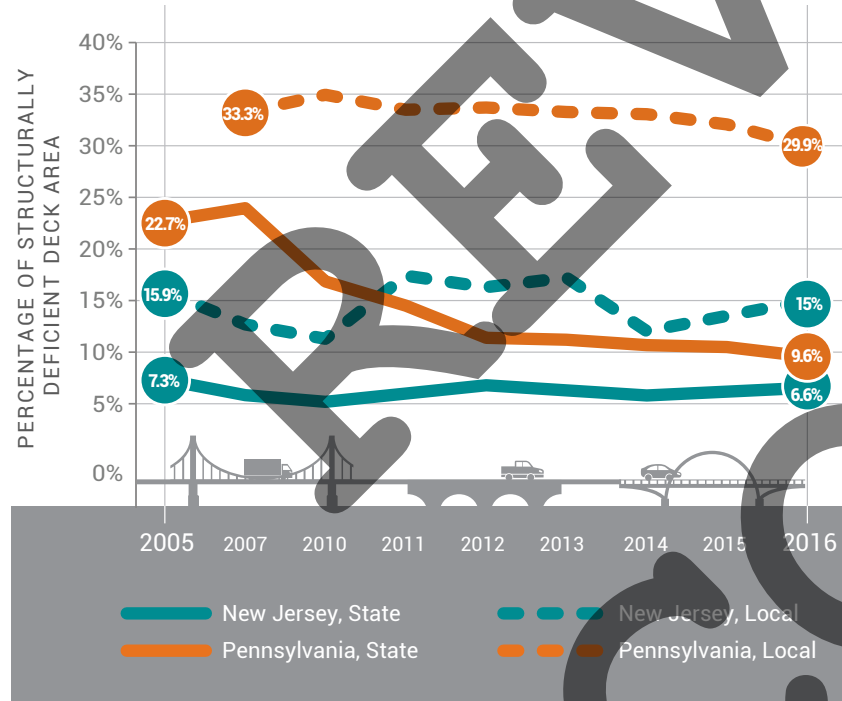
Commute times across the region continue to increase and are consistently higher than national averages. Between 2010 and 2014, commute time in Greater Philadelphia increased 1.9 percent, compared with the national average for the same time period: -2.4 percent. In many respects, this may be more indicative of land use patterns and lifestyle choices in the region than it is a reflection of congestion.

Congestion on the Pennsylvania subregion's freeways is significantly higher than on the freeways in the New Jersey subregion, although congestion has increased at a higher rate in New Jersey. As might be expected, congested freeway miles are along the major routes into and out of Philadelphia and the region's core. The Texas A&M Transportation Institute puts out an annual Urban Mobility Scorecard, which looks at congestion in each of the nation's 101 major metro areas. The most recent edition found that in 2014, the average auto commuter in the United States wasted 42 hours per year in congested conditions. In comparing metro areas, Philadelphia ranked 22nd worst, with 48 hours of congested time annually per auto commuter. To put this in context, the Greater Philadelphia region has the seventh highest population of metro areas in the United States.

With a mature transportation network, asset condition continues to be a significant challenge. Between 2005 and 2016, Pennsylvania has reduced the amount of state-maintained structurally deficient bridge deck area in the region by more than 50 percent and is now close to its desired state-of-good repair (SGR). Bridge conditions in New Jersey continue to outperform the larger region and the nation as a whole. Maintaining these conditions will be challenging as the region's pavement continues to worsen. The largest single 10-year period for building the region's infrastructure occurred during the 1960s; this means that many of these facilities have reached the end of their useful lives and need to be reconstructed soon. The region's deficient pavement increased by 8 percent overall between 2005 and 2016. New Jersey has reduced poor pavement by 11 percent, while Pennsylvania has seen a 17 percent increase in poor lane miles during this time period. Both subregions have deficiencies far greater than their SGR goals.

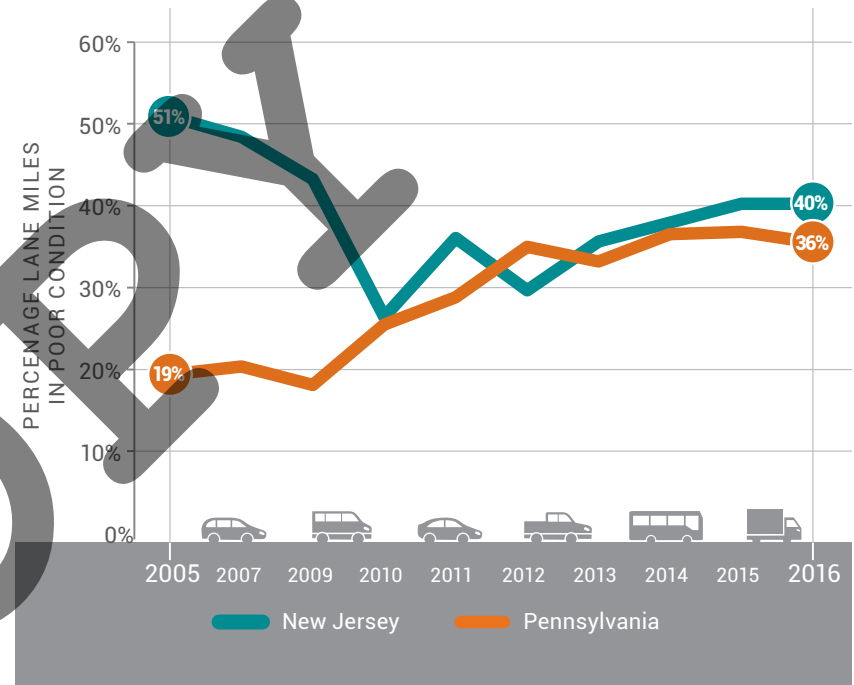
On the transit side, SEPTA has 232 regional rail vehicles past their 35-year expected useful life, and all SEPTA trolleys are approaching the end of their useful life. Act 89, passed by the Pennsylvania legislature in 2013, now provides nearly \$500 million per year in additional dedicated funding for public transit state-wide. This funding will allow SEPTA to begin to address its aging vehicle fleet. PATCO has been totally overhauling its heavy rail fleet, effectively resetting the clock on the useful life of those vehicles. PATCO expects to complete the vehicle overhauls of all its trains by the end of 2020. This will bring the New Jersey rail fleet closer to, and maybe even within, the SGR goal for rail vehicles. The average age of the NJ TRANSIT rail fleet is much newer than the current PATCO fleet, at 15.6 years.

FIGURE 15: REGIONAL STATE-MAINTAINED BRIDGE CONDITION



Source: PennDOT, NJDOT 2005-2016.

FIGURE 16: REGIONAL PAVEMENT CONDITIONS



Source: PennDOT, NJDOT 2005-2016.

REGIONAL INDICATORS

DVRPC has undertaken several initiatives that track the region's performance in various areas. *Rating the Region* and *Tracking Progress* are the two largest initiatives, but indicators are also tracked as part of several other planning efforts, such as the *Future Forces* scenarios and U.S. DOT transportation performance measures.

RATING THE REGION

Rating the Region provides an objective analysis of the state of the Greater Philadelphia region and identifies its relative strengths and weaknesses as compared with the other 25 largest metropolitan areas in the United States.

Greater Philadelphia continues to offer a diverse economy, affordable housing opportunities, quality highway and transit systems, comparatively short commute times, quality aviation and port facilities, a large number of colleges and universities, and an extensive healthcare network. The challenge now facing the region is capitalizing and building on these strengths while recognizing and working to address identified weaknesses.

In comparison with other regions, our transportation network, diverse economic base, relatively low unemployment rate, and research and development capabilities position us for economic growth. These strengths, however, threaten to be checked by the disparities between city and suburban income, low labor force participation, and poor educational attainment in the inner cities and older, developed areas. Likewise, our quality of life assets—colleges and universities, an extensive healthcare network, arts and cultural resources, and affordable housing—may be countered by challenges, such as a

DVRPC utilizes meaningful, reliable, and easy-to-replicate regional indicator data to track the region's progress towards the goals of the long-range plan, highlight successful programs, and identify which programs should be reviewed for effectiveness.

rapidly aging population, limited recreational resource funding, and the fragmentation caused by a large number of governmental entities, which can at times make it difficult to achieve regional goals.

The region's extensive healthcare network will be of tremendous value as the region works to meet the needs and demands of its growing elderly population. The region must continue to market its strengths, including extensive educational resources, affordable housing, arts and cultural opportunities, and short average commute times, to help attract and retain young, college-educated professionals.

One of the most serious issues facing the region is the disparity in employment rates, education and income between the primary cities and the suburbs. Access to existing suburban employment centers must continue to be improved. Combined with job training and workforce development, improved mobility can help provide better

"The only relevant discussions about the future are those where we succeed in shifting the question from whether something will happen to what would we do if it happened"

- Arie de Geus, Shell International

access to employment opportunities for city residents, increase labor force participation, and lower unemployment in the region's primary cities. Increased outreach and partnerships between the region's colleges and universities and the local elementary and secondary schools can increase the motivation and performance of students, particularly in the region's urban districts.

In order to remain a desirable locale and to continue growth, the Greater Philadelphia region must be prepared to compete effectively with other major metro areas around the country and around the world for new residents, new jobs, and new capital. The strengths of the region will serve us well as we move toward 2045, provided we recognize and respond to our challenges.

TRACKING PROGRESS

DVRPC utilizes meaningful, reliable, and easy-to-replicate data to track the region's progress toward the goals of the long-range plan, and compiles the data on the *Tracking Progress* website.¹ Regional indicator data is used to highlight successful initiatives and to identify which issue areas should receive priority attention in the next Plan update. *Tracking Progress* monitors 31 indicators; most are regionwide, but several of the indicators look at differences between urban, suburban, and rural areas.

Tracking Progress categorizes each of the region's 352 municipalities as one of four Planning Area types: Core Cities, Developed Communities, Growing Suburbs, and Rural Areas. Since 2005, population has increased in Philadelphia and in many Developed Communities. While the rate of growth continues to be higher in the region's Growing Suburbs and Rural Areas, residential construction and mortgage lending activity has been more robust in Core Cities and Developed Communities.

Positive trends can be seen in economic indicators, such as employment, workforce education, and average annual pay. Historically, these have been regional strengths. However, there is a growing economic disparity between the Core Cities and Developed Communities, and the Growing Suburbs and Rural Areas in these factors. Likewise, the older, developed areas continue to experience slower growth in population, employment, and residential tax base. Based on a review of the indicators, *Connections 2045* will continue to place emphasis on directing future growth and development to the identified Plan Centers and away from the Greenspace Network and Rural Resource Lands. The Plan also incorporates an increased emphasis and analysis related to transportation system preservation needs and funding.

¹DVRPC, *Tracking Progress*, <http://www.dvrpc.org/TrackingProgress>.

FIGURE 17: TRACKING PROGRESS INDICATORS

PLAN FACTORS	WHAT WE TRACK	+	TREND	-
THE ENVIRONMENT	Is land development/land consumption slowing?	+	↑	-
	Did growth occur in appropriate areas?	+	↑	-
	Have acres of public open space increased?	+	↑	-
	Have acres of privately protected open space increased?	+	↑	-
	Has the amount of farmland production in the region increased?	+	↑	-
	Is air quality improving?	+	↑	-
	Has surface water quality improved?	+	↑	-
COMMUNITIES	Is the population in Core Cities and Developed Communities increasing?	+	↑	-
	Is employment in Core Cities and Developed Communities increasing?	+	↑	-
	Has the tax base increased in Core Cities and Developed Communities?	+	↑	-
	Has residential construction activity increased in Core Cities and Developed Communities?	+	↑	-
	Has mortgage lending activity increased in Core Cities and Developed Communities?	+	↑	-
	Do development patterns support expanded transit options?	+	↑	-
ECONOMIC COMPETITIVENESS	Has the number of jobs in the region increased?	+	↑	-
	Has average annual pay in the region increased?	+	↑	-
	Is the workforce becoming more educated?	+	↑	-
	Is housing becoming more affordable?	+	↑	-
	Are GHG emissions lower?	+	↑	-
	Are we using less energy?	+	↑	-
	Are people driving less?	+	↑	-
TRANSPORTATION	Is transit ridership increasing?	+	↑	-
	Have roadway crash fatalities declined?	+	↑	-
	Is congestion getting worse?	+	↑	-
	Are fewer people driving to work alone?	+	↑	-
	Is commute time decreasing?	+	↑	-
	Has the number of deficient bridges decreased?	+	↑	-
	Are roads better maintained?	+	↑	-
	Is the transit network being maintained?	+	↑	-
	Are Transportation Improvement Program investments in Plan Centers increasing?	+	↑	-
	Are freight shipments in the region increasing?	+	↑	-
Is airline passenger traffic increasing?	+	↑	-	

Source: DVRPC, 2017.

FUTURE FORCES

Starting in the fall of 2014, DVRPC convened a group of experts in various disciplines, called the Greater Philadelphia Futures Group. This group was tasked with helping to identify and better understand nonlinear, driving forces of change that are most likely to shape the region going forward. Future Forces are observed trends, largely beyond the region's control, that will have major impacts on Greater Philadelphia and the ability to achieve the vision and goals set forth in the long-range plan. The Futures Group went through a process that identified the following five key Future Forces:



ENDURING URBANISM

People and jobs moving to walkable communities is the start of a long-term trend.



THE FREE AGENT ECONOMY

Increased outsourcing and automation means individuals must create their own economic opportunities.



SEVERE CLIMATE

Continued rise in atmospheric carbon levels leads to significant disruptions from climate change.



TRANSPORTATION ON DEMAND

Smartphones, apps, and real-time information help people get around using new and existing transportation modes.



THE U.S. ENERGY BOOM

An abundance of domestically produced oil and natural gas keeps the cost of energy low.

This effort did not try to predict the future or identify a preferred vision for it. Future Forces are not normative expressions of what we want to happen, and they are not official policy. Rather, Future Forces are exploratory; they attempt to understand how change is likely to occur and use that to guide regional decision making.

Each of the forces would have benefits and consequences for the region. The anticipated benefits of **ENDURING URBANISM** include more residents and jobs located in walkable communities, increased transit use, and improved urban schools. Consequences of this scenario, however, could include more gentrification and rising housing costs, particularly in urban areas; an increase in suburban municipalities with fiscal distress; and a loss of industrial land. In the **FREE AGENT ECONOMY**, the region would become more entrepreneurial and innovative, technology would enable working from anywhere, and on-demand services would be widespread and available for most anything. However, low-skilled workers may fall further behind, incomes may be less stable, and an increase in virtual education and telemedicine may weaken the region's two strongest economic sectors. In **SEVERE CLIMATE**, the region may benefit from a longer growing season for agriculture, lower heating costs, and may become an attractive destination for climate refugees. Potential challenges include crisis management from climate events; shortened infrastructure lifespans, with greater risk of sudden failures; and negative health and wildlife habitat impacts. In the **TRANSPORTATION ON DEMAND** scenario, the region's transportation system would operate much differently than it does today, with reduced need for car ownership and space for parking. This could bring consequences of increased suburban sprawl and congestion, with associated negative impacts to transit service and equity. In the **U.S. ENERGY BOOM**, there could be increased job

opportunities for lower-skilled workers, reduced energy prices, and less reliance on foreign energy sources. However, GHG emissions could increase; more air pollution would harm health; and cheap energy may delay the move to cleaner energy and more efficient vehicles, facilities, and equipment.

The Future Forces were modeled and analyzed as “what-if” scenarios through 2045 to highlight how the region may change over the next 30 years. The scenarios address potential shifts in travel demand and identify specific opportunities and challenges that may arise. In all scenarios, population forecasts were more optimistic, while

employment forecasts were lower than the Board-adopted forecasts (6.37 million people and 3.54 million jobs) in *Connections 2045*. Employment forecasts have been revised to match projected growth from an updated 2010 baseline compared to what is in the *Future Forces* report. Results from modeling the Future Forces scenarios are shown in Figure 18 and Table 4.

The report also recommends actions and workforce skills needed to better position the region to respond to these Future Forces. Those categorized as Universal Actions are beneficial regardless of whichever Future Force comes to fruition. Contingent Actions, on the other hand, are specific to

FIGURE 18: DAILY TRIPS PER CAPITA AND MODE SHARE

Modeshare and Daily Trips



Source: DVRPC, 2017.

TABLE 4: GREATER PHILADELPHIA FUTURE FORCES WHAT-IF SCENARIO PROJECTIONS FOR 2045

INDICATOR	2010 BASELINE	ENDURING URBANISM	THE FREE AGENT ECONOMY	SEVERE CLIMATE	TRANSPORTATION ON DEMAND	THE U.S. ENERGY BOOM
Total Population (millions)	5.63	6.58	6.44	6.45	6.51	6.48
Total Adjusted Employment (millions)	3.06	3.46	3.43	3.40	3.44	3.52
Percentage of Population <16	19%	18%	18%	19%	19%	20%
Percentage of Population >65	13%	20%	20%	19%	20%	18%
Total Households (millions)	2.13	2.62	2.38	2.32	2.46	2.50
Population per Household	2.64	2.51	2.71	2.78	2.64	2.59
New Footprint Residential Acres Developed, 2010–2045	-	20,300	64,300	70,100	145,700	226,400
New Footprint Commercial Acres Developed, 2010–2045	-	25,900	52,700	59,000	62,700	95,500
Population in Centers	23%	25%	24%	23%	23%	20%
Employment in Centers	22%	23%	23%	23%	22%	21%
Annual Residential Energy GHG Emissions per Household (MTCO ₂ E)	7.6	6.4	6.7	6.5	6.2	7.2
Average Annual Household Residential Energy Costs ^a	\$2,210	\$1,380	\$1,500	\$1,810	\$1,410	\$1,340
Vehicles per 1,000 Capita	573	518	576	565	395	627
Percentage Zero-Car Households	15%	26%	15%	15%	38%	13%
Daily VMT (millions)	107.0	116.1	114.1	109.5	146.4	139.2

continued on next page...

INDICATOR	2010 BASELINE	ENDURING URBANISM	THE FREE AGENT ECONOMY	SEVERE CLIMATE	TRANSPORTATION ON DEMAND	THE U.S. ENERGY BOOM
Annual VMT per Capita	6,940	6,440	6,470	6,190	8,220	7,840
% VMT through Ride Sourcing/AVs	0%	16%	11%	14%	58%	3%
Average Vehicle Occupancy	1.3	1.6	1.6	1.6	1.8	1.4
Daily VHT (millions)	3.57	3.74	3.66	3.48	4.98	4.68
Average Daily Speed (mph)	30	31	31	32	29	30
Annual Recurring Vehicle Hours of Delay per Capita	22	22	20	21	31	30
Annual Fatal Crashes	326	186	194	176	196	225
Annual Injury Crashes	31,784	16,730	17,410	15,785	17,750	20,240
Daily Gallons of Gasoline (millions)	5.0	2.5	2.6	2.2	2.4	3.4
On-Road GHG Emissions, Tailpipe Only (Annual MTCO ₂ E per Capita)	3.9	1.3	1.3	1.1	1.3	1.8
Daily Linked Transit Trips (millions)	0.8	1.4	1.2	1.2	1.3	0.9
Daily Walking and Biking Trips (millions)	1.5	3.8	2.3	2.3	2.3	1.7
Annual Household Transportation Costs ^a	\$10,870	\$14,260	\$8,860	\$17,530	\$15,120	\$10,490
Transportation Costs as a % of Income	15%	15%	10%	20%	16%	11%

^a in 2010 dollars.
Source: DVRPC, 2015.

each Future Forces scenario. As not all of the recommended actions can be implemented, the region must carefully weigh the costs and benefits of each and prioritize the most critical for implementation. Both sets of recommendations are incorporated into *Connections 2045*.

NETWORKING TRANSPORTATION

Following the Future Forces work, a more in-depth investigation into the Transportation on Demand scenario was undertaken. This effort aims for a better understanding of how the Digital Revolution is reshaping transportation. The Digital Revolution is enabling Transportation on Demand through real-time communications technologies and is also responsible for some of the other Future Forces. By directly connecting buyers and sellers, cutting out the middleman, helping firms operate in a leaner manner, strengthening outsourcing, bolstering automation and robotics, and flattening transaction costs, the Digital Revolution is largely behind the rise of contract employees in the Free Agent Economy. Network effects are also an indirect way in which the Digital Revolution is driving Enduring Urbanism. In addition, digital technologies could help the region to more efficiently use resources and reduce GHG emissions in the fight against Severe Climate.

Thanks to the Digital Revolution, there is a unique opportunity right now to reimagine transportation and urban areas through increased information and connection to the Internet. Grasping how to do this and perceiving the implications of new technologies requires a better understanding of the Digital Revolution.

The initial phase of the Digital Revolution, which is also called the Third Industrial Revolution, introduced widespread use of electronics and computer technologies. The key technologies driving the Digital

A network is a group of interconnected people and things. A network effect occurs when a good or service becomes exponentially more valuable as more people use it. The digital revolution is building networks in the virtual realm, which are spilling over into the physical world.



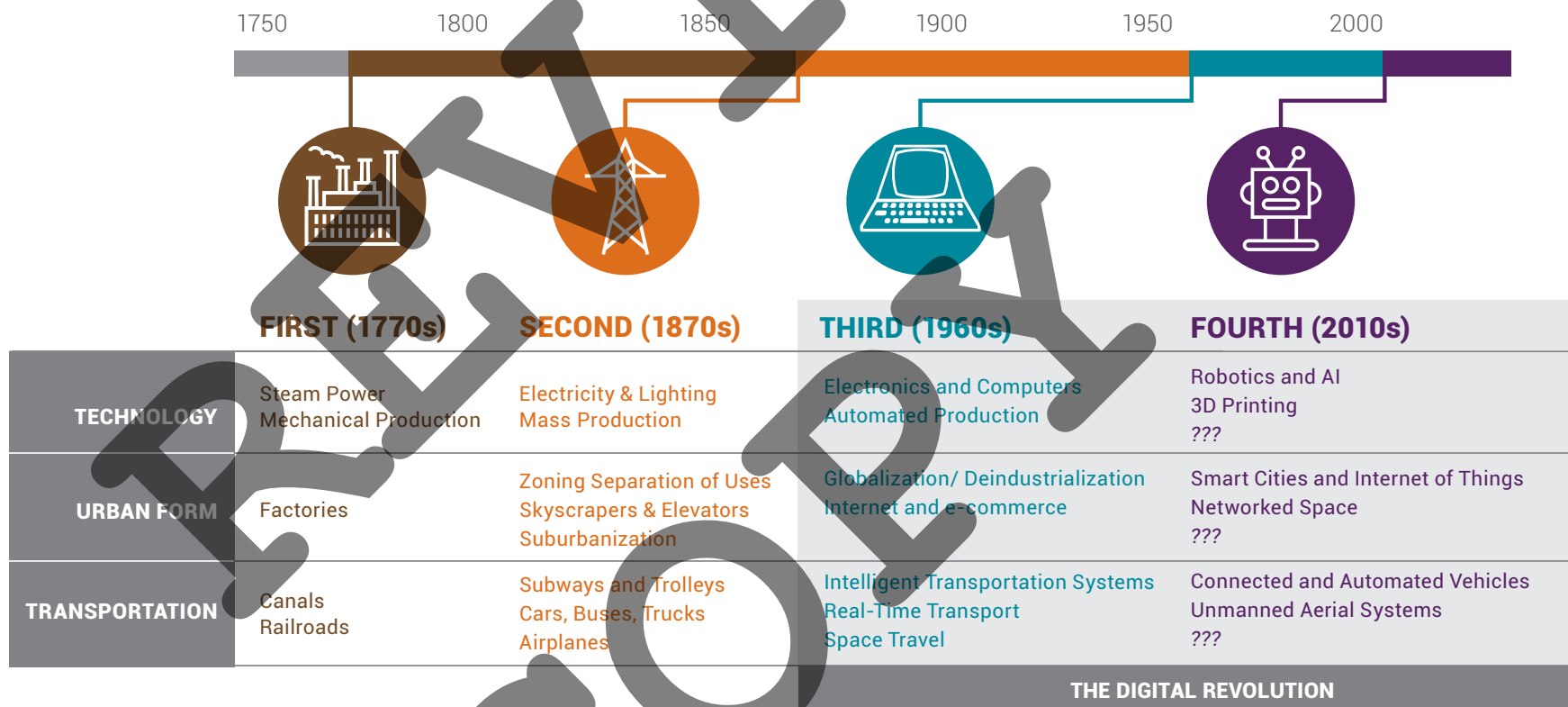
Revolution are computers, low-cost and readily available data storage, the Internet, digital devices that grant Internet access from nearly anywhere, and sensors that gather enormous amounts of data and turn it into actionable information and enable remote actions. By enabling the easy transfer of huge quantities of data over vast distances and providing for remote actions, the Digital Revolution has a flattening effect on distance. Networks are a key consideration in the digital world. They connect groups of people and things and lead to network effects (i.e., where the value of a given network increases exponentially with the number of interconnected people and things). Networks and their effects are spilling over into the real world, where a community's size and density are both important factors in determining the strength

of network effects. This is one reason why there has been so much interest in urban redevelopment over the past decade.

Beyond Intelligent Transportation Systems (ITS) infrastructure, this phase did not have significant impacts on regional and local transportation until recently. TNCs, such as Uber and Lyft, use smartphones, digital mapping and routing, and real-time information to connect drivers and passengers for on-demand trip making. Between July

and September 2016, Uber and Lyft were averaging 59,000 rides per day in the City of Philadelphia alone, according to *The Philadelphia Inquirer*.² TNCs are creating new options for how to get around while providing last-mile-to-transit solutions, and reducing the need for car ownership and parking. In addition to TNCs, smartphone apps and other sources of real-time information allow individuals to quickly and conveniently identify the best option that meets their specific needs in each circumstance.

FIGURE 19: THE FOUR INDUSTRIAL REVOLUTIONS



Source: DVRPC, 2017. Adapted from World Economic Forum.

² Jason Laughlin, "Uber and Lyft Have Made \$44 Million since Becoming Legal in Philadelphia," *The Philadelphia Inquirer*, updated February 16, 2017. <http://www.philly.com/philly/business/transportation/Uber-and-Lyft-made-44-million-since-becoming-legal-in-Philadelphia.html> (accessed September 5, 2017).

The next phase of the Digital Revolution, often referred to as the Fourth Industrial Revolution, is just getting underway and will increase the use of robotics, machine learning, and Artificial Intelligence (AI) while blending together the biological, physical, and digital worlds. This process is rapidly, fundamentally, and profoundly reshaping many aspects of our economy and society. For transportation, this is likely to mean connected vehicles (CVs); automated vehicles (AVs) and highly automated vehicles (HAVs); and, potentially, automated unmanned aerial systems (UASs), or drones, which can pilot themselves. Other technologies, such as 3D printers, the Internet of Things (IoT), and virtual communications, as well as technologies that have yet to be developed or even conceived, could further revolutionize our economic, urban, and transportation environments.

Networking Transportation also considers how the Digital Revolution is shifting transportation engineering perspectives, comparing traditional auto-oriented, planning-driven active transportation and the emerging digital transportation philosophies. While the auto-oriented philosophy has primarily guided transportation decision making over the past century, it is now widely acknowledged that it is impossible to build our way out of congestion. New roads simply push development farther out and quickly fill up with traffic. The development patterns lead to sprawl and inefficient use of natural and man-made resources.

More recently, planning has encouraged communities and transportation projects to incorporate more active transportation. This planning philosophy recognizes the key tie between development patterns and transportation demand, and focuses on building dense, mixed-use communities that shorten trip lengths and make transit, biking, and walking more feasible transportation solutions. The

Digital Revolution is focusing on putting information into the hands of individuals, where they can find the mode and route that makes the most sense for each individual trip. This can benefit the individual through personalized trip making, whether based on modal preferences, costs, reduced environmental impacts, or some other factor; and benefits society by steering people away from congested facilities.

While technology has long played a key role in transforming how people get around, the pace at which innovations are coming to the market seems to be accelerating. There are numerous transformative technologies that have the potential to revolutionize transportation; many come from the Digital Revolution. These technologies have the ability to network various modes together and increase the availability of real-time information in ways that improve both efficiency and safety. In the future, networked transportation may create more mobility-as-a-service arrangements, where individuals can buy a monthly pass with unlimited or a fixed number of trips on a variety of transportation modes. In addition, a variety of new private-market transportation services are emerging thanks to digital technologies, such as the smartphone and the Internet.

Achieving future technological solutions and services will mean that innovations will need to be economically viable, overcome potential liability and regulatory issues, and gain acceptance by society at large. Monitoring the impacts of upcoming technology is another reason for regular updates to the region's long-range plan. The following section reviews key emerging transportation-related technologies.

Alternative fuel vehicles present an opportunity to serve the region's mobility needs while simultaneously reducing energy use, petroleum

dependence, fueling costs, and GHG emissions. Electric vehicles (EVs) are powered by an electric motor using electrical energy stored in rechargeable batteries or other storage devices (such as a hydrogen fuel cell). EVs include plug-in hybrid electric vehicles—which have a supplementary internal combustion engine (ICE)—and all-electric vehicles. Vehicles may alternatively be fueled by natural gas, propane, biogas and biofuels, or compressed air. Another possibility is that they will take a hybrid approach, with the ability to be powered by a variety of fuel sources. Regardless, a well-planned infrastructure network, taking into account the different characteristics of these vehicles, will be essential to the adoption of alternative fuels.

While the United States has made no formal move to ban the ICE, a number of countries around the world are beginning to phase them out legislatively. Norway will do so by 2025, India by 2030, and France and the United Kingdom by 2040. Several cities and auto manufacturers may pursue even nearer-term ICE prohibitions.

Gas taxes are the primary way in which the region and nation pay for transportation infrastructure construction and maintenance. Increasing fuel efficiency, along with new types of fuel, will further reduce the flat-rate gas tax revenues that fund most transportation projects, making it even more difficult to maintain the system in the future. Increased use of alternative-fuel vehicles will necessitate finding a new way to raise revenue for transportation infrastructure.

TABLE 5: DIFFERENT TRANSPORTATION ENGINEERING SYSTEMS

	Auto-Oriented	Active Transportation	Digital Transportation
Overall Goal	Increase mobility	Increase accessibility	Increase information
Land Use	Separation of uses	Mixed use, high density	Live/work where you want; recognition that size and density have network effects
Trip Priorities	High speed	Short trips, getting exercise	Customization, cost, reliability, use time other than for driving
Safety	Safe mobility	Vision Zero	Connected technologies, warning systems, feedback loops, and data enhance safety
Key Metrics	Level-of-service, vehicle hours of delay, travel-time index/savings	Bike/Ped level of service, trip length, total travel time, VMT, GHG emissions, transit trips	Real-time data, person throughput, wait time, personal ratings, Big Data and analytics
Investment Priorities	New and wider roads	Connections between modes; walking, biking, and transit facilities	Multimodal Smart Roads that increase safety and efficiency
Rationale for Investment	Fight congestion; reduce delay	Build livable communities; sustainability; improve health	Create an integrated, multimodal network, profit (private market)

Source: DVRPC 2016. Adapted from Ian Lockwood, "Livable Traffic Engineering," CNU Orlando, video published November 17, 2012, <https://www.youtube.com/watch?v=o7IXbIXNOPk> (accessed June 4, 2015).

AV and **HAV** systems comprise hardware and software, both remote and on-board, which perform the functions needed to drive a vehicle. The key hardware components include an on-board computer that makes decisions; a global positioning system (GPS) signal system; an inertial measurement unit for when the GPS is out of signal; radar sensors that detect nearby vehicles; ultrasonic sensors that detect other vehicles and objects alongside the AV; LiDAR that identifies lane markings; and video cameras that read traffic signals, road signs, and watch for pedestrians and obstructions.

The National Highway and Traffic Safety Administration (NHTSA) has adopted the Society of Automotive Engineers International vehicle automation level definitions in an attempt to standardize them. These definitions classify vehicles based on “who does what, when”³

- **Level 0 No automation**—A human driver does everything.
- **Level 1 Driver Assistance**—An automated system can sometimes assist the human driver in conducting parts of a driving task.
- **Level 2 Partial Automation**—An automated system can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task.
- **Level 3 Conditional Automation**—An automated system both actually conducts some parts of the driving task and monitors the driving environment in some instances, but the human driver

must be ready to take back control when the automated system requests.

- **Level 4 High Automation**—An automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can only operate in certain environments and under certain conditions.
- **Level 5 Full Automation**—An automated system can perform all driving tasks under all conditions that a human driver could.

HAVs still face a number of technological challenges. HAVs must be able to transfer control of the vehicle in degraded conditions, but it is unclear whether a driver will be ready to take over when this happens, particularly as driver skills will atrophy when computers start to do most of the driving. Operating systems are based on millions of lines of code, and testing is occurring through trial and error, which means that it is hard to test them all. HAVs require sensitive computer equipment, which will be exposed to the elements. This creates additional risk of failure. Work zones create a particular problem for HAVs because they take precedence over all the other detailed road information that these vehicles are programmed to read.⁴

HAVs could alter the vehicle ownership model, with a decrease in privately owned cars and an increase in shared vehicle ownership. This could revolutionize the carsharing model, and by removing the sunk costs of automobile ownership, other modes may benefit. While their eventual timeline to show up in large numbers in the region's streets

³National Highway Traffic Safety Administration, *Federal Automated Vehicles Policy: Accelerating the Next Revolution in Roadway Safety* (Washington, DC: The U.S. Department of Transportation, September 2016), <https://www.transportation.gov/AV/federal-automated-vehicles-policy-september-2016>.

⁴Aarian Marshall, “Why Self-Driving Cars *Can’t Even* With Construction Zones,” *Wired*, February 10, 2017, www.wired.com/2017/02/self-driving-cars-cant-even-construction-zones/ (accessed February 13, 2017).

remains unknown, the region needs to begin planning for them now.

“Big Data” is a broad term for data sets so large or complex that traditional data processing applications are inadequate.⁵ The steadily decreasing cost of computing power—storage, memory, processing, bandwidth—is enabling Big Data.⁶ Big Data sets are often mined or use other advanced methods to extract value and/or develop predictive analytics. Big Data can help to improve decision making, which in turn can enhance operational efficiencies, reduce costs, and decrease risks.

CVs use dedicated short-range communications (DSRC) through licensed wireless networks, cellular technologies, satellites, the Internet, and telematics to connect cars, trucks, buses, motorcycles, bicyclists, pedestrians, and infrastructure.⁷ Telematics integrate telecommunication and information technologies for enhanced vehicle safety and mobility.⁸ Connected systems create machine awareness with other CVs, infrastructure, and other objects. This can provide warnings to the driver about safety hazards, such as curves, intersections, and nearby vehicles. CVs can overcome range, sight, and data interpretation problems with sensors, while enabling more coordination and traffic flow management.⁹ By cooperating with each other, CVs are anticipated to reduce crash and fatality rates for nonimpaired drivers by up to 80 percent.¹⁰ However, connected and wireless technologies open CVs up to hacking and cybersecurity risks. In the longer term, CV technologies may move much road information—

signs, speed limits, even traffic signals—to the vehicle dashboard, reducing roadside clutter and lowering maintenance costs.

The **IoT** uses physical objects and sensors embedded in electronics, software, and other devices to capture and exchange data.¹¹ The IoT was made possible by the convergence of multiple technologies, including wireless communications, the Internet, embedded systems, sensors, and microelectronics.¹² A number of technologies are driving the IoT, including wearable devices, smart homes and buildings, Smart Cities, and smart enterprises. It will eventually include CVs and HAVs. The IoT will collect and analyze data, develop algorithms to more efficiently manage systems, and enable remote actions.

Nanotechnology refers to controlling individual atoms and molecules (which are less than 100 nanometers, where a nanometer is one billionth of a meter), in order to enhance material properties with greater strength and lighter weight, gain more control over the light spectrum, and increase chemical reactivity to greater levels than larger-scale counterparts. Nanotechnology can enhance battery life, provide lightweight and high-strength materials, and reduce the size and increase the computing power of remote sensors.

Real-time information is available through traffic navigation tools and apps, such as Google Maps, Waze, and SEPTA and NJ TRANSIT apps. They help to use the transportation network more efficiently in several

⁵ Abbas Mohaddes and Peter Sweatman, *Transformational Technologies in Transportation: State of the Activities* (Transportation Research Board, May 2016), <http://www.trb.org/Main/Blurbs/174370.aspx>.

⁶ *Ibid.*

⁷ *Ibid.*

⁸ Peter Jin, *Emerging Transportation Technologies White Papers* (Austin, TX: The University of Texas at Austin Center for Transportation Research, May 2015), <http://library.ctr.utexas.edu/ctr-publications/0-6803-P2.pdf>.

⁹ Steven Schladover, “Progress toward Automated Driving,” Halmstad Colloquium (video), February 12, 2012, <https://www.youtube.com/watch?v=4wfpUSTG9zU> (accessed June 7, 2016).

¹⁰ *Ibid.*

¹¹ Mohaddes and Sweatman.

¹² *Ibid.*

ways. First, mode optimization can determine the most efficient mode using information about travel time, cost, and available travel options. Once a mode is chosen, route optimization can identify the fastest and most direct route. Second, navigation tools route people and vehicles away from congested facilities and onto less congested facilities. This lets individuals make faster trips while also benefiting society with reduced congestion. While facility optimization can balance vehicle volumes throughout the system and reduce congestion, it may increase VMT, particularly on roads with historically lower traffic volumes. Some vehicles may use residential streets that are not designed for high volumes or speeds to bypass congestion. A number of applications are improving the travel information we have at our fingertips and changing how we get around the region:

- **Dynamic carpooling apps** enable real-time ridesharing by connecting drivers and potential passengers.
- **Freight apps** are digital goods movement platforms that allow small trucking carriers to transact directly with shippers. Real-time, on-demand routing programs can promote efficiencies and reduce congestion through fewer empty truck legs and decreased truck VMT.
- **Multimodal apps** provide real-time travel and cost information for a variety of modes, allowing the user to select the option for them.
- **Parking apps** provide better space availability information or easier payment options to make parking in the region more efficient.

"In lieu of large civil infrastructure projects, transportation systems are increasingly being augmented with a range of information technologies that make them smarter, safer, more efficient, more integrated."

- Anthony Townsend, PhD.

RE-PROGRAMMING MOBILITY: The Digital Transformation of Transportation in the United States (New York: Rudin Center for Transportation Policy & Management).

- **Ridesharing apps** allow for real-time carpooling by connecting drivers and potential passengers.
- **Taxi apps** operate within the traditional taxi medallion framework. Users are able to access the technology through a handheld device to summon a licensed taxi driver, and in some apps the passenger can electronically pay for the trip.

Shared mobility providers offer service through digital networks, which are typically accessed through a smartphone app that uses real-time data to match supply and demand.¹³ Services that include vehicle sharing can vary by whether they are one way (meaning the vehicle can be picked up in one location and dropped off at another) or round trip (meaning the trip must end at the same location where it started). In Greater Philadelphia, Indego Bikesharing is an example of a one-way

¹³"Episode 2—Shared Mobility Conversation with Susan Shaheen." ITE Talks Transportation Podcast Series, <https://www.speaker.com/user/ite-talks-transportation/episode-2-shared-mobility-conversation-w>

trip, which generally ends at a different station from where it started. Typically, carsharing providers require round-trips, where the vehicle must be returned to the same location where it was picked up. Free-floating or dockless systems break away from station infrastructure altogether and aim to move vehicles and bicycle pick-up and drop-off locations closer to trip origins and destinations.¹⁴ In peer-to-peer networks, an individual rents their personal vehicle (or bike, scooter, etc.) to someone else. Types of digital transportation service providers in Greater Philadelphia include:

- **Bikesharing** services set up publicly accessible bicycles for short-term use. They can fill in gaps in transit service and can accommodate overflow of peak-period transit ridership. Bikesharing programs are often operated municipally through a Public-Private Partnership (P3), but can be found on corporate and university campuses, on residential properties, and in hotels. Removing dock infrastructure can reduce costs and expand service areas, allowing bikesharing to be more financially feasible for public and private operators.
- **Carsharing** allows an individual to rent a car on an hourly or daily basis. Reservations are usually made in advance but often can be done with very short (30 minutes or less) notice. Each carsharing vehicle is estimated to replace 9–13 personally owned vehicles.
- **Courier networking** services offer on-demand pick-up and/or delivery of goods, groceries, and take-out foods. By delivering needed, and potentially bulky or heavy, goods to a household, these services play an important role in helping individuals to live car-free or car-lite if they choose.

- **TNCs** facilitate rides through a digital network using independent contractor or professional drivers, depending on the form:
 - ◆ **Microtransit** services generally combine trips to move multiple passengers simultaneously on demand. These services often create partnerships with charter bus companies, which supply the vehicles, drivers, and insurance.
 - ◆ **Ridesourcing** uses an app to electronically hail a driver, who “contracts” with the service. The cost of the trip is indicated before the request is finalized. The app guides the driver to pick up the passenger and then take them to their desired destination. Payment is handled electronically within the app, so the driver has no need to carry cash.
 - ◆ **Ridesplitting** combines aspects of ridesourcing and microtransit. These services may use larger vehicles, which are owned by independent contractor drivers, to simultaneously pick up and drop off multiple passengers for a discounted price. This may increase vehicle occupancy rates and help to alleviate congestion.

UASs, more commonly known as drones, are remotely piloted aircraft. They can be used to inspect previously hard-to-reach facilities, such as bridges, tiers, towers, or windmills. Safety can be enhanced by not sending humans to inspect dangerous (such as first responders in disaster zones) and hard-to-reach spaces, and access can be gained to areas that were previously unreachable. Operating a UAS is much easier than flying a helicopter, so it is not surprising that different companies are working on UASs that can fly passengers.

¹⁴New Mobility (Toronto: WSP, August 2016 update), <http://www.wsp-pb.com/Globaln/WSP-Canada/In%20the%20media/Project%20News/2016/16-08-31%20-%20New%20Mobility/WSP%20Metrolinx%20New%20Mobility%20Report%20July%202016.pdf>.



3. PLANNING FOR THE FUTURE

THE VISION FOR THE FUTURE

A central purpose of the Plan is to outline a vision for the growth and development of the region. This forms a basis for defining goals and strategies to achieve a desired future. The vision is based on identifying and analyzing recent and historic trends, as well as future forecasts and forces, and collectively—through public outreach—discussing which trends and forecasts the region aims to bolster or alter. Trends provide a view of what we expect to happen if current events continue unabated, although the Future Forces work highlighted that many trends are now nonlinear. The Plan sets out a collective vision of what the region can attain, which in some instances is different from the trend-based projections. For instance, the Plan promotes additional growth in the region's Developed Communities and less growth in Rural Areas relative to the official 2045 population and employment forecasts.

DVRPC held a series of public workshops in the spring of 2016 and presented the Future Forces scenarios. Based on the ensuing discussions, DVRPC staff posed a series of questions to attendees on what they would prefer the region to look like in 2045. These results were augmented by outreach to additional stakeholders, as well as by an online survey. Responses from the outreach efforts were captured and organized into various topics, and the following vision statement captures the views with the greatest support.

FIGURE 20: VISION WORD CLOUD



Source: DVRPC, 2017.

Between now and 2045, Greater Philadelphia will:

- Sustain NATURAL RESOURCES through the preservation of open space, better stormwater management, and improved air and water quality. Address climate change by both reducing GHG emissions—through cleaner energy and energy efficiency—and adapting to a changing climate.
- Focus future development in vibrant, healthy, mixed-use LIVABLE COMMUNITIES with walkable main streets and downtowns that provide access to green space, live/work opportunities, and a variety of affordable housing options.
- Diversify and expand the ECONOMY, making it more competitive on the global stage with increased employment opportunities, business retention, entrepreneurialism, advanced manufacturing, and expansion of the region's tech sector. Higher education institutions will be incubators of new technologies and business opportunities.
- Be more EQUITABLE with a reduction in poverty, increased economic mobility, and racially and socioeconomically integrated communities. Give all children in the region, no matter where they live, access to good schools and an education that prepares them for the jobs of the future.
- Create a well-maintained, INTEGRATED, MULTIMODAL TRANSPORTATION NETWORK that provides accessibility, reduces congestion and auto-dependence, incorporates new technologies, and moves the region toward zero roadway deaths.

Two other areas that stand out in the vision discussions were the need to increase regional cooperation and government efficiency. These are seen as key strategies to achieving the vision and would mean more transparency and openness, innovation and sustainable practices, collaboration between business and government, and use of data and metrics, with a fairer and more equitable tax structure that will spur regional growth.

Connections 2045 is developed around five core principles that help achieve the vision for the future.

- Sustain the Environment;
- Develop Livable Communities;
- Expand the Economy;
- Advance Equity and Foster Diversity; and
- Create an Integrated, Multimodal Transportation Network.

The five core principles are related to the five major topics considered in the Plan: the environment, communities, economic competitiveness, equity, and transportation. Each core principle is outlined in the following pages, and each section contains issues and challenges related to the principle, as well as a set of goals and strategies to implement the principle. Since the principles are holistic and inter-related, strategies frequently pertain to multiple principles. For the sake of conciseness, though, they are only listed once under a single principle in the Plan.

PRINCIPLE: SUSTAIN THE ENVIRONMENT

Open space, natural areas, farmland, and historic resources are indispensable to our region and its residents. However, many of these resources are threatened by development. *Connections 2045* recognizes that the continued loss of these resources is not sustainable, and the need to accelerate and coordinate growth management and resource protection activities is urgent. Between 1970 and 2015, 375,500 acres of farms, fields, and forests were lost to development, an average of 22 acres each and every day for 45 years. A continued improvement in the economy would likely increase the rate of development absent other policies to protect open space. The continued disappearance of undeveloped land has serious consequences for air and water quality, agricultural productivity and the farm economy, wildlife habitat, opportunities for recreation and healthy lifestyles, and our region's character and quality of life.

LAND USE VISION

The *Connections 2045* Land Use Vision defines a regional visualization for Centers-based development and the preservation of agricultural and natural lands. The Land Use Vision divides the entire region up into four layers: Infill and Redevelopment areas, Emerging Growth areas, Rural Resource Lands, and the Greenspace Network. Overlaid on these land use areas are over 125 Centers, which are points of more concentrated development around which new development should be focused.











Emerging Growth areas should have relatively low-intensity development. The overall goal of the Land Use Vision is to create a clean and sustainable environment, where key natural resource areas and agricultural lands are

DVRPC's Growth Management and Resource Protection Planning Philosophy

- Land use, growth, and resource protection must be integrated into a comprehensive, cooperative, continuing, and coordinated process.
- The regional Land Use Vision will support the goals and policies of the DVRPC long-range plan.
- Growth should be encouraged in areas of existing development as Infill and Redevelopment, and discouraged in agricultural, natural, and rural areas.



FIGURE 21: LAND USE VISION

-  Metro Center
-  Metropolitan Subcenter
-  Suburban Center
-  Town Center
-  Planned Town Center
-  Rural Center
-  Infill and Redevelopment
-  Emerging Growth
-  Greenspace Network
-  Rural Resource Lands



Source: DVRPC, 2017.

Sustaining the Environment will provide the following benefits:

- Limit the need for additional water, wastewater, and transportation infrastructure, which is becoming increasingly difficult to finance, build, and maintain.
- Preserve natural features, including important habitat areas, woodlands, stream buffers, and wetlands. These features maintain water quality, reduce flooding, recharge groundwater, improve air quality, strengthen biodiversity, enhance personal health, and beautify the region.
- Decrease dependence on the automobile for personal mobility, leading to lower levels of air pollution, less dependence on fossil fuel energy, and fewer GHG emissions.
- Preserved farmland will strengthen the local agricultural industry, enhancing local food production at a time when demand for local food is increasing.
- Prevent expansion of suburban development into rural communities to preserve agricultural character and heritage.
- Protect the context and integrity of historic sites and cultural landscapes that make the Greater Philadelphia region unique.
- Provide an exceptional source of outdoor recreation opportunities that delivers entertainment and increases well-being.

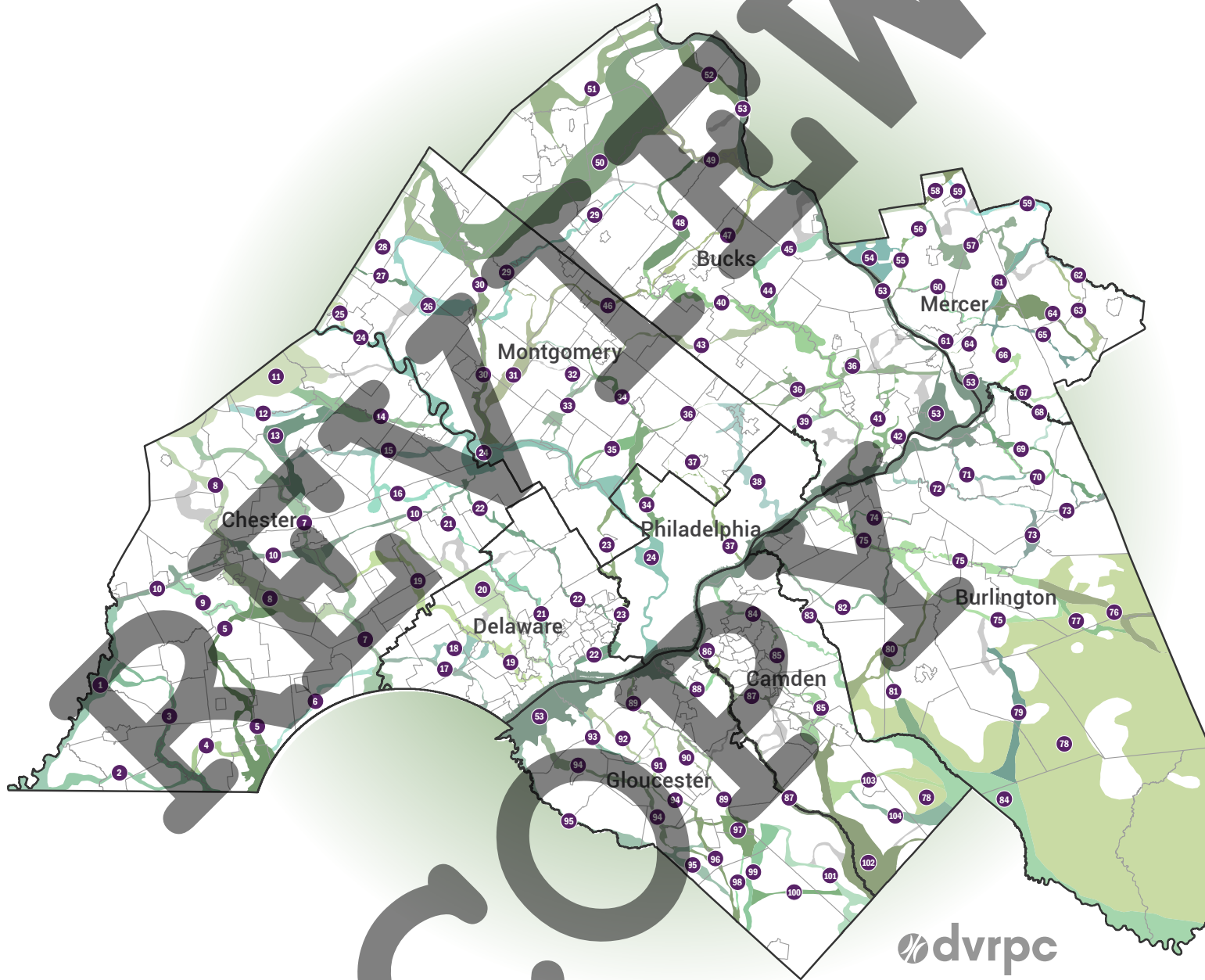
protected, open space is provided in an interconnected network, and most new growth is concentrated around identified Centers and as Infill and Redevelopment in areas previously developed.

There are 2.4 million acres of land in the region. The Plan proposes that at least one million acres be permanently preserved for natural resource protection, farmland preservation, outdoor recreation, and shaping and differentiating the region's communities. These lands should be strategically located in the Greenspace Network and Rural Resource Lands to protect environmentally sensitive areas, create interconnected networks of forests and riparian corridors, and preserve key agricultural landscapes. This open space system will enhance ecosystem health, improve water quality, provide abundant recreational opportunities, and strengthen the region's agricultural economy. With just under 600,000 acres of protected lands in the region to date, the region is over halfway toward meeting this goal.

GREENSPACE NETWORK

The Plan proposes linking and expanding the region's existing protected natural areas into a Greenspace Network, where parks, forests, meadows, stream corridors, and floodplains are joined together in an interconnected system. The Greenspace Network is based on the twin principles of protecting core natural resource areas and linking them with greenways to create a connected system of naturally vegetated open space spanning urban, suburban, and rural areas. The vision of the Greenspace Network is to permanently protect currently unprotected acres in the system through acquisitions, easements, and land use regulations. The network is broken down into approximately 100 distinct corridors. Each corridor is named to promote its identity and brand it as a unique preservation project.

FIGURE 22: GREENSPACE NETWORK



Source: DVRPC, 2017.

1	Octoraro Creek	36	Cross County Corridor	71	Crafts Creek
2	Serpentine Barrens	37	Tacony-Cresheim Creek	72	Assicunk Creek - Annaricken Brook
3	Big Elk Creek	38	Pennypack Creek	73	Budd Run-North Run
4	White Clay-Ways Run	39	Poquessing Creek	74	Mill Creek
5	White Clay Creek-Doe Run	40	Neshaminy Creek	75	Rancocas Creek
6	Delaware Arc	41	Mill-Queen Anne Creek	76	Mount Misery
7	Brandywine Creek	42	Delaware Canal	77	Bishpams Mill Creek
8	West Branch Brandywine Creek	43	Little Neshaminy Creek	78	Pinelands Conservation Areas
9	Buck Run	44	Mill Creek	79	Batsto-Friendship
10	Great Valley Ridgelines	45	New Hope-Ivyland	80	Southwest Branch Rancocas Creek
11	Big Wood Corridor	46	West Branch Neshaminy	81	Haynes Creek
12	Warwick-Elverson	47	Paunnaoussing-Pine Run	82	Pennsauken-Masons
13	Marsh Creek-Beaver Run	48	Peace Valley-Deep Run Creek	83	South Pennsauken Creek
14	French Creek	49	Tohickon Creek	84	River To Bay
15	Pickering Creek	50	North Woods	85	Cooper River
16	Valley Creek-Pigeon Run	51	Quakertown-Cooks Creek	86	Little Timber
17	Harvey Run-Naaman's Creek	52	Tinicum-Nockamixon	87	Big Timber
18	West Branch Chester Creek	53	Delaware River	88	Woodbury Creek
19	Chester Creek	54	Washington Crossing	89	Mantua Creek
20	Ridley Creek	55	Jacobs Creek	90	Chestnut Branch
21	Crum Creek	56	Pennington Mountain	91	Edwards Run
22	Darby Creek	57	Stony Brook	92	Repaupo Creek
23	Cobbs-Mill Creek	58	North Hopewell	93	Pargey Creek
24	Schuylkill River	59	North Mercer	94	Raccoon Creek
25	Manatawny Creek	60	Shabakunk-Ewing	95	Oldmans-Reed
26	Swamp-Deep Creek	61	Delaware And Raritan Canal	96	Still Run (Maurice River)
27	Minister Creek	62	Millstone River	97	Glassboro Wildlife Management Area
28	Middle Creek	63	Big Bear Brook	98	Little Ease Run
29	East Branch Perkiomen Creek	64	Assunpink Creek	99	Scotland Run
30	Perkiomen Creek	65	Miry Run	100	Indian-Faraway
31	Skippack Creek	66	Pond Run-Back Creek	101	Hospitality Branch
32	Towamencin Creek	67	Doctors Creek	102	Great Egg Harbor River
33	Stony Creek	68	Crosswicks Creek	103	Sleeper Branch
34	Wissahickon Creek	69	Blacks Creek	104	Pump Branch
35	Plymouth Meeting	70	Bacons Run		

The Greenspace Network reflects numerous regional high-priority environmental goals, including the need to maintain and improve surface water quality and protect large, intact ecosystems. As the region continues to experience the impacts of climate change in the form of more extreme heat and bouts of intense rainfall, the Greenspace Network will help to minimize the damage to life and property caused by flooding, as well as reduce the impacts of extreme heat through vegetative cooling.

The Greenspace Network is also a blueprint for creating a system of landscape-scale green infrastructure that extends into the region's urban and suburban core. Bringing green corridors into urban landscapes and connecting them back out to larger natural areas makes denser communities more attractive and appealing places to live, work, and play; boosts property values; and encourages increased investment in our towns and cities.

RURAL RESOURCE LANDS AND CONSERVATION FOCUS AREAS

Rural Resource Lands depict agricultural, natural, and rural areas worthy of heightened preservation efforts by governments and nonprofit land trusts. These lands contain villages and scattered low-density development, but they remain mostly agricultural and rural in character. Their integrity should be maintained through strategic acquisitions and easements, land use regulations, good stewardship, and appropriate forms of growth. Rural Resource Lands are not “no-growth zones” but instead are areas whose values can be protected while allowing for limited growth that is in character with the local context.

Rural Resource Lands comprise all of the region's significant remaining agricultural landscapes. Protecting these resources is not only critical

to maintaining the rural character of our region, but also to maintaining the region's agricultural economy. While farming has always been a dominant economic sector in Greater Philadelphia, it has taken on new importance in recent years with the growing emphasis on eating locally produced food. The many advantages of locally produced food include improved health, better food quality, and lower outlays of energy and materials for processing and transportation. Greater Philadelphia has some of the most highly productive, fertile soils in the Northeast. These soils provide the region with a unique competitive advantage, which is lost when farmland is converted to housing or other developed uses.

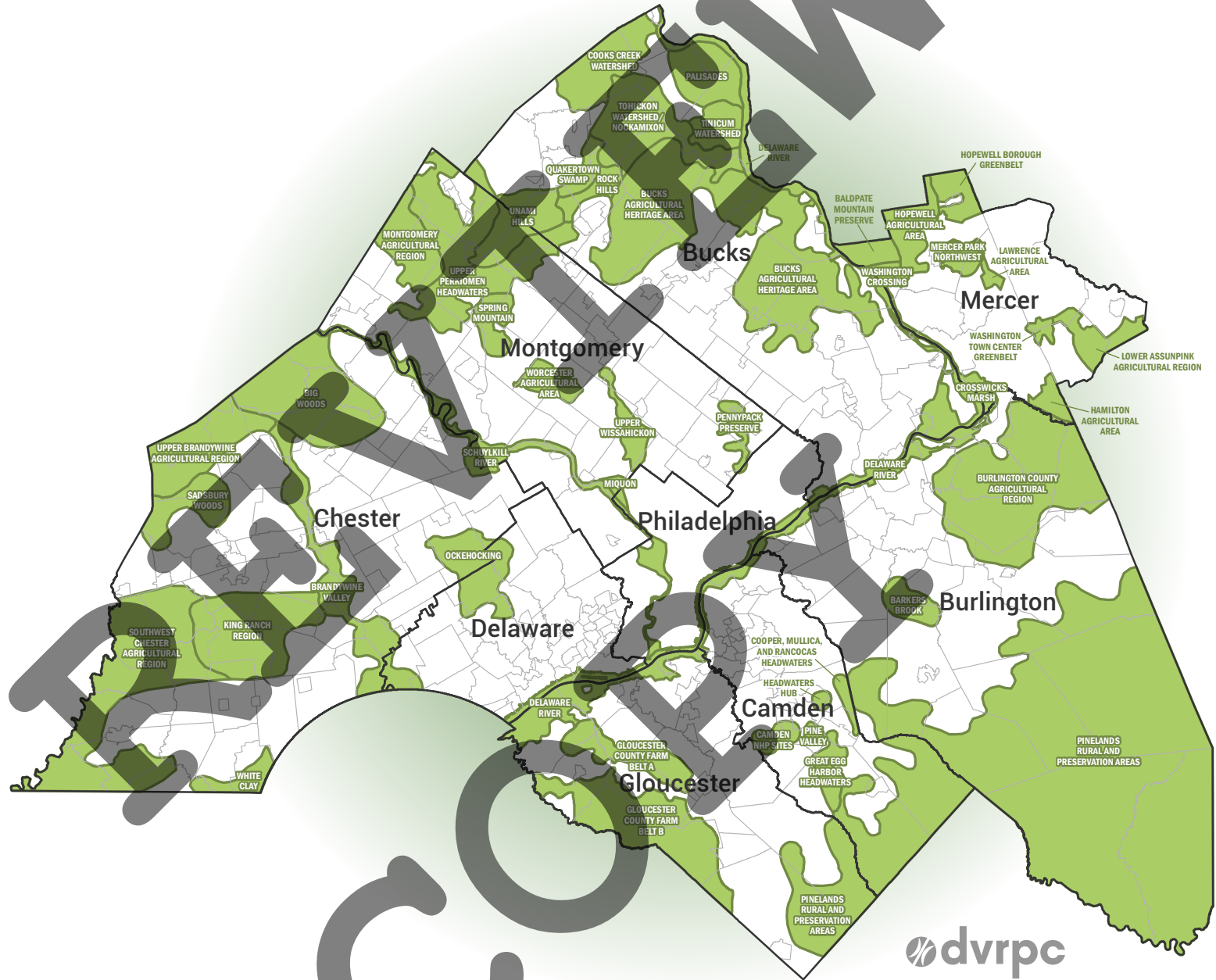
For planning purposes, the region's natural and rural areas have been divided up and branded as Conservation Focus Areas. Examples include the Hopewell Big Woods and the King Ranch Region, which both cross Chester County; the Unami Hills in Bucks County; and the New Jersey Pinelands, touching Burlington, Camden, and Gloucester counties. The Conservation Focus Areas can be either agricultural or natural in character and comprise both Rural Resource Lands and portions of the Greenspace Network. Preserving unprotected open space and making sure that any new development is context sensitive are key policy recommendations for the Conservation Focus Areas.

GOAL: PRESERVE OPEN SPACE

Over the last 65 years, Greater Philadelphia's farms, fields, and natural areas have been vanishing, while the amount of developed land has steadily increased. This trend is largely the result of sprawling land use patterns, not population growth. This land consumption pattern has negative consequences for the environment, the transportation network, and the competitiveness of the regional economy.

The loss of healthy forested headwaters, riparian buffers, and naturally

FIGURE 23: CONSERVATION FOCUS AREAS



Source: DVRPC, 2017.

functioning floodplains increases stormwater runoff, degrades water quality, fragments natural habitats, decreases biodiversity, and makes natural areas more susceptible to invasive plants and pests. Fragmented and diminished natural resources are also more susceptible to further degradation from the impacts of climate change. The consequences for local communities are costly: increased flooding; higher costs for clean drinking water; decreases in soil productivity, nutrient cycling, and carbon storage; and reduced property values. Farmland loss threatens the viability of the agricultural industry and reduces the availability of local food at a time when the demand for local food is experiencing significant growth. Finally, and perhaps most noticeably, unmanaged growth and the loss of open space strain the region's transportation infrastructure, diminish community character, and limit opportunities for personal interaction with nature and green spaces.

Reversing the current land consumption trend will require the use of growth management and open space preservation techniques. Strategic land preservation, market-based conservation, smart growth, and enhanced community design will be needed to manage growth and protect open space.

Strategies to Preserve Open Space:

- Preserve and protect undeveloped lands through acquisitions, market-based programs, such as donated conservation easements, transfer of development rights (TDRs), and purchase of development rights (PDRs); regulatory tools and techniques; and promotion of good stewardship.
- Enact and implement local open space funding programs.

- Promote Infill and Redevelopment in Centers and existing developed areas.
- Promote compact, Centers-based development through smart growth tools and techniques, such as transit-oriented development (TOD), traditional neighborhood design (TND), designating official growth areas, and enhanced community design.
- For new residential projects in Rural Areas, encourage or require TDR programs, conservation subdivision design, and/or TND.
- Remove transportation-related barriers to wildlife crossings and reconnect key habitat corridors.

GOAL: IMPROVE WATER QUALITY AND MANAGE STORMWATER

In natural areas, such as forests, most rainfall soaks into the ground, where it is used by trees and other vegetation or is filtered through the soil to become groundwater. Only a small amount actually runs off land surfaces into waterways. In urban and built-up suburban areas, rooftops, streets, sidewalks, parking lots, and even compacted soils associated with lawns prevent rainwater from soaking into the ground. Instead, water that drains off these impervious surfaces flows into drains and is carried by pipes quickly to rivers and streams. In built-up areas this stormwater runoff leads to nonpoint source pollution, such as fertilizers and nutrients, insecticides, oils and greases, salts, sediments, and heavy metals. Rapid stormwater runoff also increases the volume and velocity of stormwater, thereby eroding and enlarging stream channels. The end result is impaired water quality and degraded stream health.

Conversion of land from natural to developed uses is the greatest contributor to impairments in water quality over time. Accordingly, protection of natural and forested areas is the most important technique for maintaining water quality at the regional scale. However, since much of the region is already developed and some additional development is inevitable, it is important to effectively manage stormwater and improve water quality in urban and suburban settings. Techniques to manage stormwater in developed landscapes include conservation landscaping, naturalized retention basins, street trees, warm-season meadows, vegetated riparian buffers, and other types of soil-vegetation systems that soak up and slowly infiltrate stormwater. Even a relatively narrow wooded riparian buffer of 50 feet can generate significant improvements in stream health over an impervious or even grassy riparian zone. Buffers of 150 feet or more are generally optimal along permanent streams.

Stream restoration, where an eroded and gullied stream is reconnected to its natural floodplains through regrading and reconstruction of the stream channel, is another technique for improving water quality. This technique diminishes the erosive force of high-velocity floodwaters by allowing the floodwaters to spread out over a larger floodplain.

In more developed settings, engineered soil-vegetation systems such as rain gardens, green roofs, tree trenches, stormwater planters and vegetated bioswales, can be used to soak stormwater directly into the ground. There it can be stored and used by vegetation and trees, as opposed to running off into rivers and streams. Collectively, these techniques are referred to as Green Stormwater Infrastructure (GSI). In addition to absorbing stormwater, GSI performs other valuable functions like improving air quality, greening the community, ameliorating the urban heat island effect, and fostering a sense of place. GSI can also replace

some types of gray infrastructure, such as underground stormwater pipes. And unlike gray infrastructure, green stormwater infrastructure beautifies a community, boosts property values, and promotes livability.

Whether part of a sophisticated, engineered GSI-approach, or simply planted along a public right-of-way (ROW), street trees are one of the oldest and most effective forms of stormwater management and “greening” in an urban environment. Studies from the University of Pennsylvania show that each year, a single large shade tree can absorb 90 pounds of carbon dioxide (CO₂) and 10 pounds of air pollution, including four pounds of ozone and three pounds of particulates. One hundred mature tree crowns intercept approximately 100,000 gallons of rainfall per year. Translated into dollars, a single street tree produces \$90,000 of direct benefits, such as stormwater retention and air quality improvements, over its lifetime. At the same time, planting a tree within 50 feet of a house can increase the house’s value by 9 percent. American Forests recommends the following generalized tree canopy targets for built-up areas:

- 50 percent tree canopy in suburban residential;
- 25 percent tree canopy in urban residential; and
- 15 percent tree canopy in central business districts.

Methods to achieve these goals include developing strategies to plant trees in suitable spaces, such as vacant lots, parks, and riparian areas; requiring trees in redevelopment and new development projects; and maintaining existing trees. Tree protection ordinances, tree inventories, and street tree commissions can help communities achieve their goals.



View looking east on PA Route 291 toward the US 322 offramp, provided by Oak Valley Design.



Photo simulation of potential GSI enhancements to PA Route 291 by Oak Valley Design.

Strategies to Improve Water Quality and Manage Stormwater

- Protect and restore vegetated riparian buffers, maintain naturally functioning floodplains, and preserve wetland buffers to manage stormwater and improve water quality.
- Enact and enforce local ordinances to protect water quality, control stormwater, and limit development in floodplains.

- Promote the use of GSI in the development and redevelopment of streets and parcels so the landscape can infiltrate stormwater, reduce flows, and improve water quality.
- Reduce impervious coverage by requiring maximum impervious coverage zoning standards; reducing parking surface through shared parking, institute parking maximum standards, and use of on-street parking; and right-sizing road widths.
- Promote the planting and stewardship of shade trees in urban and suburban areas.
- Encourage school districts to undertake schoolyard greening initiatives by working with nonprofits, civic associations, parent-teacher associations, and municipal officials.

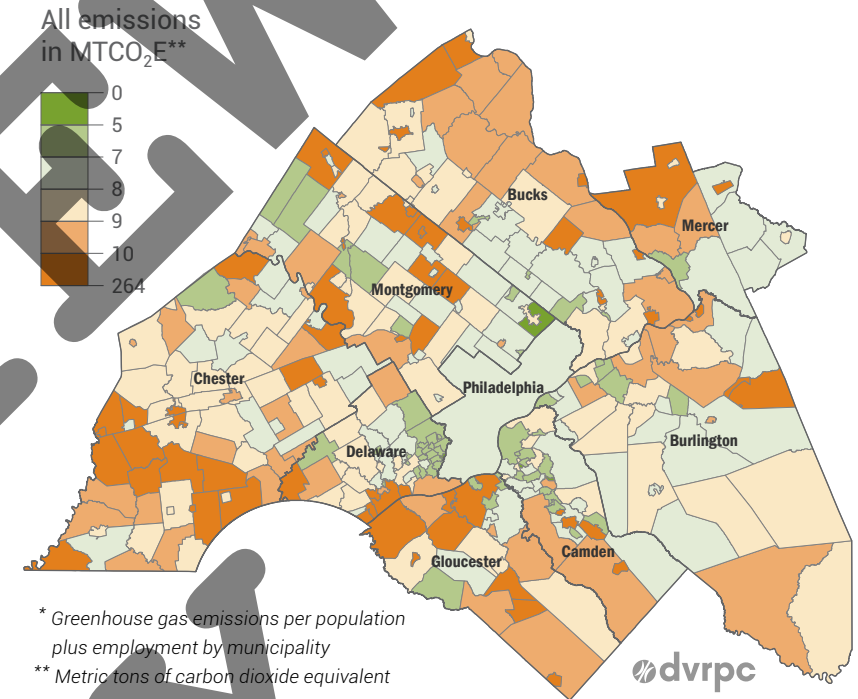
GOAL: REDUCE GHG EMISSIONS

Severe weather events and changes to our climate due to global warming pose threats to both the environment and the economy. Global warming is widely recognized as being due to rising levels of GHGs in the atmosphere. In December 2015, 195 countries, including the United States, adopted the Paris Agreement, the first ever global, legally binding agreement to act on climate change.¹⁵ This agreement establishes a long-term goal of keeping the increase in global temperature to below 2°C (about 4°F). Keeping global temperature change below this threshold is expected to keep the global climate system stable enough to continue to support human civilization without radical changes to agricultural, transportation, and other systems. Under the Paris Agreement the United States set an economywide target to reduce net GHG emissions 26 to 28 percent below 2005 levels by 2025.¹⁶

DVRPC's Regional Greenhouse Gas Emissions and Energy Use Inventory estimated that in 2010, the region produced GHGs equivalent to 81.6 million metric tons of CO₂. This was roughly 1.2 percent of the United States' total 2010 GHG emissions, and about equal to the emissions in Austria, which had a population about 1.5 times that of the DVRPC region.

The primary source of regional GHG emissions is the burning of fossil fuels (primarily gasoline, natural gas, and heating oil) to produce energy. This burning takes place in furnaces and boilers used to heat

FIGURE 24: GHG EMISSIONS PER CAPITA AND EMPLOYMENT BY MUNICIPALITY (2010)

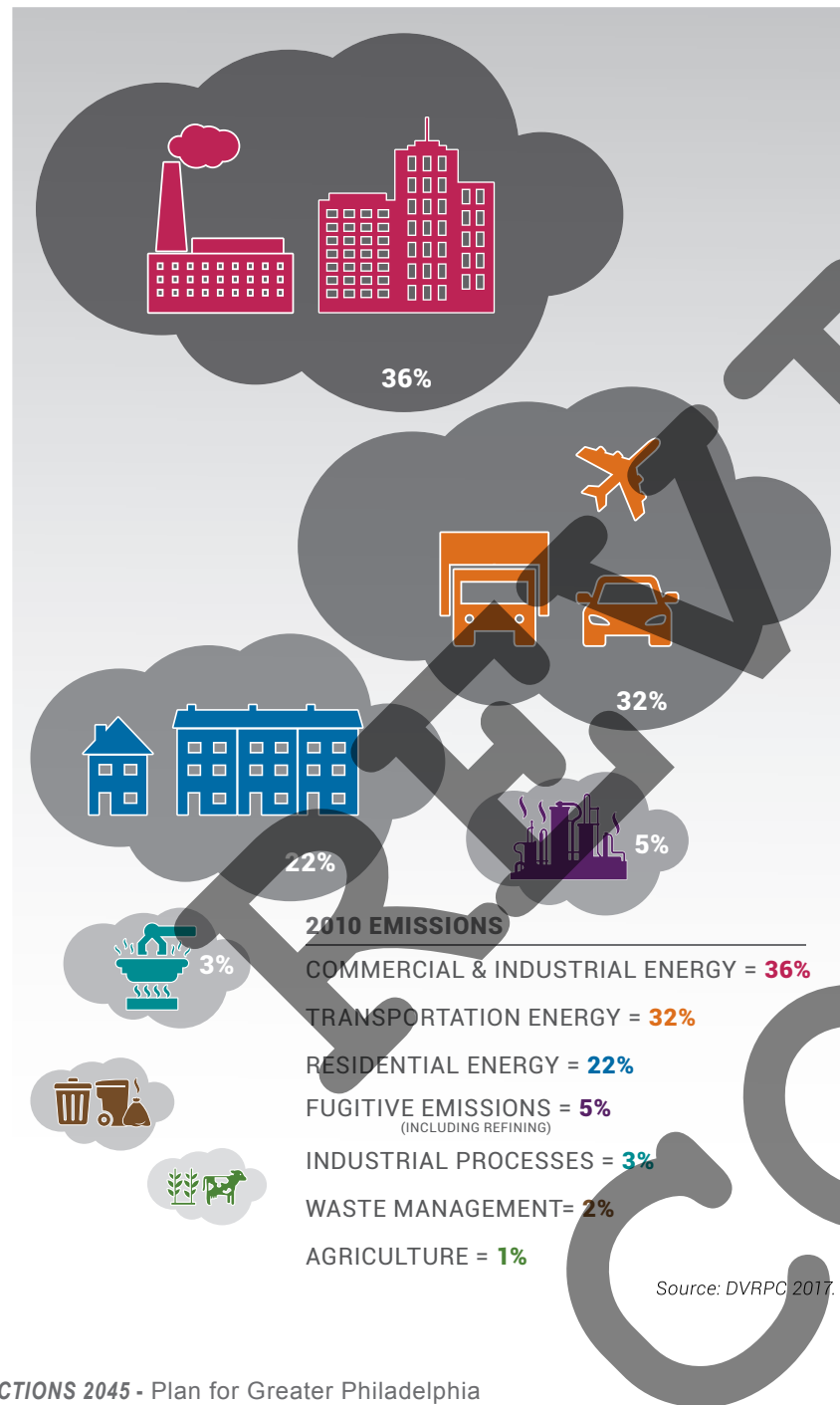


Source: DVRPC, 2017.

buildings; inside vehicle engines to move our cars, trucks, and buses; in industrial operations; and at electrical generating plants to produce the steam that spins generators. Other sources of GHG emissions include methane from agriculture and natural gas system leakages, emissions from oil refining, some industrial processes, and clearing land for buildings and roads.

¹⁵On June 1, 2017, U.S. President Donald Trump announced that the United States would cease all participation in the 2015 Paris Agreement. In accordance with Article 28 of the Paris Agreement, the earliest possible effective withdrawal date by the United States cannot be before November 4, 2020, one day after the 2020 U.S. presidential election. Until the withdrawal takes effect, the United States may be obligated to maintain its commitments under the agreement, including the requirement to continue reporting its emissions to the United Nations.

¹⁶Shortly after the announcement, the governors of a number of U.S. states formed the United States Climate Alliance to continue to advance the objectives of the Paris Agreement despite the federal withdrawal, with similar sentiments also being expressed by other state governors, mayors, and businesses.

FIGURE 25: GHG EMISSIONS BY SECTOR (2010)


The data needed to complete DVRPC's 2015 Inventory is not yet fully available. However, preliminary results based on electricity and natural gas utility data, as well as highway transportation data, indicate that GHG emissions from these sources were about 7 percent lower in 2015 than they were in 2010. Lower emissions from electricity generation—more than 20 percent over this period—driven largely by the continued shift from coal to natural gas, as well as a 6 percent decrease in electricity demand, were responsible for the bulk of this reduction. In addition, solar photovoltaic and wind together doubled their share of electricity generation in the region, increasing from 0.7 percent in 2010 to 1.5 percent in 2015. While this remains a small share of generation, its share is increasing at a faster pace than even natural gas. Moreover, solar and wind have achieved price parity with fossil fuels for energy production.

DVRPC's *Connections 2040* Plan set a target of reducing regional 2005 GHG emissions by 60 percent by the year 2040: a goal in accord with the City of Philadelphia's stated goal of an 80 percent reduction in GHG emissions by 2050. The preliminary data for 2015 indicates that the emissions are headed in the right direction, but the pace of reductions needs to be accelerated to achieve these targets.

The long-term regional goal is challenging for an economy that is highly dependent on fossil fuels for energy. Achieving it will be possible only with significant, coordinated action at the household, firm, community, regional, state, national, and global levels. Attaining the regional goal will also require substantial advances in technologies that produce and use energy. Meeting this challenge requires a commitment across all levels of governance, all economic sectors, and throughout society to convert from fossil fuels to low- to no-carbon energy sources.

In addition to lowered GHG emissions, reduced burning of fossil fuels means cleaner air and improved public health (asthma and other respiratory diseases are exacerbated by air pollution). Retrofitting buildings to be more energy efficient creates local jobs. A regional electricity supply transformed to solar energy—while extremely challenging—has the potential to be more resilient and less susceptible to disruption of fossil fuel supply.

Maintaining and enhancing forests and soils that store carbon is also important. In addition to being a place of beauty and providing critical habitat, the trees located in the Hopewell Big Woods, a 73,000-acre, mostly intact forestland on the border of Chester and Berks counties, store close to three million tons of carbon valued at over \$90 million.

Regional land use, housing, and business development patterns will also shape energy use and GHG emissions in the coming decades. As Figure 24 illustrates, those municipalities with walkable, mixed-use neighborhoods; near transit infrastructure; and with smaller houses, use less energy and produce lower GHG emissions per person plus employment. DVRPC's transportation and land use planning policies, priorities, and projects are all aligned to advance these goals. However, it must be emphasized that the impacts of GHG emissions are spread globally. Thus, reductions in the region alone will have little to no impact on the future course of climate change in Greater Philadelphia. Global action is required.

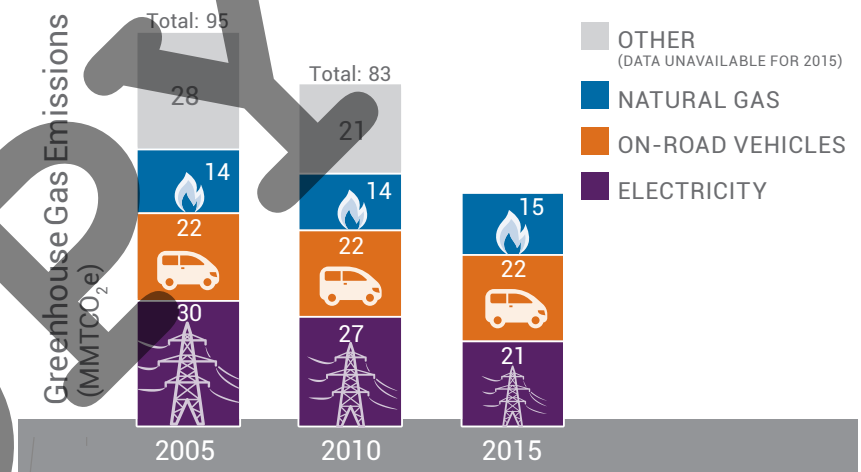
Strategies to Reduce GHG Emissions

Effective strategies to reduce GHG emissions provide incentives and disincentives to encourage people to use less energy and choose to use low-carbon fuels or modes of transportation. These can include

pricing or taxing policies, zoning measures, permitting, and education on the relative benefits of saving energy and using low-carbon fuels.

- Support the production of energy with fewer GHG by helping municipalities draft and adopt ordinances to ensure that clean energy production, such as solar photovoltaics, is encouraged in a manner compatible with existing land uses.
- Promote initiatives that improve regional air quality; most initiatives to do so will also reduce GHG emissions.
- Promote energy efficiency in outdoor lighting and buildings, such as the use of LED lighting, smart thermostats, air sealing building envelopes, and high-efficiency HVAC systems; and through the

FIGURE 26: REGIONAL GHG EMISSIONS BY YEAR



Note: "Electricity" and "natural gas" include emissions resulting from the use of electricity and the combustion of natural gas sold by the region's utilities. "On-road vehicles" includes fossil fuels consumed by motorized vehicles operating on the region's roads. "Other" refers to all other sources of emissions. Estimates for these other sources are available for 2005 and 2010, and are currently under development for 2015. "Total" refers to gross GHG emissions and does not account for GHG sequestration in the region's trees and forests.

Source: DVRPC, 2017.

- Reduce transportation energy demand by locating jobs, housing, and services closer together.
- Support low-energy transportation: walking, cycling, and transit.
- Support the uptake of plug-in electric vehicles.
- Maintain healthy forests by encouraging development in Centers.
- Promote planting of additional trees and plants appropriate for a changing climate.
- Support a “carbon pricing” policy that shifts the burden of impacts from GHG emissions to their emitters, and provide them with a financial incentive to reduce emissions.

GOAL: PREPARE COMMUNITIES FOR THE IMPACTS OF CLIMATE CHANGE

Despite global efforts to reduce GHG emissions, atmospheric levels continue to rise. This trend has fueled a pattern of rising global temperatures, leading to continued climate change. The amount and rate of climate change that will take place over the remainder of this century and into the next depends on the success or failure of global efforts to reduce GHG emissions. Lower emissions ensure less severe long-term impacts; higher emissions ensure an increasingly untenable future.

However, even the most concerted global action to reduce emissions will have little impact on the climate change that will take place over the course of this 28-year plan. The climate the region experiences today will shift, exposing the region and its residents to new dangers and heightened risks. According to the U.S. Environmental Protection Agency (U.S. EPA), our region can expect increased episodes of extreme

heat, more freeze-thaw cycles, more intense precipitation events, sea level rise, and increased severity of storms in the coming decades. These changes are likely to amplify coastal, riverine, and other inland flooding; harm coastal and inland ecosystems; disrupt fishing and farming; and increase risks to human health.

Climate change poses new threats and exacerbates existing hazards for communities throughout Greater Philadelphia. Yesterday's climate no longer provides a reliable guide for planning for the future. Fortunately, adapting to climate change builds on ongoing regional initiatives like green infrastructure planning and implementation, smart growth initiatives, floodplain management, ecological restoration, asset management, and efforts to reduce the heat island effect. All of these efforts help communities become more resilient to the impacts of climate change.

Strategies to Prepare Communities for the Impacts of Climate Change

- Use climate projections, not historical precedents, to plan, maintain, and construct transportation system elements, such as pavements, bridges, drainage structures, catenary, and rails.
- Leverage Federal Emergency Management Agency-mandated hazard mitigation planning to integrate climate change hazards into comprehensive planning.
- Evaluate the critical transportation and community assets that are vulnerable to climate change, and take steps to minimize risk.
- Establish cooling centers for extreme heat days.

- Coordinate and cooperate with federal, state, local, and other agencies involved in regional resiliency, transportation security planning, emergency response efforts, and recovery efforts.
- Update floodplain ordinances and building codes and practices to make structures less prone to unpredictable extreme weather events.
- Protect and restore vegetated riparian buffers, maintain naturally functioning floodplains, and enhance wetlands. Incorporate green infrastructure into urban stormwater management systems to reduce flooding.

GOAL: IMPROVE AIR QUALITY

The U.S. EPA has established air quality standards for six criteria pollutants. These pollutants pose a threat to human health and welfare. Regions that do not attain the standards are required to establish emission controls to reduce levels to meet federal air quality regulations.

In recent years, the Greater Philadelphia region has violated two of the six criteria pollutants: ground-level ozone and fine particulate matter (PM_{2.5}). Currently, the region does not attain the standard for ground-level ozone. While the region has attained the standard for fine particle pollution, there are still a few days each year when PM_{2.5} levels are deemed unhealthy for groups of people that are sensitive to air pollution. These groups include the elderly, the very young, and people with cardiovascular diseases.

Ground-level ozone is generally a summertime issue, when sunlight provides the energy needed to drive the chemical reaction to form

ozone from its constituent pollutants (nitrogen oxides [NO_x] and volatile organic compounds [VOCs]). NO_x emissions are mostly associated with power generation and transportation sources, while VOCs can come from a number of petroleum-based chemicals. Ground-level ozone can damage lung tissue, exacerbate breathing disorders, and trigger asthma attacks. The region generally experiences between 10 and 30 episodes each year when the ozone standard is violated.

PM_{2.5} pollution is the term for tiny drops of liquid or small bits of dust. Some particles are large enough to be seen as soot or smoke. Other particles are so small that they can only be seen with an electron microscope. Fine particle pollution comes from a variety of natural and man-made sources, such as vehicles, diesel engines, power generation, and forest fires. PM_{2.5} pollution has been implicated in a wide range of health problems, including heart disease, breathing disorders, and even premature death. While the region is in attainment for the PM_{2.5} standard, fine particle pollution reaches unhealthy levels for sensitive groups between two and five days per year. These days can occur any time of the year, when weather conditions allow local sources of pollution to accumulate over the region, or when PM_{2.5} pollution is blown into the region from forest fires or other major sources.

In the Greater Philadelphia region, transportation sources (cars, trucks, and buses) emit up to 50 percent of regional NO_x emissions, which contribute to both ozone and PM_{2.5} pollution. Commercial and residential energy generation and heating account for an additional 25 percent of NO_x emissions. Pollutant sources that contribute to ground-level ozone and PM_{2.5} pollution generally also emit GHGs, so many actions that address climate change also help improve general air quality and benefit public health.

Planning for a sustainable future requires not only decreasing the demand for trips but also making the transportation system more efficient by reducing congestion and optimizing the movement of people, goods, and services in the most energy-efficient ways. Renewable and alternative fuels can play a role in reducing emissions from both the energy generation and transportation sectors, while efficiency and conservation will promote both environmental quality and public health.

Strategies to Improve Air Quality

- Provide air quality forecasts to alert the public about poor air quality days and encourage voluntary measures to reduce air emissions, particularly on days when pollution is forecasted to violate the standards.
- Advance strategies and projects that reduce motor vehicle emissions through trip reduction, alternative commute options, technology advancements for fuels and vehicles, and public policies that support cleaner fuels and emissions standards.
- Work with regional partners to reduce air pollution impacts on at-risk populations.
- Work with refineries, port facilities, pipeline operators, and freight railroads to promote safety, clean air, and “freight as a good neighbor” initiatives within facility host communities, on National Highway System (NHS) connector roads, and at key highway-railroad grade crossings and railroad bridges.

- Support transportation and land use projects and policies that promote bicycle, pedestrian, and transit transportation to improve air quality, equity, and accessibility.

GOAL: INCREASE LOCAL FOOD PRODUCTION, DISTRIBUTION, AND ACCESS

Agriculture as both a land use and a way of life dominated Greater Philadelphia and its surrounding countryside from precolonial times to the mid-20th century. Native Americans cultivated small patches of agricultural fields, growing corn, beans, and rice. Early European settlers established farms that not only provided food for their families, but also became a thriving industry, selling crops and livestock to nearby cities. As the transportation network grew, so too did the market for the region's products, with local farmers exporting their goods throughout the states and overseas.

As Greater Philadelphia industrialized, the number of farmed acres dropped from 1.91 million in 1900 to 1.26 million in 1950 and then to 430,000 in 2012.¹⁷ Today, farming and food production face a number of challenges. Food system activities take up a significant amount of land, but farmland in metropolitan areas like Greater Philadelphia is often more valuable for development than for farming, resulting in its conversion to other uses. Additionally, the average age of farmers continues to rise, with fewer and fewer young people choosing to pursue a career in agriculture.

Despite these challenges, recent years have seen an increasing interest in food, especially locally produced. This interest is evident in the growth of farmers' markets and other market opportunities

¹⁷U.S. Census of Agriculture, 1900, 1950, and 2012.

like community-supported agriculture and online food deliveries via platforms, such as FreshDirect. The renewed attention to food presents economic opportunities for farmers and local businesses all along the food supply chain—from production to processing and distribution to retailing. Local food production, preparation, and distribution also offer entrepreneurial and job opportunities, and agricultural products remain strong exports.

Although the emerging local food economy presents opportunities for growth, a lack of access to healthy food—whether due to financial, physical, or social constraints—remains a concern for many people. Between 2009 and 2015, the number of households receiving Supplemental Nutrition Assistance Program (SNAP) benefits in our region grew by over 100,000 households.¹⁸ Additionally, between 2004 and 2013 the prevalence of obese adults in the region increased, growing from 22.5 percent to 26.7 percent.¹⁹ However, during a similar time period, the rate of childhood obesity in the City of Philadelphia decreased for the first time in many years, dropping 6.5 percent, thanks in large part to the efforts of Get Healthy Philly, the School District of Philadelphia, and many other nonprofit and community organizations.²⁰

Efforts like Get Healthy Philly that seek to increase local food production, distribution, and/or access are emerging across our region. DVRPC will continue to work with local and healthy food system stakeholders at the regional, county, and municipal levels to support a healthier, more equitable food system.

Food system planning aims to assist stakeholders in recognizing the region's competitive advantages, and overcoming its challenges in order to create a more sustainable, equitable, and resilient food system.



Strategies to Increase Local Food Production, Distribution, and Access

- Enhance coordination between all food system stakeholders, from the private sector to the public sector, from sustainable agriculture advocates to hunger relief organizations, and from farmland preservation coordinators to economic development agencies, to collaborate on improvements to the evolving food system.
- Incorporate farming and food into economic development policies and funding programs.
- Increase food production on protected lands within the region.

¹⁸American Community Survey 5-Year Estimates, 2005–2009, 2011–2015.

¹⁹Centers for Disease Control and Prevention, May 16, 2016, <https://www.cdc.gov/diabetes/data/countydata/countydataindicators.html>.

²⁰Robert Wood Johnson Foundation, Signs of Progress, Pennsylvania: Philadelphia, June 23, 2016, <http://www.rwjf.org/en/library/articles-and-news/2013/07/philadelphia--signs-of-progress.html>.

- Facilitate local food production and increased access to healthy food in rural, suburban, and urban areas through planning activities, supportive land use ordinances, and innovative incentive programs.

GOAL: PRESERVE HISTORIC RESOURCES AND CULTURAL LANDSCAPES

Greater Philadelphia's rich past is reflected in the variety and number of historic and cultural resources throughout the region. From Native American archaeological sites to early Swedish settlements, and from the colonial-era row houses of Society Hill to the hallowed grounds of Valley Forge, Greater Philadelphia's history is incorporated into and enriches the fabric of present-day life. The wealth of resources is underscored by the number of historic landmarks, sites, and districts on the national register of historic places, state- and nationally recognized historic landscapes and heritage areas, sites protected through local historic designations, and countless other historic buildings and resources that lack any formal designation. These resources often form the bedrock of a community's character and identity. While more sites are deemed eligible for the national register every year, there are still many significant sites that have not been identified, recorded, or protected. Nonprofit organizations, government agencies, and local governments are working to identify, protect, preserve, rehabilitate, and restore the region's historic and cultural resources and landscapes as a way to increase livability, enhance "sense of place," and cultivate a unique identity.

Despite efforts to protect the region's historic and cultural resources, they continue to be threatened by demolition, neglect, encroaching sprawl, incompatible land uses, poor planning, and insensitive design.

Transportation projects, for example, can impair or destroy historic resources through road widenings, realignments, and capacity enhancements. Furthermore, some historic resources, like bridges, are a part of the transportation network itself, and maintenance and care are needed to ensure their preservation. There are several federal and state laws that were enacted to avoid and minimize impacts and disturbances to historic resources, including the National Environmental Policy Act, Section 106 of the National Historic Preservation Act, Section 4(f) of the Department of Transportation Act, the Pennsylvania History Code, and the New Jersey Register of Historic Places Act. All federally funded transportation agencies must follow federal laws and plan their projects accordingly. As part of this process, state historic preservation offices work with federal agencies to identify historic resources and avoid or minimize any potential adverse effects during the planning, permitting, design, and construction of federally funded and licensed projects.

Since 2005, federal transportation regulations have established formal consultation requirements for MPOs and state DOTs to work with environmental, regulatory, and historic resource agencies in the development of long-range transportation plans. DVRPC is actively working with the Pennsylvania Historical and Museum Commission and is seeking to work more with New Jersey's State Historic Preservation Office to more carefully consider historic and cultural resources in the planning and design of transportation projects. Additionally, DVRPC continually works with resource agencies and local governments to explore how transportation projects and local plans can better support, rather than impair, historic preservation and revitalization efforts.

Strategies to Preserve Historic Resources and Cultural Landscapes

- Promote the use of historic district designations and tax credits, where appropriate.
- Identify and document historic sites, buildings, and structures that contribute to community identity and character but which may currently lack any type of formal historic designation.
- Promote growth management and enhanced community design through land development ordinances, design review, and local preservation planning processes in order to protect the context and integrity of historic sites and cultural landscapes.
- Encourage open space and farmland preservation as a means to also preserve the scenic, historic, and cultural context of many historic sites in the region.
- Investigate opportunities for advanced and alternative mitigation and mitigation banking to both speed transportation project delivery and incorporate a community's historic preservation priorities through the Section 106 review process.



PRINCIPLE: DEVELOP LIVABLE COMMUNITIES

From 2015 to 2045, Greater Philadelphia is expected to gain more than 658,000 residents, an increase of 11.5 percent. Similarly, employment in the region is expected to increase by over 372,000 employees, a nearly 12 percent increase. Left uncontrolled, it will increase suburban sprawl, create the need for expensive new infrastructure, underutilize existing facilities, and contribute to the further disappearance of our open space and depletion of our natural resources. These issues can be averted by increasing the livability of the region's existing communities. Livable communities can be found throughout the region: in Core Cities and their component neighborhoods, in older suburbs, and in town and rural Centers scattered throughout suburban and rural areas. These communities provide a unique sense of place, possess existing infrastructure and institutions, and offer opportunities for new development and revitalization.

PLANNING AREAS

Diversity in our region's development patterns is useful for defining planning policies and is a real strength. *Connections 2045* respects this diversity and identifies various planning approaches to restore, preserve, foster, or contain future regional growth and development. Four geographic areas are used to help organize the overall Plan.

DVRPC'S CENTERS-BASED PLANNING PHILOSOPHY

- Livable communities can be found throughout the region: in Core Cities and their component neighborhoods, in the region's older suburbs, and in town and rural Centers scattered throughout the region's suburbs and rural areas.
- Livable communities can be created and supported by investing in and redeveloping Centers, enhancing community design, promoting affordable housing in appropriate locations, increasing parks and recreation opportunities, and creating and maintaining community-centered schools.
- *Connections 2045* envisions numerous thriving, compact, mixed-use Centers, where people intuitively want to live, work, and play.
- Investing in Centers will facilitate the most efficient use of infrastructure, conserve open space and natural resources, strengthen local economies, and create the densities needed to support walking, biking, public transit, and agglomeration economies.

Core Cities in the region include Philadelphia, Trenton, Camden, and Chester. These cities serve as critical employment, cultural, commercial, and educational centers of the region. Targeted infrastructure investment, maintenance and rehabilitation, and comprehensive neighborhood revitalization can help to revitalize the region's cities and reinforce them as engines of economic growth.

Developed Communities are places that have already experienced most of their population and employment growth. These areas include inner-ring communities adjacent to the Core Cities, railroad boroughs and trolley car communities, and mature suburban townships. Many of these communities are stable and thriving, offering affordable housing opportunities, access to transit, safe pedestrian and bicycling environments, and a strong community identity. Others, however,

are struggling with population and employment losses, deteriorating infrastructure systems, aging resident populations living on limited incomes, and stagnant or declining tax bases that cannot keep pace with rising service demands. Rehabilitation and maintenance of infrastructure systems and the housing stock, and local economic and community development, can help to reinforce location advantages while stabilizing neighborhoods and stemming decline.

Growing Suburbs are communities that have many developable acres remaining and are experiencing—or are forecasted to experience—significant population and/or employment growth. Key planning policies in these communities often focus on growth management, open space preservation, congestion management, and community design. Smart growth strategies that support a more concentrated

Core City



Source: Google Earth, 2017.

Developed Community



Source: Google Earth, 2017.

development pattern can provide the critical mass necessary to support transit services and other alternatives to the automobile.

Rural Areas include agricultural communities and those with large natural areas. Key policy objectives for these areas include conserving natural resources, limiting development, and preserving the rural lifestyle and village character that makes these areas unique. Livable communities in Rural Centers have an identifiable main street, a mix of land uses, higher densities than their surrounding areas, and a true sense of place.

Greater Philadelphia is a complex mosaic of 352 diverse cities, boroughs, and townships. Many municipalities have characteristics of more than one of these Planning Area types. Gloucester Township (in Camden County, New Jersey), for example, has neighborhoods that are fully developed, but it also has a significant number of undeveloped acres and a forecasted population and employment growth more characteristic of a Growing Suburb. While Planning Areas are a guide for policy direction at the regional scale, actual approaches should always be guided by local conditions.

Growing Suburb



Source: Google Earth, 2017.

Rural Area



Source: Google Earth, 2017.

Developing Livable Communities will provide the following benefits:

- Revitalize neighborhoods, support economic growth, and reduce suburban sprawl.
- Create business-friendly Town Centers that strengthen our local and regional economy.
- Improve safety and security through stronger community connections.
- Reduce automobile dependence while promoting transit, walking, and biking.
- Preserve unique community and architectural character.
- Conserve open space to promote access to recreational opportunities and local foods.
- Reduce living and service delivery costs, transportation and logistics needs, and resulting pollution.
- Increase and diversify the region's housing stock that is located near employment opportunities and public transit.

GOAL: INVEST IN CENTERS

Centers are the cornerstone of *Connections 2045*. Centers are neighborhoods, districts, or downtowns that serve as focal points in the regional landscape while also reinforcing a sense of community for local residents. Centers serve as a basis for organizing and focusing the development landscape and provide a framework for the most efficient provision of supportive infrastructure systems, including water, sewer, and transportation. By concentrating growth in and around Centers, we can preserve open space; reduce strains on our natural resources; and create thriving, pedestrian-friendly communities that offer an improved quality of life for all residents.

Connections 2045 identifies a hierarchy of seven Center types based on their geography and local context. Each Center has unique characteristics, assets, challenges, and needs. The planning strategies for Centers universally focus on redevelopment and revitalization through targeted investments, increasing employment opportunities, utilizing the existing infrastructure, and supporting social and educational programs. Identified Centers are listed in Tables 6 and 7, and illustrated in Figures 27 and 28.

Metropolitan Center

The region's Metropolitan Center includes Center City, University City, and the Camden Central Business District, spanning the Delaware River and bounded roughly by 40th Street from Girard to Washington avenues in Philadelphia, and by the Ben Franklin Bridge and Interstate 676 to Clinton Street in Camden. This dense, compact, urban area includes the central business districts of Philadelphia and Camden, leading academic and medical institutions, and major tourist and entertainment destinations.

Metropolitan Subcenters

The Plan identifies five Metropolitan Subcenters, reflecting the magnitude of jobs and commercial activity located in these areas. These include the downtown area of Trenton (Mercer County), the destinations of King of Prussia/Valley Forge (Montgomery and Chester counties), International Airport/Navy Yard/Sports Complex (Philadelphia and Delaware counties), Cherry Hill/Mount Laurel/Marlton (Burlington and Camden counties), and the Route 1 Corridor (Mercer County).

Suburban Centers

Suburban Centers are larger geographical areas that may be represented by a developed corridor and can cross municipal boundaries. They are defined primarily by single-use districts, such as office, retail, professional, and light industrial. Recently, there have been attempts to increase the number of mixed-use areas in these communities. Suburban Centers generally have more jobs than residents and are more auto dependent, rather than transit oriented or pedestrian scale. Suburban Centers include places such as Oxford Valley (Bucks County), Deptford (Gloucester County), City Avenue (Philadelphia and Montgomery counties), and Great Valley (Chester County).

Town Centers

Town Centers have a mixture of high-density residential and commercial uses that also display a unique history and sense of place. Town Centers are often identifiable by a thriving downtown or main street that is pedestrian friendly and transit oriented. Town Centers are surrounded by traditional suburban residential development. Town Centers include places such as Doylestown Borough (Bucks County), Kennett Square (Chester County), Lansdowne Borough (Delaware

County), Narberth (Montgomery County), Haddonfield Borough (Camden County), and Pitman Borough (Gloucester County).

Rural Centers

Rural Centers, like Town Centers, have a mix of land uses, a higher density than the surrounding area, and often an identifiable smaller-scale downtown or main street. Rural Centers are usually surrounded by rural or agricultural land uses. Rural Centers include places such as Oxford Borough (Chester County), Harleysville (Montgomery County), and Browns Mills (Burlington County).

Planned Centers

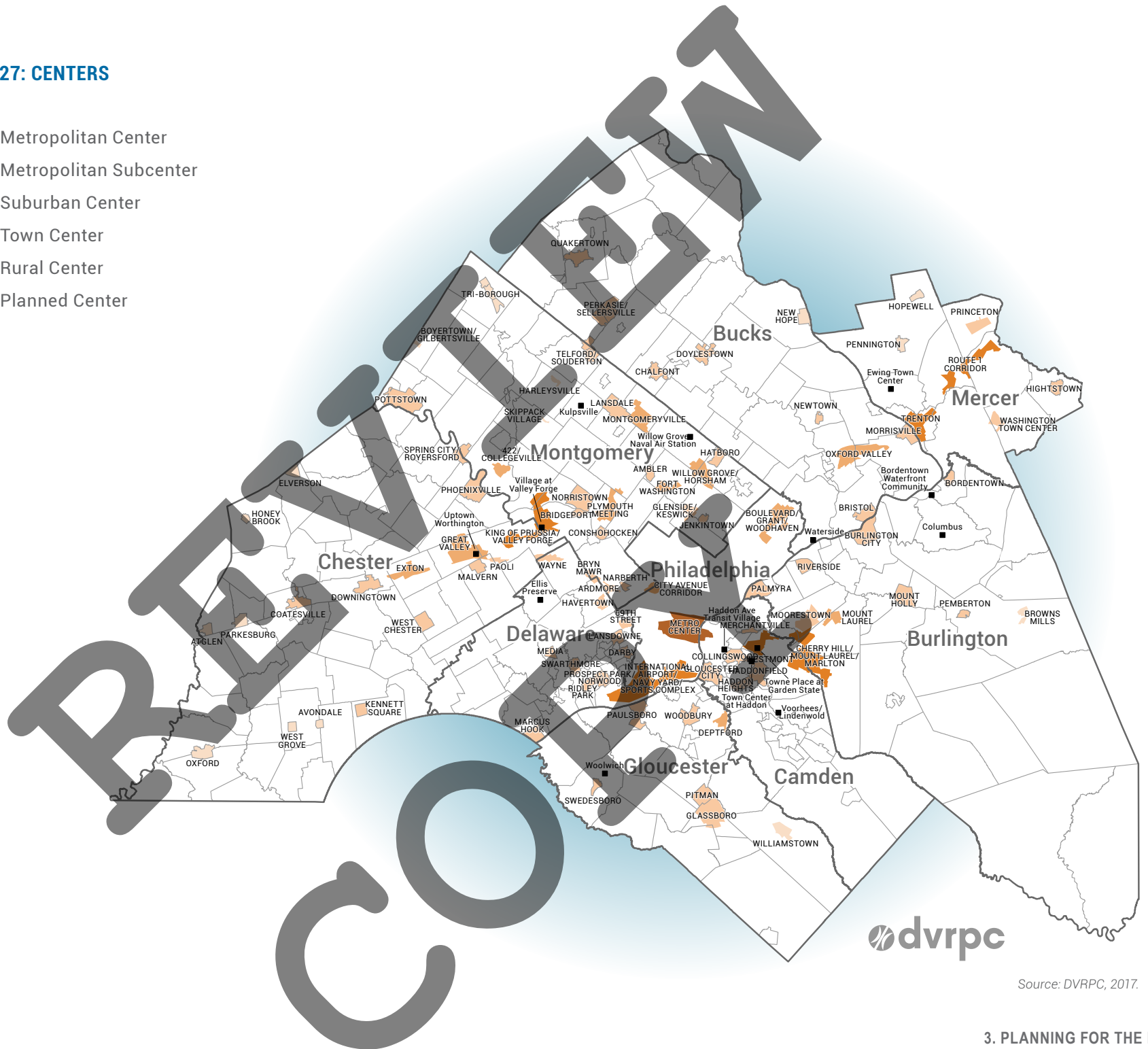
Planned Centers are newly constructed Town-Center-type developments, usually built by a single developer, on greenfield sites within Growing Suburbs or Rural Areas. Planned Centers can also be found in Developed Communities through redevelopment of greyfields. Planned Centers often call for traditional neighborhood development and incorporate a mix of uses at higher density that support transit and walkability. Planned Centers can be found throughout the region and include places such as The Town Center at Haddon (Camden County), Woolwich Town Center (Gloucester County), and the Village at Valley Forge (Montgomery County).

Neighborhood Centers

Embedded within the region's Core Cities of Philadelphia, Trenton, Camden, and Chester are Neighborhood Centers, which are recognizable places with a mix of commercial, retail, anchor institutional, and residential activities. Neighborhood Centers have an identifiable main street or focal point, are walkable, and have a unique history or sense of a community within the larger city setting.






FIGURE 27: CENTERS

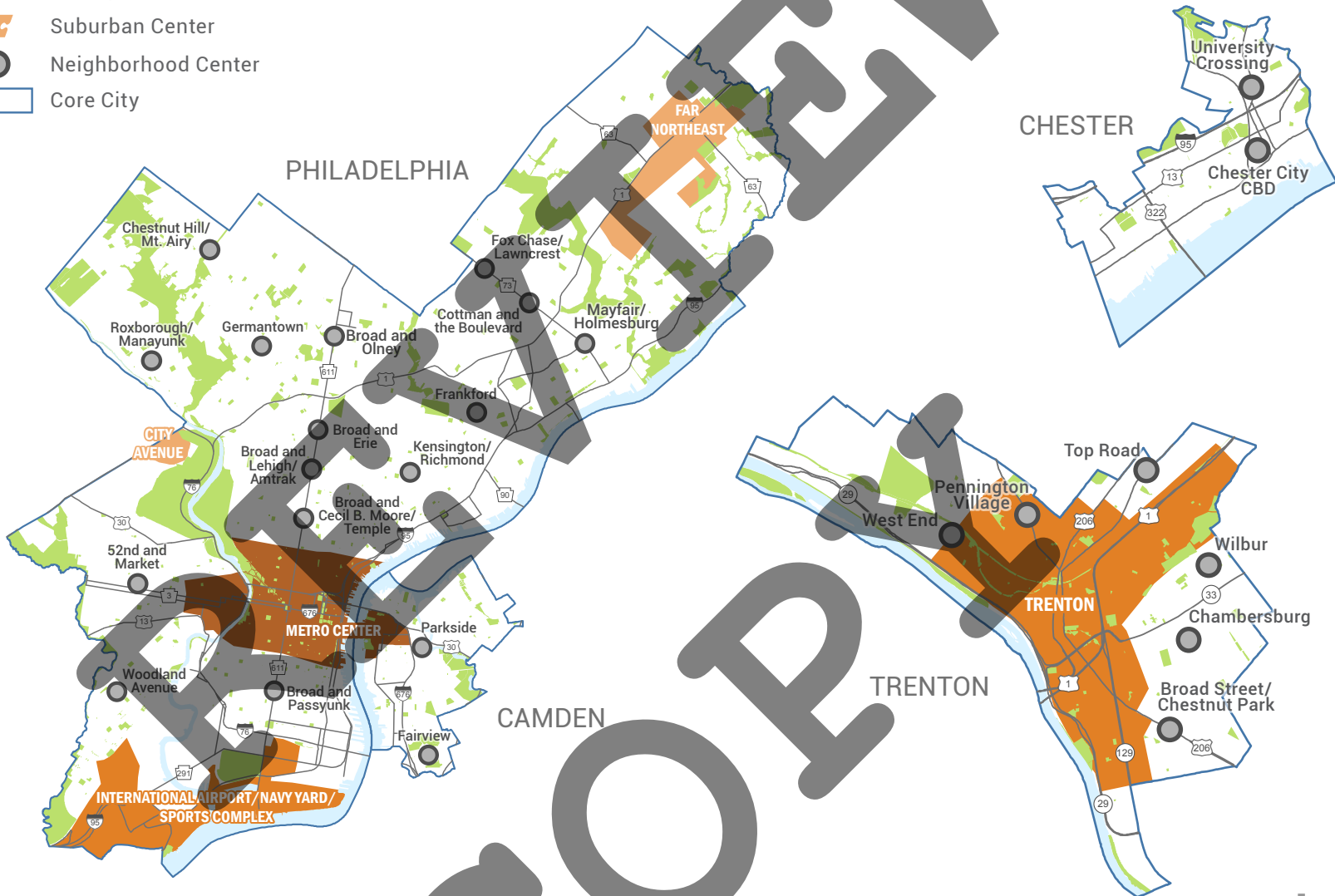
- Metropolitan Center
- Metropolitan Subcenter
- Suburban Center
- Town Center
- Rural Center
- Planned Center



Source: DVRPC, 2017.

FIGURE 28: CORE CITIES AND NEIGHBORHOOD CENTERS

-  Metropolitan Center
-  Metropolitan Subcenter
-  Suburban Center
-  Neighborhood Center
-  Core City



Note: Maps not drawn to scale

Source: DVRPC, 2017.

TABLE 6: PENNSYLVANIA CENTERS

COUNTY	METROPOLITAN SUBCENTERS	SUBURBAN CENTERS	NEIGHBORHOOD CENTERS	TOWN CENTERS	RURAL CENTERS	PLANNED CENTERS
Bucks		Oxford Valley		Bristol Borough, Chalfont Borough, Doylestown Borough, Morrisville, Newtown Borough, Perkasie/Sellersville, Quakertown, Telford/Souderton	New Hope Borough	Waterside
Chester	King of Prussia/Valley Forge	Exton, Great Valley		Coatesville, Downingtown Borough, Kennett Square, Malvern, Paoli, Phoenixville, Spring City/Royersford, West Chester	Atglen, Avondale, Elverson, Honeybrook Borough, Oxford Borough, Parkesburg, West Grove	Uptown Worthington
Delaware	International Airport / Navy Yard / Sports Complex		Chester City: Chester Central Business District, University Crossing	Darby Borough, Havertown, Lansdowne Borough, Marcus Hook, Media, Prospect Park/ Norwood, Ridley Park, Wayne, Swarthmore, 69th Street		Ellis Preserve
Montgomery	King of Prussia/Valley Forge	City Avenue, Fort Washington, Montgomeryville, Plymouth Meeting, Willow Grove, Horsham, Route 422/Collegeville		Ambler Borough, Ardmore, Bridgeport, Bryn Mawr, Conshohocken, Glenside/Keswick, Hatboro Borough, Jenkintown, Lansdale, Narberth, Norristown, Pottstown, Spring City/Royersford, Telford/Souderton	Tri-Borough, Boyertown/Gilbertsville, Harleysville, Skippack Village	Kulpsville, Village at Valley Forge, Willow Grove Naval Air Station
Philadelphia	International Airport / Navy Yard / Sports Complex	City Avenue, Far Northeast	Broad & Passyunk, Woodland Avenue, 52nd & Market, Broad & Cecil B. Moore/Temple, Broad & Lehigh/Amtrak, Broad & Erie, Kensington/Richmond, Roxborough/Manayunk, Germantown, Chestnut Hill/Mt. Airy, Broad & Olney, Frankford, Cottman & the Boulevard, Fox Chase/Lawncrest, Mayfair/Holmesburg			

Source: DVRPC, 2017.

TABLE 7: NEW JERSEY CENTERS

COUNTY	METROPOLITAN SUBCENTERS	SUBURBAN CENTERS	NEIGHBORHOOD CENTERS	TOWN CENTERS	RURAL CENTERS	PLANNED CENTERS
Burlington	Cherry Hill/Mount Laurel/Marlton	Mount Laurel		Bordentown, Burlington City, Mount Holly, Palmyra, Pemberton Borough, Riverside, Village of Moorestown	Browns Mills	Columbus, Bordentown Waterfront Community
Camden	Cherry Hill/ Mount Laurel/ Marlton		Camden City: Fairview, Parkside	Collingswood, Gloucester City, Haddonfield, Haddon Heights, Merchantville, Westmont		Voorhees/Lindenwold, The Town Center at Haddon, Haddon Avenue Transit Village, Towne Place at Garden State Park
Gloucester		Deptford		Glassboro, Paulsboro, Pitman, Swedesboro, Woodbury	Williamstown	Woolwich Town Center
Mercer	Trenton, Route 1 Corridor		Trenton: Broad Street/Chestnut Park, Chambersburg, Wilbur, Top Road, Pennington Village, West End	Hightstown, Princeton, Washington Town Center	Pennington Borough, Hopewell Borough	Ewing Town Center

Source: DVRPC, 2017.

Neighborhood Centers include places such as the Chester Central Business District (Chester City), Parkside and Fairview (Camden City), Pennington Village (City of Trenton), and Germantown (City of Philadelphia).

Strategies to Invest in Centers

- Update local regulatory documents to support transit-oriented economic development activities, such as mixed-use overlay zones, density bonuses, and codes that set separate standards with areas identified for infill and redevelopment.
- Protect the character and uniqueness of existing Centers and communities with historic preservation policies, community identity, or marketing practices.
- Provide funding, specifically for Infill and Redevelopment, through financial incentives, tax credits, or accessible private capital.
- Create special taxing districts for downtown areas, such as Business Improvement Districts, Merchants Funds, or Business Associations, to provide services such as streetscaping, maintenance, and marketing.
- Prioritize infrastructure investments in the region's Centers.
- Implement Complete Streets policies to accommodate all users, including goods movement, along with protected bike lanes, pedestrian-only areas, shared space/living streets, and/or open/play streets that promote bike and pedestrian use.
- Work to improve the jobs-to-housing balance in Suburban Centers and Metropolitan Subcenters.

GOAL: PROMOTE AFFORDABLE AND ACCESSIBLE HOUSING

The availability of affordable and accessible housing is critical, both for enhancing the livability of individual neighborhoods and maintaining the economic competitiveness of the region as a whole. A lack of affordable housing opportunities that are accessible within a reasonable commute of the workplace affects workers' quality of life and can have significant consequences on employers, including difficulty in attracting and maintaining a qualified workforce, increased retraining costs, a need to pay disproportionately high wages, and decreased employee productivity. Local economies may also suffer, as more and more of each family's disposable income is consumed by housing and/or transportation costs.

First-time homebuyers, in particular, may find it difficult to locate an affordable home in the neighborhoods where they grew up, near their current workplace, or close to public transit. Limited opportunities for first-time homeownership can result in a tightening of the rental market, as families that would traditionally purchase their first home find it increasingly difficult to locate an affordable unit in an attractive location. Increased demand for a limited supply of rental units leads to increased rental costs, making it even more difficult to accumulate the necessary capital for a down payment and closing costs. Rental housing has been rapidly increasing in price since the Great Recession, when the foreclosure crisis pushed many individuals and families out of homeownership and back into the rental market.

With the region's baby boomers reaching retirement age over the next 10–15 years, accessible units woven into the fabric of existing and planned centers, with easy access to public transportation, services,

shops, restaurants, and other activities, will be needed. *Connections 2045* envisions thriving, vibrant communities where families can afford to live close to work, the disabled can find accessible units, and seniors can remain in the communities where they raised their children while maintaining the greatest possible independence.

Strategies to Promote Affordable and Accessible Housing

- Build lifelong communities that enable aging in place.
- Support housing programs that encourage rehabilitation or modification of existing units using universal design elements, or visitability (one no-step entrance, minimum 32-inch opening for all doorways, and a bathroom on the first floor) at a minimum.
- Increase and preserve the stock of affordable, accessible housing units in areas that are served by public transit and close to jobs and essential services.
- Investigate strategies designed to mitigate the displacement of existing residents in areas experiencing rapid redevelopment.
- Revise local zoning to allow a mix of residential housing types (including a variety of smaller housing options, such as more attached homes, multifamily developments, accessory dwelling units [ADUs], and microapartments) and adaptive reuse, with increased densities; streamline plan review and permitting processes; and enable P3s.
- Support shared housing programs that help to make efficient use

of the existing housing stock, promote affordable housing, and potentially lessen the need for long-term institutional care.

- Increase employment in places where affordable housing opportunities currently exist, including the region's Core Cities and Developed Communities, by increasing their attractiveness to moderate- and middle-income families searching for affordable housing close to work and in places where they would want to live and raise their families.
- Create accessible, pedestrian-friendly neighborhoods where families with children, seniors, and the disabled can safely walk, bike, and take public transit to jobs and services. Smaller multifamily apartment buildings may be an effective way to add density to choice neighborhoods without compromising their character.

GOAL: ENHANCE COMMUNITY DESIGN

Well-designed communities add value to the region. They can spur economic development, raise the quality of life, increase residential and retail market values, improve local safety, enhance individual health and wellness, and positively affect the region's image. Well-designed communities are places where people want to live, work, study, and socialize, due to their combination of amenities and character. Greater Philadelphia has many examples of good community design in the identified Centers throughout the region. The region should ensure that redevelopment and new growth are designed to a human scale, according to smart growth principles.

A core tenet of community design is to understand how people use the public realm, such as streets, sidewalks, parks, trails, and bridges,

and how the private realm impacts the public realm. Does a building turn a blank wall to the street, or does it have an inviting facade with awnings and interesting shop windows? How wide is the sidewalk, and are there pedestrian-scale lighting, benches to allow for places to rest, restrooms, and street trees to encourage walking? Are public spaces well maintained? Are blocks overly long and fronted by surface parking, making it less likely that people will want to walk? Does the design of a road make for inhospitable walking, crossing, and biking conditions? Can a senior, parent with a stroller, or wheelchair user cross the street safely? Are the streets kept clean of trash and debris? Does the design of housing allow privacy and community at the same time? A variety of decisions impact the public realm in ways we may not even realize.

Key community design principles include valuing the pedestrian experience; mixing residential and commercial uses; locating and orienting buildings toward streets and/or transit stations; preserving and/or adaptively reusing historic buildings; infilling vacant land with context-sensitive development; placing parking on street, behind buildings, in alleyways, or in structures with liner buildings; creating wayfinding and signage systems; locating public facilities, such as schools and municipal offices, in areas that are accessible by a variety of transportation modes and integrated into the existing community's fabric; and investing in facades, green infrastructure, and streetscaping. Local regulations should provide a predictable development environment that allows for preservation of unique community characteristics and facilitates appropriate growth and change.

Strategies to Enhance Community Design

- Adopt form-based zoning ordinances and codes that focus on form or building type over use-based codes. Municipalities should adopt separate design guidelines if not using a form-based code.
- Encourage or require transit-oriented design, live/work space, ADUs, street trees, sidewalks, parking maximums, active design strategies, and universal design standards in zoning, and subdivision and land development ordinances.
- Invest in streetscapes and street cleaning programs that contribute to the public realm and integrate GSI when possible to manage stormwater and green urban communities.
- Investigate opportunities to retrofit large single-use districts, such as office parks and aging shopping centers, into denser, mixed-use neighborhoods.
- Develop parking standards based on parking supply and demand, reduce parking minimums, and better manage existing parking resources to allow more room for pedestrian spaces and services.
- Design with potential for adaptive reuse in mind. Consider the context and the potential impacts of technological advances, such as autonomous vehicles, when designing parking facilities for different land uses and building types.
- Encourage development patterns that incorporate smart growth and ecological principles, such as TND and conservation subdivisions.

- Ensure effective and contextually appropriate signage, including wayfinding, with well-written zoning codes and design standards that serve the needs of residents, businesses, and visitors.
- Use public art and other creative placemaking strategies that use art and cultural activities to animate public spaces, enhance transportation facilities, celebrate local history, shape the physical, social, and economic character of a place, revitalize local business districts, and promote social cohesion.

GOAL: ENCOURAGE REGIONAL COOPERATION AND MULTIMUNICIPAL PLANNING

Regions and, increasingly in a globally connected economy, megaregions are the basic block of economic competitiveness. As regions and megaregions compete with each other, the most successful ones will cooperate internally to find new efficiencies and ensure all key players are pulling in the same direction. The Philadelphia region is politically fragmented, with 352 local governments, nine county governments, six regional councils of government, two state governments, and hundreds of school and municipal authorities. Although home rule undeniably enhances the ability of local governments to effectively respond to their constituents' unique needs, fragmentation also poses a greater risk for institutional overlap and parochialism.

Through recent efforts to combat suburban sprawl and preserve natural resources, many municipalities have been taking a proactive approach to planning and are working cooperatively with neighboring municipalities to plan for future development. Some of the benefits that multimunicipal planning can bring include:

- Multimunicipal planning can encourage economic development. By cooperating, local governments can formulate a consistent and comprehensive strategy for economic development, rather than competing for tax revenues. Because local governments may designate growth areas, they can identify areas where commercial or industrial development should be encouraged and provide public investment in these areas to attract developers. This can also strengthen existing communities by focusing development within existing Centers, and by concentrating commercial and high-density residential growth in these areas.
- Multimunicipal planning can preserve farmland and natural resources. Often, natural features, such as watersheds, are more appropriate areas for environmental planning activities than political boundaries. Also, by allowing TDRs across municipal boundaries, more farmland and other natural resources can be preserved.
- Multimunicipal planning can save money. Not only can costs of activities, such as developing a comprehensive plan, be shared by several municipalities, but multimunicipal planning can also provide the basis for other service-sharing relationships. State agencies often give priority in grant programs and funding decisions to multimunicipal planning areas and often give greater weight to multimunicipal plans than to individual local plans.
- Multimunicipal planning can provide additional defense against curative amendments. Municipalities are required to provide land for every type of use. Local governments that adopt multimunicipal planning still must provide land for every use, but not individually. For example, if several municipalities participate in a

multimunicipal plan and one already has adequate high-density housing, the participating communities may collectively satisfy their high-density housing requirements. If the ordinance is challenged, the court would evaluate the entire area of the multimunicipal plan, not just the individual municipality, enhancing the rationale for the zoning strategy.

A joint zoning ordinance may be prepared after adopting a multimunicipal comprehensive plan, and would become the primary implementation tool. However, each municipality may still enact their own zoning ordinance. If separate zoning ordinances do remain, each of the participating municipalities needs to work together to ensure consistency with the multimunicipal comprehensive plan.

While municipal cooperation can be taken to greater lengths, as with the merger of Princeton Borough and Princeton Township in 2013, most cooperative partnerships happen on a much smaller scale. Municipalities can cooperate in several ways, whether by sharing services, equipment, or personnel; pooling procurement efforts; or by regularly collaborating on regional approaches and ideas to help facilitate sound local decision making.

Shared municipal services, such as fire or police protection, can allow municipalities to provide more cost-effective and efficient services. In addition to helping municipalities share knowledge and gain confidence in their decision making, properly planned and implemented shared services provide benefits in at least one of six distinct areas:

- Allows municipalities to offer new services to their constituents where none previously existed;

- May reduce costs and time spent on existing services by creating economies of scale;
- Avoids future costs of programs and tools through coordinated planning and efficiencies;
- Eliminates service duplication that can save time, money, and other municipal resources;
- Offers municipalities options for maintaining or expanding service within an existing budget despite fiscal or staffing constraints; and
- Increases competitiveness for outside funding, as government agencies often give priority in grant programs and funding decisions to areas with multimunicipal plans.

Strategies to Encourage Regional Cooperation and Multimunicipal Planning

- Local governments can work with neighboring municipalities to develop a shared vision and coordinate on planning issues such as growth management, infrastructure, preservation of natural and historic resources, economic development, and shared services.
- State agencies should give greater priority in grant programs and funding decisions to multimunicipal planning areas and more weight in decision making to multimunicipal plans.

GOAL: INVEST IN COMMUNITY SCHOOLS AND PARKS

Parks, trails, and recreational facilities benefit public health, social life, property value, water quality, wildlife habitat, and overall quality of life for many communities. There is an extensive and growing body of research on the benefits of parks and natural spaces for people and neighborhoods.

In many Developed Communities, parks provide the only connection to the natural world, which satisfies the psychological, emotional, and spiritual needs of humans. Parks can be important places for forming and maintaining social ties because people can meet new people at parks or socialize with those they already know. Urban green space helps lower public healthcare costs by providing benefits, such as active or passive recreation opportunities, injury recovery, improved pregnancy outcomes, lowered obesity rates, and reduction in stress and depression.

A direct economic benefit to parks and recreation can be found in the increased property value of homes located near quality parks. Studies have shown that homeowners are willing to pay a premium to live in close proximity to protected open space. This results in increased wealth for citizens when selling their homes and increased tax revenue to government based on higher assessments or property transfer taxes.

Landscaped parks provide environmental services like improved air and water quality, and provide habitat for wildlife, especially in urban environments. The trees, plants, and open space in parks provide natural stormwater management, reducing the amount of polluted runoff entering waterways and mitigating flooding. Trees in parks also absorb air pollution, provide shade, lower air temperature, and absorb GHGs.

Organizations Promoting Regional Cooperation

In addition to DVRPC's coordination efforts there are other organizations that bring together municipal officials on a regular basis to discuss issues and solve problems. Local examples include:

- **Municipal Leagues** (e.g., New Jersey League of Municipalities, Pennsylvania League of Cities and Municipalities);
- **County Associations** (e.g., New Jersey Association of Counties, County Commissioners Association of Pennsylvania);
- **Elected Official Associations** (e.g., Pennsylvania State Association of Township Supervisors, Pennsylvania State Association of Township Commissioners, Pennsylvania State Association of Boroughs);
- **Planning/Zoning Associations** (e.g., American Planning Association—New Jersey chapter, American Planning Association—Pennsylvania chapter, Montgomery County Zoning Officers Association, New Jersey Planning Officials, New Jersey County Planners Association, Pennsylvania Association of Zoning Officers);
- **Municipal Management Associations** (e.g., New Jersey Municipal Management Association, Association for Pennsylvania Municipal Management);
- **Mayors' Associations** (e.g., New Jersey Conference of Mayors, Pennsylvania State Mayors' Association); and
- **Consortia or Councils of Governments** (e.g., Bucks County Consortium).



While education isn't a traditional role for Metropolitan Planning Organizations, DVRPC has heard repeatedly from residents and stakeholders alike that fostering educational opportunities is integral to achieving the vision and goals of the plan.

Community-centered schools build connections in the community and help create stronger neighborhoods with greater social cohesion. In addition to offering a first-rate education, community-centered schools can become community hubs by offering programs and facilities that meet the needs of all generations. By integrating smart growth principles into educational facility planning, community-centered schools can offer many benefits similar to smart growth: enhanced working environments for employees, better quality of life for students and parents, stronger sense of place, and healthier lifestyles (since walking and biking are viable options), as well as a safe and secure learning environment. Schools that are accessible by multiple forms of transportation can decrease the amount of paved surfaces, reduce pollution, and encourage regular physical activity for children.

Strategies to Invest in Community Parks and Schools

- Provide a mix of programming at popular parks to attract a larger number and more diverse group of users.
- Make capital investments in parks based on a long-term strategic vision, effective ongoing maintenance, and significant community involvement of local partners and advocates.
- Develop more parks in underserved areas, as urban greening and access to active and passive recreation can improve mental health, as well as encourage more active lifestyles.
- Engage all community stakeholders in the school facility planning process. Collaborate and share population growth data and demographics with adjacent school districts, municipalities, and other educational agencies.
- Share space by co-locating schools with other public services, such as health clinics, senior centers, senior housing, childhood development centers, day care, after-school programs, and employment services. Other types of services may be explored, such as nonprofits or perhaps a community college, fitness center, or medical office. Co-location can offer cost savings, community integration, and intergenerational support.
- Consider adaptive reuse for new schools or for schools that are no longer in operation. Placing new schools in existing communities helps conserve undeveloped land and ultimately reduces sprawl.

- Integrate school renovation or construction plans into the community revitalization or redevelopment plans and offer bonuses if smart growth goals are met. Community-centered schools should highlight environmentally sensitive features and sustainable design practices.
- Improve accessibility and consider active transportation options in connecting parks and schools to the community. Adopt a Safe Routes to School program for all community-centered schools in the neighborhood or local jurisdiction.



PRINCIPLE: EXPAND THE ECONOMY

Greater Philadelphia's regional economy is large and complex, with an annual gross domestic product of over \$391 billion.²¹ The region's economy ranks among the most diverse of the nation's major metro areas. Although not booming, the region's economy is resilient; its diversity guards against the extremes in growth or decline that economies dependent on one or two major industries often experience.

Greater Philadelphia's economy includes concentrations of cutting-edge sectors, such as biotechnology, health services, higher education, and the creative industries. There is also a burgeoning alternative and clean energy industry—a sector poised for continued growth during the coming years—as well as tech industry start-ups. Numerous businesses and professionals possess the skills necessary to transform challenges in energy efficiency and ecological sustainability into a competitive economic advantage. An important driver of continued economic growth is the ability to transfer innovative discoveries from the region's numerous academic and research institutions to industry partners, and to commercialize new technologies.

Greater Philadelphia has tremendous potential for continued economic growth. Its location in the heart of the nation's Northeast Corridor provides a superb locational advantage, with a vast consumer base of over 100 million people living within a 500-mile radius. The region boasts an enviable transportation network (including major highways, an international airport and a network of regional airports, and a myriad

²¹Bureau of Economic Analysis, 2016. This coverage area includes the nine-county DVRPC region, plus Salem County, New Jersey; New Castle County, Delaware; and Cecil County, Maryland.

DVRPC's Economic Development Planning Philosophy

- *Connections 2045* reiterates the goals and strategies embodied in Investing in People and Places, the adopted regional Comprehensive Economic Development Strategy (CEDS).
- Continued coordination across state, city, and county lines; sectoral interests; and the public and private sectors is essential to maintaining a broad regional perspective and finding a common vision and goals.
- Invest in Centers to facilitate the most efficient use of infrastructure; conserve open space and natural resources; provide employers with easy access to supplies, markets, and a qualified workforce; and create concentrations of “knowledge density.”
- Invest in people to ensure that the region's workforce meets the needs of the region's current and future employers.
- Support the growth of key economic sectors within the region and invest in innovation, creative thinking, entrepreneurs, and start-ups.

Expanding the Economy will provide the following benefits:

- A high-quality, productive workforce;
- A steady supply of jobs in emerging, high-growth industries;
- Business growth in Centers well served by infrastructure and utilities;
- An enhanced climate for entrepreneurship, innovation, and new business formation;
- The creation of jobs that match the skills of the region's workforce, including jobs that provide employment opportunities as a ladder out of poverty for those most in need;
- Reduced energy consumption, resulting in a lower cost of business for area companies; and
- Expanded regional connections to the global economy.

of public transit options), and is home to an impressive network of educational and healthcare institutions.

While the region is well positioned, the ongoing development of the Digital Revolution provides much economic uncertainty around the world. Digitization has upended nearly every major industry to date, with education, healthcare, government, and transportation being the most notable holdouts. This process topples dominant market players by new entrants, who often come from outside the industry. It increases fragmentation and creates more options in the short term. However, it risks winner-take-all, monopolistic outcomes in the long run. Digitally connected networks are able to connect potential employers or sellers with readily available workers or buyers in real-time. This can cut out the middleman, or reduce the need for employees. By greatly reducing transaction costs, multisided platforms are the emerging digital business model. They provide network benefits, where the more members that are using a good or service, the more other market segments will offer it. An example is how the more consumers carry a specific credit card, the more businesses will take it.

Digital companies are not constrained by shelf space and other real-world limitations. They can readily scale up their services to meet increasing demand with little additional cost, reducing the impacts found by traditional economies of scale. 3D printing allows each item to be unique, customized, and personalized to individual needs or desires. Digital companies tend to be light on assets and use capital and technology to find new efficiencies, including a reduced need for labor. As robotics and AI become more commonplace, there are growing concerns not just for routine and manual labor jobs, but also for the higher-skill cognitive and nonroutine ones. While many are rightly concerned about how technology will affect the future of work, it is

likely that it will be used to augment much of our workplace activities. The combination of humans working with technology is generally more effective than either humans or technology working on their own.

Scores of public and private economic development organizations are at work in the Greater Philadelphia region, each seeking to promote or attract a wide variety of sectors or specific interests. Continued coordination across state, city, and county lines; between sectoral interests; and among the public and private sectors is essential to maintaining a broad view of the region and finding a common vision, goals, and policies.

Connections 2045 reiterates the goals and strategies embodied in *Investing in People and Places*, accepted by the U.S. Economic Development Administration as the regional Comprehensive Economic Development Strategy (CEDS). The regional CEDS was created and is maintained under the direction of a committee of state, county, city, and regional economic development and planning professionals. Through the regional CEDS process, DVRPC is actively engaged in regional efforts to support and grow the economy.

GOAL: SUPPORT AND PROMOTE THE GROWTH OF KEY ECONOMIC SECTORS, INCLUDING TOURISM

Like many urban areas, the Greater Philadelphia region's economy has undergone a major transition in recent decades. Roughly half a century ago, manufacturing dominated the economy of both the city and the suburbs, accounting for almost 60 percent of the region's jobs. As traditional heavy manufacturing employment has declined, knowledge-based and digital industries have gained prominence, with life sciences, IT, professional services, and chemicals ranking among

the region's top industries. Sectors, such as education and health services, professional and business services, financial activities, and IT have emerged as principal drivers of the digital economy. Tourism is becoming increasingly important to the region, given its key role in the nation's creation and development, status as the nation's only World Heritage City, and variety of recreational and cultural opportunities. Other key sectors include alternative energy and energy conservation, the creative industries, specialty and precision manufacturing, and food production and distribution.

In order to compete both nationally and internationally, the region must continue to attract new companies and encourage the retention and expansion of existing companies in key economic sectors that have both the greatest potential for growth and pay higher wages. With limited available funding for infrastructure improvements, facilities that serve clusters of key economic sectors should receive priority attention.

Strategies to Support and Promote the Growth of Key Economic Sectors

- Identify key sectors and work with academic institutions, business incubators, venture capitalists, and others to attract or create new companies while simultaneously supporting and expanding existing companies in those sectors.
- Invest in the infrastructure necessary to support the region's businesses, including highways, transit, ports, airports, high-speed broadband and wireless Internet, and pipelines.
- Prioritize transportation and other infrastructure investments in

places that serve clusters of companies, especially those in key economic sectors.

- Develop an economic vision for the digital age.
- Identify and protect key industrial zones, particularly those with multimodal access.
- Increase transit service during off-peak hours to accommodate flexible work schedules, and improve intrasuburban service and service to suburban office parks.

GOAL: INCREASE INNOVATION AND NEW BUSINESS FORMATION

An important driver of continued economic growth is the ability to transfer innovative discoveries and intellectual knowledge from universities to industry partners, and to commercialize new technologies to stimulate economic growth. Greater Philadelphia has a rich history of innovative thinking and bringing promising new technologies to market. Since 2000, annual research and development (R&D) expenditures by academic and research institutions in the region have consistently amounted to almost 3 percent of the nation's overall R&D expenditures.

Greater Philadelphia is rich in academic resources, and many of the region's universities have affiliations with technology and science incubators, allowing businesses to access a vast pool of university talent and equipment. The availability of venture capital is critical; in 2015, venture capitalists supplied over \$625 million to companies throughout the region, but the region's share of what is available nationally has declined in recent years.

Trends over the past 20 years point to the slow but steady growth of a free agent economy, where large companies contract out many necessary tasks, and employees are more likely to freelance, consult, and do temporary work. Strengthened by the expansion of the Internet and other communications technologies, this trend suggests that workers may be less tied to corporate jobs in the future, and individuals will need to be more entrepreneurial to be successful. While there will still be traditional industries and jobs, and large companies will remain major economic players, outsourcing, efficiency gains, and technology will enable them to effectively compete with fewer employees. Individuals in the traditional workforce will move between jobs more often, with less commitment to one employer. More individuals may have to create their own economic opportunities, opening their own small businesses or temporary pop-up enterprises. They may also have to contribute more to their healthcare and retirement savings as labor efficiency and the rising costs of full-time employees encourage large companies to continue to reduce their workforces.

Many young adults are seeking careers with a higher purpose. The impact economy is a concept which combines economic and social challenges that our communities face. The goal of the impact economy is to do well by doing good. It includes companies that generate a profit while also making positive environmental and social impacts, creating shared value through P3s, and using private and endowment capital to do public good while seeking a return on investment. Cooperatives are businesses where workers are also its owners, users, or managers, depending on the arrangement. Cooperatives aim to bring together producers, buyers, sellers, and workers in order to align goals and efforts more efficiently, applying democracy to the market.²² There is still capital and profit, but unlike a corporation, it serves the co-op's

members rather than business owners. Cooperatives also benefit from network effects, where the more members are involved, the stronger their market power becomes.²³ This allows them to be more inclusive, and makes them an effective tool in the battle against income inequality.²⁴

Strategies to Increase Innovation and New Business Formation

- Accelerate technology transfer from research institutions to stimulate new company formation related to research results.
- Expand and support small business incubators and accelerators.
- Expand the availability of venture and other investment capital.
- Foster and enhance the region's entrepreneurship by generating collaboration among inventors, venture capitalists, academics, and experienced start-up business executives.
- Expand programs that provide technical support, mentoring, training, and funding to prospective entrepreneurs and small start-up businesses.
- Update zoning codes to allow for co-working and shared office spaces, mixed-use buildings, and home-based businesses.
- Avoid regulations that restrict the pop-up economy.
- Support the impact economy and the formation of cooperatives.

²² Marshall, *The Surprising Design of Market Economies*.

²³ *Ibid.*

²⁴ Jon Liss, "Uber and the Taxi Industry's Last Stand: What the Rise of the App-Based Cab Service Says about the Future of Work in America," *The Nation*, January 27, 2015, <https://www.thenation.com/article/uber-and-taxi-industrys-last-stand> (accessed June 28, 2016).

²⁵ Klaus Schwab, "The Fourth Industrial Revolution: What it means, how to respond," *World Economic Forum*, January 14, 2016. <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>.

GOAL: ENHANCE BUSINESS GROWTH THROUGH GOVERNMENTAL EFFICIENCY

There are a number of ways in which government can enhance business growth through efficiency, including rethinking government's role in the digital age, streamlining regulations, using technology to engage citizens and stakeholders, tax reform, using Big Data to improve decision making, and incorporating Smart City technology to collect data and improve management.

In a globally connected world, capability is not what you can do on your own, but rather what you can accomplish by working with others. Government operated as a bureaucracy throughout the industrial era, where decision making and regulation was linear and top down. The digital age requires a wholesale rethinking to make government more agile at all levels.²⁵ Fast-changing innovations will stretch regulations and regulators' ability to keep up. New technologies offer citizens the ability to engage directly with their representatives on scales that were previously unimaginable. Technology is redistributing and decentralizing power. To be effective and efficient, government needs to be reimagined as more of a network.

Government-as-a-network (GaaN) can provide a platform of engagement, data sharing, and transparency with citizens and businesses. Examples of GaaN exist in 3-1-1 and 5-1-1 information systems; open-source and open-data efforts such as Code for America and data.gov; and apps such as Represent Me, DemocracyOS, and Ushahidi. These should be inspiration for reinventing government in a way that harnesses

collaborative software and applications to connect with citizens, facilitates their connections with each other, and which enables citizens to be problem solvers. In this new vision, government is a platform that expands access to data and information, promotes transparency, and serves as a convener and coordinator for collective action.

Decision makers and policy makers must work cooperatively to make the region attractive to current and prospective employers. Multilevel governmental regulations and review processes that unreasonably extend the time required to make permitting decisions are viewed as lacking predictability and transparency. Regulations that impose an unfair tax burden on existing or prospective employers can dissuade businesses from expanding or locating in the region.

Over-reliance on the local property tax has led to municipal fiscal distress throughout the Commonwealth of Pennsylvania. New Jersey is likewise overly dependent on the property tax. The property tax often does not grow organically in communities due to poor reassessment practices or declining property values. As core services increase in cost each year, local governments are unable to increase or add services or make new investments when they are needed. As the ability to provide services declines, the demand for them actually increases: the remaining population is often lower income, and those who can afford to vote with their feet do so. Since individuals can easily travel from one community to another for shopping, jobs, or even a new home, there is a mismatch between municipal boundaries and the regional economy. Multimunicipal planning and service provision can help to build economies of scale, potentially reducing costs. Reassessing tax policy should ideally be addressed at the statewide level.

The City of Philadelphia's wage tax is often cited as a reason for its long-term declining share of the region's jobs. In 1990, the city had 837,000 jobs representing 31 percent of the region's total jobs. In 2015, the city had 773,000 jobs, representing just 24 percent of the region's total jobs. This higher rate in the city has been a push factor. A recently proposed revenue-neutral approach to reduce the wage tax to under 3 percent, while also lowering other business taxes, is to shift a higher tax burden onto commercial real estate. However, the plan would require changing the uniformity clause in the Commonwealth's constitution and could risk further over-reliance on the property tax (although these taxes tend to be lower in the city than in the surrounding counties). It does, however, follow the old tax adage of "tax what you don't want or can't move." While no solution has been reached to date, the disparity between city and suburban taxes weakens the region's overall ability to compete in the global economy, particularly by making it harder to build network effects and agglomeration economies in the region's core Metropolitan Center. Issues, such as tax reform, education, and workforce development, must be seen as Greater Philadelphia competing against other regions around the world, and not as a contest between city and suburb.

Governmental investments, including those for transportation projects, should support the *Connections 2045* five core plan principles of sustaining the environment; developing livable communities; expanding the economy; advancing equity and fostering diversity; and creating an integrated, multimodal transportation network. In particular, investments should serve areas that are either already developed or designated as appropriate for future growth, encourage growth and reinvestment in the region's Centers, have limited environmental impact, and support key economic sectors. Potential projects are evaluated to make sure that they help achieve the key principles outlined in the Plan. Governments and agencies at all levels must make

sound investment decisions and be good stewards of limited public resources.

There are many other areas where government can better coordinate, and information is a key tool to facilitate that. Data coordination is an area of growing interest that can help different levels of government and others better coordinate, but more importantly, make better decisions. Smart Cities use intelligent infrastructure with embedded sensors that are connected to the Internet and capture data. The local government uses this data to monitor its environment, send information, and even perform actions remotely. Smart Cities also use Big Data analytical techniques, and apply smart grid technologies, that efficiently and dynamically transmit and distribute electricity in response to demand. Smart Cities are made up of smart buildings, which integrate systems into a common network that shares information and functionality in order to gain efficiency. In addition to efficiency, Smart Cities increase transparency, partnerships, and citizen engagement.

Strategies to Enhance the Climate for Business Growth through Governmental Efficiency

- Continue to promote and secure a more attractive wage and business tax environment to encourage the attraction, retention, and expansion of businesses in the region.
- Increase the speed, predictability, and transparency of government decision making.
- Foster regional collaboration and engage local business leaders in growing the regional economy.
- Work to enhance the government network, using 3-1-1 and 5-1-1 systems as guidance.
- Simplify business tax collection, licensing, and permitting.
- Strengthen megaregional cooperation and collaboration, build partnerships, and recognize that Greater Philadelphia benefits from a broader economic unit. Support efforts to improve mobility within megaregions, particularly through the provision of high-speed inter-regional rail.
- Explore land value taxation as an alternative to the property tax. This increases the tax rate on the value of land while reducing the rate on the value of buildings. It can encourage reinvestment in

Increased regional cooperation and government efficiency are key strategies to achieving the vision for the future. It leads to increased transparency and openness, innovation and sustainable practices, collaboration between business and government, use of data and metrics, and a fairer and more equitable tax structure that will spur regional growth.

older areas by lowering the cost of property improvements and increasing the cost of vacant or underutilized land.

- Use triple-bottom-line accounting, which considers social, environmental, and financial impacts, as the basis for decision making.
- Share in the risks and rewards of Smart City investments.

GOAL: FOSTER A HIGH-QUALITY, PRODUCTIVE WORKFORCE

The availability of a skilled, productive workforce is critical if the region expects to continue to compete effectively in today's economy. Greater Philadelphia is home to an impressive number of higher education facilities and ranks sixth nationally in the number of education and knowledge-creation workers. There is a tremendous opportunity to leverage the region's vast higher education resources to raise the level of educational attainment, especially in the region's Core Cities and urbanized areas. Colleges and universities should be actively involved with local elementary and secondary schools to increase the performance and motivation of students.

In an era of rapid technological change, we can no longer expect that a four-year degree will be capable of instilling all the skills one will need for the rest of their career. Instead, workers will need to become lifelong learners in order to keep their skills current. Opportunities to help develop skills through industry and school partnerships, and specialized training that offers pathways into specific careers, such as biotechnicians or energy auditors. Small employers must be better connected with the resources available through workforce training programs.

Over the past two decades, immigrants have helped to offset population declines in many U.S. cities, including Philadelphia. In addition to expanding the available labor force, studies have shown that foreign-born residents open small businesses at a higher rate than native-born people and play an important role in supporting and invigorating local and regional economies. As the average age of the region's population continues to increase, the role immigrants play in bolstering the number of working-aged individuals will become even more significant.

Strategies to Foster a High-Quality, Productive Workforce

- Explore ways to improve and expand the linkages between the region's high schools and vocational training, technical certification programs, community colleges, and other higher education institutions.
- Leverage the region's impressive higher education resources to raise the level of educational attainment, especially in urban districts.
- Support industry-school partnerships and specialized training (in manufacturing, for example) that offer pathways into specific careers.
- Improve the connections between small employers and the region's workforce training resources.
- Expand programs designed to support immigrants seeking to enter the workforce or start a business, including ESL programs, specialized training, and entrepreneurial support.

- Develop portable benefits programs that can be moved from job to job, or gig to gig, creating a modern social safety net that is not tied to a single employer. At a minimum, these programs should include health insurance, retirement, and worker disability. They could also offer dental, vision, life insurance, vacation time, education and training, and other benefits.
- Enable employees to maintain the digital reputations and credentials they build by allowing them to be transferred between platforms.
- Encourage policies and practices that focus on supporting older workers, such as flexible work schedules, shared jobs, paid and unpaid opportunities, retraining and skill-development programs for “encore careers,” senior entrepreneurship, and post-retirement options.

GOAL: EXPAND THE REGION'S CONNECTIONS TO THE GLOBAL ECONOMY

Expanding the Greater Philadelphia region's connections to the global economy is essential to effectively competing in an interconnected world. In today's economy, the region is competing not only with other nearby major metro areas, but also with global markets, including China, the European Union, Japan, Mexico, and Canada. International trade must be promoted, and foreign direct investment must be attracted.

Competing successfully on an international level requires expanded capacity and connections at Philadelphia International Airport (PHL), as well as enhanced utilization of the region's ports and overall leverage of the region's multimodal infrastructure. Global challenges present

local opportunities to redirect regional economic development efforts and to prepare the region to compete in a future where energy-efficient and environmentally safe products and services will be key drivers of growth.

Additionally, Philadelphia must position itself as a world class city and region—an international destination for businesses, talent, visitors, and immigrants. Philadelphia's strengths include its historic architecture, walkability, affordability, museums and cultural attractions, restaurants, and universities. Philadelphia is the nation's first World Heritage City. Achieving the status of “world class” will require continued investment in regional arts, cultural, and historical institutions; maintaining effective and reliable infrastructure systems; promoting international tourism; improving environmental quality; and promoting entrepreneurship and innovation.

Strategies to Expand the Region's Connections to the Global Economy

- Promote international trade and increase exports from the region.
- Attract additional foreign direct investment.
- Improve domestic and international mobility connections to the nation and world. Expand capacity and improve international connections — particularly to Asian and Latin American markets — at PHL. Support the implementation of the Federal Railroad Administration's (FRA) Northeast Corridor (NEC) Future plan.
- Enhance utilization of the region's ports and overall leverage of the region's multimodal infrastructure.

- Enhance the region's desirability to both employers and employees by investing in arts, cultural, and recreational amenities; supporting entrepreneurs and innovative thinkers; improving environmental quality; maintaining affordable housing opportunities; and investing in public infrastructure.
- Support ongoing efforts to make Philadelphia a world-class city and region.

GOAL: DEVELOP A MORE ENERGY-EFFICIENT ECONOMY

High quality of life does not require high energy use: delivering services with less energy has benefits beyond the cost savings. Less driving means shorter trips and less time in traffic. Green buildings, with better insulation and more efficient heating and cooling systems, mean greater comfort. Ninety percent of GHG emissions in the Greater Philadelphia region are associated with the combustion of fossil fuel to produce energy, including that burned to generate electricity. Total expenditure in the region for energy (electricity, natural gas, gasoline, diesel, heating oil, and jet fuel) in 2010 is estimated at about 6 percent of the region's economy. Thus, an energy-efficient economy is essential to the region's goal of reducing GHG emissions.

Municipal, regional, and state-level policies that encourage energy efficiency and conservation in buildings will further reduce our region's energy requirements. Municipalities can lead by example by adopting energy efficient practices within their own operations. The lessons learned and dollars saved will serve as an example to the broader community. Should energy become more expensive, municipalities with lower energy consumption per capita will be more desirable places to live and locate businesses.

A profound transformation of the global economy is expected over the coming decades. Regions that deliver energy efficiency and low GHG emissions will have a competitive advantage. This shift presents a tremendous opportunity for Greater Philadelphia. As we build on our historic advantages of mixed-use development and transit infrastructure, we will also transform our business and workforce infrastructure to provide the products, services, and skills required for this future. This transformation will require the regional cooperation and strong coordination between the states, counties, and municipalities that DVRPC continues to play a critical role in building and leading.

Strategies to Develop a More Energy-Efficient Economy

- Provide services with less energy by encouraging the use of more efficient vehicles, buildings, and equipment, and by expanding multimodal transportation options.
- Encourage local governments to continue to take the lead in increasing energy efficiency by reducing energy use in their daily operations.
- Focus on land use policies that allow people to live, work, and play within a smaller area, requiring less travel.
- Educate and prepare the region for emerging energy-efficient technologies.
- Encourage the use of more fuel-efficient or alternative-fuel vehicles to reduce GHG emissions.

PRINCIPLE: ADVANCE EQUITY AND FOSTER DIVERSITY

Equity is a principle that goes beyond treatment of individuals to influence the functioning infrastructure, policies, and operations of a region. It is a strategy for promoting fair treatment, and encouraging success and prosperity by addressing the unique needs and obstacles of all persons. By lifting barriers, addressing civil rights, and protecting the most vulnerable people in our region, issues of poverty, education, mobility, health, and community can be addressed fairly.²⁶

FEDERAL REQUIREMENTS

All MPOs in the United States must meet certain requirements as mandated by the federal government.

Title VI of the Civil Rights Act of 1964 states that “no person in the United States shall, on the grounds of race, color, or national origin, be excluded from the participation of, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.”

Environmental Justice (EJ) builds on this framework. EJ is the fair treatment and meaningful involvement of all people, regardless of religion, race, ethnicity, income, or education level, in the planning and decision-making process. Executive Order 12898 mandates that federal agencies incorporate EJ considerations and analysis in their policies, programs, and activities. To meet the requirements of these laws, an MPO must:

DVRPC's Philosophy On Advancing Equity and Fostering Diversity

- Allocate funds following the principles of Title VI and EJ.
- DVRPC will support and enhance the principles of equity, which include accessibility, mode choice, affordability, safety, health, diversity, inclusion, living wages, and quality education.
- Encourage planning partners to use DVRPC's equity tools and data sources to further support and enhance equity at the local level
- DVRPC will seek public input in an inclusive and engaging way and will meaningfully respond to comments and suggestions from the public throughout the planning process.
- DVRPC's commitment to Title VI and EJ is reflected in the plans and programs, public involvement efforts, and general way the agency does business.
- DVRPC has created an internal technical methodology, the Indicators of Potential Disadvantage (IPD), to identify disadvantaged populations within the Greater Philadelphia region.

²⁶ Esoko, "What is 'Equity'?" *Cultural Organizing*, October 2016, <http://culturalorganizing.org/wp-content/uploads/2016/10/SalomePDF.pdf>.

Advancing equity and fostering diversity will provide the following benefits:

- A prosperous, economically stable region;
- A skilled, supported, and healthy workforce;
- A safe, affordable transportation network;
- Resilient, inclusive, and vibrant communities;
- Healthy housing for people of all income levels; and
- Quality educational opportunities for all persons.

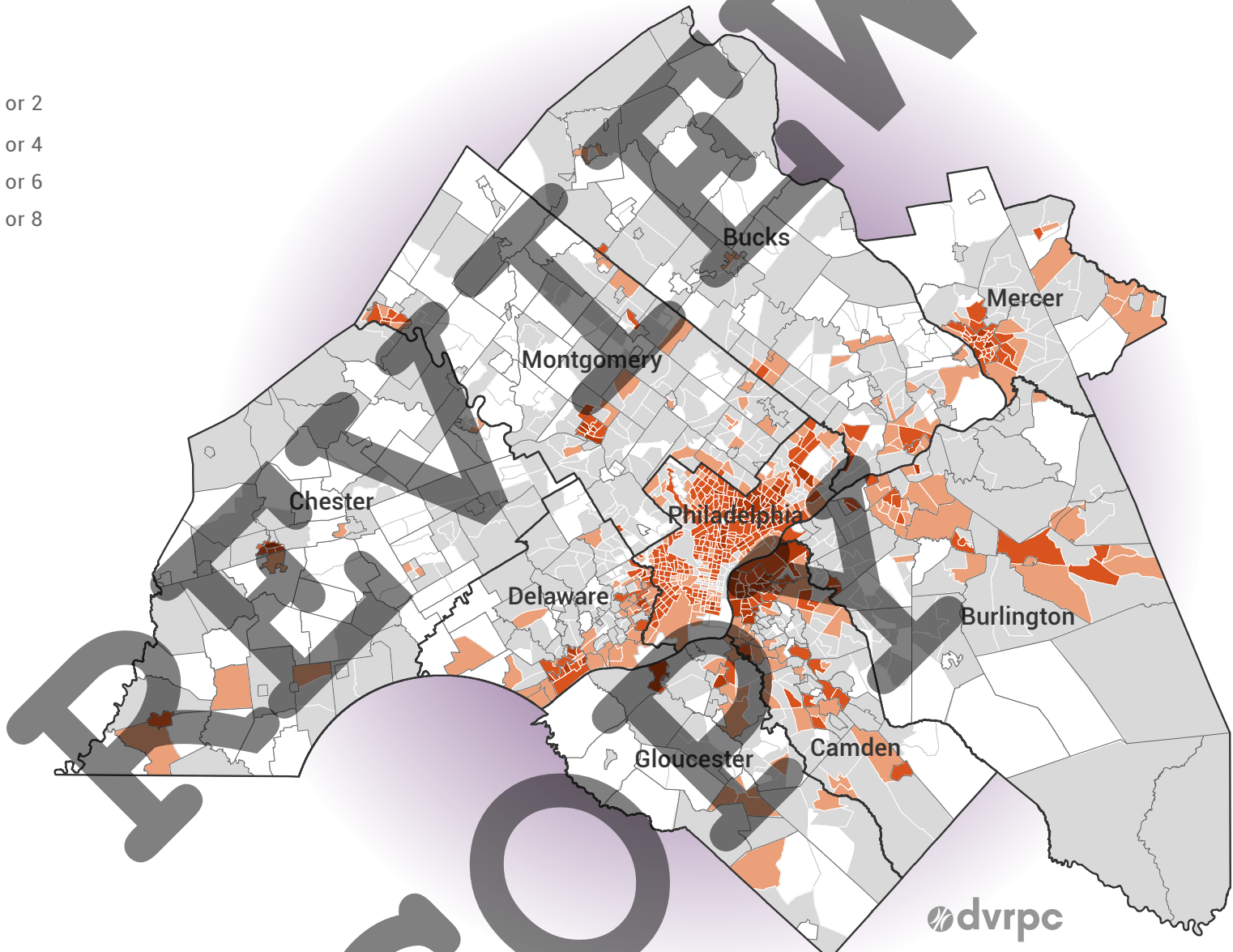
- Enhance its analytical capabilities to ensure that the long-range plan and the Transportation Improvement Program (TIP) comply with Title VI.
- Identify residential, employment, and transportation patterns of low-income and minority populations so that their needs may be identified and addressed, and the impacts of transportation can be fairly distributed.
- Evaluate and improve the public involvement process to eliminate barriers and engage minority, disabled, elderly, and low-income populations in regional decision making.

EJ is traditionally concerned with the impacts of disparate funding and services on defined minority and low-income groups. DVRPC currently assesses and maps populations based on IPD.²⁷ These indicators help DVRPC to identify which areas may face unique planning-related challenges and would be categorized as communities of interest under Title VI and EJ regulations:

- Poverty;
- Carless Households;
- Non-Hispanic Minority;
- Physically Disabled;
- Hispanic;
- Limited English Proficiency;
- Elderly; and
- Female Head of Household with Child.

²⁷Using the American Community Survey 5-Year Estimates data set from the U.S. Census.

FIGURE 29: IPD BY CENSUS TRACT



Source: DVRPC, 2017.

The IPD methodology is an integral tool that DVRPC uses to understand the region's demographics. This information is used for a variety of DVRPC programs and plans to analyze impacts, recommend solutions that may mitigate adverse project or program consequences, or direct public outreach efforts.

DVRPC's IPD methodology:

- Identifies the impacted groups;
- Locates them in the region;
- Plots key destinations—such as employment or health care locations—that these population groups would access;
- Overlays these destinations with the region's existing and proposed transportation network; and
- Determines what transportation service gaps exist for these disadvantaged groups.

The work undertaken by DVRPC inherently includes opportunities for EJ considerations and promotes an open public participation process. Specifically, programs, such as the Coordinated Human Services Transportation Plan, the AQP, and the Transportation and Community Development Initiative (TCDI), are designed to positively affect various disadvantaged groups and communities throughout the region.

The concept of creating a sustainable future is one that can particularly benefit EJ populations, and many of the goals presented in *Connections*

2045 further DVRPC's commitment to EJ and planning for all residents of the nine-county region. Aside from the equity-specific goals in this section, goals related to food systems, investing in the region's Centers, green infrastructure, and economic and workforce development are inter-related and can have far-reaching benefits for the identified populations in the IPD methodology. Policies that promote urban agriculture, revitalizing brownfields and greyfields; creating jobs that match the workforce supply; and upgrading transit, bicycle, and pedestrian facilities, are just a few of the recommendations to improve the quality of life for all residents of the region.

GOAL: PROMOTE EQUITABLE ACCESS TO TRANSPORTATION FOR VULNERABLE PERSONS

To equitably improve economic and social opportunity in the region, planners must consider access to essential services for vulnerable populations. Vulnerable populations include individuals who are low income, senior, or physically or mentally disabled and who are more acutely affected by infrequent transit service and gaps in infrastructure, such as poor sidewalk connectivity, inaccessible transit stops or vehicles, and disconnected land use planning. These persons are more likely than the general population to be transit dependent and have unique transportation needs for reaching essential services. Essential services are those destinations needed to meet a standard quality of life, including places of employment, grocery stores, schools, medical facilities, recreation and open space areas, senior centers, and centers for the developmentally disabled.

The region's transportation network should link places where people live and work and be navigable with comfort and dignity by users of all ages and abilities. Improving transportation service in the region requires

strengthening coordination efforts, increasing reliability, and developing flexible services that improve access to essential services and job opportunities. Fixing infrastructure gaps will require the dedicated efforts of many actors, including federal, state, and local governments; transit agencies; social services providers; real estate developers; major employers; and funders. These investments often prove to have a much wider benefit than initially conceived. For example, Americans with Disabilities Act (ADA) curb cut requirements have made walking accessible for a whole range of users, such as children in strollers or on bicycles; individuals using crutches, canes, or walkers; and travelers with wheeled suitcases.

Strategies to Promote Equitable Access to Transportation for Vulnerable Persons

- Make transit stop locations, connecting pathways, and street crossings physically accessible.
 - Encourage TOD that includes affordable housing and essential services.
 - Support policies that make travel safer and more convenient, such as Complete Streets, Vision Zero, connective sidewalks, public restrooms, and places to sit or rest in all communities.
 - Link modes by clustering infrastructure, coordinating arrival and departure times, implementing effective wayfinding, and providing free or affordable transfers.
 - Prioritize accessibility improvements at/int:
- ◆ key transportation hubs and activity centers that serve significant numbers of vulnerable populations;
 - ◆ communities with concentrations of disabled and/or senior populations; and
 - ◆ essential service locations, such as hospitals, medical facilities, and senior centers.
- Expand discounted transit passes for vulnerable communities, such as free full-week passes for public school students and discounted passes for low-income customers.
 - Improve transportation service generally through the deployment of new technology, shared-use mobility, and intercity connections.
 - Improve vulnerable populations' access to online travel information, including outreach and communications provided for Limited English Proficiency populations.
 - Prioritize convenience and affordability of lifeline services, such as paratransit and low-frequency, fixed-route transit and connections to essential services, employment, and last-mile connections.
 - Work with shared mobility companies, taxis, TNCs, and transit agencies to enhance service in low-income and EJ communities, and provide increased accessible-vehicle service.
 - Collaborate to develop pilot projects, awareness of options, and subsidies to increase access for low-income individuals to shared mobility services.

GOAL: CREATE AGE-FRIENDLY COMMUNITIES

As life expectancy continues to increase, populations are aging around the world. In the United States, the baby boomers, born between 1946 and 1964, began to turn 65 in 2011, with the last boomers turning 65 in 2029. In many ways, the Philadelphia region is getting a preview of what the rest of the nation will eventually face: a demographic imperative to plan better environments for aging populations. It is clear that while the urgency is understood, solutions and the political will to address the needs of an aging population are less apparent. In response, DVRPC seeks to find ways that planners and policy makers can improve and prepare communities for aging, specifically with relation to transportation, housing, and public spaces.

Age-friendly describes places where older adults, defined as anywhere from 50+ to 65+, can “age actively.” Active is defined as a physical environment that supports older people and allows them to be independent. Perhaps most importantly, it also refers to a place that enables adults to engage with social, economic, and civic life. Because different groups define older adults starting at different ages, a better term might be *aging-friendly* communities, which focuses on the dynamic process of aging rather than a specific age.

The World Health Organization (WHO) created the Global Network of Age-friendly Cities and Communities (GNAFCC) in 2010 as the first major global policy response to aging in cities. AARP is the U.S. institutional affiliate of GNAFCC, and began their own Network of Age-Friendly Communities in 2012, targeting some of the environmental, economic, and social factors that influence the well-being of older adults. AARP works through their state offices to identify communities for membership in the WHO Global Network. There is growing interest

in the age-friendly community designation in Philadelphia and the region. Communities that join undertake an assessment of the eight age-friendly domains: outdoor spaces and buildings, transportation, housing, social participation, respect and social inclusion, civic participation and employment, communication and information, and community support and health services.

Strategies to Create Age-Friendly Communities

- Update county and municipal master or comprehensive plans to support age-friendly communities.
- Adopt transportation policies and practices that require or encourage TOD, Complete Streets, lower speed limit or senior pedestrian zones, wayfinding and legible signage, bus shelters, benches, public restrooms, programs for older cyclists, and playgrounds/outdoor exercise equipment for all ages.
- Retrofit age-restricted communities in the Growing Suburbs with sidewalks, connected streets, enhanced transit access, and ridesharing services or partnerships.
- Consider establishing an age-friendly business program to help businesses attract, engage, and retain older adults as customers by providing places to rest, minimizing excessive noise, providing well-lit displays, offering home delivery, and training staff on how to assist those with vision, hearing, or cognitive issues.
- Support the creation of more villages: grassroots membership organizations that coordinate access to affordable services and social

support for older adults through vetted providers to enable seniors to remain in their homes and communities. Support services should include adult day care centers, long-term care facilities, home-based offices, healthcare, social work, and social activities.

- Offer support services to naturally-occurring retirement communities, which are often market-rate apartment buildings predominantly occupied by seniors.
- Encourage the development of alternative housing types, such as co-housing, cottage housing, ADUs, and grandfamilies housing (allows grandparent caregivers to house grandchildren without violating rules of age-restricted senior housing; combines features of senior housing with on-site services, such as after-school education, youth activities, and case management).
- Require or incentivize the building of new housing or adapting existing housing to make homes visitable at a minimum (one no-step entrance, at least 32 inch openings for all doorways, and a bathroom on the first floor) or using universal design features as a best practice.

GOAL: GIVE ALL CHILDREN IN THE REGION ACCESS TO GOOD SCHOOLS

Schools play an invaluable role in educating our children and serving the broader needs of the community. However, income, social, and racial inequality can create challenges for our schools and communities.

Children from low-income households, students with special needs, and students of color often arrive with more intensive needs than their peers.

The disadvantages these students face become evident when looking

at indicators such as standardized test scores, school size, disciplinary records, out-of-school time, and graduation rates.

Closing opportunity and achievement gaps and promoting equitable outcomes for all children requires a comprehensive approach that is based on the needs of families in a specific community. At a broader level, we must realize that discrepancies in educational attainment may be reinforced by educational funding inequities and the lack of access to support services in many of our lower-income communities. By reviewing the impact of education finance policies, communities in our region may help to improve the well-being of disadvantaged schools and students.

Connected educational programs think of communities as ecosystems and use human and social capital to gain better understanding of, and solutions to, problems. They better prepare individuals for the working world while enhancing community, family, and social life. These efforts should connect middle and high schools with other parts of the existing and emerging educational ecosystem: maker labs, innovation challenges, hack-a-thons, interactive art installations, online experiences, and universities.

Strategies to Give All Children in the Region Access to Good Schools

- Develop connected learning communities that are production-centered, have a shared purpose, and are openly networked to leverage technology as an educational resource.²⁸

²⁸Judi Fusco, Julie Remold, Jeremy Roschelle, and Patti Schank, "Smart and Connected Communities for Learning," *The Center for Innovative Research in Cyber Learning*, undated, <http://circlcenter.org/smart-and-connected-communities-for-learning/> (accessed May 18, 2016).

- Explore opportunities to provide universal pre-kindergarten programs that offer high-quality affordable educational services for all age-appropriate residents.
- Promote schools as platforms to provide multiple support services, such as extended learning programs, nutrition counseling, free or subsidized breakfasts and lunches, and health services to low-income families in the community.
- Create after-school programs for students and adult community members that incorporate a variety of educational and recreational activities, such as art programs, English as a Second Language (ESL), and General Education Development classes.
- Work with political leaders and community stakeholders on school funding allocations to ensure all school districts receive adequate financial support.
- Collect and share relevant data related to student opportunity and achievement with researchers, education advocates, and policy makers so that they can make informed decisions about state education finance policy.

GOAL: BUILD INCLUSIVE COMMUNITIES AND DEVELOP WITHOUT DISPLACEMENT

As global migration increases, and the suburbanization of poverty continues, many communities in the region and around the nation are experiencing significant changes to their traditional socioeconomics and demographics. As parts of the region become increasingly multicultural, they can work to form inclusive communities. These communities respect all citizens, ensure everyone has full access to resources, promote equal treatment and opportunity for all, work to eliminate discrimination, engage citizens in decision making, value diversity, and respond quickly to discrimination and other incidents. Two of the biggest keys to forming inclusive communities is to make sure that everyone has access to safe and healthy housing, and to create forums where dialogue can be shared between different groups, bringing them together as equals. Institutional support and leadership is critical to advancing dialogue, finding shared values, building relationships, and identifying collective actions.

As previously lower-income areas have seen renewed development interest, there is rising concern that lower-income individuals could be priced out of their community. While development, particularly in the region's Centers, is generally a positive outcome, there needs to be structural and institutional safeguards that ensure more equitable housing, health, educational, and economic outcomes for low- and moderate-income individuals and families.²⁹ At the same time, many other neighborhoods continue to struggle with vacancy, lack of opportunity, and disinvestment. Residents of all communities want access to jobs, better education, and healthier and more vibrant

²⁹Philadelphia Association of Community Development Corporations, *Beyond Gentrification: Toward Equitable Neighborhoods* (Philadelphia, PA: Philadelphia Association of Community Development Corporations, 2015), http://pacdc.nationbuilder.com/_publications_EcDevPlat_Full%20Platform.pdf.



Inclusive Communities welcome diversity, promote safe and affordable dwellings, enable participation in community services and local government, support fair access to opportunities and services, reduce violence, and advocate social justice.

– adapted from The Municipal Research and Services Center (MRSC)

neighborhoods. Regardless of where individuals live, they should have influence over the decision-making process that affects their community, benefit from improvements, have access to resources and services that improve quality of life and fulfill basic needs, have choices about where they live and work, and should not be involuntarily displaced from their preferred neighborhood.

Strategies to Build Inclusive Communities and Develop without Displacement

- Seek regional cooperation to identify policies that can alleviate poverty and homelessness.
- Obtain input from neighborhood groups and community organizations about decisions and policies impacting them in advance of decision making. Strengthen the ability of neighborhood groups and residents to create inclusive neighborhoods through community organizations, planning and zoning decisions, and other means.
- Create and preserve quality affordable housing throughout the region.
- Expand economic opportunity in neighborhood and regional centers and work with major employers to increase local hiring and sourcing.
- Research and better understand the impacts of displacement and extend assistance programs.
- Improve efforts to increase hiring of minority-, women-, and disabled-owned business enterprises and workers in projects with public funding.
- Use local land banks, code enforcement, and other means to fight blight, decay, and abandonment.

- Reduce the digital divide by through dig once policies that limit the expense of developing broadband infrastructure, enrolling people in existing low-income broadband plans while expanding these programs, and increasing outreach and education around digital literacy
- Require landlords to provide a 'good cause' when attempting to evict tenants at the end of a lease.



PRINCIPLE: CREATE AN INTEGRATED, MULTIMODAL TRANSPORTATION NETWORK

Transportation is entering an era of rapid change fueled by the Digital Revolution. TNCs, such as Uber and Lyft, are providing tens of thousands of rides each day, just a few years after commencing service in the region. Sensors, the IoT, and other communications technologies are collecting vast amounts of data. They can be used to provide real-time information and improve decision making, from individual routing to operations and capital investments. CV and AV technologies are not far off and are likely to lead to even safer and more efficient travel.

Communication technologies enable the ability to work remotely from anywhere in the world, potentially creating a disconnect between where people live and where they are employed. This further breaks down the notion of a region being a commute shed around a principal city. The future may anticipate a move away from using a personal vehicle to complete all trips, to one where individuals use the most convenient mode(s) available. The future of transportation is multimodal, and each individual trip will be more likely to rely on multiple modes.

Recognizing how technology is reshaping transportation, *Connections 2045* envisions a well-maintained, integrated multimodal transportation network that provides accessibility and equity for all citizens and visitors throughout the region, reduces congestion and auto-dependence, enhances goods movement, and moves the region toward zero roadway deaths. Integrated, multimodal transportation networks use digital devices connected to the Internet to collect data in order to provide real-time information about how to more efficiently move

DVRPC's Transportation Planning Philosophy

- Transportation investments will support the goals and policies of the DVRPC long-range plan.
- The transportation planning process will go beyond the federally required "3C" process to be Comprehensive, Cooperative, Continuing, Coordinated, and Compatible.
- Priorities are to (1) preserve and maintain the existing transportation network and rights-of-way; (2) use technology, design, and markets to improve the operation and efficiency of existing transportation facilities for all users; and (3) address the capacity of the existing multimodal transportation network, limiting the addition of through travel lanes.
- Investment benefits and costs should be strategically distributed across the region, with careful consideration of land use, environmental, economic, and social impacts. Projects should be affordable and incorporate context-sensitive design and other smart transportation techniques.
- The region will be innovative at incorporating policy approaches, ITS applications, and emerging technologies. DVRPC will be bold in supporting projects that continue to transform the region into a better place to live, visit, work, and play.

Establishing an integrated, multimodal transportation network will provide the following benefits:

- A safer, lower-cost, more sustainable and equitable transportation network with more options in how to get around;
- Increased use of data and real-time information will enable more efficient movement of people, goods, and services within existing transportation facilities;
- Reduced automobile dependence, congestion, and associated pollution;
- Preservation of open space and natural and cultural resources that would be lost by the construction of new roads;
- Generating added value via freight distribution channels and increased productivity;
- Creation of new jobs and building of agglomeration economies by focusing investment in Centers and attracting businesses that benefit from a high-performing transit network, educated workforce, and location within the Northeast and Mid-Atlantic megaregions;
- Reduced parking demand, flexible employment opportunities, more customer service, improved connections between modes, pricing to balance supply and demand, and more responsive operations; and
- Increased transparency, better decision making, and a more engaged citizenry.

people and goods within existing transportation facilities, and how to use a variety of shared modes to get around an area or region quickly. The region's transit system is a tremendous asset and serves as the backbone to this larger network. It provides a significant competitive advantage for the region, responds to concerns about climate change, and recognizes the role of space-efficient transportation in supporting more concentrated development patterns and agglomeration economies. This vision, is further illustrated in Figure 30.

Transportation networks have been key components of prosperous regions throughout history, and the efficient movement of people and goods locally, regionally, and internationally will continue to be a hallmark of thriving regions in the future. Greater Philadelphia enjoys a tremendous advantage by virtue of its location in the Northeast and Mid-Atlantic megaregions. However, the region must address several challenges to continue to take advantage of this locational benefit in the future. We need to make investments in new digital transportation technologies. At the same time, the region's 20th-century physical infrastructure of roads, bridges, and transit remains critical to our ability to travel about the region. These facilities are too often in poor condition. Much of the region's transportation infrastructure will need to be reconstructed and brought up to modern standards over the next several decades. In addition, the region needs to upgrade maritime ports and Philadelphia International Airport, and support FRA's NEC Future plan. These facilities serve as vital links to the nation and world in a global economy.

Given the limited funding available for building new facilities, the region's transportation agencies need to find ways to do more within existing constraints. Transportation Systems Management and Operations (TSMO) is one way in which the region is finding new

efficiencies. TSMO is the application of technology, robust planning, improved preparedness, and extensive inter- and intra-agency coordination. TSMO strategies can facilitate more reliable travel times for people and goods movement; provide a variety of transportation options and traveler information to meet diverse travel demands; and enhance transportation safety, security, and incident management (IM) for all modes. The I-76 Integrated Corridor Management project in Montgomery County is one example of a TSMO application. Another opportunity to increase efficiency is to increase vehicle occupancy. Every day a huge surplus of transportation supply is squandered because 85 percent of vehicles on the road contain only a single occupant. Many of the new TNCs and real-time information apps are actively seeking ways to capitalize on this opportunity.

During the visioning workshops that helped develop the Plan, the region's residents stated a desire for more walkable communities and noted that transportation is more about having choices in how to get around and less about vehicle ownership. The main tools to develop an integrated network are community and market design, along with applying new technologies. These tools are used in the Plan to classify the different strategy recommendations needed to achieve an integrated, multimodal transportation network.

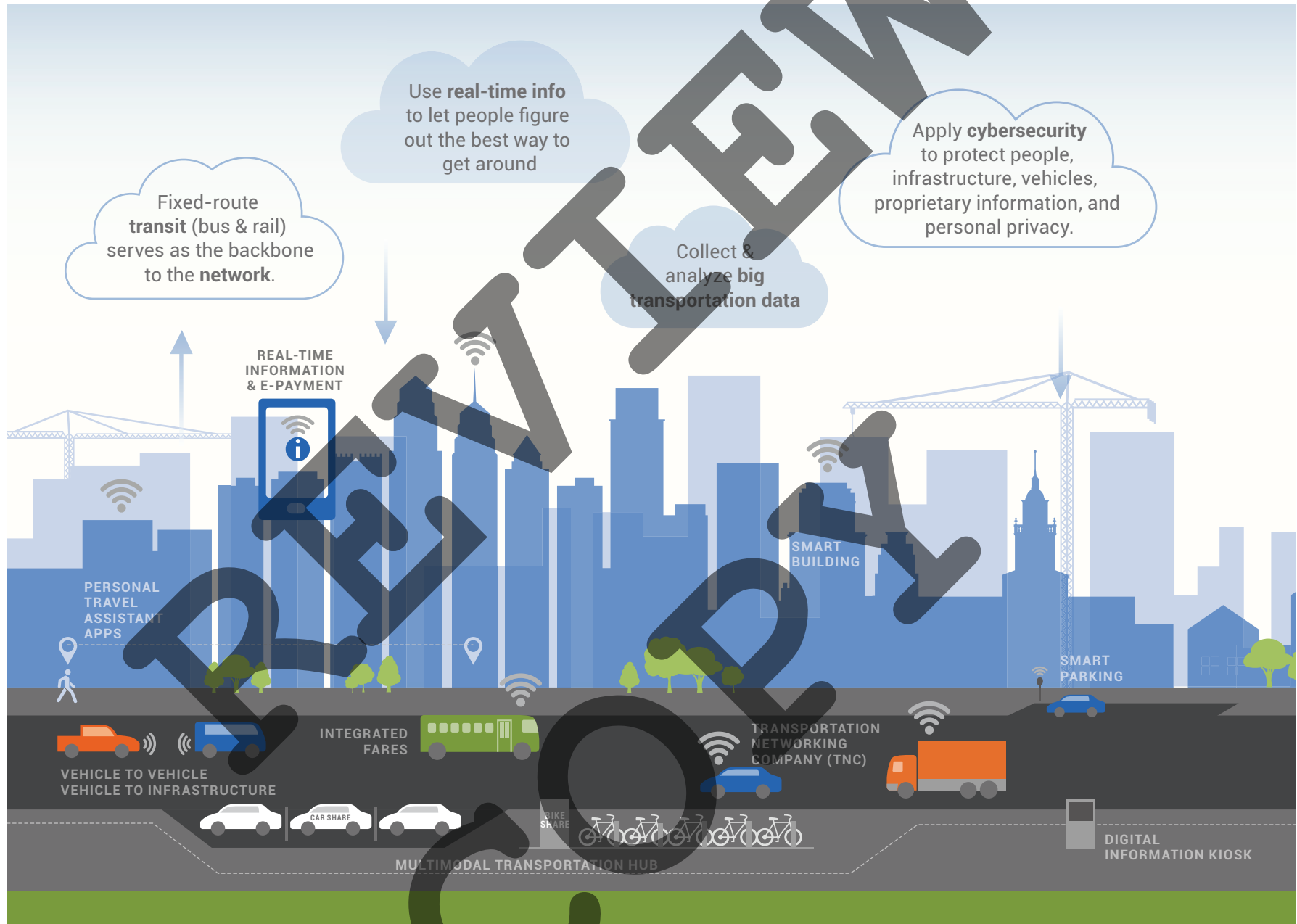
GOAL: INTEGRATE EXISTING AND NEW MODES INTO AN ACCESSIBLE MULTIMODAL NETWORK

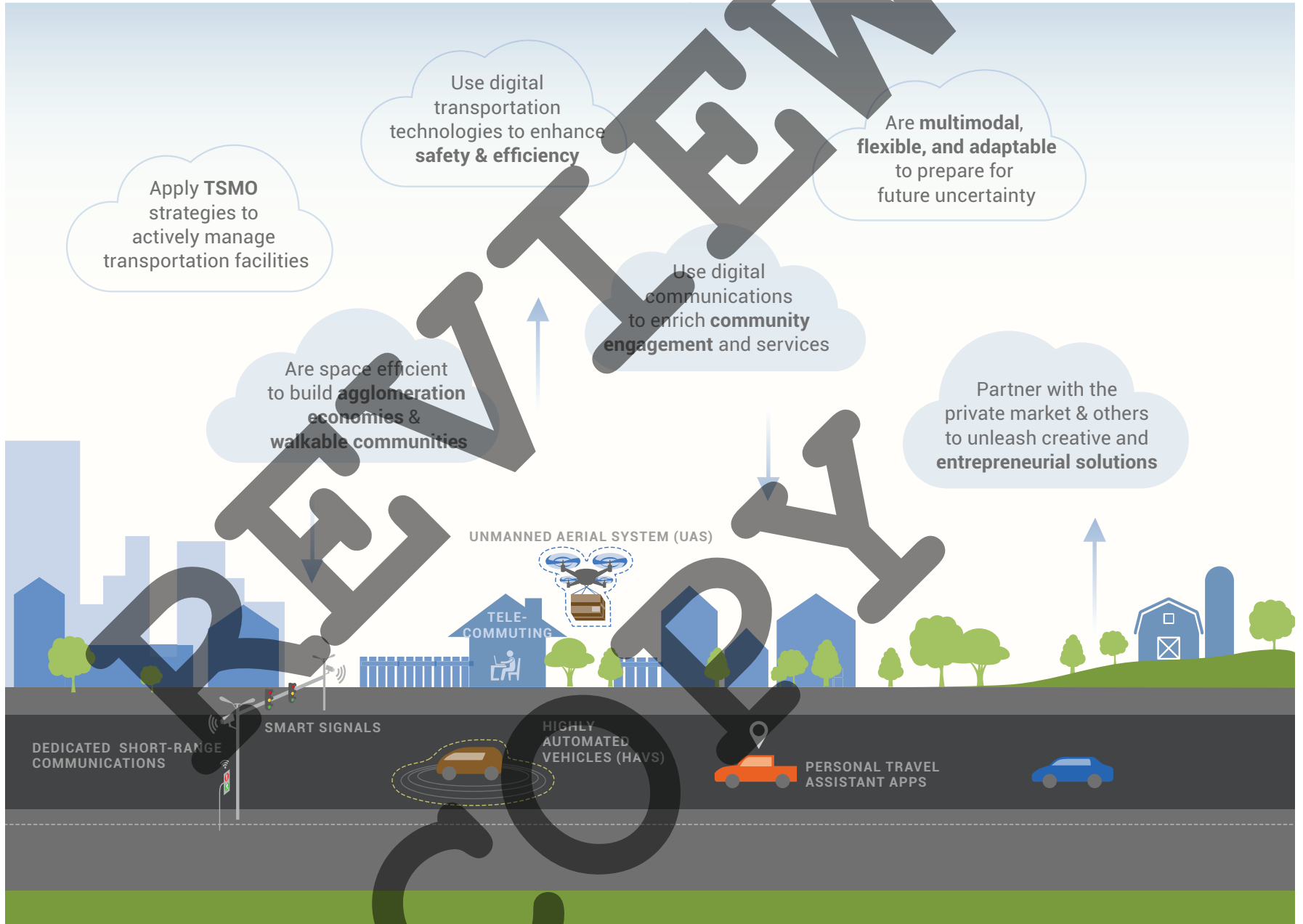
The region's transportation network is an ecosystem consisting of a variety of modes: walking, biking, bikesharing, transit, paratransit, intercity buses and rail, ridesourcing, microtransit, personal vehicles, freight, and aviation. Each of these modes must become more accessible, which is the ability to reach desired destinations

within the region. Seamless connections that enable easy transfer between modes are critical to promoting transit, biking, and walking, and to achieving a more sustainable future. Creating multimodal transportation hubs that combine a transit station with carsharing, bikesharing, and TNC and taxi pick-up and drop-off areas can enhance connections. Pick-up/drop-off areas will become more important than parking lots for accessing destinations, and transit stations will need to improve kiss-and-ride access.

Biking and **walking** are low impact, healthy, environmentally friendly, and sustainable modes of transportation that are accessible to a wide range of users for a variety of trip purposes. They are also increasing in popularity as a healthy alternative to driving, and these forms of transportation are ideal for a Centers-based development pattern. Improving safety, comfort, and connectivity for bicyclists and pedestrians is critical to this objective. A common transportation planning adage is that every trip is a pedestrian trip, since even trips by car will begin and end on foot. As a result, pedestrian planning and the consideration of pedestrian needs are integral elements of nearly all regional planning activities. More short trips in the region could be made by bicycle if safer and more comfortable accommodations were provided. Context-sensitive bicycle and pedestrian accommodations should be pursued throughout the region as part of a Complete Streets policy framework. Complete Streets are those that accommodate pedestrians, bicyclists, transit, freight vehicles, and cars, and allow us to maximize regional transportation choices and mobility. Continued investments in the Circuit regional trail network will enhance walking and biking, as well as community livability.

FIGURE 30: AN INTEGRATED, MULTIMODAL TRANSPORTATION NETWORK



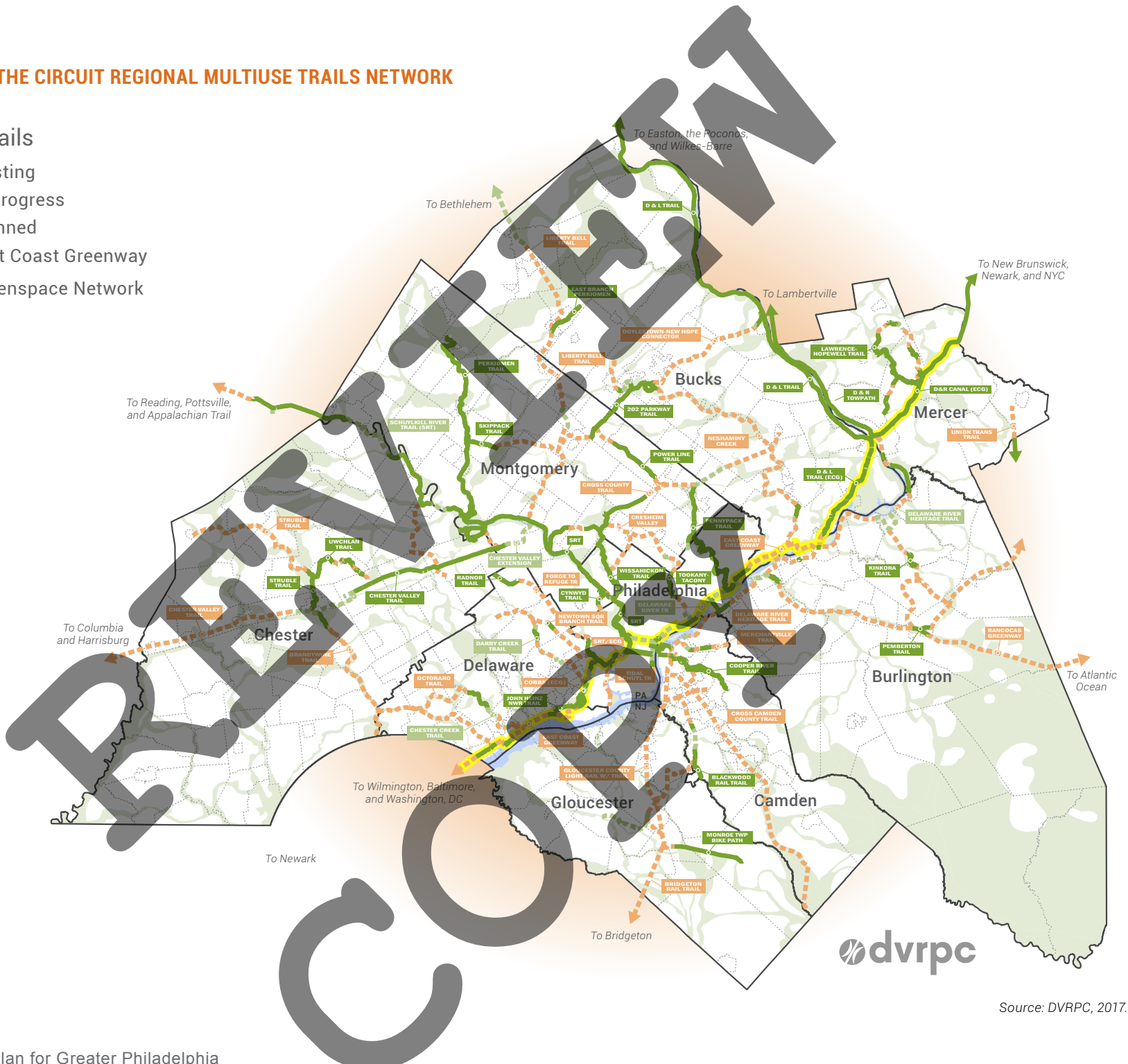


Source: DVRPC, 2017.

FIGURE 31: THE CIRCUIT REGIONAL MULTIUSE TRAILS NETWORK

Circuit Trails

- Existing
- - - In Progress
- - - Planned
- East Coast Greenway
- Greenspace Network



Source: DVRPC, 2017.

The Circuit Coalition is a collaboration of more than 65 nonprofit organizations, foundations, local governments, and agencies working to complete a connected network of multiuse trails—the Circuit Trails—across the Greater Philadelphia region. Today, 320 miles of the 775-mile trail network are complete, with an additional 65 miles expected to be constructed over the next five years. The Circuit Coalition has a goal of completing 500 miles of trails by 2025. When fully constructed, the Circuit Trails will be a network unlike any other in the country—connecting urban, suburban, and rural communities with dedicated nonmotorized rights-of-ways separated from vehicular traffic. The Circuit trails are connected to a larger system of local trails.

Utilizing a unique partnership of private foundations, county governments, state agencies, and the Pennsylvania and New Jersey DOTs, the region is actively leveraging tens of millions of dollars to build these significant pieces of transportation infrastructure. The Circuit will make our region stronger by providing a place for healthy transportation and recreation, connecting our communities to green space, and making our neighborhoods more attractive places to live and work.

Achieving a more walkable and bikeable Greater Philadelphia requires improvements in infrastructure and changes in policy that facilitate greater local mobility and regional access. These policies include an emphasis on bicycle- and pedestrian-friendly engineering solutions, more focused enforcement of bicycle and pedestrian safety, and the provision of educational programs for cyclists, pedestrians, and drivers.

Our robust **public transit** system in Greater Philadelphia represents a significant competitive advantage at a time when mixed-use, transit-served Centers are also places of increasing value and economic

success. However, the challenge of maintaining our inherited transit infrastructure makes it hard to adapt to new service needs and opportunities. The existing system has a large backlog of SGR needs. As a result, riding transit is not always as easy, reliable, seamless, and accessible as it could be. DVRPC works with our partner transit agencies to think about transit system improvements, operations, expansion, access, and TOD priorities in a coordinated way.

Various new digital **shared mobility** services, such as bikesharing, carsharing, courier networking services, ridesharing, and TNCs (including microtransit, ridesourcing, and ridesplitting), along with traditional taxi services can help to fill gaps in the walking, biking, and transit systems. These services are providing new options in getting around the region, and are making it more feasible to live in a car-free or car-lite household.

GOAL: FACILITATE GOODS MOVEMENT AND AVIATION

Freight shipments and deliveries provide vivid evidence of the Greater Philadelphia region's vigorous economic activity and open trade with other regions, states, and countries. The movement of goods by trucks, trains, ships, and airplanes is enabled by an extraordinary multimodal freight network. Among the primary attributes of the nine-county Greater Philadelphia's freight transportation network are:

- 319 miles of the Primary Highway Freight System;
- 700 miles of rail lines that can be used to haul freight;
- 31 port terminals on the Delaware and Schuylkill rivers; and
- two commercial airports and 11 reliever airports.

The freight network serves local businesses and residents, and it may also be used as a platform to reach the 100 million people who live within 500 miles of the region. Greater Philadelphia has 67 identified “Freight Centers,” which are major focal points and trip generators. The Freight Centers are a testament to the broad range of manufacturing, warehousing, transportation, quarry, and utility activity that occurs locally. They also highlight the strong linkage between freight transportation and job retention and creation.

The growth in e-commerce, along with the flourishing of downtown areas throughout the region, has led to a significant increase in deliveries of goods to stores, homes, and offices. This important form of commerce must be integrated with street design and personal travel modes, such as bicycling, walking, and transit. Among the identified best practices are internal loading zones, off-hour deliveries, and alternate delivery sites.

Recent innovations in logistics and supply chains, such as containerization, just-in-time deliveries, and e-commerce have revolutionized and altered global shipping patterns. For example, just a few years ago, it would have been hard to imagine that shop owners and individual consumers would be able to place orders and initiate same-day deliveries with a simple click at a personal computer or a phone.

Major external projects also exert significant influences. For example, the extraction of Marcellus Shale natural gas is leading to the repurposing of idled refineries to process liquid products, and pipelines are being constructed to transport propane and ethane for processing and shipping from the port. Additionally, the expansion of the Panama Canal has helped drive the deepening of the main channel of the

Delaware River to 45 feet; the opening of a new general cargo marine terminal in Paulsboro, New Jersey; and major renovations to the Tioga and Packer Avenue marine terminals in search of new business and new markets.

Private sector freight activity is so important that DVRPC and many of its member governments are formulating plans and projects to better accommodate the unique needs of shippers, receivers, and carriers, and plan for the demands placed on transportation infrastructure due to goods movement. Goods movement planning includes promoting freight-as-a-good-neighbor strategies and fostering P3s to fund necessary projects. New analytic tools are also emerging, such as freight performance measurements. Among the region’s top objectives for utilizing and targeting traditional funding sources to integrate freight facilities and operations with community goals are:

- Maintain and enhance the newly designated National Highway Freight Network, made up of the Primary Highway Freight System and Critical Urban Freight Corridors.
- Monitor the availability and promote the adequate supply of overnight truck parking.
- Improve first-mile and last-mile connections (both highway and rail) to designated Freight Centers.
- Incorporate goods movement and delivery considerations within the design of Complete Streets.
- Enhance safety for pedestrians, rail operators, and motorists at

highway-railroad grade crossings (especially for the 29 grade crossings on the region's Interstate, Class I main lines).

- Provide additional capacity at rail freight bottlenecks, railyards, and rail lines shared with passenger rail operations.
- Promote the use and acquisition of vehicles and equipment throughout all freight modes that help achieve improved air quality.
- Assist partners with the pursuit of project funding through competitive grant programs (e.g., U.S. DOT's grant Infrastructure for Building America [INFRA] grant program and NJ DOT and PennDOT freight-eligible programs).

Aviation is a critical link in connecting the Greater Philadelphia region with the nation and world. The region's aviation system encompasses commercial, reliever, and general aviation airports, as well as three heliports, in the traditional nine-county DVRPC jurisdiction, as well as Salem County, New Jersey; New Castle County, Delaware; and Cecil County, Maryland. Having an accessible and efficient aviation system helps foster a high quality of life for residents, businesses, and visitors alike, allowing access to people and markets worldwide. PHL also plays a key role in regional goods movement, helping to move high-value and time-sensitive shipments, such as medicine.

PHL regularly ranks among the busiest airports nationwide by aircraft movements (takeoffs or landings). PHL produces \$15.4 billion in annual output within the 11-county Philadelphia metropolitan statistical area, supporting 96,300 jobs and \$4.8 billion in total earnings.³⁰ PHL's hub status means flights are abundant for business and leisure travelers, as

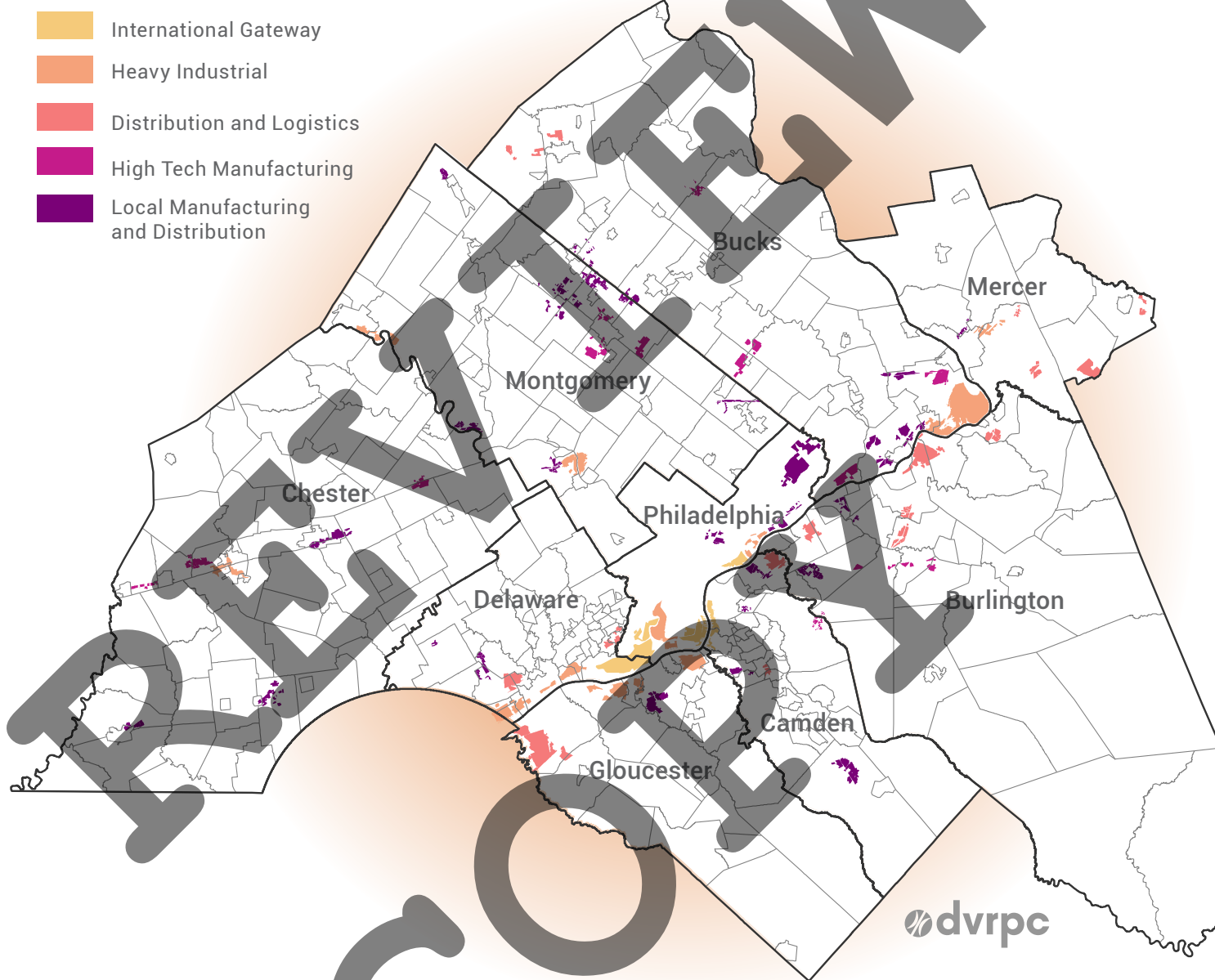
well as cargo needs. As commercial aviation continues to consolidate, it is economically vital for the region that PHL be maintained and expanded as a hub operation; for instance, by adding direct flights to emerging markets in Asia and Latin America. In addition to PHL, commercial service is once again available from Trenton/Mercer airport, providing a choice between two commercial airports in the region for travelers and airlines. Future plans at PHL include two runway extensions, a new front entrance to replace the terminals B and C ticketing areas, and other terminal infrastructure improvements. Growth at PHL not only creates jobs, but also contributes to the region's overall economic development by providing greater transportation and shipping services, which attract a diversity of industries.

In addition to the three commercial airports in the 12-county Aviation Planning region, the 10 reliever airports play a key role in the regional aviation system by providing access for business aircraft. These facilities allow for improved access to business centers throughout the area while freeing up capacity at commercial airports. Another 11 general aviation airports provide facilities for both business and recreational aircraft. The region is further complemented by three heliports, providing dedicated facilities for helicopter, or vertical flight (VF), needs, in addition to VF facilities at many airports. One airport is dedicated to military aircraft.

With the scarcity of undeveloped land in Greater Philadelphia, airports are often affected by competing land uses. Commercial airports may seek to expand into neighboring areas, while, conversely, new residential or commercial developments may encroach on existing reliever and

³⁰*Econsult Solutions, Regional Economic Impact of Philadelphia International Airport.*

FIGURE 32: FREIGHT CENTERS

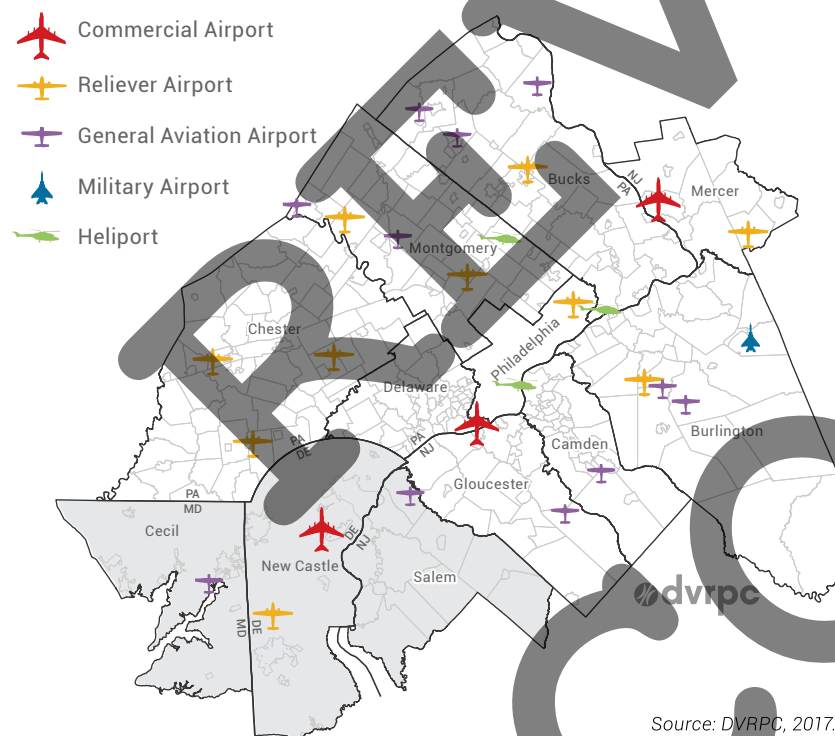


Source: DVRPC, 2017.

general aviation facilities. As the replacement cost and feasibility of building new airports is prohibitive, and available open land in the region is hard to find for future airports, preservation of these facilities is important for future aviation success in stimulating regional economic activity and relieving congestion at commercial airports.

Aviation planning has many challenges, including congestion, competing land uses, and economic uncertainty. The decisions made now in regard to aviation planning will be felt for many decades to come, so it is critical that the region work together to provide a comprehensive and effective plan. Greater Philadelphia's most recently

FIGURE 33: 12-COUNTY AVIATION PLANNING REGION



completed *Regional Airport System Plan* (2014) identified the following key recommendations for the region's extensive and complementary system of aviation facilities:

- Expand commercial air service within the region.
- Preserve public-use general aviation and reliever facilities.
- Sustain and improve infrastructure to attract more users.
- Improve community outreach to inform the public of the importance of airports to the local and regional economy.
- Improve efforts to attract students to careers in aviation fields.

GOAL: MOVE TOWARD ZERO TRANSPORTATION DEATHS

Traffic crashes are not accidents; they are preventable incidents that can be systematically eliminated. Vision Zero and Toward Zero Deaths are planning philosophies that aim to end fatal and serious injury crashes by protecting all roadway users through equitable engineering, education, and enforcement, while prioritizing speed control. Both New Jersey and Pennsylvania are Toward Zero Death states, and in 2016 Philadelphia became a Vision Zero city. In 2017, DVRPC's Regional Safety Task Force (RSTF) also adopted Vision Zero policy.

Created in collaboration with the RSTF, the region's data-driven *Transportation Safety Action Plan* (TSAP) focuses on key regional emphasis areas for reducing crashes, injuries, and fatalities on the roadways in Greater Philadelphia. It provides a roadmap for effective

collaboration and coordination among safety professionals and stakeholders to address various road-user issues, including: intersection safety, impaired driving, roadway departure crashes, and pedestrian and bicyclist safety. The TSAP is a living document that is coordinated with New Jersey's and Pennsylvania's statewide safety plans.

The goal of Moving Toward Zero Deaths is already an integral part of DVRPC's work. The TIP evaluation criteria use safety as the second most heavily weighted criteria to inform regional transportation investment decisions. Crash analyses using available crash data obtained from state partners are standard components in most of our intersection, corridor, and area studies.

The Strategic Highway Safety Plans of Pennsylvania and New Jersey seek to maximize funds from the federal Highway Safety Improvement Program (HSIP). DVRPC supports these efforts by facilitating coordination among county and municipal partners, state DOT's, and FHWA to bring data-driven safety improvements to both local and state roads. And because both states are FHWA Pedestrian and Bicyclist Safety Focus States, it remains a regional priority to expand pedestrian and bicyclist safety planning in an effort to help our partners identify eligible projects and secure HSIP funds.

FAST Act safety performance measures require MPOs and states to set safety targets and measure performance toward safety goals. DVRPC has collaborated with state and federal partners on target-setting and will support our partners by adopting both Pennsylvania's and New Jersey's targets. These data driven performance measures are a positive step forward in tracking progress and prioritizing safety.

GOAL: LIMIT TRANSPORTATION IMPACTS ON THE NATURAL ENVIRONMENT

Transportation has significant impacts on the natural environment. These include direct impacts from the construction and operation of transportation facilities, such as water pollution, increased rates and volumes of stormwater runoff, air pollution, greenhouse gas emissions, noise pollution, habitat fragmentation, and the creation of barriers to the movement of wildlife. Transportation systems also impact the natural environment indirectly: the construction and gradual expansion of highway capacity into less developed areas permits sprawling development patterns that convert natural areas, woodlands, and farms into residential and commercial development, further fragmenting and disrupting the balance of flora, fauna, soil, water, and air.

Strategies to address these problems are presented throughout this plan and include the use of green stormwater infrastructure to capture and cleanse rainfall runoff; enhanced culverts and bridges to facilitate the movement and passage of wildlife; incentives to increase the use of less polluting and non-motorized modes of transportation; and policies to limit the expansion of new capacity into rural areas while focusing new development in existing cities, towns, and villages. At the same time, DVRPC will work to identify and minimize conflicts between transportation projects and environmental resources during all phases of project development—from planning to TIP development and final design. In Pennsylvania, the PennDOT Connects process offers DVRPC and the region a ready-made pathway for expediting this type of coordination between planning and project implementation.

GOAL: REBUILD AND MAINTAIN THE REGION'S TRANSPORTATION INFRASTRUCTURE

Infrastructure is a critical platform upon which we build our communities and the economy. The region's 20th-century physical infrastructure of roads, bridges, and transit remains essential to our ability to travel about the region. These facilities are too often in a state of disrepair. Pennsylvania has the second highest number of structurally deficient state-maintained bridges in the nation, and 38 percent of the region's state-maintained lane miles of pavement are in poor condition. SEPTA has rail bridges that are a century old, substations and catenary from the 1930s, commuter trains from the 1970s, and trolleys from the early 1980s. Pavement distress continues to be a larger problem in New Jersey than in many other states and the U.S. as a whole. NJ TRANSIT, Amtrak, and freight rail operators also have older infrastructure that requires modernization. The rebuilding of existing roads, transit lines, and other transportation facilities is the priority for transportation investments moving forward at the national, state, and regional level. Rebuilding is an opportunity to digitize these facilities by incorporating technologies like DSRC, which can talk with CVs and infrastructure; connecting traffic signals to the Internet; and using sensors to track infrastructure condition and better time repairs.

We must continue to prioritize projects based on quantitative data to ensure that funds are spent efficiently and effectively. We must also plan for the future and preserve vital rights-of-way so that the system can expand when necessary.

GOAL: INCREASE MOBILITY AND RELIABILITY AND REDUCE CONGESTION

Mobility refers to the movement of people and goods. Mobility is increased when the transportation network is multimodal and provides connections between various modes. The ability to reach destinations throughout the region is a challenge for many members of society who do not have access to an automobile.

Roadways can only move so many vehicles within a given time period. When too many vehicles try to use a roadway at once, all of them are slowed down and congestion is the result. Congestion has a significant impact on a region's economic competitiveness since people and goods sitting in traffic equates to money lost. In 2015, the average auto commuter in the Greater Philadelphia region sat in traffic in excess of 48 hours due to congestion, which ranked 22nd nationally. This cost the average commuter more than \$1,100 in lost time and wasted fuel consumption. Reducing congestion has traditionally been accomplished by expanding capacity. Widening roads, however, leads to unintended consequences that promulgate auto-dependence and the need to build more roads. When roads are built for cars, they can become barriers to pedestrians and other modes. People and businesses locate farther and farther from regional core areas to avoid congestion. Parking lots become oversized, creating another barrier to alternative modes. Vehicle ownership rates increase as people have fewer options for how to get around. As development continues to spread out, the need for auto-oriented transportation is reinforced. Rather than solving problems as intended, building new and wider roads creates a rebound effect that actually makes congestion worse over time.

The same peak hours of travel generally occur every weekday, but on any given day unusual circumstances like crashes or weather can dramatically change the performance of the roadway. Travelers want consistency or dependability in travel times from one day to the next. This is referred to as *travel-time reliability*. Travel-time reliability is a measure of the variation in how long it takes to make the same trip from one day to another.

When your usual half-hour trip takes an hour and makes you late, it can be frustrating. Data collected by the FHWA indicates that nonrecurring congestion—which is caused by weather, crashes, construction, disabled vehicles, and special events—actually accounts for more hours of delay than the everyday (recurring) congestion that results from road capacity constraints and heavy volumes.

In addition to promoting transit, walking, and bicycling, the transportation network can be made more reliable by reducing demand through travel demand management (TDM) strategies. These strategies include carpool and vanpool programs, telecommuting, variable work hours, parking cash out, and other policies that provide alternatives to the single-occupant vehicle.

Congestion pricing uses economic principles to encourage more efficient use of transportation facilities. The cost to use the facility increases when demand is high during peak periods, which can help to balance supply of and demand for transportation infrastructure. This may be the most effective and efficient way to reduce congestion. New digital vehicle and infrastructure technologies make congestion pricing, and other alternative funding strategies, possible.

The federally required **Congestion Management Process (CMP)** advances the goals of the long-range plan and strengthens the

connection between the Plan and the TIP. The CMP's guiding principle is that transportation investments should support the land use goals and policies of the Plan. It identifies and prioritizes the region's congested corridors and multimodal design and technology strategies to mitigate congestion. Where additions to capacity are found to be appropriate, the CMP includes supplemental strategies to get the most long-term value from the project.

Regulations require projects that add single-occupancy vehicle capacity to be consistent with the CMP in order to be eligible for federal funding. The CMP defines procedures for all federally funded major capacity-adding road projects, whether in congested corridors or not. Additionally, the CMP provides information about the performance of the regional transportation system and identifies inexpensive strategies appropriate almost everywhere to minimize congestion and enhance the mobility of people and goods.

GOAL: BUILD PARTNERSHIPS AND ADAPT TO A CHANGING TRANSPORTATION MARKETPLACE

The Digital Revolution is generating new energy, entrepreneurship, and creativity to address transportation challenges. New digital shared services are expanding transportation options and mobility, particularly for less mobile populations, such as the young, the elderly, and individuals with disabilities. TNCs are offering new services and using "surge" or peak-period pricing to better manage supply and demand. Increased private market investment may come from new ways of doing business in the digital world. In a knowledge economy, data is currency.³¹ Companies

³¹*New Mobility (Toronto: WSP, August 2016 update) <http://www.wsp-pb.com/Globaln/WSPCanada/In%20the%20media/Project%20News/2016/16-08-31%20-%20New%20Mobility/WSP%20Metrolinx%20New%20Mobility%20Report%20July%202016.pdf>.*

may find ways to collect and monetize data to get a return on investment. The future of transportation generally portends the emergence of HAVs within a few years or over the course of the next several decades. While there is considerable uncertainty surrounding HAVs, there is much work that needs to be done in order to prepare for them. Some initial considerations in planning for HAVs, based on DVRPC's research and stakeholder dialogue, include:

- HAVs still have technological, legal, and administrative hurdles to overcome. It is not clear when they will be commercially available, where they are on the cost curve, or what their rate of uptake will be once they are on the market. Their land use, vehicle ownership, VMT, road capacity, crashes, pavement distress, and job implications are also unclear. See Table 8.

- ◆ Supporting regional Centers with denser land use patterns

and building agglomeration economies, consistent with the *Connections 2045 Plan*, should be the goal.

- ◆ There is no guarantee HAVs will be shared, though sharing should be the goal.
- ◆ While they may increase the capacity of existing facilities, the rebound effect suggests they would equally increase VMT. Particularly significant is the potential for zero-occupant vehicles to clog the road, increasing the need for road pricing.

- HAV infrastructure needs include pavement, road markings, signs, construction zones, TSMO, and updated design standards.

- ◆ Pavement must be smooth and well maintained as potholes and other bumps could cause equipment to become misaligned or malfunction.
- ◆ HAVs need well-maintained road markings for guidance.

TABLE 8: HAV UNCERTAINTY

COULD DECREASE DUE TO	IMPLICATION	COULD INCREASE DUE TO
Vehicle sharing, HAV availability, higher vehicle costs Lower in-vehicle travel time cost	Vehicle Ownership	Smaller, lighter-weight vehicles bring down cost
Vehicle sharing, denser development	Land Use Density	Network effects, shared & transit vehicles, less parking
Follows all road rules / defensive driving	VMT / Trips	Lower operating costs, zero-occupant trips, mode shift, expanded mobility for non-drivers
Machine precision	Road Capacity / Speed	Reduced headways, smoother traffic flow, shorter signal lag times, fewer crashes, and real-time route optimization
Low-emission vehicles, right-sized vehicles, eco-driving	Crashes	Hacking, human interactions
Vehicles avoid deficiencies, smoother traffic flow	Air and Noise Pollution	More travel, larger vehicles
AI (deep learning) displaces human workers	Pavement Distress	Platooning / closer vehicle spacing, increased VMT
	Jobs	Technology creates more new high-skill jobs than the lower-skill ones it disrupts

Source: DVRPC, 2017 adapted from Bryant Walker Smith, *How Governments Can Promote Automated Driving*, *New Mexico Law Review*, forthcoming, March 17, 2016, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2749375; and Johanna Zmud, Ginger Goodin, Maarit Moran, Nidhi Kalra, and Eric Thorn, *Advancing Automated and Connected Vehicles: Policy and Planning Strategies for State and Local Transportation Agencies*, National Cooperative Highway Research Program; Transportation Research Board, National Academies of Sciences, Engineering, and Medicine, 2017, <http://nap.edu/24872>.

- ◆ Signs need to be clear, readable, and standardized across the state or ideally the nation; and may require additional tree trimming to ensure visibility.
 - ◆ A database of all active construction zones will need to be created and updated to inform HAVs when and where the rules of the road have changed.
 - ◆ Roadway geometry design standards will likely be revised.
 - ◆ TSMO strategies are a first step toward automating roads.
 - ◆ HAVs are likely to be electric, increasing the need to build out EV infrastructure.
- Initial applications may be limited to geofenced areas where at least two of the following is in place: highly detailed digital maps, slow speeds, or good weather. There may be a long period where HAVs and human-driven vehicles share the road. Until HAVs are operating on their own infrastructure, society may not see significant safety, congestion, and other expected benefits. Achieving these sooner could require:
- ◆ Construction of new HAV-only facilities;
 - ◆ Conversion of existing facilities, or a proportion of existing facilities, to HAV-only; or
 - ◆ Banning human drivers.
- HAVs will make the system more complex and reliant on advanced communications networks, increasing the risk of system failures.
- The actual price to use shared HAVs is likely to vary based on supply and demand. Shared HAV fleets are unlikely to be sized to meet peak-hour demand, as this would be inefficient. This means the calculus of each trip that an individual takes could vary based on



Tim Chapin, Lindsay Stevens, and Jeremy Crute, 2017.

"The impacts of AVs on roadway design and functionality will be profound in the long run. Since driverless vehicles are expected to be smaller in size, drive more precisely than humans, and have the ability to travel in harmony and platoon, travel lanes will likely be narrowed. That would allow for smaller rights-of-way and different allocations of space along existing rights-of-way. Fewer overall vehicles, combined with AVs' ability to communicate with each other, could bring further efficiencies and more opportunities for reclaiming rights-of-way for other uses."

- Tim Chapin, Lindsay Stevens, and Jeremy Crute, "Here Come the Robot Cars," Planning Magazine, April 2017.

the available supply and demand for each mode and create price surges, leading to affordability and equity issues.

- A number of externalities in the existing transportation system could slow the deployment of CV and HAV technologies, which are widely expected to provide societal benefits for safety, the environment, health, and mobility for those that lack it. These include:
 - ◆ Congestion, where underpriced roads mean each vehicle entering a roadway operating at its capacity causes more delay to each driver using the facility;
 - ◆ Air and noise pollution, which could be reduced by new technologies but are not currently priced in the existing system;
 - ◆ Insurance, where personal vehicles do not pay full liability for crash costs; and human drivers regularly travel above the speed limit and travel through yellow and red lights, while CVs and HAVs are likely to be bound by all the rules of the road. This will potentially slow these vehicles down relative to human driven ones. Automated enforcement could help to level the playing field.
- HAVs may reduce the need for parking, particularly if they are shared. To encourage shared HAV fleets, communities can relax parking requirements in existing zoning codes and begin to identify reuse opportunities for existing parking facilities, such as pick-up and drop-off zones, transfer stations between modes, EV charging stations, wider sidewalks, green infrastructure, protected bike lanes, street furniture, or bus-only lanes.

HAVs increase uncertainty for long-range planning, travel demand models, and financial projections. Scenario planning is a tool for

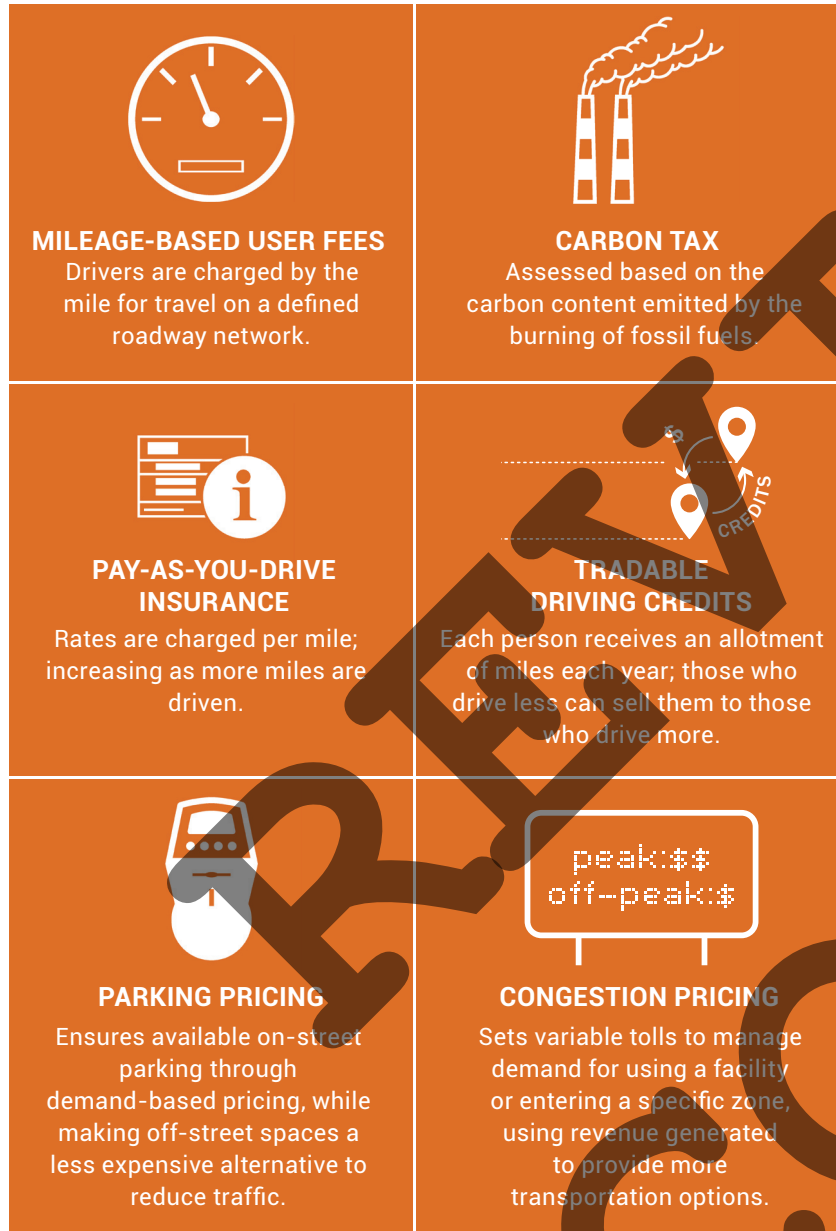
dealing with uncertainty and preparing for a range of plausible futures. HAV infrastructure needs and implications are likely to be better understood as the technology continues to develop.

New technologies and services allow traditional government and non-profit transportation partnerships to improve and refocus their efforts. Local governments must build partnerships with stakeholders and residents through open data, crowdsourcing, prototyping, and trials. These partnerships can help generate new community activities and ideas, tap into citizen knowledge and expertise, and enhance local government services.

As public funding for transportation infrastructure continues to stagnate, the private market seems poised to take more of a lead in developing the digital transportation infrastructure of the future. This may mean a new world of financing infrastructure, one that might rely more heavily on public-private partnerships. Partnerships between TNCs, transit agencies, and local governments have sought to improve transportation all over the country. These partnerships can help to grow services and promote more efficient transportation and car-free or car-lite lifestyles. For instance, paratransit services can partner with TNC app technologies, and provide an opportunity to vastly improve dial-a-ride programs for seniors and persons with disabilities. The existing programs often require individuals to make requests up to 24 hours in advance. Real-time, app-based technology can allow requests to be made as needed and reduce wait times and missed appointments.

There is a risk, however, that increasing private-market participation in the delivery of infrastructure and services can reduce the nature of transportation as a utility. Transportation is critical in our daily lives.

FIGURE 34: POTENTIAL TRANSPORTATION INFRASTRUCTURE MARKET FUNDING MECHANISMS



Source: DVRPC, 2017.

We use it to get to our jobs, our schools, doctors' appointments, the grocery store, and to visit friends and relatives. Transportation keeps the economy moving by conveying the goods and services we all produce and consume. In the past, when private railroad corporations controlled transportation, their power had a negative economic impact by reducing trade. As the modern transportation network was being built around new roads starting in the early 20th century, two major goals in setting up this new market was to ensure that everyone would have access and that trade would not be slowed. The tendency of network effects to generate monopolies over the long run should also be a concern. If a future world arises where transportation goes to the highest bidder, low-income individuals could be left behind and further isolated by reduced access.

A future where new services routinely enter and leave the transportation marketplace will stretch regulatory agencies' ability to keep up. Outdated regulations risk slowing innovation or failing to adequately protect service providers, users, and others. As new services emerge, regulations will need to be reviewed and possibly updated more frequently. Ultimately, there needs to be more discussion about the role for public and private investment in transportation infrastructure. If increasing public investment is desired, then a replacement for the gas tax will need to be identified. Digital technologies may make other best practices—such as pay-as-you-drive insurance policies, mileage-based user fees (MBUF), tolling, and congestion pricing—more feasible. Increasing private-market investment could come in different forms. Digitization offers the opportunity to readily charge vehicles by use, time-of-day, carbon emissions, or any other relevant factor. These new forms of charging can help the region to meet other goals, such as reducing congestion or limiting GHG emissions.

GOAL: CREATE A MORE SECURE TRANSPORTATION NETWORK

There has been an increased national focus on security since the events of September 11, 2001, which established a larger role for MPOs in this area. One goal of this effort is to explore ways that MPOs can play a part in security planning. DVRPC's primary role is facilitating the exchange of ideas and resource sharing to build upon existing programs to further security efforts in the region.

Cybersecurity is a new and growing need in transportation due to the increasing use of digitally connected and automated systems, along with mobile devices. Increasing data in the cloud, the IoT, mobile devices, wearable technologies, and CVs and AVs all create a variety of potential hosts and networks that cybercriminals can hack into.³² Protection of CVs and their users must incorporate up-to-date cybersecurity strategies. Currently, these include testing of security measures with crowdsourcing, improvement of mobile device protections, enterprise networks, placement of smart devices inside the IoT, user interface web protections, next-generation endpoint security, and cloud-based data security. Passenger and customer privacy must be protected by safeguarding sensitive data and reviewing and revising open-records statutes and policies to ensure personal data is kept private. The way traveler information is transferred to the public also needs to be safeguarded.

³²Abbas Mohaddes and Peter Sweatman, *Transformational Technologies in Transportation: State of the Activities* (Transportation Research Board, May 2016), <http://www.trb.org/Main/Blurbs/174370.aspx>.

GOAL: IMPROVE TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS

Approximately 60 percent of traffic congestion in major urban areas like Greater Philadelphia is due to temporary or nonrecurring conditions, such as disabled vehicles, traffic crashes, maintenance and construction activity, or adverse weather conditions. TSMO targets mitigating nonrecurring congestion and addresses the entire transportation network as a whole because it deals directly with the root causes of congestion and unreliable travel. TSMO programs are defined by the FHWA as "a set of integrated strategies to optimize the performance of operations on existing infrastructure through implementation of multimodal, cross-jurisdictional systems, services, and projects designed to preserve capacity and improve security, safety, and reliability of a transportation system." It optimizes the existing infrastructure, is complementary to many short- and long-range transportation strategies, and should be integrated to address current and future goals.

Benefits of TSMO programs have been widely documented. For example, deploying emergency service patrols on expressways in New Jersey yields a benefit-to-cost ratio of over 33:1 and results in reductions in incident duration, fewer secondary crashes, and saving millions of gallons of fuel. Improving traffic signal timings by installing adaptive traffic signal control technologies reduces travel times and delays by 10 to 50 percent, translating into a noticeable reduction in emissions of pollutants. Using automatic vehicle location systems on buses has improved on-time bus performance by 12 to 23 percent, thereby reducing passenger wait time at bus stops.

DVRPC's TSMO Plan was developed in cooperation with the TOTF, which is composed of traffic, transit, and emergency management operators in the region. The TSMO Plan contains three major operational policies: reliability, mobility, and safety and IM. Several basic tenets cut across them: viewing the transportation system as an integrated network, using technology to support TSMO strategies, the need to obtain accurate real-time transportation network status, the ability to share information among agencies and with the public, and having the appropriate resources available to respond to various situations.

DESIGN, MARKETS, AND TECHNOLOGY: KEY TOOLS FOR IMPROVING TRANSPORTATION

The strategy recommendations for improving Greater Philadelphia's transportation network are laid out under three different key tools: design, markets, and technology.

Design Strategies

How we lay out our neighborhoods and design our streets has major implications for how we get around. The region's Centers-based land use strategy is also a transportation strategy. By prioritizing investment in dense, mixed-use communities, the region can limit demand on the transportation network and reduce how much infrastructure is needed to meet travel needs while providing more options in moving about. Likewise, streets that are limited to a few narrow lanes, and incorporate bike lanes and sidewalks, can calm traffic and encourage alternative forms of transportation. This combination of Complete Streets with GSI can transform urban environments. It is imperative that the region's transportation network be both comprehensive in the modes it comprises and seamless in the connections between the various modes. This requires designing for space-efficient transportation

options, such as walking, biking, and transit trips; and centralizing major destinations within multimodal development Centers.

- Promote land use and development patterns that reduce the need for long trips.
 - ◆ Encourage investment in the region's Centers and older, developed areas.
 - ◆ Promote TOD and mixed-use development.
 - ◆ Reduce parking minimums.
 - ◆ Prioritize shared and transit vehicle parking over personally owned vehicles.
- Provide more options for transportation network users by developing safe, efficient, and multimodal street networks.
 - ◆ Context-sensitive solutions can help to distinguish between the design needs for high-mobility facilities, like limited access highways; and high-accessibility facilities, such as residential and main streets.
 - ◆ Develop Complete Streets to accommodate all modes and users, including space for goods delivery. Provide for safe-system accessibility for all segments of the population, including the young, elderly, and persons with disabilities; and increase affordable transportation alternatives.
 - ◆ Use traffic calming, roundabouts, and road diets to enhance safety and operations where appropriate.
 - ◆ Evaluate and pursue opportunities to reduce travel lane widths, where context and operations permit, in order to increase safety, calm traffic, and enhance walkability.
 - ◆ Comply with regulations and guidelines of the ADA and Title VI.
 - ◆ Build multimodal transportation hubs combining transit stations and stops with carsharing, bikesharing, and pick-up/

drop-off zones. Improve scheduling and operations to accommodate intermodal movements.

- ◆ Optimize efficiency through IM, access control, signal system improvements, and needed highway improvements.
 - ◆ Improve bicycle and pedestrian facilities, and increase transit coverage area, service hours, and the number of multimodal transportation centers. Establish pedestrian-only zones, protected bike lanes, and additional pedestrian and bike bridges or tunnels to provide safe crossings along rail ROW.
 - ◆ Develop multipurpose infrastructure that integrates water, waste, energy, communications, and other types of infrastructure to achieve greater efficiencies.
- Avoid and minimize impacts to sensitive environmental resources throughout project planning, design, and construction.
- ◆ Where impacts are unavoidable, work with federal and state resource agencies to assist in the identification of compensatory mitigation measures.
 - ◆ Incorporate green infrastructure into road construction, rehabilitation, and retrofit projects to capture and infiltrate stormwater.
 - ◆ Increase resilience of the transportation network and communication networks to infrastructure failure, floods, winter weather, and other extreme weather events.
- Consider safety in all projects.
- ◆ Seek funding for specific improvements to transportation infrastructure to increase safety.
 - ◆ Maintain a regional crash database and use it to identify high crash locations and develop safety enhancements.
 - ◆ Support appropriate enforcement to improve safety, including

building knowledge for applicable legislative initiatives, supporting relevant professional development for law enforcement staff, and educating members of the judicial branch of the consequences of frequently reducing charges.

- ◆ Promote and coordinate programs that educate about, and market, safety.
- ◆ Use traffic IM to:
 - Improve interagency communication and coordination.
 - Improve incident detection and verification.
 - Respond to and clear traffic incidents as quickly and safely as possible.
 - Reduce the number of overall major, secondary, and work-zone-related traffic incidents.
 - Reduce crashes at signalized intersections.

Market-Based Strategies

How states, regions, and municipalities address transportation marketplaces with rules, regulations, and taxes will have major implications on our region's ability to achieve the goals set in *Connections 2045*. Smart investments in transportation save time and money, improve the environment, and enhance the region's economy. Being competitive in the global economy requires well-maintained, safe, reliable, and space-efficient transportation infrastructure that promotes network effects and agglomeration economies.

- Use TDM strategies and pricing to balance the demand for and supply of transportation infrastructure.
- ◆ Support and enhance programs that reduce the number of vehicle trips and VMT, particularly single-occupant—and future zero-occupant—vehicle trips, and encourage practices that spread travel throughout the day and throughout the week.

- ◆ Change pricing structures and use sensors and real-time information to increase the use of off-street parking spaces and increase the availability of on-street spaces.
 - ◆ Use digital technologies and variable roadway pricing to reduce congestion and balance demand for road space with available supply.
- Increase travel-time reliability for all users.
 - ◆ Use ITS to enable TSMO strategies.
 - ◆ Prioritize systems that reduce delays through bottlenecks.
 - ◆ Enhance regional traffic signal coordination systems and support systems that respond to current conditions.
 - ◆ Implement and expand transportation systems that improve reliability for transit, pedestrians, bicycles, commercial vehicles, and the freight network.
 - Prepare for the increased provision of private-market shared mobility services.
 - ◆ Reduce barriers to entry and allow for the formation of new transportation services and innovation.
 - ◆ Provide public oversight of new shared mobility services in advance of regulations.
 - ◆ Encourage mobility-as-a-service multimodal travel pass or ticket options that combine different modes and services onto a single payment platform.
 - ◆ Revise zoning and regulations to offer density bonuses for developments that incorporate shared mobility infrastructure.
 - ◆ Avoid exclusive agreements with singular service providers.
 - ◆ Determine where technology and data sharing can complement customer protection regulations.
 - ◆ Clearly define the process for licensing and regulating new private-market transportation services.
- ◆ Review taxi regulations in light of the rules developed to govern TNCs.
 - Build partnerships with the private-market and nonprofits.
 - ◆ Incentivize the private sector, nonprofits, and P3s to speed up and incorporate new technologies into infrastructure development.
 - ◆ Seek mutually beneficial partnerships between local governments and transit agencies with TNCs and other digital transportation service providers.
 - Select projects for capital programming based on sound long-range strategic planning considerations, lifecycle investment analyses, and system performance and condition data.
 - ◆ Consider the land use impacts of transportation investments in the development of plans and programs.
 - ◆ Increase the level of investment in transportation facilities that promote freight movement and economic development.
 - ◆ Prepare a structured freight enhancement plan to identify and prioritize freight infrastructure investments, raise awareness of freight issues, manage delivery times, designate truck routes, and pay for freight improvements through market pricing, such as congestion pricing or loading zone fees.
 - ◆ Develop asset-management systems to select cost-effective capital projects, and devote sufficient resources to address reconstruction and maintenance needs.
 - ◆ Set goals and indicators to track performance and progress toward attaining them.
 - ◆ Conduct analysis and planning on a corridor-wide basis, rather than at a facility level, to expand the scope of potential

solutions, consider all modes, and choose the most efficient way to move people and goods on a case-by-case basis.

- ◆ Limit new capacity to appropriate areas, as identified in the CMP, and focus construction of new capacity on missing links and priority bottlenecks.
- ◆ Preserve existing rail and road right-of-way for future transportation uses.
- ◆ Modernize and speed up procurement. Digitization will require purchasing and maintaining new types of technology and may challenge traditional procurement practices.
- ◆ Undertake flexible, low-cost pilot projects to test ideas in advance of major capital expenditures.

Strategies to Incorporate New Technologies and Services

New technologies can be used to make existing facilities safer and more efficient, seamlessly connect different modes, and provide real-time travel information. Incorporating new technologies can enable easy accessibility and mobility within the region while also physically and virtually connecting it with major economic centers around the world. Policies and planning for new technologies, such as HAVs, should follow the goals and strategies in the *Connections 2045* Plan for land use, the environment, the economy, equity, and transportation. Although technology has done much to improve our living standards and well-being, technological solutions can create unanticipated problems. Increased efficiency generally generates higher total consumption of a good or service due to the rebound effect (also known as Jevons Paradox). For instance, imagine a future where HAVs have filled roads with zero-occupant vehicles. This is why it is important to approach challenges with a more holistic perspective using markets and design, along with technology.

- Connect modes to each other and the Internet.
 - ◆ Improve connections between modes, e.g., via standardized multimodal routing apps and digital payment systems.
 - ◆ Work with the private sector to build a regional “Mobility Internet.”
 - ◆ Integrate paratransit with new mobility options.
 - ◆ Use technologies and digital networks to improve the reach of emergency communications and create evacuation plans for larger numbers of carless households.
 - ◆ Identify best practices for digital infrastructure development and partnerships, and incorporate technologies through traffic signal upgrades and roadside warning devices.
 - ◆ Be flexible and avoid tech “lock-ins” that limit what can be done to respond to changing future conditions.
- Use TSMO strategies to improve the flow of people and goods.
 - ◆ Take an Integrated Corridor Management approach to manage traffic across multiple modes and jurisdictions.
 - ◆ Provide real-time traveler information across all modes and enhance regional multimodal trip planning tools.
 - ◆ Expand traffic surveillance and transportation network condition data collection capabilities.
 - ◆ Implement advanced integrated traffic and transit management systems.
 - ◆ Ensure public safety agencies have the necessary technologies to share interoperable voice, data, and video during an emergency to allow first responders to do their jobs safely and effectively.
- Make transit more competitive.
 - ◆ Pursue transit-first strategies, such as transit signal priority,

off-board fare payment, and dedicated bus lanes.

- ◆ Use Big Data, on-demand, and automated technologies to optimize bus routes to better meet demand by time and location.

■ Provide open access to data and use it to promote more efficient transportation.

- ◆ Adopt open data and open-source software policies.
- ◆ Create interdisciplinary regional or local data coordination teams, as well as agreements among private transportation operators that ensure transportation data is open and freely available while protecting competitive and proprietary information and personal privacy.
- ◆ Set goals and indicators to track performance and progress toward attaining them.
- ◆ Continue to monitor new technologies to gain knowledge and understanding of how they can be applied to improve the safety and efficiency of our transportation network.

■ Create a more secure transportation network.

- ◆ Elevate security in the planning process by considering regional transportation security in programs and projects.
- ◆ Conduct studies, analysis, and mapping to improve transportation security planning.
- ◆ Coordinate and cooperate with federal, state, local, and other agencies involved in regional resiliency, transportation security planning, emergency response, and recovery efforts.
- ◆ Implement up-to-date cybersecurity strategies to protect transportation infrastructure and personal privacy.
- ◆ Regularly take inventory of all technology assets, assess their vulnerability, identify clear end-of-life dates or supported notes for devices, and work with vendors to understand risks

and potential responses included in their services.

- ◆ Appoint a digital risk officer, especially as more transportation activity moves to the Internet.

■ Prepare for CVs, EVs, HAVs, and UASs.

- ◆ Governments should appoint an HAV point-person, develop technological expertise, and perform a legal audit for regulations covering all vehicle types and transportation services.
- ◆ Develop an HAV action plan.
- ◆ Improve pavement condition and enhance management systems for maintenance of signs and lane markings, as well as timing and location for road construction activities.
- ◆ Have CVs relay the type, severity, and location of damage to a vehicle to more effectively alert first responders what equipment and personnel is needed to contain and clear incidents.
- ◆ Transmit road weather conditions, lane closures, incident scenes, and work zone information to vehicle interfaces
- ◆ Ensure federal and state HAV regulations reflect and respond to specific needs of dense, urban areas.
- ◆ Improve EV charging infrastructure availability and allow drivers to easily locate them.
- ◆ Review comprehensive plans, infrastructure projects, zoning and building codes, and budgets to account for potential HAV impacts.
- ◆ Track level of automation in vehicle registration databases.
- ◆ Coordinate with state DOTs and FHWA on implementing DSRC.
- ◆ Reduce speed limits and implement traffic calming.
- ◆ Implement advanced integrated traffic and transit management systems.

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4. TRANSPORTATION INVESTMENTS

The vision for the future is to achieve and maintain an SGR for all existing transportation infrastructure, integrating modes and improving the safety and efficiency of the network—through design, markets, and technology—while making it more connected and multimodal. To achieve this vision, we will need to make the choices that support it through the investments identified in the long-range financial plan.

Connections 2045 outlines a strategy for how Greater Philadelphia will make capital investments in transportation infrastructure to help achieve the Plan's vision over the next 28 years. DVRPC worked with PennDOT, NJ DOT, SEPTA, NJ TRANSIT, the Delaware River Port Authority (DRPA)/PATCO, county and municipal government partners, and other regional stakeholders to determine what investments need to be made over the life of The Plan. A Long-Range Plan Working Group, comprised of members from DVRPC's Regional Technical Committee, was highly involved in the development of the financial plan.

The financial plan consists of five steps:

- assessing transportation infrastructure needs;
- forecasting revenue;
- allocating forecasted revenue to project types;
- evaluating and selecting Major Regional Projects; and
- identifying options to close the funding gap.

At the heart of this exercise is an in-depth needs assessment that utilizes asset management systems, which collect detailed data and monitor the various components of the network to identify maintenance and replacement needs for existing infrastructure. The needs assessment identifies what is required to bring the existing roadway and transit systems to an SGR. This is the first step in creating the Vision Plan for transportation infrastructure. In addition to the needs assessment, the Vision Plan identifies operational improvements and system expansion projects that are necessary for the region to continue to grow and prosper in the future. The financial plan then prioritizes projects for funding by developing forecasts of reasonably anticipated revenue, allocating the revenue to project categories based on need and policy, and evaluating and selecting specific major regionally significant projects for funding in the Plan. The reality is that we cannot

afford all of the identified needs. Therefore, *Connections 2045* outlines a Vision Plan and then identifies a fiscally constrained plan (Funded Plan) of projects that can be achieved over the life of the Plan.

Federal regulations require that MPOs, such as DVPRC, develop a regional long-range transportation plan with a fiscally constrained financial plan covering a minimum 20-year planning horizon. Fiscal constraint means that total transportation expenditures identified in a long-range plan must not exceed the total revenues reasonably expected to be available for the region over the life of the Plan, and over each individual funding period in the Plan. All revenues and project funding categories' needs are presented in year-of-expenditure (Y-O-E) dollars, which account for the impact of inflation over time. *Connections 2045* forecasts a 3 percent annual inflation rate over the life of the Plan.

The TIP is a short-term implementation program of capital improvements that are drawn from and consistent with the DVRPC long-range plan. The TIP is multimodal in nature and includes bridge, roadway, bicycle, pedestrian, freight, operational, public transit station, vehicle, equipment, and SGR projects of all sizes and scopes. Required by federal law to cover a four-year time period, the TIP represents the transportation improvement funding priorities of the region and lists all projects that intend to use federal funds, along with state-funded capital projects. Anticipated costs and schedules by phase are indicated for every project in the TIP. Project phases may include preliminary engineering, final design, ROW acquisition, utility clearance, and construction for highway-funded projects and purchase, capital, operating, or debt service phases for public transit projects. The list of projects in the TIP must be financially constrained to the amount of funds that are reasonably expected to be available.

There are four separate financial plans, one roadway and one transit, for each of the Pennsylvania and New Jersey subregions. Each contains four funding periods that align with both the 2017 Pennsylvania and 2018 New Jersey TIPs. In Pennsylvania, the first funding period will comprise years two to six of the 2017 TIP. The second period will round out the statewide 12-year plan. In New Jersey, the first funding period matches up with the first four years of the 2018 New Jersey TIP. The second funding period corresponds with the remainder of the 10-year plan.

TABLE 9: *Connections 2045* FUNDING PERIODS

FUNDING PERIOD	PENNSYLVANIA	NEW JERSEY
1	2018–2022	2018–2021
2	2023–2028	2022–2027
3	2029–2035	2028–2035
4	2036–2045	2036–2045

Source: DVRPC, 2017.

ASSESSING FUTURE NEEDS

The Vision Plan determined the projects that are necessary to achieve the goals outlined in *Connections 2045*. Detailed documentation on the Vision Plan and the needs assessment is found in Appendix D. The *Connections 2045* financial plan analysis uses asset management systems data developed by PennDOT, NJ DOT, and SEPTA. The Fixing America's Surface Transportation Act (FAST Act) continues the directions given to MPOs in the Moving Ahead for Progress in the 21st Century Act (MAP-21) to be more proactive in identifying asset

management needs, and DVRPC continues to improve its efforts in quantifying system preservation needs over the life of a long-range plan. The Plan is based on the best data and methodology available to date, and DVRPC will continue to partner and work with the DOTs and transit agencies to improve this analysis in the future. Roadway, bike and pedestrian, and transit investments are grouped into the following categories:

Roadway System Preservation maintains existing roadway pavement and bridge infrastructure. Needs estimates for these categories were developed using the federally required Pavement Management System and Bridge Management System databases, which track the condition of each roadway lane mile and bridge. DVRPC used historic data from these management systems to estimate future rates of decline. This estimate also includes what DVRPC forecasts as the needs for county and local roadways and bridges eligible for federal aid.

Roadway Operational Improvements use physical changes or technology to improve the efficiency of the existing system. Physical improvements include roundabouts, new turn lanes, and roadway realignment to improve the functionality and safety of the roadway system. Technological improvements include the use of ITS, incident management programs, traffic signal upgrades, and connected vehicle and infrastructure technologies. The region's 2017 TSMO Plan is the basis for the needs assessment for this category. ITS and incident management programs have capital funding components but also have substantial maintenance (e.g., hardware and software) and operations (e.g., personnel) costs associated with them. These costs are considered in the operations Needs Assessment in Appendix D.

Bike and Pedestrian needs are reflected in the region's desire to build more bikeable and walkable communities and to develop more space-efficient transportation options. On-road needs are based on increasing existing sidewalk locations by 50 percent and tripling the number of bike lanes in the region. Off-road needs are based on constructing all unbuilt, multiuse trails in The Circuit regional trail network, along with some other multiuse trails that are not a part of The Circuit.

Roadway System Expansion projects add capacity to the roadway system by widening or extending existing facilities, or building new roads or interchanges. These projects have a significant impact on regional travel, and most projects in this category are listed in the Plan as Major Regional Projects. Minor new capacity projects are widenings of generally less than three lane miles in length on minor arterial, collector, or local roads. The need for Major Regional Projects was based on the projects included in the previous *Connections 2040* Plan, a review of recent transportation and corridor studies, and a call for projects from planning partners. All roadway system expansion projects are required to be consistent with the region's CMP and are evaluated to be consistent with land use, environmental, economic development, environmental justice, and transportation goals.

Roadway Other includes needs for miscellaneous items, such as parking facilities, drainage, environmental mitigation, Transportation Management Associations (TMAs), engineering, regional and local planning, and debt service. These needs are forecasted using projects and costs that are included in the current TIPs for Pennsylvania and New Jersey.

Transit System Preservation represents needs for existing rail infrastructure, vehicle fleets, and stations. Regular vehicle track, signal, catenary, power substations, signals, vehicle overhaul and replacement, station renovations, and ADA accessibility needs were used to develop the need for each of these three categories using asset management data.

Transit Operational Improvements reflect the need to improve the functionality of the existing system. Types of projects include real-time information systems, signal preemption, fare modernization, and double tracking and sidings to improve service frequency. The estimated needs were developed by DVRPC working with regional transit agencies.

TABLE 10: TOTAL TRANSPORTATION VISION PLAN (2018–2045, IN BILLIONS OF Y-O-E \$)

MODE	PROJECT CATEGORY	PENNSYLVANIA	NEW JERSEY
Roadway	System Preservation	\$ 19.0 B	\$ 7.8 B
	- Pavement Preservation	\$ 23.6 B	\$ 3.5 B
	- Bridge Preservation		
	Operational Improvements	\$ 8.2 B	\$ 3.8 B
	Bicycle and Pedestrian	\$ 3.4 B	\$ 1.5 B
	System Expansion	\$ 1.8 B	\$ 0.6 B
	Other	\$ 0.7 B	\$ 0.7 B
Roadway Subtotal		\$ 56.6 B	\$ 17.8 B
Transit	System Preservation	\$ 9.1 B	\$ 1.0 B
	- Rail Infrastructure	\$ 12.9 B	\$ 4.9 B
	- Vehicles	\$ 3.8 B	\$ 0.6 B
	- Station Enhancements		
	Operational Improvements	\$ 4.5 B	\$ 0.5 B
	System Expansion	\$ 8.7 B	\$ 3.8 B
	Other	\$ 4.7 B	\$ 1.3 B
Transit Subtotal		\$ 43.7 B	\$ 12.0 B
Region Total		\$ 100.3 B	\$ 29.9 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

Transit System Expansion identifies new transit facilities, routes, and lines that the region would like to pursue. Need for this category is based on a short list of projects developed by the Long-Range Plan Working Group and includes projects listed in the Plan and recent transit expansion project studies conducted by DVRPC and other entities.

Transit Other is a miscellaneous category that includes safety, security, coordinated human services, trackage fees paid by regional transit agencies to Amtrak, federal operating funds, and debt service. Need for this category is estimated by remaining debt obligation payments and accounting for outlays over the life of the Plan based on current and future expenditures.

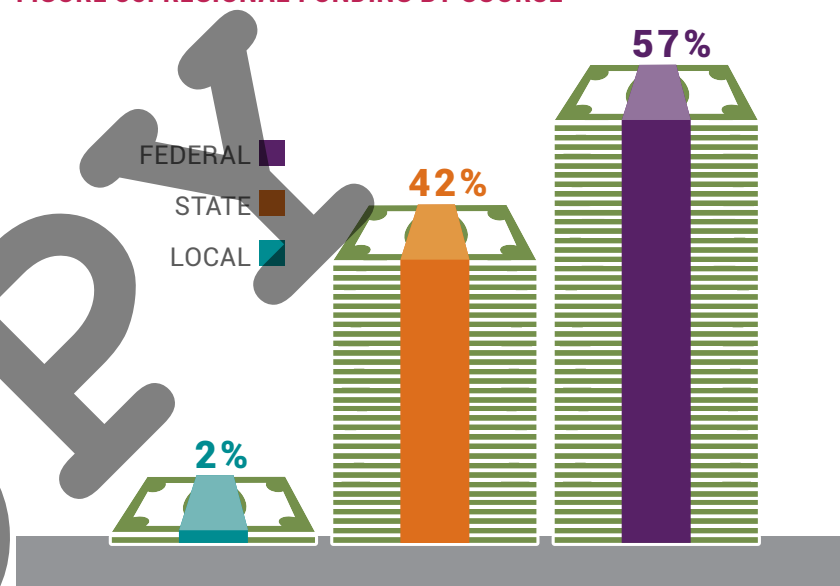
Regionally, the Vision Plan identified approximately \$130 billion in transportation improvements, predominantly to preserve and maintain our existing system. These needs represent the region's desired investments, or the Vision Plan.

The infrastructure in the Pennsylvania subregion is generally older and more expansive, and this is reflected in the total estimated need for the subregion. In Pennsylvania, there is an estimated \$56.6 billion in roadway need, and more than \$43.7 billion in transit need, over the life of the Plan. Total roadway need for the New Jersey subregion is estimated to be nearly \$18 billion, and total transit need for the New Jersey subregion over the life of *Connections 2045* is estimated to be greater than \$12 billion. These figures are in Y-O-E dollars to account for the impact of inflation over time.

PROJECTING FUTURE REVENUES

DVRPC identified all federal, state, and local revenue sources that the region can reasonably expect to receive through the year 2045. Revenue estimates are for capital project expenditures. Preparation of this financial plan revenue estimate included a review of historical data and trends. All planning principles and financial assumptions in identifying federal and state financial resources and investment needs are developed with and reviewed by federal, state, and transit partners. The Plan anticipates \$65.3 billion Y-O-E dollars in total federal, state, and local funding from 2018 to 2045. Detailed assumptions that went into the revenue forecast can be found in Appendix C. This does not account for add-on funds such as TIGER, New Starts, or casino revenues.

FIGURE 35: REGIONAL FUNDING BY SOURCE



Source: DVRPC, 2017.

TABLE 11: FUNDING BY SOURCE AND MODE (2018–2045, IN BILLIONS OF Y-O-E \$)

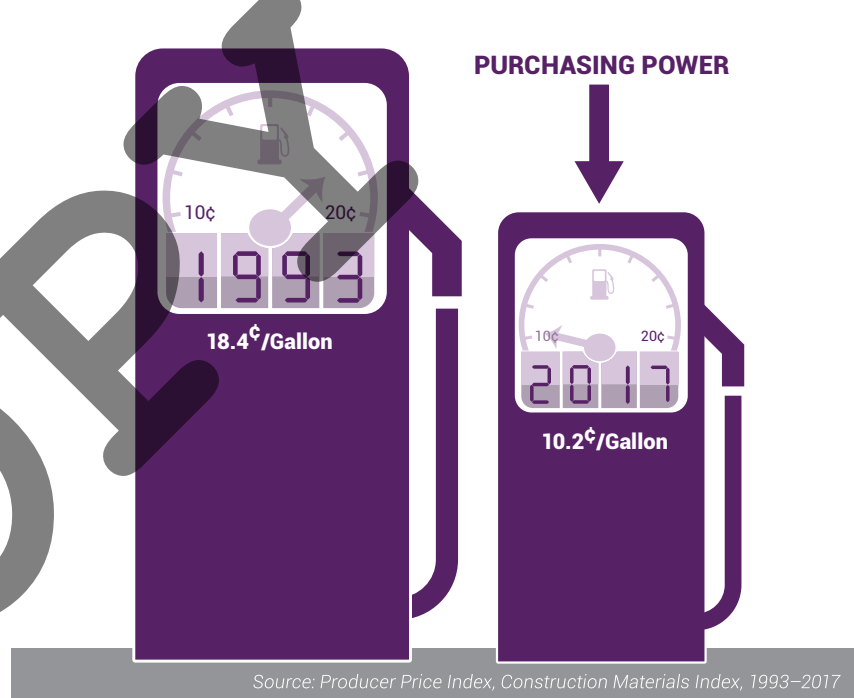
STATE	MODE	FEDERAL	STATE	LOCAL	TOTAL
Pennsylvania	Highway	\$ 17.5 B	\$ 6.8 B	\$ 0.3 B	\$ 24.7 B
	Transit	\$ 9.1 B	\$ 9.9 B	\$ 0.6 B	\$ 19.7 B
	Subtotal	\$ 26.6 B	\$ 16.7 B	\$ 0.9 B	\$ 44.4 B
New Jersey	Highway	\$ 7.8 B	\$ 5.9 B	\$ 0.0 B	\$ 13.7 B
	Transit	\$ 2.5 B	\$ 4.5 B	\$ 0.1 B	\$ 7.2 B
	Subtotal	\$ 10.3 B	\$ 10.4 B	\$ 0.1 B	\$ 20.9 B
Region Total		\$ 37.0 B	\$ 27.2 B	\$ 1.0 B	\$ 65.3 B

Source: DVRPC, 2017.

FEDERAL FUNDING

Federal funding includes the federal Highway and Transit Trust Funds, which are primarily funded through gas tax receipts and are the region's largest funding source, accounting for approximately 57 percent of forecasted revenue. The federal gas tax of 18.4 cents per gallon has not been increased since 1993. Meanwhile, the FAST Act transfers \$52 billion from the General Fund to the Highway Trust Fund and \$18 billion to the Transit Trust Fund to keep both solvent through the year 2020. Since 2008, the Highway and Transit Trust Fund accounts have required \$143 billion in general fund infusions to meet authorized funding levels. The Congressional Budget Office (CBO) estimates \$139 billion will be required to maintain current spending levels between 2020, when the FAST Act expires, and 2027, the last year in the most recent CBO projection. More fuel-efficient and alternative-fuel vehicles and a slight decrease in total driving since the economic recession have meant flat gas tax revenue collection. Inflation since the last gas tax increase has eaten away 45 percent of its purchasing power.

FIGURE 36: THE EFFECT OF INFLATION ON THE FEDERAL GAS TAX



Source: Producer Price Index, Construction Materials Index, 1993–2017

Connections 2045 assumes federal funding will remain flat through the year 2029. After that time, it assumes a growth rate of 3 percent per year compounded annually from 2029 to 2045, based on an eventual need to shift to a new paradigm for federal transportation funding.

STATE FUNDING

State funding is the second largest source of funding for transportation projects. The states contribute 42 percent of total regional funding (Pennsylvania contributes 26 percent and New Jersey 16 percent of total anticipated funding) in *Connections 2045*.

Pennsylvania's Act 89 of 2013 is now fully implemented and is generating billions in additional transportation revenue each year. It rescinded the state retail tax of 12 cents per gallon on gasoline and diesel fuels, removed the \$1.25 cap on the wholesale gas tax over a five-year period, and increased fees on vehicle registrations, driver's licenses, traffic violations, and permits. This act is advancing many transportation projects throughout the commonwealth.

In 2016, New Jersey also passed legislation to increase state transportation funding through its Transportation Trust Fund (TTF). The combined Motor Fuels/Petroleum Products Gross Receipts Tax rate at the consumer level increased from 14.5 to 37.1 cents per gallon of tax imposed. Thanks to the Public Question 2 Amendment Referendum, voted on in November 2016, these receipts are now constitutionally dedicated to the TTF. Passage of Question 2 also enables the state to

authorize up to \$12 billion in bonds to fund transportation projects. This legislation increases annual spending on New Jersey's road, bridge, and rail infrastructure by \$400 million annually. It also plans to double transportation aid for municipalities and counties, fund light-rail expansion projects in both North and South Jersey, and upgrade New Jersey's freight-rail infrastructure.

Financial guidance from PennDOT and NJ DOT assumes flat funding in both states through 2045.

LOCAL FUNDING

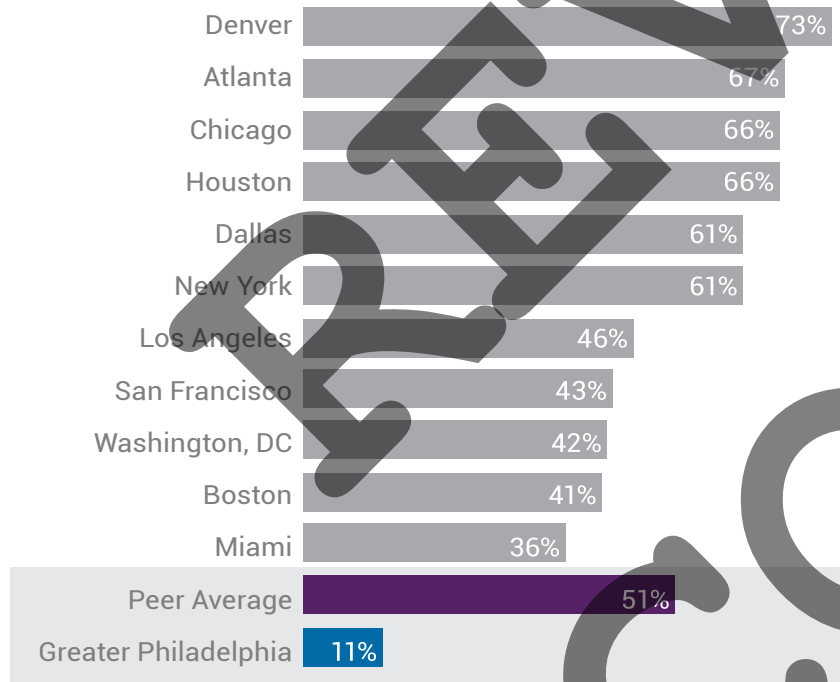
Local funding is the source of just 2 percent of the reasonably anticipated funds documented in *Connections 2045*. Many regions around the country contribute a significant amount in local funding toward transportation projects. Local transportation funding generally comprises revenues derived within the jurisdiction, such as a dedicated sales tax or dedicated bonds. Due to its flexibility, local funding is critical to making multimodal investments and improvements to transportation networks. The Greater Philadelphia region provides very little transportation funding from local sources, compared to peer regions around the country. For example, over the past decade, Greater Philadelphia has generated just 11 percent of transit capital expenditures locally, while 11 peer regions (the other nine largest in the United States, plus San Francisco and Denver) have collectively generated 51 percent of their transit capital funds locally; see Figure 37.³³ If federal funding decreases in the future, regions

³³This figure uses National Transit Database (NTD) definitions for state and local funding sources. Whereas Act 44 Pennsylvania Turnpike payments into the Motor License Fund are considered state funding in the Plan in Figure 35 and TIP, NTD defines it as local funding. Similar discrepancies apply in New Jersey, where Turnpike and Port Authority funds that were planned for the Access to the Region's Core project were instead transferred into the Transportation Trust Fund. No changes have been made to the NTD definitions for consistent comparison across regions; however, this creates a difference between the local funding projection in the Plan and what is shown in Figure 37.

with a strong dedicated local source of transportation funding will be more competitive by better maintaining their network and promoting economic growth.

Act 89 increases state funding allocations to local projects in Pennsylvania by 60 percent, about \$220 million per year. It provides state funds for better timing of local traffic signals; increases the prevailing wage law threshold to projects costing more than \$100,000; allows for local match savings by participating in PennDOT's bridge bundling program; and waives local match requirements for some transit capital investment projects. Higher levels of investment in state

FIGURE 37: PERCENTAGE OF TRANSIT CAPITAL FUNDING FROM LOCAL SOURCES, 10-YEAR AVERAGE (2006–2015)



Source: National Transit Database, 2006–2015.

projects are likely to increase the need for local match funds. To offset this need, Act 89 allows counties to place a \$5 annual surcharge on vehicle registration fees. Bucks, Chester, Montgomery, and Philadelphia counties have all enacted this county vehicle registration surcharge to help fund local transportation infrastructure repairs.

New Jersey does not grant authority to raise transportation revenues at the regional or local level. Limited or no local funding options in the region mean that local matches for state-maintained facilities must largely come from municipal or county general funds. Not only do transportation projects have to compete with many other municipal budget needs, but state-maintained facilities also have to compete with all the locally maintained roads and bridges that municipalities and counties manage. These local facilities are often in worse condition than state roads and bridges.

AUTHORITY AND OTHER FUNDING

There are several transportation authorities in the region, such as the Pennsylvania and New Jersey turnpike authorities, Delaware River Joint Toll Bridge Authority (DRJTBA), South Jersey Transportation Authority (SJTA), and DRPA, which generate their own revenues, generally via tolling. Revenue generated by these authorities is not included as a revenue source in the Plan.

THE FUNDING GAP

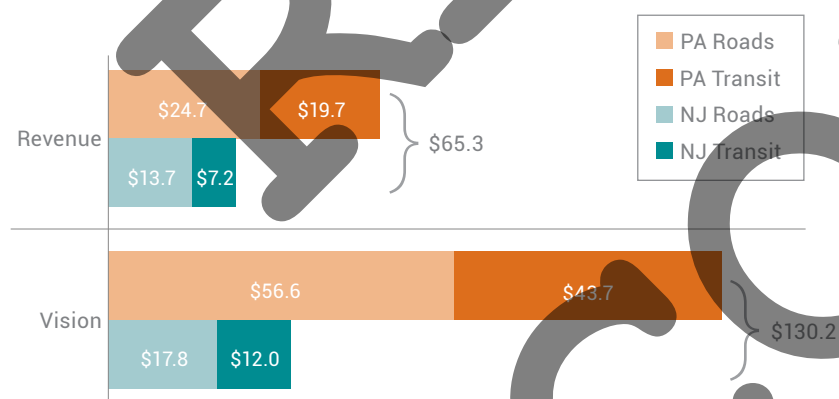
In the Pennsylvania subregion, there is a total estimated funding gap of about \$32 billion for roadway projects over the life of the Plan. Only about 44 percent of the total roadway vision can be funded. There is a total transit funding deficit of \$24 billion over the life of the Plan. Only about 45 percent of the total identified transit vision can be funded.

In the New Jersey subregion, there is a roadway funding deficit of \$4.1 billion over the life of the Plan. About 77 percent of the total vision can be funded. On the transit side, there is a total funding deficit of about \$4.8 billion over the life of the Plan, with the ability to fund approximately 60 percent of the projects identified in the transit vision.

ALLOCATING REVENUES TO PROJECT TYPES

Funding is allocated to each of the roadway and transit funding categories based on comparative need, as well as meeting regional goals. Long-range plan policy prioritizes preservation and maintenance needs, followed by operational improvements, then system expansion projects. This approach follows the lead of the U.S., Pennsylvania, and New Jersey DOTs. This “fix-it-first” policy allocates more funding to preserving and maintaining existing roadway and transit networks. The goal is to achieve and maintain an SGR for existing transportation infrastructure.

FIGURE 38: REGIONAL TRANSPORTATION VISION COMPARED TO AVAILABLE FUNDING (BILLIONS OF Y-O-E \$)



Source: DVRPC, 2017.

Connections 2045 revised the roadway funding allocation to reflect a changing transportation vision and needs. In Pennsylvania, the cap on roadway system expansion was reduced from 5 percent to 4 percent of available roadway funds. This 1 percent was reallocated to pavement preservation, operational improvements, and the “Other” category. It will help the region to better prepare for the needs of CVs and AVs—which will require better pavement conditions, line striping, and vehicle-to-infrastructure communications—as well as climate change and increased precipitation, which will require more investment in stormwater infrastructure and wetlands mitigation (in the “Other” category).

Table 12 identifies the target allocations and resulting revenue for each funding category. Funding within each category is allocated to both Major Regional Projects, which are listed in the Plan, and to smaller-scale projects as they are programmed in the TIP. The Plan also sets aside funding for smaller-scale projects that will be identified in the current and future TIPs.

Together, roadway maintenance and preservation categories (pavement reconstruction and bridge replacement) account for 80.5 percent of total roadway expenditures in Pennsylvania and 73.5 percent in New Jersey. In Pennsylvania, the transit preservation and maintenance categories (rail infrastructure, vehicles, and station enhancements) account for over 70 percent of transit expenditures; in New Jersey, they account for nearly 45 percent of transit expenditures. A higher percentage was allocated in Pennsylvania because it has a much larger and older system.

Even if all anticipated Plan revenues were directed toward preserving and maintaining the roadway and transit systems, there would not be enough money to address the identified need. Furthermore, the region would not have funding for any other critical types of improvements to address congestion, safety, or mobility. With system preservation needs on the rise, only 4 percent of expected revenue was allocated for roadway system expansion projects in Pennsylvania and New Jersey,

primarily for eliminating choke points in the system and for improving connections between facilities. A larger percentage of funding is reserved for operational improvements, which tend to have a higher return on congestion reduction than system expansion projects, per dollar spent. SGR needs are a higher priority than system expansion for transit. In New Jersey 35.7 percent of funding is dedicated to transit system expansion.

TABLE 12: FUNDING ALLOCATION TO PROJECT CATEGORIES

MODE	PROJECT CATEGORY	PENNSYLVANIA		NEW JERSEY	
		TARGET ALLOCATION	ALLOCATED REVENUE	TARGET ALLOCATION	ALLOCATED REVENUE
Roadway	System Preservation	30.5%	\$ 7.5 B	48.5%	\$ 6.7 B
	- Pavement Preservation	50.0%	\$ 12.3 B	25.0%	\$ 3.4 B
	- Bridge Preservation				
	Operational Improvements	11.75%	\$ 2.9 B	15.25%	\$ 2.1 B
	Bicycle and Pedestrian	1.5%	\$ 0.4 B	2.0%	\$ 0.3 B
	System Expansion	4.0%	\$ 1.0 B	4.0%	\$ 0.5 B
	Other	2.25%	\$ 0.6 B	5.25%	\$ 0.7 B
Roadway Subtotal		100.0%	\$ 24.7 B	100.0%	\$ 13.7 B
Transit	System Preservation	14.00%	\$ 2.8 B	7.5%	\$ 0.5 B
	- Rail Infrastructure	45.80%	\$ 9.0 B	34.3%	\$ 2.5 B
	- Vehicles	10.90%	\$ 2.1 B	3.0%	\$ 0.2 B
	- Station Enhancements				
	Operational Improvements	3.50%	\$ 0.7 B	2.0%	\$ 0.1 B
	System Expansion	3.60%	\$ 0.7 B	35.7%	\$ 2.6 B
	Other	22.20%	\$ 4.4 B	17.5%	\$ 1.3 B
Transit Subtotal		100.0%	\$ 19.7 B	100.0%	\$ 7.2 B
Region Total		100.0%	\$ 44.4 B	100.0%	20.9 B

Source: DVRPC, 2017.

MAJOR REGIONAL PROJECT EVALUATION AND SELECTION

With constrained available funding, it is imperative to select projects judiciously, based on quantitative assessment. Investments in the system need to support the core principles of *Connections 2045*: Sustain the Environment; Develop Livable Communities; Expand the Economy; Advance Equity and Foster Diversity; and Create an Integrated, Multimodal Transportation Network. Investments also need to focus on modernizing the region's aging transportation network while working toward other key goals, such as: improving safety, reducing congestion, increasing mobility options for people and goods, incorporating technology, seamlessly connecting different modes, and identifying additional funding. As projects move from the Plan into the TIP, capital programming should be based on sound long-range strategic planning considerations, life-cycle investment analyses, and network performance and condition data (actual and projected). Careful tradeoff analysis must be done in order to ensure that the region gets the best possible return on its transportation investments.

Major Regional Projects are large-scale projects that will have a significant impact on regional travel. Almost all system expansion projects are Major Regional Projects, as are large-scale reconstruction projects on the region's freeways. Major Operational Improvement initiatives, such as SEPTA's fare modernization project, are also listed in the Plan. For the sake of brevity, smaller-scale projects that were identified in the needs assessment are not listed in the Plan document. Instead, the various funding categories in the Plan serve as placeholders for their funding, and they may be explicitly listed in future iterations of the TIP. Major regional projects are defined as:

System Expansion:

- **Roads:** Addition of new through lanes by widening, extending, or building new limited-access freeways of any length; creating a new interchange or adding missing movements between freeways (High Performance Monitoring System [HPMS] functional classes 1 or 2) and arterials (HPMS functional classes 3 or 4); or widening, extending, or building new principal arterials (HPMS functional classes 3 or 4) for more than three lane miles.
- **Transit:** New stations on existing lines (including station parking needs), extension of existing lines, or new rail and bus rapid transit (BRT) routes.

Operational Improvement and System Preservation:

- **Roads:** Projects that improve or reconstruct NHS facilities, or facilities with more than 25,000 vehicles per day, have more than 25,000 square feet of bridge deck area, cover more than 20 lane miles, or cost more than \$10 million.
- **Transit:** Projects that improve or make major repairs to existing rail lines at a cost greater than \$20 million; make major improvements to stations (generally aimed at rehabbing/upgrading the full facility; but can include major ADA initiatives to bring a station into compliance or roof replacements greater than 50,000 square feet) with more than 5,000 daily boardings or alightings, or cost greater than \$20 million; make procurements that replace five or more vehicles in existing rail fleets; double track or add sidings to existing passenger rail lines; or upgrade a traditional bus route with bus rapid transit service.

Major Regional Project costs are typically broken out over several funding categories, as their scope can involve reconstruction, replacement or rehabilitation, operational or safety improvements, and/or system expansion components.

Project Screening: For system expansion projects, DVRPC and its planning partners developed a screening and evaluation process to assess whether they meet key objectives of the Plan. The first step in the analysis is a screening process to determine if a proposed project meets the key criteria of investing in areas that are currently developed or have been identified as areas appropriate for development over the life of the Plan on the Land Use Vision map (Figure 21). Major regional roadway projects have an additional screening criterion: consistency with the region's CMP. Consistency is determined by whether the subcorridor where a potential new roadway expansion project is located has been identified in the CMP as appropriate for adding capacity. If a project fails the screening process, it is not considered for inclusion in either the Vision or Funded Plan. Expansion projects that pass this screening go through the full set of roadway or transit evaluation criteria.

DVRPC and its planning partners use three sets of evaluation criteria: the first is for roadway system expansion, the second is for transit system expansion projects, and the third is for all other types of projects. See Appendix E for more information on the project evaluation criteria.

Major regional roadway system expansion projects that pass the screening are further evaluated by the following criteria:

- Does the project serve the region's identified population and employment Centers?

- Are there significant environmental issues that will be impacted by a project, as measured by DVRPC's Environmental Screening Tool?
- Is the project located in a CMP Priority Subcorridor?
- What is the average annual daily traffic multiplied by the peak-period volume-to-capacity ratio within the project limits?
- What is the daily truck traffic on the facility?
- How far has the project advanced in the TIP?

Major regional transit system expansion projects are evaluated with the following criteria:

- Does the project serve areas that will support a high level of transit service, as measured by DVRPC's Transit Score Index?
- Does the project serve EJ communities with additional transit needs, as identified by DVRPC's IPD analysis?
- What is the potential for TOD?
- What is the status of the project?
- Is the project located in a CMP Priority Subcorridor?
- What is the project's anticipated farebox recovery rate?

Major regional roadway and transit system preservation and operational improvement projects were prioritized using the multimodal benefit criteria developed for the TIP. These criteria consider:

- **Facility/Asset Condition:** Does the project bring a facility or asset into an SGR, extend the useful life of a facility, or remove a functionally obsolete bridge rating?
- **Safety:** Is the project safety-critical for transit, in a high-crash road location, a DOT-identified safety priority, or does it incorporate an FHWA proven safety countermeasure?
- **Reduce Congestion:** Is the project located in a CMP congested corridor, or is it an appropriate-everywhere CMP strategy; and annual average daily traffic per lane, or daily transit riders per daily seats?
- **Invest in Centers:** Is the project located in a *Connections 2045* Center or Freight Center; or high, medium-high, or medium transit score areas; or will it improve a connection between two or more key Centers?
- **Facility/Asset Use:** What is the daily VMT, truck VMT, and transit ridership?
- **Economic Competitiveness:** Will the project result in reduced operating/maintenance costs, or is it part of an economic development or TOD project?
- **Multimodal Bike/Pedestrian:** Do a large number of bicyclists

and pedestrians use the facility, does the project create new trails, sidewalks, bike lanes; or make connections to other multimodal facilities?

- **EJ:** Will the project benefit high IPD communities?
- **Air Quality/Green Design:** Will the project deliver air quality benefits and incorporate environmentally friendly principles and techniques?

Project selection was based on this evaluation criteria and collaboration with the Long-Range Plan Working Group. Once projects were selected, they were broken out into two lists: An aspirational Vision Plan, and a fiscally constrained Funded Plan.

Air Quality Conformity

The U.S. EPA has established health-based standards for six criteria air pollutants, referred to as the National Ambient Air Quality Standards (NAAQS). Air quality in the region does not meet the standard for ground-level ozone and previously has not met the standards for PM_{2.5}. The Clean Air Act requires DVRPC to demonstrate that the transportation projects contained in the TIPs and Plan do not make the region's air quality worse, or impede the region's progress toward meeting the NAAQS. The process of this demonstration is referred to as transportation conformity.

DVRPC demonstrates transportation conformity by using a travel demand model to estimate the motor vehicle emissions from all of the regionally significant, nonexempt projects in the TIPs and Plan and comparing those emissions against budgets or limits established

by the states. This process is conducted in close coordination with an interagency consultation group, comprised of state and federal regulatory environmental and transportation agencies. DVRPC has successfully demonstrated the transportation conformity of *Connections 2045* and the Pennsylvania and New Jersey TIPs in accordance with the corresponding State Implementation Plans and Clean Air Act requirements. More details are available at: www.dvrpc.org/AirQuality/Conformity/

THE VISION PLAN

The Vision Plan includes all of the identified improvements that are needed to attain the region's transportation goals outlined in the long-range plan. It includes the system preservation needs assessment, along with desired investments in operational improvements, system expansion, and bike and pedestrian projects needed to achieve the Plan's vision. Since the Plan considers a 28-year horizon, there is a focus on Major Regional Projects. However, the financial plan considers all sizes and types of projects that are critical to achieving our transportation goals. Major Regional Projects that are not included in the Funded Plan are listed as unfunded aspirational projects.

THE FUNDED PLAN

The Funded Plan is the list of fiscally constrained projects that can be paid for with the reasonably anticipated revenue through 2045. The Long-Range Plan Working Group helped form definitions for Major Regional Projects and identify the projects that are ultimately included in the Funded Plan. The Working Group reviewed the project evaluation and used it to guide and inform project selection.

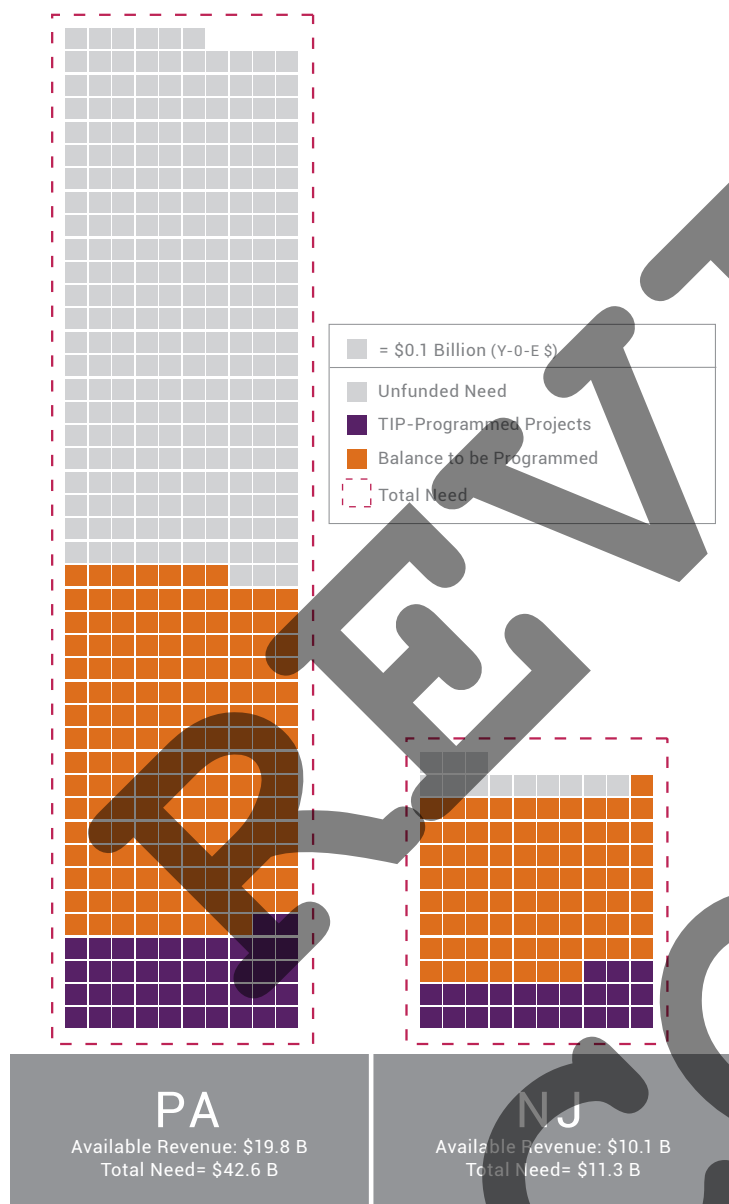
The Major Regional Projects that the region intends to fund over the life of the Plan are indicated in the following tables for system preservation, operational improvements, and system expansion projects for both roadways and transit, as well as for bike and pedestrian investments. There is also a table for externally funded Major Regional Projects, which do not anticipate using federal or state transportation funds. Each project is identified by facility, project scope and location, and completion date based on the end of the funding period that the project is expected to be complete. Project costs are given in Y-O-E dollars for funded projects and in current-year dollars for the unfunded projects that are part of the Vision Plan. A detailed, interactive webmap of Major Regional Projects can be found at www.dvrpc.org/webmaps/MRP2045/.

MAJOR REGIONAL ROADWAY PRESERVATION PROJECTS

The major regional roadway preservation projects identified in the Plan illustrate the scope and the scale of the effort needed to maintain the existing system. Identifying the timing and scope of reconstruction projects is difficult, as minor repairs can extend facility lifespans, but generally are costlier over time than repairing and replacing as needed. In addition, any given facility can decline more quickly—or slowly—than predicted. Some of the projects identified will be completed, drawing from the balance of unallocated system preservation funds, but some of them will not be able to advance as a result of funding constraint. Figure 39 illustrates the programmed and available funding for roadway preservation projects as compared with the total need in each state's subregion.

I-95 is a clear example of the difficult task of addressing the rebuilding of our infrastructure in a fiscally constrained environment. The focus right now is on reconstructing the portion between Cottman Avenue

FIGURE 39: ROADWAY SYSTEM PRESERVATION TIP PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045, IN BILLIONS OF Y-0-E \$)



Source: DVRPC, 2017.

Innovations In Project Delivery

Better transportation project delivery methods can increase worksite safety, reduce congestion from construction, and lower the cost of transportation projects. FHWA's Everyday Counts campaign highlights the economic and quality-of-life benefits from maintaining and reconstructing transportation facilities while minimizing impacts on the traveling public. **Some examples of the techniques that are being used in the region and around the country to do this include:**

- **INVEST** is an FHWA tool that provides information and techniques to help agencies integrate sustainability best practices into their projects and programs.
- **Accelerated bridge construction** uses geosynthetic materials to quickly and cheaply construct abutments and roadway approaches, and prefabricated bridges that are built off-site, or nearby, and can be slid into place and paved, and allow the road to reopen within 48 to 72 hours.
- **AASHTOWare** is bridge and pavement management software that can more accurately design facility requirements for given traffic and weather conditions.
- **Cold-in-place recycling** is a no-heat paving solution. Two to five inches of the current road surface are pulverized down to a specific aggregate size, mixed with a rejuvenating asphalt emulsion, and then reused to pave that same road, saving labor, material, and transportation costs.
- **Warm-mix paving** asphalt's heating requirements are 30 to 120 degrees Fahrenheit less than traditional asphalt, reducing fuel consumption and emissions. Secondary benefits include allowing and prolonging the construction period in cold climate, extending material handling time, and fume reduction.
- **Waste and recycled materials**, such as rubber tires, coal ash, fly ash, foundry sand, slag, asphalt shingles, construction and demolition materials, and silica fume, have been added to pavement mixtures to reduce cost and improve performance.
- **Precast concrete paving** involves panels being precast offsite, where they can be subject to higher quality-control standards, and installed during low-volume periods—such as overnight or weekends. They can reduce one of the major causes of road delay: construction.

TABLE 13: ILLUSTRATIVE LIST OF MAJOR REGIONAL ROADWAY PRESERVATION PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	LRP PROJECTS FUNDED IN TIP MILLIONS OF Y-O-E \$\$	ILLUSTRATIVE PROJECT COST MILLIONS OF 2017 \$\$
PA 309 Sellersville Bypass	Resurface from Church Road to Tollgate Road	Bucks	2018–2028	\$ 56.6	
I-95	Rehabilitate bridges over Neshaminy Creek	Bucks	TBD		\$ 36.0
US 1 Lincoln Highway	Rehabilitate bridge over Delaware Canal and Conrail	Bucks	TBD		\$ 16.5
PA 332 Newtown Bypass	Reconstruct bridge over SEPTA	Bucks	TBD		\$ 10.0
Butler Pike	Reconstruct bridge over PA 611 Bypass	Bucks	TBD		\$ 27.0
Old Lincoln Highway	Reconstruct bridge over Conrail	Bucks	TBD		\$ 26.0
Newportville-Falls Road	Rehabilitate bridge over Conrail	Bucks	TBD		\$ 11.0
Darby Road Extension	Replace North Valley Road Bridge; realign to connect new bridge with Darby Boulevard	Chester	2018-2022	\$ 37.2	
Baltimore Pike	Replace bridge over Brandywine Creek	Chester	TBD		\$ 26.0
US 202 Section 200	Reconstruct Section 200 (from Matlack Street north to US 30); intersection improvements at PA 100 Bypass	Chester	TBD		\$ 150.0
Swedesford Road	Replace bridge over County Line Expressway	Chester	TBD		\$ 24.0
Black Rock Road	Rehabilitate bridge over Schuylkill River	Chester	TBD		\$12.0
US 1	Reconstruct from Schoolhouse Road to Maryland state line	Chester	2018–2028	\$ 125.9	
US 422	Reconstruct from Sanatoga Interchange to just east of Stowe Interchange and west of Schuylkill River bridge; realign from Porter to Park Road; improve acceleration lane for westbound on-ramp from Sanatoga Interchange; reconstruct bridge over Schuylkill River and provide Schuylkill River Trail crossing	Chester, Montgomery	2018–2028	\$ 217.2	
I-476	Reconstruct throughout Delaware County	Delaware	TBD		\$ 700.0
Media Bypass	Replace bridge over Crum Creek and Crum Creek Road	Delaware	TBD		\$ 25.0

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	LRP PROJECTS FUNDED IN TIP MILLIONS OF Y-O-E \$\$	ILLUSTRATIVE PROJECT COST MILLIONS OF 2017 \$\$
PA 291	Replace bridge over Little Crum Creek and Conrail	Delaware	TBD		\$ 29.0
I-95	Reconstruct throughout Delaware County	Delaware	TBD		\$ 725.0
I-476	Reconstruct bridges over Balligomingo Road	Montgomery	TBD		\$ 80.0
US 422 Pottstown Expressway	Replace bridges over Perkiomen Creek	Montgomery	TBD		\$ 67.5
Belmont Avenue	Rehabilitate bridge over Schuylkill River	Montgomery	TBD		\$ 33.0
Church Road/Schoolhouse Road/Water Street	Reconstruct roadway to provide for truck traffic bypass	Montgomery	TBD		\$ 25.0
Langely Avenue	Reconstruct, realign, and new streetscaping from 26th Street to Broad Street	Philadelphia	2018–2022	\$ 3.0	
US 1 Roosevelt Boulevard	Reconstruct bridge over Wayne Junction	Philadelphia	2018–2028	\$ 84.4	
Passyunk Avenue	Rehabilitate bridge over Schuylkill River	Philadelphia	TBD		\$ 65.0
Henry Avenue	Replace bridge over Lincoln Drive	Philadelphia	TBD		\$ 95.0
I-95 Girard Point Bridge	Rehabilitate bridge over Schuylkill River	Philadelphia	TBD		\$ 30.0
I-95 South Philadelphia	Reconstruct from I-676 to Broad Street	Philadelphia	TBD		\$ 3,000.0
I-76	Rehabilitate throughout Philadelphia	Philadelphia	TBD		\$ 400.0
Henry Avenue	Replace bridge over Wissahickon Creek	Philadelphia	TBD		\$ 46.0
NJ 70	Reconstruct from NJ 38 to Cropwell Road	Burlington, Camden	2018–2027	\$ 62.5	
I-676	Reconstruct from County Route 537 to US 30	Camden	TBD		\$ 26.0
I-76	Reconstruct from I-676 to I-295	Camden	TBD		\$ 47.0
US 30	Reconstruct bridge over Cooper River	Camden	TBD		\$ 27.0
NJ 73	Reconstruct bridge over US 130	Camden	TBD		\$ 22.5
I-295	Reconstruct bridges over Big River Creek	Gloucester	TBD		\$ 35.0
US 322	Reconstruct bridge over Main Street	Gloucester	TBD		\$ 43.0
US 130	Reconstruct bridge over Big Timber Creek	Gloucester	2022–2027	\$ 31.8	
US 1	Rehabilitate bridge over D&R Canal	Mercer	TBD		\$ 22.0
Clarksville Road (CR 638)	Replace Clarksville Road bridge over NE Corridor rail line, adding bike and pedestrian facilities	Mercer	TBD		\$ 27.5
NJ 133	Reconstruct bridges over NJ Turnpike	Mercer	TBD		\$ 36.0

Source: DVRPC, 2017.

and Race Street in Philadelphia. Starting in the 2030s, the next section of reconstruction will be in Center City and South Philadelphia between I-676 and Broad Street. Much of this segment in South Philadelphia is a viaduct bridge structure. Then reconstruction will need to advance from Broad Street all the way to the Delaware state line. Funding these projects—along with a myriad of other major facilities to reconstruct, such as portions of I-76 and I-476—will be highly challenging at current funding levels. Roadway reconstruction projects often include improvements for bicycle and pedestrian facilities, and funding constraints on those projects can affect several modes - not just automobiles.

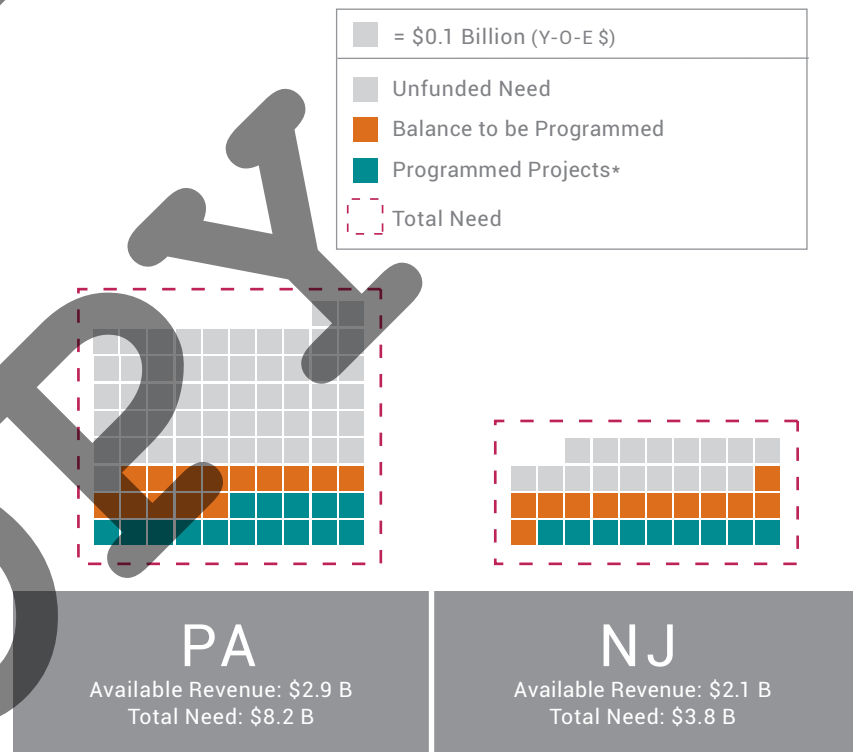
Table 13 identifies major regional roadway preservation projects that are currently funded in the TIP, with a list of illustrative projects and their costs as a sample of major regional reconstruction projects that need to be advanced over the life of *Connections 2045*. Only about 46 percent of the Pennsylvania subregion's roadway preservation needs and 89 percent of the New Jersey subregion's roadway preservation needs are met in the Plan.

MAJOR REGIONAL ROADWAY OPERATIONAL IMPROVEMENT PROJECTS

Operational improvements increase the efficiency of the existing transportation system. In many cases, these projects make interchange improvements that will improve the flow of traffic and help to remove traffic from local streets. Examples of this type of project are the I-95 and I-476, and the I-476 and I-76 interchange improvements, along with US 1 between PA 352 and PA 452 in Delaware County. Other types of operational improvement projects include the intersection improvement at US 202 and PA 926: the result of "right-sizing" what was a widening

and grade-separated interchange project into an affordable, short-term project that can improve safety and reduce congestion more immediately. Figure 40 illustrates the programmed and available funding for roadway operations projects as compared with the total need in each state's subregion. Any major regional system preservation project that has operational improvement components is listed here.

FIGURE 40: ROADWAY OPERATIONAL IMPROVEMENT PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045)



Source: DVRPC, 2017.

TABLE 14: MAJOR REGIONAL ROADWAY OPERATIONAL IMPROVEMENT PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	ILLUSTRATIVE PROJECT COST MILLIONS OF 2017 \$\$
US 202 at PA 926	Intersection improvements	Chester	2018–2022	\$ 3.3	
US 422 Corridor ITS	ITS improvements along US 422, Ridge Pike, PA 23, and PA 724	Chester, Montgomery	Unfunded		\$ 50.0
US 1 at PA 352 and PA 452	Reconstruction of PA 352 cloverleaf interchange, Media Bypass/Baltimore Pike interchange, and PA 452 intersection; eliminate lane drops	Delaware	2018–2028	\$ 187.8	
I-95 and I-476 Interchange	One new lane in each direction on I-95 through interchange; addition of lane on ramp from SB I-476 to SB I-95	Delaware	2029–2035	\$ 195.0	
US 202 (Section 500) Markley Street	Reconstruct from Main Street to Johnson Highway; widen to add center turn lane between Marshall Street and Johnson Highway	Montgomery	2018–2022	\$ 17.0	
Ridge Pike	Reconstruct four-lane road from Butler Pike to I-276 PA Turnpike; widen to add center turn lane; reconstruct two bridges over Norfolk-Southern rail tracks	Montgomery	2018–2022	\$ 25.7	
I-476 and I-76	Ramp modifications	Montgomery	2029–2045	\$ 18.0	
I-76 and PA 23 Matsonford Road	Interchange modification	Montgomery	2029–2045	\$ 18.0	
US 422 at Sanatoga Interchange	Ramp modifications	Montgomery	2029–2045	\$ 16.0	
US 422	Reconstruct from Berks County line to Schuylkill River Bridge; reconfigure "S" curve in West Pottsgrove; realign Stowe interchange	Montgomery	2018–2022	\$ 41.5	
I-276 at PA 611 Willow Grove	Interchange modification	Montgomery	2029–2045	\$ 36.0	
US 202 Dekalb Street	Convert from one-way traffic flow to two-way, and full reconstruction of road in Norristown	Montgomery	Unfunded		\$ 15.0

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	ILLUSTRATIVE PROJECT COST MILLIONS OF 2017 \$\$
PA 100 at PA 73	Modify interchange into a single-point urban-style interchange	Montgomery	Unfunded		\$ 70.0
PA 611 – Easton Road	Corridor, signals, and intersection improvements between Blair Mill Road and County Line Road	Montgomery	2029–2045	\$ 73.0	
PA 611 ITS	Eastern Montgomery County ITS improvements and multimodal upgrades from Cheltenham Avenue to County Line Road	Montgomery	2029–2045	\$ 36.0	
Sumneytown Pike	Corridor and intersection improvement from PA 63 to PA 363	Montgomery	2029–2045	\$ 36.0	
Traffic-Management Center	New regional traffic management center to be constructed in PennDOT District 6 headquarters building	Montgomery	Unfunded		\$ 40.0
I-95 Philadelphia North	Reconstruct from Race Street to Cottman Avenue; interchange improvements at Vine, Girard, Allegheny, Betsy Ross Bridge, Bridge, and Cottman interchanges	Philadelphia	2018–2028	\$ 1,800.0	
Roosevelt Boulevard	Reconstruct and improve safety from Broad Street to Bensalem Township	Philadelphia	Unfunded		\$ 1,500.0
Eakins Oval	Reconfiguration of circulation paths and patterns around Eakins Oval and Benjamin Franklin Parkway	Philadelphia	2029–2045	\$ 45.0	
30th Street Station Vehicle Circulation	Improvements from 30th Street District Plan, including repurposing Little Market Street; improvements to Market Street, Arch Street, and 30th Street; realignment of JFK Boulevard; I-76 ramp reconfigurations	Philadelphia	2029–2045	\$ 75.0	
Vision Zero in Philadelphia	Improve road safety with engineering enhancements	Philadelphia	2029–2035	\$ 80.0	\$ 50.0
US 130 Corridor Improvements	Eliminate US 130-Rising Sun intersection by realigning Rising Sun Road to connect with Dunns Mill Road; add jughandles and signalize Campus Drive intersection; replace jughandle at northbound US 130 and Bridgeboro Road (CR 625) and add new signalized intersection and connecting road; redesign intersection at Florence-Bustleton Road (CR 659) to replace northbound US 130 jughandle with reverse jughandle; add left-turning lane southbound from US 130 to Florence-Columbus Road (CR 656) and separate ramp from CR 656 to northbound US 130	Burlington	2028–2045	\$ 445.0	
NJ 70	Operation and safety improvements from NJ 38 to NJ 73; intersection improvements at Kingston Road and Covered Bridge Road	Burlington, Camden	2028–2045	\$ 305.0	
NJ 29	Convert to an urban boulevard from US 1 to Sullivan Way	Mercer	Unfunded		\$ 220.0

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	ILLUSTRATIVE PROJECT COST MILLIONS OF 2017 \$\$
Princeton-Hightstown Road Improvements	Widening, reconstruction, and signal upgrades from Wallace-Cranbury Road to Clarksville Road	Mercer	2018–2021	\$ 5.0	
I-195 ATM	Dynamic speed limit, dynamic lane assignment, and queue warning between NJ Turnpike and I-295	Mercer	2028–2035	\$ 25.0	

Source: DVRPC, 2017.

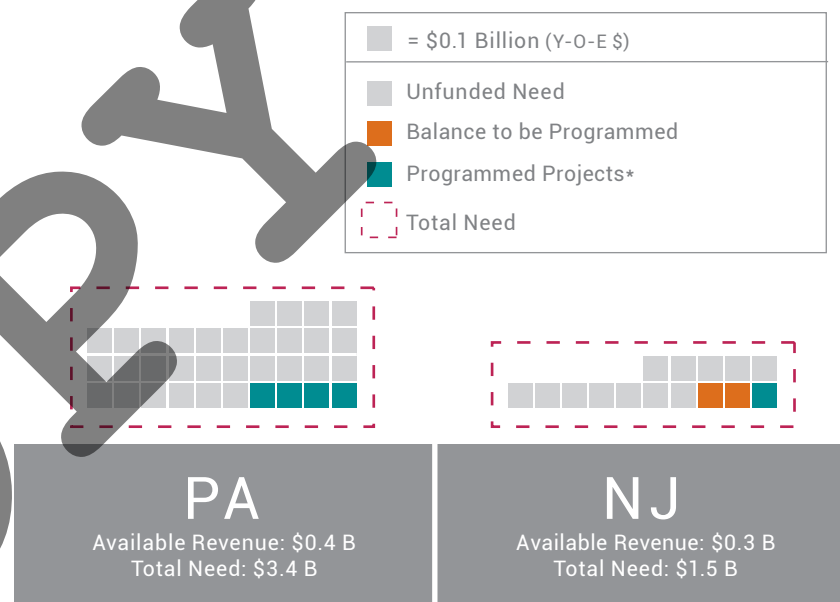
Major Regional Roadway Operational Improvement Projects do not only focus on physical changes to the roadway system. DVRPC and its planning partners developed a TSMO Plan that details specific ITS, DSRC, Active Traffic Management (ATM), and signal improvement projects. ATM blends technology and increased management to enhance roadway throughput using techniques, such as variable speed limits, queue detection, dynamic lane assignments, junction control, adaptive ramp metering, and continuous monitoring systems. Only about 37 percent of the Pennsylvania subregion's and 55 percent of the New Jersey subregion's operational improvements can be funded in the Plan.

MAJOR REGIONAL BIKE AND PEDESTRIAN PROJECTS

Bike and pedestrian improvements in *Connections 2045* include on-road improvements and completing The Circuit, a 775-mile regional trail network. About 320 miles of this system are complete, and about 65 miles are anticipated to be constructed over the next five years. At current funding levels, another 120 miles of trail are projected to be completed over the life of the Plan. The City of Philadelphia, the Commonwealth of Pennsylvania, and the William Penn Foundation have created a partnership that will build a cap over I-95 in Old City, Philadelphia, helping to better connect Penn's Landing with Center City. In addition, there are countless on-street facilities that are on their way to being built or envisioned to be

in the scope of future reconstruction projects. Only about 11 percent of the Pennsylvania subregion's and 20 percent of the New Jersey subregion's bicycle and pedestrian improvements can be funded. Figure 41 illustrates the programmed and available funding for roadway bike and pedestrian

FIGURE 41: BIKE AND PEDESTRIAN PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045)



*Includes projects programmed in the TIP and funded Major Regional Projects in the Long-Range Plan

Source: DVRPC, 2017.

TABLE 15: MAJOR REGIONAL BIKE AND PEDESTRIAN PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	LOCAL, PRIVATE, AND OTHER FUNDED	STATE AND FEDERAL FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
The Circuit in Pennsylvania	Complete 243 miles of the Circuit regional trail network	Pennsylvania Subregion	2018–2045		\$ 108.0	\$ 172.0
The Circuit in New Jersey	Complete 142 miles of the Circuit regional trail network	New Jersey Subregion	2018–2045		\$ 44.0	\$ 100.0
Penn's Landing Cap and Civic Space	Cap over I-95 and Columbus Boulevard between Walnut and Chestnut Streets creating an 8-acre civic space; extension of the South Street Bridge to the waterfront; and construction of a two mile on-road section of the Delaware River Trail from Spring Garden Street to Washington Avenue in Center City, Philadelphia.	Philadelphia	2018–2045	\$ 115.0	\$ 110.0	\$ 10.0
Vine Street Expressway	New cap over I-676 around 10th Street	Philadelphia	Unfunded			\$ 35.0
Schuylkill River Swing Bridge	As part of the Circuit Trail network, provide a bicycle and pedestrian connection between the Kingsessing and Grays Ferry neighborhoods of Philadelphia across the Schuylkill River	Philadelphia	2018–2022		\$ 14.0	
30th Street Station Bike/ Pedestrian Bridge Connections	Construction of two new bike/ped bridges over the Schuylkill River as part of the 30th Street Station District Plan	Philadelphia	Unfunded			\$ 225.0
Schuylkill Promenade and Boardwalk	Construct new promenade and boardwalk on the west bank of the Schuylkill River between Market Street and Arch Street	Philadelphia	Unfunded			\$ 40.0

Source: DVRPC, 2017.

projects as compared with the total need in each state's subregion.

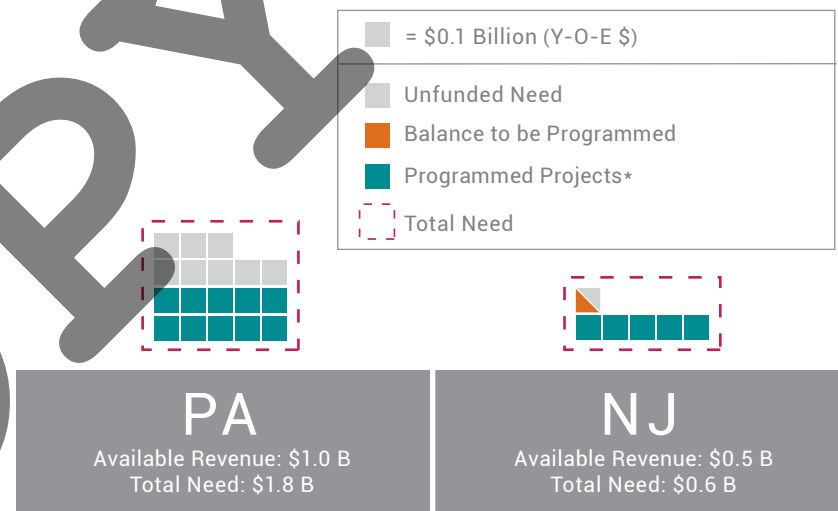
MAJOR REGIONAL ROADWAY SYSTEM EXPANSION PROJECTS

Due to overwhelming needs in system preservation and increasing needs for operational improvements, new roadway capacity funding is capped at 4 percent of total anticipated roadway revenue. Although limited in scope, the system expansion investments included in the Plan support its land use, environmental, and economic development goals. Any major regional system preservation or operational improvement project that increases system capacity is listed here. The US 1 reconstruction in Bucks County is one example of an expansion project that is also helping to rebuild the system. Costs for such projects are accounted for within the system preservation, operational improvements, and system expansion categories.

A number of the major regional roadway system expansion projects improve operations by eliminating bottlenecks or bridging gaps. The Adams Avenue Connector, for example, provides a connection between I-95 and the Betsy Ross Bridge. Similarly, the I-295 and I-76/NJ 42 direct connection and I-295 at NJ 42 Missing Moves projects complete this critical interchange and improve the functionality and safety of the system. Each of these will also help to better facilitate goods movement. Other system expansion projects improve the region's economic competitiveness. The North Delaware Avenue and Lafayette Street extensions provide access to planned residential and recreational facilities in key regional Centers. System expansion projects also go through right-sizing to ensure the improvement is cost affordable. US 1 in Mercer County was originally programmed as a set of grade-separated intersections. However, the project will now consist of minor widening in one section, along with improvements at several other key intersections, in an effort to improve safety and reduce congestion.

Improved movements and new exits along the Pennsylvania Turnpike are proposed to give better access to a number of key regional business centers. Although not funded in the Plan, these projects would support the redevelopment of these areas and make the Turnpike more of a regional beltway. They have the potential to become a P3 between PennDOT, the Pennsylvania Turnpike, and property developers. Figure 42 illustrates the programmed and available funding for roadway system expansion projects as compared with the total need in each state's subregion. Only about 56 percent of the Pennsylvania subregion's, and 83 percent of the New Jersey subregion's roadway system expansion projects can be funded.

FIGURE 42: ROADWAY SYSTEM EXPANSION PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045)



*Includes projects programmed in the TIP and funded Major Regional Projects in the Long-Range Plan

Source: DVRPC, 2017.

TABLE 16: MAJOR REGIONAL ROADWAY SYSTEM EXPANSION PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	SYSTEM EXPANSION COST MILLIONS OF Y-O-E \$\$	TOTAL FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
US 1	Reconstruct from I-276 (PA Turnpike) to NJ state line; widen from PA Turnpike to PA 413; interchange improvements	Bucks	2018–2035	\$ 61.9	\$ 269.0	
I-95 at Street Road (PA 132)	Replace bridge over I-95 and Amtrak Northeast Corridor with wider structure; provide turning lanes on bridge; widen I-95; improve connection to US Route 13	Bucks	Unfunded			\$ 162.0
John Fries Highway (PA 663)	Widen and reconstruct from PA 309 to PA Turnpike	Bucks	Unfunded			\$ 27.0
County Line Road	Widen and reconstruct from Doylestown Road to PA 611	Bucks, Montgomery	2018–2028	\$ 6.9	\$ 15.7	
PA 309 Connector Road	Construct new road from Allentown Road to County Line Road; improve PA 309 Interchange	Bucks, Montgomery	2018–2028	\$ 70.9	\$ 94.5	
I-95 Bucks/Philadelphia Active Traffic Management	Part-time shoulder use and other operational strategies from Woodhaven Road to Academy Road	Bucks, Philadelphia	Unfunded			\$ 22.0
US 30 Coatesville-Downingtown Bypass	Reconstruct from Exton Bypass to PA 10; complete interchanges at PA 113 and Airport Road; potential addition of through lanes and capacity enhancements between PA 113 and PA 340 (as determined by traffic analysis)	Chester	2018–2028	\$ 272.8	\$ 826.3	
US 202 (Section 100)	Widen from West Chester to Delaware state line from four to six lanes; grade separated interchanges at US 1 and at PA 926	Chester, Delaware	Unfunded			\$ 350.0
US 322	Widen and reconstruct from US 1 to I-95	Delaware	2018–2028	\$ 94.1	\$ 240.8	
I-95/US 322/ Highland Avenue Interchange	Realign I-95 and add new movements at interchange to US 322, Bethel Road, and Highland Avenue	Delaware	2029–2045	\$ 22.2	\$ 147.7	
I-476 Active Traffic Management	Part-time shoulder use and other operational strategies from PA 3 to I-95	Delaware	2029–2045	\$ 22.5	\$ 45.0	

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	SYSTEM EXPANSION COST MILLIONS OF Y-0-E \$\$	TOTAL FUNDED COST MILLIONS OF Y-0-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
I-95 Delaware County Active Traffic Management	Part-time shoulder use and other operational strategies from Stewart Avenue to US 322 East	Delaware	Unfunded			\$ 23.0
Lafayette Street	Extend roadway from Barbadoes Street to Diamond Avenue	Montgomery	2018-2022	\$ 12.0	\$ 24.1	
US 202 (Section 600)	Widen and reconstruct from Johnson Highway to PA 309	Montgomery	2018-2028	\$ 104.0	\$ 203.9	
US 422 Bridge and PA 23 Interchange	Bridge replacement and new bridge over Schuylkill River—existing bridge is five lanes, new bridge will have six lanes; intersection/interchange improvements at US 422 and PA 23 Interchange	Montgomery	2018-2022	\$ 10.6	\$ 21.1	
I-76 Integrated Corridor Management	ATM, multimodal improvements and coordination, and safety analysis from PA Turnpike to US 1; part-time shoulder use from US 202/US 422 to I-476/Conshohocken, and I-476/ Conshohocken to Belmont Avenue/ Green Lane	Montgomery	2018-2028	\$ 71.6	\$ 143.2	
US 422 Mainline Widening	Reconstruct and widen from four to six lanes from US 202 to PA 363	Chester, Montgomery	2029-2045	\$ 18.3	\$ 36.6	
I-276/I-76 Valley Forge Interchange	Ramp modifications	Montgomery	Unfunded			\$ 22.0
I-276 and Virginia Drive	Add full movements	Montgomery	Unfunded			\$ 49.0
I-276 and Henderson Road	New interchange	Montgomery	Unfunded			\$ 43.0
I-276 and PA 63 Welsh Road	New interchange	Montgomery	Unfunded			\$ 43.0

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	SYSTEM EXPANSION COST MILLIONS OF Y-O-E \$\$	TOTAL FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
I-276 Fort Washington Interchange	Ramp modifications	Montgomery	Unfunded			\$ 22.0
US 202 Dannehower Bridge and Lafayette Street Interchange	Reconstruct Dannehower Bridge and add new half-diamond interchange at Lafayette Street	Montgomery	Unfunded			\$ 58.0
US 422 Active Traffic Management	Part-time shoulder use and other operational strategies from US 202 to PA 29	Chester, Montgomery	Unfunded			\$ 18.0
North Delaware Avenue	Extend roadway from Orthodox Street to Buckius Street	Philadelphia	2018–2022	\$ 6.6	\$ 6.6	
Adams Avenue Connector	Extend roadway to new ramps at I-95 and Aramingo Avenue	Philadelphia	2018–2022	\$ 13.7	\$ 13.7	
I-76 Philadelphia Active Traffic Management	Part-time shoulder use and other operational strategies from US 1 to I-676	Philadelphia	Unfunded			\$ 48.0
I-295 at NJ 38	Add missing movements at interchange	Burlington	2018–2027	\$ 121.0	\$ 121.0	
NJ 73 at Church Road and Fellowship Road	Convert intersections into grade-separated interchanges	Burlington	2018–2027	\$ 30.2	\$ 60.4	
I-295 Direct Connect	Direct connection of I-295 through interchange at I-76/NJ 42	Camden	2018–2027	\$ 152.4	\$ 325.0	
I-295 and NJ 42 Missing Moves	Add Missing Movements to interchange at I-76/NJ 42	Camden, Gloucester	2018–2021	\$ 80.0	\$ 160.0	
US 322	Widen from US 130 to NJ Turnpike	Gloucester	2028–2045	\$ 45.5	\$ 91.0	
US 322 Rowan University Bypass	Bypass around US 322 and NJ 55 interchange; intersection improvements at US 322 and Joseph Bowe Boulevard; corridor improvements in campus/downtown area between Lehigh Road and Yale Road	Gloucester	Unfunded			\$ 36.0
US 1 Alexander Road to Mapleton Road	Widen from six to eight lanes from Dinky Bridge to Scudders Mill Road; intersection improvements at Washington Road and Harrison Street	Mercer	2018–2027	\$ 4.7	\$ 4.7	
Vaughn Drive Connector	Extend Vaughn Drive to Princeton Hightstown Road (CR 571)	Mercer	2028–2045	\$ 57.0	\$ 57.0	

Source: DVRPC, 2017.

TABLE 17: OTHER MAJOR REGIONAL PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	TOTAL FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
I-95	Sound walls in Chester City	Delaware	2018–2028	\$ 20.0	
Delaware River Ferry	Year-round service between Philadelphia and City of Camden	Camden, Philadelphia	Unfunded		TBD

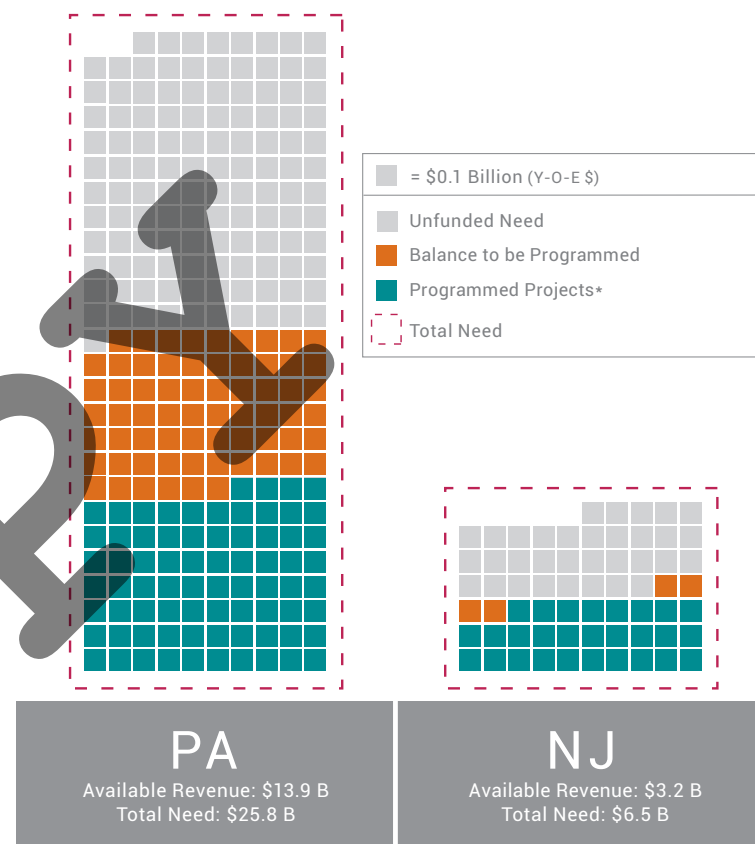
Source: DVRPC, 2017.

MAJOR REGIONAL TRANSIT SYSTEM PRESERVATION PROJECTS

Major regional transit system preservation projects (vehicles, stations, and rail infrastructure) will occur on the Atlantic City Rail Line, along with a number of key SEPTA bridges and power substations, which are critical to the long-term viability of the regional rail system. A major renovation of City Hall Station is underway, and significant Regional Rail station upgrades are in the works at Villanova, Paoli, Exton, Ardmore, Levittown, and Fern Rock. Major transit rail bridge rehabilitations are planned for the Chestnut Hill East and West and Norristown High Speed lines, along with the mainline track between Suburban Station and 30th Street Station. Critical trolley and Regional Rail vehicle replacements will occur over the life of the Plan. Fleets will have expanded seating capacity through the purchase of multilevel vehicles and larger trolleys, helping to reduce system overcrowding. Trolley modernization aims to make service faster and more reliable, meet ADA-accessibility requirements, and positively transform the streetscape in the neighborhoods where they operate.

Figure 43 illustrates the programmed and available funding for transit preservation projects as compared with the total need in each state's subregion. About 54 percent of the Pennsylvania subregion and 49

FIGURE 43: TRANSIT SYSTEM PRESERVATION PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045)



*Includes projects programmed in the TIP and funded Major Regional Projects in the Long-Range Plan

Source: DVRPC, 2017.

TABLE 18: MAJOR REGIONAL TRANSIT SYSTEM PRESERVATION PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
Trenton Line	Levittown Station Reconstruction	Bucks	2018–2022	\$ 36.0	
Woodbourne Substation	New substation on West Trenton Line	Bucks	2018–2022	\$ 23.5	
Paoli-Thorndale Line	Devon Station renovation	Chester	2023–2035	\$ 20.0	
Frazer Shop and Yard	Rail shop and yard upgrade	Chester	2018–2022	\$ 119.1	
Paoli Thorndale Line	Paoli Intermodal Center (phases 1 and 2)	Chester	2018–2028	\$ 81.9	
Paoli-Thorndale Line	Exton Station improvements	Chester	2018–2035	\$ 62.9	
Paoli-Thorndale Line	Villanova Station rehabilitation	Delaware	2018–2035	\$ 32.2	
Media-Elwyn Line	Secane Station renovation	Delaware	2018–2035	\$ 24.2	
Wilmington–Newark Line	Marcus Hook Station renovation	Delaware	2023–2035	\$ 22.5	
Norristown High Speed Line	Tie replacement and continuous welded rail	Delaware, Montgomery	2018–2028	\$ 26.0	
Routes 101 & 102	Positive Train Control	Delaware	2018–2022	\$ 75.0	
69th Street Transportation Center	Construct parking structure; Transportation Center enhancements	Delaware	2018–2028	\$ 31.0	
Market-Frankford Line	Replace existing heavy-rail vehicle fleet	Delaware, Philadelphia	2029–2045	\$ 1,100.0	
Trolleys	Street track improvements	Delaware, Philadelphia	2023–2035	\$ 27.3	
Norristown High Speed Line	Replace heavy-rail vehicles	Delaware, Montgomery	2036–2045	\$ 130.0	
West Trenton Line	Philmont Station parking	Montgomery	2018–2022	\$ 25.0	
Norristown High Speed Line	Rehabilitate Bridgeport Viaduct over Schuylkill River and Bridge 0.15 over 69th Street yard tracks	Delaware, Montgomery	2018–2028	\$ 50.5	

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
West Trenton Line	Noble Station renovation, parking garage, and storage track	Montgomery	2018–2028	\$ 53.0	
Paoli-Thorndale Line	Ardmore Transportation Center (phases 1 and 2)	Montgomery	2018–2035	\$ 46.3	
Regional Rail Mainline	Jenkintown-Wyncote Station renovation	Montgomery	2018–2028	\$ 25.3	
Wayne Junction Station	Static Frequency Converter (SFC) #1-4	Philadelphia	2018–2022	\$ 60.0	
Regional Rail	Catenary replacement from 30th Street Station to K and Zoo interlockings	Philadelphia	2018–2022	\$ 77.0	
Regional Rail	Signals, catenary, and right-of-way improvements from 30th Street to Phil interlocking	Philadelphia	2018–2022	\$ 41.8	
Buses and Trolleys	Computer Aided Radio Dispatch signal and communication system upgrades and replacements	Philadelphia	2018–2022	\$ 32.5	
Market-Frankford Line	30th Street Station improvements	Philadelphia	2018–2022	\$ 11.0	
Market-Frankford Line	40th Street Station renovation	Philadelphia	2018–2022	\$ 10.9	
Market-Frankford Line	Arrott Transportation Center (Margaret-Orthodox Station) renovation	Philadelphia	2018–2022	\$ 39.9	
Market-Frankford Line	11th Street Station renovation	Philadelphia	2018–2022	\$ 9.5	
Broad Street Line	Erie Station renovation	Philadelphia	2018–2028	\$ 9.0	
Wissahickon Transportation Center	Improvements	Philadelphia	2018–2022	\$ 13.3	
City Hall and 15th Street Stations	Renovation	Philadelphia	2018–2028	\$ 146.5	
Regional Rail and Broad Street Line	Station ventilation improvements at Suburban and AT&T stations	Philadelphia	2018–2028	\$ 20.0	
Center City Concourse Improvements	Renovation	Philadelphia	2018–2035	\$ 59.7	
Regional Rail Mainline	Rehabilitate bridges from 30th Street to Suburban Station	Philadelphia	2018–2035	\$ 58.0	

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
Wayne Junction Shop	Shop Improvement/Expansion	Philadelphia	2018–2035	\$ 150.0	
Midvale Bus Garage	Facility and security enhancements	Philadelphia	2018–2035	\$ 26.7	
Broad Street Line	Replace existing heavy-rail vehicle fleet	Philadelphia	2029–2045	\$ 625.0	
Chestnut Hill East Line	Rehabilitate five bridges	Philadelphia	2023–2035	\$ 39.0	
Chestnut Hill West Line	Rehabilitate seven bridges	Philadelphia	2023–2035	\$ 45.5	
Fern Rock Station	Transportation Center and parking enhancements	Philadelphia	2023–2035	\$ 77.5	
Regional Rail Vehicles	Replace Silverliner IV fleet	Pennsylvania Subregion	2023–2029	\$ 1,100.0	
SEPTA Multilevel Push-Pull Cars	Procure 45 new ADA-accessible push-pull cars to replace existing fleet	Pennsylvania Subregion	2018–2022	\$ 174.3	
Regional Rail Locomotives	Procure (15) electric locomotives	Pennsylvania Subregion	2018–2022	\$ 154.5	
Trolley Modernization	Replace existing trolley fleet with ADA-compliant trolleys to expand capacity and provide faster, more reliable service	Delaware, Philadelphia	2018–2045	\$ 713.3	
Atlantic City Line Vehicles	Procure five locomotives and 20 commuter rail vehicles	Camden, Philadelphia	2028–2045	\$ 215.0	
River Line	Procure 20 light-rail vehicles	Camden, Burlington, Mercer	2036–2045	\$ 130.0	
PATCO	Procure 120 heavy-rail vehicles	Camden, Philadelphia	2036–2045	\$ 100.0	
Atlantic City Line Stations	Rehabilitate Cherry Hill, Lindenwold, and Atco stations	Camden	2036–2045	\$ 65.0	
Walter Rand Transportation Center	Station enhancements	Camden	2028–2035	\$ 50.0	
NJ TRANSIT NE Corridor	Replace 42 commuter rail vehicles for routine fleet replacement	Mercer	2028–2045	\$ 390.0	

* Project cost includes federal funding portion only; DRPA-PATCO funds make up the balance.

Source: DVRPC, 2017.

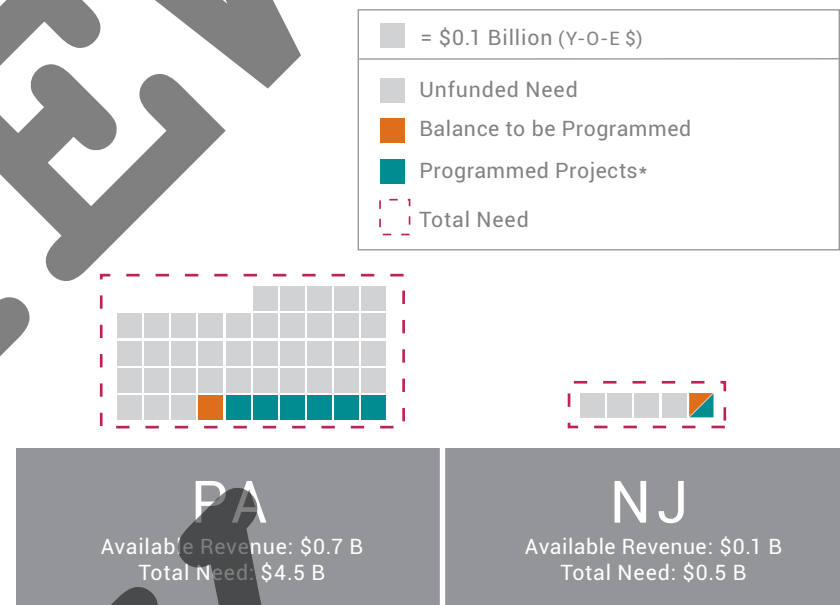
percent of the New Jersey subregion's transit system preservation improvements can be funded.

MAJOR REGIONAL TRANSIT OPERATIONAL IMPROVEMENT PROJECTS

Operational improvements include new sidings, additional vehicles to expand the fleet, and other projects that allow for increased service frequency. Projects, such as the Norristown Line third track, will enable service and safety improvements. New, frequent express bus service along the Roosevelt Boulevard corridor in Philadelphia with amenities like high-quality stations and a unique brand will serve multiple travel markets. Funding for these Enhanced Bus services may partially or fully come from the region's roadway revenues such as the Congestion Mitigation and Air Quality fund (CMAQ). NJ TRANSIT will fully implement positive train control on the routes. Finally, completion of the SEPTA Key project will give the region one of the most advanced payment systems in the country.

Figure 44 illustrates the programmed and available funding for transit operational improvement projects as compared with the total need in each state's subregion. Only about 16 percent of the Pennsylvania subregion's and 20 percent of New Jersey subregion's transit operational improvements can be funded.

FIGURE 44: TRANSIT OPERATIONAL IMPROVEMENT PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045)



*Includes projects programmed in the TIP and funded Major Regional Projects in the Long-Range Plan

Source: DVRPC, 2017.

TABLE 19: MAJOR REGIONAL TRANSIT OPERATIONAL IMPROVEMENT PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
Regional Rail System: Core Capacity Improvements	Interlockings, sidings, flyovers, and freight separation projects to increase service frequency on Regional Rail lines	Bucks, Delaware, Montgomery, Philadelphia	Unfunded		\$ 850.0
Roosevelt Boulevard Direct Bus Phase I	Station infrastructure and passenger amenities to allow direct bus service along Roosevelt Boulevard between Neshaminy Mall and Frankford Transportation Center	Bucks, Philadelphia	2018–2021	\$ 4.0	
West Chester Pike Enhanced Bus Service	Signal prioritization and transit amenities from West Chester Transportation Center to 69th Street Transportation Center	Chester, Delaware	Unfunded		\$ 8.0
Media Trolley Line Second Track	Double tracking from east of Pine Ridge Station to Woodland Avenue	Delaware	Unfunded		\$ 19.0
Trolley Modernization	Communications, signals, power supplies, subway station and in street stops, track and bridge improvements, fare payment and trolley maintenance upgrades	Delaware, Philadelphia	2018–2045	\$ 440.0	
Norristown Regional Rail Line	Third track at Norristown Station	Montgomery	2023–2035	\$ 34.5	
Market-Frankford Line Capacity Enhancements	Lengthened station platforms, 80 supplemental rail cars, reconfigured railcar seating, power system improvements, and ADA accessibility improvements	Delaware, Philadelphia	Unfunded		\$ 870.0
Roosevelt Boulevard Direct Bus Phase II	Station infrastructure and passenger amenities to allow direct bus service along Roosevelt Boulevard between Frankford Transportation Center and Wissahickon Transportation Center	Philadelphia	Unfunded		\$ 6.0
SEPTA Key	Updated system-wide fare collection system	Pennsylvania subregion	2018–2022	\$ 130.3	
Real-Time Information/ Audio Visual Public Address System	New passenger information at rail and transit stations	Pennsylvania subregion	2018–2022	\$ 34.7	

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$	UNFUNDED COST MILLIONS OF 2017 \$\$
Improved Transit Service to Philadelphia International Airport	Infrastructure improvements to increase Airport Line service frequency, as well as enhancement of other transit modes that serve PHL	Delaware, Philadelphia	Unfunded		\$75.0
NJ TRANSIT Positive Train Control	Installation of positive train control on all active NJ TRANSIT rail lines	Camden, Mercer, Burlington	2018–2021	\$ 21.6	
Atlantic City Line Frequency Improvements	Siding and station improvements; new commuter rail vehicles	Camden, Philadelphia	Unfunded		\$ 105.0

Source: DVRPC, 2017.

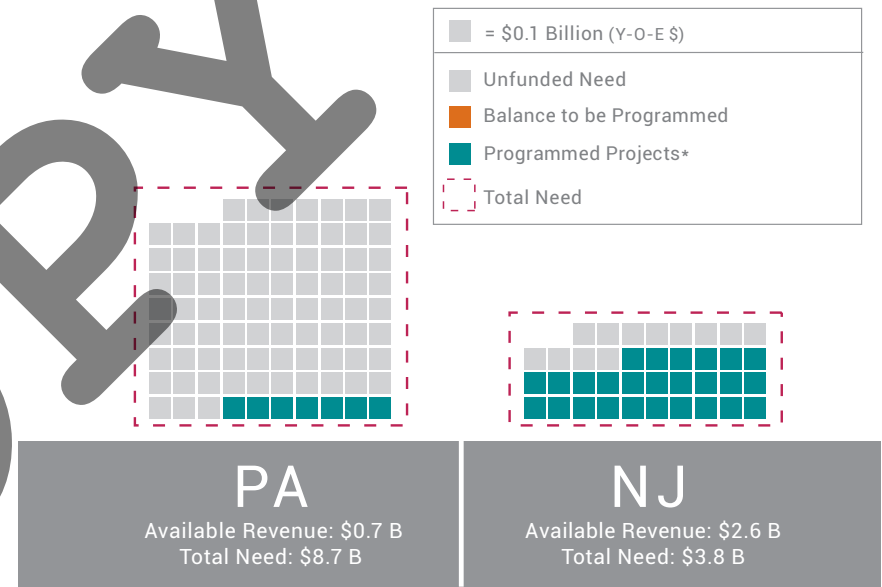
MAJOR REGIONAL TRANSIT SYSTEM EXPANSION PROJECTS

The Media-Elwyn Line extension to Wawa is funded in the TIP's 12-year program and will open by 2026. It is being financed with the help of EB-5 program funds. The Norristown High Speed Line Spur to King of Prussia is funded in the Plan and will open in the later years of the Plan. PATCO's Franklin Square Station will also be reopened.

In New Jersey, the South Jersey BRT will run along NJ 42 and NJ 55 in Gloucester County into Center City, Philadelphia. The Glassboro-Camden Line will be constructed in the later years of the Plan.

Figure 45 illustrates the programmed and available funding for transit system expansion projects as compared with the total need in each state's subregion. Only about 8 percent of the Pennsylvania subregion's and 68 percent of the New Jersey subregion's transit system expansion improvements can be funded.

FIGURE 45: TRANSIT SYSTEM EXPANSION PROGRAMMED PROJECTS, ALLOCATED REVENUE, AND TOTAL NEED (2018–2045)



*Includes projects programmed in the TIP and funded Major Regional Projects in the Long-Range Plan

Source: DVRPC, 2017.

TABLE 20: MAJOR REGIONAL TRANSIT SYSTEM EXPANSION PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$		UNFUNDED COST MILLIONS OF 2017 \$\$
				STATE AND LOCAL	FEDERAL NEW STARTS/SMALL STARTS	
Bethlehem Branch Passenger Rail Extension	Extend service from Lansdale to Perkasie	Bucks, Montgomery	Unfunded			\$ 282.0
Atglen Regional Rail Extension	Extend Paoli-Thorndale Line to Atglen	Chester	Unfunded			\$ 15.5
West Chester Rail Service restoration	Extend Media/Elwyn/Wawa Line to West Chester Borough	Chester, Delaware	Unfunded			\$ 126.0
Pottstown Rail Extension	Extend Norristown Line to Pottstown	Chester, Montgomery	Unfunded			\$ 419.0
Media-Elwyn Line Rail Extension	Extend from Elwyn to Wawa	Delaware	2018–2022	\$ 150.6		
Norristown High Speed Line King of Prussia Expansion	Rail Line Extension from Hughes Park to King of Prussia	Montgomery	2023–2035	\$ 550.0	\$ 550.0	
New West Market Market- Frankford Line Station	New Station on Market-Frankford Line	Philadelphia	Unfunded			\$ 345.0
Roosevelt Boulevard Surface Transit Line	New surface transit line along Roosevelt Boulevard	Bucks, Philadelphia	Unfunded			\$ 500.0
Delaware Avenue Transit Service	New transit service within Philadelphia	Philadelphia	Unfunded			\$ 920.0
Broad Street Transit Extension	Transit Extension to Navy Yard	Philadelphia	Unfunded			\$ 1,250.0

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FACILITY	PROJECT SCOPE	LOCATION	TIMING	FUNDED COST MILLIONS OF Y-O-E \$\$		UNFUNDED COST MILLIONS OF 2017 \$\$
				STATE AND LOCAL	FEDERAL NEW STARTS/ SMALL STARTS	
Franklin Square Station	Reopened station on the PATCO Line in Philadelphia	Philadelphia	2018–2027	\$ 5.2	\$ 20.8	
South Jersey BRT	New BRT from Avondale Park-and-Ride and Delsea Drive to Center City, Philadelphia	Camden	2028-2045	\$ 90.0		
Glassboro-Camden Line	Construct new transit line from Camden to Gloucester County	Camden, Gloucester	2028–2035	\$ 2,430.0	\$ 700.0	
US 1 BRT	Express bus network serving the US 1 corridor and providing access from Somerset County on US 206, Monmouth County on CR 571, Burlington County on I-295, and Bucks County on I-95	Mercer, Bucks	Unfunded			\$ 150.0
West Trenton Line	Re-establish passenger service on the West Trenton Line to Newark and Secaucus (from West Trenton Station to Bridgewater); relocate West Trenton Station to Parkway Avenue TOD	Mercer	Unfunded			\$ 150.0

Source: DVRPC, 2017.

EXTERNALLY FUNDED PROJECTS

In addition to those projects receiving federal and state transportation dollars, *Connections 2045* includes a list of non-federal- and state-funded projects. These projects are generally funded through toll revenues, but some have other sources. The New Jersey Turnpike has recently completed its Exits 6 to 9 widening project. The new I-95 and Pennsylvania Turnpike Interchange addresses the missing movement between these two critical facilities. The Pennsylvania Turnpike is the

subject of two widening feasibility studies. The first study is for the section between Mid-County and Bensalem (mileposts 50 to 59); the second is for the area around the Delaware River Crossing. Separately, the extension of Lafayette Street in Norristown and the Lafayette St./Ridge Ave. interchange will provide direct access from the Pennsylvania Turnpike to Norristown: one of the region's Town Centers.

TABLE 21: EXTERNALLY FUNDED MAJOR REGIONAL PROJECTS

FACILITY	PROJECT SCOPE	LOCATION	TIMING	COST MILLIONS OF 2017 \$\$
I-95 at PA Turnpike	New partial interchange at I-276; widen Pennsylvania Turnpike from US 1 to New Jersey; widen I-95 from PA 413 to Pennsylvania Turnpike	Bucks	2018–2022	\$ 140.0
I-95 at Scudder Falls Bridge	Widen I-95 from PA 332 to the Delaware River Bridge; replace and widen the Delaware River Bridge; reconfigure I-95 interchanges at Taylorsville Road and NJ 29; repave I-95 from PA 332 to CR 579 (Bear Tavern Road)	Bucks, Mercer	2018–2022	\$ 512.0
PA Turnpike	All electronic tolling	Bucks, Chester, Montgomery	2018–2028	\$ 257.0
NEC Future	Includes capacity improvements throughout corridor; new right-of-way and station to directly serve PHL airport; new hub station at Baldwin/Chester, and other improvements to support higher speeds and increased levels of service.	Bucks, Delaware, Philadelphia, Mercer	Unfunded	TBD
I-476 PA Turnpike NE Extension	Reconstruct and widen to six lanes from Lansdale to Quakertown	Bucks, Montgomery	2018–2028	\$ 450.0
I-76 PA Turnpike	Reconstruct and widen from Morgantown, Berks County to Valley Forge	Chester, Montgomery	2018–2035	\$500.0
I-276 and Lafayette Street/Ridge Avenue	New interchange	Montgomery	2023–2028	\$ 66.4
30th Street-Mantua-Philadelphia Zoo Connector	New fixed-guideway shuttle service connecting 30th Street Station; new 30th Street District development; the Mantua neighborhood; and the Philadelphia Zoo	Philadelphia	Unfunded	TBD
Atlantic City Expressway	Construction of a third lane in the westbound direction from milepost 31 to milepost 44	Camden	2018–2027	\$ 150.0
Atlantic City Expressway	Implement all electronic tolling throughout entire facility	Camden, Gloucester	2018–2021	\$ 50.0

Source: DVRPC, 2017.

PORT AND RAIL FREIGHT IMPROVEMENTS

Strategic improvements to the region's world-class port and rail freight networks will streamline operations, strengthen Greater Philadelphia's ability to compete with other regions, complement highway and highway connector improvements, and enhance the industry's ability to be a good neighbor. Many of these projects will be identified through statewide freight plans and result from P3s and from revenue sources outside of DVRPC's traditional funding purview. FASTLANE grants are just one example of these outside funding sources that assist nationally and regionally significant freight and highway projects that align with the FHWA program goals.

The Commonwealth of Pennsylvania recently unveiled a \$300 million Capital Investment Program, which targets the Packer Avenue Marine Terminal complex and the Tioga Marine Terminal in Philadelphia. These improvements will result in doubling container capacity at the facilities, provide increased capacity for noncontainerized cargoes, and bring a substantial increase in automobile-handling capacity. In New Jersey, a project of similar consequence was recently realized with the opening of the South Jersey Port Corporation's new Paulsboro Marine Terminal.

Dramatic advances have also occurred with regional rail freight facilities, such as the modernization of the Delair Bridge, the region's most important railroad link between New Jersey and Pennsylvania. Future rail freight projects may include providing doublestack clearance on CSX's Philadelphia Subdivision Line traversing Philadelphia and Delaware County, and removing bottlenecks and creating additional capacity for freight trains serving the Delaware County industrial waterfront.

PHILADELPHIA INTERNATIONAL AIRPORT

Airport capital improvements are primarily funded with fees paid by commercial airlines. PHL is planning a number of major improvements and renovations in the coming years that will significantly enhance and facilitate the traveling experience. A new air traffic control tower and a new arrivals building for terminals B and C will be constructed. Travelers will have access to new restaurants and retail offerings and be able to order food directly to their seats as they wait at gates. Also, the airport's fuel pumping and storage system will be modernized; many roofs, elevators, escalators, and HVAC units will be replaced; and aircraft de-icing equipment and airfield snow removal equipment will be purchased.

CLOSING THE FUNDING GAP

DVRPC's transportation infrastructure needs assessment found a minimum regional funding gap of nearly \$65 billion between the Vision Plan and the Funded Plan over the life of *Connections 2045*. Failure to maintain and improve the transportation network reduces the region's economic competitiveness, and it becomes a less attractive location for business investment; the environment is degraded due to increased congestion; more vehicular damage is caused due to poor road conditions; and vehicular crashes increase due to less-safe travel conditions.

The majority of the funding that the region currently uses to build, maintain, and repair its road and transit infrastructure currently comes from the federal and state governments. The region does not have the power to control the level of federal or state funding that it receives. Given the large set of needs that will remain unmet at current funding levels, the region should continue to explore ways to close its

funding gap. This can be through project right-sizing, better program management, innovative project delivery, and raising additional revenues with a focus on local funding options or P3s. It is likely that a combination of several funding mechanisms, with help from all levels of government, is needed to fully fund the region's identified needs. The region's local funding contribution is low compared to other large metropolitan areas. This restricts Greater Philadelphia's ability to fulfill the Vision Plan and puts the region at a competitive disadvantage when compared to its peers across the nation and around the world.

The Plan continues the dialogue and consensus building around the search for optimal funding solutions. The gas tax that is used to fund road and transit projects at the federal and state levels is quickly becoming obsolete due to increased use of electric vehicles that do not pay into it, more fuel-efficient vehicles that pay less per mile driven, and flat rates of total VMT. There is a need to have a serious discussion about what sort of tax or fee should replace the gas tax. This is also an opportunity to think about how the design of markets and pricing the system can help to further the goals of the Plan while creating a more equitable, safe, and efficient transportation network. Funding will become an even more significant issue if federal transportation dollars do not grow to keep up with future needs or even with inflation.

PROJECT RIGHT-SIZING

Right-sizing and seeking efficiencies throughout the transportation network works to resolve transportation problems with solutions that are context sensitive, affordable, supported by the surrounding communities, and implementable in a reasonable timeframe. Right-sizing means the DOT will consider reduced-scale alternatives like TSMO before developing alternatives, such as new or widened

roadways. If safety, and not congestion, is the problem, then the DOT will consider focused solutions that can improve safety without increasing capacity. That said, safety must be considered in all projects.

LOCAL FUNDING OPTIONS

Additional funding is needed if the region wants to realize the transportation vision set forth in this Plan. New funds will most likely need to be generated at all levels, including locally. To do this, the region needs to find ways to translate recent growth into improvements in the transportation system. Ideally, any new local transportation funding sources should be easy to implement, stable and sustainable over time, equitable both for system users and over geographic areas, should further the goals and policies of the Plan, and not yield unintended negative economic impacts. In addition, the region can use financing to help advance large-scale projects using tools, such as bonds, Transportation Infrastructure Finance and Infrastructure (TIFIA) loans, the EB-5 program, state infrastructure banks, and P3s. See Appendix F for more information on these tools.

DVRPC's work in this effort recognizes that poor infrastructure conditions and the failure to improve transportation system performance puts the region at an economic disadvantage compared to our peer competitor regions, both in the United States and around the world. The goal has been to find ways to use the region's economic growth as a means to enhance the transportation network. DVRPC has reviewed more than two dozen different taxes or fees that could potentially fund the region's transportation system. *Connections 2045* maintains the focus on direct user fees, which are widely considered to be the fairest way to pay for system improvements. These fees are

related to the use of the transportation system and can include MBUF, tolling, gas taxes, or transit fares, among others. Most of these funding options require state-enabling legislation before the region can pursue them. It is not likely that any single option could fill the funding gap on its own. DVRPC has not identified any of the options as a preferred alternative. Rather, the hope is to encourage discussion and develop consensus on the optimal funding mechanisms to help the region achieve its transportation goals. The implications of HAVs and other emerging technologies must also be a part of this conversation. The transition to HAVs is likely to be far more transformative than changing revenue sources, and may even necessitate new funding methods.

None of these fees are necessarily easy to implement, as state-enabling legislation (for anything besides transit fares) is required. Adding tolls to Interstate highways would require federal government approval and is not allowed under current federal regulations. It is likely much easier to implement an increase to an existing fee, than it is to create a new payment system. The way in which we charge for the use of the transportation network can potentially help realize some of the Plan's goals while also building agglomeration economies needed to make the region more economically competitive. Achieving this means new charges should support denser, Centers-based development patterns, encourage more development in areas served by transit, with the requisite pedestrian and bike facilities. This can reduce pressure to grow in the less-developed portions of the region. Careful market design can help to make the transportation network more efficient, while reducing energy use and lowering congestion.

INVESTING IN THE VISION

The transportation investments outlined in *Connections 2045* help to create a well-maintained, safe, sustainable and seamlessly connected multimodal transportation network. These investments will also further the regional transportation, land use, environmental, equity, and economic competitiveness goals contained in the Plan. The top priority is to rebuild, maintain, and update existing transportation infrastructure. Nearly 70 percent of projected available funding will be allocated to rebuild the roadway and transit systems. Transit, bicycle, and pedestrian projects reflect a significant funding commitment in the Plan. These types of investments will help to focus growth and development in Centers, make transportation more space efficient, and lower demand for new roadway facilities. Building less infrastructure can reduce future maintenance needs. Placing development near existing transit routes will help increase ridership. It will improve the operating cost recovery of our transit system, making it more self-sufficient, and will allow for more capital funding for system improvements.

The next largest amount of funding is allocated toward improving the operation of the system and using technology to increase the flow of information, find new efficiencies, and improve safety. Given future uncertainty with regard to a changing climate and advances in technology, a multimodal network offers flexibility to respond to shifts in demand. Taken altogether, the financial plan reflects the goal of constructing an integrated multimodal transportation network. While the financial plan serves as an initial down payment for achieving the vision, there is still much work to be done. The system needs a new way of funding that can both support the goals and policies set within the Plan while also addressing the funding needed to make the vision a reality.

TABLE 22: REGIONAL USER FEES SUMMARY

FUNDING OPTION	DESCRIPTION	PROPOSED RATE	% INCREASE	ANNUAL REVENUE (2017 MM \$\$)		LONG-TERM ANNUAL CHANGE		LONG-TERM IMPLICATIONS
				PA SUB-REGION	NJ SUB-REGION	VMT (MM)	TRANSIT RIDERSHIP (MM)	
Access Fees	Charge on nonresidential taxable property located within a quarter-mile of transit stations	\$0.25 per square foot	Varies	\$ 40.0	\$ 5.0	0.0	0.0	Could lead to slight shift away from transit-oriented locations; alternatively could finance new transit routes, increasing transit-accessible locations and ridership
Carbon Tax	Tax placed on carbon emissions	\$30 per MTCO ₂ E	2.3% to cost of driving per mile	\$ 480.0	\$ 210.0	-280.0	+0.8	Likely to increase use of alternative-fuel or energy-efficient vehicles, and may encourage alternative modes of transportation
Congestion Pricing	(a) Cordon toll around Center City; (b) Peak-hour congestion pricing on region's highways	(a) \$5 per vehicle entering cordon area; (b) \$0.20 per peak hour vehicle mile driven	(a) ~25% per Center City vehicle trip; (b) ~37% per peak-period highway trip	(a) \$110.0 (b) \$300.0	(a) \$0.0 (b) \$160.0	(a) -180.0 (b) -270.0	(a) +3.6 (b) +5.6	(a) May have negative impacts on Center City, but this area of the region has the most transportation options; (b) Option with most congestion reduction; high administration costs
Fuel Sales Tax	Applies a sales tax to the purchase price of gasoline, not including liquid fuels taxes	2% of the retail gasoline price	2% increase to fuel cost	\$ 40.0	\$ 25.0	-40.0	+0.1	Likely to increase use of alternative-fuel or energy-efficient vehicles, and may encourage use of alternative modes

continued on next page...

FUNDING OPTION	DESCRIPTION	PROPOSED RATE	% INCREASE	ANNUAL REVENUE (2017 MM \$\$)		LONG-TERM ANNUAL CHANGE		LONG-TERM IMPLICATIONS
				PA SUB-REGION	NJ SUB-REGION	VMT (MM)	TRANSIT RIDERSHIP (MM)	
Mileage-Based User Fees	A fee on each vehicle mile driven, assessed at inspection and/or registration	\$0.01 per mile	1.9% compared to cost per mile driven	\$ 240.0	\$ 150.0	-660.0	+2.9	Largest decline in VMT; may encourage more compact development patterns
Regional Toll Surcharge	a) Add surcharge to 12 regional turnpike exits; (b) add surcharge to nine bridges over the Delaware River	(a) \$1.00 per trip; (b) \$1.00 per crossing	20-100%	(a) \$ 95.0 (b) \$ 45.0	(a) \$ 20.0 (b) \$ 45.0	(a) -190.0 (b) -90.0	(a) +0.6 (b) +2.0	Many trips lack transportation alternatives; may benefit goods movement through reduced congestion
Sales Tax	Levied as a percentage of the purchase price for goods, products, and services	Increase 0.5%	13-17%	\$ 250.0	\$ 100.0	-8.0	0.0	Little impact on transportation system use and development patterns
Toll Existing Highways	Assessed as a user fee on designated limited access roads and bridges	\$0.10 per mile	~19% per highway trip	\$ 420.0	\$ 290.0	-290.0	+0.7	May shift traffic onto local roads; high administration costs; may encourage TOD
Transit Fare Increases	Cost per transit trip or monthly/weekly pass	3.0%	3% fare increase	\$ 9.0	\$ 1.0	+16.0	-5.6	May reduce transit ridership and increase congestion
Vehicle Registration Fee	Annual assessment on vehicle ownership	\$10 per vehicle per year	0.2% to annual vehicle ownership cost	\$ 20.0	\$ 10.0	-2.4	0.0	Very little impact on transportation system use and development patterns

Source: DVRPC, 2017.



Credit-Pennsylvania Horticultural Society (PHS)



Photo Credit: UPENN.



5. TAKING ACTION

Connections 2045 serves as the key policy directive for DVRPC, but it is also a regional blueprint for future growth and development. The Plan seeks to create more transportation choices to serve vibrant communities and provide easy access to a variety of transportation modes. Drivers will benefit from the provision of better information, improved safety, and reduced congestion. In a world of rapid technological and intense global competition, the provision of mixed-use, transit-oriented neighborhoods are critical for building a flexible transportation network, reducing GHG, and enhancing community livability in ways that can attract skilled workers and provide for a high quality of life.

Implementing the Plan is an ongoing process. As such, it will require collective action to achieve its vision. Attaining the vision and goals outlined in the Plan will require a shared effort that begins with an assessment of the impact our individual actions have on the region. Two themes routinely heard during the public outreach for *Connections 2045* are the increased need for regional coordination and government efficiency. These are key strategies to implement the Plan, and they offer a future that is more transparent, innovative, and collaborative. They can increase partnerships between businesses and governments,

and develop a fairer and more equitable tax structure that can spur regional growth. Multimunicipal planning and shared services are one way in which local governments can leverage network effects and economies of scale. Multimunicipal planning is a key foundation to increasing both regional coordination and government efficiency. There are many other areas where government can better coordinate, and information is a key tool to facilitate that. Data coordination is an area of growing interest that can help governments and others better coordinate, but more importantly, make better decisions.

By "thinking regionally but acting locally," the region can achieve coordinated and cooperative action across municipal, county, state, and federal levels, and between the public and private sectors. DVRPC acts as a facilitator to bring together stakeholders throughout the area to discuss regional issues. A number of committees bring together elected officials, planners, professional practitioners, and the private sector. DVRPC also strives to implement the vision and policies of *Connections 2045* through its work program and projects, and to provide an array of services to municipalities throughout the region. The next section highlights some initiatives from DVRPC and its stakeholders, and includes action steps that everyone in the region can take to help bring the Plan to fruition. Taking these steps can

help reduce energy use and resulting GHG emissions, strengthen and create livable communities, support local economies, make the region more equitable for everyone, and improve the functionality of the region's transportation system. Many actions will even save money and contribute to a healthier lifestyle.

ACTIONS TO SUSTAIN THE ENVIRONMENT

DVRPC SPOTLIGHT

Air Quality Partnership is a public-private coalition of businesses and organizations that promote better air quality through voluntary actions to reduce air pollution. The partnership is administered by DVRPC and provides a daily air quality forecast for the region and tips to protect personal health through a broad-based outreach effort.

TreeVitalize is a program launched by the Pennsylvania Department of Conservation and Natural Resources (DCNR) to increase public awareness of the importance of community trees and to reverse the loss of tree cover in the state's metropolitan areas. To directly reverse that loss, DVRPC has partnered with the Pennsylvania Horticultural Society (PHS) to access funding from the Pennsylvania Infrastructure Investment Authority (PENNVEST) for tree planting projects that manage stormwater. To date, the DVRPC/PHS partnership has received funding awards from PENNVEST to plant over 4,500 trees in communities across the region.

Municipal Actions to Protect Water Quality is a recent two-year DVRPC project funded by the William Penn Foundation, working with stakeholders across the Delaware River Watershed to assist municipalities in their efforts to protect and improve water quality.

Intensive stakeholder input obtained through hundreds of one-on-one phone and in-person interviews confirmed that nonpoint-source stormwater runoff caused by development, suburbanization, and forest fragmentation is among the most serious threats to water quality across the watershed. The technical results of this project, due to be published in the fall of 2017, will advance key recommendations to protect headwater forests, preserve and restore vegetated riparian buffers, and mimic natural processes in urban settings by utilizing GSI.

The Climate Adaptation Forum is an ongoing series of DVRPC-hosted, half-day, solutions-focused workshops, taking place two to four times per year. The Forum brings together regional professionals currently engaged in preparing for climate change. Each workshop features one or more professionals presenting on their current activities related to addressing a particular climate change adaptation issue. Topics have included: Forests, Urban Trees, and Climate Change; Public Health and Climate Change; and Waterfront Development and Climate Change.

FOCUS ON REGIONAL STAKEHOLDERS

SEPTA SUSTAINABILITY PROGRAM

SEP-TAINABLE 2020 outlines SEPTA's triple-bottom-line approach to sustainability: accounting for environmental, social, and economic organizational needs and regional opportunities. One of the guiding principles of the sustainability program is to develop financially sound investments and programs. As a result, a new economic goal was added to track and report the grants, revenue, and savings SEPTA receives from sustainability initiatives. By tracking the positive financial impacts of sustainability initiatives, SEPTA knows which investments and programs provide the greatest financial yield. Having

this information allows SEPTA to make financially informed decisions on whether to continue or expand programs, helping SEPTA to grow its environmental and social impact while simultaneously improving its economic position. The total positive financial impact of sustainability initiatives exceeds \$121 million. For more information about SEPTA's sustainability program visit: www.septa.org/sustain.

NEW JERSEY RESILIENT COASTAL COMMUNITIES INITIATIVE³³

New Jersey's Resilient Coastal Communities Initiative is run by the New Jersey Department of Environmental Protection's (NJDEP's) Office of Coastal and Land Use Planning, and DVRPC is an active participant in this initiative. NJDEP has been working with six municipalities along tidal waterways in Burlington County to help them understand their vulnerability to coastal storms and sea level rise. The project uses maps and data to show municipalities how they may be affected by flooding from sea level rise and storm surge in the second half of the 21st century. In visualizing how these hazards differ from historic and current coastal floods, partner communities can better plan and prepare for a future of increasing coastal hazards. At the same time, this partnership helps make the communities more resilient to current threats from flooding, coastal erosion, and severe storms.

The project used two tools—the Coastal Vulnerability Assessment, and the Getting to Resilience questionnaire—to assess each municipality's vulnerable assets (such as buildings, infrastructure, and natural resources) and develop strategies for making them more resilient to future coastal floods. The Coastal Vulnerability Assessment models the impacts of storm surge and sea level rise in different decades and

generates maps to help communities see how buildings, infrastructure, and natural resources could be harmed by flooding. The assessment also helps identify vulnerable populations that may require additional assistance in the event of a coastal emergency.

Final reports for each of the six municipalities will be published in late 2017. These documents will be the basis for implementing projects that will enable them to best guard against the effects of coastal flooding, such as zoning or land development ordinance updates; green and gray stormwater infrastructure improvements; wetland conservation and restoration; and other, risk-based management strategies.

SEPTA PROTERRA EMISSIONS-FREE ELECTRIC BUS DEBUT AT THE 2016 DEMOCRATIC NATIONAL CONVENTION (DNC) IN PHILADELPHIA



³³ New Jersey Department of Environmental Protection, Land Use Management, Coastal Hazards of New Jersey: Now and with a Changing Climate, Updated January 26, 2017, http://www.state.nj.us/dep/cmp/czm_hazards.html.

WHAT YOU CAN DO

- Start or join a neighborhood composting program and recycle to reduce household waste.
- Make sure your home is properly insulated and turn the thermostat to 75 degrees or higher in the summer months, and 68 degrees or lower in the winter months.
- Reduce polluting activities, such as driving, mowing your lawn, or filling your car's gas tank on days with poor air quality.
- Purchase LED or compact fluorescent light bulbs, and energy-efficient appliances and vehicles; turn off lights and appliances when not in use.
- Support local farmers by purchasing fresh food from local sources.
- Plant a tree or grow a garden.

ACTIONS TO DEVELOP LIVABLE COMMUNITIES

DVRPC SPOTLIGHT

Transportation and Community Development Initiative (TCDI) provides grants to support local planning initiatives that implement the region's long-range plan. Between fiscal years 2002 and 2017, DVRPC has distributed \$16.0 million to over 230 communities throughout the region for TCDI planning grants, leveraging over \$330 million in public and private funding. Leveraged dollars include additional planning, engineering, and construction activities.

Municipal Implementation Tools are a series of brochures specifically written for busy municipal officials and staff who want an introductory overview on topical issues. Twenty-nine brochures have been published to date. Recent publications have focused on tax incentives, attracting immigrant populations, the pop-up economy, and crime prevention. Previous issues have covered a wide range of topics, such as shared services, noncontiguous parcel clustering, zoning for wireless service facilities, and energy-efficient traffic signals and streetlights.

Classic Towns is a marketing program that aims to promote the region's developed municipalities and neighborhoods as great places to live, work, and play. This competitive program includes 22 designated Classic Towns that financially contribute to a pool of funding collectively used for marketing the Classic Towns and enhancing their staffs' skills. Marketing includes a promotional video, website, and events, such as a Classic Towns photo contest and traveling show. Targeted professional development bolsters skills in public relations, marketing, using social media, and engaging local businesses.

The Healthy Communities Task Force was first convened in 2014 to bring together public health, planning, and related professionals in the Greater Philadelphia area. The Task Force provides a venue for people interested in fostering healthy communities to learn about other communities, both near and far, that are successfully integrating planning and public health. It serves as a way for professionals in these fields and stakeholders in our communities to deepen their understanding of healthy communities and build the relationships to achieve them. Recent meeting topics have included the Intersection of Civic Space and Mental Health, Climate Change and Health, Health and Housing, Active Transportation and Equity, Aging-Friendly Communities, and Integrating Health into Comprehensive Planning. DVRPC will continue to convene the Task Force, as well as work both internally and with state, county, and municipal partners to support the integration of health into different projects and processes across our region.

Promoting Green Stormwater Infrastructure in Montgomery County is part of a larger greenway planning effort for western Montgomery County. The Montgomery County Planning Commission engaged DVRPC to help small towns and boroughs envision how they can incorporate GSI directly in their downtowns. GSI systems will improve the livability of these downtown locations through greening and beautification and by increasing amenities for pedestrians, while at the same time managing stormwater. DVRPC recently developed photo simulations of curb bump-outs and stormwater planters in downtown Harleysville and Red Hill Borough to help them visualize these techniques and promote their implementation.

Green Stormwater Infrastructure: BEFORE



Green Stormwater Infrastructure: AFTER



FOCUS ON REGIONAL STAKEHOLDERS

OXFORD MILLS—SOUTH KENSINGTON, PHILADELPHIA³⁵

In 2014, a pair of abandoned factory buildings in Philadelphia's South Kensington neighborhood were reborn as Oxford Mills: a mixed-use hub for the city's education and nonprofit communities. Included in the development are 94 below-market-rate apartments and a collection of office and retail spaces, with most tenants having close ties to the city's public school system. Oxford Mills was conceived as a collaborative and supportive environment for teachers and like-minded professionals to live, work, and socialize at a low cost. The project was the brainchild of business partners Gabe Canuso and Greg Hill, of D3 Real Estate Developers, and the Seawall Development Company, modeled on similar facilities delivered by Seawall in Baltimore. Monthly rent discounts of \$200–400 are made possible through their decision to use federal historic and New Market tax credits, which ultimately lowered the debt-service required to finance redevelopment of the former textile mill and lamp factory. According to Hill, roughly 60 percent of the units are rented by educators, with the remaining occupants having comparable earnings. Tenants of each residence can appreciate their design on top of their affordability, with carefully preserved details, original masonry, and sustainably sourced and manufactured materials on many new installations. On-site amenities are plentiful, including a fitness center, copy room, courtyard with outdoor furniture, event space, and coffee shop.

³⁵<https://savingplaces.org/stories/at-philadelphias-oxford-mills-former-textile-mill-becomes-beacon-for-educators>

KING OF PRUSSIA

With more than 21 million square feet of commercial space and 45,000 jobs, the King of Prussia area is Greater Philadelphia's second largest economic center. This regional center includes the King of Prussia Mall and is located near two of the region's top tourist destinations: Valley Forge National Historic Park and the Valley Forge Casino resort. SEPTA, PennDOT, Upper Merion Township, the King of Prussia Business Improvement District, Greater Valley Forge TMA, and many others are working together to make this part of the region more multimodal and accessible. King of Prussia Rail (Norristown High Speed Line Spur from Hughes Park to the King of Prussia Business Park) will improve connections to other regional centers, such as Philadelphia and Norristown, Pennsylvania. By creating new travel options, visitors, employees, and residents can avoid congested roadways in the area. The First Avenue Linear Park is a P3 that will be a model for many other areas in the future. The Linear Park will stretch 2.6 miles, traversing 26 privately owned parcels, from North Gulph Road to Allendale Road. It will feature a multiuse path, landscaping, lighting, activities, and street furniture. First Avenue itself will be given a road diet, with bike lanes and center-turn lanes. These transportation improvements will help to serve new development in the area, such as the new Village at Valley Forge and King of Prussia Town Center. These developments utilize New Urbanism to create a new walkable main street with nearly 400,000 square feet of retail and restaurants; 1.5 million square feet of office space; 500 hotel rooms; and more than 3,000 residential units. By making the area into a multimodal and mixed-use live, work, play center, King of Prussia will be set to prosper in the age of Centers-based development.

CAMPBELL'S HEALTHY COMMUNITIES PROGRAM³⁵

In 2011, the Campbell Soup Company launched Campbell's Healthy Communities, a 10-year, \$10 million effort to measurably improve the health of young people in Camden, New Jersey, by reducing childhood obesity and hunger. The program follows a collective impact framework, focusing on four strategic areas: food access, physical activity and access, nutrition education, and advancing positive social change. During the first four years of the program, Campbell's Healthy Communities funded 10 organizations to implement strategic programmatic interventions in 10 school- and community-based sites. According to the program's 2014 Annual Report, "the funding also addressed system-wide change targeting environmental and policy changes in our schools, behavioral changes in our children and families, and citywide changes in our food system." In Fiscal Year 2015 alone, Campbell's Healthy Communities' support helped The Food Trust add seven new stores to the Camden Healthy Corner Store Network; helped the YMCA and Soccer for Success to provide over 100,000 hours of physical activity; and helped a number of organizations provide almost 30,000 hours of nutrition education to Camden children and adults.

30TH STREET STATION DISTRICT PLAN

Philadelphia's 30th Street Station is one of Pennsylvania's busiest intermodal stations serving Amtrak, SEPTA, and NJ TRANSIT. The 30th Street Station District Plan creates a vision for an entirely new neighborhood above the rail yards on the western bank of the Schuylkill River. The District Plan will create an extraordinary gateway to the

city, add 40 new acres of open space and 18 million square feet of new development, and develop a new center for economic growth and opportunity expanding the region's core and its largest economic center. Included in the long-range plan are significant improvements to the stations including: new concourses and mezzanines for regional rail at 30th Street Station; improvements to the headhouse and station at 30th Street on SEPTA's subway and trolley lines; restoring the underground connection between 30th Street Station and the subway station; and, creation of an intercity bus station. The vision builds on ideas from a diverse and highly engaged group of stakeholders, including elected officials, community organizations, business, trade and advocacy groups, anchor institutions and major employers, transportation passengers, area citizens, and the general public. This project expands the region's core metropolitan center and helps to

The Future 30th Street Station District



Image courtesy of SOM / © Amtrak

³⁵ Campbell Soup Company and The Food Trust, *Campbell Healthy Communities Annual Report Fiscal Year 2014*, November 1, 2014, http://thefoodtrust.org/uploads/media_items/campbell-healthy-communities-annual-report-fy-2014-final.original.pdf.
Campbell Soup Company, *Campbell Healthy Communities Annual Report Fiscal Year 2015*, January 2016, <https://www.campbellsoupcompany.com/wp-content/uploads/sites/31/2016/05/2015-Healthy-Communities-Annual-Report.pdf>.

build network effects and agglomeration economies, while providing enhanced access to the Northeast Megaregion.

WHAT YOU CAN DO

- Live, work, shop, and play in the region's Centers.
- Volunteer to help clean up your street, local park, or open space.
- Support community-building, mixed-use developments when they are proposed in your neighborhood.
- Reduce stormwater runoff and water use by planting native plants, installing rain barrels, and replacing pavement with pervious materials.
- Take advantage of our region's extensive park and trail network by getting exercise and enjoying the outdoors.
- Facilitate walking or biking "school buses" in your neighborhood to help children learn how to safely get around on these modes.
- Keep your sidewalks clean and in good repair.

ACTIONS TO EXPAND THE ECONOMY

DVRPC SPOTLIGHT

DVRPC administers the **Regional Comprehensive Economic Development Strategy (CEDS)**. Called Investing in People and Places, it includes an overview of the regional economy; identifies regional strengths, weaknesses, opportunities, and threats; indicates performance measures that are tracked to measure progress made toward achieving the regional goals; and contains a list of key regional economic development projects and activities designed to advance the CEDS goals and objectives. The CEDS is updated annually and is developed under the ongoing guidance of a review committee,

which includes representatives of state, county, and city planning and economic development agencies; regional economic development organizations; chambers of commerce; academia; and the private sector. It is also a basis for the Plan's economic goals and strategies.

DVRPC's **Regional Street Lighting Procurement Program** pools together municipal buying power to assemble the resources needed to design, procure, and finance the transition to LED street lighting and other outdoor lighting needs. By pooling buying power, municipalities can access energy performance contracting, technical expertise, and financing for their projects without a need for upfront capital or in-house technical expertise.

The Regional Circuit Rider for Energy Efficiency in Local Government Operations (Circuit Rider) serves as a shared energy management resource for smaller municipalities in southeastern Pennsylvania, helping identify and implement cost-effective strategies to reduce energy use in municipal buildings, outdoor lighting, and water/sewage treatment facilities. The Circuit Rider provides municipal governments with a forum to learn about and share energy management best practices, and serves as a one-stop-shop for municipalities to access resources and funding to implement cost-effective energy management projects in their municipal operations. The Circuit Rider has worked directly with municipal governments in southeastern Pennsylvania to provide free technical consulting services to measure, analyze, and develop implementation strategies for cost-effective energy-management practices.

FOCUS ON REGIONAL STAKEHOLDERS

SELECT GREATER PHILADELPHIA COUNCIL

The Select Greater Philadelphia Council, part of the Chamber of Commerce for Greater Philadelphia, is the business attraction organization for the 11-county southeastern Pennsylvania, southern New Jersey, and northern Delaware region. Select highlights Greater Philadelphia's unique business assets to national and global audiences with the ultimate goal of growing the economic vibrancy of the collective community through attracting new businesses and new jobs to the region. Their efforts include: marketing and communications services to encourage companies to relocate or expand their operations in the community; business expansion services to help organizations from around the world relocate or expand in our region; connector and collaborative services to help relocating companies connect with economic development teams, real estate professionals, business experts, civic and community leaders, and other professionals; and, research services that provide comprehensive regional data to help companies, site selectors, economic development teams, and others make informed decisions when relocating to and expanding across the region.

SELLING TO THE WORLD: THE GREATER PHILADELPHIA EXPORT PLAN

In April 2016, the Economy League of Greater Philadelphia and the World Trade Center of Greater Philadelphia released *Selling to the World: The Greater Philadelphia Export Plan*, a metro export plan developed by business leaders, state and federal trade officials, and economic development experts from across southeastern Pennsylvania, southern New Jersey, and northern Delaware. Created

with support from the Global Cities Initiative, a joint project of the Brookings Institution and JPMorgan Chase, the Plan provides an action-oriented guide to export-led job and revenue growth in Greater Philadelphia. To implement the plan, the World Trade Center will enhance and leverage its export assistance programs, providing exporters in targeted sectors with counseling, market research, seminars and workshops, and assistance on overseas exhibitions and trade missions.

SMART CITIES COUNCIL GRANT – CITY OF PHILADELPHIA³⁶

In 2017, Philadelphia was one of five cities, out of more than 130 applicants, that was awarded a Smart Cities Council Readiness Challenge Grant by the Smart Cities Council. The grant recognized



Source: PhilaPort, 2017.

³⁶ beta.phila.gov/press-releases/mayor/philadelphia-awarded-smart-cities-council-readiness-challenge-grant/

Philadelphia's efforts to integrate existing information and communication technologies to improve municipal services, and provided resources to support the city in creating a strategic plan for implementing Smart City technology. As a grant awardee, the city will host a Smart Cities Readiness Workshop and receive supporting products and services from companies involved in the Smart Cities Council, including: Ameresco, AT&T, CH2M, CompTIA, Dow Building and Construction, IDC, Qualcomm, Sensus, Telit, TM Forum, and Transdev. The city is currently reviewing comments received from a request for ideas on how to leverage existing infrastructure to help build the IoT. In addition to efficiency, Smart Cities increase transparency, partnerships, and citizen engagement. Smart Cities Council Chairman Jesse Berst said "smart cities are cities where everyone works together toward a common vision...[to make]...a meaningful difference in the lives of the city's residents."

IMPACTPHL

ImpactPHL promotes the region's impact economy and unifies stakeholders from the investment, philanthropic, civic, and entrepreneurial ecosystems that are uniquely poised to define Philadelphia's present and future. ImpactPHL provides a point of entry—a "front door"—for investors, entrepreneurs, and civic leaders to engage in Philadelphia's impact ecosystem and facilitate further conversation around impact investing.

ImpactPHL is a partnership founded by Ben Franklin Technology Partners, the Germination Project, SustainVC, Dilworth Paxson, Halloran Philanthropies, Threshold Group, The Economy League of Greater Philadelphia, The Investors' Circle—Philadelphia Local Network, and A Way to Donate. The group aims to increase connections and

collaboration, grow the number of successful impact start-ups, engage established enterprises in impact objectives, increase the flow of impact investment capital, and position the region as a leading center of the impact economy; while pioneering fourth sector strategies that brings together governments, businesses, and nonprofits.

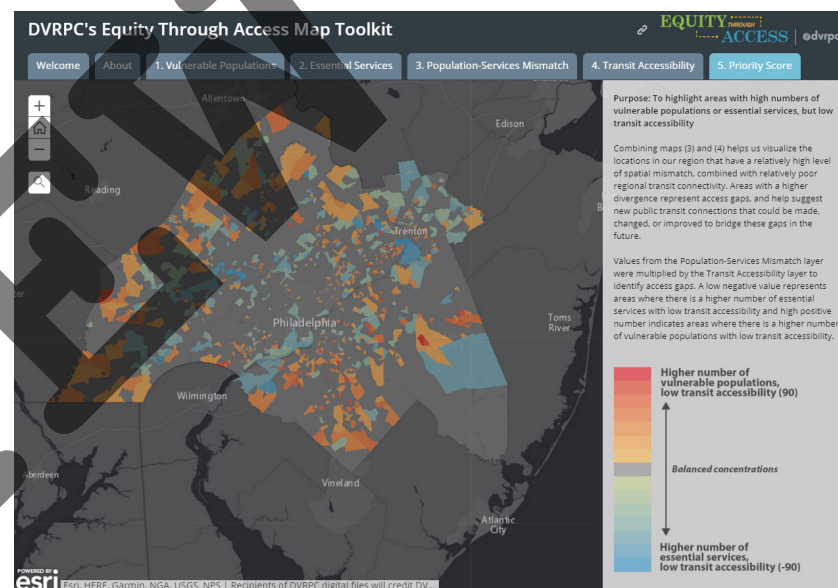
Current efforts include ImpactPHL Ventures, which is a regional investment partnership for emerging and technology-oriented impact enterprises; the Impact Investment Breakfast Series with a focus on social enterprise, entrepreneurship, and impact investing; Village Capital: Health & Fintech Accelerators for programming and investment; Best for PHL campaign to engage a variety of companies as a force for good, assessing them with B Lab tools; and the Chamber ImpactPHL Award to recognize the company most actively creating a positive impact.

THE PENNOVATION CENTER

The Pennovation Center is an innovation hub, incubator, and laboratory at the University of Pennsylvania that stimulates entrepreneurial activity and promotes the commercialization of research discoveries. The Center's mission is to facilitate the creation and growth of technology-based start-ups by providing them with value-added University of Pennsylvania and local tech community resources. The 58,000-square-foot facility features a shared co-working space operated by Benjamin's Desk and offers multiple community spaces reserved for activities that foster collaboration among faculty, students, entrepreneurs, investors, and corporate and economic development partners.

WHAT YOU CAN DO

- Conduct an energy-efficiency audit of your home or business and consider renewable energy sources.
- Integrate sustainable business practices into your company's operation.
- Buy local goods and services from businesses in your community.
- Consider the shipping impacts of online purchases, faster delivery often means greater carbon emissions.
- Develop key workforce skills for the information economy, such as STEM (science, technology, engineering, and math), entrepreneurialism, social skills, analytical skills, flexibility to adapt to shifting economic needs, critical thinking, problem solving, sales, self-promotion, the ability to work with one's hands, and understanding of natural systems and sustainable design.



Source: DVRPC, 2017.

ACTIONS TO ADVANCE EQUITY AND PROMOTE DIVERSITY

DVRPC SPOTLIGHT

As part of the **Equity Through Access (ETA)** project, DVRPC created an ETA Priority Score Map Toolkit. This interactive web-based tool demonstrates disparities in access to essential health services like hospitals, health clinics, recreational spaces, senior centers, and more in the Greater Philadelphia region. Users can view layers representing different data sets, including the locations of essential services; bus routes, transit stops, and rail lines; transit walksheds; distributions of vulnerable populations like seniors, households in poverty, and people with disabilities; and areas where transit access is low. By reviewing these simple, color-coded layers, users can explore the relationships

between transportation access, opportunity, and equity.

In February 2017, DVRPC staff led a regional **Paratransit Coordination Workshop** for human service transportation providers from Mercer County and neighboring counties as part of the ongoing ETA project.

The workshop was requested by Mercer County, which was concerned that mobility-restricted populations lacked adequate information about their transportation options and that a general lack of communication between local providers was causing service requests to go unfulfilled.

This workshop brought together representatives from human service transportation providers, TMAs, and TNCs to discuss existing mobility issues in the region and develop coordination strategies to help solve them. Workshop activities included presentations on regional best practice examples of transportation coordination, opportunities for

collaboration between human service transportation providers and TNCs, identifying existing service overlaps and potential service transfer points, and a brainstorming session to identify current issues facing service providers and ways to collaborate to meet the existing need. Attendees identified a need for agencies to improve data sharing practices, for human service transportation operators to better coordinate among themselves and with TNCs to redirect customers that they cannot serve, and for agencies and TNCs to collaborate on ways to work through regulatory limitations related to driver and vehicle qualifications.

FOCUS ON REGIONAL STAKEHOLDERS

JOHN C. ANDERSON APARTMENTS—CENTER CITY PHILADELPHIA³⁷

The stylish John C. Anderson Apartments debuted in 2014 as the state's first senior housing project specifically catering to the Lesbian, Gay, Bisexual, and Transgender (LGBT) community. Situated in the heart of Center City Philadelphia's well-known Gayborhood, the development features 62 one-bedroom apartments with modern kitchens and open floor plans. Applicants of any sexual orientation are welcome, as long as they qualify under the income and age restrictions. Units are reserved for those who earn between \$8,000 and \$33,000 annually, equating to 20%–60% of area median income. Monthly rents are paid on a sliding scale, ranging from \$192 to \$786. Named for a former city councilman whose political legacy was cut tragically short due to his sudden AIDS-

³⁷ Sources: https://www.washingtonpost.com/politics/a-philadelphia-apartment-building-may-be-a-national-model-for-low-income-lgbt-seniors/2014/09/12/f64e06bc-352d-11e4-8f02-03c644b2d7d0_story.html and http://www.philly.com/philly/columnists/inga_saffron/20140117_Changing_Skyline__John_C_Anderson_Apartments__LGBT-friendly_and_urban-friendly.html

related death in 1983, the John C. Anderson Apartments provide an affordable option to an aging LGBT cohort. Many from this generation were pioneering activists urging equal rights, although they often suffer from housing discrimination to this day.

The Anderson Apartments were among the first of several federally supported LGBT-friendly residences to emerge across the nation after a report from the U.S. Department of Housing and Urban Development brought to light the adverse treatment prevalent within the housing market. Mark Segal, publisher of the *Philadelphia Gay News*, helped arrange a P3 to develop the property with federal and state grants and low-income housing tax credits. Overwhelming interest in the John C. Anderson Apartments has spilled over onto a 100-person waitlist, suggesting that the model can be scaled up or replicated elsewhere in the region and nationwide.



THE WELCOMING CENTER FOR NEW PENNSYLVANIANS

The Welcoming Center for New Pennsylvanians is a nonprofit organization based in Philadelphia created to provide economic opportunity for newly arrived individuals from around the world. Its mission is to accelerate immigrant integration and economic advancement through education and training, employment, and entrepreneurship. Since opening in 2003, the Welcoming Center has worked tirelessly to help new Americans in this region, both through direct services and by raising awareness among the business and political community about the positive impact that immigrants have on the local and regional economy.

Working closely with the many regional stakeholders that have a stake in immigration, the Welcoming Center acts as a centralized employment and referral center for the region's growing immigrant community. Immigrants of all ages and education levels attend the Center's contextualized English and high school equivalency classes year round. Targeted classes with a focus on job preparedness are also made available so students may obtain the skills needed to thrive in the region's growing economy. The Center's Small Business Department helps immigrant entrepreneurs to start or expand their own businesses by providing free business classes and one-on-one technical assistance. Attracting and supporting immigrants reinvigorates and enhances the region's economy by providing a steady influx of new customers, workers, and entrepreneurs. By providing education, resources, and vocational training, the Welcoming Center helps to cultivate a stronger and more diverse economy.

ENTREPRENEUR WORKS

Entrepreneur Works, a program partner of the Urban Affairs Coalition, provides business loans of up to \$50,000; peer support and mentoring; business skills training; business counseling; credit building; and networking opportunities to low-income microentrepreneurs and the self-employed in low- and moderate-income neighborhoods in the Greater Philadelphia metropolitan region. Across the region, Entrepreneur Works clients have opened and expanded small businesses, created jobs for themselves and their neighbors, and strengthened the local economy.

ZLINE

In 2012, the Greater Mercer Transportation Management Association (GMTMA) learned that businesses located in the Matrix Business Park in Robbinsville, New Jersey, were having issues filling available positions. At the time, the business park was home to Green Mountain Coffee and several other light industrial businesses. Unemployment rates were still high following the recession, and many local people were in need of jobs. However, the business park was about five miles away from the nearest transit lines. To help resolve this issue, GMTMA developed a partnership with the Chamber of Commerce, the town of Robbinsville, Rise (a social services provider), and Mercer County Community College, among other partners, and obtained a technical assistance grant from the Community Transportation Association of America to address job access issues. In 2013, Amazon announced that it would be moving 2,000 jobs to the Matrix Business Park. Amazon's arrival helped move the project forward by providing the additional funding necessary to launch the shuttle. The aforementioned partnership met with human resource representatives from the 13 participating companies and gathered data, like shift times and policies on mandatory overtime, to ensure that a shuttle could be scheduled

at convenient times. They also worked to ensure that the ZLine would be connected to existing transit and that bus schedules would be coordinated.

The partnership secured New Jersey Job Access Reverse Commute funding, and the ZLine was launched in 2014. The ZLine runs a 4.2-mile route between Hamilton Marketplace and the Matrix Business Park, bridging the gap between four bus lines and the business center, and connecting residents from Trenton, Hightstown, and East Windsor to job opportunities. After its launch, ZLine ridership surveys found that 89 percent of riders reported a household income of less than \$35,000 and 37 percent reported less than \$15,000. Additionally, 41 percent of riders reported that they would not have been able to make the trip to the Matrix Business Park without the shuttle, and 74 percent reported that they did not have a car to make the trip. In its first year, the ZLine amassed 98,000 total rides.

WHAT YOU CAN DO

- Stay informed on the issues facing your community and the region.
- Attend public meetings to participate in and influence the decision-making process in your community.
- Support policies, organizations, and programs that voice action and support for equity.

ACTIONS TO CREATE AN INTEGRATED, MULTIMODAL TRANSPORTATION NETWORK

DVRPC SPOTLIGHT

The **Mobility Alternatives Program (MAP)** works with companies to improve their benefits package, helps employees save time and money on their commute, and reduces traffic and air pollution in the region. MAP provides information on transportation alternatives, including transit, carpooling, vanpools, and working from home, and helps companies and individuals utilize them. In addition, there is information on incentives, emergency rides home, flex time, and parking management. DVRPC works with TMAs to provide these services, and also enables companies to use Share-A-Ride, a free, comprehensive, computerized commute match service that can put employees in touch with the most convenient transit options or other commuters going their way.

Ride ECO is a commuter benefit program administered by DVRPC that employers can offer to their employees to help pay for commuting on transit. It encourages transit use and saves employers and commuters money because the program takes advantage of federal legislation that allows tax-free dollars to pay for transit fares.

The **Regional Trails Program**, administered by DVRPC, with funding from the William Penn Foundation, aims to capitalize upon opportunities for trail development by providing funding for targeted, priority trail design, construction and planning projects that promote a truly connected, regional network of multiuse trails with Philadelphia and Camden as its hub. DVRPC coordinates this program with the region's TIP, Transportation Alternatives Program, DNCR, and other mechanisms

to leverage funding. Currently, the region enjoys 320 miles of trail network and expects 65 additional miles to be constructed over the next five years. The program also provides technical assistance to trail developers, counties, municipalities, and nonprofit organizations.

FOCUS ON REGIONAL STAKEHOLDERS

PENNDOT CONNECTS

PennDOT Connects recognizes the critical role that transportation plays in connecting communities and supporting economic development. It is a tool to increase collaboration between PennDOT and local communities, governments, and agencies as transportation projects are being developed. PennDOT will consider comprehensive plans, trail plans, multimodal plans, resource management studies, bicycle and pedestrian facilities, transit access, stormwater management, utility issues, freight generators, and more. The DOT will use outreach to better understand issues in the area they are working in and ensure that projects will support the community's stated goals. PennDOT Connects will document these efforts to make sure recommendations are considered throughout the scoping and design process. By reaching out more and earlier in the process, and building better partnerships throughout, PennDOT aims to improve decision making that helps to deliver projects that reduce costs, improve economic competitiveness, enhance quality of life, increase safety, and make the commonwealth's transportation network more efficient.

NEW JERSEY 130 IN BURLINGTON CITY

NJ 130 was a divided six-lane arterial through this *Connections 2045* Town Center. As part of a repaving project in April 2017, the road was restriped with two lanes in each direction. Each lane was narrowed

from 12 feet to 11 feet, and a 12-foot shoulder now acts as a buffer to protect bicyclists and pedestrians. With fewer and narrower lanes, the distance and time needed to cross the road has been reduced. Pedestrian and bicyclist safety will be further enhanced by a lower 25-mile-per-hour speed limit around schools during school hours. Current traffic volumes on this facility can be handled just as well with two lanes as with three, so the flow of vehicles will not be impeded. Additional projects include left-turn lanes onto Jones Street, pedestrian countdown timers, ADA-compliant curb cuts, and a road safety audit that will be conducted to identify other potential safety improvements. This project makes multimodal walkability and bikeability improvements and enhances safety in one of the region's key development centers.

TRANSPORTATION MANAGEMENT ASSOCIATIONS (TMAs)

The region's TMAs are nonprofit, member-based organizations that seek to improve transportation in the region. They serve as an important link with the region's business community and help to promote Transportation Demand Management strategies, such as taking transit, car or vanpooling, walking or biking to work, telecommuting, and compressed work hours. There are several TMAs that serve the Greater Philadelphia region, and they each offer a range of programs and services, such as shuttles, ride matching, education, and advocacy.

TMAs in Pennsylvania:

- Bucks County TMA;
- Delaware County TMA;
- Greater Valley Forge TMA;
- TMA of Chester County;

- Central Philadelphia TMA; and
- Partnership TMA.

TMA in New Jersey:

- Cross-County Connection TMA; and
- Greater Mercer TMA.

VISION ZERO

In November 2016, recognizing that traffic deaths are both preventable and unacceptable, Philadelphia Mayor James F. Kenney signed Executive Order 11-16 to create a Vision Zero Task Force. The task force's efforts build on the city's traffic safety actions, with an ultimate goal of reducing all traffic-related fatalities and serious injuries to zero by 2030. The Vision Zero Task Force has created a three-year action plan based on principles that preserving human life takes priority over convenience; that the city's transportation network should be safe in all neighborhoods for all users; that human error is inevitable and unpredictable and the transportation network must be designed to anticipate errors; that safe behavior, education, and enforcement are keys to safe transportation; and that people are inherently vulnerable with speed being a fundamental predictor of crash survival. This last principle means the transportation network should be designed for speeds that protect human life. The action plan identifies engineering, data and evaluation, education and engagement, traffic safety enforcement, fleet management, and policy strategy and actions. It also sets benchmarks to track progress toward achieving the goal. *Connections 2045* provides some initial funding for Vision Zero that can be drawn from as individual projects advance.

NEC FUTURE

The "grow" locally preferred alternative from FRA's NEC Future Final Tier 1 Environmental Impact Statement (FEIS) plans to make targeted capital improvements to address bottlenecks, make new connections, and expand service on the Northeast Corridor Line. The total capital costs of this project are estimated between \$123 and \$128 billion. It would shorten travel times between 30th Street Station and New York Penn Station by 15 minutes, and 30th Street and Washington Union Station by 20 minutes. NEC Future's LPA also provides for significantly greater capacity for both commuter and intercity rail. In Greater Philadelphia, it proposes a new PHL airport station with a new 10-mile, two-track ROW parallel to PA 291 and the CSX Chester Secondary freight line, avoiding the John Heinz National Wildlife Refuge; improvements to Trenton Station and yard; a new hub station at Baldwin/Eddystone/Chester; upgrading North Philadelphia and Cornwells Heights into hub stations with increased service; a new parallel 10-mile alignment between 30th Street and Bridesburg through North Philadelphia; capacity expansion at Penn interlocking; and curve modifications north of 30th Street Station, between North Philadelphia and Bridesburg stations, and between Holmesburg Station and Bucks County line to permit higher speeds. A service development plan, overseen by a new working group, will start on implementation phasing as the next step. Implementation of this project will provide greatly improved connections to the Northeast Megaregion.

ROOSEVELT BOULEVARD ROUTE FOR CHANGE

Roosevelt Boulevard is a critical transportation corridor through Northeast Philadelphia. It carries 90,000 vehicles per day, including significant truck volumes, while connecting to the Pennsylvania Turnpike, Woodhaven Road with access to I-95, and the Schuylkill

Expressway (I-76). However, this 12-lane facility creates a barrier within the 20 neighborhoods it crosses through, and it has a number of safety concerns. From 2010 to 2014 51 deaths (40 percent of which were pedestrians) occurred on this roadway, along with 72 serious injuries and more than 3,200 reportable crashes. This accounted for 12 percent of all traffic deaths in the City of Philadelphia during this period.

The Route for Change program plans to improve safety, accessibility, and reliability along Roosevelt Boulevard at identified crossings. It also plans for a phased approach to improving transit. In the short-term, Roosevelt Boulevard Enhanced Bus service will offer faster service through limited station stops, off-board fare payment, and transit signal priority. The longer-term redesign of the boulevard will include a busway.

GLASSBORO-CAMDEN LINE

The Glassboro-Camden Line will restore passenger rail service to an 18-mile long corridor between the City of Camden, New Jersey and Glassboro, New Jersey, while connecting to other *Connections 2045* Centers, such as: Gloucester City, Woodbury, and Pittman, along with a stop at Rowan University. The project will improve transportation between established communities, jobs, and activity centers. This line can help to support Rowan University's \$350 million in investments in Glassboro's historic downtown. Glassboro built a new street grid in downtown, including the new Rowan Boulevard, which now serves as the borough's main street. Rowan's improvements include classroom buildings, a new hotel, university bookstore, restaurants and retail space, new town square, a parking garage, and student housing. The university is moving some of its other programs—such as performing arts—into other sections of the borough, helping to further integrate the school into the community.

INTERSTATE 76 INTEGRATED CORRIDOR MANAGEMENT PROJECT

An Integrated Corridor Management project will provide for the active management of transportation and demand on I-76 (the Schuylkill Expressway) and supporting arterials in Montgomery County between the Pennsylvania Turnpike and the US 1 interchanges. This project will enable dynamic management of recurring congestion based on prevailing and predicted traffic conditions. This facility will be the first in the region that can fully connect infrastructure and vehicles with real-time communications capabilities. The project scope includes:

- variable speed limits and queue detection;
- dynamic lane assignments and junction control improvements;
- adaptive ramp metering;
- continuous monitoring systems;
- responsive traffic signal system, and transit signal priority along parallel arterials;
- multimodal coordination with SEPTA and biking enhancements; and
- full safety analysis.

This project may also incorporate part-time shoulder use, depending on the results of a DVRPC feasibility assessment.

WHAT YOU CAN DO

- Take transit, walk, or bike to work and for trips shorter than two miles.
- Carpool, or link automobile trips together, and travel during off-peak times.
- Use green driving techniques: avoid rapid acceleration and unnecessary braking, keep tires properly inflated, remove excess weight from your vehicle, maintain steady speeds, use cruise control and the highest gear, keep your engine tuned and follow the manufacturer's recommend maintenance schedule, and don't let your car idle for longer than 30 seconds.
- Use real-time information, multimodal travel apps, virtual ticketing, and E-ZPass to make your trip more efficient. However, do not use your cellphone while driving.
- Purchase the least-polluting vehicle you can afford. If buying an electric vehicle is not an option, consider a hybrid or a model with high fuel economy.
- Keep a travel diary and use it to examine your travel behavior.

MOVING FORWARD

Connections 2045 was developed with input from a broad array of regional stakeholders and the general public and is intended to provide a path forward toward a more sustainable future. Likewise, its implementation will also rely on a large cast of governmental entities; federal, state, and local agencies; nonprofit groups; and citizens. DVRPC will continue to work with regional stakeholders and the public to make the vision of the Plan a reality.

The rapid acceleration of technology over the next several decades creates opportunities and challenges to implementing the Plan. Technology should not entirely dictate how we design and develop our built environment. Rather, it should be a tool we leverage to build more people-centric communities. More attention will need to be given to how we design markets and to community design practices.

There has been and will continue to be much consideration in how we can "future-proof" investments. This requires thinking about how the future could unfold differently and determine which types of investments will be beneficial over a variety of different plausible futures. The findings to date suggest that thinking of transportation as an ecosystem, which creates space for the safe use of many different modes, will create the most robust network that is best prepared for whatever the future actually brings. As the Digital Revolution continues to build network effects in the physical world, large and dense communities that enable the flow of ideas and interactions will be the places best suited to thrive. This requires transportation to be space efficient. This is consistent with the vision for Centers-based development, which is the linchpin of the Plan. Focusing growth preserves open space and agricultural land; helps to build

agglomeration economies and save money on infrastructure; and makes walking, biking, and transit use more feasible.

The Plan's projected reasonably available funding for transportation will not be enough to maintain and improve the network. The gas tax is becoming obsolete as driving rates remain flat; vehicles become more fuel efficient; and increasing use of fuels, like electricity, that do not contribute funding. Meanwhile, a future of CVs and HAVs will require new types of digital infrastructure, and threaten to fill our roads with zero-occupant vehicles. This could reduce walkability, bikeability, and community livability. For these reasons, the design of markets will need to be much more front and center to the future of transportation, from how we charge for network use to how we regulate new private market services. Regulations will need to be designed in ways that ensure the protection of public safety, while not stifling innovation.

As the region implements *Connections 2045*, it will be important to determine whether the goals contained in the Plan are being met. DVRPC will continue to compile a meaningful time-series data set, *Tracking Progress*, that will help us assess how well we are doing. This, in turn, will help us prioritize attention where it is most effective and will inform future DVRPC activities, including subsequent long-range planning efforts.

Implementing the Plan depends on making everyday decisions to support the vision. Your help is needed to advance the principles and goals in *Connections 2045*. Join us in shaping the future of our region by participating in public meetings, reviewing our website and publications, or submitting comments on our plans and programs.

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Appendix A: Acronyms

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5G	5th Generation Wireless System	CO₂	Carbon Dioxide
AADT	Average Annual Daily Traffic	CPI	Consumer Price Index
ADA	Americans with Disabilities Act	CV	Connected Vehicle
ADAS	Advanced Driver Assistance Systems	CZM	Coastal Zone Management
ADU	Accessory Dwelling Unit	DCNR	Department of Conservation and Natural Resources (Pennsylvania)
AEIS	Automatic Emergency Intervention Systems	DMS	Dynamic Message Sign
AI	Artificial Intelligence	DOT	Department of Transportation
AQP	Air Quality Partnership	DRJTBC	Delaware River Joint Toll Bridge Commission
ARLE	Automated Red-Light Enforcement	DRPA	Delaware River Port Authority
ASCT	Adaptive Signal Control Technology	DSRC	Dedicated Short-Range Communications
ATM	Active Traffic Management	DJ	Dwelling Unit
AV	Automated Vehicle	DVGMTF	Delaware Valley Goods Movement Task Force (of DVRPC)
AVL	Automatic Vehicle Location systems	DVRC	Delaware Regional Center
B/C	Benefit-Cost Ratio	DVRPC	Delaware Valley Regional Planning Commission
BMS	Bridge Management System	EJ	Environmental Justice
BPN	Business Plan Network	EPA	Environmental Protection Agency
BRT	Bus Rapid Transit	ESL	English as a Second Language
CAAA	Clean Air Act Amendments	ETA	Equity Through Access
CAIT	Center for Advanced Infrastructure and Transportation (Rutgers University)	EV	Electric Vehicle
CAV	Connected and Automated Vehicle	FAA	Federal Aviation Administration
CBO	Congressional Budget Office	FAST Act	Fixing America's Surface Transportation Act
CCTV	Closed-Circuit Television Cameras	FASTLANE	Fostering Advancements in Shipping and Transportation for the Long-Term Achievement of National Efficiencies (U.S. Department of Transportation)
CEDS	Comprehensive Economic Development Strategy	FHWA	Federal Highway Administration
CHSTP	Coordinated Human Services Transportation Plan	FRA	Federal Railroad Administration
CJTF	Central Jersey Transportation Forum	FTA	Federal Transit Administration
CMAQ	Congestion Mitigation and Air Quality (Federal Funding)		
CMP	Congestion Management Process		
CO	Carbon Monoxide		

FY	Fiscal Year (July 1 to June 30)	LiDAR	Light Detection and Ranging
GA	General Aviation	LOS	Level of Service
GaaS	Government-as-a-Network	LPA	Locally Preferred Alternative
GHG	Greenhouse Gases	LPN	Linking Planning and NEPA (National Environmental Policy Act)
GIS	Geographic Information System	LRP	Long-Range Plan
GMTMA	Greater Mercer Transportation Management Association	LRS	Linear Reference System
GNAFCC	Global Network of Age-friendly Cities and Communities	MaaS	Mobility-as-a-Service
GPS	Global Positioning System	MAP	Mobility Alternatives Program
GSI	Green Stormwater Infrastructure	MAP 21	Moving Ahead for Progress in the 21st Century (2012 Federal Transportation Funding Bill)
HAV	Highly Automated Vehicle	MBUF	Mileage-based user fee.
HOT	High Occupancy Toll lane	MIT	Municipal Implementation Tool (of DVRPC)
HOV	High-Occupancy Vehicle	MMTCO₂E	Million Metric Tons of Carbon Dioxide Equivalent (Air Quality)
HPMS	Highway Performance Monitoring System	MPH	Miles per Hour
HSIP	Highway Safety Improvement Program	MPO	Metropolitan Planning Organization
HVAC	Heating, Ventilation, and Air Conditioning	MSA	Metropolitan Statistical Area
ICE	Internal Combustion Engine	MTCO₂E	Metric Tons of Carbon Dioxide Equivalent (Air Quality)
IM	Incident Management	NAAQS	National Ambient Air Quality Standards
IMP	Interstate Management Program	NCHRP	National Cooperative Highway Research Program
IoT	Internet of Things	NEPA	National Environmental Policy Act
IPD	Indicators of Potential Disadvantage	NEC	Northeast Corridor
IREG	Information Resources Exchange Group (of DVRPC)	NETS	National Establishment Time-Series
IRI	International Roughness Index	NGV	Natural Gas Vehicle
ISTEA	Intermodal Surface Transportation Efficiency Act (1991 Federal Funding Bill)	NHPP	National Highway Performance Program (MAP-21 Federal Funding Program)
IT	Information Technology	NHCCI	National Highway Construction Cost Index
ITS	Intelligent Transportation Systems	NHS	National Highway System
IVHS	Intelligent Vehicle Highway System	NJDCA	New Jersey Department of Community Affairs
LED	Light-Emitting Diode		
LGBT	Lesbian, Gay, Bisexual, and Transgender		

NJDEP	New Jersey Department of Environmental Protection	PWKP	Plenary Walsh Keystone Partners
NJDOT	New Jersey Department of Transportation	R&D	Research and Development
NJOPA	New Jersey Office for Planning Advocacy	RAC	Regional Aviation Committee (of DVRPC)
NJT	New Jersey Transit	RASP	Regional Aviation Systems Plan
NLT	Natural Lands Trust	RBR	Rapid bridge replacement (PennDOT P3 project)
NOx	Oxides of Nitrogen (Air Quality)	RFP	Request for Proposals
NTD	National Transit Database	RIMIS	Regional Integrated Multimodal Information Sharing Project
O₃	Ozone (Air Quality)	RMS	Roadway Management System
OCFT	Oil Company Franchise Tax	ROW	Right-of-Way
P3	Public-Private Partnership (also called "3P")	RSTF	Regional Safety Task Force (of DVRPC)
PADCED	Pennsylvania Department of Community and Economic Development	RTC	Regional Technical Committee (of DVRPC)
PADCNR	Pennsylvania Department of Conservation and Natural Resources	RTMC	Regional Traffic Management Center
PADEP	Pennsylvania Department of Environmental Protection	RWIS	Road Weather Information Systems
PADOT	Pennsylvania Department of Transportation ("PennDOT")	SAFETEA-LU	Safe, Accountable, Flexible Efficient Transportation Equity Act: A Legacy for Users (2005 Federal Transportation Funding Bill)
PART	Pottstown Area Rapid Transit	SAR	Share-A-Ride
PATCO	Port Authority Transit Corporation	SDRP	State Development and Redevelopment Plan (New Jersey)
PennDOT	Pennsylvania Department of Transportation	SDI	Surface Distress Index
PENNVEST	Pennsylvania Infrastructure Investment Authority	SEPTA	Southeastern Pennsylvania Transportation Authority
PHL	Philadelphia International Airport	SGR	State-of-Good Repair
PHS	Pennsylvania Horticultural Society	SHSP	Strategic Highway Safety Plan
PIB	Pennsylvania Infrastructure Bank	SIP	State Implementation Plan (Air Quality)
PM_{2.5}	Particulate Matter finer than 2.5 micrometers (Air Quality)	SOV	Single-Occupant Vehicle
PMS	Pavement Management System	SSP	Safety Service Patrol
PPI	Producer Price Index	STEM	Science, Technology, Engineering, and Math
PPP	Public-Private Partnership ("P3" or "3P")	STIP	State Transportation Improvement Program
PPTF	Public Participation Task Force (of DVRPC)	STP	Surface Transportation Program (Highway Funding)
PSR	Pavement Service Rating		
PTC	Pennsylvania Turnpike Commission		

TAP	Transportation Alternatives Program	UWAG	Urban Waterfront Action Group (of DVRPC)
TAZ	Traffic Analysis Zone	V-2-I	Vehicle-to-Infrastructure
TCDI	Transportation Community Development Initiative (of DVRPC)	V-2-V	Vehicle-to-Vehicle
TDM	Transportation Demand Management	V/C	Volume to Capacity Ratio
TDR	Transfer of Development Rights	VMD	Vehicle Miles Driven
TEA-21	Transportation Equity Act for the 21st Century (1998 Federal Transportation Funding Bill)	VMS	Variable Message Sign
TIFIA	Transportation Infrastructure Finance and Infrastructure	VMT	Vehicle Miles Traveled
TIGER	Transportation Investment Generating Economic Recovery	VOC	Volatile Organic Compounds (Air Quality)
TIP	Transportation Improvement Program	WHO	World Health Organization
TMA	Transportation Management Association	Y-O-E	Year of Expenditure
TMC	Traffic Management Center		
TNC	Transportation Network Company		
TND	Traditional Neighborhood Development		
TOC	Transportation Operations Center		
TOD	Transit-Oriented Development		
TOTF	Transportation Operations Task Force		
TRID	Transit Revitalization Investment District		
TRO	Trip Reduction Ordinance		
TSMO	Transportation System Management and Operations		
TTI	Travel Time Index		
TTF	Transportation Trust Fund		
UAS	Unmanned Aerial System		
UPWP	Unified Planning Work Program (of DVRPC)		
U.S. DOT	United States Department of Transportation		
U.S. EDA	United States Economic Development Administration		
U.S. EPA	United States Environmental Protection Agency		

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Appendix B: DVRPC Board Members and Participatory Nonvoting Members

The Board is an 18-member body having the authority and responsibility to make decisions affecting the entire organization, as well as the nine-county region. It creates and defines the duties of the Office of the Executive Director and the various DVRPC committees and approves and adopts the annual planning work program. In its capacity as the MPO for the region, the Board establishes regional transportation policies, determines allocation of available transportation funds, and prioritizes transportation projects for the region. In addition to transportation planning for highways, transit, airports and freight, the agency develops plans and policies for other regional physical planning elements, such as land use, air quality, housing, water supply, and water quality.

OFFICERS

Chair | Richard T. Hammer, New Jersey Department of Transportation

Vice Chair | Mark Squilla, City of Philadelphia

Secretary | Theresa Ziegler, Gloucester County

Treasurer | Gina Burritt, PA Governor's Appointee

BOARD MEMBERS AND ALTERNATES

Pennsylvania Department of Transportation

Leslie Richards, Secretary of Transportation

James Ritzman, Deputy Secretary for Planning

Larry Shifflet, Director, Center for Program Development and Management

James Mosca, Metropolitan Manager

Pennsylvania Governor's Appointee

Gina Burritt, Senior Project Manager

Co-Counsel for the Commission (Pennsylvania)

Andrew T. Bockis, Attorney at Law

City of Chester

Thaddeus Kirkland, Mayor

Peter Rykard, Planning Director/Zoning Director

City of Philadelphia

Mark Squilla, Councilman

Michael A. Carroll, Deputy Managing Director for Transportation

Christopher Puchalsky, Director of Policy and Strategic Initiatives

Bucks County

Diane M. Ellis-Marseglia, Bucks County Commissioner

Chester County

Michelle Kichline, Chester County Commissioner

Brian O'Leary, Executive Director,

Chester County Planning Commission

Delaware County

John P. McBlain, Council Member, Delaware County Council

Linda F. Hill, Director, Delaware County Planning Department

Thomas Shaffer, Manager of Transportation Planning,

Delaware County Planning Department

Montgomery County

Valerie Arkoosh, Montgomery County Commissioner

Jody Holton, Executive Director,

Montgomery County Planning Commission

New Jersey Department of Transportation

Richard Hammer, Commissioner

New Jersey Governor's Appointee

John Spinello, Director

Thomas Huth, Assistant Counsel

Co-Counsel for the Commission (New Jersey)

Thomas J. Coleman, Esq.

City of Camden

Dana L. Redd, Mayor

Edward Williams, Director,
Department of Planning and Development

City of Trenton

Eric E. Jackson, Mayor

Jeffrey Wilkerson, Acting Planning Director/
Supervising Planner

Burlington County

Mark A. Bensa, Director of Economic Development
and Regional Planning, Burlington County Bridge Commission

Carol Ann Thomas, Principal Transportation Planner,
Burlington County

Edward Fox, Regional Planning Coordinator,
Burlington County Bridge Commission

Camden County

Louis Cappelli, Jr., Esq., Camden County Freeholder Director

Andrew Levecchia, Director of Planning

Gloucester County

Theresa M. Ziegler, Gloucester County

Heather Simmons, Gloucester County Freeholder

Mercer County

Brian M. Hughes, County Executive

Leslie Floyd, Director, Mercer County Planning Division

Matthew Lawson, Principal Planner—Transportation,
Mercer County Planning Division

PARTICIPATORY NONVOTING MEMBERS AND ALTERNATES

U.S. Department of Transportation

Federal Highway Administration—Pennsylvania Division

Renee Sigel, Division Administrator

Dan Walston, Community Planner

Federal Highway Administration—New Jersey Division

Robert Clark, Division Administrator

Calvin Edghill, Director

U.S. Department of Housing and Urban Development, Region III

Jane C. W. Vincent, Regional Administrator

Sheppard “Van” Williams, Operations Specialist

Paul Lehmann, Regional Environmental Officer

Southeastern Pennsylvania Transportation Authority

Jeffrey Knueppel, General Manager

Elizabeth Smith, Director, Strategic Planning and Partnerships

New Jersey Transit Corporation

Louis Millan, Director, Programmatic Planning

Charles Ingoglia, Director, Capital Project Management and Public Affairs

Delaware River Port Authority

John Hanson, Chief Executive Officer

Barbara Holcomb, Grant Specialist, Government Relations,

Grants Administration & Security

Port Authority Transit Corporation

John Rink, General Manager

Rohan K. Hepkins, Assistant General Manager

Federal Transit Administration, Region III

Terry Garcia-Crews, Regional Administrator

Timothy Lidiak, Region III

U.S. Environmental Protection Agency, Region III

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Sachin Shankar, Assistant Regional Director

New Jersey Department of Environmental Protection

Robert Martin, Commissioner

William Purdie, Director, Office of Policy, Planning and Science

New Jersey Office of Planning Advocacy

Gerard Scharfenberger, Director

Pennsylvania Department of Community and Economic Development

Aliyah Furman, Director

C

Appendix C: Revenue Forecast

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Revenue estimates for *Connections 2045* come from all federal, state, and local sources that the region can reasonably expect to receive from fiscal year (FY) 2018 through FY 2045. All planning principles and financial assumptions in identifying federal and state financial resources are developed with, and reviewed by, the federal, state, and transit partners.

Federal funds to the region are dependent on federal authorization bills. The current federal funding legislation is the Fixing America's Surface Transportation (FAST) Act. State funding is set by state law, such as Act 89 in Pennsylvania and the 2017 Transportation Trust Fund (TTF) reauthorization, which increased the gas tax in New Jersey. Historical data and trends serve as general guidance as to how much funding the region can expect to receive in the future. Sources of this information include:

- the current and previous statewide transportation improvement programs (STIPs);
- information from state DOTs and transit agencies; and
- FHWA, FAST Act planning guidance, and federal authorization levels.

These revenue estimates are for capital project expenditures only and do not include any operating funds. All revenue amounts are in year of expenditure (Y-O-E) dollars, as required by federal regulations. No new or undefined funding sources are recognized for the fiscally constrained plan. Relevant planning principles and financial assumptions are detailed in the following sections.

FEDERAL FUNDING

The current five-year (through FY 2020), \$305-billion FAST Act federal transportation bill was passed after a series of short-term funding "patches" over the course of almost 18 months following the expiration of the previous bill, MAP-21. The FAST Act is the first transportation legislation with a length greater than two years since the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) passed in 2005, although it is still shorter than the typical six-year bills that have historically been authorized. It also falls short of the spending level recommended by the Obama Administration, under which it was passed.

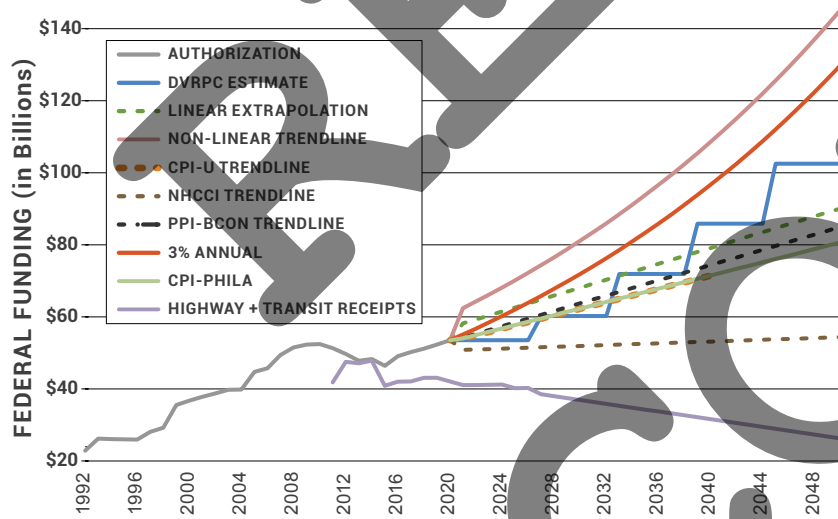
This is just one of several stark departures from previous long-range financial plan assumptions. Other assumptions that now appear less certain include the expectation that funding will continue to increase with each new piece of transportation legislation; and that federal transportation legislation authorization will cover longer-term six-year periods. These are signs that the transportation funding status quo cannot hold.

In the past, DVRPC used a method of estimating future federal funding by mimicking federal transportation legislation, with each six-year bill increasing by 19.4 percent (3 percent compounded annually), assuming an 80/20 split of federal funds between highways and transit, following a 3 percent takedown. This methodology was the basis for forecasts in the *Destination 2030* and *Connections (2035) Plans*. Before the *Connections 2040 Plan*, 3 percent growth was a conservative rate compared to the growth over the previous federal transportation bills. The Intermodal Surface Transportation Equity Act (ISTEA), enacted in 1992, provided \$155 billion in federal transportation funds over a six-

year period. The Transportation Equity Act for the 21st Century (TEA-21), enacted in 1998, provided \$217 billion over six years, a 40 percent increase over ISTEA. SAFETEA-LU then provided \$294 billion, again over six years. This was an increase of 35 percent over TEA-21 funding levels.

Figure C-1 shows historic and current transportation funding levels from 1992 to 2020 and projected funding levels to 2050 using a variety of methods. The stepped line is DVRPC's traditional forecast of future federal transportation authorizations. DVRPC's methodology, although once conservative, would now expect a higher growth rate than most standard measures of inflation. Beginning with the *Connections 2040* Plan, DVRPC has moved away from the default assumption of 3 percent compound annual growth toward more conservative, and realistic, projections.

FIGURE C-1: HISTORIC AND FORECASTED FEDERAL TRANSPORTATION FUNDING LEVELS (NATIONWIDE)



Source: DVRPC, 2017.

Recent analysis by the Congressional Budget Office (CBO) indicates long-term federal funding concerns. Tables C-1 and C-2 show June 2017 projections for the Highway Trust Fund and Transit Trust Fund accounts. Although the CBO reflects relatively flat transportation expenditures (outlays) out to 2027, the Highway Trust Fund would need an infusion of \$99 billion to maintain this level of spending (Table C-1), while the Transit Trust Fund would need \$39 billion (Table C-2).

Fixed Guideway Capital Investment Grants

The Federal Transit Administration's (FTA) discretionary New Starts program is the federal government's primary financial resource for supporting locally planned, implemented, and operated fixed guideway transit capital investments. The FAST Act authorizes appropriations from the General Fund for Capital Investment Grants (CIG) at \$2.3 billion in FY 2016 and each year thereafter. This is a 20.7 percent first-year increase over the MAP-21 authorized level, but the level remains flat over the five years of the bill.

CIGs are broken into New Starts, Small Starts (including Very Small Starts), and Core Capacity categories. New Starts projects are new fixed guideway projects or extensions to existing fixed guideway systems with a total estimated capital cost of \$300 million or more (\$50 million for Very Small Starts), or that are seeking \$100 million or more in CIG program funds. Small Starts are those new projects or extensions, or corridor-based bus rapid transit (BRT) projects, with a total estimated capital cost of less than \$300 million and that are seeking less than \$100 million in CIG program funds. The Core Capacity category (which was included under MAP-21's New Starts program) is now separated out and funds substantial corridor-based capital investments in existing fixed guideway systems that increase capacity

TABLE C-1: CBO FEDERAL HIGHWAY TRUST FUND JUNE 2017 FORECAST (\$ BILLIONS)

Highway Account	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Start-of-Year Balance	\$ 9	\$ 51	\$ 42	\$ 32	\$ 21	\$ 10	\$ (3)	\$ (16)	\$ (31)	\$ (46)	\$ (63)	\$ (80)
Revenues and Interest	\$ 36	\$ 36	\$ 37	\$ 37	\$ 36	\$ 36	\$ 35	\$ 35	\$ 35	\$ 35	\$ 35	\$ 35
Intergovernmental Transfers	\$ 52	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Outlays	\$ 44	\$ 44	\$ 44	\$ 45	\$ 46	\$ 46	\$ 47	\$ 48	\$ 49	\$ 50	\$ 50	\$ 51
End-of-Year Balance	\$ 51	\$ 42	\$ 32	\$ 21	\$ 10	\$ (3)	\$ (16)	\$ (31)	\$ (46)	\$ (63)	\$ (80)	\$ (99)

Source: Congressional Budget Office, 2017

TABLE C-2: CBO FEDERAL TRANSIT TRUST FUND JUNE 2017 FORECAST (\$ BILLIONS)

Transit Account	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027
Start-of-Year Balance	\$ 3	\$ 18	\$ 15	\$ 11	\$ 7	\$ 3	\$ (2)	\$ (8)	\$ (13)	\$ (19)	\$ (25)	\$ (32)
Revenues and Interest	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5	\$ 5
Intergovernmental Transfer	\$ 18	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
Outlays	\$ 8	\$ 10	\$ 10	\$ 10	\$ 11	\$ 11	\$ 11	\$ 11	\$ 12	\$ 12	\$ 12	\$ 12
End-of-Year Balance	\$ 18	\$ 15	\$ 11	\$ 7	\$ 3	\$ (2)	\$ (8)	\$ (13)	\$ (19)	\$ (25)	\$ (32)	\$ (39)

Source: Congressional Budget Office, 2017

10 percent or more in corridors that are at capacity today or will be in five years. They may not include elements designed to maintain a state-of-good repair (SGR).

The FAST Act made a change to New Starts funding by reducing the maximum federal share from 80 percent to 60 percent but maintained the 80 percent for Core Capacity and Small Start projects. Other federal funds, including the Surface Transportation Program Block Grant Program (the new iteration of the Surface Transportation Program [STP]) and Congestion Mitigation and Air Quality Improvement Program (CMAQ), Transportation Infrastructure Finance and Innovation Act program (TIFIA), and Transportation Investment Generating Economic Recovery (TIGER) grants can still be “flexed” to supplement New Start match funds up to 80 percent.

The FAST Act also includes a pilot program for public-private partnerships (P3s) that was included, but never implemented, under MAP-21. This program streamlines regulatory steps for up to eight grant awards for projects seeking less than 25 percent in federal funding and which have dedicated investment from a third party.

With the *Connections 2045* Plan update, DVRPC will assign New Starts, Small Starts, and Core Capacity funds to specific projects. DVRPC has traditionally assumed that the region as a whole may be able to receive two New Start matches over the life of the long-range plan: one for each state subregion. If no project is likely to be eligible for the funding, no funding is assumed. New Starts and Small Starts projects must include plans for a local financial commitment of both capital and operating funds.

In the past, two major issues have hurt the region’s chances of securing this competitive funding. The first is that the region has largely lacked a specific plan for how to obtain the required local funding match. The second is that the region’s proposed projects have not scored high enough to be eligible for funding. Most projects funded through the New Starts program over the past few years have had upwards of a 60 percent local funding match. Both Pennsylvania and New Jersey restrict the ability of local taxation to support transportation projects. Ways to meet the local funding need could include a direct commitment of state funds or a private-public partnership. In Pennsylvania, a local funding option exists through the creation of a Transit Revitalization Investment District (TRID). However, a TRID alone is not likely to provide enough funding to fully pay for a major new network expansion project.

The Trump Administration

Priorities within the Trump administration have shifted regularly throughout the general election and into the new administration, but economic growth and prosperity, with jobs and infrastructure as the primary means to this end, has been a repeated promise. As part of its 2018 budget proposal, the administration has laid out its vision for a \$1 trillion infrastructure plan over a 10-year period, \$200 billion of which is dedicated federal spending¹. Compare this with the \$305 billion in spending over five years approved by Congress in late 2015.

Throughout the election, President Trump proposed using debt to finance improvements, but senior advisors have drawn up a far less conventional infrastructure funding plan: private investment. Although the 2018 Budget Infrastructure Initiative Fact Sheet released in May 2017 offers no definitive answer on how or where federal dollars will be spent, the administration has previously stated that it would

offer government backing and tax credits to private investors who would finance infrastructure projects. Elaine Chao, U.S. Secretary of Transportation, has stated support for heavy transportation infrastructure investment. Still, the infrastructure plan relies heavily on “leveraging” private investment; divesting from certain transportation functions, such as air-traffic control; and encouraging state and local government to fund infrastructure and services. Critics say the \$200 billion in federal funding not only falls short of the \$1 trillion promise but is more than wiped out by cuts to key infrastructure programs.

The infrastructure plan's low levels of federal government spending (potentially none to local projects) and reliance on third-party investors also insists that projects are profitable. While vital, transportation infrastructure is not lucrative historically. Toll highways are just one example of investments that typically stay in the red. In addition, the new administration has hinted it wants to renegotiate international trade agreements, such as NAFTA, to be more favorable to the U.S. Such deals could backfire, however, if the global flow of goods and services is hindered, which could lead to higher inflation rates.

Finally, the administration's infrastructure plan offers no clear path for rehabilitation, maintenance, operations, and other non-capacity-building improvements, which are the focus of this region and many others. It fails to bring in funding from entities that do not have federal tax liability, and a portion of tax credits handed out will go to parties that would have invested in infrastructure even without incentive: a potentially inefficient use of resources. To add to the hurdles,

¹Fact Sheet 2018 Budget: Infrastructure Initiative, Whitehouse.gov, n.d. https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/budget/fy2018/fact_sheets/2018%20Budget%20Fact%20Sheet_Infrastructure%20Initiative.pdf

Senate Majority Leader Mitch McConnell has marked transportation infrastructure as a low priority for the Senate, pointing to the high level of uncertainty surrounding federal funding.

STATE FUNDING

Revenue from Pennsylvania and New Jersey are the region's other major sources for transportation funding.

Pennsylvania

The commonwealth has one of the largest and oldest transportation systems in the country, along with the second highest number of structurally deficient bridges, and 23 percent of its roads are in poor or mediocre condition. Act 89 was passed in 2013, creating the most comprehensive piece of state transportation legislation in decades and generating much-needed state infrastructure funding. By 2017, the legislation was fully implemented and now invests billions in additional revenues into roads and bridges, local transportation facilities, public transportation, and turnpike expansion projects. It also established a multimodal fund that covers ports and waterways, freight and passenger rail, aviation, transit, and bicycle and pedestrian projects.

Act 89 eliminated both the state's flat 12-cent gas tax and the \$1.25 cap on the wholesale price of gasoline under the Oil Company Franchise Tax (OCFT). The OCFT cap was lifted in thirds over five years and was completely eliminated in 2017. A floor of \$2.99 per gallon on the wholesale price of gasoline sets a lower limit for revenue collection. Pennsylvania has the highest gas tax in the nation at 50.4 cents per gallon as of January 1, 2017. However, the commonwealth is in a far better position than most states that face similarly decaying infrastructure and are searching for new sources of revenue. In addition

to these taxes, Act 89 increased vehicle registration and driver licensing fees, violation fines, and permits prices. Ten years after enactment, the \$450 million annual lease payments made by the Pennsylvania Turnpike Commission (PTC) to PennDOT will be reduced to \$50 million annually and ultimately discontinued in 2047. This would greatly impact SEPTA, as the entirety of these annual lease payments are used for transit operating subsidies throughout the commonwealth.

The Pennsylvania State Police are supported through the TTF. The budget projections for their needs have grown substantially and were forecasted to receive an increasing share of the total available revenues over the next decade. A legislative solution has capped Motor License Funds going to the State Police budget, with a proposal to place a \$25 per capita fee on municipalities that exclusively rely on State Police enforcement. This agreement is binding through FY 2028 and will generate an additional \$2.1 billion in transportation funding over this period. Of that amount, \$500 million will go into the Interstate Management Program, \$600 million will go into reconstruction and rehabilitation projects throughout the commonwealth, and \$1 billion will go to the roadway maintenance budget.

Another key transportation bill preceded Act 89: The Public and Private Partnerships for Transportation Act (Act 88 of 2012). This act enabled the rapid bridge replacement (RBR) P3, which will eventually replace 558 bridges across the commonwealth—including 12 in the region—and maintain them for 25 years. This is the signature project that has occurred to date under this legislation. Although PennDOT expected the winning bidder might pursue some alternative bridge replacement techniques, such as prefabricated bridges, the program has been using traditional bridge reconstruction methods.

New Jersey

Major transportation funding has recently been passed in the state of New Jersey as well. The state's TTF, which provides a stable and predictable funding source for transportation system improvements in New Jersey, renewed for a sixth time in the fall of 2016. During the 2016 election, a legislatively referred constitutional amendment known as Public Question 2 was approved. This amendment required all revenue derived from taxes on motor fuels to be deposited into the TTF and concurrently authorized its renewal at \$16 billion over eight years. Prior to the passage of Question 2, only 10.5 cents of the gasoline and diesel fuel taxes was required to be deposited into the TTF. The Question 2 amendment complemented a gas tax increase of 23 cents per gallon that was passed by Governor Christie and the Democratic-controlled state legislature in September 2016 and signed into law the next month. The combined Motor Fuels/Petroleum Products Gross Receipts Tax rate at the consumer level is now 37.1 cents per gallon of tax imposed and is now constitutionally dedicated to the TTF.

This legislation boosts annual spending on New Jersey's road, bridge, and rail infrastructure by \$400 million. The legislation also calls for doubling transportation aid for municipalities and counties, funding light rail expansion projects in Bergen and Gloucester counties, and upgrading New Jersey's freight-rail infrastructure. The bipartisan compromise came several months after the fund's last five-year plan ran dry and restarts state-funded infrastructure projects that were shut down as of the summer of 2016. The key to this deal was a broad-based tax cut for all New Jerseyans, which would be slightly more than the \$1.2 billion that will be generated each year by the increased gas tax. As the TTF is an off-budget account, these tax cuts leave a hole in the state budget barring significant economic growth.

LOCAL FUNDING

The amount of local funds forecasted for the life of the Plan is based on match fund levels in the current Pennsylvania and New Jersey STIPs. Local funds are forecasted to grow with state and federal funds to maintain their appropriate match levels.

COMPETITIVE FUNDS

Both the state and federal governments have increasingly made transportation funding available on a competitive project-level basis. Federal Transportation Investments Generating Economic Recovery (TIGER) funds were the forerunner and have increasingly become the model for competitive grant programs. There have now been eight rounds of TIGER grant funds since their initial application in 2009. The region has received a number of awards from this program:

- TIGER I / TIGER 2009
 - ▶ National Gateway Freight Rail Corridor
 - ▶ Philadelphia Area Bicycle and Pedestrian Network
- TIGER II / TIGER 2010
 - ▶ Dilworth Plaza and Concourse Improvements (Philadelphia)
- TIGER III / TIGER 2011
 - ▶ South Jersey Port Rail Improvements
 - ▶ IMPACT Philadelphia
- TIGER IV / TIGER 2012
 - ▶ SEPTA Wayne Junction substation replacement
- TIGER V / TIGER 2013
 - ▶ SEPTA-CSX grade separation project
- TIGER VI / TIGER 2014
 - ▶ Roosevelt Boulevard Multimodal Study
- TIGER VII / TIGER 2015

- ▶ Closing the Gaps, City of Philadelphia
- TIGER VIII / TIGER 2016
 - ▶ Camden Connections for the Future

Demand for TIGER funds has been high. The most recent round in 2016 had 585 applications, requesting \$9.3 billion. In all, the TIGER program has granted \$5.1 billion to 421 projects across the nation.

In Pennsylvania, Act 89 created two new Multimodal Transportation Funds. PennDOT administers the first, and eligible projects for this funding include intercity bus and rail service improvements, bus stops, transportation centers, park-and-ride facilities, rail freight sidings, land acquisition for eligible airport development, land interests required for air approach and clear zone purposes, sidewalk-crosswalk safety improvements, bicycle lanes, route designation, infill development by assisting with traffic impact mitigation, local highway development, highway noise and sound barriers, bridges, and greenways. The second is administered by the Department of Community and Economic Development and provides economic development grants between \$100 thousand and \$3 million. These funds can be used to rehabilitate or enhance transportation assets, such as streetscaping, lighting, sidewalks, pedestrian safety, transportation facility connectivity, and TOD.

Pennsylvania also administers competitive Automated Red-Light Enforcement (ARLE), Annual Freight Rail Assistance Program (RFAP), Annual Rail Transportation Assistance Program (RTAP), and Green Light Go programs. ARLE funds are used to make safety improvements. Green Light Go funds are targeted to maintaining and upgrading municipality owned traffic signals and signal infrastructure.

Both states administer a federally funded Transportation Alternatives

Program (TAP). TAP funds build pedestrian and bicycle facilities, create safe routes to school, preserve historic transportation structures, provide environmental mitigation, and develop multiuse trails.

Federal and state competitive grants are considered to be additional funds to the region within the TIP and the long-range financial plan.

AUTHORITY AND OTHER FUNDING

DVRPC works with several partner transportation authorities that generate their own revenues, generally via tolling. Revenue generated by partner authorities is not included as a revenue source in DVRPC's long-range plan. For the most part, all capital and operating expenditures of these authorities are covered by authority toll revenues. In some instances, federal dollars are used in conjunction with authority revenue to fund specific capital projects. In these cases, DVRPC tracks both federal and nonfederal capital expenditures for such projects and accounts for the federal funding as a part of its regional transportation expenditures.

Financing Tools

Large transportation projects cause spikes in expenditures, and financing tools can help to fill the resulting short-term funding gaps created by implementing major system improvements. When construction costs are rising faster than interest rates, financing can speed up project development and reduce expenses. Smart transportation investments can generate positive economic returns through increased efficiency. This should increase general revenues, which can help to pay off debt. Although financing tools are useful for advancing projects, they are not a source of revenue, and there still needs to be a mechanism that can eventually retire them.

There are a variety of sources from which transportation agencies can get additional financing to help deal with lumpy project costs, including bonds, P3s, TIFIA financing via the FAST Act, the EB-5 Immigrant Investor Visa program, and state infrastructure banks. Beyond existing loan programs, this type of financing cannot be assumed and is not included in the Plan.

Bonds

Bonds are a debt instrument where the holder loans money to the issuer, usually a corporation or government entity, for a defined time period at either a fixed or variable interest rate. They are used to pay for all kinds of different projects or activities and are commonly used within the transportation field.

The New Jersey Transportation Trust Authority is holding \$15.6 billion in outstanding transportation bonds and a total of \$30.0 billion in outstanding debt. Annual debt service amounts to \$1.18 billion. The recent increase in the gas tax enables the state to move toward more of a pay-as-you-go model. Debt servicing comes from the state's annual capital appropriation, not the New Jersey TTF. PennDOT has focused on a pay-as-you approach to transportation investments but did issue \$600 million in bonds to expedite statewide bridge repairs in 2010.

P3s

P3s are a way to have the private sector implement one or more portions of project delivery, including design, construction, financing, maintenance, or even operations. These arrangements allow some of the risk to be undertaken by the private sector, in return for the opportunity for financial gain. P3s generally do not create new revenues for transportation but allow for streamlined project delivery,

innovative financing approaches, and leveraging of public-sector funds. Private investments in infrastructure will still need to be repaid, whether through direct tolling or lease agreements that use TTF or General Fund revenues.

PennDOT's RBR project is a P3 with Plenary Walsh Keystone Partners (PWKP) to replace 558 structurally deficient bridges across the commonwealth, including 12 in southeastern Pennsylvania. The bridges in this program were selected for their similar size and design and are largely on lower-volume and rural roadways, potentially enabling the bridges to be prefabricated or otherwise take advantage of economies of scale. Once installed, PWKP will maintain each bridge for 25 years.

Pennsylvania formally legalized P3s in Act 88 of 2012. This act created a Public Private Transportation Partnership Board to review and approve P3 projects. Regional public entities, such as PennDOT, the Pennsylvania Turnpike Authority, and SEPTA, can solicit a Request for Proposal (RFP) through this board. Responses to the RFP go to the Board, which then selects the private respondent whose proposal offers the highest value and meets the best interests of the commonwealth and its residents. Potential projects can build new facilities or improve the capacity or performance of existing facilities.

New Jersey does not currently have state-enabling legislation for transportation P3s, although the River LINE was designed and built, and is still operated and maintained, by a private entity.

TIFIA

TIFIA provides supplemental or subordinate financing for surface transportation projects, including highway, transit, intercity passenger

rail, some freight rail, and intermodal freight transfer facilities. Eligible projects have a total cost of more than \$50 million and less than \$100 million. There are exceptions to this for ITS projects, infrastructure to support TOD, local or rural infrastructure projects, or projects with a total cost greater than one-third of the federal formula funding allocation to the state in which the project is located. This funding offers a line of credit to a public or private project sponsor of up to 33 percent of the total project cost, a loan of up to 49 percent of the project cost, or a combination of a loan and a line of credit. The current federal transportation act, the FAST Act, provided contract authority for up to \$275 million in TIFIA loans in FY 2016 and increases to \$300 million in FYs 2019 and 2020. This program was reduced by 67 percent in annual funding compared with the previous MAP-21 federal transportation legislation. This reduction is due to the fact that the program has not been able to attract enough demand, and U.S. DOT is then required to reallocate any unapportioned funds that are less than 75 percent of the total program.

State Infrastructure Banks

State infrastructure banks can provide low-interest loans that help to finance eligible aviation, roadway, rail freight, and transit capital projects in the state. The Pennsylvania Infrastructure Bank (PIB) was launched in 1998. It has loaned more than \$200 million to transportation projects while leveraging another \$325 million in additional investments. Local governments, transportation authorities, economic development agencies, nonprofits, and corporations can apply for PIB loans. The PIB can loan up to \$30 million per year and does not require a local match for most projects. The PIB helps to break large transportation project expenditures down into more affordable chunks, with up to a 10-year repayment period. However, like bonds and

other alternative financing options, the PIB helps to advance project delivery and leverage state and federal funds but is not a funding source on its own. Downingtown Borough in Chester County recently received a low-interest \$500 thousand loan from the PIB to replace its Green Street Bridge while elevating it to reduce flooding risk. The loan will be repaid using a portion of the borough's annual allotment of liquid fuels funds from PennDOT.

New Jersey does not currently have a state infrastructure bank. Governor Christie vetoed a bill to create one in 2014. Since then, New Jersey gained experience with state infrastructure banks by creating a temporary one for energy-resiliency investments as part of the Hurricane Sandy recovery efforts. New state transportation infrastructure bank legislation was proposed in 2016.

EB-5

The EB-5 Immigrant Investor Visa Program was created by the Immigration Act of 1990 and is one of the nation's five employment-based visa programs. The program provides foreign nationals who invest money in the United States with a means of obtaining a Visa or "green card." Applicants must invest \$1 million in a project that creates a minimum of ten 10 full-time jobs, which may be indirect as a result of the investment. Most immigrant investors who use the EB-5 program invest in a targeted employment area—a rural area or community with high unemployment—which lowers the investment threshold to \$500 thousand.

Greater Philadelphia has benefited from several EB-5 loans through the Delaware Valley Regional Center (DVRC). In January 2016, SEPTA entered into a loan agreement with DVRC that will be made available to SEPTA over a period of several years and will provide up to \$300 million

to partially fund several projects, including the City Hall/15th Street Station rehabilitation and the Elwyn to Wawa rail restoration. The PTC launched its first EB-5 program in 2014 and raised \$200 million in EB-5 funding for a highway construction project that connects the Turnpike with I-95. By 2014, most EB-5 visas were granted through regional centers: federally approved, third-party intermediaries that connect investors with developers in need of funding. A maximum of 10,000 visas are issued annually through the EB-5 program. About 80 percent of these visas are issued to nationals of China, South Korea, Taiwan, the United Kingdom, or Hong Kong.

FUNDING DISTRIBUTION

Once federal and state funds have been estimated for each year from 2018 to 2045, funding distribution formulas are used to estimate federal funding to the region.

Federal Roadway Funding to States

For roadways, federal funds are first allocated to each state. DVRPC estimates how much of the state share will be allocated to the region. Both states reserve a pool of transportation funds that can be allocated anywhere within their jurisdictions based on needs. These funds are often used to help areas pay for larger projects.

Controversy between donor and donee funding states is a long-term issue that has been largely mitigated by the \$125 billion in General Fund transfers from FY 2008 to FY 2020. This has allowed virtually every state to get more federal funding back than they have put in. A comparison of Federal Highway Trust Fund Highway Account Receipts and Apportionments between FY 1957–2015 show both Pennsylvania and New Jersey as donee states, receiving 1.25 and 1.06 times their

outlays to the fund, respectively. Connections 2045 assumes that future SGR needs will play some role in future apportionments. Over time, the Plan assumes that both state shares are likely to remain about the same as they currently are. The assumption is that modest population growth, compared to the entire nation, will be canceled out by the region's far greater backlog of SGR needs.

Federal Roadway Funding Estimates for the Region

DVRPC uses percentage allocations of federal roadway funding to each state, then distributed to the region, and state funding allocated to the region to determine how much funding the region expects to receive each year. Short-term funding comes from dividing each state's STIP-identified formula funds by total authorized federal funding. For this plan update, DVRPC used the average state funding apportionments for Pennsylvania and New Jersey in the FAST Act.

Pennsylvania is receiving about 4.2 percent of federal roadway funds in the FAST Act. In previous federal transportation legislation, the commonwealth was receiving 4.5 percent of federal funds. Slow state population growth, particularly relative to the nation as a whole, accounts for this decrease. With an expectation that future funding will be based more on asset-management needs, and that the commonwealth has the second highest number of structurally deficient bridges in the nation, DVRPC anticipates that this federal apportionment will continue. In New Jersey, federal roadway funds are expected to remain at 2.5 percent.

In Pennsylvania, federal road funds are then divided up into several different funding pots. The largest of these is allocated to each of the MPOs (and regional planning organizations in Pennsylvania). In

addition, the Interstate Management Program (IMP) funds projects on the Interstate System. Several other programs, called Line Items, are distributed through state-level decision making, largely based on need. These Line Items include spike funds, the statewide program, and the statewide reserve. The five-county southeastern Pennsylvania region is currently receiving about 14.9 percent of the commonwealth's formula funds. This is forecasted to rise to 26 percent of roadway funding in the longer term, based on the region's percentage of total population in the commonwealth.

In New Jersey, NJ DOT manages all state facilities through a statewide program. Formula funds are directed to each of the state's three MPOs for maintenance of county and local road facilities. The region is currently receiving a higher than normal percentage of funds in New Jersey, largely due to the Direct Connect project on I-76 and NJ 42 in Camden County. Longer term, this is forecasted to return to about 20 percent of funds.

FEDERAL TRANSIT FUNDING APPORTIONMENTS

Federal transit funds are allocated directly to urban areas. Short-term allocations are based on actual funds identified in each state's STIP. Longer-term allocations are based on expected funding levels, as well

TABLE C-3: DISTRIBUTION OF FEDERAL ROADWAY FUNDS TO STATES

Time Period	PA Statewide	NJ Statewide
Short-term (2018–27)	4.2%	2.5%
Long-term (2028–45)	4.2%	2.5%

Source: DVRPC, 2017.

as regional, state, and national population; employment; VMT; transit ridership; and infrastructure condition trends. Different types of funds have different formula criteria. The region receives federal funds from:

- FTA Section 5307—Urbanized Area Formula Program that funds transit capital projects with allocations based on population, density, operating expenses, revenue miles, and route miles.
- FTA Section 5340 Growing States and High Density States Formula Program allocations are based on population forecasts and population density. SEPTA receives Growing States program funding.
- FTA Section 5337—SGR Program that funds High Intensity Fixed Guideway (rail) and High Intensity Motorbus capital projects with allocations based on vehicle revenue miles and route miles.
- FTA Section 5339—Bus and Bus Facilities Formula Program that funds capital projects to replace, rehabilitate, or purchase buses and related facilities with allocations based on population and service factors after providing a minimum amount per state.
- Highway Flex—federal highway program funds that PennDOT provides to state transit agencies for capital improvement projects;

based on the governor's commitment, \$25 million per year is flexed annually statewide to transit operators.

FTA 5307 and 5340 funding formulas are apportioned based on the following factors:

- Population;
- Population density;
- Bus revenue vehicle miles;
- Bus incentive (operating cost);
- Fixed guideway revenue miles;
- Fixed guideway route miles;
- Rail incentive (operating cost); and
- Low income (formerly Job Access and Reverse Commute [JARC]).

FTA 5337 SGR apportionment factors include:

- Fixed guideway revenue miles (>7 Years in operation);
- Fixed guideway route miles (>7 years); and
- SAFETEA-LU formula: apportionment from 2011.

Section 5339 apportionment factors include:

- Population;
- Population density;
- Bus revenue vehicle miles;
- Bus incentive (operating cost);
- Per-state minimum (\$1.75 million).

TABLE C-4: DISTRIBUTION OF FEDERAL FUNDS TO THE REGION

Time Period	PA Subregion			NJ Subregion
	Roadway Formula	Line Items	IMP	Roadway Formula
Short-term (2018–27)	18.0%	26.0%	42.4%	22.9%
Long-term (2028–45)	26.0%	26.0%	32.0%	20.0%

Source: DVRPC, 2017.

Thus, important considerations in future transit funding levels are: (1) how Greater Philadelphia's population growth will compare to the nation as a whole; (2) how its transit ridership will grow relative to the nation's; and (3) how much rail service will increase relative to that of all other transit agencies.

For Pennsylvania transit, the region has grown ridership steadily over the past decade and needs are high. The region currently receives 2.5 percent of federal funds and hopes to maintain this apportionment level as a reflection of the backlog of SGR needs over the long term. The New Jersey' subregions long-term apportionment is expected to remain flat at 0.7 percent.

State Funds Apportioned to the Region

New Jersey's short-term allocation percentages are based on historic state funding in the STIP, while the long-term allocation recognizes that higher growth is likely to occur in the southern part of the state. Although New Jersey Transit receives state funding through the NJ TTF, that funding is not allocated via formula but rather through legislative appropriations. In Pennsylvania, Section 1517 Capital Improvements funds are allocated by formula: the percentage of transit passengers in the region compared to the total passenger ridership on all transit

systems in the commonwealth. Section 1514 funds are allocated by grant. It is assumed that the region will receive a similar percentage of the grant-allocated funds as formula-allocated funds. Table C-6 also includes funds from IMP, a statewide program containing both state and federal funding sources. The region assumes that it will receive about 32 percent of these funds over the long term, although this amount will fluctuate from year to year.

Pennsylvania reserves federal and state funds for use anywhere in the state at the discretion of the PennDOT secretary and state-level decision makers. These include federal programs, such as Safe Routes to School and TAP, as well as a 20 percent reserve of NHS, STP, and state highway funds to the SPIKE program. For all of these discretionary sources, the region assumes that it will receive the same overall funding allocation as it does for formula funds. However, these funds will have much more variance year to year.

New Jersey has a statewide funding program that allows for funds to be used on larger projects or directed to where needs are otherwise the greatest. The region anticipates receiving about 17 percent of these funds on average each year.

TABLE C-5: DISTRIBUTION OF FEDERAL TRANSIT FUNDS TO THE REGION

Time Period	PA Subregion	NJ Subregion
Short-term (2018–27)	2.5%	0.7%
Long-term (2028–45)	2.5%	0.7%

Source: DVRPC, 2017.

ANTICIPATED REGIONAL FUNDING THROUGH 2045

DVRPC sought guidance from both state DOTs, along with its other planning partners, to estimate what the region can expect in funding over the life of the Plan. Guidance from both Pennsylvania and New Jersey was for flat state and federal funding over the life of the respective 12-year and 10-year TIPs.

To maintain current levels of federal expenditure, without increasing taxes, would require an estimated \$138 billion in General Fund transfers between FY 2018 and FY 2027 (refer to Tables C-1 and C-2). Even then, increasing vehicle fuel efficiency, alternative fuels, and flat levels of driving mean that these forecasts may be optimistic.

Funding Scenarios

Beginning with the *Connections 2040* Plan, DVRPC recognized a paradigm shift surrounding transportation funding. The traditional assumption has been that revenue shortfalls will be made up for with future increases in funding. Given the current political and economic climate, the region must rethink how it forecasts future revenues.

DVRPC came up with four future funding scenarios to model what federal transportation funding might look like through the life of the long-range plan. The four scenarios that were modeled include:

1. Actual Gas Tax, which modeled declining federal funds based on actual gas tax revenues and projections;
2. Flat Funding, which modeled flat federal and state funding growth outside both TIPs;
3. Two Percent Annual Federal and State Funding Increase, which followed the traditional method of modeling a consistent

Compound Annual Growth Rate mimicking six-year federal transportation bills, albeit at a lower rate than previously forecasted; and

4. Paradigm Shift, which modeled an optimistic one-time 50 percent increase in funds in the year 2030, 1 percent annual federal and state increases thereafter.

In each funding projection, the next 11 years reflect the flat funding levels anticipated in each state subregion's TIP. DVRPC identified a series of future revenue forecasts for discussion with its planning partners. This assumption means that the \$138 billion federal funding gap identified by the CBO forecasts for the federal highway and transit trust funds out until 2027 will be filled one way or another. Projecting this to 2028 would add approximately another \$26 billion to this gap. All of the funding scenarios assume that each subregion could receive up to one New Start and one Small Start project; however, these potential revenues are not included in the funding assumption and will instead be assigned as additional funds to projects that have a reasonable expectation of receiving them.

Table C-7 estimates the funding available based on actual gas tax receipts. Gas tax receipts follow a trend projection, starting from the peak year for gas tax collections of \$42.6 billion in 2013. By 2045,

TABLE C-6: REGIONAL DISTRIBUTION OF STATE FUNDS

Time Period	DVRPC PA Subregion				DVRPC NJ Subregion	
	Roadway	IMP	Line Items	Transit	Roadway	Transit
Short-term (2014–24)	14.9%	20.6%	26.0%	64.4%	17.3%	20.7%
Long-term (2025–40)	26.0%	32.0%	26.0%	69.4%	17.0%	12.0%

Source: DVRPC, 2017.

federal revenue collection is projected to decrease to just \$29.5 billion. This scenario forecasts just \$50.6 billion in revenue over the 28-year *Connections 2045* long-range plan.

The second forecast assumes federal and state funding remains at current levels through 2045. This anticipates \$56.9 billion in transportation revenue, shown in Table C-8.

The third funding scenario assumes that federal and state revenues grow at 2 percent compounded annually from 2029 to 2045. This scenario estimates \$66.6 billion over the life of the Plan; see Table C-9.

TABLE C-7: PROJECTIONS BASED ON ACTUAL HIGHWAY AND TRANSIT RECEIPTS

Funding Source		PA Subregion	NJ Subregion	LRP Total
Roadway	Federal	\$ 10.9 B	\$ 5.1 B	\$ 15.1 B
	State	\$ 5.9 B	\$ 5.9 B	\$ 11.8 B
	Local	\$ 0.3 B	\$ 0.0 B	\$ 0.3 B
	Roadway Total	\$ 17.1 B	\$ 11.0 B	\$ 28.2 B
Transit	Federal	\$ 5.7 B	\$ 1.6 B	\$ 7.3 B
	State	\$ 9.9 B	\$ 4.5 B	\$ 14.5 B
	Local	\$ 0.6 B	\$ 0.1 B	\$ 0.7 B
	Transit Total	\$ 16.2 B	\$ 6.2 B	\$ 22.4 B
DVRPC Total		\$ 33.4 B	\$ 17.2 B	\$ 50.6 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

The final funding scenario assumes a paradigm shift in funding starting in 2029. A new revenue source, such as a mileage-based user fees (MBUF), would replace the gas tax. This fee would generate a substantial one-time funding increase and potentially return to a more routine growth as travel increases with growing population and increasing economic activity. This scenario forecasts \$71.4 billion in roadway and transit revenues over the life of the *Connections 2045* Plan; see Table C-10.

It is worth noting that none of the scenarios in DVRPC's *Greater Philadelphia Future Forces* exercise projected an increase in transportation funding.² A key background force that repeatedly came up in stakeholder discussions—partisan paralysis—suggests that major

TABLE C-8: FLAT FEDERAL AND STATE FUNDING, 2018–2045

Funding Source		PA Subregion	NJ Subregion	LRP Total
Roadway	Federal	\$ 14.0 B	\$ 6.4 B	\$ 20.4 B
	State	\$ 5.9 B	\$ 5.9 B	\$ 11.8 B
	Local	\$ 0.3 B	\$ 0.0 B	\$ 0.3 B
	Roadway Total	\$ 20.2 B	\$ 12.3 B	\$ 32.4 B
Transit	Federal	\$ 7.3 B	\$ 2.0 B	\$ 9.3 B
	State	\$ 9.9 B	\$ 4.5 B	\$ 14.5 B
	Local	\$ 0.6 B	\$ 0.1 B	\$ 0.7 B
	Transit Total	\$ 17.8 B	\$ 6.6 B	\$ 24.5 B
DVRPC Total		\$ 38.0 B	\$ 18.9 B	\$ 56.9 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

²<http://www.dvrpc.org/Connections2045/FutureForces/>

increases in federal or state transportation funding are unlikely. In *Networking Transportation*, which is a deeper dive of the *Future Forces Transportation on Demand* scenario, found that the digitization of transportation (particularly vehicles) will make it much more feasible to implement alternative funding, such as MBUF or congestion pricing.³ This thinking, in combination with infrastructure funding emerging as a potential point for agreement, is the basis for the paradigm shift funding scenario.

RECOMMENDED FORECAST

The Long-Range Plan Working Group reviewed the scenarios, proposed funding projections, and recommended blending elements of the

second and third scenarios. However, the working group felt the 2 percent federal forecast was excessive, given how long it has been since the gas tax was increased and the growing probability that it will need to be replaced in the not-too-distant future. The resulting forecast assumes a 3 percent growth in federal funds beginning in 2029 compounded annually and flat state funding over the life of the Plan. It projects \$65.3 billion in revenue over the life of the *Connections 2045* Plan. This is only a slight increase over the Amended *Connections 2040* projection of \$63.5 billion.

Table C-11 shows the estimated reasonably anticipated funding by time period and mode in the recommended forecast.

TABLE C-9: FLAT FEDERAL AND STATE FUNDING, 2018–2028; 2 PERCENT FEDERAL AND STATE GROWTH, 2029–2045

Funding Source		PA Subregion	NJ Subregion	LRP Total
Roadway	Federal	\$ 14.0 B	\$ 6.4 B	\$ 20.4 B
	State	\$ 5.9 B	\$ 5.9 B	\$ 11.8 B
	Local	\$ 0.3 B	\$ 0.0 B	\$ 0.3 B
	Roadway Total	\$ 20.2 B	\$ 12.3 B	\$ 32.4 B
Transit	Federal	\$ 7.3 B	\$ 2.0 B	\$ 9.3 B
	State	\$ 9.9 B	\$ 4.5 B	\$ 14.5 B
	Local	\$ 0.6 B	\$ 0.1 B	\$ 0.7 B
	Transit Total	\$ 17.8 B	\$ 6.6 B	\$ 24.5 B
DVRPC Total		\$ 38.0 B	\$ 18.9 B	\$ 56.9 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

TABLE C-10: PARADIGM SHIFT

Funding Source		PA Subregion	NJ Subregion	LRP Total
Roadway	Federal	\$ 19.7 B	\$ 8.8 B	\$ 28.5 B
	State	\$ 6.3 B	\$ 6.5 B	\$ 12.8 B
	Local	\$ 0.3 B	\$ 0.0 B	\$ 0.3 B
	Roadway Total	\$ 26.4 B	\$ 15.3 B	\$ 41.7 B
Transit	Federal	\$ 10.3 B	\$ 2.9 B	\$ 13.2 B
	State	\$ 10.9 B	\$ 4.9 B	\$ 15.8 B
	Local	\$ 0.6 B	\$ 0.1 B	\$ 0.7 B
	Transit Total	\$ 21.8 B	\$ 8.0 B	\$ 30.8 B
DVRPC Total		\$ 48.12 B	\$ 23.2 B	\$ 71.4 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

³<http://www.dvrpc.org/Reports/17059.pdf>

ADDITIONAL FUNDS

In addition to this formula-based funding, including the New Jersey Statewide and Pennsylvania IMP funds that the region expects, the current Pennsylvania and New Jersey TIPs anticipate about \$2.4 billion in grants and add-ons. These funds include ARLE; Green Light Go; and federal TIGER grants, New Starts, and Small Starts funds. SETPA's \$300 million EB-5 loan is included here as well. Pennsylvania Turnpike funds being used to advance the I-95 and PA Turnpike interchange are not included, as this is now considered to be an externally funded project. Only funds that can be reasonably anticipated in the Plan are considered add-ons; this includes funds the region has already secured or has a reasonable hope of securing in the future.

Table C-13 adds together the reasonably anticipated formula funds in Table C-11 and the add-ons from Table C-12.

TABLE C-11: RECOMMENDED CONNECTIONS 2045 REASONABLY ANTICIPATED FUNDING BY TIME PERIOD AND MODE

Subregion	Mode	Funding Period				LRP Total 2018–2045
		1	2	3	4	
Pennsylvania	Roadway	\$ 3.6 B	\$ 4.4 B	\$ 6.2 B	\$ 10.5 B	\$ 24.7 B
	Transit	\$ 3.2 B	\$ 3.8 B	\$ 4.9 B	\$ 7.8 B	\$ 19.7 B
	Subregion Total	\$ 6.8 B	\$ 8.3 B	\$ 11.0 B	\$ 18.3 B	\$ 44.4 B
New Jersey	Roadway	\$ 1.9 B	\$ 3.0 B	\$ 3.6 B	\$ 5.2 B	\$ 13.7 B
	Transit	\$ 1.0 B	\$ 1.4 B	\$ 2.0 B	\$ 2.8 B	\$ 7.2 B
	Subregion Total	\$ 2.8 B	\$ 4.4 B	\$ 5.6 B	\$ 8.0 B	\$ 20.9 B
DVRPC Total		\$ 9.6 B	\$ 12.7 B	\$ 16.7 B	\$ 26.3 B	\$ 65.3 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

TABLE C-12: ADDITIONAL FUNDS TO THE REGION INCLUDED IN CONNECTIONS 2045

Subregion	Mode	Funding Period				LRP Total 2018–2045
		1	2	3	4	
Pennsylvania	Roadway	\$ 0.4 B	\$ 0.1 B	\$ - B	\$ - B	\$ 0.6 B
	Transit	\$ 0.4 B	\$ 0.1 B	\$ 0.6 B	\$ - B	\$ 1.1 B
	Subregion Total	\$ 0.9 B	\$ 0.2 B	\$ 0.6 B	\$ - B	\$ 1.7 B
New Jersey	Roadway	\$ - B	\$ - B	\$ - B	\$ - B	\$ 0.0 B
	Transit	\$ - B	\$ - B	\$ 0.7 B	\$ - B	\$ 0.7 B
	Subregion Total	\$ - B	\$ - B	\$ 0.7 B	\$ - B	\$ 0.8 B
DVRPC Total		\$ 0.9 B	\$ 0.2 B	\$ 1.3 B	\$ - B	\$ 2.4 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

TABLE C-13: REASONABLY ANTICIPATED FORMULA FUNDS PLUS ADDITIONAL FUNDS TO THE REGION

Subregion	Mode	Funding Period				LRP Total 2018–2045
		1	2	3	4	
Pennsylvania	Roadway	\$ 4.0 B	\$ 4.5 B	\$ 6.2 B	\$ 10.5 B	\$ 25.3 B
	Transit	\$ 3.6 B	\$ 3.9 B	\$ 5.5 B	\$ 7.8 B	\$ 20.8 B
	Subregion Total	\$ 7.7 B	\$ 8.5 B	\$ 11.6 B	\$ 18.3 B	\$ 46.1 B
New Jersey	Roadway	\$ 1.9 B	\$ 3.0 B	\$ 3.6 B	\$ 5.2 B	\$ 13.7 B
	Transit	\$ 1.0 B	\$ 1.4 B	\$ 2.7 B	\$ 2.8 B	\$ 7.9 B
	Subregion Total	\$ 2.8 B	\$ 4.4 B	\$ 6.3 B	\$ 8.0 B	\$ 21.7 B
DVRPC Total		\$ 10.5 B	\$ 13.0 B	\$ 18.0 B	\$ 26.3 B	\$ 67.7 B

Figures may not add up due to rounding. | Source: DVRPC, 2017.

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Appendix D:
Transportation Infrastructure Vision Plan

REVIEW COPY

Connections 2045 develops a vision for transportation infrastructure based on achieving and maintaining an SGR, improving the operation of existing facilities, and, where appropriate, expanding the system. In short, maintaining and modernizing our transportation system.

Tables D-1 and D-2 indicate the extensive scope of the roadway and transit infrastructure in the Greater Philadelphia region. Roadway infrastructure includes all auto-accessible roads and bridges controlled by state, county, local, and private entities. Transit infrastructure consists of facilities that are maintained and operated by the region's local transit service providers.

A number of facilities are used by the region's transit service providers but are not listed in Table D-2 because they lease the asset and are not responsible for its maintenance. One example is 30th Street Station in Philadelphia, which is used by both SEPTA and New Jersey Transit; while Amtrak is responsible for its maintenance. Both SEPTA and New Jersey Transit lease rail track from Amtrak and various other regional freight rail operators. At the same time, there is rail infrastructure for which the region's transit operators have maintenance responsibility but that is not in active service. Examples of these types of facilities include SEPTA's Chester Trunk Line from Chester City to West Chester, Pennsylvania, and New Jersey Transit's Vineland Secondary Route.

TABLE D-1: ROAD INFRASTRUCTURE IN GREATER PHILADELPHIA

Infrastructure	Owner	Pennsylvania Subregion	New Jersey Subregion
Roads (Linear Miles)	State DOT	3,557	536
	Other State/Federal Agency	1,579	236
	Turnpike/Toll Authority	94	100
	County / Local / Municipal	11,550	7,263
Bridges	State-Maintained Bridges >8'	2,755	597
	State-Maintained Deck Area (millions of square feet)	25.7	6.7
	Locally Maintained Bridges, >20'	846	430
	Locally Maintained Deck Area (millions of square feet)	2.7	0.9

Source: DVRPC, 2017.

TABLE D-2: TRANSIT INFRASTRUCTURE IN GREATER PHILADELPHIA

Infrastructure	SEPTA	NJ Transit	PATCO	PART
Rail Track Miles	397.4	117.4	35.3	-
- Elevated Track Miles	30.8	-	-	-
- Tunnel Track Miles	58.4	-	2.4	-
Interlockings	90	33	14	-
Bridges	341	58	26	-
At-grade Crossings	182	99	-	-
Power Substations and Switching Stations	77	-	11	-
Rail Stations and Bus Terminals	342	28	13	-
- Regional Rail Stations	154 ^a	7	-	-
- Heavy Rail Stations	52	-	13	-
- Trolley/Light Rail Stations	75	20	-	-
- Bus Terminals or Loops	62	1	-	-
Buses	1,404	279	-	13
Heavy Rail Vehicles	369	-	121	-
Light Rail Vehicles	159	20	-	-
Regional Rail Vehicles	335	42	-	-
Trackless Trolleys	38	-	-	-
Locomotives	8	12	-	-
Push Pull Cars	45	20	-	-
Vehicle Maintenance and Storage Shops	23	5	3	1

* Includes three stations in Delaware: Claymont, Churchman's Crossing, and Newark. Wilmington Station is owned by Amtrak.

Sources: SEPTA, New Jersey Transit, PATCO, and PART, 2012; National Transit Database, 2015.

This needs assessment breaks road, bike, pedestrian, and transit infrastructure and service needs into nine major categories. These are:

- Roadway Preservation (R1–R2)
- Roadway Operational Improvements (R3)
- Bicycle and Pedestrian (R4)
- Roadway Network Expansion (R5)
- Roadway Other (R6)

Tables D-3 and D-4 describe the types of projects contained in each expenditure category.

- Transit Network Preservation (T1–T3)
- Transit Operational Improvements (T4)
- Transit Network Expansion (T5)
- Transit Other (T6)

TABLE D-3: ROADWAY EXPENDITURE CATEGORIES AND PROJECT TYPES

Category ID	Category	Types of Projects
R1	Pavement Preservation	Preventative maintenance; resurfacing; reconstruction; appurtenances (signs, guardrails, pavement markings, drainage, and retaining walls); local and county Federal Aid road maintenance
R2	Bridge Preservation	Preventative maintenance; painting; substructure rehabilitation; superstructure rehabilitation or replacement; bridge deck overlays or replacement; parapet repairs; culvert rehabilitation or replacement; local Federal Aid bridges; bridge removal
R3	Operational Improvements	Access management; roadway, interchange, or intersection realignment; channelization new turn lanes; roundabouts; complete streets; road diets; safety initiatives (Highway Safety Improvement Program [HSIP]); rail crossings; ITS deployment; active traffic management; integrated corridor management; traffic operations centers; incident management; signal modernization, interconnection, or closed-loop signal systems; DSRC, 5G, vehicle-to-infrastructure, and vehicle-to-vehicle infrastructure
R4	Bicycle and Pedestrian	Streetscaping; sidewalks; multiuse paths; bike lanes; pedestrian and bicycle safety improvements; pedestrian bridge or tunnel; ADA curb cuts
R5	Network Expansion	New roads, lanes, bypasses, bridges, or interchanges; roadway relocations
R6	Other	Debt service; environmental mitigation; RideECO; MAP; air quality programs; dams; CMAQ; TMAs; regional and local planning; parking facilities

Source: DVRPC, 2017.

TABLE D-4: TRANSIT EXPENDITURE CATEGORIES AND PROJECT TYPES

Category ID	Category	Types of Projects
T1	Rail Infrastructure	Track rehabilitation, resurfacing, or replacement; catenary rehabilitation or replacement; signal replacement; rail bridge rehabilitation or replacement; substation improvements
T2	Vehicles	New or rehabilitated buses, paratransit, commuter rail, light rail, or heavy rail vehicles; maintenance and storage facilities; vehicle maintenance equipment
T3	Station Enhancements	Station rehabilitation and improvements; access improvements; nonexpansion parking improvements and maintenance; TOD; transportation centers; ADA compliance
T4	Operational Improvements	ITS; real-time passenger information; positive train control; fare modernization; traffic signal preemption; double tracking; sidings; light rail restoration
T5	Network Expansion	New stations on existing lines (including station parking needs), extension of existing lines, or new rail and BRT routes
T6	Other	Safety and security; Amtrak lease agreements, coordinated human services; preventative maintenance (operating budget), debt service

Source: DVRPC, 2017.

INFLATION AND Y-O-E DOLLARS

Federal regulations require that future transportation project cost estimates use Y-O-E dollars. These dollars account for the inflation that can be reasonably anticipated between the present day and the year(s) that the project is planned for construction. Generally, inflation related to the construction industry is more variable than the larger economy. Figure D-1 shows annual inflation rates for four indices: the National Highway Construction Cost Index (NHCCI), the Producer Price Index for Construction Materials Special Index (PPI-Construction Materials Index), the Consumer Price Index for all urban areas (CPI-U All Urban Areas), and the Consumer Price Index for the greater Philadelphia area (CPI-U Philadelphia-Wilmington-Atlantic City).

Table D-5 shows the average annual inflation rates for the four selected indices through 2017.

The NHCCI was deflationary in 2016, decreasing by -4.2 percent. In 2017, the other indices had modest increases in 2017 ranging from 1.3 to 2.5 percent. Inflation has now been consistently lower than typically expected, even over a longer period. However, the PPI-Construction Materials Index has continued to track higher than the CPI indices. The Greater Philadelphia Future Forces report estimated different inflation rates for each scenario. The higher technology scenario, Transportation on Demand, forecasted the lowest inflation, 2.0 percent annually, as new materials, processes, and innovation drives down the cost of goods and services. The next lowest was the Free Agent Economy, where a glut of workers kept inflation to 2.75 percent due to low labor costs. Severe Climate, based on the potential worst-case outcomes of climate change forecasts, estimated a 5.0 percent inflation rate due increasing energy costs, material shortages, and weather events continuously interfering in the economy.

The next four sections detail the region's vision plan for each roadway and transit category, in both state subregions.

PENNSYLVANIA SUBREGION ROADWAY VISION

The following sections detail the identified roadway vision over the life of the Plan for the Pennsylvania subregion for each of the six roadway funding categories. Categories R1 and R2 are based off a robust needs assessment to achieve and maintain an SGR for existing pavement and bridge infrastructure.

R1. Pennsylvania Subregion Pavement Vision

PennDOT maintains a Pavement Asset Management System (PAMS), which tracks the condition of all federal- and state-maintained roadways. The PAMS tracks conditions for each road segment in the region. One measure of road condition is the International Roughness Index (IRI). The IRI determines pavement roughness conditions based on total inches of surface variation per mile. Depending on the functional class of road, different IRI ratings are acceptable; see Figure

D-2. Roadway that is in "poor" condition by its IRI rating is considered deficient. PennDOT's PAMS contains data on 9,276 lane miles of roadway in the DVPRC region, of various state, municipal, and turnpike owners. Of these, approximately 28.6 percent are currently in poor condition.

PennDOT has divided the region's road system into four Business Plan Networks (BPNs) as follows:

- BPN 1 is Interstate highways.
- BPN 2 is the non-Interstate portion of the NHS.
- BPN 3 is for arterial and connector roads with greater than 2,000 vehicles per day.
- BPN 4 is for arterials and connector roads with less than 2,000 vehicles per day.

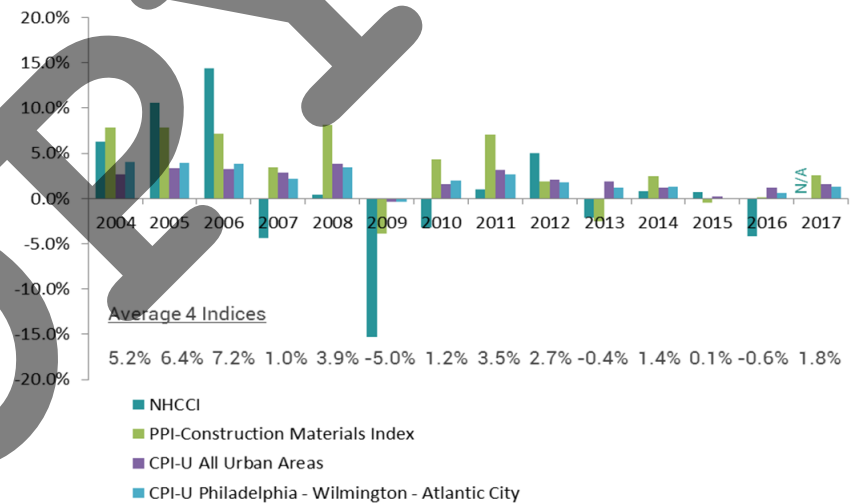
TABLE D-5: AVERAGE ANNUAL INFLATION RATES FOR SELECTED INDICES

Index	One-Year	10-Year	25-Year
NHCCI*	-4.2%	-1.7%	0.7%
PPI-Construction Materials	2.5%	2.0%	2.6%
CPI-U	1.6%	1.6%	2.2%
CPI-U Philadelphia	1.3%	1.4%	2.1%

* NHCCI is only available from 2003 onward, so the 25-year value is only for the 18-year period from 2003 to 2016.

Source: FHWA, 2003–2016; and Bureau of Labor Statistics, 1992–2017.

FIGURE D-1: ANNUAL INFLATION COMPARISON



Source: FHWA, 2003–2016; and Bureau of Labor Statistics, 2003–2017.

MAP-21 and the FAST Act require each state to track performance measures and set targets for the following:

- percentage of non-Interstate NHS pavements in good condition;
- percentage of non-Interstate NHS pavements in poor condition;
- percentage of Interstate System pavements in good condition; and
- Percent of Interstate System pavements in poor condition.

Pavement performance targets will be set by each state DOT and MPO (and can be different from each other) for a four-year period. The initial set of targets is due to be reported by DOTs to FHWA by May 20, 2018, with a target horizon date of 2021. MPOs then have 180 days to report their targets to state DOTs for the same four-year period. Targets are required for the full extent of the system, regardless of ownership. Data is based on through, mainline lanes only and does not include ramp conditions. Data must be collected in one direction for IRI, cracking

percentage, rutting, and faulting. Pavement Surface Rating (PSR) can be used as an optional performance measure on roads with speeds of less than 40 miles per hour (mph). No more than 5 percent of the system can have missing or invalid data. The rules also set a minimum target threshold for Interstate pavements, where no more than 5 percent can be in poor condition.

DVRPC developed a methodology for analyzing future pavement condition based on normal wear and tear on the roads and accounting for the impact of future road projects. Needs for culvert rehabilitation and replacement are included in pavement reconstruction and are not included in the bridge vision plan (R2).

FIGURE D-2: PENNDOT INTERNATIONAL ROUGHNESS INDEX REPORTING GUIDELINES

IRI Ranges (inches per mile)	National Highway System		Non-National Highway System	
	Interstate	Non-Interstate	ADT ≥ 2000	ADT < 2000
≤ 70	Excellent	Excellent	Excellent	Excellent
71-75	Good	Good	Good	Good
76-100	Fair	Fair	Fair	Fair
101-120	Poor	Poor	Poor	Poor
121-150				
151-170				
171-195				
196-220				
>220				

Source: PennDOT, 2004.

TABLE D-6: MAP-21/FAST ACT PAVEMENT PERFORMANCE MEASURE METRICS

Rating	Good	Fair	Poor
IRI (inches/mile)	<95	95–170	>170
PSR* (0.0–5.0 value)	≥4.0	2.0–4.0	≤2.0
Cracking Percentage (%)	<5	CRCP: 5–10 Jointed: 5–15 Asphalt: 5–20	>10 >15 >20
Rutting (inches)	<0.20	0.20-0.40	>0.40
Faulting (inches)	<0.10	0.10–0.15	>0.15

* PSR can only be used on routes where the posted speed limit is less than 40 mph.

Source: DVRPC, 2017. If a state DOT does not meet its target for two consecutive four-year periods, it must obligate National Highway Performance Program and STP funds to improving pavement condition. Using PennDOT's current pavement condition definitions, and not the more prescriptive MAP-21/FAST Act performance measure, 11.6 percent of the Pennsylvania subregion's tested Interstate segment miles, and 33 percent of the non-Interstate NHS pavement miles, are currently in poor condition. Fifty-four percent of Interstate miles and 30 percent of non-Interstate NHS miles are in either good or excellent condition.

“Major Regional Pavement Reconstruction” [R1.01] is for specific regional NHS roadway reconstruction priorities. These are listed as Major Regional Projects in Chapter 4.

“Preventative Maintenance” [R1.02] projects include crack sealing, milling and filling, shoulder cuts, oil chip sealing, or microsurfacing. Regular preventative maintenance can delay future resurfacing and reconstruction needs by extending the life of pavement.

“Resurfacing” [R1.03] generally occurs every seven years on Interstates, every 12–15 years on BPNs 2 and 3, and every 25 years on BPN 4, but only on roads less than 50 years old.

“Reconstruction” [R1.04] needs are identified for roads when they are more than 50 years old and in poor condition.

“Appurtenances” [R1.05] include signs, guardrail/guide barriers, drainage, pavement markings, lighting, and retaining walls that are part of the roadway network.

“Local Federal Aid Roadways” [R1.06] needs estimate the cost for routine preventative maintenance, resurfacing, and reconstruction costs for local federal aid roads.

TABLE D-7: PENNSYLVANIA SUBREGION PAVEMENT NEEDS (R1)

R1	Roadway Reconstruction/Resurfacing	2018–2022	2023–2028	2029–2035	2036–2045	Total
R1.01	Major Regional Pavement Reconstruction	\$ 624.0	\$ 1,046.3	\$ 1,132.7	\$ 2,623.0	\$ 5,426.0
R1.02	Preventative Maintenance	\$ 150.2	\$ 212.1	\$ 299.9	\$ 550.8	\$ 1,213.1
R1.03	Resurfacing	\$ 324.1	\$ 391.4	\$ 692.0	\$ 1,053.9	\$ 2,461.5
R1.04	Reconstruction	\$ 1,061.7	\$ 1,432.8	\$ 2,164.3	\$ 3,757.9	\$ 8,416.7
R1.05	Appurtenances	\$ 95.6	\$ 135.0	\$ 190.9	\$ 350.5	\$ 772.0
R1.06	Local Federal Aid Roadways	\$ 82.0	\$ 115.7	\$ 163.6	\$ 300.4	\$ 661.7
R1	Total	\$ 2,337.6	\$ 3,333.4	\$ 4,643.4	\$ 8,636.6	\$18,950.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding.

Source: DVRPC, 2017.

R2. Pennsylvania Subregion Bridge Vision

PennDOT maintains a Bridge Asset Management System (BAMS), which tracks the structural condition of key bridge elements for all bridges greater than 20 feet in length, regardless of ownership. The BAMS contains the most recent bridge inspection data. These inspections are done every two years for all bridges and more often on structurally deficient bridges. The inspections determine the condition of the deck, substructure, and superstructure on a scale of zero to nine; any of these items scoring a four or below indicates that the bridge is structurally deficient and in need of significant repair work or replacement.

MAP-21 and the FAST Act require each state to track performance measures and set targets for the following:

- percentage of NHS bridge deck area in good condition; and
- percentage of NHS bridge deck area in poor condition.

Bridge performance targets will be set by each state DOT and MPO (and can be different from each other) for a four-year period. Bridges that carry on- and off-ramps connected to NHS facilities, and bridges

that cross state borders, must be included in these measures (and are counted in both states' totals). The initial set of targets is due to be reported by DOTs to FHWA by May 2018, with a target horizon date of 2021. MPOs then have 180 days to report their targets to state DOTs for the same four-year period. FHWA has set a minimum target threshold of 10 percent of NHS bridge deck area in structurally deficient condition. If a state DOT fails to meet the minimum condition level for three consecutive years, it must obligate and set aside funds for eligible NHS bridge projects. Currently, 8.7 percent of the Pennsylvania subregion's NHS bridge deck area is in poor, or structurally deficient, condition.

DVRPC developed a routine for analyzing future bridge conditions based on normal wear and tear on the facilities and accounting for the impact of future bridge projects. Need for culvert rehabilitation and replacement is included in pavement reconstruction (R1) and is not included here in the bridge vision plan.

“Major Regional Bridge Replacement” [R2.01] generally involves major regional bridge projects that are replacements on the NHS and are among the largest bridges by deck area for each county. These are listed as Major Regional Projects in Chapter 4.

“Bridge Maintenance” [R2.02] projects include scouring, washing, or replacement of expansion joints, rocker bearings, or underpinning. These projects should occur at each bridge every 15–25 years, as long as the bridge is in an SGR. Bridges in poor condition are generally targeted for rehabilitation or replacement and undergo basic maintenance only as an emergency stopgap measure to ensure it can remain open to traffic.

“Bridge Rehabilitation” [R2.03] generally involves rehabilitating or

TABLE D-8: MAP-21/FAST ACT BRIDGE PERFORMANCE MEASURE METRICS

NBI Rating Scale	Good	Fair	Poor
Deck (Item 58)	≥7	5–6	≤4
Superstructure (Item 59)	≥7	5–6	≤4
Substructure (Item 60)	≥7	5–6	≤4
Culvert (Item 62)	≥7	5–6	≤4

Source: DVRPC, 2017.

replacing one or more of the three main bridge components: the deck, the superstructure, or the substructure. This can also include painting metal bridges and deck overlays. Keeping the bridge deck watertight is critical to keeping corrosive materials out of the substructure and superstructure structural components.

“Bridge Replacement” [R2.04] generally replaces a bridge that has passed its expected 50- to 100-year lifespan and has two or more of its components (deck, superstructure, or substructure) in poor condition.

“Bridge Removal” [R2.05] includes funds for removing bridges that will not be replaced.

“Local Federal Aid Bridges” [R2.06] accounts for rehabilitation and replacement needs for local federal aid bridges.

“Public-Private Partnerships” [R2.07] accounts for the region's share of the rapid bridge replacement project with PWKG.

TABLE D-9: PENNSYLVANIA SUBREGION BRIDGE REHABILITATION REPLACEMENT (R2)

R2	Bridge Replacement / Rehabilitation	2018–2022	2023–2028	2029–2035	2036–2045	Total
R2.01	Major Regional Bridge Replacement	\$ 660.5	\$ 863.9	\$ 2,788.3	\$ 6,432.2	\$ 10,744.9
R2.02	Bridge Maintenance	\$ 191.2	\$ 270.0	\$ 381.7	\$ 701.0	\$ 1,544.0
R2.03	Bridge Rehabilitation	\$ 1,019.7	\$ 1,467.2	\$ 1,447.5	\$ 2,134.1	\$ 6,068.6
R2.04	Bridge Replacement	\$ 446.1	\$ 657.2	\$ 302.4	\$ 31.0	\$ 1,436.7
R2.05	Bridge Removal	\$ 2.7	\$ 3.9	\$ 5.5	\$ 10.0	\$ 22.1
R2.06	Local Federal Aid Bridges	\$ 464.4	\$ 655.7	\$ 927.0	\$ 1,702.5	\$ 3,749.6
R2.07	Public-Private Partnerships	\$ 0.9	\$ 1.4	\$ 1.6	\$ 2.2	\$ 6.0
R2	Total	\$ 2,785.6	\$ 3,919.2	\$ 5,854.0	\$ 11,013.0	\$ 23,571.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding.

Source: DVRPC, 2017.

R3. Pennsylvania Subregion Operational Improvement Needs

The Transportation Systems Management and Operations (TSMO) Plan presents a comprehensive long-term vision of transportation operations, bridging individual programs to create a cohesive regional vision. It was developed in cooperation with DVRPC's TOTF, which is composed of traffic, transit, and emergency management operators in the region.

The TSMO Plan highlights four major operational themes: incident management (IM), traffic management, transit operations, and traveler information. Several operational needs emerged, including obtaining real-time accurate information, sharing information among agencies and with the public, and having the appropriate resources available to respond to incidents. The TSMO Plan identifies operational strategies, such as the addition of transportation operations centers (TOCs), variable speed limit signs, closed-circuit television cameras (CCTV), weigh-in-motion detectors, modernization of traffic signals, closed-loop traffic signal systems, cyclical resynchronization of traffic lights, and locations for parking management systems.

Transportation operations have unique funding and implementation requirements. Although ITS projects are like other major transportation capital investments in that they are funded through the TIP, there are substantial maintenance and operations costs associated with them. Hardware, software, and communications have to be continually maintained and updated to remain consistent with the latest IT standards.

"Major Regional Safety/Operational Projects" [R3.01] include specific safety and operational projects, along with the safety/operational components of major preservation and network expansion projects.

These are listed as Major Regional Projects in Chapter 4.

"Safety/Operational Improvements" [R3.02] include intersection/interchange improvements, roadway realignments, channelization, roundabouts, access management, new turning lanes, and grade-separated rail crossings. Funding for these projects will be identified in the current and future TIPs. Some example projects include:

- intersection improvements at Philmont Avenue, Tomlinson Road, and Pine Road in Montgomery County;
- restriping Washington Lane from four lanes to three lanes, providing center-turn lane, bike lanes, and sidewalks from Cheltenham Avenue to Township Line Road in Cheltenham Township, Montgomery County;
- adding dedicated vehicle turning lanes to the PA 29 and PA 113 intersection in Montgomery County; and
- corridor and intersection improvements on Blair Mill Road from Easton Road (PA 611) to Welsh Road (PA 63) in Horsham and Upper Moreland townships in Montgomery County.

"Intelligent Transportation Systems" [R3.03] includes capital and operating costs for ITS deployment and traffic operations centers. Funds will support DOT, local/county, and DRPA operations. Proposed projects and facilities include, but are not limited to:

- ITS infrastructure (mostly infill to additional equipment where needed along these facilities):
 - ▶ I-76 Schuylkill Expressway;
 - ▶ US 1 Expressway;
 - ▶ I-95;

- ▶ I-476;
- ▶ I-676;
- ▶ US 1;
- ▶ US 30 Bypass;
- ▶ US 202;
- ▶ US 422;
- ▶ PA 309;
- ▶ US 322;
- ▶ PA 100; and
- ▶ PA Turnpike;
- Road Weather Information Systems (RWIS):
 - ▶ Bucks County;
 - ▶ Chester County;
 - ▶ Delaware County;
 - ▶ Montgomery County; and
 - ▶ Philadelphia;
- City of Philadelphia—variable message sign, CCTV, detectors;
- Operations and maintenance for existing TOCs;
- new PennDOT District 6-0 Regional Traffic Management Center (RTMC); and
- CV/AV communication network.

"Incident Management" [R3.04] includes capital and operating funds for safety service patrols (SSPs). Proposed IM projects and locations include, but are not limited to:

- SSPs:
 - ▶ I-95;
 - ▶ I-76/US 1 Freeway (Roosevelt Expressway);
 - ▶ I-476;

- ▶ US 422;
- ▶ PA 309;
- ▶ US 1;
- ▶ PA Turnpike;
- ▶ US 202; and
- ▶ US 30 Bypass;
- Regional Integrated Multimodal Information Sharing (RIMIS):
 - ▶ enhancements/upgrades; and
 - ▶ data interfaces;
- IM:
 - ▶ IM task forces;
 - ▶ IM grant initiative;
 - ▶ quick clearance/IM safety issues (i.e., "Move It/Move Over/Quick Clearance" policies);
 - ▶ accident investigation equipment; and
 - ▶ towing incentive program;
- Emergency communications network; and
- Arterial Management—Integrated Corridor Management.

"Traffic Management and Signals" [R3.05] includes needs for traffic signal replacement and retiming, traffic management through variable speed limit signs, ATM, and local traffic signals. It also includes funding needs for upgrading to adaptive signal control technology, which uses real-time data to optimize traffic flow. Traffic management and signal projects and locations include, but are not limited to:

- Traffic signal retiming and upgrade programs:
 - ▶ project management;
 - ▶ priority network signal retiming program;
 - ▶ priority network signal upgrade program; and

- ▶ integrate signals into PennDOT RTMC;
- Traffic signal communication hubs;
- Philadelphia traffic signals;
- ATM systems which may include strategies such as ramp metering, variable speed limits, queue detection, and part-time shoulder use:
 - ▶ I-76;
 - ▶ I-676;
 - ▶ I-95;
 - ▶ I-476;
 - ▶ US 30 Bypass;
 - ▶ US 422; and
 - ▶ PA 309.
- Parking management.

TABLE D-10: PENNSYLVANIA SUBREGION ROADWAY OPERATIONAL IMPROVEMENT NEEDS BY SUBCATEGORY (R3)

R3	Roadway Operational Improvements	2018–2022	2023–2028	2029–2035	2036–2045	Total
R3.01	Major Regional Safety/Operational Projects	\$ 224.7	\$ 386.0	\$ 898.5	\$ 1,504.0	\$ 3,013.2
R3.02	Safety/Operational Improvements	\$ 400.9	\$ 566.1	\$ 686.0	\$ 1,469.9	\$ 3,122.8
R3.03	Intelligent Transportation Systems	\$ 32.4	\$ 166.5	\$ 222.1	\$ 344.3	\$ 765.3
R3.04	Incident Management	\$ 27.0	\$ 52.1	\$ 143.1	\$ 267.6	\$ 489.8
R3.05	Traffic Management and Signals	\$ 192.0	\$ 84.0	\$ 201.1	\$ 278.5	\$ 755.5
R3	Total	\$ 877.0	\$ 1,254.6	\$ 2,150.8	\$ 3,864.3	\$ 8,146.6

All figures in millions of Y-Q-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R4. Pennsylvania Subregion Bicycle/Pedestrian Needs

This category identifies needs for trails, sidewalks, bike lanes, and other infrastructure to increase the region's bike and pedestrian friendliness to achieve Plan goals of a more multimodal transportation system.

"Off-road Trails" [R4.01] includes funding for The Circuit priority regional trail network and the completion of some additional trail segments not considered to be part of The Circuit.

"On-road Facilities" [R4.02] include needs for pedestrian and bike safety and intersection improvements (countdown timers and crosswalks), streetscaping, sidewalks, ADA curb cut requirements, bike lanes, bike/pedestrian bridges, overpasses or tunnels, and project engineering. *Connections 2045* increases the need for bike and pedestrian infrastructure significantly as part of the desire for more walkable, bikeable communities. The vision would triple the number of bike facilities and increase the amount of sidewalks by 50 percent throughout the region by 2045. It includes specific projects, such as better pedestrian connections between the two Radnor train stations.

TABLE D-11: PENNSYLVANIA SUBREGION BICYCLE/PEDESTRIAN PROJECTS (R4)

R4	Bicycle and Pedestrian	2018–2022	2023–2028	2029–2035	2036–2045	Total
R4.01	Off-road Trails	\$ 41.0	\$ 129.3	\$ 126.8	\$ 233.0	\$ 530.1
R4.02	On-road Facilities	\$ 358.4	\$ 506.0	\$ 715.4	\$ 1,313.9	\$ 2,893.8
R4	Total	\$ 399.5	\$ 616.0	\$ 854.6	\$ 1,569.6	\$ 3,423.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R5. Pennsylvania Subregion Roadway Expansion Needs

The vision plan was developed by updating the costs from the Major Regional Project list in the *Connections 2040* long-range plan. Additional needs were identified during a review of recent transportation studies and a call for projects with regional stakeholders.

“Major Regional Projects” [R5.01] are large-scale projects that will have a significant impact on regional travel. Major new roadway capacity is defined as widening, extending, or building new limited-access freeways of any length; creating a new interchange or adding missing movements between freeways (HPMS functional classes 1 or 2) and arterials (HPMS functional classes 3 or 4); or widening, extending, or

building new principal arterials (HPMS functional classes 3 or 4) for more than three lane miles. These are listed as major regional network expansion projects in Chapter 4.

“Minor Network Expansion Projects” [R5.02] includes funding for minor network expansion projects in the current fiscally constrained TIP, projects identified in the unfunded TIP illustrative list, and projects brought forward during the call for projects. These are listed in Table D-12

TABLE D-12: PENNSYLVANIA SUBREGION ROADWAY NETWORK EXPANSION (R5)

R5	Roadway Expansion	2018–2022	2023–2028	2029–2035	2036–2045	Total
R5.01	Major Regional Projects	\$ 219.1	\$ 518.2	\$ 356.2	\$ 489.0	\$ 1,582.9
R5.02	Minor Network Expansion Projects	\$ 31.9	\$ 85.1	\$ 74.9	\$ 137.6	\$ 329.5
R5	Total	\$ 251.0	\$ 603.3	\$ 431.1	\$ 627.0	\$ 1,912.4

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

TABLE D-13: PENNSYLVANIA SUBREGION MINOR ROADWAY EXPANSION PROJECTS

MRP ID	Facility	Project Scope	Location	Timing	Local Cost Millions of Y-O-E \$	Federal and State Network Expansion Cost Millions of Y-O-E \$	Total Federal and State Funded Cost Millions of Y-O-E \$	Unfunded Cost Millions of 2017 \$
44	US 1, Baltimore Pike	Selective widening from two lanes in each direction to three lanes in each direction and relocate the School House Road intersection. Add left-turn lanes on US 1 at School House Road and install new traffic signals.	Chester	2018–2022		\$ 3.9	\$ 7.8	
54	Henderson Road and South Gulph Road	Widen Henderson Road from South Gulph Road to Shoemaker; widen South Gulph Road from Crooked Lane to I-76 Gulph Mills intersection.	Montgomery	2023–2035		\$ 12.9	\$ 25.7	
101	Bryn Mawr Avenue	Bypass for PA 3 West Chester Pike and PA 252 Newtown Street Intersection.	Delaware	2029–2045	\$ 1.1	\$ 4.9	\$ 9.8	
116	PA 113	Widen from US 30 to Peck Road.	Chester	2029–2045		\$ 7.3	\$ 7.3	
117	Bridgewater Road	Extend roadway from Concord Road to PA 452/US 322.	Delaware	2018–2028		\$ 23.8	\$ 23.8	
119	Bristol Road	Extend roadway from US 202 to Park Avenue.	Bucks	2018–2022		\$ 13.3	\$ 13.3	
120	Belmont Avenue at I-76 Interchange	Widen Belmont Avenue to provide additional lanes, intersection improvements and streetscape improvements; modify I-76 and railroad overpasses.	Montgomery	2018–2028		\$ 22.5	\$ 45.1	
123	US 202 and US 1 Loop Road	Complete southwestern loop road.	Chester	2018–2022		\$ 3.6	\$ 3.6	
125	Guthriesville Loop Road	Extend new road from Reeceville Road to Horseshoe Pike.	Chester	2029–2045		\$ 9.6	\$ 9.6	
126	G.O. Carlson Boulevard Extension	New two-lane collector road and bridge between two unconnected portions of G.O. Carlson Boulevard (PA 340 and Lloyd Avenue).	Chester	2029–2045		\$ 6.9	\$ 6.9	
160	Second Collegeville	Provide additional bridge over the Perkiomen Creek between Ridge Pike and Germantown	Montgomery	2018–2028		\$ 28.8	\$ 57.7	

continued on next page...

TABLE D-13: PENNSYLVANIA SUBREGION MINOR ROADWAY EXPANSION PROJECTS

MRP ID	Facility	Project Scope	Location	Timing	Local Cost Millions of Y-O-E \$	Federal and State Network Expansion Cost Millions of Y-O-E \$	Total Federal and State Funded Cost Millions of Y-O-E \$	Unfunded Cost Millions of 2017 \$
161	PA 23 and Trout Creek Road Bridge	Replace weight-restricted bridge on a new alignment; realign roadway between Moore Road and Vanderburg Road, providing two westbound lanes and one eastbound lane	Montgomery	2018–2028		\$ 4.1	\$ 16.5	
163	Ridge Pike	Reconstruct from Butler Pike to Philadelphia City Line; widen from three to four lanes from Church Lane to Philadelphia.	Montgomery	2018–2022		\$ 4.0	\$ 16.1	
174	Germantown Pike	Rebuilding/3R and widening from Whitehall Road to Potshop Road.	Montgomery	Unfunded				\$ 44.0
177	Keystone Boulevard	Extend from current terminus to Grosstown Road.	Montgomery	Unfunded				\$ 30.0
178	Market Street, Douglass Township	Construct new connector roadway between Grosser Road and PA 73.	Montgomery	Unfunded				\$ 30.0
181	Second Conshohocken Bridge	Over Schuylkill River.	Montgomery	Unfunded				\$ 50.0
184	PA 63 Welsh Road	Bridge replacements and minor widening between Blair Mill Road and Twining Road.	Montgomery	Unfunded				\$ 20.0

Source: DVRPC, 2017.

R6. Pennsylvania Subregion Other Needs

To develop the “Roadway Other” vision, DVRPC maintained current TIP spending levels for most of the subcategories over the life of the Plan, updating in instances where PennDOT was able to give a better cost estimate. Many of these needs are fixed, so this category is generally fully funded.

“**Environmental Mitigation**” [R6.01] includes PennDOT’s environmental cleanup and protection program, consisting of remediation and testing associated with underground storage tanks, lead-based paint and asbestos abatement, contaminated soil and groundwater, and air quality. This line item is also for nonproject-specific needs, including wetland mitigation and cultural resource preservation. In many instances, an environmental mitigation project is attached to a specific highway project. When this happens, the environmental mitigation need is included as part of the highway project costs and is not included in this funding category. However, ongoing maintenance needs for completed projects are included here.

“**Air Quality**” [R6.02] includes funding for the CMAQ project engineering,

diesel retrofits, and the Air Quality Action Program. Current federal guidance suggests a minimum of 25 percent of CMAQ funds should go toward diesel retrofit projects.

“**Debt Service**” [R6.03] has no current funding need in the Pennsylvania subregion.

“**Travel Demand Management**” [R6.04] includes funding for TMAs; marketing for the RideECO commuter benefits program, MAP, and Share-A-Ride. Some of these programs require a local match, which is not reflected in the need here.

“**Rail Improvements**” [R6.05] include improvements to both the freight and passenger rail systems.

“**Miscellaneous Other**” [R6.06] includes funding for parking facilities, security, consultant and design services, dam rehabilitation/reconstruction, local and regional planning, regional geographic information system (GIS) support, and the regional travel demand model, and other miscellaneous items, such as equipment purchases, and maintenance and storage facilities.

TABLE D-14: PENNSYLVANIA SUBREGION ROADWAY OTHER (R6)

R6	Roadway Other	2018–2022	2023–2028	2029–2035	2036–2045	Total
R6.01	Environmental Mitigation	\$ 31.7	\$ 23.6	\$ 28.6	\$ 61.3	\$ 145.3
R6.02	Air Quality	\$ 4.9	\$ 5.5	\$ 8.5	\$ 18.2	\$ 37.1
R6.03	Debt Service	\$ -	\$ -	\$ -	\$ -	\$ -
R6.04	Travel Demand Management	\$ 14.2	\$ 20.3	\$ 24.6	\$ 52.7	\$ 111.8
R6.05	Rail Improvements	\$ 21.5	\$ 25.8	\$ 46.9	\$ 86.1	\$ 180.3
R6.06	Miscellaneous Other	\$ 33.0	\$ 24.3	\$ 37.9	\$ 81.2	\$ 176.5
R6	Total	\$ 105.4	\$ 99.5	\$ 146.5	\$ 299.5	\$ 650.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

PENNSYLVANIA SUBREGION TRANSIT NEEDS

The following sections detail the identified transit needs over the life of Connections 2045 for the Pennsylvania subregion for each of the six transit funding categories. Categories T1, T2, and T3 are based off a robust needs assessment to achieve and maintain an SGR for existing rail, transit vehicle, and station infrastructure.

T1. Pennsylvania Subregion Rail Infrastructure Needs

SEPTA rail infrastructure needs were developed using its asset management system to determine regular maintenance cycles, such as how often they need to be rehabilitated, restored, or replaced. Rail infrastructure needs include bridges, rails, rail ties, beds, signals, catenaries, and power substations.

“Track Rehabilitation/Resurfacing/Replacement” [T1.01] includes yards program, yard tracks program, track and right-of-way (ROW) regional rail service improvements, and regular funding for rail maintenance through SEPTA's infrastructure safety and renewal program. It also includes tunnels and tunnel support systems. Much of SEPTA's rail track infrastructure is approaching the end of its 50-year life expectancy.

“Catenary and Substation Rehabilitation/Replacement” [T1.02]

includes SEPTA's transit substation program, which powers regional rail and transit routes. This program replaces major power components, such as transformers, transformer breakers, trolley breakers, feeder switches, substation switchgears and protective relaying. Current projects are programmed at the following rail substations: 18th/12th/Portal, Allen Lane, Bethayres, Brill, Chestnut Hill East, Hatboro, Lansdale, Neshaminy, and Yardley; as well as transit substations: Market, Ellen, Ranstead, Park, Broad, Loudon, and Castor.

“Signal and Communications Rehabilitation/Replacement” [T1.03]

includes funding improvements to communications systems, signal systems, and IT infrastructure.

“Rail Bridge/Elevated Structure Improvements” [T1.04]

include replacement of bridges for rail. This category includes the Stone Arch Bridge Program, as well as funding from the infrastructure safety and renewal program to address future bridge needs as they arise.

TABLE D-15: PENNSYLVANIA SUBREGION RAIL INFRASTRUCTURE REHABILITATION AND RESTORATION (T1)

T1	Rail Infrastructure Rehabilitation, Restoration	2018–2022	2023–2028	2029–2035	2036–2045	Total
T1.01	Track Rehabilitation/Resurfacing/Replacement	\$ 1,008.1	\$ 628.4	\$ 1,429.2	\$ 553.2	\$ 3,618.9
T1.02	Catenary and Substation Rehabilitation/Replacement	\$ 455.0	\$ 139.4	\$ 448.7	\$ 149.4	\$ 1,192.5
T1.03	Signal and Communications Rehabilitation/Replacement	\$ 440.2	\$ 193.7	\$ 791.9	\$ 1,249.4	\$ 2,675.3
T1.04	Rail Bridge/Elevated Structure Improvements	\$ 966.4	\$ 141.3	\$ 241.7	\$ 244.8	\$ 1,594.1
T1	Total	\$ 2,869.7	\$ 1,102.9	\$ 2,911.5	\$ 2,196.8	\$9,080.8

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T2. Pennsylvania Subregion Transit Vehicle Infrastructure Vision

The vehicle infrastructure needs assessment was determined using SEPTA's asset management system. Major new vehicle purchases may be completed through bonding to flatten large upfront costs. SEPTA's willingness or ability to issue additional bonds may be limited in the future due to already high levels of indebtedness.

"New Bus" [T2.01] includes the need to regularly replace buses every 12 years. Current procurements include electric buses for routes 29 and 79 in South Philadelphia and hybrid bus purchases for routine replacement on other routes. Future SEPTA needs are also identified. The vision plan also indicates replacing a bus on the PART network every other year.

"New Light Rail Vehicle" [T2.02] includes the trolley modernization program, which includes procurement of new ADA-accessible articulated trolleys and nonarticulated trolleys. Reactivating routes 23 and 56 as trolleys will be studied as a part of this program.

"New Heavy Rail Vehicle" [T2.03] includes the need to either purchase new vehicles or rehabilitate vehicles.

"New Commuter Rail Vehicle" [T2.04] includes the purchase of vehicles to replace the aging Silverliner IV vehicles and expand the size of the fleet to deal with overcrowding issues on the regional rail lines. The last funding period includes need to replace the Silverliner V fleet, which will be 35 years old in 2045.

"New Paratransit Vehicle" [T2.05] includes purchasing new minivans, hi-cap paratransit vehicles, or paratransit sedans for SEPTA operations.

"Vehicle Overhaul Program" [T2.06] includes regular vehicle overhaul (buses, light, heavy, and commuter rail cars) at the mid-year of the expected lifespan (six years for buses and 15–20 years for rail vehicles).

"Vehicle Storage and Maintenance Facilities" [T2.07] includes replacing shop roofs, installing new fencing, and constructing or expanding a new rail shop or yard storage to meet the needs of a larger rail fleet. This category also includes replacement of vehicle maintenance equipment, such as new vehicle washers. Maintaining PART's vehicle facility is included in this category.

"Utility Vehicles" [T2.08] includes maintenance and replacement needs for all nonrevenue transit vehicles. This line item includes SEPTA's utility fleet renewal program.

TABLE D-16: PENNSYLVANIA SUBREGION TRANSIT VEHICLE REHABILITATION AND REPLACEMENT (T2)

T2	Vehicle Rehabilitation / Replacement	2018–2022	2023–2028	2029–2035	2036–2045	Total
T2.01	New Bus	\$ 825.1	\$ 567.2	\$ 737.2	\$ 1,075.8	\$ 3,205.3
T2.02	New Light Rail Vehicle	\$ 22.7	\$ 536.4	\$ 152.7	\$ 130.0	\$ 841.8
T2.03	New Heavy Rail Vehicle	\$ -	\$ -	\$ 130.0	\$ 1,725.0	\$ 1,855.0
T2.04	New Commuter Rail Vehicle	\$ 342.7	\$ 361.8	\$ 1,318.1	\$ 153.8	\$ 2,176.4
T2.05	New Paratransit Vehicle	\$ 58.1	\$ 69.8	\$ 78.1	\$ 132.9	\$ 338.9
T2.06	Vehicle Overhaul Program	\$ 623.8	\$ 773.8	\$ 838.0	\$ 1,251.0	\$ 3,486.7
T2.07	Vehicle Storage and Maintenance Facilities	\$ 245.3	\$ 173.6	\$ 163.5	\$ 231.9	\$ 814.3
T2.08	Utility Vehicles	\$ 34.0	\$ 36.0	\$ 37.5	\$ 50.0	\$ 157.5
T2	Total	\$ 2,151.8	\$ 2,518.6	\$ 3,455.1	\$ 4,750.5	\$ 12,875.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T3. Pennsylvania Subregion Station Infrastructure Vision

Infrastructure needs were determined using SEPTA's asset management system.

"Station Renovation" [T3.01] includes regular renovation, approximately every 30 years, for all stations in the subregion, including meeting ADA accessibility requirements. Some specific stations that will be renovated include Conshohocken, East Falls, Hatboro, Lawndale, Roslyn, Swarthmore, Willow Grove, Wyndmoor, Wynnewood, and Yardley on the regional rail system. On the transit network, improvements are planned at Wyoming, Fairmount, Tasker-Morris, 5th Street/

Independence Hall, Susquehanna-Dauphin, Hunting Park, and Norristown High Speed Line Villanova stations.

The station vision also accounts for relocating Highland Avenue Station in Chester City and consolidating separate stations on the Norristown High Speed Line and the Paoli-Thorndale Line in Radnor Township.

"Parking" [T3.02] includes expansion of parking at existing stations, creation of new park-and-ride lots, and rehabilitation of existing parking facilities. Specific project locations include Gwynedd Valley and North Wales.

“Passenger Amenities” [T3.03] includes historic preservation, rehabilitation, and related activities; bus shelters; landscaping and other scenic beautification, including street lights and public art; pedestrian access and walkways; bicycle access, storage facilities and installation of equipment for transporting bicycles on transit vehicles;

transit connections to parks; signage; and enhanced access to transit for persons with disabilities. This category includes SEPTA's bicycle-transit access program and passenger and crew amenities at Suburban Station.

TABLE D-17: PENNSYLVANIA SUBREGION TRANSIT STATION ENHANCEMENTS (T3)

T3	Station Enhancements	2018–2022	2023–2028	2029–2035	2036–2045	Total
T3.01	Station Renovation	\$ 343.3	\$ 353.6	\$ 432.2	\$ 990.0	\$ 2,119.1
T3.02	Parking	\$ 51.4	\$ 68.2	\$ 72.0	\$ 150.0	\$ 341.6
T3.03	Passenger Amenities	\$ -	\$ -	\$ -	\$ -	\$ -
T3	Total	\$ 394.7	\$ 421.7	\$ 504.2	\$ 1,140.0	\$ 2,460.6

Source: DVRPC, 2017.

T4. Pennsylvania Subregion Operational Improvement Vision

SEPTA identified the vision plan for operational improvements.

“Major Regional Projects” [T4.01] includes funding for all major regional transit operating improvement projects. Trolley modernization will account for a redesign of the street networks with existing trolley routes.

“ITS and Real-Time Information” [T4.02] includes improvements to the SEPTA Operations Center, which covers all operating assets (rail, subway surface, buses, SEPTA police dispatch, and paratransit).

“Signal Prioritization” [T4.03] needs estimate is based on creating bus and trolley priority treatment at intersections for two bus or trolley routes per year at an average cost of \$5 million per route. Example locations could include recent DVRPC signal prioritization studies along West Chester Pike and PA 611.

TABLE D-18: PENNSYLVANIA SUBREGION TRANSIT SYSTEM/OPERATIONAL IMPROVEMENTS (T4)

T4	Transit Operational Improvements	2018–2022	2023–2028	2029–2035	2036–2045	Total
T4.01	Major Regional Projects	\$ 165.0	\$ 175.5	\$ 1,309.6	\$ 2,308.3	\$ 3,958.4
T4.02	ITS and Real-Time Information	\$ 59.7	\$ 30.0	\$ 30.0	\$ 60.0	\$ 179.7
T4.03	Signal Prioritization	\$ 54.6	\$ 77.1	\$ 93.5	\$ 183.3	\$ 408.5
T4	Total	\$ 279.4	\$ 282.7	\$ 1,433.1	\$ 2,551.6	\$ 4,546.7

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T5. Pennsylvania Subregion Transit Expansion Vision

The region's desired list of transit expansion projects is drawn from the *Connections 2040* Plan, DVRPC's Long-Range Vision for Transit report, and county and transit agency priorities.

"Transit Expansion" [T5.01] includes potential rail extensions projects, such as the extension of the Elwyn Line to Wawa, rapid transit service along Roosevelt Boulevard, extension of the Norristown High Speed Line to King of Prussia, extension of the Lansdale Line to Perkasie, extension of the Paoli-Thorndale Line to Atglen, and a new transit line along Delaware Avenue in Philadelphia. A full list of the projects in the Plan can be found in Chapter 4.

TABLE D-19: PENNSYLVANIA SUBREGION TRANSIT NETWORK EXPANSION (T5)

T5	Transit Expansion	2018-2022	2023-2028	2029-2035	2036-2045	Total
T5	Total	\$-	\$150.6	\$2,373.0	\$6,785.6	\$9,309.2

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T6. Pennsylvania Subregion Transit Other Needs

The estimated cost for the “Other” transit vision in the Pennsylvania subregion is based on safety and security needs identified by SEPTA, Amtrak trackage leases, funding for coordinated human services, federal preventative maintenance funds, and outstanding debt service.

“Safety and Security” [T6.01] includes environmental cleanup and protection activities. This can include remediation and testing associated with underground storage tanks, lead-based paint and asbestos abatement, contaminated soil and groundwater, and air quality. This category also includes site assessments to determine environmental exposures prior to acquiring properties, as well as activities that reduce transit’s environmental footprint.

“Amtrak Lease Agreements” [T6.02] are payments that SEPTA makes to Amtrak to use tracks on the Trenton, Wilmington, and Paoli-Thorndale lines. These leases also help Amtrak pay for track, bridge, signal, and catenary needs along these routes.

“Coordinated Human Services” [T6.03] includes grants for senior and disabled services or by shared ride programs. The category funds items such as communications equipment, capital equipment, operating costs, or vanpools.

“Debt Service” [T6.04] includes existing debt service for the 1234 Market Street building, variable rate interest, the Silverliner V cars, and Wayne Junction Station.

“Preventative Maintenance” [T6.05] recognizes federal funds for operating assistance and preventative maintenance included in the TIP but used to fund SEPTA’s operating budget. They can be used for program administration; repair of buildings, grounds, and equipment (including transit vehicle overhaul); operating of electric power facilities; maintenance of vehicle movement control systems, fare collection, counting equipment and structures; and maintenance of general administration buildings, grounds and equipment, and electrical facilities.

“Transit Other” [T6.06] includes warehouse lease, copier leases, CARD microwave Towers Lease, and Federal PM Operating and Tire leases, funds for the Delaware River Ferry system, and operating assistance funds for PART.

TABLE D-20: PENNSYLVANIA SUBREGION TRANSIT OTHER (T6)

T6	Transit Other	2018–2022	2023–2028	2029–2035	2036–2045	Total
T6.01	Safety and Security	\$ 77.4	\$ 46.5	\$ 61.2	\$ 115.0	\$ 300.1
T6.02	Amtrak Lease Agreements	\$ 265.3	\$ 361.5	\$ 475.4	\$ 771.2	\$ 1,873.4
T6.03	Coordinated Human Services	\$ 43.8	\$ 61.8	\$ 87.3	\$ 160.4	\$ 353.3
T6.04	Debt Service	\$ 226.3	\$ 271.5	\$ 316.8	\$ 452.5	\$ 1,267.0
T6.05	Preventative Maintenance	\$ 246.2	\$ 306.1	\$ 136.3	\$ 169.9	\$ 858.5
T6.06	Transit Other	\$ 15.5	\$ 21.6	\$ 19.1	\$ 32.0	\$ 88.2
T6	Total	\$ 874.3	\$ 1,068.8	\$ 1,096.1	\$ 1,701.1	\$ 4,740.3

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

NEW JERSEY SUBREGION ROADWAY VISION

The following sections detail the identified roadway vision plan over the life of *Connections 2045* for the New Jersey subregion for each of the six roadway funding categories. Categories R1 and R2 are based off a robust needs assessment to achieve and maintain an SGR for existing pavement and bridge infrastructure.

R1. New Jersey Subregion Pavement Vision

NJ DOT has defined an SGR as achieving and maintaining 80 percent of its lane miles in either “good” or “fair to mediocre” condition (less than 20 percent deficient by IRI and Surface Distress Index [SDI]). The IRI measures smoothness conditions, while the SDI evaluates the type,

severity, and extent of surface distress exhibited by cracking and other visible deterioration. SDI is reported on a scale of zero to five (where five is a perfect pavement free of any distress). The criteria used to evaluate the pavement condition status are shown in Table D-21.

TABLE D-21: NJDOT PAVEMENT CONDITION CRITERIA

Condition Status	IRI (in/mi)	SDI
Deficient (Poor)	>170	0–2.4
Fair	95–170	>2.4 and <3.5
Good	>0 and <95	3.5–5.0

Source: The Road Information Program, Washington, DC, 2004

State DOTs are required to maintain a PMS, which tracks the condition of all federal- and state-maintained roadways. Statewide, NJ DOT maintains approximately 10,430 lane miles of pavement. Of this amount, approximately 1,970 lane miles are within the DVRPC region: about 18.8 percent of the total statewide network. New Jersey will also need to set targets for Interstate and non-Interstate NHS pavement performance measures. (See "R1 Pennsylvania Subregion Pavement Needs" section in this appendix for more information on this federal requirement.)

DVRPC developed a routine for analyzing future pavement condition based on normal wear and tear on the roads and accounting for the impact of future road projects. This analysis used data from NJ DOT's PMS and relied on average segment data from PennDOT where data was missing.

"Major Regional Pavement Projects" [R1.01] includes funding needs for pavement reconstruction associated with major regional system preservation, operational improvement, and roadway expansion projects. These projects are listed in Chapter 4 of *Connections 2045*.

"Preservation" [R1.02] projects include crack sealing and regular maintenance that is both corrective and preventative. In addition, it includes minor rehabilitation projects, such as milling and filling, shoulder cuts, oil chip sealing, or microsurfacing, that are due on a routine basis. Regular preventative maintenance can delay future resurfacing and reconstruction needs by extending the life of pavement.

"Resurfacing" [R1.03] generally occurs every seven years on Interstates, every 12–15 years on arterials and major collectors, and every 25 years on low volume roads (less than 2,000 vehicles per day); generally only for roads less than 50 years old.

"Reconstruction" [R1.04] needs are identified for roads when they are more than 50 years old and in poor condition.

"Appurtenances" [R1.05] include signs, guardrail/guide barriers, drainage, pavement markings, lighting, and retaining walls that are part of the roadway network.

"Local Federal Aid Roadways" [R1.06] assumes \$7,500 per lane mile annually (in 2010 \$s) for 660 linear miles of local federal aid roads, assuming two lane miles per linear mile.

TABLE D-22: NEW JERSEY SUBREGION PAVEMENT (R1)

R2	Roadway Reconstruction / Resurfacing	2018–2021	2022–2027	2028–2035	2036–2045	Total
R1.01	Major Regional Pavement Projects	\$ 110.4	\$ 54.5	\$ 177.7	\$ 331.2	\$ 673.8
R1.02	Preservation	\$ 75.6	\$ 131.5	\$ 212.5	\$ 346.5	\$ 766.1
R1.03	Resurfacing	\$ 205.0	\$ 411.4	\$ 557.9	\$ 1,009.2	\$ 2,183.5
R1.04	Reconstruction	\$ 253.1	\$ 495.0	\$ 835.1	\$ 1,229.5	\$ 2,812.7
R1.05	Appurtenances	\$ 85.5	\$ 148.7	\$ 240.3	\$ 391.8	\$ 866.3
R1.06	Local and Federal Aid Roadways	\$ 46.8	\$ 81.4	\$ 131.6	\$ 214.6	\$ 474.5
R1	Total	\$ 776.4	\$ 1,322.6	\$ 2,155.0	\$ 3,523.0	\$ 7,776.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R2. NEW JERSEY SUBREGION BRIDGE VISION

State DOTs are required to maintain a BMS, which tracks the structural condition of key bridge elements for all bridges greater than 20 feet in length, regardless of ownership. The BMS scores the condition of the deck, substructure, and superstructure on a scale of zero to nine. Any of these items scoring a four or below indicates that the bridge is structurally deficient and in need of major repair work or replacement.

The four-county DVRPC New Jersey subregion currently has 597 state-maintained bridges greater than eight feet in length with 6.7 million square feet of bridge deck area. In addition, county and local transportation agencies maintain 430 bridges over 20 feet in length,

with 860,000 square feet of deck area. Approximately 6.6 percent of the state's bridge deck area is rated as structurally deficient, while 15.0 percent of the locally maintained deck area is structurally deficient. New Jersey will also need to set targets for NHS bridge performance measures. (See "R2 Pennsylvania Subregion Bridge Needs" section in this appendix for more information on this federal requirement.)

DVRPC developed a methodology for analyzing future bridge condition based on normal wear and tear and accounting for the impact of bridge projects programmed in the 2018 NJ TIP. Needs for culvert rehabilitation and replacement are included in pavement reconstruction needs and are not included in the bridge needs assessment (R2).

“Major Regional Bridge Replacement” [R2.01] reconstruction projects considered here can be found in the fiscally constrained and unfunded transportation vision Major Regional Project tables in *Connections 2045*.

“Bridge Maintenance” [R2.02] projects include bridge deck overlays, scour, expansion joint replacement, painting, and other low-cost preservation activities. These projects should occur at each bridge every 15–25 years, as long as the bridge is in an SGR. Bridges in poor condition are generally targeted for rehabilitation or replacement and undergo basic maintenance only as emergency stopgap measures to ensure that the bridge can remain open to traffic.

“Bridge Rehabilitation” [R2.03] generally involves rehabilitating or replacing one or more of the three main bridge components: the deck, the superstructure, or the substructure.

“Bridge Replacement” [R2.04] generally replaces a bridge that has passed its expected 50- to 100-year lifespan and has two or more of its components (deck, superstructure, or substructure) in poor condition.

“Bridge Removal” [R2.05] is a line item for the permanent removal of bridges from the roadway network. There are currently no identified bridges planned for removal in the New Jersey subregion.

“Local Federal Aid Bridges” [R2.06] includes needs for county and locally maintained bridges over 20 feet in length that are eligible for federal aid.

TABLE D-23: NEW JERSEY SUBREGION BRIDGES (R2)

R2	Bridge Replacement / Rehabilitation	2018–2021	2022–2027	2028–2035	2036–2045	Total
R2.01	Major Regional Bridge Replacement	\$ 3.3	\$ 28.5	\$ 154.6	\$ 225.2	\$ 411.5
R2.02	Bridge Maintenance	\$ 21.9	\$ 38.0	\$ 61.4	\$ 100.1	\$ 221.4
R2.03	Bridge Rehabilitation	\$ 131.1	\$ 228.0	\$ 368.4	\$ 600.9	\$ 1,328.5
R2.04	Bridge Replacement	\$ 62.3	\$ 114.0	\$ 184.2	\$ 300.4	\$ 661.0
R2.05	Bridge Removal	\$ -	\$ -	\$ -	\$ -	\$ -
R2.06	Local and Federal Aid Bridges	\$ 87.4	\$ 152.0	\$ 245.6	\$ 400.6	\$ 885.6
R2	Total	\$ 306.0	\$ 560.5	\$ 1,014.2	\$ 1,627.2	\$ 3,508.0

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R3. New Jersey Subregion Operational Improvement Needs

DVRPC's transportation operations staff developed the TSMO Plan for the nine-county region. The purpose of the TSMO Plan is to present a comprehensive long-term vision of transportation operations, bridging individual programs to create a cohesive regional vision. It was developed in cooperation with DVRPC's TOTF, which is composed of traffic, transit, and emergency management operators in the region. The TSMO Plan highlights four major operational themes: IM, traffic management, transit operations, and traveler information. Several operational needs emerged, including obtaining real-time accurate information, sharing information among agencies and with the public, and having the appropriate resources available to respond to incidents. The TSMO Plan identifies operational strategies, such as the addition of TOCs, variable speed limit signs, CCTV, weigh-in-motion detectors, modernization of traffic signals, closed-loop traffic signal systems, cyclical resynchronization of traffic lights, and locations for parking management systems.

Transportation operations have unique funding and implementation requirements. Although ITS projects are like other major transportation capital investments in that they are funded through the TIP, there are substantial maintenance and operations costs associated with them. Hardware, software, and communications have to be continually maintained and updated to remain consistent with the latest IT standards.

"Major Regional Safety/Operational Projects" [R3.01] includes the NJ 29 conversion from a freeway to a parkway and the operational portion of other Major Regional Projects, including Direct Connect and Missing Moves.

"Safety/Operational Improvements" [R3.02] includes intersection/interchange improvements, roadway realignments, channelization, roundabouts, access management, new turning lanes, and grade-separated rail crossings.

Intelligent Transportation Systems [R3.03] includes capital and operating costs for ITS deployment and traffic operations centers. Funds will support DOT, local/county, and DRPA operations. ITS deployment includes:

- ITS Infrastructure (mostly infill to additional equipment where needed along these facilities):
 - ▶ I-76;
 - ▶ I-95;
 - ▶ I-195;
 - ▶ I-295;
 - ▶ I-676;
 - ▶ US 1 Freeway;
 - ▶ US 130;
 - ▶ NJ 42;
 - ▶ NJ 55;
 - ▶ NJ 90; and
 - ▶ NJ 29/NJ 129:
- RWIS:
 - ▶ Burlington County;
 - ▶ Camden County;
 - ▶ Gloucester County; and
 - ▶ Mercer County;
- NJ DOT TOCs;
- County TOCs:
 - ▶ Camden County;

- ▶ Burlington County;
- ▶ Gloucester County; and
- ▶ Mercer County; and
- ▶ DRPA TOC.

“Incident Management” [R3.04] includes capital and operating funds for SSPs. Proposed IM projects include:

■ SSPs:

- ▶ I-76;
- ▶ I-95;
- ▶ I-195;
- ▶ I-295;
- ▶ I-676;
- ▶ NJ 29;
- ▶ NJ 42; and
- ▶ NJ 55;

■ RIMIS:

- ▶ enhancements/upgrades; and
- ▶ data interfaces;

■ IM:

- ▶ IM task forces;
- ▶ IM grant initiative;
- ▶ quick clearance/IM safety issues (i.e., “Move It/Move Over/Quick Clearance” policies);
- ▶ accident investigation equipment; and
- ▶ towing incentive program; and

■ Arterial Management—Integrated Corridor Management.

“Traffic Management and Signals” [R3.05] includes needs for traffic signal replacement and retiming; traffic management through variable speed limit signs; ATM to allow for hard shoulder running; and local traffic signals. Traffic Management and Signal needs include:

■ County traffic signal retiming and upgrade programs;

■ ATM systems, which may include strategies such as ramp metering, variable speed limits, queue detection, and part-time shoulder use:

- ▶ I-195;
- ▶ I-295;
- ▶ I-76;
- ▶ I-676;
- ▶ NJ 42; and
- ▶ NJ 55;

■ Parking management; and

■ CV/AV communication network.

TABLE D-24: NEW JERSEY SUBREGION ROADWAY OPERATIONAL IMPROVEMENTS (R3)

R3	Roadway Operational Improvements	2018–2021	2022–2027	2028–2035	2036–2045	Total
R3.01	Major Regional Safety/Operational Projects	\$ 143.5	\$ 112.1	\$ 400.6	\$ 703.8	\$ 1,360.0
R3.02	Safety/Operational Improvements	\$ 142.9	\$ 248.5	\$ 351.4	\$ 655.0	\$ 863.5
R3.03	Intelligent Transportation Systems	\$ 17.4	\$ 57.9	\$ 105.5	\$ 134.7	\$ 315.5
R3.04	Incident Management	\$ 23.3	\$ 76.8	\$ 97.0	\$ 159.5	\$ 356.7
R3.05	Traffic Management and Signals	\$ 23.2	\$ 67.1	\$ 87.2	\$ 167.1	\$ 344.6
R3	Total	\$ 350.4	\$ 562.4	\$ 1,041.6	\$ 1,820.1	\$ 3,774.5

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R4. New Jersey Subregion Bicycle/Pedestrian Needs

This category identifies the vision for trails, sidewalks, bike lanes, and other infrastructure to increase the region's bike and pedestrian friendliness to achieve Plan goals of a more multimodal transportation system.

"Off-road Trails" [R4.01] includes funding for The Circuit priority regional trail network and the completion of some additional trail segments not considered to be part of The Circuit.

"On-road Facilities" [R4.02] include needs for pedestrian and bike safety and intersection improvements (countdown timers and crosswalks), streetscaping, sidewalks, ADA curb cut requirements,

bike lanes, bike/pedestrian bridges, overpasses or tunnels, and project engineering. *Connections 2045* increases the need for bike and pedestrian infrastructure significantly as part of the desire for more walkable, bikeable communities. The vision would triple the number of bike facilities and increase the amount of sidewalks by 50 percent throughout the region by 2045.

TABLE D-25: NEW JERSEY SUBREGION BICYCLE/PEDESTRIAN PROJECTS (R4)

R4	Bicycle and Pedestrian	2018–2021	2022–2027	2028–2035	2036–2045	Total
R4.01	Off-road Trails	\$ 20.5	\$ 35.7	\$ 57.7	\$ 94.1	\$ 208.1
R4.02	On-road Facilities	\$ 126.8	\$ 220.4	\$ 356.1	\$ 580.9	\$ 1,284.2
R4	Total	\$ 147.3	\$ 256.1	\$ 413.9	\$ 675.0	\$ 1,492.3

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R5. New Jersey Subregion Roadway Expansion Vision

The roadway expansion vision is based on updating the costs from the Major Regional Project list in the *Connections 2040* long-range plan. Additional needs were identified during a review of recent transportation studies and a call for projects with regional stakeholders.

"Major Regional Projects" [R5.01] are projects that add to or substantially change regional traffic patterns. Projects included in the Plan can be found in the Major Regional Roadway Expansion Projects table in Chapter 4.

"Minor Network Expansion Projects" [R5.02] has identified a number of smaller-scale expansion projects that do not fit into the Major Regional Project categorization. They are listed in Table D-26.

TABLE D-26: NEW JERSEY SUBREGION MINOR ROADWAY EXPANSION PROJECTS (R5)

MRP ID	Facility	Project Scope	Location	Timing	Local Cost	Millions of Y-O-E \$		Unfunded Cost Millions of 2017 \$s
						Federal and State Network Expansion Cost	Total Federal and State Funded Cost	
83	West Trenton Bypass	New Connector from Bear Tavern Road to Intersection of Decou Avenue and Parkway Avenue.	Mercer	2028–2045	\$ 5.0	\$ 13.0	\$ 13.0	
99	Quakerbridge Road (CR 533)	Grade Separate Interchange by Adding One Flying Express Lane in each direction on CR 533 over Grovers Mill Road/Clarksville Road (CR 638).	Mercer	2028–2045		\$ 25.0	\$ 25.0	
127	Sylvia Avenue Extension	Connect Sylvia Avenue through Ewing Town Center.	Mercer	2018–2027	\$ 3.5			
207	US 206 and New CR 543 Bypass	Extend New CR 543 Bypass to replace CR 543, utilizing West Main Street through Columbus Village.	Burlington	Unfunded				\$ 24.0
208	US 206 and Monmouth Road (CR 537)	Redesign intersection geometry to add left and through lanes for both approaches of CR 537 to US 206.	Burlington	Unfunded				\$ 7.3
209	Route 73 and CR 544 (Evesham Road/Marlton Parkway)	Widen from NJ 70 to Evesham Road/Ardsley Drive; add left-turn lanes at Both Brick Road and Evesham Road/Marlton Pkwy intersections with Dual Left Addition; add Roundabout on Marlton Parkway.	Burlington	2018–2027		\$ 10.7	\$ 21.3	
210	Route 73 and Church Road	Intersection improvements at Church Road (CR 616) and Fellowship Road (CR 673).	Burlington	2018–2027		\$ 30.2	\$ 60.4	

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

TABLE D-27: NEW JERSEY SUBREGION ROADWAY EXPANSION PROJECTS (R5)

R5	Roadway Expansion	2018–2021	2022–2027	2028–2035	2036–2045	Total
R5.01	Major Regional Projects	\$ 189.4	\$ 138.0	\$ 54.7	\$ 102.0	\$ 484.2
R5.02	Minor Network Expansion Projects	\$ 1.8	\$ 8	\$ 9.1	\$ 45.5	\$ 105.1
R5	Total	\$ 191.2	\$ 146.8	\$ 103.8	\$ 147.6	\$ 589.3

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

R6. New Jersey Subregion Roadway Other Vision

To develop the roadway “Other” needs assessment, DVRPC extended historic spending levels on most of the subcategories in these areas and updated in the instances where NJ DOT was able to give a better cost estimate.

“**Environmental Mitigation**” [R6.01] includes remediation and testing associated with underground storage tanks, lead-based paint and asbestos abatement, contaminated soil and groundwater, and air quality. This line item is also for nonproject-specific needs, including wetland mitigation, cultural resource preservation, etc. In many instances, an environmental mitigation project is attached to a specific highway project. When this happens, the environmental mitigation need is included as part of the highway project costs and is not included in this funding category. Ongoing need for previously completed projects is listed here.

“**Air Quality**” [R6.02] includes funding for CMAQ project engineering, diesel retrofits, and the Air Quality Partnership. Current federal

guidance suggests that a minimum of 25 percent of CMAQ funds should go toward diesel retrofit projects.

“**Debt Service**” [R6.03] has no current regional need for NJ DOT roadways.

“**Travel Demand Management**” [R6.04] includes funding for TMAs and marketing for the RideECO commuter benefits program, MAP, and Share-A-Ride

“**Rail Improvements**” [R6.05] includes improvements to both the freight and passenger rail systems. The vision is based on annual funding for these projects in the 2018-2027 NJ STIP.

“**Roadway Other**” [R6.06] includes funding for parking facilities, security, consultant and design services, dam rehabilitation or reconstruction, local and regional planning, regional GIS support, the regional travel demand model, and other miscellaneous items, such as equipment purchases, and maintenance and storage facilities.

TABLE D-28: NEW JERSEY SUBREGION ROADWAY OTHER (R6)

R6	Roadway Other	2018–2021	2022–2027	2028–2035	2036–2045	Total
R6.01	Environmental Mitigation	\$ 23.6	\$ 41.0	\$ 58.0	\$ 108.2	\$ 230.8
R6.02	Air Quality	\$ 6.6	\$ 11.4	\$ 16.1	\$ 30.0	\$ 64.1
R6.03	Debt Service	\$ -	\$ -	\$ -	\$ -	\$ -
R6.04	Travel Demand Management	\$ 17.0	\$ 29.6	\$ 41.9	\$ 78.1	\$ 166.7
R6.05	Rail Improvements	\$ 10.9	\$ 19.0	\$ 26.9	\$ 50.1	\$ 106.9
R6.06	Roadway Other	\$ 21.6	\$ 22.8	\$ 32.2	\$ 60.0	\$ 136.5
R6	Total	\$ 79.7	\$ 123.8	\$ 175.1	\$ 326.4	\$ 705.1

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

NEW JERSEY SUBREGION TRANSIT VISION

The following sections detail the identified transit needs over the life of *Connections 2045* for the New Jersey subregion for each of the six transit funding categories.

T1. New Jersey Subregion Rail Infrastructure Vision

The basis for New Jersey Transit rail infrastructure vision is the 2018–2027 New Jersey STIP. DRPA/PATCO identified its needs as part of the Plan update.

“Track Rehabilitation/Resurfacing/Replacement” [T1.01] is based on allocating 6 percent of New Jersey Transit’s annual statewide needs to

the DVRPC region, as identified in the 2018–2027 New Jersey STIP and a federal share for track and tunnel needs identified by DRPA/PATCO. This category includes the Immediate Action Program, Rail Capital Maintenance, Track Program, High Speed Track Program, and Light Rail Infrastructure Improvements.

“Catenary and Substation Rehabilitation/Replacement” [T1.02] is a federal share based on needs identified by DRPA/PATCO.

“Signal/Communications Rehabilitation/Replacement” [T1.03] is based on allocating 6 percent of New Jersey Transit’s annual statewide needs to the DVRPC region, as identified in the 2018–2027 New Jersey STIP

and a federal share for needs identified by DRPA/PATCO. This category includes Signals and Communications/Electric Traction Systems.

“Rail Bridge/Elevated Structure Improvements” [T1.04] is based on allocating 6 percent of New Jersey Transit’s annual statewide needs to the DVRPC region, as identified in the 2018–2027 New Jersey STIP and a federal share for needs identified by DRPA/PATCO.

TABLE D-29: NEW JERSEY SUBREGION RAIL INFRASTRUCTURE REHABILITATION AND RESTORATION (T1)

T1	Rail Infrastructure Rehabilitation, Restoration	2018–2021	2022–2027	2028–2035	2036–2045	Total Need
T1.01	Track Rehabilitation/Resurfacing/Replacement	\$71.4	\$115.0	\$230.7	\$308.8	\$725.9
T1.02	Catenary and Substation Rehabilitation/Replacement	\$0.4	\$0.8	\$1.2	\$2.0	\$4.4
T1.03	Signals/Communications Rehabilitation/Replacement	\$11.5	\$16.7	\$29.4	\$42.1	\$99.7
T1.04	Rail Bridge/Elevated Structure Improvements	\$24.7	\$16.8	\$57.9	\$65.3	\$164.8
T1	Total	\$108.0	\$149.3	\$319.3	\$418.2	\$994.8

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T2. New Jersey Subregion Vehicle Infrastructure Vision

New Jersey Transit identified the funding period in which each of its transit vehicles operating in the DVRPC region would need to be replaced or rehabilitated. DRPA/PATCO’s vehicle fleet is currently being overhauled.

“New Bus” [T2.01] includes the Bus Acquisition Program. New Jersey Transit plans to expand bus seating capacity by replacing all 40’ buses in the region with 45’ buses.

“New Light Rail Vehicle” [T2.02] includes replacement needs for the River LINE vehicles in the 2031–2040 funding period. There may be an opportunity to upgrade to battery powered electric light rail vehicles.

“New Heavy Rail Vehicle” [T2.03] includes the federal share for new PATCO vehicles in fourth funding period.

“New Commuter Rail Vehicle” [T2.04] includes Rail Rolling Stock Procurement. Regional rail needs include replacing the Northeast

Corridor Arrow cars with new multilevel cars, and replacing Atlantic City Line locomotives and rail cars.

“New Paratransit Vehicle” [T2.05] includes regular replacement of paratransit vehicles for New Jersey Transit operations. Programs included in this category are the Private Carrier Equipment Program, Small/Special Services Program, Section 5310, and Section 5311.

“Vehicle Overhaul Program” [T2.06] includes the need to regularly overhaul buses and rail vehicles (light, heavy, and commuter) at the mid-year of the expected lifespan, as well as rehabbing six Atlantic City Line locomotives in the early 2020s. Programs in this category are Preventative Maintenance-Rail, Locomotive Overhaul, Rail Fleet Overhaul, and Preventative Maintenance-Bus.

“Vehicle Storage and Maintenance Facilities and Vehicle Maintenance Equipment” [T2.07] includes needs to maintain vehicle storage buildings and facilities and includes replacement needs for vehicle maintenance equipment. In the four-county southern New Jersey region. This includes the Hamilton, Newton Avenue, and Washington Township bus facilities; and the Camden City and Morrisville, Pennsylvania, train yards. Programs in this category are Bus Vehicle and Facility Maintenance/Capital Maintenance, Rail Support Facilities and Equipment, Bus Maintenance Facilities, and Physical Plant.

“Utility Vehicles” [T2.08] includes maintenance and replacement needs for all nonrevenue transit vehicles. This includes the Bus Support Facilities and Equipment program.

TABLE D-30: NEW JERSEY SUBREGION TRANSIT VEHICLE REHABILITATION AND REPLACEMENT (T2)

T2	Vehicle Rehabilitation / Replacement	2018–2021	2022–2027	2028–2035	2036–2045	Total Need
T2.01	New Bus	\$ 122.1	\$ 183.1	\$ 374.8	\$ 611.3	\$ 1,291.3
T2.02	New Light Rail Vehicle	\$ -	\$ -	\$ -	\$ 130.1	\$ 130.1
T2.03	New Heavy Rail Vehicle	\$ -	\$ -	\$ -	\$ 108.4	\$ 108.4
T2.04	New Commuter Rail Vehicle	\$ 12.6	\$ 39.9	\$ 92.1	\$ 100.1	\$ 244.7
T2.05	New Paratransit Vehicle	\$ 27.3	\$ 47.4	\$ 76.6	\$ 124.9	\$ 276.2
T2.06	Vehicle Overhaul Program	\$ 214.9	\$ 373.6	\$ 603.7	\$ 984.6	\$ 2,176.9
T2.07	Vehicle Storage and Maintenance Facilities and Vehicle Maintenance Equipment	\$ 68.8	\$ 99.1	\$ 182.7	\$ 276.7	\$ 627.3
T2.08	Utility Vehicles	\$ -	\$ -	\$ -	\$ -	\$ -
T2	Total	\$ 445.5	\$ 743.2	\$ 1,330.0	\$ 2,336.2	\$ 4,854.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T3. New Jersey Subregion Station Infrastructure Vision

New Jersey Transit identified when its stations in the region are planned for renovation. DRPA/PATCO estimated ongoing federal need for station renewal activities.

"Station Renovation" [T3.01] is based on New Jersey Transit's capital budget program and includes Other Rail Station/Terminal Improvements and ADA-Platforms/Stations.

"Parking" [T3.02] includes needs to expand parking at existing stations, create new park-and-ride lots, and maintenance and repaving needs at existing parking facilities.

"Passenger Amenities" [T3.03] includes historic preservation, rehabilitation, and related activities; bus shelters; landscaping and other scenic beautification, including street lights and public art; pedestrian access and walkways; bicycle access, including storage facilities and installation of equipment for transporting bicycles on transit vehicles; transit connections to parks; signage; and enhanced access to transit for persons with disabilities. Programs in this category are Bus Passenger Facilities/Park-and-Ride, and Transit Enhancements/TAP.

TABLE D-31: NEW JERSEY SUBREGION STATION ENHANCEMENTS (T3)

T3	Station Enhancements	2018–2021	2022–2027	2028–2035	2036–2045	Total Need
T3.01	Station Renovation	\$ 13.0	\$ 9.3	\$ 47.2	\$ 74.4	\$ 143.9
T3.02	Parking	\$ 6.5	\$ 11.4	\$ 18.4	\$ 29.9	\$ 66.2
T3.03	Passenger Amenities	\$ 35.4	\$ 61.6	\$ 99.5	\$ 162.3	\$ 358.7
T3	Total	\$ 55.0	\$ 82.2	\$ 165.0	\$ 266.6	\$ 568.8

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T4. New Jersey Subregion Transit Operational Improvements

New Jersey Transit, DRPA/PATCO, and DVRPC worked together to identify system and operational improvements. New Jersey Transit's primary focus is improving real-time passenger information.

"Major Regional Projects" [T4.01] needs estimate is based on the major regional operational improvement projects listed in Chapter 4. Increased service frequency on the Atlantic City Line is an unfunded aspirational vision Major Regional Project. Any future investments in this facility should ideally include even higher service frequency

between Cherry Hill station and 30th Street Station in Philadelphia.

"ITS and Real-Time Information" [T4.02] includes New Jersey Transit's ITS program and federal share for information technologies estimate from DRPA/PATCO.

"Signal Prioritization" [T4.03] needs estimate is based on creating bus and trolley priority treatment at intersections for one bus route per year at an average cost of \$5 million per route.

TABLE D-32: NEW JERSEY SUBREGION TRANSIT OPERATIONAL IMPROVEMENTS (T4)

T4	Transit Operational Improvements	2018–2021	2022–2027	2028–2035	2036–2045	Total Need
T4.01	Major Regional Projects	\$ 21.6	\$ -	\$ 116.3	\$ -	\$ 137.9
T4.02	ITS and Real-Time Information	\$ 10.6	\$ 18.4	\$ 29.8	\$ 48.5	\$ 107.3
T4.03	Signal Prioritization	\$ 21.9	\$ 38.0	\$ 61.4	\$ 100.1	\$ 221.4
T4	Total	\$ 54.0	\$ 56.4	\$ 207.5	\$ 148.7	\$ 466.6

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

T5. New Jersey Subregion Transit Expansion Vision

New Jersey Transit is committed to studying the expansion of public transit through a continued obligation of the TTF and federal resources. Specific network expansion projects include new stations on existing lines (including station parking needs), extension of existing lines, new bus or rail routes, and development of BRT. Transit expansion vision is based on updated cost estimates for expansion projects in the *Connections 2040 Plan*.

BRT service could be accompanied by intercept parking garages and park-and-ride lots to increase multimodal connectivity. Other opportunities include promoting TOD around stations, encouraging and implementing new commuter option programs, and working with the state TMAs to further extend reach into local communities. Shuttles, vanpools, taxis, and local paratransit services will feed the regional rail, bus, and light rail services, facilitating easy, timed transfers between services at key stations in the region.

“Transit Expansion” [T5.01] needs are determined under the Study and Development program and Transit Rail Initiatives program.

TABLE D-33: NEW JERSEY SUBREGION TRANSIT EXPANSION VISION (T5)

T5	Transit Expansion	2018–2021	2022–2027	2028–2035	2036–2045	Total Need
T5	Total	\$7.5	\$19.5	\$1,292.1	\$2,528.7	\$3,847.8

Source: DVRPC, 2017.

T6. New Jersey Subregion Transit Other Needs

Transit “Other” funding needs are based on spending levels in the FY 2018–2027 STIP and by need as indicated by New Jersey Transit and DRPA/PATCO.

“**Safety and Security**” [T6.01] includes needs -that New Jersey Transit and PATCO have identified under the Environmental Compliance and Safety Improvement Programs, along with upgrades, emergency, and annual needs identified in the Security Improvements program.

“**Amtrak Lease Agreements**” [T6.02] accounts for annual payments made by New Jersey Transit to lease track from Amtrak on the Northeast Corridor.

“**Coordinated Human Services**” [T6.03] includes grants for senior and disabled services or by shared ride programs, including revenue

collected via the Casino Revenue Fund. The category funds items such as communications equipment, capital equipment, operating costs, or vanpools.

“**Preventative Maintenance**” [T6.04] has no current regional estimated need.

“**Debt Service**” [T6.05] includes funds to retire the remaining debt on the River LINE light rail transit line.

“**Transit Other**” [T6.06] includes the expenditure estimates under the Claims Support, Building Capital Leases, Capital Program Implementation, and Miscellaneous programs.

TABLE D-34: NEW JERSEY SUBREGION TRANSIT OTHER (T6)

T6	Transit Other	2018–2021	2022–2027	2028–2035	2036–2045	Total Need
T6.01	Safety and Security	\$ 26.3	\$ 36.0	\$ 73.8	\$ 101.0	\$ 237.1
T6.02	Amtrak Lease Agreements	\$ 9.2	\$ 74.1	\$ 119.7	\$ 195.3	\$ 398.3
T6.03	Coordinated Human Services	\$ 21.0	\$ 31.5	\$ 64.5	\$ 105.1	\$ 222.1
T6.04	Preventative Maintenance	\$ -	\$ -	\$ -	\$ -	\$ -
T6.05	Debt Service	\$ 50.6	\$ -	\$ -	\$ -	\$ 50.6
T6.06	Transit Other	\$ 36.4	\$ 63.3	\$ 102.3	\$ 166.8	\$ 368.8
T6	TOTAL	\$ 143.5	\$ 204.9	\$ 360.3	\$ 568.2	\$ 1,276.9

All figures in millions of Y-O-E dollars. Figures may not add up due to rounding. | Source: DVRPC, 2017.

E

Appendix E: Project Evaluation

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Regional transportation needs stretch well beyond the reasonably anticipated revenue available to fund them. As a result, it is ever more imperative that transportation investments are made wisely and efficiently. A primary objective of DVRPC's long-range planning process is to ensure that transportation investments help further the goals of the long-range plan. *Connections 2045* has five core principles: Sustain the Environment; Develop Livable Communities; Expand the Economy; Advance Equity and Foster Diversity; and Create an Integrated, Multimodal Transportation Network. These five principles form a framework for the goals of the Plan. Transportation investments should work toward other key long-range plan goals, such as improving the condition, maximizing safety and efficiency, reducing congestion, increasing mobility options for people and goods, incorporating technology, and seamlessly connecting the multimodal transportation network.

The *Destination 2030* plan began the process of developing project evaluation criteria. The *Destination 2030* criteria were both quantitative and qualitative and were established around key transportation goals. Previous *Connections* (2035) and *Connections 2040* plans moved toward more quantitative criteria, although they focused primarily on just network expansion projects. *Connections 2045* continues to carefully define Major Regional Projects that are included in the financial plan, including new definitions for system preservation and operational improvement projects. It also expands use of the TIP Benefit criteria to evaluate system preservation, operational improvement, and bicycle/pedestrian projects for their suitability for funding and inclusion in the long-range plan.

EVALUATION CRITERIA

Three sets of evaluation criteria were used in *Connections 2045* to assess which Major Regional Projects should be included in the fiscally constrained plan. The long-range plan criteria are used to analyze major regional roadway and transit network expansion projects. All other Major Regional Projects (bike and ped, system preservation, operational improvements) use the TIP Project Benefit Criteria.

The TIP evaluation criteria build off the asset management systems being built by the region's DOTs and transit agencies. This includes the pavement and bridge asset management systems, along with transit asset management systems. The evaluation criteria were developed and weighted using Decision Lens, a proprietary decision-making software program licensed by PennDOT. Decision Lens operates in a three-step process. It first builds a model by developing the criteria that will analyze the different alternatives while identifying which alternatives will be considered. Second, it uses a pairwise judgment process to compare and weight the criteria with each other and evaluating the alternatives. Third, it analyzes the alternative costs to benefits to select those with the best return on investment.

DVRPC uses three sets of criteria to measure different types of projects.

1. TIP Project Benefit Criteria
 - Roadway Preservation
 - Roadway Operational Improvements
 - Bike/Ped
 - Transit Preservation
 - Transit Operational Improvements
2. Long-Range Plan Roadway Expansion Screening and

Evaluation Criteria

3. Long-Range Plan Transit Expansion Screening and Evaluation Criteria

Each of these three sets of criteria is explained further in the following sections.

TIP PROJECT BENEFIT CRITERIA

Universal criteria were established that can be used to evaluate a variety of modes (roadway, transit, bike, pedestrian, freight) and project types, and can be used in the New Jersey and Pennsylvania counties in the DVRPC region. The TIP evaluation criteria were used in *Connections 2045* to evaluate major regional roadway and transit preservation, operational improvements, and bicycle and pedestrian projects.

The criteria were developed with New Jersey and Pennsylvania members of a Long-Range Plan Working Group and were designed to align directly with the multimodal goals of the region, as well as reflect the increasingly multimodal nature of projects in the TIP. The criteria generally consider one of two key questions:

- Is this project in a location where we want to make investments? or,
- How beneficial or effective is this project?

The TIP Benefit Criteria were developed using the following best practice recommendations:

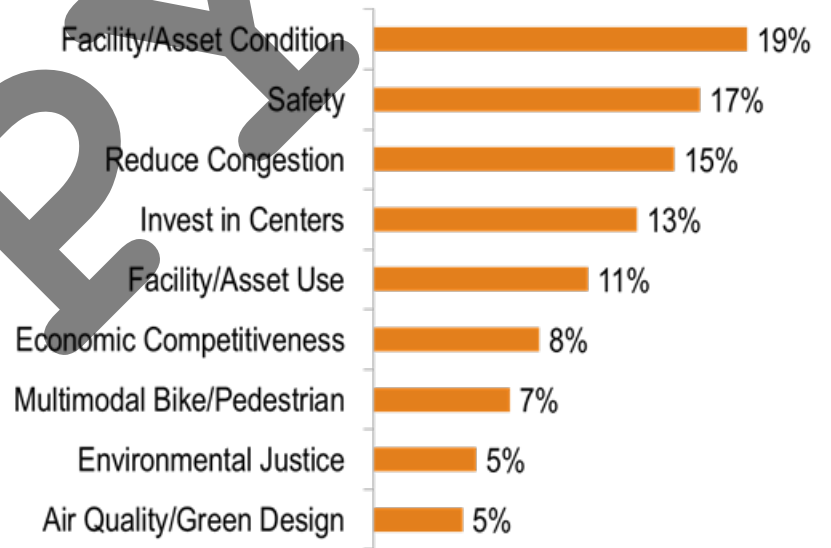
- Align with the long-range plan and other regional objectives.
- Be relevant to different types of TIP projects.
- Indicate differences between projects.
- Avoid measuring the same goal(s) multiple times.
- Cover the entire nine-county region.

- Be more quantitative than qualitative.
- Use readily available data with a strong likelihood of continued availability.
- Be simple and understandable.

After defining the criteria in 2014, Decision Lens was used to assign weights the criteria using pairwise comparison. The higher the weight, the higher the priority for the DVRPC region.

Each criterion could receive up to a maximum of 1 point. Each project can receive a total score that is the sum of the weight times the rating for each criterion. The tool can compare the project's estimated total state and federal cost to the total score, as a benefit-cost ratio. Other sources of funding that may increase a project's benefit-cost

FIGURE E-1: TIP BENEFIT CRITERIA WEIGHTING



Source: DVRPC, 2014

ratio, such as additional local funding beyond match requirements, nontraditional funding grants, and developer or private contributions, will not count toward a project's cost for the benefit-cost ratio. The tool provides a ranking of projects with the highest benefit-cost ratios, but the Regional Technical Committee (RTC) recommends, and ultimately the DVRPC Board makes, the final decisions to determine TIP project selections.

TIP Evaluation Criteria and Measures

The following sections detail each of the TIP Evaluation Criteria:

1. Facility/Asset Condition

This criterion relates to the *Connections 2045* goal of rebuilding and maintaining the region's transportation infrastructure. The region has a substantial backlog of road, bridge, and transit infrastructure repair needs. These "fix-it-first" projects need to be the regional priority until an SGR is achieved. Data will come from road, bridge, and transit asset management systems.

Transit Project Rating

- 1 point if the improvement brings the asset into an SGR; or
- 0.5 points if the project extends the useful life of a facility/asset not in poor condition.

Roadway and Bridge Project Rating

- 1 point if the project will bring a Bridge deck/super/sub/culvert rating of 3 or less, a posted or weight-restricted bridge, an Interstate road segment with an IRI of ≥ 180 , an NHS facility with an IRI ≥ 200 , a roadway with more than 2,000 vehicles per day with an IRI ≥ 230 , or a roadway with less than 2,000 vehicles per day and an IRI of ≥ 260

into an SGR;

- 0.8 points if the project will bring a facility or asset with a "Poor/Worst on four- or five-point scale" asset management system rating into an SGR;
- 0.5 points if the project will extend the useful life of a facility that is not in poor condition, or resolves a fracture critical issue on a bridge; or
- 0.25 points if the project eliminates a functional obsolete issue on a bridge.

2. Safety

This criterion relates to the *Connections 2045* Plan goal of creating a safer transportation system. Projects that improve DOT-identified high-crash locations and have a safety component will score 0.5 points per high-crash location. In addition, projects that incorporate one or more FHWA proven safety countermeasures can score 0.5 points per measure. Transit projects that are deemed safety critical will receive 1 point.

Transit Safety Rating

1 point if project is a safety critical transit project.

Roadway Safety Rating

Up to a maximum of one point:

- 0.5 points per safety improvement in 1 or more DOT-identified high crash location (up to 1 point),
- Pennsylvania Roadway Departure Improvement Program—The project must implement the specific identified safety improvement: enhanced signs and markings for curves, enhanced signs and markings for curves and high-friction surfaces, center-line rumble strips,

edge-line rumble strips or shoulder rumble strips, wider shoulders/ edge-line rumble strips, center- and edge-line pavement markings, alignment delineation/lighting, high-friction surfaces, guiderail relocations/safety enhancements, tree removal/safety enhancements, utility pole removal/safety enhancements, enforcement and education–alcohol related, enforcement and education–speeding related, enforcement and education–restraint related, infrastructure improvements–speeding related, or install cable median barrier;

- Pennsylvania Intersection Safety Improvement Program–The project must implement the specific identified safety improvement: Stop, Signal, Left Turn, Ped, or Speed;
- NJ HSIP-Eligible Local Road Locations–These locations are the result of a data-driven analysis prepared by NJ DOT that prioritizes fatal and injury crash trend concentrations. Appropriate design and construction projects at these roadway locations are eligible for HSIP. Four safety categories are included: intersections, high-risk rural roads, pedestrian corridors, and pedestrian intersections.
- 0.5 points per incorporated FHWA proven safety countermeasure (up to 1 point);
 - ▶ roundabouts;
 - ▶ access management;
 - ▶ signal back-plates with retroreflective borders;
 - ▶ longitudinal rumble strips and stripes on two-lane roads;
 - ▶ enhanced delineation and friction for horizontal curves;
 - ▶ safety edge;
 - ▶ medians and pedestrian crossing islands in urban and suburban areas;
 - ▶ pedestrian hybrid beacons; or
 - ▶ road diets.

3. Reduce Congestion

Reducing congestion is a goal in the *Connections 2045* Plan. This has a significant impact on the region's economy, as competitiveness within a global economy means the region needs to be able to efficiently move people and goods. This criterion considers location in CMP corridors and the facility's existing level of congestion or overcrowding.

Is the project located in a CMP Priority or Congested Subcorridor?

The CMP has conducted considerable analysis of the regional transportation network and the impact of congestion. Developed with the counties, DOTs, transit operators, and other regional stakeholders, the CMP has identified a subset of Priority Subcorridors for transportation investment with specific strategies for mitigating congestion. This criterion also considers Congested Subcorridors and Emerging Corridors as additional rating factors. In areas where Priority, Congested Subcorridors, or Emerging Corridors overlap, only the higher value will be counted.

CMP Rating

Maximum of A or B:

A. 0.5 points if project implements an appropriate-everywhere strategy in the CMP. CMP appropriate-everywhere strategies include:

- safety improvements and programs;
- signage;
- context-sensitive design;
- improvements for walking and bicycling;
- basic upgrade of traffic signals;
- signal prioritization for emergency vehicles;

- making transfers easier for passengers;
- intersection improvements of a limited scale;
- bottleneck removal of a limited scale;
- Environmental Justice outreach for decision making;
- access management;
- marketing/outreach for transit and TDM services;
- revisions to existing land use or transportation regulations;
- growth management;
- smart growth; or
- Complete Streets.

B. $(\text{Project length in priority corridor} \times 100 \text{ percent} + \text{project length in congested corridor} \times 70 \text{ percent} + \text{project length in emerging corridor} \times 30 \text{ percent})$ divided by total project length.

What is the average annual daily traffic (AADT) divided by the average number of lanes, or transit ridership divided by the number of seats?

This criterion looks at facility- or route-specific congestion or overcrowding. AADT and average lanes data will come from the Roadway Management System (RMS). Transit seats will be computed by seats per vehicle multiplied by average number of vehicles (for rail routes) multiplied by daily service frequency. This data will come from annual route statistics reports or from the transit agency itself.

Congestion/Overcrowding Rating

- For limited-access facilities: 1 point if Daily AADT/Lane is greater than 25,000; otherwise, AADT/Lane divided by 25,000;
- For arterials, collectors, and local roads: 1 point if Daily AADT/Lane is greater than 12,500; otherwise, AADT/Lane divided by 12,500; and
- For transit facilities: 1 point if Daily Passengers/Daily Seats (# of ve-

hicles \times seats per vehicle \times Total Daily Service frequency) is greater than 1; otherwise, Daily Passengers/Daily Seats.

4. Invest in Centers

This criterion reflects the *Connections 2045* core plan principle to develop livable communities. Identifying focus areas for future development in Planned Centers and Freight Centers creates a better linkage between land use and transportation.

Projects will be rated on how well they serve Centers by their location within Centers, or high, medium-high, or medium transit score areas. A hybrid GIS layer has been created with a quarter-mile buffer around all of the region's planning Centers (from the Metropolitan Center to Rural and Neighborhood Centers), and all non-Center areas of the region are high, medium-high, or medium transit score locations, or none of the above. All project limits within the Centers and Center buffer areas, or within high transit score areas, will receive 1 point. All project areas within medium-high transit score areas will receive 0.75 points. All project limits within medium transit score areas will receive 0.5 points. The sum of the project within these three limits (multiplied by the rating), will then be divided by the total project length to get a Centers/transit score rating.

Projects can also be rated for being a critical link between two or more Centers. Projects that either maintain or improve service on a facility that links Centers will get 0.25 points added to their Centers/transit score rating (up to a maximum of 1 point).

Centers Rating

$(100\% \times \text{Project length within quarter-mile or inside Planned and$

Freight Centers + 100% × project length in high transit score areas + 75% × project length in medium-high transit score areas + 50% × project length in medium transit score areas) ÷ total project length.

Bonus: +0.25 points (up to 1 point maximum) if the project improves or maintains a critical facility that links two or more regional Planned or Freight Centers.

5. Facility/Asset Use

This criterion looks at how much use the facility or asset receives in a multimodal manner, to determine the scale of the project's impact on the transportation system. Use will be determined by the total VMT, average number of daily trucks, or affected daily transit riders. The greater the facility's use, the more important it is in terms of risk to negative regional impacts, and the broader the benefits are that can be delivered by implementing the project. Only existing users are counted, and the TIP Benefit Criteria do not attempt to estimate future users as a result of the project.

VMT

VMT will be determined by using the average AADT for all segments multiplied by facility length. Data will come from the RMS. Projects that are located at specific intersection(s) and bridge(s) will assume a project length of one mile, essentially using AADT as the proxy for usage. Intersections and bridges that are improved as part of a larger corridor project will be embedded into the overall project length (and will not use the one-mile assumption). New segments will use their length multiplied by the average AADT for the facilities they connect to (beginning and endpoints only). Data will come from the RMS.

Daily VMT Rating

1 point if the average AADT of all road segments multiplied by the total length of the segments within the project limits is more than 500,000; otherwise, total daily VMT divided by 500,000.

Daily Trucks

Daily trucks will be determined by multiplying the percentage of daily trucks by the average AADT for all segments. Data will come from the RMS. For freight rail projects, DVRPC will work with the private rail company to estimate daily truck equivalents.

Daily Trucks Rating

1 point if the average road segment has more than 7,500 trucks or truck equivalents per day; otherwise, trucks or truck equivalents per day divided by 7,500.

Daily Affected Transit Riders

Daily affected transit riders will account for the average daily ridership using the route in question, or routes the asset depends on. For example, the Jenkintown Substation powers the Lansdale-Doylestown, Warminster, and West Trenton lines. A project to improve the Jenkintown substation affects the riders of all three lines.

Daily Affected Transit Riders Rating

Ridership values will come from annual route ridership reports published by the transit agencies or from direct transit agency data. 1 point if the number of daily transit riders affected is 50,000 or above; otherwise, daily affected ridership divided by 50,000.

6. Economic Competitiveness

This criterion rewards projects that build the regional economy by investing in transportation improvements related to economic development or TOD, reducing agency operating or maintenance costs, or reducing transportation system user costs. Projects rated for economic development or TOD must indicate the specific development they are supporting.

Economic Competitiveness Rating

This criterion relates to the *Connections 2045* core plan principle to expand the economy. Score is the sum of each bullet below, up to a maximum of 1 point:

- Does the project reduce agency maintenance or operating costs? (0 points if cost increases; 0.25 points if no change; 0.5 points if cost decreases);
- Does the project reduce public/private transportation system user vehicle maintenance or operating costs? (0 points if cost increases; 0.25 points if no change; 0.5 points if cost decreases); and
- Does the project support a known economic development project or TOD? (0.5 points if it supports).

7. Multimodal Bike/Pedestrian

This criterion relates to the *Connections 2045* Plan principle of creating an integrated, multimodal transportation network. It will rate new facilities based on length and connections to existing multimodal facilities or to existing use of facilities. In some cases, a road may add a bike lane where there is already significant bicycle use. This project will be able to score based on both the new bike lane and the existing use.

The rating for existing facilities will be based on daily bicyclists and

pedestrian use. This data will come from DVRPC counts and can be supplemented with county counts and other relevant sources if no DVRPC counts are available. New bike and pedestrian facilities will be rated based on project length and connections to other existing bike and pedestrian facilities, transit stations, or bus routes. Projects that make a critical last-mile transit connection or link facilities over a difficult connection, such as a bridge, will receive a 0.5-point bonus

Sum of each bullet below, up to a maximum of 1 point:

- 1 point if the number of daily bicyclists and pedestrians is 1,000 or above; otherwise, daily bicyclists and pedestrians divided by 1,000;
- Up to 0.5 points for a new trail, sidepath, bike lane, or sidewalk; total length in miles divided by 10;
- 0.1 points for each bus route, each train station, or each existing bike/ped facility the proposed new bike/ped facility connects to; and
- +0.5 points for new sidewalks and bike facilities to fill a difficult gap, such as on a bridge, or new "first/last-mile" bike/ped connection to a public transit station or key destination.

8. EJ

Does the project serve EJ communities and the additional population groups with additional transportation needs, as defined by the DVRPC IPD methodology? This criterion relates to the *Connections 2045* principle to advance equity and foster diversity. This indicator helps to ensure that these communities do not suffer from worse overall infrastructure condition than other communities.

Environmental Justice Rating

- $(100\% \times \text{project length in 7-8 IPD communities} + 70\% \times \text{project$

length in 5–6 IPD communities + 30% × project length in 3–4 IPD communities) ÷ total project length.

9. Air Quality/Green Design

This criterion relates to the *Connections 2045* Plan goal of limiting transportation impacts on the natural environment. Projects will rate if they provide air quality benefits, incorporate green design principles, use green or recycled materials, or reduce environmental impact. Examples of projects for each category are shown below, but this list is not intended to be limited to these examples only. Other green design principles not listed here can also be considered with TIP subcommittee group consensus.

Air Quality Rating

0.5 points for air quality improvements:

- Air quality: low-emissions vehicles (hybrid, hydrogen, genset/clean diesel); trees, sound walls, or other buffers that reduce exposure to transportation noise and emissions; separating freight and diesel traffic from local roads, schools, parks, or residential areas; reducing vehicle hours of driving, VMT, GHG emissions, or vehicle idling.

Green Design Rating

0.5 points for incorporating any item from one of the bullets below:

- green design: bioswales/rain gardens, tree trenches, vegetated medians (more than just grass)/vegetated curb bump-outs, naturalized stormwater basins;
- green or recycled materials: use of warm-mix asphalt, long-life pavement materials, pervious pavement, or smog-absorbing con-

crete; use of recycled materials (fly ash, glass, plastic, etc.); or project supports or enhances recycling efforts; and

- reduced environmental impact: alternative energy generation (solar, wind, regenerative braking); climate adaptability/resiliency components; enhanced habitat connectivity or wildlife crossings.

LONG-RANGE PLAN EXPANSION CRITERIA

Almost all expansion projects are Major Regional Projects. The Long-Range Plan expansion analysis is done in a two-tier project evaluation. The first tier is a screening to determine if the project warrants additional consideration. The second tier evaluates projects using the project evaluation criteria. Roadway and transit expansion projects each have their own set of evaluation criteria.

Screening Criteria

Roadway screening checks that a proposed project invests in areas that are currently developed or have been identified as areas appropriate for development over the life of the Plan and that the project is consistent with the region's CMP. Transit projects must also serve areas that are currently developed or have been identified as areas appropriate for development over the life of the Plan.

Screening criteria removes projects that do not meet certain basic stipulations from the project selection process. Both highway and transit network expansion projects should be primarily located in either Existing Infill and Redevelopment or Emerging Growth areas, as defined by the *Connections 2045* Land Use Vision map. For arterials, more than 75 percent of total project limits, at a minimum, should be included in such areas. For limited-access freeways, all interchanges must be located in these areas. For fixed guideway rail and BRT projects, 75

percent of station stops should be located in Infill and Redevelopment or Emerging Growth areas.

Any highway project adding SOV capacity must be consistent with the CMP to be eligible for federal funding. The CMP identifies Congested Subcorridors and multimodal strategies to mitigate the congestion. Where more SOV road capacity is appropriate, the CMP includes potential supplemental strategies to get the most long-term value from the investment. The CMP also identifies emerging/regionally significant corridors, where proactive steps are especially important to prevent congestion, and inexpensive strategies that are appropriate everywhere.

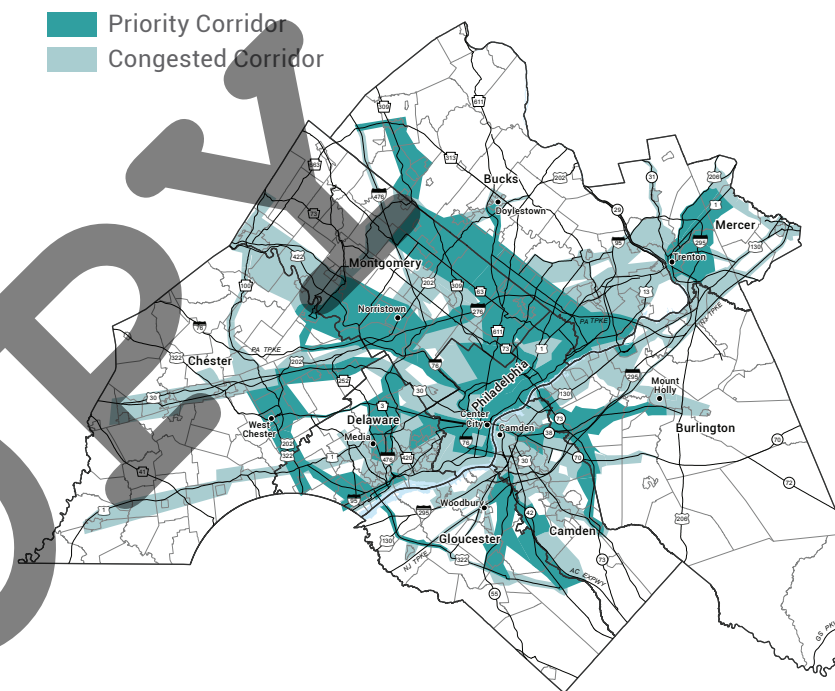
To be consistent with the CMP, a proposed roadway network expansion project must be located in a subcorridor where adding SOV capacity is listed as a very appropriate or secondary strategy. If adding SOV capacity is not included as a strategy, the project must undergo quantitative analysis, including the listed strategies and comparison of the results for the region, as well as for the project area. Projects outside of corridors must demonstrate consistency with the Plan, follow CMP procedures, and compare well with projects located in corridors.

While not a screening criterion, network expansion projects should be timed to the greatest extent possible to align with the ongoing effort to rebuild the regional transportation system. Due to ongoing funding constraints, any selected network expansion project should be timed so as to coincide with the existing facility's normal reconstruction cycle.

Roadway Expansion Evaluation Criteria

Projects that pass the initial screening will be assessed based on the following criteria. Each criterion has a set of rating measures to score the project. These criteria were weighted in Decision Lens by the Long-Range Plan Working Group and used to create an overall benefits score using both the project's rating and the criteria weights. The resulting score was then compared to the project's federal and state costs. Decision Lens performs an optimization to identify the set of projects that best maximize the cost-to-benefit ratio, within a constrained funding level.

FIGURE E-2: 2015 CMP PRIORITY SUBCORRIDORS



Source: DVRPC, 2017.

Is the project located in a CMP Priority or Congested Subcorridor?

The CMP has conducted considerable analysis of the regional transportation network and the impact of congestion. Developed with the counties, DOTs, transit operators, and other regional stakeholders, the CMP has identified a subset of Priority Subcorridors for transportation investment with specific strategies for mitigating congestion. This criterion also considers Congested Subcorridors as a secondary rating factor. In areas where Priority and Congested Subcorridors overlap, only the higher value will be counted.

- Definition: Percentage of project limits in a Priority Subcorridor × 100 percent + percentage of project limits in a Congested Subcorridor × 50 percent.
- Rating: >80 percent = 1 point; >60 percent = .5 point; >40 percent = .25 point; >20 percent = .125 point

What is the average annual daily traffic multiplied by the peak-period volume-to-capacity (V/C) ratio within the project limits?

This criterion elevates those projects that have the greatest significance for carrying regional travel while prioritizing the largest facilities by their level of congestion. Thus, a road with less daily traffic but more congestion could receive a higher score relative to a road with more daily traffic but less congestion depending upon actual AADT and/or V/C ratio.

- Definition: Use AADT data from the most current available RMS for Pennsylvania, or Linear Reference System (LRS) for New Jersey, and compute V/C ratio using daily capacity as defined in DVRPC's travel demand model.
- Rating: Highest AADT * V/C ratio quintile = 1 point; second highest

AADT * V/C ratio quintile = .5 point; third highest AADT * V/C ratio quintile = .25 point; fourth highest AADT * V/C ratio quintile = .125 point; lowest AADT * V/C ratio quintile = 0 points.

What is the daily truck traffic on the facility?

Truck traffic is critical for the movement of freight and a very important segment of the regional economy. Improvements to facilities with high amounts of truck traffic will contribute to the improvement of goods movement in the region.

- Definition: Using data from the most current available RMS for Pennsylvania, and by functional class using DVRPC average regional values for "heavy trucks" plus buses as derived from traffic counts and travel surveys over time for New Jersey
- Rating: >7,500 = 1 point; >5,000 = .5 point; >2,500 = .25 point; >1,000 = .125 point.

Are there significant environmental issues that will be impacted by the project?

MAP-21 includes language that directs MPOs to more fully incorporate environmental considerations into the short- and long-range transportation planning process. The Environmental Screening Tool aims to evaluate the impacts of transportation projects on environmental features and assigns a quantitative value to those impacts. To begin this process, each proposed Major Regional Project is assigned a buffer. For highway projects, the size of the buffer is based upon the type of facility and whether the capacity increase is a widening of an existing facility within an existing ROW or is a new alignment. Buffer sizes reflect the fact that transportation impacts extend well beyond the project ROW, due to habitat fragmentation,

the systemic nature of ecosystem function, and secondary impacts, such as potential land use change and water quality impacts. Buffer distances are sized based on similar studies and in a “regionally appropriate” manner. The buffer categories are as follows:

- highway capacity enhancement within existing arterial ROW: one-half of a mile;
- highway capacity enhancement within existing freeway ROW: one mile; and
- new highway ROW facility: two miles.

Proposed projects are overlaid with 10 key environmental data layers outlined below. The presence of an environmental feature within a cell will give that cell a value of 1 point. The presence of two features will give the cell a value of two, and so forth, with a maximum cell value of 10. The value of each and every cell within a project’s buffer area will be summed to produce a cumulative score.

This analysis calculates the natural and ecological context of transportation projects and provides an early indication of potential relative environmental impacts. A high score indicates a higher likelihood of potential impacts and conflicts with conservation objectives.

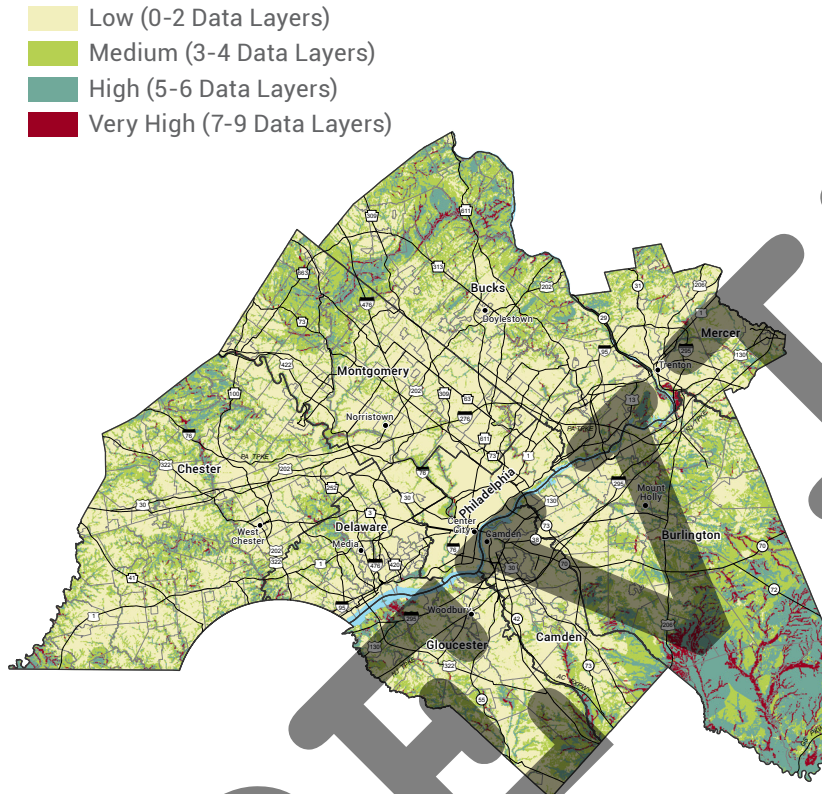
The following data layers are included in the Environmental Screening Tool:

- 2045 Greenspace Network;
- 2045 Conservation Focus Areas;
- 2045 Rural Resource Lands;

- Wetlands:
 - ▶ Pennsylvania—2016 National Wetlands Inventory; and
 - ▶ New Jersey—2012 NJ DEP Land Use/Land Cover Data;
- Woodlands—DVRPC 2015 Land Use;
- Floodplains—Federal Emergency Management Agency 100-year floodplains: Burlington (2016), Camden (2009), Gloucester (2016), Mercer (2016), Bucks (2002), Chester (2006), Delaware (2009), Montgomery (2001), Philadelphia (2006);
- Steep Slopes—over 10 percent;
- Riparian Buffers—all streams within the DVRPC region are assigned a 300-foot buffer;
- High-Value Habitat Areas:
 - ▶ Pennsylvania—Smart Conservation Model values of 8, 9, and 10; and
 - ▶ New Jersey—Landscape Project Critical Habitat Areas version 3.1; and
- Significant Natural Areas
 - ▶ Pennsylvania—2017 Natural Areas Inventory Sites; and
 - ▶ New Jersey—2007 Natural Heritage Priority Sites.

Each of these environmental data layers are weighted equally since the point of the analysis is to evaluate and compare the impacts of transportation projects on the environment, not compare the relative weight of one environmental feature to another. However, the screening tool achieves appropriate weight or “depth” due to feature overlap. For example, a wooded floodplain area within the Greenspace Network scores three times higher than land that is wooded but not within a floodplain or the Greenspace Network. It should be noted that key agricultural lands are incorporated into this analysis insomuch as they are included within DVPRC’s Conservation Focus Areas.

FIGURE E-3: DVRPC ENVIRONMENTAL SCREENING TOOL



Source: DVRPC, 2017.

- Definition: For capacity enhancement on a limited-access freeway or interchange, consider a one-mile buffer around project limits; for capacity enhancement on an arterial, consider a .5-mile buffer; for new alignments, consider a two-mile buffer.
- Rating: Percentage of project area with a range of 0 to 2 Environmental Screening Tool score; >90 percent = 1 point; >75 percent = .5 point; >60 percent = .25 point; >40 percent = .125 point.

How far has the project advanced?

This criterion reflects project readiness and gives a higher score to those projects that have advanced through the various stages of the project development process. Projects that have advanced further through this process have undergone rigorous examination and typically have a higher level of support from regional stakeholders compared to other projects. This criterion prioritizes those projects that are most ready to move forward to construction.

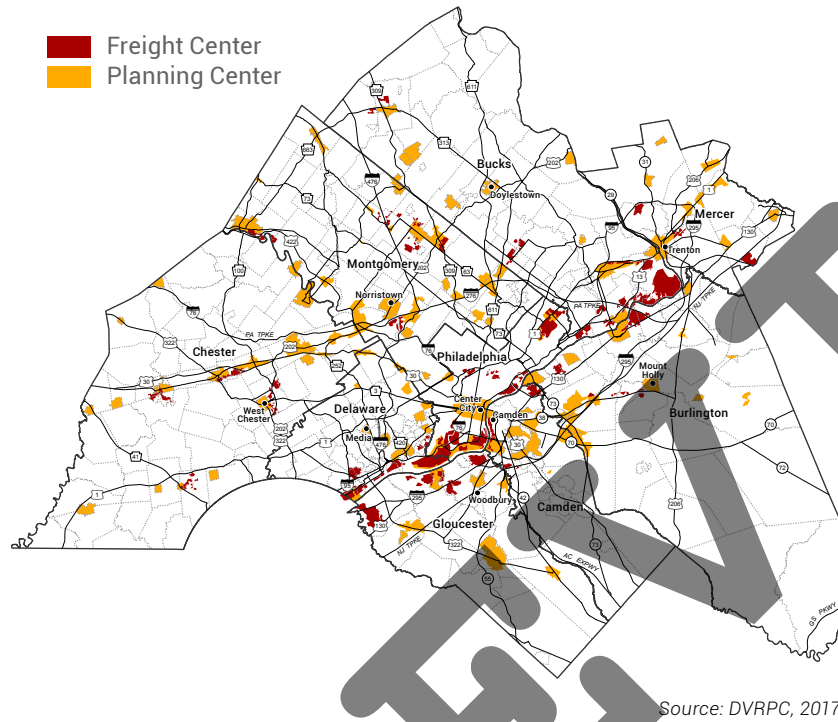
- Definition: Project status in the respective Pennsylvania or New Jersey DOT project database. This criterion gives credit for the highest authorized phase. Each preceding phase must also have been authorized (e.g., a project would not receive credit for authorized Utility or ROW unless it had previously been authorized for Final Design).
- Rating: Authorized for Construction = 1 point; Authorized for Utility or ROW = .5 point; Authorized for Final Design = .25 point; Authorized for Preliminary Engineering = .125 point.

What is the total population and employment in regional Plan Centers and Freight Centers served by the project?

Highway network expansions should enforce existing or planned developed places that are designated as a Planned or Freight Center in *Connections 2045*.

- Definition: Use population and employment data from the U.S. Census. To be counted as serving a Center, an arterial, interchange(s), or on-/off-ramps of a limited-access freeway, the project must be located within one mile of the Center.
- Rating: All evaluated projects will be broken down into quintiles ranging from the highest population plus employment quintile =

FIGURE E-4: CONNECTIONS 2045 PLANNING AND FREIGHT CENTERS



1 point; second highest population plus employment quintile = .5 point; third highest population plus employment quintile = .25 point; fourth highest population plus employment quintile = .125 point; lowest population plus employment quintile = 0 points.

TRANSIT NETWORK EXPANSION EVALUATION CRITERIA

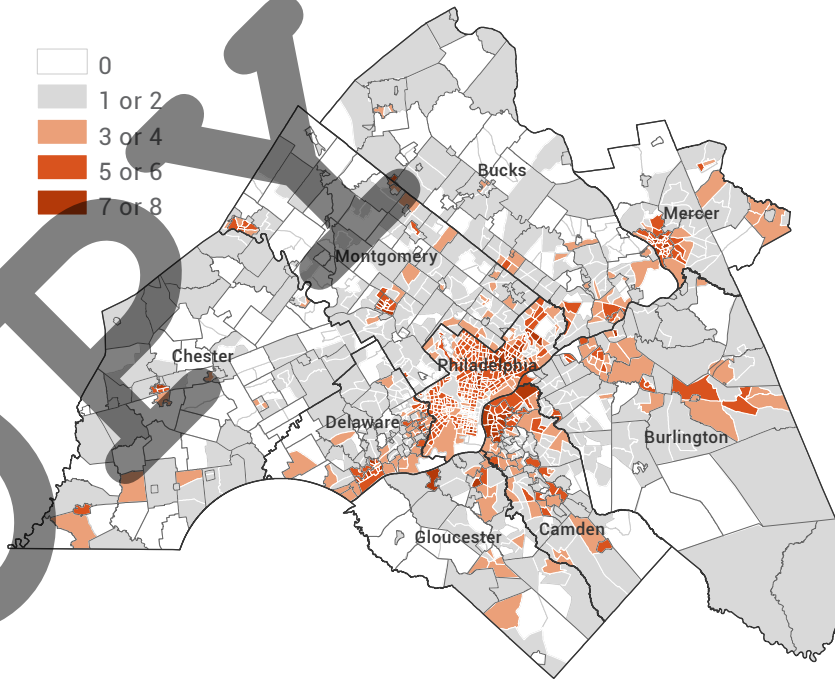
Projects that pass the initial transit screening will be assessed based on the following criteria. Each criterion has a set of rating measures to score the project. These criteria were also weighted in Decision Lens by the Long-Range Plan Working Group and used to create an overall benefits score using both the project's rating and the criteria weights.

The resulting score will be compared to the project's federal and state costs. Decision Lens will then identify the set of projects that best maximize the cost-to-benefit ratio.

How well does the project serve EJ communities and underserved population groups?

Many communities are heavily reliant on transit service to provide accessibility to school, employment, and services. Does the project serve EJ communities and the additional population groups, as defined by the DVRPC IPD methodology, with additional transit needs? This analysis uses the eight IPDs identified by DVRPC. The IPDs are based on census tracts that meet or exceed the regional average in Poverty;

FIGURE E-5: IPD



Carless Households; Non-Hispanic Minority; Physically Disabled; Hispanic; Limited English Proficiency; Elderly; and Female Head of Household with Child.

- Definition: Percentage of station stops in IPD communities.
- Rating: Percentage of proposed station stops in areas with seven to eight IPDs × 100 percent + percentage of station stops in areas with five to six IPDs × 75 percent + percentage of station stops in areas with three to four IPDs × 50 percent + percentage of station stops in areas with one to two IPDs × 25 percent; >70 percent = 1 point; >50 percent = .5 point; >30 percent = .25 point; >10 percent = .125 point.

How fully has the project been studied?

The FTA has set definitions for the level of study that a transit network expansion project must complete in order to be eligible for federal New Starts funding. A more detailed level of study produces more robust farebox recovery rates and cost estimates, as well as a better understanding of various alternative routings, and indicates a higher level of local and political support.

- Rating: If the project has a completed Environmental Impact Statement = 1 point; a completed FTA Alternatives Analysis (Full Alternatives Analysis) = .5 point; a feasibility analysis or non-FTA alternatives analysis (Conceptual AA) = .25 point; a sketch-level planning study (Sketch Plan) = .125 point.

Is the project located in a CMP Priority or Congested Subcorridor?

The CMP has conducted considerable analysis of the regional transportation network and the impact of congestion. Developed with the counties, DOTs, transit operators, and other regional

stakeholders, the CMP has identified a subset of Priority Subcorridors for transportation investment with specific strategies for mitigating congestion. This criterion also considers Congested Subcorridors as a secondary rating factor.

- Definition: Percentage of proposed fixed guideway or BRT station stops in Priority Subcorridor × 100 percent + percentage of proposed fixed guideway or BRT station stops in Congested Subcorridor × 50 percent.
- Rating: >80 percent = 1 point; >60 percent = .5 point; >40 percent = .25 point; >20 percent = .125 point.

How much new transit ridership is generated by the project?

The ability of a transit project to attract new riders to the transit network, as opposed to merely shifting riders from bus to rail, is critical for reducing congestion, increasing safety, promoting livability, and achieving sustainability.

- Definition: Projects will be evaluated using DVRPC's travel demand model using 2045 demographics and the existing base year transportation system as a baseline, and 2045 demographics and the existing base year transportation system plus the built project for comparison.
- Rating: Evaluated projects will be broken down into quintiles ranging from the highest new passenger quintile = 1 point; second highest new passenger quintile = .5 point; third highest new passenger quintile = .25 point; fourth highest new passenger quintile = .125 point; to lowest new passenger quintile = 0 points.

What is the anticipated farebox recovery rate?

Given that future funding constraints will likely be ongoing, we must ensure that future revenues from a project will be able to fund its ongoing operating and maintenance costs

- Definition: Use estimated farebox recovery rate from highest level of study completed to date.
- Rating: Evaluated projects farebox recovery rate >100 percent = 1 point; farebox recovery rate >80 percent = .5 point; farebox recovery rate >60 percent = .25 point; farebox recovery rate >40 percent = .125 point; farebox recovery rate <40 percent or not estimated as part of a study = 0 points.

What is the proposed project's TOD potential?

Transit network expansions should encourage future TOD. This indicator looks at the TOD potential of station stops along the proposed route.

- Definition: Amount of vacant land within one-half mile of proposed station stops based on DVRPC's 2015 land use file.
- Rating: Evaluated projects will be broken down into quintiles ranging from the highest vacant acres quintile = 1 point; second highest vacant acres quintile = .5 point; third highest vacant acres quintile = .25 point; fourth highest vacant acres quintile = .125 point; lowest vacant acres quintile = 0 points.

What is the transit score of the communities the route proposes to serve?

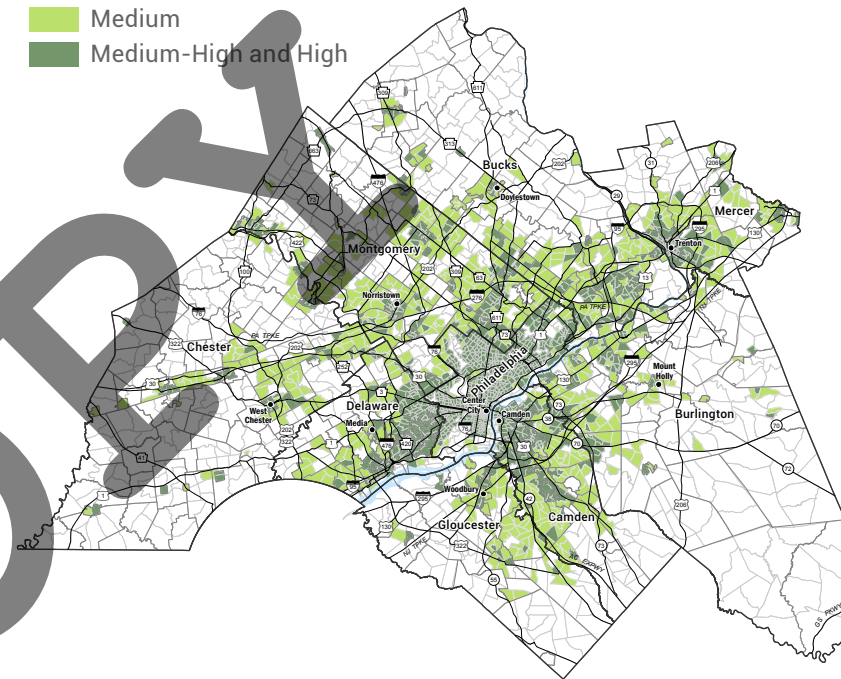
Transit network expansions should enforce existing or planned developed places where the requisite density exists to ensure high levels of ridership. The Transit Score Index indicates whether a project

has the requisite density to be successful. Because the region's Centers have a high degree of density, this measure also serves as a proxy for serving Centers of place. Analysis is based on the percentage of the proposed station stops that serve census tracts ranked as either Medium-High or High using the Transit Score Index for fixed guideway, and Medium, Medium-High, or High for BRT.

- Definition: Based on the 2015 DVRPC/New Jersey Transit Score Index.
- Rating:

FIGURE E-6: 2015 TRANSIT SCORE BY TAZ

- Low and Marginal
- Medium
- Medium-High and High



Source: DVRPC, 2015

- ▶ For Fixed Guideway Rail: percentage of proposed station stops in Medium-High or High transit score traffic analysis zones (TAZs): >80 percent = 1 point; >60 percent = .5 point; >40 percent = .25 point; >20 percent = .125 point; and
- ▶ For BRT: percentage of proposed station stops in Medium, Medium-High, or High transit score TAZs: >80 percent = 1 point; >60 percent = .5 point; >40 percent = .25 point; >20 percent = .125 point.

WEIGHTING THE LONG-RANGE PLAN EVALUATION CRITERIA

The Decision Lens software was used by the Long-Range Plan Working Group to conduct a pairwise comparison of each of the evaluation criteria, in which each criterion is compared to every other criterion on an individual basis. A separate exercise was conducted for roadway and transit evaluation criteria. Tables E-4 and E-5 show the weighting of each criterion based on the results of the Decision Lens voting.

SCORING PROJECTS

In the next step in the project evaluation process, DVRPC staff evaluated each candidate project using the selection criteria and computed a final score based on the weight of each of the criterion. As Plan development continued, the timing of modeling each project individually proved unfeasible, largely due to an upgrade in DVRPC's modeling software. The Long-Range Plan Working Group agreed to revise the weighting, removing the vehicle hours of travel criterion and proportionally reweighting the rest of the criteria. The resulting project ranking and cost optimization was used by the Long-Range Plan Working Group to consider when selecting projects to include in the fiscally constrained long-range plan.

TABLE E-1: REVISED ROADWAY CRITERION WEIGHTING FACTORS

Criterion	Original Weight	Revised Weight
What is the total population and employment in regional Plan Centers and Freight Centers served by the project?	27.2%	32.2%
What is the project's status in the respective Pennsylvania or New Jersey DOT project database?	22.5%	26.6%
Is the project located in a CMP Priority or Congested Subcorridor?	10.8%	12.8%
What is the facility's vehicular AADT multiplied by its V/C ratio?	10.7%	12.7%
What is the percentage of the project limits with low DVRPC Environmental Screening Tool impacts?	7.4%	8.8%
What is the facility's truck AADT?	5.9%	7.0%

Source: DVRPC, 2012

TABLE E-2: REVISED TRANSIT CRITERION WEIGHTING FACTORS

Criterion	Original Weight	Revised Weight
How much new ridership is generated by the line?	27.2%	30.8%
What is the transit score of the communities that the route proposes to serve?	18.0%	20.4%
What is the potential for TOD?	11.3%	12.8%
How fully has the project been studied?	10.1%	11.4%
Is the project located in a CMP Priority or Congested Subcorridor?	8.0%	9.1%
What is the project's anticipated farebox recovery rate?	7.9%	8.9%
How well does the project serve EJ and IPD population groups?	5.8%	6.6%

Source: DVRPC, 2012

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Appendix F: Details on Local Funding Options

REVIEW ITEM
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This appendix provides further information on potential local funding options identified in Chapter 4. To be equitable, the cost of paying for transportation improvements should be spread among various facilities to reduce the impact on users throughout the region, as opposed to on fewer facilities, which unfairly burdens only a portion of the region's transportation network users. Although all the potential fees can be viewed as regressive in one way or another as they would charge all consumers the same amount for an item, regardless of income. This can be overcome to a certain extent by providing more lower-cost options, such as transit, walking, and biking facilities. No preferred option has emerged to date, but this analysis considers the following key concerns for implementing any potential tax or fee:

- **Ease of Implementation**—Is there an existing mechanism for collection of this revenue source?
- **Revenue Yield and Adequacy**—How much would the source generate, and will it be sufficient?
- **Stability and Sustainability**—Will the source be stable and not fluctuate unpredictably?
- **Fairness and Equity**—Will the costs of the revenue be balanced with the benefits? Will the revenue distribute across jurisdictions?
- **Economic Efficiency**—How will the source impact economic behavior? How will it impact regional land development patterns?

For revenue and adequacy, taxes and fees deemed to have very high local yields would generate more than \$300 million regionally per year; high yields would generate more than \$150 million; good yields would generate more than \$75 million; medium yields would generate more than \$25 million; and low yields would generate less than \$25 million annually. The region currently generates about \$100 million per year

in local funding. Revenue yield considers the ability to roughly double (good rating or better) the current regional contributions, with no more than a 10 percent increase in current transportation costs.

ACCESS FEES

Access fees levy a charge on nonresidential taxable property located near transit stations. This is a similar concept to a business improvement district (BID). Analysis using CoStar property data estimates that there are 165 million square feet of commercial space within a quarter-mile of a transit station in the five-county southeastern Pennsylvania region, and 15 million square feet of commercial space in the four southern New Jersey counties.

- **Ease of Implementation**—Can be combined with existing property tax, although new revenue collection mechanisms may be necessary. Would require state enabling legislation.
- **Revenue Yield and Adequacy**—Medium; could generate approximately \$45 million per year, at \$0.25 per square foot of commercial space within a quarter-mile of a transit station each year.
- **Stability and Sustainability**—Should maintain predictable and consistent revenue generation and increase with more TOD. Will grow with new development near transit and as properties are reassessed. Longer-term impacts of HAVs on transit may portend some risk.
- **Fairness and Equity**—Places transportation funding responsibility on property owners near transit. Landowners can benefit through increased property values from transit access and improvements. These fees could recapture some of the appreciation brought about by the transit network and return it to help generate additional value.
- **Economic Efficiency**—Employers near transit benefit from the re-

duced need to supply parking for employees and customers. However, this tax could negatively influence business location decisions away from transit, possibly reducing ridership and encouraging more driving.

CARBON TAXES

Carbon taxes levy a fee on CO₂ generation. In 2010, the region emitted 21.5 million metric tons of carbon dioxide equivalent (or 23.7 metric tons of carbon dioxide equivalent) from on-road motor vehicle and transit uses. At a fee of \$30 per ton (approximately the current estimated social cost of carbon emissions, with a general range between \$20 and \$200 per ton), the carbon tax mechanism would be the equivalent of 1.2 cents per mile in additional cost per VMT for a vehicle with average fuel efficiency. Drivers facing increased fuel costs can take fewer trips, shorter trips, complete trips with alternative modes, or use/purchase more fuel-efficient or lower-carbon content-fueled vehicles.

This fee could reduce annual VMT in the region by 0.7 percent, or around 280 million miles. It would generate an estimated 800,000 additional transit trips per year, and is estimated to reduce annual CO₂ equivalent emissions by about 260,000 tons.

- **Ease of Implementation**—Taxes do not currently exist and would require state enabling legislation.
- **Revenue Yield and Adequacy**—Very high; it could generate approximately \$705 million annually at a rate of \$30 per ton of transportation-generated CO₂.
- **Stability and Sustainability**—Would have to increase at the rate of declining carbon emissions to remain stable and effective over time.

- **Fairness and Equity**—This tax, and any other option that would drastically lower VMT and fuel use, could be seen as less regressive. Reducing GHG emissions is one of the preeminent challenges of our time. Using economics to do so will increase intergenerational equity for future populations. It will also reduce impacts on poorer populations, which most analysts find to be more likely to be substantially burdened by climate change.
- **Economic Efficiency**—Taxes that encourage environmental efficiency can lead to technological innovations that in turn lead to more efficient resource use and other economic gains.

CONGESTION PRICING

Congestion pricing changes the cost of using a road by time of day to reduce peak-period demand, using economic principles to manage travel demand and encourage more efficient use of transportation facilities. When demand is high during peak periods, the cost to use the facility increases. In many ways this is similar to, or dependent upon, tolling. Many economists and transportation experts consider this to be the most effective way to reduce congestion. There are a number of different ways to implement congestion pricing, such as pricing a single facility or bridge, pricing a class of facilities, pricing all roads, putting a cordon line toll around a major destination area, or increasing the cost of parking during peak-period demand.

Although not proposed or further discussed here, new roadway widening and part-time shoulder-use projects proposed in the Plan could be priced as High Occupancy Toll (HOT) lanes. In this case, new through lanes could be priced during peak periods for single-occupant drivers, but would be free to use for carpoolers. The existing lanes on the facility would remain unpriced. By potentially freeing up some

traffic in the existing free lanes, congestion can be reduced while at the same time generating revenue to pay for the project and ongoing operating costs.

The analysis considers a cordon line charge on the roads entering Center City, Philadelphia, and congestion pricing along all major limited-access highway facilities.

Cordon Line Tolls

Cordon line tolls demarcate a congestion pricing zone around Center City (at Callowhill Street, South Street, and the Schuylkill and Delaware rivers for this analysis). About 250,000 cars pass through this Center City cordon line during the peak period each weekday. Each entering vehicle would be charged a \$5 fee during peak travel times, from 7 AM to 6 PM each day. While some may travel using other modes, and other trips simply are passing through and may find another route, this may decrease the overall number of trips made into the region's core area—potentially weakening its critical networking and agglomeration functions.

This cordon line congestion fee is estimated to generate \$110 million in additional funding each year. It would decrease annual VMT by 190 million while encouraging an additional four million transit trips. Other benefits may accrue from reduced noise and air emissions; improved bike, pedestrian, and transit access; and enhanced public space and more space-efficient transportation in the region's core.

- **Ease of Implementation**—Requires state enabling legislation. Digital vehicle technologies make fee much more feasible.
- **Revenue Yield and Adequacy**—Good; it could generate approximate-

ly \$110 million annually, at \$5 per vehicle entering the Center City cordon line.

- **Stability and Sustainability**—This charge requires Center City to remain the economic and cultural center of the region. If such a fee could not be implemented without harming the future growth of Center City, then this charge would be inconsistent with the Plan's goal of investing in existing Centers. More study is needed to make that determination.
- **Fairness and Equity**—May place a heavier burden on a subset of peak-period regional commuters and travelers into the region's central business district.
- **Economic Efficiency**—A cordon line congestion charge risks shifting regional development patterns and limiting growth in Center City relative to the rest of the region. However, a cordon line charge takes advantage of the plethora of transportation options into and around Center City. NOHRP Report 689 estimates that cordon line tolls administrative costs are 38.7 percent of revenues. Electronic tolling can have higher up-front capital costs but is expected to reduce administrative and operating costs in the long-term.

Congestion Priced Highways

This analysis would apply a fee of approximately \$0.20 per mile on all limited-access highways during the peak period. This is double the current per mile fee on the Pennsylvania Turnpike. The peak period used here is 6 AM to 9 AM each weekday morning and 3 PM to 7 PM each weekday afternoon. These seven hours account for 47 percent of the VMT that occurs on the region's highways. Options for peak-period drivers include: pay the increased rate (and benefit from reduced congestion), switch the trip to a nonpeak period, shift from charged highways to nontolled local roads, shift modes, or not take the trip.

Congestion priced highways would generate \$460 million in additional funding annually. It would reduce peak-period highway VMT by about 650 million, helping to ensure a smoother flow of traffic, and increase transit ridership by 5.6 million trips per year. However, it shifts about 110 million annual VMT from the peak to off-peak period, and adds about 260 million annual VMT to local roads (from highways) during peak periods. The net decline in annual VMT is about 270 million miles.

- **Ease of Implementation**—Tolls are not currently collected on these facilities, and adding them would require state and federal enabling legislation.
- **Revenue Yield and Adequacy**—Congestion priced highways could generate \$460 million annually with an average \$0.20 per peak hour VMT.
- **Stability and Sustainability**—Congestion pricing on highways should remain consistent over time, with minor fluctuations due to the economy. The longer-term impact of driverless cars is a bit of an unknown at this point.
- **Fairness and Equity**—May place a heavier burden on a subset of peak-period regional highway transportation users.
- **Economic Efficiency**—Congestion pricing can promote the more efficient use of the transportation network throughout the day, reducing the need to make costly network expansions while promoting alternative modes. NCHRP Report 689 estimates that tolled facility operating and administrative costs are 33.5 percent of revenue. Electronic tolling can have higher up-front capital costs but is expected to reduce administrative and operating costs in the long-term.

FUEL SALES TAX

A local-option fuel sales tax could be assessed as a percentage of consumer fuel price, excluding the portion made up by the liquid fuels tax. Drivers confronted with an increasing fuel price may take fewer or shorter trips, complete trips with alternative modes, or purchase more fuel-efficient or alternative-fuel vehicles.

The U.S. Energy Information Administration's 2016 average fuel cost for the mid-Atlantic region was \$2.31 per gallon for gasoline and \$2.44 per gallon for diesel. The estimate assumes the region's gasoline fleet gets an average of 19 miles per gallon and drives about 39.3 billion miles per year. A 2 percent regional fuel sales tax would generate about \$40 million in additional funding in Pennsylvania and \$25 million in New Jersey. It could reduce vehicle travel by 40 million miles per year and increase transit ridership by 100,000 trips per year.

- **Ease of Implementation**—Sales taxes are currently collected on most goods and services in both states, but not on fuel. May require new fuel sales tracking mechanisms. Would require state enabling legislation.
- **Revenue Yield and Adequacy**—Medium at a 2 percent regional fuel sales tax rate, which could generate about \$65 million annually.
- **Stability and Sustainability**—Fuel sales taxes are dependent on gasoline and diesel remaining the primary fuel sources. They also face risks from improving fuel efficiency, leading to lower overall consumption and possible fuel price decreases. Percentage-based rate will increase with rising fuel prices, but revenues would decline with lower energy costs.
- **Fairness and Equity**—Places transportation improvement responsibility on drivers, who are the primary users.

- **Economic Efficiency**—Can reduce driving and encourage alternative modes of transportation while improving air quality and reducing congestion. May also lead to purchases of more fuel-efficient vehicles and increase TOD.

MILEAGE-BASED USER FEE

An MBUF is assessed at a specific rate per miles driven and can be imposed on either all VMT or only on specific facilities. This charges roads more like a utility, directly based on system use. Technology can be used to track VMT on all road segments and charge drivers as they use them. With such a system, fees could vary by type of road and time of day. This could help to better capture the impact of congestion and even reduce the use of local roads (assuming a higher charge per mile than arterials and highways).

Fees can be assessed by reading the odometer at each vehicle inspection, or each time the car is refueled. The former option would require substantial one-time payments every year. A trial in Oregon had each participant's car record miles driven in state and out of state, charging only for the in-state miles. Where and when those miles were driven was not recorded. Even with this sort of MBUF system, fees could vary by vehicle weight and/or fuel efficiency. This could capture the impact a vehicle has on road deterioration and emissions.

This analysis considers a one-cent charge per VMT. In New Jersey, this fee could generate \$150 million per year while reducing annual VMT by 260 million miles and increasing transit ridership by about 1.1 million trips. In Pennsylvania, this fee could generate \$240 million per year while reducing annual VMT by 400 million miles and increasing transit ridership by about 1.8 million trips.

- **Ease of Implementation**—Fee does not currently exist and would require state enabling legislation. Digital vehicle technologies make enacting this fee much more feasible.
- **Revenue Yield and Adequacy**—Very high; a \$0.01 per mile fee could generate \$390 million per year regionally.
- **Stability and Sustainability**—Should maintain consistent revenue generation, with some minor fluctuation due to the economy. May need occasional rate increase to keep up with inflation.
- **Fairness and Equity**—Although it is generally regressive in that it does not vary charges based on income, it is considered to be one of the most equitable transportation funding structures because it is based on how much driving an individual does. National Cooperative Highway Research Program (NCHRP) Report 689 estimates MBUF operating administrative costs are 6.6 percent of revenue.
- **Economic Efficiency**—May need to be based on vehicle weight or fuel efficiency to reward lower emissions rates. It can reduce driving and encourage increased transit use and more TOD.

REGIONAL TOLL SURCHARGE

A regional toll surcharge for this analysis would levy an additional \$1.00 on the 14 Pennsylvania Turnpike interchanges and 11 New Jersey turnpike interchanges in the region. A second option would apply it to the nine toll bridges crossing the Delaware River in the region.

Toll Road Surcharge

A toll road surcharge would add a \$1.00 cost to vehicles using 14 Pennsylvania Turnpike, eight New Jersey Turnpike, two Atlantic City Expressway, and one Garden State Parkway exits within the region. The revenue generated by the surcharge would be about \$95 million on the Pennsylvania Turnpike. The surcharge would result in 160 million fewer

VMT on the Pennsylvania Turnpike. This would decrease Pennsylvania Turnpike revenues by about \$30 million. It would also shift 45 million annual VMT onto local roads and generate about 450,000 additional transit trips.

In New Jersey, the \$1.00 surcharge would result in \$20 million in revenues while reducing New Jersey turnpike revenue by \$7 million. From a transportation impact, it would reduce VMT on these facilities by 30 million miles while increasing VMT on local roads by nine million miles per year. It could increase transit ridership by 100,000 annual trips.

- **Ease of Implementation**—Tolls are already collected on these facilities, but enactment would require state enabling legislation and would be subject to bondholder approval.
- **Revenue Yield and Adequacy**—Good; a regional \$1.00 toll road surcharge could generate approximately \$115 million per year.
- **Stability and Sustainability**—Highway travel should remain consistent over time, with minor fluctuations due to the economy. The longer-term impact of driverless cars is a bit of an unknown at this point. Flat rate fees can be difficult to increase, and often fail to keep up with inflation.
- **Fairness and Equity**—May place a heavier burden on a subset of regional turnpike users, while funding would be distributed to a wider range of transportation facilities.
- **Economic Efficiency**—Can help to manage demand for finite highway capacity. A surcharge may push more drivers onto local and non-tolled roads, increasing congestion. It could also encourage transit use, which would decrease congestion, improve air quality and promote TOD.

Bridge Toll Surcharge

For this analysis, a bridge toll surcharge would add a \$1.00 cost to the nine current and soon-to-be tolled Delaware River crossings in the region. These facilities are the Commodore Barry, Walt Whitman, Benjamin Franklin, Betsy Ross, Tacony-Palmyra, Burlington-Bristol, US 1 Trenton-Morrisville, US 202 New Hope-Lambertville, and (soon) the I-95 Scudder Falls bridges. The surcharge is estimated to generate \$100 million in revenue and result in an annual VMT reduction of 180 million miles, increasing transit ridership by about 1.8 million annual trips.

- **Ease of Implementation**—Tolls are already collected on these facilities, but enactment would require state enabling legislation and would be subject to bondholder approval.
- **Revenue Yield and Adequacy**—Medium, could generate \$45.0 million annually with a \$1 toll surcharge on nine Delaware River crossing facilities.
- **Stability and Sustainability**—Highway travel should remain consistent over time, with minor fluctuations due to the economy. The longer-term impact of driverless cars is a bit of an unknown at this point. Flat rate fees can be difficult to increase and often fail to keep up with inflation.
- **Fairness and Equity**—May place a heavier burden on a subset of regional toll bridge users, while funding would be distributed to a wider range of transportation facilities.
- **Economic Efficiency**—Can help to manage demand for finite highway and bridge capacity. A surcharge may reduce travel between Pennsylvania and New Jersey, with minor trade and economic implications.

SALES TAX

The sales tax is levied as a percentage of the purchase price for goods, products, and services. It is commonly used as a revenue generator for transportation in other regions around the country. Virtually all goods and services require some use of the transportation system.

The current sales tax rate is 8 percent in Philadelphia, 6 percent in the four suburban Pennsylvania counties, and 7 percent in the state of New Jersey.

Increasing the sales tax would have minor transportation impacts, based on reduced discretionary income. The revenue generated from a sales tax increase can be computed from the receipts reported by the Pennsylvania Department of Revenue and New Jersey Department of Taxation. For the DVRPC counties in Pennsylvania, sales tax revenue by county does not capture the entire sales tax receipts because many businesses report their sales at a statewide level and not for each county. DVRPC estimates that the five-county southeastern Pennsylvania region generates 33 percent of the state's total receipts. Similarly, the New Jersey subregion's population is 18 percent of the state total, while it generates about 16 percent of the state's income. The average of these two (17 percent) is used as a proxy for sales tax share of the state total. Based on the current sales tax revenues, a 0.5 percent rate increase would bring in an additional \$250 million and \$100 million to the Pennsylvania and New Jersey subregions, respectively.

- **Ease of Implementation**—Can use existing revenue collection mechanisms but requires state enabling legislation to collect locally.
- **Revenue Yield and Adequacy**—Very high; a 0.50 percent increase to each state's sales tax could generate approximately \$350 million

annually in Greater Philadelphia.

- **Stability and Sustainability**—Percentage-based tax will increase with the economic growth and should maintain consistent revenue generation, with some fluctuation due to regular business cycles. A percentage-based rate helps to keep pace with inflation.
- **Fairness and Equity**—This tax is generally considered the most regressive of transportation funding options, and it is not based on the use of the system. It does, however, cover a broad base of the economy, which is dependent in many ways on the transportation network.
- **Economic Efficiency**—Economists have generally found that sales taxes are a good way to generate revenue without harming economic growth, distorting development patterns, or use of the transportation network. It could lead to more out-of-region purchases.

TOLLING EXISTING HIGHWAYS

Tolling existing highways would add fees to the use of these facilities. Currently, there is no enabling federal legislation to allow tolling on publicly built facilities. However, future facility replacement needs and lack of funding may require some sort of tolling either to repay infrastructure bank loans or as part of a PPP. This fee estimates the revenue potential of tolling on all limited-access facilities in the region, including I-76, I-95, I-676, I-476, and US 422, and sections of US 1, US 202, and PA 309 in Pennsylvania; and I-76, I-95 (the section in Mercer County that is not the New Jersey Turnpike), I-195, I-295, I-676, and portions of NJ 42 and NJ 55 in New Jersey.

In New Jersey, a 10 cent per mile toll is estimated to decrease annual VMT by 270 million miles on the region's highways. However, local road VMT would increase by about 140 million miles, leaving a net 130

million-mile reduction in annual VMT. Transit ridership is estimated to increase by 100,000 trips per year. Tolling major regional highways under these assumptions is estimated to generate \$290 million in revenue in southern New Jersey.

In Pennsylvania, a 10 cent per mile toll is estimated to reduce annual VMT by 390 million miles on the region's highways. However, local road VMT would increase by about 220 million miles, leaving a net 170 million-mile reduction in annual VMT. Transit ridership is estimated to increase by 600,000 trips per year. Tolling major regional highways under these assumptions is estimated to generate \$420 million in revenue in the five-county southeastern Pennsylvania subregion.

- **Ease of Implementation**—Tolling does not currently occur on these facilities, and implementation would require state and federal enabling legislation.
- **Revenue Yield and Adequacy**—Very high; an average toll of \$0.10 per mile is estimated to generate \$710 million in revenue in the region.
- **Stability and Sustainability**—Facilities should grow traffic volumes with increasing population, with some fluctuation due to the economy. Flat rate fees can be difficult to increase and often do not keep up with inflation.
- **Fairness and Equity**—Places higher transportation funding responsibility on drivers, who are the primary beneficiaries of transportation investments.
- **Economic Efficiency**—Tolling has generally had very high administrative costs associated with it. The cost of collecting tolls can be up to 30 percent of the amount collected (which has been accounted for in the estimate). Electronic tolling can have higher up-front capital costs but is expected to reduce administrative and operating costs

in the long-term. May push more drivers onto local roads, increasing congestion. It could encourage transit use, which would decrease congestion, improve air quality, and may lead to more TOD.

TRANSIT FARE INCREASES

Transit fares are collected through weekly or monthly passes, tokens, tickets, and cash payments on buses, trolleys, regional and commuter lines, and heavy rail lines. This analysis considers a 3 percent transit fare increase, which could increase VMT in our region by approximately 8.4 million miles, while reducing annual transit trips by 2.9 million.

Transit fares are generally used to support operations and are rarely used to make capital investments.

- **Ease of Implementation**—Transit agencies already collect fares and have the authority to increase them.
- **Revenue Yield and Adequacy**—Low; a 3 percent transit fare increase could generate about \$10 million per year.
- **Stability and Sustainability**—Increasing transit costs is likely to reduce ridership, diminishing returns. Flat rate fees can be difficult to increase and often fail to keep up with inflation.
- **Fairness and Equity**—Increasing fares may place a heavier burden on a subset of regional transit users. However, it does place funding responsibility on a population that benefits from transportation investments.
- **Economic Efficiency**—Reduced ridership means less space-efficient transportation, which is critical to building agglomeration economies.

VEHICLE REGISTRATION FEES

Vehicle registration fees are collected each year, or every other year, for all vehicles in the region. Pennsylvania vehicle registration fees are slated to increase as part of Act 89 to keep pace with inflation. Act 89 enabled Pennsylvania counties to collect a \$5 local surcharge each year to pay for road maintenance projects. Pennsylvania could follow New Jersey's lead and vary these fees by vehicle weight, age, and fuel efficiency.

A \$10 increase in the vehicle registration fee would generate \$22 million per year in Pennsylvania and \$10 million per year in New Jersey. Its impact on the transportation system is minimal, with an annual estimated reduction of two million VMT and no substantial change in total transit ridership.

- **Ease of Implementation**—Fee exists but would require state enabling legislation to collect locally beyond the \$5 county fee option created in Act 89.
- **Revenue Yield and Adequacy**—Medium, a \$10 per vehicle fee could generate \$30 million per year.
- **Stability and Sustainability**—Flat rate fees can be difficult to raise but would need occasional increases to keep up with inflation. Although vehicle ownership rates have outpaced population growth over the past several decades, future vehicle technologies, such as driverless cars, may revolutionize the vehicle ownership model. In a future with more carsharing, there may be fewer cars in the region to pay vehicle registration fees.
- **Fairness and Equity**—Generally regressive in that it charges all individuals the same regardless of income. Lower-income and high-income individuals are more likely to not own personal vehicles.

- **Economic Efficiency**—Not likely to distort development patterns or use of the transportation network.

G

Appendix G: Planning Areas

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FIGURE G-1: PENNSYLVANIA PLANNING AREAS

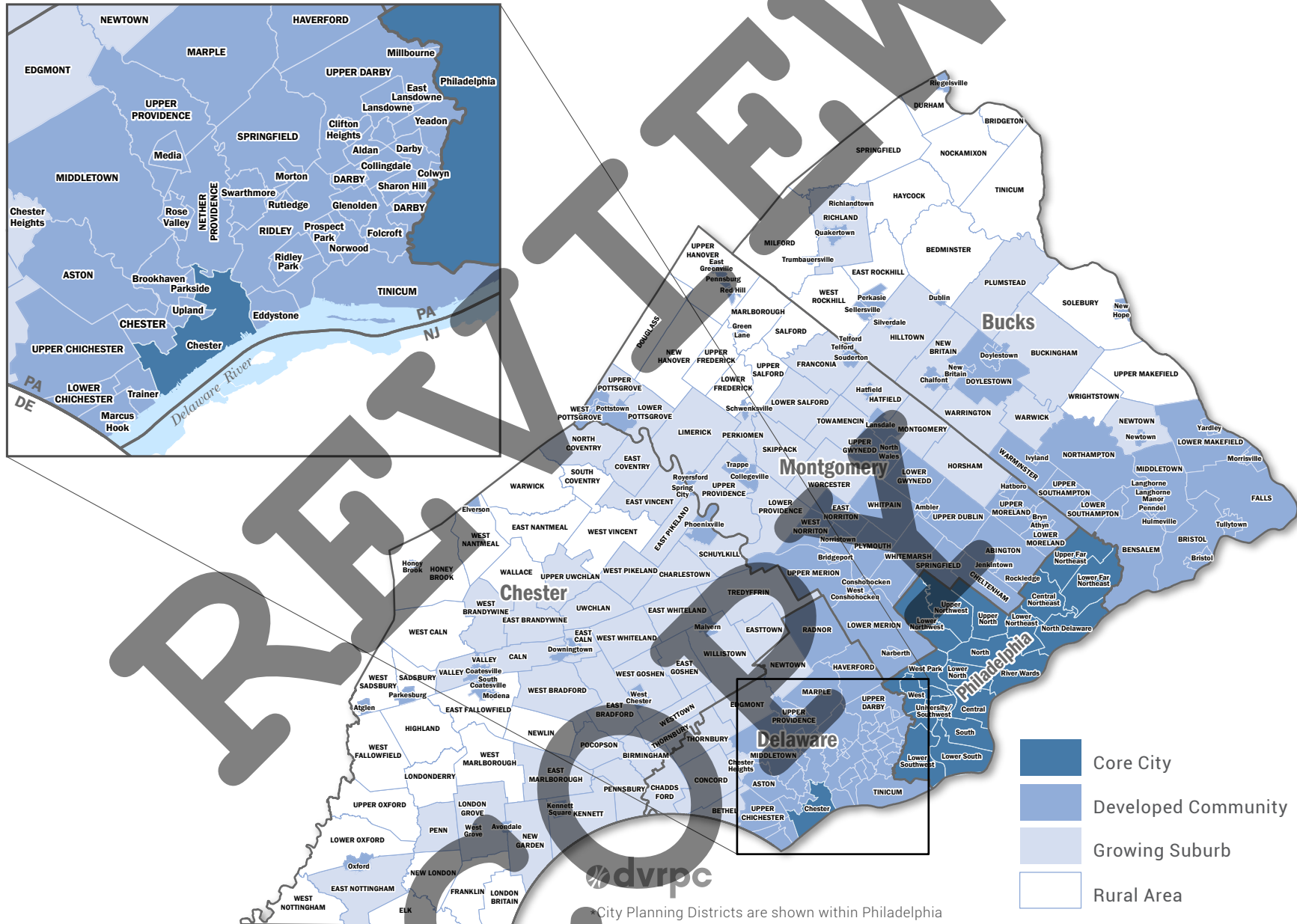
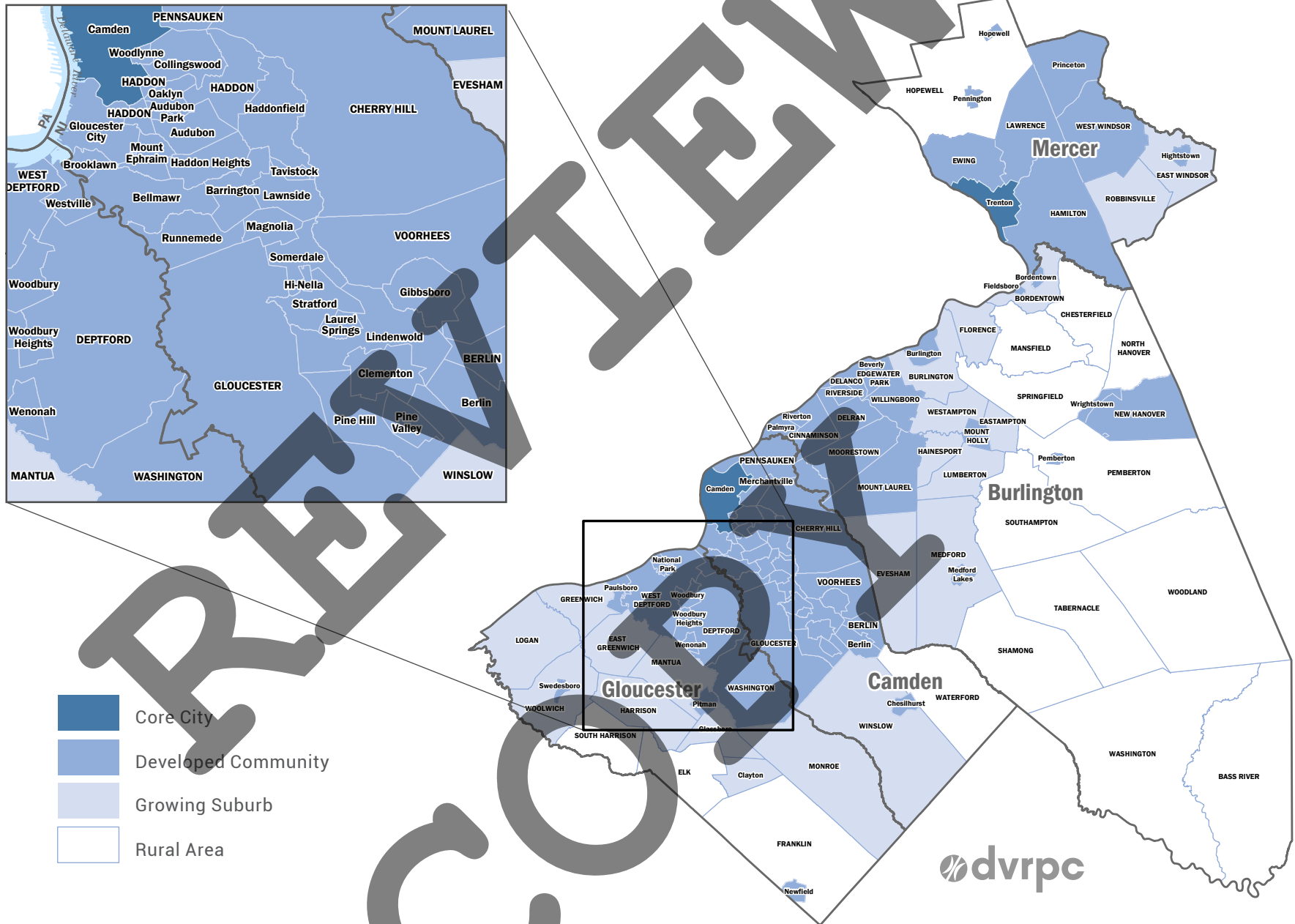


FIGURE G-2: NEW JERSEY PLANNING AREAS



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Connections 2045
PLAN FOR GREATER PHILADELPHIA

Publication Number: 17039B

Date Published: October 2017

Geographic Area Covered:

The nine-county DVRPC region, which covers the counties of Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey.

Key Words:

Long-Range Plan, Greater Philadelphia, regional policy, core planning principles, sustainability, equity, innovation, financial plan, transportation needs, trends, forecasts, vision, future, funding gap, funding options, multimodal, growth management, livable communities, economy, land use, centers, technology, major regional projects, MPO, implementation, natural resource protection, open space preservation, transportation

Abstract:

Connections 2045 Plan for Greater Philadelphia is the Long-Range Plan for the Greater Philadelphia region. It assesses regional trends and forecasts and sets forth a vision for the future. The Plan is organized around five core principles to achieve the vision: Sustain the Environment; Develop Livable Communities; Expand the Economy; Advance Equity and Foster Diversity; and Create an Integrated, Multimodal Transportation Network. The Plan includes goals and strategies under each of the five core principles. It also identifies a set of investments in the region's transportation system that are needed to preserve and maintain the existing system, as well as other critical improvements that make the system operate more efficiently and expand capacity. Due to declining funding revenues, only a portion of these investments can be afforded. The Plan prioritizes investments, based on quantitative analysis, and presents an overview of alternatives to address the funding shortfall.

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