# Transit-Oriented Development (TOD): A Solution for Reducing Greenhouse Gas Emissions

Why does it matter?

The transportation sector is the largest contributor to carbon pollution in the US. Within the sector, privately owned vehicles and medium- and heavy-duty trucks contribute 82% of the greenhouse gas (GHG) emissions.

Although many factors contribute to GHG emissions, driving is a huge contributor. Reducing the need for cars and the number of vehicle miles traveled (VMT) is a critical strategy in reducing emissions.

2017 U.S. Transportation Sector GHG Emissions by Source

- Light-Duty Vehicles – 59%
- Medium- and Heavy-Duty Trucks – 23%
- Aircraft – 9%
- Other – 4%
- Rail – 2%
- Ships and Boats – 3%
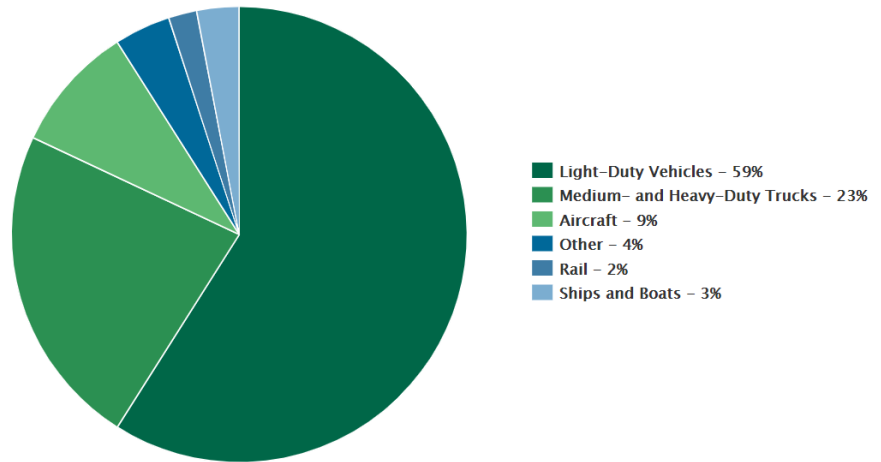
Note: Totals may not add to 100% due to rounding. Transportation emissions do not include emissions from non-transportation mobile sources such as agriculture and construction equipment. "Other" sources include buses, motorcycles, pipelines and lubricants.

Image Credit: US Environmental Protection Agency[i]

What is transit-oriented development?

Transit-oriented development (TOD) is a land use strategy that focuses on building mixed-use, compact, walkable, and transit-accessible communities. Great examples of TOD in the DC region include Arlington County in Virginia, Downtown Silver Spring in Montgomery County, and a significant portion of the District of Columbia.

GHG and VMT are intertwined – reducing VMT is a primary tool for reducing GHG emissions from transportation. The best way to reduce VMT is by building transit-oriented communities. In these communities, proximity to daily needs and jobs, access to walking, bicycling, and public transit are maximized, and reliance on single-occupancy vehicles is minimized.

How can transit-oriented development help to reduce greenhouse gas emissions?

Summary of findings from Coalition for Smarter Growth and partner reports:

- **GreenPlace (2016) by Coalition for Smarter Growth (CSG)[ii]**
  - A study of five transit-oriented projects in DC showed daily household VMT and CO2 output per household to be far lower than regional averages.

- **Cool Communities (2010) by Coalition for Smarter Growth (CSG)[iii]**
  - Location, not just design, of development makes a huge difference. Hypothetical relocation of TOD projects to non-TOD suburban locations in the DC region increased CO_2 emissions. Conversely, hypothetically relocating a non-TOD suburban development to a suburban TOD location reduced CO_2 emissions.
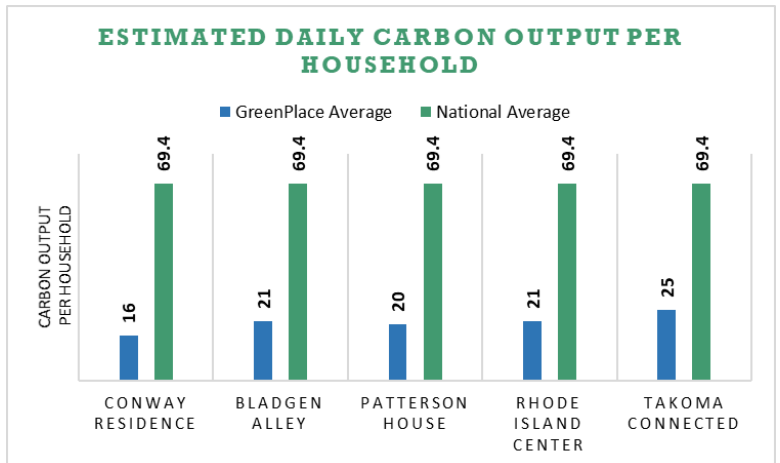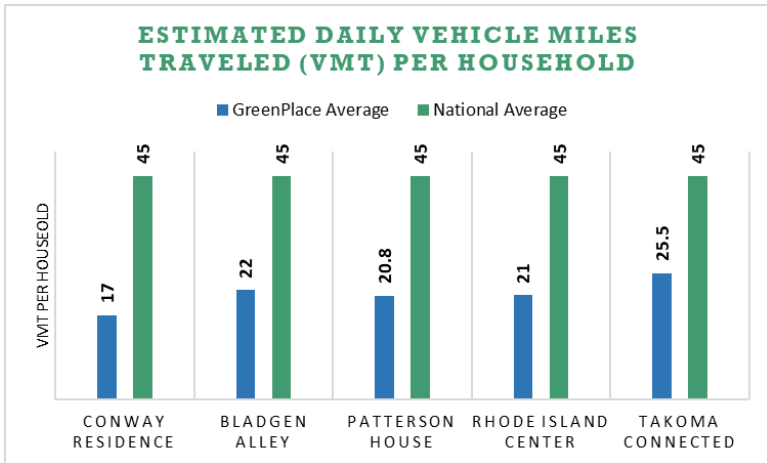
- **Growing Cooler (2008) by Reid Ewing, Kevin Bartholomew, Steve Winkelman, Jerry Walters, and Don Chen[iv]**
  - Proximity of homes, jobs, and services directly correlates to VMT reduction – the more compact an area, the lower the VMT per capita.
  - Living in a moderate to higher density, mixed-use neighborhood increases the probability that a household will commute by transit and own fewer cars.

- **Commuter Connections 2016 State of the Commute Survey (2018) by Metropolitan Washington Council of Governments (MWCOG)[v]**
  - In areas where transit is more accessible, like Arlington County, VA and Washington DC, people are 60% more likely to commute by bus, train, walk, or bicycle.

- **2019 State of the Commute Survey (2019) by Metropolitan Washington Council of Governments (MWCOG)[vi]**
  - In the National Capital region, those residing in outer ring suburbs (Calvert, Charles, Frederick, Loudoun, Prince William) and middle ring suburbs (Fairfax, Montgomery, and Prince George's) are much more likely to drive than residents living in the inner core

- **The Housing and Transportation (H+T® Index) Affordability Index by Center for Neighborhood Technology (CNT)[vii]**
  - Arlington, the largely transit-oriented county, had lower VMT and GHG emissions per household, and higher rates of transit ridership among workers than more suburban Loudoun County.

GreenPlace by CSG

ESTIMATED DAILY VEHICLE MILES TRAVELED (VMT) PER HOUSEHOLD

Legend: ■ GreenPlace Average ■ National Average

VMT PER HOUSEHOLD

	CONWAY RESIDENCE	BLADGEN ALLEY	PATTERSON HOUSE	RHODE ISLAND CENTER	TAKOMA CONNECTED
GreenPlace Average	17	22	20.8	21	25.5
National Average	45	45	45	45	45

ESTIMATED DAILY CARBON OUTPUT PER HOUSEHOLD

Legend: ■ GreenPlace Average ■ National Average

CARBON OUTPUT PER HOUSEHOLD

	CONWAY RESIDENCE	BLADGEN ALLEY	PATTERSON HOUSE	RHODE ISLAND CENTER	TAKOMA CONNECTED
GreenPlace Average	16	21	20	21	25
National Average	69.4	69.4	69.4	69.4	69.4

Transit-oriented communities averaged 17 to 25.5 vehicle miles traveled (VMT) per household and 16-25 lbs of daily carbon output per household, compared to regional averages of 45 VMT and 69.4 lbs daily carbon output.

Cool Communities by CSG

Project	Comparison Site (stimulated relocation of project)	% Change in CO2 emissions project vs. comparison site
New Carrollton Transit District (MD)*	Konterra Town Center (MD)	-11.2%
White Flint Sector Plan (MD)*	Gaithersburg West area (MD)	-12.3%
Gaithersburg West Life Sciences Center (MD)	White Flint (MD)*	+9.7%
One Loudoun Center (VA)	Route 772 Metrorail Station (VA)*	+13.8%
MetroWest, Vienna-Fairfax-GMU Metro (VA)*	Arcola Center (VA)	-13.5%
Braddock Metro Neighborhood Plan (VA)*	Lorton (VA)	-27.1%
King Farm (MD)*	Relocation of residential uses to Derwood in suburban form (MD)	-41.8%
EYA Arts District Hyattsville (MD)*	Konterra Town Center (MD)	-7.9%
The Tower Building (MD)	Rockville Town Center (MD)*	+16.1%
Nature Conservancy Building (VA)*	Office park in Reston (VA)	-12.6%
5220 Wisconsin Avenue (DC)*	Gaithersburg West area (MD)	-20.3%

A site with high walkability, mix of uses, and frequent transit service will have reduced CO2 emissions (negative value) compared with a less accessible site. For example, the New Carrollton plan reduces CO2 emissions by 11.2% when compared against relocating the plan build-out to Konterra.
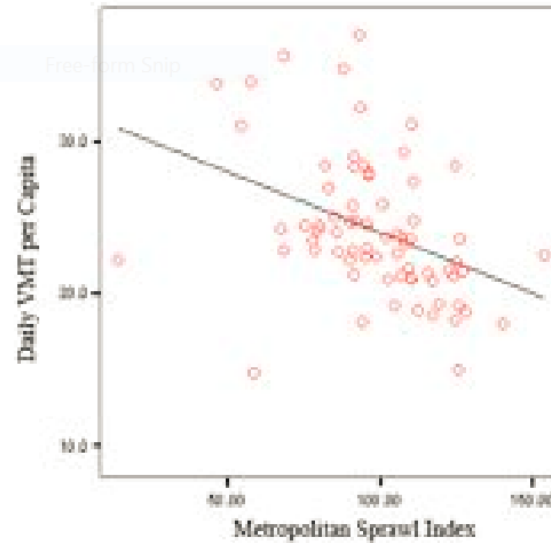
Note:
* = Indicates a site that has high walkability, mix of uses, and frequent transit services.

Figure 3-5 Simple Correlation between Daily VMT per Capita and Metropolitan Sprawl Index*
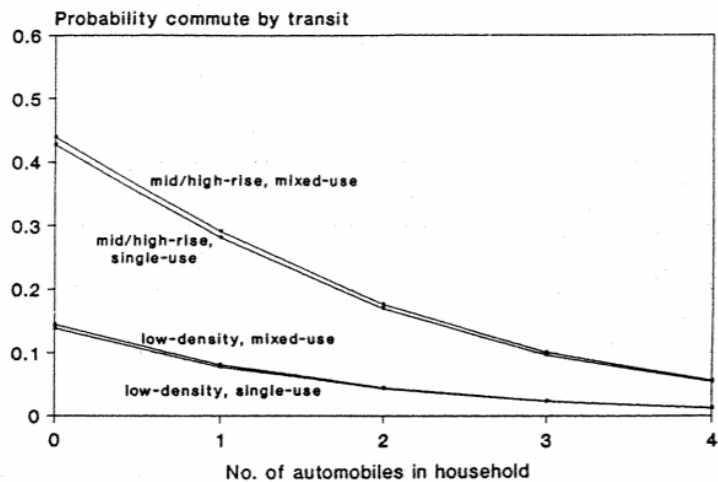*Source: Ewing, Pendall, and Chen 2002.*

*Larger index values = less sprawl.

The more compact an area is, the lower the VMT per capita.

Figure 3-11 Effects of Density and Mixed Use on Choice of Transit for Commutes*
Source: Cervero 1996.

*Data for more than 45,000 U.S. households showed transit use primarily dependent on density of development. At higher densities, the addition of retail uses in neighborhoods was associated with several percentage point higher levels of transit commuting across 11 U.S. metropolitan areas.

Living in a mid/high-rise, mixed-use neighborhood increases the probability that a household will commute by transit and own fewer cars.

Commuter Connections 2016 State of the Commute Survey by MWCOG

Table 6
Commute Mode (Primary Mode)
by Home and Work Locations – Arlington and Neighboring Jurisdictions

Mode by HOME Jurisdiction	Arlington (n = 504)	Alexandria (n = 473)	District of Columbia (n = 557)	Fairfax (n = 552)	Suburban Maryland* (n = 1,004)
Drive alone	44%	59%	34%	67%	65%
Bus or train	38%	18%	40%	15%	19%
Carpool or vanpool	3%	3%	4%	4%	4%
Bike or walk	6%	7%	15%	1%	2%
Telework / CWS	9%	13%	7%	13%	10%

| Mode by WORK Jurisdiction	Arlington (n = 404)	Alexandria (n = 293)	District of Columbia (n = 1,711)	Fairfax (n = 871)	Suburban Maryland* (n = 961)
Drive alone	55%	72%	37%	76%	73%
Bus or train	23%	11%	43%	6%	12%
Carpool or vanpool	8%	3%	6%	3%	6%
Bike or walk	4%	4%	6%	1%	3%
Telework / CWS	9%	10%	8%	14%	6%

* Suburban Maryland counties includes Montgomery County and Prince George's County

When comparing commute mode by home jurisdiction, Arlington residents are more likely to take the bus or train (38%) than their Fairfax County counterparts (15%). Workers in Arlington County are also more likely to take the bus or train (23%) than workers in Fairfax County (6%).

2019 State of the Commute Survey by MWCOG

Figure 9
Primary Mode by Home Area
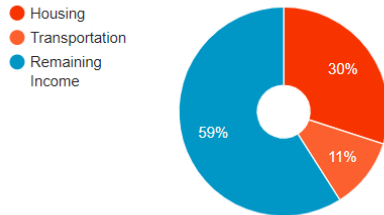(Inner Core n = 2,198, Middle Ring n = 2,421, Outer Ring n = 4,488)
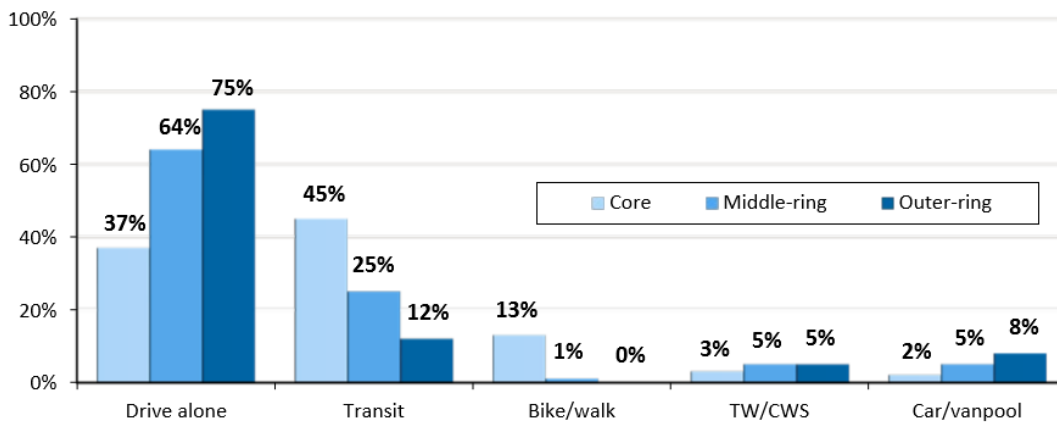
In the National Capital Region, driving alone was much more common among outer ring (75%) and middle ring (64%) residents than among inner core residents (37%).

The Housing and Transportation (H+T®) Affordability Index by CNT
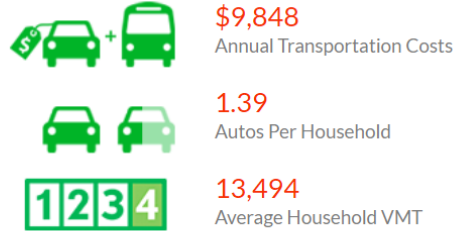
Arlington County

Average Housing + Transportation Costs % Income

Factoring in both housing *and* transportation costs provides a more comprehensive way of thinking about the cost of housing and true affordability.

- Housing
- Transportation
- Remaining Income

30%
11%
59%

Transportation Costs

In dispersed areas, people need to own more vehicles and rely upon driving them farther distances which also drives up the cost of living.

$9,848
Annual Transportation Costs

1.39
Autos Per Household

13,494
Average Household VMT

26%
Transit Ridership % of Workers

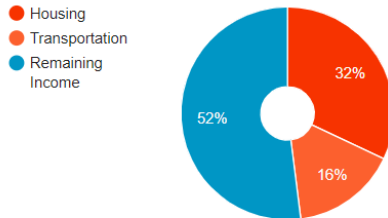**33**
Annual Transit Trips

5.05 Tonnes
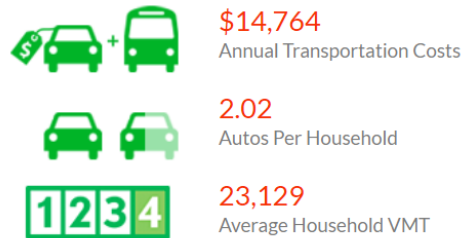Annual Greenhouse Gas per Household

Loudoun County

Average Housing + Transportation Costs % Income

Factoring in both housing *and* transportation costs provides a more comprehensive way of thinking about the cost of housing and true affordability.

- Housing
- Transportation
- Remaining Income

32%
16%
52%

Transportation Costs

In dispersed areas, people need to own more vehicles and rely upon driving them farther distances which also drives up the cost of living.

$14,764
Annual Transportation Costs

2.02
Autos Per Household

23,129
Average Household VMT

3%
Transit Ridership % of Workers

10
Annual Transit Trips

10.26 Tonnes
Annual Greenhouse Gas per Household

A Virginia example: Arlington County is a great example of a place that has focused on building transit-oriented and compact communities. Loudoun County, on the other hand, is more suburban, spread-out, and auto-dependent.

In Arlington, 26% of workers ride transit, compared to 3% in Loudoun. Average household VMT is 13,494 in Arlington, compared to 23,129 in Loudoun. Additionally, the annual GHG emissions per household is much smaller in Arlington (5.05 tonnes) than in Loudoun (10.26 tonnes).

Contact

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Sources

[i] Image credit: Environmental Protection Agency. Fast Facts on Transportation Greenhouse Gas Emissions. https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions

[ii] Coalition for Smarter Growth (CSG). (2016). GreenPlace. https://www.smartergrowth.net/greenplace/

[iii] Coalition for Smarter Growth (CSG). (2010). Cool Communities. https://www.smartergrowth.net/resources/cool-communities-2/

[iv] Ewing, R., Bartholomew, K., Winkelman, S., Walters, J., and Chen, D. (2008). Growing Cooler: The Evidence on Urban Development and Climate Change. https://www.nrdc.org/sites/default/files/cit_07092401a.pdf

[v] Metropolitan Washington Council of Governments (MWCOG). (2018). Commuter Connections 2016 State of the Commute Survey. https://mobilitylab.org/research-document/regional-state-of-commute-survey-2016-arlington-analysis/

[vi] Metropolitan Washington Council of Governments (MWCOG). (2019). 2019 State of the Commute Survey. https://www.mwcog.org/newsroom/2019/09/24/three-big-takeaways-from-the-2019-state-of-the-commute-survey/

[vii] The Center for Neighborhood Technology (CNT). The Housing and Transportation (H+T®) Affordability Index. https://htaindex.cnt.org/