

**VMT?**

1 MILE  
1 VMT

10 MILES  
40 VMT


**FEHR & PEERS**  
Ronald T. Milam, AICP, PTP  
May 2022

# Transportation Impact Analysis and the Transition to VMT

An Evolving Story

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## Introductions



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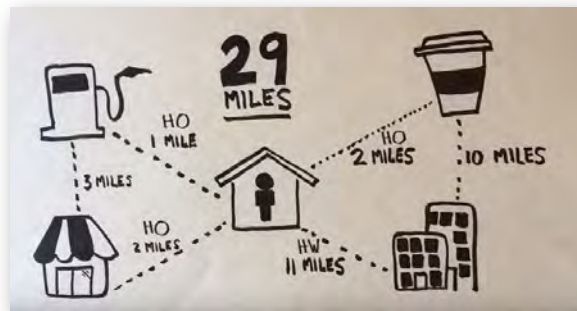
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## What is VMT?

Measures amount of vehicle travel

- Depends on perspective and what technical or policy questions are being analyzed

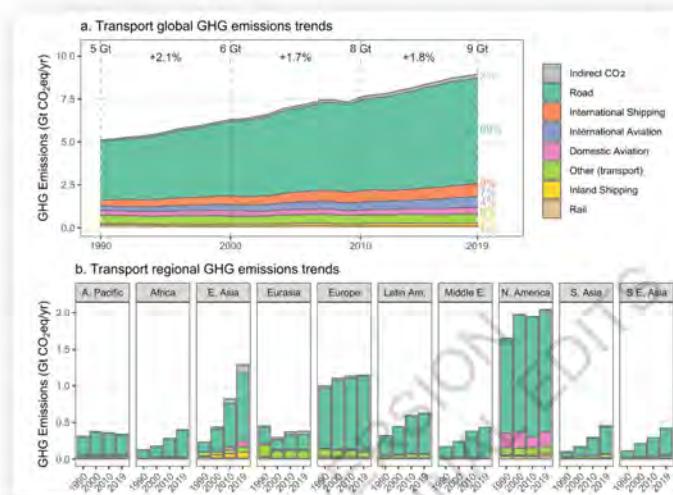


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## Brief History of VMT/GHG Trends

Influence of population growth on VMT

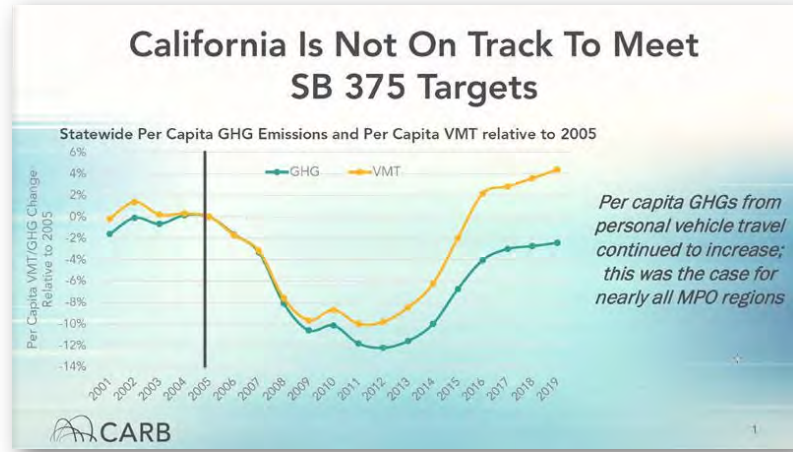


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# Brief History of VMT/GHG Trends

VMT/GHG Trends Outside the Control of Local Agencies

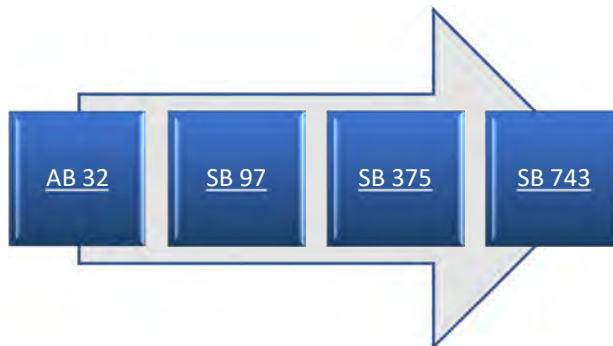


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# A Brief History of VMT/GHG in CA

Attempt to connect thresholds to California GHG reduction goals



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Senate Bill (SB)  
743 Legislative  
Intent

## A Brief History of VMT in CA

Appropriately balance the needs of congestion management with statewide goals related to:



Infill Development



Promote public health through active transportation (e.g. walking, biking)



Reducing Greenhouse Gas Emission

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Relationship to  
Safety

## VMT Reduction and Co-Benefits

Cutting Greenhouse Gas Emissions Is Only the Beginning: A Literature Review of the Co-Benefits of Reducing Vehicle Miles Traveled

March 2017

A White Paper from the National Center for Sustainable Transportation

Kevin Fang, University of California, Davis  
Janey Wilker, University of California, Davis

National Center for Sustainable Transportation

ITS UC DAVIS INSTITUTE OF TRANSPORTATION STUDIES

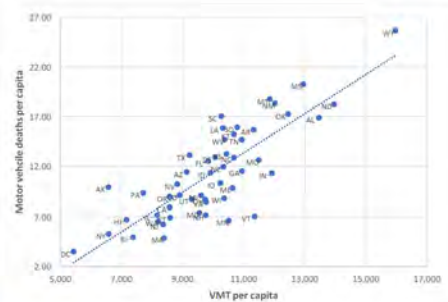


Figure 2. Motor-vehicle related deaths per capita increases as VMT per capita increases

NCST

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Low VMT/capita associated with lower collision rates and less severe collisions

# VMT Reduction and Co-Benefits

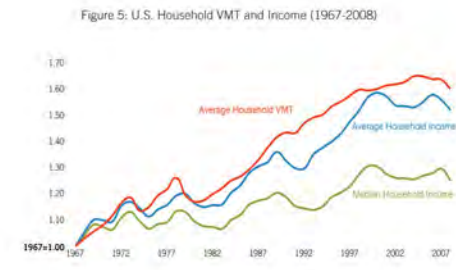
TABLE 2: US COUNTIES WITH HIGHEST AND LOWEST SPRAWL INDEX VOLUMES

County	Sprawl Index*	All-mode traffic fatality rate (per 100,000)	County	Sprawl Index*	All-mode traffic fatality rate (per 100,000)
Counties with more compact urban form			Counties with more sprawling urban form		
New York, NY (New York)	352	4.42	Stokes County, NC (Winston Salem)	71	15.66
Kings County, NY (New York)	264	4.46	Miami County, KS (Kansas City)	71	38.80
Bronx County, NY (New York)	250	4.20	Davie County, NC (Winston Salem)	71	25.84
Queens County, NY (New York)	219	4.58	Isanti County, MN (Minneapolis St. Paul)	70	12.78
San Francisco County, CA (San Francisco)	209	6.31	Walton County, GA (Atlanta)	70	19.77
Hudson County, NJ (Jersey City)	190	5.91	Yadkin County, NC (Winston Salem)	69	38.52
Philadelphia County, PA (Philadelphia)	188	8.04	Goochland County, VA (Richmond)	68	35.58
Suffolk County, MA (Boston)	179	4.49	Fulton County, OH (Toledo)	67	38.02
Richmond County, NY (New York)	163	5.63	Clinton County, MI (Lansing)	67	16.99
Baltimore City, MD (Baltimore)	163	7.68	Geauga County, OH (Cleveland)	63	20.90

\*Lower sprawl index values indicate more sprawling urban form.  
Source: Ewing et al., 2003.

\*Lower sprawl index values indicate more sprawling urban form.  
Source: Ewing et al., 2003.

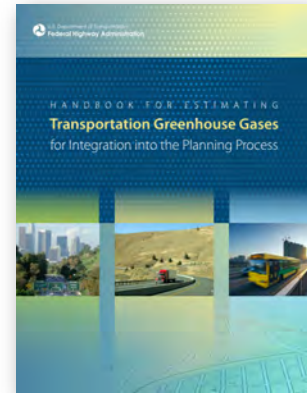
VMT Trends and Economic Relationships



Source: [http://growingwealthier.info/docs/gw\\_summary.pdf](http://growingwealthier.info/docs/gw_summary.pdf)

## Initial Concerns about VMT as an Environmental Impact Metric

- Legal risk of new CEQA content
- Lack of consistent technical guidance
- No common VMT lexicon
- Limitations of data, tools, models, and practitioners



## Initial Concerns about VMT

§ 15003 (f) = fullest possible protection of the environment...

§ 15003 (i) = adequacy, completeness, and good-faith effort at full disclosure...

§ 15125 (c) = the EIR must demonstrate that the significant environmental impacts of the proposed project were adequately investigated...

§ 15144 = an agency must use its best efforts to find out and disclose...

§ 15151 = sufficient analysis to allow a decision which intelligently takes account of environmental consequences...

## Initial Concerns about VMT

§ 15064.3(a) = ...“vehicle miles traveled” refers to the amount and distance of automobile travel...

§ 15064.3(b)(4) = A lead agency has discretion to choose the most appropriate methodology to evaluate a project’s vehicle miles traveled, including whether to express the change in absolute terms, per capita, per household, or in any other measure.

## VMT Guidance – OPR Technical Advisory

- Final version released in December 2018
- A technical advisory is not state law
- Legal considerations



## Technical and Legal Risks

# Public Agency Decisions

- VMT Methodology
  - Model
  - Metric
  - Screening
- Thresholds
  - Project vs Cumulative
- Feasible Mitigation



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## Model Choices

# VMT Methodology

- Use of Models vs Spreadsheets (ITE)
- Total VMT vs partial VMT
- Automobile vs Truck VMT
- Full accounting



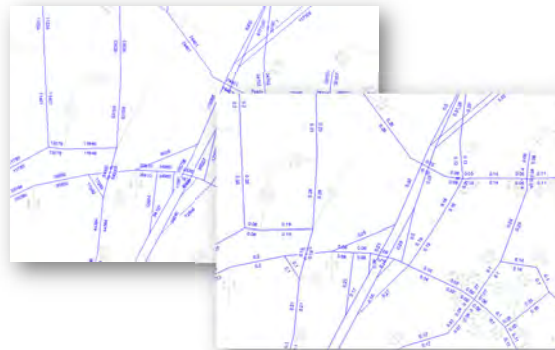
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## What is VMT?

- Network VMT = volume x distance
- Land Use VMT = trips x trip length



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## What is VMT?

- **Boundary Method**
  - VMT inside the boundary consumes fuel that generates emissions
  - Emissions affect sensitive receptors inside the boundary
  - Method produces 1,000,110 daily VMT



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GHG  
Example

## What is VMT?

- **Origin-Destination (OD) Method**
  - VMT associated with trips that have at least one end in the jurisdiction of analysis
  - Method produces 1,397,340 daily VMT



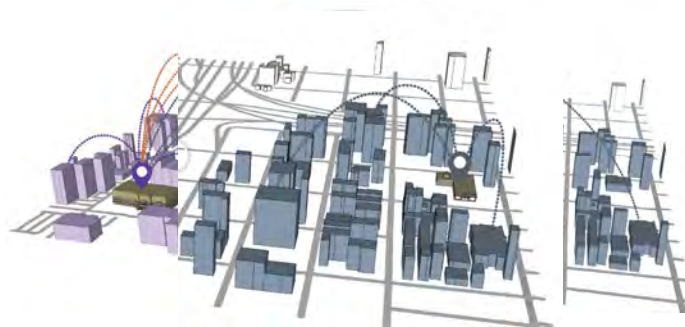
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Model Choices –  
a complete  
impact story

## VMT Methodology

- **Project generated VMT vs Project Effect on VMT**



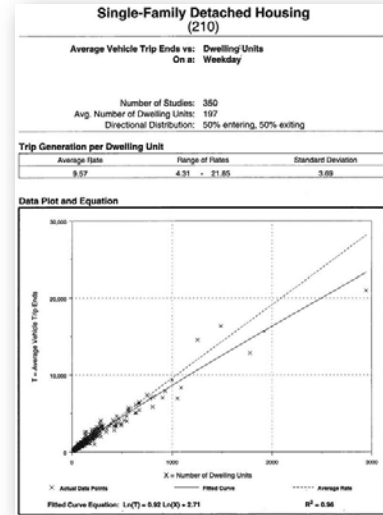
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# VMT Methodology

Model Choices – threshold consistency

- ITE does not apply
- No benchmark for thresholds (i.e., city-wide or region-wide average)
- Not locally valid



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# VMT Methodology

Metric Choices – the full lexicon



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# VMT Methodology

Metric Choices – consistency?

Vehicle Trip Type	VMT Trip Purposes Used in Analysis			
	AQ	GHG	Energy	SB 743* Transportation
<i>Residential Project</i>				
Home-based work	✓	✓	✓	✓
Home-based other	✓	✓	✓	✓
Non-home-based	✓	✓	✓	
<i>Office Project</i>				
Home-based work	✓	✓	✓	✓
Visitor	✓	✓	✓	
Delivery	✓	✓	✓	
Security/Maintenance	✓	✓	✓	

\* OPR Technical Advisory recommendations for trip-based models.



Home-based VMT per resident



Home-based VMT per employee

# VMT Methodology

Metric Choices – model limitations



Total VMT



Total VMT Generated by a Project



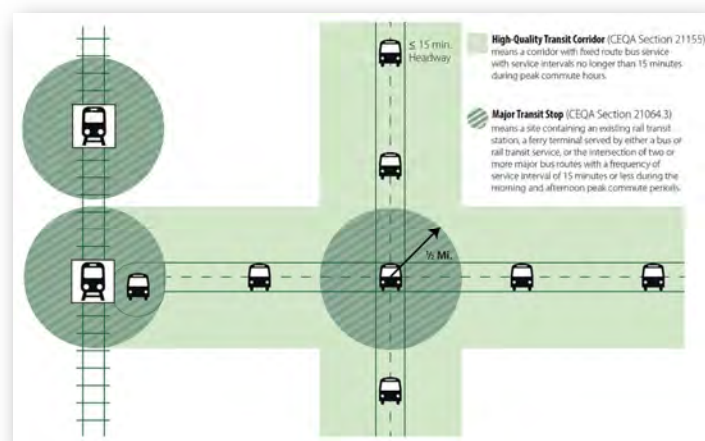
Total VMT per Service Population

## VMT Methodology - Screening

OPR Technical Advisory Recommends Screening using partial data/analysis

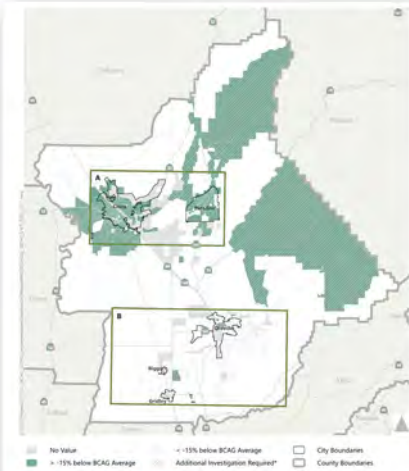
- Small projects
- Residential or office projects in low VMT areas
- Residential, office, and retail (or their mix) projects within ½ mile of high-quality transit stations
- Affordable housing projects
- Local serving retail projects less than 50ksf

## VMT Methodology - Screening



# VMT Methodology - Screening

Screening Decisions - Low VMT Areas

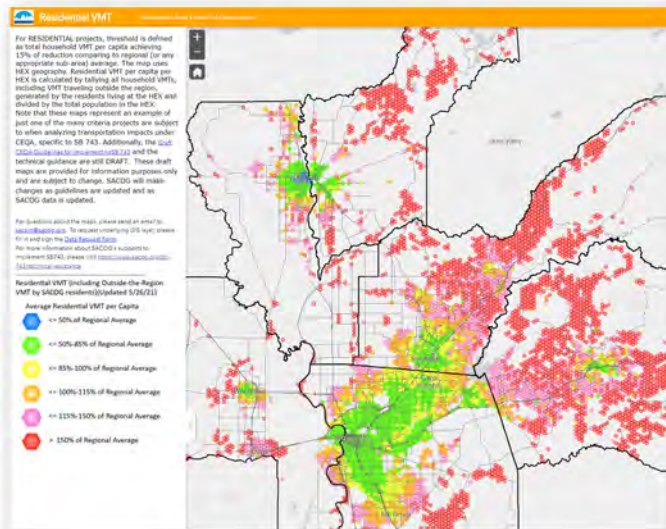


**FIGURE 6: DAILY HOME-BASED VMT PER RESIDENT COMPARISON TO REGIONAL AVERAGE**  
 Source: Modified version 2.2.17.21 of the SCAG ITR/SCS Model  
 \*Areas may not qualify for screening due to land use context.  
 A, B inset maps can be found in Figure 6A.

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# VMT Methodology - Screening

Screening Decisions - Low VMT Areas

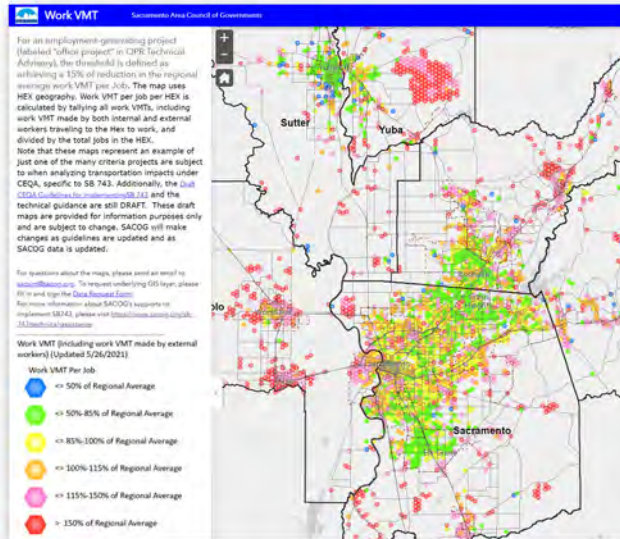


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# VMT Methodology - Screening

Screening  
Decisions  
- Low VMT  
Areas

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## Thresholds


What is good vs  
bad VMT?

- What is the desired change in VMT and why?  
What outcomes related to VMT are expected?
- What is being protected?
  - What is being avoided?
  - What is being created?

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Threshold Decisions



# When is VMT a problem?

## SB 743 Statute

(b) (1) The Office of Planning and Research shall prepare, develop, and transmit to the Secretary of the Natural Resources Agency for certification and adoption proposed revisions to the guidelines adopted pursuant to Section 21083 establishing criteria for determining the significance of transportation impacts of projects within transit priority areas. **Those criteria shall promote the reduction of greenhouse gas emissions, the development of multimodal transportation networks, and a diversity of land uses.** In developing the criteria, the office shall recommend potential metrics to measure transportation impacts that may include, but are not limited to, vehicle miles traveled, vehicle miles traveled per capita, automobile trip generation rates, or automobile trips generated. The office may also establish criteria for models used to analyze transportation impacts to ensure the models are accurate, reliable, and consistent with the intent of this section.

## CEQA Guidelines

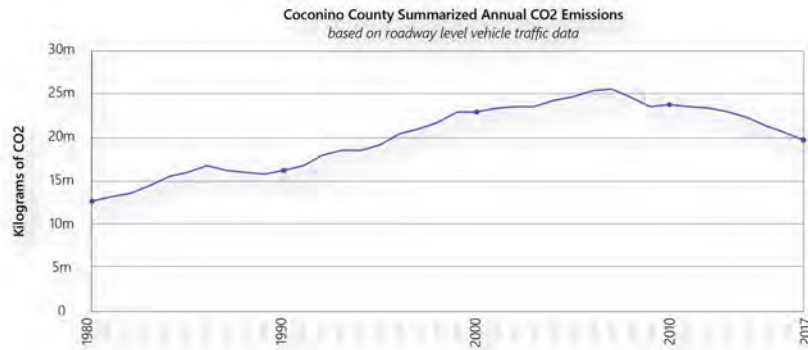
**(b) Criteria for Analyzing Transportation Impacts.**

**(1) Land Use Projects. Vehicle miles traveled exceeding an applicable threshold of significance may indicate a significant impact. Generally, projects within one-half mile of either an existing major transit stop or a stop along an existing high quality transit corridor should be presumed to cause a less than significant transportation impact. Projects that decrease vehicle miles traveled in the project area compared to existing conditions should be presumed to have a less than significant transportation impact.**

GHG Trends in Coconino County



# Brief History of VMT/GHG Trends



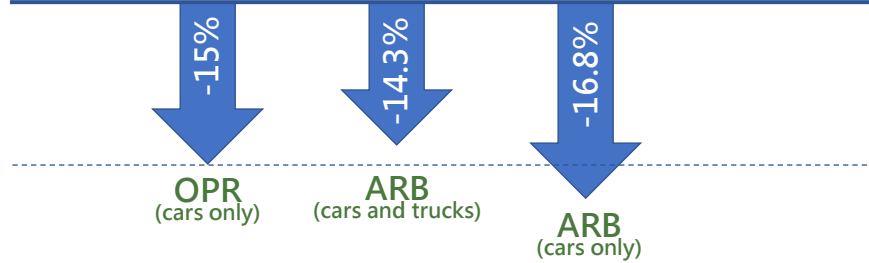
All data is from the Gately, C., L.R. Hutvra, and I.S. Wing. 2019. DARTe Annual On-road CO2 Emissions on a 1-km Grid, Conterminous USA, V2, 1980-2017. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/1735>  
[https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds\\_id=1735](https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=1735)



Threshold Decisions  
- Land Use Projects

# State Agency Recommendations

Baseline VMT – Citywide or Regional Average



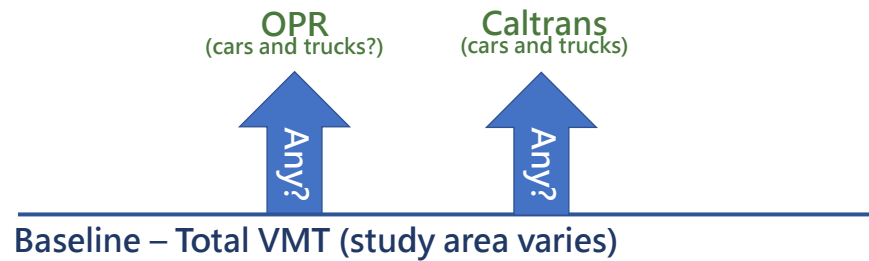
Important Note: OPR threshold endorsed in *Vehicle Miles Traveled-Focused Transportation Impact Study Guide*, Caltrans, May 20, 2020.

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Threshold Decisions  
- Transportation Projects

# State Agency Recommendations

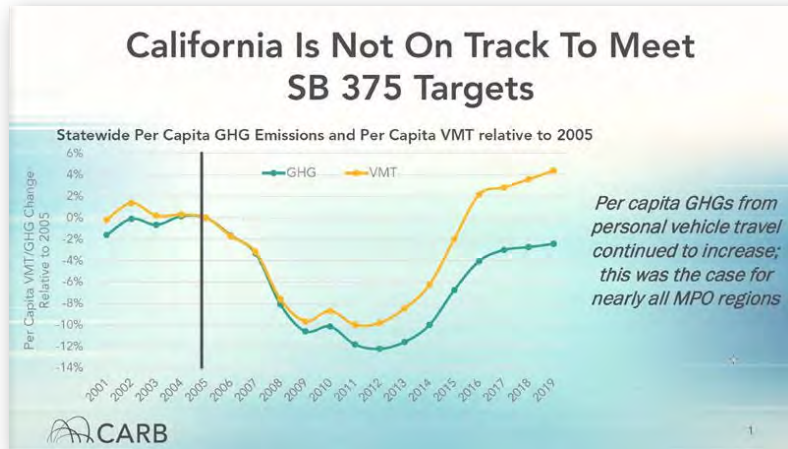


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Impact Conclusions?

# Disconnect between VMT Trends and Threshold Expectations

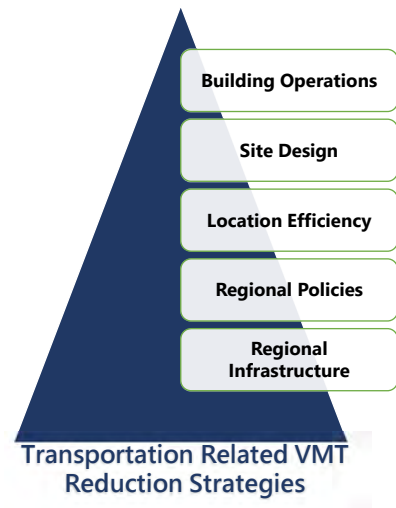


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How do we mitigate VMT impacts?

# Mitigation Options

- VMT reduction involves changing travel behavior.
- Strategies range from regional built-environment changes to project site transportation demand management (TDM).
- Effectiveness is often uncertain.

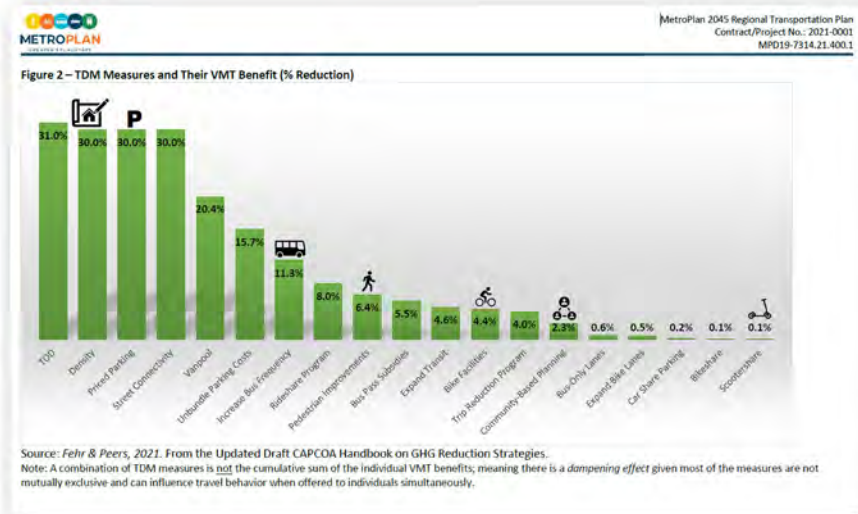


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How do we mitigate VMT impacts?

# Mitigation Options

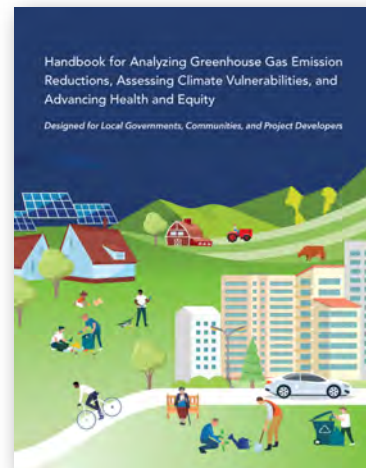


Effective and enforceable?

# Mitigation Feasibility

CAPCOA Handbook Update –  
 Reduced quantitative measures  
 from ~50 to 30

- Most effective strategies are off-site (community scale) and require a program (e.g., impact fee, bank, or exchange)
- TDM strategies are building tenant dependent



<https://www.airquality.org/business/es/ceqa-land-use-planning/ghg-handbook-calemod>

# Mitigation Feasibility

## Examples

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**Transportation**

<p><b>LAND USE</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> T-1 Increase Residential Density</li> <li><input type="checkbox"/> T-2 Increase Job Density</li> <li><input type="checkbox"/> T-3 Provide Transit-Oriented Development</li> <li><input type="checkbox"/> T-4 Improve Affordable and Below Market Rate Housing</li> <li><input type="checkbox"/> T-7 Improve Street Connectivity</li> </ul> <p><b>TRIP REDUCTION PROGRAMS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> T-5 Implement Commute Trip Reduction Program (Voluntary)</li> <li><input type="checkbox"/> T-6 Implement Commute Trip Reduction Program (Mandatory Implementation and Monitoring)</li> <li><input type="checkbox"/> T-7 Implement Commute Trip Reduction Marketing</li> <li><input type="checkbox"/> T-8 Provide Ridesharing Program</li> <li><input type="checkbox"/> T-9 Implement Subsidized or Discounted Transit Program</li> <li><input type="checkbox"/> T-10 Provide End-of-Trip Bicycle Facilities</li> <li><input type="checkbox"/> T-11 Provide Employer-Sponsored Vanpool</li> <li><input type="checkbox"/> T-12 Provide Workplace Parking</li> <li><input type="checkbox"/> T-13 Implement Employee Parking Cash-Out</li> <li><input type="checkbox"/> T-23 Provide Community-Based Travel Planning</li> </ul> <p><b>PARKING ON ROAD PRICING/MANAGEMENT</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> T-14 Provide Electric Vehicle Charging Infrastructure</li> <li><input type="checkbox"/> T-15 Limit Residential Parking Supply</li> <li><input type="checkbox"/> T-16 Unbundle Residential Parking Costs from Property Cost</li> <li><input type="checkbox"/> T-24 Implement Market Price Public Parking (On-Street)</li> </ul>	<p><b>NEIGHBORHOOD DESIGN</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> T-18 Provide Pedestrian Network Improvement</li> <li><input type="checkbox"/> T-19-A Construct or Improve Bike Facility</li> <li><input type="checkbox"/> T-19-B Construct or Improve Bike Boulevard</li> <li><input type="checkbox"/> T-20 Expand Bicycle Network</li> <li><input type="checkbox"/> T-21-A Implement Conventional Carshare Program</li> <li><input type="checkbox"/> T-21-B Implement Electric Carshare Program</li> <li><input type="checkbox"/> T-22-A Implement Pooled (Non-Electric) Bikeshare Program</li> <li><input type="checkbox"/> T-22-B Implement Electric Bikeshare Program</li> <li><input type="checkbox"/> T-22-C Implement Scooter Share Program</li> </ul> <p><b>TRANSIT</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> T-25 Extend Transit Network Coverage or Hours</li> <li><input type="checkbox"/> T-26 Increase Transit Service Frequency</li> <li><input type="checkbox"/> T-27 Implement Transit-Supportive Roadway Treatment</li> <li><input type="checkbox"/> T-28 Provide Bus Rapid Transit</li> <li><input type="checkbox"/> T-29 Reduce Transit Fare</li> </ul> <p><b>CLEAN VEHICLES AND FUELS</b></p> <ul style="list-style-type: none"> <li><input type="checkbox"/> T-30 Use Cleaner Fuel Vehicles</li> </ul>
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# Mitigation Feasibility

## Examples

**T-18. Provide Pedestrian Network Improvement**



**GHG Mitigation Potential**

Up to 0.4% of GHG emissions from vehicle travel in the plan community

**Co-Benefits** (See key on pg. 34)

**Climate Resilience**

Improving pedestrian networks increases accessibility of outdoor spaces, which can provide health benefits and thus improve community resilience. This can also improve connections that may be needed in an extreme weather event.

**Health and Equity Considerations**

Ensure that the improvements also include accessibility features to allow for people of all abilities to use the network safely and comfortably. Ensure that sidewalk network is clearly consistently visible, built on sidewalks, open, and well-maintained.

**Measure Description**

This measure will increase the sidewalk coverage to improve pedestrian access. Providing sidewalks and an enhanced pedestrian network encourages people to walk instead of drive. This measure also results in a reduction in VMT and GHG emissions.

**Subsector**  
Neighborhood Design

**Locational Context**  
Urban, suburban, and rural

**Scale of Application**  
Plan Community

**Implementation Requirements**

The GHG reduction of this measure is based on the VMT reduction associated with expansion of sidewalk coverage exposure, which includes not only building of new sidewalks but also improving degraded or substandard sidewalks (e.g., damaged from street tree roots). However, pedestrian network enhancements with non-sustainable GHG reductions are encouraged to be implemented, as discussed under Expanded Mitigation Options.

**Cost Considerations**

Depending on the improvement, capital and infrastructure costs may be high. However, improvements to the pedestrian network will increase pedestrian activity, which can increase businesses patronage and provide a local economic benefit. The local municipality may achieve cost savings through a reduction of gas on the road leading to lower infrastructure and roadway maintenance costs.

**Expanded Mitigation Options**

When improving sidewalks, a best practice is to ensure they are contiguous and link connectivity with existing and planned pedestrian facilities. Barriers to pedestrian access and interconnectivity, such as walls, landscaping buffers, slopes, and unprotected crossings should be minimized. Other best practice features could include high-visibility crosswalks, pedestrian hybrid beacons, and other pedestrian signals, mid-block crossing walkways, pedestrian refuge islands, speed tables, bulb-outs (curb extensions), curb ramps, signage, pavement markings, pedestrian-only crossings and signals, landscaping, and other improvements to pedestrian safety (see Measure T-25, Provide Traffic Calming Measures).

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Competition for mitigation dollars?

# Mitigation Programs

Implementing community scale strategies

- VMT impact fee program
- VMT mitigation exchange
- VMT mitigation bank

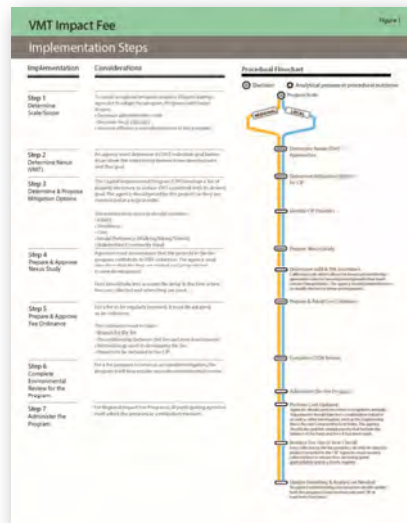


Impact Fee Program

# Mitigation Programs

Questions

- How to meet nexus expectations related to burden on public facilities
- Do impact fees compete for same pool of mitigation dollars?



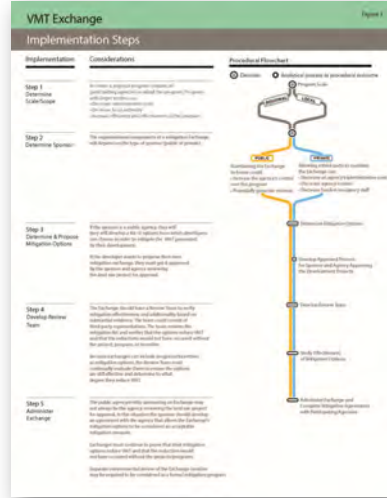
# VMT Mitigation Exchange



## Mitigation Programs

### Questions

- How to best match project mitigation needs with available menu of VMT reduction projects?



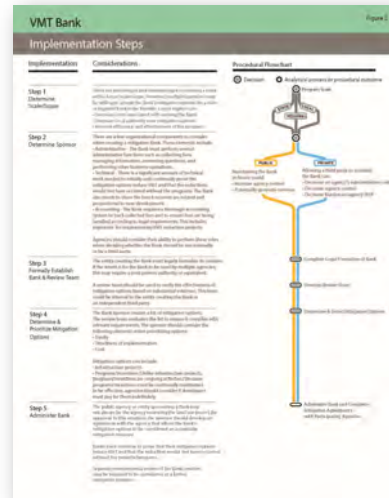
# VMT Mitigation Bank




## Mitigation Programs

### Questions

- How to verify VMT reduction strategy effectiveness over time?
- How to determine the cost to reduce one VMT?



Pilot Example



# Mitigation Programs


## LA Metro's Transit Pass Subsidy Program

- Will 'free fares' undermine mitigation program?
- Should equity be a consideration if it reduces VMT reduction effectiveness?



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What happens in practice



# Challenges

### Common Issues/Challenges

- Recognition of past court decisions on technical adequacy
  - Use of screening and partial VMT analysis
- Limited land use types in guidance and disparate treatment
- Quality or absence of travel demand models
- Screening justification/application
- Disparate thresholds and treatment of rural areas within MPO boundaries
- Recognition of the significant limitations of VMT mitigation

### Advanced Issues (if time allows)

- Threshold justification
- Recognition of VMT trends (e.g., SB 150 Report)
- Complexity of induced vehicle travel analysis
- Innovative or programmatic mitigation options

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What are practitioners doing?

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## 'Other' Land Use Types

ITE Trip Generation Manual contains ~150 land use types while the OPR Technical Advisory covers 3

- Work-related land uses are treated like office (e.g., industrial, commercial, warehouse, distribution centers, hospitals)
- Local-serving land uses treated like retail (e.g., schools, parks, recreational amenities, urgent care, medical office, hotels)
- Expansion of campus-based (work and education) uses evaluated against their own baseline performance

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What are practitioners doing?

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## 'Other' Land Use Types

Travel demand models often contain <20 land use types

- Mapping project land uses to model land uses.
- Verifying 'regional' model reasonableness and sensitivity for producing VMT outputs based on the project land use type and study area.
  - Must be adequately validated. Regional models 'off the shelf' do not commonly meet validation expectations (see [sample checklist](#)).
  - FHWA - <https://tmip.org/content/travel-model-validation-and-reasonableness-checking-manual-second-edition>
  - CTC - <https://dot.ca.gov/programs/transportation-planning/regional-planning/federal-state-planning-program/2017-rtp-guidelines-for-mpos>

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What are practitioners doing?

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# Unique Projects

## Advanced Practice – StreetLight Data

<https://www.streetlightdata.com/sb-743-vmt-solutions/>

**Say goodbye to LOS and hello to VMT**

Help your region minimize greenhouse gas emissions. Use our VMT for SB 743 implementation including screening, performance updates, compliance, adapting to rapid behavioral changes, new modes, and more. Compare your project's location to city, county, or regional averages. Get access to the following required metrics (and more) for cities, counties, or MPOs:

- Household VMT per resident
- Home-based VMT per resident
- Home-based work VMT per employee
- VMT for visitors

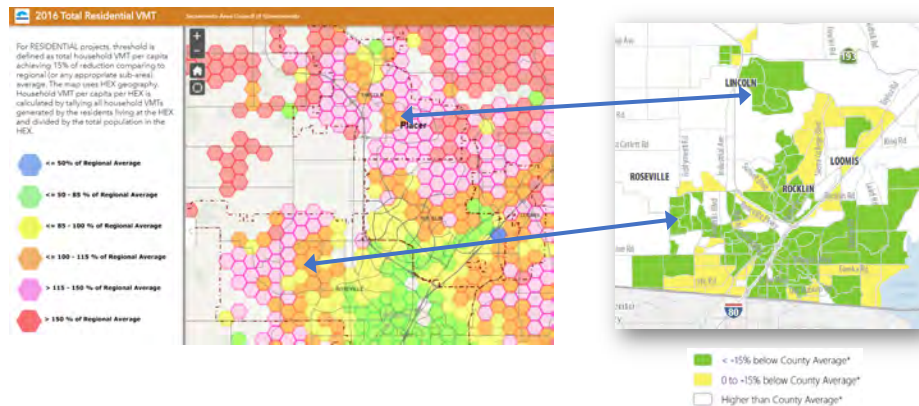
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What are practitioners doing?

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# Unique Projects

## Advanced Practice – StreetLight Data (Age Qualified Housing)



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What are practitioners doing?

# Advanced Practice

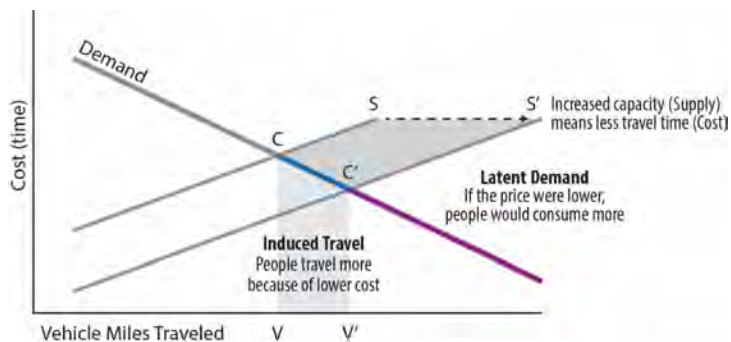
Dqdcvlv#Dhd	Edvhdqgh#P W#e # rgh			
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Wrvdc#P W#Jhghudvng#e #Sumfw#lq#hjr	4/94;/753	65</586	7;/<;4	4/<<9/987
YP W#Jhghudvng#e #Sumfw#xw.lgh#hjr	658/;:4			
Wrvdc#P W#Jhghudvng#e #Sumfw	5/655/858			

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Transportation Projects Can Have VMT Impacts

# What is Induced VMT?



NOTES:  
 C = Initial Cost  
 C' = New Cost  
 S = Initial Supply/Capacity  
 S' = New Supply/Capacity  
 V = Initial VMT  
 V' = New VMT

Source: Susan Handy

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## Transportation Projects Can Have VMT Impacts

FEHR PEERS

# What is Induced VMT?

Roadway expansion reduces travel time, which leads to:

1. Longer trips ( ↑ VMT)
2. Mode shift toward automobile ( ↑ VMT)
3. Newly generated trips ( ↑ VMT)
4. Route changes (can ↑ or ↓ or VMT)
5. More disperse land use development ( ↑ VMT)

Each of these effects are expected as a result of basic supply and demand.

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## Induced VMT Impacts

FEHR PEERS

# What is Induced VMT

- Recognized by FHWA and Caltrans
- Caltrans has most robust guidance TAF/TAC
- Raises questions about new capacity projects

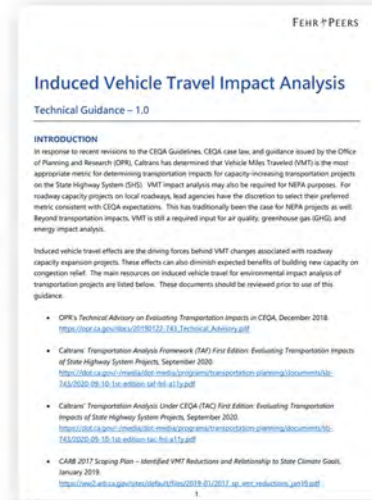


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Induced VMT Impacts

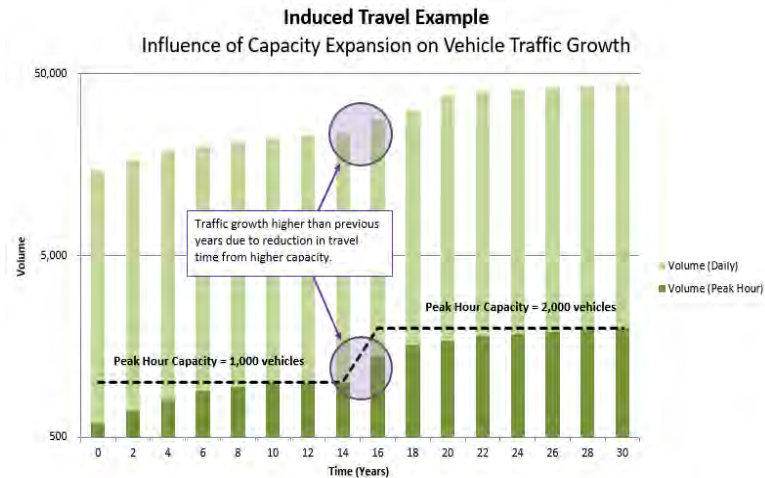
# What is Induced VMT

- FHWA and Caltrans guidance do not fully cover methodology limitations
- Supplemental guidance important for considering context



Transportation Projects Can Have VMT Impacts

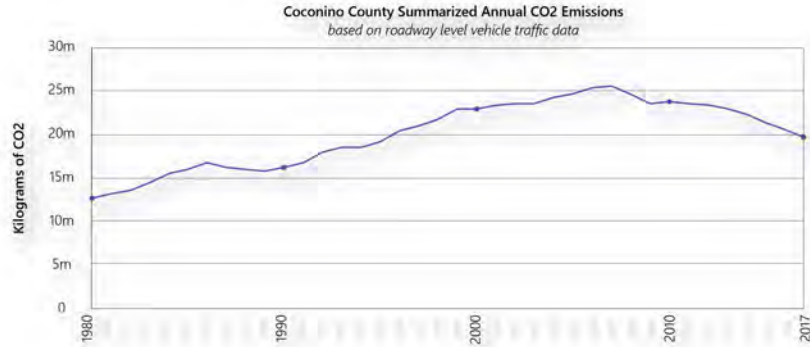
# What is Induced VMT?



### GHG Trends in Coconino County



## Brief History of VMT/GHG Trends



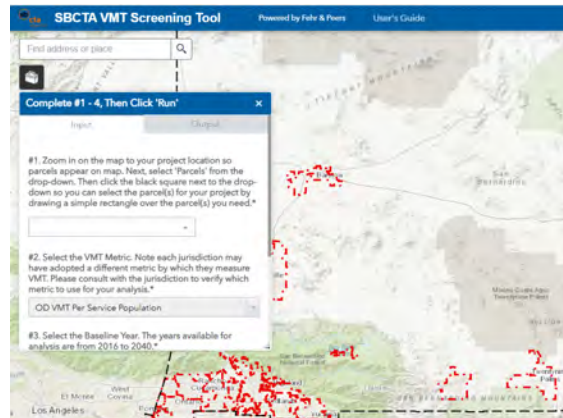
All data is from the [Gately, C., L.R. Hutyrta, and J.S. Wing, 2019. DARTe Annual On-road CO2 Emissions on a 1-km Grid, Conterminous USA, V2, 1980-2017. ORNL DAAC, Oak Ridge, Tennessee, USA. https://doi.org/10.3334/ORNLDAAC/1735](https://daac.ornl.gov/cgi-bin/dsvviewer.pl?ds_id=1735)

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### Impact Screening Tools



## Screening



<https://sbcta.maps.arcgis.com/apps/webappviewer/index.html?id=779a71bc659041ad995cd48d9ef4052b>

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# Screening

Impact Screening Tools

**San Bernardino County Transportation Authority VMT Tool**

**Project Information**

Project Name: [Text Field]  
 Project Number: [Text Field]  
 Agency: [Text Field]

**Screening Criteria for Montclair**

Use the criteria below to determine if the project is covered by Transit Priority Area or located in a bus VMT generating area?

Is the Project one of these land use types?  No

Do the project generated less than 100 daily trips?  No

Does the project land use in the transit (batter)?  No

**Project Land Use Information**

Code	Use
0	Residential - Single Family Home
1	Residential - Multi-Family Home
2	Office
3	Retail
4	Industrial
5	Public School
6	University
7	Hotel
8	General Additional Land Use 1
9	General Additional Land Use 2

**Project Trips, VMT, and TAZ SED Information**

Project Location: [Map View]

Project VMT Thresholding:  Origin Destination (OD)  All Mode Mile

Analysis View: Daily Trips: 50 Average Trip Length: 5.5 Section Population: 20

**Project Location TAZ Summary**

Land Use	Block	Land Use	Block
FD1	D1	TRIGS	E90
FD2	D1	AMPS	E90
KIC	S10	FRE	E90
COLLEGE	S11	PKCF	E90
AG	EP	EDC	E90
CONST	EP	ARTIST	E90
PAVIL	EP	CHIEF	E90
TRUCK	EP	TRUCKP	E90
RET	EP		

**Project VMT Thresholds Comparison**

Select the VMT Thresholds for comparison to project VMT

Daily Counting

Better than General Plan Budget

CPTA Guidelines (By Below Counting)

County Thresholds (By Below Counting)

Legend: Project VMT (in General Plan Budget), Daily Counting, Better than General Plan Budget, CPTA Guidelines, CPTA Guidelines, County Thresholds

SBCTA VMT Tool