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DVRPC

White Paper

# The Future of Scenario Planning



DELAWARE VALLEY dvrpc REGIONAL PLANNING COMMISSION

# Contents

## Summary

Scenario planning plays an important role in the long-range planning process. It can foster strategic thinking about the future, help to deal with uncertainty, improve decision-making, and engage stakeholders and the public in the visioning process. The Delaware Valley Regional Planning Commission (DVRPC) has conducted four scenario planning exercises and developed an interactive online scenario application, Choices & Voices (www.dvrpc.org/choicesandvoices).

This white paper reviews current practices in scenario planning, DVRPC's scenario planning experience and lessons learned, and makes key recommendations about how DVRPC can improve its practices, including:

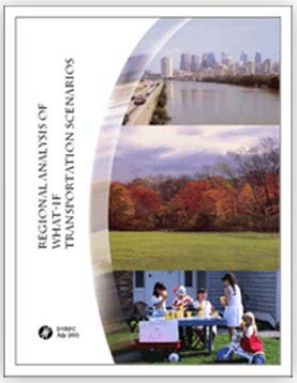
- Improving collaboration with regional stakeholders in scenario work;
- Broadening public outreach and using social media to reach diverse constituents;
- Continuing to build on the Choices & Voices framework, adding new options and allowing for more variance; and
- Identifying action steps to achieve a desired future or better prepare for drivers of change.

It also proposes new directions for the next round of scenario planning:

- Investigate underlying **driving forces of change**, such as the social (i.e., shifting lifestyle preferences of Millennials), technological (i.e., autonomous vehicles), environmental (i.e., climate change), economic (i.e., cheap/volatile energy or the shared economy), and political changes that are likely to transform the future. These are things that the region has little control over, but it is important to understand their potential impacts and how we can prepare for and adapt to them; and
- Identify **regional gamechanger(s)**, which could be major transportation infrastructure projects, such as high-speed rail in the Northeast Corridor, or significant new development centers.

The next scenario exercise should be conducted in collaboration with a working group, comprised of key regional stakeholders, and involve the general public to a greater extent. Social media should be used to poll the public and regional stakeholders on their priorities and areas that they would like the region to focus on in scenario planning. Starting with a blank slate, the futures working group should consider the future out to the year 2045 by:

1. Engaging transportation, land use, economic, environmental, and health experts about future drivers of change, challenging conventional wisdom;
2. Brainstorming global drivers of change and regional gamechangers;
3. Voting on impact and likelihood of identified drivers and gamechangers;
4. Identifying four or five highly differentiated scenarios for further analysis;
5. Fleshing out the selected scenarios to create robust visions of the future in each;
6. Analyzing scenarios and identify probable implications;
7. Identifying robust actions that the region can take to be successful across all futures, and contingent actions to be more successful in each different future;
8. Identifying potential leading indicators for each scenario; and
9. Creating a short, graphic publication about the scenarios, and incorporating new options into the existing Choices & Voices framework.






# I. Scenario Planning

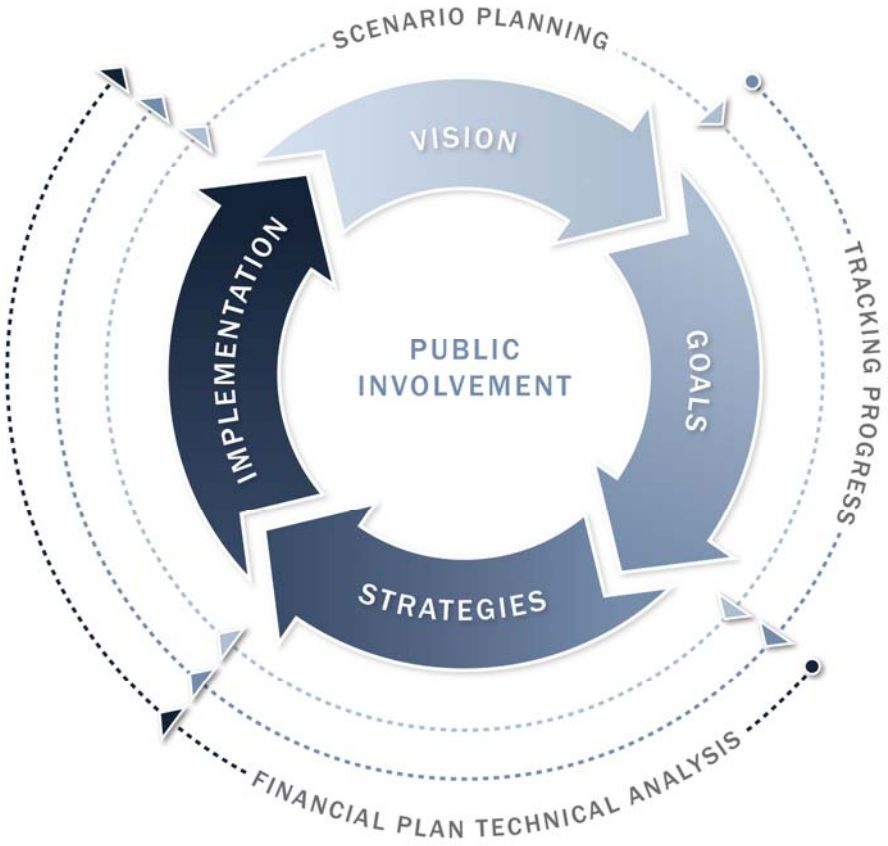
The Delaware Valley Regional Planning Commission (DVRPC) recognizes that scenarios play a key role in the long-range planning process and can allow the agency to think strategically about the future, deal with uncertainty, improve decision-making, and engage stakeholders and the public. Scenario planning is most effective if it is part of a broader management program that contains performance measures and strategy implementation.

The region's long-range plan ("the Plan") sets regional goals and vision. The *Connections 2040* vision is:

- A more sustainable future that offers a superior quality of life by:
  - Increasing mobility choices;
  - Channeling development to appropriate areas;
  - Reinvigorating existing communities; and
  - Reducing demand for energy.

Additional long-range planning efforts seek to refine goals and strategies for the Plan's implementation, and/or guide future updates to the Plan. These products include: Tracking Progress indicators, scenario planning, and financial plan technical analysis. Scenario planning potentially plays a role in all steps of the long-range planning process: creating a vision for the future; goal setting, strategy development, and implementation.

### DVRPC's Long-Range Planning Process and Products




*Source: DVRPC 2013.*

As DVRPC is not in a position to implement all elements of the Plan, this phase is a particular challenge. The Commission works with regional stakeholders, operating agencies, and the public to make the Plan a reality. DVRPC can help to bring about positive transformative impacts for the region by showing the benefits of better ways of building and envisioning transportation infrastructure, community development patterns, and understanding the critical roles of technology and economics. Using scenarios to model future alternatives for the region under different development patterns, investment levels, or full implementation of the Long-Range Plan are some of the ways that DVRPC has attempted to show benefits.

There are numerous types of scenarios, including:

- Normative scenarios – identify and articulate people's values to develop alternative visions for the future. These could consider how funding different types of transportation projects, or how changing land use regulations would shape the community in the future, and they are often compared to a baseline trend or business-as-usual scenario;
- Exploratory scenarios – start in the present and project into the future using anticipated trends;
- Alternative Futures (global driving forces) – develop out of driving forces of change that are beyond the control of an organization, but affect the organization's operating environment. They can be used to develop strategies, assess strategic plans, or serve as an educational tool to develop goals;
- Anticipatory scenarios (backcasting, or prescriptive scenarios) – set a long-term vision for the future, then develop intermediate steps on how to get there;
- Interactive scenarios (war games) – set rules of interaction amongst a set of variables or actors, which are then allowed to play out the future. Unexpected events may provide additional challenges; and
- Event-driven scenarios – consider how specific events would impact the underlying business operations of a firm, or perhaps an evacuation plan or recovery efforts in transportation planning.

Normative and exploratory scenarios are most commonly used in regional planning. Business and industry most commonly use global driving forces scenarios. These three types of scenarios will be the focus of this white paper. Although the goals between regional planning (cost-effective, competitive transportation system) vary from business perspectives (maximizing profits and staying afloat in a competitive and dynamically changing world), there is value to considering practices from both fields. There are a variety of approaches to conducing scenario analysis:

- The Delphi technique uses expert group opinion to gauge scenario impacts. It generally utilizes a more qualitative, group-driven analysis;
- Quantitative (or probability-based) models use mathematical projection and forecasting techniques to estimate best-case, likely-case, and worst-case scenarios. These models assume that all the key variables are known and their relationships are static;
- Deductive analysis combines the most critical uncertainties into a matrix; and
- Inductive analysis starts with an official vision of the future and then considers how it could evolve differently.

This white paper reviews current practices in scenario planning, DVRPC's scenario planning experience and lessons learned, and makes key recommendations about how DVRPC can improve its practices, including identifying preliminary options for the next generation of scenario planning.

> "*A primary goal of scenario planning is to engage the general public, the business community, resource agencies, and elected officials on a broad scale; to gain a thorough understanding of community values, growth trends, and tradeoffs; and to incorporate participants' values and feedback into future plans*."
>
> - FHWA
>
> Scenario Planning: A Holistic Approach to Integrating Land Use and Transportation

*"With limited resources available, state policy makers are being forced to make difficult choices about transportation policies and spending. But the need for more strategic and data-driven deliberation goes beyond the immediate budget crisis. Transportation plays a vital role in every state's ability to bolster jobs and commerce, improve mobility and access, help ensure public safety and protect the environment."*

- The Rockefeller Foundation and the Pew Center on the States

Measuring Transportation Investments: The Road to Results.

## Regional Planning Scenarios

In 2005, Dr. Keith Bartholomew of the University of Utah reviewed 80 Metropolitan Planning Organization (MPO) scenario plans from a 15-year period, including DVRPC's 2003 *Regional Analysis of What-If Transportation Scenarios*. The review was summarized in *Integrating Land Use Issues into Transportation Planning: Scenario Planning.* It found that nearly all transportation planning scenarios consider the impact that land use and the transportation system have on each other. Thus, each transportation scenario will have a different resulting land use pattern. This report particularly influenced DVRPC's *Making the Land Use Connection*.

The Federal Highway Administration (FHWA) created a *Scenario Planning Guidebook* that recommends the use of scenario planning to better create a regional vision for the future. FHWA recommends using scenarios to analyze the health, transportation, livability, economic, and land use forces that will affect communities in the future. FHWA envisions a six-step scenario planning process:

1. Getting started;
2. Where are we now?
3. Who are we and where do we want to go?
4. What could the future look like?
5. What impacts will different scenarios have? and
6. How do we reach our desired future?

The most common types of transportation scenarios consider land use, different levels of growth, or changes in policies:

- Center, cluster, or satellite land use;
- Compact land use;
- Dispersed, fringe, or highway-oriented land use;
- Corridor land use;
- Infill or redevelopment;
- Baseline/continuation of trends;
- Growth/socioeconomic change;
- Policy changes; or
- Hybrid of the above.

Other factors that scenario analysis could consider include climate change, alternative energy, population growth, and population decline. The next generation of scenario planning could consider how demographic shifts, such as immigration or aging populations, technology, fuel type and prices, climate change and associated policies, and economic shifts could impact the future.

Engaging the public in scenario planning is a good practice. Visualization techniques can help to illustrate different scenarios to the public and stakeholders:

- Chip games to identify preferred development locations and types;
- Charrettes;
- Place-type renderings to present a human-scale look and feel for development patterns;
- Schematic images over a broad area; and

- GIS mapping and other visualizations.

Endeavors should consider four or five scenarios per exercise. Having only two scenarios suggests that one is "good" and one is "bad," while three scenarios usually leads to the selection of the one in the middle as a compromise between the three. More than five can lead to information overload, as individuals are limited by how much information they can process at once, especially when comparing alternative choices over time.

The order in which alternatives are presented can make a difference in how they are perceived. In general, regardless of which scenario is presented first, it becomes the normative case against which all others are compared. Presenting the baseline case first compounds this problem. Also, scenario names can show bias. For instance, "sprawl" and "business as usual" connote a bad choice, while "smart growth" or "village/town centers" implies a positive choice.

A good outcome of a scenario planning process "is a comprehensive vision that identifies how state, community, regional, or study-area stakeholders would like the transportation system to look and function in the future, given anticipated factors and trends."[1] The comprehensive vision should also identify strategic actions, performance measures, and a plan for monitoring progress.

## Business and Industry Scenario Practices

The business world uses scenarios to guide short-term strategic decision-making, while keeping abreast of long-term drivers of change. Some best practice recommendations are similar to transportation planning, such as conducting scenario development and analysis as a team-building exercise, collaborating, and using in-depth analysis to make better sense of a fast-changing world.

Peter Schwartz, of the Global Business Network, describes business-focused scenarios as being a team oriented process that extends thinking. The scenario team should begin by collaborating with diverse groups and bringing in outside experts to extend thinking beyond conventional wisdom. This background information should influence development of the scenarios to analyze. The team should question underlying assumptions, use in-depth analysis to enhance comprehension of the future and make better sense of the complex world, and extend the realm of possibilities. The conversation to identify the scenarios is a critical part of the process. It can uncover options that hadn't been previously considered. The developed scenarios should paint vivid descriptions of the future and contain both insight and creativity.

Once credible scenarios have been identified, the next step is to determine leading indicators that identify which future scenario the world is moving toward. The group should then consider what to do, or stop doing, in order to be successful; identify risks and opportunities; and look for actions that would be beneficial, regardless of which future ultimately comes to fruition. The goal is not to get the future exactly right, but rather to identify intermediate actions that should be undertaken in order to make the most strategic decisions.

*NCHRP Report 750: Scenario Planning for Freight Transportation Infrastructure Investment* reviews the results of the Future Freight Flows workshop conducted at DVRPC and other locations around the United States in 2011. It lists a few desired attributes that commonly came up in researching scenarios:

Scenario planning is a method for assessing differing long-term strategies. This has numerous benefits, including:

- Basis for an analytical framework and process for understanding complex issues and responding to change;
- Consensus building by giving communities the capacity to participate actively in planning;
- Developing tools and techniques to assess the impact of transportation and other public policy choices on a community;
- Opportunity to recognize the impact of tradeoffs among competing goals;
- Enhanced decision-making framework; and
- Helps ensure improved management of increasingly limited resources.

- FHWA

[1] FHWA 2011.

- Incorporate two to four scenarios;
- Challenge conventional wisdom;
- Use highly differentiated futures;
- Contain alternatives – there should not be a 'preferred' future scenario. Scenarios that replicate an established vision for the future should be avoided—this tends to attract interested parties and defeats the purpose of the task;
- Scenarios should focus on specific issues related to an organization's near-term decision-making, but should not directly answer the focal question;
- Scenarios should be plausible, given the current world situation. A scenario that assumes that technology will solve all the world's problems is not realistic because it relies on a highly improbable outcome; and
- Scenario names should be catchy, so they can easily be evoked after the fact.

The NCHRP 750 report also offers an alternative, more business-oriented process for conducting a scenario planning exercise:

1. Identify the focal issue – what is the central question to be answered?
2. Identify key local factors – what are the things that influence the success or failure of the focal issue, and how do they relate to the stakeholders?
3. Identify driving forces – what are the macro factors that affect the organization, but are not controlled or influenced by it?
4. Rank driving forces by importance and uncertainty – focus scenario development on the most critical forces;
5. Select scenario logic – identify the set of most critical forces identified in the ranking set. Often the two most important and uncertain forces are selected, allowing for the creation of a two by two matrix with four possible options;
6. Flesh out scenarios – less critical factors (those background forces are most likely to occur regardless of the scenario) are incorporated to create credible and logical scenarios;
7. Apply the scenarios and uncover implications – appropriate stakeholders discuss and evaluate the proposed scenarios. The group will then separate robust decisions (useful in all situations) from the contingent ones (useful in specific scenarios); and
8. Identify leading indicators and signposts – these are identified as a way to determine which scenario the world may be heading toward.

## Criticisms of Scenario Planning

General criticisms of scenario planning can be summarized as:

- A lack of confidence in subjective scenario analysis;
- It is difficult to determine if the chosen scenarios are the right ones. If other scenarios are selected, one may arrive at different conclusions;
- It is difficult to avoid information overload, and most people have a difficult time keeping multiple indicators for multiple scenarios clear in their mind;
- Many people and organizations have a difficult time conceiving single views of the future, let alone multiple views;
- It can be difficult to go from scenario results to decision-making; and

- It is unclear how scenario analysis performs with other methods to forecast and plan for the future; especially in terms of the cost to develop relative to performance.[2]

In response to these general criticisms, DVRPC generally has not conducted purely subjective scenario analysis, and does not intend to do so. Expanding the group voting done in DVRPC's *Regional Analysis of What-if Scenarios* to determine the impact and likelihood of potential scenarios is a way to improve scenario selection. DVRPC has worked to reduce information overload by sticking to two or three scenarios, and limiting the number of indicators used. Choices & Voices allows users to develop their own unique future scenario and uses eight indicators to give feedback. Action steps have been formulated through other long-range planning efforts. An example of this is the needs assessment in the financial plan and the *Transportation Investment Scenarios*, both showing serious consequences for future bridge conditions at current funding levels. As a result, the *Connections 2040* plan proposed to increase allocation for bridge maintenance and repairs to 50 percent of all roadway revenues. DVRPC is continually working to create more overlap between long-range plan analytical efforts. One way to simplify analytical measures is to use similar approaches and indicators at both the macro (i.e. scenarios, long-range plan technical analysis, tracking progress) and the micro levels (project evaluation, transportation facility project needs).

The Lincoln Institute of Land Policy in *Opening Access to Scenario Planning Tools* had the following goals for improving scenario planning practices:

- Increase understanding and acceptance of scenario planning;
- Overcome the complexity and cost of tools;
- Improve access to existing data;
- Enhance interoperability among different tools; and
- Create mechanisms to integrate foresight and anticipation into planning processes and implementation.

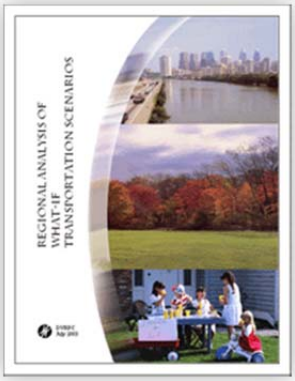
Simplifying, gaining acceptance, improving data access, interoperability between analytical tools, and bringing more thinking about how the future could be different and how we should prepare and respond to it is good advice to remember as the next generation of scenario planning is being developed at DVRPC.

[2] Peers to scenario planning include contingency planning (for a single uncertainty), sensitivity analysis (which varies one variable and sees how other variables react), and computer simulation. In some ways, these tools can be a part of a larger scenario analysis, though they can also stand on their own.

## DVRPC Scenario Planning Efforts

Over the past 10 years, DVRPC has conducted four internal scenario planning exercises in support of long-range planning efforts. These scenarios have helped shape the preferred vision of the region's future and gauge how the region performs under different resource levels. They have also led to the development of an interactive online scenario application. The Commission's scenario planning endeavors include:

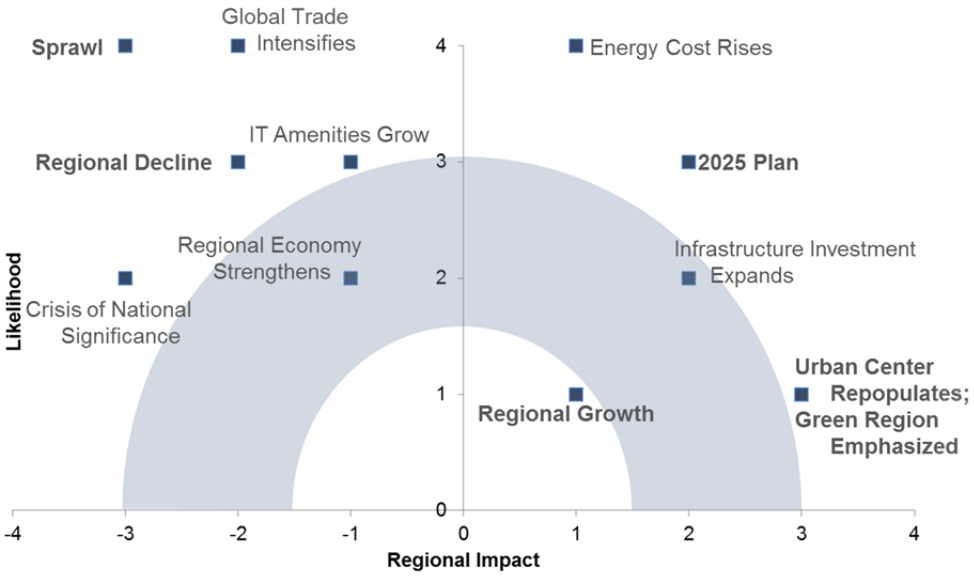
- *Regional Analysis of What-if Transportation Scenarios* (2003, DVRPC publication #03020);
- *Making the Land Use Connection: Regional What-if Scenario Analysis* (2008, DVRPC publication #08059);
- *Implementing Connections: The Benefits for Greater Philadelphia* (2011, DVRPC publication #11045);
- *Connections 2040: Transportation Investment Scenarios* (2012, DVRPC publication #13004);
- Choices & Voices version 1.0 (www.dvrpc.org/asp/choicesandvoicesv1, launched October 2012); and
- Choices & Voices version 2.0 (www.dvrpc.org/asp/choicesandvoices, launched October 2013).




### Regional Analysis of What-if Transportation Scenarios

The *Regional Analysis of What-if Transportation Scenarios* began with a working group that brainstormed 12 different future scenarios. It conducted an impact and likelihood analysis to determine which scenarios were most likely to occur and which ones would yield the greatest change relative to then-current trends. This assessment was used to identify scenarios for further analysis.

**Regional What-if Transportation Scenarios Impact-Likelihood Comparison of Scenarios**




*Bolded scenarios were selected for additional analysis.*

*Source: DVRPC 2013.*

The working group chose to further analyze five scenarios: Sprawl, 2025 Plan, Recentralization (combining Urban Center Repopulates and Green Region Emphasized), Regional Decline, and Regional Growth. The transportation impacts of these scenarios were analyzed through the regional travel demand model. Some of the proposed scenarios were identified as trends that are likely to happen, particularly global trade intensifying, IT amenities growing, and rising energy costs. These trends were incorporated as assumptions into all the scenarios analyzed.

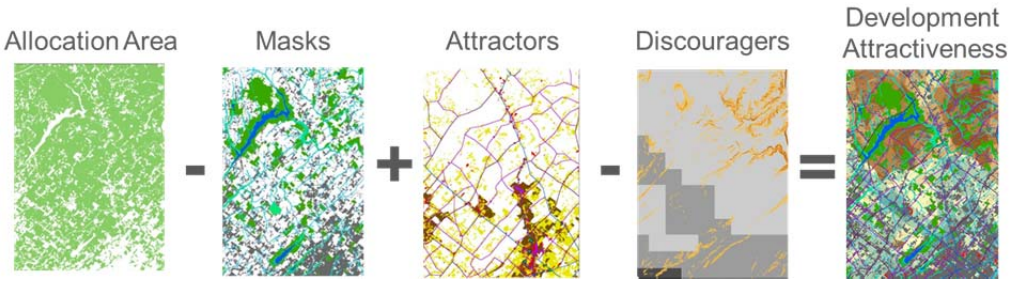
The *Regional Analysis of What-if Transportation Scenarios* identified a need for a regional land use model, and developed the framework for the two land use scenario analyses: *Making the Land Use Connection* and *Implementing Connections: The Benefits for Greater Philadelphia*. These scenarios focused largely on the impacts of different development patterns on the region's transportation system, the environment, and the economy.

## Making the Land Use Connection


*Making the Land Use Connection* focused on three different future development patterns: an increase in sprawl to the outer portions of the nine-county region, a continuation of the development trend (with most growth occurring in the outer portions of the region), and a recentralization of population and employment around the region's core. In recentralization, most population and employment growth was considered to be infill, and very little new footprint greenfield development was anticipated.

These scenarios were modeled using a then-new land use model, UPlan. This program was developed at the University of California-Davis and calibrated for the Greater Philadelphia region using land use changes between the 1990 and 2000 U.S. Census. UPlan is a planning decision support system, and not an urban growth model. It is rule based, but has no statistical calibration. It runs on a Geographic Information Systems (GIS) platform and infers long-term land use outcomes in a synthetic land market, with no interim use basis. Development can be located using either a grid (as done by DVRPC) or a parcel layer, and can be conducted using zoning or through municipal policy coefficients (as done by DVRPC).

### UPlan Future Development Attractiveness




- Allocation = Vacant + Wooded + Agricultural
- Masks = Water + Existing Development + Protected Lands
- Attractors = Similar Type Development (Clustering) + Transportation Facilities + Sewers + Municipal Policy Coefficients
- Discouragers = Congestion + Steep Slope + Municipal Policy Coefficients

*Source: DVRPC 2008.*

UPlan restricts development to new footprint (undeveloped land) or user-identified redevelopment areas, called the allocation layer. It then masks out undevelopable

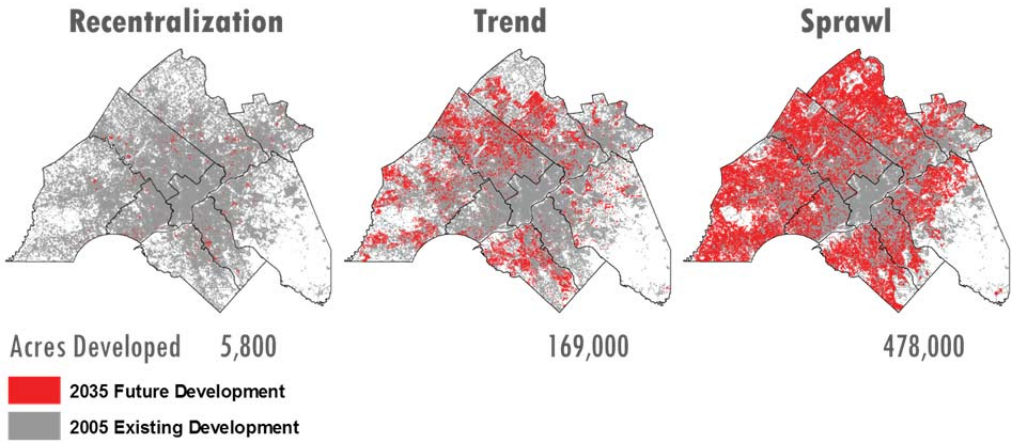
land. Attractors identify data that is appealing to development, and these are unique for each land use. Detractors identify data that are not appealing to future development. The resulting layer combines all these factors and is unique for each of the seven different land uses.

UPlan then allocates future development by type, with the following bidding priority, in order from highest to lowest:

1. Industrial – highest bidder;
2. Commercial high density;
3. Residential high density;
4. Commercial low density;
5. Residential medium density;
6. Residential low density; and
7. Residential very low density – lowest bidder.

The results of the UPlan land development allocation for *Making the Land Use Connection* are shown in the following figure. The sprawl scenario featured large lot greenfield suburban development patterns, while the recentralization featured a dense, mixed-use infill development pattern, primarily located in the region's core.

### Making the Land Use Connection Scenarios



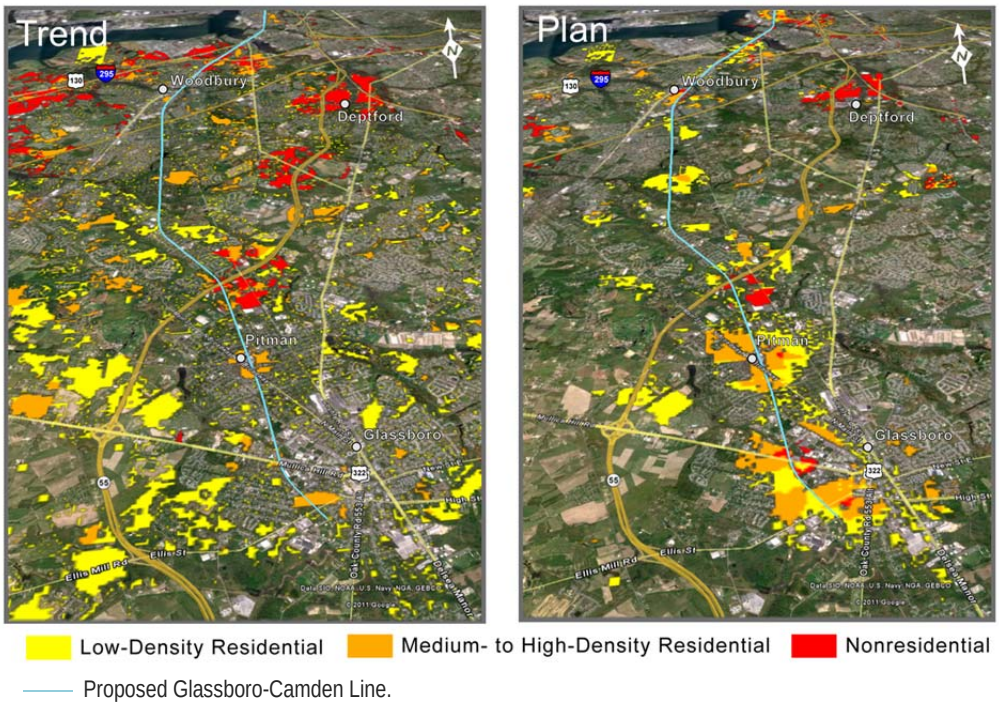

*Source: DVRPC 2008.*

Each of these scenarios' transportation impacts were identified using the DVRPC travel demand model. As might be expected, sprawl generated more driving, and more congestion. Recentralization meant more transit ridership, and more biking and walking trips. These scenarios were presented in a series of public workshops throughout the nine-county region. Workshop participants voiced a preference for recentralization, but at a slightly lower development density. Thus, the *Connections (2035)* plan focused future development around more than 120 Centers spread throughout Greater Philadelphia.

## Implementing Connections: The Benefits for Greater Philadelphia


After *Connections (2035)* was adopted, DVRPC followed up with a scenario analysis, *Implementing Connections*, which quantified the benefits of the Plan. This analysis compared then-present-day (2010) conditions to future (2035) conditions in the 'Plan' and business-as-usual 'Trend' scenarios. The Plan focused development at a lower density than Recentralization in 120-plus regional development Centers. These Centers were then prioritized for investment in the long-range plan project evaluation process. By coordinating land use and transportation projects, the region can expect a better return on investment on its limited funds.

### Implementing Connections Glassboro-Camden Line Corridor Analysis




*Source: DVRPC 2011.*

## Connections 2040: Transportation Investment Scenarios


As the region's funding situation became critical, the *Connections 2040: Transportation Investment Scenarios* considered what different funding levels would mean for the region's transportation infrastructure and the larger regional economy. The high funding scenario was seen as a best-case outcome for transportation funding, the medium a likely outcome, and the low a worst-case outcome. The report then considered what could and could not be afforded in each scenario. This analysis was conducted with collaboration from a variety of regional planning partners. It was more narrative and asset management system driven, and didn't use the travel demand model. It also included more short- and medium-term impacts, helping to bring the scenarios into more immediate focus.

The final product was a more publicly accessible report, and one that tied investment back to economic competitiveness and quality of life. It was also used to provide guidance for the *Connections 2040* financial plan. It led to the allocation of a greater proportion of the region's transportation funding to system preservation, while reducing the level of investment in system expansion.

## Choices & Voices

The results of both the land use and transportation investment scenarios were used to create the Choices & Voices online scenario tool. Choices & Voices allows the user to identify preferred future development patterns, additional funding sources, and make investments to improve the region's transportation system. It provides instant feedback through eight indicators, including:

- Total acres developed;
- Annual vehicle miles traveled per capita;
- Annual biking and walking trips per capita;
- Annual transit trips per capita;
- Annual transportation and residential energy costs;
- Annual vehicle hours of delay per capita;
- Greenhouse gas emissions per capita; and
- Road fatalities per 100,000 population.

The site is crowdsourced, allowing the user to compare their scenario to the average of all other submitted scenarios. Version 1.0 of the site was up for one year, and afterwards DVRPC posted a short summary of all results and comments. These results were one of many inputs to the development of the *Connections 2040* plan. Choices & Voices version 2.0 was launched in October 2013 to account for projects, funding assumptions, and future travel forecasts developed in the *Connections 2040* plan.

## Future Freight Flows Workshop

In November 2010, DVRPC was one of six host sites across the country for the Massachusetts Institute of Technology's (MIT) Center for Transportation and Logistics Future Freight Flows workshop. Four separate future scenarios were developed over the course of a year through a series of focused expert panel sessions, practitioner proof testing, and industry-wide surveys. The key driving forces and critical uncertainties were identified and formed the basis of the scenarios. While designed to be used for freight transportation planning, they can be employed for a wide variety of different planning purposes.

### Future Freight Flows Workshop Scenarios


*Source: NCHRP 2013.*

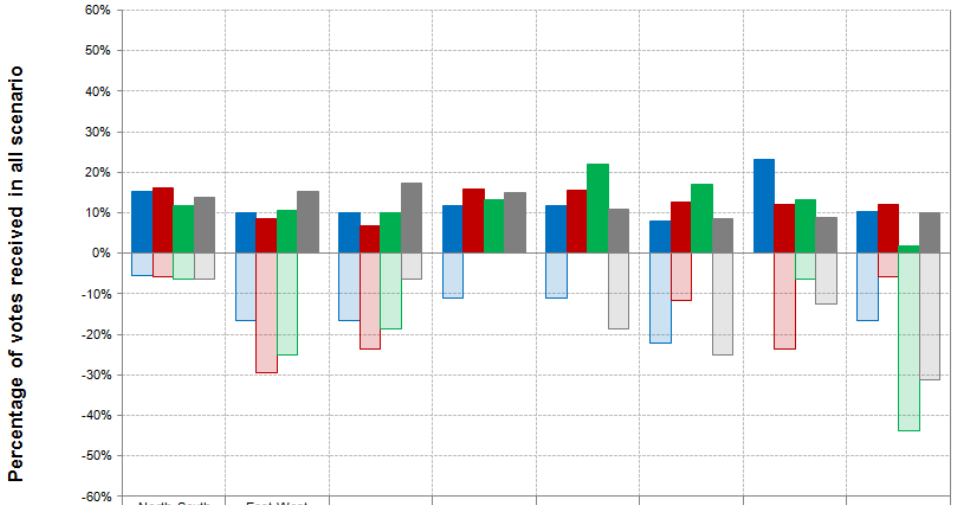
- One World Order: Facing global scarcity of key resources, nations establish international rules to ensure their fair and sustainable use. Global trade thrives, but its course is shaped by the very visible hand of regulation;
- Global Marketplace: This is a highly competitive and volatile world. Open, vigorous trade between virtually all nations has led to market-based approaches to most contemporary challenges;
- Naftastique: As world trade moves away from a global market, a number of regional trading blocs emerge. China, Europe, and South America form their own clusters. The U.S. leads an effort to make North America a self-sufficient economic community; and
- Technology Savior: Through advanced technological breakthroughs, the United States becomes highly "self-reliant" in terms of energy, agriculture, manufacturing, and other needs. Local trade soars and consumer affluence rises as technology enables a wider dispersion of the population across the U.S.

The DVRPC workshop was attended by over 70 individuals, representing various freight industry personnel (trucking, Class 1 freight rail, short line rail, ports, and airports), industry, county, state, and federal governments, along with state departments of transportation and DVRPC representatives. The workshop at DVRPC began with an overview of the four scenarios. Videos showing news reports from the year 2037 helped to further show the world as it could exist in each scenario. Then each individual was assigned to a break-out group to focus on one of the scenarios.

### Naftistique Break Out Group at DVRPC


The break-out groups further contemplated what their scenario would mean for Greater Philadelphia's transportation system. Each group then considered the worthiness of a series of transportation investment bundles in its scenario. Each individual had to vote for the most and the least beneficial investments for their scenario.

### Future Freight Flows Transportation Investment Bundles by Future Freight Flow Scenario




| | North-South Interstate Highways | East-West Interstate Highways | Complementary Highways | Freight Connectors | Class-I Rail Freight | Local Rail Freight | Sea Ports | Airports |
|---|---|---|---|---|---|---|---|---|
| Global Marketplace (Y) | 15% | 10% | 10% | 12% | 12% | 8% | 23% | 10% |
| Naftástiquel (Y) | 16% | 9% | 7% | 16% | 15% | 13% | 12% | 12% |
| One World Order (Y) | 12% | 10% | 10% | 13% | 22% | 17% | 13% | 2% |
| Technology Savior (Y) | 14% | 15% | 17% | 15% | 11% | 9% | 9% | 10% |
| Global Marketplace (N) | -6% | -17% | -17% | -11% | -11% | -22% | 0% | -17% |
| Naftástiquel (N) | -6% | -29% | -24% | 0% | 0% | -12% | -24% | -6% |
| One World Order (N) | -6% | -25% | -19% | 0% | 0% | 0% | -6% | -44% |
| Technology Savior (N) | -6% | 0% | -6% | 0% | -19% | -25% | -13% | -31% |

(Y) – Indicates percent of voters who thought the investment bundle would be beneficial in the future scenario.

(N) – Indicates percent of voters who thought the investment bundle would not be beneficial in the future scenario.

*Source: NCHRP 2013.*

The first idea of these bundles is to focus investment in the robust projects that make the region more competitive regardless of future economic conditions. In this case, the workshop found that the region is generally best served by investing in North-South interstates, freight connectors, and class 1 rail. The second idea is to determine which future we are heading toward, using leading indicators. Once future directions are determined, this analysis can guide future contingent investment decisions. For example, if leading indicators reveal that the economy is headed toward global marketplace, then regional seaports may be an investment priority.

## Scenario Planning Lessons Learned

DVRPC has demonstrated the technical ability to develop and model scenarios and create web-based scenario applications. One of the biggest challenges for DVRPC has been to garner public attention and interest in scenario planning. Most of the comments received through Choices & Voices were complimentary. However, several expressed frustration that the options they would like to consider were not included in the application. Similar comments were also made by members of the public and transportation stakeholders in discussions about Choices & Voices. Bringing together a larger and more diverse group of stakeholders from the start of the process should help to ensure a wider set of project, policy, and planning ideas to build upon. It should also help to generate more interest in the effort.

The largely technical nature of the effort, as well as its long-term horizon, may limit its appeal. DVRPC has strived with each new scenario analysis to make it simpler, and to shorten and improve the narrative to make it more interesting to read. Avoiding

data overload means writing in clear, concise text, stripping out unnecessary data, and using simple, to-the-point graphics. The *Transportation Investment Scenarios*, in particular, tried to incorporate more short- and medium-term impacts of the different investment levels.

Much of the scenario efforts have shown only marginal change. Regional development patterns are largely set, and with low growth—less than 0.5 percent per year—forecast, different future development patterns have minor impacts. Not only in terms of land use, but many transportation, environmental, and livability indicators reflect only small amounts of change. Without the potential for major changes and improvements, it is hard to generate interest and support for the planning process, which can begin to look more and more like maintaining the status quo.

In considering scenario planning as a results-oriented process, DVRPC has completed four scenario plans and two versions of an online scenario tool. Scenario planning at DVRPC continues to evolve, focusing on presenting big-picture ideas in a simple, straightforward manner. How well this has been done, and how it could improve, is something a futures working group, proposed later in this white paper, could consider. The hope is that anyone who has read a scenario report, or taken Choices & Voices has a better understanding of the myriad and shifting challenges that our region's transportation system faces, such as: the impact of low-density development patterns on travel demand and congestion; low funding levels largely used to preserve the aging system; the need to reduce greenhouse gas emissions; and to improve safety. Scenario planning has identified potential solutions by focusing future growth around regional development centers and investing in transit and roadway operational improvements that increase efficiency. Some 1,900 people, outside of DVRPC, viewed Choices & Voices version 1.0, and 226 individuals submitted their own scenario. The *Transportation Investment Scenarios* was the fourth most viewed report on DVRPC's website in 2013, with nearly 250 unique page views.

## Performance Measures

Indicators are used to measure how well certain objectives are being met. They can show how different scenarios perform relative to each other.

Guidance from Moving Ahead for Progress in the 21$^{st}$ Century (MAP-21), the current federal transportation legislation, requires the use of more performance measures in transportation planning. It will identify 13 performance measures related to the nation's Interstate and National Highway System (NHS) road networks, and a set of criteria related to the transit system that will be tracked across the nation. While the exact criteria have not yet been identified, they will measure the following goals.

Interstate and National Highway System

- Infrastructure condition – To maintain the highway infrastructure asset system in a state of good repair;
  - Pavement Condition (Interstate/NHS);
  - Bridge Condition (NHS);
- System reliability – To improve the efficiency of the surface transportation system;
- Safety – To achieve a significant reduction in traffic fatalities and serious injuries on all public roads;
  - Injuries per vehicle mile traveled (VMT);
  - Fatalities per VMT;

- Number of serious injuries;
- Number of fatalities;
- Measures used to address safety on all public roads;

- Congestion reduction – To achieve a significant reduction in congestion on the NHS;
- Environmental sustainability – To enhance the performance of the transportation system, while protecting and enhancing the natural environment;
- Freight movement and economic vitality – To improve the national freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development; and
- Reduced project delivery delays – To reduce project costs, promote jobs and the economy, and expedite the movement of people and goods by accelerating project completion through eliminating delays in the project development and delivery process, including reducing regulatory burdens and improving agencies' work practices.

Transit System

- Safety; and
- Condition.

MAP-21 will require setting targets for key transportation indicators. The scenarios could track how the region can achieve these targets under each scenario's assumptions. Or they could be used to guide regional target setting.

Critical to any of the performance measures will be the ability to accurately project them into the future. The region will need to be able to understand how undertaking action X will impact measure Y. Any performance measures used to analyze the differences between scenarios should be indicators that are clear, concise, and simple. The goal should be to limit the number of indicators, while still telling a complete story.

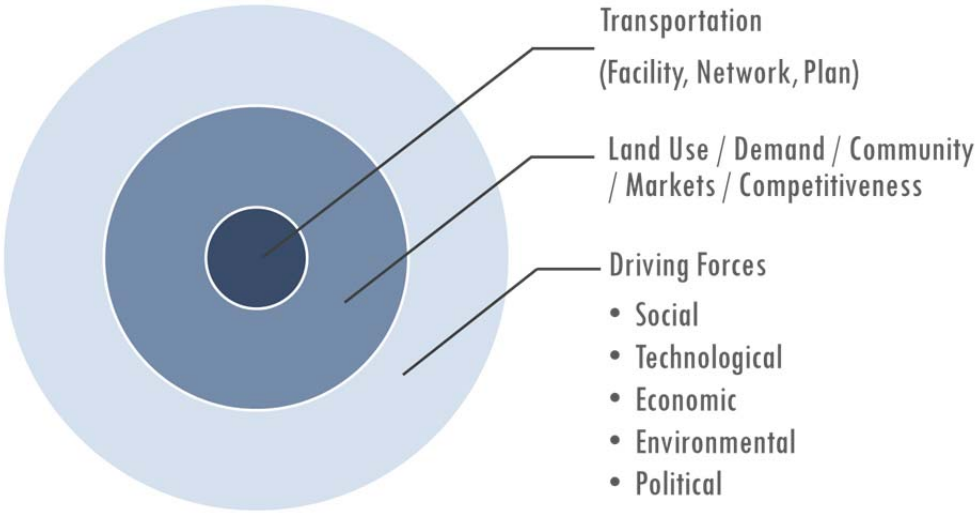
# II. Options for the Next DVRPC Scenario Exercise

This research on scenario planning was done to contemplate how DVRPC should focus its next effort. Two possibilities stand out: the first is to look at underlying driving forces of change in the future. The second is to focus on identifying and pursuing regional "gamechangers." Future scenario efforts should be relevant to the region's long-range plan and consider new topics and issues that haven't already been covered in previous efforts. This particularly applies to land use and transportation funding levels.

## Driving Forces of Change

Many planning processes build up from a local vantage point. From a transportation perspective, a facility, network, or plan can be a type of scenario analysis, such as: alternatives analysis, conformity, or build/no-build. Typically, Metropolitan Planning Organizations (MPOs) have considered changes in land use or shifting demand for transportation as the basis for scenario planning. Scenarios can also start from the 'outside,' looking at mega forces that are driving change and consider how they will shape the region and its needs in the future. These scenarios identify uncertainties, which could create vastly different futures—not just marginal changes.

### Transportation System and Change Agents




*Source: DVRPC 2013.*

Driving forces are often beyond the control of a firm, government, or organization. They are the broader social, technical, economic, environmental, and political (STEEP) forces that create change. These changes can be sudden and rapid. Current events often create a bias toward specific STEEP impacts; however, these may only be short-term drivers and not long-term gamechangers.

NCHRP Document 195 *Driving Forces Influencing Future Freight Flows* identifies a number of key factors that could bend the current trends from a freight planning perspective. The report authors, from the Massachusetts Institute of Technology (MIT), developed an initial list of driving forces. The initial list was then refined and expanded by a working group (the 'MIT working group') of freight experts to consider:

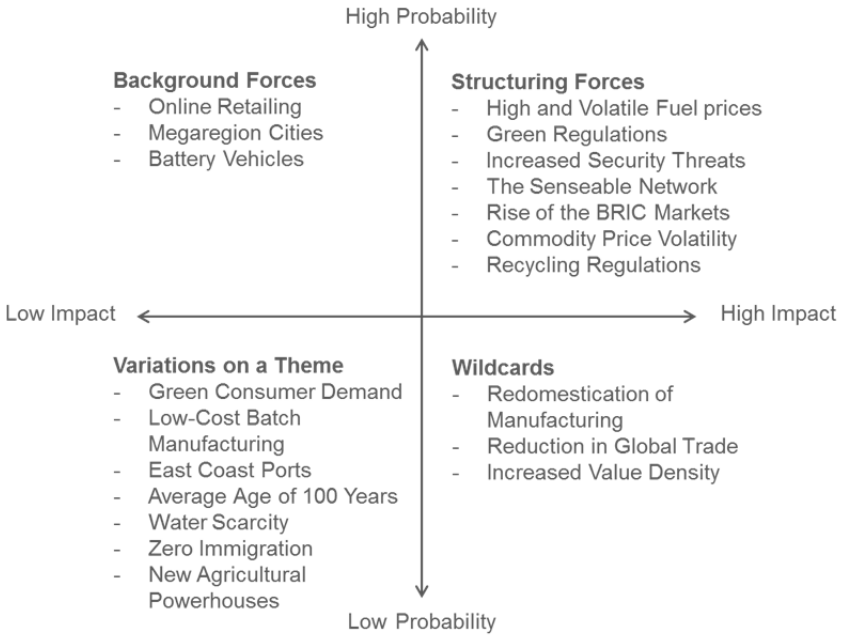
- Redomestication of manufacturing – substantial return of manufacturing back to the United States;

- Reduction in global trade – sustained reduction in global trade volume (both imports and exports), possibly due to rise in protectionism, pandemics, etc.;
- Increased security threats – large increase in both the number and magnitude of security threats (both domestic and abroad);
- Green regulations – stringent environmental and sustainability regulations adopted and strictly enforced by the United States and most other countries;
- High and volatile fuel prices – dramatic increase in price and volatility of all oil-based fuels;
- Rise of BRIC markets – ascendency of consumer markets in Brazil, Russia, India, China, and other counties, leading to increased demand for products manufactured in the United States;
- Low-cost batch manufacturing – widespread adoption of technologies that enable efficient and low-cost small batch manufacturing for most consumer goods;
- Online retailing – dramatic shift toward online purchase and point-of-use delivery, leading to the reduction of physical retail stores;
- The 'senseable' network – widespread ability to capture and monetize real-time sensing data on all products, vehicles, and facilities across a supply chain at essentially no cost;
- Recycling regulations – strict enforcement of regulations and rules requiring recycling and reuse of all manufactured products;
- Average age of 100 years – average life expectancy increases to 100 years in the United States;
- East Coast ports – shifting point of entry for a majority of imports to the East Coast (i.e., due to a rise in manufacturing in Africa, more ships using the Panama Canal, etc.);
- New agriculture powerhouses – new countries (such as Russia or India) emerge as agricultural powerhouses, supplanting the United States for some commodities;
- Water scarcity – pervasive water scarcity in some regions leads to reduction in products for export that contain water (e.g., fruit) or require a water-intensive manufacturing process (i.e., soda, electronic chips);
- Green customer demand – the sustainability and environmental friendliness of a product becomes the dominant factor for consumer demand for most products (supplanting cost);
- Mega cities – over 90 percent of the United States consumers living and working in megaregion cities and urban areas;
- Zero immigration – immigration into the United States is reduced to virtually zero;
- Battery vehicles – new battery technologies dramatically reduce the cost and increase the efficiency and range of electric vehicles;
- Commodity price volatility – shifting geopolitics and other factors lead to tremendous price volatility for almost all commodities (such as wheat, copper, lithium, etc.); and
- Increased value density – advancements in manufacturing, materials, and other technologies increase the average value per ton moved in the United States from about $700 to over $2,000.

This list shows the range of futures that can be identified through a brainstorming session. The MIT working group did an impact and likelihood assessment for each of these scenarios. The results were analyzed and used to classify each potential

scenario. Structuring forces are those potential futures that have a high probability of occurring and a high impact (oftentimes they are identified as such because of events actually happening at the time). These are the scenarios to focus on for more analysis. Background forces are drivers where the probability is high, but the likely impact is low. These are forces that may be incorporated as near certain changes into all scenarios analyzed. Variations on a theme are scenarios where both the probability and impact are expected to be low. They generally don't receive additional consideration. Wild cards are driving forces with low probability, but high potential impact. Wildcard scenarios may also be of interest for additional analysis.

### Impact and Likelihood of MIT Driving Forces




*Source: Caplice and Phadnus 2010.*

A third dimension to the above chart could anticipate whether the impacts are expected to be positive or negative. The MIT working group would next focus on the structuring forces for further analysis, perhaps also considering one or two wildcards. The MIT working group used this process to develop the four scenarios employed in a workshop at DVRPC described in the Future Freight Flows section of this white paper.

The probability and impact results of these scenarios are based on national considerations. For Greater Philadelphia, scenarios such as 'East Coast ports' or 'water scarcity' (as an opportunity for this relatively water rich region) may have a greater impact and warrant additional consideration.

The MIT working group identified some additional future driver considerations. These concepts were either incorporated into the above scenarios or were otherwise not further analyzed:

- Aging transportation infrastructure;
- Green energy for transportation;
- Growing labor strength;
- Increasing disparity between knowledge workers and manual laborers;

- World population levels;
- Business taxation;
- Stronger non-U.S. trading blocs (i.e., Asia less dependent on the U.S.);
- Changing cultural face of America;
- Rising sea levels;
- Dollar valuation;
- Airline industry insolvency;
- Increasing power of China;
- Opening of a Northwest Passage;
- Political and economic blocs forming (Venezuela, Iran, Bolivia);
- Lack of credit availability; and
- Advances in robotics (making some workers redundant).

Much, though not all, of this effort translates into regional scenario planning. Scenarios that don't have a major transportation or land use element, such as other current industry considerations like antibiotic immunity, cheap cell phones, or the end of privacy, should be avoided.

Minnesota DOT's Minnesota Go CitiZing tool is a similar transportation planning effort to what DVRPC is proposing for its next scenario exercise. The CitiZing tool features online surveys, videos of transportation experts discussing key trends, and was supplemented by a number of in-person workshops.[3] The online videos consider topics such as aging population, supply chains, e-learning, global competitiveness, telecommuting, Minnesota's economy, cars of the future, options for freight and transit, technology for cars and roads, public health and transportation, water quality, fuels, community design, robot cars, Minnesota's energy, the role of the government, traffic safety, and climate change.

While there is little the region can do to control these driving forces, there is much it can do to better prepare for them. One option for the next DVRPC scenario planning effort is to consider how future STEEP changes could affect the region's transportation system. In addition to the future scenarios identified by the MIT working group, DVRPC offers six additional drivers of change examples:

- A cheap but volatile energy future;
- The shifting lifestyle preferences of Millennials;
- The shared economy;
- Low-cost transportation infrastructure;
- Confronting climate change; and
- Autonomous vehicles.

These drivers are presented to stimulate the type of thinking expected in this exercise. The futures working group, proposed later on will be free to further explore them, or to identify their own drivers of change.

[3] The Minnesota Go CitiZing tool can be accessed at www.citizing.org/projects/minnesotago.

## A Cheap but Volatile Energy Future

DVRPC has forecast that peak oil will constrain energy supplies in the future.[4] However, natural gas fracking has become cost effective thanks to rising oil prices. This has led to an overproduction of it, and generally a future of cheap and abundant natural gas is more probable, at least in the 25-year long-range planning horizon. However, the global nature of the economy means that supply chain disruptions, from extreme weather events, wars, threats of war, or trade disputes means that energy is likely to continue to suffer from occasional dramatic spikes in price.

In the U.S., fracking may yield a competitive advantage relative to other countries (natural gas is about four times as expensive in China).[5] This suggests a possibly radically different driving force (cheap and abundant natural gas) compared to assumptions that the Commission has been working under (expensive and constrained oil). Natural gas is still a limited, nonreplenishable form of energy that has significant detrimental factors associated with its extraction, refinement, and use. It could allow more carbon to be released into the atmosphere, worsening the long-term risks associated with climate change.

Natural gas does not have to be the only source of a low cost energy future. Radical improvements in solar panel, wind turbine, hydrogen, or new disruptive technologies could generate a low-cost, clean energy future. These clean technologies may be able to reduce the risk of price volatility.

## The Shifting Lifestyle Preferences of Millennials

Per-capita vehicle miles traveled (VMT) in the U.S. has fallen every year since 2004. The U.S. Public Research Interest Group (U.S. PIRG) has dubbed this the 'end of the driving boom.' Several forces are seen as driving this change, most notably: the baby boomer generation is reaching its retirement age; and the Millennial generation (or Generation Y), born between the early 1980s and the early 2000s, has shown a strong preference for urban living, transit use, and biking and walking. The Millennials have favored access over ownership, and embraced mobile technologies to help them interact with others, work from home, and shop; all of which has reduced their need to drive. In 2009, young people between 16 and 34 years old drove 23 percent fewer miles than the same age group did in 2001. Meanwhile, mobile technologies have made alternative forms of transportation more appealing. Bike trips taken by young people have increased by 24 percent, and transit miles traveled by 40 percent during this same 2001 to 2009 period. Generation X, born between 1965 and 1982, has shown similar, but less extreme, trends as well.

In *A New Direction: Our Changing Relationship with Driving and the Implications for America's Future*, the U.S. PIRG considered whether reduced driving by Millennials is a long-term trend or a short-term blip. The logic for a short-term blip is summed up as poor economic conditions, especially high unemployment, have made driving both unnecessary and unaffordable for many young people. Once the economy improves, the Millennials will drive as much as previous generations. While the recession likely accounts for some of the reason for decreased driving, U.S. PIRG points out a number of additional reasons why this is not just a result of the economy:

- Driving started to decline in 2004, well before the onset of the Great Recession;
- Driving has declined by those who are employed. Between 2001 and 2009, driving by young people with jobs decreased by 16 percent;

4 DVRPC 2006.

5 China's natural gas reserves are greater than those in the U.S., so this advantage will likely only be temporary.

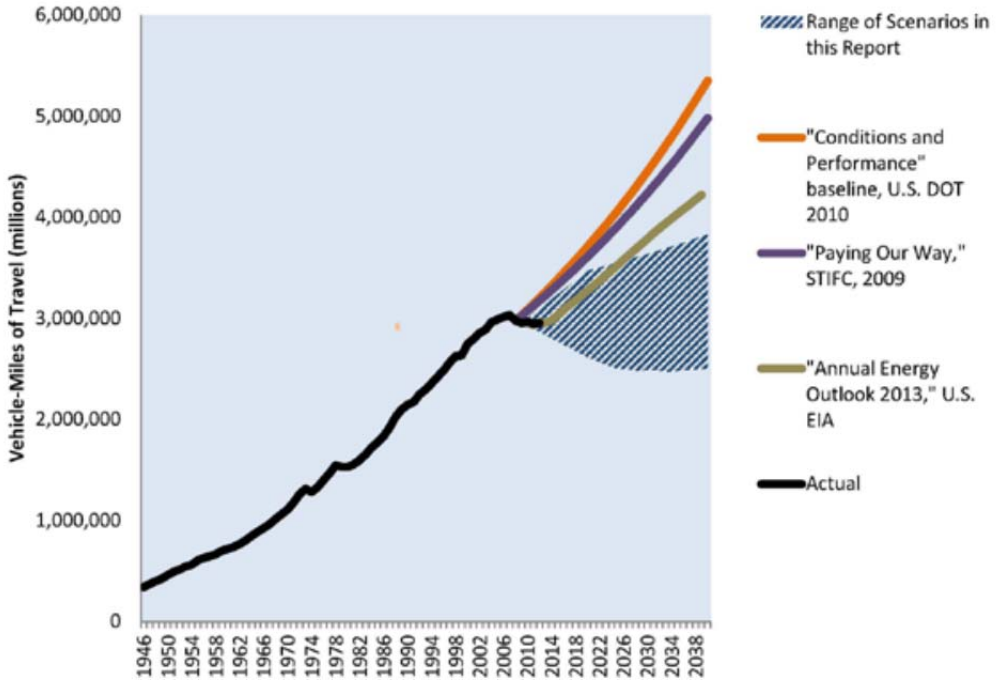
- Driving and economic growth have diverged. Up until the late 1990s, upticks in Gross Domestic Product (GDP) increased at a nearly 1:1 rate with increases in VMT. Since then, GDP has continued to rise, while VMT has been flat;
- Millennials have indicated a greater preference for urban living and alternative transportation in a number of surveys; and
- Laws, such as graduated permits, have restricted the right of young people to drive and imposed additional costs to their driving.

To explore the uncertainty in how much the forecasted change in future driving will be, U.S. PIRG created three scenarios:

- Back to the future – assumes that the dip in driving is a temporary 'blip' and not a long-term trend. The Millennials and future generations will eventually drive at similar per-capita rates as previous ones;
- Enduring shift – the recent change in per capita driving is real and will be sustained into the future. Thus, the current rate of per-capita driving will continue at levels reported by age into the future, and future generations will drive at the same levels as the Millennials do now; and
- Ongoing decline – assumes the current dip is just the beginning of a long-term shift away from driving. Millennials and previous generations will continue to drive at their current per-capita rates, but future generations will drive even less.

The 'back to the future' scenario would anticipate a 24 percent increase in VMT between 2009 and 2040, slightly higher than the nation's forecasted 21 percent population growth over that period. This is below most official estimates of long-term VMT growth. 'Enduring shift' would likely mean only a seven percent increase, while 'ongoing decline' would mean a 19 percent decline in total VMT by 2040.

### VMT Estimates in *A New Direction* Compared with those from the Energy Information Administration (EIA), the U.S. Department of Transportation (U.S. DOT) and the Surface Transportation Infrastructure Financing Commission (STIFC)




*Source: Dutzik and Baxendall 2013.*

VMT estimates from the years 2010 through 2012 suggest that the nation is on the path of 'ongoing decline.' Some of the anticipated impacts of an 'ongoing decline' scenario include:

- Less congestion;
- Reduced fossil fuel consumption and air pollution;
- Reduced expenditure on highway expansion and maintenance;
- Reduced revenue from gasoline tax; and
- Increased risk for public-private partnerships (PPPs).

The report's authors propose new ways of thinking about transportation:

- Plan for uncertainty;
- Support the desire of Millennials and other Americans to drive less;
- Revisit the need for planned new or expanded highways;
- Refocus the federal role; and
- Use transportation revenue where it is most needed.

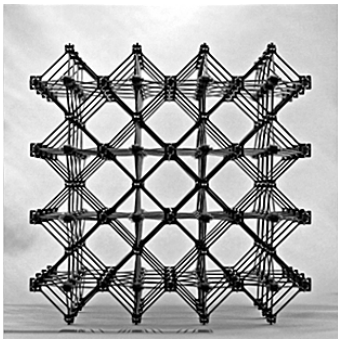
## The Shared Economy

In a shared economy (also called collaborative consumption), owners and service providers use internet-based technologies to rent out goods and services. For the owner, this becomes a source of extra revenue from previously underutilized assets, while for the renter, this serves as a cost savings compared to buying something that will get little use. Car sharing, bike sharing, streaming video, and music on-demand services are all examples of what the shared economy promises to bring. Sales of DVDs and CDs are already declining as a result. New services allow for individuals to rent rooms in their homes on a short-term basis, or provide rides on demand. Less ordinary items, such as power tools, parking spaces, instruments, and kennel services, are being incorporated into the shared economy. All of this has been possible to do for a long time, but the internet has made sharing significantly more feasible. The web dramatically reduces transaction and communications costs. Social networks and online reviews build trust between owners and renters.

The shared economy faces some regulatory challenges, due to perceived safety, along with liability and tax collection concerns. While many consumers may benefit from the shared economy, there may be losers in it. Peer-to-peer rentals could cost service-sector jobs and result in driving up housing prices. It may even lead to lower utilization of housing, if property owners find higher economic benefits to renting on a nightly basis to tourists than on a longer-term basis to residents.[6]

A private car is typically driven less than 10 percent of the day and parked the rest of the time, guest rooms are slept in only a few nights a year, and sporting goods and tools may be used infrequently. Creating a marketplace where these things can be rented allows them to be better utilized. This may also convince people who own things that they rarely use to rent when needed instead of owning. The rise of the shared economy could transform how we think about the ownership and use of material assets.

6 Monroe, Rachel. *More Guests, Empty Houses*. Slate.com. www.slate.com/articles/business/moneybox/2014/02/airbnb_gentrification_how_the_sharing_economy_drives_up_housing_prices.html. Accessed 2/13/2014.



Interlocking, high-strength composite 3-D printed materials.

*Source: Massachusetts Institute of Technology.*

## Low-Cost Transportation Infrastructure

In the summer of 2013, researchers at MIT announced that they had developed 3-D printed tiny interlocking composite material pieces that can be linked together to build structurally sound vehicles, airplanes, bridges, levees, or dams.[7] Much like legos or similar types of children's toys, these materials can easily be disassembled and reassembled, potentially simplifying maintenance and repairs. In the future, such materials may be the basis for road and bridge construction. Perhaps then, technology may unlock a 'Wright's Law' for transportation infrastructure, reducing long-term construction costs.[8]

## Confronting Climate Change

A major contemporary challenge is to envision a 21st century transportation system that prepares to adapt to the reality of climate change. The Plan needs to create a road map for drastically reducing greenhouse gas emissions from the transportation system. A certain amount of climate change is likely already inherent at this point, and the region also must consider how to adapt to a very different future climate.

Ralph Hall's 2006 PhD dissertation, *Understanding and Applying the Concept of Sustainable Development to Transportation Planning and Decision-Making in the U.S.,* begins with a key assumption that a sustainable transportation system can only be created as part of a larger economy-wide sustainability paradigm.[9] Hall's research centers on how decision-making focused on sustainability can create a process that ceases clearly unsustainable practices and encourages investments in innovations and technologies that make transportation more environmentally sustainable.[10] The ongoing evolution of technology and globalization, as the key drivers of change, must be acknowledged and responded to in a sustainable decision-making process.

> "*Sustainable transportation is not an end state, but rather a process of continual improvement that removes perverse incentives and halts or reverses clearly unsustainable development.*"
>
> - Dr. Ralph Hall
>
> Understanding and Applying the Concept of Sustainable Development to Transportation Planning and Decision-Making in the U.S.

DVRPC's efforts to reduce greenhouse gas emissions have focused on a three-pronged approach of reducing demand for goods and services (including compact, mixed-use development patterns that reduce travel demand); reducing the carbon content of energy sources; and promoting increased efficiency in everything that uses energy (vehicles, lighting, appliances, houses, business and government operations).

The Brookings Institution's *Making Transportation Sustainable: Insights from Germany* compared transportation in Germany and the United States. It found that Germans emit one-third fewer greenhouse gases per capita than residents of the U.S. do. One of the major differences in transportation policy between the two countries is the level of gasoline taxation. Gasoline cost nearly $8 a gallon in Germany in 2007, while it cost less than half that amount in the U.S. Despite this, the average German household spends less on transportation both in total amount and as a percent of income compared to its American counterpart. In addition, Germany spends less of its Gross Domestic Product on transportation (1.6 percent) than the U.S. does (1.7 percent).

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[7] Source: www.web.mit.edu/newsoffice/2013/how-to-make-big-things-out-of-small-pieces-0815.html. Accessed 12/9/2013.

[8] Wright's Law predicts that as total production increases, there is an increase in production efficiency. In other words, we learn by doing and become more efficient as a result.

[9] The reason that this is important can be illustrated through the Route 15 trolley conversion (from diesel bus). The expectation was that converting to electrified trolleys would reduce greenhouse gas emissions. However, the region's electrical grid, at the time of conversion, was so dependent on coal-fired power plants that the conversion actually led to higher greenhouse gas emissions. Source: SEPTA. *SEPTA Energy Action Plan*. Philadelphia, PA. 2012.

[10] Efforts to reduce environmental impacts should focus on innovation. Innovative processes can use technology and reforms to improve the efficiency of institutions, organizations, and social structures.

The Brookings Institution identified a number of elements that allowed Germany's transportation system to have lower greenhouse gas emissions than the U.S., including shorter trip lengths and higher modeshare for less energy intensive forms of transportation. Germany has used a number of policies to achieve a more sustainable transportation system:

- Pricing, restrictions, and mandated technological improvements have reduced the negative externalities of automobile use;
- Extensive regional and national public transportation service provides a viable alternative to driving;
- Regional land use policy has encouraged compact, mixed-use development, helping to keep trip lengths short and encourage walking and biking;
- Local and federal governments have focused on making walking and bicycling safe and convenient modes of transportation; and
- All the above have been coordinated to ensure a symbiotic impact.

There are a number of instruments that the region could use to reduce greenhouse gas emissions, including: pricing, vehicle restrictions, better land use, alternative transportation, technology, and cleaner energy sources.

### Pricing, Restrictions, Land Use, and Alternative Transportation

Germany uses taxes or pricing as a stick. Higher gas taxes mean Germany's current vehicle fleet is on average 50 percent more fuel efficient than in the U.S. Sales tax on new vehicles is generally around 19 percent in Germany, compared to about six percent in the U.S. Vehicle registration fees are generally about three times higher in Germany. The cost of a German driver's license is about $2,250, compared to around $100 in the U.S. As result, German households generally only have one car, while the U.S. often has two or three cars per household.

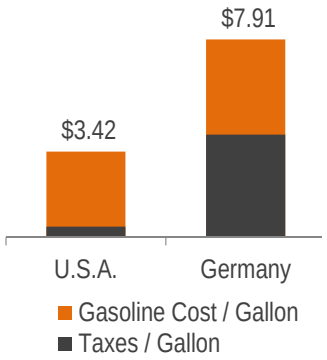
Germany uses restrictions such as lower speed limits, near-universal traffic calming and roundabouts, and priced parking to encourage safer transportation for all users. Speed limits on local streets, which comprise about 70 to 80 percent of all roads, are 19 mph or less. In many residential areas, speed limits are four mph, about the same pace as walking. Free nonresidential parking is almost unheard of in Germany.

Germany has a denser development pattern than much of the United States. This means overall trip lengths are shorter, leading to lower VMT per trip, as well as making alternative transportation more feasible. Only six out of every 10 trips are made by car in Germany, compared to nine out of 10 in the U.S. Germans are about three times as likely to walk or bike, and four times as likely to take transit. While much of the U.S. has a lower development density, areas of Greater Philadelphia have densities comparable to Germany. This is a competitive advantage to build on.

Shorter trips and fewer daily trips by car mean the average German drives less than half the annual miles compared to the average American. Less driving means fewer road fatalities, while more bike and pedestrian trips mean fewer fatalities for those modes as well (through greater safety in numbers). Less driving and more fuel-efficient vehicles means the average German emits about one-third the amount of transportation-generated carbon emissions than the average American. Higher transit ridership leads to a greater cost-recovery ratio, requiring fewer subsidies.

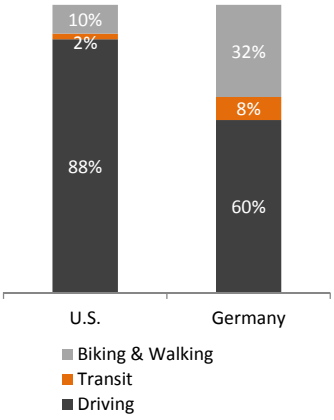
Even with their sustainability efforts, the average German household spends only 14 percent, or $5,660, of its annual income on transportation. In comparison, the average household in the U.S. emits far more greenhouse gas emissions and spends more do so, about $8,700, which is 19 percent of its annual income.

**2007 Comparison of USA and Germany Gas Prices**



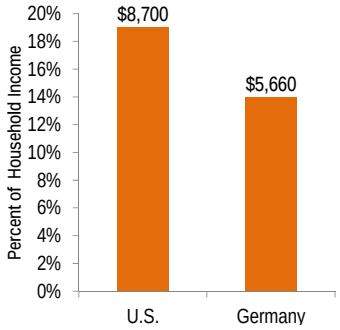

*Source: Energy Information Administration, 2012.*

**Modeshare in the U.S. and Germany**




*Source: Brookings Institution 2009.*

## Annual Transportation Expenditures per Household




*Source: Brookings Institution 2009.*

## Comparison of Germany and U.S. Transportation Statistics

| | Germany | USA |
|---|---|---|
| Annual vehicle miles traveled per capita | 6,800 | 14,900 |
| Average number of trips per day per capita | 3.3 | 4.1 |
| Average trip distance (miles) | 6.9 | 9.9 |
| Average distance traveled per person per day (miles) | 23 | 40 |
| Miles of interstate highways / autobahns | 8,000 | 42,700 |
| Miles of high speed rail (150 mph+) | 800 | 0 |
| Annual traffic fatalities per 100,000 population (2002-2005) | 6.5 | 14.7 |
| Cyclist fatalities per 100 million miles of cycling (2002-2005) | 4.0 | 18.0 |
| Pedestrian fatalities per 100 million miles of walking (2002-2005) | 4.0 | 8.0 |
| Car fatalities per billion miles of car travel (2002-2005) | 12.5 | 14.4 |
| Annual transportation generated $CO_2$ emissions per capita (metric tons) | 1.32 | 3.90 |
| Cars per 1,000 population | 560 | 780 |
| Average vehicle fuel efficiency (mpg) | 30 | 20 |
| Annual linked public transportation trips per capita (2005) | 133 | 21 |
| Transit fare recovery ratio | 62% | 26% |
| Average household expenditure on transportation (2003) | $5,660 | $8,700 |
| Percent of household budget spent on transportation (2003) | 14% | 19% |
| Percent of GDP spent on transportation infrastructure | 1.6% | 1.7% |

*Source: Brookings Institution, 2009.*

### Technology and Alternative Energy

The U.S. uses corporate average fuel economy (CAFE) standards as a carrot. New CAFE standards in the U.S. will require manufacturer fleets to get the equivalent of 54.5 miles per gallon by 2025. At that time, the U.S. is likely to surpass Germany in fuel efficiency. However, improved fuel efficiency in the U.S. creates a rebound effect that leads to more driving as cost per mile decreases.

The New Economic Perspectives website recently posted a "Pedal to the Metal" plan for dealing with climate change in the U.S. This plan also assumes that sustainability will take an economy-wide effort. It identifies a series of transportation strategies that would reduce greenhouse gas emissions, including:[11]

1. Move long-distance freight transport to electrified rail, or electrified grid-charged or powered trucks. Improve rail infrastructure to increase its modeshare;
2. Promote electric battery powered freight and passenger vehicle fleets:
    a. Build rapid charge, roadway charging, and/or battery swap infrastructure to facilitate electric vehicle travel over middle and longer distances;
    b. Incorporate electric vehicle charging infrastructure into multi- and single-family residences, commercial facilities, and public streets;
    c. Double electrical energy storage capability every 10 years;
3. Transition from self-driven to autonomous vehicles, increasing existing road capacity and lowering emissions;
4. Build electrified high-speed rail, or equivalent rapid transit service between major cities. This can replace much of the short and middle distance air travel services and reduce the need for intercity personal vehicle trips; and

[11] From: www.neweconomicperspectives.org/2013/09/the-only-way-forward-a-pedal-to-the-metal-plan-for-energy-system-transformation-pt-1-of-3.html. Accessed 1/14/2014.

5. Convert high-traffic public transportation routes to electrified commuter rail, light rail, subway, elevated rail, trackless trolley, street car, or electric bus.

The Pedal to the Metal plan relies heavily on technological solutions and lacks other low-carbon options such as biking and pedestrian improvements, compact and mixed-use development patterns, pricing, or demand management. The source of electricity to power the transportation system in this plan must come from lower carbon sources. It is not clear at this time that electrification is the only way to go. Alternatives, such as hydrogen or compressed air, could be the transportation fuel of the future. Looking out to 2045, it is possible that natural-gas-powered vehicles could also be a significant portion of a lower-emissions fleet.

### Adapting to Climate Change

Global temperatures are expected to rise regardless of what is done to mitigate greenhouse gas emissions. The region must also consider how to adapt to climate change. Higher temperatures and more extreme weather events mean transportation infrastructure (roads, rails, and bridges) may be more prone to failure, or will have a shorter useful life. Increased likelihood of flooding events means some transportation infrastructure will need to be elevated or relocated out of flood prone areas.

### Reducing Greenhouse Gas Emissions

The Brookings Institution report suggests that developing a more sustainable transportation system will take a three-pronged approach of: technology, restrictions (particularly traffic calming on local streets), and pricing. Brookings offers several additional recommendations for a more sustainable transportation system:

1. Get the price right;

2. Integrate transit, biking, and walking as viable alternatives;

3. Fully coordinate land use and transportation;

4. Provide public information and education to make changes feasible; and

5. Implement in stages with long-term perspective.

The ‘Pedal to the Metal’ plan identified a number of technological and energy innovations that could also reduce greenhouse gas emissions, including freight rail and highway electrification, increased transit rail, improvements to vehicle battery and battery-charging technology, and development of autonomous vehicles.

Hall identified adequate transportation funding as a need in order to finance and maintain transformative projects. Funding levels will dictate the pace at which transportation can adopt new, cleaner technologies. A lack of funding likely leads to a continuation of the current petroleum-based system. However, a move away from gasoline will require a different revenue paradigm, as transportation infrastructure is now primarily funded by the gas tax.

Reducing greenhouse gas emissions has been a goal of the last several iterations of the region’s long-range plan, but it has not yet been explored in depth in a scenario planning exercise. Ideas for a 21$^{st}$ century transportation system with significantly lower greenhouse gas emissions could be further explored in response to climate change as a global driver of change.

## Autonomous Vehicles

Autonomous vehicles are one of the most significant transportation technologies on the horizon. The National Highway Traffic Safety Administration (NHTSA) has identified four levels of vehicle automation. The first level is automated control of specific functions, such as parallel parking. These features have been available on cars for several years. The second level has automation of multiple integrated components, such as adaptive cruise control with lane centering. These features are just becoming available on new automobiles. In the first two levels, a person must monitor the road and be ready to take control of the vehicle at any moment. Level three includes limited self-driving of all vehicle functions. The vehicle's computer monitors road conditions that would require a person to take control. Level four is full self-driving automation, where the vehicle performs all driving functions, and may do so with occupants that are not expected to take control, or no occupants at all.[12]

In the near term, connected vehicles (or vehicle-to-vehicle and vehicle-to-infrastructure technologies) may incorporate many of the safety benefits anticipated by autonomous vehicles. NHTSA has recently taken steps to enable connected vehicle technologies in light vehicles. Connected vehicles will compare speed and position with other vehicles, stop signs, and traffic signals. They will be able to identify roadway risks and announce them as warnings to drivers.[13] The expectation is that this technology could reduce crashes between unimpaired drivers by 70 to 80 percent. It may also facilitate the move toward pay-as-you drive insurance, which would create lower rates for those who drive less.[14]

The rest of this section considers the impacts of level-four fully autonomous vehicles. These are just part of what may be a new mobility platform, as identified by Burns et al. from the Earth Institute in *Transforming Personal Mobility*. In such a system, autonomous vehicles combine with the 'mobility internet' (which coordinates spatial and infrastructure data to assist with the flow of goods and people in real time), shared vehicles (which are used by many people throughout the day), specific purpose vehicles (sized for the number of people using them to make them more energy, space, and cost efficient), and use advanced engine systems that may be powered by alternative energy.

The Eno Center for Transportation's *Preparing a Nation for Autonomous Vehicles: Opportunities, Barriers and Policy Recommendations* identified a number of potential benefits from an autonomous vehicle future, including: improved safety, reduced congestion, less need for parking, providing more mobility to the elderly and disabled, shorter travel times, and reduced insurance and parking costs. They are also likely to substantially affect travel choices, land use patterns, infrastructure investment, goods movement, and other activities. In the shorter term, connected vehicles may yield considerable safety improvements relative to vehicles on the road today.

Currently, the cost of the equipment needed for an autonomous vehicle is more than $100,000. Once these costs are down to about $37,500, some individuals will find the technology worthwhile to invest in. It will need to be less than $10,000 per vehicle to be a reasonable cost for mass production. Some other key findings include:

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[12] Litman 2013.

[13] Source: www.nhtsa.gov/About+NHTSA/Press+Releases/2014/USDOT+to+Move+Forward+with+Vehicle-to-Vehicle+Communication+Technology+for+Light+Vehicles. Accessed 2/20/2014.

[14] Source: www.business-news.thestreet.com/philly/story/vehicle-vehicle-communication-could-revolutionize-car-insurance-0/1. Accessed 2/20/2014.

- Through car sharing, a single autonomous vehicle could replace between 9 and 13 private vehicles;
- While autonomous vehicles will likely increase VMT, reduced braking and accelerating are likely to lower per-mile emissions; and
- Autonomous technologies can also be applied to the trucking industry. This would significantly reduce employment in the trucking field, and reduce fuel consumption and associated emissions. Truck platoons could draft off each other, further reducing energy use, increasing road capacity, and enhancing safety. Such platoons may need thicker and stronger concrete to handle their loads, and require designated truck only lanes to prevent trucks from blocking highway on- and off-ramps.

Though more study is needed to better anticipate these impacts, Eno considered three different levels of autonomous vehicle penetration into the marketplace: 10 percent, 50 percent, and 90 percent of the vehicle fleet being self-driving, shown in the following table. Each of these is a back-of-the-envelope estimate.

### Estimated Autonomous Vehicles Impacts in the U.S. Relative to Conditions in 2013

| | Percent Autonomous Vehicles in Total Fleet[1] | | |
|---|---|---|---|
| | 10% | 50% | 90% |
| Road Capacity | +1.0% | +21.0% | +80.0% |
| Reduced Fatalities | 1,100 | 9,600 | 21,700 |
| Percent Fatality Reduction[2] | -3.4% | -29.7% | -67.0% |
| Vehicle Miles Traveled (VMT) | +2% | +7.5% | +9% |
| Number of Autonomous Vehicles (millions) | 12.7 | 63.7 | 114.7 |
| Total Number of Vehicles | -4.7% | -23.7% | -42.6% |
| Travel Time Savings (millions of hours) | 756 | 1,680 | 2,772 |
| Fuel Savings (millions of gallons) | 102 | 224 | 724 |
| Fuel Use (assumption) | -13.0% | -18.0% | -25.0% |
| Additional Cost of Autonomous Technology per Vehicle | $10,000 | $5,000 | $3,000 |
| Annual Safety Cost Savings (billions) | $5.5 | $48.8 | $109.7 |
| Annual Congestion Cost Savings (billions) | $16.8 | $37.4 | $63.0 |
| Annual Parking Cost Savings (billions) | $3.2 | $15.9 | $28.7 |
| Total Annual Cost Savings (billions) | $25.5 | $102.2 | $201.4 |
| Annual Savings per Autonomous Vehicle | $2,000 | $1,610 | $1,670 |

[1] No year is estimated for these market penetration numbers.

[2] Assuming the 2011 total number of fatalities, 32,367, is the base-year comparison.

*Source: Eno Center for Transportation, 2013.*

AAA estimates that driving costs in 2013 were about 60 cents per mile. Burns et al. estimated an autonomous vehicle cost of about 40 to 50 cents per mile (higher in rural areas, due to more 'deadhead' miles). Small, specific purpose vehicles that carry just one or two passengers may cost as little as 15 cents per mile. Litman (2013) assumes that costs will be similar to the current cost of car sharing, which is about 80 cents per mile. This is due to requirements for additional equipment and navigation software, maintenance, development cost recovery, and profit margin.

The safety features of autonomous vehicles could allow for much lighter weight vehicles in the future. Lighter weight vehicles (including potential nanotechnology improvements), autonomous technologies, and more efficient engines are among the multitude of ways in which the vehicles of the future can become more fuel efficient.

There are a number of critical barriers to autonomous vehicle implementation, including: cost, licensing, litigation, liability, perception, security, privacy, and

incomplete research. Litman (2013) identifies a number of other potential issues with self-driving vehicles:

- Increased cost – due to additional vehicle equipment, service and maintenance requirements, and possibly new roadway infrastructure;
- Additional risk - such as system failures and emboldening some road users to participate in unsafe actions;
- Security and privacy concerns – possibly susceptible to hacking, while GPS tracking and data-sharing features may create privacy concerns;
- Induced vehicle travel and increased external costs – increased convenience and affordability may allow autonomous vehicles to induce additional travel, which increases external costs of parking and pollution (and maybe crashes as well);
- Social equity concerns – there may be unfair impacts, such as reduced convenience and safety for other transportation modes;
- Reduced employment and business activity – fewer driving jobs and less need for vehicle repairs due to lower crash rates; and
- Misplaced planning emphasis – focus on technological solutions may deter action on conventional, cost-effective projects, such as pedestrian and transit improvements, pricing reforms, and other demand management strategies.

There are likely to be holdouts to driverless cars, particularly those who like driving. This means for quite some time there will be a mixing of person-driven and self-driving vehicles, potentially reducing some of the safety and congestion benefits of autonomous vehicles. Tradesmen need their vehicles to carry tools, while individuals often use their car to store items while running errands or enjoying the day. Car sharing limits these possibilities. Some car sharing proposals have suggested that individuals who do not know each other may share autonomous vehicle trips, much the way transit riders share a vehicle. It is not clear that individuals will be comfortable with or safe under these arrangements. Litman (2013) expects that all shared autonomous vehicles will be monitored by remote camera, meaning individuals will have to give up some privacy. He also expects that vehicles will be highly utilitarian, in order to be easily cleaned. This means a lower level of comfort compared to current vehicle conditions. The need for frequent cleaning and constant video monitoring would add costs to shared autonomous vehicle operations.

Autonomous vehicle impacts on land use are uncertain. Many analysts expect autonomous vehicles to support dense urban development patterns. However, transportation innovation has nearly always led to a more spread out development pattern. The Eno report estimated that the 90 percent autonomous vehicle fleet would increase road capacity by 80 percent, but VMT by only 9 percent. This goes against the history of roadway expansions, where new capacity is quickly filled by additional travel demand. In *The Fundamental Law of Road Congestion: Evidence from US Cities*, Duranton and Turner found that each one percent increase in regional road capacity was accompanied by a one percent increase in VMT. The degree and structure of driverless car sharing may be a key determinant on future land use and VMT. Paying for driverless vehicles based on time or distance could help to support dense, urban development patterns.[15] Other issues that need further exploration include: autonomous commercial vehicle operation, cyber security, data privacy, interaction between humans and machines, infrastructure and operations

[15]Jaffe, Eric. *Imagine a World Where Nobody Owns a Car*. The Atlantic Cities. February 2014. www.theatlanticcities.com/commute/2014/02/imagine-world-where-nobody-owns-their-own-car/8387/ Accessed 2/25/2014.

needs, shared mobility impacts on transit, testing and certification of autonomous vehicles, and vehicle-to-vehicle communication systems.

Although it seems likely that autonomous vehicles will be commercially available within the next decade, it remains unclear as to when they will make up a substantial portion of the fleet. Litman (2013) estimates that the time needed for the technology to develop and existing fleets to turn over means autonomous vehicles will likely only have a modest impact on road conditions over the next 30 years. This means autonomous vehicles are unlikely to substantially impact parking, and transit needs for at least the foreseeable future. However, there are many optimistic predictions that autonomous vehicles will have a larger impact in the nearer term.

## Regional Gamechanger(s)

Ideally, the long-range plan's analysis of trends and forecasts will identify any regional "gamechangers," which could be a good way to generate momentum for the region's vision. A major new development center, such as redeveloping the 30th Street rail yards, capping I-95 and/or I-676 in Center City, significantly higher or lower transportation funding levels, or a momentous regional transportation project, such as implementation of Amtrak's northeast corridor high speed rail plan, could all be gamechangers.[16] Regional gamechanger(s) could also come from abandoning some legacy systems, which no longer fit into a 21st century transportation system. Given current funding levels, and low appetite for increased public revenue, financing for any regional megaprojects will likely need to come largely from the private sector, or through public-private partnerships.

## Other Issues for Scenarios

Much transportation discussion over the past several years has focused on the long-term unsustainability of the gas tax used to fund transportation infrastructure. There are a number of potential replacements, such as: fees on vehicle miles traveled, congestion pricing, broad based tolling, carbon taxes, etc. Instead of focusing on regional funding, scenario discussion could focus more on the long-term replacement of the gas tax and how it would impact use of the transportation system.

Local taxes (beyond transportation funding), crime, and educational issues invariably arise during discussions about the future of Greater Philadelphia. While DVRPC's expertise in each field is limited, the proposed futures working group may choose to address them. Specific reform efforts and their expected regional impacts should be identified, if the working group decides to consider these issues.

Health outcomes from the transportation system have been an area of growing interest over the past few years. Much focus has been on health impact assessments (HIA). An HIA subjectively analyzes the likely health outcomes of different plans or projects. It looks to identify both beneficial outcomes and adverse effects. Where adverse effects are found, it makes recommendations to mitigate them.

About 60 transportation-oriented HIAs have either been completed or are in progress around the nation, including two that have considered long-range plan impacts to health (in Atlanta and San Francisco).[17] HIAs have been conducted in Philadelphia for the City Planning Commission's Lower South District Plan, a proposed Spring Garden Street greenway, and a casino. Another HIA in the region considered the impact of Trenton, New Jersey's farmers' market. The need to add a layer of analysis

[16] DVRPC is currently participating in a Tier 1 Environmental Impact Statement for NE Corridor high speed rail.

[17] Source: www.healthimpactproject.org/hia/us. Accessed 1/14/2014.

and area of expertise to the traditional regional planning effort has probably held this concept back. While the reports generated provide an impressive and comprehensive health analysis, they tend to be quite long and contain numerous indicators. The result runs the risk of data overload. Many reports have similar findings and recommendations, suggesting that as the research evolves, health indexes or travel demand model postprocessors may be able to simplify the analysis.

A second option is to look at health outcomes using a more traditional benefit-cost analysis, as has been suggested by the American Public Health Association (APHA) in *The Hidden Health Costs of Transportation*. This report looks at how the transportation system effects key health outcomes related to physical activity and body weight, air pollution, traffic safety, household expenses, and equity. Nationally, this report estimates that the health costs associated with the first three issues was about $370 to $400 billion (in 2008 dollars). APHA recommends developing a health cost analysis technique by determining:

1. The population that is exposed or affected;

2. The health impact to the exposed population; and

3. The costs associated with that health impact.

### Hidden Health Costs of Transportation – Cost of Transportation Related Health Outcomes

| Health Outcome | Annual Cost (Billions of 2008 $s) | Includes |
|---|---|---|
| Obesity and Overweight[1] | $142 | - Healthcare costs;<br>- Lost wages due to illness & disability; and<br>- Future earnings lost by premature death. |
| Air Pollution from Traffic[2] | $50 - $80 | - Health care costs; and<br>- Premature death. |
| Traffic Crashes[3] | $180 | - Healthcare costs;<br>- Lost wages;<br>- Property damage;<br>- Travel delay;<br>- Legal/administrative costs;<br>- Pain and suffering; and<br>- Lost quality of life. |

[1] National Institutes of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Statistics Related to Overweight and Obesity: The Economic Costs. Available at: http://win.niddk.nih.gov/statistics/index.htm.
[2] Federal Highway Administration. 2000. Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, May 2000. Available at: www.fhwa.dot.gov/policy/hcas/addendum.htm.
[3] AAA. Crashes vs. Congestion? What's the Cost to Society? Cambridge, MD: Cambridge Systematics, Inc.; 2008. Available at: www.aaanewsroom.net/assets/#les/20083591910.crashesVscongestionfullreport2.28.08.pdf.

*Source: APHA 2010.*

A few sketch planning models include a component that measures health outcomes and costs. The most prominent of these models is Urban Footprint. A spreadsheet-based companion to this program is called Rapid Fire. These are both open source software tools developed by Calthorpe and Associates.

Given the long-term issues with the gas tax, the next generation of DVRPC scenarios may consider how different funding sources for the region's transportation system would affect demand. It is possible that a rise in concern from the negative health outcomes of the transportation system drive significant reform and demand for change. This could be a scenario for the working group to consider. Or the working group may want to consider public health outcomes from any of the other identified drivers of change. There may be other topical issues, such as crime, taxes or education, the group identifies that aren't included in this white paper.

# III. Using Social Media to Better Involve the Public in Scenario Planning

Public participation in scenario or long-range planning is a major challenge. Choices & Voices version 1.0 was active on the DVRPC website for one year. In that time it had about 1,900 unique, non-DVRPC hits. Some 226 scenarios were completed.[18] DVRPC developed Choices & Voices internally, than marketed it through:

- Link on all DVRPC webpages;
- Like on Facebook (posts a link from a Facebook user account);
- DVRPC Twitter feed;
- User retweet option;
- News articles (Inquirer, Newsworks.org, Plan Philly);
- Regional blogs;
- DVRPC newsletter sent to about ~10,000 subscribers;
- Tailored e-mails to ~200 regional organizations;
- Business cards;
- Presentations and meetings; and
- Partner organizations, such as county planning departments and transportation management associations.

Choices & Voices is crowdsourced, so that the user can compare his or her scenario to the average of all submitted scenarios up to that point in time. This crowdsourcing concept is something to continue to pursue and improve upon. The public could be utilized and crowdsourced throughout the development of the scenarios to determine their thoughts on transportation system goals, future drivers of change, regional gamechangers, and ways to reduce greenhouse gas emissions. By involving the public upfront in scenario development, more interest can be generated in the effort from the beginning. By continuing to maintain and update the Choices & Voices online web platform, DVRPC can continue to build name brand recognition.

There are a number of proprietary scenario planning software programs that are being utilized by MPOs around the country. Choices & Voices was partially inspired by Metroquest. This program uses a simple, highly graphic interface. It generally consists of four or five screens/questions to identify community preferences and priorities, goals and challenges, strategies, or even individual project recommendations. It gives simple green and red arrows to show the change in community indicators, which increase in size as the impact becomes greater.

The Philadelphia City Planning Commission used Community Planit as part of the Philadelphia 2035 Plan development. Mindmixer is a similar program to Planit. Both of these programs engage the user by identifying a crowdsourced vision and general ideas for future improvements. The ideas and visions can then be commented on by other users, and include a like/dislike feature. Ideas with the most positive comments are then identified as priorities. They also use polling and surveys to get additional feedback. Both sites offer rewards to users in exchange for their feedback. Rewards are similar to credit card points, in that they can be redeemed for use at museums, and for other local activities. The goal of these programs is to have a public dialogue about issues and ways to improve them. A turn off for some users may be the

[18] Choices & Voices version 1.0 results are summarized at www.dvrpc.org/ChoicesAndVoices/pdf/results.pdf.

registration requirement, though this can help to gather more demographic data about the site users.

CitiZing is an online community engagement platform based on “civic networking.” Citizens can log into CitiZing either through a Facebook account, or by creating an account with CitiZing. This program uses surveys, wikis, prioritizers, and maps to engage citizens and utilize their problem solving capabilities. The CitiZing process has three steps: problem diagnosis, analysis and conclusion, and implementation. The collaborative results should guide decision makers on action steps. CitiZing’s Minnesota Go tool, mentioned earlier in this white paper, is the closest known transportation planning scenario exercise to what DVRPC is proposing in its next effort.

Textizen is a mobile phone ‘text’ tool for citizen engagement. It creates text-based surveys that can reach broad demographic groups. Textizen can be used for visioning and idea generation, needs assessment, or feedback and benchmarking. Much of the platform is similar to Survey Monkey, but based on mobile phone texting technology. The text based platform may be a better way to reach lower income individuals. The Textizen website notes that nearly 90 percent of the adult population owns a cell phone.

There is an opportunity to get more public input in the development and selection of the scenarios through polling and the use of social media. Polling could be conducted in a number of ways, including via text messaging, Survey Monkey, or a survey built into the DVRPC website. DVRPC newsletters, its Twitter feed, and Facebook page and other social media could help publicize the surveys.

Scenario development surveys could ask the public to identify what future drivers of change are most likely to happen, and which would have the greatest impact, similar to what was done for the *Regional Analysis of What-if Transportation Scenarios*. A second survey could ask the region to identify the biggest potential regional gamechanger(s). They could also feature more open-ended questions that allow for more dialogue. These could help to focus regional goals and scenario efforts by better answering the question of “What are the major issues to be addressed?”

In 2008, DVRPC conducted a short eight-question web-based survey on the region’s development and transportation preferences as part of the *Connections (2035)* long-range plan update. It offered a chance to enter a drawing for an IPod Touch as a reward for completing the survey. This gave incentive for the survey taker to leave an e-mail address and helped to generate more than 5,000 responses to the survey. It is unclear how big of a motivator the IPod was to participate in the survey, but some sort of reward can help to generate additional response.

Not all outreach has to be done through social media. The nature of this scenario exercise could allow for easy, quick discussion, guerrilla format outreach. DVRPC or the working group could set up a table in a transit station, park, community event, or mall and ask for individuals to tell us what will change how they get around, or the need to get around in the future.

How to better involve the public in developing the scenarios and generate interest in the completed scenario products should be a focus area for a DVRPC futures working group.

# IV. Recommendations

This effort should continue to inform the next update to the region's long-range plan, help to better deal with future uncertainty, and enhance near term regional decision making. Following a similar process as the MIT Future Freight Flows, the next DVRPC scenario planning effort should:

- Improve collaboration with regional stakeholders in scenario work;
- Broaden public outreach and utilize more social media;
- Investigate global driving forces of change, such as the social (i.e., shifting Millennial preferences), technological (i.e., autonomous vehicles), environmental (i.e., climate change), economic (i.e., cheap/volatile energy or the shared economy), and political shifts that are likely to transform the future. While these are things the region cannot control, it is important to understand their potential impacts and how to best prepare for and adapt to them;
- Consider regional gamechangers, which could be new development centers, or major transportation projects;
- Build on Choices & Voices, with new options and allow for more variance; and
- Identify action steps to achieve a desired future or better prepare for change.

Scenarios could also incorporate public health impacts, or other issues relevant to the long-range plan. As scenarios are best conducted as a team-building exercise, DVRPC should form a diverse futures working group to determine which directions, goals, and options should be undertaken in the next scenario analysis.

## DVRPC Futures Working Group

The futures working group should consist of transportation, land use, economic, and environmental stakeholder experts from academic, nonprofit, governmental, and private sector realms. This group will collaborate in an open environment for engagement and will help with public outreach, including polling and the use of social media to guide decision-making and to spread the word about the effort. It should consider drivers of change that are relevant to the region's long-range plan, and avoid replicating previous efforts on land use and funding levels. The working group should consider the future out to the year 2045 (the horizon of the next plan) by:

1. Engaging transportation, land use, economic, environmental, and health experts about future drivers of change, and challenge conventional wisdom;
2. Brainstorming global drivers of change and regional gamechangers;
3. Voting on impact and likelihood of identified drivers and gamechangers;
4. Identifying four or five highly differentiated scenarios for further analysis;
5. Fleshing out the selected scenarios to create robust visions of the future in each;
6. Analyzing scenarios and identify probable implications;
7. Identifying robust actions that the region can take to be successful across all futures, and contingent actions to be more successful in each different future;
    a. What are the region's economic opportunities in each scenario?
    b. What are the environmental risks in each scenario?
    c. What is the best way to develop the region in each scenario?
    d. How should we invest in transportation in each scenario?
8. Identifying potential leading indicators for each scenario; and
9. Creating a short, graphic publication about the scenarios, and incorporate new options into the existing Choices & Voices framework.

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# ABSTRACT

**Title:** The Future of Scenario Planning

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**Geographic Area Covered:**
The nine-county DVRPC region, which covers the counties of Bucks, Chester, Delaware, Montgomery, and Philadelphia in Pennsylvania, and Burlington, Camden, Gloucester, and Mercer counties in New Jersey.

**Key Words:**
Scenario planning, long-range planning, performance measures, gamechangers, driving forces, technology, energy, Millennials, shared economy, transportation infrastructure, climate change, autonomous vehicles, and futures working group.

**Abstract:**
This white paper reviews current practices in scenario planning, DVRPC's scenario planning experience and lessons learned, makes recommendations about how DVRPC can improve its practices, and identifies options for the next round of scenario planning. These options include investigating underlying driving forces of change in the future, and identifying regional land use and transportation gamechanger(s). It recommends creating a futures working group from regional transportation, land use, environmental, and economic experts to drive the analysis, and to use social media and polling to engage the public and other key stakeholders.

**Staff Contact:**
Brett Fusco
Sr. Transportation Planner
Phone: 215.238.2937
Email: bfusco@dvrpc.org

190 N. Independence Mall West, 8th Floor
Philadelphia, PA 19106
Phone: 215.592.1800
Fax: 215.592.9125
Web: www.dvrpc.org

The Delaware Valley Regional Planning Commission (DVRPC) 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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**190 N. Independence Mall West**
**8th Floor**
**Philadelphia, PA 19106**
**Phone: 215.592.1800**
**Fax: 215.592.9125**
**Web: www.dvrpc.org**