New Directions

Land Use, Transportation, and Climate Change in Virginia

Southern
Environmental
Law Center

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Southern Environmental Law Center
201 West Main Street, Suite 14
Charlottesville, VA 22902
Phone 434-977-4090
Fax 434-977-1483
SouthernEnvironment.org

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Trip Pollard
Southern Environmental Law Center

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The Challenges of Growth

Virginia is being rapidly transformed. Our abundant natural resources, beautiful landscapes, bountiful farmland, vibrant communities, and wealth of historic and cultural resources provide an outstanding quality of life that has helped to drive the tremendous growth that is reshaping the Commonwealth. This growth has brought significant benefits, as well as serious challenges. Demographic shifts, rising energy prices, and climate change due to global warming are shaping Virginia as well. These challenges must be addressed.

Rapid Changes: Demographics, Development, and Transportation

During the past decade, Virginia's population rose from just under 6.2 million to over 7 million, adding more than the combined populations of the Roanoke, Lynchburg, Danville, Charlottesville, and Bristol metropolitan areas in ten years. Virginia added another 488,000 people between 2000 and 2005. Rapid population growth is likely to continue, with over 9.8 million people expected to live in the Commonwealth in 2030. This would mean adding the equivalent of another Northern Virginia between 2000 and 2030. Virginia also is experiencing an overall shift in population from cities to suburbs (although many cities have begun to make a comeback), changes in racial and ethnic composition, and an aging population.

Most new development in recent decades has occurred beyond existing communities. Almost 350,000 acres were developed in Virginia in just five years between 1992 and 1997, and rapid development has continued since then. This means an average of roughly 180 acres is being developed daily—the equivalent of converting a farm each day into highways, parking lots, strip malls, and subdivisions. The rate of development is more than double the rate of population growth. If current patterns continue, we will develop more land in the next 40 years than in the previous 400 years.

As we spread farther out, the number of miles we drive and the amount of time we spend behind the wheel escalate. Increasing sprawl and decisions to devote most taxpayer funds for transportation to roads mean most trips must be taken by car and most freight moved by truck. As a result, people in Virginia drove over 80 billion miles in 2005, the equivalent of driving farther than the distance to the sun and back every day. Driving has increased far more rapidly than population, leading to clogged highways despite—and to some extent because of—an asphalt-centered transportation strategy. Although we cannot simply build our way out of congestion, Virginia continues to pursue costly, destructive highway projects. Funding and use of transit, freight and passenger rail, bicycling, and walking facilities have increased, although they remain seriously underfunded.

The Adverse Impacts of Growth

Rapid growth has had tremendous—and often unintended—adverse impacts. From fast-growing suburban localities to areas with little population growth, nearly every community has experienced some of the harm sprawling development patterns and rising vehicle use can bring.

A primary consequence of auto-dependent, sprawling development is the enormous amount of energy required to fuel our economy and our lifestyle. Transportation uses more energy than any other sector in Virginia. Over 5 billion gallons of motor fuels were consumed in the state in 2005, and fuel consumption has been rising almost twice as fast as population. Record and volatile fuel prices have highlighted some of the many costs of our energy-intensive transportation and land use patterns.

The most urgent consequence of current growth patterns is the threat of climate change due to global warming. There is now broad scientific consensus that global warming is real, that humans are contributing to the problem, and that we have a narrow window of time to avoid potentially catastrophic impacts. Virginia is vulnerable to impacts such as increased drought, more intense storms, flooding, harm to the Chesapeake Bay, loss of historic

islands, loss of wetlands, beach erosion, and the extinction of plant and animal species. Virginia produces more carbon dioxide than many countries, and these emissions rose 34% between 1990 and 2004. Power plants and home and business energy use are leading sources of greenhouse gas emissions, and must be addressed by reducing emissions from plants, increasing use of clean, renewable energy resources, and increasing energy efficiency. Transportation is the leading—and fastest rising—source of carbon dioxide in the state, generating almost 43% of the carbon dioxide emitted from fuel combustion in 2004. Sprawl plays a critical role as well, both by increasing driving and by destroying forests and farmland that help store carbon.

There are many other adverse impacts of current growth patterns, and they include the following:

- Loss of an unprecedented amount of farmland, rural landscapes, and open space;
- Longer commutes and record traffic congestion;
- Rising costs to taxpayers to provide schools, roads, water, and other services to far-flung development;
- Air and water pollution that harms our health and damages natural treasures such as the Chesapeake Bay and Shenandoah National Park;
- A housing affordability crisis in many areas; and
- Draining of investment, jobs, and people from many cities and rural areas, while other towns and rural areas experience loss of a way of life as they are engulfed by highways, strip malls, and subdivisions.

New Directions

We cannot afford "business as usual." We must begin in earnest to address the challenges of growth in order to sustain and enhance our economy, communities, health, and environment.

Increasingly, Virginians are beginning to support change. In recent polls, voters demonstrated significant concern with sprawl, traffic, and global warming, and expressed strong support for steps to tackle these problems. Further, citizens and decision-makers alike recognize that development and transportation decisions are influenced by a host of governmental incentives and regulations that promote sprawl. Among other things, public investments in highways often subsidize scattered development, steering growth away from existing communities, while zoning requirements can prohibit development of traditional neighborhoods. Reorienting governmental policies provides important opportunities for addressing the challenges of growth.

There also is increasing understanding of the limitations of current land use and transportation approaches. For example, although it is intuitively appealing to think that new highways can solve our traffic problems, experience has shown that they often have the opposite effect by encouraging more scattered development and more driving.

Promising efforts are underway throughout Virginia to capture the benefits of economic growth without harming our quality of life, and the Governor and the General Assembly have adopted some important steps in recent years to promote smarter growth and to reform transportation policies. In addition, Governor Kaine recently unveiled a new energy plan that contained the state's first target to reduce carbon dioxide emissions.

The positive steps taken so far are only a beginning, and they could easily be overwhelmed by destructive new highway and development projects. Nonetheless, they indicate the enormous potential for promoting better ways to grow. Moreover, since many of the challenges of growth are interrelated, the same solutions often address multiple goals.

Innovative, practical steps are needed that fundamentally change our development, transportation, and energy policies and patterns. These steps include the following:

- Revitalize existing communities and promote better planned, more compact neighborhoods and town centers;
- Provide incentives for greener building to make new and existing structures healthier, cleaner, and more energy efficient;
- Promote more affordable housing;
- Protect rural and natural areas, and promote agricultural vitality;
- Provide greater transportation choices, including increasing funding for transit, rail, and other alternatives to driving, as well as for local street networks;
- Maximize the efficiency and safety of existing roads by placing greater emphasis on maintenance and on improved access management; and
- Provide incentives for more efficient, cleaner vehicles and cleaner fuels.

The challenges of growth must be addressed if we are to enjoy sustainable economic growth, vibrant communities, energy security, a healthy environment, and a desirable quality of life for all citizens.

Demographic & Economic Trends

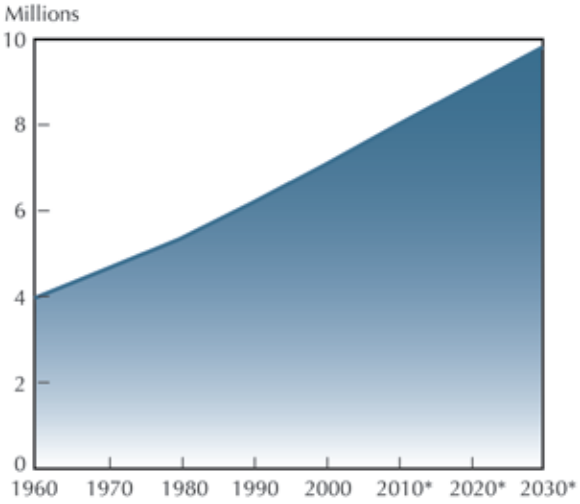
Virginia has experienced tremendous increases in overall population, employment, and economic development in the past 25 years. Although these changes have not been uniform, they have had—and will continue to have—a major influence on land development, transportation, and quality of life. Virginia also is experiencing an overall shift in population from cities to suburbs, changes in racial and ethnic composition, an aging population, and changes in household composition and size. These changes will further shape growth, as well as efforts to address the challenges of growth.

Population Growth and Distribution

Virginia's population rose by about 14.4% in the past decade, increasing by almost 890,000 between 1990 and 2000.[1] This is the largest population increase in a single decade in Virginia history. The state had the eleventh fastest growing population in the U.S. during this period, and its rate of growth also outpaced the 13.2% population increase nationwide.

This rapid growth raised Virginia's population from just under 6.2 million to over 7 million. It is the equivalent of adding more than the combined populations of the Roanoke, Lynchburg, Danville, Charlottesville, and Bristol metropolitan areas—in only one decade. This growth came on the heels of even more explosive growth during the 1980s, when population expanded by over 15.75%.

Virginia State Population Growth (1960-2030)

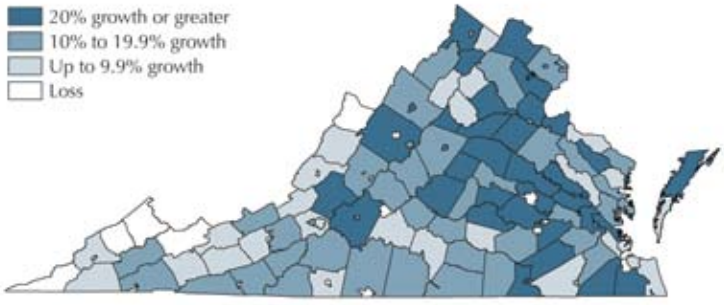


* Projected
Source: U.S. Census Bureau

Virginia's population growth has continued to outpace the nation in recent years, rising by approximately 488,000 people between 2000 and 2005. Preliminary figures indicate that Virginia's total population reached roughly 7.6 million in 2006, and is on track to surpass 8 million by 2010—more than twice the population in 1960.

Population growth has varied statewide. Some regions and localities have experienced exponential growth, while others have seen their numbers decline. The bulk of recent population growth occurred in the Northern Virginia, Hampton Roads, and Richmond regions, and two-thirds of Virginia's population now lives in one of these three regions.

Population Growth in Virginia 1990-2005



Sources: U.S. Census Bureau; Viginia Employment Commission

Almost half of the population growth during the past decade occurred in Northern Virginia,[2] and one-third of Virginians now reside in this region. Northern Virginia had both the greatest number and the highest percentage increase of any metropolitan area of the state, adding over 435,000 people as it grew by more than 25% between 1990 and 2000. Loudoun County was the fastest-growing locality in the state and the sixth fastest growing locality

in the U.S., as its population surged by almost 97% in the past decade. Indeed, Northern Virginia had the three fastest growing localities in the state in terms of the number of people added. It also had the state's fastest growing cities, on a percentage basis. The region's rapid growth has continued. Loudoun County has remained the most rapidly growing locality, adding an estimated 100,000 residents between 2000 and 2006.

Population Growth in Virginia Metropolitan Areas (1990-2000)

Metro Areas	1990	2000	Amount	Percent
Northern Virginia	1,732,437	2,167,757	435,320	25.13
Richmond	865,640	996,512	130,872	15.12
Hampton Roads	1,430,974	1,551,351	120,377	8.41
Charlottesville	131,373	159,576	28,203	21.46
Lynchburg	193,928	214,911	20,983	10.82
Roanoke	244,592	235,932	11,340	5.05
Bristol	87,517	91,873	4,356	4.97
Danville	108,728	110,156	1,428	1.31

Source: U.S. Census Bureau

Throughout the state, metropolitan areas are spreading into increasingly distant places. The localities that have grown the quickest in percentage terms tend to be the outer suburban areas—the next ring of counties farther away from urban areas—while many cities have lost population. Northern Virginia's rapid growth, for example, has helped to place Spotsylvania and Stafford Counties—and more recently Caroline and King George—among Virginia's fastest-growing localities.[3]

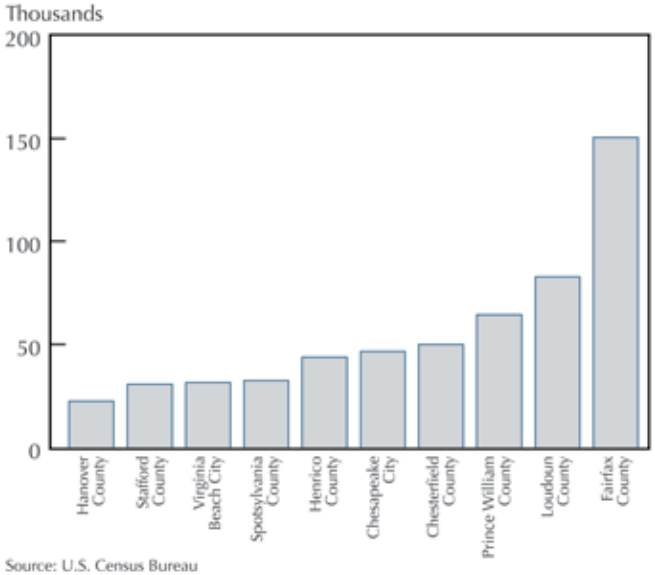
The Richmond region has had the second largest amount of population growth. There, Chesterfield, Henrico, and Hanover Counties have added the most population, while Powhatan County had the highest percentage increase in population. In contrast, the City of Richmond declined by 2.6% in the 1990s, a drop of over 5,000 residents.

The Hampton Roads region showed a similar pattern, growing more diffusely as well. James City County and York County were among the fastest growing counties in the past decade, and Chesapeake and Virginia Beach added more people than any other cities in the state during the same period. The City of Norfolk, on the other hand, lost more population than any other city in the state, almost 27,000 people during the 1990s.

Although population has declined in many older cities, this trend has started to slow in a number of areas, and some core cities even gained population in the past decade. The percentage of Virginians living in rural areas, however, continues to shrink.

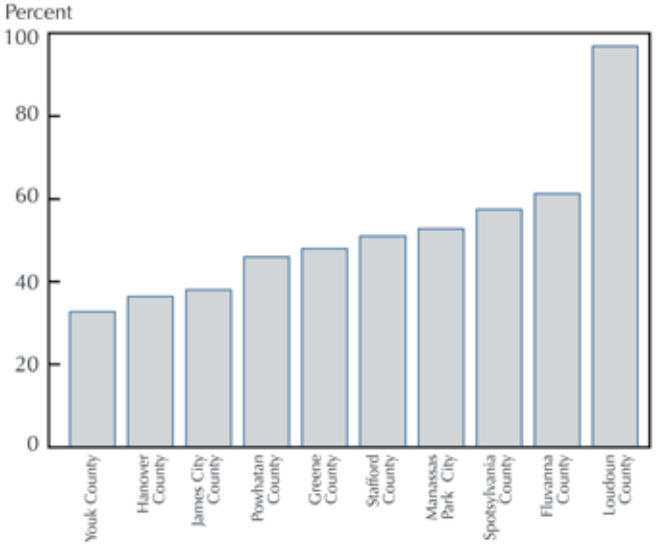
Virginia's overall population is projected to continue to grow rapidly. It is estimated that almost 2.75 million residents will be added between 2000 and 2030, bringing the total population to over 9.8 million by 2030. This would be equivalent to adding another Northern Virginia. The greatest population increase is projected to continue to be in Northern Virginia, followed by the Richmond and Hampton Roads regions.

Localities with Greatest Population Gain (1990-2000)



Source: U.S. Census Bureau

Localities with Greatest Percent Population Gain (1990-2000)



Source: U.S. Census Bureau

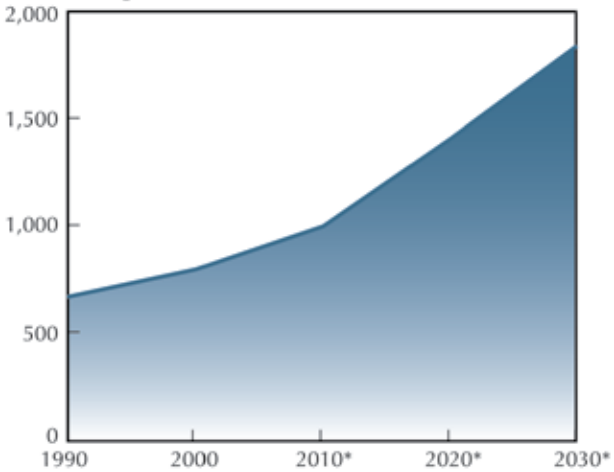
Population and Household Composition

The makeup of Virginia's population is changing as well.

Virginia is becoming more diverse. The fastest rate of population growth in recent years has been among Hispanics and Asians, and 1 in 10 Virginians were born in other countries.[4] Approximately 72% of the state's population in 2005 was white, while 19% was African-American, 6% Hispanic, and 5% Asian. In 1980, 79% of the population was white, 19% African-American, 1.5% Hispanic, and 1.2% Asian. The distribution of these populations is uneven throughout the state.

The state's population is also aging.[5] The number of residents age 65 and older increased by 19.25% between 1990 and 2000. This trend is projected to accelerate, with the amount of the population 65 years and older rising 133% between 2000 and 2030, to over 1.8 million. By 2030, almost one-fifth of Virginia's population is projected to be 65 or older. The number of residents age 85 and older is projected to increase even more rapidly on a percentage basis, growing by 186% between 2000 and 2030. An aging population will have very different types of housing and transportation needs, typically requiring housing and neighborhood design that can better accommodate the physical needs of elderly individuals and allow them to remain engaged in the community, and transportation options that offer mobility to people who are no longer able to drive.

Aging Population (1990-2030)



* Projected
Source: U.S. Census Bureau

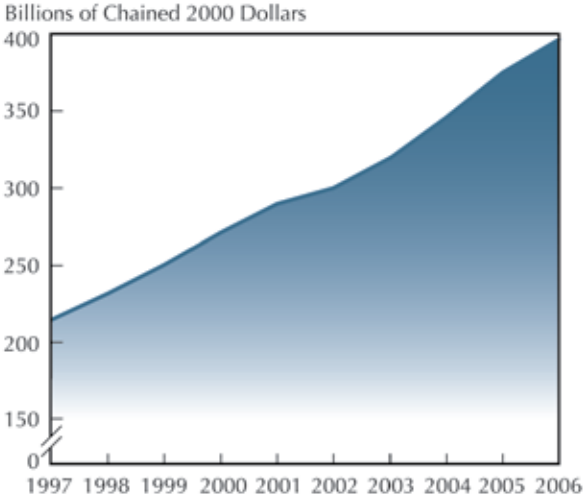
Household composition is changing as well. Although the majority of households in Virginia are still families, by 2000 only a little over half of households had married couples. Family structures with no spouse present are increasing much more rapidly than married couple families. Non-family households have increased to over 30% of all households, and increased more than twice as rapidly as family households during the 1990s.

The average household size has also changed, declining in recent decades. In 2005, the average household size in Virginia was 2.54 people, down from 2.61 in 1990. Over a third of all households have two people in them, and 25% are one-person households. Average household size is likely to shrink further, particularly with an aging population.

Economic Growth

Virginia's economy has enjoyed healthy growth for most of the past few decades, experiencing significant economic development, job growth, and a higher standard of living.

Gross Domestic Product in Virginia (1997-2006)



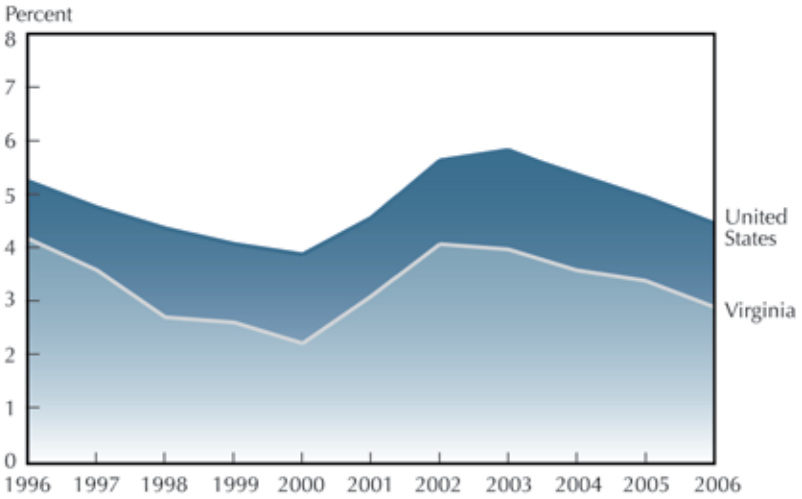
Source: U.S. Department of Commerce

One measure of this growth is the steady increase in the gross state product. Adjusted for inflation, gross state product has risen from almost $212 billion in 1997 to just under $370 billion in 2006,[6] an increase of almost 75%. In comparison, overall gross state product for the entire U.S. increased about 60% during that time.

The benefits of this economic growth are also apparent in the rise of per capita personal income, which has almost quadrupled in 25 years, rising from $10,144 in 1980 to $31,120 by 2000 and over $39,500 in 2006.[7] Although some of this increase is due to inflation, the rise in income has outpaced inflation and has slightly outpaced increasing income nationwide. Virginia had the seventh highest level of per capita income in 2005, and average household income is also higher than the national average. There are, however, wide gaps in income, and 10% of Virginia households are living in poverty.

Employment has steadily grown, rising from just over 3.35 million in August 1997 to over 3.94 million in August 2007.[8] The state unemployment rate has

Unemployment Rates (1996-2006)



Source: Virginia Employment Commission, Local Area Unemployment Statistics

consistently been below the national rate in recent years, and has been among the lowest in the nation. For example, the August 2007 rate for Virginia was 3.1%, compared to a national rate of 4.6%.[9]

Prosperity has not, however, been equally enjoyed throughout the state. The majority of recent economic growth has occurred in the "Golden Crescent," a swath reaching from Northern Virginia south to Richmond and then east to Hampton Roads. Incomes are highest in Northern Virginia, and Fairfax County and Loudoun have the highest median household income of any large counties in the U.S.[10] In contrast, a number of communities are economically stressed, particularly in Southside and Southwest Virginia, areas which have been hit hard by cuts in major industries such as textile, clothing, and furniture manufacturing.[11]

Unemployment rates likewise vary widely. The statewide jobless rate in August 2007 was 3.1%, but it was estimated that local rates ranged from 1.9% in Arlington County to 8.9% in the City of Martinsville.[12] Among metropolitan areas, Northern Virginia, Harrisonburg, and Charlottesville had the lowest unemployment rates at that time (2.3, 2.6, and 2.7% respectively), while the Danville area had the highest (6.4%).

Job growth and location also vary significantly within metropolitan areas. This can have a significant impact on land use and transportation patterns. The dominant trend in the state has been toward greater dispersal of job location. In the Richmond region, for example, almost 80% of new jobs created between 1990 and 2004 were in Henrico and Chesterfield, followed by Hanover County. Yet in percentage terms, the highest job growth occurred in Goochland and Powhatan Counties. In contrast, the City of Richmond lost over 41,000 jobs. However, the City still has the second highest number of jobs in the region.[13]

Development Trends

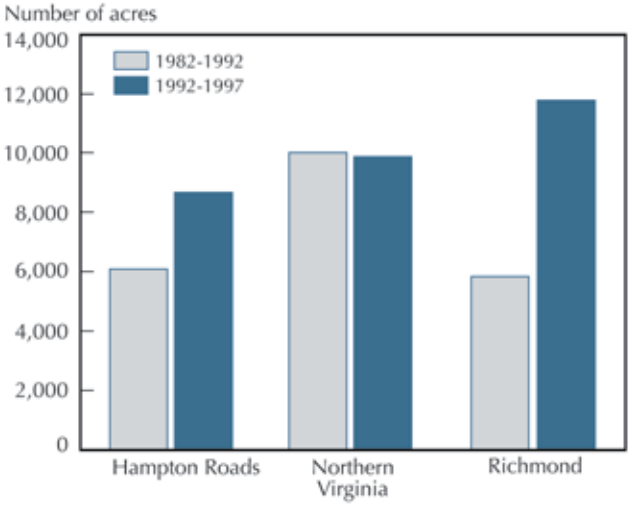
Most new development in Virginia in recent decades has been haphazard and sprawling, with rapid, far-flung residential and commercial growth, expanding house sizes, and businesses and jobs increasingly located beyond existing communities.

Land Conversion

Virginia's farmland, natural areas, and open spaces have been rapidly disappearing. The primary factors spurring this unprecedented land conversion include population growth, changes in employment patterns, and land use and transportation policies that encourage inefficient, scattered development.

According to the U.S. Department of Agriculture, over three-quarters of a million acres were developed in just 15 years in Virginia.[14] Between 1982 and 1997, 784,500 acres were developed in the state for projects such as new subdivisions, office parks, highways, and parking lots. This is equivalent to developing roughly 19 areas the size of the City of Richmond. Newer data from USDA suggests a continuation of these trends, although changes in data collection and reporting mean that more definitive information is not yet available.

Average Annual Land Developed Per Year (1982-1997)



Source: USDA Natural Resources Inventory

In addition, the rate of land development has accelerated. In the ten years between 1982 and 1992, an estimated 441,000 acres were developed statewide; this translates into an average of 41,000 acres each year, or more than 120 acres per day. In the five years between 1992 and 1997, however, an estimated 343,500 acres were developed. This means an average of 188 acres are being developed daily—the equivalent of converting a farm each day into highways, parking lots, strip malls, and subdivisions.[15]

Development rates differ by region. Overall, Northern Virginia has been the fastest developing part of the state, although it appears at times other regions have developed more rapidly. Almost 100,000 acres were developed there between 1982 and 1992, compared to 60,800 acres in Hampton Roads, and 58,300 acres in the Richmond region.[16] Between 1992 and 1997, the Richmond area led the state in land conversion with 58,800 acres developed in the region, followed by 49,300 acres in Northern Virginia, and 43,300 acres in Hampton Roads.

Following trends at the state level, the pace of land consumption in the largest metropolitan areas has increased

in recent years. The Richmond region developed more land in the five years between 1992 and 1997 than it had in the previous ten, converting an average of 11,760 acres each year. During that same period, Northern Virginia developed an average of 9,860 acres each year, and Hampton Roads an average of 8,660 acres each year.

Richmond Region Impervious Surfaces –1992

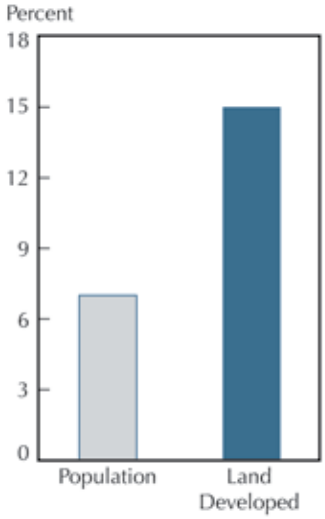
Richmond Region Impervious Surfaces –2001

Other analyses have gauged the rate of development by focusing on impervious surfaces—hard areas such as roads and rooftops. Between 1990 and 2000, impervious surfaces in Virginia's portion of the Chesapeake Bay watershed increased by 44.7%.[17] Analysis of impervious surfaces in particular localities is even more striking. For example, impervious surfaces in Chesterfield County increased by over 90% between 1992 and 2001, and by 67% in Henrico County during that period. Over 12,089 acres were covered in these two counties alone in less than ten years.[18]

Although population growth is a factor driving increased development, the rate of land consumption is increasing much faster than population. Statewide, the rate of population increase slowed in the 1990s compared to the previous decade, yet the pace of land loss accelerated. Between 1992 and 1997, land development increased more than twice as rapidly as population statewide.

Development in many areas has outpaced population growth by an even wider margin. In the Richmond area, for example, the average annual rate of land consumption doubled between 1992 and 1997, although the region's population increased by a little under 8% during that time.[19] In addition, the amount of Chesterfield's impervious surfaces apparently increased 90% between 1992 and 2001, while the County's population increased 17% during that time.

Increase in Population and Land Development (1992-1997)



Source: U.S. Census Bureau; USDA Natural Resources Inventory

If current patterns continue, Virginia will develop more land in the next 40 years than in the previous 400 years. Over 1.37 million acres would be developed over the next 20 years and almost 2.75 million acres over the next 40 years.

Farmland, Forest, and Tree Cover Loss

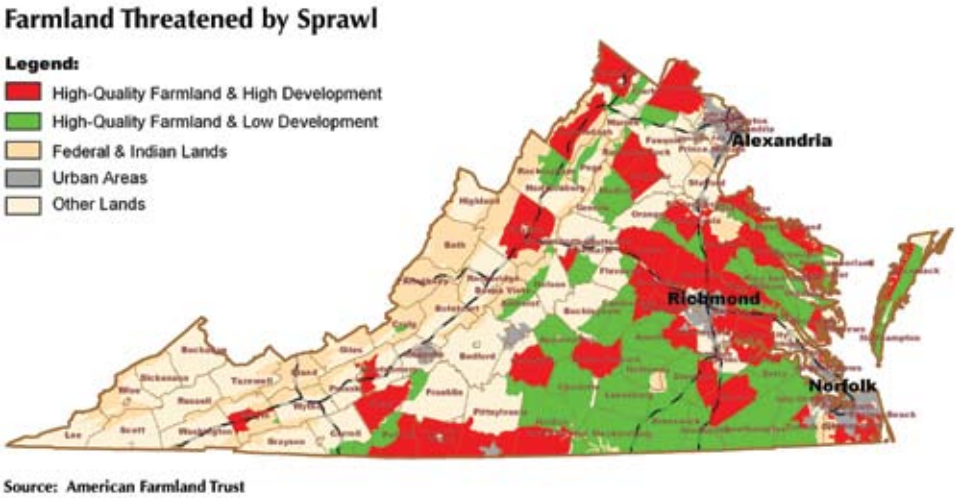
The dramatic increase in land development is having an enormous impact on farmland and forests. The U.S. Department of Agriculture estimates that more than 31% of the land developed statewide between 1992 and 1997 was prime farmland.[20] This loss included 57,700 acres of cropland, 7,600 acres of pastureland, and 42,600 acres of forests. On average, the Commonwealth has been losing over 21,500 acres of prime farmland to development each year, almost 60 acres per day.

If this trend continues, 431,000 acres of prime farmland will be lost over the next 20 years. This is the equivalent of 2,384 average-sized farms.

Reflecting the threat such rapid development poses to farming, the American Farmland Trust previously ranked an area of the Northern Piedmont that includes a number of Virginia counties as the second most threatened farming region in the entire country, and has produced a map showing a number of farm areas in Virginia facing the greatest threat from sprawl.[21]

The amount of farmland developed varies widely among localities. Some areas have lost little farmland, while others have experienced dramatic declines. According to USDA figures, York County, for example, saw a 192% drop in the number of acres in farms in just five years between 1997 and 2002, Fairfax County had a 51.7% drop, and Virginia Beach saw a 19% decline during that time.[22] If such trends continue, several counties will soon lose all of their remaining farmland.

In addition to the impact on farmland, the Virginia Department of Forestry estimates that development was responsible for 62% of the more than 650,000 acres of forest land lost to land use changes in Virginia between 1992 and 2001.[23]

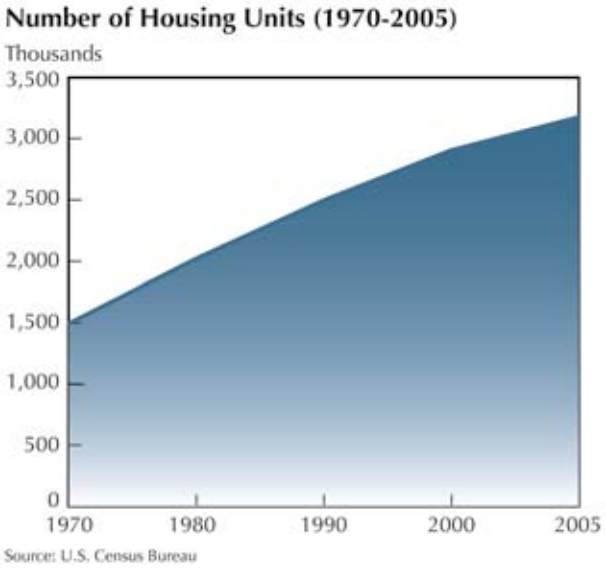


Further, towns, cities, and suburbs throughout Virginia have lost a significant amount of tree cover. A series of studies found that between 1973 and 1997, areas with a high degree of tree canopy declined by over 30% in the Chesapeake Bay region, by 64% in the Washington, D.C. area, and by about 25% in the Roanoke area, and that high canopy coverage fell by 19% in Charlottesville and several surrounding counties between 1976 and 2000.[24]

Housing Growth and Growing House Size

The number of new housing units in Virginia has risen rapidly. There were over 3.17 million housing units in Virginia in 2005, an increase of over 270,500 units since 2000. This represents a 9.3% increase in housing units in five years, and comes on the heels of an increase of almost 408,000 housing units in the 1990s and 475,400 units in the 1980s.[25]

Not surprisingly, housing growth has occurred in regions with the greatest population growth. Most of the new housing units in recent years have been built in the Northern Virginia, Hampton Roads, and Richmond regions. Northern Virginia has seen the greatest number and percentage increase of new housing units among the three largest metro areas, including over 36,000 housing units added in Loudoun County (a 58% growth rate that was the fifth highest in the U.S.) and over 31,200 units added in Fairfax County between 2000 and 2006.[26]



Despite the current housing slump, the number of housing units in Virginia is likely to continue growing significantly over time. We will need over 1 million new housing units between 2000 and 2030 to meet projected population increase if average household size remains the same—and it is likely to shrink. A recent study using slightly different assumptions and taking into account units lost each year due to demolition, fire, and other causes concluded that Virginia will need more than 1.67 million new units between 2000 and 2030. If accurate, 41.5% of all housing units in 2030 will have been built since 2000.[27]

In addition, house sizes have expanded substantially—even though the average number of people in each household has decreased. In 2005, the average new house size in the South was 2,463 square feet, a 4% increase in just one year, and an almost 41% increase from 1980.[28] In 2005, homes in Virginia ranked third highest in the U.S. in the number of bedrooms they have, with 26.5% having four or more bedrooms.[29]

Virginia's housing is predominantly single-family, detached structures. The percentage of such structures is increasing—from 61.4% in 1990 to 62.3% of all housing units in 2000—despite increasing diversity in household composition and age.

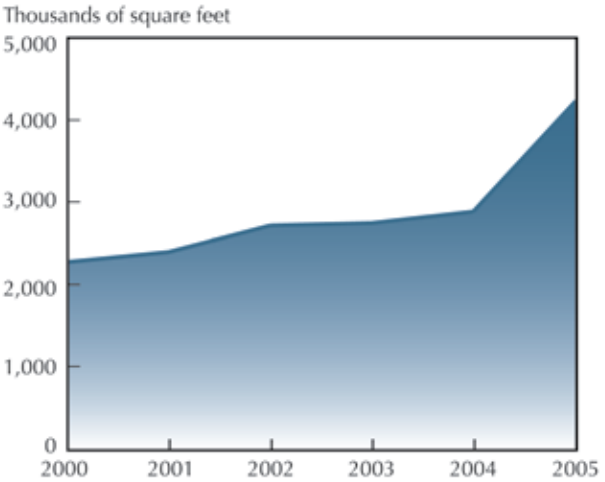
Commercial Development

Commercial development has also played a major role in Virginia's rapid land use changes. Many localities have experienced explosive growth of shopping centers and office parks, as well as the proliferation of big-box retail stores with extensive parking.

In Albemarle County, for example, existing retail space at the end of 2000 totaled a little over 3.9 million square feet. By the end of 2005, retail space in the County had reached roughly 4.7 million square feet, an increase of almost 20% in just five years.[30]

Chesterfield has 67 million square feet of commercial and industrial space; almost two-thirds of that space was built between 1980 and 2006, with almost 10 million square feet built between 2000 and 2006.[31]

Albemarle County Retail Space – Existing (2000-2005)



Source: U.S. Census Bureau

A recent study projected that—when demand for new construction and the need to replace existing structures is considered—over 2.6 billion square feet will need to be built in Virginia by 2030.[32] This is almost equal to all of the commercial and institutional square footage that existed in the state in 2000.

Industrial facilities are projected grow as well. Virginia had an estimated 201 million square feet of industrial space in 2000, and it is estimated that over 130 million square feet of industrial space will be built in the Commonwealth between 2000 and 2030.[33]

In recent years, the location of businesses has become more dispersed, as discussed in the preceding chapter. Jobs are increasingly decentralized, and many new jobs are located in areas limited to commercial uses where residences are prohibited or greatly restricted, pushing home buyers and renters farther out. The result is an imbalance between the location of jobs and housing in many regions and even within some jurisdictions.

Transportation Trends

Virginia's transportation system has brought many benefits, including economic growth and increased mobility. However, citizens, business leaders, and political leaders in both parties have expressed concern and frustration with lengthening commutes, increasingly clogged roads, massive expenditures of taxpayer dollars on highways, record gas prices, a lack of transportation choices, and other problems.[34] Aggressive roadbuilding has failed to cure these problems, and in many cases has made them worse. Sprawling development has fueled driving and congestion, and an increasing population further strains our transportation system.

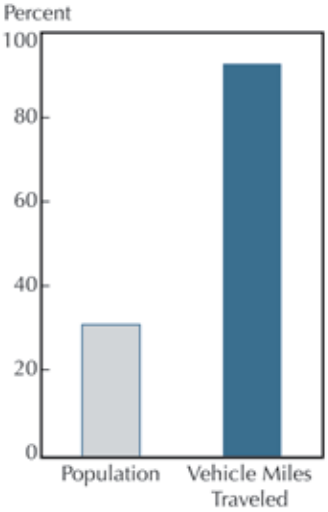
Driving and Congestion

People in Virginia drove over 80.3 billion miles in 2005.[35] This is an average of over 220 million miles daily, the equivalent of driving farther than to the sun and back every day. In the Northern Virginia urban area, driving averaged over 46 million miles each day in 2005. In Hampton Roads, over 35.6 million miles are driven daily, while Richmond area drivers log more than 26 million miles per day.

The Richmond area has the highest rate of vehicle travel per capita—an average of 28 miles per person per day. In Hampton Roads, the daily average is 23 miles per person; in Northern Virginia, 22.9 miles. These rates are all above the national average.

The amount of driving has far outpaced population growth. Between 1980 and 2000, the total number of vehicle miles traveled (VMT) in Virginia escalated by over 94%—three times the 32% population growth during that period.[36] Since 2000, VMT has continued to outpace population, although by a narrower margin.

Population and Miles Traveled (1980-2000)



Source: U.S. Census Bureau and FHWA

Driving is projected to continue to increase, and it's not just passenger vehicles. Truck traffic is projected to increase by 80% by 2025.[37]

Given the rapid increase in driving, it is not surprising that traffic congestion is getting worse in much of the state. Drivers in the Washington area experienced over 127 million hours of delay in 2005, an average of 60 hours per peak traveler.[38] This was the eighth worst rate in the U.S. The Hampton Roads area endured almost 25.6 million hours of delay in 2005, an average of 30 hours per peak traveler, while the Richmond area experienced over 10 million hours of delay and 20 hours per peak traveler. Between 1985 and 2005, total delay per year increased over 229% in the Washington area, 183% in Hampton Roads, and 434% in the Richmond area.

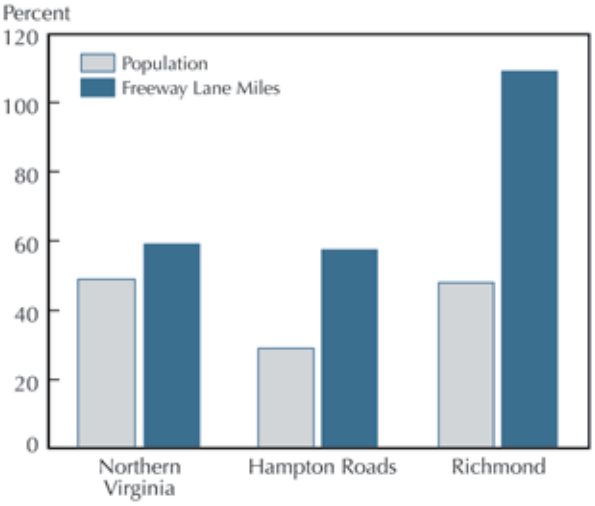
Roadbuilding

Congestion has increased despite—and to some extent

because of—the fact that for decades Virginia has pursued an asphalt-centered transportation strategy. Although there have been steps toward a more balanced approach in recent years, the bulk of taxpayer funds spent on transportation continues to go to roads. Almost $4 billion of the $4.8 billion transportation funding program for Fiscal Year 2007-2008 goes to VDOT.[39] Virginia's $11 billion improvement program for FY 2008-2013 earmarks about 80% for highway construction.

Construction has increased more rapidly than population in major metropolitan areas, particularly on the busy freeway system. In the Washington area, population grew by over 49% between 1985 and 2005 and freeway lane miles by almost 59%.[40] In Hampton Roads, population rose by over 29% during this period and freeway miles by 57.5%. In the Richmond area, population increased by over 48% and freeway miles by 109%. The overall number of lane miles per capita, however, has decreased statewide.

Population and Freeway Construction (1985-2005)



Source: Texas Transportation Institute

Roadbuilding is likely to increase significantly in Virginia over the next few years. The FY 2008-2013 Six-Year Improvement Program includes $8.7 billion for road construction over the next six years, reflecting a transportation funding package adopted in 2007 designed to boost spending by over $1 billion annually.

In addition, there has been an explosion of proposals under Virginia's Public-Private Transportation Act (PPTA), which allows private companies to develop and manage highways and other transportation facilities. The PPTA is designed to tap into the creativity and financial resources of the private sector. The Act, however, is flawed, and its track record raises serious concerns.[41] Instead of attracting new private capital for transportation projects, proposed public-private partnerships have relied almost exclusively on tolls and/or taxpayer dollars. Moreover, the costs and potential liability to taxpayers for projects are often understated, PPTA projects tend to circumvent normal state planning process (limiting public input and consideration of alternatives), and most proposals have been for new and expanded highway projects that would fuel sprawl.

There is broad recognition of the need to overhaul Virginia's transportation program, and there have been some notable improvements in recent years. For example, VDOT is completing more projects on time and on budget. The primary focus, however, has been on improving the efficiency of project delivery rather than on improving the quality of projects selected.

VDOT continues to pursue costly, destructive highway projects, such as the Tri-County Parkway, a new Route 460, the Southeastern Expressway, Harrisonburg Bypass, and wholesale widening of I-81. These highways would cost billions of dollars, yet they offer minimal transportation benefits and would cause considerable damage to communities, farmland, and the environment.

We cannot build our way out of congestion. A recent study concludes that a total of 418 lane miles would have to be built in the Washington, Hampton Roads, and Richmond urban areas each year just to maintain current congestion levels.[42] Fiscal, physical, and environmental constraints prohibit such a massive effort.

Although it is intuitively appealing to suggest that building or widening roads will reduce congestion, evidence indicates that new and wider highways actually generate significant new traffic and often fail to provide long-term congestion relief. The reason is that demand for roads does not remain constant. New and expanded roads sometimes offer the best solution to a transportation problem, and can offer temporary congestion relief, but they can also encourage more driving. For one thing, new roads can spur development in outlying areas, lengthening and increasing the number of automobile trips and thus increasing congestion. As a report by the Commission on the Future of Transportation in Virginia concluded, "Congestion increases as people move outward from urban centers, and additional lane miles of roads to accommodate the people lead to more development, and more people, and more congestion, and more lane miles, and around it goes. Urban planning experts say it is a futile exercise to attempt to build your way our of congestion problems by adding more highways."[43] Yet that remains the primary focus of Virginia's transportation program.

Maintenance

The increase in driving is also taking a heavy toll on existing roads, increasing the need for maintenance and repair. A number of other factors further contribute to rapidly in-

creasing maintenance costs in Virginia, including an aging road system, an expanding system (with roughly 200 miles of new roads accepted into the system each year), and rising costs of materials and labor. Virginia has significant maintenance needs, with 10.5% of interstate and 15.4% of primary road pavement needing repair, and 39% of bridges needing repair.[44] Although maintenance funding has increased in recent years, much more is needed, and the state has not always taken advantage of available funding.

Transportation and Land Use

There are many reasons for the tremendous rise in driving and congestion in Virginia. A primary factor is the haphazard, sprawling development described in the previous chapter. As homes and businesses spread farther out, people often are left with little choice but to drive—and to drive longer distances—to go to work, to shop, to take their children to school, or to engage in other activities.

A major aspect of the interaction between transportation and land use is the balance between jobs and housing in particular areas. Among other things, an imbalance between jobs and housing requires longer commutes and increases congestion. Over half of all workers in Virginia age 16 and over work outside the county in which they live. This is the highest rate in the U.S., and contributes to the strain on the transportation system.[45]

Another important aspect of the transportation-land use link is the impact of sprawl on transportation alternatives. Scattered, low-density development may not provide enough riders to support transit efficiently, and can make bicycling and walking impractical for most purposes.

A Lack of Transportation Choices

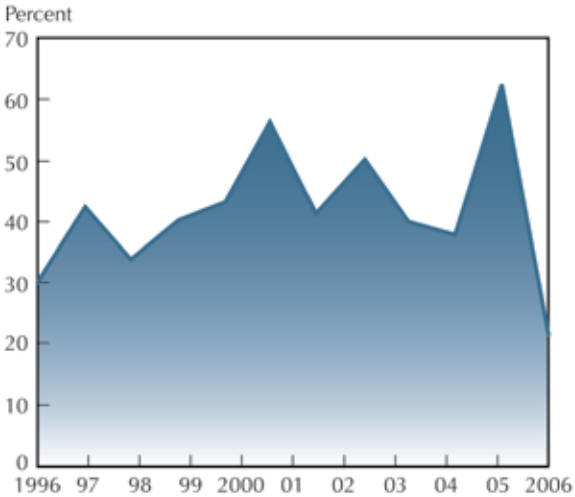
The state's focus on building new and expanded roads as the solution to virtually every transportation problem also increases automobile dependence and congestion. For the most part, VDOT still functions as the Department of Highways rather than as the Department of Transportation. Of course, some new roads are needed. But the overemphasis on roads contributes to transportation problems in two key ways. First, roads can play a major role in determining where people live and work. By opening new areas to development and by making it cheaper and easier to develop farther from existing communities, roads spur scattered development, driving, and congestion. Second, by concentrating transportation spending so heavily on roads, we have built a transportation system that offers few alternatives, forcing most people to drive.

Public Transit and Passenger Rail

Transit includes a range of vehicles and services that carry multiple passengers such as vanpools, trolleys, buses, bus rapid transit, light rail, and commuter rail. It can be local or regional, public or private.

Between 1990 and 1999, the state spent an average of only $6.77 per capita of the federal transportation funds it received on transit, far below the national average of $16.85.[46] In contrast, Virginia's annual expenditure of federal funds on road-related projects averaged $53.59 per capita during this period.

State Share of Transit Expenses (1996-2006)



Source: Virginia Secretary of Transporation Office of Intermodal Planning and Investment

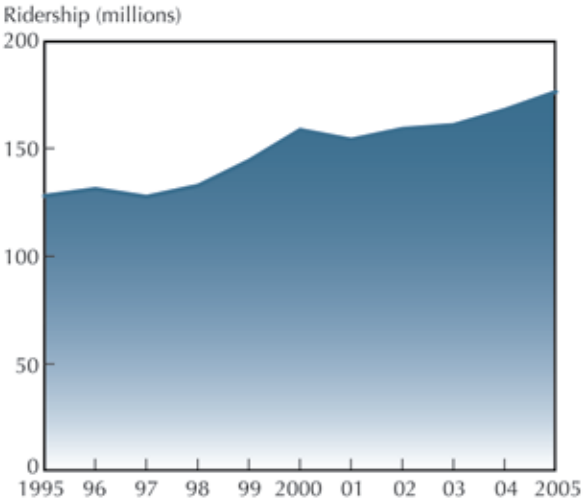
State funding for transit has been low as well, and it has fluctuated widely. State support of the non-federal share of transit capital projects, for example, ranged between 22% and 63% between FY 1996 and 2007, with the high in FY 2006 and the low the following year. As a report on Virginia's transportation system noted, "The unreliable state participation rate makes it difficult for transit operators to plan for replacing buses, improving facilities, or purchasing additional equipment to expand services."[47]

There also are tremendous disincentives for localities to invest in transit. The state's long range multi-modal plan found that "[c]urrently, a disparity exists in funding

responsibilities between transit and highways."[48] Federal and state funds pay almost all costs of road construction and maintenance, but only a fraction of public transit capital and operating expenses. This creates an unlevel playing field, offering an enormous incentive for localities to select road construction over transit alternatives.

The financial disincentives and relative lack of investment in transit are among the primary reasons for the comparatively small percentage of trips using transit. Despite these hurdles, transit has become more popular, reversing decades of decline. The number of people using public transportation is at its highest level in 49 years nationwide.[49] In Virginia, transit ridership in 2005 totaled approximately 176.3 million trips, roughly a 38% increase since 1995.[50] Between 1995 and 2005, annual passenger miles of transit travel increased 29% in Washington, 30% in Richmond, and 54% in Hampton Roads.[51] Transit use is expanding in other parts of Virginia as well. Charlottesville Transit Service ridership, for example, grew an estimated 90% between 1998 and 2006.[52]

Transit Ridership Statewide (1995-2005)



Source: VA Department of Rail and Public Transportation

Transit received a boost as part of the 2007 funding package. The FY 2008-2013 Six-Year Improvement Program provides approximately $2 billion for public transportation. Although a step in the right direction, as the Secretary of Transportation observed, "the remaining funding gaps that must be filled by our federal and local partners and through fare box revenues are still significant. Otherwise, transit services must be reduced."[53]

Freight

Freight traffic has increased significantly, and is projected to continue rising rapidly. By 2035, truck tonnage is projected to double, rail traffic to double, air freight tonnage to triple, and container traffic in ports to quadruple.[54] Facility expansions are planned and underway to increase capacity for each mode, as well as to transfer freight among various modes (such as moving containers from rail to trucks or from ports to rail).

Virginia has begun to invest in freight rail projects after decades of largely ignoring this mode. Rail is at a disadvantage in competing with trucks for freight since, among other things, trucks generally use roads built and maintained by the general public, and only pay fees for direct usage, while railroads own, maintain, and pay taxes on their rights of way whether they are in use or not. Public funding for rail improvements can provide a more balanced approach for freight transportation, and at the same time can aid passenger rail service since they typically use the same right of way. In the new state six-year plan, rail projects are slated to receive $322 million in fiscal years 2008-2013, a 68% increase in funding from the last six-year plan.

Bicycling and Walking

Transportation planning and investments throughout Virginia often overlook bicycling and walking as viable options, discouraging these means of transportation. Between 1990 and 1999, the state spent just 14 cents per person per year of the federal transportation funds it received to encourage bicycling or walking, the fourth lowest rate in the country.[55] A recent study found that although the level of spending has increased somewhat, Virginia continues to rank as one of the lowest states in the percentage of transportation dollars going to bicycle and pedestrian projects.[56]

The findings in a bicycle and pedestrian plan prepared by the Thomas Jefferson Planning District Commission apply almost everywhere: "Cycling and walking under current conditions can be risky. One of the factors contributing to unsafe travel is the general lack of facilities in the region. … Existing facilities do not yet provide for continuous bicycle travel between major destinations ... Sidewalks are often discontinuous, can be overgrown with vegetation, and are a common location for obstacles such as utility poles and street signs."[57]

As a result of these hurdles, it is not surprising that bicycling and walking currently do not account for a significant percentage of travel. Recognition of the importance of these alternatives is increasing, however, as are the number of trips taken by bicycling and walking.

Energy & Climate Change Trends

Population and economic growth, sprawling development, and increased driving are all major factors fueling increasing energy consumption in Virginia. Energy is central to our quality of life and to the economic vitality of the Commonwealth. Energy consumption also is a matter of great concern in an era of growing dependence on imported oil, record and volatile fuel prices, dwindling oil supplies, and global climate change. No issue is more pressing than global warming, which is driven in large part by the burning of fossil fuels, as well as by land use changes.

Energy Consumption and Supply

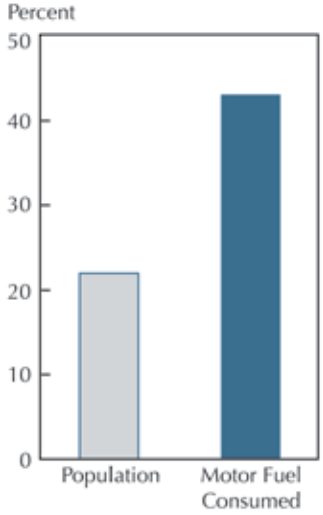
Virginians consume enormous amounts of energy.

Our homes and businesses require increasing amounts of energy for heating, cooling, appliances, and manufacturing. House sizes have expanded even as the average number of people in each house has decreased, requiring more energy to heat and cool. Rapid commercial development has occurred throughout the Commonwealth, driving up energy demand. The industrial sector uses a range of fuels to meet its tremendous energy needs.

In addition, as we spread out farther and drive more, transportation energy use rises. A nationwide trend towards purchasing larger and heavier vehicles also has increased energy consumption.

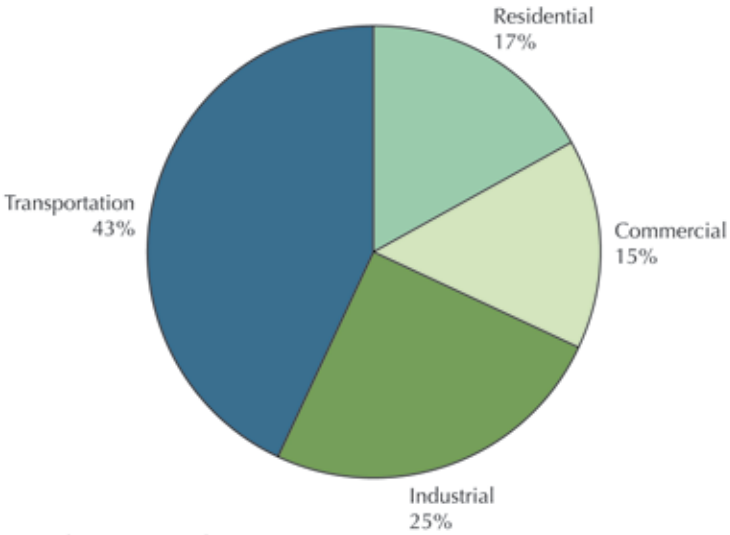
The total amount of energy used in Virginia has grown steadily in recent decades. Energy consumption per capita has increased as well, rising from 291 million BTUs in 1990 to 319 million BTUs in 2005,[58] an increase of almost 10%.

Population vs. Motor Fuel Consumption (1980-2000)



Source: Federal Highway Administration

Energy Use in Virginia by Sector (2003)



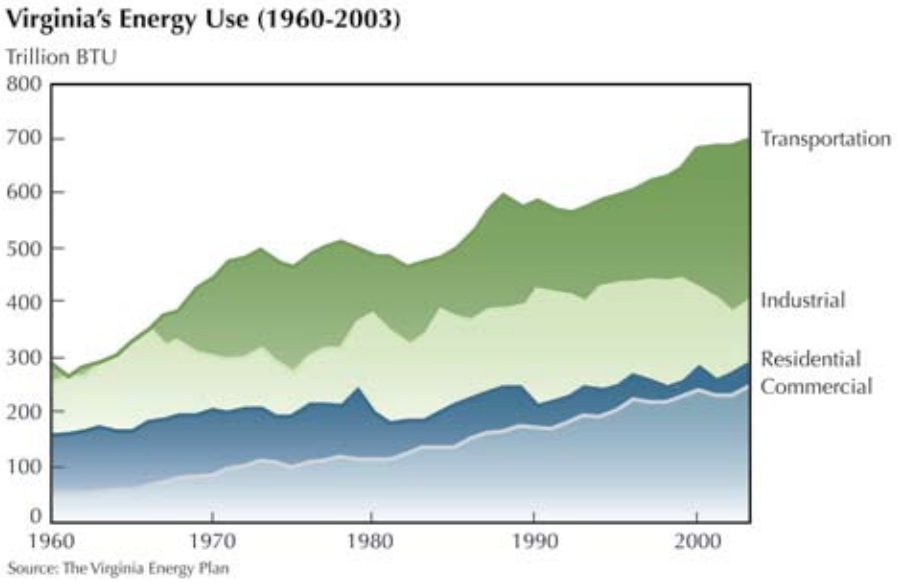
Source: The Virginia Energy Plan

Transportation consumes more energy than any other sector in Virginia. Although there are various ways to calculate and assign energy consumption, transportation leads under most measures. The state energy plan concludes that transportation is responsible for approximately 43% of Virginia's total energy use.[59] Other measures put transportation's share somewhat lower, but still rank it as the largest consumer of energy.

The vast majority of the transportation energy used (94%) is petroleum. Over 5 billion gallons of motor fuels were consumed in Virginia in 2005.[60] In addition to motor fuel, almost 1.9 million barrels of jet fuel were consumed in Virginia in 2005.[61]

Energy use is increasing fastest in the transportation sector. The amount of motor fuel consumed in Virginia rose almost 43% between 1990 and 2005, almost double the 22% rate of population growth during that time.[62]

Buildings, appliances, and commercial and industrial activities consume 57% of the energy used in Virginia according to the state energy plan—with 25% used by industrial, 15% by commercial, and 17% by residential users.[63]



The world appears to have entered a new era of higher energy prices, tighter supplies, and more volatile prices and supplies.

Virginia imports much of its energy, particularly oil, and faces serious issues concerning the reliability and future of its energy supply. Land use and transportation decisions are still typically based on often unarticulated assumptions of the availability of cheap, plentiful oil. Forecasts of travel demand used to make decisions regarding the need for new road capacity, for example, have not considered the potential impacts of rapidly increasing fuel prices and dwindling oil supplies on travel behavior.

Many estimates project that global oil production will peak in the next several decades. There is growing evidence, however, that global oil production is likely to peak and begin to decline much sooner,[64] including evidence that estimates of oil reserves by producing nations are overly optimistic and that the extent of China's burgeoning demand has been underestimated. One recent study concludes that peak production occurred in 2006.[65] Peak oil does not mean the end of oil, but it does mean that production will decline and the price of exploration and extraction will rise, making oil more expensive. Even if peak oil is years away, crude oil prices have hit a series of record highs, demand is outpacing supply worldwide, and few major new supplies have been discovered in recent years.

Energy supply issues will have a significant impact on transportation and land use patterns that should be factored into planning for the future. Current energy-intensive transportation and land use patterns also have many consequences, including national security, economic, social, and environmental impacts. A number of these impacts are discussed in the following chapter.

Climate Change and Global Warming

Global warming remains a controversial topic. Although there is continued uncertainty about the nature and extent of climate change, the evidence of global warming is steadily accumulating—and it is overwhelming. Increasingly, the debate is about what steps should be taken to address the problem rather than whether it exists.

There is now broad scientific consensus that climate change due to global warming is real. As the U.S. National Academy of Sciences has concluded, "Greenhouse gases are accumulating in Earth's atmosphere as the result of human activities…"[66] In February 2007, the Intergovernmental Panel on Climate Change concluded that evidence of global warming is now "unequivocal," that there is at least a 90% certainty that human activities have caused warming, and that potentially massive and long-lasting changes will result.[67] Most scientists believe that we have a relatively narrow window to avoid potentially catastrophic impacts.

The basic mechanics of global warming are well understood. Greenhouse gases in the atmosphere, such as carbon dioxide and methane, trap some of the sun's energy, warming the Earth. This natural "greenhouse effect" makes life as we know it possible. The concentration of these heat-trapping gases is increasing, however, as humans generate greenhouse gases by burning fossil fuels (coal, natural gas, and oil) and

by other activities such as removing forests and other vegetation that stores carbon.

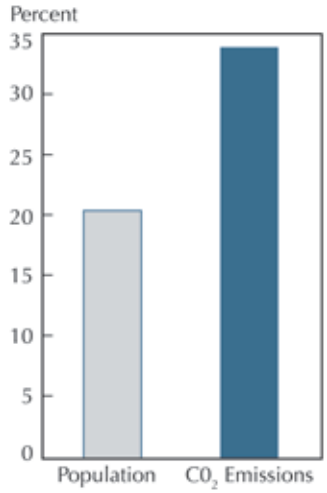
There is no debate that the concentration of greenhouse gases is increasing. Carbon dioxide (CO_2) levels in the atmosphere have naturally ranged between 180 and 300 parts per million (ppm) during the past 650,000 years.[68] During the past 150 years, CO_2 levels have increased rapidly, reaching 379 ppm in 2005. Global temperatures have risen by over 1 degree Fahrenheit during this time, with most of this change in recent years. Estimates vary, and future projections are difficult to make, but if current trends continue, worldwide CO_2 emissions could double by 2100 and temperatures rise by up to 9 to 10.4 degrees. Some projections call for even greater warming in the Southeast, including much of Virginia.[69]

Virginia is making an enormous contribution to this problem. Although figures vary slightly, the Virginia Energy Plan estimates that carbon dioxide emissions in the Commonwealth totaled approximately 130 million metric tons in 2005.[70] This is a higher level of CO_2 than is produced by energy consumption in many countries, including industrialized countries such as Austria, Sweden, Switzerland, and Spain.[71] Preliminary data from a study by the Metropolitan Washington Council of Governments found that the Washington region produces 65.6 million metric tons of carbon dioxide—more than a number of industrial nations with a greater population.[72]

Carbon dioxide emissions in Virginia have been increasing rapidly, rising by 34% between 1990 and 2004.[73] This is the ninth highest amount of increase of any state during this period, and energy-related CO_2 emissions grew at nearly twice the national rate of increase.

In comparison, state population rose by 20.5% during that time. As the Greenhouse Gas Working Group of Virginia's Advisory Board on Air Pollution noted, though, Virginia's per capita rate of CO_2 emissions has been below the national average—although much higher than the rate per person in most other industrialized countries.[74]

Population vs. CO_2 Emissions (1990-2004)



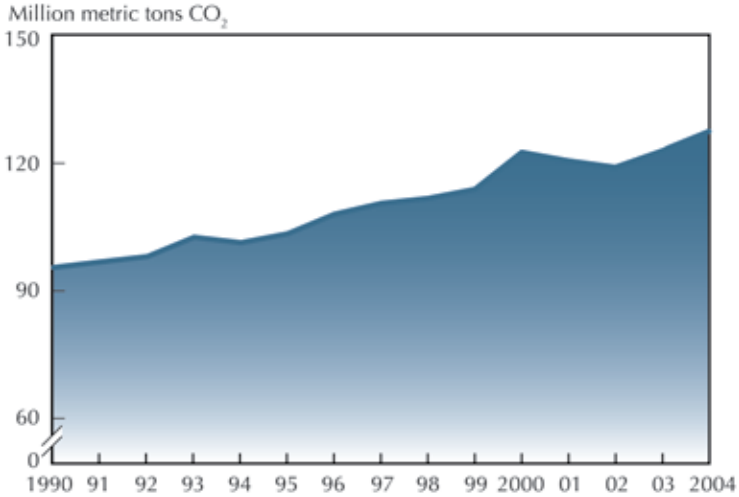
Source: U.S. Census Bureau and FHWA

Transportation is the leading source of carbon dioxide in Virginia. On average, 20 pounds of CO_2 emissions are produced by burning a gallon of gasoline. The amount of driving and fuel burned in the Commonwealth quickly adds up to an enormous amount of carbon dioxide pollution. Almost 43% of CO_2 emitted from fossil fuel combustion in Virginia was from transportation in 2004—over 54 million metric tons in that year alone.[75] Transportation is also the fastest growing source of CO_2 emissions in the state, rising 31% between 1990 and 2004. Most of these emissions are from cars and trucks, primarily the result of limited use of fuel-efficient vehicles and increased miles driven. Emissions from air travel have increased as well.

The second largest source of carbon dioxide emissions in Virginia is electric power generation, which was responsible for 31.6% of emissions in 2004. The other primary sources of CO_2 emissions from fossil fuel combustion are 14.8% from industrial, 4.3% commercial, and 6.6% from residential sources. The industrial, commercial, and residential sectors, of course, use both transportation and electricity and thus are responsible for a far greater share of emissions.

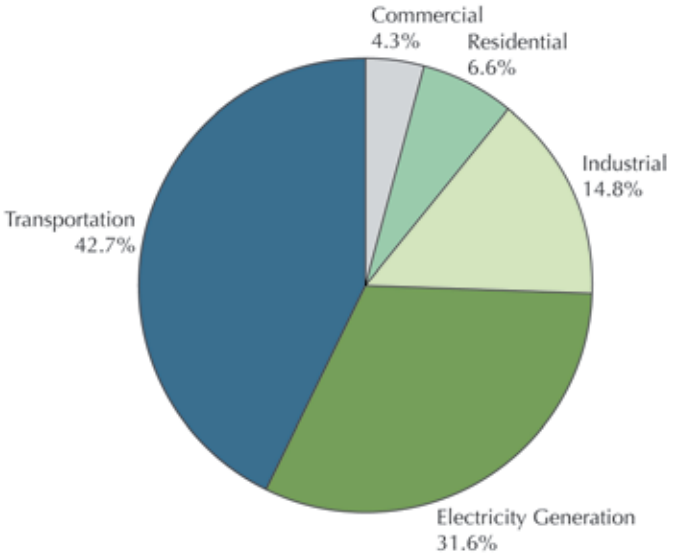
Land use also plays an important role in global warming. As noted previously, sprawling development patterns foster greater driving and fuel consumption, thus increasing carbon dioxide pollution. Land use patterns and practices play other roles in global warming. On the one hand, carbon dioxide is released when forests are cut and burned, and other greenhouse gases are released by livestock. On the other hand, agricultural and forest land and urban forests can offset carbon dioxide emissions, removing CO_2 from the air and storing carbon in trees and soils. Conservation tillage, organic fertilizing, and other practices can increase the amount of carbon sequestered. Forest buffers, for example, are estimated to sequester 3,000 pounds of carbon per acre per year.[76]

CO_2 Emissions from Fossil Fuel Combustion (1990-2004)



Source: EPA

CO_2 Emissions in Virginia by Sector (2003)



Source: EPA

It has been estimated that in Virginia forest tree growth sequesters the equivalent of 23.54 million metric tons of carbon dioxide annually—based on forest data between 1992 and 1997.[77] More recent data, although preliminary, suggests that the amount of carbon dioxide sequestered in forests has dropped significantly in recent years.[78]

As the Virginia Department of Forestry notes, "converting forests to other land use makes an immediate contribution to CO_2 emissions as the land is cleared, debris is burned and soil is removed or disturbed." The rapid conversion of forest and farmland described in an earlier chapter thus raises carbon dioxide emissions not only by increasing fossil fuel burned in motor vehicles but also by eliminating forests that help store carbon.

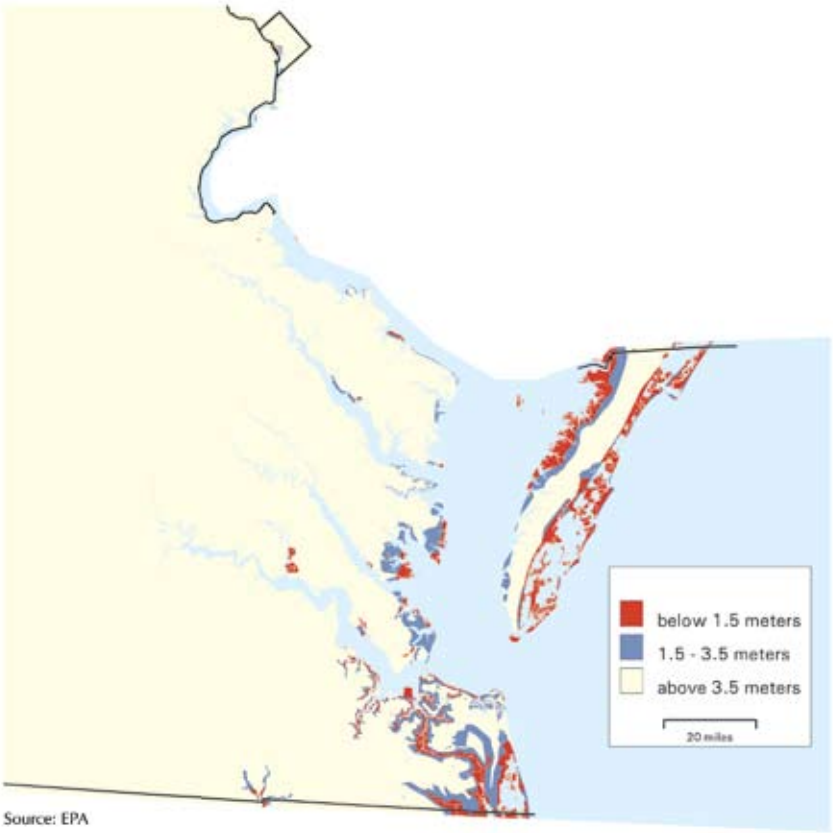
Greenhouse gas emissions in Virginia are forecast to continue increasing along with projected increases in driving, electricity production and consumption, and sprawling development. A recent study, for example, projects roughly a 40% increase in emissions in Northern Virginia and the rest of the Washington area by 2030.[79]

Virginia is vulnerable to the impacts of climate change resulting from global warming. These impacts are likely to be significant, including increased drought, more intense storms and hurricanes, sea level rise, increased flooding (particularly in coastal areas), harm to the Chesapeake Bay, loss of many coastal islands, wetlands loss, beach erosion, and species extinction. Some of the economic, social, health, and environmental consequences of these potential changes are explored in the next chapter.

Some of the impacts of climate change appear to be occurring already. For example, sea level rise is already occurring more rapidly in the Chesapeake Bay region than almost anywhere else in the world—a result of land subsidence, groundwater removal and, probably, climate change—and the highest sea level rise indicated by monitors in the Bay region is in Hampton Roads.[80] Sea level has risen by more than a foot in the Bay region since 1900, and it has been estimated that six inches of this increase is due to global warming.[81] The Virginia Institute for Marine Science estimates additional sea level rise of 4 to 12 inches by 2030 in the Mid-Atlantic region, which could inundate coastal islands, wetlands, and low-lying residential areas.[82] Other modeling by EPA suggests sea level rise in the Chesapeake Bay region could reach 27 inches above 1990 levels by 2100, and some recent estimates project even greater levels of sea level rise.

Although there is disagreement as to the severity and timing of the impacts of global warming, and models of likely impacts are not adequate to predict the future, the consequences of current development, transportation, and energy patterns are potentially catastrophic.

Lands Vulnerable to Sea Level Rise



Source: EPA

The High Cost of Current Trends

The demographic, development, transportation, and climate trends transforming Virginia have enormous impacts that affect residents across the Commonwealth, shaping the lives and the quality of life of present and future generations.

Economic

Virginia has enjoyed strong economic growth, including an increasing gross state product, low overall unemployment, and growing personal income. However, sprawl, traffic, energy, and climate trends threaten the state's economic health and competitiveness.

In our mobile society, if a high quality of life is not available in one area, businesses and employees can simply move. A national report found that business leaders "are recognizing that quality of life directly affects economic prosperity, and that sprawl threatens quality of life in many communities."[83] As one article similarly noted, traffic problems "make it more difficult for Northern Virginia companies to recruit and retain employees."[84]

Other adverse economic impacts of current trends include the following problems:

- Air pollution from vehicles, power plants, and other sources increases health costs. Direct medical costs due to air pollution in Virginia have been estimated to reach $4.8 billion per year.[85] Northern Virginia and the rest of the Washington area do not meet Clean Air Act standards to protect health, which can hurt business and employee recruitment and retention. In addition, the region could face a cutoff of federal funds for new roads due to a failure to make adequate progress towards meeting air quality standards. The Hampton Roads, Richmond, Roanoke, and Winchester regions currently meet requirements but have recorded numerous violations of air quality standards.
- Virginia's enormous appetite for fossil fuels contributes to its dependence on imported oil, takes money out of the state economy, and leaves it vulnerable to volatile fuel prices and to potential shortages if global oil production begins to decline in the near future.[86]
- The travel and tourism industry is one of the Commonwealth's largest employers, with over 208,000 jobs directly related to tourism.[87] Travelers spent almost $17.7 billion in the state in 2006, generating over $707 million in state taxes and $503 million in local taxes. Increasing traffic, air and water pollution, changes to weather and to resources (such as the loss of beaches) from global warming, and the loss of rural landscapes and historic resources due to spreading development can all damage this vital industry.
- Agriculture and forestry are Virginia's top industry, generating nearly $47 billion of annual sales and roughly 15% of jobs in the state.[88] Yet development is consuming prime farmland, ozone pollution costs Virginia farmers millions of dollars by reducing crop yields, water pollution has devastated the seafood industry, and warmer waters and sea level rise from climate change may cause the collapse of key fisheries. Climate changes

farmers major economic losses, and may cause more frequent and more severe drought in the future.

- Traffic congestion imposes substantial costs on businesses and individuals. In 2005, the total annual congestion cost in the Washington area is estimated to have been $2.3 billion, or $1,094 per peak traveler; in Hampton Roads $467 million, or $550 per peak traveler; and in the Richmond area $181 million, or $362 per peak traveler.[89]
- The potential costs of damage from climate change are astronomical. Among other things, as Governor Kaine noted, "The Hampton Roads region of Virginia is the largest population center that is at greatest risk from sea level rise outside of New Orleans."[90] Recent hurricanes and projected impacts from climate change are driving up insurance costs for businesses and homeowners. One report noted that insurance premium increases in Virginia between 2001 and 2006 were one of the five highest in the country.[91] As in other coastal states, some carriers have stopped writing new policies in areas near the ocean or plan to write fewer policies to reduce their exposure.[92]

Current trends also have tremendous impacts on household finances. In addition to congestion and insurance costs, gas prices have reached record levels, and the percentage of income spent on gas has risen sharply.[93] The average southern household spent $7,990 on transportation in 2005, almost 19 cents out of every dollar spent.[94] Transportation expenses are second only to spending on housing, and are almost as much as families spend on health care and food combined. Transportation costs tend to be highest in areas with more scattered development, since greater distances between home, work, school, and other activities increase the amount and cost of driving.[95] Moreover, the lack of transportation choices can limit the ability of people without a car to find and retain employment.

Housing costs have risen rapidly as well, and a growing number of people can no longer afford to purchase or rent housing in many parts of Virginia. Increasingly, elements of the workforce such as police officers, firefighters, nurses, teachers, and secretaries are priced out of the market. In the Richmond region, for example, the median value of owner-occupied housing rose over 50% in just five years; sales prices have climbed even higher, and have continued to rise despite the recent national housing slowdown.[96] A shortage of affordable housing most directly harms individuals and families in need of housing, hitting their pocketbooks and limiting choices of where to live or work.

Moving farther out in search of affordable housing often leads to higher transportation costs that eat up any savings on housing.[97] The shortage of affordable housing also can harm Virginia's economic competitiveness by making it difficult to attract and retain employees.

Fiscal

Sprawling development and aggressive roadbuilding can be a major drain on state and local financial resources, carrying a hefty price tag that ultimately burdens taxpayers.

At the state level, as noted in the transportation trends chapter, VDOT spends billions of taxpayers' dollars annually, yet congestion has grown worse. Questions have been raised about the need and effectiveness of numerous highway projects the state is planning—particularly in light of growing evidence that we cannot simply build our way out of congestion.

Questions also have been raised about the ability to fund the lengthy wish list of projects. The state's long-range transportation plan concluded in 2005 that identified transportation projects and maintenance would cost $203 billion between 2005 and 2025, and that this tab is more than twice the projected funds available, leaving a shortfall of over $108 billion.[98] Roughly three-quarters of the unmet needs—$925 million per year—were estimated to be for highways. The controversial transportation funding package adopted in 2007 will reduce, but not eliminate, this gap through steps such as tapping money from the general fund, authorizing tax increases in Northern Virginia and Hampton Roads, and imposing stiff abuser fees for Virginians who commit certain driving infractions.

The fiscal impact of current patterns and policies is more severe at the local level. New developments are often justified by promises of tax revenues they will bring. Localities have increasingly discovered, however, that growth may not pay for itself and must be subsidized by higher tax rates, higher debt, or both. Although new development does bring increased tax revenues, it often does not generate enough revenue to pay for the water and sewer lines, schools, roads, and other infrastructure and services needed to serve that development. The money spent to serve scattered development can mean fewer funds for other parts of a locality and for other purposes—such as education and health.

It has been estimated, for example, that it would cost $5.7 billion to serve new development allowed under Chesterfield County's comprehensive plan.[99] A report prepared for Chesapeake and Virginia Beach found that the demand for services by new residential development "has often outpaced the municipalities' ability to provide these services, because costs historically have exceeded the tax revenues generated by the development."[100] Similarly, studies in localities such as Culpeper, Frederick, and Loudoun Counties found that costs to serve residential development often exceed revenues from the development.

In contrast, the costs to serve more compact development typically are far less, and farmland and open space usually have a positive fiscal impact for localities. Studies of over 125 communities nationwide found that the local tax revenues from farmland and open space average almost three times more than the costs of providing services to them.[101]

The rapid loss of open spaces and tree cover generates other costs the public must bear, such as increased stormwater management costs and increased flooding since roads, rooftops, and other impervious surfaces do not retain as much water as forests or meadows. For example, vegetation loss between 1973 and 1997 is estimated to have removed the equivalent of $419 million worth of stormwater management in the Roanoke area.[102]

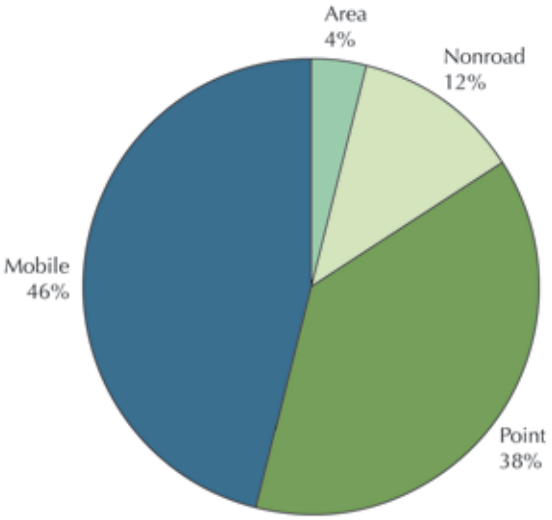
Environmental

Land use and transportation patterns are causing substantial environmental damage, and are a primary cause of virtually every pressing environmental problem in the state, from air and water pollution to the loss of wildlife habitat, open space, endangered species, and wetlands. The potential damage from climate change is even greater, since global warming is likely to change entire ecosystems and wipe out entire species.

Air

The dramatic increase in driving spurred by scattered development and a road-centered transportation system is a primary cause of air pollution. Motor vehicles directly produced about 46% of the nitrogen oxide, 71% of the carbon monoxide, and over 39% of the volatile organic compounds emitted in Virginia in 2002, and the total share of pollution attributable to driving and sprawl is much greater.[103] These and other pollutants from cars and trucks contribute to smog, visibility impairment, acid rain, and other environmental problems. Ports and airplanes are major sources of air pollution as well.

Percentage of Nitrogen Oxide Emissions from Various Sources (2002)



Source: Virginia Department of Environmental Quality

Between 1990 and 2007, monitors showed that ozone levels exceeded the eight-hour health standard 2,156 times in Virginia.[104] Northern Virginia has averaged almost 70 violations per year, Richmond 25, and Hampton Roads 13 exceedences each year. Treasured natural areas such as the Shenandoah National Park are affected as well. Air pollution has dramatically reduced summertime visibility and damaged a number of types of trees and plants as the Park registered some of the highest concentrations of ozone smog in the country—although its air quality has improved in recent years.

Spreading development and roadbuilding also exacerbate air quality problems by destroying tree cover that could help to remove air pollution from the atmosphere. Tree canopy lost to development between 1973 and 1997 could have removed an estimated 354,000 tons of air pollutants annually in the Washington region and 2.93 million pounds in the Roanoke area.[105]

Moreover, a recent study projects that temperature increases due to global warming will increase smog and cause more unhealthy air days.[106] Air quality is projected to violate health standards 8 additional days each summer in the Washington region and 10 additional days each year in Hampton Roads due to higher temperatures.

Violations of Ozone Health Standard (1990-2007)

Region	Number of Violations	Average Per Year
Richmond	448	25
Northern Virginia	1,242	69
Hampton Roads	238	13
Roanoke	43	3
Shenandoah Valley	153	9
Southwest	32	2
State Total	**2,156**	**128**

Source: Virginia Department of Environmental Quality

Pollution from motor vehicles is likely to increase further if current trends continue. Although technological innovations and federal requirements have curtailed pollution from individual vehicles, the steady increase in the number of miles driven and the amount of fossil fuels burned is negating many of these gains.

Water and Wetlands

Sprawl, road-building, and driving also take a heavy toll on water resources, including harm to water quality, wetlands, rivers, streams, and the Chesapeake Bay.

Buildings, roads, and parking lots are replacing hundreds of thousands of acres of forests, farms, and wetlands that would otherwise filter water. Statewide, 23,886 acres of wetlands were destroyed between 1982 and 1989.[107] Between 1994 and 2000, there was a net loss of almost 2,100 acres of wetlands in just part of Hampton Roads.[108] Development and transportation projects continue to threaten wetlands. Proposals for a new Route 460 and the Southeastern Expressway, for example, each could impact hundreds of acres of wetlands.[109] Rising sea levels due to climate change could destroy up to 80% of Virginia's vegetated tidal wetlands this century.[110]

Development and transportation projects also have dramatically increased the amount of impervious surfaces—hard areas such as roads and rooftops—which in turn can increase the volume of runoff of pollutants, increase erosion and flooding, and slow groundwater replenishment, depleting water supplies. A one-acre parking lot creates an estimated 16 times more runoff than a meadow of the same size.[111] Between 1992 and 2001, impervious surfaces increased by more than 2,500 acres in Augusta, Chesterfield, Fairfax, Hanover, Henrico, Loudoun, Prince William, and Rockingham counties, with Fairfax and Henrico seeing over 6,000 acres covered.[112]

Runoff, pollution, the loss of wetlands, and sedimentation all plague the Chesapeake Bay, the country's largest estuary and one of Virginia's most important natural resources. Efforts to curb these impacts have met with limited success. A recent report found that development "is increasing nutrient and sediment loads at faster rates than restoration efforts are reducing them."[113] As noted in the development chapter, impervious surfaces in Virginia's portion of the Bay watershed increased by 44.7% between 1990 and 2000.[114] Global warming is likely to compound current problems through sea level rise that destroys wetlands, warmer water that encourages invasive species and algae blooms, and more intense storms that increase sediment and polluted runoff.[115]

The same mix of factors is harming rivers throughout Virginia, overwhelming efforts to improve water quality and resulting in fish kills, algae blooms, and other problems.[116]

Population growth, as well as expanding home and lawn sizes, increases water consumption and stresses water supplies. Highway projects all too often harm or threaten water supplies. VDOT has proposed building a Route 29 Bypass of Charlottesville, for example, at the top of steep slopes along the area's main reservoir. The regional water and sewer authority has warned that potential spills and erosion from the bypass threaten the drinking water supply for over 80,000 people. Moreover, a likely consequence of climate change is increased drought, which would further stress water supplies.

Health and Safety

Dirtier air from escalating driving harms our health. Pollutants in the air we breathe can damage lung tissue and shorten our lives, and nitrogen oxides, small particle pollutants, sulfur dioxide, and toxic pollutants are among the harmful emissions from burning fossil fuels in motor vehicles.

Nitrogen oxides, for example, are a major contributor to ground level ozone, which can cause pain when inhaling, shortness of breath, coughing, and headaches. It may also cause asthma attacks and even premature death. Long-term exposure can result in more frequent and severe respiratory pain and possible lung tissue damage.

As noted above, ozone levels exceeded the eight-hour health standard 2,156 times in Virginia between 1990 and 2007. The problem is probably even more severe since many localities do not have any monitors, and every area with a monitor has recorded at least some violations.

Studies have shown that diesel exhaust contains small particulate matter that can damage lung tissue and take years off of people's lives.[117] A number of Virginia localities

have high levels of particle pollution from vehicle exhaust, power plants, and other sources.

Children, the elderly, and people with certain types of health conditions are particularly vulnerable to the health problems caused by ozone and particle pollution. The American Lung Association estimates that there are millions of individuals whose health is at risk in the numerous

Virginia localities exceeding standards for these pollutants in recent years: including over 1.2 million children under age 18 and more than 464,000 people over 65; over 107,000 children with pediatric asthma and more than 307,000 people with adult asthma; almost 144,000 people with chronic bronchitis; and over 1 million people with cardiovascular disease.[118] Anyone exercising or working outdoors also faces increased health risks from ozone pollution.

Several studies have shown that deaths and visits to emergency rooms for breathing difficulties increase when air pollution levels are high, and that respiratory illness is more common near high traffic areas. A study in Atlanta, for example, found a 35% increase in emergency room visits for respiratory-related illnesses on high ozone days.[119]

It is estimated that the death rate attributable to air pollution is about 8% of overall mortality, greater than the rate for alcohol, firearms, and motor vehicle accidents put together.[120]

There also is increasing evidence that current transportation and land use patterns are having a dramatic impact on our health by decreasing physical activity. Physical inactivity contributes to health problems such as obesity, diabetes, cardiovascular disease, certain forms of cancer, and depression. The Governor's Health Reform Commission recently concluded that obesity is increasing in Virginia, that it is "adversely affecting the quality of health in the Commonwealth,"[121] and that "obesity-linked health costs in Virginia currently exceed $1.6 billion annually."[122] The decline in physical activity rates appears to be linked in part to sprawling development, poor community design, and a lack of adequate and safe facilities that can make walking and bicycling impractical if not impossible.[123]

Further, high rates of driving are accompanied by high rates of injuries and fatalities from accidents. In 2006 alone, there were over 151,000 vehicle crashes in Virginia, resulting in over 73,000 injuries and 961 deaths.[124]

Social

Virginia's sprawl, transportation, energy, and climate trends have profound social and community impacts as well, including:

- Loss of a sense of community and a way of life as towns, rural areas, and historic places are engulfed by highways, strip malls, parking lots, and subdivisions.
- Increased time commuting, running errands, and stuck in traffic means less time for families, careers, and community activities, as well as increased stress.
- A transportation system that offers few alternatives to driving limits the activities of people unable to drive, can increase their isolation, and restrict access to jobs.
- Virginia's aging population poses special transportation challenges. The Transportation Accountability Commission recently noted that "senior citizens will face increased difficulty moving from place to place due to aging and health concerns," and concluded that it "does not believe that Virginia's transportation system is currently equipped to deal with this growing problem."[125]
- A transportation system and development based on the automobile mean many children can no longer walk or bicycle to school or to a friend's house, nor can they play safely along streets built for speed.
- Spreading development has reduced areas available for recreational activities such as hunting and fishing. Climate change is likely to have even more profound impacts, including warmer water that could lead to the loss of certain fish species and alteration of waterfowl habitat and migration patterns.[126]
- A lack of affordable housing can undermine communities by forcing essential employees such as teachers, nurses, police, firefighters, and many other members of the workforce to live outside the area where they work.

- An affordable housing shortage can limit the ability of elderly residents to keep their homes or to find new housing to fit their changing needs, as well as limit the ability of young adults just entering the job market to find housing. It also can reduce the economic and racial diversity that can provide a more vibrant community.

Historic and Scenic

Virginia is blessed with unparalleled historic, cultural, and archaeological resources, and breathtaking natural and rural landscapes. These resources offer significant benefits, including generating tourism revenues and jobs, helping define our sense of community and sense of place, and educating us about our past. Yet many historic and scenic resources have been destroyed or are threatened by development and transportation policies and projects.

One of the many examples of the adverse impacts of sprawl on historic resources is Old Salem Church, which played an important role in the Civil War during the Battle of Chancellorsville and is now surrounded by miles of parking lots and strip malls. A leading example of the threat from transportation projects is the proposal to expand Interstate 81 by up to two lanes each way from one end of Virginia to the other. This proposal would harm historic towns, rural areas, and a dozen Civil War battlefields.

State and national groups have recognized the threats development and road building can pose to Virginia's historic and scenic resources. Recent lists of "Virginia's Most Endangered Historic Places" from APVA Preservation Virginia include the possible expansion of I-81 and a proposed shopping center and other development that would ruin the rural setting of the Booker T. Washington National Monument in Franklin County. The National Trust for Historic Preservation has listed numerous Virginia sites among the most endangered historic places in the country due to development and road projects and proposals, including the Route 15 "Journey Through Hallowed Ground" corridor, Chancellorsville Battlefield, and Jackson Ward in Richmond. The Civil War Preservation Trust in 2007 named Cedar Creek (in Frederick County) and Petersburg as two of the ten most endangered battlefields in the U.S., and five of the 15 threatened battlefields were also in Virginia.

View from Salem Church, Chancellorsville

New Directions

The tremendous impacts of current land use and transportation patterns have fueled public and political support for change. Increasing awareness of the demographic changes transforming the Commonwealth, the need to substantially cut greenhouse gas emissions, and the need to reduce energy costs are providing further impetus for change. We cannot afford "business as usual." There has been a surge of efforts to develop innovative, practical alternatives that can promote smarter growth, more sustainable transportation, affordable housing, and greener building, all of which provide sustainable economic development without harming our quality of life. Although the steps taken so far are only a beginning, they indicate the enormous potential for promoting better ways to grow.

Opportunities for Change

Government subsidies, decisions, and policies are primary factors promoting scattered development, excessive driving, and greenhouse gas emissions. For example, taxpayers often subsidize the costs of providing roads, schools, water, and sewer facilities to new development. As long as taxpayers cover these costs, there is little incentive to build where infrastructure already exists. In addition, planning and zoning policies that require large lots, minimum house sizes, and the geographic separation of commercial and residential uses can drive up housing costs and energy consumption while effectively mandating scattered development and driving. Other regulations, such as building code requirements, frequently make it more costly and difficult to redevelop existing structures.

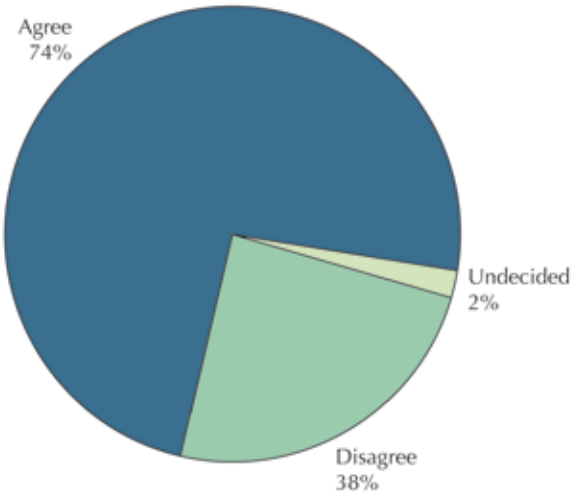
Recognizing the central role public policies play in shaping development and transportation patterns suggests promising opportunities for choosing better ways to grow.

Support for Change

Public concern over growth-related issues is strong. Polls consistently show that Virginians highly value their natural resources and are deeply concerned about threats to the land, air, and water in general, and about sprawl in particular. In a recent statewide poll, 94% agreed with the need to preserve natural lands, rivers, lakes, and streams for future generations, and 86% recognized that having clean air and water and undeveloped lands are critical to a strong state economy.[127] Roughly three-fourths of Virginians have expressed concern that the current pace of growth and sprawl threatens the quality of life in their community.[128]

Virginia's Growth Concerns: Agree or Disagree?

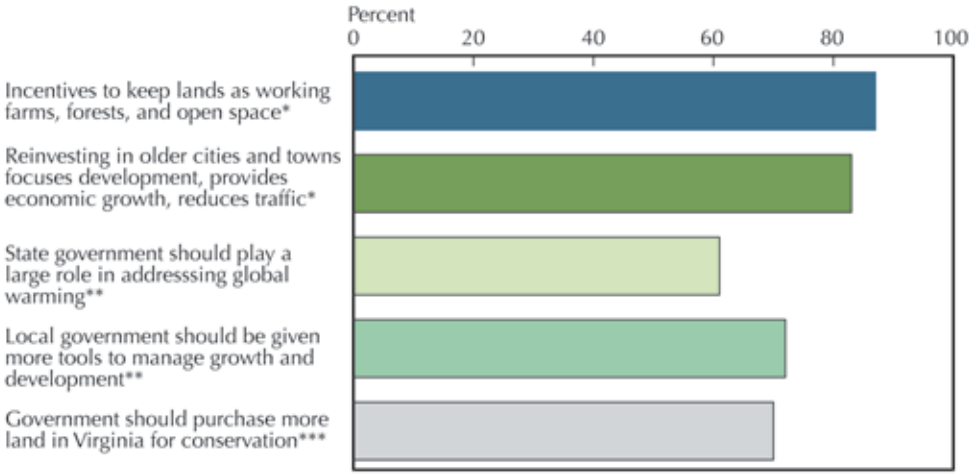
I am concerned that the current pace of growth and sprawl is threatening the quality of life in my county.



Source: Mason-Dixon Polling and Research, Virginia Voter Survey 2003

There also is significant public support for addressing Virginia's growth challenges. A statewide poll found that 83% of voters support policies that reinvest in older cities and towns in order to focus development, provide economic growth, and reduce traffic.[129] Large majorities also support government purchasing more land for conservation, incentives to keep lands as working farms and forests, state government playing a large role in addressing global warming, and providing local governments more tools to manage growth and development.[130]

Public Support for Better Growth Policies



* Virginia Voters Survey 2003; ** Virginia Voters Survey 2007
*** Virginia's Conservation Finance Work Group 2007

Virginians also support a different transportation focus. Although they see traffic congestion as a serious problem, three-fourths of voters statewide agree that building more roads will lead to more development and congestion; instead, they favor halting sprawl, better planning, and more carefully managing growth.[131] A series of polls further shows that the public is much more likely to support expanding public transportation than to support new highways,[132] and Virginians do not want transportation projects to harm the environment.[133]

Taxpayer groups, conservationists, historic preservationists, health organizations, and business leaders increasingly have been active in seeking alternatives to current development policies and promoting more transportation options. There also is greater awareness among a range of groups of the need to address global warming. Although differences exist among various groups, there is agreement on both the need for change and on some of the particular changes needed.

The public support for new approaches to growth is increasingly evident at the ballot box. In a recent poll, 65% of voters say that a candidate's view on land use and curbing sprawl is the most important or an important basis for their voting decision,[134] and growth and development issues have figured prominently in a number of recent elections.

State and local officials of both parties are also recognizing the need to improve land use and transportation policies and to address climate change. Governor Kaine has stated: "We cannot allow runaway development to clog our roads and ruin our beautiful landscapes."[135] He also has recognized that "[i]n Virginia, where we rely so heavily on the health of our natural resources for their economic, social, and historical value, we simply can't afford to postpone action [on global warming] any longer."[136] Bill Howell, Speaker of the House of Delegates, has noted: "Overheated development has dramatically contributed to growing suburban sprawl, creating excessive pressure on our existing transportation infrastructure.[137]

Addressing the Challenges of Growth

Efforts are underway across the Commonwealth to capture the benefits of growth while reducing or eliminating growth's adverse impacts, and to address the intertwined issues of sprawl, transportation, affordable housing, and climate change.

At the state level, recent positive steps include enhancing transportation choices by boosting funding for transit and rail, adopting provisions to improve the efficiency of existing transportation systems, and enacting measures to better link transportation and land use planning that potentially are among the most significant ever adopted in Virginia. These are important steps, but they are relatively minor in light of the magnitude of the challenges, and the benefits they produce will be overwhelmed by proposed new highway and development projects.

More fundamental changes are needed, including steps to strengthen existing communities and carefully plan new development, to promote affordable housing and greener buildings, to protect farmland and natural areas, to offer more transportation choices while reducing damage from highways and vehicles, and to curb greenhouse gas pollution.[138]

Many solutions are complementary and offer multiple benefits. For example, steps to reduce the climate impacts of driving and sprawl can also trim energy costs, strengthen communities, give people and businesses more transportation choices, and save open space and farmland. The rest of this chapter outlines some of the strategies and solutions needed to address the challenges of growth.

Building Better Communities

Revitalizing communities and carefully planning new development offer a host of benefits, including reducing pressure to develop rural and natural areas and reducing the burden on taxpayers by guiding growth to areas with infrastructure already in place. Steps to bring development to existing communities and to encourage new projects to be more compact and walkable can also decrease travel time to various activities and make alternatives to driving more feasible, thus reducing energy costs and pollution

while promoting healthier lifestyles and greater accessibility for an aging population. Additional steps are necessary to promote an adequate supply of affordable housing in communities and to encourage greener building that can further reduce the environmental impacts of new development.

One study looked at alternative growth scenarios in a region including parts of Albemarle and Greene and all of Fluvanna and Louisa Counties. It assumed the same increase in jobs and population, but different development patterns. When compared to a dispersed, business-as-usual scenario, the more compact development pattern would reduce the amount of area developed from 45% to 35%, cut traffic congestion in half, reduce gas consumption by almost 30%, and cut the cost of transportation improvements needed in half.[139]

The following steps can help make development part of the solution to the growth challenges facing the Commonwealth—rather than part of the problem.

Guide Growth to Targeted Areas. Many Virginia localities have sought to guide growth by targeting residential and commercial development—as well as the capital improvements and services growth will require—to designated areas. Although this can be a very valuable tool, the results of these efforts have been mixed. Localities should be careful not to draw overly broad development areas, to take adequate steps to promote or require more compact projects within targeted areas, and to limit development outside targeted areas. In addition, the state should target spending to existing communities and designated growth areas to ensure that public investments do not subsidize sprawling development.

Promote Revitalization. We can promote the revitalization of cities, towns, and older suburban communities through tools such as rehabilitation tax credits or loans, and building code provisions and programs that support rehabilitation of older buildings. State and local historic preservation incentives and the Virginia Main Street program, for example, have been particularly effective at rejuvenating historic neighborhoods and districts, and they should receive greater funding. Richmond's Neighborhoods in Bloom program offers another promising model. Working with a range of private and non-profit partners, the City changed the way it allocated federal and city housing funds to focus expenditures on renovation, restoration, construction, and sales in neighborhoods most likely to benefit from such efforts.[140] The state and localities could further promote revitalization by devoting a larger share of infrastructure spending to older areas (such as repairing and upgrading existing roads and schools).

Encourage Infill Development. There are a variety of strategies to promote infill development, encouraging development of vacant land and redeveloping abandoned or blighted structures. These strategies include revising building code and zoning requirements, offering incentives to developers for infill projects, public acquisition of vacant property and land, cleaning up or offering incentives for cleaning contaminated brownfields, and land banking by local government to help with land assembly.

Promote More Compact, Traditional Development. There has been a resurgence of interest in neighborhood and town development patterns that were dominant in Virginia until the past fifty to sixty years, offering proximity of residences to stores, restaurants, and jobs; the ease of walking to various destinations; and other benefits. Yet government policies often make it difficult—if not impossible—to develop in this manner, such as zoning ordinances that require large lot sizes and deep setbacks or prohibit mixing residential and commercial uses. Regulatory provisions that effectively mandate sprawl and limit housing choices should be revised. In addition to removing regulatory barriers, higher density, mixed income, mixed use developments can be encouraged through a variety of incentives, including density bonuses, reduced impact fees, and expedited approval processes.

Foster Transit-Oriented Design. Another valuable tool to promote more sensible development and transportation patterns is to guide growth to areas with access to transit. Arlington County has worked for over 20 years to revamp its zoning provisions and to offer incentives to create pedestrian-oriented development around transit stations. Today, virtually all office space and about two-thirds of the retail space is within walking distance of transit, and the County has the highest transit commuting rate in Virginia. The state and localities need to target transportation funding and planning resources to encouraging transit-oriented development and expanding transit systems. In addition, areas that are candidates for future transit service should be developed using mixed use zoning and other steps to create compact, walkable development that is ready to take full advantage of transit services.

Promote More Affordable Housing. A number of the steps listed above will help increase the supply of affordable housing. In addition, revamping local ordinances that prohibit or severely restrict accessory dwelling units (such as an apartment over a garage), multi-family housing, townhouses, and live-work units can help promote more affordable housing and permit a greater range of housing choices. Further, some localities require developments above a certain size to include a specified percentage of affordable homes or rental units—or to make a contribution to a housing affordability fund.[141] In return, developers may receive incentives such as streamlined approvals or bonuses that allow more units to be built. Other localities offer incentives to encourage developers to add affordable units to projects. Although less controversial, voluntary programs typically result in fewer affordable units. Community land trusts are another promising tool. Run by a non-profit organization or local government, a trust accumulates land donated, acquired, or already owned, and holds it to be used for affordable housing.[142] Further, there is a pressing need for the state and localities to increase funding for successful programs and partnerships already helping to provide affordable housing.

Encourage Greener, Healthier Buildings. New and existing buildings can be made healthier, cleaner, and more energy efficient. Greener buildings can create healthier places to live and work by eliminating toxic paint, finishes, and other materials. Green building also can protect the environment by using products and technologies that significantly reduce energy, water, and material use. These measures can slash utility bills as well, making housing more affordable in the long run. The state and localities should adopt a variety of measures to encourage green building, including information and technical assistance programs, grants and loans, streamlined permitting, tax incentives, and requiring all public buildings to meet certain sustainability standards.

Protecting Rural and Natural Areas

Protecting and enhancing farmland, forests, and natural areas is central to our economy, environment, health, and quality of life. Moreover, efforts to protect these critical resources also can help slow global warming by preserving vegetation that captures and stores carbon. In 2000, under Governor Gilmore, Virginia agreed to conserve 20% of its land in the Chesapeake Bay watershed. Although Maryland and Pennsylvania have met similar goals, Virginia has not—and there is need for greater land conservation statewide. In 2006, Governor Kaine set a goal of protecting an additional 400,000 acres in Virginia by 2010.

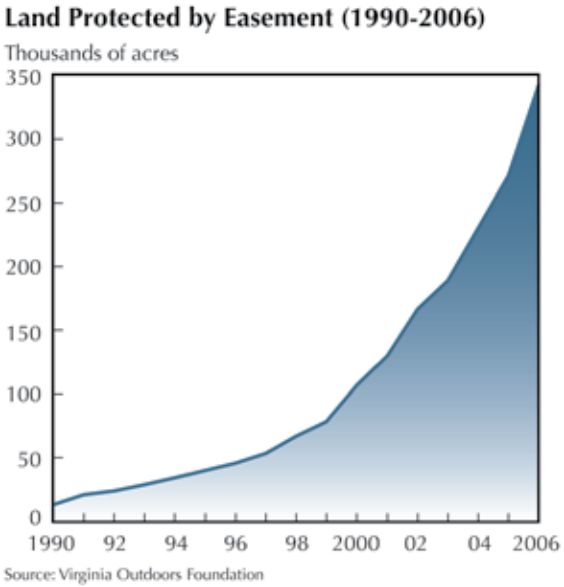
Guiding growth to existing communities and encouraging more compact, walkable development will help reduce pressure to develop rural and natural areas. Efforts to protect such areas have increased significantly, but rapid development has continued. Stronger steps are required.

Encourage Conservation Easements. One of the most effective land protection tools is the conservation easement, a voluntary agreement between a property owner and a non-profit organization or government agency that limits certain uses of land to protect its conservation value. An easement can, for example, prohibit development of a subdivision on a farm while enabling agricultural uses to continue. In addition to guaranteeing protection of their land, landowners can receive significant financial benefits from donating an easement, such as reduced federal taxes, state income tax credits, and lower local taxes. The number of easements has increased significantly. At the end of 2006, the Virginia Outdoors Foundation held easements on just under 400,000 acres, and in the past three years VOF had the highest levels of donations in its 38-year history.[143] There also has been an increase in the formation and activities of non-profit land trusts that protect land

through easements, purchases, and other means. Virginia had 32 land trusts as of 2005, protecting 662,302 acres—the fifth highest state total of land protected by trusts in the country.[144] Virginia should retain its successful tax credit program that encourages such results.

Increase the Purchase of Development Rights. Another way to protect land while leaving it in private hands is a program for the purchase of development rights (PDR). An increasing number of Virginia localities have adopted or are exploring a PDR program. Since 1995, for example, the City of Virginia Beach's Agricultural Reserve Program has acquired development rights in designated areas using a dedicated portion of its property tax and other funding sources. Most programs lack dedicated funding, however, and most lack adequate funding. The state and localities both need to increase funding for these programs significantly, including providing state matching funds for local PDR programs.

Increase Conservation Funding. The state and localities have invested in acquiring land for parks, greenways, wildlife areas, and other conservation purposes. Funding has been insufficient, however, and has varied widely from year to year; efforts to create a permanent funding source for land conservation have been defeated. Virginia's land conservation funding has lagged far behind neighboring states. Between 1998 and 2005, North Carolina spent an average of over $106 million per year on land conservation, $12.26 per capita per year, and Maryland spent an average of over $51 million per year or $9.22 per capita; in contrast, Virginia spent less than $7 million per year, only 91 cents per capita per year.[145] A significant, dedicated land conservation funding stream is needed.



Expand Efforts to Promote Agricultural Vitality. Too often, localities have failed to plan for the continuation of a viable agricultural sector, viewing farmland as land waiting to be developed. In 2000, the General Assembly funded the creation of the Virginia Agricultural Vitality Program to promote agricultural preservation through PDR programs and by connecting retiring and beginning farmers. In addition, there have been a range of efforts to promote agricultural products, including a recent emphasis on purchasing local products to help preserve working farms and to reduce energy use, greenhouse gases, and other pollutants from importing products. The state and localities need to expand efforts to promote agricultural vitality, as well as efforts to reduce the environmental impacts of agricultural activities.

Developing A More Efficient, Sustainable Transportation System

State, regional, and local efforts have increased to create a more balanced, less destructive transportation approach. Roads continue to receive the bulk of transportation funds, though, and a slew of projects to build or expand highways are underway or under consideration. A new transportation approach is urgently needed that provides meaningful alternatives to motor vehicle use, increases the efficiency of the current transportation system, reduces the environmental impacts of the roads we do build, and better reflects the true cost of driving.

Drop Costly, Destructive Projects. Virginia will not be able to curb sprawl, reduce air emissions and other impacts from escalating vehicle use, or meet its greenhouse gas emission reduction goals, unless the state's misplaced focus on building new highways is altered. Expensive, destructive highway projects such as the Tri-County Parkway, a new Route 460, the Southeastern Expressway, the Harrisonburg Bypass, and wholesale widening of I-81 would cost taxpayers billions, damage communities and the environment, and spur sprawl and driving while offering minimal transportation benefits. These projects

should be rejected in favor of practical, less destructive alternatives that address our transportation needs.

Provide More Transportation Choices. Efforts to develop alternatives to driving have increased, including more state funding for projects to expand transit, freight rail, passenger rail, bicycling, and walking. Among their many benefits, these alternatives can reduce traffic congestion and free up road capacity by replacing many vehicle trips, reduce greenhouse gas emissions and air pollution, and reduce vulnerability to high fuel prices. Dwight Farmer, deputy executive director of transportation for the Hampton Roads Planning District Commission, has stated that in his region "if everyone would carpool one day of every 10 work days, all our existing congestion problems today would disappear. If everyone carpooled every week, one day out of five, congestion would be eliminated for 20 years."[146]

Virginians have expressed a strong desire for more transportation choices and have shown that they will use alternatives that are convenient, safe, and affordable. Although only 4% of commuters statewide used transit in 2000, in Arlington County 23% did—in large measure because Arlington has high-quality transit service and is a leader in guiding growth to areas served by transit.[147] In Charlottesville, with its proximity of many jobs and housing, 16% of people walk to work, and in neighborhoods near downtown and the University of Virginia, this figure rises to up to 48%; in neighboring Albemarle County, 2% walk to work.[148]

State, regional, and local spending should be reoriented to provide alternatives for freight and passenger travel. Greater financial incentives for using transportation alternatives are needed as well, such as a state commuter choice tax incentive to employers who provide transit or vanpool benefits. Further, priority should be given to multimodal and intermodal projects since connecting various forms of transportation can significantly improve the efficiency of the overall system and increase the convenience and attractiveness of alternatives.

Fix it First and Increase System Efficiency. A significant share of transportation funding will continue to go to roads, and these funds should be shifted from sprawl-inducing new projects to improving and linking existing roads. The Virginia Code has a "fix it first" policy requiring that road maintenance take priority over road construction. By making the most of existing infrastructure, the state and localities can reduce the need for costly new road projects and protect the public investment in existing roads. The state should increase funding to address the serious backlog of highway and bridge maintenance. The state also should place a higher priority on measures to

If we focus on moving people rather than cars, existing streets often have plenty of capacity, especially when people use alternatives to driving. The photos above show the same amount of people and the different space they take up depending on their mode of transportation. Top photo—cars; next photo—space needed for cars; third photo—space if riding a bus; bottom photo—space required for cyclists and pedestrians.

improve the efficiency of the present transportation system, such as access management and corridor preservation. Managing access to new and existing roads, for example, can improve their capacity, travel speed, and safety while reducing the need for costly new facilities.[149] As a report by the Virginia Transportation Research Council noted, "in almost all cases, the cost of managing access is substantially lower for the state than the alternative of reconstruction or bypass."[150]

Further, road funding should be shifted to projects that help to link existing roads. Building a more complete street network using parallel and connector roads offers drivers more choices of routes, which reduces choke points and is often a more effective and less costly way to relieve congestion than alternatives such as building bypasses.

Reduce Adverse Impacts of Roads. Road projects often are built without adequate efforts to reduce their impact on communities or on natural, historic, scenic, or cultural resources. Although there has been some progress, Virginia lags behind other states in adopting a context-sensitive solutions approach to planning, design, and construction that uses a more open, collaborative process with substantial public involvement and seeks to design solutions that can meet transportation needs while minimizing environmental and community harm. Priority should be placed on flexible, context-sensitive design solutions and on steps to improve the environmental performance of projects.

Reform Transportation Planning. Despite efforts to reform VDOT and improve transportation planning, significant problems remain. Among other things, there currently is little analysis of the impact of proposed highway projects on driving, development patterns, pollution, and greenhouse gas emissions. Nor is there adequate analysis of alternatives to meet transportation demands. Stronger performance measures are also needed. Plans should be required to meet goals such as reducing the amount of driving, reducing carbon dioxide and other emissions, and increasing the share of pedestrian, bicycle, and transit trips. Preference should be given to funding projects that advance these goals.

The Public-Private Transportation Act (PPTA) presents further problems. As discussed earlier, the Act has become a key part of Virginia's transportation program, yet it is flawed and its track record raises serious concerns. Steps to improve the statute include requiring greater public input into proposals, requiring approval of proposals by the Commonwealth Transportation Board, limiting proposals to projects in state transportation plans and to projects with complete environmental studies, requiring full disclosure of all public costs and potential liability, and giving priority to proposals with private-sector equity contributions. No additional funding should be provided for PPTA projects until the Act is reformed.

Send better price signals. Current policies provide subsidies that mask the costs of driving and distort travel decisions. Local zoning regulations, for example, often require developers to provide large amounts of free parking, which encourages people to drive more and use other travel modes less. In most cases, minimum parking standards should be reduced. In addition, congestion pricing or tolls that are highest when congestion is greatest should be evaluated for some roads to send a signal that driving at certain times costs more—including the economic costs of congestion, the environmental costs, and the fact that peak congestion can lead to costly road expansion. Another market-based tool to improve transportation sustainability is pay-as-you-drive insurance. Most driving costs—such as vehicle purchase, maintenance, insurance—do not change with the amount of driving. Shifting some costs so that they increase as people drive more would send a more accurate price signal and provide an incentive to drive less.

Provide Incentives for Cleaner Vehicles. The state and localities should launch a comprehensive effort to increase the development and purchase of more efficient, cleaner vehicles and cleaner fuels. Potential tools include incentives such as tax breaks for purchasers of vehicles that meet certain standards, government vehicle purchases

and leases, research and development grants, and other steps.[151] Measures that promote biofuels from food crops, however, raise serious economic, equity, and environmental issues—including potential damage to the Chesapeake Bay—and should be evaluated carefully.[152]

In addition, Virginia should adopt a clean car requirement 15 states have now adopted that would reduce carbon dioxide emissions from vehicles.[153] The state should also require new cars to display information on the carbon dioxide emissions they produce.

Further, the state and localities should launch comprehensive programs to reduce diesel emissions from motor vehicles, including retrofitting school buses, providing truck stop electrification to reduce the need for engine idling, and enforcing anti-idling limitations on trucks, buses, and marine vessels. Further, the state should require the best available control technologies to reduce emissions from all diesel engines it owns or purchases, as well as from contractors with the state.

Linking Transportation, Land Use, and Environmental Quality

State and local land use, transportation, and environmental policies and programs often work at cross purposes. Although some significant steps to improve the link between land use and transportation have been taken at the state level and in a number of localities in recent years, much more needs to be done. Many of the measures mentioned above would improve the link between transportation, land use, and environmental quality. Additional steps include:

- Tying transportation funding or giving extra funds to localities that adopt improved land use policies and take steps to reduce greenhouse gas emissions;
- Targeting transportation spending to existing communities and designated growth areas;
- Providing technical assistance and funding to localities to review and improve their land use and transportation plans and policies to reduce greenhouse gas emissions and to support and promote alternatives to driving (for example, by revising zoning codes to encourage transit-oriented development and infill development);
- Requiring an assessment of the greenhouse gas and land use impacts of major transportation projects;
- Creating a program to include the savings on transportation costs for people who live near public transit when calculating housing affordability, enabling them to qualify for higher mortgages. The location-efficient mortgage, or LEM, recognizes that when people live in a location that allows motor vehicle costs to be lowered, they will have increased money for mortgage payments. LEMs thus increase household purchasing power and provide an incentive for purchasing more efficient housing.

Reducing Greenhouse Gas Emissions

Many measures outlined above are critical to curbing Virginia's significant—and growing—greenhouse gas emissions. The Virginia Energy Plan goal of reducing emissions to 2000 levels by 2025—an estimated 30% cut from what they would be otherwise—is an important step. This goal, however, is weaker than other state targets for reducing carbon, and it should be strengthened to reflect the serious threat climate change poses to Virginia. Some localities have pledged to meet greenhouse gas reduction targets as well.

These targets will not be met without significant policy changes. A number of provisions in the Virginia Energy Plan are a good start, including steps that will reduce energy demand and improve efficiency to reduce emissions from power plants. But much more is needed, particularly in the area of transportation and land use. Several general concepts can help guide Virginia's efforts to cut greenhouse gas emissions:

- Ensure that state funds are not promoting increased greenhouse gas emissions;
- Ensure that regulations do not hinder more sustainable transportation, land use, and energy patterns;
- Provide incentives for more sustainable transportation, smarter growth, energy efficiency, and clean energy.

In addition to the concepts outlined above, some of the additional steps needed are to

- Develop an action plan for cutting greenhouse gas emissions that includes immediate, mid-term, and long-term solutions;
- Require agencies to reduce emissions, and require audits and progress reports;
- Make reducing greenhouse gas emissions a priority in energy and transportation plans;
- Conduct periodic, comprehensive statewide greenhouse gas emissions inventories and forecasts so we can know where we stand and where we are heading;
- Conduct extensive mapping of coastal areas, as North Carolina and Maryland have done, to better understand the potential extent of impacts of sea level rise on wetlands and other resources;
- Support strong federal legislation to reduce greenhouse gas emissions, such as an enhanced version of the bill Senator John Warner has introduced with Senator Lieberman—and make sure it addresses transportation and land use;
- Create an emissions cap and allow factories and businesses to trade credits, joining with other states to the greatest extent possible (one possibility would be for Virginia to join the Regional Greenhouse Gas Initiative that a number of Northeastern and Mid-Atlantic states have formed).

A Comprehensive Vision

The challenges presented by the trends transforming the Commonwealth and its localities require a comprehensive vision of the future, and an integrated approach to land use, community design, transportation, and environmental quality.

Steps need to be taken at the federal, state, and local level. Greater cooperation among localities is needed as well, since the challenges of growth—as well as solutions to those challenges—increasingly transcend the boundaries of any city, town, or county. Greater cooperation is also needed with other states, especially to advance transportation alternatives, such as inter-city passenger rail and long-haul freight rail, and to address climate change.

The challenges we face are urgent, and the stakes are high. Opportunities abound, however, to sustain economic growth while pursuing smarter development and more sustainable transportation.

We must act quickly, creatively, and wisely.

These three images of the same street from the same angle show some of the opportunities available for smarter growth and more sustainable transportation.

Endnotes

[1] U.S. Census Bureau. See www.census.gov. All statistics in the population section of this report come from the Census Bureau, unless indicated otherwise.

[2] Different sources of data used in this report define various regions differently. Northern Virginia, for example, is often included within Washington, D.C., statistics that cover areas of Virginia, Maryland, and the District of Columbia. In addition, the counties, cities, and towns included within Northern Virginia may vary from one data source to another. Further, data cited is often based on statistical sampling, which is useful to show general trends, but is not a precise measurement.

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[4] Jeff E. Schapiro, "Two Groups Pace Virginia Growth," *Richmond Times-Dispatch*, Aug. 5, 2006.

[5] Calculations in this paragraph are based on data from the Virginia Employment Commission, Population projections by age for Virginia (http://www.vec.virginia.gov/vecportal/lbrmkt/popproj.cfm).

[6] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Accounts Data, Gross State Product Data (www.bea.gov/bea/regional/gsp).

[7] U.S. Department of Commerce, Bureau of Economic Analysis, Regional Accounts Data, Annual State Personal Income (http://www.bea.doc.gov/bea/regional/spi).

[8] U.S. Department of Labor, Bureau of Labor Statistics, Local Area Unemployment Statistics.

[9] Virginia Employment Commission, Monthly Unemployment Press Release, Oct. 2, 2007.

[10] "Fairfax Leads in Income at $100,318," *The Washington Post*, Sept. 6, 2007.

[11] See, for example, Peter Galuszka, "The State of the State: How Bad?," *Virginia Business*, Feb. 2002.

[12] Virginia Employment Commission, note 9.

[13] Trip Pollard and Frances Stanley, *Connections and Choices: Affordable Housing and Smarter Growth in the Greater Richmond Area*, p. 25 (2007).

[14] U.S. Department of Agriculture, Natural Resource Conservation Service, *1997 Natural Resources Inventory* (2000)(www.nrcs.usda.gov/technical/NRI). The statistics in the first part of this section are contained in or derived from this report, unless noted otherwise. Although there are a number of different approaches to measuring land conversion, with various strengths and weaknesses, the overall direction and magnitude of the trends is clear.

[15] The average size of a farm in Virginia is 181 acres. U.S. Department of Agriculture, National Agricultural Statistics Service, *2002 Census of Agriculture, Virginia State and County Data* (2004) (http://www.nass.usda.gov/census/census02/volume1/va/index1.htm).

[16] Rex Springston, "Area Now Champion of Sprawl: Land Development is Fastest in State," *Richmond Times-Dispatch*, Feb. 12, 2001 (analysis performed by Natural Resource Conservation Service, defining the Richmond area as the city of Richmond and the counties of Chesterfield, Henrico, Goochland, Powhatan, Hanover, and New Kent; Northern Virginia as Fairfax, Prince William, Stafford, Loudoun and Fauquier counties; and Hampton Roads as Virginia Beach, Chesapeake, Portsmouth, Suffolk, and Isle of Wight and York counties).

[17] Karl Blankenship, "It's a hard road ahead for meeting new sprawl goal," *Bay Journal*, July/Aug. 2004. The area studied includes most of Virginia, including all of the Northern Virginia and Richmond regions and much of Hampton Roads. There are limitations to the study that prevent exact comparisons in various years, such as the limitations on the quality of satellite data used.

[18] U.S. Geological Survey data compiled for Goetz, Jantz, et al., "Integrated Analysis of Ecosystem Interactions with Land Use Change: the Chesapeake Bay Watershed," pp. 263-275 in DeFries, Asner and Houghton, eds., *Ecosystems and Land Use Change* (2004).

[19] Land development data, Springston, note 16; population data, The Weldon Cooper Center for Public Service, Estimates for Counties and Cities (www.ccps.virginia.edu/Demographics/estimates/city-co/city-co.html).

[20] USDA, note 14, Summary Report, Table 9.

[21] American Farmland Trust, *Farming on the Edge* (1997); the map is from American Farmland Trust, *Farming on the Edge: Sprawling Development Threatens Our Best Farmland* (2002).

[22] U.S. Department of Agriculture, National Agricultural Statistics Service, *2002 Census of Agriculture* (note, however, that a decline in the number of acres in farms does not necessarily mean that the same number of acres were developed).

[23] Virginia Department of Forestry, Forest Facts (Sept. 2003) (www.dof.virginia.gov/resinfo/forest-facts.shtml).

[24] The Urban Ecosystem Analysis that American Forests conducted for each of these areas is available at http://www.americanforests.org/resources/rea. The Chesapeake Bay and Washington studies were not limited to Virginia localities.

[25] U.S. Census Bureau.

[26] Dena Levitz, "Loudoun Shows Large Growth Rate in Housing," *The Examiner*, Sept. 12, 2007.

[27] Arthur C. Nelson, *Toward a New Metropolis: The Opportunity to Rebuild America*, Appendix Table 2 (Dec. 2004) (http://www3.brookings.edu/metro/pubs/20041213_RebuildAmerica.pdf).

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[29] U.S. Census Bureau, More Houses Have More Bedrooms (May 22, 2007). Two of the top five large counties in the U.S. with the highest percentage of homes with four or more bedrooms were Loudoun County and Stafford County.

[30] Southern Environmental Law Center, *Too Much of A Good Thing? Retail Overload in Albemarle* (2006) (citing data from Albemarle County Tax Database).

[31] Chesterfield County Planning Department, *2007 Chesterfield County Business Report*, p. 42.

[32] Nelson, note 27, Appendix Table 5.

[33] *Id.*, Appendix Table 7.

[34] This report focuses primarily on passenger surface transportation; it does not focus on air and water transportation, nor on freight transportation.

[35] FHWA, *Office of Highway Policy Information, Highway Statistics 2005* (www.fhwa.dot.gov/policy/ohim/hs05/index.htm). The data in this paragraph and the following paragraph are taken or derived from Tables VM-2 and HM-72 of this report.

[36] Population figures derived from U.S. Census Bureau data; driving data from FHWA.

[37] *VTrans 2025: Virginia's Statewide Multimodal Long-Range Transportation Plan, Phase 3 and Final Report*, p. 7 (Nov. 17, 2004).

[38] Texas Transportation Institute, *2007 Urban Mobility Report*. All of the data in this paragraph and the following paragraph is taken or derived from this report.

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[40] Texas Transportation Institute, note 38.

[41] James J. Regimbal, Jr, *An Analysis of the Evolution of the Public-Private Transportation Act of 1995* (www.southernenvironment.org).

[42] Texas Transportation Institute, note 38.

[43] Commission on the Future of Transportation in Virginia, *Interim Report*, House Document No. 12, p. 39 (1998). New and expanded roads can also lead motorists to switch from other travel routes or encourage people to drive rather than use alternative means of transportation.

[44] Office of Intermodal Planning and Investment of the Secretary of Transportation, *Virginia's Transportation Performance Report-2006*, p. 11; see also, VDOT Asset Management Division, *State of the Pavement – 2006*.

[45] U.S. Census Bureau, *2006 American Community Survey*.

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[47] Office of Intermodal Planning and Investment, note 43, p. 2.

[48] VTrans, note 37, p. 14.

[49] American Public Transportation Association Press Release, Oct. 4, 2007.

[50] Office of Intermodal Planning and Investment, note 43, p. 15.

[51] Texas Transportation Institute, note 38.

[52] John Yellig, "Study: Public transit booms," *Daily Progress*, Oct. 23, 2006.

[53] Secretary of Transportation Pierce R. Homer, Memorandum to General Assembly Members and Local Governing Bodies, April 16, 2007.

[54] Virginia Statewide Multimodal Freight Study Phase I Overview, presented to the Commonwealth Transportation Board, Oct. 17, 2007.

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[59] *Id*, p. 44.

[60] FHWA, note 35, Table MF-21.

[61] Energy Information Administration, State Energy Data System, Table F2.

[62] FHWA, *Highway Statistics 2005*, *Highway Statistics 2000*, and *Highway Statistics 1990*.

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[64] *See, e.g.,* Robert L. Hirsch, Roger Bezdek, Robert Wendling, *Peaking of World Oil Production: Impacts, Mitigation and Risk Management*, U.S. Dept. Of Energy (Feb. 2005).

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[67] Intergovernmental Panel on Climate Change, *Working Group I Fourth Assessment Report, Climate Change 2007: The Physical Science Basis, Summary for Policymakers* (Feb. 2007).

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[77] Virginia Department of Forestry, Virginia Forests and Climate Change (http://www.dof.virginia.gov/resinfo/climate-change.shtml); based on data from Richard A. Birdsey & George M. Lewis, *Carbon in United States Forests and Wood Products, 1987-1997: State-by-State Estimates*.

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[79] Dan Genz, "Air Pollution Will Surge in N.Va. Without New Regulations," *The Examiner*, Sept. 27, 2007; Presentation, note 72.

[80] Testimony of Dr. Donald F. Boesch, Professor and President, University of Maryland Center for Environmental Science, U.S. Senate Committee on Environment and Public Works Hearing on an Examination of the Impacts of Global Warming on the Chesapeake Bay, Sept. 26, 2007; see also, Scott Harper, "Virginia isn't prepared for rising sea, study warns," *The Virginian-Pilot*, June 6, 2007.

[81] EPA, National Park Service, and U.S. Fish and Wildlife Service, "Climate Change, Wildlife, and Wildlands" (http://www.epa.gov/climatechange/wycd/downloads/CS_Ches.pdf).

[82] Virginia Energy Plan, note 58, p. 24.

[83] National Association of Local Government Environmental Professionals, *Profiles of Business Leadership on Smart Growth*, p. 4 (1999). See also, National Association of Local Government Environmental Professionals and Smart Growth Leadership Institute, *Smart Growth is Smart Business: Boosting the Bottom Line & Economic Prosperity* (2004).

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[86] See note 64.

[87] Travel Industry Association, *The Economic Impact of Domestic Travel Expenditures on Virginia Counties 2006* (Sept. 2007) (http://www.vatc.org/research/2006VAReport9-17-07.pdf).

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[102] American Forests, note 24.

[103] Virginia Department of Environmental Quality, Virginia Emissions Inventory Briefing to the State Air Pollution Control Board (June 22, 2005) (this data captures pollutants emitted by sources in Virginia; it does not account for pollutants that may drift into the state). Sprawling development and driving also account for a share of the other major categories of air pollutants, since point sources include fixed emission sources such as petroleum storage tanks and refineries, and area/non-road sources include refueling cars at gas stations, bulldozers and paving equipment, and lawn mowers.

[104] Compiled from Virginia Department of Environmental Quality data, available at http://www.deq.virginia.gov/airquality.

[105] American Forests, note 24.

[106] Natural Resources Defense Council, *Heat Advisory: How Global Warming Causes More Bad Air Days* (Sept. 2007).

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[112] USGS, note 18.

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[114] Blankenship, note 17. The area studied includes most of Virginia, including all of the Northern Virginia and Richmond regions and much of Hampton Roads. There are limitations to the study that prevent exact comparisons in various years, such as the limitations on the quality of satellite data used.

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[129] *Ibid*.

[130] These results come from various polls, including those mentioned in notes 127 and 128, as well as poll conducted by Myers Research & Strategic Services and American Viewpoint for the Virginia League of Conservation Voters Education Fund and the Piedmont Environmental Council, June 7-12, 2007 (margin of error +/- 4%) (Virginia Voter Survey 2007).

[131] Virginia Voter Survey 2007, note 130.

[132] Poll conducted by QSA Research & Strategy for the Northern Virginia Transportation Authority, April 26-May 10, 2005 (margin of error +/- 2.8%); Tom Holden, "Survey weighs views on traffic problems," *The Virginian-Pilot*, Sept. 11, 2005.

[133] VTrans, note 37, p. 81. In fact, protecting the environment ranked as Virginians' top priority in addressing transportation needs. Cambridge Systematics and Southeastern Institute of Research, Inc., Presentation to VTrans 2025 Policy Committee, March 18, 2004.

[134] Virginia Voters Survey 2007, note 130.

[135] Governor's acceptance speech, Nov. 8, 2005.

[136] Testimony, note 90.

[137] Press Statement, Feb. 7, 2007.

[138] It is beyond the scope of this report to give an exhaustive list of possible measures or a thorough analysis of any particular measure. A wealth of additional information is available.

[139] Thomas Jefferson Planning District Commission, "Building Livable Communities: Jefferson Area Eastern Planning Initiative" (http://www.tjpdc.org/pdf/rep_comm_epiBrochure.pdf).

[140] See, Local Initiatives Support Corporation, *The Ripple Effect: Economic Impacts of Targeted Community Investments* (2005).

[141] A locality currently would have to receive authorization from the General Assembly to adopt such a requirement.

[142] For more information on community land trusts, see the Institute for Community Economics website at www.iceclt.org.

[143] Virginia Outdoors Foundation (www.virginiaoutdoorsfoundation.org).

[144] Land Trust Alliance, *2005 National Land Trust Census Report*.

[145] Presentation by Virginia's Conservation Finance Work Group, note 127. These figures do not tell the whole story, however, since they do not include revenues lost for land preservation tax credits.

[146] Quoted in Lynn Waltz, "In a jam: While the region's economy grows, so does the traffic." *Virginia Business*, May 2004.

[147] U.S. Census Bureau, *Census 2000*.

[148] Thomas Jefferson Planning District Commission and Charlottesville Albemarle Metropolitan Planning Organization, *UnJAM 2025: United Jefferson Area Mobility Plan*, p. 22 (adopted May 13, 2004).

[149] One report identified over 100 access management tools. National Cooperative Highway Research Program, *Impacts of Access Management Techniques*, NCHRP Report 420 (1999).

[150] Donald L. Bowman and C. Colin Rushing, *Access Management: Transportation Policy Considerations for a Growing Virginia*, p. 31 (Nov. 1998).

[151] Governor Kaine's Executive Order 48 (April 2007) took some steps in this direction, among other things calling for development of requirements for the purchase of efficient and alternative fuel vehicles by the state and a preference for renting such vehicles.

[152] Lawrence Latane III, "Corn Fueling Concern Over Bay: More crops increases threat of farm runoff reaching Chesapeake," *Richmond Times-Dispatch*, Sept. 6, 2007.

[153] California established policies currently awaiting federal approval that would reduce CO_2 emissions beginning with model year 2009 vehicles and become increasingly stringent through 2016. Fourteen other states thus far have adopted these provisions contingent on their approval for California.

Southern
Environmental
Law Center

201 West Main Street, Suite 14
Charlottesville, VA 22902
Phone 434-977-4090
Fax 434-977-1483
SouthernEnvironment.org