MnDOT GHG Analysis Requirements & Minnesota Infrastructure Carbon Estimator (MICE)

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Outline

- Background
- Overview of MnDOT's greenhouse gas analysis guidance
- Overview of MICE
- Example analyses
- Resources

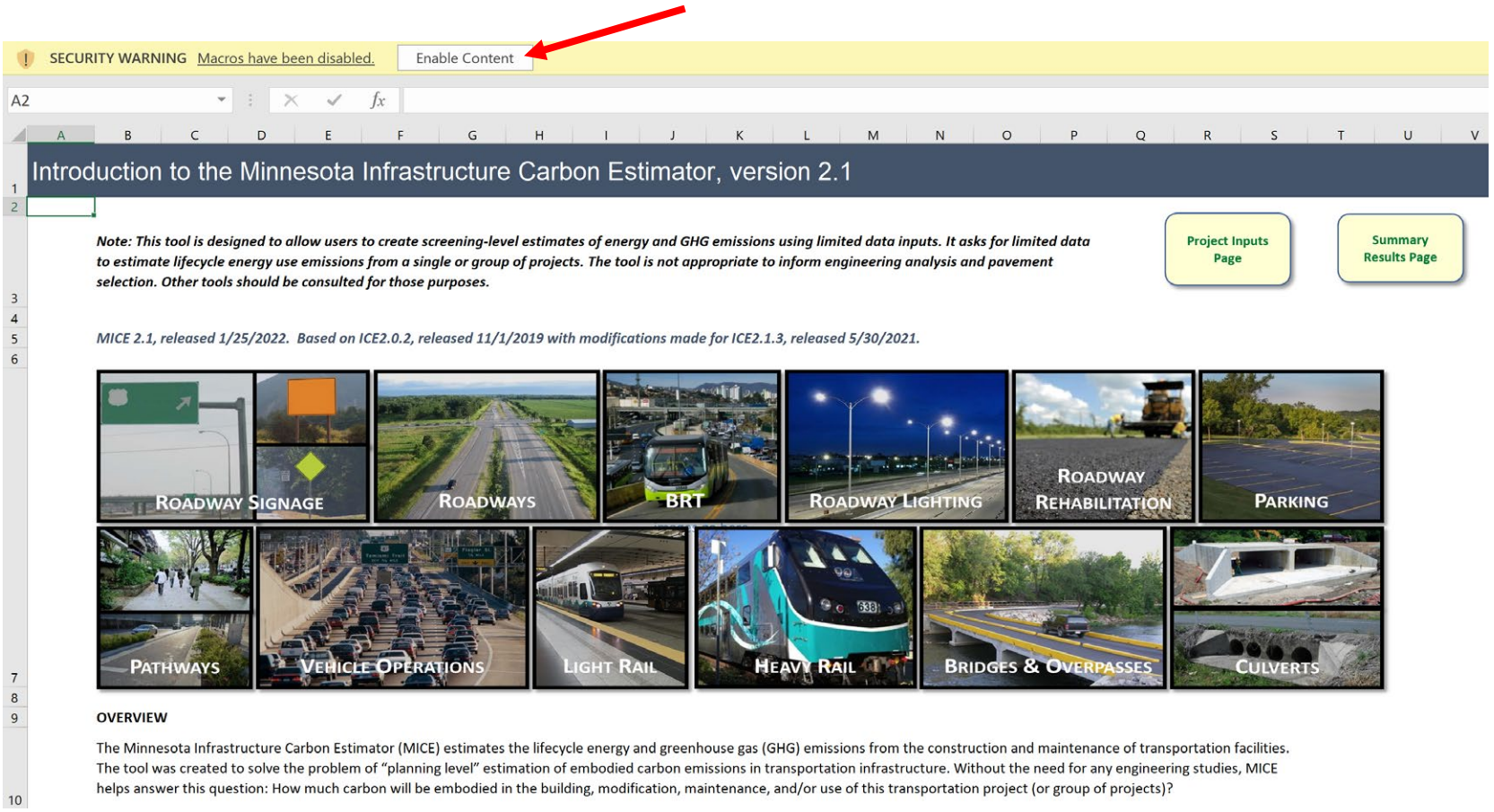
Quick overview of process

- **Step 1:** Select the location (MN) and lifetime (years) on the *Project Inputs* tab.
- **Step 2:** Select Planning operating mode for your analysis.
- **Step 3:** Select all types of infrastructure associated with your project, and select Vehicle Operations if your project affects traffic volumes and/or speeds.
- **Step 4:** Enter information in the comment boxes per MnDOT policy—District #, Highway #, State Project ID, analyst name and date.
- **Step 5:** The selections in Step 3 open up additional tables below the comment boxes; input all relevant data using information from the project you want to analyze. Blue and gray cells display fixed values and results; do not change the information in these cells.
- **Step 6:** Apply any applicable mitigation measures on the *Mitigation Strategies* tab.
- **Step 7:** View summary outputs on the *Summary Results* tab.

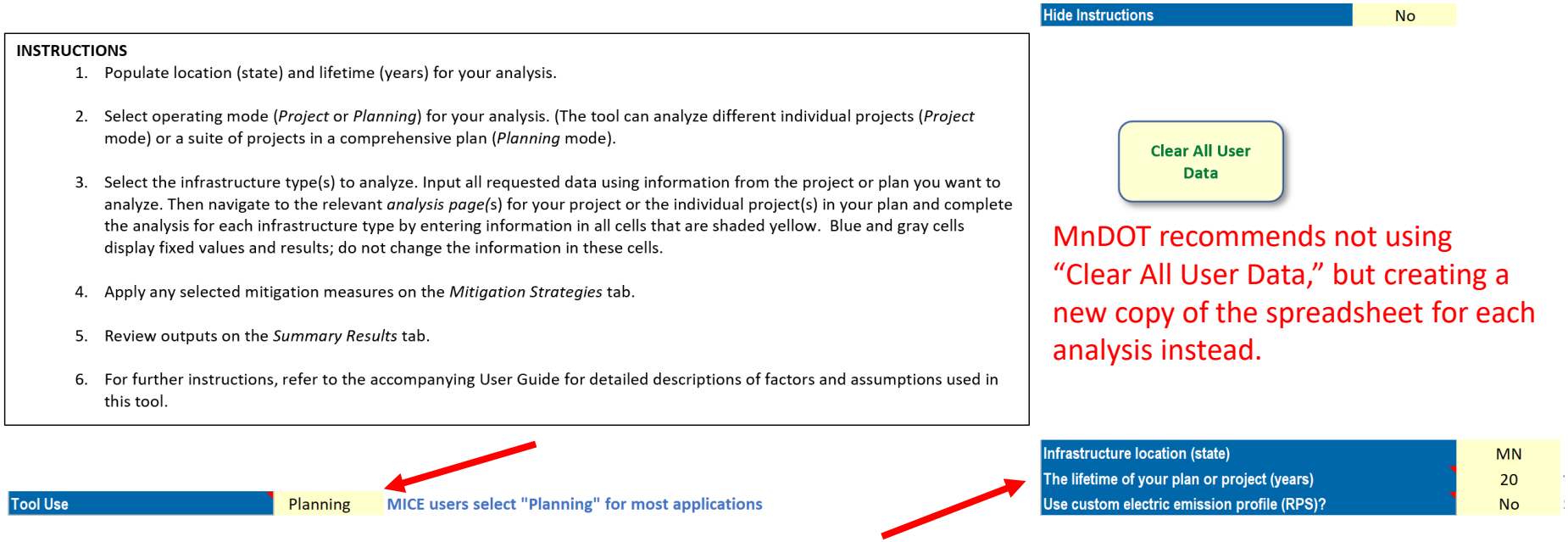
Tips

- MICE is an Excel spreadsheet that uses macros. When first opening MICE, enable macros if prompted to do so (click on “Enable Content”). The tool will not operate without macros enabled.
- To conduct an accurate analysis, entering information on all project activities is more important than ensuring that all activities are sorted into precise categories. That is, it is most important to ensure that all lane miles and track miles of construction and rehabilitation activity are included.
- Users should make reasonable assumptions based on their knowledge of the project area in order to fill any data gaps.
- MnDOT recommends that you retain a “Master” copy of MICE, and for each analysis, save a new copy with a project-specific filename and edit that copy. That way, each analysis will start with a fresh version of MICE that does not contain any inputs from previous analyses.

Intro screen



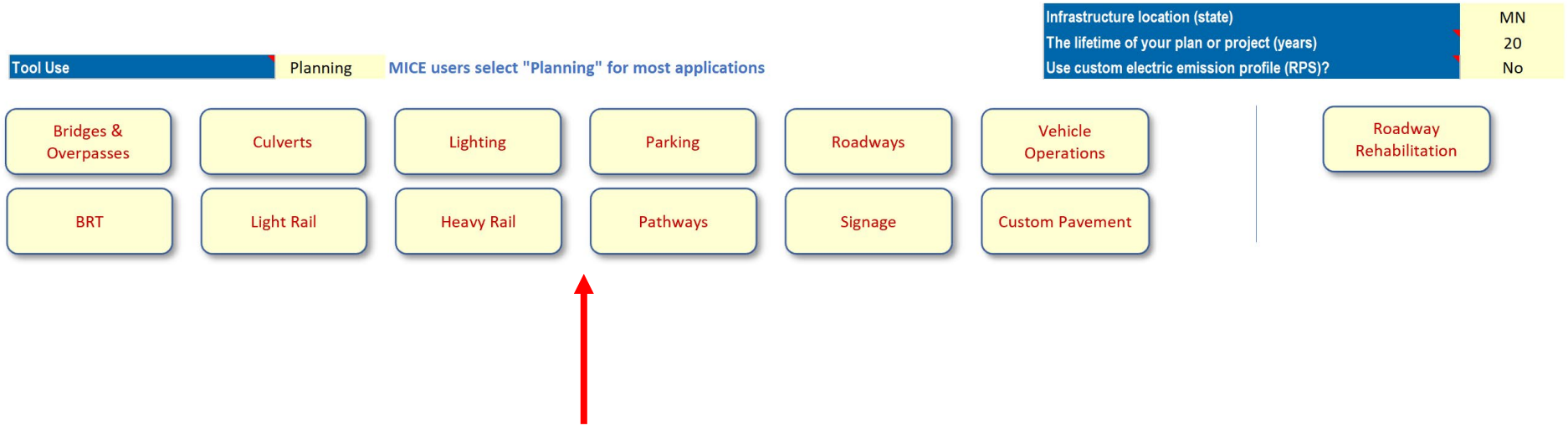
Project Inputs (1)



- Make sure "MN" is selected as the location (selecting a state "turns on" the rest of the functions of the tool)
- Enter a project lifetime in years; needs to be consistent with any traffic data years entered later
- Custom electric emission profile should be "No"
- Select "Planning" mode of operation

Project Inputs (2)

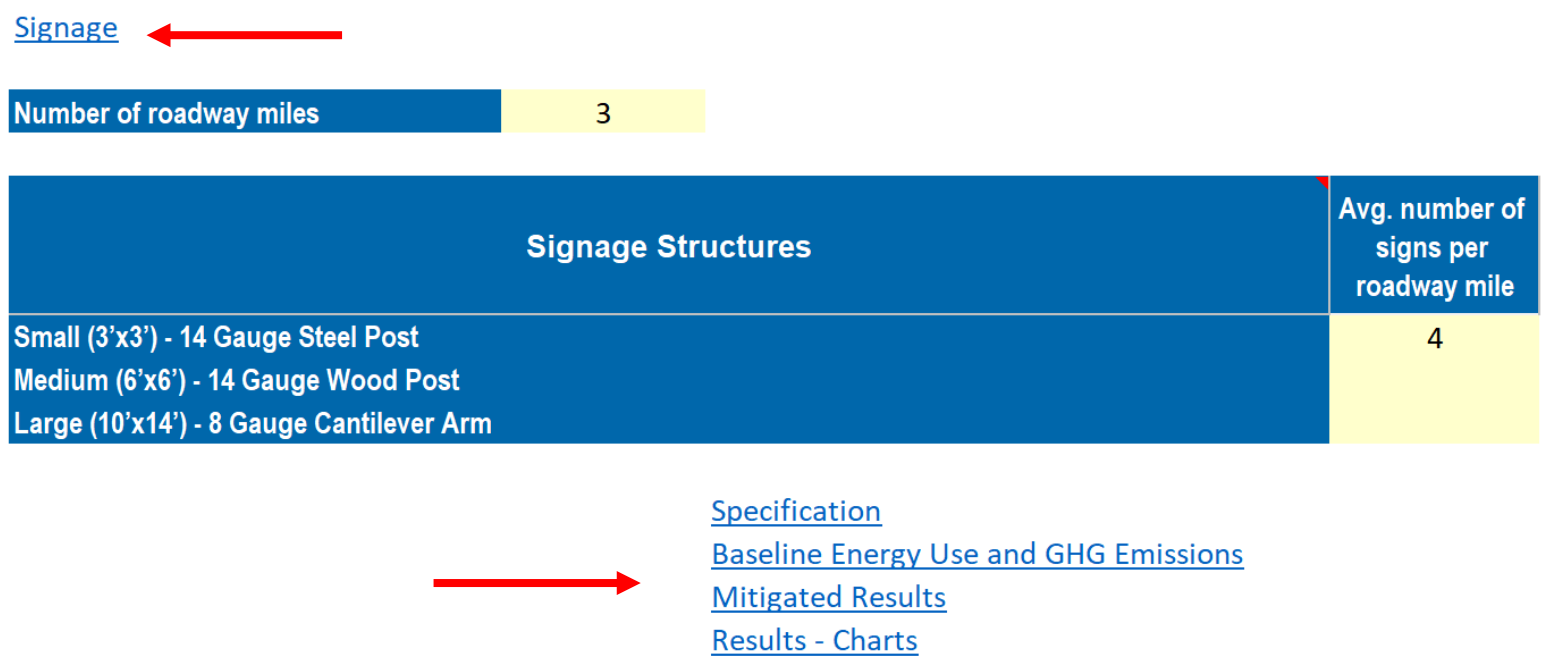
- Click all applicable types of infrastructure associated with your project (will turn green when selected)



Project inputs (3)

- Enter comments as needed to document your analysis. Some placeholders are included in the title boxes, but more detailed comments can be entered in the larger comment boxes below.

Navigation Options



- On the Project Inputs tab, each type of selected infrastructure includes hyperlinks leading directly to the tab for that infrastructure
- Most users won't need these to enter data

Inputs: Bridges and Overpasses

Bridges & Overpasses

Bridge/Overpass Structure	Construct New Bridge/Overpass				Reconstruct Bridge/Overpass				Add Lane to Bridge/Overpass			
	Number of bridges & overpasses	Average number of spans per structure	Average number of lanes per structure	Total number of lane-spans	Number of bridges & overpasses	Average number of spans per structure	Average number of lanes recon-structed per structure	Total number of lane-spans	Number of bridges & overpasses	Average number of spans per structure	Average number of lanes per structure added	Total number of lane-spans
Single-Span		1		0		1		0		1		0
Two-Span		2		0		2		0		2		0
Multi-Span (over land)				0				0				0
Multi-Span (over water)				0				0				0

- Inputs are in terms of the # of bridges, # of lanes, and for longer bridges, # of spans
- Bridge emissions estimates reflect just the underlying structure, not the pavement surface, lights, signs, etc. These need to be added using the Roadways, Lighting, and Signage tabs.

Inputs: Bus Rapid Transit

Bus Rapid Transit

Bus Rapid Transit	
Total existing lane miles of bus rapid transit	

Bus rapid transit construction	
New lane or right-of-way - lane miles	
Converted or upgraded lane/facility - lane miles	
New BRT Stations	

- Inputs include existing lane miles (if applicable—0 for new projects), new lane miles, converted or upgraded lane miles, and # of stations

Inputs: Culverts and Storm Sewers

Culverts

	Single Box Culverts and Sewers		Double Box Culverts and Sewers		Pipe Culverts and Sewers	
	Number of culverts	Average culvert length (ft)	Number of culverts	Average culvert length (ft)	Number of culverts	Average culvert length (ft)
Small (e.g., 6'x6' cell or 12" pipe)						
Medium (e.g., 8'x8' cell or 24" pipe)						
Large (e.g., 12'x12' cell or 48" pipe)						

- Inputs include # of culverts and storm sewers by size and type, and the length (average length if multiple culverts)

Inputs: Heavy & Light Rail

Heavy Rail Infrastructure	
Total existing track miles of heavy rail	

Heavy Rail construction	
Project Type	Heavy rail
New construction (at grade) - track miles	
New construction (elevated) - track miles	
New construction (underground - hard rock) - track miles	
New construction (underground - soft soil) - track miles	
Converted or upgraded existing facility - track miles	0
New rail station (at grade) - stations	
New rail station (elevated) - stations	
New rail station (underground) - stations	

Light Rail Infrastructure	
Total existing track miles of light rail	

Light Rail construction	
Project Type	Light rail
New construction (at grade) - track miles	
New construction (elevated) - track miles	
New construction (underground - hard rock) - track miles	
New construction (underground - soft soil) - track miles	
Converted or upgraded existing facility - track miles	
New rail station (at grade) - stations	
New rail station (elevated) - stations	
New rail station (underground) - stations	

- Inputs are similar for both types of rail: existing track miles, new track miles (at grade, elevated or underground), converted/upgraded track miles, stations

Inputs: Lighting

Number of roadway miles				
Lighting Structures				
MnDOT Luminaire Type	**Typical Lumens**	**Ave. number of HPS lights per roadway mile**	**Ave. number of LED lights per roadway mile**	**Typical wattage of LED lights in this lumen range**
Roadway Use 40' Mount 250 W HPS Replacement	15,450			120
Roadway Use 49' Mount 400 W HPS Replacement	18,120			147
Roadway Underpass Use 250 W HPS Replacement	10,320			100
High Mast Luminaire - Asymmetrical	43,300			322
High Mast Luminaire - Symmetrical	85,300			629
Roadway Luminaire - 5 Lane Shoulder	43,264			325
Roadway Luminaire - 5 Lane Median	31,341			226
Rest Area Parking Lot Luminaire	15,850			130
Rest Area Walkway Luminaire	4,150			35
Other (specify wattage in Column G)				

- These inputs customized to reflect MnDOT lighting practices
- Inputs include # of roadway miles affected, and # of lights by type. Default wattages based on MnDOT specs included.
- "Other" category available for non-standard lights; # of lights *and* wattage needed
- Instead of using the roadway miles and number of lights to calculate lights per mile, you can also just enter "1" for the number of roadway miles, and enter the total number of lights of each type.

Inputs: Parking

Parking

	Spaces
Surface Parking	
Structured Parking	

- Parking includes rest area parking, park & ride lots, etc.
- Inputs include # of spaces of surface and structured parking

Inputs: Pathways (Bike & Ped Facilities)

Pathways

Bicycle and Pedestrian Facilities		
Project Type	New Construction	Resurfacing
Off-Street Bicycle or Pedestrian Path - miles		
On-Street Bicycle Lane - lane miles		
On-Street Sidewalk - miles		N/A

- Inputs are in terms of miles of construction or resurfacing, by type of project (off-street path, on-street bike lane, sidewalks)
- Use Construction inputs for both new construction and reconstruction

Inputs: Roadway Rehab (resurfacing/reconstruction)

Roadway System for Road Rehabilitation		
Facility type	Resurface (lane miles)	Reconstruct (lane miles)
Rural Interstates		
Rural Principal Arterials		
Rural Minor Arterials		
Rural Collectors		
Urban Interstates / Expressways		
Urban Principal Arterials		
Urban Minor Arterials / Collectors		

% roadway construction on rocky / mountainous terrain	

- Inputs are lane miles of resurfacing and/or reconstruction by functional class, along with % construction in rocky/ mountainous terrain

Inputs: Roadways

Roadway System	
Total existing centerline miles	
Total newly constructed centerline miles	

Roadway Projects						
Facility type	Roadway System	Roadway Construction				
	Existing Roadway (lane miles)	New Roadway (lane miles)	Construct Additional Lane (lane miles)	Realignment (lane miles)	Lane Widening (lane miles)	Shoulder Improvement (centerline miles)
Rural Interstates						
Rural Principal Arterials						
Rural Minor Arterials						
Rural Collectors						
Urban Interstates / Expressways						
Urban Principal Arterials						
Urban Minor Arterials / Collectors						

Include roadway rehabilitation activities (reconstruct and resurface)	No
% roadway construction on rocky / mountainous terrain	

For Minnesota, this box should always read No.

Inputs: Roadways

- Enter the total centerline miles for the existing roadway network (if applicable- enter “0” or leave blank when analyzing totally new roadways).
- Enter the total newly constructed centerline miles for the proposed project analysis (if applicable).
- Enter the total lane miles, of each roadway type, for the existing roadway network (if applicable)
- Enter the number of lane miles for each type of roadway construction associated with the project:
  - New roadway
  - Adding additional lanes to an existing roadway
  - Roadway realignment
  - Lane widening
  - Shoulder improvement
- Estimate the percentage of the project area that is in hilly or mountainous terrain.
- “Include Roadway Rehab Activities” should always read “No” (under MnDOT guidance, these projects are analyzed as standalone projects)

Inputs: Land Use

Land Use		
Acres of Land Used		
Grassland covered by pavement & shoulder	Forest covered by pavement & shoulder	Forest converted to grassland (ROW)

- Land use inputs included in the Roadways section (you need to select "Roadways" to enter land use information, even for non-roadway projects)
- Enter acres of land converted from forest, converted from grassland, or converted from forest to grassland (e.g., for cleared ROW)
- MnDOT has a "no-net-loss" policy for wetlands, so wetlands inputs aren't necessary
- (Land use factors sourced from "A Landowner's Guide to Carbon Sequestration Credits" by the Central Minnesota Regional Sustainable Development Partnership)

Inputs: Signs

Number of roadway miles	

Signage Structures	Avg. number of signs per roadway mile
Small (3'x3') - 14 Gauge Steel Post Medium (6'x6') - 14 Gauge Steel Post Large (10'x14') - 8 Gauge Cantilever Arm	

- Inputs are the # of road miles affected, and the # of signs (by type) per mile
  - Instead of using the roadway miles and number of signs to calculate signs per mile, you can also just enter "1" for the number of roadway miles and enter the total number of signs of each type.
- Emissions from signage are typically very low. If you don't have data on the number of signs, MnDOT recommends either making an educated guess, or disregarding this source of emissions altogether. The emissions are too low to justify any additional effort to gather input data.
- Variable message signs are not an available sign type

Inputs: Vehicle Operating Emissions and Construction Delay

	Vehicle Operating Emissions			
	Year		Avg Daily VMT on project	Average Daily (Congested) Speed (mph) (or NA)
	Default	Custom		
Project Base Year	2020			
Project Design Year/No Build	2040			
Project Design Year/Build	2040			

	Construction Delay, Additional Emissions			
	Year		Avg Daily VMT impacted by project	Average Daily (Congested) Speed (mph) (or NA)
	Default	Custom		
Construction start year	2022			
Pre-construction (baseline) year	2020			
Project Base Year				
Construction timeframe (months)	N/A			

Inputs: Vehicle Operating Emissions

- This only applies for projects that affect vehicle traffic volumes or speeds.
- Enter in a base and project design/horizon year for vehicle emissions. The interval between the base year and design year must be consistent with the "project lifetime" entered on the Project Inputs page.
- Enter the average daily vehicle miles traveled for the base year, design year no build, and design year build. This is the total VMT for all road segments associated with the project.
- Enter the average daily (congested) speed for the base year, design year no build, and design year build. If unknown, enter "NA" (in capital letters).

Inputs: Vehicle Operating Emissions

- Vehicle operating emissions are usually the largest source of emissions for projects that include them.
- Use the traffic data that you have available; MnDOT does not require MICE users to go out and gather traffic data just for purposes of GHG analysis.
  - MnDOT traffic data and forecasts available at www.dot.state.mn.us/traffic/data/tma.html
- If you know VMT but not speeds, enter “NA” for speed; MICE will use average emissions rates
  - You can also just enter the speed limit
- MICE User Guide include tips for users with more refined traffic data (peak & offpeak, etc.)

Inputs: Vehicle Operating Emissions

- Vehicle Operating Emissions are not required for projects that do not impact traffic:
  - Resurfacing/reconstruction
  - Rebuilding a bridge to the same capacity
  - Stand-alone culvert, lighting, parking, pathway, or signage projects
- Some projects might impact speeds, but not traffic volumes
  - Straightening a curved section of road
  - Adding a truck climbing lane
- If you are also required to perform a mobile source air toxics analysis for your project with the MOVES model, use that model for vehicle operating GHG emissions, not MICE

Calculating Average Speed (example)

- Two roads associated with project
  - Freeway segment, 3 miles, 150,000 ADT, 65 mph
  - Arterial segment, 2 miles, 20,000 ADT, 35 mph
- Calculate VMT (vehicle miles traveled):
  - Freeway: 3 * 150,000 = 450,000
  - Arterial: 2 * 20,000 = 40,000
  - Total: 490,000
- Calculate VHT (vehicle hours traveled):
  - Freeway: 450,000 miles/65 mph = 6923 hours
  - Arterial: 40,000 miles/35 mph = 1143 hours
  - Total: 8066 hours
- Average speed: 490,000 miles/8066 hours = 60.7 mph

Inputs: Construction Delay

- Under MnDOT guidance, construction delay is only considered if it lasts longer than one year
- If estimating emissions from construction delay, enter in the construction start year and a preconstruction year (representing an uncongested situation prior to lane closings). Enter the construction timeframe in months.
- Enter the average daily vehicle miles traveled for the start and preconstruction years.
- Enter the average daily speed for the construction period (congested) and pre-construction (before construction delay effects are observed).
  - If you don't know the congested speed (or work zone speed limit) during construction, enter "NA"; MICE will assume that the construction speed is half of the pre-construction speed
  - If you don't know the pre-construction speed, enter the speed limit.

Custom Pavement (not used)

Roadway System	
Total centerline miles for custom pavement	
Total lane miles for custom pavement	

Lifecycle Energy Factor (mmBTU per lane mile)	
Lifecycle Emissions Factor (MT GHG per lane mile)	

- This input is designed to allow the user to model emissions of custom pavement types (MICE is based on national average use of asphalt and concrete)
- Not currently used by MnDOT
- In the future, as emissions data become available, this feature might be used to model emissions from alternative pavements, pavement overlays (like chip seal projects)

Mitigation

Strategy	"BAU" = Business As Usual, or measures that apply to all projects (biodiesel in MN) BAU deployment	Planned deployment	Deployment increase	Energy reduction factor	GHG reduction factor	BAU Reductions Energy reductions	BAU Reductions GHG reductions	Planned Reductions Energy reductions	Planned Reductions GHG reductions
Alternative fuels and vehicle hybridization									
Switch from diesel to Soy bean-based BD20	60%	60%	0.0%	-5%	12%	-2.8%	7.0%	-2.8%	7.0%
Switch from diesel to Soy bean-based RDII 100			0.0%	-20%	66%	0.0%	0.0%	0.0%	0.0%
Switch from diesel to Forest Residue-based RDII 100			0.0%	-61%	71%	0.0%	0.0%	0.0%	0.0%
Switch from diesel to E-Diesel, Corn			0.0%	-3%	0%	0.0%	0.0%	0.0%	0.0%
Switch from diesel to PHEV: Diesel and Electricity (U.S. Mix)			0.0%	41%	44%	0.0%	0.0%	0.0%	0.0%
Switch from diesel to CNG, NA NG			0.0%	-6%	11%	0.0%	0.0%	0.0%	0.0%
Switch from diesel to LNG, NA NG			0.0%	-11%	7%	0.0%	0.0%	0.0%	0.0%
Hybrid maintenance vehicles and equipment			0.0%	11%	11%	0.0%	0.0%	0.0%	0.0%
Combined hybridization/B20 in maintenance vehicles and equipment			0.0%	1%	27%	0.0%	0.0%	0.0%	0.0%
Hybrid construction vehicles and equipment			0.0%	11%	11%	0.0%	0.0%	0.0%	0.0%
Combined hybridization/B20 in construction vehicles and equipment			0.0%	1%	27%	0.0%	0.0%	0.0%	0.0%
Vegetation management									
Alternative vegetation management strategies (hardscaping, alternative mowing, integrated roadway/vegetation management)			N/A	25%	25%	0.0%	0.0%	0.0%	0.0%
Snow fencing and removal strategies									
Alternative snow removal strategies (snow fencing, wing plows)	Yes	Yes	N/A	50%	50%	50.0%	50.0%	50.0%	50.0%
In-place roadway recycling									
Cold In-place recycling			0.0%	33%	37%	0.0%	0.0%	0.0%	0.0%
Full depth reclamation			0.0%	68%	68%	0.0%	0.0%	0.0%	0.0%
Warm-mix asphalt									
Warm-mix asphalt			0.0%	37%	37%	0.0%	0.0%	0.0%	0.0%
Recycled and reclaimed materials									
Use recycled asphalt pavement as a substitute for virgin asphalt aggregate			0.0%	12%	12%	0.0%	0.0%	0.0%	0.0%
Use recycled asphalt pavement as a substitute for virgin asphalt bitumen			0.0%	84%	84%	0.0%	0.0%	0.0%	0.0%
Use industrial byproducts as substitutes for Portland cement			0.0%	59%	59%	0.0%	0.0%	0.0%	0.0%
Use recycled concrete aggregate as a substitute for base stone			0.0%	58%	58%	0.0%	0.0%	0.0%	0.0%
Pavement preservation									
Pavement preservation extends roadway life by (years)			N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement preservation frequency (every N years, for entire roadway system)			N/A	N/A	N/A	N/A	N/A	N/A	N/A

Reporting results in your NEPA document

<Table X.X> Analysis Result

Operational Emissions (Base Year and Design Year)	$CO2_e$, Metric Tons Per Year
Base Year (year)	
No Action Alternative (year)	
Build Alternative (Year)	
Difference Build vs No-Build	
Cumulative Difference over project lifetime (20 years)	$CO2_e$, Metric Tons (total)

Build/No Build Results

Annual		Emissions CO2e (MT/year)	LCA Energy, Mbtu/year
Project Base Year	2020	15,845	207,920
Project Design Year/No Build	2040	16,182	211,218
Project Design Year/Build	2040	14,562	190,299
Difference Between Build and No Build		(1,620)	(20,919)
Cumulative Difference Over Project Lifetime		(16,197)	(209,189)
Project Total (Build)	20	304,068	3,982,198

Construction $CO2_e$ Emissions (Total over Construction Period)	$CO2_e$, Metric Tons (total)
Build Alternative	
No Build (maintenance of existing system)	(see next slide)

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	1,360	1,360	1,360
Transportation	153	142	142
Construction	984	915	915
Maintenance	779	725	725
Usage	306,218	306,218	306,218
Total	309,494	309,360	309,360

Additional emissions attributable to construction delay

Years	Emissions CO2 (MT)	LCA Energy, Mbtu
1.166666667	2,150	28,078

Vehicle usage emissions outputs are in the same format as required by MnDOT guidance, and are in the first green table on the Summary Results tab

For Construction, sum the MICE emissions from materials, transportation, construction, and maintenance on the Summary Results tab; also add in construction delay, if modeled

Maintenance Emissions for No Build

- Even though a No Build scenario typically doesn't involve any construction, it may include some maintenance emissions *if* there is existing infrastructure (e.g., you are widening an existing road)
    - Only applies to BRT, rail, and roadways
- To calculate these emissions, *first* populate MICE with the existing infrastructure, record the maintenance emissions results, and then add the new infrastructure to calculate Build emissions (or, use a separate copy of MICE for No Build)

Roadway System	
Total existing centerline miles	3
Total newly constructed centerline miles	

Roadway Projects				
Facility type	Roadway System			Roadway
	Existing Roadway (lane miles)	New Roadway (lane miles)	Construct Additional Lane (lane miles)	Re (l
Rural Interstates				
Rural Principal Arterials				
Rural Minor Arterials				
Rural Collectors				
Urban Interstates / Expressways				
Urban Principal Arterials	12			
Urban Minor Arterials / Collectors				

Existing only

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	-	-	-
Transportation	-	-	-
Construction			
Maintenance	528	491	491
Total	528	491	491

Maintenance Emissions for No Build

- Estimating and reporting of maintenance emissions is not required for projects that do not change the amount of infrastructure in place, such as:
  - Rebuilding a bridge with the same length and number of lanes
  - Roadway rehabilitation projects (repaving or reconstruction of an existing road)

Example projects

1) New interchange
2) Bridge replacement
3) Resurfacing

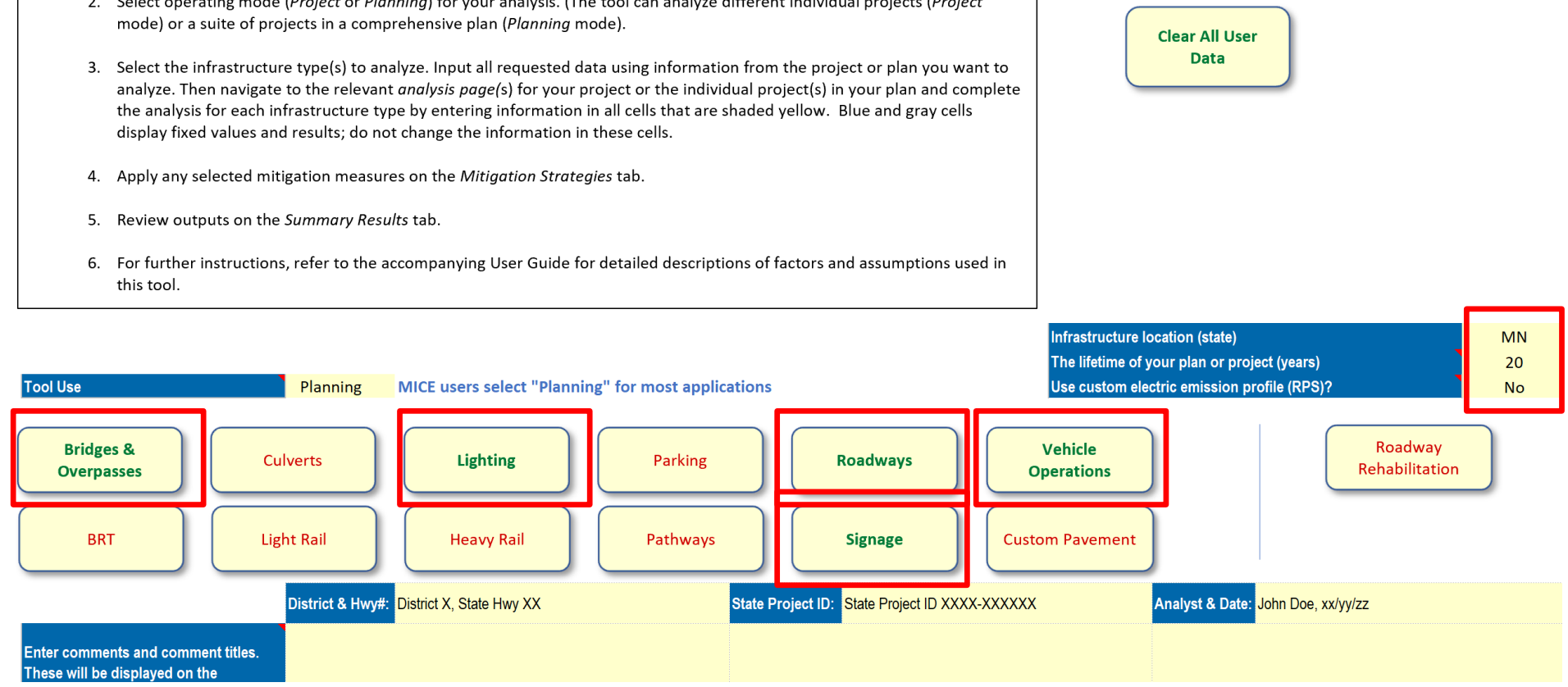
Example Project 1: New Interchange

- New interchange on an rural freeway segment
- Infrastructure elements:
  - New 4-lane single-span bridge
  - 1.5-mile 4-lane crossing arterial, plus 4 .2-mile single-lane ramps
    - Not in rocky or mountainous terrain
  - 4 high-mast asymmetrical luminaires, 8 roadway luminaires in the arterial median
  - 12 small signs and 4 medium signs
  - 15 acres of grassland consumed
- Affect on traffic: slight reduction in VMT (project creates a more efficient route); no change in speeds. No construction delay.

Example Project 1: Project Inputs

INSTRUCTIONS

1. Populate location (state) and lifetime (years) for your analysis.
2. Select operating mode (*Project* or *Planning*) for your analysis. (The tool can analyze different individual projects (*Project* mode) or a suite of projects in a comprehensive plan (*Planning* mode).
3. Select the infrastructure type(s) to analyze. Input all requested data using information from the project or plan you want to analyze. Then navigate to the relevant *analysis page*(s) for your project or the individual project(s) in your plan and complete the analysis for each infrastructure type by entering information in all cells that are shaded yellow. Blue and gray cells display fixed values and results; do not change the information in these cells.
4. Apply any selected mitigation measures on the *Mitigation Strategies* tab.
5. Review outputs on the *Summary Results* tab.
6. For further instructions, refer to the accompanying User Guide for detailed descriptions of factors and assumptions used in this tool.



Example Project 1: Bridge and Lighting Inputs

Bridges & Overpasses

Bridge/Overpass Structure	Construct New Bridge/Overpass: Number of bridges & overpasses	Average number of spans per structure	Average number of lanes per structure	Total number of lane-spans	Number of bridges & overpasses
Single-Span	1	1	4	4	
Two-Span		2		0	
Multi-Span (over land)				0	
Multi-Span (over water)				0	

Specification
Baseline Energy Use and GHG Emissions
Mitigated Results
Results - Charts

Number of roadway miles	1

Lighting Structures: MnDOT Luminaire Type	Typical Lumens	Ave. number of HPS lights per roadway mile	Ave. number of LED lights per roadway mile	Typical wattage of LED lights in this lumen range
Roadway Use 40' Mount 250 W HPS Replacement	15,450			120
Roadway Use 49' Mount 400 W HPS Replacement	18,120			147
Roadway Underpass Use 250 W HPS Replacement	10,320			100
High Mast Luminaire - Asymmetrical	43,300		4	322
High Mast Luminaire - Symmetrical	85,300			629
Roadway Luminaire - 5 Lane Shoulder	43,264			325
Roadway Luminaire - 5 Lane Median	31,341		8	226
Rest Area Parking Lot Luminaire	15,850			130
Rest Area Walkway Luminaire	4,150			35
Other (specify wattage in Column G)				

Lights entered as specified; entering 1 mile for roadway miles will give total emissions for all lights

Example Project 1: Roadway Inputs

Roadways

Roadway System	
Total existing centerline miles Total newly constructed centerline miles	2.3

Roadway Projects				
Facility type	Roadway System	Roadway Cons		
	Existing Roadway (lane miles)	New Roadway (lane miles)	Construct Additional Lane (lane miles)	Realignr (lane m
Rural Interstates Rural Principal Arterials Rural Minor Arterials Rural Collectors Urban Interstates / Expressways Urban Principal Arterials Urban Minor Arterials / Collectors		6.8		

Include roadway rehabilitation activities (reconstruct and resurface)	No
% roadway construction on rocky / mountainous terrain	0%

For Mini

- 1.5-mile 4-lane crossing arterial, plus 4 .2-mile single-lane ramps
  - = 2.3 new centerline miles (1.5 + 0.8)
  - And 6.8 lane miles (1.5*4 + 0.8)

Example Project 1: Land Use Inputs

Land Use		
Acres of Land Used		
Grassland covered by pavement & shoulder	Forest covered by pavement & shoulder	Forest converted to grassland (ROW)
15		

Example Project 1: Signage and Traffic Inputs

Number of roadway miles	1

Signage Structures	Avg. number of signs per roadway mile
Small (3'x3') - 14 Gauge Steel Post	12
Medium (6'x6') - 14 Gauge Steel Post	4
Large (10'x14') - 8 Gauge Cantilever Arm	

Specification
Baseline Energy Use and GHG Emissions
Mitigated Results
Results - Charts

Vehicle Ops

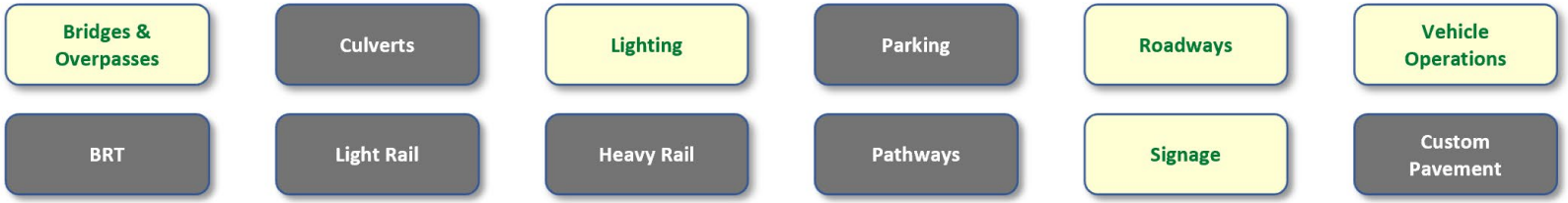
	Vehicle Operating Emissions			
	Year		Avg Daily VMT on project	Average Daily (Congested) Speed (mph) (or NA)
	Default	Custom		
Project Base Year	2020	2020	100000	NA
Project Design Year/No Build	2040	2040	120000	NA
Project Design Year/Build	2040	2040	115000	NA

	Construction Delay, Additional Emissions			
	Year		Avg Daily VMT impacted by project	Average Daily (Congested) Speed (mph) (or NA)
	Default	Custom		
Construction start year	2022			
Pre-construction (baseline) year	2020			
Project Base Year				
Construction timeframe (months)	N/A			

- Signs entered as specified; using 1 mile will give total emissions for all signs
- Traffic data entered; using "NA" for speeds because speeds don't change
- No construction delay

Example Project 1: Summary Results

Summary Results



Show	Total Greenhouse Gas Emissions	Units	MT CO2e

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	1,133	1,133	1,133
Transportation	151	141	141
Construction	1,331	1,258	1,258
Maintenance	430	335	335
Usage	398,615	398,615	398,615
Total	**401,659**	**401,482**	**401,482**

- The Summary Results tab includes total lifetime emissions for the Build scenario
- Buttons at the top show which elements included; note that Total Greenhouse Gas Emissions selected

Example Project 1: Build/No-Build Traffic and Land Use Results (MnDOT-specific tables)

Vehicle Ops: Build/No Build results (the Usage totals on this page reflect only the Build scenario)

		Emissions CO2e (MT/year)	Emissions CO2e (US Tons/year)	Energy, Mbtu/year
Project Base Year	2020	21,249	23,423	277,684
Project Design Year/No Build	2040	19,422	21,409	253,477
Project Design Year/Build	2040	18,613	20,517	242,915
Difference Between Build and No Build		-809	-892	-10,562
Cumulative Difference over project lifetime		-8,093	-8,921	-105,615
Project Total (Build scenario)	20	398,615	439,397	5,205,992

Emissions associated with land use changes (these are also included in the Construction totals on this page**)**

	CO2 (MT)	CO2 (US Tons)
Total	300.0	330.7
Annual	15.0	16.5

Example Project 3: Bridge Replacement

- Replace one 6-lane double-span bridge, 180’ long
- Need to also account for replacement of pavement surface (180’ * 6 lanes = 0.205 lane miles, 0.034 centerline miles)
  - (for a real project, might also need to replace lights, signs, sidewalks)
- Assume a 50-year project lifetime
- No change in traffic, no construction delay

Example Project 3: Project Inputs

Infrastructure location (state)	MN
The lifetime of your plan or project (years)	50
Use custom electric emission profile (RPS)?	No

Tool Use	Planning	MICE users select "Planning" for most applications

Bridges & Overpasses | Culverts | Lighting | Parking | Roadways | Vehicle Operations | Roadway Rehabilitation

BRT | Light Rail | Heavy Rail | Pathways | Signage | Custom Pavement

Bridges & Overpasses

Bridge/Overpass Structure	Construct New Bridge/Overpass				Reconstruct Bridge/Overpass				Add L	
	Number of bridges & overpasses	Average number of spans per structure	Average number of lanes per structure	Total number of lane-spans	Number of bridges & overpasses	Average number of spans per structure	Average number of lanes recon-structed per structure	Total number of lane-spans	Number of bridges & overpasses	Ave numi span stru
Single-Span		1		0		1		0		
Two-Span		2		0	1	2	6	12		
Multi-Span (over land)				0				0		
Multi-Span (over water)				0				0		

Roadway System	
Total existing centerline miles	
Total newly constructed centerline miles	0.034

Roadway Projects						
Facility type	Roadway System	Roadway Construction				
	Existing Roadway (lane miles)	New Roadway (lane miles)	Construct Additional Lane (lane miles)	Realignment (lane miles)	Lane Widening (lane miles)	Shoulder Improvement (centerline miles)
Rural Interstates						
Rural Principal Arterials	0.205					
Rural Minor Arterials						

(This shows Build; for No Build, these are under “existing”)

Example Project 3: Results

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	-	-	-
Transportation	-	-	-
Construction	-	-	-
Maintenance	22	21	21
Total	**22**	**21**	**21**

(No Build)

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	670	670	670
Transportation	21	20	20
Construction	189	176	176
Maintenance	22	21	21
Total	**903**	**886**	**886**

(Build)

MICE does not account for maintenance of bridge structures, only maintenance of the roadway surface (same amount in No Build and Build)

Example Project 4: Resurfacing

- Resurface 12 lane miles of rural collector
- Project less than 1 year = analysis of construction delay not required

Example Project 4: Project Inputs and Results

Roadway System for Road Rehabilitation		
Facility type	Resurface (lane miles)	Reconstruct (lane miles)
Rural Interstates	12	
Rural Principal Arterials		
Rural Minor Arterials		
Rural Collectors		
Urban Interstates / Expressways		
Urban Principal Arterials		
Urban Minor Arterials / Collectors		

% roadway construction on rocky / mountainous terrain	

Show	Total Greenhouse Gas Emissions	Units	MT CO2e

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	287	287	287
Transportation	35	33	33
Construction	122	113	113
Total	**444**	**433**	**433**

Introduction | Project Inputs | Mitigation Strategies | Roadway_Rehab

Results are on the Roadway_Rehab tab; for resurfacing and reconstruction projects, MICE does not open a Summary Results tab (Be sure to select Total GHG units) No Maintenance emissions for these projects

Grouping Projects

- Under MnDOT's GHG guidance, similar projects can be grouped and analyzed together. CE documents can reference the grouped analysis, instead of an individual analysis for each project.
- Example for resurfacing:

Roadway System for Road Rehabilitation		
Facility type	Resurface (lane miles)	Reconstruct (lane miles)
Rural Interstates	24	
Rural Principal Arterials	38	
Rural Minor Arterials	22	
Rural Collectors	12	
Urban Interstates / Expressways		

	Total Greenhouse Gas Emissions		
	MT CO2e Baseline	MT CO2e BAU	MT CO2e Mitigated
Materials	2,880	2,880	2,880
Transportation	394	366	366
Construction	1,442	1,341	1,341
Total	**4,715**	**4,587**	**4,587**

Resources

- GHG guidance:
  - http://www.dot.state.mn.us/planning/hpdp/index.html
  - Note: the MnDOT HPDP is currently being updated to a new TPDP; the scope of MnDOT's guidance will remain the same, but there may be formatting and other nonsubstantive changes for reporting
- MICE tool and User Guide:
  - http://www.dot.state.mn.us/environment/airquality/index.html
- ICE 2.1 and User Guide:
  - https://www.fhwa.dot.gov/environment/sustainability/energy/tools/carbon_estimator/

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