

Carbon Emissions Tool (CET)

Instructions and Tips

February 13, 2024

Table of Contents

About the CET	1
Overview of the components of the CET.....	1
Steps to take to use the CET.....	5
Step 1: Identify the project type for analysis in the CET.....	5
What to do if your project type does not appear in the CET?.....	6
Step 2: Enter project-specific information.....	6
Develop appropriate inputs and assumptions	7
Estimate timeframe for duration of project emissions benefits	8
What to do if the project does not seem to fit the parameters of the calculation in the CET?.....	9
VMT calculations.....	9
Characteristics outside available inputs	9
What about secondary impacts?	10
Conducting off-tool analysis	11
Calculating Changes in VMT by Conventional Vehicles	11
Calculating Travel Time Savings	12
Using the MICE Tool.....	13
Step 3: Enter project-related cost information.....	13
Step 4: Review the results.....	14

About the CET

The Carbon Emissions Tool (CET) is a spreadsheet tool developed by MnDOT to estimate the carbon emission reductions associated with transportation project investments. The CET may be used to estimate emissions reductions associated with a wide variety of transportation projects.

For applicants seeking funding under the Carbon Reduction Program (CRP), the CET is used as part of the application process. Applicants input information about their proposed projects and use the tool to calculate the estimated cumulative carbon emissions benefits (in metric tons of CO₂e) and cost-effectiveness (in dollars per metric ton of CO₂e reduced) of those projects. This information, along with information on the co-benefits of these projects, is then used to prioritize projects for CRP funding.

Outside of the CRP application process, the CET may be used to calculate the carbon emission reductions of various transportation projects. Consequently, the CET includes project types that are CRP-eligible and project types that are not CRP-eligible, but eligible for other federal or state funding sources.

Overview of the components of the CET

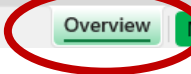
The CET enables the user to calculate the carbon emissions benefits of 26 transportation project types falling under the Minnesota Carbon Reduction Strategy (CRS) categories of Electrification, Travel Options and Low Carbon Infrastructure and System Management.

The spreadsheet includes individual project type tabs for calculating specific types of projects. Each tab allows the user to input information about the project to calculate the carbon emissions benefits of the project.

The first three dark green tabs labeled 'Overview', 'Mapping' and 'Results Summary' are where users will likely start and end the analysis. The 'Overview' tab provides descriptions, definitions and examples of project types contained within the tool (Figure 1). The 'Mapping' tab provides information on which project-type tab to use depending on the project type (Figure 2). Finally, the 'Results Summary' tab provides the emissions calculation results after a user completes emissions reduction calculations on the project-specific tab or tabs (Figure 3). On the 'Results Summary' tab, users will also be able to input the overall cost of the project, and the CET will determine the cost-effectiveness of the project.

Figure 1. Preview of the 'Overview' tab, Minnesota CET 2024

OVERVIEW OF STRATEGIES		
Project Type	Definition	Example
Electrification		
E1	Expand public EV charging infrastructure network for light-duty vehicles	Install public electric vehicle charging stations (EVCS), including both level 2 (L2) and direct-current fast chargers (DCFC) for light-duty vehicles (LDVs) • Install Level 2 chargers for light-duty electric vehicles • Install DCFC chargers for light-duty electric vehicles
E2	Deploy charging infrastructure for medium- and heavy-duty freight vehicles	Install public and depot electric vehicle charging stations (EVCS) for medium- and heavy-duty (MD/HD) vehicles • Install Level 2 chargers for MD/HD electric vehicles • Install DCFC chargers for MD/HD electric vehicles • Install megawatt charging system (MCS) for MD/HD electric vehicles
E3	Purchase or lease battery electric transit buses	Purchase or lease battery electric buses (BEB) to replace conventional diesel-powered buses; this equipment replacement does not account for any changes related to service coverage, ridership, etc. If the nature of bus service changes, please refer to projects T5 - T10, and T15. • Replace transit buses powered by gasoline, diesel, natural gas, or other internal combustion engines with electric buses
E4	Purchase or lease battery electric school buses	Purchase or lease battery electric buses (BEB) to replace conventional diesel-powered school buses; this equipment replacement does not account for any changes related to service coverage, ridership, etc. • Replace school buses powered by gasoline, diesel, natural gas, or other internal combustion engines with electric buses
E5	Transition public fleet through purchase & lease of ZEVs	Purchase or lease zero emissions vehicles (ZEVs) to replace gasoline, compressed natural gas (CNG), and diesel-powered vehicles in a public fleet • Replace police vehicle powered by gasoline, diesel, natural gas, or other internal combustion engines with electric vehicles. • Replace refuse trucks powered by gasoline, diesel, natural gas, or other internal combustion engines with electric trucks. • Replace utility vehicles powered by gasoline, diesel, natural gas, or other internal combustion engines with electric vehicles.
E6	Initiate ZEV or EV sharing programs	Implement an electric carshare program; this tool only accounts for primary program benefits due to displaced vehicle miles traveled (VMT) from the program itself and does not include any induced EV purchase. Secondary benefits can be quantified using project T15. • Launch a community car share program with a 10-vehicle EV fleet.
Travel Options and System Management		
T1	Construct or improve bicycle network	Add bicycle facilities to improve bicycling conditions, displacing vehicle travel by encouraging bicycling instead • Construct a new bike path along a roadway • Construct a new bike trail that aims to reduce community vehicle miles traveled (VMT) • Convert an on-road bike lane to a separated bikeway
T2	Construct or improve pedestrian network	Add pedestrian facilities to improve the area's walkability, reducing vehicle travel through modal shifts; this methodology requires applicants to acquire information on existing streets within 0.6 miles of the project area. If such information is not available, please refer to project T15 instead. • Expand the existing pedestrian network • Construct a new sidewalk in the community
T3	Establish or expand micromobility programs	Implement a micromobility program, including e-scooters, e-bicycles, and traditional pedal bicycles • Expand the current micromobility (bicycles, e-scooter) program • Launch a new micromobility (bicycles, e-scooter) program
T4	Improve street connectivity	Improve street connectivity to reduce the trip distance between a pair of origin and destination • Increase intersection density in a community • Construct new intersection
T5	Implement Bus Rapid Transit (BRT) systems with dedicated lanes and stations	Implement dedicated lanes and stations for Bus Rapid Transit (BRT) systems, with additional services such as a limited number of stops, intelligent transportation technology (e.g., transit signal priority), advanced technology vehicles, efficient fare payment and branding of the system; this calculation does not require users to provide ridership increase on their own. • Improve current service with a dedicated all-day bus lane • Construct dedicated stations for the current service • Provide passenger amenities at stations of the current service
T6	Implement bus transit priority treatments	Implement bus transit priority treatments to reduce the travel times and reliability of transit systems by implementing a combination of roadway infrastructure and traffic signal improvements; this calculation requires users to provide ridership increase on their own. • Convert a conventional transit service to BRT • Implement a combination of multiple measures that result in service ridership improvement without increasing bus mileage
T7	Add or expand bus service	Expand or add bus service in a region to improve the transit coverage area, providing transit service to more people • Add new local fixed routes, bus rapid transit, or demand response services. • Expand coverage and service area of existing local fixed routes, bus rapid transit, or demand response services.
T8	Enhance bus frequency or hours of service	Increase bus frequency to reduce wait time for transit users, making bus use more convenient • Increase service frequencies of existing local fixed routes, bus rapid transit, demand response, commuter bus, or commuter rail services during a certain time period
T9	Establish or expand intercity bus services	Build or expand intercity bus services allows passengers to use transit to travel between cities rather than using personal light-duty vehicles (LDV) • Add new intercity or commuter bus services (long-distance bus service). • Expand coverage of existing intercity or commuter bus services (long-distance bus service).
T10	Develop or improve intercity passenger rail services	Develop or improve intercity passenger rail services to provide efficient and comfortable intercity travel options • Add new intercity or commuter rail services. • Expand coverage of existing intercity or commuter rail services.
T11	Construct, expand, or enhance park and ride facilities	Construct park and ride facilities near transit or high-occupancy vehicle lanes, encouraging people to use transit or car- and van-pooling • Construct a new park-and-ride facility with 100 parking spaces
T12	Construct roundabout to improve traffic flow	Add a roundabout to an existing 4-way signalized intersection to significantly reduce drivers' travel delays • Add a roundabout facility at an intersection
T13	Construct left turn lane to improve traffic flow	Add two-way left turn lanes to an existing un-divided roadway to significantly reduce drivers' travel delays • Add two-way left turn lanes at an intersection
T14	Synchronize traffic signals to reduce delay time	Synchronize traffic signals to reduce travel times that would decrease systemwide emissions • Synchronize traffic signals along a corridor
T15	Reduce Auto VMT (Generic)	Reduce vehicle miles traveled (VMT) from light-duty and/or medium/heavy-duty vehicles; Any projects that do not fit under E1-E6 or T1-T14 could use this method instead • Any project that reduces light-duty auto vehicle trips • Any project that reduces medium/heavy-duty vehicle trips
Low Carbon Infrastructure Projects		
LC1	Use low carbon materials in road construction and maintenance	Use low carbon materials in the construction process to minimize carbon footprint of transportation construction and maintenance projects • Sustainable asphalt
LC2	Recycle pavement on construction sites	Recycle pavement on construction sites • Pavement recycling
LC3	Replace street lighting and traffic control devices with LEDs	Replace existing street lighting or traffic lights with higher efficiency LED lighting • Replace a traffic light with LED
Renewable Energy Projects		
RE1	Implement renewable energy projects in highway right-of-way	Install new renewable electricity generation assets in the right-of-way for highway transportation projects • Install solar panels at highway right-of-way
RE2	Install solar panels on transit stations, rest stops, parking, and other facilities	Install solar panels in spaces controlled by transportation agencies as a means of producing low-cost and low carbon electricity for those spaces and the surrounding grid • Install a solar panel at a transit hub



Overview Mapping Results Summary E1 LD EV Chargers E2 MHD EV Chargers E3 Electric Transit Buses E4 Electric

Figure 2. Preview of the 'Mapping' tab, Minnesota CET 2024

Calculator Strategy	CRS Category	CRS Strategy	CRS Project Type
E1 Expand public EV charging infrastructure network for light duty vehicles	Electrification	Install EV charging infrastructure	• Expand public EV charging infrastructure network for light duty vehicles
E2 Deploy charging infrastructure for medium- and heavy-duty freight vehicles	Electrification	Install EV charging infrastructure	• Implement public and depot EV charging infrastructure for transit buses • Provide EV charging infrastructure grants for school districts • Deploy public/shared private charging infrastructure for medium and heavy-duty freight vehicles
E3 Purchase or lease battery electric transit buses	Electrification	Purchase/lease EVs or other ZEVs	• Zero emission transit buses
E4 Purchase or lease battery electric school buses	Electrification	Purchase/lease EVs or other ZEVs	• Zero emission school buses
E5 Transition public fleet through purchase & lease of ZEVs	Electrification	Purchase/lease EVs or other ZEVs	• Transition public fleet (e.g., vehicles operated by municipalities, such as police vehicles or fleet vehicles) through purchase and lease of ZEVs or Evs
E6 Initiate ZEV or EV sharing programs.	Electrification	Purchase/lease EVs or other ZEVs	• Initiate ZEV or EV sharing programs (e.g., making ZEVs or EVs accessible to more people without the commitment of ownership)
T1 Construct or improve bicycle network	Travel Options	Install and maintain infrastructure network improvements for walking, rolling and bicycling	• Construct or improve bicycle network (e.g., add on-street bike lane, add protected bike lane/separated bikeway, shared use paths, trails)
T2 Construct or improve pedestrian network	Travel Options	Install and maintain infrastructure network improvements for walking, rolling and bicycling	• Construct or improve pedestrian network (e.g., add sidewalks, expand sidewalks, fill gaps in sidewalk network, shared use paths, trails) <i>[Note: This methodology is primarily designed for sidewalk/path network improvements, and may not be applicable for some types of pedestrian connections such as connection to a transit station or activity center, which may require off-tool calculation]</i>
T3 Establish or expand micromobility programs	Travel Options	Install and maintain infrastructure network improvements for walking, rolling and bicycling	• Establish or expand micromobility programs (e.g., bicycle sharing stations, scooter sharing program)
T4 Improve street connectivity	Travel Options	Implement context sensitive design for travel options	• Improve street connectivity (e.g., increasing vehicle intersection density allowing shorter and more efficient trips between destinations, reducing travel times and congestion)
T5 Implement Bus Rapid Transit (BRT) systems with dedicated lanes and stations	Travel Options	Add high-capacity public transit options (operations & capital)	• Implement Bus Rapid Transit (BRT) systems that use dedicated lanes and stations with off-board fare collection to provide faster and more efficient service
T6 Implement bus transit priority treatments	Travel Options	Add high-capacity public transit options (operations & capital)	• Implement bus transit priority treatments (e.g., transit signal priority to reduce travel time and enhance reliability, infrastructure improvements such as bus only lanes during certain hours)
T7 Add or expand bus service	Travel Options	Add high-capacity public transit options (operations & capital)	• Expand or add bus service (e.g., expanded coverage area, new bus routes or on-demand services) <i>[Note: Only transit capital projects are eligible for CRP funding, not transit operations]</i>
T8 Enhance bus frequency or hours of service	Travel Options	Add high-capacity public transit options (operations & capital)	• Enhance bus frequency or hours of service <i>[Note: Only transit capital projects are eligible for CRP funding, not transit operations]</i>
T9 Establish or expand intercity bus services	Travel Options	Add intercity and regional public transit options (operations & capital)	• Establish or expand intercity bus services that connect different towns and cities <i>[Note: Only transit capital projects are eligible for CRP funding, not transit operations]</i>
T10 Develop or improve intercity passenger rail service	Travel Options	Add intercity and regional public transit options (operations & capital)	• Develop and improve intercity passenger rail service <i>[Note: Only transit capital projects are eligible for CRP funding, not transit operations]</i>
T11 Construct, expand, or enhance park and ride facilities	Travel Options	Add intercity and regional public transit options (operations & capital)	• Develop mobility hubs (e.g., stations that connect transit routes to other travel options and between regions considering land use and amenities, stations that include park and ride facilities to encourage commuters to leave vehicles and use transit)
T12 Construct roundabout to improve traffic flow	Low-Carbon Infrastructure and System Management	Optimize transportation system management and operations	• Implement intersection improvements (e.g., roundabouts, turn lanes)
T13 Construct left turn lane to improve traffic flow	Low-Carbon Infrastructure and System Management	Optimize transportation system management and operations	• Implement intersection improvements (e.g., roundabouts, turn lanes)
T14 Synchronize traffic signals to reduce delay time	Low-Carbon Infrastructure and System Management	Optimize transportation system management and operations	• Implement traffic signal improvements to reduce delays and improve traffic flow (e.g., adaptive traffic signal systems that adjust signal timings based on real-time traffic conditions, signal coordination)
T15 Other projects that reduce vehicle miles travel (VMT) by fossil fueled vehicles	Travel Options	Multiple strategy types	This calculation tab may be used to calculate the carbon emissions benefit of any project that reduces light-duty or medium/heavy-duty vehicle travel in conventionally fueled vehicles. The user must conduct an off-model calculation of the VMT reduction as an input. This calculation may be used for any of the types of project options listed in the table below, or as an alternative to using the calculation procedures on other tabs if there are unique factors that should be accounted for. [See table below]
LC1 Use low carbon materials	Low-Carbon Infrastructure and System Management	Utilize low-carbon transportation infrastructure and construction	• Use low carbon materials and recycled materials in the construction process to minimize carbon footprint of transportation construction/maintenance projects (e.g., sustainable asphalt)
LC2 Recycle pavement on construction sites	Low-Carbon Infrastructure and System Management	Utilize low-carbon transportation infrastructure and construction	• Recycle pavement on construction sites (e.g., maximize the amount of recycled pavement used on a construction site)
LC3 Replace street lighting and traffic control devices with LEDs	Low-Carbon Infrastructure and System Management	Utilize low-carbon transportation infrastructure and construction	• Replace street lighting and traffic control devices with energy-efficient alternatives (e.g., LED lighting)
RE1 Implement renewable energy projects in highway right-of-way	Low-Carbon Infrastructure and System Management	Support renewable energy generation	• Implement renewable energy projects in highway right-of-way
RE2 Install solar panels on transit stations, rest stops, parking, and other facilities	Low-Carbon Infrastructure and System Management	Support renewable energy generation	• Implement solar panels or other renewable energy generation on transit stations, rest stops, parking and other facilities.

Figure 3. Preview of the 'Results Summary' tab, Minnesota CET 2024

Strategy	Year 1 emissions reduction (CO ₂ e MT per year)	Cumulative emissions reduction (CO ₂ e MT)	Total Costs (\$) USER INPUT REQUIRED	Cost Effectiveness (\$/MT)
E1	Expand public EV charging infrastructure network for light duty vehicles			
E2	Deploy charging infrastructure for medium- and heavy-duty freight vehicles			
E3	Purchase or lease battery electric transit buses			
E4	Purchase or lease battery electric school buses			
E5	Transition public fleet through purchase & lease of ZEVs			
E6	Initiate ZEV or EV sharing programs.			
T1	Construct or improve bicycle network			
T2	Construct or improve pedestrian network			
T3	Establish or expand micromobility programs			
T4	Improve street connectivity			
T5	Implement Bus Rapid Transit (BRT) systems with dedicated lanes and stations			
T6	Implement bus transit priority treatments			
T7	Add or expand bus service			
T8	Enhance bus frequency or hours of service			
T9	Establish or expand intercity bus services			
T10	Develop or improve intercity passenger rail services			
T11	Construct, expand, or enhance park and ride facilities			
T12	Construct roundabout to improve traffic flow			
T13	Construct left turn lane to improve traffic flow			
T14	Synchronize traffic signals to reduce delay time			
T15	Reduce vehicle miles traveled			
LC1	Use low carbon materials in road construction and maintenance			
LC2	Used recycled pavement on construction sites			
LC3	Replace street lighting and traffic control devices with LEDs			
RE1	Implement renewable energy projects in highway right-of-way			
RE2	Install solar panels on transit stations, rest stops, parking, and other facilities			
Total		0.00	0.00	\$0

The CET is generally intended to be used to analyze individual projects. That said, if a project contains multiple types of project elements that reduce carbon emissions, the user may input the project data on different tabs and see the results of each project display on the 'Results Summary' tab¹. This also means the 'Total' row on the 'Results Summary' tab can be used to sum the total cumulative emissions benefits and overall cost-effectiveness of the project. If the project involves more than one project type, users need to enter the cost components by project type, so that the sum of all components equals the overall project cost and use the 'Total' row to calculate for the overall emissions benefits.


Each project type tab within the calculator has three different sections: INPUTS, CONSTANTS & INTERIM CALCULATIONS and RESULTS. Directions are also provided on top of each tab to provide guidance on how to use the calculator.

Default values for some parameters are listed on each sheet and filled in for the user. These defaults should be replaced by the user if more appropriate project-specific information is available. Each tab

¹ Note: If a user has multiple projects within a specific project category, the user will need to calculate each project separately with the tool and record each result in an alternative location.

also has a 'Reset to Default' button which can be used to clear user inputs and start over with pre-populated default parameters.

Figure 4. Example project type tab showing directions and calculator layout, Minnesota CET 2024



DEPARTMENT OF TRANSPORTATION

PROJECT TYPE: E1 – EXPAND PUBLIC EV CHARGING INFRASTRUCTURE NETWORK FOR LIGHT DUTY VEHICLES

DIRECTIONS:

Enter project data needed within the “INPUTS” section below. Note that default values are available for many inputs, which are shown to the right and are pre-populated in the calculator. You may replace the default values in the calculation with your own data if you have project-specific data. Click the “Reset to Default” button if you would like to go back to using all default values.

The “CONSTANTS & INTERIM CALCULATIONS” section shows assumptions that cannot be changed or interim results that are calculated by the tool based on the project input data.

The “RESULTS” section shows the results of the carbon emissions calculations, both estimated emission reductions in year 1 and cumulative emission reductions over the duration of the project.

INPUTS

Variables	Value	Unit	Minnesota Region Default Value (For Reference Only)
Year of project implementation		-	-
Number of Level 2 Ports installed		-	-
Number of DC Fast Ports installed		-	-
Project lifetime		10 years	10
Level 2 charger power level		6.6 kW	6.6
DC fast charger power level		50 kW	50
Average L2 charger utilization rate		10.0% percent	10%
Average DC fast charger utilization rate		5.0% percent	5%
Annual hours in use of charging facility		8760 hours/year	8760

CONSTANTS & INTERIM CALCULATIONS

Variables	Value	Unit
Average EV energy efficiency		0.294 kWh/mi
Regional light-duty vehicle (LDV) fleet average GHG emission factor (Year 1)		#N/A g CO2e/mi
Regional light-duty vehicle (LDV) fleet average GHG emission factor (average of project lifetime)		#N/A g CO2e/mi

RESULTS

Variables	Value	Unit
Emissions reduction in year 1		#N/A CO2 e MT per year
Cumulative emissions reduction		#N/A CO2 e MT

Steps to take to use the CET

The following sections provide more information on steps to take to use the CET, things to consider when using the CET and tips for ensuring the most accurate results for purposes of project comparisons.

Step 1: Identify the project type for analysis in the CET

The first step in the process is to select the project type or types that align with the proposed project. Within the 'Overview' tab there is a list of example projects that fit within each project type.

Once a user selects the project type or project types, the user can click the corresponding link or scroll through the calculator tabs at the bottom of the spreadsheet. The full list of project types is within the 'Mapping' tab (see Figure 2).

What to do if your project type does not appear in the CET?

Please note that several types of Electrification and Travel Options projects do not have their own project type tab but emissions effects may be calculated using the 'T15 Reduce VMT' tab.

If the specific project type is not directly listed but the project is designed to reduce VMT from passenger vehicles or medium/heavy-duty that are powered by internal combustion engines, such as through encouraging shifts to electric vehicles, transit, bicycling, walking, ridesharing or other options, users may use the 'T15 Reduce VMT' tab. This tab requires users to calculate the light-duty and medium/heavy-duty VMT that is anticipated to be reduced by the project outside of the CET for use in the emissions calculation. CRP project applicants should make sure to document the methodology and assumptions that are used to estimate the VMT reduction level in their project application.

For Low Carbon Infrastructure and System Management project types whose emissions benefits cannot be captured by the 'T15 Reduce VMT' tab, applicants should provide justification and the calculation methodology to quantify emission reductions in their application.

Step 2: Enter project-specific information

The next step is to enter the information about the project into the CET. There is inherently some uncertainty around these numbers, so it is appropriate to use estimates. Common project information that a user may need to prepare includes the following²:

- Year of project implementation
- Project lifetime
- Number of units being implemented (e.g., number of level 2 EV chargers, number of buses being converted to battery electric, number of EVs deployed in a program)
- Average annual vehicle miles traveled (VMT) of vehicles being replaced
- Facility information such as project length, city/town type, type of facility, number of destinations within a certain distance, and average annual days in use of facility

² Note that these inputs are not exhaustive but rather a sample of inputs. See the specific project type tab or tabs for what specific information is required for the project the user is calculating.

For many project inputs, additional guidance is provided within the spreadsheet via pop-up boxes (Figure 5). More detailed information on the project calculations and project inputs can be found in Appendix D of the [2023 Minnesota CRS](#).

Figure 5: Example of a pop-up box describing a variable within a calculation, Minnesota CET 2024



PROJECT TYPE: T5 – IMPLEMENT BUS RAPID TRANSIT (BRT) SYSTEMS WITH DEDICATED LANES AND STATIONS

DIRECTIONS:

Enter project data needed within the “INPUTS” section below. Note that default values are available for many inputs, which are shown to the right and are pre-populated in the calculator. You may replace the default values in the calculation with your own data if you have project-specific data. Click the “Reset to Default” button if you would like to go back to using all default values.

The “CONSTANTS & INTERIM CALCULATIONS” section shows assumptions that cannot be changed or interim results that are calculated by the tool based on the project input data.

The “RESULTS” section shows the results of the carbon emissions calculations, both estimated emission reductions in year 1 and cumulative emission reductions over the duration of the project.

INPUTS		Reset to Default		Minnesota Region Default Value (For Reference Only)
Variables	Value		Unit	
Year of project implementation			-	
Transit fuel type			-	
Dedicated lane improvement 1			-	
Dedicated lane improvement 2			-	
Station improvement 1			-	
Station improvement 2			-	
Annual ridership in current bus services			riders/boardings	
Total annual vehicle mileage of current bus service			miles	
Project lifetime			20 years	20
Average travel speed of the transit			13.4 mph	13.4
Average travel speed of the transit after improvement			15 mph	15
Adjustment factor for transit dependency			0.62 -	0.62
Average length of vehicle trip replaced by bus service			4.61 miles	4.61

CONSTANTS & INTERIM CALCULATIONS	
Variables	Value
<div style="border: 1px solid black; padding: 5px; width: fit-content;"> Description of the variable Average auto vehicle miles displaced from one transit trip. This could be estimated using current average trip distance from transit services in the project area. </div>	

Develop appropriate inputs and assumptions

When developing the inputs for a given project, use project-specific data when available instead of the default value provided. Project-specific information provides the most accurate estimates of project-level impacts. When developing inputs, note the assumptions being made and the source of these assumptions in the project application. If local or project-specific data is not available, the default value can be used, as it is tailored to Minnesota wherever it was possible.

Also, some inputs are project-specific and do not have default values (e.g., number of buses, year of project implementation). These must be input by the user.

Estimate timeframe for duration of project emissions benefits

The duration of project benefits associated with the project is a key factor used to calculate cumulative emissions benefits³. Default lifetimes are available for most, but not all, project types (see Table 1 below).

Table 1. Project lifetime defaults and sources, Minnesota CET 2024

Default Project Duration (yrs.)	Project Type	Project ID	Source
20	Bicycle/pedestrian/roadway (roundabouts, turn lanes)/BRT infrastructure, solar panels and renewable energy projects	T1, T2, T4, T5, T6, T10, T11, T12, T13, RE1, RE2	USDOT Benefit-Cost Analysis Guidance
14	Bus replacements (transit buses ⁴ , school buses), heavy-duty vehicle replacements	E3, E4, E5	FTA Useful Life Benchmarks (ULB)
10	EV charging infrastructure, docked micromobility equipment, street lighting	E1, E2, LC3	Assumptions used by MnDOT for NEVI program for EV charging infrastructure; best available estimate on micromobility from Minnesota
8	Light-duty vehicles in fleets or carsharing programs	E5, E6	FTA Useful Life Benchmarks; typical life of light-duty vehicles
7	Synchronized traffic signals	T14	USDOT Benefit-Cost Analysis Guidance
5	Dockless micromobility equipment	T3	Best available estimate on micromobility from Minnesota

For other project types that involve operational costs no default is provided. These include:

- Expand bus service or add new bus service (T7)
- Enhance bus frequency or hours of service (T8)
- Establish or expand intercity bus service (T9)
- Travel demand management programs and outreach (which may be analyzed off-tool and input into T15)

³ Note that the maximum duration of project benefits calculated is 20 years, reflecting typical long range planning horizons.

⁴ Transit bus useful life can differ based on body type and applications; according to the FTA ULB, although most buses (articulated, over-the-road, standard, double decked) have a useful life of 14 years, cutaway bus only has a useful life of 10 years, and trolley bus has a useful life of 13 years. Users may need to adjust this value on a case-by-case basis.

The lifetime of these projects should be selected to match the time period over which the project or program will be funded⁵.

Low carbon emissions infrastructure projects (e.g., use low carbon materials in road construction and maintenance, or use recycled pavement on construction sites), the emissions benefits account for lifecycle emissions.

What to do if the project does not seem to fit the parameters of the calculation in the CET?

Be aware that some types of projects may not fit exactly within the project type parameters in the CET.

VMT calculations

Many of the calculation methods in the CET for projects that reduce VMT (e.g., T1 through T10) are designed to calculate the impacts of a project on VMT.

Example:

'T2 Pedestrian Network' project category methodology is designed primarily to analyze the addition of sidewalks within a community street network. It requires the following inputs to calculate the reduction in VMT:

- *Length of the new facility*
- *Length of existing streets within 0.6 mile of the project area (to estimate the increase in the pedestrian network)*

The T2 project type is not applicable for certain types of pedestrian improvements. Two examples where T2 project type calculations are not appropriate are:

- *A pedestrian bridge crossing a highway. It would be better to examine the anticipated use of the bridge based on connections between activity centers to calculate the VMT reduction.*
- *Pedestrian improvements around a transit station. This may yield larger VMT reductions than calculated in the CET by connecting people to transit and yielding greater VMT reductions from longer trips that include both walking and transit use.*

If the project calculation methodology does not fit well for a project that reduces VMT, users should estimate the VMT reduction outside of the CET and then use the 'T15 Reduce VMT' tab to calculate the carbon emissions reduction.

Characteristics outside available inputs

In some cases, a project may have characteristics that do not exactly fit the input parameters.

⁵ Note that transit operation costs are not an eligible expense for CRP funds.

Example:

‘E1 LD EV Chargers’ project category methodology asks for information about the number of Level 2 ports installed and number of DC fast ports installed and the power level of each. However, if the project involves Level 2 ports or DC fast ports with multiple different power levels, then you must average the power levels as an input to the tool.

Please use your best judgement to adjust the parameters for your project to be able to be used in the CET.

What about secondary impacts?

The CET calculates the direct impacts of transportation projects and does not calculate indirect or secondary impacts. It is important to be aware of this limitation.

Applicants for CRP funding may wish to qualitatively describe indirect impacts that may occur or in some cases may attempt to calculate these effects separately. If an applicant chooses to attempt to calculate the effects outside of the CET it is encouraged that the applicant provides justification and the calculation methodology in their application.

Example:

‘E6 Initiate or Expand ZEV Carsharing Programs’ accounts for reduced emissions from reduced VMT of those using the carshare program. It is possible that a ZEV carshare program may encourage consumers to shift to electric vehicles or zero emission vehicles (EVs/ZEVs) since people may have tried using a ZEV and may see more ZEVs on the road, and this may improve consumer confidence in the technology and lead to higher ZEV ownership in the region. Such secondary impact on reducing VMT by conventionally fueled vehicles could be estimated outside of the CET, such as by making an assumption about how many people might switch their vehicle purchase decisions in response. The reduced VMT from owners that switch to EVs could then be input into ‘T15 Reduce VMT’ to calculate the additional emissions reduced by conventional vehicles that are replaced by ZEVs.

These figures are very uncertain, however, so caution should be used to carefully document assumptions and the research basis for such assumptions.

Table 2 identifies the direct project impacts that are calculated and the potential indirect or secondary impacts that are not calculated for several project categories.

Table 2. Direct project impacts calculated and indirect or secondary impacts not calculated, Minnesota CET 2024⁶

Project ID	Project Types	Direct Project Impact Calculated	Indirect or Secondary Impact Not Calculated
E1, E2, E3, E4, E5, E6	EV charging infrastructure and replacement of conventional buses or fleet vehicles with EVs	Reduced emissions due to replacement of conventional fuel by EVs	Potential for EV charging infrastructure/buses/public fleets to encourage households or private sector fleets to switch from conventional fueled vehicles to EVs
T5, T6, T7, T8, T9, T10	Transit enhancements (BRT, bus priority treatment, new bus service, bus frequency improvements, intercity bus and passenger rail)	Reduced emissions due to mode shifts to transit	Potential for transit infrastructure or transit improvements to support land use changes and transit-oriented development that yields further vehicle trip reductions through more walking or biking trips and shorter trip distances
T12, T13, T14	Roundabouts, left turn lanes, traffic signal synchronization	Reduced emissions due to reduced vehicle delay	Potential for project to enhance pedestrian or bicycling environment as part of the project design Potential to induce additional vehicle travel (which would negate some of the emissions benefits)

Conducting off-tool analysis

Users that need to make calculations or assumptions outside of the CET should document their assumptions in the project funding application.

Calculating Changes in VMT by Conventional Vehicles


For projects using the ‘T15 Reduce VMT’ tab (Figure 6) the estimated reduction in VMT by conventional fossil fueled vehicles will need to be calculated separately. Users should document the assumptions used for the calculation, based on experience with similar projects or assumptions associated with the specific project.

Example: T1 Bicycle Network facility project

⁶ Note that outside of the three project types ‘LC3 LED Street Lights’, ‘RE1 Renewable Energy’ and ‘RE2 Solar Panels’, and other low carbon infrastructure projects that are analyzed separately by MICE, all the project emission impacts calculated in the CET reflect a reduction in tailpipe emissions only and do not account for full life-cycle emissions.

If users do not have inputs (i.e., average annual daily traffic (AADT) on the road parallel or adjacent to the bicycle facility) or has a better way to estimate the use of the facility and likely shifts from driving, users may explain how the estimated VMT from the project was estimated, instead of using the 'T1 Bicycle Network' tab.

Figure 6: Tab for Estimating VMT Reduction, Minnesota CET 2024



**DEPARTMENT OF
TRANSPORTATION**

PROJECT TYPE: T15 - REDUCE VEHICLE MILES TRAVELED

DIRECTIONS:
 Enter project data needed within the "INPUTS" section below. Click the "Reset to Default" button to clear all user input.
 The "CONSTANTS & INTERIM CALCULATIONS" section shows assumptions that cannot be changed or interim results that are calculated by the tool based on the project input data.
 The "RESULTS" section shows the results of the carbon emissions calculations, both estimated emission reductions in year 1 and cumulative emission reductions over the duration of the project.

INPUTS

Variables	Value	Unit
Year of project implementation		-
Project lifetime		years
Annual reduction in light duty passenger vehicle miles traveled (total)		miles/yr
Annual reduction in medium/heavy duty vehicle miles traveled (total)		miles/yr

CONSTANTS & INTERIM CALCULATIONS

Variables	Value	Unit
Regional light-duty vehicle (LDV) fleet average GHG emission factor (Year 1)		#N/A g CO2e/mi
Regional light-duty vehicle (LDV) fleet average GHG emission factor (average of project lifetime)		#N/A g CO2e/mi
Regional medium/heavy duty fleet average GHG emission factor (Year 1)		#N/A g CO2e/mi
Regional medium/heavy duty fleet average GHG emission factor (average of project lifetime)		#N/A g CO2e/mi

RESULTS

Variables	Value	Unit
Emissions reduction in year 1		#N/A CO2 e MT per year
Cumulative emissions reduction		#N/A CO2 e MT

Calculating Travel Time Savings

The CET suggests other tools or resources that may be helpful to retrieve the required input information. This can mean there are extra steps for users when calculating these project types.

Example:

Projects T12, T13 and T14 include implementing intersection improvements and projects to optimize transportation system management and operations. These require estimation of travel time savings or delay reductions as inputs for the CET.

Users may use FHWA's [Congestion Mitigation and Air Quality Improvement \(CMAQ\) Emissions Calculator Toolkit](#) to calculate these inputs. Although the available project emissions tools in the FHWA CMAQ Emissions Calculator Toolkit can provide emission reductions along with travel time savings directly, the tools do not reflect the latest vehicle emission factors for Minnesota as

embedded in the CET. Therefore, CET requires an extra step to calculate emissions based on CMAQ output, using Minnesota carbon emission factors. Users may also have conducted their own project-specific analyses of changes in delay or travel time, which may be incorporated into the CET.

Using the MICE Tool

For low carbon infrastructure projects, such as sustainable pavements or recycled asphalt (LC1 and LC2), applicants should use MnDOT’s [Minnesota Infrastructure Carbon Estimator \(MICE\) tool](#). MICE is a custom-built tool designed to estimate the life-cycle carbon emissions benefits of different types of construction and maintenance treatments. After using MICE, users then enter the carbon emissions benefits from MICE into the designated project tab. The CET will then calculate the cost-effectiveness of the project by dividing the emissions benefit by the user-input cost using the ‘Results Summary’ tab (see Step 3 for further information on appropriate cost to use in the calculations).

Step 3: Enter project-related cost information

On the ‘Results Summary’ tab, input costs data for the corresponding strategy, as shown in Figure 7. This cost information is used to calculate the cost-effectiveness of each project at reducing carbon emissions.

Figure 7: ‘Results Summary’ tab, Minnesota CET 2024

Strategy		Year 1 emissions reduction (CO2 e MT per year)	Cumulative emissions reduction (CO2 e MT)	Total Costs (\$) USER INPUT REQUIRED	Cost Effectiveness (\$/MT)
E1	Expand public EV charging infrastructure network for light duty vehicles				
E2	Deploy charging infrastructure for medium- and heavy-duty freight vehicles				
E3	Purchase or lease battery electric transit buses				
E4	Purchase or lease battery electric school buses				
E5	Transition public fleet through purchase & lease of ZEVs				
E6	Initiate ZEV or EV sharing programs.				
T1	Construct or improve bicycle network				
T2	Construct or improve pedestrian network				
T3	Establish or expand micromobility programs				
T4	Improve street connectivity				
T5	Implement Bus Rapid Transit (BRT) systems with dedicated lanes and stations				
T6	Implement bus transit priority treatments				
T7	Add or expand bus service				
T8	Enhance bus frequency or hours of service				
T9	Establish or expand intercity bus services				
T10	Develop or improve intercity passenger rail services				
T11	Construct, expand, or enhance park and ride facilities				
T12	Construct roundabout to improve traffic flow				
T13	Construct left turn lane to improve traffic flow				
T14	Synchronize traffic signals to reduce delay time				
T15	Reduce vehicle miles traveled				
LC1	Use low carbon materials in road construction and maintenance				
LC2	Used recycled pavement on construction sites				
LC3	Replace street lighting and traffic control devices with LEDs				
RE1	Implement renewable energy projects in highway right-of-way				
RE2	Install solar panels on transit stations, rest stops, parking, and other facilities				
Total		0.00	0.00	\$0	\$0

The costs reflected in the 'Total' row should account for the total costs associated with implementing the emissions reduction project. Some guidelines for entering costs are provided here:

Include the full costs associated with the emissions reduction project, not just funds requested through the CRP. The intent of the cost-effectiveness calculation is to determine the overall cost-effectiveness of the project at reducing carbon emissions. As such, the user should input the costs that are needed to implement the project, which would not have been incurred without the project:

- **For transit projects, these costs may include both capital and operating costs.** For instance, expanding transit services may involve both capital components, such as the purchase of new buses, and operating⁷ costs of the new service (e.g., driver costs, fueling costs). For a bus rapid transit (BRT) project or transit priority project that is along an existing bus route or corridor, however, it is generally assumed that the existing service has operating costs so only the incremental costs beyond existing operating costs should be included (or may assume generally no change or minimal change in operating costs).
- **For engineering or planning studies (e.g., a planning study on bicycle network improvements), the costs should account not only for the study costs but also include an estimate of construction costs for the improvements,** since the engineering or planning study will not yield emission reductions without the actual construction of infrastructure.
- **For low carbon infrastructure projects, only account for the incremental cost associated with the low carbon treatment.** In the case of low carbon road infrastructure (e.g., a repaving project using recycled asphalt), it is assumed that the repaving project would have been implemented as part of the regular maintenance of the roadway. The cost that should be analyzed in the CET is the cost of using recycled pavement instead of traditional pavement materials, which will only be a portion of the total pavement resurfacing project cost. Applicants should subtract the total from the project that would be the cost of the project not using recycled materials. Please consult MnDOT or your project team to develop an estimate of these incremental costs.

Step 4: Review the results

Once all the inputs have been entered, the 'Results Summary' tab (Figure 7) will display the results.

- Year 1 emissions reduction (CO₂e MT per year)
- Cumulative emissions reduction (CO₂e MT)
- Cost-effectiveness (\$/MT)

⁷ Note that transit operating costs are not eligible for CRP funds. Capital expenses are eligible for CRP funds.

For those applying for CRP funds, the results displayed on the ‘Results Summary’ tab should be included on the CRP project application.

Keep in mind that the CET produces an estimate of each of these figures and that different types of projects have different levels of certainty associated with the results. Table 3 summarizes general levels of uncertainty and factors that affect uncertainty of the emissions impacts associated with each project type.

Table 3. Uncertainty associated with project emissions benefits, Minnesota CET 2024

Project ID	Project Type	Level of Uncertainty	Rationale
E1	Expand public EV charging infrastructure network for light duty vehicles	High	Does not account for the extent to which EV charging infrastructure encourages shift in vehicle purchase decisions; accounts for displaced fuel used by EVs, but owners already have opted for EVs
E2	Deploy charging infrastructure for medium- and heavy-duty freight vehicles	High	Does not account for the extent to which EV charging infrastructure encourages shift in vehicle purchase decisions; accounts for displaced fuel used by EVs, but owners already have opted for EVs
E3	Purchase or lease battery electric transit buses	Low	Bus operators generally have good information on bus use
E4	Purchase or lease battery electric school buses	Low	Bus operators generally have good information on bus use
E5	Transition public fleet through purchase & lease of ZEVs	Low	Fleet operators generally have good information on vehicle use
E6	Initiate ZEV or EV sharing programs.	High	Uncertainty associated with how different car sharing programs affect VMT; does not account for the extent to which the program may encourage shifts in vehicle purchase decisions
T1	Construct or improve bicycle network	Medium	Uncertainty associated with how network improvements affect VMT
T2	Construct or improve pedestrian network	Medium	Uncertainty associated with how network improvements affect VMT
T3	Establish or expand micromobility programs	Medium	Uncertainty associated with how network improvements affect VMT
T4	Improve street connectivity	High	Uncertainty associated with how network improvements affect VMT

T5	Implement Bus Rapid Transit (BRT) systems with dedicated lanes and stations	Medium	Uncertainty associated with effects on ridership and reducing VMT
T6	Implement bus transit priority treatments	Medium	Uncertainty associated with effects on ridership and reducing VMT
T7a	Expand bus service	Medium	Uncertainty associated with effects on ridership and reducing VMT
T7b	New bus service	Medium	Uncertainty associated with effects on ridership and reducing VMT
T8	Enhance bus frequency or hours of service	Medium	Uncertainty associated with effects on ridership and reducing VMT
T9	Establish or expand intercity bus services	Medium	Uncertainty associated with effects on ridership and reducing VMT
T10	Develop or improve intercity passenger rail service	Medium	Uncertainty associated with effects on ridership and reducing VMT
T11	Construct, expand, or enhance park and ride facilities	Low	Generally have relatively good estimates of use of facilities
T12	Construct roundabout to improve traffic flow	High	Uncertainty about impacts on delay, and indirect effects on travel demand
T13	Construct left turn lane to improve traffic flow	High	Uncertainty about impacts on delay, and indirect effects on travel demand
T14	Synchronize traffic signals to reduce delay time	High	Uncertainty about impacts on delay, and indirect effects on travel demand
T15	Reduce vehicle miles traveled	High	Depends on assumptions about project
LC3	Replace street lighting and traffic control devices with LEDs	Medium	Generally should have good estimates of electricity use, but uncertainty about future electricity emissions factors
RE1	Implement renewable energy projects in highway right-of-way	Medium	Generally should have good estimates of electricity generation, but uncertainty about future electricity emissions factors
RE2	Install solar panels on transit stations, rest stops, parking, and other facilities	Medium	Generally should have good estimates of electricity generation, but uncertainty about future electricity emissions factors