A Planner's Guide to Calculating VMT per Capita

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Introduction

The Transportation Planning Rules (TPR) requires vehicle miles traveled (VMT) per capita to be measured as part of a Transportation System Plan (TSP) under certain conditions. Specifically, those cities or counties that meet the population thresholds in OAR 660-012-0160(1) and have decided to include a proposed facility subject to review by OAR 660-012-0830 on its financially constrained TSP project list. Rule 0830 enhanced review analysis does not specifically require a proposed project to meet a VMT per capita threshold for the project to be authorized for inclusion in a jurisdiction's TSP. However, once the proposed Rule 0830 project is added to a jurisdiction's TSP financially-constrained list, the jurisdiction is required to meet the requirement in OAR 660-012-0160(4) to adopt the TSP. OAR 660-012-0160(2-4) requirements state that a jurisdiction's financially-constrained project list must demonstrate a horizon year VMT per capita that is lower than the VMT per capita in the base year. When a jurisdiction is required to measure VMT per capita for a TSP, the methodology described below should be used.

Definitions

The TPR defines VMT as all light vehicle travel for all households in a jurisdiction, regardless of where the travel occurs as described in OAR 660-012-0005(64). "Light vehicle" is defined in OAR 660-044-0005(10) and includes passenger cars and pickup trucks.

This definition identifies three specific components of VMT that differ from prior methods of calculating VMT in Oregon. By incorporating these components, the VMT per capita calculation methodology accounts for vehicle travel, regardless of purpose, by households that reside within a jurisdiction.

Specifically, this definition of VMT incorporates the following:

1. **Household-based trips:** All light vehicle trips that are generated by households located within a jurisdiction's Urban Growth Boundary[1] (UGB)
2. **Trip purpose:** All trip purposes are included
3. **Travelshed:** Regardless of where the travel occurs within the travel demand model[2].

[1] In the Portland metropolitan (Metro) region and the Salem-Keizer metropolitan area, the UGB constitutes the entire metropolitan area. For the jurisdictions with those MPOs, VMT is calculated for the city limits.

[2] Future revisions to the VMT per capita methodology will incorporate the Statewide Integrated Model (SWIM), which can estimate the VMT of the portion of a household-based trip that occurs outside the boundary of an MPO's travel demand model area.

Methodology

Geography

A jurisdiction's UGB defines the planning area for a TSP. This area is used to determine the households whose trips will be included in the VMT calculation and the population that is used to create the "per capita" portion of the calculation. The TSP will contain a jurisdiction's horizon year financially-constrained and unconstrained project lists. A TSP's financially-constrained project list is programmed in the metropolitan planning organization's (MPO) travel demand model and serves as one of the many factors which impact the jurisdictional household-based VMT per capita calculation. The MPO's travel demand model includes the financially-constrained projects for the jurisdictions (contained within a Regional Transportation Plan) within the metropolitan area. This is important because, for the VMT per capita calculation, there is some network effect and influence from other metropolitan area jurisdictions on travel behavior in any specific jurisdiction. This is a fundamental feature of travel demand models[3], and the network effect is present in all applications of the model.

Types of Household-Based Light Vehicle Travel Included

The VMT per capita methodology measures how residents of a jurisdiction travel from their homes in their personal vehicles – the methodology refers to this as "household-based light vehicle miles per capita". Think of your car's odometer – any driving trip that increases the mileage shown on your odometer, regardless of where the travel occurs, is attributed to your jurisdiction of residence. There are three types of 'household-based' trips considered:

1. **Home-based trips (HB)**
   Home-based trips either begin or end at home (household) within the jurisdiction. These include several trip purposes. Some of the common trip purposes in the travel demand model are:

   a. Work trips (travel from home to a workplace and back)
   b. Shopping trips (travel from home to a grocery store and back)
   c. School trips (travel from home to school and back)
   d. Recreational trips (travel from home to a park or community center and back)

   When calculating household-based VMT, the specific purpose of home-based trips, the route, or the destination does not matter, even if the destination is outside of the jurisdiction's boundary. A travel demand model can determine the number of home-based trips produced within a jurisdiction and assign the route and length of each of those trips to calculate an estimated total VMT for a specific trip. Summing up the VMT for all home-based trips results in the total VMT from home-based trips for the specific jurisdiction.

[3] Using observed data instead of a travel demand model would be preferred. ODOT Research is working to develop observed odometer-based data to use for this purpose (and others) in the future. Currently, travel models are used per the guidance provided in this document.

For example, David lives in Portland and works in Hillsboro. David travels by car from Portland to Hillsboro for work and then drives back home from Hillsboro to Portland. Both of those trips are considered 'home-based' trips and count toward Portland's VMT.

2. **Non-home-based trips (NHB)**

   Non-home-based (NHB) trips are generated by the residents of a household within a jurisdiction but do not originate or end at the home location. Building on the previous example, David, who lives in Portland and works in Hillsboro, takes a lunch break while at work in Hillsboro. For lunch, David drives from his work location to a restaurant in Forest Grove to eat lunch and then returns to his workplace in Hillsboro. Because this trip does not have an origin or destination at a home location, it is classified as an NHB trip. If one visualizes that the odometer on David's car has increased during his drive from work to the restaurant and back, the miles attributed to his NHB trip are added to the total VMT for Portland, which is David's home location.

   Calculating NHB trips in a trip-based model is challenging. The methodology makes some assumptions and relies on the fact that the model forecasts how many NHB trips are produced by a household. But, because a trip-based model does not link a household to a specific NHB trip, we cannot directly attribute the VMT of a specific NHB trip (and therefore the length is unknown) to a household. Instead, the average trip length[4] for all NHB trips within the travel demand model is used.

   The total number of NHB trips generated by a jurisdiction is first reduced by the percentage of non-auto-based trips generated by the jurisdiction to account for an estimate of the non-auto mode split of the NHB trips. Multiplying the remaining number of NHB trips generated by all households within a specific jurisdiction by the average trip length of a NHB trip provides a reasonable approximation of the total amount of VMT produced by all NHB trips generated by the households in a specific jurisdiction.

3. **External trips**

   External trips are those trips attributed to a household within a jurisdiction that travel outside the travel model boundary.

   For example, David lives in Portland, but instead of working in Hillsboro on Tuesday, he has a client meeting in Astoria. His drive to and from Astoria are examples of an external trip because Astoria lies outside the geographic boundary of Metro's travel demand model. The current

[4] Oregon's travel demand models are built on the foundation of the statewide household travel survey, which provides the travel behavior and trends that are input into travel demand models. Those models are then calibrated and validated to reproduce the travel survey in the base (existing) year. The outputs produced by the travel demand models include the distances for each of the non-home-based trips in the model. Horizon year scenarios use estimated forecasts because there is no survey of the future, but the travel demand model output is similar.

methodology for measuring the amount of VMT for these trips only captures the amount of travel for an external trip that occurs within the travel demand model area. The process for capturing the VMT for the component of external trips that lie beyond the travel demand model boundary is still being tested and refined.

Applying the Methodology

A uniform, "one size fits all" approach for VMT methodology is challenging given the diversity of travel models within Oregon. However, the VMT methodology was developed with an understanding of the differences between travel models.

If jurisdictions are required to calculate VMT per capita per Rule 0160, they must use the travel demand model from their MPO. At the time of the VMT calculation, the MPO travel model will include most projects on the jurisdiction's financially-constrained project list from their TSP and the projects on the MPO's Regional Transportation Plan's financially-constrained project list.

No jurisdiction is an island in a travel demand model

Because VMT per capita is calculated using a regional travel demand model, it is possible that projects that are outside the jurisdiction's planning area may have some effect on a jurisdiction's VMT. For example, roadways constructed in one city may change VMT per capita for a different jurisdiction. Because no jurisdiction exists in isolation within a metropolitan area, this creates opportunities for coordination between jurisdictions in a metropolitan area - which is a key function of the MPO. This interconnectivity is an essential feature of both regional travel demand models and metropolitan planning efforts. Here are two examples (one roadway project, one transit project) to aid understanding why this part of the methodology is important:

Roadway project affecting VMT in a neighboring jurisdiction

Rainyville has a project in their TSP to add two new travel lanes to an existing three-lane arterial that is located near a popular shopping area with several big box stores. Any travel by residents of Rainyville that use that widened roadway is included in Rainyville's VMT per capita calculation. Because the project relieves some congestion, it reduces the time it takes residents in the neighboring jurisdiction of Sunshine City to travel to the shopping area. This makes the shopping area a more attractive destination for the Sunshine City residents and increases their travel to the shopping area. Though the roadway widening project was included on the financially-constrained list as part of Rainyville's TSP, the VMT created by residents from Sunshine City while on their trips to the shopping center in Rainyville are part of Sunshine City's VMT - **not** Rainyville's.

To summarize the impact on VMT shown in this example: the transportation project in Rainyville will have the effect on increasing the VMT per capita for residents living in Sunshine City, an adjacent jurisdiction.

Transit projects affecting VMT in a neighboring jurisdiction

Here is another project example that may have the effect of reducing VMT per capita in an adjacent jurisdiction:

Rainyville operates a bus transit system and has two projects in their TSP. First, investments in new transit strategies (such as a bus-priority lane and increased frequency) that seek to improve the efficiency and reliability of the local transportation system. The second project is to extend an existing route to include a stop at a major employment area located just outside the boundary of Sunshine City. The first project is a success – the shorter wait times and improved reliability encourage more residents of Rainyville to rely on transit for transportation. The second project is also a success – many Sunshine City residents who work, shop, and attend the community college in Rainyville now take advantage of the new bus stop and begin riding the bus to save money on fuel, parking, and vehicle maintenance. This mode shift by residents of Sunshine City results in a reduction in VMT per capita for Sunshine City, even though the transit improvement and cost were part of Rainyville's TSP.

To summarize the impact shown in this example: the investment in transit in Rainyville would have the effect of decreasing the VMT per capita for residents living in Sunshine City, an adjacent jurisdiction.

When results may seem counter-intuitive

Rule 0160 does not set a specific numerical value for VMT per capita reduction. The rule merely states that, when evaluating the financially-constrained project list in the TSP, the VMT per capita in the TSP horizon year must be lower than the TSP base year. If Rainyville has a relatively low VMT per capita (compared with other jurisdictions in the same MPO) in the base year because of previously made land use, transportation, and other planning decisions, it may be more difficult for Rainyville to further reduce VMT per capita in the horizon year. Conversely, if Sunshine City has historically been a highly auto-centric place and has a relatively high VMT per capita, it may be easier for Sunshine City to reduce VMT per capita by including multi-modal transportation projects in their financially-constrained list or by successfully encouraging more housing density in their Climate-Friendly Area. Each jurisdiction should be reviewed individually during their TSP process to consider the impact of the financially-constrained project list and any proposed changes to land use. Reductions in VMT per capita can result from many actions, from investing in non-driving infrastructure to increasing housing density.