VMT Monitor Methodology and Validation

Introduction

This white paper outlines our motivation, methodology, and some validation results for StreetLight Data's daily Vehicle Miles Travelled (VMT) Monitor. This is a living document! We developed the VMT Monitor very quickly in light of the COVID-19 crisis to help the transportation industry track economic and personal travel activity through VMT on a daily basis, and we are continuing to enhance the monitor. We will continue to improve our methodology as we learn more and as our community suggests improvements.

StreetLight's VMT Monitor provides our estimate of total vehicle miles travelled (VMT) by residents of each county, each day since the COVID-19 crisis began. To access the VMT Monitor go to this webpage: https://www.streetlightdata.com/VMT-monitor-by-county/

Motivation: Why VMT Monitor and Not a "Mobility Index?"

At StreetLight Data, our purpose is to help the transportation community put Big Data to work. We know that several companies have published different measurements derived from

locational data to capture rapidly changing levels of activity during the COVID-19 crisis, many in the form of a "Mobility Index." After reading the methodology documentation and reviewing the results of several such indices, we felt that these did not serve to answer some important questions for the transportation community. **This is not a criticism of mobility indices!** They are a tool developed for the epidemiological community. We are not epidemiologists and cannot comment on their usefulness. In fact, as this methodology paper describes, we built our VMT Monitor in part on a derivative of the Mobility Index published by our partner Cuebiq. We are transportation professionals – so we derived a different Metric for our community.

Why Focus on VMT?

We decided that a daily VMT update would be most useful for the transportation community for several reasons:

1. It is a well-known and widely used measurement in the field in general. Therefore, it will be more intuitive for many practitioners.
2. VMT is directly correlated with things that matter to transportation practitioners including: gas tax revenues, road wear-and-tear, greenhouse gas emissions, and other smog/particulate creating emissions.
3. VMT captures and measures all individuals in a region, not just one representative individual (see description of mobility indices below and why this matters).
4. VMT takes into account the frequency of trips, not just the length of the median trip (see description of mobility indices below and why this matters).

VMT Methodology

To capture total travel, we evaluate both the mean trip length and the total number of trips taken by the full population, as shown in this framework equation:

$$VMT = \overline{Trip\ Length} * Total\ \#\ of\ Trips\ by\ All\ Individuals$$

Note: Because of the impact of very long trips, to get total VMT one cannot rely on the *median* trip length or distance from home by the population. Trips by individuals are calculated using the trips that start or end in a county, and do not include trips that pass through the county without stopping.

As additional months are processed and made available in StreetLight InSight®, we calculate VMT estimates for each county-day combination.

Validation Compared to FHWA Statistics

Since VMT is a known industry metric, we compared our VMT monitor data with publicly available sources, such as the FHWA's Traffic Volume Trends from the Office of

Highway Policy Information[1]. The FHWA uses approximately 5,000 continuous traffic counting locations nationwide to estimate the percent change in traffic for the current month compared with the same month in the previous year. The estimates are re-adjusted at the end of the year to match VMT from the Highway Performance Monitoring System. We note that this means the 2020 estimates from FHWA are just that – estimates. The 5,000 counters create a relatively small sample size to cover all travel in the U.S., and counters do not take trip length into account. Thus, we don't present the FHWA numbers as "ground truth" – merely as another credible estimate for comparison.

There are other differences between the FHWA VMT methodology and the StreetLight VMT monitor. The FHWA methodology uses just 5,000 counters (most on highways as opposed to local or arterial roads) to derive changes in VMT across the whole U.S. The StreetLight VMT Metric uses data from a larger sample of devices across the country, on all road types. This data is collected and compiled each day. The FHWA data is updated in monthly intervals. In addition, the FHWA estimates VMT by looking at empirical counts and applying past understanding of trip lengths. StreetLight looks at both empirical counts and empirical measurements of trip length. This could be quite important since, during COVID-19, much about the pattern of travel has changed, including the mix of trip purposes, and thus the mix of trip lengths.

As shown in the graphs below, FHWA and StreetLight estimates are highly correlated. In general, StreetLight estimates VMT slightly higher than the FHWA. We think, because of the differences in method and source data, this does not represent an "over-estimation" but instead could be a more accurate view of total VMT. The chart below shows total monthly VMT for the U.S.[2] from January 2019 to March 2021.

[1] https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm
[2] FHWA Estimates include Alaska and Hawaii, which account for 0.4% of total US VMT. StreetLight's do not.

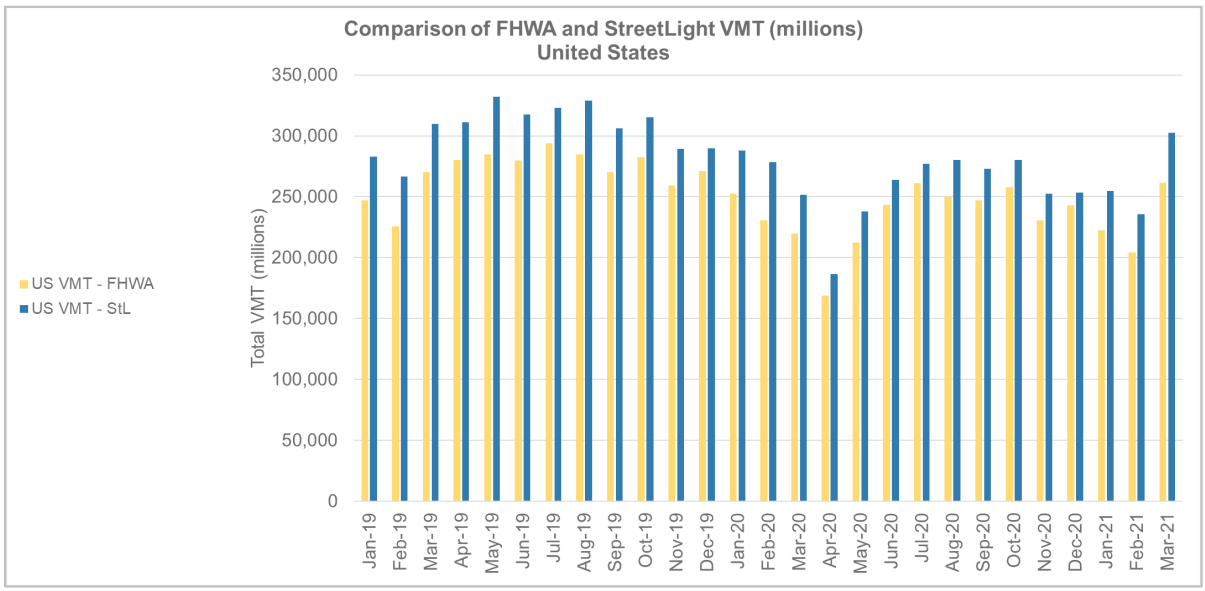

Figure 1: Comparison of FHWA and StreetLight VMT (millions), United States.

We also compared monthly VMT at the state level. The chart below shows that StreetLight VMT is highly correlated with the FHWA VMT data, with an R^2 of 0.96. No outliers were excluded.

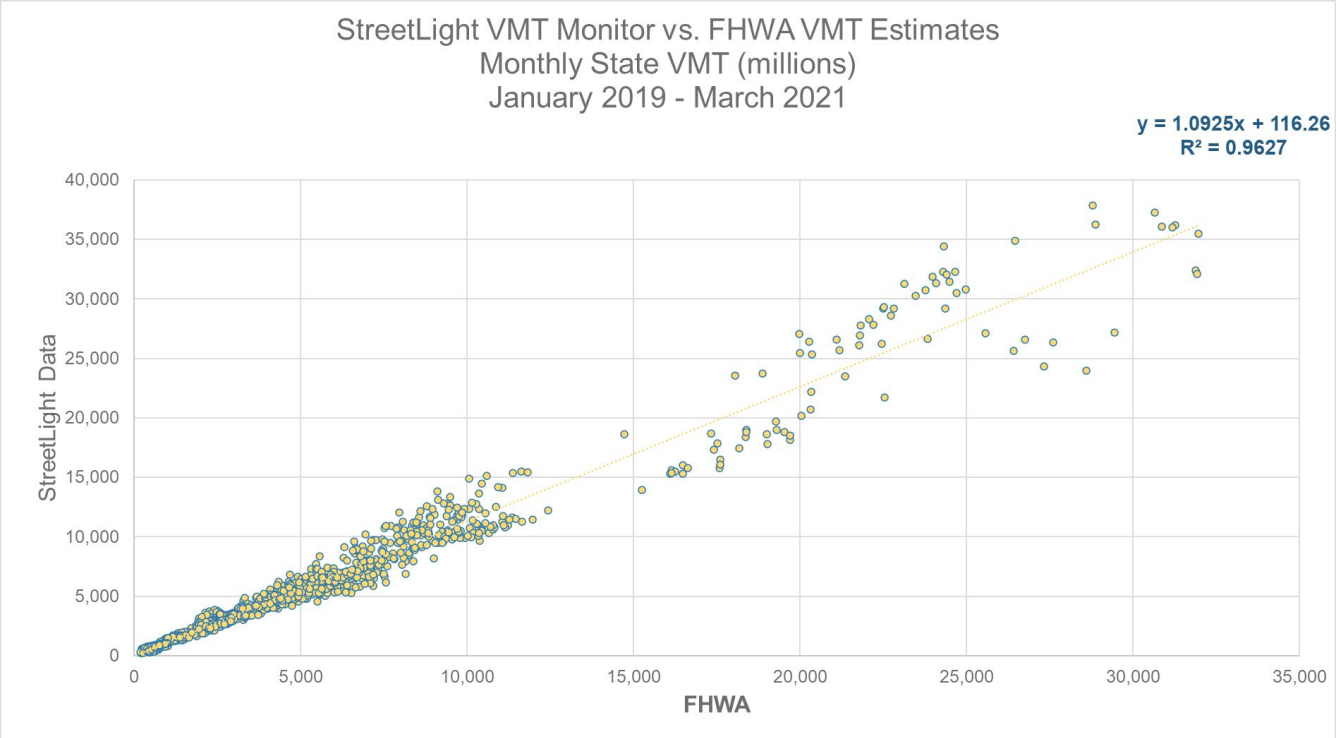

Figure 2: Scatterplot of StreetLight VMT Metric compared to FHWA VMT.

Since both VMT data sources use different methodologies to derive the total VMT, comparing the relative changes is also important. We find that the StreetLight VMT Metric tracks the change in VMT from January through May very closely. The charts below show the VMT normalized to January 2019 VMT for the U.S., as well as several selected states. The pattern of VMT change in these states for the five-month period tracks fairly well between StreetLight's VMT and FHWA VMT, with a few differences for individual months.

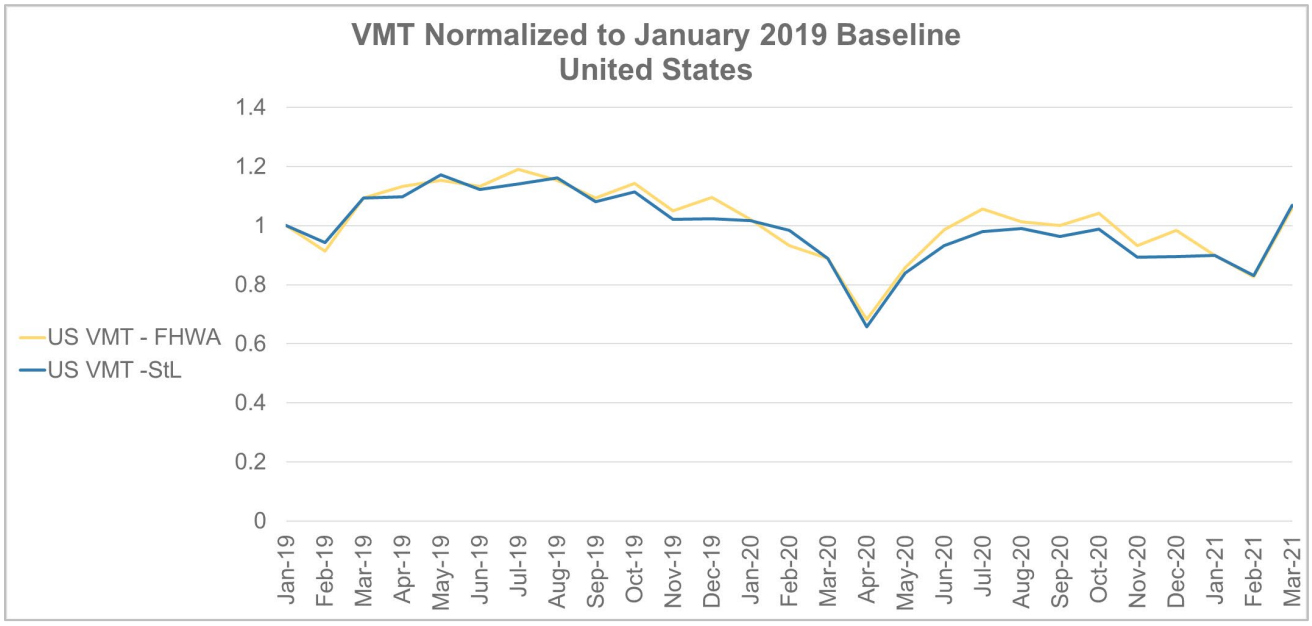

Figure 3: Comparison of VMT normalized to January 2019 in the U.S.

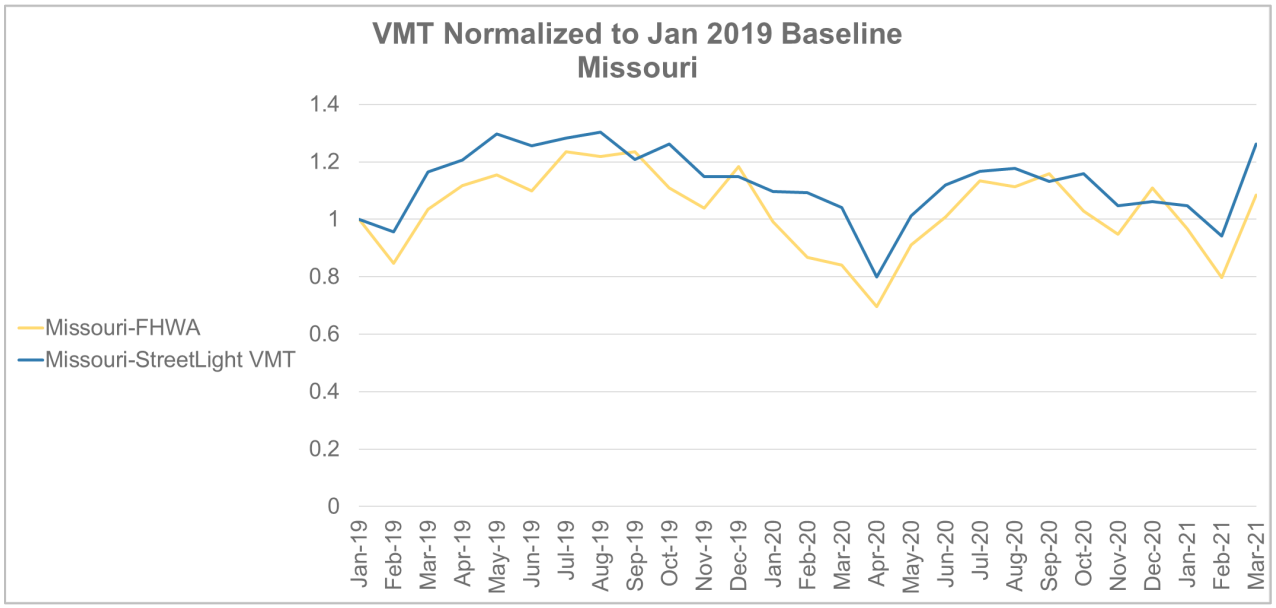

Figure 4: Comparison of VMT normalized to January 2019 in Missouri.

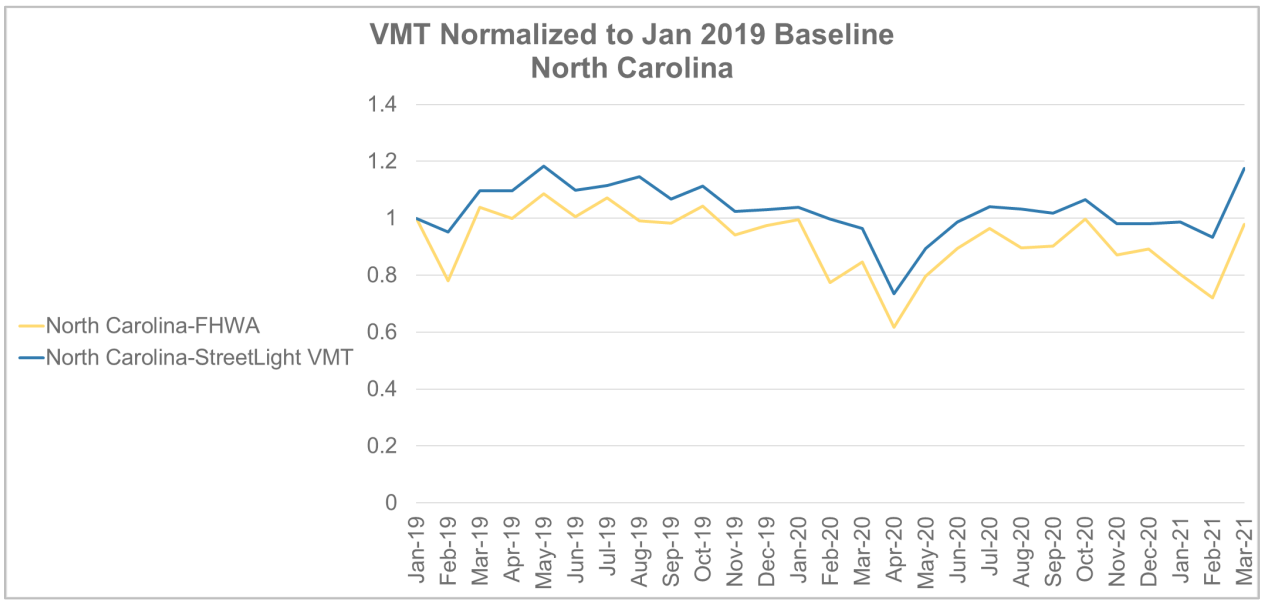

Figure 5: Comparison of VMT normalized to January 2019 in North Carolina.

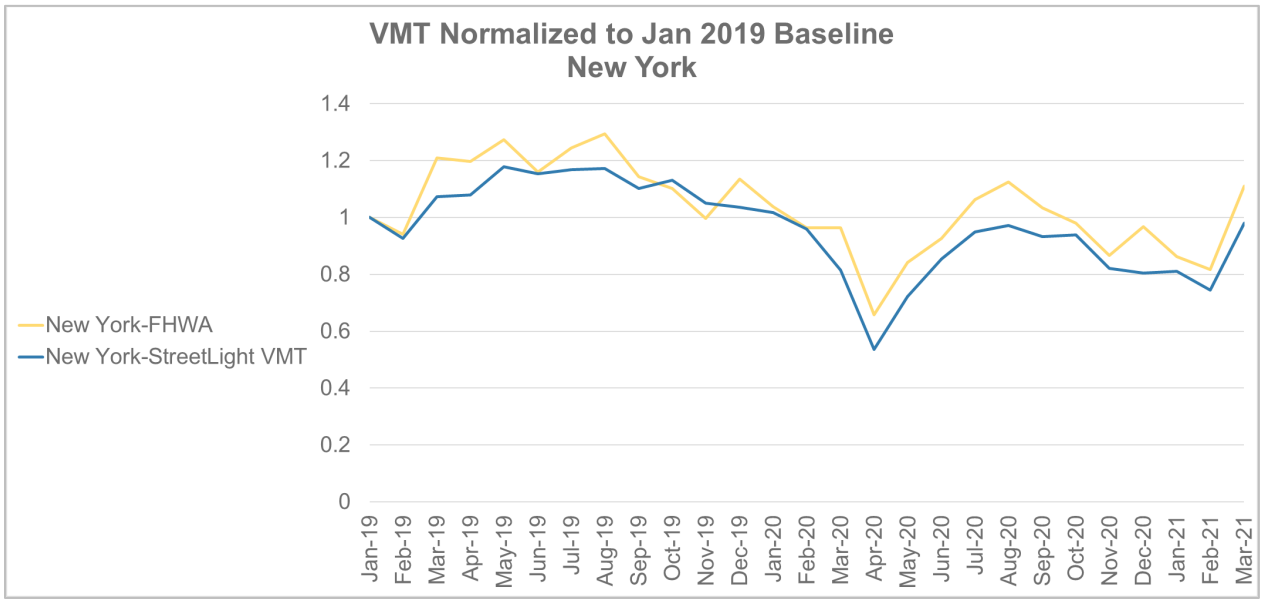

Figure 6: Comparison of VMT normalized to January 2019 in New York.

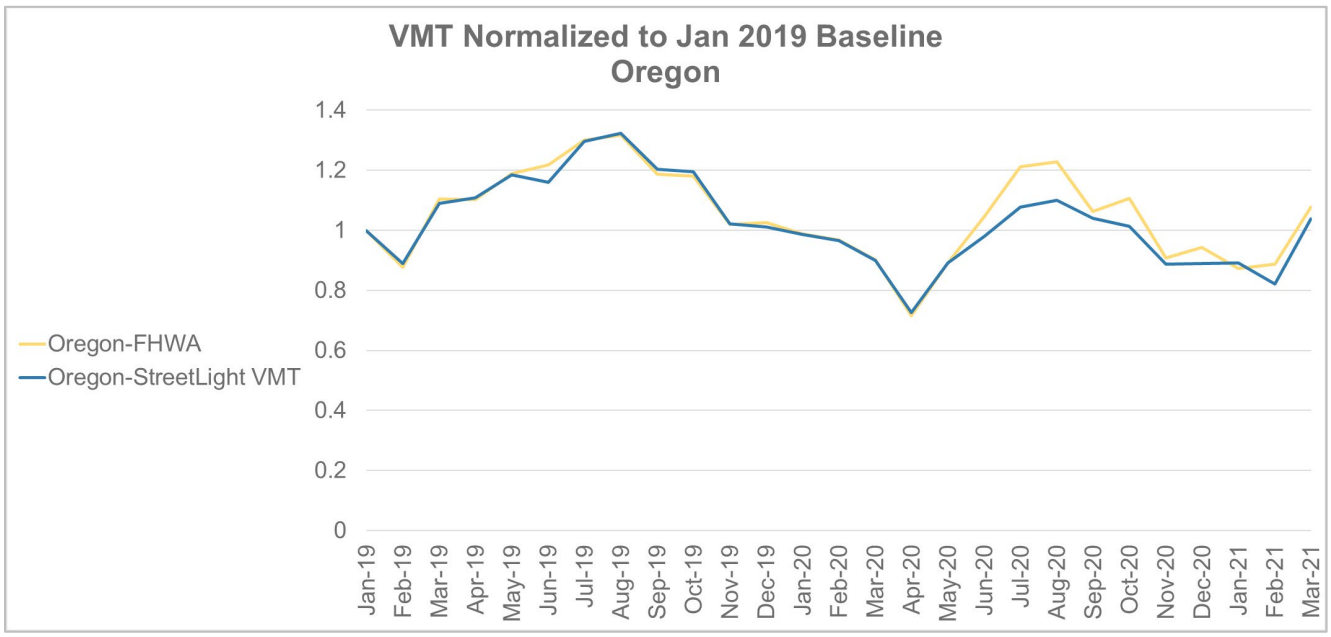

Figure 7: Comparison of VMT normalized to January 2019 in New York.

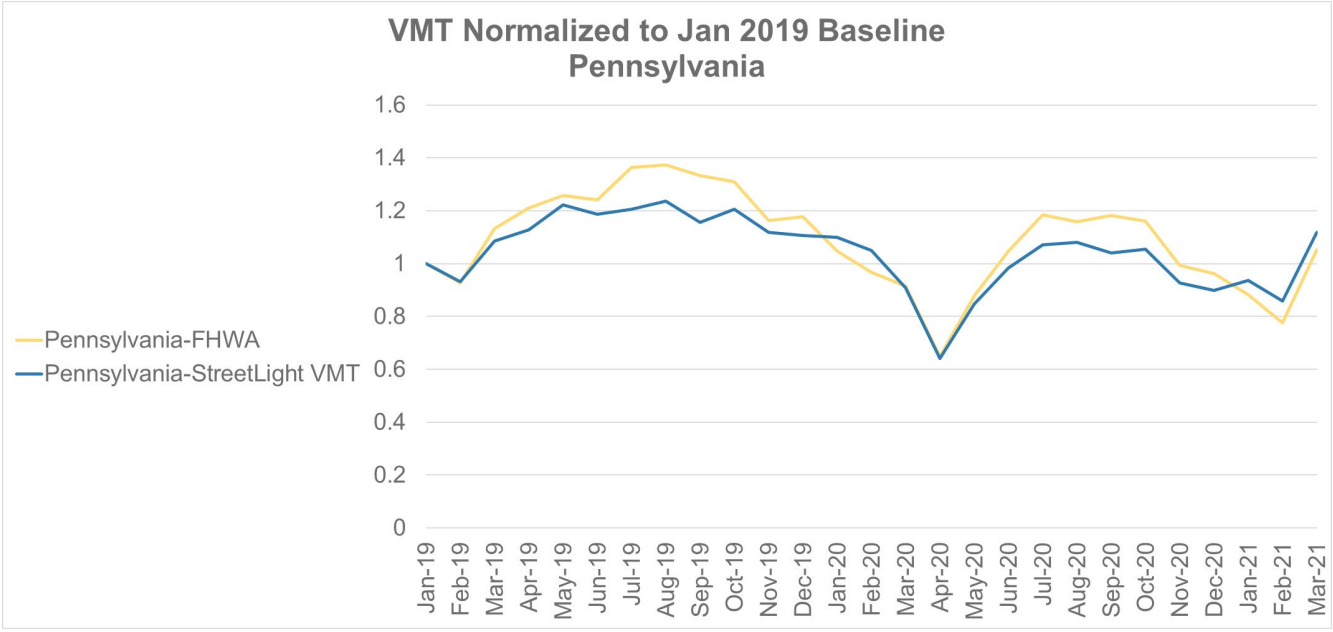

Figure 8: Comparison of VMT normalized to January 2019 in Pennsylvania.

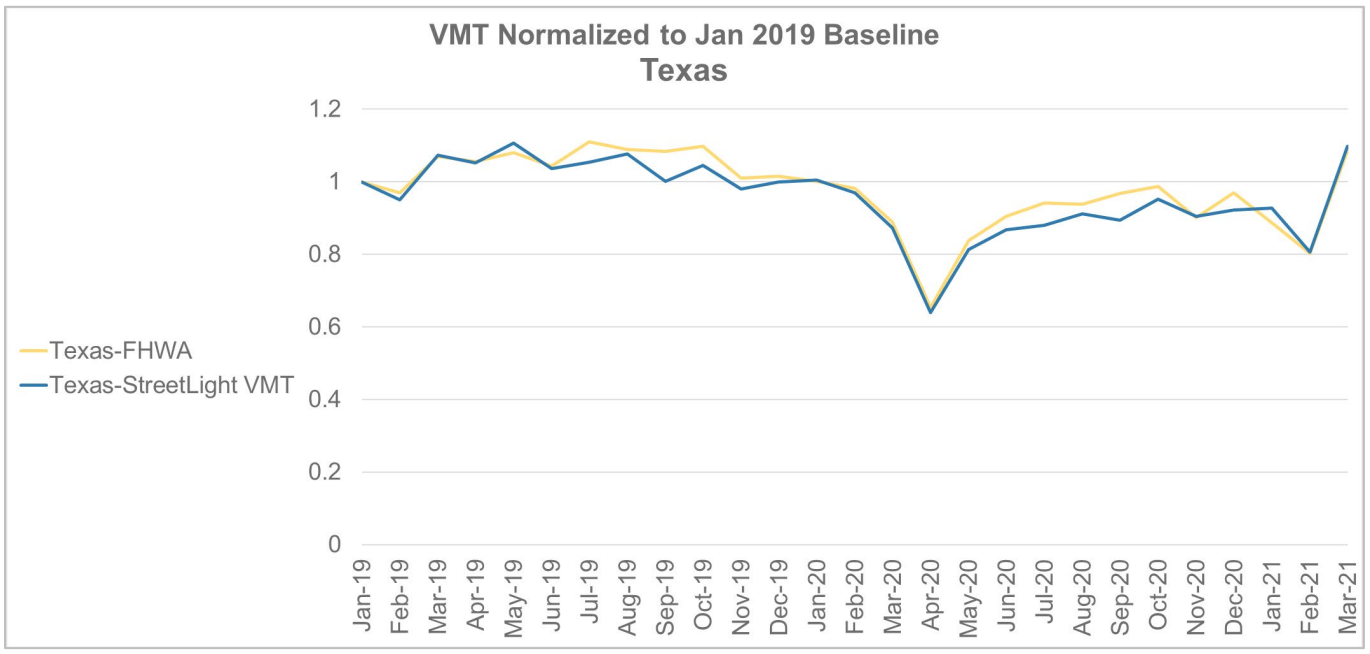

Figure 9: Comparison of VMT normalized to January 2019 in Texas.

Validation Compared to Permanent Counter Data

In addition to comparing our VMT Metric to FHWA VMT data, we also looked at how our VMT Metric compares to changes in traffic counter data. We looked at over 150 traffic counters across the U.S. As shown in the chart below, the change in StreetLight VMT over time mirrors changes in traffic counts over time for the U.S.

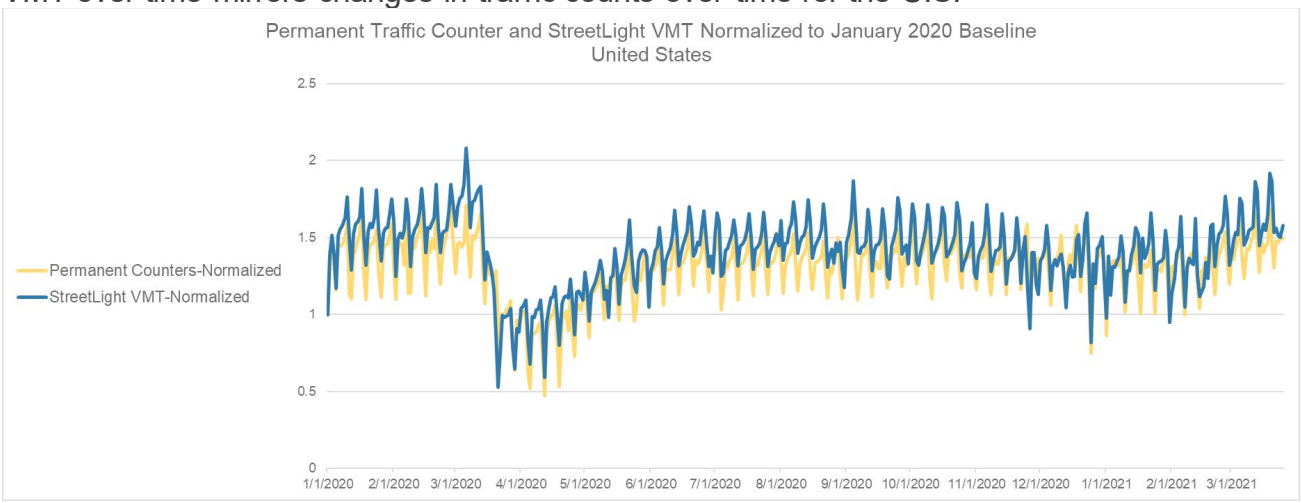

Figure 10: StreetLight VMT and Permanent Traffic Count Data normalized to January 2020 baseline for the United States.

About StreetLight

StreetLight Data pioneered the use of Big Data analytics to help transportation professionals solve their biggest problems. Applying proprietary machine-learning algorithms to over four trillion spatial data points over time, StreetLight measures diverse travel patterns and makes them available on-demand via the world's first SaaS platform for mobility, StreetLight InSight®. From identifying sources of congestion to optimizing new infrastructure to planning for autonomous vehicles, StreetLight powers more than 6,000 global projects every month. For more information please visit: www.streetlightdata.com