Cool Communities

Identifying Climate-Friendly Developments in the Washington D.C. Region

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A Coalition for Smarter Growth research report

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Cover Image
5220 Wisconsin Avenue, Washington D.C. approved project by Akridge, adjacent to the Friendship Heights Metro station.

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Executive Summary

Over the last decade, a consensus has emerged about the importance of focusing a significant share of our region's job and population growth in compact, mixed-use places around transit, particularly our Metrorail system. Doing so reduces traffic congestion, lowers household transportation costs, cuts air pollution, reduces loss of forests, farms and natural habitats, and improves health and access to jobs. The threat of climate change now looms, but smart growth policies can also contribute to the reduction of greenhouse gas emissions. This report modeled the travel characteristics and greenhouse gas emissions from eleven development projects in the Washington metropolitan region. The analysis found that compact, mixed-use development within walking distance of high frequency transit offers substantial reductions in CO_2 emissions from new housing and commercial space. Transit-oriented locations and walkable designs can reduce CO_2 emissions by anywhere from 8 to over 40 percent.

A Growing Region: Officials at the Metropolitan Council of Governments expect the Washington D.C. region to add 1.2 million people and 1 million jobs by 2030. Where and how we grow and travel is important not only for families seeking access to quality housing, jobs, services and neighborhoods, but also for regional efforts to reduce our carbon footprint. Fortunately, smart growth solutions not only provide greater housing and transportation choice and affordability, but also help meet our greenhouse gas emissions reduction goals. Vacant land at Metro stations, infill development and commercial corridor revitalization offer significant opportunities to create mixed-use walkable/bikeable and transit-accessible communities.

Regional Climate Goals: The Washington Metropolitan Council of Governments has set a goal that by 2020 we reduce CO_2 emissions by 20 percent below 2005 levels, and by 80 percent by 2050. Aggressive savings throughout the energy and transportation sectors are needed. The production and consumption of fossil-fuel-based energy – in our homes and offices, and in our travel – generate most of the CO_2 emissions in our region. Thirty percent of regional emissions come from the transportation sector – predominately the driving of passenger vehicles. Thus, more efficient transportation and land use must play a central role in reaching our climate protection goals.

Measuring CO_2 Reductions Achieved Through Smart Growth: Shrinking the emissions from transportation and land use will occur in three key ways: increased vehicle fuel economy, reduced carbon content of fuel, and decreased vehicle miles traveled (VMT). This report models the reductions in VMT and CO_2 achieved by development projects with high frequency transit and walkable community designs in regionally-accessible locations throughout the Washington metropolitan area. The results of this analysis using URBEMIS, a land use and transportation model, are consistent with recent national studies by leading academics and researchers. This model greatly improves on the Institute for Traffic Engineers (ITE) standard vehicle trip generation assumptions. Standard ITE trip projections are the most commonly used approach throughout the United States for estimating the projected vehicle traffic created by new development. ITE numbers assume conventional suburban, automobile-dependent, single-use land uses with little or no access to transit.

The URBEMIS model uses standard ITE values, but then credits traffic-reducing features by accounting for the many factors affecting to what degree residents and workers will reduce driving by considering on-site features such as local-serving retail, mix of uses and density of housing, walkability/bikeability (measured through intersection density and sidewalk availability) and amount of affordable and senior housing (which generate fewer vehicle trips than market rate housing). URBEMIS also measures regional accessibility of a development indirectly through the level of transit service, measuring the daily number of buses and trains serving the number of homes and businesses within a quarter and half mile. This "transit service index" is a key variable affecting how much residents, shoppers and workers drive.

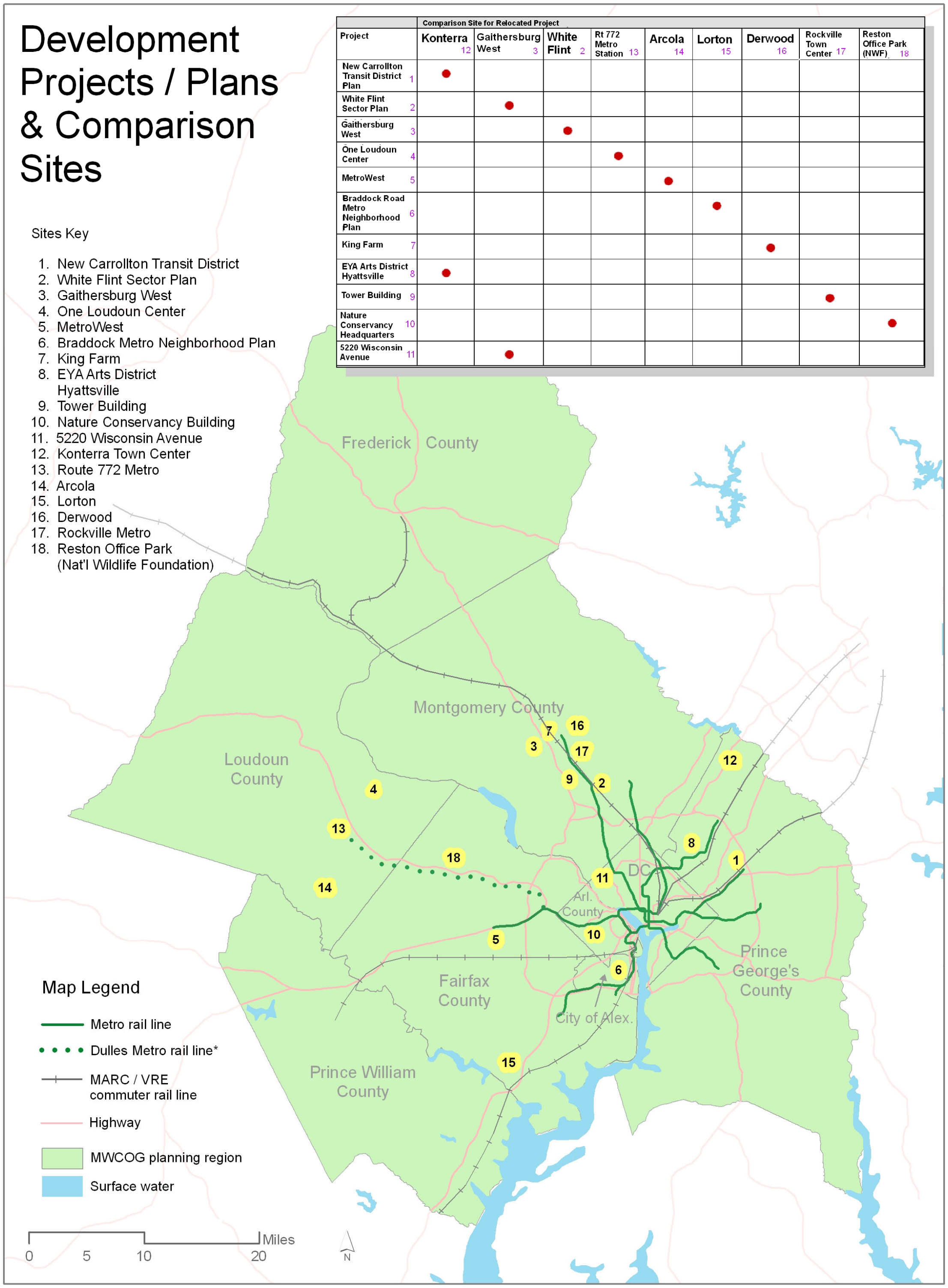
This study examined eleven projects – seven large-scale, mixed-use development plans, two mainly residential developments and two office buildings – against comparison sites (Figures i-1, i-2). The analysis first compared the project for the ITE baseline, which assumes isolated land uses, with the results of URBEMIS accounting for features that reduce driving and increase walking, bicycling and transit use. Second, the analysis compared the project to a comparison site. The comparison site was selected as a reasonable alternative site for such a project. Eight of the eleven projects were located in more transit-accessible locations (all but one at a Metrorail station), and three of the projects were in less transit-accessible locations than their comparison sites.

Figure i-1. Development Projects Analyzed for Effect on Emissions

Project /State/Status	***Comparison Site*** *(simulated relocation of project)*
New Carrollton Transit District Plan (MD)	Relocated to Konterra (MD)
White Flint Sector Plan (MD)	Relocated to Gaithersburg West area (MD)
Gaithersburg West Life Sciences Center Plan (MD)	Relocated to White Flint Metro station area (MD)
One Loudoun Center (VA) (approved)	Relocated to Route 772 (Ryan Road) Metro station (planned Dulles Rail extension) (VA)
MetroWest, Vienna-Fairfax-GMU Metro (VA)(approved)	Relocated to Arcola (VA)
Braddock Metro Neighborhood Plan (VA)	Relocated to Lorton (VA)
King Farm (MD) (built)	Relocated to Derwood (MD)
Arts District Hyattsville (MD) (partially built)	Relocated to Konterra (MD)
The Tower Building (MD) (built)	Relocated to Rockville Town Center (MD)
Nature Conservancy Building (VA) (built)	Relocated to a Reston office park - National Wildlife Federation location (VA)
5220 Wisconsin Avenue NW – (DC) (approved)	Relocated in Gaithersburg West area (MD)

Mixed-Use Centers
Urban Neighborhoods
Office Buildings
Residential Buildings

Figure i-2 Map of Study Development Projects / Plans and Comparison Sites



	Comparison Site for Relocated Project								
Project	Konterra 12	Gaithersburg West 3	White Flint 2	Rt 772 Metro Station 13	Arcola 14	Lorton 15	Derwood 16	Rockville Town Center 17	Reston Office Park (NWF) 18
New Carrollton Transit District Plan 1	●								
White Flint Sector Plan 2		●							
Gaithersburg West 3			●						
One Loudoun Center 4				●					
MetroWest 5					●				
Braddock Road Metro Neighborhood Plan 6						●			
King Farm 7							●		
EYA Arts District Hyattsville 8	●								
Tower Building 9								●	
Nature Conservancy Headquarters 10									●
5220 Wisconsin Avenue 11		●							

Note: Project locations approximated on this map.
* Under construction.

Map created on March 10, 2010 by Jake Aftergood.

Major Findings: Mixed-use walkable developments with a dense street grid and frequent transit perform much better than indicated by the standard ITE traffic estimates. These developments significantly reduce vehicle trips, vehicle miles traveled and greenhouse gas emissions compared to typical auto-oriented suburban development estimated in an ITE baseline assessment. Reductions in CO_2 range from 10 to 35 percent. The study also compared the CO_2 emissions of each project or plan to a simulated relocation. Each project was analyzed at a site that would be a plausible alternative location where potential residents would live and/or work. Total CO_2 reductions when combining on-site design and regional accessibility were substantial, ranging from 8 to over 40 percent (see Figure i-3). This assessment demonstrates that there is great potential to reduce the carbon footprint of future growth while simultaneously improving access to jobs, increasing transportation choices and offering better housing opportunities for households throughout the region.

Figure i-3 CO_2 emissions from Study Site vs. Comparison Site (%)

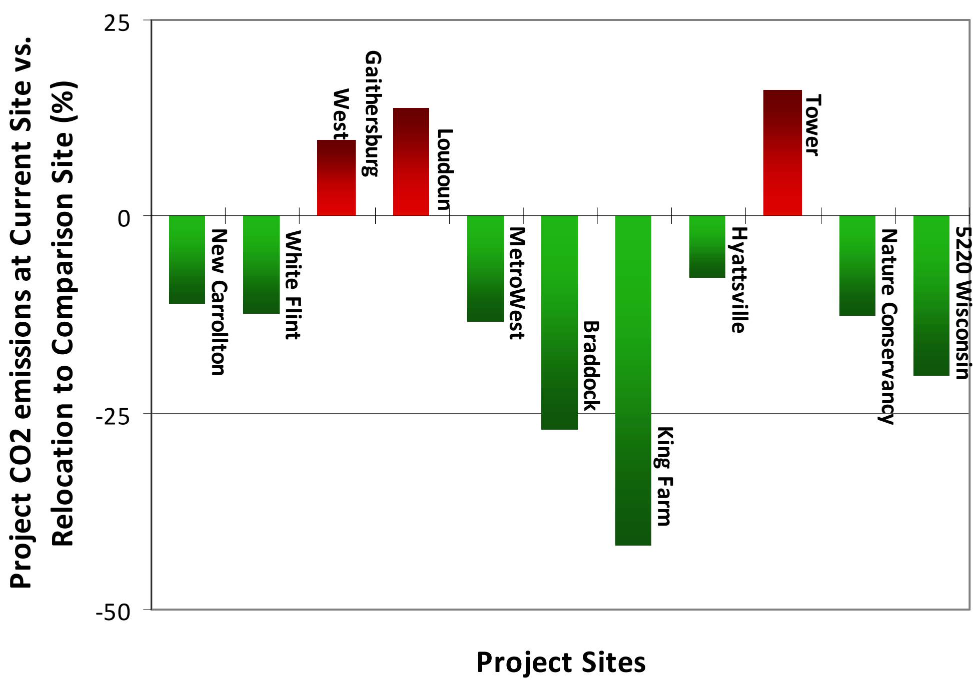


Figure i-3 shows the percent in CO_2 reduction (or increase) compared to alternative sites. Projects located at sites with lower regional accessibility show higher emissions (projects with positive values,) and projects with higher regional accessibility show savings in $C0_2$ emissions (projects with negative or reduced values).

Related Observations: Compact development, even in a regionally less accessible site, performs better than low density, single-use sprawling patterns, but large scale increases in jobs and housing at distant locations increase overall CO_2 emissions. One Loudoun Center in Virginia Gaithersburg West in Maryland performed 14 and10 percent worse, respectively, than their regionally accessible comparison sites. While this result alone is significant, it

Figure i-4 Annual Tons of CO_2 Emissions at Study Site versus Comparison Site

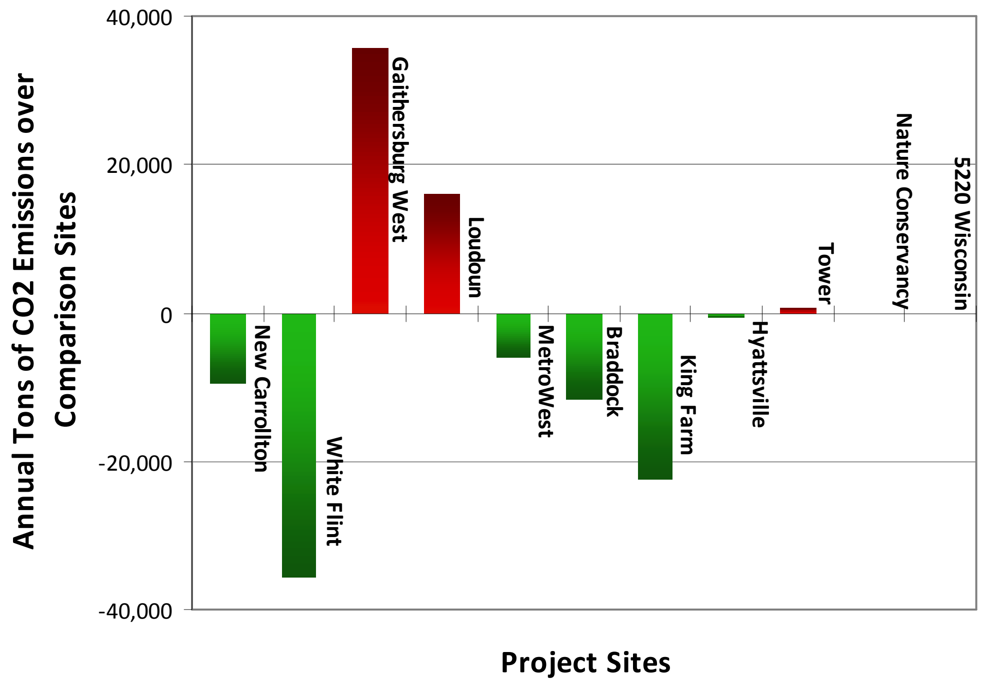


Figure i-4 shows the absolute number of tons of CO_2 reduction (or increase) compared to alternative sites. Larger projects at sites with lower regional accessibility show higher emissions (projects with positive values), and projects with higher regional accessibility show savings in CO_2 emissions (projects with negative or reduced values). Thus, larger projects in low- accessibility locations have higher impacts on the region's overall emissions.

is more important when the tons of CO_2 emissions are considered. The Gaithersburg West plan – even after accounting for high levels of transit service with the proposed but uncertain Corridor Cities Transitway – would emit over 35,000 more metric tons of carbon per year than a comparison site at the White Flint Metro station (see Figure i-4). This is equivalent to the electricity use of over 4,600 homes per year.

Most of this analysis focuses on compact, mixed use developments - both those proposed at regionally accessible locations and at more remote sites from the urban core. The residential portion of these developments, with their convenient access to services and transit, achieves dramatic reductions in VMT and CO_2 emissions when compared to low density residential-only suburban developments with little transit access. For example, the study compared the residential portion of King Farm, a compact, mixed-use development near the Shady Grove Metro station, to a nearby typical suburban lower density housing development in Derwood with a "lollipop" suburban street layout and limited bus service. The model shows that King Farm's 3,200 homes would produce 42 percent more CO_2 emissions if located at the Derwood site in a typical suburban pattern. This amounts to 22,482 metric tons of CO_2 per year, or the equivalent of annual electricity use for nearly 3,000 homes.

Comparing each of the eleven projects to the standard ITE baseline, all projects are given trip reduction credits from the URBEMIS model. The projects close to Metro stations or close to the urban core (Arts District Hyattsville) performed better than the three projects with little or no access to transit (Tower, One Loudoun, Gaithersburg West) (Figure i-5).

Figure i-5 Percent Difference in CO_2 Emissions from Study Site vs. ITE Baseline

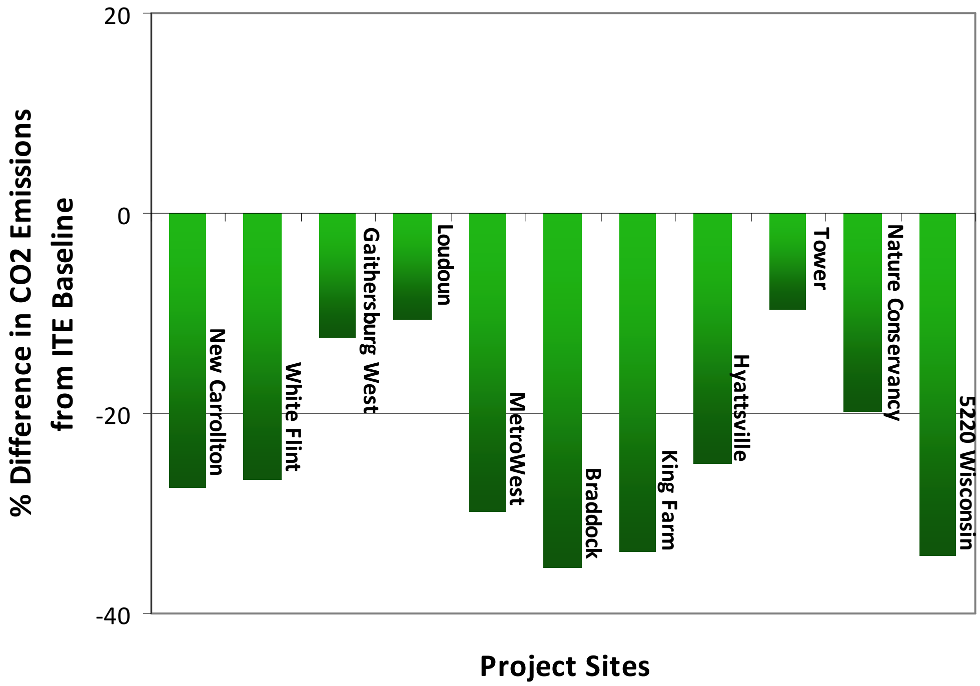


Figure i-5 shows the percent of CO_2 reduction compared to the standard Institute for Transportation Engineers (ITE) baseline, which assumes suburban automobile-dependent development patterns. While all projects receive credits by the URBEMIS land use and transportation model for trip reduction characteristics, projects with higher regional accessibility show substantially greater savings in CO_2 emissions (projects with more negative or reduced values).

Recommendations for Cool Communities in the Washington D.C. Region

Smart growth offers substantial savings in VMT and CO_2

This analysis reinforces the potential traffic and CO_2 savings from regionally-accessible, transit-rich, compact, walkable development. The findings show that VMT and CO_2 savings between 8 and over 40 percent can be achieved with mixed-use, higher density, walkable, regionally accessible development. The results summarized in Figures i-3 and i-4 illustrate the relative and absolute benefits of compact, mixed-use, regionally accessible development.

Despite some limitations to URBEMIS, our analysis demonstrates the importance of locating housing and job growth at high frequency transit nodes, in urban and inner suburban infill locations, with compact, walkable designs. The analysis also shows that higher density, mixed-use developments in outer areas perform better than standard single-use suburban development in these areas, but the lack of regional accessibility results in much higher CO_2 emissions than more accessible locations. Based on this analysis, we recommend the following:

1. **Implement a regional vehicle miles traveled (VMT) reduction goal** as proposed in the Metropolitan Washington Council of Governments' (COG) Climate Change report to meet the CO_2 emissions reduction targets. While the new Corporate Average Fuel Economy (CAFE) fuel efficiency requirement will slow the increase in emissions compared to the business-as-usual scenario, transportation emissions will still exceed goals by 35 percent in 2020 and 80 percent in 2030. This shortfall illustrates that even with fuel economy improvements much more is needed to reach regional mobile source CO_2 reduction goals. We recommend setting an aggressive VMT reduction goal by land use decisions to help the region meet its greenhouse gas reduction goals. To achieve this, we call on all level of government and business to do the following:

    - COG should develop an evaluation tool to assess land use and transportation decisions to support this VMT reduction goal.
    - COG should revise its "Regional Activity Centers" criteria and maps to add all existing Metro stations and older inner suburban commercial corridors for redevelopment, while reevaluating the number, size and location of the distant suburban clusters.
    - All levels of governments, major employers and institutions should do their part by locating activities near transit, as recommended by the COG report.

2. **Focus large-scale development at regional Metro stations.** Despite over three decades of Metrorail service, many stations remain underutilized. Metrorail stations should receive a significant share of the region's growth in order to provide greater regional accessibility for residents and jobs, and to reduce the carbon footprint of growth. Figure i-4 illustrates this point: even a project with relatively good mixed-use design generates significantly higher emissions than a more regionally-accessible and compact site. For Metro stations not designed to serve regional-scale development, more housing and businesses can be accommodated at a moderate scale that carefully transitions into lower scale neighborhoods surrounding the station area.

3. **Make infill development and infill transit top priorities.** Increasing housing and jobs near existing transit and adding transit service to existing close-in communities will help maximize reductions in VMT and CO_2. These measures take advantage of compact, mixed-use urban neighborhoods using frequent bus service or convenient access to a Metro station. By "infill transit," we mean investing in cost-effective transit services that build on existing ridership and supportive land uses, such as components of the WMATA Bus Priority Corridors Network, streetcar plans in D.C. and Arlington, the Purple Line in inner Montgomery and Prince George's Counties, and funding for Metrorail and Metrobus to increase service. To a lesser extent, walkable, mixed-use development at commuter rail stations and greater frequency of commuter rail service, including mid-day service, will help to capture a larger share of work trips - which are the longest trips. On the other hand, outward, long distance extensions of commuter rail service and low frequency transit services can be extremely costly per rider without achieving much in

CO_2 emissions reduction. The heavy cost of long distance transit extensions can also threaten the maintenance, operating and capital improvement budgets for existing transit service.

4. **Increase employment centers on the east side of the region.** Prince George's County's 15 Metro stations are among the county's top assets, but the county has not seen the same growth in jobs as the west side of the region. Commitment by the State of Maryland and Prince George's to increased job growth in compact, walkable, mixed-use environments around these Metro stations could greatly contribute to the region's ability to reduce CO_2 emissions and improve the performance of the region's transportation system. In addition, focusing job growth at Metro stations on the east side of the region will match employment opportunities with a larger housing stock that is affordable to more of the workforce.

5. **Create urban street grids and compact, mixed-use development around high frequency transit.** This analysis demonstrates the importance of site design – urban, walkable character, mix of uses, and an interconnected street grid of small blocks – for maximizing use of high frequency transit and walking for many trips. State and local policies too often require overly wide streets and long blocks. Also they often neglect connectivity. All these characteristics severely undermine walk and bicycle access to transit and commercial centers. To build truly accessible places, we recommend that area and state governments implement complete and green streets policies, and street connectivity standards that require full integration of pedestrians and bicyclists into street layouts and more connections to surrounding neighborhoods. We also urge governments to reallocate scarce public funds to maintaining and improving existing transit services, pedestrian/bicycle facilities and "complete streets' retrofits rather than funding new road and other infrastructure capacity expansions outside existing high transit districts.

   This analysis shows that some developments promoted as "town centers" do not achieve urban block dimensions or a compact mix of uses within walking distance. Local governments need to establish more stringent criteria to create highly connected street networks and mixed-uses proximate to each other and tied to major transit stations and corridors.

6. **Support further research to refine VMT and CO_2 emissions analysis for land use and transportation projects.** While our analysis is limited, it replicates the findings of national studies and reinforces the importance of smart growth land use and transportation investments for reducing greenhouse gas emissions. The state of the art is young and requires more refinement to sharpen analytical tools and data. We urge all levels of government to provide better data and to support improved models that are accessible and usable to the public. URBEMIS could be refined by better tailoring baseline assumptions to existing characteristics in the region and important key factors such as added CO_2 emissions from conversion of natural land cover and the regional jobs/housing imbalance. A refined URBEMIS or similar land use/transportation model could be systematically applied by COG, local and state governments to assess the CO_2 emissions impact of development proposals. This tool will help officials to guide the

location and designs of development to meet climate protection goals while also creating more livable communities.

7. **Reduce development capacity outside high frequency transit districts.** Local land use plans throughout the region allow for large amounts of scattered, low density, single-use development that will generate disproportionately high levels of VMT and CO_2 emissions. This study demonstrates that low density development and poor street connectivity are the most inefficient and most polluting forms of growth. Thus, COG and local governments should commit to shifting development capacity permitted under current land use plans and zoning from areas that are not served by medium and high-levels of transit. This development capacity should be allocated to districts within half of a mile of rail transit stations or high frequency bus corridors. Local governments should also avoid high amounts of growth in “town centers” far from regionally accessible sites such as Metrorail stations or heavily served bus corridors. This analysis demonstrates that although high density, mixed-use “town centers” reduce VMT per capita, the magnitude of developments far from high frequency transit will negate the benefit of reduced vehicle trips by increasing the length of commute trips as a result of poor regional accessibility. Priorities should be build-out of current and planned Metrorail stations and redevelopment of older commercial corridors with mixed-use and increased transit service on dedicated lanes (BRT or LRT).

Faced with the challenge of climate change, rising energy prices, and an era of shrinking government budgets, we must make wise decisions about land use and transportation investments. Fortunately, smart growth solutions will help us meet these new challenges while also addressing traffic congestion; lowering household transportation costs; cutting air pollution, reducing loss of forests, farms and natural habitats; and improving health and access to jobs.

Structure of this Report: Chapter 1 outlines the climate challenge facing our region, regional greenhouse gas reduction goals, and national research on smart growth and greenhouse gas emissions. Chapter 2 discusses the URBEMIS model and the methodology applied by this study. Chapter 3 contains case studies and their results. Chapter 4 discusses how the URBEMIS model could be tailored to our region and used in modeling plans and projects. Chapter 5 outlines our recommendations for the region’s decision-makers.

Chapter 1 Our Growing Region Faces Climate Change

The Washington Region is Growing

How can the National Capital region prosper, adding jobs and increasing its quality of life, while combating climate change? Part of the answer has to do with where we grow and how we design our communities.

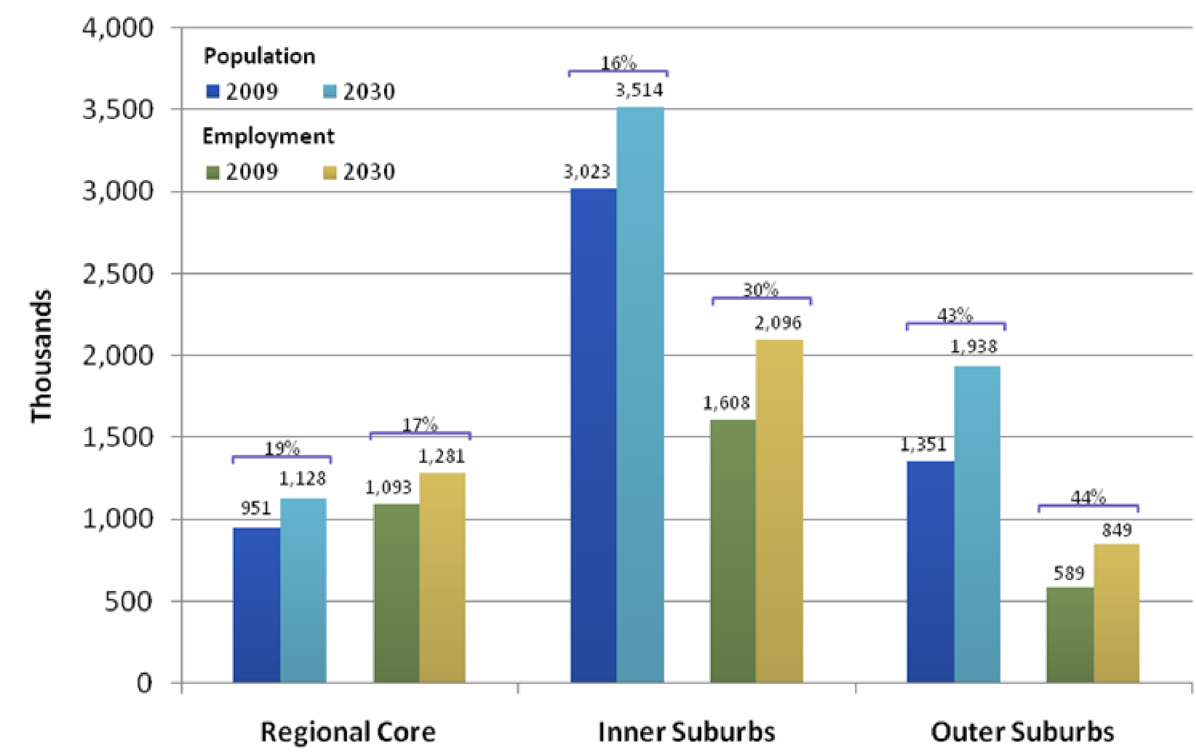
The Washington D.C. region is expected to grow in population, with the Metropolitan Washington Council of Governments (COG) forecasting that another 1.2 million people will make the COG region their home by the year 2030.[1] In the meantime, nearly 1 million jobs will be created in the region. Overall, COG projections show that by 2030, the region will include 6.6 million people and 4.2 million jobs.[2] Where this new growth occurs and how it is designed will affect the region's carbon footprint almost as much as the design, materials and power sources for the new buildings. On average, energy used in transportation to and from conventional suburban buildings consumes more energy than is consumed in heating, cooling and powering the buildings.[3] While efficient green buildings are an important part of the solution, reducing energy use and emissions from transportation remains critical.

A variety of factors including local planning decisions, major highway expansions, cheap gas prices, failure to offer enough affordable housing close to jobs, and speculative development in rural areas have contributed to spread-out patterns of development and have caused increased driving and greenhouse gas emissions. Growth in driving (VMT) is projected to outpace forecasted population and employment growth in the region for the year 2030. COG shows higher rates of population growth in the outer suburbs, increasing 47 percent compared to 18 to 20 percent in the regional core and inner suburbs. Yet, in terms of absolute numbers, most people in 2030 – 70 percent – will live in the region's core (D.C., Arlington, Alexandria) and inner suburbs (Fairfax, Montgomery, Prince George's) (see Figure 1-1).[4] Population growth in the outer areas would mean residents living there will travel farther distances to commute to jobs in the inner suburbs and regional core.

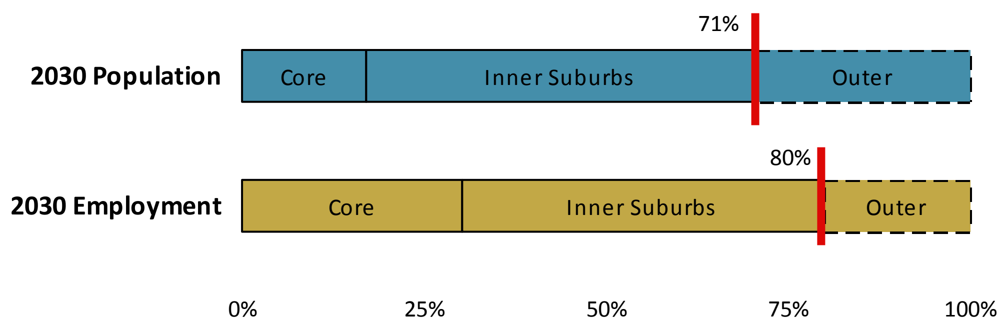
COG's predictions for the location of growth are heavily influenced by input from the local member jurisdictions. However, the location of jobs and housing may change due to future high energy prices, shifting demographics and changing consumer preferences. Higher energy prices in the last few years and their impact on household budgets may have contributed to the much steeper decline in real estate prices and sales in the outer suburbs during the recent collapse of the housing market, and are expected to contribute to increased demand to live closer to jobs and transit.[5]

Demographic changes will also contribute to shifting demand for where to live. With baby boomers approaching retirement, the proportion of the U.S. population over the age of 65 will increase from 12.4 percent in 2000 to 20.7 percent in 2050.[6] Furthermore, households without children will account for 88 percent of new household growth in the U.S., and by 2025, only 28 percent of households will have children compared with 47 percent in 1960. These demographic trends will alter the housing market, shifting demand away from large-lot housing to multifamily, attached, and small lot homes. According to Professor Chris Nelson, demand for these homes is projected to exceed the current supply by 35 million units by 2025, as illustrated in Figure 1-2.[7] Conversely, a small surplus of large lot single family homes is projected in the same period.

Figure 1-1 Population and Employment Growth Projections, 2009 - 2030



Source: TPB and COG (Nov. 2008). *The Financially Constrained Long-Range Transportation Plan: 2008 Update.*

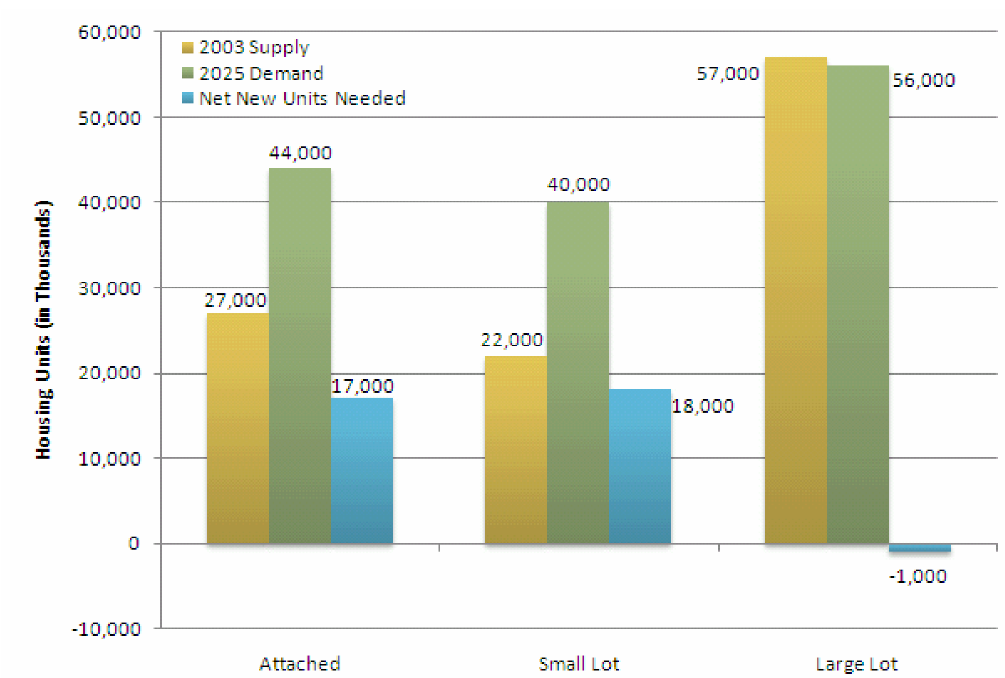


Note
Regional Core: District of Columbia; Arlington County and the City of Alexandria in Virginia.
Inner Suburbs: Montgomery and Prince George's Counties in Maryland; Fairfax County, the City of Fairfax and the City of Falls Church in Virginia.
Outer Suburbs: Loudoun, Prince William, and Stafford Counties, and the Cities of Manassas and Manassas Park in Virginia; Frederick, Calvert and Charles Counties in Maryland.

Demographic projections for our region over the next ten years reflect the national trend for changing demand in housing types. Population forecasts by age group shown in Figure 1-3 suggest that changing lifestyle preferences of Generation X and Y will increase demand for location-driven urban housing. At the same time, baby boomers looking to downsize but to stay in the region will be looking for smaller homes with less yard to maintain, townhomes, condos and apartments.[8] They may look for more walkable communities to maintain better health, increased access to transit and reduced reliance on driving. These projections point to the need to plan for an aging population and changing housing preferences.

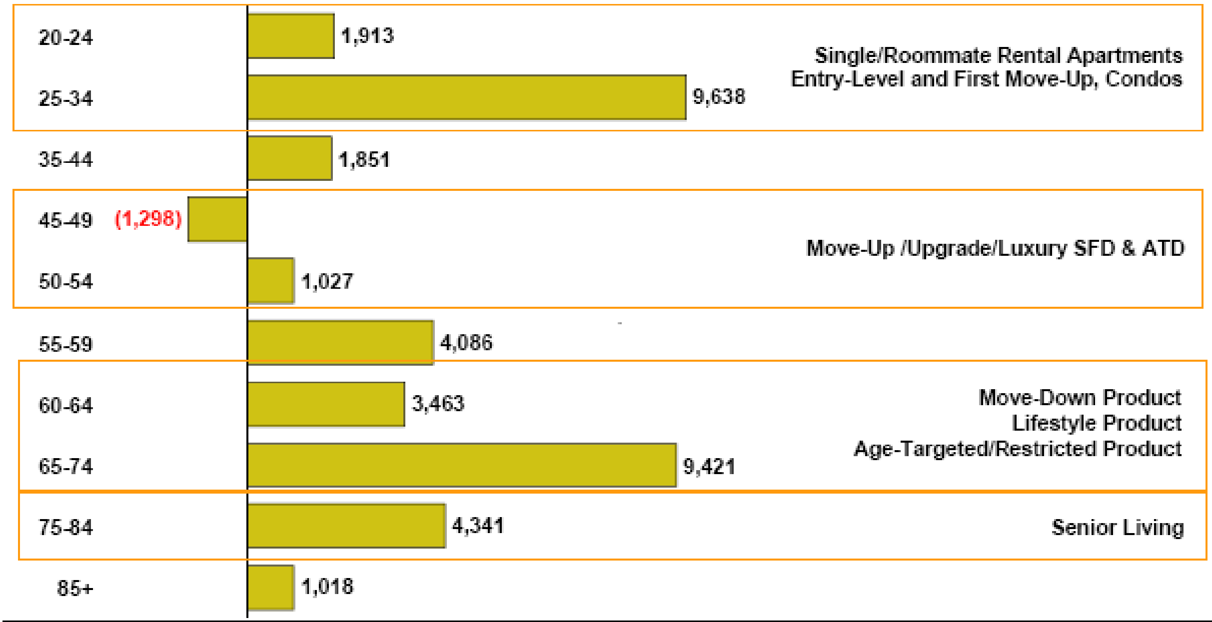
COG predicted high rates of growth in the outer suburbs, but over 70 percent of the region's population and 80 percent of employment will be found in the core and inner suburbs over the next 30 years. However, more recent findings from COG's 2007/2008 Household Travel Survey will likely cause COG to adjust projections.[9] Most notably, the survey found a significant increase in single person households, a decrease in auto driver drips, and increases in walking, bicycling and use of transit. The survey also found that persons 25 to 34 are more likely to live in Regional Activity Centers. Energy prices and changing demographics could increase the share of jobs and housing in the core and inner suburbs. Adding more housing in the regional core would result in more convenient access to jobs and lower greenhouse gas emissions.[10]

Figure 1-2 2003 U.S. Housing Supply Compared to 2025 Demand



Source: Nelson, A. C. (2006). Leadership in a New Era. *Journal of the American Planning Association*.
The need for attached and small lot housing units will grow while the need for large lot housing will decline. All of the large lot houses estimated to be needed to meet demand in 2025 have already been built in the U.S.

Figure 1-3. Projected Annual Population Growth by Age, Washington MSA 2010 – 2020



Source: Robert Charles Lesser Company (2009). *Housing Market Outlook for the Washington D.C. region*

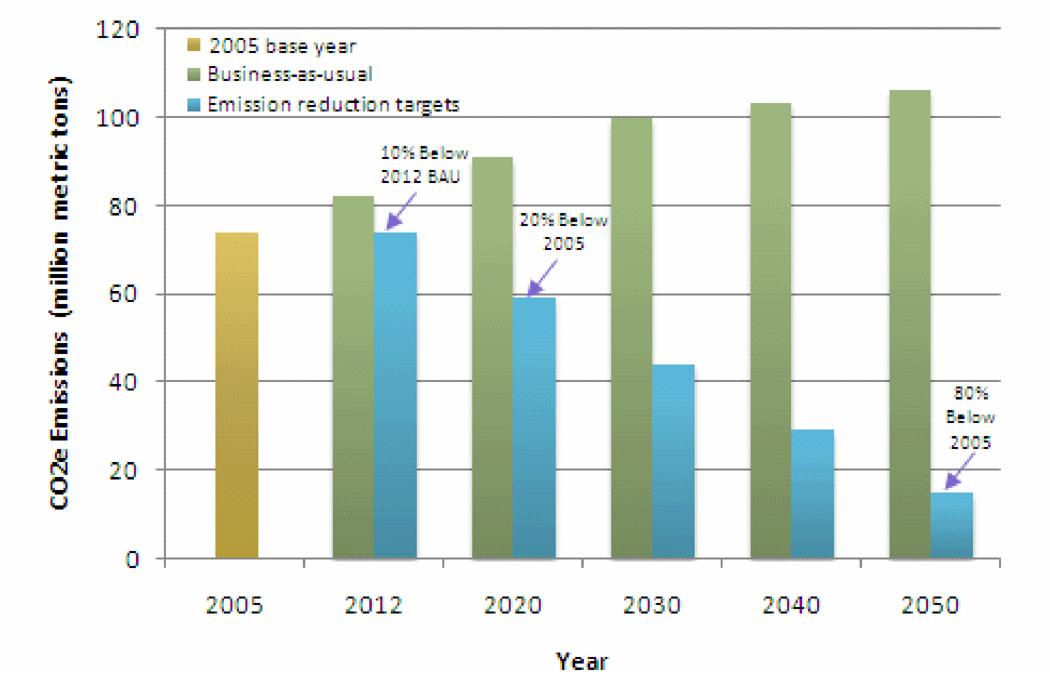
Figure 1-3 A leading real estate market research firm reports people over 60 years old and under 34 years old will dominate the D.C. regional market, and show preferences for smaller homes, multifamily and attached housing.

Targets for Regional Emissions

Development patterns and the transportation networks that serve our homes and workplaces have significant influence on the emissions that cause climate change. The transportation sector accounts for 30 percent of emissions in the National Capital region, and emissions from transportation are expected to increase 38 percent by 2030.[11] This will be greater than the projected 24 percent increase in population and 28 percent increase in employment by 2030 unless we change course.

To help prevent harmful effects from greenhouse gas emissions, COG created a regional climate initiative and released the *National Capital Region Climate Change Report* in November 2008. The report recommends aggressive targets for reducing greenhouse gas emissions with an interim goal of lowering emissions to 20 percent below 2005 levels by 2020 and a long-term goal of decreasing emissions to 80 percent below 2005 levels by 2050. Figure 1-4 compares these targets with the projected growth in emissions under the business-as-usual (BAU) scenario. With 30 percent of emissions coming from transportation, curbing emissions from this sector is an important element of reaching the established regional goals.

Figure 1-4. Recommended Regional Greenhouse Gas Emission Reduction Targets Compared to Regional Greenhouse Gas Emissions under Business-As-Usual ("BAU"): 2005–2050



Source: Metropolitan Washington Council of Governments (2008). *National Capital Region Climate Change Report*

Mitigating Emissions from Transportation and Land Use

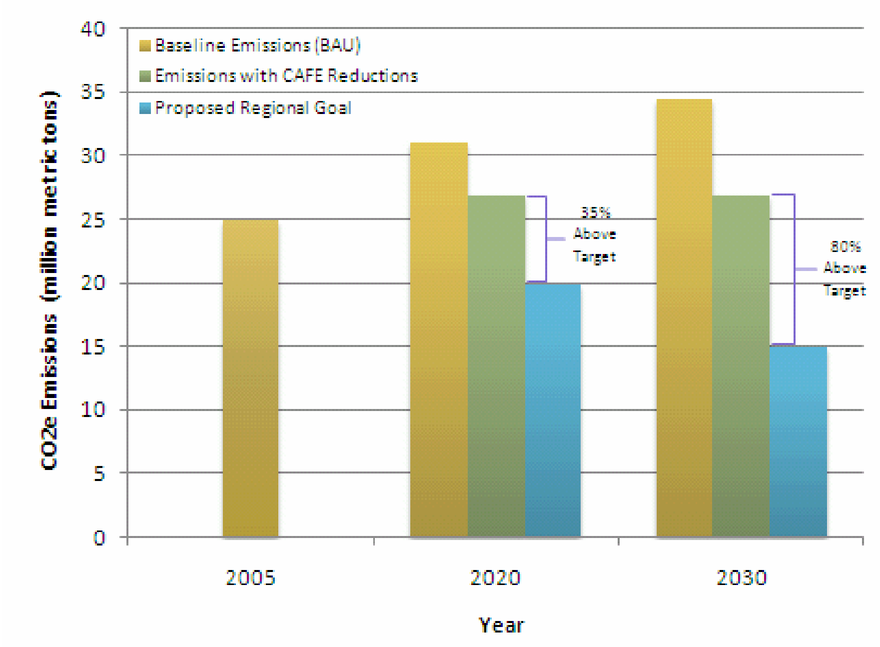
Greenhouse gas emissions from transportation can be reduced in three ways:

- increasing vehicle fuel economy,
- reducing the carbon content of fuel, and
- decreasing vehicle miles traveled (VMT).

In the 2008 study, *Growing Cooler: Evidence on Urban Development and Climate Change*, Professor Reid Ewing and colleagues characterize these strategies as a three-legged stool, emphasizing that a stool cannot stand on only two legs. All three of these strategies must play a role in reducing greenhouse gas emissions from the transportation sector.

Similar to the national findings in *Growing Cooler*, better fuel efficiency alone will not be sufficient to reach the 2020 Washington, D.C. regional emissions reduction goal recommended by the COG climate change committee. The 2007 federal CAFE requirements contained in the Energy Independence and Security Act of 2007 will improve overall fuel economy to 35 miles per gallon for cars and light trucks. The National Capital Region Transportation Planning Board (TPB) found that the 2007 CAFE requirement will slow the increase in emissions compared to the business-as-usual scenario, but transportation emissions will still exceed goals set for 2005 by 35 percent in 2020 and 80 percent in 2030 (figure 1-5).[12] Given the challenge, the COG report recognizes the importance of adopting VMT reduction measures as key to the overall strategy to achieve greenhouse gas emissions reduction goals.

Figure 1-5. CO_2 Emissions with CAFE (Fuel Efficiency) Reductions Compared to Regional Goal

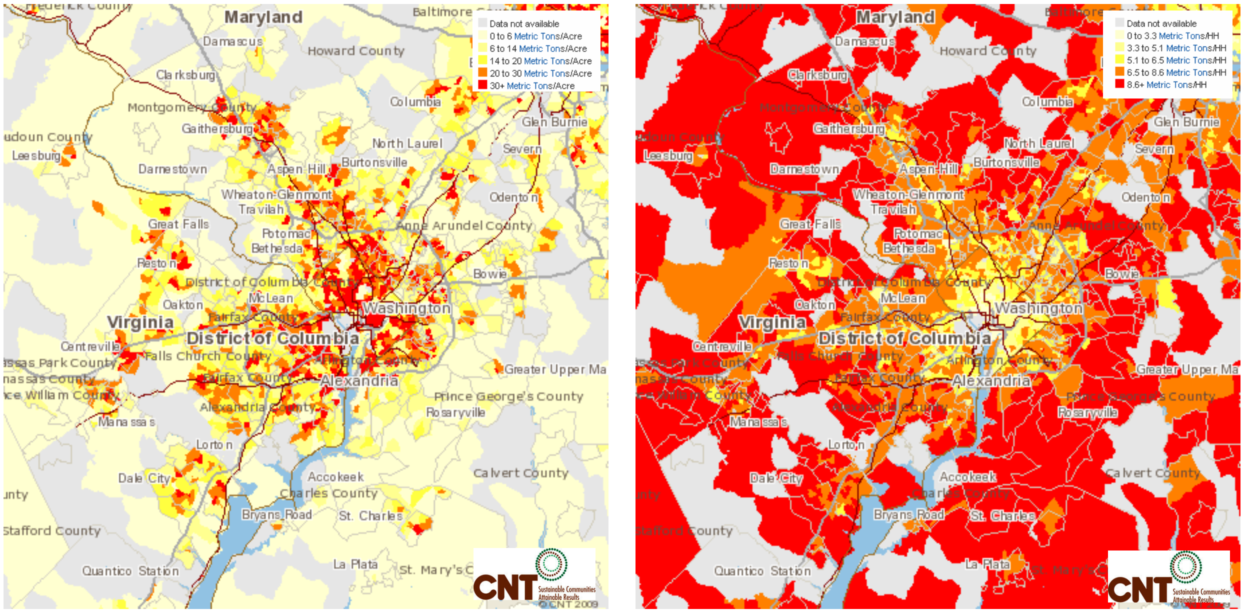


Source: Metropolitan Washington Council of Governments (2008). *National Capital Region Climate Change Report.*

Fig. 1-5 depicts how improvements in fuel efficiency will fall short of the COG climate change emissions targets.

Strategies to reduce VMT include expanding transit use and commuter options, but also carefully planning the location and design of homes, workplaces and retail stores to promote walkable communities and regional accessibility (e.g. close proximity to concentrations of jobs and housing and downtowns). In *Growing Cooler,* analysts estimated that compact, regionally-accessible development reduces how much people drive (VMT) by 20 to 40 percent, compared to development at the outer suburban edge located in isolated homes, stores and workplaces. The following maps (Figure 1-6) offer a powerful illustration of the difference in "emissions per household from driving" between urban, transit-accessible locations and less accessible, outer suburban locations.

Figure 1-6. Conventional vs. Emerging View of Urban Households' Carbon Footprint



Average VMT-related Emissions per Acre **Average VMT-related Emissions per Household**

Source: Center for Neighborhood Technology (2009). *Terwilliger Housing + Transportation Calculator.*

While greenhouse gas production per acre is greater in areas with higher population density (left map), emissions per household are lower in urban centers, in towns, and near transit and concentrations of jobs (right map).

Given national trends in increased market share for urban-style development, *Growing Cooler* estimated that smart growth could reduce transportation-related CO_2 emissions by 7 to 10 percent nationwide. A more recent study by the National Academy of Sciences found similar results, but also proposed more conservative scenarios.[13]

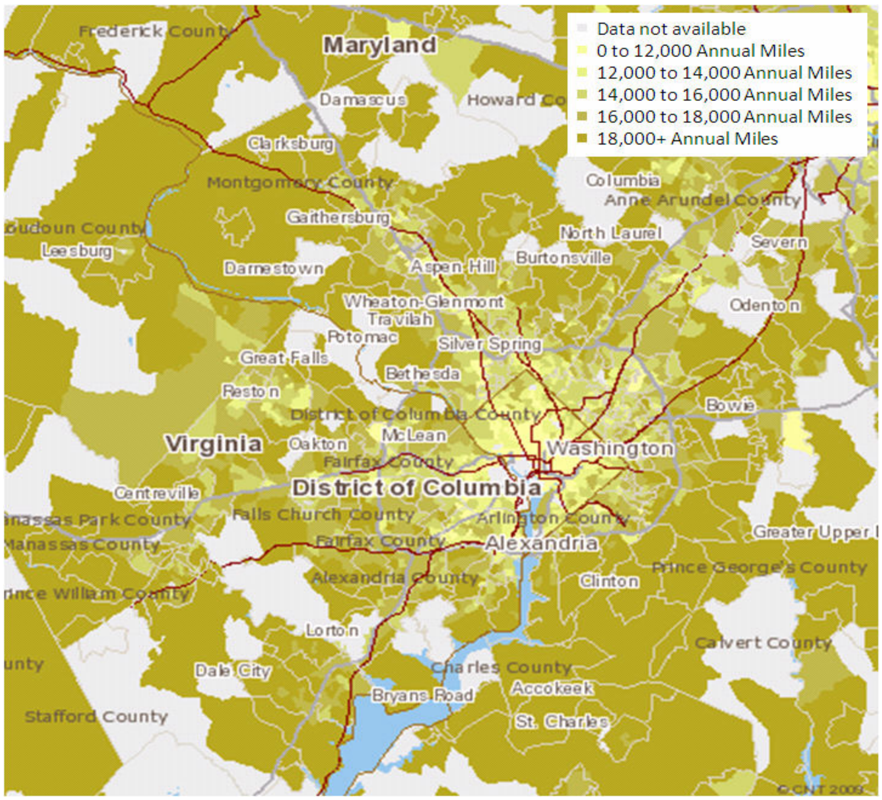
Where We Live and Work Affects How Much We Drive

While new vehicle technologies, such as alternative fuels and hybrid engines, will reduce the emissions for each mile driven, these gains will be offset if area residents continue to drive longer and longer distances to reach their destinations. Between 2002 and 2008, the number of vehicle trips in the D.C. region grew from 20 million to 22 million per day and total VMT grew from 146 million to 160 million miles per day. The Federal Highway Administration reports total daily VMT per capita of 22.6 for the Washington Metropolitan Statistical Area, amounting to an annual VMT of 18,242 miles per household.[14] The cost to households to drive this far is significant. According to AAA, in 2007, the average cost to own and operate an automobile driven 15,000 miles per year was $9,641.[15]

Looking at just home-based trips, households located in the outer suburbs report greater annual VMT than households in the regional core or inner suburbs, as shown in Figure 1-7.[16] VMT for households in the outer suburbs of the Maryland counties of Frederick and Calvert is approximately 1.5 times the regional average.

However, several jurisdictions report an annual VMT far below the regional average. Areas with high regional accessibility, near the urban core, have lower average VMT because residents do not have to travel as far to reach a large share of the region's jobs and services. For example, average VMT for households in the City of Alexandria, with its walkable neighborhoods, convenient transit and close proximity to downtown D.C., is about half the regional average. Communities with low VMT are not limited to urban core jurisdictions. Historic towns like the City of Fredericksburg, Virginia, and City of Frederick, Maryland, experience over 40 percent lower household VMT than their corresponding counties.[17]

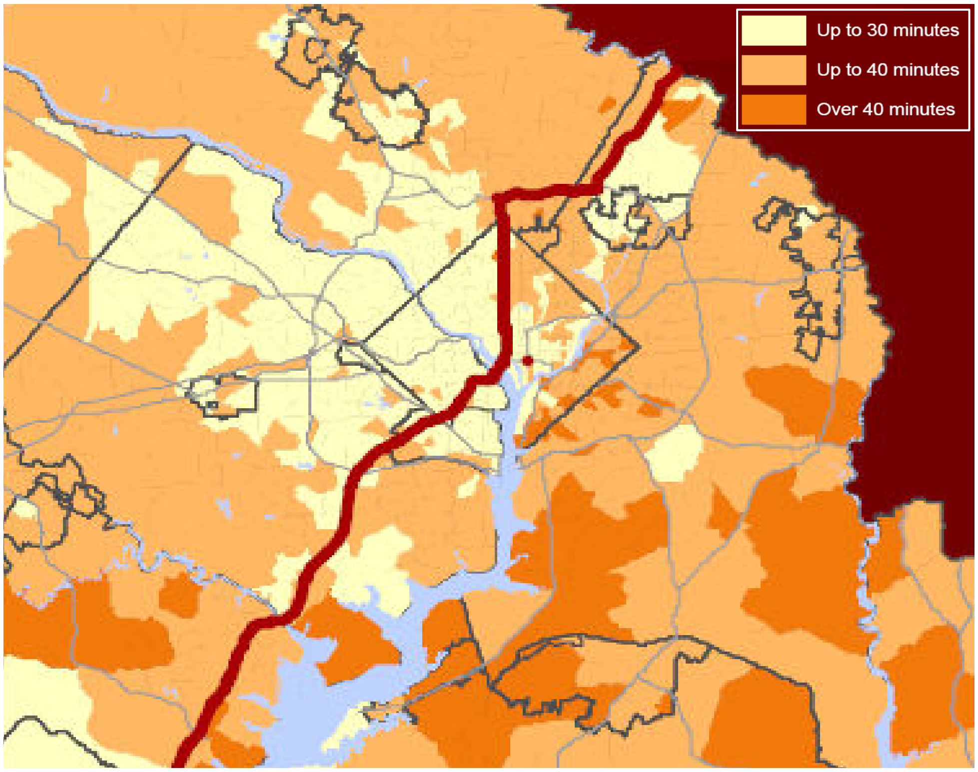
Figure 1-7. Map of Annual VMT per Household in the D.C. Region



Source: Center for Neighborhood Technology (2009). *Terwilliger Housing + Transportation Calculator*.

In addition to the long distance commutes from the outer suburbs, an east-west jobs/housing imbalance also increases VMT and emissions. The Brookings Institution 1999 report, *A Region Divided: The State of Growth in Greater Washington, D.C.*, identified this imbalance across a dividing line running approximately along 16th Street NW in the District and I-95 in Maryland and Virginia. There are more jobs and a larger share of higher paying jobs located in the west, but more affordable housing in the east.[18] Commuters living in eastern areas like Prince George's County are forced to drive long distances to the west for work. With so many cars traveling in the same direction, the roadways clog and workers living in the east tend to face longer commute times, as illustrated in Figure 1-8.[19]

Figure 1-8. Average Commute Time in the Washington D.C. Region



Source: COG (2007). *What if…The Washington Region Grew Differently: TPB Regional Mobility and Accessibility Scenario Study*

Reducing Emissions with Smarter Growth

How can we drive less? The opportunity to live and work in walkable and transit-accessible neighborhoods and employment centers will play an essential part in reducing our carbon footprint. Daily commutes and errands that can be done by a pleasant walk to the corner store or by hopping on Metrorail or a bus make for a pleasant quality of life and produce far less carbon dioxide. For a number of reasons – long stressful commutes, volatile energy prices, smaller household sizes, or a desire for a greener lifestyle – many Washingtonians are showing the desire for better options for living and commuting that enable them to get out of the car and decrease the amount they drive.[20]

Vehicle use, and even car ownership, can be reduced through a variety of location and community design factors. For example, neighborhoods with a greater mix of uses result in residents traveling shorter distances to reach jobs and shopping, even allowing some trips to be made by foot. Figure 1-9 shows the relative effect of different land use factors on per capita trips and VMT calculated by Ewing and Cervero.[21] Although the first three are modest as individual figures, combined, they achieve a 13 percent reduction in vehicle trips and VMT. Regional accessibility, referring to an individual site's location relative to the regional center (e.g. Downtown D.C.) and the number of jobs and public services within a given travel time (e.g. 30 minutes), has a stronger effect on VMT than all other factors combined, reducing VMT by 20 percent.[22] Building new homes in an area that has high regional accessibility – close to the central employment district or major employment centers and high frequency regional transit

Figure 1-9 Travel Reductions from Neighborhood and Regional Characteristics

Doubling of:	Description	VMT impact
Neighborhood Characteristics		
Local Density	Residents and employees per land area	5% reduction
Local Diversity (mix of uses)	Jobs/residents	5% reduction
Local Design	Sidewalk completeness/route directness and street network density	3% reduction
Regional Characteristics		
Access to Destinations & Transit	Proximity to jobs/activity centers; jobs within a 30 minute transit travel time; number of daily trains and buses	20% reduction

Source: Ewing and Cervero (2002). Travel and the Built Environment, modified in Litman (2009)

Figure 1-9 shows the relative effect of different land use factors on reducing the number of per capita vehicle trips and vehicle miles traveled. Regional accessibility has a far more significant effect (20% reduction in VMT) than all local site factors combined (13% reduction in VMT).

service – as opposed to a greenfield site on the suburban fringe can lower VMT up to 20 to 30 percent.[23]

Careful design, high levels of connectivity and transit access, and incentives to reduce the amount we have to drive can greatly influence the carbon footprint produced by a new development. Among the strategies are access to carshare services, bicycle storage facilities,[24] and effective management of parking – including shared parking and charging the market cost for parking spaces. Figure 1-10 and 1-11 outline how location, building design and transportation management strategies can influence travel.

Figure 1-10. Building Location and Design Factor Impacts on Travel

Factor	*Definition*	*Travel Impacts*
Density	People or jobs per unit of land area (acre or hectare)	Increased density tends to reduce vehicle travel. Each 10% density increase typically reduces per capita VMT 1-3%.
Mix	Degree that related land uses (housing, commercial, institutional) are located close together	Increased land use mix tends to reduce per capita vehicle travel, and increase use of alternative modes, particularly walking for errands. Neighborhoods with good land use mix typically have 5-15% lower vehicle-miles.
Regional accessibility	Location of development relative to regional urban center	Improved accessibility reduces per capita vehicle mileage. Residents of more central neighborhoods typically drive 10-30% fewer vehicle-miles than urban fringe residents.
Centeredness	Portion of commercial, employment, and other activities in major activity centers	Centeredness increases use of alternative modes. Typically, 30-60% of commuters to major centers use alternative modes, compared with 5-15% at dispersed locations.
Network connectivity	Degree that walkways and roads are connected to allow direct travel between destinations	Improved roadway connectivity can reduce vehicle mileage, and improved walkway connectivity tends to increase walking and cycling.
Roadway design and management	Scale, design and management of streets	More multi-modal street design can help reduce motor vehicle traffic and increase walking and cycling activity.
Walking and cycling conditions	Quantity, quality and security of sidewalks, crosswalks, paths, and bike lanes	Residents of more walkable communities typically walk 2-4 times as much and drive 5-15% less than if they lived in more automobile-dependent communities.
Transit quality and accessibility	Quality (frequency, speed, reliability, comfort) of transit service and degree to which destinations are transit accessible	Residents of transit oriented neighborhoods tend to own 10-30% fewer vehicles, drive 10-30% fewer miles, and use alternative modes 2-10 times more frequently than residents of automobile-oriented communities.

Source: Litman, T. (2005). *Land Use Impacts on Transport*.

Figure 1-11. Transportation Management Strategies

Strategy	*Description*	*Typical Reduction*
New urbanist design	Compact, mixed, multi-modal development	10-30%
Mobility management	Policies and programs that encourage more efficient travel patterns	10-30%
Parking supply and management	Number of parking spaces per building unit or acre, and how parking is regulated and priced	10-30%.
Carsharing & public bikes	Availability of automobiles and bicycles for hourly rental or loan	2-10%.
Site design	The layout and design of buildings and parking facilities	2-10%.
Walking and cycling improvements	Improve walking and cycling conditions to increase travel options and improve public transit accessibility	5-15%
Commute trip reduction programs	Employers actively encourage more efficient commute patterns	10-30%
Financial incentives	Provide financial incentives to shift mode such as parking cash out	10-30%
Parking pricing	Charge motorists directly and efficiently for using parking facilities	10-30%
Unbundle parking	Rent or sell parking facilities separately from building space	10-30%
Carshare services	Provide hourly vehicle rental services within or near buildings	5-15%
Bicycle facilities	Provide bicycle storage and changing facilities	5-15%
Improve user information and marketing	Provide convenient and accurate information on travel options using maps, signs, websites and direct marketing programs	5-15%

Source: Litman, T. (2006). *Parking Management: Strategies, Evaluation and Planning.*

The region's leaders make choices every day that affect development patterns and transportation options. Do we change development regulations to permit mixed use, walkable neighborhoods? Do we approve expensive highway expansions or improve transit? Do we allow higher density, mixed-use development near underutilized Metrorail stations? Given the fiscal challenges faced by the region's governments, we have no choice but to use our money more wisely. We cannot afford to invest in costly transportation projects that will not pay off in the long term and miss opportunities to both improve our quality of life and reduce greenhouse gas emissions.

COG calls for integrating greenhouse gas analysis into comprehensive land use planning. By quantifying the projected greenhouse gas emissions from development projects in the region, this report shows how well-designed projects in regionally accessible locations would provide a range of benefits including greater reductions in greenhouse gas emissions. The goals of this report are to:

- Offer an analytical approach to estimating the emissions reductions benefits of these projects,
- Encourage use and refinement of this tool in the Washington D.C. region, and
- Promote approval of mixed-use, mixed-income walkable/bikeable and transit-oriented communities in regionally accessible locations in order to realize a range of benefits including reduction in greenhouse gas emissions.

Chapter 2 Measuring the Emissions Impact of How We Grow

Site Specific Impacts

The goal of this report is to illustrate the type of projects that reduce the need to drive, and therefore curb VMT-related emissions, so that developers, public officials, and residents can make decisions that lead to sustainable communities and lower greenhouse gas emissions. To achieve this purpose, several development projects in the Washington D.C. region, from individual buildings to grand neighborhood plans, were analyzed for this report. While some projects have been completed and others are set for groundbreaking, others are proposed or approved plans for future development. Figure 2-1 lists the analyzed projects and their comparison location.

Figure 2-1. Development Projects Analyzed for Effect on Emissions

Project	***Comparison Site***
New Carrollton Transit District Plan (MD)	Relocated to Konterra (MD)
White Flint Sector Plan (MD)	Relocated to Gaithersburg West area (MD)
Gaithersburg West Life Sciences Center Plan (MD)	Relocated to White Flint Metro station area (MD)
One Loudoun Center (VA) (Approved)	Relocated to Route 772 (Ryan Road) Metro station (planned Dulles Rail extension) (VA)
MetroWest, Vienna-Fairfax-GMU Metro (VA)(Approved)	Relocated to Arcola (VA)
Braddock Metro Neighborhood Plan (VA)	Relocated to Lorton (VA)
King Farm (MD) (Built)	Relocated to Derwood (ME)
Arts District Hyattsville (MD) (Built)	Relocated to Konterra (MD)
The Tower Building (MD) (Built)	Relocated to Rockville Town Center (MD)
Nature Conservancy Building (VA) (Built)	Relocated to a Reston office park - National Wildlife Federation location (VA)
5220 Wisconsin Avenue NW – (DC))(Approved)	Relocated in Gaithersburg West area (MD)

Mixed-Use Centers
Urban Neighborhoods
Office Buildings
Residential Buildings

URBEMIS Model

We used the URBan EMISsions (URBEMIS) 2007 software model (version 9.2.4) to estimate the greenhouse gas emissions for these projects. URBEMIS is a land use model designed to calculate the air quality impacts of development projects. It is in widespread use by the Air Pollution Control Districts in California.[25] Building on the standard Institute of Transportation Engineers Trip Generation method, URBEMIS uses a variety of factors to determine how the location of a new development affects traffic. In addition to the type of development and amount of new building taken into account by the trip generation step, the URBEMIS tool can also consider:

- Mix of uses
- Local serving retail
- Transit service

- Bicycle and pedestrian infrastructure
- Affordable housing
- Transportation demand management programs and strategies
- Parking supply

Together, these inputs are used to quantify how a new development will influence its surrounding neighborhood in terms of vehicle trips, vehicle miles traveled, and emissions. URBEMIS is a sophisticated method to predict traffic impacts by examining a new development's regional accessibility, physical characteristics, and transportation demand management strategies.[26] URBEMIS is able to show the benefits of mixed-use, walkable, transit-oriented and regionally accessible developments which are not apparent when localities and developers use the standard ITE trip generation factors based on suburban and auto-oriented environments.

Regional Trip Characteristics and Fleet Mix

Average trip length and speed data were obtained from the COG Planning Department's 2009 traffic model, with the final inputs shown in Figure 2-2. Vehicle fleet data was derived from historic vehicle sales presented in the *2007 Mobile Source Emissions Inventory*, with the regional average found by weighting vehicle percentages by population.[27] Figure 2-3 presents the URBEMIS inputs for the vehicle fleet.

Figure 2-2 Inputs for Trip Characteristics to URBEMIS

Average Speed (mph)	Trip Type	Trip Percentages**	Trip Length Urban (miles)
20	Home-based Work	24.9 %	12.0
25	Home-based Shop	19.6 %	10.3
25	Home-based Other	55.5 %	10.3
25	Commercial-based Commute		10.3
25	Commercial-based Non-Work		10.3
25	Commercial-based Customer		10.3

**Home-based trip % must sum to 100.

Figure 2-3 Inputs for Vehicle Fleet Data to URBEMIS

Fleet %	Vehicle Type
37.1%	Light Auto (passenger cars)
8.7%	Light Truck < 3750 lbs (includes small SUVs)
43.3%	Light Truck 3751-5750 lbs (includes compact SUVs, minivans)
5.5%	Med Truck 5751-8500 lbs (includes larger SUVs, full size vans)
1.6%	Lite-Heavy Truck 8501-10,000 lbs (includes largest SUVs)
0.2%	Lite-Heavy Truck 10,001-14,000 lbs
1.1%	Med-Heavy Truck 14,001-33,000 lbs
1.7%	Heavy-Heavy Truck 33,001-60,000 lbs
0.1%	Other Bus

0.1%	Urban Bus
0.5%	Motorcycle
0.1%	School Bus
0.0%	Motor Home

Residential Land Use Definitions

URBEMIS trip generation rates for residential land uses vary based on housing type. Housing types are defined by building height and by tenure (e.g., ownership or rental), as presented in Figure 2-4**.** References to a housing type in this report follow the URBEMIS definitions. For example, high rise condominiums refer to condo/townhouse buildings with three or more stories.

Figure 2-4 URBEMIS Definitions of Residential Land Uses

Land Use Type	Floors	Tenure
Single family housing	N/A	Own
Apartments low rise	1-3	Rent
Apartments mid rise	4-10	Rent
Apartments high rise	11+	Rent
Condo/townhouse general	1-2	Own
Condo/townhouse high rise*	3+	Own

Note: the upper limit of a three-story condo building appears to be a extremely conservative assumption for the Washington D.C. region. Most of the condo buildings analyzed in this report ranged from 5-30 stories.

Local Jobs/Housing Balance

Mix of uses was determined by calculating the ratio of housing units to study area employment. Large-scale neighborhood plans provide these data for both the existing conditions and the proposed build-out. For smaller projects, housing units were estimated using Census 2000 data made available through county mapping tools and *American FactFinder*. A conversion factor of one job for every 1,000 square feet of retail and office space was used to determine the new employment opportunities from a small project's commercial development. To calculate the study area's current employment, 2006 data for jobs within a ½ mile radius of each project were obtained from the U.S. Census Bureau's Local Employment Dynamics *OnTheMap Version 3*.[28] The local jobs/housing balance factor, however, does not account for the existing regional-scale jobs/housing imbalance. Our region is recognized to have far more jobs on the west side than the east, causing major flows of commuters from east to west in the morning rush hour and back again at night. While local jobs/housing balance measures local mix of uses, it does not capture the larger east-west jobs/housing divide that affects the region's major travel patterns. Greenbelt Alliance, a land conservation and smart growth organization in the San Francisco Bay Area has addressed this deficiency by adapting a "jobs-rich" and "jobs-poor" application to be used with URBEMIS.[29]

Transit Service

The Washington Metropolitan Area Transit Authority (WMATA), Montgomery County Ride On, and Fairfax County Connector provided information on transit service near the project sites. Additional local bus service was estimated based on published schedules for Alexandria's

DASH, Arlington's ART, Loudoun County Transit, Prince George's The Bus, and Laurel's Connect-a-Ride.

Three additional transit projects were assumed to be completed when calculating emissions impact: the Purple Line, the Dulles Corridor Metrorail Project, and the Corridor Cities Transitway. Headways (time between trains) for the Purple Line were modeled to be six minutes during peak hours and ten minutes off peak for 138 daily transit vehicles in each direction.[30] The Dulles Corridor final Environmental Impact Statement proposes seven-minute peak period and twelve-minute off-peak service, corresponding to 116 daily trains in each direction.[31] The Montgomery County Planning Board staff report was used to estimate bus rapid transit (BRT) or light rail transit (LRT) service from the proposed Corridor Cities Transitway based on six-minute headways during peak hours and ten-minute headways off-peak.[32] In addition, the Loudoun County Transit Plan was used to forecast future bus service to One Loudoun Center and the Arcola site.[33]

Figure 2-5 and Figure 2-6 summarize the transit inputs for the project sites considered in this analysis. To calculate bus service for developments larger than a ½ mile across, the site was broken into smaller units and daily buses were summed for each unit. The average service was then calculated by dividing the total count of buses by the number of access areas. A similar process was used for BRT, LRT, Metrorail, and commuter train service, multiplying the number of transit vehicles by the percentage of the project estimated to be within a ½ mile radius of the station.

Figure 2-5 Inputs for Bus Service to URBEMIS

Projects	***Routes***	***Total Count of Buses***	***# of Access Areas***	***Average Daily Service***
New Carrollton Transit District	The Bus: 15x, 16, 21 , 21x WMATA: 84, 88, B21/B22, B24/B25, B27, B29/B31, C28, F4/F6, F12, F13, F14, R12, T16/T17, T18	2,580	4	645
Konterra	Connect-a-Ride: A, D, G, H WMATA: 89, 89M, Z29/9	139	2	70
White Flint Sector Plan	RideOn: 5, 26, 38, 46, 81 WMATA: C8, J5	1,800	5	360
Gaithersburg West Life Sciences Center	RideOn: 43, 56, 66, 67, 74 UM Shuttle 124	840	7	120
One Loudoun Center	Loudoun County 7 to 7 on 7, One Loudoun Commuter (proposed)	172	2	86
Route 772 Metro Station	Loudoun County Parkway Circulator, Ashburn Village Connector	60	1	60
MetroWest, Vienna-Fairfax-GMU Metro	Fairfax Connector: 462, 463, 466, 641, 621/622/623, 630/631/632, 640/642/644, 641, 650/651/652 WMATA: 12A, 1A/1Z, 20F/20W/20X/20Y, 2B/2G CUE: Gold 1/2, Green 1/2 and Fair Lakes Shuttle	1,310	2	655
Arcola	Loudoun County Dulles South Circulator, Dulles South Commuter Bus	52	N/A	N/A
Braddock Metro Neighborhood Plan	DASH: AT2, AT3, AT3/4, AT4, AT5, AT8 WMATA 9A, 10A, 10B, 10E, 11Y, 29K/29N	1,820	2	910
Lorton**	Fairfax Connector: 307	40	N/A	N/A
King Farm*	RideOn: 46, 55, 59, 63, 67 WMATA: Q2, T2	1,142	4	286

Derwood	RideOn: 53, 57	126	3	42
Arts District Hyattsville	The Bus: 13, 14 WMATA: 81/83, F4, F8	525	1	525
The Tower Building	RideOn: 81 WMATA: J7/J9	64	1	64
Rockville Town Center	RideOn: 45, 46, 47, 54, 55, 56, 63 WMATA: Q2, T2	1,219	1	1219
Nature Conservancy Building	ART: 41, 42, 51/52, 53, 62, 75 WMATA: 1A/1B/1E/1F/1Z, 2A/2B/2C/2G, 10B, 20W/20X, 22A, 23A/23C, 25A, 25B, 38B	1,387	1	1387
National Wildlife Federation***	At Wiehle Avenue Park-n-Ride, Fairfax Connector: 505, 552/554, 952, RIBS1/3	195	N/A	N/A
5220 Wisconsin Ave	RideOn: 1, 11, 23, 29, 34 WMATA: 31, 32/36, 37, E2/E3/E4, E6, L7/L8, N2/N3/N4/N6, T2	1,226	1	1226

* King Farm provides a dedicated shuttle service to the Shady Grove Metro. Based on published schedules, URBEMIS also credits the King Farm project with 36 daily shuttle buses.
** Existing bus service at Lorton is assumed to double to accommodate the development shifted from the Braddock Metro Neighborhood Plan in this analysis.
*** Although the National Wildlife Federation building is not within ¼ mile of the Wiehle Avenue Park-n-Ride, for a conservative estimate, bus service in the URBEMIS model is entered as half of the service to the park-n-ride.

Figure 2-6 Inputs for BRT/LRT/Metrorail/Commuter Train Service to URBEMIS

Projects	*Routes*	*# of Daily Trains/BRT*	*% of project within ½ mile of station*	*Average Daily Service*
New Carrollton Transit District	WMATA: Orange, Purple (proposed) MARC: Penn (Amtrak not counted)	450	100%	450
Konterra	MARC: Camden	12	100%	12
White Flint Sector Plan	WMATA: Red	350	86%	300
Gaithersburg West Life Sciences Center	CCT	138	88%	121
One Loudoun Center	None	N/A	N/A	N/A
Route 772 Metro Station	WMATA: Silver (proposed)	250	100%	250
MetroWest, Vienna-Fairfax-GMU Metro	WMATA: Orange	250	100%	250
Arcola	None	N/A	N/A	N/A
Braddock Metro Neighborhood Plan	WMATA: Blue, Yellow	425	100%	425
Lorton	None	N/A	N/A	N/A
King Farm	CCT WMATA: Red	Red: 300 CCT: 138	Shady Grove: 50% CCT: 100%	288
Derwood	None	N/A	N/A	N/A
Arts District Hyattsville	MARC: Camden	12	100%	12
The Tower Building	None	N/A	N/A	N/A
Rockville Town Center	WMATA: Red MARC: Brunswick	375	100%	375
Nature Conservancy Building	WMATA: Orange	250	100%	250
National Wildlife Federation	None	N/A	N/A	N/A
5220 Wisconsin Avenue	WMATA: Red	400	100%	400

Bicycle and Pedestrian Infrastructure

Walkability was calculated based on the density of the street grid represented by the number of intersections. Hand counts for a one square mile section surrounding the project were taken, with "T" intersections adding three points and four-way intersections adding four points to the total network density factor. The URBEMIS user manual references this technique to gather intersection data.[34] For comparison, a value of 440 is roughly equal to a street grid with four-way intersections every tenth of a mile. A square mile of perfect four-legged intersections with 600 foot blocks would equal a 324 intersection density factor. A square mile of perfect 400 foot blocks would equal an intersection density factor of 784.

Sidewalk completeness and bicycle lanes were assigned constant default values given the lack of readily available data on the bicycle and pedestrian facilities. The model assigned 100 percent sidewalks on both sides of the street, and zero bicycle lanes for the arterials/collectors for all of the projects; therefore, reductions were not given for these facilities.

Affordable Housing

For projects where a commitment to providing affordable housing was identified, the percentage of new housing units that would be sold or rented below market rate was included in the URBEMIS model. The URBEMIS user manual states that "a significant amount of evidence points to the fact that lower-income households and senior citizens own fewer vehicles and drive less" and therefore, affordable housing units result in lower emissions than projects with only market-rate residential development. Overall, URBEMIS awards up to a 4 percent reduction for offering affordable housing.[35]

Transportation Demand Management and Parking Supply

The URBEMIS user manual reveals that transportation demand management strategies can further reduce vehicle miles traveled by 3.75 percent for residential land uses. For non-residential uses, demand management and parking pricing could reduce driving by 31.65 percent beyond what is included in this report's analysis. Unfortunately, travel demand management plans and parking policies are not usually developed to a sufficient level of detail for the neighborhood sector plans, and documentation for the smaller projects was incomplete. This prevented accurate analysis and fair comparison of TDM measures across projects.

Parking supply reductions are only considered in URBEMIS if they result in vehicle trip reductions that are greater than the sum of other trip reduction measures.[36] Parking supply numbers for the large-scale projects could not be obtained, but were available for smaller projects. However, parking supply estimates were not accounted for in the final URBEMIS model analysis due to inconsistencies with the reduction rates to be applied to the unduly high ITE parking assumptions.

VMT Reduction Credits

Figure 2-7 summarizes the VMT reduction credits available for various project attributes accounted for in this analysis. These credits were developed by Nelson/Nygaard and are inherent in the URBEMIS model.[37]

Figure 2-7 URBEMIS Traffic Reductions Applied to ITE Average Trip Generation Rates

Physical Measures	Residential*	Non-Residential
Net Residential Density	Up to 55%	N/A
Mix of Uses	Up to 9%	Up to 9%
Local-Serving Retail	2%	2%
Transit Service	Up to 15%	Up to 15%
Pedestrian/Bicycle Friendliness	Up to 9%	Up to 9%
Affordable Housing	Up to 4%	N/A
Total	**Up to 94%**	**Up to 35%**

* For residential uses, the percentage reductions shown apply to the ITE average trip generation rate for single-family detached housing. For other residential land use types, some level of these mitigation measures is included in ITE average trip generation rates, therefore the percentage reduction applied by URBEMIS would be less than the percentages shown in the table.

For the purposes of this study, a subset of factors was selected to analyze projects and comparison sites. The specific factors are listed in each of the project pages in Chapter 3. Figure 2-8 summarizes this study's factors.

Figure 2-8 Project inputs to URBEMIS used for this study

Inputs to URBEMIS
of Homes
of Commercial square feet
of Retail square feet
of Floors
of Acres
Intersection Density Factor
Daily Buses within a ¼ mile
Daily Trains/BRT within a ½ mile
Households within study area
Employees within study area

Chapter 3 Identifying Climate-Friendly Developments

Evaluating the Emissions Impact of Development Projects

This chapter presents the results of the URBEMIS model for selected development projects proposed throughout the Washington D.C. region. Figure 3-1 shows the development plan or project analyzed and its comparison site if the plan or project was relocated to this alternative location.

Figure 3-1	**Comparison Site for Relocated Project**								
Project	Konterra	Gaithers-burg West	White Flint	Rt. 772 Metro station	Arcola	Lorton	Derwood	Rockville Town Center	Reston Office Park (NWF)
New Carrollton Transit District Plan	●								
White Flint Sector Plan		●							
Gaithersburg West LSC Plan			●						
One Loudoun Center				●					
MetroWest, Vienna Metro (approved)					●				
Braddock Road Metro Plan						●			
King Farm (built)							●		
EYA Arts District Hyattsville (partially built)	●								
Tower Building (built)								●	
Nature Conservancy (built)									●
5220 Wisconsin Avenue (approved)		●							

Figure 3-2 includes a brief description of the eleven projects and an estimate for the change in vehicle trips, vehicle miles traveled and emissions. The table shows the results in emissions reductions (or increases) by locating the eleven development projects/plans at alternative locations. Study projects in areas with high regional accessibility and adjacent to high frequency transit stations show considerable emissions reductions over alternative, less accessible or less compact sites.

In Figure 3-3, URBEMIS results of the study sites are compared against the ITE baseline. The ITE manual uses standard, suburban, single-use trip generation assumptions. This is the basis of the ITE baseline scenario. The "ITE baseline" with a "mitigated scenario" – where URBEMIS applies vehicle trip reductions based on specific project characteristics such as a mix of uses, density, transit accessibility, and trip reduction incentives – is the reported result of the project after it receives credits from the URBEMIS model. The project profiles that follow Figures 3-2 and 3-3 briefly describe the project, model inputs and results.

Figure 3-2 Emissions Impact for Development Project – Relocation to Comparison Site

Project	*Location*	*Description*	*Comparison site*	*% Change in CO_2 emissions project vs. comparison site*
New Carrollton Transit District	Prince George's County, MD	Transit-oriented development planned for New Carrollton Metro station	Konterra Town Center	- 11.2%
White Flint Sector Plan	Montgomery County, MD	Mixed-use center proposed for White Flint Metro station	Gaithersburg West area	-12.3%
Gaithersburg West Life Sciences Center	Montgomery County, MD	Research and bio-science live/work development west of I-270	White Flint	+ 9.7%
One Loudoun Center	Loudoun County, VA	Mixed-use project along Route 7 in Dulles Airport Technology Corridor	Route 772 Metrorail station	+13.8%
MetroWest, Vienna-Fairfax-GMU Metro	Fairfax County, VA	Mixed-use center proposed for end station of Orange Line in Virginia	Arcola Center	-13.5%
Braddock Metro Neighborhood Plan	City of Alexandria, VA	Redevelopment plan of several sites near the Braddock Road Metro station	Lorton, VA	-27.1%
King Farm	Montgomery County, MD	New Urbanist community near Shady Grove Metro station	Relocation of residential uses to Derwood in suburban form	-41.8%
EYA Arts District Hyattsville	Prince George's County, MD	Urban infill with local serving retail in Hyattsville, MD	Konterra Town Center	-7.9%
The Tower Building	Montgomery County, MD	Green commercial office building along I-270 corridor	Rockville Town Center	+16.1%
Nature Conservancy Building	Arlington County, VA	Commercial office building located near the Ballston Metro station	office park in Reston, VA	-12.6%
5220 Wisconsin Avenue	District of Columbia	Condominiums with ground floor retail at Friendship Heights Metro station	Gaithersburg West area	-20.3%

Figure 3-2 shows the change in CO_2 emissions at the study site when compared to an alternative site. Thus, a site with high walkability, mix of uses, and frequent transit service will have reduced CO_2 emissions (negative value) compared with a less accessible site. For example, the New Carrollton plan reduces CO_2 emissions by 11.2% when compared against relocating the plan build-out to Konterra.

Figure 3-3 Emissions Impact for Development Projects – Compared to ITE Baseline

Project	*Location*	*Description*	*% Change in Vehicle CO_2 Emissions compared to ITE Baseline*[1]
New Carrollton Transit District	Prince George's County, MD	Transit-oriented development planned for New Carrollton Metro station	-27.3%
White Flint Sector Plan	Montgomery County, MD	Mixed-use center proposed for White Flint Metro station	-26.5%
Gaithersburg West Life Sciences Center	Montgomery County, MD	Research and bio-science live/work development west of I-270	-12.4%
One Loudoun Center	Loudoun County, VA	Mixed-use project along Route 7 in Dulles Airport Technology Corridor	-10.6%
MetroWest, Vienna-Fairfax-GMU Metro	Fairfax County, VA	Mixed-use center proposed for end station of Orange Line in Virginia	-29.7%
Braddock Metro Neighborhood Plan	City of Alexandria, VA	Redevelopment plan of several sites near the Braddock Road Metro station	-35.4%
King Farm	Montgomery County, MD	New Urbanist community near Shady Grove Metro station	-27.3%
EYA Arts District Hyattsville	Prince George's County, MD	Urban infill with local serving retail in Hyattsville, MD	-25.0%
The Tower Building	Montgomery County, MD	Green commercial office building along I-270 corridor	-9.5%
Nature Conservancy Building	Arlington County, VA	Commercial office building located near the Ballston Metro station	-19.7%
5220 Wisconsin Avenue	District of Columbia	Condominiums with ground floor retail at Friendship Heights Metro station	-34.3%

[1] "ITE Baseline" refers to the default trip generation rates published in Institute for Traffic Engineers' (ITE) Trip Generation report and Handbook. The URBEMIS model uses ITE rates unless alternative values are inputted.

Figure 3-4 CO_2 emissions from Study Site vs. Comparison Site (%)

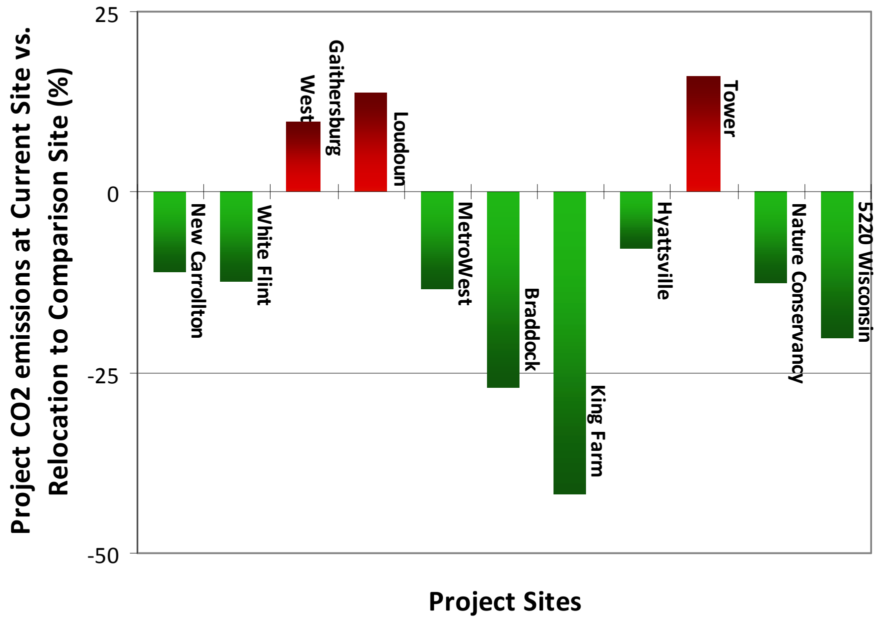


Figure 3-5 shows the percent in CO_2 reduction (or increase) compared to alternative sites. Projects located at sites with lower regional accessibility show higher emissions (projects with positive values), and projects with higher regional accessibility show savings in $C0_2$ emissions (projects with negative or reduced values).

Figure 3-5 Annual Tons of CO2 Emissions at Study Site versus Comparison Site

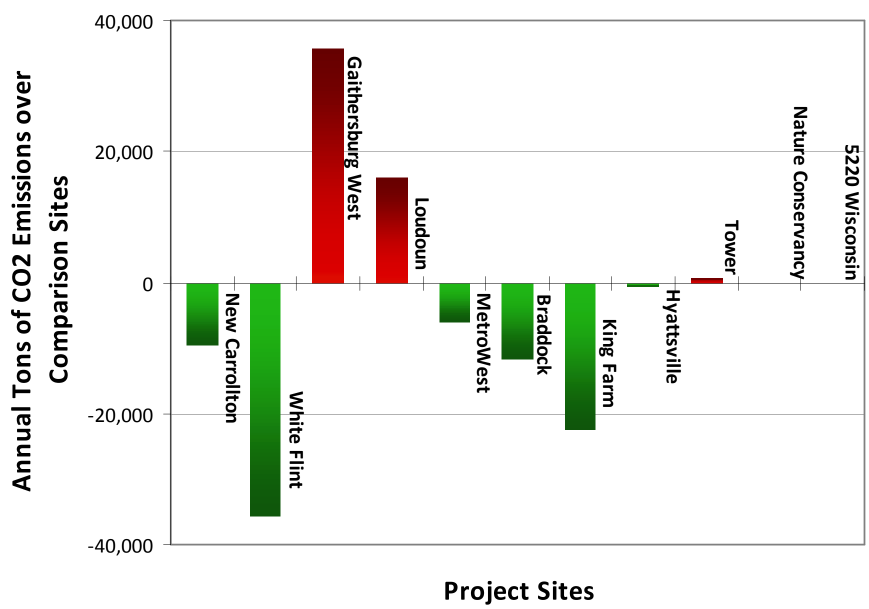


Figure3-5 shows the absolute number of tons of CO_2 reduction (or increase) compared to alternative sites. Larger projects at sites with lower regional accessibility show higher emissions (projects with positive values), and projects with higher regional accessibility show savings in CO_2 emissions (projects with negative or reduced values). Thus, larger projects in low accessibility locations have higher impacts on the region's overall emissions.

Figure 3-6 Percent Difference in CO_2 Emissions from Study Site vs. ITE Baseline

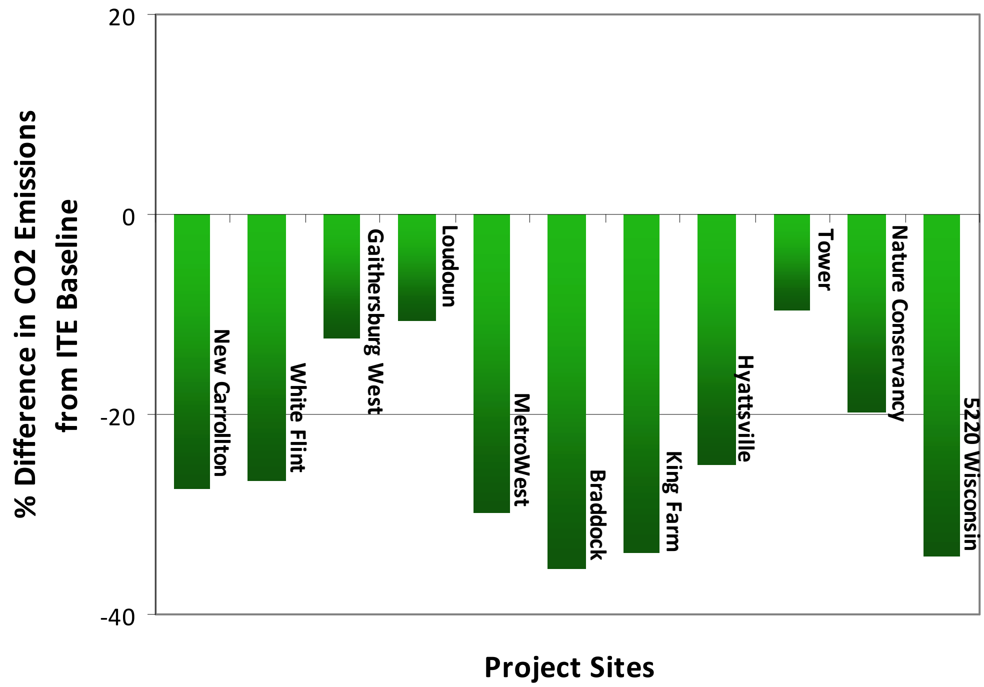


Figure 3-6 shows the percent of CO_2 reduction compared to the standard Institute for Transportation Engineers (ITE) baseline which assumes suburban automobile-dependent development patterns. While all projects receive credits by the URBEMIS land use and transportation model for trip reduction characteristics, projects with higher regional accessibility show substantially greater savings in CO_2 emissions (projects with more negative or reduced values).

New Carrollton Transit District

This 2009 development plan envisions the neighborhood surrounding the New Carrollton Metro Station emerging as a major urban center with a mix of new commercial office, retail, and residential uses. With direct access to Metrorail, Amtrak, MARC, and extensive bus service, as well as considerations for pedestrians and bicyclists, the New Carrollton Transit District will provide a variety of modal choices to travelers. Furthermore, the first phase of the Purple Line service is planned to terminate at the New Carrollton Metro Station, significantly increasing transit service in the vicinity of the proposed development.

Photo Credit: New Carrollton Transit District Development Plan[1]

This analysis only considers the development planned for the Metro Core, blue shaded center around the M in the map at right. At project completion, this area will host 3,000 high rise units, 100,000 square feet of retail space, and 2.6 million square feet of office space. The rental-ownership split is assumed to be 40 percent apartment and 60 percent condo.

New Carrollton Metro Core Features	
# of Homes	3,000
# of Commercial square feet	2,600,000
# of Retail square feet	100,000
Floors	4 to 16
# of Acres	102
Intersection Density Factor	238
Daily Buses within a ¼ mile	645
Daily Trains/BRT within a ½ mile	450
Households within study area	8,160

The comparison site, Konterra, is assumed to offer twelve daily MARC trains and seventy daily buses. Konterra developers propose 4,500 homes and 5.3 million square feet of retail and office at the 488-acre east town center for a job/housing ratio of 1.18. Based on the site plan, the intersection density factor is modeled as 220.[38]

The URBEMIS model reveals that focusing new jobs and housing in a transit-oriented neighborhood like New Carrollton would reduce emissions by 27 percent compared to the ITE baseline scenario and 11 percent compared to a walkable town center, like Konterra, with little transit access.

	Baseline	Project Build	Comparison Site
Scenario Description	ITE baseline trip generation rates	Project build scenario accounting for site-specific mitigation measures	If project located at Konterra Town Center East
Annual Metric Tons of CO_2	104,978	76,294	85,948
Daily Car Trips	48,724	35,577	40,002
Miles of Driving per day	508,547	370,546	416,990

White Flint Sector Plan

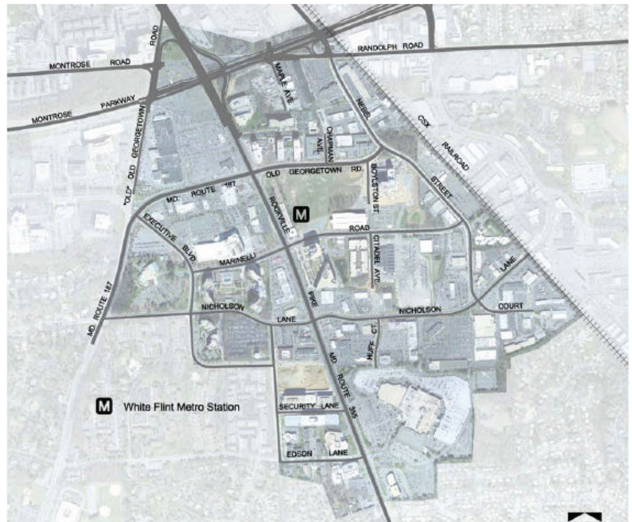


Photo Credit: White Flint Sector Plan[2]

The White Flint Sector Plan transforms the auto-oriented suburban development pattern near the White Flint Metro Station to a mixed-use center where people can walk to work, shops, and transit. The White Flint Sector Plan calls for 9,800 new residential units. For this analysis, we assume 4,700 high rise condos, 3,380 high rise apartments, 1,320 mid rise apartments, and 400 townhomes. Including the existing uses, the area will offer 4.2 million square feet of retail and 8.2 million square feet of office space.

Currently, households in White Flint drive an average of 22.2 miles per day, 47 percent lower than the Montgomery County average of 41.8 miles. Assuming a fuel economy of 30 miles per gallon, homes in White Flint could save 240 gallons of gas per year or around $640 based on current Maryland fuel prices.[39]

White Flint Sector Plan Features	
# of Homes	9,800
# of Affordable Housing Units	2,205
# of Commercial square feet	4,268,000
# of Retail square feet	1,423,000
Floors	1 to 30
# of Acres	430
Intersection Density Factor	260
Daily Buses within a ¼ mile	360
Daily Trains/BRT within a ½ mile	300
Households within study area	14,341
Employees within study area	48,600

What if this project were relocated to upper Montgomery County (in the Gaithersburg West area) away from a Metro station? This new site is assumed to have 120 daily buses, no access to rail or BRT, a job/housing balance of 2.75, and an intersection density factor of 220. Not captured by the model is the benefit of remaking Rockville Pike into a calmed, multimodal boulevard, whereas Gaithersburg West is planned for wide arterial roads and grade-separated interchanges uninviting to walkers and bicyclists.

The project mitigation measures (transit, mixed-uses, etc) are expected to save 91,957 metric tons of CO_2 each year, a reduction of 26.5 percent over the baseline ITE rates. Shifting this development to a site in the Gaithersburg West area would increase vehicle CO_2 emissions by 35,646 metric tons of CO_2 each year, a rise of 14.0 percent over the project build scenario. This equals the CO_2 emissions from the electricity use of 4,635 homes for one year.[40]

	Baseline	Project Build	Comparison Site
Scenario Description	ITE baseline trip generation rates	Project build scenario accounting for site-specific mitigation	If project located in Gaithersburg West area
Annual Metric Tons of CO_2	346,664	254,708	290,353
Daily Car Trips	161,060	118,904	135,261
Miles of Driving per day	1,681,335	1,238,646	1,410,340

Gaithersburg West

The Gaithersburg West Master Plan[41] proposes a Life Sciences Center to provide commercial labs, research space and classrooms in a live/work community over two miles west of the Shady Grove Metro station. The plan calls for a realignment of the Corridor Cities Transitway (CCT) to serve the new development and new streets to create more of a grid.

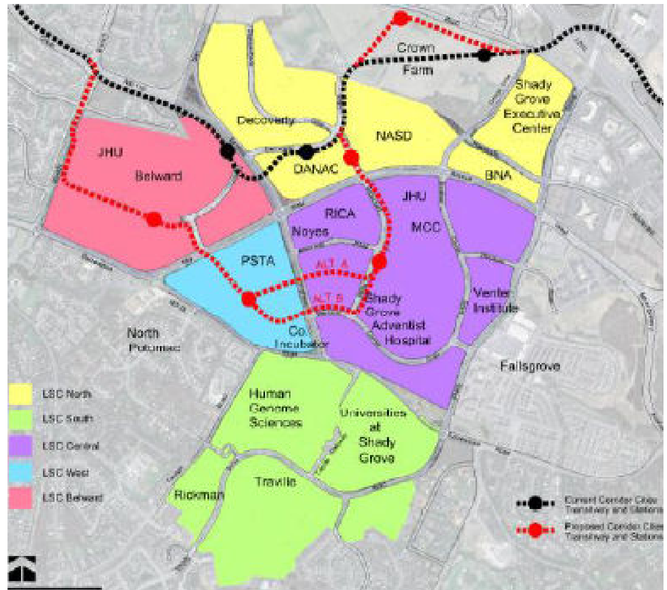


Photo Credit: Montgomery Planning[1]

The master plan proposes 5,700 new households and 13 million square feet of new commercial development. This analysis assumes that the housing types are 1,815 mid rise apartments, 1,635 high rise apartments, and 2,280 high rise condominiums. Of the proposed commercial development, 10 percent is assumed to be retail and 90 percent is estimated to be office space.

The large-scale growth in jobs at this location in the I-270 corridor would worsen the significant, existing, regional jobs/housing imbalance by increased employment that is not compensated by new housing. This regional imbalance is not captured by the URBEMIS model.

Gaithersburg West Features	
# of Homes	5,700
# of Commercial square feet	11,754,000
# of Retail square feet	1,306,000
# of Acres	939
Intersection Density Factor	220
Daily Buses within a ¼ mile	120
Daily Trains/BRT within a ½ mile	121
Households within study area	9,000
Employees within study area	60,000

The URBEMIS model determines that the Gaithersburg West Master Plan reduces daily driving by 277,549 miles compared to the unmitigated scenario based on the anticipated BRT/LRT service. Shifting this project to White Flint would increase transit service to 360 buses and 300 trains each day. The intersection density factor at this site is slightly higher at 260. Relocating to White Flint at an existing Metrorail station would save an additional 173,726 miles of driving each day, a decrease of 8.8 percent compared to the project build scenario. This translates to a savings of 35,669 metric tons of CO_2 annually, or the amount of CO_2 emitted by providing electricity to 4,632 homes for one year.

	Baseline	Project Build	Comparison Site
Scenario Description	ITE baseline trip generation rates	Project build scenario accounting for site-specific mitigation measures	If project located at White Flint
Annual Metric Tons of CO_2	458,758	401,772	366,103
Daily Car Trips	216,588	189,891	173,181
Miles of Driving per day	2,244,015	1,966,466	1,792,740

One Loudoun Center

This proposed mixed use project is located on a 360 acre site at the junction of Route 7 and Loudoun County Parkway in Virginia. The site plan calls for 3 million square feet of office space, 700,000 feet of retail and 1,040 homes built around a central park.[42]

Photo Credit: One Loudoun Center[4]

Based on the county assessment of land use impacts, this analysis assumes 265 single family detached homes, 329 townhomes, and 446 mid rise apartments. Affordable and workforce housing units (70-100% AMI) will total 97, or 9 percent of the proposed residential units.

The developer makes provisions for onsite bus stops, and the Loudoun County Transit Plan designates a new bus route to the project site.[43] However, the separation of uses illustrated in the site plan and the low frequency of bus service indicate that residents and workers will be auto-dependent.

One Loudoun Center Features	
# of Homes	1,040
# of Affordable Housing Units	97
# of Commercial square feet	3,000,000
# of Retail square feet	700,000
# of Acres	360
Intersection Density Factor	350
Daily Buses within a ¼ mile	86
Daily Trains/BRT within a ½ mile	0
Households within study area	1,498
Employees within study area	6,252

What if One Loudoun Center was designed as a transit-oriented development at the future Metro station at Route 772 serving the Dulles Corridor? Metro service at this location is predicted to be 250 trains and 60 buses each day.[44] Just accounting for better transit access, the One Loudoun Center development could save 6.5 percent in emissions.

Taking this analysis one step farther, we assume a more compact housing mix of 265 townhomes, 329 high rise condominiums, and 446 mid rise apartments. The job/housing balance would also change at this new location with households and employment estimated to be 1,757 units and 4,148 jobs. In this scenario, driving would decrease by 78,437 miles each day and transport emissions would fall by 12 percent compared to the current project site. Introducing parking supply and transportation demand management strategies could lead to even greater savings in emissions.

	Baseline	Project Build	Comparison Site
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	Redesign project as TOD at future Route 772 Metro
Annual Metric Tons of CO_2	148,601	132,803	116,667
Daily Car Trips	70,463	62,997	55,468
Miles of Driving per day	728,892	651,547	573,110

MetroWest

MetroWest is a planned transit-oriented, mixed use project just south of the Vienna-Fairfax-GMU Metro station. The project will offer a variety of homes, convenience retail, commercial offices, public spaces and enhanced pedestrian connections to the Metro station.

Photo Credit: MetroWest[5]

MetroWest Features	
# of Homes	1,780
# of Affordable Housing Units	180
# of Commercial square feet	1,000,000
# of Retail square feet	80,000
Floors	1 to 14
# of Acres	55
Intersection Density Factor	362
Daily Buses within a ¼ mile	655
Daily Trains/BRT within a ½ mile	250
Households within study area	2,735
Employees within study area	2,734

Based on the latest plan, the model assumes 1,780 new homes, 1 million square feet of office space, and 80,000 square feet of local serving retail. Based on the site plan and an estimated 60 percent ownership level, this analysis assumes 630 high rise condos, 420 high rise apartments, 442 low rise apartments, and 288 townhomes.

What if instead of redeveloping the underutilized land surrounding the Vienna-Fairfax-GMU Metro station, this project was proposed for a greenfield site west of the Dulles Airport? This analysis considers relocating the development near the Arcola Center, a 400-acre proposed mixed-use site at the junction of Route 50, Route 606, and Loudoun County Parkway.[45] Transit service is estimated to be 52 daily buses, and the job/housing balance is assumed to be 1.8 based on the 3.2 million square feet of office and retail space planned for Arcola - a conservative estimate based on shifting the 1,780 homes from MetroWest.[46] The intersection density factor is assumed to be 400 based on the latest Arcola site plan – slightly higher than the MetroWest project because the Arcola site is not constrained by the existing street grid.

The URBEMIS model indicates that the MetroWest site could save 30 percent and 14 percent compared to the baseline and comparison site, respectively. Because the Arcola Center site is approximately eight times larger than the MetroWest site and is likely to have a more sprawling design, the emissions reductions could be even greater for the MetroWest development.

	Baseline	Project Build	Comparison Site
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	If project located at Arcola Center
Annual Metric Tons of CO_2	54,351	38,205	44,184
Daily Car Trips	25,014	17,664	20,387
Miles of Driving per day	262,114	184,713	213,383

Braddock Metro Neighborhood

The Braddock Metro Neighborhood Plan in the city of Alexandria, Virginia, is an effort to enhance the livability of the area while preserving the neighborhood's character and integrating higher density uses. Building projects are planned at seventeen different sites, along with new public spaces and improved pedestrian/bike connections.

Photo Credit: Braddock Metro Neighborhood Plan[6]

Braddock Metro Neighborhood Plan Features	
# of Homes	2,000
# of Commercial square feet	560,000
# of Retail square feet	110,000
Floors	1 to 10
# of Acres	25
Intersection Density Factor	539
Daily Buses within a ¼ mile	910
Daily Trains/BRT within a ½ mile	425
Households within study area	4,966
Employees within study area	6,951

For this analysis, we assume that 40 percent of new housing units will be rental, resulting in a housing mix of 700 mid rise apartments, 1,050 high rise condominiums and 250 townhomes. The plan also proposes 110,000 square feet of retail space and 560,000 square feet for new office buildings.

This analysis looks at the emissions impact if this new development were shifted south along the I-95 Corridor near Lorton, Virginia. Currently, there are 40 buses that pass the Lorton comparison site, and this analysis doubles the existing service to account for the proposed increase in development. The street grid of the comparison site is assumed to be approximately tenth mile blocks, similar to Reston Town Center, for a network density factor of 440. The job/housing ratio follows the proposed new development of 2,000 homes and 670 new jobs.

The URBEMIS model reveals that the Braddock Metro location will reduce CO_2 emissions by 35 percent compared to the unmitigated scenario and 27 percent compared to relocating the development to Lorton. The EPA's greenhouse gas equivalencies calculator shows that saving 11,637 metric tons of CO_2 by building at the Braddock Metro location instead of near Lorton equals the emissions from producing electricity for 1,511 homes annually.[47]

	Baseline	Project Build	Comparison Site
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	If project located along I-95 Corridor in Lorton, VA
Annual Metric Tons of CO_2	48,520	31,324	42,961
Daily Car Trips	22,169	14,402	19,658
Miles of Driving per day	233,116	151,019	206,578

King Farm

King Farm is an existing New Urban community in Rockville, Maryland. The mix of uses offer residents close access to neighborhood amenities, and parking located behind the buildings helps create a pleasant walking environment. There are several nearby transit options, including bus, rail, and a King Farm shuttle system to the Shady Grove Metro Station.

Photo Credit: U.S. EPA Smart Growth[7]

King Farm Features	
# of Homes	3,200
# of Affordable Housing Units	400
# of Commercial square feet	2,200,000
# of Retail square feet	118,000
# of Acres	430
Intersection Density Factor	583
Daily Buses within a ¼ mile	286
Daily Trains/BRT within a ½ mile	288
Dedicated Daily Shuttles	36
Households within study area	3,200
Employees within study area	2,318

The 430-acre development has 392 single family homes, 943 townhomes, 665 high rise condos, and 1,200 mid rise apartments for a total of 3,200 residential units. In addition, King Farm offers 2.2 million commercial square feet and 118,000 square feet of retail.

For comparison, the model shifts only the residential uses to nearby Derwood in a large lot development pattern consisting of 1,335 single family homes, 665 townhomes, and 1,200 low rise apartments. The current neighborhood job/housing balance estimated in this area significantly favors households with four homes for every job. The pedestrian connectivity is poor due to the "lollipop" suburban street layout, represented as an intersection density factor of 212. Transit service is assumed to be limited with 42 daily buses.

Looking at office and retail uses alone, building in the King Farm neighborhood saves 22 percent in CO_2 emissions compared to the unmitigated scenario. Focusing on residential uses, the neighborhood's regional accessibility, walkability, and diverse transit options reduces emissions by 34 percent. If these homes were shifted to a sprawl development pattern, the model estimates that emissions would increase by 72 percent compared to the current King Farm residences.

	Baseline		Project Build		Comparison Site
Scenario Description	Unmitigated scenario using standard ITE trip rates		Project build scenario accounting for site-specific mitigation measures		If housing located at Derwood in sprawl form
Land Use	*Office/Retail*	Residential	*Office/Retail*	Residential	Residential
Annual Metric Tons of CO_2	*61,257*	47,227	*47,608*	31,285	53,767
Daily Car Trips	*29,289*	20,668	*22,763*	13,691	23,530
Miles of Driving per day	*301,676*	221,630	*234,456*	146,815	252,323

EYA Arts District Hyattsville

EYA's Arts District project in the city of Hyattsville, Maryland, is an urban infill project located on Route 1, two miles from the D.C. line. A new restaurant, shops and a fitness center will serve the area and 550 new townhomes. With live-work units and performance space, the developer, EYA, hopes to build on the city's effort to cater to local artists and create a sense of community.

Photo Credit: EYA[8]

Limited retail parking, small street blocks and sidewalks encourage residents to visit local retail by foot. With over 500 daily buses and a MARC rail station within walking distance, the community offers several transit options. The Prince George's Plaza Metro station is one mile away, and the West Hyattsville and College Park Metro stations are within two miles.

EYA Arts District Hyattsville Features	
# of Homes	550
# of Retail square feet	50,000
Floors	3
# of Acres	25
Intersection Density Factor	432
Daily Buses within a ¼ mile	525
Daily Trains/BRT within a ½ mile	12
Households within a ½ mile	2,822
Employees within a ½ mile	2,210

Prince George's County averages 42.3 vehicle miles traveled for daily home-based trips, or a total of 15,449 miles per year. The Traffic Analysis Zones containing the Arts District project indicate that these households will generate 8,578 annual VMT, or 44.4 percent below the county average.[48]

How would daily driving change if these townhomes were located farther outside the urban core? For comparison, these homes were moved to the 488-acre east town center at Konterra. This site is assumed to have a job/housing ratio of 1.18 and offers 12 daily MARC trains, 70 daily buses, and an intersection density factor of 220.[49]

Based on the URBEMIS model, the Arts District project is estimated to reduce daily car trips by 1,409 and decrease driving by 14,941 miles each day compared to the ITE trip generation rates. This translates to an annual reduction of 3,139 metric tons of CO_2, a savings of 25 percent, which is equal to the electricity use of 408 homes for one year.[50] Relocating the project at Konterra shows a rise in emissions of 8.5 percent, releasing an extra 804 metric tons of CO_2 per year.

	Baseline	Project Build	Comparison
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	If project located at Konterra Town Center East
Annual Metric Tons of CO_2	12,566	9,427	10,231
Daily Car Trips	5,689	4,280	4,640
Miles of Driving per day	60,096	45,155	48,978

The Tower Building

Recognized as a pioneer in green design, the Tower Building is well-known for its unique features such as an advanced air treatment system, recycled and non-toxic building materials, and Low-E Glass exterior for maximum daylight. All together, the Tower Building's green features allow it to use 30 percent less energy than typical office buildings.

Photo Credit: The Tower Building[9]

The dedication of the developers to green design – purchasing 100 percent wind power to make the building a carbon neutral work environment – is commendable. This commitment has led the Tower Building to win several awards for its environmentally-friendly design: a LEED-EB Silver Certification and the Metropolitan Washington Apartment and Office Building Association's Green Building of the Year award.[51]

Tower Building Features	
# of Commercial square feet	276,000
Floors	10
# of Acres	12
Intersection Density Factor	141
Daily Buses within a ¼ mile	64
Daily Trains/BRT within a ½ mile	0
Households within a ½ mile	2,136
Employees within a ½ mile	1,175

However, the benefits of the Tower Building's green design could be improved if the building were located in a walkable, transit-accessible neighborhood. The comparison site at Rockville Town Center is assumed to have 1,219 buses and 375 trains each day, an intersection density factor of 380, and a job/housing ratio of 2.78.

According to the URBEMIS model, if the Tower Building were located in Rockville Town Center, the operational emissions from transportation would be 14 percent lower. While Montgomery County provides a shuttle from the Tower Building to nearby Metrorail stops, and the Tower Building hosts an onsite café, a setting closer to the Rockville Metro Station would allow many more workers to commute by transit or walk to a wide variety of lunch options.

The Tower Building developer should be applauded for achieving significant energy and emissions reductions and for drawing attention to green design. Combining green design with building sites that have high levels of regional transit accessibility and a mix of uses in a walkable environment would achieve even greater reductions.[52]

	Baseline	Project Build	Comparison Site
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	If project located at Rockville Town Center
Annual Metric Tons of CO_2	6,361	5,757	4,960
Daily Car Trips	3,039	2,750	2,370
Miles of Driving per day	31,299	28,327	24,407

Nature Conservancy Headquarters

The Nature Conservancy Headquarters is located in Arlington, Virginia, across the street from the Ballston Metro station. The eight-story building hosts 172,000 square feet of office space with parking, accommodated in a below-ground garage. Constructed on a brownfield site, which was formerly home to a surface parking lot, the building "now contributes to Ballston's urban fabric" and even preserves a half-acre behind the facility for a neighborhood park.[53]

Photo Credit: Hellmuth, Obata + Kassabaum, Inc.[10]

Nature Conservancy Building Features	
# of Commercial square feet	172,000
Floors	8
# of Acres	1.5
Intersection Density Factor	455
Daily Buses within a ¼ mile	1,387
Daily Trains/BRT within a ½ mile	250
Households within a ½ mile	4,890
Employees within a ½ mile	23,046

The Conservancy has instituted many strategies to encourage employees to take the Metro or bicycles to work, such as providing bicycle storage and showers for commuters. It also provides an on-site charging station for electric vehicles. In addition, officials approved a smaller parking structure with only 185 parking spaces instead of the 298 spaces required by the Metrorail Corridor standard rate.[54]

For comparison, the model relocates the building to an office park off the Dulles Toll Road in Reston, Virginia, at the National Wildlife Federation (NWF). The NWF building is behind office park buildings and parking lots and just over a half mile from the Wiehle Avenue Park-and-Ride (and future Dulles Rail station). Poor street connectivity, with an intersection density factor of 168, makes it difficult for commuters to access bus service. While this bus service is outside the quarter mile radius, for a conservative estimate, the comparison site is assumed to offer half the bus service from the park-n-ride site with 98 daily buses. The local job/housing ratio at this location is estimated to be 6.2.

According to the URBEMIS model, the Nature Conservancy Building's location along the Arlington Corridor reduces emissions by 20 percent over the unmitigated scenario and by 13 percent compared to an office park in Reston along the Dulles Toll Road.

	Baseline	Project Build	Comparison Site
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	If project located along Route 7 in Reston, VA
Annual Metric Tons of CO_2	3,964	3,182	3,639
Daily Car Trips	1,894	1,520	1,739
Miles of Driving per day	19,505	15,659	17,908

5220 Wisconsin Avenue, NW

This project is an approved residential condominium and retail building located steps away from the south entrance of the Friendship Heights Metrorail Station in Washington, D.C. With 13,200 square feet of ground floor retail, the building will offer local services to its 70 high rise condominiums and nearby neighbors. In addition, the building will dedicate 10 percent of the total residential space to affordable units (affordable at 80% area median income).

Photo Credit: Akridge[11]

5220 Wisconsin Avenue, NW Features	
# of Homes	70
# of Affordable Housing Units	7
# of Retail square feet	13,200
Floors	5 to 7
# of Acres	0.52
Intersection Density Factor	655
Daily Buses within a ¼ mile	1,226
Daily Trains/BRT within a ½ mile	400
Households within a ½ mile	4,367
Employees within a ½ mile	4,308

The developer will provide dedicated parking spaces for carshare vehicles and secure bicycle parking with showers and changing facilities for employees. A limited retail parking supply of fifteen spaces will ensure that stores cater to local residents and encourage patrons to access shopping on foot. Furthermore, the developer will fund a transportation management coordinator to identify and address transportation issues in the area.

How would car use change if this project were relocated to upper Montgomery County in the Gaithersburg West LSC area away from a Metro station? The comparison site is assumed to have 120 daily buses, no access to rail or BRT, an intersection density factor of 220, and a job/housing balance of 2.75.

Compared to the standard ITE trip rates, the project is expected to decrease driving by 3,192 miles each day and reduce emissions by 34 percent. The URBEMIS model predicts that residents will drive an average of 25.5 miles per day compared to the Montgomery County average of 41.8 miles.[55] Overall, the project would save 665 metric tons of CO_2 each year, equivalent to the CO_2 emissions from the annual electricity use of 86 homes.[56] In comparison, the site in the Gaithersburg West area increases emissions by 25 percent. If the analysis accounted for the limited retail parking it would result in even greater emissions reductions.

	Baseline	Project Build	Comparison
Scenario Description	Unmitigated scenario using standard ITE trip rates	Project build scenario accounting for site-specific mitigation measures	If project located in Upper Montgomery County
Annual Metric Tons of CO_2	1,939	1,274	1,598
Daily Car Trips	899	595	743
Miles of Driving per day	9,396	6,204	7,758

Chapter 4 Discussion

Projects that combine regional accessibility – located in the urban core and inner suburbs – with high frequency service at rail transit stations and higher density mixed-use, walkable designs with jobs and housing in close proximity achieve the most significant emissions reductions.

While the URBEMIS model offers many benefits for analyzing and comparing plans and projects, it has a number of shortcomings that possibly make this assessment more conservative than a more refined model with more comprehensive data. A model better tailored to our region could provide a more effective tool to evaluate the relative CO_2 reduction benefits of different development projects.

Regional accessibility: A significant shortcoming of this analysis is the treatment of regional accessibility. We used average trip length data for home and work trips. We could have used average trip lengths at the Transportation Analysis Zone (TAZ) level obtained from COG, but each zone may include a variety of land uses that might be very different than the characteristics at the project site. However, even with TAZ level data, the analysis would be affected by historic trends of lopsided employment growth in the region. For example, historic job shifts to the western side of the region and inadequate numbers of jobs on the east side of the region mean that an east side transit station location like New Carrollton would be disadvantaged in a regional accessibility analysis. As a result, despite New Carrollton's high access to transit, including Metro, and proximity to D.C., it might not perform as well compared to a job-rich area like Gaithersburg West, which is more distant from the regional core and far from a Metrorail station. Greenbelt Alliance's jobs-rich and housing-rich calculations begin to address unbalanced growth in the region and should be incorporated into a more robust assessment.

Parking supply: URBEMIS's default assumptions (from ITE) about parking supply were one of the model's chief shortcomings. First, the model is not designed to consider parking supply for residential land use to avoid potential double counting of certain reductions. For example, close access to transit would allow for lower parking supply rates at a development, but the benefits of transit service are already accounted for in the model. However, low parking supply rates demonstrate a commitment to promoting alternatives to car use, can create additional incentive and self-selection for transit use, and should be assigned additional trip reduction credit. In the D.C. area, households without a single vehicle make up a sizable portion of residents in the core and inner suburbs. According to the 2000 Census, 37 percent of households in D.C. do not own a car. Low rates of car ownership extend into urban parts of inner suburbs, where 10 -15 percent of households do not own cars. The importance of parking in predicting vehicle trip generation and the low car ownership rates in many urban communities in the Washington D.C. region calls for a model that better recognizes the role of parking supply.

For office and retail, standard ITE parking supply assumptions are so great that even projects with typical parking rates for our region received a large reduction credit from the unmitigated scenario, which overwhelmed all other factors. For this reason, we eliminated consideration of the default parking value in our analysis. For example, the Tower Building provides parking consistent with the zoning requirements, offering 930 parking spaces for a ratio of 3.37 spaces for every 1,000 square feet. This standard parking ratio is awarded a 53 percent emissions reduction credit for its supply by the ITE parking ratios that are the default values in URBEMIS. In comparison, applying the aggressive rates that the LCOR Nuclear Regulatory Commission building fought for at the White Flint Metro Station (1.83 spaces for every 1,000 square feet) to the Tower Building would reduce parking supply to 505 spaces, a 46 percent decrease in spaces. For The Nature Conservancy Headquarters Building, officials approved a smaller parking supply with only 185 parking spaces (a rate of 1.08 spaces for every 1,000 square feet), instead of the already reduced 298 spaces required by the Metrorail Corridor standard rate.[57] Thus, the extremely generous credits (the 53 percent emissions reduction credit for the Tower building) given to relatively high parking ratios demonstrates that existing ITE expectations are inappropriate for this analysis and for this region. These expectations need to be recalibrated for further use of URBEMIS in this region.

ITE assumptions do not reflect the realities in more urban environments where mixed land uses and transit are common: In addition to the inflated assumptions for parking supply, the ITE default rates may be ill-suited for this region where transit ridership is higher than most regions in the country. For example, ITE has no category for ground floor retail located in a pedestrian-oriented building such as 5220 Wisconsin Ave., NW. We had to choose between large format retail (a.k.a big box) and "strip mall" as the type of retail. We chose strip mall. We included the "unmitigated" results in our report because ITE trip generation rates are still used as the default values for many, if not most, traffic analyses of development projects in our region and across the country. This means that modeling of walkable, mixed-use and transit-oriented developments with standard ITE numbers will tend to show higher trip generation than will turn out to be the case. The poor match of ITE land use assumptions to the study's projects point to the need for better data and better analytical approaches to assessing the traffic impacts of development, and the value of mitigating measures to reduce vehicle trips as a result of new development.

Standard menu of Transportation Demand Management (TDM) options would assist assessment: Information about TDM measures planned for development projects was inconsistent. A better listing of TDM options and what will be implemented in the project would have helped this analysis. TDM information was often buried in text or omitted because of iterative bargaining with public officials. Regional sharing of information on TDM initiatives and establishing consistent and standard TDM measures and reporting would assist in evaluating the role that TDM can play in reducing greenhouse gases in area development projects.

Sidewalk and bicycle infrastructure: Due to staff-time limitations, we were unable to provide a detailed analysis of each project's and comparison site's sidewalk and bicycle network. We assumed 100 percent sidewalk and zero percent bicycle infrastructure for each project. We originally assumed zero for both values. Changing assumptions from zero sidewalks to 100 percent sidewalks on both sides of the street improved the emissions reduction as much as 7 percent. This demonstrates the value of providing complete pedestrian accessibility.

High transit assumptions for Gaithersburg West may be somewhat speculative: For our analysis of the Life Sciences Center in the Gaithersburg West plan, we used the high levels of transit service proposed for the area – six minute headways (intervals) on-peak, ten minute off-peak. This is the same standard for the Purple Line. The Corridor Cities Transitway project, however, is less advanced than the Purple Line or City of Baltimore's Red Line. With typical Montgomery bus service, assuming 120 daily buses and no BRT/LRT service, URBEMIS model predicts that emissions would be 416,150 metric tons of CO_2 – an increase of 3.6 percent over the project build scenario with the Corridor Cities Transitway in place. Longer headways for the CCT would result in a benefit in between these two transit assumptions.

Transit levels of service – compiled into a Transit Service Index: Bus and BRT/Rail transit service inputs shown in Figures 2-5 and 2-6 show the discrepancy between different sites. To better understand the relative levels of transit service provided at each site, and to present URBEMIS's valuation of this service, we compiled a "Transit Service Index" – see Figure 4-1.

Figure 4-1

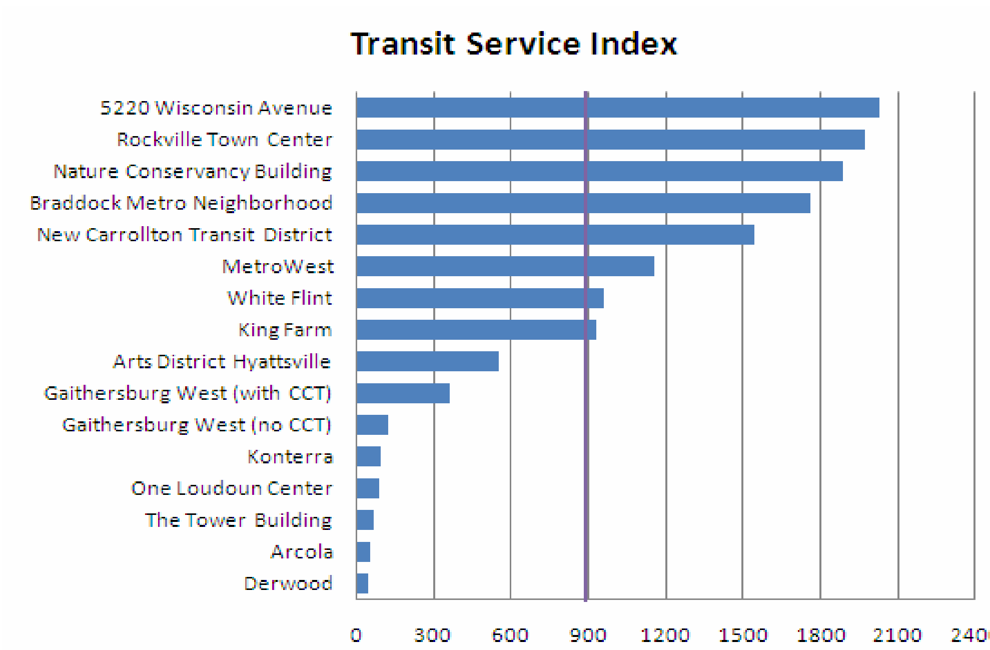


Figure 4.1: The Transit Service Index measures the number of buses, 2 x trains, 2 x shuttles per day for each site. URBEMIS assumes 900 is the point where maximum transit benefits are achieved and does not give additional credit above this level.

In URBEMIS, the Transit Service Index is determined as follows:

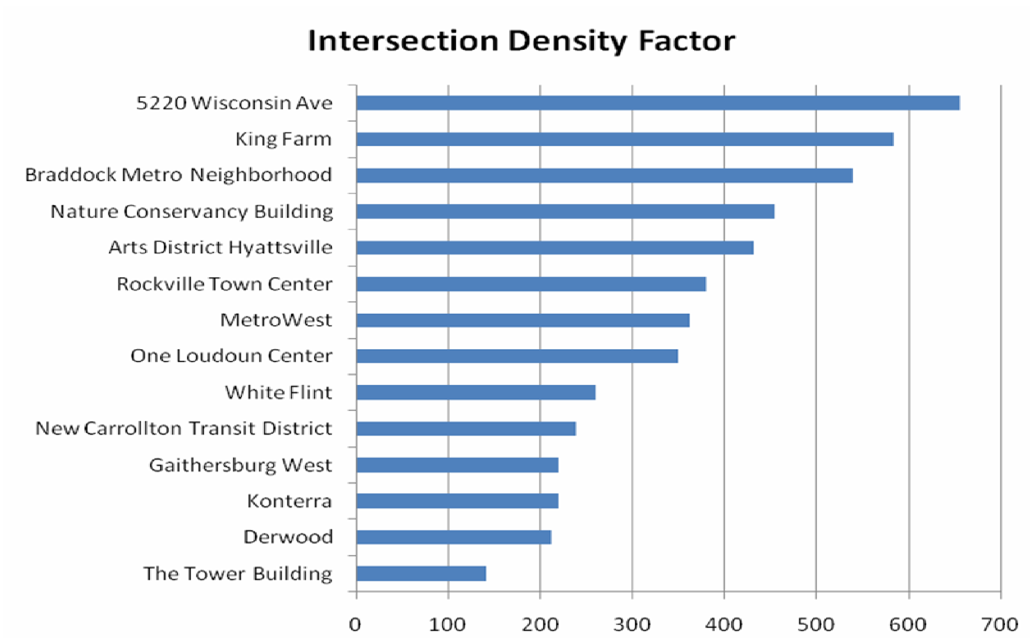
- number of average daily weekday buses stopping within a quarter of a mile of the site;
- plus *twice* the number of daily rail or bus rapid transit trips stopping within half of a mile of the site;
- plus *twice* the number of dedicated daily shuttle trips.

Unsurprisingly, the Transit Service Index reveals that Metrorail stations offer far more transit than non-Metro stations. These stations also offer extensive bus service. The extensive bus service accessible to the entire EYA Arts District project in the inner suburb of Hyattsville sets it above the level of transit service even for a CCT-served Gaithersburg West project; and far above other suburban sites with limited bus or rail access.

URBEMIS assumes that 900 is the point at which the maximum transit benefits are reached, so additional credit is not given above this level of service. This equates to a San Francisco BART station on a single line, plus four bus lines at 15-minute headways. We are unable to assess if this limit significantly undercounts the ridership (and vehicle trip and VMT reduction) potential of higher transit frequency services in our region. We consider this a limitation of the model and recommend that this assumption be assessed and adjusted to better account for our area's characteristics.

Commuter rail stations offer another opportunity to link development with transit. Compact, historic towns with a walkable grid of streets possess many of the beneficial features measured by URBEMIS and tying these communities with commuter rail service also reduces VMT and CO_2 emissions from long work trips. However, due to the limited number of daily trains from commuter rail services (12-50 trains/day on MARC and VRE service), new development tied to this type of transit should be scaled to the land use and density features of historic towns.

Figure 4-2



Intersection density: Given staff-time limitations, we used the Intersection Density Factor as the key variable in assessing pedestrian and bicycle friendliness. Urban designers and transportation planners generally agree that block sizes that encourage walking and bicycling should be ideally 200 feet to 400 feet but not exceed 600 feet.[58] Assuming the maximum number of four-legged intersections for 600 foot blocks within a square mile, the Intersection Density Factor would be 324. For 400 foot blocks, the Intersection Density Factor would be 784.

Street grid patterns typical of older neighborhoods stand out when evaluated using the Intersection Density Factor (see Figure 4-2). Braddock Road Metro neighborhood in Alexandria, Hyattsville, Wisconsin Ave., D.C., and the Nature Conservancy Building at the Ballston Metro station in Arlington are highly urban infill projects with Intersection Density Factors greater than 400. Greenfield sites, designed by urbanist architects and developers, have the ability to create fine-grained street grids. This is the case with the new urbanist development of King Farm, which has a factor of 583.

At the other extreme is the Tower Building site with large block sizes, sparse connectivity and an Intersection Density Factor of only 141. Several factors appear to contribute to this low figure: the building is located close to I-270 and next to a private golf course, which are significant barriers, and looping suburban roads offer limited connectivity. Few, if any, pedestrians are likely to walk to or from the site.

While the Gaithersburg West plan makes an effort to increase street connectivity the block sizes remain large compared to other new mixed-use suburban projects. The Intersection Density Factor at Gaithersburg West (220) is lower than project sites on Metro (e.g., MetroWest with a value of 362) and even other greenfield suburban locations (e.g., One Loudoun Center at 350).

Some suburban infill sites can face challenges in achieving sufficient intersection density. Because of the barriers created by above ground Metrorail, passenger rail and freight rail tracks, and freeways, the intersection density at White Flint (260) and New Carrollton (238) is not much higher than Gaithersburg West.

CO_2 emissions impact of conversion of natural lands into urban lands should be assessed: When land is converted from a naturally vegetated state to urban development, a certain amount of carbon is released from the soil into the atmosphere. This study did not attempt to assess this, but the Greenbelt Alliance has developed a calculation to assess this based on soil type. Expansion of Greenbelt Alliance's analysis would better capture the CO_2 emissions impact of the difference between greenfield and redevelopment of already urbanized land

Chapter 5 Recommendations

This analysis reinforces the potential traffic and CO_2 savings from regionally-accessible, transit-rich, compact, walkable development. The findings show that VMT and CO_2 savings between 8 and over 40 percent can be achieved with mixed-use, higher density, walkable, regionally accessible development. The results summarized in figures 3-4 and 3-5 illustrate the relative and absolute benefits of compact mixed-use, regionally accessible development.

Despite some limitations to URBEMIS, our analysis demonstrates the importance of locating growth in housing and jobs at high frequency transit nodes, and in urban and inner suburban infill locations with compact, walkable designs. The analysis also shows that higher density, mixed-use developments in outer areas perform better than standard single-use suburban development in these areas, but the lack of regional accessibility results in much higher CO_2 emissions than more accessible locations. Based on this analysis, we recommend the following:

1. **Implement a regional vehicle miles traveled (VMT) reduction goal** as proposed in the COG's Climate Change report to meet the CO_2 emissions reduction targets. While the new CAFE fuel efficiency requirement will slow the increase in emissions compared to the business-as-usual scenario, transportation emissions will still exceed goals by 35 percent in 2020 and 80 percent in 2030. This shortfall illustrates that even with fuel economy improvements much more is needed to reach regional mobile source CO_2 reduction goals. We recommend setting an aggressive VMT reduction goal by land use decisions to help the region meet its greenhouse gas reduction goals. To achieve this, we call on all level of government and business to do the following:

    - COG should develop an evaluation tool to assess land use and transportation decisions to support this VMT reduction goal.
    - COG should revise its "Regional Activity Centers" criteria and maps to add all existing Metro stations and older inner suburban commercial corridors for redevelopment, while reevaluating the number, size, and location of the distant suburban clusters.
    - All levels of governments, major employers, and institutions should do their part by locating activities near transit, as recommended by the COG report.

2. **Focus large-scale development at regional Metro stations:** Despite over three decades of Metrorail service, many stations remain underutilized. Metrorail stations should receive a significant share of the region's growth in order to provide greater regional accessibility for residents and jobs and reduce the carbon footprint of growth. Figure 3-5 illustrates this point – even a project with relatively good mixed-use design generates significantly higher emissions than a more regionally-accessible and compact site. For Metro stations not designed to serve regional-scale development, more housing and businesses can be accommodated at a moderate scale that carefully transitions into lower scale neighborhoods surrounding the station area.

3. **Make infill development and infill transit top priorities:** Increasing housing and jobs near existing transit and adding transit service to existing close-in communities will help maximize reductions in VMT and CO_2. These measures take advantage of compact, mixed-use urban neighborhoods, using frequent bus service or convenient access to a Metro station. By “infill transit,” we mean investing in cost-effective transit services that build on existing ridership and supportive land uses such as components of the WMATA Bus Priority Corridors Network, streetcar plans in D.C. and Arlington, the Purple Line in inner Montgomery and Prince George’s Counties, and funding for Metrorail and Metrobus to increase service. To a lesser extent, walkable, mixed-use development at commuter rail stations and increasing the frequency of commuter rail service, including mid-day service, will help to capture a larger share of work trips, which are the longest trips. On the other hand, outward, long distance extensions of commuter rail service and low frequency transit services can be extremely costly per rider without achieving much in CO_2 emissions reduction. The heavy cost of long distance transit extensions can also threaten the maintenance, operating and capital improvement budgets for existing transit service such as Metrorail.

4. **Increase employment centers on the east side of the region:** Prince George’s County’s fifteen Metro stations are among the county’s top assets, but the county has not seen the same growth in jobs as the west side of the region. Commitment by the State of Maryland and Prince George’s to increased job growth in compact, walkable, mixed-use environments around these Metro stations could greatly contribute to the region’s ability to reduce CO_2 emissions and improve the performance of the region’s transportation system. In addition, focusing job growth at Metro stations on the east side of the region will match employment opportunities with a larger housing stock affordable to more of the workforce.

5. **Create urban street grids and compact mixed-use development around high frequency transit.** This analysis demonstrates the importance of site-design – urban, walkable character, mix of uses, and an interconnected street grid of small blocks – for maximizing use of high frequency transit and walking for many trips. State and local policies too often require overly wide streets and long blocks. They also often neglect connectivity. All these characteristics severely undermine pedestrian and bicycle access to transit and commercial centers. To build truly accessible places, we recommend that area and state governments implement complete and green streets policies and street connectivity standards that require full integration of pedestrians and bicyclists into street layouts, both within and connected to surrounding neighborhoods. We also urge governments to reallocate scarce public funds to maintaining and improving existing transit services, pedestrian/bicycle facilities and “complete streets’ retrofits rather than funding new road and other infrastructure capacity expansions outside existing high transit districts.

   This analysis shows that some developments promoted as “town centers” do not achieve urban block dimensions or a compact mix of uses within walking distance. Local governments need to establish more stringent criteria to create highly connected street networks and mixed-uses proximate to each other and tied to major transit stations and corridors.

6. **Support further research to refine VMT and CO_2 emissions analysis for land use and transportation projects.** While our analysis was limited, it replicated the findings of national studies and reinforced the importance of smart growth land use and transportation investments for reducing greenhouse gas emissions. The state of the art is young and requires more refinement to sharpen analytical tools and data. We urge all levels of government to provide better data and to support improved models that are accessible and usable to the public. URBEMIS could be refined by better tailoring baseline assumptions to existing characteristics in the region and important key factors such as added CO_2 emissions from conversion of natural land cover and regional jobs/housing imbalance. A refined URBEMIS or similar land use/transportation model could be systematically applied by COG, local, and state governments to assess the CO_2 emissions impact of development proposals. This tool will help officials to guide the location and designs of development to meet climate protection goals while also creating more livable communities.

7. **Reduce development capacity outside high frequency transit districts.** Local land use plans throughout the region allow for large amounts of scattered, low density, single-use development that will generate disproportionately high levels of VMT and CO_2 emissions. This study demonstrates that low density development and poor street connectivity are the most inefficient and most polluting forms of growth. Thus, COG and local governments should commit to shifting development capacity permitted under current land use plans and zoning from areas that are not served by medium and high levels of transit. This development capacity should be allocated to districts within half of a mile of rail transit stations or high frequency bus corridors. Local governments should also avoid high amounts of growth in "town centers" far from regionally accessible sites, such as Metrorail stations or heavily served bus corridors. This analysis demonstrates that although high density mixed-use "town centers" reduce VMT per capita, the magnitude of developments far from high frequency transit will negate the benefit of reduced vehicle trips by increasing the length of commute trips as a result of poor regional accessibility. Priorities should be build-out of current and planned Metrorail stations and redevelopment of older commercial corridors with mixed-use and increased transit service on dedicated lanes (BRT or LRT).

Faced with the challenge of climate change, rising energy prices, and an era of shrinking government budgets, we must make wise decisions about land use and transportation investments. Fortunately, smart growth solutions will help us meet these new challenges while also addressing traffic congestion; lowering household transportation costs; cutting air pollution; reducing loss of forests, farms and natural habitats; and improving health and access to jobs.

Photo Credits

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Endnotes

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