

Commute Trip Reduction Calculations

Last Updated August 28, 2024

Survey Response Validation

- The system shows the number of “Accepted Responses” for each worksite. This is based on automatic validation of excluding responses that match these criteria:
 - One-way commute distance greater than 30 miles if the person indicates biking 3 or more times a week.
 - One-way commute distance greater than 10 miles if the person indicates walking 3 or more times a week.
 - One-way commute distance greater than 100 miles, unless the person indicates full-time remote work.
 - Non-telework one-way commute distance greater than or equal to 150 miles.
- Only accepted responses are used when performing calculations of metrics, but all responses are included when downloading a survey’s individual responses.
- The system can show calculations that include or exclude non CTR-affected employees.
 - An employee is CTR-affected if they are full-time and have an arrival time between 6 am and 9 am.

Definitions

Compressed work week (CWW): Alternate work schedule (anything other than 5/8s).

- 5/8s or “other” = 0 CWW trips
- 4/10s = 1 CWW trip
- 9/80s = 0.5 CWW trips
- 3/12s = 2 CWW trips
- Note: If respondents select a CWW schedule and enter more trips than days they are supposed to work, they still get credit for the CWW trip(s)

Drive-alone rate (DAR): Percent of trips driven alone as determined by SOVe (aka adjusted trips).

Greenhouse gas (GHG) emissions: Estimated greenhouse gas (CO₂) emissions. Uses constants from the [EPA](#). Calculated in metric tons.

- Emission factor: GHG emissions per mile = 0.0003912 metric tons
 - This value can change depending on updates from the EPA. This is the current value used in the tool as of 3/13/2024.
 - This is based on CO₂ emissions per gallon of gasoline consumed and the average mpg of cars.

Single occupancy vehicle (SOV): Vehicle with a single occupant (driver).

Single occupancy vehicle equivalent (SOVe): Method of adjusting SOV trips based on mode and occupancy. Also known as adjusted trips.

SOVe Trips: Fraction of a single occupancy vehicle (SOV) trip determined by mode and occupancy. Previously known as Adjusted Trips.

- 100% or 1 for drive alone trips.
- $1 / n$ % for pooled trips where n is the number of occupants (e.g. $1 / 4 = 25\%$ or 0.25 for a 4-person carpool).
 - Modes that are potentially pooled are carpool, vanpool, motorcycle, and rideshare (Lyft/Uber/Taxi).
 - Determining number of occupants:
 - If available, use self-reported occupancy.
 - If not reported, use default occupancy of 1 for motorcycle, 2 for carpool, and 4 for vanpool.
 - Cap motorcycle occupancy at 2.

SOVe Trips, Potential: Total number of drive-alone trips that could be taken. For calculations, this is the total number of trips reported in survey (regardless of the respondent’s work schedule) plus CWW trips. Telework days also count as trips.

Vehicle miles traveled (VMT): Number of SOVe miles traveled.

Vehicle miles traveled per employee (VMT/Employee): Worksite- and aggregate worksite-level metric to measure how many SOVe miles are being traveled on an average commute.

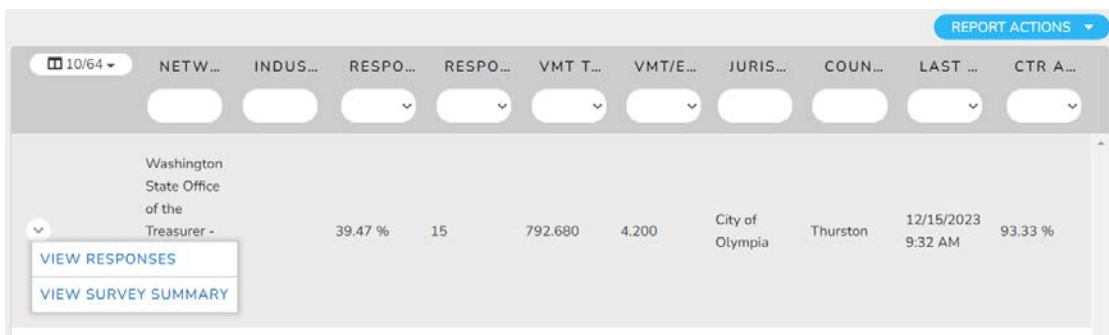
Response-Level Data

Response-level data can be found by:

1. Going to CTR Survey Results
2. Selecting “view worksite report” for a worksite
3. Selecting “view responses” for that worksite



2. Selecting a worksite



3. Viewing responses

The screenshot shows a detailed table with columns: SU..., WO..., AR..., ORI..., CO..., MO..., TU..., WE..., TH..., FRI..., SA..., SU..., DRI..., OT... The table contains two rows of data. The first row is for 'College St SE & Montcl... Dr SE, Lacey, Washin... 98503' and the second row is for '506 Cimme... St NW, Olympia, Washin... 98502'. The table includes various metrics such as dates, times, and work patterns. A footer indicates 'Page 1 of 1' and '1 - 15 of 15 items'.

Response-level table

Column Descriptions

Column Name	Description
Survey ID	Unique identifier for the survey.
User ID	Unique identifier for the respondent. May be blank.
Response ID	Unique identifier for the survey response.
Submitted Date	Date and time that the survey response was submitted.
Work Schedule	Respondent's work schedule. Used to determine CWW trips (see Definitions section).
Other Work Schedule	Description of respondent's work schedule if they select "Other (please specify)" for Work Schedule.
Arrival Time	Respondent's arrival time. Specified as an hour interval (e.g. 8am-9am).
Origin	Address that represents where the respondent starts their commute.
Origin Zip Code	Zip code of the origin address.
Work	Address that represents where the respondent ends their commute (their worksite).
Work Zip Code	Zip code of the work address.
Commute Distance	Distance between the origin address and work address. Either automatically calculated or specified by the respondent.
[Day of Week] Commute Mode	Mode of transportation that the respondent used for the specified day of the week.
Vehicle Type	Fuel type of the vehicle used if the respondent drove alone for a commute.
Ferry Commute	Mode of transportation that the respondent used to get to the ferry if they indicated using it.
[Mode] Occupancy	Occupancy of the vehicle for carpool, vanpool, motorcycle, or rideshare modes. If not specified by the respondent, default values are used (see Definitions section).
Drive Alone Alternatives	Mode(s) that would make the respondent consider not driving alone. Option for open-ended response.

Other Modes Used	Other mode(s) that the respondent used in the past three months for at least five minutes of a commute, but did not indicate in their typical weekly commute.
Other Information	Open-ended question for respondents to share other information about their commute.
Network Name	Name of the network that the survey is for.

The following values are calculated by the tool for use in worksite-level calculations, but are not displayed as columns:

Value Name	Formula/Description
SOVe Trips, Potential	See Definitions section.
SOVe Trips	See Definitions section.
VMT	<i>Adjusted Trips * Commute Distance</i>

Worksite-Level Data

Worksite-level data can be found by:

1. Going to CTR Survey Results
 - a. Viewing all worksites in your jurisdiction (automatically displayed) *or*
 - b. Selecting “view worksite report” to look at an individual worksite

	NETW...	INDUS...	RESPO...	RESPO...	VMT T...	VMT/E...	JURIS...	COUN...	LAST ...	CTR A...
>	Washington State Department of Enterprise Services - BRD/TDM & Parking Services		28.57 %	6	1,421,700	15,623	City of Olympia	Thurston	12/12/2023 11:02 PM	66.67 %
>	Cascade Investment - BMGI Kirkland		70.97 %	110	6,180,273	7,846	City of Kirkland	King	11/2/2023 9:19 PM	84.55 %

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a. Viewing all worksites in your jurisdiction

	NETW...	INDUS...	RESPO...	RESPO...	VMT T...	VMT/E...	JURIS...	COUN...	LAST ...	CTR A...
>	Washington State Department of Enterprise Services - BRD/TDM & Parking Services		28.57 %	6	1,421,700	15,623	City of Olympia	Thurston	12/12/2023 11:02 PM	66.67 %

Page 1 of 1 1 - 1 of 1 items

b. Viewing an individual worksite

Column Descriptions and Formulas

The Σ symbol means “sum of”. Metric/column names with an “R” subscript are from the response level, and those with a “W” subscript are from the worksite level. For example, $\Sigma Potential Trips_R$ means “sum of response-level potential trips”.

Many metrics are now being calculated to be representative of the worksite’s total employee count, rather than just those that responded to the survey. This is indicated by the *Total Employees/Responses* multiplier in the formulas.

Column Name	Formula/Description
Jurisdiction	Jurisdiction (city or county) that the network/worksite belongs to.
CTR ID	Unique identifier for the network.
Network	Network/worksite name, usually an organization name and some descriptor for the location of the worksite, e.g. “Thurston County - Atrium Building”.
Address	Address for the worksite.
City	City for the worksite.
County	County for the worksite.
ZIP Code	ZIP code for the worksite.
Industry	Type of industry that best fits the worksite.
Last Submission	Date that the most recent response was submitted for the worksite’s survey.
Survey Cycle	Biennium that the survey is for, e.g. 2023-2025.
Total Employees	Total number of employees at the worksite.
Responses	Total number of responses for the worksite’s survey.
Response Rate	$\frac{Responses}{Total\ Employees}$
	Response rate for the worksite’s survey.
CTR-Affected Employee Count	Number of CTR-affected employees from the pool of respondents (see Survey Response Validation section for criteria).
CTR-Affected Employees (%)	$\frac{CTR-Affected\ Employee\ Count}{Responses}$

	Percentage of respondents that are CTR-affected.
Estimated CTR-Affected Employees	$Total\ Employees * CTR\ Affected\ Employee\ (\%)$
	Estimated number of CTR-affected employees at the worksite.
SOVe Trips, Potential	$\sum SOVe\ Trips, Potential_R * \frac{Total\ Employees}{Responses}$
	Total weekly potential SOVe trips (see Definitions section).
SOVe Trips	$\sum SOVe\ Trips * \frac{Total\ Employees}{Responses}$
	Total weekly SOVe trips (see Definitions section).
Drive Alone Rate	$\frac{\sum SOVe\ Trips_R}{\sum SOVe\ Trips, Potential_R}$
	Weekly drive alone rate (see Definitions section).
Weekly One-Way Commute Distance	$\sum (Commute\ Distance_R * SOVe\ Trips, Potential_R) * \frac{Total\ Employees}{Responses}$
	Total weekly number of SOV miles traveled if everyone at the worksite drove alone for all of their potential trips.
Average One-Way Commute Distance	$\frac{Weekly\ One-Way\ Commute\ Distance}{SOVe\ Trips, Potential_W}$
	Average number of SOV miles traveled per trip per employee if everyone at the worksite drove alone for all of their potential trips.
Average One-Way Commute Distance Average	$\frac{\sum Commute\ Distance_R}{Responses}$
	Average distance between the respondents' origin address and the worksite address.
VMT/Employee	$\frac{\sum VMT_R}{\sum SOVe\ Trips, Potential_R}$
	Average VMT per trip per employee.
Yearly GHG Total Metric Tons (All Employees)	$\sum Non-EV\ VMT_R * 100 * Emission\ Factor * \frac{Total\ Employees}{Responses}$

	<p><i>See Definitions section for emission factor. The 100 is to multiply VMT to a total yearly amount (by 2 for round trips, by 50 for work weeks in a year).</i></p> <hr/> <p>Estimated yearly greenhouse gas emissions in metric tons.</p>
Weekly CWW Days	$\sum CWW\ Trips_R * \frac{Total\ Employees}{Responses}$ <p><i>See Definitions section for CWW trips.</i></p> <hr/> <p>Weekly number of CWW days (see Definitions section).</p>
Weekly Work from Home Days	$\sum Work\ From\ Home\ Days_R * \frac{Total\ Employees}{Responses}$ <hr/> <p>Weekly number of days that respondents worked from home.</p>
Weekly [Mode] Trips	$\sum [Mode]\ Trips_R * \frac{Total\ Employees}{Responses}$ <hr/> <p>Weekly number of trips that used the specified mode.</p>
Total Weekly Trips	$\sum Weekly\ [Mode]\ Trips_W * \frac{Total\ Employees}{Responses}$ <hr/> <p>Weekly number of trips across all modes.</p>
[Mode] %	<p>Weekly number of trips that used the specified mode.</p> <hr/> <p>Weekly percentage of trips that used the specified mode.</p>
VMT Total [Day of Week]	$\sum VMT\ Total\ [Day\ of\ Week]_R * \frac{Total\ Employees}{Responses}$ <hr/> <p>Total VMT for the specified day of the week.</p>
VMT Total EV	$\sum EV\ VMT_R * \frac{Total\ Employees}{Responses}$ <hr/> <p>Weekly total VMT for electric vehicles.</p>
VMT Total Non-EV	$\sum Non-EV\ VMT_R * \frac{Total\ Employees}{Responses}$ <hr/> <p>Weekly total VMT for non-electric vehicles.</p>

VMT Total	$\sum VMT_R * \frac{Total\ Employees}{Responses}$
	Weekly total VMT for all vehicles.
Yearly Total VMT EV	$VMT\ Total\ EV * 100 * \frac{Total\ Employees}{Responses}$ <i>The 100 is to multiply VMT to a total yearly amount (by 2 for round trips, by 50 for work weeks in a year).</i>
	Yearly total VMT for electric vehicles.
Yearly Total VMT Non-EV	$VMT\ Total\ Non-EV * 100 * \frac{Total\ Employees}{Responses}$ <i>The 100 is to multiply VMT to a total yearly amount (by 2 for round trips, by 50 for work weeks in a year).</i>
	Yearly total VMT for non-electric vehicles.
Yearly Total VMT	$VMT\ Total * 100 * \frac{Total\ Employees}{Responses}$ <i>The 100 is to multiply VMT to a total yearly amount (by 2 for round trips, by 50 for work weeks in a year).</i>
	Yearly total VMT for all vehicles.

Aggregate Worksite-Level (Jurisdiction-Level) Data

These values are shown in the dashboard on the CTR Survey Results page. The “report” values are jurisdiction-level values (aggregations of worksite-level values using the formulas in the table below).



Dashboard on CTR Survey Results page

Value Descriptions and Formulas

Value	Formula
Drive Alone Rate	$\frac{\sum Adjusted\ Trips_W}{\sum Potential\ Trips_W}$
Estimated Annual Greenhouse Gas Emissions for All Employees	$\sum Yearly\ GHG\ Total\ Metric\ Tons_W$
Vehicle Miles Traveled (VMT/Employee)	$\frac{\sum VMT\ Total_W}{\sum Potential\ Trips_W}$

Example VMT and VMT/Employee Calculations

Response-Level VMT Calculations

Employee A: full-time, works 4/10s, and has a 10-mile commute:

Day	Commute Mode	Adjusted Trips	Commute Distance	VMT
Monday	Drove alone	1	10 miles	10
Tuesday	Vanpool with 5 people total	0.2	10 miles	2
Wednesday	Bus	0	10 miles	0
Thursday	Telework	0	10 miles	0
Friday	Left blank (CWW day off)			
			Total VMT	12
			Number of Trips	4
			CWW Trips	1
			Potential Trips	5

Employee B: part-time (3 days a week) and has a 20-mile commute:

Day	Commute Mode	Adjusted Trips	Commute Distance	VMT
Monday	Drove alone	1	20 miles	20
Wednesday	Carpool with 2 people total	0.5	20 miles	10
Friday	Bicycle	0	20 miles	0
			Total VMT	30
			Number of Trips	3
			CWW Trips	0
			Potential Trips	3

Employee C: full-time, works 9/80s, and has a 15-mile commute:

Day	Commute Mode	Adjusted Trips	Commute Distance	VMT
Monday	Drove alone	1	15 miles	15
Tuesday	Drove alone	1	15 miles	15
Wednesday	Drove alone	1	15 miles	15
Thursday	Drove alone	1	15 miles	15
Friday	Drove alone	1	15 miles	15
			Total VMT	75
			Number of Trips	5
			CWW Trips	0.5
			Potential Trips	5.5

Note that this employee filled out the survey for the week that they worked on a Friday.

Employee D: full-time, works 5/8s, and has a 9-mile commute:

Day	Commute Mode	Adjusted Trips	Commute Distance	VMT
Monday	Telework	0	9 miles	0
Tuesday	Drove alone	1	9 miles	9
Wednesday	Drove alone	1	9 miles	9
Thursday	Drove alone	1	9 miles	9
Friday	Telework	0	9 miles	0
			Total VMT	27
			Number of Trips	5
			CWW Trips	0
			Potential Trips	5

Worksite-Level VMT and VMT/Employee Calculations

Worksite 1 – 4 total employees, 2 responses (employees A and B):

- VMT Total: $(12 + 30) * (4 / 2) = 84$
- Potential Trips: $(5 + 3) * (4 / 2) = 16$
- VMT/Employee for one week: $(12 + 30) / (5 + 3) = 5.25$

Worksite 2 – 6 total employees, 2 responses (employees C and D):

- VMT Total: $(75 + 27) * (6 / 2) = 306$
- Potential Trips: $(5.5 + 5) * (6 / 2) = 31.5$
- VMT/Employee for one week: $(75 + 27) / (5.5 + 5) = 9.71$

Aggregate Worksite-Level VMT and VMT/Employee Calculations

Using Worksites 1 and 2 from above.

- VMT Total: $84 + 306 = 390$
- Potential Trips: $16 + 31.5 = 47.5$
- VMT/Employee for one week: $390 / 47.5 = 8.21$

Example DAR Calculations

Employees and worksites are the same as previous example.

Response-Level DAR Calculations

Employee A:

Day	Commute Mode	Adjusted Trips
Monday	Drove alone	1
Tuesday	Vanpool with 5 people total	0.2
Wednesday	Bus	0
Thursday	Telework	0
Friday	Left blank (CWW day off)	
	Total Adjusted Trips	1.2
	Total Potential Trips	5
	DAR	0.24 or 24%

Employee B:

Day	Commute Mode	Adjusted Trips
Monday	Drove alone	1
Wednesday	Carpool with 2 people total	0.5
Friday	Bicycle	0
	Total Adjusted Trips	1.5
	Total Potential Trips	3
	DAR	0.5 or 50%

Employee C:

Day	Commute Mode	Adjusted Trips
Monday	Drove alone	1
Tuesday	Drove alone	1
Wednesday	Drove alone	1
Thursday	Drove alone	1
Friday	Drove alone	1
	Total Adjusted Trips	5
	Total Potential Trips	5.5
	DAR	0.91 or 91%

Employee D:

Day	Commute Mode	Adjusted Trips
Monday	Telework	0
Tuesday	Drove alone	1
Wednesday	Drove alone	1
Thursday	Drove alone	1
Friday	Telework	0
	Total Adjusted Trips	3
	Total Potential Trips	5
	DAR	0.6 or 60%

Worksite-Level DAR Calculations

Worksite 1:

- Sum of adjusted trips: $1.2 + 1.5 = 2.7$
- Sum of potential trips: $5 + 3 = 8$
- DAR: $2.7 / 8 = \mathbf{0.34}$ or **34%**

Worksite 2:

- Sum of adjusted trips: $5 + 3 = 8$
- Sum of potential trips: $5.5 + 5 = 10.5$
- DAR: $8 / 10.5 = \mathbf{0.76}$ or **76%**

Aggregate Worksite-Level DAR Calculations

- Worksite 1 adjusted trips: $(1.2 + 1.5) * (4 / 2) = 5.4$
- Worksite 2 adjusted trips: $(5 + 3) * (6 / 2) = 24$
- Worksite 1 potential trips: 16
- Worksite 2 potential trips: 31.5
- DAR: $(5.4 + 24) / (16 + 31.5) = \mathbf{0.62}$ or **62%**

Example GHG Emissions Calculations

GHG emissions are not calculated on the response level.

Worksite-Level GHG Calculations

Assume no employees reported driving with an electric vehicle.

Worksite 1:

- Sum of non-EV VMT: $12 + 30 = 42$
- Total Employees / Responses: $4 / 2 = 2$
- Yearly GHG: $42 * 100 * 0.0003912 * 2 = \mathbf{3.29 \text{ metric tons}}$

Worksite 2:

- Sum of non-EV VMT: $75 + 27 = 102$
- Total Employees / Responses: $6 / 2 = 3$
- Yearly GHG: $102 * 100 * 0.0003912 * 3 = \mathbf{11.97 \text{ metric tons}}$

Aggregate Worksite-Level GHG Calculations

- Yearly GHG: $3.29 + 11.97 = \mathbf{15.26 \text{ metric tons}}$