
DECEMBER 2016

# TRANSPORTATION IMPACT ANALYSIS – FUTURE CONSIDERATIONS WHITE PAPER

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# INTRODUCTION

This white paper describes a series of policy and technical considerations for potential future advancements to the Transportation Impact Analysis (TIA) process within the City of Alexandria, Virginia. This paper has been developed in conjunction with the winter 2016/2017 series of amendments to the City's TIA process. The current TIA amendments are generally of a minor administrative nature, but provide a useful opportunity to open a dialogue with constituents interested in the development review process on other, more substantial, changes that could be considered in the future based on the evolving state of the practice.

The following discussion topics are organized in a generally descending order of their current potential to affect substantial changes to the TIA process:

- Considering pro-rata share districts, which can replace traditional TIA processes for each development with a consolidated areawide approach to implementing planned transportation system elements.
- Synchronizing Alexandria's TIA and Transportation Management Plan (TMP) processes
- Considering impacts of person trips (and mode share) in contrast to vehicle trips as the basis for TIA impacts, with a link to TMP effectiveness
- More fully integrating parking management and TIA approaches
- Considering vehicle miles of travel (VMT) as a regulatory metric, an approach currently underway in California through Senate Bill 743 implementation
- Considering how autonomous vehicles could affect travel demand and therefore be incorporated within the TIA process

# PRO RATA SHARE DISTRICTS

$$\text{PRO RATA SHARE} = \frac{\text{private sector funding for total system supply}}{\text{unit of development demand}}$$

A pro-rata share district leverages the private sector role towards implementing a comprehensive plan holistically, rather than incrementally. In a pro-rata share district, each development contributes resources (whether facility construction or funding) towards a well-defined set of projects with the contribution defined in proportion to the relative level of demand contributed by that development. The pro-rata share concept can be expressed as a fraction in which the numerator is the private sector funding for total system supply and the denominator is the unit of development demand. The most typical assignment of supply and demand variables is "dollars per trip". For instance, if a pro-rata share district will need $5M of private-sector infrastructure investment and generate 5,000 new vehicle trips, the pro-rata share for each development is $1,000/vehicle trip. The units can be changed to incorporate persons rather than vehicles, total miles of travel rather than trips, or various options for considering the net present value of funding needs, but the general concept of numerator and denominator remain the same.

Beyond this basic concept, the details of defining the numerator and denominator vary from place to place; they are dependent upon the physical, environmental, and political context.

The primary advantages of a pro-rata share district are to:

- Limit the “free rider” or “last in” problem associated with typical threshold-based TIA approaches in which exactions are based more on timing than impact (i.e., 95% of available or remaining system supply might be used by the free-riders with the full burden of improvement imposed upon the applicant using the last 5%),
- Focus exaction efforts on planned system improvements rather than identifying ad-hoc improvements (even though based logically on TIAs) that may not contribute to the desired end state, and
- Measure success more through implementation of both the planned private infrastructure (planned land development per zoning) and public infrastructure (a multimodal transportation network in a comprehensive plan) than by mitigation based on site-specific level of service (LOS) or quality of service (QOS) objectives.

The principal argument against a pro-rata share district is that its establishment and maintenance requires a significant amount of up-front collaboration among a variety of stakeholders to define how the contributions will be defined and administered over time. Successful pro-rata share districts share several common elements:

- A compact geographic area, generally several hundred acres in size, that is large enough to leverage participation among multiple property owners but small enough to focus administrative efforts on specific implementation objectives at a high level of detail
- An inventory of unbuilt transportation system needs and expected levels of private development that facilitates the definition of an appropriate relationship between future supply and demand
- A reflection of the needs and interests of constituents including public sector agencies, the residences and businesses they represent, and the development community
- Coordination with state, regional, and local implementers and operators, as the pro-rata share district will typically, but not necessarily, be designed to address facilities that are the responsibility of the local jurisdiction
- Regular monitoring and revision processes and schedules, typically on a regular four to six-year cycle that establishes a relative level of predictability for the development market yet is designed to incorporate changes to local and regional variables over time.

The importance of developing a pro-rata share for a compact geographic area is related primarily to the value of focusing on project-level (both private land use projects and public infrastructure projects) plans and outcomes and tailoring the district to the needs and interests of the local community (even if under a jurisdiction-wide umbrella policy), much in the same manner and for the same reasons that small area plans are developed to update a comprehensive master plan. The development (or maintenance) of a pro-rata share district commensurate with a small area plan amendment is therefore logical practice, but not a prerequisite.

## Examples Nationwide

**Montgomery County, MD** established a pro-rata share approach for the 430-acre White Flint Sector Plan. The White Flint Special Taxing District takes the form of an ad valorem tax on all commercial properties that replaces Local Area Transportation Review (LATR) traffic studies and impact taxes for new development. The ad valorem tax incorporates funding for elements that are beyond typical LATR improvements such as the redesign of a mile of Rockville Pike for BRT within the Plan area and a second entrance to the Metrorail station. The tax does not include any changes beyond the study area (although five intersections were analyzed and considered for funding during the Plan development). Further, potential master planned improvements were distributed among three "buckets" of funding; private sector "on-site" streets, projects funded by the Special Taxing District revenue, and projects funded through other public sector sources.

http://www.montgomerycountymd.gov/council/resources/files/res/2010/20101130_16-1570.pdf

http://www6.montgomerycountymd.gov/content/council/pdf/agenda/cm/2010/101109/20101109_PHEDMFP1-2.pdf (see p. 33/35 of PDF)

Montgomery County is developing a second pro-rata share district for the White Oak Science Gateway sector plan area, where discussions are currently underway regarding the extent of intersections to be analyzed (and potentially, but not necessarily, funded) from the Pro-Rata Share approach.

http://www.montgomerycountymd.gov/council/Resources/Files/agenda/col/2015/150428/20150428_5.pdf

In November 2016, the Montgomery County Council adopted an amended subdivision staging policy that signals their intent to continue to develop additional pro-rata share districts to replace the Local Area Transportation Review (LATR) process.

The following table demonstrates how the characteristics of Montgomery County's established White Flint district, pending White Oak district, and potential future areas are customized to the needs and interests of local stakeholders. One such area is the Bethesda Downtown area which is currently the subject of a small area plan amendment. This material in this table was presented by Eric Graye of the Planning Department in ITE's November 2016 webinar "The Traffic Study is Dead – Long Live the Transportation Impact Study".

| *Characteristic* | White Flint | White Oak | Other Areas Like Bethesda |
|---|---|---|---|
| *Funded by* | Special taxing district | LATR fee in lieu | TBD |
| *Applies to* | All commercial properties | New development | New development? |
| *Funding for* | Agreed upon set of multimodal projects | Intersection improvements<br>Bike/ped improvements | Bike-sharing?<br>Street-scaping?<br>Buffered bike lanes?<br>One-way streets?<br>Purple Line? |
| *Calculation basis* | Capital cost of projects | Capital cost of projects | Capital cost of projects? |
| *Payment basis* | Annual ad-valorem tax | One-time vehicle trip generation fee | One-time vehicle or person trip generation fee? |
| *Replaces* | LATR, Policy Area Review, and impact tax | LATR | LATR and impact tax? |
| *Includes transit facilities?* | Yes, as negotiated | No | BRT? |
| *Includes operations?* | No | No | Transportation Management District /parking? Transit? |
| *Extends beyond plan area?* | No | Yes (2 intersections beyond) | BRT Corridors? |
| *Interim monitoring?* | Staging plan, Transportation Management District biennial reports, mode shares | Transportation Management District biennial reports, other? | Transportation Management District biennial reports, other? |
| *Costs updated?* | Never? | To be determined | Every 4 years? |

**The City of Portland, Oregon** has established two Transportation System Development Charge (TSDC) overlay zones, where the TSDC (similar to Montgomery's transportation impact tax) has been increased to provide funds for local contributions to a series of targeted projects, including the City's $55M contribution to the $1.5B Portland-Milwaukie Light Rail project. TSDC charges citywide can be paid up front or in installments, with interest, for up to 20 years. The

TSDC is supplemental to the land use review process but plays a key role in several similar overlay districts where development only has an impact for levels above and beyond that explicitly included in a local master plan that informs the TSDC rates.

**The City of Baltimore, MD** establishes fees for their Traffic Mitigation Zones in the central part of the city based on 10-year programmed improvements with the possibility of updating fees every five years.

**The Delaware Department of Transportation** has established a Transportation Improvement District (TID) process for a Pro-Rata Share approach that is implemented in coordination with local jurisdictions as needs arise, with parameters defined to meet those needs. Horizon years are generally 20 years in the future and incorporation of the TID parameters are part of the comprehensive plan.

The **state of Florida has initiated Mobility Fee programs** to implement both short-term and long-term needs, although like most impact fee programs (and both the calculation, and implementation, of Montgomery's impact tax), they do not necessarily abolish traffic impact study requirements. Smaller jurisdictions, like Temple Terrace, Kissimmee and Destin, have sufficiently defined **Multimodal Transportation Districts** to identify and fund sidewalks, bike paths, and transit circulator services. Larger jurisdictions tend to pursue a consumption-based approach that considers average unit costs for roadway based improvements (i.e., the total number of arterial lane miles needed), with the assumption that multimodal elements of the roadway are incorporated in those costs. Osceola County's current examination of a Mobility Fee provides one example of this consumption based approach to replace their current Road Impact Fee:
http://www.osceola.org/core/fileparse.php/2731/urlt/040915_Mobility_Fee_Study.pdf

## Relationship to CDDs and SAPs

In a sense, the current application of TIA analyses for Coordinated Development Districts (CDD) and Small Area Plans (SAP) could be thought of as background analysis for establishing a pro-rata share district.

One of the concepts explored in the comments from practitioners on the TIA process was the potential for CDD and SAP findings to be codified as applicable for the Development Special Use Permit (DSUP) process.

The primary advantages of applying CDD and SAP findings to subsequent DSUP applications are that the analysis and assessment of the potential mitigations can be identified in a holistic manner at the CDD/SAP stage and phased in logical stages, as opposed to assessing piecemeal improvements at each stage of the project that might not yield as coherent or valuable a completed network at end state.

The primary drawback of this process is that the entitlement allows the applicant to have "first in" status, using development capacity that warrants their being considered as background traffic in studies for subsequent nearby development sites. The adverse effects of this drawback can be reduced with clearly agreed upon triggers and timelines for entitlement expiration in the event that the development project schedule is delayed.

A secondary drawback is that it is possible for "on the ground" conditions to change so that the proffer determined at the time of zoning or concept plan is no longer as valuable when the

development phases require delivery of the proffer. The adverse effects of this drawback can be reduced by agreed upon levels of change (perhaps total traffic volumes or neighborhood development types) that would trigger the need to renegotiate the proffer.

## SYNCHRONIZING TMP AND TIA REQUIREMENTS

The focus of the current amendment effort is on the Transportation Impact Analysis (TIA) process, which guides the development of one-time mitigations to mitigate adverse effects of proposed site plan development on the transportation system as authorized by Section 11-709 of the city's zoning ordinance.

The Transportation Management Plan (TMP) process, authorized by Section 11-700 of the ordinance, administers the continuing travel demand management efforts of larger development sites with a focus on multimodal operations and reducing reliance on single-occupant vehicle travel.

The City's process currently has similar, yet different, thresholds for Transportation Management Program (TMP) and TIA requirements. In both cases, developments are categorized into three tiers that can be described as small, medium, or large. The thresholds for these three tiers vary substantially as indicated in the table below; the TIA thresholds of 50, 100, and 250 peak hour vehicle trips are generally higher than those for TMPs, although the TIA thresholds are dependent on the specific land use codes in the ITE Trip Generation Manual, so this table provides more of a sense of scale than a definitive finding.

| Land Use | | Thresholds for TMP Zoning Ordinance Section 11-704 | | | Vehicle Trips Generated by TMP Thresholds | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minimums triggering: | | | Assumed | AM Peak Hour | | | PM Peak Hour | | |
| | | Tier 1 | Tier 2 | Tier 3 | ITE LUC | Tier 1 | Tier 2 | Tier 3 | Tier 1 | Tier 2 | Tier 3 |
| Residential | DU | 21 | 100 | 350 | 230 | 9 | 44 | 154 | 11 | 52 | 182 |
| Commercial/professional office | KGSF | 10 | 100 | 250 | 710 | 16 | 156 | 390 | 15 | 149 | 373 |
| Retail* | KGSF | 10 | 75 | 150 | 820 | 10 | 72 | 144 | 37 | 278 | 557 |
| Hotel | Rooms | | 30 | | 310 | | 19 | | | 22 | |
| Industrial/warehouse | KGSF | | 30 | | 151 | | 1 | | | 1 | |
| | | | | | | Small | Medium | Large | | | |
| Comparison - Peak Hour Thresholds for TIA: | | | | | | 50 | 100 | 250 | | | |

* Note: Retail has a second trigger in Section 11-704 referencing "small" study trip generation total of 50 trips if KGSF > 3.

Future consideration might be given to synchronizing these approaches to some degree, with three basic possibilities:

**Full synchronization**: It might be desirable to fully synchronize the tiers so that the TMP requirements are associated with the development site levels identified by trip generation in the TIA, and only one threshold is needed. However, one advantage of the TMP thresholds is their simplicity using only broad five types of land uses and development size rather than more complex trip generation rates. This simplicity provides greater utility for TMP requirements, particularly as the TMP program, focused as it is on system operations more than capacity, may evolve to cover existing uses, or to incorporate site evolution over time such as replacement of a retail tenant with relatively low trip generation rates (such as a caterer) with one who has

similar building program needs but a higher trip generation rate (such as a coffee shop) and doesn't require a full site plan modification.

**Partial synchronization**: It may be desirable to bring the vehicle trip generation thresholds closer together by raising the TMP thresholds somewhat to be more in alignment with the TIA thresholds. This evaluation should consider the relative effectiveness of the TMP programs to date in relation to the administrative costs for both the city staff and the private TMP partners.

**Threshold clarification**: At a minimum, since both TIA and TMP are guided by Section 11-700 of the zoning ordinance, it will likely be useful to clarify how the two processes are differentiated within the zoning ordinance and their related administrative elements.

## CONSIDERING PERSON TRIP GENERATION

Across the nation, jurisdictions are realizing that the consideration of multimodal travel demands needs to become both more accurate and more precise. The Institute of Transportation Engineers (ITE) has recognized this need in a full revamping of their "how-to" guide on trip generation, called the Trip Generation Handbook, which is a companion to the more frequently referenced "Trip Generation" (aka Trip Generation Manual) compendium of observed vehicle trip generation rates compiled from studies nationwide. The first two editions of the Trip Generation Handbook, published in 2001 and 2004, provide guidance on nuances such as pass-by trips and internal trip capture in mixed use activity centers, but remain oriented on vehicle trips. The 3rd edition of the Trip Generation Handbook was published in draft form (as a Proposed Recommended Practice) in August 2014 and proposes a sweeping change from a vehicle-trip orientation to a person-trip orientation. In most suburban and rural environments, the 3rd edition recognizes that vehicle trips may continue to be the only mode which warrants quantitative analysis. However, the handbook recommends "thinking" in terms of person trips and then assigning those trips to each mode of travel, particularly important in environments such as mixed use centers, transit-friendly developments, and infill developments, where the NADMS non-auto drive mode share will be substantially higher than the primarily suburban environments for which the Trip Generation Manual has vehicle trip generation rates.

The 3rd Edition of the Trip Generation Handbook provides available information to estimate NADMS for vehicle trip generation rates for many common land use codes. In suburban environments, the primary component of NADMS is auto passengers; Table C.3 of the draft Trip Generation Handbook demonstrates that for most uses, each auto tends to carry between 1.1 and 1.4 persons (i.e., with an average auto occupancy of 1.25, even if there are zero walk, bike, and transit trips, the NADMS equals 20%).

Montgomery County, MD is in the process of developing context-sensitive multimodal trip generation rates within Montgomery County that pivot from ITE vehicle trip generation rates based on policy-area factors derived from the MWCOG regional travel demand model (also described as the TPB model Version 2.3). ITE trip generation rates are generally based on surveys in suburban areas and are not representative of most of the Montgomery County development environment. Factors created using the TPB Travel Forecasting Model are created by policy area and land use. The framework for this methodology is based on NCHRP Report 758, Trip Generation Rates for Transportation Impact Analyses of Infill Developments. Chapter 4 of NCHRP Report 758 provides a framework to compute the mode share percent of person

trips based on factors from a household travel survey such as that used by MWCOG to help calibrate the regional travel demand model:

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_758.pdf

## INTEGRATING PARKING MANAGEMENT

Substantial research is underway on linking parking to trip generation and mode share behavior, particularly regarding multifamily residential developments (with or without ground-floor retail).

*Editor's note: this is a topic area that might wisely be deferred until after TRB. DDOT has some ongoing research being presented that has found a preliminary relationship between parking supply and vehicle trip generation rates; not clear to me yet how applicable this will be even five miles away in Alexandria.*

The **Montgomery County Planning Board** has developed an approach to allow applicants to propose reduce vehicle trip generation rates if they are conditioned to reduced on-site parking below the "baseline minimum" amounts and provide specific complementary travel demand management actions, both as specified in the zoning code.

Research suggests that there is a correlation between parking supply and vehicle trip generation, particularly when applied in a supportive parking-pricing environment with alternative transportation options. Applicants may reduce trip generation rates if, per Section 59.6.2.4 of the County Code, they propose parking ratios lower than the baseline minimums that include specific supportive actions identified to reduce parking demand.

For residential uses, each 2 percent reduction in parking below the minimum number of spaces yields a 1 percent reduction in vehicle trip generation rates for that use. This relationship is based on the equation in Table 2-9 of the Transportation Research Board's TCRP Report 128, "Effects of TOD on Housing, Parking, and Travel". Applying this equation to a prototypical TOD site with 10 DU/acre, a ratio of 1 parking space per dwelling unit would yield 0.24 peak hour vehicle trips and a ratio of 0.5 parking spaces per dwelling units would yield 0.18 peak hour vehicle trips (in other words, a 50% reduction in parking yields a 25% reduction in vehicle trips).

For office uses, each 3 percent reduction in parking below the minimum number of spaces yields a 1 percent reduction in vehicle trip generation rates for that use. This relationship is based on the relationships shown in Figure 6-9 of a 2004 report by Lund, Cervero, and Willson for Caltrans "Travel Characteristics of Transit Oriented Development in California", which shows that in a transit/TDM rich environment a similar reduction from 1.0 to 0.5 parking spaces at an office site could be expected to increase transit mode share from 41% to 50% (which for simplicity sake is assumed to equal a reduction in auto mode share from 59% to 50%). In other words, in this case a reduction of 50% of parking spaces reduces auto trips by about 15%, or roughly a 3:1 ratio.

# CONSIDERING VEHICLE MILES OF TRAVEL

Vehicle miles of travel (VMT) combines vehicle trip generation with average trip length. From a holistic planning perspective, VMT is more directly correlated than vehicle trip generation with most auto-related measures of effectiveness, including congestion, emissions, fuel consumption, and carbon footprint.

The adoption of **California's Senate Bill #743 (SB 743)** removing the state requirement for auto Level of Service (LOS) in the California Environmental Quality Act (CEQA) requirements has focused renewed attention on VMT as a potential evaluation metric for a variety of purposes, including development review. This is partly because California's Office of Planning and Research (OPR) has suggested that state agencies and local jurisdictions conducting CEQA reviews consider VMT as a replacement measure for auto LOS. The conversation at both state and local levels is expected to continue through most of 2017 as individual jurisdictions consider whether they want to retain auto LOS. The conversion from LOS to VMT is an option for localities – SB 743 removes the consideration of auto LOS as an adverse impact from the perspective of state agencies, but does not mandate local jurisdictions stop using auto LOS) or replace with VMT or any other metric.

The OPR also suggests VMT be used first as a means for identifying a trigger for further study, with a suggestion that any development (or public agency action such as building a road or transit line) that generates per-unit VMT (i.e., per capita, per square foot, etc.) at a rate less than the regional average be considered to have no significant impact on transportation, unless any of several safety-related measures are triggered.

The implementation of SB 743 has taken roughly three years to date, from Governor Brown's signature in October 2013 through the release of OPR's second set of implementation guidelines in January 2016:

https://www.opr.ca.gov/docs/Revised_VMT_CEQA_Guidelines_Proposal_January_20_2016.pdf

The guidelines recommend a two-year "opt-in" period for local jurisdictions to explore and develop any necessary changes to their local processes to leverage the change in the state law. SB 743 is widely heralded as signaling "the end of LOS" throughout California, but at a minimum what it means is that local jurisdictions will no longer be able to rely on state guidance for LOS standards. Should some jurisdictions want to retain LOS as an administrative tool, they must ensure that such requirements are contained in their own local legislative powers. On the other hand, many jurisdictions that have felt bound by LOS standards are now able to pursue their own ideas. Notably, San Francisco replaced auto LOS analysis with VMT analysis and Pasadena has added a VMT screening threshold (but retains auto LOS as an indicator of neighborhood protection).

## Advantages to VMT

The primary advantage of a VMT-based approach to considering transportation impacts is that it increases the degree to which land use type and location are evaluated in a regional context. The proposal to relocate the Sacramento Kings NBA franchise to a more centrally located downtown arena served as an early case study regarding the degree to which VMT can be a compelling performance metric in the development review arena and helped lawmakers pass SB 743. From the perspective of a traditional CEQA transportation impact analysis, the

construction of a new arena in downtown Sacramento created additional local traffic in the vicinity of the arena and mitigation approaches using typical roadway capacity enhancements to meet LOS requirements would not be cost-effective, particularly considering the special event nature of the site. When viewed from the perspective of VMT, however, the data clearly showed that the new downtown location was closer to the critical mass of season-ticket holder residences and workplaces and therefore the new location would actually substantially reduce VMT overall. Like the proverbial ripples on a pond created by a thrown rock, each new land development does have its greatest individual traffic impact in the immediate site vicinity; hence the long-standing practice of local area traffic impact studies. When the cumulative effect of many local land use decisions are considered in tandem, however, the actions that reduce total VMT are often most beneficial to reducing overall adverse community impacts due to travel demand.

## Limitations to VMT

There are several basic structural concerns with the OPR proposal:

- The comparison to a regional average is unclear, but has many potential adverse consequences:
- If not separated from land use type, it may have the effect of making low-intensity uses (i.e., self-storage) more desirable than high-intensity uses (i.e., grocery stores)
- If segregated by land use type, it would likely penalize non-core jurisdictions where VMT rates are usually lower than even smart-growth locations in suburban jurisdictions. For instance, from a regional perspective, it is likely that any hospital in DC, Arlington, or Alexandria would generate lower than average VMTs for hospitals, therefore having no significant impact, and that any hospital in a more exurban part of the region like Prince William County would generate higher than average VMTs for hospitals, a significant impact.
- The analysis of safety impacts complicates the reliance on VMT. There is widespread concurrence nationwide that safety for all modes of travel is of paramount importance. The OPR draft suggests that safety impacts would be triggered if additional traffic generated by a new development (regardless of its location or VMT generation characteristics) created a 15-MPH speed differential between adjacent roadway travel lanes, or an off-ramp backup onto a freeway. These safety concerns are important, but both require the analysis the initiative was designed to minimize and suggest auto-oriented mitigation actions the initiative was designed to avoid.

The City might consider the use of VMT for several applications. From a planning perspective, VMT generation using travel demand model approaches is a useful tool to assess the differences among a variety of land use and transportation investment scenarios. From a development impact screening perspective, VMT could be a useful metric to gauge development efficiency, both in terms of the relative impact of a new development on VMT per capita as well as considering mitigating VMT as contrasted with vehicle trips. For example, one approach considered in Montgomery County noted that when residential development is added to a jobs-heavy Metro station area such as Bethesda or Silver Spring, the total number of vehicle trips is likely to increase but the total VMT might be reduced (as some new residents will, through regular employment turnover, take local jobs that replace employees who had much longer commutes. As with pro-rata share districts, the use of a metric like VMT as a

regulatory tool, however, would require a champion at the staff or elected official level for the approach coupled with substantial outreach to develop stakeholder concurrence that total VMT is more important to defining success than localized transportation system performance measures such as congestion.

## EFFECTS OF AUTONOMOUS VEHICLES

The possible effect of increasingly autonomous vehicles in the US market on societal norms is of interest to a variety of disciplines including land use and transportation planners. It may be useful to think of autonomous vehicle penetration into the marketplace as simply a part of a broader technological change than as an independent phenomenon.

Several factors limit the immediate relevance of autonomous vehicles as an explicit part of the TIA process:

- The implementation of autonomous vehicles will continue to be evolutionary rather than revolutionary. A useful concept is that "driverless" doesn't immediately mean the lack of a driver, just that the driver is doing less; a trend that started with crankless ignitions a century ago and has proceeded through decades of innovations like cruise control and automatic braking systems. A critical mass of truly autonomous vehicles will not likely be on the roads for several decades.
- The market effects of autonomous vehicles are related more to societal choices than to the technology itself, creating uncertainty regarding the effects on travel. A National Renewable Energy Laboratory meta-analysis in 2013 considered likely effects of a series of autonomous vehicle effects on fuel demand, most of which were related to traveler behavior effects on VMT. Some effects are expected to reduce VMT (i.e., shared economy from both traveler and parking perspectives) and others might increase VMT (i.e., more trips by those unable to drive due to age or capability, longer trips by SOV drivers who would choose to multitask in a vehicle). The upshot on fuel demand was that autonomous vehicles could cut consumption in half or cause it to triple. http://www.nrel.gov/docs/fy13osti/59210.pdf
- Uncertainty regarding the effect of autonomous vehicles is less likely to have a large effect in any one direction than that expected from similar societal effects such as:
    - fuel costs;
    - overall economic indicators influencing employment levels and discretionary consumer spending;
    - population pyramid effects influencing how the baby boom and millennial generation cohort needs and desires for travel change over time; and
    - the marketplace of travel choices ranging from information technology to a sharing economy.
- In summary, **continued market changes regarding autonomous vehicles will be reflected in successive evolutionary changes in data compiled and used within the transportation impact analysis processes by jurisdictions nationwide**. This process will be similar to the ways in which fairly recent technology changes affecting land use patterns (i.e., telecommuting, automated banking, the "paperless office", home delivery services) are reflected as they become mainstream.

The Victoria Transport Policy Institute provides a useful 20-page perspective on the current state of the practice regarding autonomous vehicles:

http://www.vtpi.org/avip.pdf