IMPLEMENTING CONNECTIONS

THE BENEFITS FOR GREATER PHILADELPHIA

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PLANNING COMMISSION

The Delaware Valley Regional Planning Commission is dedicated to uniting the region's elected officials, planning professionals, and the public with a common vision of making a great region even greater. Shaping the way we live, work, and play, DVRPC builds consensus on improving transportation, promoting smart growth, protecting the environment, and enhancing the economy. We serve a diverse region of nine counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer in New Jersey. DVRPC is the federally designated Metropolitan Planning Organization for the Greater Philadelphia Region — leading the way to a better future.

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TABLE OF CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

Connections: The Regional Plan for a Sustainable Future lays the foundation for a more sustainable transportation system in Greater Philadelphia by linking it with the environment, the economy, energy efficiency, and land use. The Plan envisions preservation of an additional 500,000 acres of open space and farmland; development focused in and around over 100 centers spread across the region; a 50-percent reduction in greenhouse gas (GHG) emissions; and the creation of a modern, multimodal transportation system, while creating at least a $100 million annual regional funding source to help pay for it. This analysis compares the benefits in the year 2035 of an implemented Plan scenario, based on *Connections*, with a Trend scenario that continues the region's business-as-usual development practices. Key findings include:

- **Managing Growth and Protecting Resources:** By focusing on infill and dense, mixed use development, the Plan scenario meets the region's future residential and commercial needs while developing less than 28,000 acres of land. The Trend, on the other hand, would likely consume nearly 108,000 acres of land. The difference between the two scenarios is the equivalent of more than eight Fairmount Park systems. Developing less land means more can be available for future preservation. This will also benefit air and water quality; reduce flooding; provide wildlife habitat as well as agricultural, aesthetic, recreational, and economic value.
- **Creating Livable Communities:** In 2035, both scenarios forecast regional population to increase by 11 percent and employment by 13 percent. By concentrating development in and around centers, the Plan scenario increases options for housing, commercial, and retail space; reduces the cost of supportive infrastructure for each new housing unit by $14,000; enhances municipal fiscal health; and provides new opportunities for Environmental Justice (EJ) communities.
- **Building an Energy-Efficient Economy:** The compact, mixed use development pattern in the Plan scenario will lower CO_2 emissions compared to the Trend, though these policies alone will not be enough to achieve the region's GHG reduction goal. Fulfilling the vision will require substantial political leadership and incentives for producing services with less energy, and generating energy with less CO_2.
- **Modernizing the Transportation System:** Individuals living and working in centers and near transit have more transportation options and shorter average trip lengths. As a result, the Plan scenario forecasts a six percent increase in pedestrian trips, a three percent increase in bike trips, a 13 percent increase in transit trips, and three million fewer vehicle miles traveled (VMT) per day compared to the Trend. This will help the region reduce traffic congestion and energy need, lower GHG emissions and increase economic competitiveness.
- **Creating a Local Funding Source to Improve Transportation Infrastructure:** Current funding will not be enough to achieve and maintain a state of good repair (SOGR) for Greater Philadelphia's deteriorating transportation infrastructure. The Plan scenario assumes the creation of a regional funding stream of $100 million annually but finds that additional federal, state, or private-sector revenue will still be needed to achieve an SOGR. Though enacting such a funding source is always difficult, improvements in pavement condition alone will yield a 4:1 benefit-to-cost ratio, or over $17 billion in direct benefits over the life of the Plan. Additional benefits accrue from reduced congestion, enhanced safety, improved quality of life, and increased economic competitiveness in the global marketplace.

Figure 1 summarizes each scenario's performance compared to key *Connections* Plan goals. Two plus (++) symbols indicate the best performer between the baseline (2010), Plan, and Trend scenarios. A single plus (+) indicates the second best performer among the three scenarios. This analysis shows the myriad of benefits the region can obtain by having federal, state, and local governments, the private-sector, and individuals work together to implement the *Connections* Plan.

Figure 1. Comparison of Baseline, Plan, and Trend Scenarios

Long-Range Plan Goal	2010 Baseline	Trend (2035)	Plan (2035)	Plan Scenario Notes/Benefits
Total Acres Developed per Capita	+		++	Denser development pattern allows region to meet development needs while using less land
Preserve Open Space		+	++	
Reduce Household Water Use	+		++	Denser households have smaller yards to water and fewer cars to wash
Increase Population and Jobs Located in Centers		+	++	Focusing public investment around centers will help to make them more attractive places to live, work, and play
Increase Population and Jobs with Transit Access	+		++	Centers have better transit access than most parts of the region
Lower Supportive Infrastructure Cost	N/A	+	++	Denser development patterns have a lower cost per acre of development
Reduce Household Energy Use		+	++	Smaller housing units with more shared walls require less energy to power, heat, and cool; and provide more transportation options when located closer to jobs, services, retail, and entertainment options
Reduce Residential, Transportation, and Industrial CO_2 Emissions	++		+	
Jobs in EJ Communities		+	++	Centers and EJ communities often, but not always, align; focusing development in centers benefits EJ communities
Reduce Household Vehicle Miles Traveled	++		+	Providing more transportation options reduces the need for driving
Transit Ridership		+	++	Locating jobs and housing closer to transit encourages ridership
Pedestrian and Bike Trips		+	++	Mixed use, center-based development patterns allow for many short trips to be completed on foot or by bike
Shorten Peak-Period Trip Lengths	++		+	Locating jobs and housing closer together reduces the trip length between home and work
Vehicle Hours of Delay	++		+	Providing transportation options helps to take cars off the region's congested roadways, especially during peak periods
Reduce Crashes and Fatalities	++		+	Increased use of alternative transportation options, and less driving, reduces chances of being in a crash
Reduce Transportation Emissions		+	++	Compact development pattern allows for more use of environmentally friendly transportation alternatives
Reduce Household Vehicle Operating Costs	++		+	Additional funding allows for more road maintenance. Improved pavement condition and reduced vehicle miles traveled decreases cost
Truck Operating and Travel Time Costs	++		+	
Bridge Condition	++		+	Additional funding allows for more investment in roads, bridges, buses, and rail vehicles, making the transportation system safer, more reliable and environmentally friendly
Pavement Condition	++		+	
Bus Fleet Age	++		+	
Rail Vehicle Fleet Age		+	++	
Total	+23	+9	+34	

Note. ++ = best performing scenario, + = second best performing scenario; EJ = Environmental Justice.
Source: DVRPC 2010

INTRODUCTION

The Greater Philadelphia region is expected to gain over 600,000 residents and nearly 400,000 jobs between now and the year 2035. If current trends hold, the vast majority of this growth will occur at the rural edges of the nine-county region. This will increase the region's sprawling development pattern, create additional need for expensive new infrastructure, contribute to the ongoing disappearance of our open space, and further deplete our natural resources.

In response to these issues and to guide the development of *Connections: The Regional Plan for a Sustainable Future*, the Delaware Valley Regional Planning Commission (DVRPC) utilized three scenarios to inform the public and key stakeholders about the trade-offs between different regional development patterns. These scenarios—Recentralization, Trend, and Sprawl—are outlined in *Making the Land Use Connection: Regional What-If Scenario Analysis* (DVRPC report #08059).

These three scenarios were presented and discussed in-depth at a series of public meetings held from November 2008 to January 2009 in each of the nine counties in the DVRPC region as part of the long-range Plan update public outreach effort. Participants at these meetings overwhelmingly preferred the Recentralization scenario. However, they expressed concern that this scenario did not adequately reflect future development needs. A compromise was reached in that the updated Plan would primarily be based on the Recentralization scenario, but with slightly lower development densities and more land available for development outside the core cities and developed communities. The resulting *Connections* Plan identifies policies and sets goals for achieving the region's vision for the future: one that differs significantly from the recent development trends.

This analysis utilizes DVRPC's modeling capabilities to illustrate and quantify the benefits of the Plan scenario based on the goals and policies set forth in the *Connections* Plan, compared to a continuation of our region's business-as-usual Trend scenario.[1] Both

[1] The Trend scenario differs in many instances from the one in *Making the Land Use Connection* due to two years of additional data feeding into baseline conditions. Modeling based on past trends does not account for the possibility of disruptive future technology, the impact of potential future resource shortages, significant shifts in consumer preferences, or other natural or man-made disasters that could befall the region.

THE CONNECTIONS PLAN

Connections: The Regional Plan for a Sustainable Future is developed around four core planning principles:

- managing growth and protecting resources;
- creating livable communities;
- building an energy-efficient economy; and
- modernizing the transportation system.

Taken together, these principles will forge a more sustainable future: one that will ensure that we address the needs of the present without compromising the ability of future generations to meet their own needs. Each core plan principle is associated with a quantifiable target:

- preserving 500,000 acres of land;
- focusing development in over 100 centers;
- reducing GHG emissions by 50 percent; and
- building a multimodal transportation system and creating a local transportation funding source of at least $100 million annually to help pay for it.

Implementation of the Plan will require a major change in the status quo to:

- achieve a more compact development pattern;
- conserve critical natural resources;
- reinvest in and revitalize older communities;
- increase options for transit, walking, and biking to get around; and
- achieve meaningful public and private-sector input in the planning process.

scenarios are set in the horizon year of the Plan, 2035, and compared to each other and current conditions (2010). The findings in this report should not be seen as absolute, but rather the relative differences between the Trend and Plan scenarios should guide regional decision making and continue thought and discussion among citizens and regional stakeholders as to what we collectively would like the future to hold.

Implementing *Connections* gives Greater Philadelphia the opportunity to forge a new approach and give the region's residents new and greener options for housing and transportation. Development is seen as a positive for the region. It generally indicates that we are thriving while increasing the number of people and jobs locating here. People and jobs will need more land. However, the way in which we develop and consume land will impact our region's future sustainability as well as its economic competitiveness.

As a "blueprint" scenario for the region, the Plan scenario revises the region's Board-adopted population and employment forecasts to better meet smart growth development goals set forth in *Connections*, as shown in Figure 2.[2] The Trend scenario is based on Board-adopted forecasts. However, due to the fact that future population and employment locations are identified by DVRPC's UPlan land use model, it is a close but not an exact match of these forecasts. Both scenarios maintain the Board-adopted forecast for 2035 of a regional population of 6.15 million people and 3.15 million jobs.

The Plan scenario supposes that more population and employment locate in the 100-plus development centers identified in *Connections*. Though these centers are spread throughout the region, a greater amount of population and employment growth occurs in the more developed counties in the region—such as Philadelphia, Camden, Mercer, and Delaware—than is forecast in the official Board-adopted estimates. This allows growth to occur more evenly around the region, as shown in Figures 3 and 4. In the Trend scenario, developed communities in and around the region's core are expected to lose population and jobs, while significant growth is forecast in currently undeveloped, rural areas.

Figure 2. 2035 Population and Employment for the Plan and Trend Scenarios Compared with the Board-Adopted Forecast by County

	Board-Adopted		Trend		Plan	
County	Population	Employment	Population	Employment	Population	Employment
Bucks	753,784	342,236	750,205	341,691	728,731	329,542
Chester	622,498	337,093	628,698	337,156	579,952	308,297
Delaware	559,956	243,547	563,699	243,607	588,035	261,080
Montgomery	894,136	585,430	898,159	585,494	877,219	569,131
Philadelphia	1,480,023	736,268	1,485,800	737,065	1,558,502	782,551
Pennsylvania Subtotal	4,310,397	2,244,574	4,326,561	2,245,013	4,332,439	2,250,601
Burlington	541,203	260,529	535,236	260,534	521,382	248,476
Camden	524,684	226,682	524,359	226,005	544,882	240,892
Gloucester	369,374	145,895	360,013	146,649	341,653	133,478
Mercer	403,976	269,446	401,718	269,549	412,378	265,308
New Jersey Subtotal	1,839,237	902,552	1,821,326	902,737	1,820,295	888,154
DVRPC Region Total	6,149,634	3,147,126	6,147,887	3,147,750	6,152,734	3,138,755

Note. Regional population and employment totals in the Plan and Trend scenarios are determined by DVRPC's UPlan model. Though these forecasts are not exact matches, they are well within a 1 percent standard modelling tolerance for error.
Source: DVRPC 2010

[2] See the Appendix for more information on blueprint scenarios.

Figure 3. Percent Change in Population by Municipality and Scenario: 2005–2035

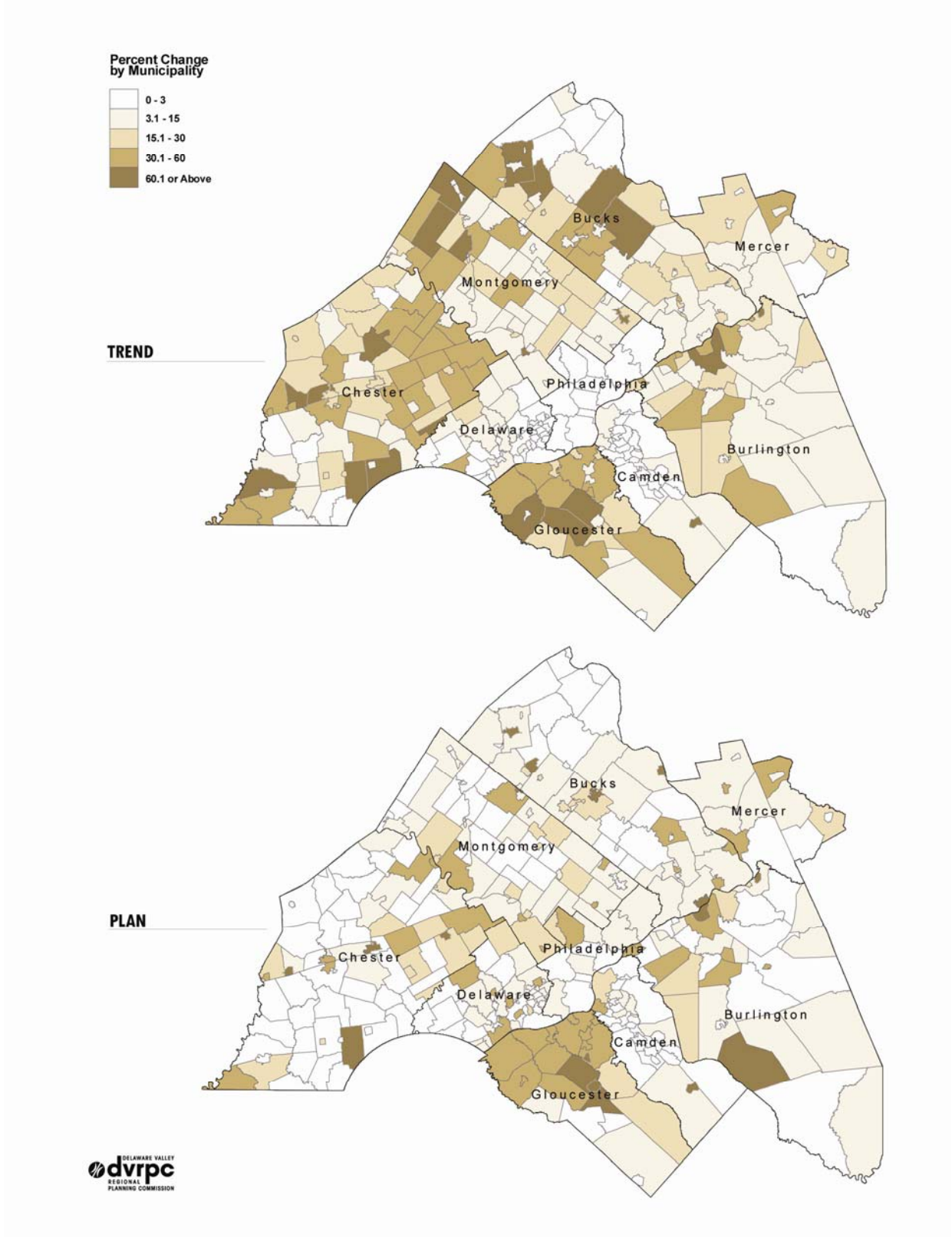
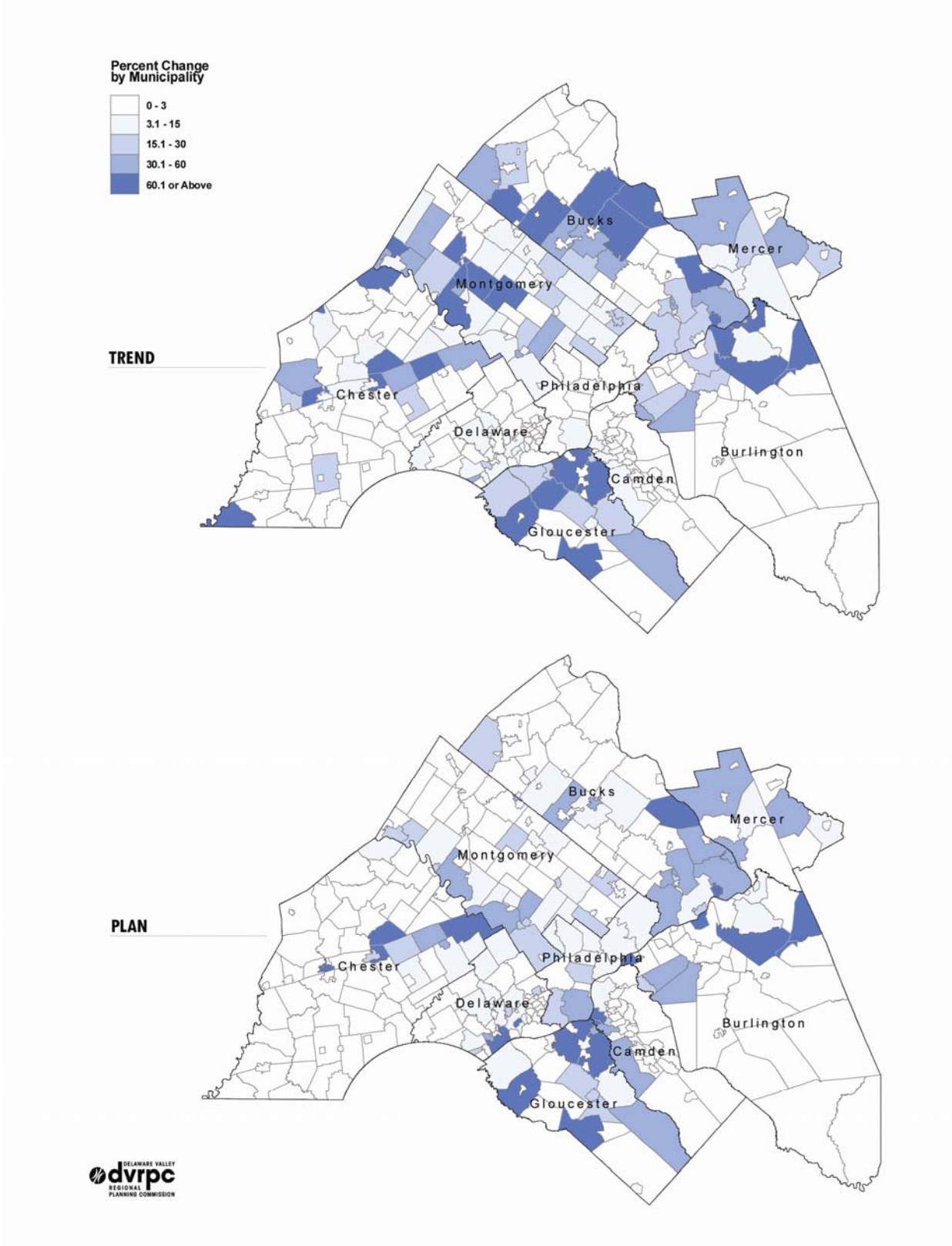


Figure 4. Percent Change in the Number of Jobs by Municipality and Scenario: 2005–2035



MANAGE GROWTH AND PROTECT RESOURCES

The *Connections* Plan calls for the preservation of 500,000 additional acres of land by 2035 through a variety of strategies, primarily by:

- focusing future development as infill and redevelopment in established communities and targeting new development to designated future growth areas;
- encouraging compact, center-based development through smart growth tools and techniques, such as transit-oriented development, traditional neighborhood design, transfer of development rights (TDR), and revitalization and stabilization of existing communities; and
- employing a range of regulatory, voluntary, and funding techniques to preserve open space, including: fee-simple acquisitions; conservation easements; locally funded open space programs; statewide preservation trusts; municipal natural resource protection plans and ordinances; and market-based conservation, such as TDR programs.

In order to ensure that important resources lands are available for preservation, the region must meet future development needs with less new footprint or greenfield development than has been the trend (see Figure 5). This often means infilling future development into areas that have already been developed. The Plan scenario does just this, and as a result develops one-fifth as many acres as the Trend between now and 2035. The difference between the two scenarios saves the equivalent of more than eight Fairmount Park systems from development (see Figure 6).[3]

Figure 5. Land Use Indicators

All Figures in Acres	2005	Trend	Plan
New Footprint Acres of Development 2005-2035	N/A	108,000	28,000
Total Acres Developed	963,000	1,071,000	991,000
Percent of Region Developed	39%	44%	40%
Developed Land Per Capita	0.17	0.18	0.16
New Footprint Acres per New Population 2005-2035	N/A	0.18	0.05

Source: DVRPC 2010

[3] Including 63 neighborhood parks spread throughout the City of Philadelphia, the entire Fairmount Park systems comprises 9,200 acres.

IMPLEMENTING THE PLAN

In many ways, *Connections* is a response to the low-density, single-use, land-consumptive, and auto-oriented development pattern that has been the norm over the last 60 years. The causes of the pattern are well understood, and there is wide-spread consensus that it is not sustainable. Implementing the plan requires effective growth management and open space preservation carried out in a mutually reinforcing manner. Land use policies that can help accomplish this include:

- designating growth areas;
- creating TDR programs;
- fee-simple acquisitions;
- conservation design ordinances;
- conservation easements;
- dedicated open space funding programs;
- protecting natural resources and farmland;
- increasing local food production and distribution; and
- preserving historic and cultural resources.

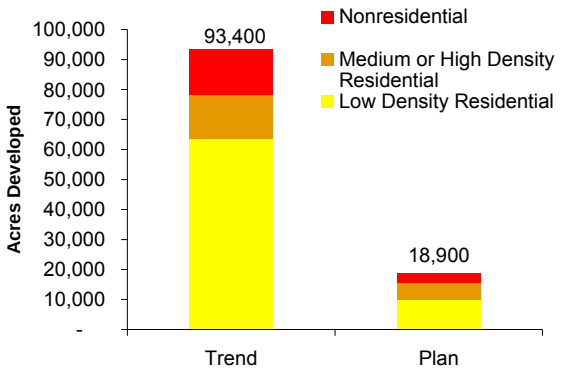
For more information about how to preserve open space and implement the *Connections* plan, see *Implementing Connections: A Guide for Municipalities* (DVRPC Publication #10047) or go to www.dvrpc.org/connections.

The Economic Value of Open Space

The *Economic Value of Protected Open Space* commissioned by the Greenspace Alliance and DVRPC found that permanently preserved open space provides considerably more than just scenic value. Protected open space in the five-county southeastern Pennsylvania region provides significant economic, environmental, and health benefits to the region. These benefits accrue to individuals, businesses, and local governments, including:

- $16.3 billion added to the value of housing stock;
- $240 million in annual property and transfer tax revenue for local government;
- $133 million in annual costs avoided as a result of the natural provision of environmental services;
- $577 million in annual benefit for residents who recreate on protected open space;
- $795 million in annually avoided medical costs as a result of recreation that takes place on protected open space; and
- 6,900 jobs created on or as a result of protected open space in the five-county region.

Figure 6. Residential and Commercial New Footprint Development by Scenario: 2005–2035

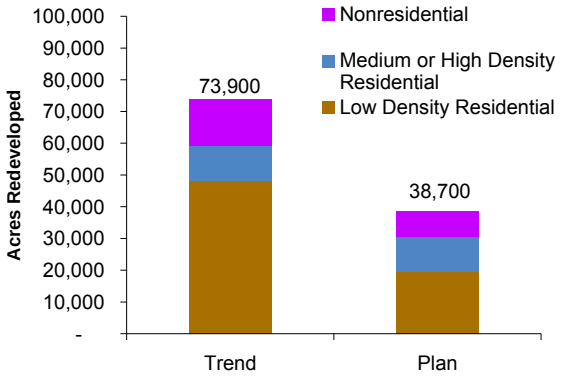


Source: DVRPC 2010

Preventing land from development is not the same as preservation. Permanently protecting land requires public and private sector support for acquisitions and easements, effective preservation ordinances, and best management practices ensuring good stewardship. Predicting how this will play out over the next 25 years is difficult. Regardless, achieving the goal of preserving an additional 500,000 acres will require a dramatic increase in the region's current land preservation efforts.

The Plan scenario not only develops fewer acres of new footprint land, it redevelops only about half as many currently developed acres (see Figure 7). The Plan scenario's denser development patterns and concentration in developed communities, reduces the need to build over as suburban many acres while creating a variety of future residential and employment areas. This will give the region's residents more options in where they live, work, and play. By redeveloping less land, there may also be more opportunity to shift currently vacant land to agriculture or open space uses while ensuring that plentiful area remains for those who prefer a suburban-based lifestyle.

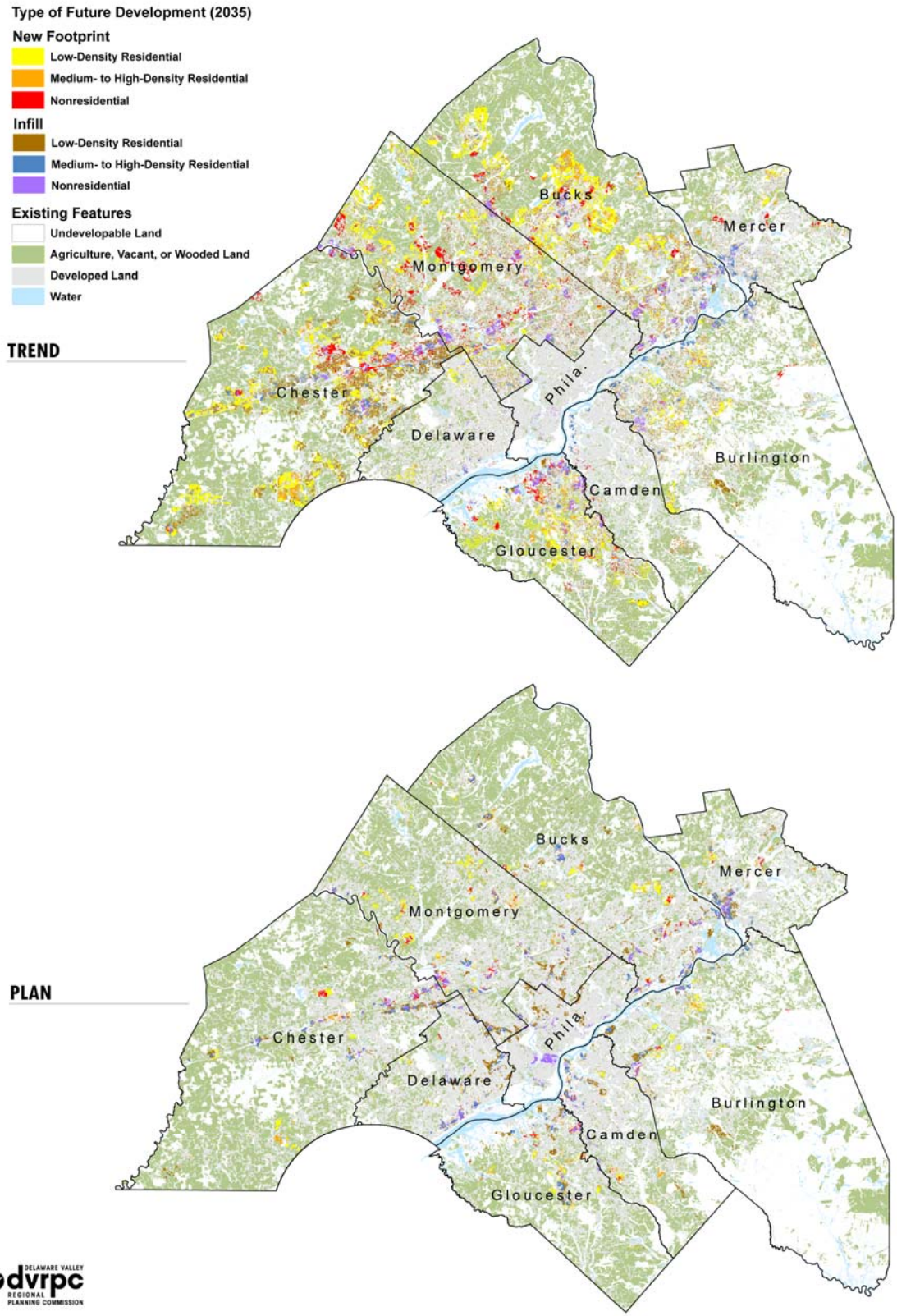
Figure 7. Residential and Commercial Infill Development by Scenario: 2005–2035



Source: DVRPC 2010

Figure 8 indicates where in the region future infill and new footprint development occurs under each scenario, as determined by DVRPC's UPlan land use model. The densities in this figure are generalized. On average, low-, medium-, and high-density is about 50 percent higher in the Plan scenario than in the Trend, see Figures A-4 and A-5 in the Appendix for actual density assumptions in both scenarios. Undevelopable land in Figure 8 refers to land that is permanently protected park, open space and farmland, or environmentally sensitive areas.

Figure 8. Total Acres Developed by Scenario: 2005–2035



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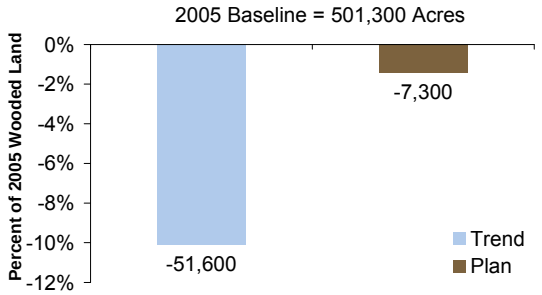
Open Space

Both the Plan and Trend scenarios forecast some development in areas that are open space today. However, development under the Plan scenario will ensure that much more land that is open space today can remain so in the future. Figure 9 shows the wooded acres lost to development by scenario. By developing one-seventh as many acres under the Plan scenario, the region can retain a multitude of open space benefits such as reduced flooding and erosion, recreational opportunities, wildlife habitat, removal of airborne pollutants, and carbon sinking. This also protects wetlands, helping to recharge aquifers, absorb stormwater run-off, and improve water quality.

Figure 9. Wooded Acres Lost to Development: 2005–2035

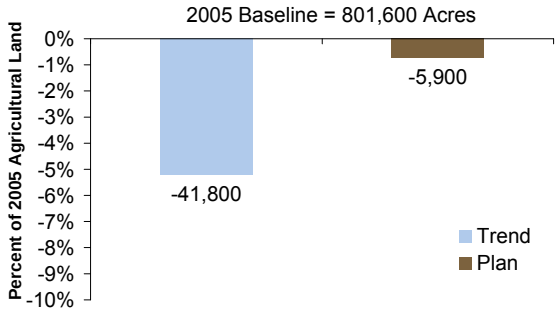


Source: DVRPC 2010

Farmland

Preserving existing farmland from development over the next 25 years will allow for more food to be grown locally, providing nutritional and economic benefits to the region's residents, in addition to providing environmental services such as carbon sequestration (see Figure 10). Saving farmland can allow rural, suburban, and even urban communities to focus on agricultural economic development. Reserving more land for agricultural use may help the region better respond to changes in global trading, particularly related to shifts in energy and food prices. It can also improve municipal fiscal health, as the revenue-to-expenditure ratio for both farmland and open space has been found to be comparable to commercial and industrial uses.[4]

Figure 10. Agricultural Acres Lost to Development: 2005–2035



Source: DVRPC 2010

Making the Connection

By developing fewer acres over the next 25 years, the Plan scenario will ensure that more land will be available for future preservation and agricultural production. The center-based development pattern will also reduce open space fragmentation, meaning the region will have higher quality animal habitat and receive more eco-system services. Preserving open space will help to protect wetlands, which will reduce the cost of providing clean water to the region's residents, enhancing economic competitiveness.

Water Use

Denser development patterns decrease run-off by reducing impervious surfaces and increase infiltration by leaving more land undeveloped. Also, by concentrating more development in and around the region's core where there is currently excess public water capacity, and lowering demand for water through smaller yards, the region can avoid having to build additional costly water treatment facilities (see Figure 11).

Figure 11. Estimated Water Use in 2035

Daily Water Use (Gallons/Day)	2010	Trend	Plan
Total Residential (Millions)	477.3	540.4	527.0
Average per Household	230.3	231.9	226.2

Source: DVRPC 2010

[4] American Farmland Trust, *Cost of Community Services Study Fact Sheet* (Washington, DC: American Farmland Trust, 2002).

CREATING LIVABLE COMMUNITIES

The *Connections* Plan aims to create livable communities by investing in more than 100 development centers spread throughout the region. The Plan recommends:

- updating zoning codes to allow for increased density and a mix of uses in select, appropriate areas to encourage transit-oriented and pedestrian-friendly development;
- increasing the stock of affordable housing units in suburban centers close to jobs and services accessible by public transit while also increasing employment in places where affordable housing opportunities currently exist; and
- increasing community-scale green infrastructure through techniques such as planting and stewardship of shade trees, green streets, green roofs, green schoolyards, community gardens, and trails.

Over the last 60 years, the development trend has been low-density development spreading further and further from the region's core. By prioritizing redevelopment in older, more established communities, these places are expected to grow faster under the Plan scenario than in the Trend (see Figure 12). The region's elderly residents will particularly benefit from the Plan's development pattern, with easy access to shops, restaurants, and cultural activities.

Figure 12. Population and Employment in Centers

All Figures in Millions	2005	Trend	Plan
Population	2.40	2.45	2.62
Employment	1.49	1.61	1.82

Source: DVRPC 2010

Transit Access

Increasing the number of households and jobs with access to transit will improve mobility options for residents by not limiting them to the personal automobile as the only means of transportation. As a result, this encourages more ridership. In turn, every person riding transit instead of driving takes another vehicle off the region's congested road network. Transit ridership also enhances the region's sustainability by lowering energy use and GHG emissions. Transit is particularly critical for providing transportation to work or school for zero-car and low-income households, and especially for lower wage service sector jobs. For these reasons, transit access is a key component for meeting the region's EJ goals (see Figure 13).

IMPLEMENTING THE PLAN

Implementing *Connections* means developing accessible communities that have origins and destinations close together and thereby reduce the need for auto trips. Unfortunately, dense, mixed use main-street type development that provides a variety of housing, retail, work, and transportation options is often not allowed under current zoning regulations. There are a number of approaches available to municipalities to update their zoning codes, such as:

- form-based codes;
- transit-oriented development, particularly through Transit Revitalization Investment District (TRID) legislation;
- incentive zoning;
- performance zoning;
- live/work zoning; and
- inclusionary zoning.

Centers should focus on infill and redevelopment strategies, especially the reuse of existing greyfields and brownfields. Municipalities can encourage this by utilizing revitalization elements within their comprehensive plan to create specific recommendations for these sites and by developing residential infill ordinances or design guidelines to better integrate new development into the fabric of the community.

IMPLEMENTING THE PLAN (CONTINUED)

A key element of making an urban or traditional community desirable is the use of community green infrastructure (CGI)–defined as small parks, street trees, community gardens, green streets, green roofs, green schoolyards, trails, and naturalized stormwater infiltration.

These features perform valuable ecosystem functions that would otherwise have to be performed by grey infrastructure. They also transform denser urban areas, which often lack natural amenities, into attractive, desirable places. And unlike most forms of grey infrastructure, CGI boosts property values, supports retail activity, protects water quality, counters climate change, provides natural habitat, and improves roadway safety. Municipal actions to increase CGI include:

- green roofs;
- green streets;
- tree management plans;
- street tree ordinances;
- tree protection requirements; and
- landscape ordinances.

For more information about how to focus development in regional centers and implement the *Connections* plan, see *Implementing Connections: A Guide for Municipalities* (DVRPC Publication #10047) or go to www.dvrpc.org/connections.

Figure 13. Population and Employment with Transit Access

All Figures in Millions	2005	Trend	Plan
Population	3.84	3.96	4.08
Employment	2.19	2.41	2.53

Source: DVRPC 2010

Supportive Infrastructure Costs

The capital expense portion of new local roads, sewers, utilities, and sometimes schools is generally paid by developers as part of the cost of development. These costs are passed on to the consumer of the final product. Though they primarily represent private costs, they can vary dramatically. The new housing units built in each scenario have supporting infrastructure costs that vary based on location and density. Initial infrastructure costs are paid by the housing unit purchasers, but system maintenance costs for the expanded system are spread out over all users.

A 10,000 Friends of Pennsylvania study found that the City of Philadelphia and its surrounding, older developed communities have significant excess capacity in their existing water treatment facilities.[5] Considerably more population and jobs could be supported before there is any need to expand treatment capacity. Increased population and employment around the region's core in the Plan scenario will more efficiently utilize this existing infrastructure. Figure 14 shows the Plan scenario will deliver supportive infrastructure for future development in a cost effective manner, saving $14,300 per new housing unit.

Figure 14. Supportive Infrastructure Costs

	2010 $s	
Type of Infrastructure	Trend	Plan
Sewer and Water (Billions)	$ 7.36	$ 4.32
Roads (Billions)	$ 2.65	$ 1.86
Schools (Billions)	$ 2.37	$ 2.49
Total Cost (Billions)	$ 12.4	$ 8.7
Cost per New Household	$ 48,000	$ 33,700

Source: DVRPC 2010

Beyond the initial capital investment, this additional infrastructure needs to be maintained. The Plan scenario is estimated to need about 6,000 new lane miles of local subdivision type roads, whereas the Trend would likely require about 12,700 additional

[5] 10,000 Friends of Pennsylvania, *Water and Growth: Toward a Stronger Connection Between Water Supply and Land Use in Southeastern Pennsylvania* (Philadelphia: 10,000 Friends of Pennsylvania, 2007).

lane miles. Each lane mile costs municipalities nearly $2,000 per year to maintain. The Trend scenario would add more than $13 million (in 2010 $s) in expenses to local government budgets regionwide compared to the Plan.

Corridor Analysis

The region contains a number of established high growth corridors and areas. A close look at two of these, the US 30 corridor in Chester and Montgomery counties and the proposed Gloucester rail corridor, will help to illustrate the different development patterns in the Trend and Plan scenarios. Both of these corridors include a number of adjacent centers, and will receive significant transportation investment in the *Connections* Plan. However, the assumptions of each scenario will lead to very different development patterns.

US 30 Corridor

The US 30 corridor in Figure 15 looks west from Malvern. By 2035, this corridor is slated for road widening along US 30 business between US 202 and the Exton Mall, US 202 from PA 252 to US 30, and US 30 from the Exton Bypass to Reeceville Road. The Thorndale rail line will be extended to Atglen.

In the Trend scenario, commercial development locates in the US 30 corridor within the traditional borough centers of Malvern, Paoli, Phoenixville, West Chester, the Great Valley suburban center, and to a lesser extent the King of Prussia metro subcenter. Lower commercial density means that this development takes up more land. Meanwhile, low-density residential development sprawls out into the areas in between each of these centers.

In the Plan scenario, commercial and high-density residential development clusters in traditional borough centers. Commercial and some high-density residential development locates in the Great Valley suburban center. The King of Prussia metro subcenter receives substantial residential development, creating a more mixed use center. A new commercial center forms around the intersection of the Pennsylvania Turnpike and PA 100, surrounded by medium- to low-density residential development.

Making the Connection

The Plan's compact growth pattern will create vibrant regional centers, giving the region's residents more options in where they live, work, and play. Numerous studies have found that by increasing density, local governments can deliver services more efficiently at a lower per-unit cost and benefit from higher per-acre revenues. By considering revenues and expenditures on a per-acre basis and using increased density to help keep property taxes low, the region can better retain existing residents and employers, and make itself a more attractive destination for relocating individuals and businesses.

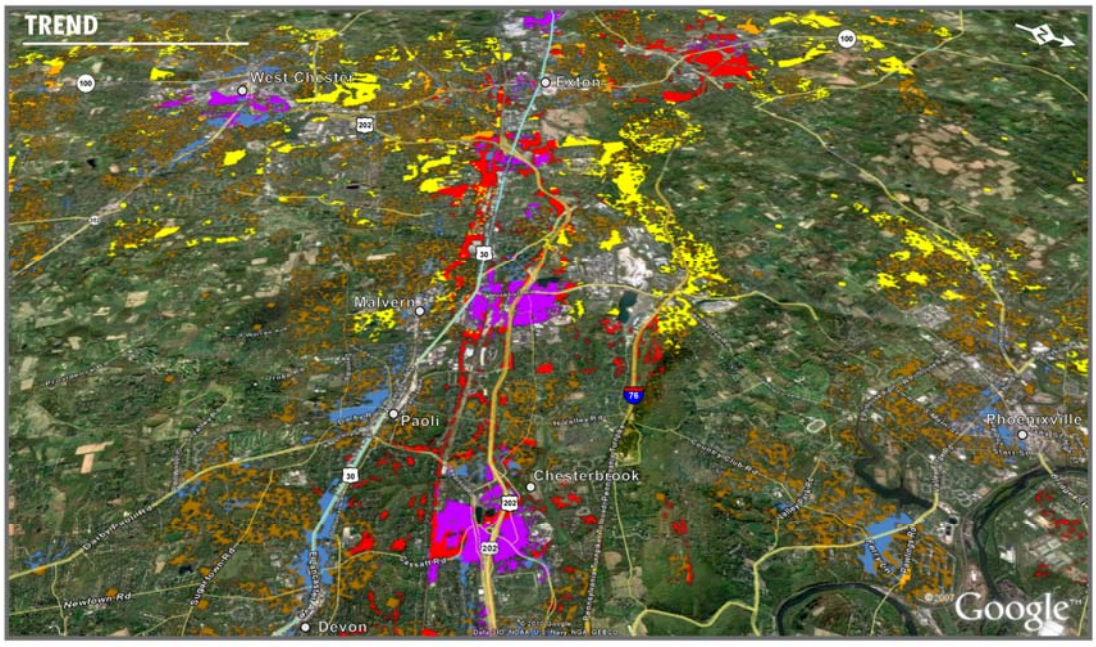
Gloucester Rail Corridor

The Gloucester rail corridor in Figure 16 looks north from Glassboro. In addition to the proposed rail line from Glassboro to Camden, *Connections* anticipates reconstructing the NJ 42 freeway with a new interchange at College Drive and widening the New Jersey Turnpike between Exit 4 and the Delaware Memorial Bridge.

In the Trend scenario, the Deptford suburban center receives significant commercial growth, while most other new development locates along routes NJ 55 and NJ 42, outside of the traditional boroughs. The lower development densities in this scenario consume much more land while putting more vehicles onto the already congested NJ 42 and NJ 55 freeways.

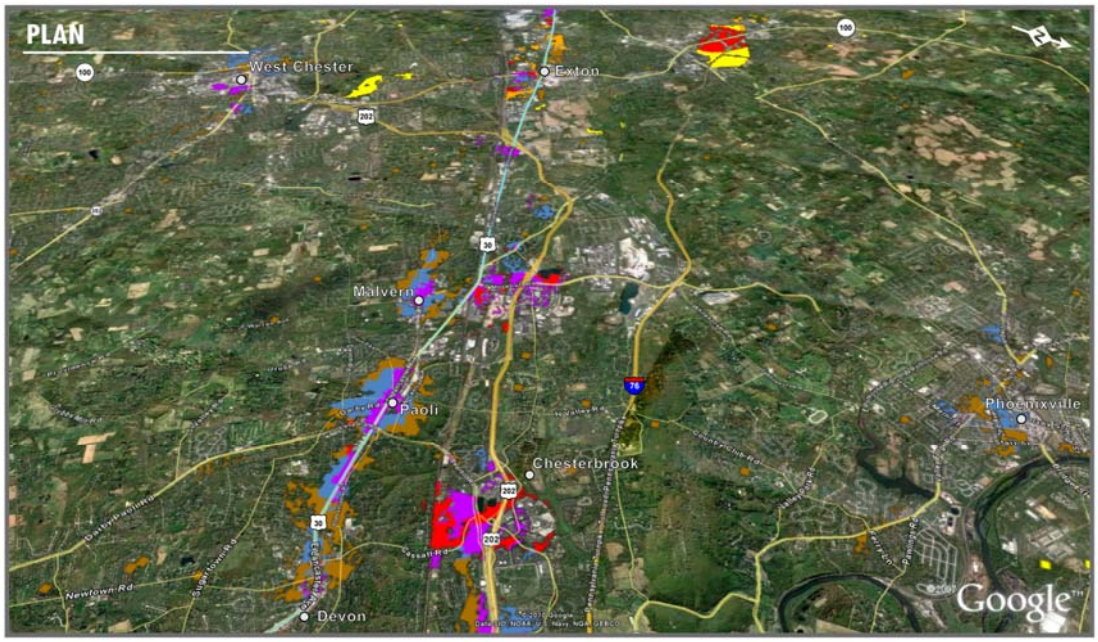
In the Plan scenario, traditional boroughs of Glassboro, Pitman, and Woodbury receive significant high-density residential and commercial infill and new footprint development. Deptford again receives substantial commercial development. The Plan's development pattern enhances access to and ridership on the proposed Gloucester rail line.

Figure 15. US 30 Corridor in 2035 by Scenario



Type of Future Development (2035)

New Footprint	*Infill*
Low-Density Residential	Low-Density Residential
Medium- to High-Density Residential	Medium- to High-Density Residential
Nonresidential	Nonresidential



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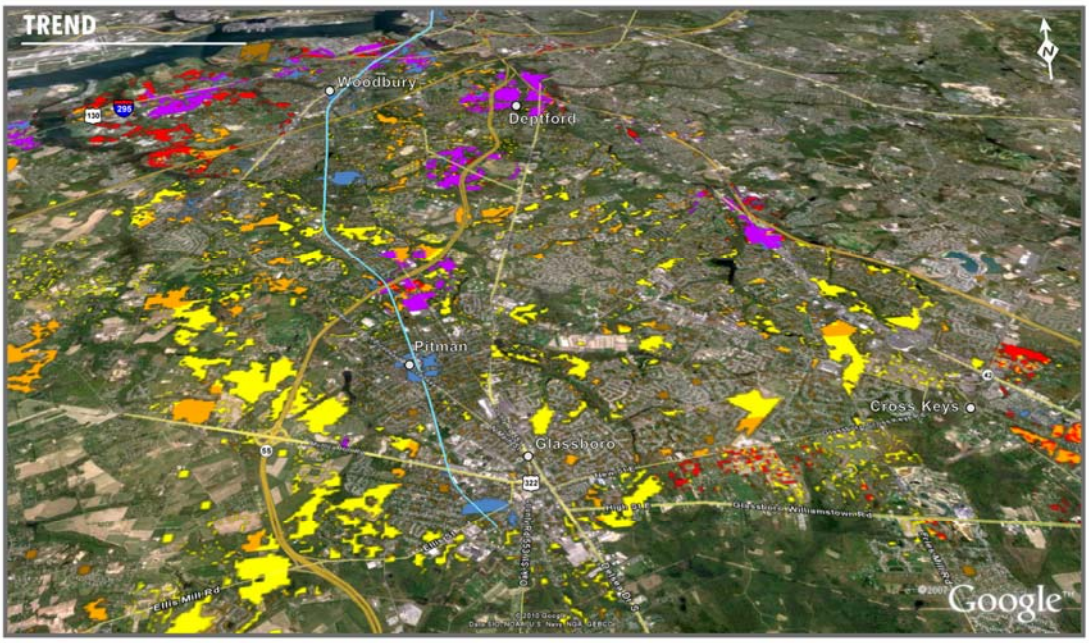
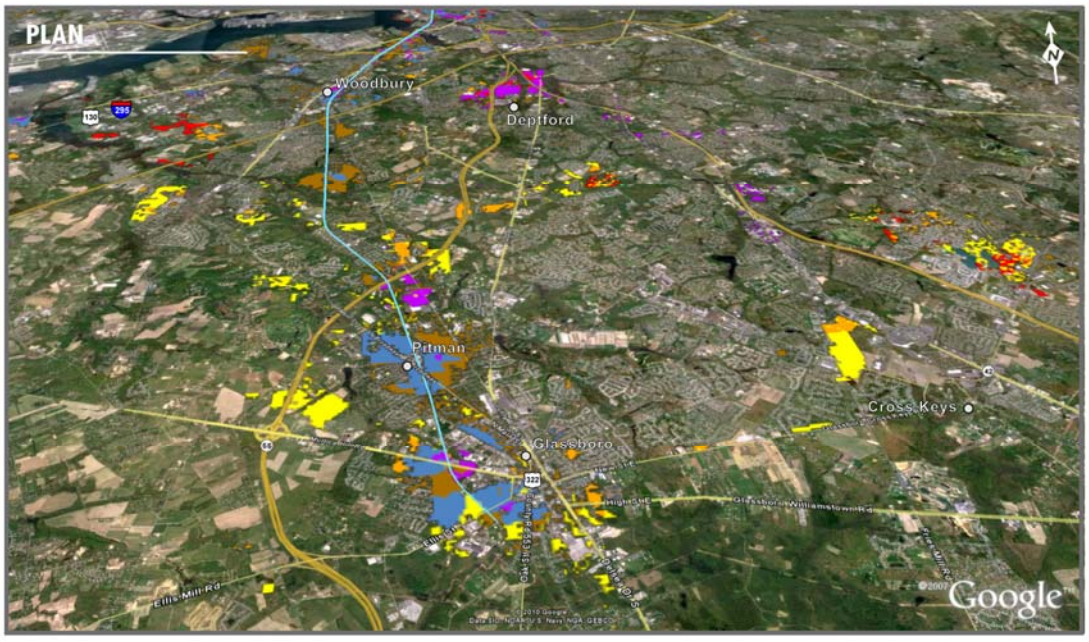
Note. The densities in this figure are generalized. On average, low-, medium-, and high-density is about 50 percent higher in the Plan scenario than in the Trend, see Figures A-4 and A-5 in the Appendix for actual density assumptions in both scenarios.

Figure 16. Gloucester Rail Corridor in 2035 by Scenario



Type of Future Development (2035)

New Footprint	*Infill*
Low-Density Residential	Low-Density Residential
Medium- to High-Density Residential	Medium- to High-Density Residential
Nonresidential	Nonresidential



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Note. The densities in this figure are generalized. On average, low-, medium-, and high-density is about 50 percent higher in the Plan scenario than in the Trend, see Figures A-4 and A-5 in the Appendix for actual density assumptions in both scenarios.

IMPLEMENTING THE PLAN

The strategies to achieve the challenge of reducing GHG emissions by 50 percent by 2035 include:

- reducing demand for energy through promoting compact development patterns and alternative modes of travel other than the single-occupant vehicle;
- encouraging energy efficiency and conservation by businesses, governments, industries, and individuals;
- enhancing community- and regional-scaled green infrastructure to act as a carbon sink; and
- promoting the use and deployment of distributed generation and renewable energy.

For more information about reducing GHG emissions and implementing the *Connections* plan, see *Implementing Connections: A Guide for Municipalities* (DVRPC Publication #10047) or go to www.dvrpc.org/connections.

BUILDING AN ENERGY-EFFICIENT ECONOMY

The *Connections* Plan calls for reducing the region's GHG emissions by 50 percent from 2005 to 2035. In light of rising energy prices and likely requirements to reduce GHG emissions, building an energy-efficient economy is critical to the region's future economic competitiveness and environmental sustainability. The green economic development strategies in the *Connections* Plan will build the region's energy-efficient economy, and generate new jobs and revenue while making the region more competitive globally. Policies to encourage this include:

- prioritize transportation system investments that serve key employment sectors and expand the Greater Philadelphia region's connections to the global economy;
- provide services with less energy by encouraging the use of more efficient cars, furnaces, and lighting; improved building envelopes; and expanded transit services;
- produce energy with less CO_2 by promoting biofuels, solar hot water and electricity, wind power, geothermal energy, and nuclear power as alternatives to fossil carbon-based fuels; and
- reduce demand for services and energy provision by locating jobs, housing, and other services closer together and encouraging denser development.

Reducing the region's GHG emissions by 50 percent presents a formidable challenge requiring a concerted effort at the global, national, state, regional, county, local government, neighborhood, household, and individual level. DVRPC's activities and goals laid out in *Connections* are necessary to reach these goals, but they are not, by themselves, sufficient. Figure 17 shows estimated energy use for the average household in the region in 2035 under the Trend and Plan scenarios. Increasing energy efficiency in buildings and vehicles indicates there is likely to be a slight drop in energy use at the household level. However, forecasts of increased population and job growth mean the region is still likely to use more energy in the future, under both scenarios.

While broad reductions in energy use are possible with today's technology, the confluence of low energy prices, high upfront cost of more energy-efficient technologies, economic recession, and a lack of political will for long-term investments to transform our energy and transportation sectors makes the deep changes needed in our economy and society difficult to achieve.

Figure 17. Annual Residential and Auto Energy Use

	Billions of BTUs		
Use	**2005**	**Trend**	**Plan**
Residential Energy	240,700	258,400	257,200
Auto Fuel	268,300	311,500	301,500
Regional Total	509,000	569,900	558,700
Average Per Household	0.246	0.245	0.240

Source: DVRPC 2010

Energy consumed by on-road vehicles and commercial, industrial, and residential buildings accounted for roughly 86 percent of the region's GHG emissions in 2005. Reducing energy use in these sectors is essential to achieve a 50-percent reduction in GHG emissions below 2005 levels by 2035. Again, due to projected growth in population, employment, and energy use, both the Trend and Plan scenarios forecast an increase in regional GHG emissions, though the increase is lower in the Plan scenario (see Figure 18).

Figure 18. Annual Energy-Related Greenhouse Gas Emissions

	$MMTCO_2E$		
Source	**2005**	**Trend**	**Plan**
On-Road Vehicles	21.9	26.1	25.5
Residential Energy	21.1	24.6	24.4
Commercial and Industrial Energy	32.1	38.4	37.8
Total	75.2	89.0	87.7

Note. $MMTCO_2E$ = million metric tons carbon dioxide equivalent.
Source: DVRPC 2010

The following sections detail the strategies the region can use to help achieve reductions in energy use and GHG emissions.

Provide Services with Less Energy

All of the services that society uses—powering our homes and businesses, commuting to our daily destinations, transporting our goods—can be provided using less energy. Providing services with less energy can be achieved at an individual, institutional, or societal level, requiring upfront investments in capital or labor, or by simply changing behavior. For example:

Local Government Energy Use Reduction

Local governments play a key role in the effort to reduce GHG emissions in the region. By reducing energy consumption in their own operations, local governments are demonstrating that cost-effective energy efficiency solutions are available. In their own operations, local governments can save significant operational expenses through no- to low-cost energy efficiency improvements. For example, incandescent traffic signals can be retrofitted with LEDs for energy savings of 80–90 percent. Office plug loads, which represent up to 10 percent of a building's energy bill, can typically be reduced by 40–50 percent through powering-down features and the purchase of energy-efficient products. The collective buying power of the local governments in the region can spark demand for jobs, goods, and services that will support a new green economy.

- Typical best practices to reduce energy use in existing buildings through retrofits and operational improvements have the potential to reduce GHGs by 10–20 percent in commercial and 24 percent in residential buildings.
- Vehicle efficiency strategies can increase vehicle fuel economy through advanced engine and transmission design improvements (up to 30 percent for gasoline and 15 percent for diesel vehicles), the use of lighter-weight materials, improved vehicle aerodynamics, and reduced rolling resistance.
- Methods to optimize the design, construction, operation, and use of transportation networks, such as lowering speed limits, eliminating bottlenecks and improving traffic management, can reduce total transportation GHG emissions by up to 2 percent.

Many of these changes will result in energy cost and maintenance cost savings that will pay back the investment over time. Energy efficiency and conservation can help the region meets its GHG reduction goal, but these strategies alone will not be sufficient to meet the *Connections* goal.

Reduce the Demand for Services and Energy Provision

Society can reduce overall demand for energy by locating jobs, housing, and services closer together and encouraging denser development. Electricity demand can be reduced by living in more compact and right-sized dwellings. Carbon-intensive travel can be decreased by reducing trip lengths, increasing vehicle occupancy, promoting efficient driving practices, or shifting travel to more energy-efficient modes such as transit, biking, or walking. The Plan scenario is based on the type of development patterns that reduce energy use.

Produce Energy with Less CO_2

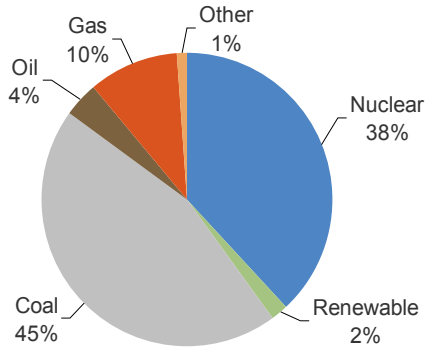
To produce energy with less CO_2 the most carbon-intensive fuels used today need to be replaced with lower-carbon fuels (see Figure 19). Coal (making up 45 percent of Greater Philadelphia's electricity generation) and petroleum (fueling over 99 percent of the region's on-road vehicles) are two of the highest carbon-content energy sources.

The ability to produce energy with less CO_2 is a challenge that is dependent on uncertain future technological improvements and requires consistent political and fiscal support. Further, regions have minimal influence on the fuels used to produce electricity. Biofuels, solar hot water and electricity, wind power, geothermal energy, and nuclear power are technologically viable today as alternatives to carbon-based fuels. The ability to transition to these fuels will require time and large-scale investment in these technologies beyond the scope of regional influence.

Making the Connection

The creation of an energy-efficient economy is directly related to land use. Denser, more compact, mixed use communities use significantly less energy and emit fewer GHGs per capita. Building on the region's existing compact settlement patterns, and promoting new center-based growth, will make the region more attractive to businesses and workers as energy prices increase and GHG reductions are required.

Figure 19. Generation Sources for the Region's Electricity in 2005



Source: DVRPC 2010 from eGRID data

Achieving the GHG Reduction Goal

Achieving a 50-percent reduction in GHG emissions in our region by 2035 presents a formidable challenge. The Plan scenario reduces demand for services and energy by building more compact housing units and commercial and industrial spaces in the region's centers that offer transportation alternatives to the car. Though the policies outlined in *Connections* will not achieve the goal on their own, they do decrease energy use and GHG emissions and create development patterns that continue to pay back over time.

There are additional policies and changes in technologies to provide services using less energy and to produce energy with less CO_2. Figure 20 outlines one possible set of changes in our region's energy profile scenario that would result in a 50-percent reduction in GHG emissions from 2005 levels by 2035. All of these changes are technologically possible today, although they will require significant investment and a deep transformation in our society.

Promoting Eco-Enterprises

By concentrating on compact, energy-efficient development, the Plan scenario supports the region's fledgling alternative-energy, energy-efficiency, and green-building "eco-enterprises." Developing these industries can transform challenges in energy efficiency and sustainability into an economic advantage that creates green jobs for professional and low-skill workers alike.

Figure 20. A Scenario to Achieve a 50-Percent Reduction in Regional Greenhouse Gas Emissions from 2005 to 2035

	Energy Use Changes to Achieve GHG Reduction Goal	Emissions Source	$MMTCO_2E$ 2005	$MMTCO_2E$ 2035	2035 Emissions as a % of 2005
Buildings	■ Reduce per capita/employee energy use to 70 percent of 2005 levels through efficiency and conservation. ■ Reduce the GHG content of electricity to 50 percent of 2005 levels through increased use of lower-carbon sources, such as natural gas, nuclear energy, solar photovoltaic, and wind. ■ Reduce the GHG content of other energy sources to 80 percent of 2005 levels by switching home heating energy from oil to natural gas or low-carbon electricity.	Residential Building Energy Use	21.1	10.6	50%
		Commercial and Industrial Building Energy Use	32.1	15.8	49%
Transportation	■ Reduce 2035 projected VMT per capita to 92 percent in the Trend scenario (7,970 to 7,340); or 94 percent in the Plan scenario (7,790 to 7,340). This would keep per capita VMT unchanged from 2005. Transit ridership will likely need to double, and resulting emissions are increased to reflect additional service. ■ Reduce the GHG content of the energy used to power vehicles by 50 percent by increasing the use of electric vehicles, biofuels, or other low-carbon fuels. ■ Double vehicle fuel (energy) efficiency.	On-Road Vehicles	21.7	5.7	26%
		Public Transit	0.5	1.0	223%
		Ports, Aviation, Rail, Off-Road and Other Transportation	5.0	3.9	78%
Non-Energy	■ Reduce per capita emissions of non-energy GHG emissions (e.g., from agriculture, waste, and wastewater) to 90 percent of 2005 levels.	Non-Energy	7.2	7.1	98%
		Total	87.7	44.1	50%

Note. $MMTCO_2E$ = Million Metric Tons CO_2 Equivalent
Source: DVRPC 2010

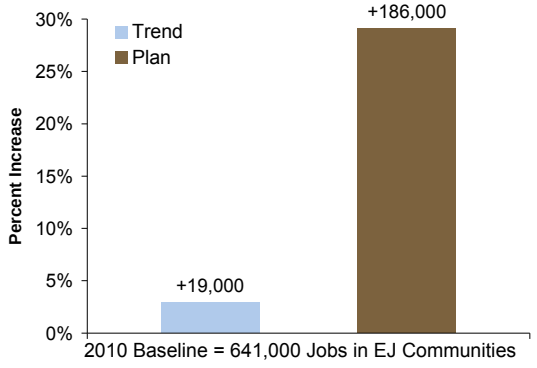
Supporting Jobs in EJ Communities

Environmental Justice (EJ) is an assessment used to mitigate potential direct and disparate impacts of the planning process and development projects on defined minority groups, persons with disabilities, and lower-income populations in Greater Philadelphia. DVRPC recognizes eight degrees of disadvantage, defined as exceeding the regional average for each of the following groups:

- non-Hispanic minorities;
- Hispanic minority;
- elderly;
- physically disabled;
- female-headed households with child;
- carless households;
- low-income households; and
- people with limited English proficiency.

Each census tract with five or more of these degrees of disadvantage is considered an EJ community. Many of the region's centers have seen significant disinvestments over the past 50 years, leaving behind a disadvantaged population living within them. By reinvesting in centers, more jobs will locate near EJ communities. This will help improve the tax base and enhance the municipal fiscal health of these local governments. The Plan scenario increases the number of jobs in EJ communities by nearly 30 percent, about 10 times more than the Trend scenario, see Figure 21.

Figure 21. Change in Jobs Located in Environmental Justice (EJ) Communities: 2010–2035



Source: DVRPC 2010

IMPLEMENTING THE PLAN

As a mature region, Greater Philadelphia's highway system is largely complete. Modernizing this system will make it more efficient and functional through technological enhancements and land use decisions that support alternative forms of transportation. To get from where we are now to a modern, multimodal system, we can focus on strategies such as:

- complete streets;
- road diets;
- context-sensitive design; and
- traffic calming.

We can also make our existing roadway network safer and more efficient with:

- Information Technology Systems (ITS);
- access management;
- coordinated traffic signal systems;
- parking management;
- improved road safety; and
- roundabouts.

We can enhance the sustainability of the transportation system through:

- Travel Demand Management (TDM) programs, such as compressed work weeks, flextime, and TransitChek; and
- fleet vehicle audits.

For more information about how to build a modern, multimodal transportation system and implement the *Connections* plan, see *Implementing Connections: A Guide for Municipalities* (DVRPC Publication #10047) or go to www.dvrpc.org/connections.

MODERNIZING THE TRANSPORTATION SYSTEM

Efficient transportation networks have been a hallmark of prosperous regions throughout history, and in the global economy the ability to efficiently move goods and people is more critical now than ever. DVRPC is committed to the regionwide promotion and implementation of a safe, convenient, and seamless passenger and freight multimodal system that includes air, water, road, rail, bus, bicyclist, and pedestrian networks of mobility. The *Connections* Plan works to build such a modern, multimodal transportation system by:

- establishing a local funding mechanism to contribute to the financing of transportation projects of regional significance;
- ensuring that transportation projects are "right-sized" in order to scale the solution to the size of the problem and tailor the approach to the specific project; and
- selecting transportation projects for capital programming based on sound long-range strategic planning considerations, life-cycle investment analyses, and system performance and condition data.

Due largely to a combination of increased density, reduced travel demand, and better alternative transportation, the Plan scenario would have the region's residents and businesses drive three million fewer VMT per day than the Trend scenario. This corresponds to about 500 fewer VMT per household per year (see Figures 22 and 23).

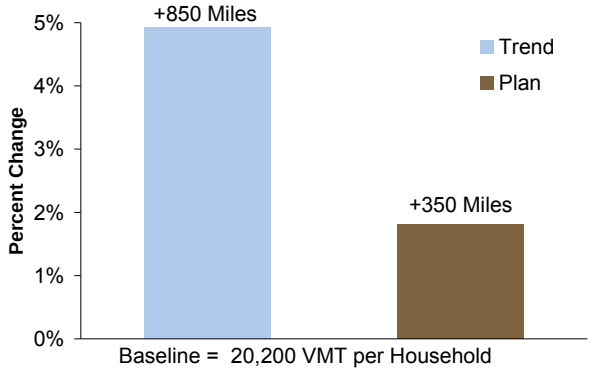
Figure 22. Daily Transportation Indicators

In Millions Except Where Noted	2010	Trend	Plan
Daily Vehicle Miles Traveled (VMT)	113.8	133.9	130.9
Daily Vehicle Hours Traveled (VHT)	4.1	4.6	4.5
Average Daily Speed (mph)	27.9	29.2	29.1
Daily Gallons of Fuel Used	6.4	7.6	7.4
Daily Truck VMT	10.2	11.9	11.7
Daily Truck Trips	1.1	1.3	1.3
Daily Vehicle Driver Trips	14.7	16.3	16.1
Daily Vehicle Passenger Trips	5.2	5.7	5.6
Daily Transit Ridership (Linked Trips)	1.1	1.1	1.2
Daily Pedestrian Trips	1.4	1.5	1.6
Daily Bicycle Trips	0.14	0.15	0.15

Source: DVRPC 2010

As a result of less driving and reduced roadway congestion, the Plan scenario requires 200,000 fewer gallons of fuel per day. As energy becomes scarcer, and its cost rises, this reduced need for fuel can significantly increase the region's competitive advantages.

Figure 23. Increase in Annual Vehicle Miles Traveled (VMT) Per Household: 2010–2035



Source: DVRPC 2010

Congestion

The Plan scenario focuses growth and development in and around areas where there are already existing residences, offices, shops, and infrastructure. Recent research has found that nearly all increases in peak-hour congestion are due to longer trips and ever-widening distances between origins and destinations, rather than to slower peak-hour travel speeds.[6] These findings indicate the best way to decrease future congestion is to create concentrated, mixed use development near or within existing activity centers. This reduces the distance that individuals need to travel while enhancing alternative transportation options.

A vehicle hour of delay is a measure of how much time is lost by commuters due to peak-period congestion on the roadways. Congested conditions cause vehicles to move more slowly than they would in free-flow speed, causing trips to take more time to complete. Not only is this a problem for the drivers who lose time stuck in traffic, but the slower speeds and stop-and-go driving conditions also mean more air pollution and wasted fuel.

> *"Data from the National Household Travel Survey show that nearly all of the increase in peak commuting times was due to longer trips rather than slower travel speeds."*
>
> Driven Apart: How Sprawl is Lengthening Our Commutes and Why Misleading Mobility Measures are Making Things Worse.
> *CEOs for Cities*

Figure 24 shows peak-hour roadway congestion for each scenario. In this report, congestion is defined by a generalized Level of Service (LOS) rating of "E," where the volume to capacity ratio (V/C ratio) is greater than or equal to 0.85.[7] The roads shown in red in the congestion maps will likely experience congested conditions of LOS "E" or "F" in the peak period. In addition, Figure 24 has clouds of congestion (shaded in light orange), where the average for all the local roads and arterials in a 2 km × 2 km grid is determined to have a V/C ratio greater than or equal to 0.85.

Figure 24 shows congestion occurring frequently in both scenarios. However, the centralized, compact nature of development in the Plan scenario suggests that it can be more easily mitigated by enhancing transit services. Transit is most efficient in dense, compact communities. It is less efficient in the low-density areas that occur more frequently in the Trend scenario. The spread-out nature of the Trend scenario likely means more roadway capacity will be necessary to reduce congestion.

[6] CEOs for Cities, *Driven Apart: How Sprawl is Lengthening Our Commutes and Why Misleading Mobility Measures are Making Things Worse* (Chicago: CEOs for Cities, 2010).

[7] LOS is a rating used by transportation engineers to quantify a roadway's performance, or ability to handle its traffic volume. LOS designations range from the best, "A," representing the most ideal, free-flowing conditions, to the worst, "F." At LOS "F," traffic operates under breakdown conditions, where demand exceeds capacity. At LOS "E," capacity is reached at its lower boundary, and traffic operations are volatile, as passing is virtually impossible and speed becomes greatly reduced.

Figure 24. Peak-Hour Congestion by Scenario in 2035

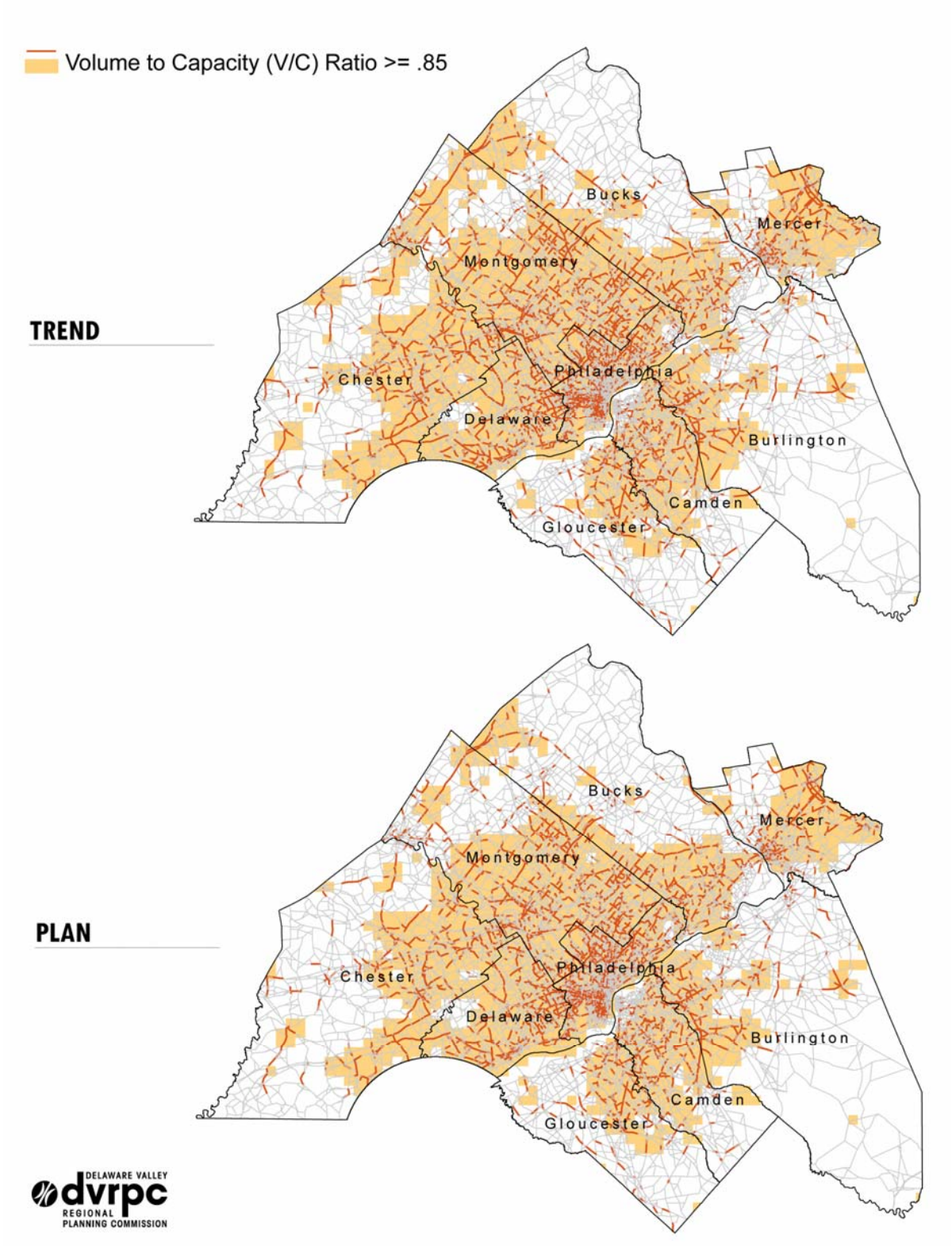


Figure 25 shows a variety of speed and congestion indicators, and that vehicle hours of delay will be 3.6 percent lower in the Plan scenario. Reducing delay increases the reliability of the transportation system. This particularly benefits freight shipments and logistics supply chains. In turn, reducing the cost to move goods lowers prices for businesses and residents and enhances the region's economic competitiveness.

Figure 25. Speed and Congestion Indicators

Indicator		2010	Trend	Plan
Average Peak-Period Speed (mph)		25.1	26.4	26.0
Daily Peak-Period VMT (Millions)		41.0	51.3	49.5
Daily Peak-Period VHT (Millions)		7.6	8.5	8.3
Average Peak-Period Vehicle Trip Length*	Miles	6.6	7.6	7.3
	Minutes	15.7	17.2	16.9
Annual Vehicle Hours of Delay per Peak-Hour Traveler	Recurring**	24.7	26.3	26.1
	Nonrecurring***	42.6	49.0	46.5
Total Annual Hours of Delay		67.3	75.3	72.6

* Includes all peak period trips, not just home to work journeys.
** Recurring congestion identifies areas where traffic volume Is regularly greater than roadway capacity.
*** Nonrecurring congestion is travel delay as a result of crashes, weather, construction, and other variable factors.
Note. VHT = Vehicle Hours Traveled. VMT = Vehicle Miles Traveled.
Source: DVRPC 2010

Safety

Vehicle crashes are a leading cause of death both within the region and in the United States as a whole. Crashes also increase nonrecurring vehicle hours of delay, reducing transportation system reliability. There are a myriad of causes of crashes: driver inattention, speeding, poor roadway maintenance or design, vehicle design, congestion, and insufficient funding for enforcement. Reducing crashes requires improvements in the three "Es": education, engineering, and enforcement.

Smoother pavement condition, less driving, and congestion in the Plan scenario will likely reduce both vehicular crashes and resulting fatalities compared to the Trend (see Figure 26). However, both scenarios forecast a slight worsening from current conditions due to the greater number of vehicles and mileage driven.

Figure 26. Safety Indicators

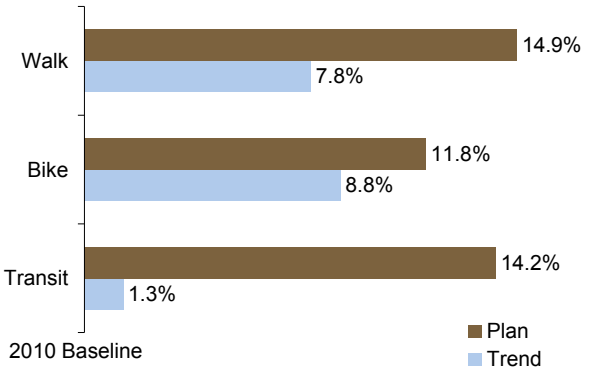
	New Jersey Subregion			Pennsylvania Subregion		
Indicator	2009	Trend	Plan	2009	Trend	Plan
Crashes*	52,204	62,871	62,047	34,015	42,685	40,684
Crashes per 100 million VMT**	343.5	360.5	359.7	129.2	135.7	133.3
Fatalities*	132	158	155	251	311	293
Fatalities per 100 million VMT	0.87	0.91	0.90	0.95	0.99	0.96

* 2009 is used as base year, with actual reported crash and fatality data. Plan and Trend are estimates based on traffic and pavement conditions in the Highway Economic Requirements System–State Version (HERS-ST) model.
** Crash rates vary between Pennsylvania and New Jersey due to different crash reporting requirements. In Pennsylvania crashes are reportable if there has been an injury or a vehicle has to be towed from the scene. In New Jersey a crash is reportable if there has been $500 or more in damage with the reporting officer making this judgment.
Note. VMT = Vehicle Miles Traveled.
Source: DVRPC 2010

Alternative Transportation

Both the Trend and the Plan scenarios forecast increases in alternative transportation use. Not only will this benefit health, but it also will save money on driving costs and help to reduce GHGs and other emissions. These modes also offer transportation system users the chance to reclaim some of their time and be more productive than when driving—not only by getting exercise but also by reading, working, or simply relaxing. By focusing on a built environment that is more conducive to these modes, the Plan scenario forecasts even greater increases in alternative transportation use (see Figure 27). Thus, the Plan scenario, with increased mixed use development in and around the region's centers, better meets the region's goal of building a multimodal transportation network.

Figure 27. Percent Increase in Alternative Transportation Use by Scenario: 2010–2035



Source: DVRPC 2010

Surface Transit Enhancements

Connections recommends improving transit service speed and reliability in Greater Philadelphia through transit enhancement initiatives such as signal prioritization, stop consolidation or limited stop operations, stop relocation from the near to the far side of the intersection, or exclusive right-of-way operations that may include shoulder operating segments, and/or queue-jumping lanes. These are the sorts of improvements pursued in Philadelphia under the Transit First program.

Active Transportation Health Benefits

Walking and biking on a regular basis provide significant health benefits. The Centers for Disease Control and Prevention has found that individuals who average more than 20 minutes of physical activity each day:*

- will be in better overall health;
- are more likely to be at a healthy weight;
- are less likely to feel depressed;
- have stronger muscles and bones;
- sleep better at night; and
- tend to live longer.

Regular physical activity helps to reduce chances of having a stroke, type II diabetes, heart disease, high blood pressure, or high cholesterol. Active transportation, such as walking and biking, helps to build physical activity into the daily routine. Even those who walk to and from their transit line can accrue these benefits. Healthier individuals, as a result of more physical activity, can yield substantial savings in medical costs and miss less work time, thereby helping to increase the region's economic competitiveness.

* Centers for Disease Control and Prevention, *Physical Activity Guidelines for All Americans* (Atlanta, GA: Centers for Disease Control and Prevention, 2008).

Figure 28. Plan Scenario Daily Transportation Indicators with and without Transit First

All Figures in Millions Except Where Noted	With Transit First	Without Transit First
Total Transit Boardings (Linked Trips)	1.2	1.1
Total Highway Trips	21.7	22.1
Highway VMT	130.9	133.5
Highway VHT	4.5	4.6
Average Peak Highway Speed (mph)	29.1	29.2

Source: DVRPC 2010

The Plan scenario assumes that transit enhancement initiatives are pursued throughout the region and can increase surface route (buses and trolleys) speed by about 10 percent. Such improvements are expected to improve operating

efficiencies, resulting in net new costs that are inconsequential. DVRPC ran its travel demand model for the Plan scenario both with and without these enhancements. Figure 28 summarizes these results.

Health Impacts from Transportation Emissions

Ground-level ozone (O_3), also known as smog, is a strong oxidizer and has a similar impact on lung tissue as a sunburn does on skin. Short-term exposure to elevated levels of ground-level ozone can irritate lung passages and cause inflammation. Exposure to elevated levels of ozone can cause coughing, wheezing, chest pains, and headaches. Ozone can aggravate chronic respiratory diseases, such as asthma and bronchitis, and lead to increased emergency room visits and hospital admissions. Exposure to long-term, low levels of ozone may cause asthma in children and can permanently damage lungs.

Fine particulate matter ($PM_{2.5}$) is composed of small particles of dust, metals, toxins, and liquids. When breathed deep into the lungs, it can cause wheezing, coughing, breathing difficulty, or aggravate asthma or bronchitis. Fine particle pollution also poses a health risk for individuals with heart conditions. The smallest particles may actually enter the blood stream, changing blood chemistry. This can make the heart work harder to get oxygen to the body. Long-term exposure to particle pollution has been linked to decreased lung function and even shortened life expectancy. Increased fine particle pollution emissions into the atmosphere raise the likelihood that at-risk groups will develop problems or have them worsen.

More information on air quality and health impacts in the DVRPC region is available at the Air Quality Partnership website: www.airqualitypartnership.org.

Transportation Emissions

Decentralized development patterns reduce open space and increase travel distance between locations. More driving increases emissions that pollute the air we breathe and contribute to the region's nonattainment of air quality standards for ground-level ozone (O_3) —which forms when oxides of nitrogen (NOx) and volatile organic compounds (VOCs) combine and bake in the sun—and fine particulate matter ($PM_{2.5}$). At the same time, developing open space reduces the ability of trees and grasslands to filter out these pollutants. This impacts health for children, the elderly, outdoor workers, and at-risk groups for heart and lung disease. On extremely poor air quality days, generally in the summer, everyone's health is at risk. Pollutants also damage crops and reduce water quality. Lower emissions rates in the Plan scenario will help to limit the negative health impacts of the transportation system, see Figure 29.

Figure 29. Daily Transportation Emissions

Tons/Day	2010	Trend	Plan
NOx	118.1	21.8	21.4
VOC	63.7	30.8	30.1
$PM_{2.5}$	2.6	1.8	1.8

Source: DVRPC 2010

Making the Connection

Center-based development patterns combined with enhanced street connectivity, improved transit service, and new bicycle and pedestrian facilities can increase the accessibility between origins and destinations. Shorter trip lengths mean that biking, walking, and transit become more feasible options for getting around the region. These transportation options save money and provide numerous health and environmental benefits. By making alternative transportation more feasible, the need for driving alone is reduced. This helps the region to prepare for future energy constraints and GHG reduction needs while enhancing community livability. Focusing investment in centers and areas that are more appropriate for development will prevent the paving over of more land on the outer areas of the region, helping to ensure that the region can meet its open space and agricultural preservation goals.

IMPLEMENTING THE PLAN

Transportation investments prioritize maintenance and operations followed by targeted capacity and operations improvements that enhance the region's centers. Lack of funding is a major challenge as we work to modernize the region's transportation system. The *Connections* plan issued a challenge to the region's leaders, stakeholders, and citizenry to reach consensus on a new local means to fund transportation projects. Sources of revenue could come from:

- bonds;
- taxes or fees;
- tolling; and/or
- public–private partnerships.

The following issues should be carefully weighed when considering the impacts of a new source of local funding:

- how directly it relates to use of the transportation system;
- stability and equity;
- adequacy of yield and revenue;
- ease of implementation; and
- potential economic impacts.

For more information about creating a local revenue source to fund transportation projects and implement the *Connections* plan, see *DVRPC's Options for Filling the Region's Funding Gap* (DVRPC Publication #07045) or go to www.dvrpc.org/connections.

CREATE A LOCAL FUNDING SOURCE TO IMPROVE TRANSPORTATION INFRASTRUCTURE

In working to modernize and create a multimodal transportation network, the region needs to maintain and update large, complex, and aging infrastructure. The transportation system has languished with decades of deferred maintenance as capacity expansion took precedence. This has created an immense backlog of maintenance and repair needs. Achieving and maintaining a state of good repair (SOGR) for all transportation infrastructure is a key goal of *Connections*. The Plan continues the fix-it-first policy of recent DVRPC long-range planning efforts, reflecting a priority to maintain existing infrastructure before making significant investments in new capacity.

As part of the development of the Plan, DVRPC conducted a full needs assessment of the cost to achieve and maintain an SOGR for all transportation infrastructure in Greater Philadelphia. The overall funding need identified in the assessment was $110 billion in year-of-expenditure (Y-O-E) dollars. This represents a significant gap as the region can only reasonably expect $65 billion in revenue over the next 25 years.[8]

More than 7 out of every 10 dollars of anticipated revenue is programmed for maintenance, this shortfall means attaining the SOGR goal will be impossible without additional funding. In addition, Greater Philadelphia relies more on diminishing federal and state funding sources, and contributes less local funding than any of the other top 10 metro regions in the country. As a result, *Connections* called for the creation of a regional funding source of at least $100 million per year to help fund significant transportation projects, and to reduce the funding gap.

Creating such a local funding source would cost the average household just over $4 per month in 2010 dollars, or a little less than $6 per household per month in Y-O-E dollars. This would yield $3.9 billion of transportation investment in Greater Philadelphia over the life of the *Connections* Plan.

The Plan scenario assumes this new local funding source is created and funds additional transportation improvements over the life of the Plan. It also gauges the potential of local funding to help the region reach the goal of achieving and maintaining

[8] These estimates, and all contained in this section, were developed using the best available information. It is important to recognize there is always a degree of uncertainty when forecasting future labor, materials, and other costs.

an SOGR for all transportation infrastructure. The Plan scenario allocates this additional revenue to each transportation category proportional to the amount of funding it received in *Connections*. Compared to the Trend scenario, this additional investment could mean:

- approximately 1,200 new jobs in the region;
- 38 additional bridges reconstructed;
- 359 additional lane miles of roadway reconstructed or resurfaced;
- 173 new buses;
- 18 new regional rail vehicles;
- 9 new light rail vehicles (LRVs);
- 5 new heavy rail vehicles (HRVs);
- 14 miles of multi-use bike and pedestrian trails and 142 miles of bike lanes; and
- additional investments in safety and operational improvements, ITS, transit station upgrades, rail infrastructure, and transit vehicle maintenance.

The following sections review the anticipated condition for bridges, pavement, and transit vehicles over the life of the *Connections* Plan for the amount of funding reasonably anticipated (Trend scenario) and with an extra $100 million in annual funding (Plan scenario).

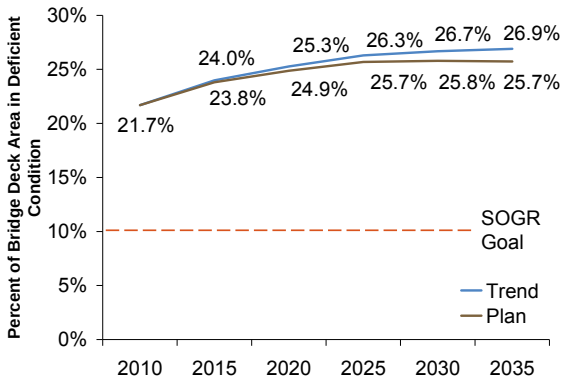
Bridge Condition

The region's SOGR goal for bridge condition is to reduce the total square feet of deck area to 10 percent or less in deficient condition. The Pennsylvania subregion has approximately 27 million square feet of deck area, and the New Jersey subregion has approximately 14 million.

Bridges have recently been the focus of considerable investment in Pennsylvania. The percent of deficient deck area has decreased from about 24 percent in 2007 to a little less than 22 percent in 2010, with some help from extra funding in the 2009 American Recovery and Reinvestment Act (ARRA). However, deficiency levels remain well above the SOGR goal of 10 percent of total deck area (see Figure 30). Current funding is nowhere near what is needed to maintain current conditions, meaning the Pennsylvania subregion will likely fall well short of achieving an SOGR.

The Plan scenario provides an additional $575 million (Y-O-E $s), which will repair an additional 327,000 square feet of deck area, about 1.2 percent of the total. Pennsylvania has an even greater number of functionally obsolete bridges in need of attention. These are older bridges that are not up to modern safety and design standards.

Figure 30. Pennsylvania Subregion Bridge Condition



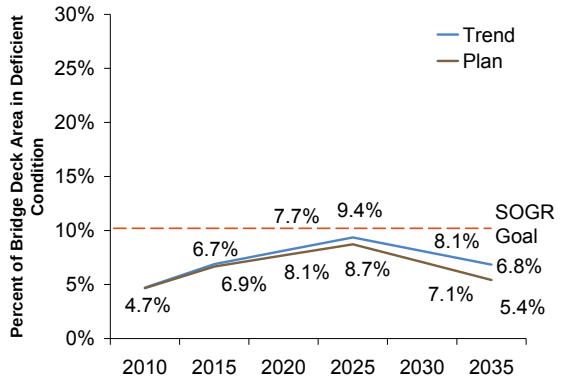
Note. SOGR = State of Good Repair.
Source: DVRPC 2010

In New Jersey, the system is considered to be in an SOGR (see Figure 31).[9] However, the current level of funding will not maintain current conditions. The Plan scenario provides an additional $360 million (Y-O-E $s) over the life of the Plan, helping to improve the SOGR. The New Jersey subregion also has a large number of structurally deficient bridges that are not state maintained and are not considered in this analysis.

By maintaining bridges in a higher SOGR, the region is less likely to suffer from negative economic consequences due to a critical bridge closure. Any unnecessary bridge closure reduces the transportation network's resiliency and could negatively impact goods movement, employees getting to work, emergency personnel, or evacuation routes.

[9] In 2009, the New Jersey subregion had 125 structurally deficient state maintained bridges, or 10.6 percent of the total. This suggests that most of the deficient bridges are smaller in size than the average.

Figure 31. New Jersey Subregion Bridge Condition

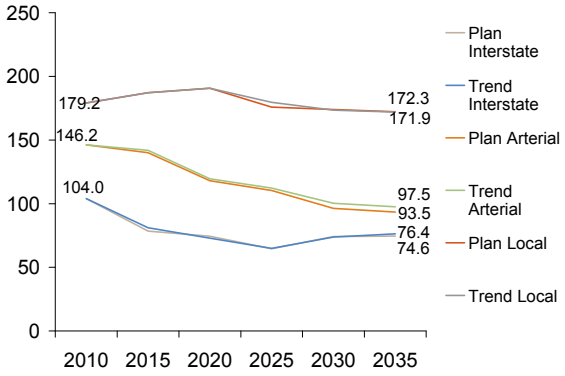


Note. SOGR = State of Good Repair.
Source: DVRPC 2010

Pavement Condition

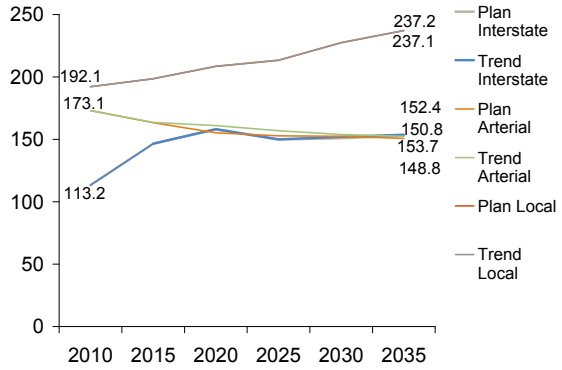
Smoother pavement is safer for drivers and leads to lower vehicle operating costs, saving money for the region's residents and businesses. The International Roughness Index (IRI) assesses pavement roughness, with 0 being a perfectly flat surface. Figures 32 and 33 show the expected IRI by functional class over the life of the Plan by scenario.

Figure 32. Pennsylvania Pavement International Roughness Index



Source: DVRPC 2010

Figure 33. New Jersey Pavement International Roughness Index

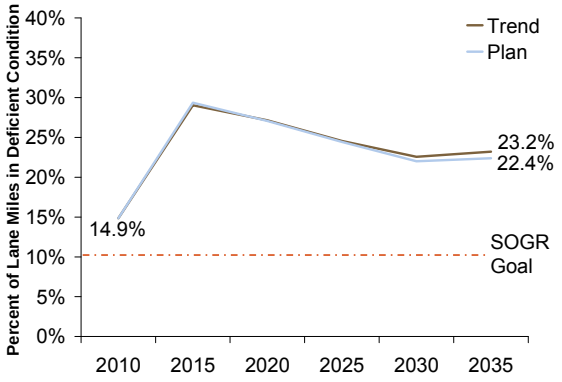


Source: DVRPC 2010

Overall IRI in Pennsylvania will improve from 146.2 in 2010 to 102.7 in the Trend scenario and 99.7 in the Plan. In New Jersey it will worsen from 144.1 to 151 in the Trend scenario and 148.8 in the Plan.

Though overall IRI will improve in Pennsylvania over the life of the Plan, funding levels for pavement reconstruction and resurfacing will not be enough to achieve the SOGR goal to reduce lane miles of pavement in poor or deficient condition to less than 10 percent of the total (see Figure 34). The Plan scenario provides an additional $410 million (Y-O-E $s) which helps to improve the state of repair relative to the Trend.

Figure 34. Pennsylvania Subregion Lane Miles of Pavement in Deficient Condition

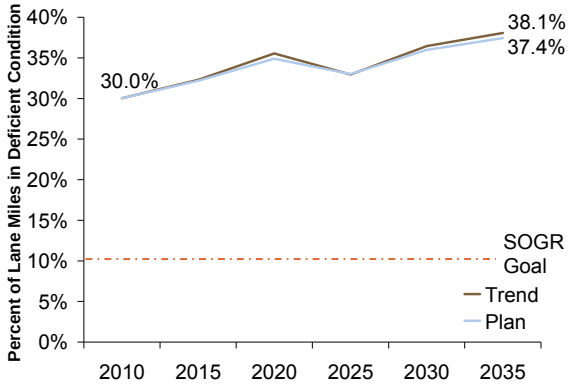


Note. SOGR = State of Good Repair.
Source: DVRPC 2010

In New Jersey, not only will the overall IRI likely increase, but so will the lane miles in deficient condition, to nearly four times the SOGR goal, as

shown in Figure 35. The Plan scenario provides an additional $280 million (Y-O-E $s) in funding for pavement over the life of the Plan, helping to improve the SOGR.

Figure 35. New Jersey Subregion Lane Miles of Pavement in Deficient Condition



Note. SOGR = State of Good Repair.
Source: DVRPC 2010

In both states, the additional funding in the Plan scenario can both improve overall IRI and reduce the total lane miles in poor condition, which will save drivers money and enhance safety.

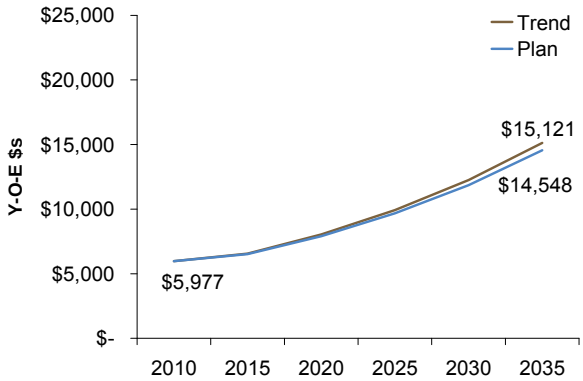
Vehicle Operating Expenses

Vehicle operating costs account for fuel, oil, tires, maintenance and repair, and mileage-related depreciation. Roads in poor condition cause excess wear and tear to vehicles, damage tires and suspension systems, increase fuel consumption, and lead to more crashes, increasing travel time and causing additional property damage, injuries, and fatalities. Roads in poor condition also produce a type of double taxation, as they cause damage to vehicles, which drivers must pay to fix, while they still must help to pay for the eventual road repair.

By investing more in pavement maintenance, the Plan scenario can save Pennsylvania drivers an estimated $9.5 billion (in Y-O-E $s) over the life of the *Connections* Plan, or about $230 annually per household (see Figure 36). In New Jersey, driving expenses are higher due to more driving (about 40 percent more VMT per household than in Pennsylvania) and slightly worse road conditions becoming much worse over the life of the Plan.

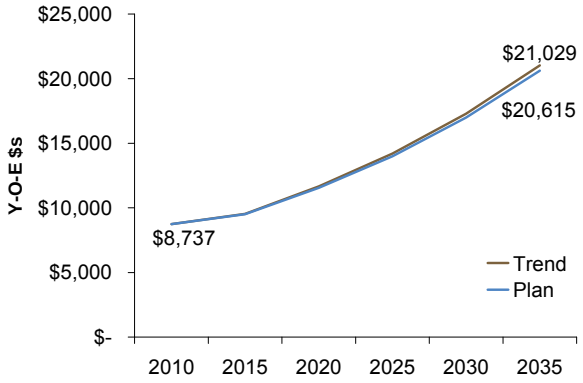
Regardless, the Plan scenario yields savings of about $1.8 billion (in Y-O-E $s) over the life of the Plan, or about $110 per New Jersey household annually (see Figure 37).

Figure 36. Pennsylvania Subregion Average Annual Household Vehicle Operating Costs



Note. Y-O-E = Year-of-Expenditure.
Source: DVRPC 2010

Figure 37. New Jersey Subregion Average Annual Household Vehicle Operating Costs



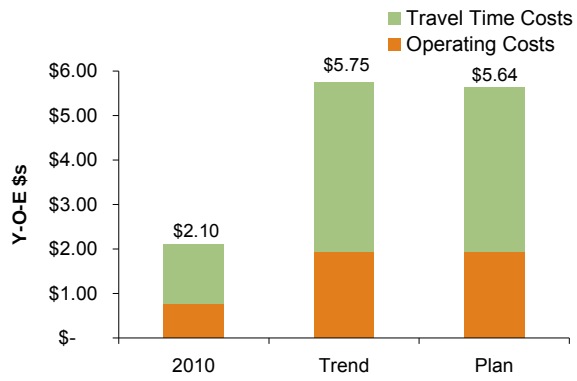
Note. Y-O-E = Year-of-Expenditure.
Source: DVRPC 2010

Truck Operating and Travel Time Costs

The ability to move goods cheaply and efficiently is critical to economic competitiveness in the global economy. Nearly all freight shipments entail a truck trip for either the entire trip or in conjunction with ship, rail, or air movements (see Figures 38 and 39). By reducing congestion and improving pavement condition to reduce truck operating costs, the region can improve its

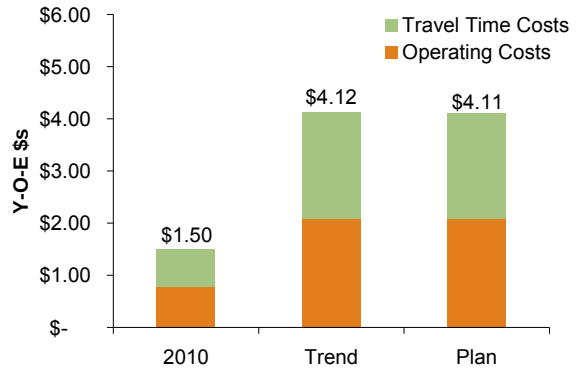
connections to the global economy and competitiveness within it.

Figure 38. Pennsylvania Subregion Truck Operating and Travel Time Costs per Mile Traveled



Note. Y-O-E = Year-of-Expenditure.
Source: DVRPC 2010

Figure 39. New Jersey Subregion Truck Operating and Travel Time Costs per Mile Traveled



Note. Y-O-E = Year-of-Expenditure.
Source: DVRPC 2010

In Pennsylvania, congestion is expected to be the primary contributor to truck expenses. In New Jersey, poor pavement condition will likely add more to operating costs. By investing extra money in the Plan scenario, the trucking industry can benefit from travel time and vehicle operating cost savings of $5 billion (Y-O-E $s) in Pennsylvania and $656 million (Y-O-E $s) in New Jersey over the life of the *Connections* Plan. These savings can then be passed on to the region's residents through goods and services purchased.

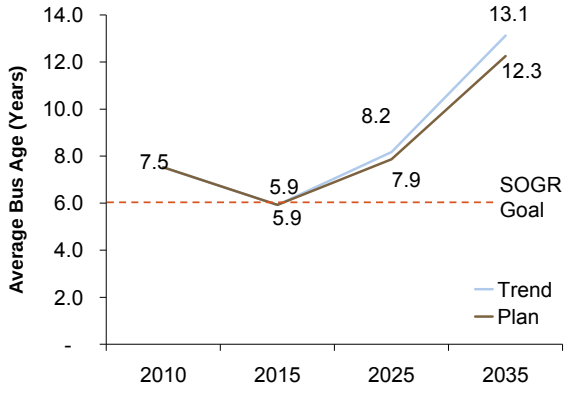
Transit Vehicle Age

Transit vehicle condition is a key component to attracting ridership and ensuring a high level of service. Older vehicles are more prone to break down, reducing service reliability and increasing maintenance expenses. Newer vehicles tend to be safer, more comfortable, and have better fuel efficiency, thereby reducing GHG emissions. Achieving and maintaining an SOGR for transit vehicles means keeping the fleet age within half of the expected vehicle life. Thus an SOGR for buses is average vehicle age under 6 years (expecting a 12 year lifespan) and 20 years for rail vehicles (assuming a 40 year lifespan).

Buses

In Pennsylvania, buses are anticipated to achieve an SOGR by the end of the first Plan funding period (2015)—thanks in part to ARRA, which provided funding for 40 new hybrid buses. However, funding in the second and third funding periods is not expected to be enough to maintain an SOGR over the life of the *Connections* Plan (see Figure 40). The additional regional funding of about $35 million (Y-O-E $s) in the Plan scenario does help to reduce the region's average. However, average bus age is a concern as buses typically need to be replaced on a 13-year schedule. The average vehicle age surpasses this in the Trend scenario, and nearly exceeds it in the Plan.

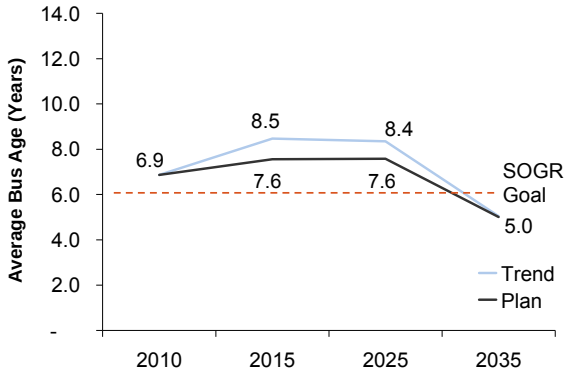
Figure 40. Pennsylvania Subregion Bus Fleet



Note. SOGR = State of Good Repair.
Source: DVRPC 2010

In New Jersey, buses are anticipated to achieve an SOGR in the final Plan funding period in both scenarios, as shown in Figure 41. Additional funding of $45 million (Y-O-E $s) in the Plan scenario helps reduce the overall bus vehicle age in the first and second funding periods relative to the Trend.

Figure 41. New Jersey Subregion Bus Fleet



Note. SOGR = State of Good Repair.
Source: DVRPC 2010

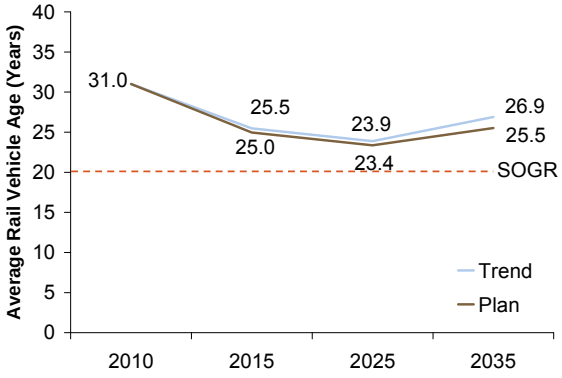
Rail Vehicles

Rail vehicles have an expected 40-year lifespan and are typically bought in large quantities to reduce costs.[10] Often the entire fleet will turn over at the same time; thus, a fleet with a 40-year average age is of more concern than one with a 20-year average age, because in the latter instance the average vehicle may only be halfway through its expected lifespan.

In Pennsylvania, the Southeastern Pennsylvania Transportation Authority (SEPTA) is currently purchasing new regional rail vehicles to replace the Silverliner IIs dating from the mid-1960s. During the Plan timespan, SEPTA will also need to replace the Silverliner III regional rail fleet dating from the early 1970s, the entire LRV fleet dating from the early 1980s, and the HRVs that operate on the Broad Street Line. Additional Plan scenario funding of about $135 million means that more of the vehicles can be purchased closer to the end of their useful life expectancy, thereby improving the state of repair (see Figure 42).

[10] The Federal Transit Administration (FTA) recommends rail vehicle replacement after 35 years.

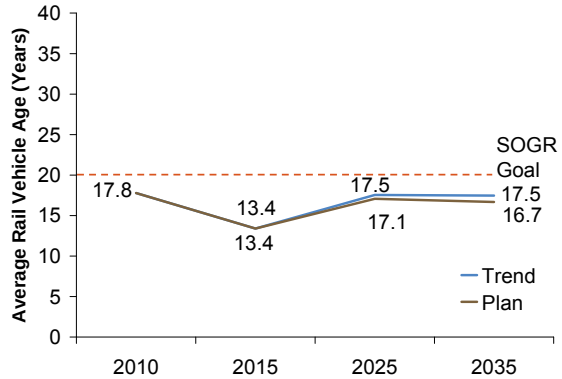
Figure 42. Pennsylvania Subregion Rail Vehicles



Note. SOGR = State of Good Repair.
Source: DVRPC 2010

In New Jersey, the current age of the region's vehicle fleet is low primarily due to the RiverLine that began operation in 2004. The New Jersey subregion will need new rail vehicles for the Atlantic City Line, as well as regularly updating and replacing the region's share of rail vehicles on the Northeast Corridor. The additional funding of $37 million in the Plan scenario helps to ensure that these vehicles are replaced in a timely manner. Though the New Jersey subregion should be able to maintain an SOGR for rail vehicles in either scenario (see Figure 43). This means the extra funding for rail vehicle replacement could be shifted to more pressing transportation needs. The flexibility gained by local funding means that the region will be better able to direct investments toward its priorities, as opposed to federal and state funding that is often formula based and mandated for specific programs.

Figure 43. New Jersey Subregion Rail Vehicles



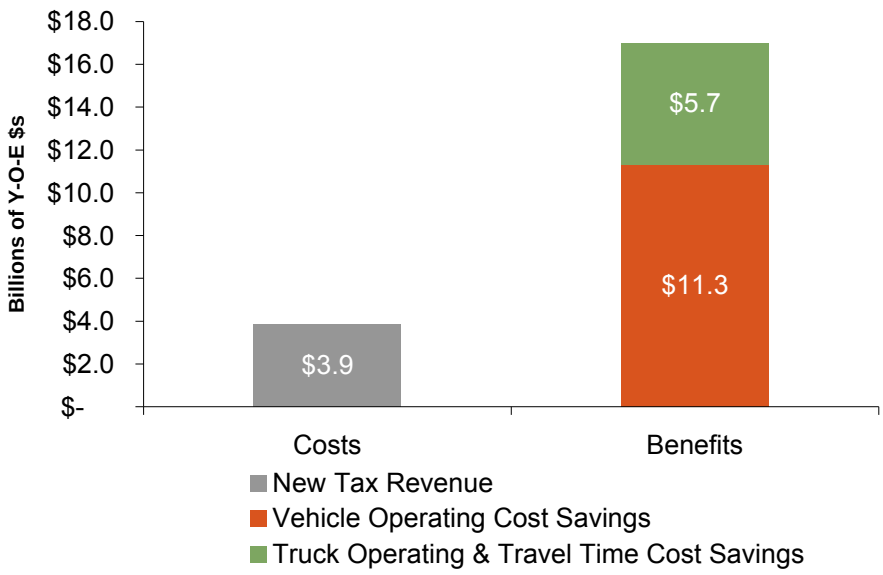
Note. SOGR = State of Good Repair.
Source: DVRPC 2010

Regional Transportation Funding Benefits and Costs

The Plan scenario assumes the creation of an $100 million additional local transportation funding revenue. This additional local investment will not on its own be enough to achieve the SOGR goal without further increased revenue, whether from state, federal, or private-sector sources. However, this funding can begin to reduce the backlog of transportation needs, and provide the region with flexibility to use the funding for regional priorities as opposed to federal and state funding that is often formula based.

Though increasing taxes or fees to improve the region's transportation infrastructure is never an easy task, Greater Philadelphia's residents and businesses will derive significant benefits from doing so. Just a portion of this revenue, about $690 million (Y-O-E $s), is directed to improving pavement condition in the Plan scenario. The improved pavement in this scenario results in $17 billion (Y-O-E $s) in vehicle operating cost savings and truck operating and travel time cost savings represent a 4:1 return on the total $3.9 billion (Y-O-E $s) investment (see Figure 44). The region's residents and businesses would further benefit from driver travel time savings; newer, more reliable transit vehicles; improved transit stations and rail infrastructure; more ITS to make the road network more reliable; more bridges in an SOGR, reducing the possibility of a critical bridge closure; more bicycle and pedestrian facilities; reduced transportation emissions; health benefits from more active transportation; and a safer transportation system.

Figure 44. Regional Vehicle and Truck Operating and Truck Travel Time Cost Savings Benefits Compared to Local Funding Cost: 2010–2035



Note. Only a portion of additional funding (shown as "costs") would go to pavement maintenance; the prorated amount of this funding generates all the benefits shown in this chart. Additional benefits would accrue from driver travel time savings; newer, more fuel-efficient and reliable transit vehicles; improved transit stations and rail infrastructure; ITS investments to make the road network more reliable; more bridges in an SOGR, reducing the possibility of a critical bridge closure; more bicycle and pedestrian facilities; reduced transportation emissions; health benefits from more active transportation; and increased safety.

Source: DVRPC 2010

CONCLUSION

Promoting center-based development is a guiding principle of the *Connections* Plan. Through infill development and redevelopment of existing centers, and by building new compact, center-based forms, the Plan can help the region provide transportation, water, and sewer infrastructure more efficiently while preserving open space. The dense, mixed use development patterns found in centers enhance alternative forms of transportation such as transit, walking, and biking, and make commercial amenities and services more accessible to residential areas.

The Plan's center-based development pattern can reduce how much undeveloped land is built upon in the future. By permanently protecting and preserving 500,000 acres of open space in the Plan scenario, the region can protect its wetlands, benefiting air and water quality, and help to reduce potential economic and ecological risks to the region from flooding, impacts to human health, and loss of biodiversity. Development of open space, which occurs more frequently in the Trend scenario, will have a detrimental effect on surface water due to the loss of natural vegetation and the increase in impervious surfaces. Surface waters are an important source of drinking water in the region. Without adequately protecting these waters, the cost of providing clean water for drinking and other uses will steadily increase, negatively impacting the region's economic competitiveness.

Developing in and around centers will benefit the region by utilizing and maintaining existing infrastructure rather than duplicating it with new facilities. This Plan scenario strategy can reduce the tax burden on the region's residents and businesses and increase economic competitiveness. More greenfield development, as is likely to occur in the Trend, means more lane miles of road, extension of sewer lines, and new schools. In many instances this duplicates existing infrastructure already built in the region's developed areas, which will still need to be maintained.

The Plan scenario increases the variety and types of housing available, helping to meet the needs of an aging and diverse population. This does not mean, however, that everyone will live in a dense, urban center. For those who prefer a more suburban way of life, there will remain plenty of housing, retail, and job options in these areas of the region.

IMPLEMENTING THE PLAN

Regions are the basic unit of economic competitiveness in the global economy. Increasing Greater Philadelphia's economic competitiveness requires regional cooperation. Thus, multimunicipal planning is the key to implementing the plan and changing business as usual. Programs and policies municipalities can use to accomplish this include:

- multimunicipal comprehensive plans;
- multimunicipal zoning;
- shared municipal services;
- voluntary agreements;
- watershed planning; and
- public participation.

Municipalities should work to share municipal services and coordinate land use plans, both of which can reduce local government costs, enhance growth management regulations, and provide for infrastructure.

For more information about how to focus development in regional centers and implement the *Connections* plan, see *Implementing Connections: A Guide for Municipalities* (DVRPC Publication #10047) or go to www.dvrpc.org/connections.

Center-based, compact, transit-oriented development patterns have been shown to use significantly less energy and emit fewer GHGs per capita than traditional development patterns. By reducing energy use, the Plan scenario helps the region prepare for rising energy prices and the coming realities and regulations of climate change. The regions that best equip their governments, businesses, and residents to deal with these issues will be the ones that thrive in the future.

The policies in the Plan alone, though, will not be enough to allow the region to meet its GHG reduction goal. Given current energy prices, costs of new technologies, weakness of the national economy, and the societal disinclination for investments with long-term payoffs, these changes will not happen without substantial political leadership and the will to provide incentives for producing services with less energy, and producing energy with less CO_2.

The Plan scenario increases the options for how we get around by encouraging alternative forms of transportation. Transit, walking, and biking are more environmentally friendly and have considerable additional benefits such as being safer and better for health. Transit also provides key services for segments of the region's population. It is a means to work for low-income workers and provides transportation to zero-car households. The Plan scenario's increased transit use, coupled with reduced driving, reduces the region's energy demand and CO_2 emissions and helps the region fulfill its EJ goals.

Current funding will not be enough to achieve and maintain an SOGR for all transportation infrastructure. The *Connections* Plan calls for creating a regional funding stream of at least $100 million annually. Raising taxes or fees for transportation funding is always difficult, especially during an economic downturn. Even this additional local investment will not be enough to achieve the SOGR goal without other supplemental revenue, whether from state, federal, or private-sector sources. However, if the region has the courage to enact such a funding source, the payback could be significant. Improvements in pavement condition will reduce vehicle and truck operating costs and truck travel times will yield a 4:1 benefit–cost ratio, or over $17 billion in direct benefits over the life of the Plan. The flexibility gained by local funding means that the region will be able to better direct investments toward its priorities, as opposed to federal and state funding that is often formula based and mandated for specific programs. A better-performing transportation system will also enhance safety, improve quality of life, and increase our region's economic competitiveness within the global marketplace.

Figure 1 on page 2 of this report summarizes how each scenario performs compared to key *Connections* Plan goals. Both the Trend and Plan scenarios are compared with each other and to the 2010 base year. Two plus (++) symbols indicates the best performer between the baseline (2010), Plan, and Trend scenarios. A single plus (+) indicates the second best performer among the three scenarios. This analysis clearly shows the wide-ranging number of benefits the region can obtain by working together between federal, state, and local governments with the private sector and individuals to implement the *Connections* Plan.

APPENDIX

APPENDIX

This document analyzes a Plan scenario based on the policies and principles in the *Connections* Plan compared to a business-as-usual Trend scenario. The Plan scenario serves as a "blueprint" type scenario in that it amends the DVRPC Board-adopted population and employment forecasts to better meet the goals of the Plan for developing around more than 100 centers while allowing more land to be preserved; envisioning how regional transportation infrastructure can be improved through a currently unidentified regional funding source of at least $100 million annually; and analyzing the GHG implications of such development patterns. This is especially relevant as several bills that have been proposed in Congress recently have called for metropolitan planning organizations (MPOs) to undertake blueprint scenario planning to guide sustainable land use practices and future decision making.[11, 12]

The Plan is compared to both current conditions in 2010 and a Trend scenario, based on DVRPC Board-adopted employment and population forecasts, that envisions the majority of population and employment growth occurring at the outer portions of the region. Figure A-1 identifies the different modeling assumptions between the Plan and Trend scenarios.

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[11] The Surface Transportation Act would require MPOs to conduct "blueprint" or alternative scenario planning with the following requirements:

- land use patterns that support improved mobility and reduced dependency on single-occupant vehicle trips;
- an adequate supply of housing for all income levels;
- limited impacts on valuable farmland, natural resources, and air quality;
- a reduction in GHG emissions;
- an increase in water and energy conservation and efficiency; and
- an increase in livable communities.

[12] The Clean Energy Jobs and American Power Act would add oil and sustainability considerations to the MPO planning process, and coordination with additional federal agencies in developing long-range transportation plans.

- Adds to planning factors that should be considered in the transportation planning process to include: promotion of sustainability and livability, reduction of surface transportation-related GHG emissions and reliance on oil, adaptation to the effects of climate change, and improvement in public health. Also includes a provision to promote consistency between transportation improvements and housing and land use patterns.
- Amends the MPO long-range transportation planning process by requiring that plans must be developed in cooperation with state and local agencies responsible for transportation, public transportation, air quality, and housing, and in consultation with public health agencies among other agencies.

Likewise the Clean Energy Jobs and American Power Act would require that scenario analysis be used to evaluate various strategies for their emission-reduction abilities. Such strategies should include:

- public transportation, walking, and biking infrastructure;
- zoning and land use changes;
- TDM (including vanpooling, telecommuting, carpooling);
- better system management;
- intercity passenger rail;
- bus and freight, hybrid vehicle facilities; and
- other efforts that are shown to reduce GHGs from transportation.

Figure A-1. Plan and Trend Modeling Policy Comparison

Policy Area	Trend	Plan
Population	Board-adopted forecast	Population growth directed toward more than 100 regional development centers
Employment	Board-adopted forecast	Employment growth directed toward more than 100 regional development centers
Development Allocation Area	Restricted by Protected Lands Inventory and Regional Greenspace Network in Connections Plan	Restricted to Existing Development and Future Growth Areas in Connections Plan
Infill Development	Population / Employment	Population / Employment
Burlington	42% / 58%	61% / 69%
Camden	49% / 37%	65% / 59%
Gloucester	39% / 55%	60% / 68%
Mercer	56% / 60%	73% / 75%
Bucks	45% / 53%	62% / 67%
Chester	60% / 55%	70% / 68%
Delaware	79% / 74%	85% / 82%
Montgomery	34% / 43%	57% / 62%
Philadelphia	N/A / 100%	100% / 100%
New Footprint Density	As calibrated in UPlan	Development densities based on Realizing Density: Strategies for Compact Suburban Development (DVRPC Publication #05009)
Attractors	As calibrated in UPlan	Increased attraction to centers, transit, and mixed use
Transportation Funding	Forecast of $64.8 billion over life of Plan	Forecast of $68.6 billion over life of Plan (includes $100 million local annual funding)
Transit Service	No Transit First Policy	Implement Regional Transit First Policy

Source: DVRPC 2010

DVRPC has updated its UPlan model since *Making the Land Use Connection: Regional What-if Scenarios* was published. UPlan's new capabilities relevant to scenario planning include locating infill development and estimating GHG emissions from buildings. DVRPC is in the process of updating its travel demand model from TranPlan to VISUM. This update was not complete at the time of modeling these scenarios, so results published here are from the TranPlan model. Test runs were completed in VISUM with similar results as TranPlan, but were not used as the model was not yet validated. DVRPC used HERS-ST (Highway Economic Requirements System–State version) to estimate pavement condition, safety, vehicle operating costs, and congestion indicators. Mobile 6.2, a postprocessor to the TranPlan model developed by the U.S. Environmental Protection Agency, is used to estimate vehicular emissions.

UPlan Assumptions

Figures A-2 to A-10 identify the assumptions for UPlan in each scenario for residential and commercial uses. These assumptions are used as inputs to the model as it simulates land development in a synthetic market. The Trend scenario inputs are based on the land use model's calibrated parameters based on land use and demographic changes in Greater Philadelphia between the 1990 and 2000 U.S. Census. Using these parameters, building densities are determined both as percent of total development for each category: low, medium, and high for residential; and low and high for commercial (Figures A-2, A-3, A-6, and A-7). Average

lot size, the inverse of units per acre, for each new residential unit is shown by scenario in Figures A-4 and A-5. Figure A-8 indicates that both scenarios make the same assumption for the amount of square feet of commercial space designed for each new employee in the region, while Figures A-9 and A-10 indicate the calibrated and adjusted floor area ratio (FAR) for commercial development in the two scenarios.

Figure A-2. Trend Residential Density Distribution

Residential Density	Growing				Stabilized				
	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
High	20.0%	15.2%	20.2%	17.2%	17.2%	28.7%	20.2%	24.3%	6.0%
Medium	22.0%	22.6%	22.6%	22.5%	22.6%	30.8%	37.1%	37.5%	18.0%
Low	57.0%	61.2%	56.2%	59.2%	59.2%	39.5%	41.7%	37.2%	74.9%
Very Low	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.1%

Source: DVRPC 2010

Figure A-3. Plan Residential Density Distribution

Residential Density	Growing				Stabilized				
	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
High	35.0%	30.1%	35.1%	31.1%	38.6%	49.4%	50.1%	42.2%	10.0%
Medium	28.5%	31.3%	28.8%	31.3%	26.3%	25.4%	26.1%	33.7%	25.0%
Low	35.5%	37.6%	35.1%	36.6%	34.1%	24.2%	23.8%	23.1%	64.9%
Very Low	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	0.1%

Source: DVRPC 2010

Figure A-4. Trend Average Lot Size in Acres by Residential Development Density

Residential Density	Growing				Stabilized				
	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
High	0.15	0.12	0.14	0.10	0.10	0.10	0.90	0.09	0.01
Medium	0.50	0.45	0.18	0.22	0.22	0.17	0.14	0.16	0.05
Low	1.00	1.10	0.67	0.77	0.77	0.71	0.30	0.50	0.10
Very Low	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Source: DVRPC 2010

Figure A-5. Plan Average Lot Size in Acres by Residential Development Density

Residential Density	Growing				Stabilized				
	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
High	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.01
Medium	0.15	0.15	0.15	0.15	0.16	0.15	0.15	0.15	0.03
Low	0.33	0.29	0.33	0.33	0.36	0.33	0.33	0.31	0.07
Very Low	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

Source: DVRPC 2010

Figure A-6. Trend Commercial Development Density Distribution

	Growing				Stabilized				
Use	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
Industrial	4.3%	0.1%	0.1%	5.0%	5.0%	8.2%	0.1%	11.7%	10.0%
Commercial High	12.0%	22.3%	22.3%	7.4%	7.4%	13.3%	22.3%	60.8%	10.0%
Commercial Low	83.7%	77.6%	77.6%	87.6%	87.4%	78.5%	77.6%	27.5%	80.0%

Source: DVRPC 2010

Figure A-7. Plan Commercial Development Density Distribution

	Growing				Stabilized				
Use	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
Industrial	4.3%	0.1%	0.1%	5.0%	5.0%	8.2%	0.1%	11.7%	10.0%
Commercial High	41.4%	48.7%	50.0%	39.2%	43.7%	45.9%	50.0%	70.8%	15.0%
Commercial Low	54.3%	51.2%	49.9%	55.8%	51.3%	45.9%	49.9%	17.5%	75.0%

Source: DVRPC 2010

Figure A-8. Trend and Plan Average Square Feet per Employee

	Growing				Stabilized				
Use	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
Industrial	1,000	600	300	1,800	600	675	300	500	500
Commercial High	400	375	200	400	600	350	450	200	200
Commercial Low	450	450	300	500	600	450	525	300	300

Source: DVRPC 2010

Figure A-9. Trend Commercial Development Floor Area Ratio

	Growing				Stabilized				
Use	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
Industrial	0.16	0.17	0.25	0.16	0.17	0.20	0.20	0.23	0.23
Commercial High	0.30	0.20	0.35	0.17	0.17	0.30	0.17	0.35	1.03
Commercial Low	0.10	0.14	0.25	0.10	0.10	0.20	0.12	0.15	0.17

Source: DVRPC 2010

Figure A-10. Plan Commercial Development Floor Area Ratio

	Growing				Stabilized				
Use	Bucks	Chester	Burlington	Gloucester	Montgomery	Delaware	Camden	Mercer	Philadelphia
Industrial	0.35	0.21	0.26	0.63	0.21	0.24	0.21	0.24	0.24
Commercial High	0.31	0.33	0.36	0.40	0.53	0.31	0.40	0.35	1.26
Commercial Low	0.26	0.26	0.26	0.28	0.34	0.26	0.30	0.17	0.21

Source: DVRPC 2010

UPlan Outputs

Based on UPlan's simulation of future development locations, the following tables detail county-level population, household, and employment estimates for each scenario. These tables are supporting documentation for this scenario analysis. Figures A-11 and A-12 show the infill and new footprint population growth for each county. Infill development occurs when already developed land is reused, has its density

increased by building additions or splitting into smaller units, or tearing down and rebuilding. New footprint development occurs on land that is open space today and has not previously been developed. Figures A-13 and A-14 show the infill and new footprint household growth. Figures A-15 and A-16 show the acres of land used for new residential development. Figures A-17 and A-18 show infill and the new footprint employment growth. Figures A-19 and A-20 show the acres of land used for new commercial and industrial development. Figures A-21 and A-22 show the square feet of commercial and industrial space built.

A key to this analysis was to ensure the amount of vacant land available to be built upon is more than the amount of land needed by scenario. Both scenarios were able to meet their development needs within the amount of land allocated as available for residential and commercial use.

Figure A-11. Trend Scenario Infill and New Footprint Population Growth: 2005–2035

County	2005 Population	2005–2035 New Footprint	2005–2035 Infill	2035 Population
Bucks	624,350	84,789	41,066	750,205
Chester	473,881	62,797	92,020	628,698
Delaware	555,204	4,009	4,486	563,699
Montgomery	780,541	66,492	51,126	898,159
Philadelphia	1,483,848	358	1,594	1,485,800
Pennsylvania Subtotal	3,917,824	218,445	190,292	4,326,561
Burlington	446,864	32,527	55,845	535,236
Camden	515,007	1,951	7,401	524,359
Gloucester	274,230	52,354	33,429	360,013
Mercer	365,093	13,531	23,094	401,718
New Jersey Subtotal	1,601,194	100,363	119,769	1,821,326
DVRPC Region Total	5,519,018	318,808	310,061	6,147,887

Source: DVRPC 2010

Figure A-12. Plan Scenario Infill and New Footprint Population Growth: 2005–2035

County	2005 Population	2005–2035 New Footprint	2005–2035 Infill	2035 Population
Bucks	624,350	33,859	70,522	728,731
Chester	473,881	26,508	79,563	579,952
Delaware	555,204	3,587	29,244	588,035
Montgomery	780,541	36,628	60,050	877,219
Philadelphia	1,483,848	3,550	71,104	1,558,502
Pennsylvania Subtotal	3,917,824	104,132	310,483	4,332,439
Burlington	446,864	24,279	50,239	521,382
Camden	515,007	8,923	20,952	544,882
Gloucester	274,230	22,072	45,351	341,653
Mercer	365,093	10,082	37,203	412,378
New Jersey Subtotal	1,601,194	65,356	153,745	1,820,295
DVRPC Region Total	5,519,018	169,488	464,228	6,152,734

Source: DVRPC 2010

Figure A-13. Trend Scenario New Footprint and Infill Household Growth: 2005–2035

County	2005 Households	2005–2035 New Footprint Households	2005–2035 Infill Households	2035 Total Households	Population / Household
Bucks	229,839	35,329	14,001	279,169	2.7
Chester	171,987	26,166	31,308	229,461	2.7
Delaware	207,606	3,643	3,088	214,337	2.6
Montgomery	299,455	27,707	17,517	344,679	2.6
Philadelphia	584,004	256	831	585,091	2.5
Pennsylvania Subtotal	1,492,891	93,101	66,745	1,652,737	2.6
Burlington	163,204	13,554	18,059	194,817	2.7
Camden	187,978	1,505	4,524	194,007	2.7
Gloucester	98,147	20,936	10,181	129,264	2.8
Mercer	130,394	6,444	8,235	145,073	2.8
New Jersey Subtotal	579,723	42,439	40,999	663,161	2.7
DVRPC Region Total	2,072,614	135,540	107,744	2,315,898	2.7

Source: DVRPC 2010

Figure A-14. Plan Scenario New Footprint and Infill Household Growth: 2005–2035

County	2005 Households	2005–2035 New Footprint Households	2005–2035 Infill Households	2035 Total Households	Population / Household
Bucks	229,839	14,719	23,744	268,302	2.7
Chester	171,987	11,522	26,322	209,831	2.8
Delaware	207,606	2,757	18,000	228,363	2.6
Montgomery	299,455	16,650	21,483	337,588	2.6
Philadelphia	584,004	2,087	33,636	619,727	2.5
Pennsylvania Subtotal	1,492,891	47,735	123,185	1,663,811	2.6
Burlington	163,204	10,555	16,954	190,713	2.7
Camden	187,978	6,368	11,860	206,206	2.6
Gloucester	98,147	9,196	14,398	121,741	2.8
Mercer	130,394	4,800	13,243	148,437	2.8
New Jersey Subtotal	579,723	30,919	56,455	667,097	2.7
DVRPC Region Total	2,072,614	78,654	179,640	2,330,908	2.6

Source: DVRPC 2010

Figure A-15. Trend Scenario Residential Land Development: 2005–2035

County	2005 Residential Land (Acres)	2005–2035 New Footprint Residential Development (Acres)	2005–2035 Infill Residential Development (Acres)	2035 Total Residential Land (Acres)	Average Units Per Acre
Bucks	110,976	25,900	10,180	136,876	2.0
Chester	123,057	21,320	25,488	144,377	1.6
Delaware	57,028	1,430	1,228	58,458	3.7
Montgomery	122,966	15,119	9,758	138,085	2.5
Philadelphia	36,405	26	149	36,431	16.1
Pennsylvania Subtotal	450,433	63,795	46,803	514,228	3.2
Burlington	65,522	5,593	7,450	71,115	2.8
Camden	52,446	272	845	52,718	3.7
Gloucester	46,089	9,896	4,796	55,985	2.4
Mercer	40,321	1,624	2,055	41,945	3.5
New Jersey Subtotal	204,377	17,385	15,146	221,762	3.1
DVRPC Region Total	654,810	81,180	61,949	735,990	3.2

Source: DVRPC 2010

Figure A-16. Plan Scenario Residential Land Development: 2005–2035

County	2005 Residential Land (Acres)	2005–2035 New Footprint Residential Development (Acres)	2005–2035 Infill Residential Development (Acres)	2035 Total Residential Land (Acres)	Average Units Per Acre
Bucks	110,976	3,054	4,973	114,030	2.4
Chester	123,057	2,305	5,281	125,362	1.7
Delaware	57,028	505	3,163	57,533	4.0
Montgomery	122,966	3,870	5,015	126,836	2.7
Philadelphia	36,405	257	2,047	36,662	16.9
Pennsylvania Subtotal	450,433	9,951	20,479	460,424	3.6
Burlington	65,522	2,028	3,248	67,550	2.8
Camden	52,446	1,002	1,881	53,448	3.9
Gloucester	46,089	1,831	2,842	47,920	2.5
Mercer	40,321	772	2,124	41,093	3.6
New Jersey Subtotal	204,377	5,633	10,095	210,010	3.2
DVRPC Region Total	654,810	15,624	30,574	670,434	3.5

Source: DVRPC 2010

Figure A-17. Trend Scenario Infill and New Footprint Employment Growth: 2005–2035

County	2005 Employment	2005–2035 New Footprint Employment	2005–2035 Infill Employment	2035 Employment
Bucks	277,886	30,093	33,712	341,691
Chester	253,628	49,986	33,542	337,156
Delaware	237,582	295	5,730	243,607
Montgomery	505,952	45,076	34,466	585,494
Philadelphia	728,054	208	8,803	737,065
Pennsylvania Subtotal	2,003,102	125,658	116,253	2,245,013
Burlington	214,621	10,802	35,111	260,534
Camden	222,721	2,103	1,181	226,005
Gloucester	108,229	17,531	20,889	146,649
Mercer	228,502	21,311	19,736	269,549
New Jersey Subtotal	774,073	51,747	76,917	902,737
DVRPC Region Total	2,777,175	177,405	193,170	3,147,750

Source: DVRPC 2010

Figure A-18. Plan Scenario Infill and New Footprint Employment Development: 2005–2035

County	2005 Employment	2005–2035 New Footprint Employment	2005–2035 Infill Employment	2035 Employment
Bucks	277,886	17,064	34,592	329,542
Chester	253,628	17,623	37,046	308,297
Delaware	237,582	4,093	19,405	261,080
Montgomery	505,952	22,103	41,076	569,131
Philadelphia	728,054	4,748	49,749	782,551
Pennsylvania Subtotal	2,003,102	65,631	181,868	2,250,601
Burlington	214,621	10,802	23,442	248,865
Camden	222,721	2,103	10,488	235,312
Gloucester	108,229	17,531	17,356	143,116
Mercer	228,502	21,311	27,614	277,427
New Jersey Subtotal	774,073	51,747	78,900	904,720
DVRPC Region Total	2,777,175	117,378	260,768	3,155,321

Source: DVRPC 2010

Figure A-19. Trend Scenario Commercial Development: 2005–2035

County	2005 Developed Land (Acres)	2005–2035 New Footprint Commercial Development (Acres)	2005–2035 Infill Commercial Development (Acres)	2035 Total Commercial Land (Acres)	Employees per Acre
Bucks	21,811	2,892	3,234	24,703	13.8
Chester	15,862	3,353	2,251	19,215	17.5
Delaware	10,877	21	296	10,898	22.4
Montgomery	22,655	5,886	4,480	28,541	20.5
Philadelphia	17,114	16	386	17,130	43.0
Pennsylvania Subtotal	88,319	12,168	10,647	100,487	22.3
Burlington	13,380	265	854	13,645	19.1
Camden	14,138	167	101	14,305	15.8
Gloucester	11,135	2,034	2,445	13,169	11.1
Mercer	8,825	567	522	9,392	28.7
New Jersey Subtotal	47,478	3,033	3,922	50,511	17.9
DVRPC Region Total	135,797	15,201	14,569	150,998	20.8

Source: DVRPC 2010

Figure A-20. Plan Scenario Commercial Development: 2005–2035

County	2005 Developed Land (Acres)	2005–2035 New Footprint Commercial Development (Acres)	2005–2035 Infill Commercial Development (Acres)	2035 Total Commercial Land (Acres)	Employees per Acre
Bucks	21,811	628	3,054	22,439	14.7
Chester	15,862	585	2,305	16,447	18.7
Delaware	10,877	148	505	11,025	23.7
Montgomery	22,655	820	3,870	23,475	24.2
Philadelphia	17,114	134	257	17,248	45.4
Pennsylvania Subtotal	88,319	2,315	9,951	90,634	24.8
Burlington	13,380	204	2,028	13,584	18.3
Camden	14,138	254	1,002	14,392	16.7
Gloucester	11,135	278	1,831	11,413	11.7
Mercer	8,825	202	772	9,027	29.4
New Jersey Subtotal	47,478	938	5,633	48,416	18.3
DVRPC Region Total	135,797	3,253	15,624	139,050	22.6

Source: DVRPC 2010

Figure A-21. Trend Scenario Commercial and Industrial Development: 2005–2035

	Millions of Square Feet		
County	Commercial New Footprint Development	Commercial Infill Development	Total New Commercial Development
Bucks	14.04	15.75	29.78
Chester	21.69	14.56	36.25
Delaware	0.14	2.61	2.75
Montgomery	27.06	20.61	47.67
Philadelphia	0.09	2.88	2.97
Pennsylvania Subtotal	63.03	56.39	119.43
Burlington	3.00	9.75	12.75
Camden	1.02	0.58	1.60
Gloucester	9.75	11.63	21.38
Mercer	5.60	5.18	10.78
New Jersey Subtotal	19.36	27.15	46.51
DVRPC Region Total	82.40	83.54	165.94

Source: DVRPC 2010

Figure A-22. Plan Scenario Commercial and Industrial Development: 2005–2035

	Millions of Square Feet		
County	Commercial New Footprint Development	Commercial Infill Development	Total New Commercial Development
Bucks	7.74	15.72	23.45
Chester	7.30	15.32	22.62
Delaware	1.73	8.22	9.95
Montgomery	13.26	24.57	37.83
Philadelphia	2.75	15.93	18.68
Pennsylvania Subtotal	32.78	79.74	112.52
Burlington	3.00	5.86	8.86
Camden	1.02	5.13	6.15
Gloucester	9.75	9.08	18.83
Mercer	5.60	6.98	12.57
New Jersey Subtotal	19.36	27.05	46.41
DVRPC Region Total	52.14	106.79	158.93

Source: DVRPC 2010

Abstract

Publication Title:	Implementing Connections: The Benefits for Greater Philadelphia
Publication Number	11045
Date Published	February 2011
Geographic Area Covered	The nine-county Greater Philadelphia area, which covers the counties of Bucks, Chester, Delaware, Montgomery and Philadelphia in Pennsylvania and Burlington, Camden, Gloucester and Mercer in New Jersey.
Key Words	Scenarios, What-if analysis, Long-Range Plan, *Connections*, Core Plan Principles, 2035, Growth Management, Land Preservation, Livable Communities, Energy-Efficient Economy, Multimodal Transportation, Transit First, Regional Funding, Transportation Funding, Transportation Infrastructure, Bridge Condition, Pavement Condition, Transit Vehicle Age, Plan Implementation, Blueprint Scenario.
Abstract	This analysis utilizes DVRPC's modeling capabilities to illustrate and quantify the benefits of implementing the policies and goals defined in the *Connections* Plan, through a Plan scenario, compared to a continuation of our region's business-as-usual Trend scenario. Both scenarios are set in the horizon year of the Plan, 2035, and compared to each other and current conditions (2010).

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REALIZING OUR POTENTIAL

We can transform our region and position ourselves for a promising future. But to achieve this goal, we must acknowledge the value of what we have and how we can capitalize on our strengths to become a model of sustainability, prosperity, and productivity.

DVRPC is working with elected officials, regional stakeholders, and the public to implement the *Connections* plan. The plan defines regional policy and establishes a collective vision to enhance our environment, promote energy conservation, optimize transportation, guide investments, ensure consistency, and improve the quality of life for all residents throughout our region. Greater Philadelphia has the opportunity to shape land use and development to create a greener, more sustainable, and economically competitive future. This in turn can help to achieve the vision of a more modern, multimodal transportation system; preservation of an additional 500,000 acres of open space; more livable communities; and a 50-percent reduction in GHG emissions.

This analysis gives local officials and citizens a concise view of the benefits that implementing the *Connections* plan and policies will mean for the region over the next 25 years.

Download the *Connections* plan and learn more about what you can do at **www.dvrpc.org/connections**.

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