

CONNECTIONS
2045

Greater Philadelphia

**FUTURE
FORCES**

In the future, regions around the world will face a number of external forces—such as climate change, new technologies, and shifting population and job locations—that will create major challenges and opportunities. These Future Forces are broader **social, technological, economic, environmental,** and **political** trends that can create sudden and rapid change. They are largely beyond the control of any individual government, business, or organization, but will have a profound impact on how we build **livable communities,** foster **growth management,** maintain **economic competitiveness,** and create a **modern, multimodal transportation** system.

FUTURE FORCES

POLITICAL

SOCIAL

ENVIRONMENTAL

TECHNOLOGICAL

ECONOMIC



🏠 LIVABLE COMMUNITIES

🌿 GROWTH MANAGEMENT

💰 ECONOMIC COMPETITIVENESS

🚗 MULTIMODAL TRANSPORTATION

As the first step in updating the region's long-range plan, the Delaware Valley Regional Planning Commission convened the Greater Philadelphia Futures Group, with experts in economics, land use, the environment, public health, transportation, and technology coming from academia, the private sector, nonprofit organizations, and government to collaboratively identify key regional **Future Forces**. Each of these are emerging trends which could, individually or collectively, influence our region.



Millennials and empty nesters moving back to walkable urban centers are the start of a long-term trend, as future generations show an even stronger desire for city living and walking, biking, and transit.



Individuals must create their own economic opportunities and contribute more toward their healthcare and retirement, as labor efficiency and the rising cost of full-time employees cause large companies to continue to reduce their workforces.



Increasing atmospheric carbon levels, due to continued global use of fossil fuels, lead to significant disruptions from climate change. The region must prepare for hotter and wetter weather, more frequent and intense storms, and rising sea levels.



Smartphones, apps, and real-time information help people get around using a multimodal network of car sharing, taxis, ride sharing, transit, biking, bike sharing, walking, and new modes such as on-demand micro transit bus service and ride sourcing, where a vehicle is e-hailed for a point-to-point trip.



The region's economy grows with domestic natural gas extraction and distribution, and renewed manufacturing. An abundance of domestically produced energy keeps the cost of energy low and helps the region and the nation become more energy independent.

What-If Scenarios

This effort is proactive and will help the region, in the words of hockey legend Wayne Gretzky, “skate to where the puck will be.” To do this, each **Future Force** is carried out over the next 30 years as a **What-If Scenario** to consider how the region may be reshaped. The reality is that some elements from many of these scenarios are likely to occur in the future, and the future will not look exactly like any one of these scenarios. Scenario planning is a tool for collaboration, and it can be used to change perceptions, deal with uncertainty, and improve strategic decision making. This endeavor does not try to identify a “preferred” scenario for the future. Rather, it focuses on the types of change that are likely to occur, and what the region can do to better prepare for them.

Taking knowledge and turning it into strategic action is a key goal and significant challenge in scenario planning. Recommendations include policy directives, skills the workforce will need to effectively compete in the global economy, and transportation investments to ensure the efficient movement of people and goods. **Universal Actions** are steps the region can take to improve its position regardless of what the future brings. **Priority Regional Actions** are specific to each Future Force.

ASSUMPTIONS USED TO BUILD WHAT-IF SCENARIOS

Source: DVRPC, 2016.

FACTOR	ENDURING URBANISM	THE FREE AGENT ECONOMY	SEVERE CLIMATE	TRANSPORTATION ON DEMAND	THE U.S. ENERGY BOOM
Demographic Trends	Young adults (20–34 years old) continue to flock to the region, and there are fewer persons per household	Population is more transitory, as people constantly move in search of economic opportunity	Region receives some in-migration from other regions that are more severely impacted by climate change	Technologies allow workers to live anywhere and work remotely	Population and jobs increase due to the energy hub and economic growth
Development Patterns	Population grows around dense regional centers but declines slightly in farther-out suburbs	New development centers emerge around universities, which become the creators and incubators of new businesses	More infill development and increased density in regional centers Movement away from major rivers and floodplains	Mix of infill development that occurs near transit access and regional centers, and more traditional suburban development	Industrial growth reactivates the Delaware River waterfront, and spurs residential growth in areas with easy access to industrial jobs
Travel Demand Shifts	Increase in walking, biking, and transit trips	Fewer 9-to-5 work schedules harm transit agencies' ability to effectively deliver service	Slower growth in trade and goods movement	New transportation services, such as ride sourcing and micro transit, become major travel providers	Overall increase in freight moved by pipeline, train, and waterways
Transportation Infrastructure	Significant push to fully pedestrianize main streets, while adding protected bike and pedestrian infrastructure to all roads (except highways)	Strong desire for low-cost options, pushing a move toward Complete Streets, which safely accommodate all users	Extreme weather shortens transportation infrastructure lifespans and increases maintenance costs	New technologies, such as 3-D printing, nanotechnology, and better asset management, extend the lifespan of transportation infrastructure and lower its costs	Low energy prices bring down the cost of building and maintaining transportation infrastructure
Miscellaneous	Demand increases for new types of housing, such as micro apartments Urban schools slowly close the quality gap, reducing the push of families with children to the suburbs	Demand grows for co-working space 3-D printing, automation, and robotics brings more local manufacturing back to the region	The need to rebuild and make infrastructure more resilient limits other investments that can encourage economic growth	A significant increase in zero-car households Innovations in alternative energy sources lead to lower energy costs	Fossil fuels remain the dominant energy source

Universal Actions

Universal actions are beneficial regardless of which forces come into play in the future. Universal workforce skill sets include **science, technology, engineering, and math** (STEM), which can help to drive **ideas and innovation**—the major building blocks for economic growth. Even more important may be **entrepreneurial skills**, which can turn ideas and innovations into viable commercial products and services.

UNIVERSAL PRIORITY REGIONAL ACTIONS

- ▶ Encourage **mixed-use infill development** where transportation and utility capacity already exist. Update zoning and building codes to allow for a variety of smaller housing options, including more attached homes, multi-family development, and micro apartment units.
- ▶ Build **lifelong communities** that allow for aging in place. Retrofit older homes, and ensure new ones have visitability (one no-step entrance, a minimum 32" opening for all doorways, and a bathroom on the first floor).
- ▶ Implement **universal pre-kindergarten** and other **programs to improve educational outcomes** for the region's future workforce, particularly for low-income and environmental justice (EJ) communities that are falling behind.
- ▶ Develop and grow the region's **impact economy**—including companies that have a positive environmental or social impact, while generating a profit-creating shared value through public-private partnerships, and using private and endowment capital to

do public good while seeking a return on their investments.

- ▶ Encourage **immigrant-friendly policies** in preparation for population growth and integration, including outreach to these communities and education about how to connect the immigrant population with existing language, social service, and business resources.
- ▶ Strengthen **Northeast megaregion collaboration** and cooperation, build partnerships, and recognize that Greater Philadelphia benefits from a broader economic unit.
- ▶ Create **regional or local data team(s)** to centralize and analyze datasets, guide decision making, and enhance government programs.
- ▶ Expand **telecommunications infrastructure** bandwidth to better connect with the global economy, and enhance Internet access and training for low-income individuals.
- ▶ Use **green infrastructure** and stream buffer ordinances to mitigate the urban heat island effect and flooding, lower costs, improve air and water quality, and bring nature back into densely developed areas.

- ▶ Create and implement **Vision Zero** plans to ensure new transportation technologies enhance safety and protect all transportation system users.
- ▶ Develop a structured **freight enhancement plan** to identify and prioritize freight infrastructure investments, raise awareness of freight issues, manage delivery times, designate truck routes, and encourage the development of freight consolidation centers.
- ▶ Create and implement regional **infrastructure resiliency** plans, increase funding for projects that reduce vulnerability, and increase flexibility and resiliency of infrastructure to climate change effects.
- ▶ Preserve, maintain, and **modernize transportation infrastructure**, while creating a multimodal network. Explore dedicated regional funding to fully modernize and improve the transportation system.

HOW WILL **CLIMATE CHANGE** IMPACT OUR REGION?

WILL OUR **CITIES AND TOWNS** THRIVE?

HOW WILL I **GET AROUND** IN 2045?

HOW MUCH WILL **ENERGY** COST IN THE FUTURE?

WHAT WILL MY **JOB** LOOK LIKE IN 25 YEARS?

What-If Scenario



ENDURING URBANISM

PHOTO: BLT ARCHITECTS

Millennials and empty nesters moving back to walkable urban centers are the start of a long-term trend, as future generations show an even stronger desire for city living and walking, biking, and transit.

© BLT ARCHITECTS 2014

The Year 2045

The City of Philadelphia is nearing a population of two million people, and the region as a whole has grown thanks to interest in urban living and having a variety of desirable communities—from large cities to small boroughs—that offer a range of economic, cultural, and social opportunities. Tax reforms have helped cities and towns regenerate themselves, and attract jobs and build new neighborhoods that have increased their tax bases.

To attract and retain top talent, communities are in competition to create the most bustling living streets, filled with green infrastructure, attractive street furniture, and small shops and restaurants.

- ▶ School quality has improved thanks to neighborhood efforts to improve public schools, charter schools, and homeschool options.
- ▶ Smaller multifamily, and communal housing units are becoming common.
- ▶ Transit ridership, biking, and walking are gaining popularity thanks to denser development patterns and redesigned streets that prioritize these modes. More active transportation helps to improve health, while increasing disposable income thanks to lower travel costs.
- ▶ Transit operators are seeing record ridership levels, and the region needs to find ways to significantly expand services in order to meet the demand.
- ▶ Car sharing, ride sourcing, and bike sharing allow residents to own fewer personal vehicles, and reduce the need for on-street parking. This frees up street space and land for goods movement, walking, biking, green infrastructure, and more economically beneficial uses.
- ▶ Growing freight demand in urban areas is being met through package consolidation centers, smaller trucks, bicycle and e-bicycle drop offs, and overnight deliveries.

Challenges

► INNER CITY GENTRIFICATION:

The cost of urban housing continues to rise, due in part to unmet demand and the market's focus on developing high-end housing.

► INCREASING POPULATION

DENSITY: Many urban neighborhoods now oppose additional development, worsening the affordable housing problems in them. Increased density has come with some risks to health through the spread of viruses, and lack of access to nature and open space. However, growing calls to limit dense development in central business districts threaten to push growth to less competitive lower-density areas or other regions.

► LOSS OF URBAN INDUSTRIAL

LAND: Residential development, particularly along waterfronts, has consumed much land that was formerly industrial. Failure to preserve it for manufacturing jobs and freight distribution has led to missed opportunities for commercial uses with access to freight rail infrastructure that is necessary to compete in the global economy.

► SUBURBAN FISCAL DISTRESS:

As suburban office parks were abandoned and maintenance was deferred for aging infrastructure, residential taxes had to be increased, creating a push factor out of these areas.

WHY THE SCENARIO MAY NOT HAPPEN

This trend may be the outcome of high oil prices, the recession, or millennials struggling with student loan debt and unemployment during their formative years. Once the economy recovers, or if energy prices remain low, young people may return to the more suburban lifestyle patterns of previous generations.

Preparing for Enduring Urbanism

A key assumption for this scenario is that urban areas can successfully implement tax reforms that ensure businesses and urban economies can grow. It is critical to maintain commercial functions in urban areas so that business and industry is not priced out by demands for residential and entertainment space. Social and analytic skills will be highly valuable in this future. Translators and language skills are a growth area with increasing globalization and continued evolution of the knowledge economy.

PRIORITY REGIONAL ACTIONS

- ▶ (Re)develop without displacing existing households; allow for more multifamily housing.
- ▶ Thoroughly implement Complete Streets to accommodate all users, including goods movement, along with protected bike lanes, pedestrian-only areas, and shared space/living streets concepts that prioritize bike and pedestrian use, particularly in the region's centers.
- ▶ Expand and increase service frequency throughout the transit system.
- ▶ Retrofit office parks and commercial districts into dense mixed-use communities, update design guidelines with form-based zoning, and relax parking requirements.
- ▶ Protect industrial zones, particularly areas with freight rail access, from encroaching residential and commercial uses.

What-If Scenario



FOR HIRE

THE FREE AGENT ECONOMY

PHOTO: BENJAMIN'S DESK

Individuals must create their own economic opportunities and contribute more toward their healthcare and retirement, as labor efficiency and the rising cost of full-time employees cause large companies to continue to reduce their workforces.

The Year 2045

Many individuals now work for themselves as continued outsourcing, the rise of robotics, and efficiency gains enable big companies to get by with far fewer employees. Mobile communication devices—particularly smartphones—are connecting people, providing information, and flattening transaction costs in real time, while substantially changing the structure of the economy, firms, and individual careers. Nearly any professional service—doctors, lawyers, accountants, engineers, web developers, and others—can now readily be found on demand. Entrepreneurial freelancers are turning ideas and innovations into new companies, which are growing the region's economy.

- ▶ Greater Philadelphia has become more appealing due to its large urban economy and proximity to many other large cities. Many people work from home or in co-working and shared workspaces.
- ▶ Renting is much more common, as individuals value flexibility and access to employment. This is most easily found in or near a regional center or university served by transit.
- ▶ Online universities with more interactive teaching methods now dominate undergraduate and continuing education. Despite this, traditional universities have become the region's main growth attractors, by focusing more on research and new business formation, and specialized and graduate education.
- ▶ Regions are in competition to attract high-skill, entrepreneurial immigrants.
- ▶ New businesses often get their start from successful trials in the pop-up economy, where a temporary shop or dining space is set up to test out new ideas.
- ▶ 3-D printing is commonplace and supports “maker” communities that personalize many of the things we purchase. Manufacturing occurs in smaller and more spread-out facilities.

Challenges

► **THE SHIFTING ROLE OF MEDS AND EDs:** Virtual classrooms and telemedicine have undermined the place-based nature of the region's two biggest employment sectors.

► **EMPLOYMENT AND INCOME STABILITY:** With fewer people working for major companies, incomes are less stable and predictable, impacting the choices people make about home ownership, having children, or even the type of work they undertake.

► **RETIREMENT AND HEALTH BENEFITS:** Amidst busy schedules and trying to make ends meet, individuals must increasingly secure their own health insurance and retirement accounts. Lack of paid vacation negatively affects both quality of life and the region's tourism industry.

► **INEQUALITY AND SUBURBAN POVERTY:** Low-skill workers have a particularly difficult time finding work, and poverty is increasing in many formerly middle-class neighborhoods. Many in the suburbs lack access to transportation and services needed to help families escape poverty.

WHY THE SCENARIO MAY NOT HAPPEN

This force is ongoing. A 2015 Kelly Services survey found about 31 percent of U.S. workers think of themselves as free agents. The key question is how much stronger it will become in the future. Intuit has forecast that this number will grow to about 40 percent of all workers by 2020.

Preparing for The Free Agent Economy

Transportation, telecommunications, and social networks are all crucial to making connections and building agglomeration economies.

Workers will need better protection to ensure fair wages, benefits, and decent working conditions.

Education is especially critical, particularly for low-income communities, where it is the key to escaping poverty. The workforce will need to be flexible, able to quickly adapt to changing economic needs; with skills in critical thinking, problem solving, sales, self promotion, and the ability to work with their hands. Independent contractors need to work well with others, be diplomatic, self-assured, and persuasive.

PRIORITY REGIONAL ACTIONS

- ▶ Expand and support regional business incubators and accelerators, and small business and entrepreneurial training programs.
- ▶ Simplify business tax collection, licensing, and permitting, and ensure regulations do not restrict the pop-up economy.
- ▶ Increase transit service during off-peak hours and improve intra-suburban service and service to suburban office parks.
- ▶ Update zoning codes to allow for shared office space and mixed-use buildings.
- ▶ Build more middle-class housing units, and foster regional cooperation for reducing poverty and homelessness.



STOP

What-If Scenario



SEVERE CLIMATE

Increasing atmospheric carbon levels, due to continued global use of fossil fuels, lead to significant disruptions due to climate change. The region must prepare for hotter and wetter weather, more frequent and intense storms, and rising sea levels.

The Year 2045

Even in the face of a rapidly changing climate, there still has not been successful coordinated global action to lower greenhouse gas emissions. Greater Philadelphia has seen increased precipitation with more intense storms and subsequent flooding, rising temperatures with more variability, a greater number of days with temperatures over 90 degrees in the summer, more freeze-thaw cycles in the winter, and sea level rise. Despite this, the region has become a more desirable place to live—relative to other areas—due to less risk of sea level rise and the continued availability of water; and the population has increased slightly due to climate change-driven immigration.

- ▶ Rampant climate change around the world has led to: heat waves causing premature deaths; growing global food insecurity that underscores the importance of food systems and the ability of regions to feed themselves; and economic and environmental declines.
- ▶ Local actions have reduced per capita residential energy and on-road transportation emissions through denser, more centralized development patterns, and more fuel-efficient vehicles, appliances, air conditioning, heating, and lighting.
- ▶ As more land area becomes vulnerable to flooding, some areas and transportation infrastructure are only usable at a very high cost. Particular concerns are Philadelphia International Airport and the Navy Yard.
- ▶ Extreme weather has led to climate-related damage to transportation infrastructure; and increased maintenance costs, crash rates, nonrecurring delay, and traffic interruptions on the region's roads.
- ▶ Excess water capacity is a competitive advantage for Greater Philadelphia, benefiting industries such as agriculture (which now has a longer growing season) and water-intensive manufacturing, both of which require new investments in freight infrastructure.

Challenges

The worst impacts of climate change are yet to come in 2045—the near-term future will see far worse outcomes than have been experienced to date.

► **TRADE AND INFRASTRUCTURE DISRUPTIONS:** Trade and goods movement growth has been slow, in part due to routine extreme weather events that cause the temporary closure of infrastructure and the fact that everything has become more expensive, particularly energy and raw materials.

► **LACK OF NATIONAL ECONOMIC COMPETITIVENESS:** Not taking action on climate change was expected to bolster the economy, but instead it has substantially increased the cost of doing business while letting other countries take the lead on clean-technology innovation.

► **CLIMATE EQUITY:** Many of the areas that have been most negatively impacted by climate change are low-income communities that were poorly equipped to handle it.

► **CRISIS MANAGEMENT:** Climate change has created a variety of challenges in electricity and drinking water distribution, and stormwater management. Lack of funding, and dealing with crises as they arise, means that infrastructure systems still have not been brought up to modern standards.

WHY THE SCENARIO MAY NOT HAPPEN

Climate change could turn out to be on the lower end of current projections. Multilateral agreements to reduce emissions in a binding manner, such as through cap and trade or carbon taxes, could lower the risk of worst-case outcomes. The invention of new technologies could create cleaner vehicles and power plants.

Preparing for Severe Climate

Action on climate change must work to both reduce its severity, and adapt to more intense weather patterns. Changing climate will mean the past is no longer a guide for designing infrastructure systems that will need to withstand a wider temperature range. Greater Philadelphia must maintain and develop additional redundancies to make the transportation system more resilient. Severe climate will push the need for a strong understanding of natural systems and sustainable design.

PRIORITY REGIONAL ACTIONS

- ▶ Increase interagency and intergovernmental coordination around climate change issues.
- ▶ Focus on adaptation by maintaining and expanding wetlands, updating building codes for more severe weather, increasing water storage capabilities, improving emergency preparedness, and developing a flood detour system for freight routes.
- ▶ Preserve agricultural land and take other measures to increase regional food production.
- ▶ Continue to reduce greenhouse gas emissions at the regional, municipal, firm, and household level.
- ▶ Continue to invest in, and make the region into an alternative energy and clean-technology hub, and accelerate the movement toward low-carbon electricity production.

What-If Scenario



TRANSPORTATION ON DEMAND

Smartphones, apps, and real-time information help people get around using a multimodal network of car sharing, taxis, ride sharing, transit, biking, bike sharing, walking, and new modes such as on-demand micro transit bus service and ride sourcing, where a driver is e-hailed for a point-to-point trip.

The Year 2045

Where people once bought cars to get around, they now increasingly purchase mobility as a service. New technologies have dramatically reshaped transportation, with more and more people—particularly those who are young, highly skilled, and well educated—finding there is little need to own a car. Mobile communication devices allow individuals to obtain real-time information on transportation services instantaneously. The sharing economy has continued to grow, and more people efficiently use assets such as bedrooms, homes, and equipment by renting them on demand. Advancements in robotics and artificial intelligence are driving economic growth. This has brought about autonomous vehicles (AVs), buses, and trucks, which make up about 30 percent of the vehicle fleet.

- ▶ The Internet of Things (IoT), combined with low-cost sensors embedded into transportation infrastructure, helps to efficiently move people and goods in real time, allowing for smarter travel choices.
- ▶ Transportation Networking Companies are offering unlimited mobility options through monthly subscriptions, on-demand bus service, and ride sourcing. This has dramatically decreased the need to own a personal vehicle.
- ▶ Reduced parking means parking lots, on-street spaces, and residential garages are finding new uses.
- ▶ Connected vehicles and AVs have further reduced fatal crashes, moving the region closer to the Vision Zero goal of no road deaths.
- ▶ Most AVs are being used as taxi-like services. However, a number of them are privately owned and operated, often by well-to-do individuals, allowing wealthy enclaves to locate even farther from population centers.
- ▶ Freight shippers routinely offer same-day delivery, which has led to items being produced or sourced closer to where the purchase is made, and more efficient urban freight routing, through consolidation centers, and on-demand trucking.

Challenges

► **DISJOINTED TRANSPORTATION NETWORK:** The system is highly fragmented, as service providers and modes tend to compete with each other, rather than working together toward the same goal of efficiently moving people and goods.

► **TRANSPORTATION EQUITY:** Transportation services provided by private companies do not have the same geographic service provision requirements as taxis and public transit. If ride sourcing and micro transit costs are beyond what residents in low-income communities can afford, they are less likely to be served by them.

► **INCREASING TRAFFIC VOLUMES:** Roads are overrun by many different modes, and better real-time road information is causing more cars and trucks to use local roads to avoid congestion. Passengerless AVs are sent out to run errands.

► **PRIVACY, SECURITY, AND GROWING COMPLEXITY:** Individuals remain concerned about how their data is collected and used, while vehicles and other devices connected to the IoT are at risk for hacking. Increasingly complicated technology makes it very difficult to recognize defects or vulnerabilities before detrimental events occur. Ensuring safety for riders in shared vehicle services remains difficult, and it is uncertain that the region can quickly evacuate large numbers of carless households in an emergency.

WHY THE SCENARIO MAY NOT HAPPEN

The big question is how quickly the technology evolves and the pace at which people and regulatory agencies embrace and adapt to these changes. Overcoming regulatory hurdles and getting to price points well below the cost of owning a vehicle are necessary to bring about widespread use of ride sourcing and micro transit services. The economic, regulatory, and/or security limitations for some of these technologies, particularly drones or AVs, may make them less viable.

Preparing for Transportation On Demand

Transportation regulations will need to keep up with fast-changing technologies; otherwise, potentially transformative transportation and safety advances could be held back. More effort should be put into creating a new vision for a reimagined transportation system utilizing these technologies. Integrating transit with new ride sourcing and on-demand services offers the opportunity to better connect low-income individuals to jobs and make last-mile transit connections. Individuals who have the skills to work with technology will be well suited for this future.

PRIORITY REGIONAL ACTIONS

- ▶ Promote coordination between public and private transportation operators to achieve a connected transportation system of complementary modes through singular fare payment instruments and multimodal travel information apps, development of multimodal hubs, and information-sharing and open-data agreements.
- ▶ Incentivize public-private partnerships, private firms, or nonprofits to speed up project delivery and incorporate new technologies.
- ▶ Use traffic calming and protected bike lanes to diversify the transportation system, safeguard nonmotorized users, and discourage through-traveling vehicles on local roads.
- ▶ Prepare evacuation plans to move larger numbers of carless households.
- ▶ Ensure that new transportation technologies and services are accessible to individuals with disabilities and families with small children.

A photograph of two industrial workers in blue uniforms and white hard hats working on a complex system of pipes and machinery. The scene is brightly lit, suggesting an outdoor or well-lit industrial environment. The workers are focused on their task, with one worker in the foreground and another slightly behind him. The machinery consists of numerous grey pipes, valves, and a large white cylindrical tank. The background shows more of the industrial structure under a clear blue sky.

What-If Scenario

A white silhouette of an industrial skyline, featuring various structures like distillation columns, storage tanks, and processing units, set against a dark brown background.

THE U.S. ENERGY BOOM

The region's economy grows with domestic natural gas extraction and distribution, and renewed manufacturing. An abundance of domestically produced energy keeps the cost of energy low and helps the region and nation become more energy independent.

The Year 2045

The energy boom in Greater Philadelphia is centered on petrochemical production in a regional energy hub along the Delaware River. The boom was strengthened by the construction of a pipeline to bring natural gas to the Philadelphia port, and the repeal of the Federal ban on energy exports that dated to the Arab Oil Embargo. This has saved consumers money, opened markets to increased global trade, made the nation more energy independent, and contributed to growth in employment, wages, and gross domestic product; while reducing reliance on rogue nations for energy. There is now less risk of global supply disruption and more stable energy prices.

- ▶ The Jones Act, which required that a cargo ship had to be built in the United States in order to go directly from one American port to another, was rescinded. U.S. shipbuilders, including Philly (formerly Aker) Shipyard, are struggling to compete in the global market without this protection. Moving goods and oil between U.S. ports by foreign-flagged ships is much less expensive. This has made transporting Bakken crude oil by train to the region cost prohibitive, and it is now moved by ship from the Gulf Coast, which it reaches via pipeline.
- ▶ U.S. ports, including those in Greater Philadelphia, are busier than ever thanks to increased international trade.
- ▶ Other manufacturing has been attracted to the region in order to gain access to energy supplies. However, technologies such as 3-D printing and automation have muted employment growth in these industries.
- ▶ Economic growth is correlated with decreasing inequality, as opportunities have expanded for lower- and medium-skilled individuals. The average homeowner has benefited from rising home value, savings on home heating, and increasing disposable income.

Challenges

► **ENVIRONMENTAL AND HEALTH CONDITIONS:** Increasing use of fossil fuels has worsened the region's air and water quality, harmed human health in a variety of ways, and hindered the ability to achieve federal air quality standards.

► **CONTINUING RELIANCE ON FOSSIL FUELS:** Increased regulations on fossil fuels are putting the future of these industries in doubt. Focusing on natural gas has also slowed the development and adoption of clean, sustainable energy technologies and has weakened the region's ability to be a leader in green technology.

► **BOOM-BUST CYCLES:** The energy boom is not driving innovation—the key to competitiveness in a global economy—and energy boom industries have been crowding out other importing/exporting industries that need access to limited key port and freight rail resources. Increased reliance on energy distribution and petrochemical production has made the region more vulnerable to economic downturns.

► **PIPELINE SAFETY:** Residents' concerns about the safety of pipelines impede infrastructure improvements needed to fully realize the energy hub.

WHY THE SCENARIO MAY NOT HAPPEN

Energy prices are highly volatile due to international forces well beyond regional control. Continued low energy costs could slow domestic energy production. Federal and state regulations will help to shape the future of energy, and it is hard to predict what those will be. Local government collaboration and coordinated decision making is critical to developing the energy hub and the infrastructure needed for it. Local opposition to expanding pipeline capacity, or shipping oil via rail through densely populated areas, could also suppress the boom.

The cost of renewable energy is quickly becoming competitive with natural gas and coal, while increasing energy efficiency and climate change concerns may reduce total demand for energy. Natural gas wells are not lasting as long as predicted and could prove to be not economically viable. Global international agreements on carbon taxes and other measures to fight climate change could alter the equation as well.

Preparing for The U.S. Energy Boom

Safety is a primary concern. Aging infrastructure is a major challenge, along with inadequate last-mile connectors, extending pipelines into port facilities, and increasing port capacity. Making long-term investments must be weighed against the short-term volatility of fuel prices and the instability of major oil-producing countries. Increasing natural gas production will require more capacity for chemical manufacturing and refining, and will increase the need for regional freight distribution facilities. Alternative means should be sought to bolster U.S. shipbuilding without Jones Act protections.

PRIORITY REGIONAL ACTIONS

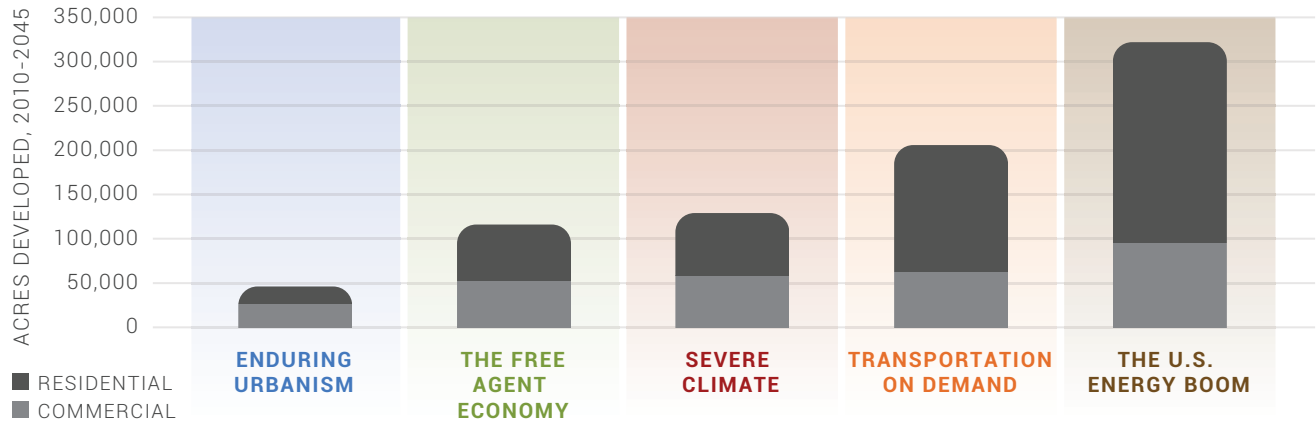
- ▶ Work with the refineries, port facilities, pipeline operators, and freight railroads to promote safety, clean air, and freight-as-a-good-neighbor initiatives within facility host communities.
- ▶ Market the region internationally as an energy hub to encourage companies to relocate here for natural gas opportunities.
- ▶ Use natural gas as an intermediate energy source until clean energy technology matures, and continue to invest in regional alternative energy research and development.
- ▶ Ensure personal safety risks and public health impacts are considered in any benefit-cost analysis for investing in pipelines and other freight infrastructure needed to support energy distribution.
- ▶ Separate freight and passenger service on the Airport Line to accommodate increasing demand for goods movement.

Key Projections

The scenarios were modeled to get an idea of how they would impact the region's future development and transportation patterns. The dense development patterns in **Enduring Urbanism** would develop the fewest new footprint acres, while low energy costs and increasing household wealth in **The U.S. Energy Boom** would develop the most new land. Efforts to minimize personal and business transportation expenses in **The Free Agent Economy** would lead to it having the lowest future costs, while everything becoming more expensive in **Severe Climate** would lead to both the highest costs for travel and the least amount of it. New modes, such as micro transit and ride sourcing, emerge across all scenarios, but are particularly strong in **Transportation on Demand**, which has the most travel, despite significantly lower rates of auto ownership, as people generally move to a transportation-as-a-service model.

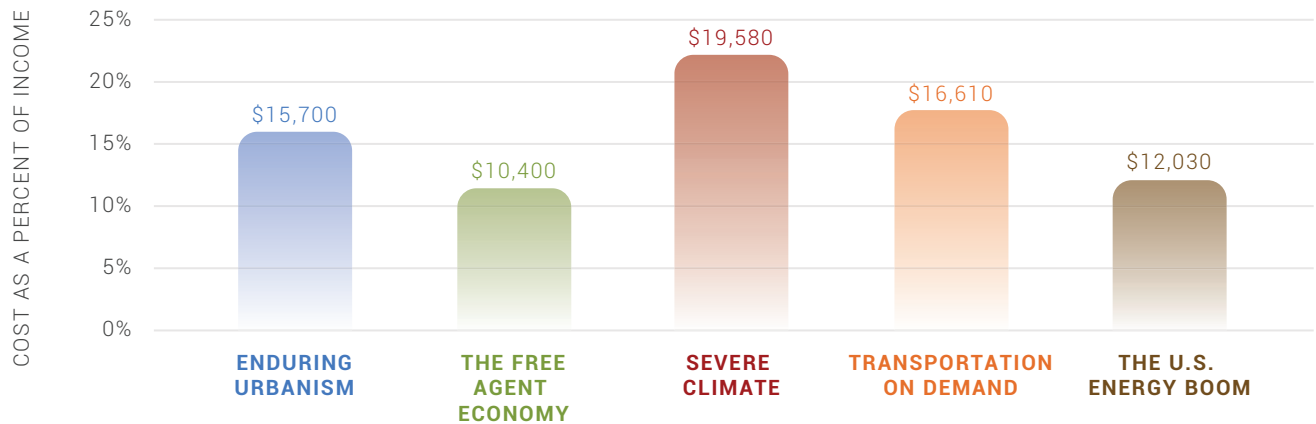
NEW FOOTPRINT RESIDENTIAL AND COMMERCIAL ACRES DEVELOPED, 2010-2045

Source: DVRPC, 2016.



ANNUAL HOUSEHOLD RESIDENTIAL ENERGY AND TRANSPORTATION COSTS IN 2045

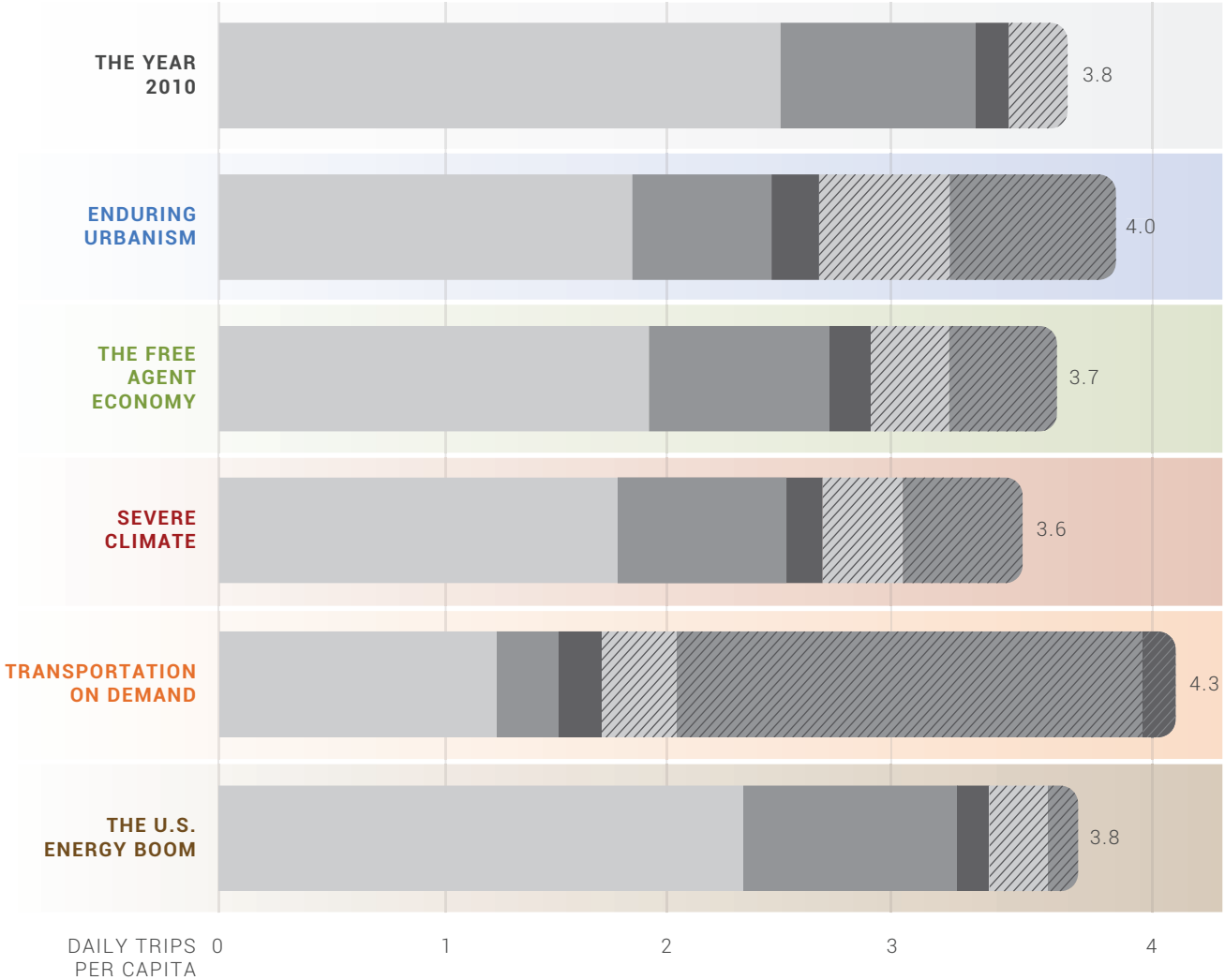
*In 2015 dollars.
Source: DVRPC, 2016.



DAILY TRIPS PER CAPITA AND MODESHARE IN 2045

Source: DVRPC, 2016.

DRIVER |
 PASSENGER |
 TRANSIT |
 WALKING / BIKING |
 RIDE SOURCING / MICROTRANSIT |
 ZERO-OCCUPANT VEHICLE



Conclusion

It is likely that some combination of elements from all five of these forces will shape the future of Greater Philadelphia. There is a very good probability that new transportation technologies and modes will emerge, climate will create major systemic risk, and population and employment locational preferences will change. The region needs to find ways to make the transportation system more flexible and resilient in order to prepare for 2045. Given the current uncertain transportation funding situation, software (such as intelligent transportation systems), rather than hardware (new facilities), will most likely be the route to making existing roads and transit systems more efficient. Beyond transportation, this report identifies a number of universal actions to be applied across all scenarios, and contingent actions to respond to specific Future Forces that arise. Taking advantage of the opportunities and overcoming the challenges these forces present will require stakeholders to collaboratively work together.

This report is an initial effort to advance the dialogue about how change is likely to occur in the region, and what we should do to strategically prepare for it. Solving today's issues, let alone those arising tomorrow, is beyond the capacity of any single entity. Action occurs when dialogue helps to build consensus, through the support of a large number of groups and individuals.

The discussion will be ongoing as the ***Connections 2045*** Long-Range Plan is developed. What other challenges do you think the region will face as a result of these forces? What other actions should we take, what skills should we focus on developing, or what investments should we make? What are the priority actions? None of the actions contained within this report are easy, but if the long-term benefits significantly outweigh the short-term costs, then it is incumbent on us all to find ways to bring them about and move forward the vision of a more sustainable, equitable, and innovative Greater Philadelphia.

Learn more about
the Future Forces
and the *Connections 2045*
Long-Range Plan update:

www.dvrpc.org/connections2045



The Delaware Valley Regional Planning Commission (DVRPC) fully complies with Title VI of the Civil Rights Act of 1964 and related nondiscrimination statutes in all activities. For more information, visit www.dvrpc.org/GetInvolved/TitleVI.

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190 N. Independence Mall West, 8th Floor
Philadelphia, PA 19106-1520
phone 215.592.1800
fax 215.592.9125
connect with us! www.dvrpc.org

